EUROCARGO TECTOR

12 TO 26 t

REPAIR MANUAL

IVECO

This publication describes the characteristics, data and correct methods for repair operations on each component of the vehicle.

If the instructions provided are followed and the specified equipment is used, correct repair operations in the programmed time will be ensured, safeguarding against possible accidents.

Before starting to perform whatever type of repair, ensure that all accident prevention equipment is available and efficient.

All protections specified by safety regulations, i.e.: goggles, helmet, gloves, boot, etc. must be checked and worn.

All machining, lifting and conveying equipment should be inspected before use.

The data contained in this publication was correct at the time of going to press but due to possible modifications made by the Manufacturer for reasons of a technical or commercial nature or for adaptation to the legal requirements of the different countries, some changes may have occurred.

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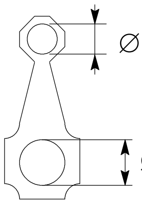
SPECIAL REMARKS

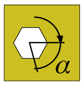
Workshop Manuals - concerning the mechanical part - are divided into several Sections. Each Section is characterised by a number and its content is shown on the general index to be found at the beginning of each workshop manual.
Each section deals generally with one of the main Assemblies (engine, transmission, etc.)
Each section deals with the following topics:
Specifications and technical data, Tightening torques, Special tools, Troubleshooting (fault diagnosis), Component removal/refitting, Repair operations.
To facilitate manual consultation, the different subjects are generally dealt with (where possible), following the same sequence.
This manual also provides graphs and symbols instead of description of parts, operations or operating procedures (see next page), to give a more immediate and friendly reference.

Example:



Ø 1 = Housing for connecting rod small end bush

Ø 2 = Housing for big end bearings



Tighten to torque + angle value

Furthermore, within each section, every heading or sub-heading concerning the operations to be carried out is preceded by a six digit number. This number is the **Product Code** that is to be found in the repair operation described in the FLAT RATE MANUALS and in the FAILURE CODES publication.
For quick reference the indication for reading this code is described below (see also the Flat Rate Manuals).

Product code:

5 0		
PRODUCT	ASSEMBLY	SUBASSEMBLY COMPONENT

The first two figures identify the PRODUCT within the vehicle.
Example :
Product 50 = Frame;
Product 52 = Axles;
Product 53 = Gearbox, etc.

Assembly code:

	0 1	
PRODUCT	ASSEMBLY	SUBASSEMBLY COMPONENT

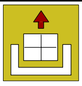
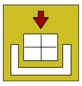
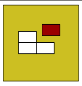
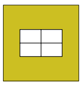
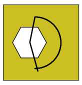
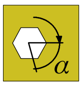
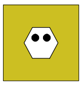
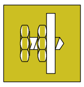
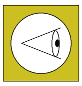
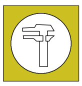
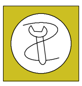
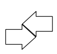
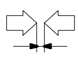
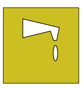
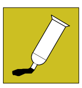
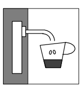
Figure three and four identify the ASSEMBLY within the PRODUCT
Example :
Product 50 = Frame;
Assembly 01 = Chassis;
Assembly 02 = Bumpers-Under run-bars, etc.

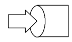
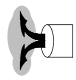
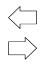
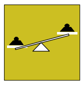
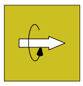
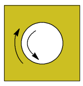
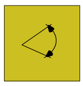
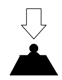
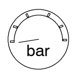
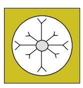
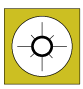
Subassembly code:

		4 0
PRODUCT	ASSEMBLY	SUBASSEMBLY COMPONENT

Figure five and six identify exactly the SUB-ASSEMBLY and the Assembly Component within the PRODUCT
Example :
Product 50 = Frame;
Assembly 01 = Chassis;
Subassembly 40 = Chassis cross members, etc.

Graph and symbols

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Warning Note
	Visual inspection Fitting position check
	Measurement Value to find Check
	Equipment
	Surface for machining Machine finish
	Interference Strained assembly
	Thickness Clearance
	Lubrication Damp Grease
	Sealant Adhesive
	Air bleeding

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
IVECO PARTS	Replacement Original spare parts
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
	Pressure
>	Oversized Higher than…. Maximum, peak
<	Undersized Less than…. Minimum
	Selection Classes Oversizing
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

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EUROCARGO Tector 12-26t

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Base - February 2003

UPDATING DATE

Section	Description	Page	Revision date

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SECTION 1

General Specifications

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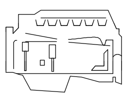
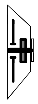
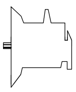
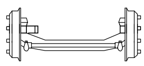
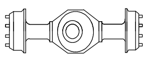
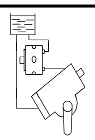
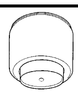
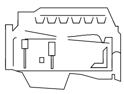
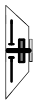
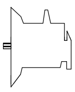
GENERAL SPECIFICATIONS
COMPOSITION OF THE MODELS

UNITS / MODELS 4 X 2			ML110EL17	ML110EL17/P	ML110EL17R	ML110EL17R/P	ML110EL21	ML110EL21/P	ML110EL21R	ML110EL21R/P	ML120EL17	ML120EL17/P	ML120EL17/R	ML120EL17R/P	ML120EL21	ML120EL21/P	ML120EL21R	ML120EL21R/P	ML120E18	ML120E18/P
	F4AE0481A	(170 HP)	•	•	•	•					•	•	•	•						
	F4AE0681E	(180 HP)																	•	•
	F4AE0681D	(210 HP)					•	•	•	•					•	•	•	•		
	F4AE0681B	(240 HP)																		
	F4AE0681A	(275 HP)																		
	Single plate	13"	•	•	•	•					•	•	•	•						
		14"					•	•	•	•					•	•	•	•	•	•
		13"/14"																	•	•
		15"/16"																		
	2855.6		•	•							•	•							•	•
	2865.6						•	•							•	•				
	2870.9		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	2895.9																			
	FSO 5206B																			
	MD 3060P																			
	5845		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	5842/5																		•	•
	5851/5																			
	5871/5																			
	MS08-125		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	MS10-144																		•	•
	MS10-164																			
	MS13-165																			
	SP145E																			
	ZF 8095																		•	•
	ZF 8098																			
	TRW-TAS 55		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	Mechanical front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Mechanical rear		•		•		•		•		•		•		•		•		•	
	Pneumatic front																			
	Pneumatic rear			•		•		•		•		•		•		•		•		•
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																			

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

COMPOSITION OF THE MODELS

UNITS	MODELS 4 x 2		ML120E18/FP	ML120E18R	ML120E18R/P	ML120E18R/FP	ML120E18K	ML120E18KR	ML120E18D	ML120E18D/P	ML120E18DR	ML120E18DR/P	ML120E18DK	ML120E18DKR	ML120E21	ML120E21/P	ML120E21/FP	ML120E21R	ML120E21R/P	ML120E21R/FP
	F4AE0481A	(170 HP)																		
	F4AE0681E	(180 HP)	•	•	•	•	•	•	•	•	•	•	•	•						
	F4AE0681D	(210 HP)													•	•	•	•	•	•
	F4AE0681B	(240 HP)																		
	F4AE0681A	(275 HP)																		
	Single plate	13"																		
		14"	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
		13"/14"	•	•	•	•	•	•	•	•	•	•	•	•						
		15"/16"																		
	2855.6		•				•		•	•			•							
	2865.6														•	•	•			
	2870.9		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
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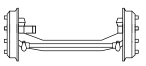
	FSO 5206B																			
	MD 3060P																			
	5845																			
	5842/5		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
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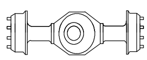
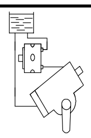
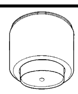
	MS08-125																			
	MS10-144		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	MS10-164																			
	MS13-165																			
	SP145E																			
	ZF 8095		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																			
	TRW-TAS 55																			
	Mechanical front			•	•		•	•	•	•	•	•	•	•	•	•		•	•	
	Mechanical Rear			•			•	•	•		•		•	•	•			•		
	Pneumatic front		•							•				•			•			•
	Pneumatic rear		•		•	•				•		•				•	•		•	•
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																			

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

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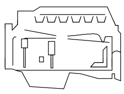
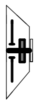
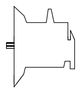
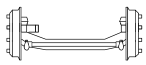
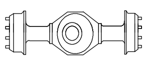
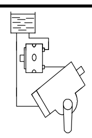
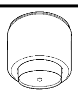
COMPOSITION OF THE MODELS

UNITS		MODELS 4 X 2	ML120E21K	ML120E21KR	ML120E24	ML120E24/P	ML120E24FP	ML120E24R	ML120E24R/P	ML120E24R/FP	ML120E24K	ML120E24KR	ML120E24D	ML120E24D/P	ML120E24DR	ML120E24DR/P	ML120E24DK	ML120E24DKR	ML120E28	ML120E28/P
	F4AE0481A	(170 HP)																		
	F4AE0681E	(180 HP)																		
	F4AE0681D	(210 HP)	•	•																
	F4AE0681B	(240 HP)			•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	F4AE0681A	(275 HP)																	•	•
	Single plate	13"																		
		14"	•	•	•	•	•				•		•	•			•			
		13"/14"																		
		15"/16"			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	2855.6																			
	2865.6		•																	
	2870.9		•	•																
	2895.9				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	FSO 5206B				•	•	•				•		•	•			•			
	MD 3060P																			
	5845																			
	5842/5		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	5851/5																			
	5871/5																			
	MS08-125																			
	MS10-144		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	MS10-164																			
	MS13-165																			
	SP145E																			
	ZF 8095		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																			
	TRW-TAS 55																			
	Mechanical front		•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•
	Mechanical Rear		•	•	•			•			•	•	•		•		•	•	•	
	Pneumatic front																			
	Pneumatic rear					•	•		•	•				•		•				•
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																			

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

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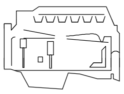
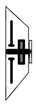
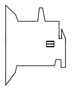
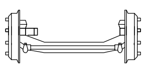
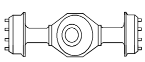
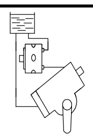
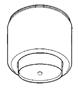
COMPOSITION OF THE MODELS

UNITS		ML120E28/FP	ML120E28R	ML120E28R/P	ML120E28R/FP	ML120E28K	ML120E28KR	ML130E18	ML130E18/P	ML130E18/FP	ML130E18R	ML130E18R/P	ML130E18R/FP	ML130E18K	ML130E18KR	ML130E18RS*	ML130E18D	ML130E18D/P	ML130E18DR	ML130E18DR/P
	F4AE0481A (170 HP)																			
	F4AE0681E (180 HP)							•	•	•	•	•	•	•	•	•	•	•	•	•
	F4AE0681D (210 HP)																			
	F4AE0681B (240 HP)																			
	F4AE0681A (275 HP)	•	•	•	•	•	•													
	Single plate 13"																			
	Single plate 14"																			
	Single plate 13"/14"							•	•	•	•	•	•	•	•	•	•	•	•	•
	Single plate 15"/16"	•	•	•	•	•	•													
	2855.6							•	•	•				•			•	•		
	2865.6															•				
	2870.9							•	•	•	•	•	•	•	•		•	•	•	•
	2895.9	•	•	•	•	•	•													
	FSO 5206B																			
	MD 3060P																			
	5845																			
	5842/5	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	5851/5																			
	5871/5																			
	MS08-125																			
	MS10-144	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	MS10-164																			
	MS13-165																			
	SP145E																			
	ZF 8095	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																			
	TRW-TAS 55																			
	Mechanical front		•	•		•	•	•	•		•	•		•	•	•	•	•	•	•
	Mechanical Rear		•			•	•	•			•			•	•	•	•		•	
	Pneumatic front	•			•					•			•							
	Pneumatic rear	•		•	•				•	•		•	•					•		•
	Disk front	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																			

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

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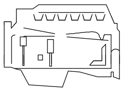
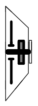
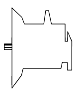
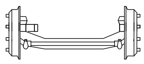
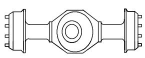
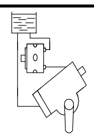
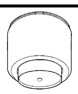
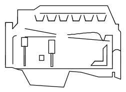
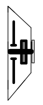
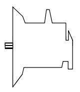
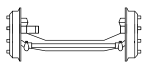
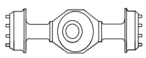
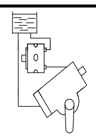
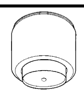
COMPOSITION OF THE MODELS

UNITS / MODELS 4 X 2			ML130E18DK	ML130E18DKR	ML130E21	ML130E21/P	ML130E21/FP	ML130E21R	ML130E21R/P	ML130E21R/FP	ML130E21K	ML130E21KR	ML130E24	ML130E24/P	ML130E24/FP	ML130E24R	ML130E24R/P	ML130E24R/FP	ML130E24K	ML130E24KR
	F4AE0481A	(170 HP)																		
	F4AE0681E	(180 HP)	•	•																
	F4AE0681D	(210 HP)			•	•	•	•	•	•	•	•								
	F4AE0681B	(240 HP)											•	•	•	•	•	•	•	•
	F4AE0681A	(275 HP)																		
	Single plate	13"																		
		14"			•	•	•	•	•	•	•	•								
		13"/14"	•	•																
		15"/16"											•	•	•	•	•	•	•	•
	2855.6		•																	
	2865.6				•	•	•				•									
	2870.9		•	•	•	•	•	•	•	•	•	•								
	2895.9												•	•	•	•	•	•	•	•
	FSO 5206B												•	•	•				•	
	MD 3060P																			
	5845																			
	5842/5		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	5851/5																			
	5871/5																			
	MS08-125																			
	MS10-144		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	MS10-164																			
	MS13-165																			
	SP145E																			
	ZF 8095		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																			
	TRW-TAS 55																			
	Mechanical front		•	•	•	•		•	•		•	•	•	•		•	•		•	•
	Mechanical Rear		•	•	•			•			•	•	•			•			•	•
	Pneumatic front						•			•					•			•		
	Pneumatic rear					•	•		•	•				•	•		•	•		
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																			

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

UNITS		MODELS 4 X 2	ML130E24D	ML130E24D/P	ML130E24DR	ML130E24DR/P	ML130E24DK	ML130E24DKR	ML130E28	ML130E28/P	ML130E28/FP	ML130E28R	ML130E28R/P	ML130E28R/FP	ML130E28K	ML130E28KR	ML150E21	ML150E21/P	ML150E21/FP	ML150E21R	ML150E21R/P
	F4AE0481A	(170 HP)																			
	F4AE0681E	(180 HP)																			
	F4AE0681D	(210 HP)															•	•	•	•	•
	F4AE0681B	(240 HP)	•	•	•	•	•	•													
	F4AE0681A	(275 HP)							•	•	•	•	•	•	•	•					
	Single plate	13"																			
		14"															•	•	•	•	•
		13"/14"																			
		15"/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	•					
	2855.6																				
	2865.6																•	•	•		
	2870.9																•	•	•	•	•
	2895.9		•	•	•	•	•	•	•	•	•	•	•	•	•	•					
	FSO 5206B		•	•			•														
	MD 3060P																•	•	•		
	5845																				
	5842/5		•	•	•	•	•	•	•	•	•	•	•	•	•	•					
	5851/5																•	•	•	•	•
	5871/5																				
	MS08-125																				
	MS10-144		•	•	•	•	•	•	•	•	•	•	•	•	•	•					
	MS10-164																•	•	•	•	•
	MS13-165																				
	SP145E																				
	ZF 8095		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																				
	TRW-TAS 55																				
	Mechanical front		•	•	•	•	•	•	•	•		•	•		•	•	•	•		•	•
	Mechanical Rear		•		•		•	•	•			•			•	•	•			•	
	Pneumatic front										•			•					•		
	Pneumatic rear			•		•				•	•		•	•				•	•		•
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																				

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

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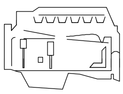
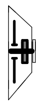
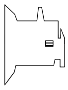
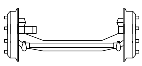
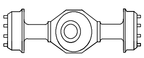
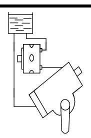
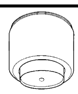
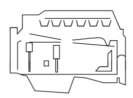
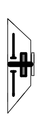
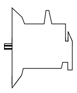
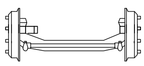
UNITS	MODELS 4 X 2		ML150E21R/FP	ML150E21K	ML150E21KR	ML150E21RS*	ML150E24	ML150E24/P	ML150E24/FP	ML150E24R	ML150E24R/P	ML150E24R/FP	ML150E24K	ML150E24KR	ML150E28	ML150E28/P	ML150E28/FP	ML150E28R	ML150E28R/P	ML150E28R/FP	ML150E28K
	F4AE0481A	(170 HP)																			
	F4AE0681E	(180 HP)																			
	F4AE0681D	(210 HP)	•	•	•	•															
	F4AE0681B	(240 HP)					•	•	•	•	•	•	•	•							
	F4AE0681A	(275 HP)													•	•	•	•	•	•	•
	Single plate	13"																			
		14"	•	•	•	•															
		13"/14"																			
		15"/16"					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	2855.6																				
	2865.6			•																	
	2870.9		•	•	•	•															
	2895.9						•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	FSO 5206B						•	•	•				•								
	MD 3060P			•			•	•	•				•								
	5845																				
	5842/5																				
	5851/5		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	5871/5																				
	MS08-125																				
	MS10-144																				
	MS10-164		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	MS13-165																				
	SP145E																				
	ZF 8095		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ZF 8098																				
	TRW-TAS 55																				
	Mechanical front			•	•	•	•	•		•	•		•	•	•	•		•	•		•
	Mechanical Rear			•	•	•	•			•			•	•	•			•			•
	Pneumatic front		•						•			•					•			•	
	Pneumatic rear		•					•	•		•	•				•	•		•	•	
	Disk front		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drum rear																				

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper

UNITS	MODELS 4 X 2	ML150E28KR	ML180E21	ML180E21/P	ML180E21/R	ML180E21R/P	ML180E21K	ML180E21KR	ML180E24	ML180E24/P	ML180E24R	ML180E24R/P	ML180E24K	ML180E24KR	ML180E28	ML180E28/P	ML180E28R	ML180E28R/P	ML180E28K	ML180E28KR	ML260E28KE (6x4)
	F4AE0481A (170 HP)																				
	F4AE0681E (180 HP)																				
	F4AE0681D (210 HP)		•	•	•	•	•	•													
	F4AE0681B (240 HP)								•	•	•	•	•	•							
	F4AE0681A (275 HP)	•													•	•	•	•	•	•	•
	Single plate 13”																				
	Single plate 14”		•	•	•	•	•	•													
	Single plate 13”/14”																				
	Single plate 15”/16”	•							•	•	•	•	•	•	•	•	•	•	•	•	•
	2855.6																				
	2865.6		•	•			•														
	2870.9		•	•	•	•	•	•													
	2895.9	•							•	•	•	•	•	•	•	•	•	•	•	•	•
	FSO 5206B								•	•			•								
	MD 3060P		•	•			•		•	•			•		•	•			•		
	5845																				
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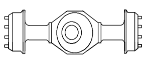	MS08-125																				
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	MS10-164	•																			
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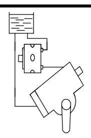
	SP145E																				•
	ZF 8095	•																			
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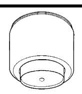
	TRW-TAS 55																				
	Mechanical front	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Mechanical Rear	•	•		•		•	•	•		•		•	•	•		•		•	•	
	Pneumatic front																				
	Pneumatic rear			•		•				•		•				•		•			•
	Disk front	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Disk rear	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Drum rear																				•

K = Dump body; R = Trailing vehicle; T = Tractor; P = Vehicles with pneumatic suspension on rear axle; FP = Vehicles with front and rear pneumatic suspension; D = Double cabin (6 + 1); RS* = Road Sweeper; KE = HENDRICKSON rear suspensions

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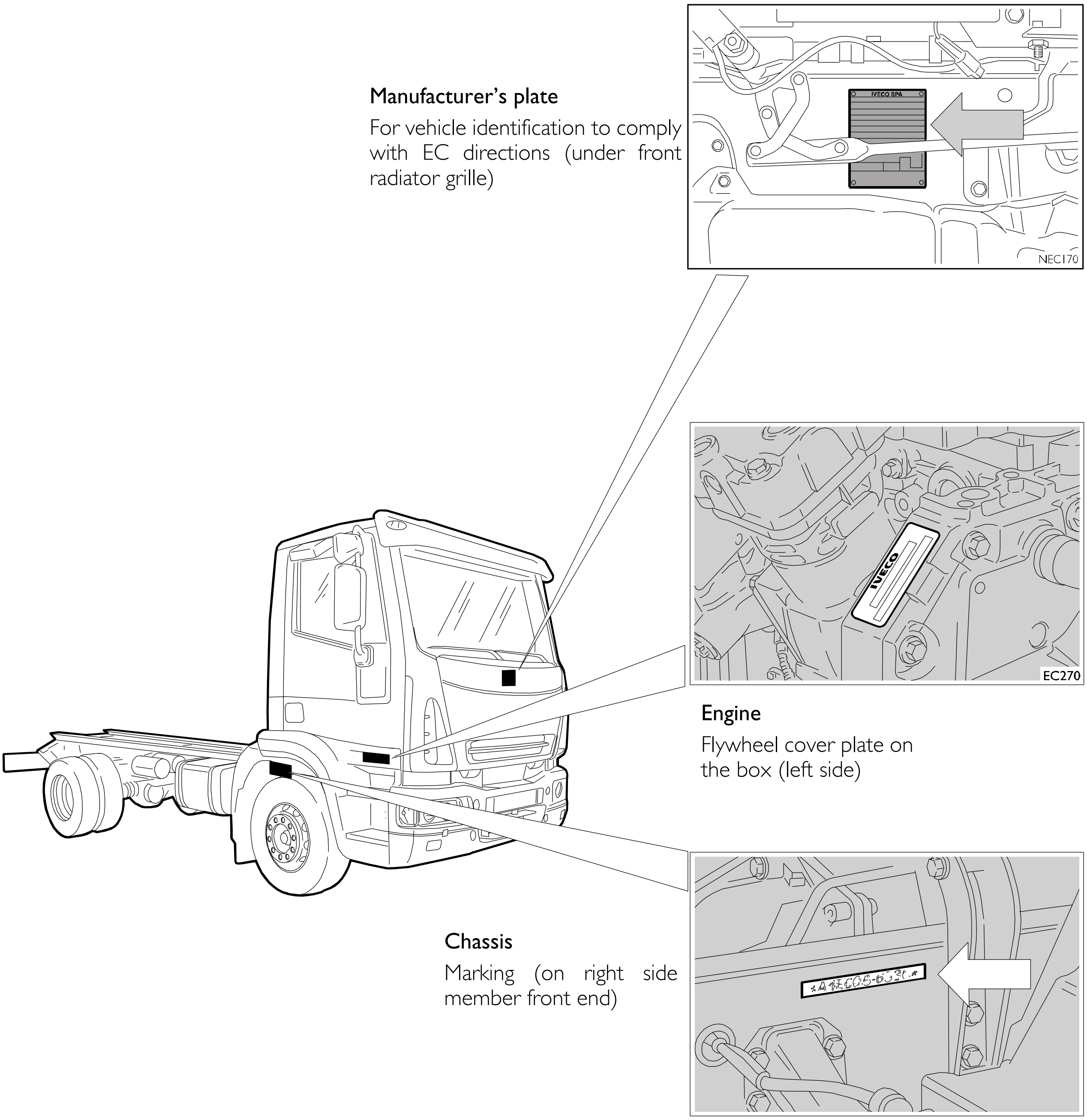
IDENTIFICATION DATA AND LOCATION ON VEHICLE



FILLING UP

LUBRICANTS RECOMMENDED BY IVECO	PARTS TO FILLED UP		Quantity Litres	Quantity kg
Urania Turbo Urania LD5	Engine – 4 cylinders			
		min.	5.3	4.8
		max	8.3	7.5
			1	0.9
	Engine – 6 cylinders			
		min.	8	7.2
		max	10.8	9.7
			1	0.9
Tutela ZC 90	Gearbox	2855.5	5.5	5
		2865.6	9	8.1
		2870.9	5	4.5
		2895.9	8.3	7.5
		FSO5206B	7	6.5
		MD3060P	28	25
Tutela W140/M - DA	Front hubs (individual)		0.2	0.18
	Rear axle	MS08-125	6.5	5.85
		MS10-125	**11.5/12*	**10.3/10.8*
		MS10-164	**12.2/11.7*	**10/10.5*
		MS13-165	**18/19*	**16.2/16.7*
		SP145E		
		Intermediate	16.2	14.5
		Rear	12.2	11
Tutela GI/A	Power steering	ZF 8095	-	-
		ZF 8098	-	-
		TRWTAS5!	-	-
Tutela TRUCK DOT SPECIAL	Clutch circuit		-	-
50% H_2O + Paraflu[11]	Cooling system Total capacity		-	-
Tutela LHM	Cab tipping system		-	-

* Rear axle with mechanical suspension
** Rear axle with pneumatic suspension

INTERNATIONAL LUBRICANT DESIGNATION

Description		FL Products	
Engine oil Compliant with ACEA E2 specifications		**Urania Turbo**	
Engine oil Compliant with ACEA E3 and ACEA E5 specifications		**Urania LD5**	
Differential and wheel hub oil Compliant with MIL-L-2105 C and API GL-5 specifications	SAE 80W/90 SAE 85W/140	**Tutela W 90/M-DA** **Tutela W140/M-DA**	(Cold climates) (Hot and temperate climates)
Manual gearbox oil Contains non EP wear resistant additives Compliant with MIL-L2105 or API GL 3 specifications	SAE 80W/90	**Tutela ZC 90**	
Automatic gearbox and power steering oil Compliant with A.T.F. DEXRON II specifications		**Tutela GI/A**	
Grease for general use Lithium-soap base grease, N.L.G.I. n. 2		**Tutela MR 2**	
Specific grease for bearings and wheel hubs Lithium-soap base grease, N.L.G.I. n. 3		**Tutela MR 3**	
Non-mineral base grease, compatible with brake system materials and suitable to lubricate brake system components		**SP 349**	
Grease for general use, suitable for components not requiring special grease (e.g., joints, pins and pivots, levers, tie rods, sliding shoes, brake callipers, etc.) Lithium-soap base grease, N.L.G.I. n. 2		**Tutela Zeta 2**	
Hydraulic brakes and clutch fluid Compliant with N.H.T.S.A. N. 116 ISO 4295 – SAE J 1703 CUNA NC 956-01 specifications and IVECO STANDARD 18-1820		**Tutela TRUCK DOT SPECIAL**	
Mineral oil for hydraulic circuits Wear resistant and very low pour point		**Tutela LHM**	
Window liquid, mixture of alcohols, water and surface-actives, CUNA NC 956-11		**Arexons DP1**	
Antifreeze, 50% concentration for temperatures up to –35°C		**Paraflu 11**	

SECTION 2
Engine

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ENGINE IDENTIFICATION CODES

F 4 A E 0 6 8 I A * C +

Exhaust emission level

Homologation power

Duty No.

Injection

Cylinder No.

Engine cycle – cylinder position

Engine

Engine series evolution

0= 4-stroke, vertical

Engine series

4 = 4 cylinders
6 = 6 cylinders

8 = DI. TCA

1 = Truck
2 = Bus
4 = M.T. vehicles and tractors
6 = Marine
9 = Army

0681	A =	202	kW - (275 HP) 2700 rpm - 930 Nm / 1250 rpm
0481	A =	125	kW - (170 HP) 2700 rpm - 560 Nm / 1200 rpm
0681	B =	176	kW - (240 HP) 2700 rpm - 810 Nm / 1250 rpm
0481	C =	110	kW - (150 HP) 2700 rpm - 490 Nm / 1200 rpm
0681	D =	154	kW - (210 HP) 2700 rpm - 680 Nm / 1200 rpm
0481	D =	95	kW - (130 HP) 2700 rpm - 430 Nm / 1200 rpm
0681	E =	134	kW - (182 HP) 2700 rpm - 600 Nm / 1200 rpm
0681	F =	202	kW - (275 HP) 2500 rpm - 930 Nm / 1250 rpm

Model No. within D.B.

Model No. within D.B.

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MAIN SERVICING OPERATIONS TO BE PERFORMED ON ENGINE FITTED ON VEHICLE

WARNINGS

Follow warnings below before operations concerning or involving fuel system components.

- Before any engine intervention always carry out the engine/vehicle test with the proper IVECO test equipment, then print the results.
- To replace the EDC7 control unit follow the Iveco procedure for electronic control unit run engines.
- It is possible to replace but not recondition the following fuel system parts: flow limiter, pressure limiting valve, fuel pressure sensor, hydraulic accumulator, fuel pump, high pressure CP3 pump with pressure adjustment valve.
- All the Common Rail system parts are packed by the supplier in oilpaper sheet and then in cardboard boxes. They shall be protected from humidity and unpacked just before assembling.
- The parts shall always be clean during their handling and assembling (even for simple operations such as filter or pre-filter replacement) to avoid dust or filth. Therefore, the hydraulic part protection caps shall be removed only immediately before the part assembling.
- Always follow assembling direction for electrical connections.
- Threaded connections shall be clamped to the prescribed coupling.

High pressure CP3 pump

Never operate on the pressure control.

When servicing operations on high pressure pipe are required, the hexagon on pump side shall be held with proper wrench.

Rail and fittings

The flow limiter and the pressure limiting valve can be assembled 5 times consecutively before being replaced. They shall be lubricated with a little oil before assembling.

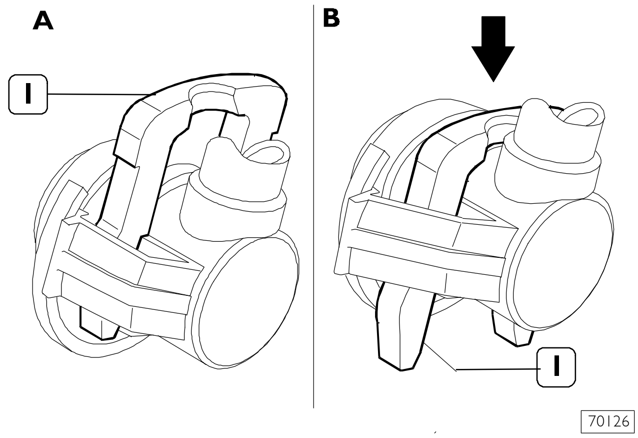
Lubricate the overpressure valve as well before assembling and always replace its gasket.

Injector

It is not necessary and permitted to disassemble the fuel nozzle or the electromagnet.

Low pressure tubing

Figure 1



A Connector properly locked

B Connector released for removal-refitting

All connectors shall be in the blocking position (see Figure 1-A) with the clip (1).

To disconnect the low pressure system tubing, press on the clip (1) (as described in 1-B) to free the connector.

After disconnecting, bring again the spring clip (1) in the blocking position (Figure 1-A) to avoid deformations.

When the low pressure system is restored, press the clip (1) (as described in 1-B) and connect the union to its connector. Bring the clip (1) in the blocking position A to guarantee the connection between the tubing and its component.

The non-observance of the above mentioned connecting procedure may cause a sudden tubing disconnection during the vehicle starting or engine working, due to pressure.

High pressure tubing

Since this hydraulic system contains high pressures, observe the following norms to avoid any risks:

- Do not connect the high pressure tubing unions with a rough clamping;
- Do not disconnect the high pressure tubing while the engine is working;

Always replace each high pressure tubing after disassembling it once.

- Replace each fuel manifold after disassembling it once.

In case of clamping or loosening of the fixing connections, keep fuel manifolds, hydraulic accumulator (rail) and high pressure pump firmly fixed and the component-side hexagon firm, if there is enough space.

- Replace involved piping in case of drippings.

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ENGINE REMOVAL-REFITTING

Before removal/refitting disconnect battery cables and place the vehicle in safety conditions.

Removal

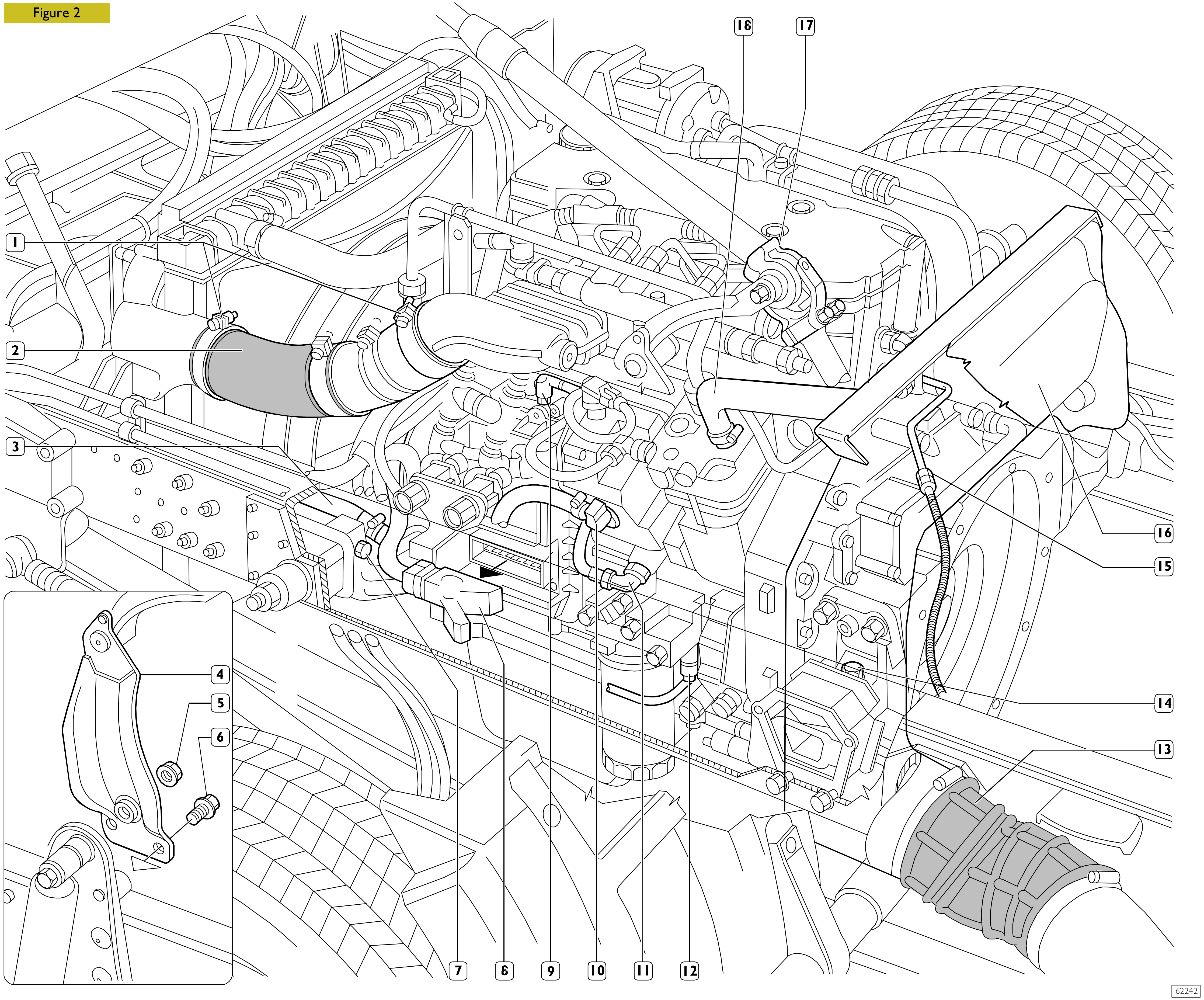
Lift the radiator cowling and overturn the cab. Remove gearbox as described in the relevant section and proceed as follows:

- Drain the engine coolant in a proper container.
- Drain the hydraulic steering system oil in a proper container.

From the engine left side:

- Disconnect tubings (18) from the compressor (13), the air cleaner and the turbine suction tubing (on the right side).
- Remove the suction tube (16) and its support by unscrewing the frame fastening nuts.
- Disconnect air tubing (15).
- Unscrew fastening screws (6), the nut (5), remove the clamp (4) and move the gear lever rightwards (17).
- Disconnect delivery (11) and return (10) tubing from the hydraulic steering pump.
- Loosen clamps (1) and remove the after-cooler tube (2).
- Disconnect fuel tubings; delivery tubings (9) from the control unit support and return ones (12) from the fuel filter support.
- Disconnect the oil pan tubing (3).
- Disconnect the connector (8) from the control unit and all those connections coming from the harness.

Figure 2



From the engine right side:

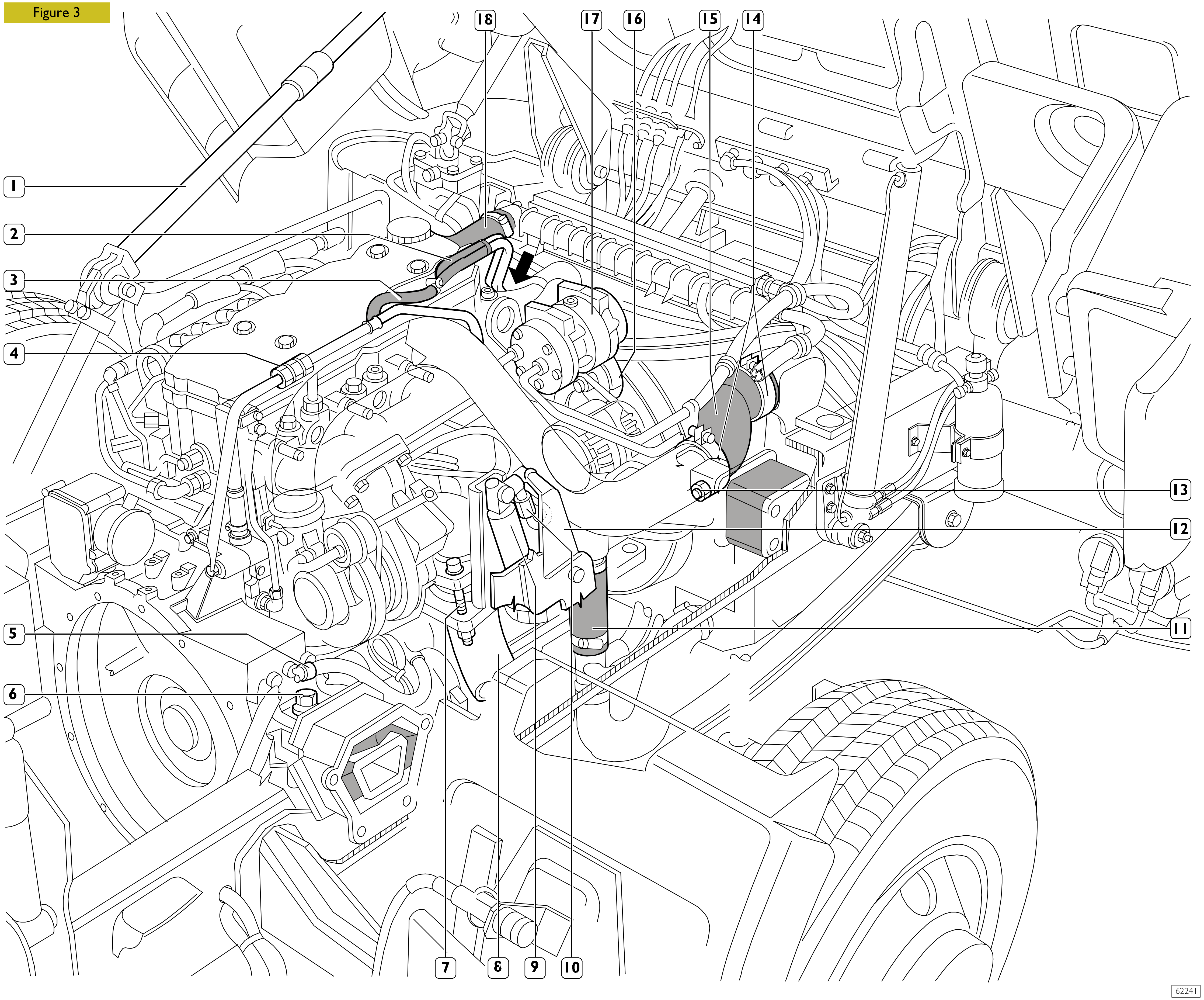
- ❑ Move the gear control lever (1) leftwards.
- ❑ Loosen clamps (14) and remove the after-cooler tubing (15).
- ❑ Loosen the tightener (16) and undermine the belt.
- ❑ Unscrew relevant fastening screws, remove the conditioner (17) compressor and place it on the condenser, tightly fastened to prevent it form dropping.
- ❑ Remove the exhaust brake throttle valve (9) guard (12).
- ❑ Disconnect the tubing (10) , unscrew the exhaust pipe fastening screws (7) and remove the throttle valve (9).
- ❑ Unscrew the elastic support (silent block) fastening nut that fixes the exhaust pipe (8) to the frame and remove it.
- ❑ Disconnect air tubing (4).
- ❑ Loosen clamps from the radiator and the thermostat and remove the cooling fluid tubing (18).

⚠ During the refitting, do not invert the tubing (18) position, because it will interfere with the fan.

- ❑ Disconnect the tubing (2) from the clamp that fixes it to the head and free it from the check clamps.
- ❑ Disconnect the tubing (3) from the clamp placed as shown (→).
- ❑ Loosen the clamp and disconnect the cooling fluid tubing (11).
- ❑ Disconnect the alternator, starter and ground cable electrical connections.
- ❑ Remove the clamp (5) that fixes the harness to the engine support bracket and disconnect all those connections coming from the harness.
- ❑ Place the lifting arm (99360595) to the engine and tension it with a proper lifting device.
- ❑ Unscrew fastening nuts (7 and 14, Figure 2) and (6 and 13, Figure 3); then, lift the engine moving it at the same time towards the rear part and remove it from the compartment.

⚠ Depending on the kind of vehicle cab, the cab rear traverse might be removed, too.

Figure 3



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Refitting

Invert the operations requested for removal and observe the following directions:

- ❑ Take great care during the engine assembling;
- ❑ Check cooling fluid and air-conveyor coupling conditions and in case they are damaged, replace them immediately;
- ❑ Check engine and speed gear unit elastic supports; in case they are damaged, replace them immediately;
- ❑ Check if the exhaust pipe parts or its fastening elements are damaged or about to be damaged and replace them;
- ❑ Fasten screws or nuts to the prescribed torque;
- ❑ Check accurately that the connections of the low pressure fuel tubings to its unions are correct, as specified in the notes concerning "main service operations to be performed on engine fitted on vehicle".
- ❑ Fill the cooling system with the cooling fluid and carry out the bleeding as described in the relevant chapters;
- ❑ Fill the hydraulic steering circuit and carry out the bleeding as described in the relevant chapter;

Check that hydraulic steering oil and the cooling fluid do not contain filth before using them; if they do, filter with appropriate net filters; in case of filling-ups, see the table REFUELING in the section "GENERAL".

- ❑ Check the engine and speed gear oil level; in case of filling-ups, see the table REFUELING in the section "GENERAL".

Tests and checks

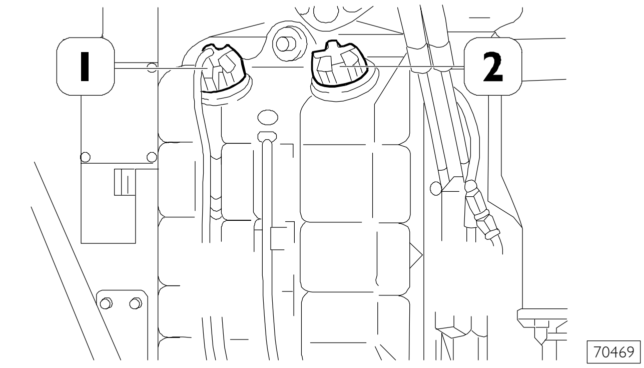
Start the engine, leave it in motion at running rate little more than the minimal and wait that the cooling fluid temperature reaches the rate for the thermostat to be opened , then check that:

- ❑ There are no water drippings from the connecting manifolds of the engine cooling tubing and the cab heating, and in case fasten by blocking collars further;
- ❑ There are no oil drippings between cover and head cylinders, oil pan and base, heat exchanger oil filter and its seatings and between the different lubrication circuits;
- ❑ There are no fuel leakages from fuel tubings;
- ❑ There are no air losses from pneumatic tubings;
- ❑ The warning lights on the instrument panels and the devices disconnected during the engine removal work correctly.

Engine cooling filling system

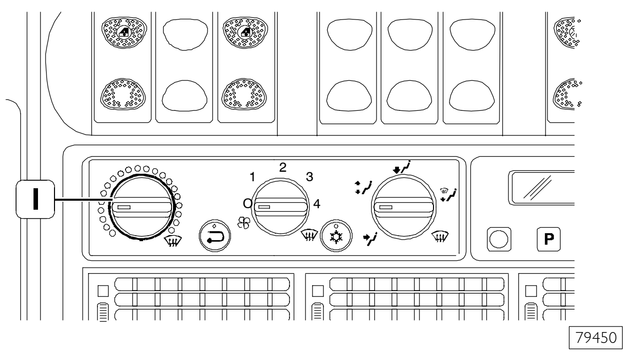
General rules

Figure 4



- ❑ These operations shall be carried out when the engine is cool.
- ❑ The cap (1) is sealed and shall never be tampered by the user.
  To empty or fill it use only the cap (2).
- ❑ To avoid air locks in the system, the fluid shall be poured very slowly (about 8 l per minute).
- ❑ The antifreeze contained in the cooling fluid shall not exceed 50%.

Figure 5



- ❑ Open the heating fluid tap knob (1) completely.
- ❑ Remove the cap (2, Figure 4) and refuel as described before until the expansion cup is full.

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Air bleeding

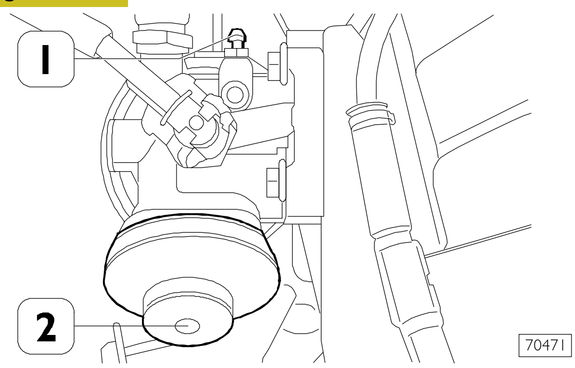
- ❑ Start air bleeding from the cooling system immediately after filling operations.
- ❑ Start the engine at the minimum speed for at least 5 minutes.
- ❑ Fill the fluid up after this time.
- ❑ Close the cap 2, Figure 4, accurately and take the engine at high revolutions to simplify fluid cooling until the thermostat opens.
- ❑ Note: Screen the radiator with a cardboard between it and the intercooler to quicken the operation.
- ❑ Take the fluid temperature to 90°C ~ (to be sure that the thermostat will open) checking the on board thermometer.
- ❑ When the fluid reaches the right temperature, keep the engine at max. revolutions possible to let the air out completely.
- ❑ Check that in the expansion cup there are no more air bubbles or foam.
- ❑ The max complete deareation time is ~ 15 minutes from the thermostat opening.

Important warnings

- ❑ From the moment the cap (2, Figure 4) is closed and the engine heating starts, do not remove the cap until the engine is completely cooled.
  Consequently, in case of filling, wait until the engine is cool.
  This will avoid two consequences:
  - Scalds to the operator;
  - Engine damages, since the system can be pressurized only with a cool engine heating.

542011 Air bleeding from fuel system

Figure 6



The bleeding shall be performed as follows:

- ❑ Insert in the bleeding screw (1) its proper small tube (1) to drain the fuel in the appropriate container;
- ❑ Loosen the screw (1).
- ❑ Start priming pump hand control (2) until fuel goes out from the bleeding screw (1) without air;
- ❑ Close the screw (1);
- ❑ Operate on the hand control until the priming pump (2) starts idle working;
- ❑ Start the engine and let it rotate at its minimum for some minutes to eliminate air residuals.

Fire danger: always close the bleeding screw to avoid fuel leakages.

501430 Air bleeding from hydraulic power steering system

Check the fuel level in the tank and in case increase it.

Lift the vehicle from the front part, start the engine and let it rotate at its minimum for some time.

Check that there are no oil drippings from the hydraulic circuit and check its level in the tank.

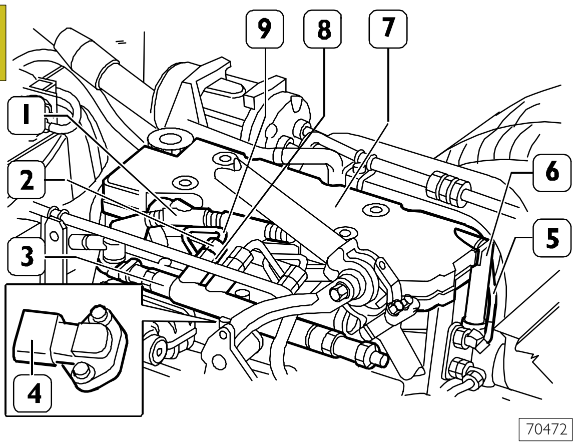
Turn the steering wheel slowly in both directions to let out the air contained in the hydraulic system.

Check again the oil level in the tank and increase it, if necessary.

INJECTORS REPLACEMENT

Removal

Figure 7



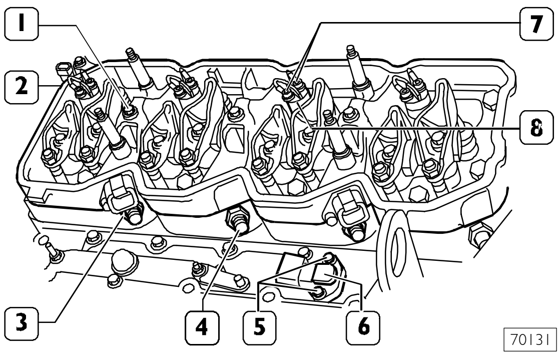
Place the vehicle in safety conditions.

Disconnect battery terminals, lift the radiator cowling, overturn the cab and operate as follows:

- ❑ Disconnect oil tubings (5 and 6) from the tappet cover (7) and remove it;
- ❑ Remove ignition harness clamps (1);
- ❑ Disconnect ignition harness (1) from injector connectors, overpressure and temperature/pressure sensors (4);
- ❑ Remove tubings (9) from the hydraulic accumulator (3) and fuel manifolds for injectors.

> During unlocking of the fitting (3) fastening pipe (9) to rail (3), avoid flow limiters (8) rotation with an appropriate wrench.

Figure 8

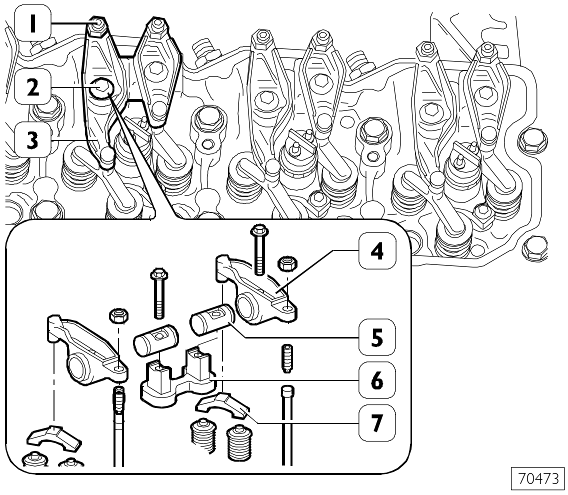


Remove nuts (7) and disconnect electrical cables from injectors (8).
Remove screws (1) and injector harness support (2) with the gasket.
Remove screws (5) and air temperature/pressure sensor (6).

Remove nuts (3) and fuel manifolds (4).

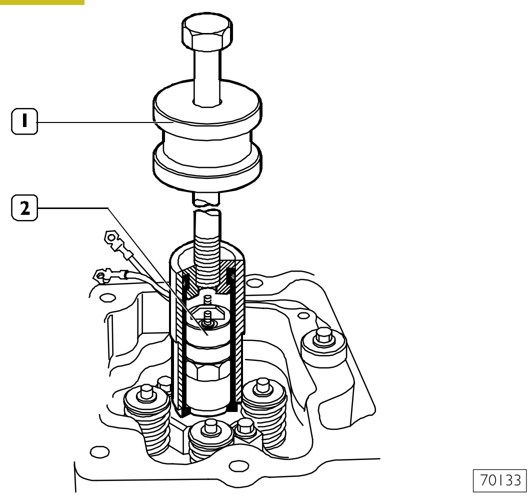
> The disassembled fuel manifolds (4) shall never be used again but replaced with new ones.

Figure 9



Loosen fastening tappet register nuts (1) and unscrew registers.
Remove screws (2), rocker unit (3) consisting of support (6), rockers (4) and shafts (5) and remove bonds (7) from the valves.

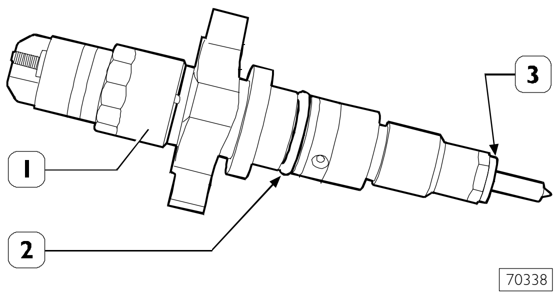
Figure 10



Remove injector fastening screws and with the tool 99342101 (1) remove also the injectors (2) from cylinder heads.

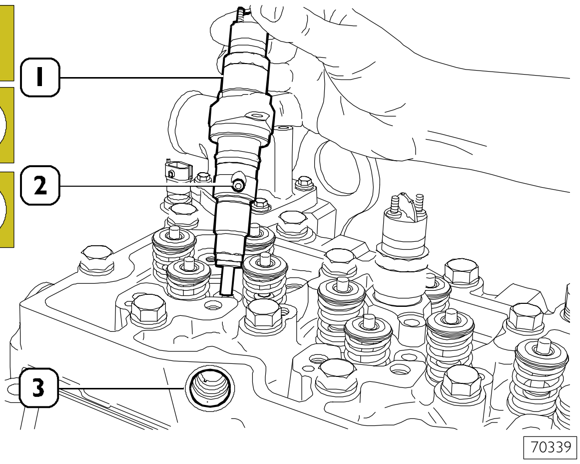
Refitting

Figure 11



Assemble a new ring (2) lubricated with vaseline and a new washer (3) on the injector (1).

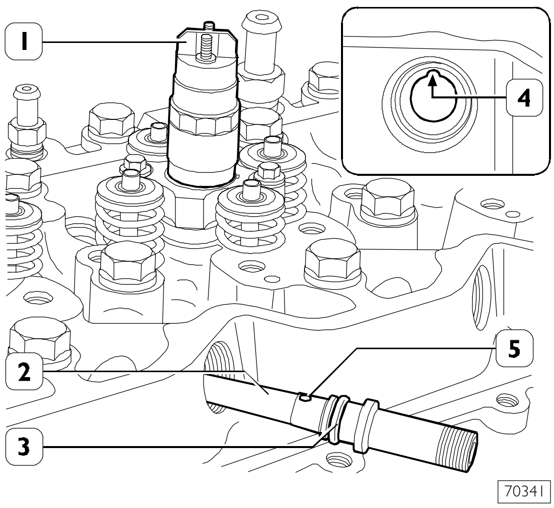
Figure 12



Assemble the injectors (1) on the cylinder heads, in a way that the fuel entrance hole (2) is turned towards the fuel manifolds housing (3).
Screw fastening screws without clamping them.

> ⚠ To fit down injectors use the tool 99342101 (Figure 10).

Figure 13



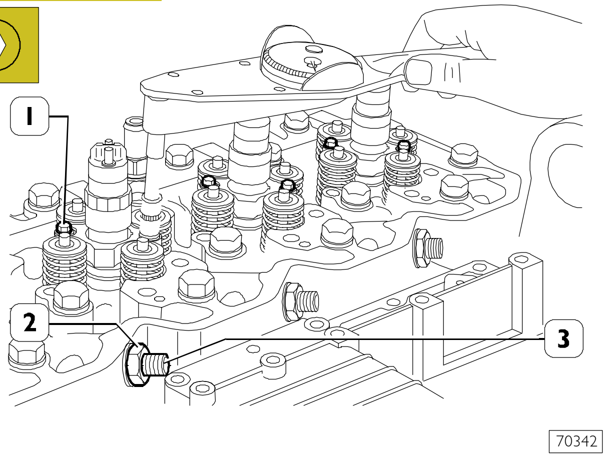
Assemble a new ring (3), lubricated with vaseline, on the fuel manifold (2) and insert it in the cylinder head housing so that the position ball (5) clashes with its housing (4).

> ⚠ The disassembled fuel manifolds (2) shall never be used again but replaced with new ones.

Screw fastening nuts without clamping them.

> ⚠ During this operation, move the injector (1) so that the manifold (2 Figure 13) can be placed correctly into the fuel entrance hole (2, Figure 12)

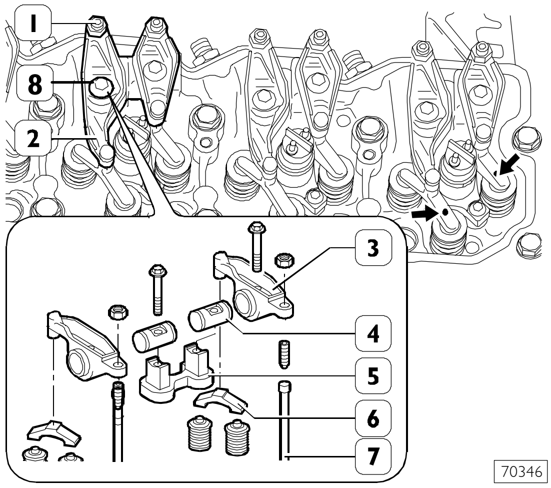
Figure 14



Fasten gradually and alternatively the injector fastening screws (1) to 8.5±0.8 Nm torque with a dynamometrical wrench.

Fasten fuel manifold (3) fastening screws (2) to the 50 Nm torque.

Figure 15



Check that the tappet registers (1) are unscrewed to avoid problems with rods (7) during rocker unit (2) assembling. Place the bond on the valve (6).

> ⚠ The notches (•) on the bonds shall be turned towards the exhaust manifold.
>
> After, assemble rocker units (2) consisting of support (5), rockers (3) and shafts (4) and fix them to cylinder heads fastening the screws (8) to the Nm 36 torque.

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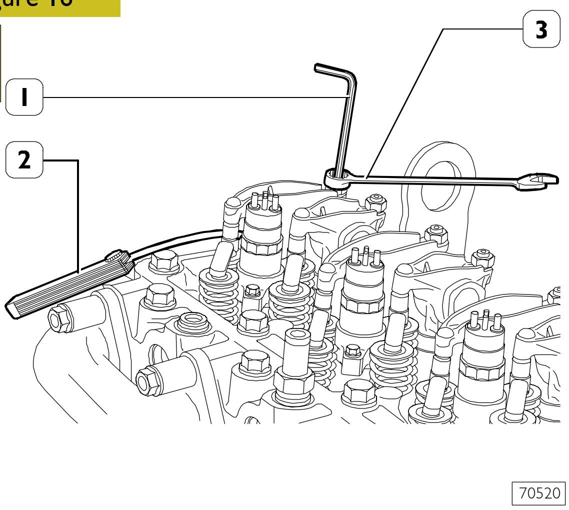
Figure 16



Adjust clearance between rockers and valves through a setscrew wrench (1), box wrench (3) and feeler gauge (2).

The clearance amounts to:

- ± 0.05
- suction valves 0.25 ± 0.05
- exhaust valves 0.51 ± 0.05

To adjust more quickly the rocker-valve clearance, operate as follows:
Rotate driving shaft, balance cylinder No. 1 valves and adjust the valves marked with * as described in the tables:

4- cylinder engine

Cylinder No.	1	2	3	4
Suction	-	-	*	*
Exhaust	-	*	-	*

Rotate driving shaft, balance cylinder No. 4 valves and adjust the valves marked with * as described in the tables:

Cylinder No.	1	2	3	4
Suction	*	*	-	-
Exhaust	*	-	*	-

6-cylinder engine

Cylinder No.	1	2	3	4	5	6
Suction	-	-	*	-	*	*
Exhaust	-	*	-	*	-	*

Rotate driving shaft, balance cylinder No. 6 valves and adjust the valves marked with * as described in the tables:

Cylinder No.	1	2	3	4	5	6
Suction	*	*	-	*	-	-
Exhaust	*	-	*	-	*	-

Complete assembling inverting the operations requested for removal, bearing in mind to:

- Fasten injector connector nuts to the prescribed torque;
- Assemble high and low pressure tubings according to the procedures described in the paragraph "main service operations to be performed on engine fitted on vehicle ";
- Fill the cooling system with cooling fluid and bleed as described before.

Check that the cooling fluid does not contain filth before using it; if it does, filter with appropriate net filters; in case of filling-ups, see the table REFUELING in the section "GENERAL".

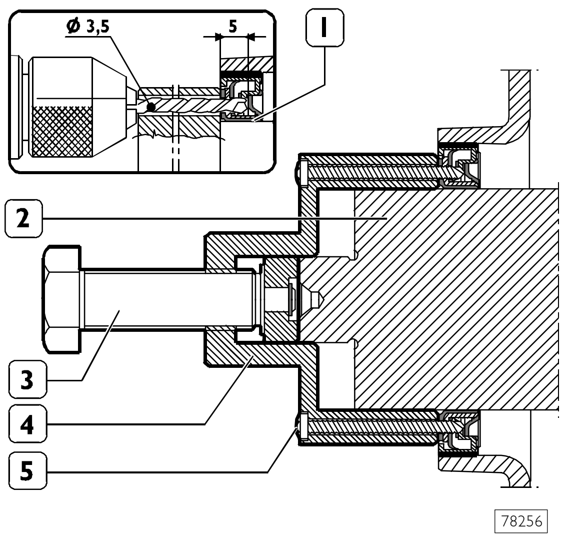
Tests and checks

Start the engine, leave it in motion at a running rate little more than the minimum and wait that the cooling fluid temperature reaches the rate for the thermostat to be opened , then check that:

- There are no water drippings from the connecting manifolds of the engine cooling tubing and the cab heating, fasten blocking collars further if necessary.

REPLACING SEAL RING FRONT COVER DRIVING SHAFT

Figure 16/1



Apply on the front tang (2) of the driving shaft fixture 99340055 (4) and through the guiding holes of the fixture itself, drill the internal seal ring (1) with a drill (Ø 3,5 mm) to a depth of 5 mm..
Fix fixture (4) to the ring (1) by means of the 6 screws in the kit e proceed with the removal of the ring by screwing up the screw (3).

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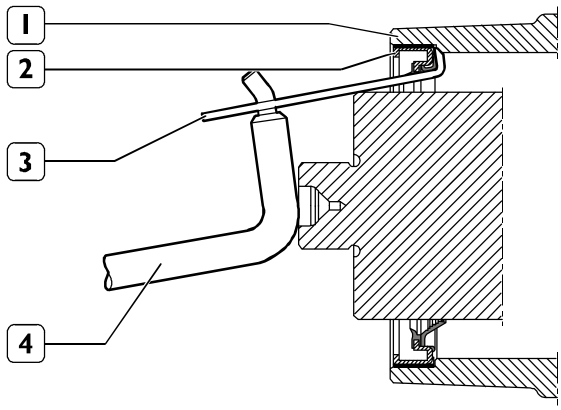
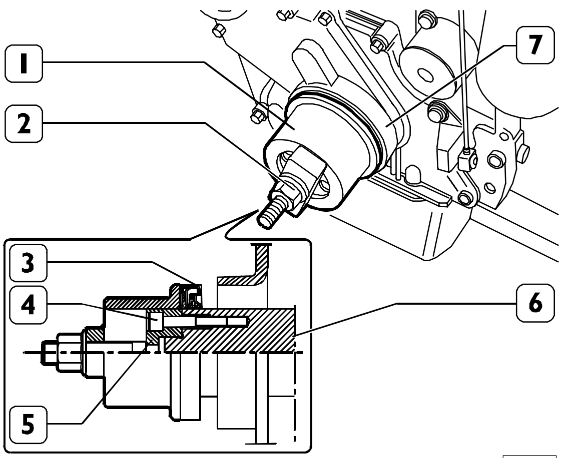
Figure 16/2



78257

Apply the proper rod (3) of fixture 99363204 to the external seal ring (2) as shown in the figure and use lever (4), to remove it from the front cover (1).

Figure 16/3

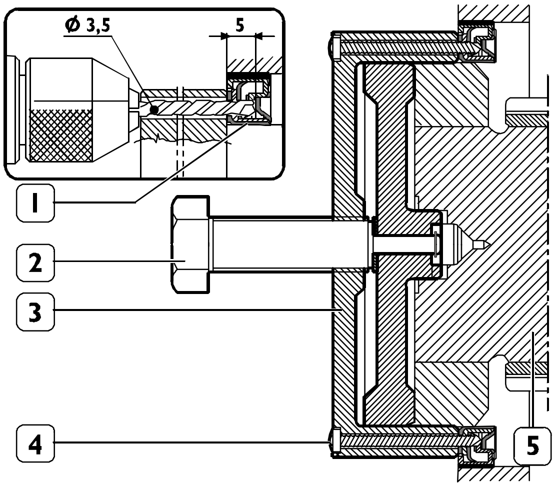


70225

Apply on the front tang (6) of the driving shaft part (5) of fixture 99346252, fix it with screws (4) and key on it the new seal ring (3). Position part (1) on part (5), tighten nut (2) till complete assembly of seal ring (3) on the front cover (7).

REPLACING SEAL RING FLYWHEEL HOUSING BOX

Figure 16/4



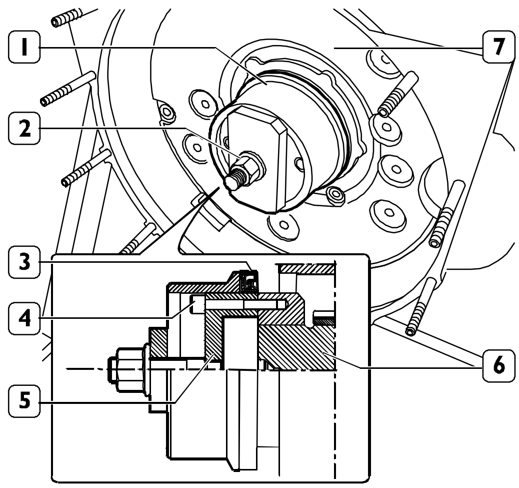
78258

Apply fixture 99340056 (3) on the rear tang (5) of the driving shaft and through the guiding holes of the fixture, drill the internal seal ring (1) with a drill (Ø 3,5 mm) to a depth of 5 mm.

Fix fixture (3) to the ring (1) by means of the 6 screws (4) in the kit e proceed with the removal of the ring by tightening the screw (2).

Perform the removal of the external seal ring as shown and described in figure 16/2.

Figure 16/5



70216

Apply on the rear tang (6) of the driving shaft part (5) of 'fixture 99346253, fix it with screws (4) and key on it the new seal ring (3).

Position part (1) on part (5) tighten nut (2) until seal ring (3) is fully assembled into the flywheel housing box (7).

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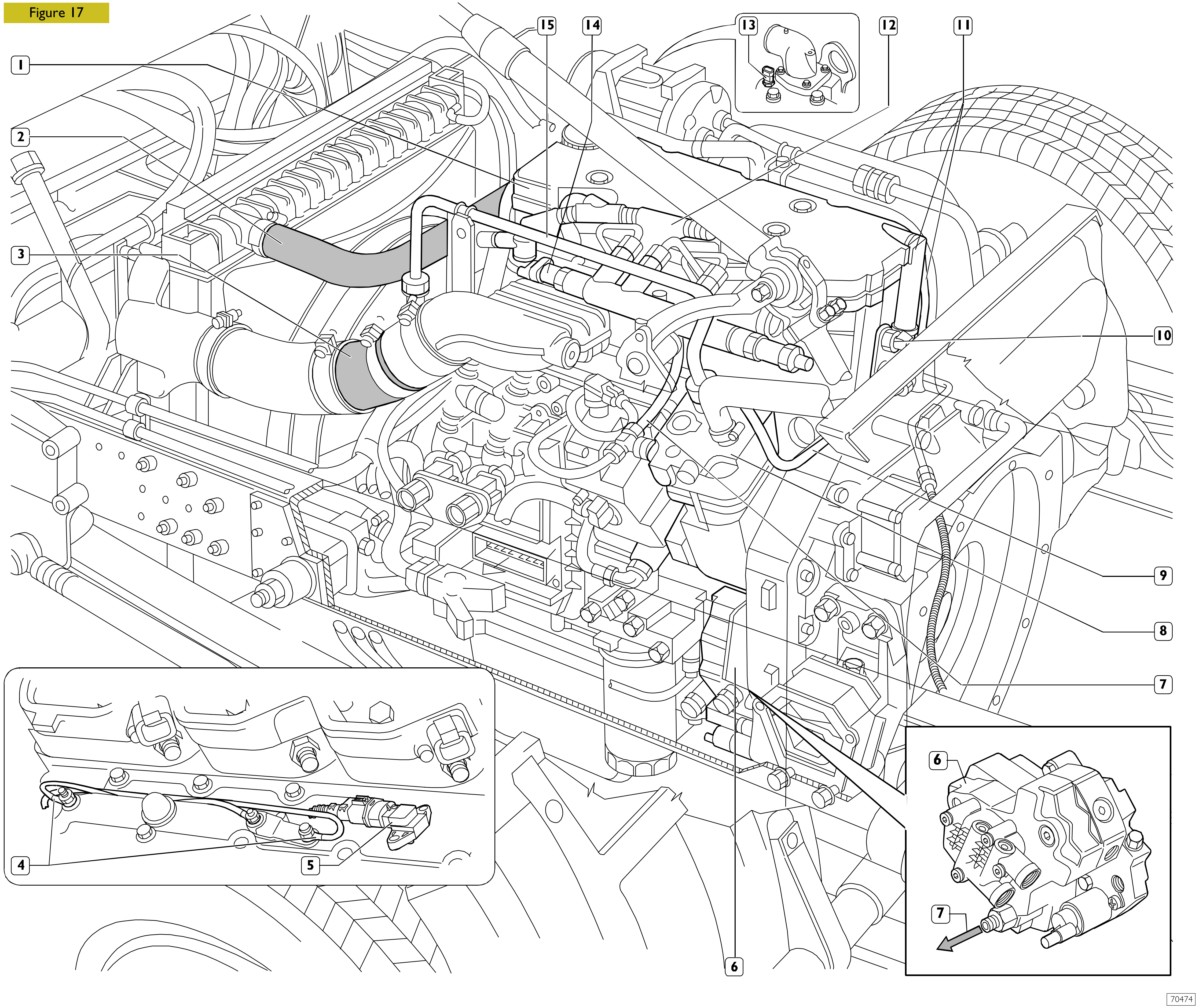
CYLINDER HEAD REMOVAL/REFITTING
Removal

Before removal/refitting operations disconnect battery terminals and place the vehicle in safety conditions.

Lift the radiator cowling, overturn the cab and operate as follows:

- Drain partially the cooling fluid in an appropriate tin;
- Disconnect the cooling fluid tubing (2) from thermostat cover;
- Disconnect the air tubing (3) from the suction manifold;
- Disconnect electrical connections;
  - (4), for heater
  - (12), for injectors
  - (13), for water temperature sensor;
  - (5) air temperature/pressure sensor;
  - (14), air from the rail pressure sensor;
- Remove the part of air tubing (15) from the remaining tubing, from the compressor (8) and from the bracket;
- Remove the cooling fluid tubing (9) from the compressor (8);
- Remove oil breathe pipes (11) from tappet cover (1);
- Disconnect exhaust fuel tubing (10) from pressure adjusting valve;
- Remove high pressure tubing (7) from the rail and high pressure pump (6).

Figure 17



- ❑ Remove air-conveyor (9) from turbosupercharger (3) and intercooler radiator (10);
- ❑ Disconnect cooling fluid tubings (1)

For vehicles with air-conditioning:

- ❑ Operating on the automatic tightener (11), loosen the compressor (13) belt tension (12);
- ❑ Remove compressor fastening screws (13) to the support and fix the compressor (13) accurately to avoid gas tubing damages in the air-conditioning system;

For all types of vehicles:

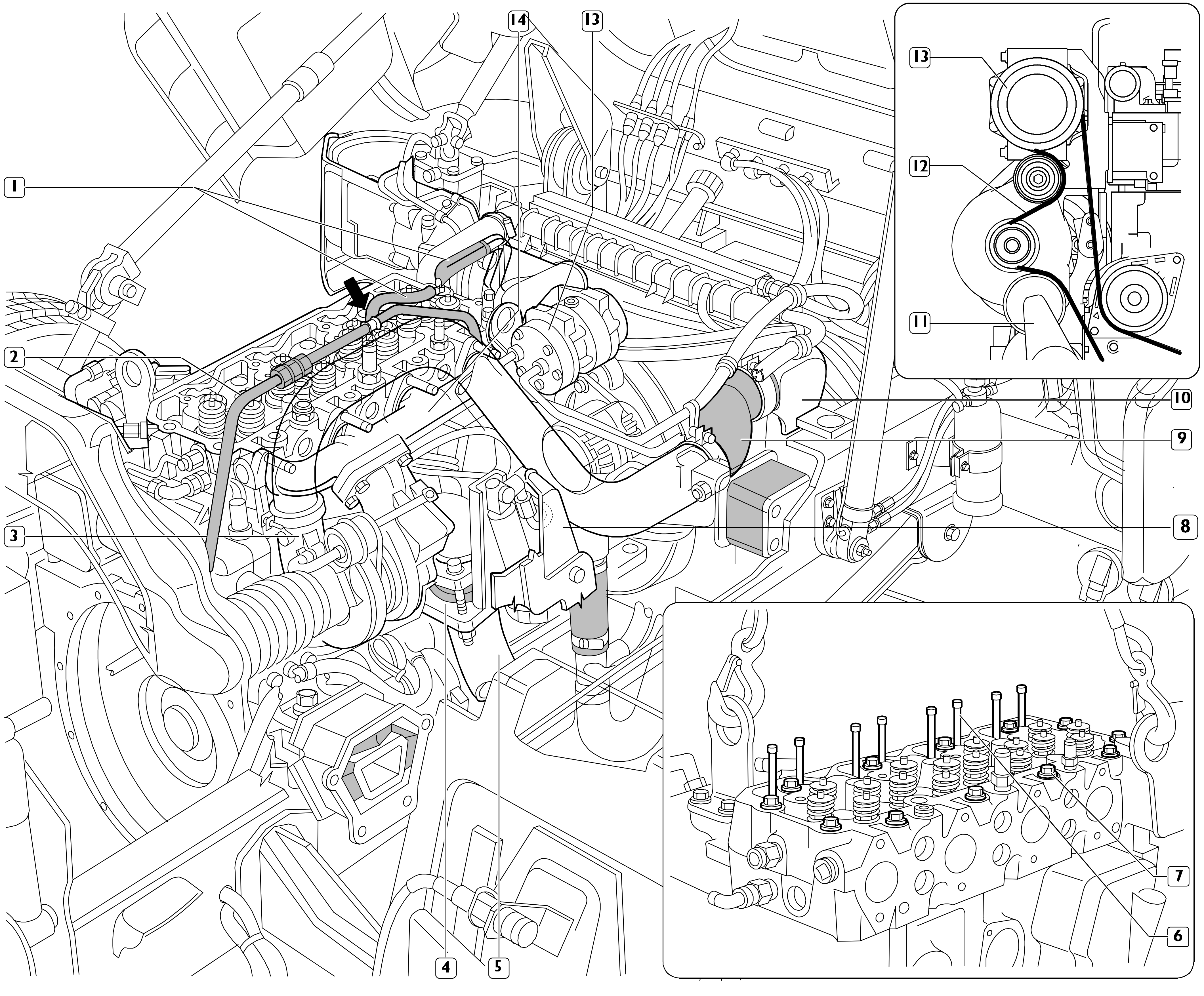
- ❑ Remove heat protection (8);
- ❑ Remove exhaust tubing fastening screws (5) and exhaust brake throttle valve (4) from the turbosupercharger (3), taking care to fasten the latter to the frame;
- ❑ Remove the air tubing bracket fastening screws (2);
- ❑ Disconnect oil tubing from the turbosupercharger (3);
- ❑ Remove exhaust manifold fastening screws (14) from the cylinder heads and remove it with the turbosupercharger (3).

⚠ Close the oil and air inlet/outlet holes in the turbosupercharger to avoid damages caused by external bodies in it.

- ❑ Remove injectors as described before;
- ❑ Remove rocker control rods (6);
- ❑ Remove cylinder head fastening screws (7).

⚠ Place the rocker 99360585 to the cylinder head lifting bracket. Hook it to the lifter and remove cylinder heads.

Figure 18



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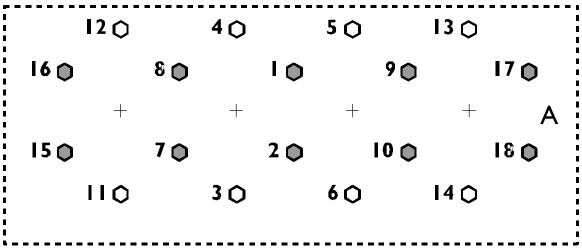
Refitting

For refitting invert the operations requested for removal and follow these warnings:
Check that the cylinder head attack surface and the base are clean;
Do not dirty the cylinder head gasket;
Assemble cylinder head, fasten and clamp the screws in three steps, as described in the following figures.

Carry out the angle closing with the tool 99395216.

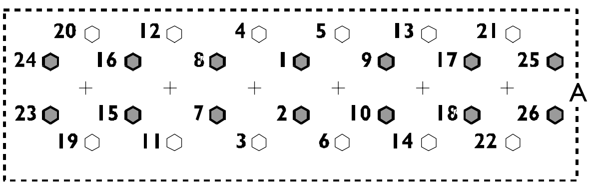
Figure 19



4-cylinder engine

70337

Figure 20



6-cylinder engine

70476

Fastening screws closing order chart:

- ❑ 1st pre-closing step, with dynamometrical wrench:
  - • Screw 12x1.75x130 (⬡) 35 ± 5 Nm
  - • Screw12x1.75 x 150 (⬢) 55 ± 5 Nm

  A= Front side
- ❑ 2nd 90°±5° angle closing step
- ❑ 3rd 90°±5° angle closing step

Assemble injectors as described in the appropriate chapter.

Assemble high and low pressure tubing as described in the paragraph "main service operations to be performed on engine fitted on vehicle".

- ❑ Check manifold, cooling fluid and air-conveyor conditions and replace them in case of damage;
- ❑ Fasten the screw to the prescribed torque;
- ❑ Fill the cooling system with cooling fluid and bleed as described before.

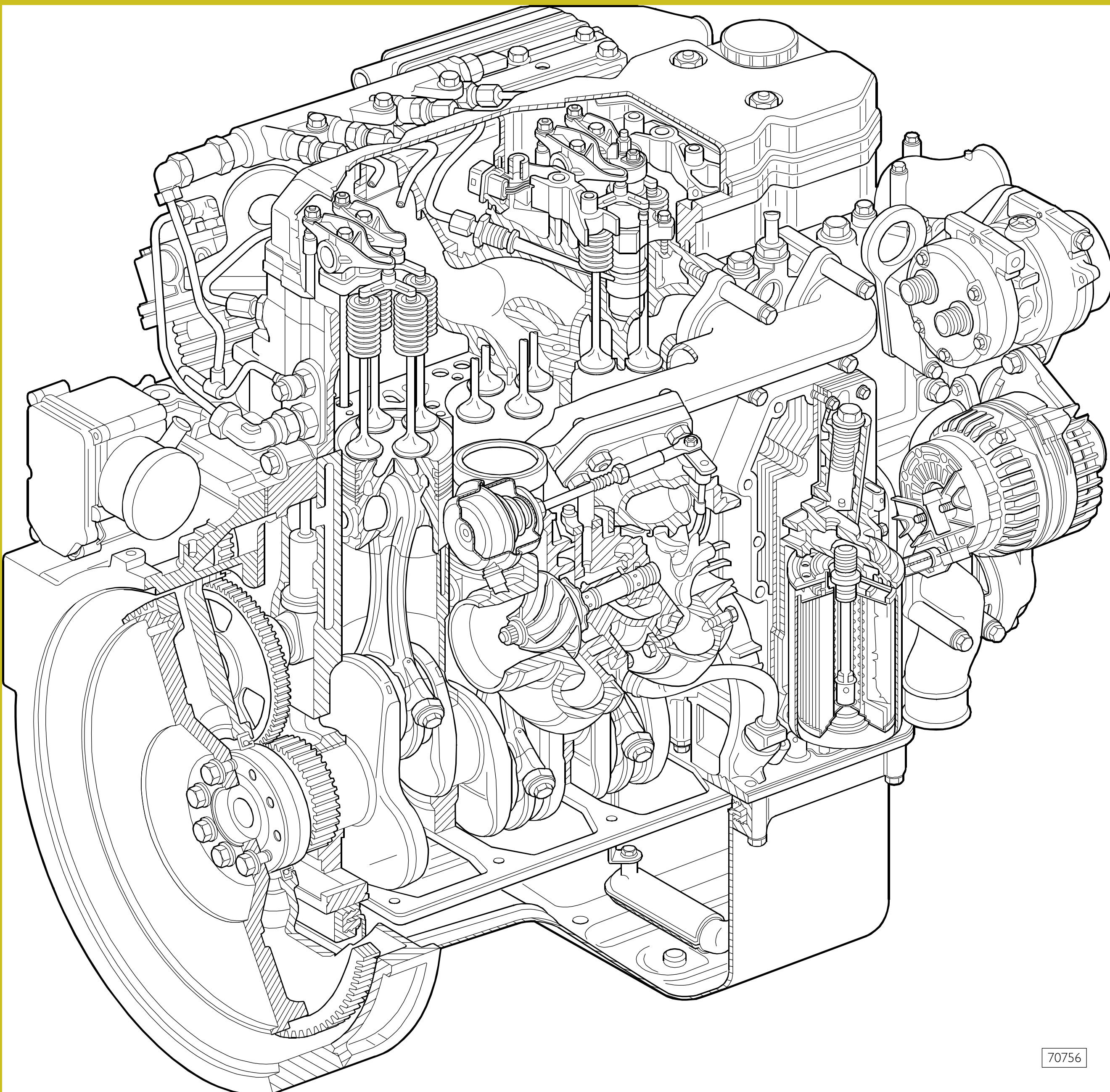
Check that the cooling fluid does not contain filth before using it; if it does, filter with appropriate net filters; in case of filling-ups, see the table REFUELING in the section "GENERAL".

Tests and checks

Start the engine, leave it in motion at a running rate little more than the minimum and wait that the cooling fluid temperature reaches the rate for the thermostat to be opened , then check that:

- ❑ There are no water drippings from the connecting manifolds of the engine cooling tubing and the cab heating, and fasten by blocking collars further if necessary.
- ❑ Low pressure fuel tubing connections and its unions are correct, as described in "main interventions on an assembled vehicle".
- ❑ There are no oil drippings between cylinder cover and head, oil pan and base, heat exchanger oil filter and lubrication circuit tubings.
- ❑ There are no fuel leakages from fuel tubings.
- ❑ There are no air losses from pneumatic tubings.
- ❑ The warning lights on the instrument panel and the devices disassembled during the engine removal work correctly.

ENGINE F4 AE 0481



Engine F4 AE 0481

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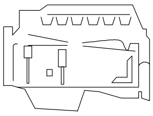
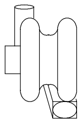
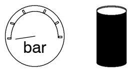
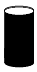
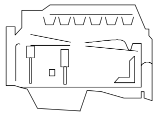
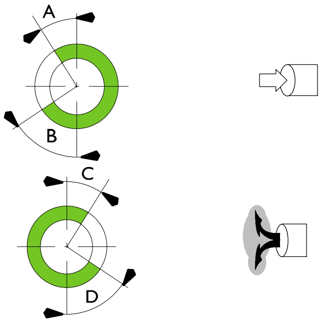
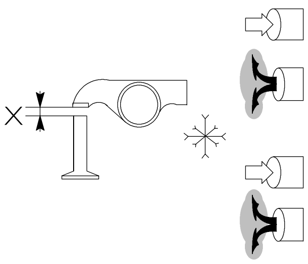
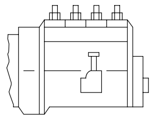
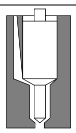
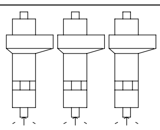
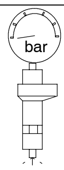
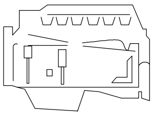
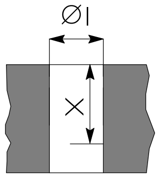
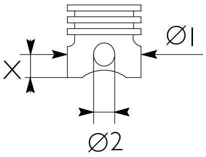
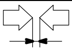
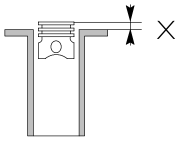
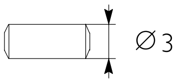
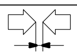
GENERAL SPECIFICATIONS

Type		**F4AE0481A (.17)**
Cycle		4 –stroke Diesel
Power Supply		Intercooler supercharged
Injection		Direct
Cylinder number		4 in line
Bore	mm	102
Stroke	mm	120
Total displacement	cm^3	3900
Compression ratio		17 : 1
Max power	kW (CV) rpm	125 (170) 2700
Max. torque	Nm (kgm) rpm	560 (57.1) 1200
Idle engine minimum rpm	rpm	750
Idle engine peak rpm	rpm	3000

			F4AE0481A (.17)	
	Type		F4AE0481A (.17)	
	**SUPERCHARGER**		With intercooler	
	Turbosupercharger type		GARRETT GT 22	
Turbosupercharger shaft radial backlash			-	
Turbosupercharger shaft end play			-	
Pressure relief valve min. opening stroke:		mm	-	
Pressure relief valve max. opening stroke:		mm	-	
Pressure corresponding to min. stroke:		bar	-	
Pressure corresponding to max. stroke:		bar	-	
	LUBRICATION		Forced by gear pump , pressure relief valve, double stage oil filter	
	Oil pressure with warm engine:			
	- idling	bar	1.2	
	- peak rpm	bar	3.8	
COOLING			By centrifugal pump, regulating thermostat, radiator, heat exchanger, intercooler	
	Water pump control		Through belt	
	Thermostat - start of opening - maximum opening		81 ± 2° C 96° C	
	FILLING Total capacity 1st filling:			
 Urania Turbo Urania LD5		liters kg	- -	
	- engine sump		**Min. level.**	**Max. level**
		liters	5.3	8.3
		kg	4.8	7.5
	- engine sump + filter	liters	6.3	9.3
		kg	5.7	8.4

	Type		F4AE0481A (.17)
	**TIMING**		
	start before T.D.C. end after B.D.C.	A B	8.5° 8.5°
	start before T.D.C. end after B.D.C.	D C	51° 12.5°
	Checking timing X	mm mm	- -
	Checking operation X	mm mm	0.20 ÷ 0.30 0.46 ÷ 0.56
	**FUEL FEED** Injection Type:	Bosch	high pressure common rail EDC7 ECU
	Nozzle type		Injectors
	Injection sequence		1 - 3 - 4 - 2
	Injection pressure	bar	250 - 1450

ASSEMBLY DATA – CLEARANCES

	Type	**F4AE0481A (.17)**
CYLINDER UNIT AND CRANKSHAFT COMPONENTS		**mm**
	Cylinder barrels Ø1	102.009 ÷ 102.031
	Spare pistons type: Size X Outside diameter Ø 1 Pin housing Ø 2	 60,5 101.781 ÷ 101.799 40.008 ÷ 40.014
	Piston – cylinder barrels	0.116 ÷ 0.134
IVECO PARTS	Piston diameter Ø 1	0.5
	Piston protrusion X	0.28 ÷ 0.52
	Piston pin Ø 3	39.9938 ÷ 40.0002
	Piston pin – pin housing	0.0078 ÷ 0.0202

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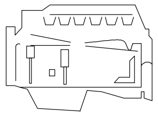
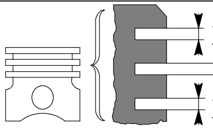
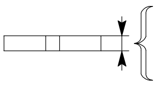
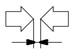
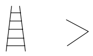
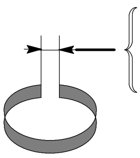
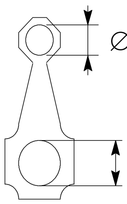
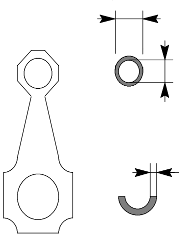
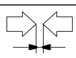
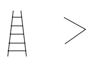
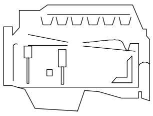
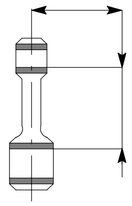
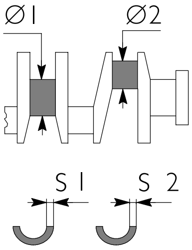
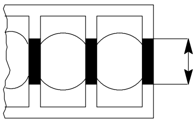
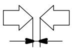
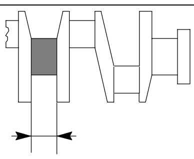
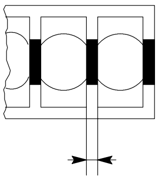
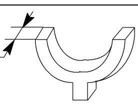
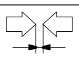
	Type		F4AE0481A (.17)
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm
	Split ring slots	X1* X 2 X 3	2.705 ÷ 2.735 2.420 ÷ 2.440 4.020 ÷ 4.040
	Split rings * measured on 98 mm	S 1* S 2 S 3 Ø	2.560 ÷ 2.605 2.350 ÷ 2.380 3.975 ÷ 4.000
	Split rings - slots	1 2 3	0.100 ÷ 0.175 0.040 ÷ 0.90 0.020 ÷ 0.065
IVECO PARTS 	Split rings		0.5
	Split ring end opening in cylinder barrel:	X 1 X 2 X 3	030 ÷ 0.40 0.60 ÷ 0.80 0.25 ÷ 0.55
	Small end bush housing Big end bearing housing	Ø 1 Ø 2	42.987 ÷ 43.013 72.987 ÷ 73.013
	Small end bush diameter Outside Inside  Spare big end half bearings	Ø 4 Ø 3 S	43.279 ÷ 43.553 40.019 ÷ 40.033 1.955 ÷ 1.968
	Small end bush – housing		0.266 ÷ 0.566
	Piston pin – bush		0.0188 ÷ 0.0392
IVECO PARTS 	Big end half bearings		0.250 ÷ 0.500

	Type		**F4AE0481A (.17)**
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			**mm**
X 	Size	X	-
	Max. tolerance on connecting rod axis alignment	—	-
	Journals Crankpins	Ø 1 Ø 2	82.99 ÷ 83.01 68.997 ÷ 69.013
	Main half bearings Big end half bearings	S 1 S 2	2.456 ÷ 2.464 1.955 ÷ 1.968
	*provided as spare part		
 Ø 3	Main bearings No. 1-3-4-5 No. 2	 Ø 3 Ø 3	 87.982 ÷ 88.008 87.982 ÷ 88.008
	Half bearings – Journals No. 1-3-4-5 No. 2		 0.041 ÷ 0.103 0.041 ÷ 0.103
	Half bearings - Crankpins		0.033 ÷ 0.041
IVECO PARTS	Main half bearings Big end half bearings		0.250 ; 0.500
 X 1	Shoulder journal	X 1	37.475 ÷ 37.545
 X 2	Shoulder main bearing	X 2	32.23
X 3 	Shoulder half-rings	X 3	32.30
	Output shaft shoulder		0.07

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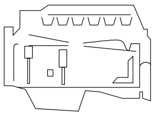
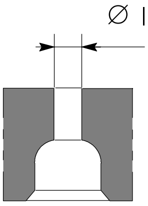
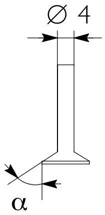
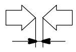
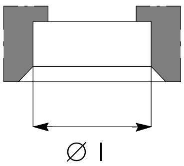
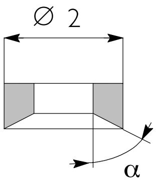
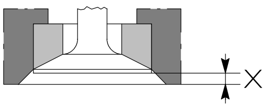
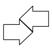
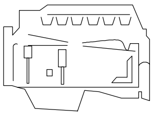
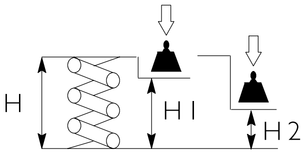
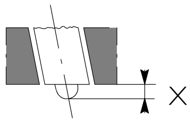
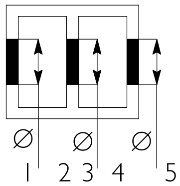
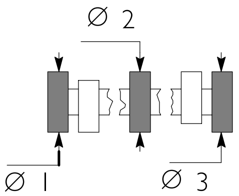
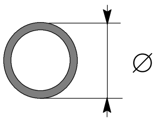
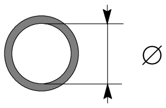
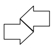
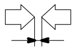
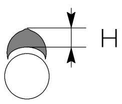
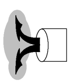
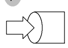
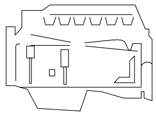
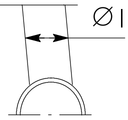
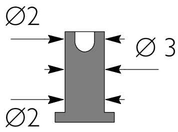
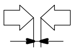
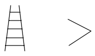
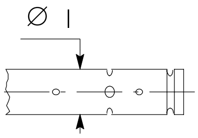
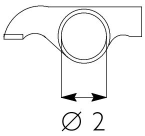
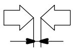
	Type		F4AE0481A (.17)
CYLINDER HEAD – TIMING SYSTEM			mm
	Valve guide seats on cylinder head	∅ 1	7.042 ÷ 7.062
	Valves:		
	(intake)	∅ 2 α	6.970 ÷ 6.990 60° ± 0.25°
	(exhaust)	∅ 2 α	6.970 ÷ 6.990 45° ± 0.25°
	Valve stem and guide		0.052 ÷ 0.092
	Housing on head for valve seat:		
	(intake)	∅1	34.837 ÷ 34.863
	(exhaust)	∅1	34.837 ÷ 34.863
	Valve seat outside diameter; valve seat angle on cylinder head:		
	(intake)	∅ 2 α	34.917 ÷ 34.931 60°
	(exhaust)	∅ 2 α	34.917 ÷ 34.931 45°
	Sinking	X (intake)	0.59 ÷ 1.11
		X (exhaust)	0.96 ÷ 1.48
	Between valve seat and head	(intake)	0.054 ÷ 0.094
		(exhaust)	0.054 ÷ 0.094
IVECO PARTS >	Valve seats		-

	Type	**F4AE0481A** **(.17)**
CYLINDER HEAD – TIMING SYSTEM		**mm**
	Valve spring height: free spring H under a load equal to: 339.8 ± 19 N H1 741 ± 39 N H2	 47.75 35.33 25.2
	Injector protrusion X	It cannot be adjusted
	Camshaft bush housings No. 1-5 Camshaft housings No. 2-3-4	59.222 ÷ 59.248 59.222 ÷ 59.248
	Camshaft journals: 1 ⇒ 5 ∅ 1-2-3	53.995 ÷ 54.045
	Camshaft bush outside diameter with a load of 3.3 kN: ∅	59,222 ÷ 59,248
	Bush inside diameter after ramming ∅	54.083 ÷ 54.147
	Bushes and housings on block	0,113 ÷ 0,165
	Bushes and journals	0.038 ÷ 0.152
	Cam lift:  H  H	 6.045 7.582

	Type	**F4AE0481A** **(.17)**
CYLINDER HEAD – TIMING SYSTEM		**mm**
	Tappet cap housing on block Ø 1	16.000 ÷ 16.030
	Tappet cap outside diameter: Ø 2 Ø 3	15.924 ÷ 15.954 15.960 ÷ 15.975
	Between tappets and housings	0.025 ÷ 0.070
IVECO PARTS 	Tappets	-
	Rocker shaft Ø 1	21.965 ÷ 21.977
	Rockers Ø 2	22.001 ÷ 22.027
	Between rockers and shaft	0.024 ÷ 0.162

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TIGHTENING TORQUE

PART		TORQUE	
		Nm	kgm
Cylinder barrel lubrication nozzle fixing screw M8		15 ± 3	1.5 ± 0.3
Engine shaft cap fixing screw M12	1st phase 2nd phase 3rd phase	50 ± 6 80 ± 6 90° ± 5°	5 ± 0.6 8 ± 0.6
Stud bolts M6 for camshaft sensors		8 ± 2	0.8 ± 0.2
Stud bolts M8 for power supply pump		12 ± 2	1.2 ± 0.2
Rear gearcase fixing screw M12 Rear gearcase fixing screw M10 Rear gearcase fixing screw M8		77 ± 12 47 ± 5 24 ± 4	7.7 ± 1.2 4.7 ± 0.5 2.4 ± 0.4
Camshaft sensor fixing nut M6		10 ± 2	1 ± 0.2
Oil pump fixing screw M8	1st phase 2nd phase	8 ± 1 24 ± 4	0.8 ± 0.1 2.4 ± 0.4
Front cover fixing screw M8		24 ± 4	2.4 ± 0.4
Screw M8 for camshaft longitudinal check plate fixing		24 ± 4	2.4 ± 0.4
Camshaft gear fixing screw M8		36 ± 4	3.6 ± 0.4
Connecting rod cap fixing screw M11	1st phase 2nd phase	60 ± 5 60° ± 5°	6 ± 0.5
Underblock plate fixing screw M10		43 ± 5	4.3 ± 0.4
Nut M8 for high pressure pump gear fixing		105 ± 5	10.5 ± 0.5
Fuel pump fixing nuts M8		24 ± 4	2,4 ± 0,4
½ inch plug on the cylinder head ¼ inch plug on the cylinder head ¾ inch plug on the cylinder head		24 ± 4 36 ± 5 12 ± 2	2.4 ± 0.4 3.6 ± 0.5 1.2 ± 0.2
Injector fixing screws M6		8.5 ± 0.35 75° ± 5°	0.35 ± 0.035
Union fixing nut for injector power supply		50 ± 5	5 ± 0.5
Pre-heating grid nut M6 on the suction manifold		8 ± 2	0.8 ± 0.2
Suction manifold fixing screw M8		24 ± 4	2.4 ± 0.4
Rear bracket fixing screw M12 for engine lifting		77 ± 12	7.7 ± 1.2
Common rail fixing M8 screws		24 ± 4	2.4 ± 0.4
High-pressure fuel pipe unions M14		20 ± 2	2 ± 0.2
Cylinder head fixing M12 screw (12x1.75x 130) Cylinder head fixing M12 screw (12x1.75x 150)	} 1st phase 2nd phase 3rd phase	35 ± 5 55 ± 5 90° ± 5° 90° ± 5°	3.5 ± 0.5 5.5 ± 0.5
Equalizer support fixing screw		36 ± 5	3.6 ± 0.5
Valve clearance adjustment nut		24 ± 4	2.4 ± 0.4
Power supply pipe fixing nuts M14 from common rail high pressure pump		20 ± 2	2 ± 0.2
High pressure pipe union fixing screw M8		24 ± 4	2.4 ± 0.4
Head bulkhead fixing screw M6 for harness		10 ± 2	1 ± 0.2
Electric harness support fixing screw M8 for injector power supply		24 ± 4	2.4 ± 0.4
Harness fixing nuts on individual injector		1.5 ± 0.25	0.15 ± 0.025
Fuel filter-holder bracket fixing screw M8		77 ± 8	7.7 ± 0.8
Fuel filter-holder fixing screw M8		24 ± 4	2.4 ± 0.4
Fuel filter		contact + ¾ turn	
Oil pressure adjustment valve fixing screw M22 on the oil filter support		80 ± 8	8 ± 0.8
Oil filter support and gasket radiator fixing screw M8		24 ± 4	2.4 ± 0.4
Oil filter		contact + ¾ turn	

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PART		TORQUE	
		Nm	kgm
11/8 inch connection on filter support for turbine lubrication		24 ± 4	2.4 ± 0.4
Pipe fixing nut M12 for turbine lubrication		10 ± 2	1 ± 0.2
Engine coolant input connection fixing screw M10		43 ± 6	4.3 ± 0.6
90° curve fixing (as necessary) on engine fluid input connection		24 ± 4	2.4 ± 0.4
Pipe on cylinder head for supercharger cooling		22 ± 2	2.2 ± 0.2
Union fixing screw M6 for engine coolant exhaust		10 ± 2	1 ± 0.2
Pin fixing on engine block for exhaust manifold		10 ± 2	1 ± 0.2
Exhaust manifold fixing screw M10 on cylinder head		53 ± 5	5.3 ± 0.5
Adapter fixing screw M12 for damper and damper on engine shaft	1st phase	50 ± 5	5 ± 0.5
	2nd phase	90°	
Pulley fixing screw M10 on engine shaft		68 ± 7	6.8 ± 0.7
Water pump fixing screw M8		24 ± 4	2.4 ± 0.4
Auxiliary part control belt screw coupling fixing screw M10		43 ± 6	4.3 ± 0.6
Fixed pulley fixing screw M10 for auxiliary part control belt		43 ± 6	4.3 ± 0.6
Flywheel housing fixing screw M10		85 ± 10	8.5 ± 1
Flywheel housing fixing screw M12		49 ± 5	4.9 ± 0.5
Heating exchanger fixing screw M6 for control unit		10 ± 2	1 ± 0.2
Heating exchanger fixing screw M8 for control unit		24 ± 4	2.4 ± 0.4
Input-output connection M12 for fuel on the heating exchanger		12 ± 2	1.2 ± 0.2
Valve cover fixing nut M8		24 ± 4	2.4 ± 0.4
Camshaft sensor fixing screw M6		8 ± 2	0.8 ± 0.2
Engine shaft sensor fixing screw M6		8 ± 2	0.8 ± 0.2
Engine coolant temperature sensor fixing screw M14		20 ± 3	2 ± 0.3
Oil temperature-pressure sensor fixing screw M5		6 ± 1	0.6 ± 0.1
Fuel pressure sensor fixing screw		35 ± 5	3.5 ± 0.5
Fuel temperature sensor fixing screw M14		20 ± 3	2 ± 0.3
Air pressure/temperature sensor fixing screw on suction manifold		6 ± 1	0.6 ± 0.1
Engine oil level sensor fixing screw M12		12 ± 2	1.2 ± 0.2
Turbine fixing to the exhaust manifold	6 cylinders { pins M10	7 ± 1	0.7 ± 0.1
	6 cylinders { nuts M10	43 ± 6	4.3 ± 0.6
	4 cylinders { pins M8	7 ± 1	0.7 ± 0.1
	4 cylinders { nuts M8	24 ± 4	2.4 ± 0.4
Adapter M12 on turbine for (input) lubricant oil pipes		35 ± 5	3.5 ± 0.5
Pipe fixing on adapter M10 for turbine lubrication		35 ± 5	3.5 ± 0.5
Oil pipe fixing on adapter M10 for block turbine lubrication		43 ± 6	4.3 ± 0.6
M8 oil exhaust pipe fixing on turbine		24 ± 4	2.4 ± 0.4
Fixing union M6 for oil return from the cylinder head to the flywheel housing		10 ± 2	1 ± 0.2
Engine flywheel fixing screw M12	1st phase	30 ± 4	3 ± 0.4
	2nd phase	60° ± 5°	
Front bracket fixing screw M8 for engine lifting		24 ± 4	2.4 ± 0.4
Engine oil torque fixing screw		24 ± 4	2.4 ± 0.4

AUXILIARY COMPONENTS

PART	TORQUE	
	Nm	kgm
Air supercharger:		
Control gear 5/8 inch fixing nut on the supercharger shaft	125 ± 19	12.5 ± 1.9
Fixing nut M12 to the flywheel housing	77 ± 12	7.7 ± 1.2
Alternator:		
Bracket fixing nut M12 on the water input union	43 ± 6	4.3 ± 0.6
Alternator fixing nut M10	43 ± 6	4.3 ± 0.6
Climate control:		
Bracket fixing screw M10	43 ± 6	4.3 ± 0.6
Supercharger fixing screw M10	24 ± 4	2.4 ± 0.4
Starter:		
Starter fixing screw	43 ± 6	4.3 ± 0.6

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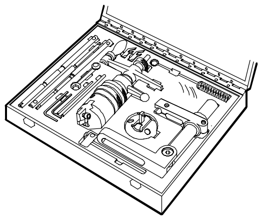
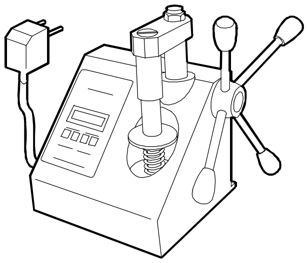
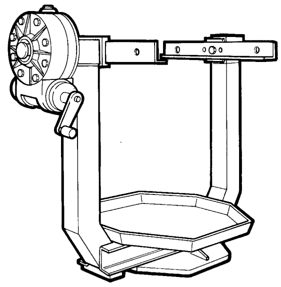
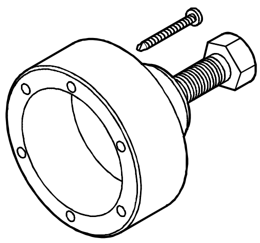
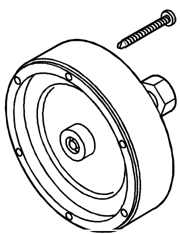
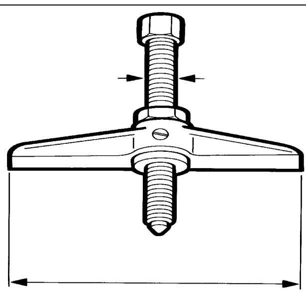
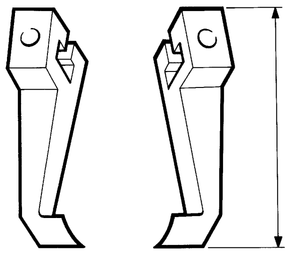
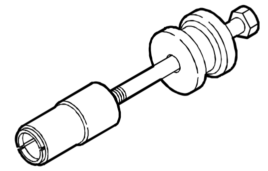
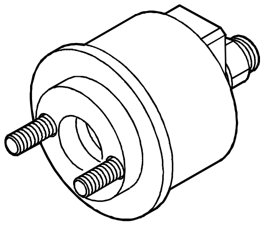
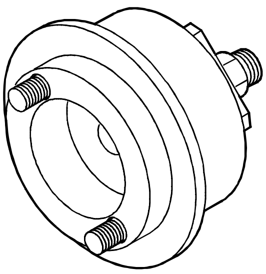
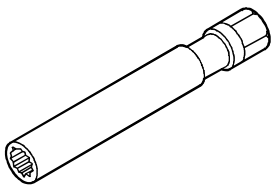
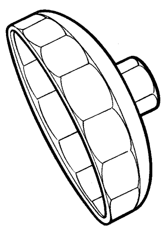
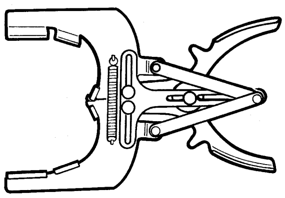
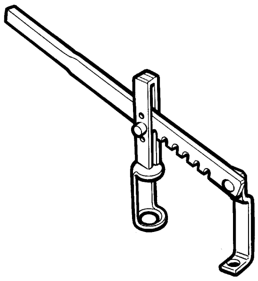
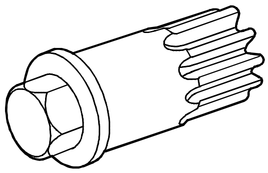
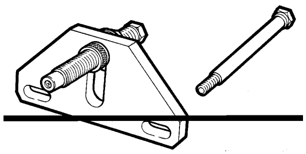
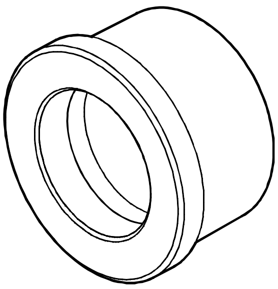
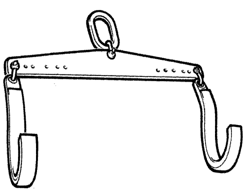
TOOLS

TOOL No.		DESCRIPTION
99305018		Kit with tooling complete of valve seat grinding tools
99305047		Spring load device
99322205		Revolving stand for group overhaul (capacity 1000 daN, torque 120 daNm)
99340055		Engine shaft front gasket extraction tool
99340056		Engine shaft rear gasket extraction tool
99341001		Double effect lift

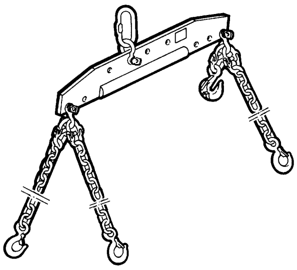
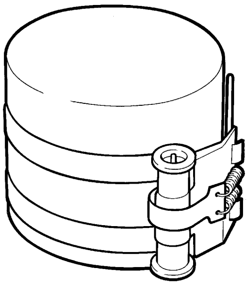
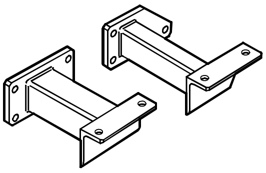
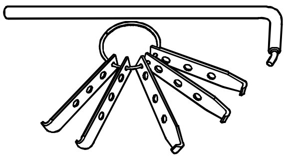
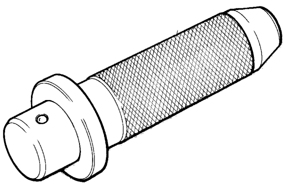
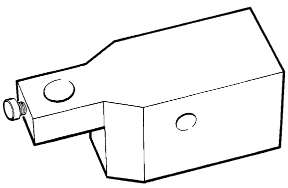
TOOLS

TOOL No.		DESCRIPTION
99341009		Bracket pair
99342101		Injector extraction tool
99346252		Tool for engine shaft front gasket assembly
99346253		Tool for engine shaft front gasket assembly
99355019		Wrench (10mm) for hydraulic power steering pump check screw
99360076		(engine) oil filter removal tool

TOOLS

TOOL No.		DESCRIPTION
99360183		Pliers for piston ring removal and assembly (65-110mm)
99360268		Engine valve assembly and removal tool
99360330		Engine flywheel rotation tool
99360351		Engine flywheel check tool
99360362		Beater for camshaft bush removal and assembly (use with tool 99370006)
99360500		Engine shaft lifting tool

TOOLS

TOOL No.		DESCRIPTION
99360595		Engine removal and assembly rocker arm
99360605		Band for piston insertion into the cylinder barrel (60-125 mm)
99361037		Engine fixing bracket to the revolving stand 99322205
99363204		Gasket extraction tool
99370006		Interchangeable beater grip
99370415		Gauge-holder block for various relieves (use with tool 99395603)

TOOLS

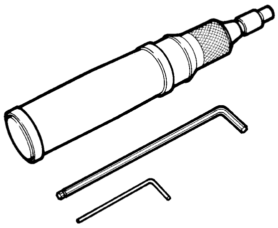
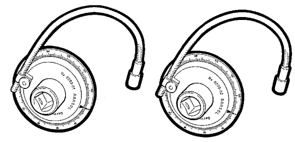
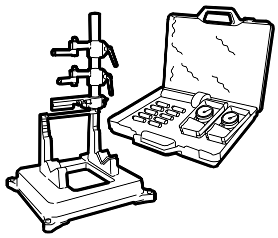
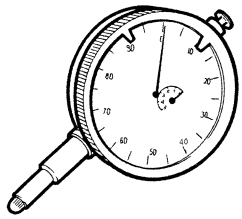
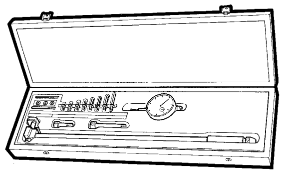
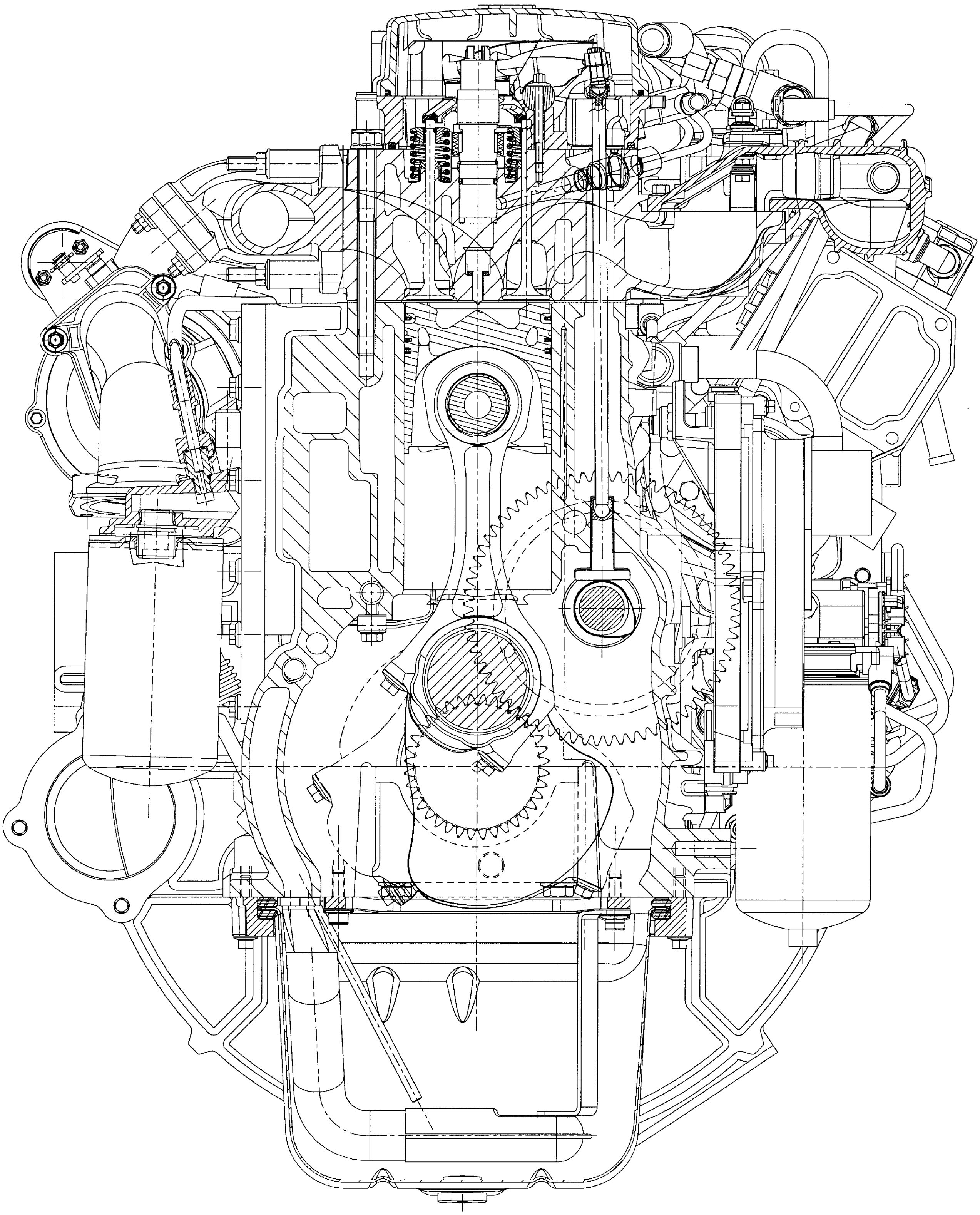
TOOL No.		DESCRIPTION
99389834		Dynamometric screwdriver for injector solenoid valve connector check nut adjustment
99395216		Measurer pair for angular tightening with ½" and ¾ " square
99395363		Square complete for connecting rod quadrature control
99395603		Gauge (0 – 5 mm)
99395687		Bore meter

Figure 1



ENGINE F4AE0481 CROSS SECTION

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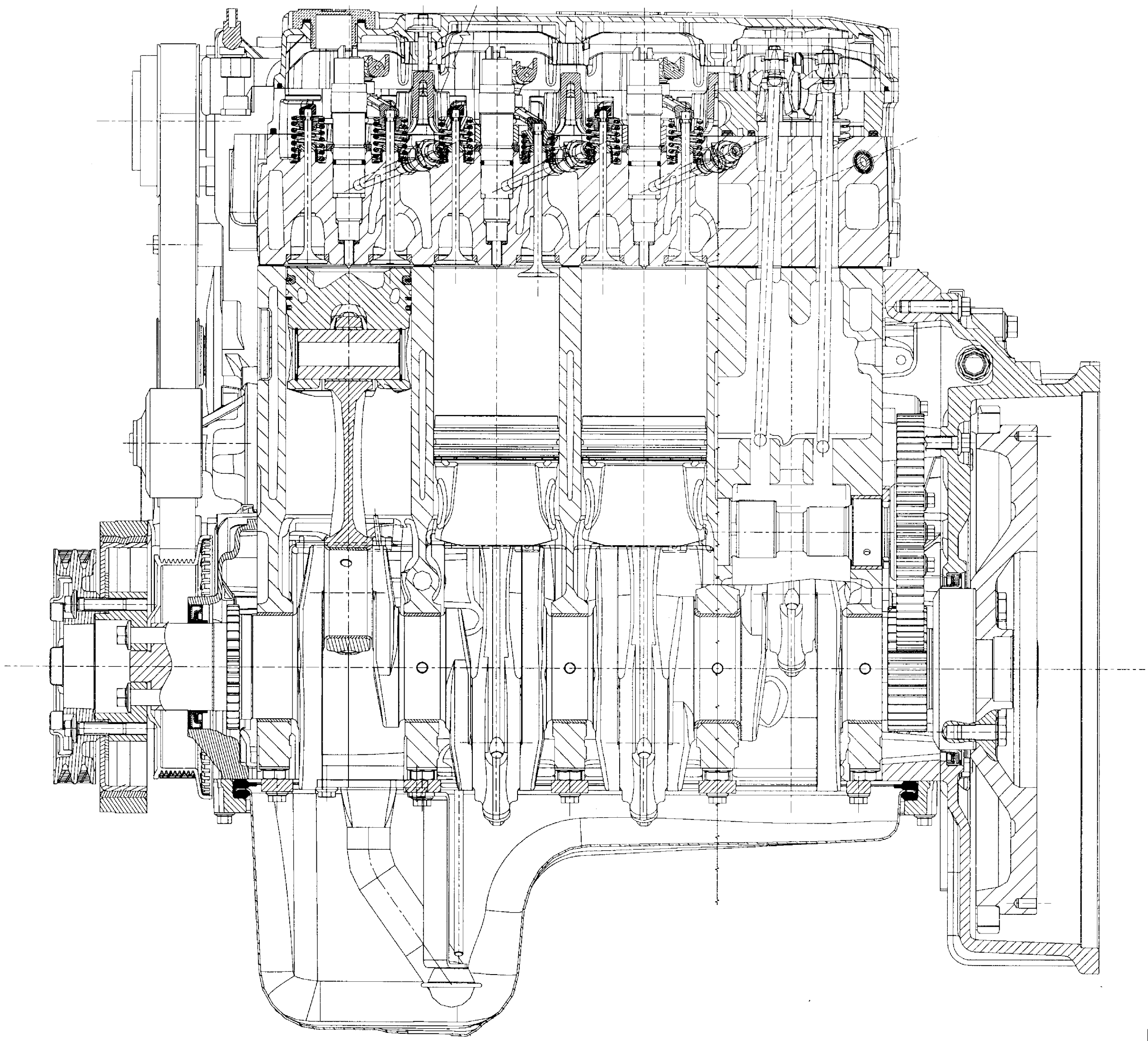
Figure 2

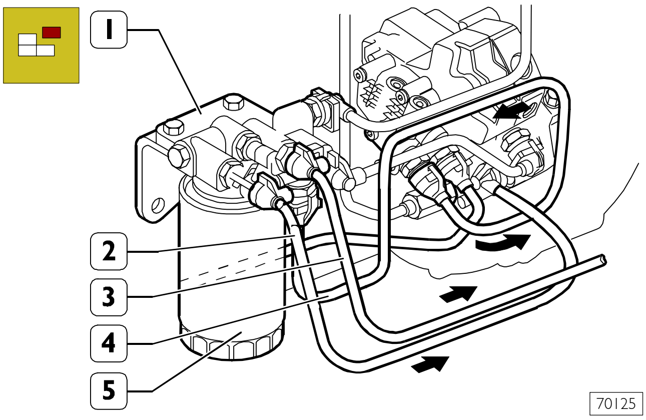


ENGINE F4AE0481 LONGITUDINAL SECTION

ENGINE OVERHAUL

540110 DISASSEMBLY OF THE ENGINE AT THE BENCH

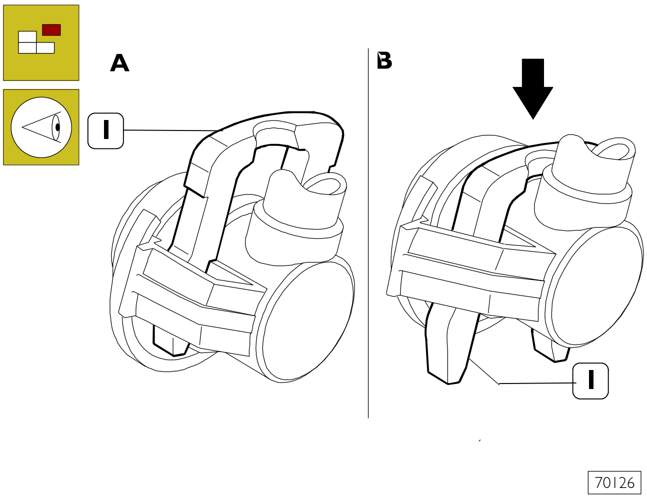
Figure 3



In order to apply to the engine block the engine fixing brackets 99341009 to the stand for the overhaul, operating on the engine left side, it is necessary:

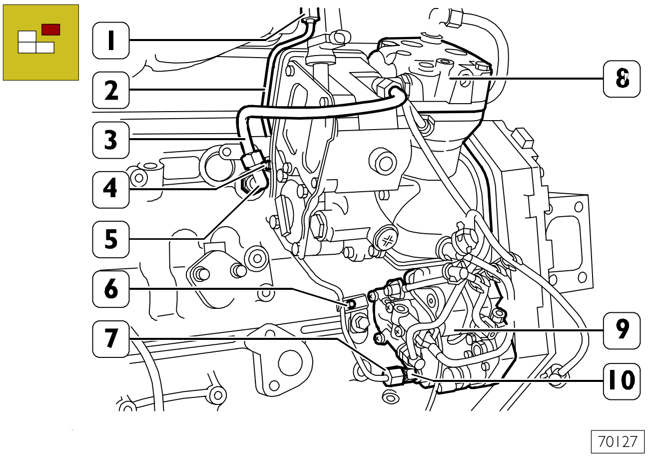
- ❑ to remove the fuel filter (5) from the support (1) by means of tool 99360076;
- ❑ to remove the low pressure fuel pipe (2-3-4) from the support (1)
- ❑ to remove the support (1) bracket from the block

Figure 4



> In order to remove the low-pressure fuel pipe (2-3-4, Figure 3) from the relevant connection unions, it is necessary to press the fastener (1) as shown in figure **B**.
>
> After removing the pipe, position the fastener (1) into its lock position, figure **A**, in order to avoid possible deformations.

Figure 5



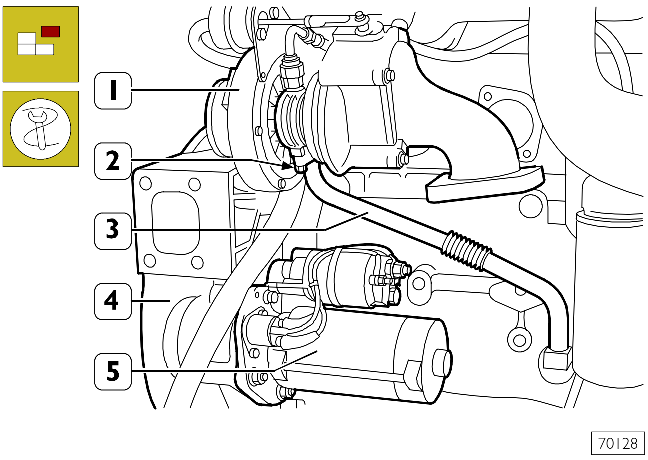
The pipe (3) from the union (4) and from the supercharger (8).

Remove the fuel pipe (2) from the rail and from the high-pressure pump (9) and remove it from the engine block, by removing the fixing screws (4 and 6)

> When unlocking the pipe (2) union (7), it is necessary to prevent the union (10) rotation of the high-pressure pump (9), by using the proper wrench.

On the right side

Figure 6



Remove the screws (2) and remove the oil pipe (3) from the supercharger pipe (1) and from the engine block.

Remove the starting engine (5) from the flywheel cover (4).

Apply to the block the bracket 99361037 and fix by means of these latter the engine to the revolving stand 99322205. Drain the engine oil by removing the plug from the sump.

Remove the fan from the engine shaft pulley.

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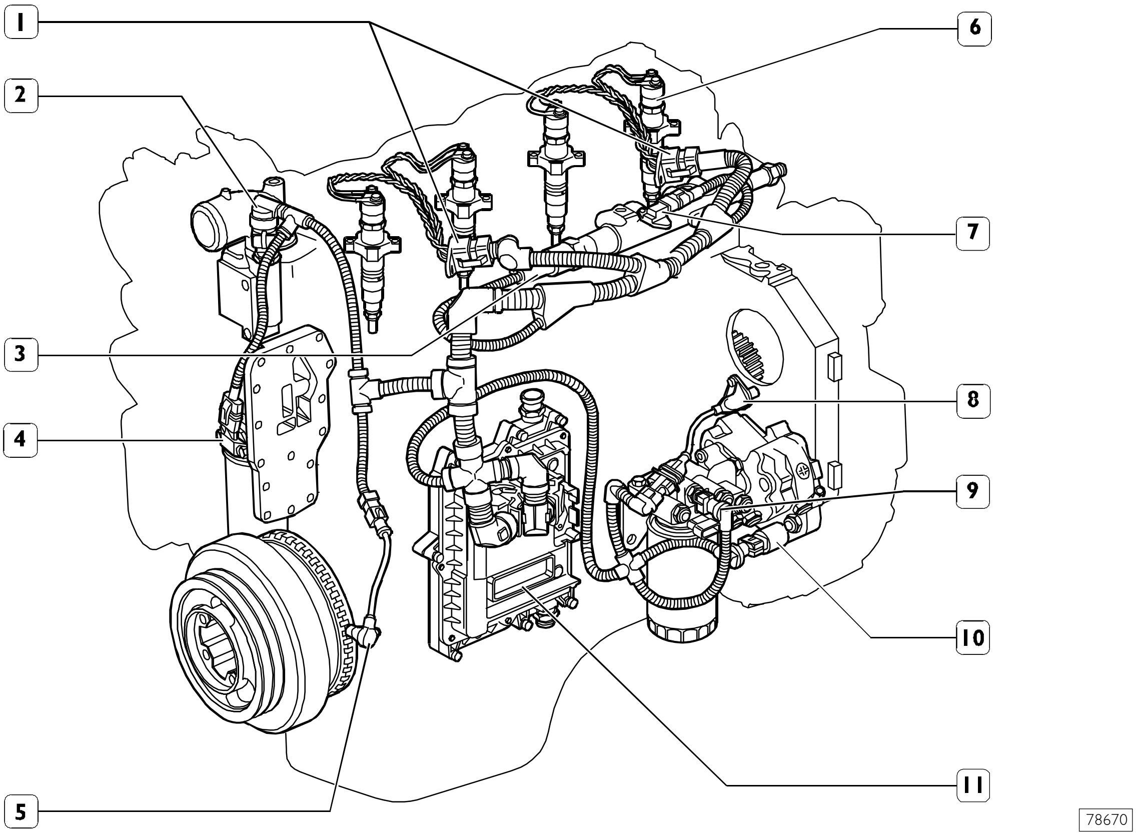
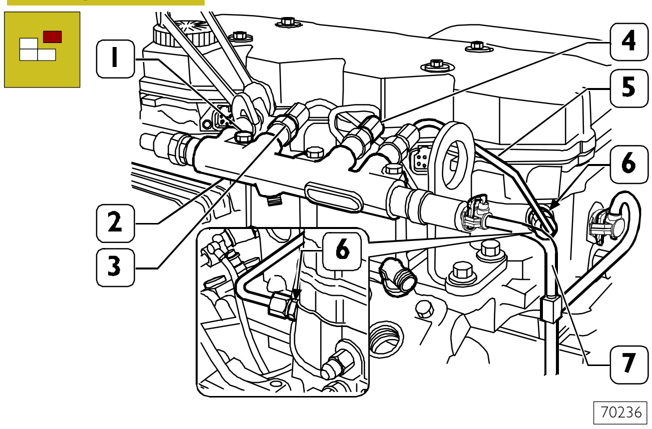
Figure 7



1. Connections for injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor - 4. Engine oil pressure and temperature sensor - 5. Engine shaft sensor - 6. Injector - 7. Temperature-air pressure sensor - 8. Timing phase sensor - 9. Fuel temperature sensor and fuel heater - 10. Pressure adjuster - 11. Control unit EDC7

Disconnect the engine wire by disconnecting the connectors: (1) from the injector harness (6); (7) air temperature /pressure sensor: (3) fuel pressure sensor; (11) control unit; (10) high pressure pump sensor; (8) timing phase sensor; (2) engine coolant temperature sensor on thermostat (5) rpm sensor;

Figure 8



Remove from the rail: the fuel pipe (7) according to the procedures described in Figure 4. Remove the fuel pipe (5) from the rail (2) and from the manifolds (6) for injectors.

During the unlocking operation of the pipe (6) fixing unions (4) from the rail (2), it is necessary to prevent the possible flow limiting device rotation (3) by means of a proper wrench.

Remove the screws (1) and the rail (2).

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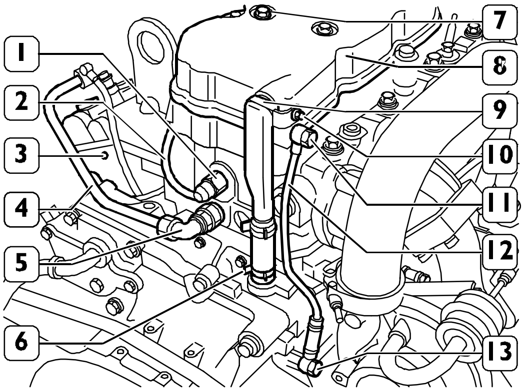
Figure 9



70130

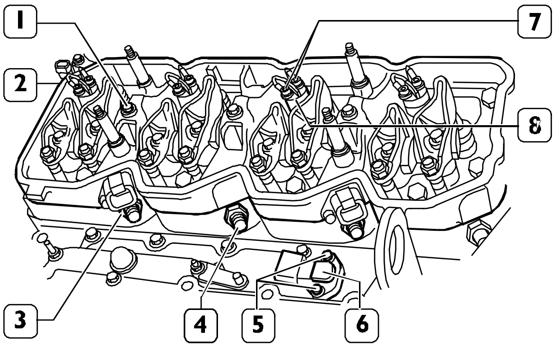
Remove from the fuel return pressure limiting device (1), the pipe (2) as described in Figure 4.

Remove the pipe (4) from the air supercharger (3) and from the union (5). Remove the nut (10) Loosen the elastic hose clamp (6) and remove the oil vapor pipe (9).

Remove the unions (13-11) and remove the pipe (12).

Remove the nuts (7) and remove the tappet (8) cover complete of gasket.

Figure 10



70131

Remove the nuts (7) and disconnect the electric wires from the injectors (8).

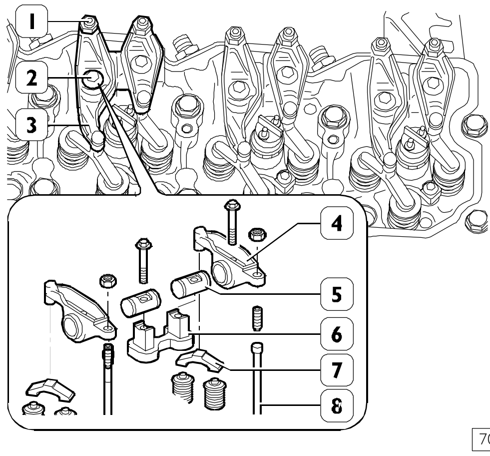
Remove the screws (1) and remove the injector harness support (2) complete of gasket.

Remove the screws (5) and remove the air pressure/temperature sensor (6).

Remove the nuts (3) and withdraw the fuel manifolds (4).

The removed fuel manifold (4) shall not be used again and they must be replaced by new ones.

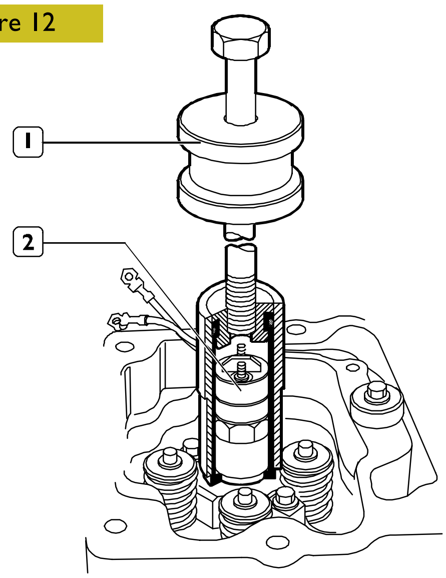
Figure 11



70132

Loosen the tappet adjuster fixing nuts (1) and unscrew the adjuster.
Remove the screws (2), remove the equalizer unit (3) composed by the support (6), equalizers (4), shafts (5) and remove the bonds (7) from the valves. Remove the rods (8)

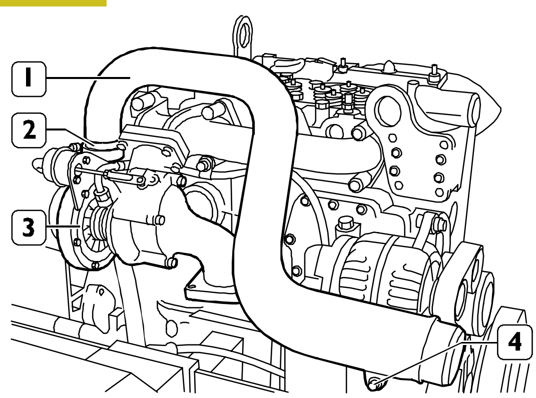
Figure 12



70133

Remove the injector fixing screws and by means of tool 99342101 (1) withdraw the injectors (2) from the cylinder head.

Figure 13



70134

Remove the screw (4), loosen the clamp (2) and remove the air conveyor (1) from the turbosupercharger (3)

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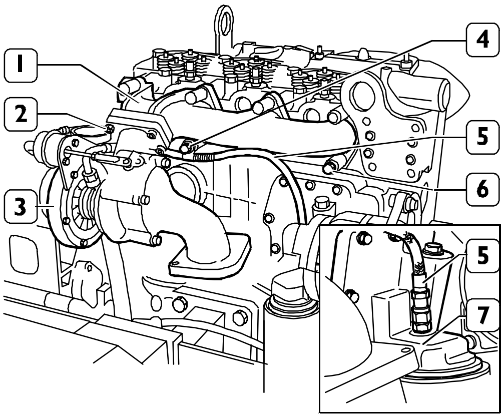
Figure 14



70135

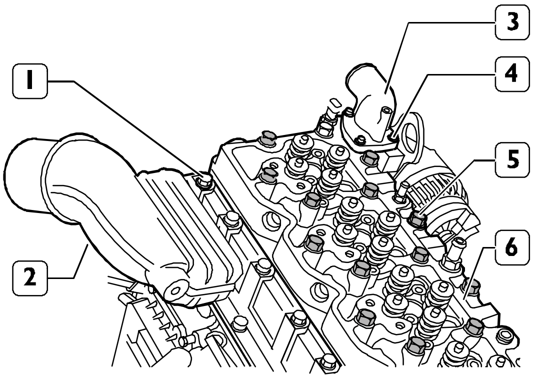
Remove the oil pipe (5) check clamp fixing screw (4) from the exhaust manifold (1).

Remove the oil pipe (5) from the oil filter/ heating exchanger support (7).

Remove the nuts (2) and remove the turbosupercharger (3) from the exhaust manifold (1).

Remove the screws (6) and remove the exhaust manifold (1) from the cylinder head.

Figure 15



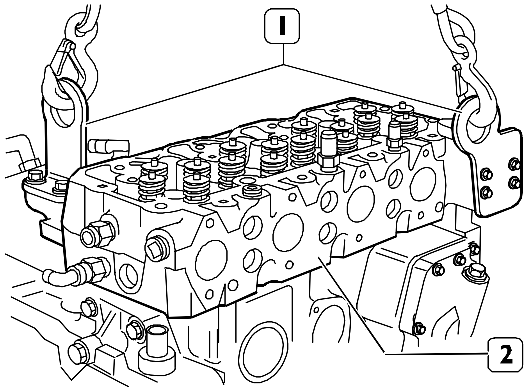
70136

Remove the screws (1) and remove the air conveyor (2) complete of heater. Remove the screws (4), remove the cover (3) and the relevant thermostat.

Remove the head cylinder (6) fixing screws (5).

The external screws pointed out are shorter.

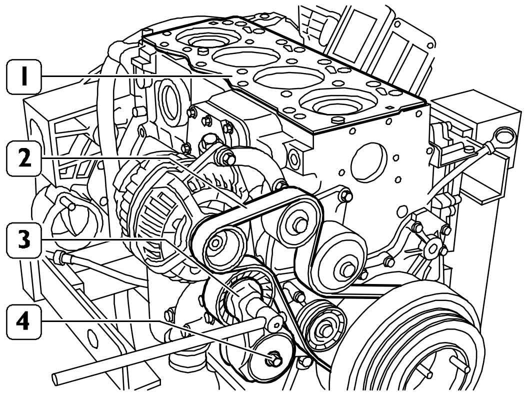
Figure 16



70137

Hook the brackets (1) with metal ropes and remove the cylinder head (2) from the block by means of a hoister.

Figure 17



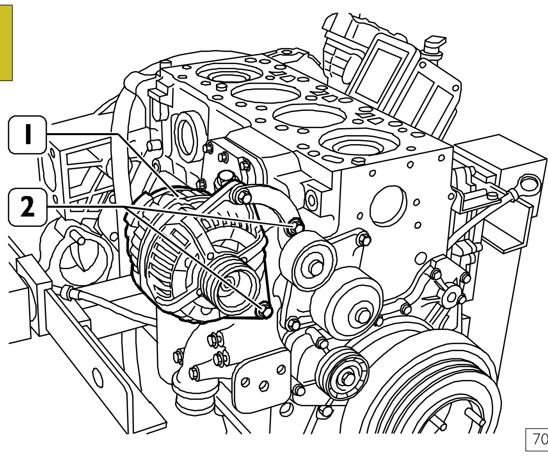
70138

Remove the cylinder head gasket (1).

Loosen the stretch of the belt (2) by means of a proper wrench, operating the automatic belt tightener (3) and remove the belt.

Remove the screw (4) and the automatic tightener (3).

Figure 18



70139

Remove the screws (2) and disconnect the alternator (1)

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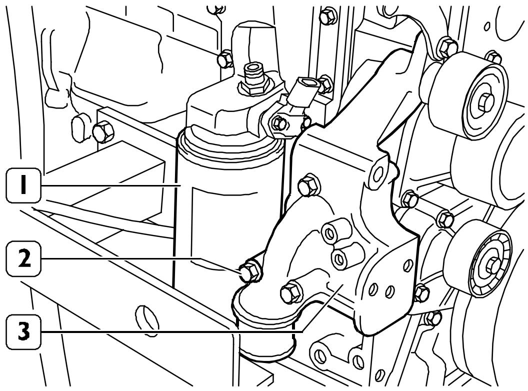
Figure 19

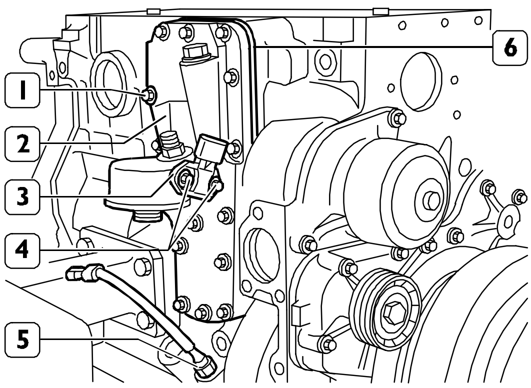


70140

Remove the screws (2) and remove the alternator support (3).

Remove the oil filter (1) by means of tool 99360076.

Figure 20



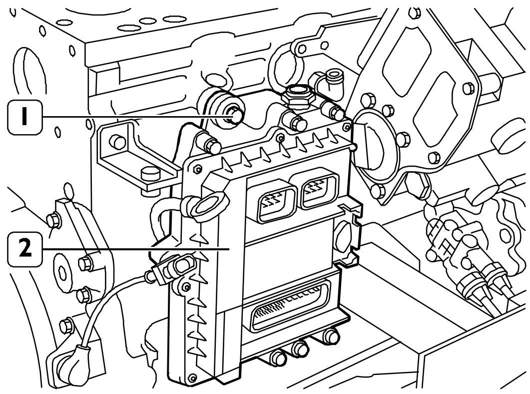
70141

Remove the screws (4) and remove oil temperature/pressure sensor.

Remove the screws (1) and remove the oil filter/heating exchanger support (2), middle plate (6) and relevant gaskets.

Remove the oil level sensor (5)

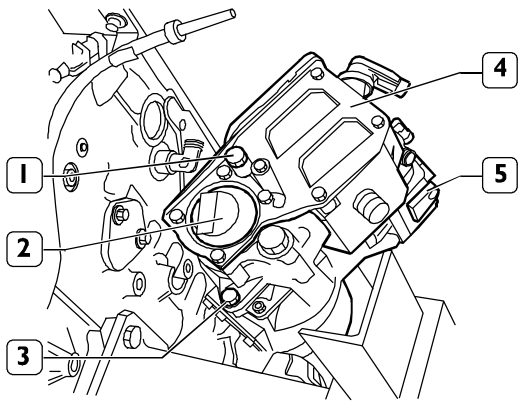
Figure 21



70142

Remove the screws (1) and the electronic control unit (2) complete of heating exchanger.

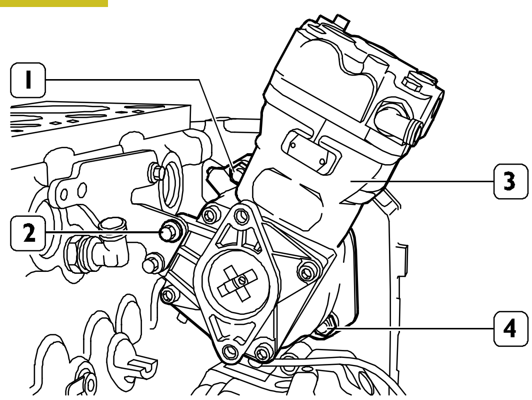
Figure 22



70143

By means of wrench 99355019, remove the screws (1) and (3) and remove the hydraulic power steering pump (2) complete of oil tank (4) from the air supercharger (5)

Figure 23

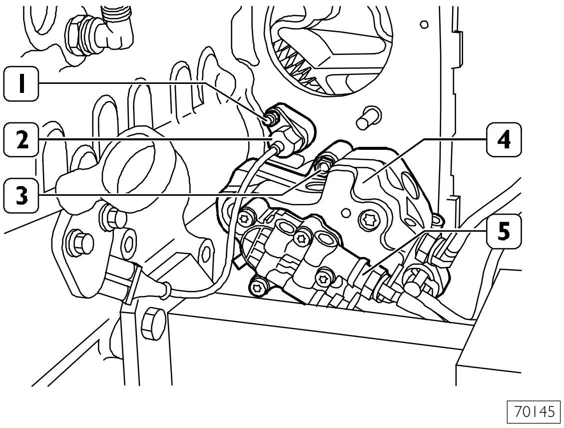


70144

Remove the screws (2) and the nuts (1-4) and remove the air supercharger (3)

Print 603.93.111

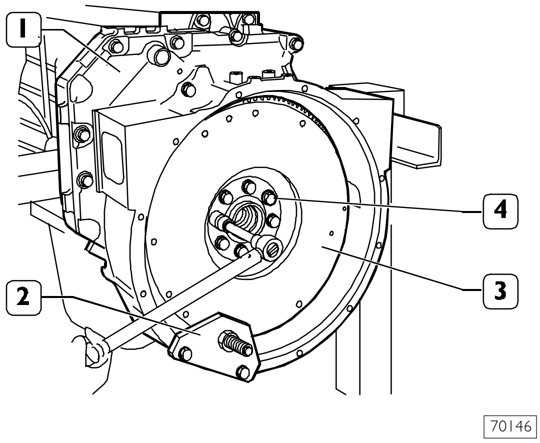
Figure 24



Remove the nut (1) and remove the phase sensor (2).

Remove the nuts (3) and remove the high-pressure pump (4) complete of power supply pump (5).

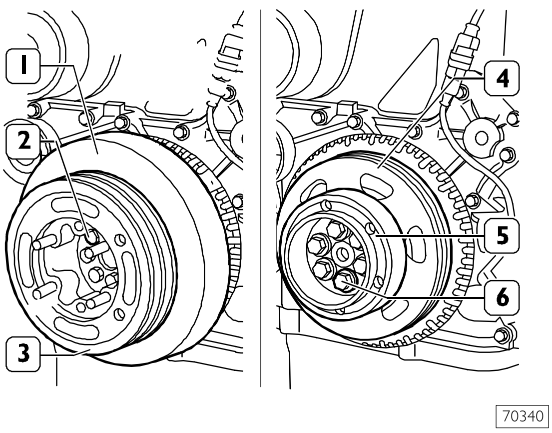
Figure 25



Apply the tool 99360351 (2) to the flywheel housing (1), to stop the flywheel (3) rotation.

Loosen the screws (4)

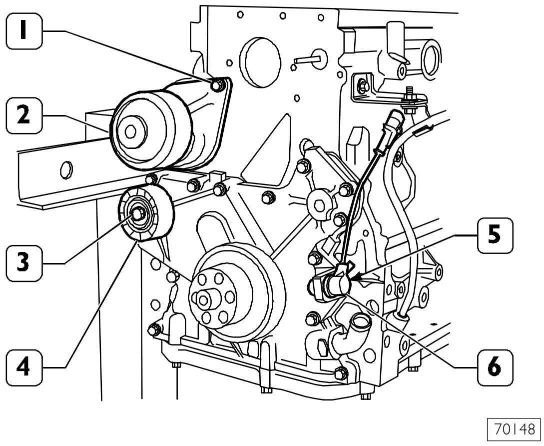
Figure 26



Remove the screws (2) and remove the pulley (3) and the bumper flywheel (1).

Remove the screws (6) and remove the hub (5) and the phonic wheel (4).

Figure 27

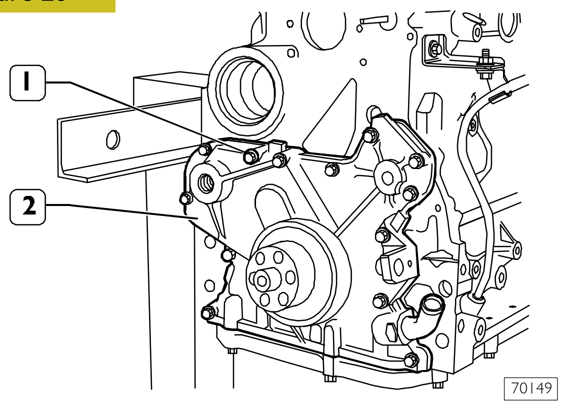


Remove the screws (1) and remove the water pump (2).

Remove the screws (3) and remove the roller (4).

Remove the screws (5) and remove the rpm sensor (6).

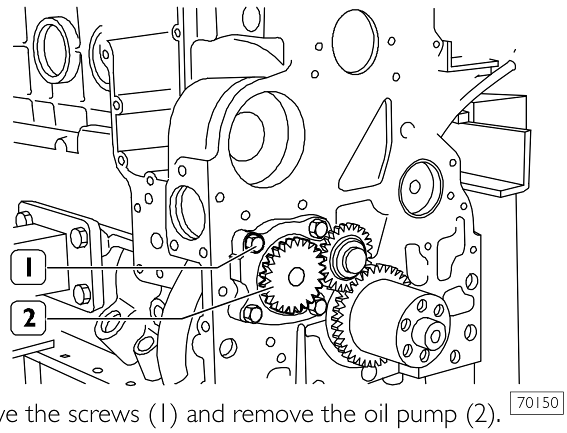
Figure 28



Remove the screws (1) and remove the front cover (2).

Write down the screw (1) assembling position because they exhibit different lengths.

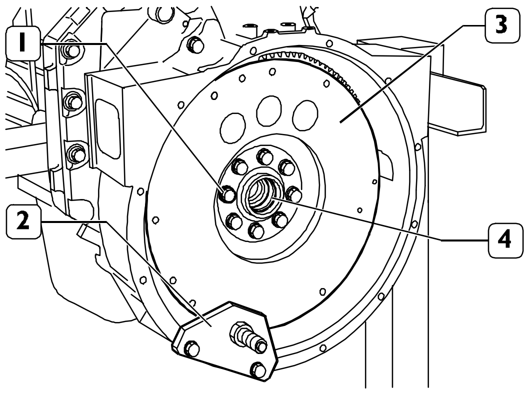
Figure 29



Remove the screws (1) and remove the oil pump (2).

It is not possible to overhaul the oil pump (2).

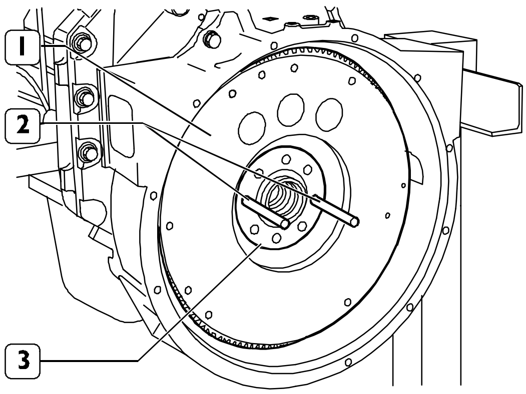
Figure 30



70151

Remove tool 99360351 (2).
Remove the engine (3) flywheel fixing screws (1) to the engine shaft (4).

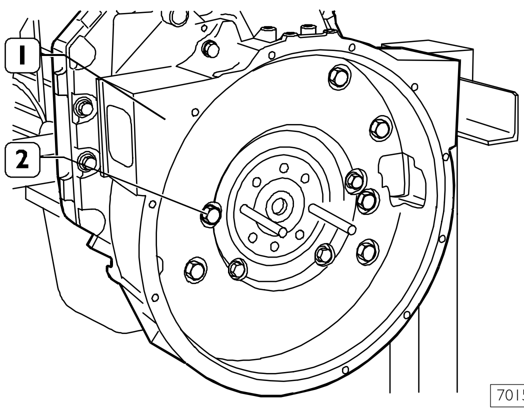
Figure 31



70152

Screw two pins (2) exhibiting a proper length into the engine shaft holes (3).
Withdraw the engine flywheel (1) in order to sling it with the hoister and position it into the container.

Figure 32

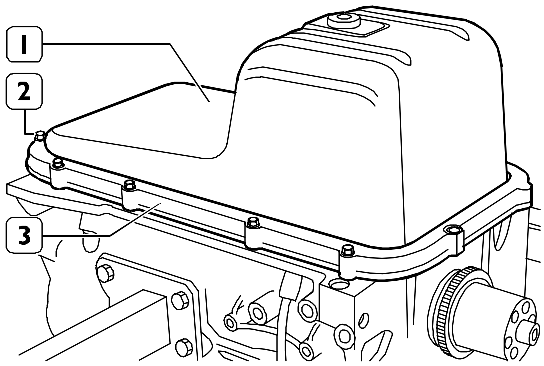


70153

Remove the screws (1) and remove the rear cover (2).

> ⚠ Write down the screw (1) assembling position because they exhibit different lengths.

Figure 33

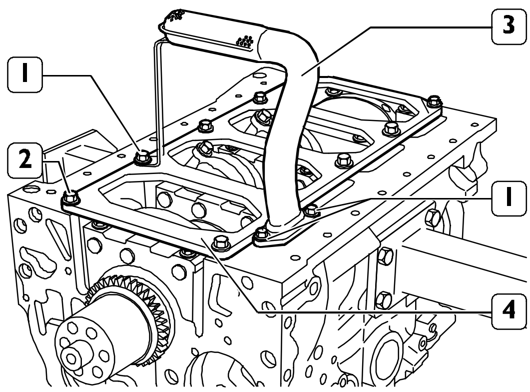


70154

Overturn the engine.

Remove the screws (2), remove the plate (3) and remove the oil sump (1).

Figure 34

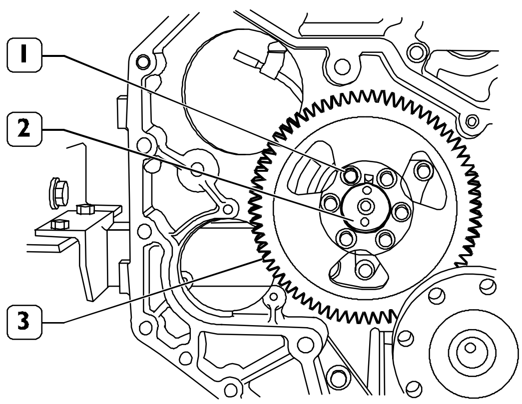


70155

Remove the screws (1) and remove the oil suction rose (3).

Remove the screws (2) and remove the stiffening plate (4).

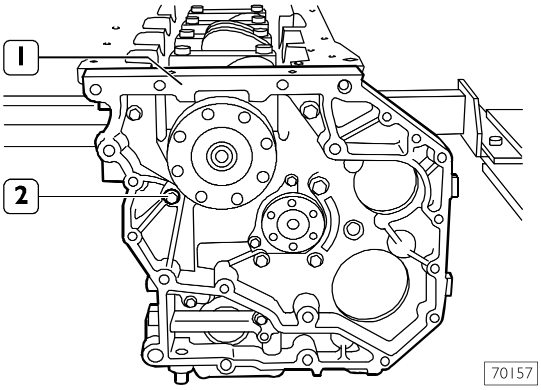
Figure 35



70156

Remove the screws (1) and remove the gear (3) from the camshaft (2).

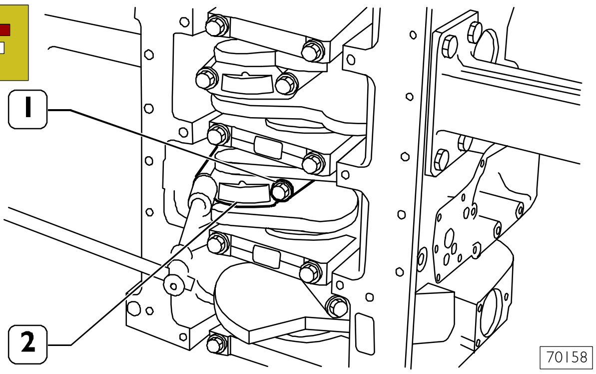
Figure 36



Remove the screws (2) and the timing gearcase (1).

Write down the screw (2) assembling position because they exhibit different lengths.

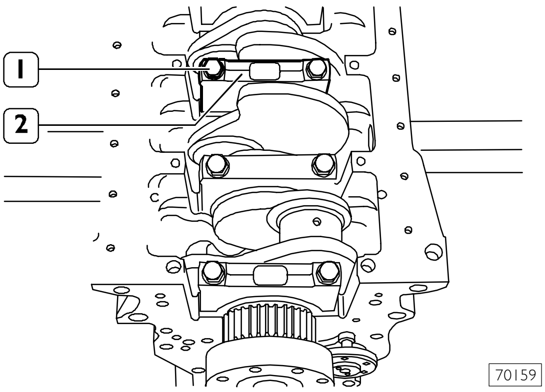
Figure 37



Remove the connecting rod cap (2) fixing screws (1) and remove them.
Remove the connecting rod piston assemblies from the upper side of the block.

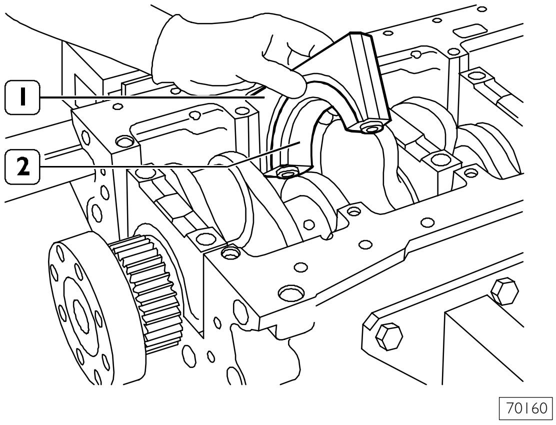
Maintain the half-bearings in their relevant seats because, in the event of use, they should be mounted in the position detected when disassembling.

Figure 38



Remove the screws (1) and remove the bench caps (2).

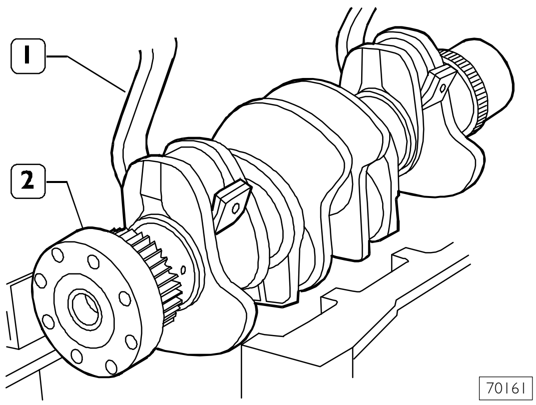
Figure 39



The second-last-bench cap (1) and its relevant support have the half-bearing (2) equipped with shoulder.

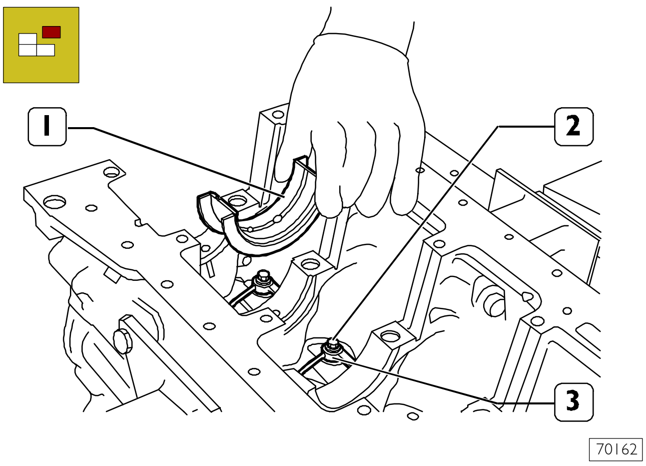
Write down the upper and lower half-bearing assembling position, in the event of use, they should be mounted in the position detected when disassembling.

Figure 40



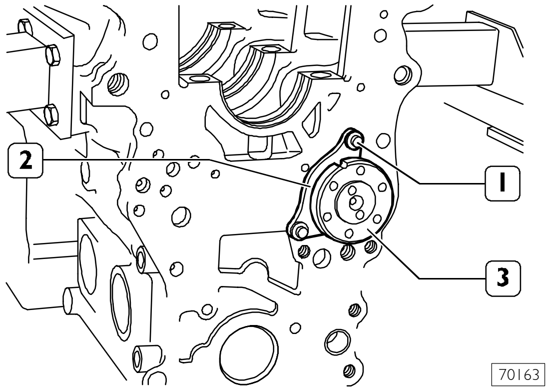
Remove the engine shaft (2) from the block by means of tool 99360500 (1) and hoister.

Figure 41



Remove the bench half-bearings (1).
Remove the screws (2) and remove the oil nozzles (3).

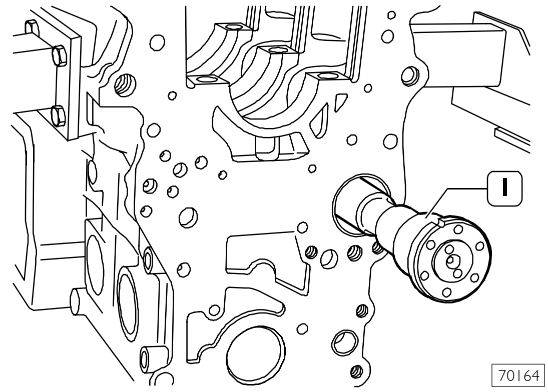
Figure 42



Remove the screws (1) and remove the camshaft (3) check plate (2)

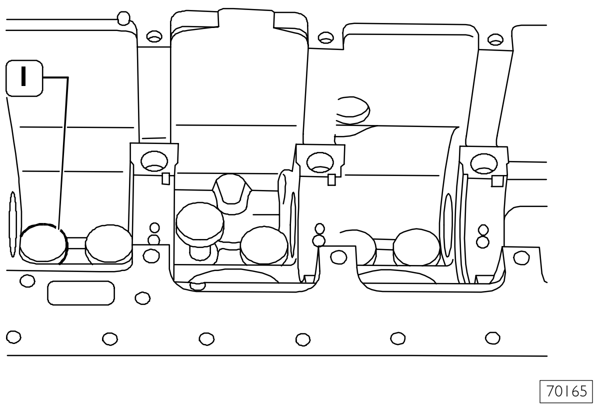
Write down the plate (2) assembling position.

Figure 43



Carefully withdraw the camshaft (1) from the engine block.

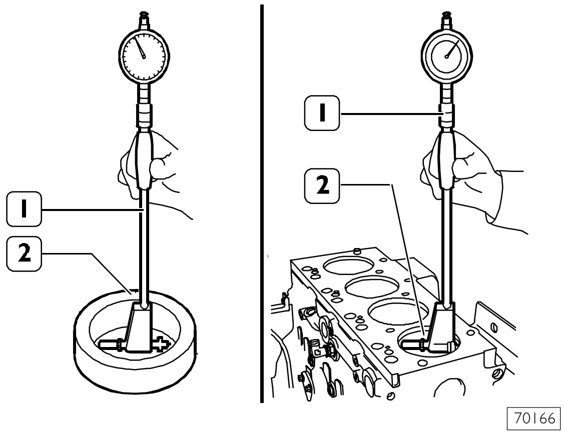
Figure 44



Withdraw the tappets (1) from engine block.

REPAIR INTERVENTIONS
540410 CYLINDER GROUP
540420 Controls and measurements

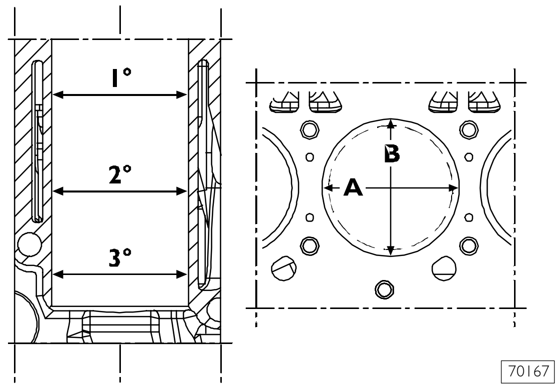
Figure 45



Carefully clean the cylinder-block group, when performed the engine disassembly.
Use the proper rings to transfer the cylinder group.
Carefully check that the block does not present any cracks.
Check the working plug conditions. Replace them if they are rusty or in case of doubt about their conditions.
Examine the cylinder barrel surfaces; they must not present any seizing, scoring, ovalization, taper, and excessive wearing traces.
The internal diameter check of the cylinder barrels, to verify the ovalization, taper and wearing entity, is performed by means of bore meter 99395687 (1) equipped with comparator previously set to zero on the ring gauge (2) of the cylinder barrel diameter.

If you do not have at your disposal the ring gauge, use a micrometer for the zero setting operation.

Figure 46



The measurements must be performed for each individual cylinder at three different heights from the barrel and on two perpendicular surfaces: one parallel to the longitudinal engine axis (A) and the other one perpendicular (B); usually the max wear is detected on this latter surface and in correspondence with the first measurement.

If you detect any ovalization, taper or wear, ream and grind the cylinder barrels. The cylinder barrel regrinding must be performed in relation to the diameter of the spare pistons oversized of 0.5 mm in respect of the nominal value and prescribed assembling clearance.

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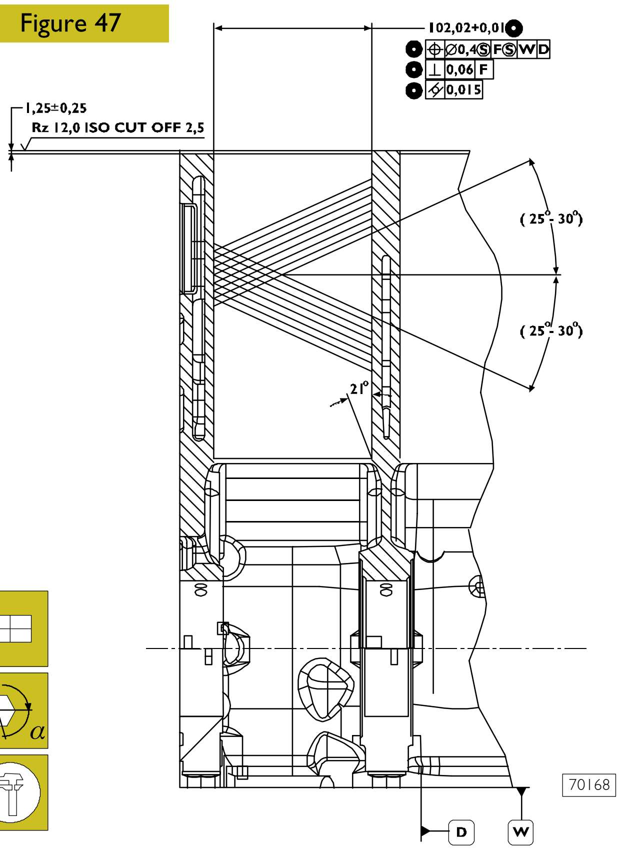
Figure 47



In the event of grinding operation, all the barrels must result of the same oversize (0.5 mm)

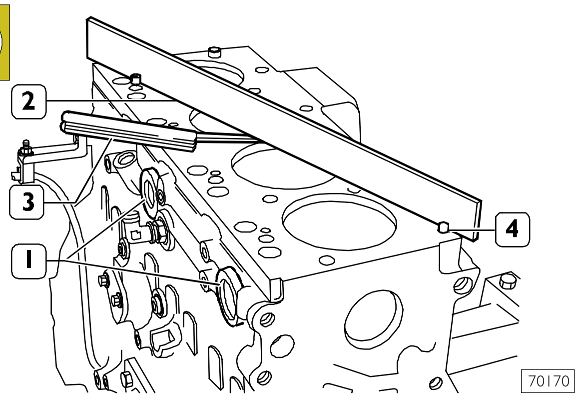
Check the bench bearing seats, proceeding as follows:

- mount the bench caps on the supports without bearings;
- screw the fixing screws to the torque prescribed;
- by means of an adequate gauge, verify that the internal diameter of the seats correspond to the value prescribed.

If you detect a higher value, replace its block

Head face check on the cylinder group

Figure 48



Check that the head face, on the cylinder group, does not present deformations.
This check can be carried out, after a previous grains (4) extraction by means of a calibrated ruler (2) and feeler gauge (3).
After verified the deformation areas, perform the flattening of the face by means of grinding machine.
The flatness error must not be higher than 0.075 mm.

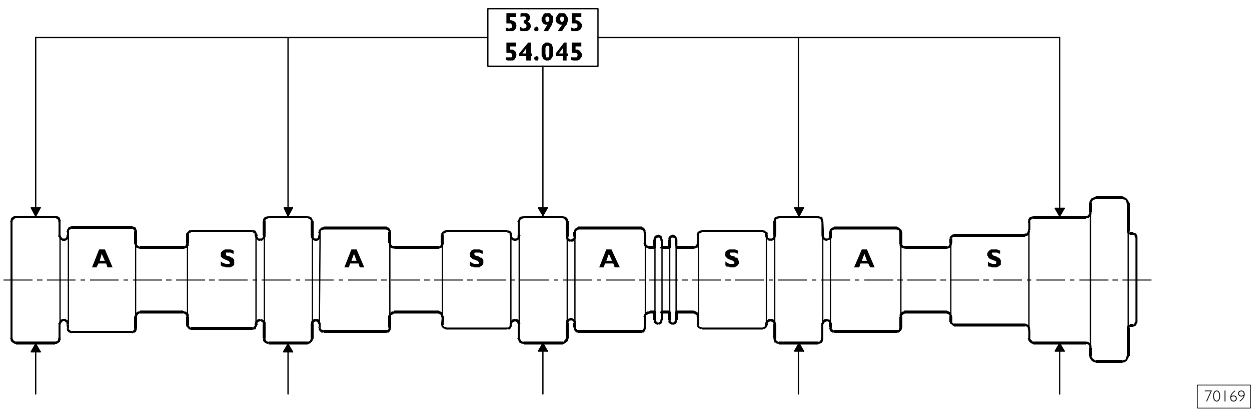
The block flattening could be performed only after you have checked that, at finished work, the piston projection from the cylinder barrel is not higher than the value prescribed.

Check the conditions of the working plugs (1) of the cylinder groups; replace them if rusty or in case of doubt about their conditions.

When flattening is finished, restore the cylinder barrel bevel as shown in Figure 47.

5412 TIMING SYSTEM
541210 Camshaft

Figure 49



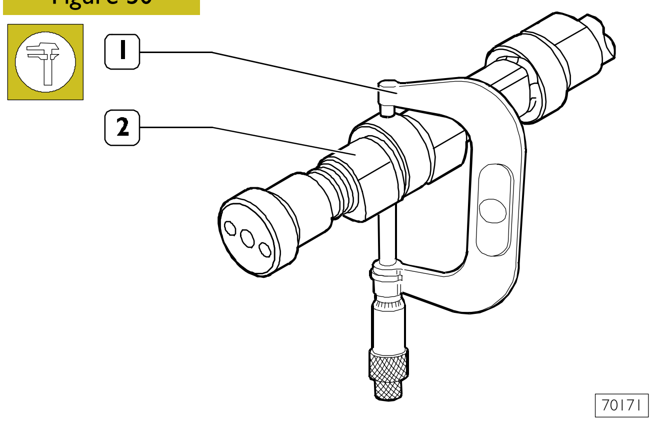
CAMSHAFT MAIN DATA
The data listed are refereed to the standard pin diameter.

The surfaces of the camshaft support pins and cams must be very smooth; if they present seizing and scoring traces, it is better to replace the shaft and relevant bushes.

541211 Cam lift check and pin alignment check

Position the shaft on counterpoints and, by means of a centesimal gauge, located on the central support, check that the alignment error is not higher than 0.04 mm: on the contrary, replace the shaft. Then, check the cam lifting: it must result of 6.045 mm for the exhaust ones and of 7.582 mm for the suction ones; if you detect different values, replace the shaft.

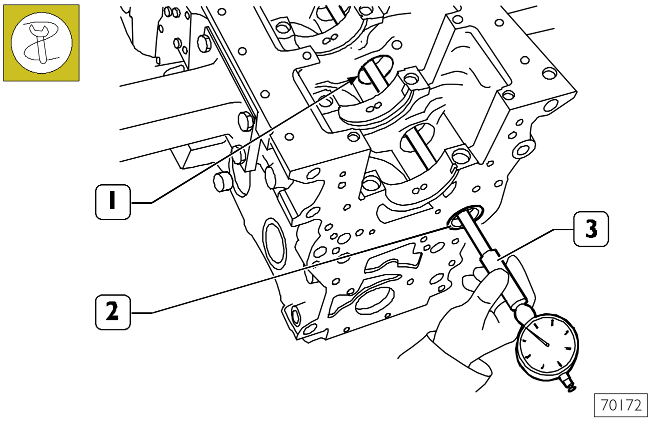
Figure 50



Check the camshaft (2) support pin diameter by means of a micrometer (1) on two perpendicular surfaces.

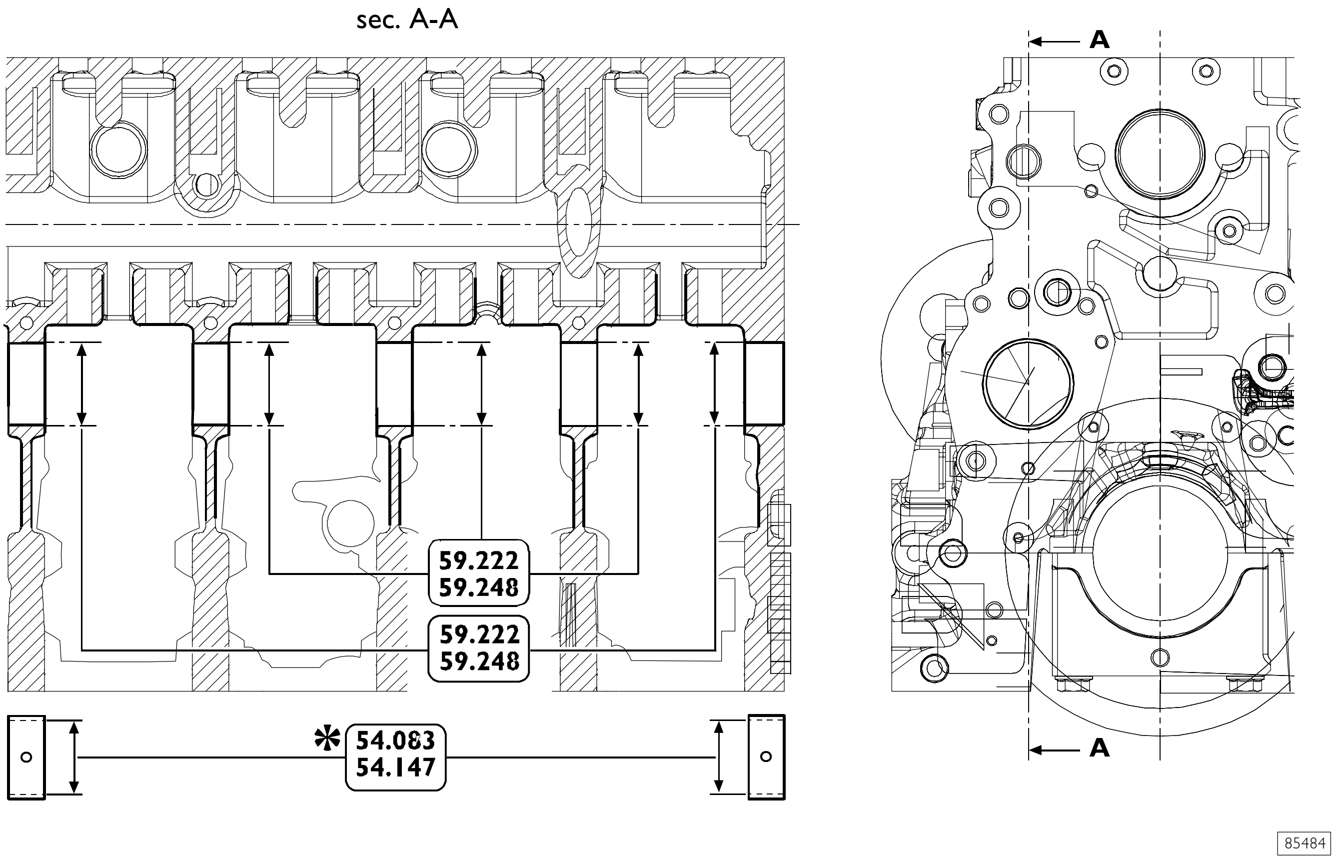
541213 BUSHES

Figure 51



The camshaft bushes (2) must result forced in their relevant seats.
The inner surfaces must result without seizing and wearing traces.
By means of a bore meter (3), measure the diameter of the rear and front bushes (2) and intermediate seats (1) for camshaft.
The measurements must be performed on two perpendicular axes.

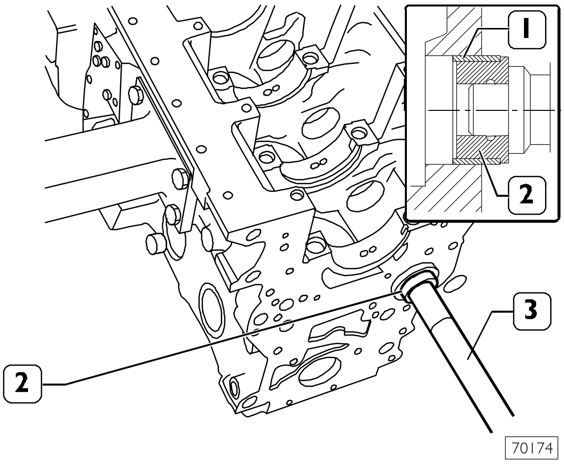
Figure 52



MAIN DATA OF THE CAMSHAFT BUSHES AND RELEVANT SEATS
* Dimensions to be obtained after the bush driving

541213 Bush replacement

Figure 53

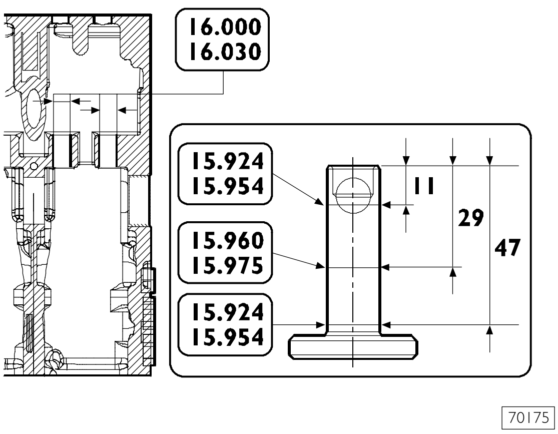


To replace front and rear bushes (1), use for their removal and refitting the tool 99360362 (2) and handgrip 99370006 (3).

When refitting bushes (1) direct them so that lubrication holes coincide with engine block housing holes.

541224 Tappets

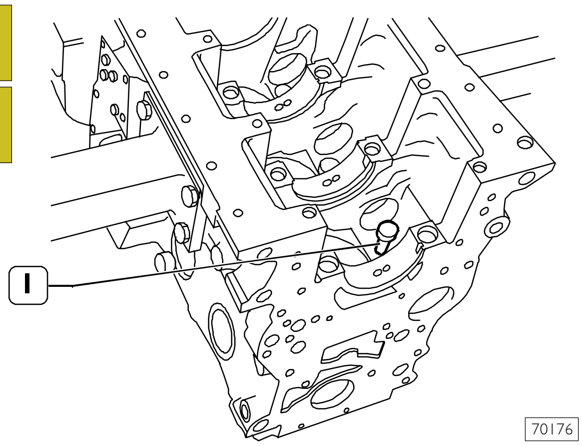
Figure 54



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON THE ENGINE BLOCK

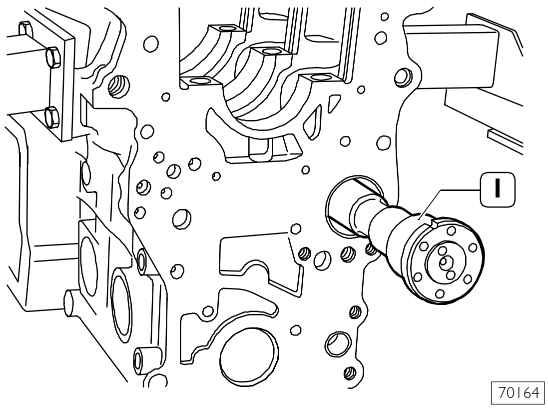
Fitting tappets – camshaft

Figure 55



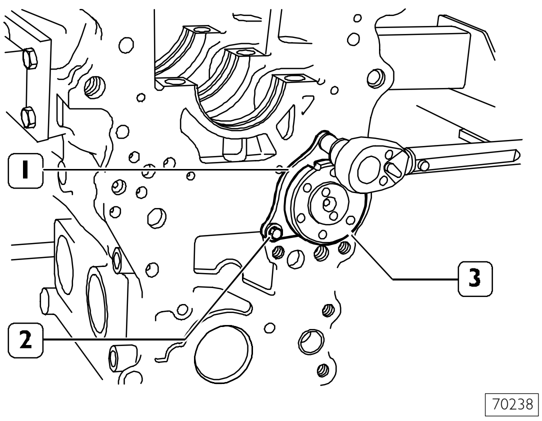
Lubricate the tappets (1) and fit them into the relevant housings on the engine block.

Figure 56



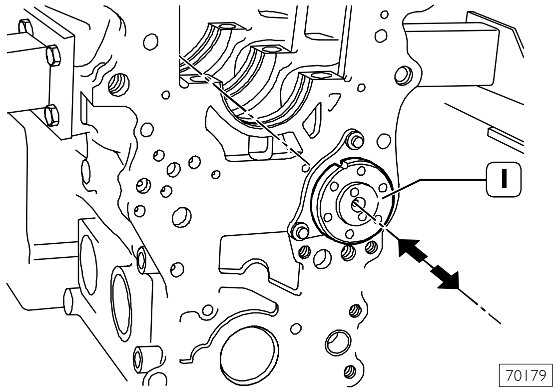
Lubricate the camshaft bushes and fit the camshaft (1) taking care not to damage the bushes or the housings.

Figure 57



Set camshaft (3) retaining plate (1) with the slot facing the top of the engine block and the marking facing the operator, then tighten the screws (2) to the specified torque.

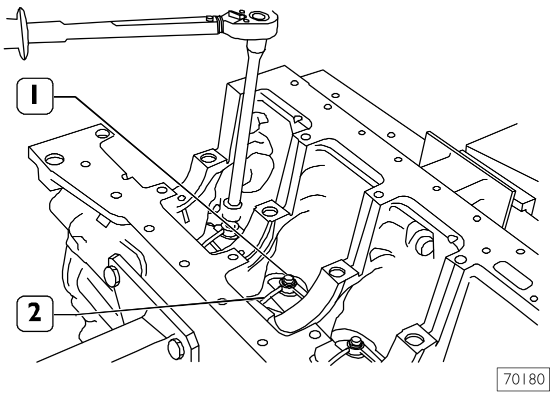
Figure 58



Check camshaft end float (1).

It shall be 0.23 ± 0.13 mm.

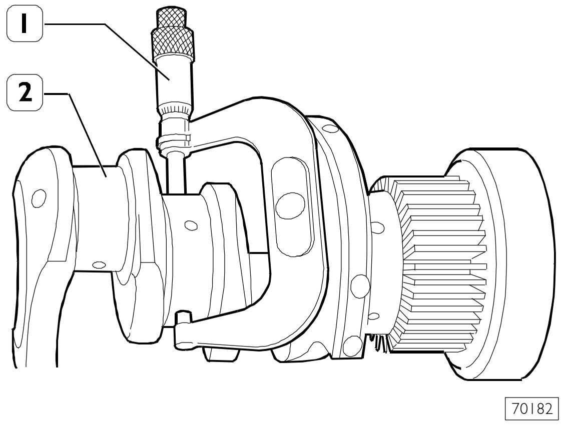
Figure 59



Fit nozzles (2) and tighten the fastening screws (1) to the specified torque.

5408 OUTPUT SHAFT
540810 Measuring journals and crankpins

Figure 60



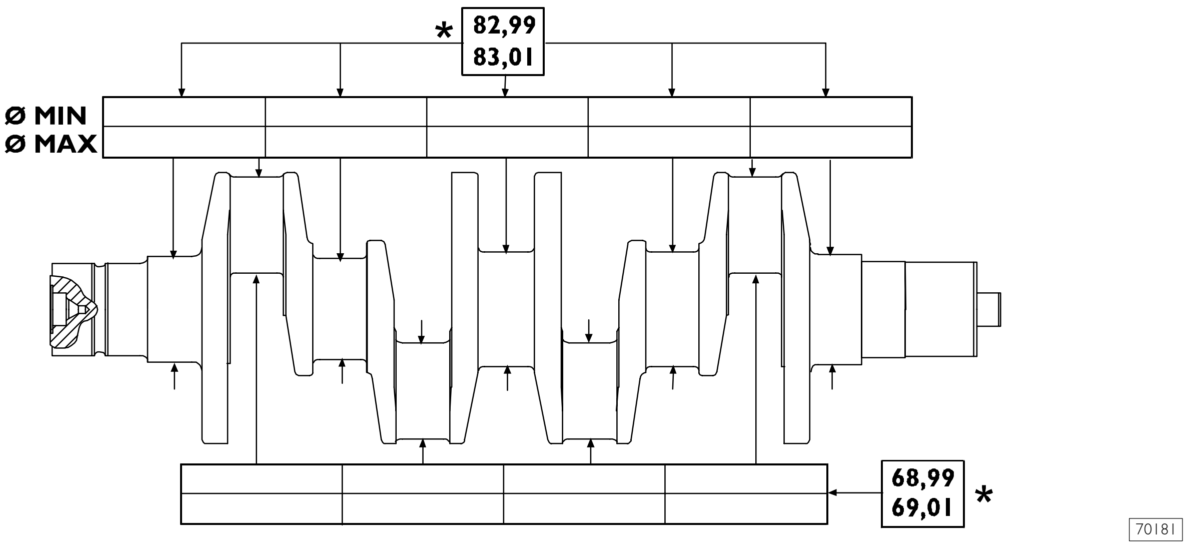
Grind journals and crankpins if seizing, scoring or excessive ovalisation are found. Before grinding the pins (2) measure them with a micrometer (1) to decide the final diameter to which the pins are to be ground.

It is recommended to insert the found values in the proper table.
See Figure 61.

Undersize classes are: 0.250 – 0.500 mm

Journals and crankpins shall always be ground to the same undersize class.
Journals and crankpins undersize shall be marked on the side of the crank arm No.1.
For undersized crankpins: letter M
For undersized journals: letter B
For undersized crankpins and journals: letters MB

Figure 61



FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES

*Rated value

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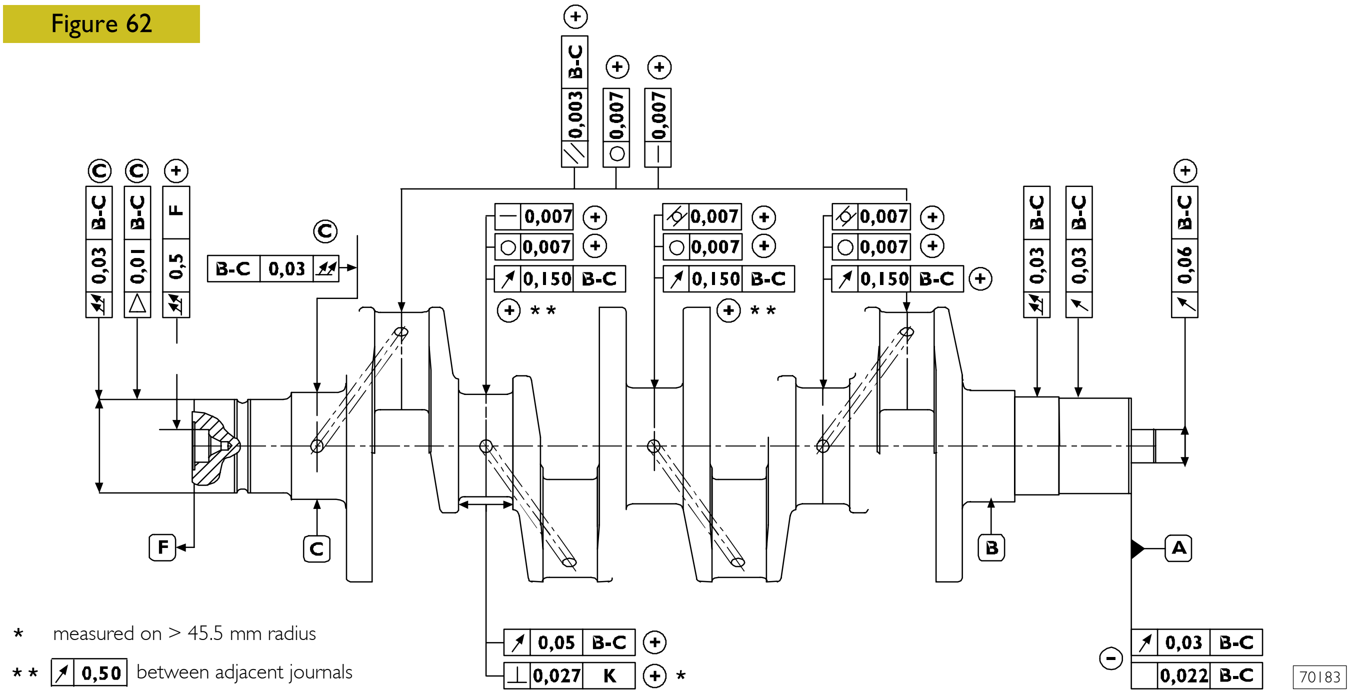
Figure 62



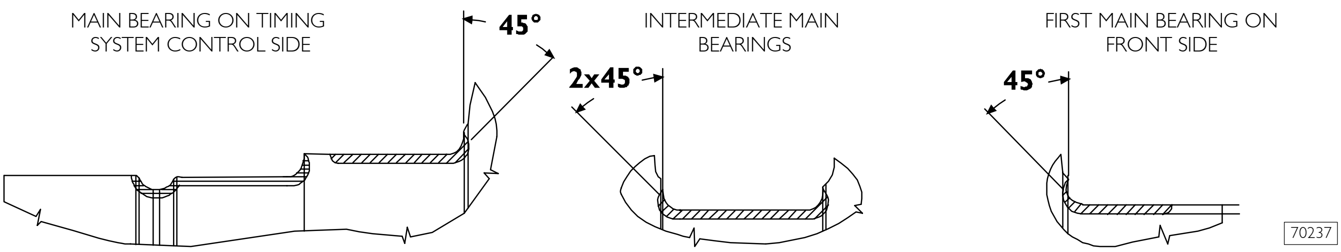
* measured on > 45.5 mm radius

* * 0,50 between adjacent journals

OUTPUT SHAFT MAIN TOLERANCES

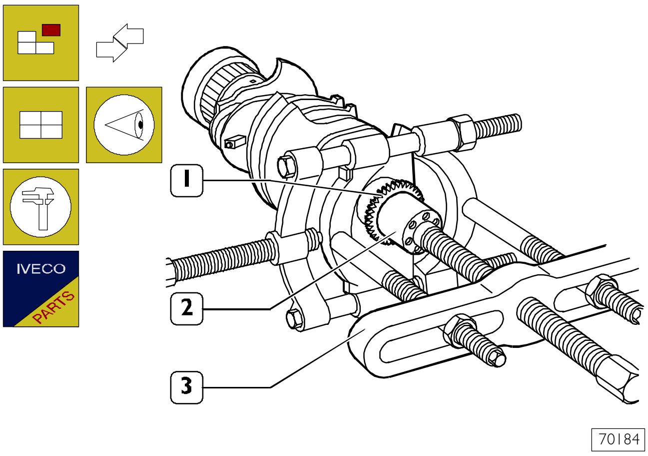
TOLERANCES	TOLERANCE CHARACTERISTIC	GRAPHIC SYMBOL
SHAPE	Roundness	○
	Cilindricity	/○/
DIRECTION	Parallelism	//
	Verticality	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	↗↗
	Taper	—▷

LEVELS OF IMPORTANCE FOR PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖



549215 Replacing oil pump control gear

Figure 63

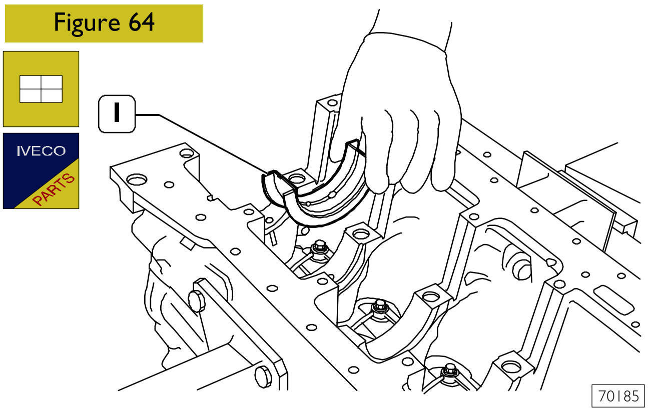


Check that gear toothing (1) is not damaged or worn, otherwise remove it using the proper puller (3).

When fitting the new gear, heat it to 180°C for 10 minutes in an oven and then key it to the output shaft.

Fitting main bearings

Figure 64



Refit the main bearings that have not been replaced, in the same position found at removal.

Main bearings (1) are supplied spare with 0.250 – 0.500 mm undersize on the internal diameter.

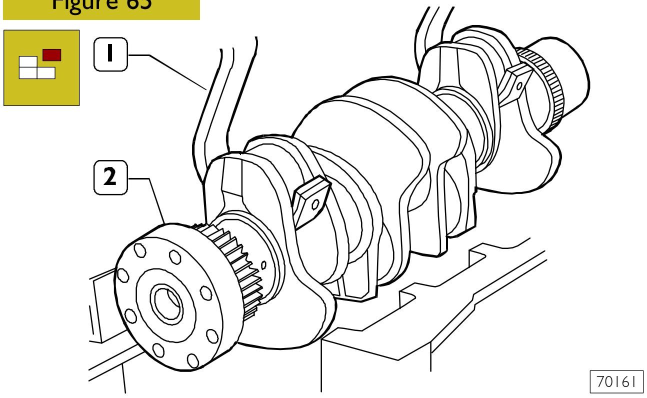
Do not try to adapt the bearings.

Clean accurately the main half bearings (1) having the lubricating hole and fit them into their housings.

The second last main half bearing (1) is fitted with shoulder half rings.

540811 Finding journal clearance

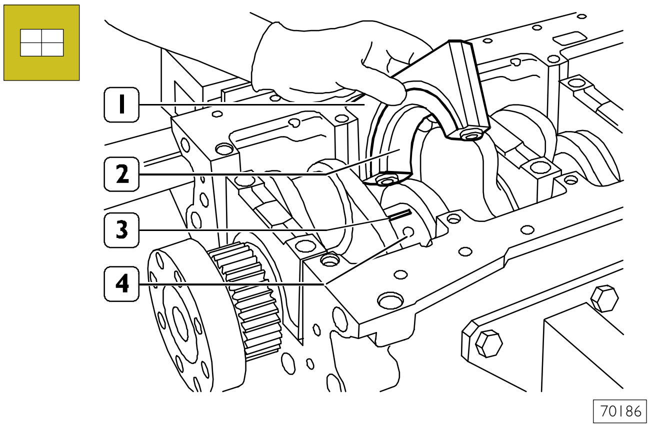
Figure 65



Refit the output shaft (2).

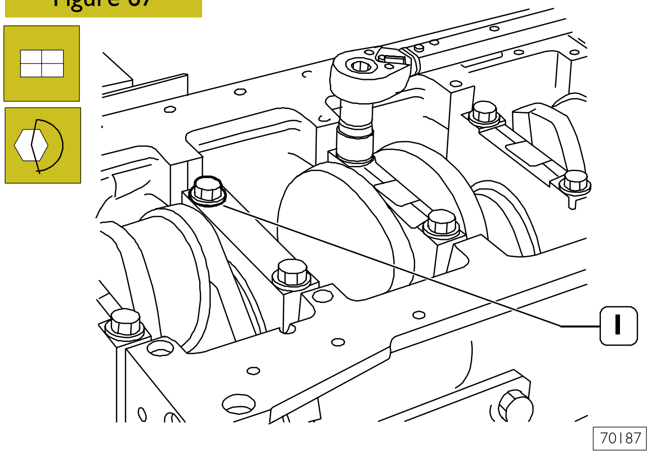
Check the backlash between output shaft main journals and the relevant bearings as follows:

Figure 66



- ❑ Clean accurately the parts and remove any trace of oil;
- ❑ position a piece of calibrated wire (3) on the output shaft pins (4) so that it is parallel to the longitudinal axis;
- ❑ fit caps (1), including the half bearings (2) on the relevant supports.

Figure 67



Tighten the pre-lubricated screws (1) in the following three successive stages:

- ❑ 1st stage, with dynamometric wrench to 50 ± 6 Nm.
- ❑ 2nd stage, with dynamometric wrench to 80 ± 6 Nm.

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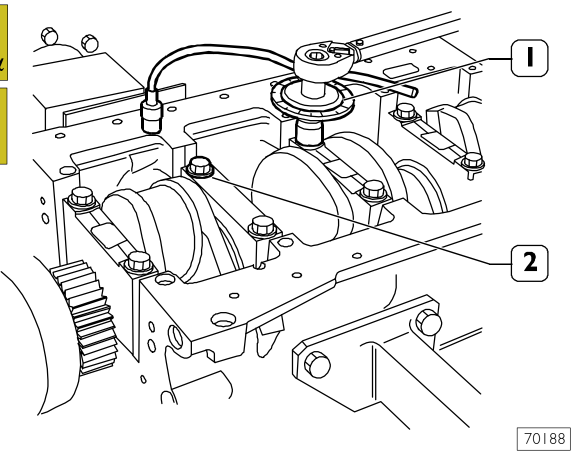
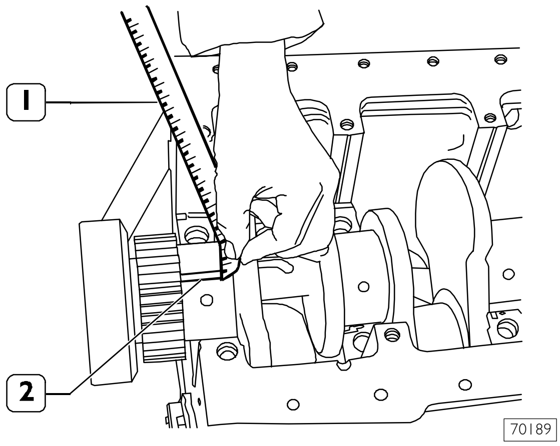
Figure 68



❑ 3rd stage, with tool 99395216 (1) set as shown in the figure, tighten the screws (2) with 90° ± 5° angle.

Figure 69



❑ Remove caps from supports.

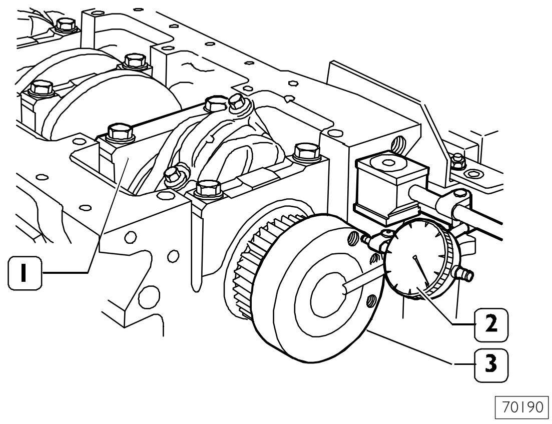
The backlash between the main bearings and the pins is found by comparing the width of the calibrated wire (2) at the narrowest point with the scale on the envelope (1) containing the calibrated wire.

The numbers on the scale indicate the backlash in mm.

Replace the half bearings and repeat the check if a different backlash value is found. Once the specified backlash is obtained, lubricate the main bearings and fit the supports by tightening the fastening screws as previously described.

Checking output shaft shoulder clearance

Figure 70

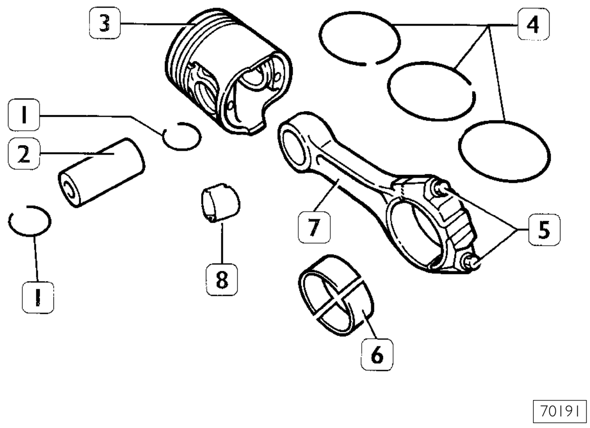


This check is performed by setting a magnetic-base dial gauge (2) on the output shaft (3) as shown in the figure, standard value is 0.068 – 0.41 mm.

If higher value is found, replace main thrust half bearings of the second last rear support (1) and repeat the clearance check between output shaft pins and main half bearings.

540830 CONNECTING ROD – PISTON ASSEMBLY

Figure 71

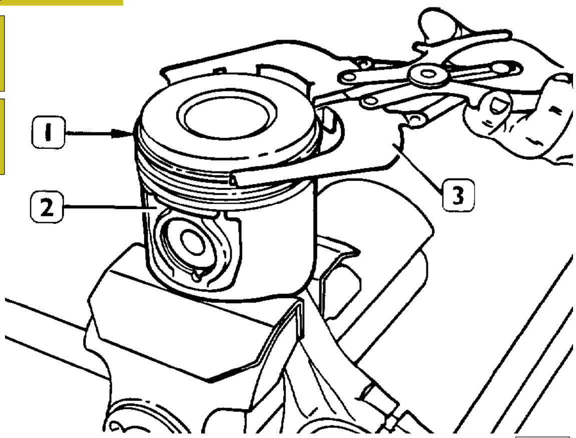


CONNECTING ROD – PISTON ASSEMBLY COMPONENTS

1. Stop rings - 2. Pin - 3. Piston - 4. Split rings - 5. Screws - 6. Half bearings - 7. Connecting rod - 8. Bush.

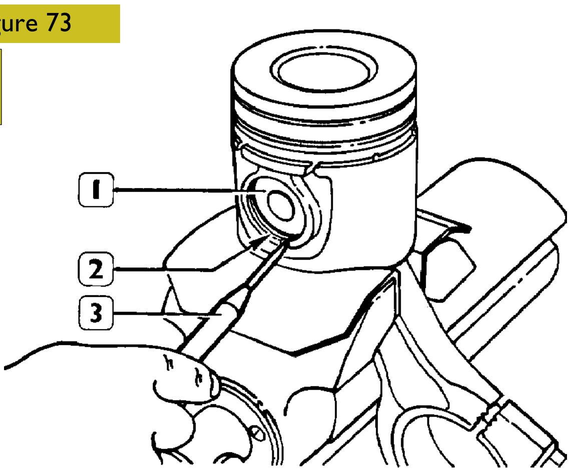
⚠ Pistons are supplied spare with 0.5 mm oversize.

Figure 72



Remove split rings (1) from piston (2) using pliers 99360183 (3).

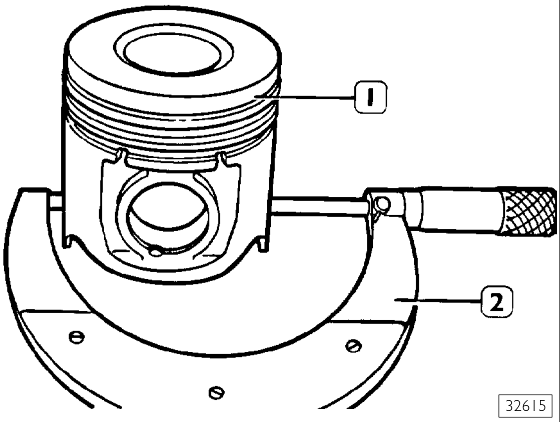
Figure 73



Piston pin (1) split rings (2) are removed using a scriber (3).

540840 Pistons
Measuring piston diameter

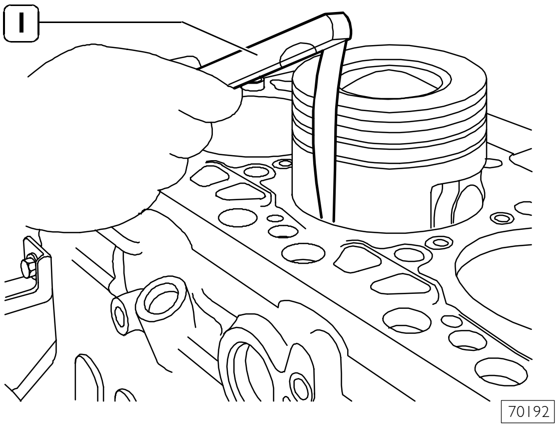
Figure 75



Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance.

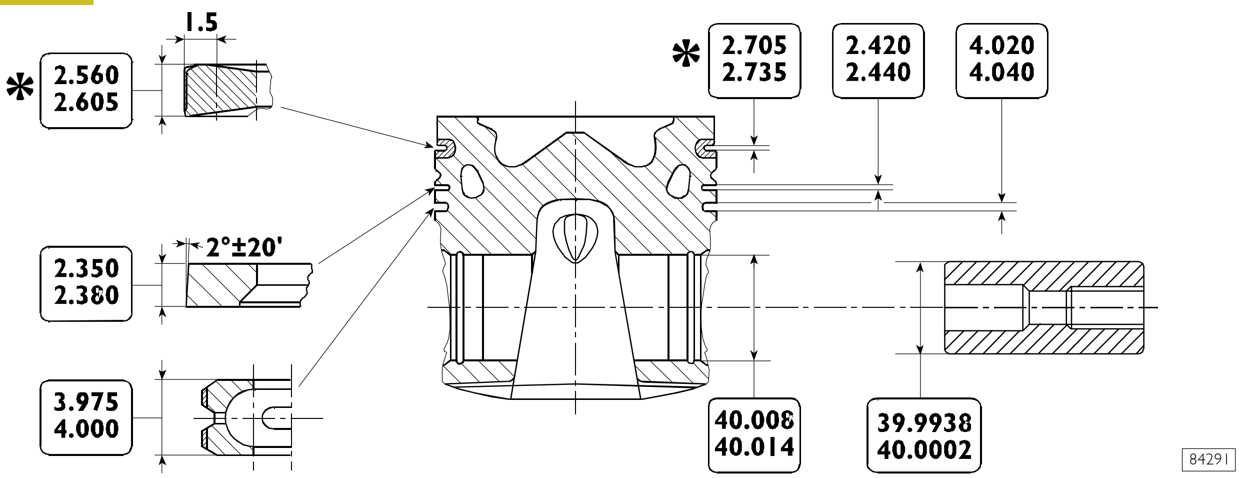
The diameter shall be measured at 12 mm from the piston skirt.

Figure 76



The clearance between the piston and the cylinder barrel can be checked also with a feeler gauge (1) as shown in the figure.

Figure 74

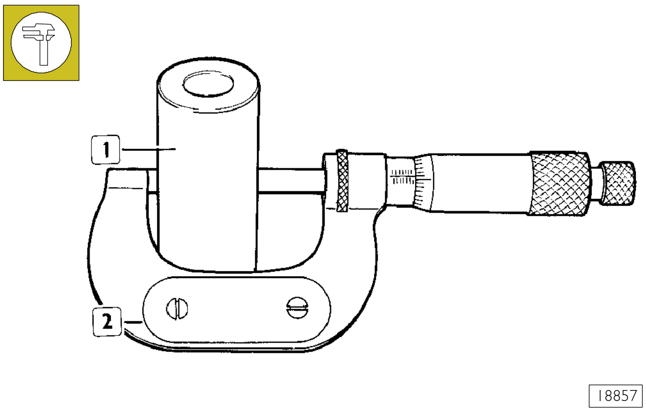


MAIN DATA CONCERNING KS. PISTON, PINS AND SPLIT RINGS

* Value measured on 99 mm diameter

540841 Piston pins

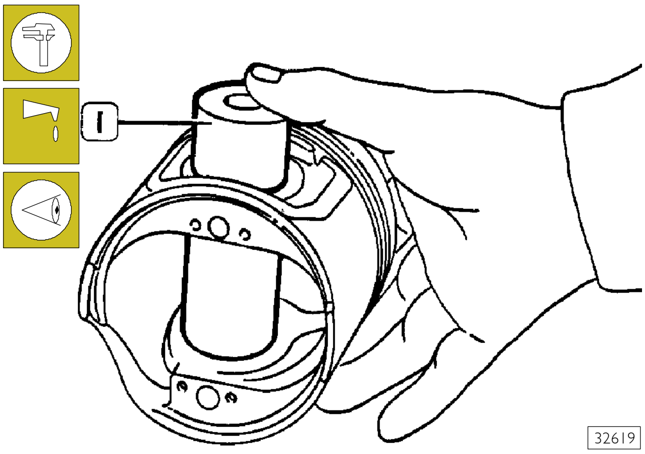
Figure 77



To measure the piston pin (1) diameter use the micrometer (2).

Conditions for proper pin-piston coupling

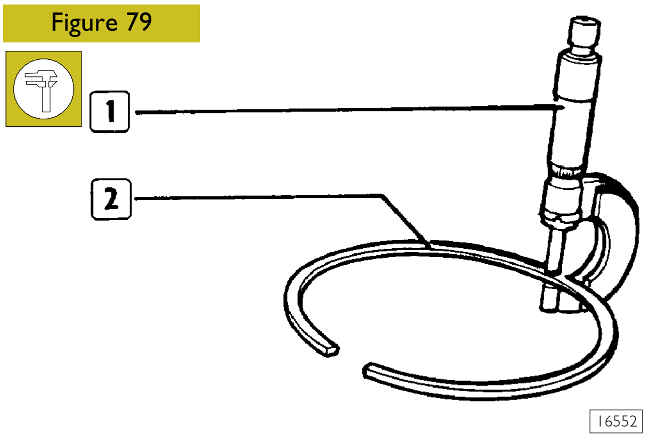
Figure 78



Lubricate the pin (1) and its seat on piston hubs with engine oil; the pin shall be fitted into the piston with a slight finger pressure and shall not be withdrawn by gravity.

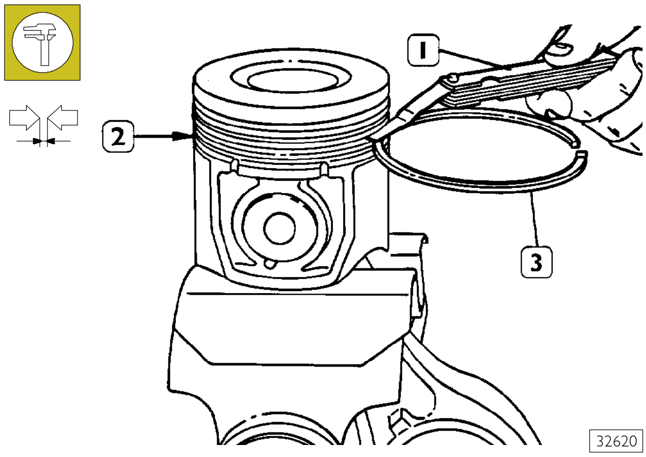
540842 Split rings

Figure 79



Use a micrometer (1) to check split ring (2) thickness.

Figure 80



Check the clearance between the sealing rings (3) of the 2nd and 3rd slot and the relevant housings on the piston (2), using a feeler gauge (1).

Figure 81

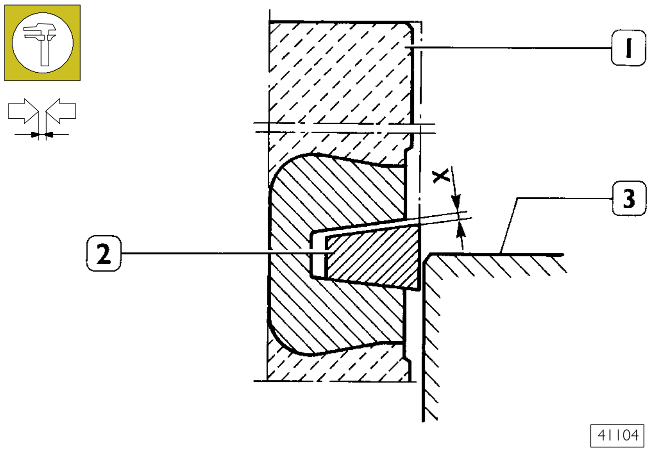
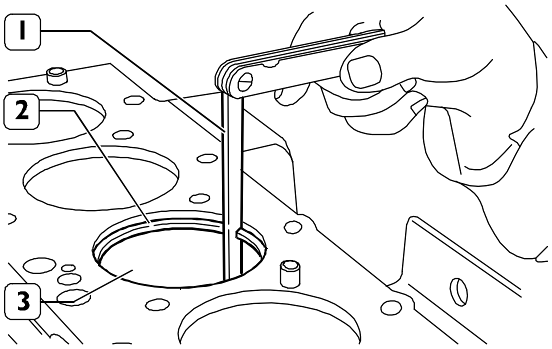


DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING

Since the first sealing ring section is trapezoidal, the clearance between the slot and the ring shall be measured as follows: make the piston (1) protrude from the engine block so that the ring (2) protrudes half-way from the cylinder barrel (3).

In this position, use a feeler gauge to check the clearance (X) between ring and slot: found value shall be the specified one.

Figure 82

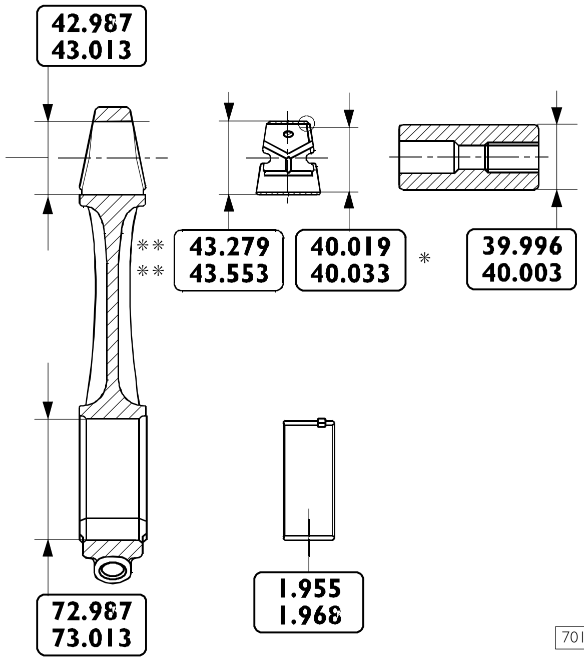


70194

Use feeler gauge (1) to measure the clearance between the ends of the split rings (2) fitted into the cylinder barrel (3).

540830 Connecting rods

Figure 83



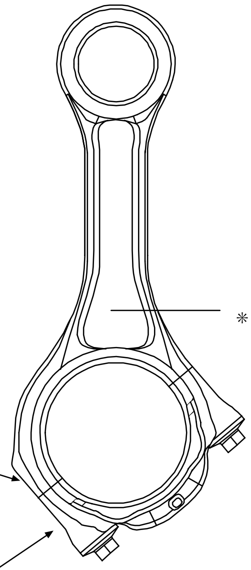
70195

MAIN DATA FOR CONNECTING ROD, BUSH, PISTON PIN AND HALF BEARINGS

* Value for inside diameter to be obtained after driving in connecting rod small end and grinding.
** Value not measurable in released condition

To obtain best coupling the connecting rod-cap coupling surfaces are knurled.
It is therefore recommended to not remove knurling.

Figure 84



CONNECTING ROD BODY	
1234	W
CONNECT-ING ROD No.	WEIGHT
0001	V
↓	W
9999	X

CONNECTING ROD CAP		
1234	A	123
CONNECTING ROD No.	YEAR	DAY
0001	A 1998	001
↓	B 1999	↓
9999	C 2000	366
	D 2001	

70196

Every connecting rod is marked as follows:

- On body and cap with a number showing their coupling and the corresponding cylinder.
  In case of replacement it is therefore necessary to mark the new connecting rod with the same numbers of the replaced one.
- On body with a letter showing the weight of the connecting rod assembled at production:
  - V, 1820 - 1860 (yellow marking);
  - W, 1861 - 1900 (green marking);
  - X, 1901 - 1940 (blue marking);

Spare connecting rods are of the W class with green marking*.

Material removal is not allowed.

540834 Bushes

Check that the bush in the connecting rod small end is free from scoring or seizing and that it is not loosen. Otherwise replace.

Removal and refitting shall be performed using the proper beater.

When refitting take care to make coincide the oil holes set on the bush with those set on the connecting rod small end. Grind the bush to obtain the specified diameter.

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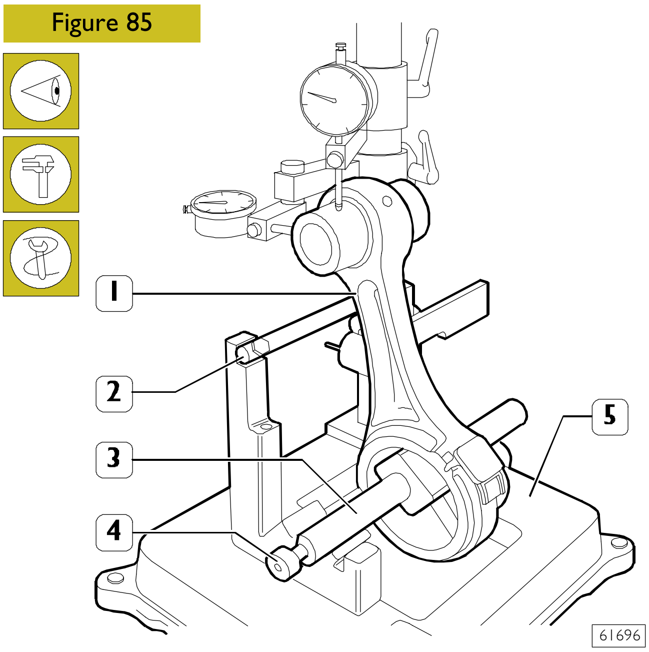
Checking connecting rods

Figure 85

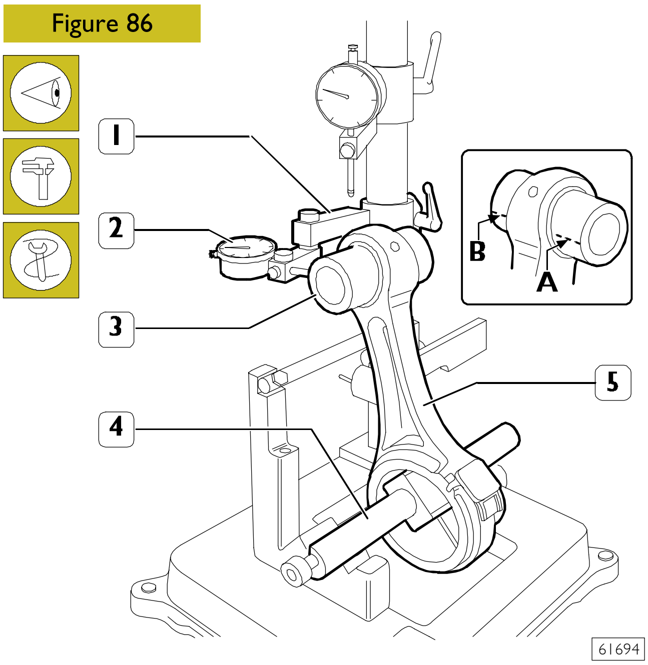


Check that the axes of the connecting rods (1) are parallel using tool 99395363 (5) as follows:

- ❑ fit the connecting rod (1) on tool 99395363 (5) spindle and lock it with screw (4);
- ❑ set the spindle (3) on V-blocks by resting the connecting rod (1) on the stop bar (2).

Checking torsion

Figure 86

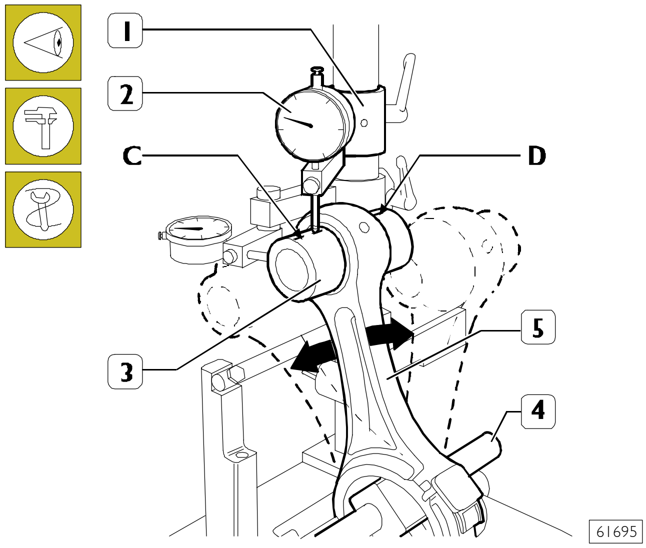


Check connecting rod (5) torsion by comparing two points (A and B) of pin (3) on the horizontal plane of the connecting rod axis.

Position the dial gauge (2) support (1) to obtain a preload of approx. 0.5 mm on the pin (3) in point A and then set the dial gauge (2) to zero. Move the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side (B) of the pin (3): the difference between A and B shall not exceed 0.08 mm.

Checking bending

Figure 87



Check connecting rod (5) bending by comparing two points C and D of the pin (3) on the vertical plane of the connecting rod axis.

Position the vertical support (1) of the dial gauge (2) to rest the latter on pin (3), point C.

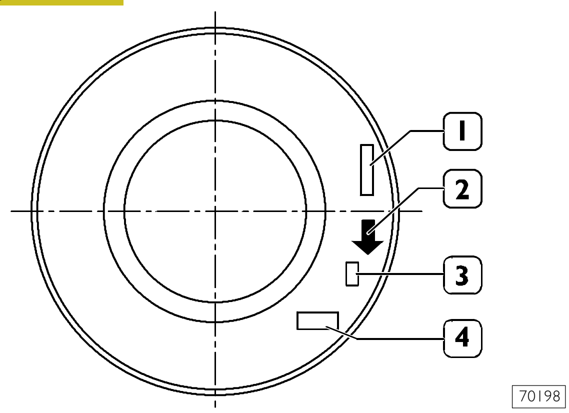
Move the connecting rod forwards and backwards to find pin top position, then in this condition reset the dial gauge (2).

Move the spindle with the connecting rod (5) and repeat the check of the top point on the opposite side D of the pin (3).

The difference between point C and point D shall not exceed 0.08 mm.

Fitting connecting rod-piston assembly
Connecting rod-piston coupling

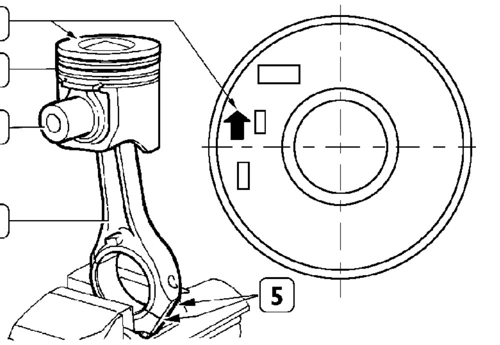
Figure 88



The piston crown is marked as follows:

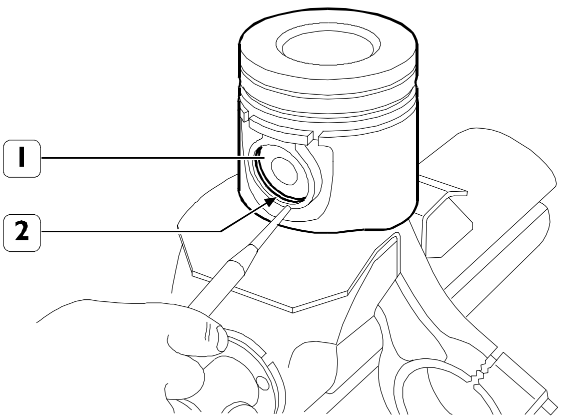
1. Part number and design modification number;
2. Arrow showing piston assembling direction into cylinder barrel, this arrow shall face the front key of the engine block;
3. Marking showing 1st slot insert testing;
4. Manufacturing date.

Figure 89



Connect piston (2) to connecting rod (4) with pin (3) so that the reference arrow (1) for fitting the piston (2) into the cylinder barrel and the numbers (5) marked on the connecting rod (4) are read as shown in the figure.

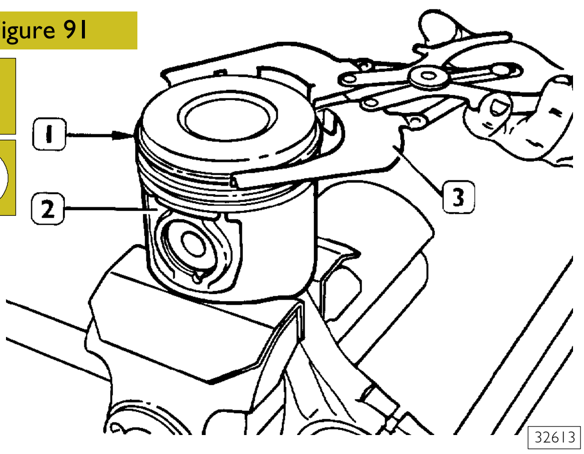
Figure 90



Fit pin (1) split rings (2).

Fitting split rings

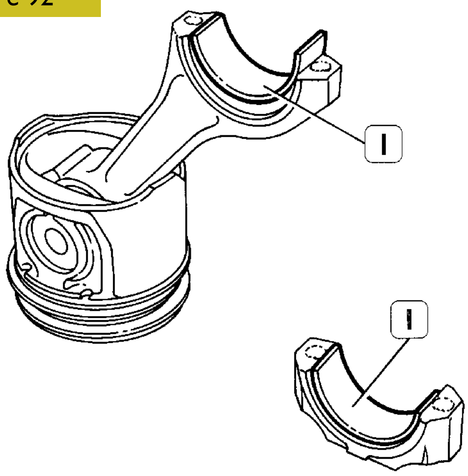
Figure 91



Use pliers 99360183 (3) to fit the split rings (1) on the piston (2).
Split rings shall be fitted with the marking "TOP" facing upwards and their openings shall be displaced with each other by 120°.

Split rings are supplied spare with the following sizes:
- standard, yellow marking;
- 0.5 mm oversize, yellow/green marking;

Figure 92

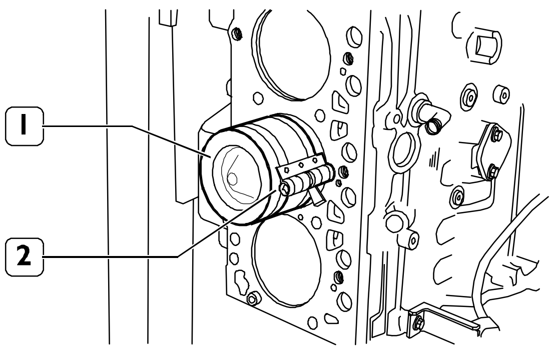


Fit half bearings (1) on connecting rod and cap.

Refit the main bearings that have not been replaced, in the same position found at removal.
Do not try to adapt the half bearings.

Fitting connecting rod-piston assembly into cylinder barrels

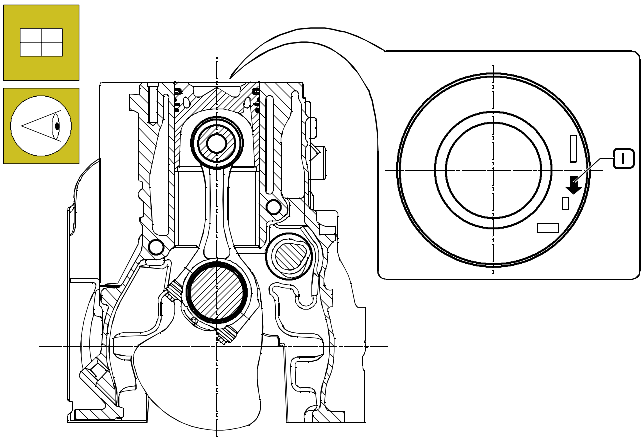
Figure 93



Lubricate accurately the pistons, including the split rings and the cylinder barrel inside.
Use band 99360605 (2) to fit the connecting rod-piston assembly (1) into the cylinder barrels and check the following:

- ❑ the number of each connecting rod shall correspond to the cap coupling number.

Figure 94



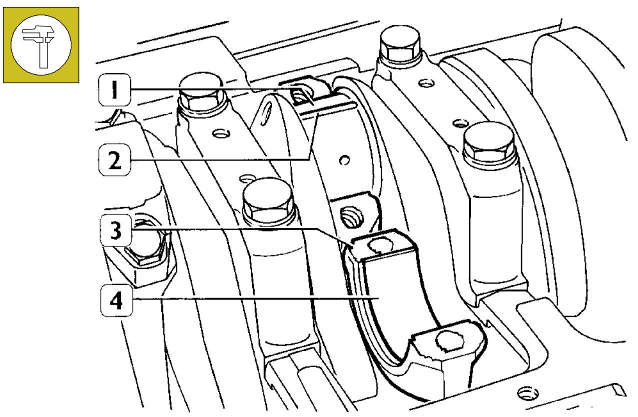
70202

DIAGRAM FOR CONNECTING ROD-PISTON ASSEMBLY FITTING INTO BARREL

- ❑ split ring openings shall be displaced with each other by 120°;
- ❑ connecting rod-piston assemblies shall have the same weight;
- ❑ the arrow marked on the piston crown shall be facing the front side of the engine block or the slot obtained on the piston skirt shall be corresponding to the oil nozzle position.

540831 Finding crankpin clearance

Figure 95

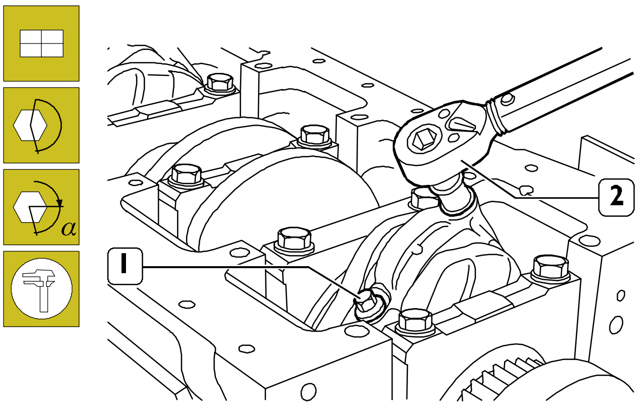


70203

To measure the clearance proceed as follows:

- ❑ clean the parts accurately and remove any trace of oil;
- ❑ set a piece of calibrated wire (2) on the output shaft pins (1);
- ❑ fit the connecting rod caps (3) with the relevant half bearings (4).

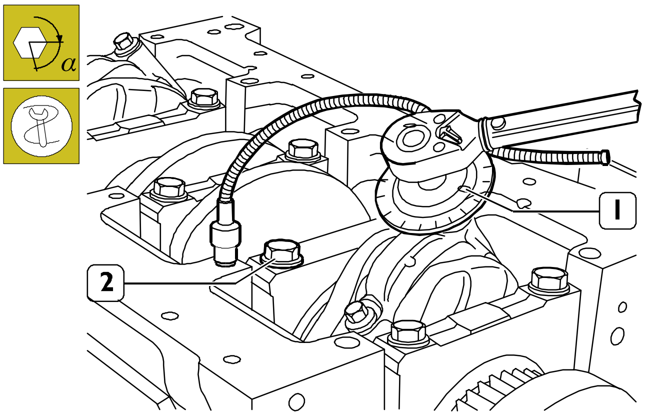
Figure 96



70204

- ❑ lubricate the screws (1) with engine oil and then tighten them to the specified torque using the dynamometric wrench (2).

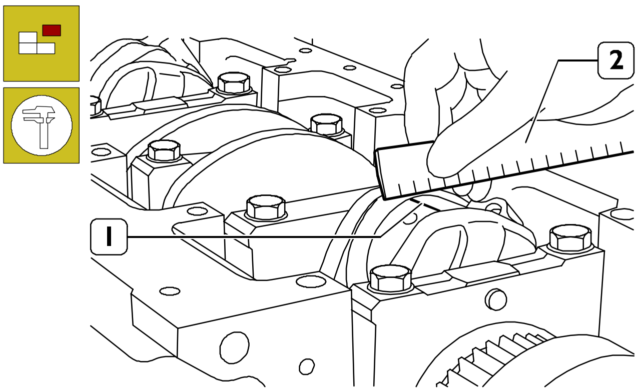
Figure 97



70205

- ❑ apply tool 99395216 (1) to the socket wrench and tighten screws (2) of 60°.

Figure 98



70206

- ❑ remove the cap and find the existing clearance by comparing the calibrated wire width (1) with the scale on the wire envelope (2).

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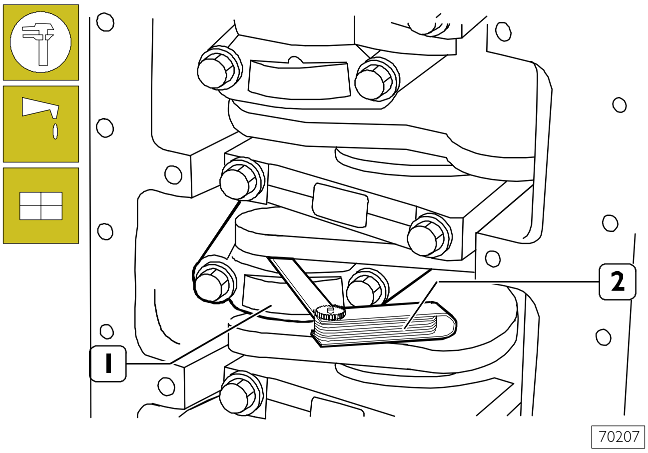
Figure 99



If a different clearance value is found, replace the half bearings and repeat the check.

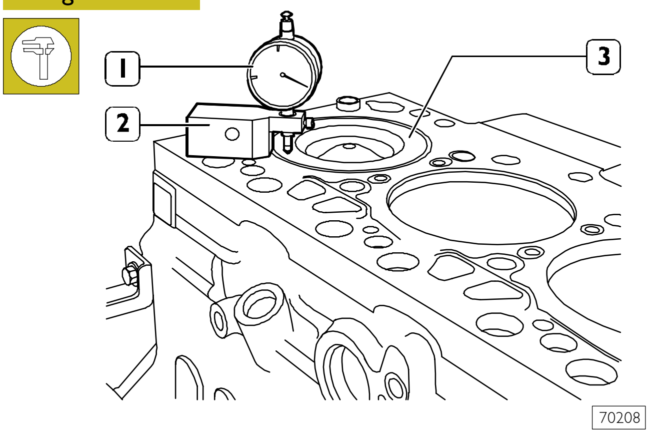
Once the specified clearance has been obtained, lubricate the main half bearings and fit them by tightening the connecting rod cap fastening screws to the specified torque.

Before the final fitting of the connecting rod cap fastening screws, check that their diameter measured at the centre of the thread length is not < 0.1 mm than the diameter measured at approx. 10 mm from screw end.

Check manually that the connecting rods (1) are sliding axially on the output shaft pins and that their end float, measured with feeler gauge (2) is 0.10 – 0.33 mm..

Checking piston protrusion

Figure 100

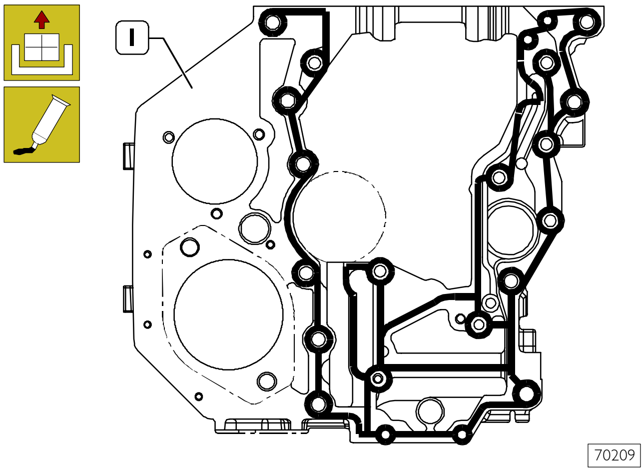


Once connecting rod-piston assemblies refitting is over, use dial gauge 99395603 (1) fitted with base 99370415 (2) to check piston (3) protrusion at T.D.C. with respect to the top of the engine block.

Protrusion shall be 0.28 – 0.52 mm.

Timing gear case

Figure 101



IVECO N. 2992545 SEALANT APPLICATION AREAS

Clean accurately the timing gear case (1) and the engine block.

Perfect seal is only obtained by cleaning accurately the surface to seal.

Smear the case with IVECO N. 2992545 to obtain a bead of few mm diameter.

It shall be uniform (no clots), without air bubbles, thin areas or discontinuities.

Any imperfection shall be corrected as soon as possible.

Avoid to use excess material to seal the joint.

Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joint shall be assembled immediately (10 – 20 minutes).

Figure 102

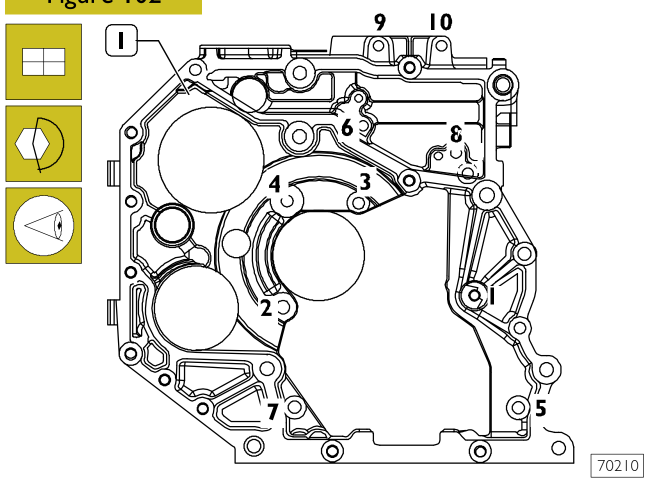


DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

Refit the case (1) to the engine block.
Screw the fastening screws in the same position found at removal and tighten them to the following torque values in the sequence shown in the figure:

Screws M12	65 - 89 Nm
Screws M8	20 - 28 Nm
Screws M10	42 - 52 Nm

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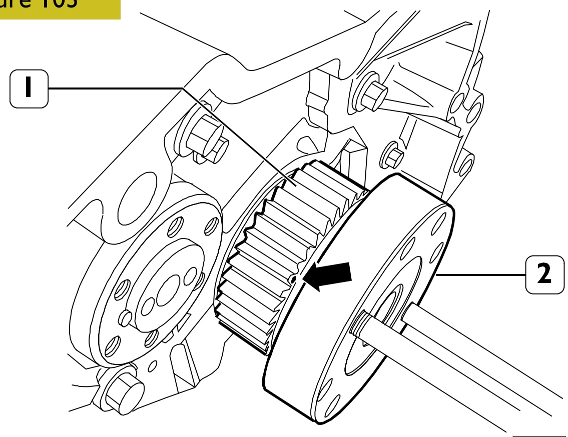
Timing

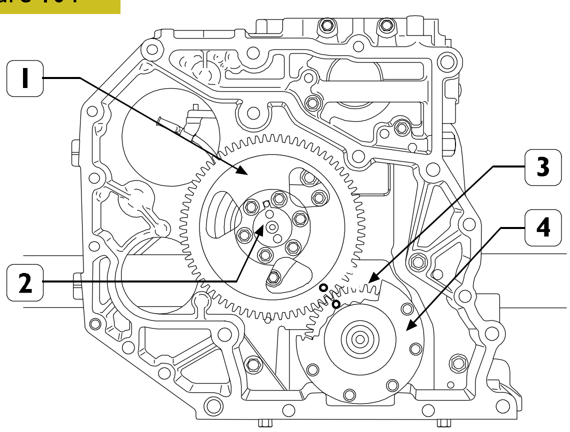
Figure 103



70211

Use a felt pen to mark the driving gear (1) tooth fitted on the output shaft (2) having the mark (→) for timing on the side surface.

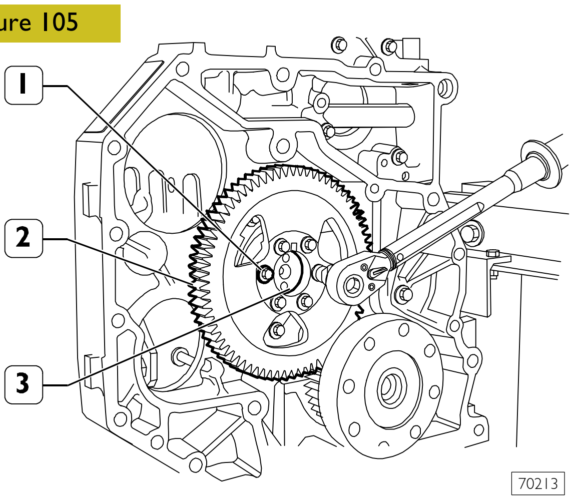
Figure 104



70212

Direct the output shaft (4) and the camshaft (2) so that when fitting the driven gear (1) on the camshaft the marks on the gears (1 and 3) are coinciding.

Figure 105

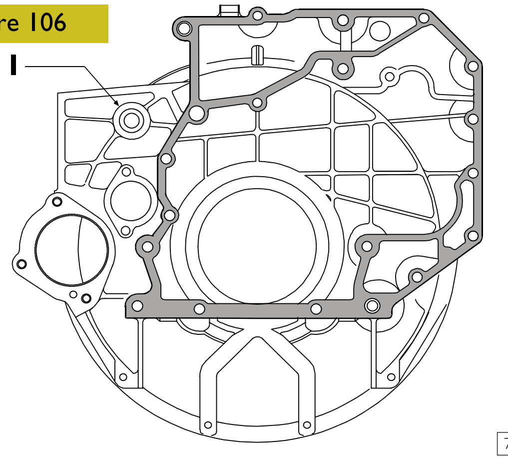


70213

Tighten the screws (1) fastening gear (2) to camshaft (3) to the specified torque.

540460 Flywheel housing

Figure 106



70214

IVECO N. 2992545 SEALANT APPLICATION AREAS

Clean accurately the flywheel housing (1) and timing gear case coupling surfaces.

Perfect seal is only obtained by cleaning accurately the surface to seal.

Smear housing (1) with IVECO N. 2992545 to obtain a bead of few mm diameter.

It shall be uniform (no clots), without air bubbles, thin areas or discontinuities.

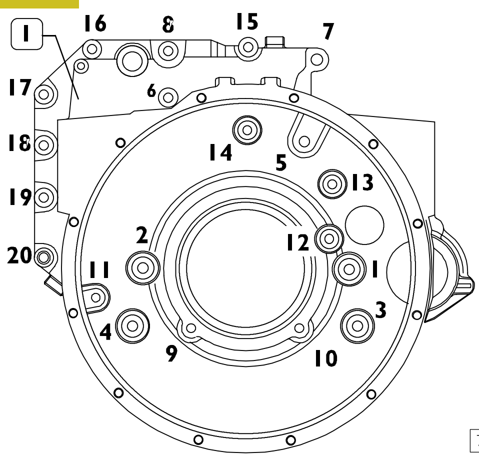
Any imperfection shall be corrected as soon as possible.

Avoid to use excess material to seal the joint.

Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joint shall be assembled immediately (10 – 20 minutes).

Figure 107



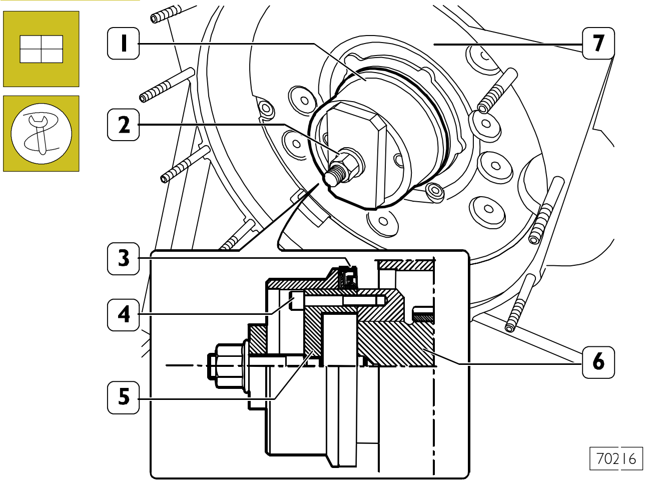
70215

SEQUENCE FOR TIGHTENING THE FLYWHEEL HOUSING FASTENING SCREWS

Refit the housing (1) to the engine block and screw the fastening screws in the same position found at removal and tighten them to the following torque values in the sequence shown in the figure:

Screws M12 75 - 95 Nm
Screws M10 44 - 53 Nm

Figure 108

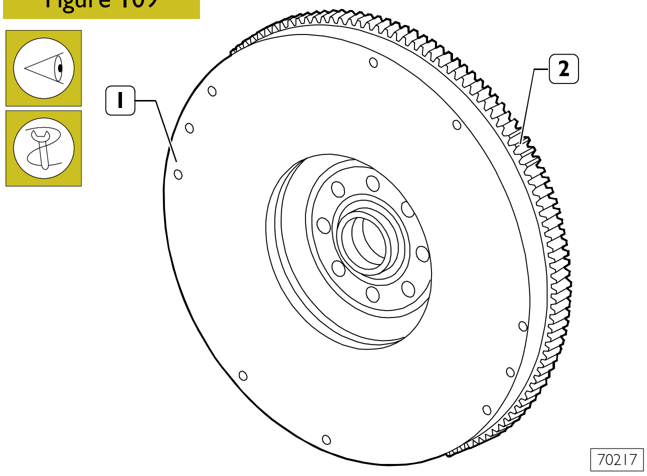


Apply tool 99346253 part (5) to the rear output shaft tang (6), secure it by screws (4) and fit the new sealing ring (3).

Position part (1) on part (5), screw nut (2) until completing sealing ring (3) fitting into flywheel housing (7).

540850 ENGINE FLYWHEEL

Figure 109



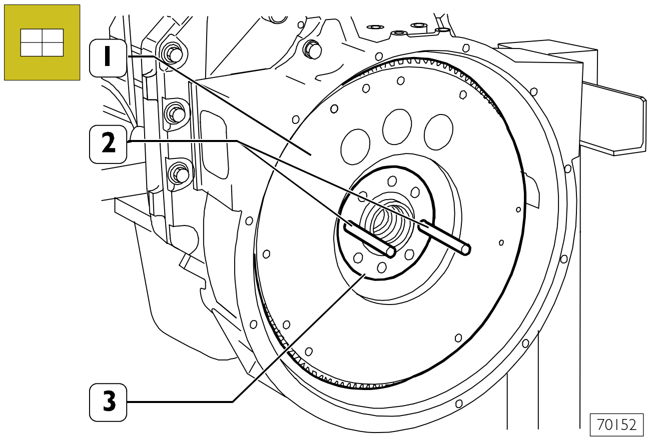
Check clutch plate supporting surface and turn it if scored.

> ⚠ Engine flywheel rated thickness is 49.6 ± 0.13 mm.

540853 Replacing engine flywheel ring gear

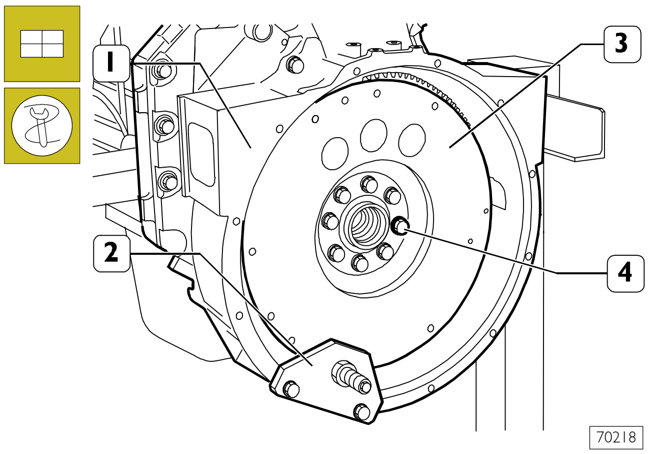
Check ring gear teeth (2), if breakage or excessive wear is found remove the ring gear from the engine flywheel (1, Figure 109) using a generic beater and fit the new one, previously heated to 150°C for 15 – 20 minutes. Chamfering on ring gear inside diameter shall be facing the engine flywheel.

Figure 110



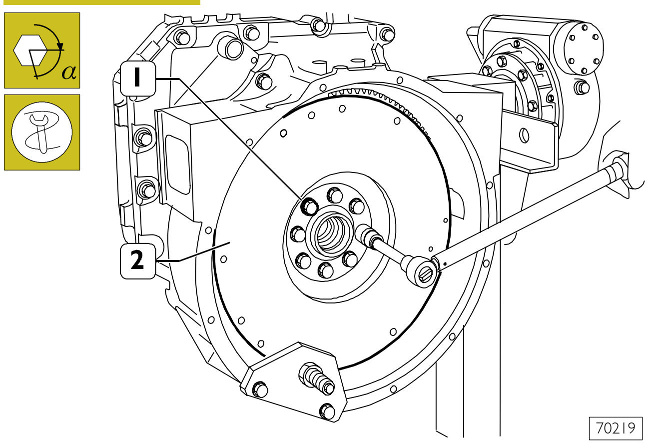
Screw two pins (2) having suitable length into shaft holes (3) and remove the engine flywheel (1) using proper sling and hoister.

Figure 111



Tighten the screws (4) fastening the engine flywheel (3) to the output shaft. Apply tool 99360351 (2) to the flywheel housing (1) to stop engine flywheel (3) rotation.

Figure 112



Tighten engine flywheel (2) fastening screws (1) in two stages:

- 1st stage, tightening to 30 ± 4 Nm torque with dynamometric wrench;
- 2nd stage, tightening to 60° ± 5° angle.

> ⚠ Tightening to angle is performed using tool 99395216.

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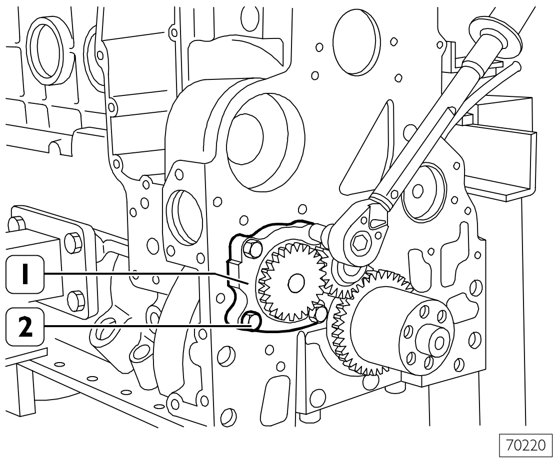
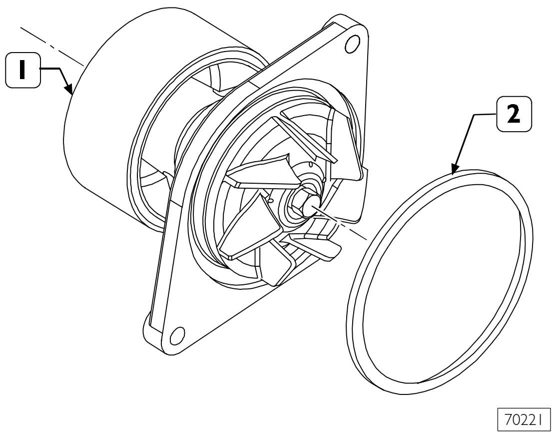
Figure 113



Fit the oil pump (1).

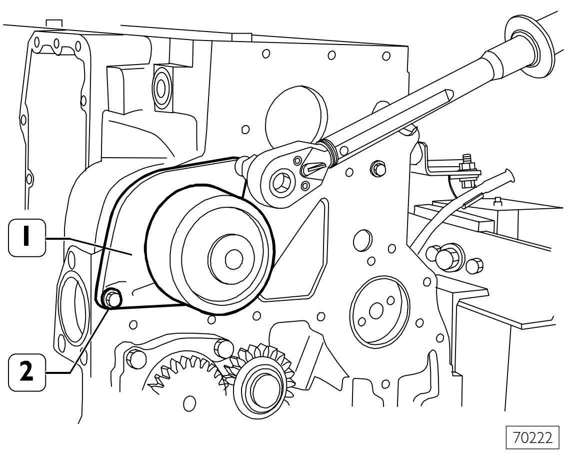
Tighten the fastening screws (2) to the specified torque.

Figure 114



Apply a new sealing ring (2) to the water pump (1).

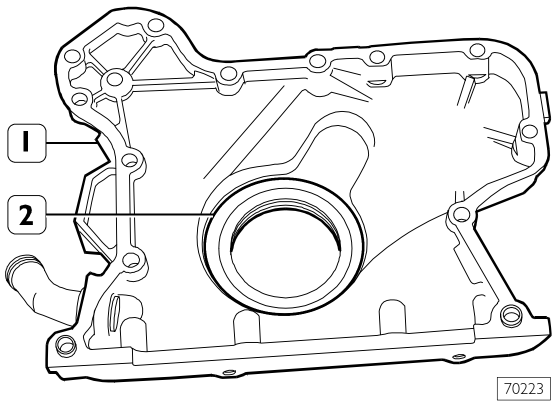
Figure 115



Fit the water pump (1).

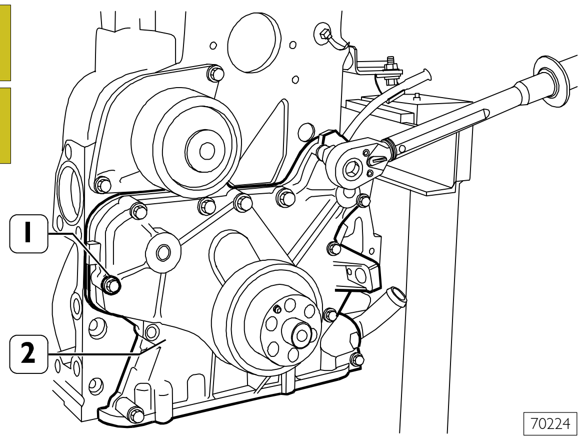
Tighten the screws (2) to the specified torque.

Figure 116



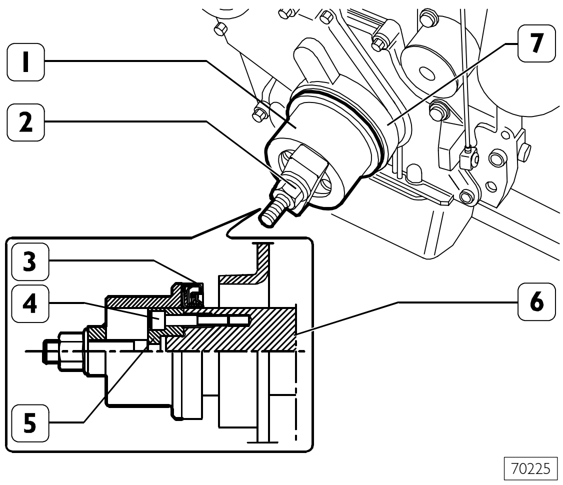
Remove the sealing ring (2) from the front cover (1), clean accurately the coupling surfaces and smear them with IVECO N. 2992545.

Figure 117



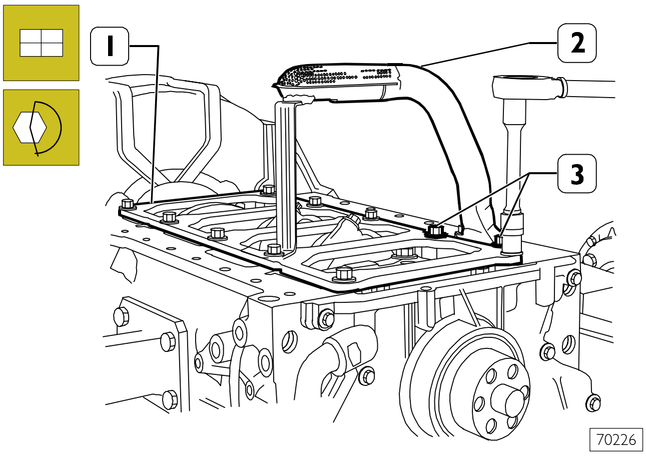
Clean accurately the front cover (2) surface and refit it. Tighten the screws (1) to the specified torque.

Figure 118



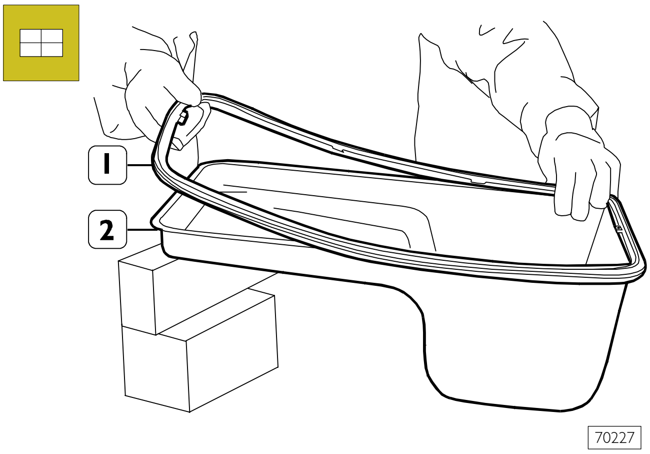
Apply tool 99346252 part (5) to the front output shaft tang (6), secure it by screws (4) and fit the new sealing ring (3). Position part (1) on part (5), screw nut (2) until completing sealing ring (3) fitting into front cover (7).

Figure 119



Fit the plate (1), the rose pipe (2) and tighten the fastening screws (3) to the specified torque.

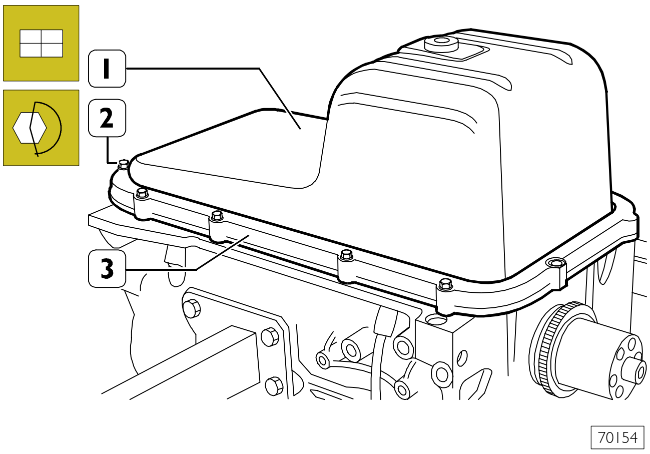
Figure 120



Set the gasket (1) on the oil sump (2).

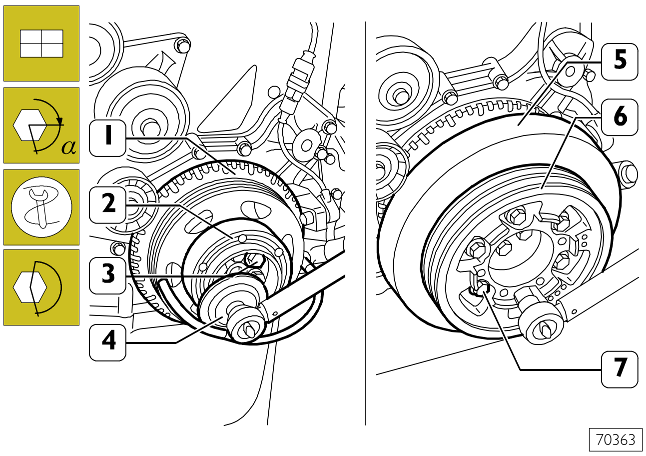
If not faulty the gasket can be reused.

Figure 121



Fit the oil sump (1) and apply the plate (3) to it.
Tighten the screws (2) to the specified torque.

Figure 122



Fit the phonic wheel (1) and the hub (2) on the output shaft.

Tighten the fastening screws (3) in two stages:

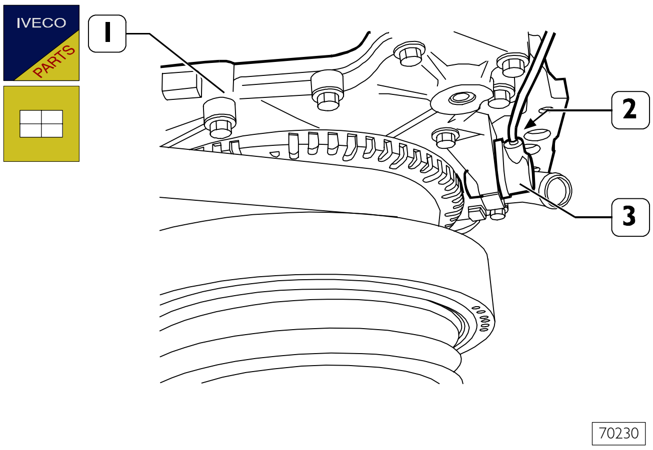
- 1st stage, tightening to 50 ± 5 Nm torque with dynamometric wrench;
- 2nd stage, tightening to 90° angle.

Tightening to angle is performed using tool 99395216 (4).

Fit the damper flywheel (5) and the pulley (6).

Tighten the fastening screws (7) to 68 ± 7 Nm torque.

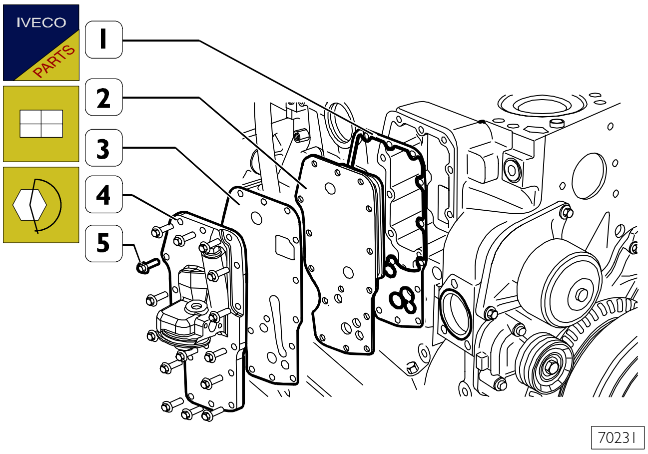
Figure 123



Fit a new sealing ring on the speed sensor (3).

Fit the speed sensor (3) on the front cover (1) and tighten the screw (2) to the specified torque.

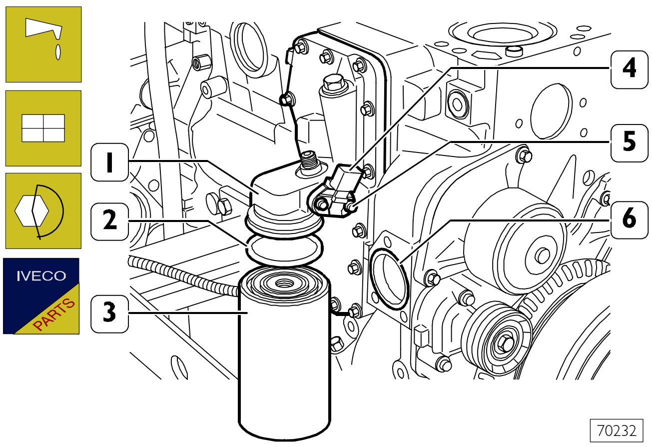
Figure 124



Fit on the engine block: a new gasket (1), the heat exchanger (2) a new gasket (3) and the oil filter support (4).

Tighten the screws (5) to the specified torque.

Figure 125



Lubricate the sealing ring (2) with engine oil and set it on the oil filter (3).

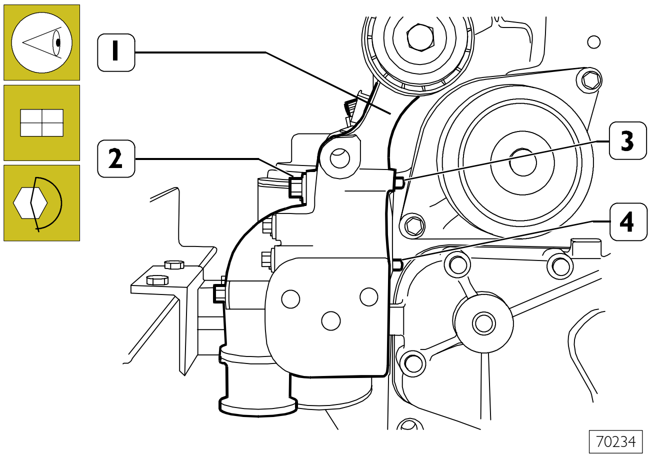
Screw manually to seat the oil filter (3) on the support connection (1) and then screw again the oil filter (3) by ¾ turn.

Apply a new sealing ring on the oil temperature/pressure sensor (4) and fit it on the support (1).

Tighten the screws (5) to the specified torque.

Fit a new sealing ring (6) in the engine block seat.

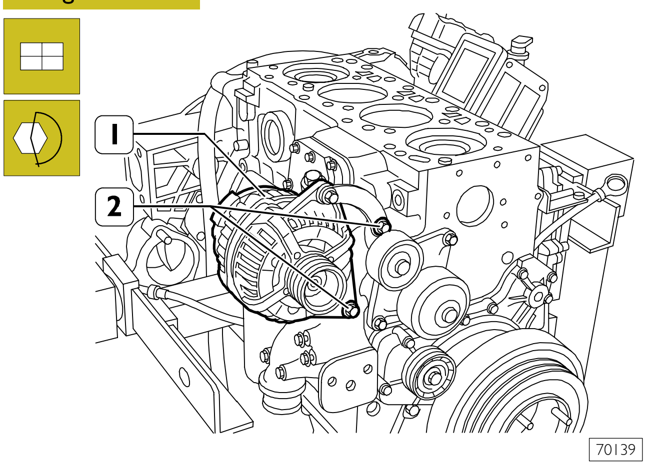
Figure 126



Position the alternator support (1) so that pins (3 and 4) are set against the engine block.

Tighten the screws (2) to the specified torque.

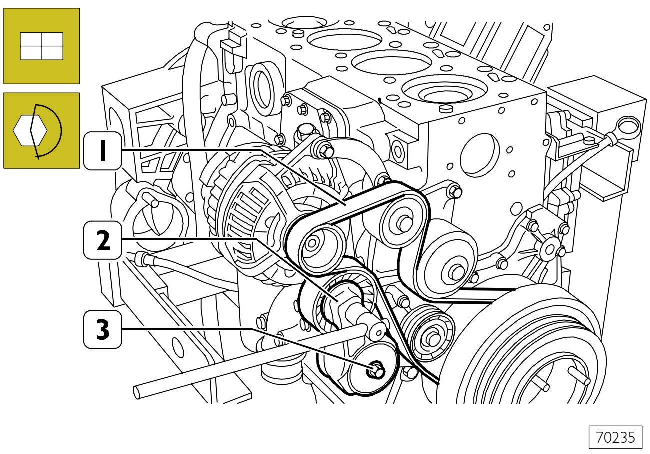
Figure 127



Refit the alternator (1).

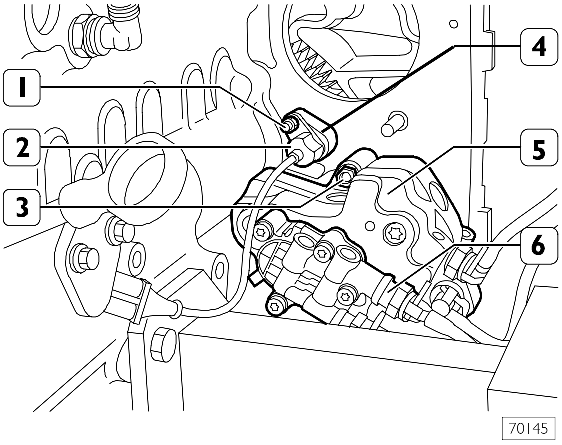
Tighten the screw (2) to the specified torque.

Figure 128



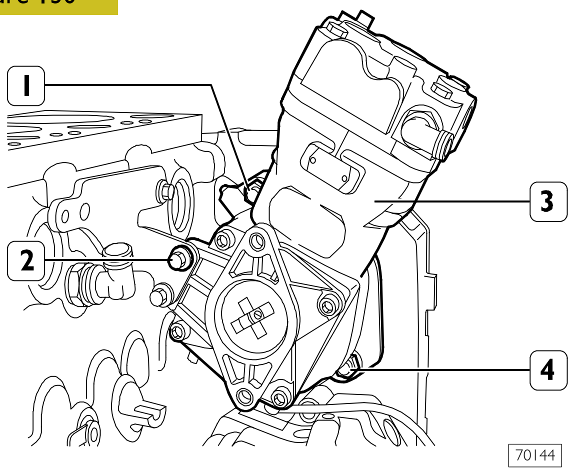
Refit the automatic belt tensioner (2).
Tighten the screw (3) to the specified torque using the proper wrench, turn the automatic belt tensioner (2) to fit the belt (1) on pulleys and guide rollers.

Figure 129



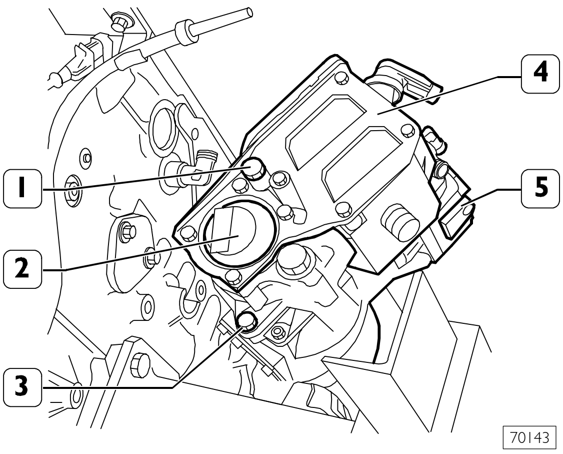
Refit the high pressure pump (5) including the feed pump (6) and tighten the nuts (3) to the specified torque. Fit the support (4) with a new sealing ring, the timing sensor (2) with a new sealing ring and tighten the relevant fastening nut (1) to the specified torque.

Figure 130



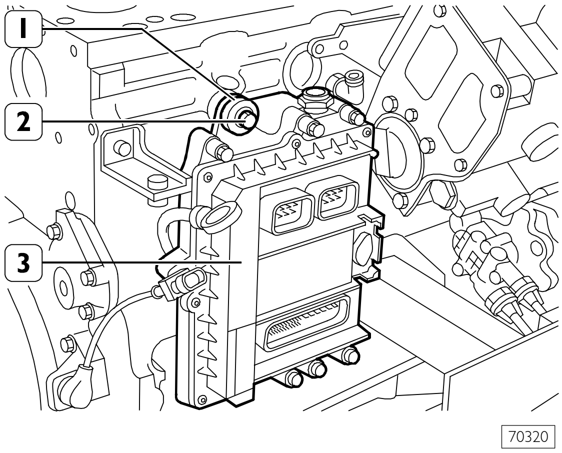
Refit the air compressor (3). Tighten the screws (2) and the nuts (1 and 4) to the specified torque.

Figure 131



Refit the hydraulic power steering pump (2) including the oil tank (4) to the air compressor (5).
Use wrench 99355019 to tighten the fastening screws (3) to the specified torque.

Figure 132

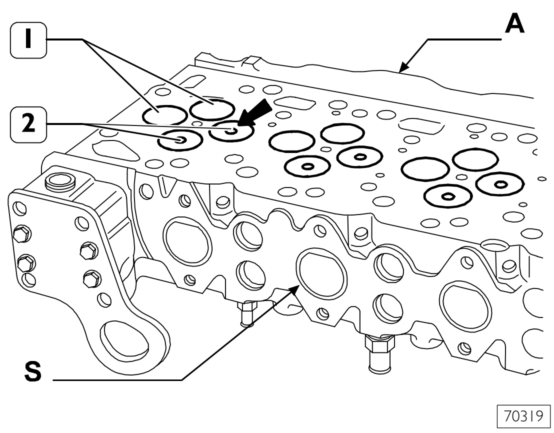


Refit the ECU (3) including the heat exchanger to the engine block and tighten the screws (2) to the specified torque.

Replace support elastic elements (1).

540610 CYLINDER HEAD
540662 Removing the valves

Figure 133



Intake (1) and exhaust (2) valves have heads with the same diameter.

The central notch (→) of the exhaust valve (2) head distinguishes it from the intake valve.

Should cylinder head valves be not replaced, number them before removing in order to refit them in the same position.

A = intake side – S = exhaust side

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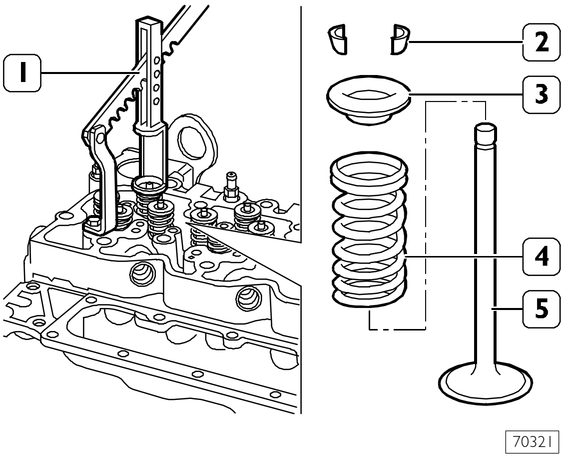
Figure 134

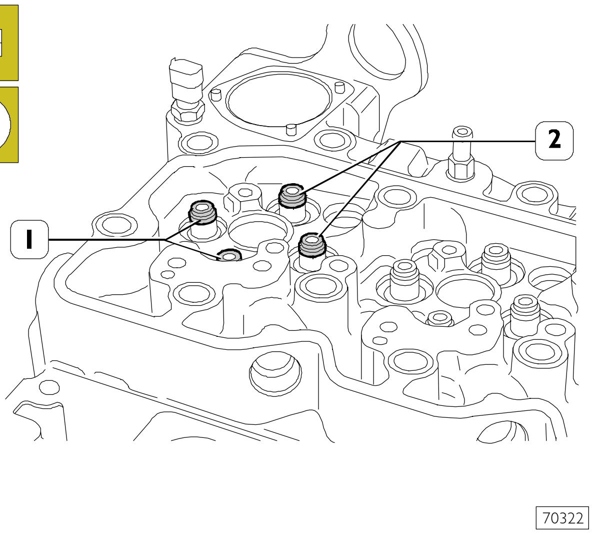


Valve removal shall be performed using tool 99360268 (1) and pressing the cap (3) so that when compressing the springs (4) the cotters (2) can be removed. Then remove the cap (3) and the springs (4).

Repeat this operation for all the valves.

Overturn the cylinder head and withdraw the valves (5).

Figure 135



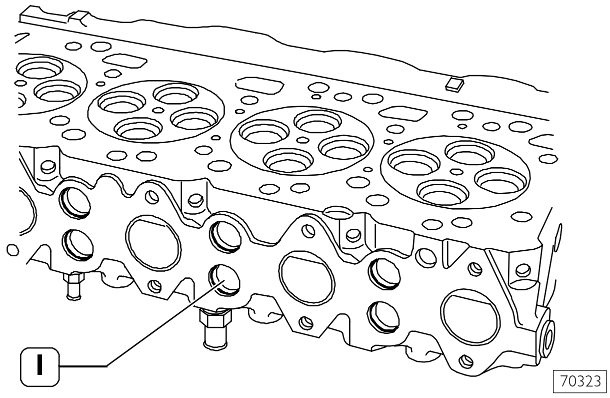
Remove the sealing rings (1 and 2) from the relevant valve guides.

Sealing rings (1) for intake valves are yellow.

Sealing rings (2) for exhaust valves are green.

Checking cylinder head wet seal

Figure 136



This check shall be performed using the proper tools.

Use a pump to fill with water heated to approx. 90°C and 2 – 3 bar pressure.

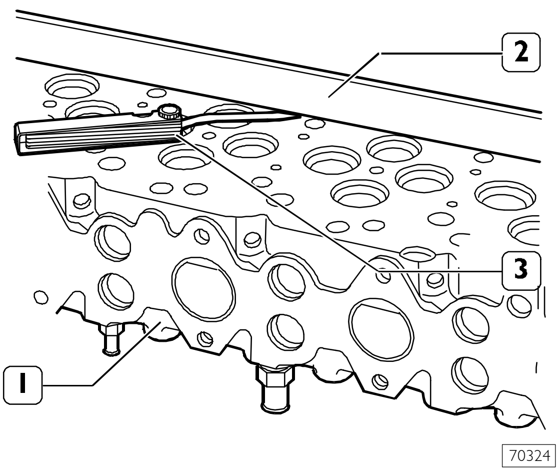
Replace the cup plugs (1) if leaks are found, use the proper beater for their removal/refitting.

Before refitting, smear the plug surfaces with water-repellent sealant.

Replace the cylinder head if leaks are found.

Checking cylinder head supporting surface

Figure 137

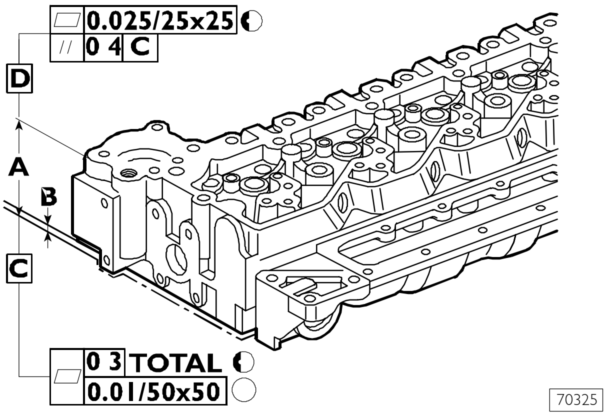


Use a rule (2) and a feeler gauge (3) to check the cylinder head (1) supporting surface.

Distortion found along the whole cylinder head shall not exceed 0.20 mm.

If higher values are found grind the cylinder head according to values and indications shown in the following figure.

Figure 138

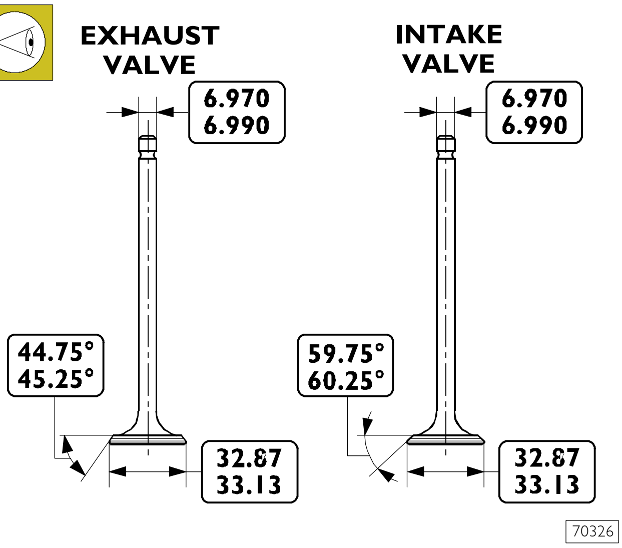


The rated thickness A for the cylinder head is 105 ± 0.25 mm, max. metal removal shall not exceed thickness B by 0.13 mm.

After grinding, check valve sinking. Regrind the valve seats, if required, to obtain the specified value.

540662 VALVES

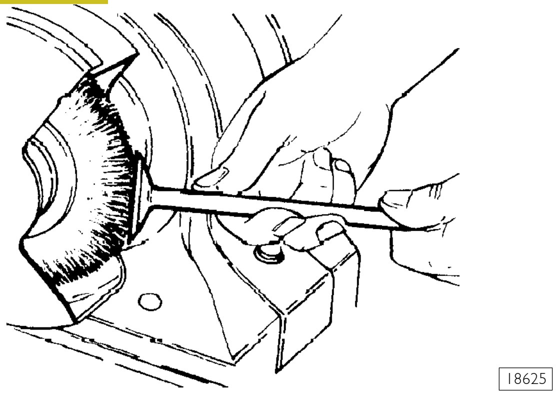
Figure 139



INTAKE AND EXHAUST VALVE MAIN DATA

Removing carbon deposits, checking and grinding valves

Figure 140

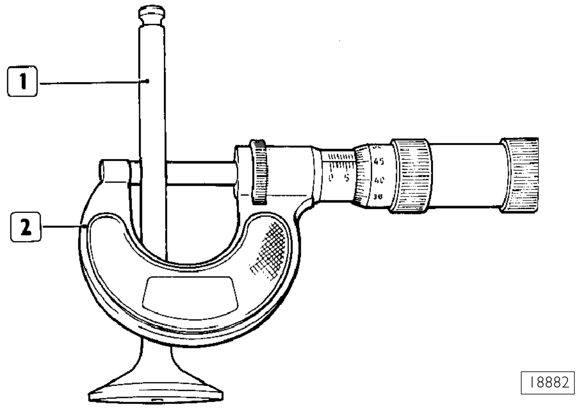


Remove carbon deposits from valves using the proper metal brush.

Check that the valves show no signs of seizing, scoring or cracking.

Regrind the valve seats, if required, using tool 99305018 and removing as less material as possible.

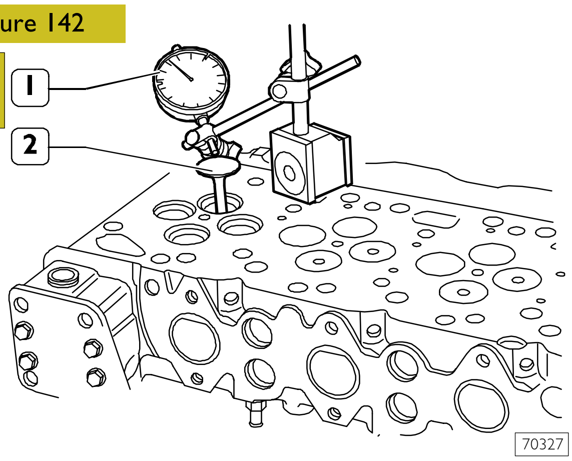
Figure 141



Check the valve stem (1) using a micrometer (2), it shall be 6.970 ± 6.999.

Checking clearance between valve stem and valve guide and valve centering

Figure 142

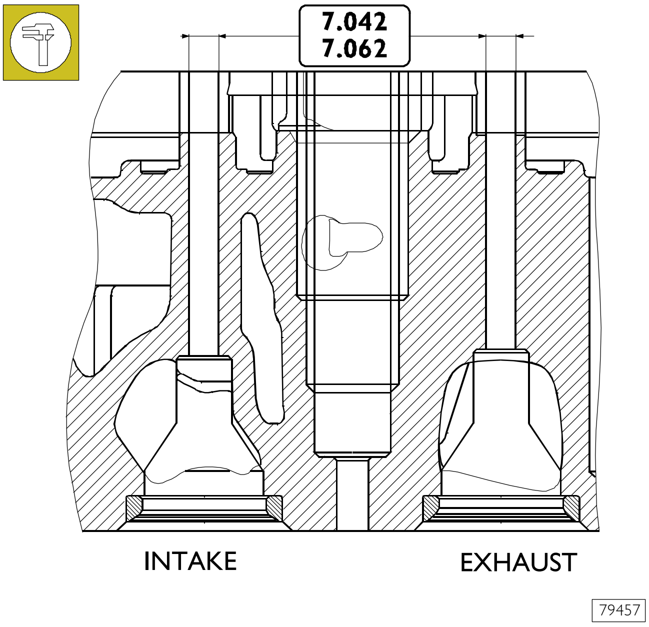


Use a magnetic base dial gauge (1) set as shown in the figure, the assembling clearance shall be 0.052 ± 0.092 mm.

Turn the valve (2) and check that the centering error is not exceeding 0.03 mm.

540667 VALVE GUIDE

Figure 143

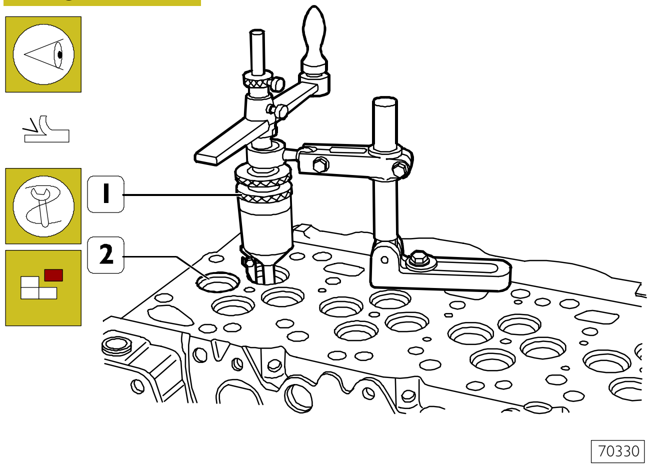


Use a bore dial gauge to measure the inside diameter of the valve guides, the read value shall comply with the value shown in the figure.

VALVE SEATS

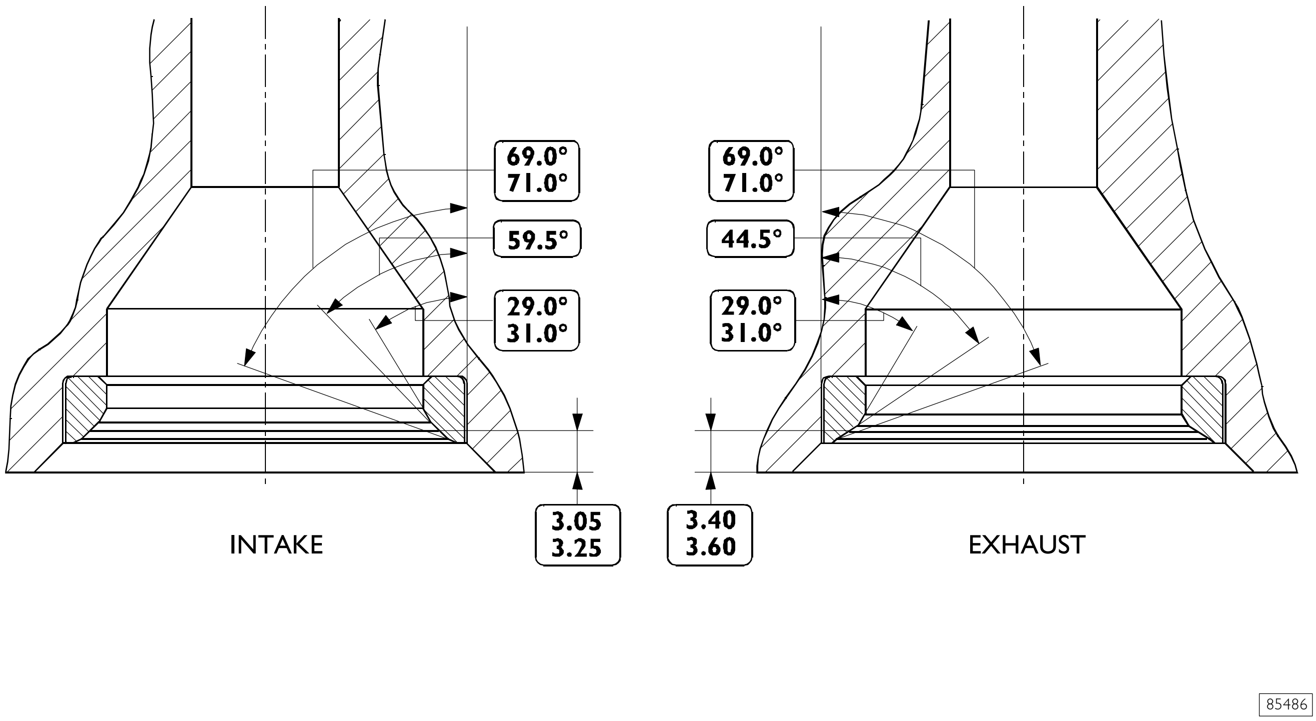
Regrinding – replacing the valve seats

Figure 144



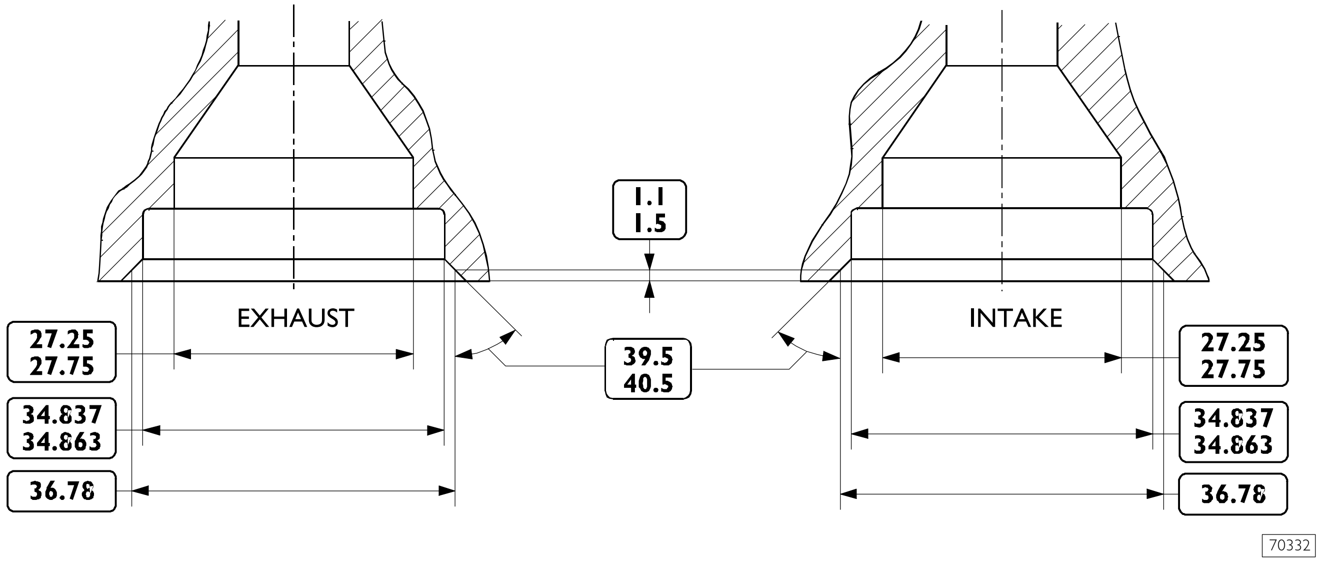
Check the valve seats (2). If slight scoring or burnout is found, regrind seats using tool 99305018 (1) according to the angle values shown in Figure 145.

Figure 145



VALVE SEAT MAIN DATA

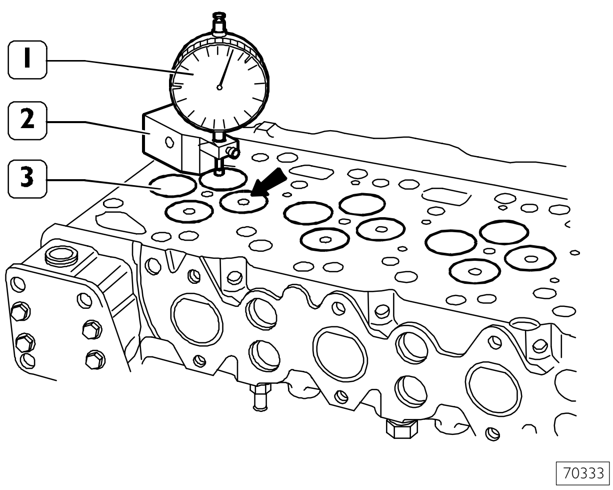
Figure 146



MAIN DATA CONCERNING THE SEATS ON THE CYLINDER HEAD

Should valve seats be not reset just by regrinding, replace them with the spare ones. Use tool 99305018 (Figure 144) to remove as much material as possible from the valve seats (take care not to damage the cylinder head) until they can be extracted from the cylinder head using a punch.

Figure 147



After regrinding, check that valve (3) sinking value is the specified one by using the base 99370415 (2) and the dial gauge 99395603 (1).

Heat the cylinder head to 80° - 100°C and using the proper beater, fit the new valve seats, previously cooled, into the cylinder head.

Use tool 99305018 to regrind the valve seats according to the values shown in Figure 145.

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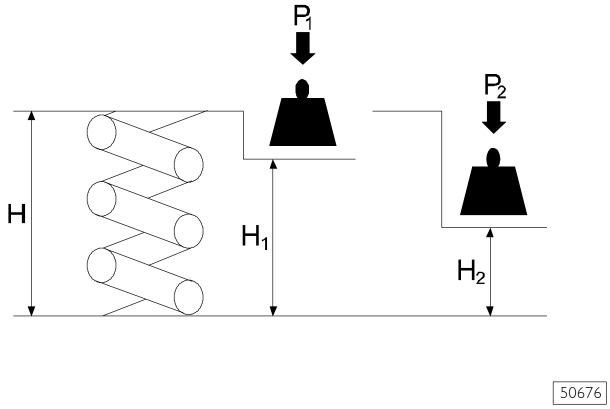
540665 VALVE SPRINGS

Figure 148



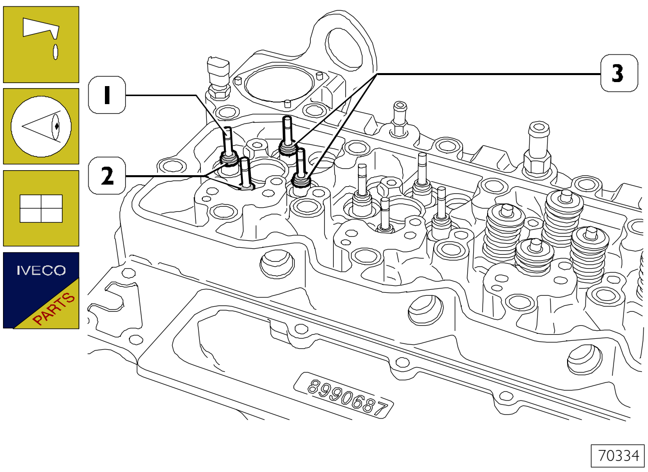
MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Before refitting use tool 99305047 to check spring flexibility. Compare load and elastic deformation data with those of the new springs shown in the following table.

Height		Under a load of	
mm		N	
H	47.75		Free
H1	35.33	P1	339.8 ± 19
H2	25.2	P2	741 ± 39

FITTING CYLINDER HEAD

Figure 149

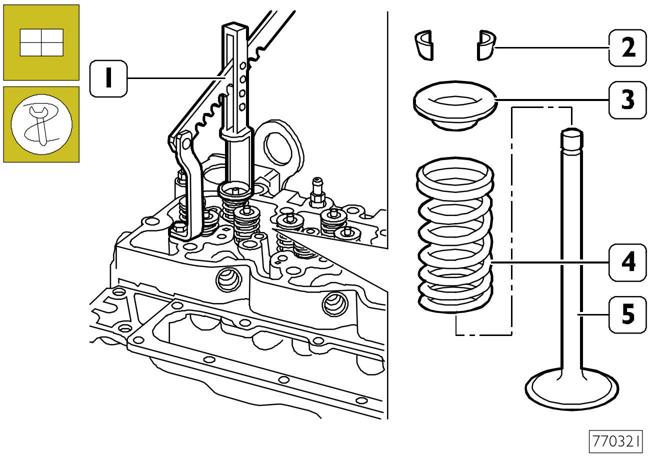


Lubricate the valve stems (1) and fit them into the relevant valve guides according to the position marked at removal.

Fit the sealing rings (2 and 3) on the valve guide.

Sealing rings (2) for intake valves are yellow and sealing rings (3) for exhaust valves are green.

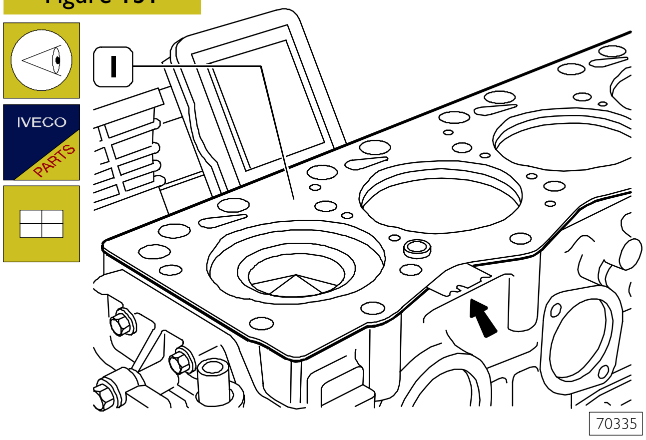
Figure 150



Position on the cylinder head: the spring (4), the upper cap (3); use tool 99360268 (1) to compress the spring (4) and lock the parts to the valve (5) by the cotters (2).

Refitting the cylinder head

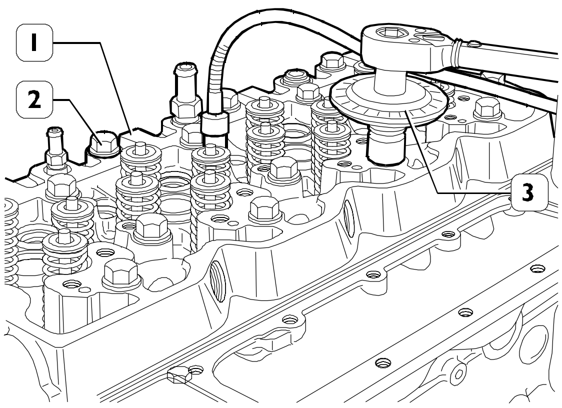
Figure 151



Check cleanness of cylinder head and engine block coupling surface.
Take care not to foul the cylinder head gasket.
Set the cylinder head gasket (1) with the marking "TOP" (1) facing the head.
The arrow shows the point where the gasket thickness is given.

Before reusing the cylinder head fastening screws check whether they are free from damages or distortions, otherwise replace.

Figure 152

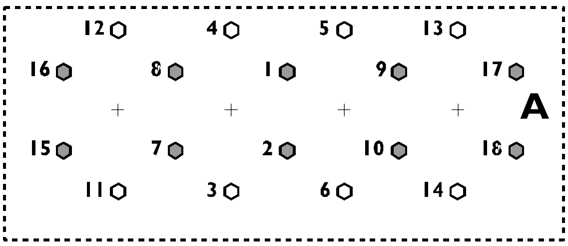


70336

Refit the cylinder head (1), tighten the screws (2) in three successive stages according to the sequence and procedure shown in the following figure.

Use tool 99395216 (3) to tighten to angle.

Figure 153



70337

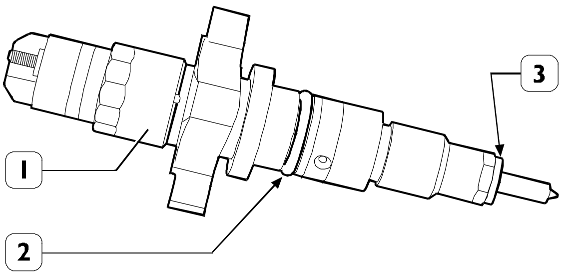
Cylinder head fastening screw tightening sequence:

- 1st stage pre-tightening, with dynamometric wrench:
  - Screw 12x1.75x130 (○) 35 ± 5 Nm
  - Screw 12x1.75 x 150 (●) 55 ± 5 Nm
- 2nd stage, tightening to 90° ± 5° angle
- 3rd stage, tightening to 90° ± 5° angle

A = front side

Fitting injectors

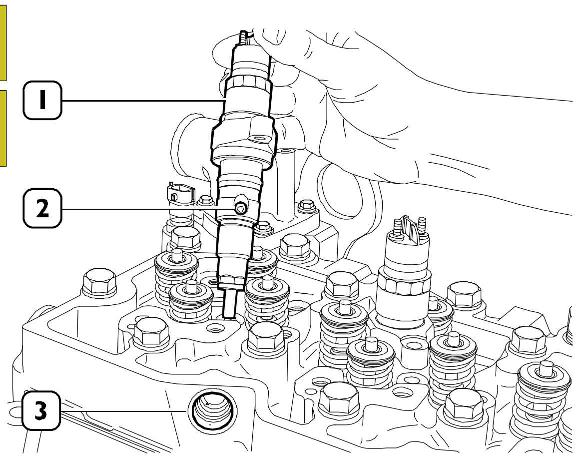
Figure 154



70338

Fit a new sealing ring (2) lubricated with vaseline and a new sealing washer (3) on injector (1).

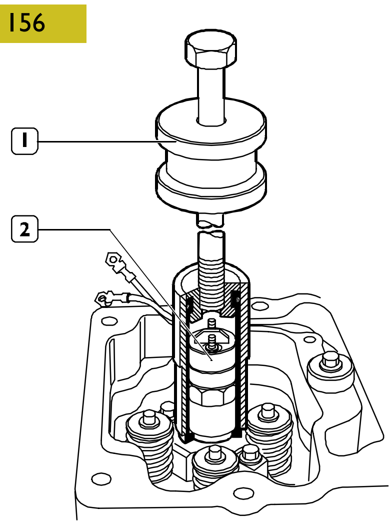
Figure 155



70339

Fit injectors (1) on the cylinder head seats, directed so that the fuel inlet hole (2) is facing the fuel manifold seat (3) side.

Figure 156



70133

Use tool 99342101 (1) to fit the injector (2) into its seat.

Screw injector fastening screws without tightening them.

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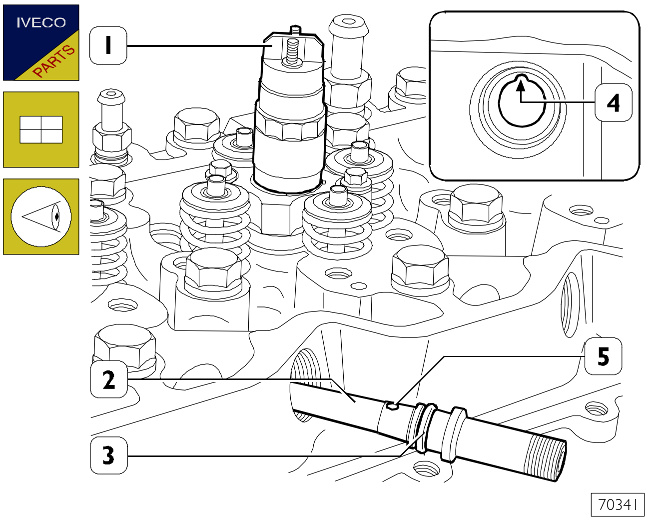
Figure 157



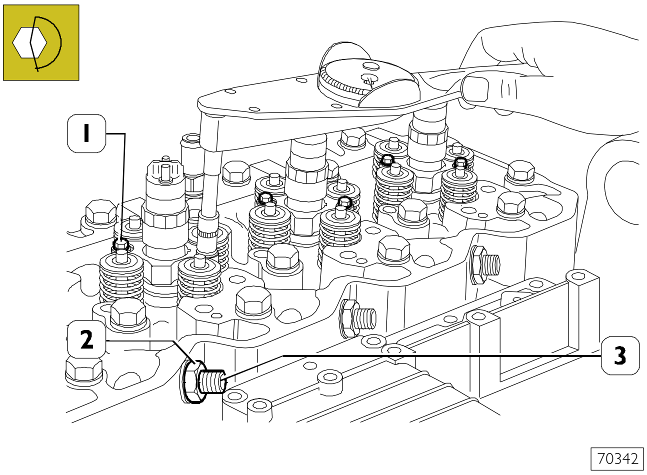
Fit a new sealing ring (3) lubricated with vaseline on the fuel manifold (2) and fit it into the cylinder head seat so that the positioning ball (5) is coinciding with the relevant housing (4).

Removed fuel manifolds (2) shall not be reused but replaced with new ones.

Screw the fastening nuts (2, Figure 158) without locking them.

During this operation, the injector (1) shall be moved so that the manifold (2) is properly inserted into the fuel inlet hole (2, Figure 155).

Figure 158

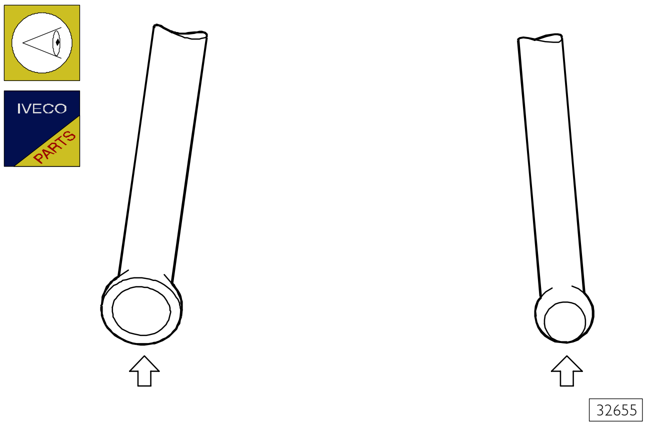


Use the dynamometric wrench to tighten gradually and alternately the injector fastening screws (1) to 8.5 ± 0.8 Nm torque.

Tighten the fuel manifold (3) fastening nuts (2) to 50 Nm torque.

541221 RODS

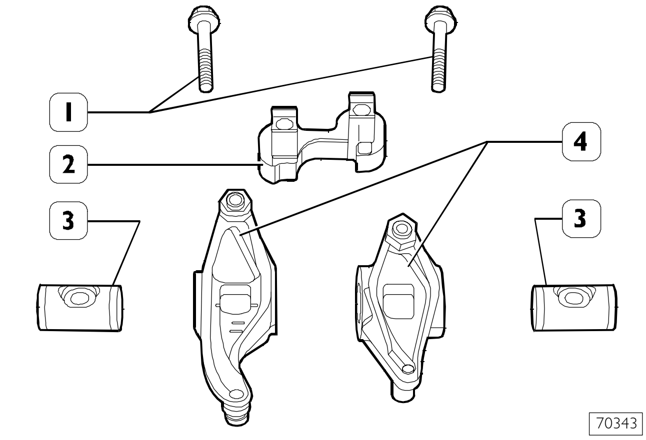
Figure 159



Rocker control rods shall not be distorted; the ball seats in touch with the rocker adjusting screw and with tappets (arrows) shall not show seizing or wear; otherwise replace them. Intake and exhaust valve control rods are identical and are therefore interchangeable.

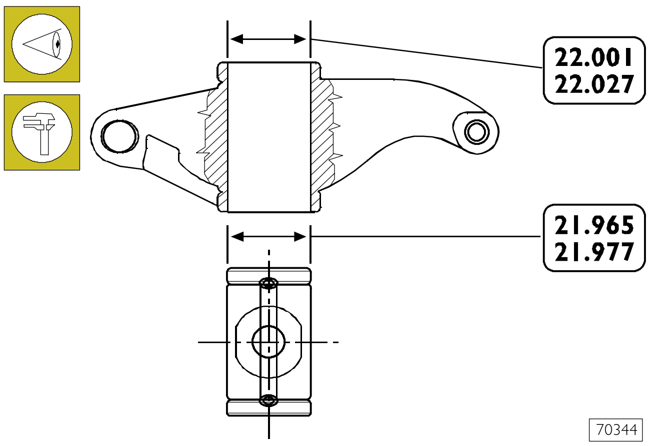
501230 Rocker assembly

Figure 160



ROCKER ASSEMBLY COMPONENTS:
1. Screws - 2. Bracket - 3. Shafts - 4. Rockers.

Figure 161



SHAFT-ROCKER MAIN DATA

Check that shaft/rocker coupling surfaces are not showing excessive wear or damages.

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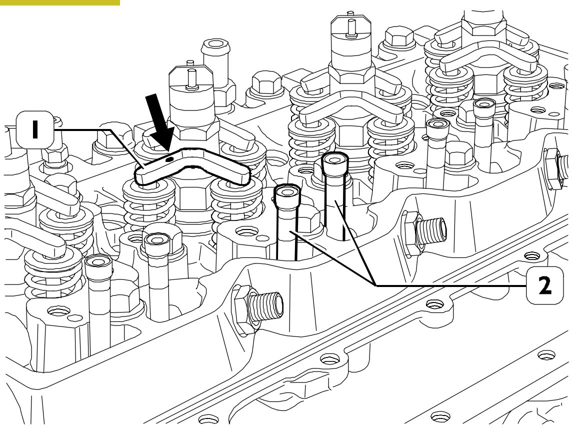
Figure 162

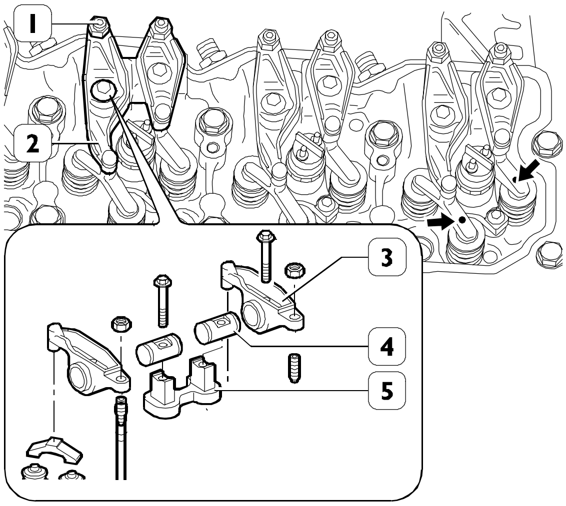


70345

Fit the rods (2).

Position jumpers (1) on valves with marks (→) facing the exhaust manifold.

Figure 163



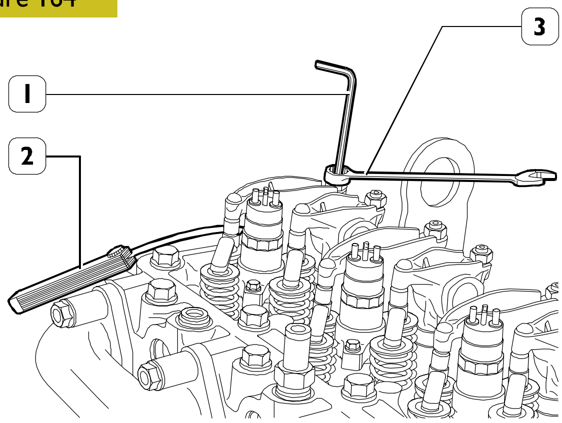
70346

Check that tappet adjusters (1) are loosen to prevent their balking on the rods (2, Figure 162) when refitting the rocker assembly.

Then refit the rocker assembly consisting of: bracket (5), rockers (3), shafts (4) and secure them to the cylinder head by tightening the fastening screws (2) to 36 Nm torque.

Tappet clearance adjustment

Figure 164



70520

Adjust clearance between rockers and valves using setscrew wrench (1), box wrench (3) and feeler gauge (2).

Working clearance shall be as follows:
- intake valves 0.25 ± 0.05 mm
- exhaust valves 0.51 ± 0.05 mm

To carry out rocker-valve clearance adjustment more quickly, proceed as follows:
rotate the output shaft, balance the valves of cylinder No. 1 and adjust the valves marked with an asterisk in the tables below:

cylinder No.	1	2	3	4
intake	-	-	*	*
exhaust	-	*	-	*

Rotate the output shaft, balance the valves of cylinder No. 4 and adjust the valves marked with an asterisk in the table below:

cylinder No.	1	2	3	4
intake	*	*	-	-
exhaust	*	-	*	-

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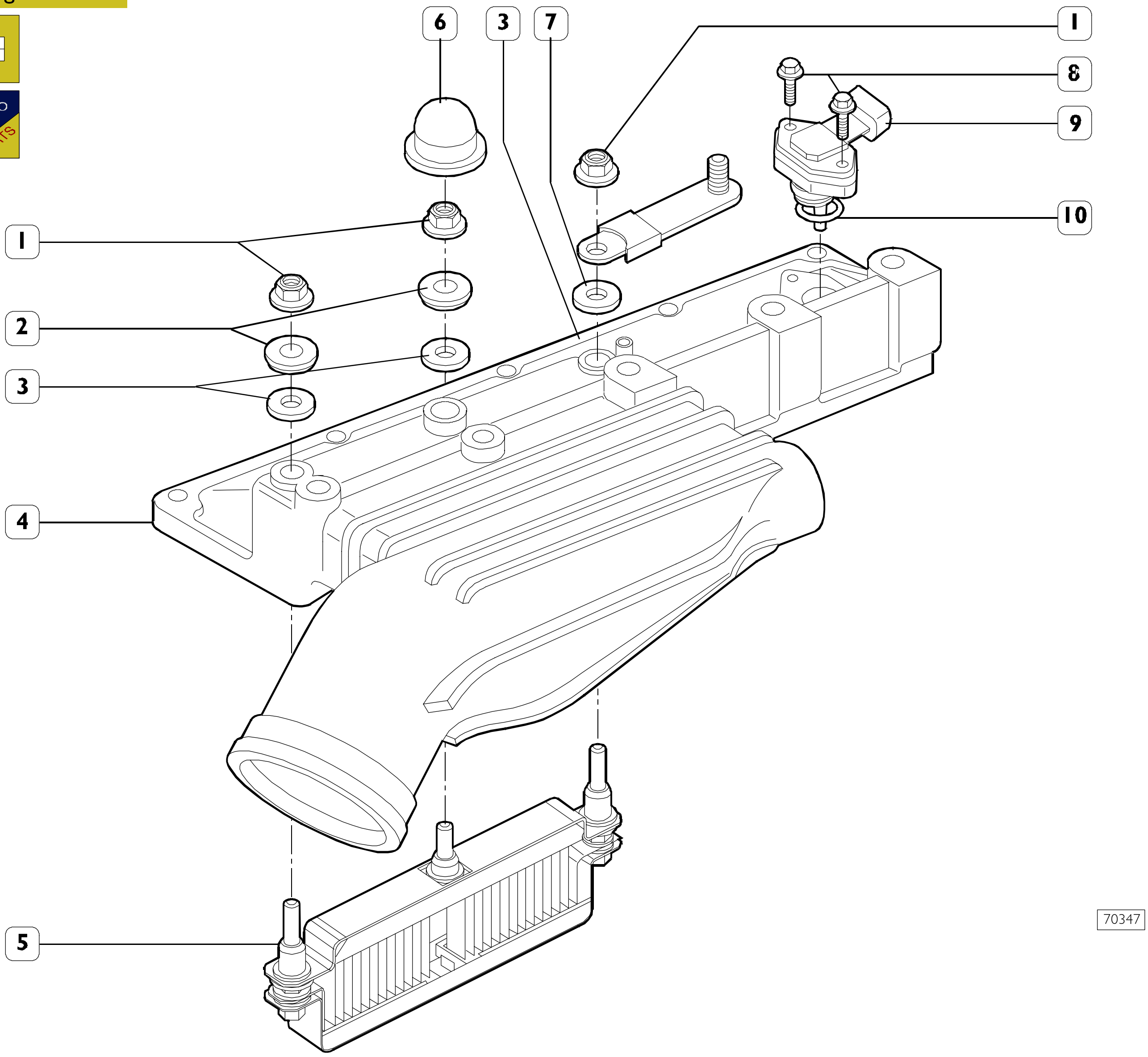
Intake manifold

Figure 165

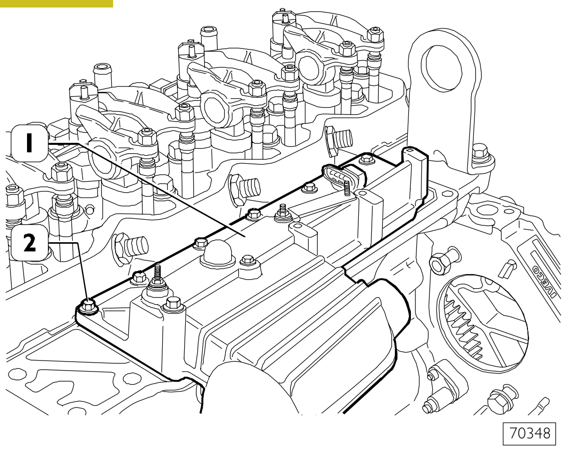


The intake manifold (4) houses the air heater (5) for cold starting. In case of failure it shall be replaced by removing the cap (6), the nuts (1), the sealing washers (2) and the washers (3). Fit the new heater (5) following the removal operations in reverse order.

> The sealing washers (2) shall be replaced with new ones.
> The nuts (1) shall be tightened to the specified torque.

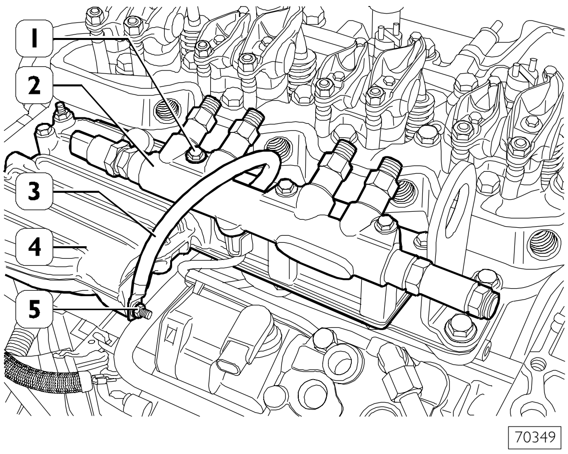
Apply a new sealing ring (10) to the air temperature/pressure sensor and fit it on the intake manifold (4), tighten the screws (8) to the specified torque.

Figure 166



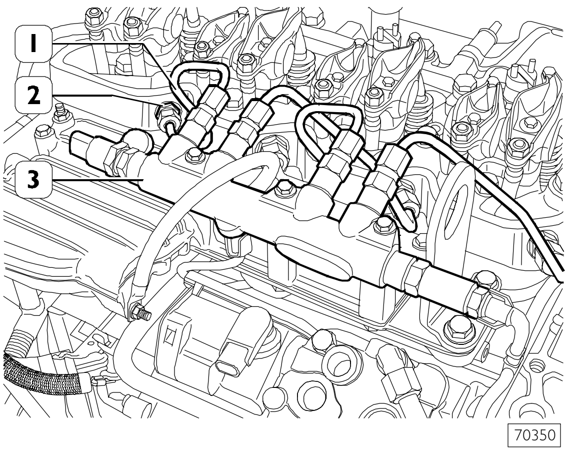
Smear the intake manifold (1) coupling surface with sealant IVECO No. 2992545 and fit it on the cylinder head. Tighten the screws (2) to the specified torque.

Figure 167



Fit the rail (2) and tighten the screws (1) to the specified torque, connect the ground cable (3) to the intake manifold (4) and tighten the fastening nut (5) to the specified torque.

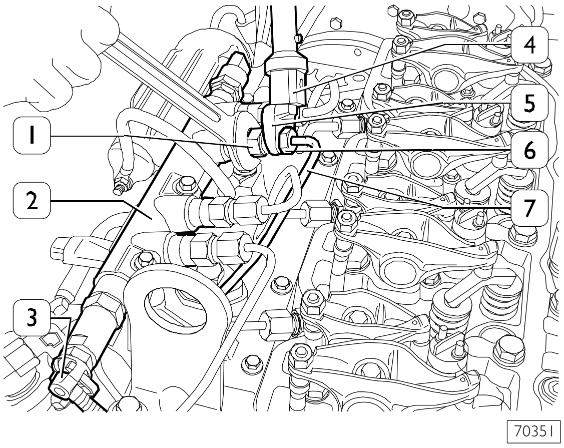
Figure 168



Connect new fuel pipes (1) to rail (3) and injector manifolds (2).

When removed, pipes (1) shall always be replaced.

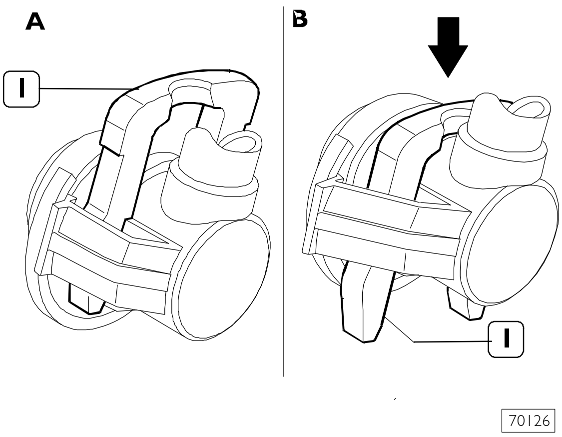
Figure 169



Pipe (7) connections shall be tightened to 20 Nm torque, using the proper wrench (5) and the dynamometric wrench 99389833 (4).
Connections (6) shall be tightened by holding the flow limiting valve hexagon (1) with the proper wrench.

Connect the fuel pipe (3) to the rail (2) following the procedure shown in the following figure.

Figure 170

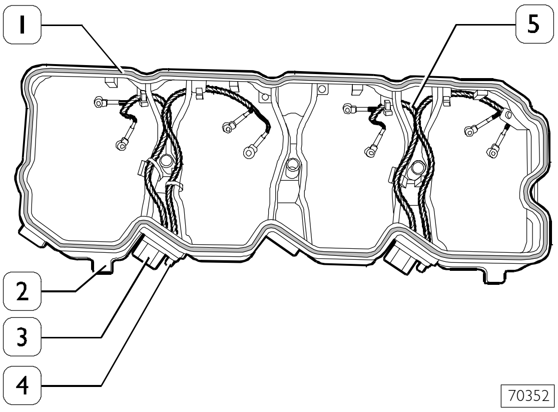


Press the clamp (1) in arrow direction (Figure B) and connect the pipe to the rail (2, Figure 169), reset the clamp to the initial locking position "A".

Check proper fuel pipe connection.

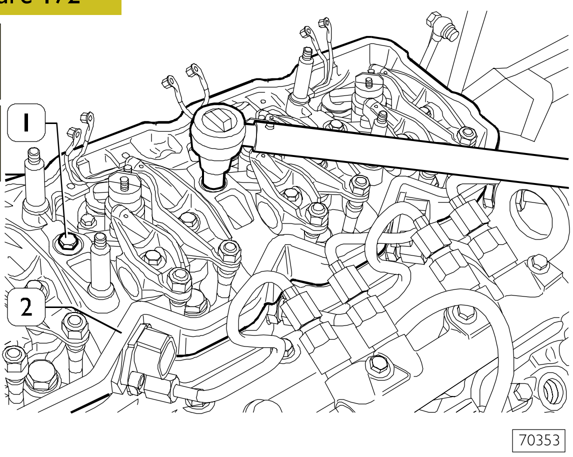
540634 Wiring support

Figure 171



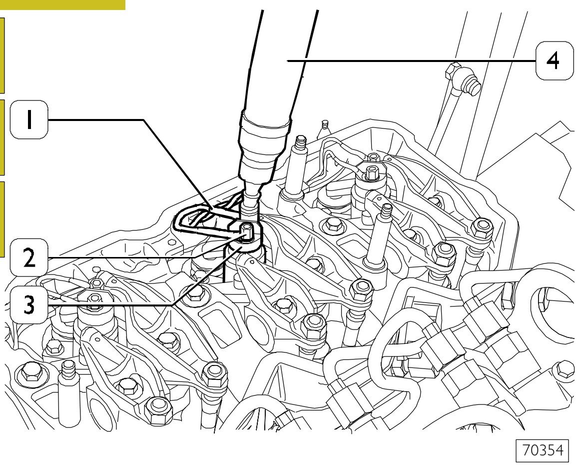
Check electrical cable (5) conditions, replace if damaged by cutting the support (2) clamps and removing the screws (4) that secure it to connections (3).
Fit a new gasket (1) on the support (2).

Figure 172



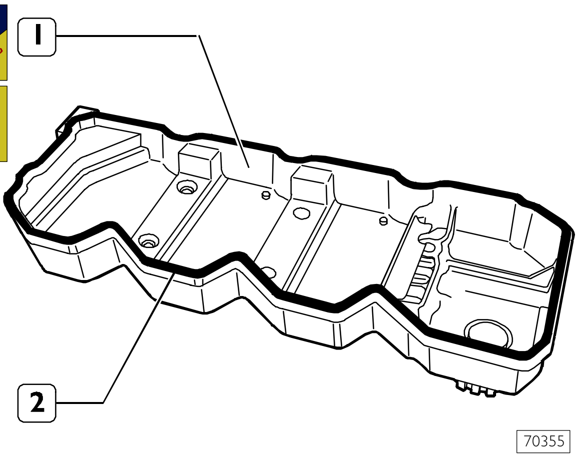
Fit the wiring support (2) and tighten the screws (1) to the specified torque.

Figure 173



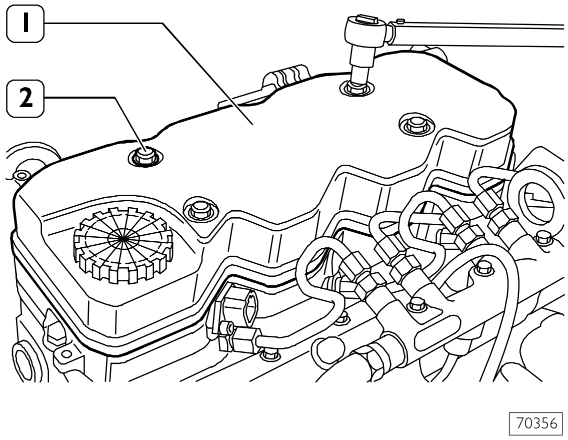
Connect the electrical cables (1) to the injectors (3) and use the dynamometric wrench 99389834 (4) to tighten the fastening nuts (2) to the specified torque.

Figure 174



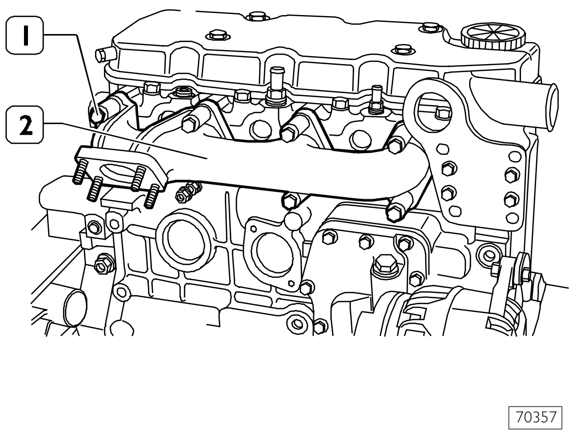
Fit a new gasket (2) on the tappet cover (1).

Figure 175



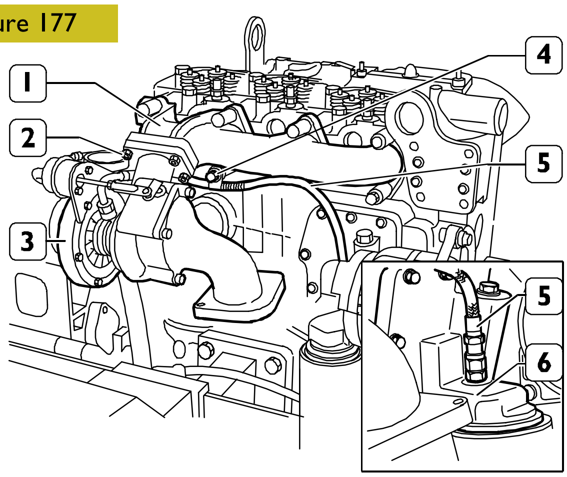
Fit the tappet cover (1) and tighten the nuts (2) to the specified torque.

Figure 176



Reconnect the exhaust manifold (2) with new gaskets. Tighten the fastening screws (1) to the specified torque.

Figure 177

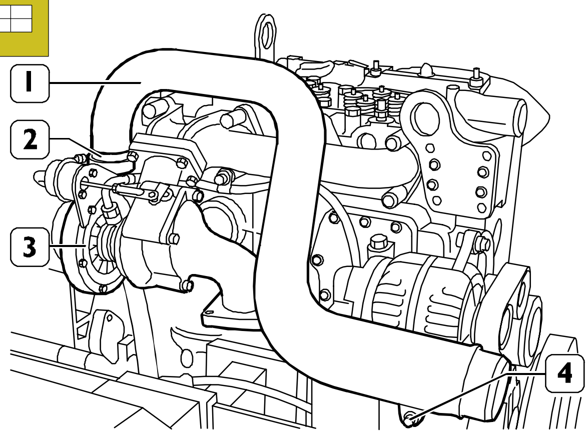


70358

Reconnect the turbosupercharger (3) with a new gasket to the exhaust manifold (1) and tighten the fastening nuts (2) to the specified torque.

Connect the oil pipe (5) to the heat exchanger support (6) and secure it to the exhaust manifold (1) by screw (4).

Figure 178

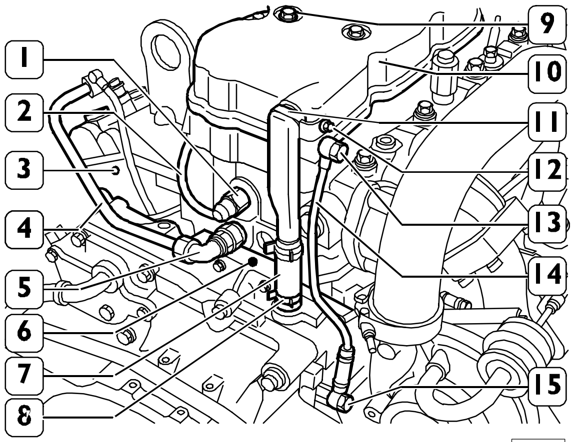


70134

Connect the air duct (1) to the turbosupercharger (3) and lock it by clamp (2).

Secure the air duct (1) to the alternator support by screws (4).

Figure 179



70360

Connect pipe (14) to tappet cover (10) and timing case (6) with connections (13-15) and new copper washers.

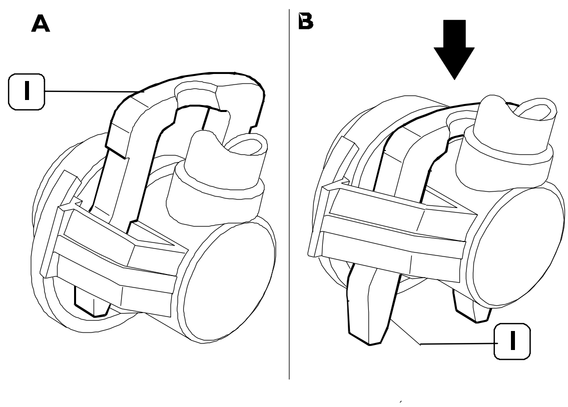
Connect pipe (7) to timing case (6) connection and lock it by the elastic clamp (8).

Fit a new sealing ring on pipe (11) connection and fit it on the tappet cover (10).

Secure the pipe (11) to the tappet cover (10) with the clip and the nut (12), connect pipe (4) to connection (5) and air compressor (3).

Connect the pipe (2) to the pressure limiter (1) as shown in the following figure.

Figure 180



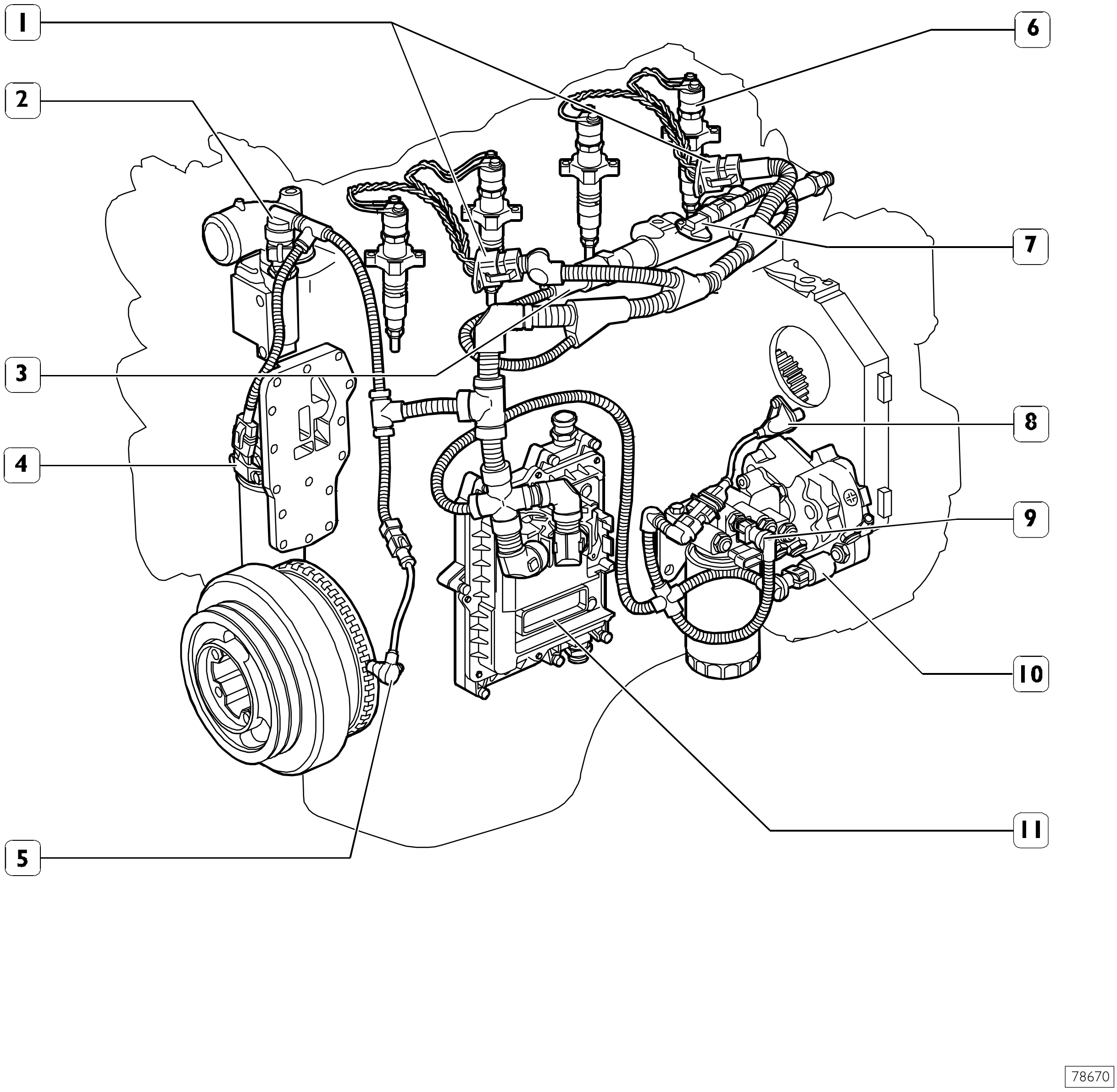
70126

Press the clamp (1) in arrow direction (Figure B) and connect the pipe.

Reset the clamp to the initial locking position A.

Check proper fuel pipe connection.

Figure 181

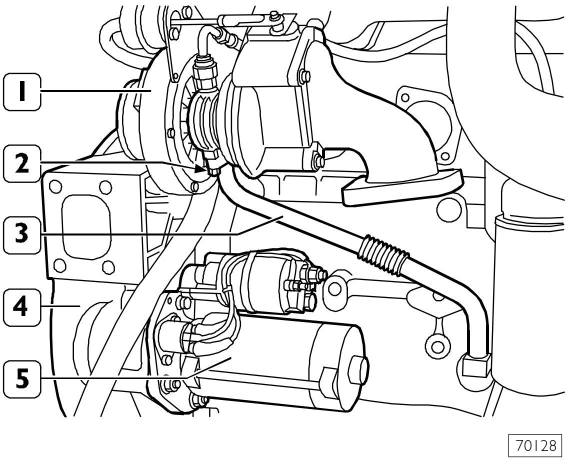


1. Injector connections - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor - 4. Engine oil temperature and pressure sensor - 5. Output shaft sensor - 6. Injector - 7. Air temperature/pressure sensor - 8. Timing sensor - 9. Fuel heater and fuel temperature sensor - 10. Pressure regulator - 11. EDC7 control unit

Reconnect the engine cable by connecting injector wiring (6) connectors (1); (7) air pressure/temperature sensor; (3) rail pressure sensor; (11) control unit; (10) high pressure pump sensor; (8) timing sensor; (2) engine coolant temperature sensor on thermostat; (5) engine speed sensor.

Apply to engine lifting hooks the lifting rig 99360555, hook the latter to the hoister and remove the engine from the revolving stand. Remove the brackets 99361037.

Figure 182



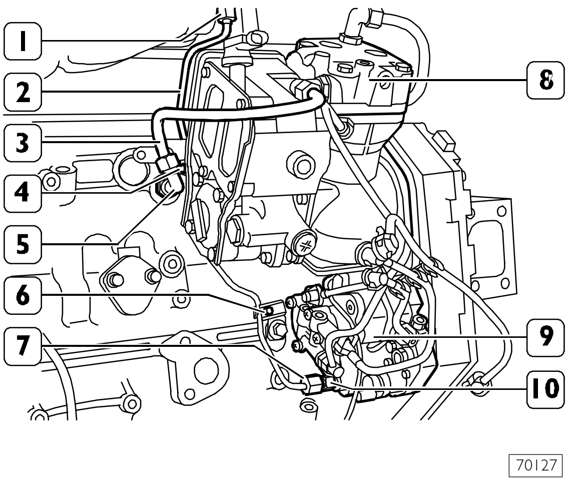
Complete engine refitting as follows:

Form the right side:

Refit the starter (5) to the flywheel housing (4) and tighten the fastening nuts to the specified torque.

Fit the oil pipe (3) with a new sealing ring into the engine block and secure it to the turbosupercharger (1) by the screws (2) tightened to the specified torque.

Figure 183



From the left side:

Connect the fuel pipe (2) to rail and to high pressure pump (9), secure it by screws (4 and 6) tightened to the specified torque.

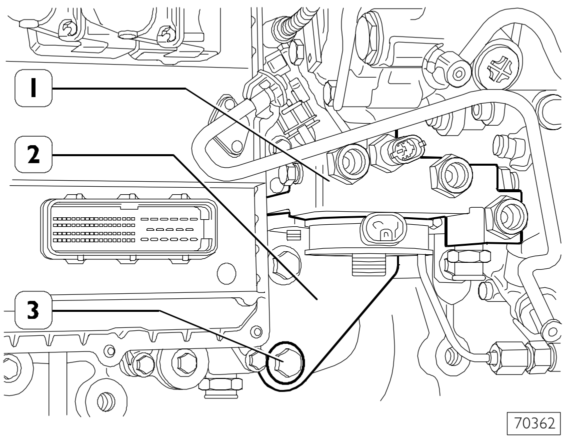
Pipe connections (2) shall be tightened to 20 Nm torque using the proper dynamometric wrench 99389834.

Connection (7) shall be tightened by holding at the same time the high pressure pump hexagon (10).

When removed pipe (2) shall always be replaced.

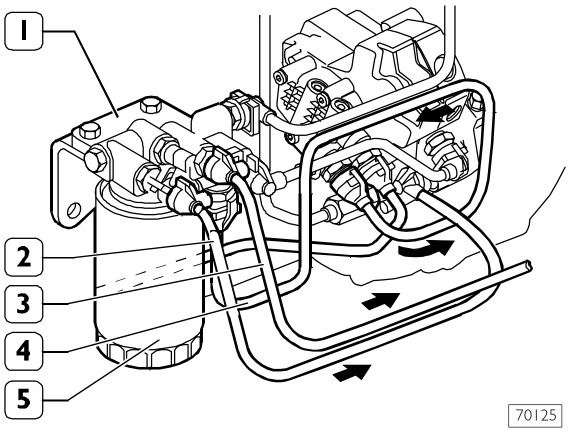
Connect pipe (3) to connection (4) and air compressor (8).

Figure 184



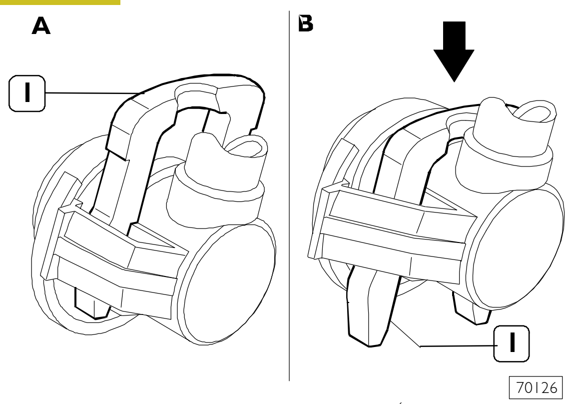
Refit the bracket (2) including the fuel filter support (1) to the engine block, tighten the screws (3) to the specified torque.

Figure 185



Screw manually the fuel filter to the support (1), screw the filter by ¾ turn, connect the pipes (2-3-4) to the relevant support connections (1) as shown in the following figure.

Figure 186



Press the clamp (1) as shown in figure B.
After disconnecting the pipe, reset the clamp (1) to the initial locking position A, to prevent deformations.
When refitting is over, fill engine with the prescribed lubricating oil in the specified quantity.

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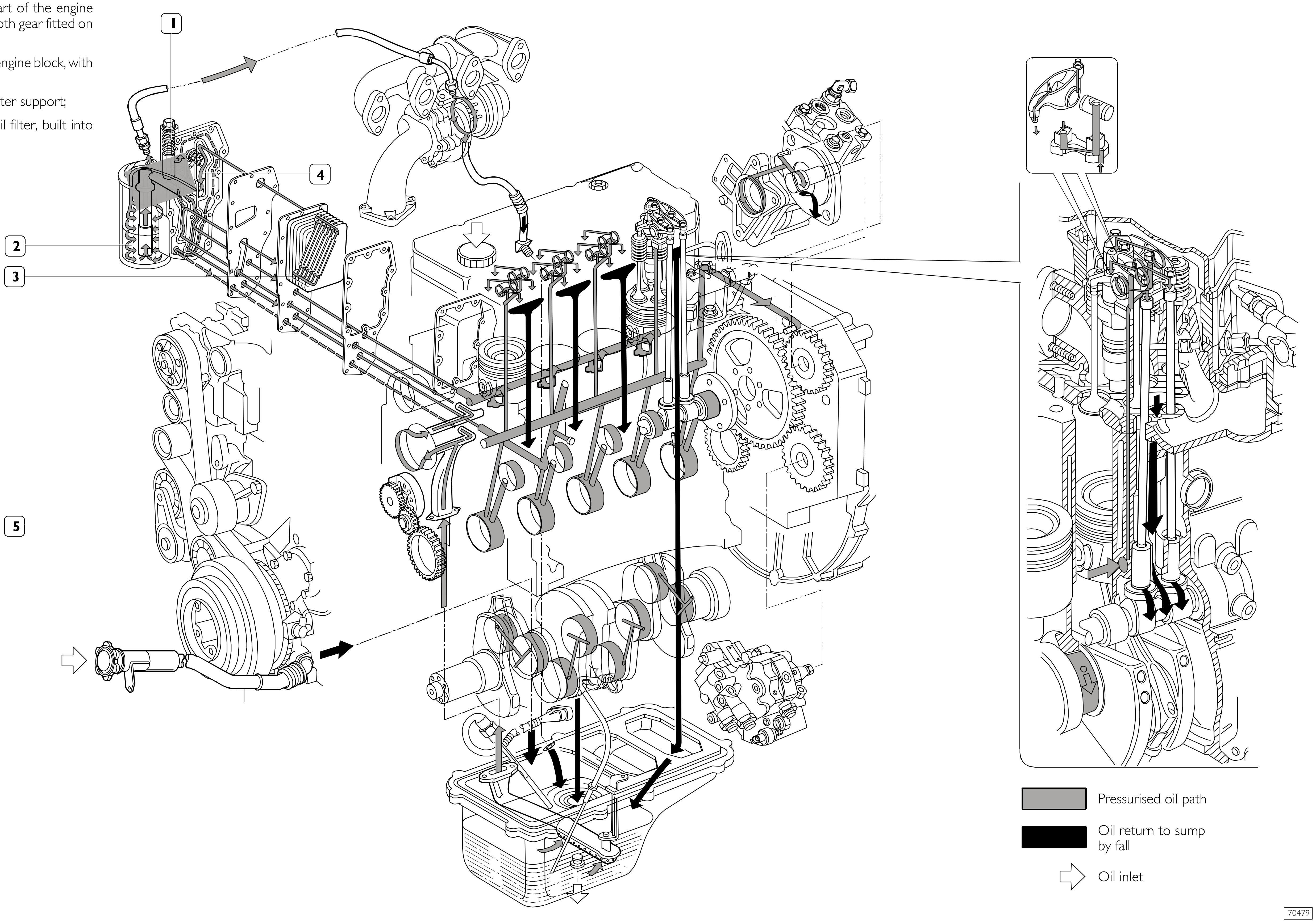
5450 LUBRICATION

Forced lubrication is implemented by the following components:

- rotor oil pump (5), set in the front part of the engine block and controlled by the straight-tooth gear fitted on the output shaft tang;
- water/oil heat exchanger (3) set in the engine block, with oil filter support;
- oil pressure relief valve (1) built into filter support;
- by-pass valve (4) to cut out clogged oil filter, built into filter support;
- cartridge oil filter (2).

Figure 187

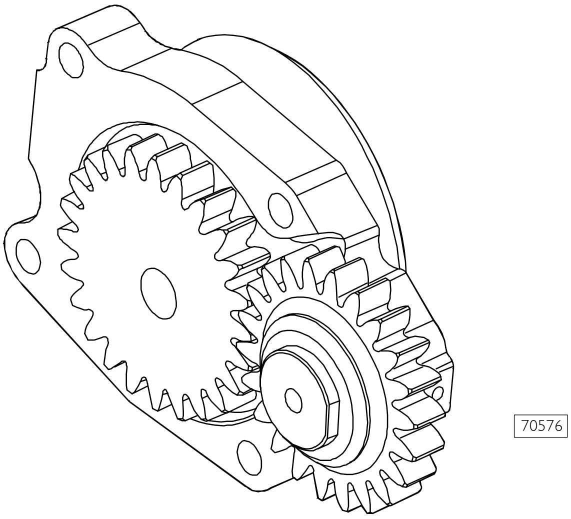


LUBRICATION SYSTEM LAYOUT

543010 OIL PUMP

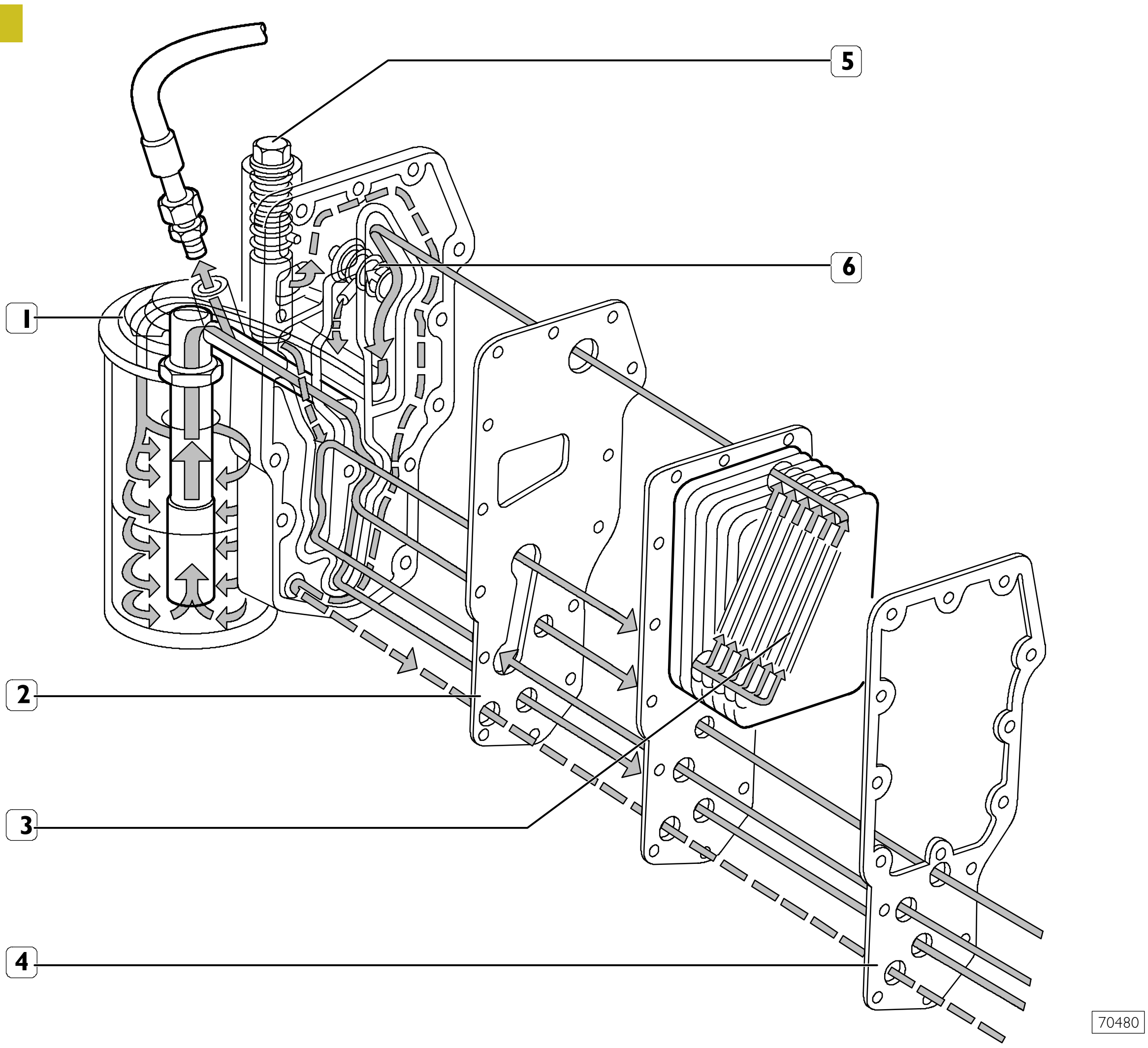
Since the oil pump cannot be overhauled, it shall be replaced when damaged.

Figure 188



543110 HEAT EXCHANGER

Figure 189



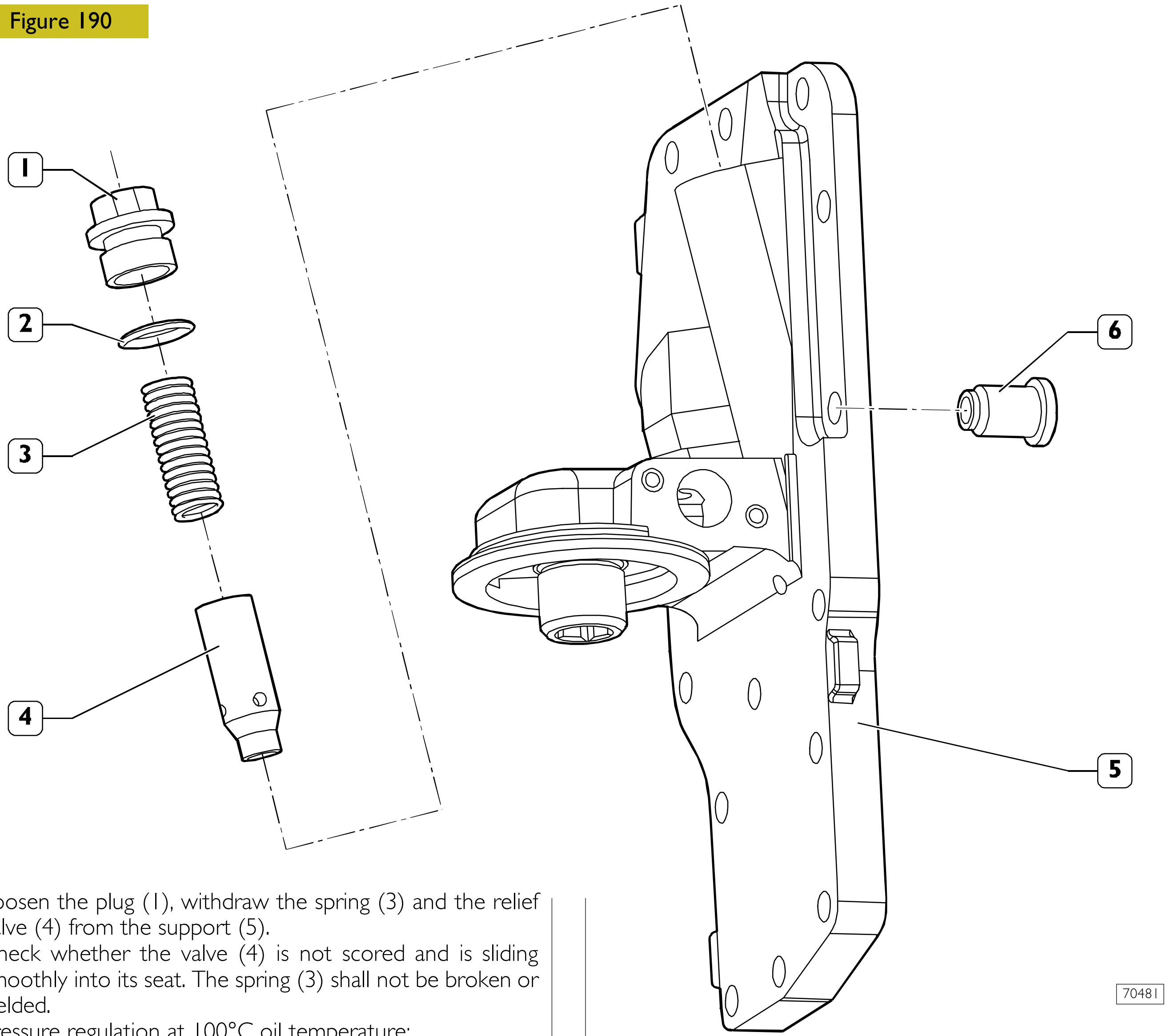
1. Heat exchanger body with filter support - 2. Internal gasket - 3. Water-oil heat exchanger - 4. Gasket between heat exchanger unit and engine block - 5. Oil pressure relief valve - 6. By-pass valve to cut out clogged oil filter.

Clean accurately the heat exchanger components

Always replace the sealing gaskets.

543075 Oil pressure relief valve

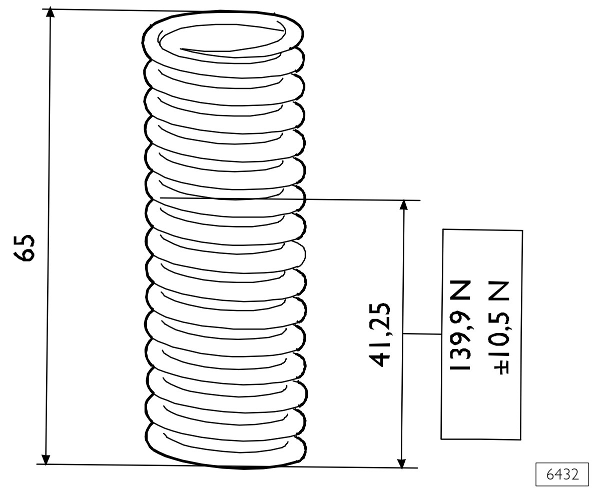
Figure 190



Loosen the plug (1), withdraw the spring (3) and the relief valve (4) from the support (5).
Check whether the valve (4) is not scored and is sliding smoothly into its seat. The spring (3) shall not be broken or yielded.
Pressure regulation at 100°C oil temperature:
- 1.2 bar min pressure;
- 3.8 bar max. pressure

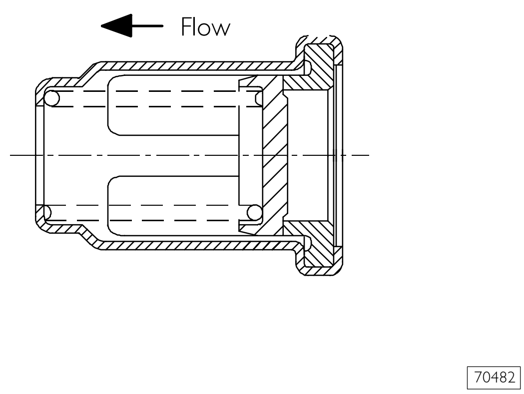
By-pass valve to cut out clogged oil filter.

Figure 191



MAIN DATA TO CHECK OIL PRESSURE RELIEF VALVE SPRING

Figure 192



Max blow-by:
22 cm^3/1' at 0.8 bar pressure and 26.7°C temperature

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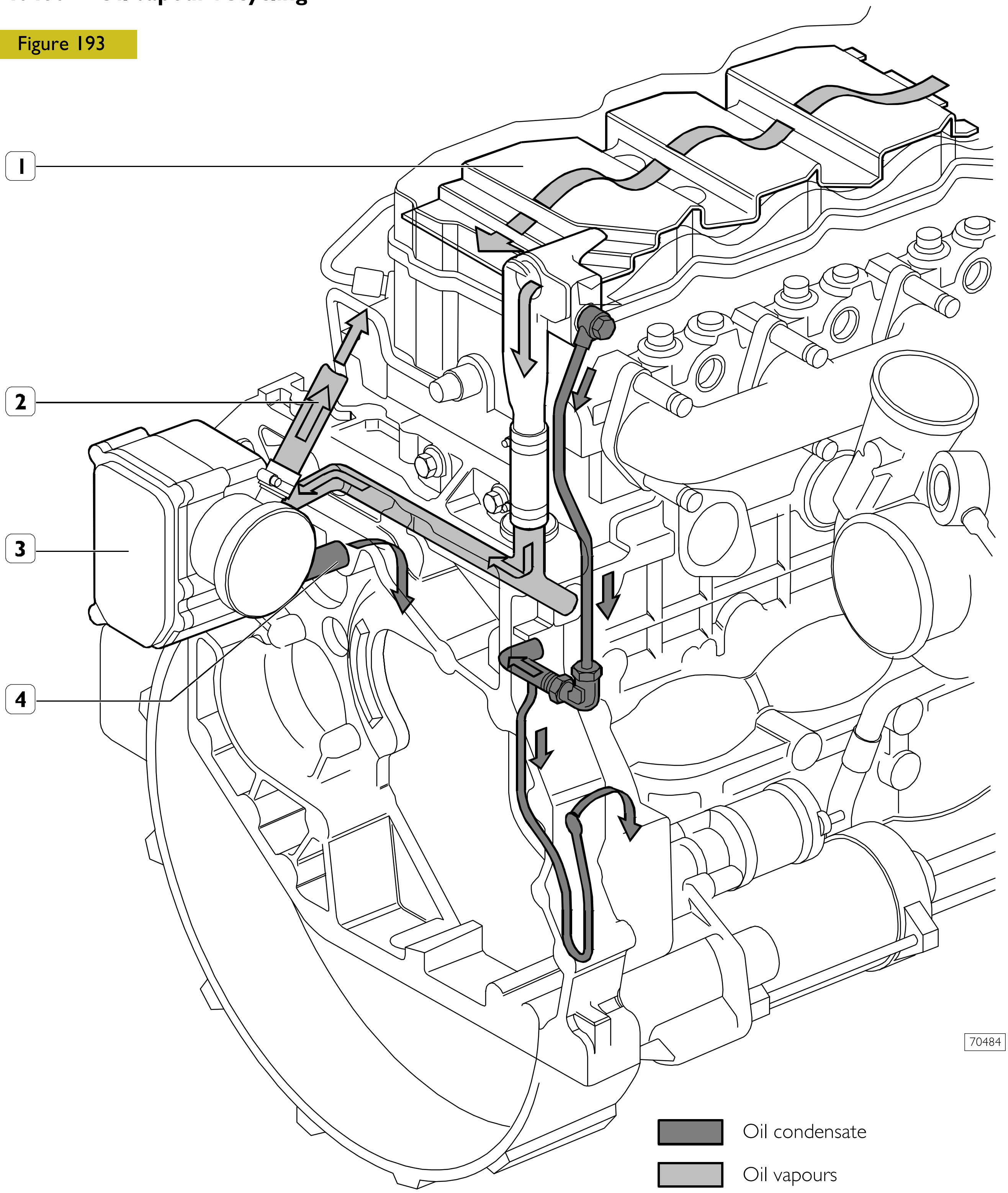
540480 Oil vapour recycling

Figure 193



1. Pre-separator - 2. Exhaust to the outside (temporary) - 3. Filter - 4. Return to engine

The tappet cover houses the pre-separator (1), whose shape and position determines an increase in oil vapour outlet speed and condenses a part of vapours at the same time.

Condensate oil returns to the oil sump whereas the residual vapours are ducted, collected and filtered in the blow-by (3).

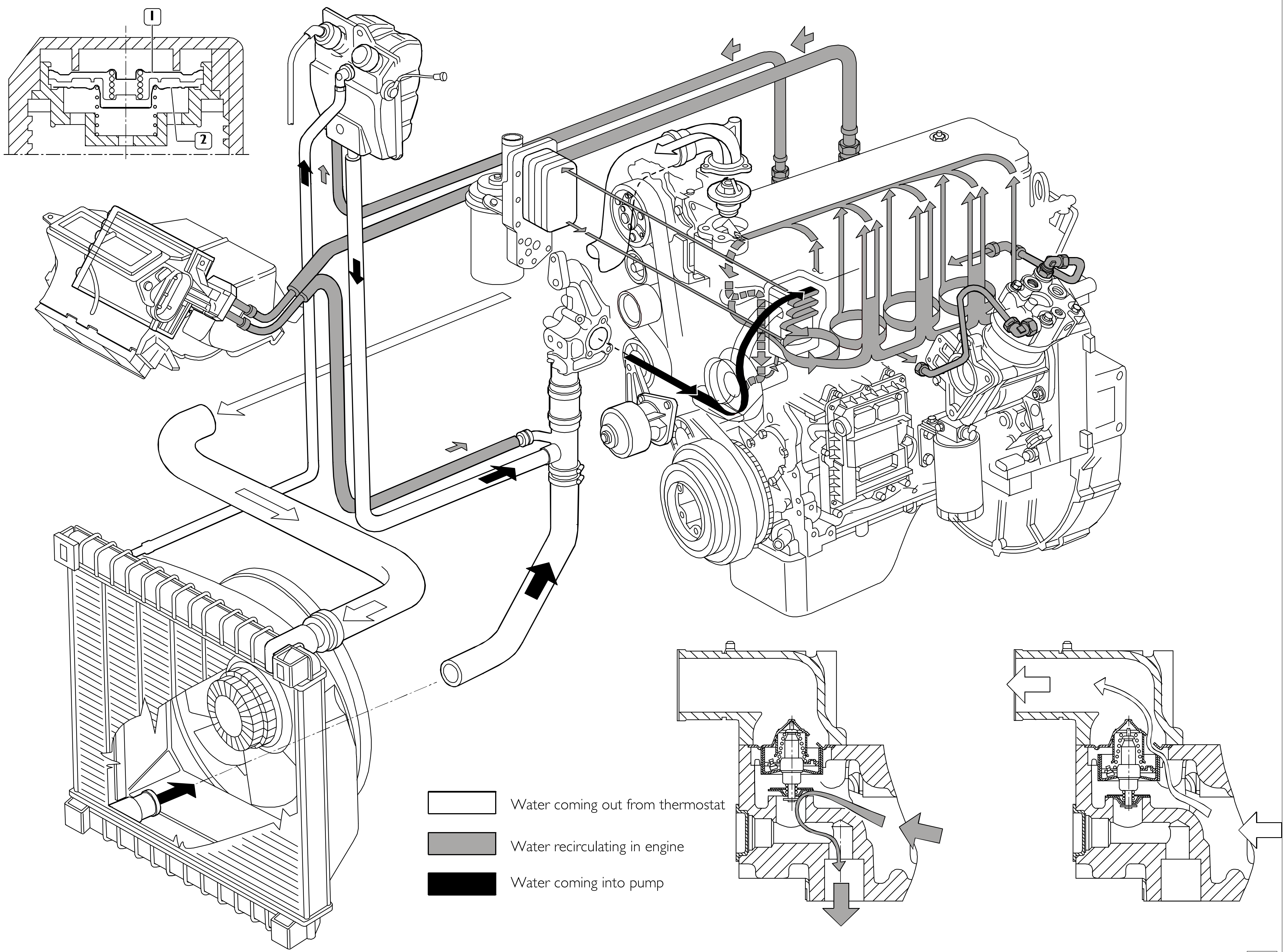
In the blow-by (3), part of the vapours condense and return to the oil sump whereas the remaining part is put into cycle again through pipe (2).

5432 COOLING SYSTEM

The closed loop forced-circulation cooling system consists of the following components:

- expansion tank with plug, with two built-in valves: exhaust valve (2) and intake valve (1) to control system pressure;
- radiator, for dissipating the heat subtracted to engine by coolant;
- viscous fan;
- heat exchanger to cool the lubricating oil (see lubrication);
- centrifugal water pump set in the front part of the engine block;
- thermostat to control coolant circulation.

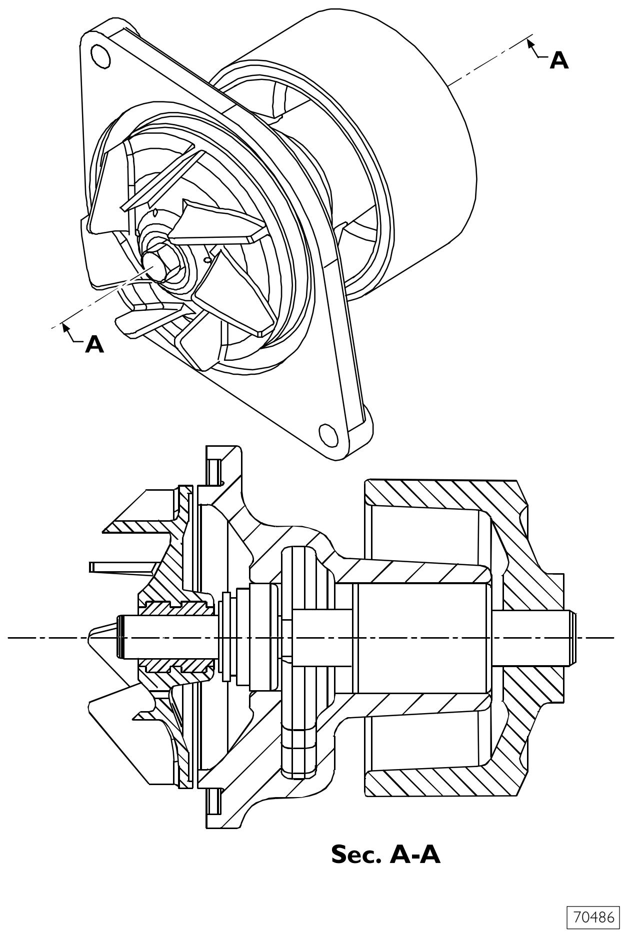
Figure 194



COOLING SYSTEM LAYOUT

543210 Water Pump

Figure 195

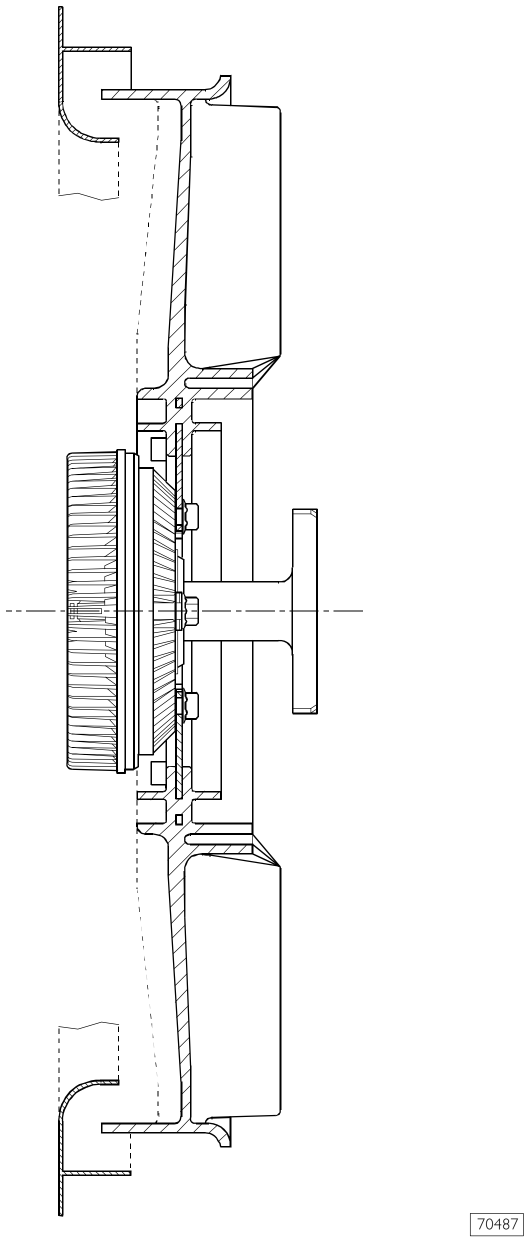


The water pump is located in a housing obtained in the engine block and is controlled by and a poly-V belt.

An automatic tensioner keeps the belt tension.

Viscous fan

Figure 196

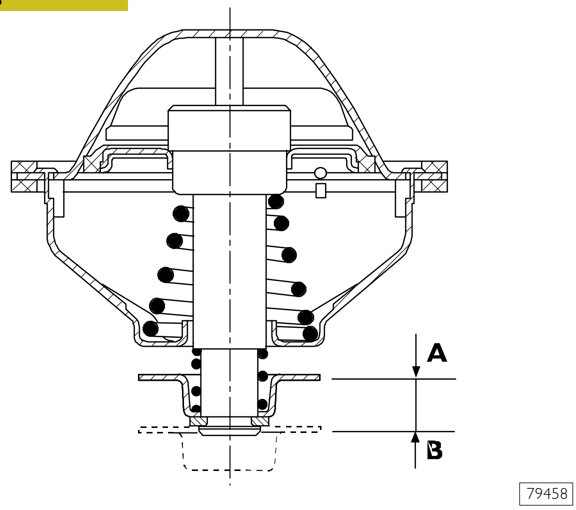


Characteristics:

Max control speed:	2700 rpm
Max fan speed:	2565 rpm ±. 50 rpm
Operating temperature:	75°C± 4°C at 2160 rpm fan speed

543250 Thermostat

Figure 197



The thermostat of the by-pass type is located in the cylinder head and doesn't need regulations.

Whenever doubts on its operation are present, replace it.

On the thermostat body are fitted the thermometric transmitter/switch and water temperature sensor.

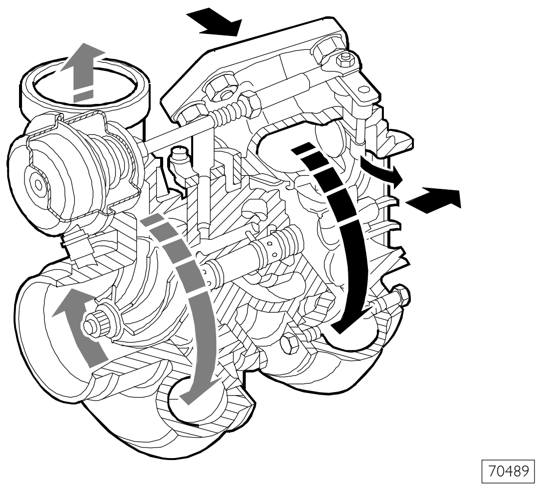
A= stroke beginning: 79.4 – 83.3° C

B= stroke at 100° C: ≥ 6.6 mm

BOOSTER

542410 Turbosupercharger

Figure 198



Exhaust

Compressed air

GARRET TURBOSUPERCHARGER

Booster pressure: 1.5 bar..
Actuator (WASTEGATE) opening start: 1600 rpm

Description

The booster system is composed of: air cleaner, turbosupercharger and intercooler.

The air cleaner is a dry type composed of a filtering cartridge that is periodically changeable.

The turbosupercharger has got the function of using the energy of engine exhaust gas in order to send pressure air to the cylinders.

It is essentially composed of:

- a main body where a shaft supported by bushes is located. At the ends of the bushes the turbine rotor and compressor rotor are fitted;
- a turbine body and a compressor body fitted on the end of the main body;
- a waste gate valve applied on the turbine body used for determining the portion of exhaust gases and sending a part of them directly to the exhaust pipe, when the booster pressure downstream the supercharger reaches the calibration value;
- the intercooler is composed of a radiator applied on the engine coolant radiator, and it is used for lowering the temperature of the air coming out from the turbosupercharger to send it to the cylinders.

Verifying an anomalous operation of the engine, due to the booster system, it is recommended, before performing controls on the turbosupercharger, to check the efficiency of the sealing gaskets and the fixing of the connection sleeves, making sure of clogging absence inside intake sleeves, air cleaner or inside radiators. If the turbosupercharger damage is due to a lack of lubrication, check that the oil circulation pipes are not broken or obstructed, in such case replace them or eliminate the trouble.

Bearing end play check

Position the tracer point of the magnetic-base dial gauge on the turbosupercharger shaft end and set to zero the dial gauge.

Move the turbosupercharger shaft axially and check that the clearance is not higher than the prescribed value.

Replace the turbosupercharger if a different value is found.

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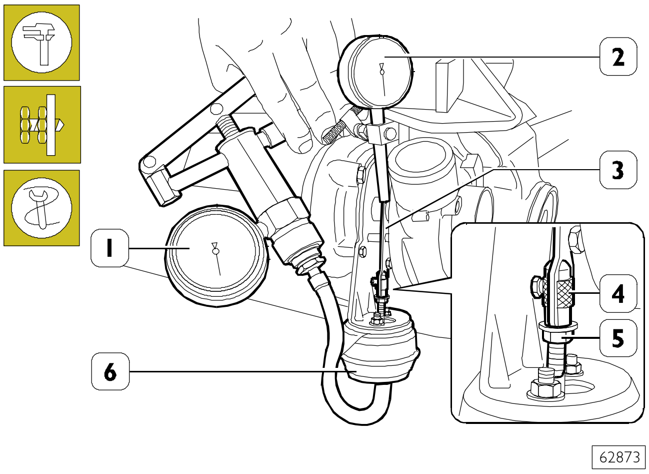
542418 TURBOSUPERCHARGER ACTUATOR

Check and adjustment

Figure 199



Cover the air, exhaust gas and lubrication oil inlets and outlets.

Carry out an accurate external cleaning of the turbosupercharger, using the anticorrosive and antioxidant solution and perform the check on the actuator (6).

Clamp the turbosupercharger in a vice.

Disconnect the pipe of the actuator (6) and apply to the actuator union, the pipe of pump 99367121 (1).

Apply the magnetic-base dial gauge (2) on the exhaust gas inlet flange in the turbine.

Position the tracer point of the gauge (2) on the tie rod (3) end and set to zero the gauge (2).

Through the pump (1) let in compressed air, in the actuator (6), at the prescribed pressure and make sure that such value is kept constant for the whole check time, otherwise replace the actuator (6).

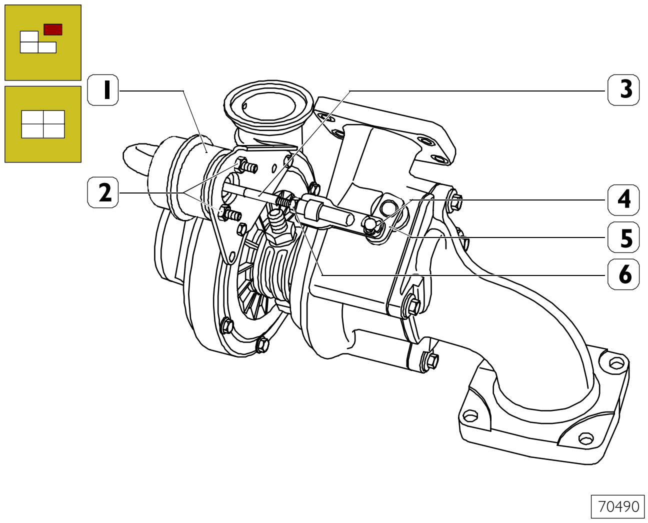
In the above-mentioned conditions, the tie rod must have carried out the prescribe stroke.

> ! During the operation, beat slightly the actuator (6) in order to eliminate possible sticking of the actuator internal spring.

If a different value is found, loosen the nut (5) and operate properly the knurled ring nut (4).

Actuator replacement

Figure 200



Remove the elastic clip (4) and withdraw the tie rod (3) from the lever (5).

Remove the nuts (2) and remove the actuator (1) from the supporting bracket. Fit the new actuator following the removal operations in reverse order and fitting a new clip (4), tighten the nuts (2) to 5.6 – 6.8 Nm torque.

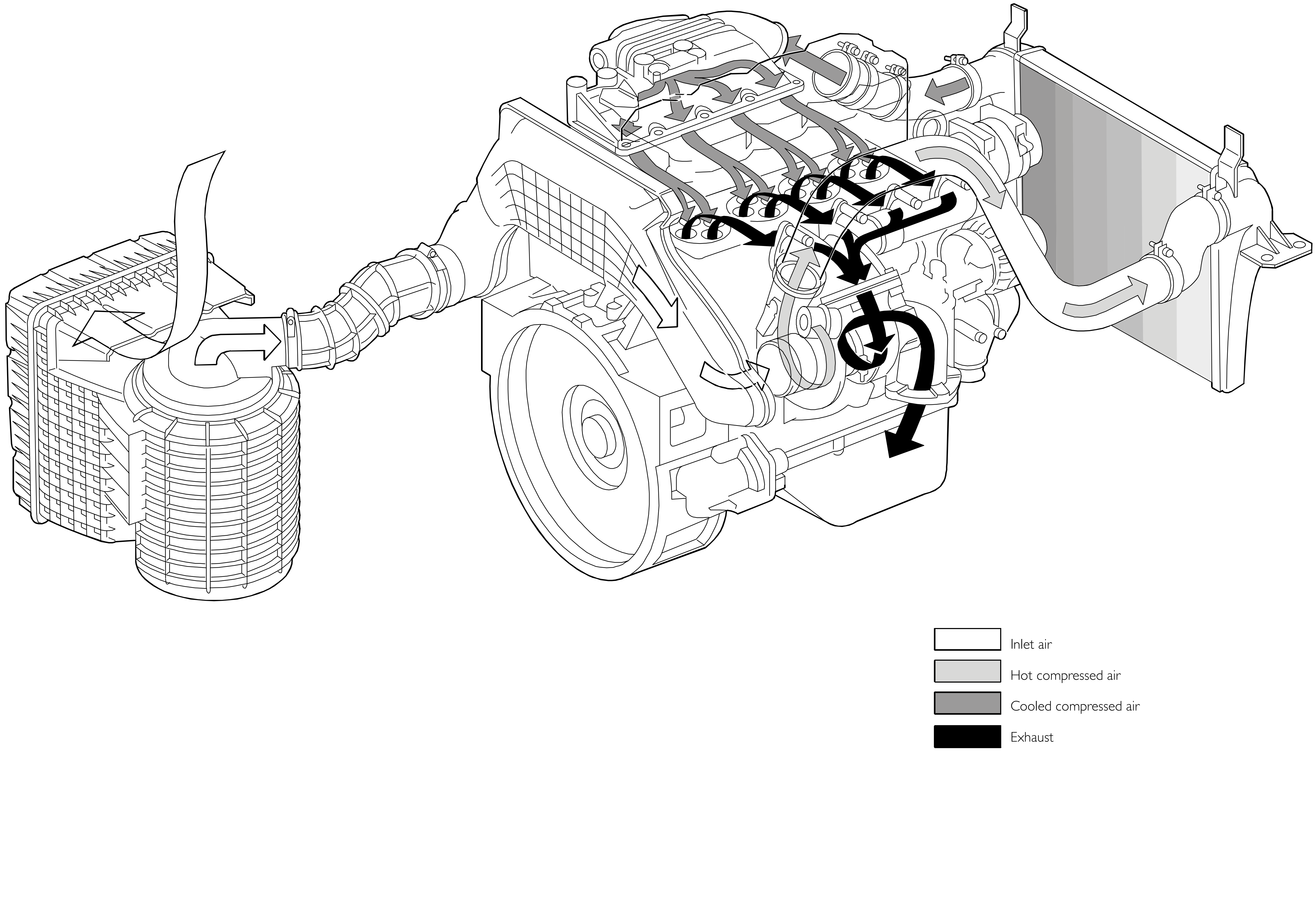
Check and adjust the actuator (1), if required, as described in the relevant chapter.

Then, paint the nut (6) with safety paint.

Before refitting the turbosupercharger on engine, fill the central body with engine oil.

TURBOSUPERCHARGER LAYOUT

Figure 201



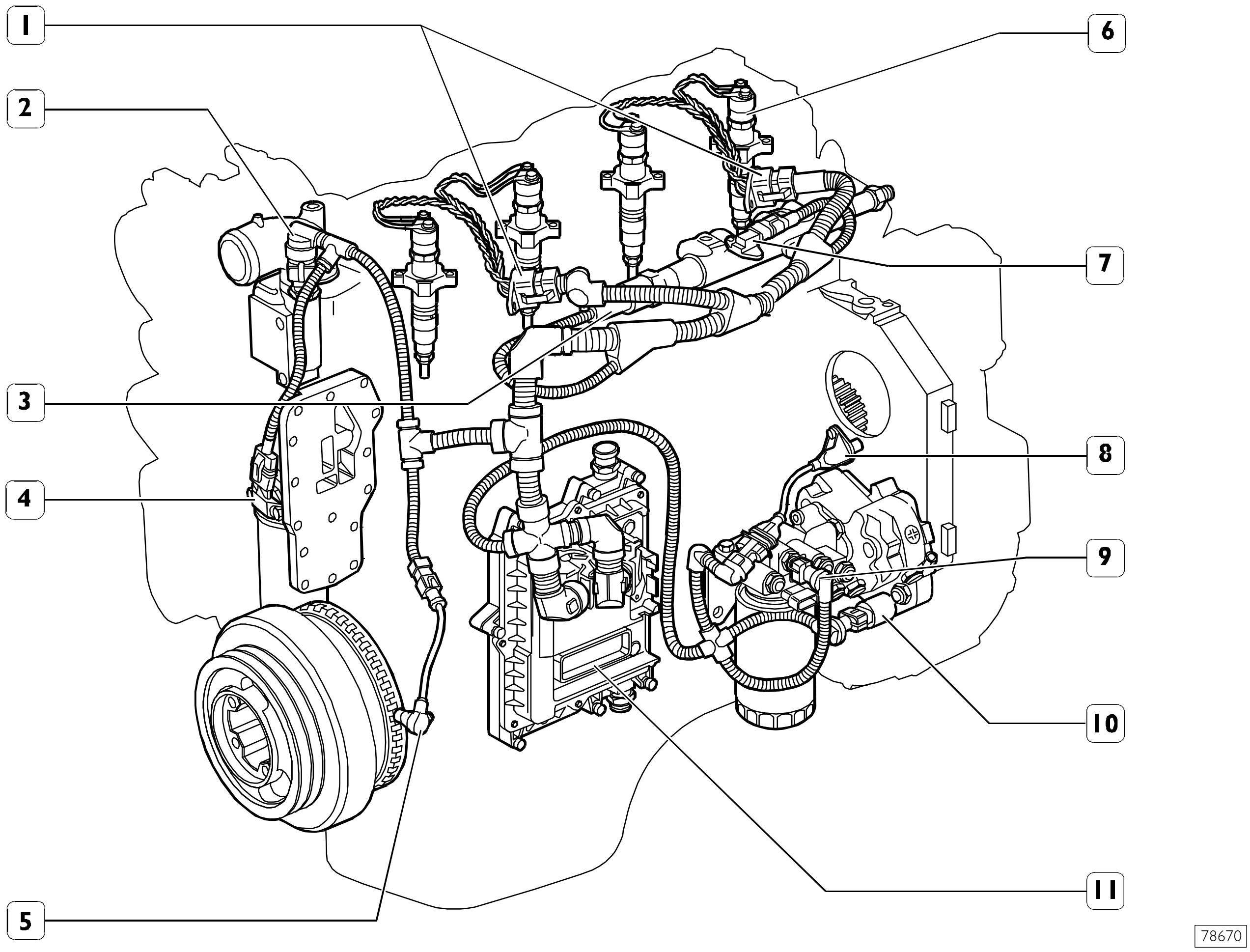
COMMON RAIL
General Specifications

In order to reduce PARTICULATES emissions, very high injection pressures are required.
The Common Rail system allows injecting the fuel up to pressures reaching **1450 bar**, at the same time, the injection precision, obtained by the electronic system control, optimizes the engine performance, reducing emissions and consumption.

System description

Electric system

Figure 202



1. Injectors connections - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor - 4. Engine oil temperature and pressure sensor - 5. Output shaft sensor - 6. Injector - 7. Air pressure/temperature sensor - 8. Camshaft sensor - 9. Fuel heater and fuel temperature sensor - 10. Pressure regulator - 11. EDC 7 control unit.

Through the sensors, present on the engine, the ECU controls the engine operation.

Air pressure/temperature sensor
It is a component integrating a temperature sensor and a pressure sensor.

Fitted on the intake manifold, it measures the max. inlet air capacity to calculate precisely the fuel quantity to inject at every cycle.

The outlet tension is proportional to the pressure or temperature obtained by the sensor.

Engine oil temperature and pressure sensor
Same as air pressure/temperature sensor, it is fitted on the engine oil filter, in a horizontal position.

It measures engine oil temperature and pressure.

Fuel pressure sensor

Assembled on a rail end, it measures the fuel pressure in the rail in order to determine the injection pressure.

The injection pressure value is used to control the pressure and to determine the electric injection control length.

Fuel temperature sensor

It is a sensor that is equal to the previous one.

It measures fuel temperature to provide the control unit with an index of the diesel fuel thermal state.

Coolant temperature sensor

It is a variable-resistance sensor suitable to measure the coolant temperature to provide the control unit with an index of the engine thermal state.

Output shaft sensor

It is an inductive sensor placed on the front engine part. Signals generated through the magnetic flow that is closed on the phonic wheel, change their frequencies depending on output shaft rotation speed.

Timing sensor

It is an inductive sensor placed on the engine rear left part. It generates signals obtained from magnetic flow lines that are closed through holes obtained on the keyed gear on the camshaft. The signal generated by this sensor is used by the ECU as injection phase signal.

Though being equal to the flywheel sensor, it is NOT interchangeable since it has a different outside shape.

System functionality

Self-diagnosis

The ECU self-diagnostic system checks signals coming from sensors by comparing them with threshold data.

IVECO Code recognition

The EDC7 control unit communicates with the Immobilizer control unit to obtain the startup consent.

Engine pre-heating resistance check

The pre-post heating is activated when even only one of the water, air or fuel temperature sensors signals a temperature that is less than 5 °C.

Timing recognition

By means of signals coming from camshaft sensor and flywheel sensor, the cylinder on which fuel must be injected is recognised upon startup.

Injection control

The control unit, depending on information coming from sensors, controls the pressure regulator, and changes pre-injection and main injection modes.

Closed-loop control for injection pressure

Depending on engine load, measured by processing signals coming from various sensors, the control unit controls the regulator in order to always have the optimum pressure.

Pilot and main injection spark advance control

The control unit, depending on signals coming from various sensors, computes the optimum injection point according to an internal mapping.

Idle speed control

The control unit processes signals coming from various sensors and adjusts the amount of injected fuel.
It controls the pressure regulator and changes the injection time of injectors.
Within certain thresholds, it also takes into account the battery voltage.

Maximum speed limiting

At 2700 rpm, the control unit limits fuel flow-rate by reducing the injectors opening time.
Over 3000 rpm it deactivates the injectors.

Cut Off

Fuel cut off upon release is controlled by the control unit performing the following logics:

- ❑ it cuts off injectors supply;
- ❑ it re-activates the injectors shortly before idle speed is reached;
- ❑ it controls fuel pressure regulator.

Smoke control upon acceleration

With strong load requests, the control unit, depending on signals received by air inlet meter and engine speed sensor, controls the pressure regulator and changes the injectors actuation time, in order to avoid exhaust smokes.

Fuel temperature control

When the fuel temperature exceeds 75 °C (measured by the sensor placed on fuel filter) the control unit intervenes by reducing injection pressure.
If the temperature exceeds 90 °C, the power is reduced to 60%.

AC compressor engagement control

The control unit is able to drive engagement and disengagement of the electromagnetic compressor clutch depending on coolant temperature.
If the coolant temperature reaches about 150 °C, it disengages the clutch.

After Run

The control unit microprocessor allows storing certain EPROM data, among which failure memory and Immobilizer information, in order to make them available upon the following startup.

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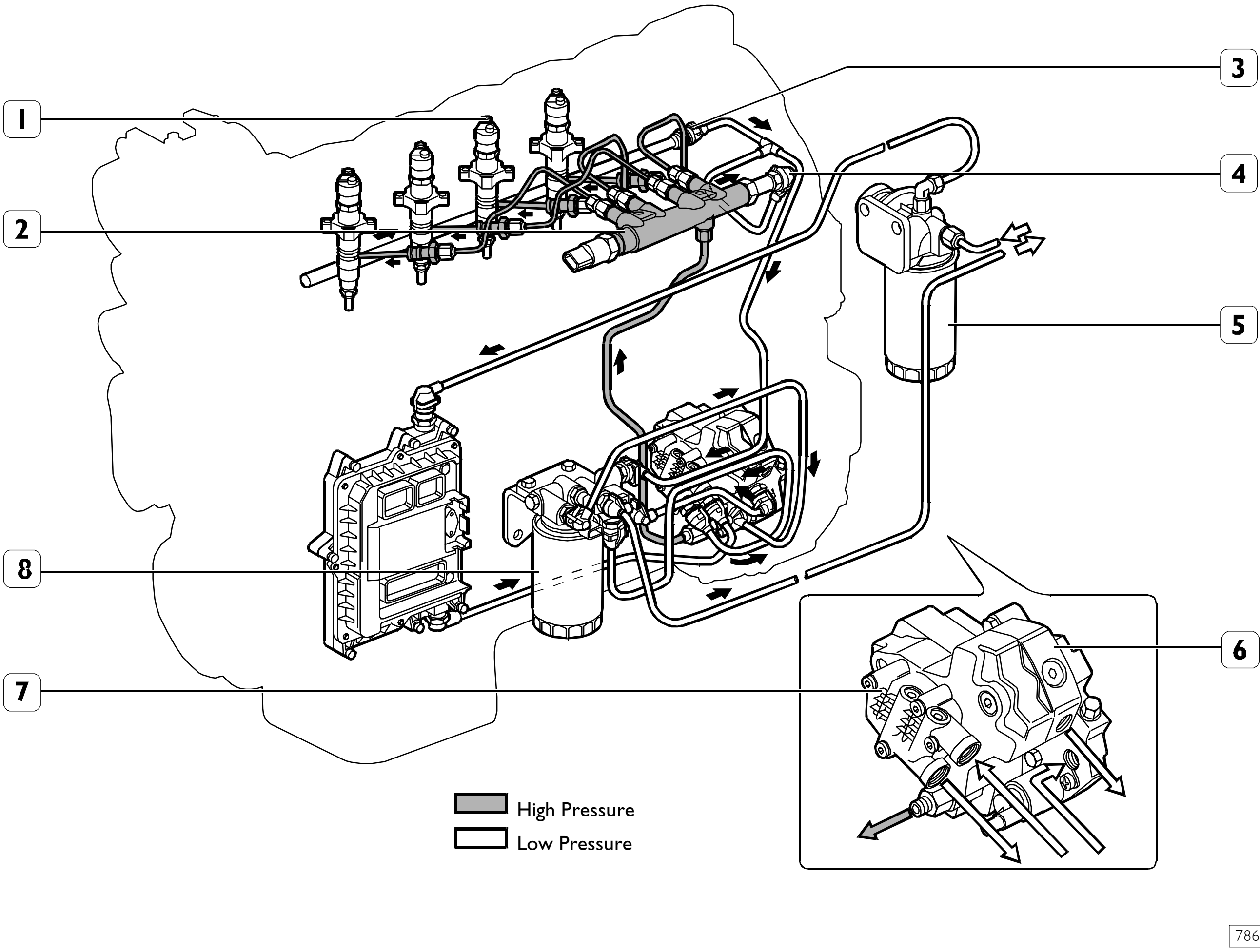
FEED SYSTEM

Figure 203



1. Injector - 2. Common Rail - 3. Pressure limiter for fuel return - 4. Rail overpressure valve - 5. Prefilter assembled on chassis - 6. High-pressure pump - 7. Mechanical rotor pump - 8. Fuel filter.

The Common Rail system has a special pump that continuously keeps fuel at high pressure, independently from stroke and cylinder that has to receive the injection and accumulates fuel in a common duct for all injectors.

Therefore, fuel at the injection pressure computed by the ECU is always available at the injectors inlet.

When an injector solenoid valve is energised by the electronic control unit, the injection of fuel directly taken from rail takes place in the related cylinder.

The feed system is implemented by a low-pressure circuit and a high-pressure circuit.

The high-pressure circuit is composed of the following pipings:

❑ piping connecting high-pressure pump outlet to rail;

❑ pipings supplying injectors from rail.

The low-pressure circuit is composed of the following pipings:

❑ fuel suction piping from tank to prefilter;

❑ pipings supplying the mechanical supply pump through the control unit heat exchanger, manual priming pump and prefilter;

❑ pipings supplying the high-pressure pump through the fuel filter.

The fuel draining circuit from rail and from injectors and the high-pressure pump cooling circuit complete the system.

FEED SYSTEM LAYOUT

This Common Rail injection system, with CP3 pump, is mostly different from the one adopted on the Daily range with CP1 pump due to the different pressure regulator position and due to the gear supply pump.

The pressure regulator, placed upstream of the high-pressure pump, adjusts the fuel flow that is necessary on the low-pressure system. Afterwards, the high-pressure pump takes care of supplying the rail properly. This arrangement, by pressurising the necessary fuel only, improves the energetic efficiency and limits fuel heating in the system.

Function of the pressure relief valve (2), assembled on the high-pressure pump, is keeping the pressure, at the pressure regulator inlet, constant at 5 bars, independently from the efficiency of the fuel filter and of the system set upstream.

The pressure relief valve (2) intervention brings about a fuel flow increase in the high-pressure pump cooling circuit, through inlet and drain piping (16) from piping (8).

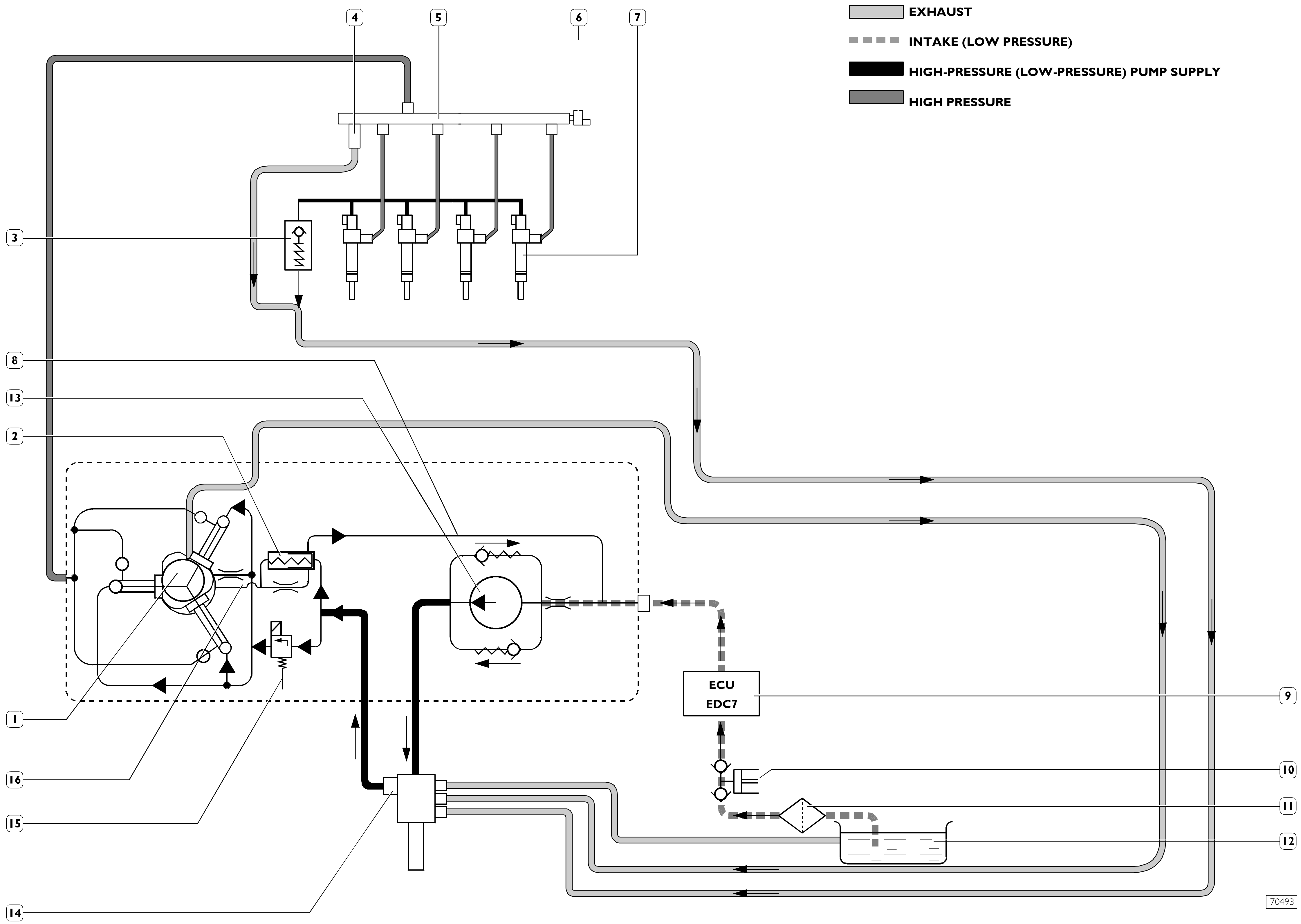
The pressure relief valve housed on the cylinder head, assembled on injector return (3), limits the fuel return flow from injectors at a pressure of 1.3 to 2 bars.

Two by-pass valves are placed in parallel with the mechanical supply pump.

The by-pass valve (18) allows fuel to flow from mechanical pump outlet to its inlet, when the fuel filter inlet pressure exceeds the allowed threshold value.

The by-pass valve (17) allows filling the supply system through the manual priming pump (10).

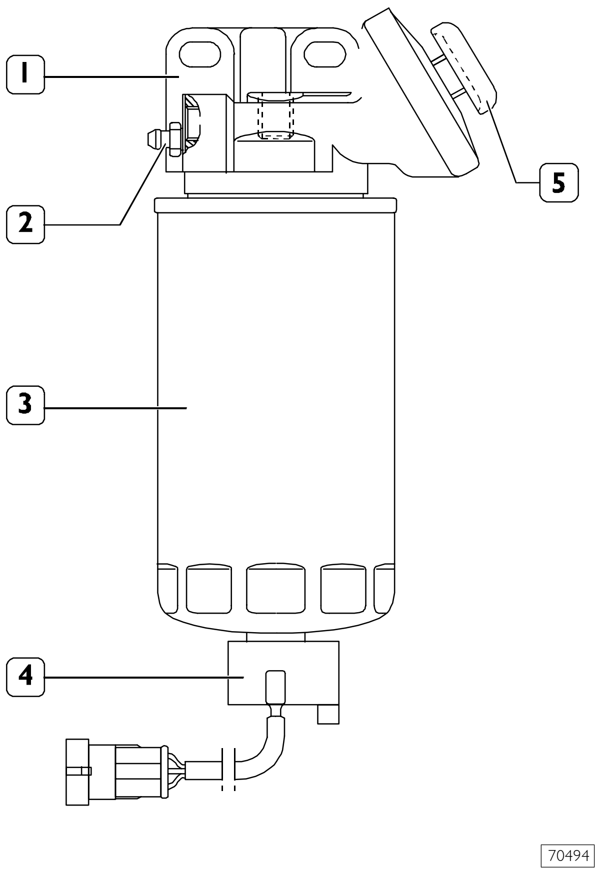
Figure 204



1. High-pressure pump. – 2. Pressure relief valve on high-pressure pump, 5 bars. – 3. Pressure relief valve assembled on fuel return from injectors, 1.3 to 2 bars. – 4. Rail overpressure valve. – 5. Common Rail. – 6. Pressure sensor. – 7. Injector. – 8. Return piping. – 9. Control unit heat exchanger. – 10. Mechanical priming pump. – 11. Prefilter assembled on chassis. – 12. Fuel tank. – 13. Mechanical supply pump. – 14. Fuel filter. – 15. Pressure regulator. – 16. High-pressure pump cooling piping. – 17. By-pass valve. – 18. By-pass valve.

FUEL PREFILTER

Figure 205



The fuel filter is of the high water separation type, is assembled on the right side of the vehicle chassis, and has the sensor (4) for detecting water in fuel placed on the cartridge (3) base.

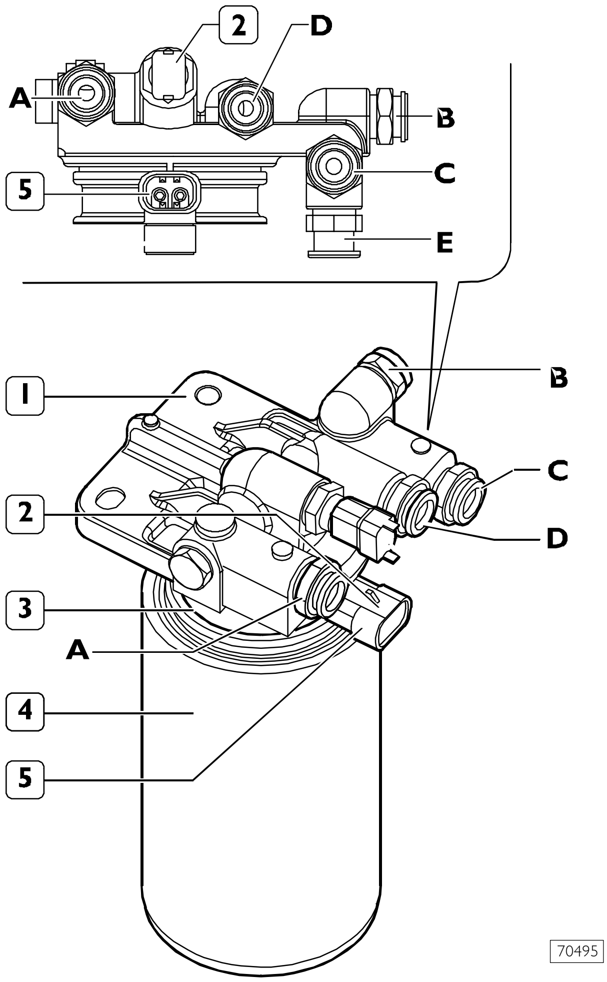
Manual priming pump (5) and air bleeding screw (2) from system are placed on filter support.

The presence of condensate into filter is signalled by sensor (4) when a warning light on the instrument panel is lit.

> ⚠ If the warning light is on, it is necessary to immediately operate to remove its cause; the common rail system components are quickly damaged by the presence of water or impurities in the fuel.

FUEL FILTER

Figure 206



1. Fuel filter support - 2. Fuel temperature sensor - 3. Electric fuel heater - 4. Fuel filter - 5. Heater connector.

It is placed on engine block in the circuit between supply pump and high-pressure pump (CP3).

Cartridge filtering degree: 4 microns, Pressure delta 2 bars.

The following are placed on the support: fuel temperature sensor and heater resistances.

Fuel temperature, signalled by the related sensor to EDC7 control unit, allows a very accurate computation of the fuel flow-rate to be injected into the cylinders.

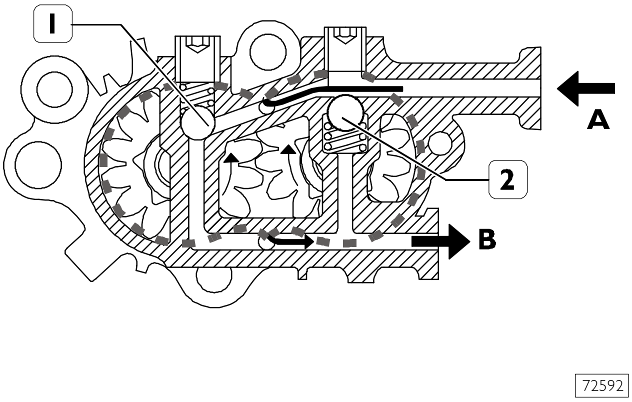
The electric heater is activated when fuel temperature is below 5 °C.

MECHANICAL SUPPLY PUMP

Gear pump, fitted on the rear side of the high pressure pump and used to supply it.
It is controlled by high pressure pump shaft

Normal operating conditions

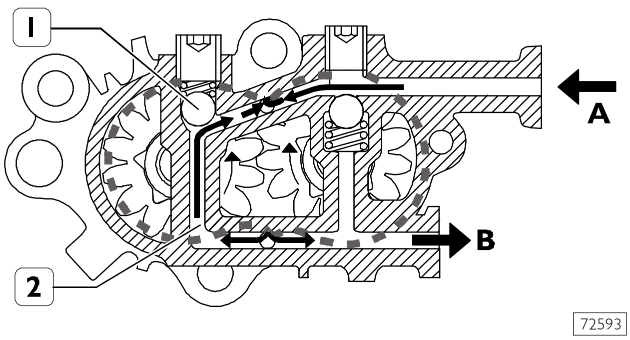
Figure 207



A Fuel inlet from tank, B fuel outlet to filter, 1-2 by-pass valves in close position

Overpressure condition at outlet

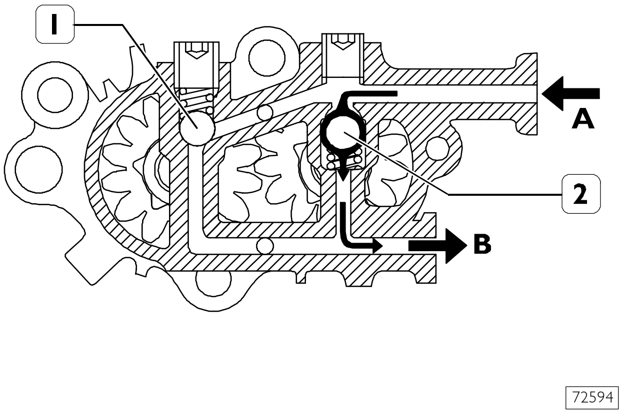
Figure 208



The by-pass valve (1) cuts in when overpressure is generated at outlet B. The existing pressure, overcoming valve spring (1) elastic strength, makes inlet and outlet communicating through duct (2).

Drain conditions

Figure 209



The by-pass valve (2) cuts in when, with engine off, the fuel system shall be filled through the priming pump. In this situation the by-pass valve (1) stays closed whereas by-pass valve (2) opens due to inlet pressure, and fuel is drained out through **B**.

> ⚠ The mechanical supply pump cannot be replaced individually, therefore it cannot be removed from the high pressure pump.

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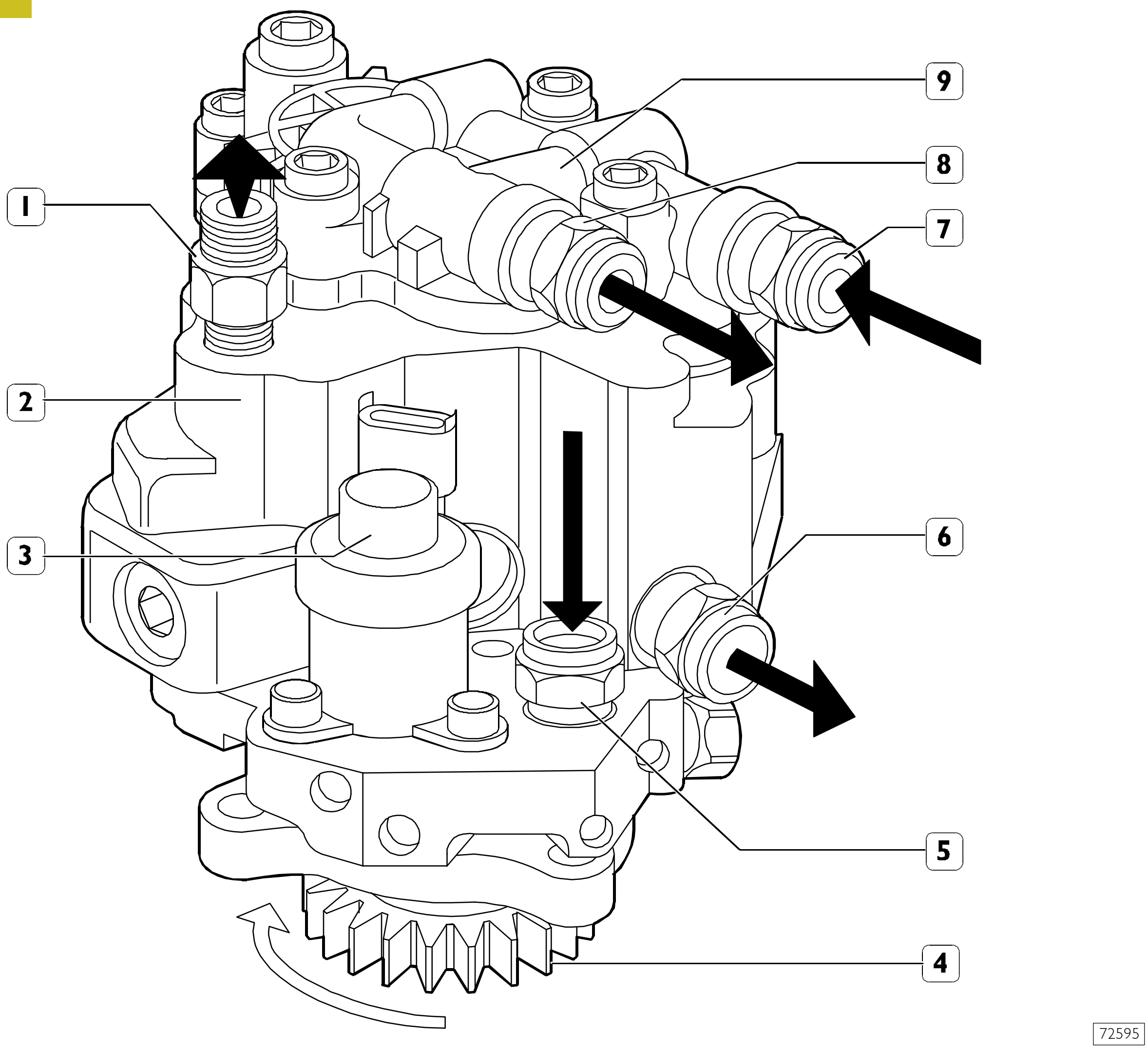
CP3 HIGH-PRESSURE PUMP

Pump with 3 radial pistons controlled by the timing gear, without needing any setting. On the rear side of the high pressure pump is fitted the mechanical supply pump controlled by the high pressure pump shaft.

The high pressure pump-mechanical supply pump unit cannot be overhauled and therefore it must not be disassembled nor its fastening screws must be tampered with.
The only admitted operation is control gear replacement.

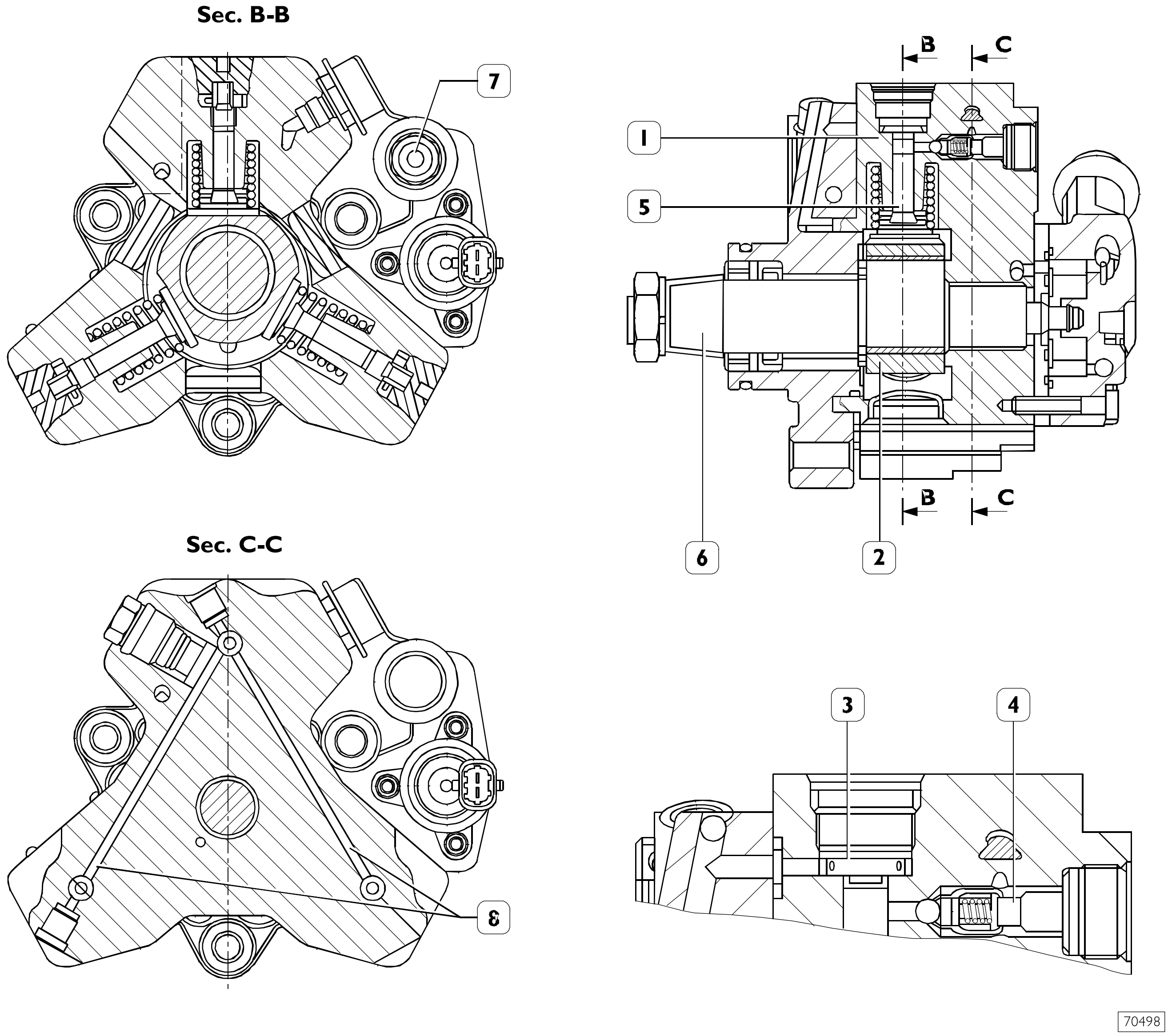
Figure 210



1. Fuel outlet fitting to rail - 2. High-pressure pump - 3. Pressure regulator - 4. Control gear - 5. Fuel inlet fitting from filter - 6. Fuel outlet fitting to filter support - 7. Fuel inlet fitting from control unit heat exchanger - 8. Fuel outlet fitting from supply pump to filter - 9. Mechanical supply pump

HIGH-PRESSURE PUMP - INSIDE STRUCTURE

Figure 211



1. Cylinder. – 2. Three-lobe element. – 3. Cap intake valve. – 4. Ball delivery valve. – 5. Piston. – 6- Pump shaft. – 7. Low-pressure fuel inlet. – 8. Pumping elements supplying fuel ducts.

Every pumping unit is composed of:

- a piston (5) actuated by a three-lobe element (2) floating on the pump shaft (6). The element (2), being **floating** on a misaligned part of the shaft (6), when the shaft rotates, does not rotate therewith but is only translated in a circular movement along a wider radius, with the resulting alternate actuation of the three pumping elements;
- cap intake valve (3);
- ball delivery valve (4).

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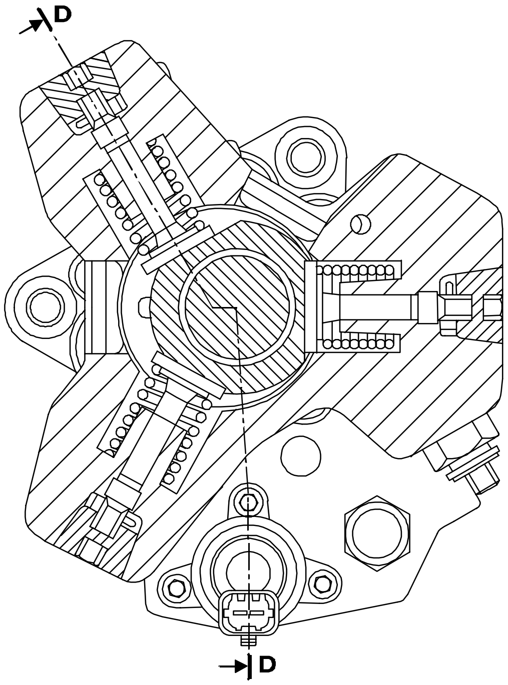
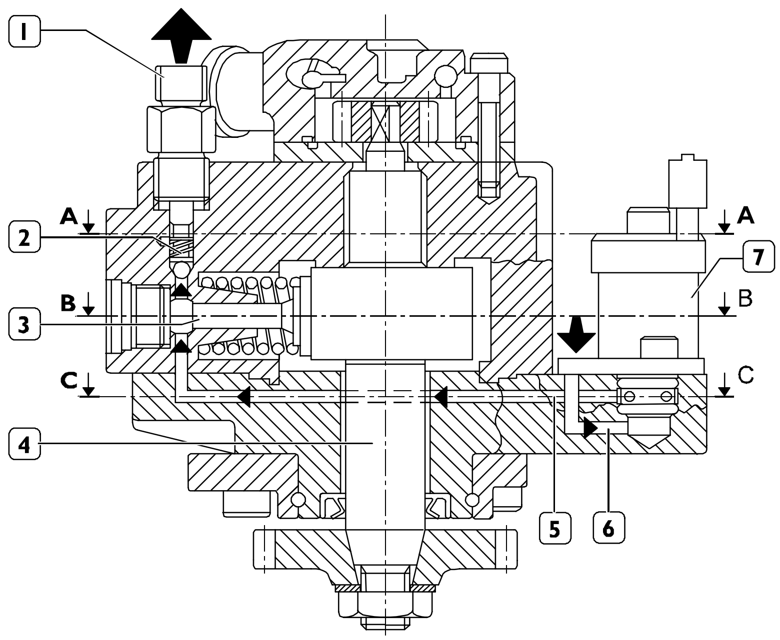
Operating principle

Figure 212

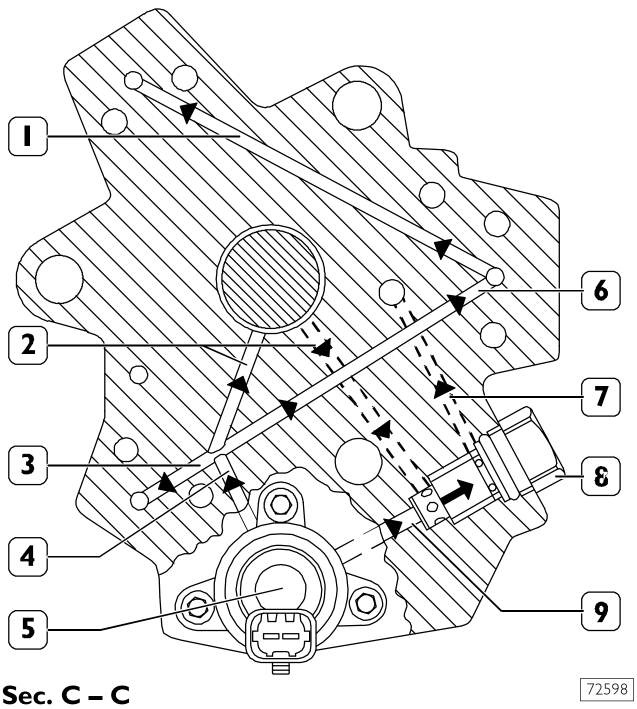




1. Fuel outlet fitting to rail - 2. Delivery valve to rail - 3. Pumping element - 4. Pump shaft - 5. Pumping element supply duct - 6. Pressure regulator supply duct - 7. Pressure regulator

Pumping element (3) is oriented to pump shaft (4) cam. During intake, the pumping element is supplied through supply duct (5). The fuel amount to be sent to the pumping element is set by the pressure regulator (7). The pressure regulator meters fuel flow to pumping element according to the PWM signal received from ECU. During pumping element compression stage, fuel reaches the pressure required to open the delivery valve to common rail (2) and to feed it through outlet (1).

Figure 213



Sec. C – C

1. Pumping element inlet - 2. Pump lubrication ducts - 3. Pumping element inlet - 4. Main pumping element supply duct - 5. Pressure regulator - 6. Pumping element inlet - 7. Regulator exhaust duct - 8. 5 bar pressure relief valve - 9. Fuel drain from regulator inlet

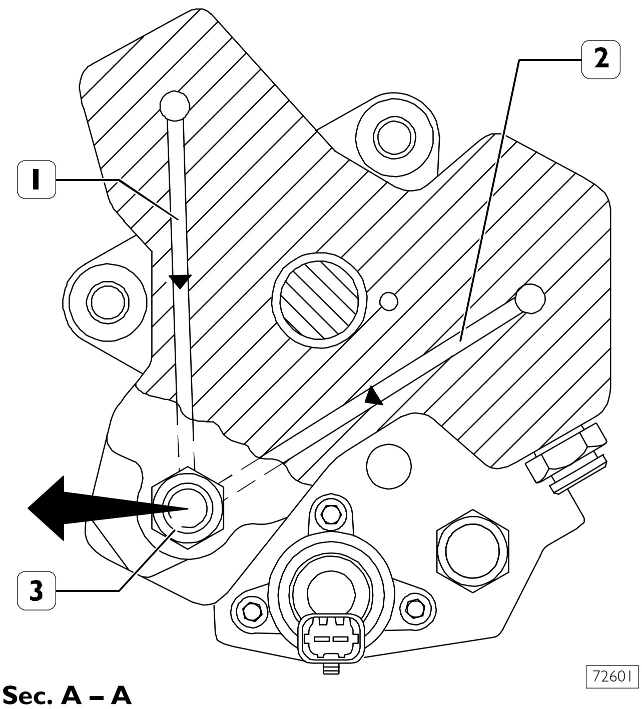
Figure 213 shows low pressure fuel paths inside the path and highlights: main pumping element supply duct (4), pumping element supply ducts (1 – 3 – 6), pump lubrication ducts (2), pressure regulator (5), 5 bar pressure relief valve (8) and fuel drain duct (7).

Pump shaft is lubricated by fuel through delivery and return ducts (2).

Pressure regulator (5) establishes the fuel amount to send to pumping elements; excess fuel is drained out through duct (9).

5 bar pressure relief valve acts as fuel exhaust manifold and keeps 5 bar constant pressure at regulator inlet.

Figure 214



Sec. A – A

1. Fuel outlet duct - 2. Fuel outlet duct - 3. Fuel outlet from pump with high pressure pipe fitting for common rail

Figure 214 shows high pressure fuel flow through pumping element outlet ducts.

Operation

The cylinder is filled through the cap intake valve only if the supply pressure is suitable to open the delivery valves set on the pumping elements (about 2 bars).

The amount of fuel supplying the high-pressure pump is metered by the pressure regulator, placed on the low-pressure system; the pressure regulator is controlled by the EDC7 control unit through a PWM signal.

When fuel is sent to a pumping element, the related piston is moving downwards (suction stroke). When the piston stroke is reversed, the intake valve closes and the remaining fuel in the pumping element chamber, not being able to come out, is compressed above the supply pressure value existing in the rail.

The thereby-generated pressure makes the exhaust valve open and the compressed fuel reaches the high-pressure circuit.

The pumping element compresses the fuel till the top dead center (delivery stroke) is reached. Afterwards, the pressure decreases till the exhaust valve is closed.

The pumping element piston goes back towards the bottom dead center and the remaining fuel is decompressed.

When the pumping element chamber pressure becomes less than the supply pressure, the intake valve is again opened and the cycle is repeated.

The delivery valves must always be free in their movements, free from impurities and oxidation.

The rail delivery pressure is modulated between **250** and **1350** bars by the electronic control unit, through the pressure regulator solenoid valve.

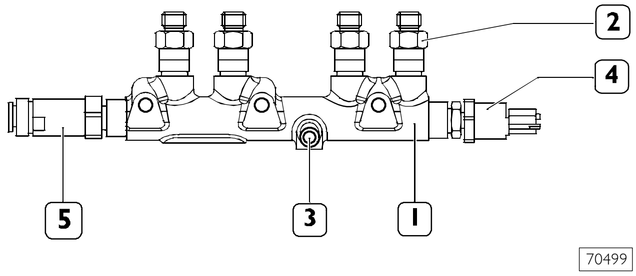
The pump is lubricated and cooled by the fuel.

The radialjet pump disconnection – reconnection time on the engine is highly reduced in comparison with traditional injection pumps, because it does not require setting.

If the pipe between fuel filter and high-pressure pump is to be removed-refitted, be sure that hands and components are absolutely clean.

RAIL

Figure 215



1. Rail. – 2. Flow limiters. – 3. Fuel inlet from high-pressure pump. – 4. Pressure sensor. – 5. Overpressure valve.

The rail volume is of reduced sizes to allow a quick pressurisation at startup, at idle and in case of high flow-rates.

It anyway has enough volume as to minimise use of plenum chambers caused by injectors openings and closings and by the high-pressure pump operation. This function is further enabled by a calibrated hole being set downstream of the high-pressure pump.

A fuel pressure sensor (4) is screwed to the rail. The signal sent by this sensor to the electronic control unit is a feed-back information, depending on which the rail pressure value is checked and, if necessary, corrected.

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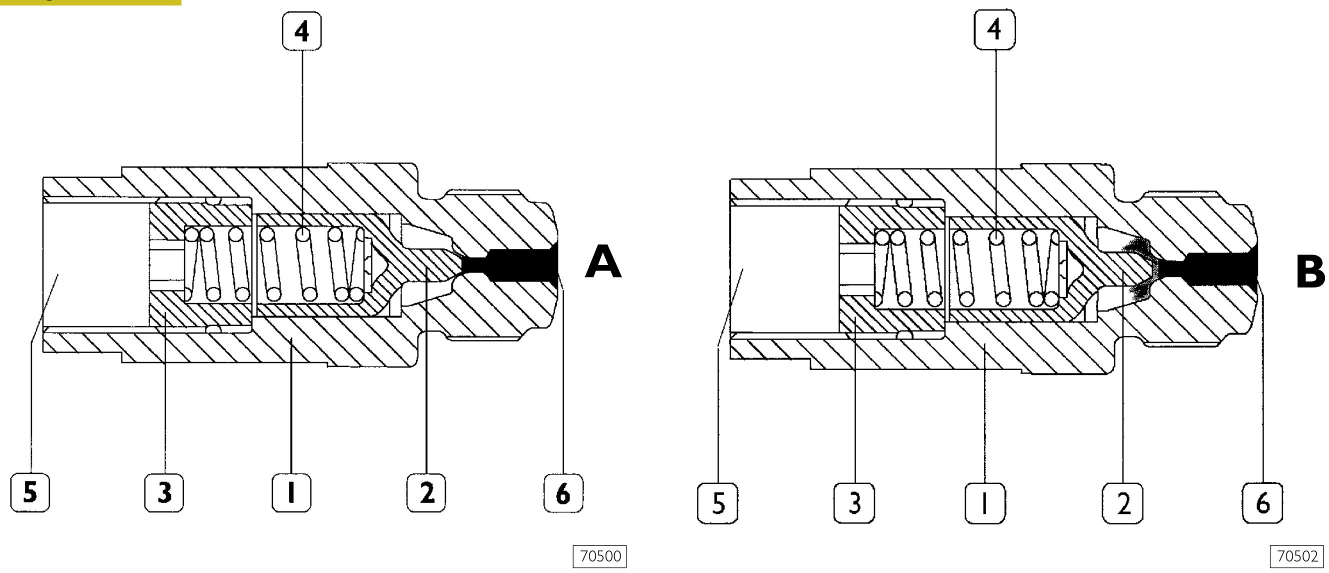
OVERPRESSURE VALVE

The overpressure valve (**1750 bars**) on the rail is used to protect system components in case of flow limiter interventions.

Figure 216



1. Body – 2. Small piston – 3. Stop – 4. Spring – 5. Direct tank discharge – 6. Seat on rail.

A Normally, the tapered piston end keeps closed the discharge towards the tank.

B IIf the 1750 bar fuel pressure is exceeded in rail, the small piston is displaced and the excess pressure is discharged into the tank.

FLOW LIMITERS

They are placed on rail fuel outlet fittings, and are used to protect engine or vehicle integrity in case of internal leaks (for example, locked-open spray nozzle) or external leaks (example: damaged high-pressure pipings).

In such cases, system operation is, within certain limits, allowed through components remained unaffected in other cylinders.

After having blocked fuel from going out of the rail, the flow limiter is automatically re-primed under spring operation. If however the reason for its intervention is not removed, upon the following startup attempt, the engine could operate only at idling or at low speeds or be again turned off depending on the amount of leakage.

Figure 217

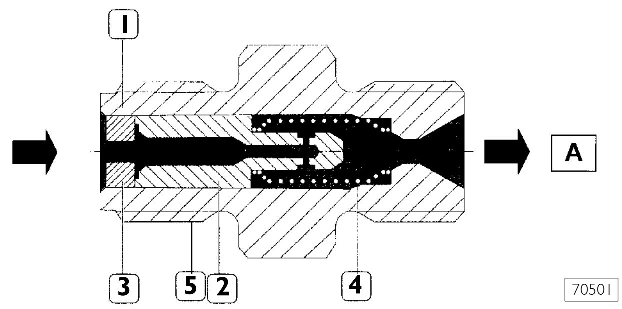
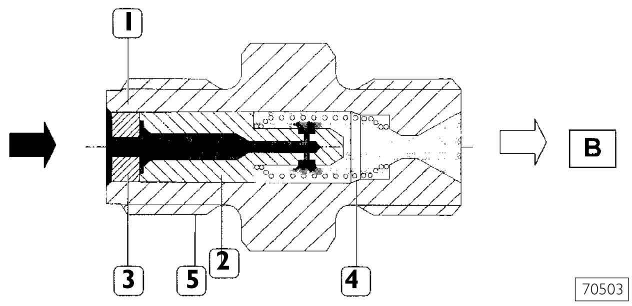


Figure 218



1. Body – 2. Small piston – 3. Fuel inlet – 4. Spring – 5. Rail-securing threading.

A The passage of fuel from rail to injectors is implemented through holes obtained on the small piston diameter. Under normal conditions, fuel pressure operates on the two piston sides, kept opened by the spring.

B In case of strong pressure leaks downstream of the limiter, the inlet pressure becomes preponderant and displaces the piston to the opposite side, closing fuel outlet.

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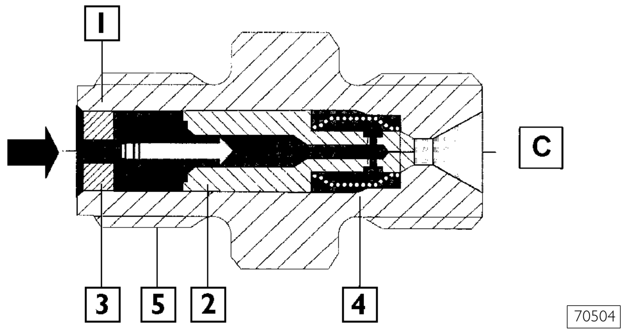
Figure 219



C Limiter with piston in outlet closing position.

INJECTOR

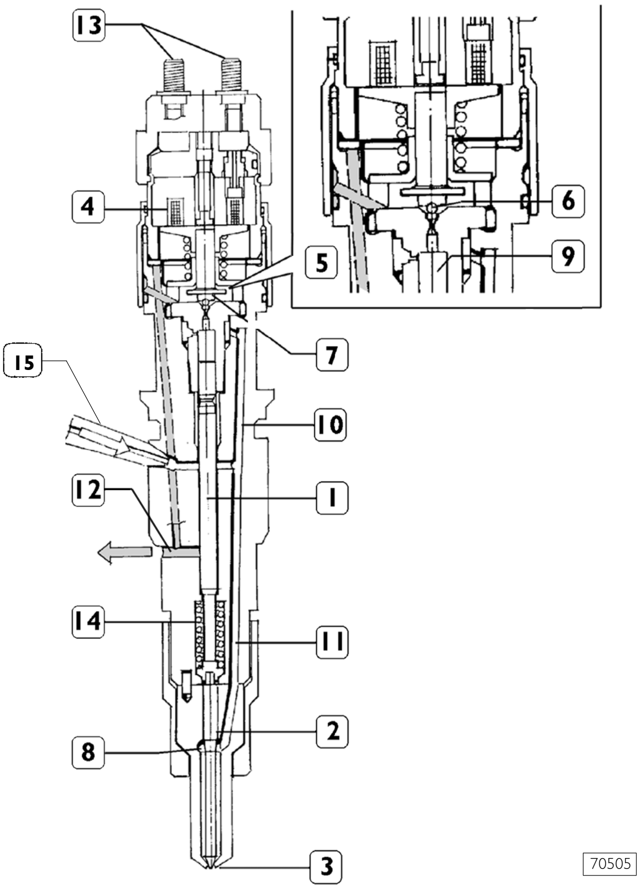
The injector is similar as construction to the traditional ones, apart from the absence of plunger return springs.
The injector can be deemed as composed of two parts:

- ❑ actuator – spray nozzle composed of pressure rod (1), plunger (2) and nozzle (3);
- ❑ control solenoid valve composed of coil (4) and pilot valve (5).

The solenoid valve controls spray nozzle plunger lift.

Injector in rest position

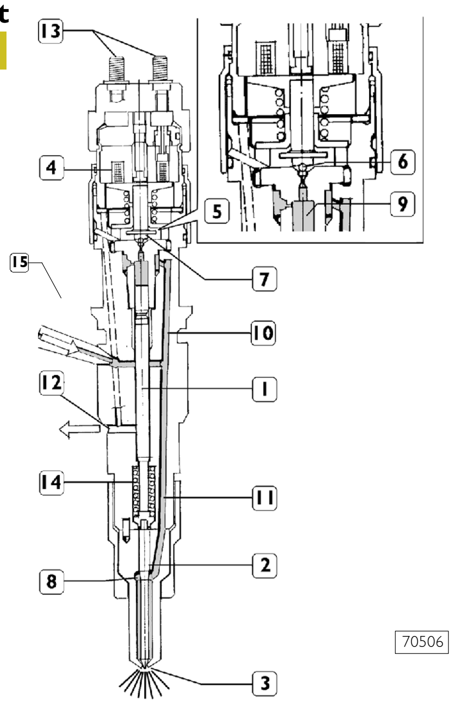
Figure 220



1. Pressure rod – 2. Plunger – 3. Nozzle – 4. Coil – 5. Pilot valve – 6. Ball shutter – 7. Control area – 8. Pressure chamber – 9. Control volume – 10. Control duct – 11. Supply duct – 12. Control fuel outlet – 13. Electric connection – 14. Spring – 15. High-pressure fuel inlet.

Injection start

Figure 221



When coil (4) is energised, it makes shutter (6) move upwards. The control volume (9) fuel flows towards flow duct (12) making a pressure drop occur in control volume (9). Simultaneously the fuel pressure into pressure chamber (8) makes plunger (2) lift, with following fuel injection into the cylinder.

Injection end

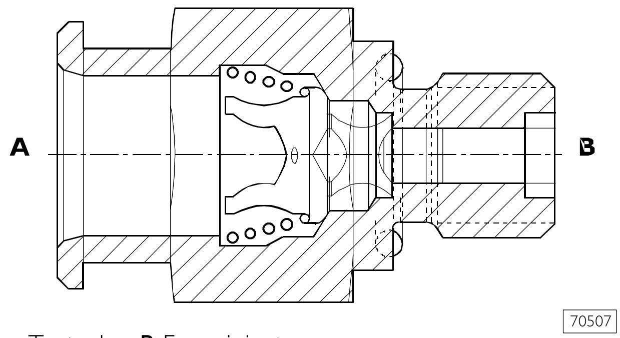
When coil (4) is de-energised, shutter (6) goes back to its closing position, in order to re-create such a force balance as to make plunger (2) go back to its closing position and end the injection.

> ⚠ The injector cannot be overhauled and therefore it must not be disassembled.

PRESSURE LIMITER FOR FUEL RETURN

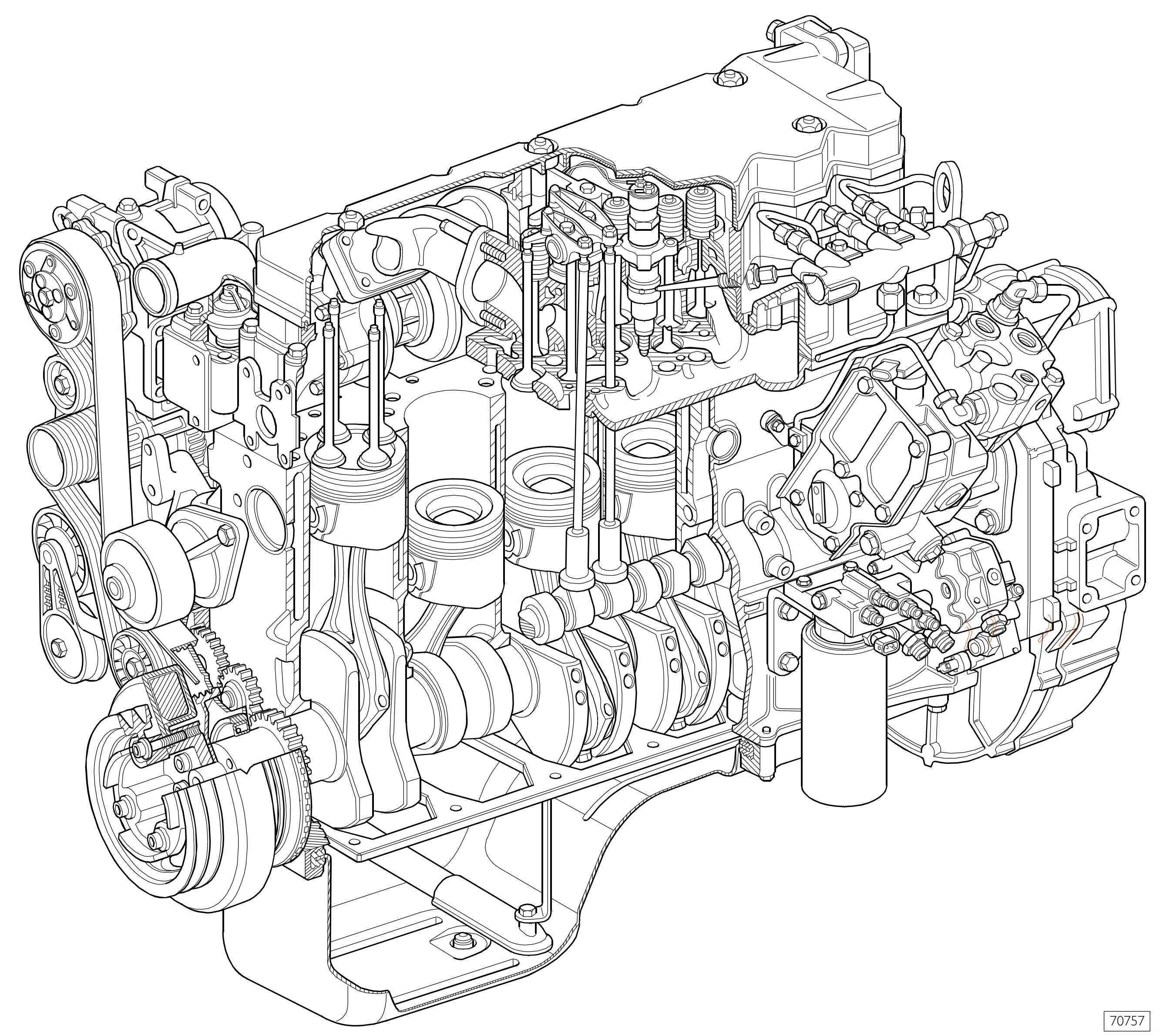
It is housed on the rear cylinder head part, and adjusts the pressure of fuel returning from injectors at a pressure included between 1.3 and 2 bars. By guaranteeing this pressure to the return fuel, the fuel vapours formation inside injectors is avoided, optimising fuel spraying and combustion.

Figure 222



A To tank – **B** From injectors

ENGINE F4 AE 0681



Engine F4 AE 0681

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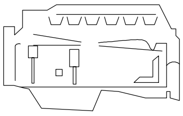
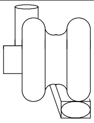
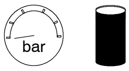
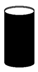
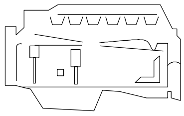
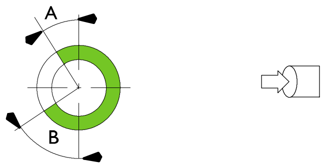
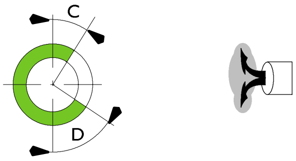
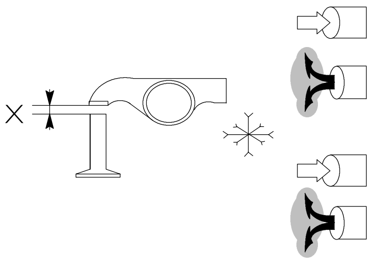
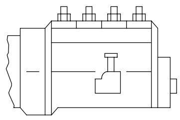
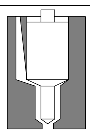
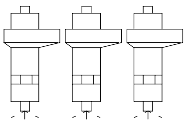
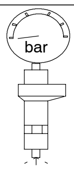
GENERAL SPECIFICATIONS

Type		F4AE 0681E (.18)	F4AE0681D (.21)	F4AE 0681B (.24)	F4AE 0681A (.28)
Cycle		Four-stroke diesel engine			
Power		Supercharged with intercooler			
Injection		Direct			
Number of cylinders		6 in-line			
Bore	mm	102			
Stroke	mm	120			
Total displacement cm^3		5900			
ϱ Compression ratio		17 : 1			
Max. output	kW (HP) rpm	132 (180) 2700	154 (210) 2700	176 (240) 2700	202 (275) 2500
Max. torque	Nm (kgm) rpm	600 61.2 1200÷2100	600 61.2 1200÷2100	600 61.2 1250÷2100	680 69.3 1250÷2100
Loadless engine idling	rpm	650	650	-	-
Loadless engine peak	rpm	3000	3000	-	-

		F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
 Type					
 SUPERCHARGING		With intercooler			
Turbosupercharger type		Borg Warner Turbo Systems K27.2		HOLSET HX 35 W	
Turbosupercharger shaft radial backlash		-		-	
Turbosupercharger shaft end play		-		-	
Pressure relief valve min. opening stroke:	mm	-		0.50	
Pressure relief valve max. opening stroke:	mm	-		1.04	
Pressure corresponding to min. stroke:	bar	-		-	
Pressure corresponding to max. stroke:	bar	-		-	
 LUBRICATION		Forced by gear pump , pressure relief valve, double stage oil filter			
Oil pressure with warm engine:					
- idling	bar	1.2			
- peak rpm	bar	3.8			
COOLING		By centrifugal pump, regulating thermostat, radiator, heat exchanger, intercooler			
Water pump control		Through belt			
Thermostat					
- start of opening		81 ± 2° C			
- maximum opening		96° C			
FILLING					
Total capacity					
1st filling:	liters	-			
	kg	-			
 Urania Turbo Urania LD 5		Min. level		Max. level	
- engine sump	liters	8		10.8	
	kg	7.2		9.7	
- engine sump + filter	liters	9		11..8	
	kg	8.1		10.6	

	Type	F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
	**TIMING** start before T.D.C. A end after B.D.C. B	8.5° 8.5°			
	start before T.D.C. D end after B.D.C. C	51° 12.5°			
	Checking timing X { mm mm	- -			
	Checking operation X { mm mm	0.20 ÷ 0.30 0.45 ÷ 0.55			
	**FUEL FEED** Injection Type: Bosch	high pressure common rail EDC7 ECU			
	Nozzle type	Injectors			
	Injection sequence	1 - 5 - 3 - 6 - 2 - 4			
	Injection sequence bar Injection pressure bar	250 - 1450			

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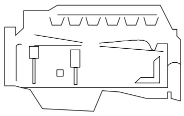
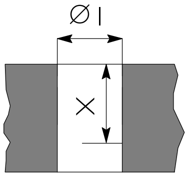
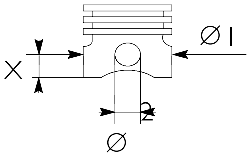
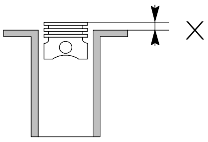
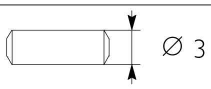
ASSEMBLY DATA – CLEARANCES

	Type	F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
					
CYLINDER UNIT AND CRANKSHAFT COMPONENTS		mm			
	Cylinder barrels: Ø 1	102.009 ÷ 102.031			
	Spare pistons: type: Size X Outside diameter Ø 1 Pin housing Ø 2	 60.5 101.721 ÷ 101.739 40.010 ÷ 40.016		 101.781 ÷ 101.799 40.008 ÷ 40.014	
	Piston – cylinder barrels	0.260 ÷ 0.300			
IVECO PARTS	Piston diameter Ø 1	0.5			
	Piston protrusion X	0.28 ÷ 0.52			
	Piston pin Ø 3	39.9938 ÷ 40.0002			
	Piston pin – pin housing	0.0098 ÷ 0.0222		0.0078 ÷ 0.0202	

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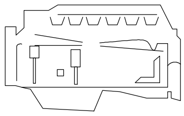
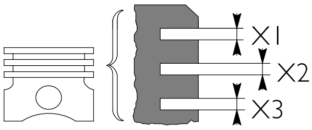
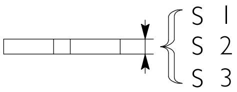
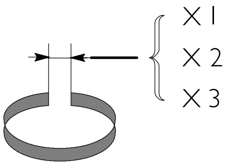
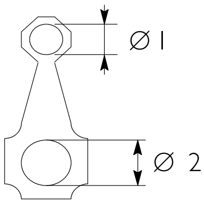
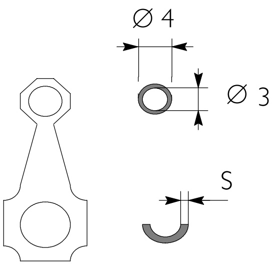
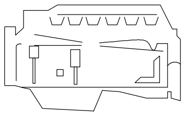
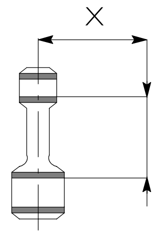
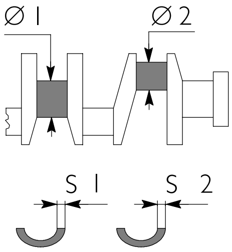
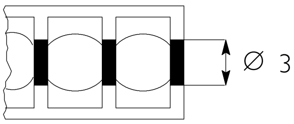
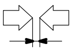
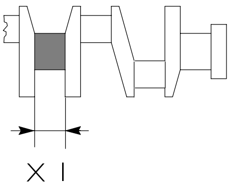
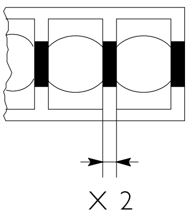
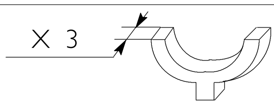
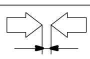
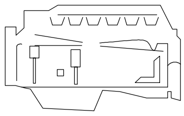
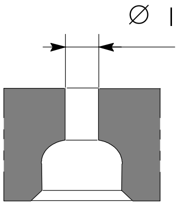
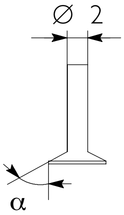
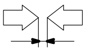
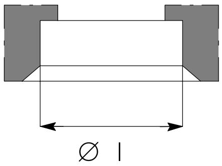
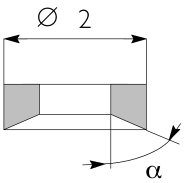
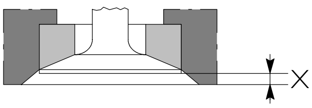
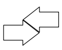
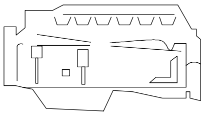
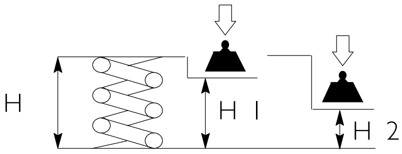
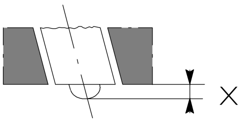
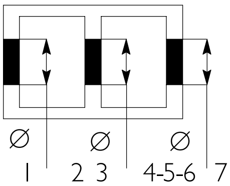
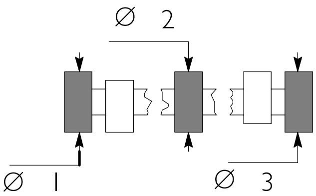
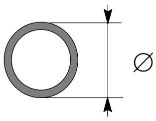
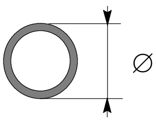
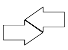
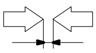
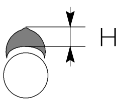
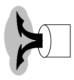
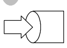
	Type		F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm			
	Split ring slots	X 1*	2.705 ÷ 2.735			
		X 2	2.430 ÷ 2.450		2.420 ÷ 2.440	
		X 3	4.040 ÷ 4.060		4.020 ÷ 4.040	
	* measured on 99 mm Ø					
	Split rings	S 1*	2.560 ÷ 2.605			
		S 2	2.350 ÷ 2,380			
		S 3	3.975 ÷ 4.000			
	* measured on 99 mm Ø					
	Split rings - slots	1	0.100 ÷ 0.175			
		2	0.050 ÷ 0.100		0.040 ÷ 0.090	
		3	0.040 ÷ 0.085		0.020 ÷ 0.065	
IVECO PARTS	Split rings		0.5			
	Split ring end opening in cylinder barrel:					
		X 1	0.30 ÷ 0.40			
		X 2	0.60 ÷ 0.80			
		X 3	0.25 ÷ 0.55			
	Small end bush housing	Ø 1	42.987 ÷ 43.013			
	Big and bearing housing	Ø 2	72.987 ÷ 73.013			
	Small end bush diameter					
	Outside	Ø 4	43.279 ÷ 43.553			
	Inside	Ø 3	40.019 ÷ 40.033			
	Spare big end half bearings	S	1.955 ÷ 1.968			
	Small end bush – housing		0.266 ÷ 0.566			
	Piston pin - bush		0.0188 ÷ 0.0392			
IVECO PARTS	Big end half bearings		-			

			F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
	Type					
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm			
	Size Max. tolerance on connecting rod axis alignment	X —	- -			
	Journals Crankpins Main half bearings Big end half bearings *provided as spare part	Ø 1 Ø 2 S 1 S 2	82.993 ÷ 83.013 68.987 ÷ 69.013 2.456 ÷ 2.464 1.955 ÷ 1.968			
	Main bearings No. 1–3–4-5- 6-7 No. 2	Ø 3 Ø 3	87.982 ÷ 88.008 87.982 ÷ 88.008			
	Half bearings – Journals No. 1–3–4-5- 6-7 No. 2		0.041 ÷ 0.103 0.041 ÷ 0.103			
	Half bearings - Crankpins		0.033 ÷ 0.041			
IVECO PARTS	Main half bearings Big end half bearings		0.250 ÷ 0.500			
	Shoulder journal	X 1	37.475 ÷ 37.545			
	Shoulder main bearing	X 2	32.23			
	Shoulder half-rings	X 3	32.30			
	Output shaft shoulder		0.07			

	Type	F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
CYLINDER HEAD – TIMING SYSTEM		mm			
	Valve guide seats on cylinder head Ø 1	7.042 ÷ 7.062			
	Valves: Ø 2 α Ø 2 α	6.970 ÷ 6.990 60° ± 0.25° 6.970 ÷ 6.990 45° ± 0.25°			
	Valve stem and guide	0.052 ÷ 0.092			
	Housing on head for valve seat Ø1 Ø1	34.837 ÷ 34.863 34.837 ÷ 34.863			
	Valve seat outside diameter; valve seat angle on cylinder head: Ø 2 α Ø 2 α	34.917 ÷ 34.931 60° 34.917 ÷ 34.931 45°			
	X Sinking X	0.59 ÷ 1.11 0.96 ÷ 1.48			
	Between valve seat and head	0.054 ÷ 0.094 0.054 ÷ 0.094			
IVECO PARTS >	Valve seats	-			

	Type		F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
CYLINDER HEAD – TIMING SYSTEM			mm			
	Valve spring height: free spring under a load equal to: 339.8 ± 19 N 741 ± 39 N	 H H1 H2	 47.75 35.33 25.2			
	Injector protrusion	X	It cannot be adjusted			
	Camshaft bush housings No. 1-7 Camshaft housings No. 2-3-4-5-6		 59.222 ÷ 59.248 59.222 ÷ 59.248			
	Camshaft journals: 1 ⇒ 7	 ∅ 1-2-3	53.995 ÷ 54.045			
	Camshaft bush outside diameter: with a load of 3.3 kN	∅	59.222 ÷ 59.248			
	Bush inside diameter after ramming	∅	54.083 ÷ 54.147			
	Bushes and housings on block		0.113 ÷ 0.165			
	Bushes and journals		0.038 ÷ 0.152			
	Cam lift:  	 H H	 6.045 7.582			

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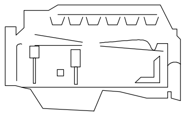
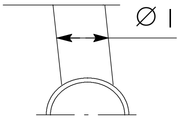
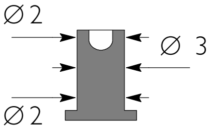
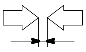
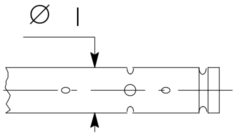
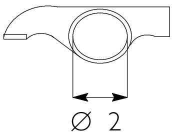
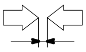
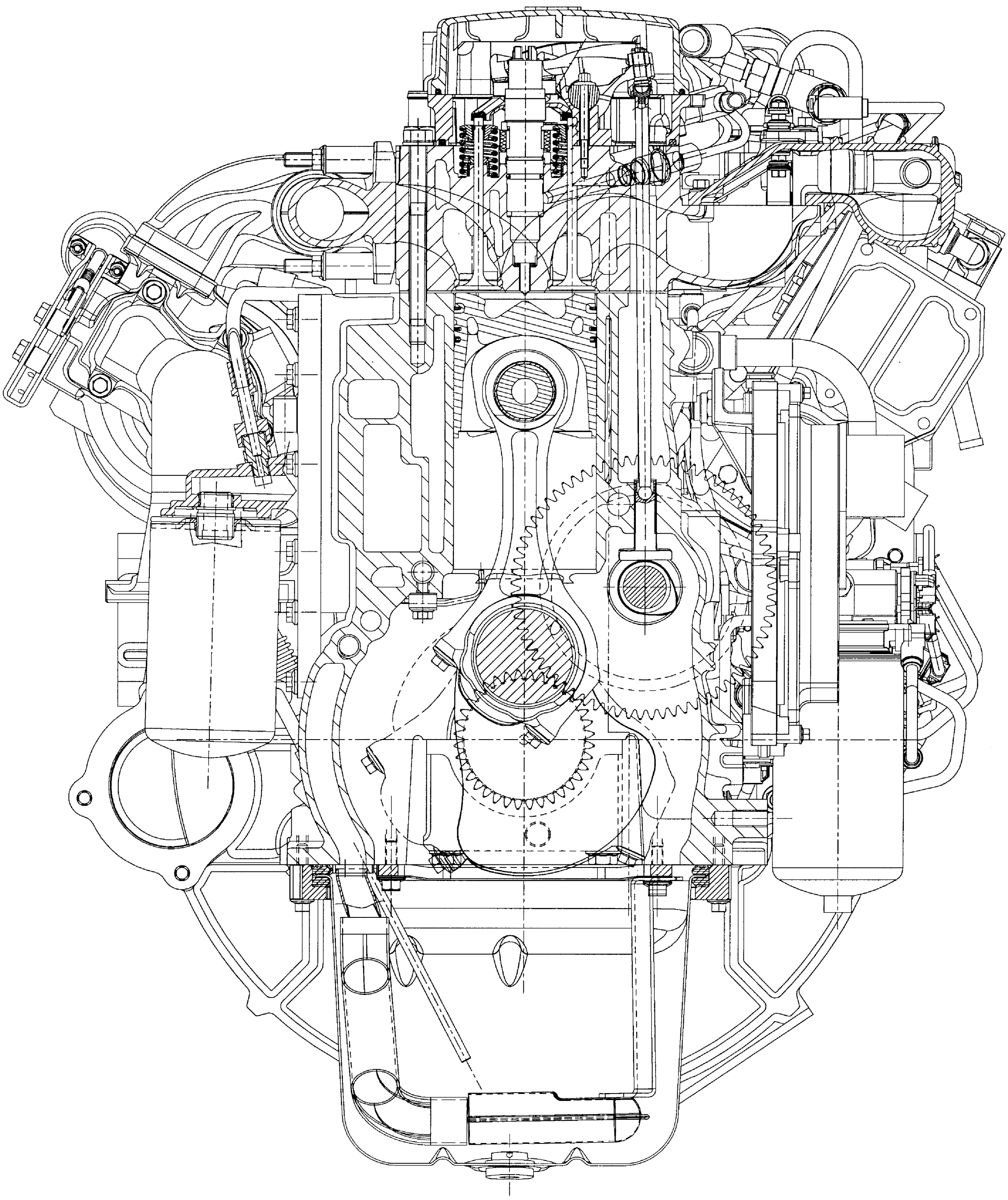
		F4AE0681E (.18)	F4AE0681D (.21)	F4AE0681B (.24)	F4AE0681A (.28)
	Type				
CYLINDER HEAD – TIMING SYSTEM		mm			
	Tappet cap housing on block Ø 1	16.000 ÷ 16.030			
	Tappet cap outside diameter: Ø 2 Ø 3	 15.924 ÷ 15.954 15.960 ÷ 15.975			
	Between tappets and housings	0.025 ÷ 0.070			
IVECO PARTS	Tappets	-			
	Rocker shaft Ø 1	21.965 ÷ 21.977			
	Rockers Ø 2	22.001 ÷ 22.027			
	Between rockers and shaft	0.024 ÷ 0.162			

Figure 1



ENGINE F4AE0681 CROSS SECTION

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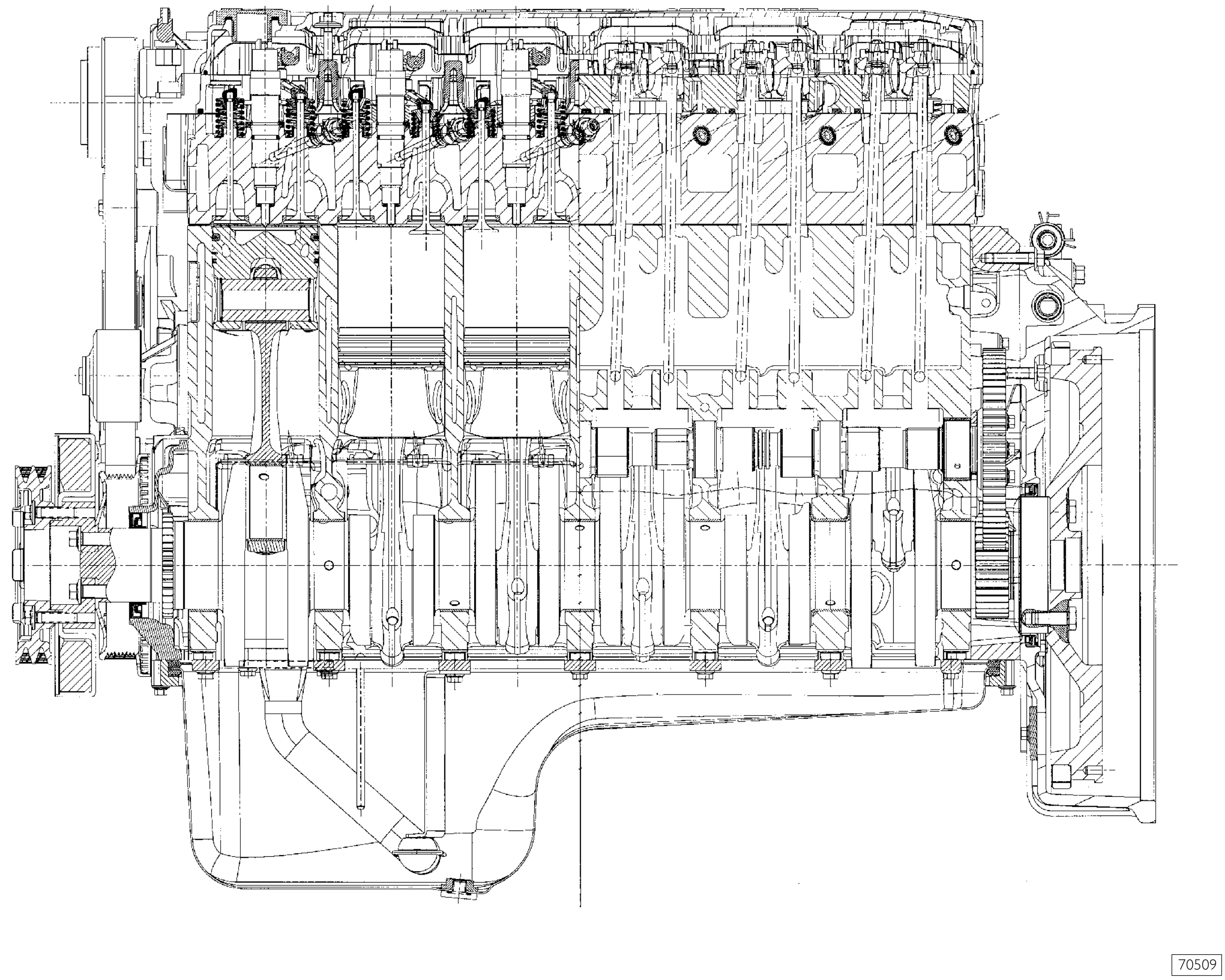
Figure 2



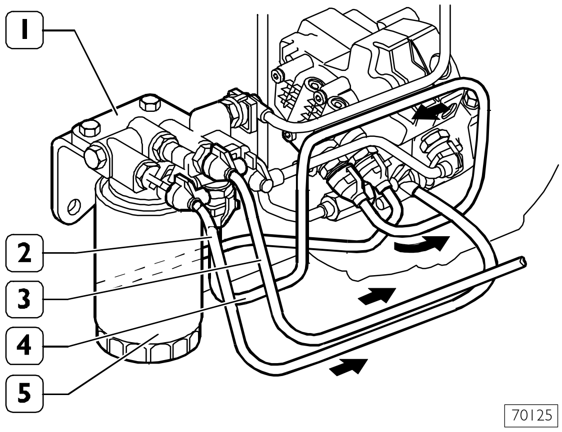
ENGINE F4AE0681 LONGITUDINAL SECTION

ENGINE F4AE0681 OVERHAUL

It is different from engine F4AE0481 overhaul as regards what is stated below.

540110 Engine removal at the bench

Figure 3

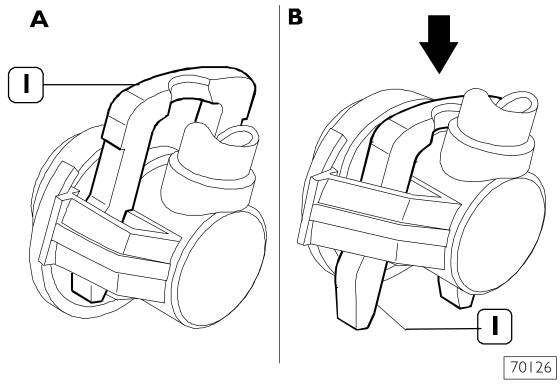


Apply to engine block brackets 99341009 securing engine to overhaul stand 99322205.

In order to apply a bracket to left engine side, it is necessary to:

- with tool 99360076, disassemble fuel filter (5) from support (1);
- disconnect low-pressure fuel pipings (2-3-4) from support (1);
- detach support bearing bracket (1) from block.

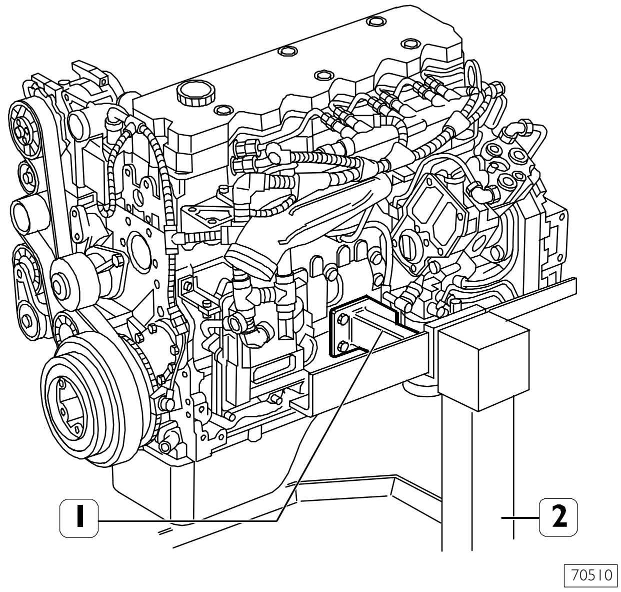
Figure 4



In order to disconnect low-pressure fuel pipings (2 – 3 – 4. Figure 3) from related connection fittings, it is necessary to press clip (1) as shown in figure **B**.

After having disconnected the piping, take back clip (1) to its locking position, figure **A**, to avoid possible distortions of the clip.

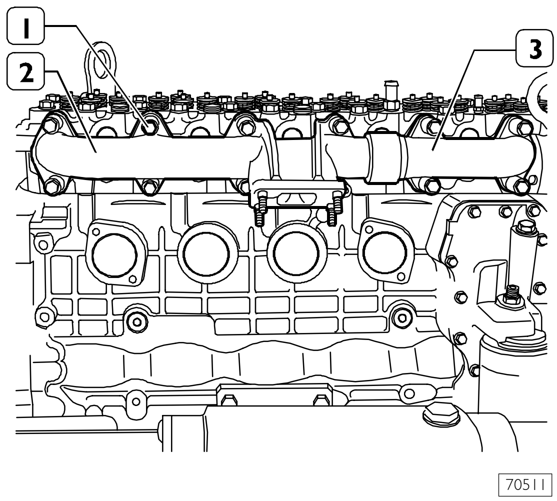
Figure 5



Assemble brackets 99341009 (1) to engine block and secure them to overhaul stand 99322225 (2).

Proceed then to overhaul the engine complying, unless otherwise stated, with what is described for four-cylinder engine F4AE0481.

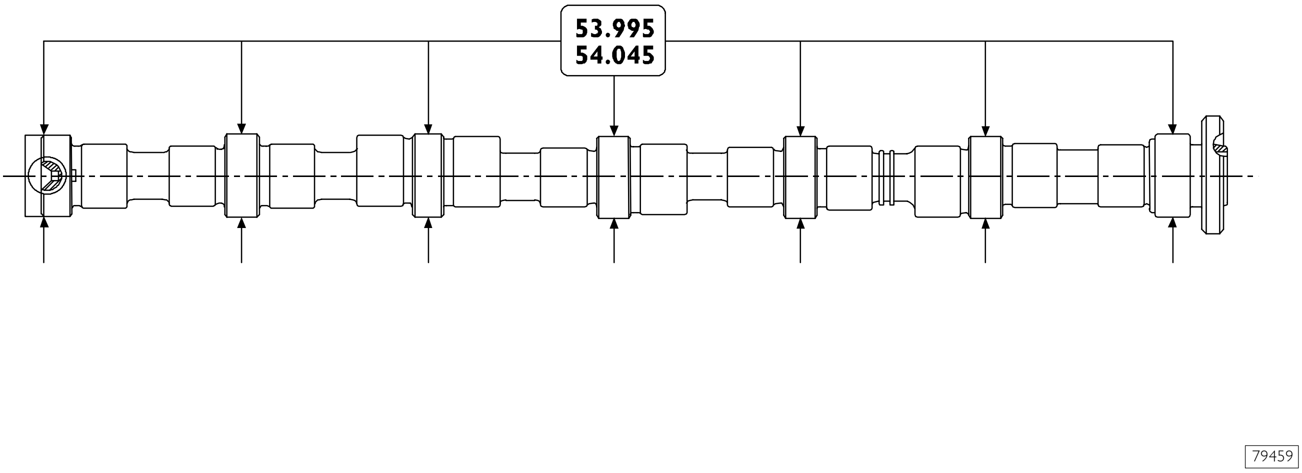
Figure 6



Remove fastening screws (1) and disconnect exhaust manifold into two sections (2-3) with related gaskets.

5412 TIMING SYSTEM
541210 Camshaft

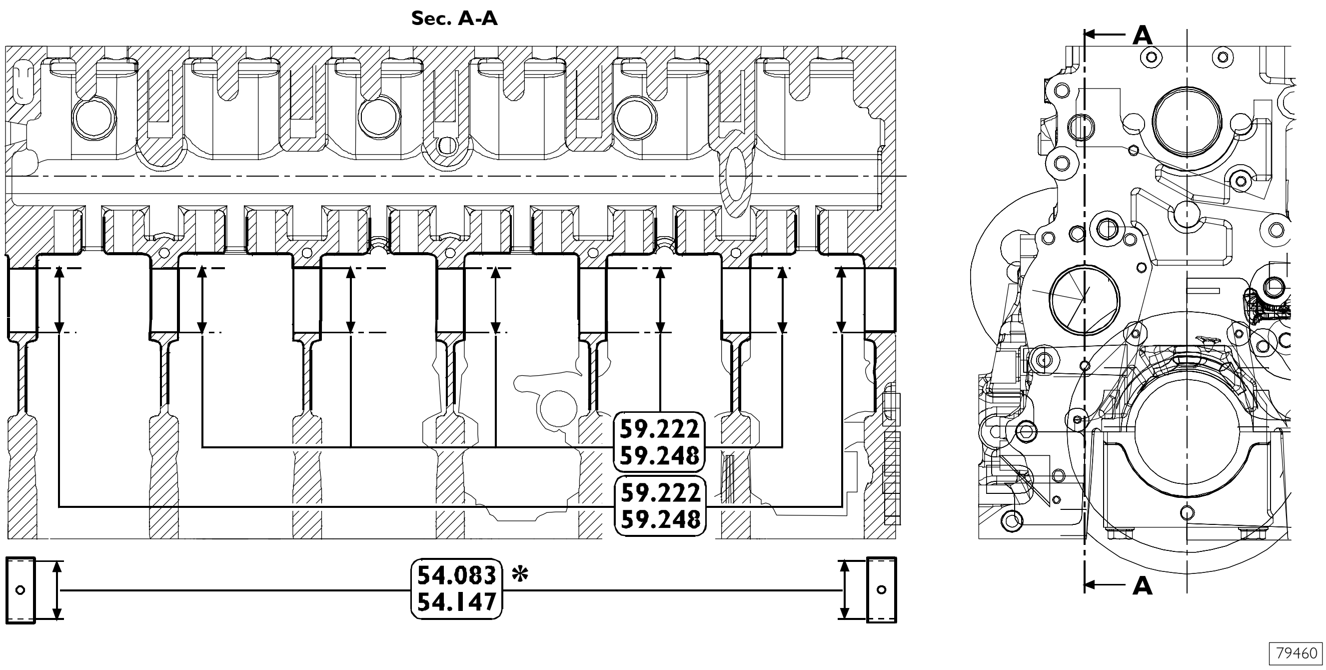
Figure 7



MAIN DATA ABOUT CAMSHAFT PINS

BUSHES

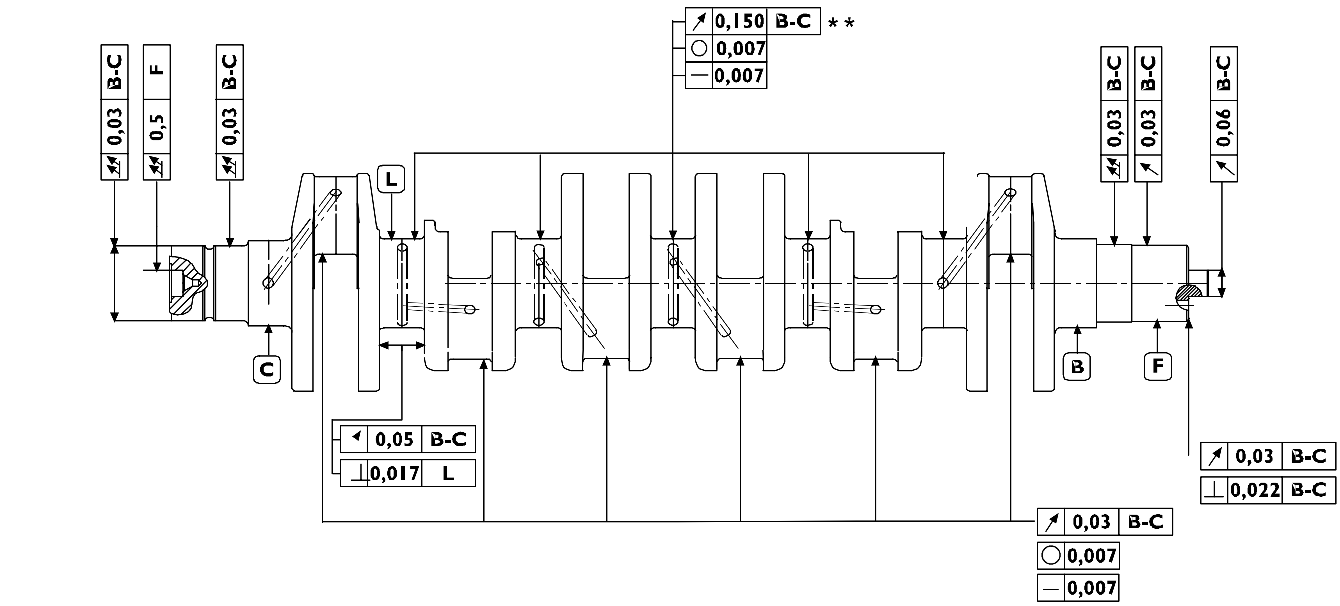
Figure 8



MAIN DATA ABOUT CAMSHAFT BUSHES AND RELATED HOUSINGS

*Height to be obtained after driving the bushes

Figure 9

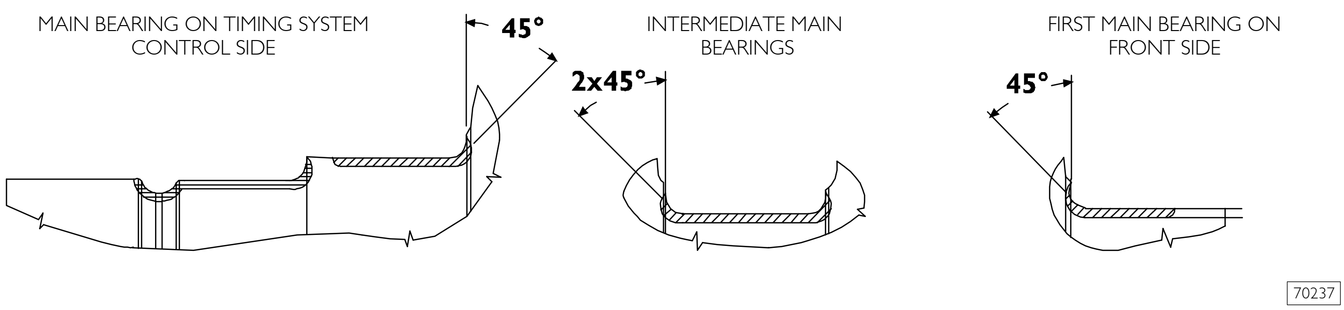


* Measured on a radius greater than 45.5 mm

** ↗ 0.500 between adjacent main journals

MAIN OUTPUT SHAFT TOLERANCES

Figure 10

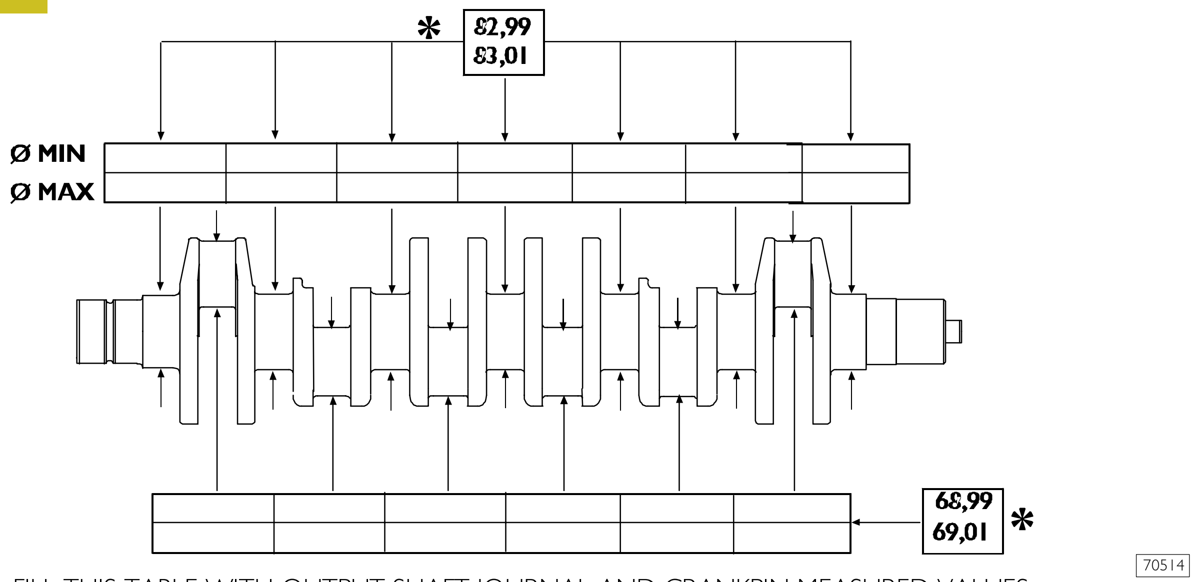


TOLERANCES	TOLERANCE CHARACTERISTIC	GRAPHIC SYMBOL
SHAPE	Roundness	○
	Cilindricity	/○/
DIRECTION	Parallelism	//
	Verticality	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	↗↗
	Taper	—▷

LEVELS OF IMPORTANCE FOR PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Print 603.93.111

Figure 11

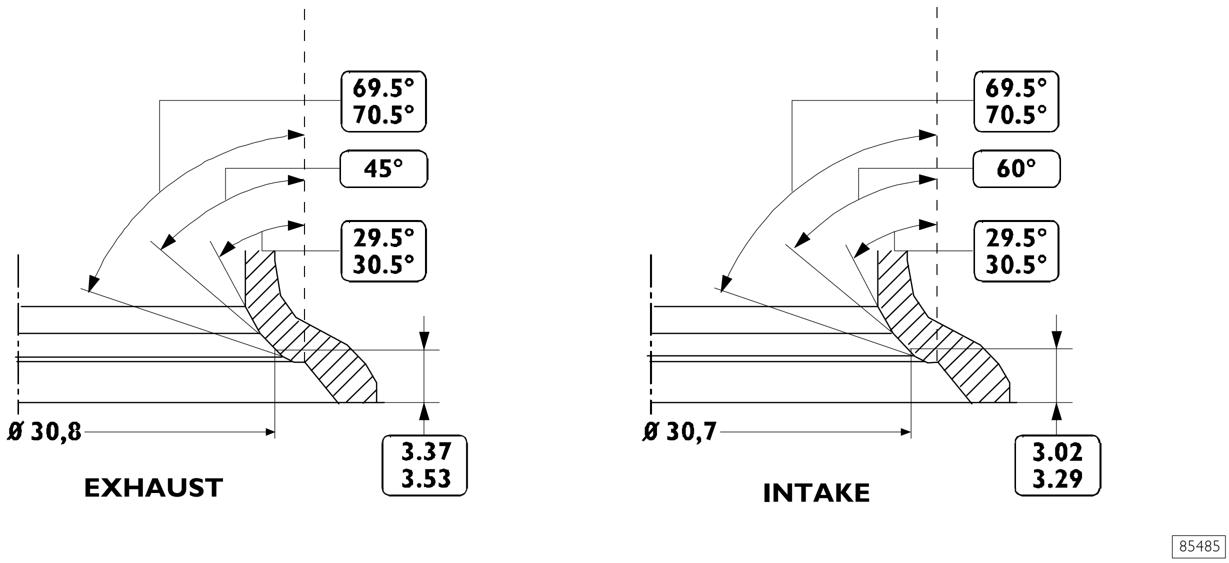


FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES

*Rated value

5406 CYLINDER HEAD VALVE SEATS

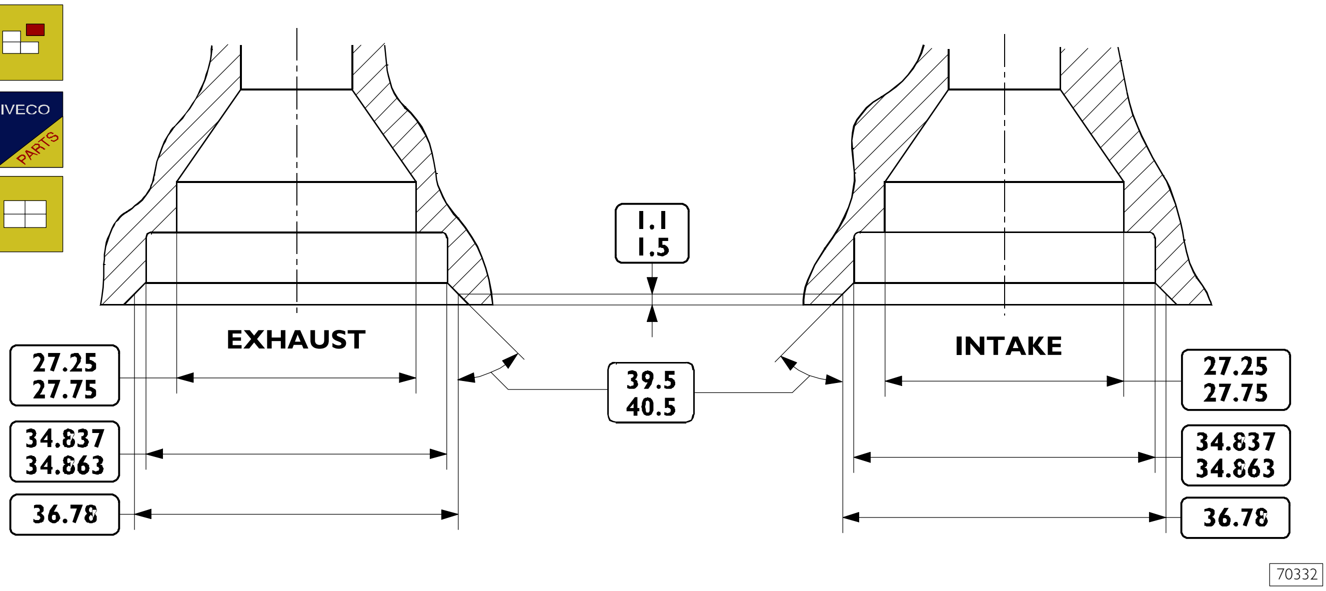
Figure 12



MAIN DATA ABOUT ENGINE VALVE SEATS

Valve seats are obtained by melting on cylinder head and machined.

Figure 13



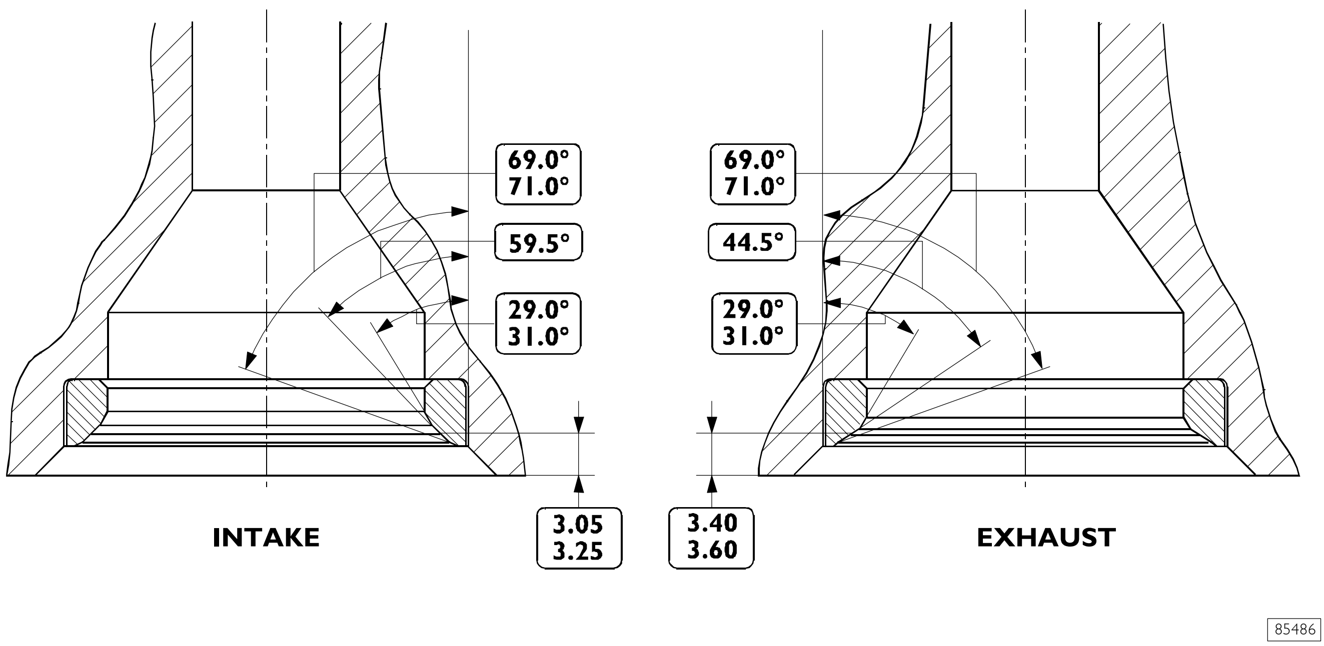
If valve seats cannot be restored just by regrinding, it is possible to assemble the spare inserts provided.

In this case, it is necessary to obtain seats into the cylinder head sized as shown in the figure and to assemble the valve seats.

In order to assemble the valve seats into the cylinder head, it is necessary to heat the cylinder head to 80° - 100°C and, through a suitable beater, to assemble the new, previously cooled valve seats (2) into the head.

Then, with tool 99305018, adjust valve seats according to the values shown in Figure 14.

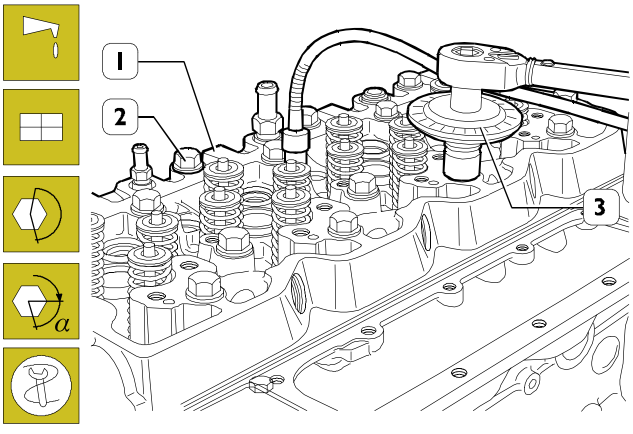
Figure 14



VALVE SEAT MAIN DATA

Cylinder head fastening screw tightening

Figure 15

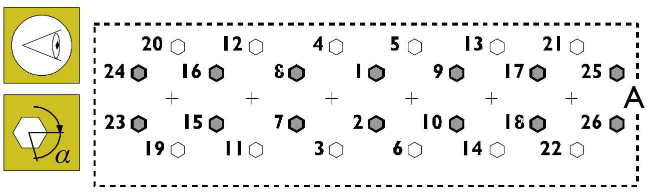


70336

Assemble cylinder head (1), tighten the screws (2) in three following steps, following order and mode shown in the figure below.

The angle tightening is carried out through tool 99395216 (3).

Figure 16



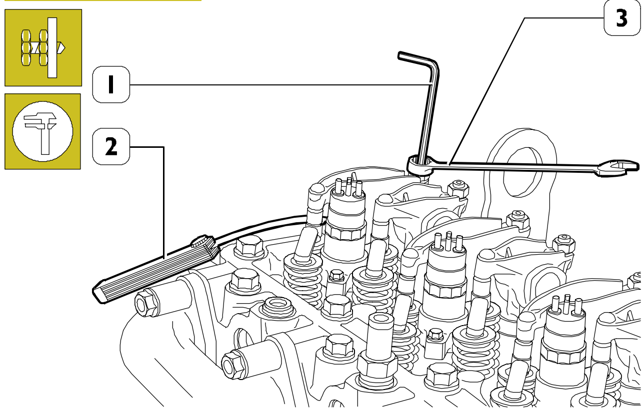
70476

Tightening order layout for cylinder head fastening screws:

- ❑ 1st step pre-tightening with dynamometric wrench:
  - Screw 12x1,75x130 (⬡) 35 ± 5 Nm
  - Screw 12x1,75 x 150 (⬢) 55 ± 5 Nm
- ❑ 2nd step tightening with a 90° ± 5° angle
- ❑ 3rd step tightening with a 90° ± 5° angle

A = Front side

Figure 17



70520

Adjust the clearance between rocker arms and valves through setscrew wrench (1), box wrench (3) and feeler gauge (2).

The operating clearance is:

- ± 0.05
- intake valves 0.25 ± 0.05 mm
- exhaust valve 0.51 ± 0.05 mm

In order to more quickly perform the operating clearance adjustment for rocker arms – valves, proceed as follows:

rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	-	-	*	-	*	*
exhaust	-	*	-	*	-	*

Rotate the drive shaft, balance cylinder 6 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	*	*	-	*	-	-
exhaust	*	-	*	-	*	-

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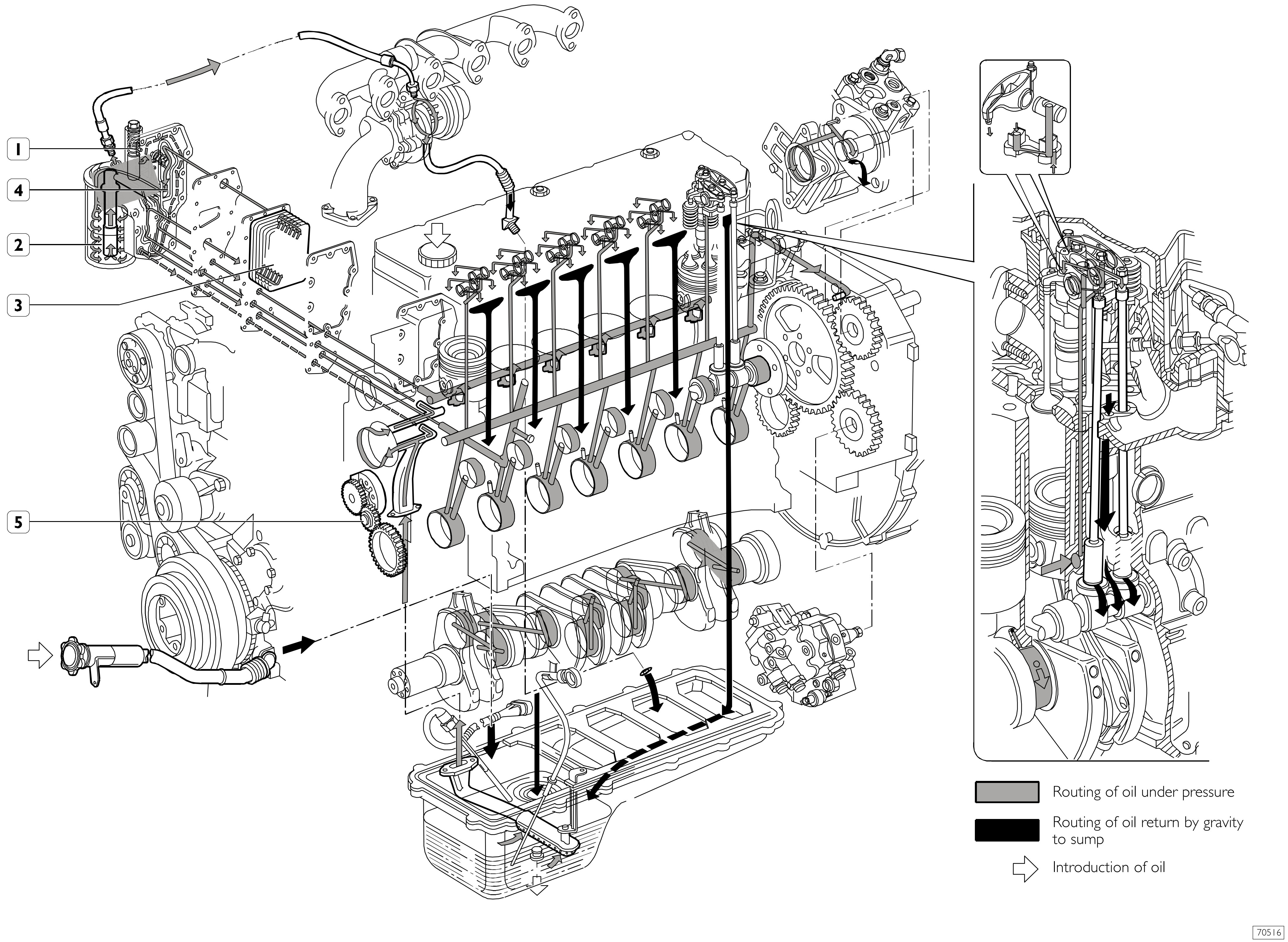
5450 LUBRICATION

The forced-circulation lubrication is carried out by the following components:

- rotor oil pump (5), housed in the front block part, controlled by the straight-tooth gear keyed to the output shaft tang;
- water/oil heat exchanger (3), housed in engine block, with oil filter support;
- oil pressure relief valve (1) embedded into filter support;
- by-pass valve (4) to cut off clogged oil filter, embedded into filter support;
- cartridge oil filter (2).

Figure 18



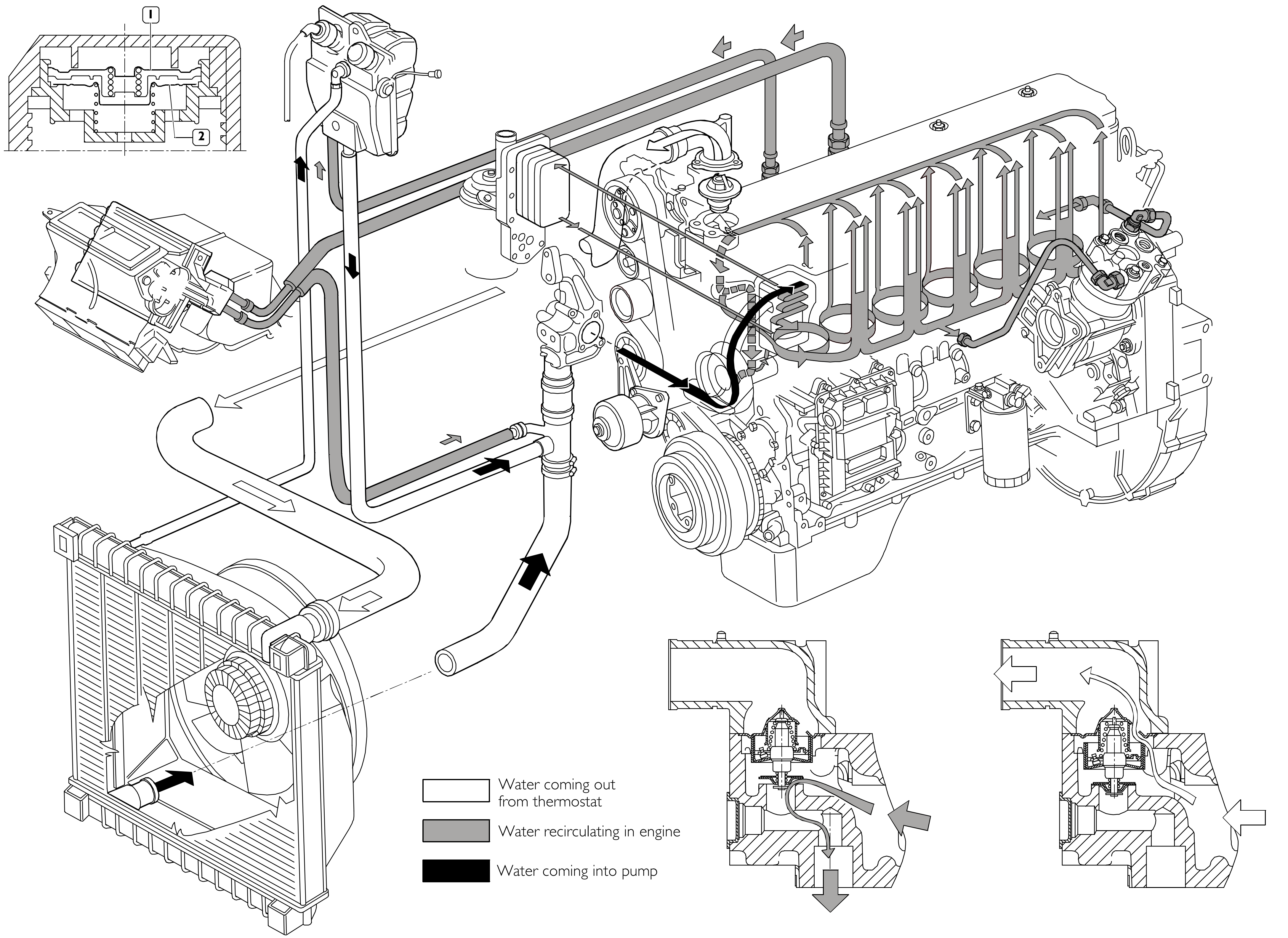
LUBRICATION SYSTEM LAYOUT

5432 COOLING SYSTEM

The engine cooling system, of the closed-loop forced-circulation type, is composed of the following components:

- expansion tank whose plug embeds two valves: an exhaust valve (2) and an intake valve (1), that adjust the system pressure;
- radiator, whose task is dissipating heat subtracted to engine by coolant;
- viscous fan;
- an heat exchanger to cool lubricating oil (see lubrication);
- a water pump of the centrifugal type housed in the front engine block part;
- a thermostat adjusting coolant circulation.

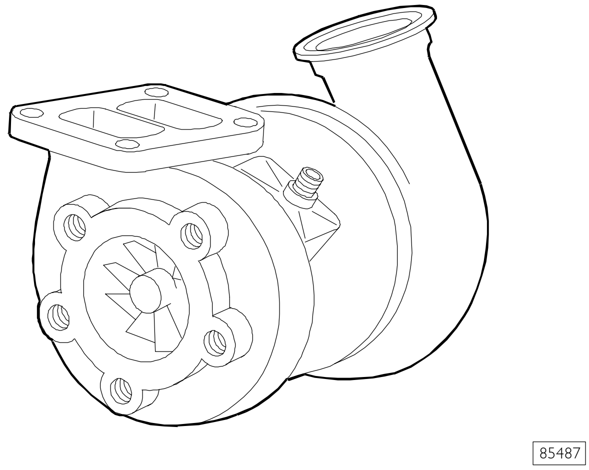
Figure 19



COOLING SYSTEM LAYOUT

BOOSTER
542410 Turbosupercharger

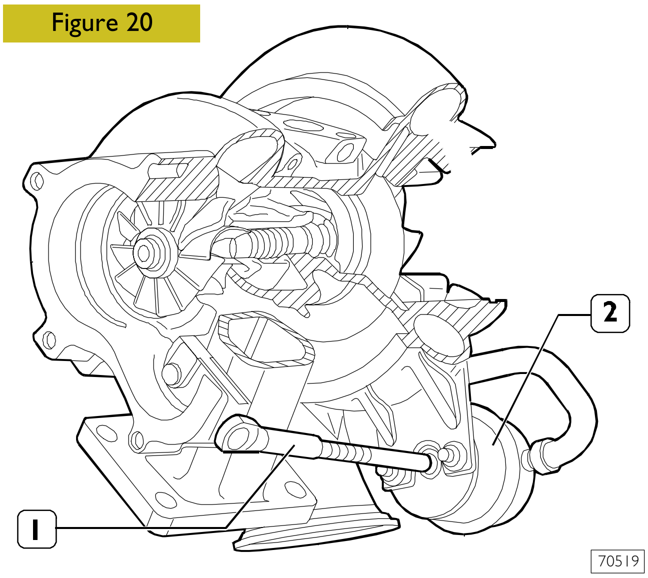
Figure 19/1



TURBOSUPERCHARGER
Borg Warner Turbo Systems K27.2

Fitted on engines
F4 AE 0681 E
F4 AE 0681 D

Figure 20



HOLSET TURBOSUPERCHARGER

Supercharging pressure: 1.5 bars.

(WASTEGATE) actuator opening start: 1600 rpm.

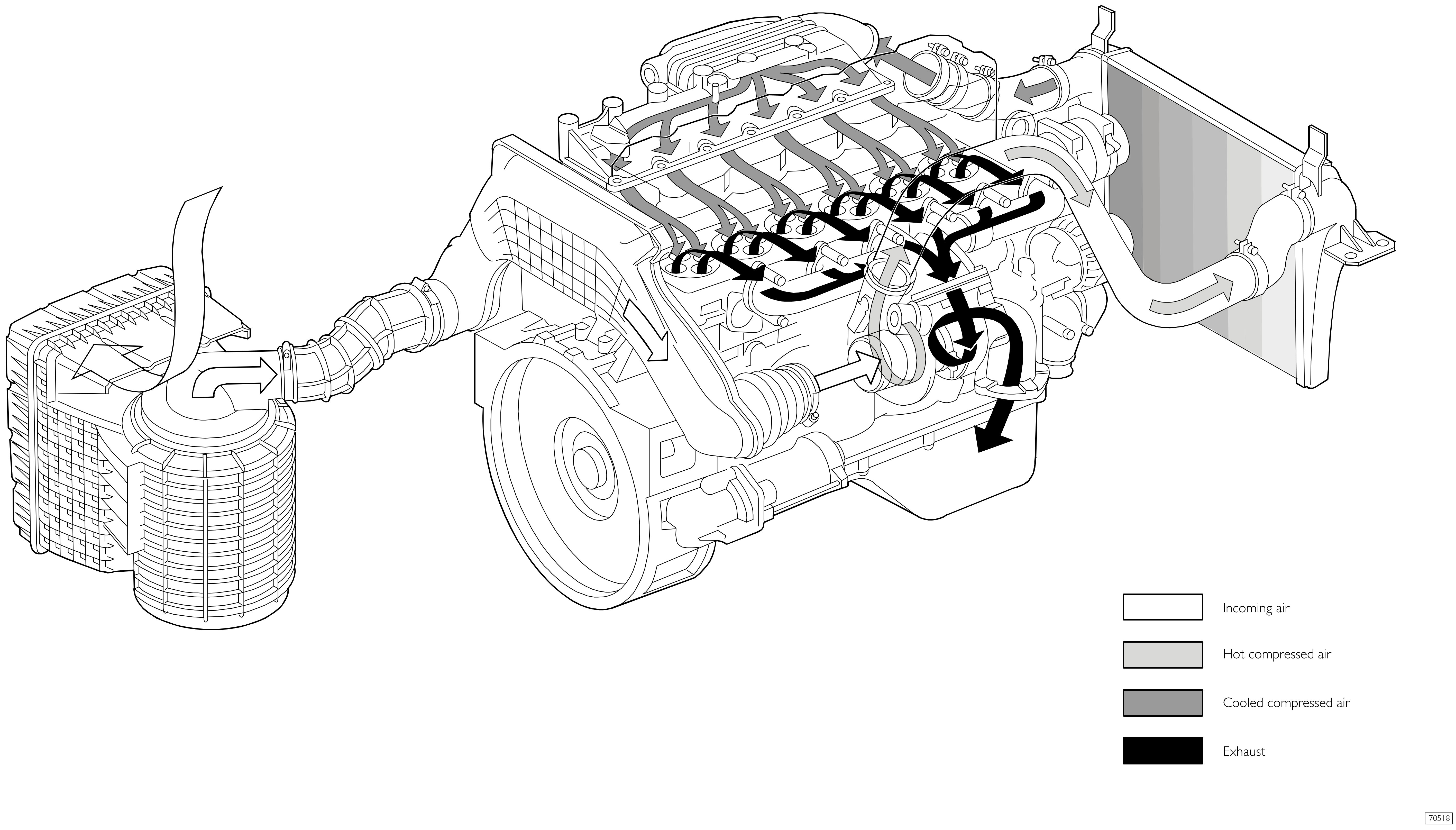
542418 TURBOSUPERCHARGER ACTUATOR
Check and adjustment

The actuator (2) check is carried out as described for GARRETT turbosupercharger assembled on 4-cylinder engines.

Adjustment is carried out by operating on tie rod (1).

TURBOSUPERCHARGER LAYOUT

Figure 21



Troubleshooting Guide

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❑ Diagnosis through instruments 143

DIAGNOSTICS 145

FOREWORD

A good diagnosis is carried out above all with electronic diagnostic instruments (Modus/IWT/IT200) developed by Iveco.
When a vehicle enters the workshop, information provided by vehicle driver are kept under right consideration, but the first thing to do is connecting Modus/IWT/IT2000 and carefully performing a complete diagnosis.

- failure memory reading
- parameters reading
- engine test
- etc.

It is useful to print the results, especially in case the Help Desk assistance has to be requested.

Diagnosis through instruments

MODUS

Computerised diagnostic station aimed to provide a diagnosis for braking systems, pneumatic suspensions, electronically-controlled engines and systems.

The station is equipped with auxiliary functions such as electronic control units programming, spare parts catalogue searching, time schedules, etc.

The vehicle is equipped with the "30-pole" diagnosis socket placed aside the U.C.I.

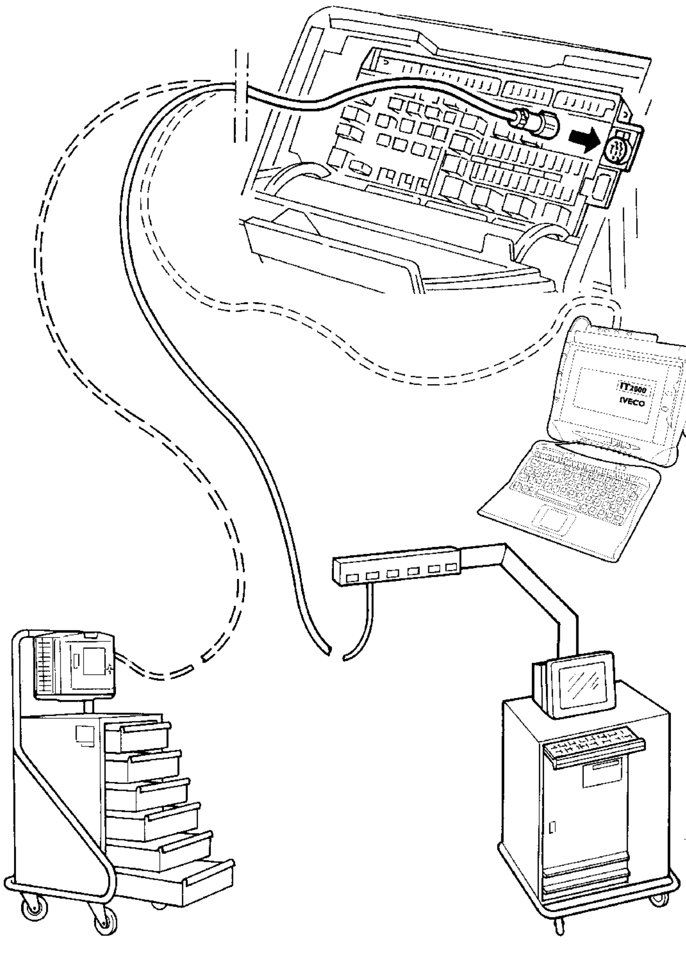
IWT

The IVECO WIRING TESTER expands and integrates MODUS.
This instrument has been implemented by IVECO to improve vehicle electric and electronic systems diagnosis.
The vehicle is equipped with the **"30-pole"** diagnosis socket placed aside the U.C.I., therefore it is necessary to use cable **"4"**.

IT2000

IT2000 is a diagnostic instrument of all Electronic Systems for IVECO vehicles.
It allows an immediate intervention on the vehicle recognising it from its chassis number.
It stores the results of performed diagnostic interventions.
It can be used also as portable Personal Computer and is preset for the remote diagnosis.
By using MODUS as mother station, it is possible to update and configure the IT2000.
IT2000 is interfaced with the vehicle through a 30-pole diagnosis socket placed aside the UCI.

Figure 22



70729

DIAGNOSTICS

Main engine operating anomalies:

1 - The engine does not start;
2 - The engine is excessively heated;
3 - The engine lacks efficiency;
4 - The engine has black or dark grey smokes;
5 - The engine has grey smokes (tending to white);
6 - The engine has cerulean smokes;
7 - The engine has anomalous rattles;
8 - The engine stops;
9 - Excessive or insufficient oil pressure;
10 - Excessive fuel consumption.

1 THE ENGINE DOES NOT START

Efficient connections to battery terminals	NO →	Clean, check, tighten terminal nuts, or replace them.
YES ↓		
Efficient batteries.	NO →	Carry out the checks described in "Electric system" Repair Manual.
YES ↓		
Efficient starter.	NO →	Carry out the checks described in "Electric system" Repair Manual.
YES ↓		
Absence of air seepages in the low-pressure supply circuit.	NO →	Remove seepage causes. Perform the drain.
YES ↓		
Absence of water traces in the supply circuit.	NO →	Remove seepage causes. Clean the supply circuit including the tank.
YES ↓		
Efficient fuel prefilter - filter.	NO →	Replace.

(continued)

Efficient pre-post heating system.	NO →	Diagnosis with Modus - IT2000 - IWT.
YES ↓		
Efficient high-pressure pump.	NO →	Engine Test with Modus - IT2000 - IWT.
YES ↓		
Efficient injector.	NO →	Engine Test with Modus - IT2000 - IWT. Check O-Ring seal.
YES ↓		
Correct compression ratio.	NO →	Revise the engine or limit intervention to affected parts (valves, elastic rings, etc.).

2 THE ENGINE IS EXCESSIVELY HEATED

Correct cooling liquid level.	NO →	Check possible losses and restore the level.
YES ↓		
Efficient water pump and fan control belts.	NO →	Check, adjust tension and possibly replace the parts.

(continued)

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Check	If NO
Efficient water pump.	Revise or replace the assembly.
Efficient thermostat.	Replace.
Efficient radiator.	Carry out an accurate washing, check whether there are liquid leakages; possibly replace the part.
Efficient air filter and circuit pipings.	Clean or replace faulty parts.
The engine brake is disengaged.	Check and possibly replace.
Efficient cylinder head.	Replace.
Efficient fan.	Replace.

3	THE ENGINE LACKS POWER

Check	Result	Action
Efficient fuel filters.	NO →	Replace, proceeding as described in "Use and Maintenance" booklet.
↓ YES		
Efficient low- and high-pressure supply circuit.	NO →	Check system fittings seal.
↓ YES		
Efficient thermostat.	NO →	Replace.
↓ YES		
Presence of fuel in the tank.	NO →	Check fuel level.
↓ YES		
Efficient fuel floating device in the tank.	NO →	Check small priming pump and clean the floating device from possible impurities.
↓ YES		
Efficient high-pressure pump.	NO →	Engine Test with Modus - IWT - IT2000, possibly replace.
↓ YES		
Efficient injectors and correctly-operating flow limiter.	NO →	Engine Test with Modus - IWT - IT2000, possibly replace. Check O-Ring seal.

(continued)

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Efficient rail overpressure valves.	NO →	Disconnect fuel return piping from rail and check the presence of blow-by.
↓ YES		
Correct compression ratio.	NO →	Engine Test with Modus – IWT – IT2000.
↓ YES		
Efficient turbosupercharger (blades, bearings, actuators integrity)	NO →	Repair or replace the assembly.
↓ YES		
Efficient valve clearance.	NO →	Check – restore.

4 THE ENGINE HAS BLACK OR DARK GREY SMOKES

Efficient air filter.	NO →	Replace.
↓ YES		
Efficient injectors.	NO →	Engine Test with Modus – IWT – IT2000. Check O-Ring seal.
↓ YES		
Correct compression ratio.	NO →	Engine Test with Modus – IWT – IT2000.

(continued)

5 THE ENGINE HAS GREY SMOKES (TENDING TO WHITE)

Check	Result	Action
Efficient injectors.	NO	Engine Test with Modus – IWT – IT2000. Check O-Ring seal.
(YES) Correct cooling liquid level.	NO	Probable cooling liquid passage in bursting chambers. Replace cylinder head gasket or revise the engine.

6 THE ENGINE HAS CERULEAN SMOKES

Check	Result	Action
Presence of oil in the cylinders.	YES	Excessive oil consumption. Turbine oil blow-by. Blow-by from valve guide.

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7 THE ENGINE HAS ANOMALOUS RATTLES

Rattle located in drive shaft.	YES →	Check clearances and main journals ovalities; screws securing for main caps and engine flywheel; oil pressure. Replace the parts or revise the engine.
NO ↓		
Rattle located in connecting rods.	YES →	Check clearances and connecting rod journals ovalities; screws securing for connecting rod caps; connecting rods quadrature. Replace the parts or revise the engine.
NO ↓		
Rattle located in plungers.	YES →	Check clearances between plungers and cylinder barrels; elastic rings integrity; plunger pins – hubs clearance. Replace the parts or revise the engine.
NO ↓		
Rattle located in cylinder head.	YES →	Check: operating clearance between rocker arms and distribution setting valves. Adjust.
NO ↓		
Rattle located in distribution.	YES →	Check and possibly replace the gears.
YES ↓		
Rattle located in air compressor.	YES →	Revise or replace the air compressor.
NO ↓		
Rattle located in injectors.	YES →	Check and calibrate them according to what is described in S.I. 1094 or replace them.

8	**THE ENGINE STOPS**

Presence of fuel in the tank.	NO →	Carry out the refueling and, if necessary, carry out the drain.
YES ↓		
Efficient fuel filters.	NO →	Replace.
YES ↓		
Efficient supply circuit.	NO →	Check the circuit and carry out the drain.

9	**INSUFFICIENT OR EXCESSIVE OIL PRESSURE**

The pressure regulating valve correctly intervenes.	NO →	Check and possibly replace.
YES ↓		
Efficient oil pump and delivery pipings.	NO →	Check and possibly replace.
YES ↓		
Efficient main and connecting rod bearings.	NO →	Replace the bearings and possibly adjust the drive shaft.
YES ↓		
Correct engine oil SAE viscosity.	NO →	Replace the engine oil with another one with a correct viscosity.

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10 **EXCESSIVE FUEL CONSUMPTION**

Efficient fuel tank and pipings.	NO →	Remove possible leakages and replace the deteriorated parts.
↓ YES		
Efficient air filter.	NO →	Replace.

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SECTION 3

Clutch

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CHECKING AND ADJUSTING THE CLUTCH PEDAL (15"/16" clutches)	19
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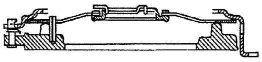
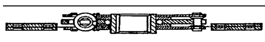
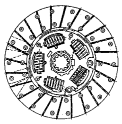
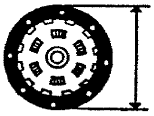
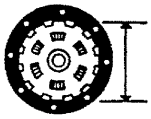
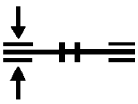
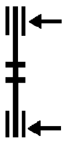
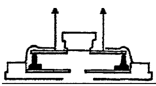
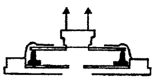
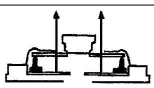
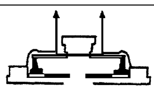
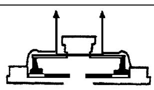
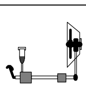
DESCRIPTION

Clutch

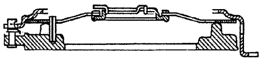
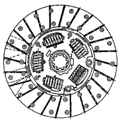
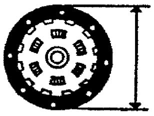
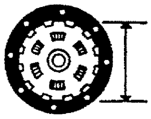
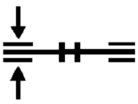
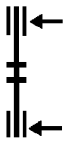
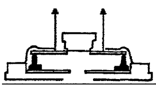
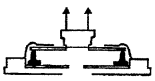
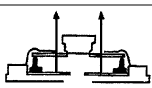
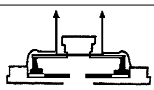
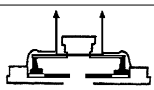
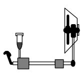
The clutch is of the single-plate, dry-operating type, with engagement mechanism of the pull type with baffle spring. The engagement control is hydraulic and comprises the master cylinder, with embedded oil tank, and the operating cylinder.

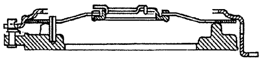
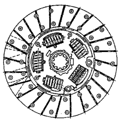
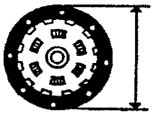
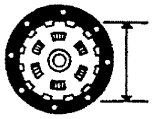
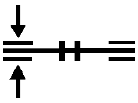
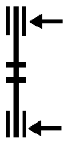
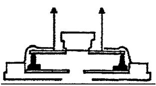
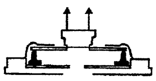
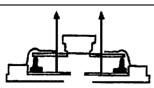
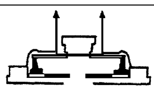
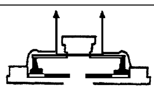
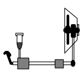
SPECIFICATIONS AND DATA

13” CLUTCH with gearboxes: 2855.6 – 2870.9			VALEO	A.P. BORG & BECK
	Type		Dry single-plate	
	Engagement mechanism		Pull with baffle spring	
	Driven plate		With friction gaskets	
	Driven plate hub		With spring drives	
	Ø External gaskets	mm	330	
	Ø Internal gaskets	mm	194.5	200
	(New) plate thickness	mm	8.5 ± 0.3	
	Max. driven plate mismatching	mm	~ 0.2	
	Load on plate-pusher	N	10100	10500
	Disengagement load	N	2500	2000
	Minimum plate-pusher lift	mm	1.5	
	Detachment stroke	mm	10^{+2}_{0}	12
	Max. consumption stroke	mm	14	13.6
	Hydraulic control		Master cylinder with embedded oil tank – operating cylinder	
	Oil type		**Tutela TRUCK DOT SPECIAL**	

Print 603.93.111

13"/14" CLUTCH with gearboxes: 2855.6 – 2870.9		VALEO
Type		Dry single-plate
Engagement mechanism		Pull with baffle spring
Driven plate		With friction gaskets
Driven plate hub		With spring drives
External gaskets ∅	mm	330
Internal gaskets ∅	mm	194.5
(New) plate thickness	mm	9.4 ± 0.3
Max. driven plate mismatching	mm	∼ 0.2
Load on plate-pusher	N	12000
Disengagement load	N	2600
Minimum plate-pusher lift	mm	1.5
Detachment stroke	mm	10^{+2}_{0}
Max. consumption stroke	mm	12.2
Hydraulic control		Master cylinder with embedded oil tank – operating cylinder
Oil type		**Tutela TRUCK DOT SPECIAL**

14” CLUTCH with gearboxes: 2865.6 – 2870.9			VALEO
	Type		Dry single-plate
	Engagement mechanism		Pull with baffle spring
	Driven plate		With friction gaskets
	Driven plate hub		With spring drives
	External gaskets ∅	mm	350
	Internal gaskets ∅	mm	195
	(New) plate thickness	mm	9.4 ± 0.3
	Max. driven plate mismatching	mm	∼ 0.2
	Load on plate-pusher	N	12000
	Disengagement load	N	2600
	Minimum plate-pusher lift	mm	1.5
	Detachment stroke	mm	10^{+2}_{0}
	Max. consumption stroke	mm	12.2
	Hydraulic control		Master cylinder with embedded oil tank – operating cylinder
	Oil type		**Tutela TRUCK DOT SPECIAL**

15" /16" CLUTCH **with gearboxes: 2895.9 - FSO 5206B**			FICHTEL & SACHS	VALEO	A.P. BORG & BECK
	Type		Dry single-plate		
	Engagement mechanism		Pull with baffle spring		
	Driven plate		With friction gaskets		
	Driven plate hub		With spring drives		
	External gaskets ∅	mm	380	380	380
	Internal gaskets ∅	mm	220	220	220
	(New) plate thickness	mm	10 ± 0.3	10 ± 0.3	10 ± 0.2
	Max. driven plate mismatching	mm	-	-	~ 0.3
	Load on plate-pusher	N	17400	19000	20000
	Disengagement load	N	4000	4000	3950
	Minimum plate-pusher lift	mm	1.7	1.7	1.7
	Detachment stroke	mm	12^{+2}_{0}	12^{+2}_{0}	12^{+2}_{0}
	Max. consumption stroke	mm	16	12.5	15
	Hydraulic control		Master cylinder with embedded oil tank – operating cylinder		
	Oil type		**Tutela TRUCK DOT SPECIAL**		

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DIAGNOSTICS

Main clutch operating anomalies:

1 - Noises when the pedal is lowered;
2 - Noises when the pedal is released;
3 - The clutch jerks;
4 - The clutch does not disengage itself;
5 - The clutch slips;
6 - Anomalous driven plate gasket wear.

1	NOISES WHEN THE PEDAL IS LOWERED

Cause		Remedy
Excessively worn, damaged or scarcely lubricated thrust bearing.	YES	Replace the thrust bearing.
NO		
Excessive clearance between gearbox entry shaft grooves and related seat on driven plate hub.	YES	Replace the shaft and, if necessary, the driven plate too.

2	NOISES WHEN THE PEDAL IS RELEASED

Cause		Remedy
Broken or excessively deteriorated driven plate springs.	YES	Replace the driven plate.
NO		
Worn gearbox entry shaft.	YES	Replace the shaft and, if necessary, the driven plate.
NO		
Thrust bearing having clearance on engagement manifold.	YES	Replace the thrust bearing.

3	THE CLUTCH JERKS

Condition		Action
Oil or grease on engine flywheel, or on driven plate gaskets.	YES →	Remove the inconvenience generating the fouling; accurately clean the flywheel, then replace the driven plate.
NO ↓		
Buckled plate-pushing ring.	YES →	Replace the clutch.
NO ↓		
Irregularly consumed friction gaskets due to driven plate mismatching.	YES →	Replace the driven plate.
NO ↓		
Weak clutch baffle spring or baffle spring with broken blades.	YES →	Replace the clutch.

4	THE CLUTCH DOES NOT DISENGAGE ITSELF

Condition		Action
Oil or grease on driven plate gaskets.	YES →	Remove the inconvenience generating the fouling; accurately clean the flywheel, then replace the driven plate.
NO ↓		
Worn gearbox entry shaft grooves so that the driven plate sliding is prevented.	YES →	Replace the shaft and, if necessary, the driven plate too.

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5 THE CLUTCH SLIPS

Check		Action
Worn or burnt driven plate gaskets.	YES →	Replace the driven plate.
NO ↓		
Weak clutch baffle spring or baffle spring with broken blades.	YES →	Replace the clutch.
NO ↓		
Oil or grease on driven plate gaskets.	YES →	Remove the inconvenience generating the fouling and replace the driven plate.

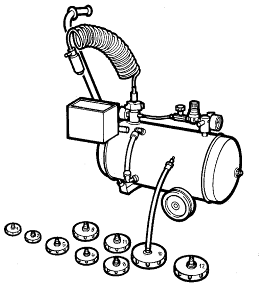
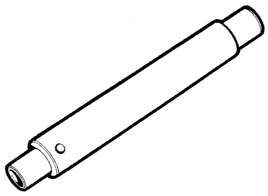
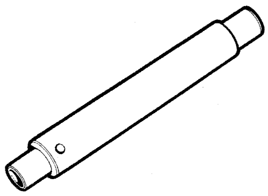
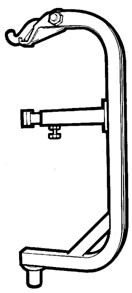
6 ANOMALOUS DRIVEN PLATE GASKET WEAR

Check		Action
The driver keeps, during the drive, his foot rested on the clutch pedal.	YES →	The driver must avoid this wrong attitude and rest his foot on the clutch pedal only when it is necessary.
NO ↓		
Baffle spring with yielded or broken blades.	YES →	Replace the clutch.

TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Flanged hexagonal-head screw for securing plate-pusher to flywheel M8	23.5 ± 2.5	(2.4 ± 0.2)
Flanged hexagonal-head screw for securing plate-pusher to flywheel M10	46.5 ± 4.5	(4.7 ± 0.4)
Hexagonal nut for securing clutch timing case to engine M8	46 ± 5	(4.6 ± 0.4)

TOOLS

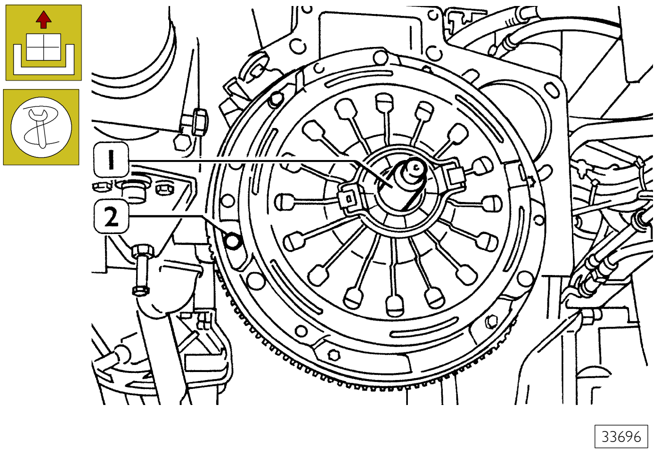
TOOL No.		DENOMINATION
99306010		Air drain apparatus for brakes and clutches system
99370280		Guide pin for clutch plate centring
99370306		Guide pin for clutch plate centring
99370547		Disengagement and re-engagement support for clutch assembly (to be applied to hydraulic jack)

505210 REMOVAL AND REFITTING

Removal

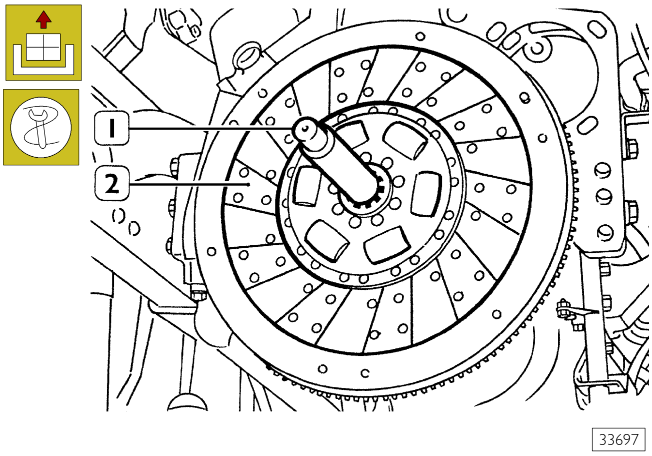
After removing the gearbox propeller shaft as described in the relevant sections, remove the clutch assembly as follows:

Figure 1



Insert clutch-centering pin 99370306 (for 12" - 13", 14"/15" clutches) or 99370280 (for 15/16" clutches) (1), unscrew assembly-securing screws (2) and withdraw the assembly.

Figure 2



Withdraw pin (1) and remove the driven plate (2).

Refitting

For refitting, reverse the removal operations.
Check conditions of fastening screws and replace the faulty ones.
Clean accurately threads and contact surfaces.

DRIVEN PLATE OVERHAUL

Upon overhauling the clutch plate, no repair is provided since components are only submitted to visual inspection to determine their wear conditions.
These checks and the overhauling procedures are specified in the following paragraphs.

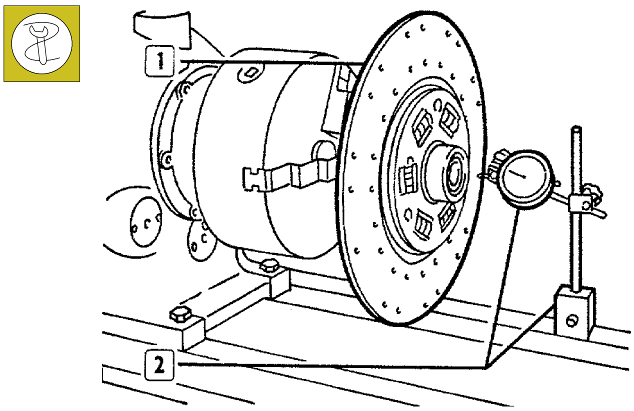
Damper hub check

Visually inspect the hub and check absence of breaks; spring drives shall not rotate into their seats and hub outline shall be within the tolerance values specified on drawing.
Replace the entire plate if the hub shows one of the above faults or hub grooved coupling sizes are out of tolerance values.

Friction gaskets

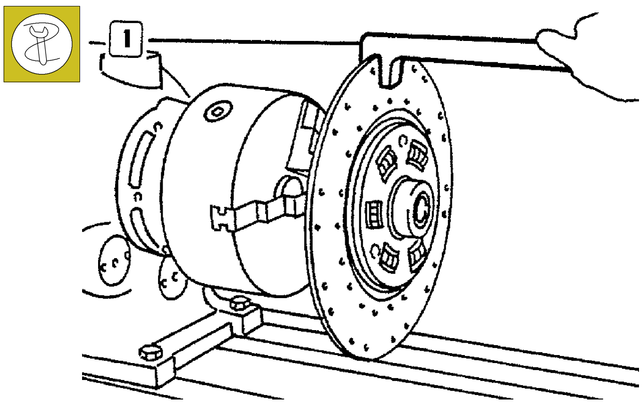
Replace the entire driven plate if gaskets are excessively worn or dirty with oil or grease, or burning traces or removal from the driving plate are visible.

Figure 3



Before fitting a new driven plate, check its centring as follows:
Place the driven plate (1) on a lathe, then using a magnetic-base gauge (2), check that the plate surface is not out of line at any point.
Max. tolerance for driven plate is 0.20 mm.

Figure 4



If plate is out-of-line, use a fork wrench (1) as shown in the figure.

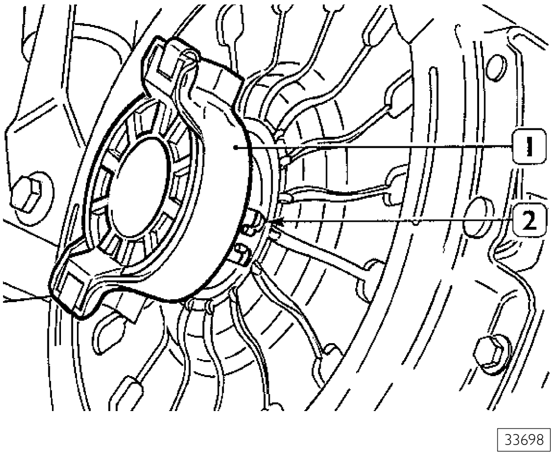
BLEEDING AIR FROM CLUTCH CIRCUIT

After any repair operations on clutch assembly or when changing oil, bleed air from hydraulic clutch circuit.
For this purpose, use tool 99306010 and operate on the bleed valve set on the operating cylinder.

If tool is missing, bleed manually.

505254 THRUST BEARING REMOVAL - REFITTING

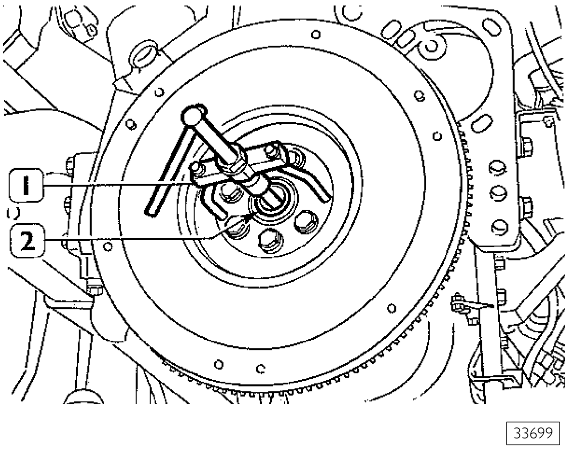
Figure 5



Use the proper pliers to open the safety split ring (2) and withdraw the thrust bearing (1).
For refitting reverse removal operations.

540852 REPLACING CLUTCH SHAFT SUPPORT BEARING

Figure 6



Use the universal extractor 99348004 (1) and remove bearing (2).
For refitting use the proper beater.

If fluid leaks are found from master and operating cylinders use the provided kits to repair.

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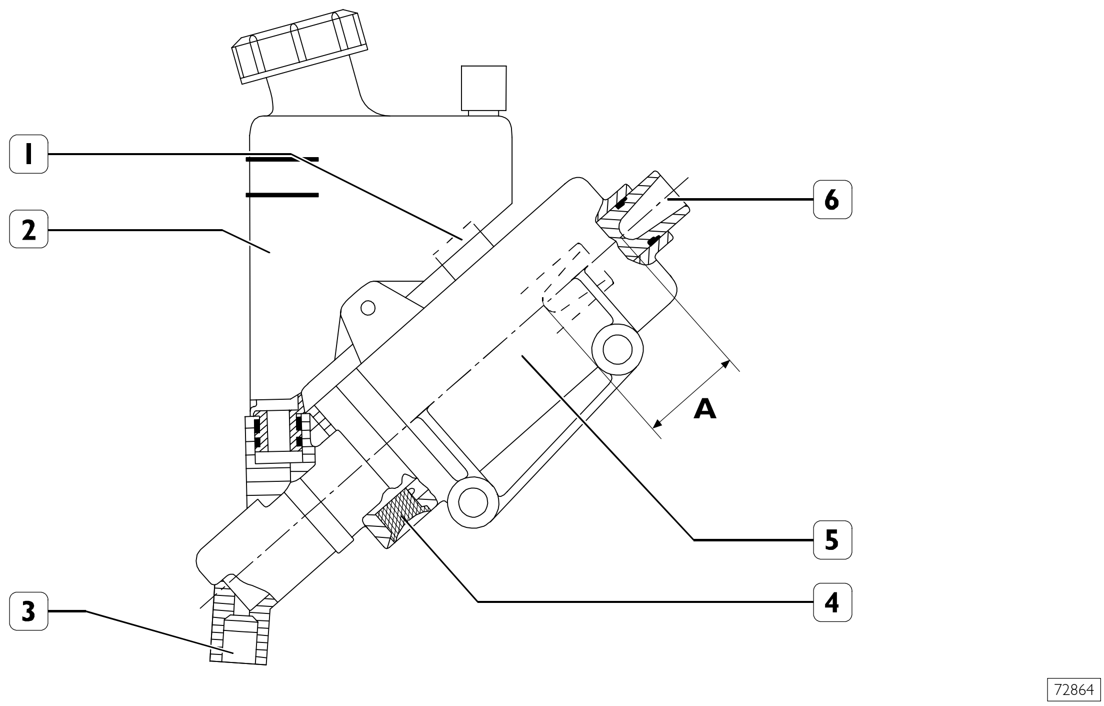
HYDRAULIC CONTROL

The hydraulic control to disengage the clutch can, depending on the model, be solely hydraulic or pneumatically servo-assisted. The fluid required by the system to work is contained in a reservoir integrated in the master cylinder.

Servo-assisted master cylinder (14" - 13"/14" clutches)

This cylinder uses a pneumatically servo-assisted operating system whose action is modulated by a spring load sensor with a threshold. The first portion of the piston stroke, under the triggering threshold, is not assisted; whereas, above this threshold, the air pressure, suitably modulated by a system of valves, is triggered to produce an action with constant pressure.

Figure 7



A: Maximum stroke = 38 mm

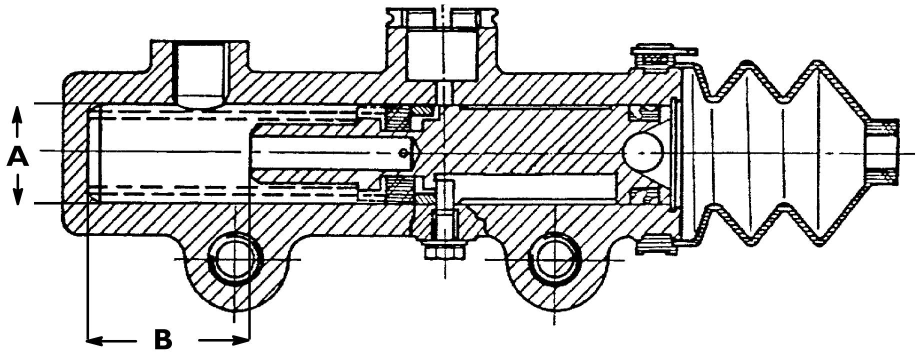
1. Air supply coupling - 2. Fluid reservoir - 3. Oil outlet - 4. Air exhaust - 5. Master cylinder - 6. Piston

Connections

Air supply pressure (Coupling 1)	10 bar
Hydraulic pressure (Coupling 3)	50 bar

Master cylinder (15"/16" clutches)

Figure 8

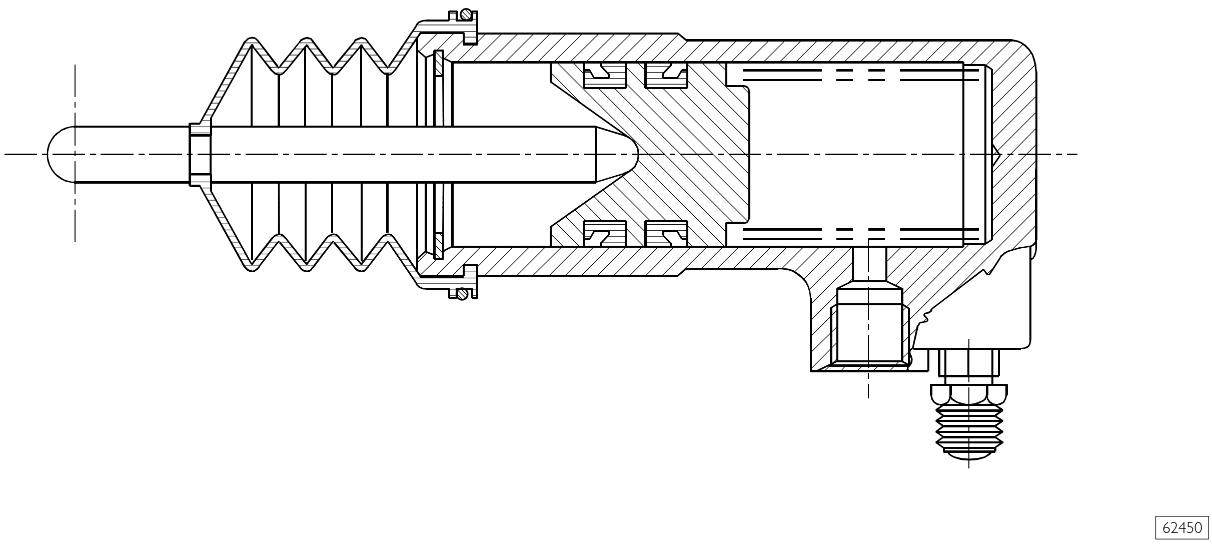


CROSS-SECTION OF MASTER CYLINDER

A. 31.75 mm - B. Stroke 42 mm

Slave cylinder (14" - 13"/14" clutches)

Figure 9



CROSS-SECTION OF SLAVE CYLINDER

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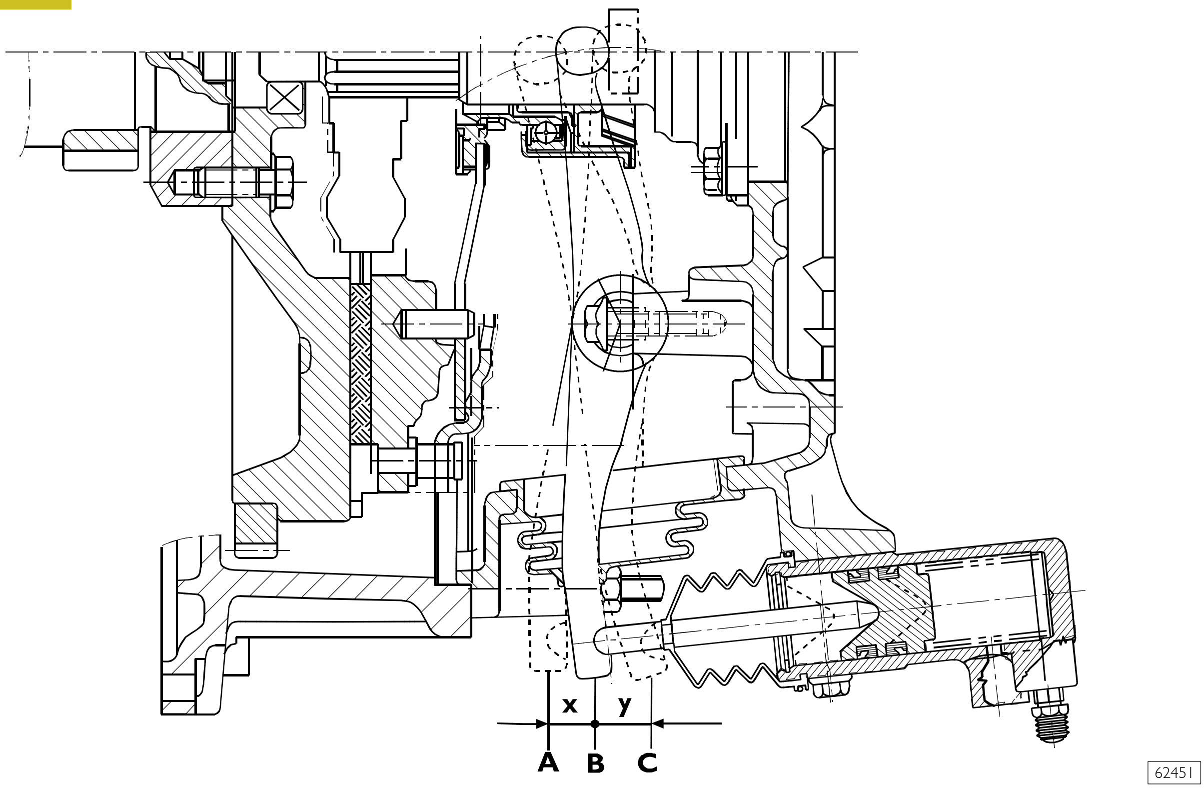
Clutch wear layout (13"/14" - 14" clutches)

Figure 10

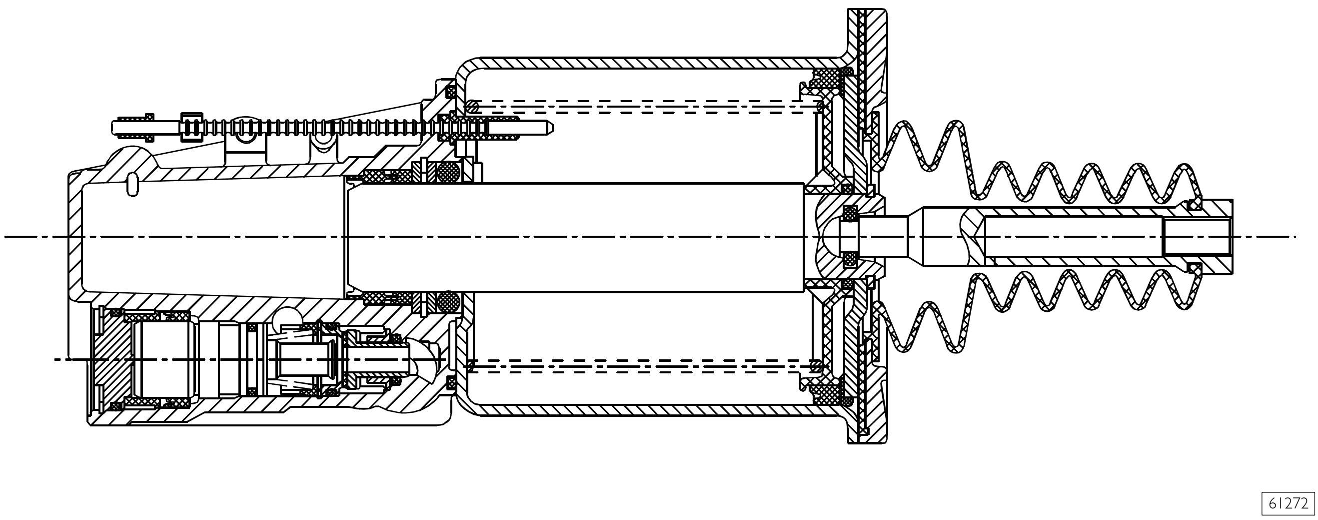


A. Maximum disengagement position – B. Nominal position – C. Position with maximum worn clutch

Clutch / Stroke (mm)	x	y
13"/14" VALEO	17.76	18.69
14" VALEO	17.76	18.69

Operating cylinder (15"/16" clutches)

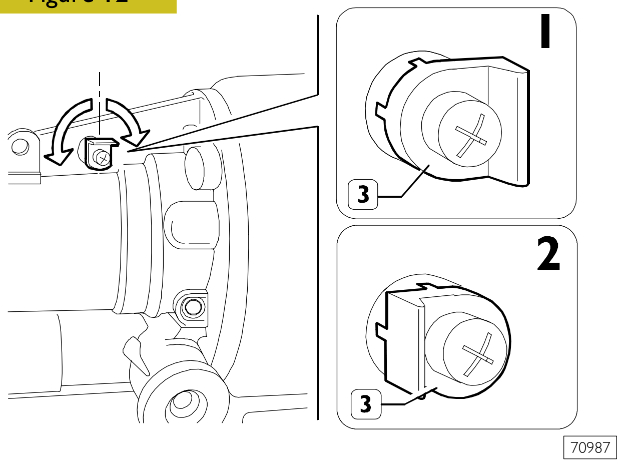
Figure 11



OPERATING CYLINDER SECTION

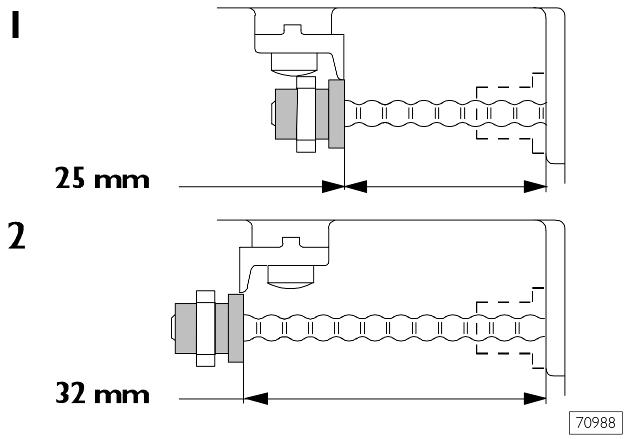
WEAR INDICATOR REFITTING AND ADJUSTMENT (15/16” clutches)

Figure 12



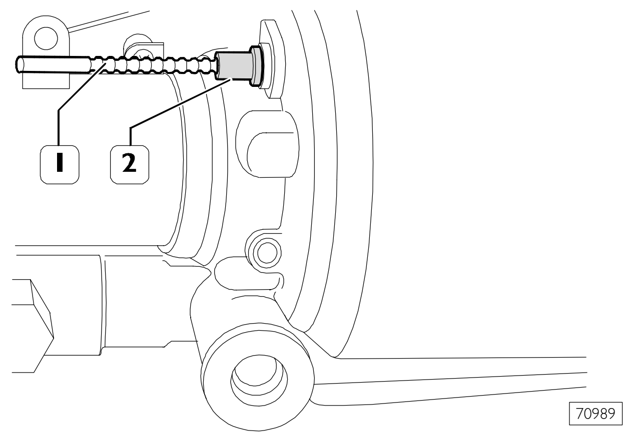
Remove the plastic rod, the rubber seal and the metal stop. Turn “worn clutch” mark (3) on the new servo clutch from rest position to 90° LH or RH, according to clutch manufacturer.

Figure 13



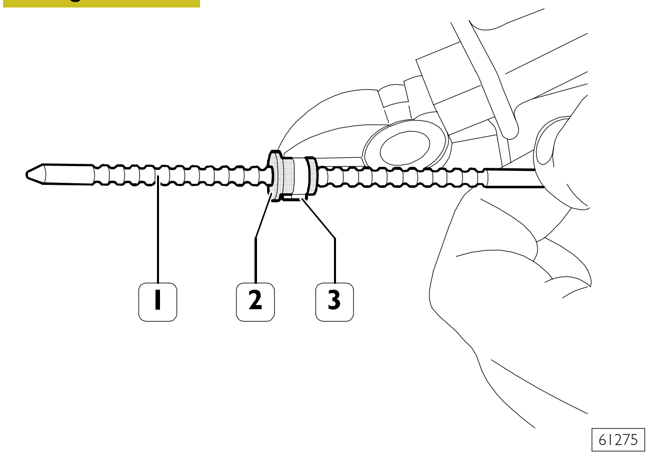
Position 1: wear/stroke (Valeo, Borg & Beck/AP) 25 mm.
Position 2: wear/stroke Fichtel & Sachs) 32 mm.

Figure 14



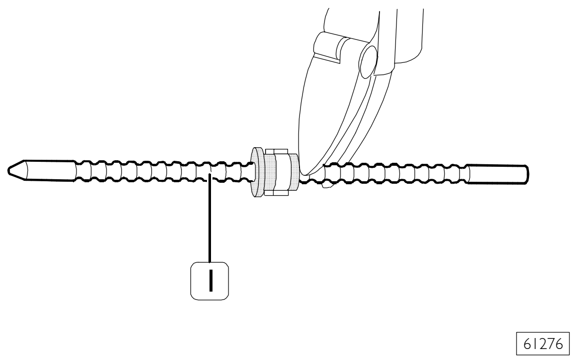
Fit the plastic rod (1) against the servo clutch stop.
Push the seal (2).

Figure 15



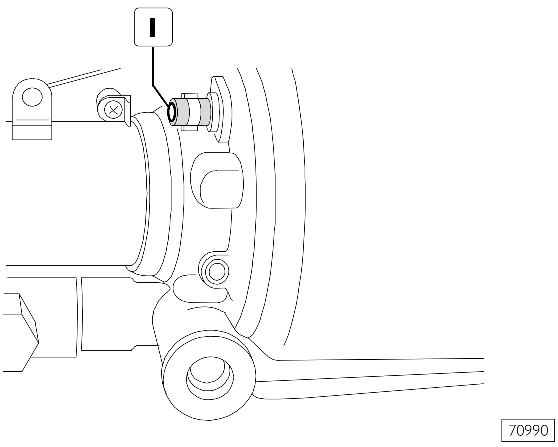
Remove the plastic rod (1) from the servo clutch; the rubber seal (2) shall not move.
Secure the seal (2) with the metal stop (3).

Figure 16



Cut the rear section of the plastic rod (1).

Figure 17

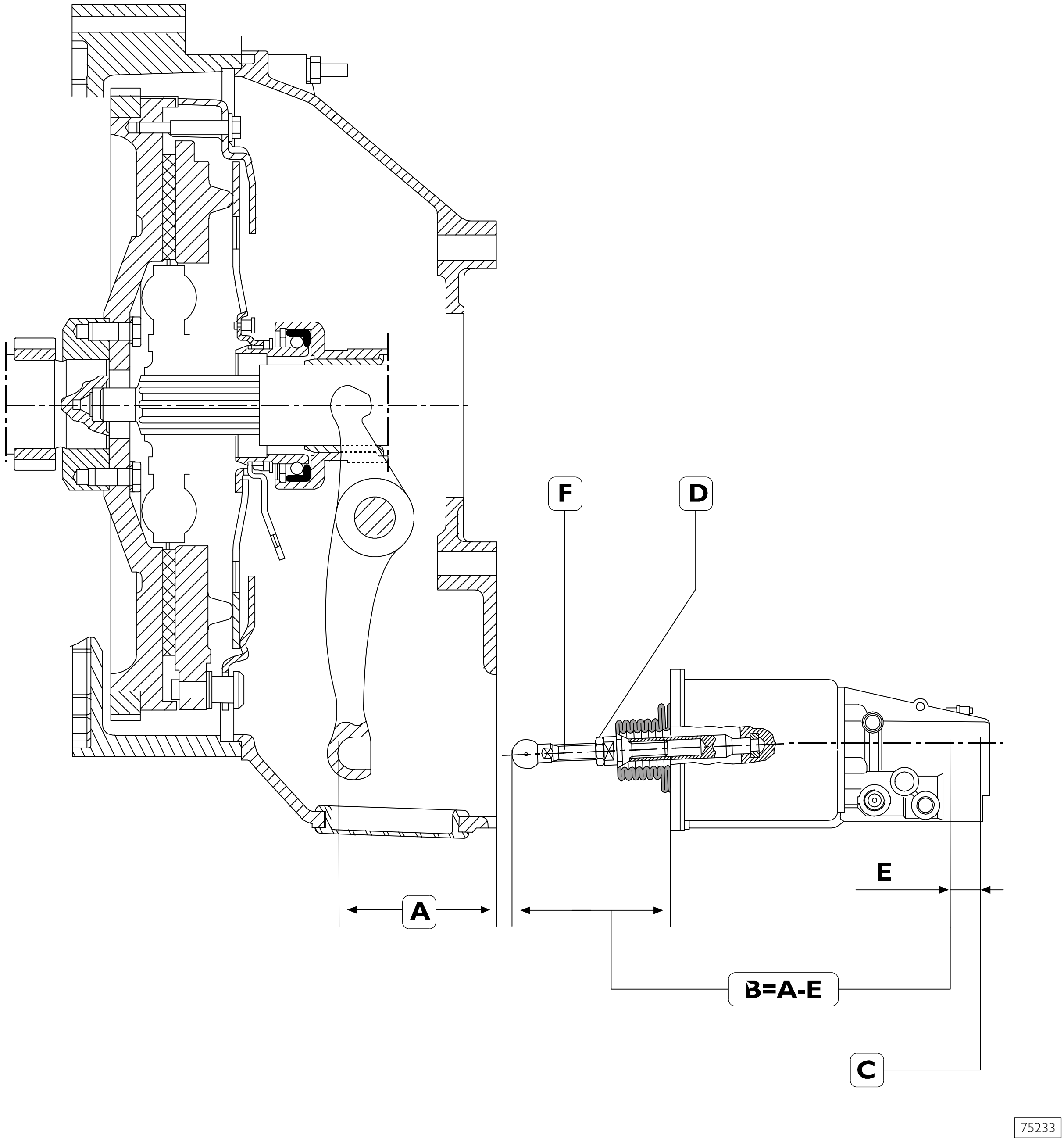


Fit the plastic rod (1) up to the servo clutch stop.

When the clutch plate is worn the plastic rod moves to the wear mark.
When replacing the clutch, fit a new wear indicator kit and adjust it as previously described.

505272 ADJUSTING OPERATING CYLINDER PUSH ROD (New 15/16" clutch)

Figure 18



Proceed as follows:

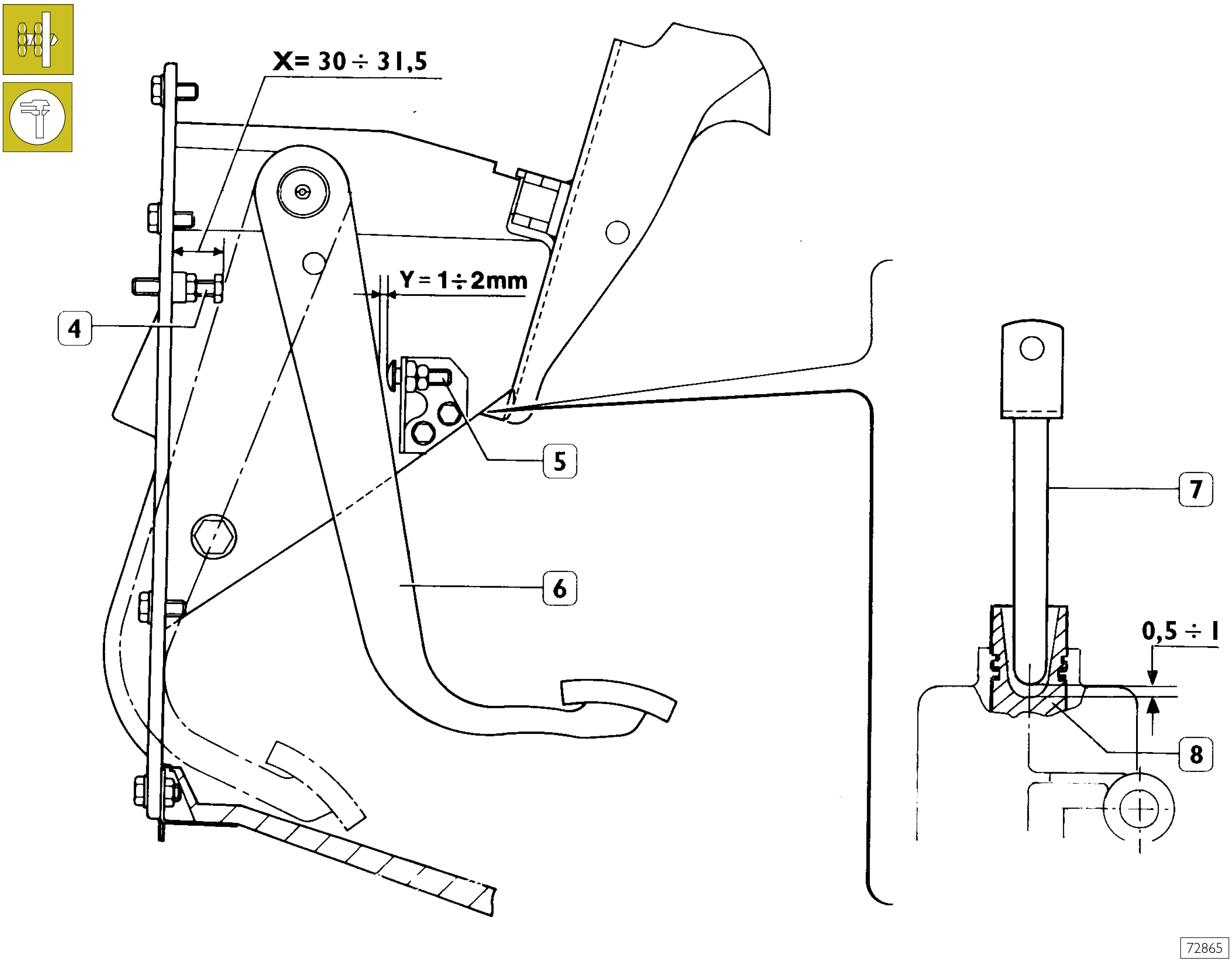
- measure the distance (A) between the bottom of the spherical cavity of the clutch lever and the servo clutch fixing surface;
- press the ball push rod until it reaches the stop (C);
- loosen the nut (D);
- tighten or loosen rod (F) until obtaining distance (B).

B = A - E
E = 25 mm (VALEO - BORG&BECK clutch)
32 mm (FICHTEL&SACHS clutch)

It is essential to carry out this setting in order that the worn disc sensor, positioned inside the operating cylinder, is enabled to operate when the friction seals are worn out.
Disc wear (90% of friction material) is indicated by a significant load increase on the pedal during clutch release.

CHECKING AND ADJUSTING THE CLUTCH PEDAL (14" - 13"/14" clutches)

Figure 19



Clutch pedal stop

Check distance **X** between support and screw (4) end; it must be 30 to 31.5 mm, otherwise tighten or loosen screw (4).

Clutch pedal idle stroke

Depress the clutch pedal (6) so as to bring rod (7) in contact with master cylinder piston (8).
Under such condition, check distance **Y** between clutch pedal (6) and screw (5) that must be 1-2 mm, otherwise tighten or loosen screw (5).
Distance **Y** corresponds to 0.5 to 1 mm clearance between rod (4) and piston (8) when clutch pedal (6) is in contact with screw (5).

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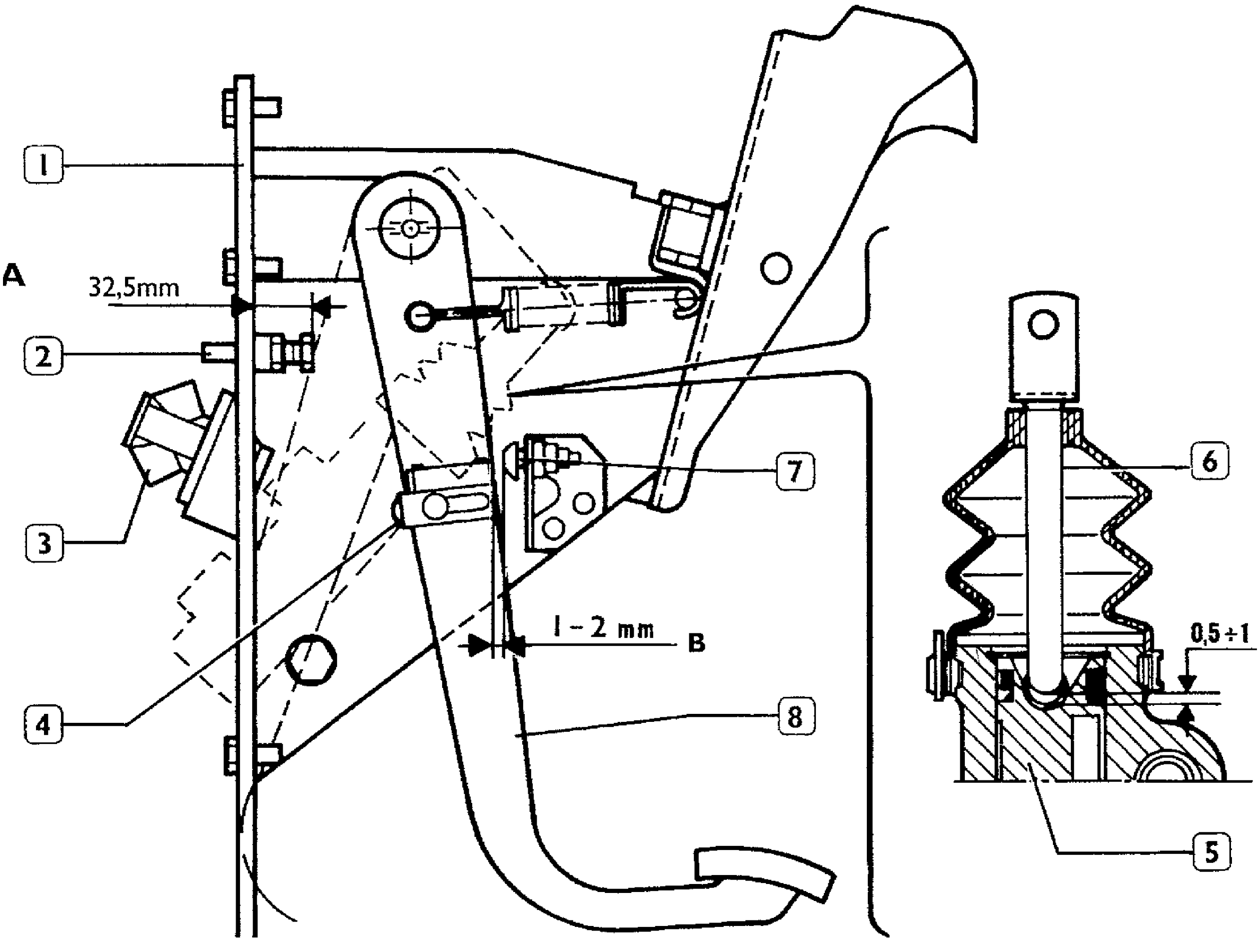
CHECKING AND ADJUSTING THE CLUTCH PEDAL (15"/16" clutches)

Figure 20



Clutch pedal stop

Check distance **A** between pedal support (1) and screw (2) end; it must be approx. 32.5 mm, otherwise tighten or loosen the screw.

Clutch pedal idle stroke

Depress the clutch pedal (8) so as to bring rod (6) in contact with master cylinder piston (5).
Under such condition, check distance **B** between clutch pedal (8) and screw (7) that must be 1-2 mm, otherwise tighten or loosen screw (7).
Distance **B** corresponds to 0.5 to 1 mm clearance between rod (6) and piston (5) when the clutch pedal (8) is in contact with screw (7).

SECTION 4

Gearbox

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❑ Gearbox control tie-rods adjustment	5
GEARBOX 2855.6	9
GEARBOX 2865.6	45
GEARBOX 2870.9	79
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GEARBOX FSO5206B	185

DIAGNOSTICS

Main gearbox operating anomalies:

1 - Noises;
2 - Spontaneous gears disengagement and engagement irregularities;
3 - Gears engagement difficulty and hardness.

1 NOISES

Cause		Remedy
Excessive clearance between gears.	YES →	Revise the gearbox and replace worn gears.
NO ↓		
Worn gears, bearings, synchronising rings and coupling bodies.	YES →	Revise the gearbox and replace parts gears.
NO ↓		
Insufficient lubricating oil level in box.	YES →	Add **TUTELA ZC 90** oil restoring the exact level.
NO ↓		
Insufficient oil pressure (only for gearboxes equipped with oil pump).	YES →	Replace the oil pump.

2 SPONTANEOUS GEARS DISENGAGEMENT AND ENGAGEMENT IRREGULARITIES

Cause		Remedy
Exact engagement manoeuvre.	YES →	Completely engage the gears before releasing the clutch pedal.
NO ↓		
Forks breakage.	YES →	Disassemble the gearbox, revise the parts and carry out necessary replacements.

(continued)

Worn synchronising rings.	YES →	Check gears and sliding sleeves for gears engagement, replacing the deteriorated ones; replace synchronising rings.
NO ↓		
Faulty epicyclic reduction gear operation (gearbox 2870.9).	YES →	Check and replace the deteriorated parts.

3 GEARS ENGAGEMENT DIFFICULTY AND HARDNESS

Fork hardening on rod.	YES →	Disassemble gearbox case and search for the hardening reason; carry out the suitable repairs.
NO ↓		
Sliding sleeves obstructed when displacing.	YES →	Check and carry out suitable repairs.
NO ↓		
Unsuitable lubricating oil quality inserted into the case.	YES →	Discharge the oil and refill with **TUTELA ZC 90** oil.

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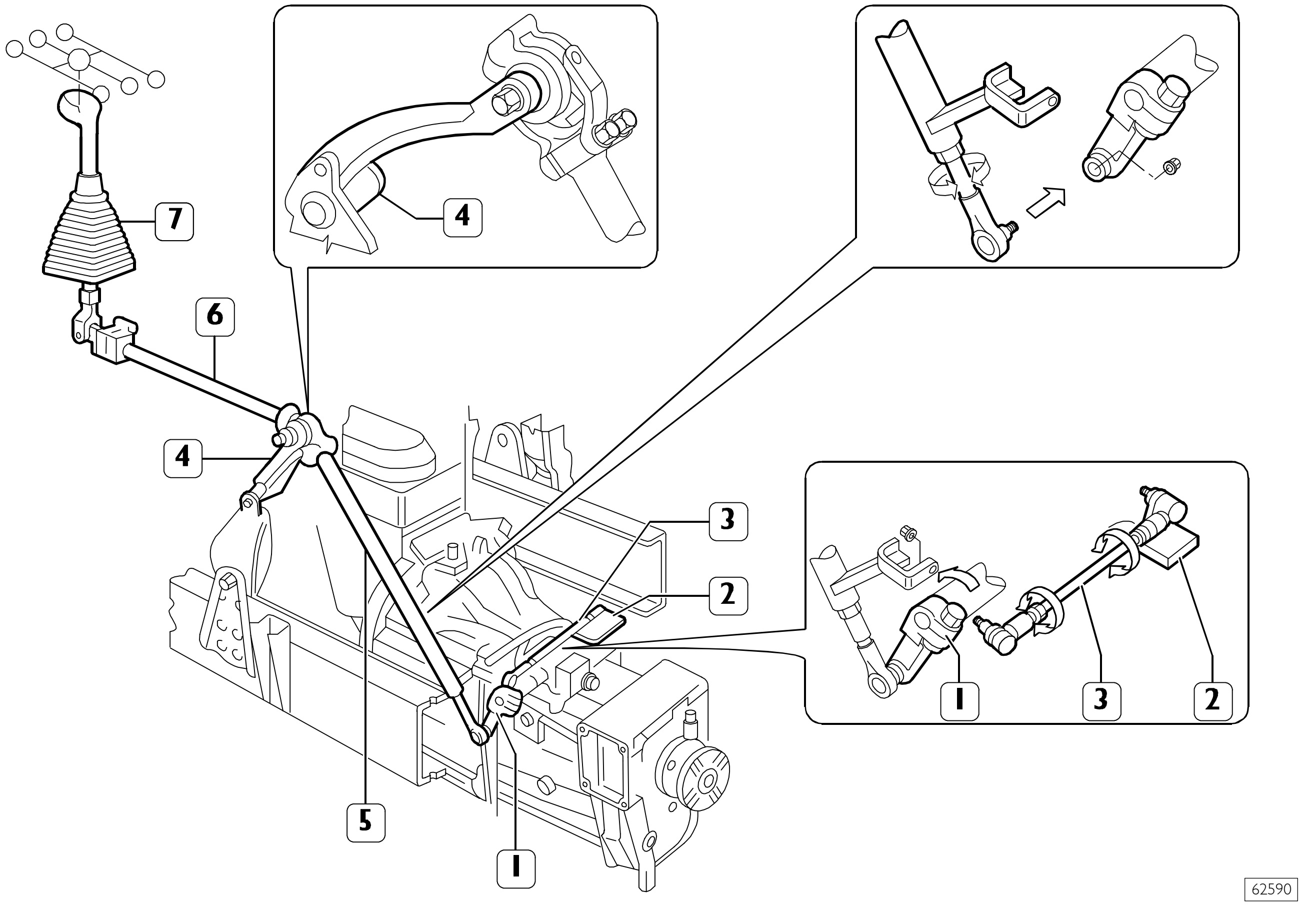
Gears control connection

The gears-controlling tie-rods bearing support is secured in the same chassis point on all models in the EuroCargo range, while the adjustment tie-rod reaction plate is secured to the gearbox gears control in different positions according to the gearbox itself.

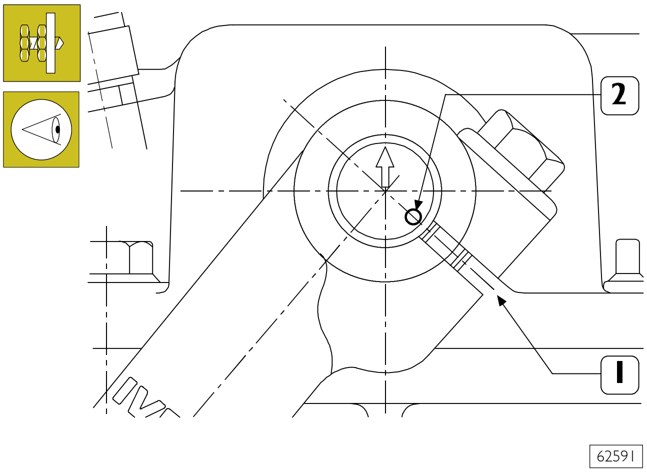
Figure 1



1. Gears control lever – 2. Reaction plate secured to gears control – 3. Adjustment tie-rod – 4. Bearing support – 5. Adjustable fixed tie-rod – 6. Telescopic tie-rod – 7. Gears lever

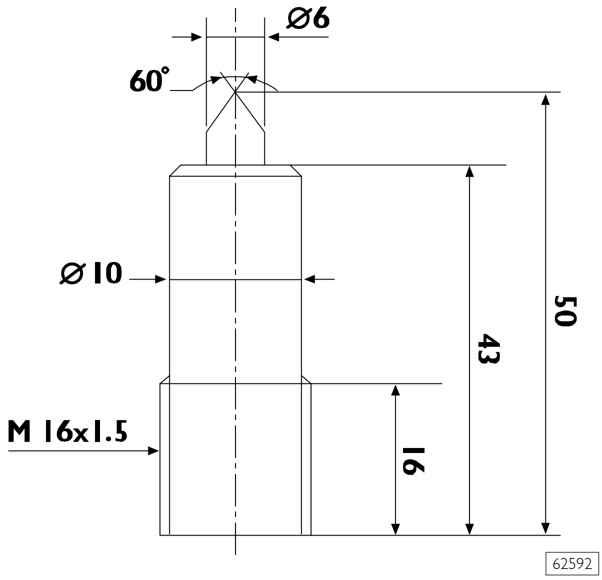
Gearbox control tie-rods adjustment

Figure 2



- ❑ Check or position, if disassembled, the gears control lever on the transverse control: upon assembling the lever, the milling (1) must correspond with the reference notch (2) punched on the transverse shaft;
- ❑ position the gearbox in idle;
- ❑ in order to be sure about such operation, it is enough to longitudinally push the transverse rod: if the rod performs the movement, it means that it is in idle.

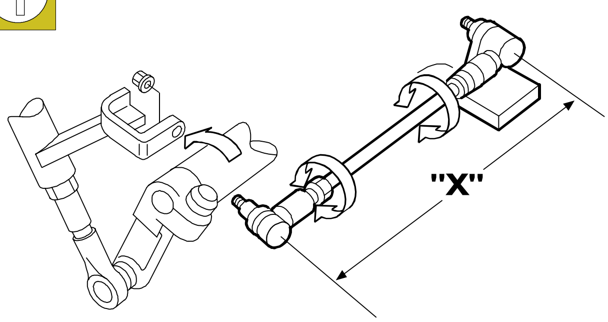
Figure 3



62592

- ❑ It is necessary that the gearbox remains in such a condition for the whole operation. In order to be sure of that, in place of the Idle-R.M. switch, a screw can be applied with equal sizes (M 16x1.5 mm) with its bit chamfered at 60° that, completely screwed, blocks any transverse rod movement for gearboxes 2855.6 and 2865.6 and the internal controls for gear boxes 2870.9 and 2895.9; it is anyhow sufficient to check whether the neutral condition remains during the different stages (avoiding any forcing on the lever);

Figure 4



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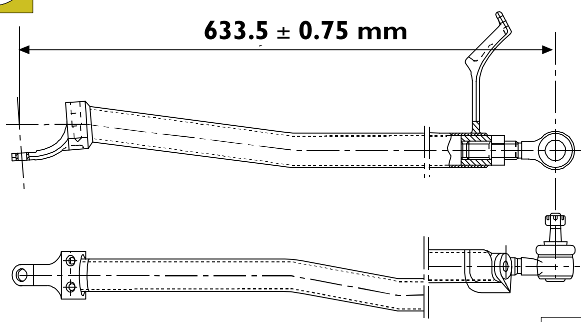
- ❑ position the reaction plate on gears control and screw the securing screws without completely tightening them;
- ❑ check/adjust the length (X) of the gearbox control reaction tie-rod that must be 329 mm;
- ❑ verify/adjust the fixed adjustable tie-rod length complying with the shown dimensions (see Figures 5, 6, 7 and 8) with a ± 0.75 mm tolerance (corresponding to 1/2 threading turns).

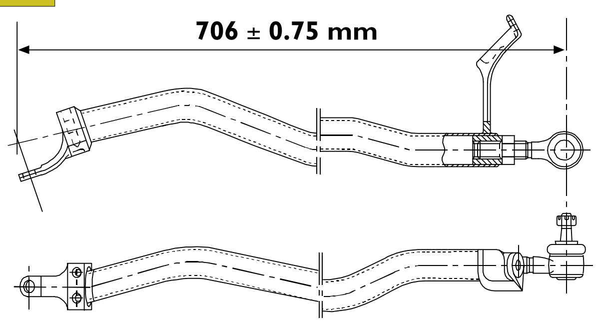
Figure 5



70992

MODELS 120EL17

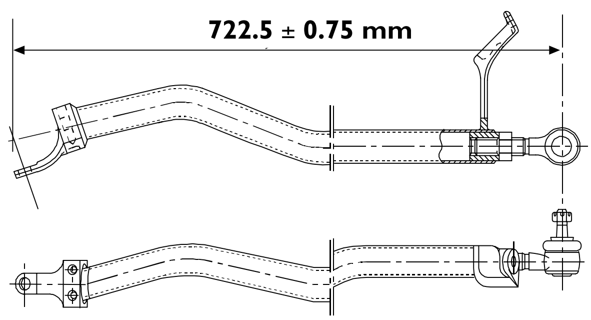
Figure 6



70993

MODELS 120EL21

Figure 7



70994

MODELS 130E18 - 150E21 - 180E21

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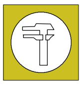
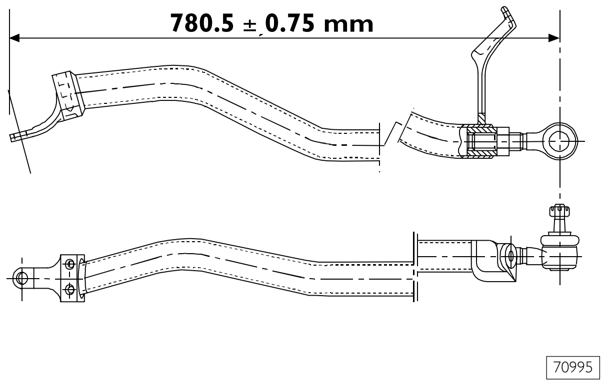
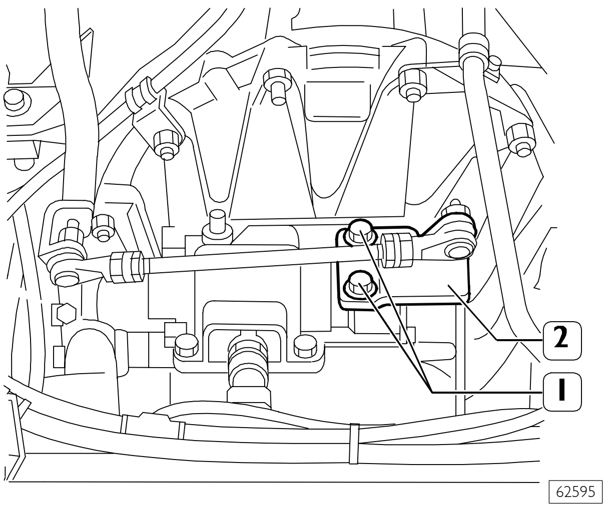
Figure 8





MODELS 130E24-28 - 150E24-28 - 260E28KE - 180E24-28

Figure 9



- close securing screws (1) of the reaction plate (2) on gear control;
- loosen the screw previously inserted to block the gearbox in idle position and refit the Idle-R.G. switch.

5302 Gearbox 2855.6

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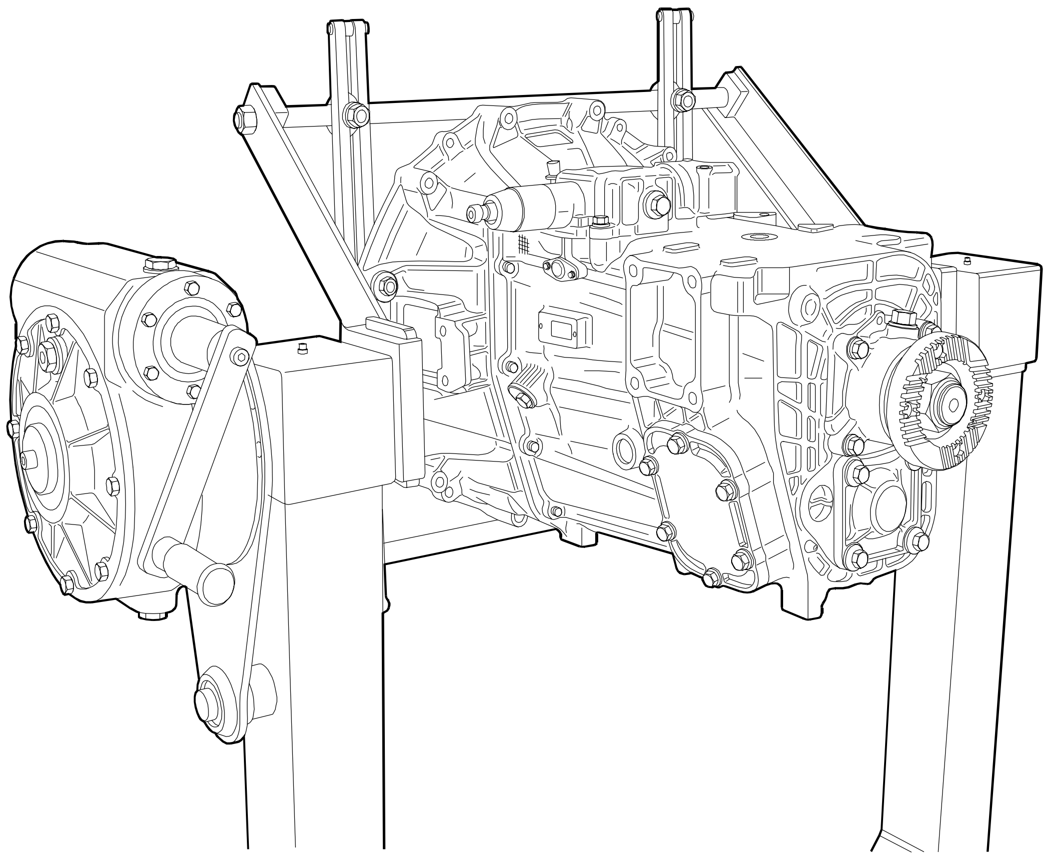
DESCRIPTION

The IVECO 2855.6 gearbox is of the mechanical type with 1st, 2nd gear engagement through a double-cone synchronising ring and 3rd, 4th, 5th and 6th gear engagement with free-ring synchronising rings. The reverse motion engagement is with a quick-connection sliding sleeve.
The gearbox case is made of light alloy and is composed of a front half-case and a rear half-case.
Three openings are obtained in the rear half-case for the possible application of a power takeoff.
Motion transmission is realised through a series of gears, always meshed and with helical teeth.

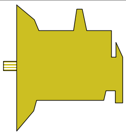
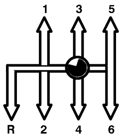
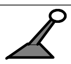
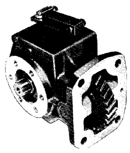
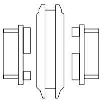
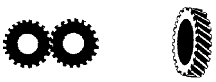
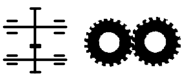
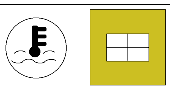
The gears are keyed or obtained on four shafts: motion entry, primary, secondary and reverse motion shafts.
The gear obtained on the motion entry shaft and those keyed on primary and reverse motion shafts idly rotate on cylindrical roller cages.
Motion entry shaft and primary shaft are supported by ball bearings in the gearbox case.
The secondary shaft is front and rear supported by tapered-roller bearings that are axially adjustable through an adjustment ring.
The gears engagement and selection control is mechanical.

Figure 1



IVECO 2855.6 GEARBOX ASSEMBLY

SPECIFICATIONS AND DATA

	GEARBOX	2855.6
	Type	Mechanical
	Gears	6 forward gears and reverse gear
	Gears engagement control	Mechanical
	Power takeoff	Upon request
	Gears engagement: 1st ⇒ 2nd 3rd ⇒ 6th Reverse gear Gears anti-disengagement	 Double-cone synchronizer Free-ring synchronizer Quick-connection type Sliding sleeve holding through rollers and springs.
	Gears	With helical teeth
	Gear ratio First Second Third Fourth Fifth Sixth Reverse gear	 1 : 6.433 1 : 3.643 1 : 2.308 1 : 1.484 1 : 1.000 1 : 0.783 1 : 5.630
	Oil type Amount	**TUTELA ZC 90** 5 kg. (5.5 litres)
	Fixed hubs assembly temperature	100°C to 130°C

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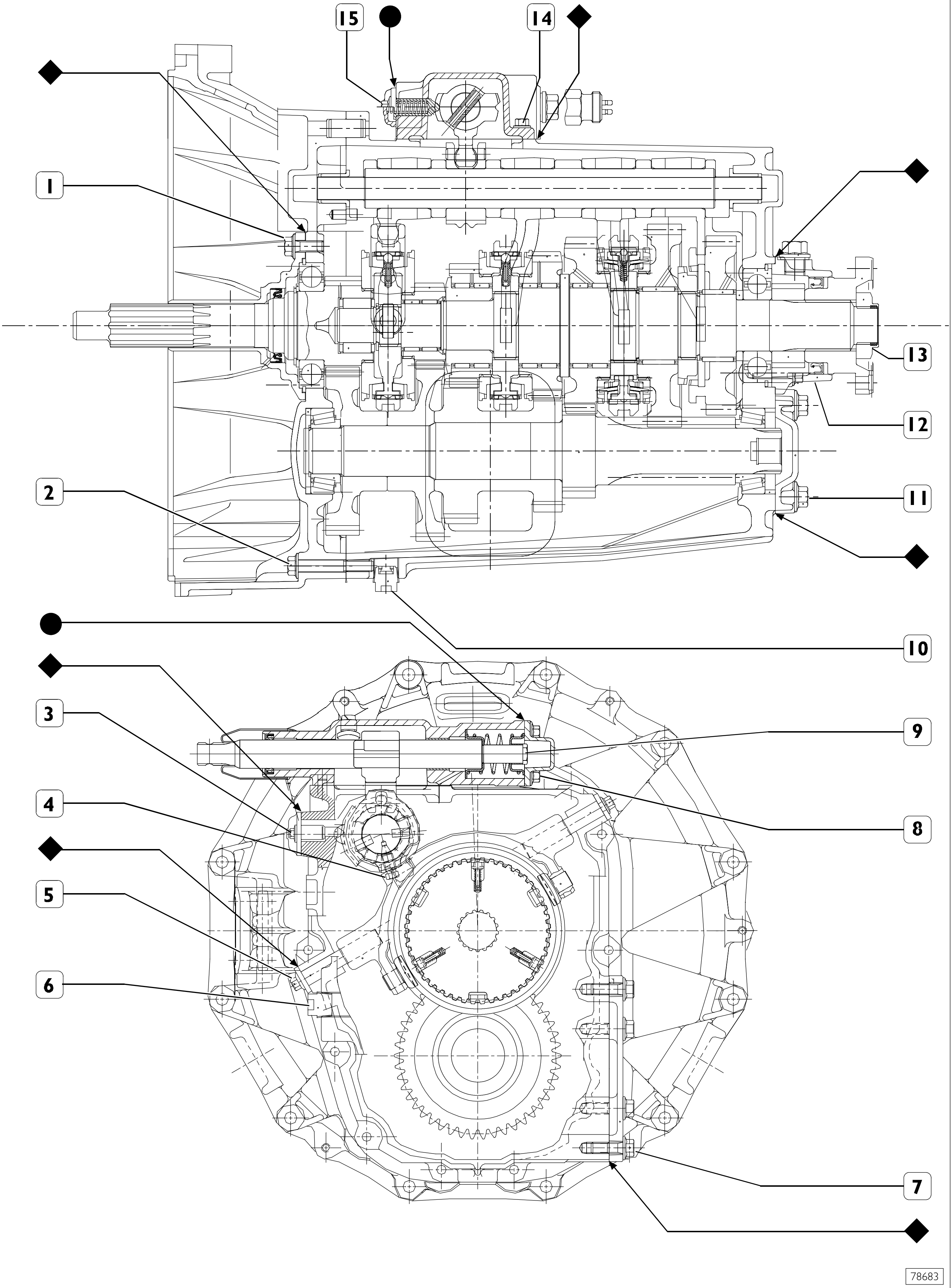
	Secondary shaft bearings	With tapered rollers
	Secondary shaft bearings pre-loading adjustment	Through rings
	Secondary shaft pre-loading adjustment rings thickness	4.0 - 4.1 - 4.2 - 4.3 - 4.4 - 4.5 - 4.6 - 4.7 - 4.8 - 4.9 - 5.0 - 5.1 - 5.2 - 5.3 Supplied in a kit
	Secondary shaft bearings assembly temperature	85°C
	Secondary shaft bearings adjusting rings thicknesses	2.40 - 2.45 - 2.50 - 2.55 - 2.60 - 2.65 -2.70 - 2.75 - 2.80

Figure 2

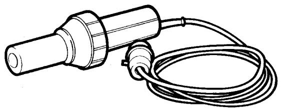
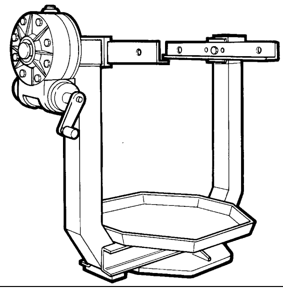
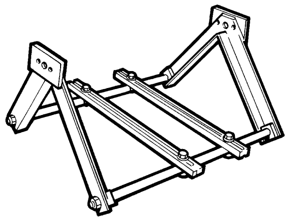
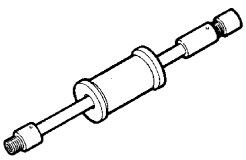
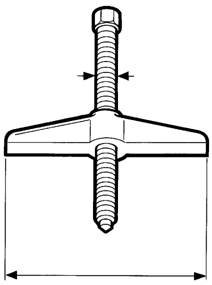
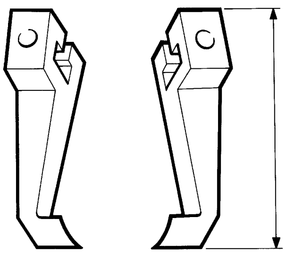


TIGHTENING TORQUES

PART		TORQUE	
		Nm	(kgm)
1	Flanged hexagonal head screw for securing front cover	32 ± 3	(3.3 ± 0.3)
2	Flanged hexagonal head screw for joining half-boxes	45.5 ± 4.5	(4.6 ± 0.5)
3	Release-proof tip cover fastening screw	22.5 ± 2.5	(2.3 ± 0.2)
4	Screw for securing hub to fork control rod	39 ± 2	(4.0 ± 0.2)
5	Flanged hexagonal head screw for pin on 5th - 6th fork	14.5 ± 1.5	(1.5 ± 0.1)
6	Threaded plug with external driving hexagon for oil level	27.6 ± 2,5	(2.8 ± 0.3)
7	Flanged hexagonal head screw for securing covers on side power takeoff connection windows	38 ± 4	(3.9 ± 0.4)
8	Flanged hexagonal head screw for securing transverse axle cover on control	19 ± 2	(1.9 ± 2)
9	Transverse axle screw	30 ± 3	(3.0 ± 0.3)
10	Threaded plug with external driving hexagon for oil discharge	27.5 ± 2.5	(2.8 ± 0.3)
11	Flanged hexagonal head screw for securing rear cover on secondary shaft	58 ± 6	(5.9 ± 0.6)
12	Flanged hexagonal head screw for securing rear cover on primary shaft	43 ± 4	(4.4 ± 0.4)
13	Output flange locking nut on primary shaft	467 ± 23	(47.6 ± 2.3)
14	Flanged hexagonal head screw for securing upper cover supporting external controls	33.5 ± 3.5	(3.4 ± 0.4)
15	Flanged hexagonal head screw for securing spring check flange on external control	19 ± 2	(1.9 ± 2)
-	Flanged hexagonal head screw for securing upper cover for internal controls (only for right-hand drive)	45.5 ± 4.5	(4.6 ± 0.5)
-	Flanged hexagonal head screw for securing clutch disengagement lever support	45.5 ± 4.5	(4.6 ± 0.5)

* Apply thread-braking LOCTITE 270 on the screw
♦ Apply liquid gasket LOCTITE 510 sealant
● Apply liquid gasket LOCTITE 518 sealant.

TOOLS

TOOL No.		DENOMINATION
99305121		Hot-air apparatus
99322205		Rotating stand for assembly revision (capacity 1000 daN, couple 120 daN/m)
99222225		Assembly bearing support (to be applied on stand 99322205)
99340205		Percussion extractor
99341003		Simple-effect bridge
99341009		Pair of brackets

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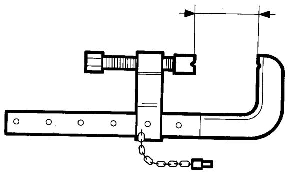
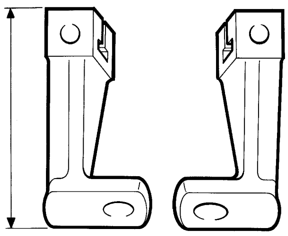
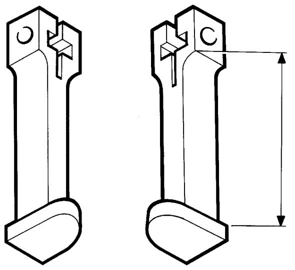
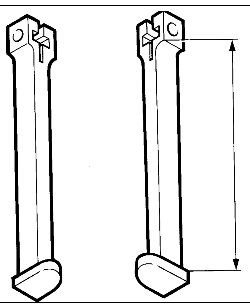
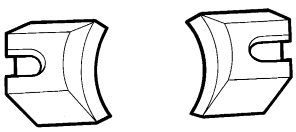
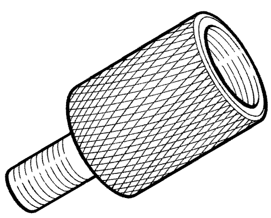
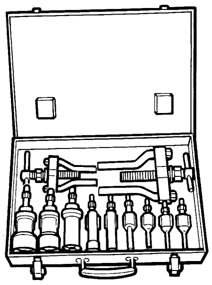
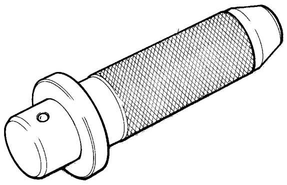
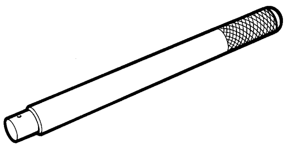
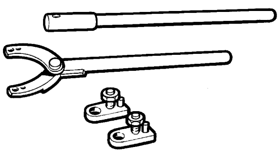
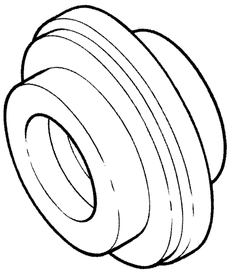
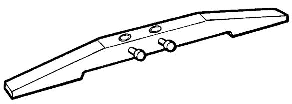
TOOLS

TOOL No.		DENOMINATION
99341015		Clamp
99341017		Pair of brackets with hole
99341019		Pair of tie-rods for holds
99341020		Pair of tie-rods for holds
99341025		Holds
99342143		Peg for removing reverse gear shaft (use with 99340205)

TOOLS

TOOL No.		DENOMINATION
99348004		Universal extractors for interiors 5 to 70
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with flange check extension
99370349		Keyer for drive shaft front gasket assembling (use with 99370006)
99370466		Comparator-holder basis for secondary shaft bearings adjustment (use with 99395604)

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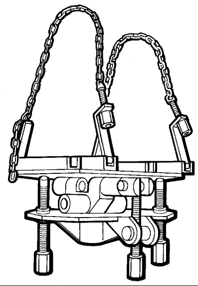
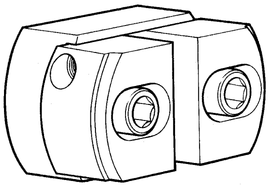
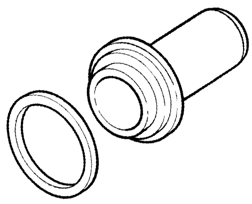
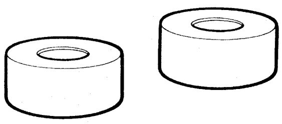
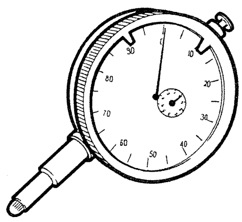
TOOLS		
TOOL No.		DENOMINATION
99370629		Gearbox bearing support during vehicle disconnection and re-connection
99374092		Beater for external bearings race assembling (69-91) (use with 99370007)
99374201		Keyer for assembling gasket on rear gearbox cover
99396031		Calibrated rings for secondary shaft bearings adjustment (use with 99370466).
99395604		Comparator (0 – 10 mm)

GEARBOX 2855.6 DISENGAGEMENT/RE-ENGAGEMENT

Before carrying out disengagement/re-engagement operations, disconnect battery cables and place the vehicle under safety conditions.

Disengagement

Lift the calender and turn the cabin over.

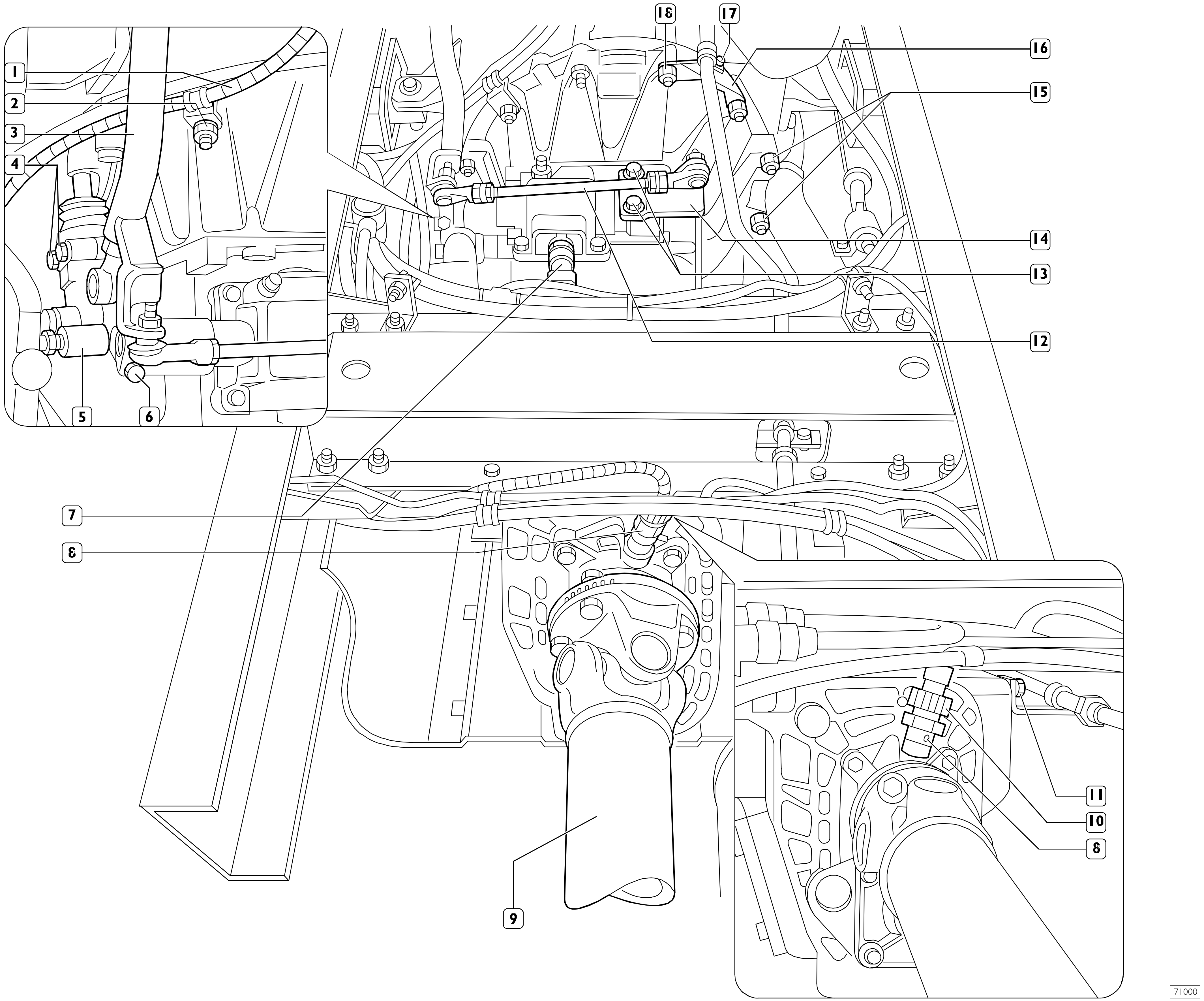
- loosen securing bolt (17), unscrew securing nuts (18) and detach air piping supporting bracket (16);
- unscrew securing nut (2) and detach air piping supporting bracket (1);
- unscrew securing nuts (13) and detach bracket (14) of reaction tie-rod (12);
- loosen securing screw (6) and detach from gearbox the gears control lever completed with tie-rod (3) and reaction tie-rod (12);
- disconnect reverse gear switch electric connection (7);
- unscrew securing nuts (15) of clutch bell to engine that will be able to be reached with difficulty from the lower vehicle part.
- rotate deadening guard locking rivets below the gearbox and remove the deadening guard;
- detach transmission shaft (9) as described in the related section;
- unscrew securing screws (4) and detach clutch control operating cylinder (5);
- disconnect electric connection (10) of odometer sensor (8);
- unscrew securing screw (11) and detach air piping support bracket;
- place an hydraulic jack equipped with support 99370629 under the gearbox;
- unscrew the remaining securing nuts of clutch bell to engine, move the gearbox backwards and lowering the jack remove it from below the vehicle.

Re-engagement

Suitably reverse the operations carried out for disengagement and tighten securing screws and nuts at the required torque.

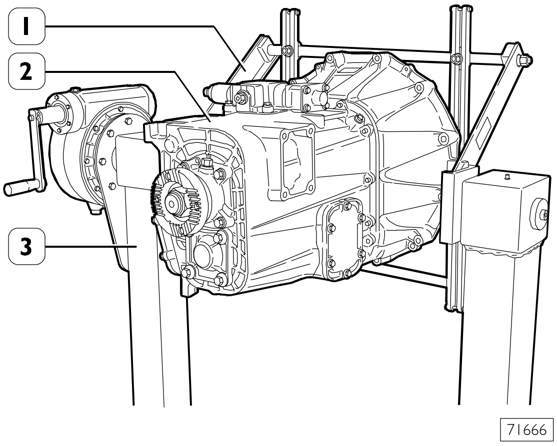
Upon re-engaging the gearbox, pay attention that the clutch control lever fork is correctly meshed to the thrust bearing.

Figure 3



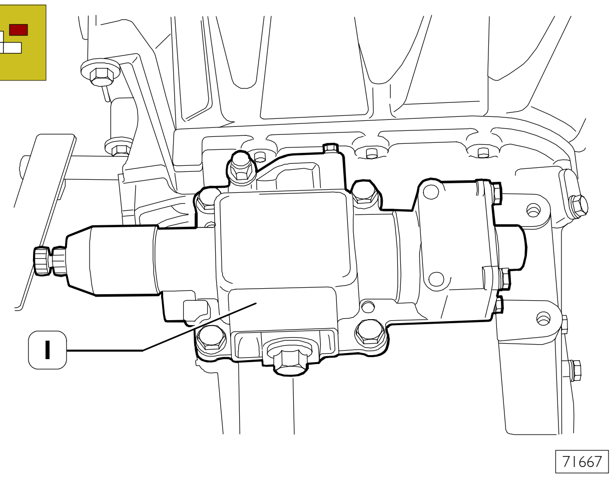
GEARBOX DISASSEMBLY

Figure 4



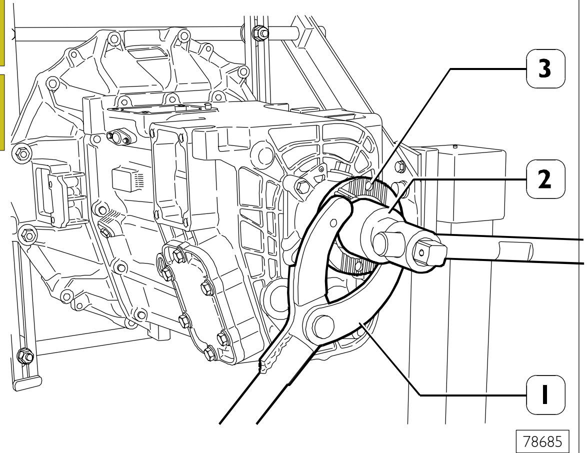
Place gearbox (2) on rotating stand 99322205 (3) equipped with brackets 99322225 (1) and discharge lubrication oil.

Figure 5



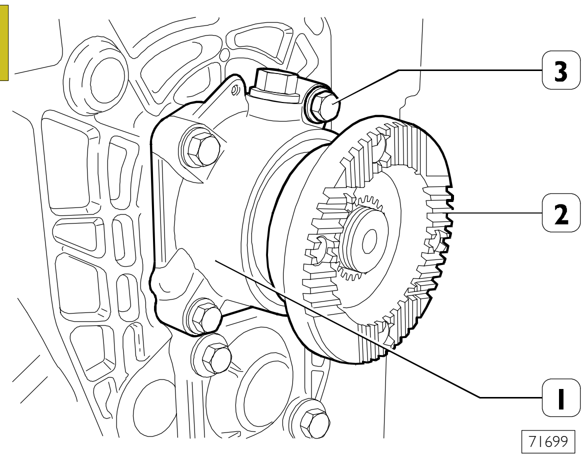
Disassemble the external control box (1).

Figure 6



Apply reaction lever 99370317 (1) on motion outlet flange (3) and unscrew nut on primary shaft with wrench 99355081 (2).

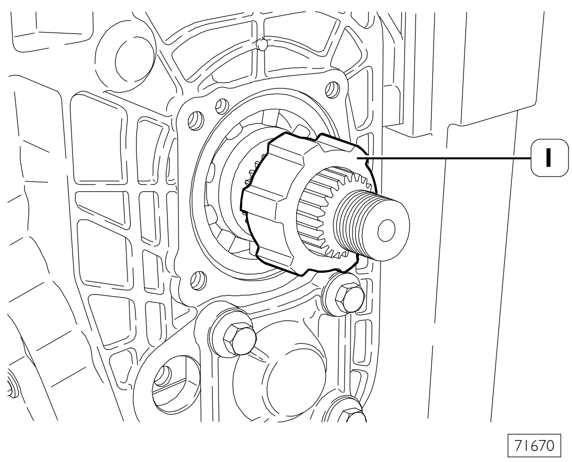
Figure 7



Remove flange (2), unscrew securing screws (3) and remove cover (1).

Disassembling rear cover from gearbox to replace the sealing gasket can also be carried out with a gearbox assembled on the vehicle by disconnecting the transmission shaft and proceeding as shown for the gearbox assembled on a rotating stand.

Figure 8



Remove phonic wheel (1) for odometer control.

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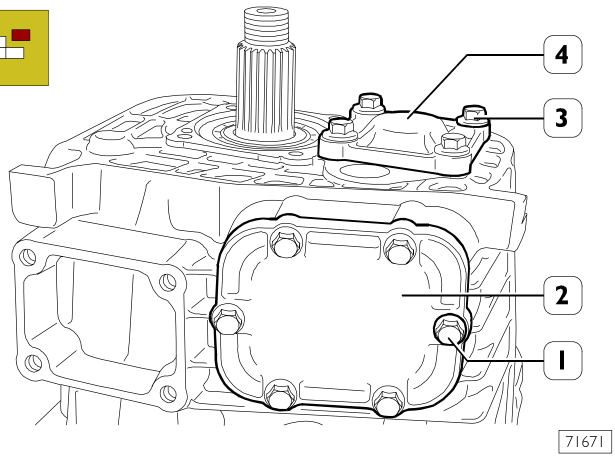
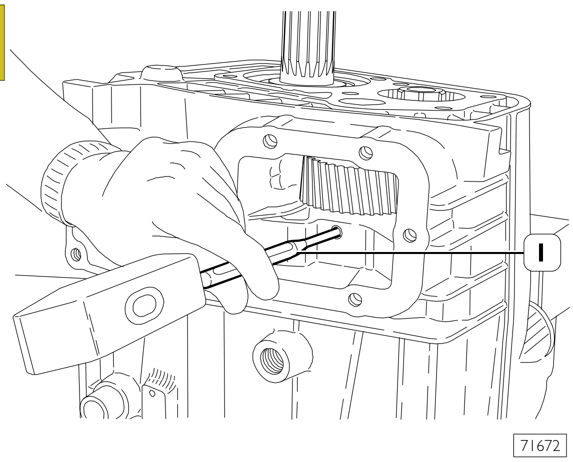
Figure 9



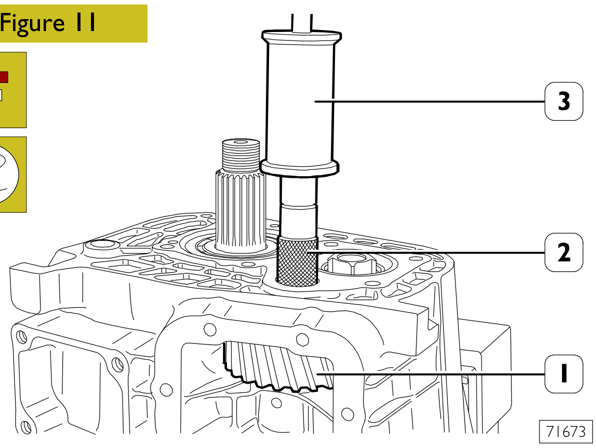
Unscrew screws (1) and remove cover (2).
Unscrew screws (3) and remove cover (4).

Figure 10



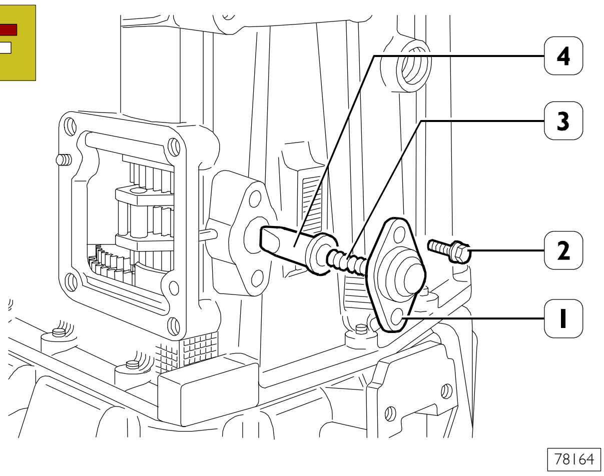
With a punch (1) with an adequate diameter, push inside the elastic peg till it abuts.

Figure 11



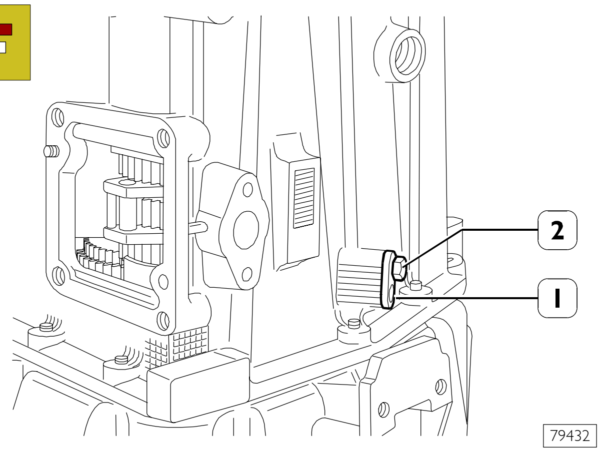
Place extraction peg 99342143 (2) and percussion extractor 99340205 (3). Extract the reverse gear supporting pin and remove the gear (1) with related shoulder washer and cylindric roller bearing.

Figure 12



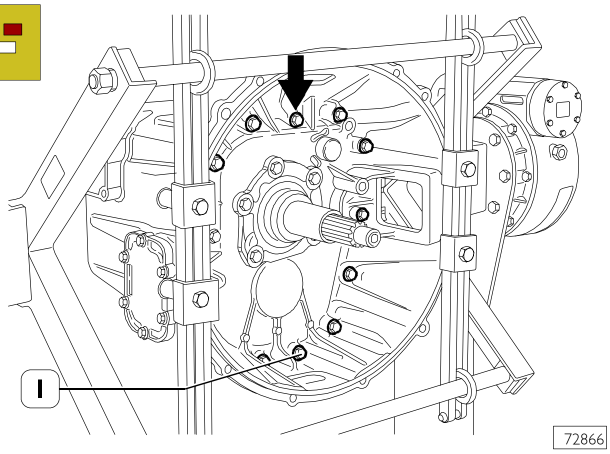
Release the screws (2) and remove the cover (1).
Remove the spring (3) and extract the push rod (4).

Figure 13



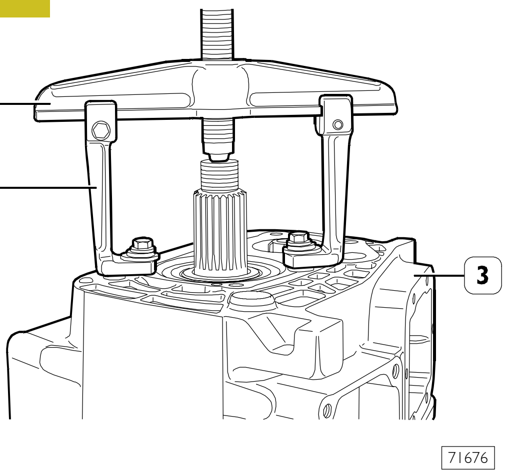
Unscrew screws (2) and remove fork pin (1) from both gear-box sides.

Figure 14



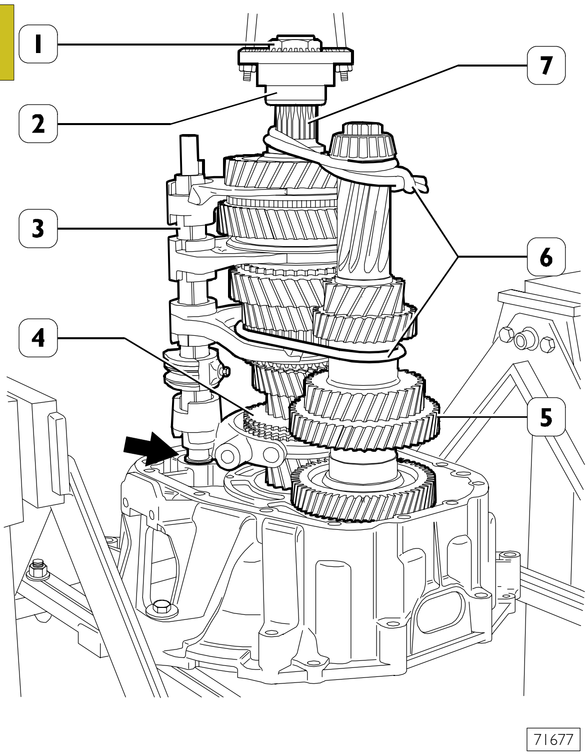
Unscrew the two securing screws for clutch disengagement lever support and remove it from the gearbox.
Unscrew screws (1), leaving a safety one (→) to be removed after having vertically placed the gearbox.

Figure 15



Extract rear half-case (3) with rear axle 99341003 (1) equipped with the pair of brackets 99341017 (2).

Figure 16

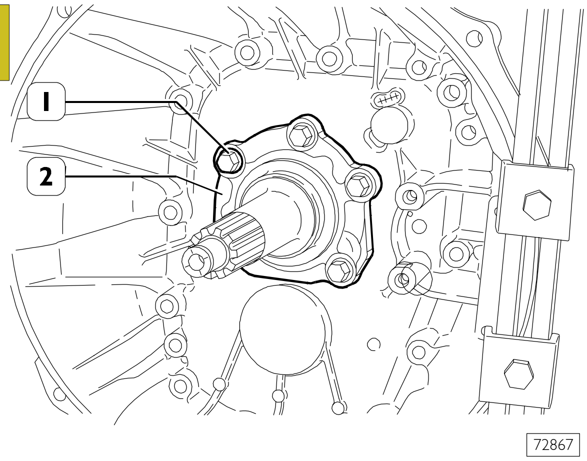


Assemble on primary shaft (7) motion outlet flange (2) and lock it with nut (1). Tie with a rope (6) secondary shaft (5) to primary shaft (7) and with the help of a lifting device extract shafts from front half-case together with internal drive shaft (3).

> Assist the internal drive shaft when going out of its seat by operating in the point shown (→) with suitable tools.

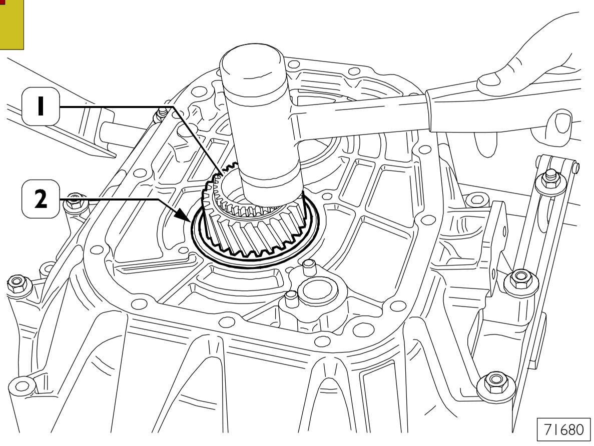
> Keep the complete synchronizer (4) manually assembled in order to prevent check springs and rollers from falling.

Figure 17



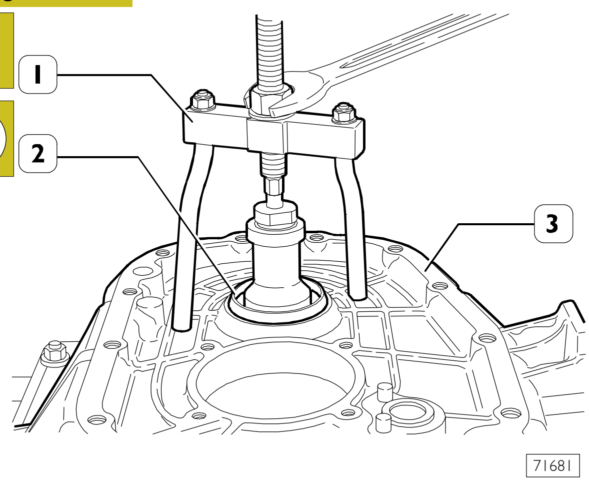
Unscrew screws (1) and remove cover (2) on motion inlet shaft.

Figure 18



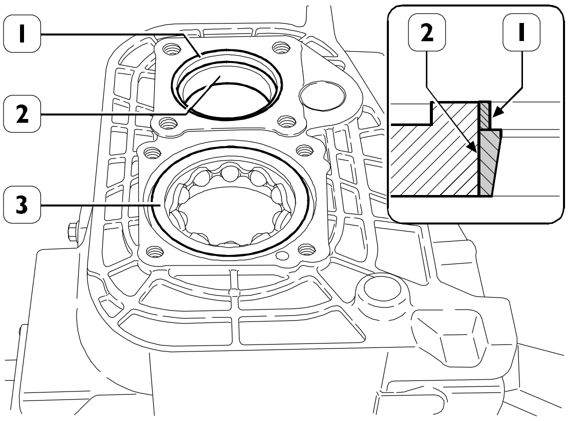
Remove cylindric roller bearing from motion inlet shaft (1) and heat contact surface (2) of front half-case. With a plastic hammer extract motion inlet shaft (1) completed with ball bearing.

Figure 19



Extract rolling race (2) of tapered roller bearing of secondary shaft, from front half-case (3) with extractor 99348004 (1). Remove the adjustment ring.

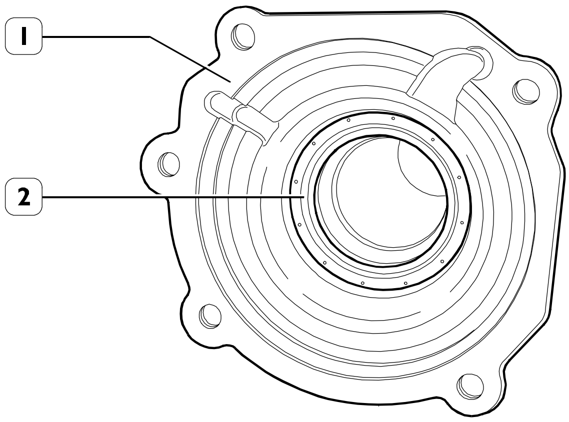
Figure 20



71682

With a suitable beater, extract from rear half-case the external race (2) of roller bearing and spacer (1). From inside the half-case, towards the outside, extract ball bearing (3).

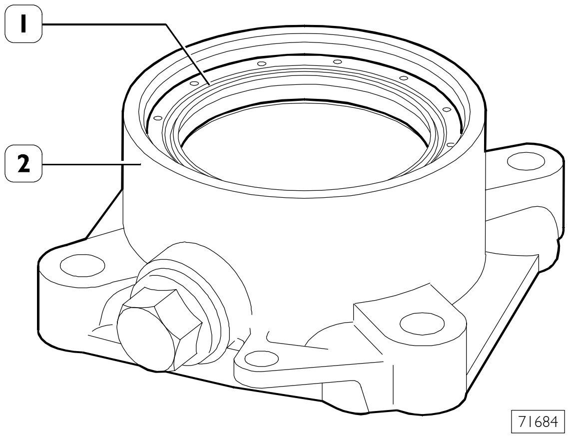
Figure 21



72868

Extract sealing gasket (2) from motion inlet shaft cover (1).

Figure 22



71684

Extract sealing gasket (1) from primary shaft cover (2).

Checks

GEARBOX CASE

Gearbox case and related covers must not show cracks. Contact surfaces between covers and gearbox case must not be damaged or distorted.
Bearing seats must not be damaged or excessively worn.

SHAFTS - GEARS

Shaft seats for bearings and gear toothings must not be damaged or worn.

HUBS - SLIDING SLEEVES - FORKS

Grooves on hubs and related sliding sleeves must not be damaged. The sliding sleeve must freely slide on the hub. Sliding sleeve positioning rollers must not be damaged or worn. Engagement toothing of sliding sleeves must not be damaged.
Forks must be healthy and must not show any sign of wear.

BEARINGS

Roller bearings or roller cages must be in perfect conditions and not show traces of wear or overheatings.
By keeping bearings manually pressed and making them simultaneously rotate along two directions, no roughness or noise when sliding must be detected.

Upon assembling, the following must always be replaced: rings, sealing gasket and springs for sliding sleeves positioning rollers.

SYNCHRONIZERS - COUPLING BODIES

Check wear of synchronising rings and respective coupling bodies: they must not show any sign of wear.

Upon assembling, do not mutually exchange the checked parts.

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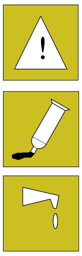
GEARBOX ASSEMBLY



Butter with hermetic type "B" the threaded part of all screws that must be screwed in the through-holes.

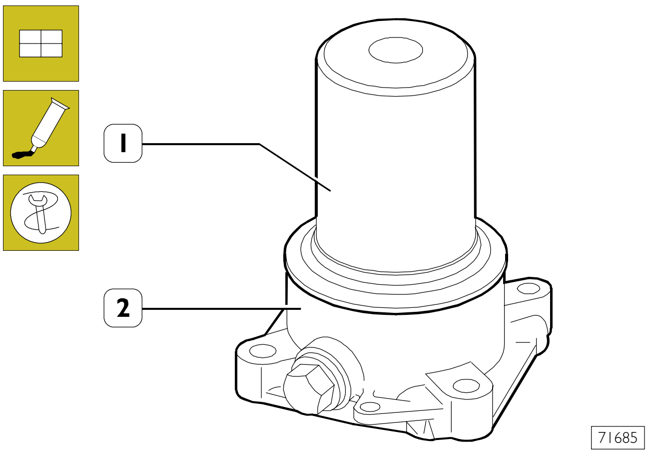
Clean the joining surfaces of case and covers and apply "LOCTITE 510" putty, before assembling, on one of the two components.

Upon assembling, make sure that the sealing gaskets are already lubrified, or butter with oil or grease the sealing lip of inlet and primary shafts gaskets.

Do not insert oil before 20 min and do not try the gearbox before 1h and 30 min.

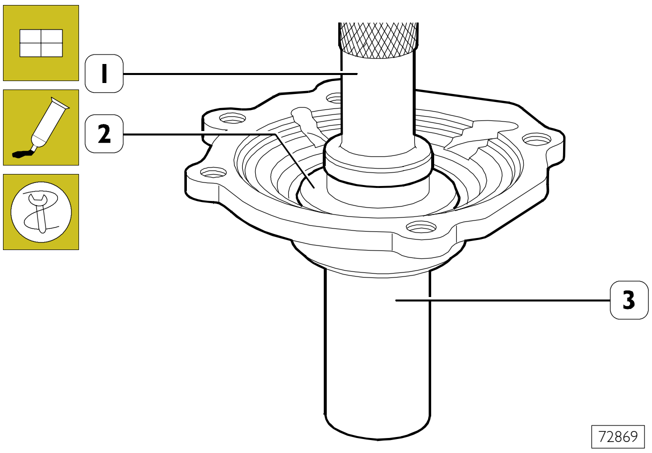
Assemble bearing cages into their respective seats and oil with TUTELA ZC 90.

Figure 23



Butter, with hermetic type "B", the coupling seat surface of cover (2) with sealing gasket and with keyer 99374201 (1) assemble the sealing gasket itself.

Figure 24

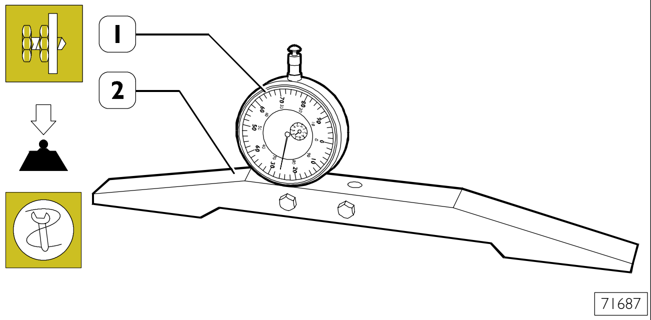


Butter, with hermetic type "B", the coupling seat surface of cover (3) with sealing gasket and with keyer 99370349 (2) and handle 99370006 (1) assemble the sealing gasket itself.

Bearings pre-load adjustment for secondary shaft

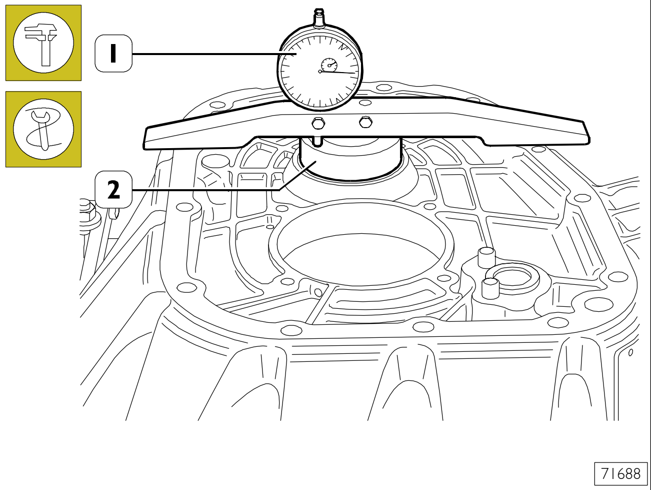
The bearings pre-load adjustment for the secondary shaft can be carried out with two procedures.

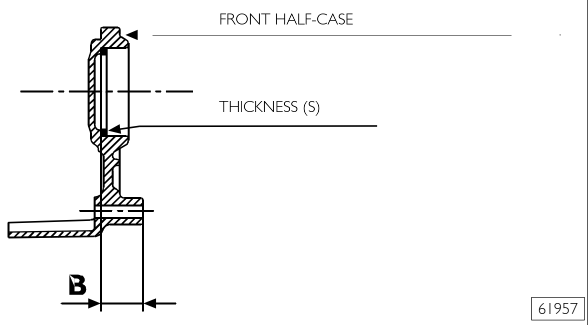
Figure 25



Assemble comparator 99395604 (1) on base 99370466 (2), pre-load it by 5 mm and zero it on an abutment plane.

Figure 26





Place calibrated ring 99396031 (2) into its seat, without adjustment ring, of bevel roller bearing on front half-case; place base 99370466 completed with comparator (1), previously zeroed, as shown in Figure 25.

First method - Take note of the value read on the comparator (Example: 2.43 mm).

Second method - Take note of the value read on the comparator and add it to calibrated ring thickness.
[Example: 2.43 + 50.5 = 52.93 mm (Dimension **B**)].

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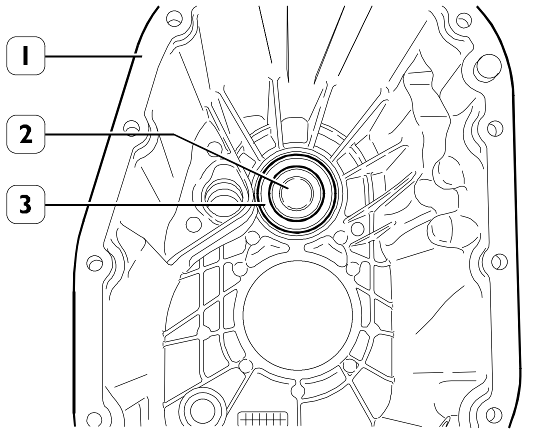
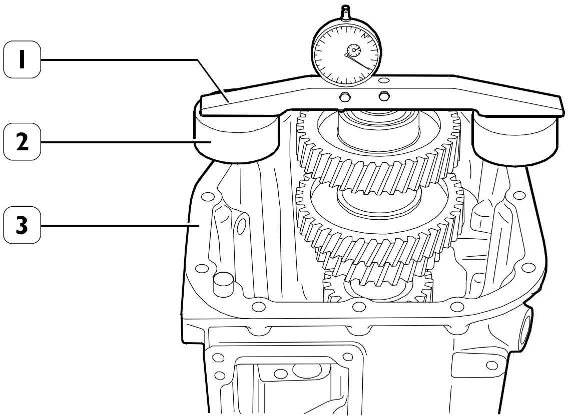
Figure 27



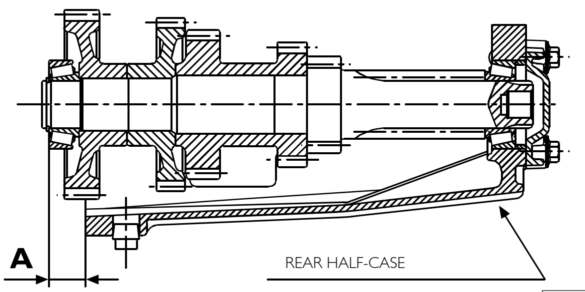
71689

Assemble on rear half-case (1) cover (2), spacer (1, Figure 20) and with beater 99374092 equipped with handle 99370007, assemble external race (3) of roller bearing, settling it till it abuts.
See Figure 30 for adjusting beater 99374092.

Figure 28



71690



61956

Assemble and simultaneously rotate, till it abuts, the secondary shaft completed with bearings in rear half-case (3). Place calibrated rings 99396032 (2) on half-case (3). Arrange, as shown in the figure, base 99370466 completed with previously-zeroed comparator (1); the comparator rod must abut on the external bearing ring. Carry out the measure on two diametrically-opposite points and perform the arithmetic mean.

First method - Take note of the value read on the comparator (Example 1.84 mm). The adjustment ring value is obtained by summing the two measured values (Example 2.43 + 1.84 = 4.27 mm)

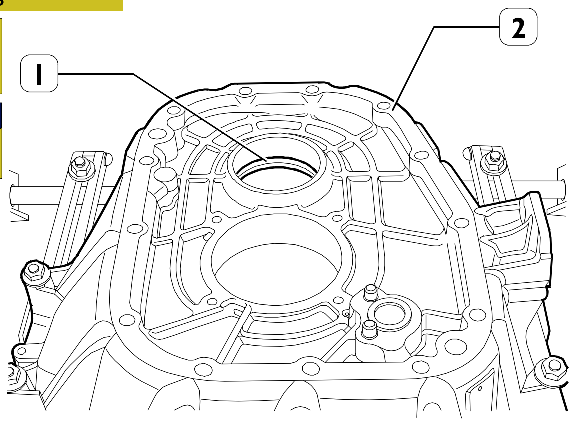
Second method - Take note of the value read on the comparator and subtract it from the calibrated ring thickness [Example: 50.5 - 1.84 = 48.66 mm (Dimension **A**)].

The adjustment ring value is obtained with formula
S = B - A Example: 52.93 - 48.66 = 4.27 mm.

> ! The adjustment ring rounding is always carried out in excess. Example; thickness S = 4.27: thickness S = 4.3 is taken. Measuring of dimension "A", carried out with secondary shaft in vertical position, that, in addition to facilitating the measure itself, allows having an axial load on the rear bearing.

After having computed the thickness value of the adjustment ring, disassemble again secondary shaft and cover from rear half-case.

Figure 29



71691

Place adjustment ring (1), whose thickness is equal to the previously-obtained one, into the secondary shaft bearing seat on the front half-case (2).

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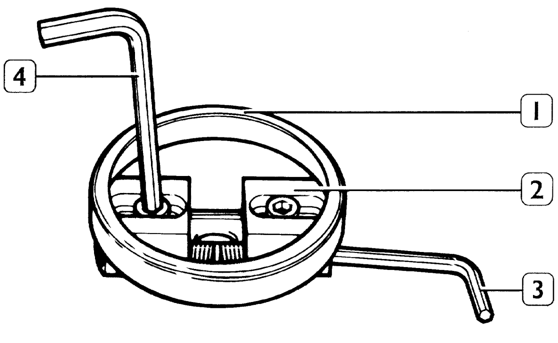
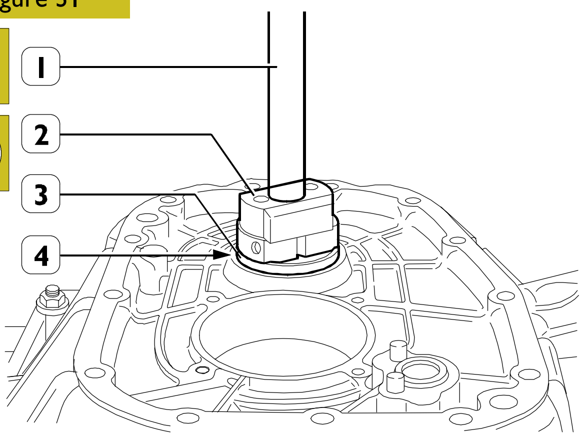
Figure 30



32447

Centre external race (1) of bevel roller bearing of front cover secondary shaft on extensible beater 99374092 (2) adjusted with socket head screw (3). Lock beater with socket head screw (4).

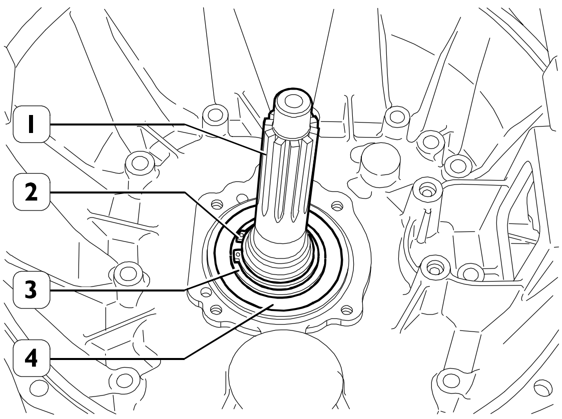
Figure 31



71692

Slightly heat seat (4) of secondary shaft bearing race on front half-case and assemble external race (3) by settling it till it abuts with beater 99374092 (2), equipped with handle 99370007 (1).

Figure 32

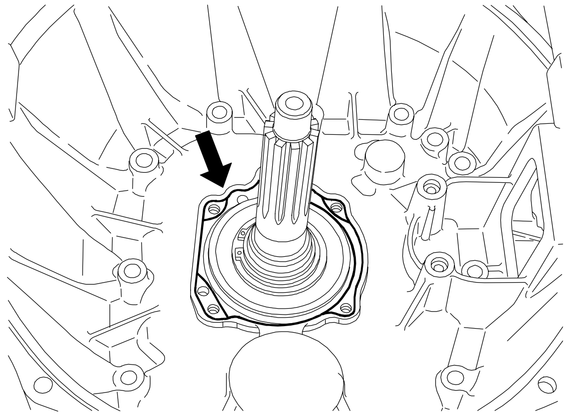


72870

Slightly heat the ball bearing seat, assemble motion inlet shaft (1) completed with bearing (4), adjustment ring (3) and elastic ring (2). Settle the bearing till it abuts.

Before assembling on front half-case the motion inlet shaft, carry out bearing adjustment as described in the related procedure on page 39.

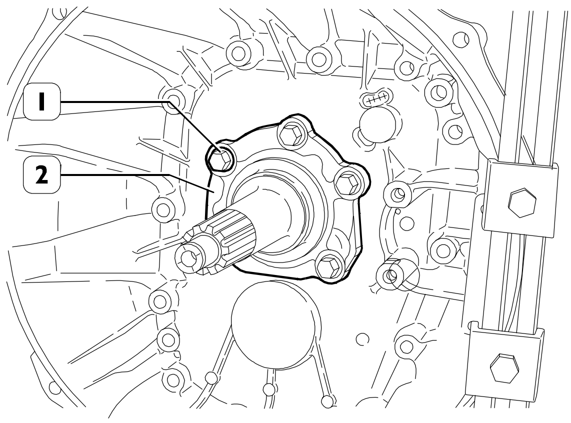
Figure 33



72871

Apply LOCTITE 510 sealant on contact surfaces between front half-case and motion inlet shaft cover.

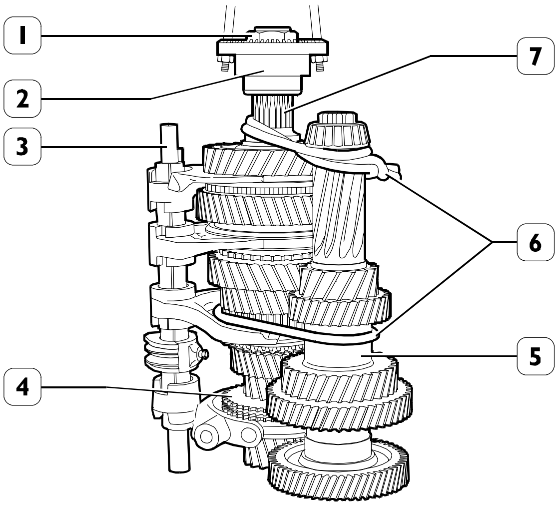
Figure 34



72867

Assemble motion inlet shaft cover (2), screw screws (1) and tighten them at the required torque.

Figure 35



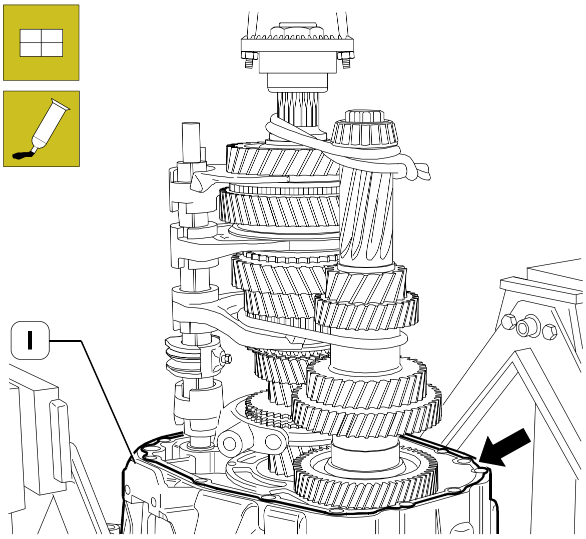
71859

Assemble on primary shaft (7) motion outlet flange (2) and lock it with nut (1). Put together on a bench and with the help of a lifting device, primary shaft (7), secondary shaft (5) and mutually tie them with a rope (6).

Keep complete synchronizer (4) manually assembled in order to prevent check springs and rollers from falling.

Place internal drive shaft (3) and manually keep it in position.

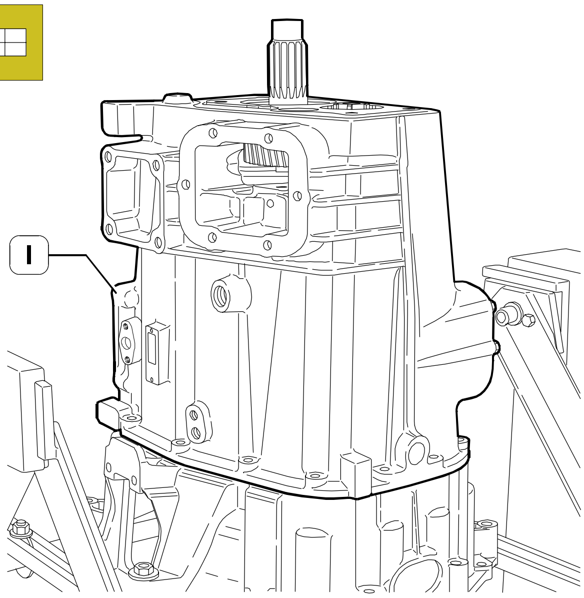
Figure 36



71860

Insert cylinder roller bearing into motion inlet shaft and assemble on front half-case (1) the three shafts together. Apply LOCTITE 510 sealant on contact surface (→) between the two half-cases.

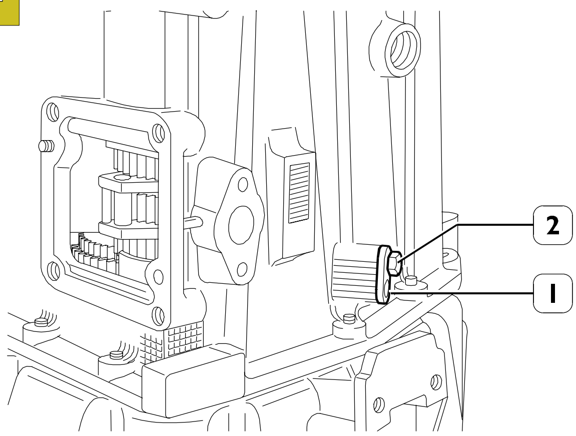
Figure 37



79433

Disassemble previously-assembled flange and nut and assemble rear half-case (1). Screw union screw between rear half-case and front half-case and tighten them at the required torque.

Figure 38



79432

Assemble fork pins (1) on both gearbox sides and screw screws (2) by tightening them at the required torque.

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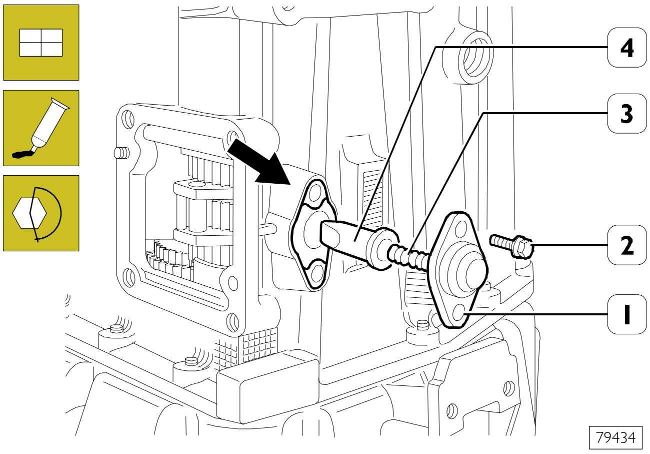
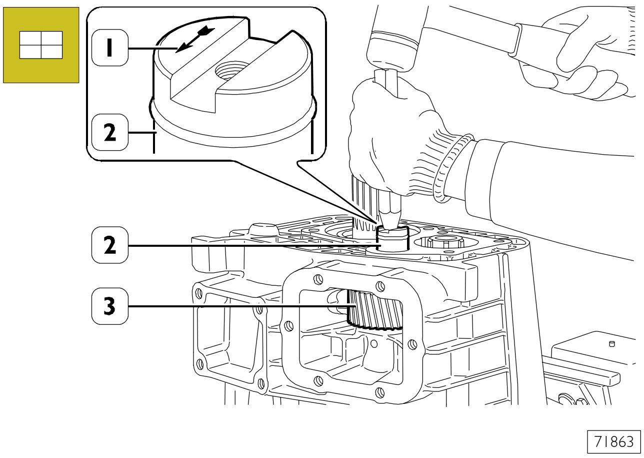
Figure 39



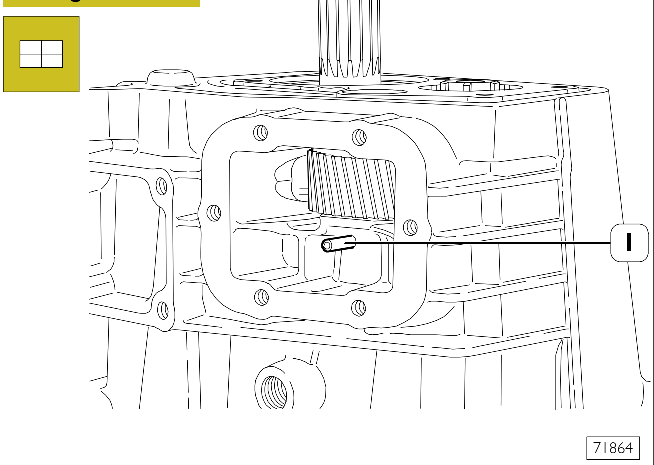
Apply sealer LOCTITE 510 on the surface (→) without staining the push rod supporting area (4).
Insert tip (4), spring (3), then mount cover (1) and fasten screws (2) by tightening them to the specified torque.

Figure 40



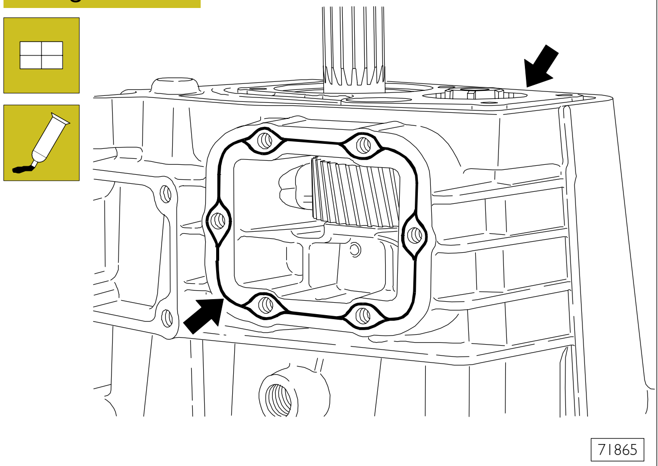
Assemble shoulder rings, placing them into their own seat and reverse gear (3) with cylindric roller bearing. Assemble reverse gear supporting shaft (2) with a suitable beater, paying attention that the arrow (1) punched on the shaft is facing the peg insertion hole.

Figure 41



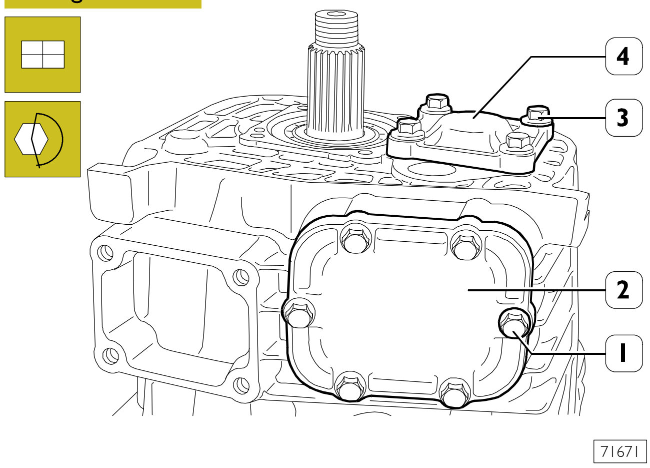
Assemble elastic peg (1).

Figure 42



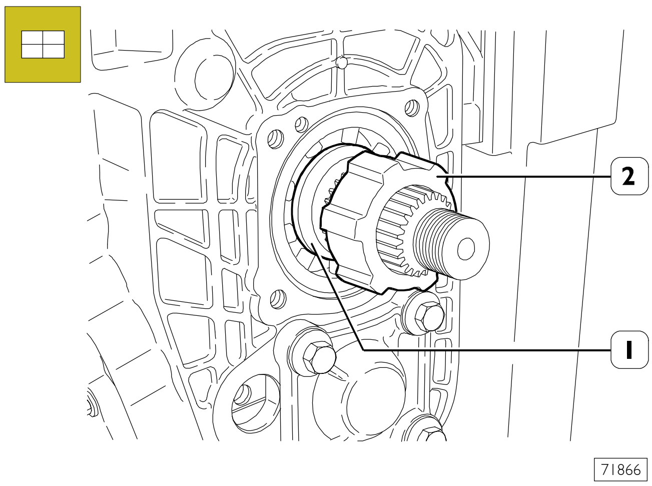
Apply LOCTITE 510 sealant on contact surface (→) between rear half-case and covers.

Figure 43



Assemble covers (2 and 4), screw screws (1 and 3) and tighten them at the required torque.

Figure 44



Slightly heat ball bearing (1) half-race and assemble it in its own seat on primary shaft. Assemble phonic wheel (2) for controlling the odometer.

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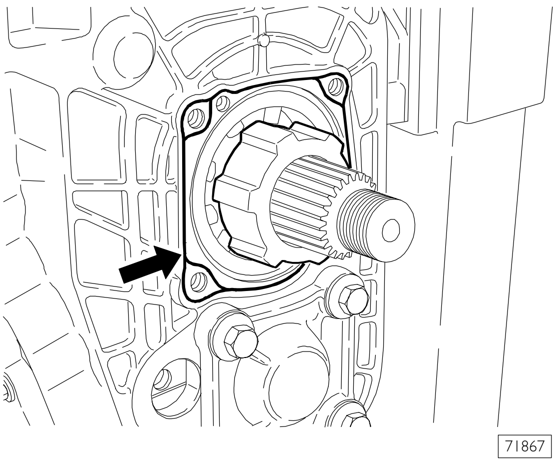
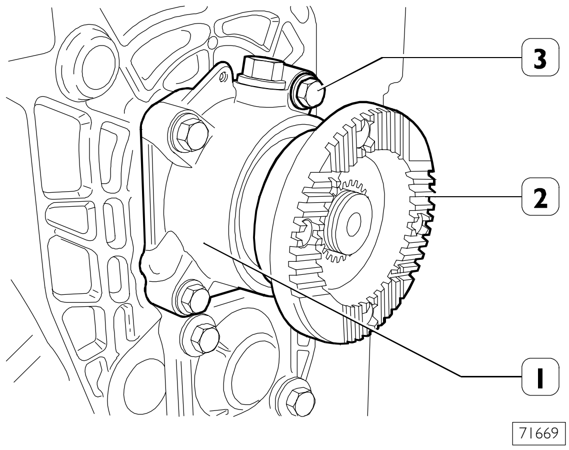
Figure 45



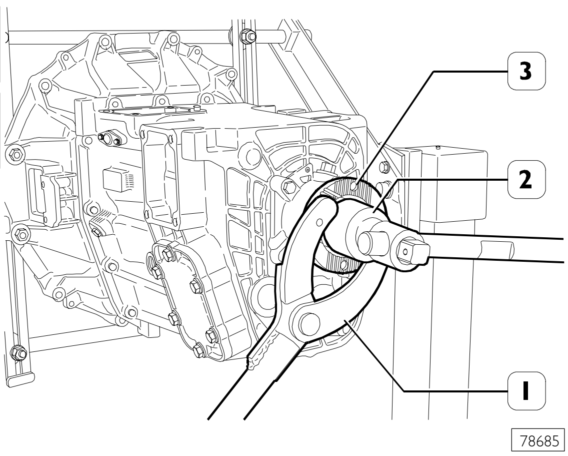
Apply LOCTITE 510 sealant on contact surface (→) between cover and rear half-case.

Figure 46



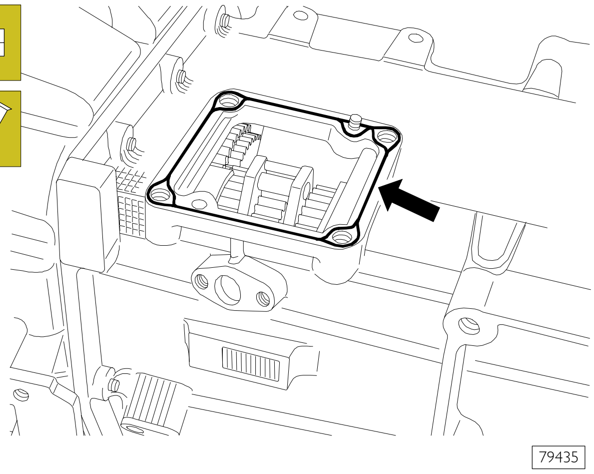
Assemble rear cover (1), screw screws (3) and tighten them at the required torque. Assemble motion outlet flange (2).

Figure 47



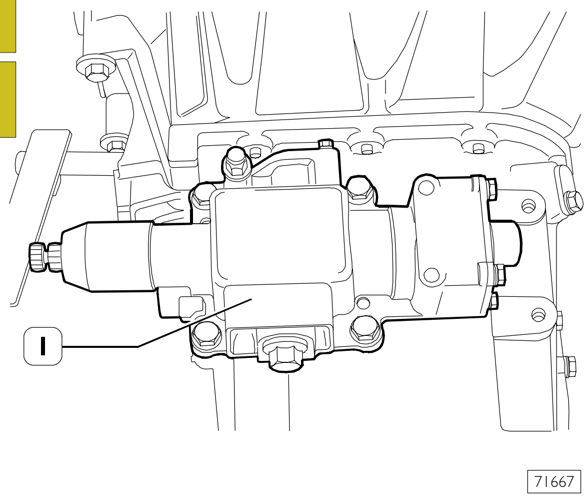
Assemble reaction bar 99370317 (1), motion outlet flange locking nut (3), key 99355081 (2) and tighten the locking nut at the required torque.

Figure 48



Apply LOCTITE 510 sealant on contact surface (→) between rear half-case and external control case.

Figure 49



Assemble complete external control box (1) and screw securing screws by tightening them at the required torque.

Assemble clutch disengagement lever and tighten the two securing screws at the required torque.

Insert lubrication oil in the prescribed amount after about 20 minutes from the last LOCTITE 510 sealant application.

Remove gearbox from rotating stand.

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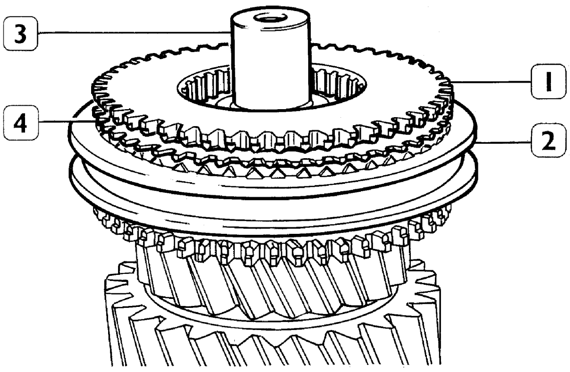
PRIMARY SHAFT DISASSEMBLY

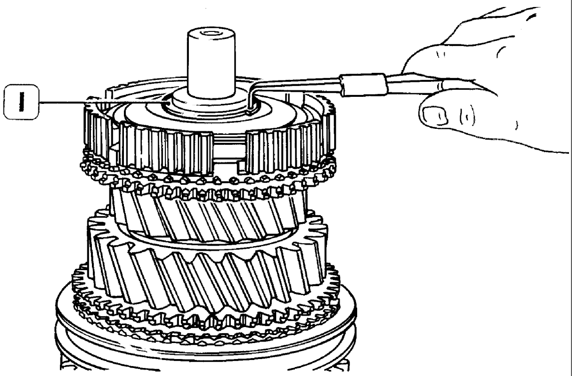
Figure 50



33618

Tighten primary shaft (3) in a clamp. Remove coupling body (1), 6^{th} speed synchronising ring (4) and sliding sleeve (2) for 5^{th} and 6^{th} speed gears, recovering check springs and rollers.

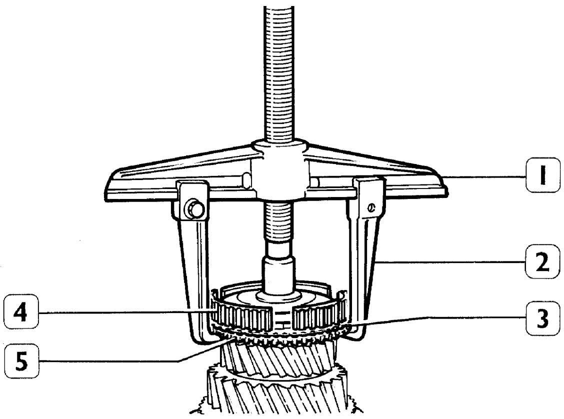
Figure 51



33619

Remove elastic ring (1).

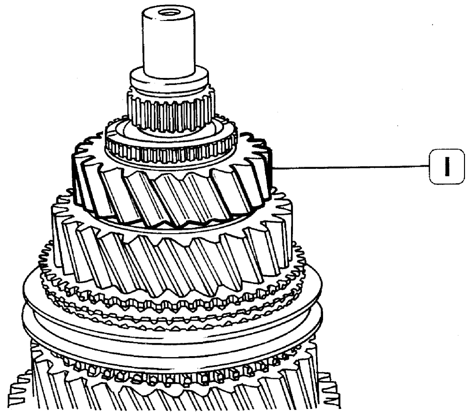
Figure 52



33620

With extractor 99341003 (1) and brackets 99341009 (2), remove fixed 5^{th} and 6^{th} speed hub (4) together with synchronising ring (3) and 5^{th} speed coupling body (5).

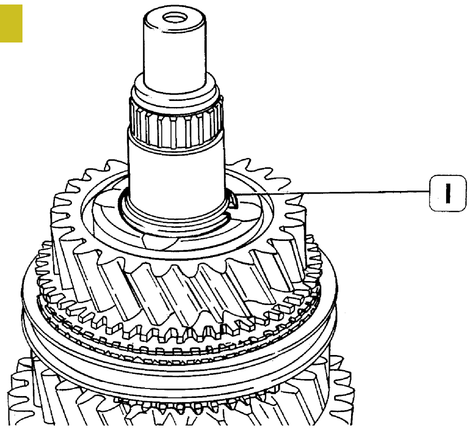
Figure 53



33621

Remove 5^{th} speed gear (1) and roller bearing below it.

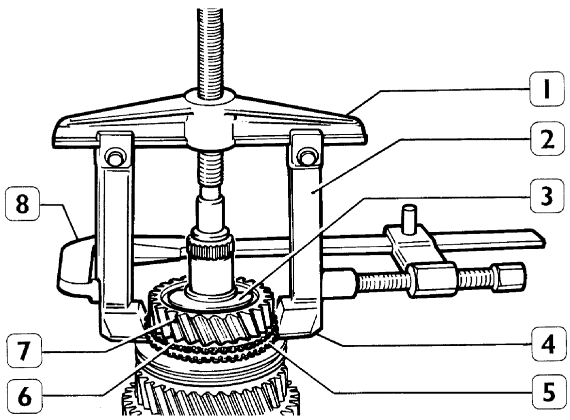
Figure 54



33622

Remove elastic ring (1).

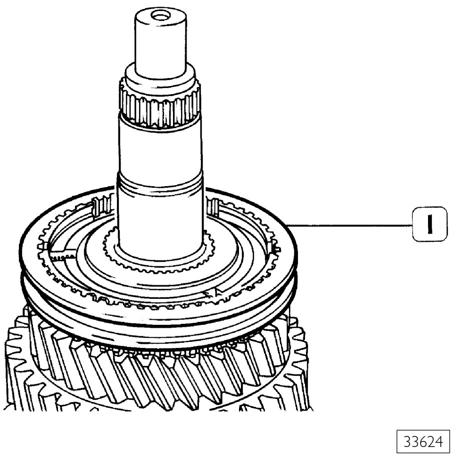
Figure 55



33623

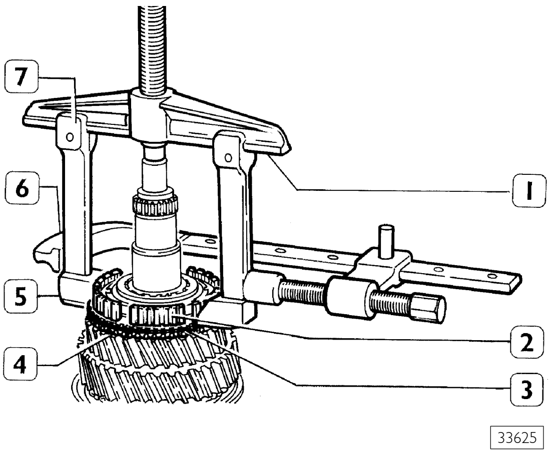
Remove 4^{th} speed gear (7) together with roller bearing and bush (3) and coupling body (6) with holds 99341025 (4), tie-rods 99341019 (2), bridge 99341003 (1) and clamp 99341015 (8). Remove synchronising ring (5).

Figure 56



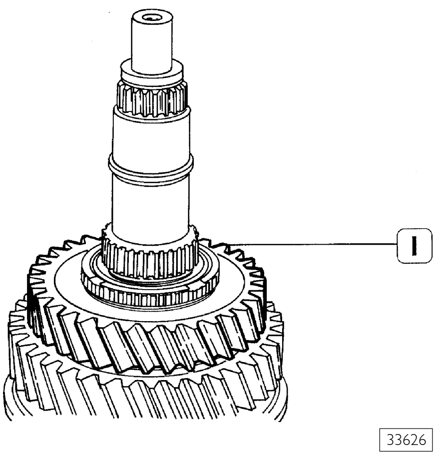
Remove 3rd and 4th gear sliding sleeve (1) recovering check springs and rollers.

Figure 57



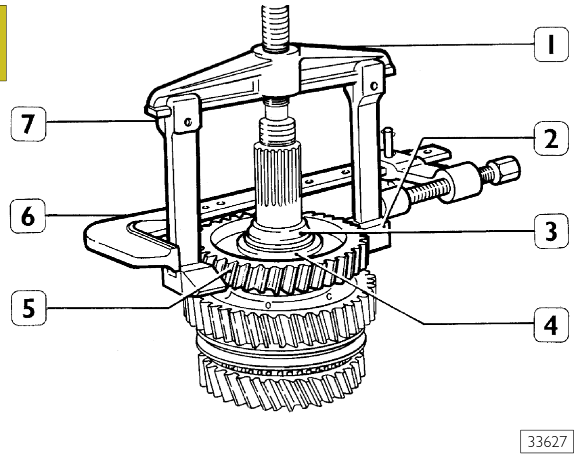
Extract 3rd and 4th speed fixed hub (2) and 3rd speed synchronising ring with holds 99341025 (5), tie-rods 99341019 (7), bridge 99341003 (1) and clamp 99341015 (6). Remove 3rd speed coupling body (4).

Figure 58



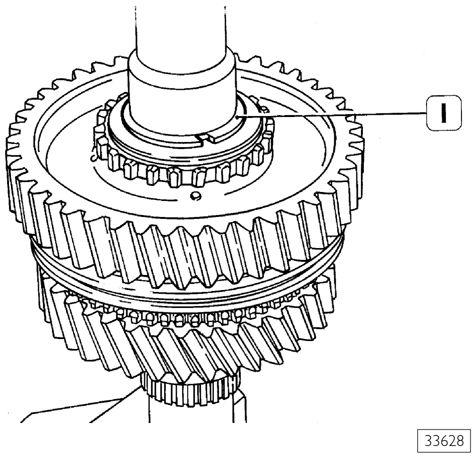
Remove 3rd speed gear (1) and roller bearing below it.

Figure 59



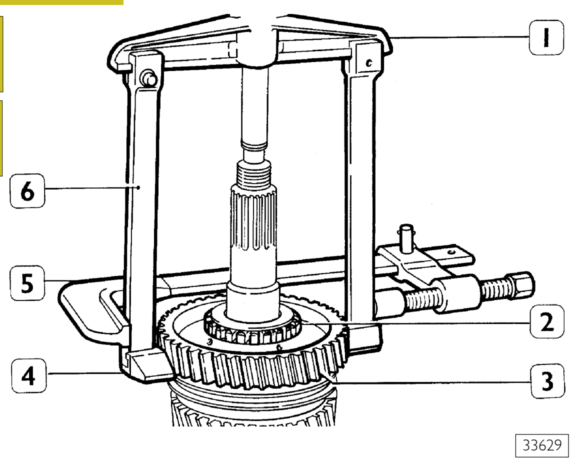
Turn the shaft over and extract reverse gear (5) with roller bearing below it, shoulder ring (4) and rolling half-race (3) with holds 99341025 (2), tie-rods 99341019 (7), bridge 99341003 (1) and clamp 99341015 (6).

Figure 60



Remove elastic ring (1).

Figure 61



Extract 1st speed gear (3) together with roller bearing and fixed sleeve (2) for reverse gear with holds 99341023 (4), tie-rods 99341020 (6), bridge 99341003 (1) and clamp 99341015 (5).

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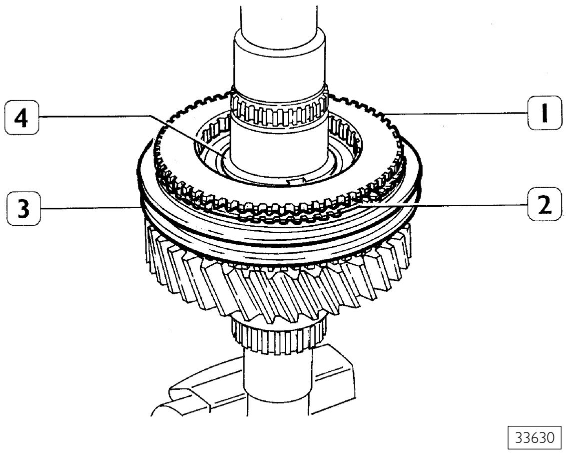
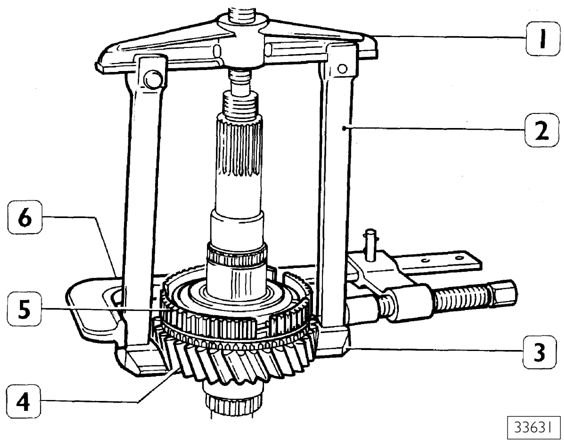
Figure 62



Remove coupling body (1), synchronising ring (2), elastic ring (4) and sliding sleeve (3) for 1st and 2nd speed gears recovering rollers and springs.

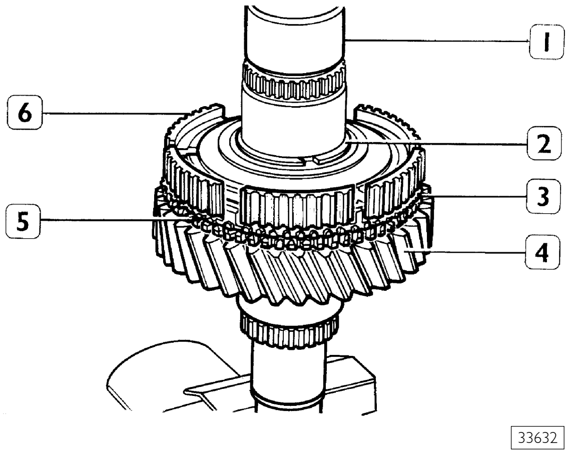
Figure 63



Extract 2nd speed (4) with roller bearing, coupling body, synchronising ring and 1st and 2nd speed fixed sleeve (5) with holds 99341023 (3), tie-rods 99341020 (2), bridge 99341003 (1) and clamp 99341015 (6).

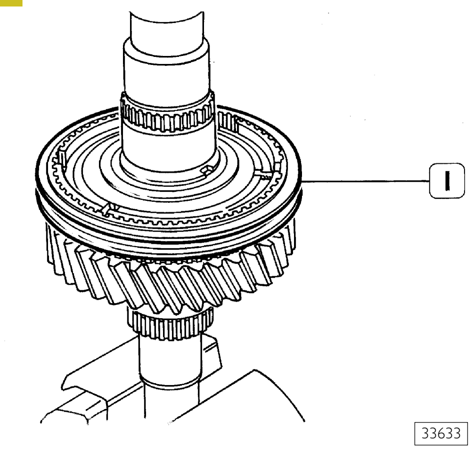
PRIMARY SHAFT ASSEMBLY

Figure 64



Assemble on primary shaft (1) 2nd speed gear (4), coupling body (5) and synchronising ring (3).
Heat fixed hub (6) for 1st and 2nd speed gears at a temperature of 100 °C ÷ 130 °C and assemble it on primary shaft (1) with the internal diameter chamfering facing the opposite part of 2nd speed gear.
When keying the hub, pay attention that synchronising ring tangential stops are inserted into respective hub seats. Assemble elastic ring (2) with an apporpriate thickness so that the fixed hub has no axial clearance (max allowed 0.03 mm).

Figure 65



Assemble sliding sleeve (1) for 1st and 2nd speed gears, springs and rollers in fixed hub seats. Assemble synchronising ring and coupling body for 1st speed gear.

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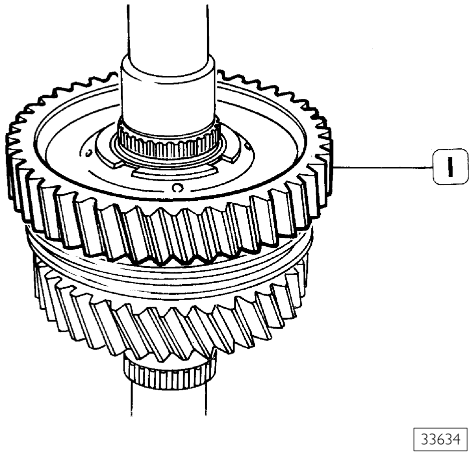
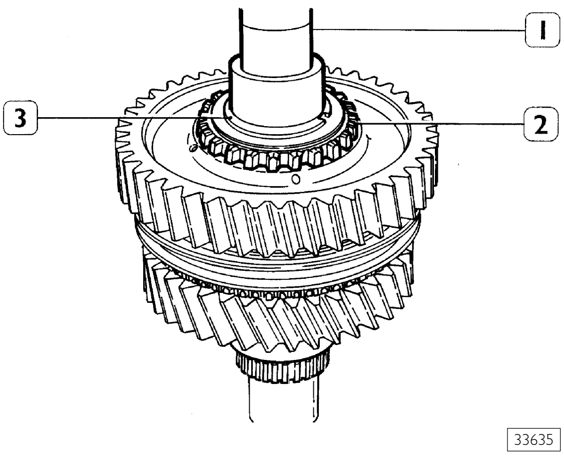
Figure 66



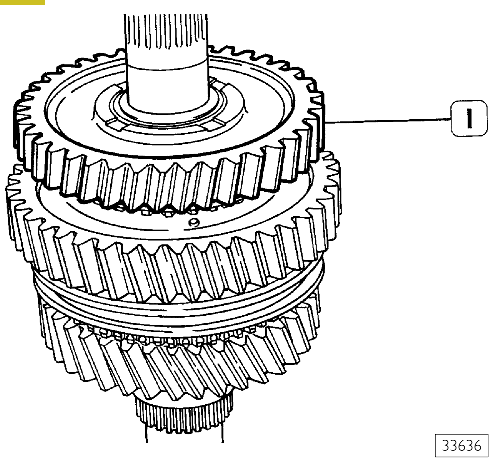
Assemble roller bearing and 1st speed gear (1).

Figure 67



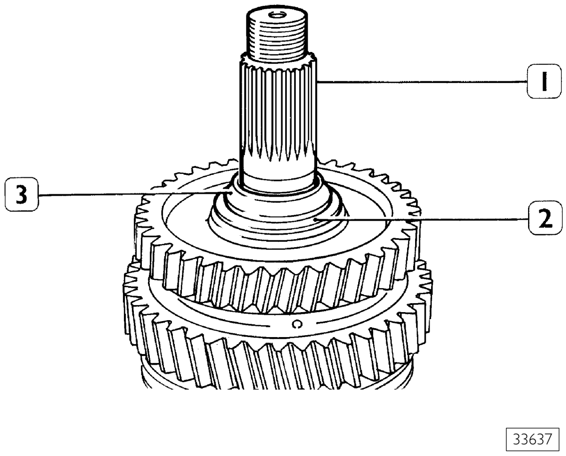
Heat at a temperature of 100 °C ÷ 130 °C fixed hub (2) for reverse gear and assemble it on primary shaft (1); asemble elastic ring (3).

Figure 68



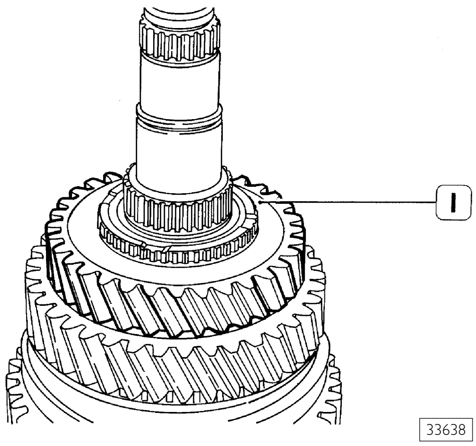
Assemble roller bearing and reverse gear (1).

Figure 69



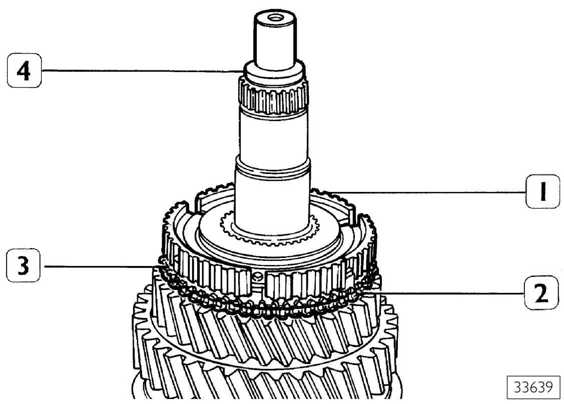
Assemble shoulder ring (2).
Slightly heat ball bearing rolling half-race (3) and assemble it on primary shaft (1).

Figure 70



Turn the shaft over in a clamp, assemble roller bearing and 3rd speed gear (1).

Figure 71



Assemble coupling body (2) and synchronising ring (3). Heat fixed hub (1) at a temperature of 100 °C ÷ 130 °C and assemble it on shaft (4) paying attention that synchronising ring tangential stops are inserted into respective hub seats.

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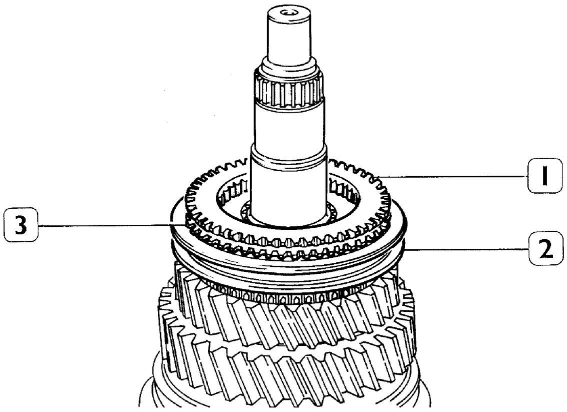
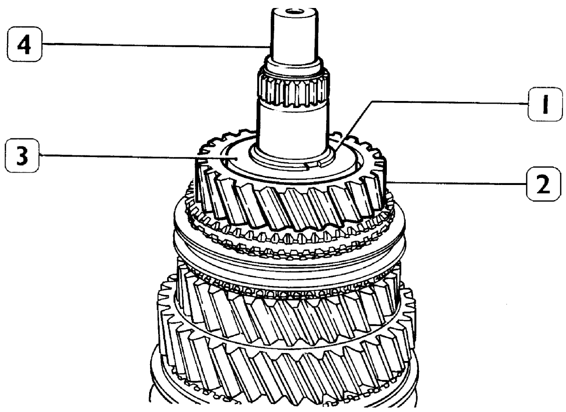
Figure 72



33640

Assemble sliding sleeve (2) for 3rd and 4th speed gears, springs and rollers into fixed hub seats. Assemble synchronising ring (3) and coupling body (1) for 4th speed gear.

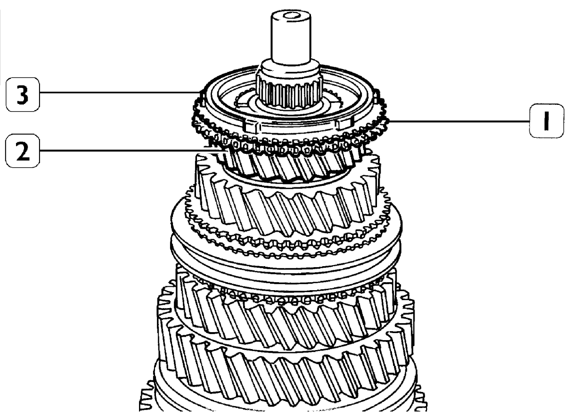
Figure 73



33641

Assemble roller bearing and 4th speed gear (2). Heat bush (3) at a temperature of 100 °C ÷ 130 °C, and assemble it on primary shaft (4). Assemble elastic ring (1).

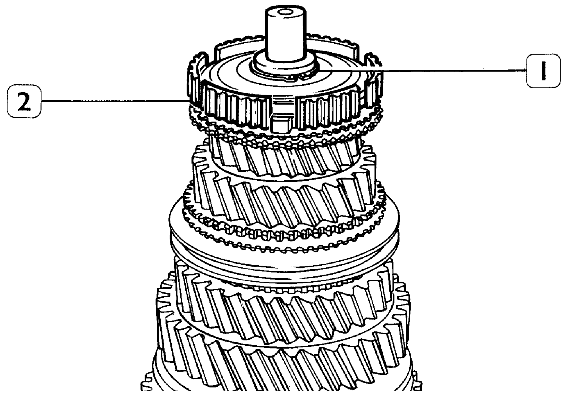
Figure 74



33642

Assemble roller bearing, 5th speed gear (2), coupling body (1) and synchronising ring (3) for 5th speed gear.

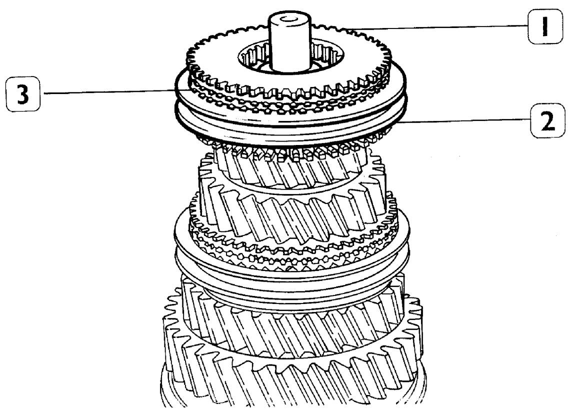
Figure 75



33643

Heat the fixed hub (2) for 5th and 6th speed gears at a temperature of 100 °C ÷ 130 °C and install it on the primary shaft with the chamfer heading towards the 5th speed gear. When keying the hub pay attention that synchronising ring tangential stops are inserted into respective hub seats. Assemble elastic ring (1) with a suitable thickness so that the fixed hub has no axial clearance (max allowed 0.03 mm).

Figure 76

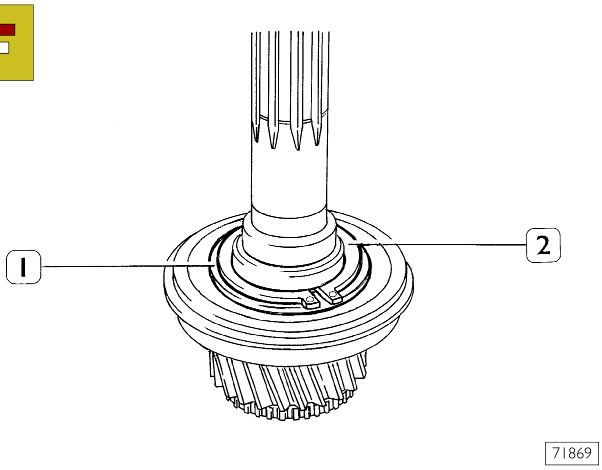


33644

Assemble sliding sleeve (2) for 5th and 6th speed gears, springs and rollers. Assemble synchronising ring (3) and coupling body (1) for 6th speed gear.

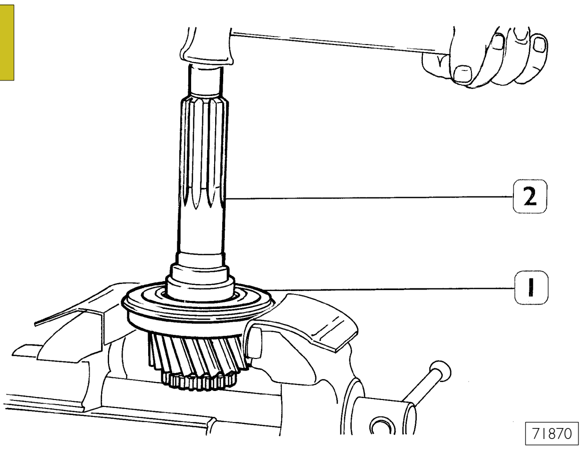
MOTION INLET SHAFT DISASSEMBLY

Figure 77



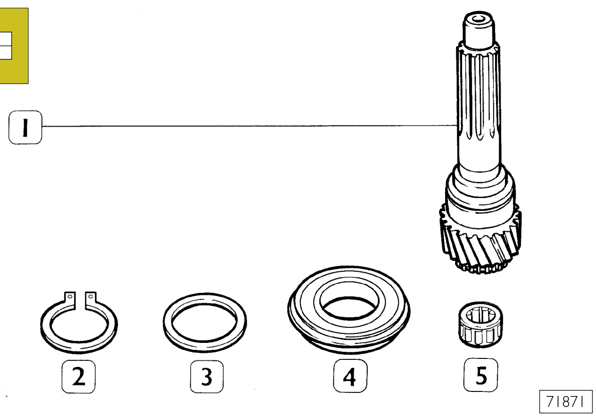
Remove elastic ring (2) and adjustment ring (1).

Figure 78



Abut bearing (1) on a vice, as shown in the figure, and by beating on shaft (2), extract it from the bearing itself.

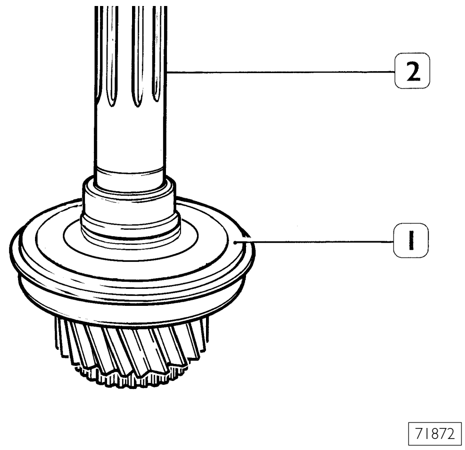
Figure 79



PARTS COMPOSING THE MOTION INLET SHAFT
1. Motion inlet shaft - 2. Elastic ring - 3. Adjustment ring - 4. Ball bearing - 5. Cylindric roller bearing.

MOTION INLET SHAFT ASSEMBLY

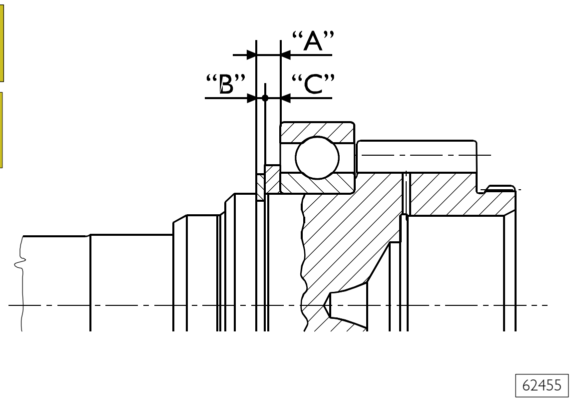
Figure 80



Assemble ball bearing (1) on motion inlet shaft (2) and carry out its adjustment.

Motion inlet shaft bearing adjustment

Figure 81



- ❑ Assemble bearing on motion inlet shaft.
- ❑ Measure dimension "**A**".
- ❑ Measure seeger "**B**" thickness.
- ❑ Define spacer ring thickness to be inserted, by defect: **C = A- B.**

Motion inlet shaft bearing adjustment spacer ring thicknesses: mm 2.40 - 2.45 - 2.50 - 2.55 - 2.60 - 2.65 - 2.70 - 2.75 - 2.80.

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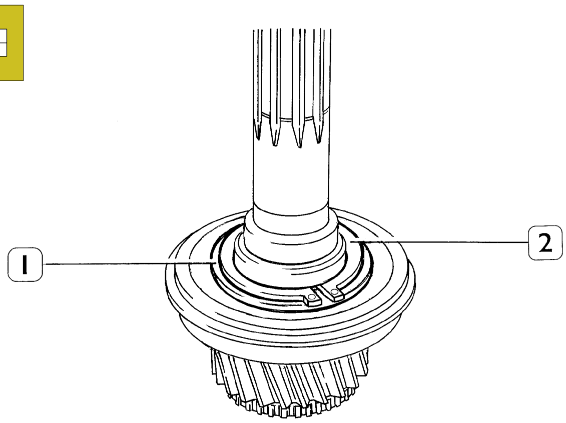
Figure 82

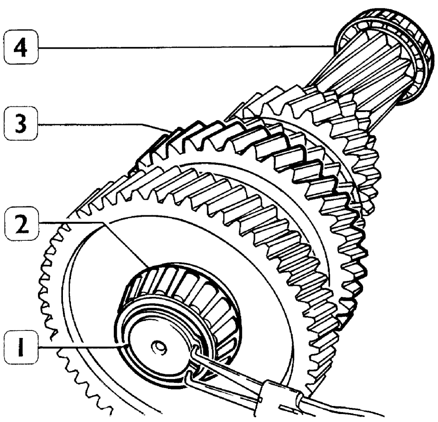


71869

Assemble adjustment ring (1) whose thickness is equal to the previously-obtained one and assemble elastic ring (2).

SECONDARY SHAFT DISASSEMBLY

Figure 83



33651

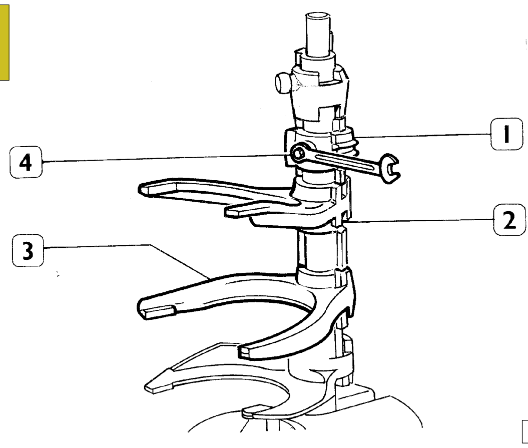
Remove elastic ring (1) from secondary shaft (3), extract bevel roller bearings (2 and 4) with a suitable punch (destructive operation).

SECONDARY SHAFT ASSEMBLY

Slightly heat bevel roller bearings (2 and 4, Figure 83) and assemble them on secondary shaft (3, Figure 83). Assemble elastic ring (1, Figure 83).

INTERNAL DRIVE SHAFT DISASSEMBLY

Figure 84

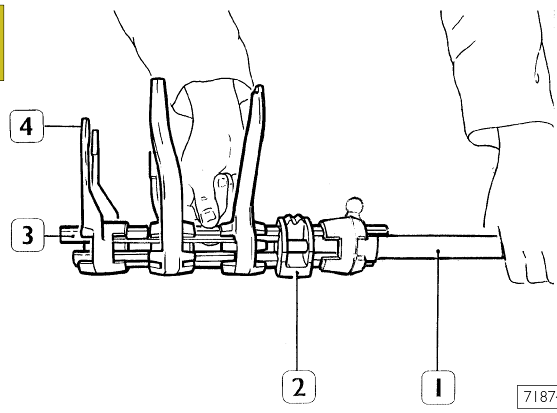


71873

Mark fork (3) assembling position. Unscrew screw (4) and withdraw all forks (3) together with fork positioning rods (2) and hub (1).

INTERNAL DRIVE SHAFY ASSEMBLY

Figure 85



71874

Place on a bench forks (4) and hub (2) according to the position marked upon disassembling. Place the two rods (3) inside fork holes and insert drive shaft (1). Tighten hub screw (2) at the required torque.

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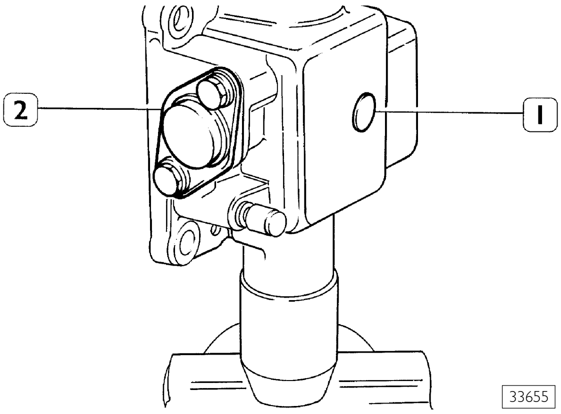
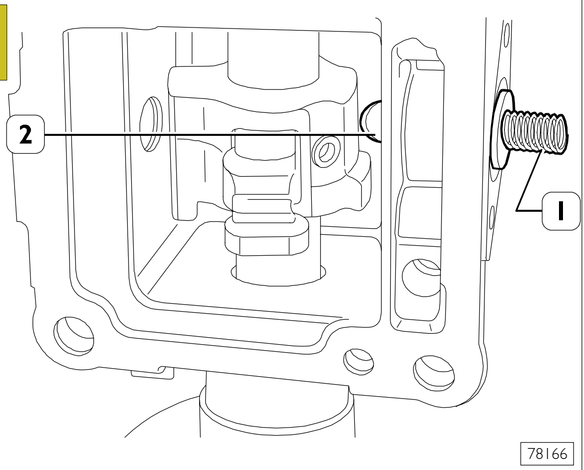
EXTERNAL CONTROL SHAFT DISASSEMBLY

Figure 86



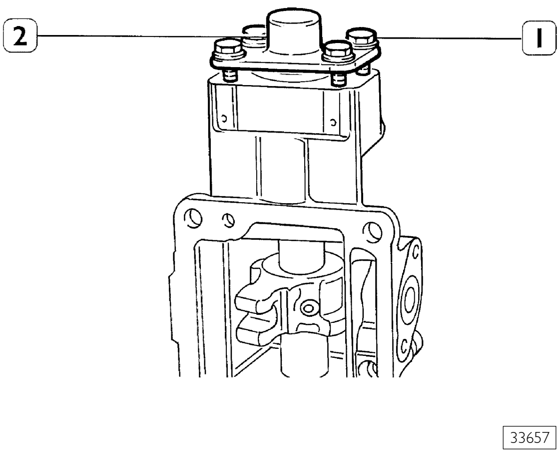
Tighten the shaft going out of the box in a clamp, remove plug (1) and disassemble cover (2).

Figure 87



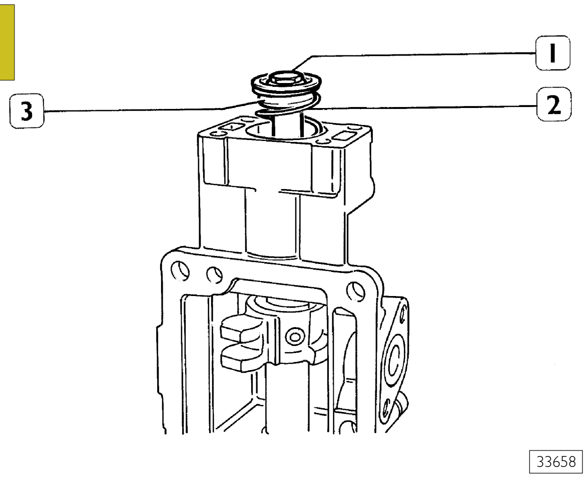
Remove control box pin (2) and spring (1).
Do not mix removed elements with those of the anti-release push rod.

Figure 88



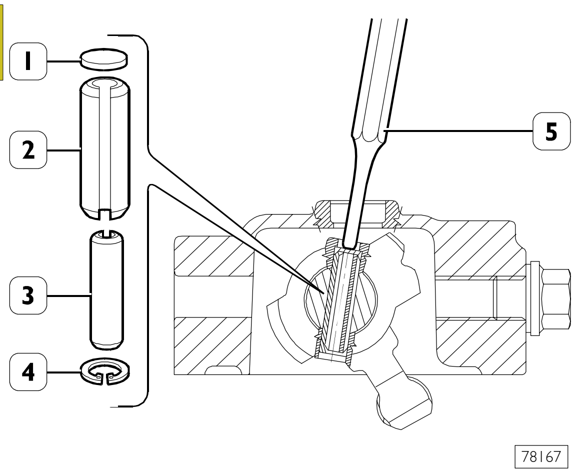
Unscrew screws (1) and disassemble cover (2).

Figure 89



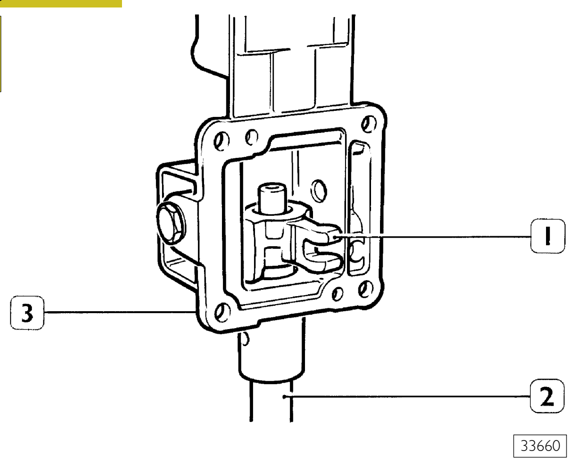
Unscrew screw (1) and remove spacer, upper cup (3) and spring (2). Remove lower cup.

Figure 90



Remove the snap ring (4) and use a punch tool (5) having the right diameter to push the extraction washer (1) and remove flexible plugs (2) and (3).

Figure 91



Extract, from the control shaft (2), control selector (1) and box (3).

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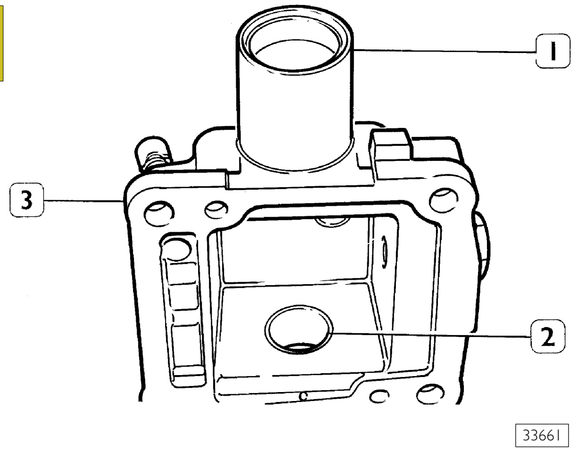
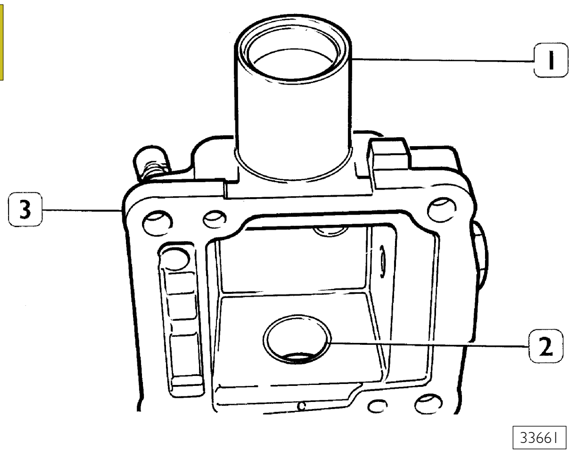
Figure 92



Extract, from the control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

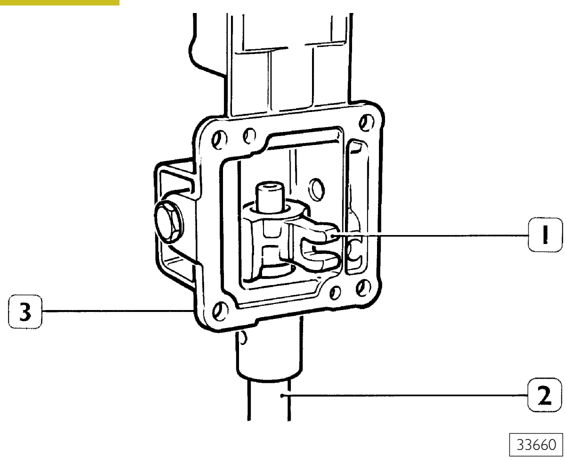
EXTERNAL CONTROL BOX ASSEMBLY

Figure 93



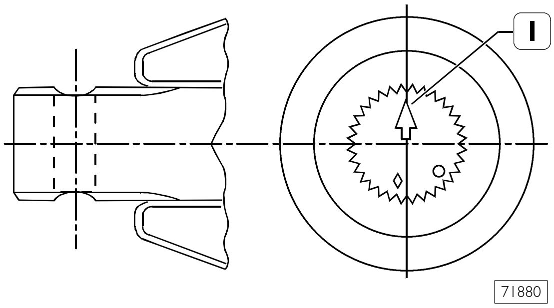
Assemble, in control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

Figure 94



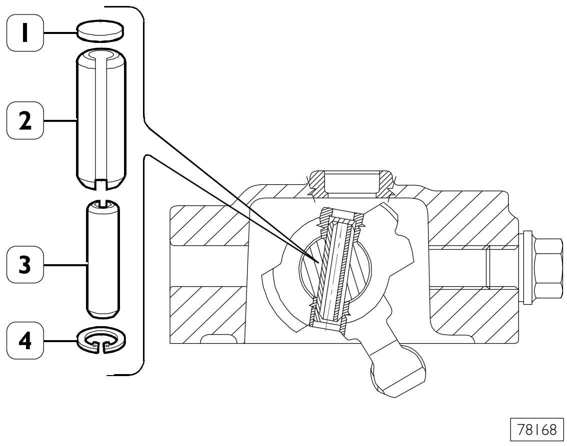
Tighten control shaft (2) in a clamp and assemble thereon box (3) and control selector (1).

Figure 95



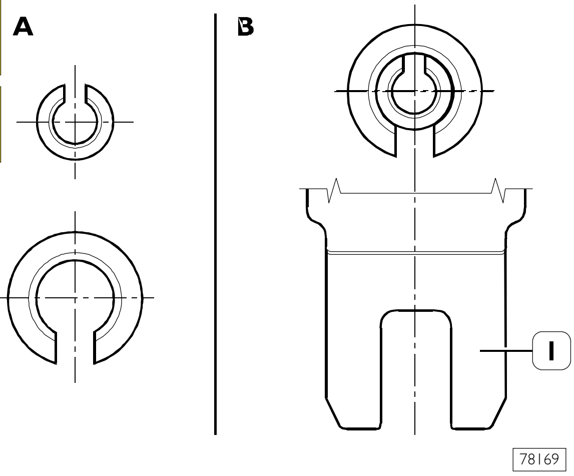
Upon assembling, the drive shaft must be assembled with the reference arrow (1) facing upwards.

Figure 96



Insert the extraction washer (1) and use a punch tool having the right diameter to install the first plug (2). Install the second plug (3) and the snap ring (4).

Figure 97



During installation, plug cuts shall be opposed by 180° (see detail A).
The bigger plug cut shall face the control selector (1) milled area (see detail B).

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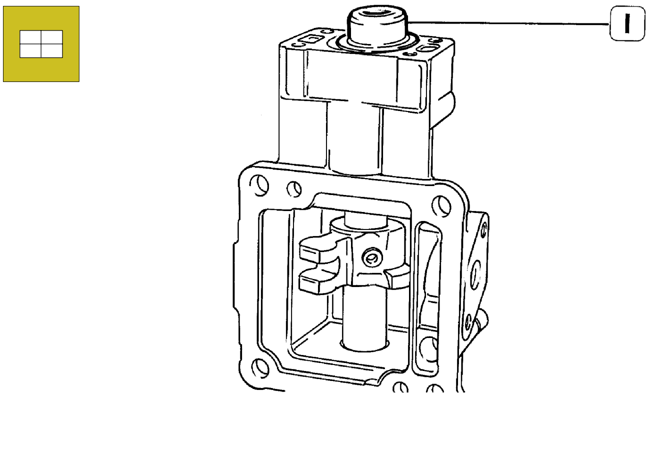
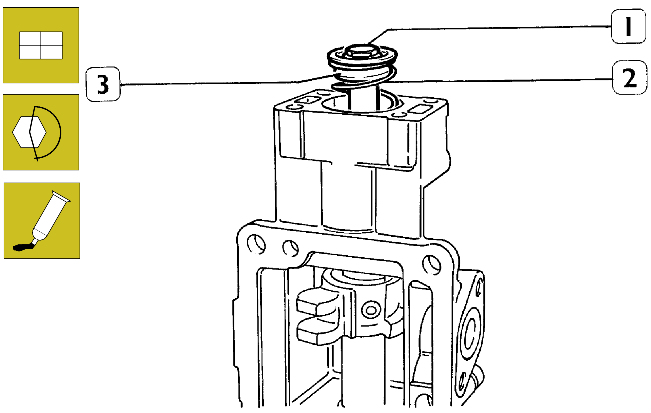
Figure 98



33663

Assemble lower cup (1).

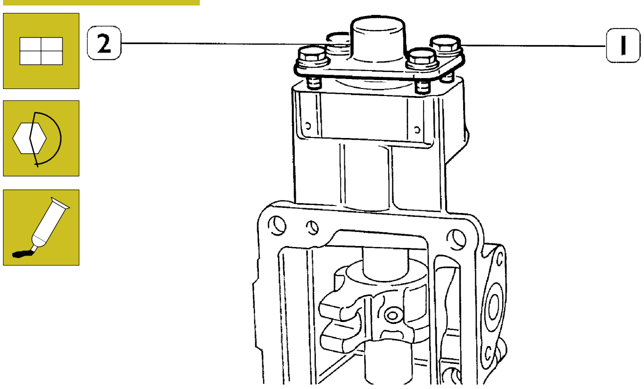
Figure 99



33658

Install the spring (2), the upper cap (3), the spacer and the screw (1) and apply threading sealer LOCTITE 270 on the screw itself.
Tighten the screw (1) to 30 Nm (3.1 kgm).

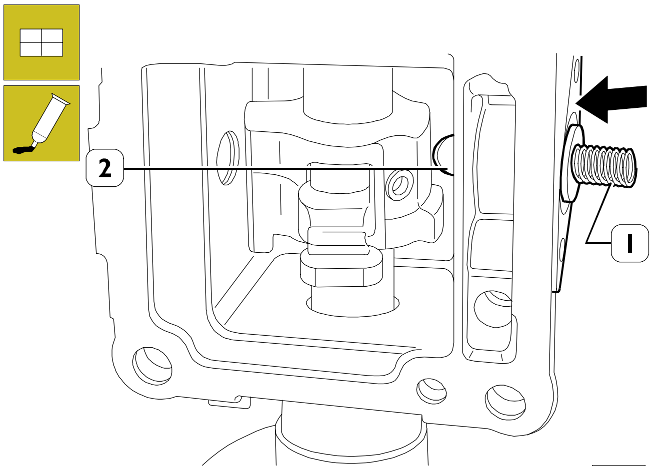
Figure 100



33657

Clean joining surfaces of control box and cover (2) and apply "LOCTITE 510" adhesive on one of the two components. Assemble cover (2) and tighten screws (1) at a torque of 36.5 Nm (3.7 kgm).
Apply threading sealer LOCTITE 270 on the screws (1).

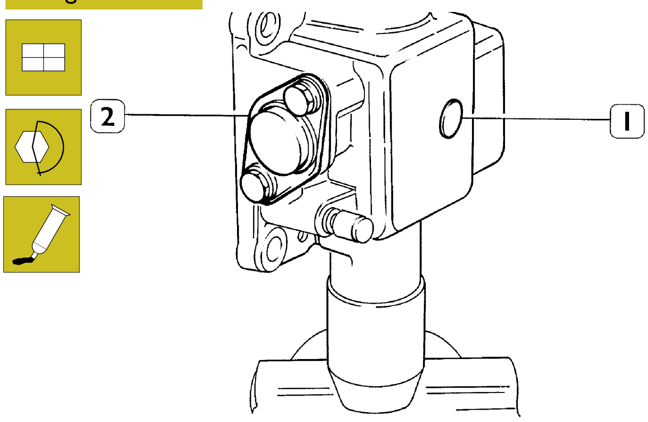
Figure 101



78170

Install the pin (2), the spring (1) and apply sealer "LOCTITE 518" (→).

Figure 102



33655

Install the cover (2) and tighten the screws to 19 Nm (1.9 kgm).
Apply sealer "LOCTITE 675" and refit the plug (1).

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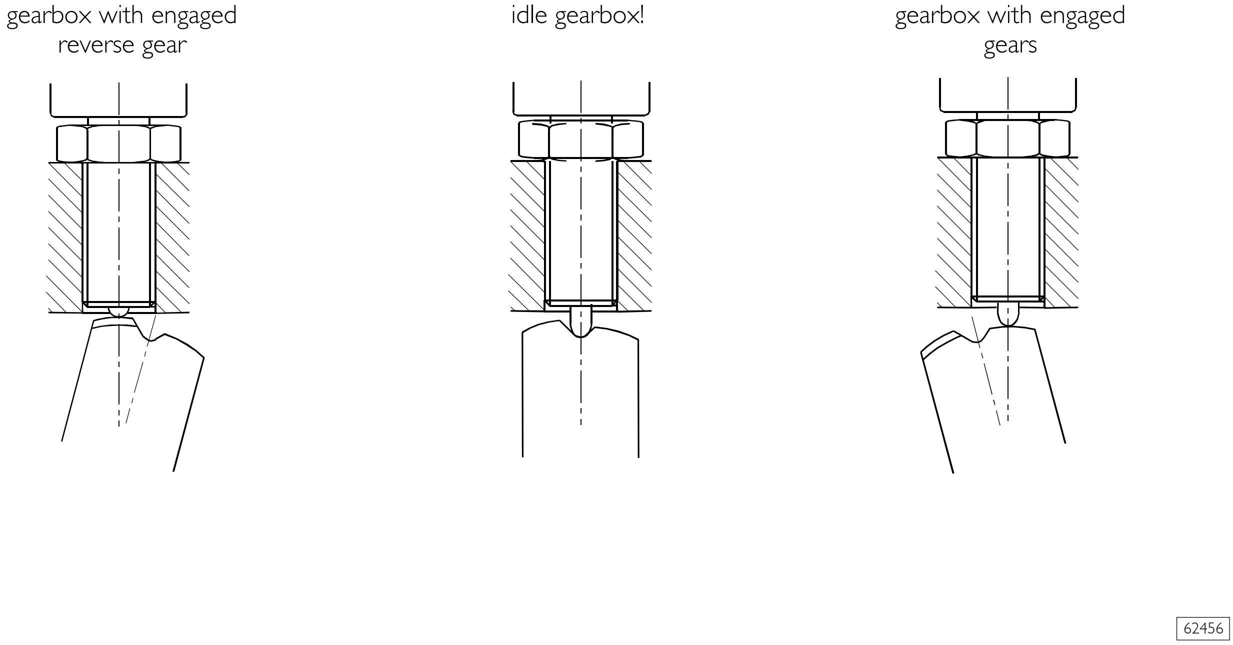
Idle-R.M. switch adjustment

The below-described sequence must be compulsorily complied with.

Figure 103



SWITCH ENGAGEMENT POSITIONS

For switch adjustment, it is necessary to carry out the following operations:

- apply silicone sealant on the threading;
- set gearbox in engaged reverse gear position;
- screw the switch till the reverse motion lamp turns on;
- screw again the switch by 45-60° corresponding to a stroke of 0.19-0.25 mm;
- tighten securing lock nut with a 24 wrench at a torque of 35 Nm.

5302 Gearbox 2865.6

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TIGHTENING TORQUES 51
TOOLS 52
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❑ Re-engagement 57
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❑ Checks 63
GEARBOX ASSEMBLY 63
❑ Bearings pre-loading adjustment for secondary shaft 64
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MOTION ENTRY SHAFT DISASSEMBLY 73
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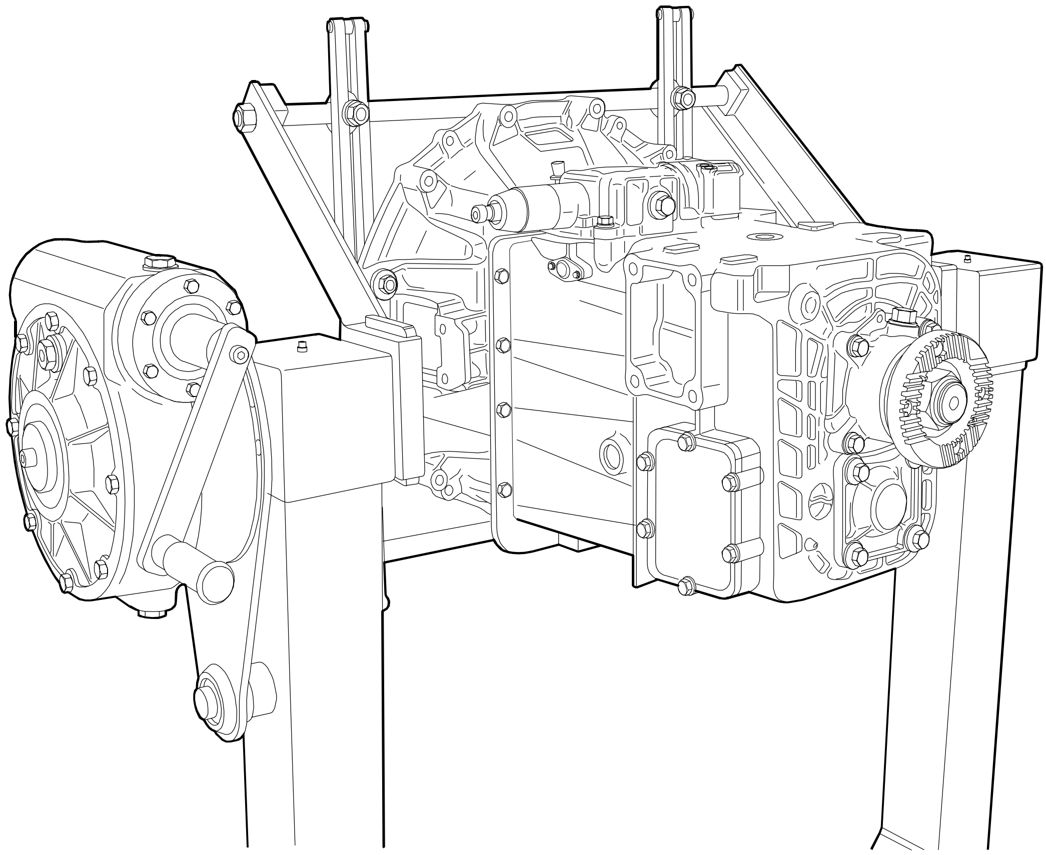
DESCRIPTION

The IVECO 2865.6 gearbox is of the mechanical type with 1st, 2nd gear engagement through a double-cone synchronising ring and 3rd, 4th, 5th and 6th gear engagement with free-ring synchronising rings. The reverse motion engagement is with a quick-connection sliding sleeve.
The gearbox case is made of light alloy and is composed of a front half-case and a rear half-case.
Three openings are obtained in the rear half-case for the possible application of a power takeoff.
Motion transmission is realised through a series of gears, always meshed and with helical teeth.

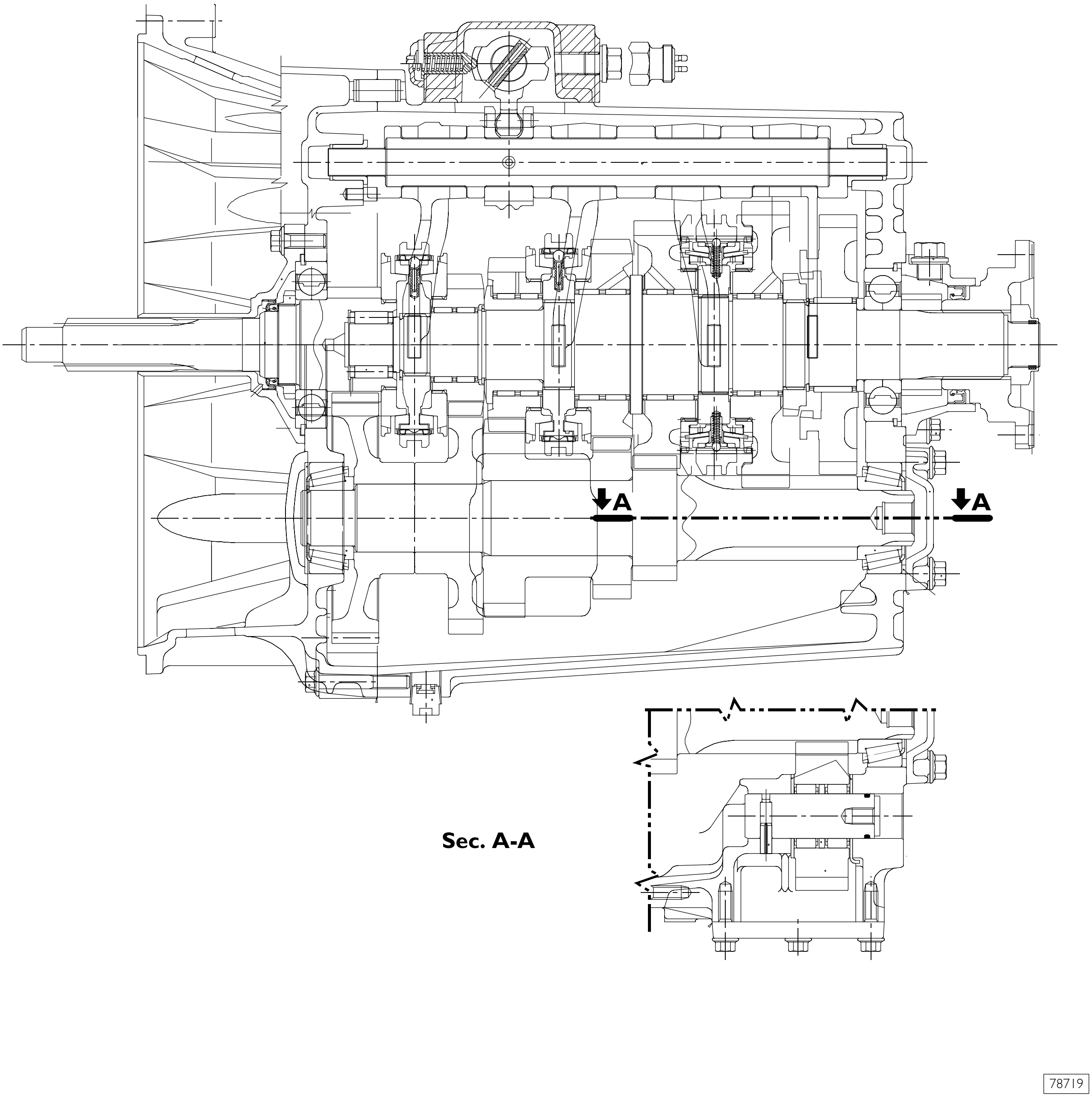
The gears are keyed or obtained on four shafts: motion entry, primary, secondary and reverse motion shafts.
The gear obtained on the motion entry shaft and those keyed on primary and reverse motion shafts idly rotate on cylindrical roller cages.
Motion entry shaft and primary shaft are supported by ball bearings in the gearbox case.
The secondary shaft is front and rear supported by tapered-roller bearings that are axially adjustable through an adjustment ring.
The gears engagement and selection control is mechanical.

Figure 1



IVECO 2865.6 GEARBOX ASSEMBLY

Figure 2



LONGITUDINAL SECTION OF 2865.6 GEARSHIFT AND SECTION ON THE REVERSE GEAR SHAFT

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SPECIFICATIONS AND DATA

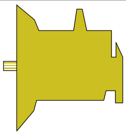
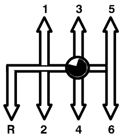
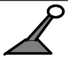
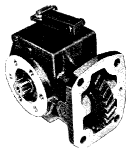
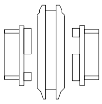
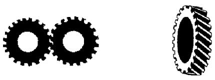
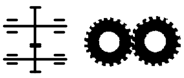
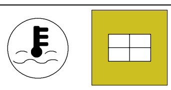
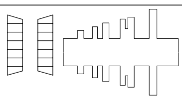
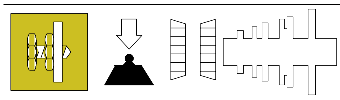
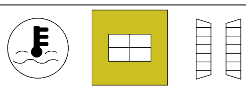
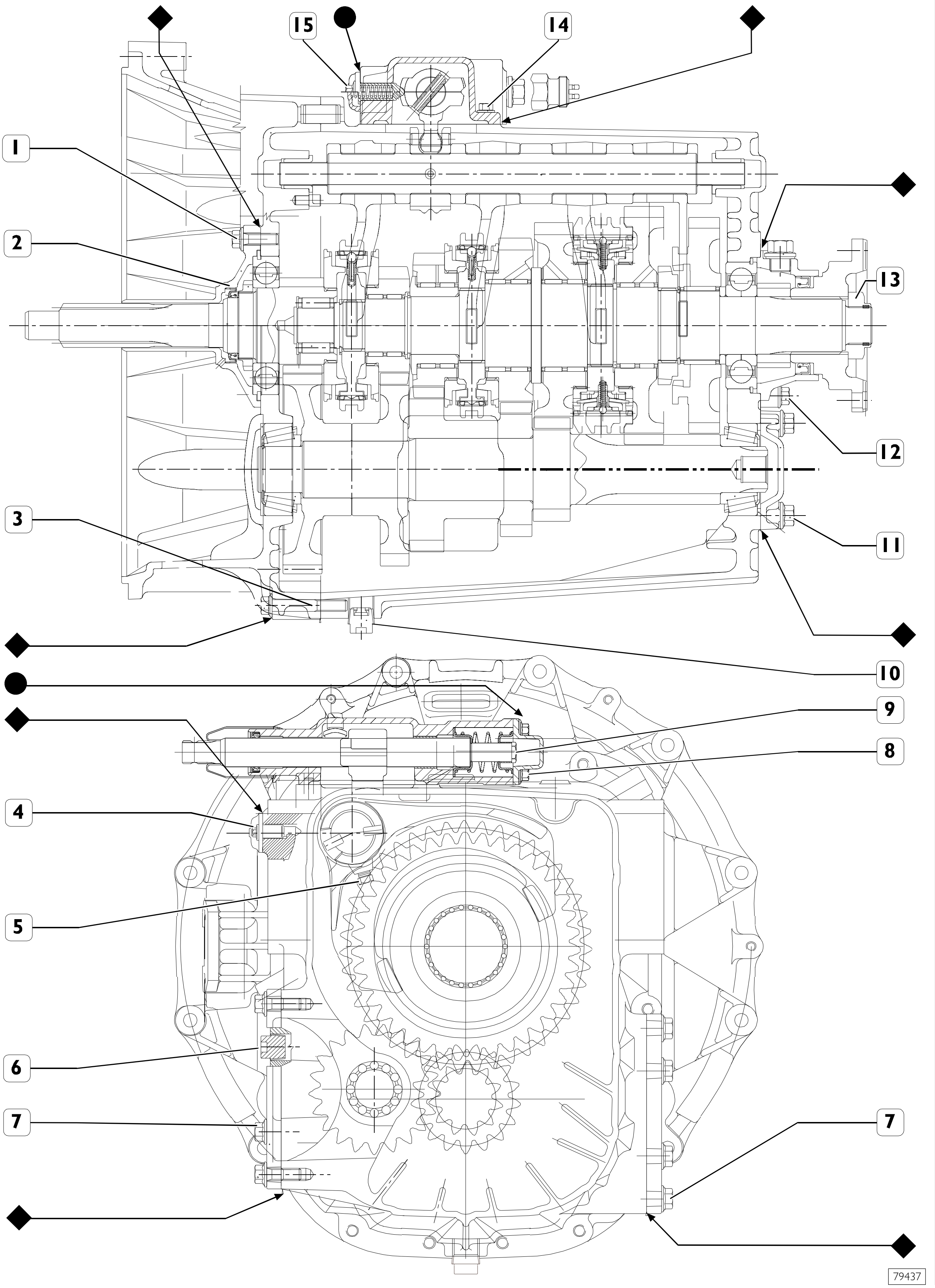
	GEARBOX	2865.6
	Type	Mechanical
	Gears	6 forward gears and reverse gear
	Gears engagement control	Mechanical
	Power takeoff	Upon request
	Gears engagement: 1st – 2nd 3rd – 4th – 5th – 6th Reverse gear Gears anti-disengagement	 Double-cone synchronizer Free-ring synchronizer Quick-connection type Sliding sleeve holding through rollers and springs.
	Gears	With helical teeth
	Gear ratio First Second Third Fourth Fifth Sixth Reverse gear	 1 : 9.007 1 : 5.015 1 : 3.206 1 : 2.066 1 : 1.370 1 : 1.000 1 : 8.170
	Oil type Amount	**TUTELA ZC 90** 8.1 Kg. (9 lt)
	Fixed hubs assembly temperature	100°C to 130°C
	Secondary shaft bearings	With tapered rollers
	Secondary shaft bearings pre-loading adjustment	By means of rings
IVECO PARTS	Secondary shaft pre-loading adjustment rings thickness mm	4.0-4.1-4.2-4.3-4.4-4.5-4.6 4.7-4.8-4.9-5.0-5.1-5.2-5.3 Supplied in a kit
	Secondary shaft bearingsassembly temperature	85°C

Figure 3



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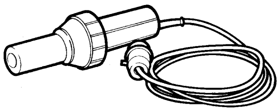
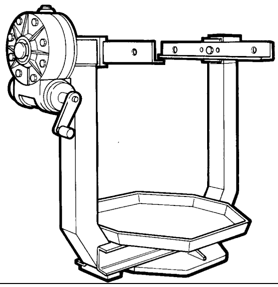
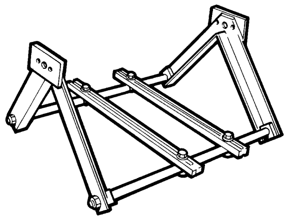
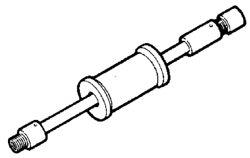
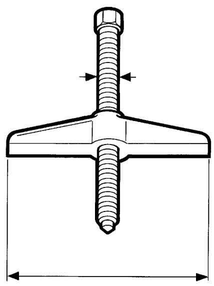
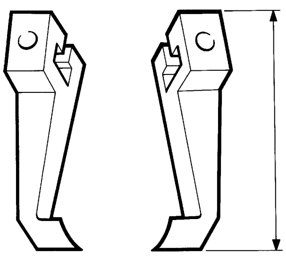
TIGHTENING TORQUES

PART		TORQUE	
		Nm	(kgm)
1	Flanged hexagonal head screw for securing front cover	32 ± 3	(3.3 ± 0.3)
2	Ring nut for securing entry shaft bearing	545 ± 55	(55.5 ± 5.6)
3	Flanged hexagonal head screw for joining clutch and case	45.5 ± 4.5	(4.6 ± 0.5)
4	Release-proof tip cover fastening screw	22.5 ± 2.5	(2.3 ± 0.2)
5	Screw for securing fork control rod hub	39 ± 2	(4.0 ± 0.2)
6	Threaded plug with external operating hexagon for oil level	27.5 ± 2.5	(2.8 ± 0.3)
7	Flanged hexagonal head screw for securing covers on side power takeoffs connection windows	38 ± 4	(3.9 ± 0.4)
8	Screw with plane washer for securing transverse axle cover on external control	19 ± 2	(1.9 ± 0.2)
9	Transverse axle screw	30 ± 3	(3.0 ± 0.3)
10	Threaded plug with external operating hexagon for oil discharge	27.5 ± 2.5	(2.8 ± 0.3)
11	Flanged hexagonal head screw for securing rear cover on secondary shaft	58 ± 6	(5.9 ± 0.6)
12	Flanged hexagonal head screw for securing rear cover on primary shaft	43 ± 4	(4.4 ± 0.4)
13	Locking nut for outlet primary shaft flange	467 ± 23	(47.6 ± 2.3)
14	Flanged hexagonal head screw for securing upper external controls support cover	33.5 ± 3.5	(3.4 ± 0.4)
15	Flanged hexagonal head screw for securing spring check flange on external control	19 ± 2	(1.9 ± 0.2)
-	Flanged hexagonal head screw for securing clutch disengagement lever support	46.5 ± 4.5	(4.6 ± 0.4)

* Apply thread-braking LOCTITE 270 on the screw
♦ Apply liquid gasket LOCTITE 510 sealant
• Apply liquid gasket LOCTITE 518 sealant.

TOOLS

TOOL No.		DENOMINATION
99305121		Hot-air apparatus
99322205		Rotating stand for assembly revision (capacity 1000 daN, couple 120 daN/m)
99322225		Assembly bearing support (to be applied on stand 99322205)
99340205		Percussion extractor
99341003		Simple-effect bridge
99341009		Pair of brackets

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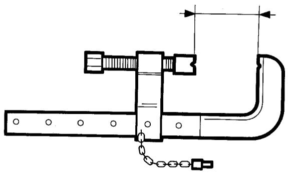
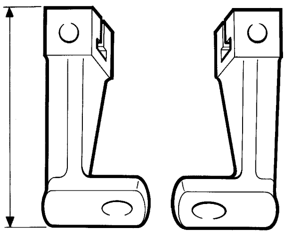
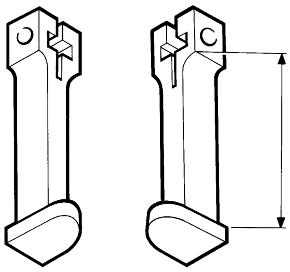
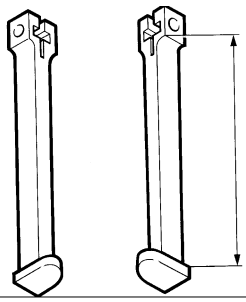
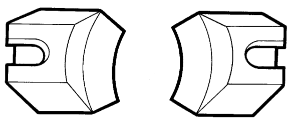
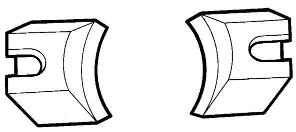
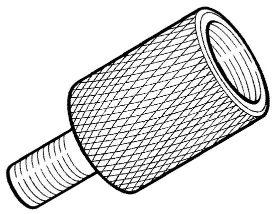
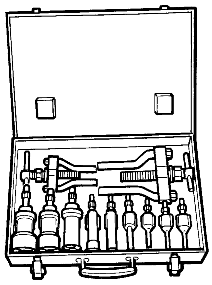
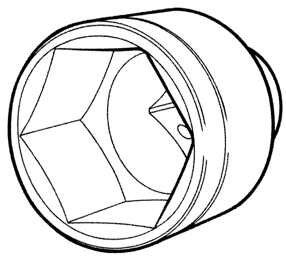
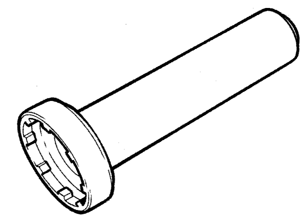
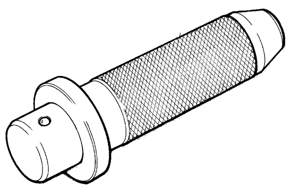
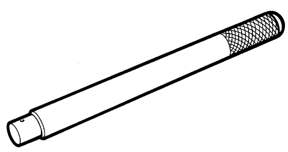
TOOLS

TOOL No.		DENOMINATION
99341015		Clamp
99341017		Pair of brackets with hole
99341019		Pair of tie-rods for holds
99341020		Pair of tie-rods for holds
99341023		Holds
99341025		Holds

TOOLS

TOOL No.		DENOMINATION
99342143		Peg for removing reverse gear shaft (use with 99340205)
99348004		Universal extractors for interiors 5 to 70 mm
99355081		Bush for disassembling and re-assembling motion outlet flange nut (use with 99370317)
99355174		Wrench for disassembling and re-assembling ring nut, gearbox top gear shaft
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters

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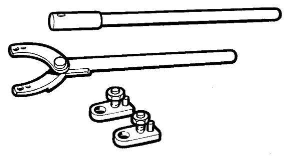
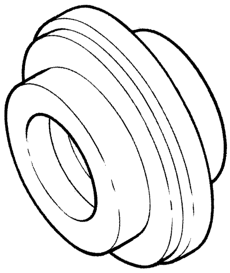
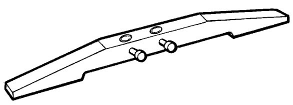
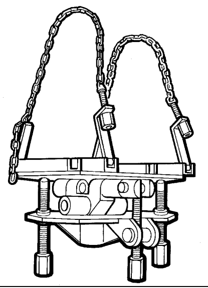
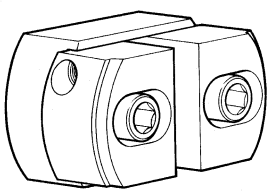
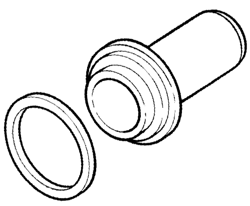
TOOLS

TOOL No.		DENOMINATION
99370317		Reaction lever with flange check extension
99370349		Keyer for drive shaft front gasket assembling (use with 99370006)
99370466		Comparator basis
99370629		Gearbox bearing support during vehicle disconnection and re-connection
99374092		Beater for external bearings race assembling (69-91) (use with 99370007)
99374201		Keyer for assembling gasket on rear gearbox cover

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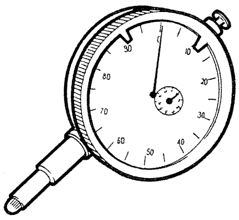
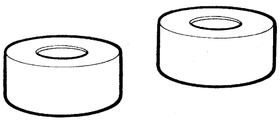
TOOLS

TOOL No.		DENOMINATION
99395604		Comparator (0 – 10 mm)
99396032		Calibrated rings for secondary shaft bearings adjustment (use with 99370466)

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GEARBOX 2865.5 DISENGAGEMENT/ RE-ENGAGEMENT

Before carrying out disengagement/re-engagement operations, disconnect battery cables and place the vehicle under safety conditions.

Disengagement

Lift the calender and turn the cabin over.

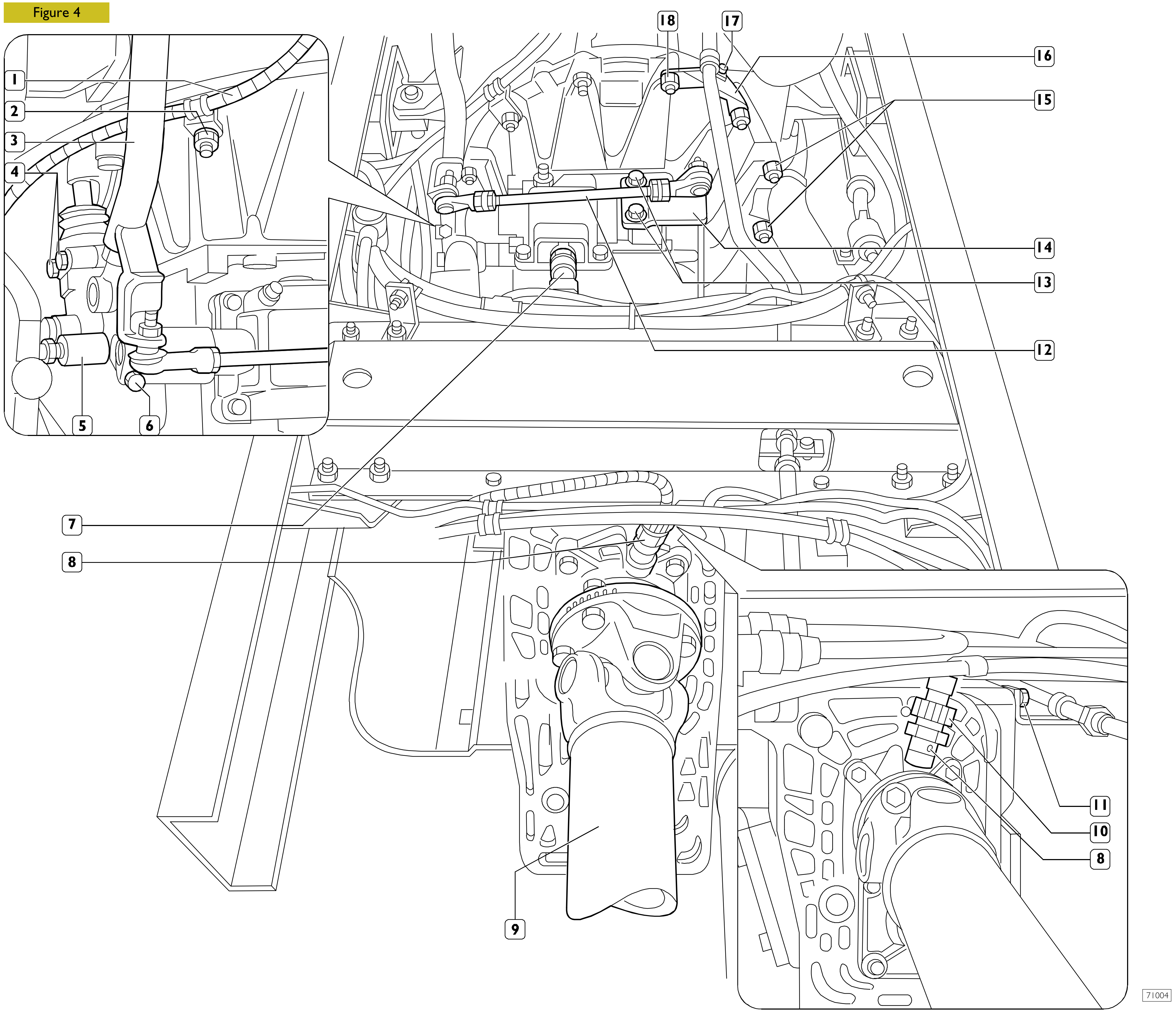
- loosen securing bolt (17), unscrew securing nuts (18) and detach air piping supporting bracket (16);
- unscrew securing nut (2) and detach air piping supporting bracket (1);
- unscrew securing nuts (13) and detach bracket (14) of reaction tie-rod (12); loosen securing screw (6) and detach from gearbox the gears control lever completed with tie-rod (3) and reaction tie-rod (12);
- disconnect reverse gear switch electric connection (7);
- unscrew securing nuts (15) of clutch bell to engine that will be able to be reached with difficulty from the lower vehicle part.
- rotate deadening guard locking rivets below the gearbox and remove the deadening guard;
- detach transmission shaft (9) as described in the related section;
- unscrew securing screws (4) and detach clutch control operating cylinder (5);
- disconnect electric connection (10) of odometer sensor (8);
- unscrew securing screw (11) and detach air piping support bracket;
- place an hydraulic jack equipped with support 99370629 under the gearbox;
- unscrew the remaining securing nuts of clutch bell to engine, move the gearbox backwards and lowering the jack remove it from below the vehicle.

Re-engagement

Suitably reverse the operations carried out for disengagement and tighten securing screws and nuts at the required torque.

Upon re-engaging the gearbox, pay attention that the clutch control lever fork is correctly meshed to the thrust bearing.

Figure 4



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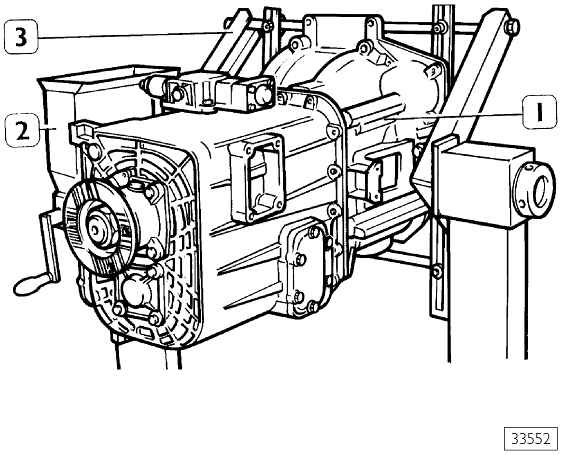
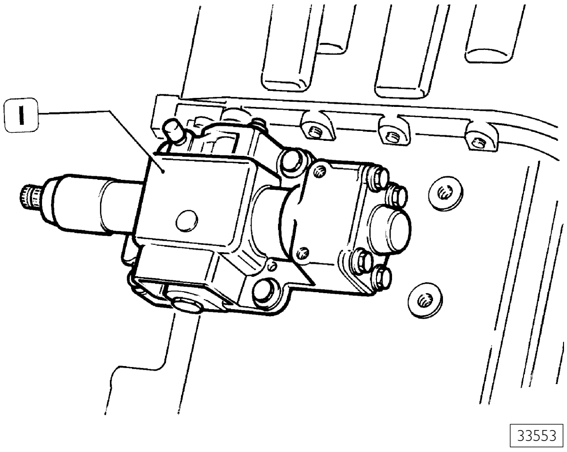
GEARBOX DISASSEMBLY

Figure 5



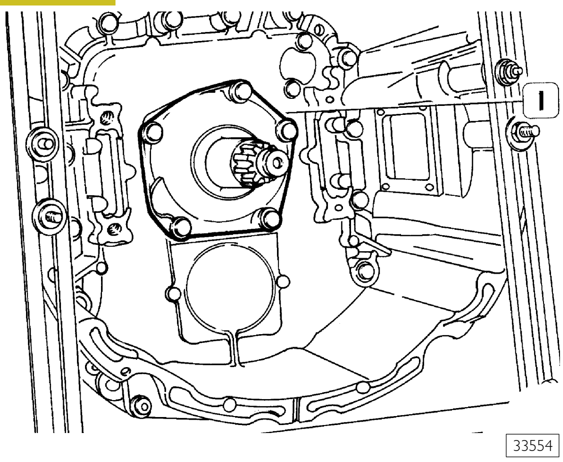
Place gearbox (1) on rotating stand 99322205 (2) equipped with brackets 99322225 (3) and discharge the lubricating oil.

Figure 6



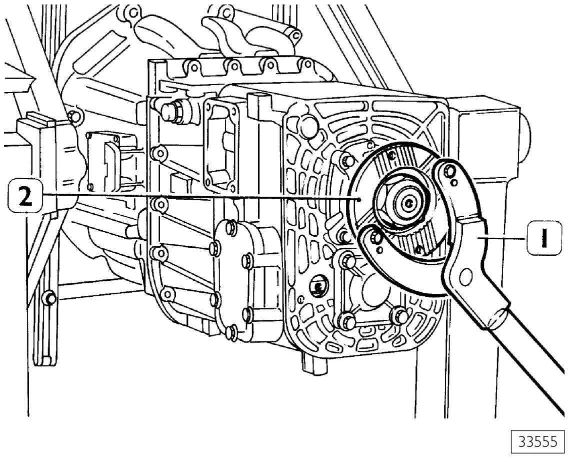
Disassemble external control box (1).

Figure 7



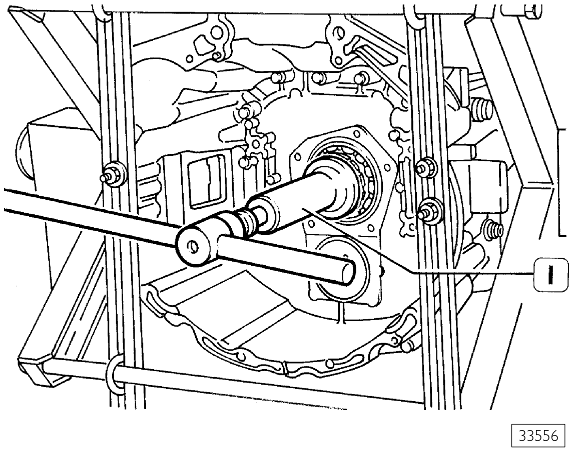
Unscrew the two securing screws for clutch disengagement lever support and remove lever from gearbox.
Disassemble cover (1) on motion entry shaft.

Figure 8



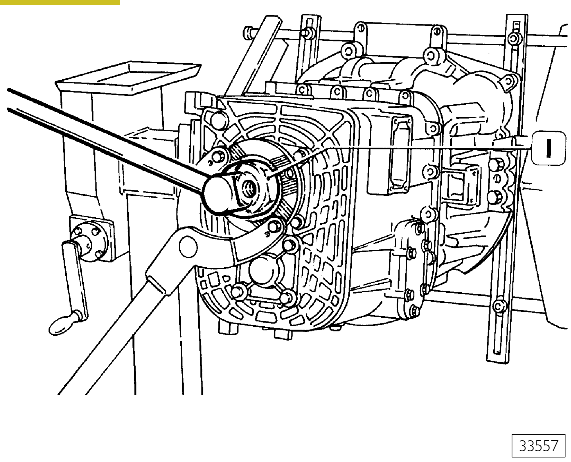
Apply reaction lever 99370317 (1) on motion outlet flange (2) and engage a gear.

Figure 9



Loosen ring nut on motion entry shaft with wrench 99355174 (1).

Figure 10



Unscrew the primary shaft screw with wrench 99355081 (1).

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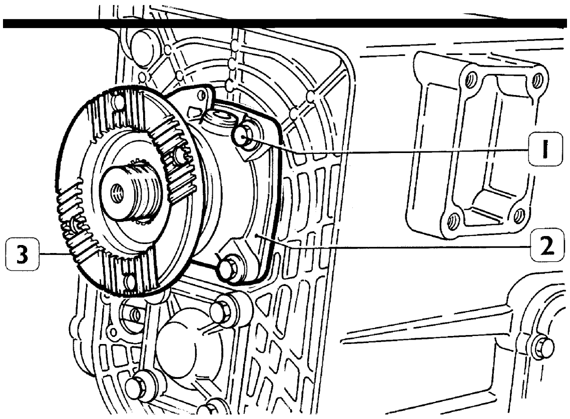
Figure 11

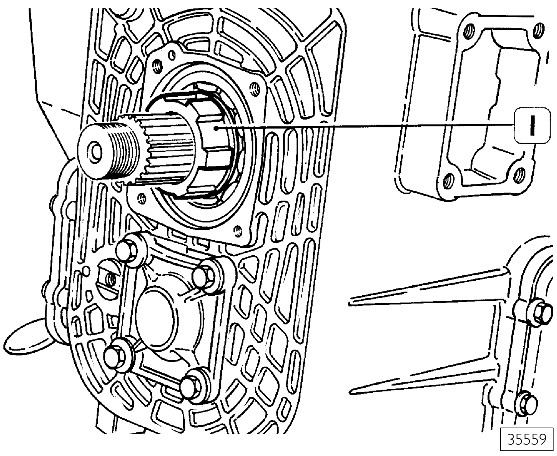


33558

Disengage engaged gear, remove flange (3), uscrew screws (1) and remove cover (2).

The disassembly of rear gearbox cover for replacing the sealing gasket can be carried out also with gearbox assembled on the vehicle, by detaching the transmission shaft and proceeding as shown for the gearbox assembled on rotating stand.

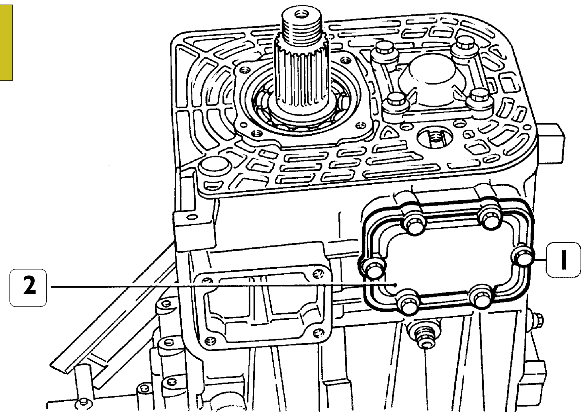
Figure 12



35559

Remove phonic wheel (1) for odometer control.

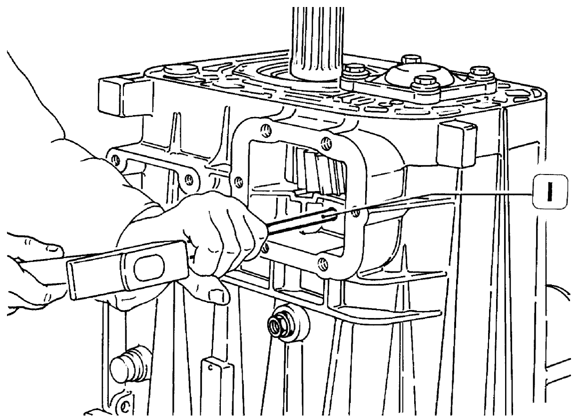
Figure 13



35560

Unscrew screws (1) and remove cover (2).

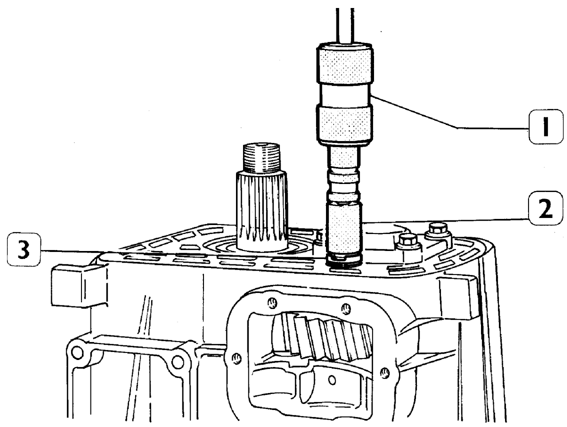
Figure 14



35561

Beat with a punch (1) and push the elastic peg till it abuts.

Figure 15



35562

Place extraction peg 99342143 (2) and percussion extractor 99340205 (1). Withdraw the reverse gear supporting pin and remove the same gear with related shoulder washers and cylindrical roller bearing.

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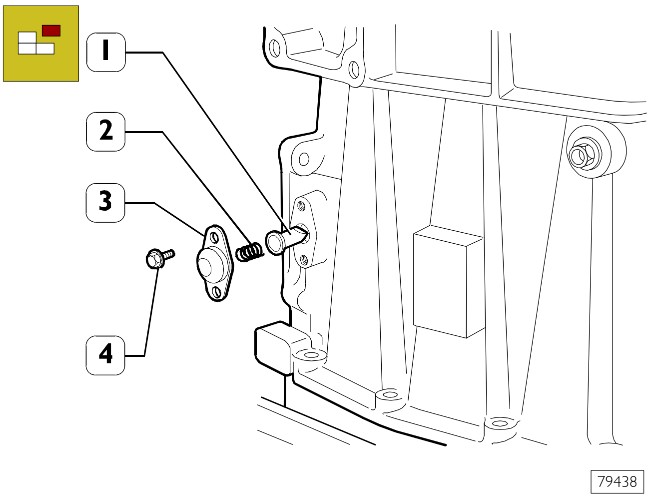
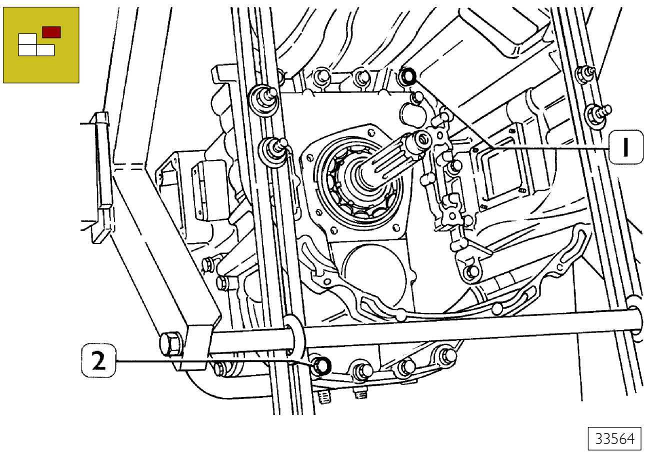
Figure 16



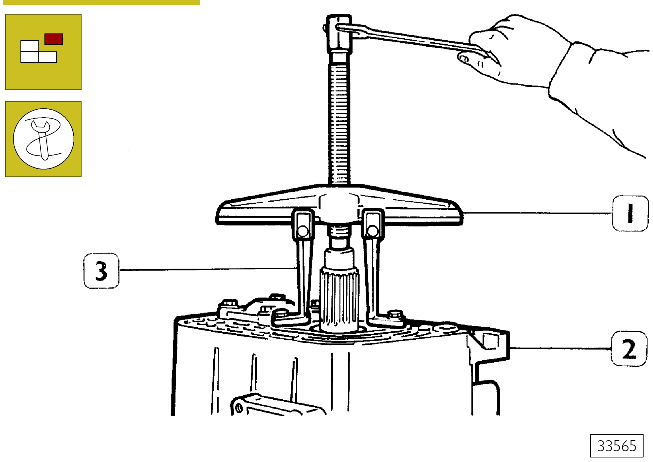
Release the screws (4) and remove the cover (3).
Remove the spring (2) and extract the push rod (1).

Figure 17



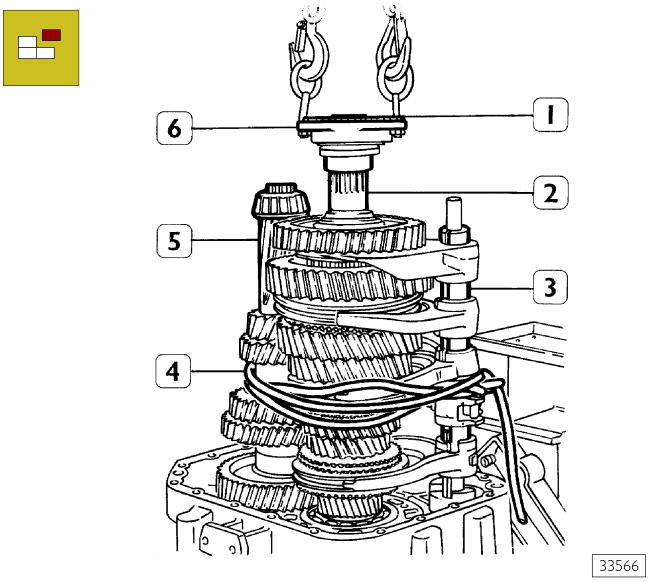
Unscrew screws (1 and 2).

Figure 18



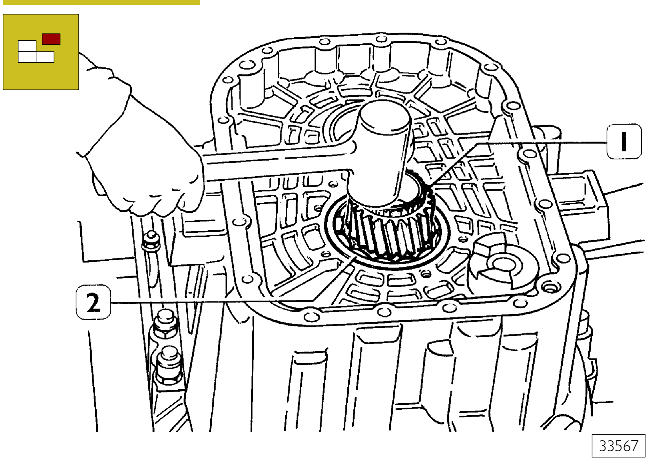
Extract box (2) with bridge 99341003 (1) equipped with the pair of brackets 99341017 (3).

Figure 19



Assemble motion outlet flange (6) on primary shaft (2) and lock it with nut (1). Tie secondary shaft (5) and internal control shaft (3) with a rope (4) to primary shaft (2) and with the help of a lifting device remove the shafts from the rear cover.

Figure 20



Remove from motion entry shaft (1) the cylindrical roller bearing and heat the cover contact surface (2). With a plastic hammer, extract motion entry shaft (1) completed with ball bearing, elastic ring and ring nut.

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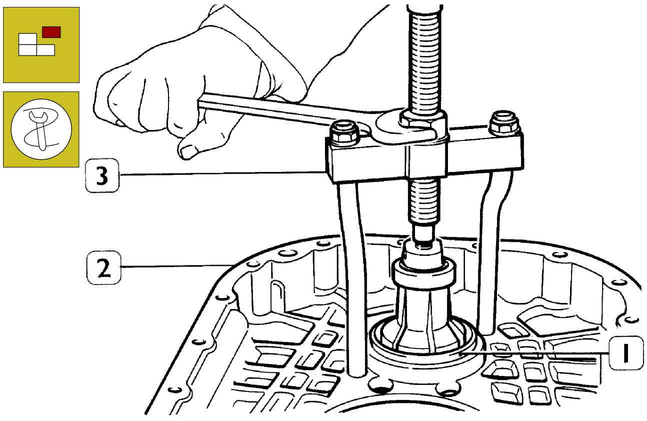
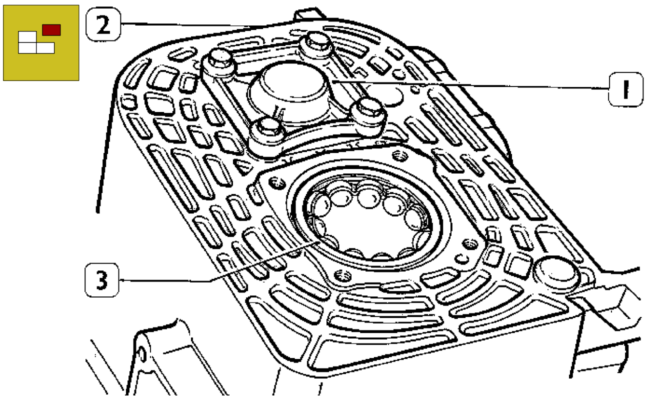
Figure 21



35568

Extract rolling race (1) of the secondary shaft tapered roller bearing, from front cover (2) with extractor 99348004 (3). Remove the adjustment ring.

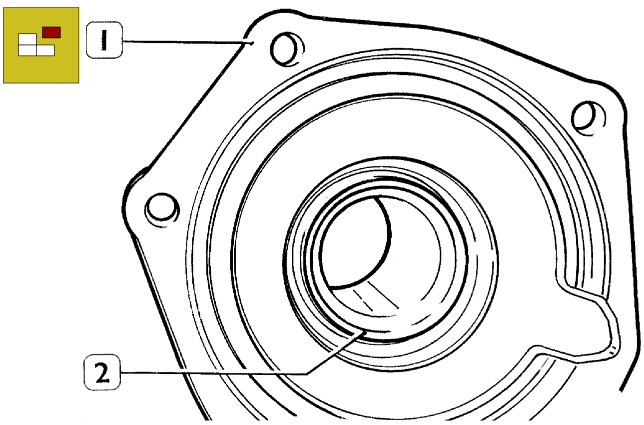
Figure 22



35569

Remove cover (1) and underlying spacer.
Extract, from case (3), the external race of secondary shaft tapered roller bearing, and the ball bearing (2) with a suitable beater.

Figure 23

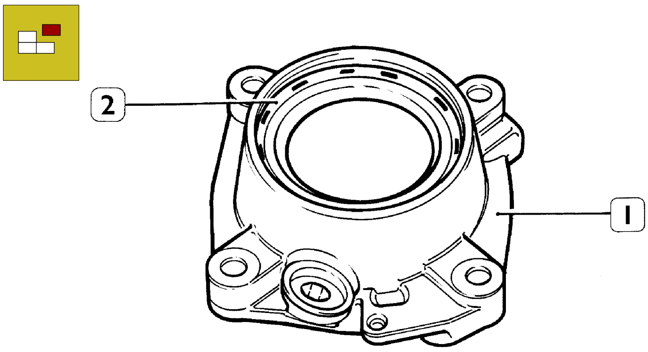


35570

Extract from motion entry shaft cover (2) the sealing gasket (1) with a suitable beater.

530514 Rear cover sealing gasket replacement

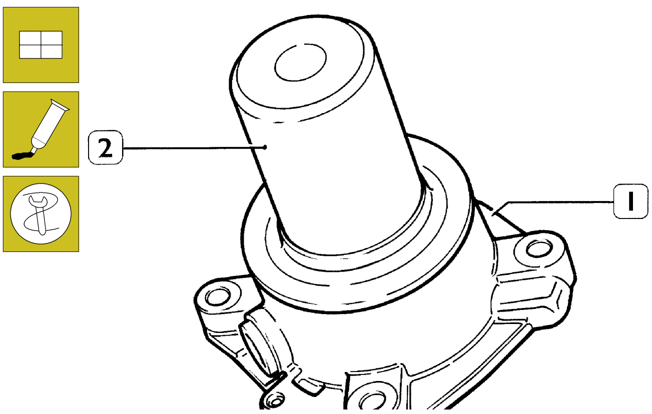
Figure 24



35571

Extract from primary shaft cover (1) the sealing gasket (2) with a suitable beater.

Figure 25



35572

Butter with sealing compound type "B", the coupling seat surface of cover (1), and with keyer 99374201 (2) assemble the sealing gasket.

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Checks

GEARBOX CASE

Gearbox case and related covers must not show cracks. Contact surfaces between covers and gearbox case must not be damaged or distorted.
Bearing seats must not be damaged or excessively worn.

SHAFTS – GEARS

Shaft seats for bearings and gear toothings must not be damaged or worn.

HUBS – SLIDING SLEEVES – FORKS

Grooves on hubs and related sliding sleeves must not be damaged. The sliding sleeve must freely slide on the hub. Sliding sleeve positioning rollers must not be damaged or worn. Sliding sleeves engagement toothings must not be damaged.
Forks must be intact and not show any sign of wear.

BEARINGS

Roller bearings or roller cages must be in perfect conditions and not show traces of wear or overheating.
Keeping the bearings pressed with a hand and making them simultaneously rotate along the two directions, no roughnesses or noises when sliding must be detected.

Upon assembling, the following must always be replaced: rings, sealing gaskets and springs for sliding sleeves positioning rollers.

SYNCHRONIZERS – COUPLING BODIES

Check wear of synchronizing rings and respective coupling bodies: they must not have any sign of wear.

Upon assembling, do not mutually exchange the controlled parts.

GEARBOX ASSEMBLY

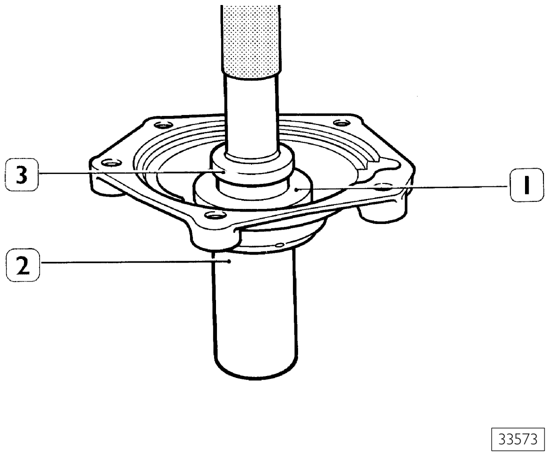
Butter with sealing compound type "B" the threaded part of all screws that have to be screwed into the through-holes.

Clean joining surface of case and covers and apply "LOCTITE 510" adhesive, before assembling, on one of the two components.

Do not insert oil before 20 min. and do not try the gearbox before 1h and 30 min.
Assemble bearing cages into their respective seats and oil with TUTELA ZC 90.

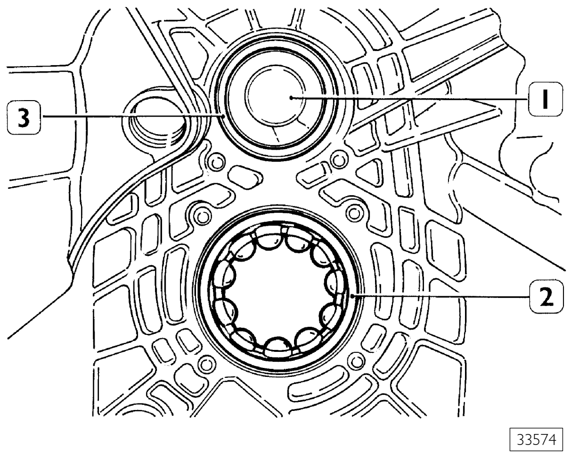
In order to guarantee oil seal upon assembly, make sure that sealing gaskets are already lubricated, or: butter with oil or grease the gasket sealing lip for entry and primary shafts.

Figure 26



Butter, with sealing compound type "B", the coupling seat surface of cover (2) and with keyer 99370349 (1) and handle 99370006 (3) assemble the sealing gasket.

Figure 27

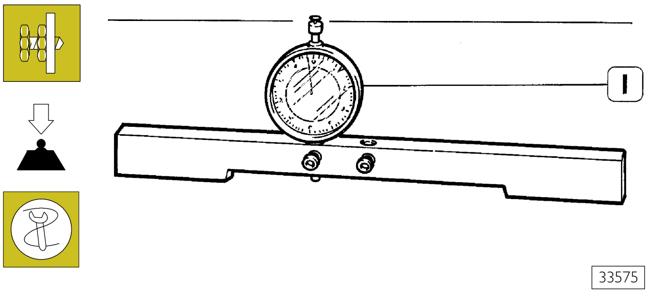


Assemble cover (1), spacer and with a suitable beater, the external race (3) of tapered roller bearing. Slightly heat the case contact surface with ball bearing and assemble the bearing itself.

Bearings pre-loading adjustment for secondary shaft

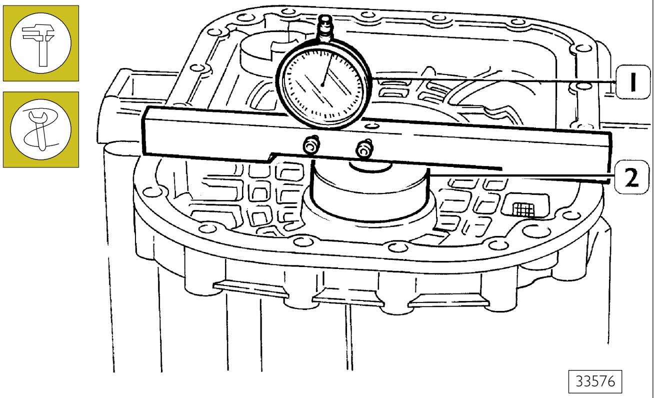
The pre-loading adjustment for secondary shaft bearings can be carried out with two procedures.

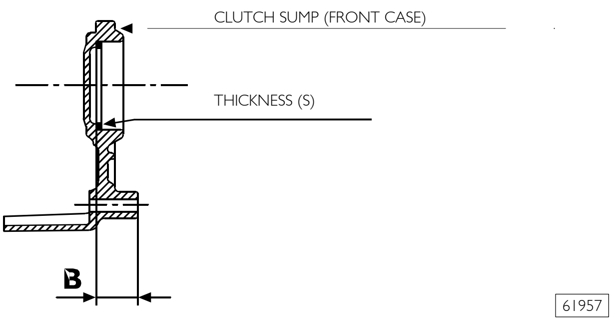
Figure 28



Assemble comparator (1) on base 99370466 (2).
Pre-load it with 5 mm and zero it on a striker plane.

Figure 29



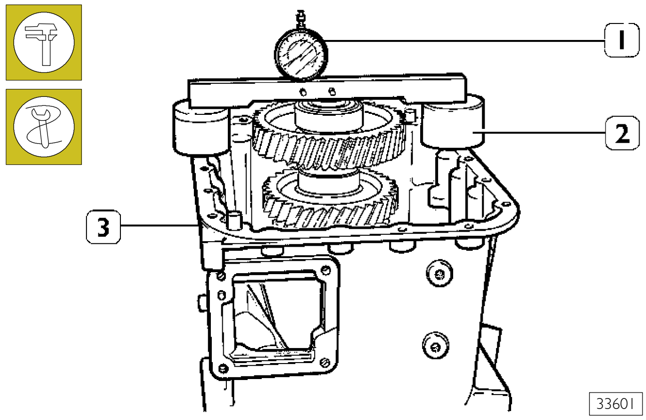


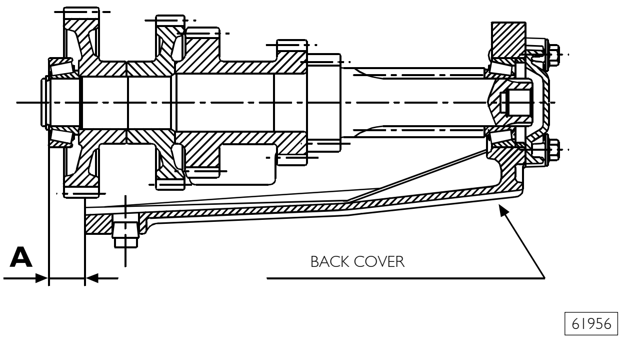
Place calibrated ring 99396032 (2) in the tapered roller bearing seat, without adjustment ring, on front cover; place base 99370466 completed with previously zeroed comparator (1), as shown in Figure 28.

First method – Take note of the value read on comparator (Example: 2.43 mm).

Second method – Take note of the value read on comparator and add it to calibrated ring thickness [Example: 2.43 + 50.5 = 52.93 mm (dimension **B**)].

Figure 30





Assemble and simultaneously rotate secondary shaft completed with bearings into rear case (3), so that it settles. Place calibrated rings 99396032 (2) on case (3). Arrange, as shown in Figure 30, base 99370466 completed with previously zeroed comparator (1): the comparator rod must abut on external bearing ring. Carry out the measure on two diametrally-opposed points and carry out the arithmetic mean.

First method – Take note of the value read on comparator (Example: 1.84 mm). The adjustment ring value is obtained by adding the two measured values (Example: 2.43 + 1.84 = 4.27 mm)

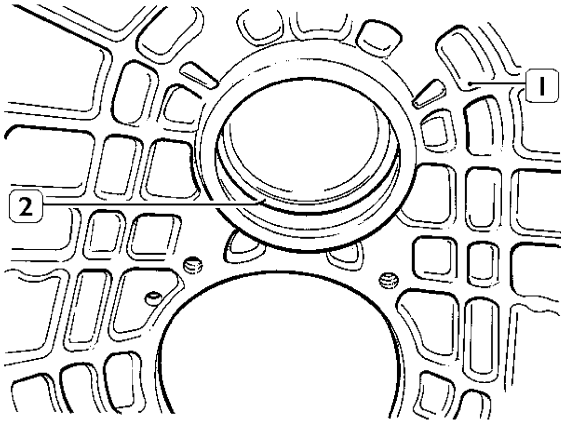
Second method – Take note of the value read on comparator and subtract it from calibrated ring thickness [Example: 50.5 – 1.84 = 48.66 mm (dimension **A**)].

The adjustment ring value is obtained through formula
S = B – A Example: 52.93 – 48.66 = 4.27 mm.

The adjustment ring rounding is carried out always in excess. Example: thickness S = 4.27: thickness S = 4.3 is taken.
The measure for dimension "A" is carried out with secondary shaft in vertical position that, in addition to making the measure itself easier, allows having an axial load on rear bearing.

After having computed the adjustment ring thickness value, disassemble again secondary shaft from rear case.

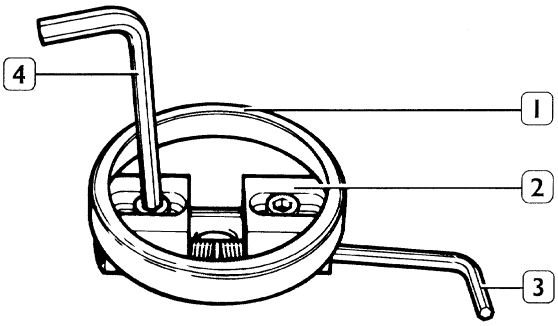
Figure 31



33604

Place, into the secondary shaft bearing seat on front cover (1), the adjustment ring (2) whose thickness is equal to the previously-obtained one.

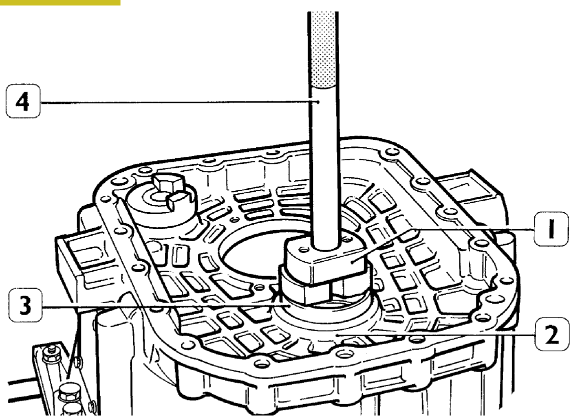
Figure 32



32447

Center the external race (1) of secondary shaft tapered roller bearing of front cover on extendable beater 99374092 (2) adjusted with the setscrew wrench (3). Lock the beater with the setscrew wrench (4).

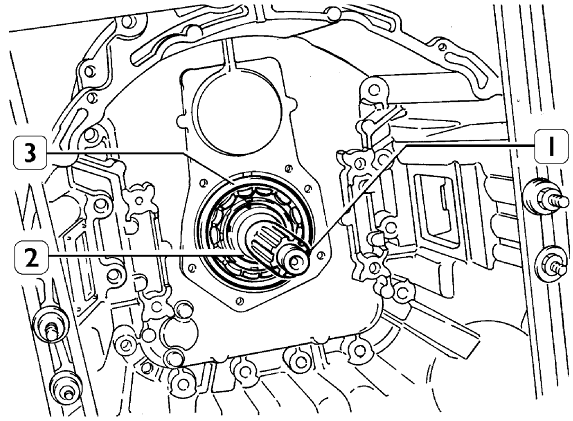
Figure 33



33605

Slightly heat seat (2) of secondary shaft bearing race and assemble external race (3) settling it till it abuts with beater 99374092 (1), equipped with handle 99370007 (4).

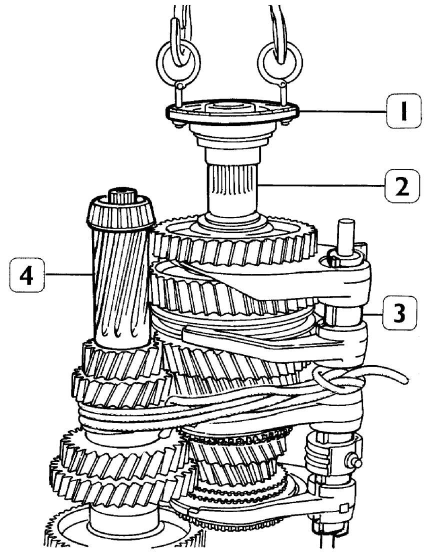
Figure 34



33606

Slightly heat the ball bearing seat, assemble motion entry shaft (1) completed with ball bearing, rolling half-races and ring nut (2). Settle bearing (3) till it abuts.

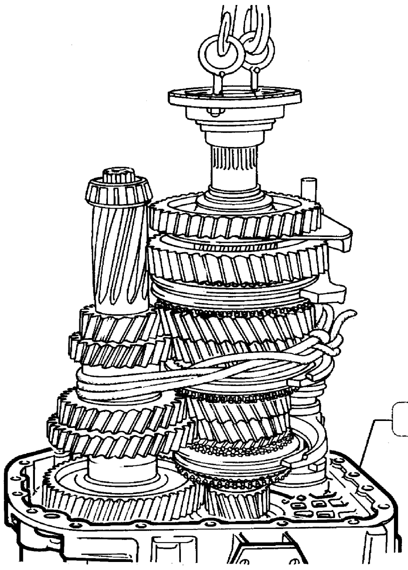
Figure 35



33607

Temporarily assemble on primary shaft the motion outlet flange and secure it with a check nut. Assemble together, on a bench and with the help of a lifter, primary shaft (2), secondary shaft (4) and engagement fork control shaft (3); keep them mutually joined by means of a rope.

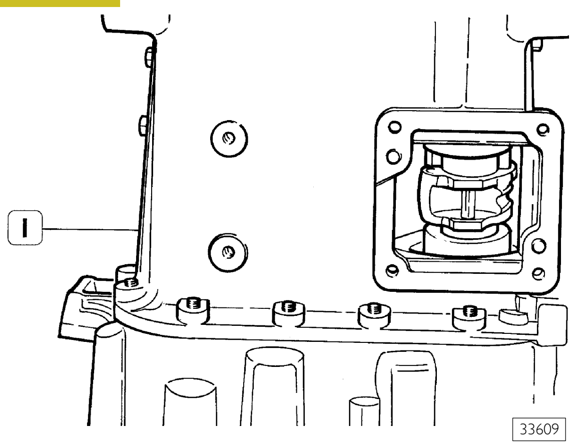
Figure 36



33608

Insert cylindric roller bearing into motion entry shaft and assemble the three shafts together on front cover (1).

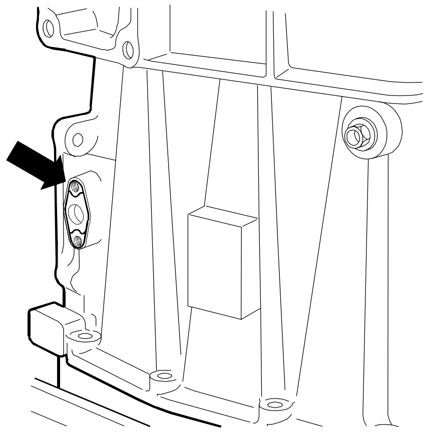
Figure 37



33609

Remove temporarily previously-assembled ring nut and nut and assemble gearbox case (1). Tighten screws joining front cover and case at the required torque.

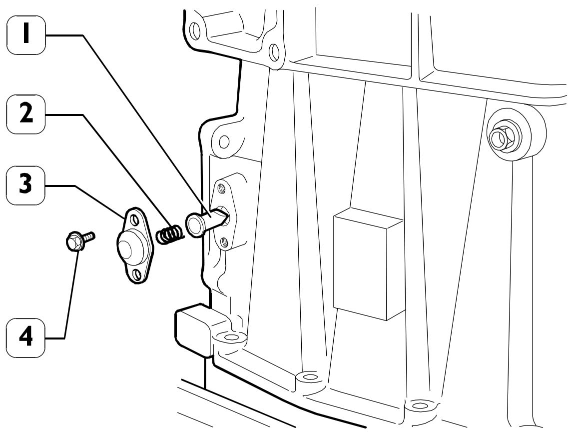
Figure 38



79439

Apply sealer LOCTITE 510 on the surface (→) without staining the push rod supporting area (1, Figure 39).

Figure 39



79438

Insert tip (1), spring (2), then mount cover (3) and fasten screws (4) by tightening them to the specified torque.

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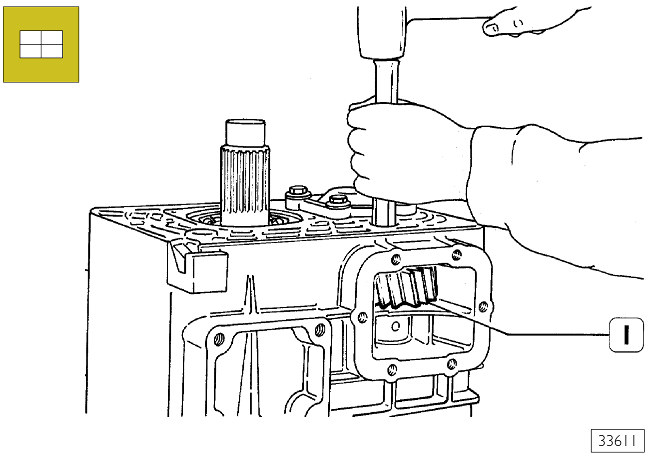
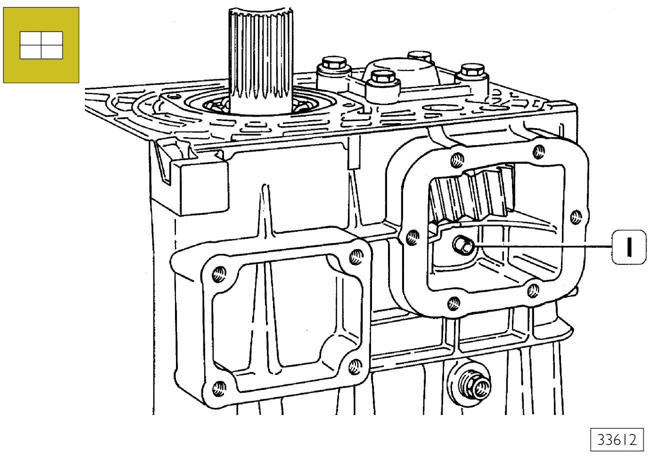
Figure 40



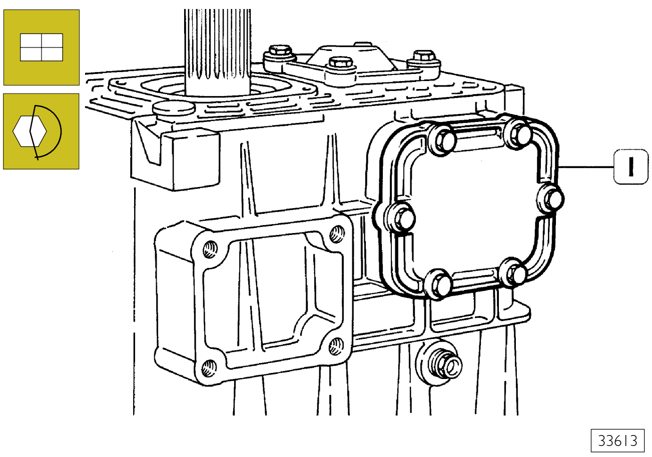
Assemble shoulder rings, placing them into their own seat and reverse gear (1) with the cylindrical roller bearing. Assemble reverse gear supporting shaft with a suitable beater.

Figure 41



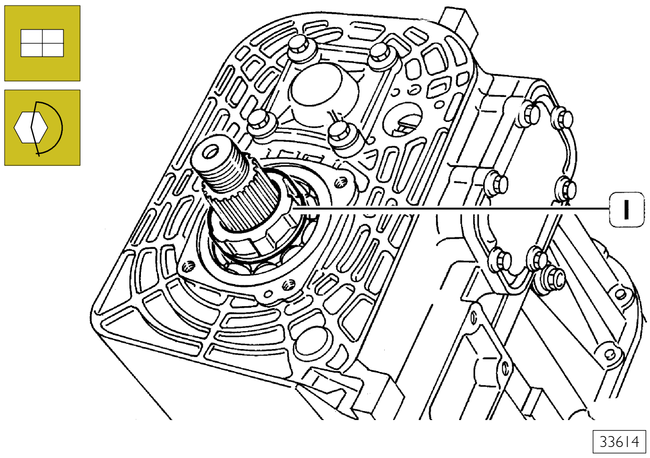
Assemble elastic peg (1).

Figure 42



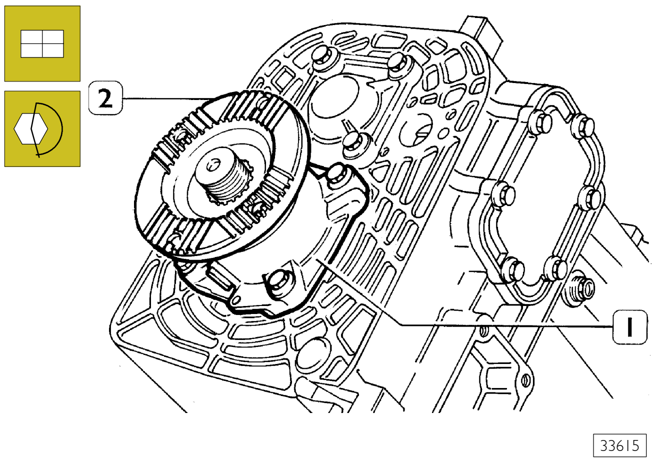
Assemble cover (1) by tightening the screws at the required torque.

Figure 43



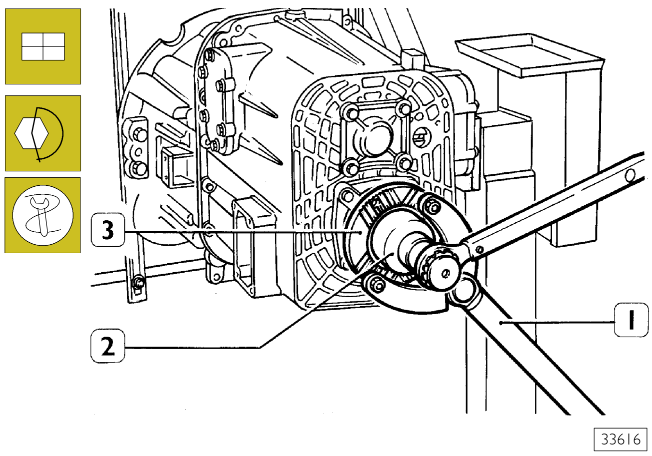
Slightly heat ball bearing half-race and assemble it into its own seat on primary shaft. Assemble the odometer controlling phonic wheel (1).

Figure 44



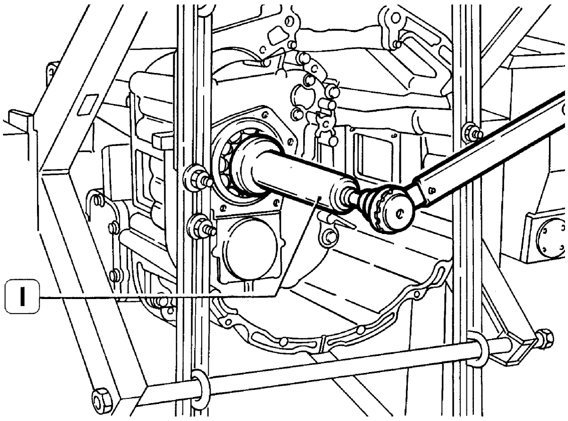
Assemble rear cover (1), completed with sealing gasket, by tightening the securing screws at the required torque. Assemble motion outlet flange (2).

Figure 45



Assemble reaction bar 99370317 (1), motion outlet flange locking nut (3), wrench 99355081 (2) and tighten the locking nut at the required torque.

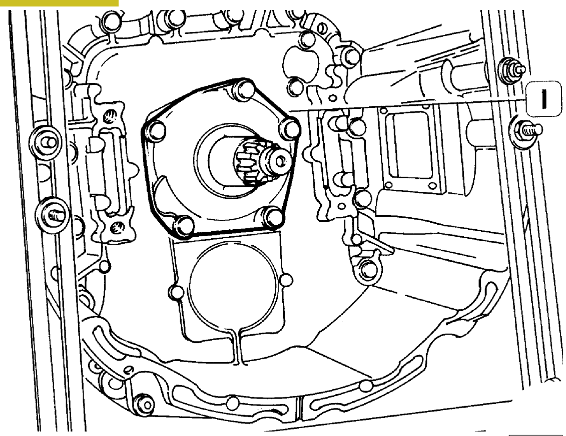
Figure 46



33617

Lock motion outlet flange rotation with bar 99370317, engage a gear and with wrench 99355174 (1) tighten the ring nut on motion inlet shaft at the required torque.

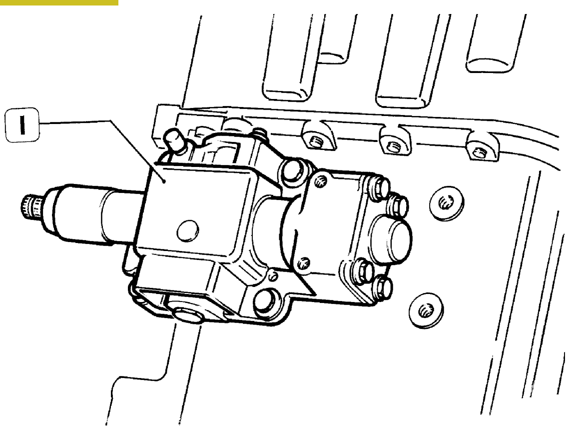
Figure 47



33554

Assemble cover (1), completed with sealing gasket, on motion inlet shaft and tighten securing screws at the required torque. Assemble clutch disengagement lever and tighten securing screws at the required torque.

Figure 48

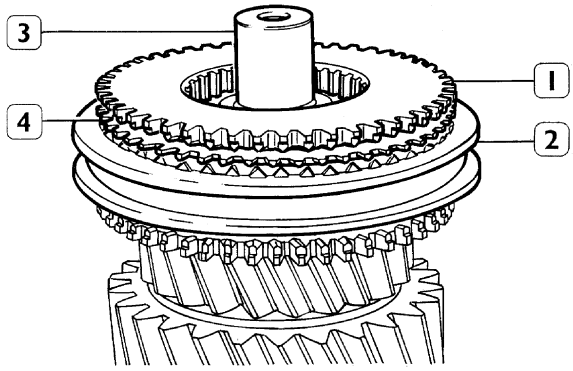


33553

Assemble the complete external control box (1).
Insert lubrication oil in the required amount, after about 20 min from application of LOCTITE 510 sealant.
Remove gearbox from rotating stand.

PRIMARY SHAFT DISASSEMBLY

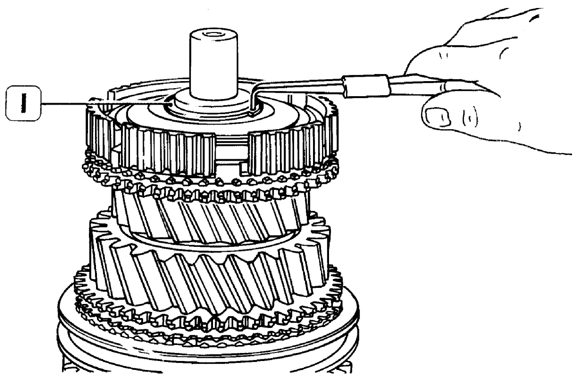
Figure 49



33618

Tighten primary shaft (3) in a clamp. Remove coupling body (1), 6^{th} speed synchronising ring (4) and sliding sleeve (2) for 5^{th} and 6^{th} speed gears, recovering check springs and rollers.

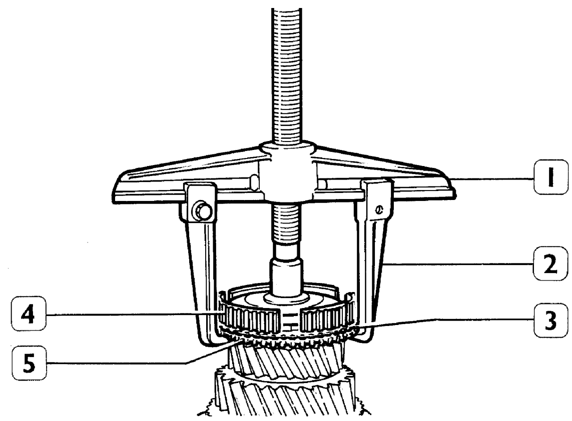
Figure 50



33619

Remove elastic ring (1).

Figure 51



33620

With extractor 99341003 (1) and brackets 99341009 (2), remove fixed 5^{th} and 6^{th} speed hub (4) together with synchronising ring (3) and 5^{th} speed coupling body (5).

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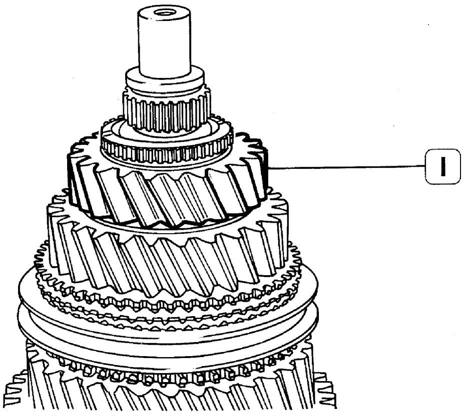
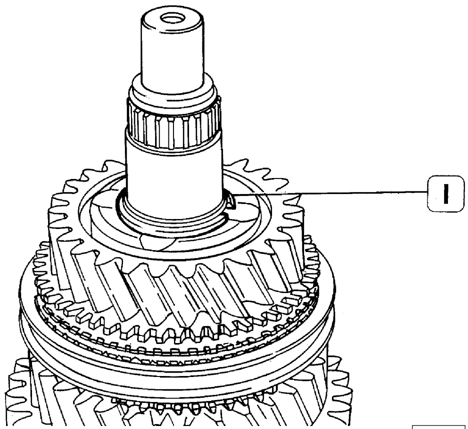
Figure 52



33621

Remove 5th speed gear (1) and roller bearing below it.

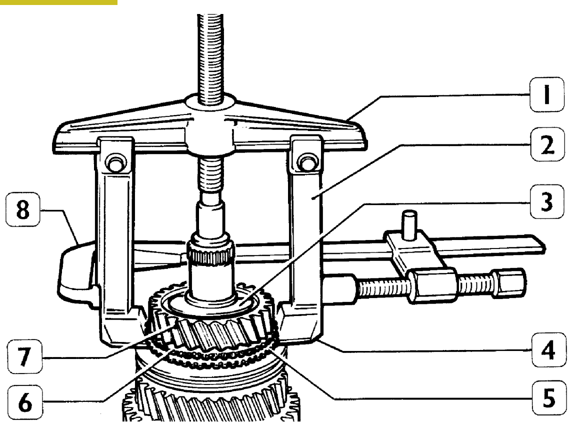
Figure 53



33622

Remove elastic ring (1).

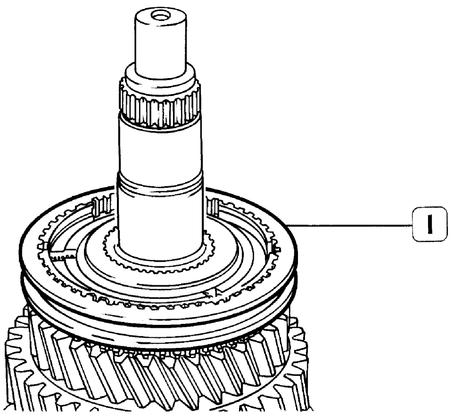
Figure 54



33623

Remove 4th speed gear (7) together with roller bearing and bush (3) and coupling body (6) with holds 99341025 (4), tie-rods 99341019 (2), bridge 99341003 (1) and clamp 99341015 (8). Remove synchronising ring (5).

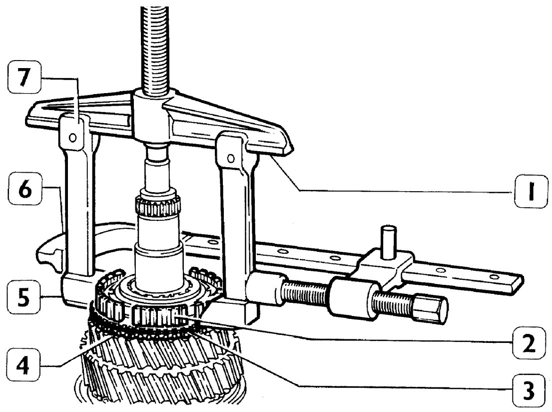
Figure 55



33624

Remove 3rd and 4th gear sliding sleeve (1) recovering check springs and rollers.

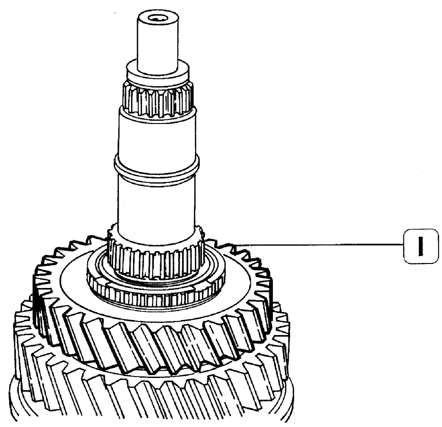
Figure 56



33625

Extract 3rd and 4th speed fixed hub (2) and 3rd speed synchronising ring with holds 99341025 (5), tie-rods 99341019 (7), bridge 99341003 (1) and clamp 99341015 (6). Remove 3rd speed coupling body (4).

Figure 57



33626

Remove 3rd speed gear (1) and roller bearing below it.

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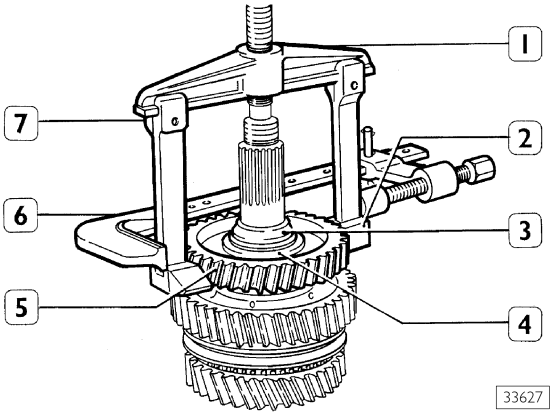
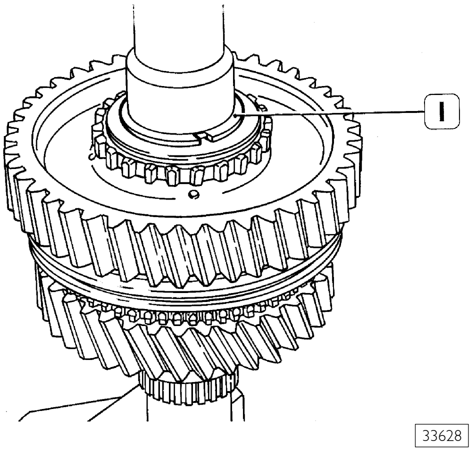
Figure 58



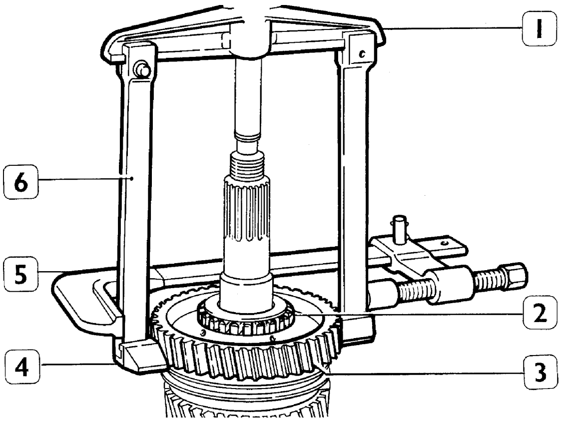
Turn the shaft over and extract reverse gear (5) with roller bearing below it, shoulder ring (4) and rolling half-race (3) with holds 99341025 (2), tie-rods 99341019 (7), bridge 99341003 (1) and clamp 99341015 (6).

Figure 59



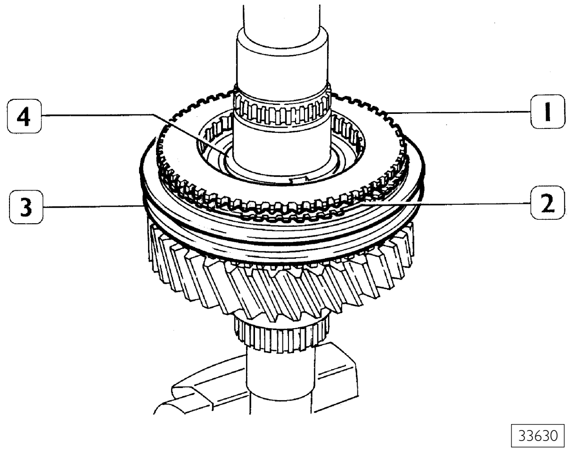
Remove elastic ring (1).

Figure 60



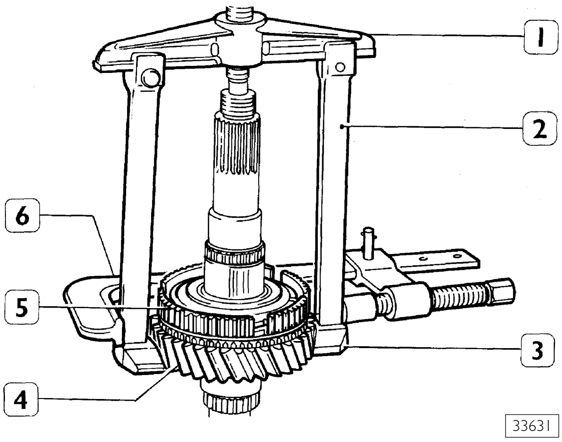
Extract 1st speed gear (3) together with roller bearing and fixed sleeve (2) for reverse gear with holds 99341023 (4), tie-rods 99341020 (6), bridge 99341003 (1) and clamp 99341015 (5).

Figure 61



Remove coupling body (1), synchronising ring (2), elastic ring (4) and sliding sleeve (3) for 1st and 2nd speed gears recovering rollers and springs.

Figure 62



Extract 2nd speed (4) with roller bearing, coupling body, synchronising ring and 1st and 2nd speed fixed sleeve (5) with holds 99341023 (3), tie-rods 99341020 (2), bridge 99341003 (1) and clamp 99341015 (6).

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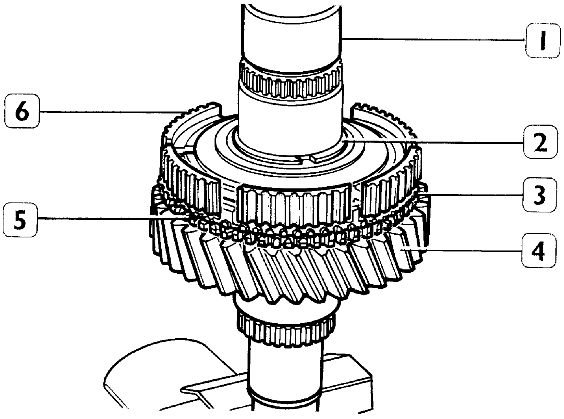
PRIMARY SHAFT ASSEMBLY

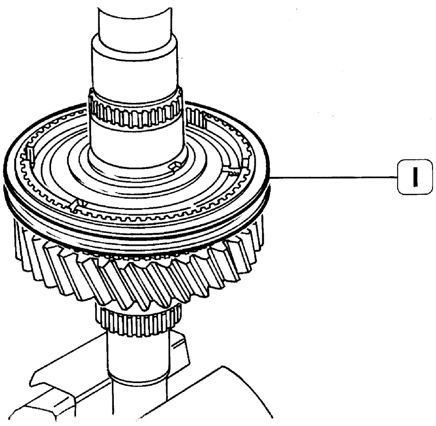
Figure 63



33632

Assemble on primary shaft (1) 2nd speed gear (4), coupling body (5) and synchronising ring (3).
Heat fixed hub (6) for 1st and 2nd speed gears at a temperature of 100 °C to 130 °C and assemble it on primary shaft (1) with the internal diameter chamfering facing the opposite part of 2nd speed gear.
When keying the hub, pay attention that synchronising ring tangential stops are inserted into respective hub seats. Assemble elastic ring (2) with an apporpriate thickness so that the fixed hub has no axial clearance (max allowed 0.03 mm).

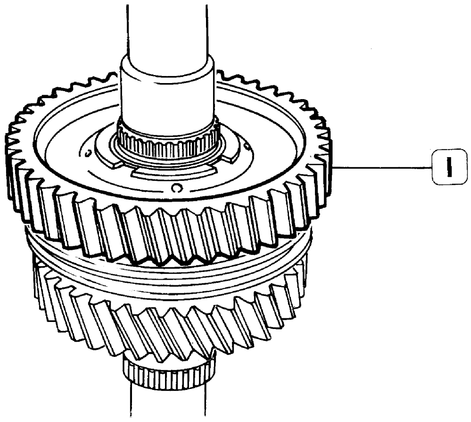
Figure 64



33633

Assemble sliding sleeve (1) for 1st and 2nd speed gears, springs and rollers in fixed hub seats. Assemble synchronising ring and coupling body for 1st speed gear.

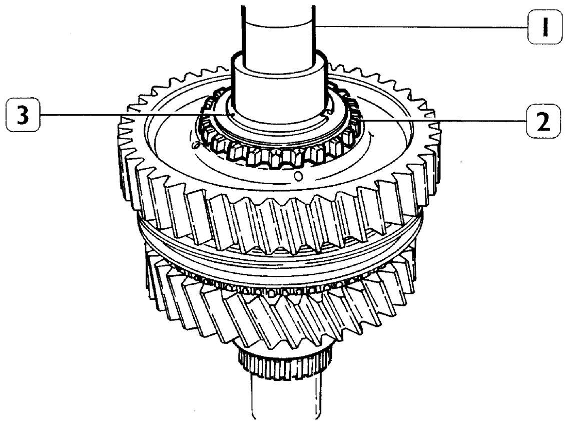
Figure 65



33634

Assemble roller bearing and 1st speed gear (1).

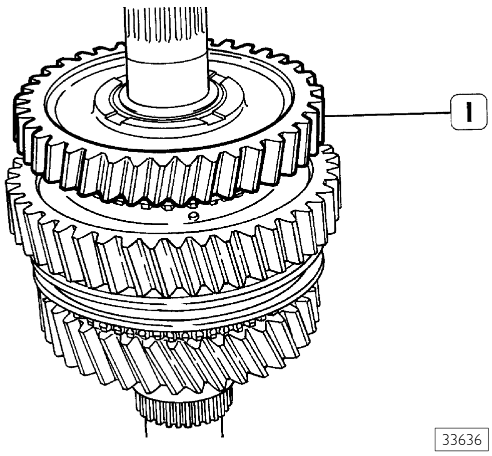
Figure 66



33635

Heat at a temperature of 100 °C to 130 °C fixed hub (2) for reverse gear and assemble it on primary shaft (1); asemble elastic ring (3).

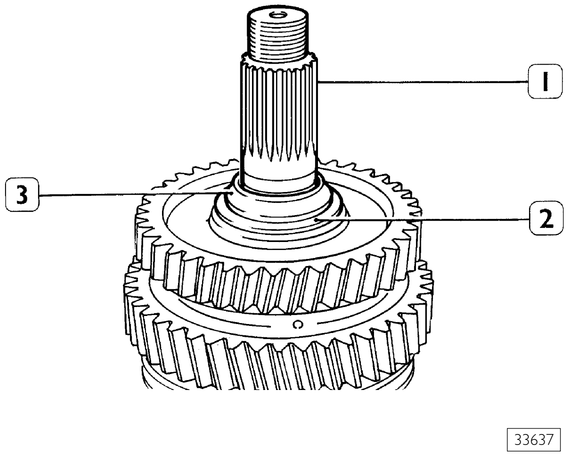
Figure 67



33636

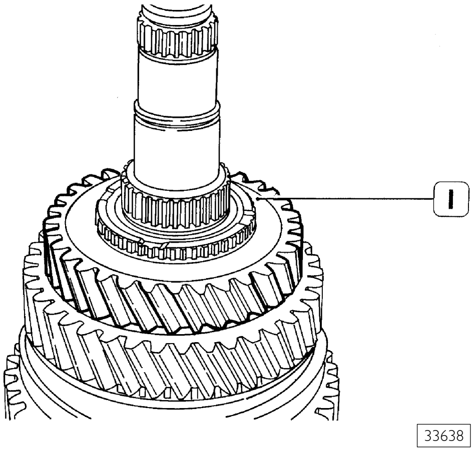
Assemble roller bearing and reverse gear (1).

Figure 68



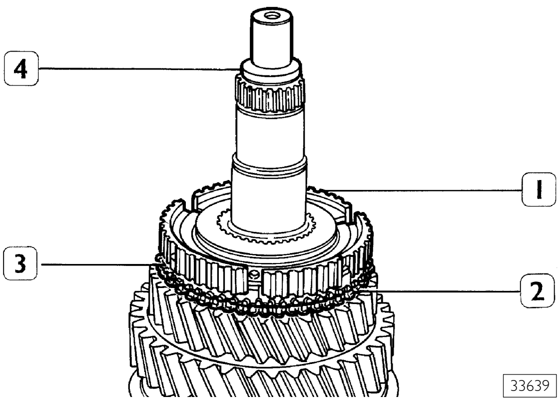
Assemble shoulder ring (2).
Slightly heat ball bearing rolling half-race (3) and assemble it on primary shaft (1).

Figure 69



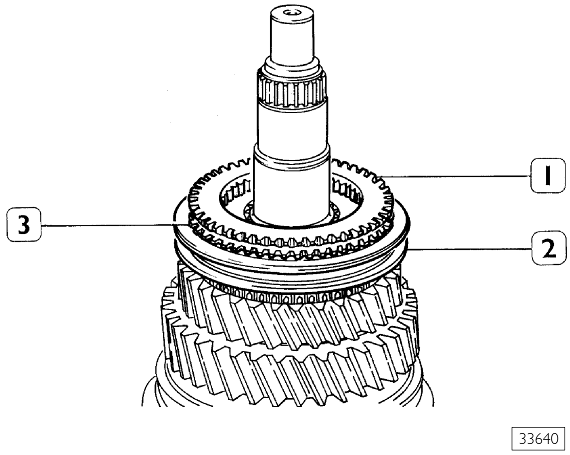
Turn the shaft over in a clamp, assemble roller bearing and 3rd speed gear (1).

Figure 70



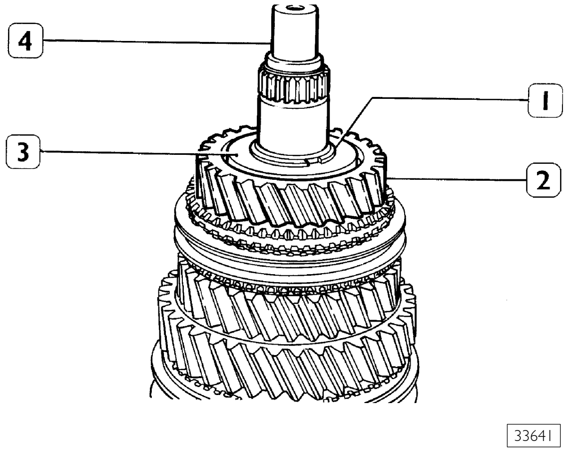
Assemble coupling body (2) and synchronising ring (3). Heat fixed hub (1) at a temperature of 100 °C to 130 °C and assemble it on shaft (4) paying attention that synchronising ring tangential stops are inserted into respective hub seats.

Figure 71



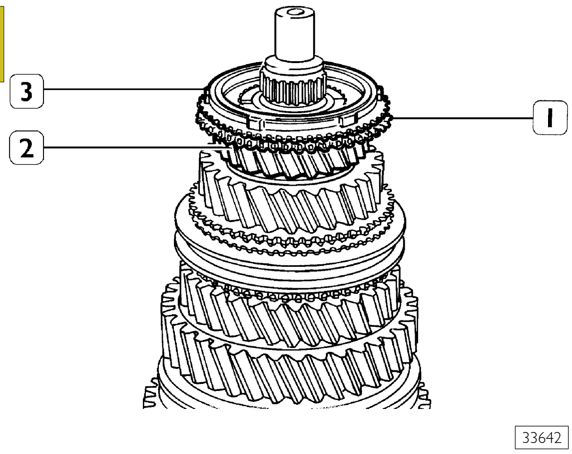
Assemble sliding sleeve (2) for 3rd and 4th speed gears, springs and rollers into fixed hub seats. Assemble synchronising ring (3) and coupling body (1) for 4th speed gear.

Figure 72



Assemble roller bearing and 4th speed gear (2). Heat bush (3) at a temperature of 100 °C to 130 °C, and assemble it on primary shaft (4). Assemble elastic ring (1).

Figure 73



Assemble roller bearing, 5th speed gear (2), coupling body (1) and synchronising ring (3) for 5th speed gear.

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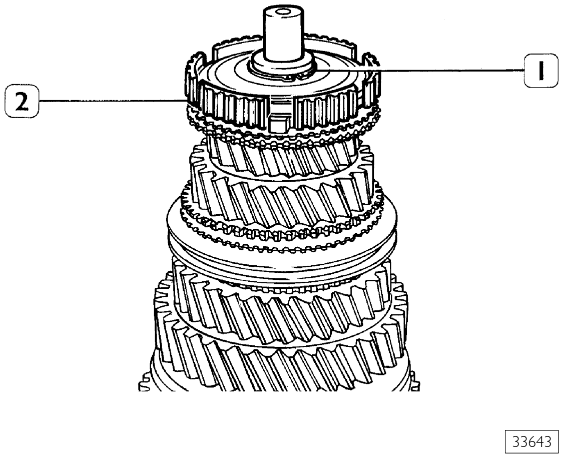
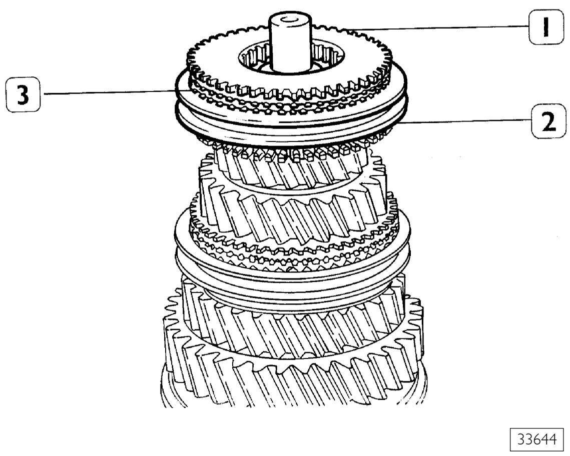
Figure 74



Heat fixed hub (2) for 5th and 6th speed gears, at a temperature of 100 °C to 130 °C, and assemble it on secondary shaft (3) with its chamfering facing 5th speed gear. When keying the hub pay attention that synchronising ring tangential stops are inserted into respective hub seats.
Assemble elastic ring (1) with a suitable thickness so that the fixed hub has no axial clearance (max allowed 0.03 mm).

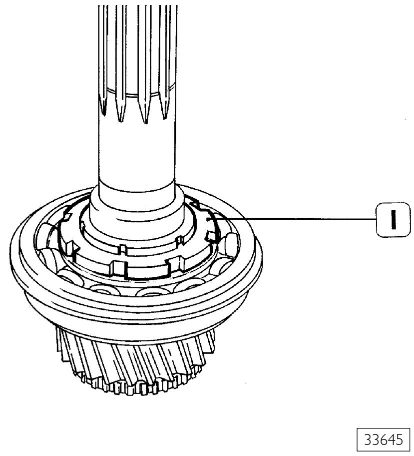
Figure 75



Assemble sliding sleeve (2) for 5th and 6th speed gears, springs and rollers. Assemble synchronising ring (3) and coupling body (1) for 6th speed gear.

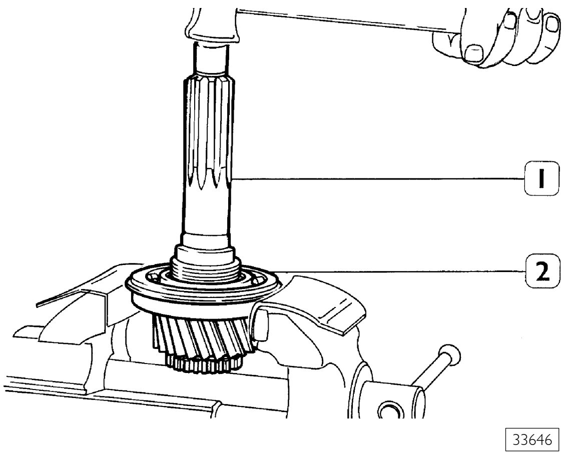
MOTION ENTRY SHAFT DISASSEMBLY

Figure 76



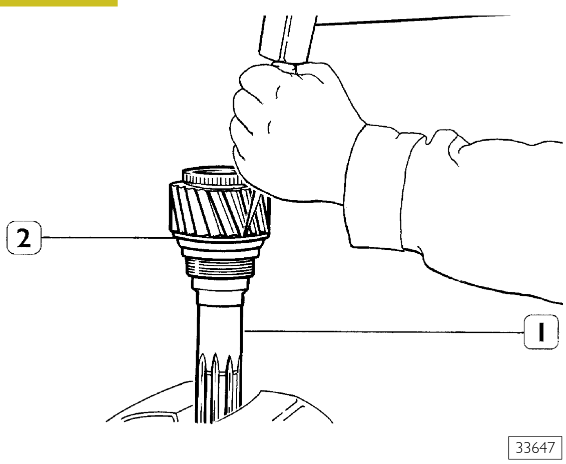
Unscrew ring nut (1).

Figure 77



Abut bearing (2), motion entry shaft (1) on a clamp and by beating the shaft extract ball roller bearing (2) and a rolling half-race of motion entry shaft (1).

Figure 78



Extract the other rolling half-race (2) from motion entry shaft (1) with a suitable punch.

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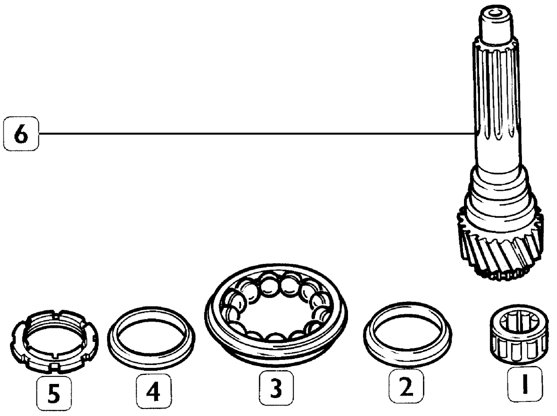
Figure 79

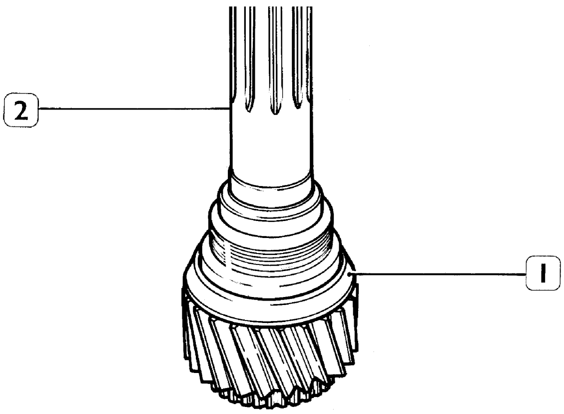


33648

PARTS COMPOSING THE MOTION ENTRY SHAFT
1. Cylindrical roller bearing – 2. Rolling hald-race – 3. Ball bearing – 4. Rolling half-race – 5. Ring nut – 6. Motion entry shaft

MOTION ENTRY SHAFT ASSEMBLY

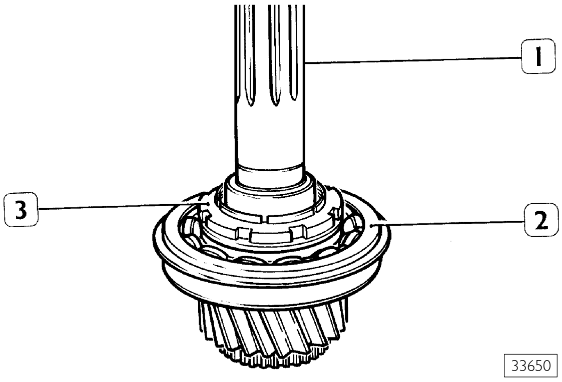
Figure 80



33649

Slightly heat rolling half-race (1) and assemble it on motion entry shaft (2).

Figure 81

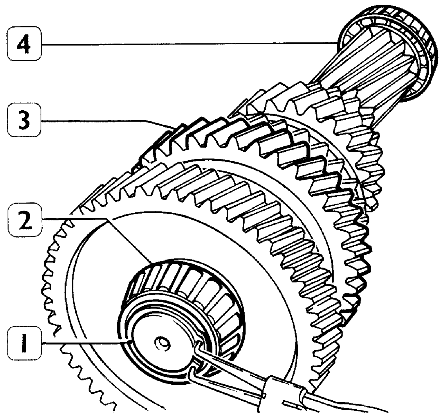


33650

Assemble ball roller bearing (2); heat the other rolling half-bearing and assemble it on motion entry shaft (1). Temporarily screw ring nut (3).

SECONDARY SHAFT DISASSEMBLY

Figure 82

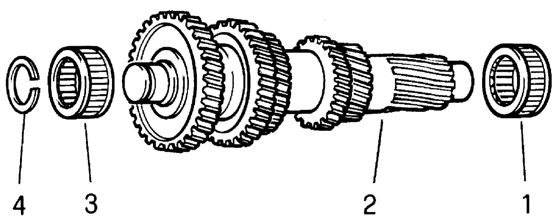


33651

Remove elastic ring (1) from secondary shaft (3), and extract tapered roller bearings (2 and 4) with a suitable punch (destructive operation).

SECONDARY SHAFT ASSEMBLY

Figure 83



33652

Slightly heat tapered roller bearings (1 and 3) and assemble them on secondary shaft (2). Assemble elastic ring (4).

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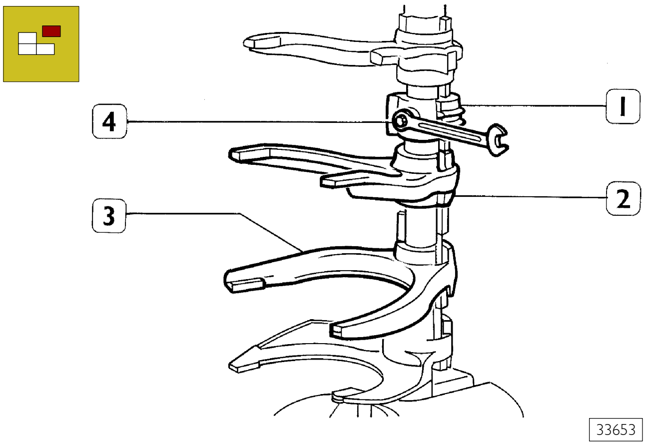
INTERNAL CONTROL SHAFT DISASSEMBLY

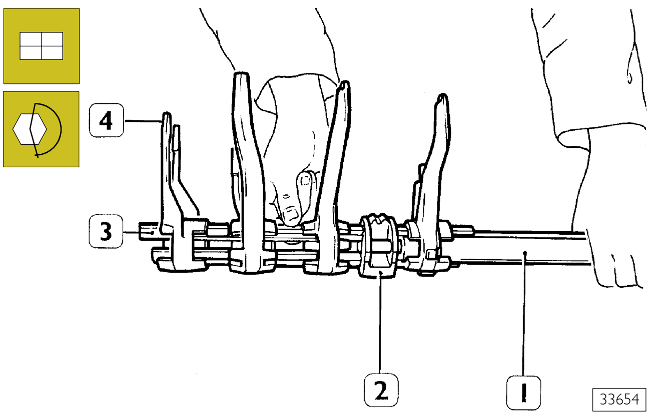
Figure 84



Mark fork (3) assembly position. Unscrew screw (4) and withdraw all forks (3) together with fork positioning rods (2) and hub (1).

INTERNAL CONTROL SHAFT ASSEMBLY

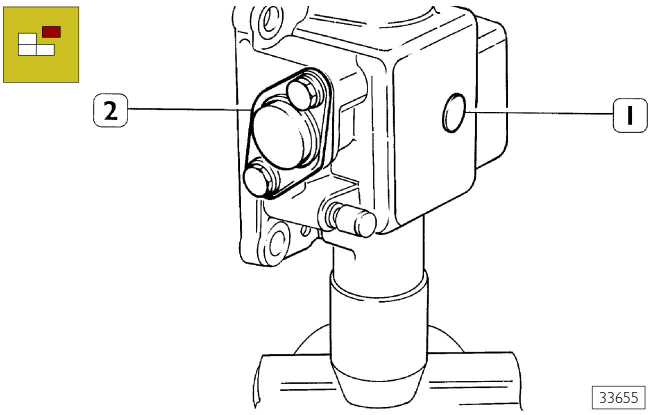
Figure 85



Place on a bench forks (4) and hub (2) according to the position marked upon disassembling. Place the two rods (3) inside fork holes and insert drive shaft (1). Tighten hub screw (2) at the required torque.

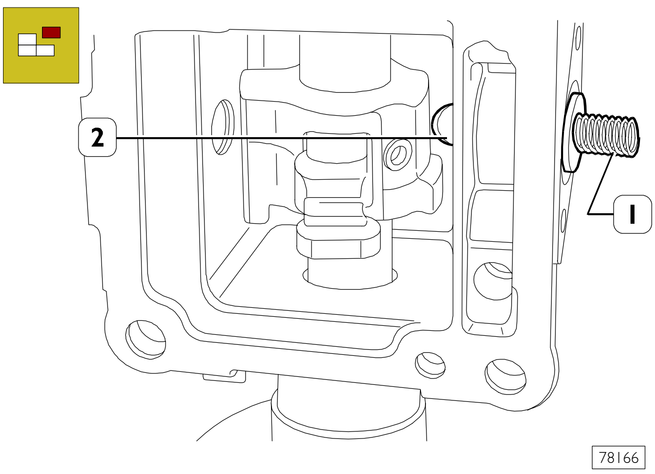
EXTERNAL CONTROL SHAFT DISASSEMBLY

Figure 86



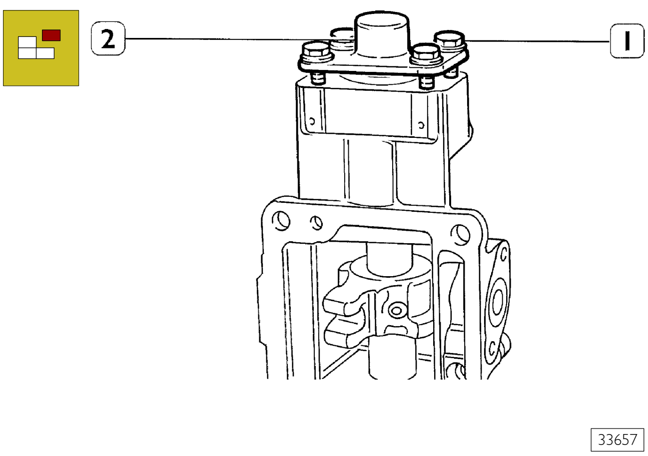
Tighten the shaft going out of the box in a clamp, remove plug (1) and disassemble cover (2).

Figure 87



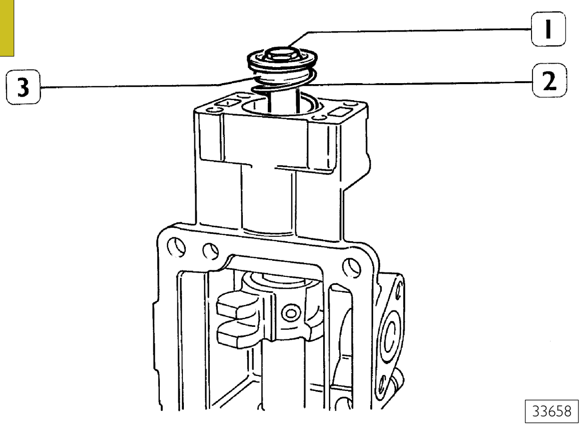
Remove control box pin (2) and spring (1).
Do not mix removed elements with those of the anti-release push rod.

Figure 88



Unscrew screws (1) and disassemble cover (2).

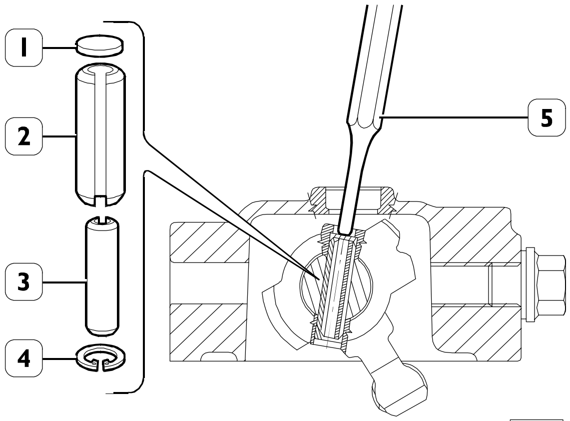
Figure 89



33658

Unscrew screw (1) and remove spacer, upper cup (3) and spring (2). Remove lower cup.

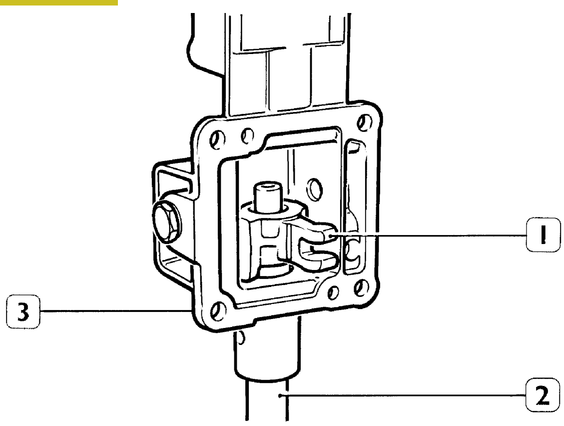
Figure 90



78167

Remove the snap ring (4) and use a punch tool (5) having the right diameter to push the extraction washer (1) and remove flexible plugs (2) and (3).

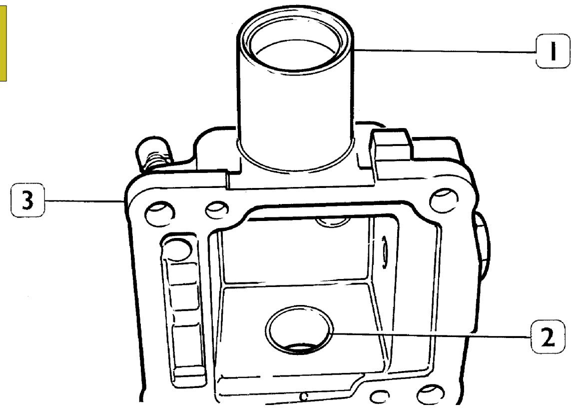
Figure 91



33660

Extract, from the control shaft (2), control selector (1) and box (3).

Figure 92

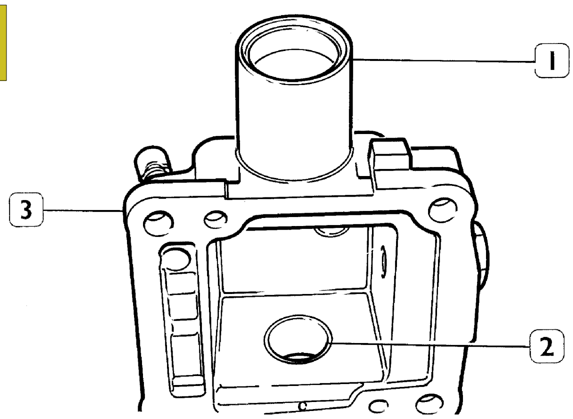


33661

Extract, from the control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

EXTERNAL CONTROL BOX ASSEMBLY

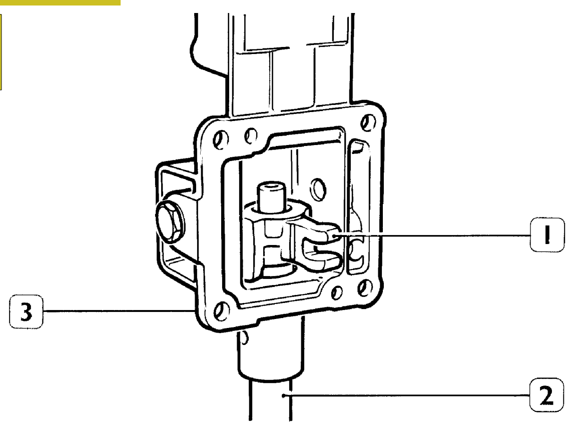
Figure 93



33661

Assemble, in control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

Figure 94



33660

Tighten control shaft (2) in a clamp and assemble thereon box (3) and control selector (1).

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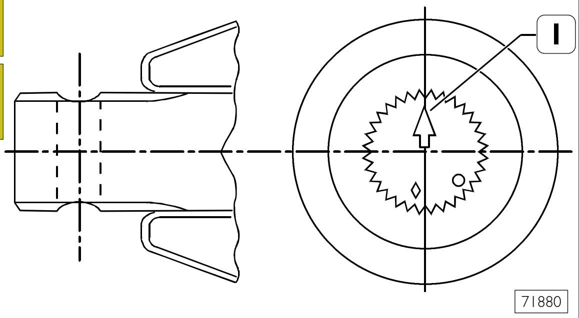
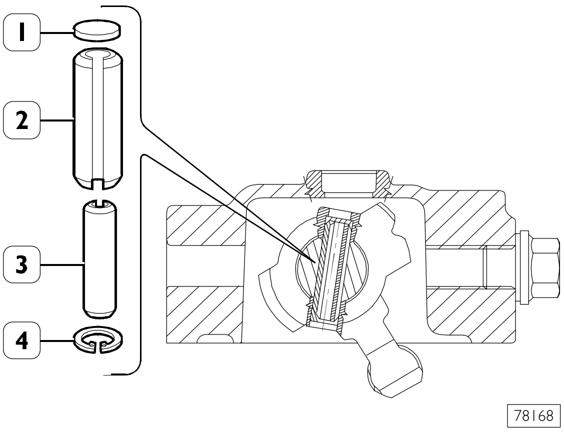
Figure 95



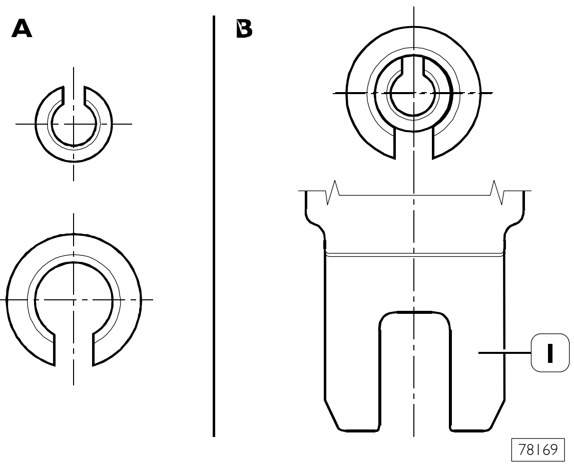
Upon assembling, the drive shaft must be assembled with the reference arrow (1) facing upwards.

Figure 96



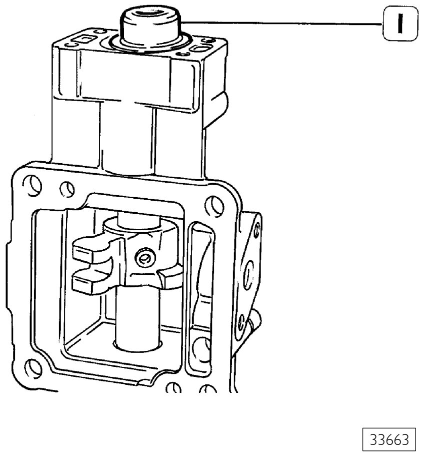
Insert the extraction washer (1) and use a punch tool having the right diameter to install the first plug (2). Install the second plug (3) and the snap ring (4).

Figure 97



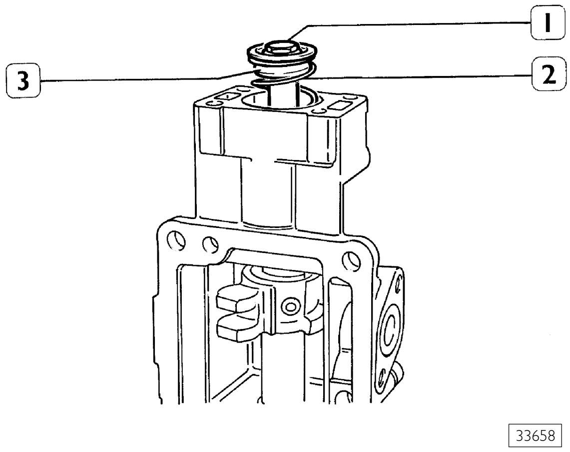
During installation, plug cuts shall be opposed by 180° (see detail A).
The bigger plug cut shall face the control selector (1) milled area (see detail B).

Figure 98



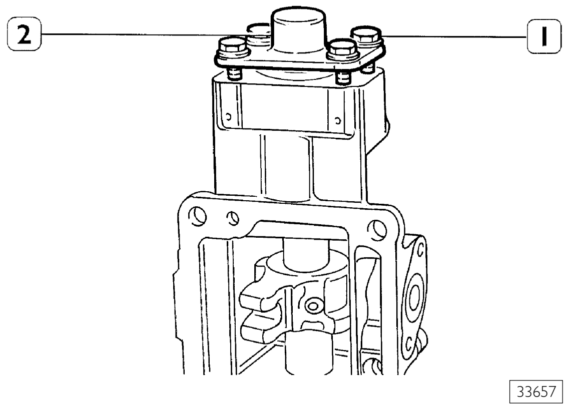
Assemble lower cup (1).

Figure 99



Install the spring (2), the upper cap (3), the spacer and the screw (1) and apply threading sealer LOCTITE 270 on the screw itself.
Tighten the screw (1) to 30 Nm (3.1 kgm).

Figure 100



Clean joining surfaces of control box and cover (2) and apply "LOCTITE 510" adhesive on one of the two components. Assemble cover (2) and tighten screws (1) at a torque of 36.5 Nm (3.7 kgm).
Apply threading sealer LOCTITE 270 on the screws (1).

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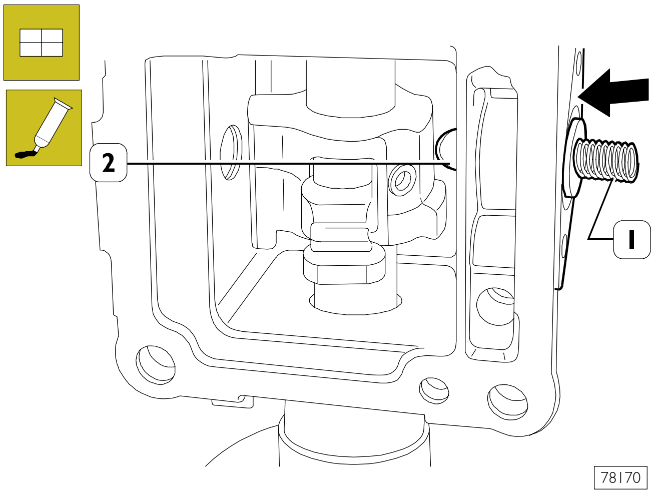
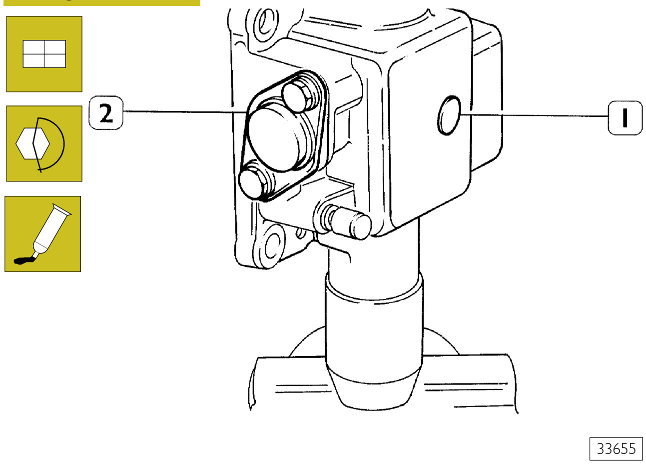
Figure 101



Install the pin (2), the spring (1) and apply sealer "LOCTITE 518" (→).

Figure 102

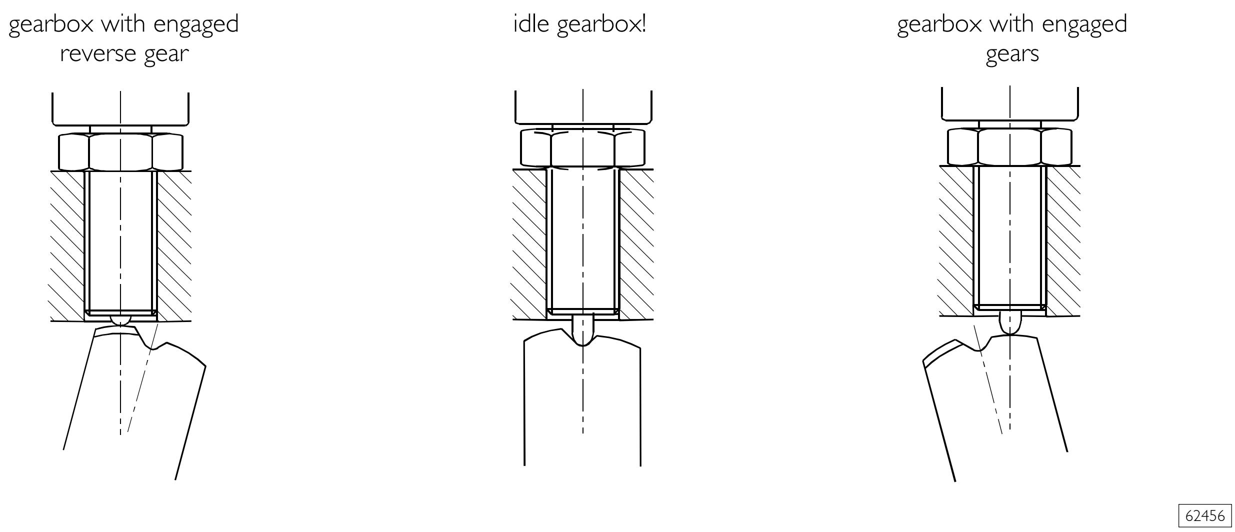


Install the cover (2) and tighten the screws to 19 Nm (1.9 kgm). Apply sealer "LOCTITE 675" and refit the plug (1).

Idle-R.M. switch adjustment

The below-described sequence must be compulsorily complied with.

Figure 103



SWITCH ENGAGEMENT POSITIONS

For switch adjustment, it is necessary to carry out the following operations:

- apply silicone sealant on the threading;
- set gearbox in engaged reverse gear position;
- screw the switch till the reverse motion lamp turns on;
- screw again the switch by 45-60° corresponding to a stroke of 0.19-0.25 mm;
- tighten securing lock nut with a 24 wrench at a torque of 35 Nm.

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5302 Gearbox 2870.9

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ASSEMBLY	118

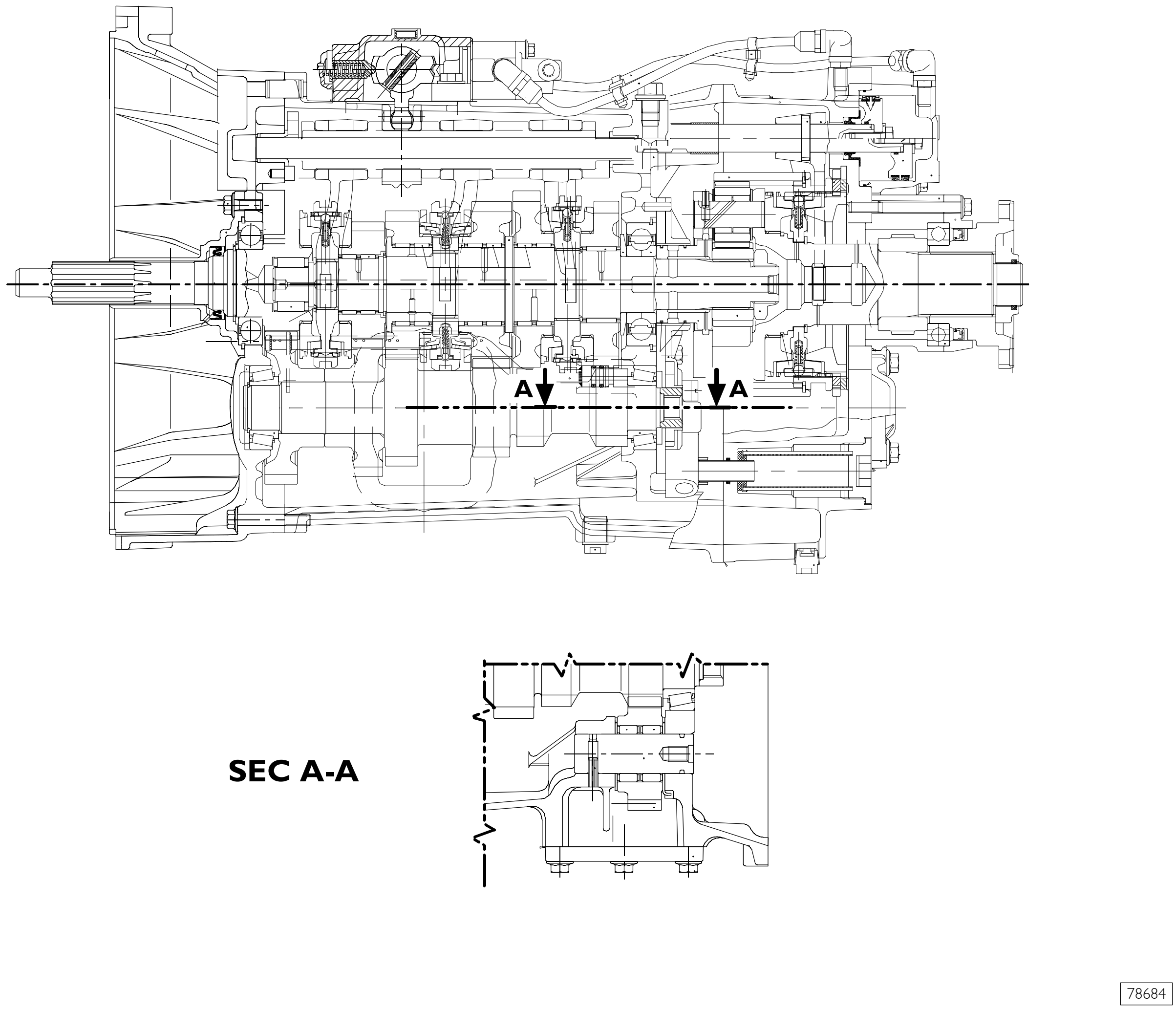
DESCRIPTION

The 2870.9 gearshift is of the mechanic type, with nine speeds and engagement of the 1^{st}, 4^{th}, 5^{th}, 8^{th} and 9^{th} speeds by means of free-ring synchronizing rings, whereas the 2^{nd}, 3^{rd}, 6^{th} and 7^{th} speeds are engaged by means of a double-cone synchronizing gear.

The reverse gear engagement is with quick-engagement sliding sleeve.

It is composed of a front section, comprising five ratios and reverse gear, and of a rear section comprising two ratios obtained through epicyclic reduction gear.
The gear switch is carried out mechanically through double-"H" control; the epicyclic reduction gear engagement is carried out mechanically with pneumatic switching.
The gearbox is equipped with an oil pump for its lubrication.

Figure 1



2870.9 GEARBOX LONGITUDINAL SECTION AND REVERSE GEAR SHAFT SECTION

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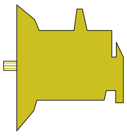
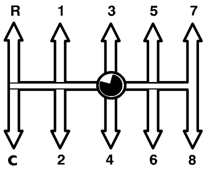
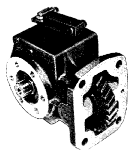
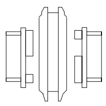
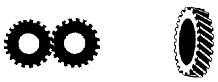
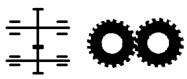
SPECIFICATIONS AND DATA

	GEARBOX	2870.9
	Type	Mechanical
	Gears	9 forward gears and reverse gear
	Gears engagement control	Mechanical
	Power takeoff	Upon request
	Gears engagement:	
	1^{st}	Free-ring synchronizer
	$2^{nd} \Rightarrow 3^{rd}$	Double-cone synchronizer
	$4^{th} \Rightarrow 5^{th}$	Free-ring synchronizer
	$6^{th} \Rightarrow 7^{th}$	Double-cone synchronizer
	$8^{th} \Rightarrow 9^{th}$	Free-ring synchronizer
	Reverse gear	Quick-connection type
	Gears anti-disengagement	Sliding sleeve holding through rollers and springs.
	Gears	With helical teeth
	Gear ratio	
	First	1 : 13.200
	Second	1 : 9.036
	Third	1 : 6.473
	Fourth	1 : 4.691
	Fifth	1 : 3.548
	Sixth	1 : 2.547
	Seventh	1 : 1.824
	Eighth	1 : 1.322
	Ninth	1 : 1.000
	Reverse gear	1 : 11.650

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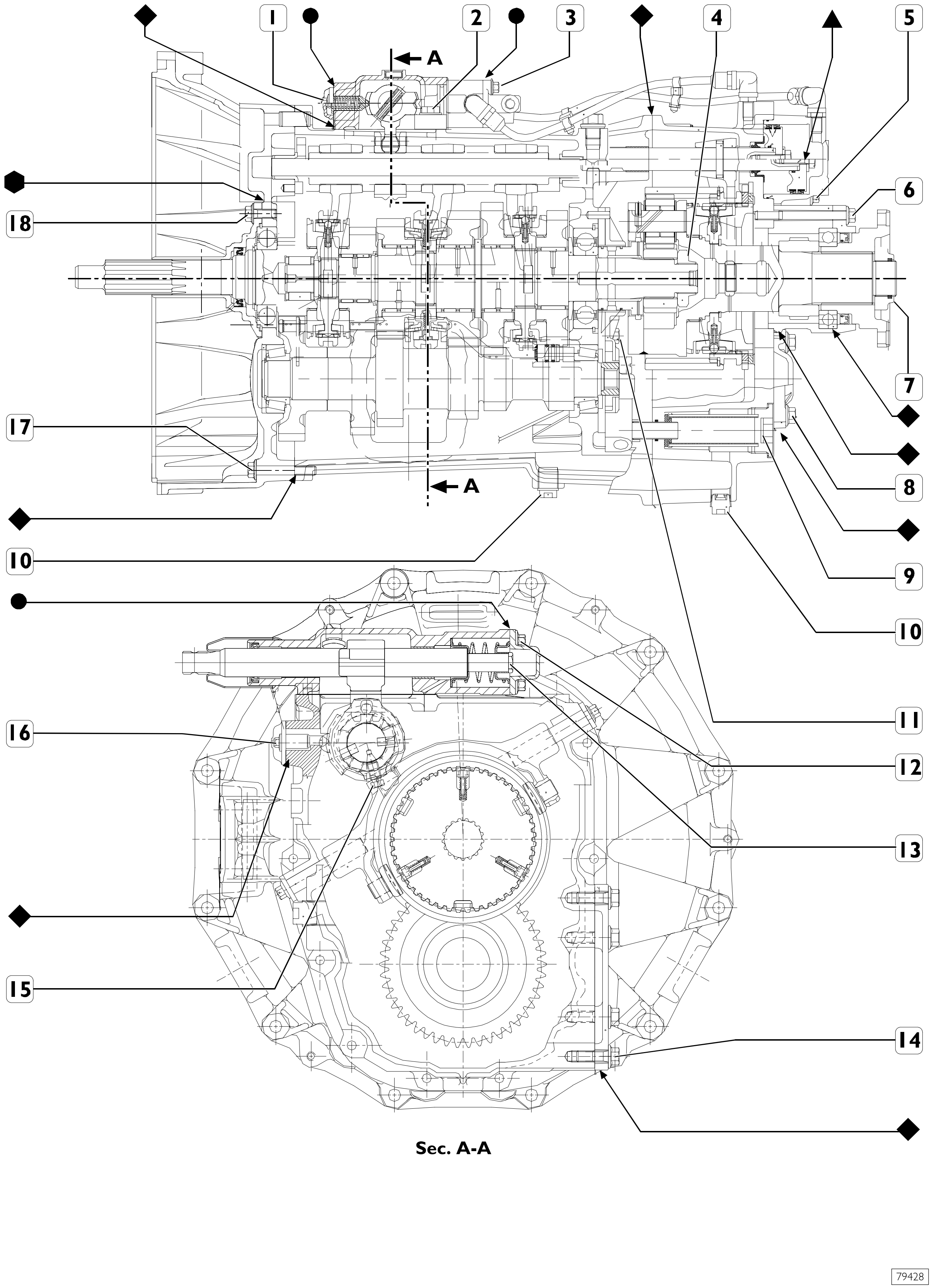
SPECIFICATIONS AND DATA

	Oil type Amount	**TUTELA ZC 90** 4.5 Kg. (5lt)
	Fixed hubs assembly temperature	100°C ÷ 130°C
	Secondary shaft bearings	With tapered rollers
	Secondary shaft bearings pre-loading adjustment	Through rings
	Secondary shaft pre-loading adjustment rings thickness	2.5 - 2.7 - 2.8 - 2.9 - 3.1 - 3.2 3.3 - 3.4 - 3.5 - 3.6 - 3.7 - 3.8 Supplied in a kit
	Secondary shaft bearings assembly temperature	85°C
	Motion entry shaft bearings adjusting rings thicknesses	2.40 - 2.45 - 2.50 - 2.55 - 2.60 - 2.65 - 2.70 - 2.75 - 2.80

Figure 2



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TIGHTENING TORQUES

PART		TORQUE	
		Nm	(kgm)
1	Flanged hexagonal head screw for securing spring check flange on external control	19 ± 2	(1.9 ± 0.2)
2	Flanged hexagonal head screw for securing upper external control support cover	33.5 ± 3.5	(3.4 ± 0.4)
3	Screw for securing reduction gear control valve	23.5 ± 2.5	(2.5 ± 0.3)
4	Ring nut for securing sun gear on primary shaft	372.5 ± 19.5	(38 ± 2)
5	Flanged hexagonal head screw for securing pneumatic reduction gear control cylinder to rear half-case	35.5 ± 3.5	(3.6 ± 0.4)
6	Flanged hexagonal head screw for securing rear cover on primary shaft	44.5 ± 4.5	(4.4 ± 0.5)
7	Output flange locking ring nut on planetary gear-holder shaft	559.5 ± 29.5	(57 ± 3)
8	Flanged hexagonal head screw for securing read cover on secondary shaft	58 ± 6	(5.9 ± 0.6)
9	Oil filter on half-case	320 ± 30	(32.6 ± 3.1)
10	Threaded plug with external manoeuvre hexagon for oil discharge	27.5 ± 2.5	(2.8 ± 0.3)
11	Hexagonal head screw for securing oil pump body to case	33.5 ± 3.5	(3.4 ± 0.4)
12	Flanged hexagonal head screw for securing transverse axle cover on drive*	19 ± 2	(1.9 ± 0.2)
13	Transverse axle screw*	30 ± 3	(3.1 ± 0.3)
14	Flanged hexagonal head screw for securing covers on side power takeoff connection windows	38 ± 4	(3.9 ± 0.4)
15	Screw for securing fork control rod hub	39 ± 2	(4.0 ± 0.2)
16	Idle positioner	78 ± 8	(8.0 ± 0.8)
17	Flanged hexagonal head screw for joining clutch cup and case	45.5 ± 4.5	(4.6 ± 0.6)
18	Flanged hexagonal head screw for securing front cover	32 ± 3	(3.3 ± 0.3)
-	Flanged hexagonal head screw for securing clutch disengagement lever support	46.5 ± 4.5	(4.6 ± 0.4)
-	Oval-headed screw for securing reduction gear reaction plate	21 ± 2	(2.1 ± 0.2)
-	Threaded plug with external manoeuvre hexagon for oil level	27.5 ± 2.5	(2.8 ± 0.3)
-	Flanged hexagonal head screw for securing upper internal controls cover (only for right-hand drive)	45.5 ± 4.5	(4.6 ± 0.5)

* Apply thread-braking LOCTITE 270 on the screw

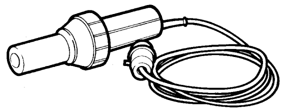
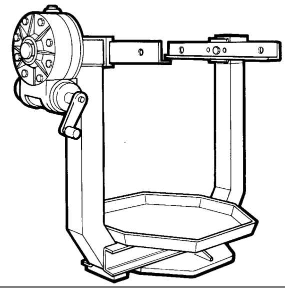
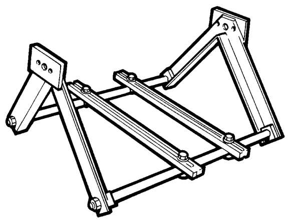
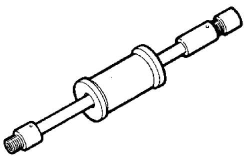
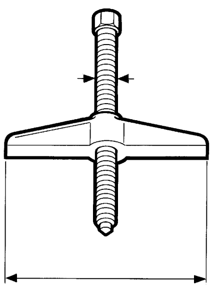
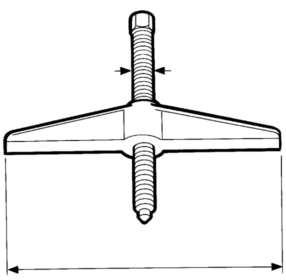
◆ Apply liquid gasket LOCTITE 510 sealant

▲ Apply thread-braking LOCTITE 242 sealant

● Apply liquid gasket LOCTITE 518 sealant.

⬢ Apply liquid gasket LOCTITE 5910 sealant

TOOLS

TOOL No.		DESCRIPTION
99305121		Hot-air equipment
99322205		Revolving stand for overhauling units (capacity 1000 daN, couple 120 daN/m)
99322225		Unit bearing support (to be applied to stand 99322205)
99340205		Percussion puller
99341003		Single acting puller
99341004		Single acting puller

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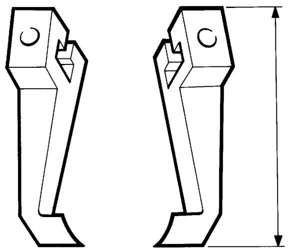
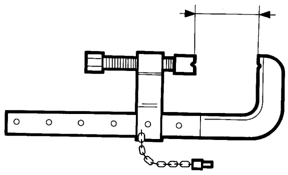
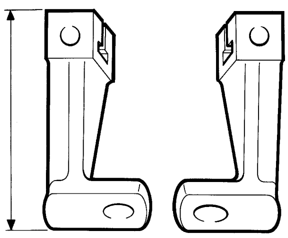
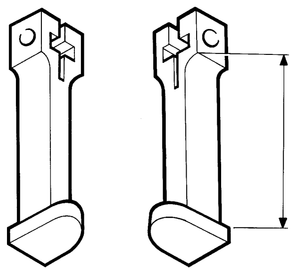
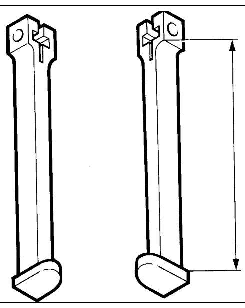
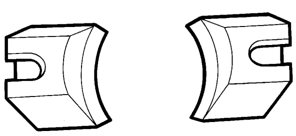
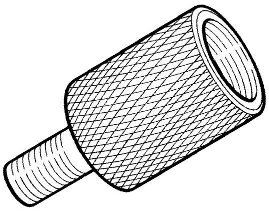
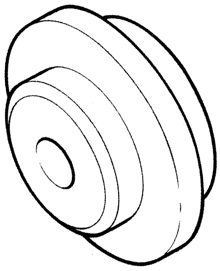
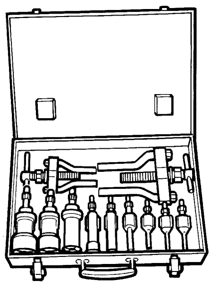
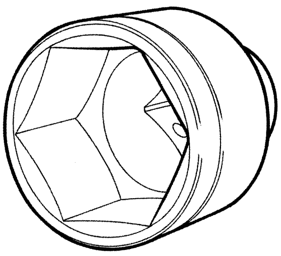
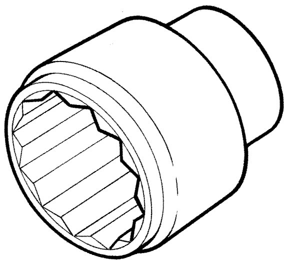
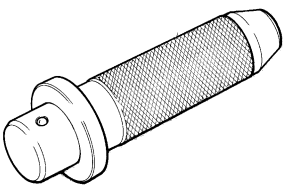
TOOLS

TOOL No.		DESCRIPTION
99341009		Pair of brackets
99341015		Clamp
99341017		Pair of brackets with hole
99341019		Pair of tie rods for grips
99341020		Pair of tie rods for grips
99341025		Grips

TOOLS

TOOL No.		DESCRIPTION
99342143		Peg for removing reverse gear shaft (to use with 99340205)
99345058		Thrust block for pullers
99348004		Universal extractor for interiors 5 to 70 mm
99355081		Bush for disassembling and assembling motion outlet flange nut (use with 99370317)
99355131		Wrench (55 mm) for gearbox sun gear retaining nut
99370006		Handle for interchangeable beaters

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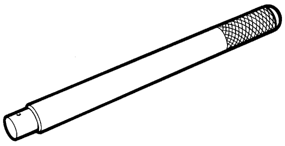
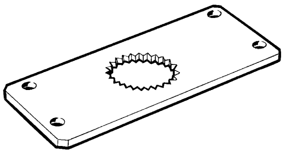
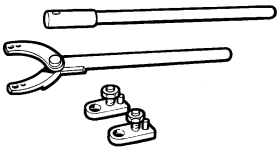
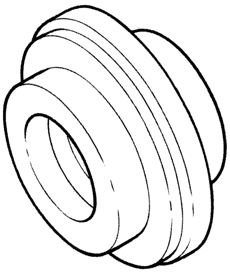
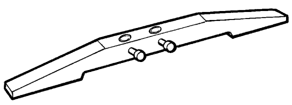
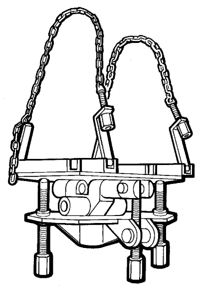
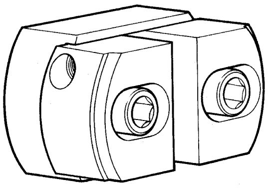
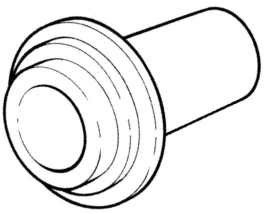
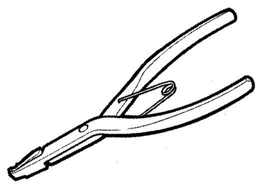
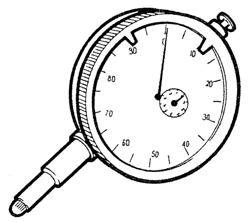
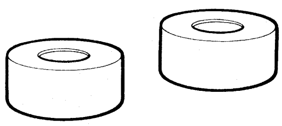
TOOLS

TOOL No.		DESCRIPTION
99370007		Handle for interchangeable beaters
99370130		Tool for holding the sun gear during nut removal and refitting
99370317		Reaction lever with extension for retaining flanges
99370349		Tool for fitting gasket on gearbox front cover (to use with 99370006)
99370466		Gauge base for transmission shaft bearing adjustment (to use with 99395604)
99370629		Support for holding gearbox during removal and refitting from/on vehicle

TOOLS

TOOL No.		DESCRIPTION
99374092		Beater for outer bearing race assembling (69-91) (use with 99370007)
99374229		Tool for refitting gasket on gearbox rear cover
99381125		Pliers for removing gearbox split rings
99395604		Comparator (0-10 mm)
99396031		Gauged rings for adjusting transmission shaft bearings (to use with 99370466)

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GEARBOX 2870.9 DISENGAGEMENT/RE-ENGAGEMENT

Before carrying out disengagement/re-engagement operations, disconnect battery cables and place the vehicle under safety conditions.

Disengagement

Lift the calender and turn the cabin over.

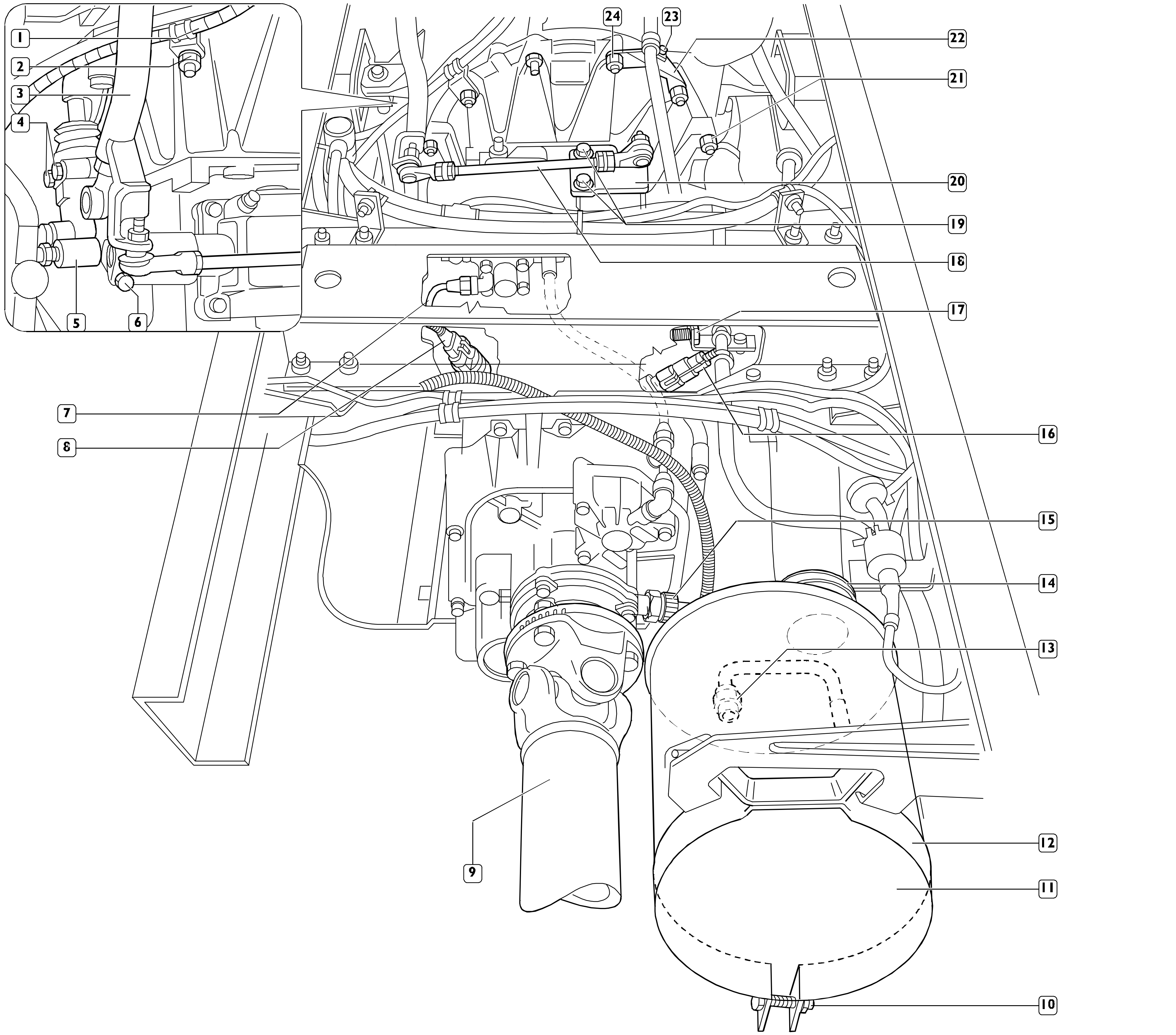
- loosen securing bolt (23), unscrew securing nuts (24) and detach air piping supporting bracket (22);
- unscrew securing nut (2) and detach air piping supporting bracket (1);
- unscrew securing nuts (19) and detach bracket (20) of reaction tie-rod (18);
- loosen securing screw (6) and detach from gearbox the gears control lever completed with tie-rod (3) and reaction tie-rod (18);
- disconnect reverse gear switch electric connection (16) and range-change switch electric connection (8);
- unscrew securing nuts (21) of clutch bell to engine that will be able to be reached with difficulty from the lower vehicle part.
- rotate deadening guard locking rivets below the gearbox and remove the deadening guard;
- detach transmission shaft (9) as described in the related section;
- disconnect air piping (13) from exhaust piping (11);
- detach terminal exhaust piping, operating on securing clip (14) bolt and on support band (12) bolt (10);
- unscrew securing screws (4) and detach clutch control operating cylinder (5);
- disconnect electric connection (15) of odometer sensor;
- unscrew securing screw (17) and detach air piping support bracket;
- place an hydraulic jack equipped with support 99370629 under the gearbox;
- unscrew the remaining securing nuts of clutch bell to engine, move the gearbox backwards and lowering the jack remove it from below the vehicle.

Re-engagement

Suitably reverse the operations carried out for disengagement and tighten securing screws and nuts at the required torque.

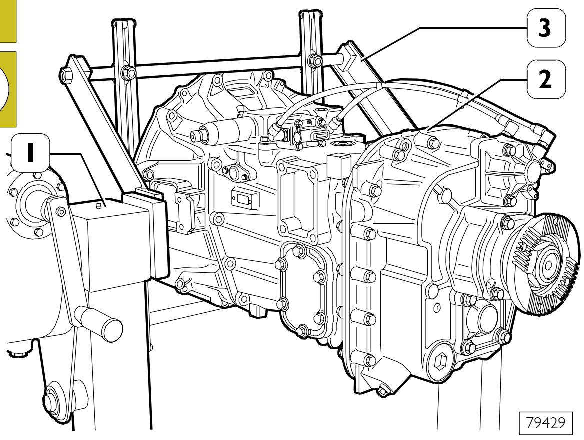
Upon re-engaging the gearbox, pay attention that the clutch control lever fork is correctly meshed to the thrust bearing.

Figure 3



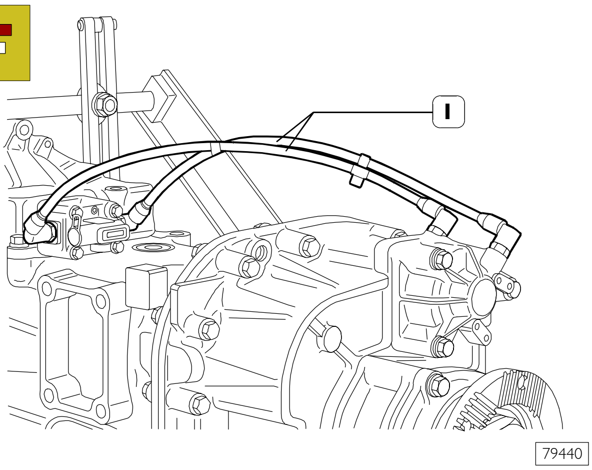
GEARBOX DISASSEMBLY

Figure 4



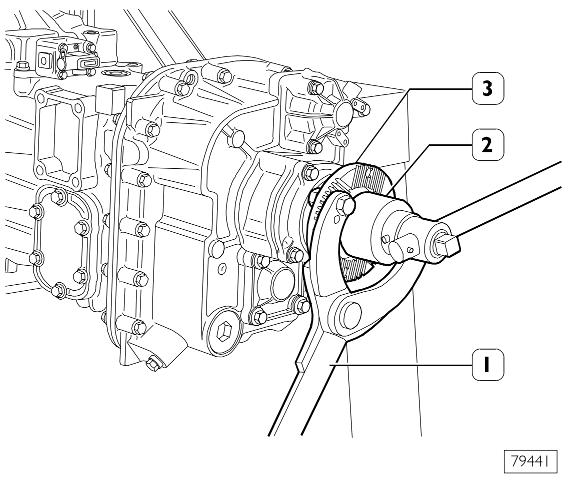
Place gearbox (2) on rotating stand 99322205 (1) equipped with brackets 99322225 (3) and discharge lubricating oil.

Figure 5



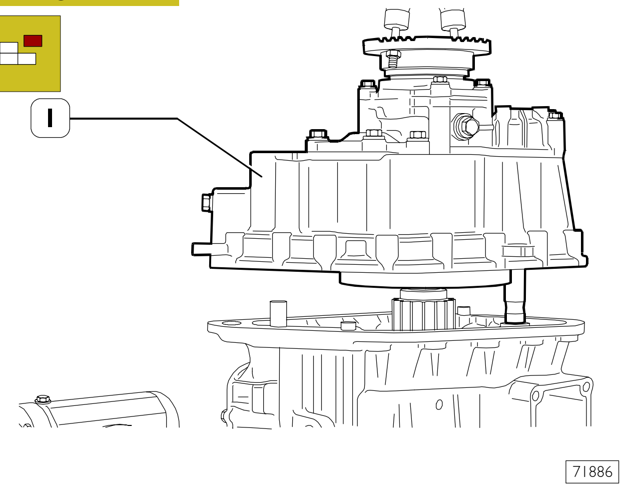
Disconnect pneumatic pipings (1) of epicyclic reduction gear. Unscrew the two screws securing clutch disengagement lever support and remove lever from gearbox.

Figure 6



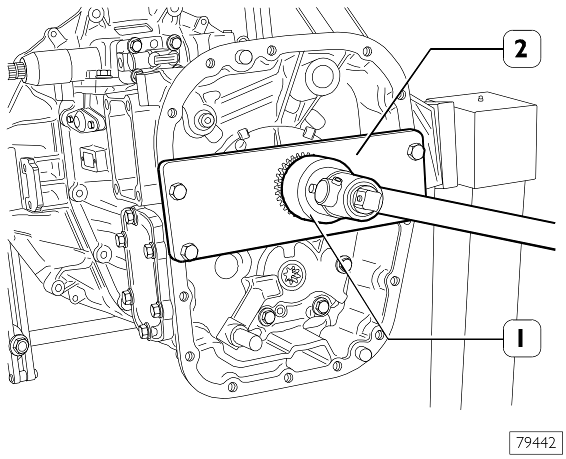
Apply reaction lever 99370317 (1) and with key 99355081 (2) loosen nut securing motion outlet flange (3).

Figure 7



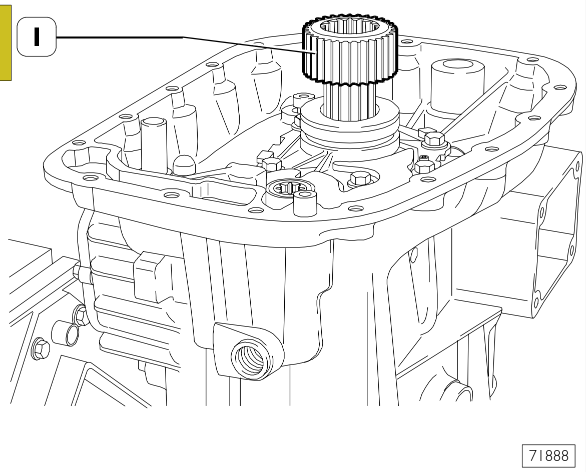
Unscrew securing screws and with the help of a lifting device, remove epicyclic reduction gear assembly (1).

Figure 8



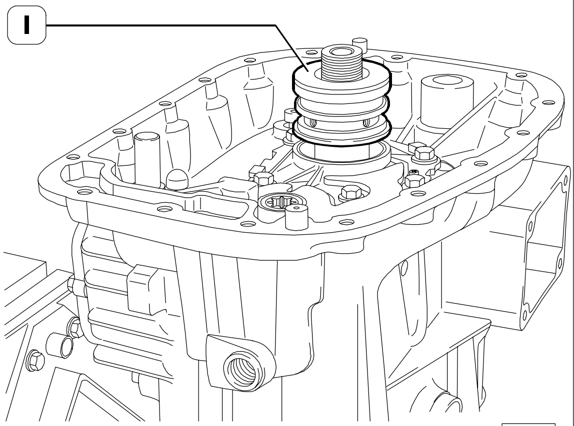
Apply tool 99370130 (2) and, through wrench 99355131 (1), unscrew sun gear check nut.

Figure 9



Remove the sun gear (1).

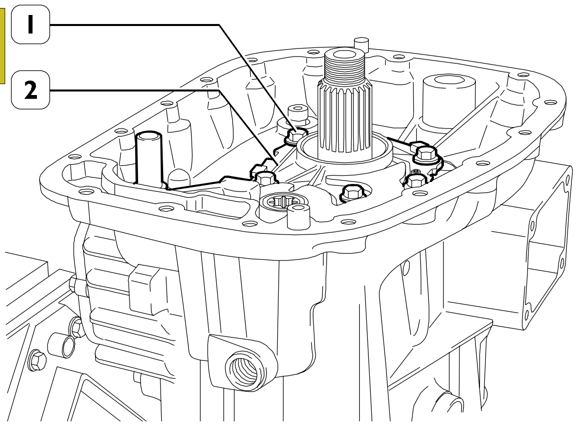
Figure 10



71889

Remove oil distributor (1) completed with sealing rings.

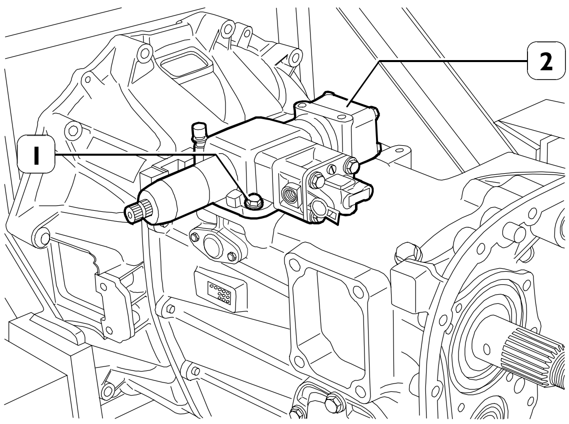
Figure 11



71890

Unscrew screws (1) and remove oil pump (2).

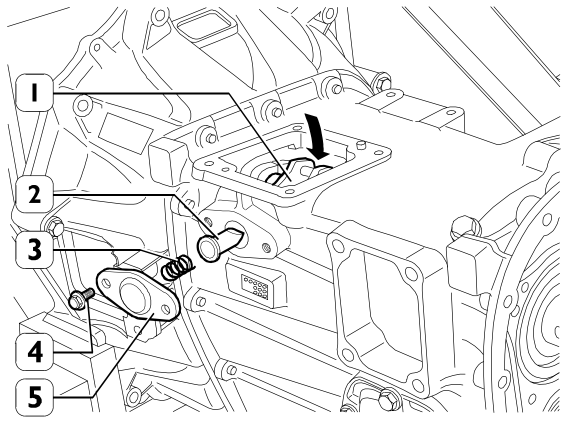
Figure 12



79443

Unscrew screws (1) and remove complete case (2) of external gear drive.

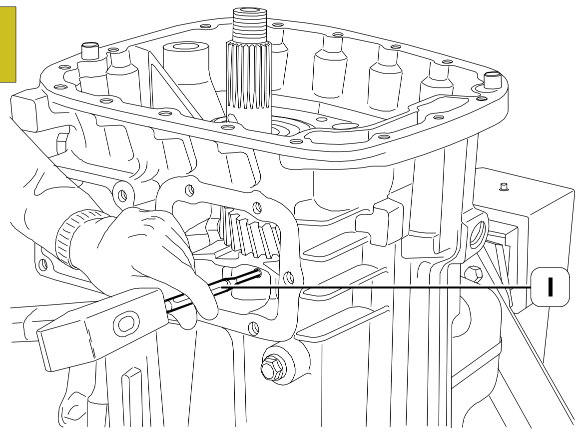
Figure 13



79444

Unscrew screws (4), disassemble cover (5), take off spring (3) and take out tip (2). Move gear selector hub (1) inwards.

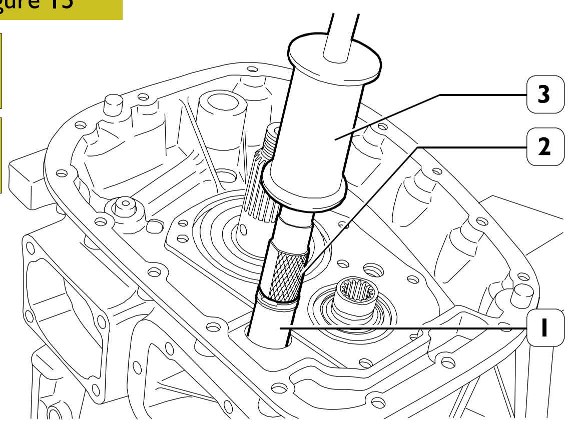
Figure 14



71893

Remove reverse gear cover; with a punch (1) of an adequate diameter, push the elastic peg inside till it abuts.

Figure 15



71894

Place extraction peg 99342143 (2) and percussion extractor 99340205 (3). Extract reverse gear support pin (1) and remove gear with related shoulder washers and cylindric roller bearing.

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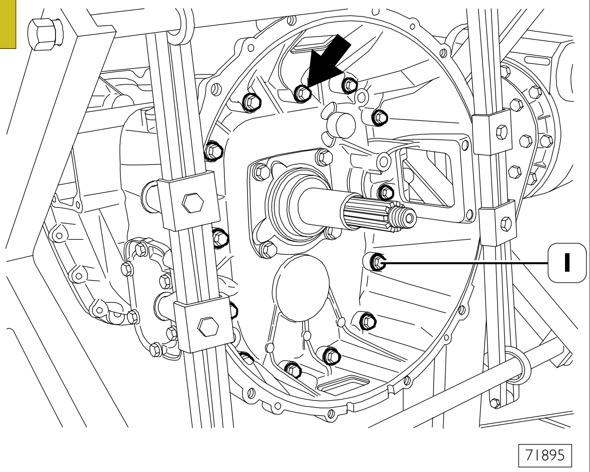
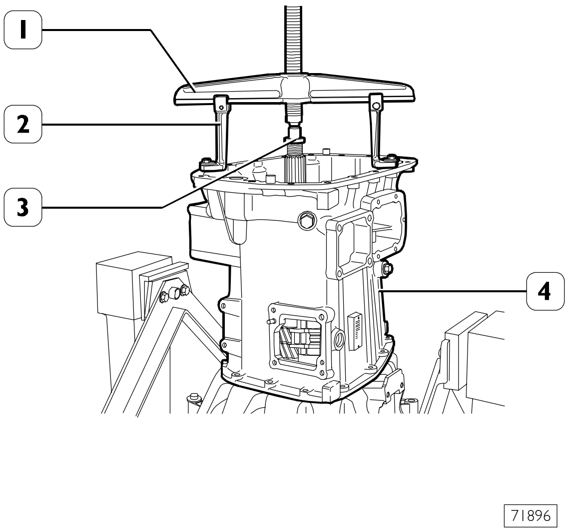
Figure 16



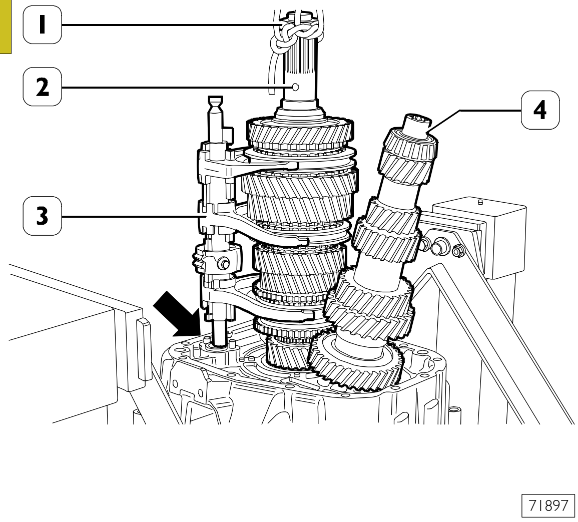
Unscrew screws (1), leaving a safety one (→) to be removed after having placed the gearbox vertically.

Figure 17



Through extractor 99341004 (1), brackets 99341017 (2) and reaction block 99345058 (3), extract intermediate gearbox case (4).

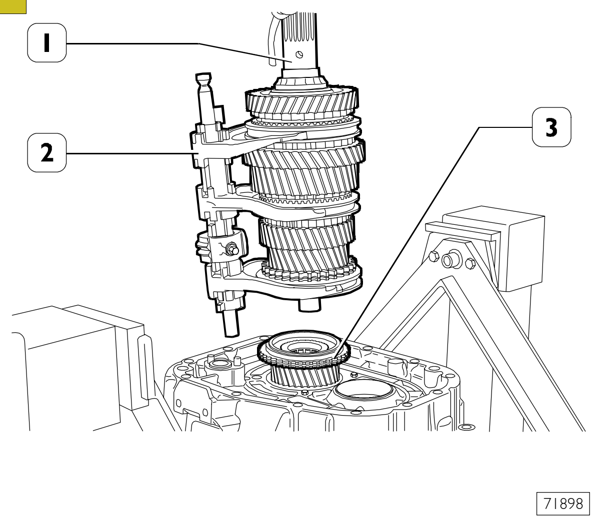
Figure 18



Screw nut (1) on primary shaft (2), lift by about 10 ÷ 20 mm primary shaft (2) together with internal drive shaft (3) and withdraw secondary shaft (4) by laterally displacing it.

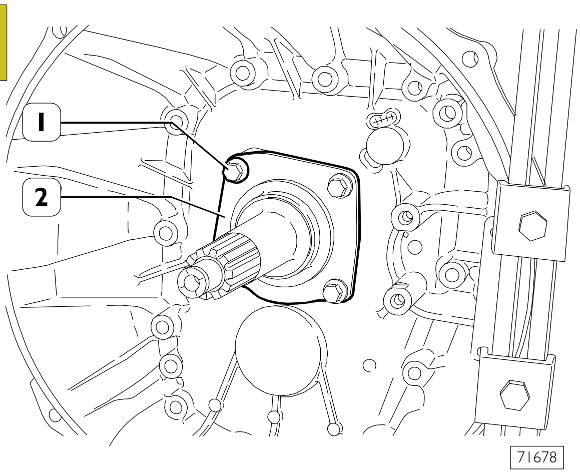
Assist internal drive shaft extraction from its seat, by operating in the shown point (→) with suitable tools.

Figure 19



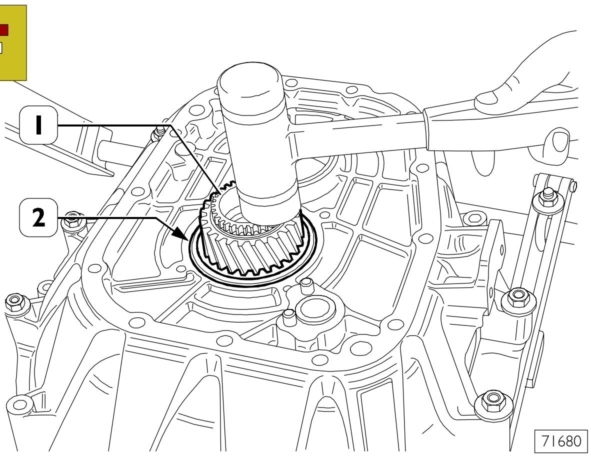
Lift and remove primary shaft (1) together with internal drive shaft (2).
Remove synchronizing rings (3).

Figure 20



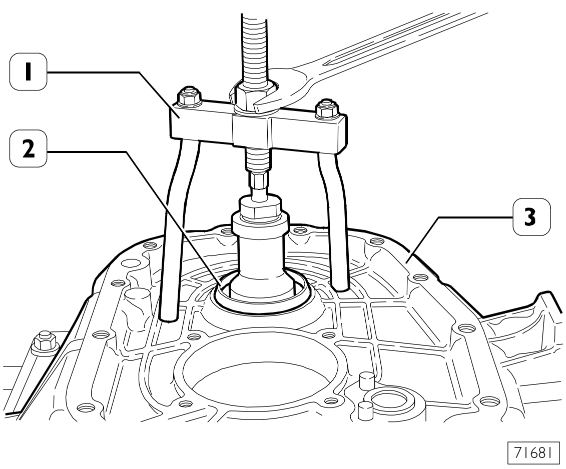
Unscrew screws (1) and remove cover (2) on motion inlet shaft.

Figure 21



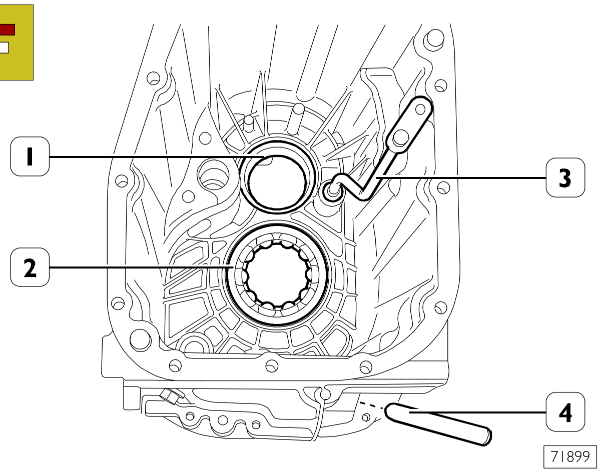
Remove cylindric roller bearing from motion inlet shaft (1) and heat front half-case contact surface (2). With a plastic hammer, extract motion inlet shaft (1) completed with ball bearing.

Figure 22



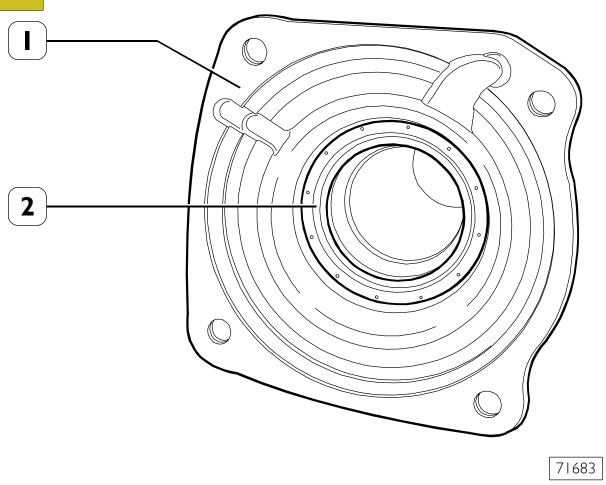
Extract rolling race (2) of secondary shaft bevel roller bearing from front half-case (3) with extractor 99348004 (1). Remove adjustment ring.

Figure 23



From intermediate case, extract roller bearing rolling race (1), ball bearing (2), reduction gear engagement safety pin (4) and oil piping (3).

Figure 24



Extract sealing gasket (2) from motion inlet shaft cover (1).

Checks

GEARBOX CASE

Gearbox case and related covers must not show cracks. Contact surfaces between covers and gearbox case must not be damaged or distorted.
Bearing seats must not be damaged or excessively worn.

SHAFTS – GEARS

Shaft seats for bearings and gear toothings must not be damaged or worn.

HUBS – SLIDING SLEEVES – FORKS

Grooves on hubs and related sliding sleeves must not be damaged. The sliding sleeve must freely slide on its hub. Sliding sleeve positioning rollers must not be damaged or worn. Sliding sleeve engagement toothings must not be damaged.

Forks must be healthy and not show any sign of wear.

BEARINGS

Roller bearings or roller cages must be in perfect conditions and not show traces of wear or overheatings.
By keeping bearings manually pressed and making them simultaneously rotate along two directions, no roughness or noise when sliding must be detected.

Upon assembling, the following must always be replaced: rings, sealing gasket and springs for sliding sleeves positioning rollers.

SYNCHRONIZERS - COUPLING BODIES

Check wear of synchronising rings and respective coupling bodies: they must not show any sign of wear.

Upon assembling, do not mutually exchange the checked parts.

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GEARBOX ASSEMBLY

Butter with hermetic type "B" the threaded part of all screws that must be screwed in the through-holes.

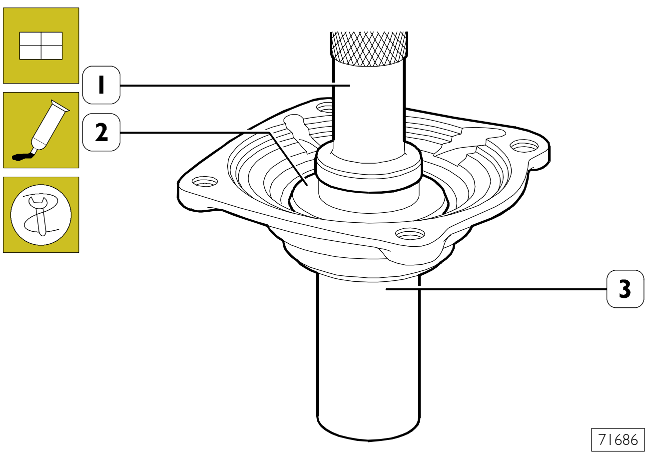
Clean the joining surfaces of case and covers and apply "LOCTITE 510" putty, before assembling, on one of the two components.

Do not insert oil before 20 min and do not try the gearbox before 1h and 30 min.

Assemble bearing cages into their respective seats and oil with TUTELA ZC 90.

To guarantee assembly oil seal, make sure that sealing gaskets are already lubricated, or butter with oil or grease the sealing lip of inlet and primary shafts gaskets.

Figure 25

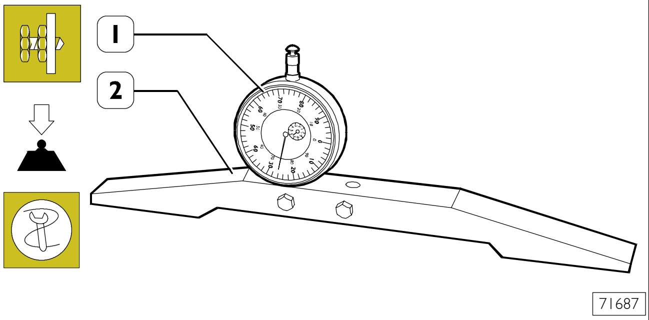


Butter, with hermetic type "B", the coupling seat surface of cover (3) with sealing gasket and with keyer 99370349 (2) and handle 99370006 (1) assemble the sealing gasket itself.

Bearings pre-load adjustment for secondary shaft

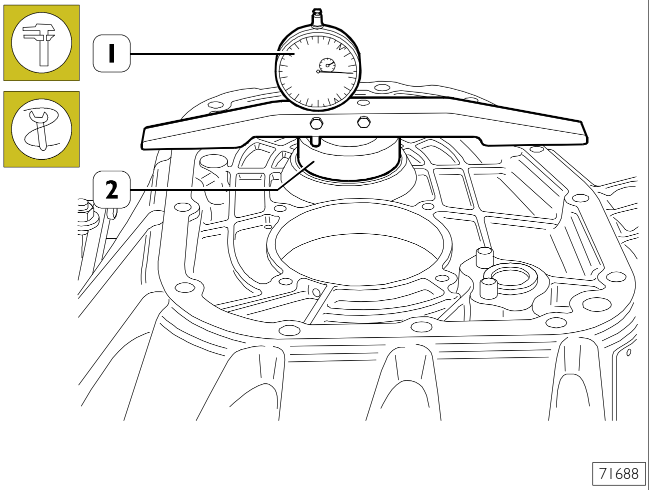
The bearings pre-load adjustment for the secondary shaft can be carried out with two procedures.

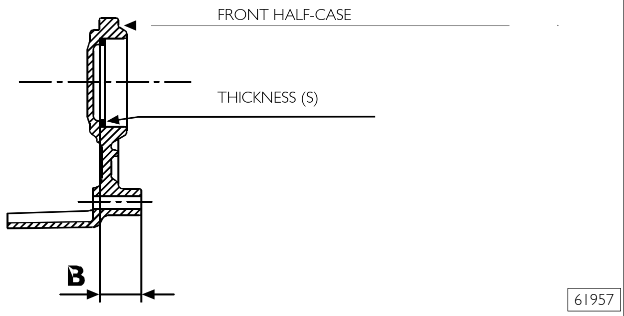
Figure 26



Assemble comparator 99395604 (1) on base 99370466 (2), pre-load it by 5 mm and zero it on an abutment plane.

Figure 27





Place calibrated ring 99396031 (2) into its seat, without adjustment ring, of bevel roller bearing on front half-case; place base 99370466 completed with comparator (1), previously zeroed, as shown in the figure.

First method - Take note of the value read on the comparator (Example: 2.43 mm).

Second method - Take note of the value read on the comparator and add it to calibrated ring thickness [Example: 2.43 + 50.5 = 52.93 mm (Dimension **B**)].

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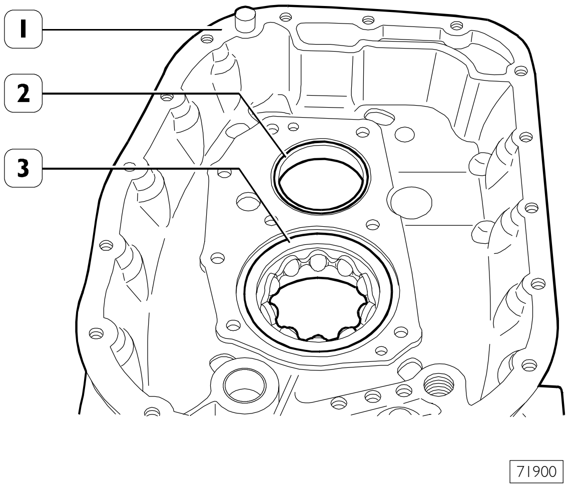
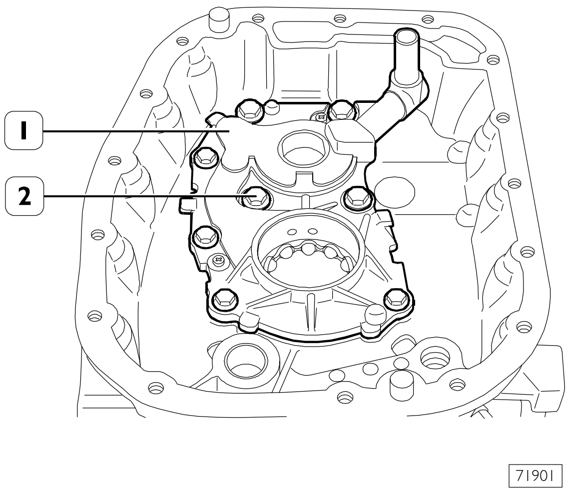
Figure 28



On intermediate case (1) assemble external race (2) for secondary shaft bearing and ball bearing (3) for primary shaft.

Figure 29



Assemble oil pump (1) by screwing screws (2) at the required torque; rotate the intermediate case.

Figure 30

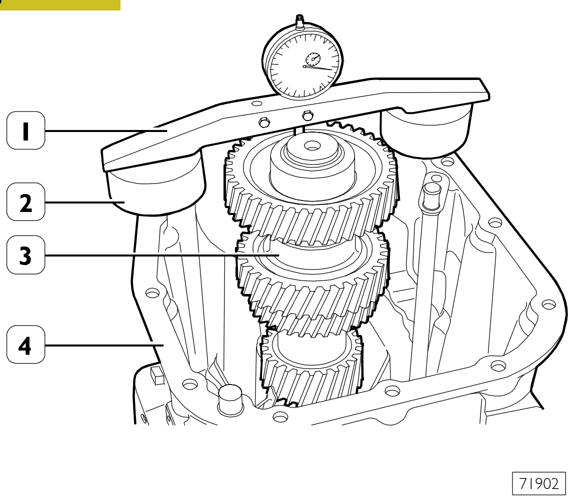
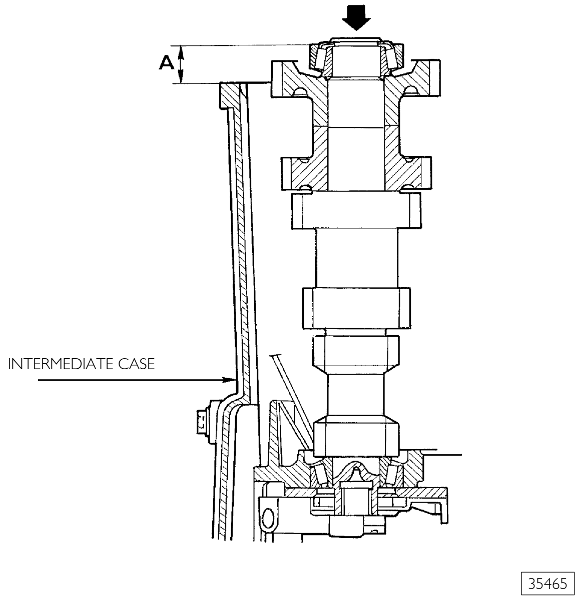


Figure 31



Assemble and simultaneously rotate, till it abuts, the secondary shaft (3, Figure 30) completed with bearings in rear case. Place calibrated rings 99396031 (2, Figure 30) on the case (4, Figure 30). Arrange, as shown in the figure, base 99370466 completed with previously-zeroed comparator (1, Figure 30); the comparator rod must abut on the external bearing ring. Carry out the measure on two diametrically-opposite points and perform the arithmetic mean.

First method - Take note of the value read on the comparator (Example 1.84 mm). The adjustment ring value is obtained by summing the two measured values (Example 2.43 + 1.84 = 4.27 mm)

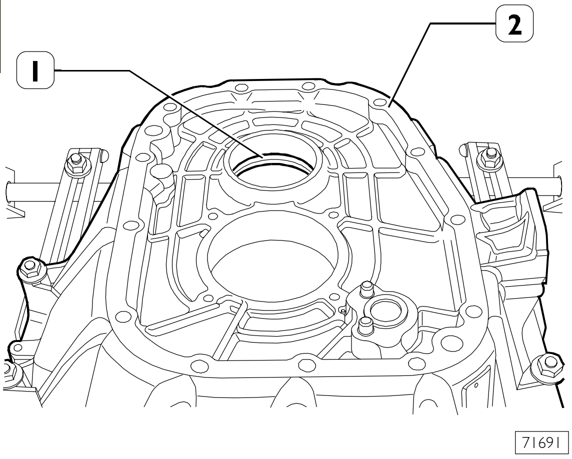
Second method - Take note of the value read on the comparator and subtract it from the calibrated ring thickness [Example: 50.5 - 1.84 = 48.66 mm (Dimension **A**, Figure 31)].

The adjustment ring value is obtained with formula
S = B - A Example: 52.93 - 48.66 = 4.27 mm.

The adjustment ring thickness choice is always carried out in excess. Example; thickness S = 4.27: thickness S = 4.3 is taken. Measuring of dimension "A", carried out with secondary shaft in vertical position, that, in addition to facilitating the measure itself, allows having an axial load on the rear bearing.

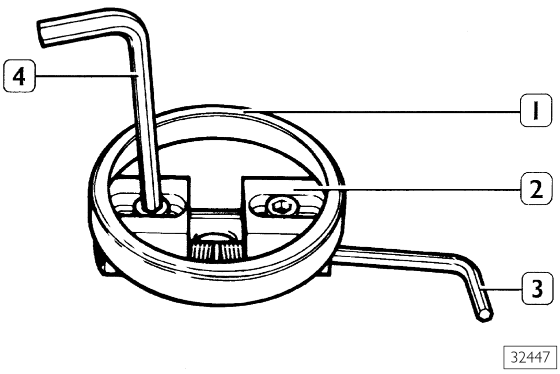
After having computed the thickness value of the adjustment ring, disassemble again secondary shaft (3, Figure 30) and oil pump (1, Figure 29).

Figure 32



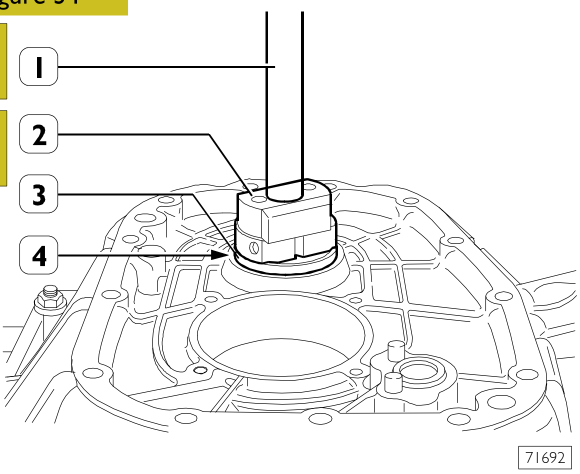
Place adjustment ring (1), whose thickness is equal to the previously-obtained one, into the secondary shaft bearing seat on the front half-case (2).

Figure 33



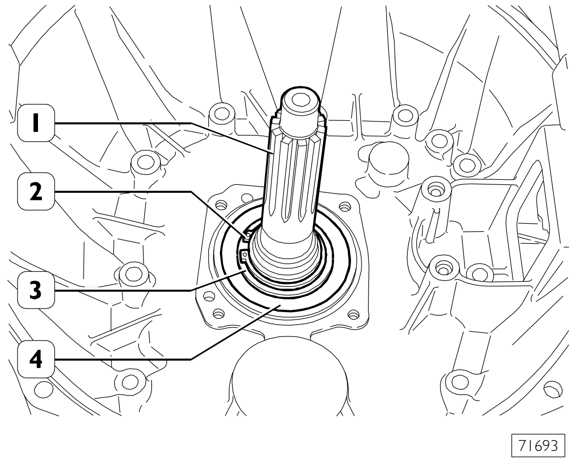
Centre external race (1) of bevel roller bearing of front cover secondary shaft on extensible beater 99374092 (2) adjusted with socket head screw (3). Lock beater with socket head screw (4).

Figure 34



Slightly heat seat (4) of secondary shaft bearing race on front half-case and assemble external race (3) by settling it till it abuts with beater 99374092 (2), equipped with handle 99370007 (1).

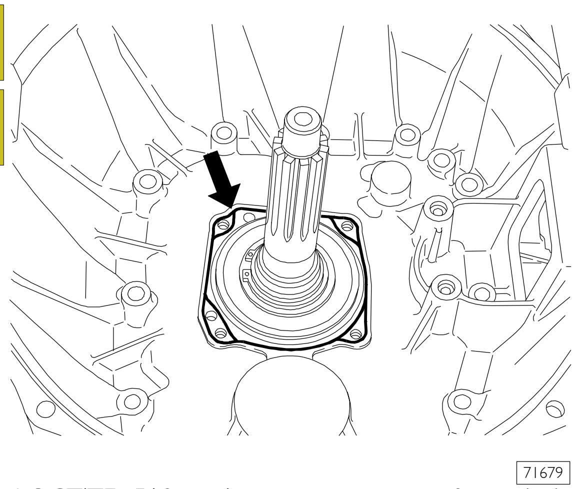
Figure 35



Slightly heat the ball bearing seat, assemble motion inlet shaft (1) completed with bearing (4), adjustment ring (3) and elastic ring (2). Settle the bearing till it abuts.

> ! Before assembling on front half-case the motion inlet shaft, carry out bearing adjustment as described in the related procedure on page 108.

Figure 36



Apply LOCTITE 510 sealant on contact surfaces (→) between front half-case and motion inlet shaft cover.

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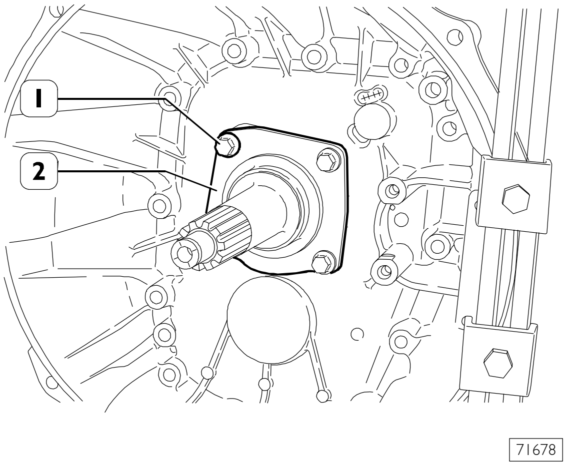
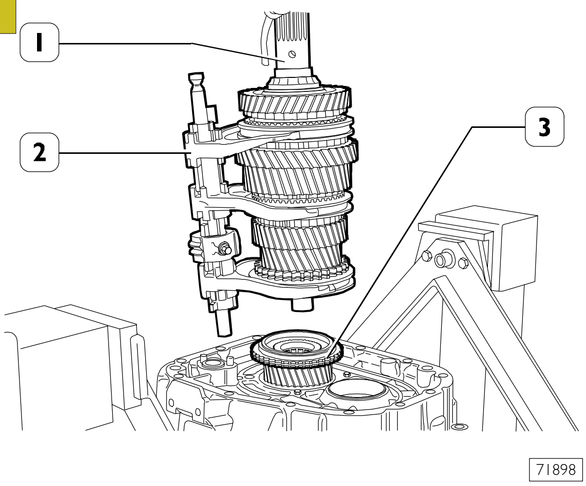
Figure 37



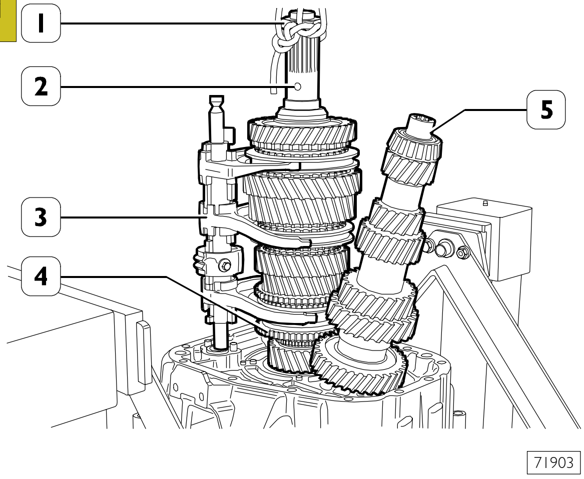
Assemble motion inlet shaft cover (2), screw screws (1) and tighten them at the required torque.

Figure 38



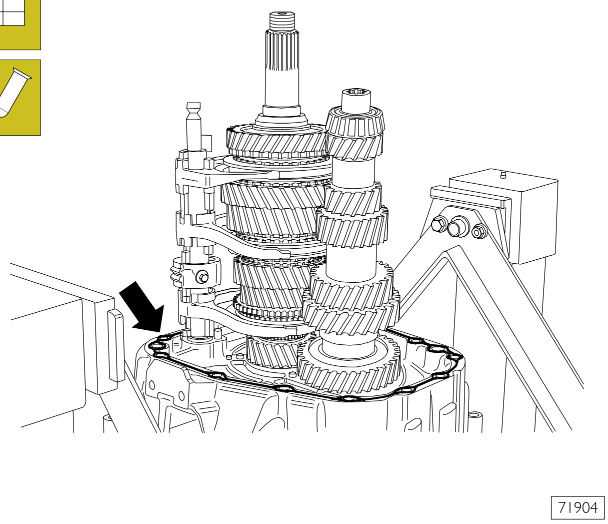
Insert roller bearing into motion inlet shaft, then assemble synchronising rings (3).
Assemble primary shaft (1) completed with internal drive shaft (2) without completely inserting it into motion inlet shaft.

Figure 39



Assemble secondary shaft (5) and simultaneously lower primary shaft (2) and internal drive shaft (3). Pay attention to the exact insertion of synchronising rings (4).
Remove nut (1).

Figure 40



Apply LOCTITE 510 sealant on contact surface (→) between the front half-case and intermediate case.

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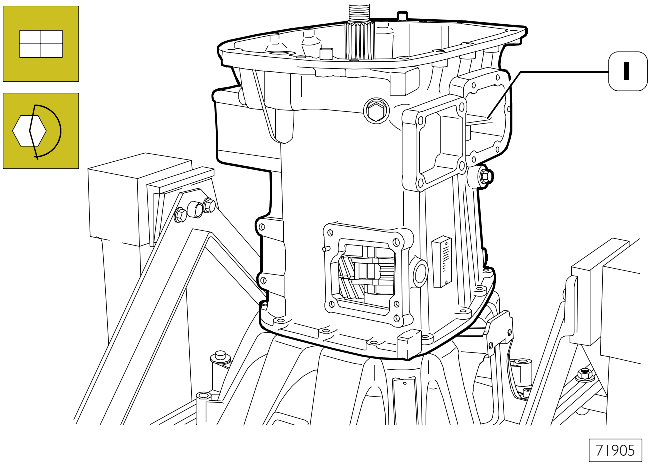
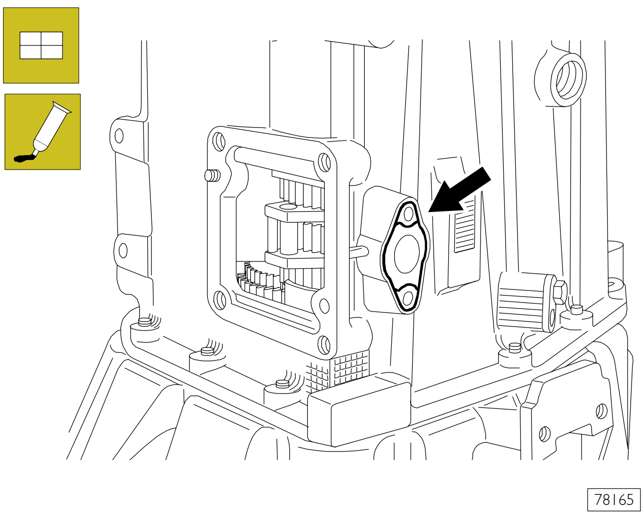
Figure 41



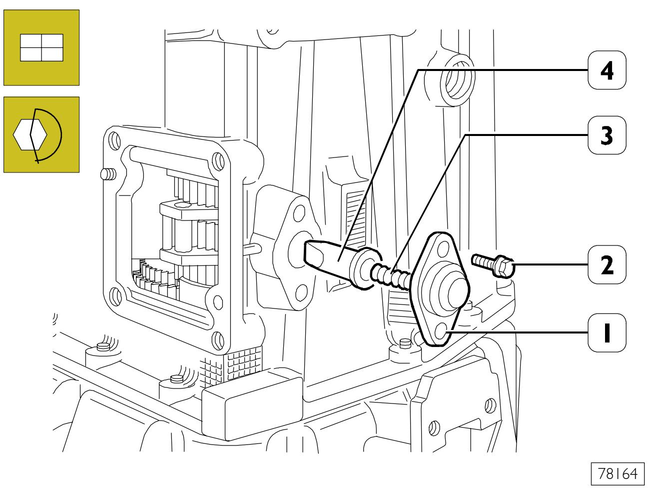
Assemble reducing gear engagement safety pin (3, Figure 23). Assemble intermediate case (1) and screw the screws at the required torque.

Figure 42



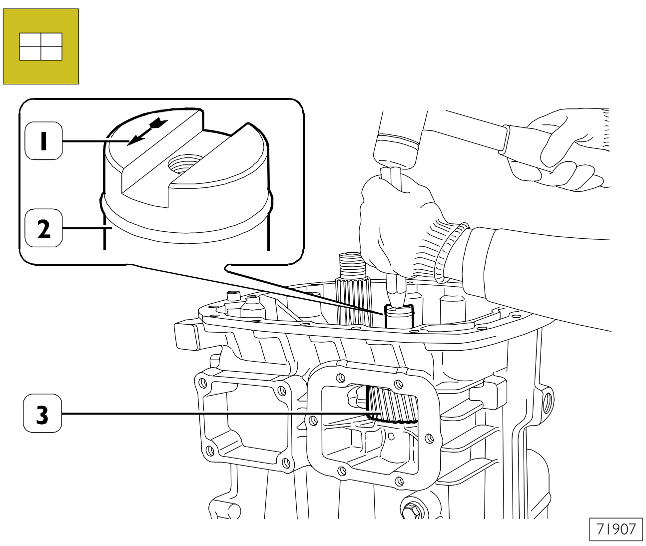
Apply sealer LOCTITE 510 on the surface (→) without staining the push rod supporting area (4, Figure 43).

Figure 43



Insert tip (4), spring (3), then mount cover (1) and fasten screws (2) by tightening them to the specified torque.

Figure 44



Assemble shoulder rings, placing them into their own seat and reverse gear (3) with cylindric roller bearing. Assemble reverse gear supporting shaft (2) with a suitable beater, paying attention that the arrow (1) punched on the shaft is facing the peg insertion hole.

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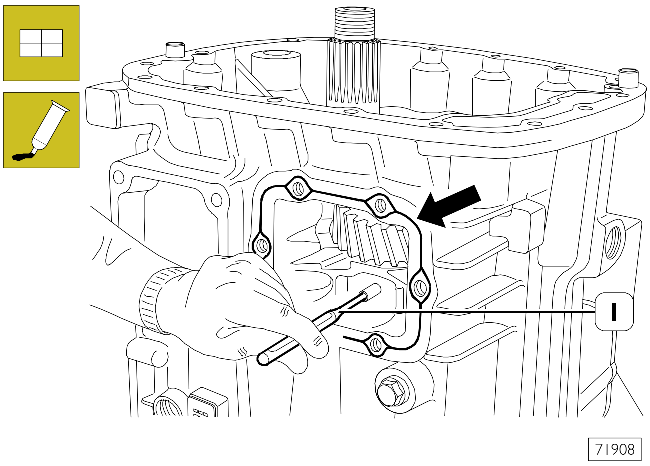
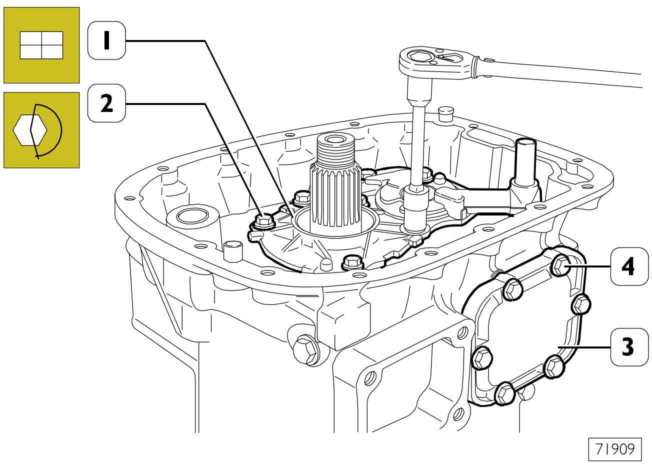
Figure 45



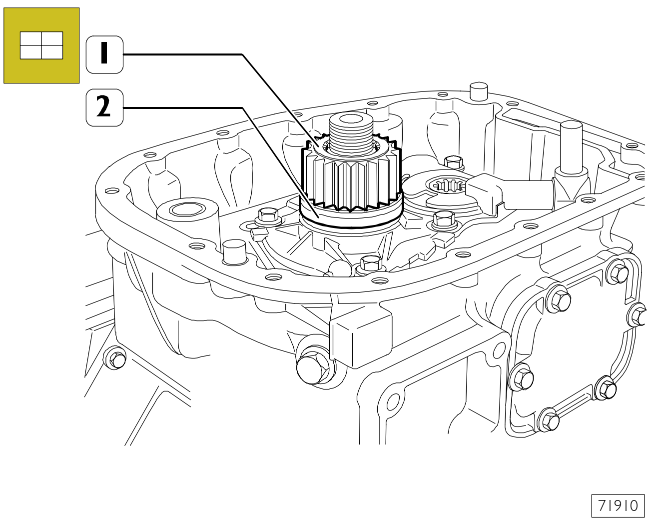
Assemble elastic peg (1).
Apply LOCTITE 510 sealant on contact surface (→) between intermediate case and cover.

Figure 46



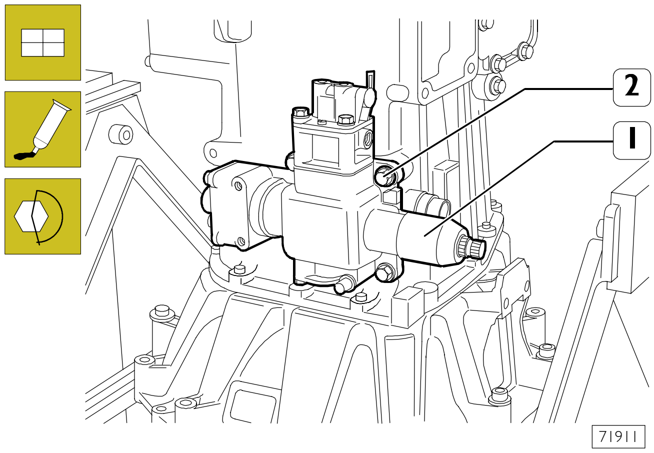
Assemble oil pump (1) and tighten screws (2) at the required torque, assemble cover (3) and tighten screws (4) at the required torque.

Figure 47



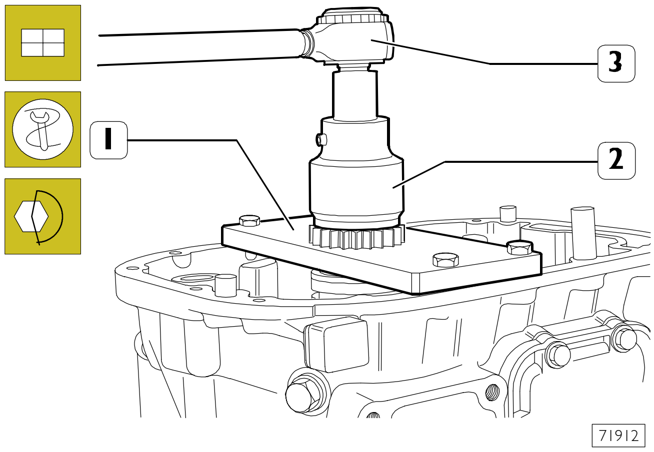
Key-in oil distributor (2) and sun gear (1).

Figure 48



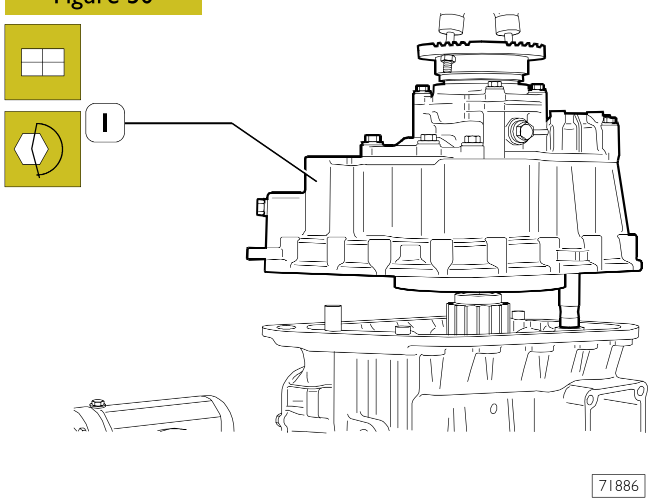
Apply LOCTITE 510 sealant and assemble external gear drive (1) tightening screws (2) at the required torque.

Figure 49



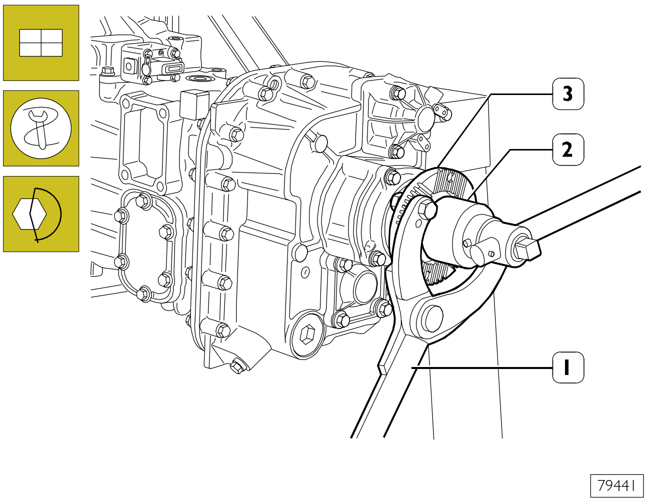
Apply tool 99370130 (1) and, through wrench 99355131 (2) and dynamometric wrench (3), screw sun gear check nut, tightening it at the required torque.

Figure 50



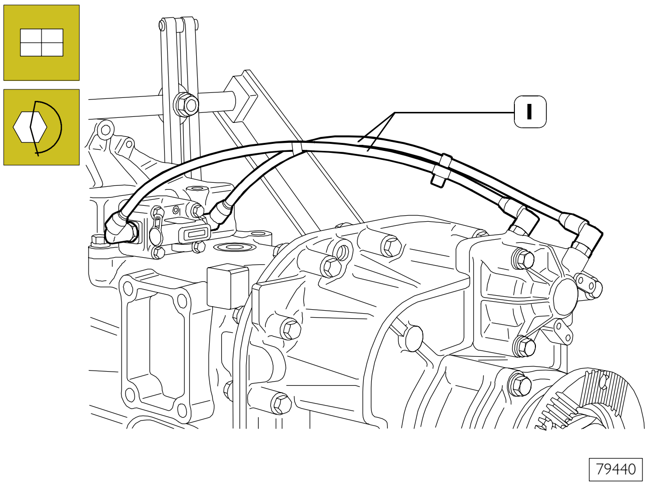
Assemble epicyclic reduction gear assemble (1) after having applied LOCTITE 510 sealant and tighten securing screws at the required torque.

Figure 51



Apply reaction lever 99370317 (1) and with wrench 99355081 (2) screw motion outlet flange securing nut (3) tightening it at the required torque.

Figure 52



Connect pneumatic pipings (1) of epicyclic reduction gear drive.
Assemble clutch disengagement lever and tighten the two securing screws at the required torque.

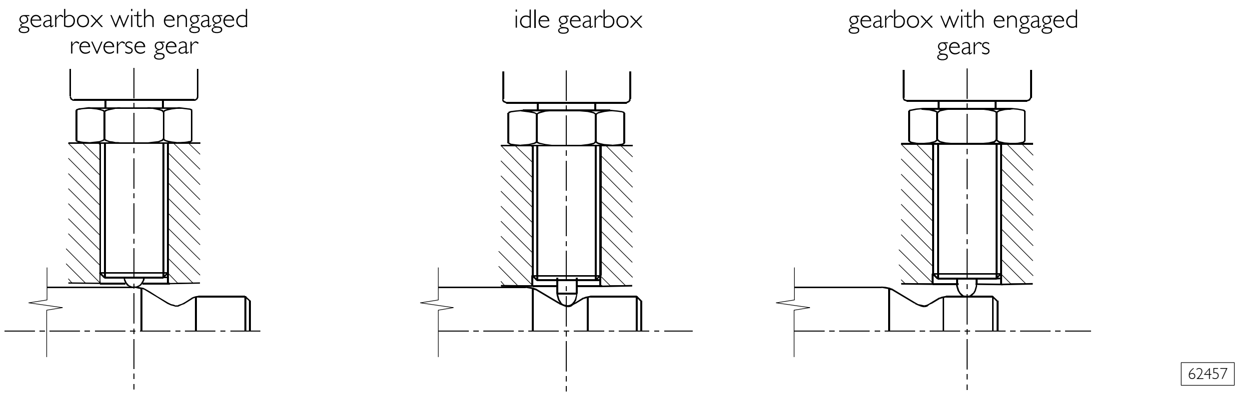
Insert lubrication oil in the prescribed amount after about 20 minutes from the last LOCTITE 510 sealant application.

Remove gearbox from rotating stand.

Idle-Reverse Gear switch adjustment

The below-described sequence must be compulsorily followed.

Figure 53



SWITCH INSERTION POSITIONS ON 2870.9 GEARBOX

For switch adjustment, it is necessary to carry out the following operations:

- Apply silicon sealant on threadings;
- Put gearbox in engaged reverse gear positions;
- Screw the switch till the reverse gear lamp turns on;
- Further screw the switch by 45-60° corresponding to a 0.19-0.25 mm stroke;
- Tighten securing lock nut with a 24-type wrench at a 35 Nm torque.

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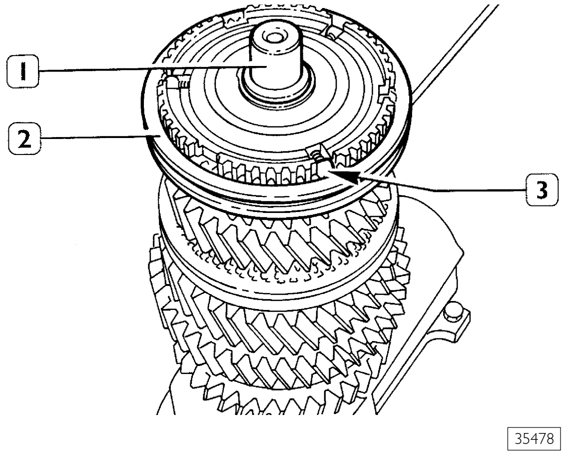
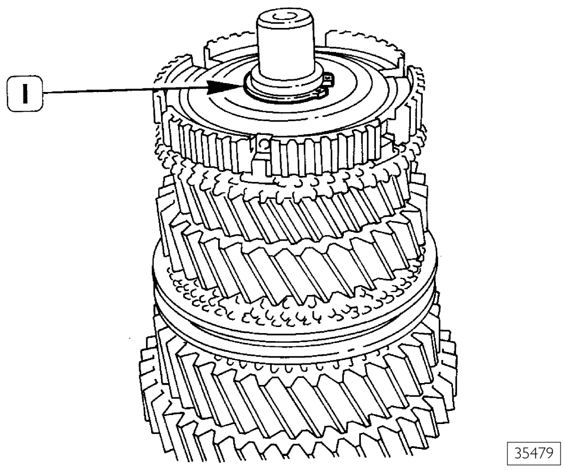
PRIMARY SHAFT DISASSEMBLY

Figure 54



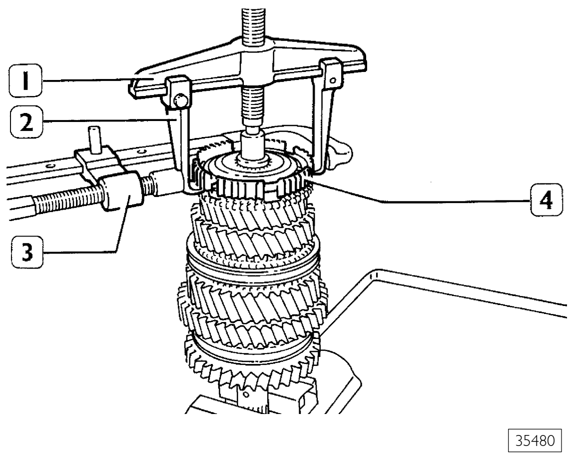
Tighten primary shaft (1) in a vice.
Withdraw sliding sleeve (2) for 4th-5th gear recovering springs, pins and rollers (3).

Figure 55



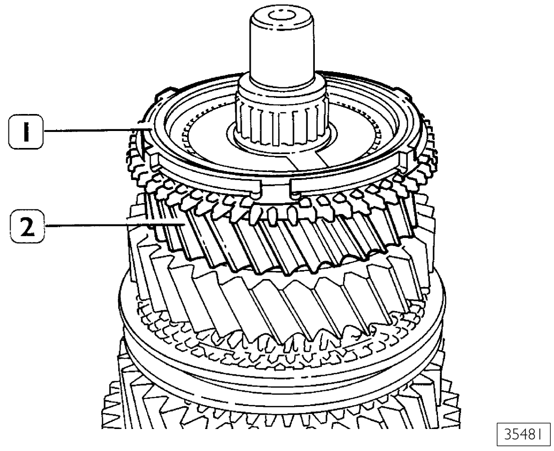
Through rounded-tip pliers, remove elastic ring (1).

Figure 56



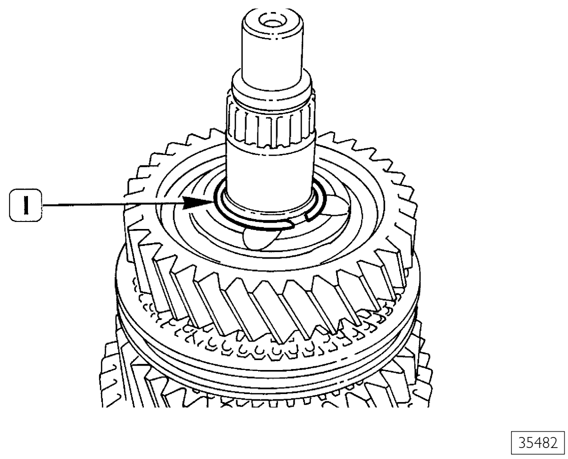
Through extractor 99341003 (1) completed with brackets (2) and clamp 99341015 (3), withdraw fixed 4th-5th gear hub (4).

Figure 57



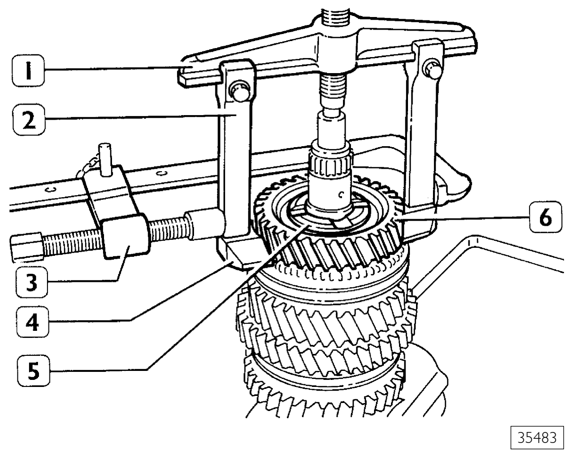
Remove synchronising ring and coupling body (1).
Withdraw 4th speed gear (2) together with roller bearing.

Figure 58



Remove elastic ring (1).

Figure 59



Through extractor 99341003 (1) completed with tie-rods (2), grips (4) and clamp 99341015 (3) extract 3rd speed gear (5) together with bush (6) and roller bearing.

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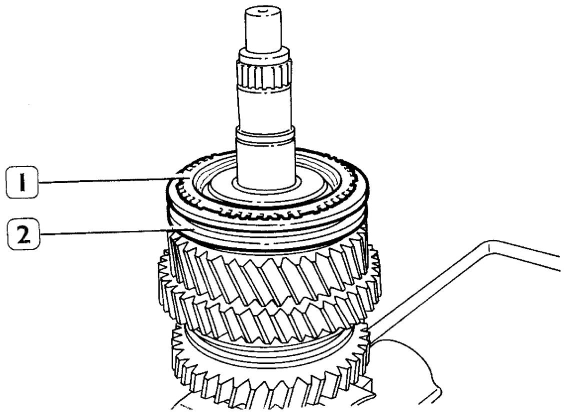
Figure 60



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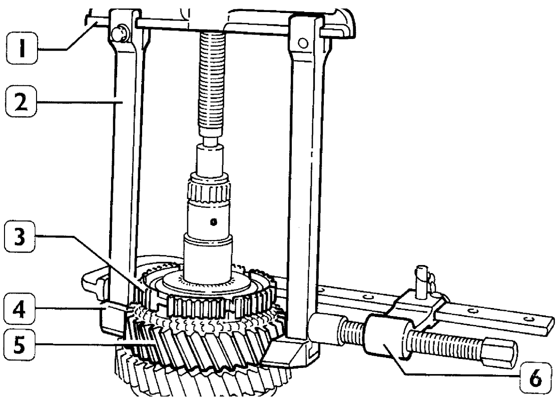
Remove synchronising ring and coupling body (1), withdraw sliding sleeve (2) recovering springs, pins and rollers.

Figure 61



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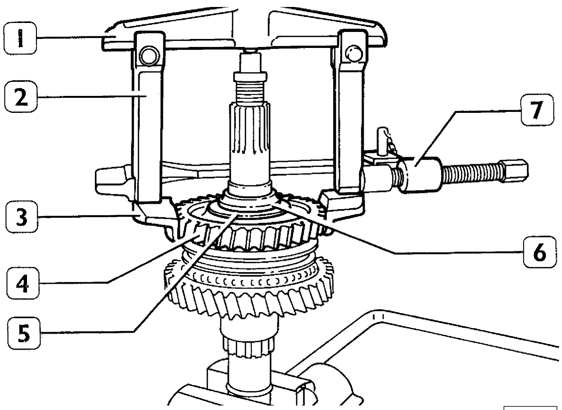
Through extractor 99341003 (1) completed with tie-rods (2), grips (4) and clamp (6), extract 2nd-3rd gear fixed hub (3) together with synchronising ring, coupling body and 2nd speed gear (5); recover the roller bearing.

Figure 62



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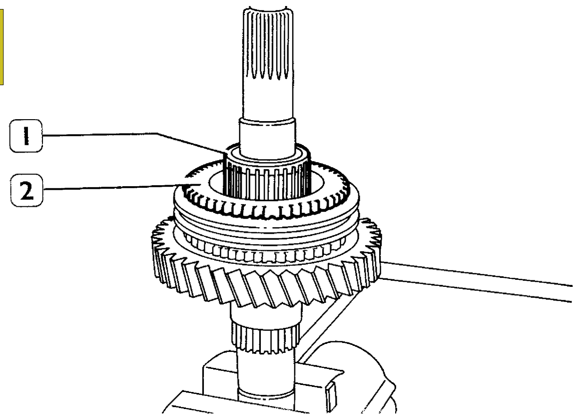
Turn primary shaft over, then through extractor 99341003 (1) completed with tie-rods (2), grips (3) and clamp (7), withdraw reverse gear (4) together with internal bearing (6) ring and shoulder ring (5).

Figure 63



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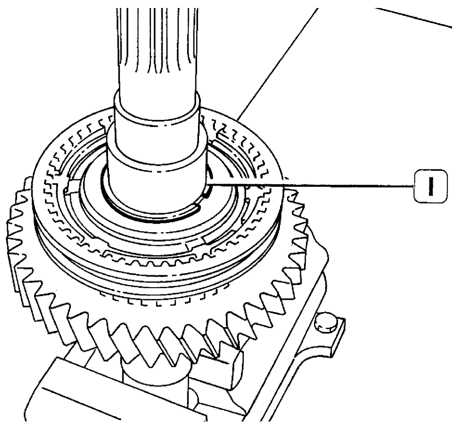
Withdraw roller bearing (1), synchronising ring and coupling body (2).

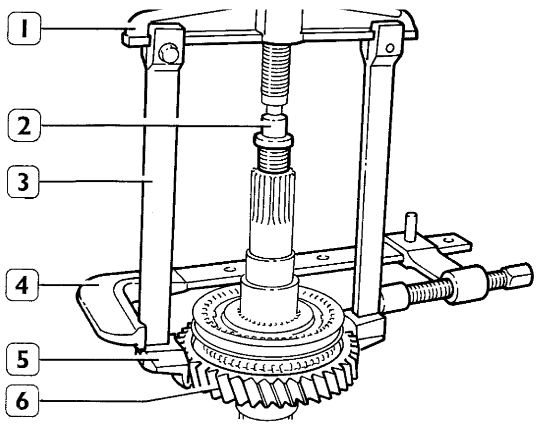
Figure 64



35488

Through suitable pliers, remove elastic ring (1).

Figure 65



35489

Through extractor 99341003 (1), reaction block (2), tie-rods (3), clamp (4), grips (5), withdraw 1st speed gear (6) completed with sliding sleeve, synchronising ring and roller bearing.

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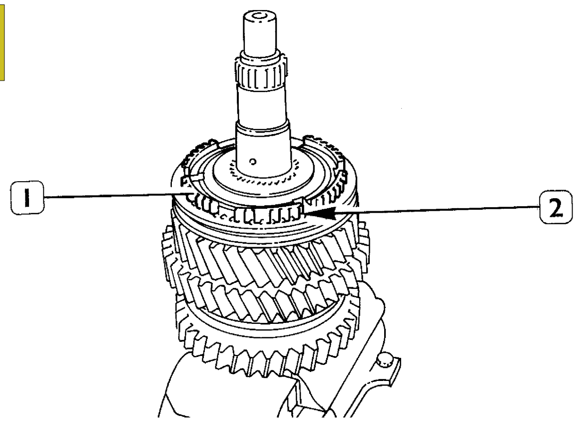
PRIMARY SHAFT ASSEMBLY

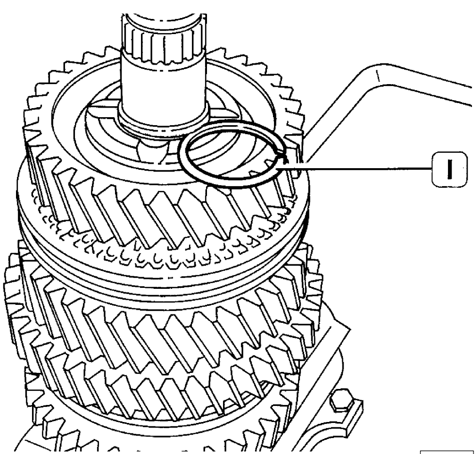
After having checked and possibly replaced all worn or broken components, in order to assemble the primary shaft, suitably reverse the previously-performed operations paying attention that:

Figure 66



- ❑ Fixed hubs (1) for 1st and reverse, 2nd – 3rd – 4th – 5th speed gears must be heated at a temperature of 100 ÷ 130 °C and driven into the primary shaft, paying attention that synchronising ring stops (2) are inserted into the respective fixed hub seats.

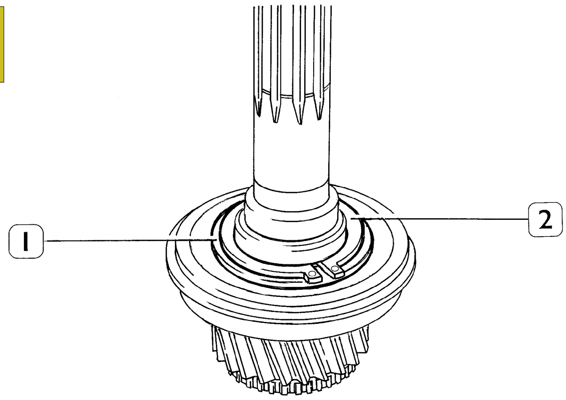
Figure 67



- ❑ Elastic shoulder rings (1) are of an adequate thickness so that they do not show an axial clearance with fixed hubs (max. allowed 0.03 mm).

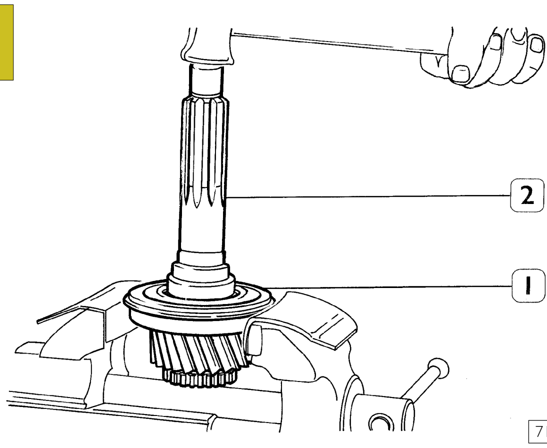
MOTION INLET SHAFT DISASSEMBLY

Figure 68



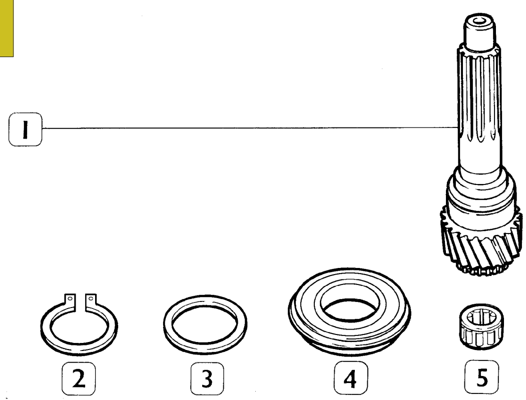
Remove elastic ring (2) and adjustment ring (1).

Figure 69



Abut bearing (1) on a vice, as shown in the figure, and by beating onto shaft (2), extract it from the bearing itself.

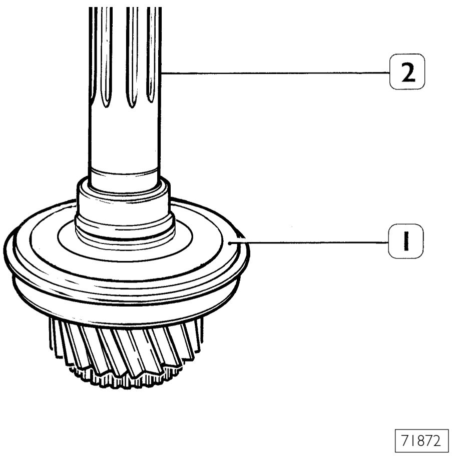
Figure 70



PARTS COMPOSING THE MOTION INLET SHAFT
1. Motion inlet shaft – 2. Elastic ring – 3. Adjustment ring – 4. Ball bearing – 5. Cylindric roller bearing

MOTION INLET SHAFT ASSEMBLY

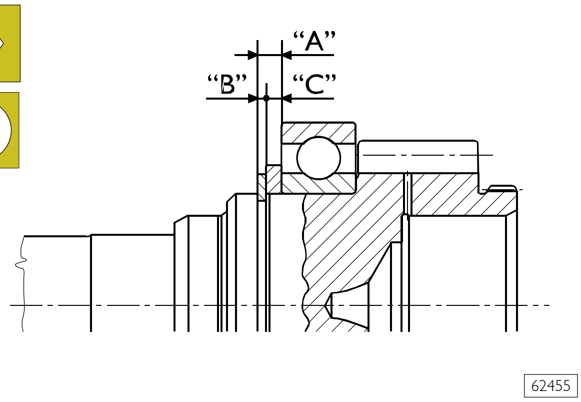
Figure 71



Assemble ball bearing (1) on motion inlet shaft (2) and carry out its adjustment.

Motion inlet shaft bearing adjustment

Figure 72



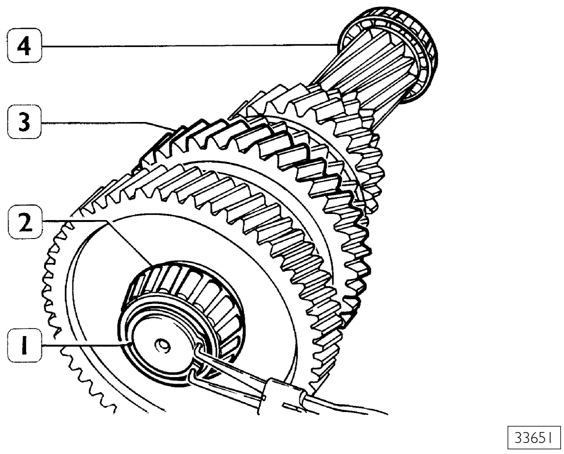
- ❑ Assemble bearing on motion inlet shaft.
- ❑ Measure dimension "**A**".
- ❑ Measure seeger "**B**" thickness.
- ❑ Define thickness of spacer ring to be inserted, by defect: **C = A – B.**

IVECO PARTS Motion inlet shaft bearing adjustment spacer ring thicknesses: mm 2.40 - 2.45 - 2.50 - 2.55 - 2.60 - 2.65 - 2.70 - 2.75 - 2.80.

Assemble adjustment ring (1, Figure 68) whose thickness is equal to the previously-obtained one and assemble elastic ring (2, Figure 68).

SECONDARY SHAFT DISASSEMBLY

Figure 73



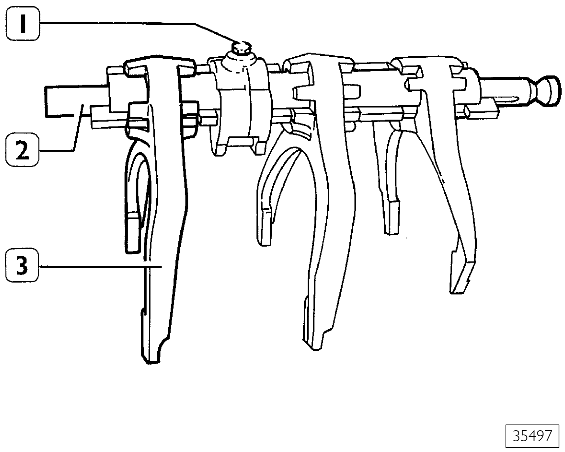
Remove elastic ring (1) from secondary shaft (3) and extract bevel roller bearings (2 and 4) with a suitable punch (destructive operation).

SECONDARY SHAFT ASSEMBLY

Slightly heat bevel roller bearings (2 and 4, Figure 73) and assemble them on secondary shaft (3, Figure 73). Assemble elastic ring (1, Figure 73).

INTERNAL DRIVE SHAFT DISASSEMBLY

Figure 74



Mark fork (3) assembling position. Unscrew screw (1), withdraw shaft (2) and decompose the assembly.

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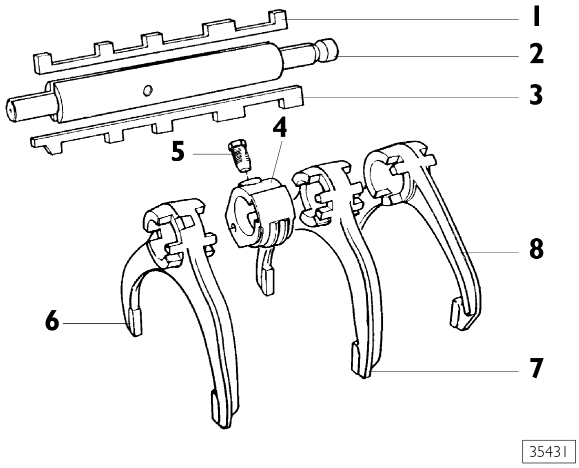
Figure 75



PARTS COMPOSING GEARS DRIVE

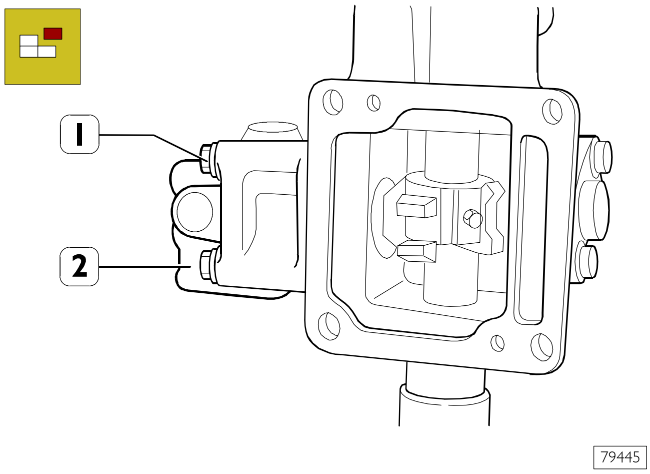
1. Selection rod – 2. Shaft – 3. Synchronising rod – 4. Hub – 5. Screw – 6. 4th-5th fork – 7. 2nd-3rd fork – 8. 1st and reverse gear fork

INTERNAL DRIVE SHAFT ASSEMBLY

Arrange on a bench forks (6-7-8) and hub (4) according to the position marked upon disassembling.
Place selection rod (1) so that the grooves are inserted into forks and hub; repeat the operation with synchronisation rod (3) and keeping them in position, insert shaft (2).
Screw the hub (4) screw (5) at the required torque.

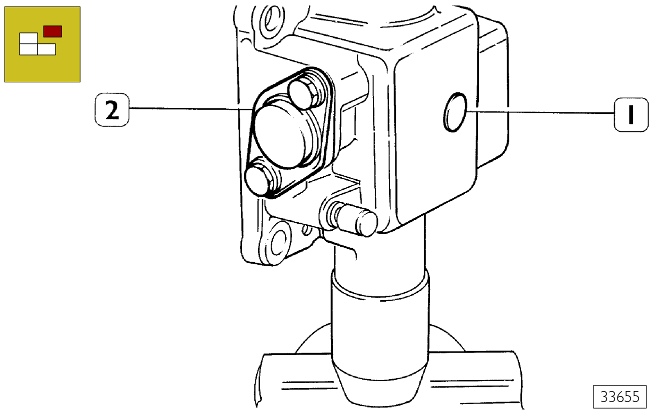
EXTERNAL DRIVE CASE DISASSEMBLY

Figure 76



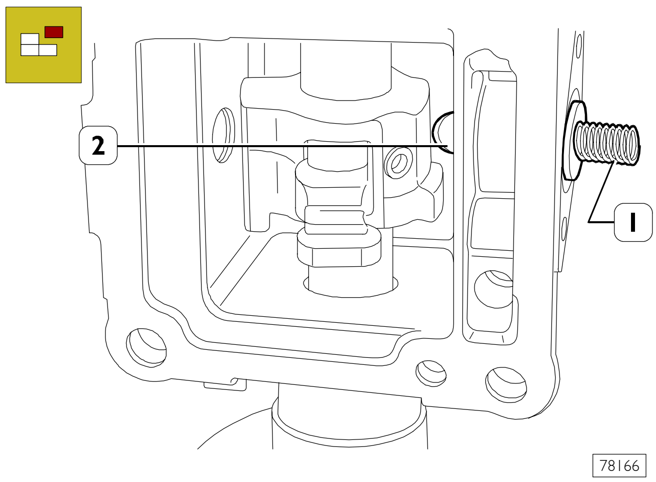
Secure the assembly in a vice, unscrew the four screws (1) and disassemble valve (2) of epicyclic reduction gear drive.

Figure 77



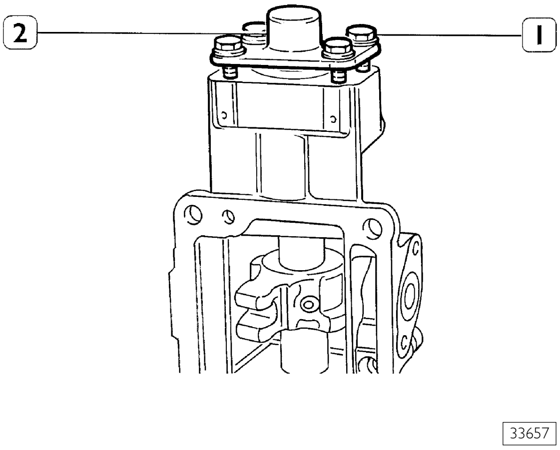
Tighten the shaft going out of the box in a clamp, remove plug (1) and disassemble cover (2).

Figure 78



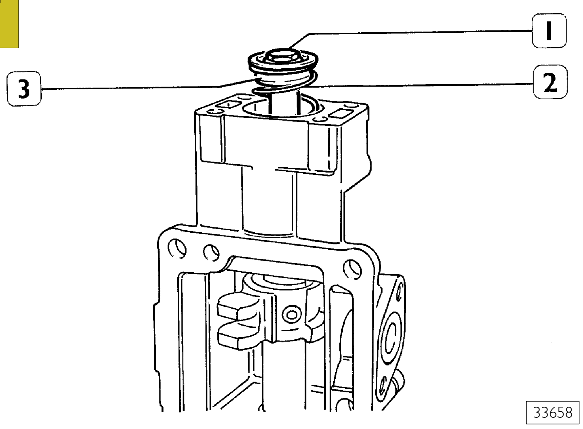
Remove control box pin (2) and spring (1).
Do not mix removed elements with those of the anti-release push rod.

Figure 79



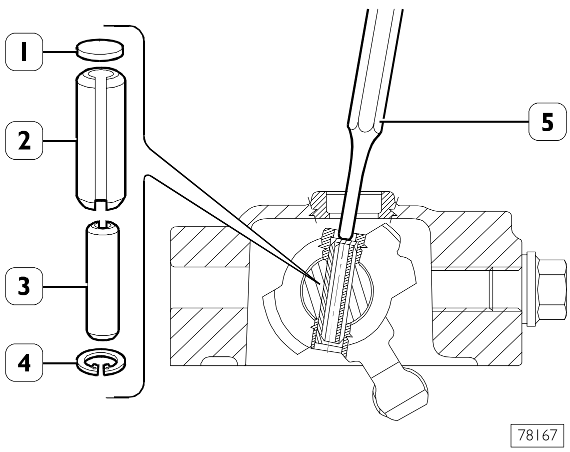
Unscrew screws (1) and disassemble cover (2).

Figure 80



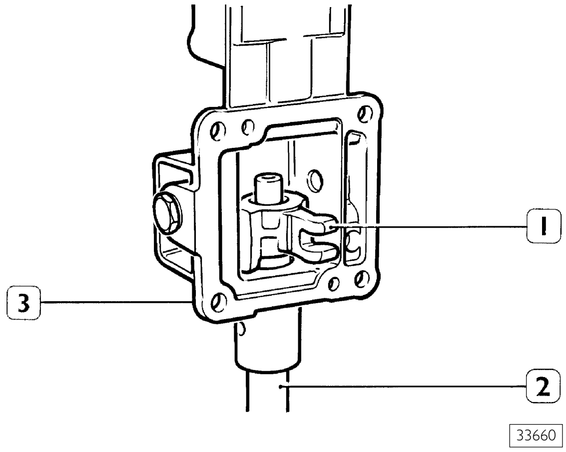
Unscrew screw (1) and remove spacer, upper cup (3) and spring (2). Remove lower cup.

Figure 81



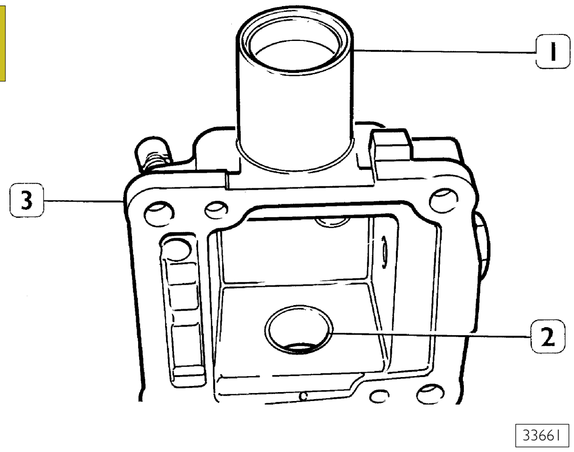
Remove the snap ring (4) and use a punch tool (5) having the right diameter to push the extraction washer (1) and remove flexible plugs (2) and (3).

Figure 82



Extract, from the control shaft (2), control selector (1) and box (3).

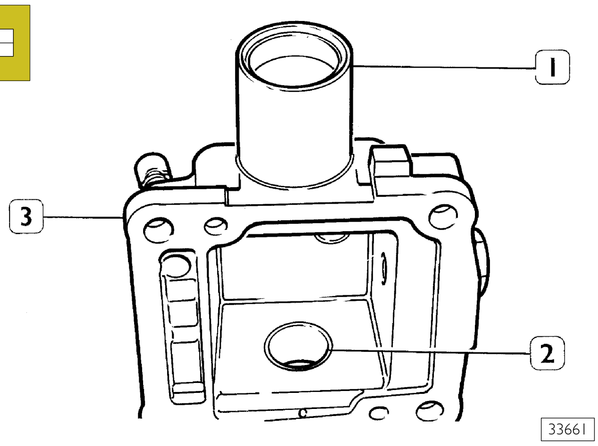
Figure 83



Extract, from the control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

EXTERNAL DRIVE CASE ASSEMBLY

Figure 84



Assemble sealing gasket (1) and bushes (2) into drive case (3) with a suitable beater.

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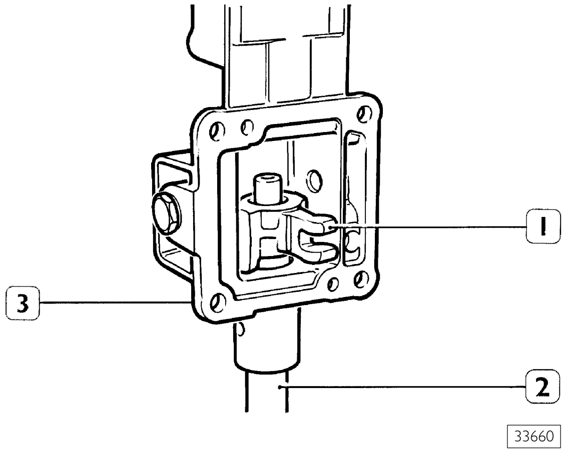
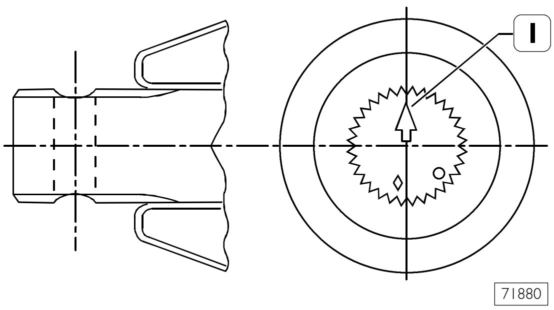
Figure 85



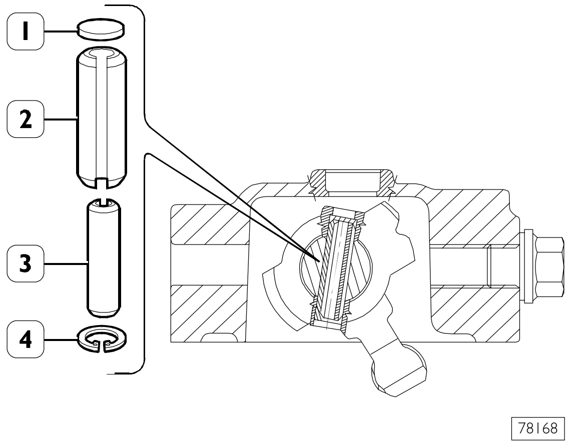
Tighten control shaft (2) in a clamp and assemble thereon box (3) and control selector (1).

Figure 86



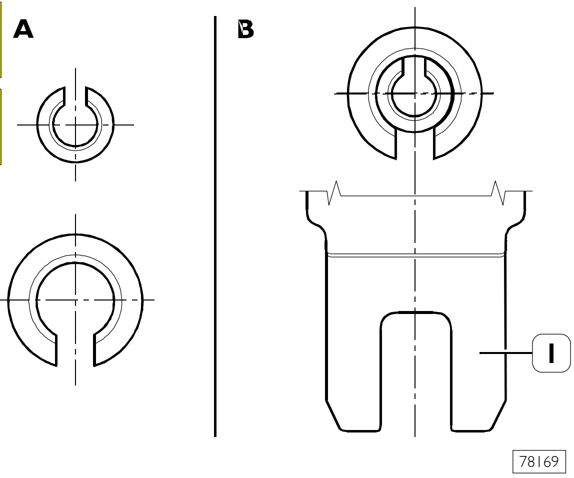
Upon assembling, the drive shaft must be assembled with the reference arrow (1) facing upwards.

Figure 87



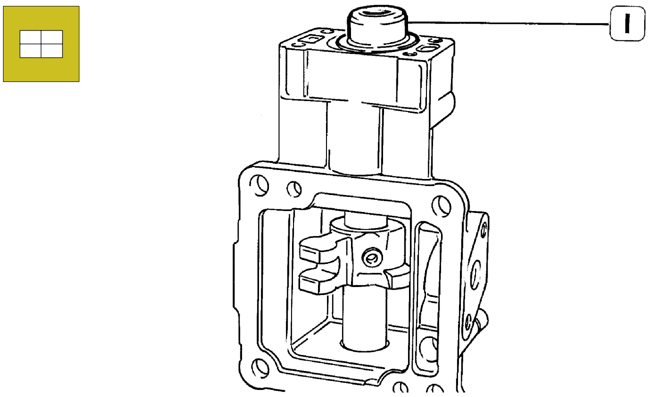
Insert the extraction washer (1) and use a punch tool having the right diameter to install the first plug (2). Install the second plug (3) and the snap ring (4).

Figure 88



During installation, plug cuts shall be opposed by 180° (see detail A).
The bigger plug cut shall face the control selector (1) milled area (see detail B).

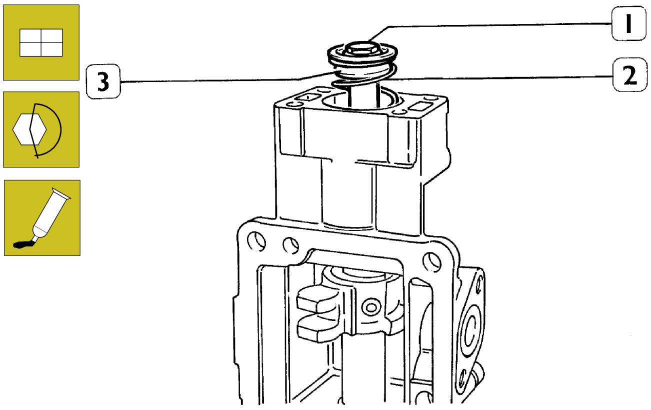
Figure 89



33663

Assemble lower cup (1).

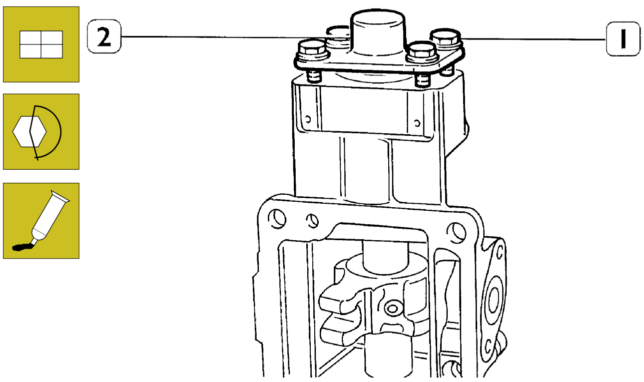
Figure 90



33658

Install the spring (2), the upper cap (3), the spacer and the screw (1) and apply threading sealer LOCTITE 270 on the screw itself.
Tighten the screw (1) to 30 Nm (3.1 kgm).

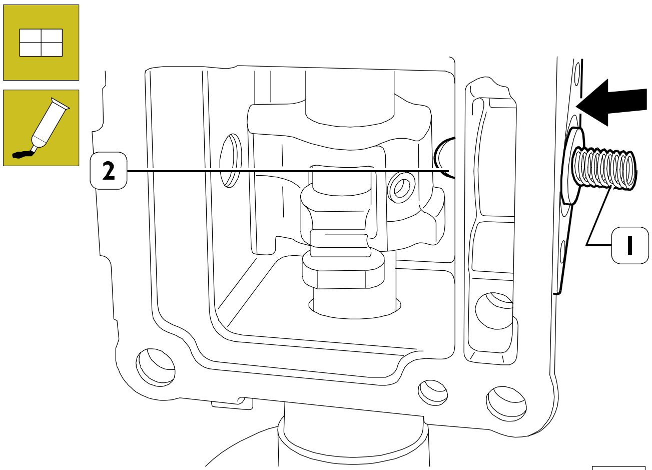
Figure 91



33657

Clean joining surfaces of control box and cover (2) and apply "LOCTITE 510" adhesive on one of the two components. Assemble cover (2) and tighten screws (1) at a torque of 36.5 Nm (3.7 kgm).
Apply threading sealer LOCTITE 270 on the screws (1).

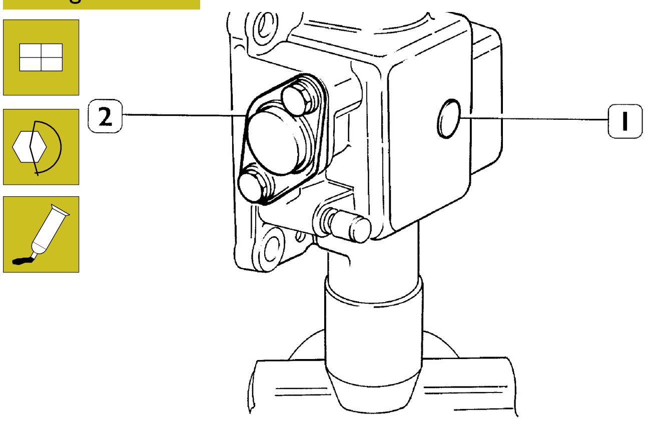
Figure 92



78170

Install the pin (2), the spring (1) and apply sealer "LOCTITE 518" (→).

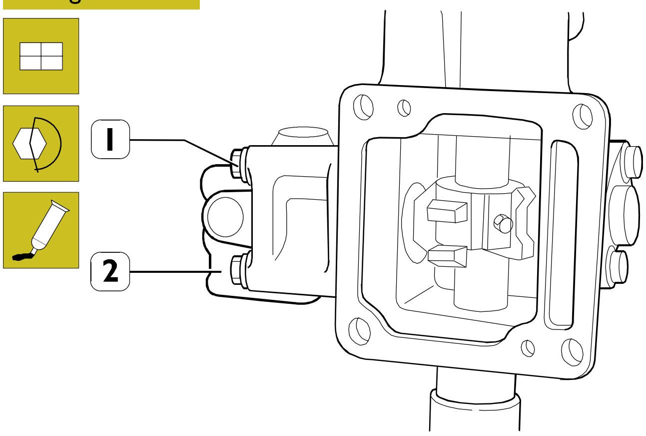
Figure 93



33655

Install the cover (2) and tighten the screws to 19 Nm (1.9 kgm).
Apply sealer "LOCTITE 675" and refit the plug (1).

Figure 94



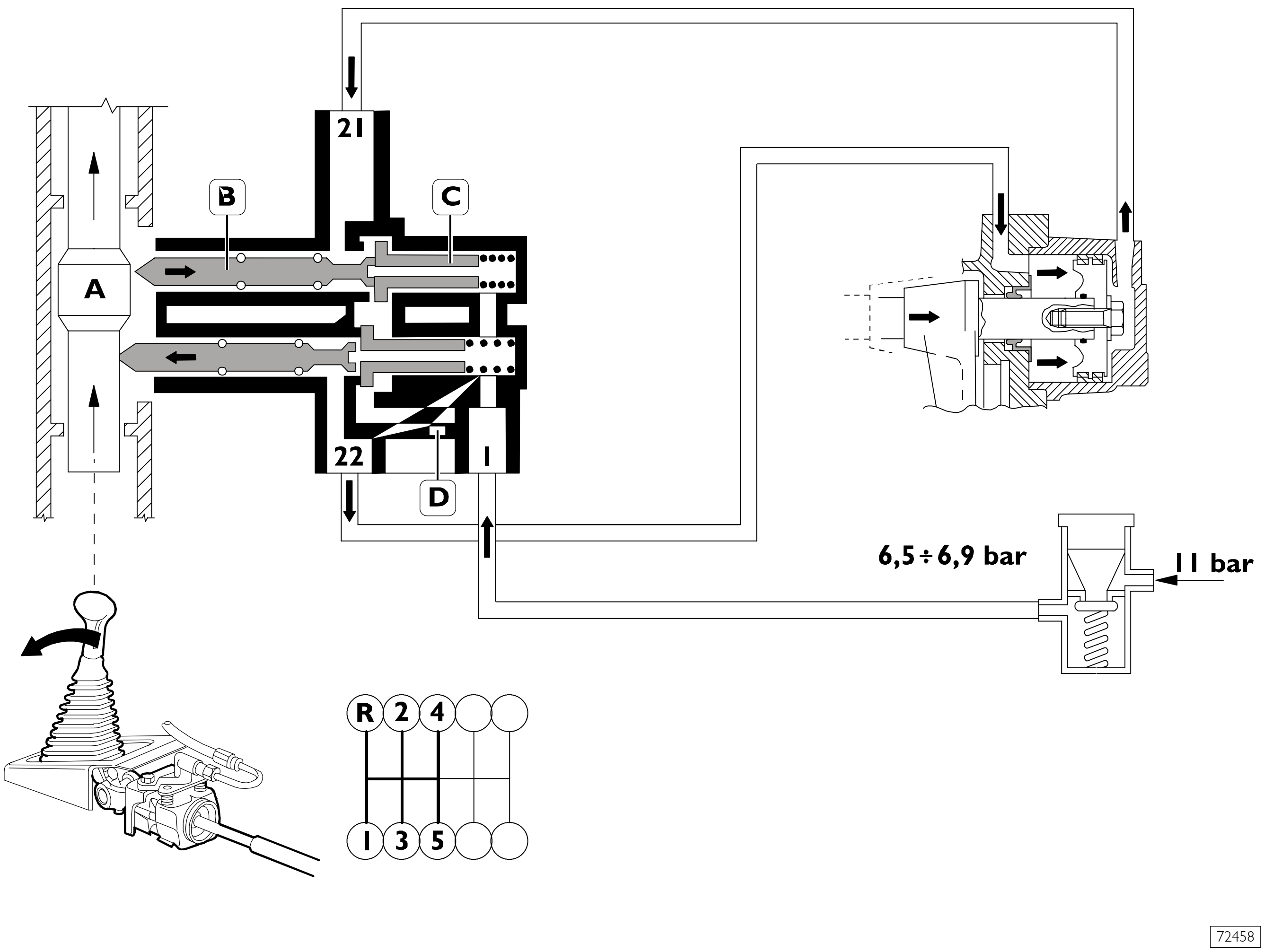
79445

Apply "LOCTITE 518" sealant, mount epicyclic reduction gear control valve (2), fasten screws (1) and tighten them to the specified torque.

533010 EPICYCLIC REDUCTION GEAR ASSEMBLY

Operating diagrams about pneumatic epicyclic reduction gear drive circuit

Figure 95



SLOW GEAR ENGAGEMENT (1st – 2nd – 3rd – 4th – 5th AND REVERSE GEAR)

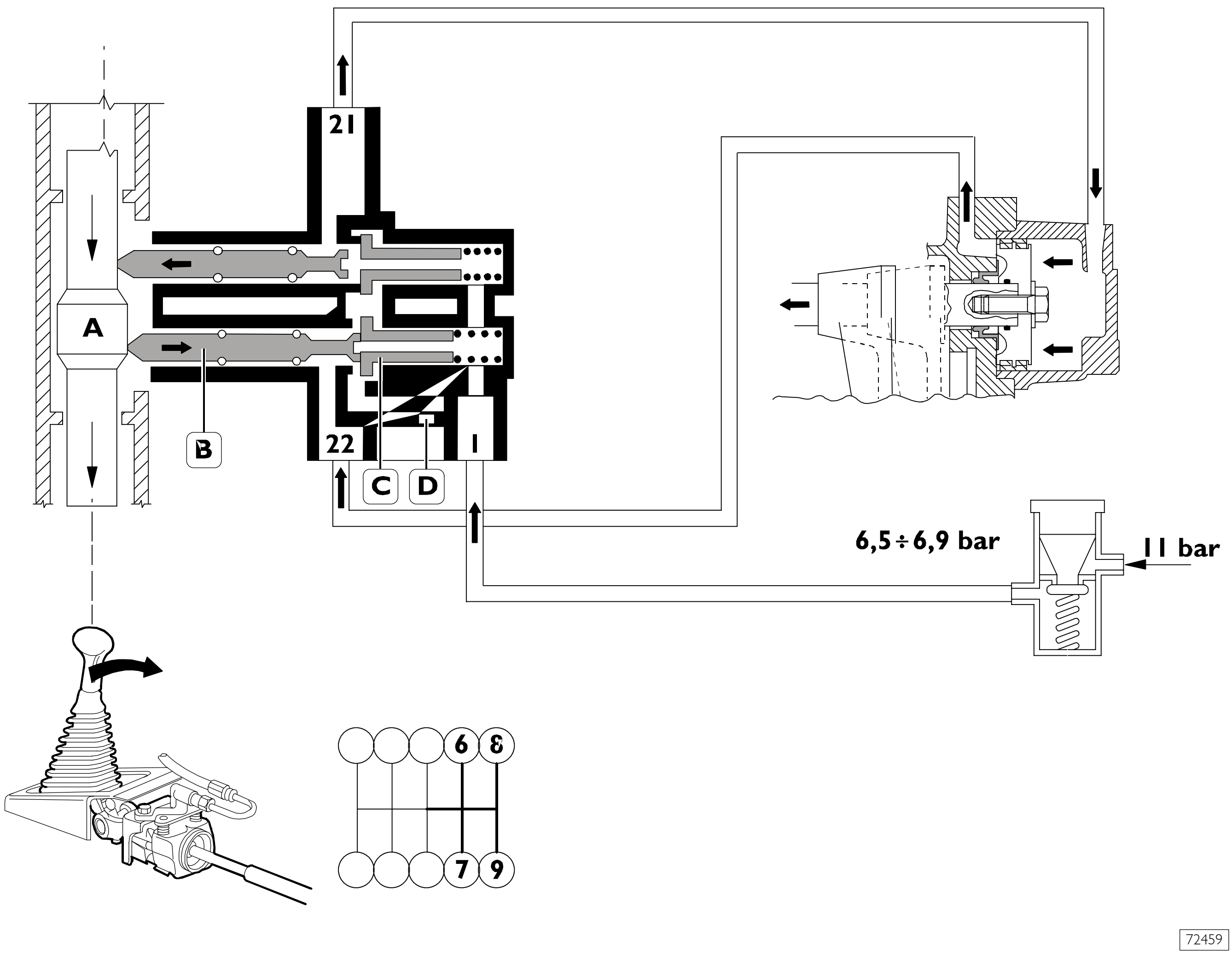
Air coming from services tank, passing through a reduction gear, is reduced to the pressure of 6.5 ÷ 6.9 bars and reaches consent valve at union **1**.

By pressing the clutch, operate on the gearbox lever to engage a gear (1-2-3-4-5-RG); cam (A) is moved upwards and pushes pin (B) leftwards.

The pin abuts on piston (C) valve and by lifting it, closes the supply to union **21**.

By discharging air contained into the cylinder through the vent hole (D), air will then go out of union **22** thereby keeping gearbox piston in slow gears.

Figure 96



QUICK GEARS (6^{th} – 7^{th} – 8^{th} – 9^{th}) ENGAGEMENT

By going with lever into second "H", cam (A) moves downwards and pushes pin (B) leftwards.

The pin abuts on piston (C) valve and, by lifting it, closes the supply to union **22** discharging air contained into the cylinder through vent hole (D).

Air will then go out of union **21** pushing the piston in reverse and allowing to insert quick gears.

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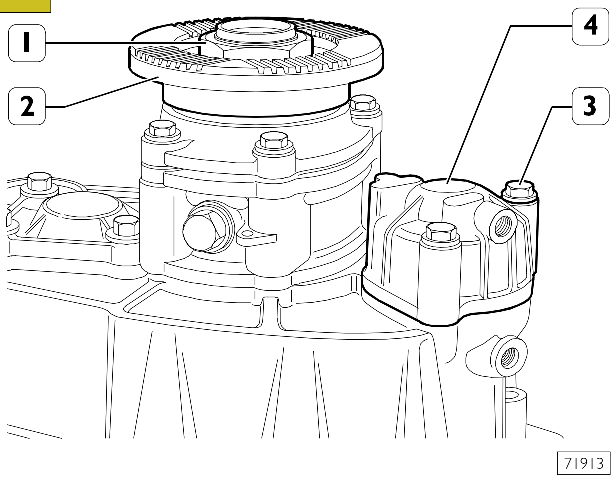
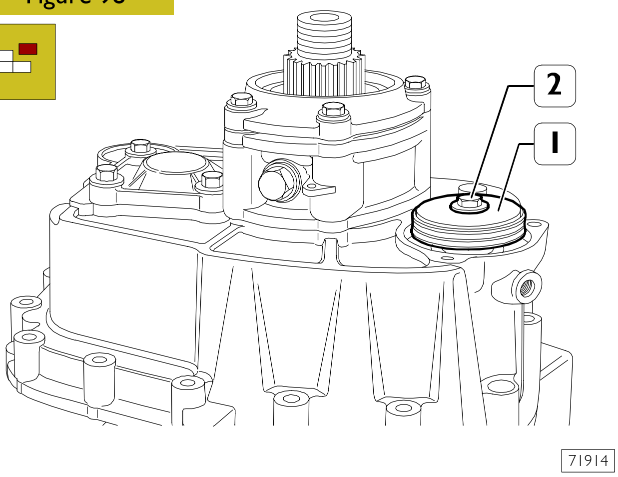
DISASSEMBLY

Figure 97



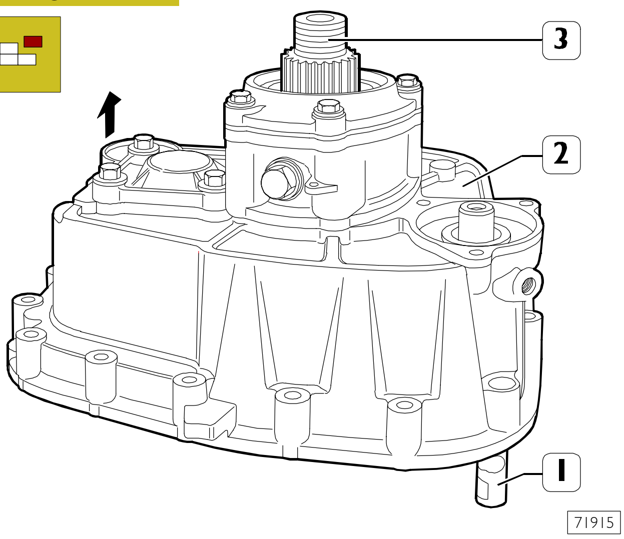
Abut epicyclic reduction gear assembly on a bench, unscrew nut (1) and remove flange (2). Unscrew screws (3) and remove cylinder (4).

Figure 98



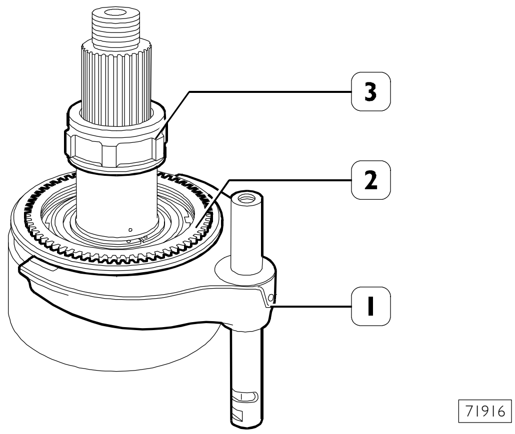
Unscrew screw (2) and remove piston (1).

Figure 99



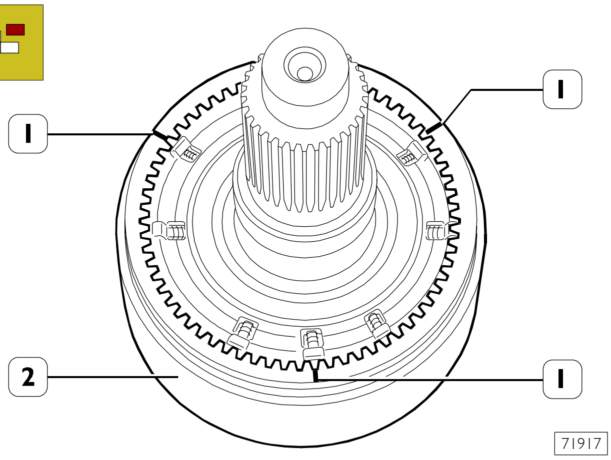
Lift case (2) in order to free outlet shaft (3) and rod (1) for synchronising drive fork.

Figure 100



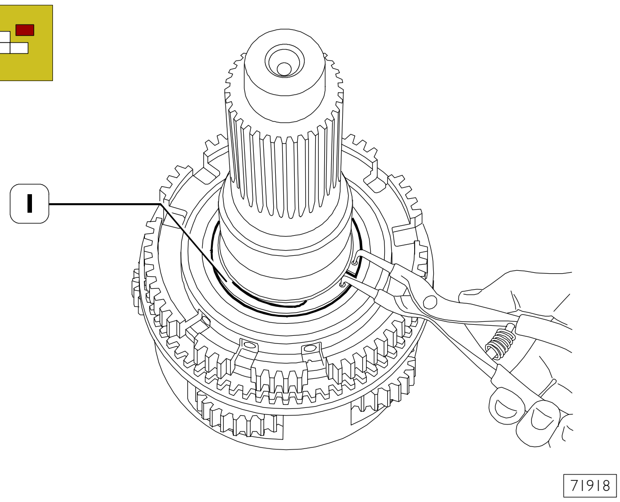
Remove rod with fork (1), withdraw phonic wheel (3) and remove synchronising ring (2).

Figure 101



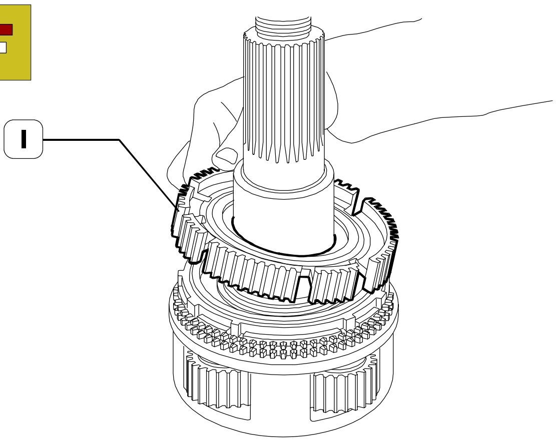
Make three reference marks (1) on sliding sleeve-crown assembly (2) next to the three central seats, on fixed hub, for positioning rollers.
Manually lift complete crown (2) and remove it, recovering rollers, pins and springs.

Figure 102



Through suitable pliers, remove elastic ring (1).

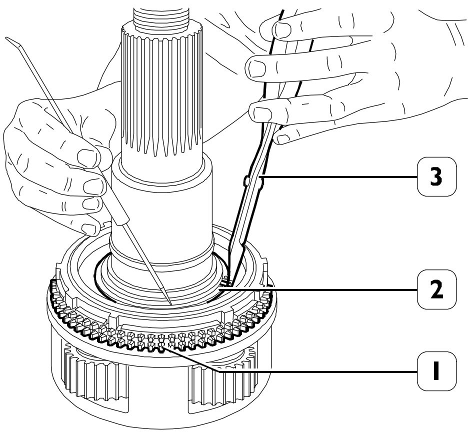
Figure 103



71919

Withdraw synchroniser fixed hub (1).

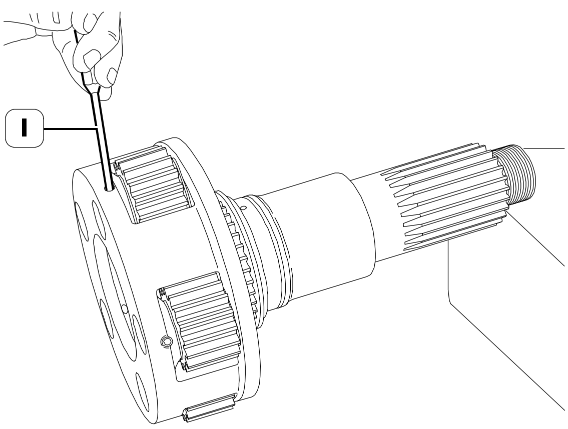
Figure 104



71920

Through pliers 99381125 (3), remove elastic ring (2) and withdraw synchroniser (1).

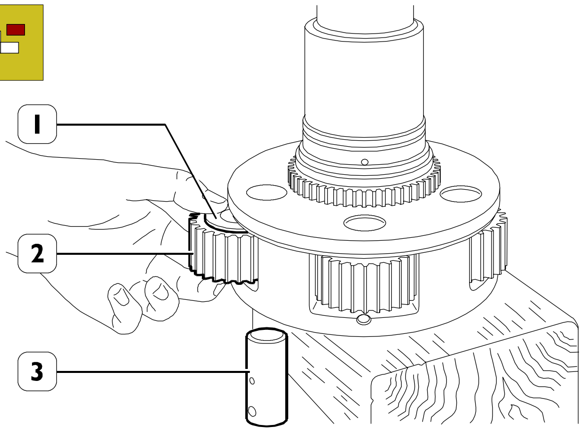
Figure 105



71921

Through a punch (1) with a suitable diameter, push the elastic peg inwards till it abuts.

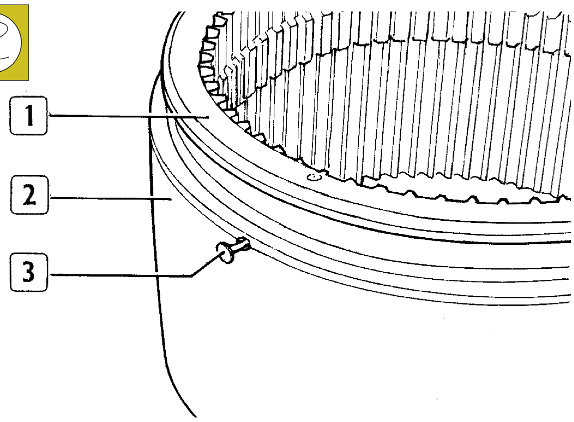
Figure 106



71922

Through a suitable beater, push away pin (3) and withdraw gear (2) completed with shoulder rings (1) and shims. Recover all rollers composing the bearing.

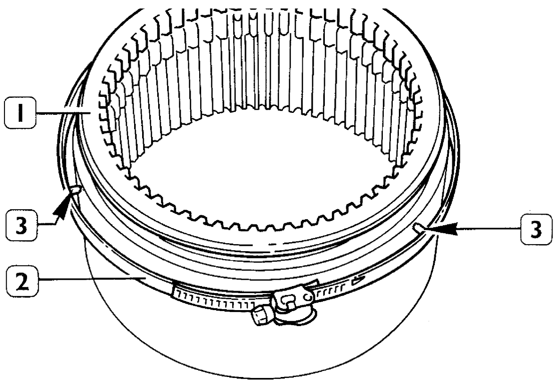
Figure 107



35514

In order to remove sliding sleeve (1) from crown (2), use small pins (3) with diameter 2 ÷ 2.3 mm and a length of 10 mm.

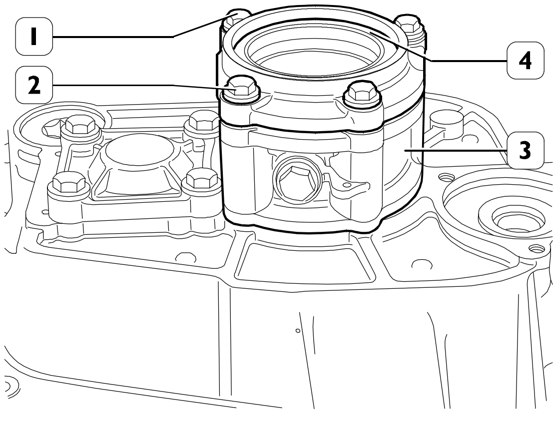
Figure 108



35515

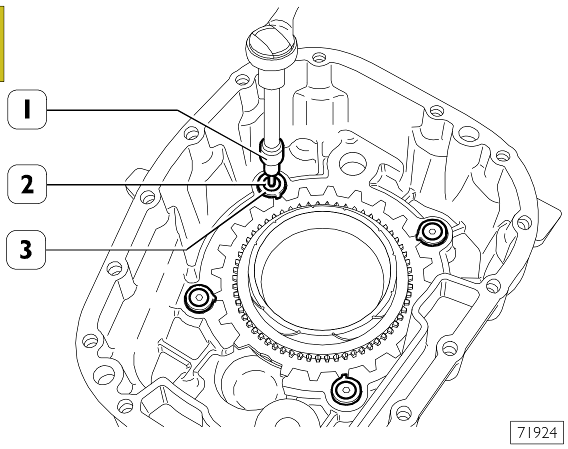
Apply a strap (2), tighten it in order to compress pins (3): in such a way, the internal check ring is detached; then, withdraw sliding sleeve (1).

Figure 109



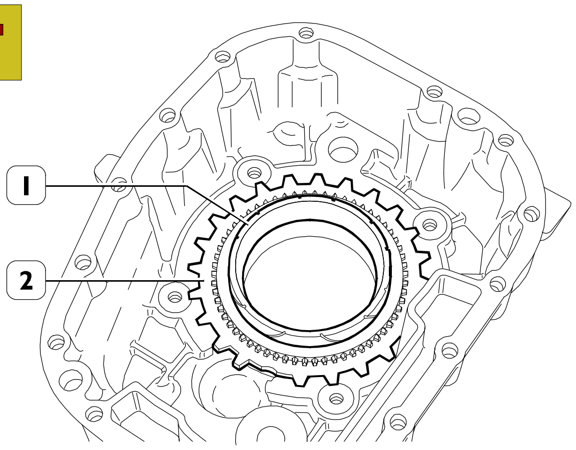
Extract sealing gasket (4) from cover (2), unscrew screws (1) and disassemble cover (2) and support (3).

Figure 110



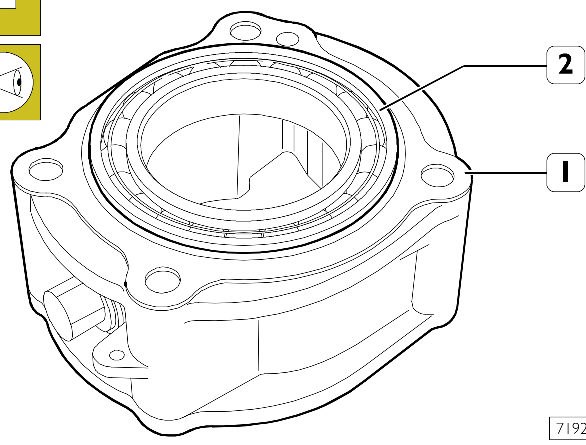
Through a suitable wrench (1), unscrew screws (2) and remove check washers (3).

Figure 111



Withdraw synchronising ring (1), reaction ring (2) and recover the spacer ring below.

Figure 112



Check that ball bearing (2), when rotating along the two directions, does not show roughness or noise when sliding. In case of a replacement of the bearing itself, slightly heat support (1) seat before disassembling it.

Checks

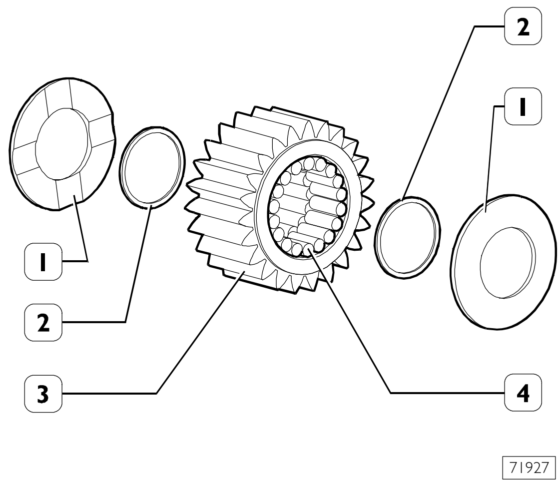
Check that all parts composing the epicyclic reduction gear assembly do not shown traces of excessive wear, seizures or breakages.

Replace the affected parts.

> ⚠ Upon assembling, the following must always be replaced: rings, sealing gaskets and springs for sliding sleeves positioning rollers.

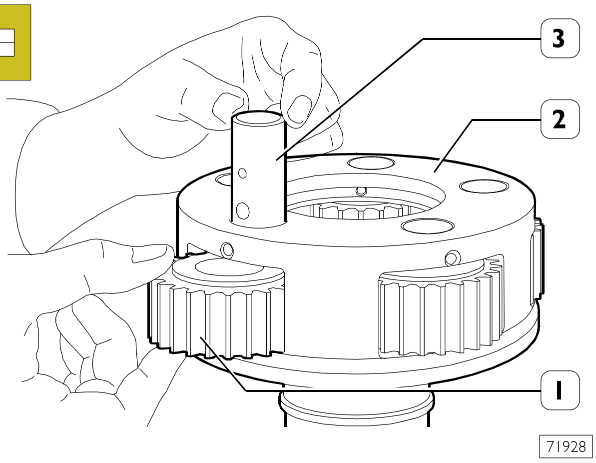
ASSEMBLY

Figure 113



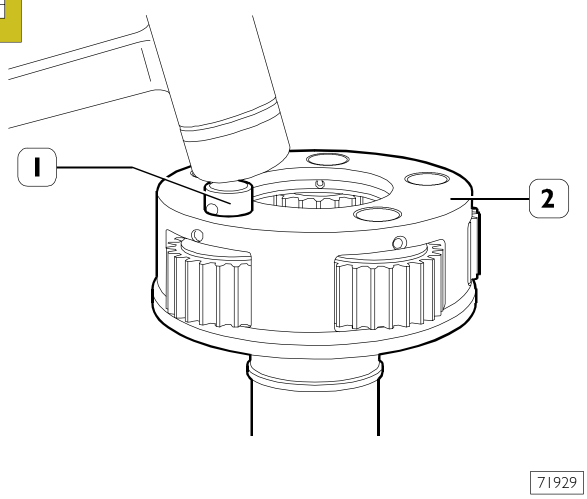
By using grease, pre-assemble rollers (4), shims (2) and shoulder rings (1) into planetary gear (3).

Figure 114



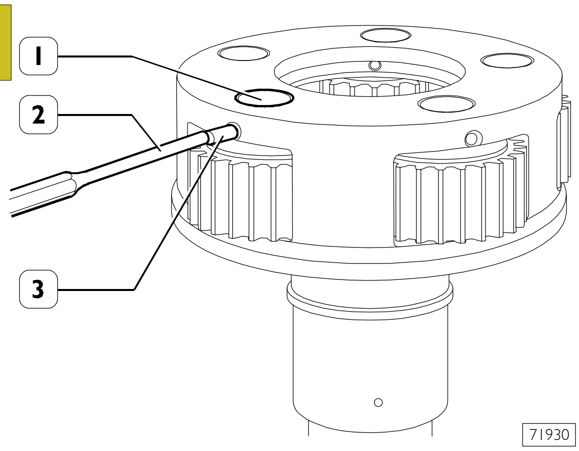
Assemble complete planetary gear (1) into planetary gear-holder shaft (2) and key-in pin (3).

Figure 115



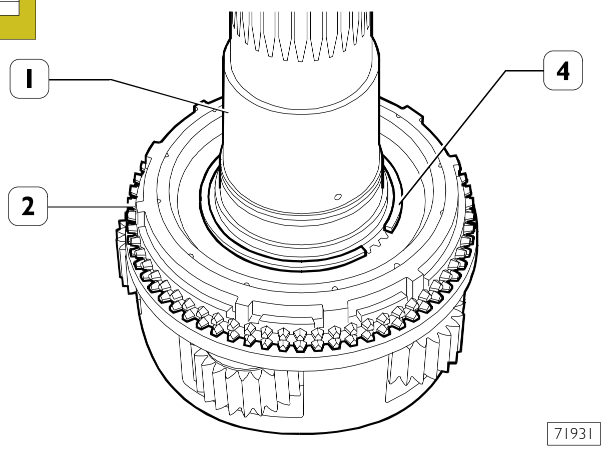
Settle pin (1) on planetary gear-holder shaft (2) by using a plastic hammer.

Figure 116



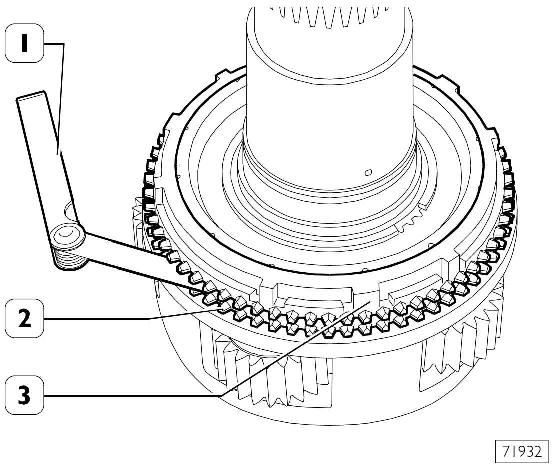
By using a punch (2), assemble elastic peg (2) checking pin (3).

Figure 117



Turn planetary gear-holder shaft (1) over, assemble synchronising rings (2) and arrange elastic check ring (4).

Figure 118



Through a feeler gauge (1), check the clearance between the two synchronising rings (2) and (3) that must be included between 0.5 and 1.9 mm. Otherwise, replace the synchronising rings.

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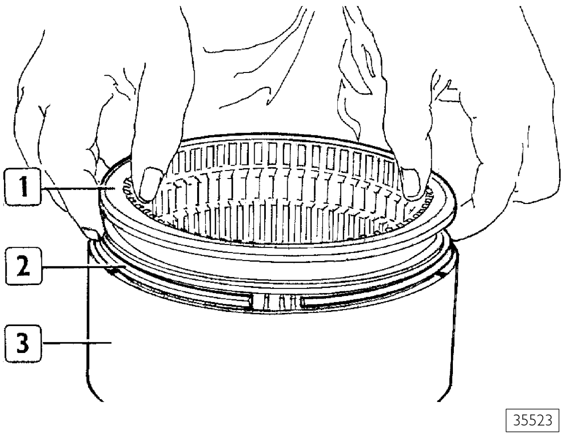
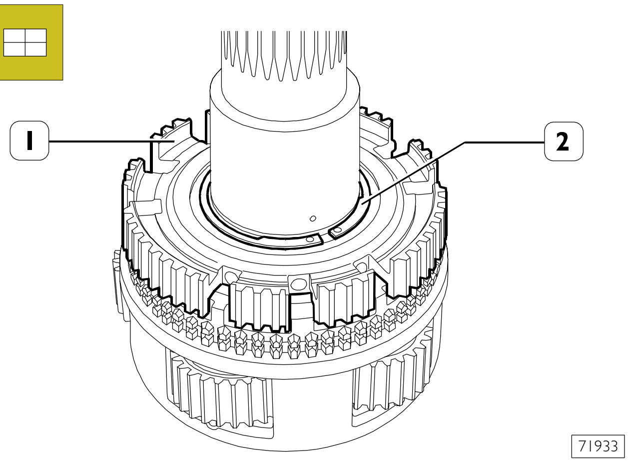
Figure 119



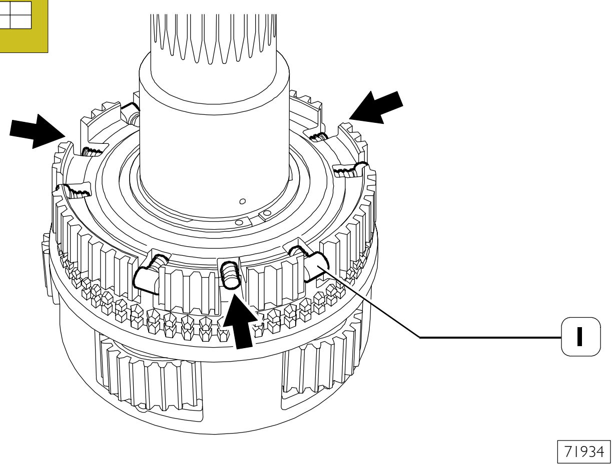
Key-in sliding sleeve (1) completed with check ring (2) on crown (3), then, by compressing ring (2), push sliding ring (1) into the crown till the check ring is hooked into its own seat.

Figure 120



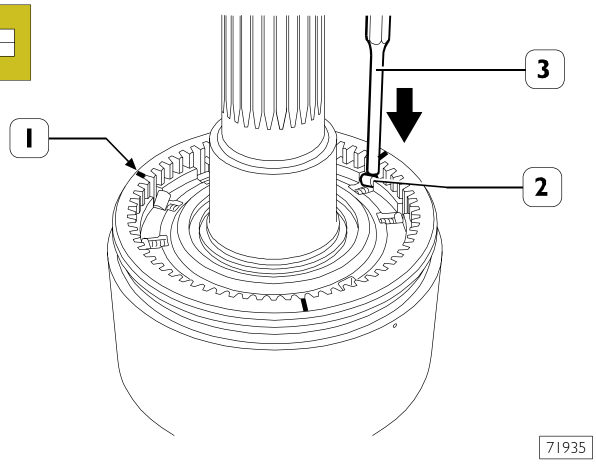
Assemble hub (1) on planetary gear-holder shaft and arrange elastic check ring (2).

Figure 121



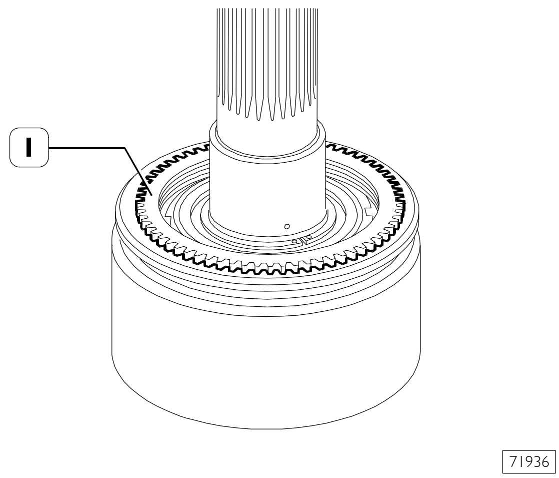
Arrange springs, pins and rollers (1), apart from the central ones (→), into the hub.

Figure 122



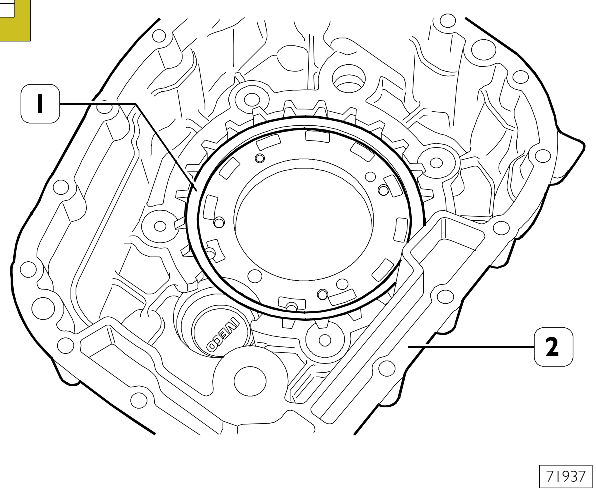
Key-in the crown, by placing it in a neutral position with marks (1) next to the seats without rollers. Arrange the three central rollers (2) and with a punch (3) push them into their seats.

Figure 123



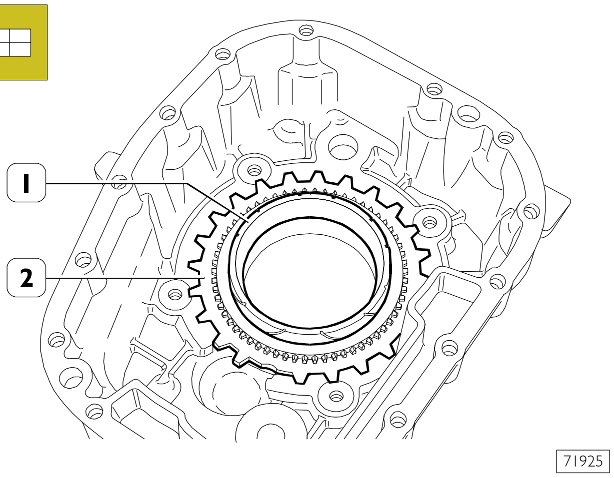
Key-in synchronising ring (1).

Figure 124



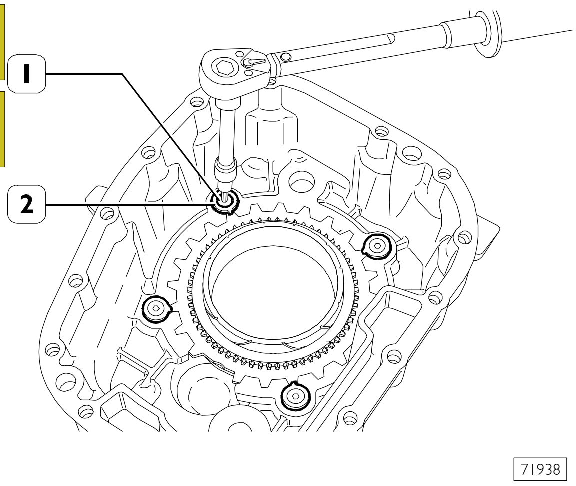
Insert spacer ring (1) into its seat in case (2).

Figure 125



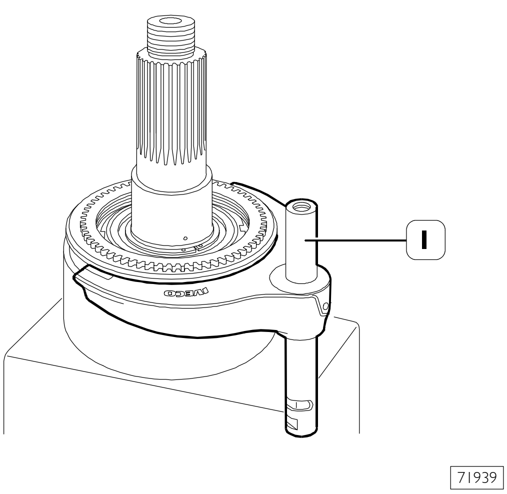
Assemble synchronising ring (1) and reaction ring (2).

Figure 126



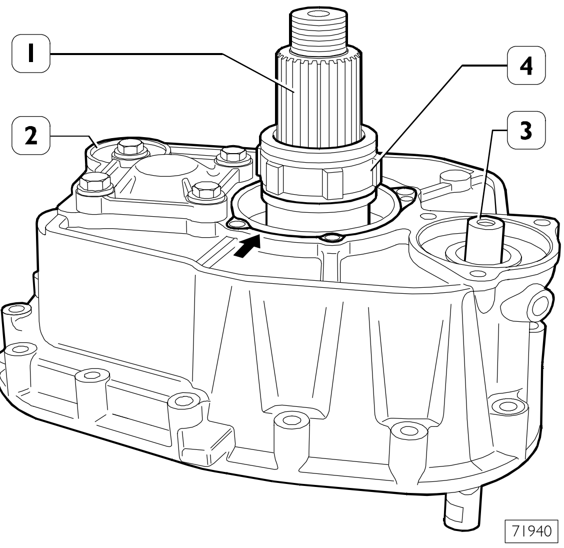
Assemble check washers (2), screw screws (1) and tighten them at the required torque.

Figure 127



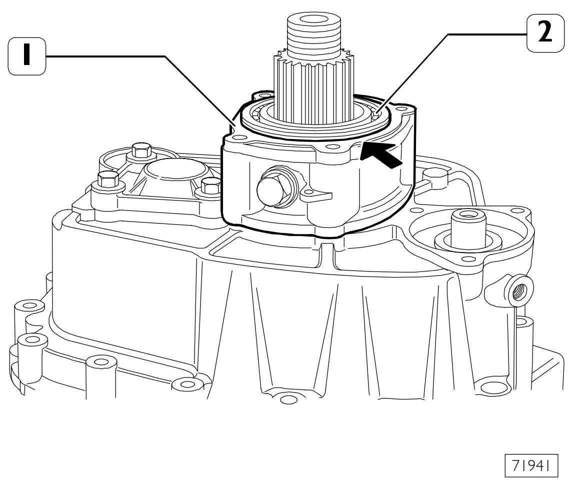
Place control fork (1) completed with rod as shown in the figure.

Figure 128



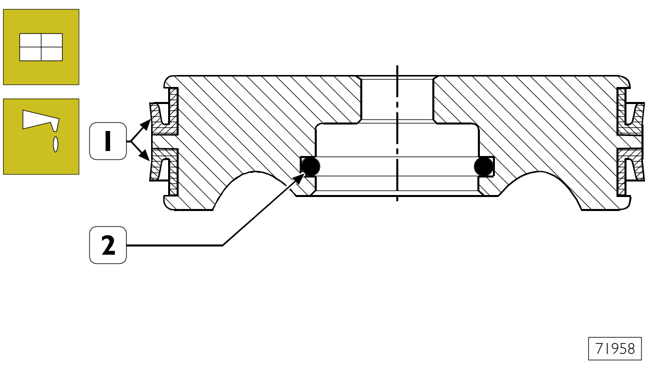
Key-in box (2) on planetary gear-holder shaft (1) and on rod for control fork (3). Key-in phonic wheel (4) on planetary gear-holder shaft (1).
Apply LOCTITE 510 sealant on contact surface (→) between case (2) and support.

Figure 129



Assemble support (1) completed with ball bearing (2).
Apply LOCTITE 510 sealant on contact surface (→) between support and cover.

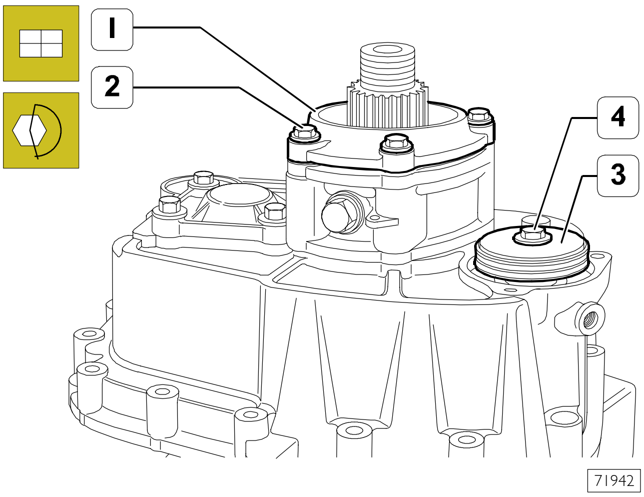
Figure 130



Abundantly pre-lubricate gaskets (1 and 2) of oil piston equal to the one used for gearbox and assemble them into their respective seats, using suitable toolings in order to guarantee a correct assembly.

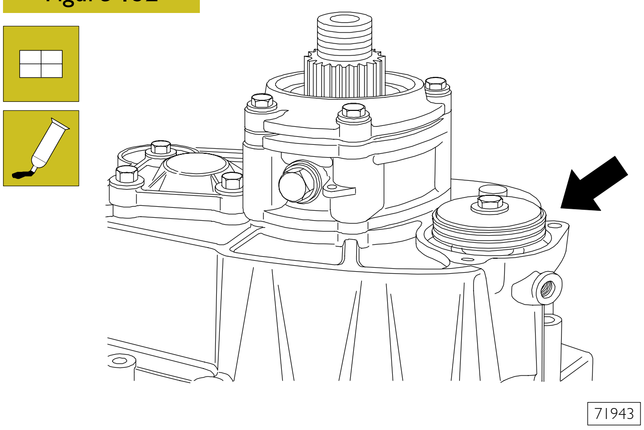
> ! Pay attention to the correct assembly of sealing gaskets (1) placed on external piston diameter.

Figure 131



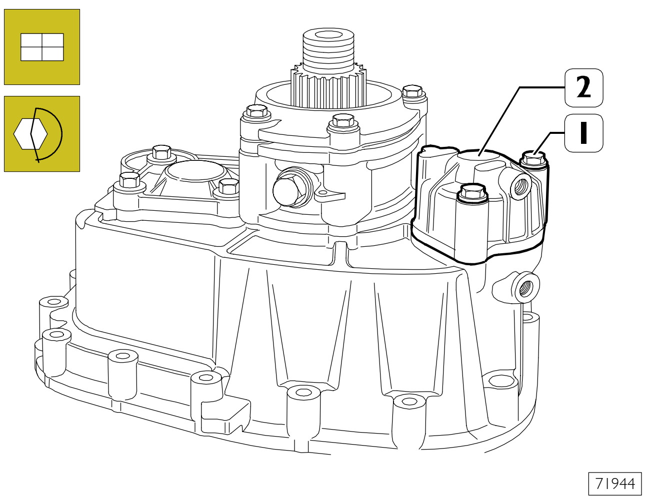
Assemble cover (1) and screw screws (2) tightening them at the required torque.
Assemble piston (3) completed with sealing rings, screw the screw (4) by tightening it at the required torque.

Figure 132



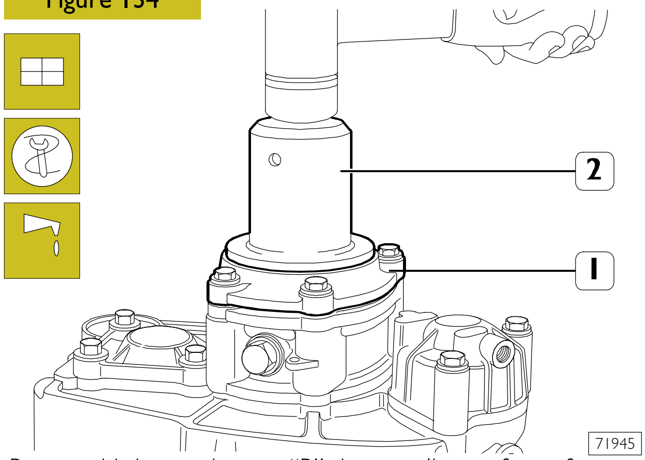
Apply LOCTITE 510 sealant on contact surface (→) between case and cylinder.

Figure 133



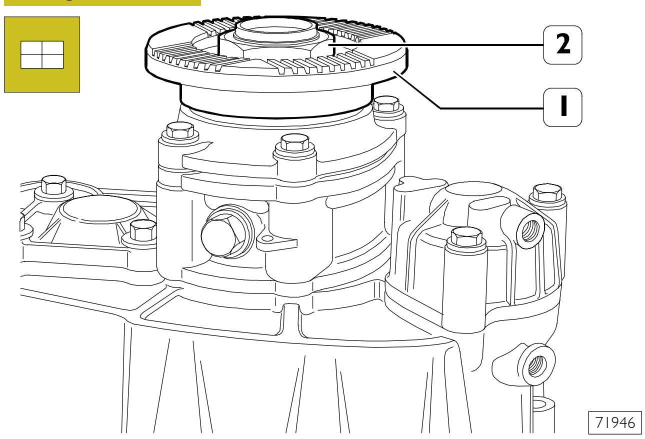
Assemble cylinder (2) and screw screws (1) tightening them at the required torque.

Figure 134



Butter with hermetic type "B" the coupling surface of cover (1) with sealing gasket and with keyer 99574229 (2), assemble the sealing gasket itself.

Figure 135



Key-in flange (1) and screw nut (2) without blocking it.

> ! Nut (2) must be blocked at the required torque after having assembled the reduction gear onto the gearbox.

5302 Gearbox 2895.9

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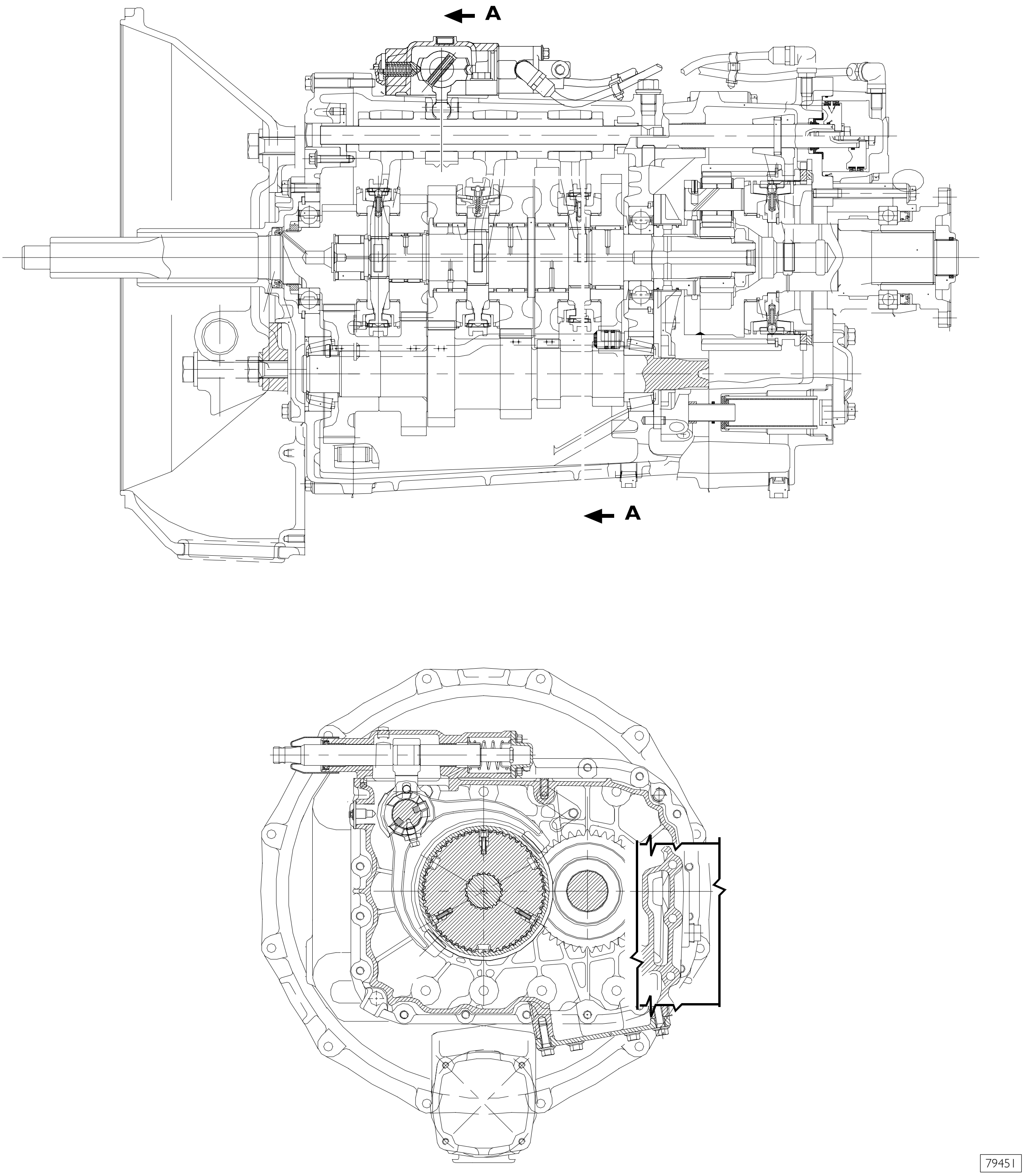
DESCRIPTION

The 2870.9 gearshift is of the mechanic type, with nine speeds and engagement of the 1st, 4th, 5th, 8th and 9th speeds by means of free-ring synchronizing rings, whereas the 2nd, 3rd, 6th and 7th speeds are engaged by means of a double-cone synchronizing gear. It consists of a front part featuring five forward gears and reverse gear and a rear part featuring two gears obtained through epicyclic reduction gear unit (E.R.U.).
Gearshifting is performed through double H mechanical control, E.R.U. switching is through pneumatic system.
Gearbox is fitted with oil pump for lubrication.

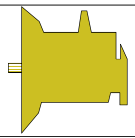
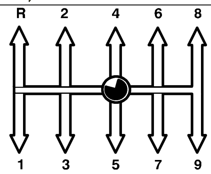
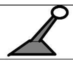
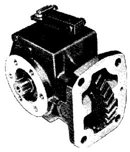
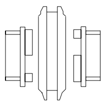
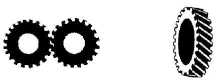
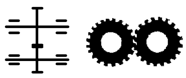
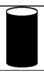
Figure 1



Sec. A-A

GEARBOX 2895.9 LONGITUDINAL SECTION AND REVERSE GEAR SHAFT SECTION

SPECIFICATIONS AND DATA

	GEARBOX	2895.9
	Type	Mechanical
	Gears	9 forward gears and reverse gear
	Gears engagement control	Mechanical
	Power takeoff	On request
	Gears engagement:	
	1^{st}	Free-ring synchronizer
	$2^{nd} \Rightarrow 3^{rd}$	Double-cone synchronizer
	$4^{th} \Rightarrow 5^{th}$	Free-ring synchronizer
	$6^{th} \Rightarrow 7^{th}$	Double-cone synchronizer
	$8^{th} \Rightarrow 9^{th}$	Free-ring synchronizer
	Reverse gear	Quick-connection type
	Gears anti-disengagement	Sliding sleeve holding through rollers and springs.
	Gears	Helical toothing
	Gear ratio	
	First	1 : 13.56
	Second	1 : 9.00
	Third	1 : 6.54
	Fourth	1 : 4.76
	Fifth	1 : 3.54
	Sixth	1 : 2.53
	Seventh	1 : 1.84
	Eighth	1 : 1.34
	Ninth	1 : 1.00
	Reverse gear	1 : 13.15
	Oil type	**Tutela ZC 90**
	Amount	7.5 kg (8.3 liters)

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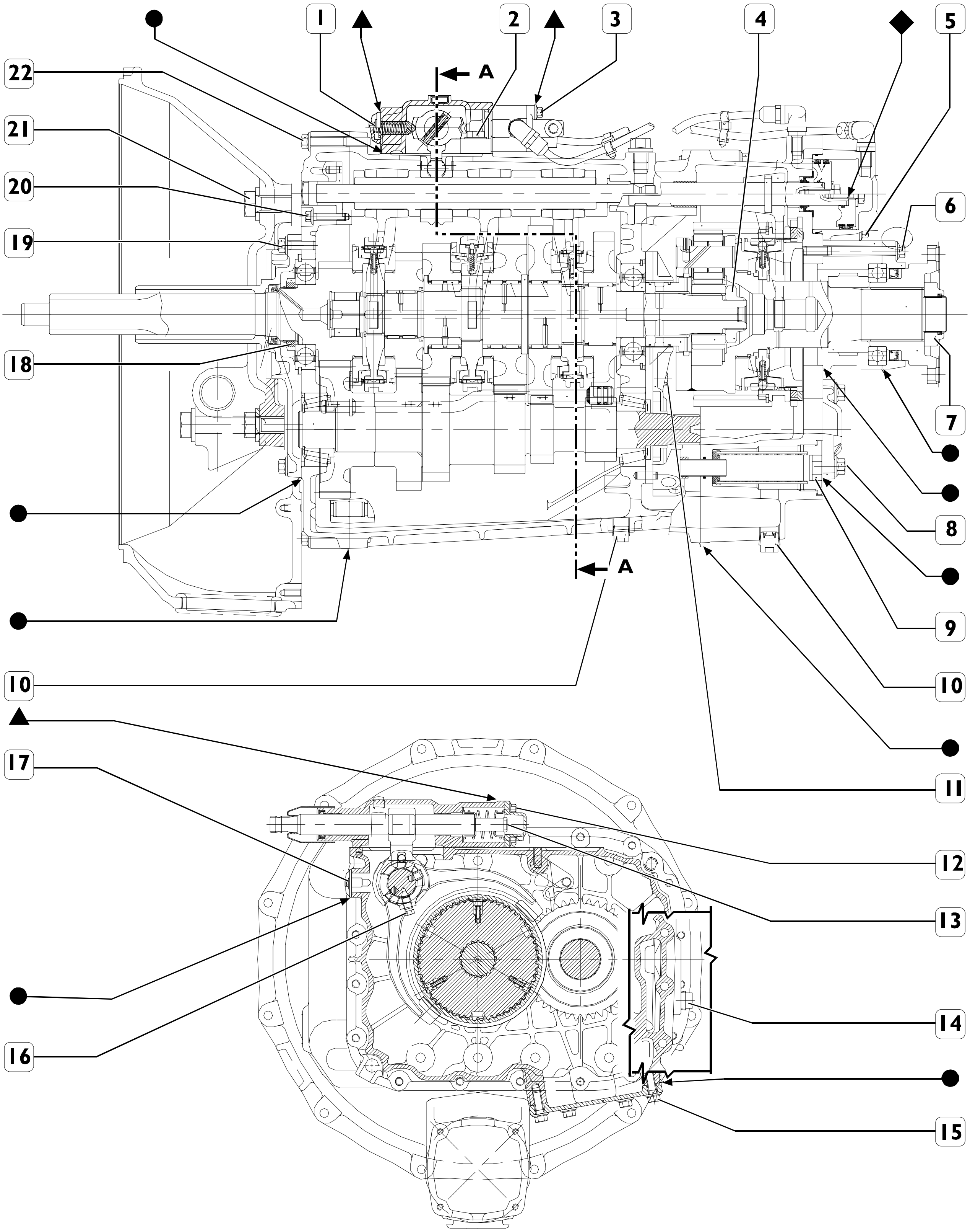
	Assembling temperature for fixed hubs	100 ÷ 130ºC
	Transmission shaft bearings	Tapered rollers
	Transmission shaft bearings pre-load adjustment	Through rings
mm	Transmission shaft axial backlash adjustment rings thickness	2.5 - 2.6 - 2.7 - 2.8 - 2.9 - 3.0 - 3.1 3.2 - 3.3 - 3.4 - 3.5 - 3.6 - 3.7 - 3.8 3.9 - 4.0 - 4.1 Provided in kit
	Assembling temperature for transmission shaft bearings	85ºC

Figure 2



sec. A-A

79452

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TIGHTENING TORQUE

PART		TORQUE	
		Nm	(kgm)
1	Flanged hexagonal head screw for securing spring retaining flange on external control	19 ± 2	(1.9 ± 0.2)
2	Flanged hexagonal head screw for securing upper external controls support cover	33.5 ± 3.5	(3.4 ± 0.4)
3	Screw for securing reduction unit control valve	23.5 ± 2.5	(2.4 ± 0.3)
4	Ring nut for securing sun gear on main shaft	372.5 ± 19.5	(37.5 ± 2)
5	Flanged hexagonal head screw for securing reduction unit control pneumatic cylinder to rear half box	35.5 ± 3.5	(3.6 ± 0.4)
6	Flanged hexagonal head screw for securing rear cover on main shaft	44.5 ± 4.5	(4.5 ± 0.5)
7	Ring nut for fastening output shaft on spider shaft	559.5 ± 29.5	(57 ± 3)
8	Flanged hexagonal head screw for securing rear cover on transmission shaft	58 ± 6	(5.9 ± 0.6)
9	Oil filter on rear half box	320 ± 30	(32.6 ± 3.1)
10	Threaded plug with external operating hexagon for oil drain	27.5 ± 2.5	(2.8 ± 0.3)
11	Hexagonal head screw for securing oil pump body to box	33.5 ± 3.5	(3.4 ± 0.4)
12	Flanged hexagonal head screw for securing transverse axle cover on external control*	19 ± 2	(1.9 ± 0.2)
13	Transverse axle screw*	30 ± 3	(3.1 ± 0.3)
14	Threaded plug with external operating hexagon for oil level	27.5 ± 2.5	(2.8 ± 0.3)
15	Flanged hexagonal head screw for securing covers on PTO connection openings	38 ± 4	(3.9 ± 0.4)
16	Screw for securing fork control rod hub	39 ± 2	(4.0 ± 0.2)
17	Idle positioning device	78 ± 8	(8.0 ± 0.8)
18	Ring nut for securing input shaft bearing	545 ± 55	(55.6 ± 5.6)
19	Flanged hexagonal head screw for securing front cover	31 ± 3	(3.1 ± 0.3)
20	Flanged hexagonal head screw for securing tangential stops block	24.5 ± 2.5	(2.5 ± 0.2)
21	Screw for securing gearbox clutch housing	177 ± 17	(18 ± 1.8)
22	Flanged hexagonal head screw for securing rear intermediate front half box	45.5 ± 4.5	(4.6 ± 0.5)
-	Countersunk screw for securing reduction unit reaction plate	21 ± 2	(2.1 ± 0.2)

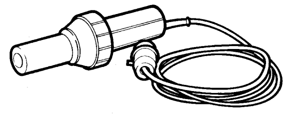
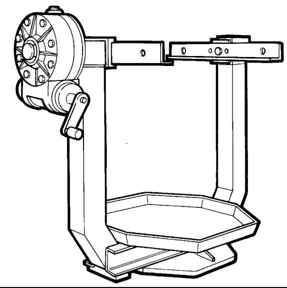
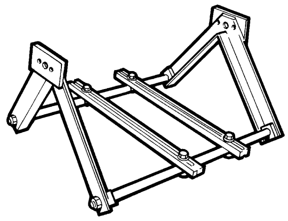
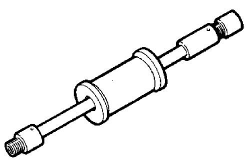
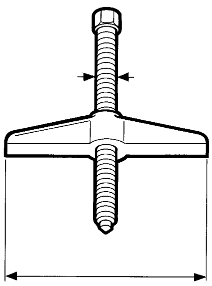
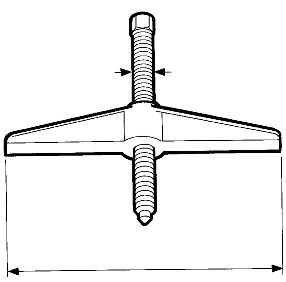
* Apply thread-braking LOCTITE 270 on the screw

● Apply liquid gasket LOCTITE 510 sealant

▲ Apply liquid gasket LOCTITE 518 sealant

◆ Apply thread-braking LOCTITE 242 on the screw

TOOLS

TOOL No.		DESCRIPTION
99305121		Hot-air equipment
99322205		Revolving stand for overhauling units (capacity 1000 daN, couple 120 daN/m)
99322225		Unit bearing support (to be applied to stand 99322205)
99340205		Percussion puller
99341003		Single acting puller
99341004		Single acting puller

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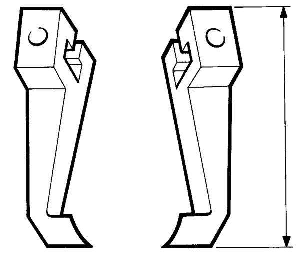
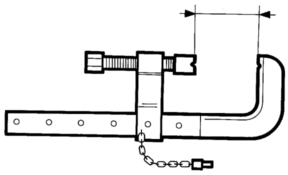
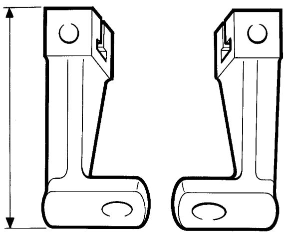
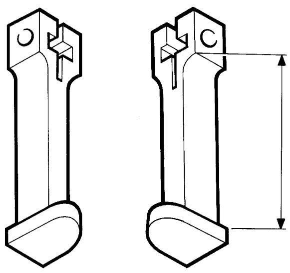
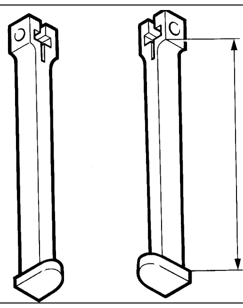
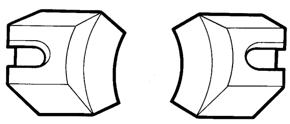
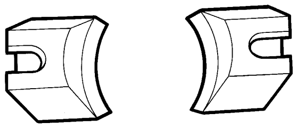
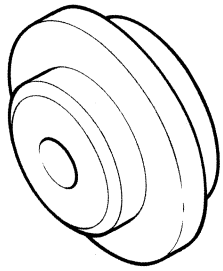
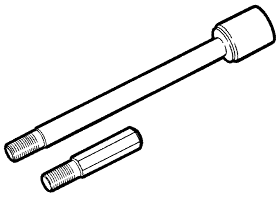
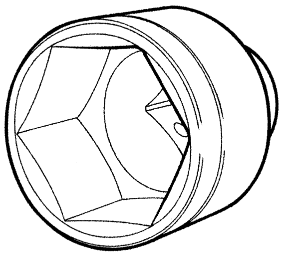
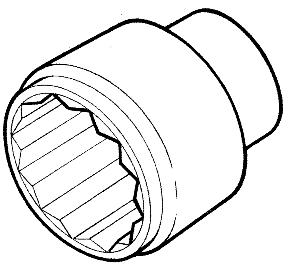
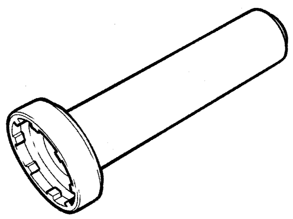
TOOLS

TOOL No.		DESCRIPTION
99341009		Pair of brackets
99341015		Clamp
99341017		Pair of brackets with hole
99341019		Pair of tie rods for grips
99341020		Pair of tie rods for grips
99341023		Grips

TOOLS

TOOL No.		DESCRIPTION
99341025		Grips
99345058		Thrust block for pullers
99347092		Peg for removing reverse gear shaft (to use with 99340205)
99355081		Wrench (60 mm) for locking ring nut of output flange on spider shaft (use with 99370317)
99355131		Wrench (55 mm) for locking ring nut of sun gear on primary shaft (use with 99370130)
99355174		Wrench for disassembling and reassembling locking ring nut of motion input

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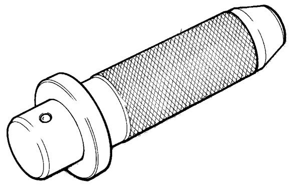
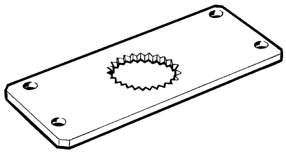
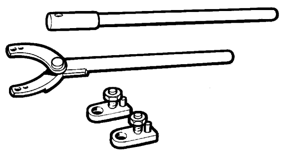
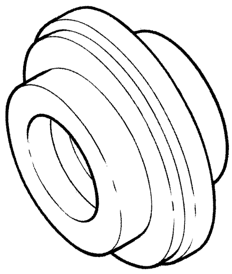
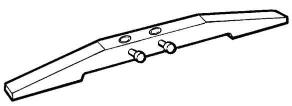
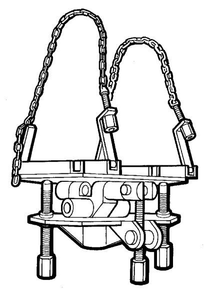
TOOLS

TOOL No.		DESCRIPTION
99370006		Handle for interchangeable beaters
99370130		Tool for holding the sun gear during nut removal and refitting
99370317		Reaction lever with extension for retaining flanges
99370349		Tool for fitting gasket on gearbox front cover (to use with 99370006)
99370466		Gauge base for transmission shaft bearing adjustment (to use with 99395604)
99370629		Support for holding gearbox during removal and refitting from/on vehicle

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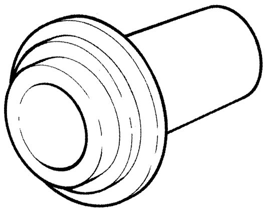
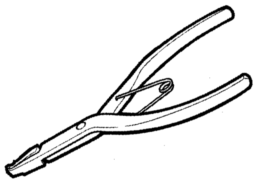
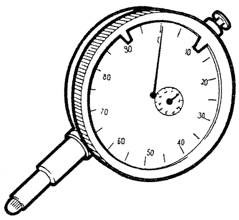
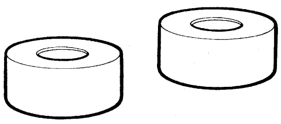
TOOLS

TOOL No.		DESCRIPTION
99374229		Tool for refitting gasket on gearbox rear cover
99381125		Pliers for removing gearbox split rings
99395604		Dial gauge (0 – 10 mm)
99396032		Gauged rings for adjusting transmission shaft bearings (to use with 99370466)

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GEARBOX DISENGAGEMENT/ RE-ENGAGEMENT

Disengagement

In order to disengage the gearbox, operate as follows:

- put the vehicle on a pit or an elevator bridge;
- disconnect battery cables to avoid possible short-circuits.

Proceed by removing the following parts:

- exhaust silencer, transmission shaft, servo clutch cylinder for electric and pneumatic connections, gear control tie rods.

Place under the gearbox an hydraulic lifting device equipped with support 99370629, unscrew the nut securing gearbox to engine, move back and withdraw the gearbox.

Re-engagement

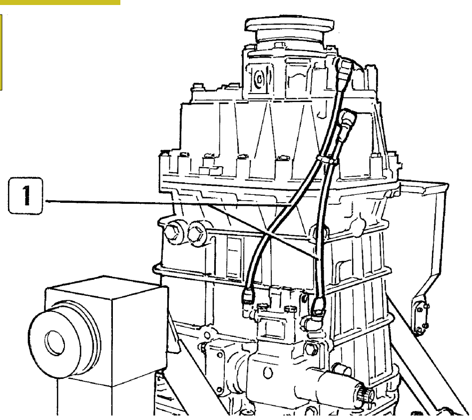
Suitably reverse the performed operations for the engagement and tighten securing screws and nuts at the required torque.

> ! Upon re-engaging the gearbox, pay attention that the clutch control lever fork is correctly meshed to the thrust bearing.

GEARBOX DISASSEMBLING

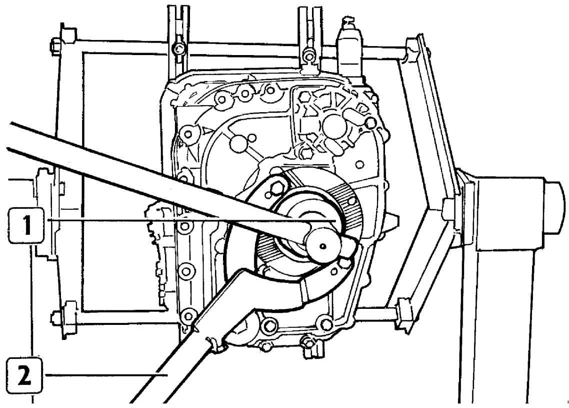
> ! Before setting the gearbox on the revolving stand, remove the entire clutch assembly with fork lever and drain out oil.

Figure 3



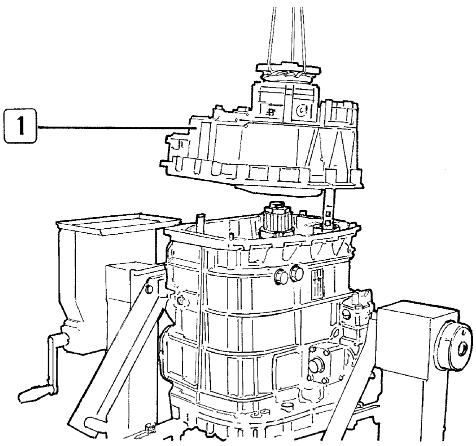
Disconnect epicyclic reduction gear unit air pipes (1).

Figure 4



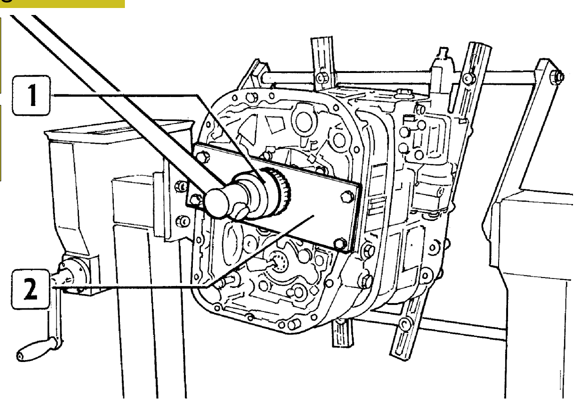
Apply reaction lever 99370317 (2) and using wrench 99355081 (1) loosen the output flange fastening nut.

Figure 5



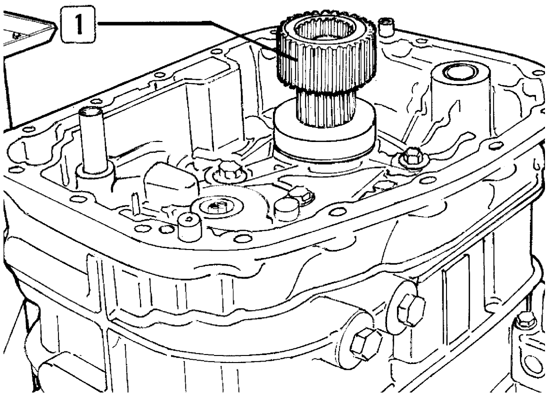
Loosen the fastening screws and remove the E.R.U. box (1).

Figure 6



Apply tool 99370130 (2) and using wrench 99355131 (1) loosen sun gear castle nut.

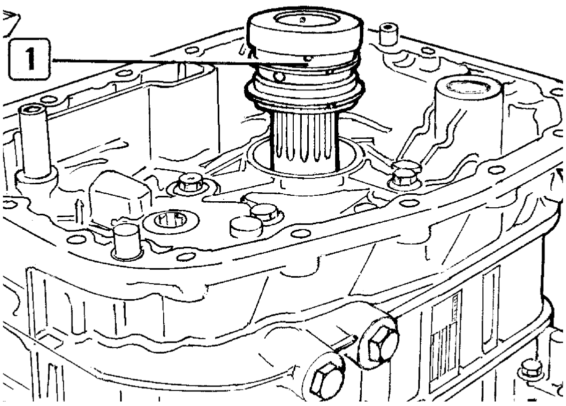
Figure 7



35439

Withdraw the sun gear (1).

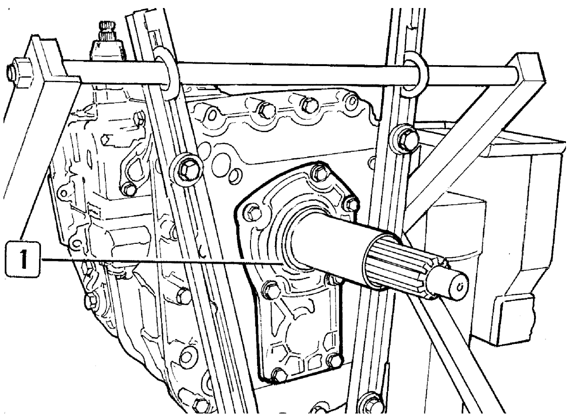
Figure 8



35440

Withdraw the oil distributor (1) with sealing rings.

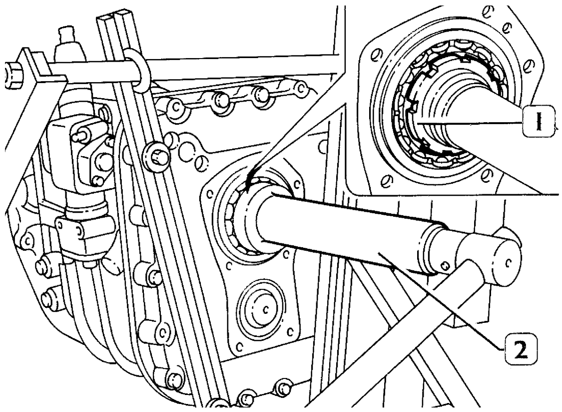
Figure 9



35441

Loosen the screws and remove input shaft front cover (1).

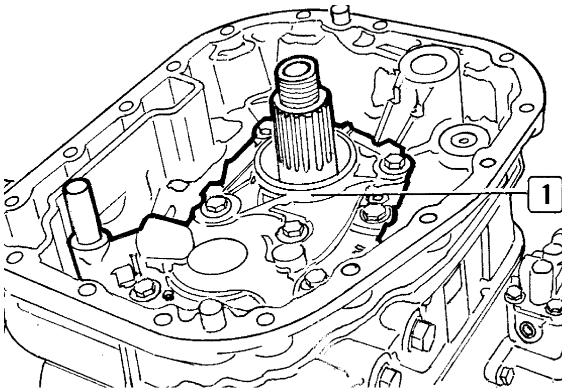
Figure 10



35442

Engage a gear and using wrench 99355174 (2) loosen input shaft ring nut (1).

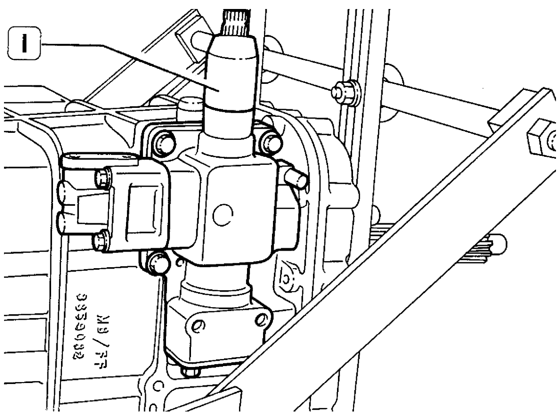
Figure 11



35443

Loosen the screws and remove the oil pump (1).

Figure 12



35444

Loosen the screws and remove the entire external control box (1).

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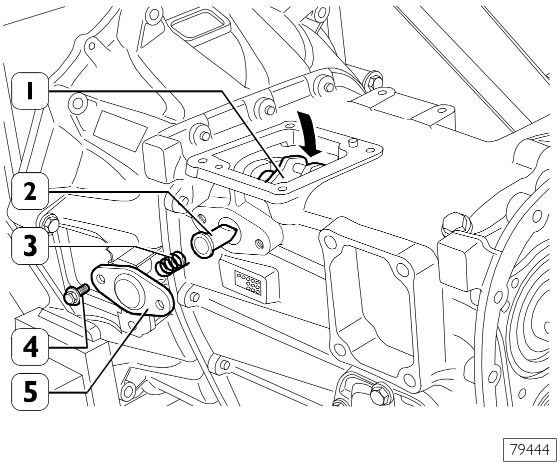
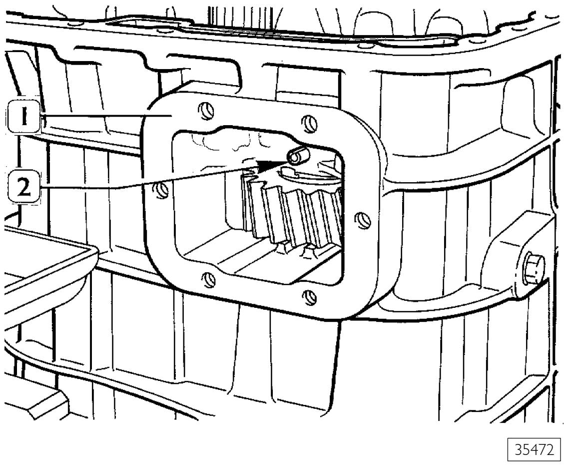
Figure 13



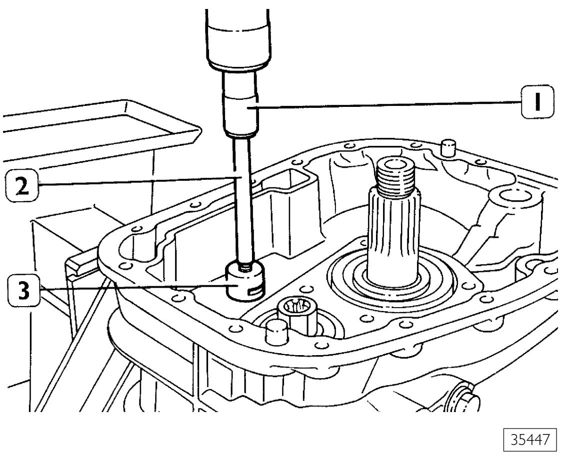
Unscrew screws (4), disassemble cover (5), take off spring (3) and take out tip (2). Move gear selector hub (1) inwards.

Figure 14



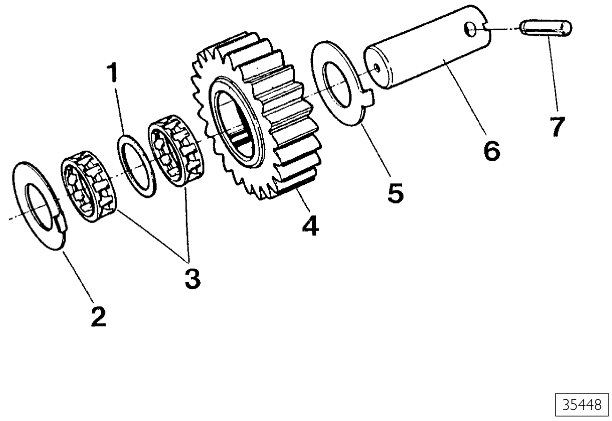
Remove reverse gear cover; drive down the split pin (2) using a punch.

Figure 15



Use percussion puller 99340205 (1) with tool 99347092 (2) to remove reverse gear shaft (3).

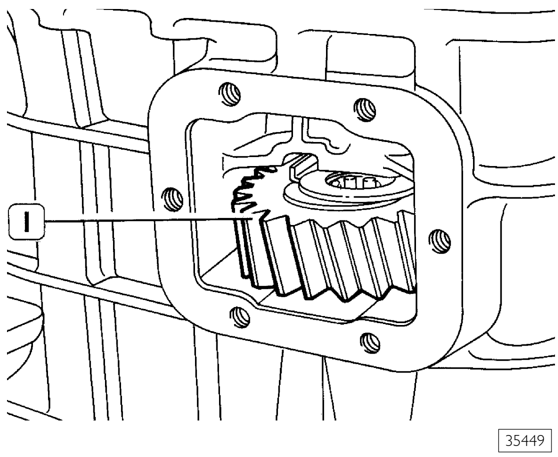
Figure 16



REVERSE GEAR COMPONENTS

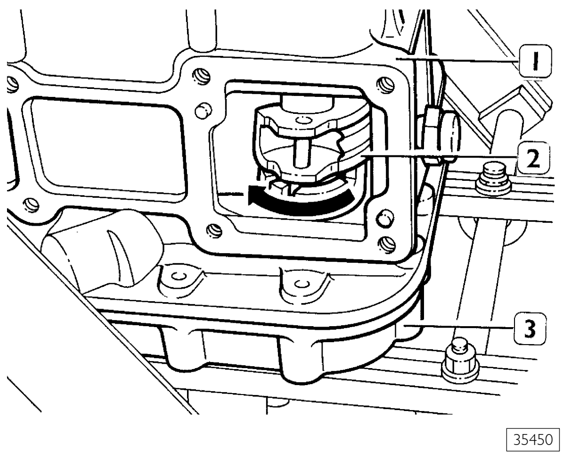
1. Bearing spacer - 2. Shoulder ring - 3. Roller bearing - 4. Reverse speed gear - 5. Shoulder ring - 6. Shaft - 7. Split pin.

Figure 17



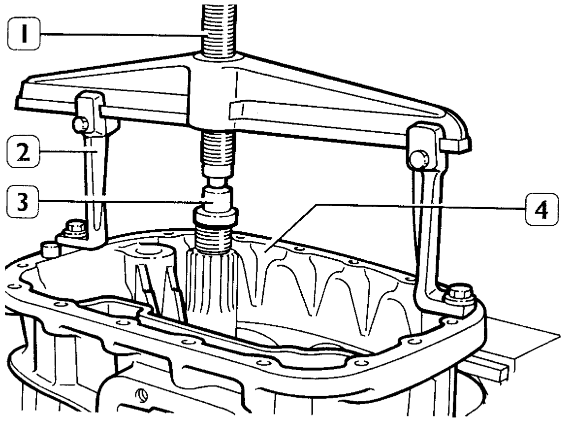
Withdraw the reverse speed gear (1) with shoulder ring and straight roller bearings.

Figure 18



Move inside the gear selector hub (2)
Loosen gearbox fastening screws (1 and 3).

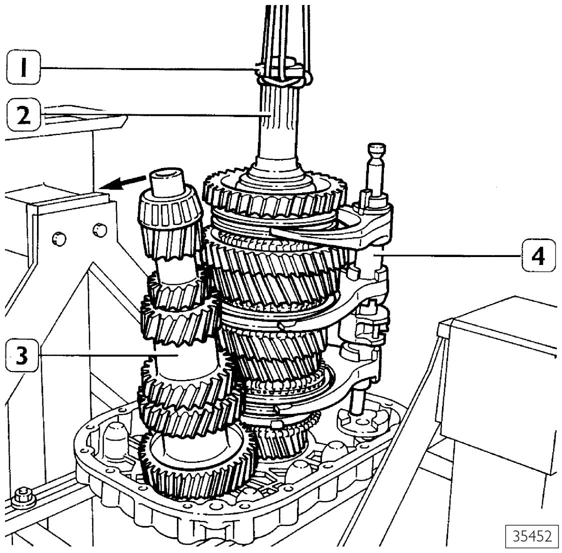
Figure 19



35451

Remove gearbox (4) using puller 99341004 (1), brackets 99341017 (2) and reaction block 99341058 (3).

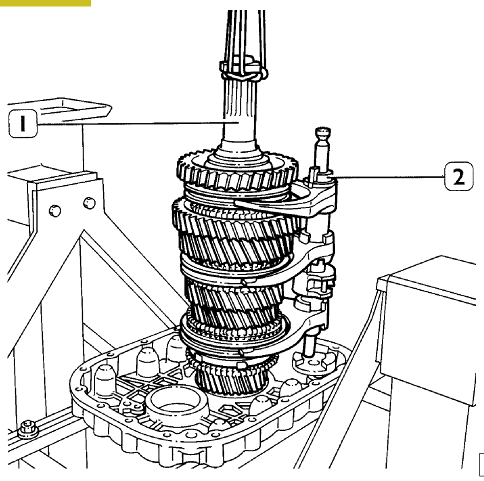
Figure 20



35452

Tighten nut (1) on main shaft (2), lift the main shaft by approx. 10 ÷ 20 mm and withdraw the transmission shaft (3) moving it sideways.

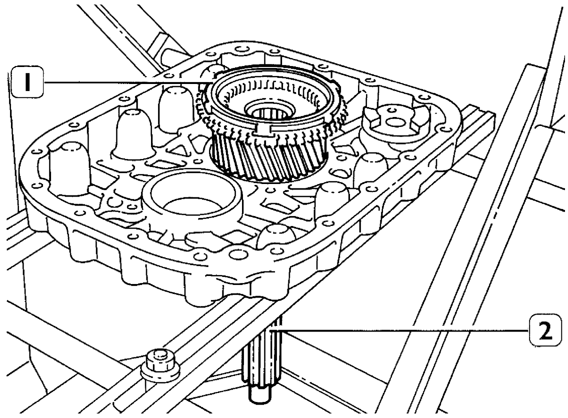
Figure 21



35453

Lift and remove the main shaft (1) with gear control assembly (2).

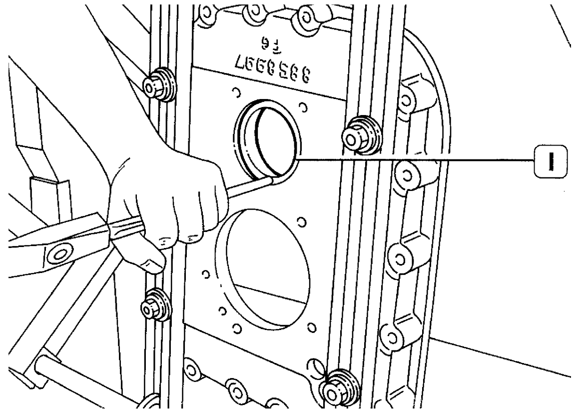
Figure 22



35454

Remove synchronising rings (1) and remove the input shaft (2) using a plastic hammer.

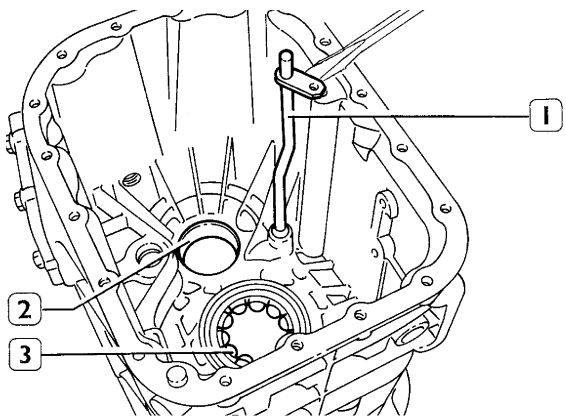
Figure 23



35455

Remove transmission shaft bearing outer ring (1) using a punch.

Figure 24



35456

Remove oil pipe (1), bearing outer ring (2) and ball bearing (3) from the gearbox case.

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Checks

GEARBOX CASE

Gearbox case and related covers must not show cracks. Contact surfaces between covers and gearbox case must not be damaged or distorted.
Bearing seats must not be damaged or excessively worn.

SHAFTS - GEARS

Shaft seats for bearings and gear toothings must not be damaged or worn.

HUBS – SLIDING SLEEVES – FORKS

Grooves on hubs and sliding sleeves must not be damaged. The sliding sleeve must slide freely on the hub. Sliding sleeve positioning rollers must not be damaged or worn. Sliding sleeves engagement teeth must not be damaged.
Forks must be intact and not show any sign of wear.

BEARINGS

Roller bearings or roller cages must be in perfect conditions and not show traces of wear or overheating.
When keeping the bearings pressed by hand and making them rotate simultaneously along both directions, no roughness or noise must be detected.

At refitting always replace: rings, sealing gaskets and springs for sliding sleeves positioning rollers.

SYNCHRONISERS – COUPLING BODIES

Check wear of synchronising rings and coupling bodies: they must not show signs of wear.

At assembling stage, do not mistake the components with each other.

GEARBOX ASSEMBLING

Smear with sealing compound type "B" the threaded part of all screws that have to be screwed into the through-holes.

Clean joining surface of boxes and covers and apply "LOCTITE 510" adhesive on one of the two components before refitting.

Do not fill with oil before 20 min. and do not operate the gearbox before 1h and 30 min.

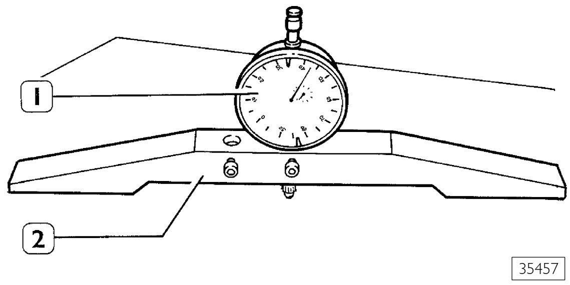
Fit bearing cages into their seats and oil with TUTELA ZC 90.

In order to guarantee oil seal at refitting, make sure that sealing gaskets are already lubricated, or:
smear with oil or grease the sealing lip of input and main shafts.

Adjusting transmission shaft bearing pre - load

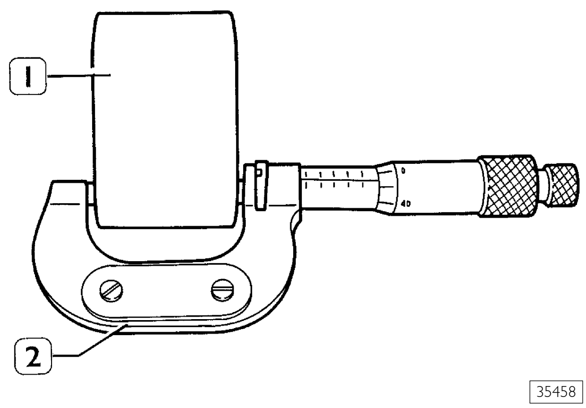
Transmission shaft bearing pre-load can be adjusted with two procedures.

Figure 25



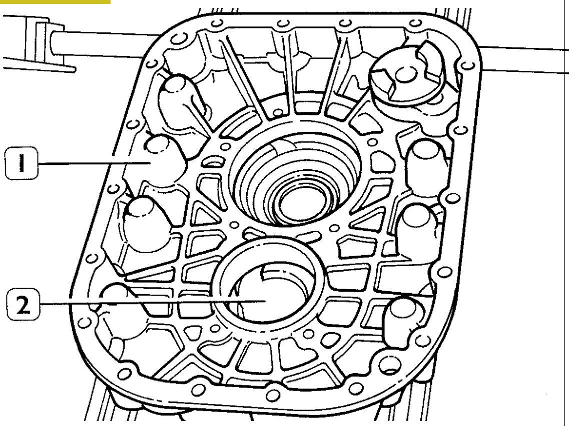
Fit gauge (1) on base 99370466 (2).
Pre-load it at 5 mm and set it to zero on a surface plate.

Figure 26



Use a micrometer (2) to check gauged ring thickness (1).

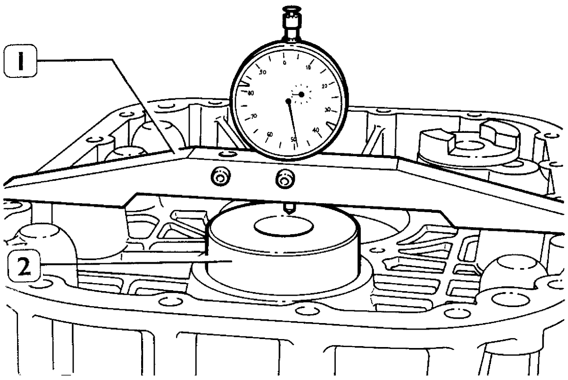
Figure 27



35459

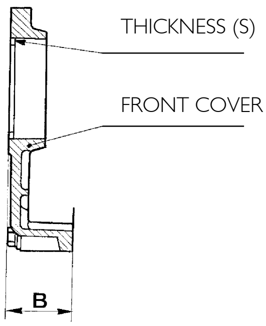
Fit temporarily cover (2) on front cover (1).

Figure 28



35460

Figure 29



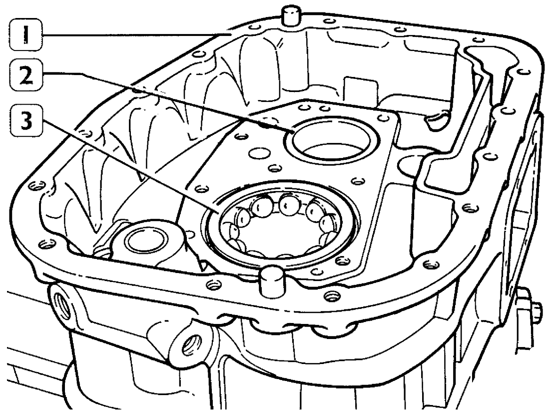
35461

Place gauged ring 99396032 (2) in the tapered roller bearing seat, without adjustment ring on front cover; place base 99370466 with gauge (1) previously set to zero as shown in Figure 25.

First method – Take note of the value read on the gauge (Example: 2.43 mm).

Second method – Take note of the value read on the gauge and add it to the gauged ring thickness [Example: 2.43 + 50.5 = 52.93 mm (Dimension **B**)].

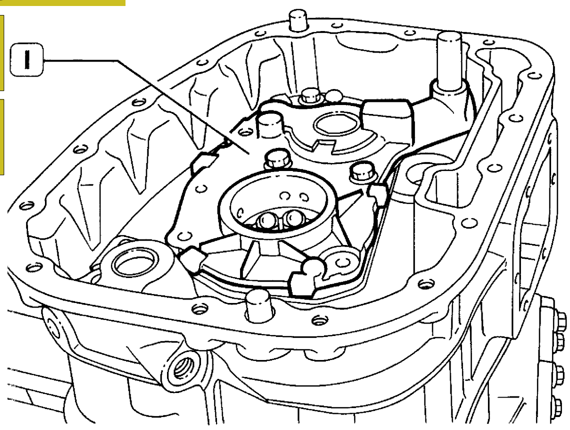
Figure 30



35462

Fit transmission shaft bearing outer ring (2) and main shaft ball bearing (3) on the intermediate box (1).

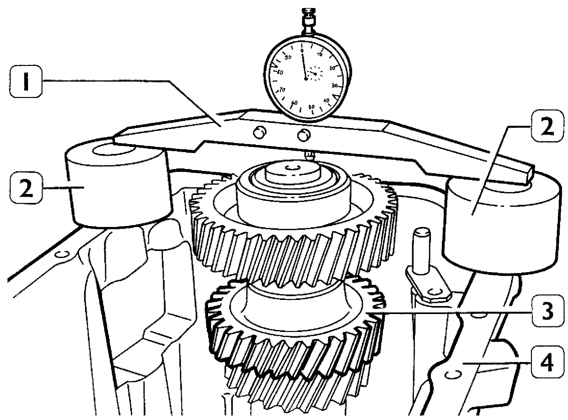
Figure 31



35463

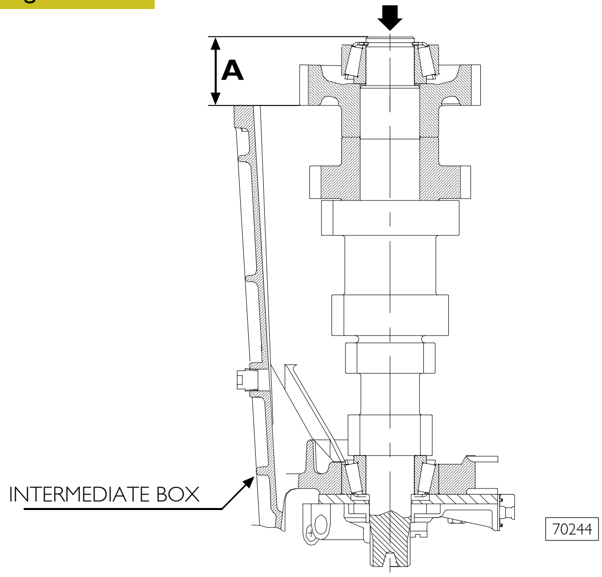
Fit the oil pump (1) and tighten the screws to the specified torque, rotate the intermediate box.

Figure 32



35464

Figure 33



Assemble and simultaneously rotate transmission shaft (3, Figure 32) with bearings into rear case, so that it settles. Place gauged rings 99396032 (2, Figure 32) on case (4, Figure 32). Arrange as shown in figure, base 99370466 with gauge (1, Figure 32) previously set to zero: gauge rod must rest on bearing outer ring. Carry out the measurement on two diametrically opposed points and obtain the arithmetic mean.

First method – Take note of the value read on the gauge (Example: 1.84 mm).
The adjustment ring value is obtained by adding the two measured values (Example: 2.43 + 1.84 = 4.27 mm)

Second method – Take note of the value read on the gauge and subtract it from gauged ring thickness [Example: 50.5 – 1.84 = 48.66 mm (Dimension **A**)].

The adjustment ring value is obtained through formula

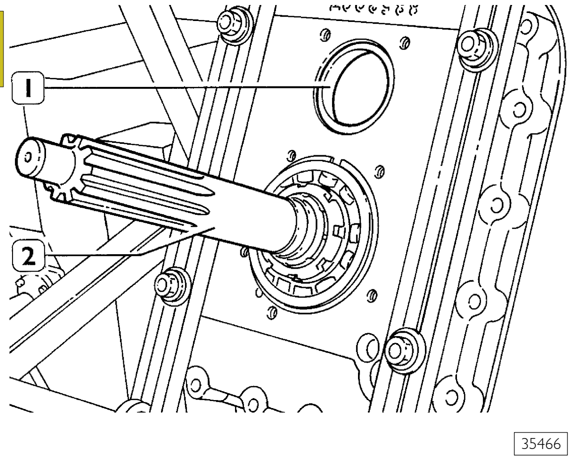
S = B – A Example: 52.93 – 48.66 = 4.27 mm.

The adjustment ring rounding is carried out always by excess. Example: thickness S = 4.27: thickness S = 4.3 is taken.

The measure for dimension "A" is carried out with transmission shaft in vertical position that, in addition to making the measure easier, enables to have axial load on rear bearing.

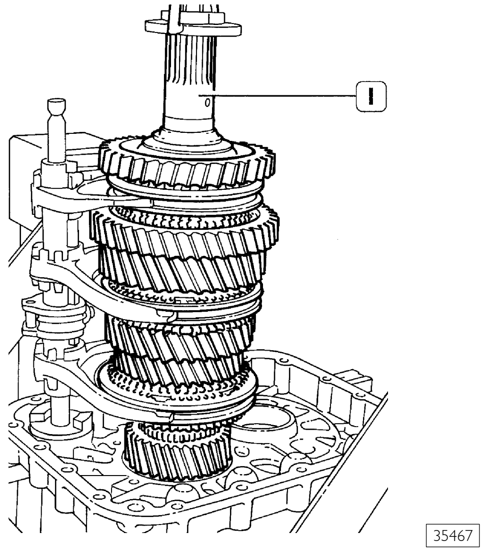
After calculating the adjustment ring thickness value, disassemble again transmission shaft (3, Figure 32) and cover (2, Figure 27).

Figure 34



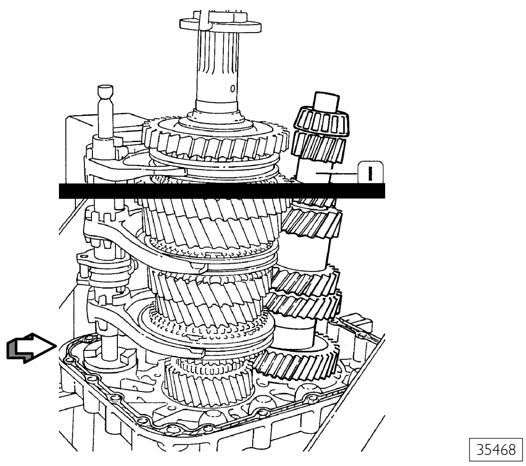
Fit input shaft (2) and transmission shaft outer ring (1) on front cover.

Figure 35



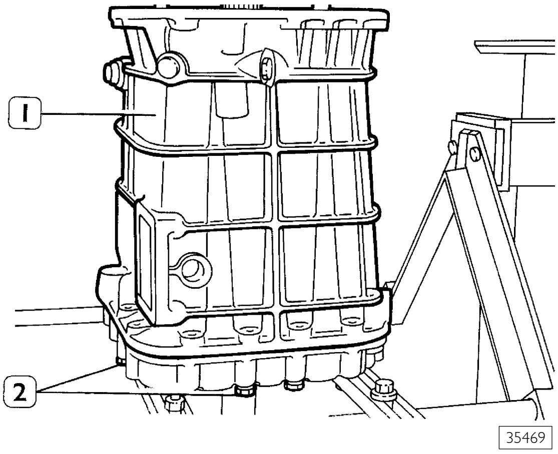
Fit roller bearing into input shaft then fit the main shaft (1) including gear engagement control.

Figure 36



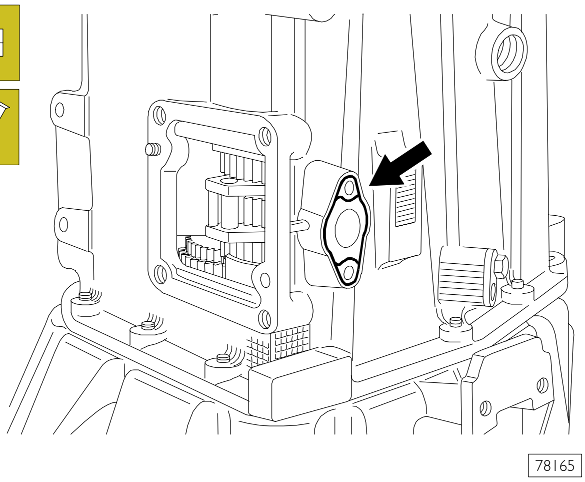
Fit the transmission shaft (1), smear LOCTITE 510 adhesive (arrow).

Figure 37



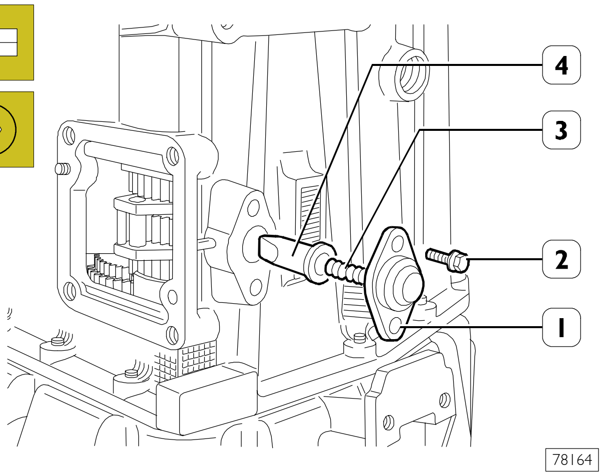
Fit the intermediate box (1) and tighten screws (2) to the specified torque.

Figure 38



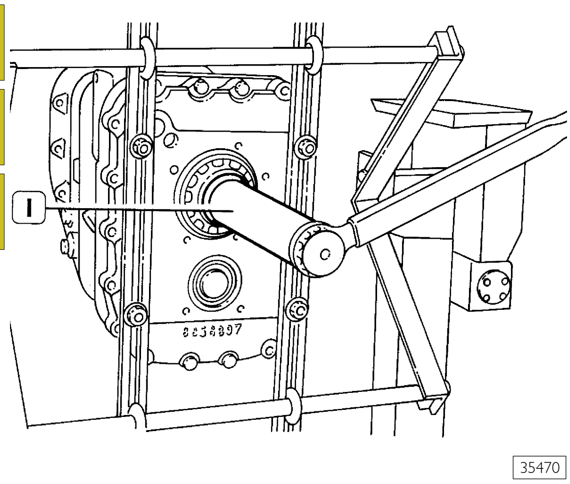
Apply sealer LOCTITE 510 on the surface (→) without staining the push rod supporting area (4, Figure 39).

Figure 39



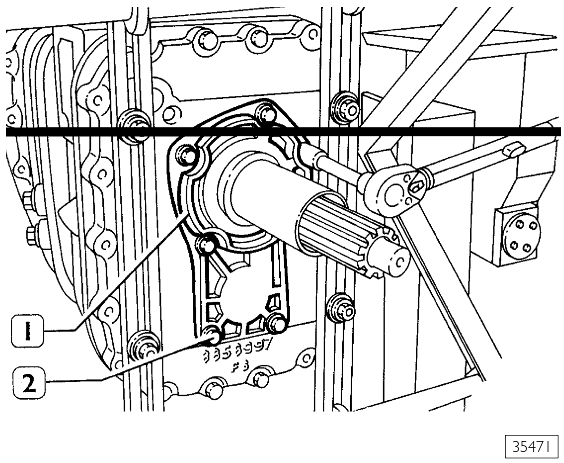
Insert tip (4), spring (3), then mount cover (1) and fasten screws (2) by tightening them to the specified torque.

Figure 40



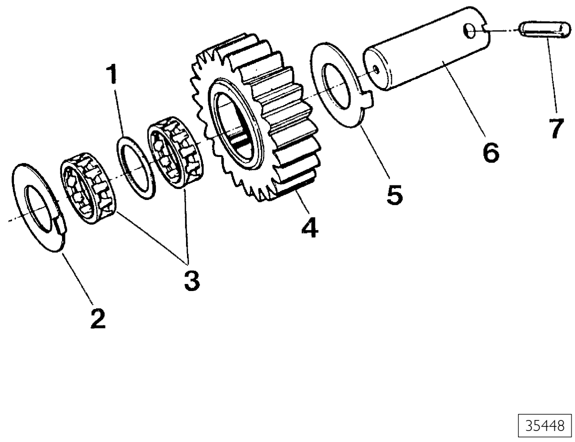
Fit tool 99370130 on the main shaft, engage a gear and with wrench 99355174 (1) and dynamometric wrench tighten ring nut to the specified torque.

Figure 41



Fit the adjustment ring, smear cover (1) with LOCTITE 510, fit cover and tighten the screws (2) to the specified torque.

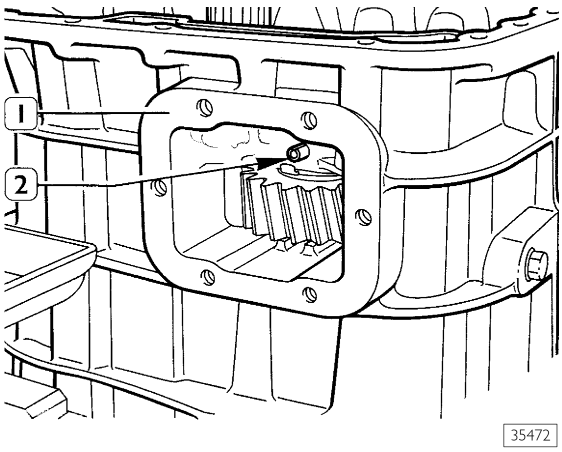
Figure 42



REVERSE GEAR COMPONENTS

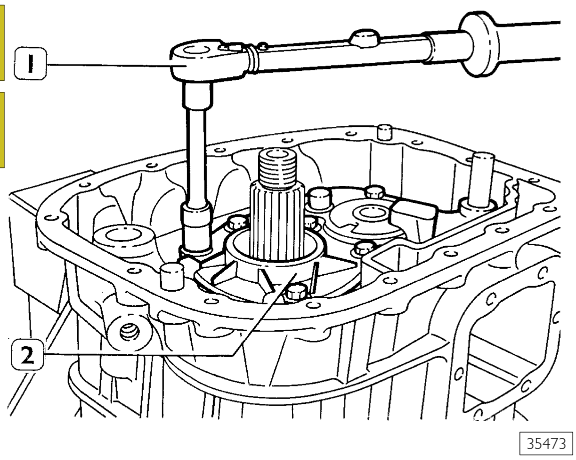
1. Bearing spacer - 2. Shoulder ring - 3. Roller bearings - 4. Reverse speed gear - 5. Shoulder ring - 6. Shaft - 7. Split pin.

Figure 43



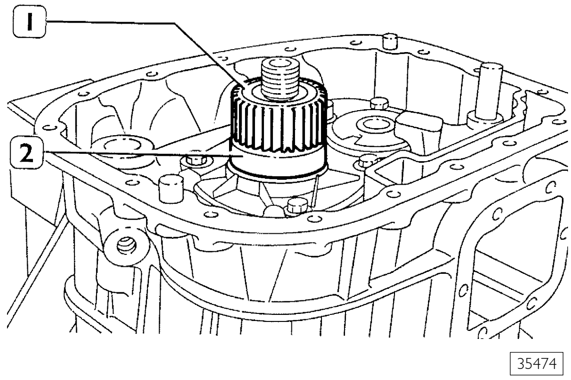
After fitting parts (1-2-3-4 and 5, Figure 43) in the intermediate box (1, Figure 42), fit shaft (6, Figure 42) and drive the split pin (2, Figure 43).

Figure 44



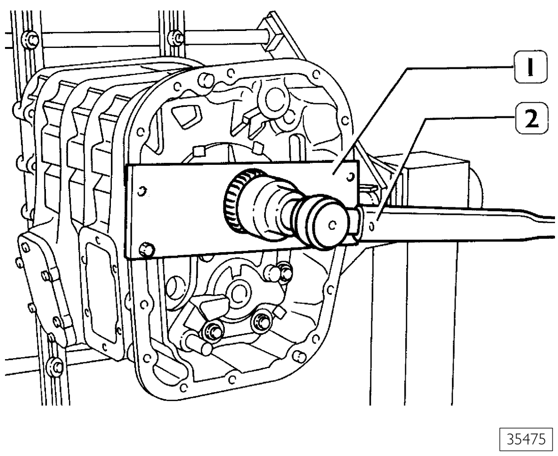
Fit the oil pump (2) and tighten screws to the specified torque using the dynamometric wrench (1).

Figure 45



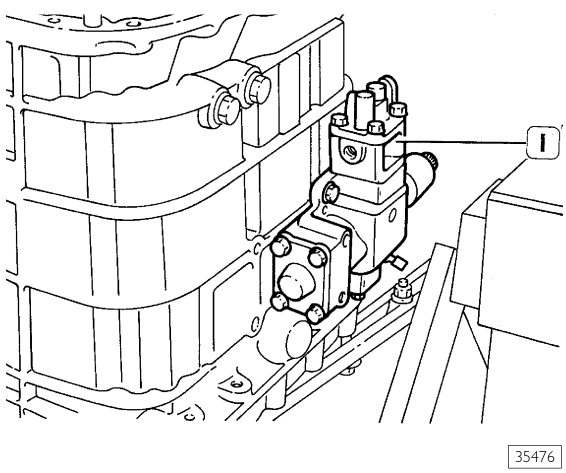
Fit down oil distributor (2) and the sun gear (1).

Figure 46



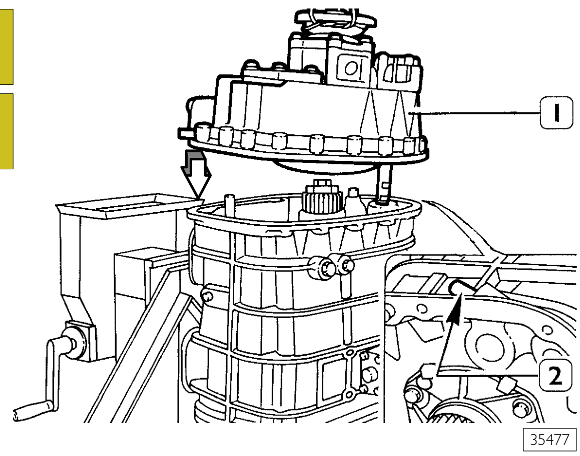
Position tool 99370130 (1), tighten castle nut to the specified torque using the dynamometric wrench (2).

Figure 47



Fit covers and external gear control (1).

Figure 48



Smear with LOCTITE 510 (arrow) and refit gear anti-disengagement safety pin (2) and the E.R.U. (1).

Tighten the screws to the specified torque using the dynamometric wrench.

Apply reaction lever 99370317 and wrench 99355081. Tighten output flange fastening nut to the specified torque.

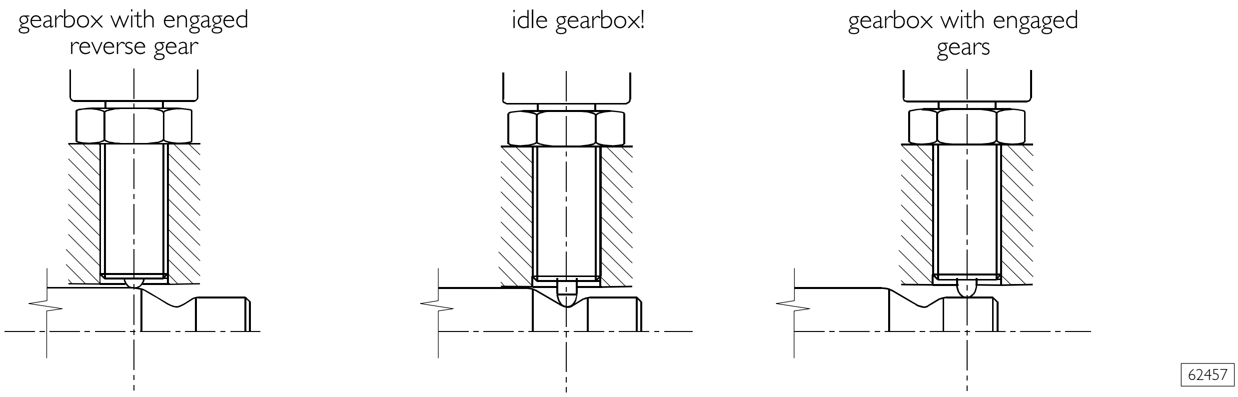
Refit E.R.U. air pipes and fill with TUTELA ZC 90 (7.5 kg).

Remove the gearbox from the stand and refit the clutch assembly.

Idle-R.M. switch adjustment

The below-described sequence must be compulsorily complied with.

Figure 49



SWITCH ENGAGEMENT POSITIONS ON GEARBOX 2870.9

For switch adjustment, it is necessary to carry out the following operations:

- apply silicone sealant on the threading;
- set gearbox in engaged reverse gear position;
- screw the switch till the reverse motion lamp turns on;
- screw again the switch by 45-60° corresponding to a stroke of 0.19-0.25 mm;
- tighten securing lock nut with a 24 wrench at a torque of 35 Nm.

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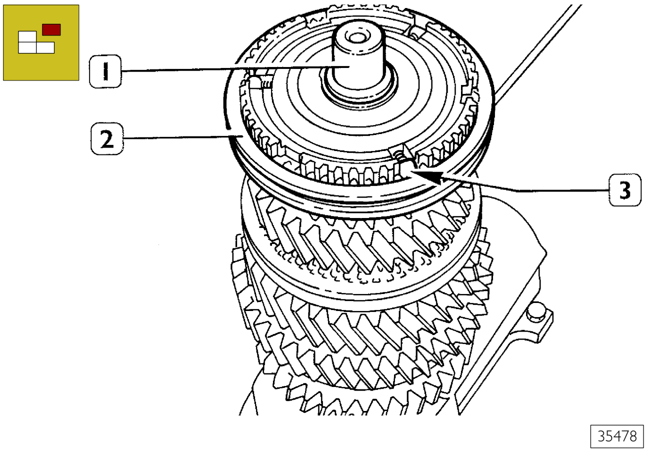
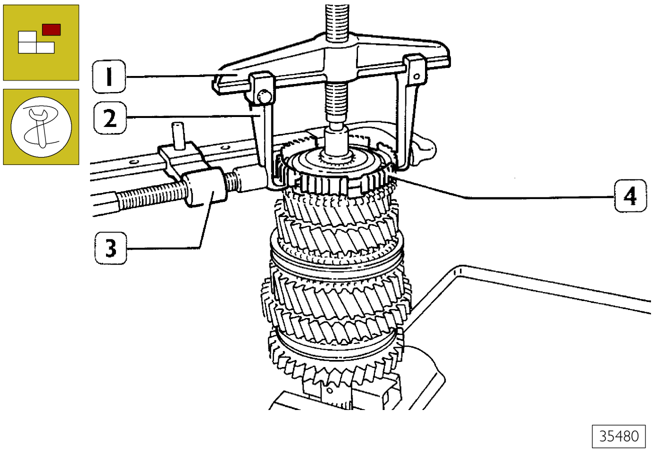
MAIN SHAFT DISASSEMBLING

Figure 50



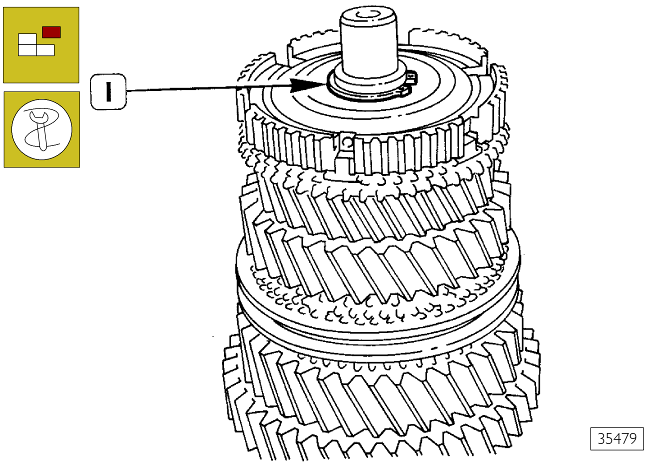
Tighten main shaft (1) in a vice.
Remove 4th and 5th speed sliding sleeve (2), recovering springs, pins and rollers (3).

Figure 52



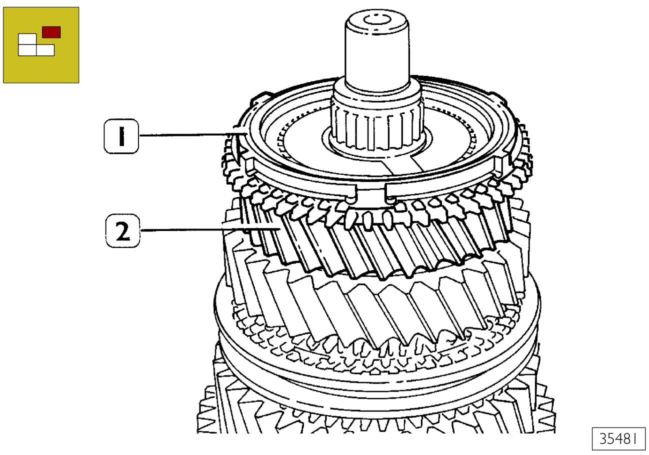
Use puller 99341003 (1) with brackets (2), and clamp 99341015 (3) to remove 4th and 5th speed fixed hub (4).

Figure 51



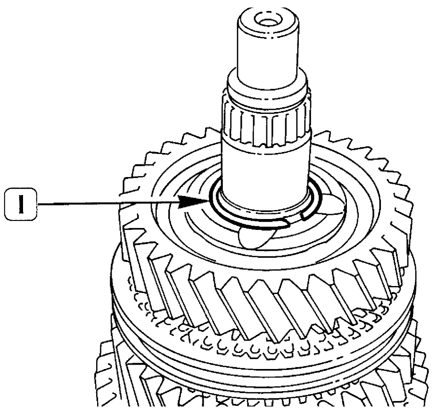
Use round-nose pliers to remove split ring (1).

Figure 53



Remove the synchronising ring and the coupling body (1).
Remove 4th speed gear (2) and the needle bearing.

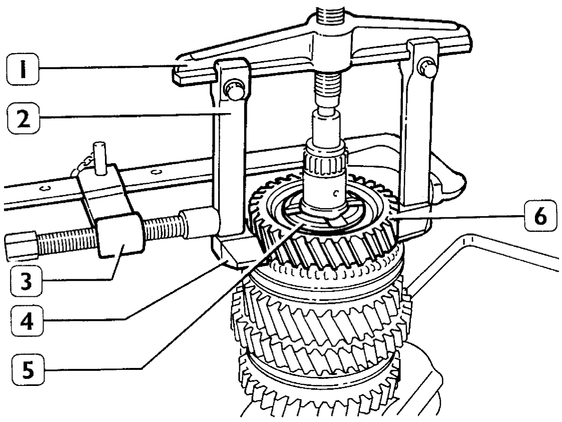
Figure 54



35482

Remove split ring (1).

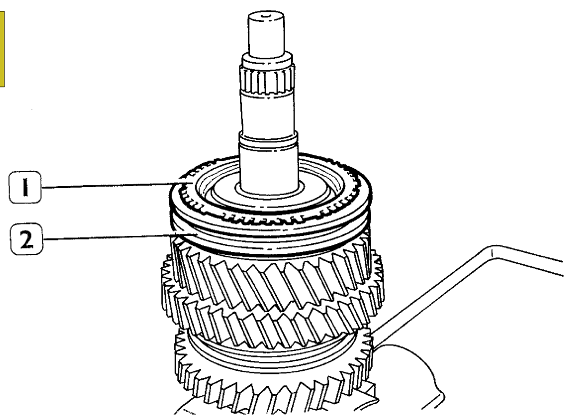
Figure 55



35483

Remove 3rd speed gear (5) together with bush (6) and needle bearing using puller 99341003 (1), tie rods (2), grips (4) and clamp 99341015 (3).

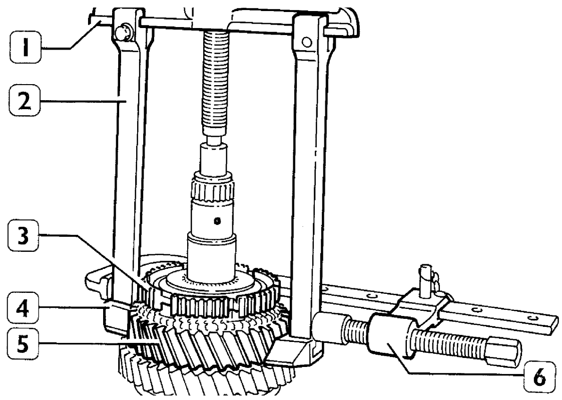
Figure 56



35484

Remove synchronising ring and coupling body (1) and withdraw sliding sleeve (2) recovering springs, pins and rollers (1).

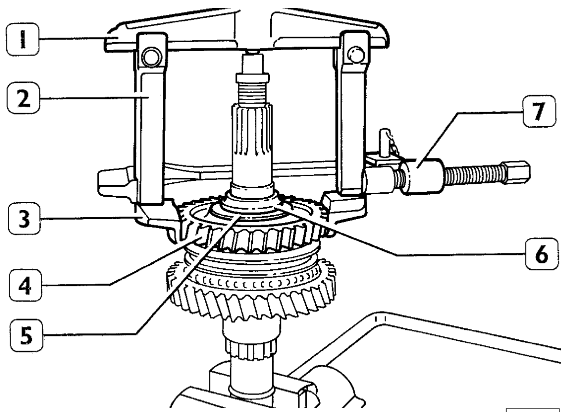
Figure 57



35485

Extract 2nd and 3rd speed gear fixed hub (3), synchronising ring, coupling body (5), and 2nd speed gear (5) using puller 99341003 (1), tie rods (2), grips (4) and clamp (6). Recover the needle bearing.

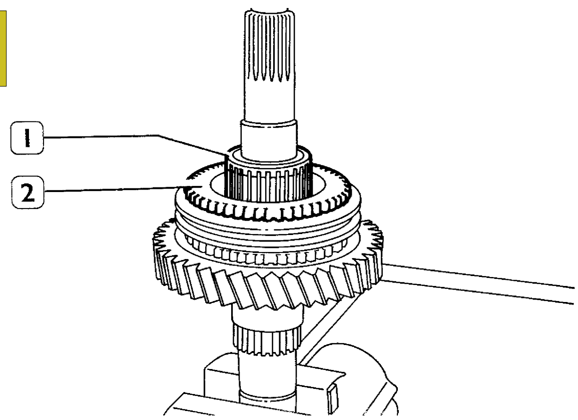
Figure 58



35486

Upset the main shaft and remove the reverse speed gear (4) with bearing outer ring (6) and the shoulder ring (5) using puller 99341003 (1), tie rods (2), grips (3) and clamp (7).

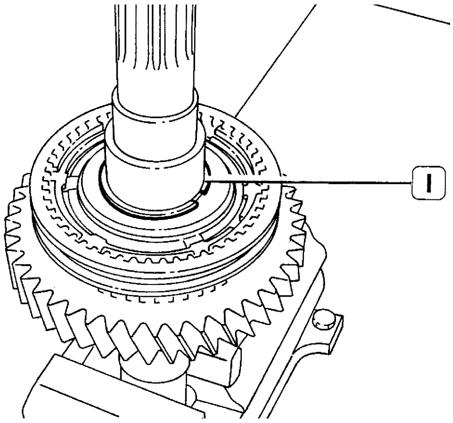
Figure 59



35487

Remove the needle bearing (1), the synchroniser ring and the coupling body (2).

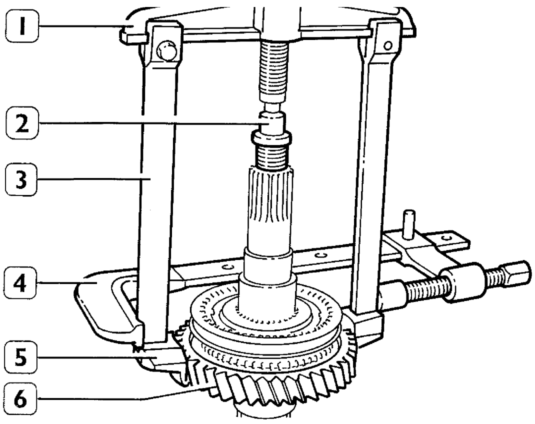
Figure 60



35488

Use the proper pliers to remove split ring (1).

Figure 61



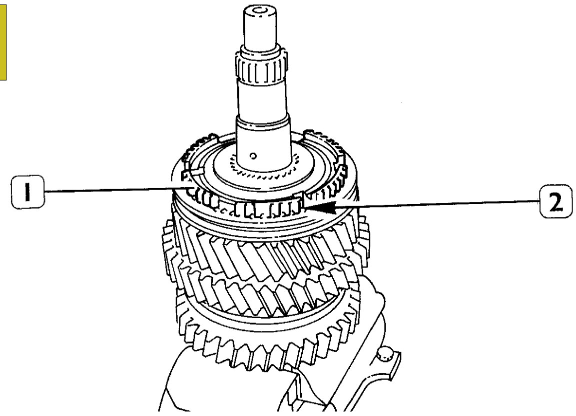
35489

Extract 1^{st} speed gear (6) with sliding sleeve, synchronising ring and needle bearing using puller 99341003 (1), reaction block (2), tie rods (3), clamp (4) and grips (5).

MAIN SHAFT ASSEMBLING

Check and replace, if required, any damaged or worn component and then reverse the removal procedures taking care to the following:

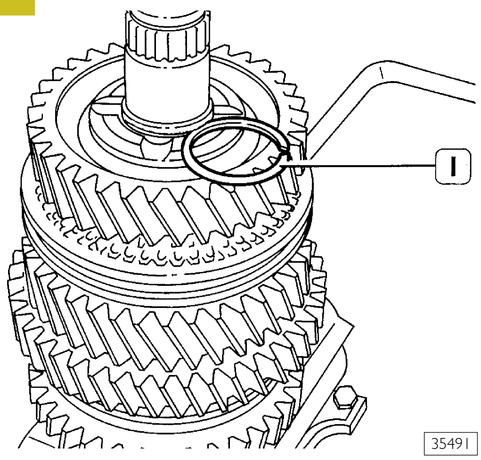
Figure 62



35490

- fixed hubs (1) for 1^{st} – 2^{nd} – 3^{rd} – 4^{th} – 5^{th} and R.G. gears shall be heated to 100 °C ÷ 130 °C and assembled on main shaft. When driving the hubs, pay attention that synchronising ring stops (2) are fitted into respective fixed hub seats;

Figure 63



35491

- shoulder split rings (1) shall have proper thickness so that to have no axial clearance with fixed hubs (max tolerated 0.03 mm).

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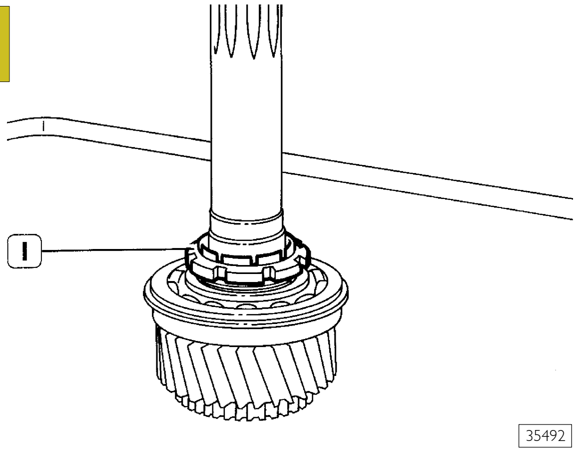
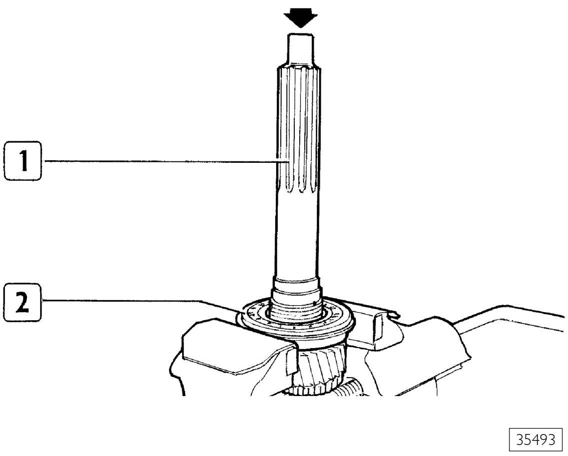
INPUT SHAFT DISASSEMBLING

Figure 64



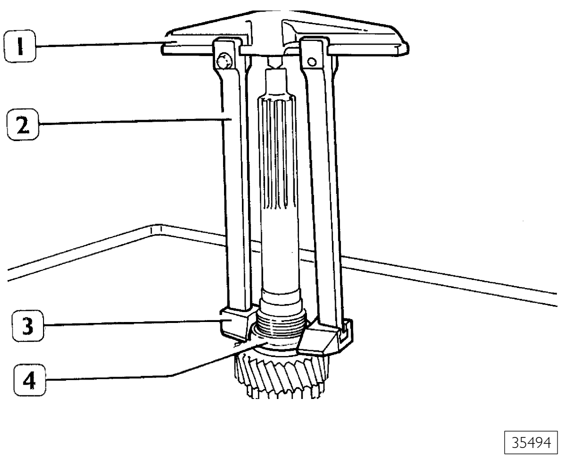
Loosen bearing fastening ring nut (1).

Figure 65



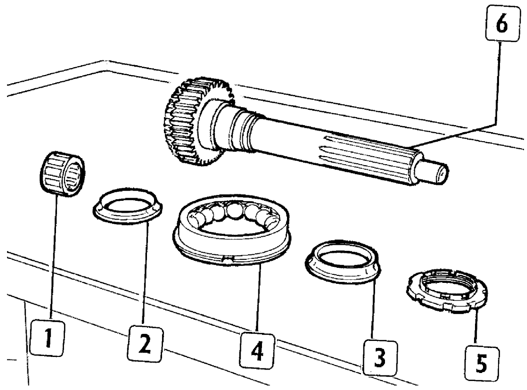
Fit bearing (2) into a vice and beat the shaft (1) to remove ball bearing (2) and one half race.

Figure 66



Use puller 99341003 (1), tie rods (2) and grips (3) to remove the other half race (4).

Figure 67



INPUT SHAFT COMPONENTS

1. Straight roller bearing - 2. Half race - 3. Half race - 4. Ball bearing - 5. Ring nut - 6. Input shaft.

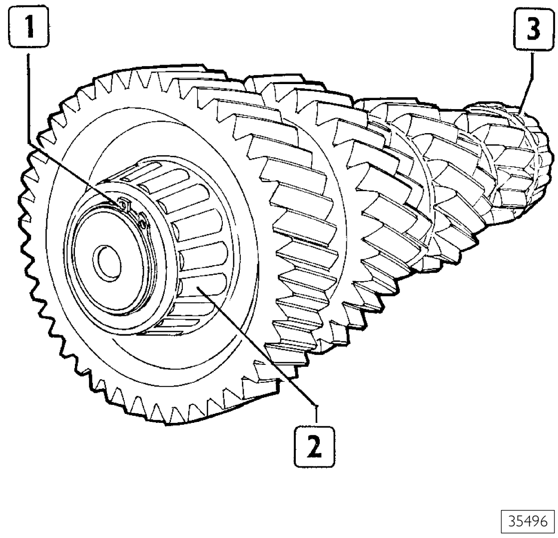
INPUT SHAFT ASSEMBLING

Suitably reverse removal operations and tighten temporarily the ring nut (1, Figure 64).

TRANSMISSION SHAFT

Bearing replacement

Figure 68



Remove split ring (1) and extract taper roller bearing (2); use a proper punch to remove also the taper roller bearing (3). When refitting warm slightly the bearings.

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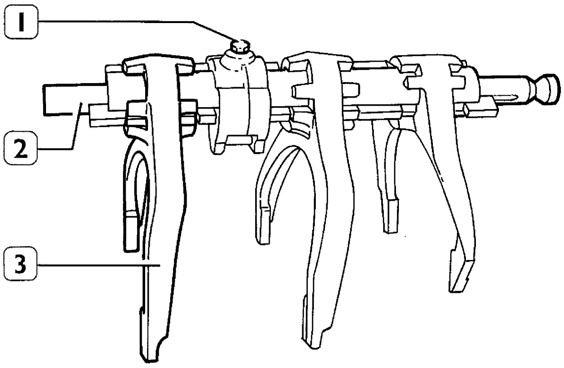
INTERNAL CONTROL SHAFT DISASSEMBLING

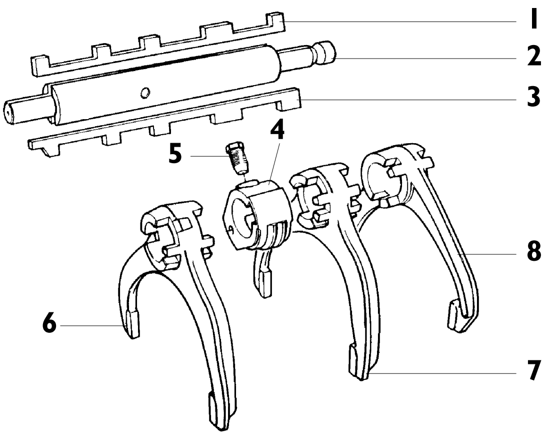
Figure 69



35497

Mark fork (3) assembling positions. Loosen screw (1), withdraw shaft (2) and disassemble the unit.

Figure 70



35431

GEAR CONTROL COMPONENTS

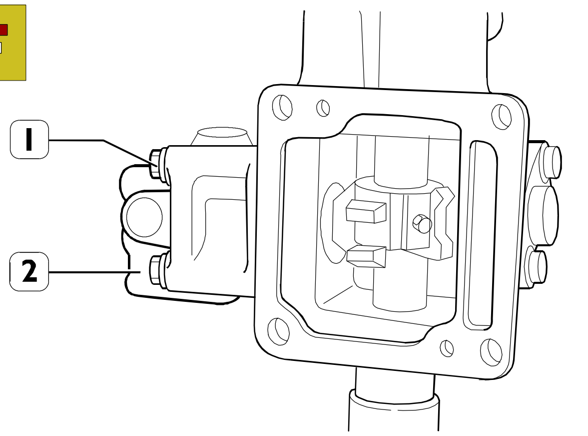
1. Selection rod - 2. Shaft - 3. Synchronising rod - 4. Hub - 5. Screw - 6. 4th and 5th speed fork - 7. 2nd and 3rd speed fork - 8. 1st and reverse gear fork.

INTERNAL CONTROL SHAFT ASSEMBLING

Set forks (6-7-8) and hub (4) on a bench according to the position marked at removal.
Set selection rod (1) so as to fit grooves into forks and hub; repeat this operation with the synchronising rod (3); keep in this position and fit shaft (2).
Tighten hub (4) screw (5) to requested torque.

EXTERNAL CONTROL BOX DISASSEMBLING

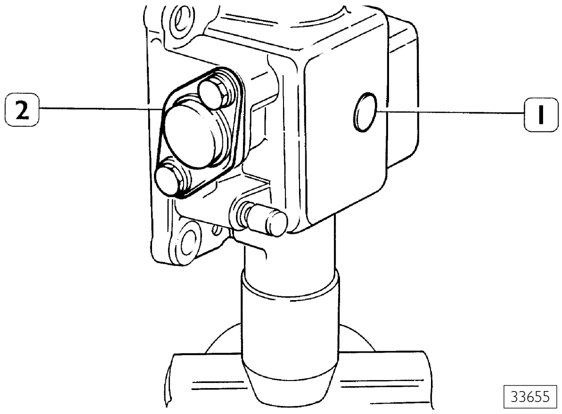
Figure 71



79446

Secure the unit in a vice, unscrew the four screws (1), then disassemble epicyclic reduction gear control valve (2).

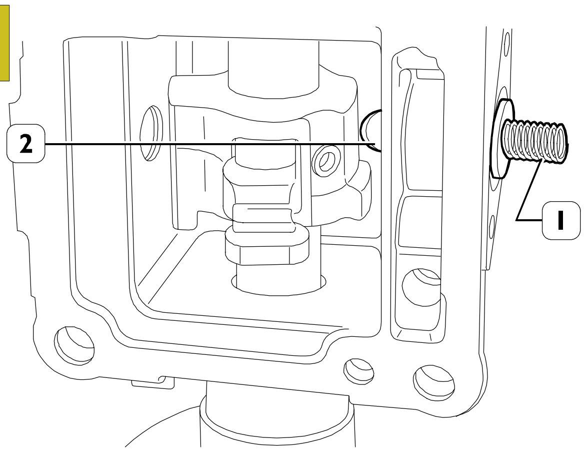
Figure 72



33655

Tighten the shaft going out of the box in a clamp, remove plug (1) and disassemble cover (2).

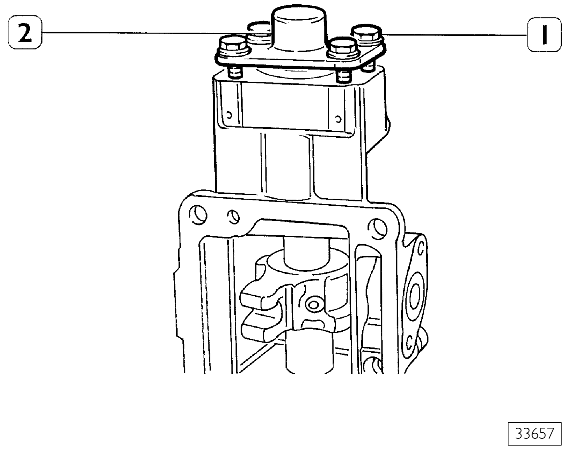
Figure 73



78166

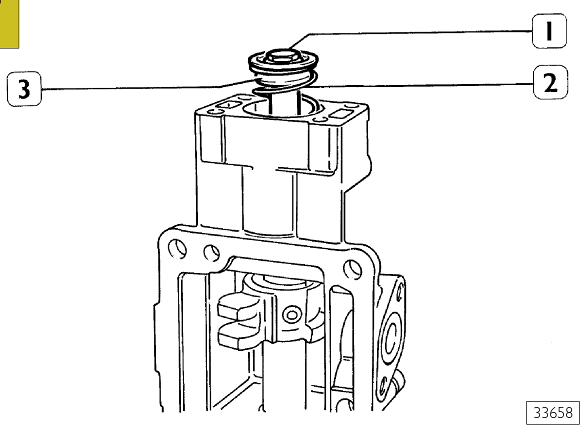
Remove control box pin (2) and spring (1).
Do not mix removed elements with those of the anti-release push rod.

Figure 74



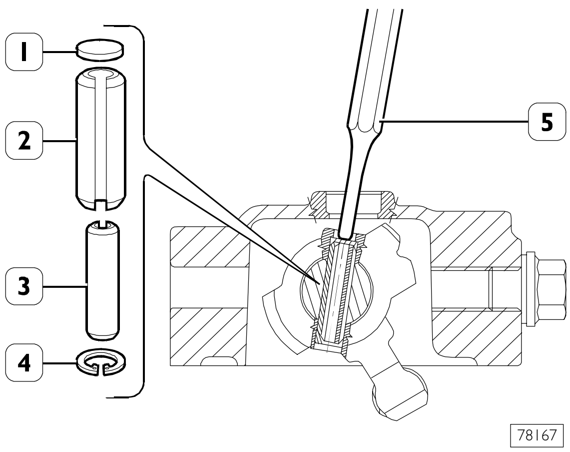
Unscrew screws (1) and disassemble cover (2).

Figure 75



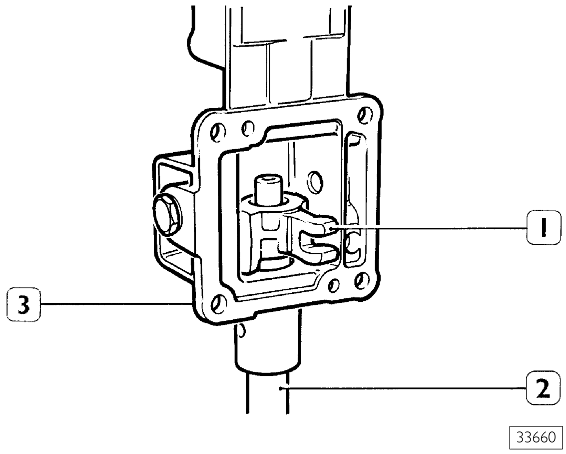
Unscrew screw (1) and remove spacer, upper cup (3) and spring (2). Remove lower cup.

Figure 76



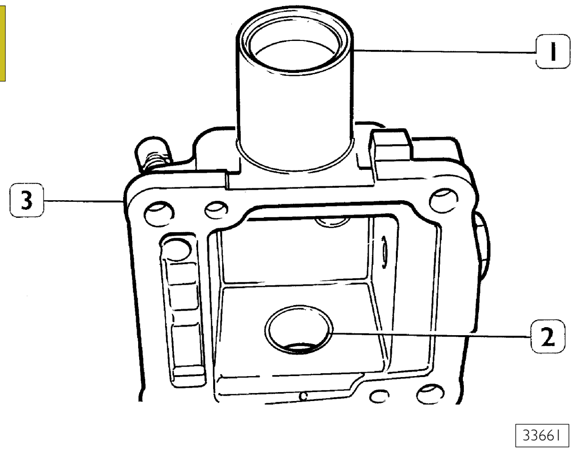
Remove the snap ring (4) and use a punch tool (5) having the right diameter to push the extraction washer (1) and remove flexible plugs (2) and (3).

Figure 77



Extract, from the control shaft (2), control selector (1) and box (3).

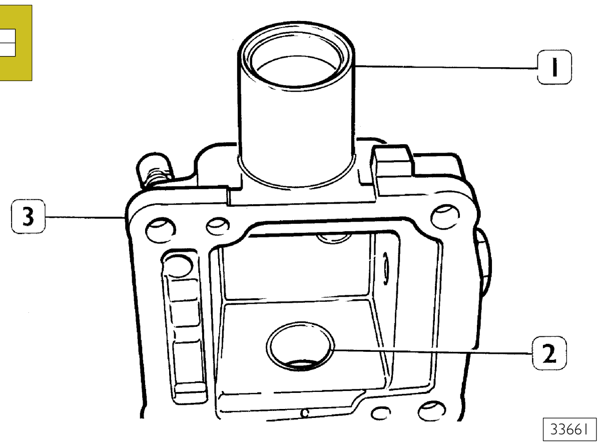
Figure 78



Extract, from the control box (3), sealing gasket (1) and bushes (2) with a suitable beater.

EXTERNAL CONTROL BOX ASSEMBLY

Figure 79



Assemble sealing gasket (1) and bushes (2) into drive case (3) with a suitable beater.

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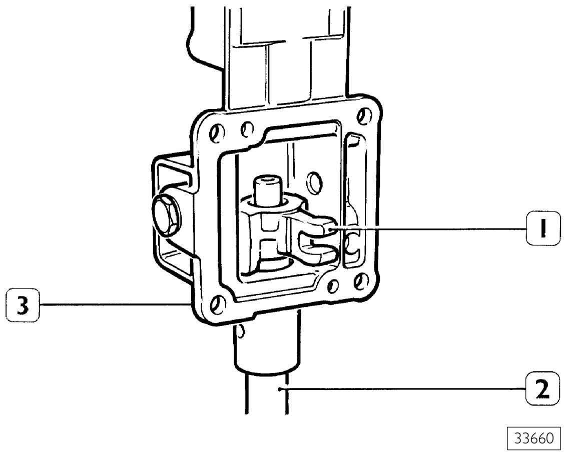
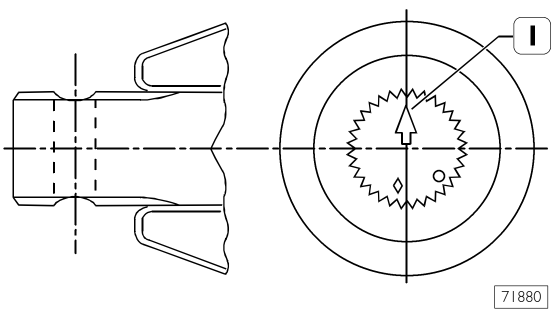
Figure 80



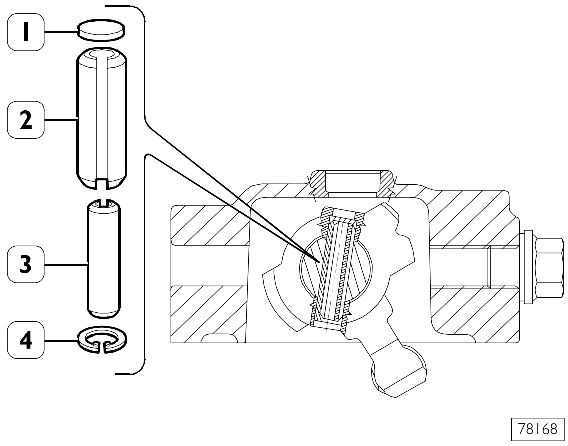
Tighten control shaft (2) in a clamp and assemble thereon box (3) and control selector (1).

Figure 81



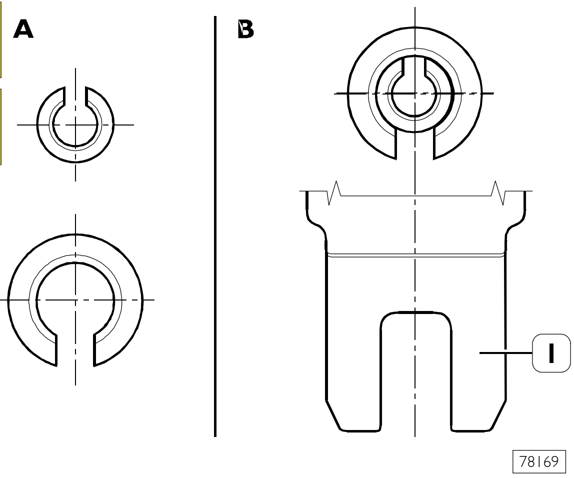
Upon assembling, the drive shaft must be assembled with the reference arrow (1) facing upwards.

Figure 82



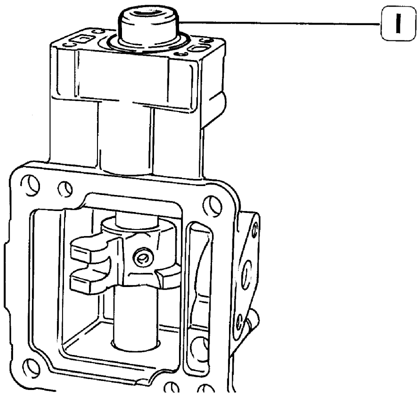
Insert the extraction washer (1) and use a punch tool having the right diameter to install the first plug (2). Install the second plug (3) and the snap ring (4).

Figure 83



During installation, plug cuts shall be opposed by 180° (see detail A).
The bigger plug cut shall face the control selector (1) milled area (see detail B).

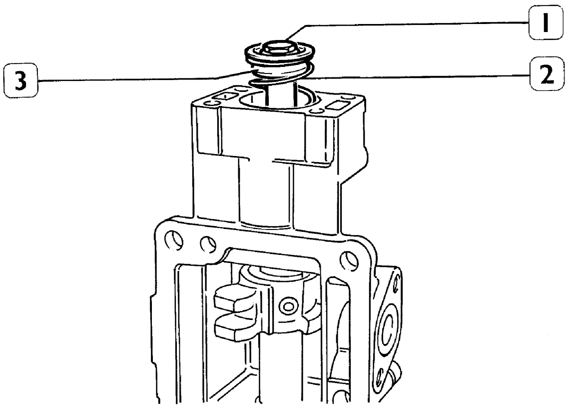
Figure 84



33663

Assemble lower cup (1).

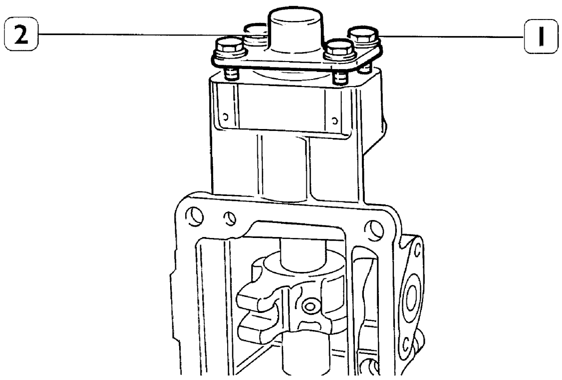
Figure 85



33658

Install the spring (2), the upper cap (3), the spacer and the screw (1) and apply threading sealer LOCTITE 270 on the screw itself.
Tighten the screw (1) to 30 Nm (3.1 kgm).

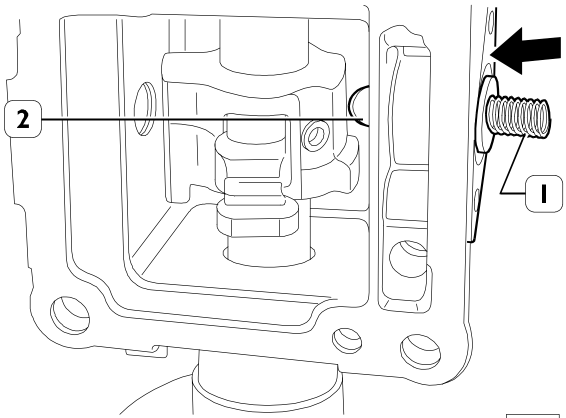
Figure 86



33657

Clean joining surfaces of control box and cover (2) and apply "LOCTITE 510" adhesive on one of the two components.
Assemble cover (2) and tighten screws (1) at a torque of 36.5 Nm (3.7 kgm).
Apply threading sealer LOCTITE 270 on the screws (1).

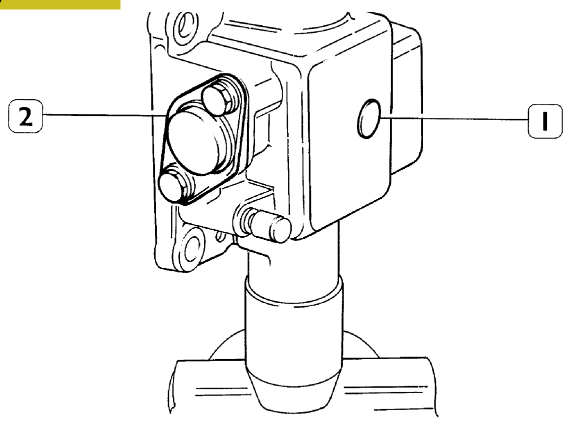
Figure 87



78170

Install the pin (2), the spring (1) and apply sealer "LOCTITE 518" (→).

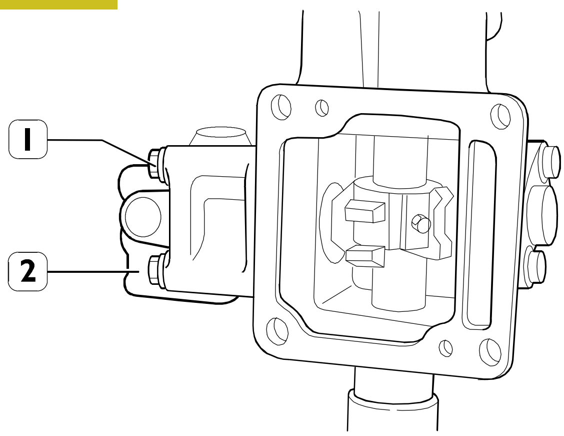
Figure 88



33655

Install the cover (2) and tighten the screws to 19 Nm (1.9 kgm).
Apply sealer "LOCTITE 675" and refit the plug (1).

Figure 89



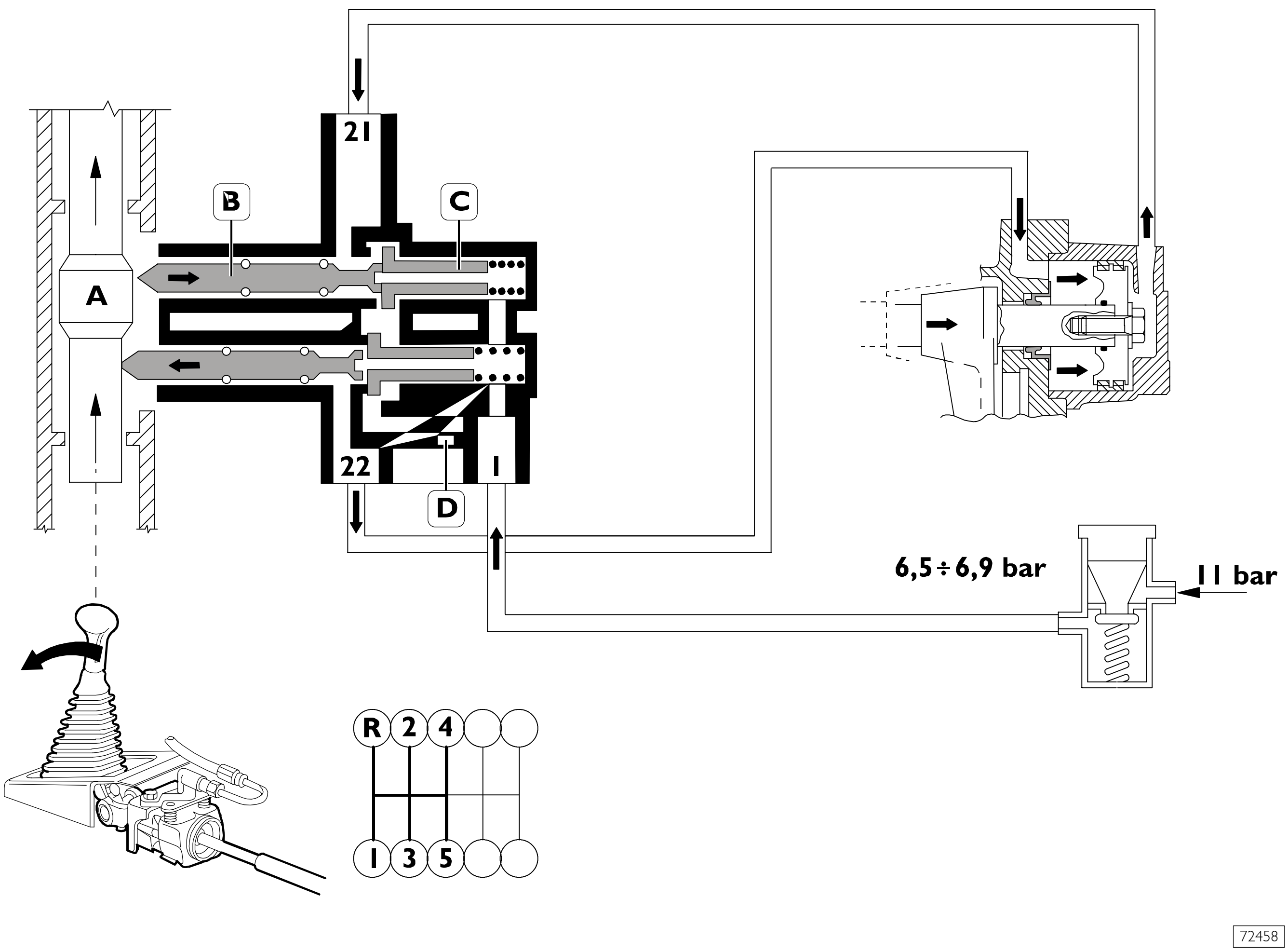
79445

Apply "LOCTITE 518" sealant, mount epicyclic reduction gear control valve (2), fasten screws (1) and tighten them to the specified torque.

533010 EPICYCLIC REDUCTION GEAR ASSEMBLY

Operating diagrams about pneumatic epicyclic reduction gear drive circuit

Figure 90



SLOW GEAR ENGAGEMENT (1st – 2nd – 3rd – 4th – 5th AND REVERSE GEAR)

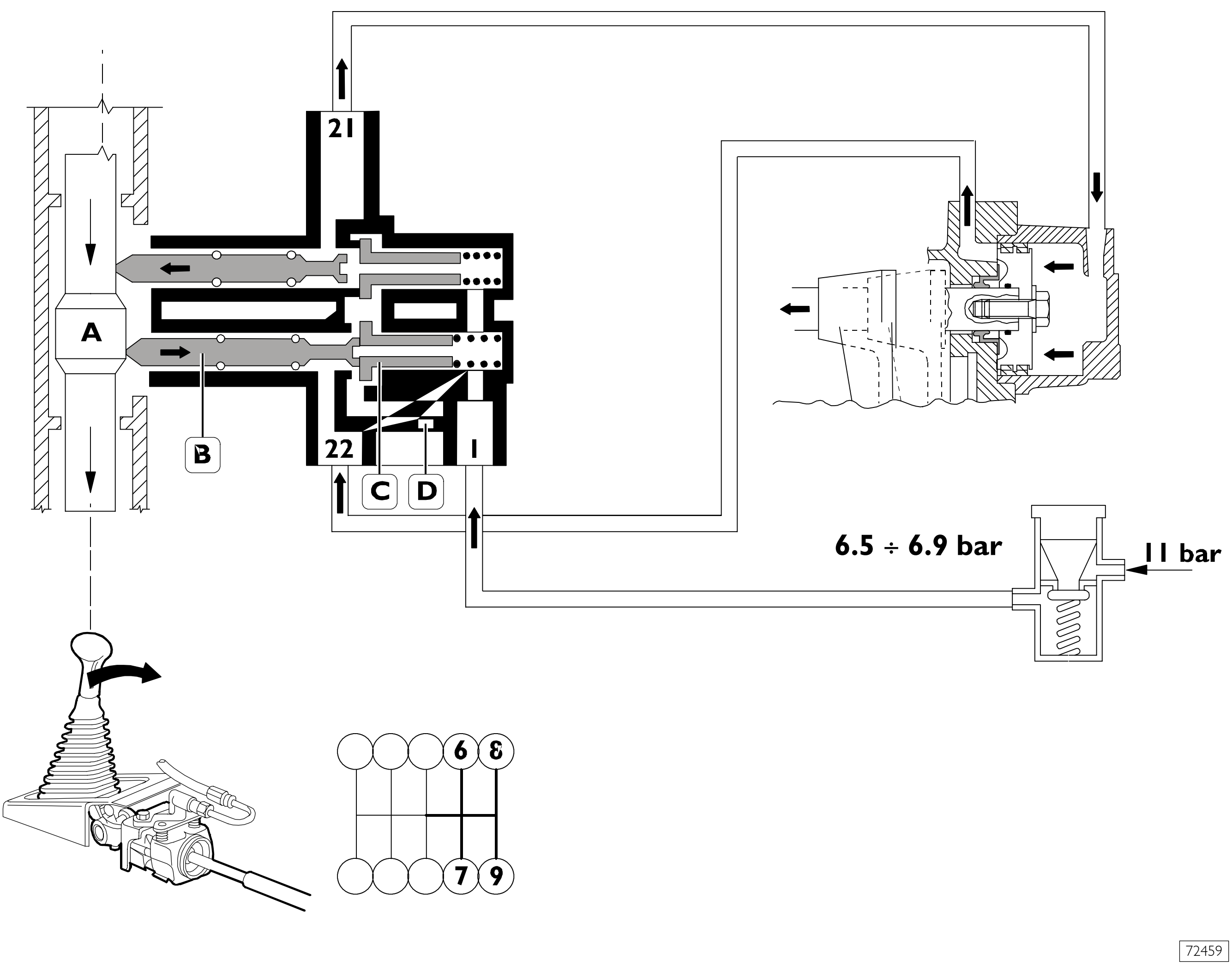
Air coming from services tank, passing through a reduction gear, is reduced to the pressure of 6.5 ÷ 6.9 bars and reaches consent valve at union **1**.

By pressing the clutch, operate on the gearbox lever to engage a gear (1-2-3-4-5-RG); cam (A) is moved upwards and pushes pin (B) leftwards.

The pin abuts on piston (C) valve and by lifting it, closes the supply to union **21**.

By discharging air contained into the cylinder through the vent hole (D), air will then go out of union **22** thereby keeping gearbox piston in slow gears.

Figure 91



QUICK GEARS (6th – 7th – 8th – 9th) ENGAGEMENT

By going with lever into second "H", cam (A) moves downwards and pushes pin (B) leftwards.

The pin abuts on piston (C) valve and, by lifting it, closes the supply to union **22** discharging air contained into the cylinder through vent hole (D).

Air will then go out of union **21** pushing the piston in reverse and allowing to insert quick gears.

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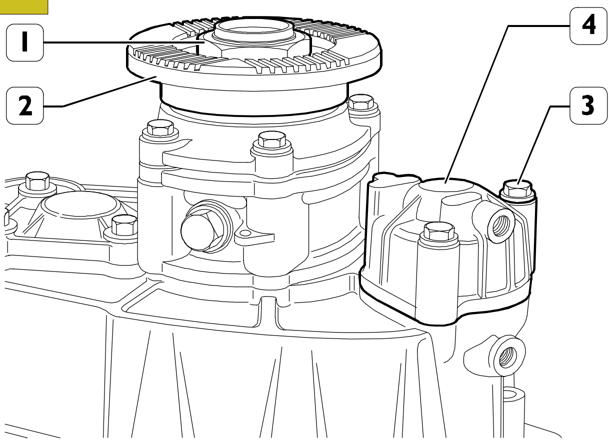
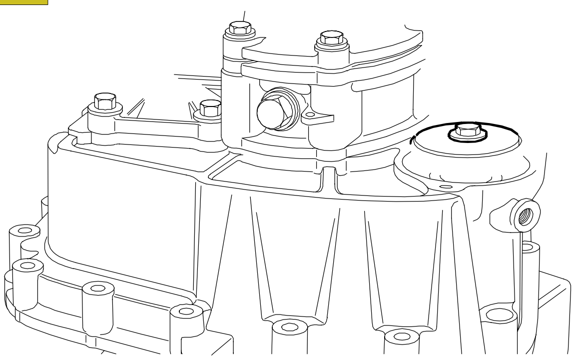
Figure 92



71913

Abut epicyclic reduction gear assembly on a bench, unscrew nut (1) and remove flange (2). Unscrew screws (3) and remove cylinder (4).

Figure 93



71914

Unscrew screw (2) and remove piston (1).

Figure 94

71915

Lift case (2) in order to free outlet shaft (3) and rod (1) for synchronising drive fork.

Figure 95

71916

Remove rod with fork (1), withdraw phonic wheel (3) and remove synchronising ring (2).

Figure 96

71917

Make three reference marks (1) on sliding sleeve-crown assembly (2) next to the three central seats, on fixed hub, for positioning rollers.
Manually lift complete crown (2) and remove it, recovering rollers, pins and springs.

Figure 97

71918

Through suitable pliers, remove elastic ring (1).

Figure 98

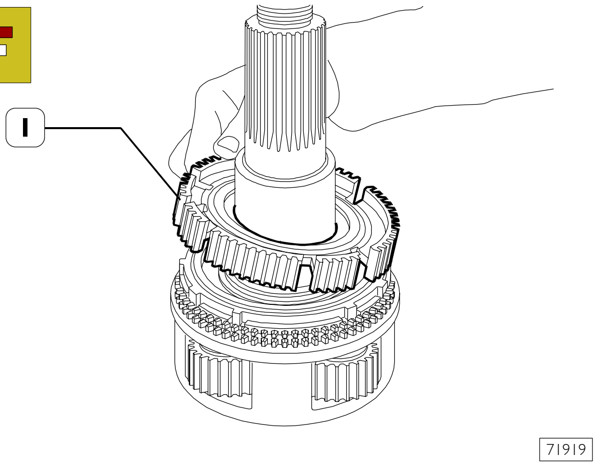
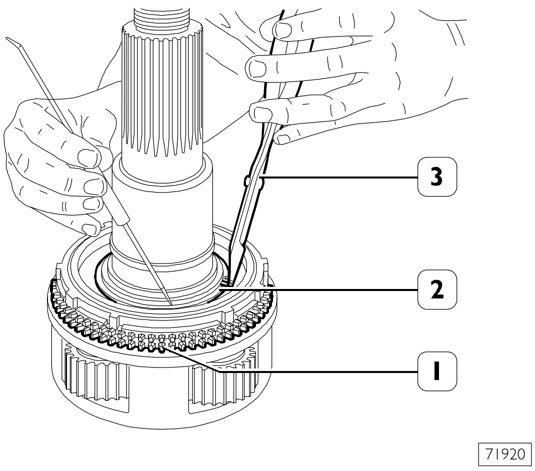
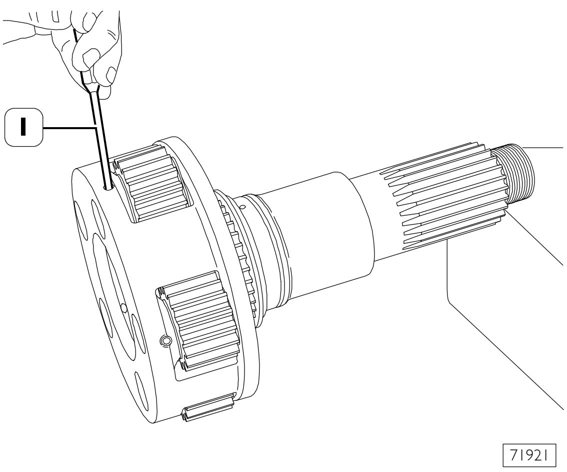


Figure 99



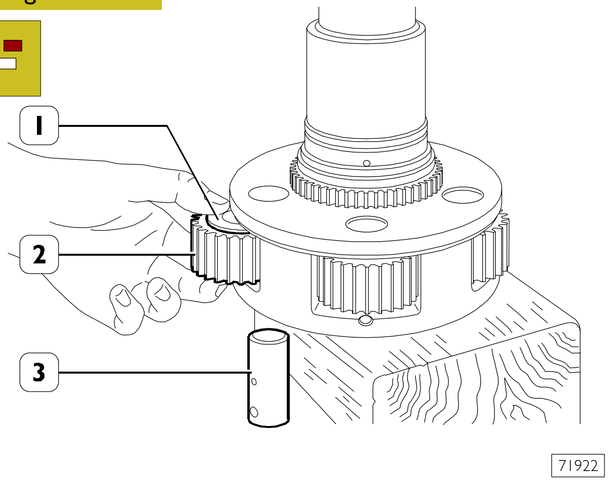
Through pliers 99381125 (3), remove elastic ring (2) and withdraw synchroniser (1).

Figure 100



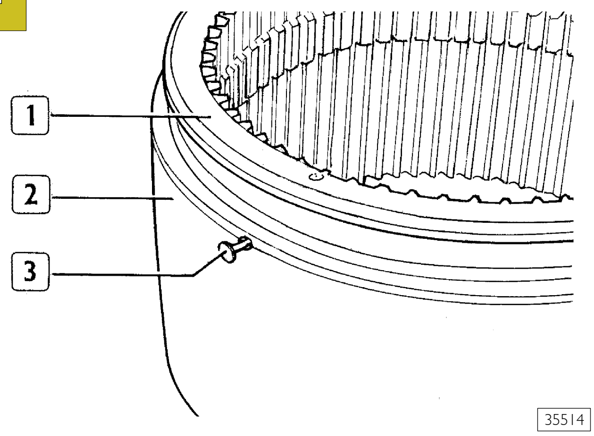
Through a punch (1) with a suitable diameter, push the elastic peg inwards till it abuts.

Figure 101



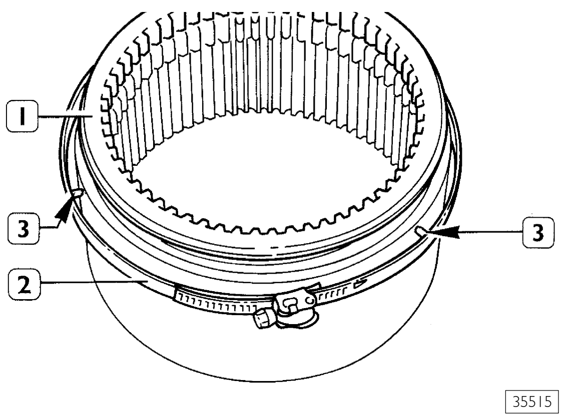
Through a suitable beater, push away pin (3) and withdraw gear (2) completed with shoulder rings (1) and shims. Recover all rollers composing the bearing.

Figure 102



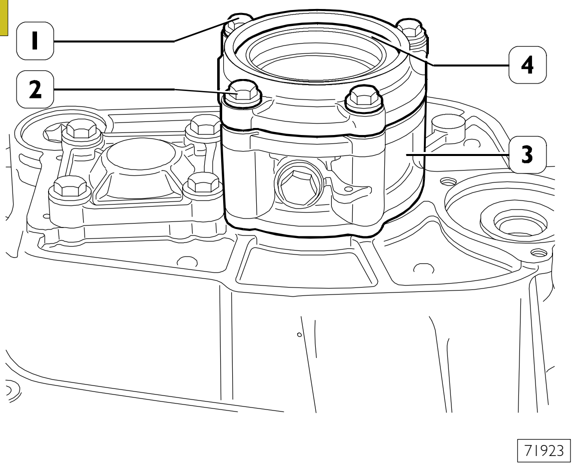
In order to remove sliding sleeve (1) from crown (2), use small pins (3) with diameter 2 ÷ 2.3 mm and a length of 10 mm.

Figure 103



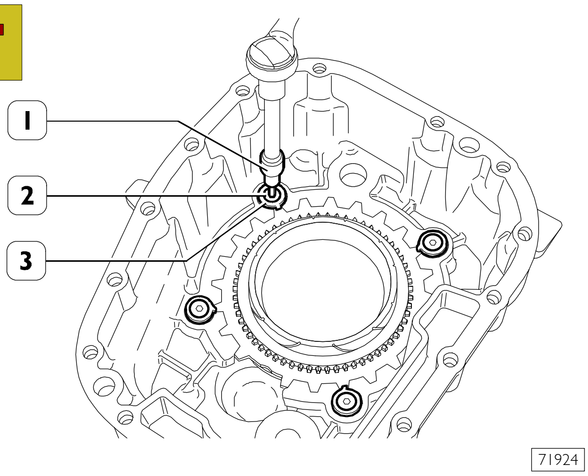
Apply a strap (2), tighten it in order to compress pins (3): in such a way, the internal check ring is detached; then, withdraw sliding sleeve (1).

Figure 104



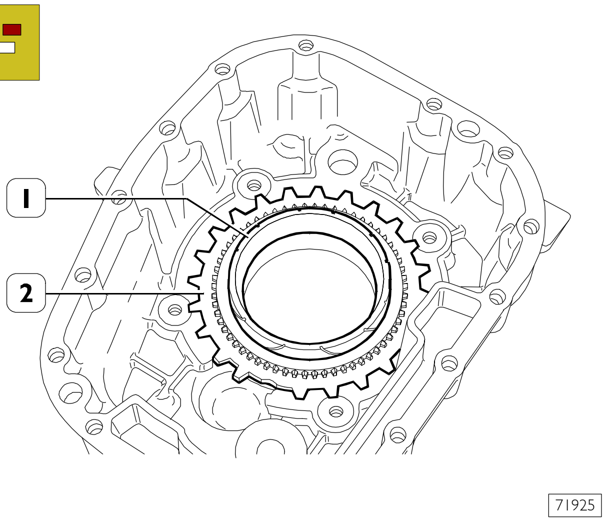
Extract sealing gasket (4) from cover (2), unscrew screws (1) and disassemble cover (2) and support (3).

Figure 105



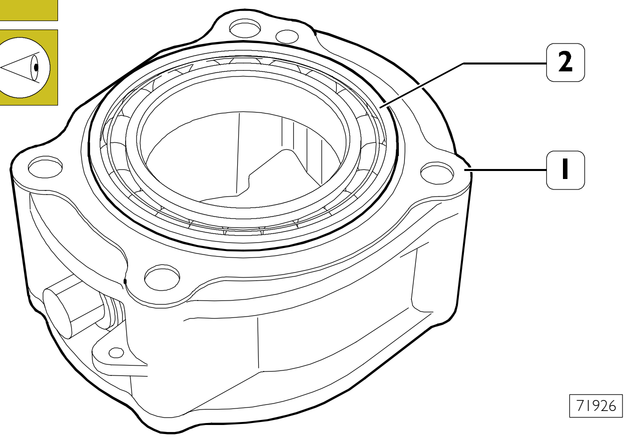
Through a suitable wrench (1), unscrew screws (2) and remove check washers (3).

Figure 106



Withdraw synchronising ring (1), reaction ring (2) and recover the spacer ring below.

Figure 107



Check that ball bearing (2), when rotating along the two directions, does not show roughness or noise when sliding. In case of a replacement of the bearing itself, slightly heat support (1) seat before disassembling it.

Checks

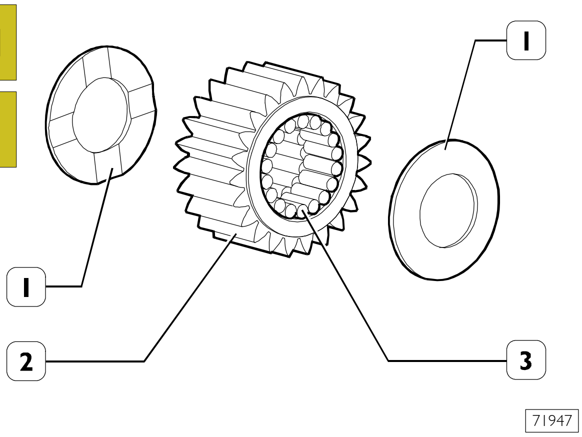
Check that all parts composing the epicyclic reduction gear assembly do not shown traces of excessive wear, seizures or breakages.

Replace the affected parts.

Upon assembling, the following must always be replaced: rings, sealing gaskets and springs for sliding sleeves positioning rollers.

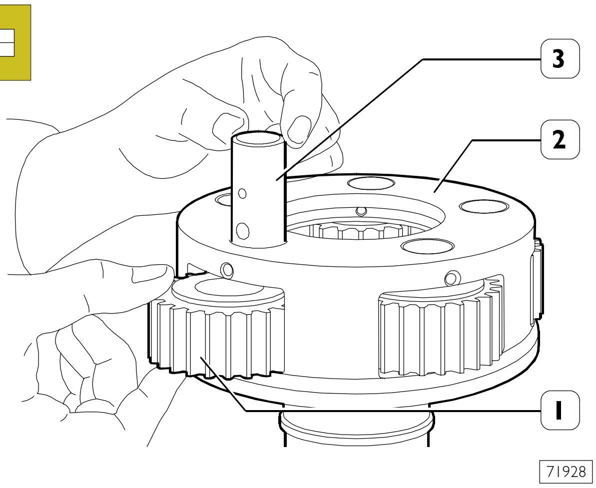
ASSEMBLY

Figure 108



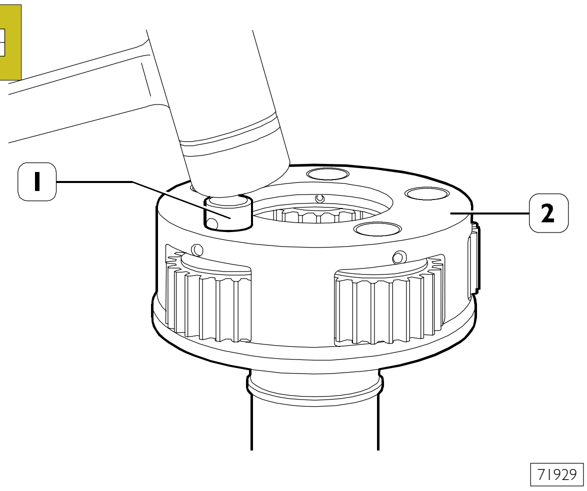
Pre-assemble roller bearing (3) and shoulder rings (1) into planetary gear (2).

Figure 109



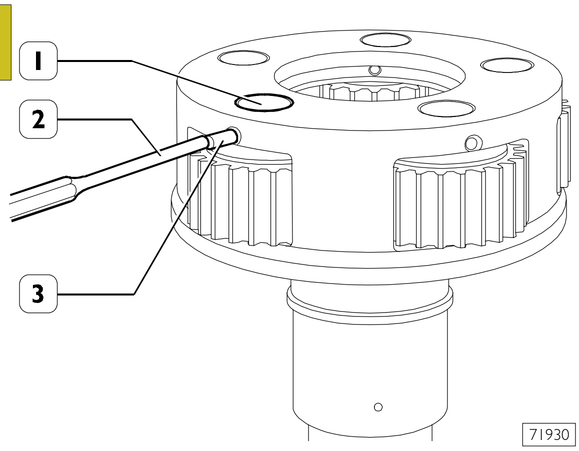
Assemble complete planetary gear (1) into planetary gear-holder shaft (2) and key-in pin (3).

Figure 110



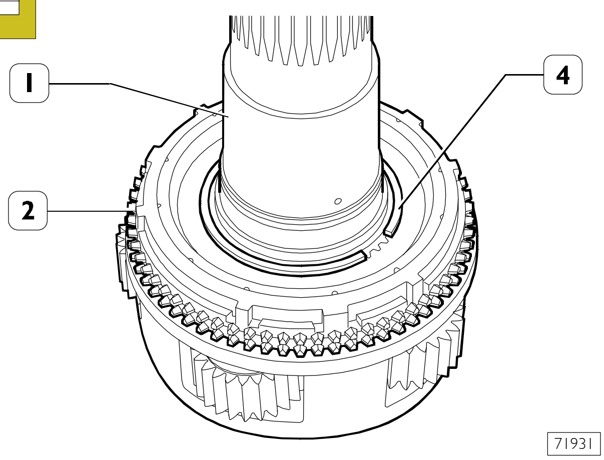
Settle pin (1) on planetary gear-holder shaft (2) by using a plastic hammer.

Figure 111



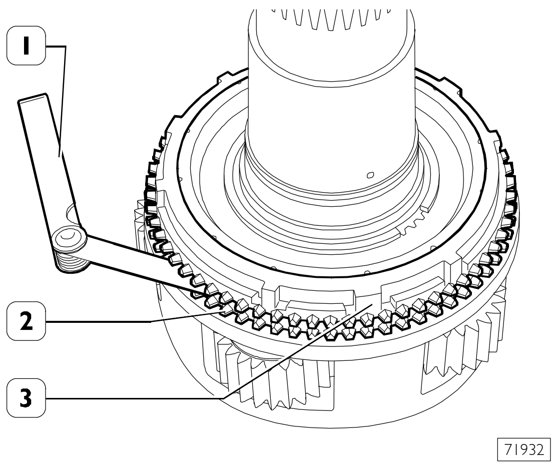
By using a punch (2), assemble elastic peg (2) checking pin (3).

Figure 112



Turn planetary gear-holder shaft (1) over, assemble synchronising rings (2) and arrange elastic check ring (4).

Figure 113



Through a feeler gauge (1), check the clearance between the two synchronising rings (2) and (3) that must be included between 0.5 and 1.9 mm. Otherwise, replace the synchronising rings.

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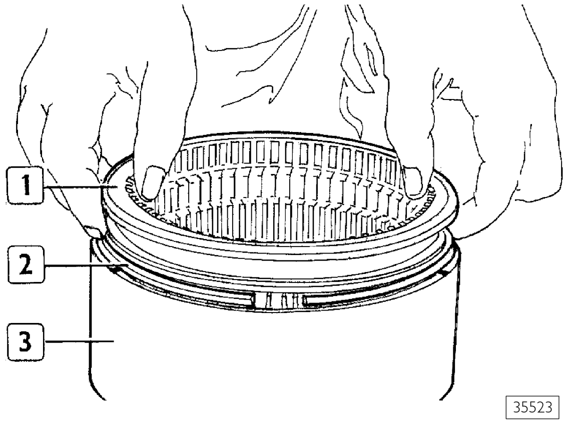
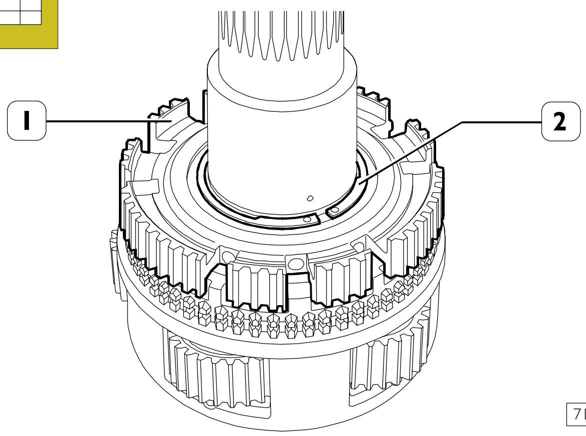
Figure 114



35523

Key-in sliding sleeve (1) completed with check ring (2) on crown (3), then, by compressing ring (2), push sliding ring (1) into the crown till the check ring is hooked into its own seat.

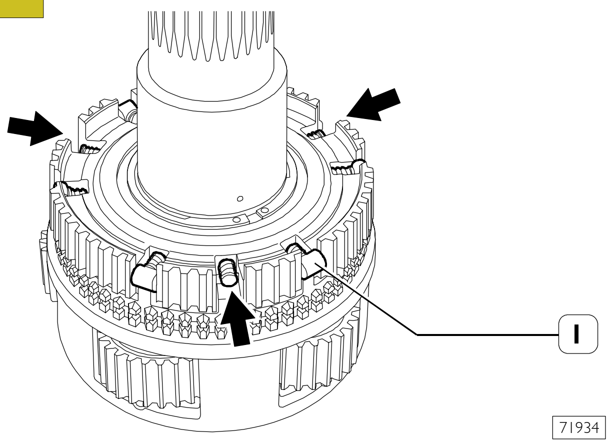
Figure 115



71933

Assemble hub (1) on planetary gear-holder shaft and arrange elastic check ring (2).

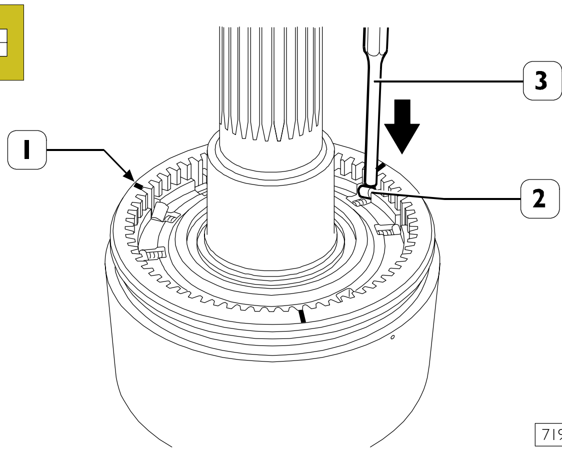
Figure 116



71934

Arrange springs, pins and rollers (1), apart from the central ones (→), into the hub.

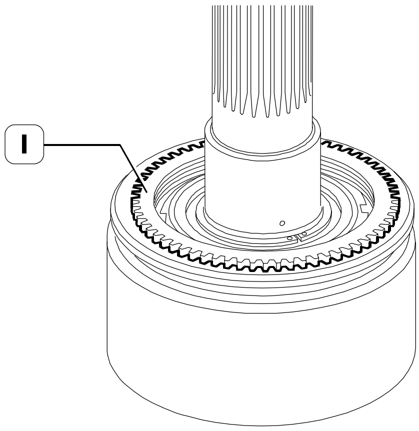
Figure 117



71935

Key-in the crown, by placing it in a neutral position with marks (1) next to the seats without rollers. Arrange the three central rollers (2) and with a punch (3) push them into their seats.

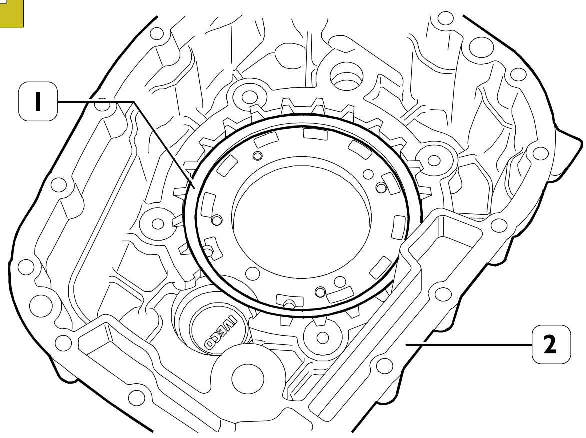
Figure 118



71936

Key-in synchronising ring (1).

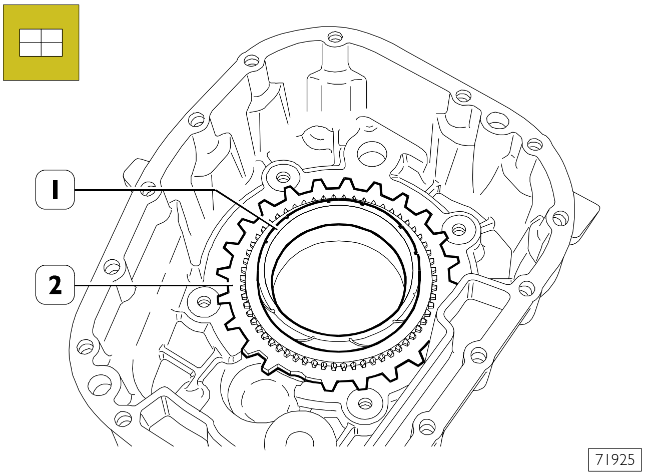
Figure 119



71937

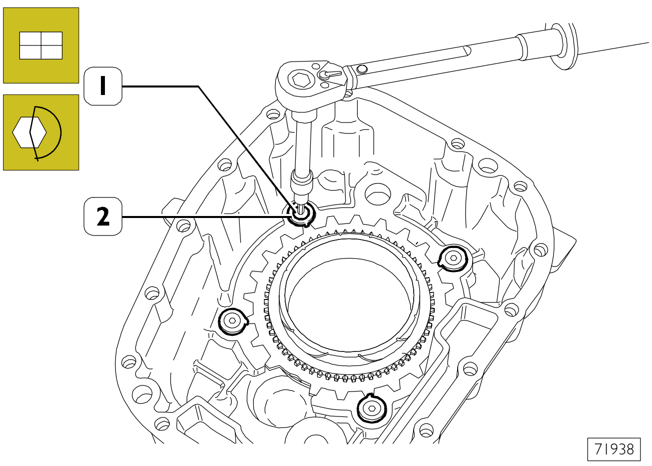
Insert spacer ring (1) into its seat in case (2).

Figure 120



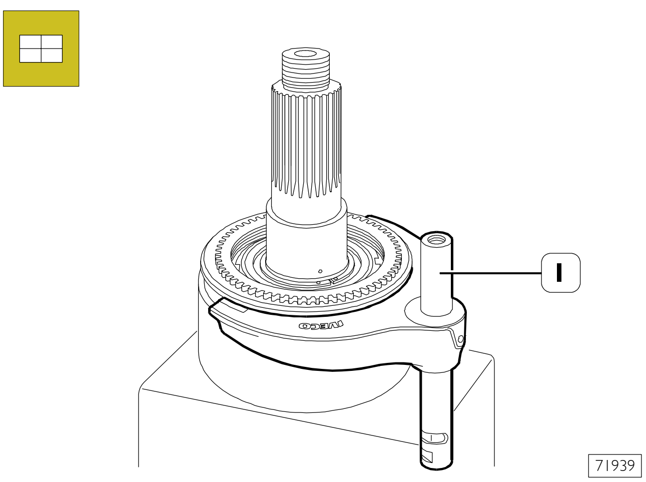
Assemble synchronising ring (1) and reaction ring (2).

Figure 121



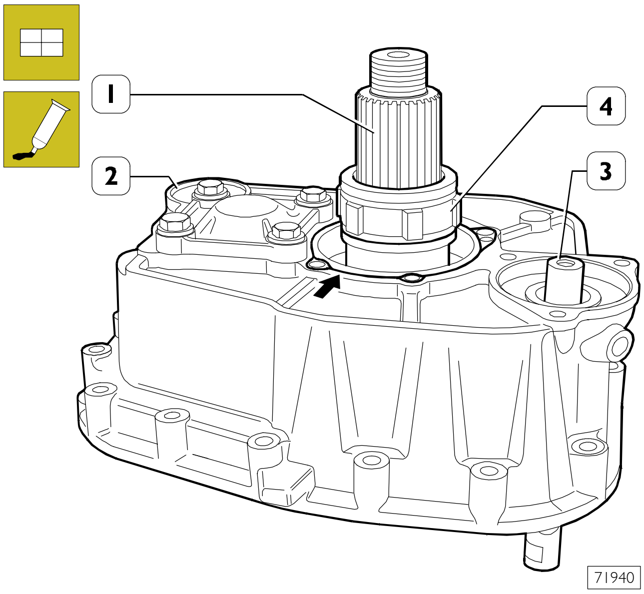
Assemble check washers (2), screw screws (1) and tighten them at the required torque.

Figure 122



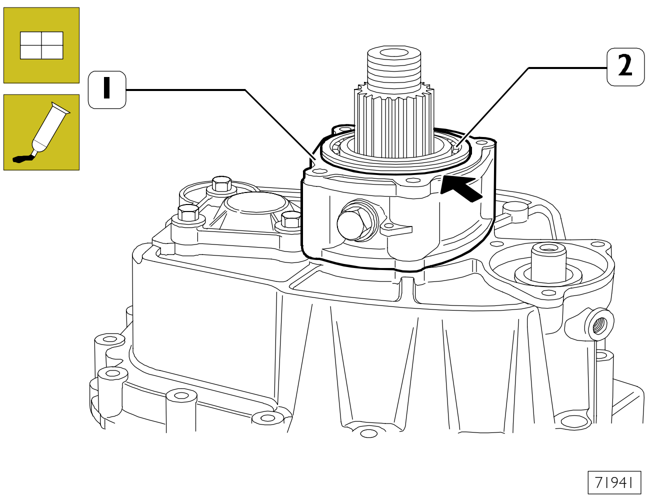
Place control fork (1) completed with rod as shown in the figure.

Figure 123



Key-in box (2) on planetary gear-holder shaft (1) and on rod for control fork (3). Key-in phonic wheel (4) on planetary gear-holder shaft (1).
Apply LOCTITE 510 sealant on contact surface (→) between case (2) and support.

Figure 124



Assemble support (1) completed with ball bearing (2).
Apply LOCTITE 510 sealant on contact surface (→) between support and cover.

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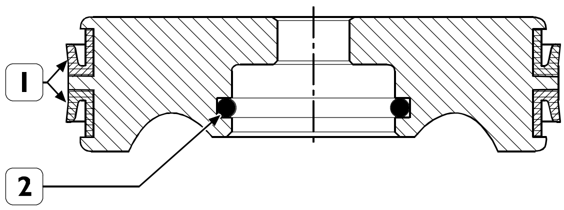
Figure 125

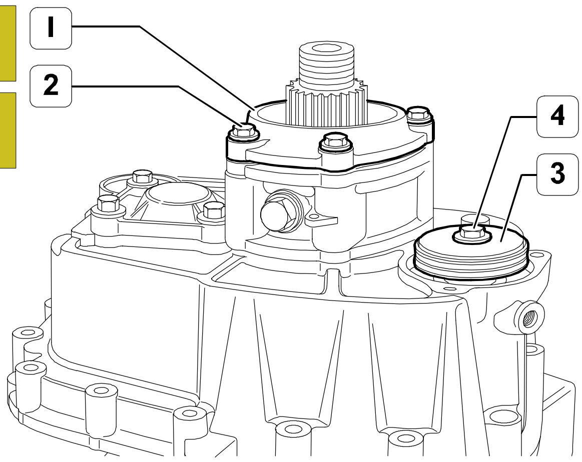


71958

Abundantly pre-lubricate gaskets (1 and 2) of oil piston equal to the one used for gearbox and assemble them into their respective seats, using suitable toolings in order to guarantee a correct assembly.

> ! Pay attention to the correct assembly of sealing gaskets (1) placed on external piston diameter.

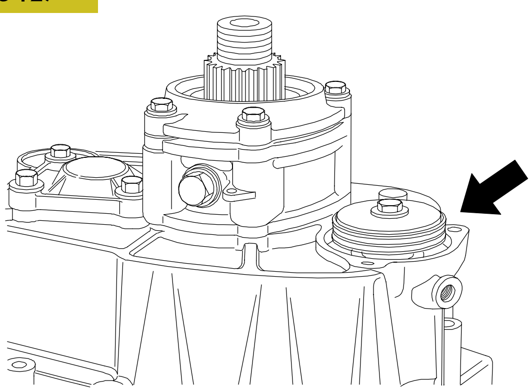
Figure 126



71942

Assemble cover (1) and screw screws (2) tightening them at the required torque.
Assemble piston (3) completed with sealing rings, screw the screw (4) by tightening it at the required torque.

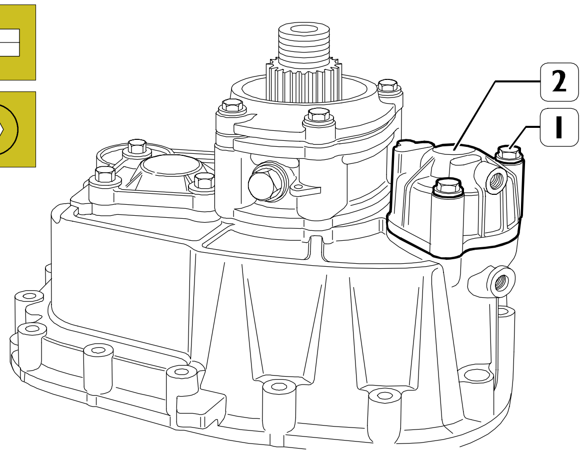
Figure 127



71943

Apply LOCTITE 510 sealant on contact surface (→) between case and cylinder.

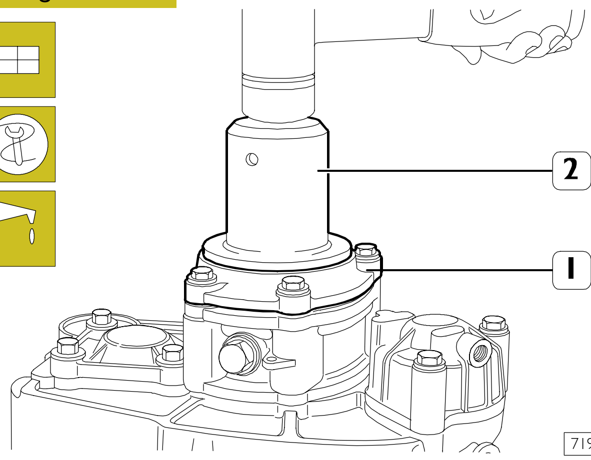
Figure 128



71944

Assemble cylinder (2) and screw screws (1) tightening them at the required torque.

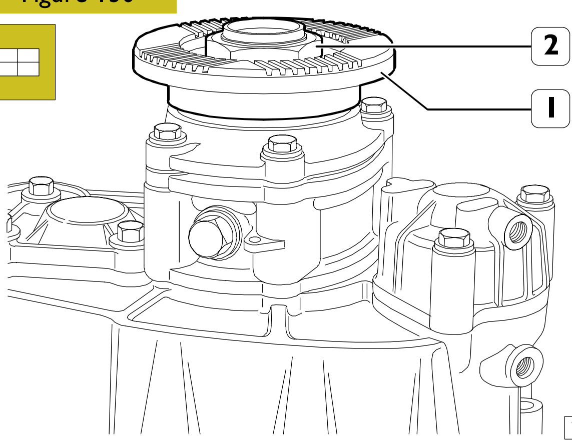
Figure 129



71945

Butter with hermetic type "B" the coupling surface of cover (1) with sealing gasket and with keyer 99574229 (2), assemble the sealing gasket itself.

Figure 130



71946

Key-in flange (1) and screw nut (2) without blocking it.

> ! Nut (2) must be blocked at the required torque after having assembled the reduction gear onto the gearbox.

5302 Allison gearbox MD 3060P

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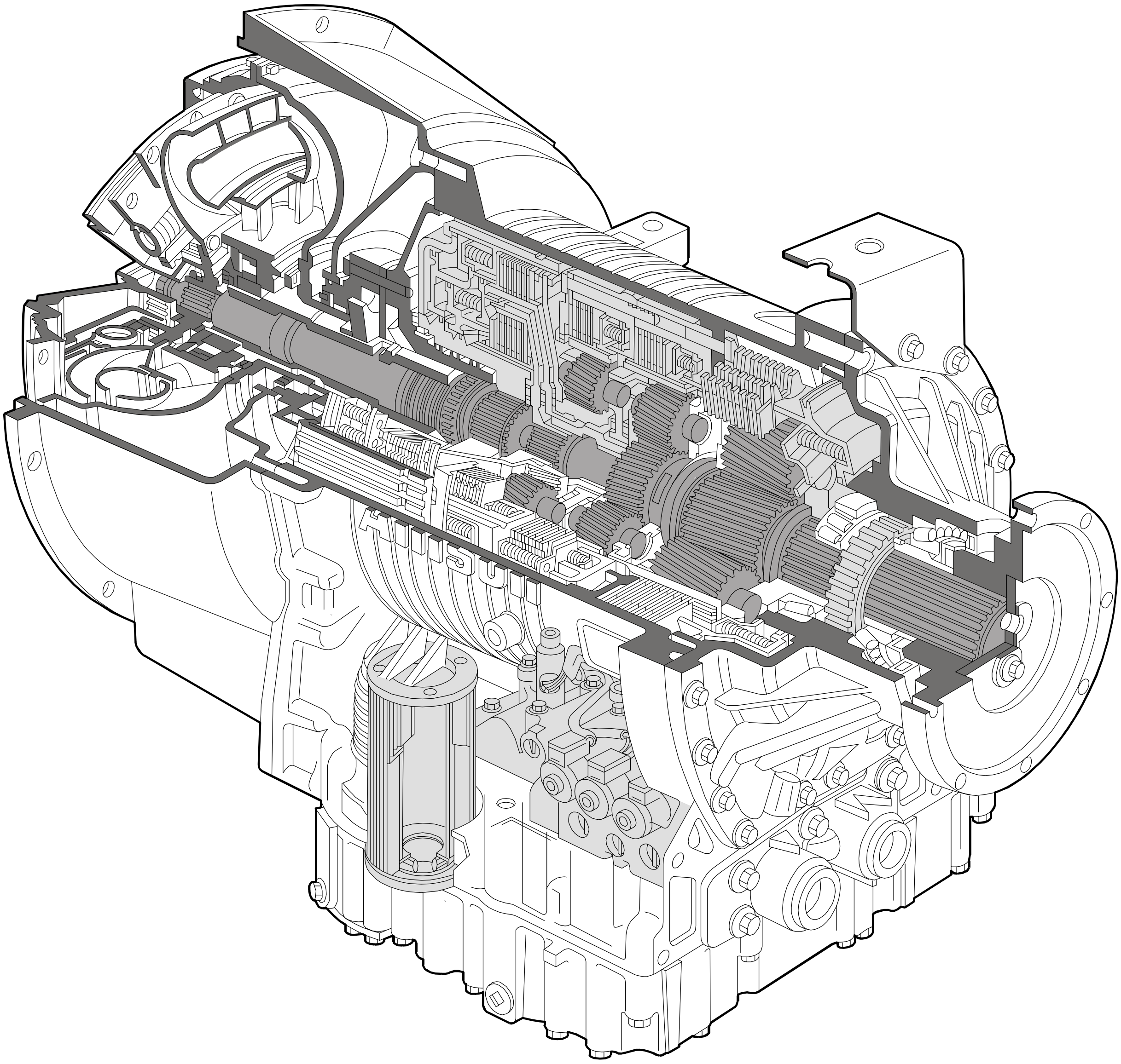
DESCRIPTION

The Allison MD 3060 P gearbox is automatic and it provides six forward speeds and one reverse speed by means of a hydrodynamic torque converter, two clutches, three brakes and tree crown wheels.

For all types of gearbox, 5th and 6th gears are overgeared up.

The reverse gear has a ratio that is greater than the first gear that allows a better speed control on slopes.

Figure 1



ALLISON AUTOMATIC GEARBOX

61402

Clutches are pressure-balanced on both piston sides to prolong the clutch life and for a more accurate control on the whole range of gearbox gears.

Planetary gears always being engaged are of the helical teeth type to allow a more silent gearbox operation.

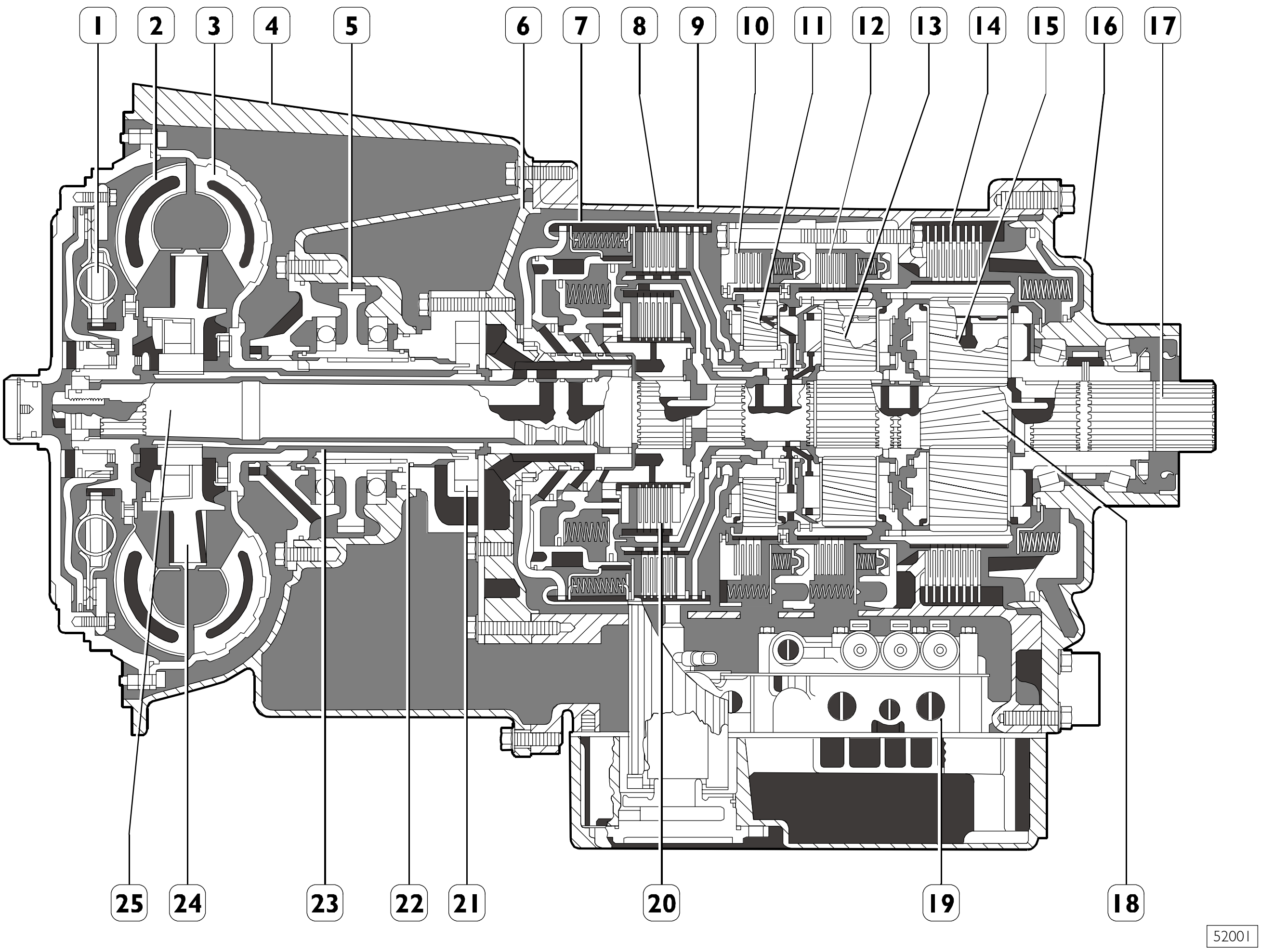
The hydrodynamic torque converter, in addition to being mandatory for vehicle start-up, allows a gearbox operation without shakes reducing wear of members composing the vehicle kinematic chain.

The torsional forces emitted by the engine are absorbed due to the clutch/damper lockup so that they are not transmitted to gears and the remaining parts of the transmission. The wide lockup operation reduces fuel consumption and improves braking efficiency.

Both gearboxes are equipped with the power takeoff gear. (5 - Figure 2).

The power takeoff can be installed on the left or on the right side of the converter box (8 - Figure 3; 3 - Figure 4).

Figure 2



ALLISON MD 3060 P AUTOMATIC GEARBOX
1. Exclusion clutch/torsional damper lockup - 2. Converter turbine - 3. Converter pump - 4. Converter box - 5. Power takeoff gear - 6. Front support - 7. Clutch box - 8. Clutch - 9. Main box - 10. Brake - 11. Front planetary gear - 12. Brake - 13. Central planetary gear - 14. Brake - 15. Rear planetary gear - 16. Rear cover - 17. Output shaft - 18. Main shaft - 19. Hydro-electric controls - 20. Clutch - 21. Oil pump - 22. Oil pump driving stub - 23. Front support sleeve - 24. Converter distributor - 25. Turbine shaft.

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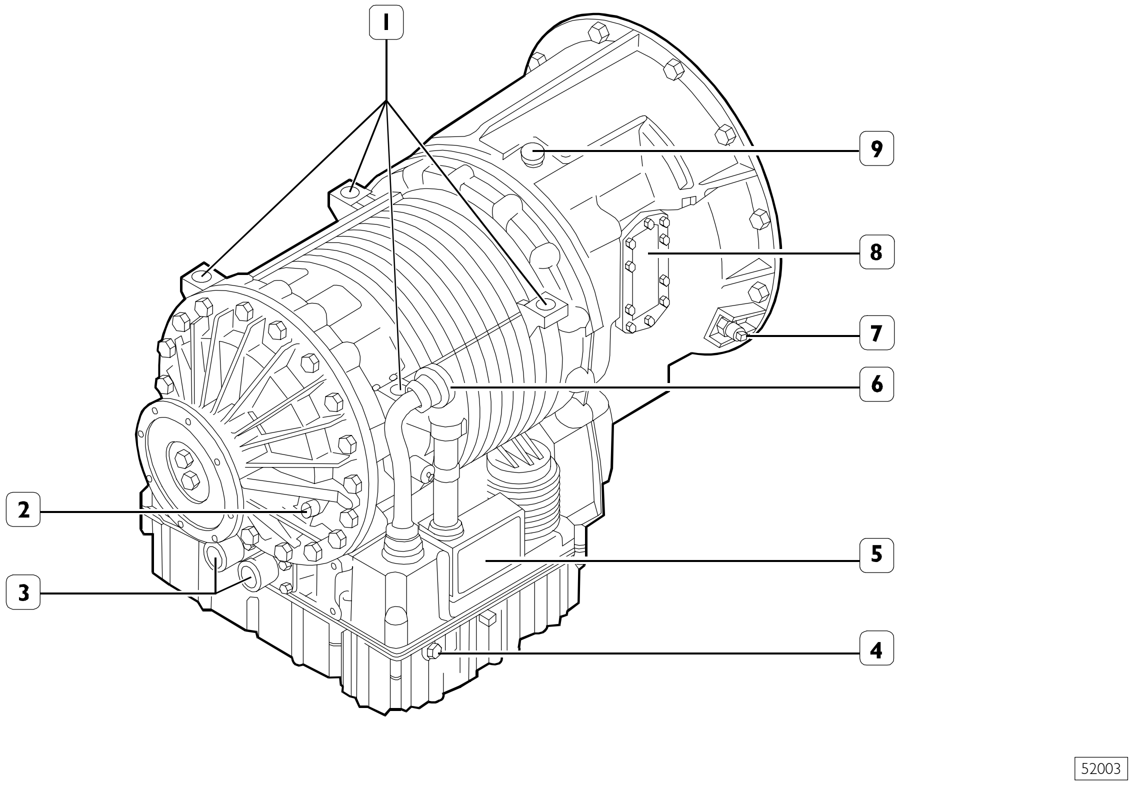
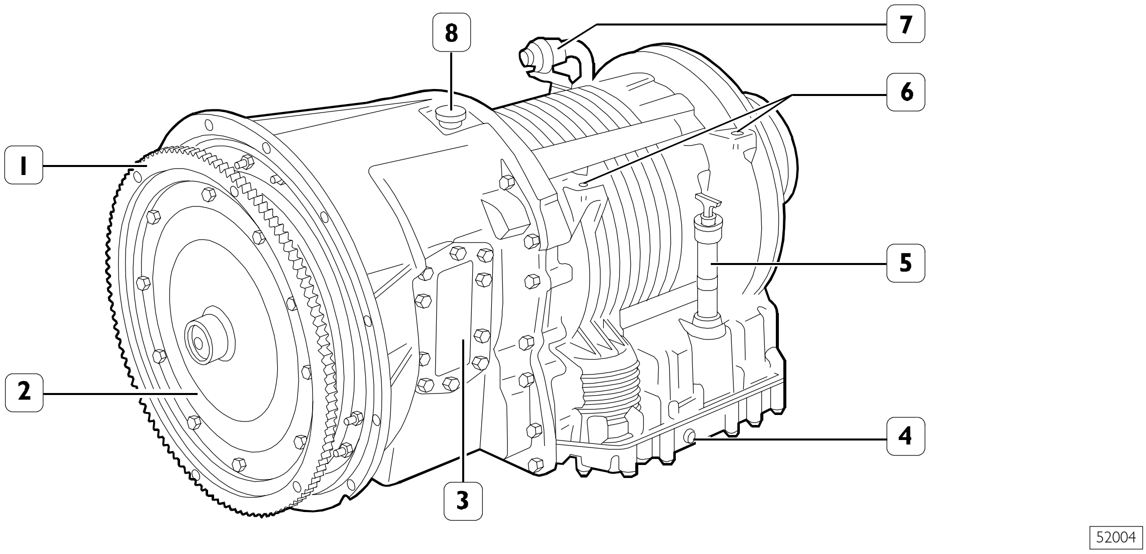
Figure 3



MD 3060 P AUTOMATIC GEARBOX REAR RIGHT VIEW
1. Assembly pads - 2. Output speed sensor - 3. Exchanger arrangement - 4. Main pressure inlet - 5. Identifying plate - 6. Electric gearbox wiring connector - 7. Engine revolution sensor - 8. Power takeoff connection (available on both sides) - 9. Exhaust.

Figure 4



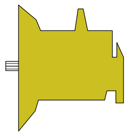
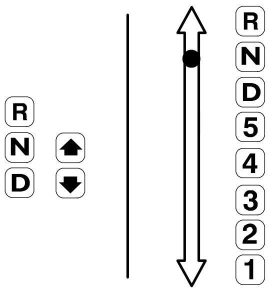
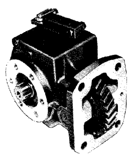
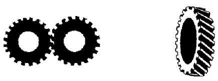
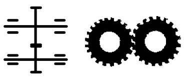
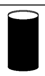
MD 3060 P AUTOMATIC GEARBOX FRONT LEFT VIEW
1. Start-up crown - 2. Front torque converter cover - 3. Power takeoff connection (available on both sides) - 4. Main power takeoff - 5. Oil filling pipe and level rod (available on both sides) - 6. Assembly pads - 7. Electric gearbox wiring connector - 8. Exhaust

Gear selection is controlled by an electronic transmission control system with a microcomputer.

The closed-loop control logic employed by the electronic control system allows the transmission to adapt to changes in the load, terrain or ambient conditions and to automatically compensate for fluctuations in engine power output and for component wear.

Electronic sensors provide information about the throttle position, the driving range selected by the driver, the engine speed and the turbine speed, the transmission output shaft speed and the various system pressures.

CHARACTERISTICS AND DATA

	TRANSMISSION	ALLISON MD 3060 P
	Type	Automatic
	Forward runnings Reverse running	6 forward gears and 1 reverse gears
	Power take-off	Optional
	Gears	With always-engaged helical teeth
	Gear ratios (*) First Second Third Fourth Fifth Sixth Reverse	3.49 1.86 1.41 1.00 0.75 0.65 5.03
	Type of oil Quantity	**Tutela GI/A** (28 litres)

(*) The gear ratio does not include torque converter gearing up

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MAIN OPERATION ANOMALIES

This paragraph lists main operation anomalies that are not identified by a diagnostic code.

For every problem, causes and related remedies are shown.

For the search of failures through a diagnostic code, refer to section "Electric/electronic system" of "Allison automatic gearboxes" Manual (printout No. 603.42.409)

The operation anomalies being examined in this section are as follows:

1 - The vehicle fails to start (engine is not started up);
2 - The gearbox does not perform forward range or reverse gear selections (it remains idle);
3 - The gearbox does not remain in forward gear or in reverse gear;
4 - The gearbox does not insert a specific selection;
5 - The gearbox does not correctly perform the selections;
6 - No response from gear selector;
7 - Clutch slippage and vibration in all ranges;
8 - Low main pressure in all ranges;
9 - Low lubrication pressure;
10 - Overheatings in all ranges;
11 - Some oil emerges from filling pipe and/or exhaust;
12 - Intermittent noises (hum);
13 - Oil leakage from output shaft;
14 - Dirty oil.

1 THE VEHICLE FAILS TO START (ENGINE DOES NOT START)

Selector lever not in neutral. — YES → Select N (neutral) and try again.

NO

Battery discharged. — YES → Recharge the battery.

NO

Battery disconnected. — YES → Connect the battery

2	THE GEARBOX DOES NOT PERFORM FORWARD RANGE OR REVERSE GEAR SELECTIONS (IT REMAINS IDLE)

Check		Action
Engine idle speed too high.	YES →	Adjust engine idle speed to between 500 and 800 rpm.
NO ↓		
Fluid level low.	YES →	Top up fluid to correct level.
NO ↓		
Connectors loose or dirty.	YES →	Connect or clean.
NO ↓		
Speed sensors faulty.	YES →	Replace speed sensors.

3	THE GEARBOX DOES NOT REMAIN IN FORWARD GEAR OR IN REVERSE GEAR

Check		Action
Fluid leaking from solenoid valve unit.	YES →	Overhaul the solenoid valve unit.
NO ↓		
Faulty solenoid valve.	YES →	Replace solenoid valve.

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4	THE GEARBOX DOES NOT INSERT A SPECIFIC SELECTION

Fault		Remedy
Incorrect fluid level.	YES →	Adjust fluid level.
NO ↓		
Speed sensors faulty.	YES →	Replace speed sensors.
NO ↓		
Fluid temperature sensor faulty.	YES →	Replace fluid temperature sensor.

5	THE GEARBOX DOES NOT CORRECTLY PERFORM THE SELECTIONS

Fault		Remedy
Engine idle speed too high.	YES →	Adjust engine idle speed to between 500 and 800 rpm.
NO ↓		
Speed sensors faulty.	YES →	Replace speed sensors.
NO ↓		
Speed sensors loose.	YES →	Tighten speed sensor mounting bolts.

(To be continued)

Incorrect fluid level. — YES → Adjust fluid level.

NO ↓

Solenoid valves stuck or blocked. — YES → Overhaul valve block. Replace defective valves.

6	NO RESPONSE FROM GEAR SELECTOR

Incorrect fluid level. — YES → Adjust fluid level.

NO ↓

Line pressure low. — YES → See point 8.

NO ↓

Solenoid valves stuck or blocked. — YES → Overhaul valve block. Replace defective valves.

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7 CLUTCH SLIP AND VIBRATION IN ALL RANGES

Incorrect signals from speed sensors. — YES → Replace the speed sensors.

NO

Incorrect fluid level. — YES → Adjust fluid level.

NO

Line pressure low. — YES → See point 8.

8 LOW LINE PRESSURE IN ALL RANGES

Incorrect fluid level. — YES → Adjust fluid level.

NO

Line filter clogged. — YES → Replace filter.

NO

Intake filter blocked or faulty. — YES → Clean or replace intake filter.

NO

Leaks from control module. — YES → Replace seals. Tighten any loose screws.

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9 LOW LUBRICATION PRESSURE

Incorrect fluid level.	YES →	Adjust fluid level.
NO ↓		
Lubrication filter clogged.	YES →	Replace filter.

10 OVERHEATING IN ALL RANGES

Air in fluid. Incorrect fluid level.	YES →	Adjust fluid level.
NO ↓		
Temperature sensor inaccurate.	YES →	Replace temperature sensor.

11 SOME OIL EMERGES FROM FILLING PIPE AND/OR EXHAUST

Dipstick cap loose or worn.	YES →	Tighten dipstick cap. Replace dipstick if necessary.
NO ↓		
Fluid level too high.	YES →	Drain off fluid to obtain correct level.

(To be continued)

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Breather clogged.	YES →	Clean or replace breather.

12 INTERMITTENT NOISE (BUZZING)

Fluid level low.	YES →	Top up to correct level.
↓ NO		
Air entering system through fluid intake filter cartridge.	YES →	Replace filter cartridge.
↓ NO		
Fluid filters clogged.	YES →	Replace fluid filters.
↓ NO		
Air in fluid causes noisy operation of pump.	YES →	Adjust fluid level.
↓ NO		
Line pressure low.	YES →	See point 8.

13	**OIL LEAKAGE FROM OUTPUT SHAFT**

Seal in output flange faulty or missing.	YES →	Fit a new seal.
NO ↓		
Bolts of output flange loose.	YES →	Tighten output flange bolts.
NO ↓		
O-ring of flange retaining plate damaged or missing.	YES →	Replace flange retaining plate O-ring.

14	**DIRTY OIL**

Fluid and filters require changing.	YES →	Change fluid and filters.
NO ↓		
Overheating.	YES →	See point 10.
NO ↓		
Fluid filters/seals damaged.	YES →	Replace filter/seals.
NO ↓		
Inferior quality fluid.	YES →	Use recommended fluid.

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TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Screws securing converter box to engine	49 to 58	(4.9 to 5.8)
Screws securing adapter - flexible plate	34	(3.4)
Hose fittings for gearbox-exchanger connection	54 to 68	(5.4 to 6.8)
Connection ring nut of external wiring to electric gearbox connector	2 to 3	(0.2 to 0.3)
Screws securing control module to gearbox	57 to 68	(5.7 to 6.8)
Oil filter covers screws	51 to 61	(5.1 to 6.1)
Oil drain plug	25 to 32	(2.5 to 3.2)
Turbine speed sensor securing screw	12 to 14	(1.2 to 1.4)
Engine revolution sensor securing screw	30 to 35	(3 to 3.5)
Output speed sensor securing screw	30 to 35	(3 to 3.5)
Suction filter cover securing screw	12 to 14	(1.2 to 1.4)
Screw securing valve bodies to control module	12 to 14	(1.2 to 1.4)
Screws connecting pressure switch to valve body	5 to 8	(0.5 to 0.8)
Electronic gearbox connector screws	5 to 7	(0.5 to 0.7)
Pressure plugs on gearbox bottom	10 to 13	(1 to 1.3)
Output flange screws	30 to 35	(3.0 to 3.5)
Vent	12 to 16	(1.2 to 1.6)

TOOLS

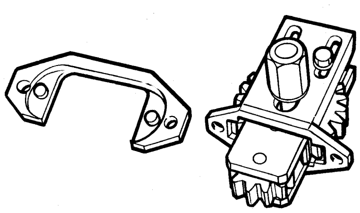
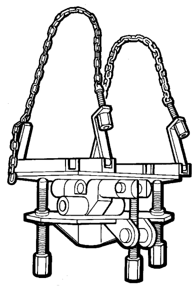
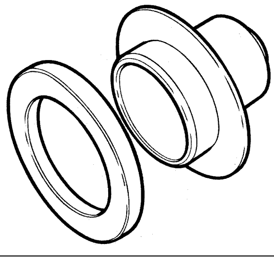
TOOL No.		DENOMINATION
99360322		Engine flywheel rotation tool
99370629		Gearbox bearing support during vehicle disconnection and re-connection
99374013		Keying device for sealing ring assembly

Figure 5

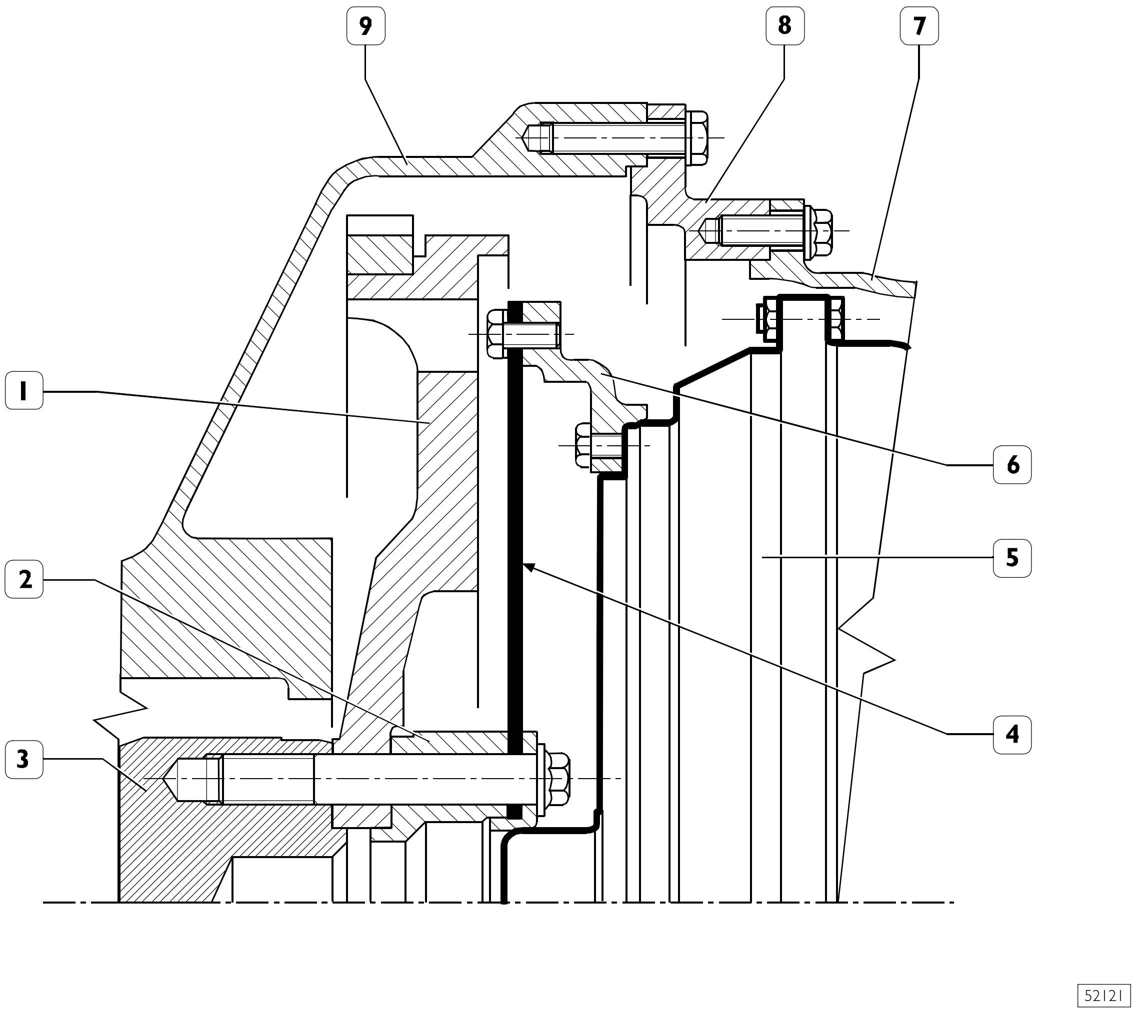
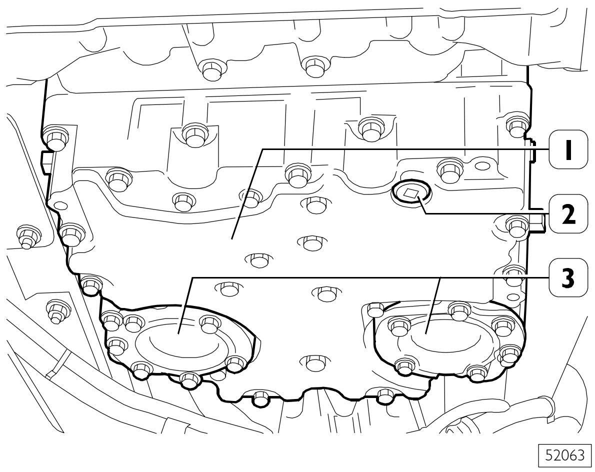


DIAGRAM SHOWING CONNECTION BETWEEN TRANSMISSION AND ENGINE
1. Engine flywheel - 2. Spacer - 3. Crankshaft - 4. Connection plate - 5. Transmission - 6. Connection plate adapter - 7. Converter housing - 8. Coupling flange - 9. Flywheel housing.

DISCONNECTING AND CONNECTING GEARBOX CONTROL MODULE AGAIN

Disconnecting

Figure 6



Position vehicle on a bridge.

Drain gearbox oil at operating temperature (71° ÷ 93°C) removing the drain plug (2) of the control module (1). After having discharged the oil, re-assemble the plug (2) with a tightening torque equal to 25 ÷ 32 Nm.

Disassemble oil filter covers (3) by unscrewing the 12 screws securing the gearbox control module. Remove filters and gaskets.

Disconnect the electric connector connecting external wiring to gearbox.

Hold gearbox control module with a proper hydraulic jack fitted with a support (module weighs 25 kg.).

Unscrew all the screws securing the gearbox control module to the main box.

By adequately operating, remove control module from gearbox compartment.

Refitting

To assemble gearbox control module, properly reverse operations described at disconnecting.

Comply with torque shown in table on page 177.

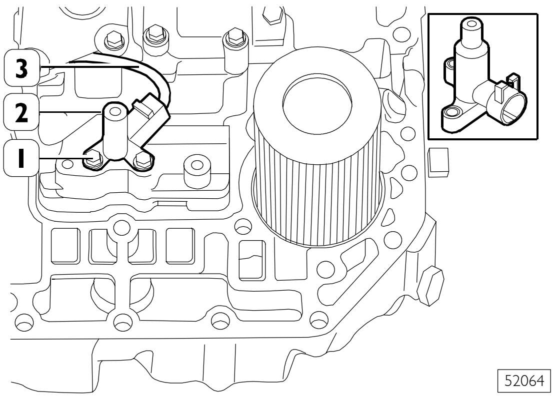
At the end of assembly check whether oil drain plug is well tightened, then introduce 28 litres of Tutela GI/A oil through filling pipe.

The below-described repair interventions deal only with replacement of faulty components: for possible diagnostics information pertaining there to, refer to Section "Electric/electronic system" of "Allison automatic gearboxes" Manual (printout No. 603.42.409).

REPLACING SPEED SENSORS

Replacing turbine speed sensor

Figure 7



To replace turbine speed sensor (2), disassemble gearbox control module complying with the previously described procedure.

Disconnect wiring from sensor (3).

Unscrew the two screws (1) connecting sensor to valve casings.

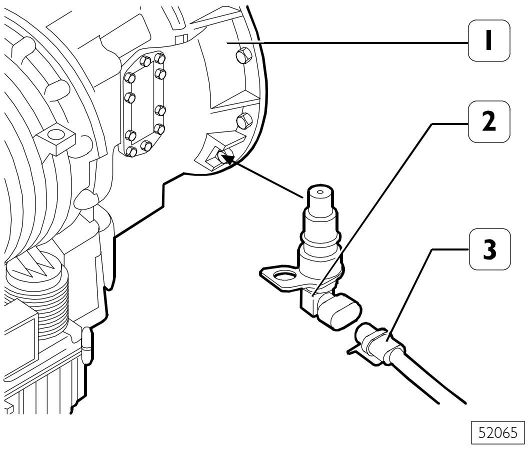
Install the new sensor by tightening screws (1) to a torque of 12 to 14 Nm.

Connect wiring (3) to sensor.

Assemble gearbox control module again according to the previously described procedure.

Engine revolutions sensor replacement

Figure 8



Disconnect wiring (3) of engine revolution sensor (2).

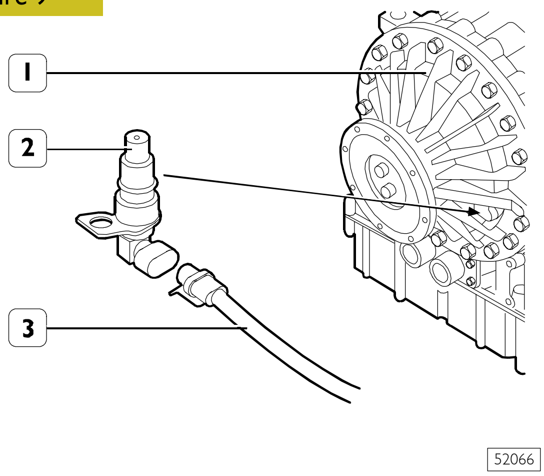
Remove sensor (2) by unscrewing the screw securing it to converter cover (1).

Install the new sensor by tightening the stop screw to a torque of 30 to 35 Nm.

Connect wiring (3) to sensor.

Replacing the output speed sensor

Figure 9



Disconnect wiring (3) from output speed sensor (2).

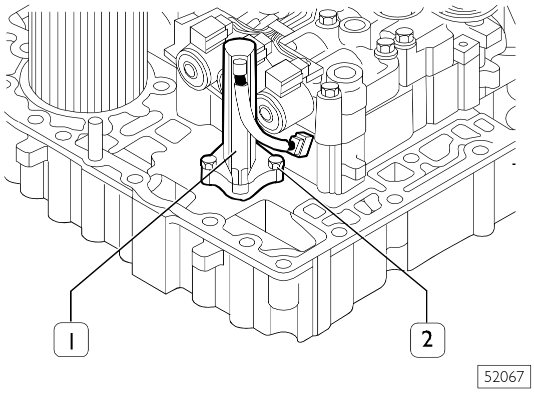
Remove sensor (2) by unscrewing the screw securing it to the rear cover (1).

Install a new sensor by tightening the stop screw to a torque of 30 to 35 Nm.

Connect wiring (3) to sensor.

REPLACING OIL LEVEL SENSOR

Figure 10



To replace oil level sensor (1) disassemble gearbox control module according to the procedure described in this Section on page 179.

Disconnect wiring from sensor (1).

Unscrew screws (2) an d remove sensor.

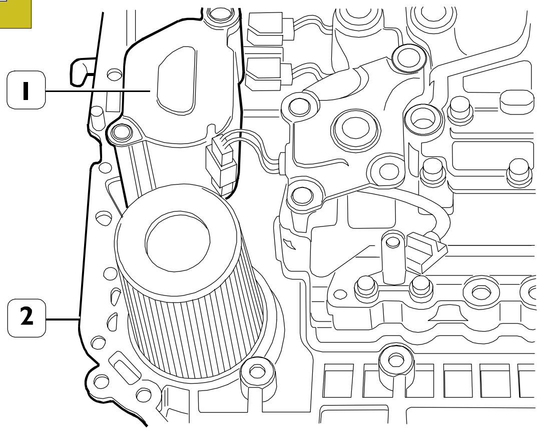
Install the the new sensor by tightening the connecting screws according to the prescribed torque.

Connect wiring to sensor (1).

Assemble gearbox control module again according to the procedure described in this Section on page 179.

REPLACING OIL SUCTION FILTER

Figure 11

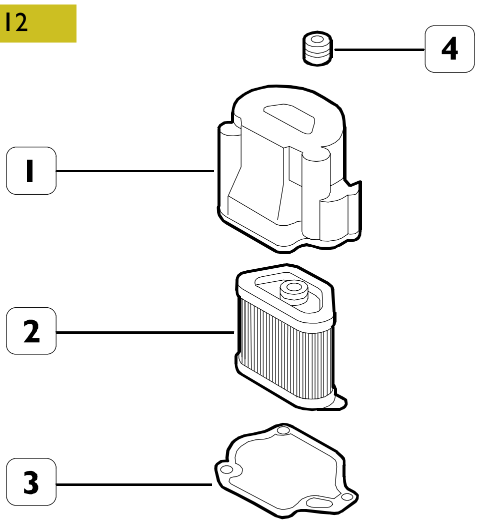


52068

Disassemble gearbox control module according to the procedure described in this Section on page 179.

Disassemble filter cover (1) by unscrewing the screws securing it to oil sump (2).

Figure 12



52069

Remove cover (1) and replace filter (2), gasket (3) and seal (4).

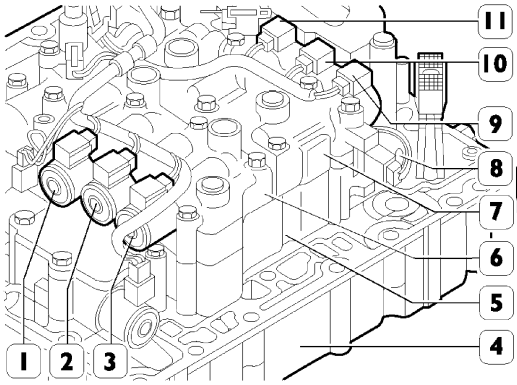
Install cover (1) and tighten securing screws to a torque of 12 to 14 Nm.

Assemble gearbox control module again according to the procedure described in this Section on page 179.

REPLACING THE SOLENOID VALVES

Disassemble gearbox control module according to the procedure described in the present Section on page 179.

Figure 13



52070

a) Solenoid valves (1), (2) and (3) belong to the N/C type (Normally Closed). To operate on these solenoid valves disconnect the wiring corresponding to the valves and disassemble valve casings (6) from the gearbox control module by unscrewing the screws connecting it to the oil sump (4).

b) Solenoid valves (9) and (11) belong to the N/O type (Normally open); solenoid valve (10) belongs to the N/C type (Normally Closed). For operating on these solenoid valves, disconnect the wiring corresponding to the different valves and disassemble valve casings (7) from the gearbox control module by unscrewing the screws connecting it to the oil sump (4).

c) To replace solenoid valve (8) (N/C type), disconnect wiring from all the solenoid valves and disassemble valve casing (6) and (7), by unscrewing the screws securing them to the oil sump (4). Remove separating plate dividing valve casings (6) and (7) from valve casing (5): Remove casing (5) from gearbox control module.

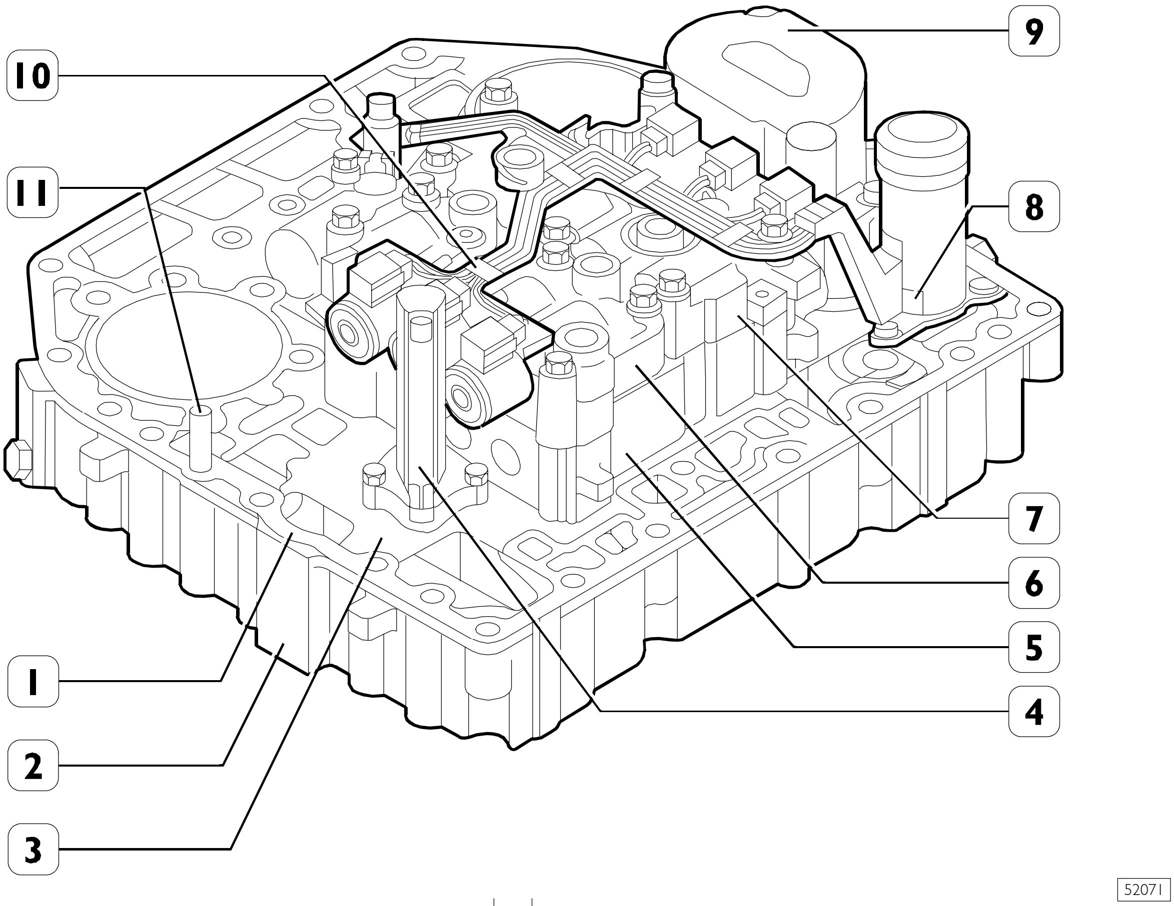
In the three case (a, b, c) proceed as follows with replacing the failed solenoid valve after disassembling the valve casing containing it:

- ❏ Remove the pin securing the solenoid valve from the valve casing bottom.
- ❏ Remove the failed solenoid valve from the valve casing.
- ❏ Install the new solenoid valve with the two O-rings in the kit.
- ❏ Use the pin to lock the solenoid valve.

After replacing the solenoid valve assemble the solenoid valve casings again by properly reversing the operations described in items a, b, c, and tighten screws to a torque of 12 to 14 Nm. Re-assemble the control module according to the procedure described in the present Section on page 179.

REPLACING PLANE GASKETS IN GEARBOX CONTROL MODULE

Figure 14



Disassemble the gearbox control module according to the procedure described in this Section on page 179.

The control module is connected to the main gearbox box by interposing a plane gasket (1), that can be replaced once having disassembled the control module.

There is second plane gasket interposed between the oil sump (2) and the separating plate (3) on which the control module components are laying.

To replace this last gasket, proceed as follows after disassembling the control module from the remaining part of the gearbox:

- ❑ Disconnect all the internal wiring connectors (10);
- ❑ Disassemble electric connector (8) from control module;
- ❑ Disassemble the oil suction filter (9);
- ❑ Disassemble the oil level sensor (4);
- ❑ Disassemble the valve casings (5), (6), (7);
- ❑ Remove the separating plate (3);
- ❑ Replace the worn out gasket with a new one and position it on oil sump (2) with the help of guiding pins (11);

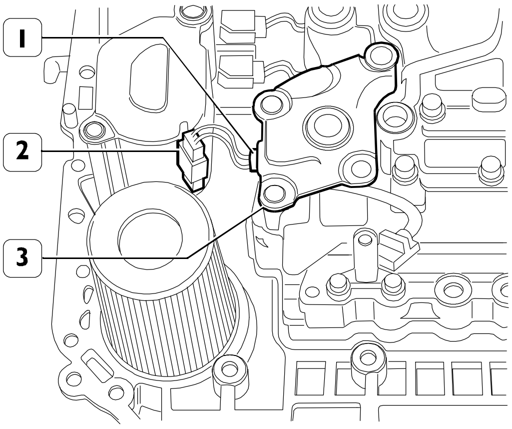
Assemble the control module again by properly reversing the above mentioned operations.

Comply with torque shown in table on page 177.

Connect control module again to the main gearbox seat complying with the procedure described in this Section on page 179.

REPLACING PRESSURE SWITCH F3

Figure 15



52072

Disassemble the control module according to the procedure described in this Section on page 179.

Disconnect connector (2) in pressure switch (1).

Remove pressure switch (1) by unscrewing the two screws connecting it to valve casing (3).

Install the new pressure switch and use the O-ring in the kit.

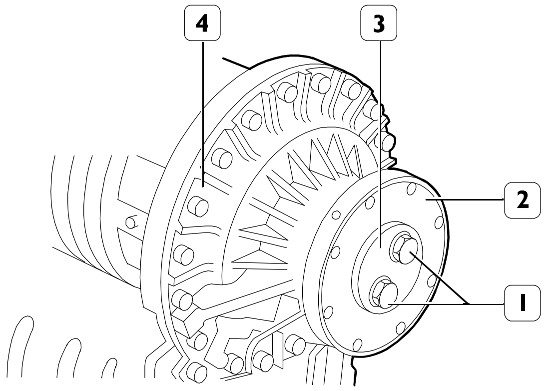
Tighten the securing screws to a torque of 5 to 8 Nm.

Connect the pressure switch connector again.

Assemble the control switch again according to the procedure described in this Section on page 179.

REPLACING THE SEAL RING ON THE OUTPUT SHAFT

Figure 16



52074

Disconnect the transmission shaft from gearbox flange (2).

Unscrew screws (1) connecting securing plate (3) to the gearbox output shaft.

Remove the safety plate, the securing plate, the O-ring and the gasket.

Remove flange (2) from the rear cover (4) and use a proper tool to remove the seal ring.

Clean the seal ring seat and remove any slag present.

Replace the seal ring and the O-ring. Use keying device 99374013 to insert the seal ring in its seat.

Assemble gearbox flange again by properly reversing the above mentioned operations.

Tighten screws (1) to a torque of 30 to 35 Nm.

Connect the transmission shaft to the gearbox again.

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5302 Gearbox EATON FSO 5206B

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DESCRIPTION

The Eaton FSO 5206 B gearshift is of the mechanic type, with synchronized forward gear engagement.

The gearbox is made of light alloy and is made up of a front half case, a rear half case (which incorporates the gear engagement gearing and controls), a drive case and a clutch bell.

The rear half case has, on its sides and rear portions, special openings for insertion of power takeoffs (where required).

Motion is transmitted by means of a constant-mesh gear set with helicoidal teeth (for $6^{th}/5^{th}$ - $4^{th}/3^{rd}$ speeds) and straight teeth (for 1^{st} speed and reverse).

The gears force-fitted onto the output shaft and the gear on the reverse gear shaft rotate idle on cylindrical roller cages.

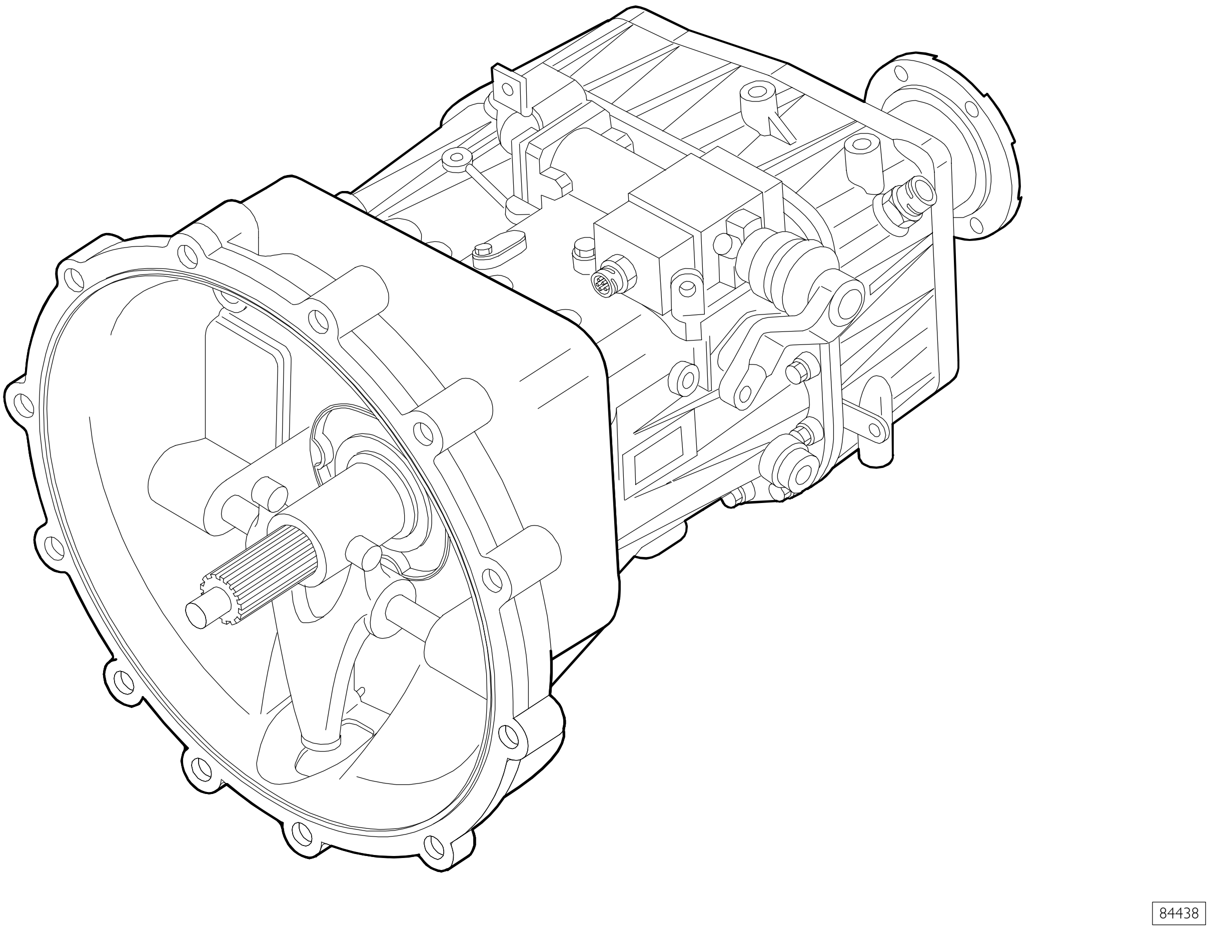
The motion inlet shaft and the output shaft are supported, in the gearbox, by non-adjustable roller bearings.

The countershaft is supported, in the gearbox, by tapered-roller bearings that can be adjusted axially by means of ring shims.

Gear engagement synchronization is obtained by means of free-ring synchronizers with single cone (for 5^{th}, 4^{th}, 3^{rd} speeds and reverse) and double cone (for 1^{st} and 2^{nd} speeds).

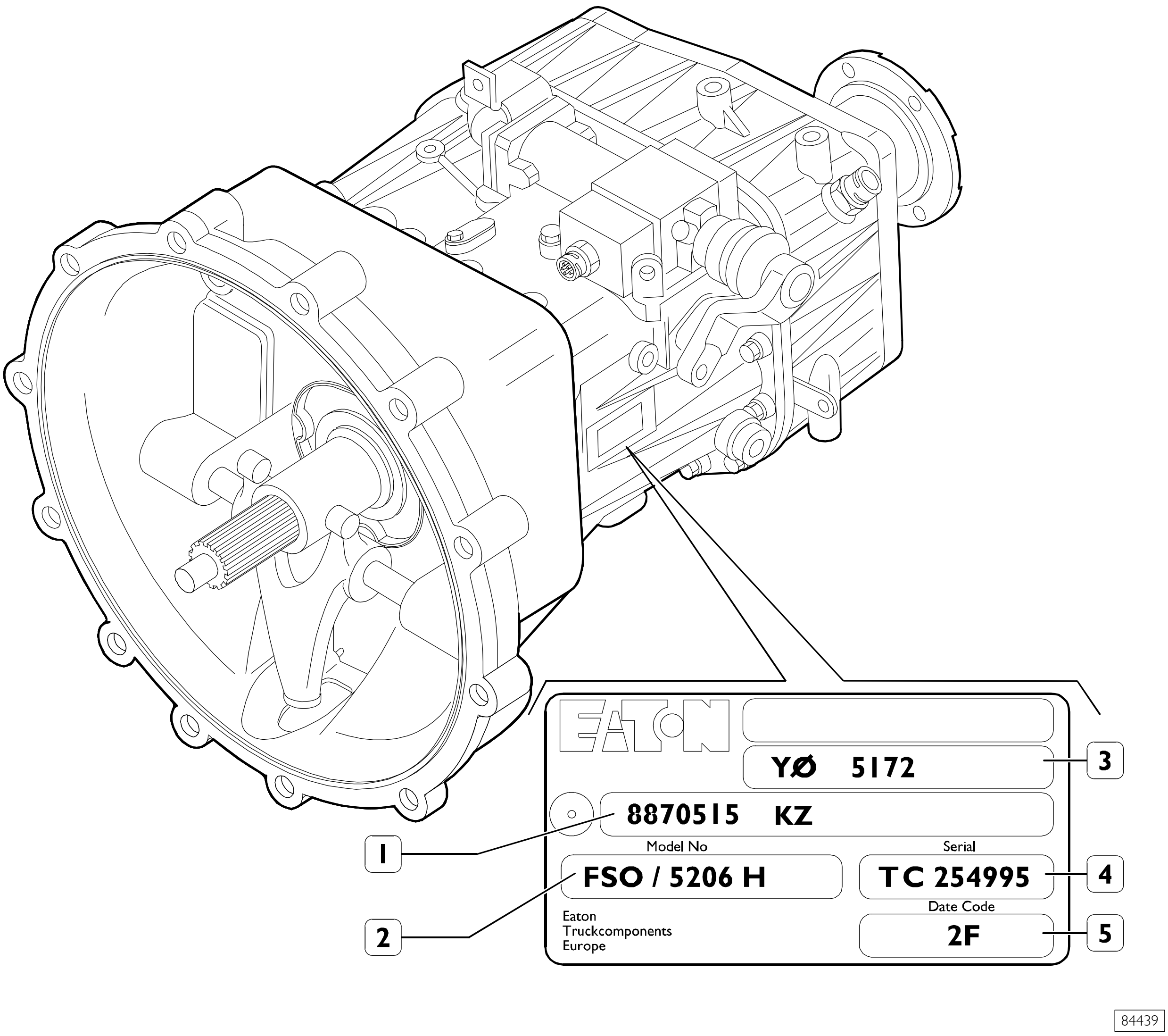
The gear engagement and selection control is of the mechanic type and is obtained by a rod on which the three engaging forks and the 4^{th} - 5^{th} speed engagement fork control block are force-fitted.

Figure 1



POSITION OF GEARSHIFT IDENTIFICATION TAG

Figure 2



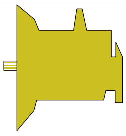
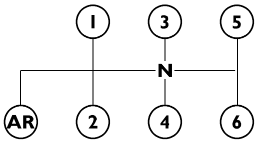
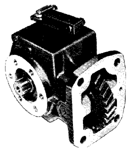
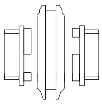
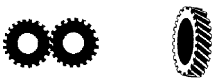
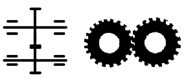
Type of transmission
FSO 5206 H

FS	Standard code
O	Overdrive
5	Rated torque, x 100 lb ft (foot-pound)
2	Series 1
06	Number of forward speeds
H	Type of specific ratio

Design no.
Y 05172

The gearbox design number is unique to each customer and provides accurate information on the gearbox design level. The number must be specified when ordering spare parts.
The middle digit indicates the design level.

SPECIFICATIONS AND DATA

	GEARBOX	Eaton FSO 5206B
	Type	Mechanical
	Gears	6 forward gears reverse gear
	Gears engagement control	Mechanical
	Power takeoff (optional)	-1, On rear part -1, On side part
	Gears engagement: ❑ 5th – 6th / 3rd – 4th ❑ 1st – 2nd Reverse gear Gears anti-disengagement - 1st – 2nd - 3rd – 4th / 5th – 6th	 Double-cone synchronizer Free-ring synchronizer Quick-connection type Retention of sliding sleeves by means of springs, pins, balls and dowels springs, pins and rollers
	Gears - 1st – 2nd - 3rd – 4th / 5th – 6th	constant-mesh straight teeth helicoidal teeth
	Gear ratio First Second Third Fourth Fifth Sixth (overdrive) Reverse gear	 6.08 3.52 2.09 1.35 1.00 0.79 5.43
	Oil type Amount	**TUTELA ZC 90** 6.5 Kg. (7 lt)

SPECIFICATIONS AND DATA

Output shaft		
	Output shaft bearings	cylindrical roller type
	Assembling temperature: - fixed hubs - bushings - bearings - motion outlet flange	85°C
	Gear axial play: - 1st speed - 2nd - 3rd - 4th speeds - 5th - 6th speeds	 0.40 to 0.57 0.35 to 0.48 0.31 to 0.53
	Play, in the seat, of fixed hub retaining snap rings	as near to zero as possible
	Fixed hub retaining snap ring thickness	
Motion inlet shaft		
	Motion inlet shaft bearing	cylindrical roller type
	Motion inlet shaft bearing	85°C
	Play, in the seat, of bearing retaining snap rings	as near to zero as possible
	Bearing retaining snap ring axial play adjusting ring thickness mm	3.70 - 3.75 - 3.80 - 3.85 - 3.90 - 3.95
Countershaft		
	Countershaft bearings	tapered-roller type
	Countershaft bearing assembling temperature	85°C
	Countershaft bearing axial play adjustment	by means of shims
	Play, in the seat, of bearing retaining snap rings	as near to zero as possible
	Bearing retaining snap ring thickness	2.12 - 2.07 - 2.02 - 1.97 - 1.92 - 1.87 - 1.82 - 1.77

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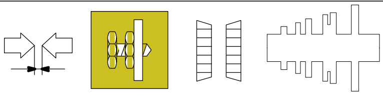
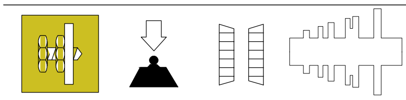
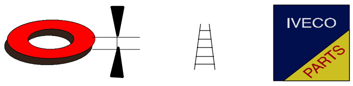
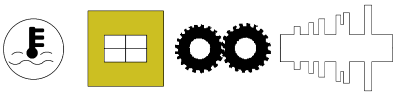
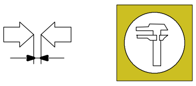
SPECIFICATIONS AND DATA

Countershaft		
	Bearing axial play: - new - used	 0.075 to 0.125 0.00 to 0.05
	Countershaft bearing preload adjustment	By means of rings
	Countershaft preload adjustment rings thickness	mm 0.051 - 0.127 - 0.254 - 0.508 - 2.40 Supplied in special kits
	Countershaft gear assembling temperature	150°C
Synchronizers		
	Synchronizing ring wear limit check dimension mm	0.5 to 1.9
	LOCTITE sealant: - for mating surfaces between cases and covers - matching body on motion inlet shaft	 5900 648

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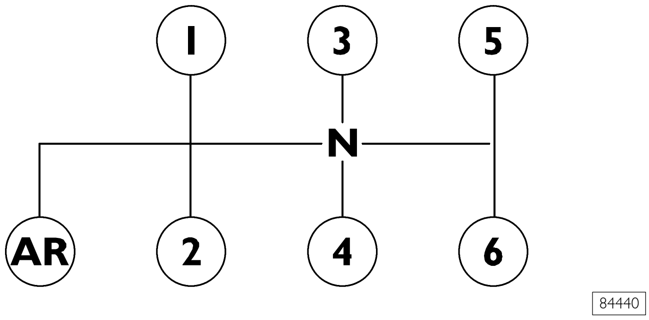
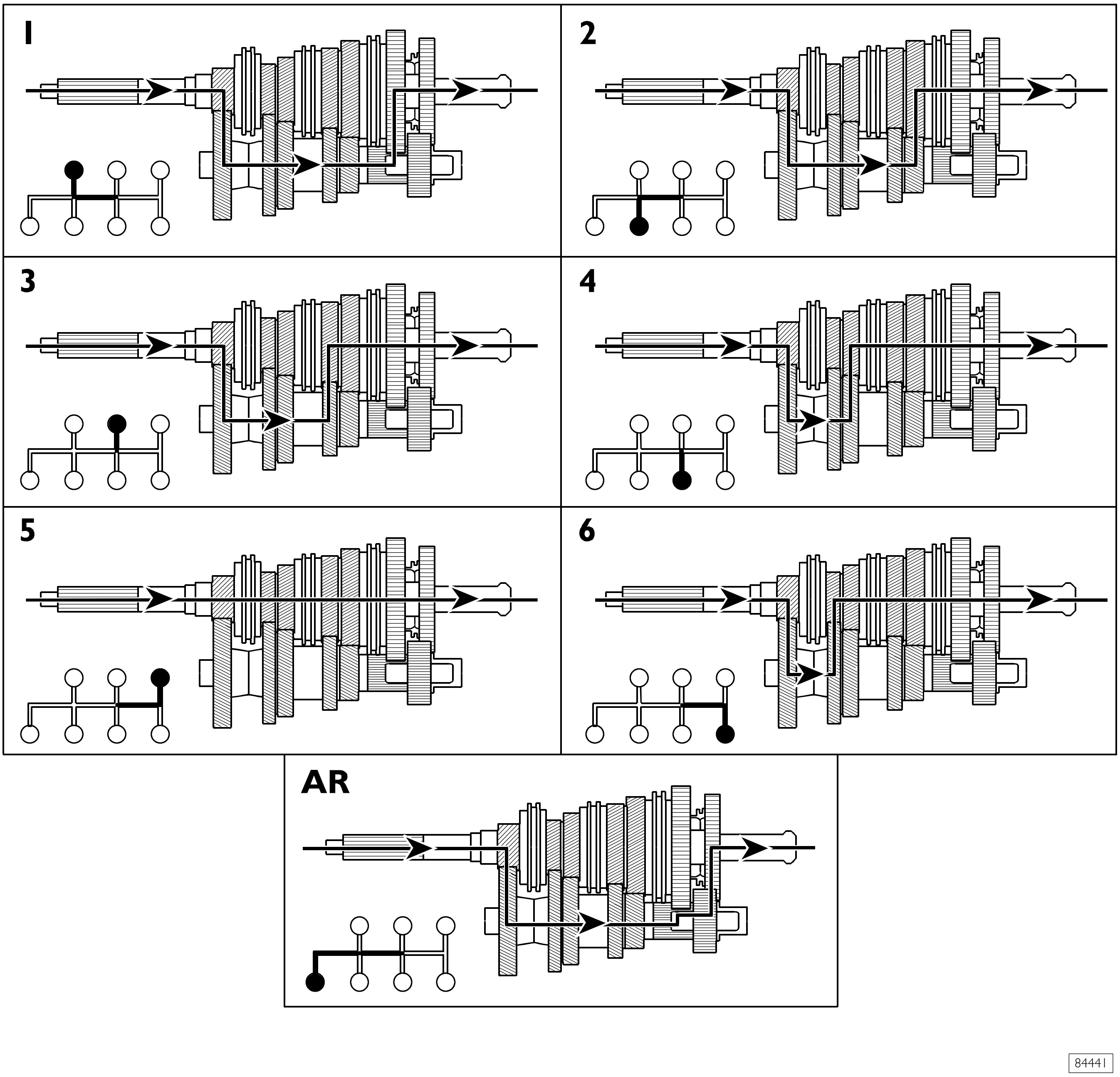
Gear selection and engagement grid

Figure 3

Plain grid with idle between the 3rd and 4th speeds.
Diagram of motion transmission with the various speeds.





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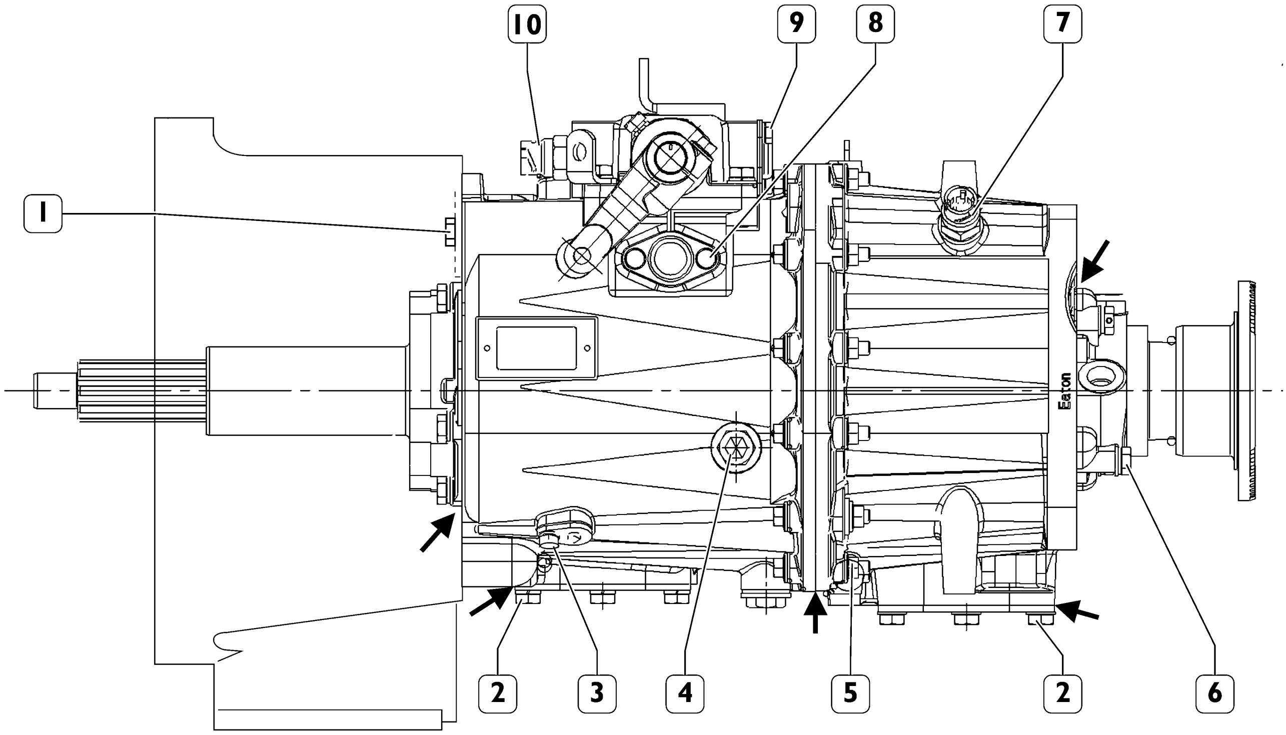
TIGHTENING TORQUES

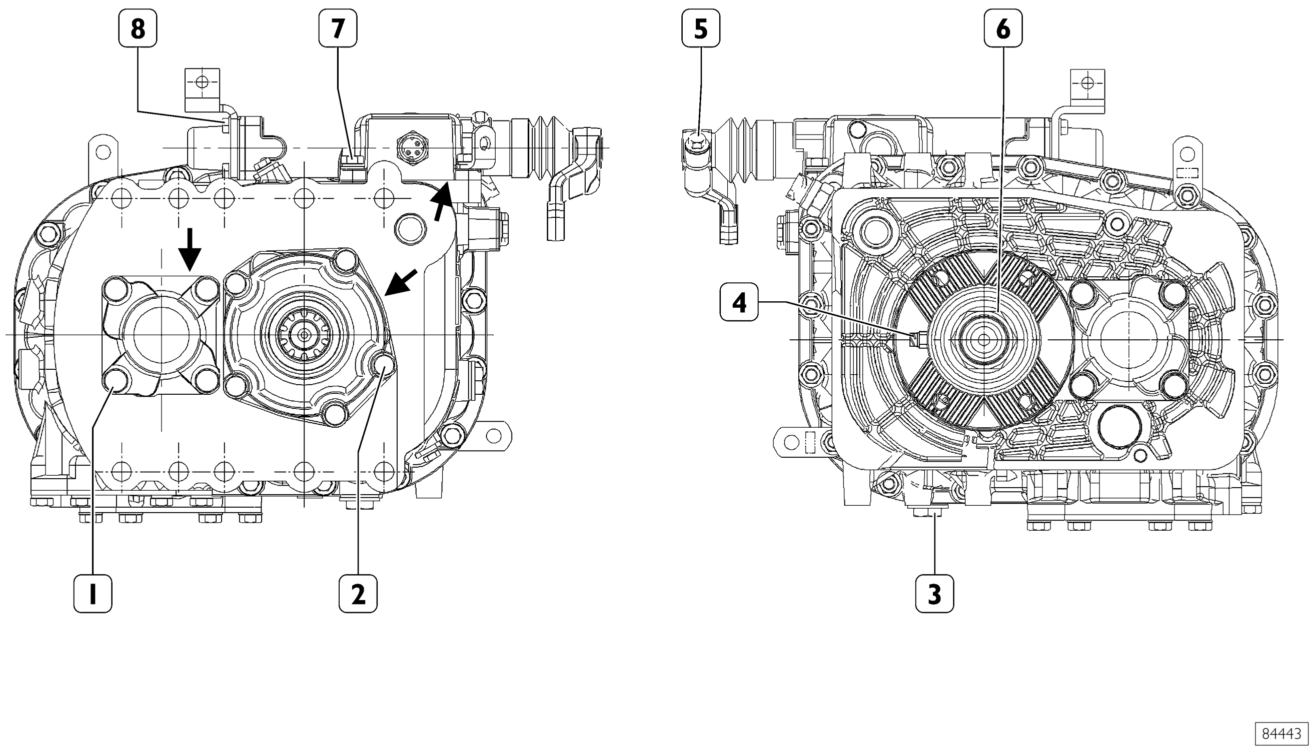
Figure 4



PART		TORQUE Nm	TORQUE (kgm)
1	Screws fastening the clutch bell to the front case	69 ÷ 78	6.9 ÷ 7.8
2	Screws fastening the cover to the case	35 ÷ 39	3.5 ÷ 3.9
3	Screw fastening the 6th - 5th speed fork trunnions	20 ÷ 24	2 ÷ 2.4
4	Oil level check cap	32 ÷ 37	3.2 ÷ 3.7
5	Screws or nuts for the screws fastening the front half case to the rear half case	51 ÷ 58	5.1 ÷ 5.8
6	Screws fastening the cover to the half case	35 ÷ 39	3.5 ÷ 3.9
7	Reverse light switch	16 ÷ 22	1.6 ÷ 2.2
8	Screw fastening the small cover to the case	20 ÷ 24	2 ÷ 2.4
9	Screw fastening the small cover to the gearbox drive case	20 ÷ 24	2 ÷ 2.4
10	Neutral gear switch	16 ÷ 22	1.6 ÷ 2.2
→	Apply LOCTITE 518 on the mounting surface		

⚠ Apply Loctite 641 on all threads (unless otherwise specified).

Figure 5



PART		TORQUE	
		Nm	(kgm)
1	Screw fastening the cover to the case	69 ÷ 78	6.9 ÷ 7.8
2	Screws fastening the cover to the case	69 ÷ 78	6.9 ÷ 7.8
3	Oil drain cap	32 ÷ 37	3.2 ÷ 3.7
4	Odometer revs sensor	16 ÷ 22	1.6 ÷ 2.2
5	M8 M10	20 ÷ 27 35 ÷ 39	2 ÷ 2.7 3.5 ÷ 3.9
6	Locknut fastening the motion outlet flange to the output shaft	490 ÷ 588	49 ÷ 58.8
7	Screws fastening the gearbox drive case to the front case	35 ÷ 39	3.5 ÷ 3.9
8	Screws fastening the side cover to the gearbox drive case	20 ÷ 24	2 ÷ 2.4
•	Tapered screw fastening the selector block to the gear control rod; apply LOCTITE 242 on the thread	35 ÷ 39	3.5 ÷ 3.9
→	Apply LOCTITE 518 on the mounting surface		

Apply Loctite 641 on all threads (unless otherwise specified).

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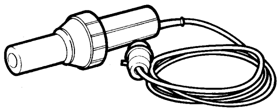
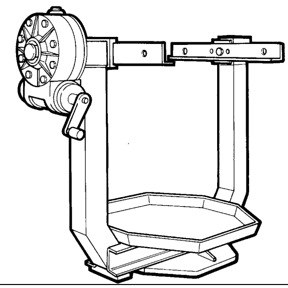
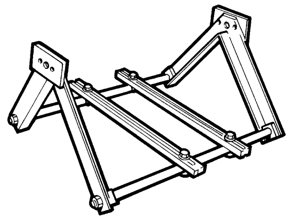
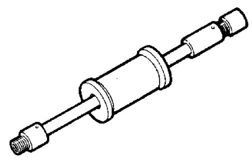
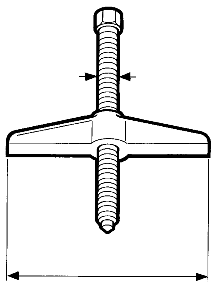
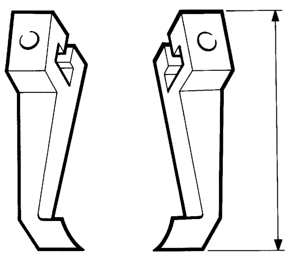
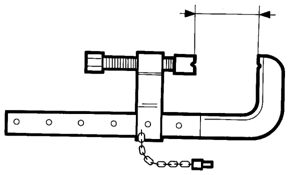
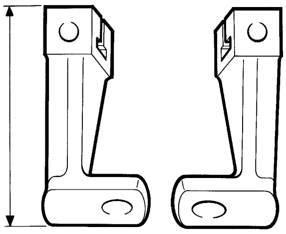
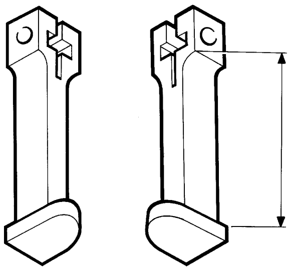
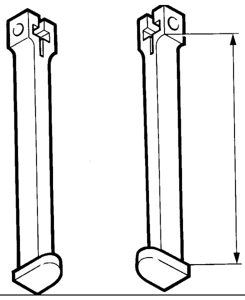
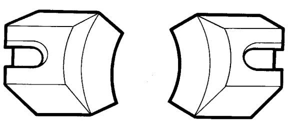
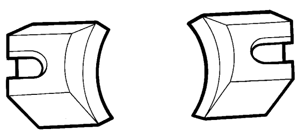
TOOLS

TOOL No.		DENOMINATION
99305121		Hot-air apparatus
99322205		Rotating stand for assembly revision (capacity 1000 daN, couple 120 daN/m)
99322225		Assembly bearing support (to be applied on stand 99322205)
99340205		Percussion extractor
99341003		Simple-effect bridge
99341009		Pair of brackets

TOOLS

TOOL No.		DENOMINATION
99341015		Clamp
99341017		Pair of brackets with hole
99341019		Pair of tie-rods for holds
99341020		Pair of tie-rods for holds
99341023		Holds
99341025		Holds

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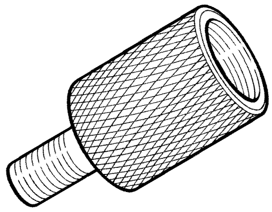
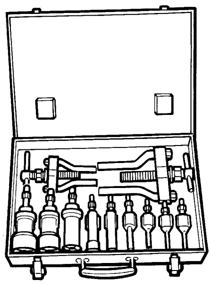
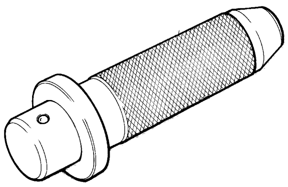
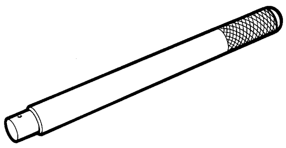
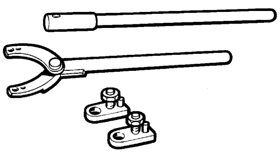
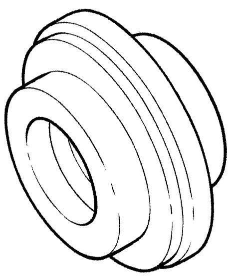
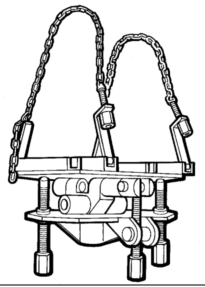
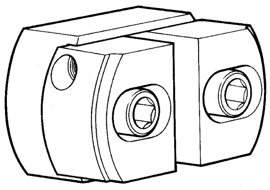
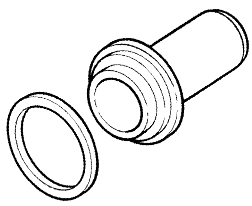
TOOLS

TOOL No.		DENOMINATION
99342143		Peg for removing reverse gear shaft (use with 99340205)
99348004		Universal extractors for interiors 5 to 70
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with flange check extension
99370349		Keyer for drive shaft front gasket assembling (use with 99370006)

TOOLS

TOOL No.		DENOMINATION
99370629		Gearbox bearing support during vehicle disconnection and re-connection
99374092		Beater for external bearings race assembling (69-91) (use with 99370007)
99374201		Keyer for assembling gasket on rear gearbox cover

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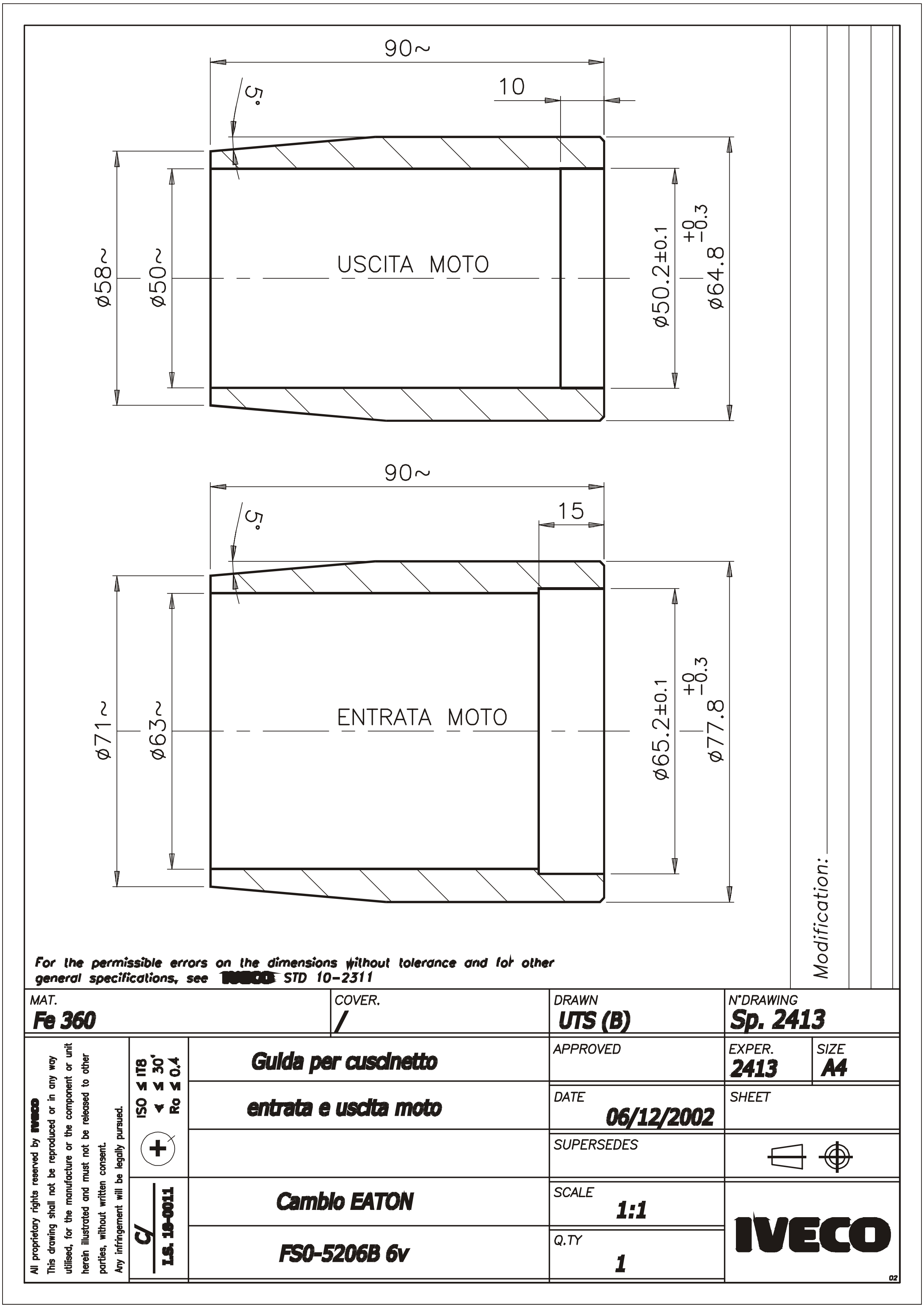
EXPERIMENTAL TOOLS

This chapter illustrates the technical working drawing of the experimental tools (S.P. 2413) used in the gearshift overhaul described in this section, which can be manufactured by the repair workshop operators themselves.



530210 GEARSHIFT OVERHAUL

The unit must be washed thoroughly prior to overhauling. The specific and/or general equipment must be used for the purpose for which they are intended. The disassembled parts must be put in the special container by following the disassembling sequence, in order to facilitate re-assembling.
Upon re-assembling, the parts must always be replaced with new ones: the gaskets and seal rings, elastic pins, safety snap rings and springs. The nuts and screws must be tightened to the specified torque, and their threads must be dry, degreased and spread with LOCTITE 641. The lubricant and detergents must be disposed of in compliance with the specific regulations in force.
Overhaul operations must be carried out by means of the specific tools indicated. On disassembling, parts must be put aside by following the disassembling sequence, to facilitate later re-assembling.

Checks

The gears, synchronizing rings, matching bodies and engagement sliding sleeves must not show faults or excessive tooth wear.

The output shaft must be free from dents, especially on the gear roller cage rotating surface.

The reverse speed idler gear shaft surface must be smooth and free from scoring.
The gearbox half cases must not show cracks and the bearing seats must not be damaged nor worn, to prevent the bearing outer races from rotating in the seats.

Verify that the shoulder spacers are not damaged nor worn.

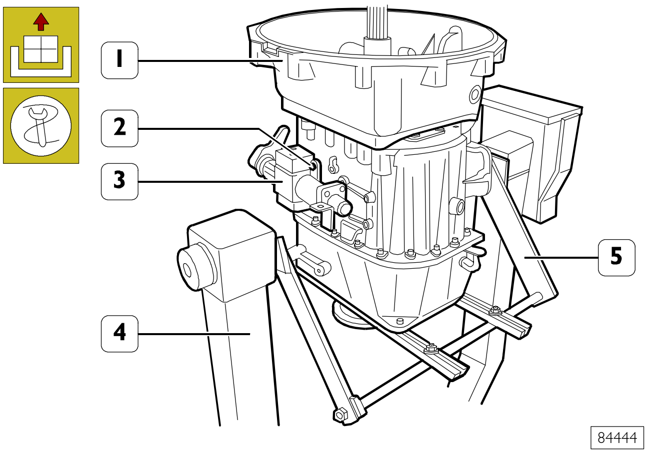
The gear engaging forks must not show cracks and must slide freely, yet with no notable play, on the control rod.

Verify that the control forks are in full working order.

Verify that the bearings and bushings are not worn, damaged or overheated.

530220 GEAR DRIVE CASE

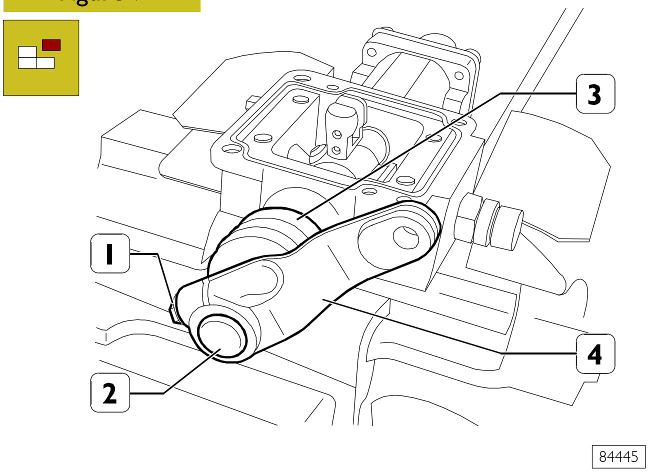
Figure 6



Use ropes, hooks and a hoist to position and secure gearbox (1) on support 99322225 (5) of rotary stand 99322205 (4).
Put the gear lever in neutral.
Remove screws (2) and take gear drive case (3) off the gearbox.

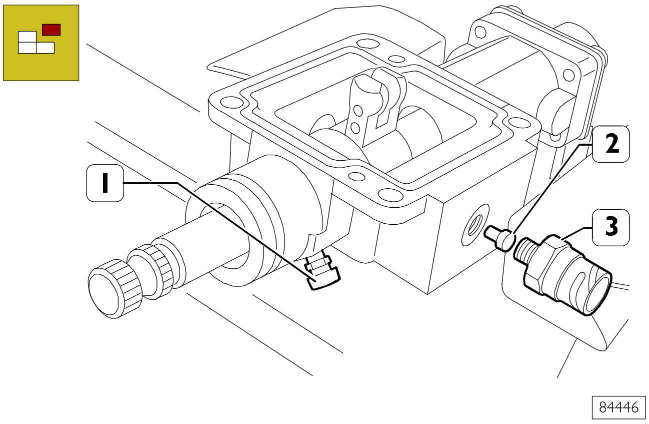
Disassembling

Figure 7



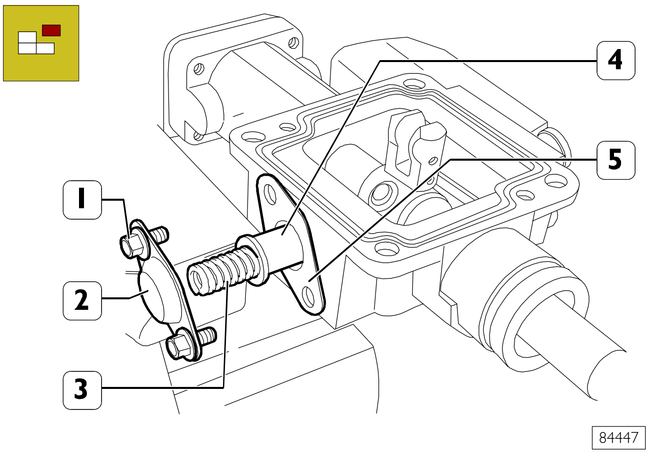
If no reference mark is found on rod (2), mark the assembling position of lever (4).
Loosen screw (1) and remove lever (4).
Remove sleeve (3).

Figure 8



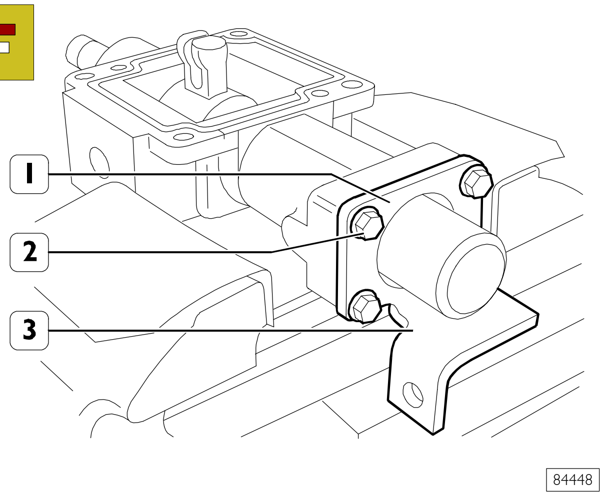
Remove the neutral gear signalling switch (3) with cap (2) below and oil vapour vent (1).

Figure 9



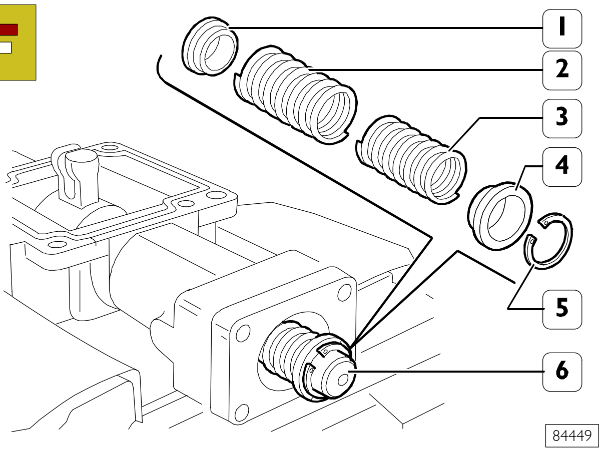
Remove screws (1) and take off small cover (2) with gasket (5). Take out spring (3) and pin (4).

Figure 10



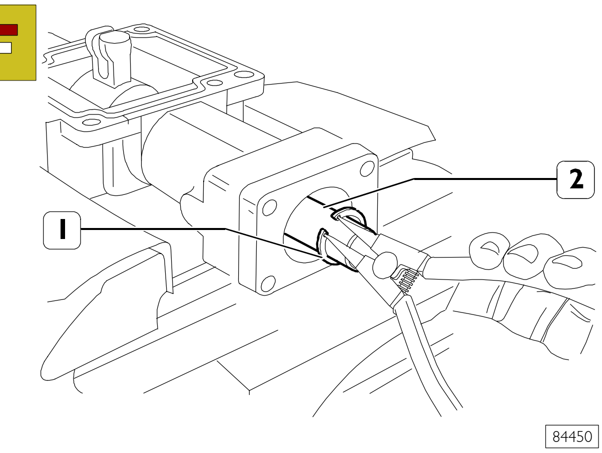
Remove screws (2), take off cover (1) and bracket (3).

Figure 11



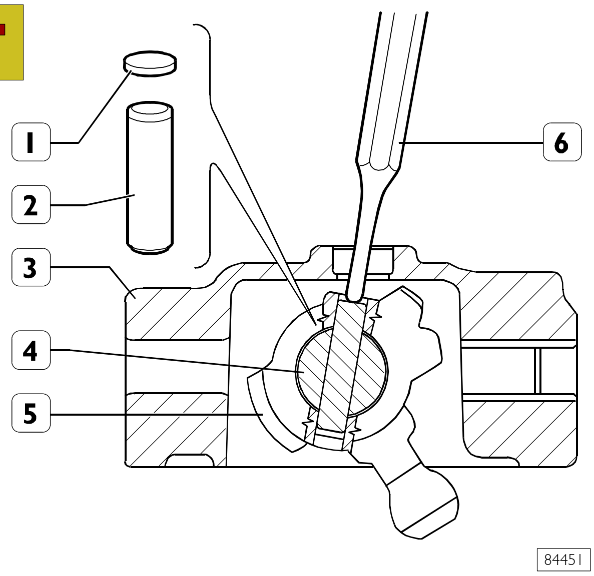
Remove snap ring (5) and take collar (4), springs (3 and 2) and collar (1) off rod (6).

Figure 12



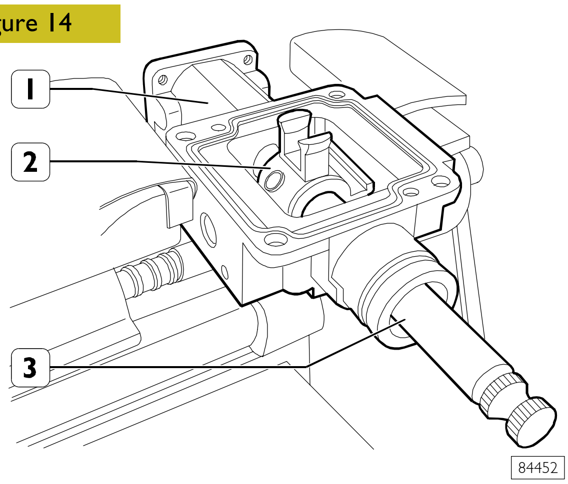
Remove snap ring (1) from rod (2).

Figure 13



Remove cap (1), with punch (6), take off plug (2) linking selector (5) to rod (4).

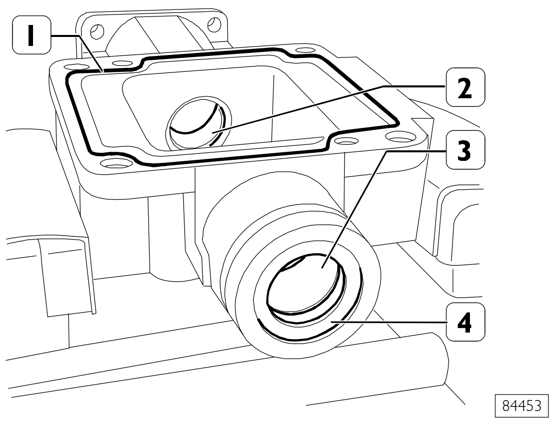
Figure 14



Take note of the assembly position of selector (2) on rod (3). Take rod (3) out of case (1) and selector (1), then remove the latter.

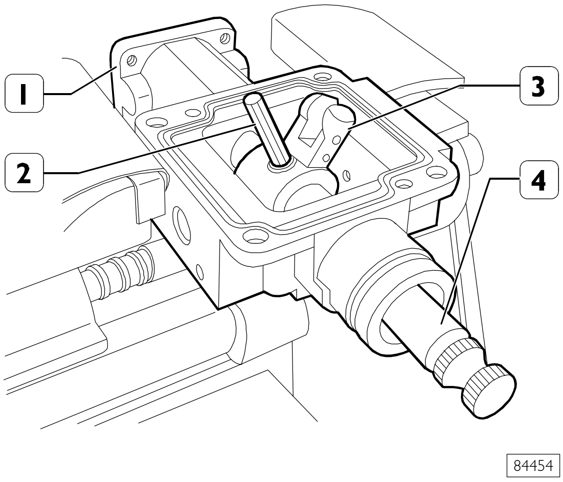
Assembling

Figure 15



Use a suitable beater and coupler to replace, where necessary, bushings (2 and 3) and seal ring (4). Gasket (1) must be replaced only if it is damaged.

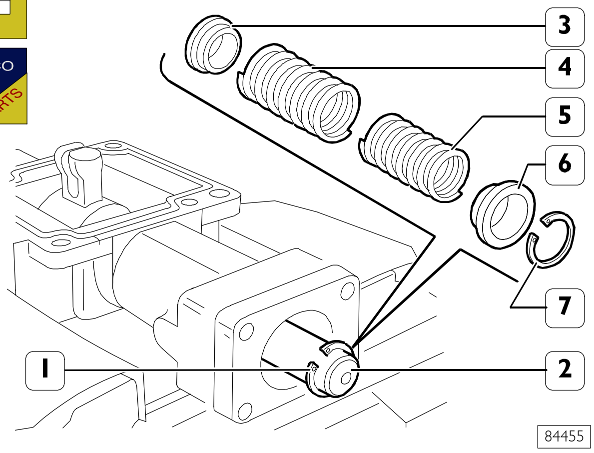
Figure 16



Place selector (3) in case (1) in the same position taken note of upon disassembling, then insert rod (4) and link with plug (2).

> ! When removing plug (2), properly support rod (4) to prevent blows caused by ramming from affecting the case bushings.

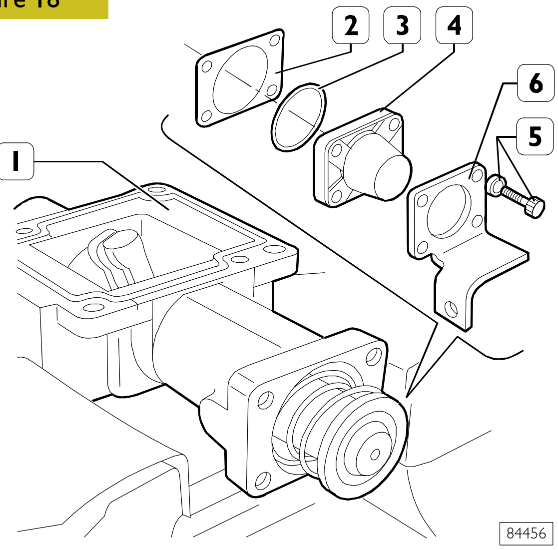
Figure 17



Mount snap ring (1), cup (3), springs (4 and 5), cup (6) and snap ring (7) on rod (2).

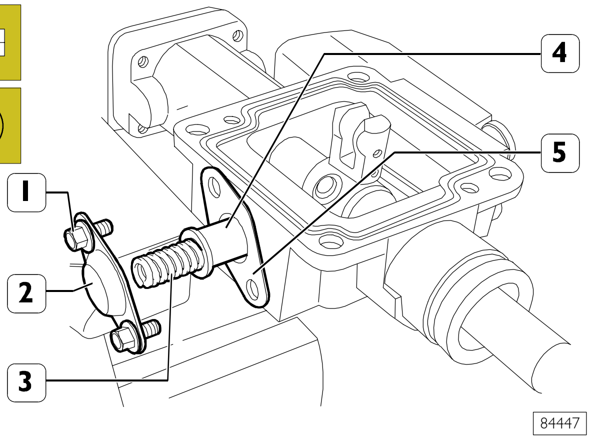
> ! Fit new snap rings.

Figure 18



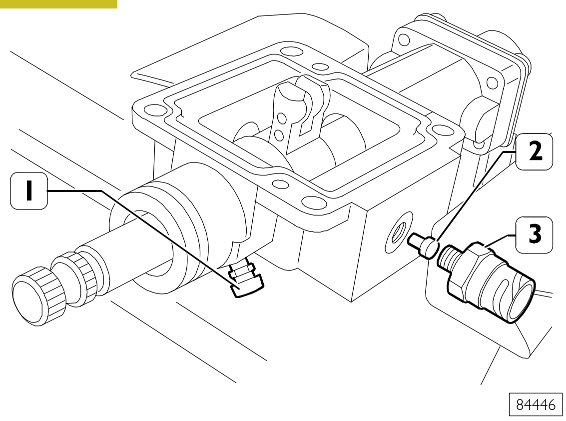
Fit a new seal ring (3) on cover (4), then mount the same with a new gasket (2) and bracket (6) on case (1). Fasten the screws by means of washers (5) and tighten them to the specified torque.

Figure 19



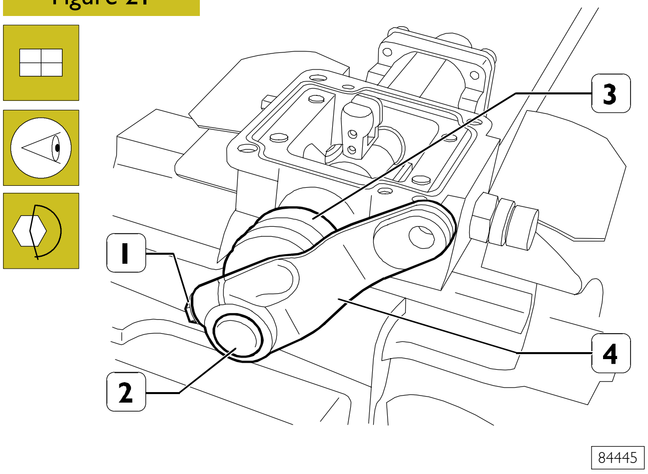
Insert pin (4) and spring (3) into the case.
Mount small cover (2) with a new gasket (5), then fasten screws (1) to the specified torque.

Figure 20



Insert cap (2) in the case, then fasten switch (3) by tightening it to the specified torque. Fasten vent (1) and tighten it to the specified torque.

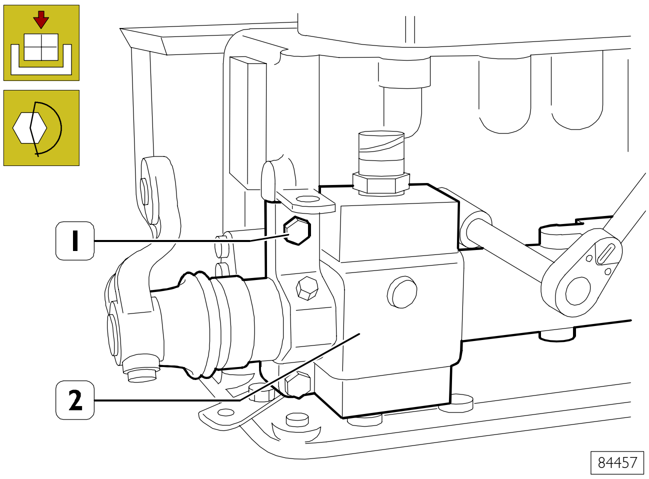
Figure 21



Fit a new sleeve (3) onto the case.
Mount lever (4) on rod (2) so that the assembly reference marks match one another. Fasten screw (1) to the specified torque.

Refitting

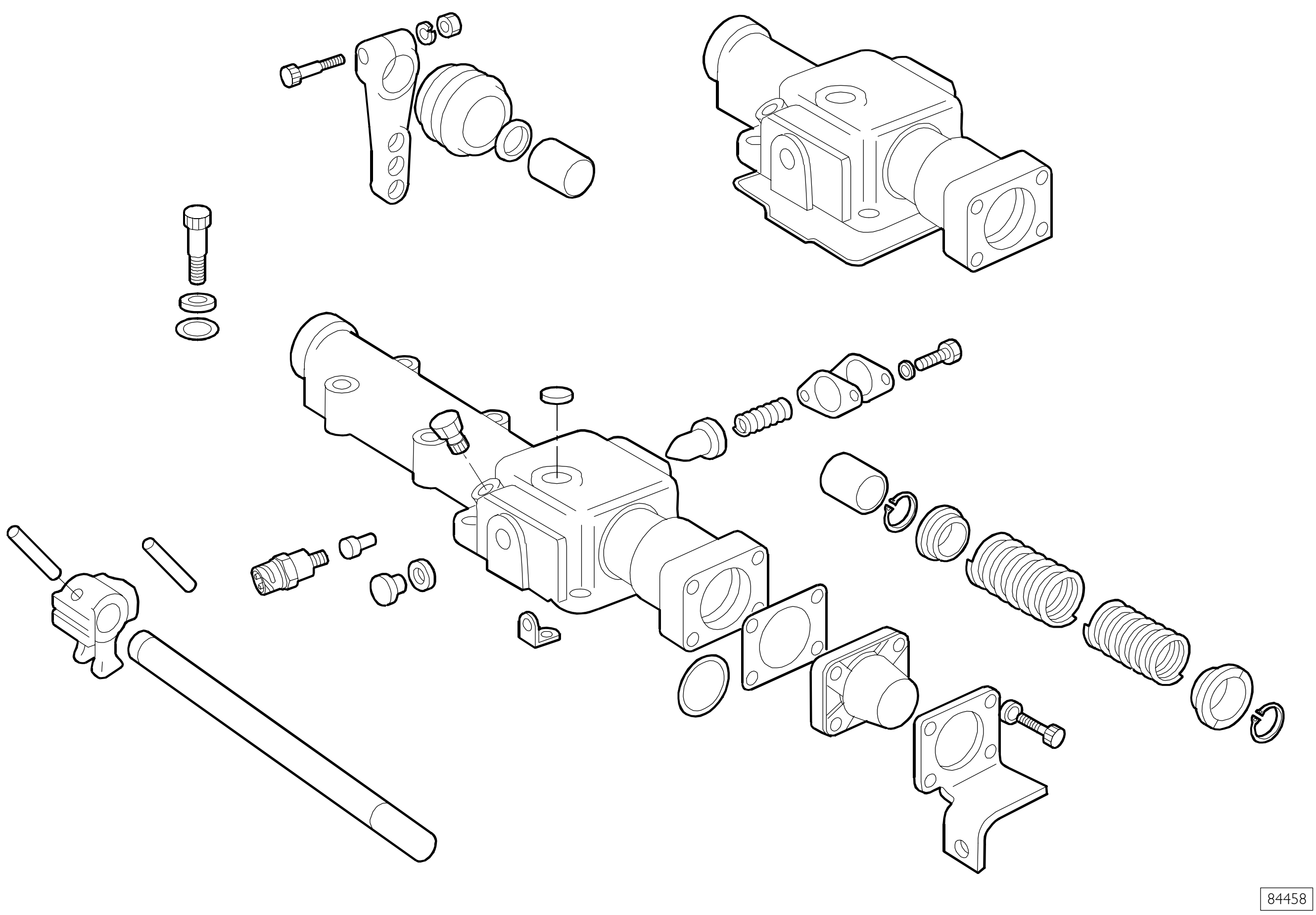
Figure 22



Fit the gear drive case (2) back to the gearbox, then tighten the screws to the specified torque.

The seal gasket placed in the case must be replaced only if it is damaged.

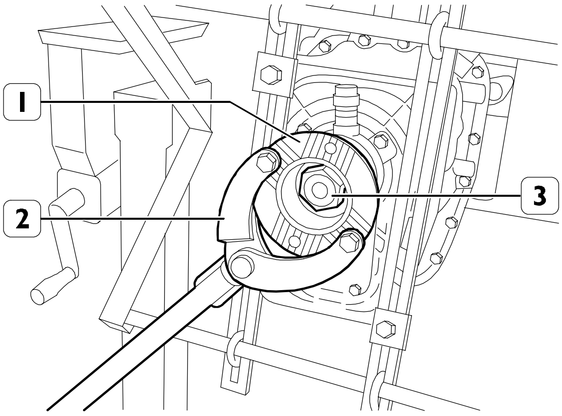
Figure 23



PARTS MAKING UP THE GEAR DRIVE CASE.

Disassembling the gearbox

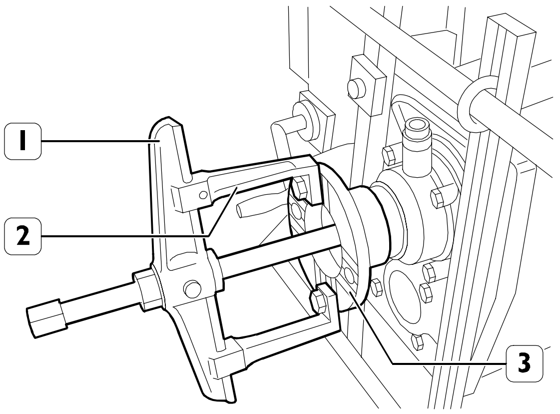
Figure 24



84459

Stop rotation of flange (1) by applying lever 99370317 (2) to the same, then remove retaining nut (3).

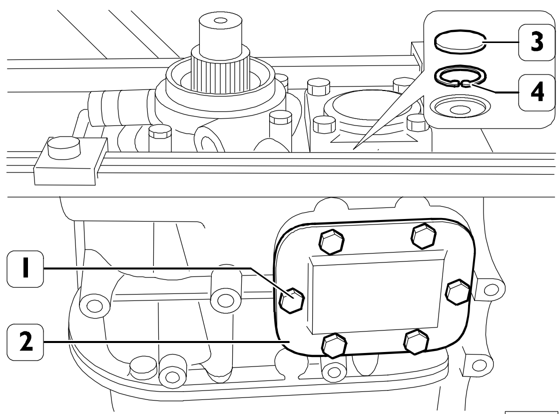
Figure 25



84460

Take flange (3) out of the output shaft by means of an extractor made up of bridge 99341003 (1) and brackets 99341017 (2) applied as shown.

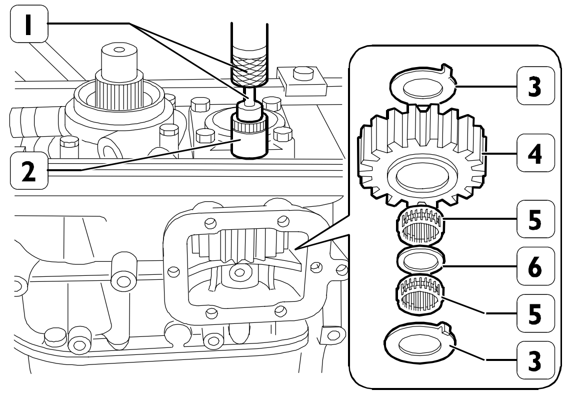
Figure 26



84461

Place the gearbox in a vertical position.
Remove screws (1) then take off cover (2).
Remove small cover (3) and snap ring (4) below.

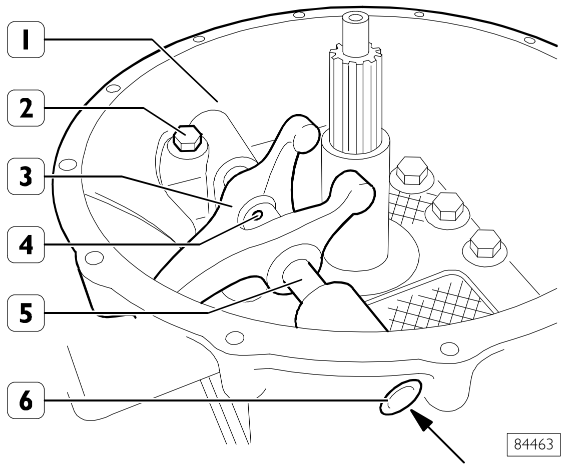
Figure 27



84462

Take off arbor (2) by means of striking extractor 99340205 (1).
Remove reverse gear (4) complete with shoulder rings (3), roller bearings (5) and spacer ring (6).

Figure 28



84463

Turn the gearbox upside down.
Eject the elastic pin by means of a suitable punch (4).
Remove protecting cap (6). Use a punch and take, by acting in the direction of the arrow, arbor (5) out of clutch bell (1) and fork (3), then remove the latter.
Remove screws (2) and take clutch bell (1) off the front case.

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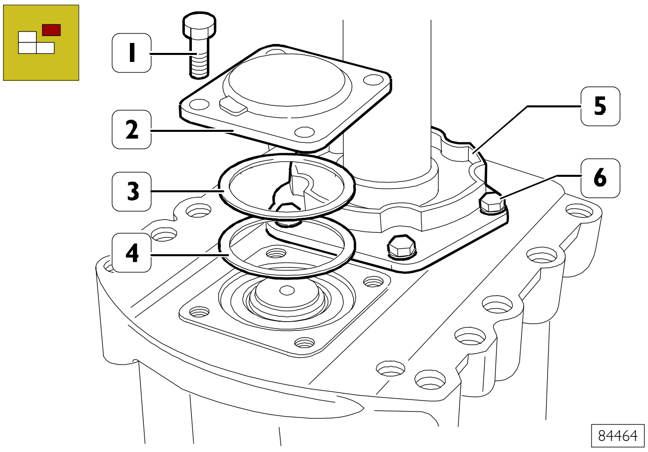
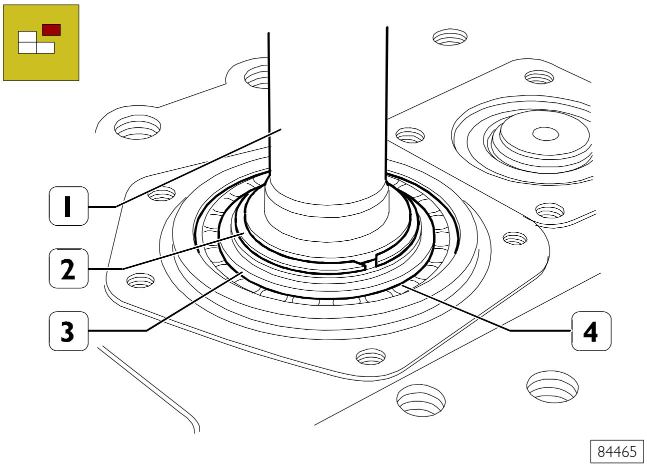
Figure 29



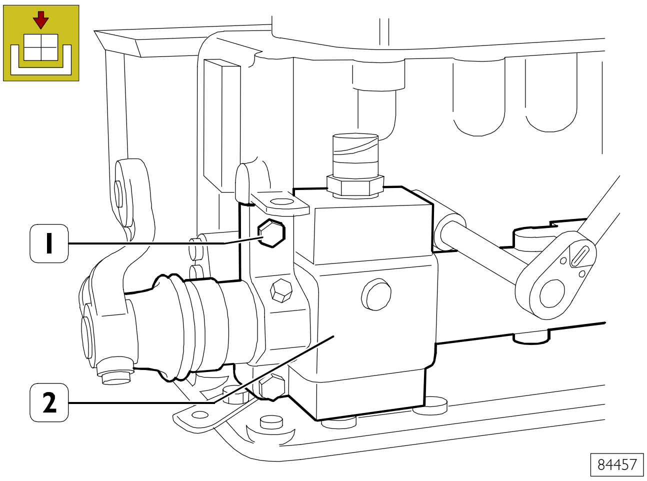
Remove screws (1) and take off cover (2), spacer (3) and adjusting ring (4).
Remove screws (6) and take off cover (5).

Figure 30



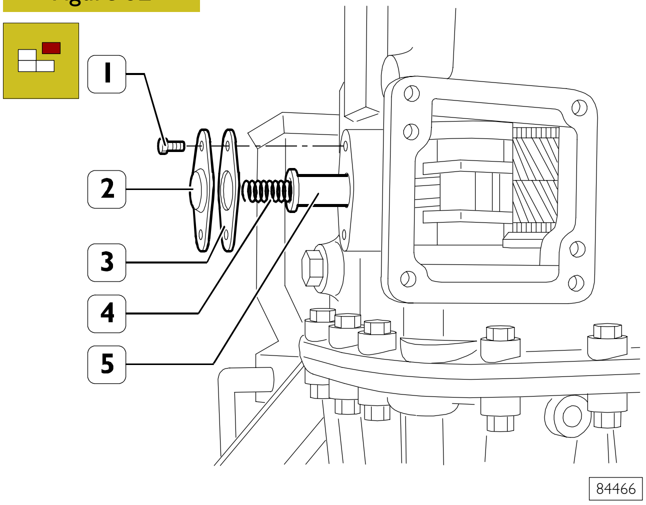
Remove snap ring (2) retaining bearing (4) to the motion inlet shaft (1), then remove spacer (3).

Figure 31



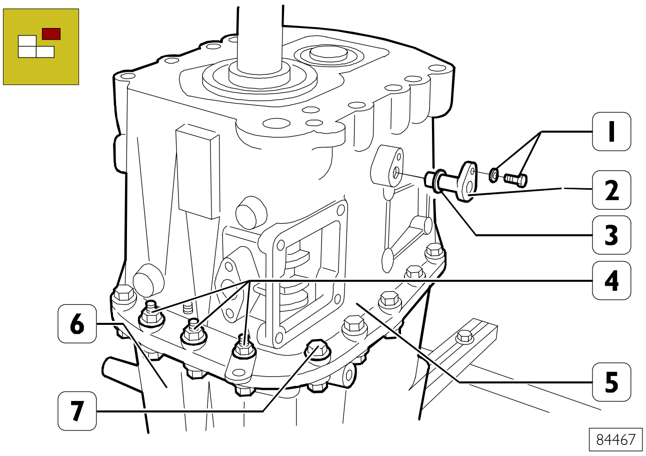
Put the gearshift in neutral.
Remove screws (1) and take gear drive case (2) off the gearbox.

Figure 32



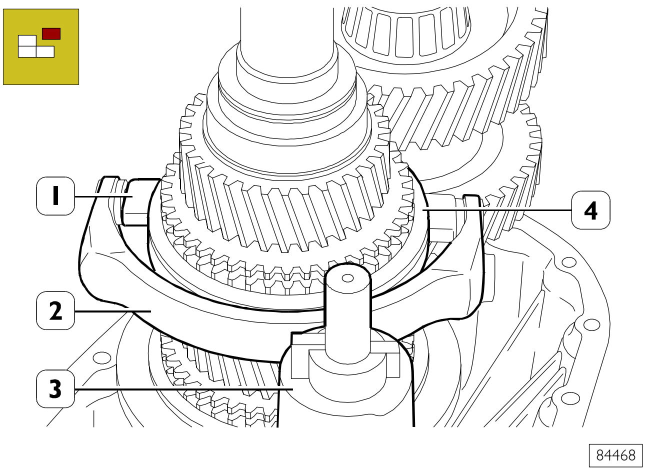
Remove screws (1), take off small cover (2) with gasket (3), then take out spring (4) and pin (5).

Figure 33



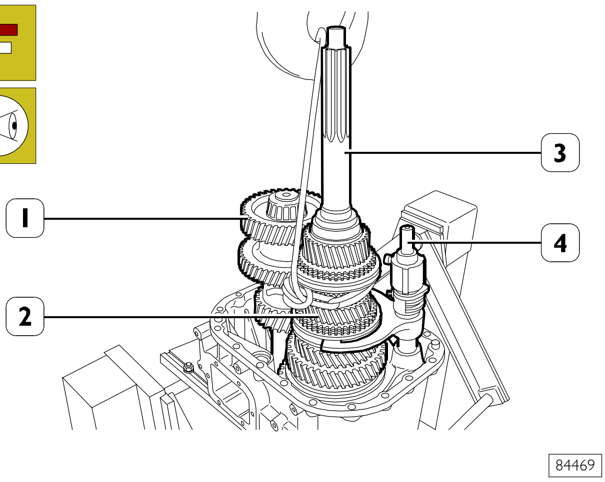
Remove screws (1) with the washers and take out fork trunnions (2) complete with seal ring (3).
Take note of the position of screws (7) and screws with nuts (4), then remove them. Take front half case (5) off rear half case (6).

Figure 34



Remove fork (2) complete with dowels (1) from sliding sleeve (4) and selector (3).

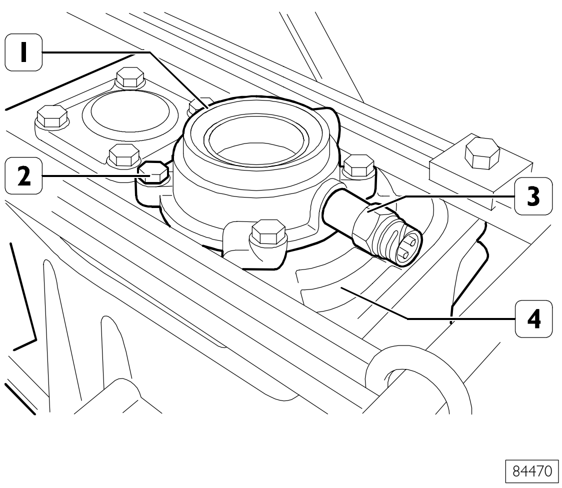
Figure 35



Secure output shaft (2) with a rope, then lift it by about 20 mm by means of a hoist so as to be able to move away countershaft (1) and remove the motion inlet shaft (3) and the underlying synchronizing ring and the roller bearing.

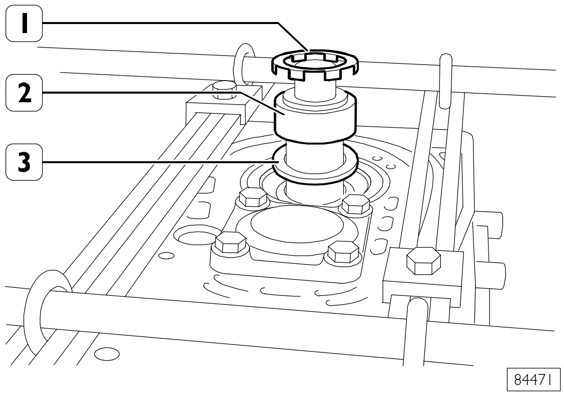
This operation must be performed with the greatest care to prevent the ends of output shaft (2) and of fork supporting shaft (4) from jamming in the relevant bearing or support bushing.
Take output shaft (2) out of the rear half case, remove fork supporting shaft (4) from the output shaft, then place both shafts on a suitable container.
Remove countershaft (1).

Figure 36



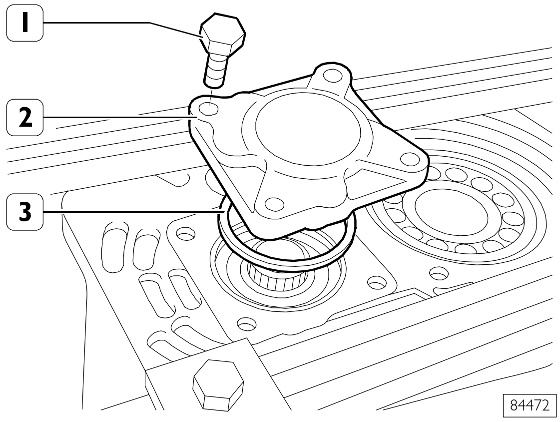
Turn rear half case (4) upside down.
Remove revs sensor (3).
Remove screws (2) and take off cover (1).

Figure 37



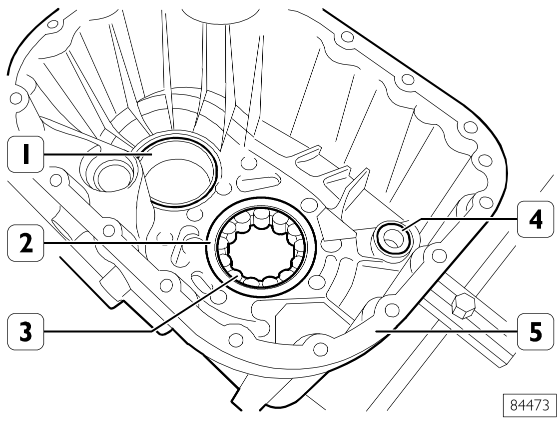
Remove phonic wheel (1), spacer (2) and ring (3) of roller bearing.

Figure 38



Remove screws (1), take off cover (2) and remove spacer (3).

Figure 39

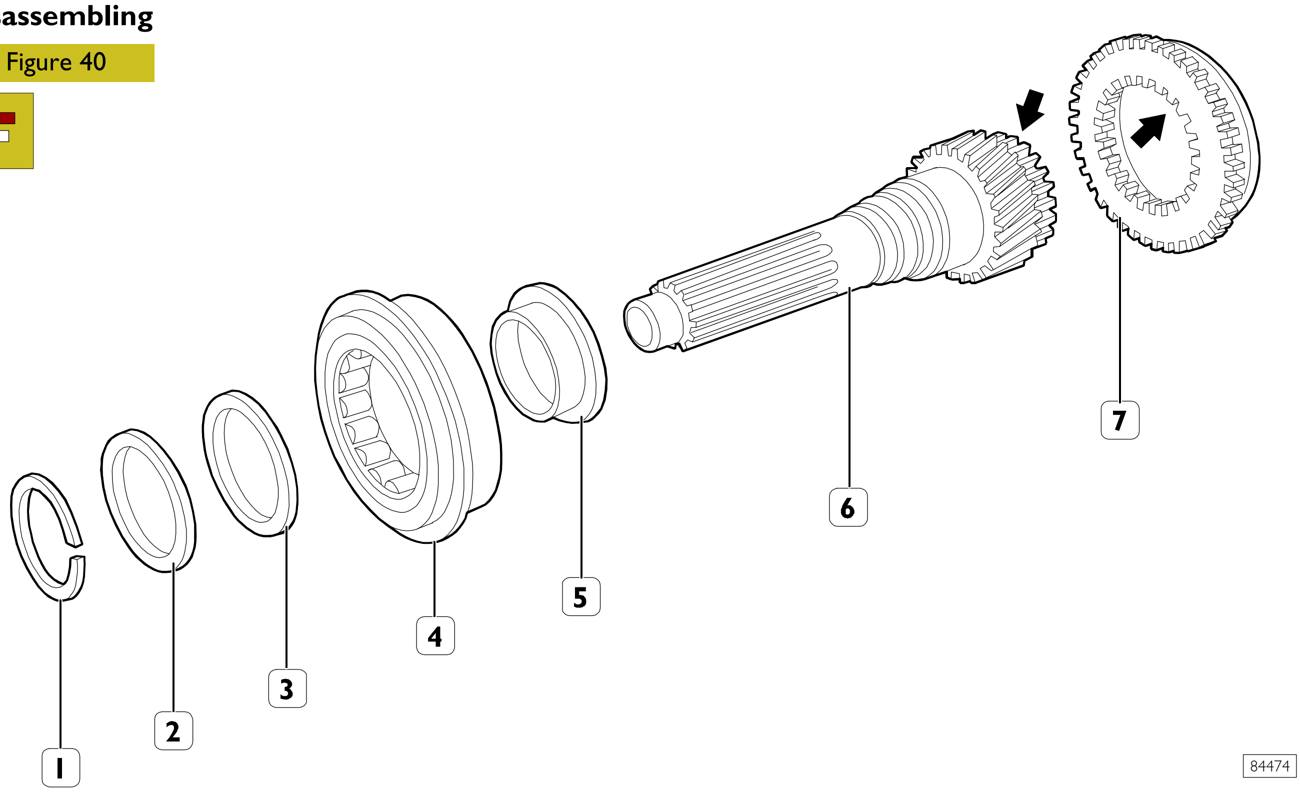


Remove the following items from rear half case (5): bushing (4) supporting the fork supporting shaft, the tapered-roller bearing outer race (1) and roller bearing outer race (2).

When removing outer race (2), pay attention to the possible escape of rollers (3) of the same from their own seat.
Repeat the same operations on the front half case.

MOTION INLET SHAFT
Disassembling

Figure 40



PARTS MAKING UP THE MOTION INLET SHAFT

1. Snap ring - 2. Spacer ring - 3. 4. 5. Cylindrical roller bearing - 6. Motion inlet shaft - 7. Matching body

Use ordinary tools to take the cylindrical roller bearing inner race (5) and matching body (7) off the motion inlet shaft (6).

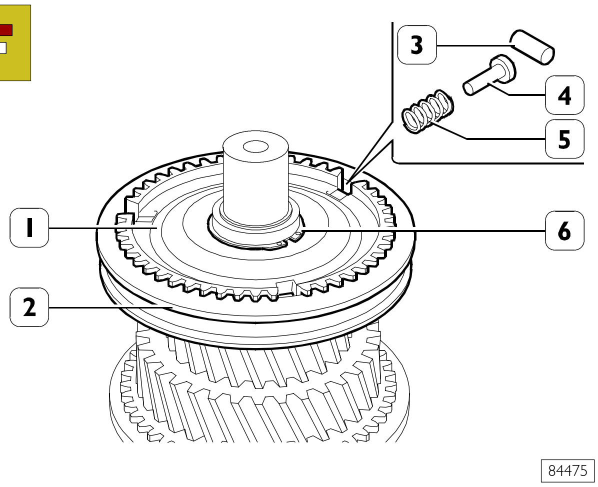
Assembling

Heat roller bearing inner race (5) to ~ 85 °C, then fit it onto motion inlet shaft (6).
Apply LOCTITE 648 on inner teeth (→) of matching body (7), then mount the latter onto motion inlet shaft (6).

OUTPUT SHAFT
Disassembling

All snap rings are provided with replacement parts of different thickness in order to obtain correct assembly play. Snap rings must be disassembled and re-assembled with care so as not to score the output shaft surface.
Prior to taking apart the output shaft, verify that the axial play of every single gear falls within the prescribed values.
Take note of the assembling position of synchronizers - matching bodies, hubs and sliding sleeves, so as to be able to fit them back in the same positions.

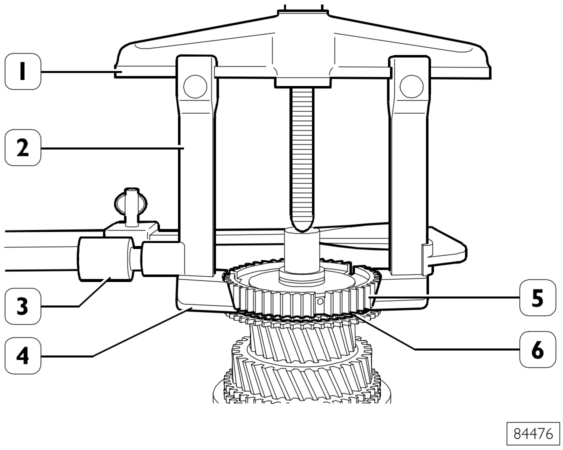
Figure 41



Take 5th - 6th gear engagement sliding sleeve (2) off hub (1); pay attention to the escape of rollers (3), pins (4) and springs (5), then recover the same.

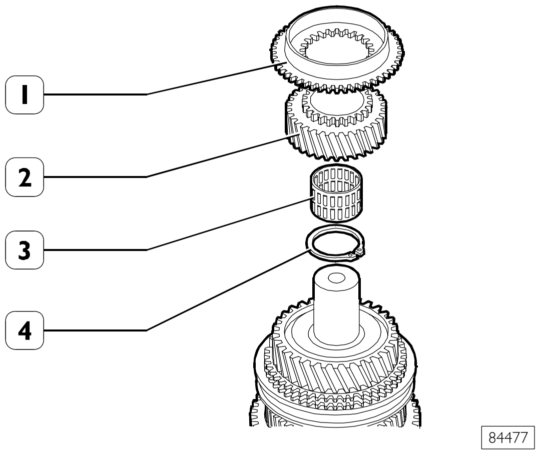
Remove snap ring (6).

Figure 42



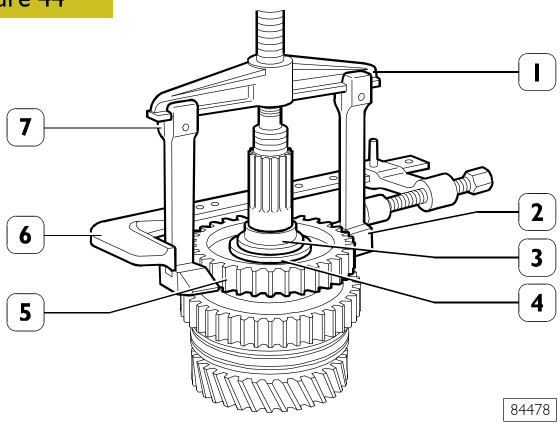
Remove hub (5) with the synchronizer (6) below, by means of an extractor made up of bridge 99341003 (1), brackets 99341019 (2), grips 99341025 (4) and clamp 99341015 (3).

Figure 43



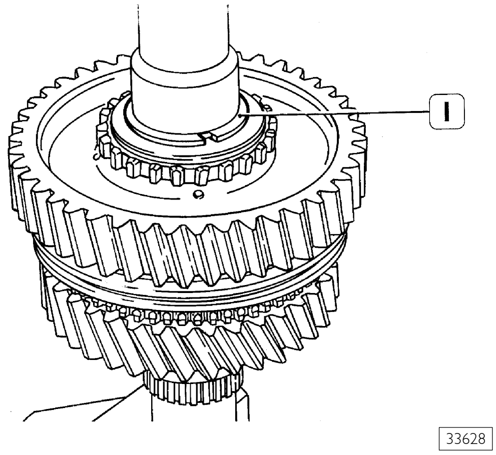
Take off matching body (1), 6th speed gear (2) and roller cage (3).
Remove snap ring (4).

Figure 44



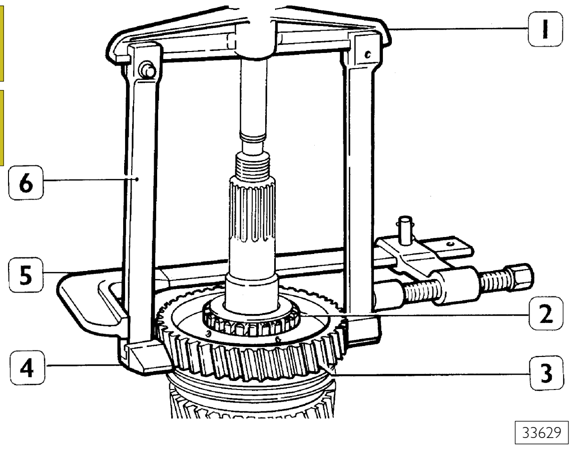
Turn the output shaft upside down.
Use an extractor made up of bridge 99341003 (1), tie bars 99341019 (7), grips 99341025 (2) and clamp 99341015 (6), to remove reverse gear (5), shoulder ring (4) and roller bearing inner race (3), then take out the roller bearing below.

Figure 45



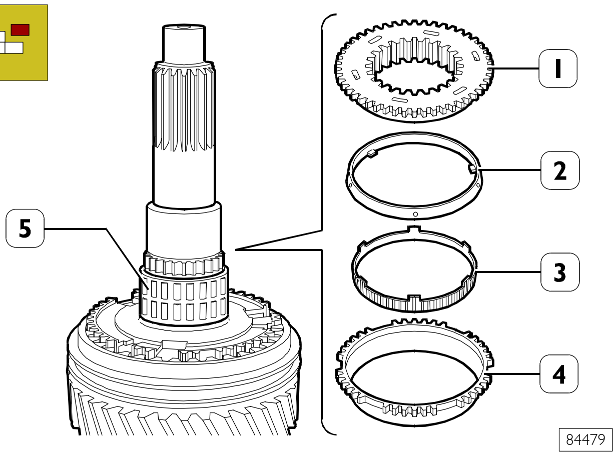
Take off snap ring (1).

Figure 46



Use an extractor made up of grips 99341023 (4), tie bars 99341020 (6), bridge 99341003 (1) and clamp 99341015 (5) to remove 1st speed gear (3) and fixed hub (2) for reverse gear.

Figure 47



Remove matching body (1), inner ring (2), intermediate ring (3), synchronizing ring (4) and roller cage (5).

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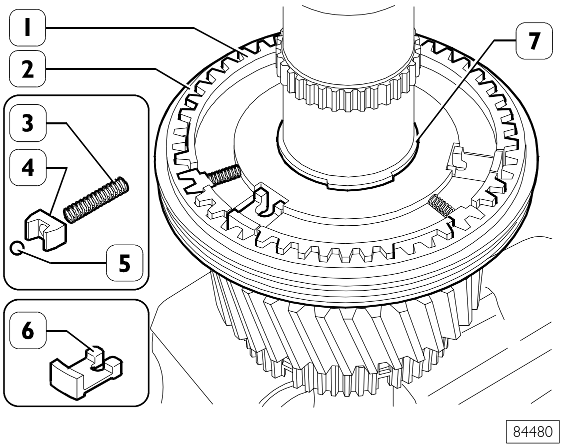
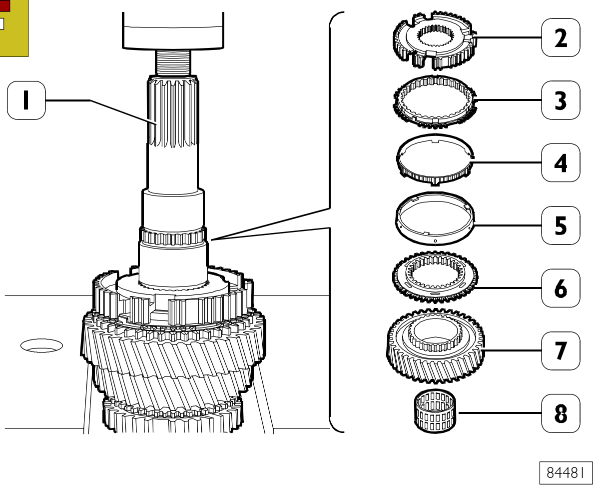
Figure 48



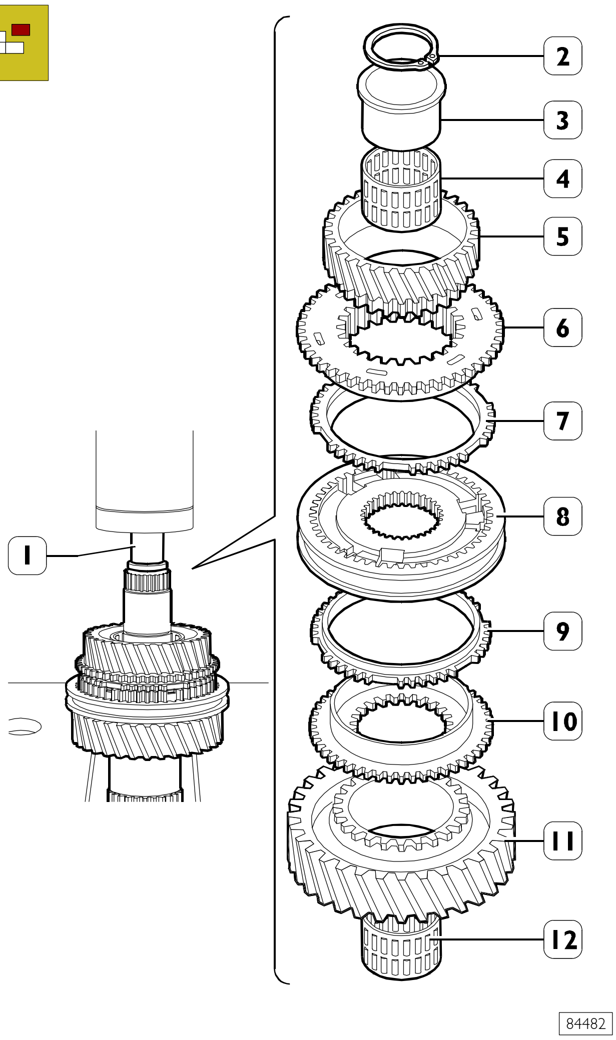
Take 1st - 2nd gear engagement sliding sleeve (2) off hub (1); pay attention to the escape of balls (5), springs (3) and dowels (4), then recover the same. Remove dowels (6) and take off snap ring (7).

Figure 49



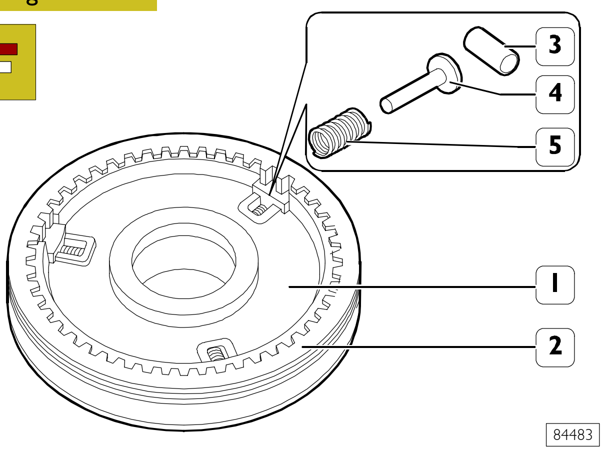
Use a hydraulic press to remove 1st speed gear (7) together with matching body (6), synchronizing ring (3), intermediate ring (4), ring (5) and hub (2) from output shaft (1).

Figure 50



Turn output shaft (1) upside down. Remove snap ring (2). Use a hydraulic press to remove 4th speed gear (11), matching body (10), synchronizing ring (6), synchronizing unit (8), synchronizing ring (7), matching body (6), 3rd speed gear (5), roller cage (4) and bushing (3).

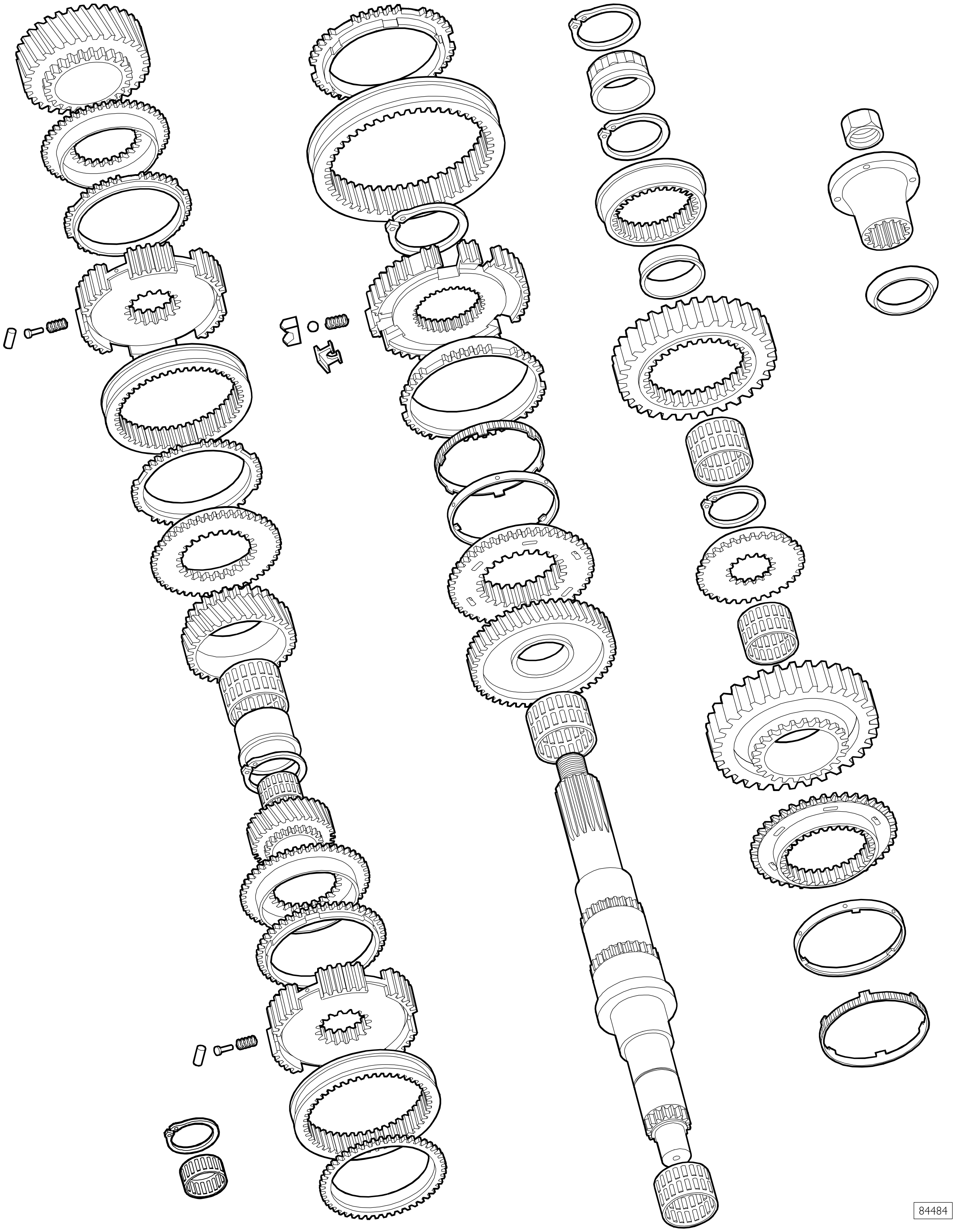
Figure 51



Take 3rd - 4th gear engagement sliding sleeve (2) off hub (1); pay attention to the escape of hub of rollers (3), pins (2) and springs (5), then recover the same.

Print 603.93.111

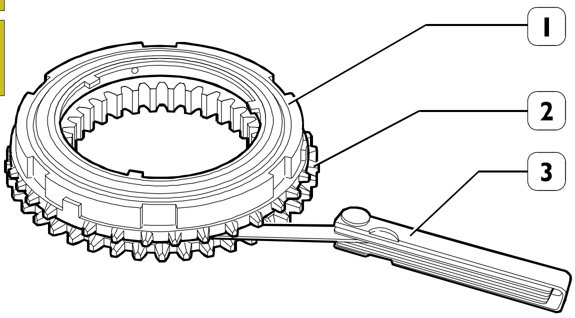
Figure 52



PARTS MAKING UP THE OUTPUT SHAFT

Assembling

Figure 53



84485

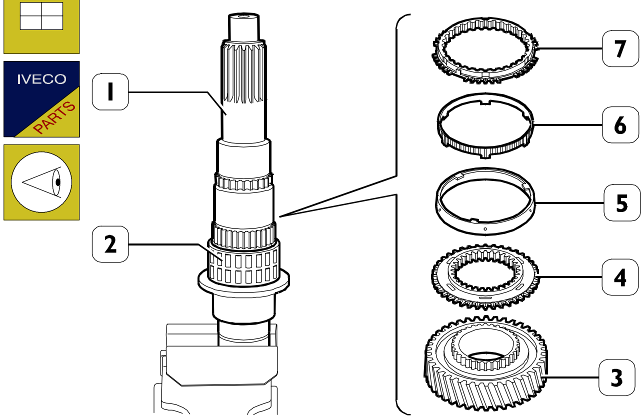
Check the amount of wear of synchronizing rings by acting as follows:

> The synchronizing rings must, after inspection, be marked on their respective matching bodies in order to avoid exchanging their position when re-assembling.

- ❑ Visually check that the friction surface is not corrugated.

Rotate synchronizing ring (1) so as to ensure correct match on matching body (2).
Use a thickness gauge (3) to check, on two diametrically opposed points, the clearance between the two parts.
If the measured value does not fall within the range of 0.5 ÷ 1.9 mm, replace the synchronizing ring.

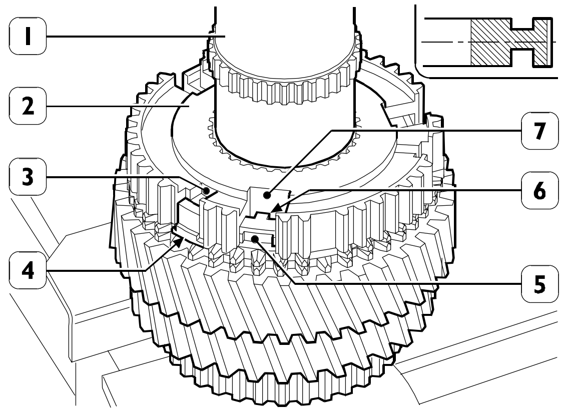
Figure 54



84486

Mount roller cage (2), 2nd speed gear (3) and matching body (4) on output shaft (1).
Mount inner ring (5) and intermediate ring (6) so that the tabs are inserted into the matching body (4) slots, then mount synchronizing ring (7) so that the outer side openings match with ring (5) inner tabs.

Figure 55

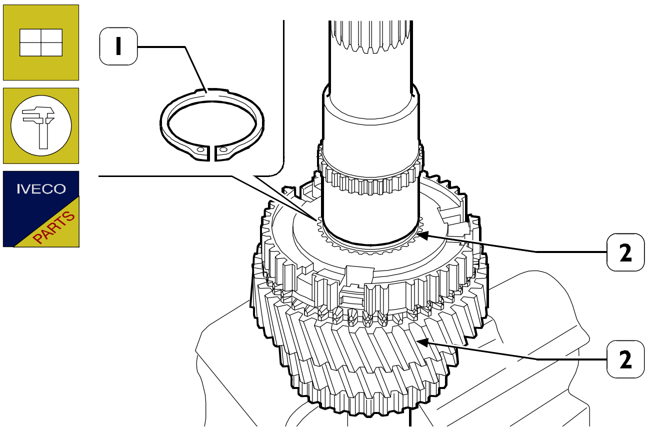


84487

Heat hub (2) to a temperature of 85°C, then fit it onto output shaft (1) so that:

- ❑ the higher shoulder faces downwards (see relevant section);
- ❑ the narrower openings (3) are inserted into the synchronizing ring projections (4);
- ❑ the wider openings (7) of the hub are aligned with synchronizing ring openings (5) and inner ring tabs (6).

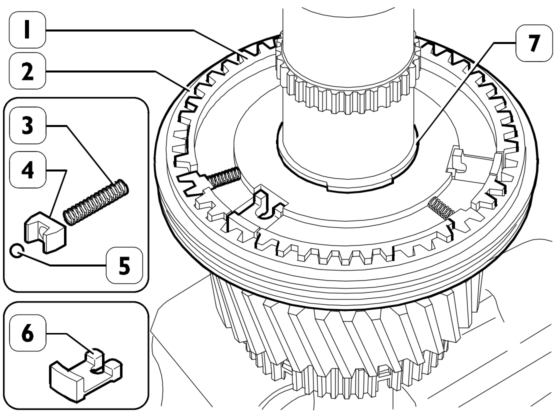
Figure 56



84488

Mount snap ring (1), the thickness of which produces axial play of the same, into its own seat (2), as near to zero as possible.
Check axial play of 2nd speed gear (2), which must fall within the range of 0.35 ÷ 0.48 mm.

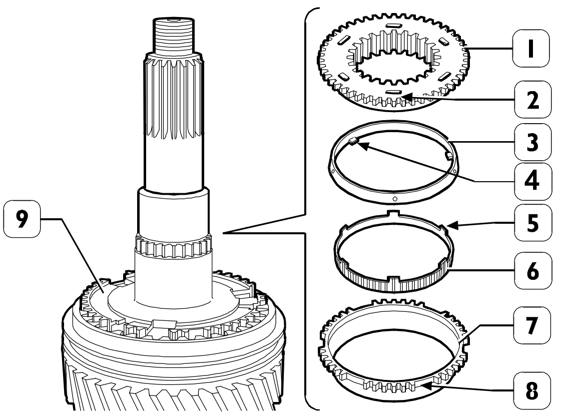
Figure 57



84480

Mount sliding sleeve (2) on hub (1) by turning it in the direction shown in the figure.
Mount dowels (6), springs (3), dowels (4) and balls (5), then secure them below sliding sleeve (2).

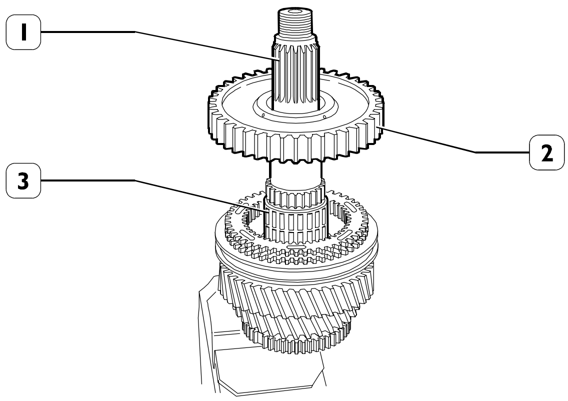
Figure 58



84507

Mount synchronizing ring (7) so that its projections (8) are inserted into the narrowest openings of hub (9).
Mount inner ring (5) and intermediate ring (3) so that the inner tabs (4) of the latter match with the outer side openings of synchronizing ring (7).
Mount matching body (1) so that the slots (2) of the same are inserted in the tabs of ring (5).

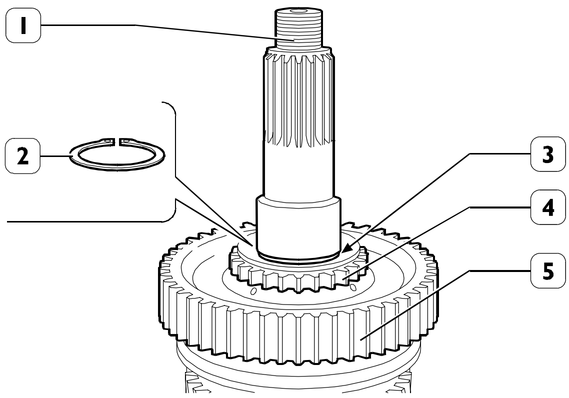
Figure 59



84509

Lubricate roller cage (3), then fit it onto output shaft (1).
Mount 1st speed gear (2).

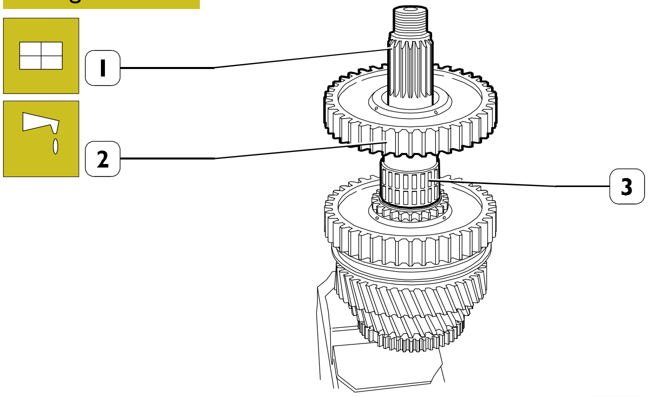
Figure 60



84510

Heat hub (4) to a temperature of ~ 85°C, then fit it onto output shaft (1).
Mount snap ring (2), the thickness of which produces axial play of the same into its own seat (3), as near to zero as possible.
Check axial play of 1st speed gear (5), which must fall within the range of 0.40 ÷ 0,57 mm.

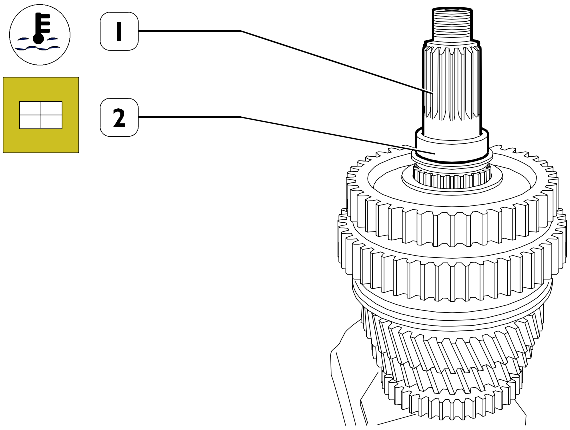
Figure 61



84511

Lubricate roller cage (3), then fit it onto output shaft (1) and mount reverse gear (2).

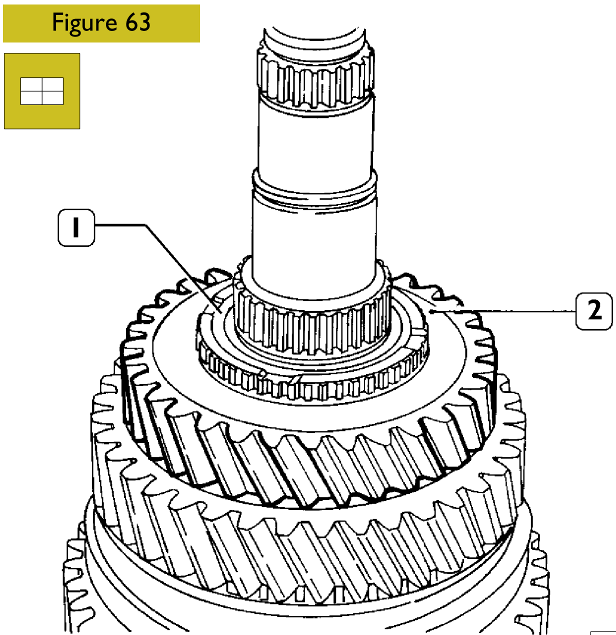
Figure 62



84512

Heat the rear roller bearing inner race (2) to ~ 85 °C, then fit it onto output shaft (1).

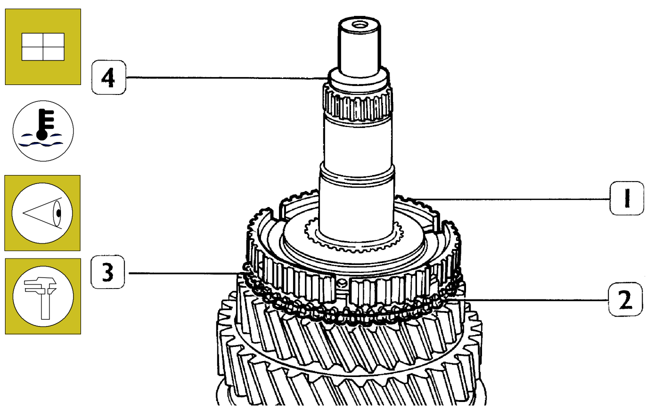
Figure 63



84513

Turn the shaft (placed in the vice) upside down, mount roller cage (1) and 3rd speed gear (2).

Figure 64

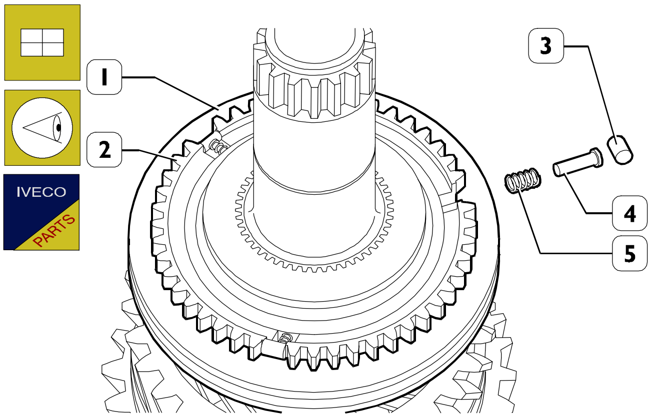


33639

Mount matching body (2) and synchronizing ring (3). Heat hub (1) to a temperature of 85°C, then fit it onto shaft (4), taking care that the synchronizing ring tangent stops are inserted into the respective seats of the hub.

Check axial play of 3rd speed gear, which must fall within the range of 0.35 ÷ 0.48 mm.

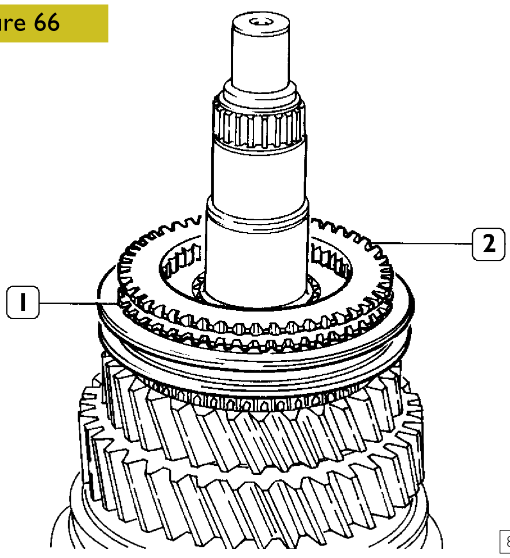
Figure 65



84514

Mount springs (5) and small pins (4) on hub (2). Mount 3rd - 4th gear engagement sliding sleeve (1) on hub (2), then place the former so that it is slightly lifted compared to hub (2), then insert rollers (3) between small pins (4) and sliding sleeve (2).

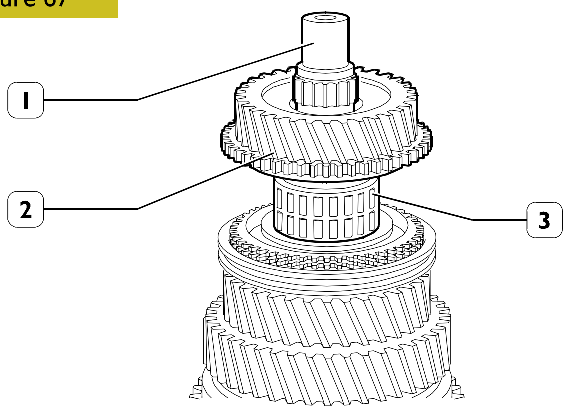
Figure 66



84515

Mount synchronizing ring (1) so that the tangent stop projections of the same are positioned in the wheel hub, then mount matching body (2).

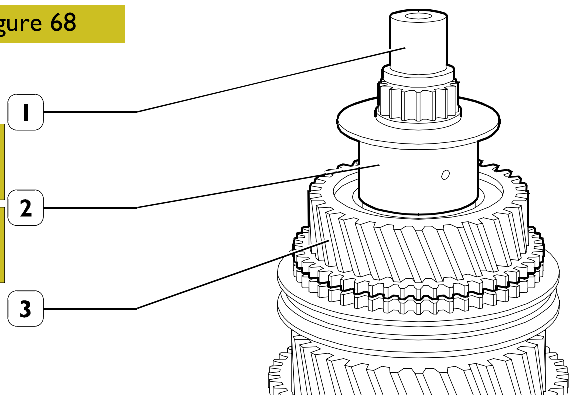
Figure 67



84516

Lubricate roller cage (3) and insert it into the 4th speed gear (2), then mount the same on output shaft (1).

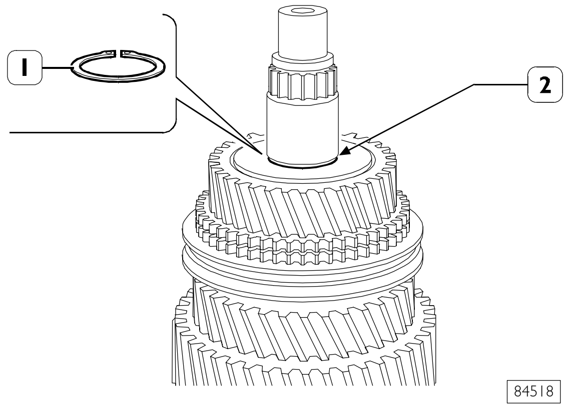
Figure 68



84517

Heat bushing (2) to a temperature of ~ 85°C, then fit it onto output shaft (1). Check axial play of 4th speed gear, which must fall within the range of 0.35 ÷ 0.48 mm.

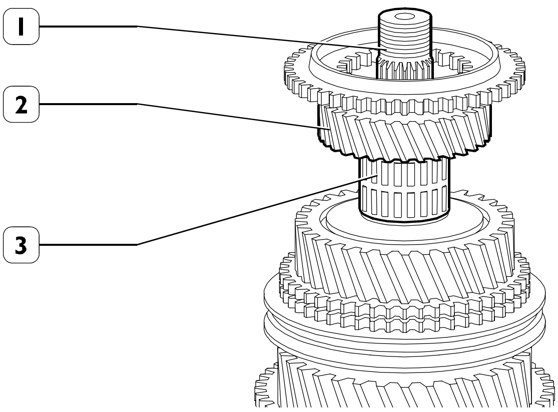
Figure 69



84518

Mount snap ring (1), the thickness of which produces axial play of the same into its own seat (2), as near to zero as possible.

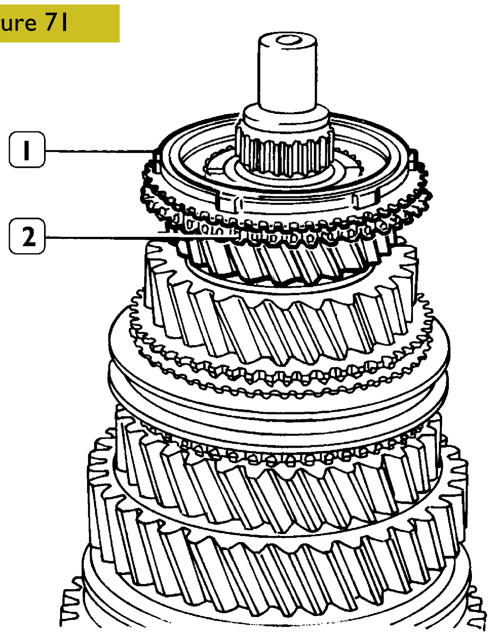
Figure 70



84508

Lubricate roller cage (3), then fit it, together with 6th speed gear (2), onto output shaft (1).

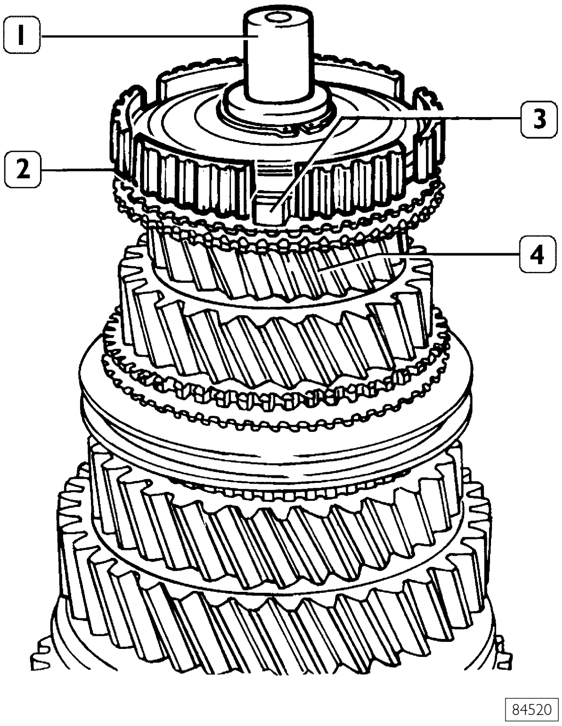
Figure 71



84519

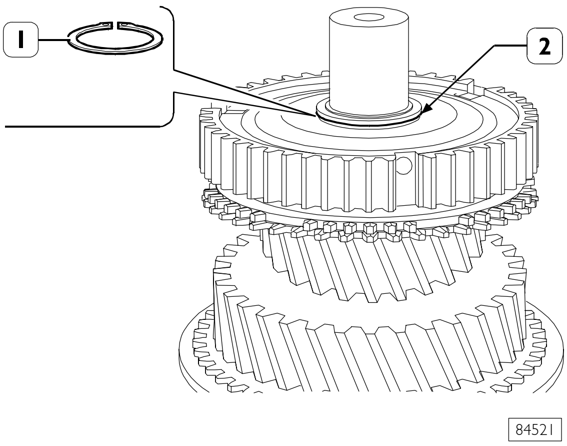
Mount matching body (2) and synchronizing ring (1).

Figure 72



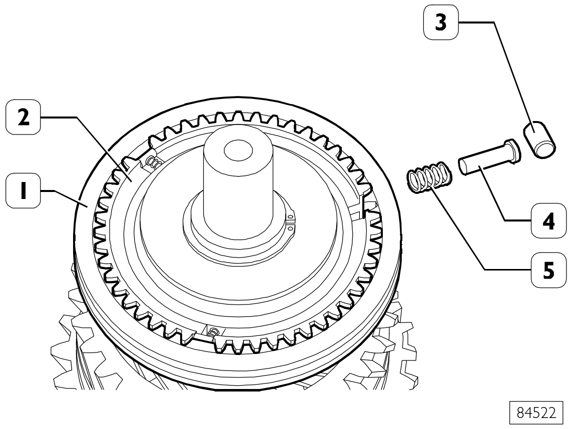
Heat hub (2) to a temperature of ~ 85°C, then fit it onto output shaft (1) taking care that the tangent stop projections (3) of the synchronizing ring are positioned in the openings of the hub itself.
Check axial play of 6^{th} speed gear (4), which must fall within the range of 0.31 ÷ 0.53 mm.

Figure 73



Mount snap ring (1), the thickness of which produces axial play of the same into its own seat (2), as near to zero as possible.

Figure 74

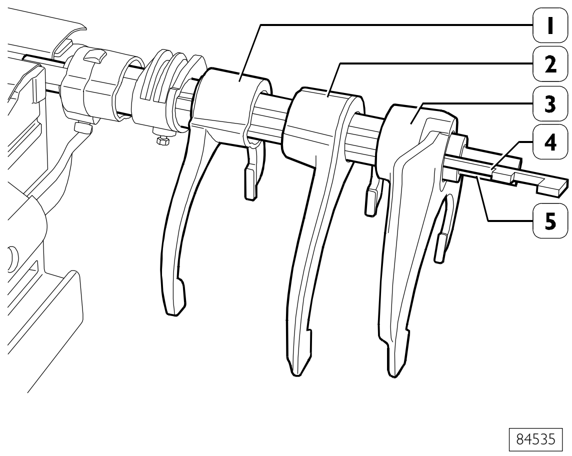


Mount springs (5) and small pins (4) on hub (2).
Mount 3^{rd} - 4^{th} gear engagement sliding sleeve (1) on hub (2), then place the former so that it is slightly lifted compared to hub (2), then insert rollers (3) between small pins (4) and sliding sleeve (2).

INTERNAL DRIVING SHAFT

Disassembling

Figure 75



Secure the internal driving shaft unit firmly in a vice.

Mark the assembly position of every single part of the unit.
Take out gear engagement enable key (4) by turning the forks in the proper direction.
Take forks (3 - 2 - 1) out of shaft (5).

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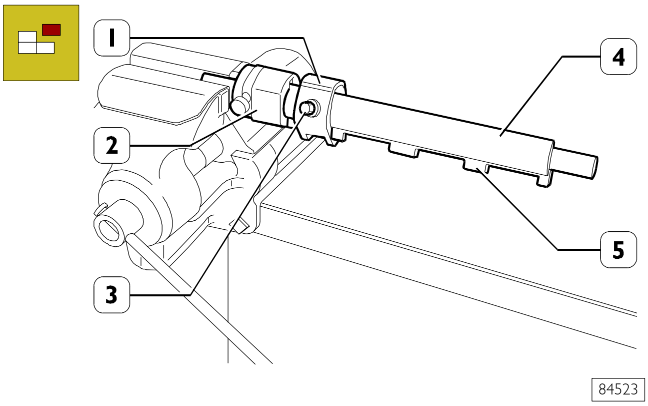
Figure 76



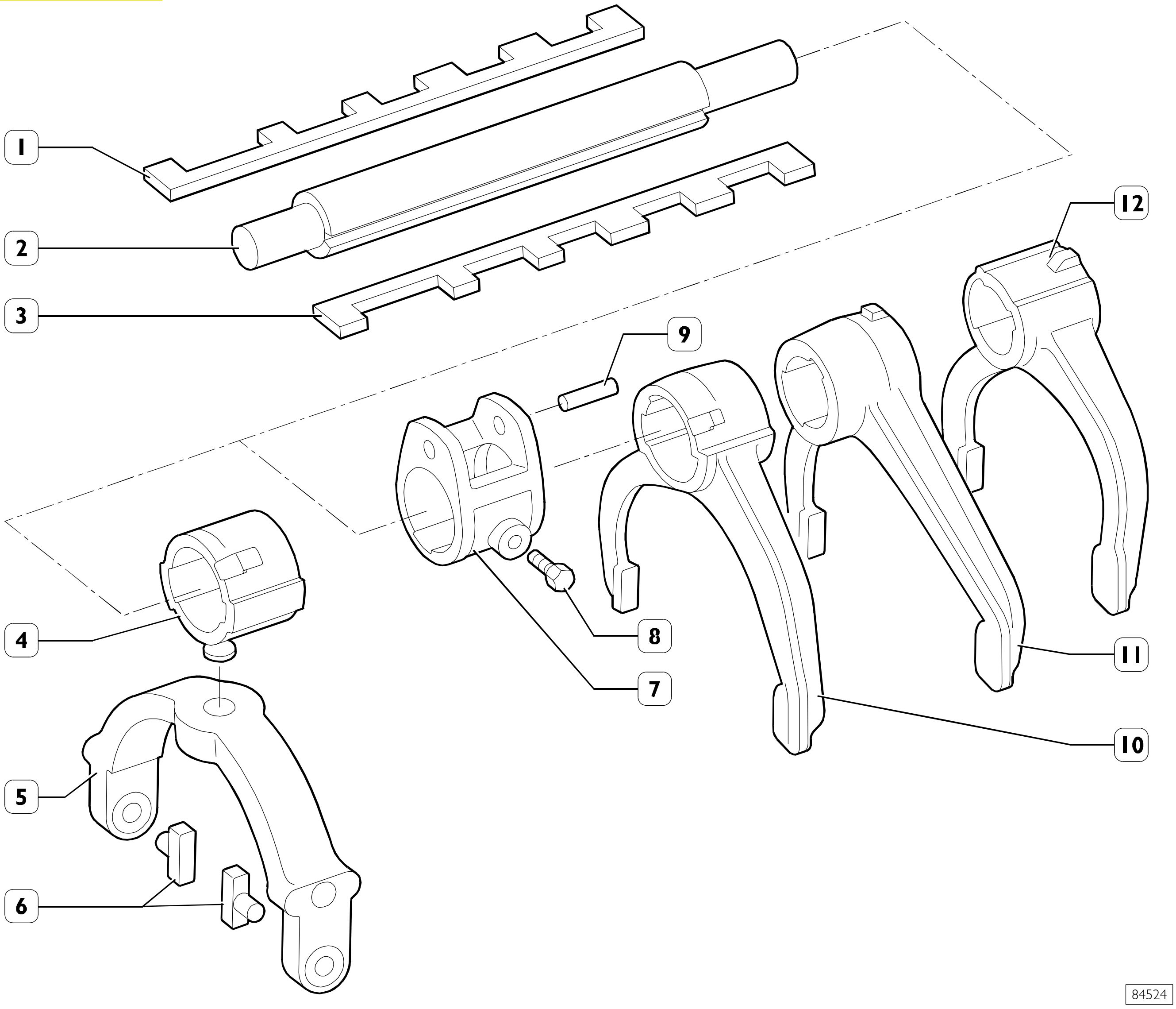
Remove screw (3), then take block (1), the selection key (5) and selector (2) out of shaft (4).

Assembling

The internal driving shaft unit is assembled by reversing the order of disassembling operations.

Apply LOCTITE 270 on screw thread (3, Figure 76), then tighten the screw to a torque of 35 ÷ 39 Nm.

Figure 77



PARTS MAKING UP THE INTERNAL DRIVING SHAFT UNIT

1. Selection key - 2. Shaft - 3. Gear engagement enable key - 4. Selector - 5. 5th - 6th speed control fork - 6. Pads - 7. Block - 8. Screw - 9. Pin - 10. 3rd - 4th speed control fork - 11. 1st - 2nd speed control fork - 12. Reverse gear control fork.

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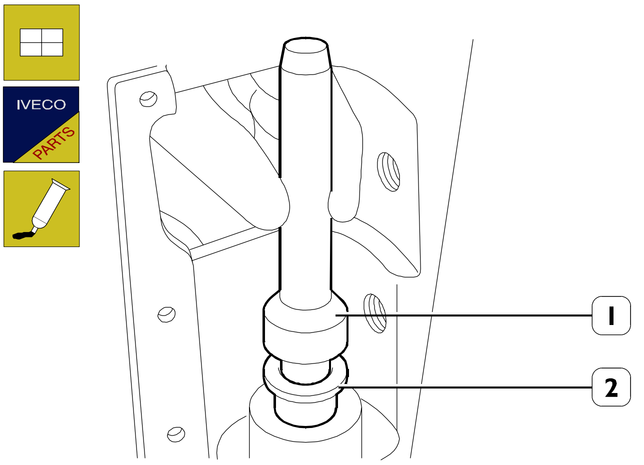
Gearbox assembling

Prior to assembling the gearbox, verify that the half cases and the covers are clean, and that all the gaskets and sealing materials have been removed from the mating surfaces. When fitting the fastening screws to the clearance holes, apply LOCTITE 641 sealant to the threads.

Figure 78

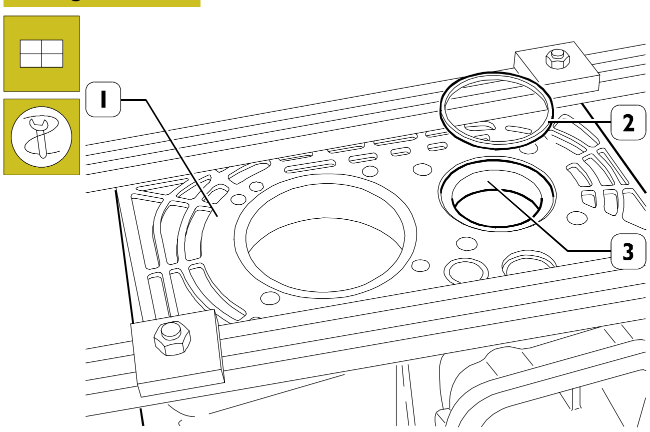


84525

Use a suitable beater (1) to replace, if necessary, internal driving shaft bushings (2) and the caps below, the front half case and rear half case.

> Apply LOCTITE 5900 on the outside of caps, then mount the latter with their concave side facing the inside of the half case.

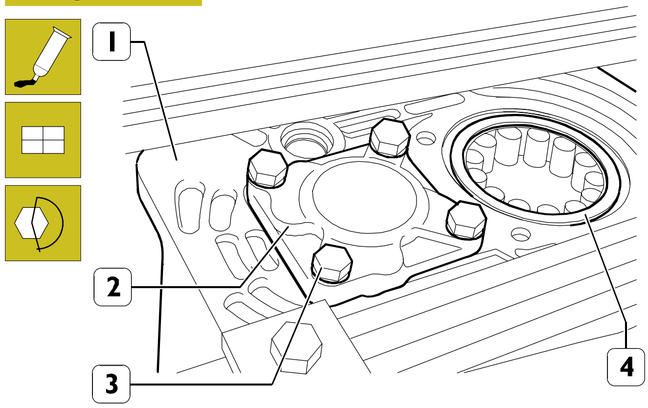
Figure 79



84526

Use beater 99374092 and handle 99370007 to mount the tapered-roller bearing outer race (3) into rear half case (1), so that it is slightly embedded compared to the case plane.
Mount spacer ring (2).

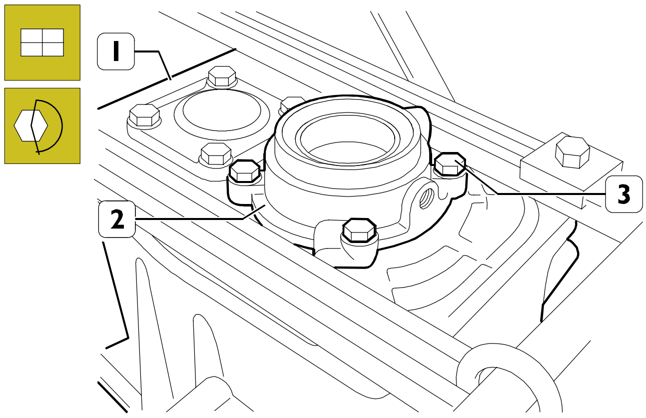
Figure 80



84527

Apply LOCTITE 5900 on cover (2) mating surface, then mount the cover on rear half case (1).
Tighten fastening screws (3) to the specified torque.
Mount output shaft roller bearing (4).

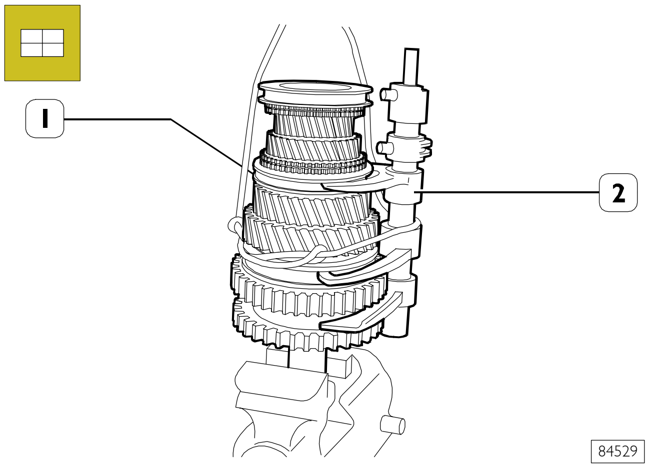
Figure 81



84528

Temporarily mount output shaft rear cover (2) on rear case (1), then tighten fastening screws (3) to the specified torque.

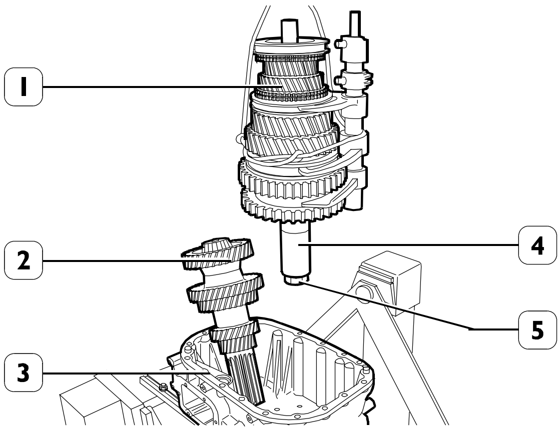
Figure 82



84529

Place internal driving shaft (2) onto output shaft (1), then secure it firmly by means of a suitable rope.

Figure 83

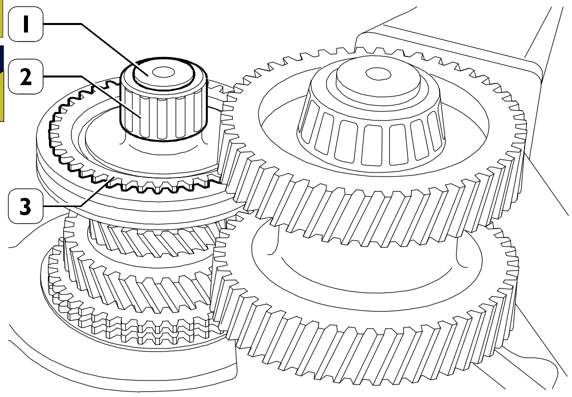


84530

Place countershaft (2) in rear half case (3). Lift the unit (1) thus assembled. Apply tool SP. 2413 (4) to the output shaft end, secure it by means of nut (5) and insert it into the rear half case.

While performing this operation, verify that the output shaft is inserted into the support bearing, the internal driving shaft is inserted into its respective bushing, and that the countershaft can be matched with the output shaft.

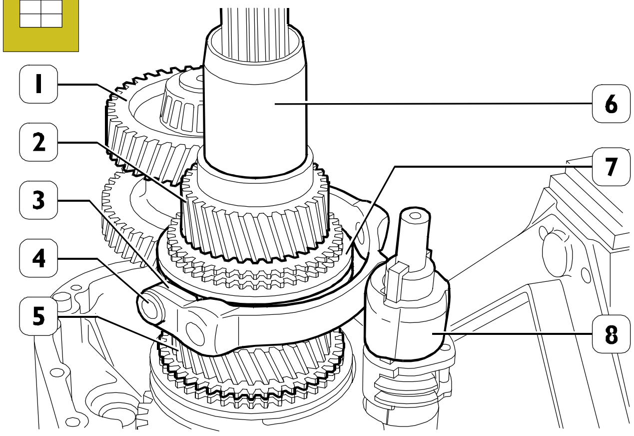
Figure 84



84531

Mount synchronizing ring (3) and roller bearing (2) on output shaft (1).

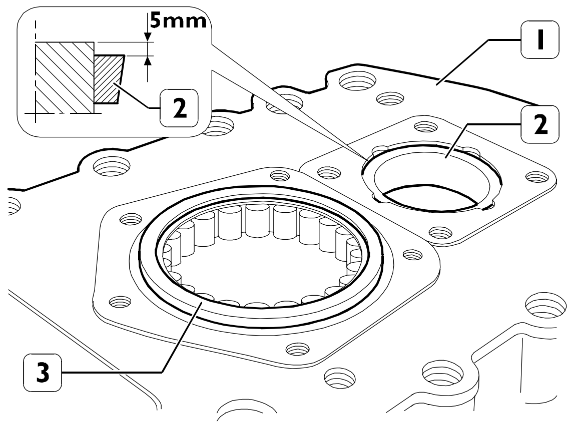
Figure 85



84532

Mount motion inlet shaft (2) by slightly lifting output shaft (5) and opening out countershaft (1).
Remove the rope.
Place fork (4) pads (3) on sliding sleeve (7), then connect fork (4) to selector (8) pin.
Force-fit tool SP. 2413 (6) onto motion inlet shaft (2).

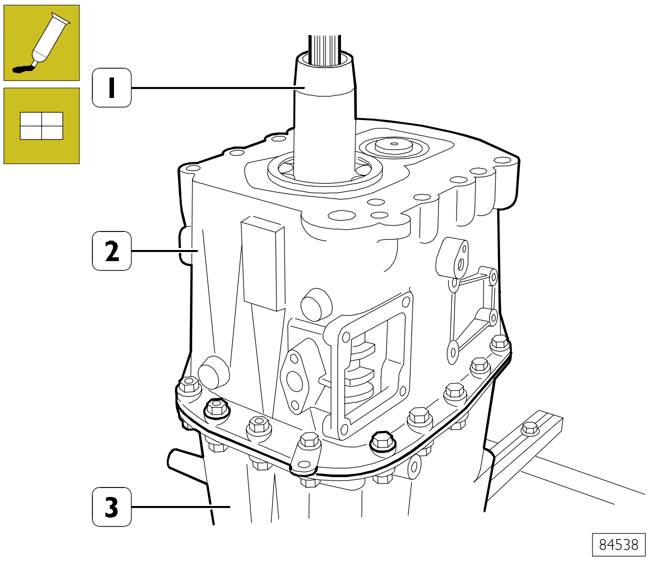
Figure 86



84533

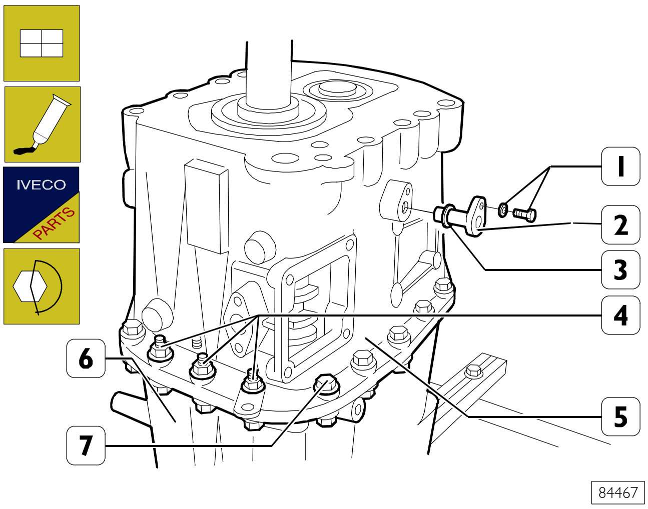
Use beater 99374092 and handle 99370007 to mount the countershaft tapered-roller bearing outer race (2) into front half case (1), so that it is slightly embedded compared to half case (1) outer plane by ~ 5 mm.
Mount cylindrical roller bearing (3) for the motion inlet shaft.

Figure 87



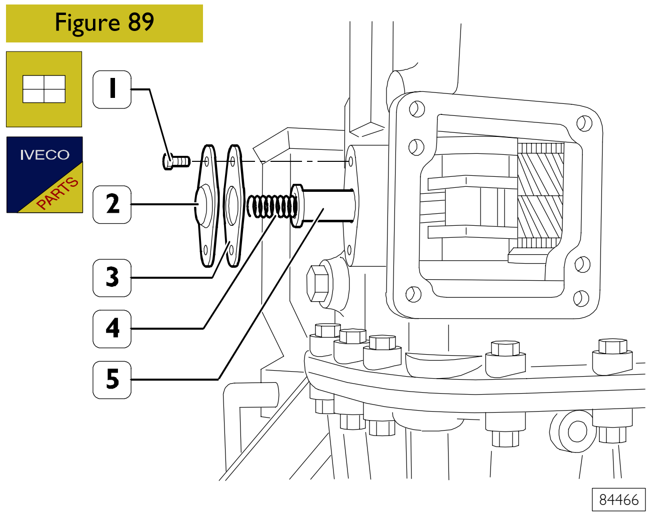
Apply LOCTITE 5900 on rear half case (3) mating surface, then mount front half case (2). Remove tool SP. 2413 (1).

Figure 88



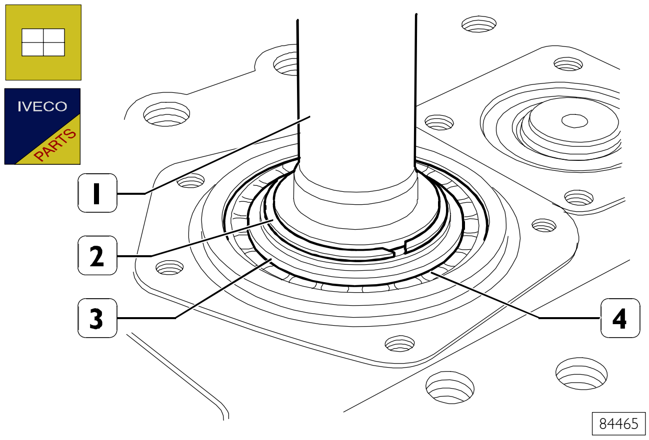
Fasten screws (7) and the screws with nuts (4) in the original assembly position, then tighten them to the specified torque.
Mount a new seal ring (3) on pins (2).
Apply LOCTITE 5900 on the mounting flange of pins (2), then insert the latter into the front half case so that they fit into the 5th - 6th speed engagement fork seats.
Fasten screws (1) with washers, then tighten them to the specified torque.

Figure 89



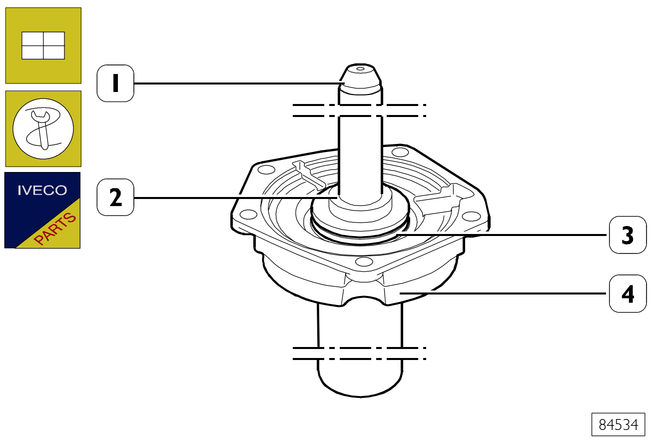
Insert pin (5) with spring (4) into the front half case.
Mount small cover (2) with a new gasket (3). Fasten screws (1) and tighten them to the specified torque.

Figure 90



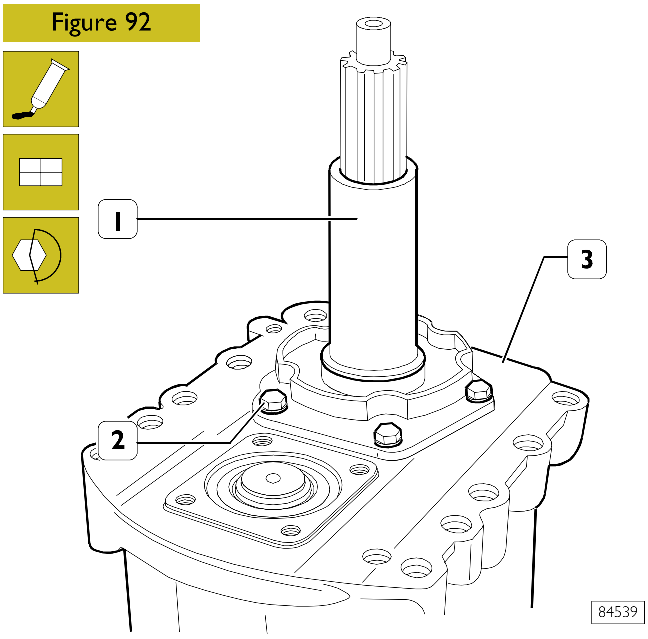
Mount spacer (3) on cylindrical roller bearing (4), then secure it to motion inlet shaft (1) by means of a new snap ring (2).

Figure 91



Use coupler 99370349 (2) and handle 99370007 (1) to fit a new seal ring (3) to motion inlet shaft cover (4).

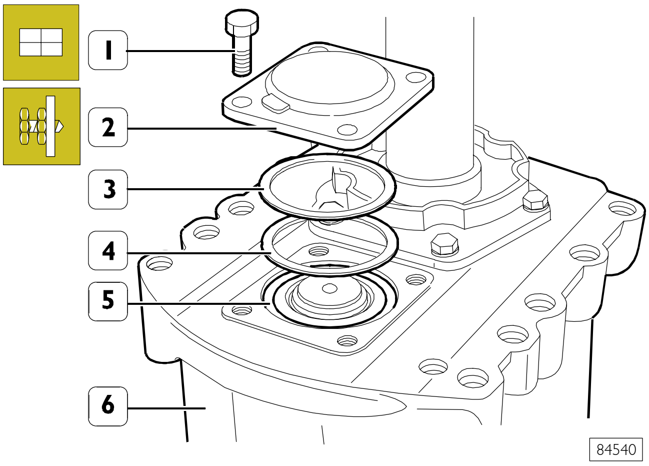
Figure 92



Apply LOCTITE 5900 on motion inlet shaft cover (1) mating surface, then mount it on front half case (3).
Fasten screws (2) and tighten them to the specified torque.

Adjusting the axial play of countershaft bearings

Figure 93

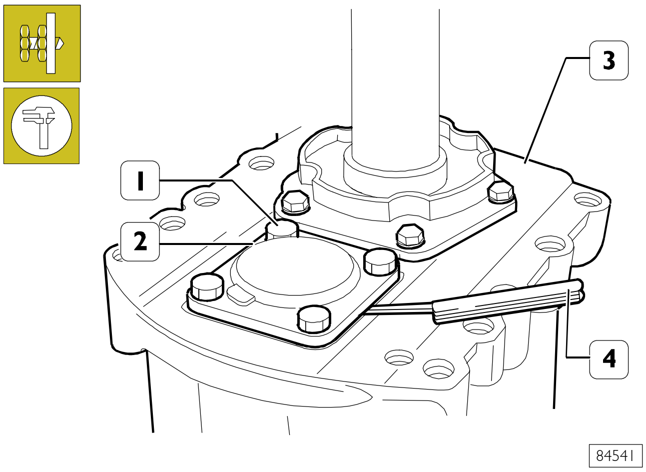


Mount adjusting ring (4) (of the greatest thickness among those of the replacement parts supplied) on tapered-roller bearing outer race (5), then mount spacer (3).

> ! With the tapered-roller bearing embedded, spacer (3) must jut out of half case (6) plane.

Mount cover (2) on half case (6), fasten screws (1) without the safety washers, tighten them evenly and, at the same time, turn the motion inlet shaft in both directions of rotation in order to correctly embed the bearings and feel some resistance when rotating.

Figure 94



Loosen screws (1) and fasten them again so as to slightly lock cover (2).
Use a thickness gauge (4) to measure, at four equidistant points, the distance 'X' between cover (2) and front half case (3).

The thickness **S** of adjusting ring (4, Figure 93) is obtained as follows:

$$S = A - X + P$$

where:

A = thickness of the adjusting ring used for measuring;

X = average value of measurements made;

P = bearing preload:

- new bearings 0.075 ÷ 0.125 mm
- used bearings 0.00 ÷ 0.05 mm

After measuring the thickness of the adjusting ring, remove screws (1) and cover (2).
Choose an adjusting ring from among those supplied as spares, of the calculated thickness, then mount it in place of the one used for measuring.
Apply LOCTITE 5900 on cover (2) mating surface, then mount the cover on half case (3). Apply LOCTITE 641 on screw (1) threads, then fasten the screws with new safety washers and tighten them to the specified torque.

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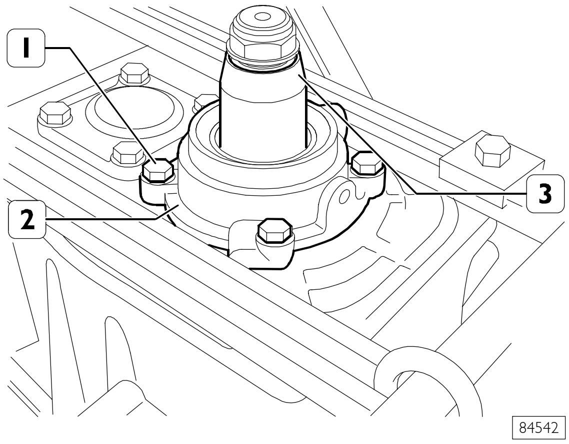
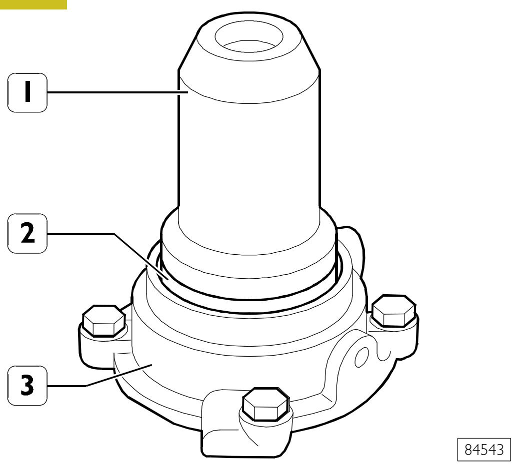
Figure 95



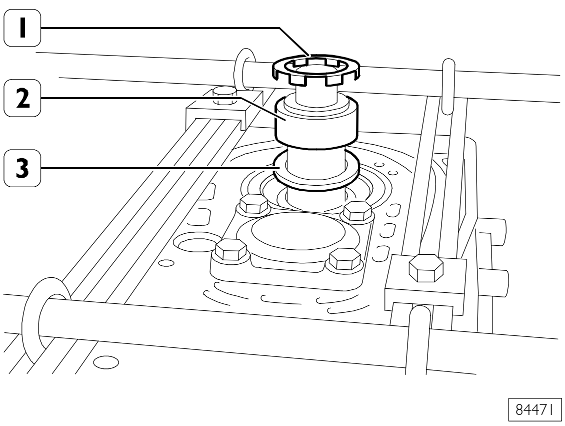
Turn the gearbox upside down. Remove screws (1), take off cover (2) and remove tool SP. 2413 (3).

Figure 96



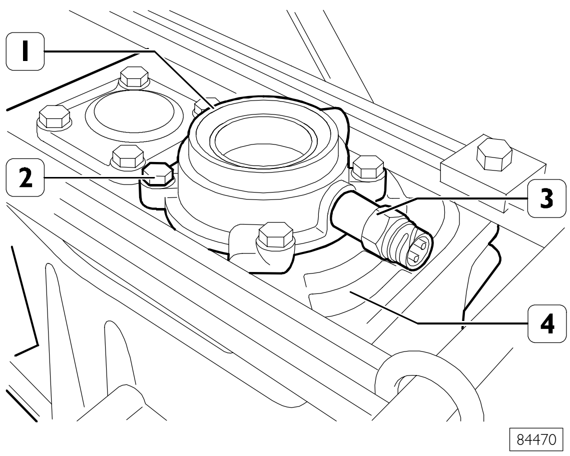
Take the seal ring off cover (3).
Use coupler 99374201 (1) to mount a new seal ring (2) into cover (3).

Figure 97



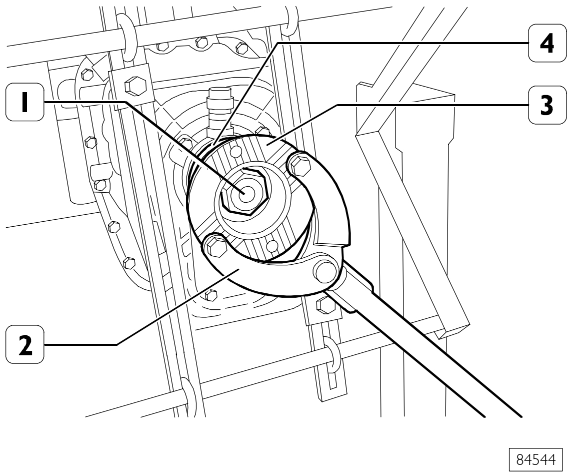
Mount roller bearing ring (3), spacer (2) and phonic wheel (1).

Figure 98



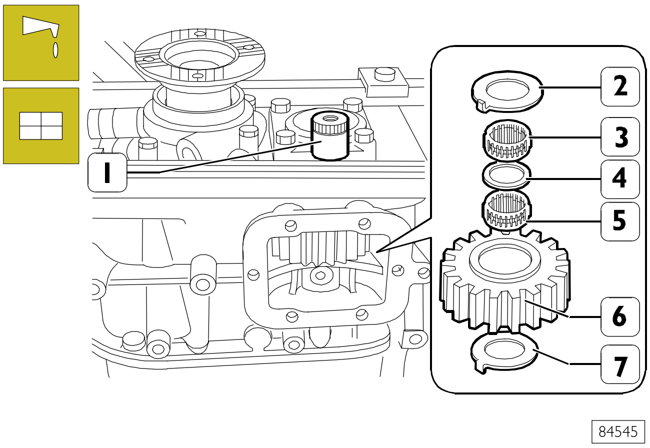
Apply LOCTITE 5900 on cover (1) mating surface, then mount the cover on rear half case (4).
Apply LOCTITE 641 on screw (2) threads, then fasten and tighten the screws to the specified torque.
Mount revs sensor (3) and tighten it to the specified torque.

Figure 99



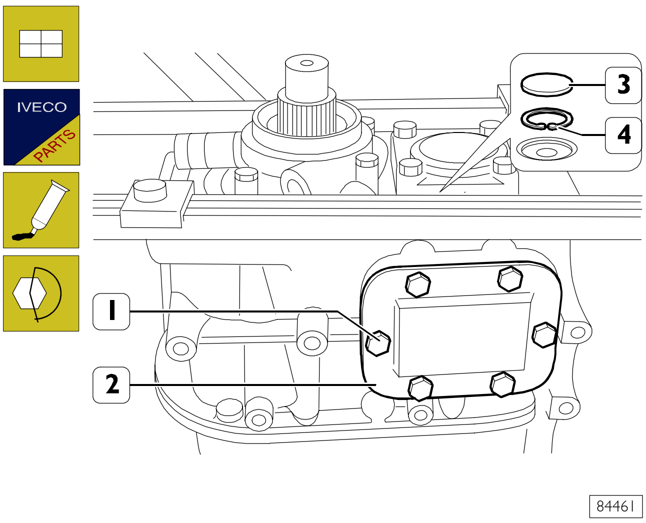
Lubricate the lip of seal ring (4) fitted into the rear cover.
Heat flange (3) to ~ 85°C, fit it onto the output shaft, then fasten locknut (1) onto the output shaft.
Stop rotation of flange (1) by means of tool 99370317 (2) applied as shown in the figure.
Fasten nut (1) to the specified torque, then remove tool (2).

Figure 100



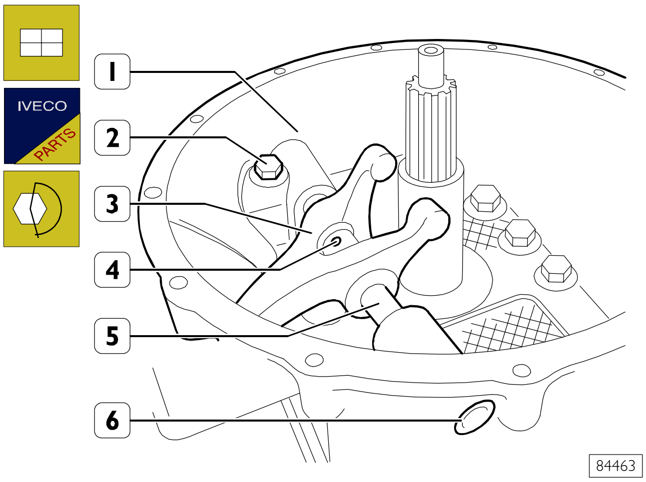
Apply a thin coat of grease to roller bearings (3 and 5) and spacer (4), then fit the roller bearings into gear (6).
Lubricate shoulder rings (2 and 7), place them into the rear half case, then mount gear (6). Mount arbor (1).

Figure 101



Mount a new snap ring (4).
Apply LOCTITE 5900 on small cover (3), then mount the latter in the rear half case.
Apply LOCTITE 5900 on side cover (2), then mount the latter in the rear half case.
Apply LOCTITE 641 on screw (1) threads, then tighten the screws to the specified torque.

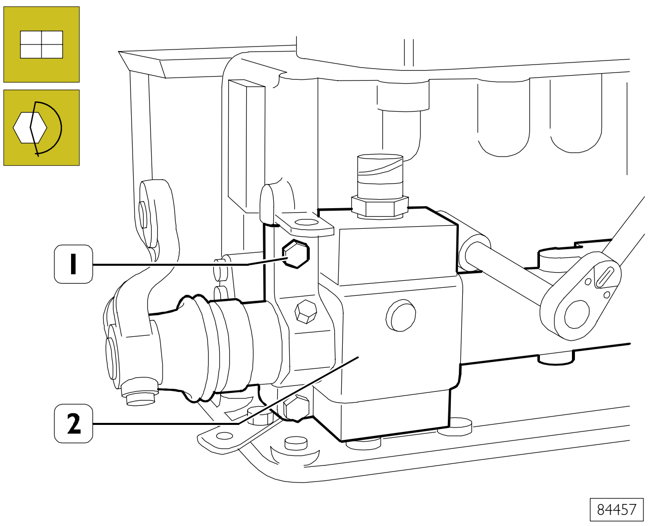
Figure 102



Turn the gearbox upside down.
Fit back clutch bell (1), then tighten fastening screws (2) to the specified torque.
Place fork (3) on clutch bell (1), then mount shaft (5).

Secure fork (3) to shaft (5) by inserting elastic pin (4). Mount new protecting caps (6).

Figure 103



Fit gear drive case (2) back to the gearbox, then tighten screws (1) to the specified torque.

> The seal gasket inserted into the case must be replaced only if it is damaged.
> Manually check the engagement of every single gear.

Mount the oil drain cap and tighten it to the specified torque.
Fill the gearbox with the proper amount of lubricating oil of the specified type.
Mount the level check and oil filling cap, then tighten it to the specified torque.

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SECTION 5

Propeller shafts

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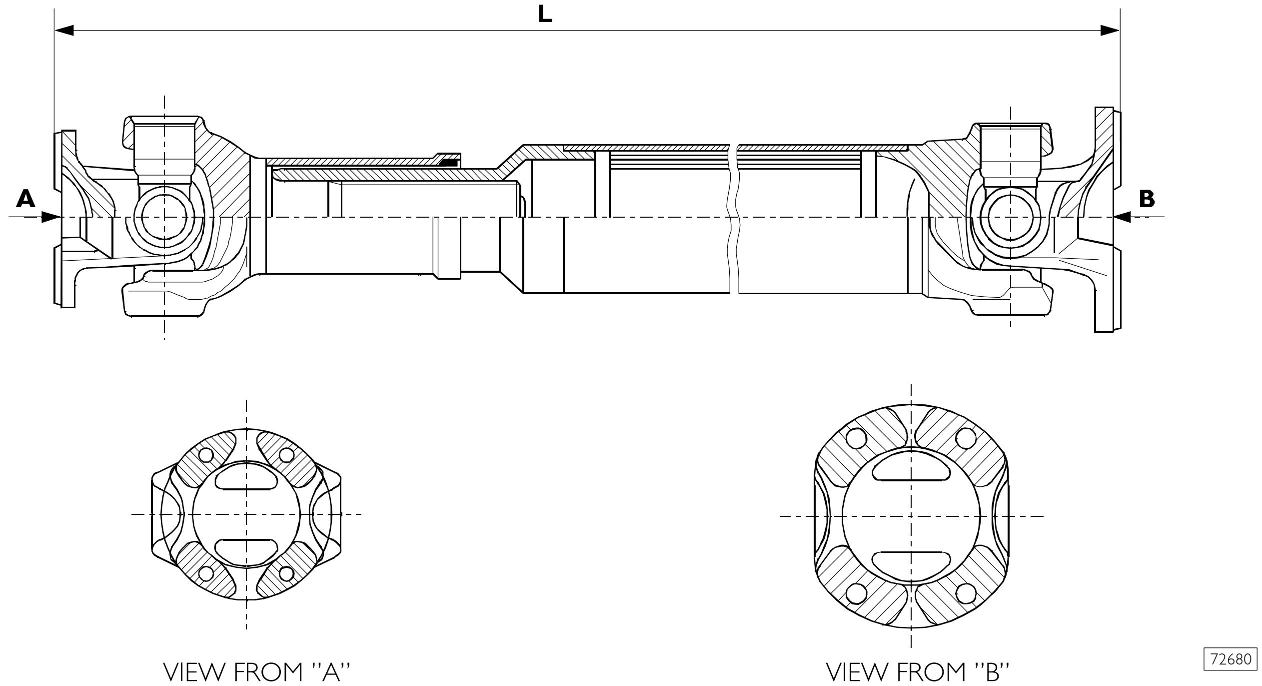
DESCRIPTION	3
PROPELLER SHAFT LAYOUT ON VEHICLES .	8
PROPELLER SHAFT SPECIFICATIONS AND DATA	9
DIAGNOSTICS	11
TIGHTENING TORQUES	11
SLIDING PROPELLER SHAFT REMOVAL- REFITTING	12
❑ Removal	12
❑ Refitting	12
FIXED PROPELLER SHAFT REMOVAL- REFITTING	12
CHECKING PROPELLER SHAFTS ON VEHICLE	12

DESCRIPTION

Motion transmission from engine-gearbox to rear axle occurs through a propeller shaft that is sliding in a single section or in two sections composed of a fixed front shaft and a sliding rear shaft.
Coupling between assemblies and shaft is implemented by universal joints.

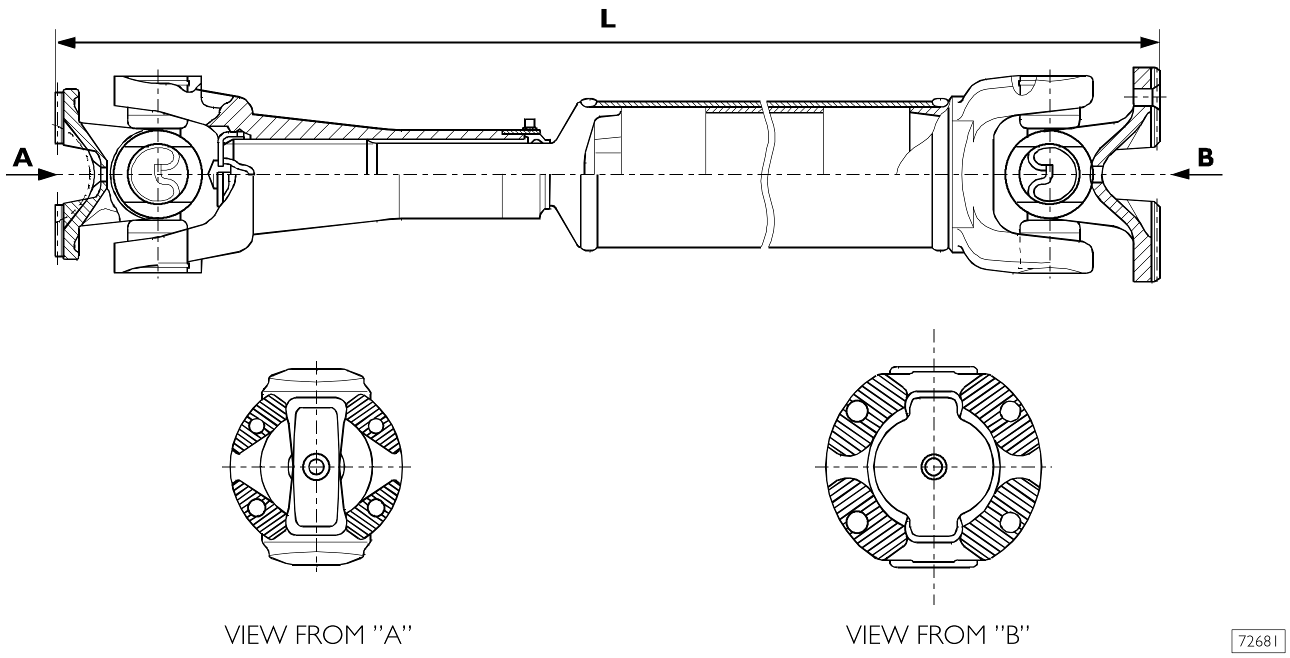
The front end of the sliding propeller shaft is composed, in addition to the universal joint, of a moving grooved sleeve also, which allows the shaft to modify its length in order to dampen possible axial transmission displacements, due to rear axle oscillations.

Figure 1



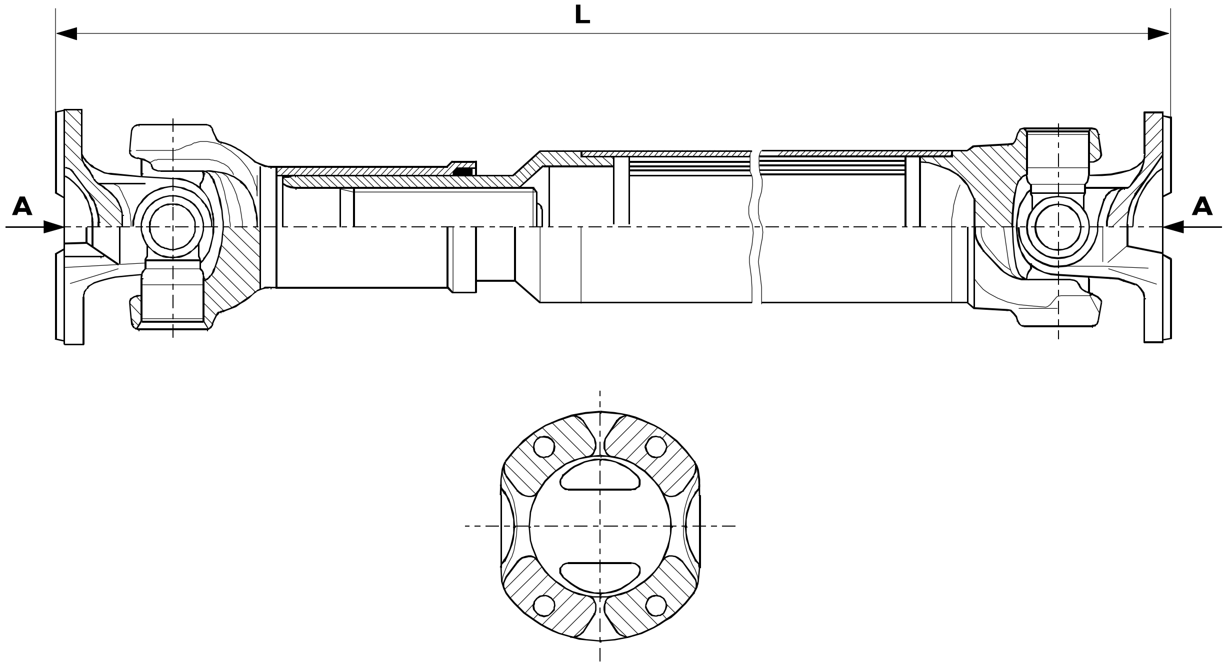
SLIDING PROPELLER SHAFT OF THE "GKN" TYPE – 120/150 FLANGE

Figure 2



SLIDING PROPELLER SHAFT OF THE "DANA" TYPE – 120/150 FLANGE

Figure 3

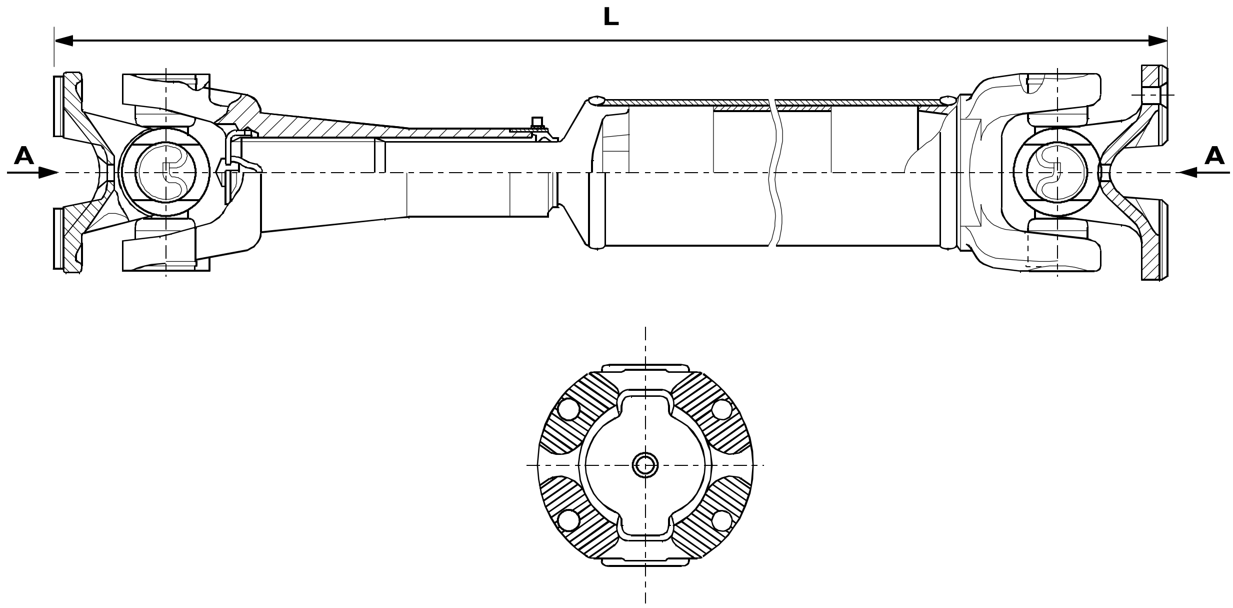


72682

VIEW FROM "A"

SLIDING PROPELLER SHAFT OF THE "GKN" TYPE – 150/150 FLANGE

Figure 4

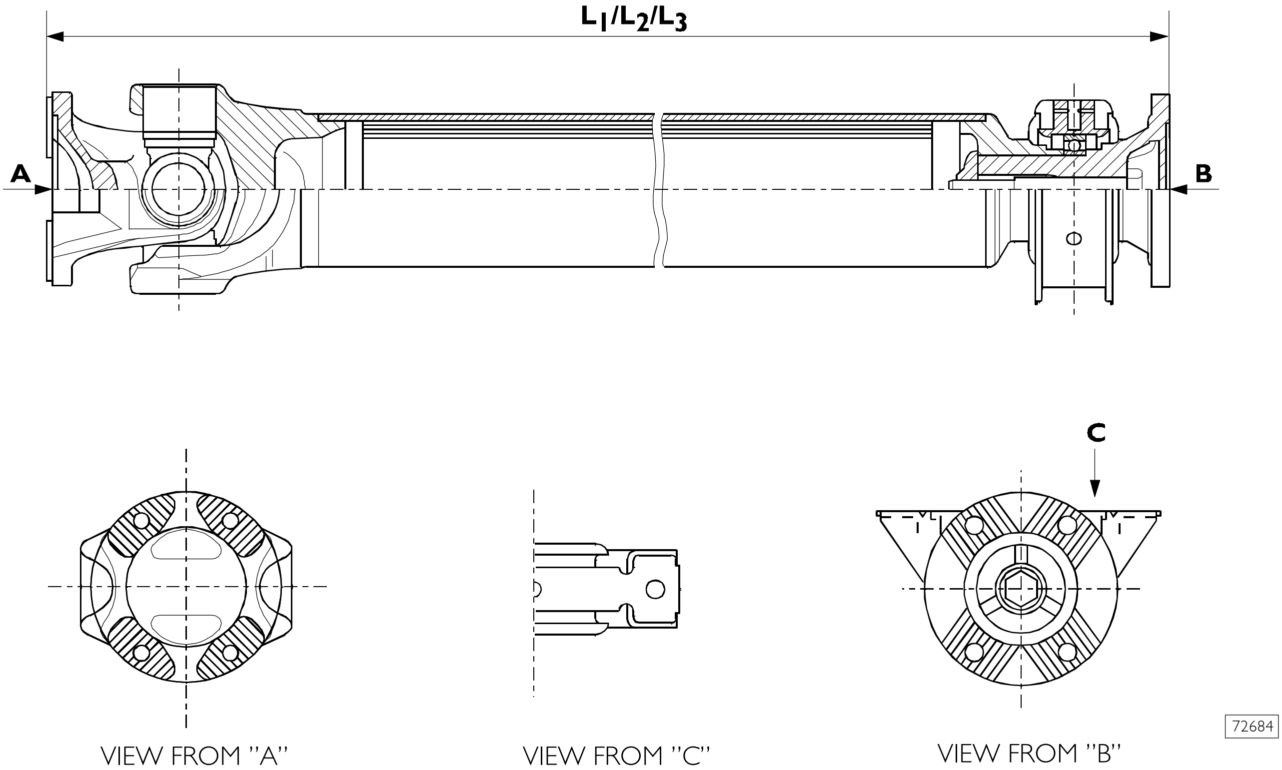


VIEW FROM "A"

72683

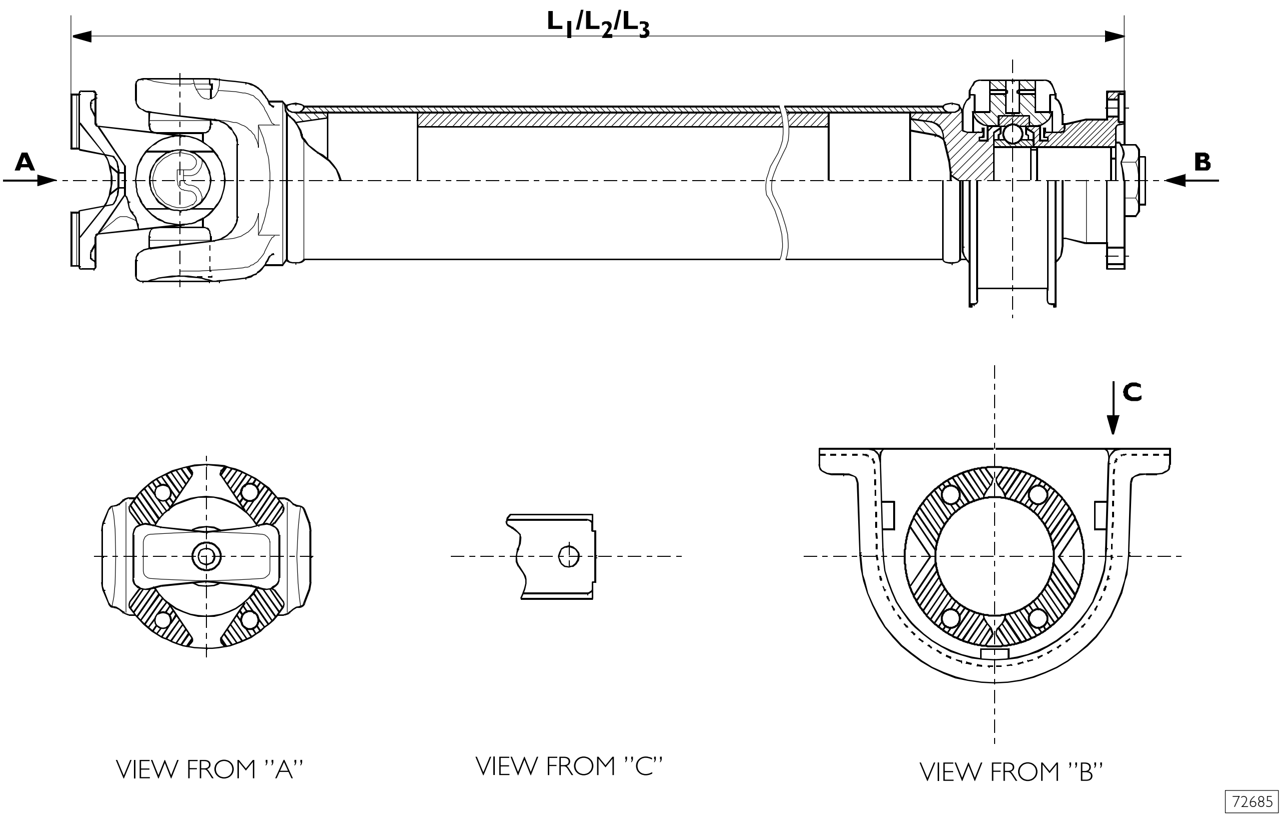
SLIDING PROPELLER SHAFT OF THE "DANA" TYPE – 150/150 FLANGE

Figure 5



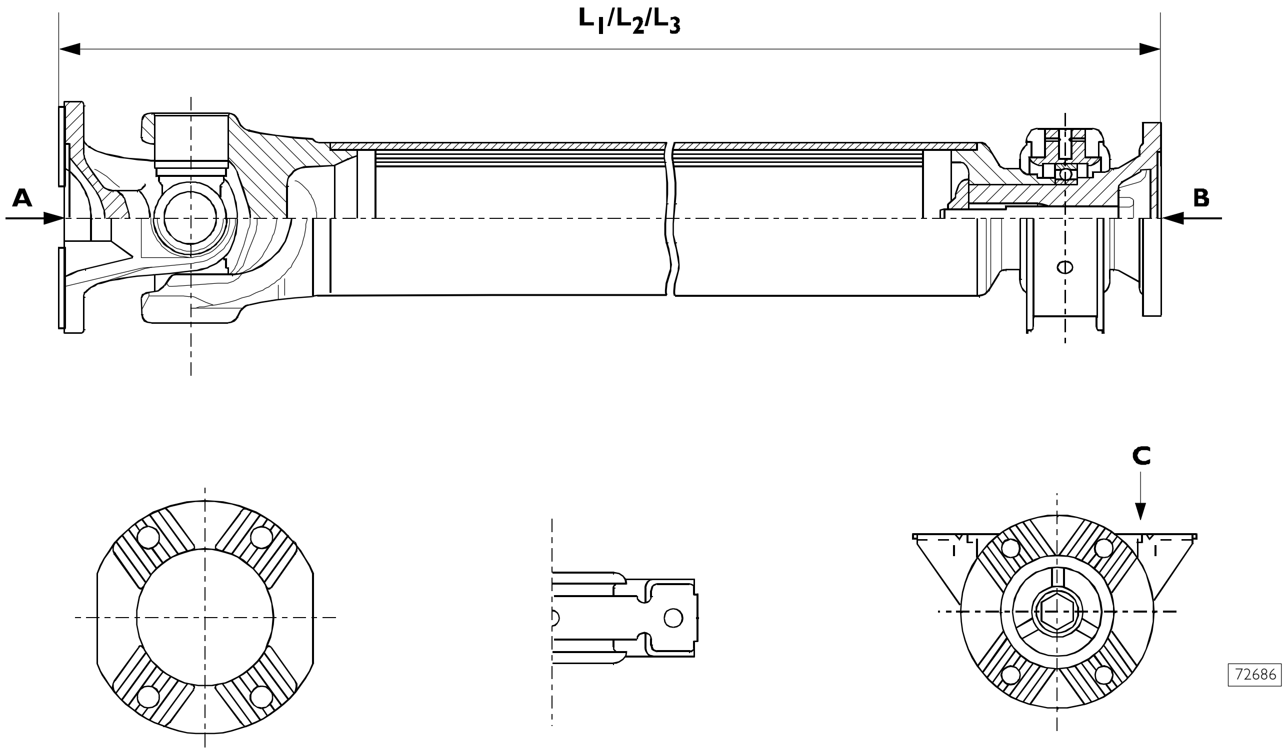
FIXED PROPELLER SHAFT OF THE "GKN" TYPE – 120/120 FLANGE

Figure 6



FIXED PROPELLER SHAFT OF THE "DANA" TYPE – 120/120 FLANGE

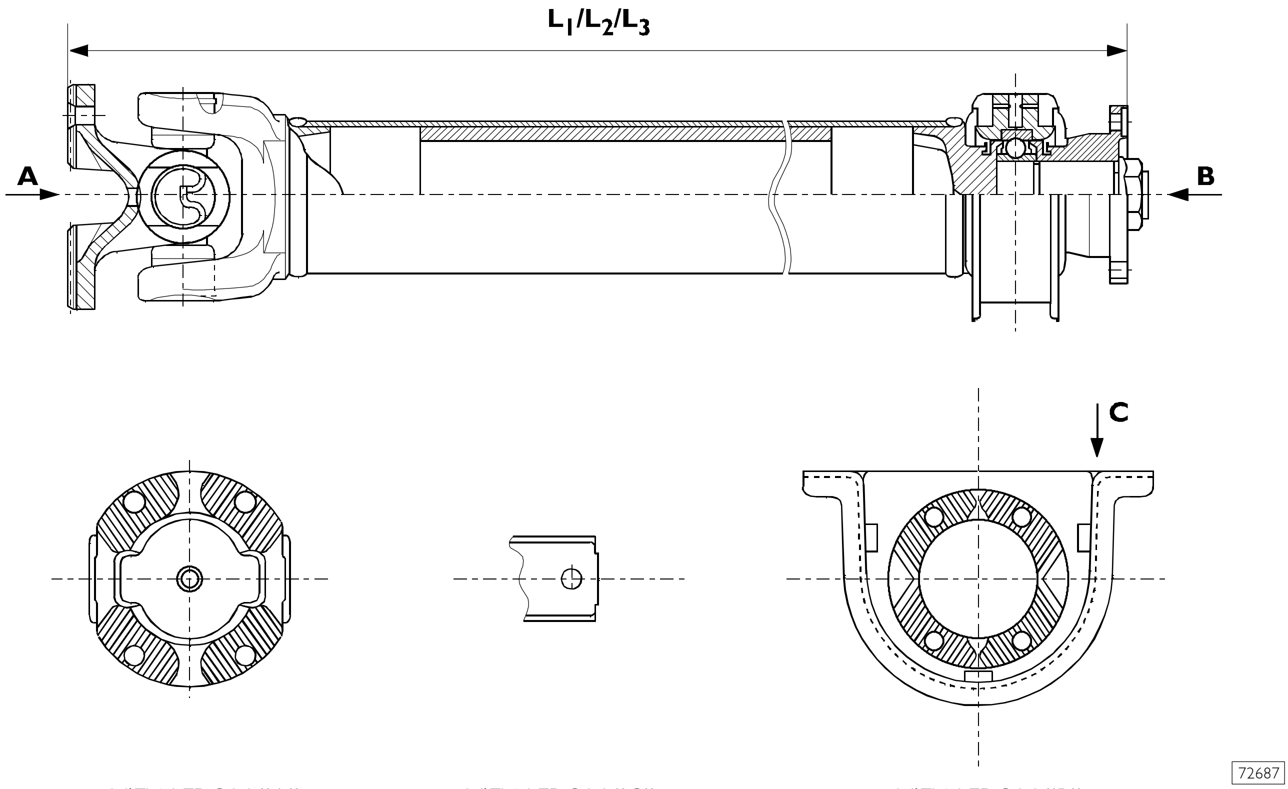
Figure 7



VIEW FROM "A" VIEW FROM "C" VIEW FROM "B"

FIXED PROPELLER SHAFT OF THE "GKN" TYPE – 150/120 FLANGE

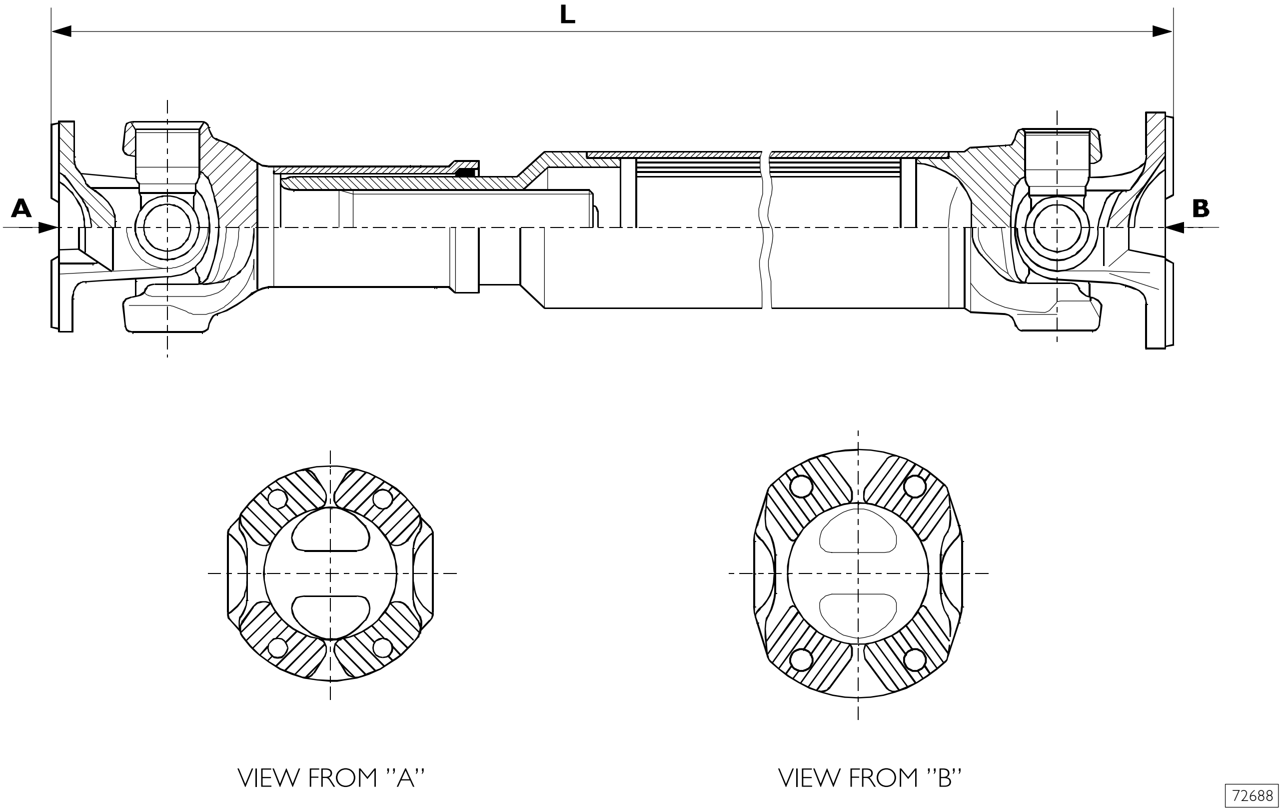
Figure 8



VIEW FROM "A" VIEW FROM "C" VIEW FROM "B"

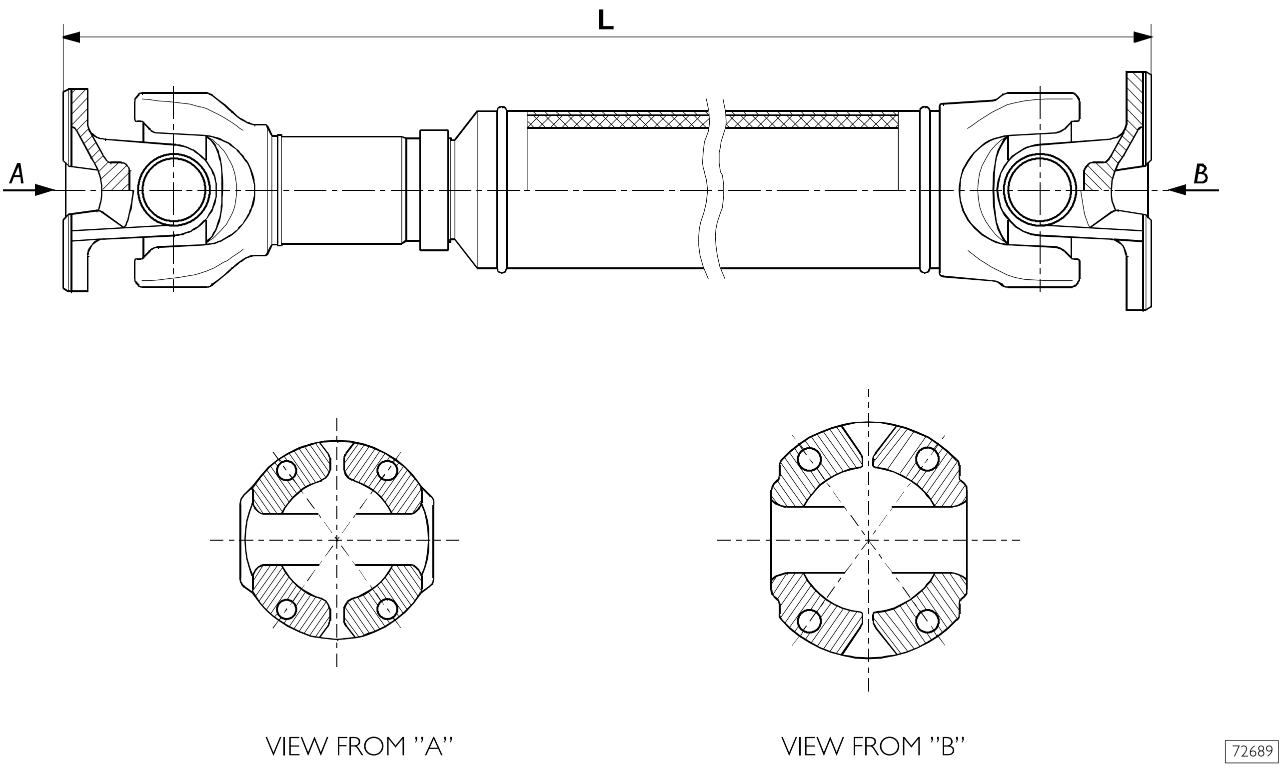
FIXED PROPELLER SHAFT OF THE "DANA" TYPE – 150/120 FLANGE

Figure 9



SLIDING PROPELLER SHAFT OF THE "GKN" TYPE - 150/180 FLANGE

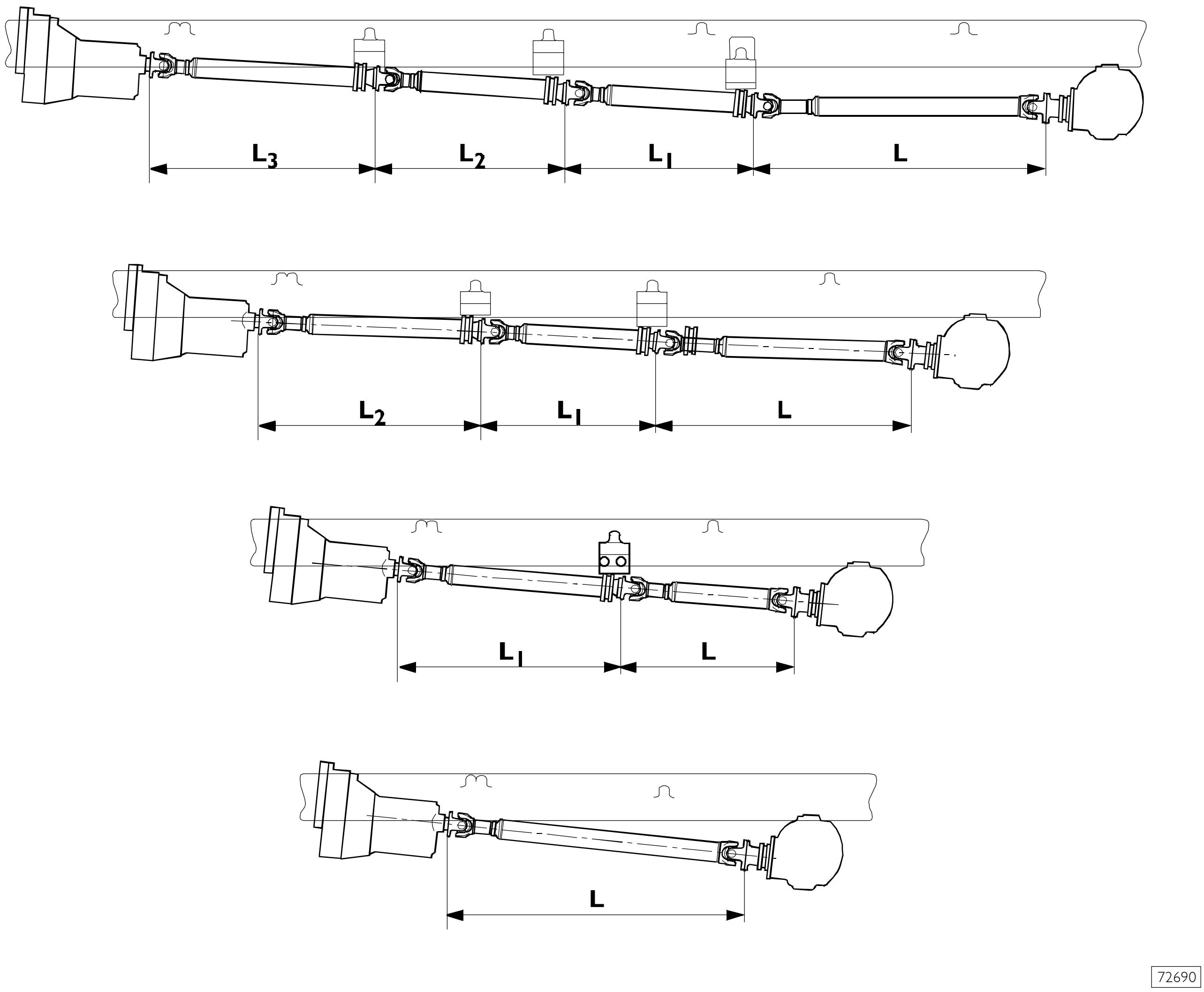
Figure 10



FIXED PROPELLER SHAFT OF THE DANA TYPE

PROPELLER SHAFT LAYOUT ON VEHICLES

Figure 11



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PROPELLER SHAFT SPECIFICATIONS AND DATA

PITCH		3105	3330		3690		4185		4455		4815		5175		5670	
		L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm
MODEL	GEARBOX TYPE	min max		min max		min max		min max		min max		min max		min max		min max
110/120 EL 17	2855.6	1725 to 1835	985	965 to 1076	1330	990 to 1100	1330	1485 to 1595	1330	1750 to 1860	1630	1740 to 1850	-	-	-	-
110/120 EL 17	2870.9	1540 to 1650	-	1765 to 1875	1140	990 to 1100	1140	1485 to 1595	1140	1750 to 1860	1610	1650 to 1760	-	-	-	-
110/120 EL 21	2865.6	1580 to 1690	-	1810 to 1920	1180	990 to 1100	1180	1485 to 1595	1180	1750 to 1860	1560	1750 to 1860	-	-	-	-
110/120 EL 21	2870.9	1420 to 1530	-	1650 to 1760	1020	990 to 1100	1020	1485 to 1595	1020	1750 to 1860	1390	1750 to 1860	-	-	-	-

PITCH		3105	3690		4185		4455		4815		5175			5670			6570			
		L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L2 mm	L1 mm	L mm	L2 mm	L1 mm	L mm	L3 mm	L2 mm	L1 mm	L mm
MODEL	GEARBOX TYPE	min max		min max		min max		min max		min max			min max			min max				min max
120/130 E 18	2855.6	1690 to 1800	1300	965 to 1075	1300	1460 to 1570	1395	1630 to 1740	1740	1650 to 1760	1300	1035	1410 to 1520	1300	1310	1630 to 1740	1300	1110	1110	1630 to 1740
120/130 E 18-21	2870.9	1490 to 1600	1110	965 to 1075	1110	1460 to 1570	1110	1725 to 1835	1730	1460 to 1570	-	1730	1830 to 1940	1110	1110	1830 to 1940	-	1270	1850	1830 to 1940
120/130 E 21	2865.6	1650 to 1760	1180	965 to 1075	1180	1460 to 1570	1235	1740 to 1850	1610	1740 to 1850	-	1860	1865 to 1975	1350	1030	1830 to 1940	-	1350	1880	1875 to 1965
120/130 E 24-28	2895.9	1410 to 1520	-	1990 to 2100	1030	1455 to 1565	1030	1725 to 1835	1380	1725 to 1835	-	1895	1580 to 1690	-	1895	2075 to 2185	-	1090	1895	1875 to 1985
120/130 E 24	FSO5206B	1540 to 1650	1155	965 to 1075	1155	1460 to 1570	1155	1740 to 1850	1500	1740 to 1850	-	1740	1865 to 1975	-	-	1830 to 1940	-	-	-	1875 to 1985
150 E 21	2865.6	1635 to 1745	1190	1040 to 1150	1270	1445 to 1555	1270	1715 to 1825	1630	1715 to 1825	-	1860	1830 to 1940	1350	1020	1830 to 1940	-	1350	1880	1865 to 1975
150 E 21	2870.9	1475 to 1585	-	2065 to 2175	1115	1445 to 1555	1115	1715 to 1825	1470	1715 to 1825	-	1700	1830 to 1940	1190	1020	1830 to 1940	-	1190	1880	1865 to 1975
150 E 24	FSO5206B	1500 to 1610	1085	1020 to 1130	1160	1425 to 1535	1160	1695 to 1805	1510	1695 to 1805	-	1740	1825 to 1935	1240	1020	1820 to 1930	-	1240	1880	1850 to 1960
150 E 24-28	2895.9	1350 to 1460	-	1930 to 2040	1030	1410 to 1520	1030	1690 to 1800	1380	1690 to 1800	-	1380	2045 to 2155	-	1895	2030 to 2140	-	1090	1895	1845 to 1955

PITCH		3105
		L mm
MODEL	GEARBOX TYPE	min max
130 E 18 RS	2865.9	1635 to 1745
150 E 21 RS	2870.9	1475 to 1585

PITCH		3830		4190		
		L1 mm	L mm	L2 mm	L1 mm	L mm
MODEL	GEARBOX TYPE	min max	min max		min max	min max
260 E 28 KE	2895.9	1975 to 2085	673 to 833	1095	1255 to 1365	673 to 833

PITCH		3690		4185		4590		4815		5175		5670			6210			6570		
		L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L1 mm	L mm	L2 mm	L1 mm	L mm	L2 mm	L1 mm	L mm	L2 mm	L1 mm	L mm
MODEL	GEARBOX TYPE		min max		min max		min max		min max		min max			min max			min max			min max
180 E 21	2865.6	1190	1030 to 1140	1270	1440 to 1550	1270	1845 to 1955	1630	1960 to 1800	1860	1825 to 1935	1270	1085	1825 to 1935	1350	1895	1475 to 1585	1350	1895	1845 to 1955
180 E 21	2870.9	-	2035 to 2145	1115	1425 to 1535	1115	1825 to 1935	1470	1690 to 1800	1700	1825 to 1935	1115	1085	1825 to 1935	1190	1895	1480 to 1590	1190	1895	1825 to 1935
180 E 24-28	2895.9	-	1950 to 2060	1030	1420 to 1530	1030	1825 to 1935	1380	1695 to 1805	1605	1830 to 1940	1030	1085	1820 to 1930	1090	1895	1490 to 1600	1090	1895	1850 to 1960
180 E 24	FSO5206B	1085	1020 to 1130	1160	1440 to 1550	1160	1845 to 1955	1510	1710 to 1820	1740	1850 to 1960	1240	1020	1825 to 1935	1240	1880	1500 to 1610	1240	1880	1850 to 1960

DIAGNOSTICS

Main propeller shaft anomalies:

1 - Transmission noises and vibration

1	TRANSMISSION NOISES AND VIBRATION

Shaft distortion	YES →	Replace the shaft.
NO ↓		
Unbalanced shaft.	YES →	Carry out balancing check and determine the points where balancing plates must be welded.
NO ↓		
Excessive clearance between grooved profiles.	YES →	Replace the shaft.
NO ↓		
Loosening of screws and nuts for securing shaft to gearbox sleeves or on rear axle.	YES →	Take care, after an accurate check, of completely tightening those screws and nuts that are loosened, and replace damaged parts if required.
NO ↓		
Seized or excessively worn propeller shaft universal joints.	YES →	Revise or replace the universal joints.
NO ↓		
Insufficient lubrication for the various parts.	YES →	Proceed with the lubrication by operating on suitable greasers.

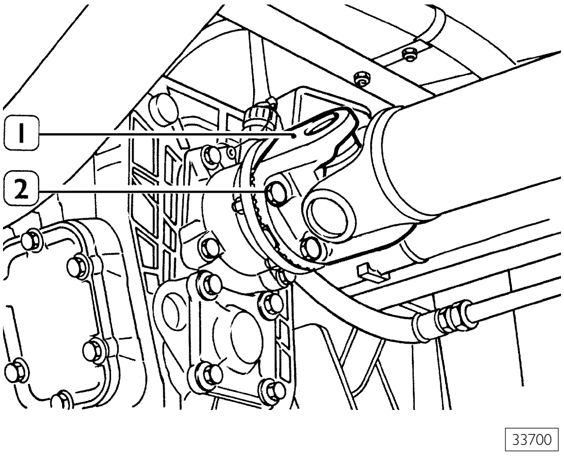
TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
M10 screw for securing transmission flanges	63.5 ± 6.5	(6.4 ± 0.6)
M12 screw for securing transmission flanges	101 ± 10	(10.3 ± 1)
M14 screw for securing transmission flanges	133.5 ± 13.5	(13.6 ± 1.4)
Self-locking flanged nut for elastic support fastening screw	82 ± 8	(8.3 ± 0.9)

505620 SLIDING PROPELLER SHAFT REMOVAL- REFITTING

Removal

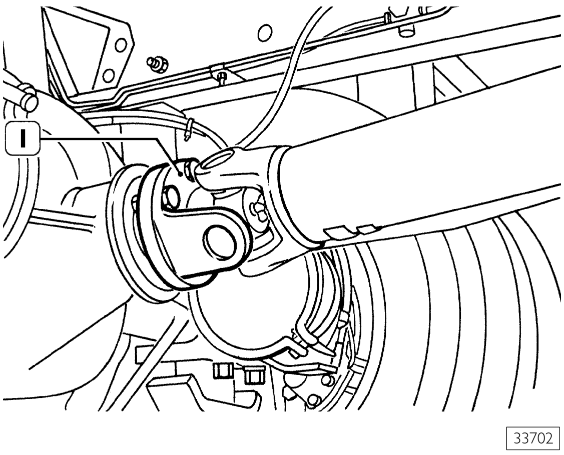
Figure 12



Set the vehicle under safety conditions and operate as described below:

- rotate locking rivets for dampening guard (6) under the gearbox and remove it;
- position an hydraulic jack equipped with support 99370618 under the propeller shaft and suitably constrain it;
- unscrew the four securing bolts (2) and detach propeller shaft (1) from gearbox;

Figure 13



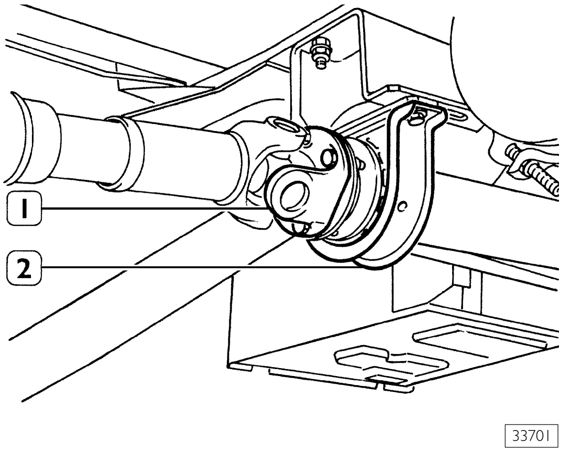
- unscrew the four securing bolts and detach propeller shaft (1) from rear axle;
- lower the hydraulic jack and remove propeller shaft from the vehicle.

Refitting

For the refitting, carry out in reverse order the operations described for the removal, complying with the following warnings:
Self-locking nuts must always be replaced and tightened at the required torque.
Check whether arrows on the sliding part and on shaft are aligned.

FIXED PROPELLER SHAFT REMOVAL- REFITTING

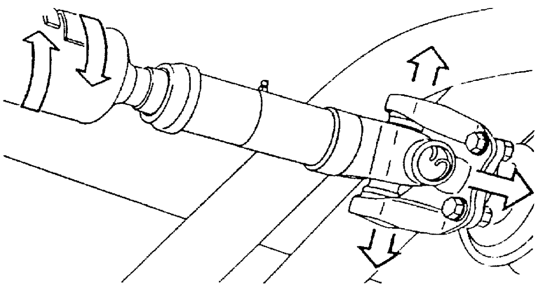
Figure 14



Removal/refitting of these propeller shafts is similar to the sliding one, apart from the presence of a rear support (2) on the fixed shaft, that must be detached from the chassis after having unscrewed the four securing bolts and detached the sliding propeller shaft (1) from the fixed one.

CHECKING PROPELLER SHAFTS ON VEHICLE

Figure 15



Propeller shafts are provided by the manufacturer as assemblies ready for being assembled.
They are statically and dynamically balanced.
The welded plates to propeller shafts are balancing plates.
In case of lack of plates, it is necessary to balance the shaft again.
By operating on the propeller shaft and simultaneously, in reverse order, on the sliding sleeve, check that there is no excessive clearance among grooved parts.
By operating on sleeve forks, check that spiders are not worn; otherwise, replace them.

SECTION 6

5250 Rear axles

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MERITOR AXLE SP 145 E	3
MERITOR AXLE MS08 - 125	*
MERITOR AXLE MS10 - 144	*
MERITOR AXLES MS10 - 164	*
MERITOR AXLES MS13 - 165	*

The rear axles marked with an asterisk will be dealt with in the next edition.

AXLES IN TANDEM
Meritor SP 145 E

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PR 140 E (R 0868) (REAR)	53

Axles in tandem (Intermediate) Meritor PD 145 E (R 2468)

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DESCRIPTION

The intermediate axle is a bearing axle type with a simple reduction; it consists of a box made in metal sheet, housing a reduction differential and a main differential. Drive transmission from the reduction to main differential is achieved through a helical gear pair. The reduction differential is made up by a drive input shaft keying: the front support, the oil pump, the driving gear housing the front crown wheel and side pinion assembly; the rear crown gear is housed on the axle box and keyed on the drive output shaft.
A sliding sleeve is mounted on the rear crown wheel to lock the differential; the sliding sleeve is driven by a pneumatic device through a fork.
Taper roller bearing axial clearance is adjusted by inserting shims between front and wheelwork support; the main differential is made up by a pair of bevel reduction gears with helical toothing (pinion – ring gear assembly) and a wheelwork box (side pinion – crown wheel assembly).
The adjustment of the bevel pinion assembly is made through adjusting rings placed between the two taper roller bearings. You can also adjust the bevel pinion position with reference to the ring bevel gear by changing the thickness of the pack of the rings, which are inserted between the taper bearing under the head and the bevel pinion support.
The wheelwork box is supported by two taper roller bearings and can be adjusted axially through two threaded ring nuts.
The axle is provided with a pneumatic control differential locking device.
The wheel hubs are supported by two tapered-roller bearings floating on a post and adjustable by means of a threaded nut.

SPECIFICATIONS AND DATA

Axle type: Bearing axle with simple reduction, with a pneumatic control differential locking device	**PD 145 E (R 2468)**
MAIN DIFFERENTIAL ASSEMBLY	
Crown wheel and pinion assembly reduction ratio (pinion/ring gear teeth number)	1/5.86 (7/41) 1/5.29 (7/37) 1/4.63 (8/37)
Bevel pinion bearings	2 taper roller bearings
Bevel pinion bearing rolling torque New bearings Nm kgm Reused bearings Nm kgm	 1.12 to 5.08 0.112 to 0.508 1.68 to 3.39 0.168 to 0.339
Bevel pinion bearing pre-load adjustment	through shims
Thickness of bevel pinion bearing pre-load adjusting rings	5.30-5.33-5.35-5.38-5.40-5.50-5.60 5.70-5.80-5.90-6.00-6.10-6.13-6.15-6.18-6.20
Clearance between pinion and ring gear mm new gears reused gears recover working conditions	0.20 to 0.46
Clearance adjustment between pinion and ring gear	Through ring nuts

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Cap opening out mm	0.08 to 0.22
Differential box bearing rolling torque Nm kgm	1.7 to 3.9 0.17 to 0.39
Cap opening out adjustment	Through ring nuts
Rolling torque between side gear pinions and crown wheels Nm kgm	Max. 68 Max. 6.8
Bevel pinion positioning with reference to differential box	Through adjusting shims
Thickness of adjusting rings inserted between bearing ring and differential carrier	0.076 - 0.127 - 0.254
REDUCTION DIFFERENTIAL ASSEMBLY	
Reduction differential bearings	2 taper roller bearings
Reduction differential bearing axial clearance mm	0.05 to 0.20
Reduction differential bearing axial clearance adjustment	Through adjusting shims
Thickness of reduction differential bearing adjusting shims mm	0.076 - 0.127 - 0.254
WHEEL HUBS	
Wheel hub bearings	Two taper roller bearings
Hub bearing axial clearance mm	0.00 to 0.05
Wheel hub bearing rolling torque Nm kgm	Max. 1.96 Max. 0.20
Wheel hub bearing axial clearance adjustment	Through nut
Axle oil TUTELA W140/M-DA with Hendrickson suspension Litres (kg)	16.2 (14.6)

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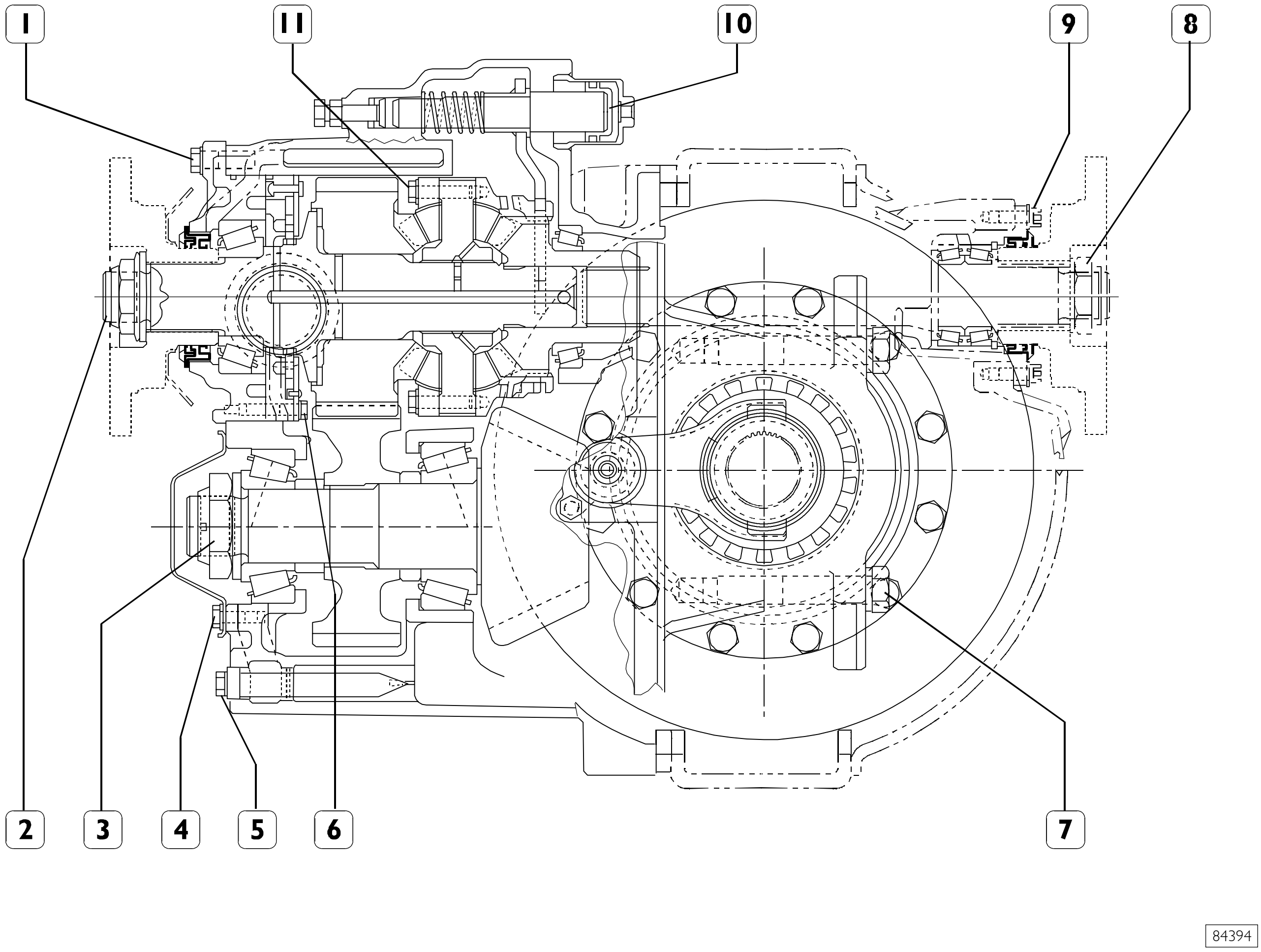
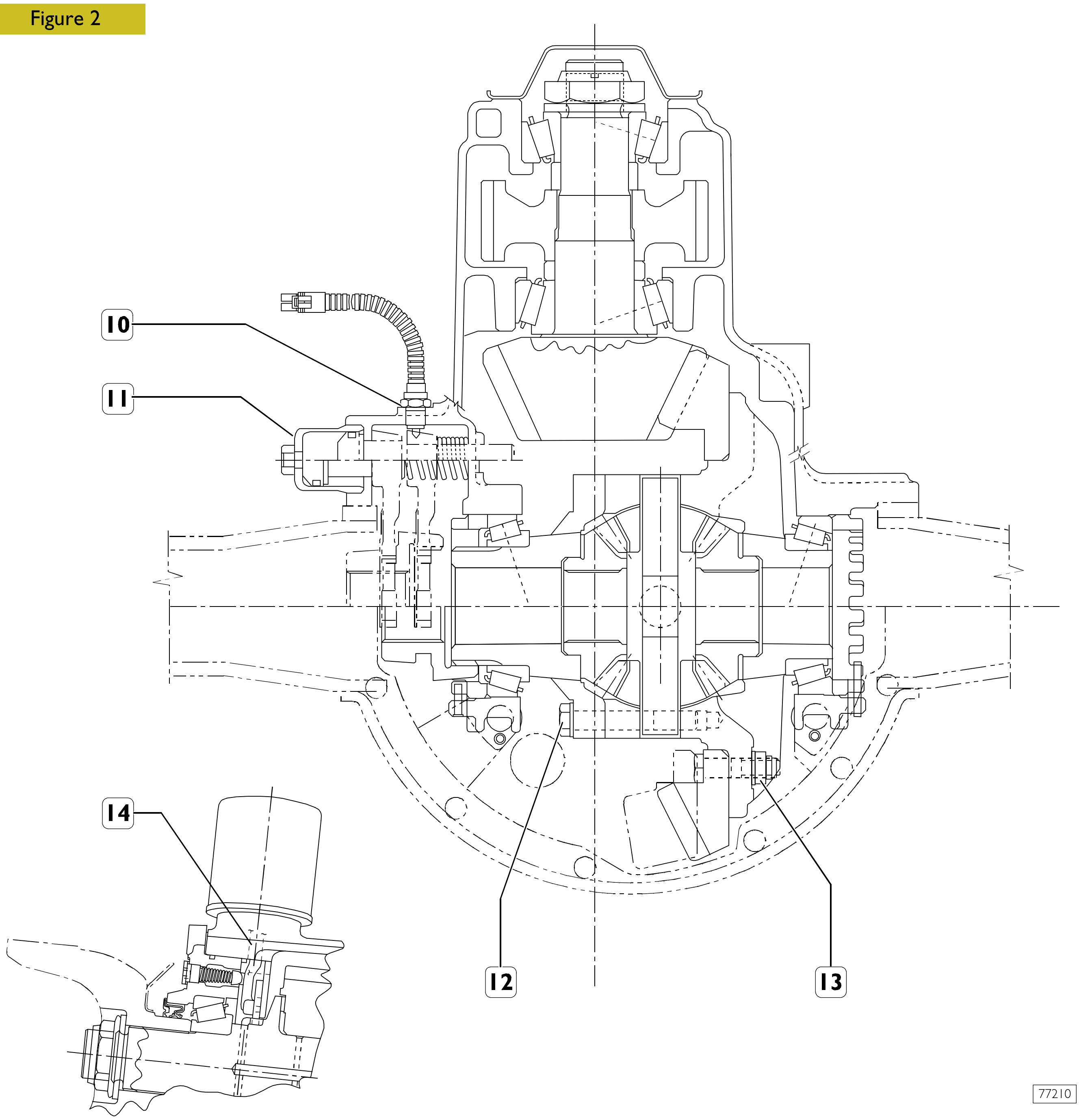
TIGHTENING TORQUES

Figure 1



PART		TORQUE	
		Nm	(kgm)
1	Screw fixing input shaft mount M12x1.75	122.5 ± 22.5	(12.4 ± 2.2)
2	Nut fixing flange to input shaft M45x1.5	950 ± 135	(96.8 ± 13.7)
3	Nut fixing parts on bevel pinion M 45x1.5	1492.5 ± 272.5	(152.1 ± 27.7)
4	Screw fixing bevel pinion cover M 10 x 1.5	55 ± 15	(5.6 ± 1.5)
5	Screw fixing mesh filter M 26x1.5	65 min.	(6.6 min)
6	Screw fixing oil pump to mounting	37.5 ± 7.5	(3.8 ± 0.7)
7	Screw fixing caps: to differential gear housing M 20x2.5	485 ± 55	(49.4 ± 5.6)
8	Nut fixing output shaft M39x1.5	745 ± 135	(75.9 ± 13.7)
9	Screw fixing output shaft bearing mount	57.5 ± 10.5	(5.8 ± 1)
10	Transfer box differential locking cylinder M 60x2	122.5 ± 13.5	(12.4 ± 1.3)
11	Screw fastening the differential case to the rear axle housing.	67.5 ± 7.5	(6.8 ± 0.7)

Figure 2



PART		TORQUE	
		Nm	(kgm)
10	Nut locking transmitter M 16x1	55 ± 20	(5.6 ± 2)
11	Differential locking cylinder M 60x2	122.5 ± 13.5	(12.4 ± 1.3)
12	Screw fixing half boxes M 12x1.75	142.5 ± 12.5	(14.5 ± 12.5)
13	Self-locking nut fixing bevel ring gear to the half box M 16x1.5	255 ± 35	(25.9 ± 3.5)
14	Oil filter coupling M 22x2.5	67.5 ± 12.5	(6.8 ± 1.2)

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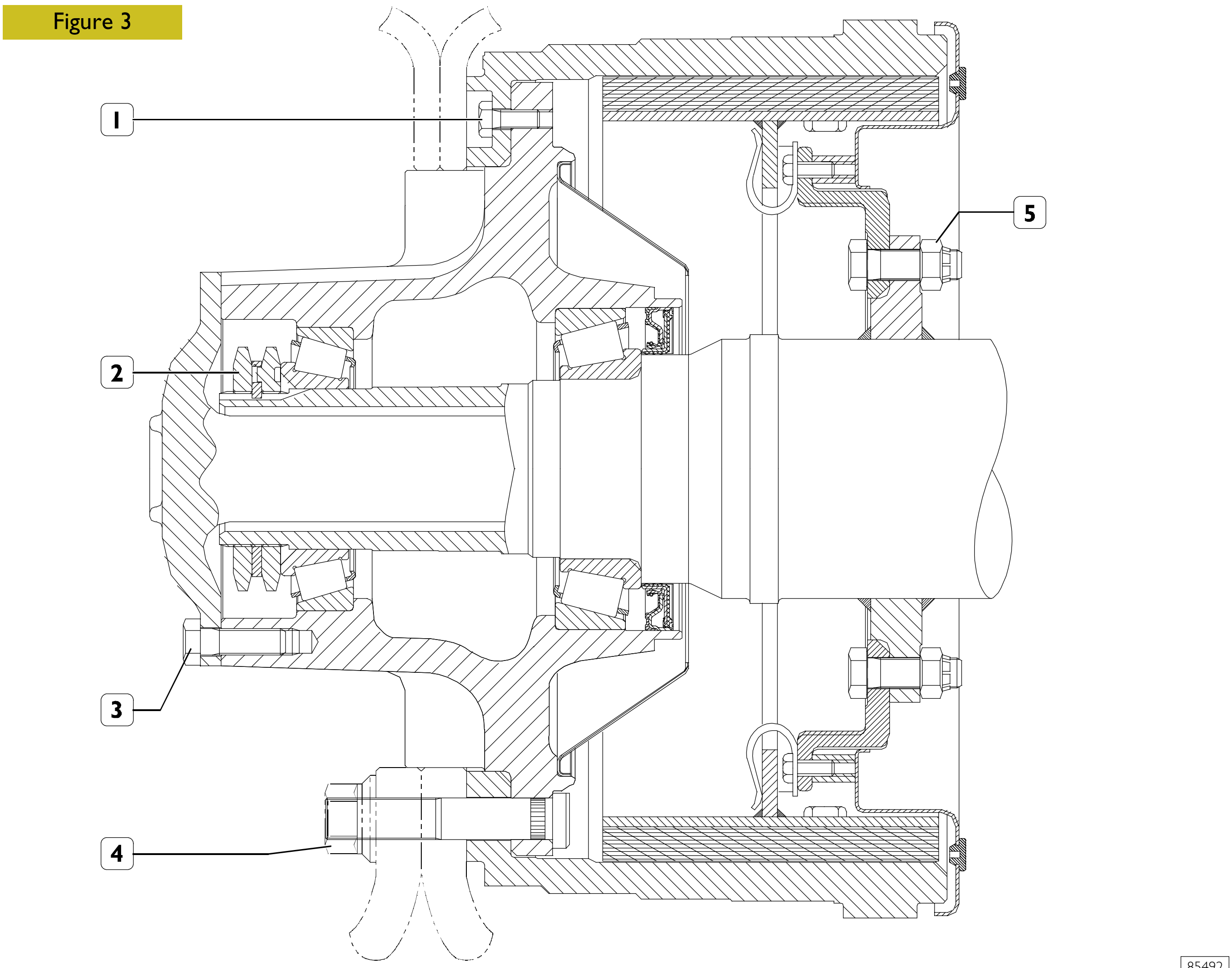
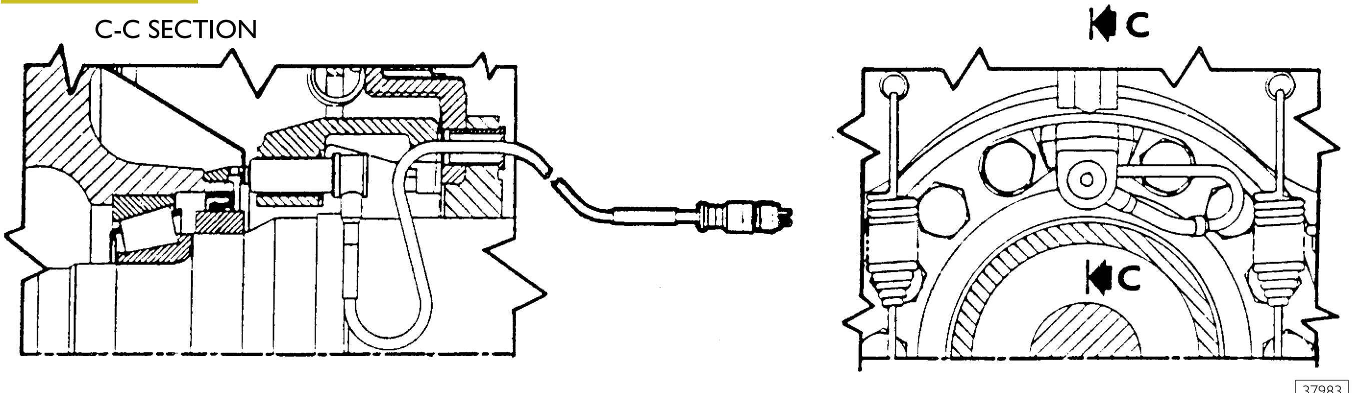
Figure 3



CROSS-SECTION THROUGH WHEEL HUB FOR AXLE IN TANDEM PD 145 E

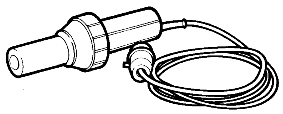
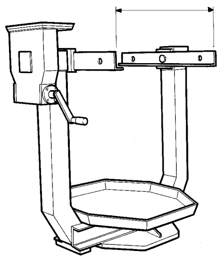
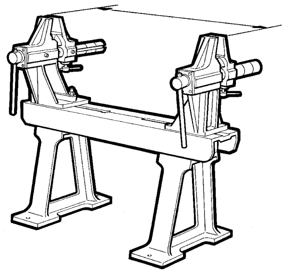
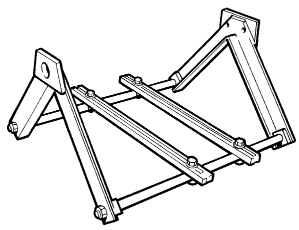
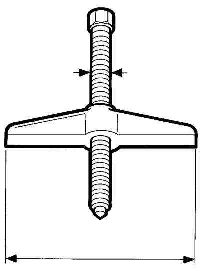
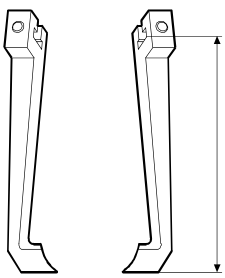
PART		TORQUE	
		Nm	(kgm)
1	Nut fastening the drum to the wheel hub	40 ± 4	(4 ± 0.4)
2	Ring nut to lock nut adjusting wheel hubs	392.3 ± 20	(40 ± 2)
3	Screw to secure half shaft to wheel hub	232.4 ± 24.5	(23.2 ± 2.4)
4	Wheel securing nuts	600^{+50}_{-20}	(60^{+5}_{-2})
5	Nut for brake shoe mounting securing screw	289	(29)

Figure 4

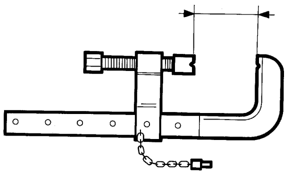
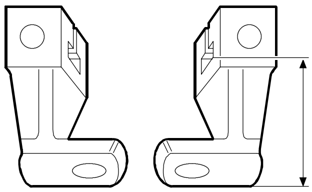
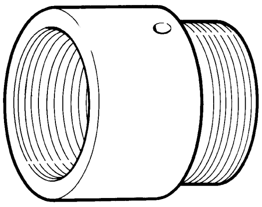
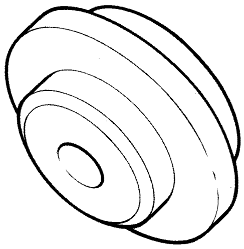
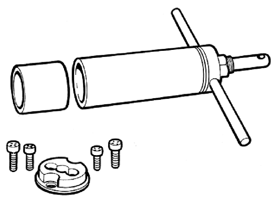
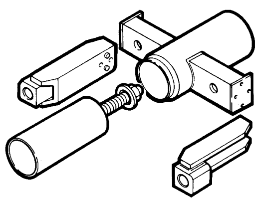


VARIANT WITH ANTI-SKID DEVICE

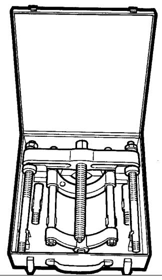
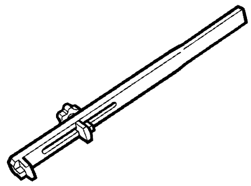
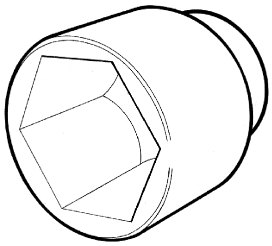
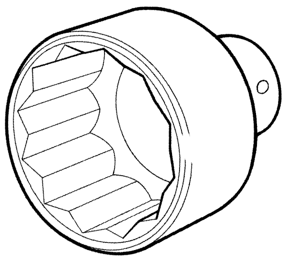
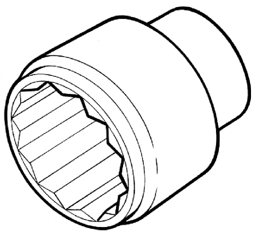
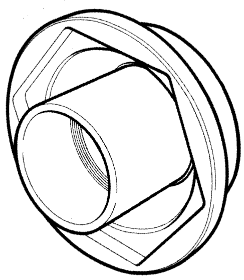
TOOLS

TOOL No.		DENOMINATION
99305121		Heater
99322205		Rotary stand for unit overhauling (capacity 1000 daN, torque 120 daN/m)
99322215		Axle overhaul stand
99322225		Unit holder (to be mounted on stand 99322205)
99341003		Single-acting lift
99341012		Pair of brackets

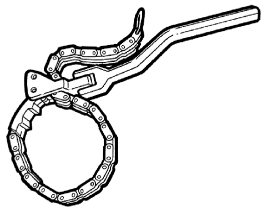
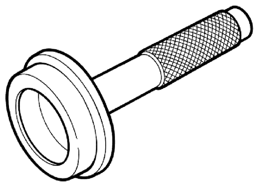
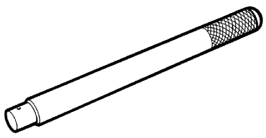
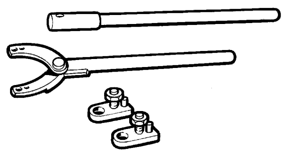
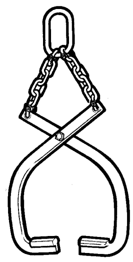
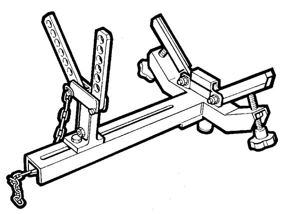
TOOLS

TOOL No.		DENOMINATION
99341015		Clamp
99341016		Pair of brackets with holes
99345029		Threaded block (use with 99345098)
99345055		Reaction block for puller tools
99345098		Installation tool for assembly of bearing and cylindrical gear on the differential bevel pinion shaft (use with 99345029)
99345103		Wheel hub fitting tool

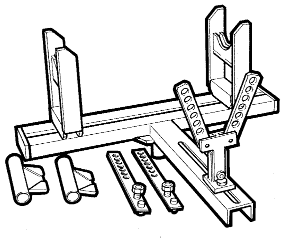
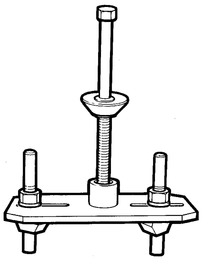
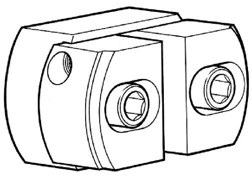
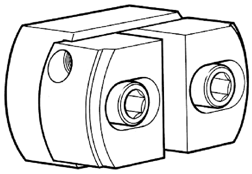
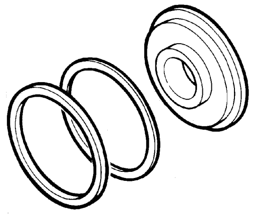
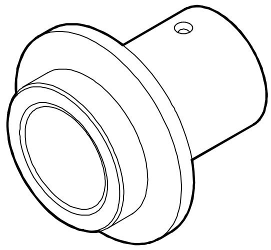
TOOLS

TOOL No.		DENOMINATION
99348001		Puller tool with clamping device
99355025		Wrench for differential gearcase bearing adjustment ring nuts
99355069		Wrench (75 mm) for differential bevel pinion nut (to be used with 99370317)
99355088		Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99355131		Wrench (55 mm) for the nut of the drive input flange of the transfer box (use with 99370317)
99355167		Wrench (114 mm) for wheel hub bearing adjustment nut

TOOLS

TOOL No.		DENOMINATION
99360311		Oil filter wrench
99370005		Hand-grip for interchangeable drift punches
99370007		Hand-grip for interchangeable drift punches
99370317		Reaction lever and extension for flange lock
99370509		Hook to remove differential gearcase half-housing
99370616		Support to remove-fit back differential

TOOLS

TOOL No.		DENOMINATION
99370617		Universal support to remove-fit back rear axles
99371047		Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 99322225)
99374093		Drift punch for installation of bearing outer races (91÷134) (use with 99370007)
99374094		Drift punch for installation of bearing outer races (134÷215) (use with 99370007)
99374134		Installer, wheel hub inner seal
99374162		Installer, transfer case input shaft seal

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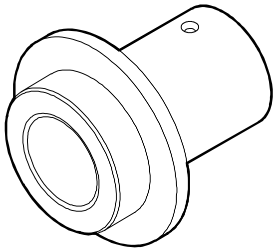
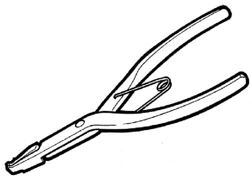
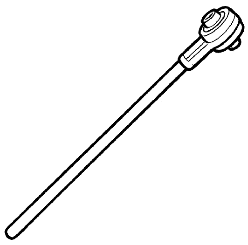
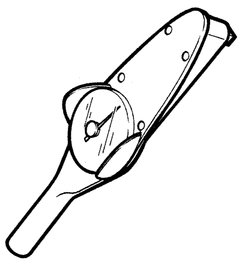
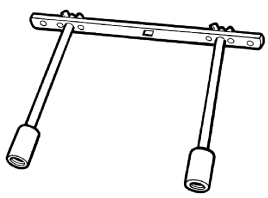
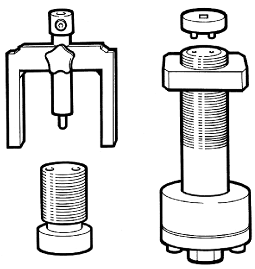
TOOLS

TOOL NO.		DESCRIPTION
99374163		Keying device for assembling the distributor motion output shaft seal
99381125		Pliers for removal of circlips on transfer box shaft
99389816		4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm)
99389819		Torque wrench (0 - 10 Nm) with 1/4" square fitting
99395026		Tool for measuring hub rolling drag torque (use with torque wrench)
99395027		Tool for determining thickness of differential bevel pinion adjustment shims (use with 99395693)

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EXPERIMENTAL TOOLS

This heading covers the technical working drawings of the experimental tools (S.P.), used when overhauling the rear axle described in this section, that can be made in your repair shop.

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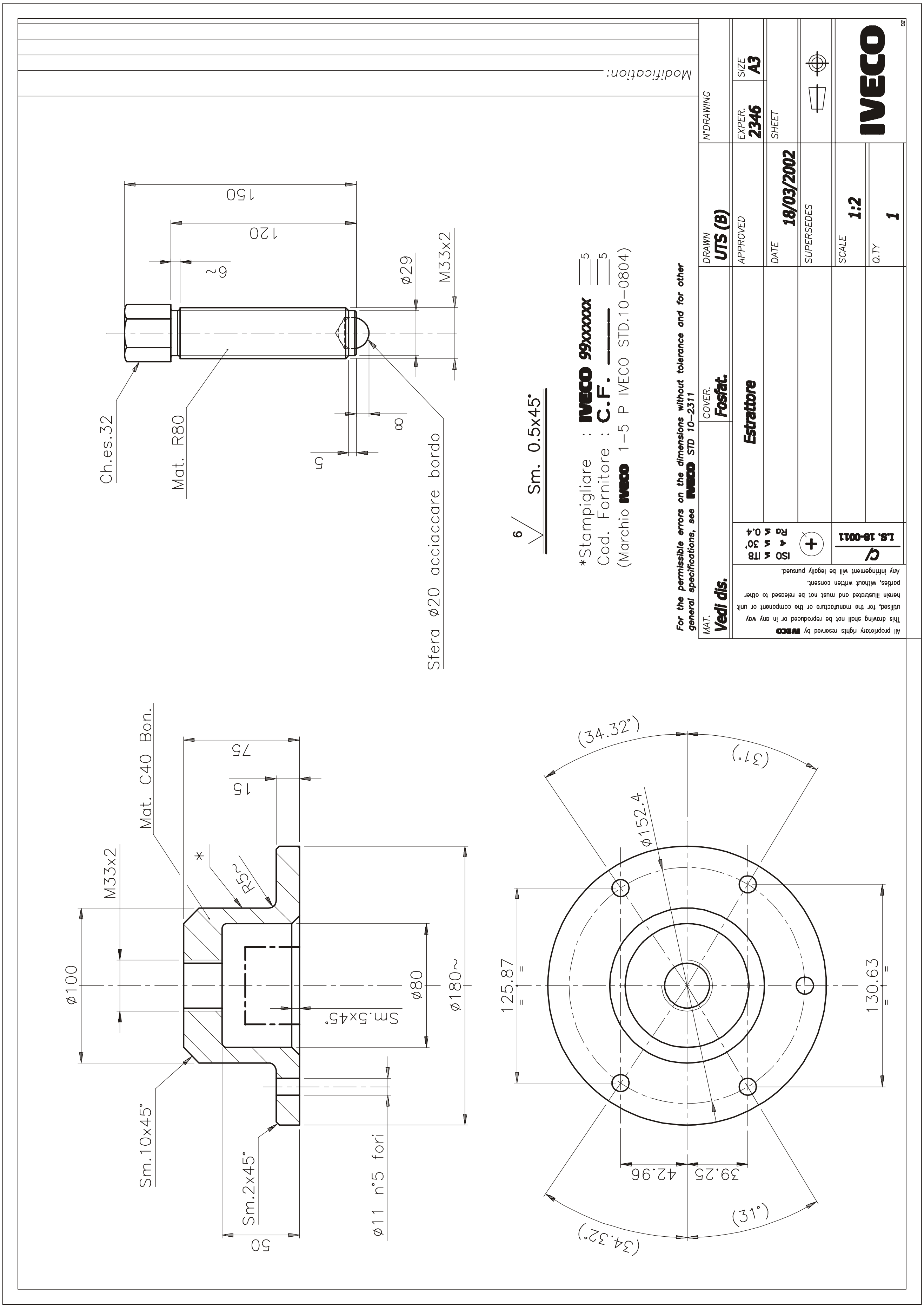
Modification:
N°DRAWING
EXPER. 2346
SIZE A3
SHEET
DRAWN UTS (B)
APPROVED
DATE 18/03/2002
SUPERSEDES
SCALE 1:2
Q.TY 1
IVECO
COVER. Fosfat.
MAT. Vedi dis.
Estrattore
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
ISO ≤ IT8
≤ 30'
Ra ≤ 0.4
I.S. 18-0011
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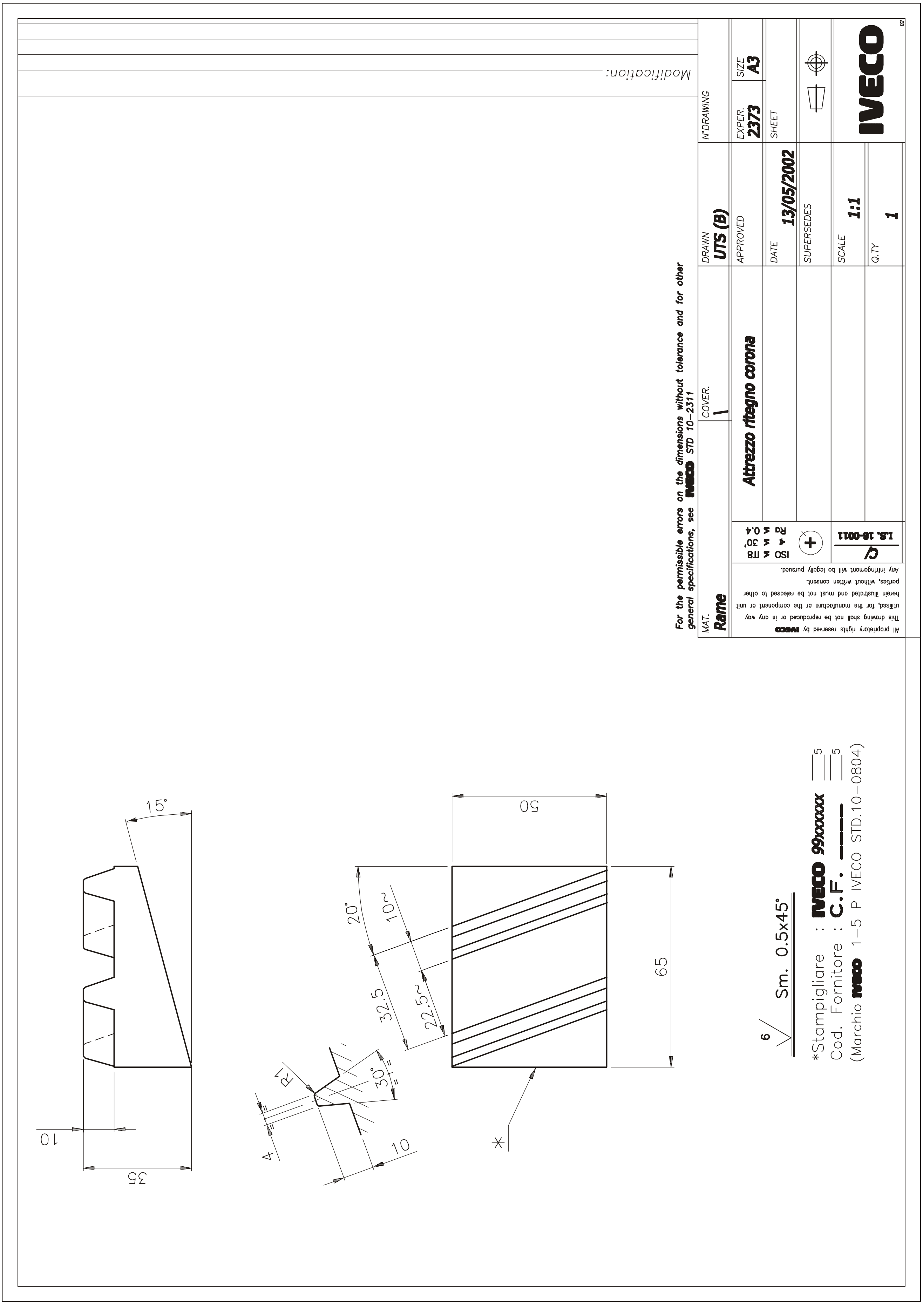
This drawing shall not be reproduced or in any way utilised, for the manufacture of the component or unit herein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
150
120
~6
Ø29
M33x2
8
5
Ch.es.32
Mat. R80
Sfera Ø20 acciaccare bordo
Sm. 0.5x45°
*Stampigliare : IVECO 99xxxxxx
Cod. Fornitore : C.F.
(Marchio IVECO 1-5 P IVECO STD.10-0804)
Mat. C40 Bon.
75
15
M33x2
*
R5~
Ø100
Ø80
Ø180~
Sm.5x45°
Sm.10x45°
Sm.2x45°
Ø11 n°5 fori
50
125.87
130.63
Ø152.4
(34.32°)
(31°)
39.25
42.96
(31°)
(34.32°)


Modification:
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
N°DRAWING
MAT.
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1
IVECO
I.S. 18-0011
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This drawing shall not be reproduced or in any way utilised, for the manufacture of the component or unit herein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
15°
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*Stampigliare : IVECO 99xxxxxx
Cod. Fornitore : C.F. ____
(Marchio IVECO 1-5 P IVECO STD.10-0804)

INTERMEDIATE AXLE DISCONNECTION/ RECONNECTION (with Hendrickson suspensions)

Before carrying out disconnection/ reconnection operations, disconnect battery cables.

Disconnection

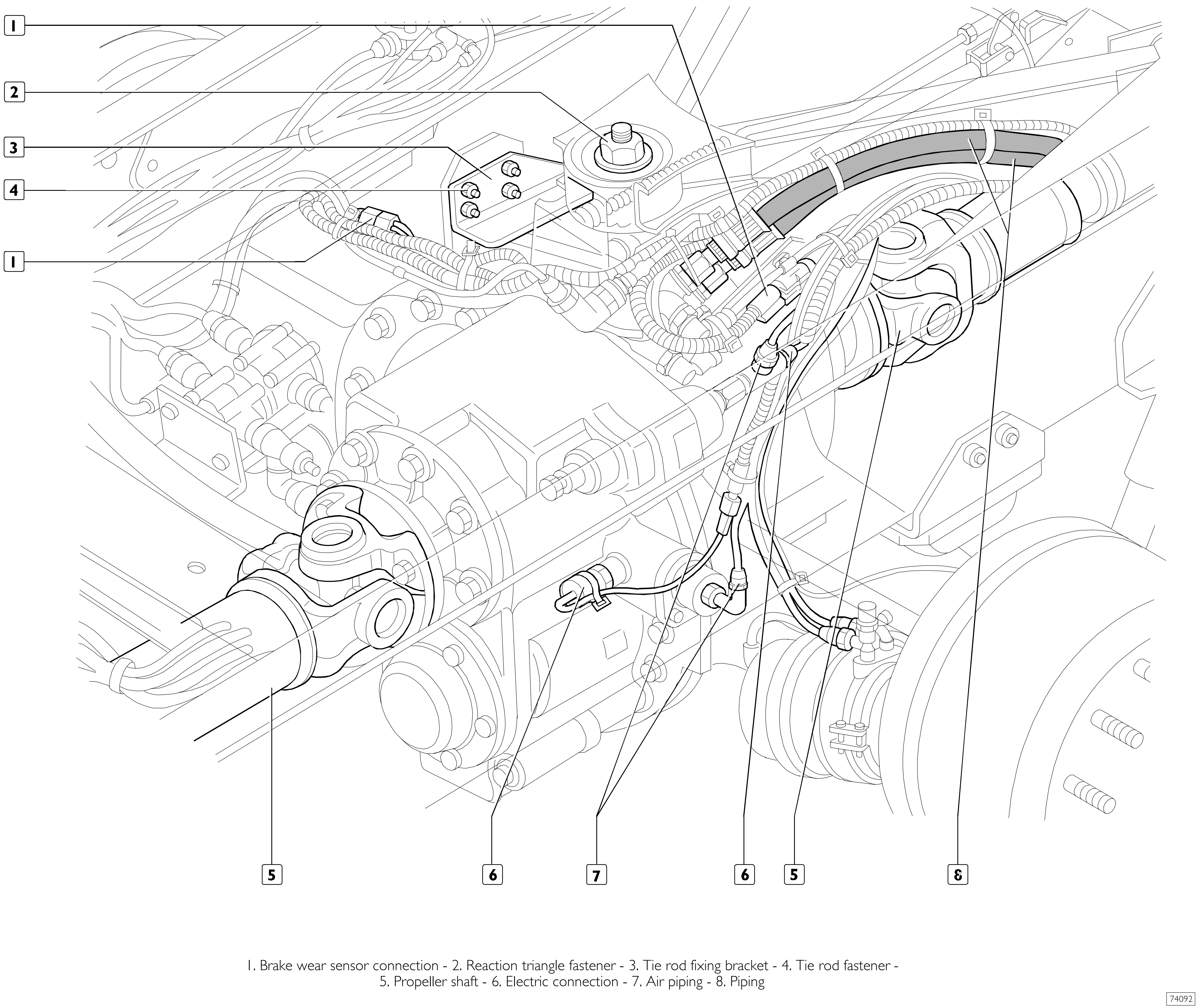
Proceed as follows:

- Place a suitable elevating trolley 99370617 under the differential of the axle to be removed.
- Disconnect propeller shafts (5) and anchor them properly to the chassis.
- Disconnect electric connections (6) and air piping (7) from the relevant differential locking devices.
- Disconnect piping (8).
- Disconnect brake wear sensor connections (1) and free wiring from the straps on the axle.
- Disconnect the bracket (3) from the axle complete with adjustment tie rods; operating on the fasteners (4) and anchor them properly to the chassis.
- Disconnect reaction triangle fasteners (2) and free it from the axle.
- Withdraw the axle.

Reconnection

Suitably reverse the operations performed for disconnecting checking the electric connections.

Figure 5



1. Brake wear sensor connection - 2. Reaction triangle fastener - 3. Tie rod fixing bracket - 4. Tie rod fastener - 5. Propeller shaft - 6. Electric connection - 7. Air piping - 8. Piping

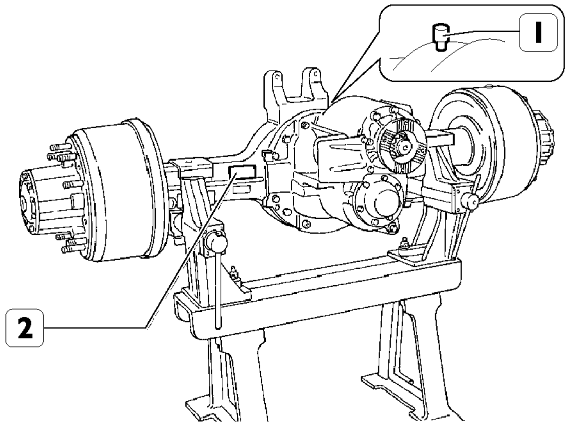
525010 SERVICING INTERMEDIATE AXLE ASSEMBLY PD 145 E (R 2468)

Removal/installation operations concerning the following units: axle shafts, brake shoes and drums, air breather, differential can be performed with the unit on the vehicle.

Before placing the axle assembly on the stand, loosen the bottom plug and drain the oil.

525013 AIR BREATHER REMOVAL-REFITTING

Figure 6



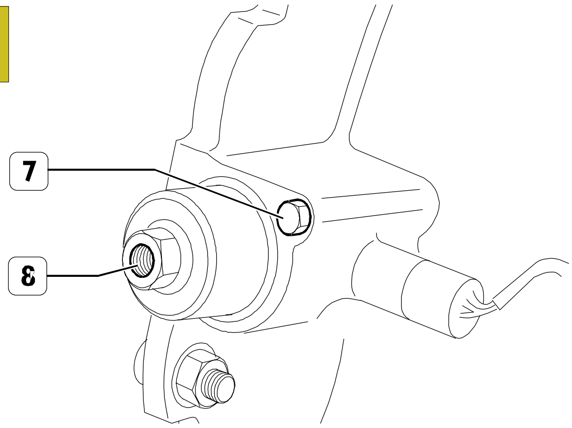
77221

Set the rear axle assembly on the stand 99322215,
Check that the air breather (1) is not clogged; if it is, remove it, clean it carefully and fit it back on.

The identification data of the rear axle assembly PD 145 E (R 2468) are given on the plate (2).

525030 SERVICING WHEEL HUBS

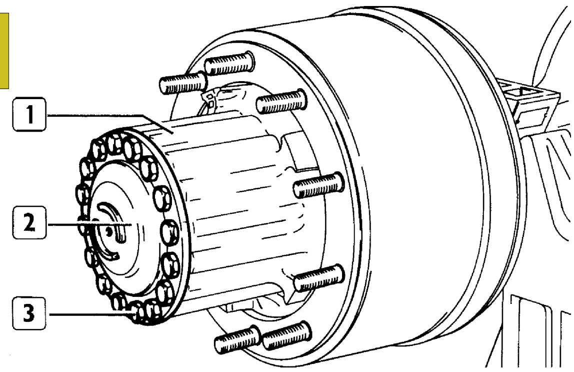
Figure 7



77222

Lock the differential gear, operating as follows: unscrew the screw (7) and screw it down in the hole (8): screw down the screw fully to get the differential lock to go in.

Figure 8

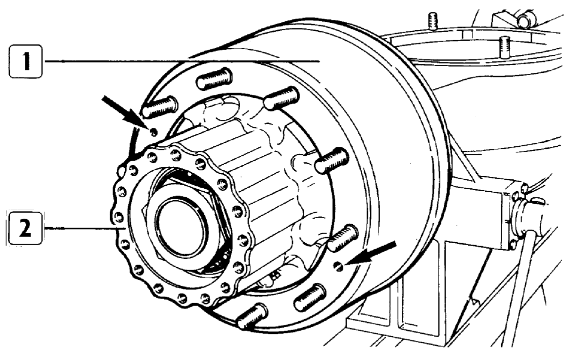


19341

Place a container under the wheel hub to recover the oil.

Unscrew the screws (3) fixing the drive shaft (2) and extract it from the hub (1).

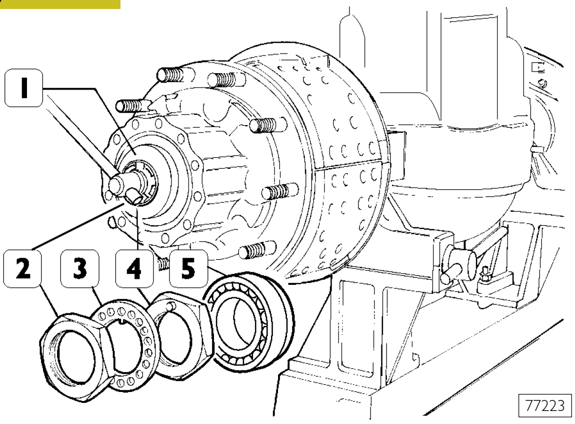
Figure 9



19349

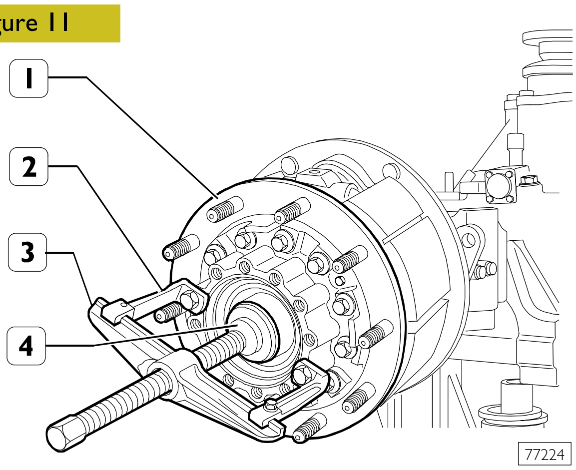
Remove the screws fixing the drum (1) to the wheel hub (2) and screw them down in the holes (→) to extract the drum (1).

Figure 10



Using the wrench 99355167 (1) unscrew the lock nut (2) locking the bearing adjustment nut (4).
Extract the retaining ring nut (3), unscrew the bearing adjustment nut (4) and take out the bearing (5).

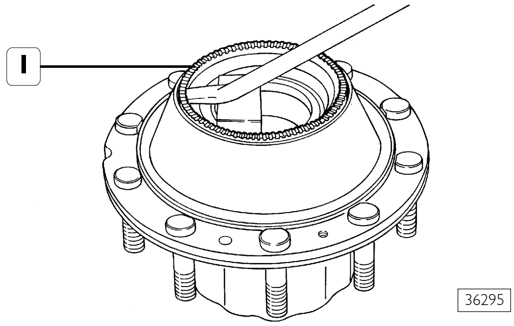
Figure 11



Disassemble the wheel hub (1). In case of difficulty, use the puller comprised of: arms 99341016 (2), yoke 99341003 (3) and block 99345055 (4), applied as shown in the figure.

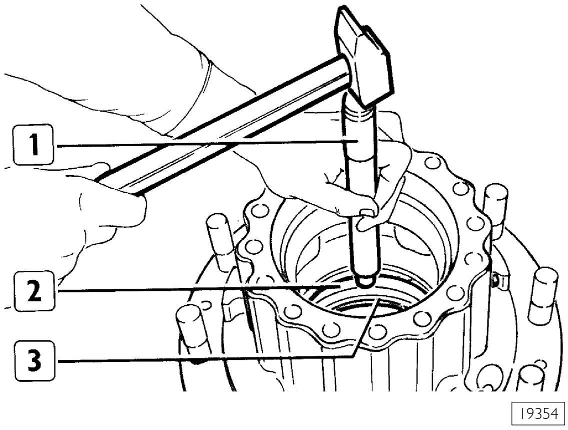
When putting aside the wheel hub, take care not to damage the phonic wheel (1, Figure 12).

Figure 12



Only dismantle the phonic wheel (1) if it is to be replaced. Do so using a suitable lever.

Figure 13



If the phonic wheel (1, Figure 12) is not to be dismantled, do not use it as a support.

Use a general purpose bronze drift (1) to remove inner bearing cup (2).
Sealing ring (3) will also be expelled.
Proceed in the same way to remove the outer bearing cup.

Checking wheel hub components

Clean every single hub component thoroughly.
Examine axle drive shafts and make sure they are free from any distortion.
Check wheel mounting bolts: if their threads are distorted or damaged replace without hesitation on a power press.
Lubricate bearings and rock roller cages; rotation must be smooth without any sign of binding.
Check condition of wheel bearing adjuster nut and axle sleeve end threads: if necessary, change the nuts.
Check the oil slinger: if damaged, replace.
Discard old seals and fit new ones.

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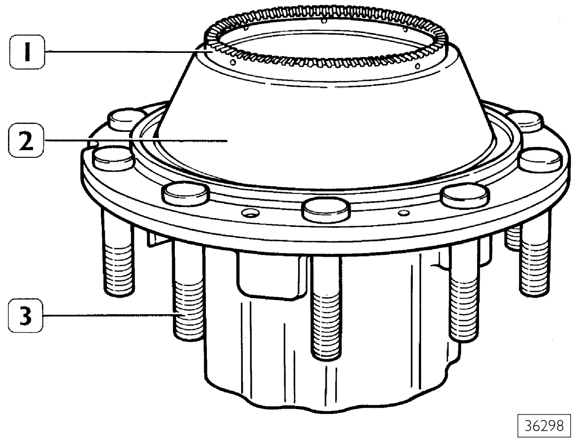
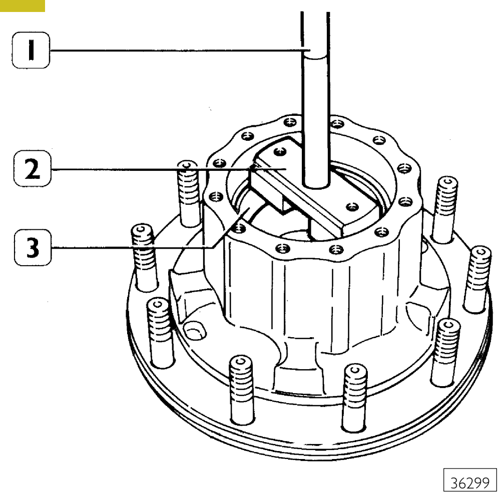
525030 ASSEMBLING WHEEL HUBS

Figure 14



Ensure the rest surface of screw heads is free from burrs, slags or nicks before fitting new screws (3).
The load to be applied to screw heads for driving them into their seats must not exceed 2300 Kg.
When driving operation is completed, screws should abut perfectly on the wheel hub face : maximum squareness tolerance 0,2 mm.
If the oil slinger (2) was removed in order to be replaced, coat oil slinger and hub mating face with sealing compound that can resist heat to temperatures of 40 to 250°C.

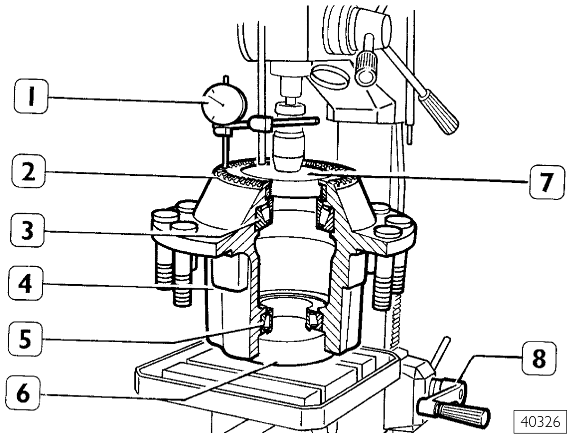
Figure 15



Fit taper roller bearing outer races in wheel hub using handle 99370007 (1) and drift (2): 99374094 for outer bearing race (3) and 99374094 for inner bearing race.

When fitting race (3) do not use phonic wheel (1) as a support base.
Press fit until bearings are 5 mm from abutting end and then complete operation by hand.

Figure 16

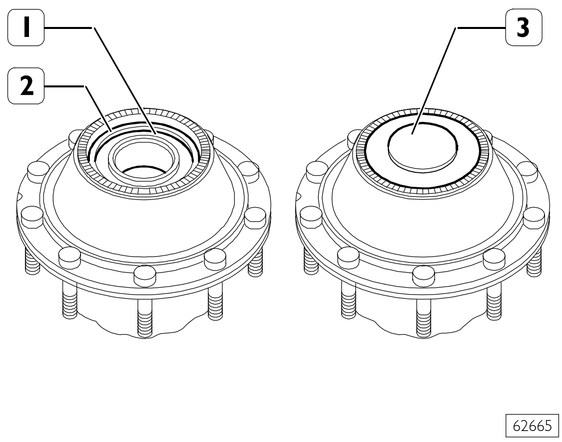


Refit phonic wheel (2), if necessary, by heating to a temperature of 150°C. Ensure phonic wheel is perfectly bedded onto hub seat after installation.
Check squareness of phonic wheel (2) as follows.
Position wheel hub (4) with taper roller bearings on base of column drill. Interpose a spacer between base and outer bearing race (5) so that wheel hub may turn.
Rest a plate (7) on the internal bearing roller ring (3).
Turn handle (8) to raise base so that drill chuck comes into contact with plate (7) and bearings (3 and 5) are slightly preloaded.

Turn wheel hub to settle bearings when pre-loading.

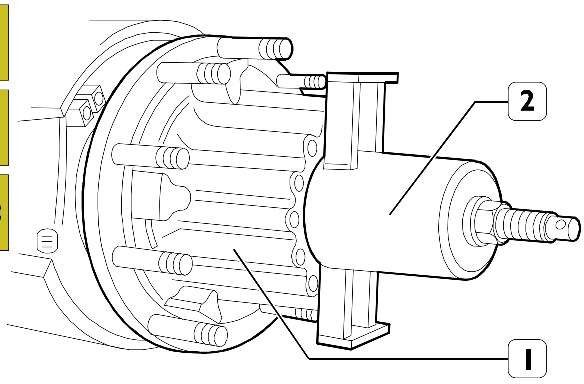
Position magnetic base dial gauge with flat base stylus as shown in figure and turn wheel hub. Check that maximum squareness error for phonic wheel (2) does not exceed 0,2 mm.

Figure 17



Place the tapered roller bearing (1) in the outer ring (2). Using the keying device 99374134 (3) fit the gasket (under a press) in the wheel hub.

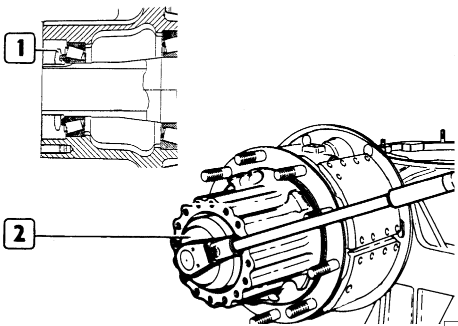
Figure 18



77225

Lubricate the bearing seat on the sleeve and the wheel hub seal (1) with TUTELA W 140/M-DA oil.
Position the tapered roller bearing in the wheel hub (1) and, using the tool 99345103 (2) applied as in the figure, fit the wheel hub (1) onto the sleeve.

Figure 19



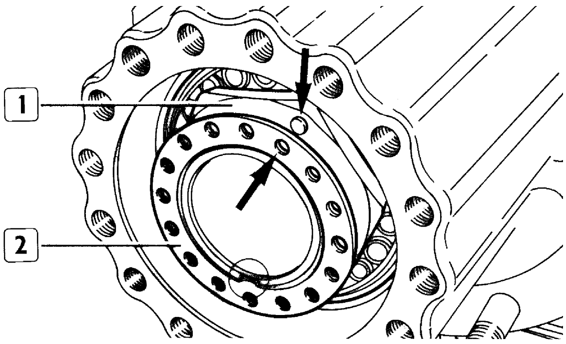
36304

Tighten nut (1). Then adjust wheel hub bearing end play as follows.
Use wrench 99355167 (2) to tighten nut (1) to a torque of 98.1 Nm (10 kgm).

> ⚠ Tighten nut by turning hub simultaneously in both directions to settle bearings.

Loosen nut (1) to obtain an end play of 0.2 ÷ 0.3 mm.

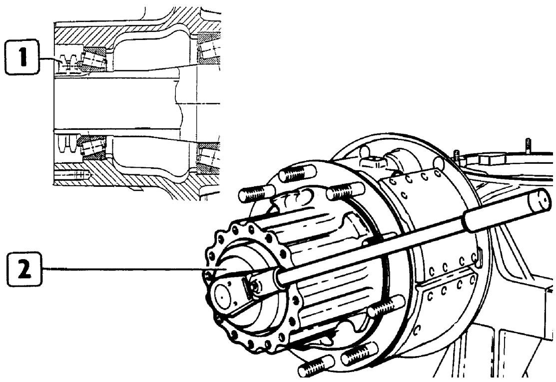
Figure 20



19366

Fit the lock ring (2).
If the nut (1) for the locating dowel does not match any of the lock ring holes (2) (see →), progressively undo the adjusting nut (1) until the lock ring can be inserted. (Consider also the end play specification obtained with the previous operation).

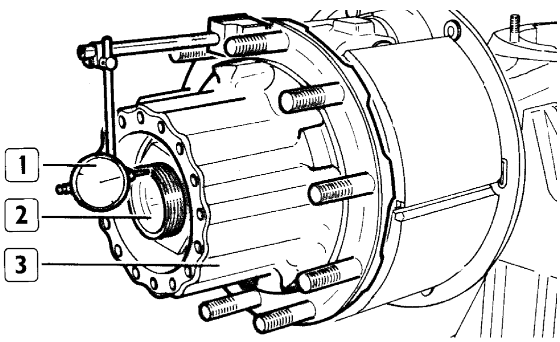
Figure 21



36305

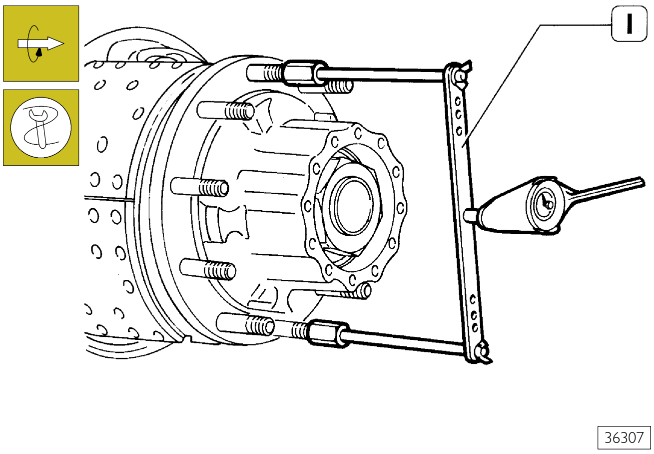
Tighten nut (1) and torque it to 392.3 Nm (40±2 kgm) using wrench 99355167 (2).

Figure 22



Place a magnetic base dial gauge (1) on wheel hub (3); rest gauge stylus on sleeve (2) and check wheel hub end play. It should not be over 0.00 ÷ 0.05 mm.

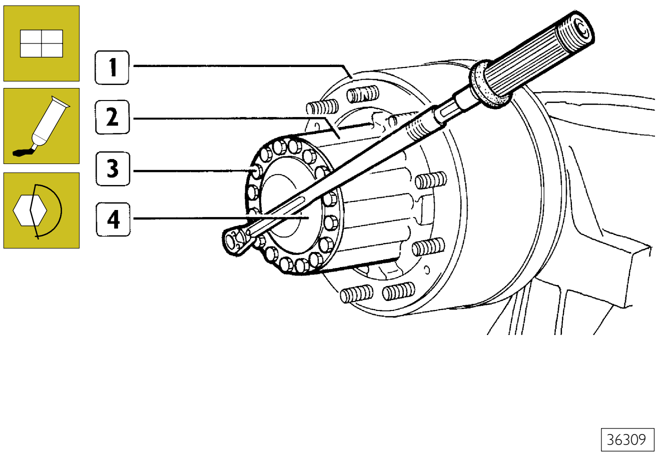
Figure 23



Apply tool 99395026 (1) to the wheel hub pins and, using a torque wrench, check that the rolling torque is no greater than: 1.96 Nm (0.20 kgm).

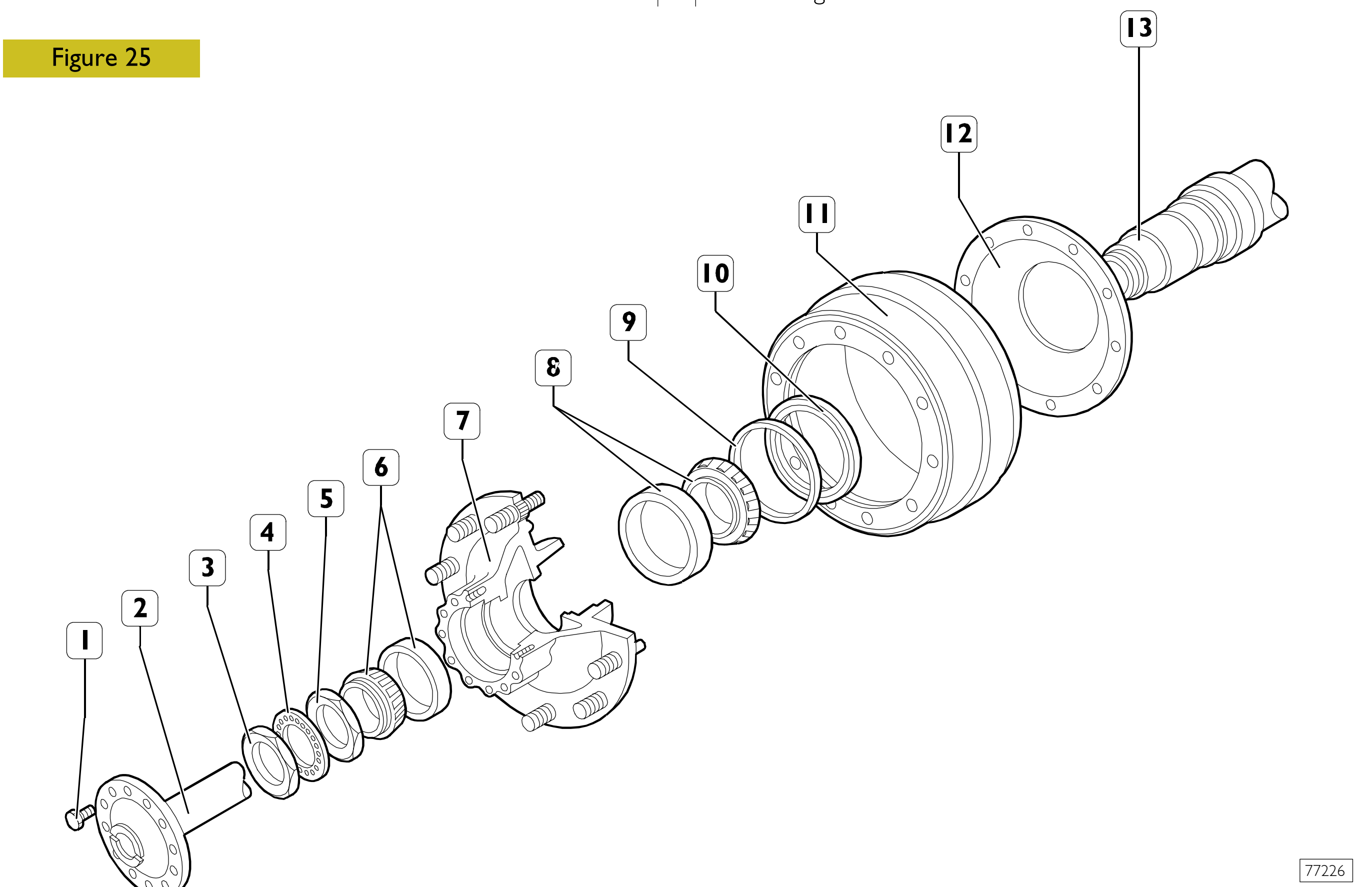
This torque must correspond to a maximum end float of the bearings of 0.05 mm.

Figure 24



Fit the drum (1) onto the wheel hub (2).
Smear "Type B" sealing compound on both contact surfaces between the drive shaft and the wheel hub.
Insert the drive shaft (4), screw down the screws (3) fixing the drive shaft (4) to the hub (2) and tighten them, using a torque wrench, to the prescribed torque.
Repeat this operation on the opposite side.
After these operations, replenish the axle housing with TUTELA W 140/M-DA oil of the prescribed quantity and proceed to check the transmitter for signalling differential locking works properly.
Check the efficiency of the ABS sensors as described in the "Fault-Diagnosis Guide" manual.

Figure 25

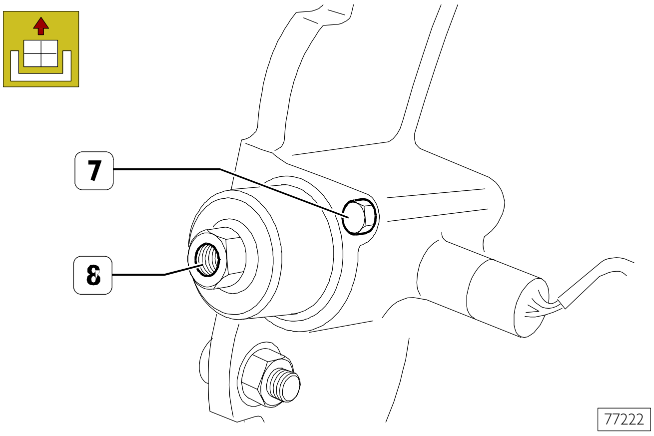


COMPONENTS OF WHEEL HUB

1. Screw - 2. Drive shaft - 3. Nut - 4. Safety ring - 5. Nut - 6. External tapered roller bearing - 7. Wheel hub - 8. Internal roller bearing - 9. Seal - 10. "Phonic" wheel - 11. Drum brake - 12. Oil sump - 13. Rear axle sleeve.

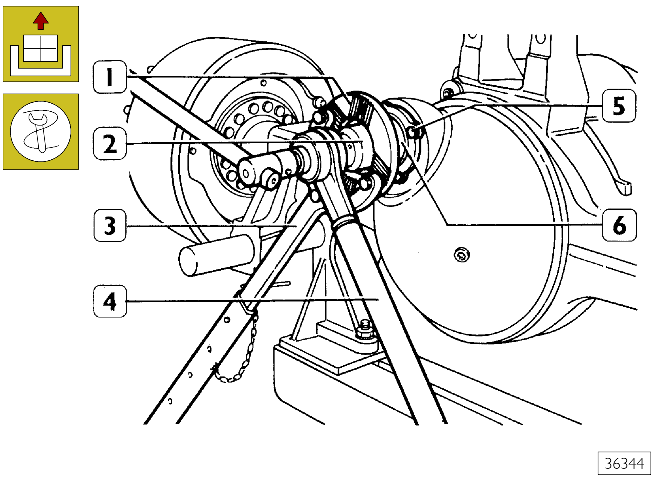
526210 REMOVING DIFFERENTIAL GEAR – TRANSFER BOX (with rear axle on stand 99322215)

Figure 26



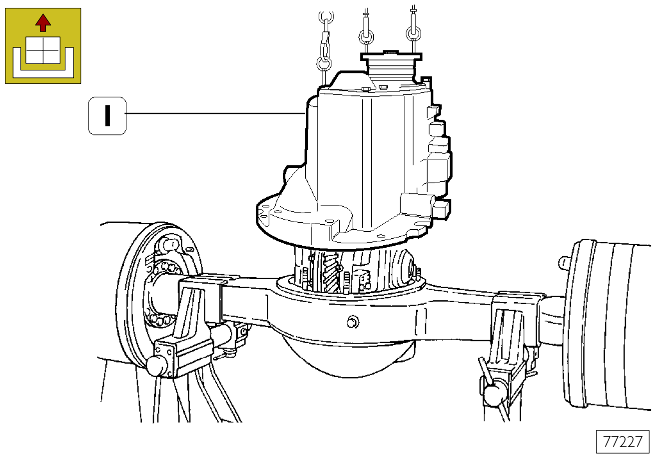
Lock the differential gear, operating as follows: unscrew the screw (7) and screw it down in the hole (8): screw down the screw fully to get the differential lock to go in.

Figure 27



Use retainer 99370317 (3) to stop flange (1) rotation. Unscrew drive flange (1) retaining nut using wrench 99355131 (2) and torque adaptor (4).
Remove screws (5) and disconnect axle housing output shaft mounting (6).

Figure 28

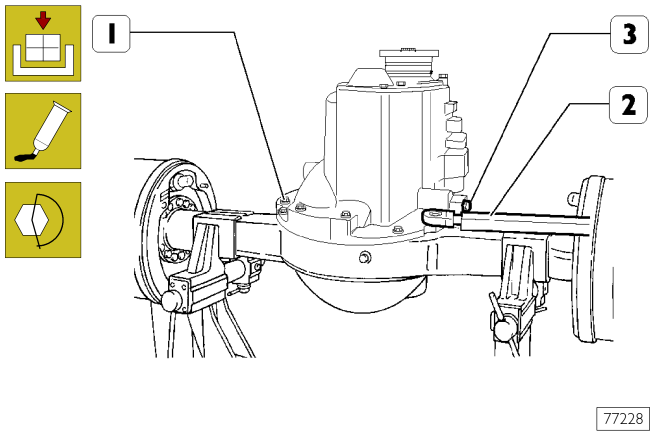


Loosen differential carrier (1) retaining screws. Screw in three screws to be used as extractors and separate differential carrier from axle housing by means of eyebolts and metal ropes.

Use mounting 99370616 for differential carrier removal with axle assembled on vehicle.

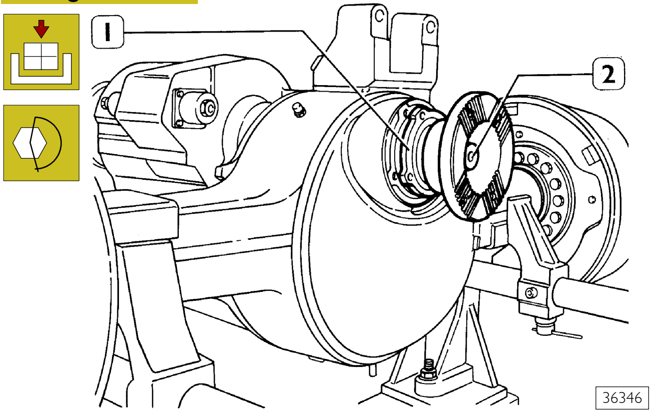
REFITTING DIFFERENTIAL GEAR – TRANSFER BOX (with rear axle on stand 99322215)

Figure 29



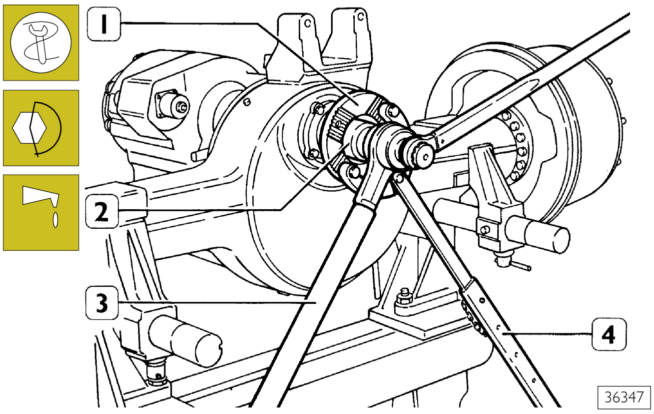
Coat the axle housing to differential mating face with sealant. Insert differential in axle housing. Tighten nuts (1) and screws with lock washers to the specified torque using a torque wrench (2).
Fit differential axle shafts as described in 525030 operation.
Backout screw (3) to release the differential lock device; insert screw in its seat.

Figure 30



Turn the axle housing by 90°. Insert support (1) with drive output shaft (2) in the axle housing and tighten screw to the specified torque.

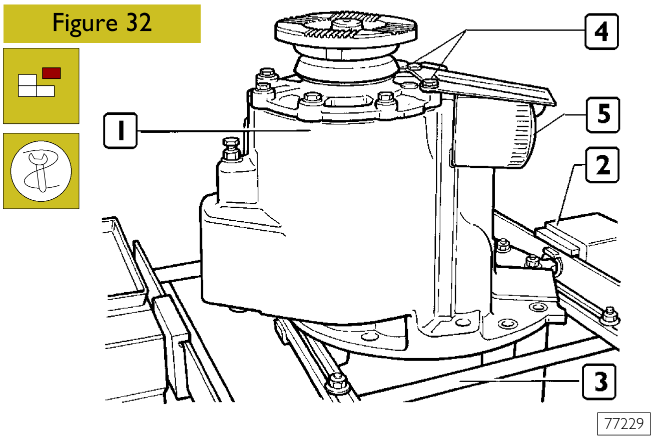
Figure 31



Stop flange (1) rotation by means of retainer 99370317 (4). With wrench 99355131 (2) and torque adaptor (3) tighten output shaft flange (1) retaining nut to the specified torque.
Once assembly operations are completed, pour the specified quantity of TUTELA W140/M-DA oil into the axle housing. Then check efficiency of differential lock connection sending unit.

526060 REPAIRING INTER-AXLE UNIT
Dismantling inter-axle unit

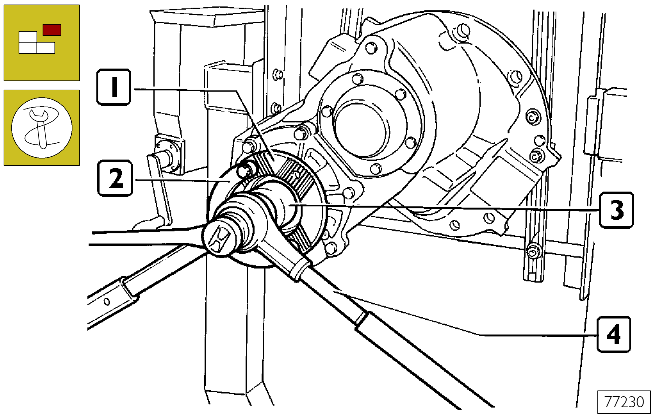
Figure 32



Detach the transfer box differential gear housing as described under the relevant heading.

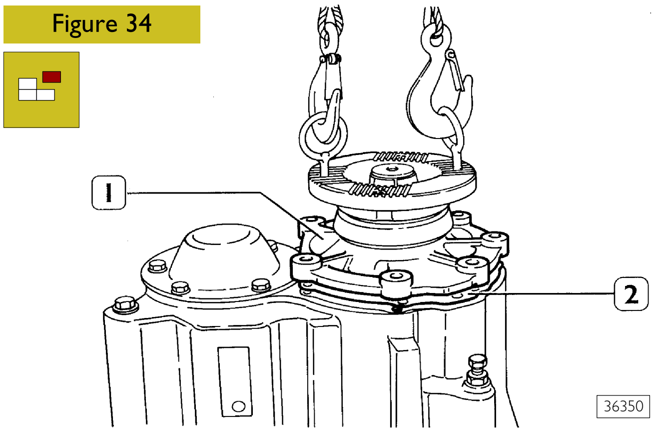
Position the transfer box differential gear housing (1) on the rotary stand 99322205 (2) together with the mount 99322225 (3).
Unscrew the screws (4) and remove the guard.
Using tool 99360311 unscrew the oil filter (5).

Figure 33



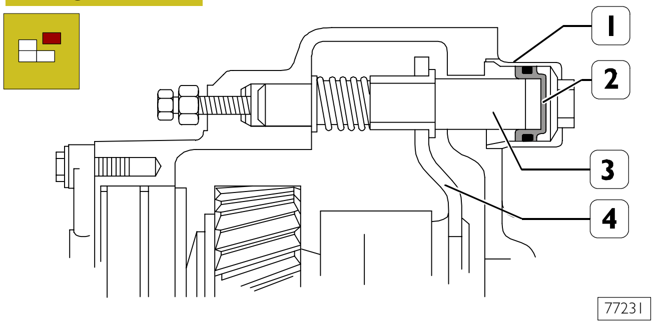
Stop flange (1) rotation with tool 99370317 (2). Undo flange retaining nut using wrench 99355088 (3) and torque adaptor (4).

Figure 34



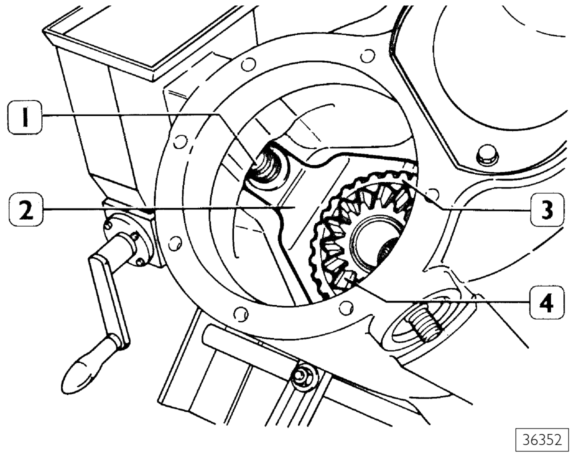
Remove nuts fixing mounting (1) to differential carrier and take it out together with input shaft, oil pump, gear and inter-axle differential.
Remove shims (2).
Separate the differential housing as described in the relative chapter.

Figure 35



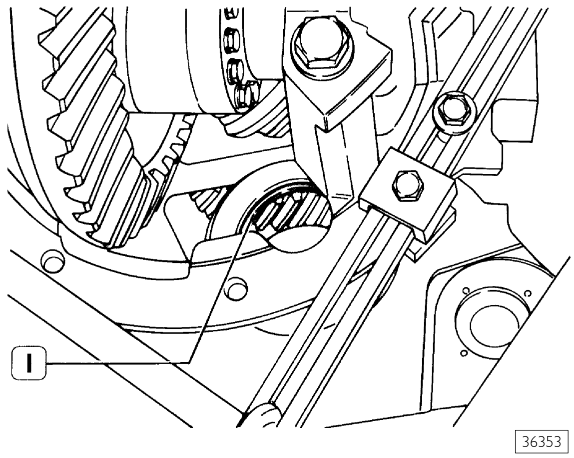
Remove cylinder (1) complete with inter-axle differential lock piston (2) and withdraw yoke (4) drive pin (3).

Figure 36



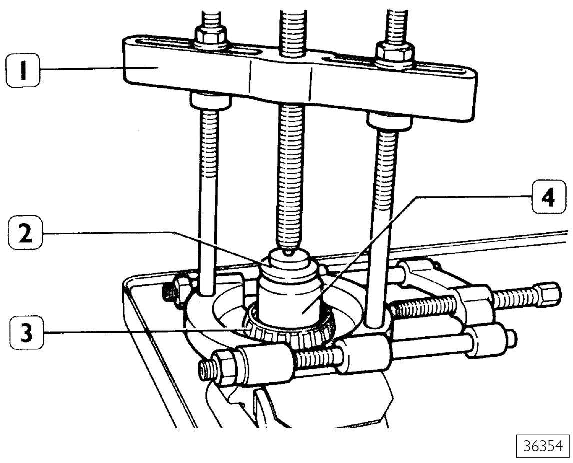
Remove the spring (1) and strip yoke (2), sleeve (3) and rear planetary gear (4).

Figure 37



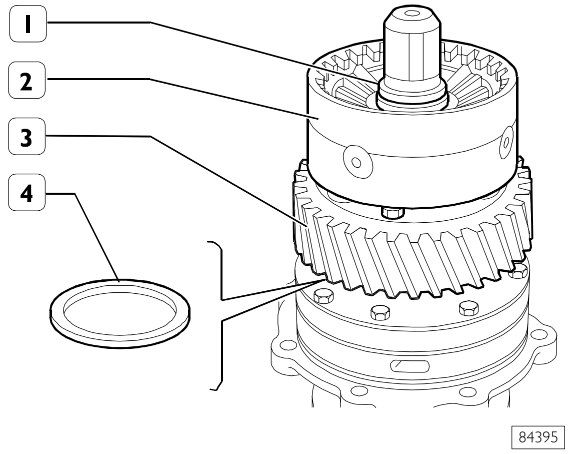
Use a punch to expel cup (1) of rear planetary gear bearing (4, Figure 36).

Figure 38



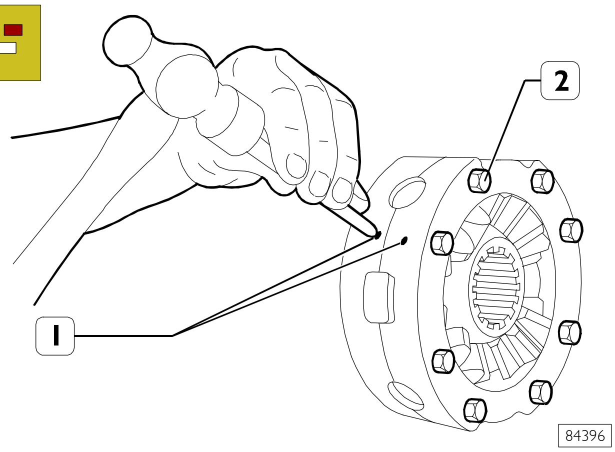
Use extractor 99348001 (1) and reaction block (2) to dismantle cone (3) of rear planetary gear (4) roller bearing.

Figure 39



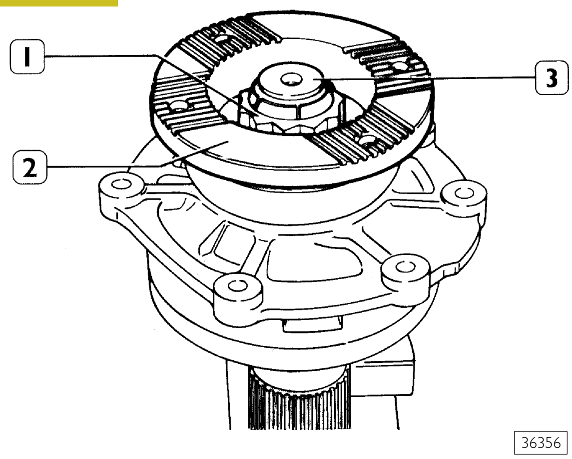
Tighten drive input shaft in a vice.
Remove snap ring (1) and take out differential gear assembly (2), gear (3) and thrust ring (4).

Figure 40



If the planet gear unit needs disassembling, make a mark (1), by means of a punch, on both half cases, in order to ensure correct match when re-assembling.
Unscrew screws (2), then separate the two half cases. Take off the spider unit, remove the four gears and pinion and the four spider thrust washers.

Figure 41



Remove nut (1) and separate flange (2) from drive input shaft (3) by means of a suitable extractor.

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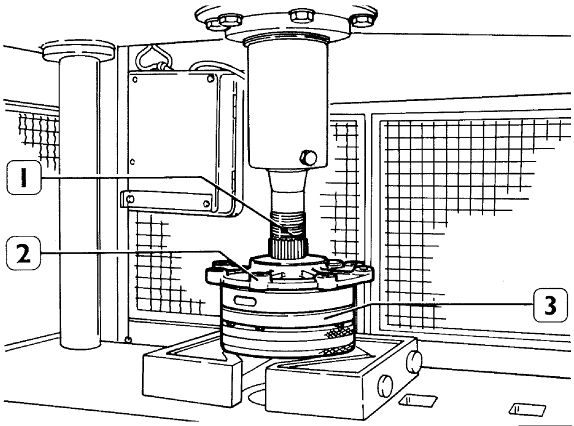
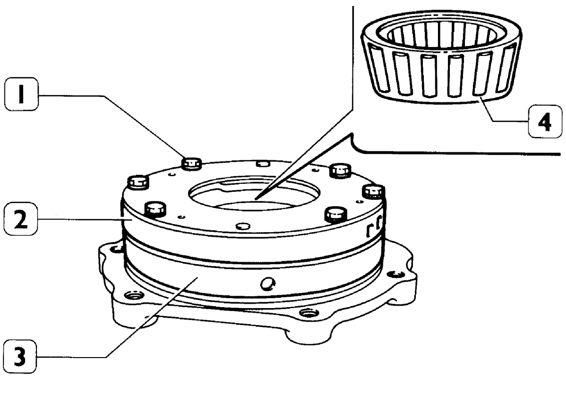
Figure 42



36357

Use a press to extract the drive input shaft (1) from bearing cage (2) and oil pump (3).

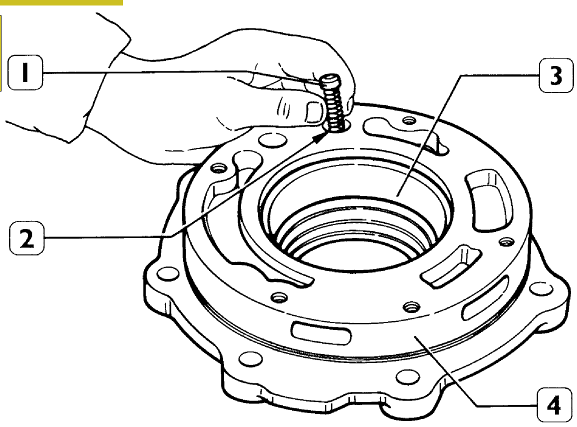
Figure 43



36430

Remove screws (1), separate oil pump (2) from bearing cage (3) and take out bearing (4).

Figure 44



36358

Remove spring (2), oil pressure relief valve (1) and cup (3) of bearing (4, Figure 43) from bearing cage (4).

Checking inter-axle unit components

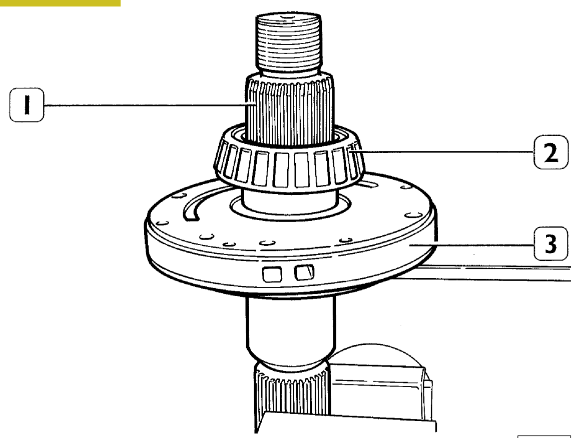
Accurately clean each single component and check for wear in view of their possible re-use.

Make sure all screw, stud and ring nut threads are cleaned accurately so that clearance and torque specifications are not effected.

Always renew sealing rings, retaining rings and washers.

Fitting inter-axle unit

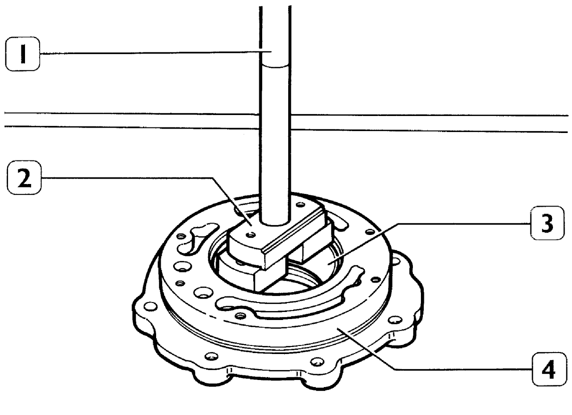
Figure 45



36359

Tighten the drive input shaft (1) in a vice and install the oil pump (3).
Heat the bearing (2) to 100°C for 15 minutes and fit it on using a drift.

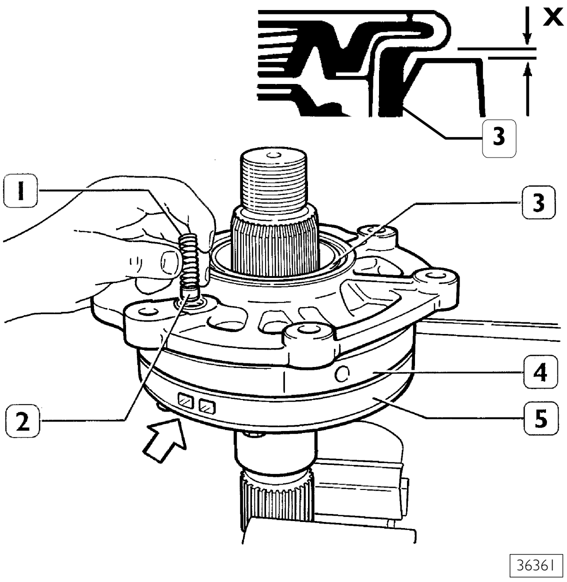
Figure 46



36360

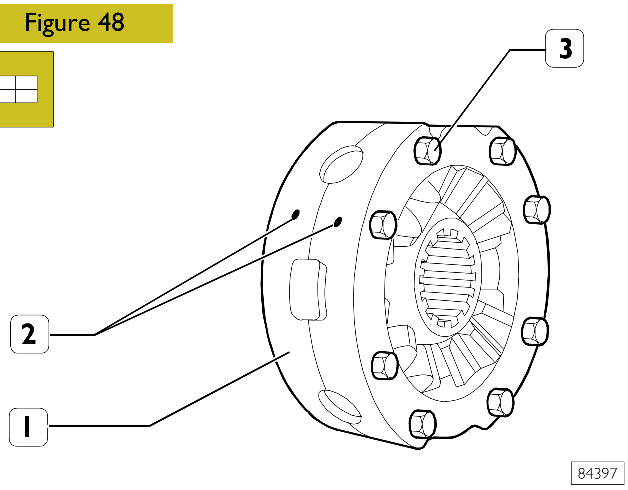
Using drift 99374093 (2) partially press fit cup (3) of bearing (2, Figure 43) in bearing cage (4). Complete installation manually using handle 99370007 (1).

Figure 47



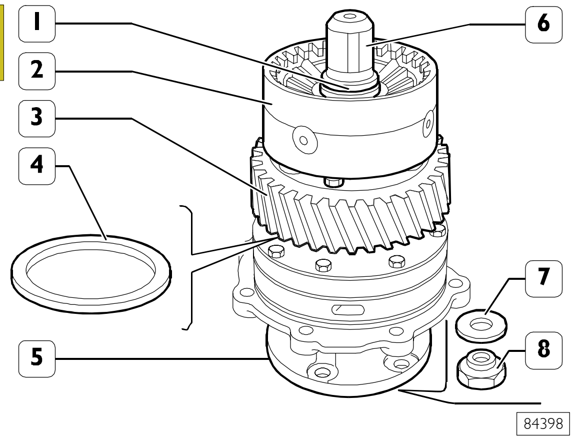
Mount seal ring (3) with tool 99374162 on support (4).
Install bearing cage (4) on oil pump (5) so that exhaust (→) matches the valve seat (2).
Insert spring (1) in the seat for oil pressure relief valve and fit the plug.
Use a feeler gauge to check distance X between sealing ring (3) and mounting (4) at four equi-distant points. Distance X should be between 0.38 ÷ 0.76 mm.

Figure 48



Mount the planet gear unit (if previously disassembled) by following the procedure below. Apply the specific lubricant used for the rear axle housing on all the other parts of the planet gear unit.
Mount the gears and pinion and the thrust washer on the spider.
Place the pinion unit and spider in one of half cases (1). Mount the remaining half case onto the half case with the spider unit.
Make sure that the marks (2) available on each half case are aligned to one another.
Screw four of the cap screws (3) after applying LOCTITE.
Screw the remaining cap screws (3) after applying LOCTITE on the thread, then tighten them to a torque of 60 ÷ 75 Nm.

Figure 49

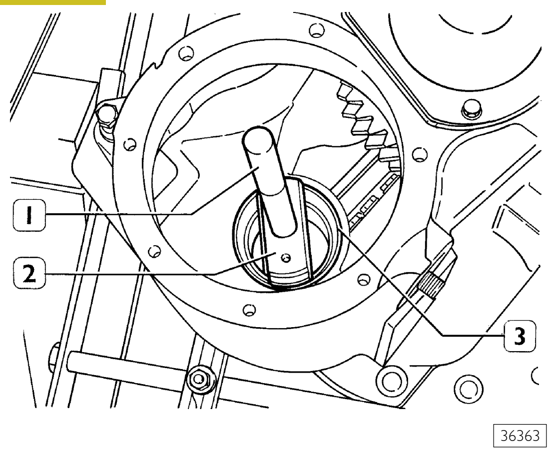


Smear the thrust ring (4) with grease and arrange it under gear (3);

- ❑ secure the gear on the drive input shaft (6),
- ❑ then differential gear assembly (2) and fasten by means of snap ring (1).

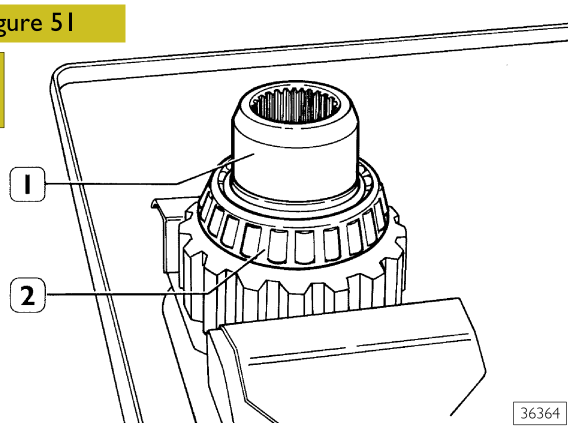
Turn the input shaft (6) upside down and spline flange (5) onto it.
Fit washer (7) and screw in retaining nut (8) without fully tightening it.

Figure 50



Use drift 99374093 (2) and handle 99370007 (1) to fit bearing (2, Figure 51) cup (3) in the rear-axle differential carrier.

Figure 51



Heat bearing (2) to 100°C for 15 minutes and fit on rear side gear shaft (1).

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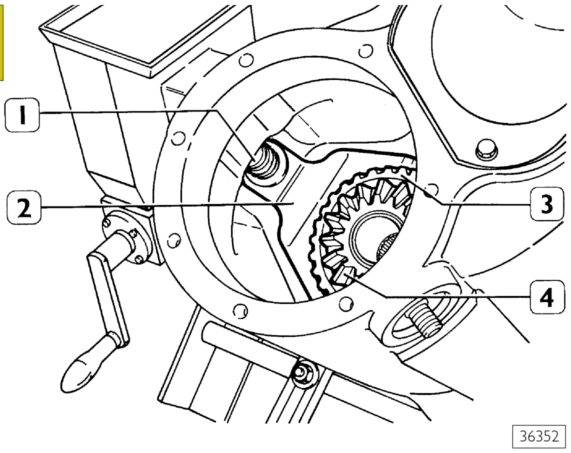
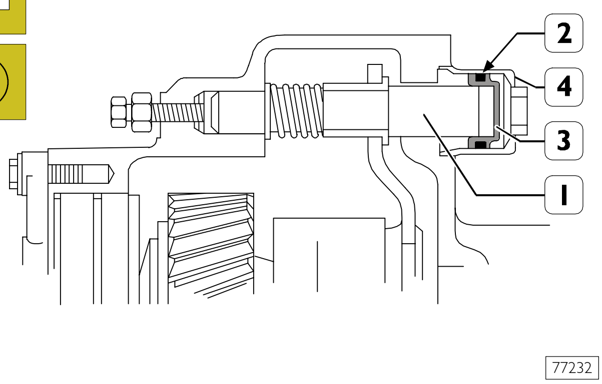
Figure 52



Place rear side gear (4) complete with sleeve (3) and fork (2) on bearing cup (3, Figure 50). Then fit spring (1) on fork (2).

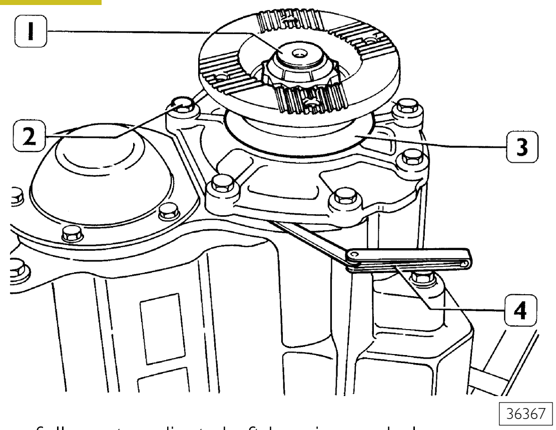
Figure 53



Mount the spindle (1) governing the transfer box differential locking, lubricate the new seal (2) and fit it on the piston (3) and insert this into the cylinder (4). Apply sealant on the thread of the cylinder (4). Screw this into the differential gear housing, tightening it to the prescribed torque.

Adjusting drive input shaft bearing end float

Figure 54

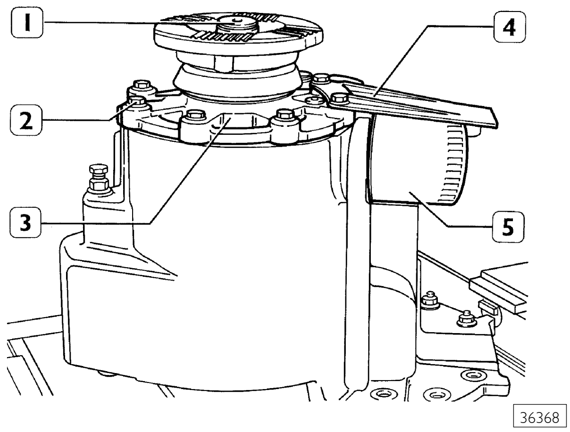


Proceed as follows to adjust shaft bearing end play:

- fit the drive input shaft into the inter-axle differential carrier;
- tighten screws (2) without washers;
- turn the input shaft in both directions to bed bearings; at the same time, tighten screws (2) without locking them;
- use a feeler gauge (4) to measure, at four equally-spaced points, the gap between bearing cage (3) and carrier rest face;
- thickness **S**, corresponding to the shim pack necessary for adjusting bearing end play is calculated as follows:
  S = A + B
- where **A** is the mean value resulting from the four measurements taken earlier;
- **B** = 0.013 is the mean value of bearing end play (0.05 ÷ 0.20 mm);
- remove screws (2) and raise the drive input shaft by 6 ÷ 12 mm.
- fit the shim pack of the correct thickness.

The shim pack must consist of at least three shims, with the thickest in the middle.
Shims are supplied as spares in the following range of thickness: 0.076 - 0.127 - 0.254 mm.

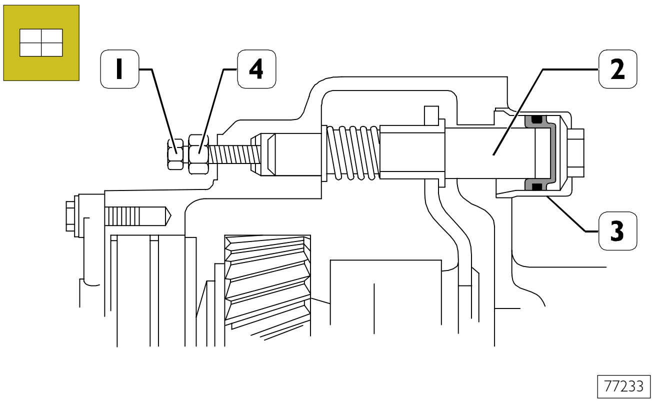
Figure 55



Fit new oil filter (5), fit guard (4) and secure it to differential carrier together with bearing cage (3) by screws (2).
Check input shaft bearing (1) end play using a dial gauge. End play should be 0.05 to 0.20 mm.
In case of a different reading, replace the shim pack with another one of the appropriate thickness.

Adjusting differential lock and inter-axle control pin end-stop

Figure 56

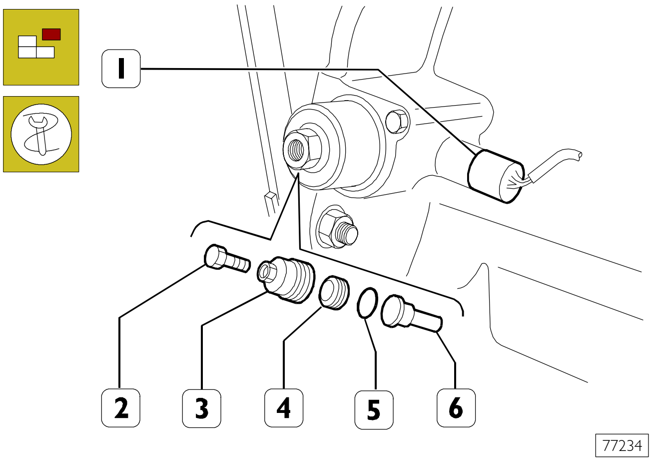


Adjust shaft (2) end-stop as follows:

- loosen capscrew (1);
- let 6 bar compressed air into the cylinder (3);
- tighten capscrew (1) until in contact with shaft (2);
- furtherly tighten capscrew (1) by 1/4 ÷ 1/2 turn and lock jam nut (4);
- Use tool 99370317 to lock flange rotation (1, Figure 55) and tighten the retaining nut to the specified torque.

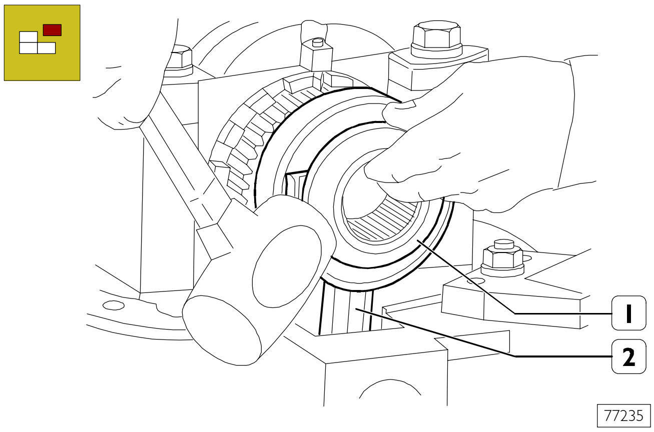
526210 REPAIRING MAIN DIFFERENTIAL-DISMANTLING DIFFERENTIAL CASING

Figure 57



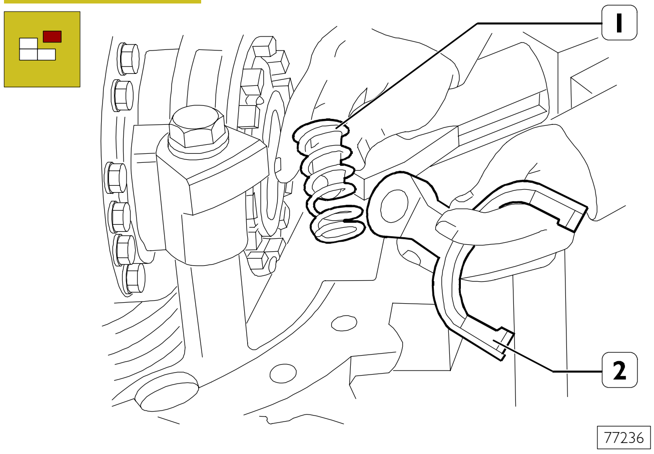
Take out the switch (1) signalling differential locking, unscrew the screw (2) to cut in manual differential locking, the cylinder (3) together with the ram (4) and the seal (5) and extract the spindle (6).
Using a punch, eject the ram (4) from the cylinder (3).

Figure 58



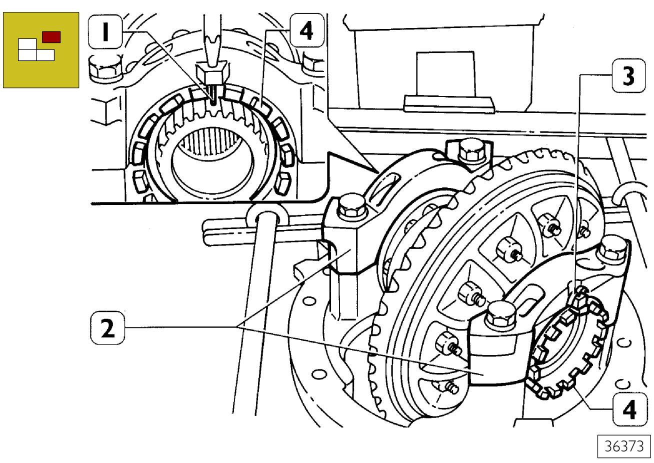
Release the coupling (1) with a rubber skirt and remove it from the fork (2).

Figure 59



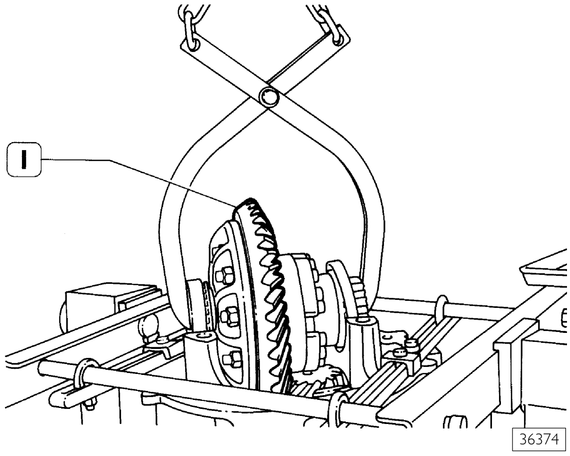
Take out the spring (1) and the fork (2) from inside the differential gear housing.

Figure 60



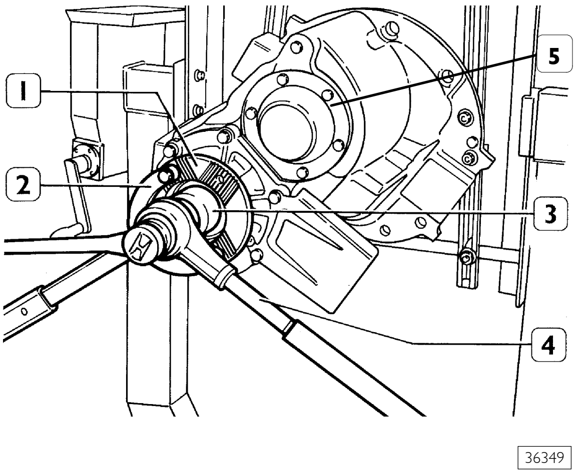
Remove split pin (3) and roll pin (1); dismantle caps (2) and bearing adjusting nuts (4).

Figure 61



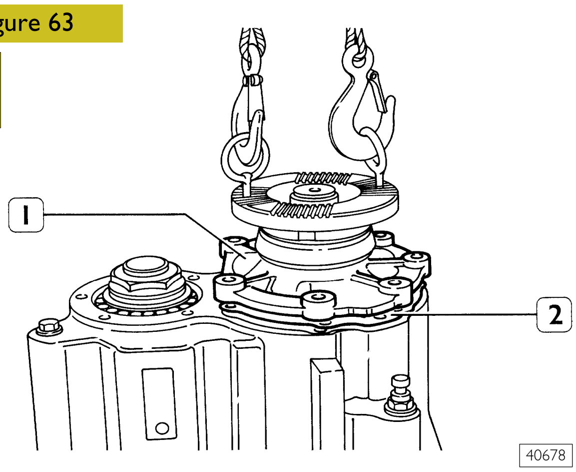
Use a sling hook to extract the gear cage (1) complete with crown wheel and bearings.

Figure 62



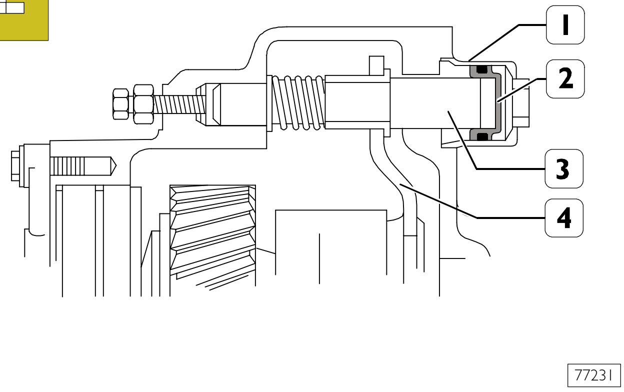
Stop rotation of flange (1) by means of retainer 99370317 (2); with wrench 99355088 (3) and torque adaptor (4) loosen flange (1) retaining nut.
Remove cover (5).

Figure 63



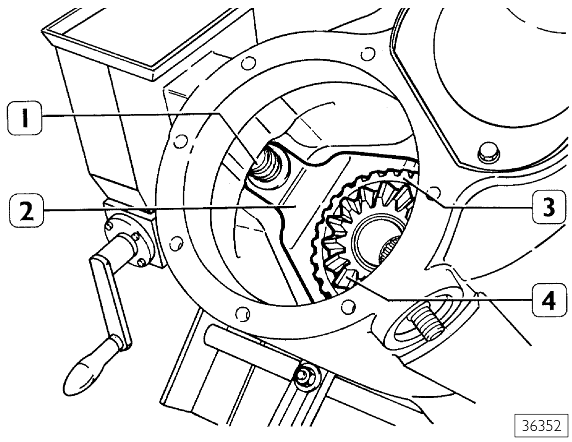
Remove nuts retaining bearing cage (1) to differential carrier.
Pull out bearing cage complete with input shaft, oil pump, gear and inter-axle differential.
Remove shims (2).

Figure 64



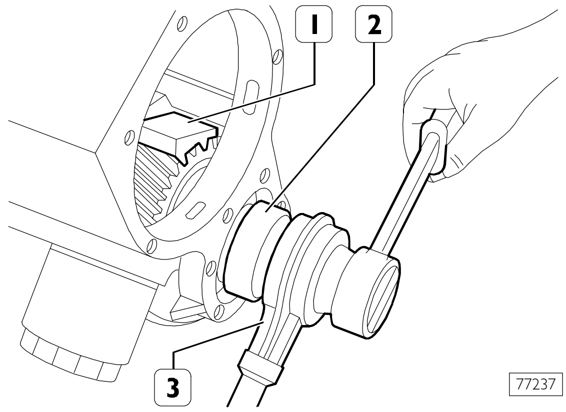
Remove the cylinder (1) together with the piston (2) of the differential locking-transfer box and extract the pin (3) governing the fork (4).

Figure 65



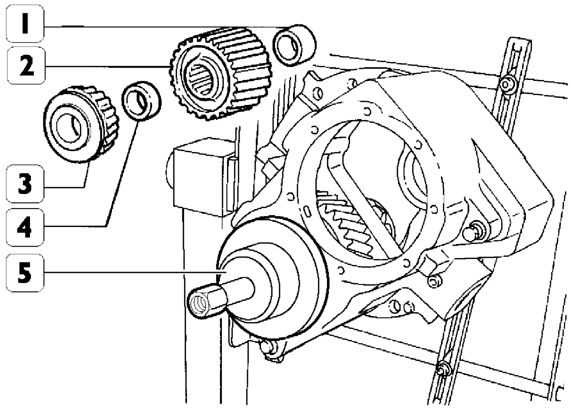
Remove drive shaft (3, Figure 57).
Remove spring (1) and strip fork (2), sleeve (3) and rear planetary gear (4).

Figure 66



Block rotation of the bevel pinion with the tool S.P. 2373 (1); with wrench 99344069 (2) and the multiplier (3) remove the nut fastening the bearings to the bevel pinion and the washer beneath.

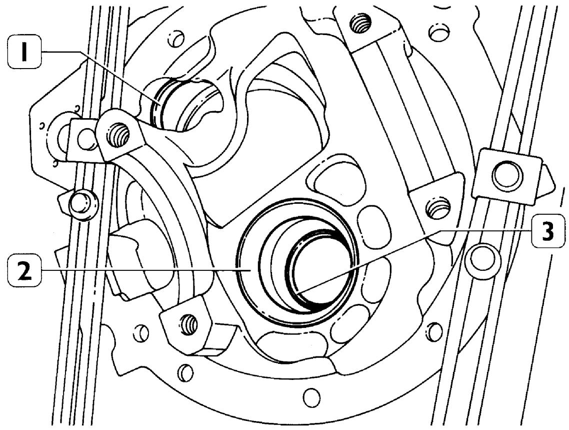
Figure 67



77238

Apply on the housing a special extractor S.P. 2346, (5) and extract the pinion from the parts: spacer (1), gear (2), spacer (3) and bearing (4).
Then remove the above-mentioned parts from the housing.

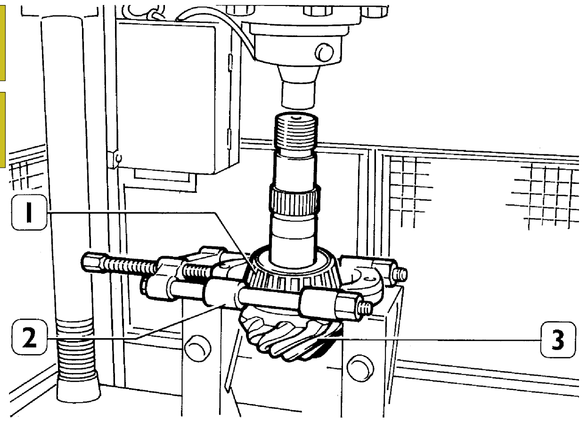
Figure 68



36380

Dismantle carrier bearing cups (1, 2, 3) using a drift.

Figure 69



36381

Place tool 99348001 (2) under the taper roller bearing (1) and pull it off the bevel pinion (3) using a press.

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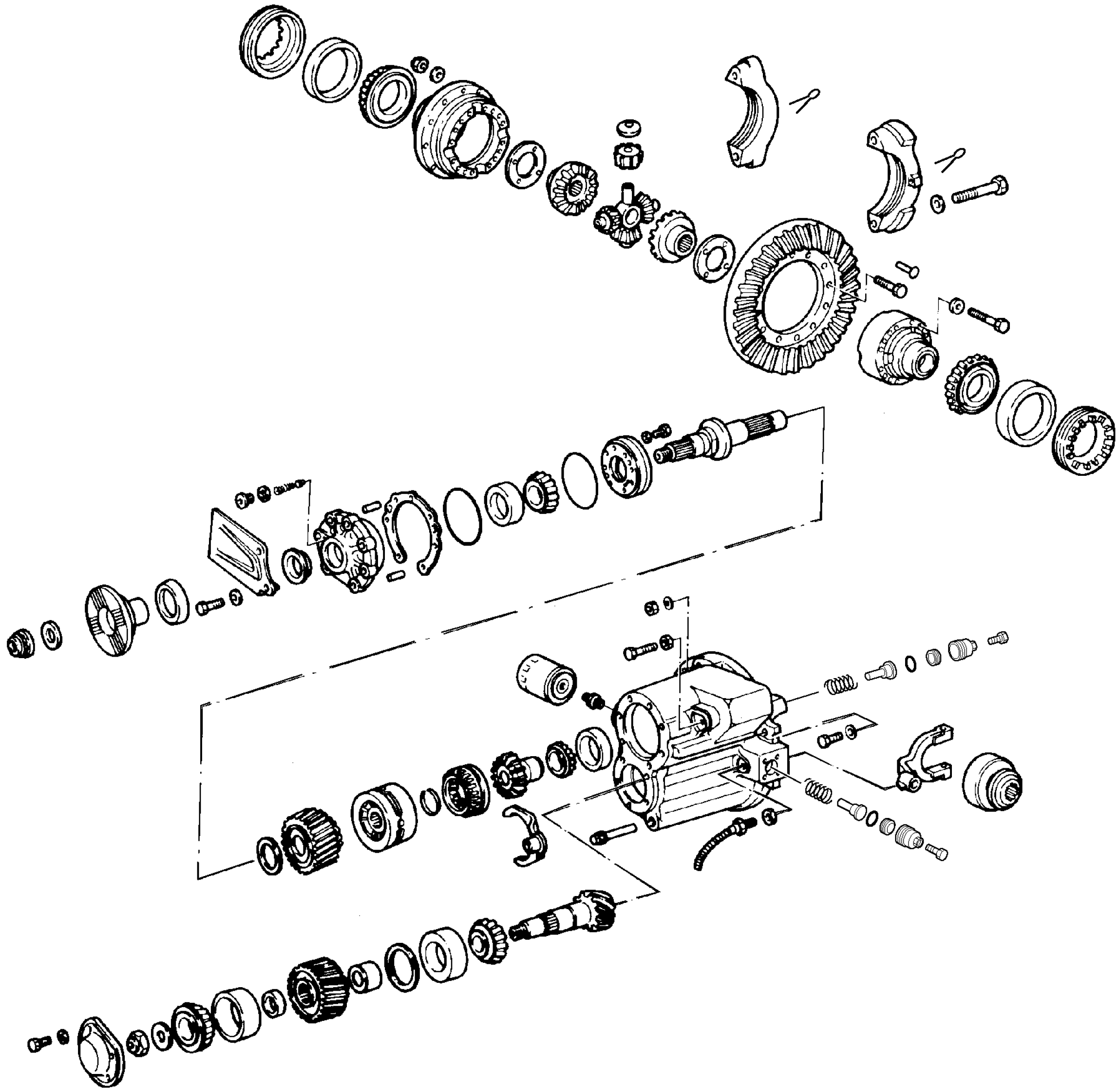
Figure 70

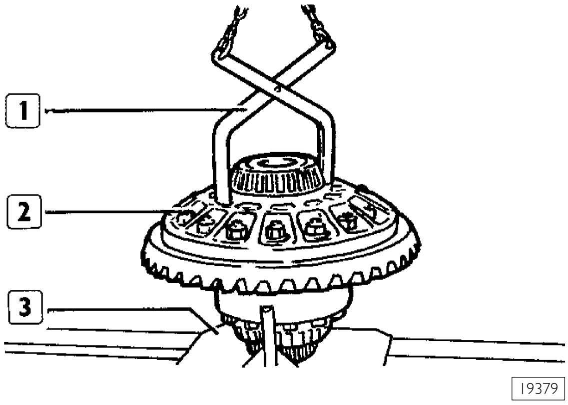


77240

INTER-AXLE DIFFERENTIAL COMPONENTS - EXPLODED VIEW

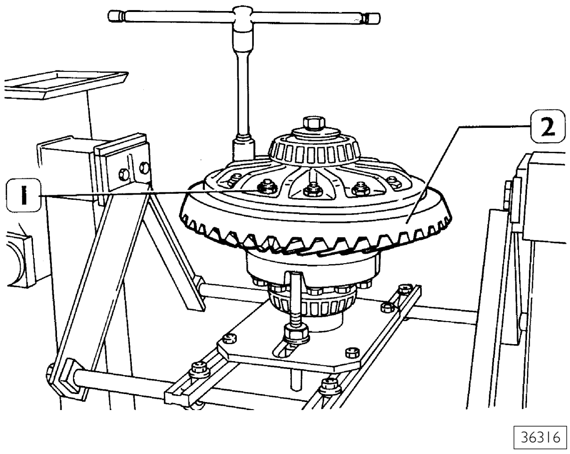
Dismantling gear cage

Figure 71



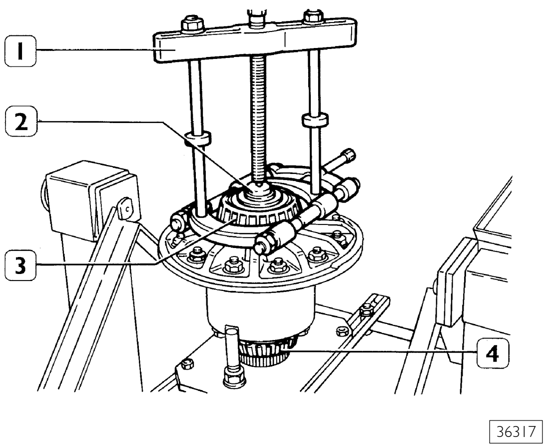
Use hook (1) to raise the gear cage assembly and position on stand 99371047 (3).

Figure 72



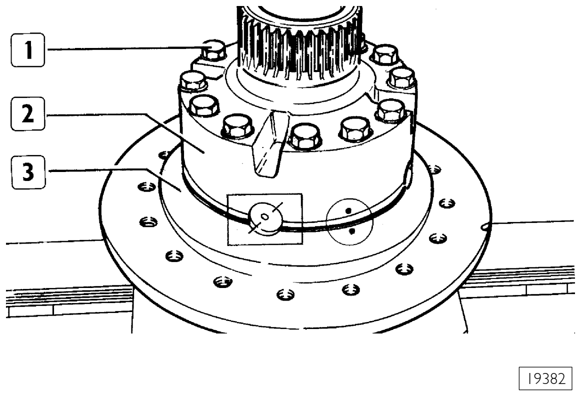
Unscrew nuts (1) and remove them with screws. Drive out bevel crown wheel (2).

Figure 73



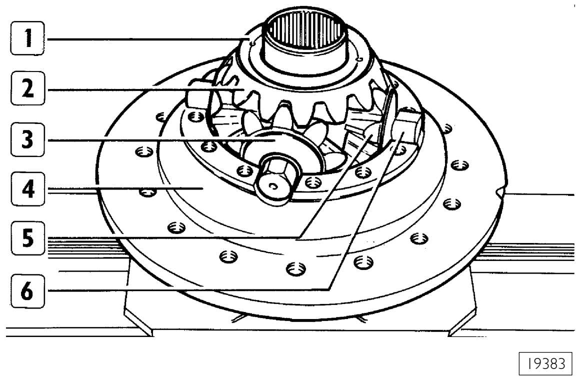
Use tool 99348001 (1) and reaction block 99345055 (2) to remove bearing (3) and bearing (4).

Figure 74



Mark the two casing halves (2 and 3) and the spider as indicated in the figure.
Unscrew screws (1) joining the casing halves. Lift the casing half (2).

Figure 75



Remove differential gear (2) with the associated thrust washer (1). Remove spider (6) with the four planetary gears (5) complete with thrust washers (3). Take the spider/planetary gear assembly apart. Remove the other differential gear with its thrust washer from the half cage (4).

Checking differential components

Thoroughly clean the individual parts making up the differential. Lubricate the bearings and spin the roller cages freely; these should rotate evenly without tight spots.
Check the seating surfaces of the bevel crown wheel and the bedding surface of the half cage so that the crown wheel adheres to it perfectly; distortion of these faces would cause vibration of the crown wheel attachment screws, compromising the satisfactory operation of the unit.

! Thoroughly clean threads of screws, studs and ring nuts to prevent clearance or torque settings from being altered.

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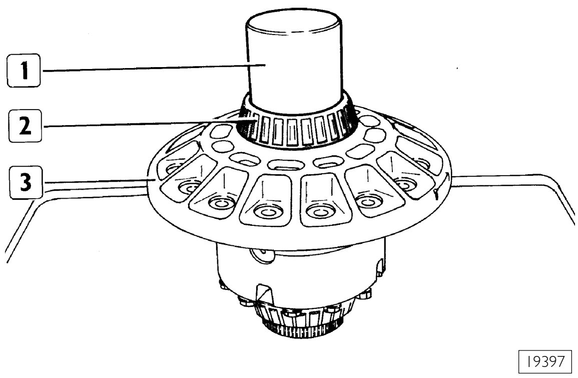
Check that there is no excessive wear in the splined portion for fitting the flange to the pinion; if there is, replace the pinion.

Check the planetary gears and associated thrust washers, the spider and differential gears and thrust washers.
Replace all seals and gaskets, the locking pin for the adjustment ring nut and all lock washers.

If it should be necessary to replace the crown wheel or pinion, both must be replaced as the parts are supplied as matched pairs.

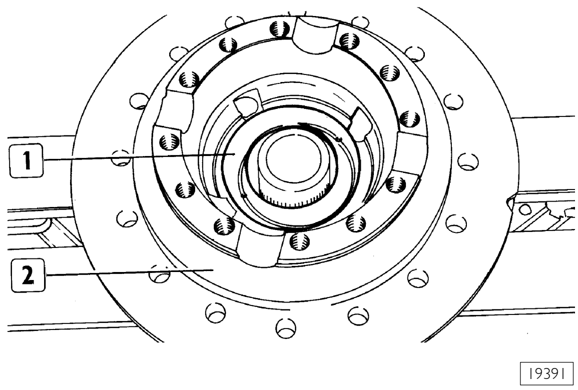
Assembling gear cage

Figure 76



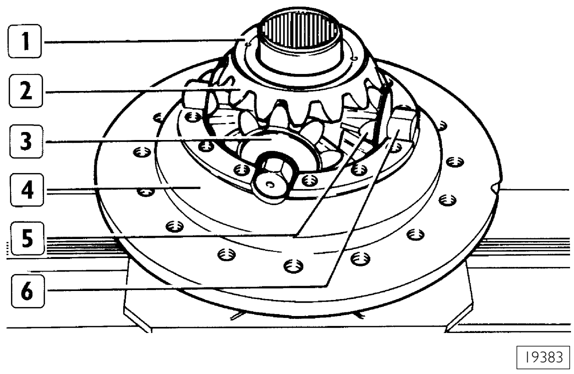
Heat the support bearing (2) for the opposite side of the locking differential in a circulating air oven to a temperature of 100°C for about 15' and fit it to the gear cage (3) using a suitable drift (1).

Figure 77



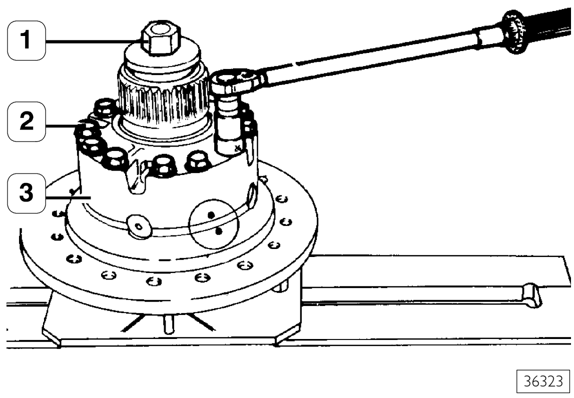
Position half cage (2) on fixture 99371047.
Position differential gear thrust washer (1) in the half cage (2) and then fit differential gear.

Figure 78



Fit spider (6) complete with planetary gears (5) and associated thrust washers (3) to half cage (4).
Position second differential gear (2) with thrust washer (1).

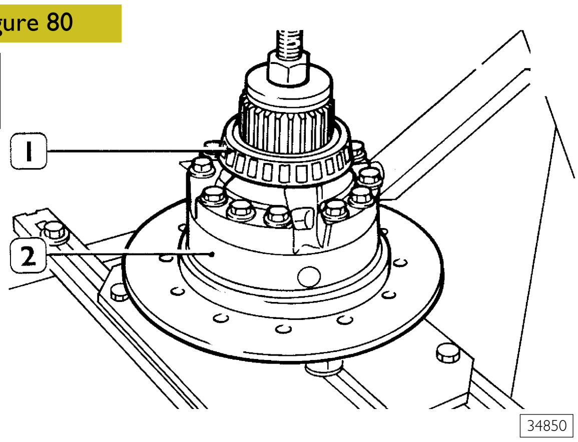
Figure 79



Lock the differential with the parts (1); fit on the half box (3).
Check that the marks made at the time of removal coincide.
Apply a few drops of "LOCTITE 270" on the thread of the screws (2).
Tighten the screws (2) to the prescribed torque.

It is always advisable to renew screws (2).

Figure 80



Heat bearing (1) in a circulating air oven to a temperature of 100°C for about 15' and fit it to the gear cage (2) using a suitable drift.

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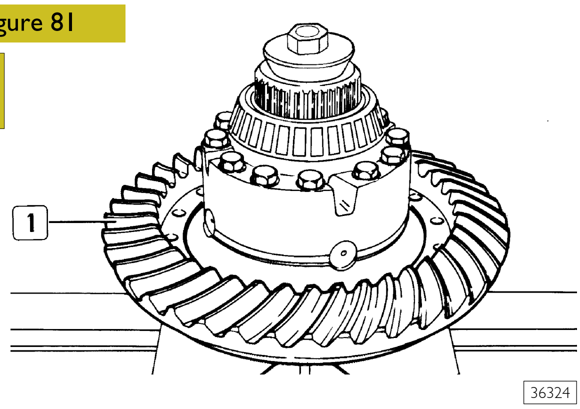
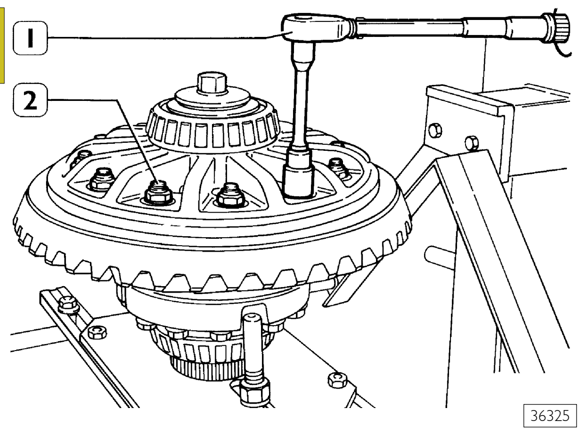
Figure 81



Heat bevel crown wheel (1) in a circulating air oven to a temperature of 100°C for about 15' and position it on its seating on the gear cage, ensuring that the holes for the bevel crown wheel/gear cage attachment screws are lined up.

Figure 82

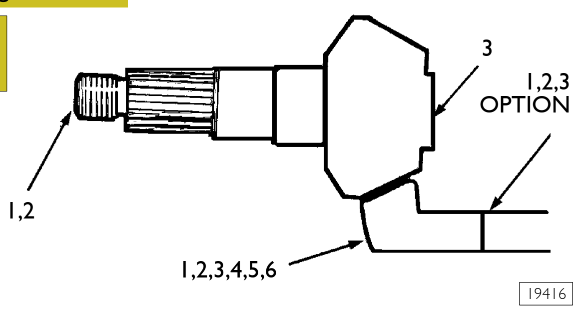


Allow the bevel crown wheel to cool before positioning the screws. Use torque wrench (1) to tighten self locking nuts (2) to the specified torque.

ASSEMBLING DIFFERENTIAL CASING

Calculating bevel pinion position in differential casing

Figure 83



If a new final drive set is installed, it will be necessary to know the meaning of the markings on pinion and crown wheel in order to position the pinion correctly:

1. part number;
2. tooth combination number.
   This number (example: 12/41) indicates that the pinion has 12 teeth and the crown wheel 41;
3. pinion/crown wheel pair set number.
   All final drive sets are available as pairs: therefore pinion and crown wheel bear the same number which is stamped on head end for pinions and the outer face for crown wheels;

> ⚠ Never use a pinion and crown wheel set unless both components have the same number.

4. variation number needed to determine the thickness of the shim pack interposed between pinion bearing cage and differential carrier (in the example below, this number is identified as CP).

Every crown wheel is marked with a variation number which indicates the nominal assembly distance. Use this number to calculate the thickness of the shim pack that is interposed between pinion bearing cage and differential carrier.
The variation number (CP + 0,1 or CP - 0,1) is stamped on crown wheel outer face.

5. Pinion/crown wheel set manufacturing and inspection month and year.
6. Specified pinion/crown wheel set clearance.

Part number and tooth combination number are stamped on threaded end of all pinions. Number may alternatively be located on outer diameter of crown wheel. On any pinion/crown wheel set, crown wheel will always bear an even stamped category number (e.g. 36786), whereas corresponding pinion will bear an odd number (e.g. 36787).

To determine the thickness of the shim pack to be interposed between bearing cage and differential carrier proceed as follows:

1. measure the thickness of the shim pack removed with the old final drive gear set. Use a micrometer or other suitable gauge and record the value found;
2. read the CP marked on pinion to be replaced: if it is a plus (+) number or a minus (-) number respectively subtract or add it from the value obtained under 1. above;
   Take note of the result.

> ⚠ The value obtained in 2. will be used to calculate the thickness of the shim to be interposed between pinion bearing cage and differential carrier for correct new final drive assembly.

3. read the CP marked on the new pinion.
   Either add or subtract this value - depending on whether the sign is a plus or a minus - to or from the value noted under 2. above.
   The result indicates the thickness which the new shim pack should have.

Refer to the following examples which cover all the possible calculation cases.

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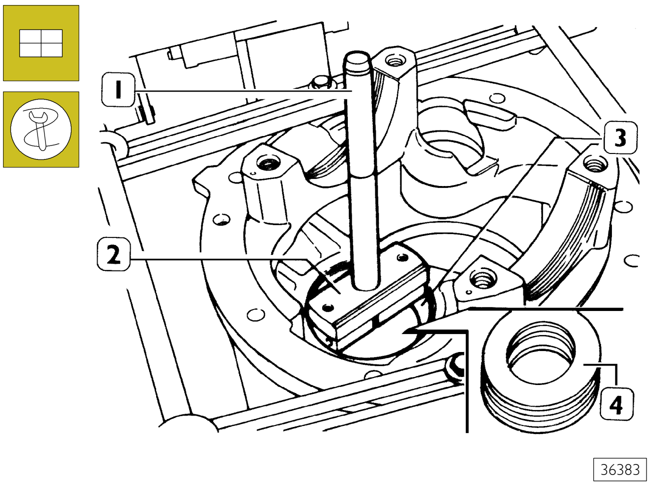
COMPUTATIONAL EXAMPLES

Case 1:	mm
Original shim pack thickness	0.76
CP marked on pinion +2	+0.05
Resulting value	0.81
CP marked on new pinion +5	-0.12
Thickness for new shim pack	0.69
Case 2:	
Original shim pack thickness	0.76
CP marked on pinion -2	-0.05
Resulting value	-0.71
CP marked on new pinion +5	-0.12
Thickness for new shim pack	-0.59
Case 3:	
Original shim pack thickness	-0.76
CP marked on pinion + 2	+0.05
Resulting value	0.81
CP marked on new pinion -5	+0.12
Thickness for new shim pack	0.93
Case 4:	
Original shim pack thickness	-0.76
CP marked on pinion -2	-0.05
Resulting value	0.71
CP marked on new pinion -5	+0.12
Thickness for new shim pack	0.83

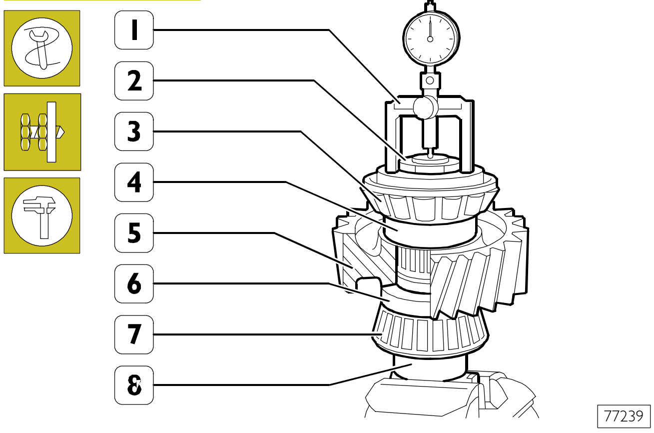
The difference between the value of the thickness of the new pack and that of the old one must be added to or subtracted from, depending on the case, the thickness of the adjustment ring (6, Figure 85).

Figure 84



Place the bevel pinion position adjustment rings (4) in the box and, using grip 99370007 (1) and drift 99374094 (2), mount the external ring (3) for the bevel pinion bearing.
Fit remaining bearing cups using drift 99374093.

Figure 85



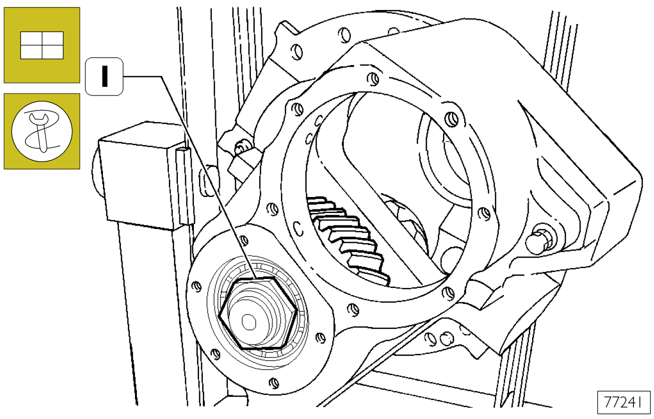
Measure the thickness of the adjustment ring (6) found on removal and note down the value (dimension A).
Tighten the tool 99395027 (8) in a vice and place the following on it:

- the bearing (7) on the pinion side;
- the ring (6) previously measured.
- the gear (5);
- the spacer (4);
- the bearing (3).

Screw down the ring nut (2) and tighten it fully.
Position part (1) of tool 99395027 (8), equipped with a dial gauge, on the bearing (3) and reset the dial gauge on the end of the tool (8).
Then remove:

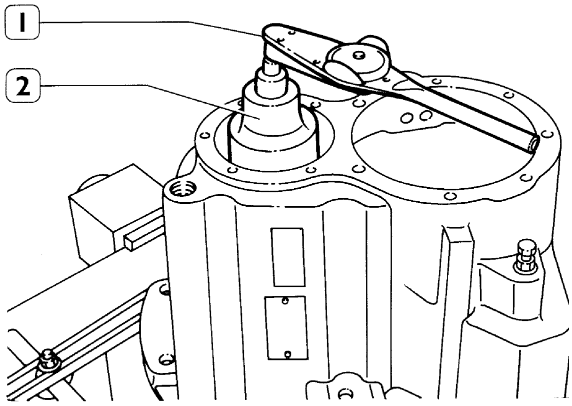
- the part (1);
- the ring nut (2);
- the bearing (3);
- the spacer (4);
- the gear (5);
- the ring (6) the bearing (7) from the tool (8).

Figure 86



Insert the tool 99394027 (8, Figure 85) in the differential gear housing, comprehensive of the bearing (7, Figure 85), ring (6), gear (5), spacer (4), bearing (3). Screw down the ring nut (1) on the tool 99394027.

Figure 87

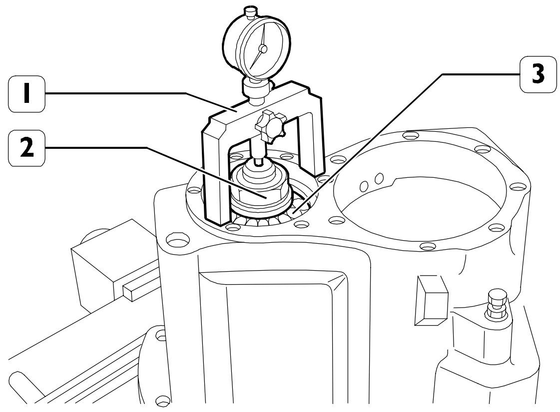


36387

Screw down the ring nut (2, Figure 88) tightening it until, with a dynamometer, you measure a rolling torque of:

- ❑ 1.12 to 5.08 Nm if the bearings are new,
- ❑ 1.68 to 3.39 Nm if the bearings have already been used.

Figure 88



78313

Reposition part (1) of tool 99395027, with the dial gauge previously reset on the bearing (3) and measure any difference (dimension B).

The thickness **S** of the ring, or of the adjustment rings, is given by the following formula:

S = A - (± B) + C

where:

A = Thickness of the adjustment ring(s) fitted to reset the dial gauge;

B = Value of the difference measured;

C = 0.2 mm coefficient that takes account of the expansion of the bearings due to the interference of assembly on the bevel pinion.

First example:

A = 13.12 mm
B = + 0.13 mm
C = 0.2 mm

S = 13.12 - (+ 0.13) + 0.2 =
S = 13.12 – 0.13 + 0.2 = 13.19 mm.

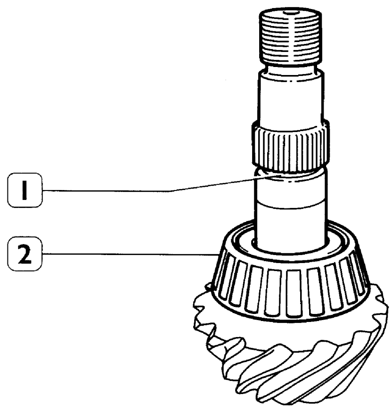
Second example:

A = 13.12 mm
B = - 0.13 mm
C = 0.2 mm

S = 13.12 - (- 0.13) + 0.2 =
S = 13.12 + 0.13 + 0.2 = 13.45 mm.

Remove from the box the tool 99395027 (8, Figure 85) and take out the bearings, spacers and gear as shown in the figure.

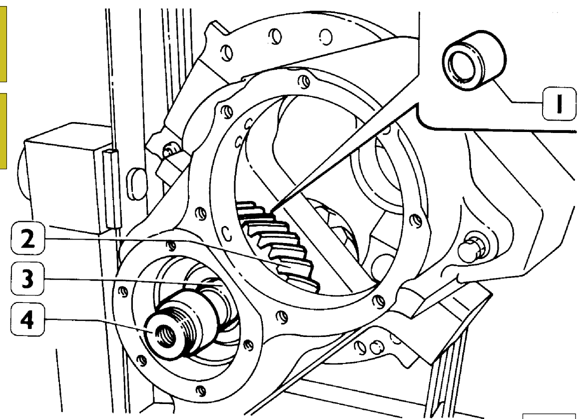
Figure 89



36386

Heat the bearing (2) to 100°C for 15 min. and, with a specific drift, fit it on the bevel pinion.

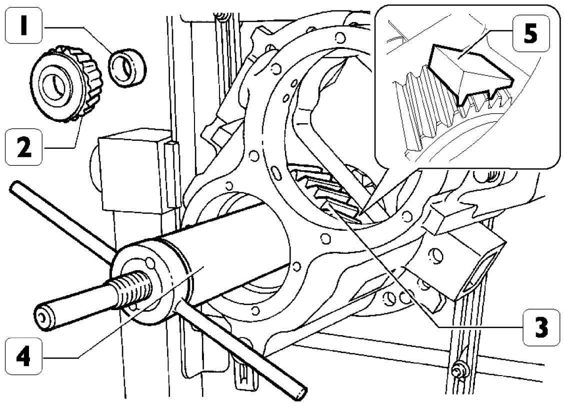
Figure 90



36385

Insert the bevel pinion (3) in the box, simultaneously keying onto it the adjustment ring (1) of the thickness determined in the preceding measurements and the gear (2); screw the part 99345029 (4) onto the bevel pinion (3).

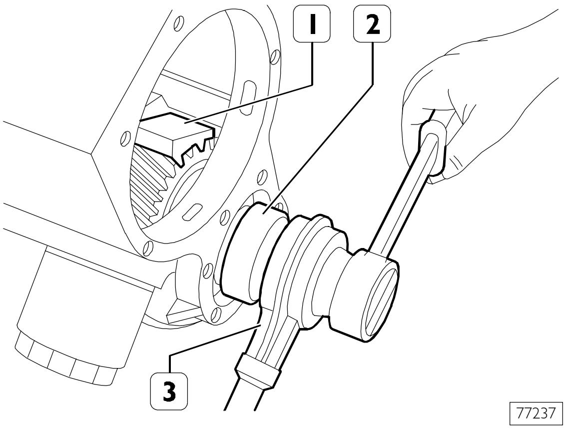
Figure 91



77242

Block rotation of the bevel pinion with the tool S.P. 2373 (5).
Screw down the inserter 99345098 (4) onto the part (4, Figure 90) and fully drive in the gear (3).
Remove the inserter (4).
Fit on the spacer ring (1).
Heat the bearing (2) to 100°C for 15 min. and fit it onto the pinion.
Screw the inserter (4) back onto the part (4, Figure 90) and take the bearing (2) into contact with its seat.

Figure 92

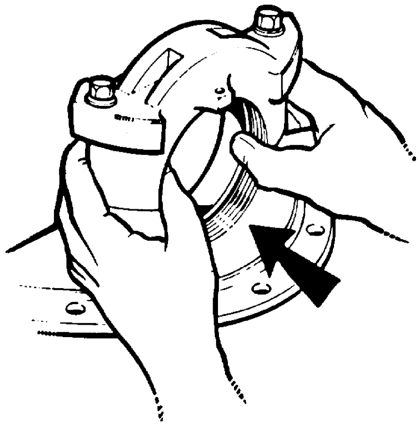


77237

Block rotation of the bevel pinion with the tool S.P. 2373 (1).
Screw down the nut fastening the bevel pinion bearings and tighten it to the prescribed torque.

> To tighten the nut use the wrench 99355069 (2) torque wrench and multiplier 99389816 (3).

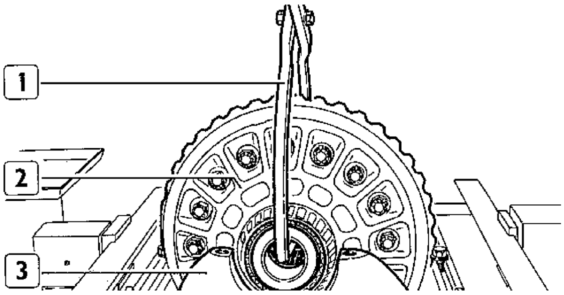
Figure 93



20670

Position the caps taking care to make the reference marks coincide.
Insert the screws, together with the washers, and tighten them, using a torque wrench, to the prescribed torque.
Then check that the external rings of the bearings slide, with a light pressure, in their respective seats without sticking.
Again unscrew the fastening screws with the washers and remove the caps.

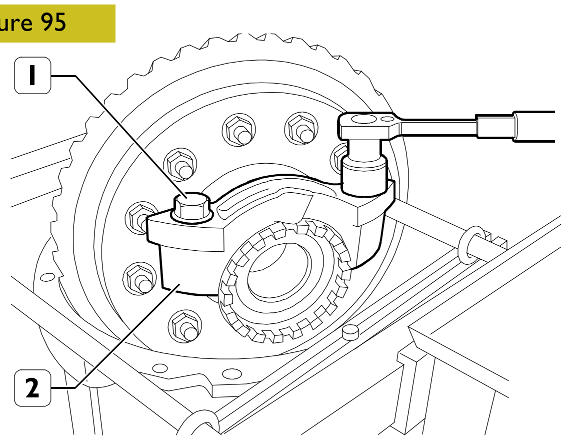
Figure 94



94191

Using the hook (1), lift the gear housing (2) previously assembled and position it on the differential casing (3).

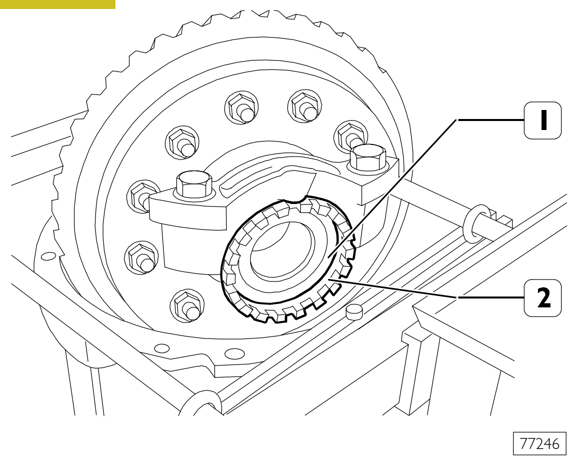
Figure 95



77245

Position the caps (2), screw down the screws (1) with the washers and tighten them to the prescribed torque.

Figure 96



Lubricate taper roller bearings (1) and fit outer races.
Screw in adjustment ring nuts (2).

Adjusting the cap gap

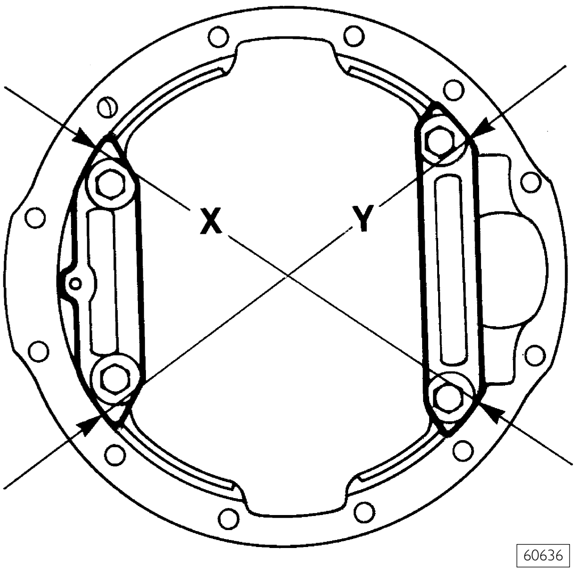
Adjusting and checking retraction of the caps can be done with two methods:

1st METHOD

1. Use wrench 99355025 (3, Figure 98) to tighten the adjustment lock rings (4) of the bearings until eliminating the pinion-crown wheel clearance and end float. At the same time check that the crown wheel does not force on the pinion;
2. using a suitable micrometer positioned diagonally and centrally in points (X-Y-arrows, Figure 97);

   measure and note the distance of the caps;

Figure 97

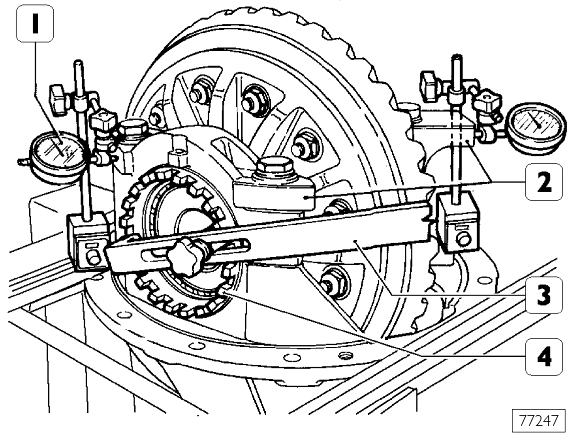


3. further tighten the two adjustment lock rings (4, Figure 98) to obtain a retraction of the caps (2, Figure 98), measured on Axis X or on axis Y as described in point "2" of: 0.08 to 0.22 mm which corresponds to a preload on the bearings of 1.7 to 3.9 Nm (0.17 to 0.39 kgm).

2nd METHOD

A. Diagonally and centrally on the outer machined seats of both caps (2, Figure 98) position two dial gauges (1) with magnetic base as shown in Figure 98;

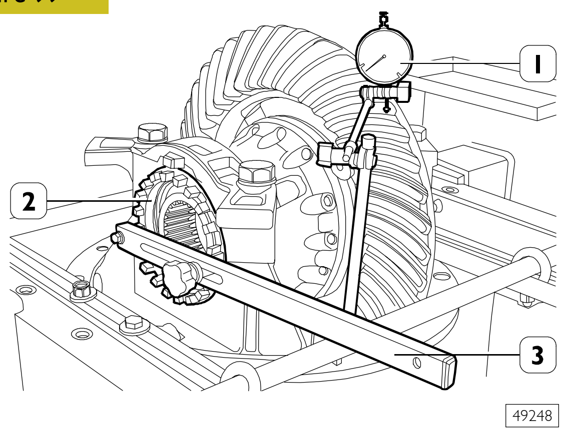
Figure 98



B. proceed as described in point "1";

C. after eliminating the end float further tighten the two adjustment lock rings (4) to obtain a retraction of the caps (2) of 0.08 to 0.22 mm, which corresponds to the sum of the readings on the dial gauges (1).

Figure 99

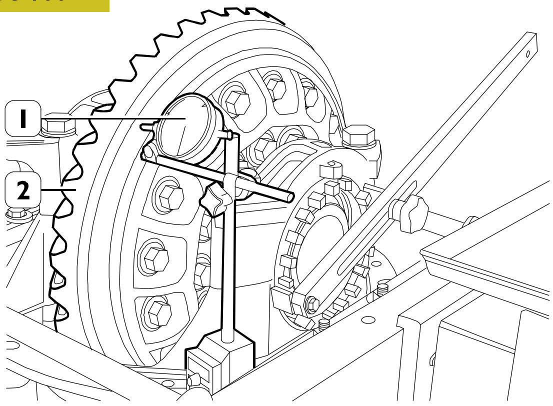


Adjust the axial clearance between the teeth of the pinion - crown wheel unit which must be 0.20 to 0.46 mm proceeding as follows:

- ❑ stop the bevel pinion from turning using tool 99370317;
- ❑ position the magnetic-based dial gauge (1) as illustrated;
- ❑ using wrench 99355025 (3) slacken the adjustment lock ring on the crown wheel side and tighten, to the same extent, the adjustment lock ring (2) of the opposite side. The purpose of this is to leave the previously-adjusted cap retraction unchanged;
- ❑ proceed as described until obtaining the specified clearance.

The clearance should be checked on 4 points the same distance apart.

Figure 100

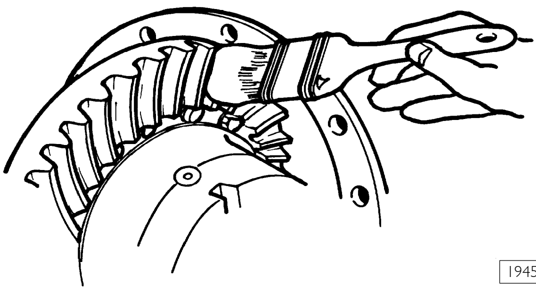


49246

Use a magnetic-based dial gauge (1) to check that the crown wheel (2) does not have any upper wobble above 0.20 mm. If it does, disassemble the differential unit and find the cause.

Refit and repeat the adjustment operations described previously.

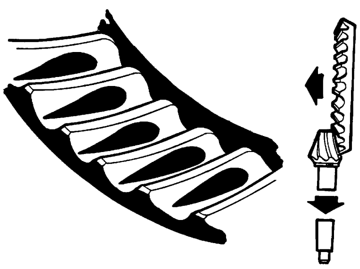
Figure 101



19451

Apply a light layer of Prussian blue on the crown wheel. Turn the pinion and measure the impression of the contact of the pinion teeth on the crown wheel teeth.
The following figures show possible contacts and how to correct any errors.

Figure 102



19452

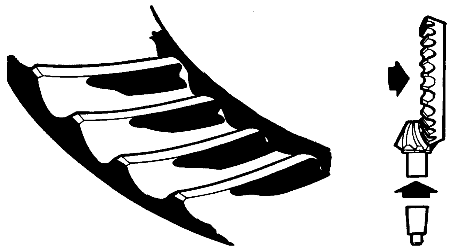
Contacts too much on crown wheel teeth bottom land

Conditions C-D. Indicates that the pinion is fastened too deeply and needs further adjustment.
To adjust the exact position of the pinion shims should be added under the pinion support to obtain the exact contact.

Condition C. Measure the clearance and restore it after adding shims.

Condition D. After adding shims, take the clearance towards minimum.

Figure 103



19453

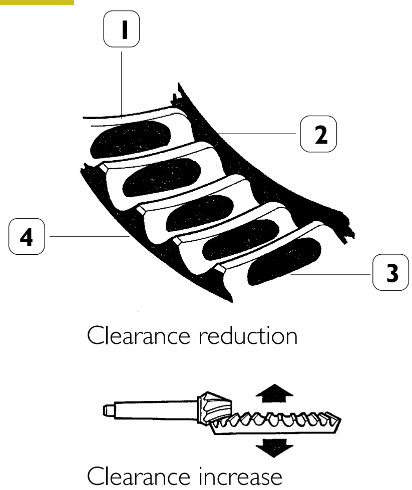
Contacts too much towards the crown wheel teeth top land

Conditions A-B. Indicates that the pinion is fastened to much towards the outside and therefore needs further adjustment. To adjust the exact position of the pinion, remove shims under the pinion support to obtain the exact contact.

Condition A. After removing the shims, take the clearance towards maximum.

Condition B. Measure the clearance and restore it after removing shims.

Figure 104



19454

THEROETICAL CONTACT AREA

1. Release, concave side of tooth
2. Top land
3. Pulling, convex side of tooth
4. Heel

PULLING. Central tending towards the top land on the tooth face and central on the tooth profile.

RELEASE. Central tending to the heel on the tooth face and central on the tooth profile.

Indicates that the pinion is fastened correctly.

The contact position can be further changed by changing the pinion-crown wheel clearance.

Condition E. Lower the clearance.

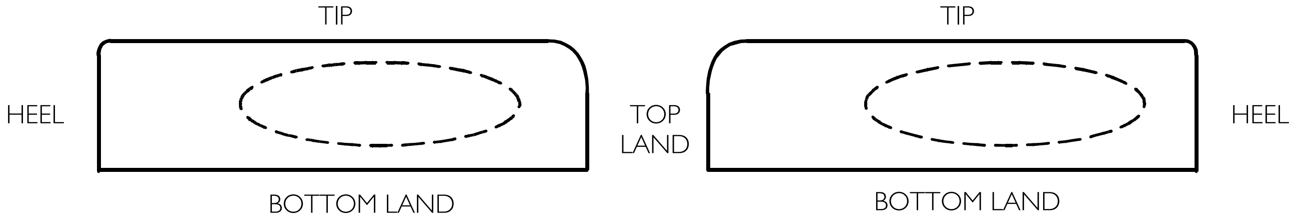
Condition F. Increase the clearance.

CORRECTING THE CROWN WHEEL AND PINION CONTACTS (AFTER ASSEMBLY)

Figure 105

THEORETICAL CONTACTS

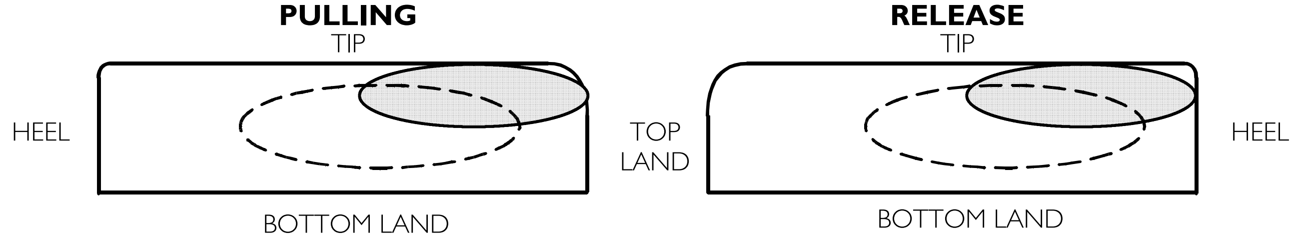
PULLING (CONVEX SIDE OF RING GEAR) **RELEASE (CONCAVE SIDE OF RING GEAR)**



- PULLING : CENTRAL TENDING TOWARDS THE TOP LAND ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE
- RELEASE : CENTRAL TENDING TOWARDS THE HEEL ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE

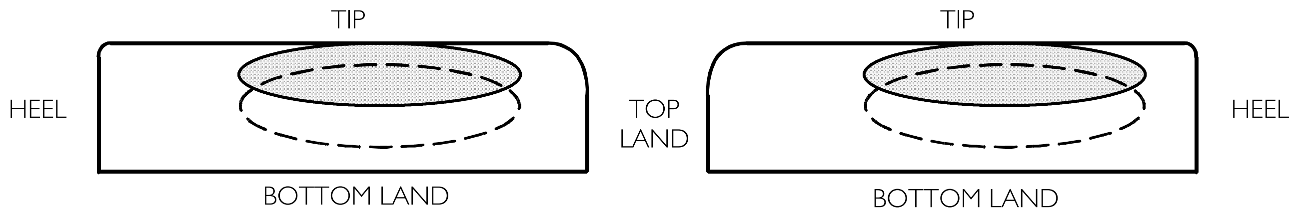
CONDITION "A"

PULLING **RELEASE**



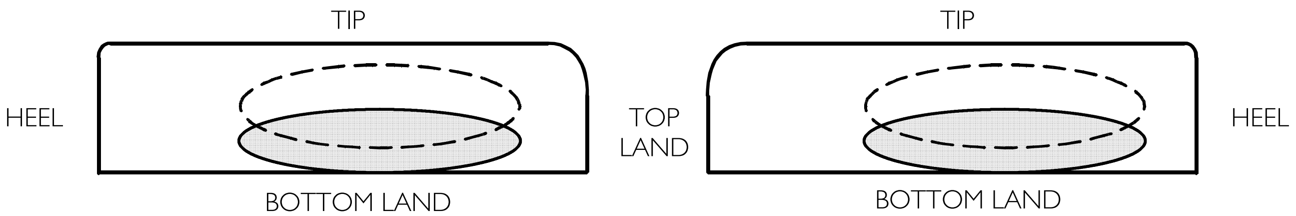
- PULLING RELEASE : CONTACTS TOO MUCH AT TIP
- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : REMOVE SHIMS AND INCREASE CLEARANCE TO MAXIMUM

CONDITION "B"



- PULLING - RELEASE : CONTACTS TOO MUCH AT TIP
- CORRECTIVE ACTION : MEASURE THE CLEARANCE AND RESTORE THE CLEARANCE

CONDITION "C"



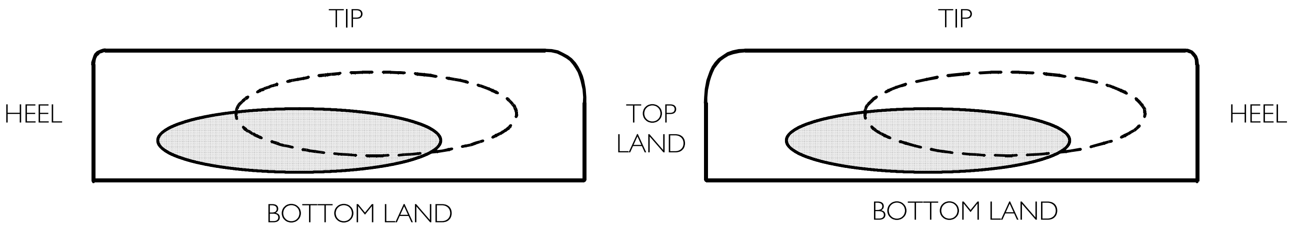
- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- CORRECTIVE ACTION : MEASURE THE CLEARANCE, ADD SHIMS AND RESTORE CLEARANCE

60676

Print 603.93.111

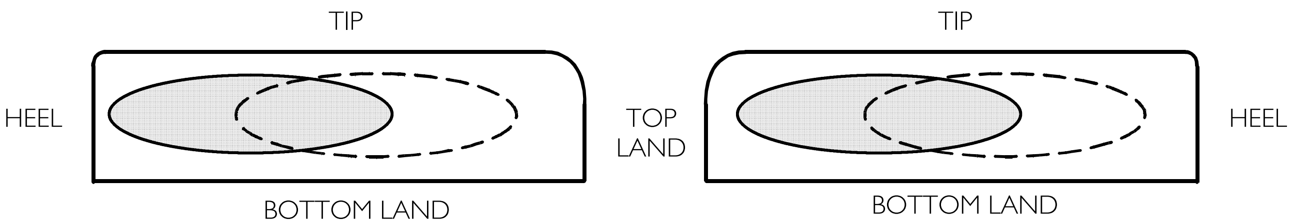
Figure 106

CONDITION "D"



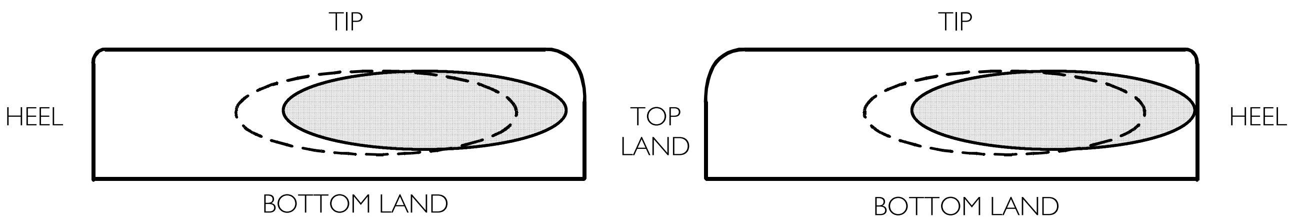
- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- PULLING: : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : ADD SHIMS AND REDUCE CLEARANCE TO MINIMUM

CONDITION "E"



- PULLING : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : REDUCE CLEARANCE

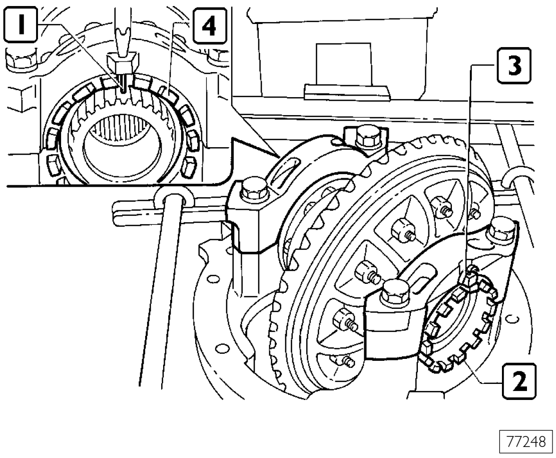
CONDITION "F"



- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : INCREASE CLEARANCE

60677

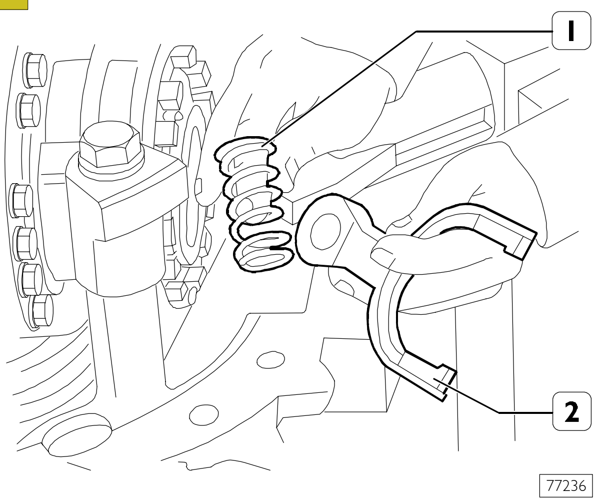
Figure 107



Fit on the spring pin (1) and the split pin (3) to lock the ring nuts (2-4).

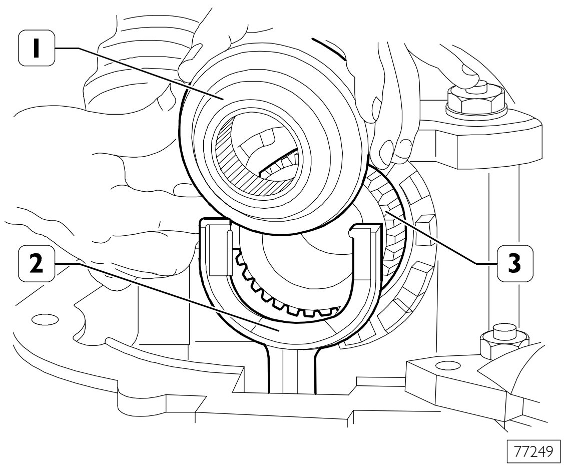
> ⚠ If the spring pin or the split pin do not coincide with their respective seats on the ring nuts, slightly turn these so it is possible to insert the spring pin or the split pin,

Figure 108



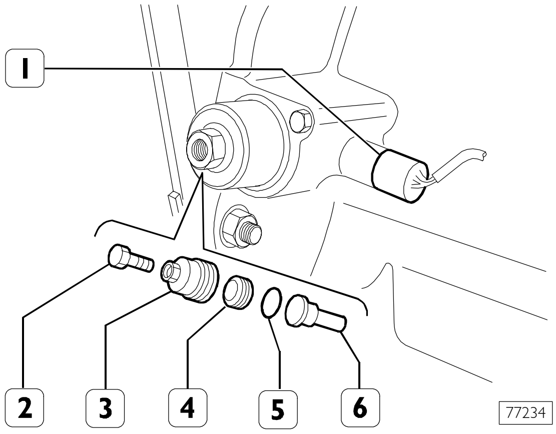
Fit on the spring (1) and the fork (2) from inside the differential casing.

Figure 109



Position the fork (2) in the groove of the coupling (1) and fit this on the toothing (3) of the differential gear.

Figure 110



Mount the spindle (6). Lubricate the new seal (5) and fit it on the piston (4) and insert this into the cylinder (3). Apply sealant on the thread of the cylinder (3) and screw it down into the differential casing, tightening it to the prescribed torque.

Screw down the screw (2) so as to provisionally prevent the differential gear unlocking.

Remove the differential casing from the mounting and fit it back on the axle housing as described under the relevant heading.

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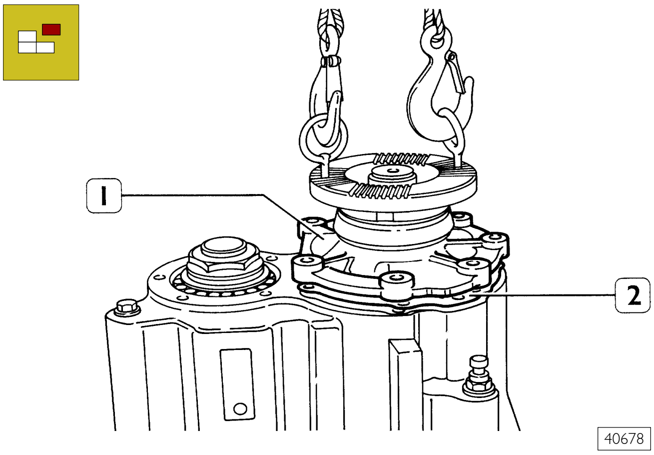
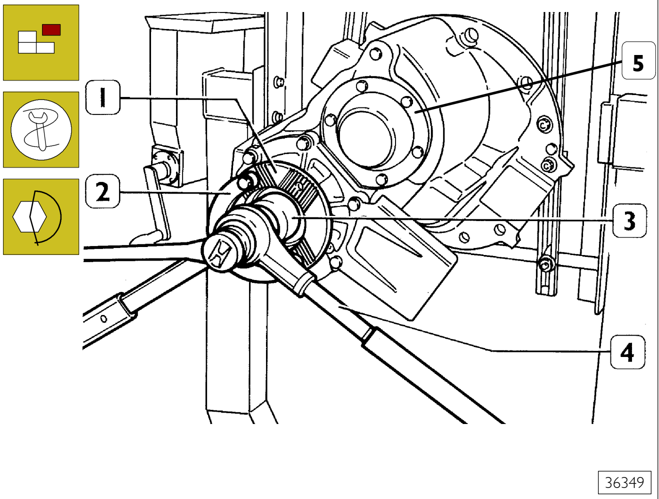
Mount the differential locking - transfer box (Figure 53, page 33) and adjust it as described under the heading, "Adjusting differential locking-transfer box pin limit switch."

Figure 111



Position on the differential casing the adjustment rings (2) of the thickness determined under the heading "Adjusting drive input shaft bearing end float" and fit on the mount (1) comprehensive of the reduction gear transfer box.

Figure 112



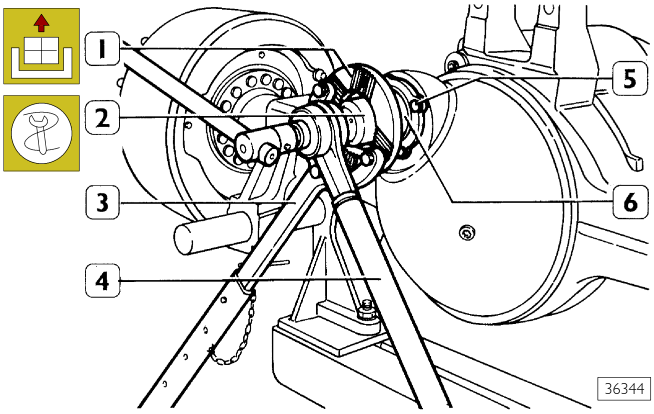
Block rotation of the flange (1) using tool 99370317 (2); with wrench 99355088 (3) and multiplier (4) tighten the nut fastening the flange (1) to the prescribed torque.

Fit on the cover (5) with a new gasket.

Remove the differential casing – transfer box from the mounting 99322228 and fit it back on the axle housing as described under the relevant heading.

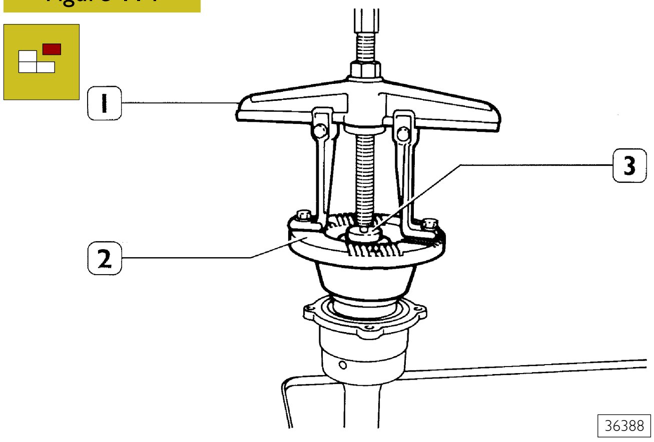
526082 REMOVING-SERVICING-REFITTING INTER-AXLE OUTPUT SHAFT

Figure 113



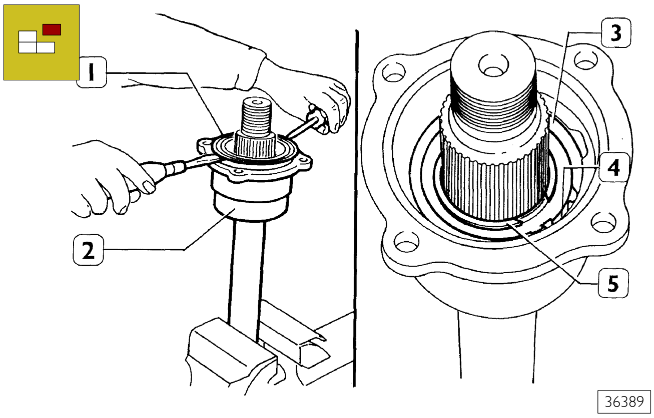
Stop rotation of flange (1) with retainer 99370317 (3). With wrench 99355131 (2) and torque adaptor (4) loosen shaft flange (1) retaining nut.
Removing retaining nuts (5) and separate shaft bearing cage (6) from axle housing.

Figure 114



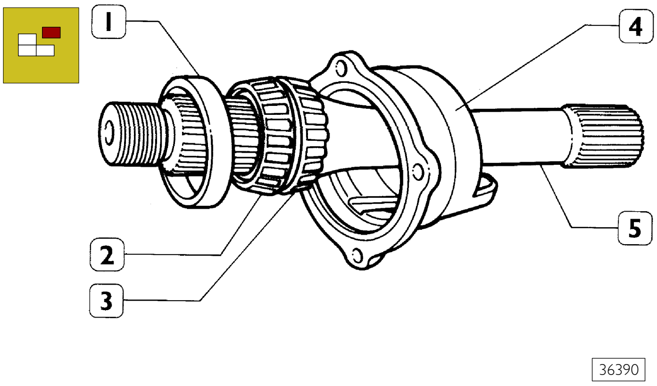
Tighten the drive output shaft (3) in a vice; remove the nut securing flange (2) to drive output shaft (3) and dismantle flange (2) from shaft (3) using an extractor.

Figure 115



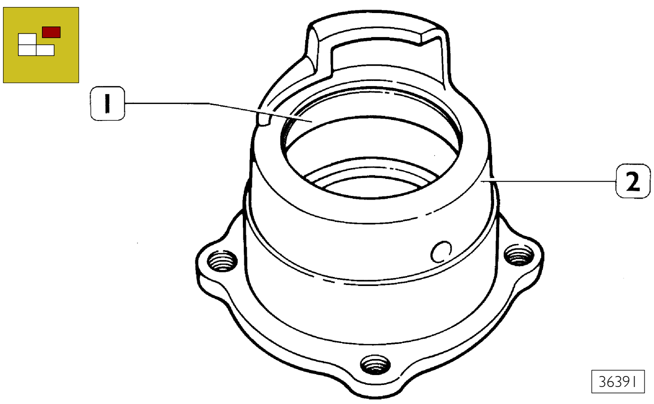
Remove sealing ring (1) from bearing cage (2) and take out snap ring (3) retaining bearing cup (4) and snap ring (5).

Figure 116



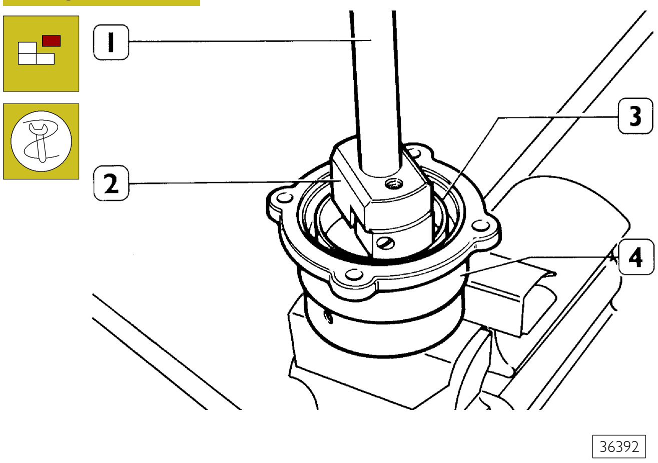
Extract the drive output shaft (5) complete with bearings (2 and 3) and bearing cup (1) from bearing cage (4).
Use a suitable extractor to remove bearings (2 and 3) from the drive output shaft (5).

Figure 117



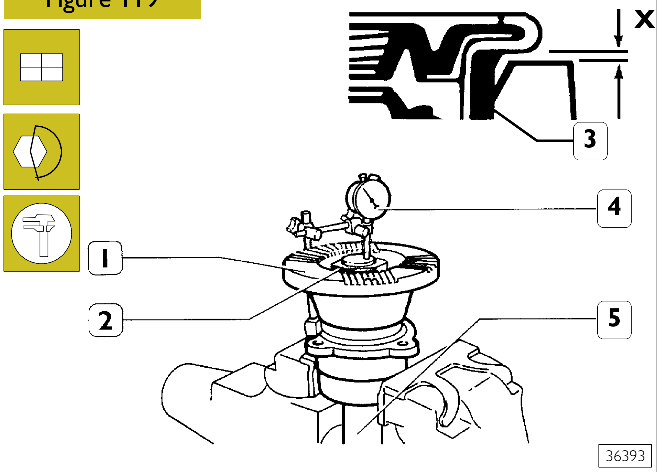
Use a punch to drive bearing (3, Figure 116) cup (1) off bearing cage (2).

Figure 118



With drift 99374093 (2) partially press fit bearing cup (3) in bearing cage (4).
Complete bearing cup fitting using drift 99374093 and handle 99370007 (1).

Figure 119

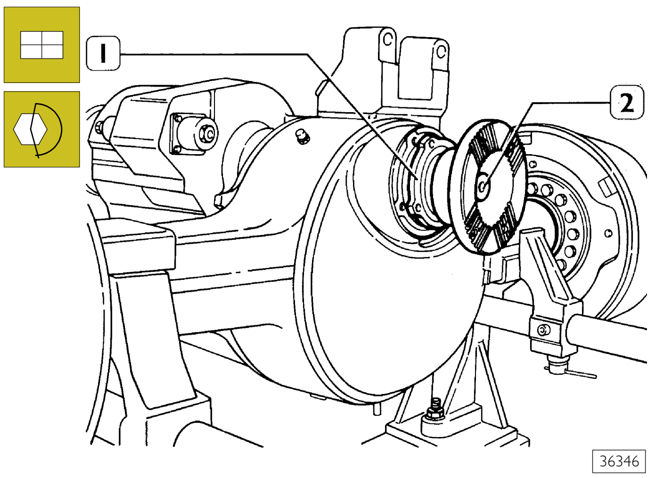


Reverse the removal operation sequence to reassemble the output shaft unit.
After using tool 99374163 to assemble seal ring (3), use a thickness gauge to check distance X between seal ring (3) and support at four equidistant points.
Distance X must be between 0.38 ÷ 0.76 mm.
Tighten nut (2) fastening flange (1) to the drive output shaft (4) to the specified torque. Then check that end play is between 0.025 ÷ 0.102 mm

using a magnetic base dial gauge (3) positioned on shaft (4).
If reading is other than specified, replace the snap ring (5, Figure 115) with one of the correct thickness.

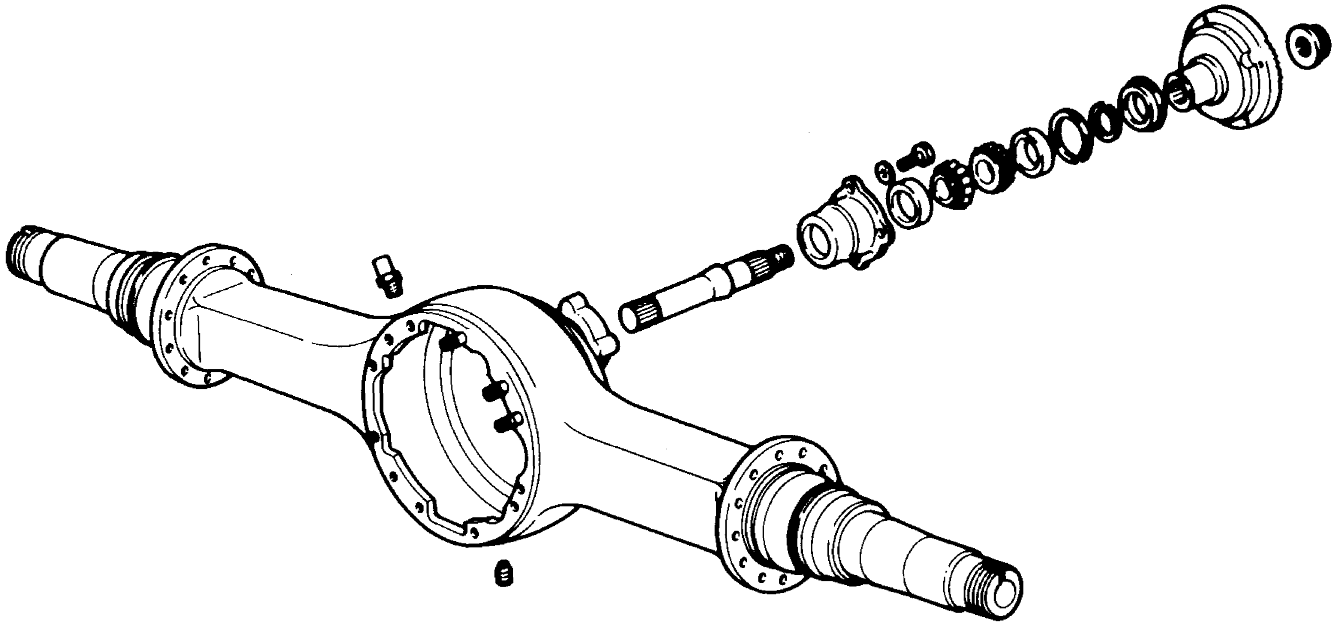
> ⚠ Snap rings are supplied in the following thickness range: 5.30 - 5.33 - 5.35 - 5.38 - 5.40 - 5.50 - 5.60 - 5.70 - 5.80 - 5.90 - 6.00 - 6.10 - 6.13 - 6.15 - 6.18 - 6.20

Figure 120



Rotate the axle housing by 90°.
Fit bearing cage (1) complete with drive output shaft (2) in the axle housing and tighten nuts to the specified torque.

Figure 121



36394

DRIVE OUTPUT SHAFT COMPONENTS

Tandem axles (Rear)
Meritor PR 140 E (R 0868)

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DESCRIPTION

The axle is a bearing axle type with a simple reduction; it consists of a box made in stamped steel sheet and properly strengthened.
The differential consists of a reduction helical-toothed gear pair (pinion – ring gear assembly) and a wheelwork box (side pinion – crown wheel assembly).
The pinion is supported by two taper roller bearings and by one straight roller bearing.
The adjustment of the bevel pinion assembly is made through adjusting rings placed between the two taper roller bearings.

You can also adjust the bevel pinion position with reference to the ring bevel gear by changing the thickness of the pack of the rings, which are inserted between the differential box and the bevel pinion support.
The wheelwork box is supported by two taper roller bearings and can be adjusted axially through two threaded ring nuts.
The axle is provided with a pneumatic control differential locking device.
The wheel hubs are supported by two taper roller bearings floating on the tube, which can be adjusted by means of a threaded nut.

SPECIFICATIONS AND DATA

Axle type: Bearing axle with simple reduction.		**PR 140 E (R 0868)**
DIFFERENTIAL ASSEMBLY Crown wheel and pinion assembly reduction ratio (pinion/ring gear teeth number)		1/5.86 (7/41) 1/5.29 (7/37) 1/4.63 (8/37)
Bevel pinion bearings		2 taper roller bearings and 1 straight roller bearing
Bevel pinion bearing rolling torque new bearings reused bearings	 Nm kgm Nm kgm	 1.5 to 5.5 0.15 to 0.55 1.5 to 3.1 0.15 to 0.31
Bevel pinion bearing pre-load adjustment		through shims
Thickness of bevel pinion bearing pre-load adjusting rings	mm	5.19 - 5.22 - 5.30 - 5.32 - 5.52 - 5.55 - 5.45 - 5.60 - 8.10 - 8.20 - 8.22 - 8.30 - 8.38 - 8.48 - 8.58
Clearance between pinion and ring gear	mm	0.20 to 0.46
Clearance adjustment between pinion and ring gear		Through ring nuts

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Cap opening out mm	0.08 to 0.22
Differential box bearing rolling torque Nm kgm	1.7 to 3.9 0.17 to 0.39
Cap opening out adjustment	Through ring nuts
Rolling torque between side pinions and crown wheels Nm kgm	Max. 68 Max. 6.8
Bevel pinion positioning with reference to differential box	Through adjusting shims
Thickness of adjusting rings inserted between bevel pinion support and differential box	0.125 - 0.200 - 0.500

WHEEL HUBS	
Wheel hub bearings	Two taper roller bearings
Hub bearing axial clearance	0.00 to 0.05
Wheel hub bearing rolling torque Nm kgm	Max. 1.96 Max. 0.20
Wheel hub bearing axial clearance adjustment	Through nut
Axle oil TUTELA W140/M-DA Hendrickson suspension Litres (kg)	12.2 (11)

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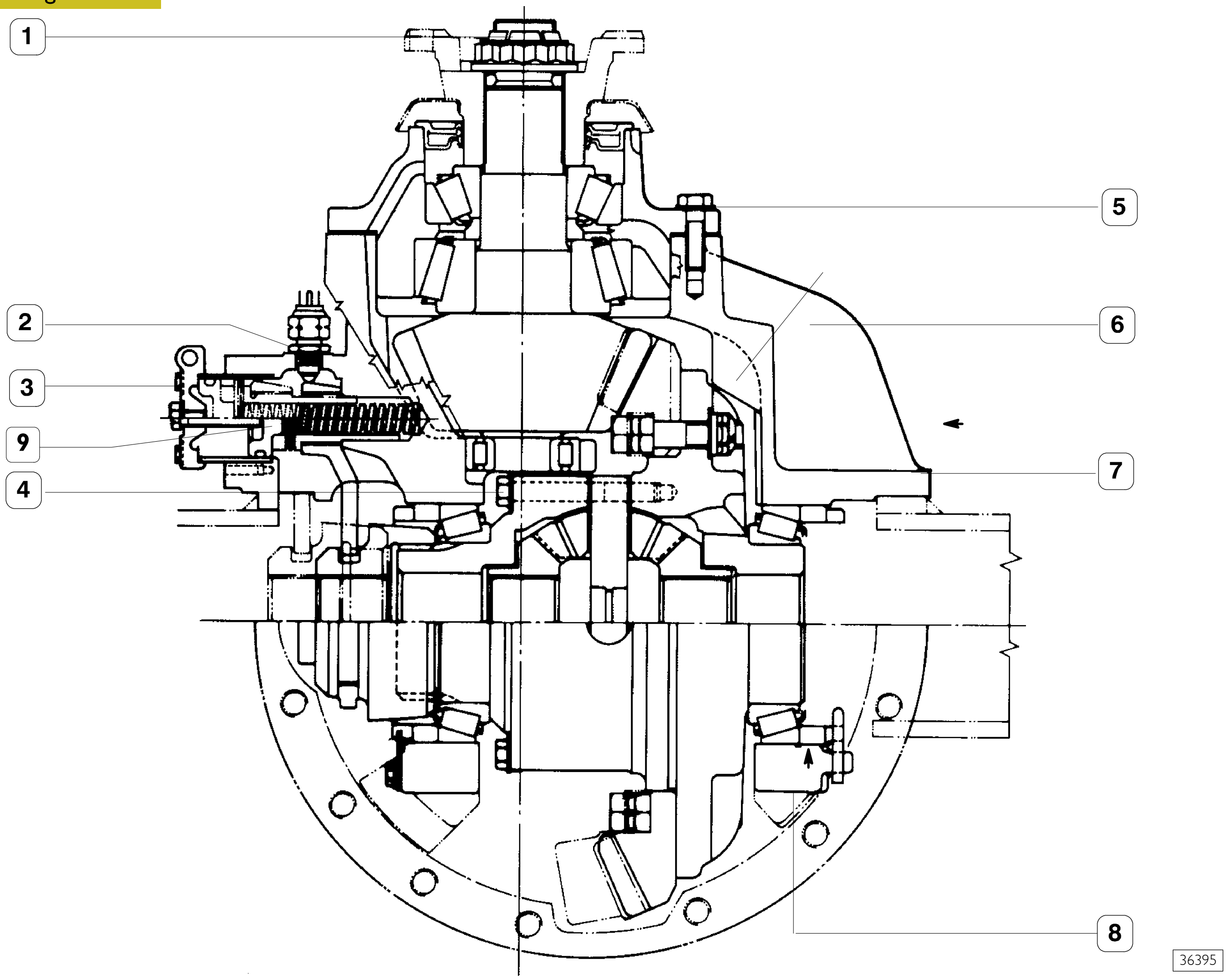
TIGHTENING TORQUES

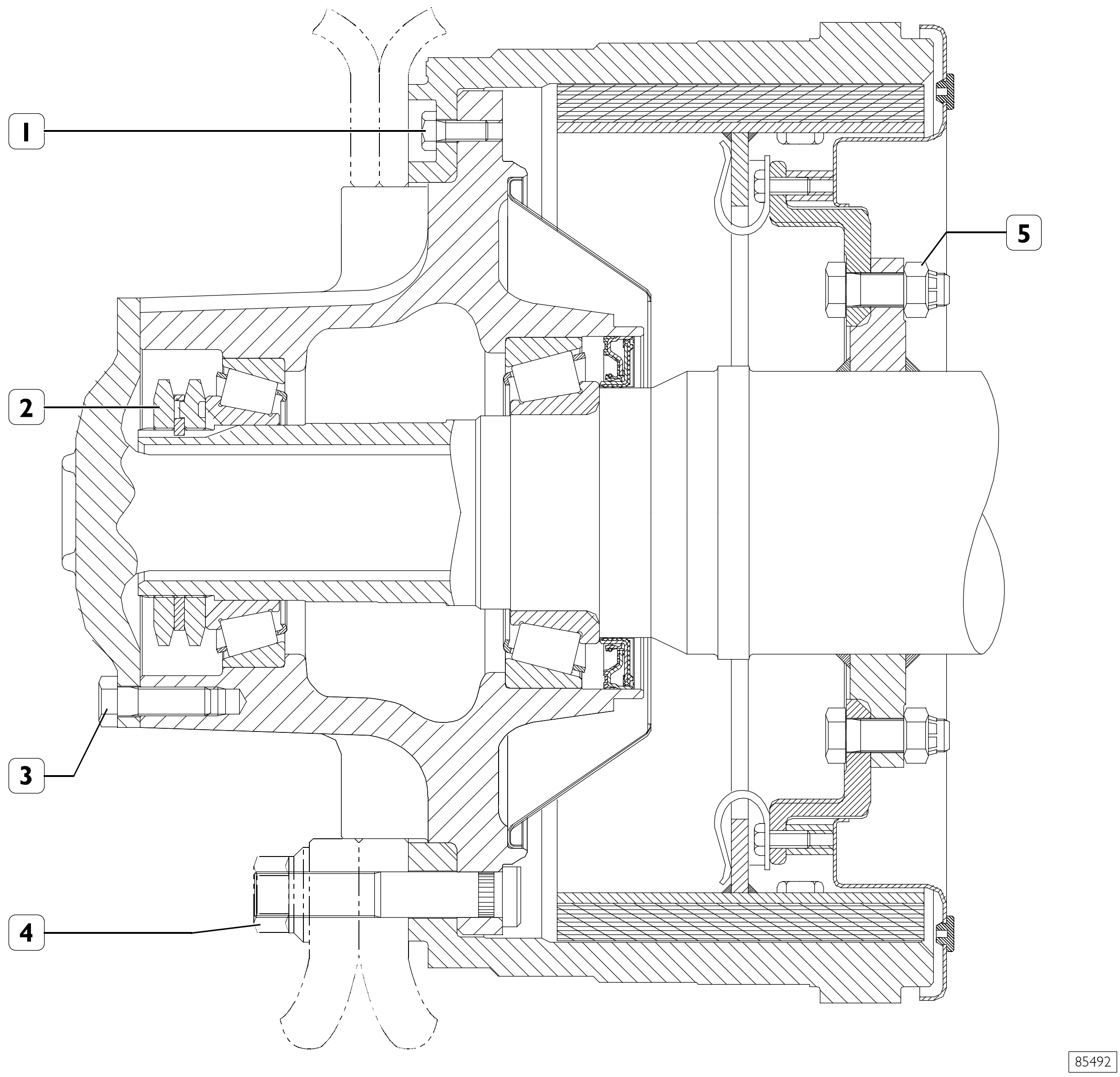
Figure 1



SECTION OF DIFFERENTIAL PR 140 E (R 0868)

PART			TORQUE Nm	(kgm)
1	Nut to secure parts on bevel pinion		1392.5± 142	(139.2 ±14.2)
2	Transmitter locking nut		40 ± 5	(4 ± 0.5)
3	Differential locking device cover securing screw	M6x1 (10.9) M6x1 (8.8)	14 ± 2 11 ± 1	(1.4 ± 0.2) (1.1 ± 0.1)
4	Half box securing screw	1st step: pre-tightening 2nd step: angle closing	60 ± 5 85° ÷ 95°	(6 ± 0.5)
5	Screw to secure bevel pinion support to differential box	1st step: pre-tightening 2nd step: angle closing	60 ± 5 55° ÷ 65°	(6 ± 0.5)
6	Self-locking nut to secure ring bevel gear to half box	1st step: pre-tightening 2nd step: angle closing	100 ± 5 115° ÷ 125°	(10 ± 0.5)
7	Screws and nuts to secure differential to axle box	1st step: pre-tightening 2nd step: angle closing	100 ± 5 80° ÷ 90°	(10 ± 0.5)
8	Screw to secure caps to differential box		527.5± 57.5	(52.75 ±5.75)
9	Differential locking device drive shaft		57.5 ± 7.5	(5.75 ± 0.7)

Figure 2



SECTION ON THE REAR AXLE WHEEL HUB IN TANDEM PR 145 2/D

	PART	TORQUE	
		Nm	(kgm)
1	Nut fixing the drum to the wheel hub	40 ± 4	(4 ± 0.4)
2	Ring nut locking wheel hub adjustment nut	392.3 ± 20	(40 ± 2)
3	Screw fixing drive shaft to wheel hub	232.4 ± 24.5	(23.2 ± 2.4)
4	Nut fixing wheels	600^{+50}_{-20}	$\left(60^{+5}_{-2}\right)$
5	Nut for screw securing brake mounting	289	(29)

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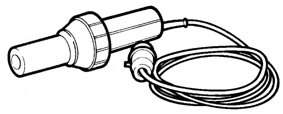
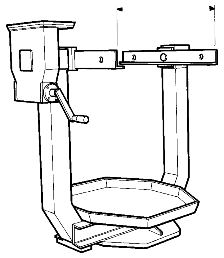
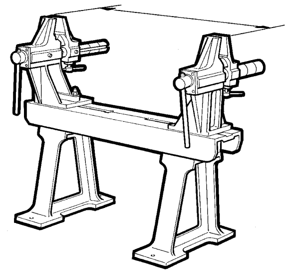
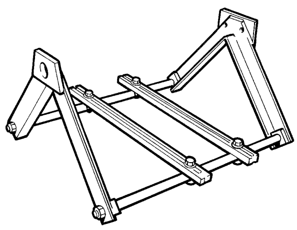
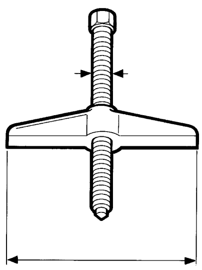
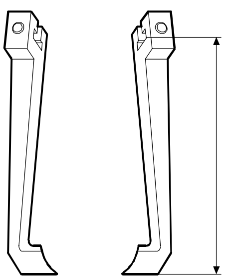
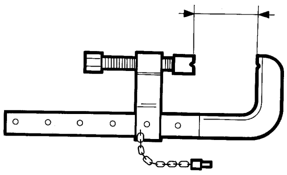
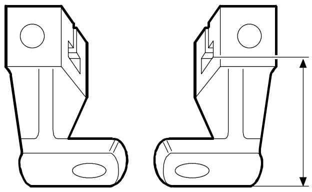
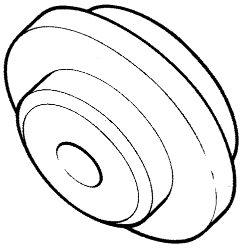
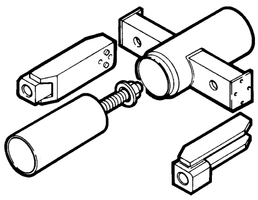
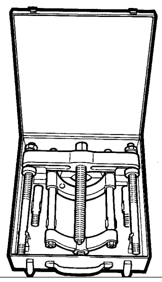
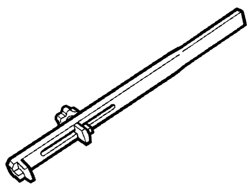
TOOLS

TOOL No.		DESCRIPTION
99305121		Heater
99322205		Rotary stand for unit overhauling (capacity 1000 daN, torque 120 daN/m)
99322215		Stand for axle overhauling
99322225		Unit holder (to be mounted on stand 99322205)
99341003		Single-acting lift
99341012		Pair of brackets

TOOLS		
TOOL No.		DESCRIPTION
99341015		Clamp
99341016		Pair of brackets with holes
99345055		Reaction block for puller tools
99345103		Wheel hub fitting tool
99348001		Puller tool with clamping device
99355025		Wrench for differential gearcase bearing adjustment ring nuts

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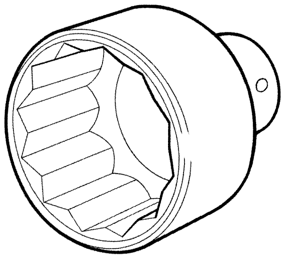
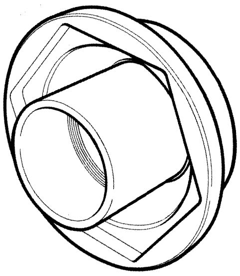
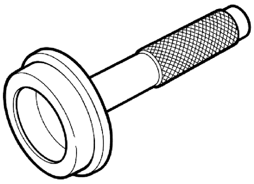
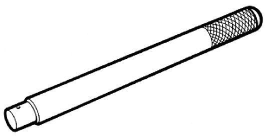
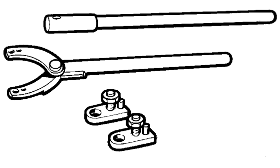
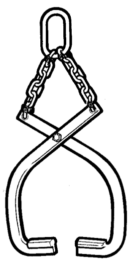
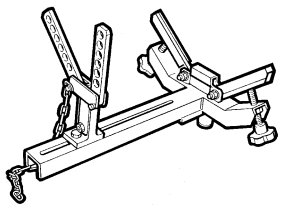
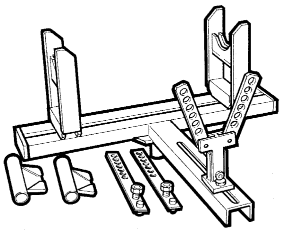
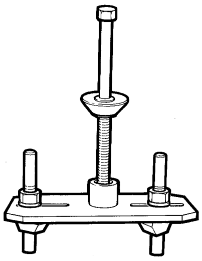
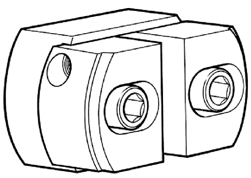
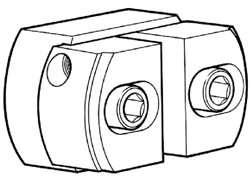
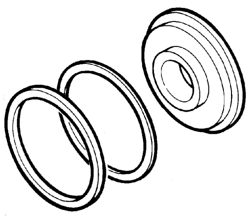
TOOLS

TOOL No.		DESCRIPTION
99355088		Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99355167		Wrench (114 mm) for wheel hub bearing adjustment nut
99370005		Tool to extract gaskets
99370007		Tool to extract gaskets
99370317		Reaction lever and extension for flange lock
99370509		Hook to remove differential gearcase half-housing

TOOLS

TOOL No.		DESCRIPTION
99370616		Support to remove-fit back differential
99370617		Universal support to remove-fit back rear axles
99371047		Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 99322225)
99374093		Drift punch for installation of bearing outer races (91÷134) (use with 99370007)
99374094		Drift punch for installation of bearing outer races (134÷215) (use with 99370007)
99374134		Guide to assemble wheel hub

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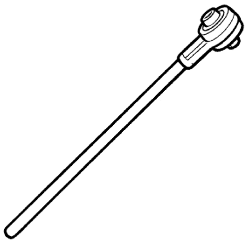
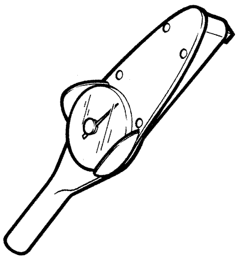
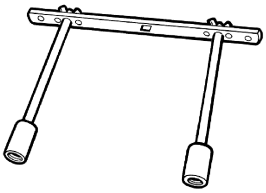
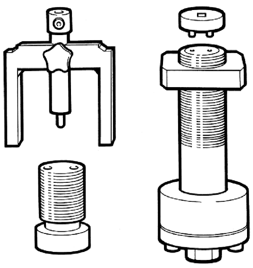
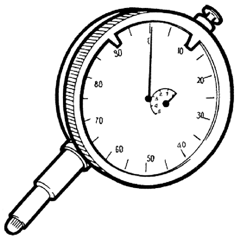
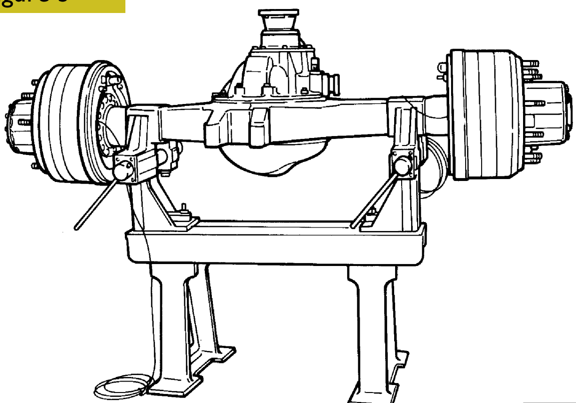
TOOLS

TOOL No.		DESCRIPTION
99389816		4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm)
99389819		Torque wrench (0 - 10 Nm) with 1/4" square fitting
99395026		Tool for measuring hub rolling drag torque (use with torque wrench)
99395027		Tool for determining thickness of differential bevel pinion adjustment shims (use with 99395603)
993395603		Dial gauge (0÷5 mm)

525010 SERVICING REAR AXLE ASSEMBLY PR 140 E (R 0868)

Figure 3



36396

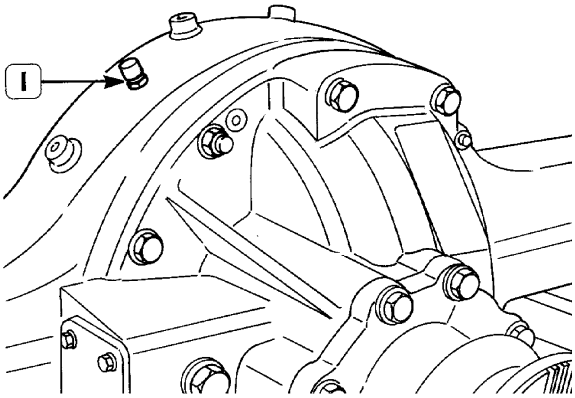
Before placing the axle assembly on the stand, loosen the bottom plug and drain the oil.

Place axle on service stand 99322215.

Rear axle identification data are provided on the plate located on left hand side leaf spring mount.

525013 AIR BREATHER REMOVAL/ INSTALLATION

Figure 4



34811

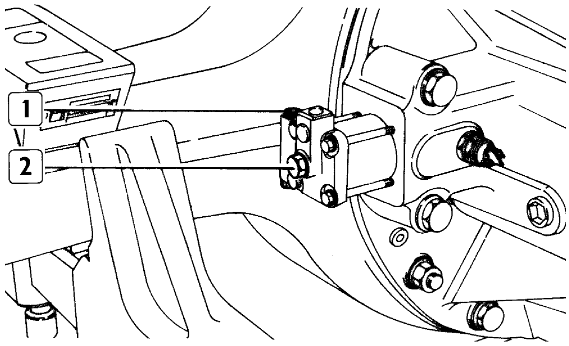
Ensure that air breather or tube (1) is not blocked; if so, dismantle, clean thoroughly and reassemble the unit.

525030 OVERHAULING WHEEL HUBS

For the operations:
overhauling the wheel hubs (555030), follow the directions given for the Meritor rear axle PD 145 E.

526210 REMOVING DIFFERENTIAL (with axle on stand 99322215)

Figure 5



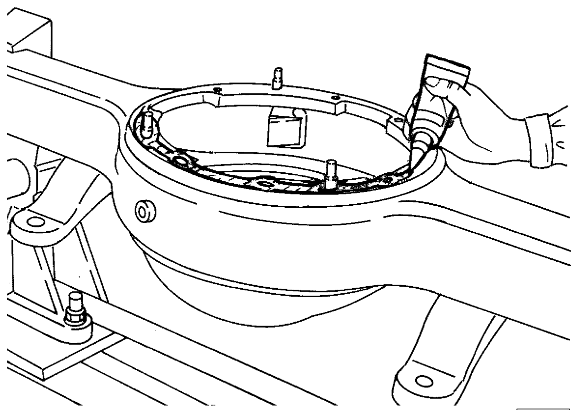
19340

Proceed as follows to lock the differential: unscrew the threaded plug (2) and fit in its place screw (1) available on cylinder cover. Tighten screw fully in until the differential lock is activated.

Remove the drive shafts as described on page 23; unscrew the screws fixing the differential casing (1) and screw down three screws, that in this phase act as extractors, and extract it from the axle housing with two metal rope eyebolts.

REFITTING DIFFERENTIAL (with axle on stand 99322215)

Figure 6



34827

Apply sealant to the rear axle housing contact surface.

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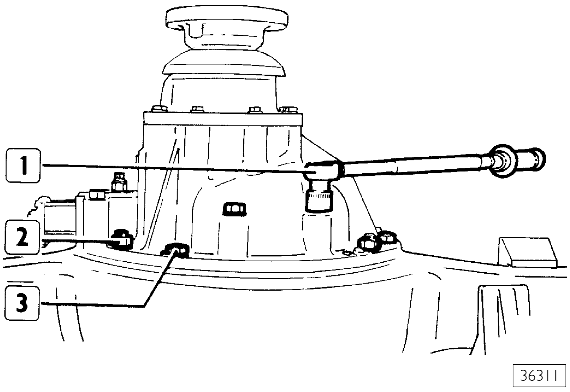
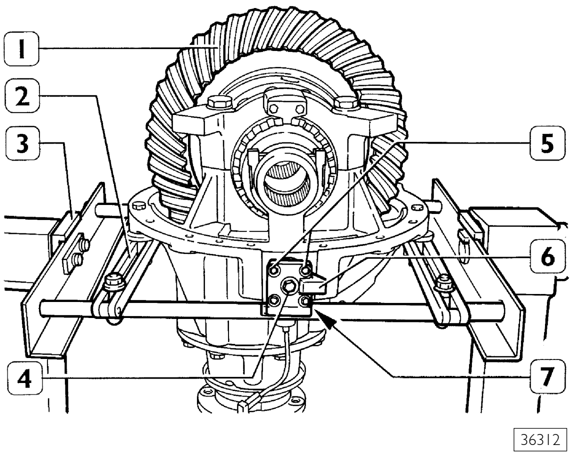
Figure 7



Fit the differential into the axle casing; screw in nuts (2) and screws (3) complete with lock washers and tighten them to the specified torque using torque wrench (1).
Fit drive shafts into the differential as described in Figure 30, page 70; release the differential lock (if the axle has one) by unscrewing screw (1, Figure 5). Fit this screw in its seat on the cylinder cover and tighten plug (2, Figure 5), with washer, in the threaded hole previously occupied by the screw. Finally, fill the axle case with the specified amount of TUTELA W 140/M-DA oil and check the operation of the differential lock activation sending unit.

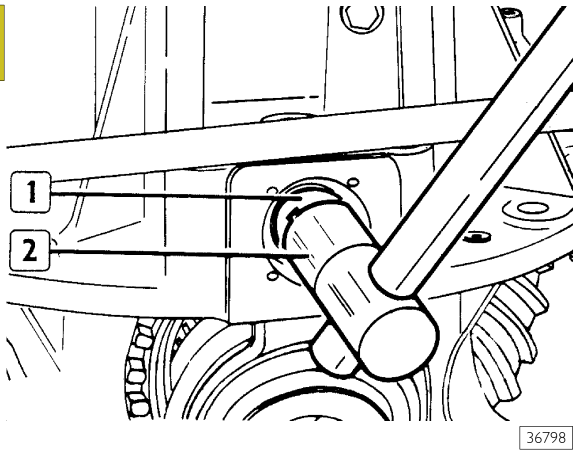
526210 REPAIRING DIFFERENTIAL
Removing differential lock

Figure 8



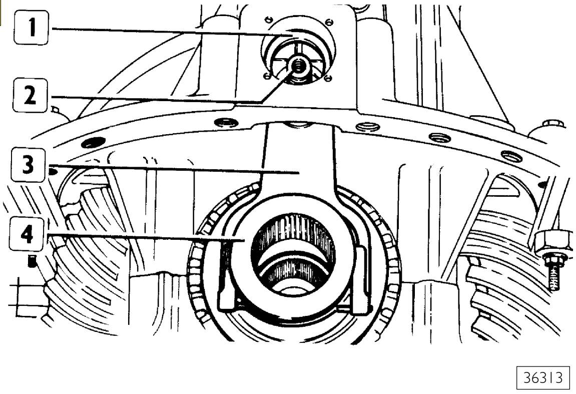
Position differential casing assembly (1) on swivelling stand 99322005 (3) complete with support 99322228 (2).
Only for axles with a differential locking device.
Remove screw (4); screws (5) and cover (6) with copper washer, cylinder (7) with piston and sealing ring.

Figure 9



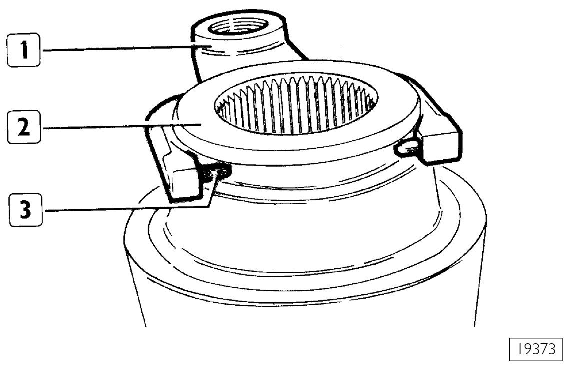
Use wrench 99355168 (2) to unscrew fork control shaft (1) and withdraw.

Figure 10



Withdraw spring (2) and flat washer (1). Remove fork (3) complete with sliding sleeve (4).

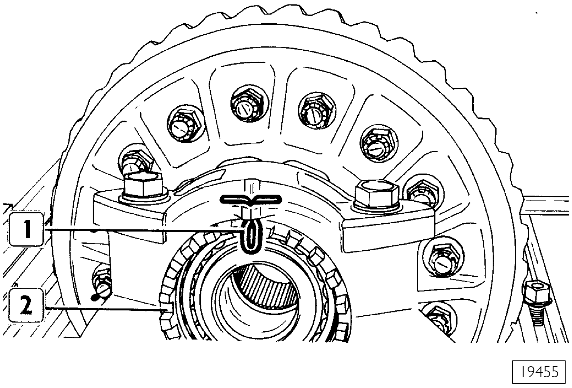
Figure 11



Use a punch to drive out the two roll pins (3) and separate fork (1) from sliding sleeve (2).

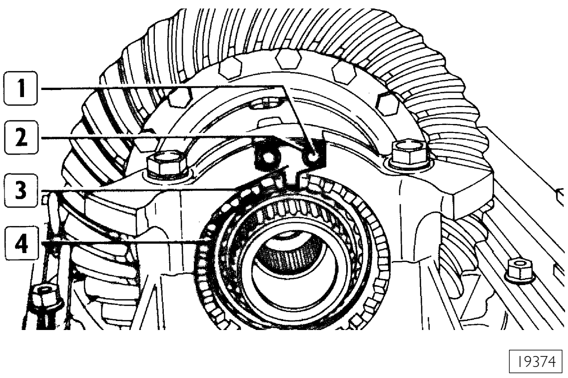
Dismantling differential casing

Figure 12



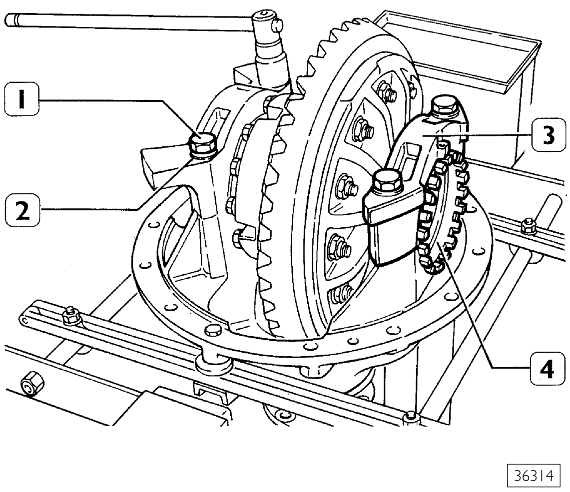
Straighten and withdraw cotter pin (1) and unscrew lock ring (2) adjusting gear cage support bearings.

Figure 13



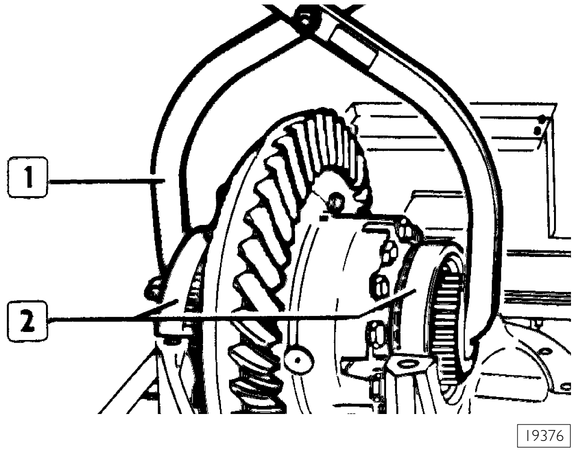
Unscrew retaining screws (1) with washers (2) and remove plate (3).
Unscrew lock ring (4) adjusting gear cage support bearings.

Figure 14



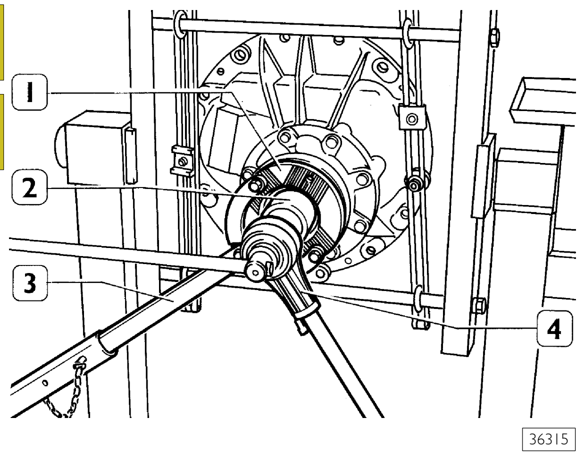
Unscrew screws (1) with washers (2), remove caps (3) and support bearing lock rings (4).

Figure 15



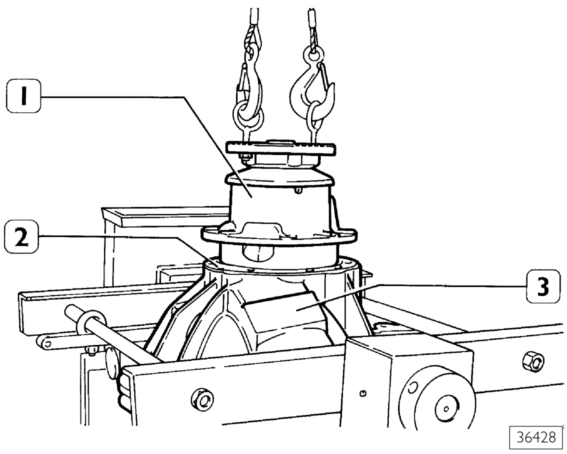
Using hook 99370509 (1), withdraw the gear cage complete with bevel crown wheel and bearing outer races (2).

Figure 16



Prevent flange (1) from rotating using holding tool 99370317 (3). Using wrench 99355088 (2) and adaptor (4), loosen the bevel pinion retaining nut.

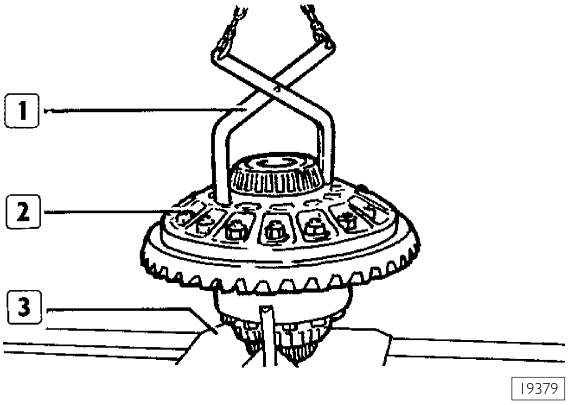
Figure 17



Unscrew the screws securing the bevel pinion support to the differential casing.
Withdraw support (1) and bevel pinion from differential casing (3). Remove shims (2) adjusting the pinion position with respect to the crown wheel.

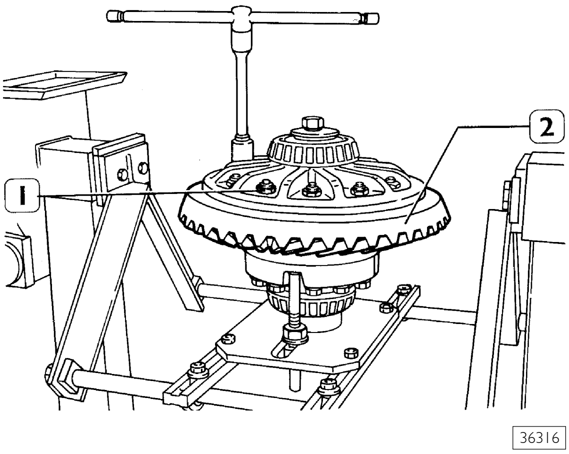
Dismantling gear cage

Figure 18



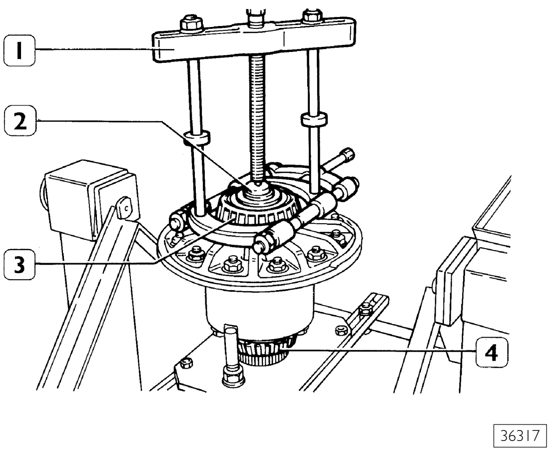
Use hook (1) to raise the gear cage assembly and position on stand 99371047 (3).

Figure 19



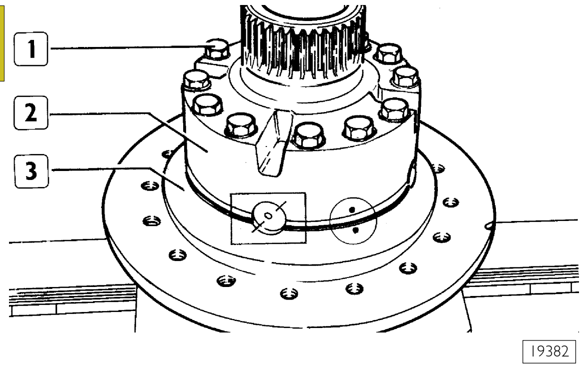
Unscrew nuts (1) and remove them with screws. Drive out bevel crown wheel (2).

Figure 20



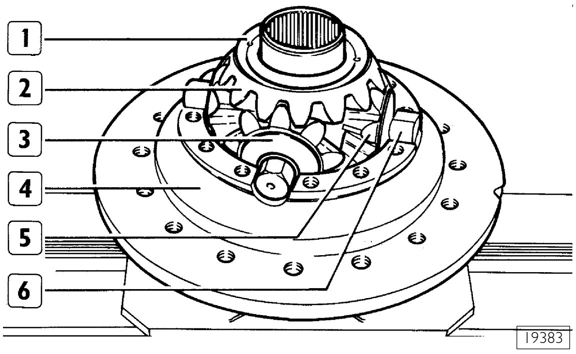
Use tool 99348001 (1) and reaction block 99345055 (2) to remove bearing (3) and bearing (4).

Figure 21



Mark the two casing halves (2 and 3) and the spider as indicated in the figure.
Unscrew screws (1) joining the casing halves. Lift the casing half (2).

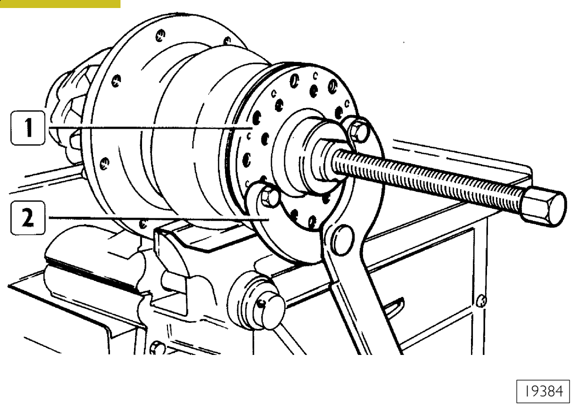
Figure 22



Remove differential gear (2) with the associated thrust washer (1). Remove spider (6) with the four planetary gears (5) complete with thrust washers (3). Take the spider/planetary gear assembly apart. Remove the other differential gear with its thrust washer from the half cage (4).

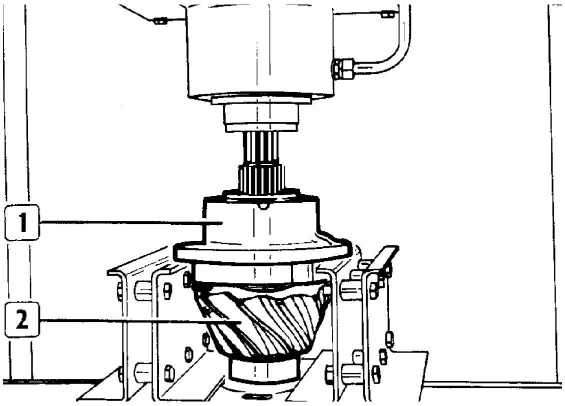
526249 Dismantling bevel pinion support

Figure 23



Prevent the flange from rotating using tool 99370317 (2) and use a universal extractor or appropriate tool (1) to remove the transmission attachment flange from the bevel pinion.

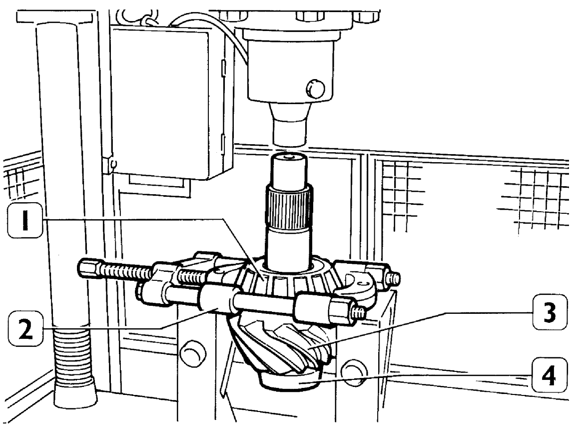
Figure 24



36318

Position the pinion support under a press and drive out bevel pinion (2) complete with intermediate bearing, rear bearing and adjustment ring from bevel pinion support (1). Remove adjustment ring from bevel pinion.

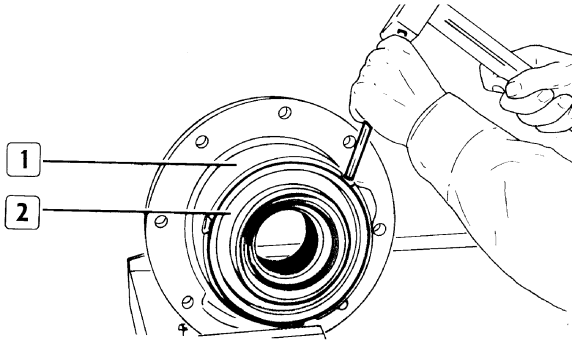
Figure 25



36319

Apply tool 99348001 (2) under taper roller bearing (1) and use a press to remove from bevel pinion (3). If necessary, remove rear bearing (4) from bevel pinion (3) in the same way (destructive operation).

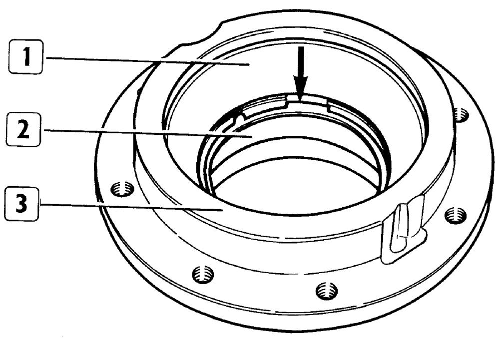
Figure 26



19388

Use a punch to remove seal carrier cover (2) from bevel pinion support (1). Then remove front bearing from support.

Figure 27



19389

Apply a drift to the point arrowed in the diagram and drive out outer race (2) of front bearing from bevel pinion support (3). Upturn the support and remove the intermediate bearing outer race (1).

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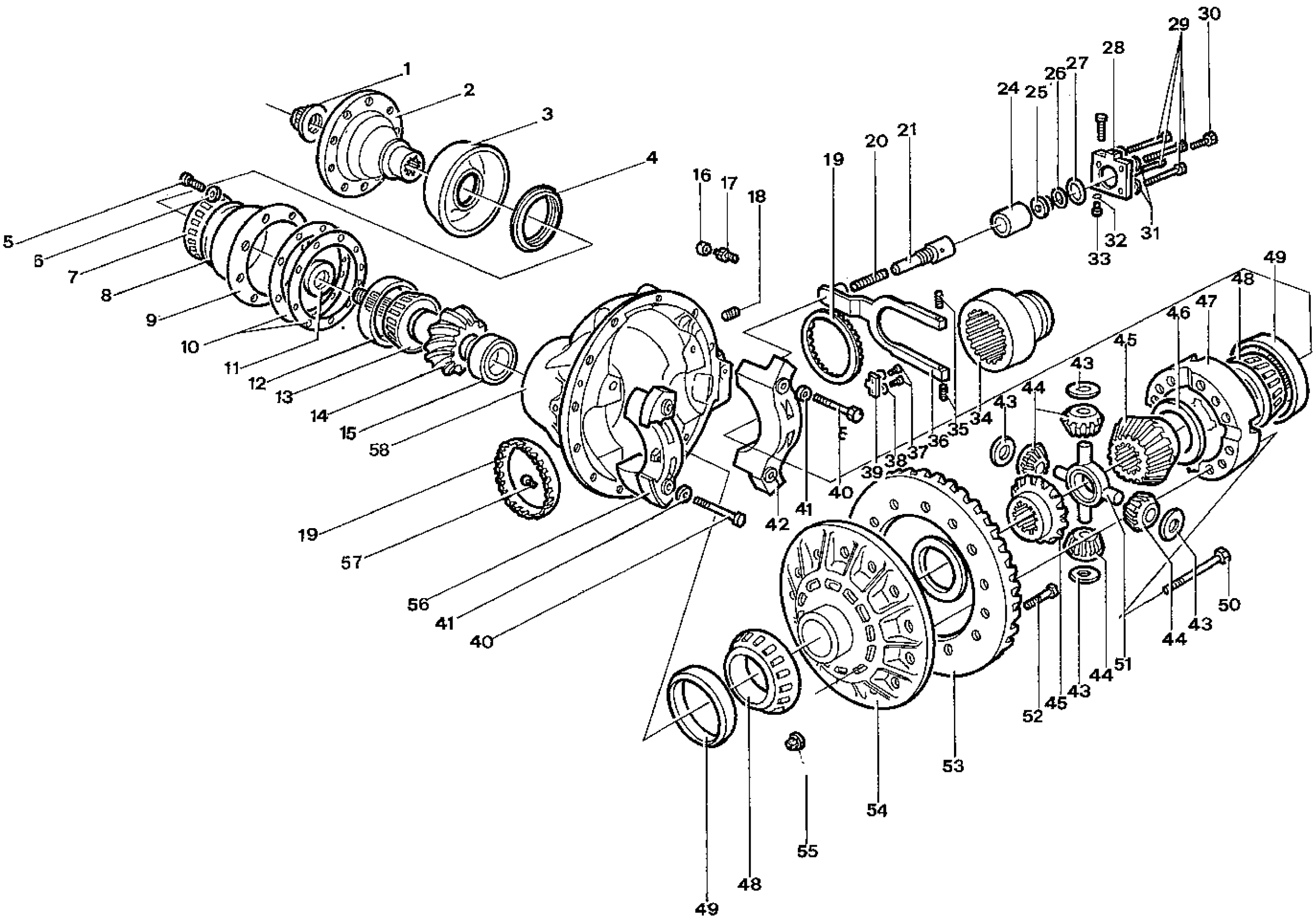
Figure 28

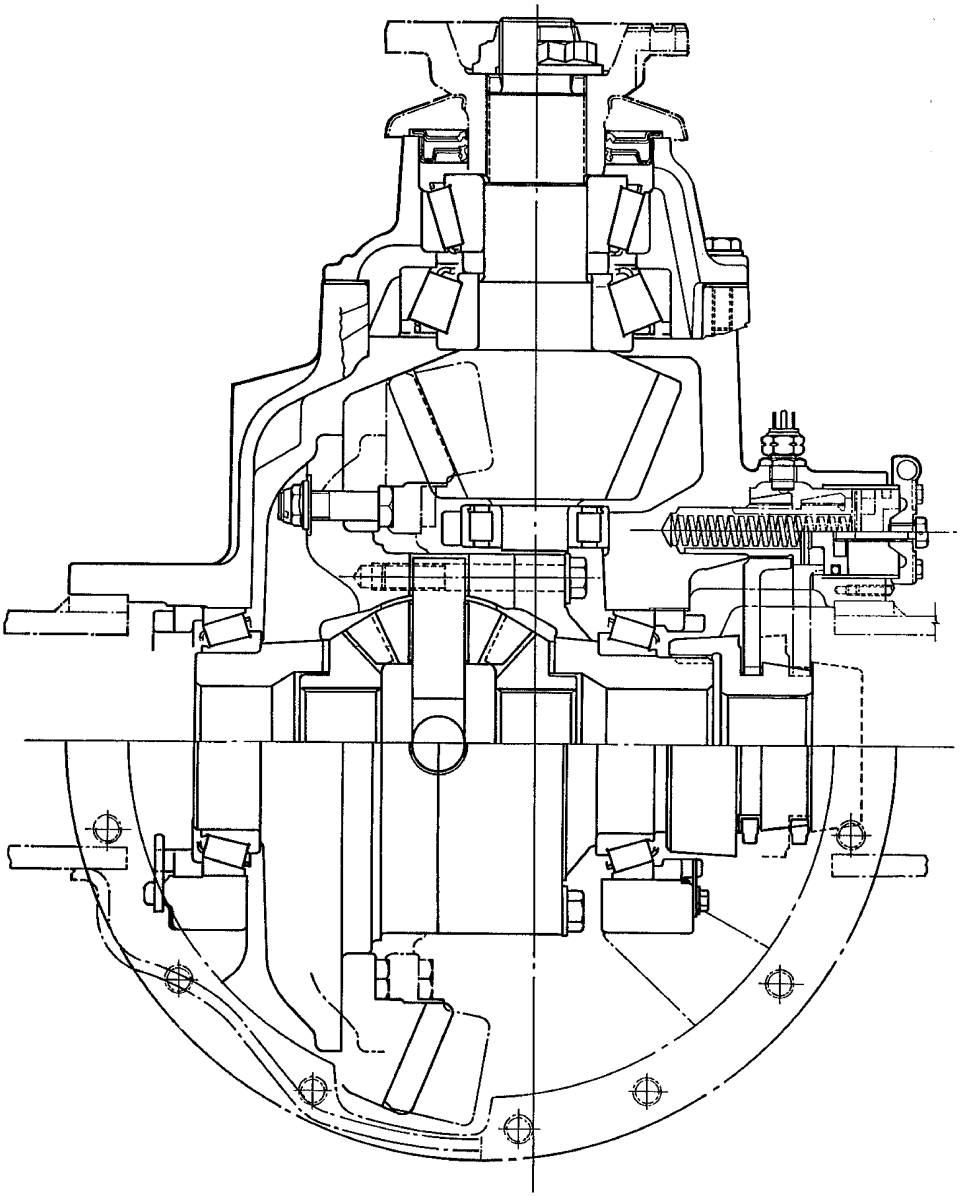


20958

DIFFERENTIAL COMPONENTS (with differential lock)

1. Bevel pinion nut - 2. Flange - 3. Deflector - 4 .Seal holder cover - 5. Screw - 6. Washer - 7. Front bearing - 8. Outer race - 9. Support - 10. Adjustment shim - 11. Adjustment ring - 12. Outer race - 13. Intermediate bearing - 14. Bevel pinion - 15. Rear bearing - 16. Lock nut - 17. Sending unit - 18. Plug - 19. Adjustment ring nut - 20. Spring - 21. Shaft - 24 .Cylinder - 25. Piston - 26. Sealing ring - 27. Copper ring - 28. Cover - 29. Screws - 30. Screw - 31. Washers - 32. Copper washer - 33. Threaded plug - 34 .Sliding sleeve - 35. Roll pins - 36. Fork - 37. Screws - 38. Washer - 39. Plate - 40. Screw - 41. Washer - 42. Cap - 43. Thrust washer - 44. Planetary gear - 45. Differential gear - 46. Thrust washer - 47. Half cage - 48. Bearing - 49. Outer race - 50. Screw - 51. Spider - 52. Screw - 53. Bevel crown wheel - 54. Half cage - 55. Nut - 56. Cap - 57. Locking pin - 58. Differential casing

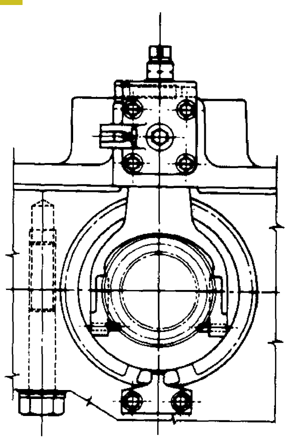
Figure 29



36321

SECTION OF DIFFERENTIALS PR 140 E (R0868)

Figure 30



36321

View of differential unit with differential lock device.

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Checking differential components

Thoroughly clean the individual parts making up the differential. Lubricate the bearings and spin the roller cages freely; these should rotate evenly without tight spots.
Check the seating surfaces of the bevel crown wheel and the bedding surface of the half cage so that the crown wheel adheres to it perfectly; distortion of these faces would cause vibration of the crown wheel attachment screws, compromising the satisfactory operation of the unit.

Thoroughly clean threads of screws, studs and ring nuts to prevent clearance or torque settings from being altered.

Check that there is no excessive wear in the splined portion for fitting the flange to the pinion; if there is, replace the pinion.

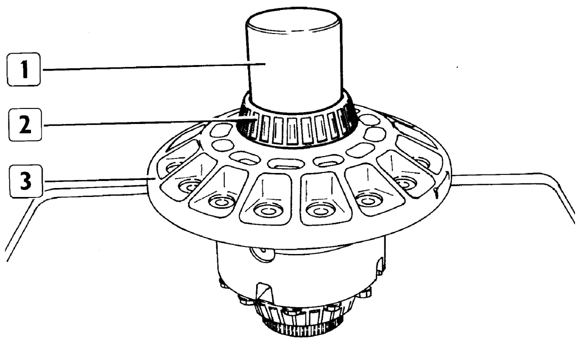
Check the planetary gears and associated thrust washers, the spider and differential gears and thrust washers.
Replace all seals and gaskets, the locking pin for the adjustment ring nut and all lock washers.

IVECO PARTS

If it should be necessary to replace the crown wheel or pinion, both must be replaced as the parts are supplied as matched pairs.

Assembling gear cage

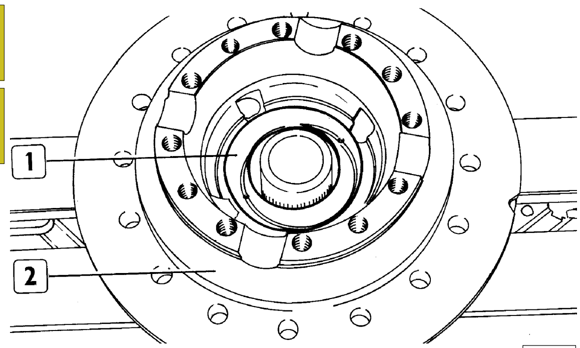
Figure 31



19397

Heat the support bearing (2) for the opposite side of the locking differential in a circulating air oven to a temperature of 100°C for about 15' and fit it to the gear cage (3) using a suitable drift (1).

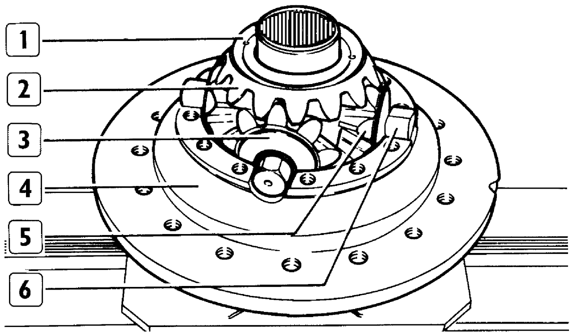
Figure 32



19391

Position half cage (2) on fixture 99371047.
Position differential gear thrust washer (1) in the half cage (2) and then fit differential gear.

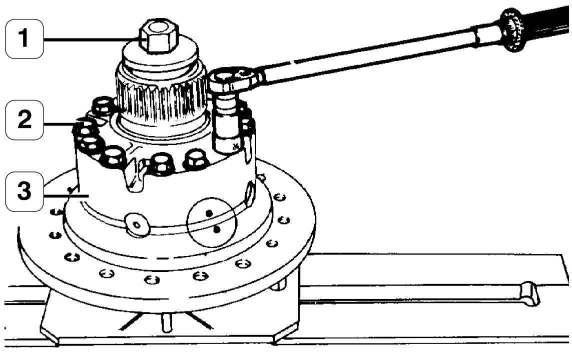
Figure 33



19383

Fit spider (6) complete with planetary gears (5) and associated thrust washers (3) to half cage (4).
Position second differential gear (2) with thrust washer (1).

Figure 34

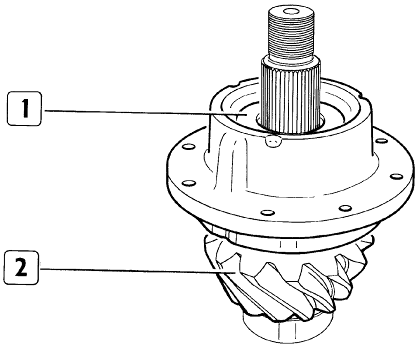


36323

Lock the differential with the parts (1); fit on the half box (3).
Check that the marks made at the time of removal coincide.
Apply a few drops of "LOCTITE 270" on the thread of the screws (2).
Tighten the screws (2) to the prescribed torque.

It is always advisable to renew screws (2).

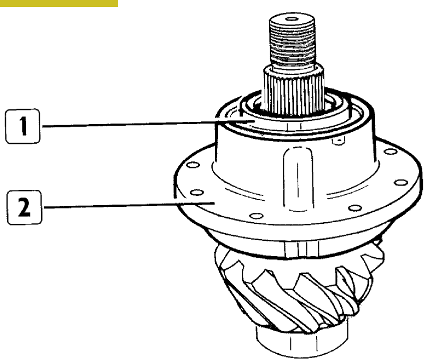
Figure 35



19413

Heat front bearing (1) in a circulating air oven to a temperature of 100°C for about 15' and fit it to its seat on the bevel pinion (2) using a suitable drift.

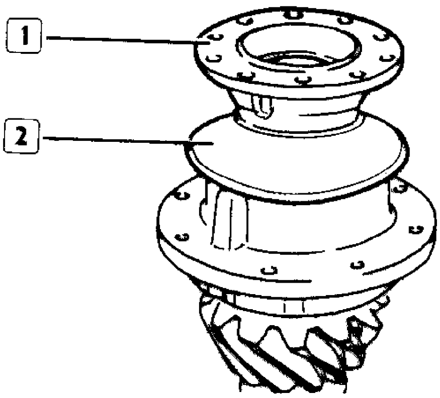
Figure 36



19414

Lubricate seal carrier cover (1) seat with differential oil and install it in support (2), using a suitable locking ring.

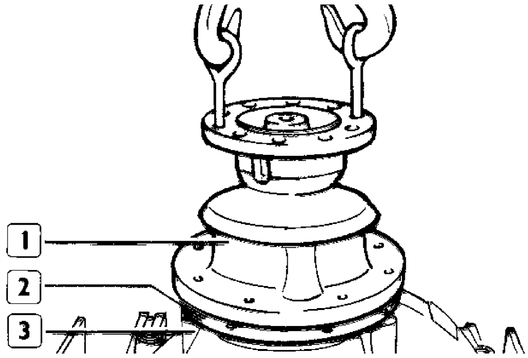
Figure 37



19415

Position drive attachment flange (1) complete with deflector (2) on the splined part of the bevel pinion. Use a drift to drive fully home. It is advisable to carry out this operation using a press.
Temporarily tighten the retaining nut.

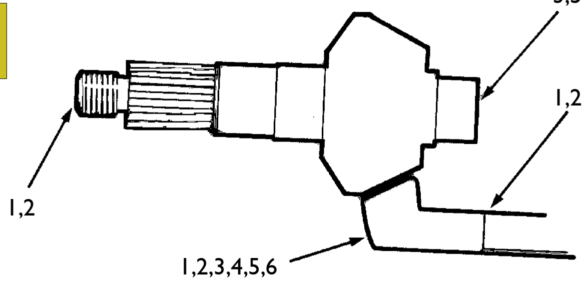
Figure 38



19378

If the old pinion/crown wheel assembly is to be refitted, position shim pack (2) and bevel pinion support (1) on the differential casing (3), making sure that the groove through which oil passes is correctly lined up.

Figure 39



19416

Where a new pinion/crown wheel assembly has to be fitted, it is necessary to understand the information stamped on the pinion and on the crown wheel in order to determine the correct location of the pinion, in other words:

1. part number;
2. tooth combination number;
3. pinion/crown wheel assembly pairing number;
4. variation number to determine the thickness of the stack of shims to be placed between the pinion support and the differential casing (this variation number is indicated by CP in the examples);
5. month and year of manufacture and inspection of the pinion/crown wheel assembly;
6. nominal end play of the pinion/crown wheel assembly.

The part number and the tooth combination number are stamped at the threaded end of all pinions. However, alternatively, they may be found on the outside diameter of the crown wheel.

In any pinion/crown wheel assembly, the crown wheel will always have an even category number (for example 36786) stamped on it, while the corresponding pinion will have an odd number (for example 36787).

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The tooth combination number (for example 5-37) indicates that the pinion has 5 teeth and the crown wheel 37, equal to a drive ratio of 7.4 / 1.

- Pinion/crown wheel assemblies are matched pairs.
- Both parts are, therefore, engraved with the same number.

On pinions, this number is generally engraved on the end of the head while on crown wheels it is generally engraved on the outside diameter

⚠ Never use a pinion and a crown wheel which do not have the same number.

Every crown wheel has a variation number which indicates the nominal assembly distance. Use this variation number to calculate the thickness of the shims to be placed between the pinion support and the differential casing.
This variation number (for example C.P. + 0.1, or C.P. - 0.1 mm) is stamped on the outer part of the crown wheel.

To calculate the thickness of the shims to be placed between the pinion support and the differential casing, proceed as follows :

1. measure the thickness of the shim pack used with the pinion/crown wheel assembly to be replaced. Use a micrometer or gauge and take note of the measurement recorded;
2. read the C.P. engraved on the crown wheel to be replaced. If this number represents a plus value (+), subtract it from the measurement recorded above at point 1.
   If this number represents a minus value (-), add it to the measurement recorded at point 1 above.

   Take note of this measurement.

⚠ The measurement obtained at point 2 will be used to calculate the shim pack to be placed between the pinion support and the differential casing, depending on the new pinion/crown wheel assembly.

7. Read the C.P. engraved on the new crown wheel. Add or subtract the value according to algebraic value (+ add, - subtract) from the measurement recorded at point 2.
   The value obtained indicates the thickness of the new shim pack to be used.

Refer to the following examples which cover all possible calculation combinations.

Specimen calculations

Example 1

Thickness of original stack	0.76 mm
C.P. engraved on crown wheel + 0.05	- 0.05
Measurement obtained	71 mm
C.P. engraved on the new crown wheel + 0.13	+ 0.13
New thickness of pack to be used	0.84 mm

Example 2

Thickness of original stack	0.76 mm
C.P. engraved on crown wheel - 0.05	+ 0.05
Measurement obtained	0.81 mm
C.P. engraved on the new crown wheel + 0.13	+ 0.13
New thickness of stack to be used	0.94 mm

Example 3

Thickness of original stack	0.76 mm
C.P. engraved on crown wheel + 0.05	- 0.05
Measurement obtained	0.71 mm
C.P. engraved on the new crown wheel - 0.13	- 0.13
New thickness of stack to be used	0.58 mm

Example 4

Thickness of original stack	0.76 mm
C.P. engraved on crown wheel - 0.05	+ 0.05
Measurement obtained	0.81 mm
C.P. engraved on the new crown wheel - 0.13	- 0.13
New thickness of stack to be used	0.68 mm

⚠ The shims to be placed between the differential casing and the bevel pinion support are supplied as spare parts in thicknesses of 0.05 - 0.125 - 0.200 - 0.500 mm.

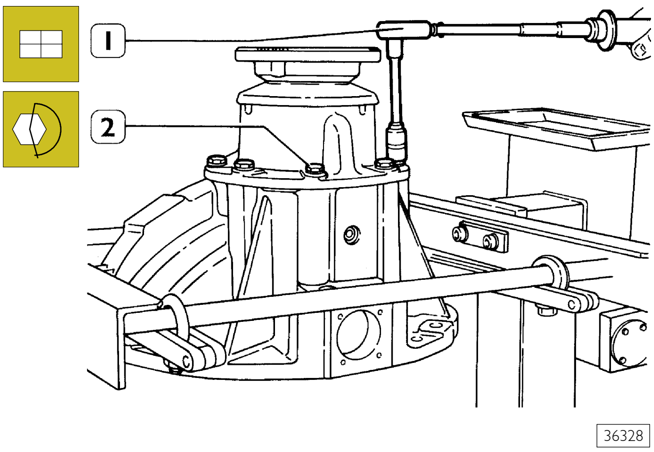
Every pinion and every crown wheel is marked with the month and year in which they were ground and inspected jointly to form a matched pair.

On the pinions, this information is given at the head end. On the crown wheels, this information is shown on the outside diameter.

All assemblies are engraved with a number which shows the nominal end play between the pinion and crown wheel obtained when machining was finished. This end play is shown on the outside diameter of the crown wheel.

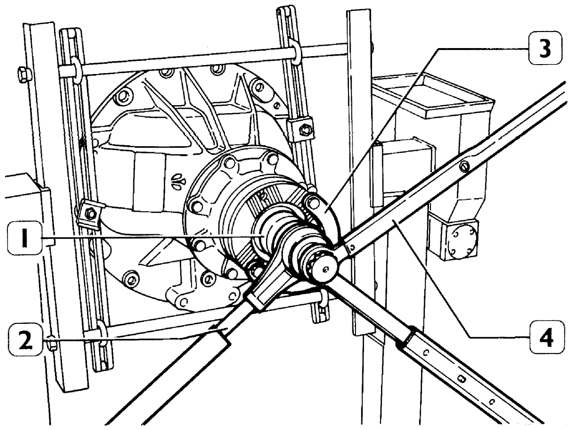
Assembling differential casing

Figure 40



Fit the eight screws (2) complete with washers and tighten them, using torque wrench (1), to the specified torque.

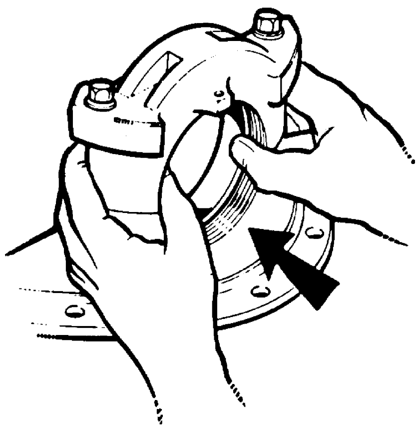
Figure 41



Swivel the stand through 90°.
Prevent the flange from rotating using tool 99370317 (3).
Position polygon wrench 99355088 (1) and use adaptor (2) and torque wrench (4) to tighten the pinion retaining nut to the specified torque.
Recheck the rolling torque of the bevel pinion, the values are shown in the table on page 55.

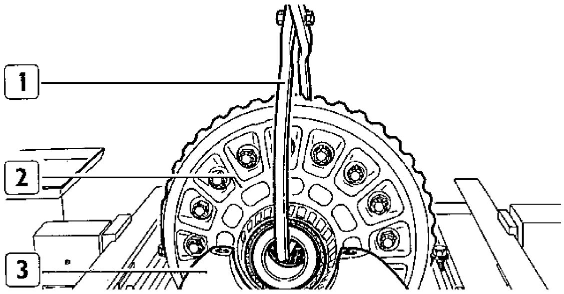
Note that the rolling torque increases by 1.5 Nm when the seal is lubricated.

Figure 42



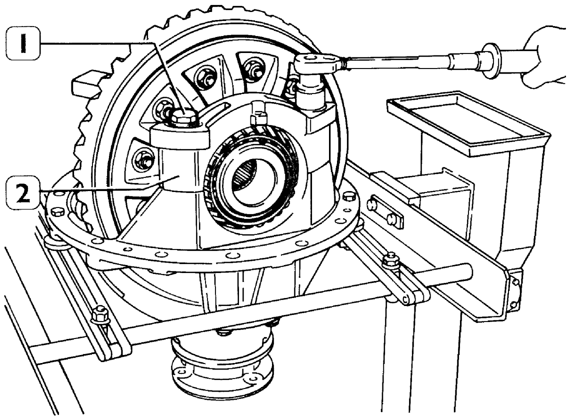
Position the caps, taking care to line up the reference marks.
Insert the screws complete with washers and tighten them using a torque wrench to the specified torque.
Then check that the outer races of the bearings slide into their housings when pushed gently without sticking.
Unscrew the retaining screws with washers again and remove the caps.

Figure 43



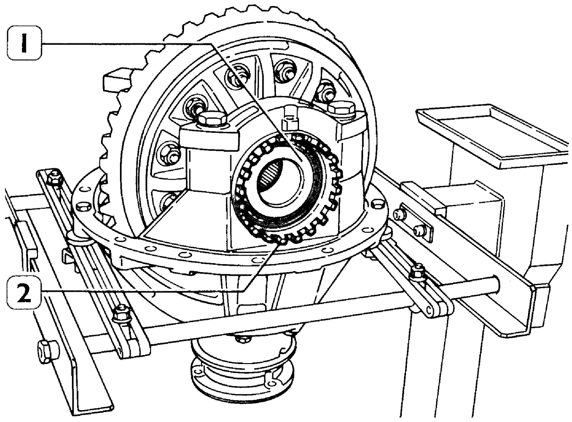
Use hook (1) to lift gear cage (2), assembled previously, and position it on differential casing (3).

Figure 44



Position caps (2), screw in screws (1) with washers and tighten to the specified torque.

Figure 45



Lubricate taper roller bearings (1) and fit outer races.
Screw in adjustment ring nuts (2).

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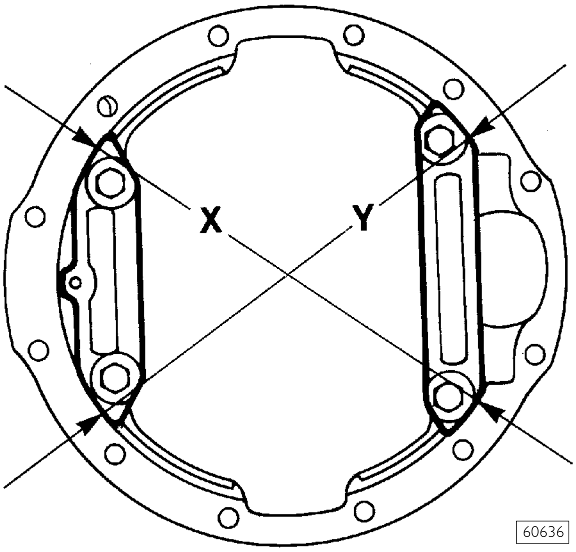
ADJUSTING THE CAP GAP

Adjusting and checking retraction of the caps can be done with two methods:

1st METHOD

1. Use wrench 99355025 (3, Figure 47) to tighten the adjustment lock rings (4) of the bearings until eliminating the pinion-crown wheel clearance and end float. At the same time check that the crown wheel does not force on the pinion;
2. using a suitable micrometer positioned diagonally and centrally in points (X-Y-arrows, Figure 46); measure and note the distance of the caps;

Figure 46

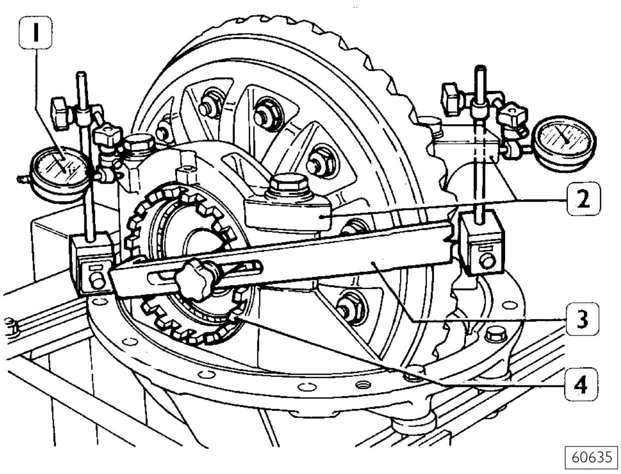


3. further tighten the two adjustment lock rings (4, Figure 47) to obtain a retraction of the caps (2, Figure 47), measured on Axis X or on axis Y as described in point "2" of: 0.080 to 0.22 mm which corresponds to a preload on the bearings of 1.7 to 3.9 Nm (0.17 to 0.39 kgm).

2nd METHOD

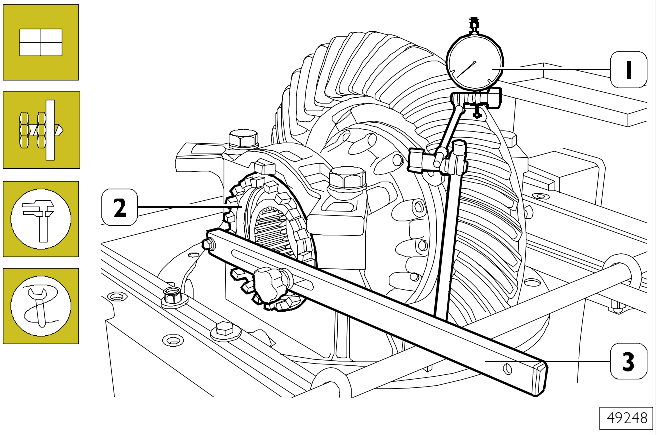
A. Diagonally and centrally on the outer machined seats of both caps (2, Figure 47) position two dial gauges (1) with magnetic base as shown in Figure 47;

Figure 47



B. proceed as described in point "1";
C. after eliminating the end float further tighten the two adjustment lock rings (4, Figure 47) to obtain a retraction of the caps (2) of 0.080 to 0.22 mm, which corresponds to the sum of the readings on the dial gauges (1).

Figure 48



Adjust the axial clearance between the teeth of the pinion - crown wheel unit which must be 0.21 to 0.45 mm proceeding as follows:

- ❑ stop the bevel pinion from turning using tool 99370317;
- ❑ position the magnetic-based dial gauge (1) as illustrated;
- ❑ using wrench 99355025 (3) slacken the adjustment lock ring on the crown wheel side and tighten, to the same extent, the adjustment lock ring (2) of the opposite side. The purpose of this is to leave the previously-adjusted cap retraction unchanged;
- ❑ proceed as described until obtaining the specified clearance.

The clearance should be checked on 4 points the same distance apart.

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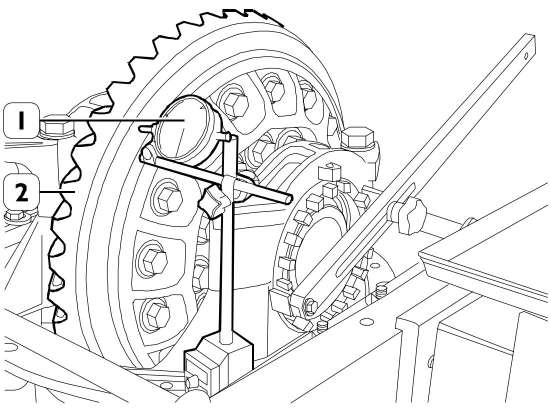
Figure 49

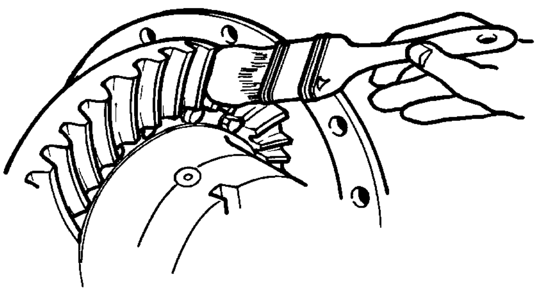


49246

Use a magnetic-based dial gauge (1) to check that the crown wheel (2) does not have any upper wobble above 0.20 mm. If it does, disassemble the differential unit and find the cause.

Reassemble and repeat the adjustment operations described above.

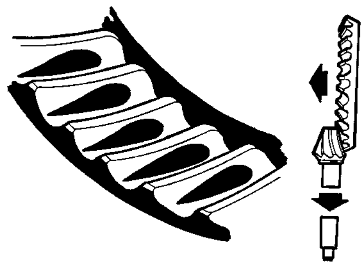
Figure 50



19451

Apply a light layer of Prussian blue on the crown wheel. Turn the pinion and measure the impression of the contact of the pinion teeth on the crown wheel teeth.
The following figures show possible contacts and how to correct any errors.

Figure 51



19452

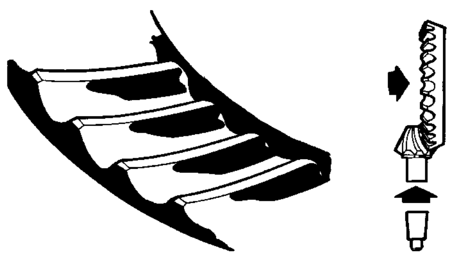
Contacts too much on crown wheel teeth bottom land

Conditions C-D. Indicates that the pinion is fastened too deeply and needs further adjustment.
To adjust the exact position of the pinion shims should be added under the pinion support to obtain the exact contact.

Condition C. Measure the clearance and restore it after adding shims.

Condition D. After adding shims, take the clearance towards minimum.

Figure 52



19453

Contacts too much towards the crown wheel teeth top land

Conditions A-B. Indicates that the pinion is fastened to much towards the outside and therefore needs further adjustment.
To adjust the exact position of the pinion, remove shims under the pinion support to obtain the exact contact.

Condition A. After removing the shims, take the clearance towards maximum.

Condition B. Measure the clearance and restore it after removing shims.

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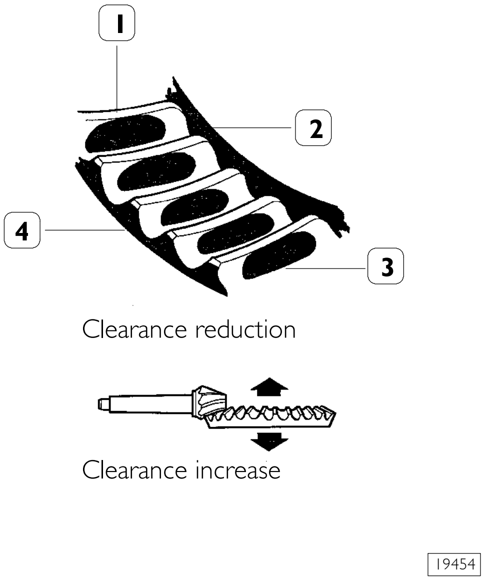
Figure 53



THEROETICAL CONTACT AREA

1. Release, concave side of tooth
2. Top land
3. Pulling, convex side of tooth
4. Heel

PULLING. Central tending towards the top land on the tooth face and central on the tooth profile.

RELEASE. Central tending to the heel on the tooth face and central on the tooth profile.

Indicates that the pinion is fastened correctly.

The contact position can be further changed by changing the pinion-crown wheel clearance.

Condition E. Lower the clearance.

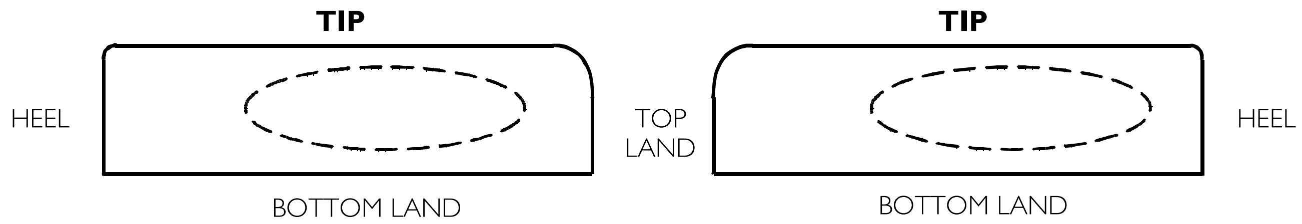
Condition F. Increase the clearance.

CORRECTING THE CROWN WHEEL AND PINION CONTACTS (AFTER ASSEMBLY)

Figure 54

THEORETICAL CONTACTS

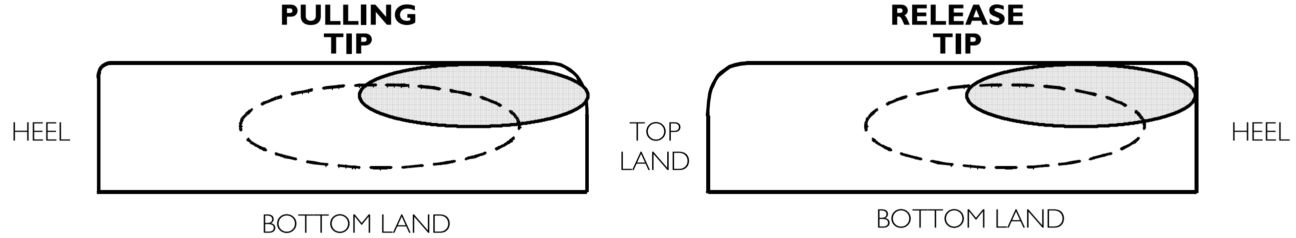
PULLING (CONVEX SIDE OF RING GEAR) | **RELEASE (CONCAVE SIDE OF RING GEAR)**



- PULLING : CENTRAL TENDING TOWARDS THE TOP LAND ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE
- RELEASE : CENTRAL TENDING TOWARDS THE HEEL ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE

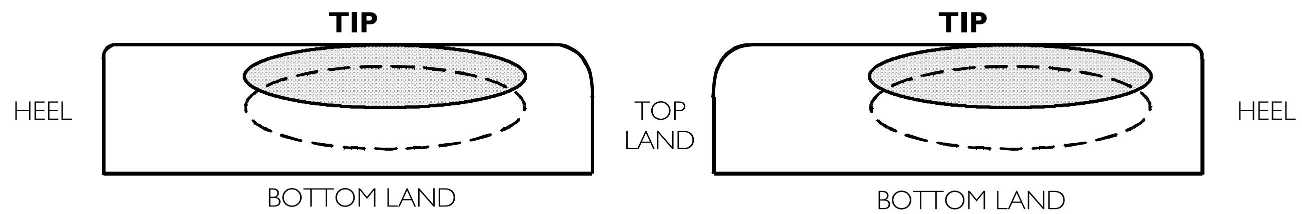
CONDITION “A”

PULLING | **RELEASE**



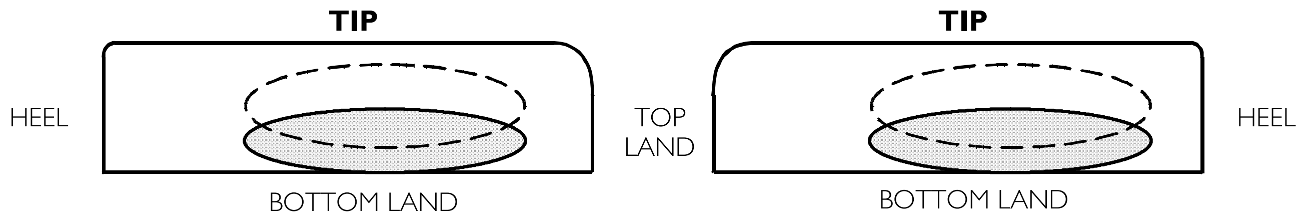
- PULLING RELEASE : CONTACTS TOO MUCH AT TIP
- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : REMOVE SHIMS AND INCREASE CLEARANCE TO MAXIMUM

CONDITION “B”



- PULLING - RELEASE : CONTACTS TOO MUCH AT TIP
- CORRECTIVE ACTION : MEASURE THE CLEARANCE AND RESTORE THE CLEARANCE

CONDITION “C”



- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- CORRECTIVE ACTION : MEASURE THE CLEARANCE, ADD SHIMS AND RESTORE CLEARANCE

60676

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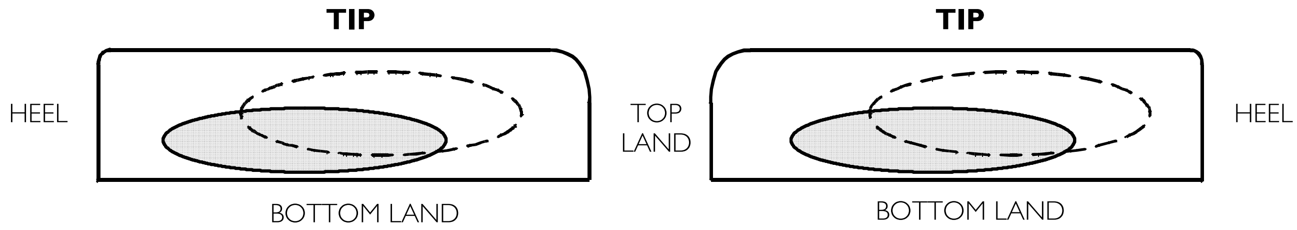
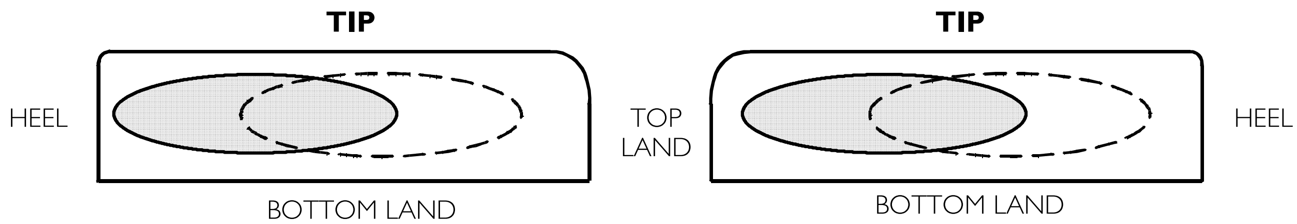
Figure 55

CONDITION "D"



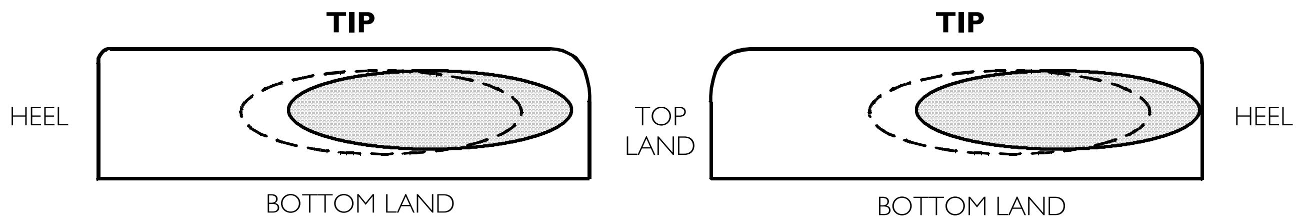
- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- PULLING: : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : ADD SHIMS AND REDUCE CLEARANCE TO MINIMUM

CONDITION "E"



- PULLING : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : REDUCE CLEARANCE

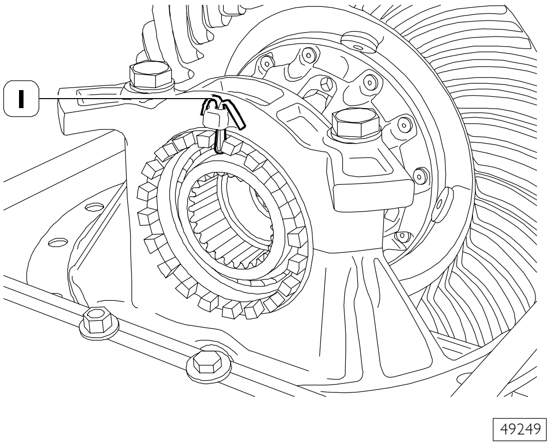
CONDITION "F"



- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : INCREASE CLEARANCE

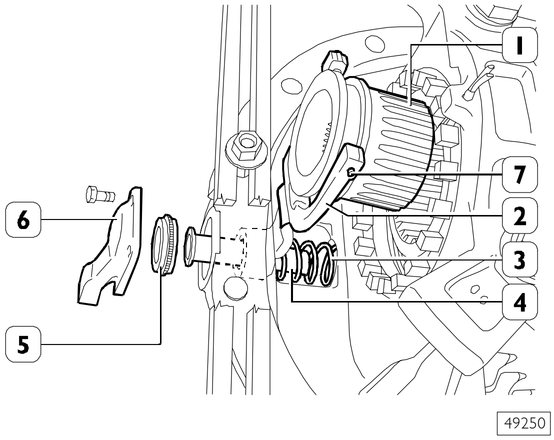
60677

Figure 56



Replace the safety split pin (1) and fold it; repeat this operation on the opposite side.

Figure 57



Place the pin (4) into its housing.
Fit the fork (2) and spring (3) to the pin (4) and push it in all the way. Fit the piston (5), complete with ring and cover (6), then fit the sliding sleeve (1) and spring plugs (7).

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SECTION 7

5206 Front Axles

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5206 Front axle 5845

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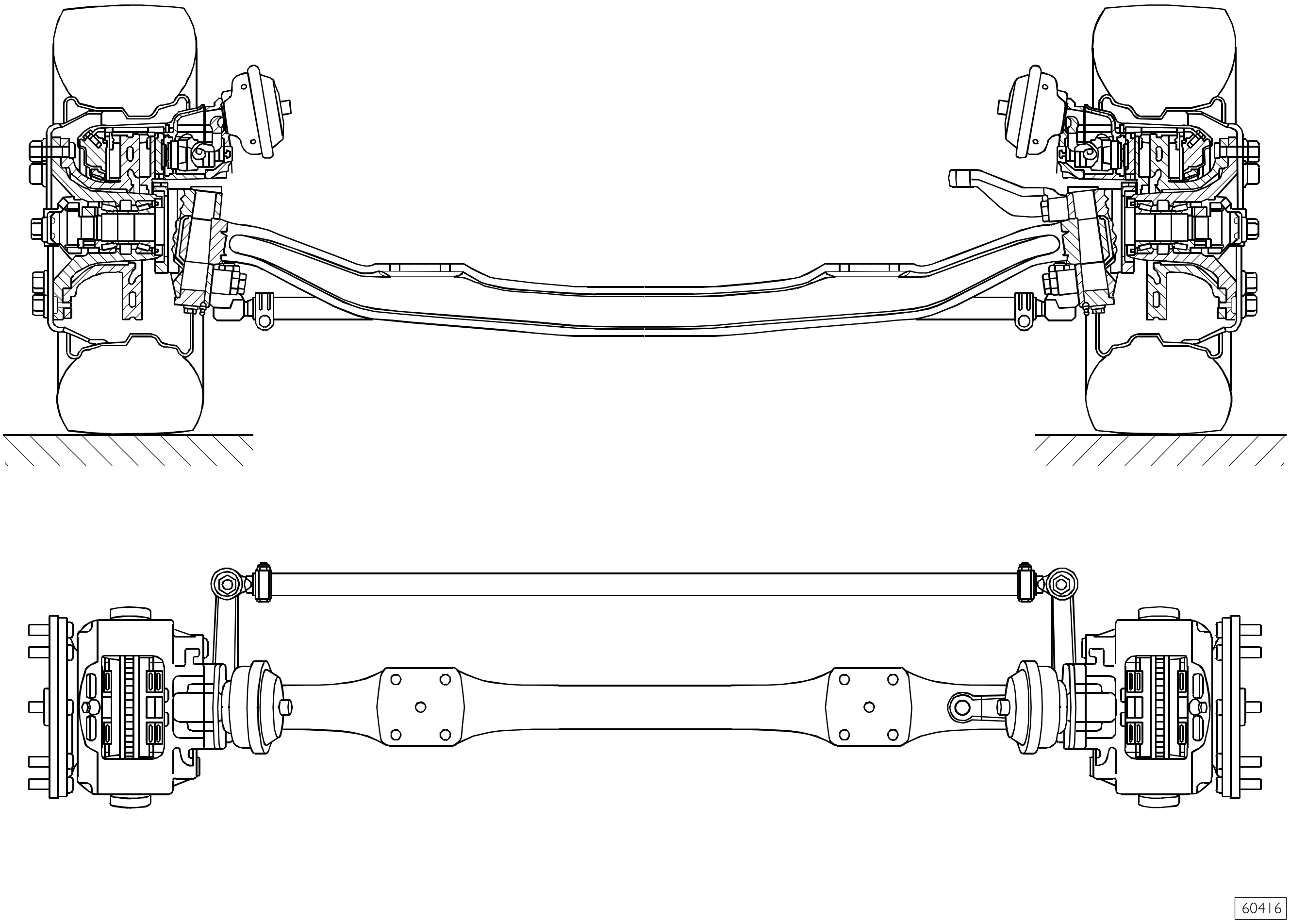
DESCRIPTION

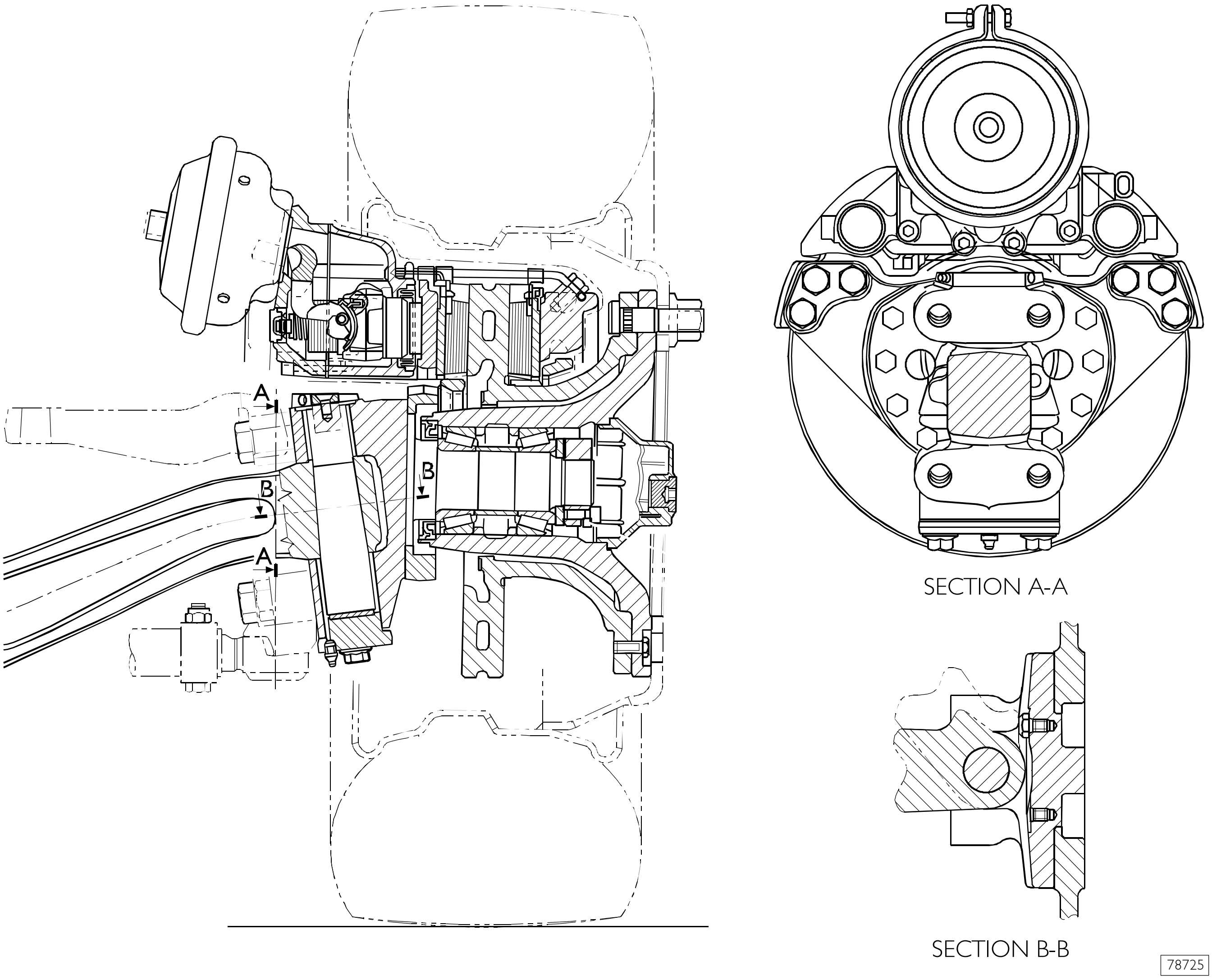
Front axle 5845 has a steel structure with a double "T" section having at the end steering knuckles.
The steering knuckles' connection is made through pins integral with the axle body and by means of four roller bearings set with interference in the holes of the steering knuckles' embossing.
The wheel hubs are supported by two conical roller bearings, "set right" type, set on the steering knuckle shank. The bearing end play is predetermined by the spacer placed between them.

Figure 1



AXLE SIGHT 5845

Figure 2



SECTION OF FRONT AXLE F 5021 (5845) WHEEL SIDE

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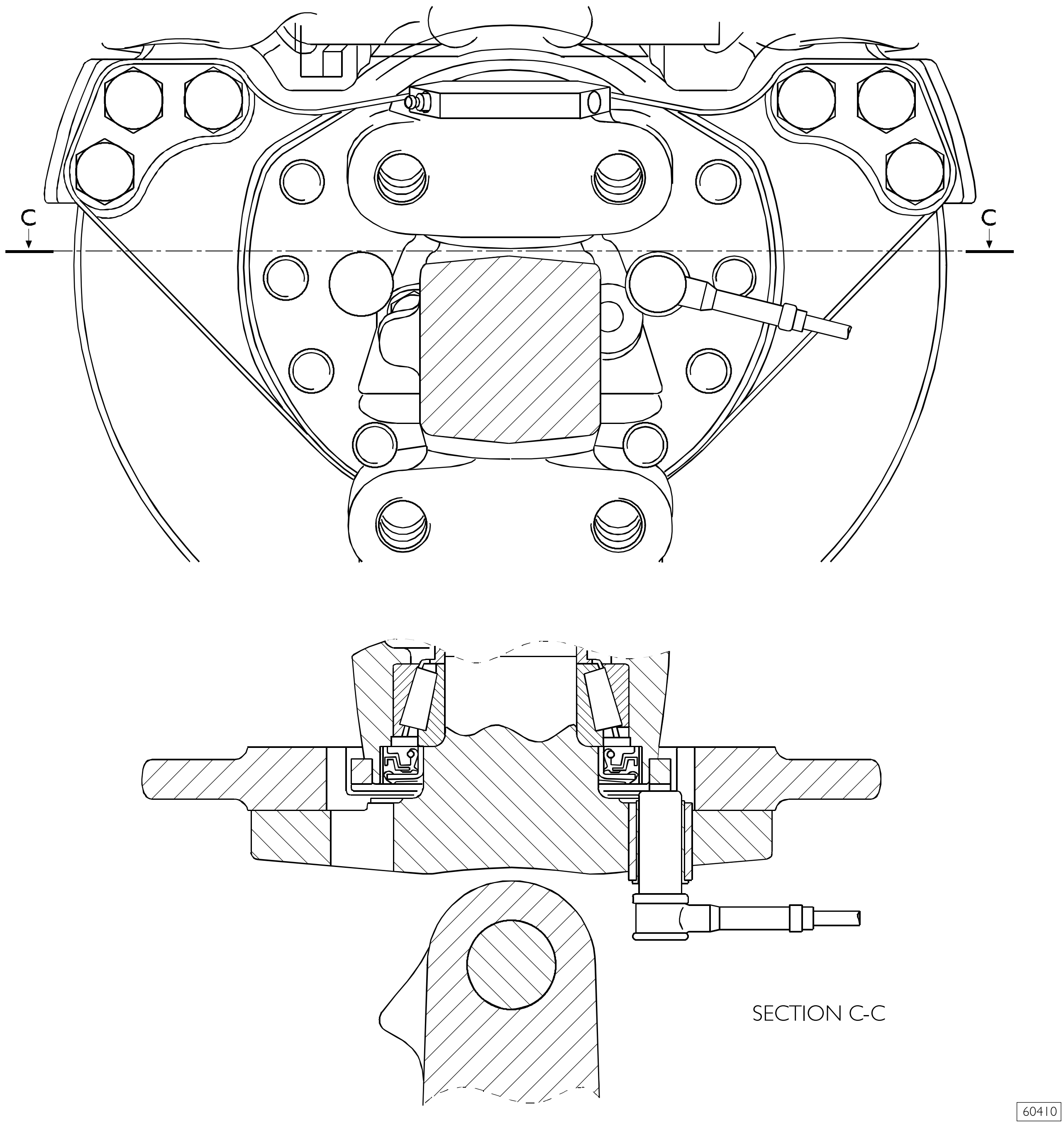
Figure 3



ABS REVOLUTIONS SENSOR LOCATION

Characteristic angles

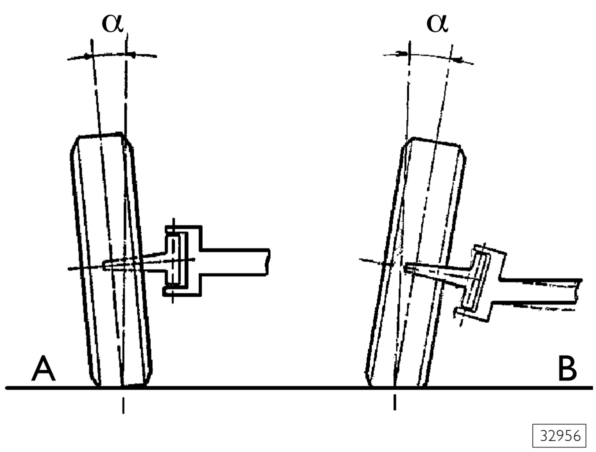
In order to have a good roadholding, a low tyre wear and to enable driving wheels to recover an upright direction after steering, it is necessary to set the wheels according to certain assembly angles:

- wheel angle of inclination
- upright angle of inclination
- clearance angle
- toe-in

Such angles, when correctly calculated, enable the vehicle to maintain the right balance among the various forces involved in its movement, in different loading conditions, which tend to alter the wheel position on the ground.

Wheel angle of inclination

Figure 4

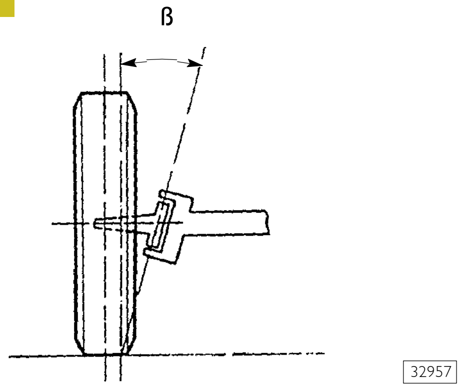


The wheel angle (α) of inclination is the one resulting from the axis passing through the wheel's centre line and the vertical to the ground, looking at the vehicle standing before it.

The inclination is positive (A) when the wheel's upper part moves outside. It is negative (B) when the wheel's upper part moves inside.

Upright angle of inclination

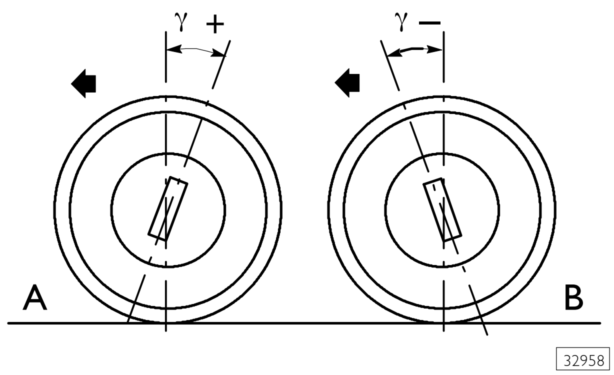
Figure 5



The upright angle (β) of inclination is the one resulting from the axis passing through the upright and the vertical to the ground, looking at the vehicle standing before it.
When the extension of the upright axis approaches the wheel when it is touching the ground (opposite direction compared to the wheel's inclination), the angle is positive. It is difficult, if not impossible, to have a negative upright angle of inclination.
The wheel angle (α) of inclination and the upright angle (β) of inclination enable the wheel axis and the upright axis to get closer to the tyre's fulcrum on the ground as much as possible. As a result, it is possible to reduce the tyre wear and to get a low value of the steering torque.

Clearance angle

Figure 6



The clearance angle (γ) is the one resulting from the upright axis and the vertical to the ground, looking at the vehicle from one side.
If the extension of the upright axis falls beyond the wheel's fulcrum on the ground in the vehicle's direction, as a rule the clearance angle is positive (A).
It is considered negative (B) if it falls behind the wheel's fulcrum on the ground.
It is null if it is absolutely perpendicular to the wheel's fulcrum on the ground.
Such an angle enables front wheels to keep an upright position when the vehicle is moving in an upright direction and to recover such a position after taking a curve as soon as the steering wheel is released by the driver.

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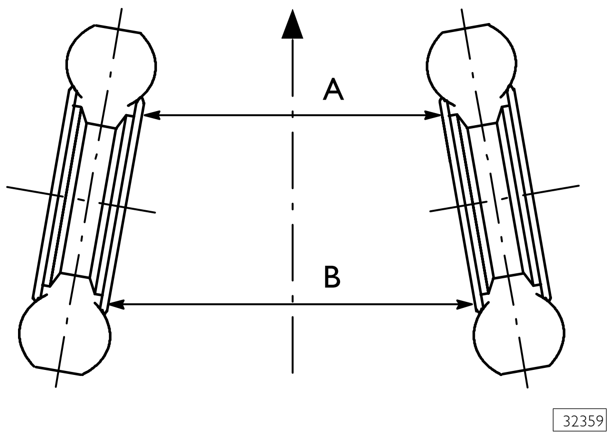
Toe-in

Figure 7

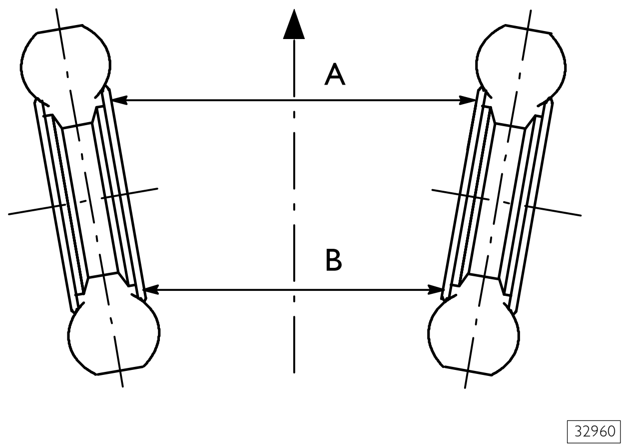


Toe-in results from the difference between distance A and B (value expressed in mm) measured on the rims' horizontal axis, looking at the vehicle from above.

In this way it is possible to drive easily and to reduce the tyre wear.

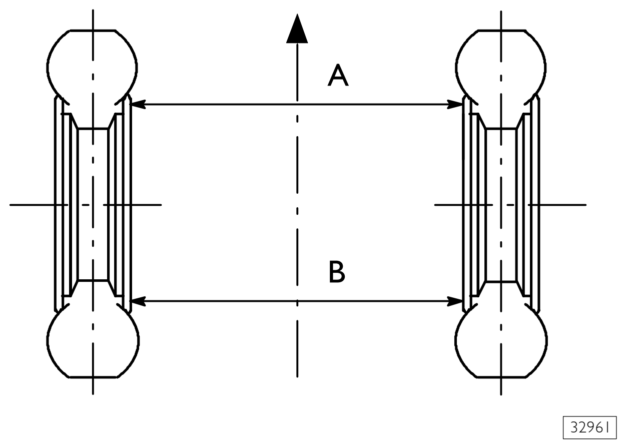
Toe-in is positive if B is bigger than A.

Figure 8



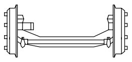
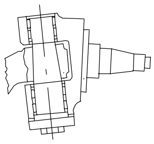
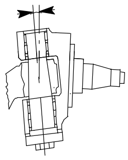
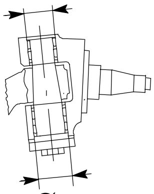
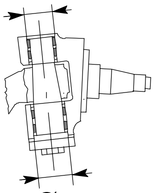
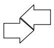
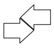
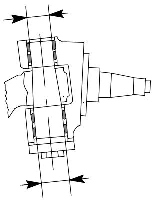
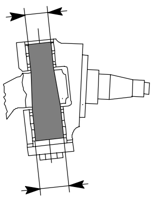
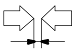
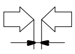
Toe-in is negative if B is lower than A.

Figure 9



Toe-in is zero if B corresponds to A.

SPECIFICATIONS AND DATA

	Axle type		**5845**
	**STEERING KNUCKLE PINS**		
α 	Inclination of steering knuckle pin housing		7°
Ø 1  Ø 2	Diameter of roller bearing housing on steering knuckle: - upper housing Ø 1 - lower housing Ø 2	 mm mm	 39.972 ÷ 39.988 46.972 ÷ 46.988
Ø 3  Ø 4	Outside diameter of roller bearings for steering knuckle: - upper bearings Ø 3 - lower bearings Ø 4	 mm mm	 40 47
	Upper bearings – steering knuckle	mm	0.012 ÷ 0.0028
	Lower bearings - steering knuckle	mm	0.012 ÷ 0.0028
Ø 5  Ø 6	Inside diameter of roller bearings for steering knuckle: - upper bearings Ø 5 - lower bearings Ø 6	 mm mm	 33.025 ÷ 33.050 40.025 ÷ 40.050
Ø 7  Ø 8	Diameter of pin for steering knuckle - upper Ø 7 - lower Ø 8	 mm mm	 32.984 ÷ 33.000 39.984 ÷ 40.000
	Upper bearings – pin	mm	0.025 ÷ 0.066
	Lower bearings – pin	mm	0.025 ÷ 0.066

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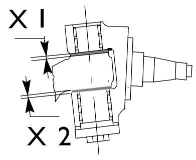
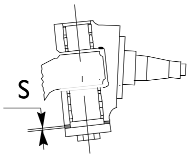
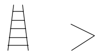
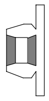
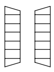
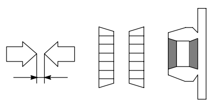
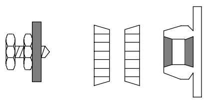
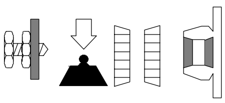
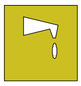
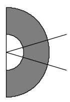
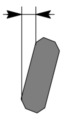
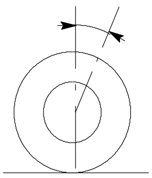
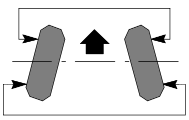
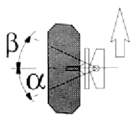
			5845
	Clearance between axle and steering knuckle upper adjustment X1 Gap between axle and steering knuckle lower adjustment X2	mm mm	0.10 ÷ 0.35 ≥ 0.25
 IVECO PARTS 	Adjusting plates X1, X2 0.25 mm S	mm	0.50 ÷ 1.75
	**WHEEL HUBS**		
	Wheel hub bearings		2 with taper rollers
	Hub bearing end play	mm	max 0.16
	Wheel hub clearance		not adjustable locking with lock nut torque
	Bearing preloading		daNm 0.30
	Oil for wheel hub bearings		Tutela W 140/M-DA
	**WHEEL SET UP**		
	Wheel inclination (vehicle with static load)		1°
	Wheel incidence (vehicle with static load)		3°
	Toe-in (vehicle with static load)	mm	0.5 ÷ 1.5
	Steering angle Inside α Outside β		 52° 36°

DIAGNOSTICS

Main malfunctioning of front axle:

1 – Steering wheel hardness
2 – Wobble
3 – Noise

1 STEERING WHEEL HARDNESS

Front axle perfectly aligned.	NO →	Reset alignment and clamp lock nuts of spring bands.
YES ↓		
Regular toe-in.	NO →	Make exact toe-in adjustment.
YES ↓		
Regular tyre pressure.	NO →	Inflate tyres according to prescribed pressure.
YES ↓		
Good joint lubrication.	NO →	Lubricate joints accurately.
YES ↓		
Right adjustment between steering knuckle and axle.	NO →	Correctly adjust clearance between steering knuckle and axle.
YES ↓		
Efficient elements involved in steering knuckle rotation on the pin.	NO →	Check and replace worn elements.

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2 WOBBLE

Regular wheel incidence.	NO →	Check axle assembly, fix or replace distorted elements.
YES ↓		
Front axle perfectly aligned.	NO →	Reset alignment and clamp spring band nuts on the axle.
YES ↓		
Regular toe-in.	NO →	Make correct toe-in.
YES ↓		
Efficient steering heads of track rods.	NO →	Replace defective elements.
YES ↓		
Regular clearance of wheel hub bearings.	NO →	Adjust end play after making appropriate replacements.
YES ↓		
Centred wheels: ❑ centred, regular rim ❑ correct assembly of tyre on rim.	NO →	Replace defective rim. Deflate and centre tyre on rim.
YES ↓		
Balanced wheels.	NO →	Make wheel balancing.

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3	**NOISE**

Good lubrication of wheel hub bearings.	NO →	Top up oil in wheel hubs.
YES ↓		
Efficient wheel hub bearings.	NO →	Replace worn bearings and adjust end play.
YES ↓		
Regular coupling between steering knuckle pin and roller bearings.	NO →	Check and replace worn elements.

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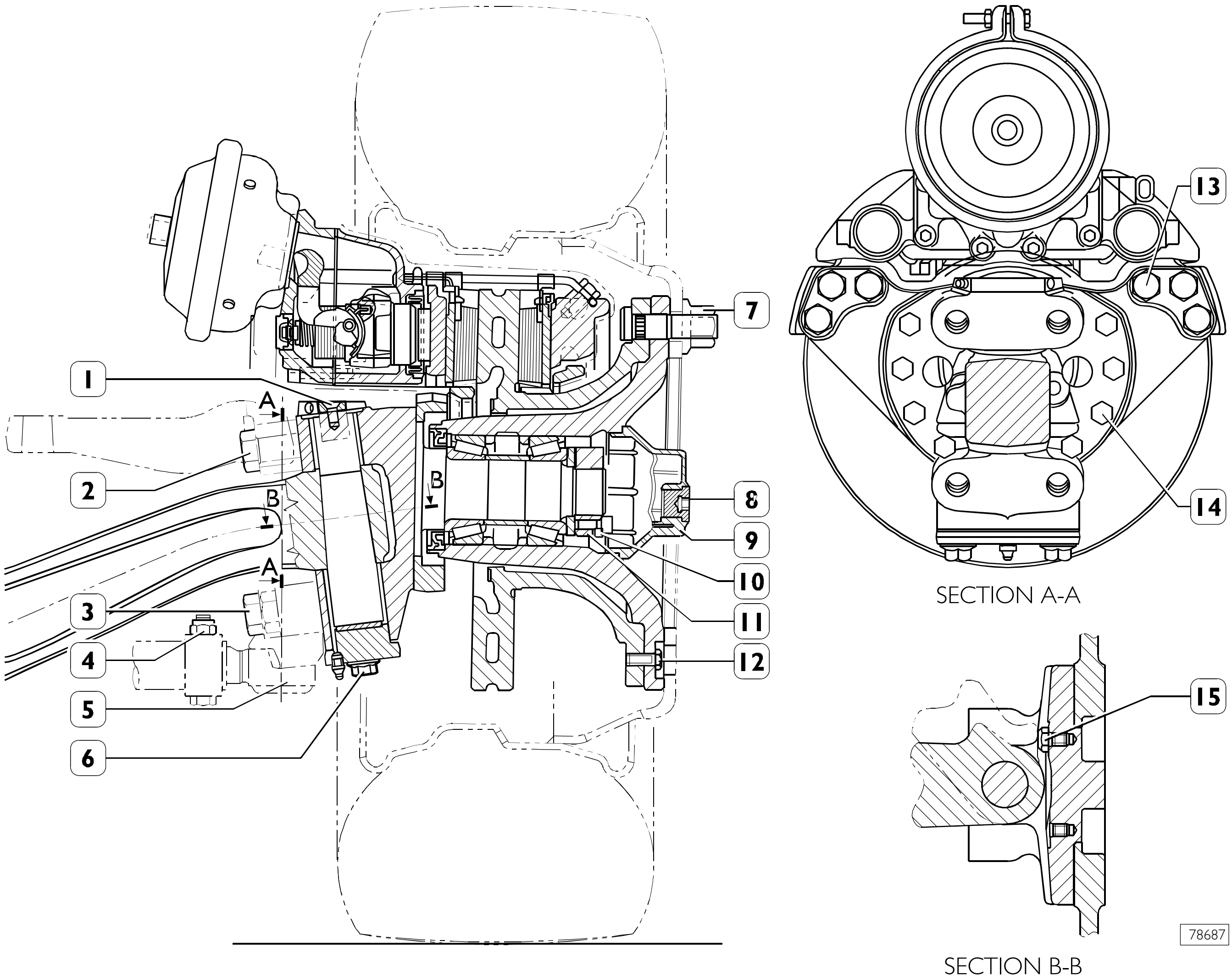
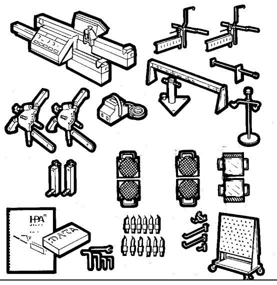
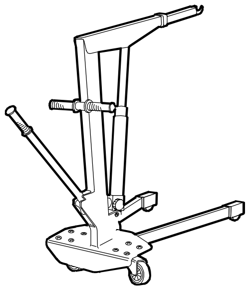
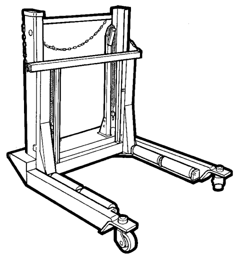
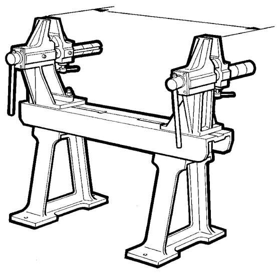
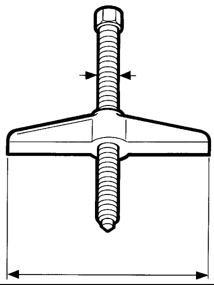
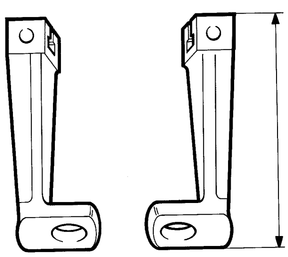
TIGHTENING TORQUES

Figure 10



PART		TORQUE	
		Nm	(kgm)
1	Flat head cap screw to clamp upper cover	16 ± 2	(1.6 ± 0.2)
2	Self-braking hexagonal head cap screw to clamp cross lever on steering knuckle	515.5 ± 24.5	(52.5 ± 2.5)
3	Self-braking hexagonal head cap screw to clamp longitudinal lever on steering knuckle	515.5 ± 24.5	(52.5 ± 2.5)
4	Nut to clamp stop block for cross tie rod	80 ± 10	(8.1 ± 1)
5	Castellated nut for steering knuckle pin	201 ± 20	(20.5 ± 2)
6	Flanged hexagonal head cap screw to clamp lower thrust block cover on steering knuckle	336 ± 17	(34.2 ± 1.7)
7	Wheel lock nut	490 ± 50	(49.9 ± 5)
8	Conical threaded cap for wheel hub cover	57.5 ± 2.5	(5.9 ± 0.25)
9	Wheel hub cover	106 ± 11	(10.8 ± 1.1)
10	Socket head cap screw to clamp adjusting stop block on wheel bearings	27.5 ± 2.5	(2.8 ± 0.25)
11	Metal ring to clamp wheel bearings	388.5 ± 18.5	(39.6 ± 1.8)
12	Hexagonal head cap screw to clamp brake disc on wheel hub	40 ± 4	(4.1 ± 0.4)
13	Self-locking hexagonal head cap screw to clamp brake callipers	188 ± 18	(19 ± 1.8)
14	Screw to clamp brake callipers support	313 ± 16	(32 ± 1.6)
15	Screw clamping steering	64.5 ± 6.5	(6.5 ± 0.7)

TOOLS

TOOL No.		DESIGNATION
99305354		Portable optical equipment for check of wheel attitude
99306004		Mobile hydraulic truck
99321024		Hydraulic truck for wheel detachment and reattachment
99322215		Stand for axle overhaul
99341003		Simple effect puller
99341018		Pair of brackets with hole

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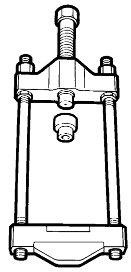
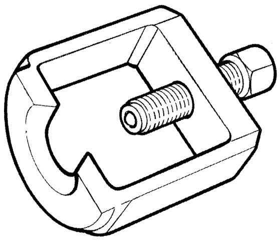
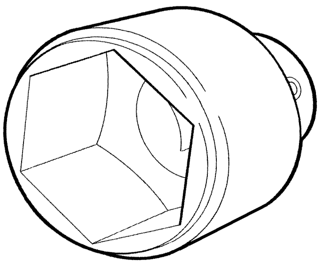
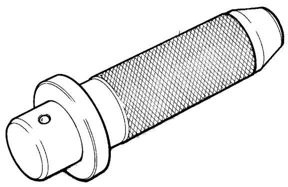
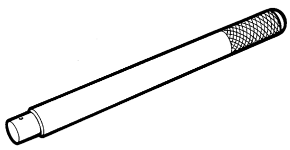
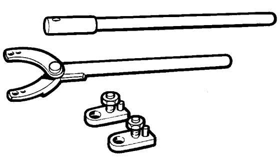
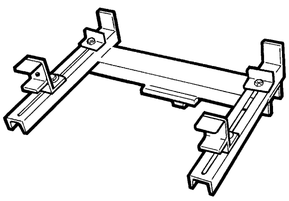
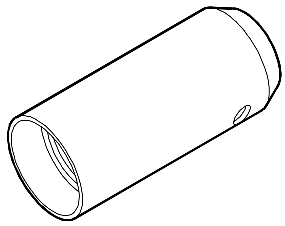
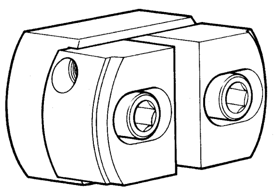
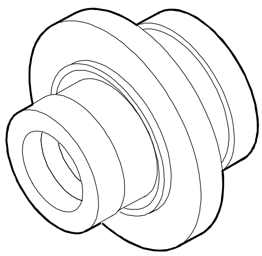
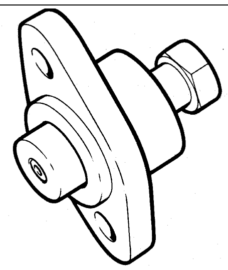
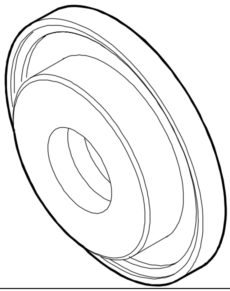
TOOLS

TOOL No		DESIGNATION
99347047		Tool for steering knuckle pin removal
99347068		Extractor for track rod head pins
99355038		Wrench (65 mm) for front wheel hub caps (to be used with 99370317)
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with extension for flange holder

TOOLS

TOOL No		DESCRIPTION
99370628		Support for axle detachment and reattachment
99370712		Rail for wheel hub assembly
99374093		Beater for assembly of bearing outside tracks (91 – 134) (to be used with 99370007)
99374171		Locking ring for assembly of steering knuckle pin gaskets (to be used with 99370007)
99374400		Tool for steering knuckle pin setting
99374457		Locking ring for inside wheel hub gasket setting (to be used with 99370006)

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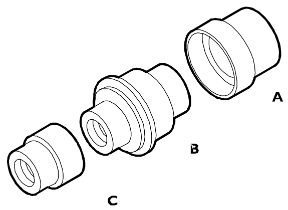
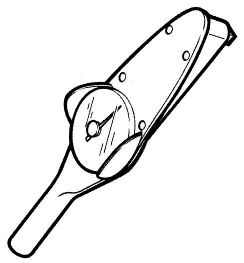
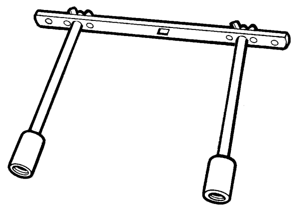
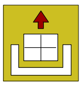
TOOLS

TOOL No.		DESIGNATION
99374527		Beater for disassembly and reassembly of steering knuckle pin bearings (to be used with 99370007)
99389819		Dynamometric wrench (0 – 10 Nm) with square connection 1/4”
99395026		Tool for hub rolling torque check (to be used with dynamometric wrench)

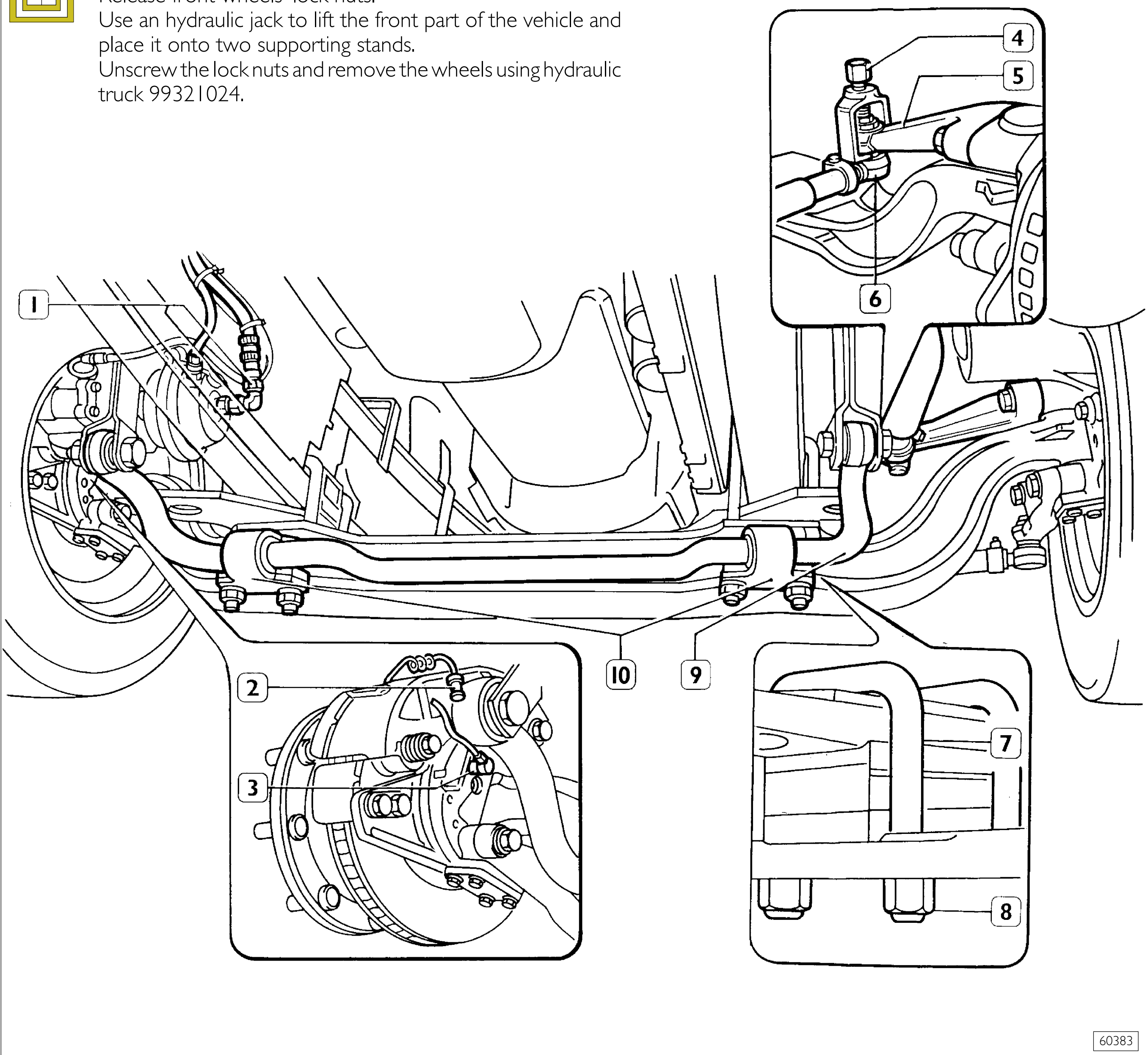
520610 AXLE DETACHMENT AND REATTACHMENT

Front axle detachment

Figure 11



Place the vehicle on a flat ground and clamp rear wheels.
Release front wheels' lock nuts.
Use an hydraulic jack to lift the front part of the vehicle and place it onto two supporting stands.
Unscrew the lock nuts and remove the wheels using hydraulic truck 99321024.



Use extractor 99347068 (4) to remove the tie rod steering knuckle (6) of the lever (5).
Disconnect the air delivery pipe (1) from the membrane brake cylinders, the wire of the wheel revolution sensor (3) and the wire (2) of the worn braking washer signaller.

Place under the axle an hydraulic jack fitted with support 99370628.
Unscrew the nuts (8) and remove the brackets (7) connecting the axle spring bands and the supports (10) clamping the stabilizer bar (9), in order not to make it interfere with the following operation.
Lower the hydraulic jack and extract the axle underneath the vehicle.

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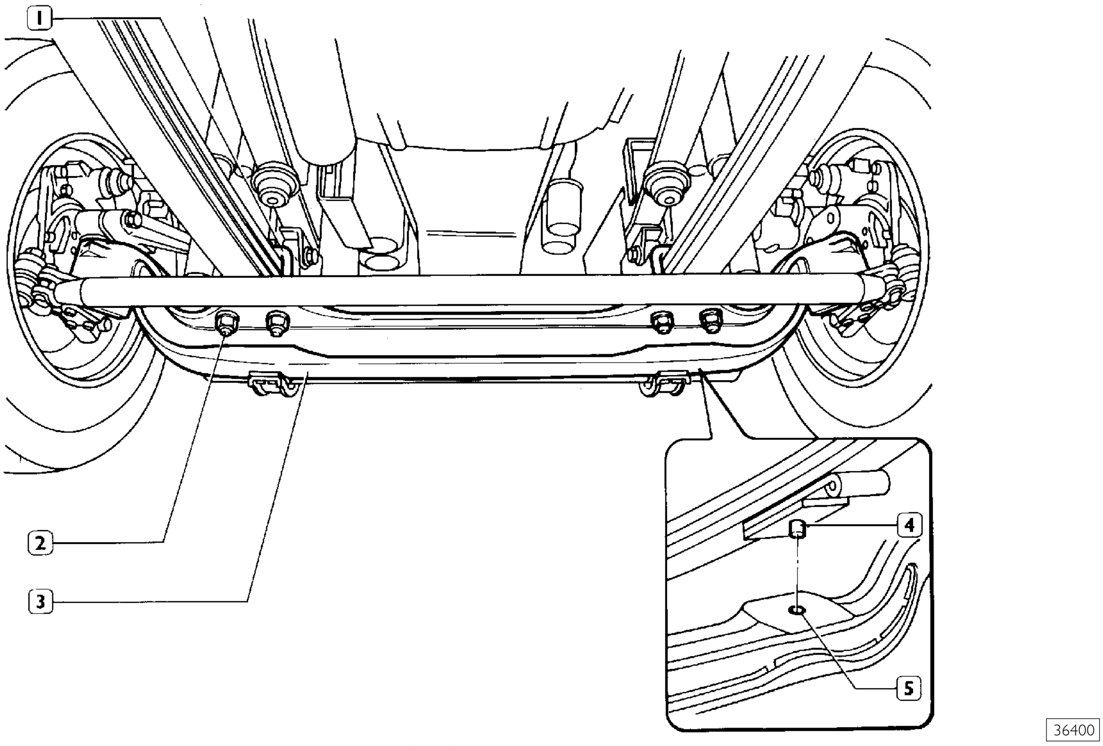
Figure 12



Front axle reattachment

Use an hydraulic jack fitted with support 99370628 to lift the axle, so that spring band connecting pins (4) are introduced in the holes (5) on the spring supporting plane on the axle. Make reattachment reversing the order of detachment operations.

Check and adjust front wheel set up.
To lock nuts consider the couples contained in the appropriate table on page 13.

CHECKS ON THE VEHICLE

Tie rods

Check that screws and stop block lock nuts of tie rods are not worn and that they are clamped according to the prescribed torque.
Tie rods must not be damaged or worn as well as the threaded part.

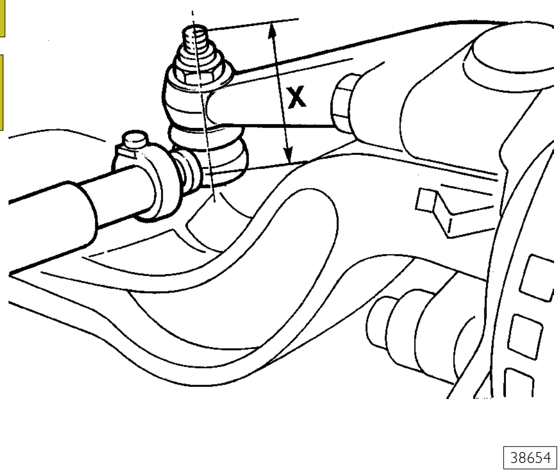
Articulated joints

Clean tie rod articulated joints, both cross and longitudinal. Such an operation must be made with dry towels or cotton wool. Do not use solvents.
Check that the articulated joint's several components are not corroded for more than 1 mm and, in particular, check the metal sheet cover next to the rolling.

Check the guard:
- it must be clamped to the joint's body and pin through circlips and it must not rotate;
- it must not be worn or damaged;
- press it manually and check if any grease comes out;
- check that the nut and the split pin are not worn.

Check clearance of articulated joints

Figure 13



Place the vehicle on a lift-bridge or a pit and do not lift the wheels.
Use a gauge to measure the distance between the articulated joint's body and its edge making three measurements in the following conditions:
- straight wheels — dimension X;
- wheels turned on the left — dimension X1;
- turned wheels (completely on the right) — dimension X2;

Calculate clearance A according to the following formula:

$$A = B - X$$

where B is the biggest value resulting from measurements X1 and X2.
Such clearance must not be over 2 mm.
If an higher clearance or any other fault are detected during the checks, replace the involved element according to the procedure described in the related chapter.

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FRONT WHEEL SET UP

Before checking, it is necessary to make a preliminary investigation of some vehicle elements which can affect set up. If any fault is detected, it is important to eliminate it in order to avoid wrong measurements.
The checks to be made are the following:

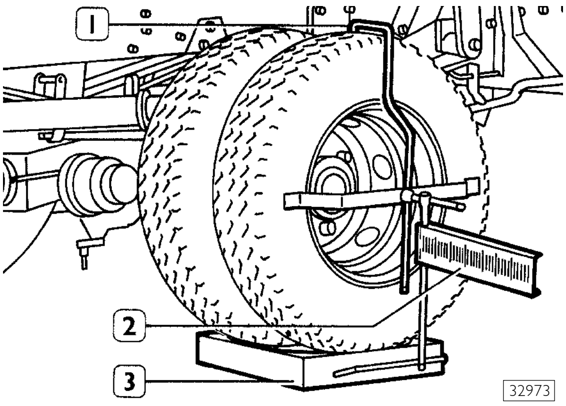
- ❑ tyre pressure;
- ❑ wheel hub bearing clearance;
- ❑ clearance between track rod pins and levers on steering knuckles;
- ❑ shock-absorber efficiency;
- ❑ wheel rims must not be dramatically distorted.

Make wheel set up check using equipment 99305354.

> Checks and possible adjustments of wheel set up must be made with the vehicle having static load. By and then, check perfect calibration of optical units.

Setting of clips and headlights

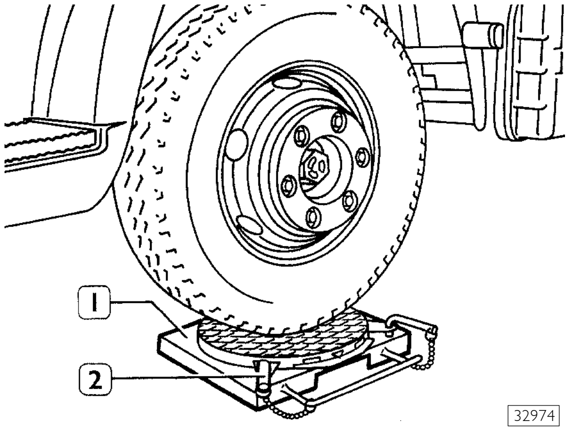
Figure 14



32973

Place the vehicle with the wheels in upright direction on a flat surface. Lift the vehicle's rear part and place the platforms under the wheels (3). Lower the vehicle, brake the rear wheels and set the hook (1) with the ruler (2).

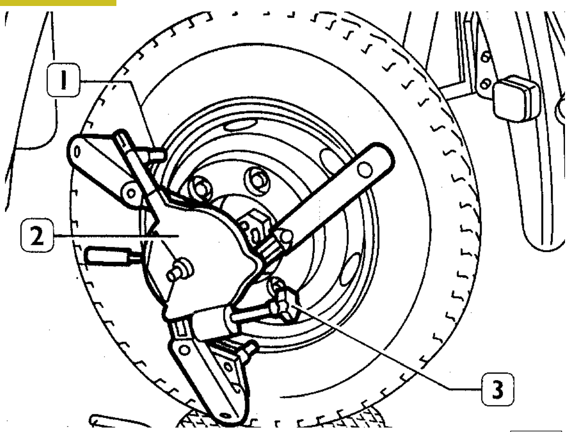
Figure 15



32974

Lift the vehicle's front part and place the swinging plates (1) under the wheels, clamping them with the appropriate locks (2).

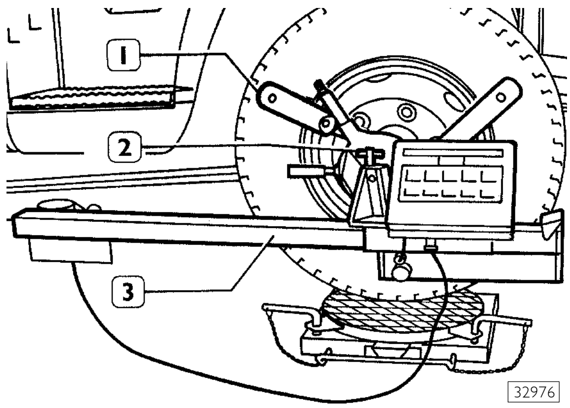
Figure 16



32975

Place on the wheel rim the self-centring clip (2) fitted with the right lock pins (1). Use the handle (3) to clamp the clip on wheel, checking that the wheel itself is well fixed.

Figure 17



32976

Set the detecting system (3) on the clips (1) and clamp it with the screw (2). Repeat the same operations on the other wheel.

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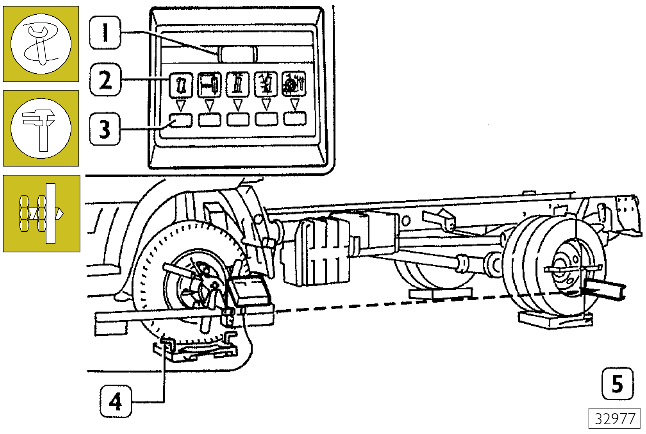
Electronic compensation for rim maladjustment

Figure 18

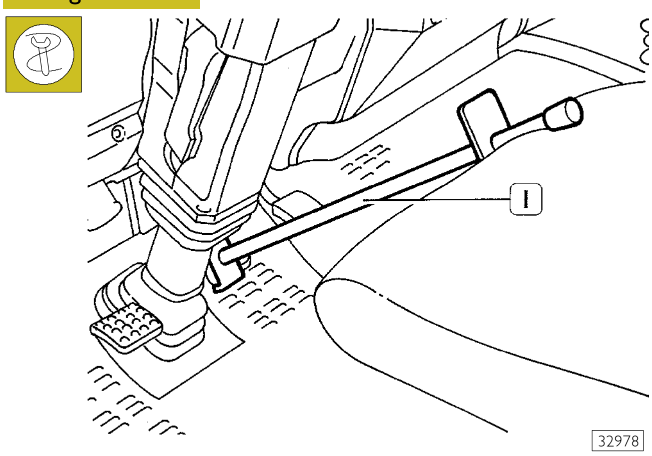


Connect detectors' plugs to the transformer and switch it on.
Release the detector's lock screw and lift the lens cover.
Push the button "off centre" (3) for at least two seconds, five lines will be displayed on the digital (1) indicator.
Slowly rotate the wheel by hand and project the light signal on the corresponding ruler scale (5).
Detect and write down the minimum and maximum excursion of the light signal: e.g. 12 and 8.
Calculate the excursion's average value: 12 + 8 = 20 : 2 = 10 and place the wheel according to the calculated average value, marking the new position.
Push again the button "off centre" (3) until the wheel inclination led (2) is switched on and on the digital indicator a fake value is displayed.
Repeat the same operations on the other wheel.

> ⚠ Be careful that the laser ray does not hit people's eyes: it would severely harm their sight.

Lower the vehicle so that the wheels, being in the marked position, touch completely the centre of the swinging plates and release the latter from the related bases by removing the pins (4).

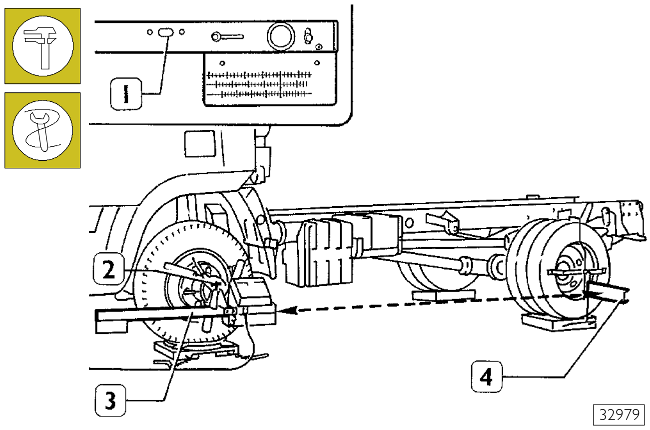
Figure 19



Push the brake pedal and leave it in this position using the appropriate tool (1) set against the seat, thus keeping the vehicle braked during the whole measurement.

Wheel alignment

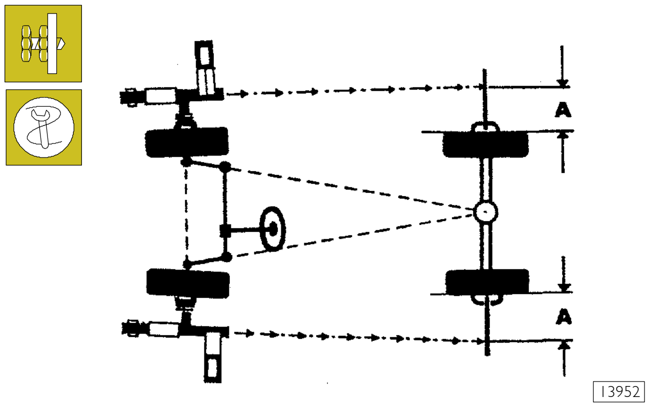
Figure 20



Balance detectors (3) by using the spirit level (1) and clamp them in this position by the screw (2).

Move the rulers (4) until they are hit by the light signal released by the detector and write the indicated values.

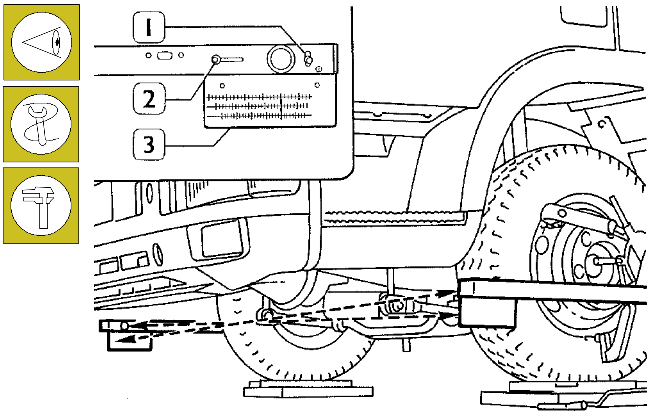
Figure 21



If the values are different, turn the wheels until the light signal indexes reach two equal values (A) and the exact average value resulting from the two previous detections. In such a way it is possible to obtain a perfect wheel alignment.

Toe-in check

Figure 22



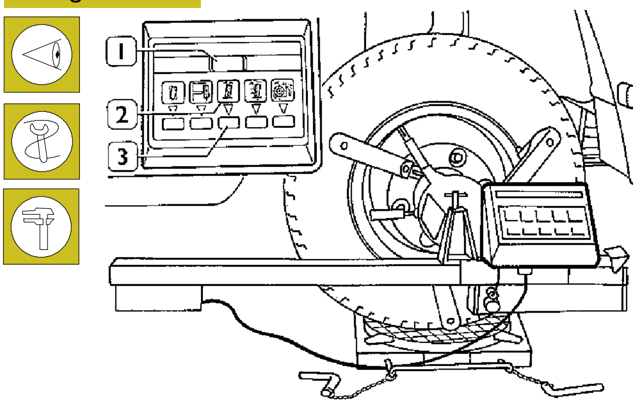
32980

Still having detectors perfectly balanced and the wheels completely aligned, use a lever (1) to move the lens cover.
Move the lever (2) and point the light signal index to the ruler's graph scale (3) corresponding to the rim's diameter.
Repeat the same operations with the opposite detector and read the toe-in values expressed in millimetres on the graph scales.
The algebraic sum of the two detected values must amount to: 0.5 ÷ 1.5 mm with static load.

Toe-in adjustment is performed by operating on the track rod so that toe-in for each wheel is from 0 to 0.5 mm.

Check of wheel inclination (Camber)

Figure 23



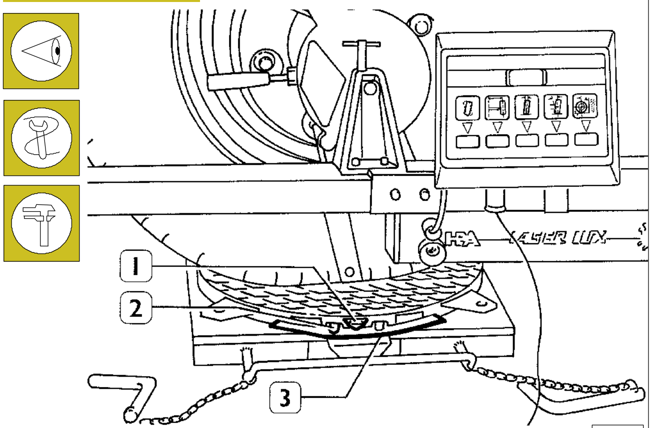
32981

If the front wheels are aligned with the rear ones and the detectors are balanced, push the wheel inclination button (3) and the led (2) will be switched on. The digital indicator (1) will give the value of the angle of inclination which must be 1°.

The wheels' angle of inclination is a fixed value which cannot be adjusted.
Therefore, if a different value is detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check upright angle of inclination (King Pin) and clearance angle (Caster)

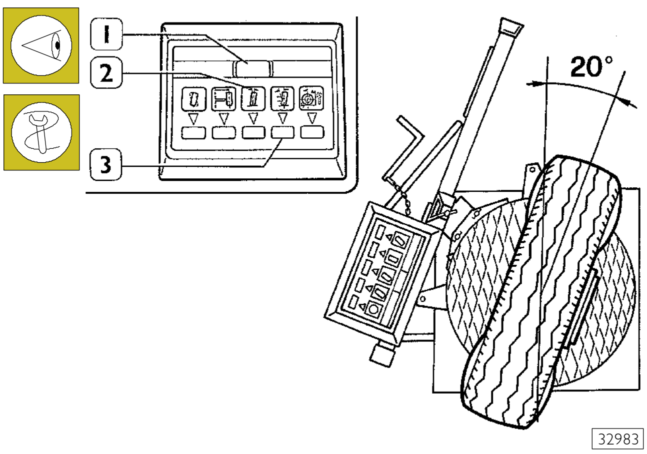
Figure 24



32982

Still having the front wheels aligned with the rear ones, loose knurled knobs (2) and set to zero the graduated sector (3) on the swinging plate's index (1).

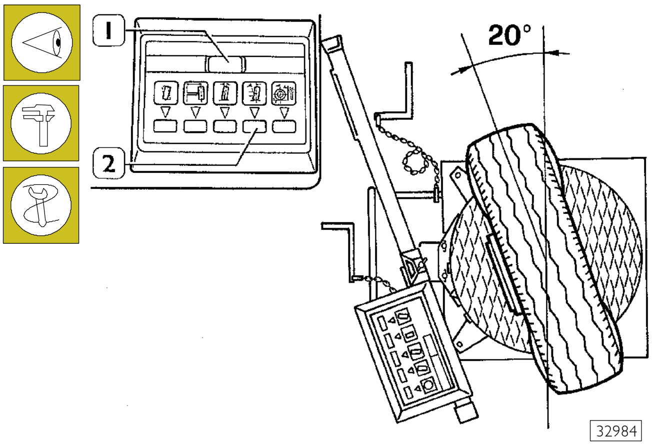
Figure 25



32983

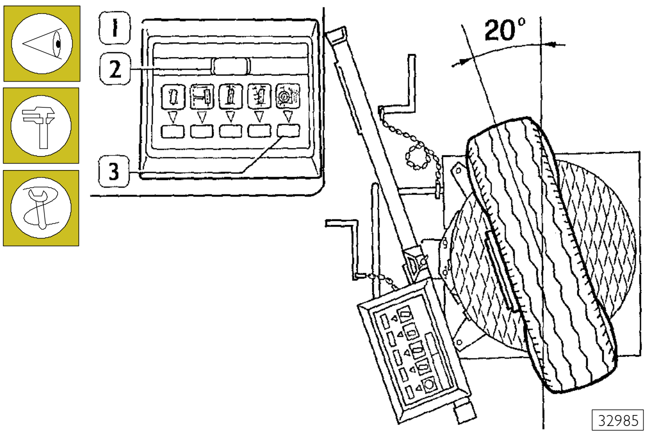
Turn the wheels inwards by 20° and push twice the upright inclination button (3), the led (2) will be switched on and nine horizontal lines will appear on the digital indicator (1).

Figure 26



Turn the wheels outwards by 20° and push again the upright inclination button (2), the digital indicator (1) will display the value of the upright angle of inclination (King Pin) which must be 7°.

Figure 27

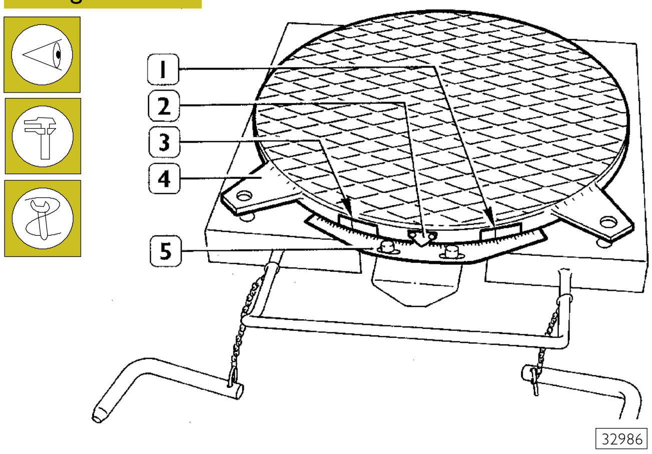


Without moving the wheel, push the clearance angle button (3). The led will be switched on (1) and the digital indicator (2) will display the value of the clearance angle (Caster) which must be 3°.

The upright angle of inclination and the clearance angle are fixed values which cannot be adjusted. Therefore, if different values are detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check steering angles

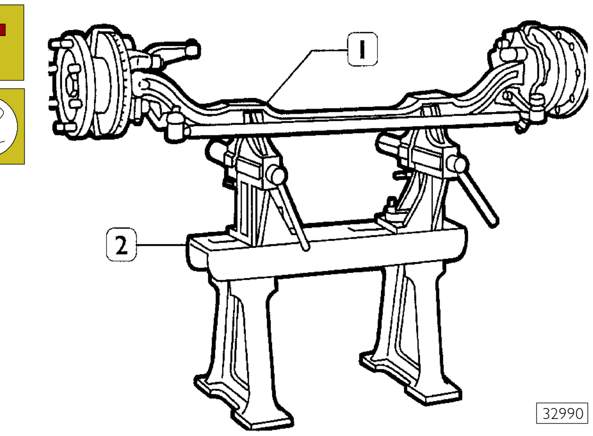
Figure 28



With the wheels in upright direction, set to zero the graduated sectors (5) on the index (2) of the swinging plates (4).
If the steering angles which must be detected are bigger than 30°, it is necessary to use as "0°" reference indexes the 20° sign (1) placed on the swinging plate and the corresponding one on the graduated sector.
Turn the inside wheel according to the prescribed value and check that the outside wheel's angle corresponds to the prescribed value, considering that to make the survey it is necessary to use as "0°" reference indexes the 20° sign (3) placed on the swinging plate and the corresponding one on the graduated sector.
Repeat the same operations and check steering of the opposite wheel.

520610 OVERHAUL OF THE FRONT AXLE ASSY

Figure 29

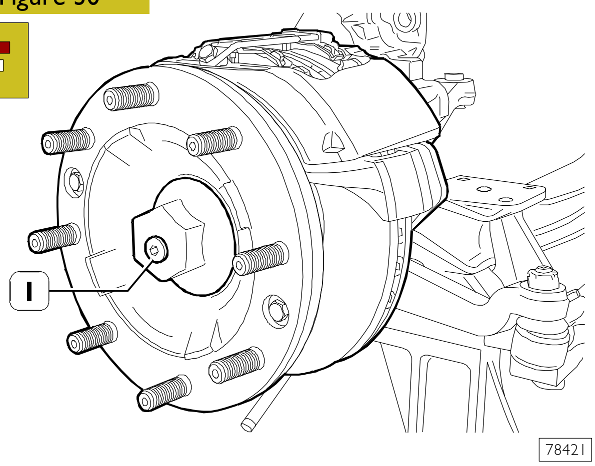


Use a lifter to place and clamp the axle assy (1) on stand 99322215 (2) in order to make overhaul.

520620 DETACHMENT AND REATTACHMENT OF WHEEL HUBS

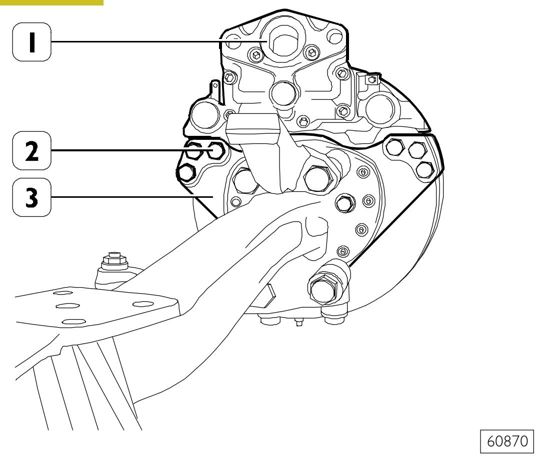
Detachment

Figure 30



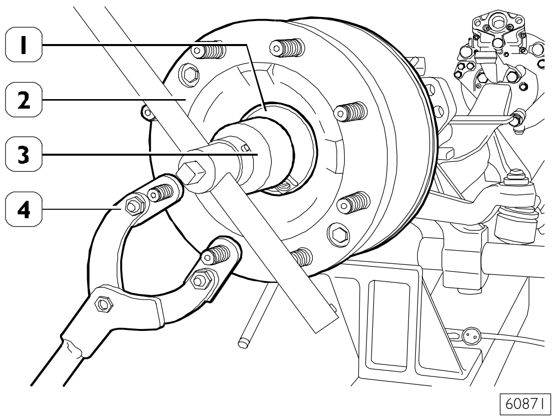
Rotate wheel hub in order to set the screw plug (1) down; unscrew plug and drain oil into a special container. Take off the brake calipers.

Figure 31



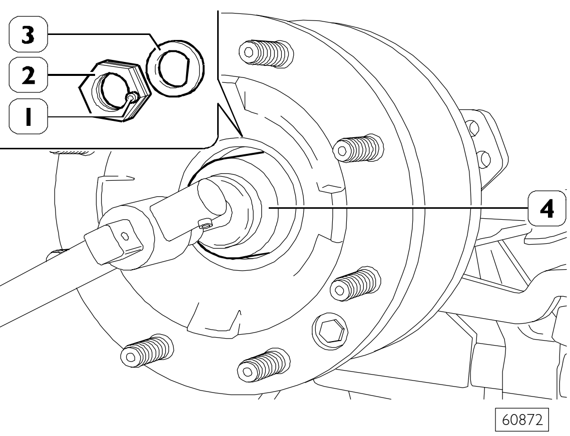
Release the screws (2) and take off the brake callipers (1) from the supporting flange (3).

Figure 32



Use torque lever 99370317 (4), to block wheel hub (2) rotation and use wrench 99355038 (3) to unscrew oil cover (1).

Figure 33



Release the screw (1), unscrew adjusting ring (2) by using wrench 99355038 (4) and remove the washer (3).

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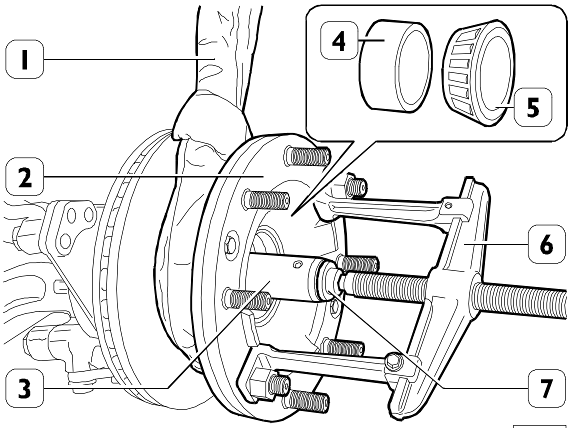
Figure 34



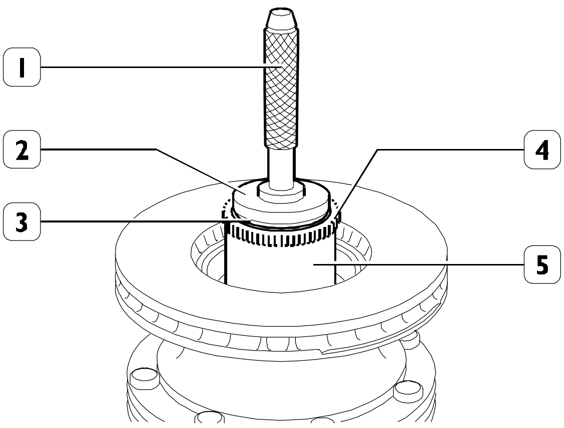
60873

Screw tool 99370712 (3) on the steering knuckle pin. Use a suitable rope (1) and a hydraulic hoist to support wheel hub (2) with axle 99341003 (6) and its respective brackets 99341018 and reaction block (7), all of them applied as shown in the figure, then take wheel hub (2) complete with tapered-roller bearing inner race (5) and spacer (4) out of the knuckle pin.

Do not lay down the wheel hub on the phonic wheel side, in order not to damage it.

Replacement of sealing ring

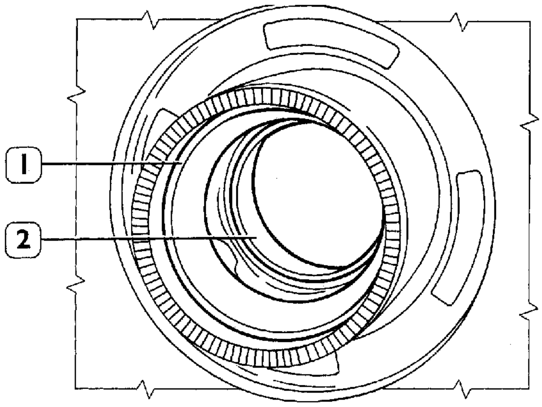
Figure 35



60874

Use general tools to remove the sealing ring (3) from the wheel hub (5). Moisten with oil the new sealing ring's inside outline.
Use locking ring 99374457 (2) and handle 99370006 (1) to place the sealing ring (3) on the wheel hub.
Replace the phonic wheel (if present).
Use general tools to remove the phonic wheel (4) from the wheel hub (5).
Before setting the phonic wheel (4), warm it up to 150°C.
Once the assembly is completed, check that the "phonic" wheel (4) touches completely the wheel hub.
Check that the maximum orthogonality error of the phonic wheel (4) is not higher than 0.2 mm.

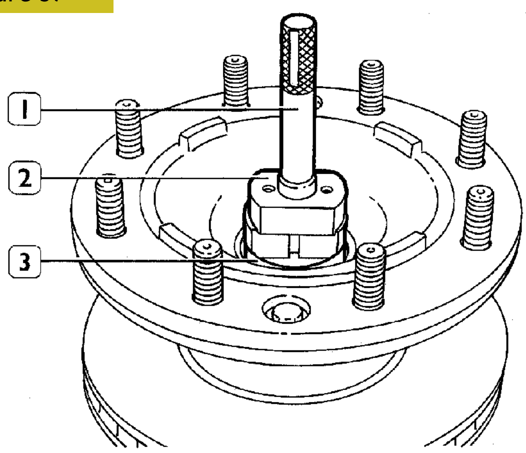
Figure 36



49180

Remove the wheel hub as described in the related chapter.
Take off the sealing ring and remove the bearing's inside ring from the wheel hub.
Use the appropriate beater to remove the bearing's outside rings (1 and 2) from the wheel hub.
Check that the bearing's outside ring housings on the wheel hub are not burred as a result of the pull out operation.

Figure 37

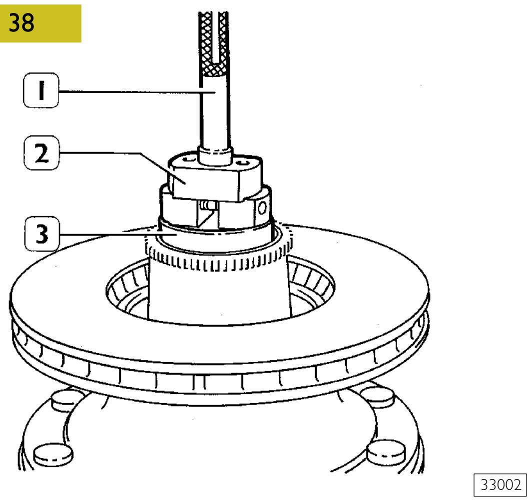


33001

Place the outside bearings's outside ring (3) and use beater 99374093 (2) and handle 99370007 (1) to make setting.

If present, do not use the phonic wheel as a supporting plane.

Figure 38



Place the inside bearing's outside ring (3) and use beater 99374093 (2) and handle (1) 99370007 to make setting.

Lubricate the inside bearing with oil SAE W 140/MDA and place it on the wheel hub.

Set the sealing ring.

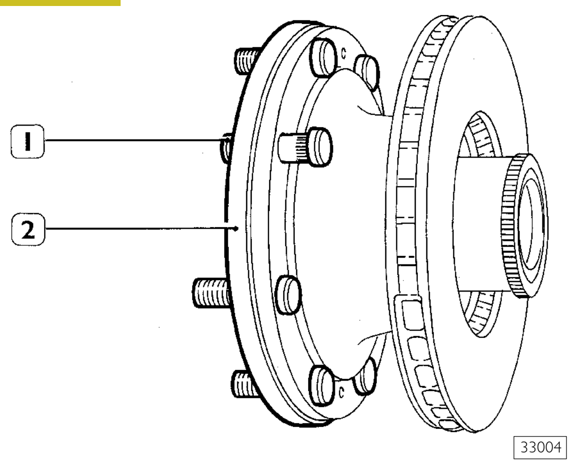
Reattach the wheel hub.

Check the wheel hub end play.

Check the rolling torque.

520625 Replacement of wheel stud bolts

Figure 39



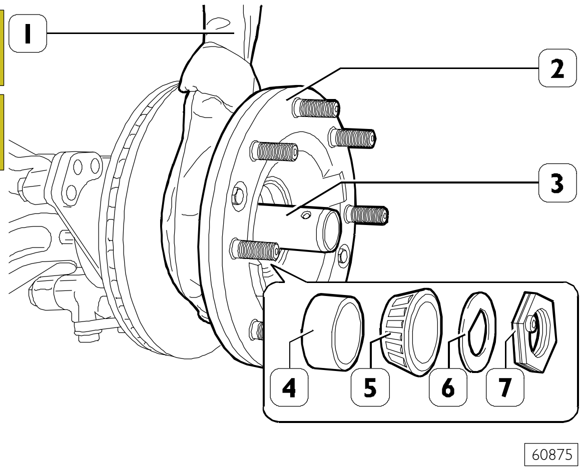
Use general tools to remove the stud bolts (1) from the brake disc (2).
Check that the supporting plane of the stud bolt heads is not burred.

Place the stud bolts accurately putting on their heads a load not higher than 2300 kg.

Once the operation is completed, check the lack of clearance between the disc plane and the area under the stud bolt head and verify that the orthogonality error is not higher than 0.3 mm.

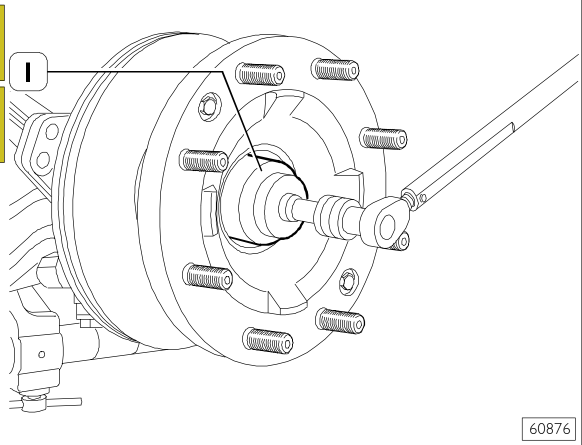
Wheel hub reattachment

Figure 40



Screw tool 99370712 (3) on the steering knuckle pin and lubricate its outside surface using oil TUTELA W 140/M-DA. Secure the wheel hub (2) with a rope (1) and support it with a lifter. Lock carefully the wheel hub (2) on the steering knuckle pin in order not to damage the sealing ring (3, Figure 35).
Mount spacer (4) and tapered-roller bearing inner race (5).
Release tool 99370712 (3).
Force-fit washer (6) and screw down retaining ring (7).

Figure 41



Tighten ring (7, Figure 40) to the specified torque by means of wrench 99355038 (1).

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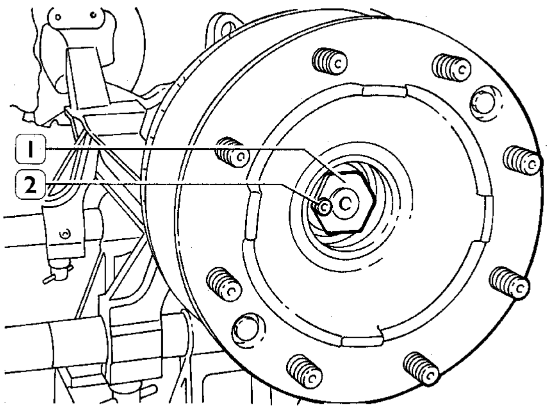
Figure 42

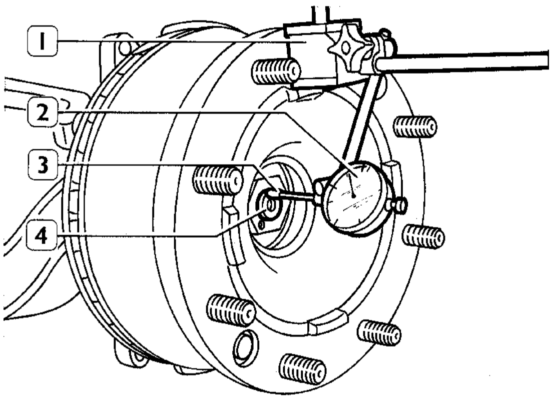


32999

Secure retaining ring (1) screw (2) to the specified torque.

Check wheel hub end play

Figure 43



32998

Hit the wheel hub in axial direction with a mallet and rotate it in both directions in order to release the bearings' rolls.

Set the magnetic base (1) fitted with a gauge (2) on the wheel hub.

Place the gauge pointer (3) perpendicular to the steering knuckle shank (4).

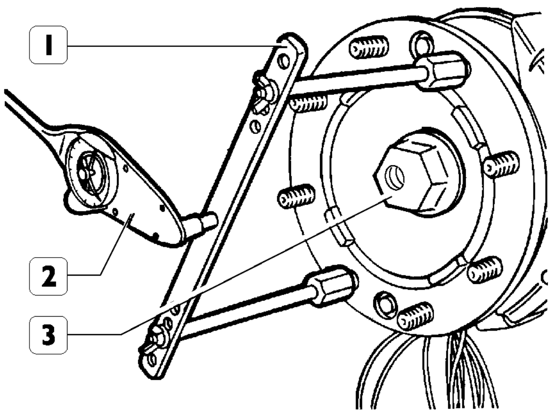
Set the gauge to zero with a preload corresponding to 1.5 ÷ 2 mm.

Move the wheel hub in axial direction by means of a lever and detect the end play which must be 0.16 mm (maximum value).

If the detected value does not correspond to the prescribed one, replace the bearing unit and make a new survey.

Rolling torque survey

Figure 44



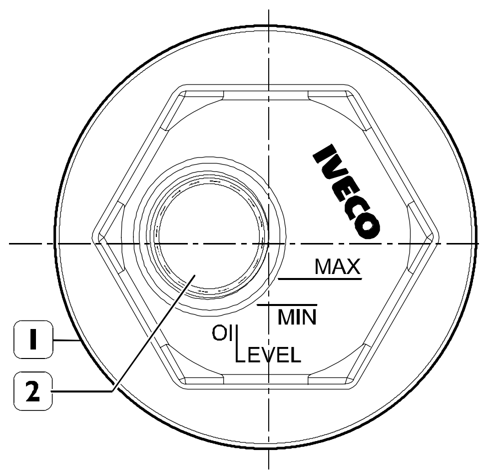
77202

Apply tool (1) 99395026 on wheel hub stud bolts and use torque meter 99389819 (2) to check whether the wheel hub rolling torque is at the set value.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.

Tighten to torque the hub cover (3).

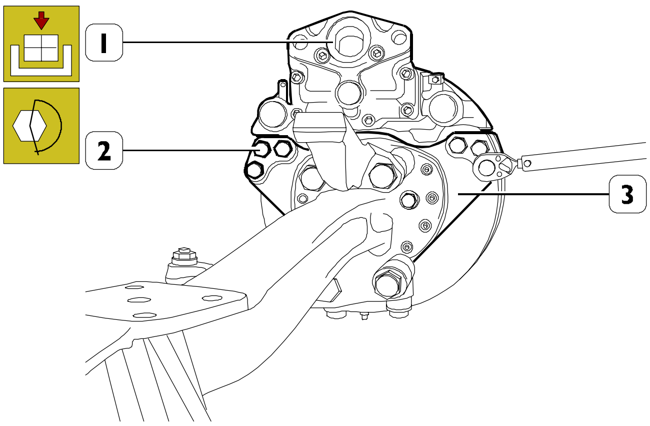
Figure 45



77203

Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

Figure 46

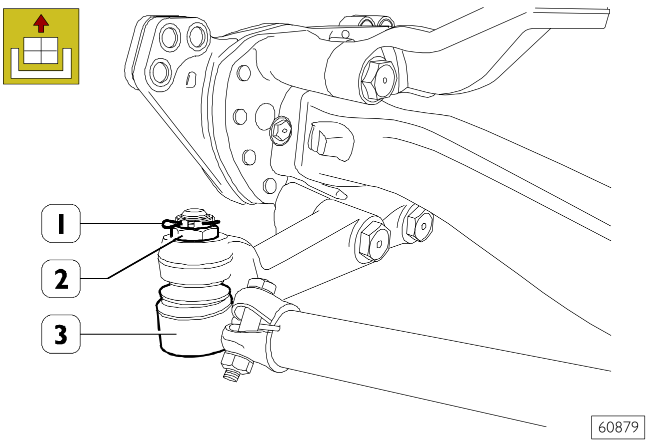


60878

Reattach the brake callipers (1) to the flange (3) and lock the screws (2) according to the prescribed torque. Set braking gaskets following the procedure described in chapter "Wheel hub overhaul" Rear axle section.

520635 Cross tie rod detachment and reattachment

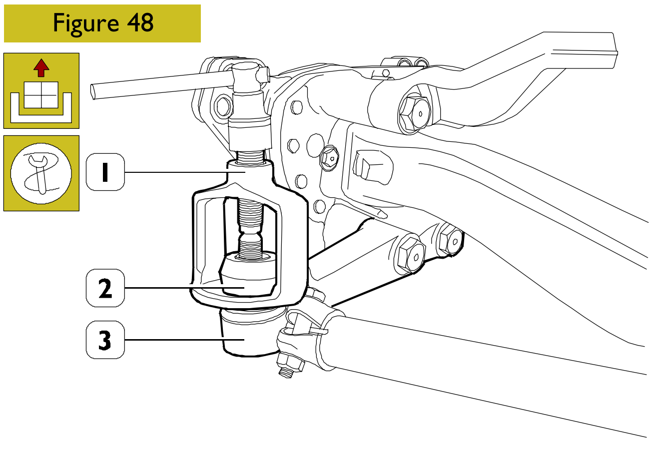
Figure 47



60879

Straighten and take off the split pin (1).
Unlock the nut (2) and release it partially in order to prevent the tie rod (3) from falling when it is removed.

Figure 48



60880

Use extractor (1) 99347068 to unlock the articulated pin (3) from the lever (2). Repeat the same operations on the opposite side, release the nut (2, Figure 47) completely and remove the cross tie rod.

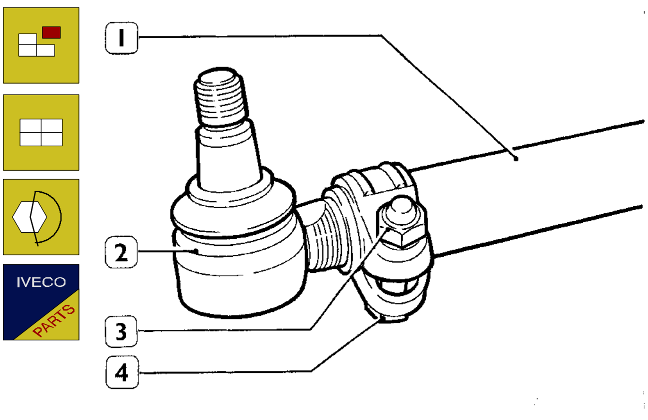
To reattach reverse the detachment operation order.

Clamp the castellated lock nuts of the articulated pins according to the prescribed torque.

Check that the nut grooves match with the cross holes on the articulated pins. If it is not possible to introduce the split pins, gradually raise the nut tightening torque until the split pins are completely put in place (angle lower than 60°).

520636 Replacement of cross tie rod articulated pins

Figure 49



33007

Block the screw (4), release the nut (3) and unscrew the articulated pin (2) from the cross tie rod (1).

Write down the number of turns needed to release every articulated pin in order to screw the new ones making the same number of turns.

Screw the articulated pin (2) in the tie rod (1). The nut (3) must be clamped according to the prescribed torque, after making toe-in adjustment as described in the "Wheel set up" chapter.

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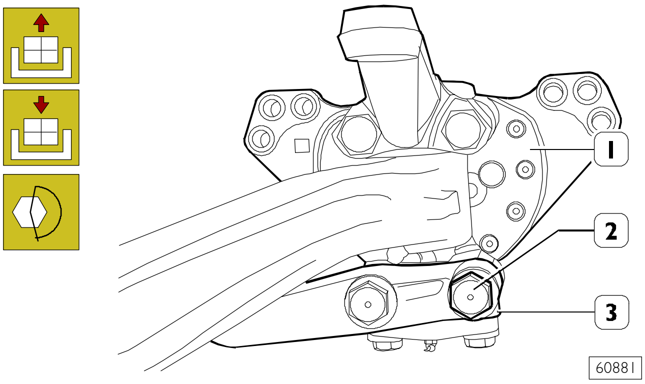
520631 Cross tie rod lever detachment and reattachment

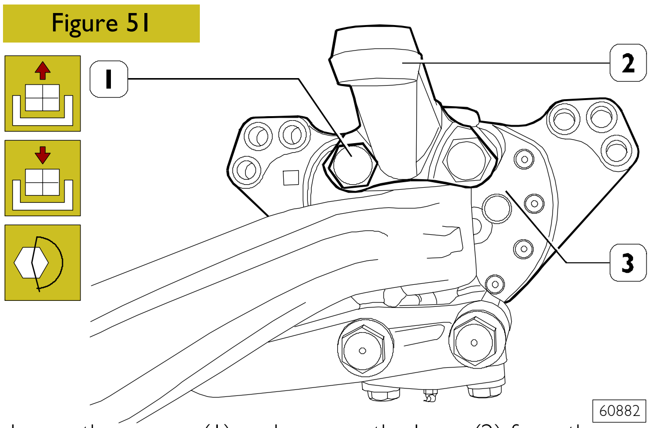
Figure 50



Loose the screws (2) and remove the lever (3) from the articulated pin (1). To make reattachment reverse the operation order and clamp the lock screws (2) according to the prescribed torque.

520632 Longitudinal tie rod lever detachment and reattachment

Figure 51

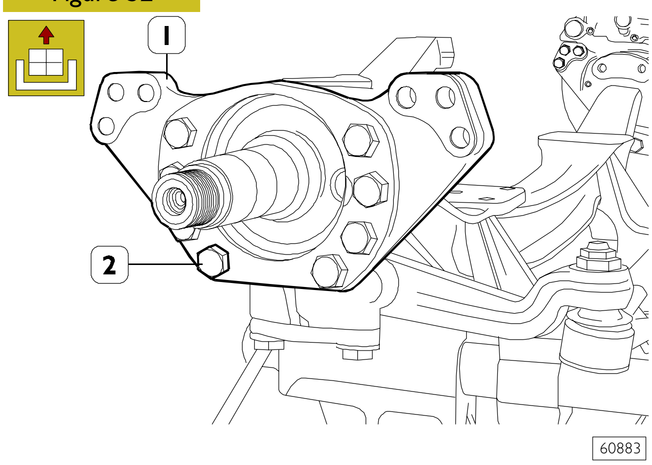


Loose the screws (1) and remove the lever (2) from the articulated pin (3). To make reattachment reverse the operation order and clamp the lock screws (1) according to the prescribed torque.

520611 Steering knuckle pin detachment and reattachment

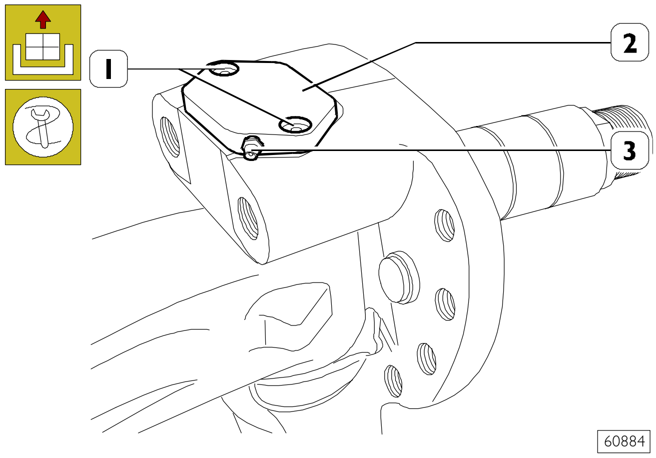
Detachment

Figure 52



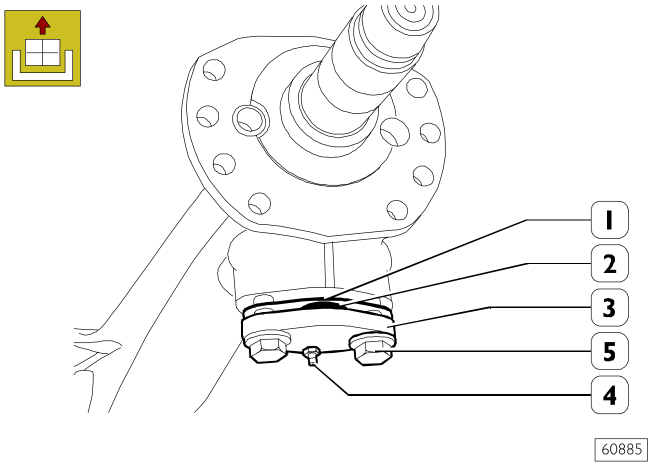
Release the screws (2) and remove the brake callipers support (1) from the axle.

Figure 53



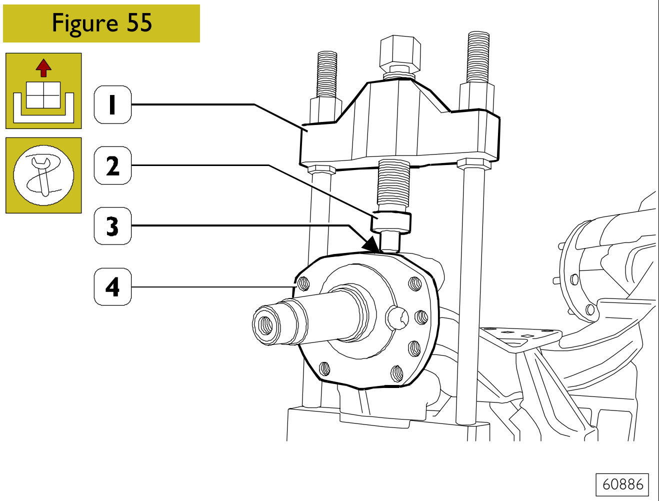
Loose the screws (1) and remove the upper cover (2) together with the lubricator (3).

Figure 54



Release the screws (5) and remove the cover (3) together with the thrust block (2), the adjusting plate (1) and the lubricator (4).

Figure 55



Use tool 99347047 (1) and element (2) to unfasten the steering knuckle (4) articulated pin (3). Remove the tool, take off the pin (3) and remove the articulated joint (4) from the axle.

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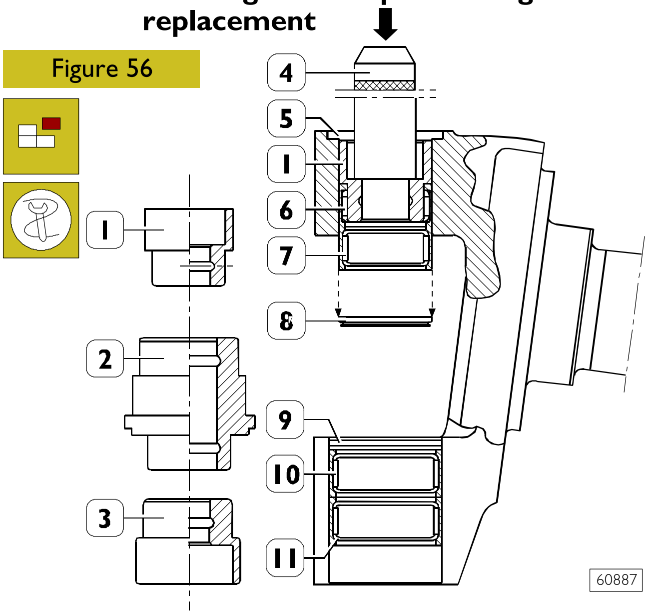
520615 Steering knuckle pin bearing replacement

Figure 56

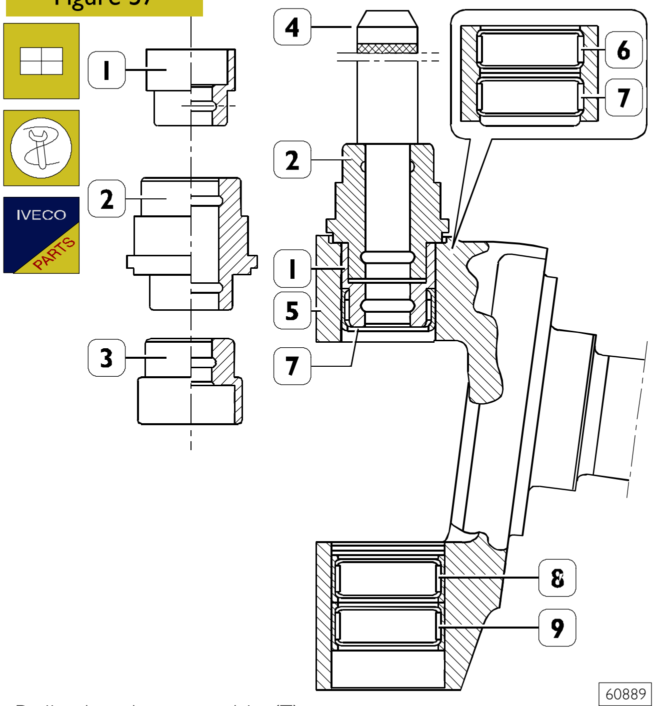


Steering knuckle bearing replacement (5) is made using for their disassembly and assembly beater's elements (1-2-3) 99374527 and handle 99370007 (4).

Use element (1) and handle (4) to disassemble the sealing ring (8) and the roller bearings (6-7) on the upper side.

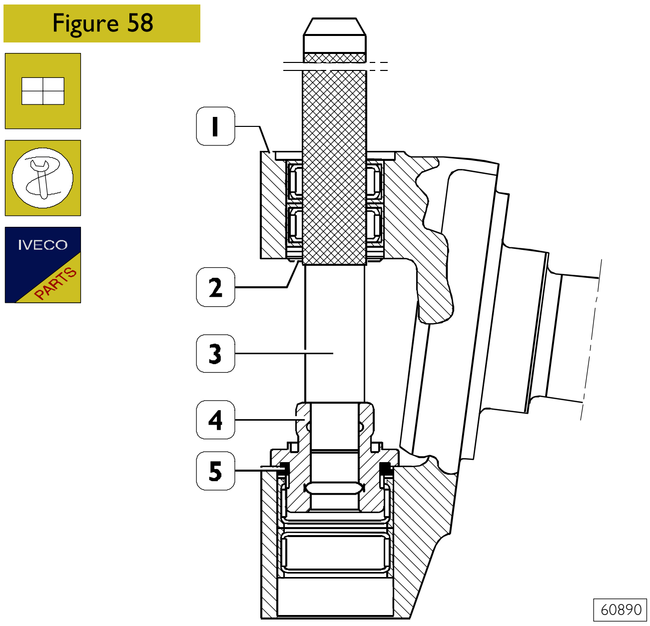
Use element (3) and handle (4) to disassemble the sealing ring (9) and the roller bearings (10-11) on the lower side.

Figure 57



Roller bearing assembly (7):
use element (1 and 2) and handle (4).
Roller bearing assembly (6):
use element (2) and handle (4).
Roller bearing assembly (8):
use elements (3 and 2) and handle (4).
Roller bearing assembly (9):
use element (2) and handle (4).

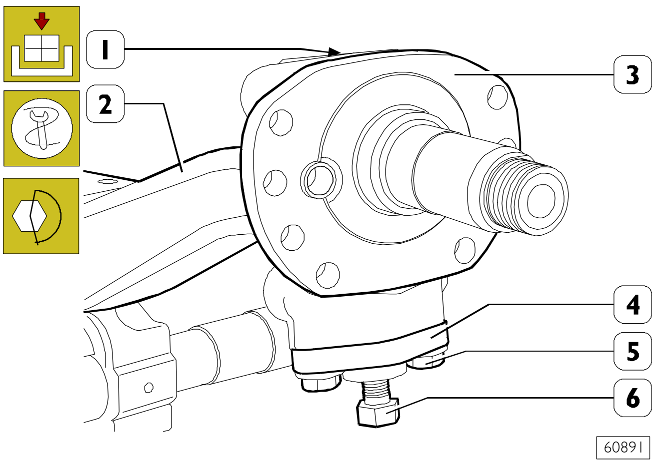
Figure 58



Use beater 99374171 (4) and handle 99370007 (3) to place sealing rings (2 and 5) in the steering knuckle (1).

Reattachment

Figure 59



Set on the axle (2) the steering knuckle (3) and place the articulated pin (1).

Set tool 99374400 (4) on the steering knuckle (3) and fasten it by using the same lower cover lock screws (5), clamping them with the right torque.

Place the pin (1) in the axle conical housing, screwing the pressure screw (6) with a torque having 10 ÷ 11 daNm.

Remove tool 99374400 (4) from the steering knuckle (3).

> ⚠ Before placing the pin (1), it is necessary to check that the conical housing on the axle and the pin surface are perfectly cleaned and dry, in order to avoid oil layers which could foster the pin rotation in its place during its introduction.

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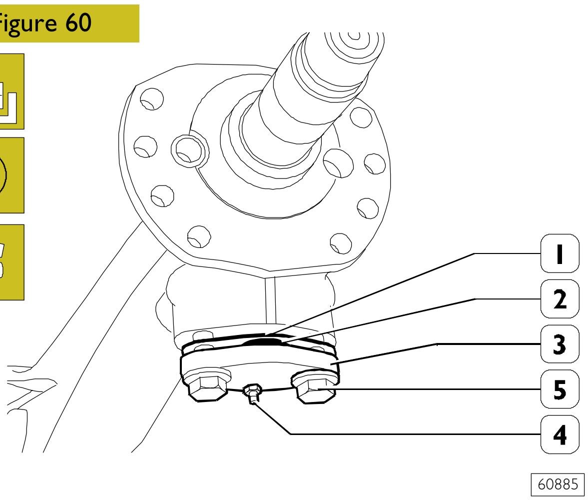
Figure 60

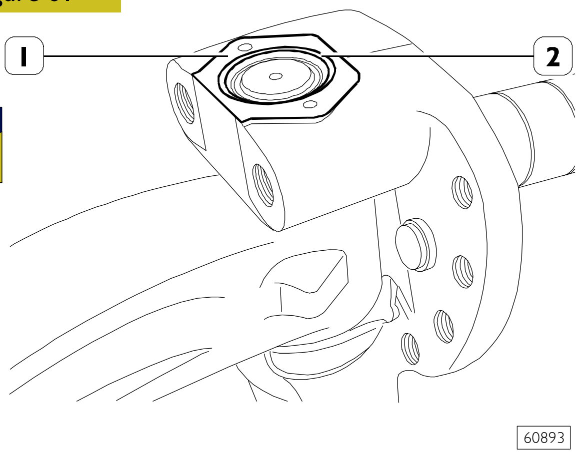


Place the lower cover (3) together with the lubricator (4), the thrust block (2), the adjusting plates (1) and clamp the lock screw (5) according to the prescribed torque.

Before making the assembly, moisten the lower cover (2) thrust block with grease Tutela MR2.

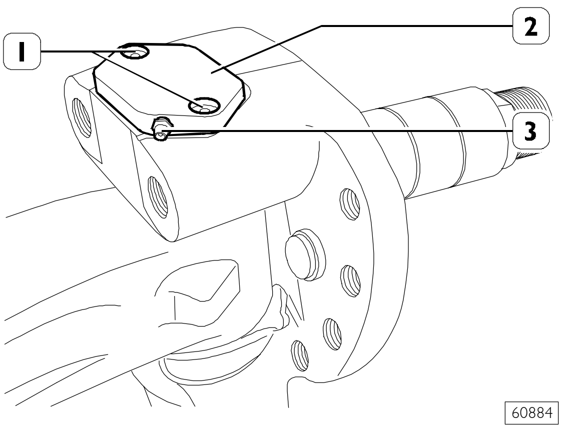
Repeat the same operations for the opposite steering knuckle.

Figure 61



Place in the steering knuckle (1) a new sealing ring (2).

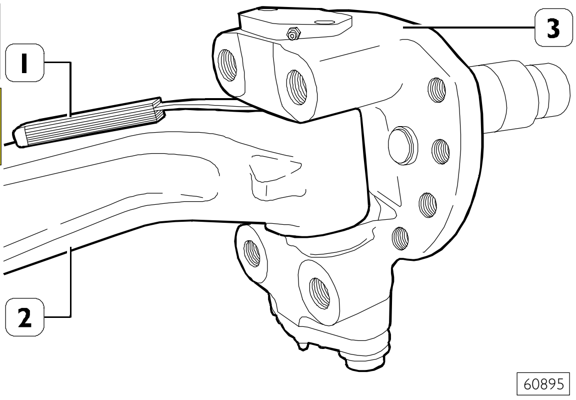
Figure 62



Place the upper cover (2) together with the lubricator (3) on the steering knuckle and clamp the screws (1) according to the prescribed torque.

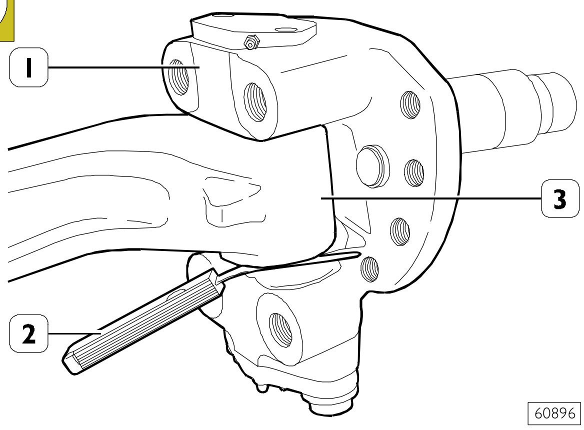
Check and adjustment of clearance between steering knuckle and axle

Figure 63



Keep the steering knuckle (3) raised and use a thickness gauge (1) to check clearance between the upper shim adjustment of the steering knuckle and the axle (2). This value must be between 0.10 and 0.35 mm.

Figure 64



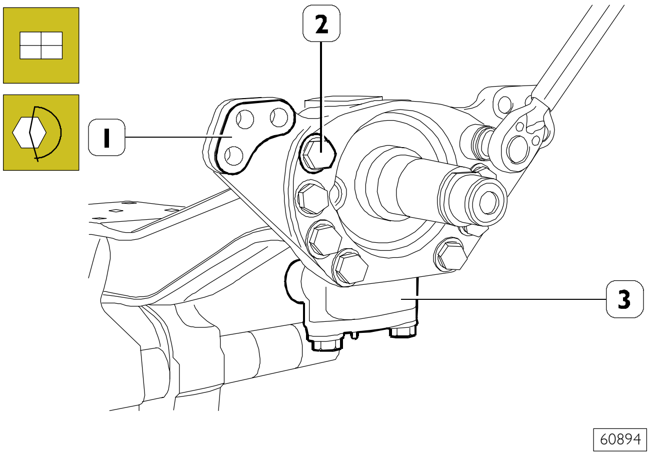
Once the clearance between the upper shim adjustment of the steering knuckle (1) and the axle (3) has been checked, use a thickness gauge (2) to check that between the lower shim adjustment of the steering knuckle (1) and the axle's (3) one there is a gap not lower than 0.25 mm.

The possible clearance adjustment can be done replacing the adjusting shims (1, Figure 60) with spare ones having the right thickness.

As to the thickness of spare rings, see table "SPECIFICATIONS AND DATA".

Lubricate the whole lower and upper articulated joint with grease MR2, checking that the grease flows through the gasket baffle.

Figure 65

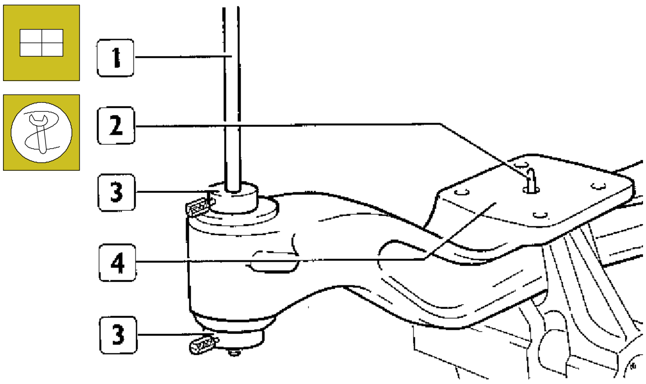


Place the brake callipers support (1) on the steering knuckle (3) and clamp lock screws (2) according to the prescribed torque.
Complete wheel hub assembly as described on page 27.

520618 CHECKS AND MEASUREMENTS OF THE AXLE UNIT

Check flatness of leaf spring surfaces compared to holes for steering knuckle pins.

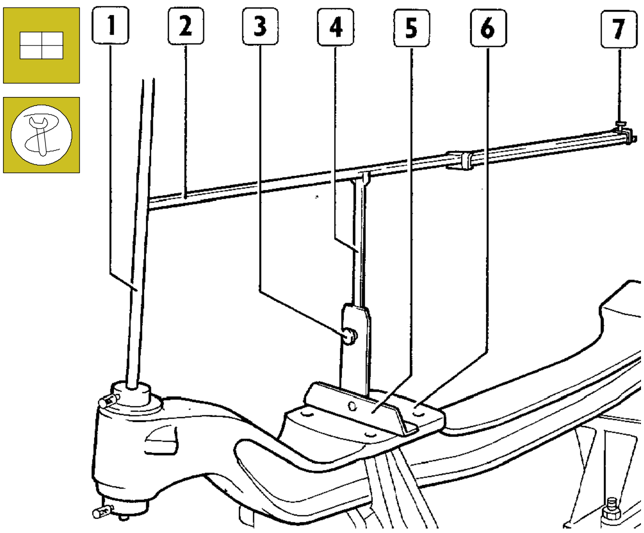
Figure 66



Place two bars (1) fitted with cones (3) in the steering knuckle pin holes. Push the cones and clamp them placing the appropriate screws on the bars.

Introduce two centring dowels (2) in the leaf spring supporting plane (4).

Figure 67



Place on the planes (6) two bases (5) using goniometers and introduce them in the centring dowels.

Before placing the bases with the goniometers, check that the supporting planes are not painted or irregular.

Place the sliding bar (2) on the goniometer's bars (4), adjusting its length so that the shaped edges touch the bars (1).

Clamp the screws of the stop block (7) and the goniometer's lock screws (3) to the bars (4).

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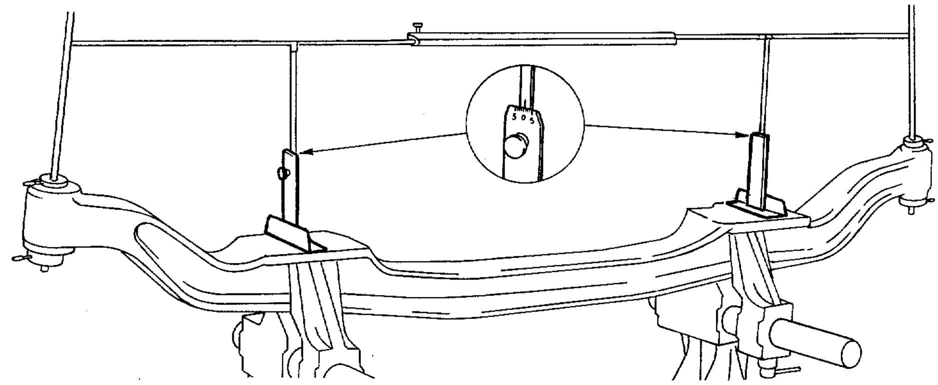
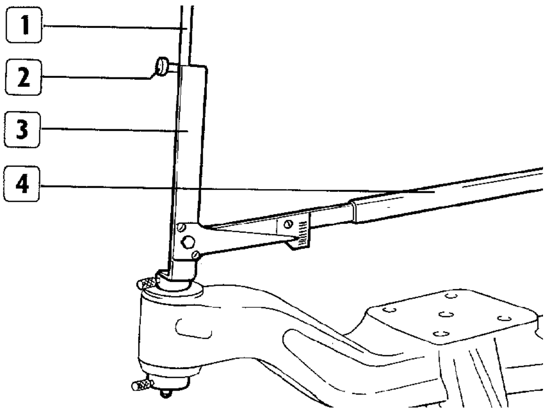
Figure 68



Check the angle of deformation on the goniometers' graduated sectors shown by the arrows.
Goniometers' indexes will, of course, detect no angle movement when the flatness of leaf spring surfaces compared to the steering knuckle pin holes is correct.

Check hole inclination for steering knuckle pins

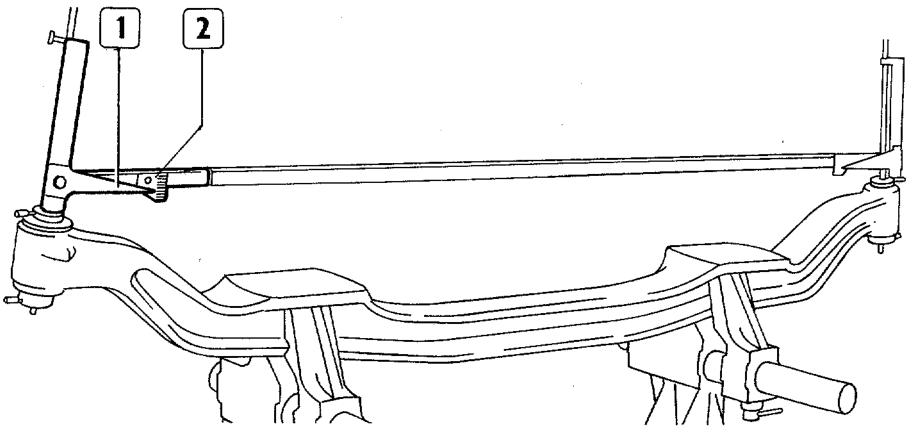
Figure 69



Place on the bars (1) the supports (3) fitted with goniometers and screw the screws (2) without clamping them.
Introduce the connecting cross tie rod (4) and tighten the screws (2) which clamp the supports touching the bars (1).

Remove the sliding bar and the goniometer's bases used to make the survey.

Figure 70



Check the angle of inclination value concerning the steering knuckle pin holes on the related graduated sectors (2), next to the gauge (1). The angle of inclination concerning the steering knuckle pin holes must be 7° ± 0°3'.

5206 Front axles 5842/5 - 5851/5

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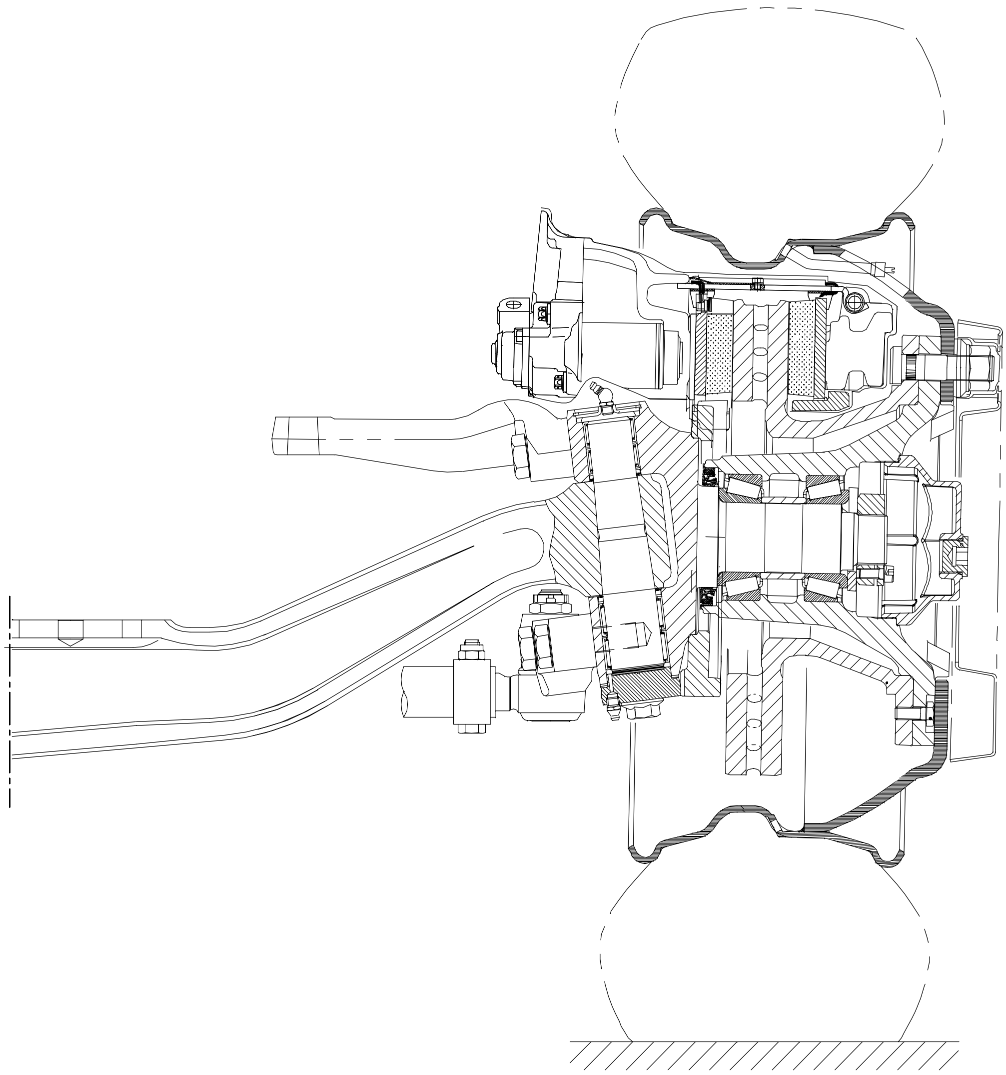
DESCRIPTION

The front axle has a steel structure with a double "T" section having at the end steering knuckles.
The steering knuckles' connection is made through pins integral with the axle body and by means of four roller bearings set with interference in the holes of the steering knuckles' embossing.
The wheel hubs are supported by two conical roller bearings set on the steering knuckle shank and adjustable by a threaded ring.

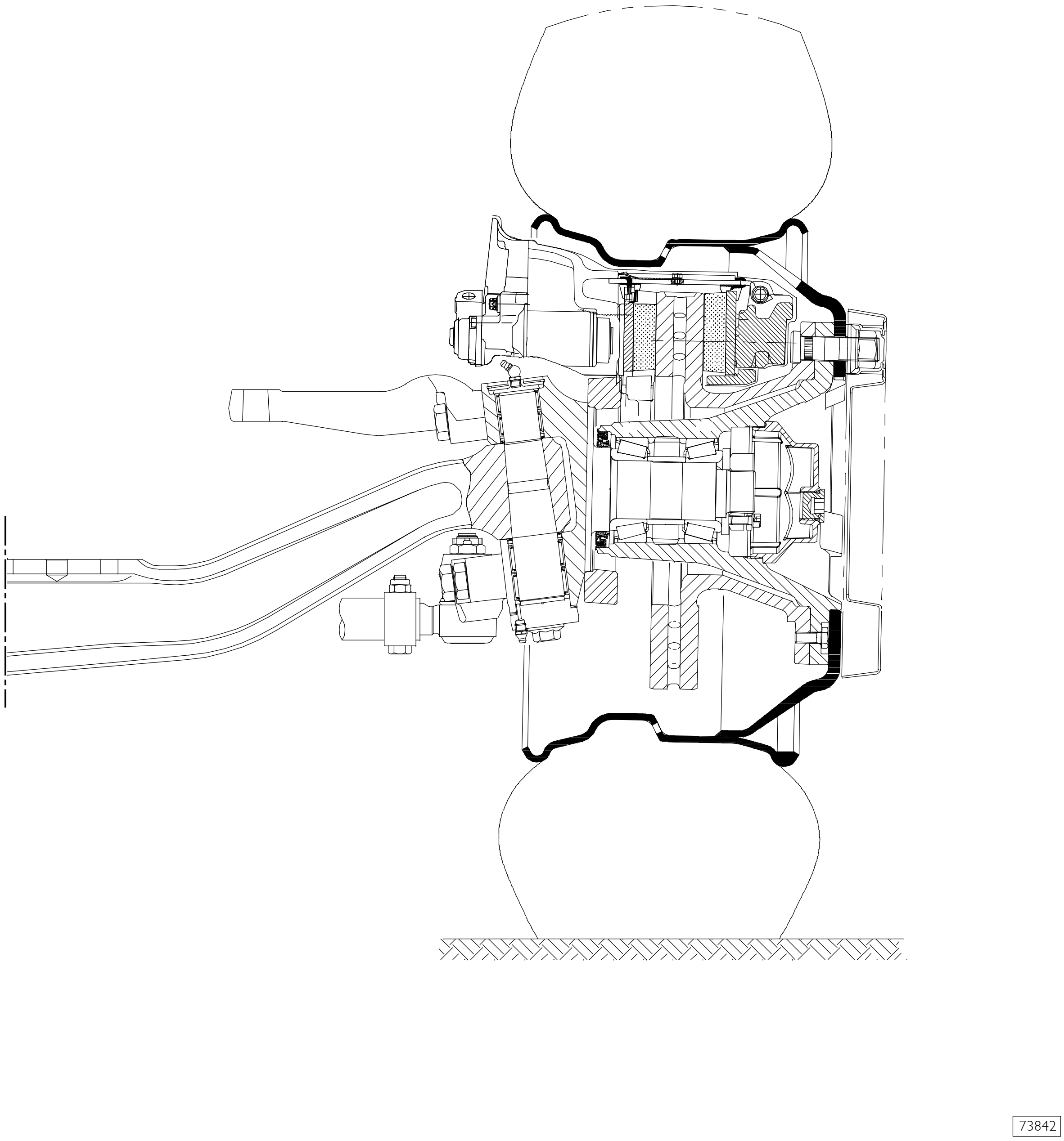
Figure 1



73841

SECTION OF FRONT AXLE 5842/5 (F 5021) WHEEL SIDE

Figure 2



SECTION OF FRONT AXLE 5851/5 (F 5521) WHEEL SIDE

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Characteristic angles

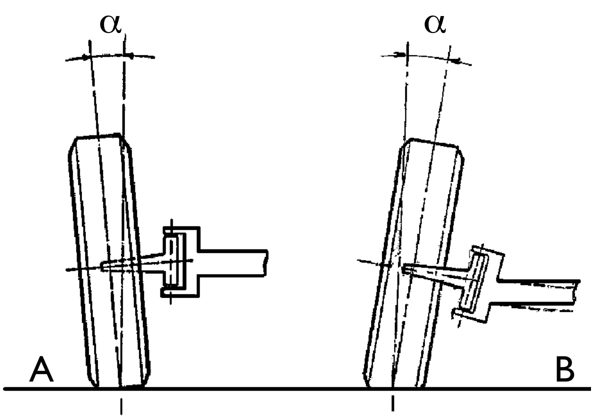
In order to have a good roadholding, a low tyre wear and to enable driving wheels to recover an upright direction after steering, it is necessary to set the wheels according to certain assembly angles:

- wheel angle of inclination
- upright angle of inclination
- clearance angle
- toe-in

Such angles, when correctly calculated, enable the vehicle to maintain the right balance among the various forces involved in its movement, in different loading conditions, which tend to alter the wheel position on the ground.

Wheel angle of inclination

Figure 3



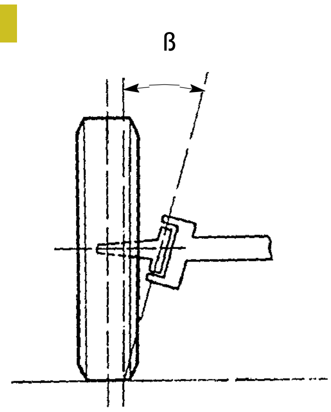
32956

The wheel angle (α) of inclination is the one resulting from the axis passing through the wheel's centre line and the vertical to the ground, looking at the vehicle standing before it.

The inclination is positive (A) when the wheel's upper part moves outside. It is negative (B) when the wheel's upper part moves inside.

Upright angle of inclination

Figure 4



32957

The upright angle (β) of inclination is the one resulting from the axis passing through the upright and the vertical to the ground, looking at the vehicle standing before it.

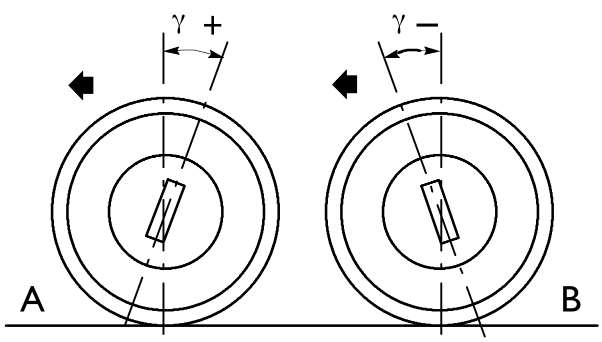
When the extension of the upright axis approaches the wheel when it is touching the ground (opposite direction compared to the wheel's inclination), the angle is positive. It is difficult, if not impossible, to have a negative upright angle of inclination.

The wheel angle (α) of inclination and the upright angle (β) of inclination enable the wheel axis and the upright axis to get closer to the tyre's fulcrum on the ground as much as possible.

As a result, it is possible to reduce the tyre wear and to get a low value of the steering torque.

Clearance angle

Figure 5



32958

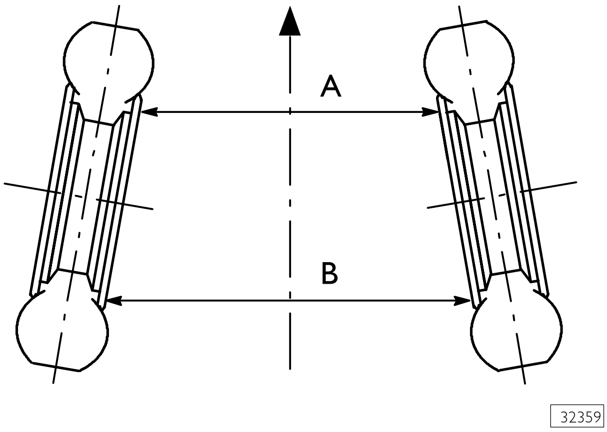
The clearance angle (γ) is the one resulting from the upright axis and the vertical to the ground, looking at the vehicle from one side.

If the extension of the upright axis falls beyond the wheel's fulcrum on the ground in the vehicle's direction, as a rule the clearance angle is positive (A). It is considered negative (B) if it falls behind the wheel's fulcrum on the ground. It is null if it is absolutely perpendicular to the wheel's fulcrum on the ground.

Such an angle enables front wheels to keep an upright position when the vehicle is moving in an upright direction and to recover such a position after taking a curve as soon as the steering wheel is released by the driver.

Toe-in

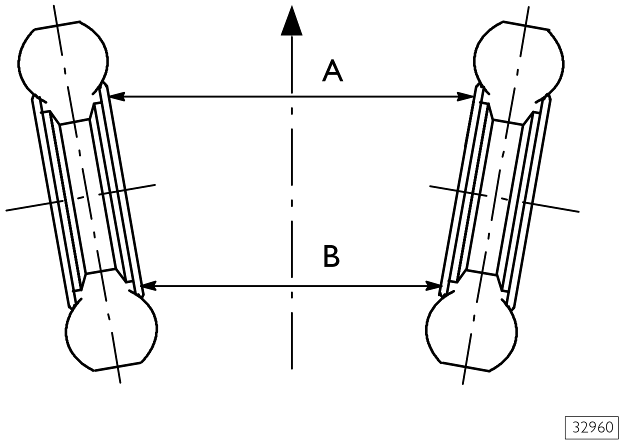
Figure 6



Toe-in results from the difference between distance A and B (value expressed in mm) measured on the rims' horizontal axis, looking at the vehicle from above.
In this way it is possible to drive easily and to reduce the tyre wear.

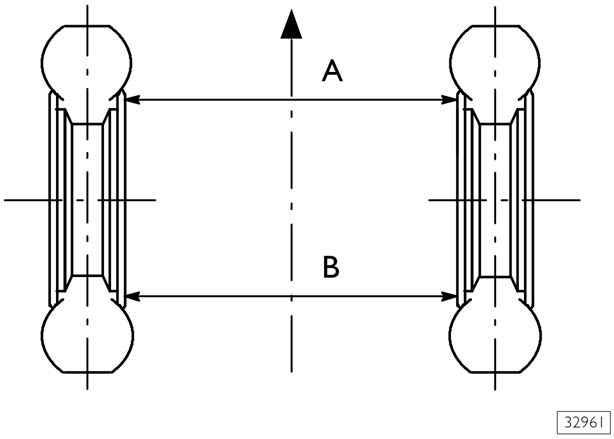
Toe-in is positive if B is bigger than A.

Figure 7



Toe-in is negative if B is lower than A.

Figure 8



Toe-in is zero if B corresponds to A.

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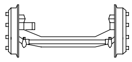
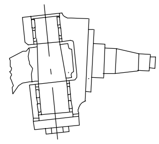
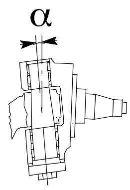
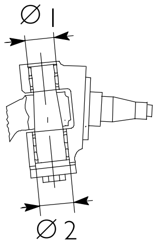
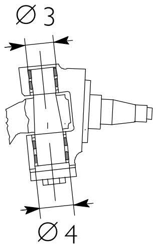
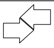
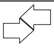
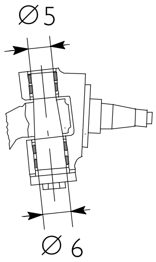
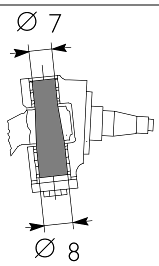
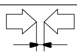
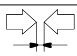
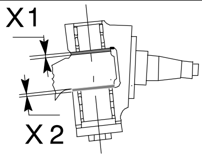
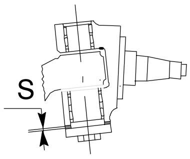
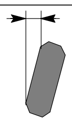
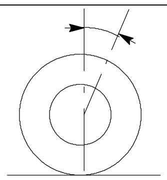
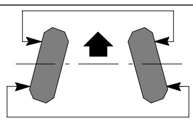
SPECIFICATIONS AND DATA

	Axle type		5842/5 (F 5021)	5851/5 (F 5521)
	**STEERING KNUCKLE PINS**			
	Inclination of steering knuckle pin housing		7° ± 3'	
	Diameter of roller bearing housing in steering knuckle: - upper housing Ø 1 - lower housing Ø 2	 mm mm	 41.972 to 41.988 51.967 to 51.986	
	Outside diameter of roller bearings for steering knuckle: - upper bearings Ø 3 - lower bearings Ø 4	 mm mm	 42 52	
	Upper bearings – steering knuckle	mm	0.012 to 0.028	
	Lower bearings - steering knuckle	mm	0.014 to 0.033	
	Inside diameter of roller bearings for steering knuckle: - upper bearings Ø 5 - lower bearings Ø 6	 mm mm	 35 43	
	Diameter of pin for steering knuckle - upper Ø 7 - lower Ø 8	 mm mm	 34.984 to 35.000 42.984 to 43.000	
	Upper bearings – pin	mm	0 to 0.016	
	Lower bearings – pin	mm	0 to 0.016	

			5842/5 (F 5021)	5821/5 (F 5521)
	Clearance between axle and steering knuckle upper adjustment X1	mm	0.10 to 0.35	
	Gap between axle and steering knuckle lower adjustment X2	mm	≥ 0.25	
	Adjusting plates X1, X2			
	0.25 mm S	mm	0.50 to 1.75	
	WHEEL HUBS			
	Wheel hub bearings		2 with tapered rollers	
	Hub bearing end play	mm	max 0.16	
	Wheel hub clearance		by means of a metal ring	
	Bearing preloading	daNm	0.30	
	Oil for wheel hub bearings		Tutela W 140/MDA	
	Quantity per hub		Litres 0.23 kg 0.207	
	WHEEL SET UP			
	Wheel inclination (vehicle with static load)		1°	
	Wheel incidence (vehicle with static load)		1° 24"	
	Toe-in (vehicle with static load)	mm	0.5 to 1.5	

DIAGNOSTICS

Main malfunctioning of front axle:

1 – Steering wheel hardness
2 – Wobble
3 – Noise

1	STEERING WHEEL HARDNESS

Check		Remedy
Front axle perfectly aligned.	NO	Reset alignment and clamp lock nuts of spring bands.
YES ↓		
Regular toe-in.	NO	Make exact toe-in adjustment.
YES ↓		
Regular tyre pressure.	NO	Inflate tyres according to prescribed pressure.
YES ↓		
Good joint lubrication.	NO	Lubricate joints accurately.
YES ↓		
Right adjustment between steering knuckle and axle.	NO	Correctly adjust clearance between steering knuckle and axle.
YES ↓		
Efficient elements involved in steering knuckle rotation on the pin.	NO	Check and replace worn elements.

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2	WOBBLE

Condition		Action if NO
Regular wheel incidence.	NO →	Check axle assembly, fix or replace distorted elements.
YES ↓		
Front axle perfectly aligned.	NO →	Reset alignment and clamp spring band nuts on the axle.
YES ↓		
Regular toe-in.	NO →	Make correct toe-in.
YES ↓		
Efficient steering heads of track rods.	NO →	Replace defective elements.
YES ↓		
Regular clearance of wheel hub bearings.	NO →	Adjust end play after making appropriate replacements.
YES ↓		
Centred wheels: ❑ centred, regular rim ❑ correct assembly of tyre on rim.	NO →	Replace defective rim. Deflate and centre tyre on rim.
YES ↓		
Balanced wheels.	NO →	Make wheel balancing.

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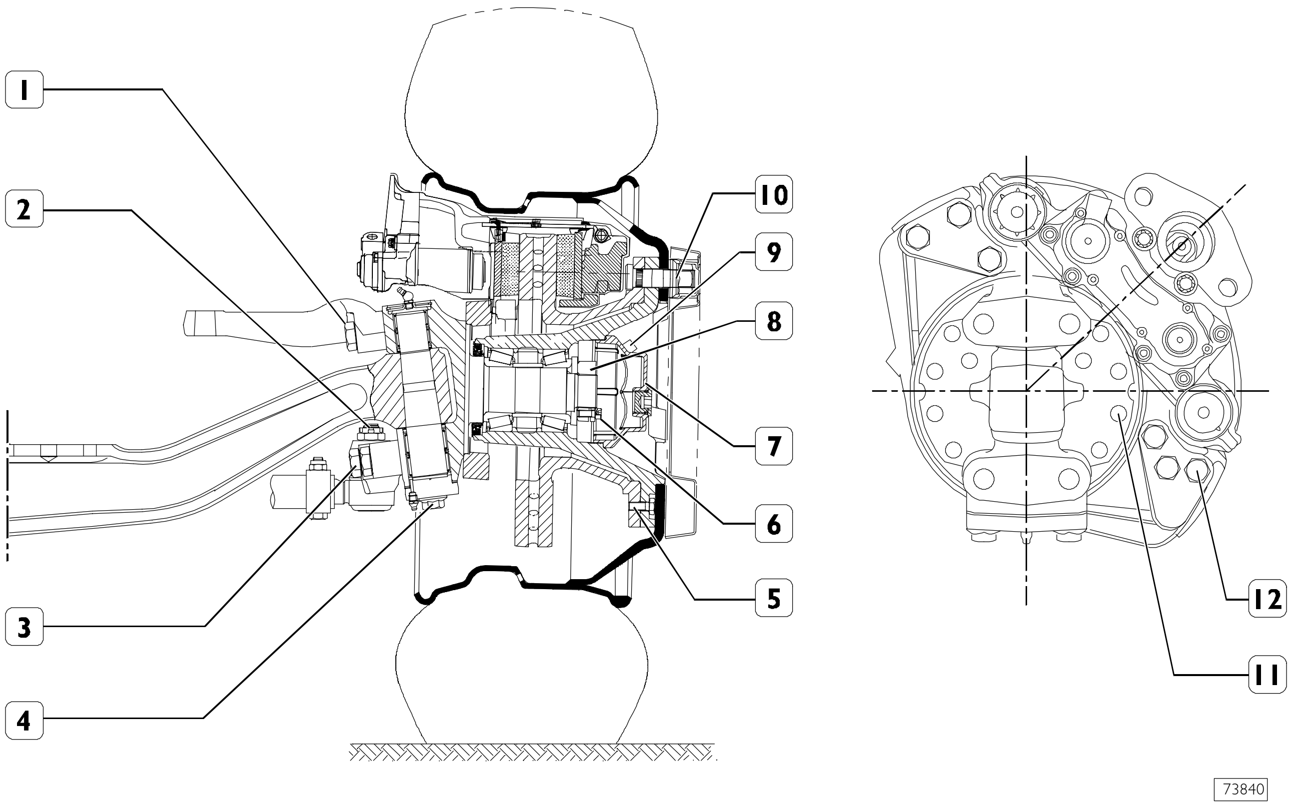
3	**NOISE**

Good lubrication of wheel hub bearings.	NO →	Top up oil in wheel hubs.
YES ↓		
Efficient wheel hub bearings.	NO →	Replace worn bearings and adjust end play.
YES ↓		
Regular clearance between steering knuckle pin and roller bearings.	NO →	Check and replace worn elements.

TIGHTENING TORQUES

Figure 9



PART			TORQUE Nm	(kgm)
1	Self-braking hexagonal head cap screw to clamp cross tie rod lever on steering knuckle		515.5 ± 24.5	(52.6 ± 2.5)
2	Castellated nut for articulated joint pin		201 ± 20	(20.5 ± 2)
3	Self-braking hexagonal head cap screw to clamp longitudinal lever on steering knuckle		515.5 ± 24.5	(52.6 ± 2.5)
4	Flanged hexagonal head cap screw to clamp lower thrust block cover on steering knuckle		336 ± 17	(34.2 ± 1.7)
5	Hexagonal head cap screw to clamp brake disc on wheel hub		40 ± 4	(4 ± 0.4)
6	Socket head cap screw to fasten wheel bearing adjusting clamp		27.5 ± 2.5	(2.8 ± 0.2)
7	Wheel hub cover		133.5 ± 13.5	(13.6 ± 1.3)
8	Wheel bearings securing ring nut		388.5 ± 18.5	(39.7 ± 1.9)
9	Tapered threaded plug for wheel hub cover		27 ± 2	(27.5 ± 2)
10	Wheel lock nuts	Axle 5842/5 (vehicles 130)	490 ± 50	(49.9 ÷ 5)
		Axle 5851/5 (vehicles 150)	627,5 ± 62,51	(63.9 ÷ 6.4)
11	Self-locking hexagonal-head screw for fastening the brake backing plate to the steering knuckle		313 ± 16	(32 ± 1.6)
12	Self-locking hexagonal head screw for fastening disk brake calipers to the plate		313 ± 16	(32 ± 1.6)

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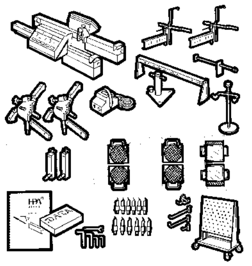
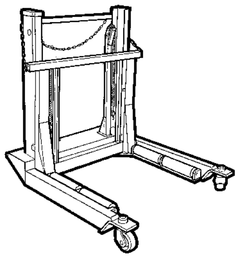
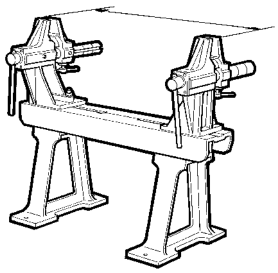
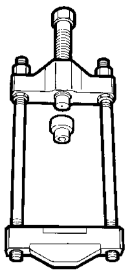
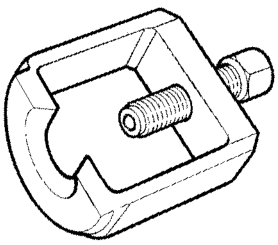
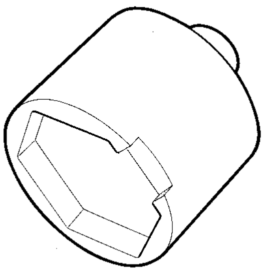
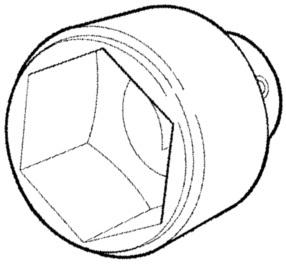
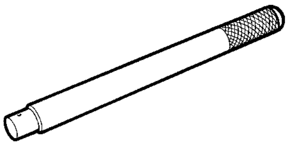
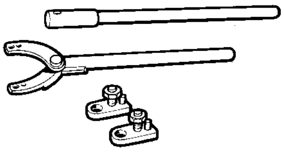
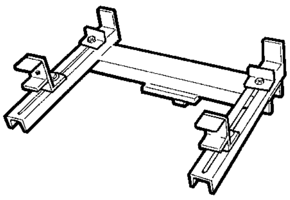
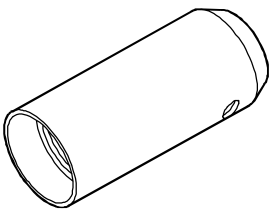
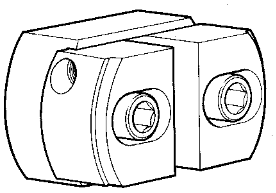
TOOLS

TOOL No.		DESIGNATION
99305354		Portable optical equipment to check wheel attitude
99321024		Hydraulic truck for wheel detachment and reattachment
99322215		Stand for axle overhaul
99347047		Tool for steering knuckle pin removal
99347068		Extractor for track rod head pins
99354207		Wrench (94.5 mm) for wheel hub cups

TOOLS

TOOL No.		DESIGNATION
99355038		Wrench (65 mm) for wheel hub bearing adjusting nut (to be used with 99370317)
99370007		Handle for interchangeable beaters
99370317		Reaction lever with extension for flange holder
99370628		Support for axle detachment and reattachment
99370714		Rail for wheel hub assembly
99374093		Beater for assembling external bearing race (91-134) use with 99370007

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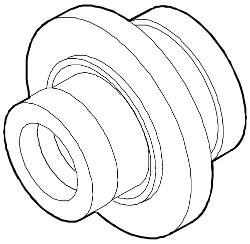
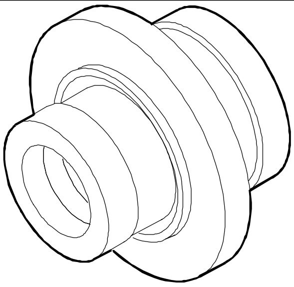
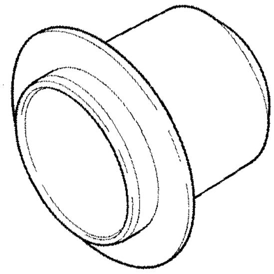
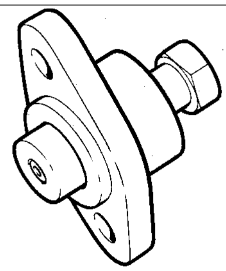
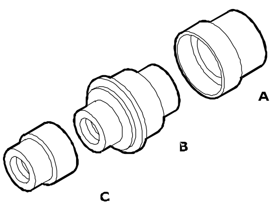
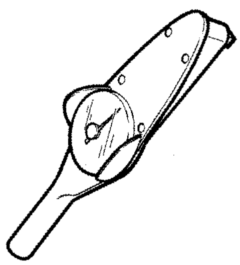
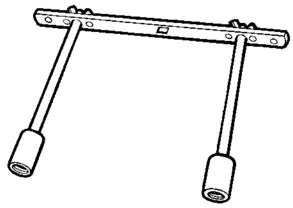
TOOLS

TOOL No.		DESIGNATION
99374172		Locking ring for assembly of upper steering knuckle pin gasket (to be used with 99370007)
99374173		Locking ring for assembly of lower steering knuckle pin gasket (to be used with 99370007)
99374233		Locking ring for assembly of inside wheel hub gasket
99374400		Tool for steering knuckle pin setting
99374529		Beater for disassembly and reassembly of steering knuckle pin bearings (to be used with 99370007)
99389819		Dynamometric wrench (0 to 10 Nm) with square 1/4" connection

TOOLS

TOOL No.		DESIGNATION
99395026		Tool for hub rolling torque check (to be used with dynamometric wrench)

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FRONT WHEEL SET UP

Before checking, it is necessary to make a preliminary investigation of some vehicle elements which can affect set up. If any fault is detected, it is important to eliminate it in order to avoid wrong measurements.
The checks to be made are the following:

- ❑ tyre pressure;
- ❑ wheel hub bearing clearance;
- ❑ clearance between track rod pins and levers on steering knuckles;
- ❑ shock-absorber efficiency;
- ❑ wheel rims must not be dramatically distorted.

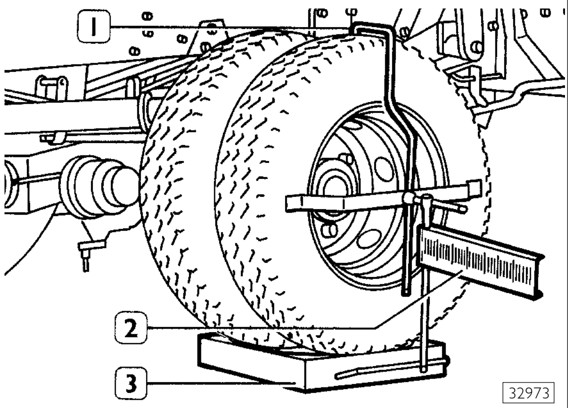
Make wheel set up check using equipment 99305354.

Checks and possible adjustments of wheel set up must be made with the vehicle having static load.

By and then, check perfect calibration of optical units.

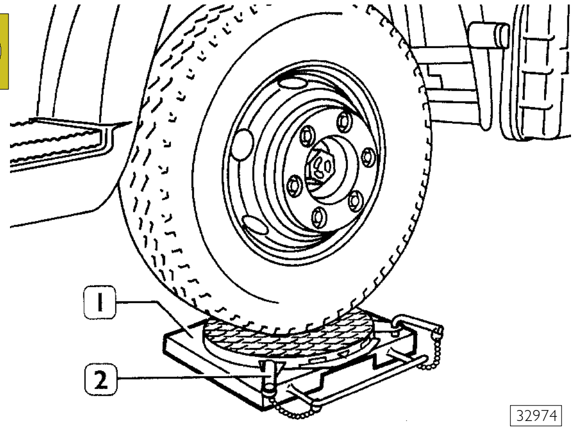
Setting of clips and headlights

Figure 10



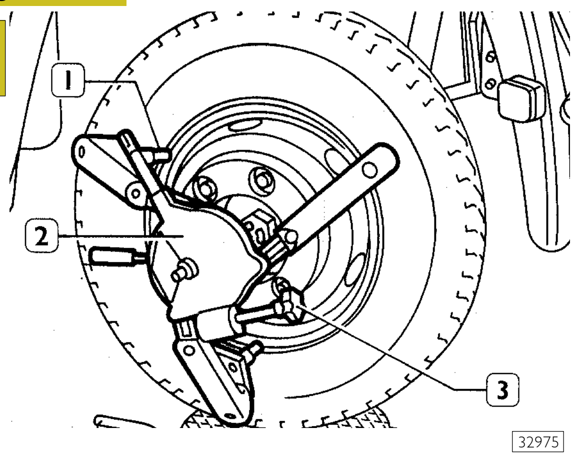
Place the vehicle with the wheels in upright direction on a flat surface. Lift the vehicle's rear part and place the platforms under the wheels (3). Lower the vehicle, brake the rear wheels and set the hook (1) with the ruler (2).

Figure 11



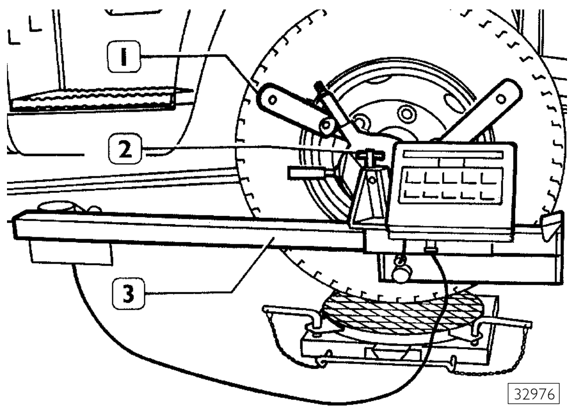
Lift the vehicle's front part and place the swinging plates (1) under the wheels, clamping them with the appropriate locks (2).

Figure 12



Place on the wheel rim the self-centring clip (2) fitted with the right lock pins (1). Use the handle (3) to clamp the clip on wheel, checking that the wheel itself is well fixed.

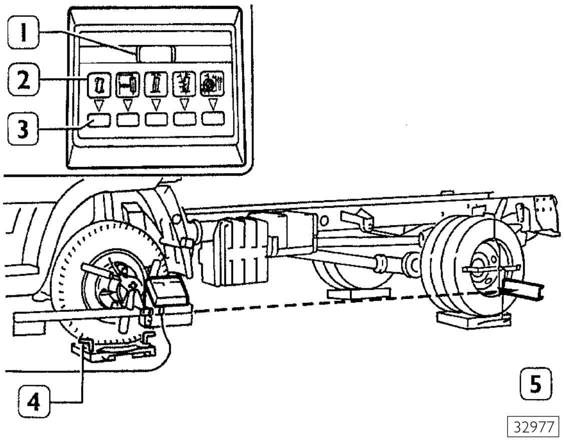
Figure 13



Set the detecting system (3) on the clips (1) and clamp it with the screw (2). Repeat the same operations on the other wheel.

Electronic compensation for rim maladjustment

Figure 14

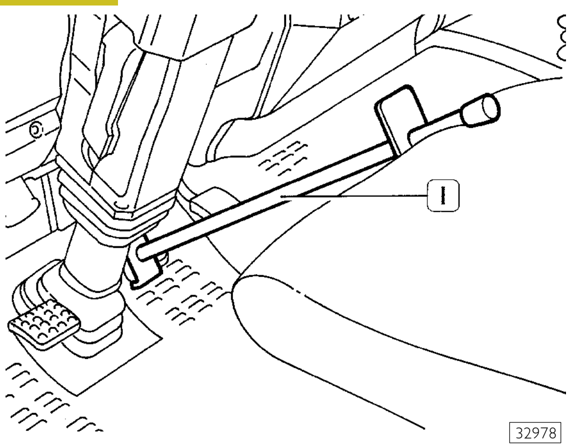


Connect detectors' plugs to the transformer and switch it on. Release the detector's lock screw and lift the lens cover. Push the button "off centre" (3) for at least two seconds, five lines will be displayed on the digital (1) indicator.
Slowly rotate the wheel by hand and project the light signal on the corresponding ruler scale (5).
Detect and write down the minimum and maximum excursion of the light signal: e.g. 12 and 8.
Calculate the excursion's average value: 12 + 8 = 20 : 2 = 10 and place the wheel according to the calculated average value, marking the new position.
Push again the button "off centre" (3) until the wheel inclination led (2) is switched on and on the digital indicator a fake value is displayed.
Repeat the same operations on the other wheel.

Be careful that the laser ray does not hit people's eyes: it would severely harm their sight.

Lower the vehicle so that the wheels, being in the marked position, touch completely the centre of the swinging plates and release the latter from the related bases by removing the pins (4).

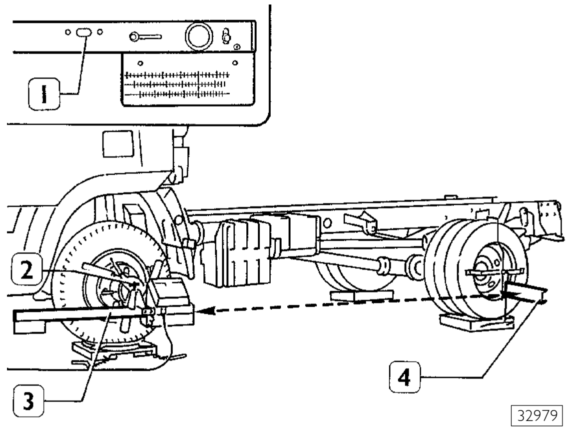
Figure 15



Push the brake pedal and leave it in this position using the appropriate tool (1) set against the seat, thus keeping the vehicle braked during the whole measurement.

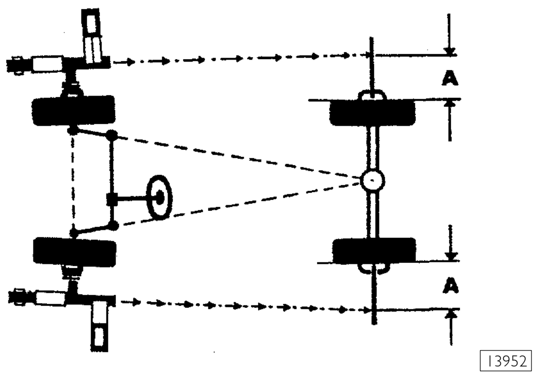
Wheel alignment

Figure 16



Balance detectors (3) by using the spirit level (1) and clamp them in this position by the screw (2).
Move the rulers (4) until they are hit by the light signal released by the detector and write the indicated values.

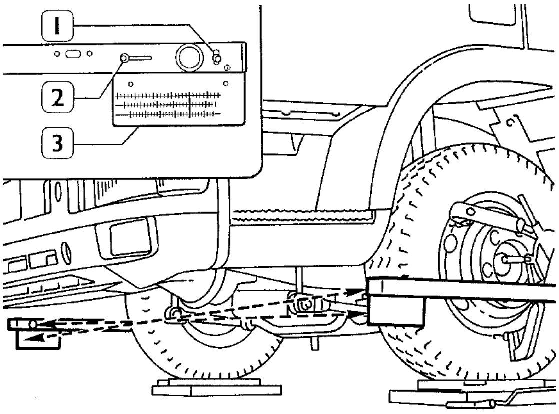
Figure 17



If the values are different, turn the wheels until the light signal indexes reach two equal values (A) and the exact average value resulting from the two previous detections. In such a way it is possible to obtain a perfect wheel alignment.

Toe-in check

Figure 18



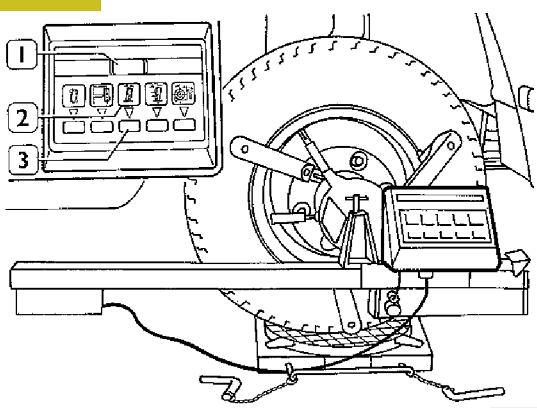
32980

Still having detectors perfectly balanced and the wheels completely aligned, use a lever (1) to move the lens cover.
Move the lever (2) and point the light signal index to the ruler's graph scale (3) corresponding to the rim's diameter.
Repeat the same operations with the opposite detector and read the toe-in values expressed in millimetres on the graph scales.
The algebraic sum of the two detected values must amount to: 0.5 ÷ 1.5 mm with static load.

Toe-in adjustment is made affecting the cross tie rod.

Check of wheel inclination (Camber)

Figure 19



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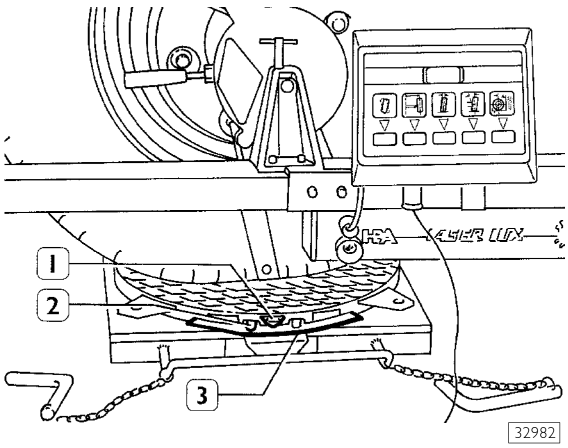
If the front wheels are aligned with the rear ones and the detectors are balanced, push the wheel inclination button (3) and the led (2) will be switched on. The digital indicator (1) will give the value of the angle of inclination which must be 1°.

The wheels' angle of inclination is a fixed value which cannot be adjusted.
Therefore, if a different value is detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check upright angle of inclination (King Pin) and clearance angle (Caster)

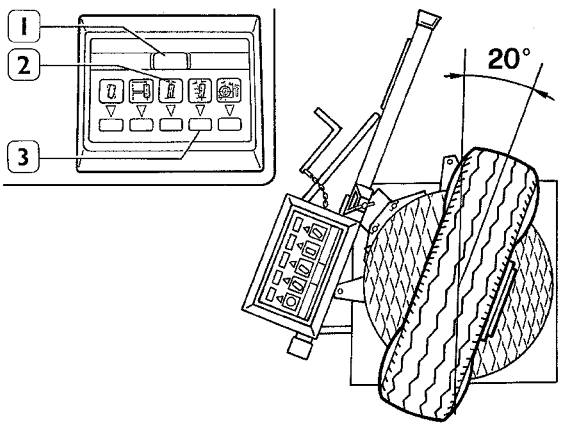
Figure 20



32982

Still having the front wheels aligned with the rear ones, loose knurled knobs (2) and set to zero the graduated sector (3) on the swinging plate's index (1).

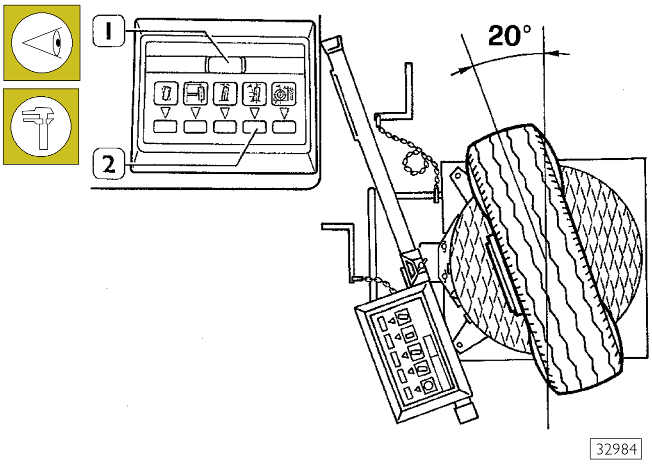
Figure 21



32983

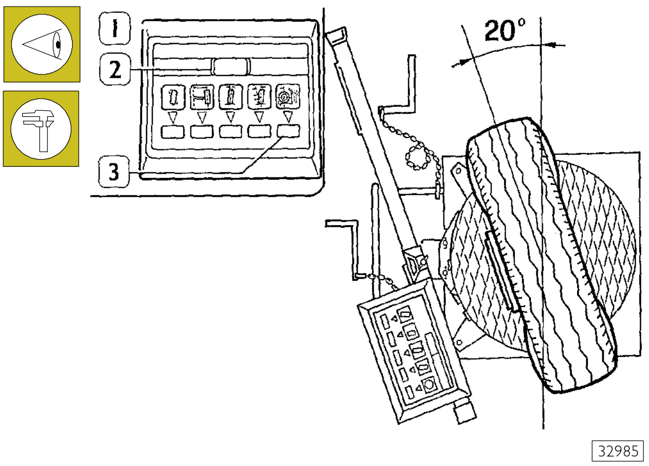
Turn the wheels inwards by 20° and push twice the upright inclination button (3), the led (2) will be switched on and nine horizontal lines will appear on the digital indicator (1).

Figure 22



Turn the wheels outwards by 20° and push again the upright inclination button (2), the digital indicator (1) will display the value of the upright angle of inclination (King Pin) which must be 7°.

Figure 23

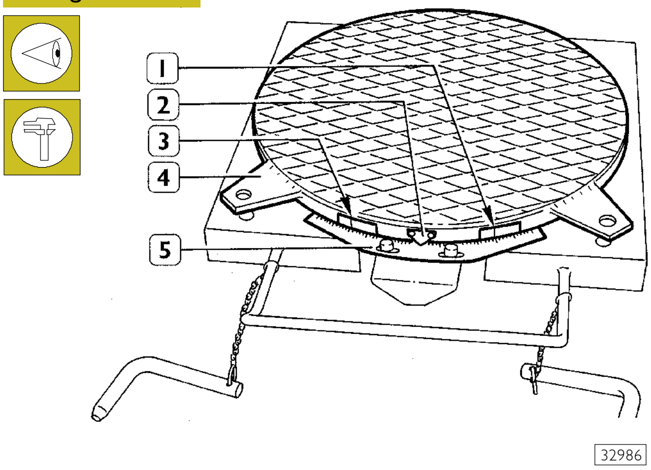


Without moving the wheel, push the clearance angle button (3). The led will be switched on (1) and the digital indicator (2) will display the value of the clearance angle (Caster) which must be 2°30'.

The upright angle of inclination and the clearance angle are fixed values which cannot be adjusted. Therefore, if different values are detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check steering angles

Figure 24



With the wheels in upright direction, set to zero the graduated sectors (5) on the index (2) of the swinging plates (4).

If the steering angles which must be detected are bigger than 30°, it is necessary to use as "0°" reference indexes the 20° sign (1) placed on the swinging plate and the corresponding one on the graduated sector.

Turn the inside wheel according to the prescribed value and check that the outside wheel's angle corresponds to the prescribed value, considering that to make the survey it is necessary to use as "0°" reference indexes the 20° sign (3) placed on the swinging plate and the corresponding one on the graduated sector.

Repeat the same operations and check steering of the opposite wheel.

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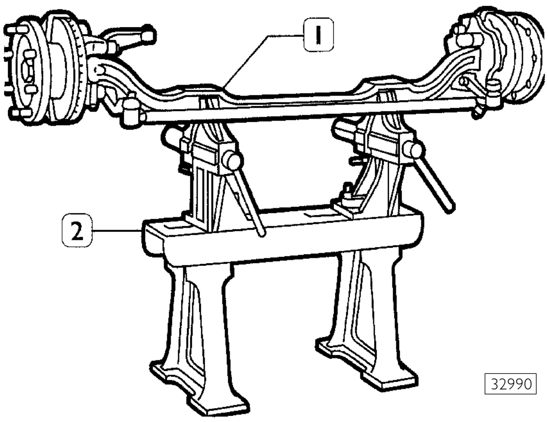
520610 OVERHAUL OF THE FRONT AXLE ASSY

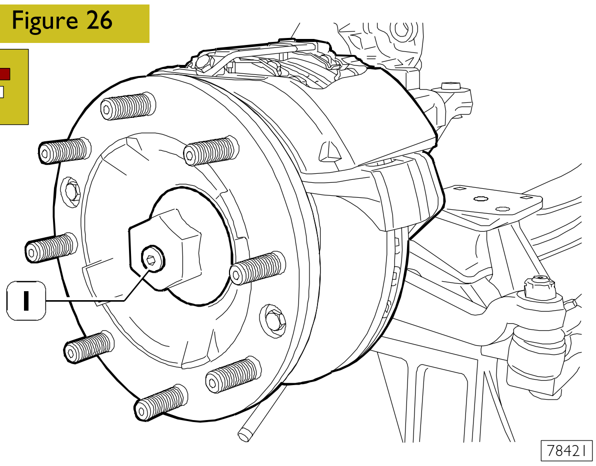
Figure 25



Use a lifter to place and clamp the axle assy (1) on stand 99322215 (2) in order to make overhaul.

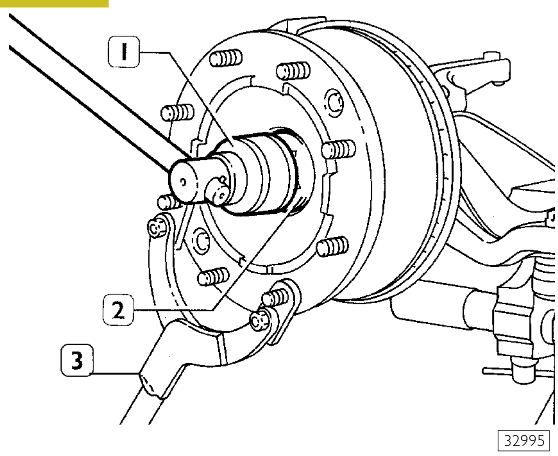
520620 Removal and refitting of wheel hubs

Figure 26



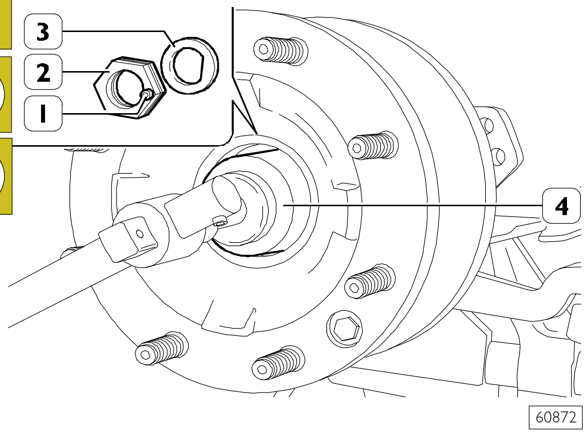
Rotate wheel hub in order to set the screw plug (1) down; unscrew plug and drain oil into a special container. Take off the brake calipers.

Figure 27



Use reaction lever 99370317(3) to stop the wheel hub rotation and use wrench 99354207 (1) to release the cover (2).

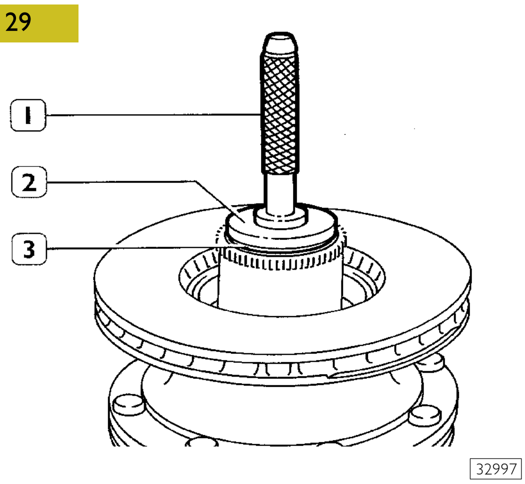
Figure 28



Loosen screw (1), unscrew adjusting ring (2) by means of wrench 99355038 (4), take out washer (3), the tapered-roller bearing and the spacer, then take off the wheel hub in the proper way.

Sealing ring replacement

Figure 29

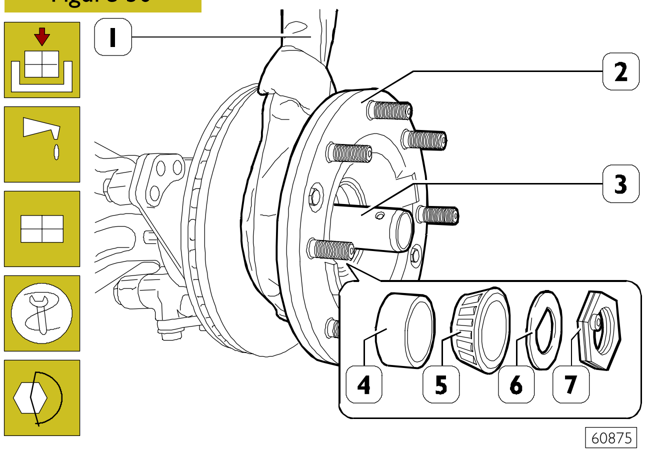


With generic tools, extract sealing ring (3).
Moisten the edges with oil.
With keyer 99374233 (2) and handle (1), assemble the sealing ring into its own wheel hub seat.

Wheel hubs refitting

Check that the surfaces of all elements inside the hub are accurately cleaned, without slag and burrs.

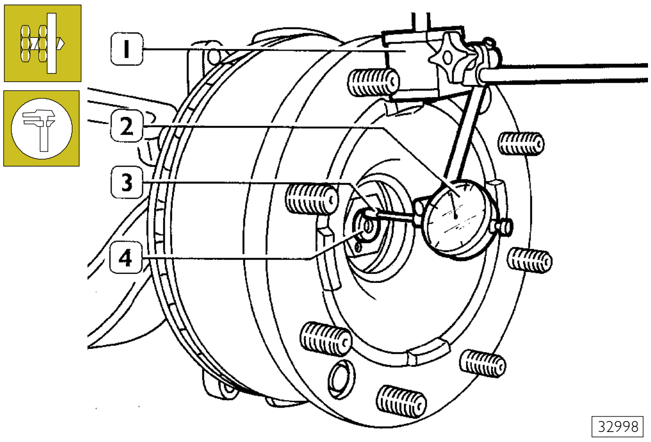
Figure 30



Screw on the steering knuckle pin the tool 99370714 (3) and lubricate its outside surface using oil TUTELA W 140/M-DA. Secure with a rope (1) the wheel hub (2) and support it with the lifter. Key the wheel hub (2) carefully on the steering knuckle pin in order not to damage the sealing ring.
Mount spacer (4) and tapered-roller bearing (5).
Release tool 99370714 (3).
Key the washer (6) and screw the check ring (7) with the requested torque.

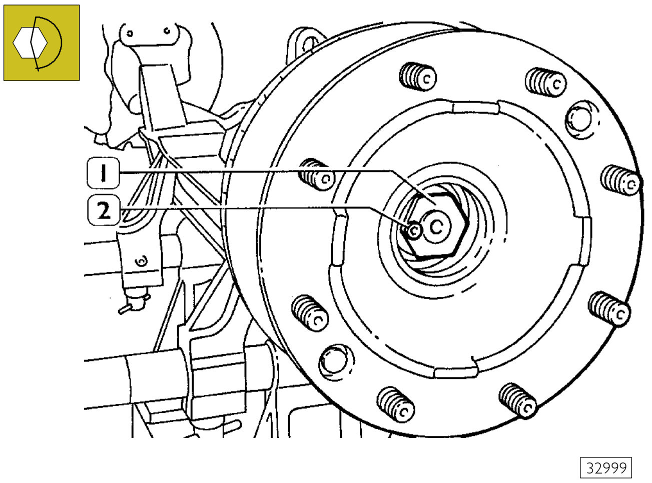
End play adjustment of wheel hub bearings

Figure 31



Hit the wheel hub in axial direction with a mallet and rotate it in both directions in order to release the bearings' rolls.
Set the magnetic base (1) fitted with a gauge (2) on the wheel hub.
Place the gauge pointer (3) perpendicular to the steering knuckle shank (4).
Set the gauge to zero with a preload corresponding to 1.52 mm.
Move the wheel hub in axial direction by means of a lever and detect the end play which must be 0.16 mm (maximum value).
If the detected value does not correspond to the prescribed one, replace the bearing unit and make a new survey.

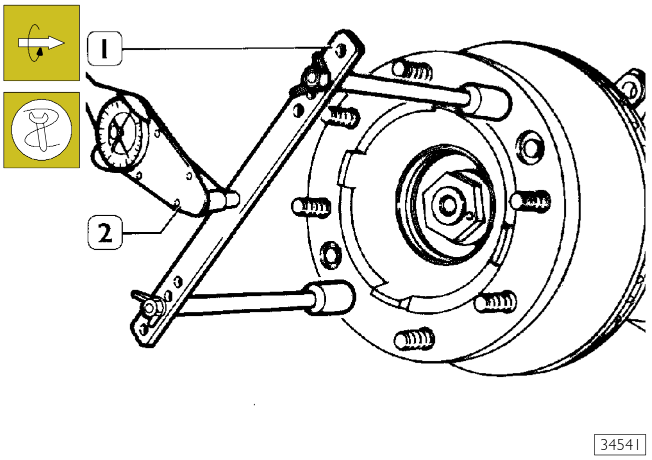
Figure 32



Once the requested end play has been reached, clamp the adjusting ring (2) check screw (1) with the requested torque.

Rolling torque survey

Figure 33



Place tool (1) 99395026 on the wheel hub stud bolts and use dynamometer 99389819 (2) to check that the wheel hub rolling torque is 3.0 Nm.

Place some sealer (Loctite type 574) only on the surface touched by the hub cover, protecting the threaded part.

Screw the hub cover with the requested torque.

Reset hubs in the wheels and the prescribed (0.2 litres) quantity of oil (Tutela W 140/MDA).

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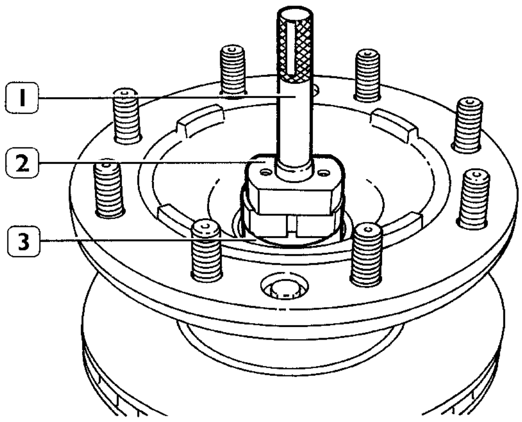
520621 REPLACEMENT OF WHEEL HUB BEARINGS

Remove the wheel hub.

Take off the sealing ring and the bearing from the location inside the wheel hub.
Use a beater to pull out the bearing's outside rings from the wheel hub.

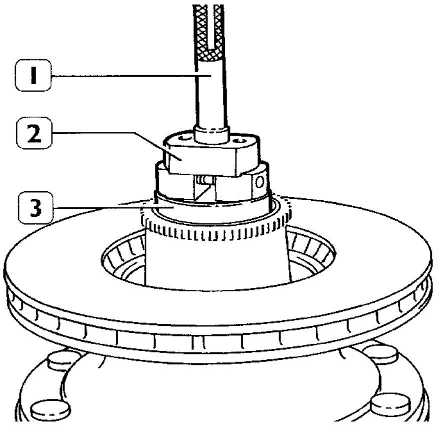
Check that the bearing's outside ring locations in the wheel hub are not dented as a result of the pull out operation.

Figure 34



Place outer bearing outer race (3) into its seat, then proceed to ramming by means of beater (2) 99374093 and handle 99370007 (1).

Figure 35



Put the inside bearing's outside ring (3) in its place and use beater 99374093 (2) and handle (1) 99370007 to settle it down.

Lubricate the inside bearing with oil SAE W 140/MDA and place it in the wheel hub.

Set the sealing ring.

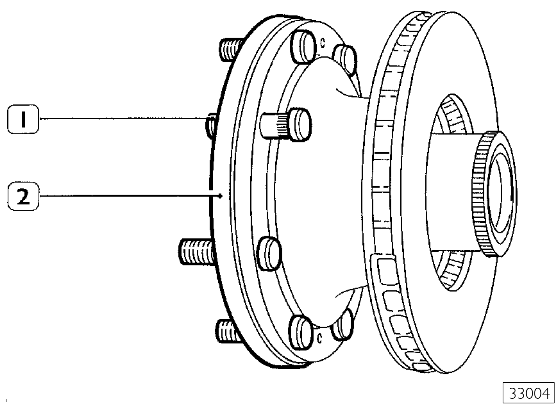
Reattach the wheel hub.

Adjust the wheel hub end play.

Check the rolling torque.

520625 REPLACEMENT OF STUD BOLTS FOR WHEEL CLAMPING

Figure 36



Use general tools to pull out stud bolts (1) from the brake disc (2).
Check that the head supporting plane of the stud bolts is not burred.

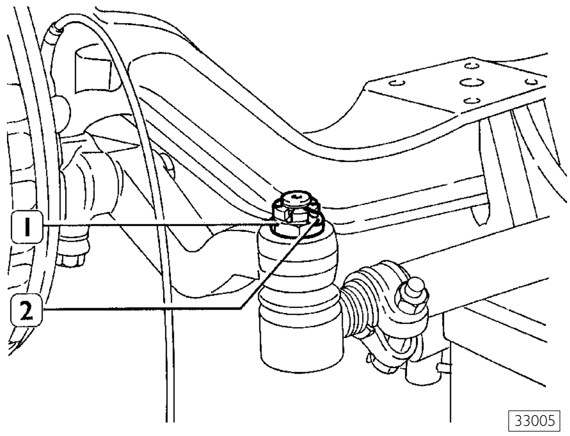
Place the stud bolts accurately and put on their head a load not higher than:

- ❑ 2300 kg for axle 5842/5
- ❑ 2500 kg for axle 5851/5

Once the operation is completed, check that there is no clearance between the disc plan and the area below the stud bolt head. Check also that the orthogonality error is not higher than 0.3 mm.

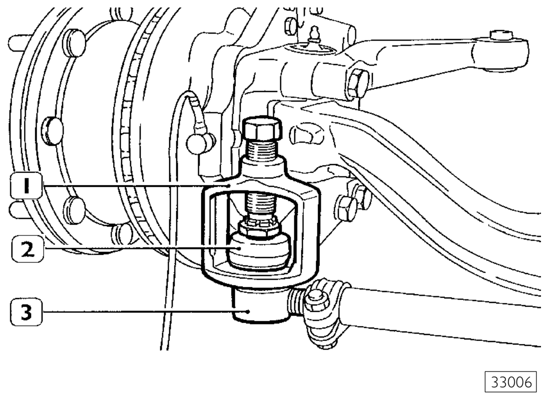
520635 CROSS TIE ROD REMOVAL AND REFITTING

Figure 37



Straighten and take off the split pin (1).
Unlock the nut (2) and release it partially in order to prevent the tie rod from falling when it is removed.

Figure 38



Use extractor (1) 99347068 to unlock the steering head (3) from the lever (2). Repeat the same operations on the opposite side, release the nuts completely and remove the cross tie rod.

To reattach reverse the detachment operation order.

Clamp the conical pin castellated lock nuts with the requested torque.

Check that the nut grooves match with the cross holes on the conical pins. If it is not possible to introduce the split pins, gradually raise the nut tightening torque until the split pins are completely put in place (angle lower than 60°).

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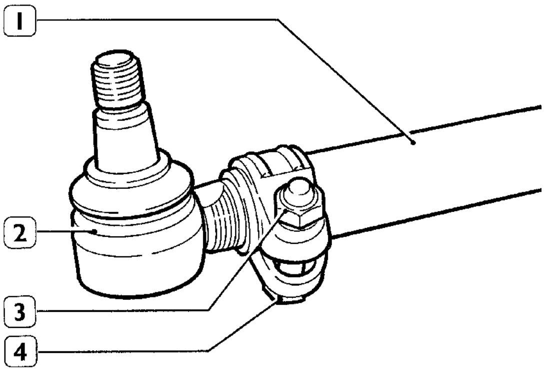
520636 REPLACEMENT OF CROSS TIE ROD ARTICULATED JOINTS

Figure 39



33007

Block the screw (4), release the nut (3) and unscrew the articulated joint (2) from the cross tie rod (1). Screw the articulated joint in the tie rod and clamp it in this position locking the lock nut with the requested torque.

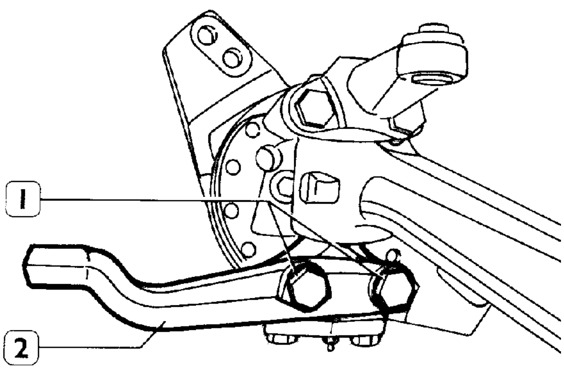
In order to ease the cross tie rod reattachment and the following toe-in adjustment, write down the number of turns needed to release every articulated joint so to avoid screwing the new one making the same number of turns.

Reattach the cross tie rod.

Check and adjust toe-in as described in paragraph "Front wheel set up".

520631 CROSS TIE ROD LEVER REMOVAL AND REFITTING

Figure 40

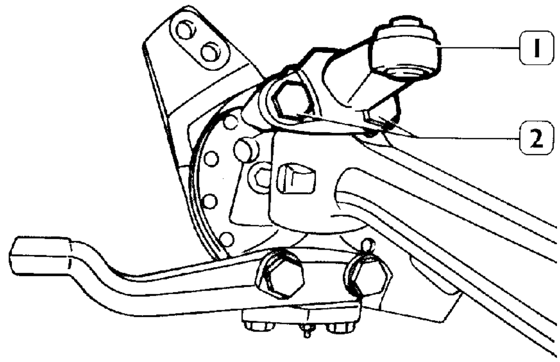


34543

Release the screws (1) and remove the lever (2). To make reattachment reverse the operation order and clamp the lock screws with the requested torque.

520632 LONGITUDINAL TIE ROD LEVER REMOVAL AND REFITTING

Figure 41



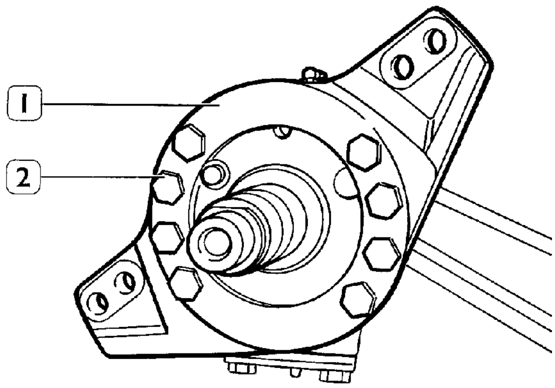
34544

Release the screws (2) and remove the lever (1). To make reattachment reverse the operation order and clamp the screws with the requested torque.

520611 STEERING KNUCKLE PIN REMOVAL AND REFITTING

Removal

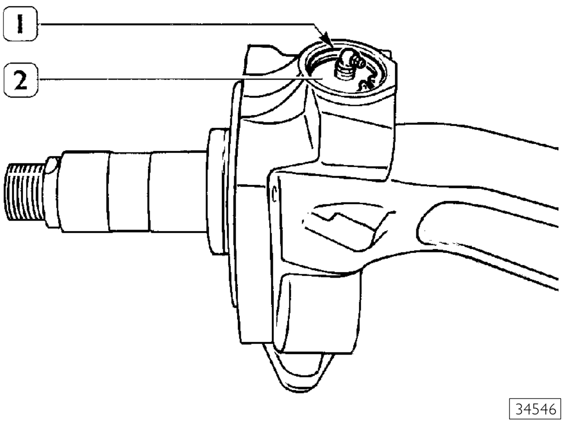
Figure 42



34545

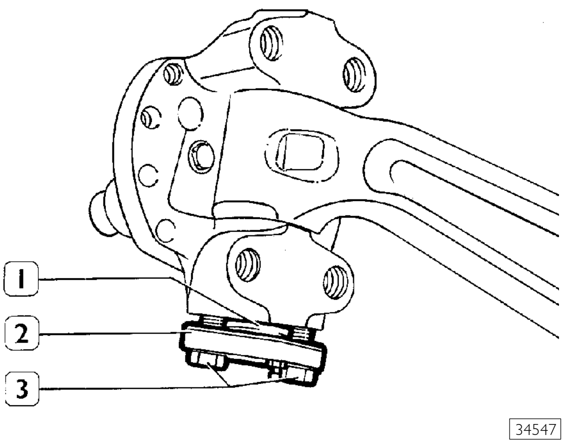
Release the screws (2) and remove the brake callipers support (1).

Figure 43



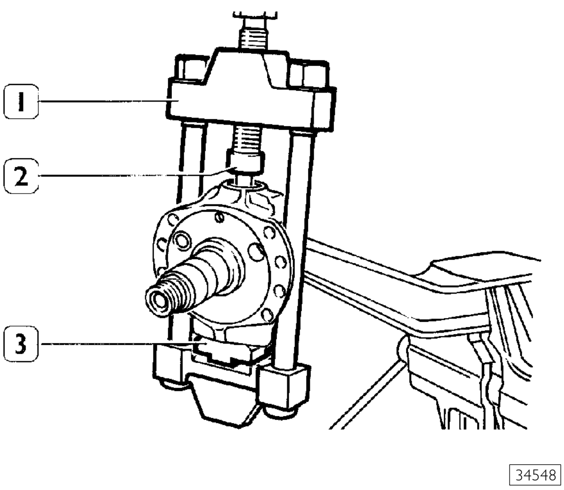
Use the appropriate pliers to take off the check ring (1) and remove the cover (2) together with the lubricator.

Figure 44



Release the screws (3) and remove the lower cover (2), the adjusting plates and the thrust block (1).

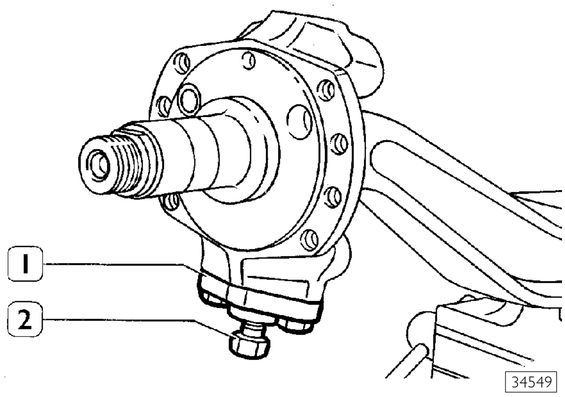
Figure 45



Use tool 99347047 (1) and elements (2 and 3) to unfasten the steering knuckle pin.
Remove the tools and take off the pin.

Refitting

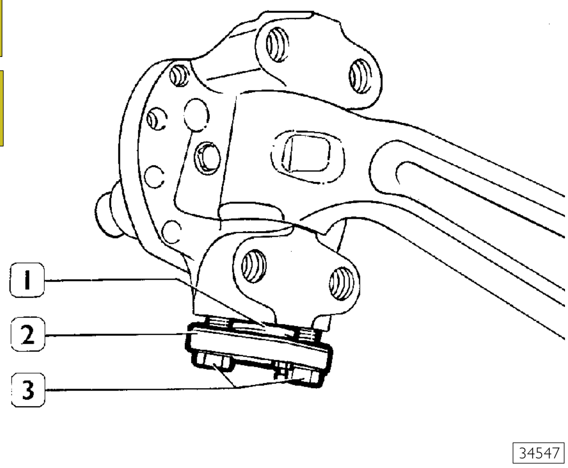
Figure 46



Set on the axle body the steering knuckle and put the pin in its place.
Set tool 99374400 (1) on the steering knuckle and fasten it by using the same lower cover lock screws, clamping them with the right torque.
Place the pin in the axle conical housing, screwing the pressure screw (2) to a torque having 7 to 8 daNm.
Remove tool 99374400 from the steering knuckle.

! Before placing the pin, it is necessary to check that the conical housing on the axle and the pin surface are perfectly cleaned and dry, in order to avoid oil layers which could foster the pin rotation in its place during its introduction.
Before making assembly, moisten the thrust block of the lower cover using grease Tutela MR2.

Figure 47



Place the lower cover (2) together with the thrust block (1) and the adjusting shims; fasten the lock screws (3) with the requested torque.
Repeat the same operations on the opposite steering knuckle.

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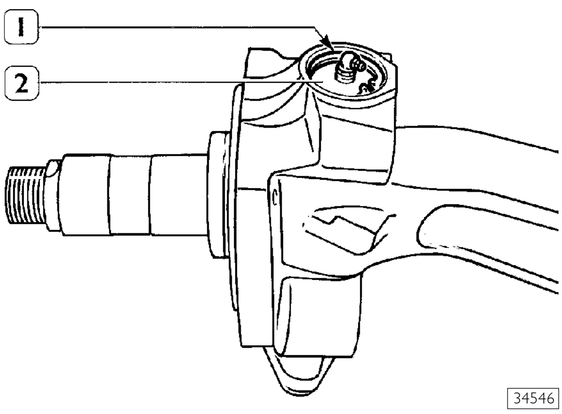
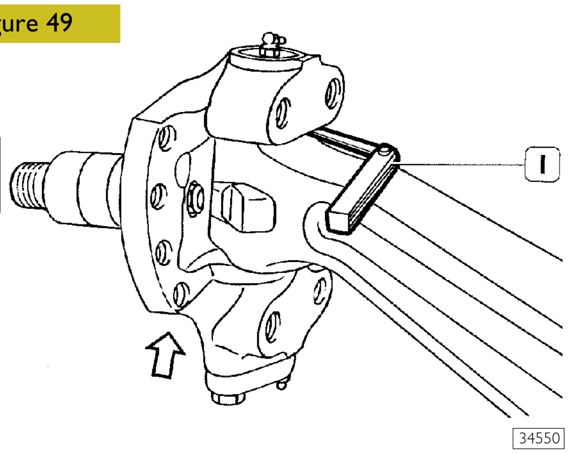
Figure 48



Place the upper cover (2) together with the related seal; place the lubricator as shown in the figure, then introduce the safety ring (1) and check that the ring expansion is made in the correct way.

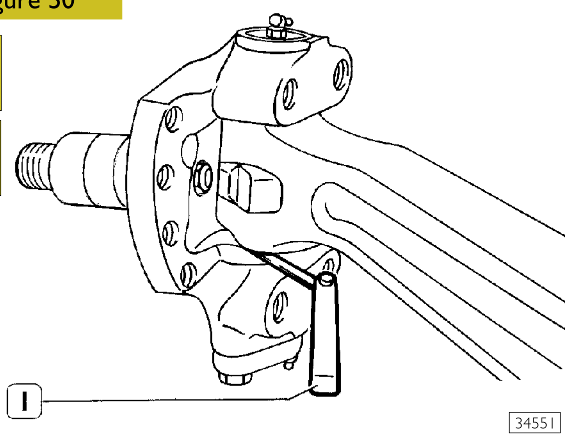
Check and adjustment of clearance between steering knuckle and axle

Figure 49



Keep the steering knuckle raised and use a thickness gauge (1) to check clearance between the upper shim adjustment of the steering knuckle and the axle. This value must be between 0.10 ÷ 0.15 mm.

Figure 50



Once the clearance between the upper shim adjustment of the steering knuckle and the axle has been checked, use a thickness gauge (1) to check that between the lower shim adjustment of the steering knuckle and the axle's one there is a gap not lower than 0.25 mm.

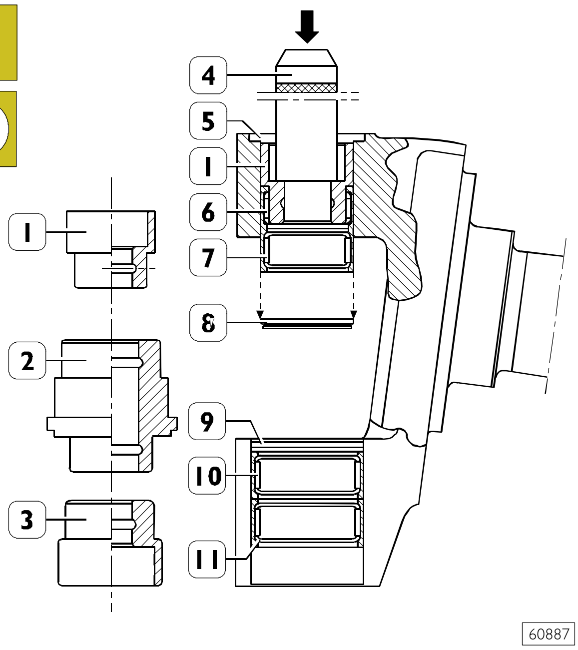
The possible clearance adjustment can be done replacing the adjusting shims with spare ones having the right thickness.

As to the thickness of spare rings, see table "SPECIFICATIONS AND DATA".

Lubricate the whole lower and upper articulated joint with grease MR2, checking that the grease flows through the gasket baffle.

520615 STEERING KNUCKLE PIN BEARING REPLACEMENT

Figure 51

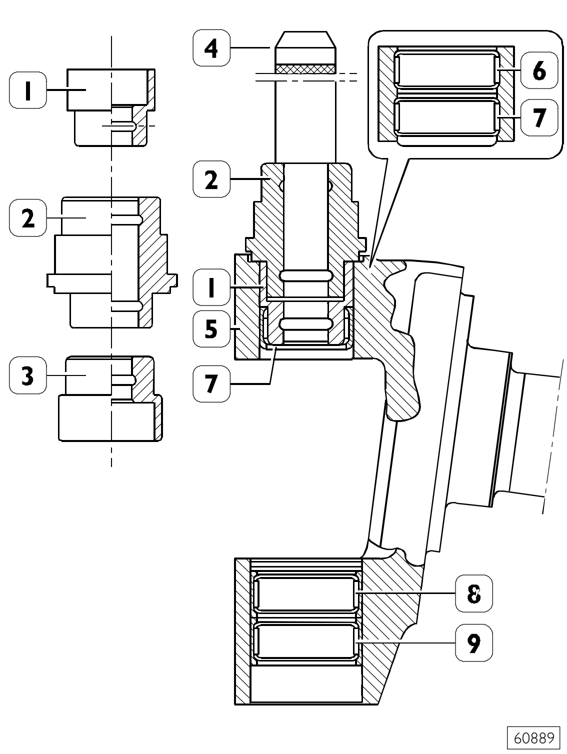


Steering knuckle bearing replacement (5) is made using for their disassembly and assembly beater's elements (1-2-3) 99374529 and handle 99370007 (4).

Use element (1) and handle (4) to disassemble the sealing ring (8) and the roller bearings (6-7) on the upper side.

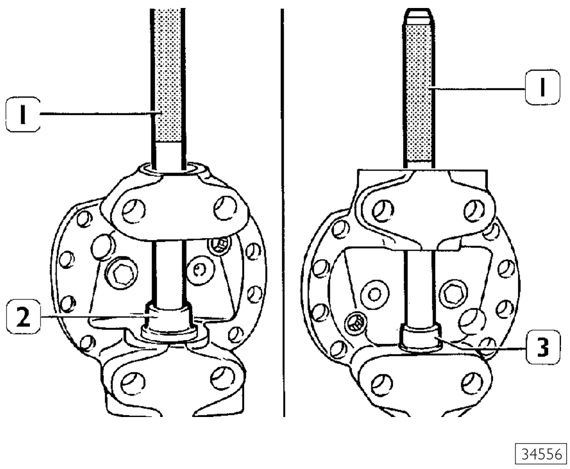
Use element (3) and handle (4) to disassemble the sealing ring (9) and the roller bearings (10-11) on the lower side.

Figure 52



Roller bearing assembly (7):
use element (1 and 2) and handle (4).
Roller bearing assembly (6):
use element (2) and handle (4).
Roller bearing assembly (8):
use elements (3 and 2) and handle (4).
Roller bearing assembly (9):
use element (2) and handle (4).

Figure 53



Use locking ring 99374173 (2) and handle 99370007 (1) to place the lower seal; use locking ring (3) 99374172 and handle 99370007 (1) to place the upper seal in the steering knuckle.

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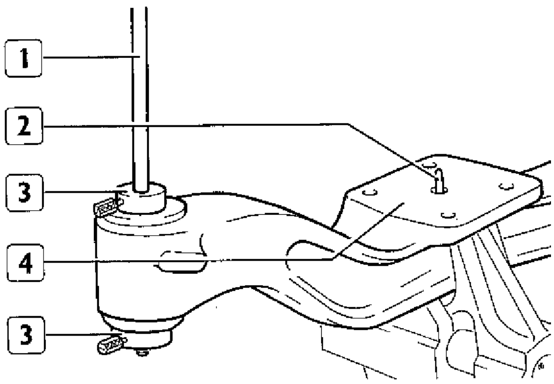
520618 CHECKS AND MEASUREMENTS OF THE AXLE UNIT

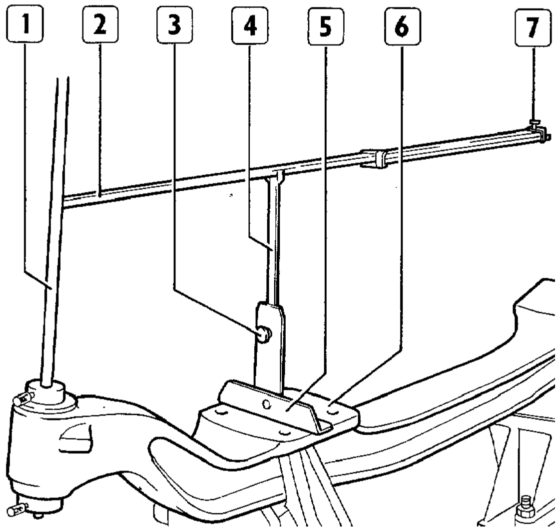
Check flatness of leaf spring surfaces compared to holes for steering knuckle pins

Figure 54



Place two bars (1) fitted with cones (3) in the steering knuckle pin holes. Push the cones and clamp them placing the appropriate screws on the bars.
Introduce two centring dowels (2) in the leaf spring supporting plane (4).

Figure 56

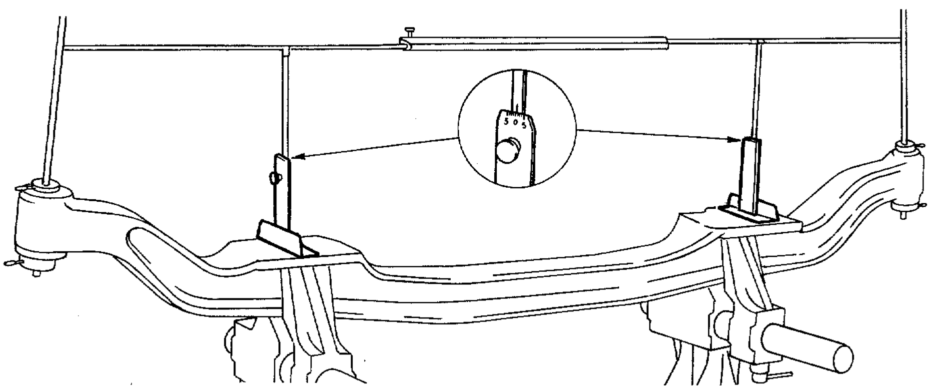


Place on the planes (6) two bases (5) using goniometers and introduce them in the centring dowels.

> Before placing the bases with the goniometers, check that the supporting planes are not painted or irregular.

Place the sliding bar (2) on the goniometer's bars (4), adjusting its length so that the shaped edges touch the bars (1).
Clamp the screw of the stop block (7) and the goniometer's lock screws (3) to the bars (4).

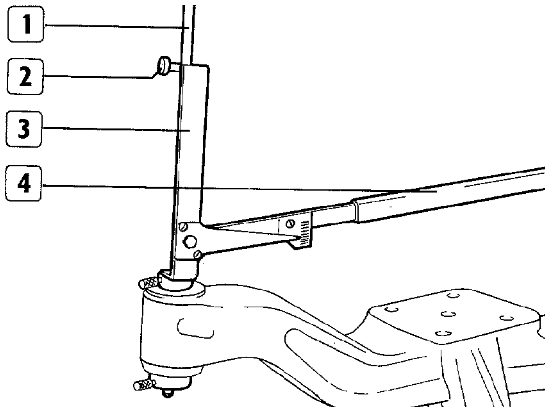
Figure 55



Check the angle of deformation on the goniometers' graduated sector shown by the arrows.
Goniometers' indexes will, of course, detect no angle movement when the flatness of leaf spring surfaces compared to the steering knuckle pin holes is correct.
Remove the sliding bar and the goniometer's bases used to make the survey.

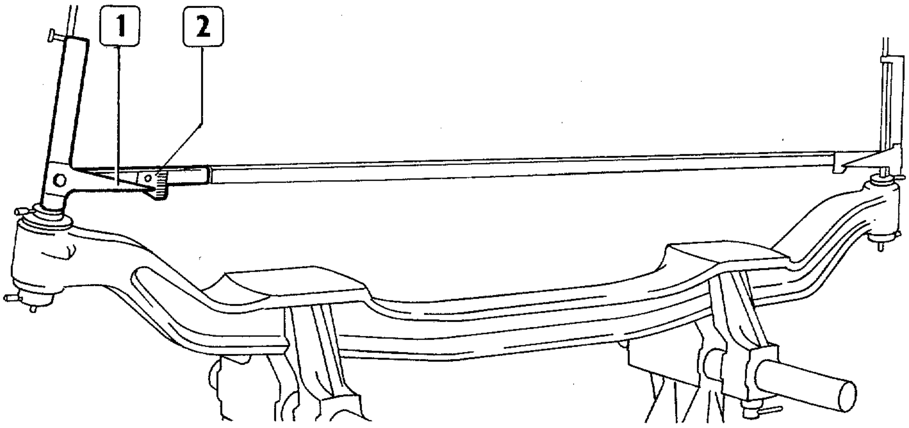
Check hole inclination for steering knuckle pins

Figure 57



Place on the bars (1) the supports (3) fitted with goniometers and screw the screws (2) without clamping them. Introduce the connecting cross tie rod (4) and tighten the screws (2) which clamp the supports touching the bars (1).

Figure 58



Check the angle of inclination value concerning the steering knuckle pin holes on the related graduated sectors (2), next to the gauge (1). The angle of inclination concerning the steering knuckle pin holes must be 7° ± 0°3'.

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5206 Front axle 5871/5

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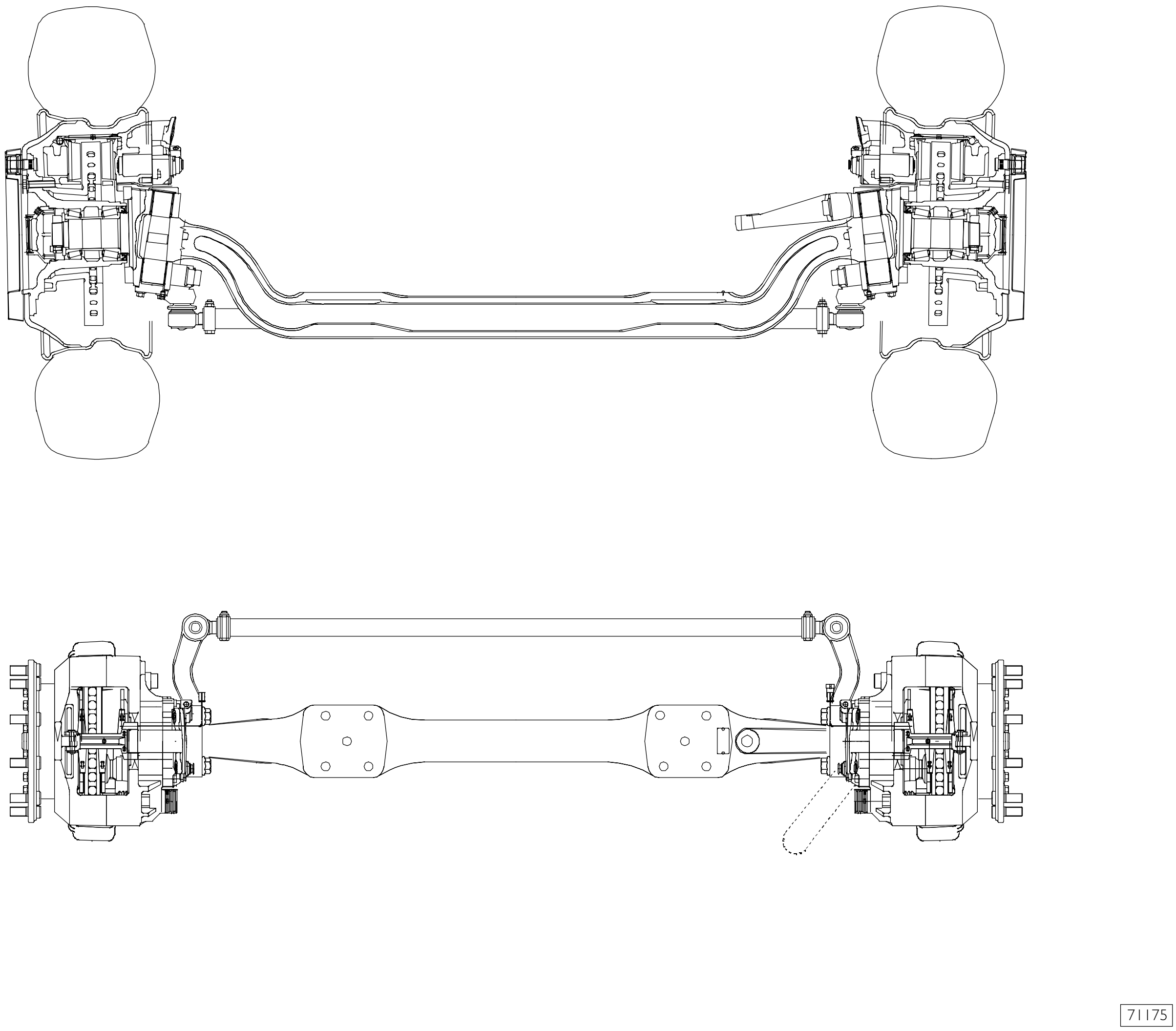
DESCRIPTION

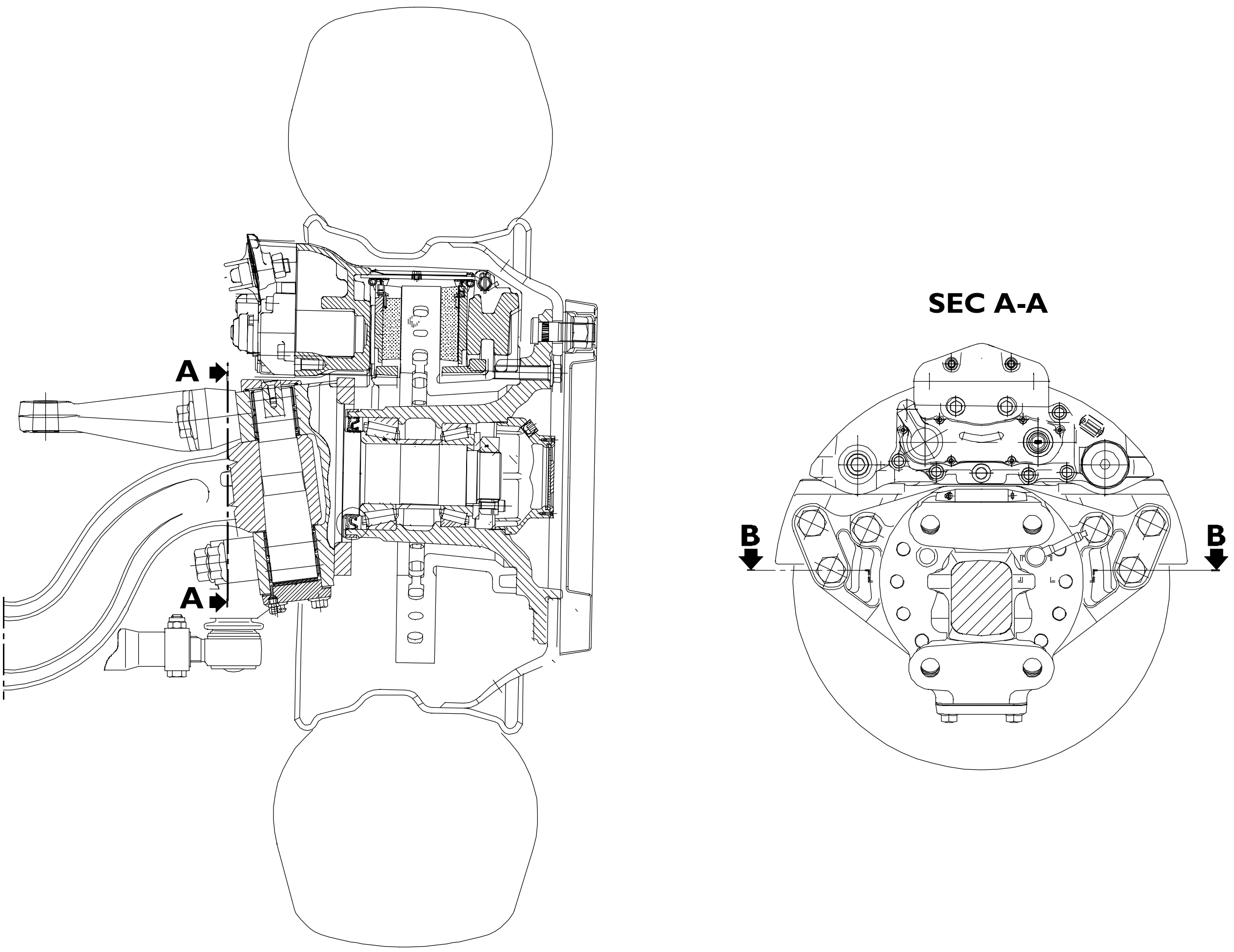
Front axle 5871/5 has a steel structure with a double "T" section having at the end steering knuckles.
The steering knuckles' connection is made through pins integral with the axle body and by means of four roller bearings set with interference in the holes of the steering knuckles' embossing.
The wheel hubs are supported by two conical roller bearings, "set right" type, set on the steering knuckle shank. The bearing end play is predetermined by the spacer placed between them.

Figure 1

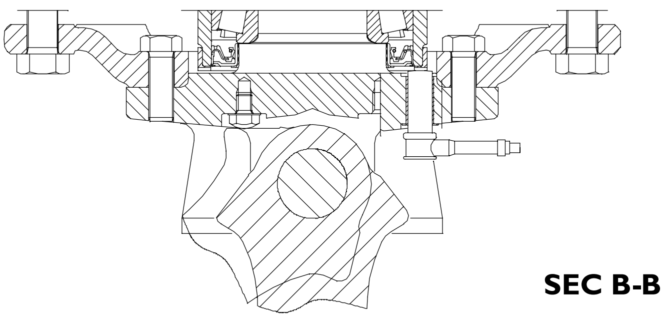


AXLE SIGHT 5871/5

Figure 2



SECTION OF FRONT AXLE WHEEL SIDE



71176

FRONT AXLE PART – ABS SENSOR LOCATION

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Characteristic angles

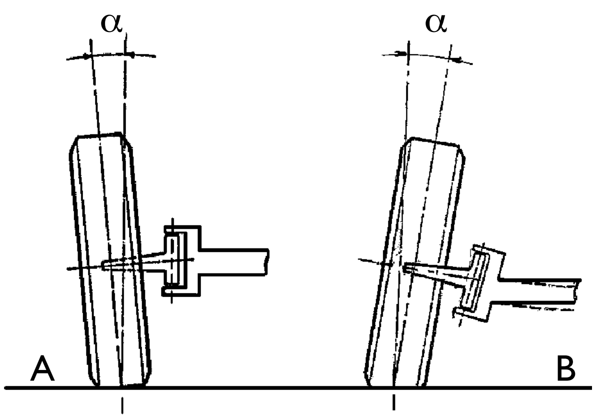
In order to have a good roadholding, a low tyre wear and to enable driving wheels to recover an upright direction after steering, it is necessary to set the wheels according to certain assembly angles:

- ❑ wheel angle of inclination
- ❑ upright angle of inclination
- ❑ clearance angle
- ❑ toe-in

Such angles, when correctly calculated, enable the vehicle to maintain the right balance among the various forces involved in its movement, in different loading conditions, which tend to alter the wheel position on the ground.

Wheel angle of inclination

Figure 3



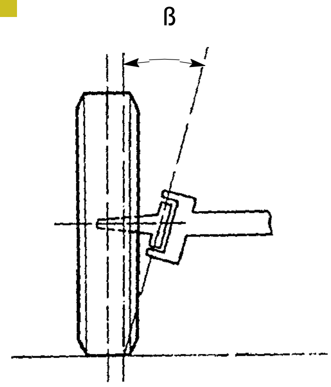
32956

The wheel angle (α) of inclination is the one resulting from the axis passing through the wheel's centre line and the vertical to the ground, looking at the vehicle standing before it.

The inclination is positive (A) when the wheel's upper part moves outside. It is negative (B) when the wheel's upper part moves inside.

Upright angle of inclination

Figure 4



32957

The upright angle (β) of inclination is the one resulting from the axis passing through the upright and the vertical to the ground, looking at the vehicle standing before it.

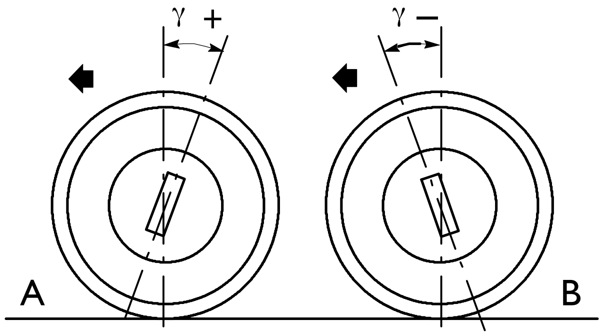
When the extension of the upright axis approaches the wheel when it is touching the ground (opposite direction compared to the wheel's inclination), the angle is positive. It is difficult, if not impossible, to have a negative upright angle of inclination.

The wheel angle (α) of inclination and the upright angle (β) of inclination enable the wheel axis and the upright axis to get closer to the tyre's fulcrum on the ground as much as possible.

As a result, it is possible to reduce the tyre wear and to get a low value of the steering torque.

Clearance angle

Figure 5



32958

The clearance angle (γ) is the one resulting from the upright axis and the vertical to the ground, looking at the vehicle from one side.

If the extension of the upright axis falls beyond the wheel's fulcrum on the ground in the vehicle's direction, as a rule the clearance angle is positive (A). It is considered negative (B) if it falls behind the wheel's fulcrum on the ground. It is null if it is absolutely perpendicular to the wheel's fulcrum on the ground. It is null if it is absolutely perpendicular to the wheel's fulcrum on the ground.

Such an angle enables front wheels to keep an upright position when the vehicle is moving in an upright direction and to recover such a position after taking a curve as soon as the steering wheel is released by the driver.

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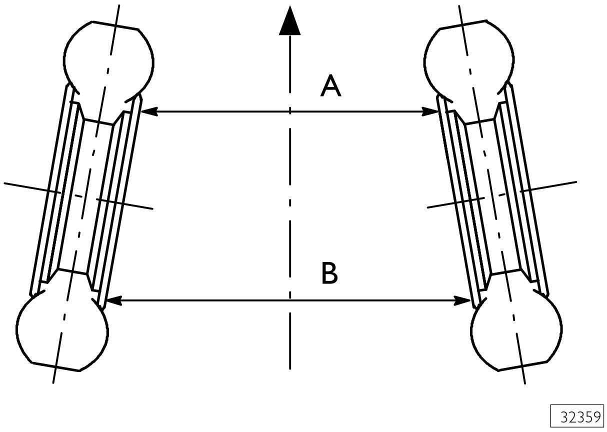
Toe-in

Figure 6

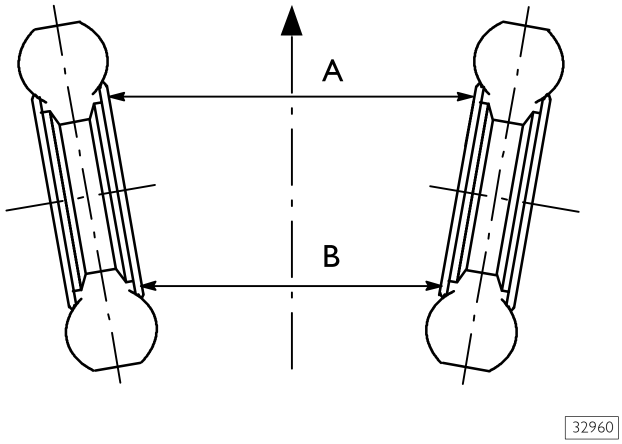


Toe-in results from the difference between distance A and B (value expressed in mm) measured on the rims' horizontal axis, looking at the vehicle from above.

In this way it is possible to drive easily and to reduce the tyre wear.

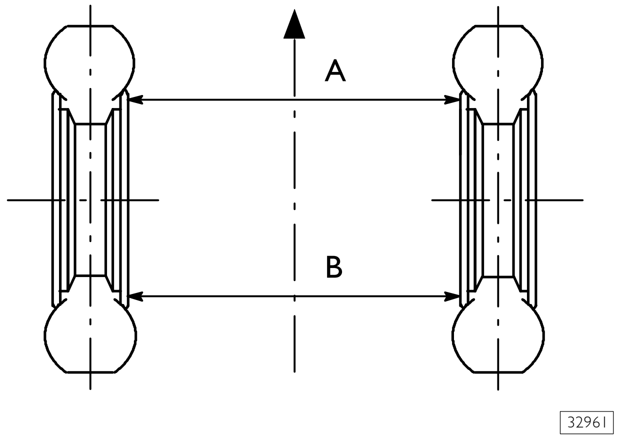
Toe-in is positive if B is bigger than A.

Figure 7



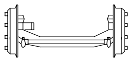
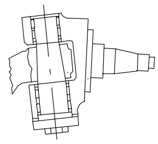
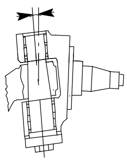
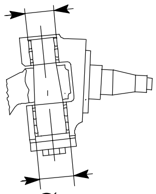
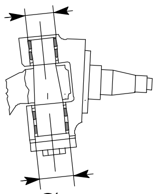
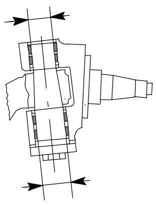
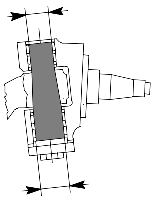
Toe-in is negative if B is lower than A.

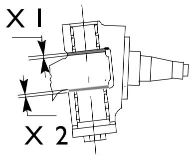
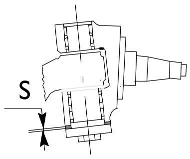
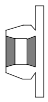
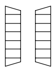
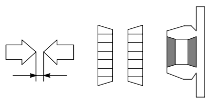
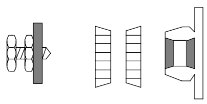
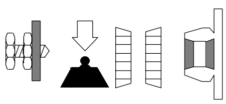
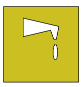
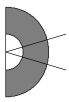
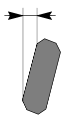
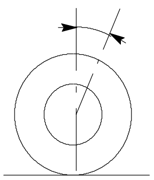
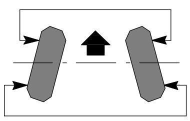
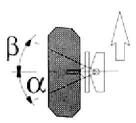
Figure 8



Toe-in is zero if B corresponds to A.

SPECIFICATIONS AND DATA

	Axle type		**5871/5**
	**STEERING KNUCKLE PINS**		
	Inclination of steering knuckle pin housing		7°
	Diameter of roller bearing housing on steering knuckle: - upper housing Ø 1 - lower housing Ø 2	 mm mm	 51.967 ÷ 51.986 59.967 ÷ 59.986
	Outside diameter of roller bearings for steering knuckle: - upper bearings Ø 3 - lower bearings Ø 4	 mm mm	 52 60
	Upper bearings – steering knuckle	mm	0.014 ÷ 0.033
	Lower bearings - steering knuckle	mm	0.014 ÷ 0.033
	Inside diameter of roller bearings for steering knuckle: - upper bearings Ø 5 - lower bearings Ø 6	 mm mm	 43 53
	Diameter of pin for steering knuckle - upper Ø 7 - lower Ø 8	 mm mm	 42.984 ÷ 43 52.981 ÷ 53
	Upper bearings – pin	mm	0 ÷ 0.016
	Lower bearings – pin	mm	0 ÷ 0.019

			5871/5
	Clearance between axle and steering knuckle upper adjustment X1 Gap between axle and steering knuckle lower adjustment X2	mm mm	0.10 ÷ 0.35 ≥ 0.25
	Adjusting plates X1, X2 0.25 mm S	mm	0.50 ÷ 1.75
	**WHEEL HUBS**		
	Wheel hub bearings		2 with taper rollers
	Hub bearing end play	mm	max 0.16
	Wheel hub clearance		not adjustable locking with lock nut torque
	Bearing preloading		daNm 0.50
	Oil for wheel hub bearings Amount per hub	 Litres (kg)	Tutela W 140/M-DA 0.35 (0.32)
	**WHEEL SET UP**		
	Wheel inclination (vehicle with static load)		1°
	Wheel incidence (vehicle with static load)		1°, 24''
	Toe-in (vehicle with static load)	mm	0 ÷ 1
	Steering angle Inside α Outside β		 52° 36°

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DIAGNOSTICS

Main malfunctioning of front axle:

1 – Steering wheel hardness
2 – Wobble
3 – Noise

1	STEERING WHEEL HARDNESS

Front axle perfectly aligned. — NO → Reset alignment and clamp lock nuts of spring bands.

YES ↓

Regular toe-in. — NO → Make exact toe-in adjustment.

YES ↓

Regular tyre pressure. — NO → Inflate tyres according to prescribed pressure.

YES ↓

Good joint lubrication. — NO → Lubricate joints accurately.

YES ↓

Right adjustment between steering knuckle and axle. — NO → Correctly adjust clearance between steering knuckle and axle.

YES ↓

Efficient elements involved in steering knuckle rotation on the pin. — NO → Check and replace worn elements.

2	**WOBBLE**

Check		Remedy
Regular wheel incidence.	NO →	Check axle assembly, fix or replace distorted elements.
YES ↓		
Front axle perfectly aligned.	NO →	Reset alignment and clamp spring band nuts on the axle.
YES ↓		
Regular toe-in.	NO →	Make correct toe-in.
YES ↓		
Efficient steering heads of track rods.	NO →	Replace defective elements.
YES ↓		
Regular clearance of wheel hub bearings.	NO →	Adjust end play after making appropriate replacements.
YES ↓		
Centred wheels: centred, regular rim correct assembly of tyre on rim.	NO →	Replace defective rim. Deflate and centre tyre on rim.
YES ↓		
Balanced wheels.	NO →	Make wheel balancing.

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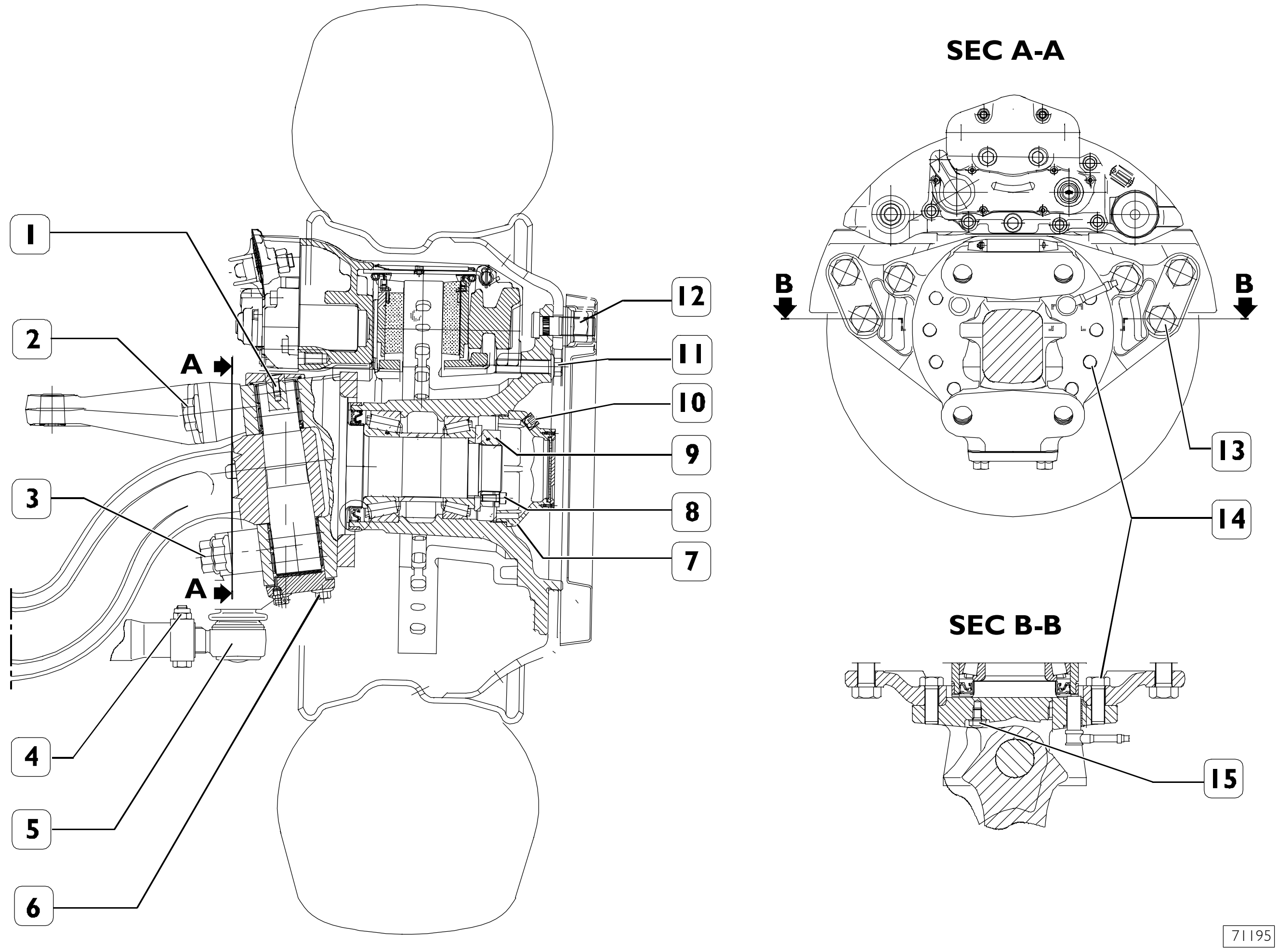
3	NOISE

Good lubrication of wheel hub bearings.	NO →	Top up oil in wheel hubs.
↓ YES		
Efficient wheel hub bearings.	NO →	Replace worn bearings and adjust end play.
↓ YES		
Regular coupling between steering knuckle pin and roller bearings.	NO →	Check and replace worn elements.

TIGHTENING TORQUES

Figure 9



PART		TORQUE Nm	(kgm)
1	Oval headed screw for securing upper cover	10.8 ± 2	(11 ± 0.2)
2	Self-braking hexagonal head screw for securing longitudinal levers on stub axle	1325 ± 75	(135 ± 7.5)
3	Self-braking hexagonal head screw for securing transverse tie rod lever on stub axle	1325 ± 75	(135 ± 7.5)
4	Clamp locking nut for transverse tie rod	80 ± 10	(8.1 ± 1)
5	Notched nut for ball head pin	201 ± 20	(20.5 ± 2)
6	Screw for securing lower cover on stub axle	117 ± 6	(11.9 ± 0.6)
7	Wheel hub cover	133.5 ± 13.5	(13.6 ± 1.3)
8	Cylindrical headed screw with embedded hexagon for locking wheel bearings adjustment clamp	27.5 ± 2.5	(2.8 ± 0.2)
9	Wheel bearings securing ring nut	515.5 ± 24.5	(52.5 ± 2.5)
10	Bevel threaded plug for wheel hub cover	57.5 ± 2.5	(5.9 ± 0.25)
11	Hexagonal head screw for securing brake disc to wheel hub	281.5 ± 13.5	(28.6 ± 1.3)
12	Wheel securing nut	627.5 ± 62.5	(63.9 ± 6.4)
13	Self-locking hexagonal head screw for securing brake shoes	615.5 ± 61.5	(62.7 ± 6.2)
14	Screw for securing brake shoes support	313.5 ± 15.5	(31.9 ± 1.5)
15	Steering stop screws	58.5 ± 5.2	(5.9 ± 0.5)

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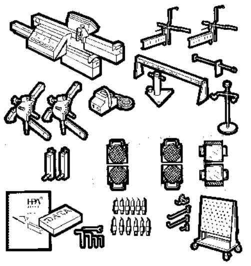
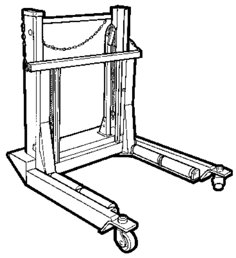
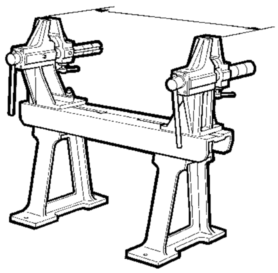
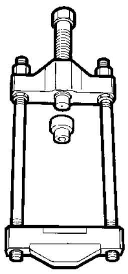
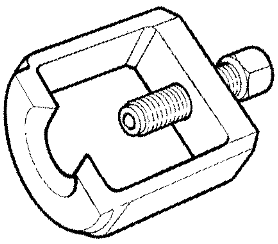
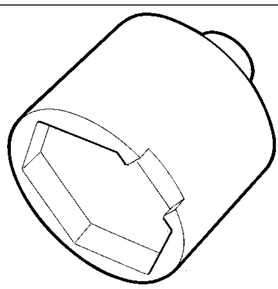
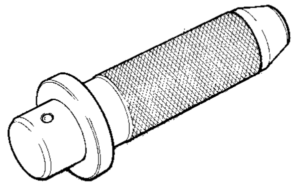
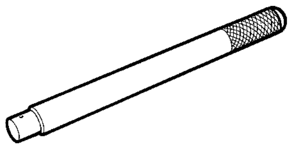
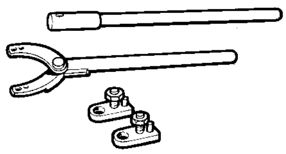
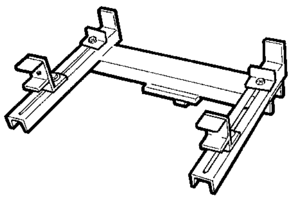
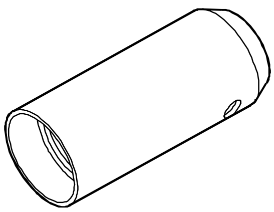
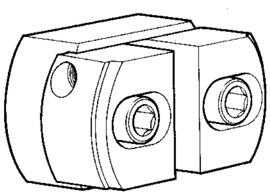
TOOLS

TOOL No.		DESIGNATION
99305354		Portable optical equipment to check wheel attitude
99321024		Hydraulic truck for wheel detachment and reattachment
99322215		Stand for axle overhaul
99347047		Tool for steering knuckle pin removal
99347068		Extractor for track rod head pins
99354207		Wrench (94.5 mm) for front wheel hub caps

TOOLS

TOOL No.		DESIGNATION
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with extension for flange holder
99370628		Support for axle detachment and reattachment
99370715		Rail for wheel hub assembly
99374093		Beater for assembly of bearing outside tracks (91 – 134) to be used with 99370007

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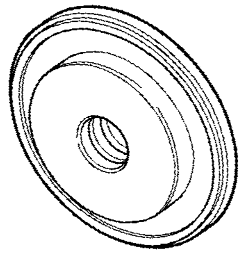
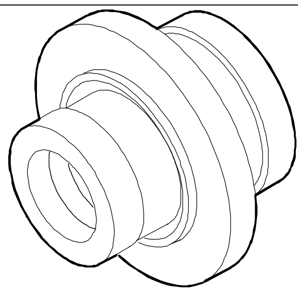
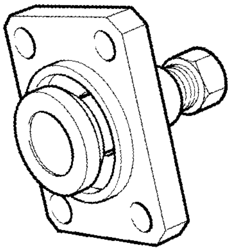
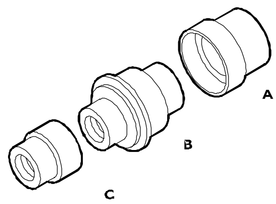
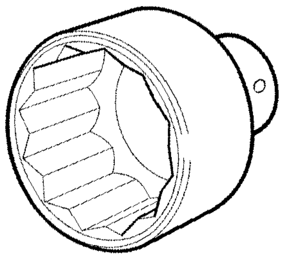
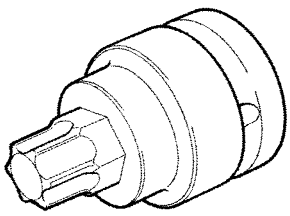
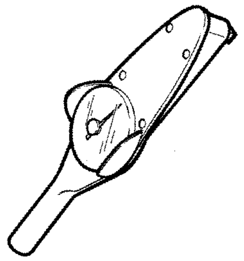
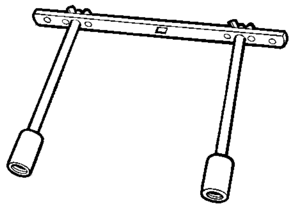
TOOLS

TOOL No.		DESIGNATION
99374132		Locking ring for assembly of inside wheel hub gasket (to be used with 99370006)
99374173		Locking ring for assembly of lower steering knuckle pin gasket (to be used with 99370007)
99374405		Tool for steering knuckle pin setting
99374530		Beater for disassembly and reassembly of steering knuckle pin bearings (to be used with 99370007)
99388001		Wrench (80 mm) for wheel hub bearing adjusting nut
99388002		Wrench for cross and longitudinal tie rod lock screws on steering knuckle

TOOLS

TOOL No.		DESIGNATION
99389819		Dynamometric wrench (0 – 10 Nm) with square connection 1/4"
99395026		Tool for hub rolling torque check (to be used with dynamometric wrench)

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FRONT WHEEL SET UP

Before checking, it is necessary to make a preliminary investigation of some vehicle elements which can affect set up. If any fault is detected, it is important to eliminate it in order to avoid wrong measurements.
The checks to be made are the following:

- ❑ tyre pressure;
- ❑ wheel hub bearing clearance;
- ❑ clearance between track rod pins and levers on steering knuckles;
- ❑ shock-absorber efficiency;
- ❑ wheel rims must not be dramatically distorted.

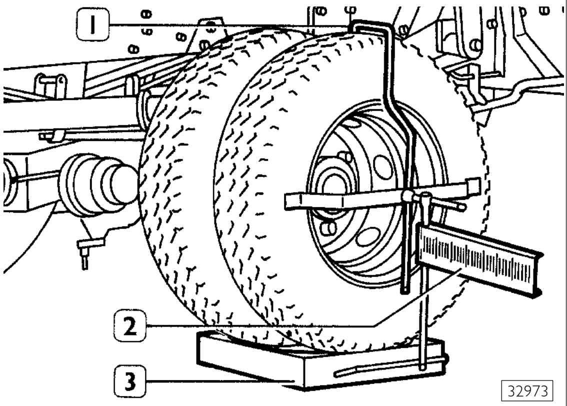
Make wheel set up check using equipment 99305354.

Checks and possible adjustments of wheel set up must be made with the vehicle having static load.

By and then, check perfect calibration of optical units.

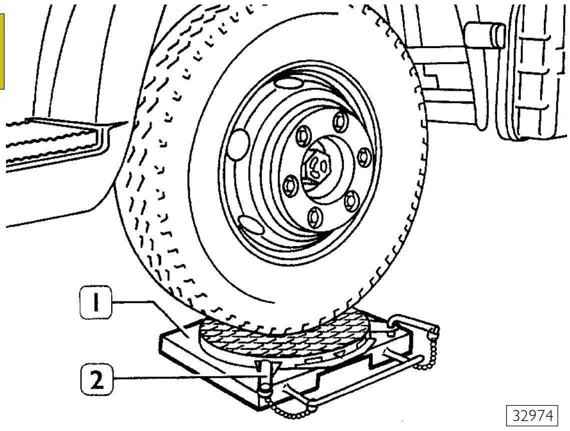
Setting of clips and headlights

Figure 10



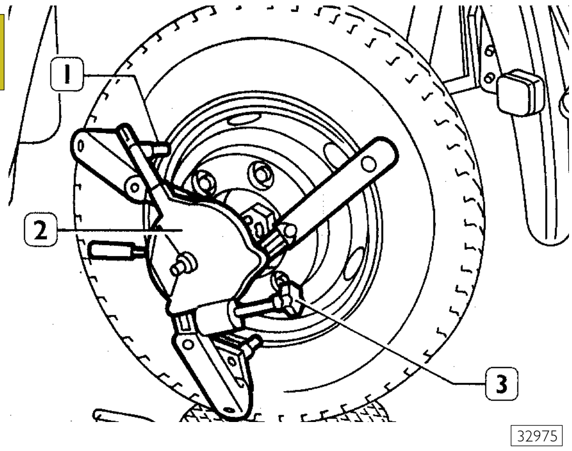
Place the vehicle with the wheels in upright direction on a flat surface. Lift the vehicle's rear part and place the platforms under the wheels (3). Lower the vehicle, brake the rear wheels and set the hook (1) with the ruler (2).

Figure 11



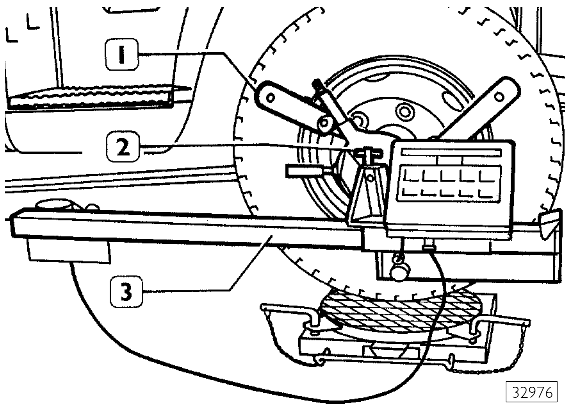
Lift the vehicle's front part and place the swinging plates (1) under the wheels, clamping them with the appropriate locks (2).

Figure 12



Place on the wheel rim the self-centring clip (2) fitted with the right lock pins (1). Use the handle (3) to clamp the clip on wheel, checking that the wheel itself is well fixed.

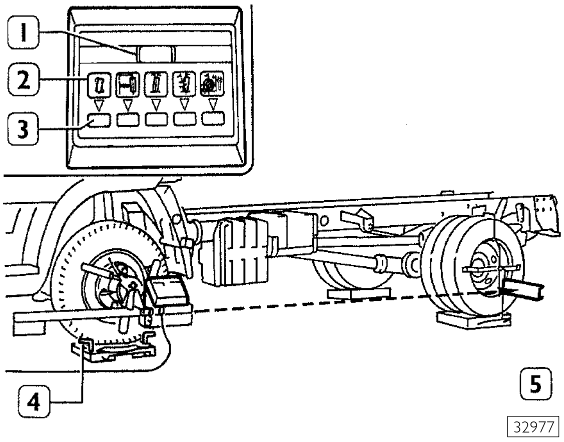
Figure 13



Set the detecting system (3) on the clips (1) and clamp it with the screw (2). Repeat the same operations on the other wheel.

Electronic compensation for rim maladjustment

Figure 14

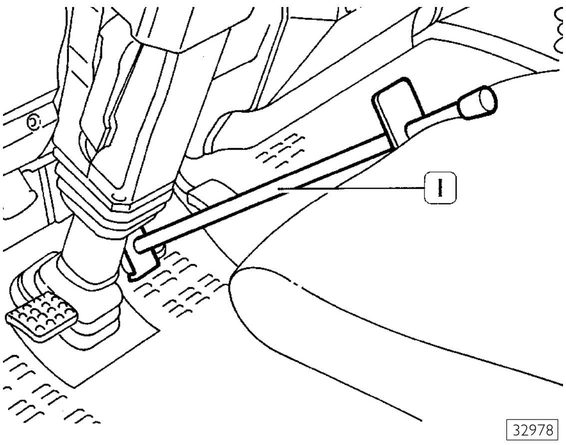


Connect detectors' plugs to the transformer and switch it on. Release the detector's lock screw and lift the lens cover. Push the button "off centre" (3) for at least two seconds, five lines will be displayed on the digital (1) indicator.
Slowly rotate the wheel by hand and project the light signal on the corresponding ruler scale (5).
Detect and write down the minimum and maximum excursion of the light signal: e.g. 12 and 8.
Calculate the excursion's average value: 12 + 8 = 20 : 2 = 10 and place the wheel according to the calculated average value, marking the new position.
Push again the button "off centre" (3) until the wheel inclination led (2) is switched on and on the digital indicator (1) a fake value is displayed.
Repeat the same operations on the other wheel.

Be careful that the laser ray does not hit people's eyes: it would severely harm their sight.

Lower the vehicle so that the wheels, being in the marked position, touch completely the centre of the swinging plates and release the latter from the related bases by removing the pins (4).

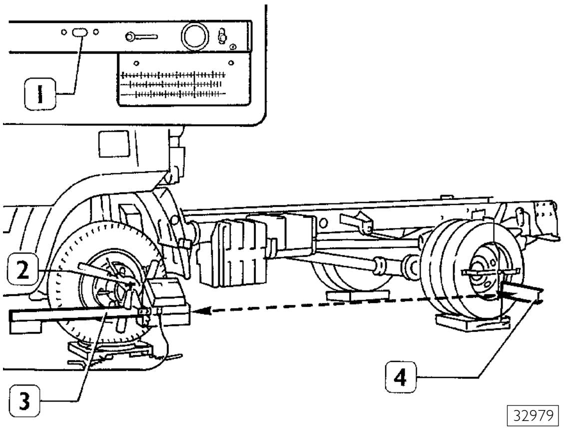
Figure 15



Push the brake pedal and leave it in this position using the appropriate tool (1) set against the seat, thus keeping the vehicle braked during the whole measurement.

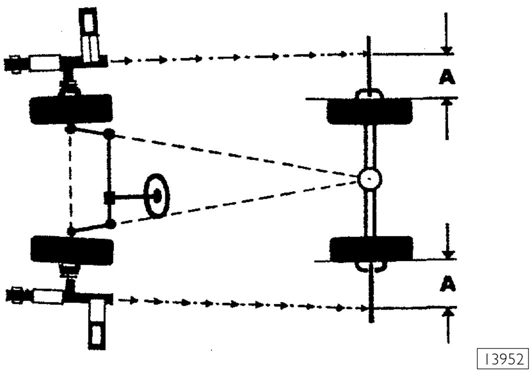
Wheel alignment

Figure 16



Balance detectors (3) by using the spirit level (1) and clamp them in this position by the screw (2).
Move the rulers (4) until they are hit by the light signal released by the detector and write the indicated values.

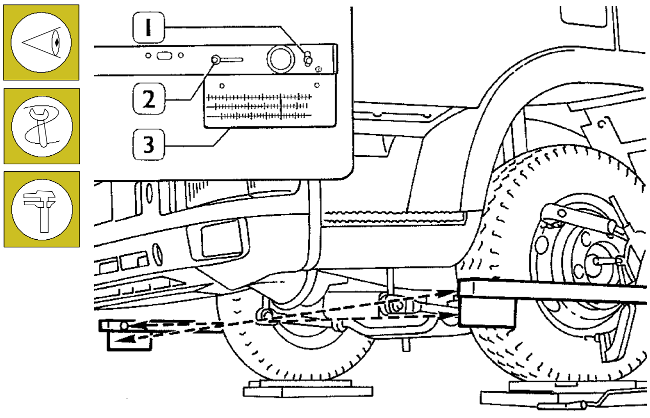
Figure 17



If the values are different, turn the wheels until the light signal indexes reach two equal values (A) and the exact average value resulting from the two previous detections. In such a way it is possible to obtain a perfect wheel alignment.

Toe-in check

Figure 18



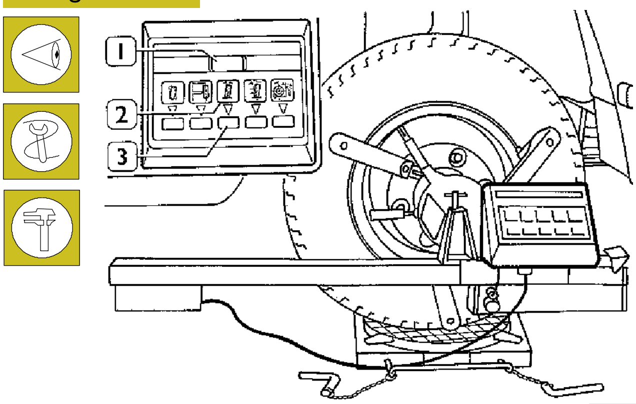
32980

Still having detectors perfectly balanced and the wheels completely aligned, use a lever (1) to move the lens cover. Move the lever (2) and point the light signal index to the ruler's graph scale (3) corresponding to the rim's diameter. Repeat the same operations with the opposite detector and read the toe-in values expressed in millimetres on the graph scales.
The algebraic sum of the two detected values must amount to: 0.5 ÷ 1.5 mm with static load.

Toe-in adjustment is made affecting the cross tie rod.

Check of wheel inclination (Camber)

Figure 19



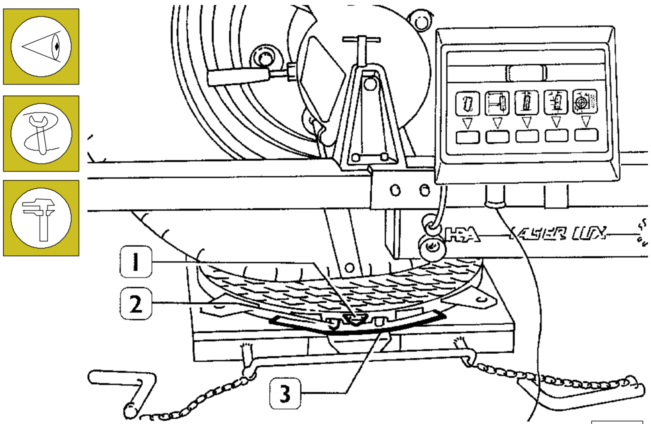
32981

If the front wheels are aligned with the rear ones and the detectors are balanced, push the wheel inclination button (3) and the led (2) will be switched on. The digital indicator (1) will give the value of the angle of inclination which must be 1°.

The wheels' angle of inclination is a fixed value which cannot be adjusted.
Therefore, if a different value is detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check upright angle of inclination (King Pin) and clearance angle (Caster)

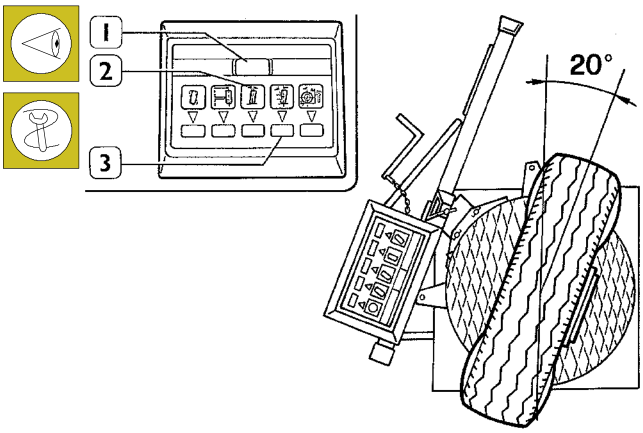
Figure 20



32982

Still having the front wheels aligned with the rear ones, loose knurled knobs (2) and set to zero the graduated sector (3) on the swinging plate's index (1).

Figure 21



32983

Turn the wheels inwards by 20° and push twice the upright inclination button (3), the led (2) will be switched on and nine horizontal lines will appear on the digital indicator (1).

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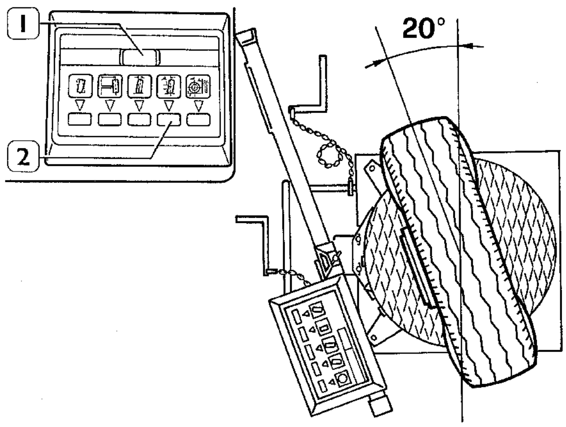
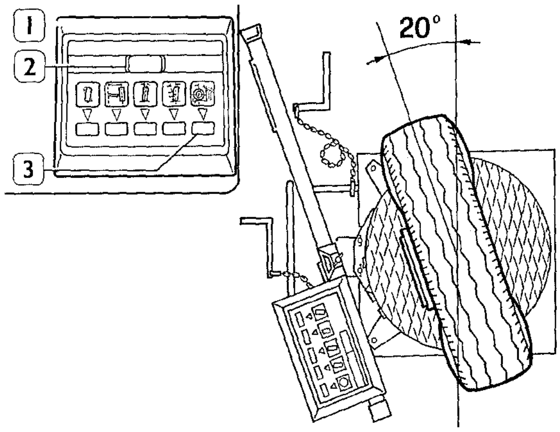
Figure 22



32984

Turn the wheels outwards by 20° and push again the upright inclination button (2), the digital indicator (1) will display the value of the upright angle of inclination (King Pin) which must be 7°.

Figure 23



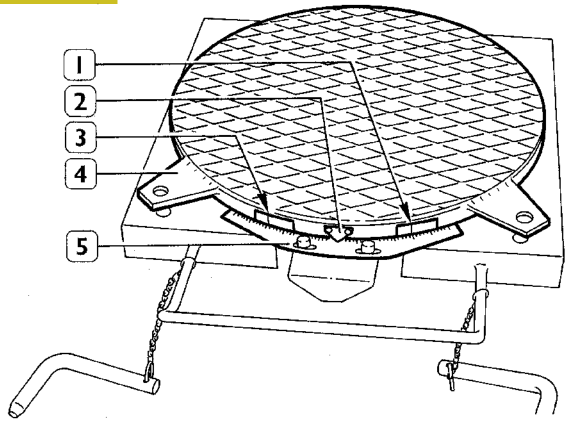
32985

Without moving the wheel, push the clearance angle button (3). The led will be switched on (1) and the digital indicator (2) will display the value of the clearance angle (Caster) which must be 2°30'.

The upright angle of inclination and the clearance angle are fixed values which cannot be adjusted. Therefore, if different values are detected, remove and dismantle the axle, make the appropriate investigations and possible replacements.

Check steering angles

Figure 24



32986

With the wheels in upright direction, set to zero the graduated sectors (5) on the index (2) of the swinging plates (4).

If the steering angles which must be detected are bigger than 30°, it is necessary to use as "0°" reference indexes the 20° sign (1) placed on the swinging plate and the corresponding one on the graduated sector.

Turn the inside wheel according to the prescribed value and check that the outside wheel's angle corresponds to the prescribed value, considering that to make the survey it is necessary to use as "0°" reference indexes the 20° sign (3) placed on the swinging plate and the corresponding one on the graduated sector.

Repeat the same operations and check steering of the opposite wheel.

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520610 OVERHAULING THE FRONT AXLE ASSEMBLY (Mechanical and pneumatic suspension)

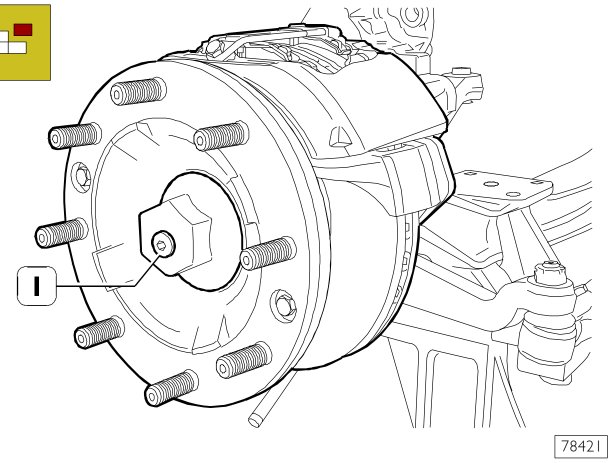
For front axle disconnection and reconnection, refer to the procedure described for 5842 and 5851 front axles.

520610 OVERHAULING THE FRONT AXLE ASSEMBLY

Using lifting gear, position and secure the axle assembly (1) on stand 99322215 (2) for overhaul.

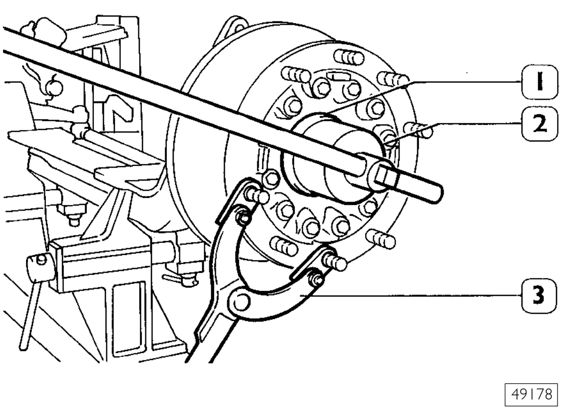
520620 Removing the wheel hubs

Figure 25



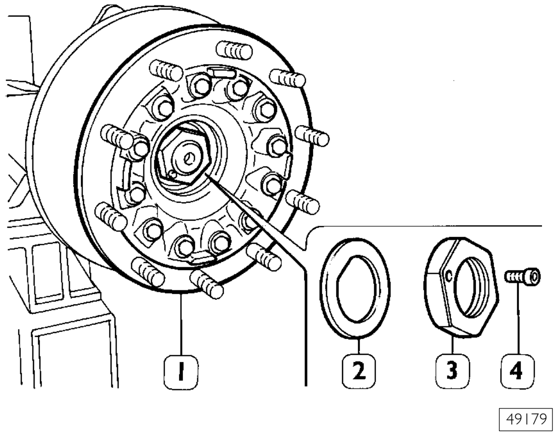
Unscrew the plug (1) and drain the oil into a proper container.
Take down the brake calipers.

Figure 26



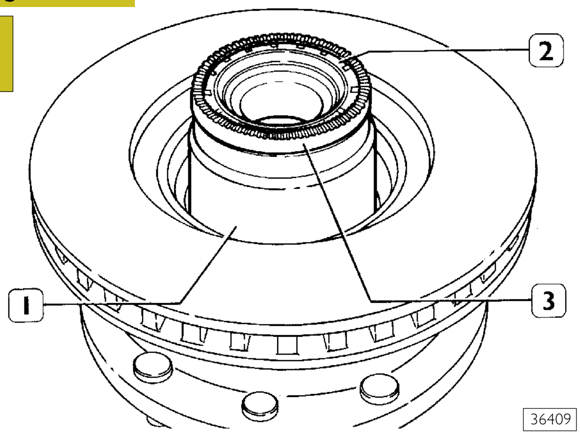
Use reaction lever 99370317 (3) to lock wheel hub rotation and with wrench 99354207 (2) unscrew the oil cover (1).

Figure 27



Loosen the screw (4), remove the adjusting nut (3) with wrench 99388001, pull out the washer (2), the outer bearing (1) and take down the wheel hub with the relactive spacer and inner bearing.

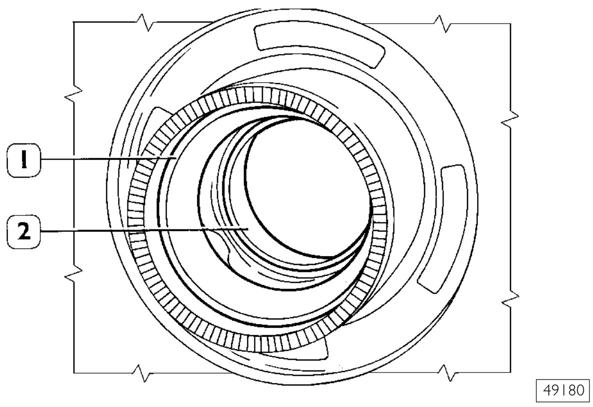
Figure 28



Using suitable tools remove the seal ring (2), inner bearing and phonic wheel (3) from the wheel hub. (1)

520621 Replacing the wheel hub bearings

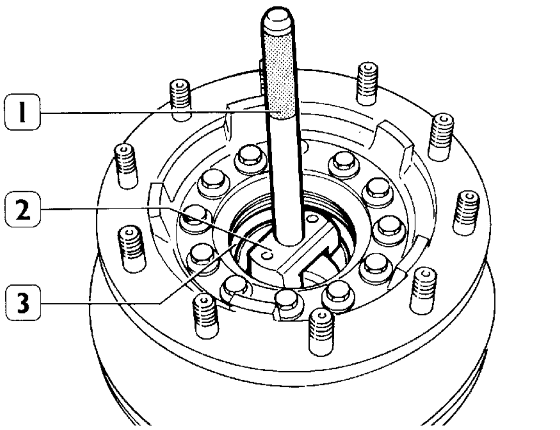
Figure 29



Using a suitable drift remove the outer rings (1 - 2) of the bearings from the wheel hub.

Make sure that the housings of the outer rings of the wheel hub bearings have not been dented by the removal operation.

Figure 30

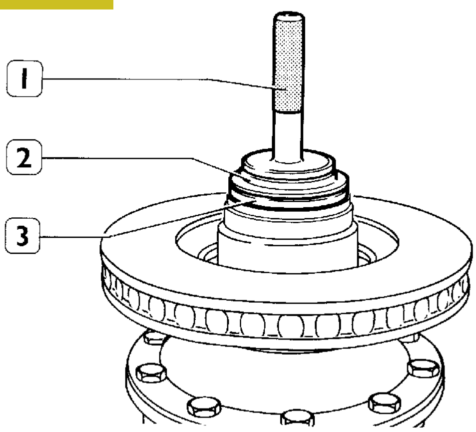


36413

Use drift 99374093 (2) to press-fit the outer race of the front hub bearing without pushing fully home. Repeat the operation on the opposite side for the rear bearing outer race.
Complete the operation of press-fitting the outer bearing races manually using drift 99374093 (2) with handle 99370007 (1).
Heat the phonic wheel (1) to a temperature of 150° (3, Figure 28) for 15 minutes, then fit it on the wheel hub (1) and let it cool down.

Replacing seal

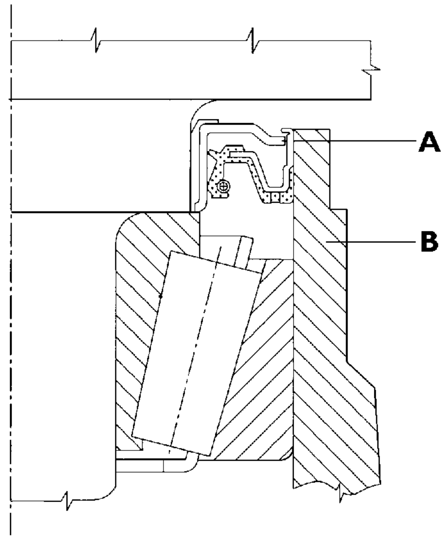
Figure 31



36410

Lubricate the inner bearing with SAE W 140M-DA oil and position it in its housing in the wheel hub.
Using drift 99374232 (1) and handle 99370006 (2) fit in place the seal ring (3) on the wheel hub checking the assembly position (Figure 32).

Figure 32



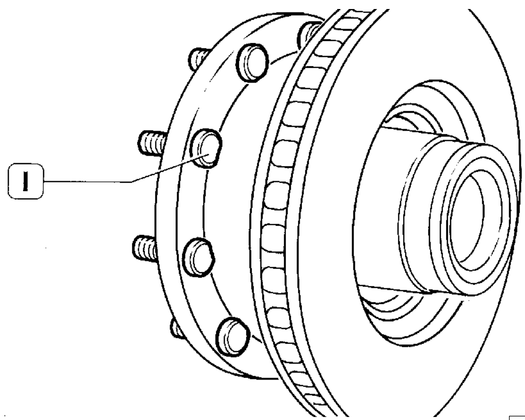
49142

ASSEMBLY POSITION OF THE SEAL RING (A) IN THE WHEEL HUB (B)

Cleaning the wheel hub cap. To prevent the polycarbonate transparent part from getting opaque, we advise you to wash it with cleaning products normally used for the body. Never use chlorotene solvents because they etch the polycarbonate.

Replacing wheel studs

Figure 33



36415

Use ordinary tools to remove studs (1) from wheel hub.
Check that the stud head mating surface is free of burrs.
Press-fit studs carefully by applying a load of not more than 2500 kg to their heads.
Once the operation is complete, check there is no play between the disc surface and stud head undersides.

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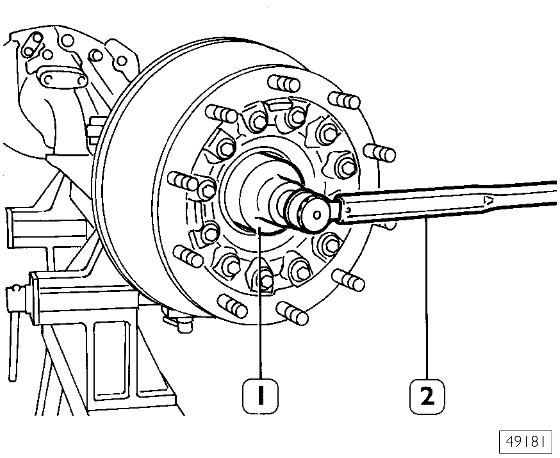
Refitting wheel hubs

Make sure that the surfaces of all components inside the hub are thoroughly clean and free from scale and burrs.

Install the wheel hub onto the stub axle.
Fit the internal spacer onto the stub axle, then position the outer bearing and thrust washer.

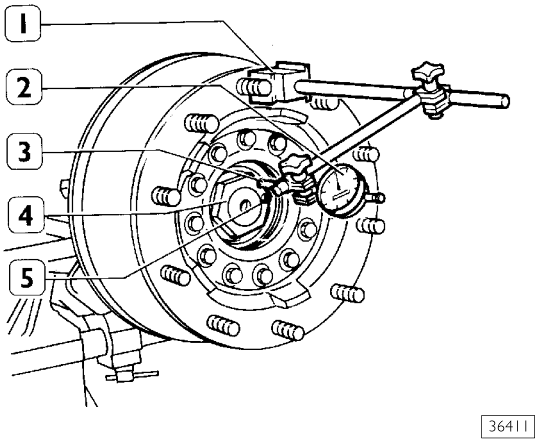
Adjusting wheel hub bearing end play

Figure 34



Using a torque wrench (2) and wrench 99388001 (2) lock the adjustment nut to the prescribed torque.

Figure 35



Give wheel hub a few blows with a mallet in axial direction, rotating it in both directions to free the bearing rollers.
Apply magnetic base (1) with gauge (2) to the wheel hub.

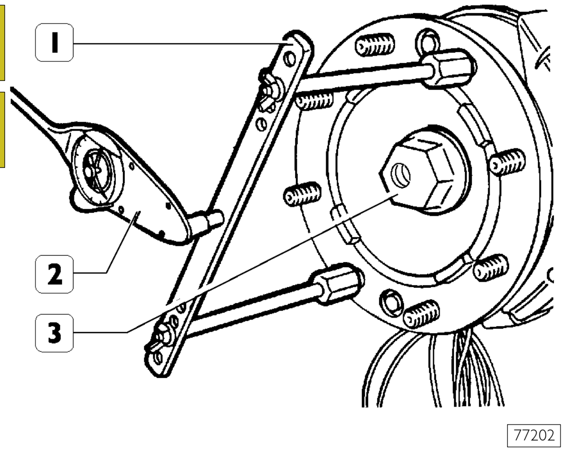
Put stylus pointer (3) perpend. to the stub axle (4) spigot.
Zero the gauge with a preload of 1.5 to 2 mm.
Use a lever to move the wheel hub along the axis and measure the end play which should be 0.16 mm (max. value).

If the end play is not as required, replace the bearing assembly e repeat the adjusting operations.

Once the specified end play is obtained, lock the adjustment nut (4) retaining screw (5) to the specified torque.

Checking the rolling torque

Figure 36

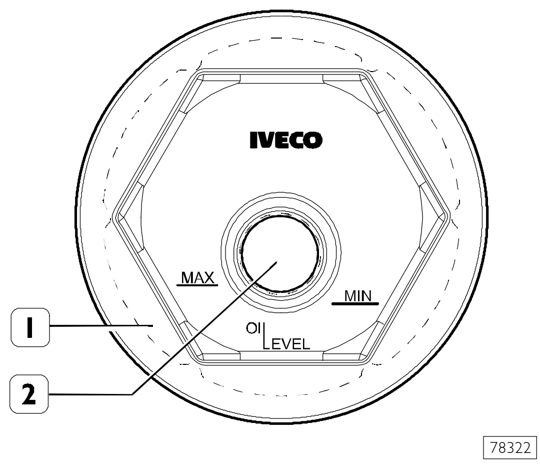


Apply tool (1) 99395026 on wheel hub stud bolts and use torque meter 99389819 (2) to check whether the wheel hub rolling torque is at the set value.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.

Tighten to torque the hub cover (3).

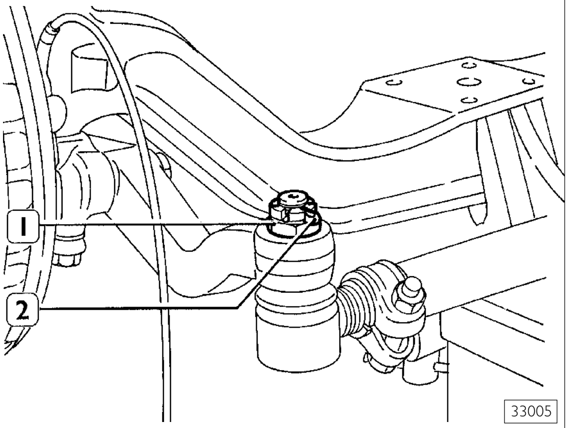
Figure 37



Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

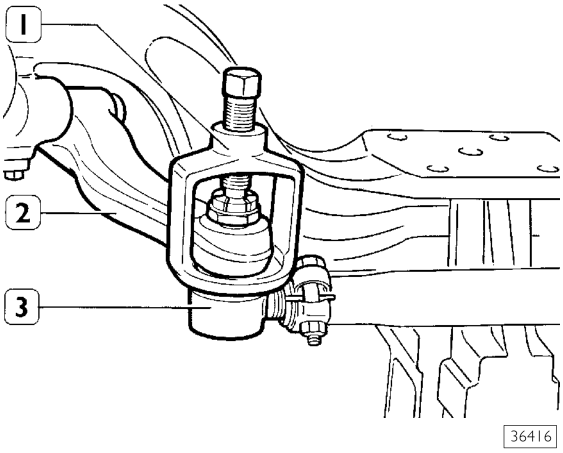
520635 REMOVING AND REFITTING TRACK ROD

Figure 38



Straighten and extract cotter pin (1).
Unlock nut (2) and partially unscrew it so as to prevent the track rod from dropping when removing.

Figure 39



Using the extractor 99347068 (1), release the ball joint (3) from the arm (2). Repeat the same operations on the opposite side, unscrew the nuts completely and remove the track rod.

To refit, carry out removal operations in reverse order.

Tighten the nuts securing the taper pins to the specified torque.

Check the position of the castellations on the nuts which line up with the transverse holes in the taper pins; if the cotter pins will not go in, progressively increase the torque of the nuts until correct insertion is achieved (angle less than 60°).

520636 REPLACING TRACK ROD BALL JOINT

Before replacing swivel head (Figures 40-41) check the axial clearance as described below.

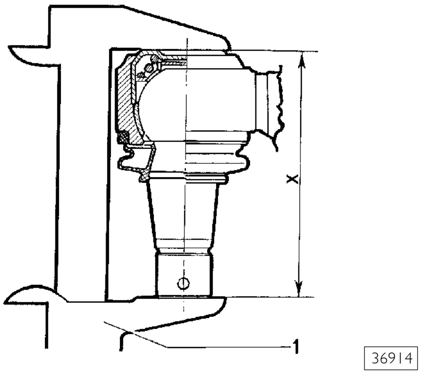
CHECKING BALL JOINT END PLAY FOR TRACK ROD AND DRAG LINK

The vehicle should not be jacked up.
Use a gauge (1, Figure 40) to measure the distance "X" with the vehicle in straight on position.
Take the measurement again with the steering turned as far as possible, to the left (X1) and to the right (X2). Take a note of the values measured.
Calculate the axial clearance "A", noting the maximum value measured between X1 and X2.
Example:

A = max (X1, X2)-X

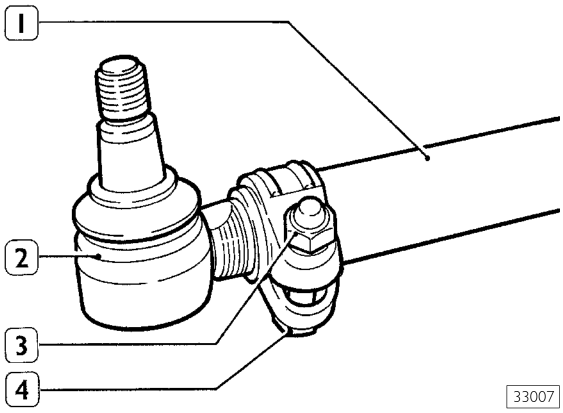
If the value rises above 2 mm replace the ball joint.

Figure 40



Replacing ball joint

Figure 41



Lock screws (4), loosen nut (3) and unscrew ball joint (2) from track rod (1).
Screw ball joint into rod and lock in position tightening locking nut to the specified torque.

To make it easier to refit the track rod and measure the wheel convergence, note down the number of turns needed to unscrew each ball joint so that the new ones can be screwed in by the same number of turns.

Refit the track rod.

Check and, if necessary, adjust front wheel toe-in as described on "Front wheel set up".

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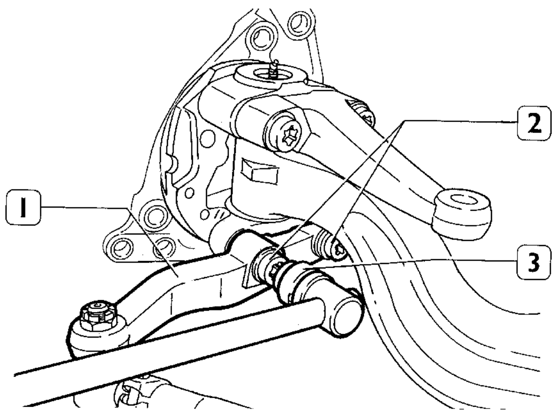
520631 REMOVING AND REFITTING TRACK ROD ARMS

Figure 42

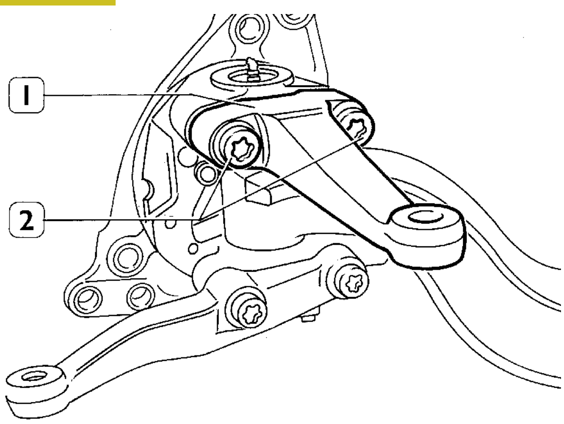


49182

Unscrew screws (2) using wrench 99388002 (3) and remove arm (1). To refit, reverse the sequence of operations and tighten the fastening screws to the specified torque.

520632 REMOVING AND REFITTING DRAG LINK ARM

Figure 43



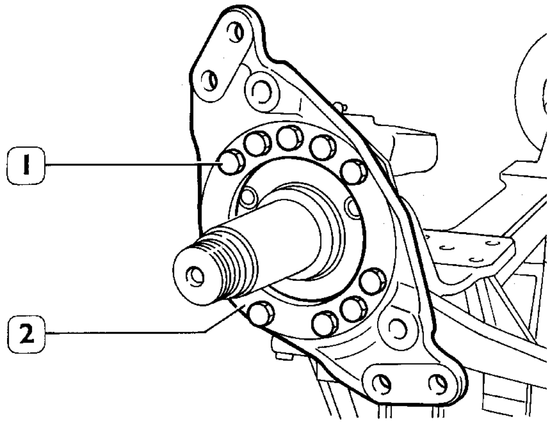
49183

Unscrew screws (2, Figure 43) using wrench 99388002 (3, Figure 42) and remove arm (1). To refit, reverse the sequence of operations, tightening the attachment screws to the specified torque.

520611 REMOVING AND REFITTING THE KINGPIN

Removing

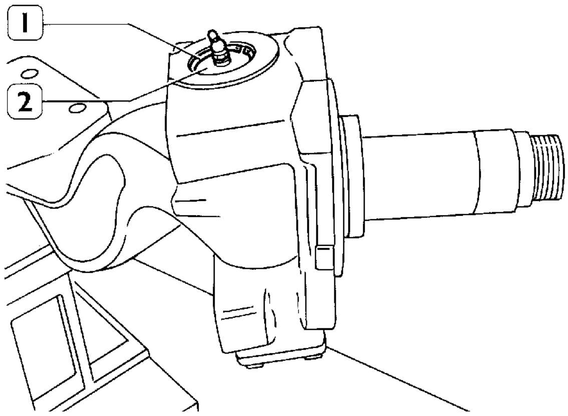
Figure 44



49184

Unscrew screws (1) and remove support (2) from the brake calliper.

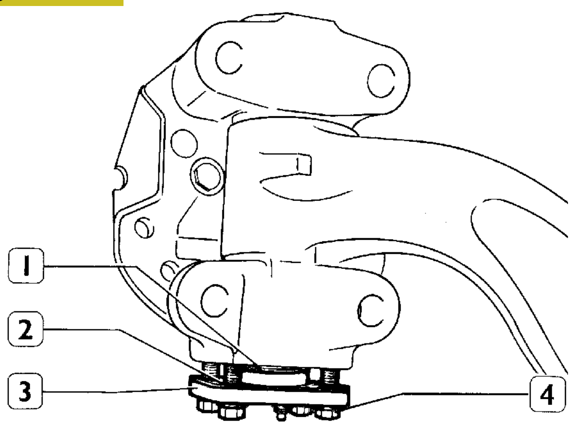
Figure 45



36420

Using suitable pliers, remove the retainer circlip (1) and take out the cover (2) complete with grease nipple.

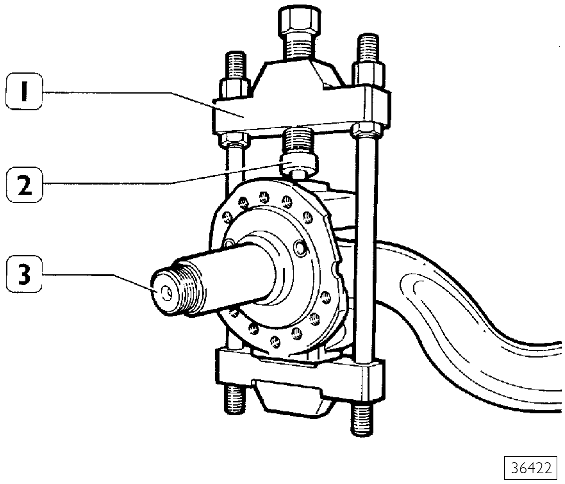
Figure 46



36421

Unscrew screws (4) and remove lower cover (3), adjustment shims (2) and thrust bearing (1).

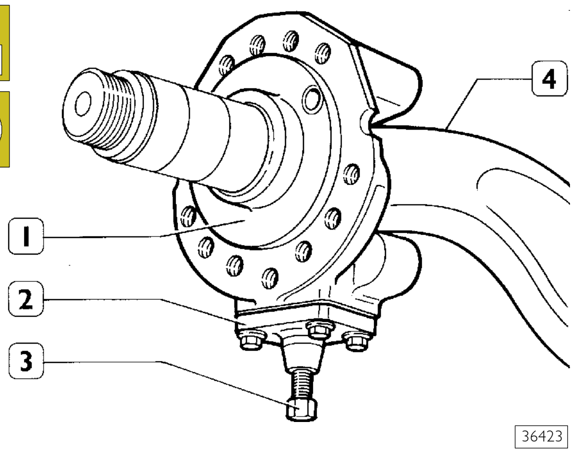
Figure 47



Use tool 99347047 (1) and part (2) to unlock swivel axle pin (3). Remove the tool and withdraw the pin.

Refitting

Figure 48

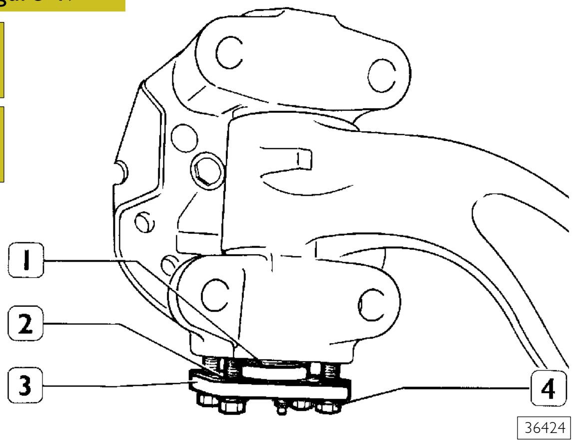


Fit stub axle (1) to axle (4) and insert the pin into its housing. Apply tool 99374405 (2) to the stub axle and secure by means of the lower cover retaining screws. Tighten to a suitable torque.
Press-fit the pin into the taper seating in the axle, tightening pressure screw (3) to a torque of 15 to 16 daNm.
Remove tool 99374405 from the stub axle.

> ! Before installing the pin, make sure that the taper seating in the axle and the surface of the pin are completely clean and dry to avoid oil films which would facilitate rotation of the pin in its seating during the installing operation.

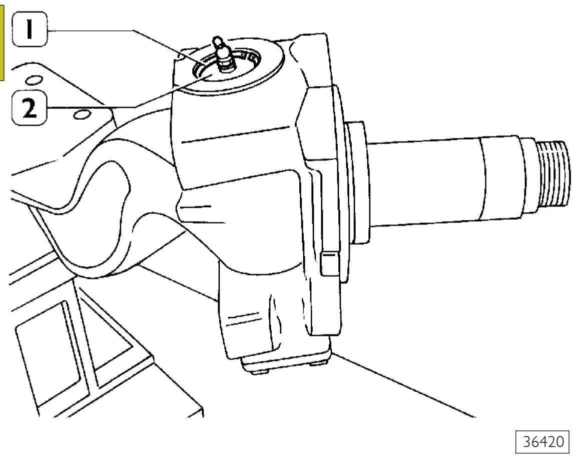
> ! Before assembling, lubricate the lower cover thrust bearing with Tutela MR2 grease.

Figure 49



Position lower cover (3) complete with thrust bearing (1) and adjustment shims (2). Tighten screws (4) to the specified torque.
Repeat the same operations for the opposite axle.

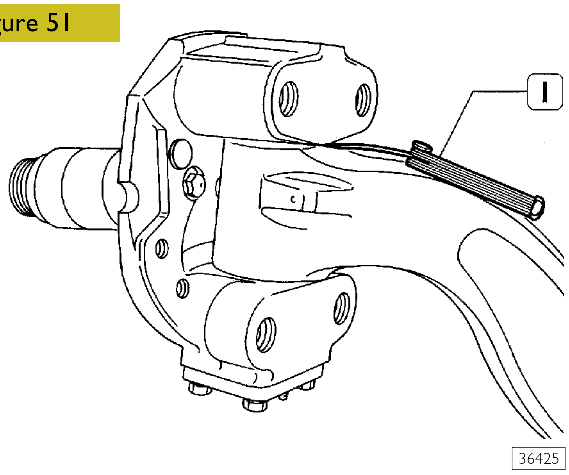
Figure 50



Insert upper cover (2) complete with seal into its housing; position grease nipple as shown in the figure, then insert retainer circlip (1) making sure that the circlip expands correctly.

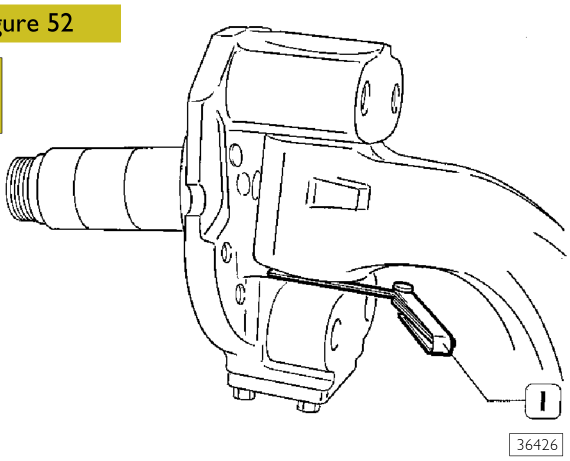
Checking and adjusting play between stub axle and axle

Figure 51



Lift the swivel axle to bring it into contact with the lower axle facing. Use feeler gauge (1) to check clearance between upper facing of swivel axle and axle. This should be between 0.10 and 0.35 mm.

Figure 52



When the clearance between the upper facing of the swivel axle and the axle has been checked, confirm by means of a feeler gauge (1) that there is a clearance between the lower facing of the swivel axle and that of the axle of not less than 0.25 mm.

Adjustment of the clearance, if any, is obtained by replacing the adjustment shims with others supplied as spares having suitable thicknesses.

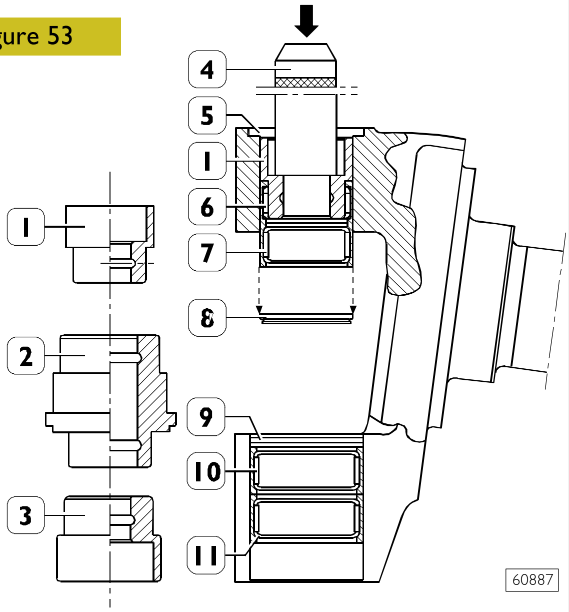
IVECO PARTS

For spare shim thicknesses, see "CHARACTERISTICS AND DATA" table on page

Grease the lower and upper joint assembly with MR2 grease making sure that the grease escapes through the deflector lips of the seals.

520615 STEERING KNUCKLE PIN BEARING REPLACEMENT

Figure 53



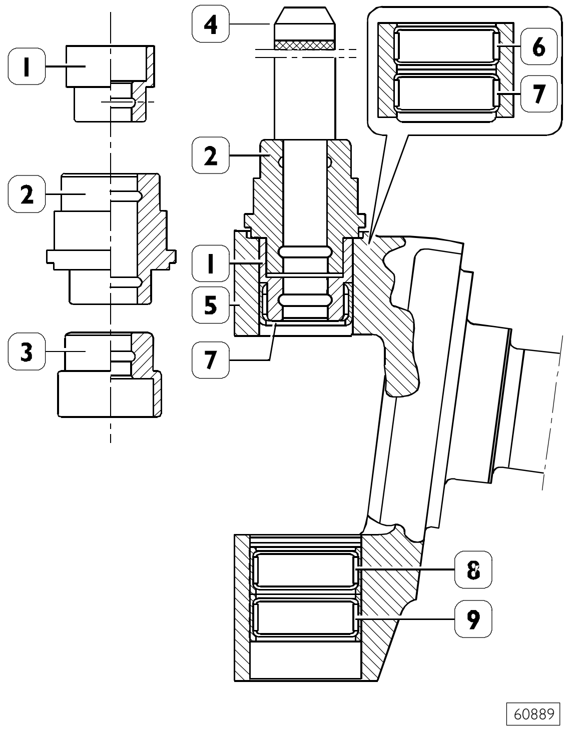
Steering knuckle bearing replacement (5) is made using for their disassembly and assembly beater's elements (1-2-3) 99374527 and handle 99370007 (4).

Use element (1) and handle (4) to disassemble the sealing ring (8) and the roller bearings (6-7) on the upper side.

Use element (3) and handle (4) to disassemble the sealing ring (9) and the roller bearings (10-11) on the lower side.

Figure 54

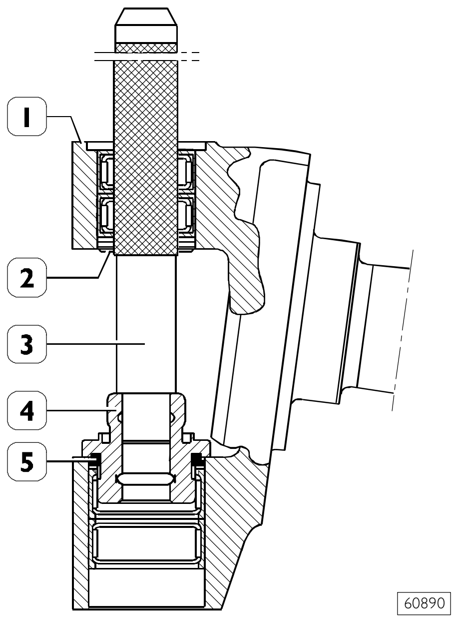
IVECO PARTS



Roller bearing assembly (7):
use element (1 and 2) and handle (4).
Roller bearing assembly (6):
use element (2) and handle (4).
Roller bearing assembly (8):
use elements (3 and 2) and handle (4).
Roller bearing assembly (9):
use element (2) and handle (4).

Figure 55

IVECO PARTS



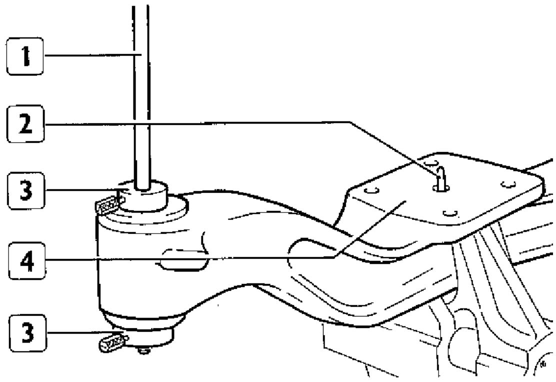
With beater 99374173 (4) and handle 99370007 (3), assemble sealing rings (2 and 5) in stub axle (1).

520618 CHECKS AND MEASUREMENTS ON AXLE BODY

Checking surface flatness of leaf spring seating with respect to holes for kingpins.

Apply two rods (as shown in Figure 56, ref. 1) complete with cones (3) in the holes for knuckle pins; press the cones and lock them in position on the rods using relevant screws.
Insert the two locating dowels (2) into the housings in the leaf spring seating surface.

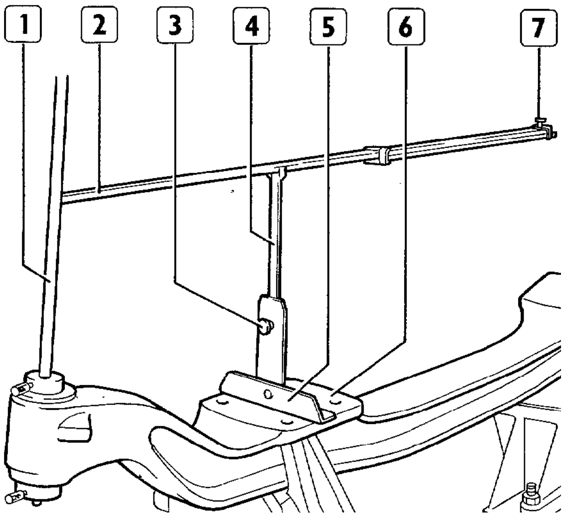
Figure 56



Apply bases (5, Figure 57) to planes (6) using protractors and fit into centring dowels.

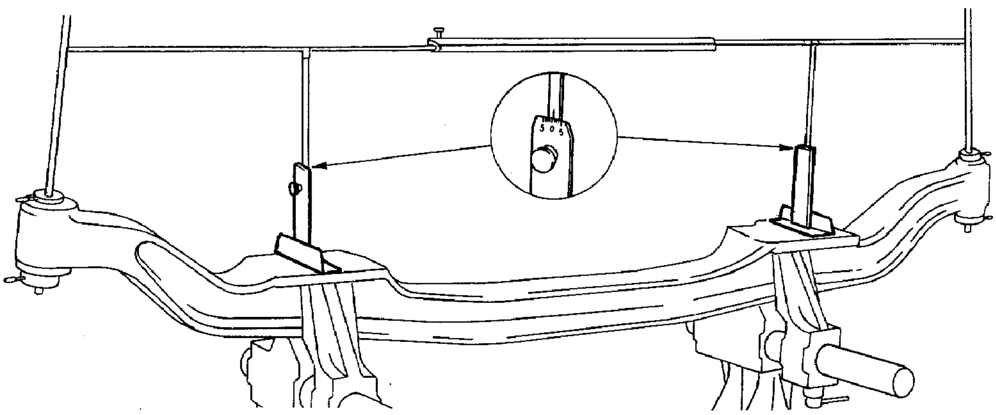
Before fitting the bases with protractors, make sure that the seating faces have no traces of paint or roughness.

Figure 57



Fit sliding bar (2) to protractor rods (4), adjusting the length so that the shaped ends come into contact with rods (1).
Lock screw of clamp (7) and screws (3) securing the protractors to the rods (4).

Figure 58



Check the angle of distortion, if any, on the graduated sectors of the protractors shown by the arrows.
Obviously the protractor pointers do not record any angular deviation when the flatness of the leaf spring seating surfaces is correct with respect to the holes for the kingpins. Remove the sliding bar and the bases with protractors used for the inspection.

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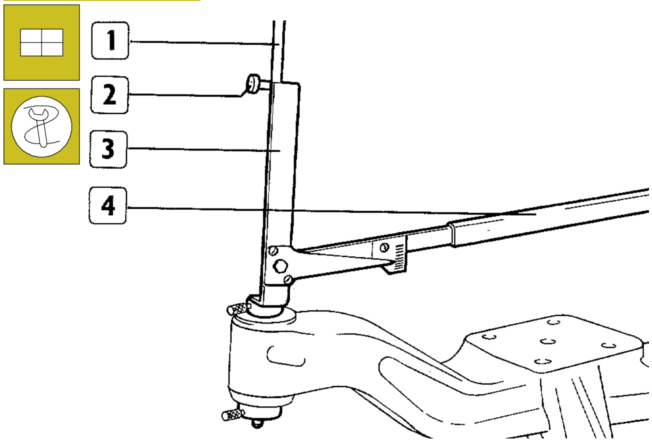
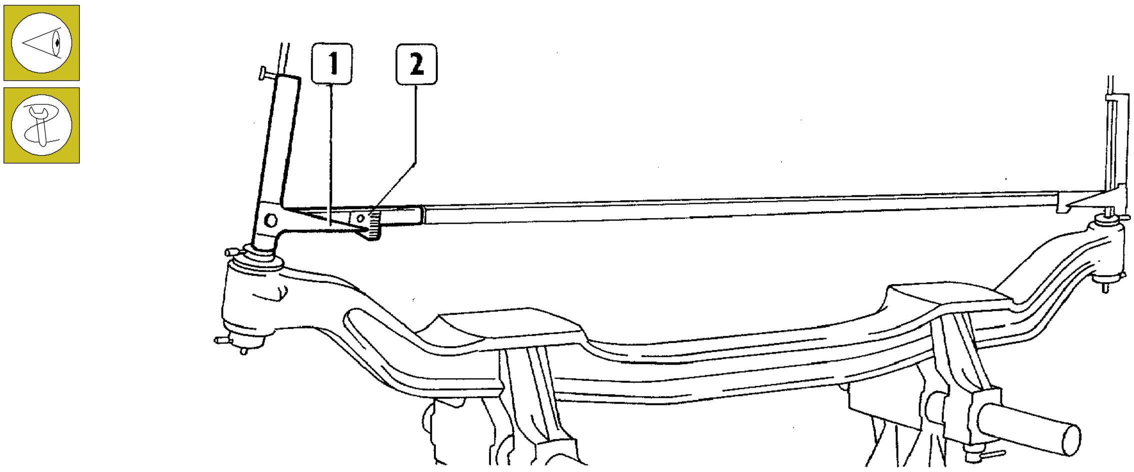
Checking inclination of holes for kingpins

Figure 59



Fit supports (3) with protractors to rods (1) and screw up screws (2) without tightening them.
Insert transverse link rod (4) and fully screw up screws (2) which secure the supports in contact with rods (1).

Figure 60



Read off the value of the angle of kingpin inclination from the relevant graduated sectors (2) in line with the pointers (1).

The value for inclination of the holes for the kingpins should be 7°.

SECTION 8

5004 Suspensions

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FRONT AND REAR MECHANICAL SUSPENSIONS 3

FRONT AND REAR PNEUMATIC SUSPENSIONS 43

5004 Front and rear mechanical suspensions

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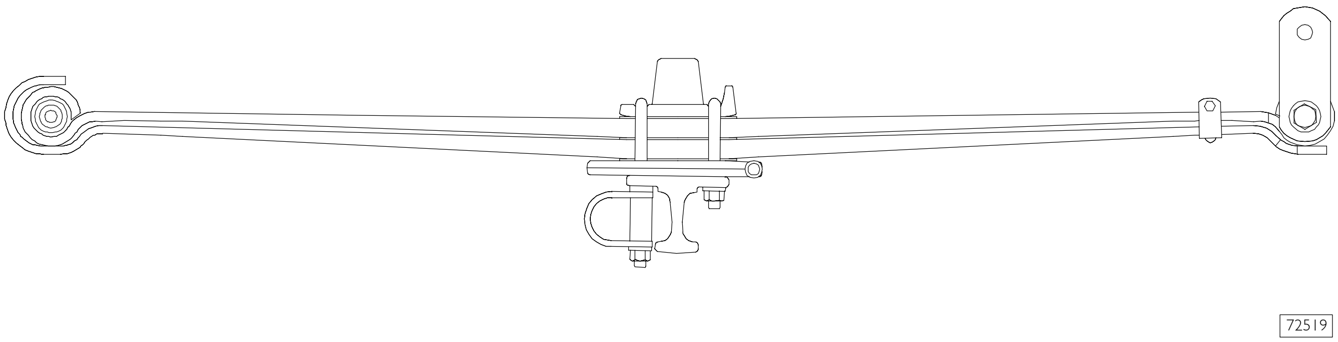
DESCRIPTION

The suspension consists of leaf springs, two double-acting telescopic shock absorbers and a sway bar.
The leaf springs can be semi-elliptical or parabolic.
Semi-elliptical leaf springs are very stiff because all the leaves have the same thickness, from one end to the other. Furthermore, the leaves are arranged to create high internal friction, whereby limiting the leaf spring movements.
Parabolic leaf springs are made of leaves which are thicker in the middle and narrower at the ends. The distanced arrangement considerably reduces internal friction.
Low internal friction and the special leaf shape makes parabolic leaf springs softer, consequently ensuring greater riding comfort.

Double-acting telescopic shock absorbers counteract wheel movement upwards and downwards, ensuring excellent riding stability.
The sway bar keeps the wheel axle and chassis parallel, cancelling any load imbalance on the wheel on any one axle.

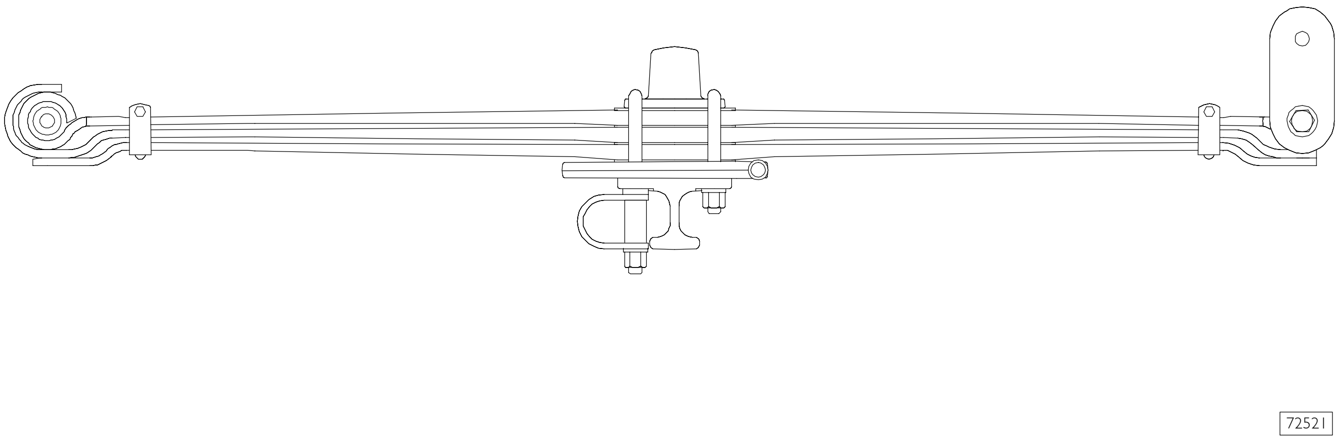
FRONT LEAF SPRINGS

Figure 1



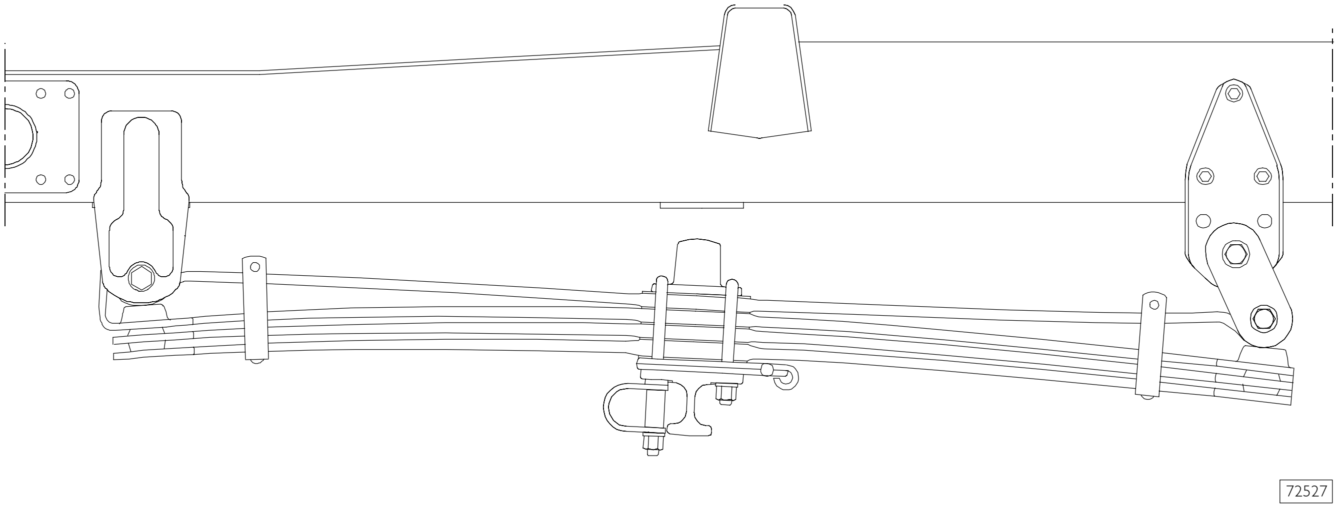
FRONT PARABOLIC LEAF SPRING ASSEMBLY
(Models 110EL..-120EL..)

Figure 2



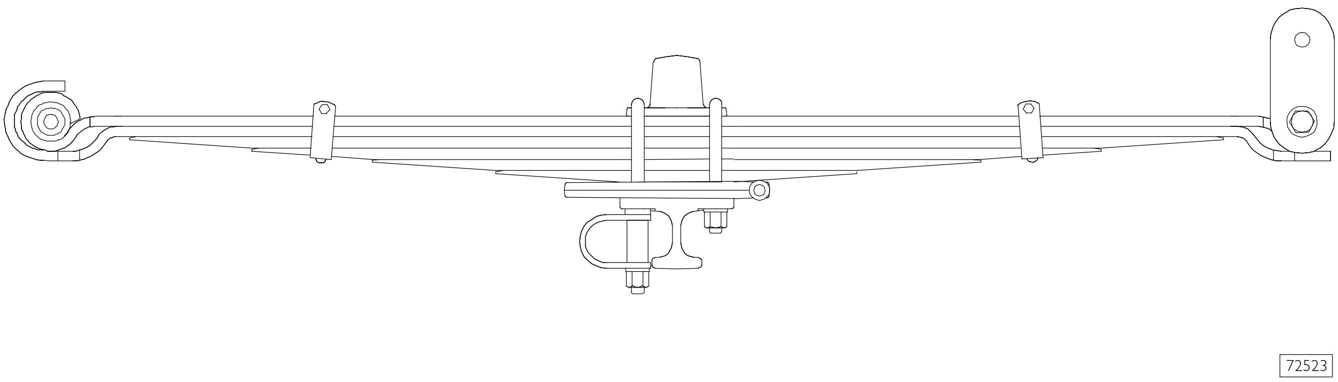
FRONT PARABOLIC LEAF SPRING ASSEMBLY
(Models 120E..-130E..-130E..RS-150E..-150E..RS)

Figure 3



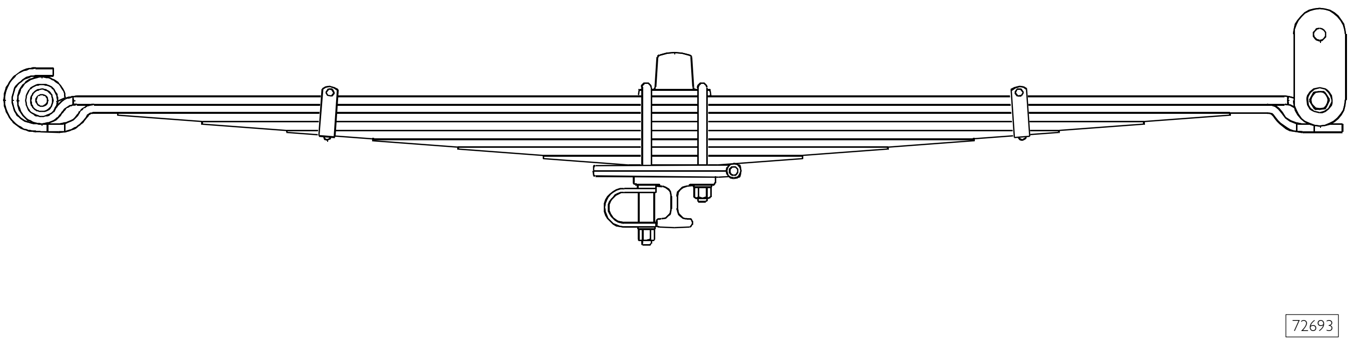
FRONT PARABOLIC LEAF SPRING ASSEMBLY
(Models 180E..-260E..)

Figure 4



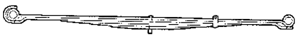
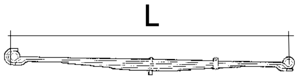
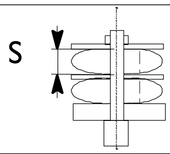
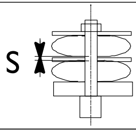
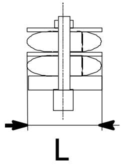
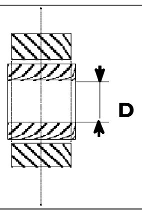
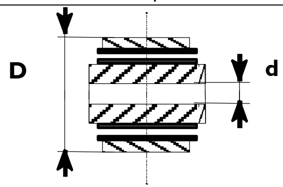
FRONT SEMI-ELLIPTICAL LEAF SPRING ASSEMBLY
(Models 120E..-130E..-180E..)

Figure 5

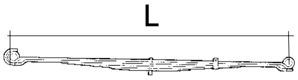
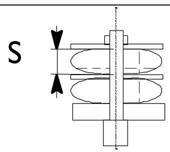
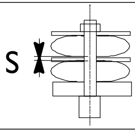
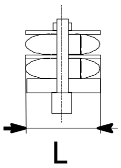
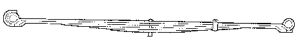
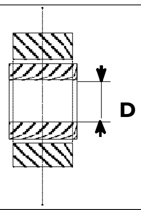
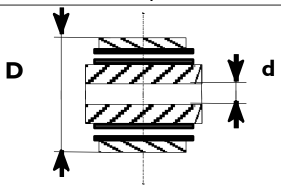


FRONT SEMI-ELLIPTICAL LEAF SPRING ASSEMBLY
(Models 120E..-130E..-150E..)

PARABOLIC LEAF SPRING SPECIFICATIONS AND DATA
FRONT SUSPENSION - Models 110EL..-120EL..

		mm
	Parabolic leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1714 ± 3
	Leaf thickness (measured in the middle)	26
	Thickness between leaves	3
	Width of leaves	70 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	 17 5.691 mm/kN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{-0.2}_{+0.6}$ $20.2^{+0.3}_{-0}$

FRONT SUSPENSION - Models 120E..-130E..

		mm
	Parabolic leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness (measured in the middle)	24
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	6 6.96 mm/kN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

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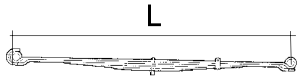
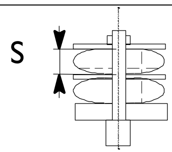
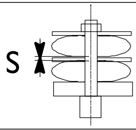
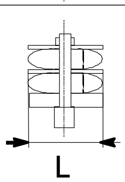
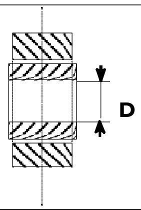
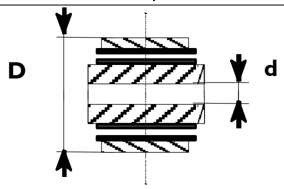
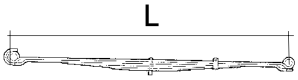
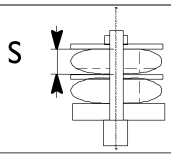
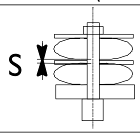
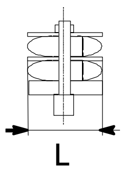
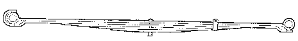
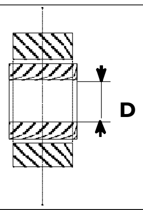
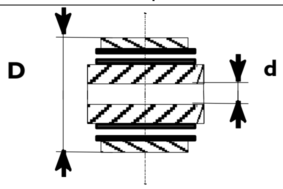
FRONT SUSPENSION - Models 120E..-120E..D-130E..-130E..D-130E18RS-150E..-150E..RS

		mm
	Parabolic leaf springs	Nº 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness (measured in the middle)	21
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	15 6,69 mm/kN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

FRONT SUSPENSION - Models 180E..-260E..

		mm
	Parabolic leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness 1st leaf (measured in the middle) 2nd - 3rd - 4th leaf (measured in the middle)	 19 21
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	 2 5.53 mm/kN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

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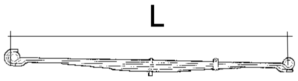
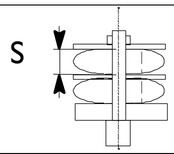
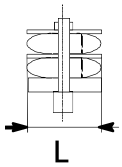
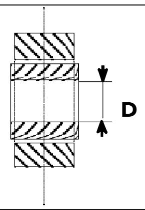
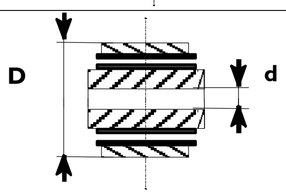
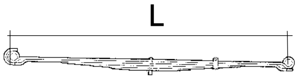
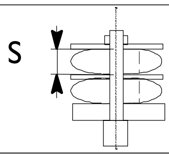
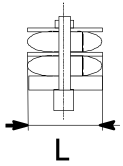
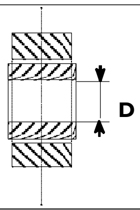
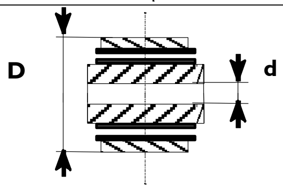
SEMI-ELLIPTICAL LEAF SPRING SPECIFICATIONS AND DATA
FRONT SUSPENSION - Models 120E..-130E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness (measured in the middle)	14
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	 12 6.31 mm /kN
	Main leaf eye internal diameter (bushing housing)	$55.5^{+0.1}_{-0}$
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

FRONT SUSPENSION - Models 120E..D-130E..D-150E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness (measured in the middle)	13
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	6.5 6.11 mm /kN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

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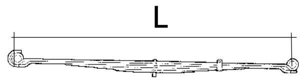
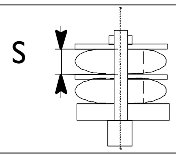
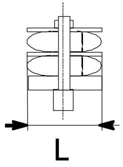
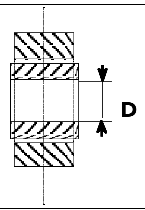
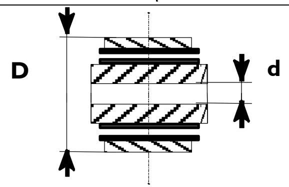
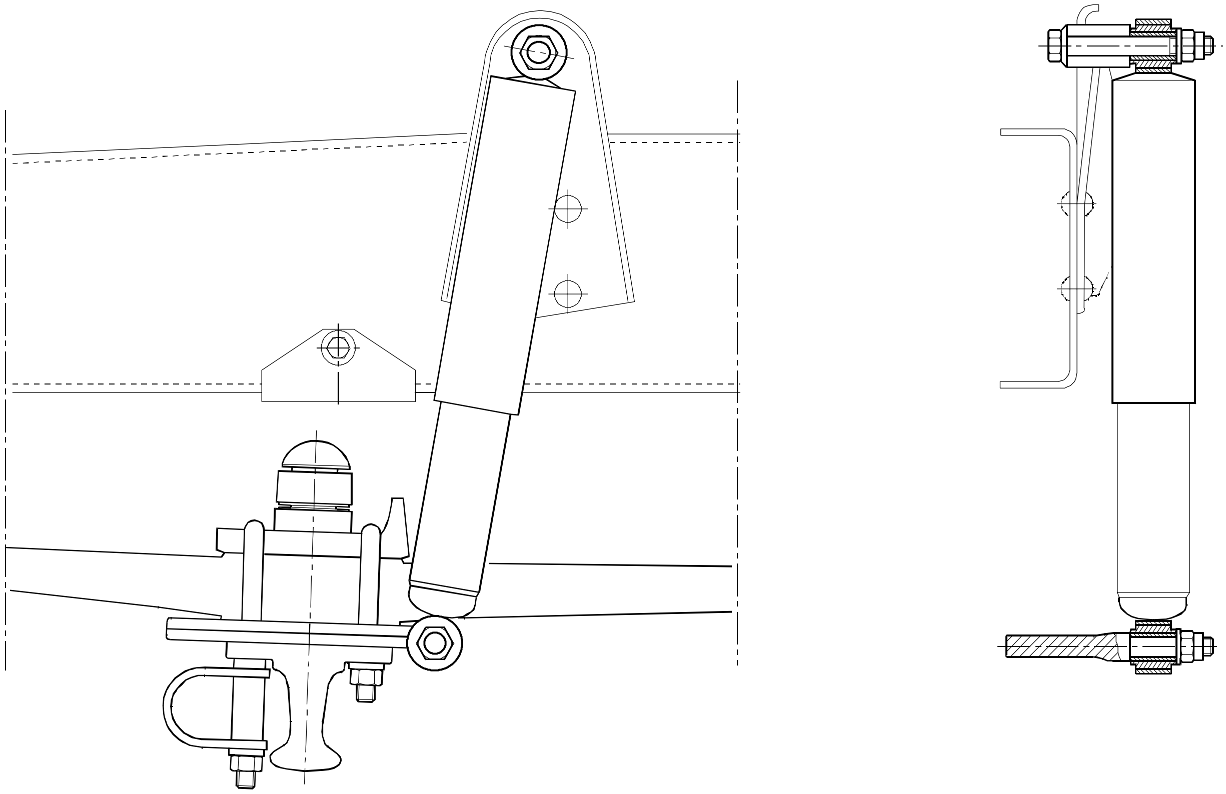
FRONT SUSPENSION - Models 180E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1758 ± 3
	Leaf thickness (measured in the middle)	16.5
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Free spring pointer Flexibility	 35 3.97 mm /kN
	Main leaf eye internal diameter (bushing housing)	$55.5^{+0.1}_{-0}$
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

FRONT SHOCK ABSORBERS
Assembly diagrams

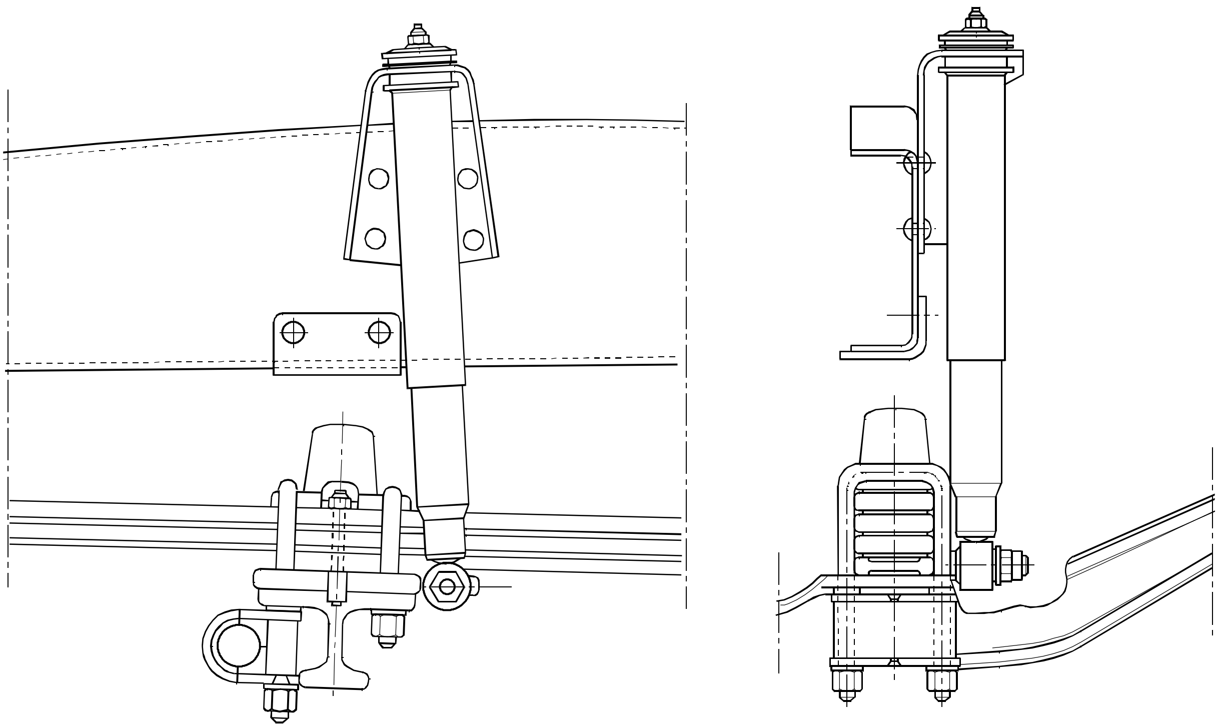
Figure 6



72694

SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 110EL..-120EL..)

Figure 7



72695

SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 120E…-130E..-150E..)

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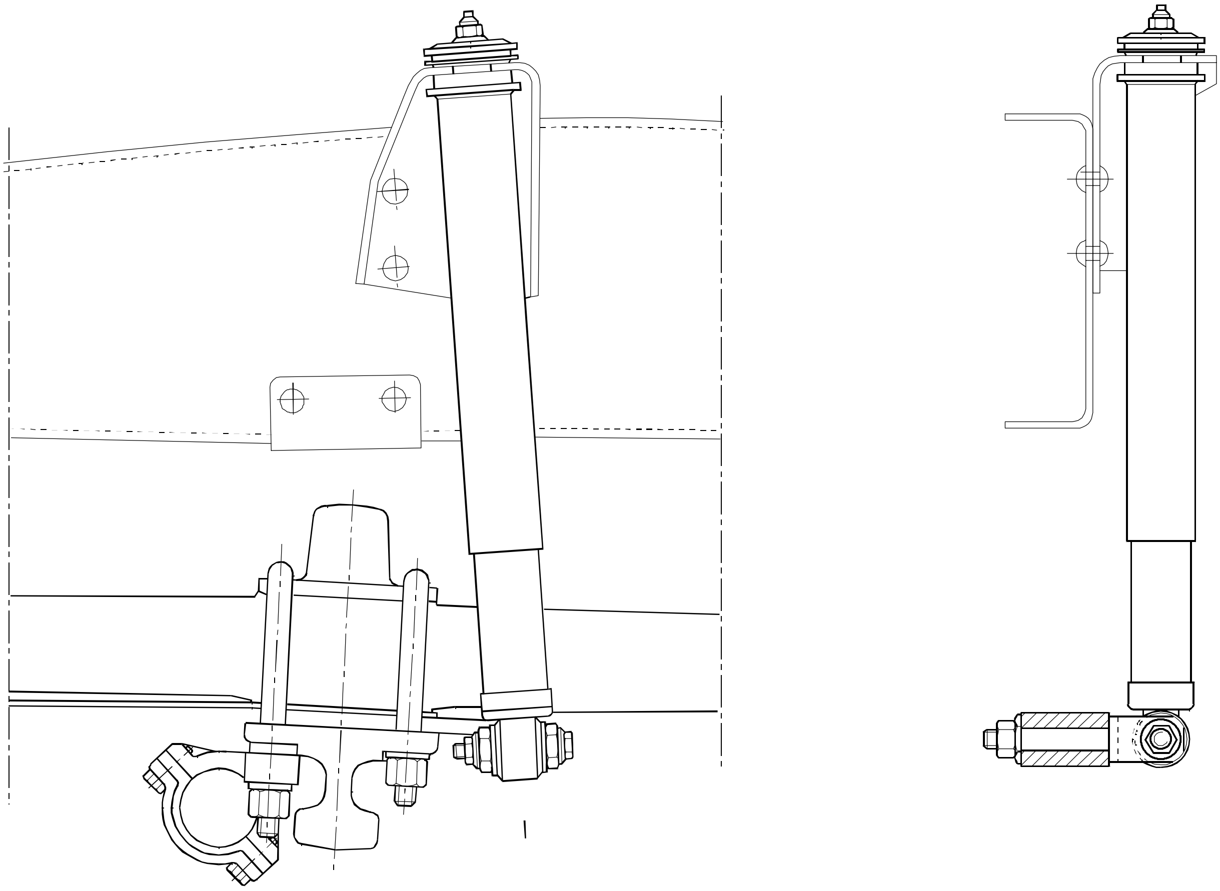
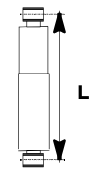
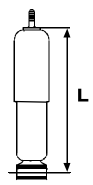
Figure 8



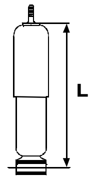
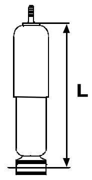
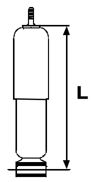
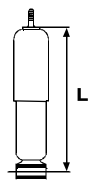
72696

SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models180E..-260E..)

SPECIFICATIONS AND DATA

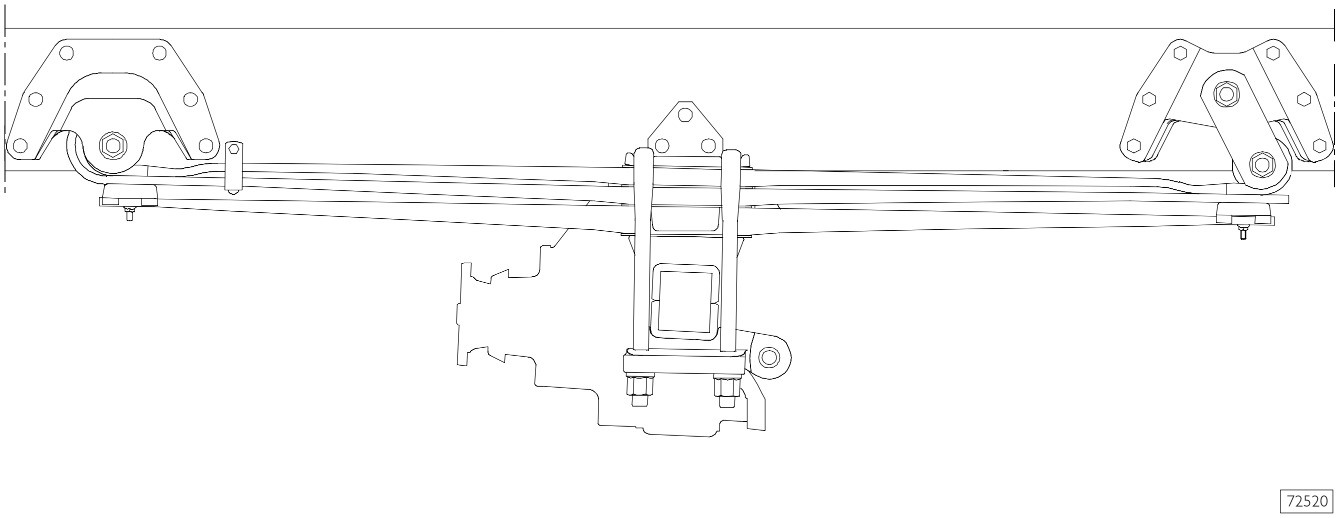
SHOCK ABSORBER		MANNESMANN & SACHS	
 MODELS: 110EL../120EL..	Length between eyebolts: Open (mm) Closed (mm) Stroke (mm)	618 ± 3 378 ± 3 240	
SHOCK ABSORBER		FICHTEL & SACHS	WAY-ASSAUTO
 MODELS: 120E../130E../ 120E..D/130E..D/ 130E..RS	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	709 ± 3 409 ± 3 300	696 ± 3 411 ± 3 285

(continued)

SHOCK ABSORBER  MODELS: 120E..-120E..D/ 130E..-130E..D/ 140E../150E..	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	MANNESMANN & SACHS 714 ± 3 414 ± 3 300
SHOCK ABSORBER  MODELS: 120E..D/ 130E..D/ 140E../ 150E..-150E..RS	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm) (with semi-elliptical springs)	FICHTEL & SACHS 725 ± 3 435 ± 3 290
SHOCK ABSORBER  MODELS: 140E../ 150E../150E..RS	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm) (with parabolic springs)	FICHTEL & SACHS 709 ± 3 409 ± 3 300
SHOCK ABSORBER  MODELS: 180E..	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	FICHTEL & SACHS 820 ± 3 470 ± 3 350

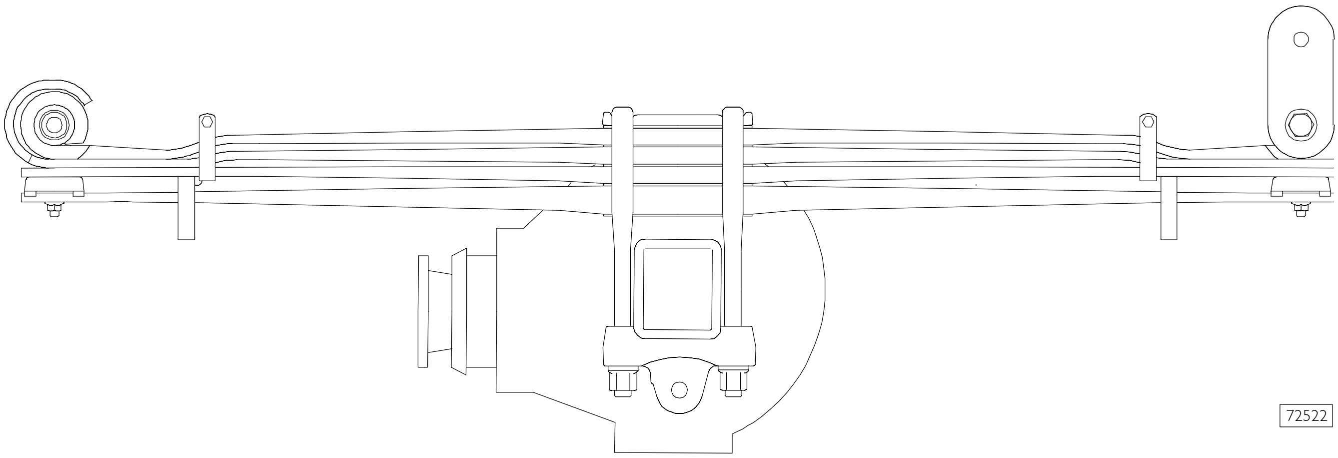
REAR LEAF SPRINGS

Figure 9



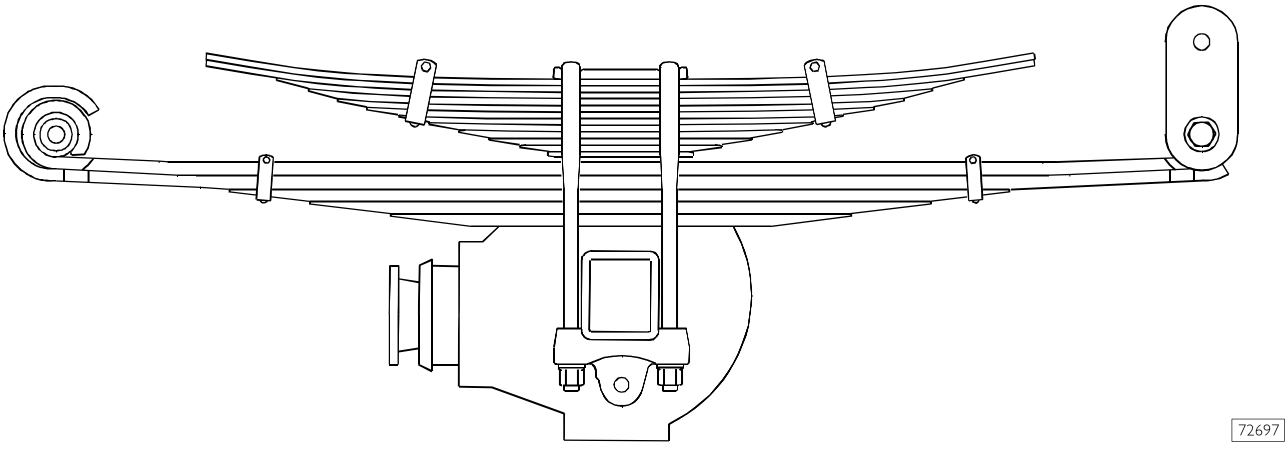
REAR PARABOLIC LEAF SPRING ASSEMBLY
(Models: 110EL..-120EL..-120E..-130E..-130E..RS)

Figure 10



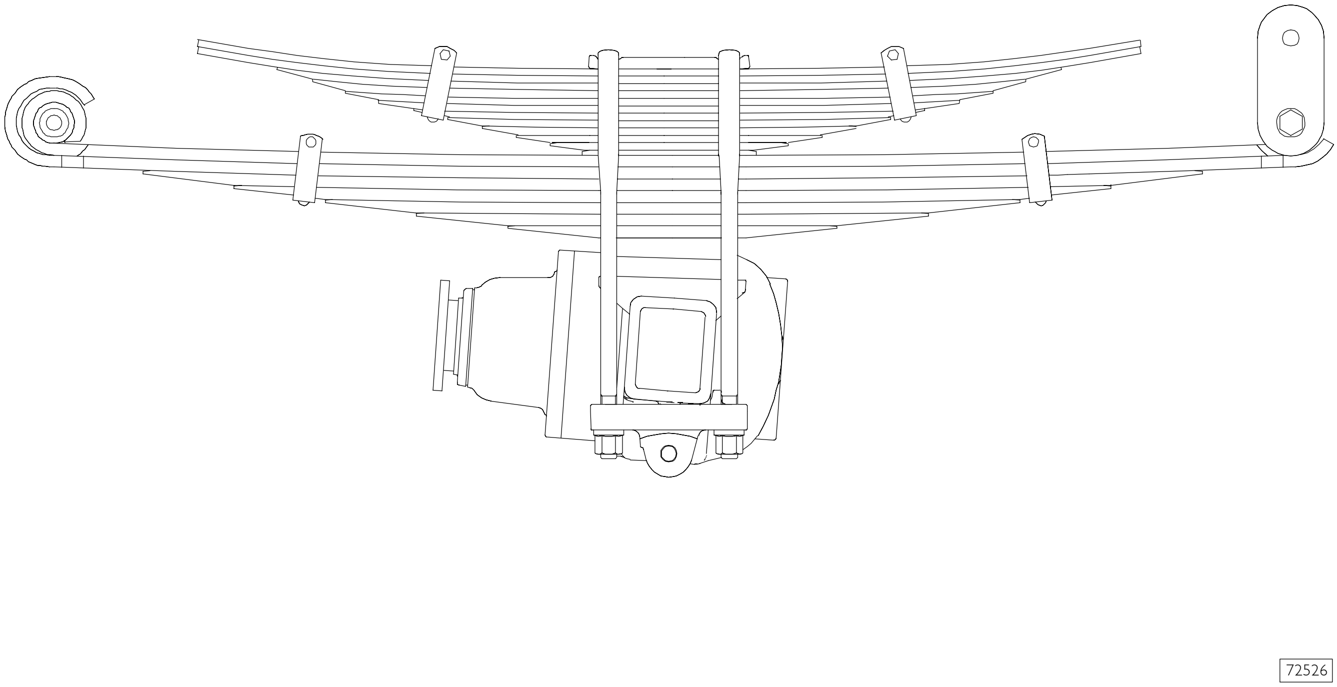
REAR PARABOLIC LEAF SPRING ASSEMBLY
(Models: 120E..D-130E..D-150E..-150E..RS)

Figure 11



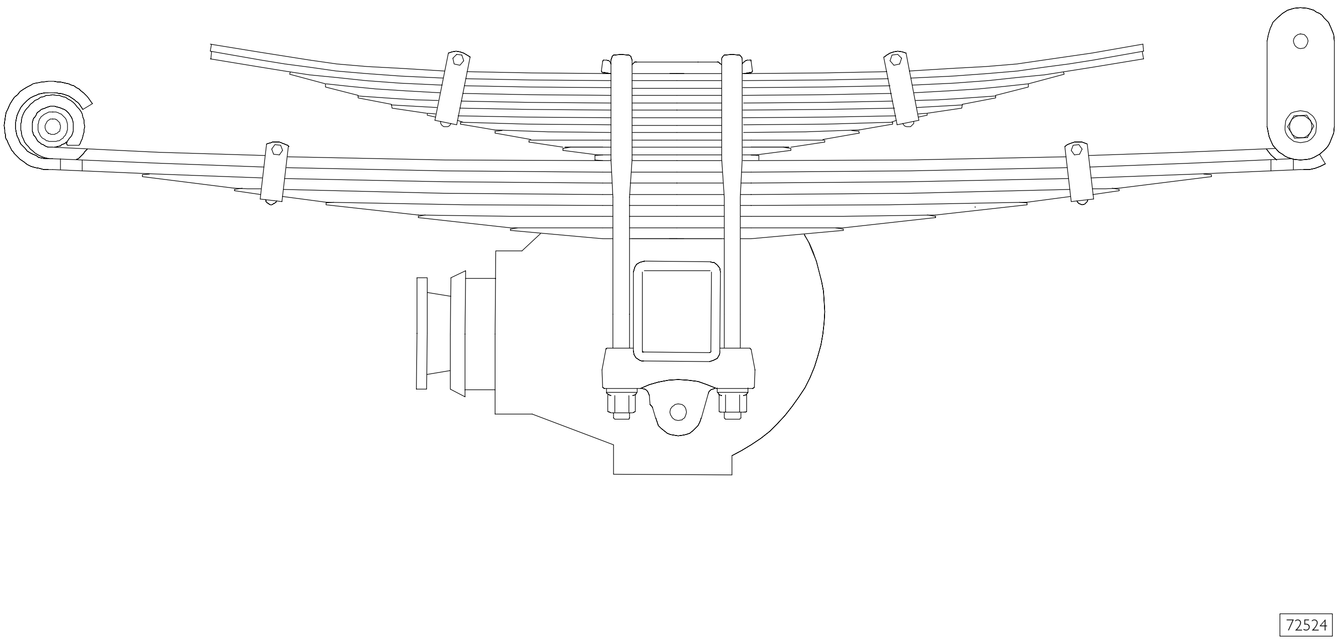
REAR SEMI-ELLIPTICAL LEAF SPRING ASSEMBLY
(Models: 120E..-130E..)

Figure 12



REAR SEMI-ELLIPTICAL LEAF SPRING ASSEMBLY
(Models: 120E..D-130E..D-150E..)

Figure 13



REAR SEMI-ELLIPTICAL LEAF SPRING ASSEMBLY
(Model:180E..)

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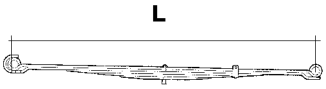
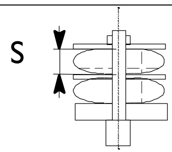
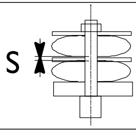
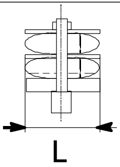
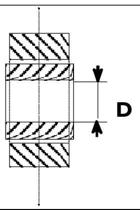
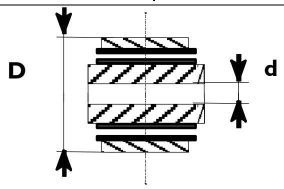
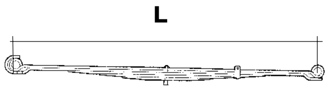
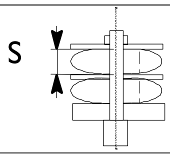
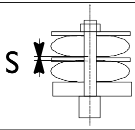
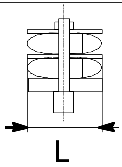
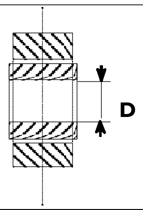
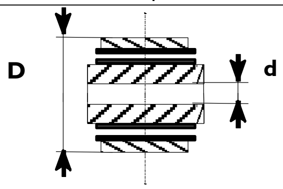
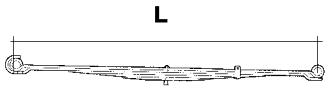
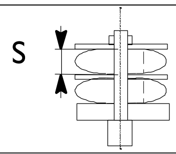
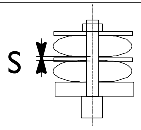
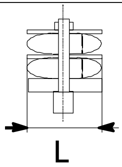
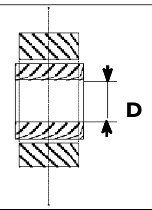
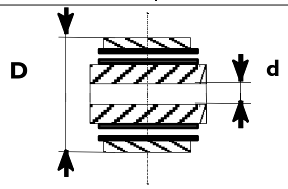
PARABOLIC LEAF SPRING SPECIFICATIONS AND DATA
REAR SUSPENSION - Models 110EL..-120EL..

		mm
	Parabolic leaf springs	N° 2
	Main leaf leaf length (measured at eye centre) Auxiliary spring length (measured between ends)	1670 ± 3 -
	Main leaf thickness (measured in the middle) Second leaf thickness (measured in the middle) Auxiliary leaf thickness (measured in the middle)	25 25 40
	Thickness between leaves	3
	Width of leaves	70 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Static load Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 14.75 5 38.05 KN 5.77 mm/KN 1.90 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

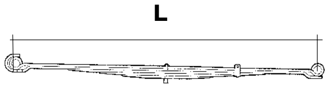
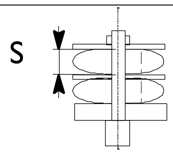
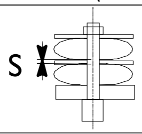
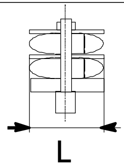
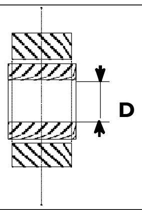
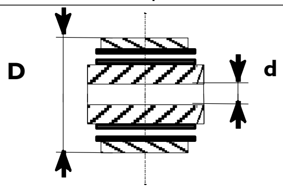
REAR SUSPENSION - Models 120E..-130E..

		mm
	Parabolic leaf springs	N° 2
	Main leaf leaf length (measured at eye centre) Auxiliary spring length (measured between ends)	1680 ± 3 -
	Main leaf thickness (measured in the middle) Second leaf thickness (measured in the middle) Auxiliary leaf thickness (measured in the middle)	25 25 38
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Static load Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 31 3.5 38.05 KN 6.55 mm/KN 2.12 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

REAR SUSPENSION - Models 120E..-130E..- 130E18RS

		mm
	Parabolic leaf springs	Nº 2
	Main leaf leaf length (measured at eye centre) Auxiliary spring length (measured between ends)	1680 ± 3 -
	Main leaf thickness (measured in the middle) Second leaf thickness (measured in the middle) Auxiliary leaf thickness (measured in the middle)	24 24 37
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Static load Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 32 7.25 41.251 KN 5.658 mm/KN 2.105 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

REAR SUSPENSION - Models 120E..-120E..D-130E..-130E..D-150E..-150E18RS

		mm
	Parabolic leaf springs	N° 2
	Main leaf length (measured at eye centre)	1680 ± 3
	Main leaf thickness (measured in the middle) Auxiliary leaf thickness (measured in the middle)	23 38
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 4 9.5 4.36 mm/KN 1.82 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

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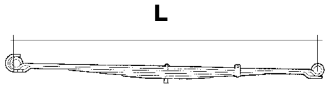
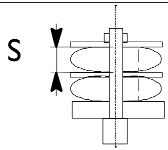
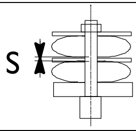
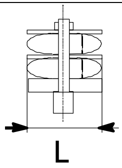
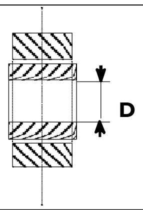
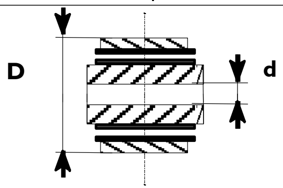
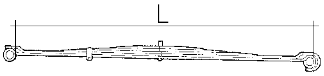
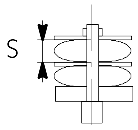
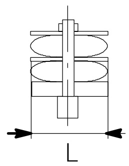
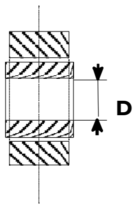
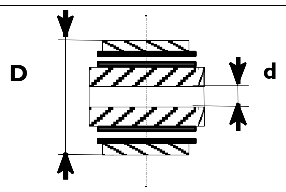
REAR SUSPENSION - Models 180E..

		mm
	Parabolic leaf springs	Nº 2
	Main leaf length (measured at eye centre)	1680 ± 3
	Main leaf thickness (measured in the middle) Auxiliary leaf thickness (measured in the middle)	24 38
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 4 6.5 3.87 mm/KN 1.73 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

SEMI-ELLIPTICAL LEAF SPRING SPECIFICATIONS AND DATA
REAR SUSPENSION 120E..-130E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf length (measured at eye centre) Auxiliary leaf length	1680 ± 3 1254 ± 3
	Main leaf thickness (1^{st}-2^{nd}) Main leaf thickness (3^{rd} - 4^{th}- 5^{th}) Auxiliary leaf thickness ($1^{st} \rightarrow 11^{th}$)	14 16 10
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 42 51 5.17 mm/KN 1.67 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{0}$

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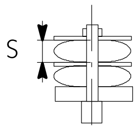
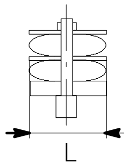
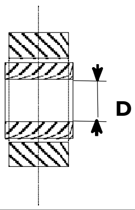
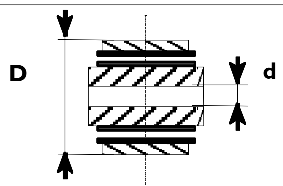
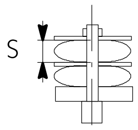
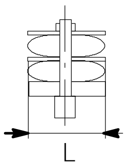
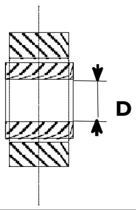
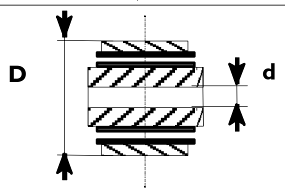
REAR SUSPENSION - Models 120E..D-130E..D-150E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf length (measured at eye centre) Auxiliary leaf length (measured between ends)	1680 ± 3 1254 ± 3
	Main leaf thickness (1st → 7th) Auxiliary leaf thickness (1st → 11th)	15 10
	width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 35 46 3.87 mm/KN 1.504 mm/KN
	Main leaf eye internal diameter (bushing housing)	$55.5^{+0,1}_{0}$
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{0}$

REAR SUSPENSION 180E..

		mm
	Semi-elliptical leaf springs	N° 2
	Main leaf length (measured at eye centre) Auxiliary leaf length (measured between ends)	1680 ± 3 1254 ± 3
	Main leaf thickness (1st →7th) Auxiliary leaf thickness (1st → 11th)	16 10
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Main leaf static load deflection Auxiliary leaf static load deflection Main leaf static load flexibility Auxiliary leaf static load flexibility after operation	 27 44 3.193 mm/KN 1.39 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0,6}_{-0,2}$ $20.2^{+0,3}_{0}$

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HENDRICKSON REAR SUSPENSION
Models 260E..

Disconnection

Operate as follows:

- ❑ Place the vehicle on a flat surface.
- ❑ Lock front wheels.
- ❑ Lift the rear part of the chassis and remove the wheels of the intermediate and rear axle.
- ❑ Place a suitable lifting tool under the equalizer to be removed.
- ❑ Disconnect the limit stop belt (12) loosening the screws (2) and removing the brackets (1).
- ❑ Disconnect the shock absorbers (3) from the lower part loosening the fasteners (10).
- ❑ Disconnect the suspension rubber springs (11) loosening the screws (4).
- ❑ Remove the screws (5) and withdraw the relevant bushes (8).
- ❑ Lower the equalizer by means of the lifting jack and extract it from its seat.

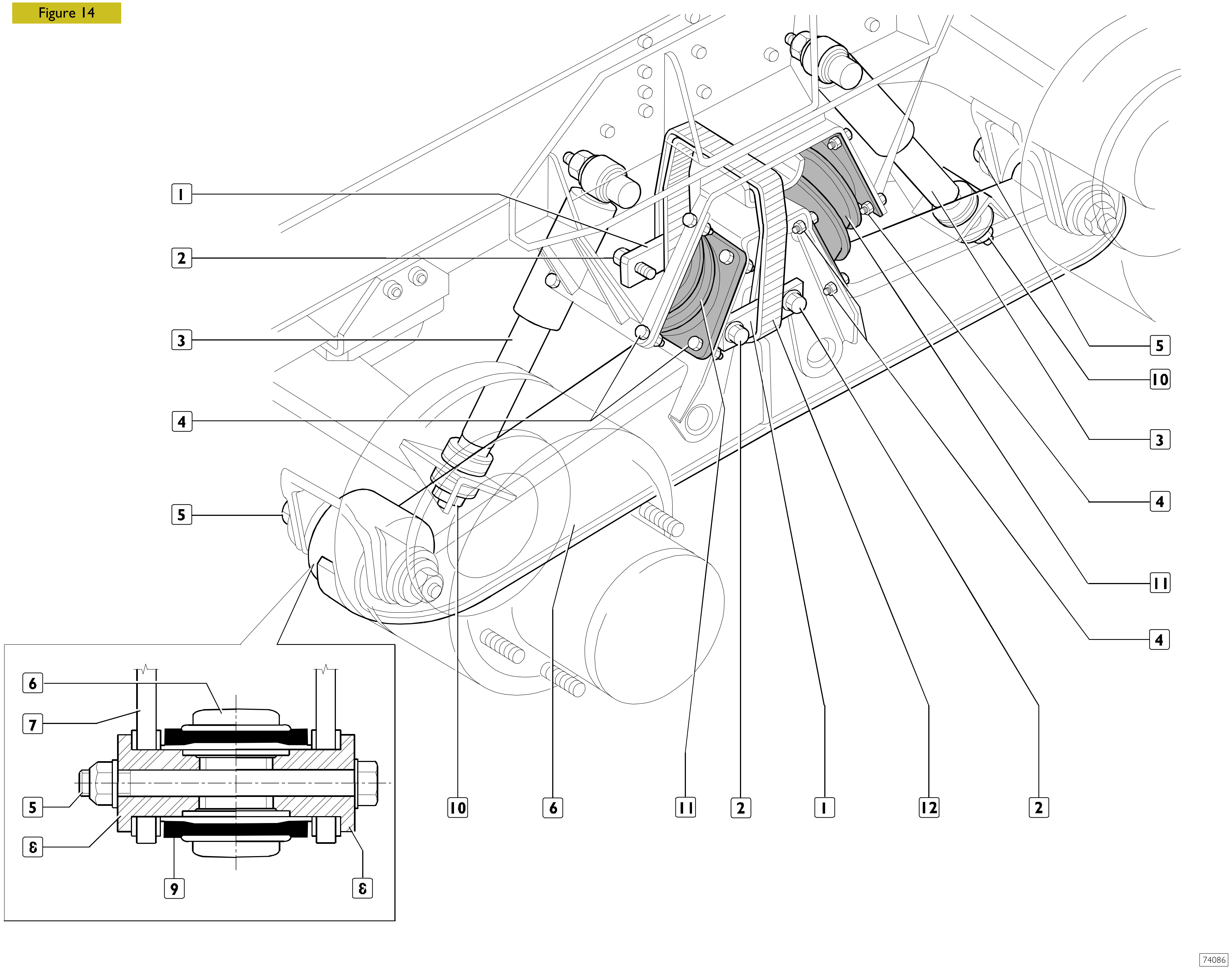
Reconnection

To reconnect follow the disconnection procedure in the reverse order.

Note: Work properly with the lifter under the equalizer (6) to obtain the centering of the axle box-type melting with the silentblock (9) in order to ease the insertion of the relevant bushes (8). Eventually lock the corresponding fasteners to the following tightening torques:

- ❑ fastener (5) to 630 Nm;
- ❑ fastener (10) to 94 Nm;
- ❑ fastener (4) to 50 Nm.

Figure 14



1. Limit stop belt locking bracket - 2. Bracket fastening screws - 3. Shock absorber - 4. Rubber spring fastening screws - 5. Silentblock fastening screws - 6. Equalizer - 7. Axle box-type melting - 8. Silentblock bush - 9. Silentblock - 10. Shock absorber fastener - 11. Rubber spring - 12. Limit stop belt

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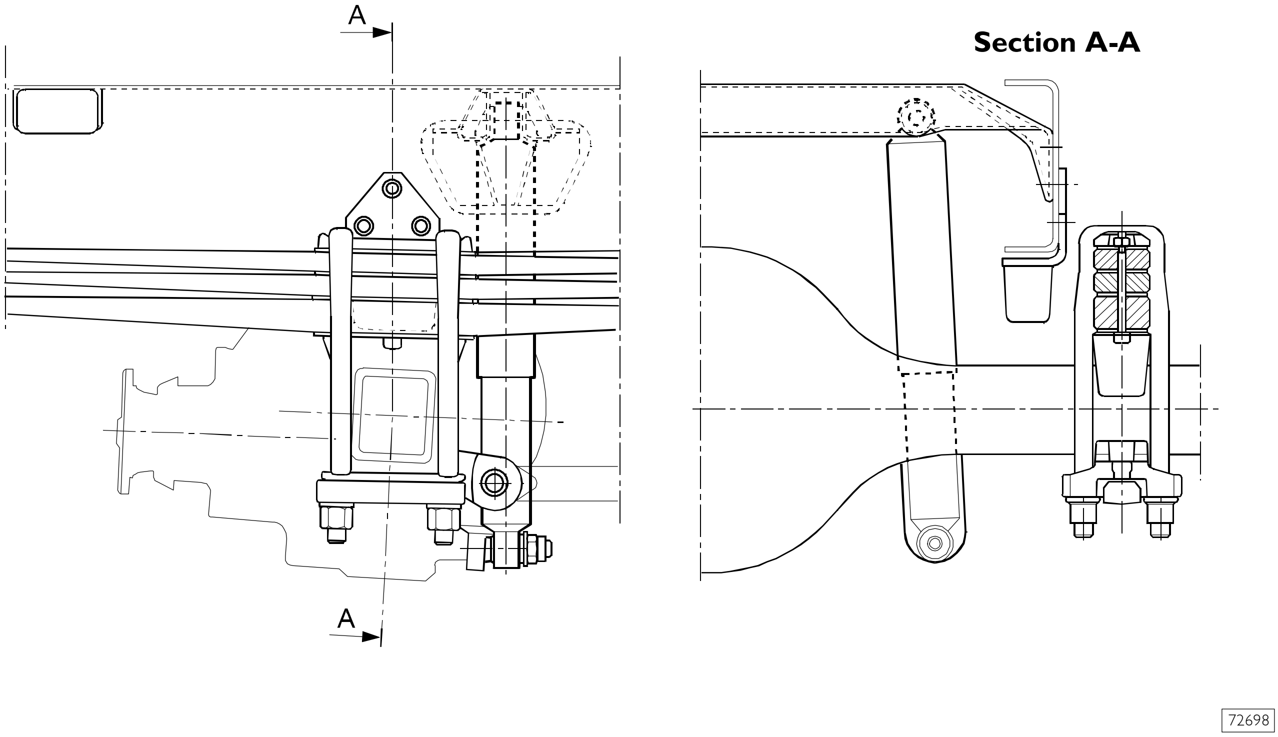
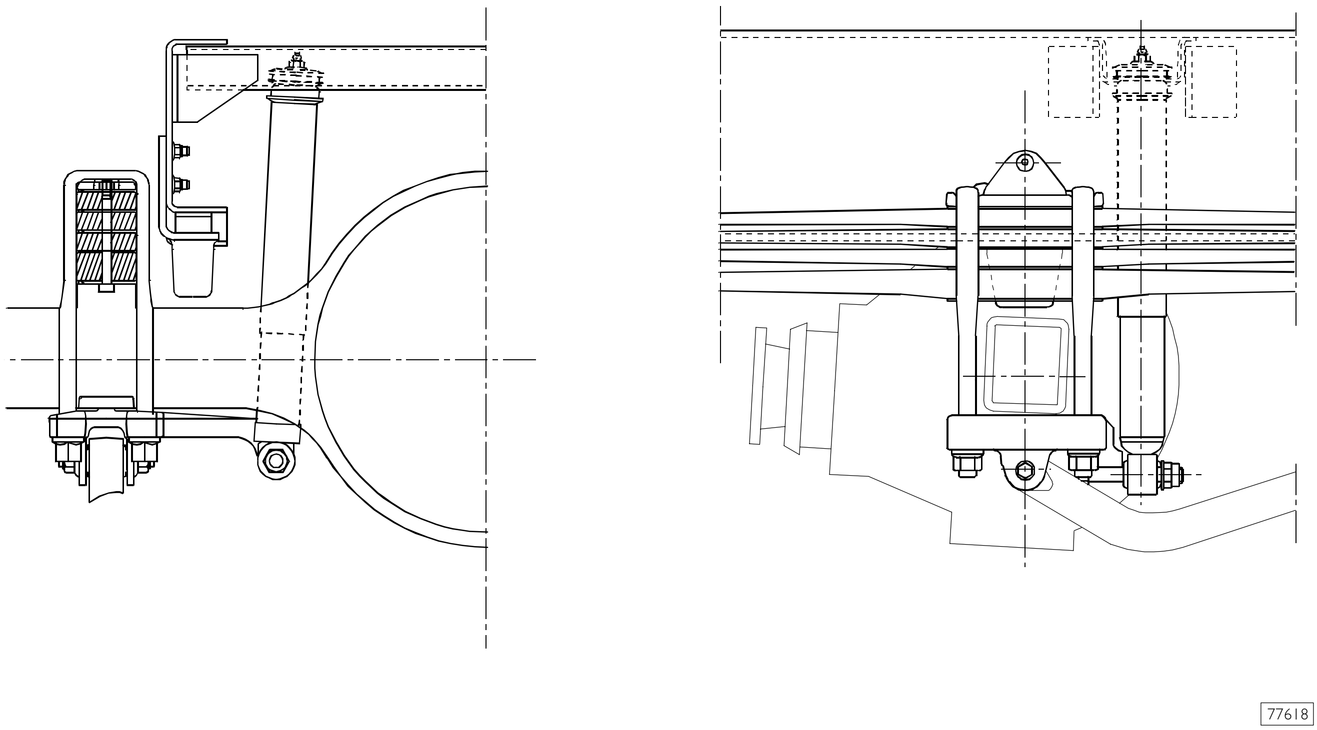
REAR SHOCK ABSORBERS
Assembly diagrams

Figure 15



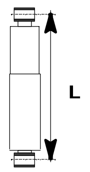
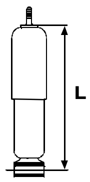
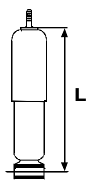
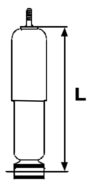
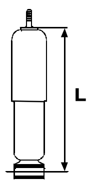
SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 110EL..-120EL..)

Figure 16



SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 120E…-130E..-180E..)

SPECIFICATIONS AND DATA

SHOCK ABSORBERS  MODELS: 110EL../120EL..	Length between eyebolts Open (mm) Closed (mm) Stroke (mm)	MANNESMANN & SACHS 669 ± 3 404 ± 3 265	
SHOCK ABSORBERS  MODELS: 120E.. 130E..-130E..RS	Length between eyelet centres Open (mm) Closed (mm) Stroke (mm)	FICHTEL & SACHS 714 ± 3 414 ± 3 300	WAY - ASSAUTO 702 ± 3 417 ± 3 285
SHOCK ABSORBERS  MODELS: 120E..D/130E..D 140E.. 150E..-150E..RS	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	FICHTEL & SACHS 714 ± 3 414 ± 3 300	
SHOCK ABSORBERS  MODELS: 180E..	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm) (with parabolic leaf springs)	FICHTEL & SACHS 666 ± 3 396 ± 3 270	
SHOCK ABSORBERS  MODELS: 180E..	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	FICHTEL & SACHS 716 ± 3 416 ± 3 300	

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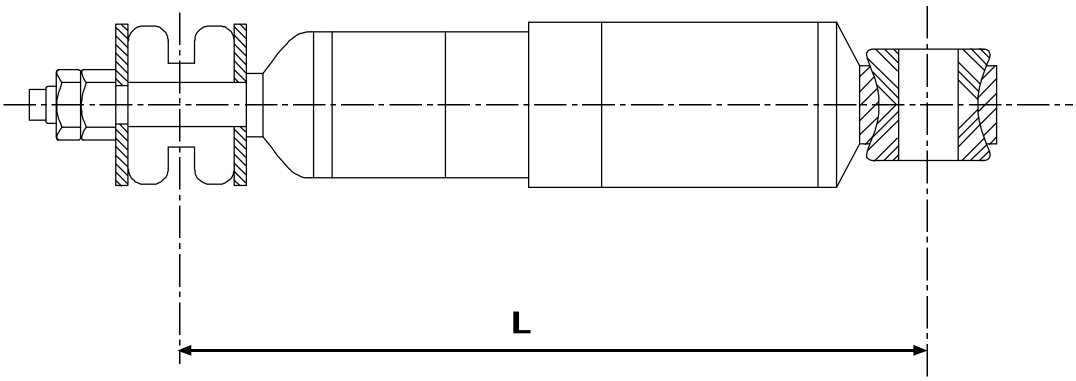
Shock absorber features and data - Models 260E..

Figure 17



SHOCK ABSORBER FOR MODEL		HENDRICKSON
260 E 28 KE	Length L Open (mm) Closed (mm) Stroke (mm)	565 ± 3 362 ± 3 203

DIAGNOSTICS

Main suspension operating problems:

1 - Noisy suspension
2 - Irregular or excessive tyre wear
3 - The vehicle tends to shift to one side
4 - The vehicle pulls to one side
5 - The suspensions are too flexible
6 - Creaking, knocking and noise in general

1	NOISY SUSPENSION

Cause		Remedy
Insufficient lubrication.	YES →	Lubricate carefully.
↓ NO		
Noisy or inefficient shock absorbers.	YES →	Overhaul shock absorbers.
↓ NO		
Worn wheel bearings; wrong play.	YES →	Carefully check bearings and replace worn parts.
↓ NO		
Loosen leaf spring mounts.	YES →	Check mounts and replace chassis fastening rivets, if loose.
↓ NO		
Loose leaf spring bundle for broken central fastening pin.	YES →	Overhaul leaf springs and replace central pin and respective lock nut.
↓ NO		
Loose leaf spring bundle for broken spring fastening bracket rivets.	YES →	Check leaf spring fastening brackets and replace fastening rivets.

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2 IRREGULAR OR EXCESSIVE TYRE WEAR

Cause		Remedy
Wrong tyre caster.	YES →	Check caster and overhaul carefully.
NO ↓		
Wrong wheel toe-in.	YES →	Check correct wheel toe-in.
NO ↓		
Low tyre pressure.	YES →	Check and restore correct tyre inflation pressure.
NO ↓		
Sudden accelerations.	YES →	Accelerations should be gradual.
NO ↓		
Unsuitable speed on gravel surfaces.	YES →	Adapt speed to terrain.
NO ↓		
Excessive wheel bearing play.	YES →	Adjust play and lubricate bearing with TUTELA MR3 grease.
NO ↓		
Loose leaf spring bundle for broken spring fastening bracket rivets.	YES →	Check leaf spring fastening brackets and replace fastening rivets.

3	THE VEHICLE TENDS TO SHIFT TO ONE SIDE

Fault		Remedy
Low, irregular tyre pressure.	YES →	Check and restore correct tyre inflation pressure.
NO ↓		
Wrong front wheel geometry.	YES →	Check and overhaul wheel geometry.
NO ↓		
Wrong front wheel bearing play.	YES →	Adjust bearing play.
NO ↓		
Ineffective hydraulic shock absorbers.	YES →	Disassemble shock absorbers and overhaul or replace them.

4	THE VEHICLE PULLS TO ONE SIDE

Fault		Remedy
Incorrect load arrangement.	YES →	Check load and arrange evenly on the load bed.
NO ↓		
Wrong pressure of all tyres.	YES →	Check and restore correct tyre inflation pressure.
NO ↓		
Damaged leaf spring.	YES →	Overhaul leaf spring and replace, as required.

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5 THE SUSPENSIONS ARE TOO FLEXIBLE

Damaged central leaf spring union pin.	YES →	Replace part and overhaul spring.

NO ↓

Damaged or broken spring leaves.	YES →	Overhaul leaf spring and replace damaged parts. Replace the entire leaf spring, if required.

6 CREAKING, KNOCKING AND NOISE IN GENERAL

Loose leaf spring mounts.	YES →	Check mounts and replace loose chassis fastening rivets.

NO ↓

Loose leaf spring bundle for broken central fastening pin.	YES →	Overhaul leaf springs and replace central pin and respective lock nut.

NO ↓

Loose leaf spring bundle for broken spring fastening bracket rivets.	YES →	Check leaf spring fastening brackets and replace fastening rivets.

NO ↓

Worn bearing and/or excessive play.	YES →	Carefully check bearings and replace damaged parts, if required. Adjust wheel geometry.

TIGHTENING TORQUES

PART		TORQUE	
		Nm	(kgm)
FRONT SUSPENSIONS			
Leaf spring bracket fastening nut	M16x1.5	238 ± 22.5	(24 ± 2.2)
Leaf spring bracket fastening nut	M18x1.5	278 ± 27	(28 ± 2.7)
Leaf spring bracket fastening nut	M20x1.5	464 ± 46	(47 ± 4.7)
Leaf spring to pad fastening nut		445 ± 45	(45 ± 4.6)
Leaf spring to front mount fastening nut		445 ± 45	(45 ± 4.6)
Shock absorber to chassis fastening nut	M16	80 ± 8	(8 ± 0.8)
Shock absorber to axle fastening nut	M16	80 ± 8	(8 ± 0.8)
Upper shock absorber fastening nut	M14x1.5	64 ± 6	(6.4 ± 0.6)
Shock absorber to axle fastening nut	M20	121 ± 12	(12.3 ± 1.2)
Shock absorber fork fastening nut		275 ± 55	(28 ± 5.6)
Connecting rod to chassis support screw nut		223 ± 22	(23 ± 2.3)
Connecting rod to sway bar fastening pin nut		311 ± 30	(34 ± 3)
Sway bar support to chassis fastening screw		76.5 ± 7.5	(8 ± 0.8)
Collar to sway bar support fastening screw	M12	111 ± 11	(11 ± 1.1)
REAR SUSPENSION			
Spring bracket on axle fastening nut	M22x1.5	623 ± 62	(63.5 ± 6.3)
Leaf spring front fastening nut	M20	445 ± 45	(45 ± 4.5)
Leaf spring to pad fastening screw	M20	445 ± 45	(45 ± 4.5)
Rear mount to chassis fastening screw nut	M16	227 ± 23	(23 ± 2.3)
Sway bar to axle mount fastening screw nut	M20	311 ± 31	(32 ± 3)
Connecting rod to chassis support fastening screw nut	M20	311 ± 31	(32 ± 3)
Upper shock absorber fastening nut	M14x1.5	64 ± 6	(6.4 ± 0.6)
Lower shock absorber fastening nut	M20	121 ± 12	(12.3 ± 1.2)
Shock absorber to chassis fastening nut	M16	80 ± 8	(8 ± 0.8)
Shock absorber to axle fastening nut	M16	80 ± 8	(8 ± 0.8)
Rebound to chassis fastening screw		77 ± 7	(7.9 ± 0.7)
Sway bar support to chassis fastening screw nut	M12	63 ± 7	(6.4 ± 0.6)
Sway bar to connecting rod fastening nut	M10	35.5 ± 3.5	(3.6 ± 0.3)

The mechanical suspension, shock absorber and sway bar removal-refitting operations described in the following paragraphs were carried out on 150E.. models and are, however, suitable for other models fitting mechanical suspension systems.

500410 FRONT MECHANICAL SUSPENSION REMOVAL-REFITTING

Disconnect the battery cables before starting removal-refitting operations.

Removal

Arrange the vehicle on level ground, block the rear wheels with wedges and proceed as follows:

- Loosen the front wheel fastening nuts, lift the vehicle and position it on stands.
- Arrange hydraulic jack 99321024 under the wheels, remove the fastening nuts and remove the wheels.
- Loosen the nuts (1 and 5), taking the pad (2) and remove the shock absorber from the vehicle (4).
- Loosen the U-bolt (12) fastening nuts (9). Remove the sway bar (8) supports (7) and remove the U-bolts taking the plate (6) and the rebound (13).
- Loosen the nut and remove the front leaf spring (11) anchoring pin (10) to the chassis mount.
- Loosen the nut and remove the rear pin (3) anchoring the leaf spring (11) to the chassis, lower the axle and remove the complete leaf spring.

Refitting

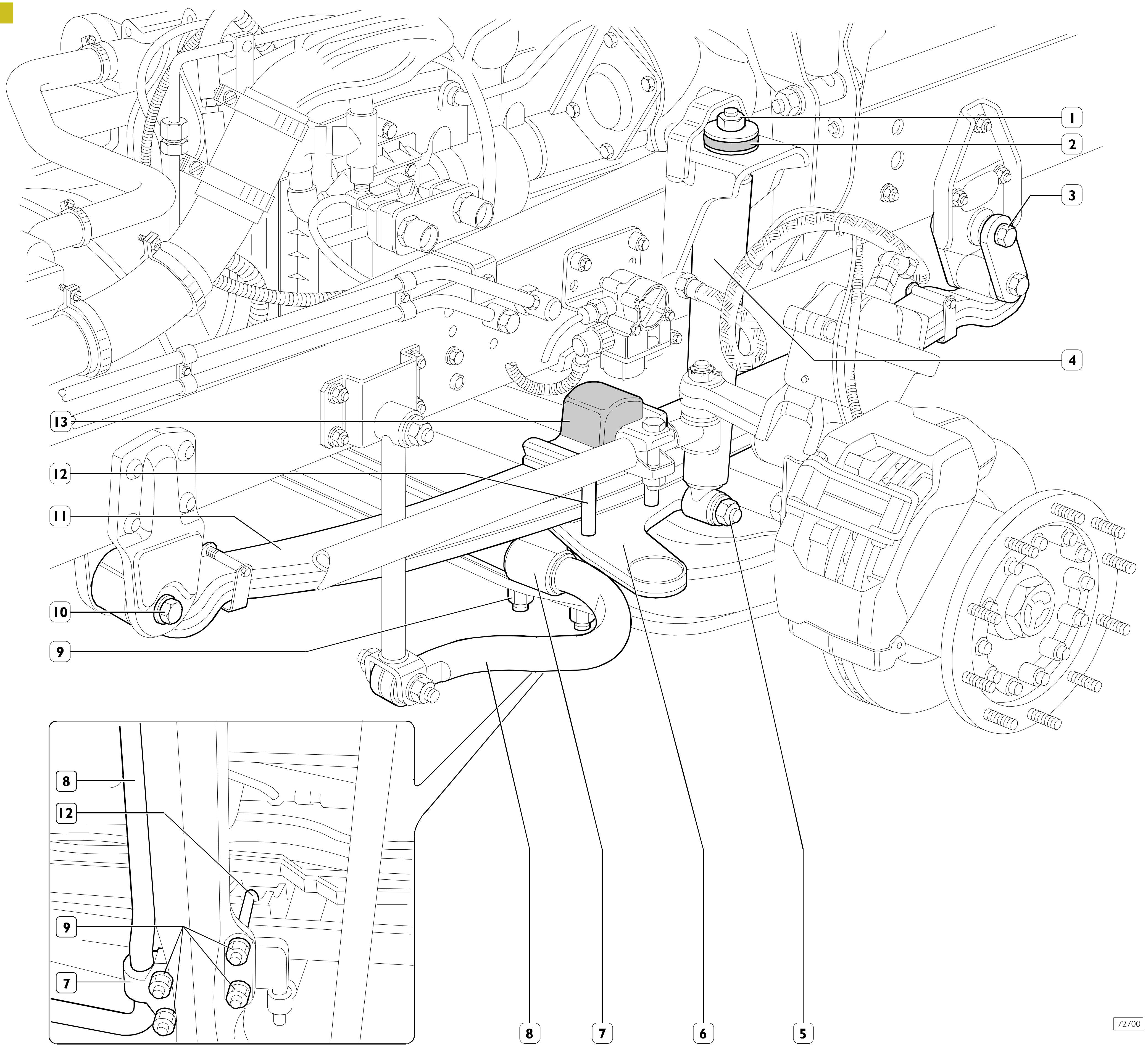
Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

Lock nuts must be replaced and fastened at the specified torque.

Check that:

- U-bolt threading is in good conditions. If required, reface the threading or replace the part.

Figure 18



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500450 REAR MECHANICAL SUSPENSION REMOVAL-REFITTING

Disconnect the battery cables before starting removal-refitting operations.

Removal

Arrange the vehicle on level ground, block the front wheels and proceed as follows:

- ❑ Loosen the rear wheel fastening nuts, lift back of the vehicle and position it on stands.
- ❑ Arrange hydraulic jack 99321024 under the wheels, remove the fastening nuts and remove the wheels.
- ❑ Loosen the nuts (3) and remove the fastening U-bolts (4).
- ❑ Loosen the nut and remove the front leaf spring (5) anchoring pin (6) to the chassis support (7).
- ❑ Loosen the nut and remove the rear pin (2) anchoring the leaf spring (5) to the chassis (1), lower the axle and remove the complete leaf spring.

Refitting

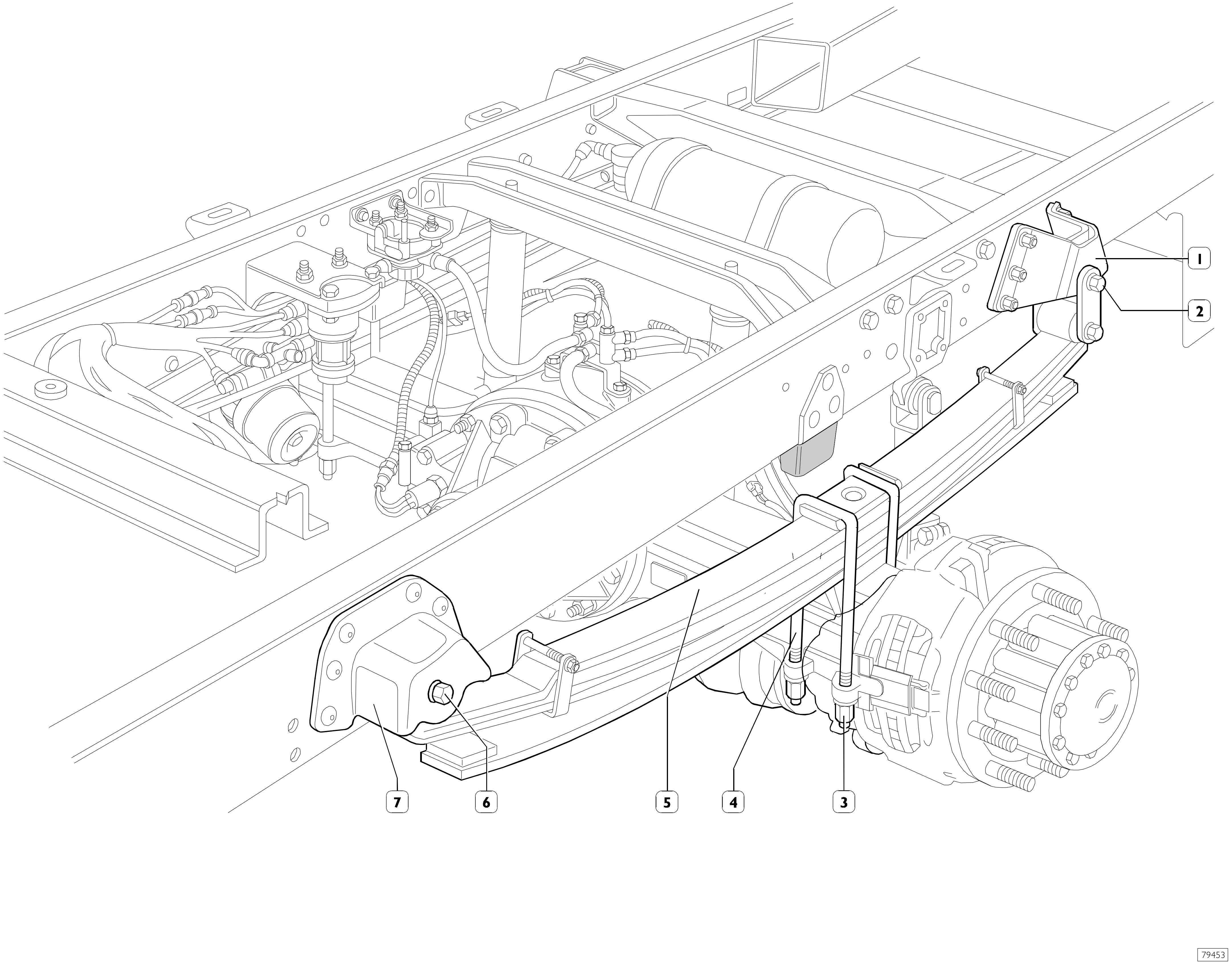
Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

Lock nuts must be replaced and fastened at the specified torque.

Check that:

- ❑ U-bolt (4) threading is in good conditions. If required, reface the threading or replace the part.

Figure 19



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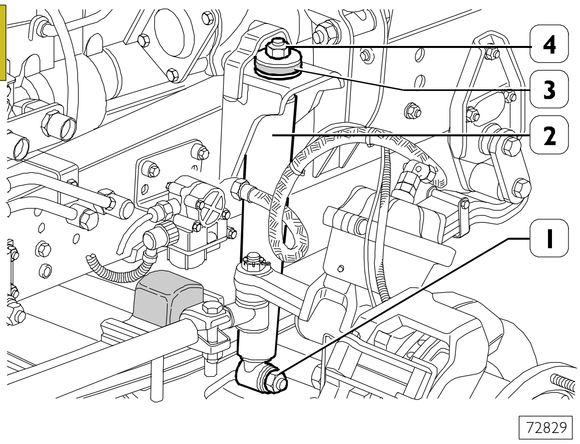
500910 FRONT SHOCK ABSORBERS

Removal

Figure 20



Loosen the nuts (1 and 4), take the rebound (3) and remove the shock absorber (2).

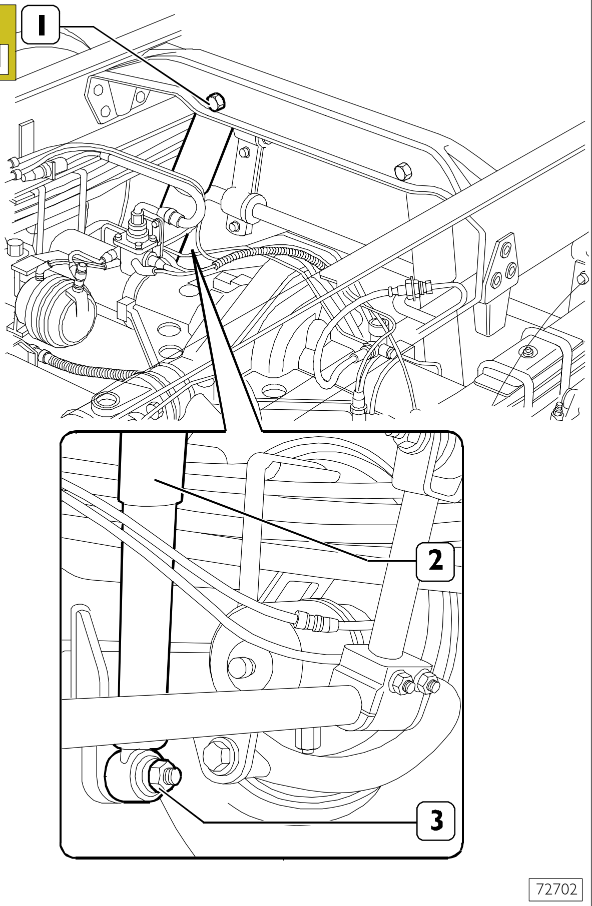
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

500940 REAR SHOCK ABSORBERS

Removal

Figure 21



Loosen the nuts (1 and 3) and remove the shock absorber (2).

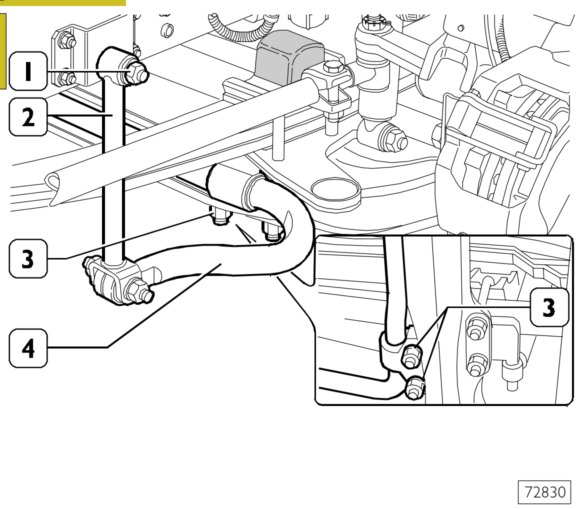
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

528930 FRONT SWAY BAR

Removal

Figure 22



Loosen the nuts (1 and 3) and remove the sway bar (4) with anchoring rod (2).

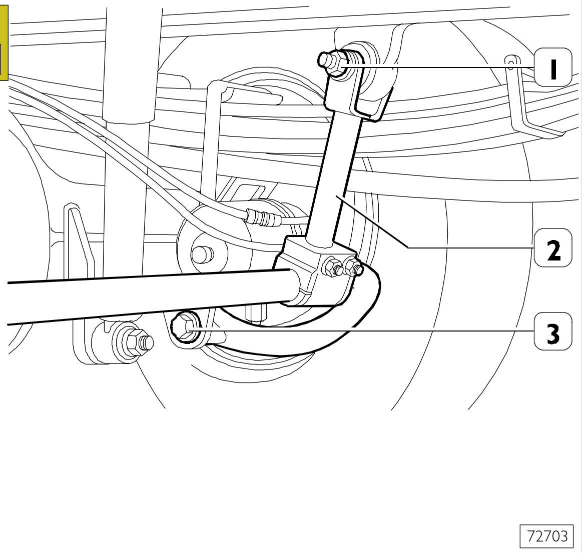
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

528960 REAR SWAY BAR

Removal

Figure 23



Loosen the nut and remove the axle support fastening pin (3).
Remove the nut (1), remove the pin and remove the sway bar with reaction rod (2).

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

REPAIRS

- Do not replace leaves if more than one leaf is broken.
- Do not replace leaves if there are less than three leaves in the faulty spring.
- Auxiliary leaf springs with main spring and auxiliary springs are an exception to the specification above. In other words, they can be replaced also if the total number of leaves in the auxiliary spring is less than three.
- Leaf springs consists on main leaves and supplementary leaves should be considered as leaf springs consisting of a main spring (main leaves) and auxiliary spring (supplementary leaves) reason for which the main leaves can be replaced if there are at least three while supplementary leaves can be replaced in any case.
- The remaining leaves of the faulty spring which are not replaced must not present superficial alterations to visual inspection nor alternations of shape which may compromise compliance with original construction principles.

Leaf spring disassembly

Arrange the leaf spring near the central pin in a vice on the specific work bench.
Remove the central union pin after removing the respective nut. Loosen the nuts fastening the side brackets and remove the brackets. This operation will free the individual leaves forming the leaf spring.

Checks

Carefully clean all parts with diesel fuel or solvent.
Make sure that the bushings are well anchored in the spring and pad holes. Make sure that the internal surface is not ovalised and that the pins are neither worn nor misshapen. Replace if this is not so.

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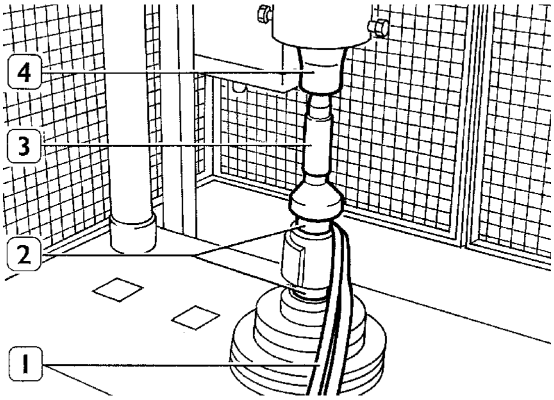
BUSHING REPLACEMENT
Removal

Figure 24



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Position the leaf spring (1) under a press (4) and remove the bushing (2) from its housing with a ram (3).

Refitting

Refit by reversing the removal sequence.

Leaf spring assembly

Make sure the surfaces in contact with the leaves are perfectly smooth and clean,
Arrange the leaves in the bundle next to each other, arrange the respective shims in between and align the central holes for fitting the union pin.
Fasten the leaves between the jaws of a vice and insert the central pin. Fasten the respective nut on the leaf side union bracket.
The brackets must be fastened to keep the leaves aligned, without restricting free movement.
After assembly, use a punch to rivet the central pin and the bracket pins to lock them safely.

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5004 Front and rear pneumatic suspensions

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❑ Removal	73
❑ Refitting	73
FRONT SWAY BAR	73
❑ Removal	73
❑ Refitting	73
REAR PNEUMATIC SUSPENSION REMOVAL-REFITTING	74
❑ Removal	74
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REAR AIR SPRINGS	75
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❑ Refitting	75
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❑ Removal	75
❑ Refitting	75
REAR SWAY BAR	76
❑ Removal	76
❑ Refitting	76

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PNEUMATIC SUSPENSIONS INTRODUCTION

Pneumatic suspensions are very flexible and offer considerable vibration damping features, regardless of vehicle load. By effect of the system self-adjusting features, the "chassis-road surface" distance is kept constant. A specific button can be used to vary the "chassis-road surface" distance, and consequently the vehicle load surface, in pneumatic suspension systems.

In addition to the advantages of pneumatic suspensions, the ECAS system ensures:

- considerable air consumption reduction;
- prompt response to adjustments;
- system simplicity;
- high safety;
- complete system diagnostics.

The **ECAS (Electronically Controlled Air Suspension)** system automatically controls the nominal vehicle pneumatic suspension level.

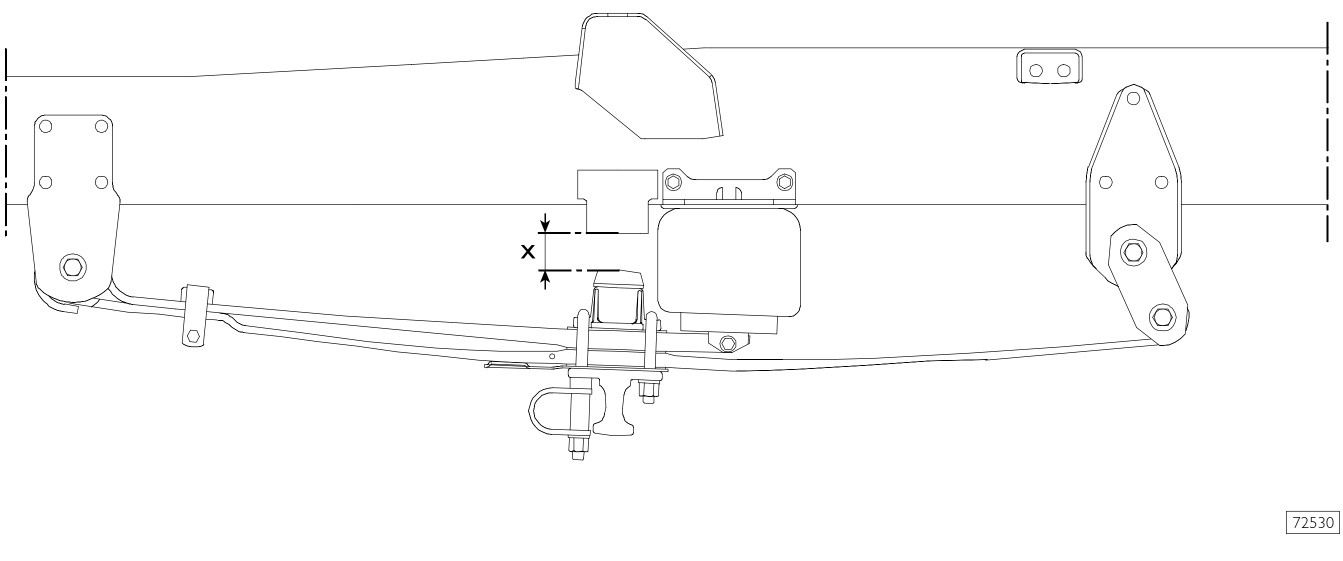
All operations depend on certain working conditions and respective safety of the connected systems.
The ECAS ECU automatically controls the level (distance from the road surface) of the chassis by means of the real values provided by sensors, comparing them to the nominal values stored in the memory.
In the event of distancing or trim changes, the ECU controls the electrical-pneumatic units to correct the real level with respect to the nominal values previously set or stored by the driver.
The system has a remote control for lifting/lowering and levelling the chassis. The system can be worked with the vehicle either stationary or moving.
In addition to lifting, lowering and levelling, the system can be used to store other chassis trim levels, which can be recalled when required.

PNEUMATIC SUSPENSION ASSEMBLIES

Models equipped with mixed suspension systems (front mechanical suspensions and rear pneumatic suspensions) fit the front suspension of the corresponding mechanical suspension models.

FRONT PNEUMATIC SUSPENSION

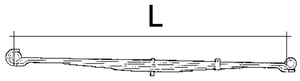
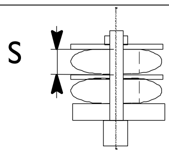
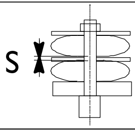
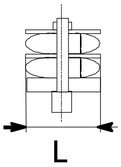
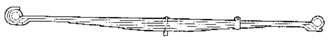
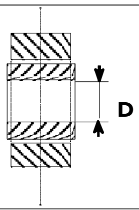
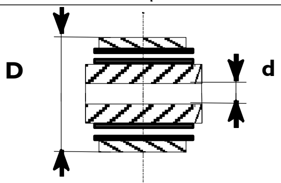
Figure 1



Dimension x = 60 mm

FRONT PNEUMATIC SUSPENSION ASSEMBLY
(Models 120E..FP/130E..FP/150E..FP)

LEAF SPRING SPECIFICATIONS AND DATA
FRONT SUSPENSION - MODELS 120E..FP/130E..FP/150E..FP

		mm
	Parabolic leaf springs	N° 2
	Main leaf and second leaf length (measured at eye centre)	1739 ± 3
	Leaf thickness 1st leaf (measured in the middle) 2nd leaf (measured in the middle)	 30 23
	Thickness between leaves	3
	Width of leaves	80 ± 0.5
	NEW SPRING CHECK DATA: Static load deflection Static load flexibility	 54 9.818 mm/KN
	Main leaf eye internal diameter (bushing housing)	55.5 + 0.1
	D = bushing external diameter d = bushing internal diameter	$57.3^{+0.6}_{-0.2}$ $20.2^{+0.3}_{-0}$

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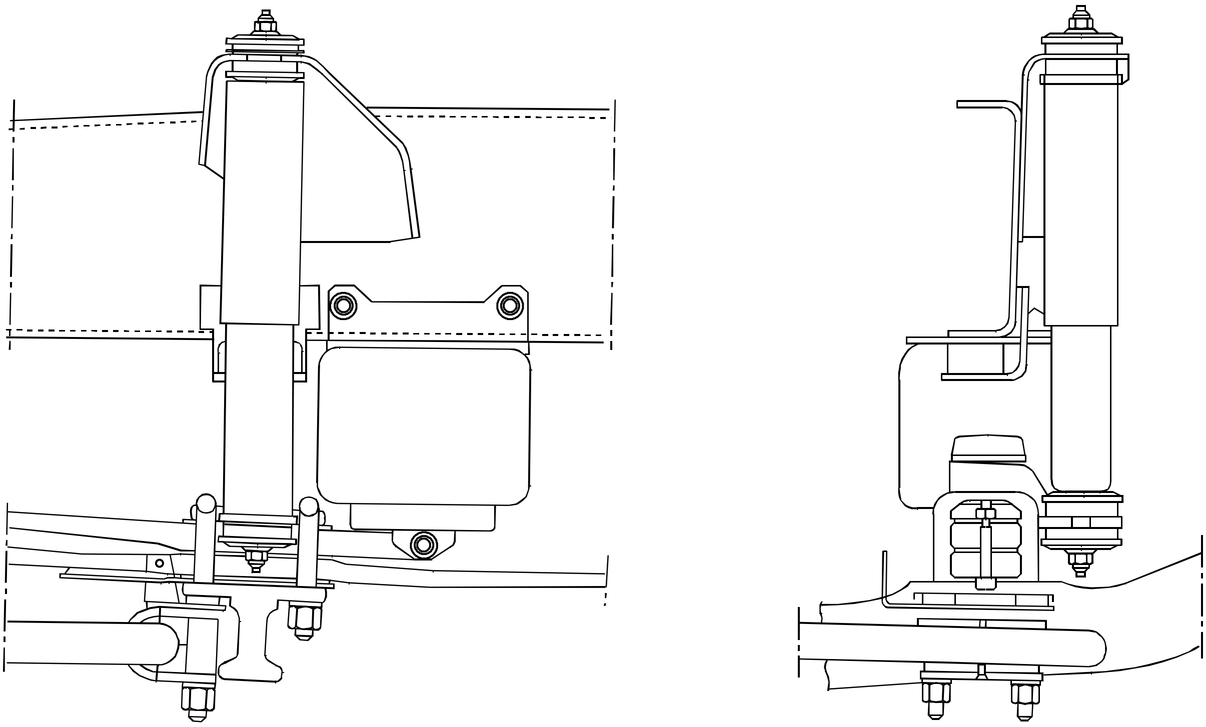
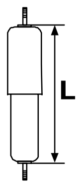
FRONT SHOCK ABSORBERS
Assembly diagrams

Figure 2



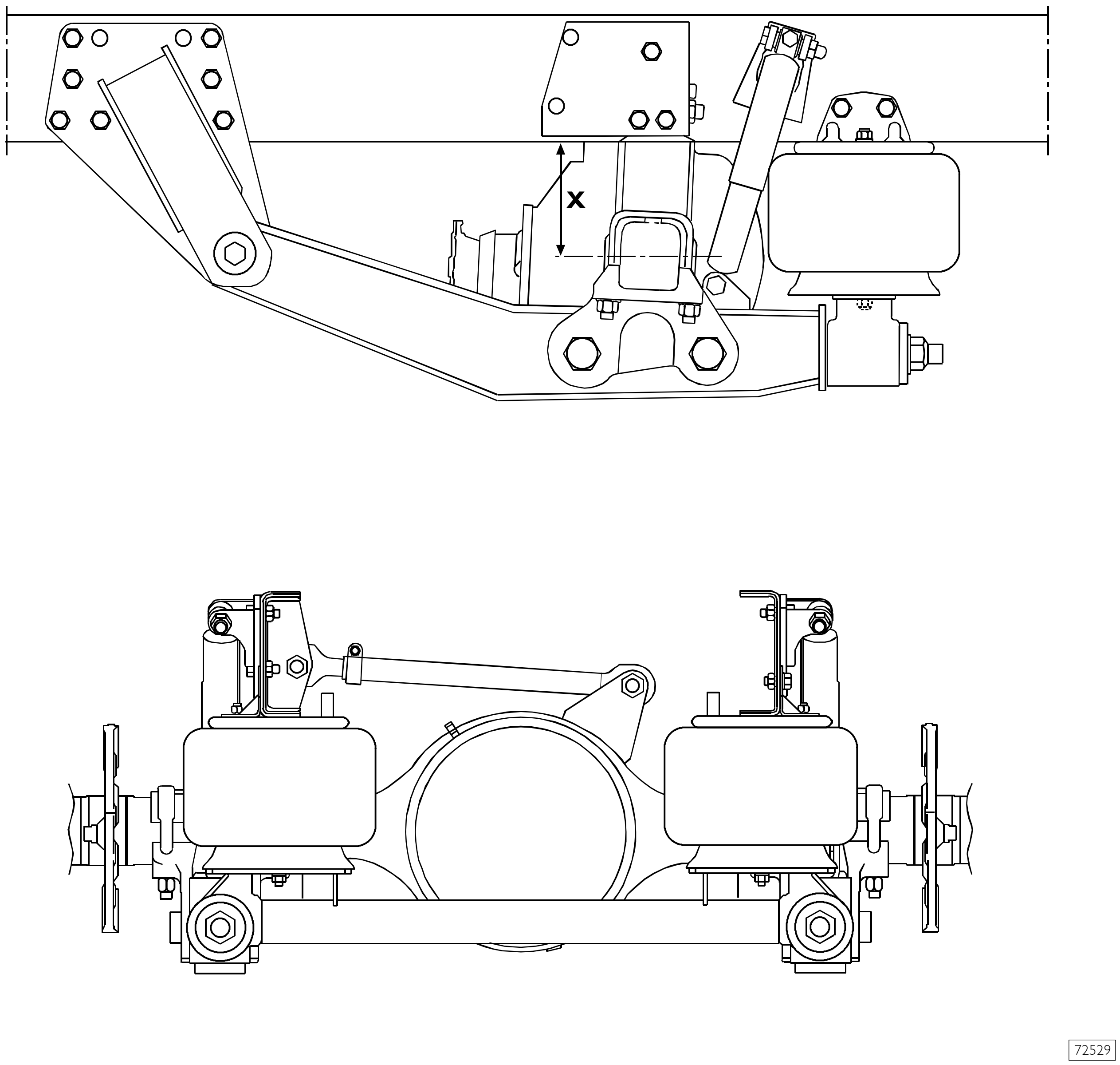
SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 120E..FP/130E..FP/150E..FP)

SPECIFICATIONS AND DATA

SHOCK ABSORBERS		FICHTEL & SACHS
 MODELS: 120E..FP/130E..FP 150E..FP	Length between the ends Open (mm) Closed (mm) Stroke (mm)	 588 ± 3 358 ± 3 230

REAR PNEUMATIC SUSPENSION

Figure 3



Dimension x = 187 mm

REAR PNEUMATIC SUSPENSION ASSEMBLY
(NEWAY for Models 110EL..P/120EL..P)

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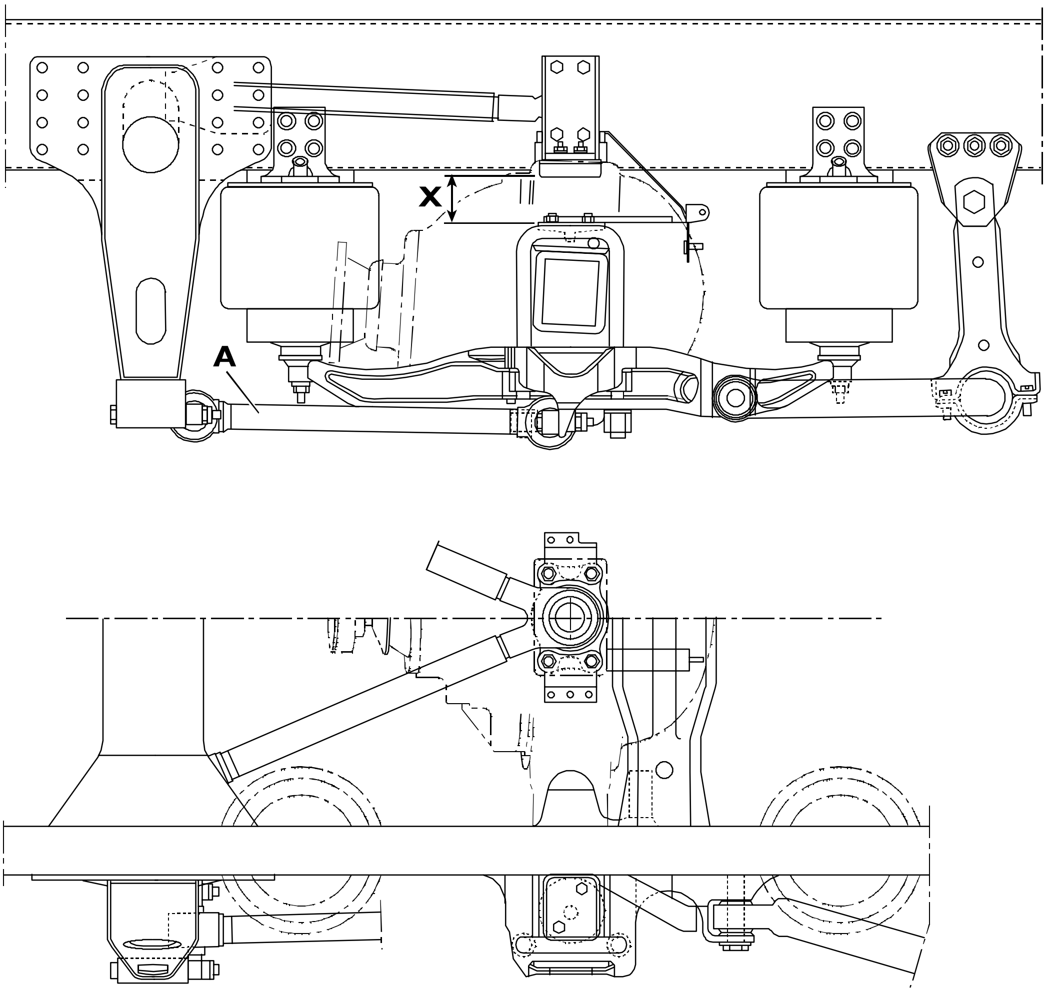
Figure 4



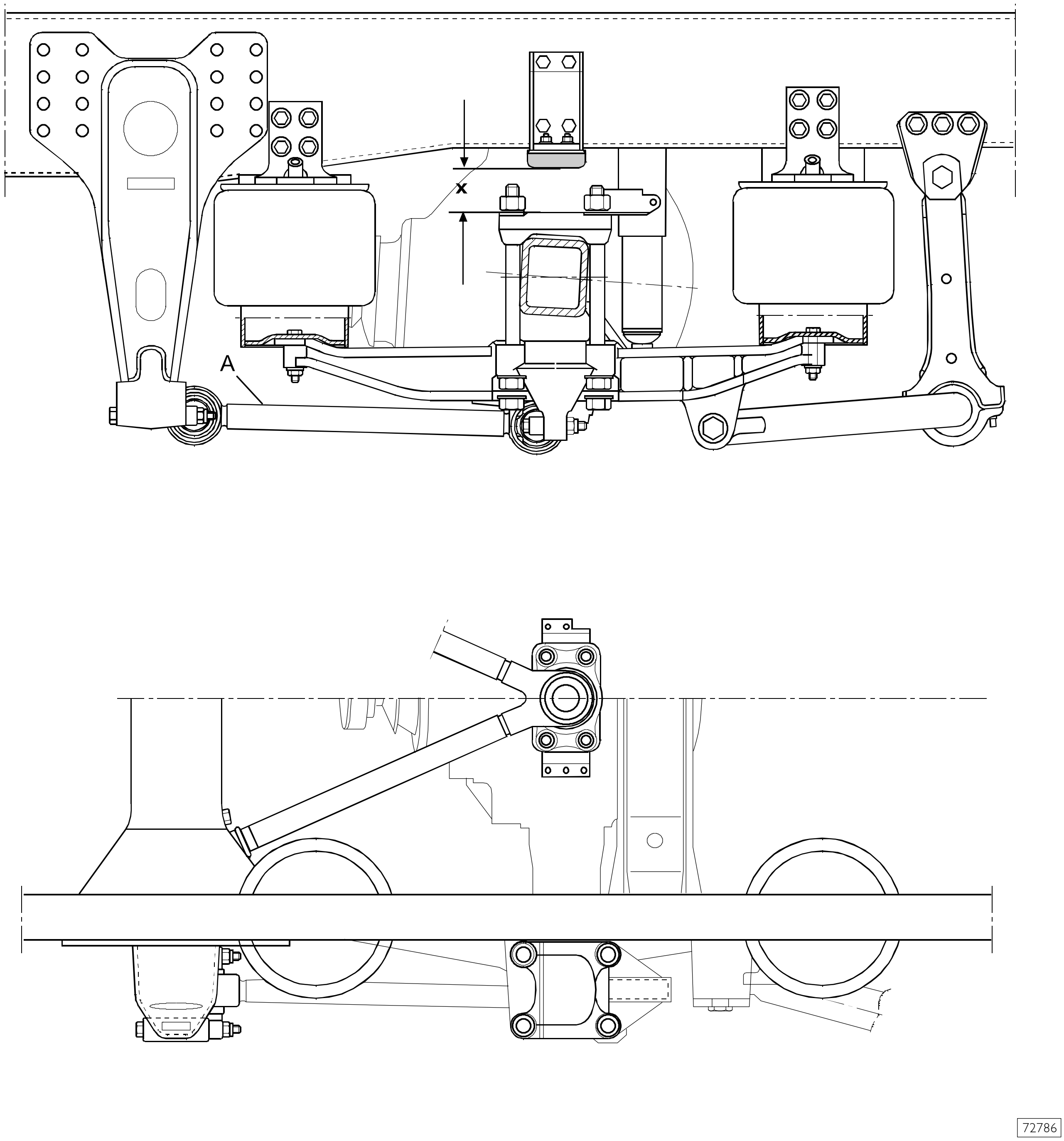
Dimension x = 77 mm with axle MS10-164E

47 mm with axle MS10-144E

60 mm with lower reaction rod alignment (A)

REAR PNEUMATIC SUSPENSION ASSEMBLY
(Models 120E../130E../150E..)

Figure 5



Dimension x = 65 mm with axle MS13-165

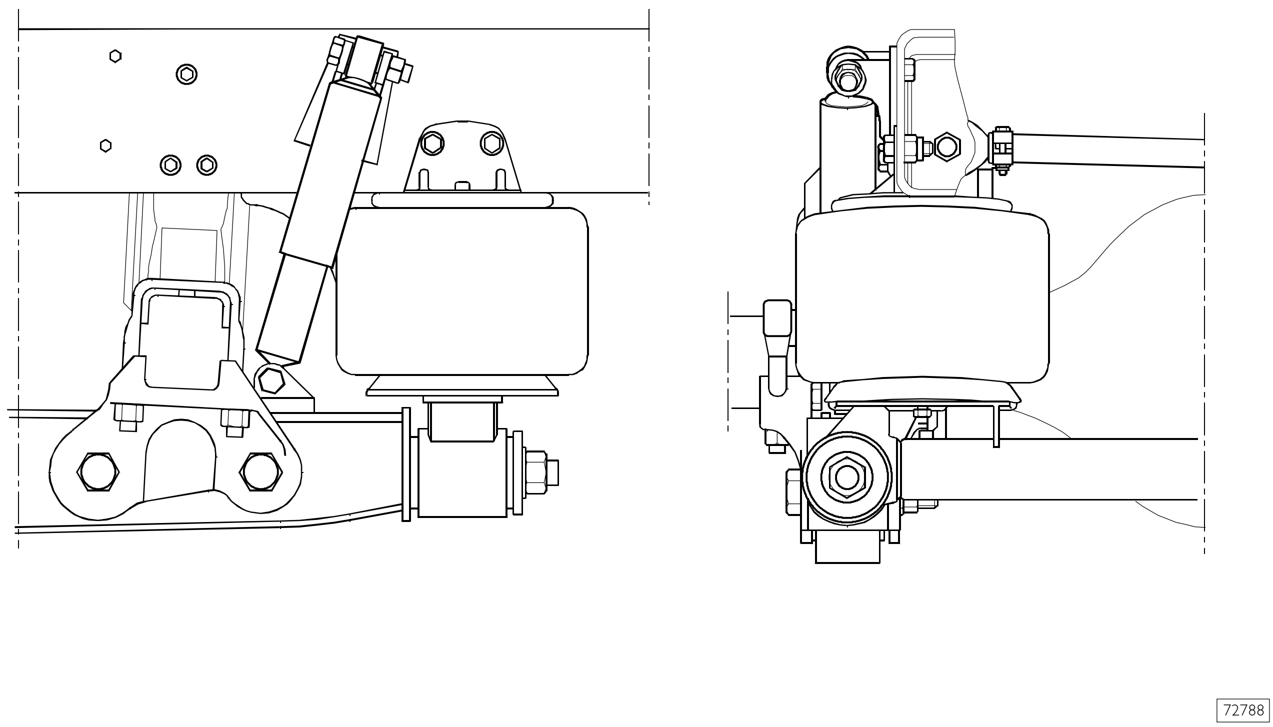
54 mm with lower reaction rod alignment (A)

REAR PNEUMATIC SUSPENSION ASSEMBLY
(Models 180E..P)

REAR SHOCK ABSORBERS

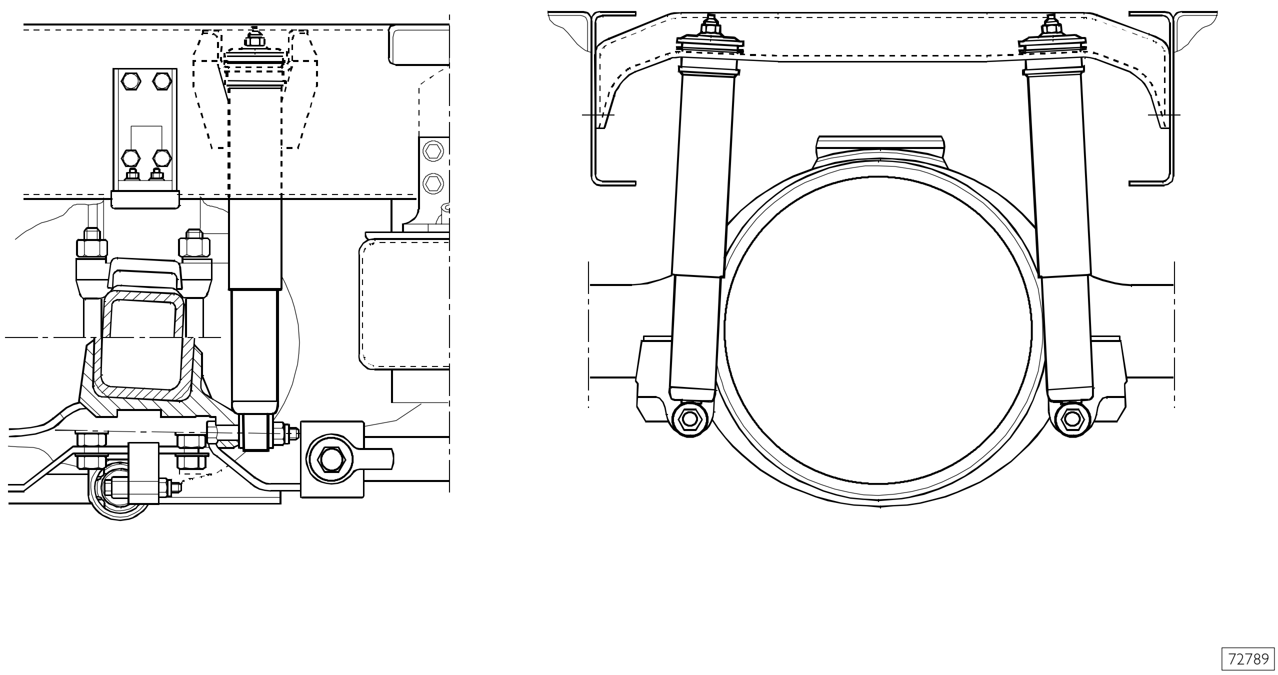
Assembly diagrams

Figure 6



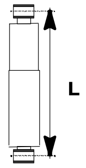
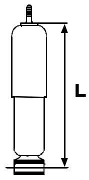
SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 110EL..P-120EL..P)

Figure 7



SHOCK ABSORBER ASSEMBLY DIAGRAM
(Models 120E..P/FP-130E..P/FP-150E..P/FP-180E..P)

SPECIFICATIONS AND DATA

SHOCK ABSORBERS  MODELS: 110EL..P/120EL..P	Length between eyebolts: Open (mm) Closed (mm) Stroke (mm)	MANNESMANN - SACHS 669 ± 3 404 ± 3 265
SHOCK ABSORBERS  MODELS: 120E..P/FP - 130E..P/FP 150E..P/FP 180E..P	Length between eyebolts and extremity: Open (mm) Closed (mm) Stroke (mm)	MANNESMANN - SACHS 674 ± 3 404 ± 3 270

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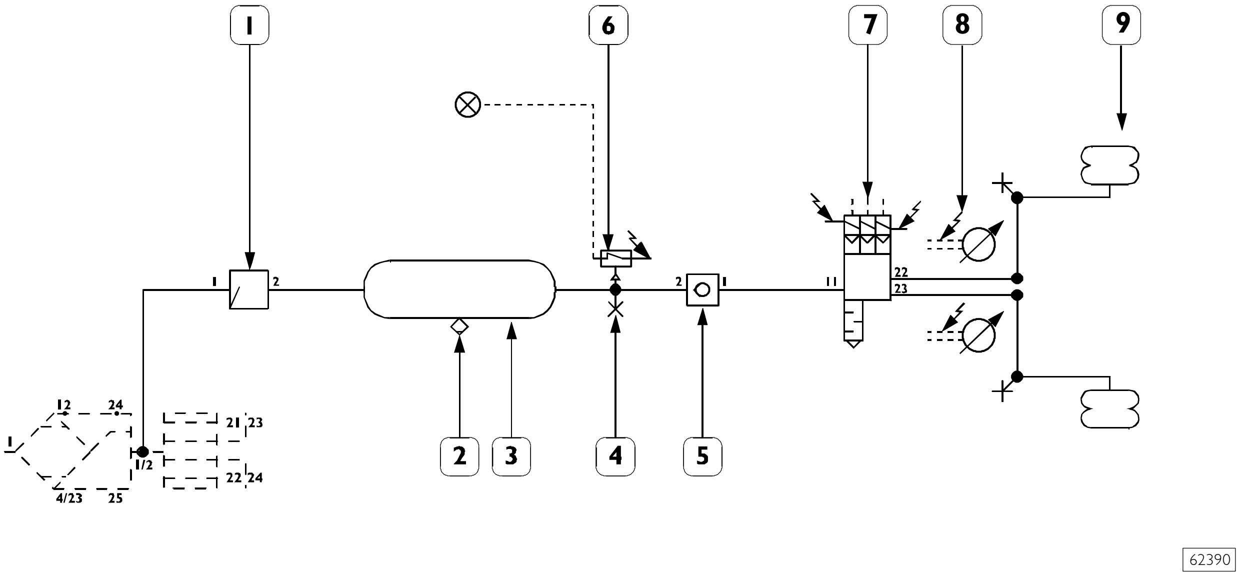
Electronically controlled rear pneumatic suspension diagram (NEWAY for Models 110EL..P-120EL..P)

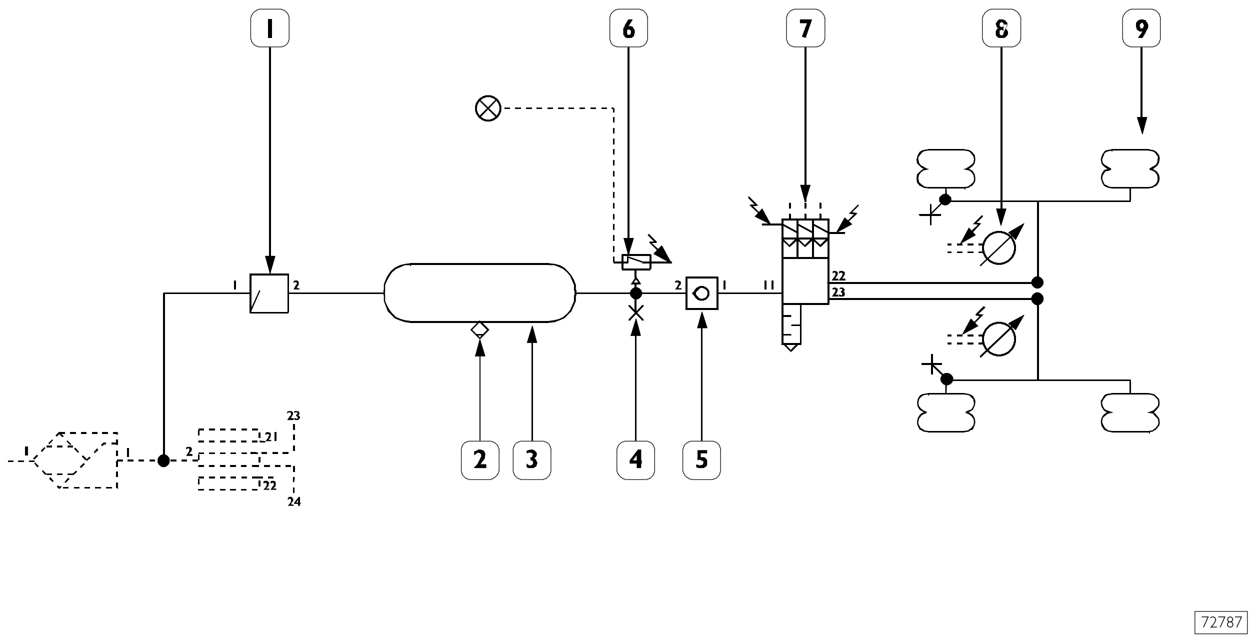
Figure 8



1. Limited return air vent valve – 2. Manual condense bleeding valve – 3. Air reservoir – 4. Pressure test point – 5. One-way valve – 6. Low pressure indicator – 7. Electro-pneumatic distributor – 8. Electronic levelling valve – 9. Axle air spring

Cable-and-trunk diagram of pneumatic rear suspensions (For Models 120E..P-130E..P-150E..P-180E..P)

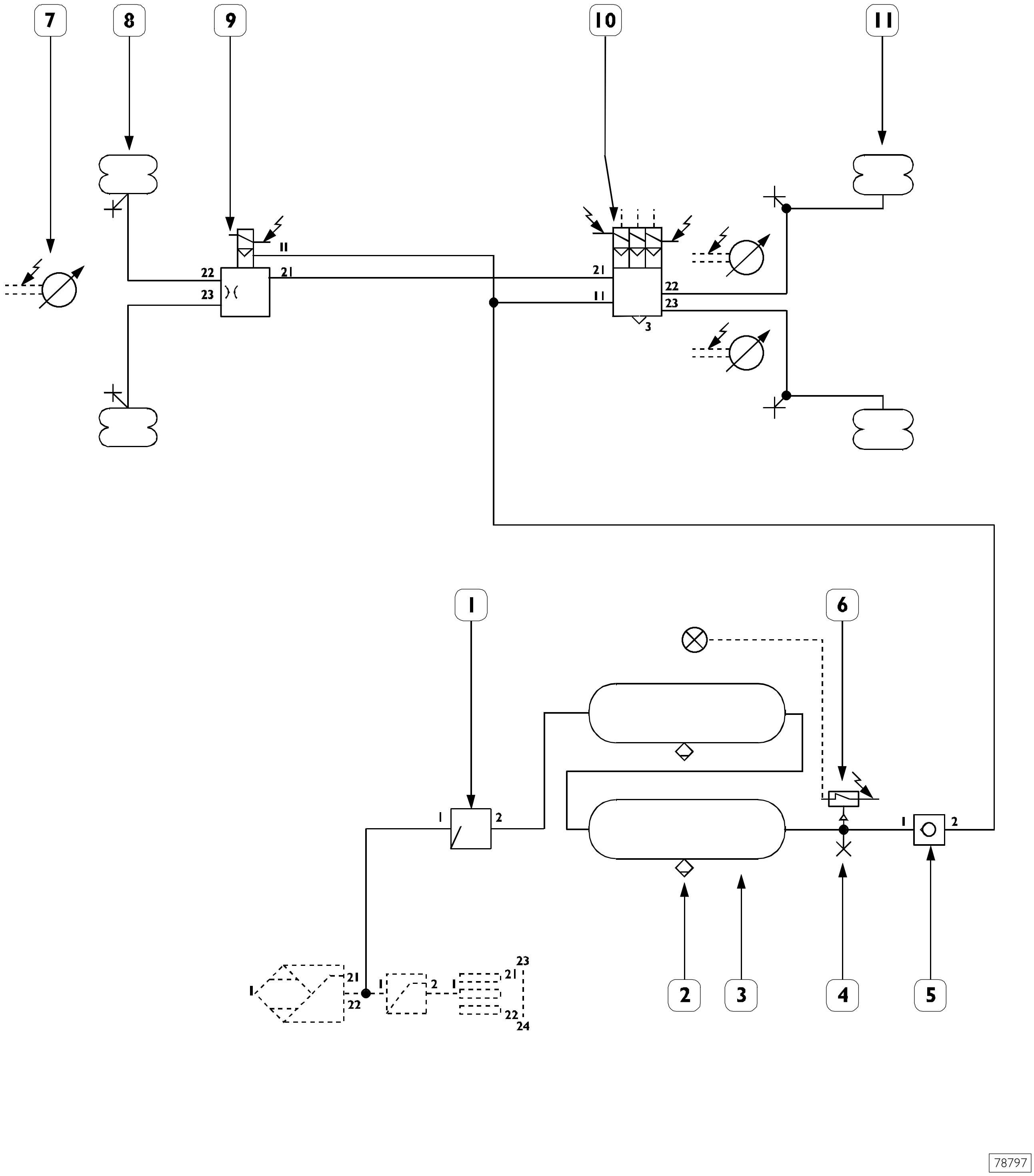
Figure 9



1. Limited return air vent valve – 2. Manual condense bleeding valve – 3. Air reservoir – 4. Pressure test point – 5. One-way valve – 6. Low pressure indicator - 7. Electro-pneumatic distributor – 8. Electronic levelling valve – 9. Axle air spring

Electronically controlled FULL PNEUMATIC suspension diagram (For Model 120E..FP-130E..FP-150E..FP)

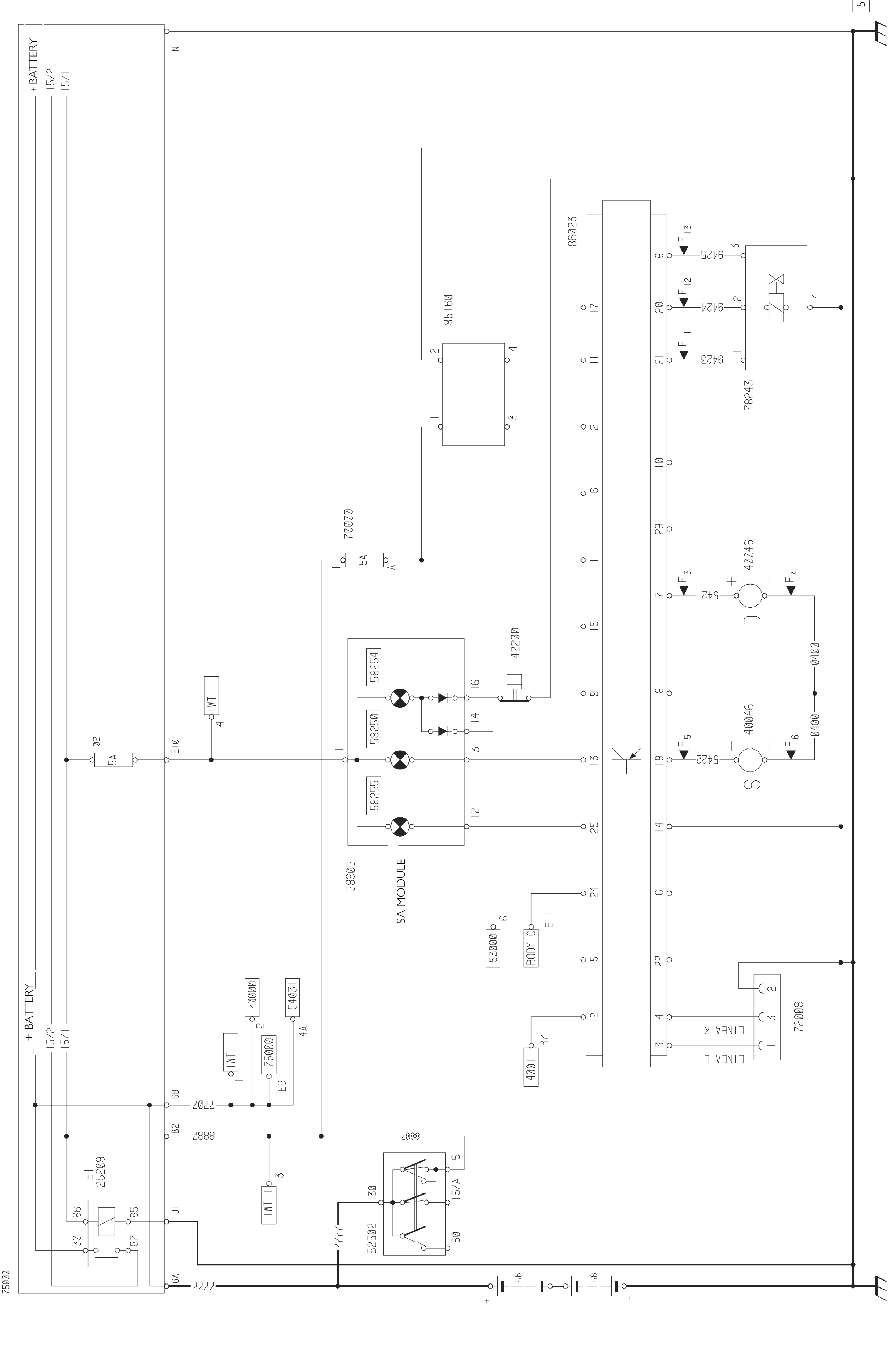
Figure 10



1. Limited return air vent valve – 2. Manual condense bleeding valve – 3. Air reservoir - 4. Pressure test point – 5. One-way valve – 6. Low pressure indicator – 7. Electronic levelling valve – 8. Front axle air spring – 9. Front axle electro-pneumatic distributor – 10. Rear axle electro-pneumatic distributor – 11. Rear axle air spring

Rear pneumatic suspension vehicle wiring diagram

Figure 11



52095

40011 Electronic odometer – 40046 Rear axle inductive chassis height sensor – 42200 Pneumatic suspension failure warning switch – 52502 Utility and ignition key switch – 53000 Warning light test switch – 58250 Suspension failure warning light – 58254 Suspension low pressure warning light – 58255 Suspension "no travel" condition warning light – 58905 Optional systems ten warning light panel – 70000 Fuse holder 6 – 72021 30-pole stationary diagnostic electrical connection socket – 78243 Electro-pneumatic distributor – 85160 Chassis trim variation control device – 86023 Vehicle lifting/lowering control unit

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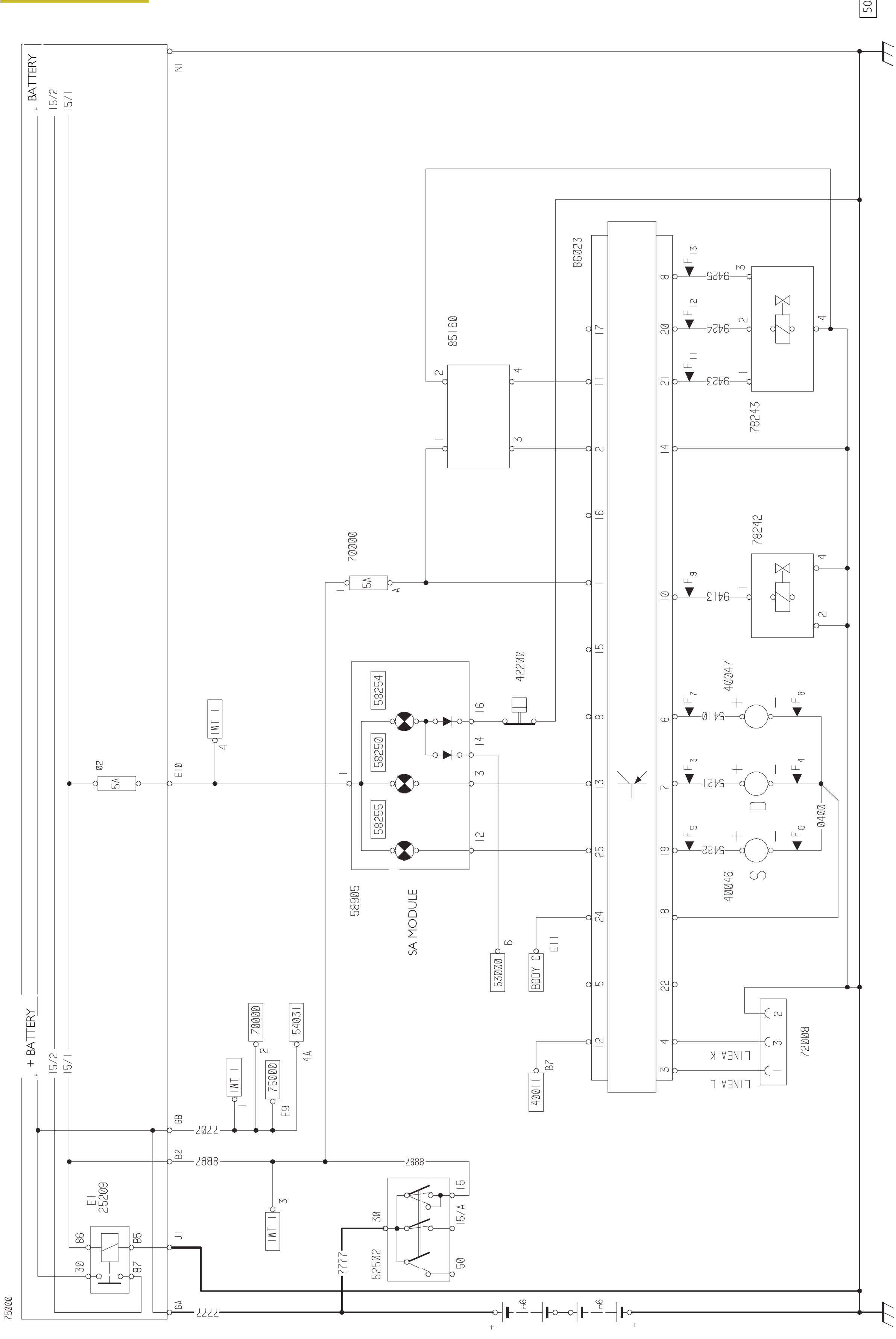
Front and rear pneumatic suspension vehicle wiring diagram

Figure 12



40011 Electronic odometer – 40046 Rear axle inductive chassis height sensor – 40047 Front axle inductive chassis height sensor – 42200 Pneumatic suspension failure warning switch – 52502 Utility and ignition key switch – 53000 Warning light test switch – 58250 Suspension failure warning light – 58254 Suspension low pressure warning light – 58255 Suspension "no travel" condition warning light – 58905 Optional systems ten warning light panel – 70000 Fuse holder 6 – 72021 30-pole stationary diagnostic electrical connection socket – 72242 Front axle electro-pneumatic distributor – 78243 Electro-pneumatic distributor – 85160 Chassis trim variation control device – 86023 Vehicle lifting/lowering control unit

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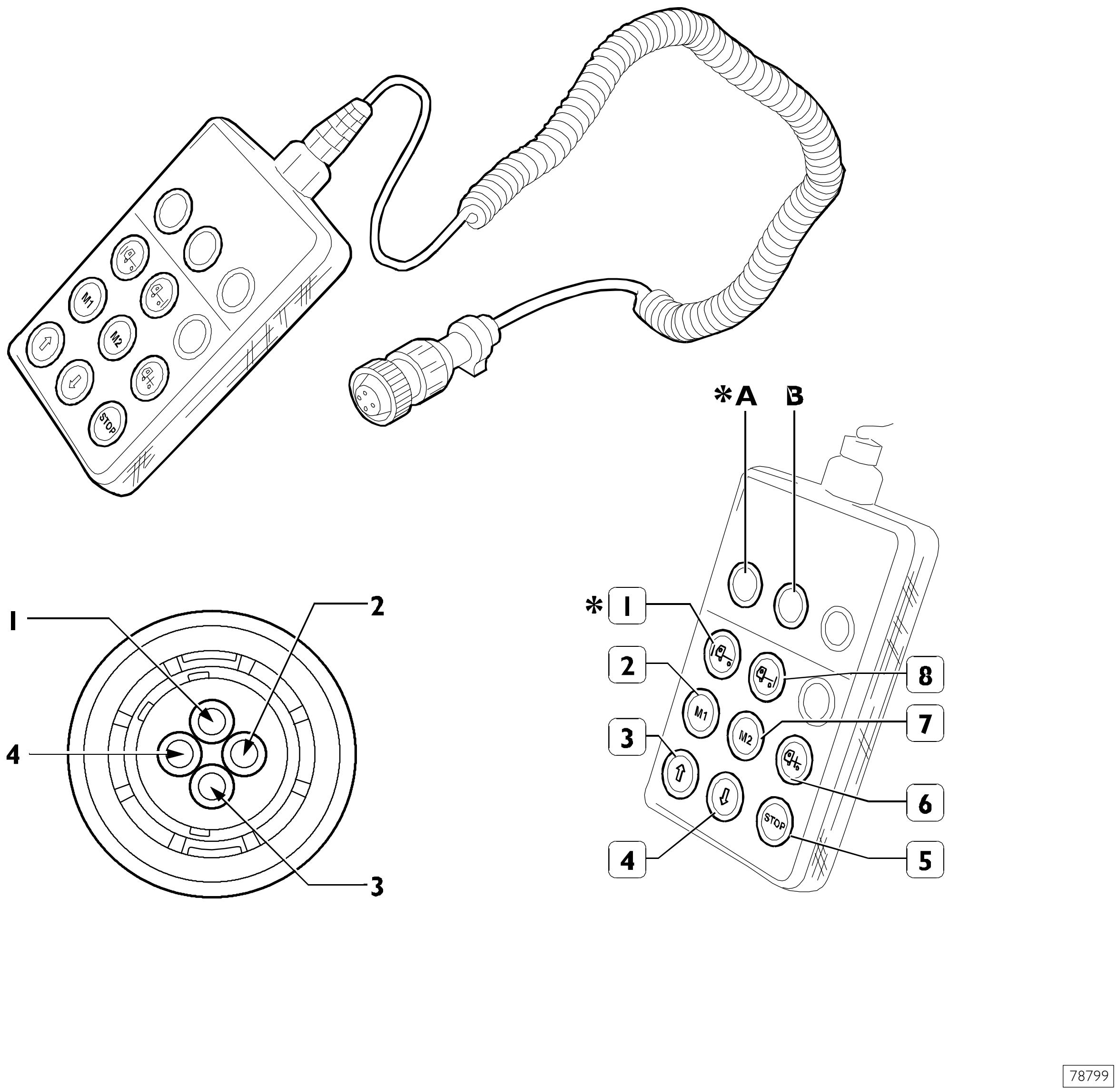
CHASSIS LIFTING/LOWERING AND LEVELLING

Remote control

Figure 13



The traditional controls arranged next to the driver's seat are replaced with a remote control on the left-hand side of the driver's seat.
This device is used to manage the various chassis trim functions.
The remote control can be extracted to make the selection from the driver's seat or from the ground.
The remote control consists of a set of buttons and two warning lights:
A) Front axle selection green warning light
B) Rear axle selection green warning light

1) Front axle selection *
2) Memory level "1"
3) Lift chassis
4) Lower chassis
5) STOP
6) Level chassis
7) Memory level "2"
8) Rear axle selection

The remote control is connected to the system by means of a four-pole connector:

Pin 1 Power positive
Pin 2 Negative
Pin 3 Communication line with ECU
Pin 4 Communication line with ECU

See "Operation" for remote control instructions.
* full pneumatic vehicles only

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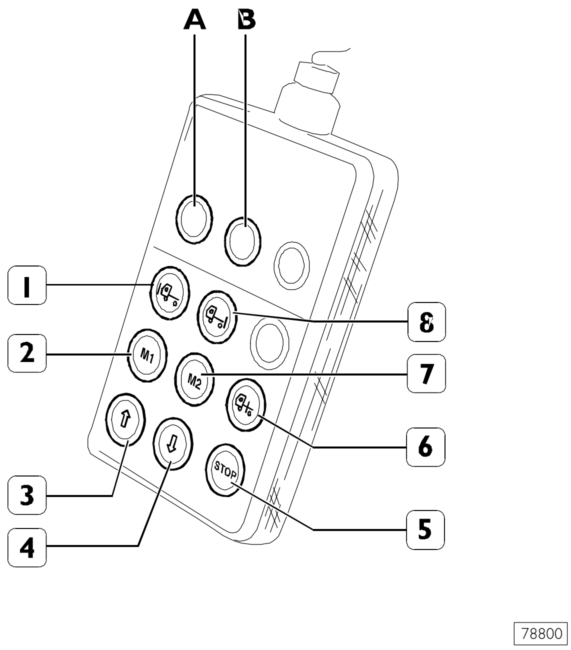
REMOTE CONTROL DESCRIPTION AND OPERATION

Lifting/lowering the chassis

Figure 14



This operation can only be activated at speeds slower than 20 km/h.

The set trim will be kept constant over this speed.

Proceed as follows to lift/lower the chassis:

- ❑ Press button (1) and/or (8) to select the required axle. The respective warning light "A" and/or "B" will come on.
- ❑ Press button (3) or (4) to reach the required level.

All solenoid valves will be de-energised and returned to home/hold condition when button (3) or (4) is released.

During this operation, the yellow warning light on the instrument panel will light up signalling that trim has not been reached.

This condition and the respective warning will be kept on, also if the ignition key is switched on and off.

The maximum lift limit is regulated by level sensors according to the calibration set by the ECU.

⚠ Button description refers to FP vehicle remote controls.

Chassis self-leveling

This operation can be carried out at any speed.

Proceed as follows to level the chassis:

- ❑ Press button (1 or 8, Figure 14) to select an axle, the respective warning light "A" or "B" will come on.
- ❑ Press button (6, Figure 14).

The yellow warning light on the instrument panel will go out when the operation is recalled to signal that the chassis has been levelled.

This condition and the respective warning will be kept on, also if the ignition key is switched on and off.

The ECU will automatically re-establish chassis level if the button is not pressed at speeds over 20 km/h.

Level "M1" - "M2"

The system can store two additional trim levels "M1" and M2" as needed.

These two positions can be recalled only at speeds lower than 20 km/h.

Proceed as follows to activate the levels:

- ❑ Press button (1 or 8, Figure 14) to select an axle, the respective warning light "A" or "B" will come on.
- ❑ Press button (3 or 4, Figure 14).

During this operation, the yellow warning light on the instrument panel will light up signalling that trim has not been reached.

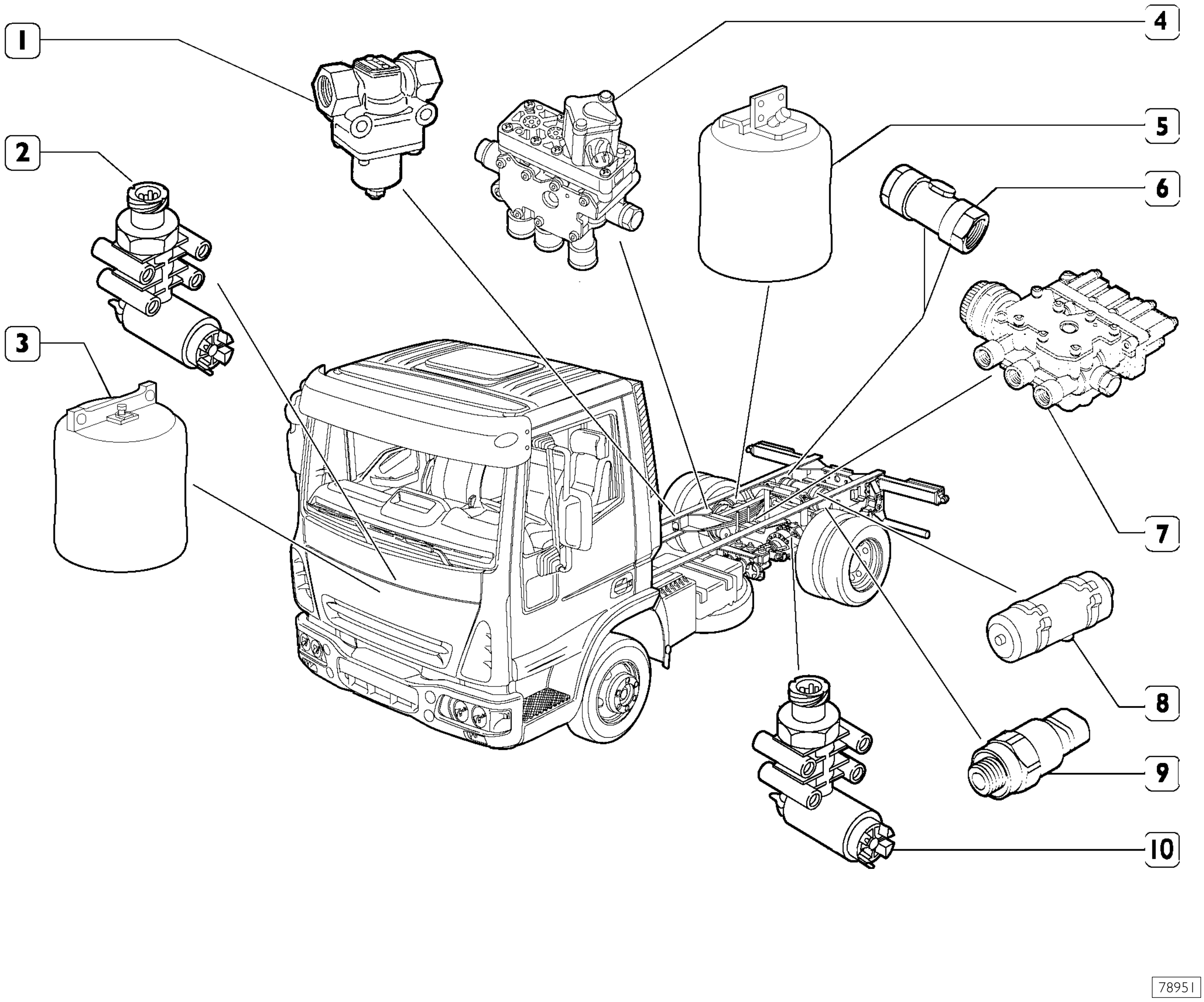
Proceed as follows to store trim levels "M1" and M2":

- ❑ Press button (1, Figure 14) to select the front axle, the respective warning light "A" will come on.
- ❑ Press button (3 or 4, Figure 14) to reach the required level.
- ❑ REPEAT THE OPERATIONS ON THE REAR AXLE.
- ❑ Hold button pressed button (5, Figure 14).
- ❑ Press button (2 or 7, Figure 14).
- ❑ Release button (2 or 7, Figure 14) and then button (5, Figure 14).

⚠ In an emergency, press button (5, Figure 14) to stop levelling operations.

VEHICLE MAIN COMPONENT ARRANGEMENT

Figure 15



1. Controlled pressure valve – 2. Front axle level sensor – 3. Front air spring – 4. Electro-pneumatic distributor – 5. Rear air spring – 6. Check valve – 7. Rear axle electro-pneumatic distributor – 8. Reservoir – 9. Pressure test point – 10. Rear axle level sensor

SPECIFICATIONS AND DATA

DESCRIPTION	
Limited return controlled pressure valve	
❑ Type: MARELLI - WABCO 434 100 232 0 - KNORR DR 4248	
Opening pressure	8.5 bar
Air reservoir	
Front suspension	15 litres
Rear suspension	15 litres
Level sensor	
❑ Type: WABCO 441 050 012 0	
Power voltage	Pulse 8 ÷ 16V
Current intake	Max 90 mA
Lever working range	Max 100°
Electro-pneumatic distributor	
❑ Type: WABCO 472 880 001 0 (for P models, on rear axle for FP models) WABCO 472 880 020 0 (on front axle for FP models)	
Working temperature range	- 40 °C ÷ + 80 °C
Working pressure range (input)	5 ÷ 13 bar
Maximum dynamic pressure (output control)	20 bar
Power voltage	24 V
Check valve	
❑ Type: WABCO WESTINGHOUSE 434 014 000 0	
Working pressure range	Max 20 bar
Working temperature range	- 40 °C ÷ + 80 °C
Pressure test point	
❑ Type: RAUFOSS 6237776 - SIRT VMF 1615 - WABCO 463.703.114.0	
Working temperature range	- 40 °C ÷ + 80 °C
Electronic control unit	
❑ Type: WABCO	
Power voltage	18 ÷ 32 V
Working temperature range	- 40 ÷ 70 °C
Manometric switch for low air pressure	
❑ Type: TDS F13016	
Working voltage	12/24 V
Permitted electric load	0.001 to 1 A
Maximum operating pressure	12 bar

DIAGNOSTICS

Main pneumatic suspension operating problems:

1 - Low or irregular pneumatic system recharging
2 - Irregular vehicle trim
3 - Chassis out of trim warning light on at speeds faster than 20 km/h

1 LOW OR IRREGULAR PNEUMATIC SYSTEM RECHARGING

Leaking or broken pneumatic system pipes.	YES →	Close or replace loose or damaged fittings. Replace broken or damaged tubes.
NO ↓		
Inefficient air compressor operation.	YES →	Overhaul or replace the air compressor.
NO ↓		
Inefficient pressure regulator built into A.P.U.	YES →	Replace A.P.U.
NO ↓		
Inefficient controlled pressure valve operation.	YES →	Replace the controlled pressure valve.

2 IRREGULAR VEHICLE TRIM

Leaking or broken pneumatic system pipes.	YES →	Close or replace loose or damaged fittings. Replace broken or damaged tubes.
NO ↓		
Wrong pneumatic and/or electrical connections.	YES →	Locate wrong connections and restore.

(continued)

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Fault		Remedy
Inefficient level sensor operation.	YES →	Adjust linkages and replace level sensor, if required.
↓ NO		
Inefficient electro-pneumatic distributor operation.	YES →	Replace the electro-pneumatic distributor.
↓ NO		
Inefficient ECU operation.	YES →	Replace the ECU.

3 CHASSIS OUT OF TRIM WARNING LIGHT ON AT SPEEDS FASTER THAN 20 KM/H

Fault		Remedy
Leaking or broken pneumatic system pipes.	YES →	Close or replace loose or damaged fittings. Replace broken or damaged tubes.
↓ NO		
Damaged electrical connections.	YES →	Restore the electrical wiring.
↓ NO		
Inefficient remote control operation.	YES →	Replace the remote control.
↓ NO		
Inefficient sensor operation.	YES →	Adjust linkages and replace level sensor, if required.
↓ NO		
Inefficient ECU operation.	YES →	Replace the ECU.

TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Front pneumatic suspension (Models 120E..FP/130E..FP/150E..FP)		
Rebound fastening screw nut	62.5 ± 6.5	(6.25 ± 0.65)
Spring brackets fastening screw nut	463.5 ± 46.5	(46.35 ± 4.65)
Spring to front mount fastening screw nut	336.5 ± 33.5	(33.65 ± 3.35
Spring to pad fastening screw nut	336.5 ± 33.5	(33.65 ± 3.35)
Rear pneumatic suspension (Models 110EL..P/120EL..P)		
Front support to chassis fastening screw	250 ÷ 306	(25 ÷ 30.6)
Suspension arm to front mount fastening screw nut	435 ÷ 530	(43.5 ÷ 53)
Suspension arm to axle box fastening screw nut	819 ÷ 1002	(81.9 ÷ 100.2)
Upper and lower shock absorber fastening screw nut	119 ÷ 146	(11.9 ÷ 14.6)
* Axle box fastening U-bolt nut	425 ÷ 440	(42.5 ÷ 44)
Sway bar fastening nut	794 ÷ 971	(79.4 ÷ 97.1)
Panhard bar fastening screw nut	40 ÷ 54	(4 ÷ 5.4)
Air spring lower fastening nut	435 ÷ 530	(43.5 ÷ 53)
Other flanged head fasteners with waxed nut: M12x1,75 R80 M12x1,75 R100	 56 ÷ 69 83 ÷ 101	 (5.6 ÷ 6.9) (8.3 ÷ 10.1)
* U-bolts must be fastened diagonally in several times to ensure contact between adapter and axle before reaching maximum specified torque.		
Rear pneumatic suspension (Models: 120E..P-FP/130E..P-FP/150E..P-FP)		
Reaction triangle to chassis fastening screw	352.5 ± 32.5	(35.25 ± 3.25)
Longitudinal arm bar fastening screw nut	418 ± 42	(41.8 ± 4.2)
Air spring support arm to air spring fastening screw nut	90 ± 10	(9 ± 1)
Air spring to chassis fastening screw nut	92 ± 9	(9.2 ± 0.9)
Nut for screw fastening the air-operated spring support arm to the rear axle.	545 ± 55	(54.5 ± 5.4)

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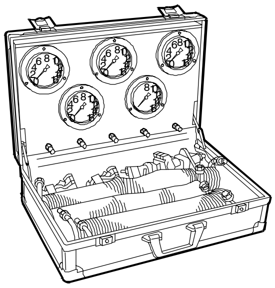
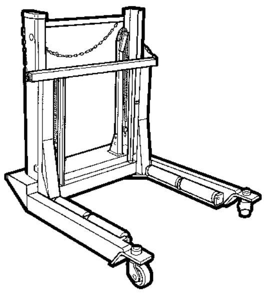
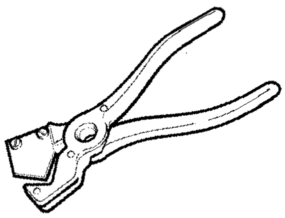
PART	TORQUE	
	Nm	(kgm)
Rear pneumatic suspension (Models: 180E..P)		
Axle to air spring support arm fastening screw nut	845 ± 170	(84.5 ± 17)
Reaction triangle to axle fastening screw	290 ± 30	(29 ± 3)
Reaction bar fastening screw nut	418 ± 42	(42.6 ± 4.3)
Support arm to air spring fastening screw nut	100 ± 10	(10 ± 1)
Air spring to chassis fastening screw nut	92 ± 9	(9.4 ± 0.9)
Sway bar to spring support arm fastening pin nut	373.5 ± 37.5	(38 ± 3.8)
Sway bar support to chassis fastening screw nut (M16)	226.5 ± 22.5	(23 ± 2.3)
Sway bar support to chassis fastening screw nut (M12)	92 ± 9	(9.4 ± 0.9)
Connecting rod to chassis support fastening pin nut	359 ± 36	(36.6 ± 3.7)
Upper shock absorber fastening pin nut	118 ± 12	(11.8 ± 1.2)
Lower shock absorber fastening pin nut	187.5 ± 18.5	(18.7 ± 1.9)
Reaction triangle to chassis support fastening screw	418 ± 42	(42.6 ± 4.3)

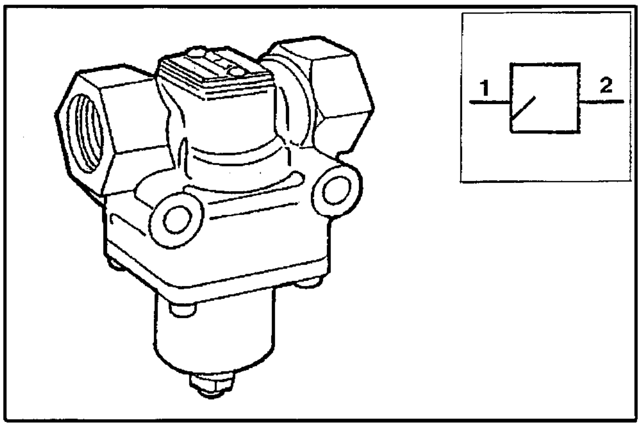
TOOLS

TOOL No.		DESCRIPTION
99305117		Pneumatic circuit check instruments
99321024		Wheel removal-refitting hydraulic trolley
99387050		Polyamide tube cutter

MAIN PNEUMATIC SYSTEM COMPONENTS

Controlled-pressure valve

Figure 16



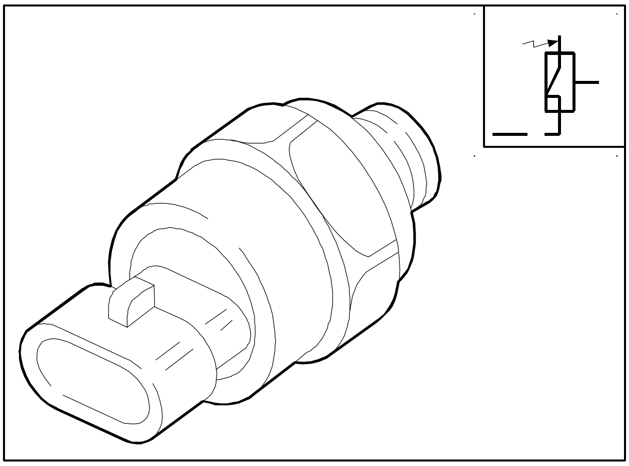
20437

The limited return valve has two functions:

- It cuts off the reservoir compressed air flow supply when the pressure drops under a certain value (calibrated) due to failures or excessive consumption.
- It supplies the reservoirs as soon as the braking system reaches a value ensuring perfect brake application.

Low pressure indicator

Figure 17

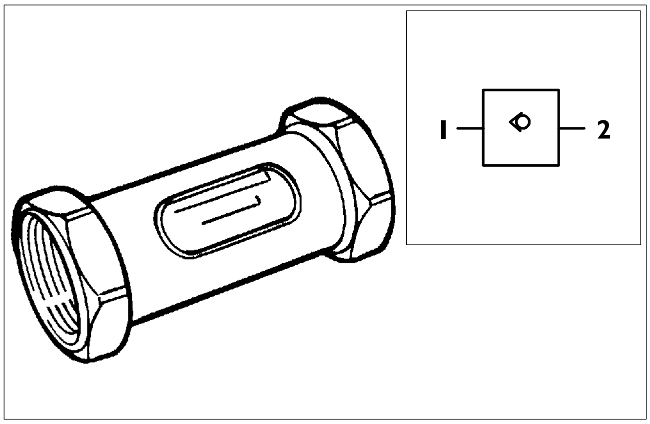


52723

This pressure switch is located near the utility air reservoir on the pneumatic suspension delivery tube.

793319 Check valve

Figure 18

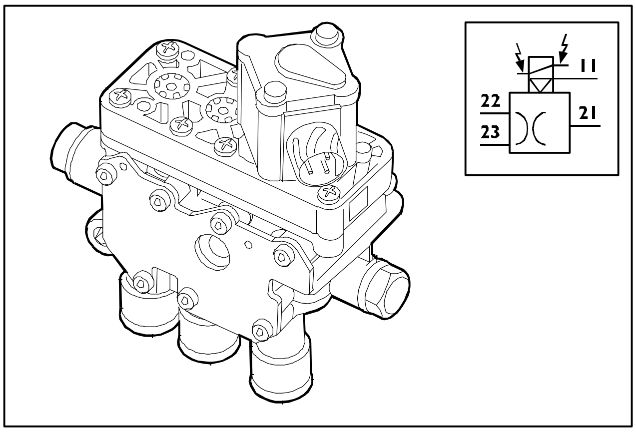


33987

This valve allows the passage of compressed air in the direction of the arrow on the valve body, preventing it from flowing back.

Electro-pneumatic front axle distributor for 4 x 2 FP vehicles

Figure 19



78802

This components consists of a control solenoid valve and two pneumatic distributors for managing both sides of the axle. A calibrated hole is provided between the two outputs to prevent pressure leakage between air springs and consequent internal connection axle stabilisation.
The electro-pneumatic distributor is connected to the system by means of a three-pole connector.

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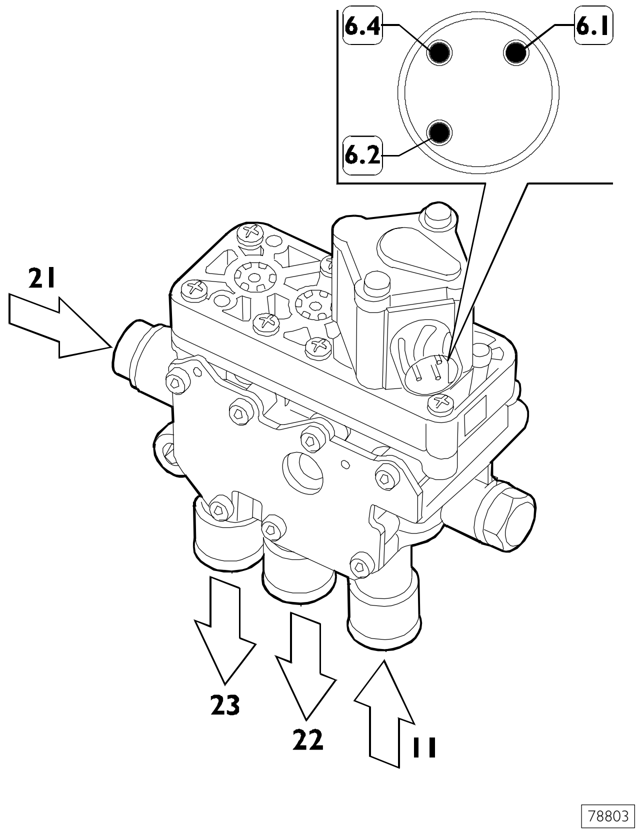
Figure 20

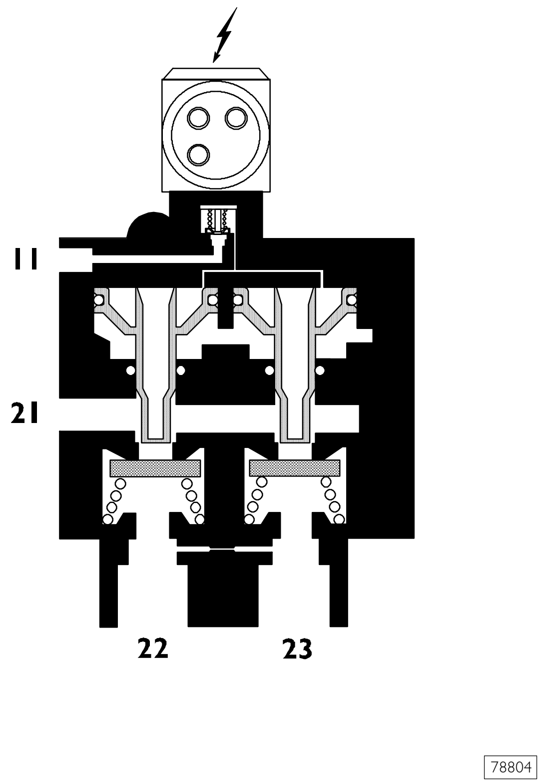


Pneumatic connections
11 - from air reservoir
21 - from axle electro-pneumatic distributor
22 - to air spring on right-hand side
23 - to air spring on left-hand side

Electrical connections
6.1 - Solenoid valve power positive
6.2 - Negative
6.4 - Free

Operation

Figure 21



Front axle lifting

The ECU energises the solenoid valve supplying the distributors via the air duct (11) from the reservoir and energising the axle electro-pneumatic distributor solenoid valve "A" (Figure 24) to supply the first distributor, closes the relief to atmosphere (3, Figure 24) and opens the air intake (11, Figure 24) from the reservoir.
In this way, the air from duct (21, Figure 24) to duct (21) supplies the axle air springs via ducts (22 and 23).

Front axle lowering

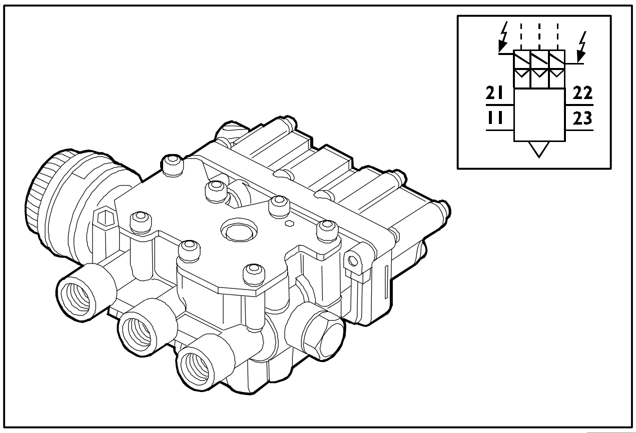
In this case, the ECU energises the solenoid valve supplying the distributor, allowing the air to be relieved from the air springs from duct (21) to duct (21, Figure 24) and opens the air input (3, Figure 24), which is open because the axle electro-pneumatic solenoid valve "A" (Figure 24) is de-energised.

Self-leveling

The ECU, according to the position of the level sensors, controls the front axle electro-pneumatic distributor solenoid valve and the rear axle electro-pneumatic distributor solenoid valves accordingly for lifting or lowering in order to reach vehicle levelling or stored positions "M1" or "M2".

Electro-pneumatic rear axle distributor for 4 x 2 P/FP vehicles

Figure 22



78805

This components consists of three control solenoid valves "A", "B", "C" and three pneumatic distributors.

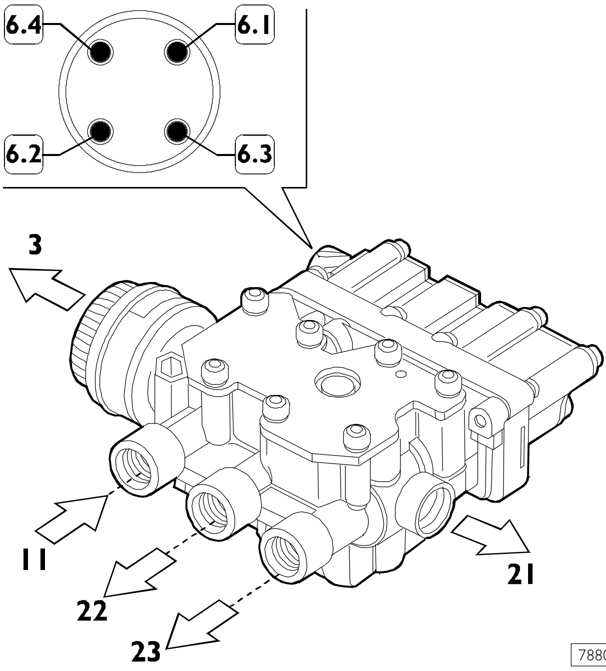
Solenoid valve "A" manages the supply/discharge distributor.

Solenoid valve "B" manages the right-hand chassis trim distributor.

Solenoid valve "C" manages the left-hand chassis trim distributor.

The distributor is connected to the system by means of a four-pole connector.

Figure 23



78806

Pneumatic connections

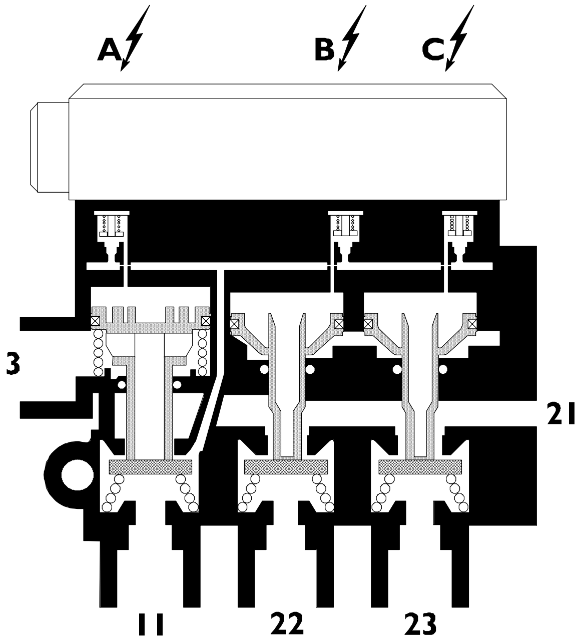
11 - from air reservoir
21 - to axle electro-pneumatic distributor
22 - to air spring on right-hand side
23 - to air spring on left-hand side

Electrical connections

6.1 - Solenoid valve "A" power positive
6.2 - Solenoid valve "B" power positive
6.3 - Solenoid valve "C" power positive
6.4 - Common negative

Operation

Figure 24



70117

Rear axle lifting

The ECU energises solenoid valve "A" supplying the first distributor that closes the relief to atmosphere (3) and opens the air intake (11) from the reservoir.
The ECU then energises solenoid valve "B" and "C" for supply the second and third distributor and to consequently supply the rear axle air springs via ducts (22 and 23).

4x2 P vehicles

Duct (21) is capped.

4x2 FP vehicles

Duct (21) is connected to front axle electro-pneumatic distributor duct (14) for supplying the air springs.

Rear axle lowering

In this case, the ECU energises solenoid valves "B" and "C" supplying the second and third distributor, allowing the air to be relieved from the air springs from duct (3), which is open because the axle electro-pneumatic solenoid valve "A" is de-energised.

Self-leveling

The ECU, according to the position of the level sensors, controls solenoid valves "A", "B" and/or "C" accordingly for lifting or lowering in order to reach vehicle levelling or stored positions "M1" or "M2".

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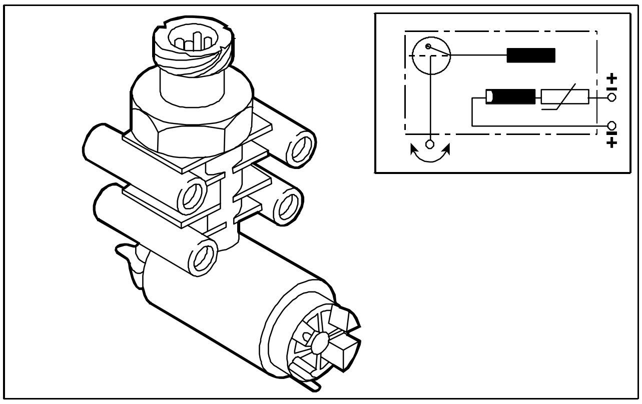
Level sensor

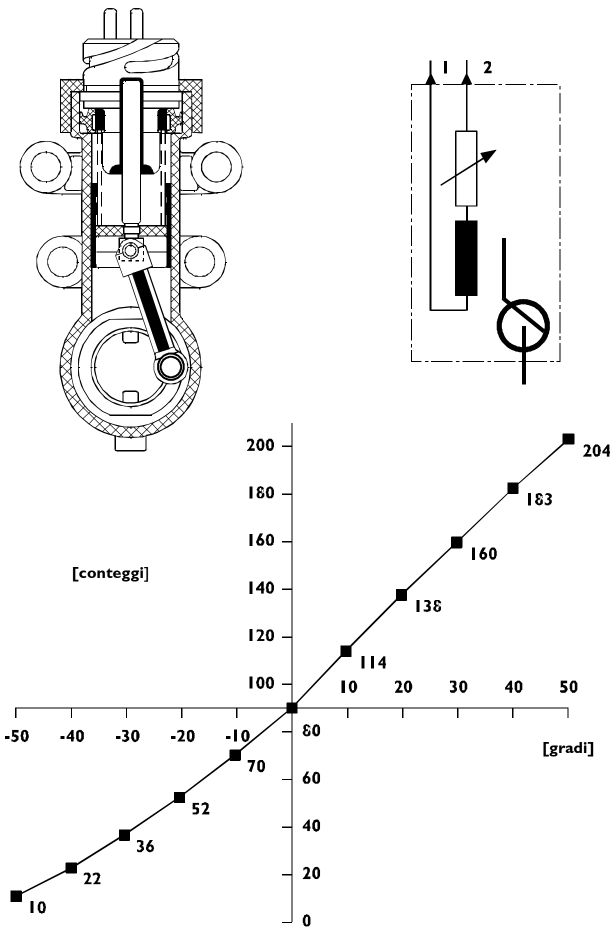
Figure 25



62421

The level sensor consists of a coil fastened to the chassis and a piston.
The piston is moved by an eccentric gear and a lever connected to the axle when the height changes, whereby changing the inductance of the coil.
These variations are used by the ECU to intervene in the various phases of system work.
The sensor connection lever **is fixed and cannot be adjusted.**

Figure 26

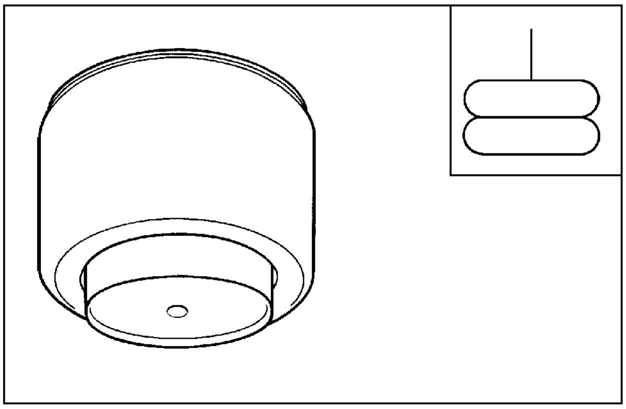


62422

Sensor nominal characteristic curve according to angular lever movement

5007 Air springs

Figure 27



30106

This elastic element contains pressurised air and changes its extension, regardless of the applied load.

ECU

The ECU manages the various chassis positions according to the requests made by the driver by means of the remote control.
When the key switch is switched on, the electronic control unit performs a system check by powering, during ~ 2 seconds, the red warning light (pneumatic suspension low pressure) found on the dashboard. If an anomaly is found, the CLUSTER display will show the corresponding symbol, according to the type of anomaly: a yellow symbol on the left portion (anomalies and faults not critical), or a red symbol on the right portion (critical faults). The ECU must keep the levels required by the driver constant and, at the same time, reduce air consumption, by cyclically monitoring the level sensor signals, cutting in ONLY when the discrepancy between sensors is > 5 counts.
Correction will be made with a delay of:

- approximately 1 second when the vehicle is stationary
- approximately 60 seconds when the vehicle is moving.

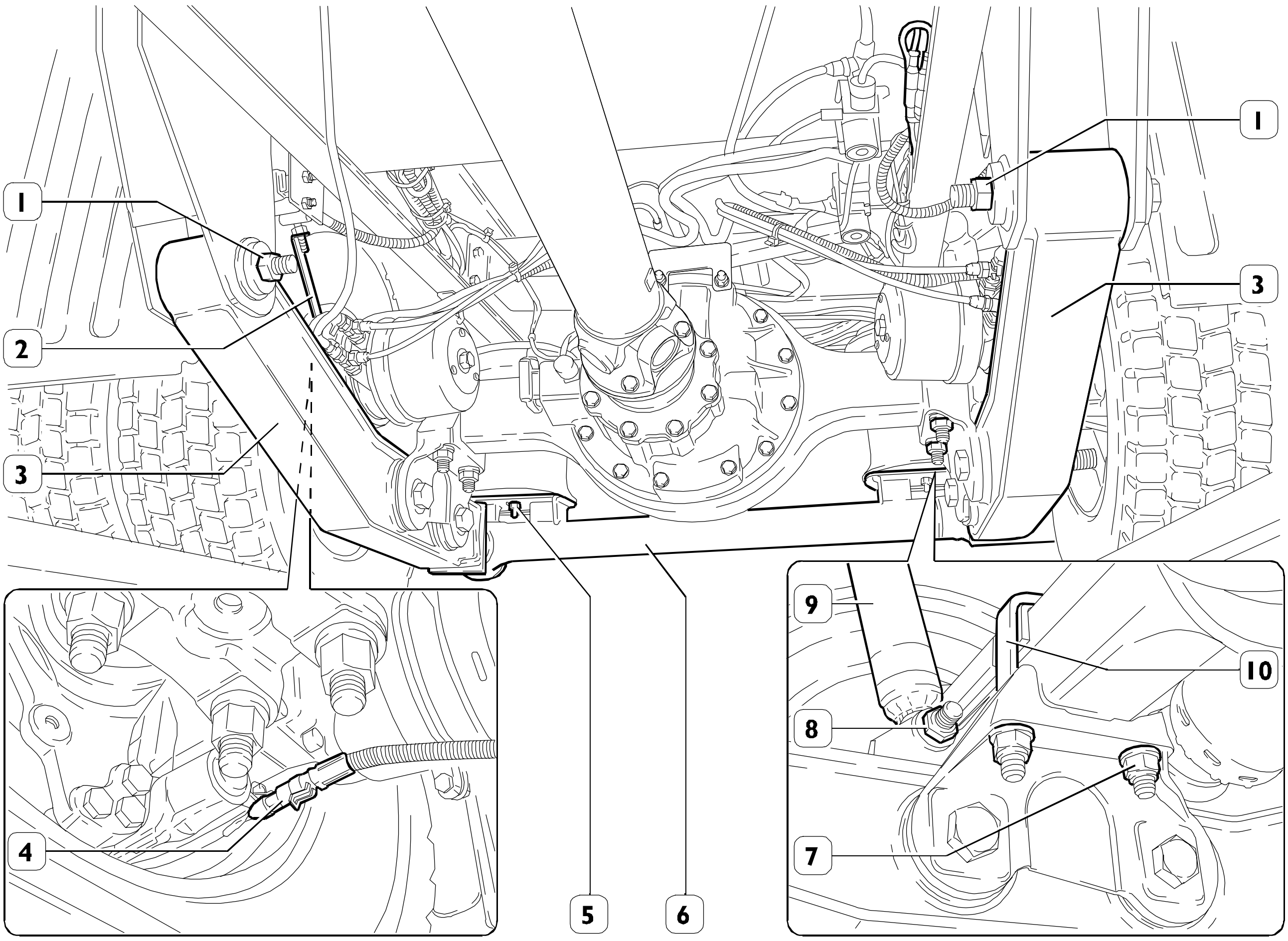
The ECU will store a plausibility error if the level is not restored within a maximum time of 30 seconds.

> ⚠ This is ONLY valid providing that the vehicle has been moving for at least five minutes, because the system details checks to allow recharging the pneumatic system.

When braking, the ECU receives a signal from the brake light switch, interrupting automatic trim adjustments. The ECU is equipped with an extremely advanced self-diagnostic system which is capable of recognising and storing system failures (also intermittent), according to environmental conditions, during operation, for ensuring correct, reliable repairs, in addition to blink codes displayed by the red warning light for preliminary troubleshooting. Diagnostic, programming and error memory deletion operations, etc., can be carried out using the MODUS computerised diagnostic station. All system components, except for the steering system, are connected to the ECU, by means of a comb connector. The pin numbering and ECU type change according to the version.

500730 REAR PNEUMATIC SUSPENSIONS REMOVAL-REFITTING (NEWAY for Models 110EL..P-120EL..P)

Figure 28



72815

Arrange the vehicle on level ground and block the front wheels.
Remove the wheel fastening nut guards and loosen the wheel fastening nuts.
Lift the back of the vehicle and position it on stands.
Arrange hydraulic jack 99321024 under the wheels, remove the wheel fastening nuts and remove the wheels.

Removal

The following procedure described for one arm is valid for both.

- ❑ Disconnect the electrical connections (4) to prevent damage.
- ❑ Loosen nut (8), remove the anchoring pin and detach shock absorber (9) from the support on the arm.
- ❑ Remove the nuts (7) and the rear axle anchoring brackets (10).

Stop the rocker arms (3) from moving while removing the nuts (7).

- ❑ Loosen the fastener and remove the level sensor tie-rod (2).
- ❑ Loosen air spring fastening nut (5).
- ❑ Loosen the fastening nuts and remove the bars (6).
- ❑ Loosen fastening nut (1). Remove the anchoring pin and remove the concerned arm (3).

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

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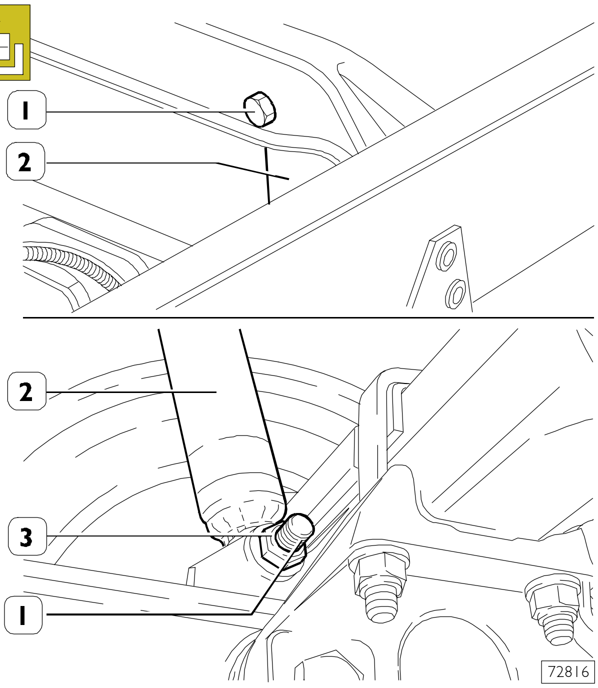
500940 REAR SHOCK ABSORBERS

Removal

Figure 29



Loosen the upper and lower nuts (3), remove the upper and lower anchoring pins (1) and remove the shock absorber (2) from the vehicle.

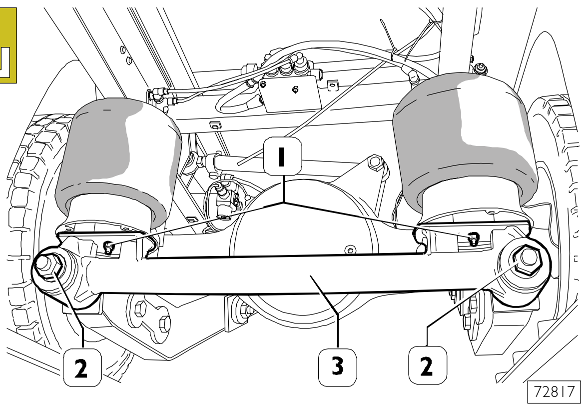
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

528960 REAR SWAY BAR

Removal

Figure 30



Loosen the air spring anchoring screws (1). Loosen the fastening nuts (2) and remove the sway bar (3) from the rocker arms.

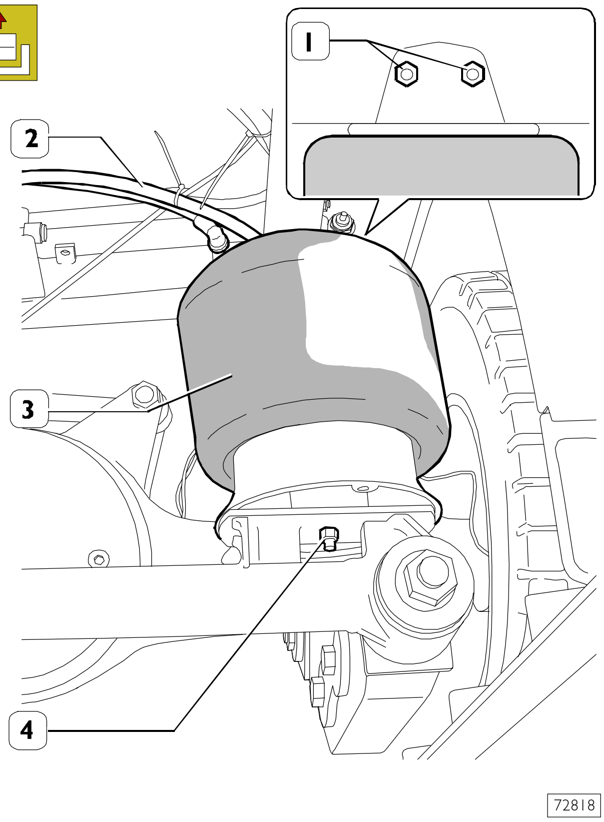
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

500731 REAR AIR SPRINGS

Removal

Figure 31



Disconnect the air supply tubes (2).

Loosen the fastening screws (1), loosen the nut (4) and remove the air spring (3) from the vehicle.

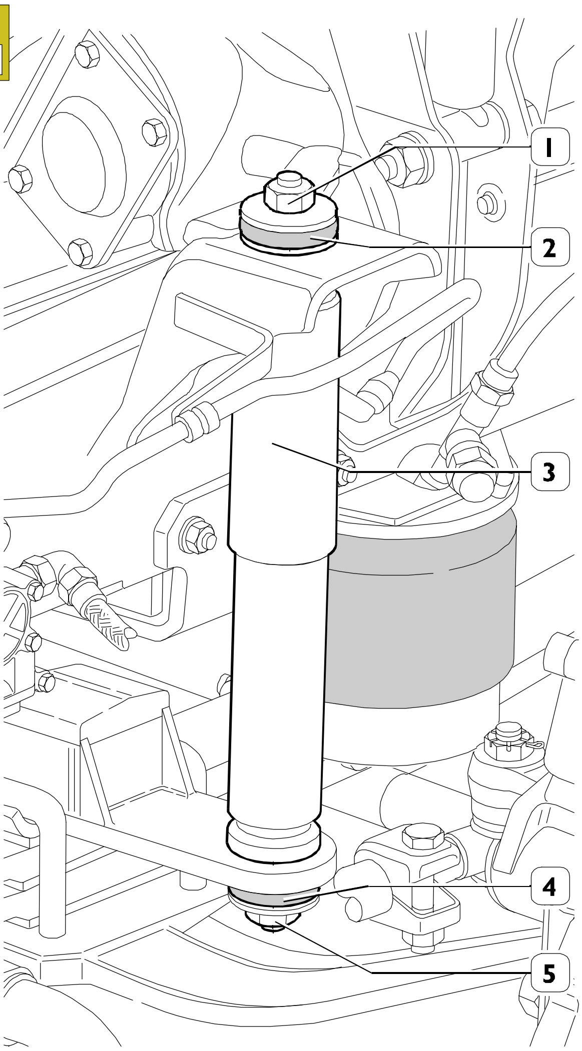
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

500910 FRONT SHOCK ABSORBERS

Removal

Figure 32



72819

Loosen upper nut (1) and lower nut (5), take the pads (2) and (4) and remove the shock absorber (3) from the vehicle.

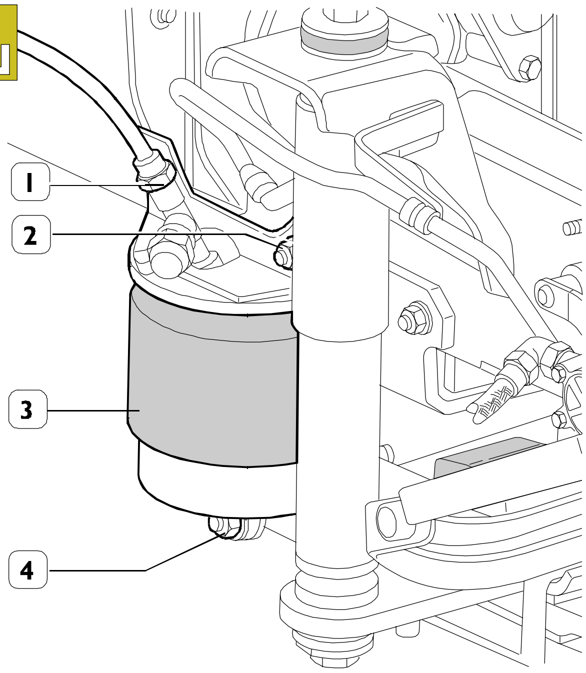
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

500711 FRONT AIR SPRINGS

Removal

Figure 33



72820

Disconnect the air supply tube (1).

Loosen the upper fastening screws (2) and the lower fastening screws (4). Remove the air springs from the vehicle.

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

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500710 FRONT PNEUMATIC SUSPENSION REMOVAL-REFITTING

Disconnect the battery cables before starting removal-refitting operations.

Removal

Arrange the vehicle on level ground, block the rear wheels with wedges and proceed as follows:

- Loosen the front wheel fastening nuts, lift the vehicle and position it on stands.
- Arrange hydraulic jack 99321024 under the wheels, remove the fastening nuts and remove the wheels.
- Loosen the nuts (6), taking the pad (10) and remove the shock absorber (14).
- On the lower side of the vehicle, loosen the nuts (4) and remove the U-bolt (3) taking the plate (11).
- Loosen the nut and remove the rear pin (13) anchoring the leaf spring (12) to the chassis mount.
- Loosen the nut and remove the front leaf spring (12) anchoring pin (1) to the chassis mount. Lower the axle and remove the complete leaf spring.
- Loosen the nut (9) and disconnect the tie-rod (8).
- Loosen the nut (7), remove the screw and disconnect the air spring from the leaf spring.

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

Lock nuts must be replaced and fastened at the specified torque.

Check that:

- U-bolt threading is in good conditions. If required, reface the threading or replace the part.

528930 FRONT SWAY BAR

Removal

On the lower side of the vehicle, loosen the front U-bolt (3) nuts (4) and remove from the housing.

- Loosen the nuts (2) fastening the sway bar connecting rod to the chassis mount.
- Remove the mounts from the axle and remove the sway bar (5) with connecting rod from the vehicle.

Refitting

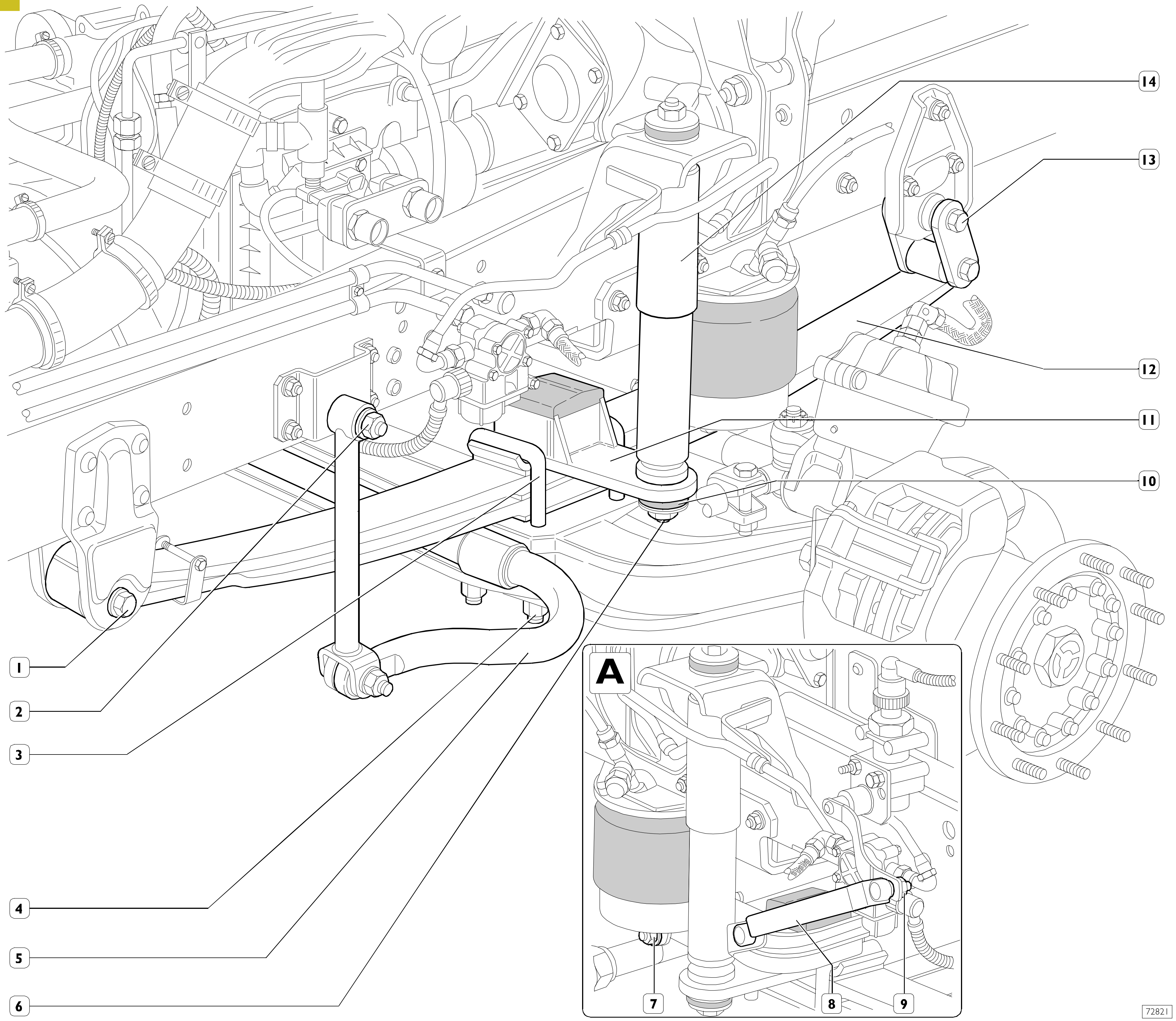
Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

Lock nuts must be replaced and fastened at the specified torque.

Check that:

- U-bolt threading is in good conditions. If required, reface the threading or replace the part.

Figure 34



A = Part seen from the right-hand side of the vehicle.

500730 REAR PNEUMATIC SUSPENSION REMOVAL-REFITTING

(Models 120E..P-FP/130E..P-FP/150E..P-FP)

The following paragraph describes the procedure for model 130E..FP and is suitable also for the other models.

Disconnect the battery cables before starting removal-refitting operations.

Removal

Arrange the vehicle on level ground, block the rear wheels with wedges and proceed as follows:

- ❑ Loosen the front wheel fastening nuts, lift the vehicle and position it on stands in the point shown by (⇒).
- ❑ Arrange hydraulic jack 99321024 under the wheels, remove the fastening nuts and remove the wheels.
- ❑ Loosen nut (13) and remove the shock absorber (14).
- ❑ Remove the air spring (2) and (11) fastening nuts (4) and (9).
- ❑ Remove the sway bar (10) fastening bolts (8).
- ❑ Loosen the fastening nuts and disconnect the level valve tie-rid (12).
- ❑ Loosen the fastening nuts (6), taking the plates and remove the U-bolts (15).
- ❑ Loosen the reaction rod (3) fastening bolts (1) and (7).
- ❑ Remove the suspension arms from the vehicle (5).

Refitting

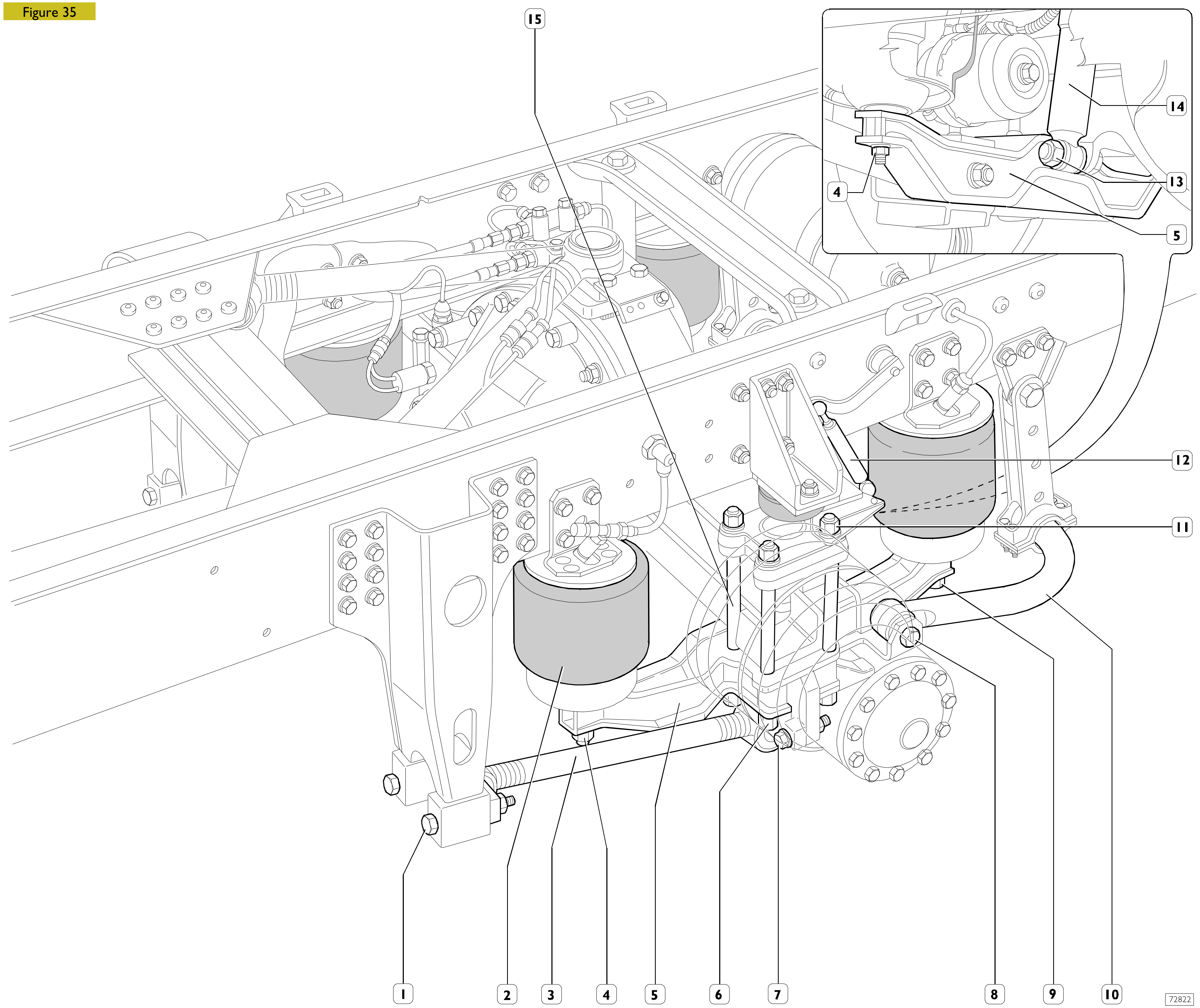
Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

Lock nuts must be replaced and fastened at the specified torque.

Check that:

- ❑ U-bolt (15) threading is in good conditions. If required, reface the threading or replace the part.

Figure 35



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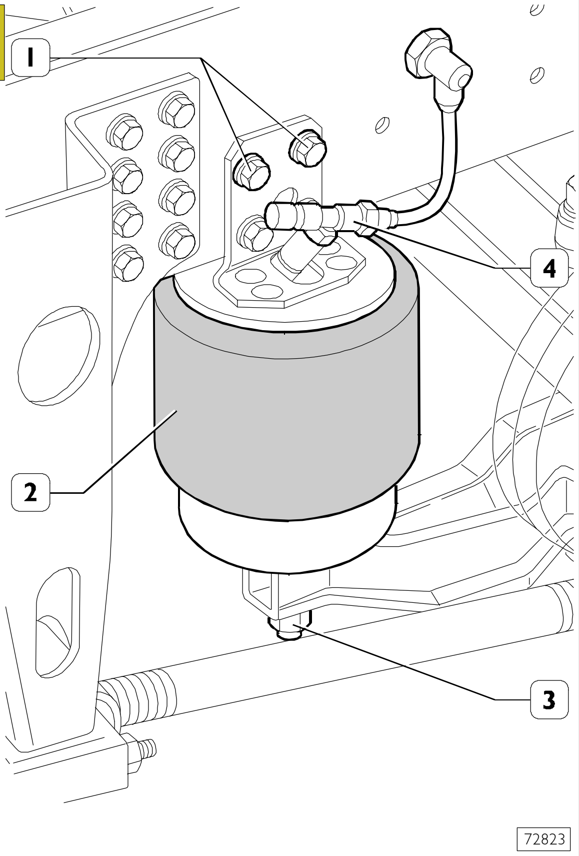
500731 REAR AIR SPRINGS

Removal

Figure 36



- ❑ Disconnect the air supply tubes (4).
- ❑ Loosen the chassis fastening screws (1).
- ❑ Loosen the nuts (3) and remove the air springs (2).

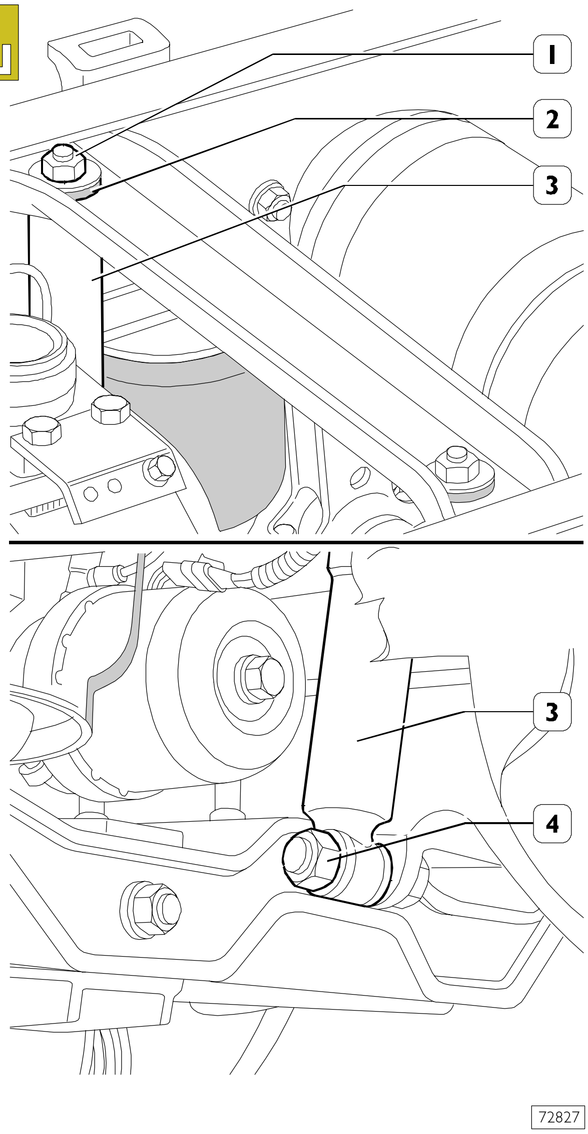
Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

500940 REAR SHOCK ABSORBERS

Removal

Figure 37



- ❑ Loosen the lower fastening nuts (4).
- ❑ Loosen the upper fastening nuts (1) and take the pads.
- ❑ Remove the shock absorbers from the vehicle (3).

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

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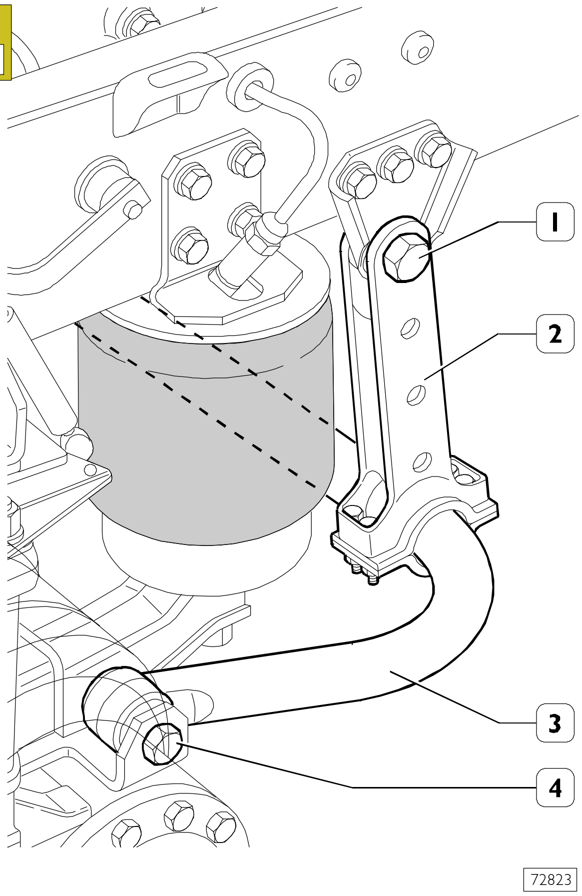
500731 REAR SWAY BAR

Removal

Figure 38



- ❑ Loosen the anchoring screws (4) to the axle.
- ❑ Loosen the anchoring screws (1) to the chassis.
- ❑ Remove the sway bar (3) with reaction rod (2).

Refitting

Refit by reversing the removal sequence. Fasten screws and nuts at the specified torque.

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SECTION 9

5025 Wheels and Tires

Page

DESCRIPTION 3

SPECIFICATIONS AND DATA 3

❑ Tire pressure values 3

TOOLS 4

DIAGNOSTICS 4

STATIC WHEELS BALANCING 7

CORRECTION OF RESIDUAL STATIC UNBALANCE 8

TIRE PRESSURE 8

TIRE BEHAVIOUR DEPENDING ON PRESSURE 9

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DESCRIPTION

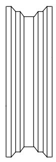
The wheel rim shows the rigid wheel structure and is identified by the following dimensions:

- rim diameter, measured at the circumferential groove base (that is on the surface on which the air chamber rests);
- circumferential wheel rim groove width (that is the distance between the surfaces on which the cover rests).

The tire has the following tasks:

- absorbing the majority of impacts generated by road projections by exploiting air resiliency;
- developing on ground the motive force provided by the engine and necessary for moving the vehicle;
- ensuring the maximum adherence established by the tire-road contact with a satisfactory length;
- supporting efforts generated by sudden brakings, by quick accelerations and by the centrifugal force thrust in a curve;
- guaranteeing vehicle stability and ensuring the directional vehicle power.

SPECIFICATIONS AND DATA



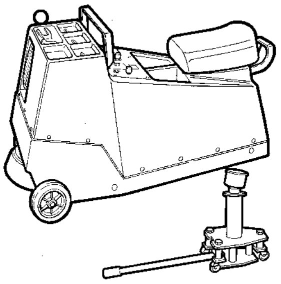
WHEEL RIMS:
Disc-type with drop center rim

MODELS 4x2	MEASURES
ML 110 EL..	17.5" x 6.75"
ML 120 EL..	17.5" x 6.75"
ML 120 E..	19.5" x 8.25" - 19.5" x 6.75" - 19.5" x 7.50" - 22.5" x 6.75"
ML 130 E..	19.5" x 6.75" - 19.5" x 7.50" - 22.5" x 6.75"
ML 140 E..	19.5" x 6.75" - 19.5" x 7.50" - 19.5" x 8.25" - 22.5" x 6.75" - 22.5" x 7.50"
ML 150 E..	19.5" x 6.75" - 19.5" x 7.50" - 19.5" x 8.25" - 22.5" x 6.75" - 22.5" x 7.50"
ML 180 E..	22.5" x 8.25" - 22.5" x 9.00"
MODELS 6x4	**MEASURES**
260E28KE	22.5" x 8.25"

Tire pressure values

For checking tire pressure, comply with values shown in the specific "Use and Maintenance" booklet.

TOOLS

TOOL No.		DENOMINATION
99305037		Electronic device for balancing front wheel on a vehicle

DIAGNOSTICS

Main tire anomalies:
1 – Excessive consumption.
2 – Irregular consumption.
3 – The vehicle tends on one side.

1	**EXCESSIVE CONSUMPTION**

Excessive speed on particularly uneven grounds.	YES →	Moderate the speed.
NO ↓		
Sudden running speed variations due to brusque starts or braking abuse.	YES →	Avoid every superfluous acceleration or braking.
NO ↓		
Excessive speed with tires with insufficient pressure.	YES →	Check pressures with cold tires.
NO ↓		
Tires at a pressure that is higher than the required one.	YES →	Decrease the pressures.
NO ↓		
Overloaded truck.	YES →	Refer to data related to allowed loads.

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2 IRREGULAR CONSUMPTION

Tire pressure differences between a pair of wheels and the other.	YES →	Check the pressures.
NO ↓		
Insufficient tire pressure: the wear is centered on two tread sides more than in the central area.	YES →	Inflate the tires.
NO ↓		
Tires inflated at a higher pressure than the required one with excessive wear of central tread surface.	YES →	Decrease the pressure.
NO ↓		
Insufficient front wheel toe-in: high wear in internal tread surfaces.	YES →	Proceed with toe-in check and adjustment.
NO ↓		
Wrong front wheels attitude.	YES →	Restore the normal wheel attitude.
NO ↓		
Wheel rims distortions with following unbalancing.	YES →	If possible, repair the rims and replace them; then balance the wheels.
NO ↓		
Wrong tire assembly on rims.	YES →	Exactly assemble the tire and balance the wheel.

(continues)

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Rear axle parallelism variation due to leaf spring central pin breakage, or different-length or twisted springs.	YES →	Revise the suspension.
NO ↓		
Excessive front wheels toe-in; excessive wear of external tread surfaces.	YES →	Check and adjust the toe-in.

3 THE VEHICLE TENDS ON ONE SIDE

Unbalanced front wheels.	YES →	Proceed with their balancing.
NO ↓		
Different inflation pressure between front tires.	YES →	Check the pressures observing the exact required value.
NO ↓		
Excessive wear difference between a pair of tires.	YES →	Replace the excessively-worn tire.

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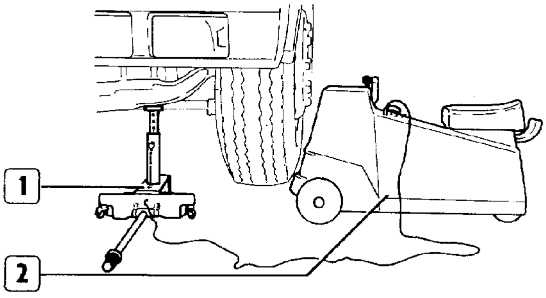
502511 STATIC WHEELS BALANCING

Figure 1

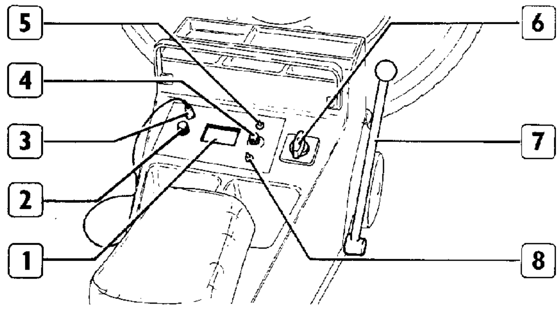


Front wheels balancing can be carried out with wheels assembled on a vehicle by using the suitable electronic balancing device 99305037; in this way there will be the additional advantage of balancing the wheel together with the rotating masses.

The operation must be carried out in the following way:

- ❑ Lift the front vehicle part and make sure that the wheels freely rotate.
- ❑ Arrange under the front axle near the examined wheel the unbalance detector (1), placing it at such a height that the starting roller of device 99305037 (2) comes in contact with the tire; under the opposite front axle side, place a support stand and lower the hydraulic jack.

Figure 2

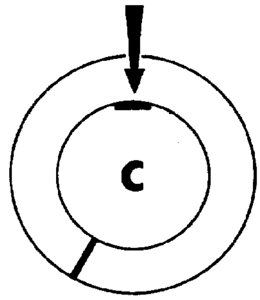


16997

- ❑ Connect cable (3) of unbalance detector to device 99305037.
- ❑ Make a reference mark on the tire, composed of a radial track obtained with chalk or band of adhesive paper.
- ❑ Put switch (2) in static balancing position and sensitivity switch (4) next to notch 5 in the graded scale.
- ❑ Insert instrument (1) light switch (5) and stroboscopic lamp switch (8).
- ❑ Insert starting switch (6) of device 99305037 in the first gear position in order to make the wheel rotate.

Take the starting switch (6) to the second gear and push the balancing device against the tire.
While the wheel is dragged rotating, it will be seen that the stroboscopic effect on the wheel makes the reference mark appear as unmoving; the instrument (1) indicator, starting from zero value, reaches on the scale a maximum value and then goes back towards zero.
When the indicator has started going back, move the balancing device away, completely disconnect the starting switch (6) and brake the engine through the brake lever (7).
The wheel continues to inertially rotate and the reference marks made on the tire moves, then mark the point where the reference moved.
Read on instrument (1) the value shown by the indicator, multiply it by 10, thereby obtaining the counterweight value to be applied on the rim.

Figure 3



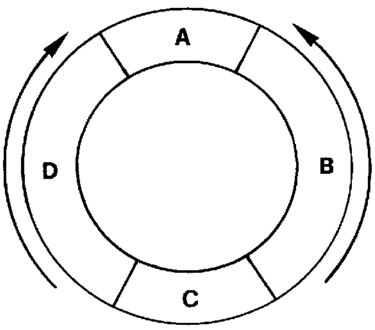
16998

Apply the thereby-computed counterweight as shown in the figure.
If during the test the instrument indicator (1, Figure 2) remains on the green case field, the wheel is balanced.

If the required weight to balance the wheel is greater than 600 ÷ 800 grams, divide the weight by half and place the two thereby-composed parts, one half on the inside, and the other half to the outside of the rim, paying attention that they are in the same position.

CORRECTION OF RESIDUAL STATIC UNBALANCE

Figure 4



23885

In order to correct the residual unbalance, repeat the already previously performed operations; according to the new indication obtained on the instrument (1, Figure 2), refer to diagram in Figure 4 and operate in the following way for the adjustment.

- If the weight is in the area marked with letter A, this means that it is too light and therefore weight must be added according to what the instrument shows (1, Figure 2).
- If the weight is in the lower area marked with letter C, this means that it is too heavy and then it must be decreased by what the measuring instrument marks.
- When the weight is in the areas marked with letters B and D, do not remove or add any weight, but rather move it by 5 cm upwards along the arrows direction, see Figure 4.

502510 TIRE PRESSURE

The tire pressure values must be checked with cold tires.
Strictly take care of the pressure correctness, because, if it is greater than the required one, it creates running stiffness and excessive wear of central tread surface, while if it is lower, the load is not distributed on the whole tread but is concentrated on the side parts, early consuming them, and damaging the internal tire structures.
A pressure unbalance between tires impairs the vehicle driving stability and impairs its running safety.
The anomalous tire wear can occur in different tread areas thereof.

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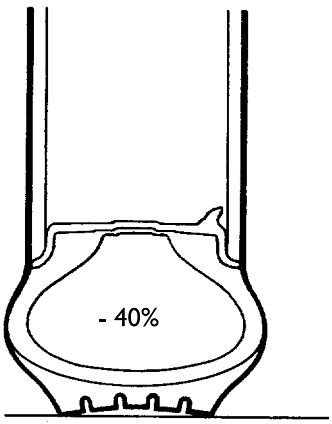
TIRE BEHAVIOUR DEPENDING ON PRESSURE

Demonstration diagrams of tire behaviour and efficiency depending on pressure.

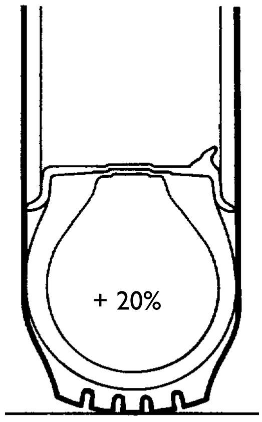
(The values placed inside every figure show the amount of tire pressure, while the efficiency is referred to the tire life.)

Figure 5



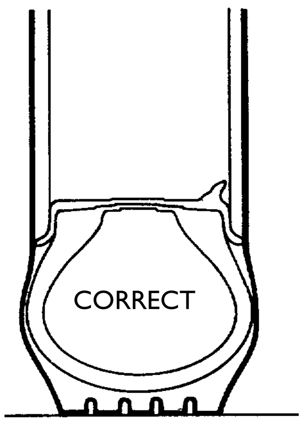
40% EFFICIENCY

Figure 6



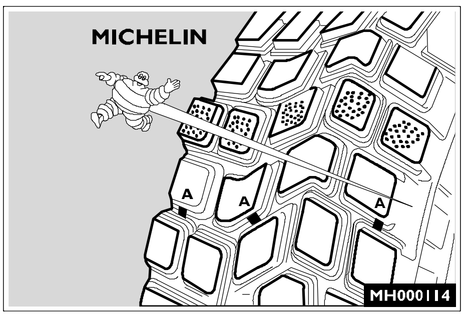
90% EFFICIENCY

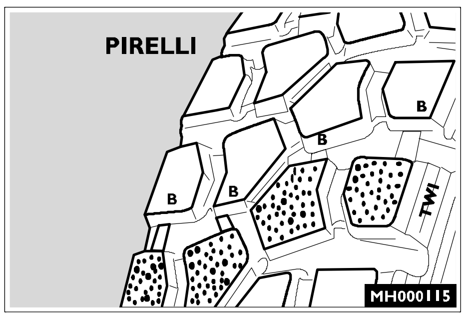
Figure 7



100% EFFICIENCY

Figure 8





It is advisable that the pair of tires assembled on an axle are replaced when on the tread, after the small blocks consumption, continuous bands appear extended to the whole tire width (displayed in the figures with dots).

The tires further have wear indicators A and B placed next to indicator TWI for PIRELLI tire (B) and next to MICHELIN (A) symbol for those of this latter manufacturer: the replacement is mandatory in case these indicators are reached.

SECTION 10

5014 Steering

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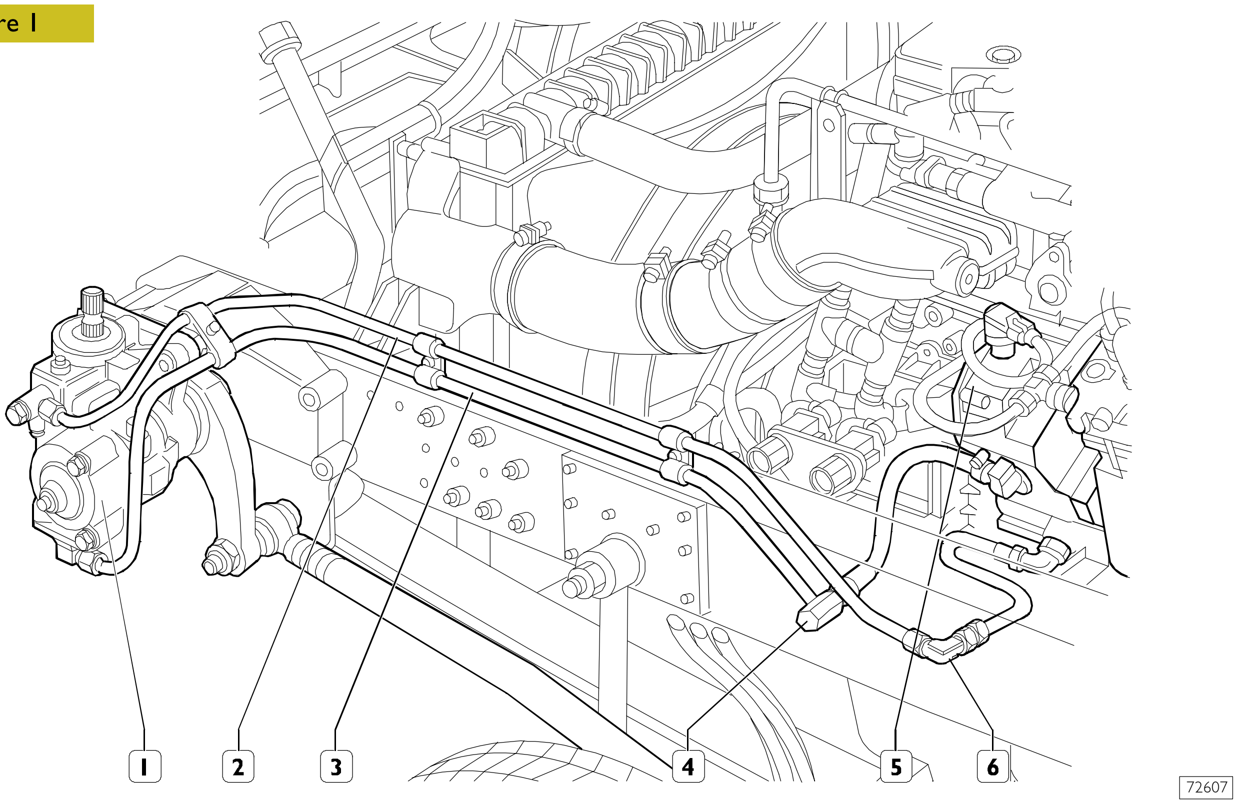
DESCRIPTION

The steering control system, that can be found on EuroCargo vehicles, is composed of an hydraulic power steering of the ball-circulation type controlled by a geared pump assembled together with the air compressor.
Such pump has the feature of having its oil tank integrated with the body.

Hydraulic power steering system installation view

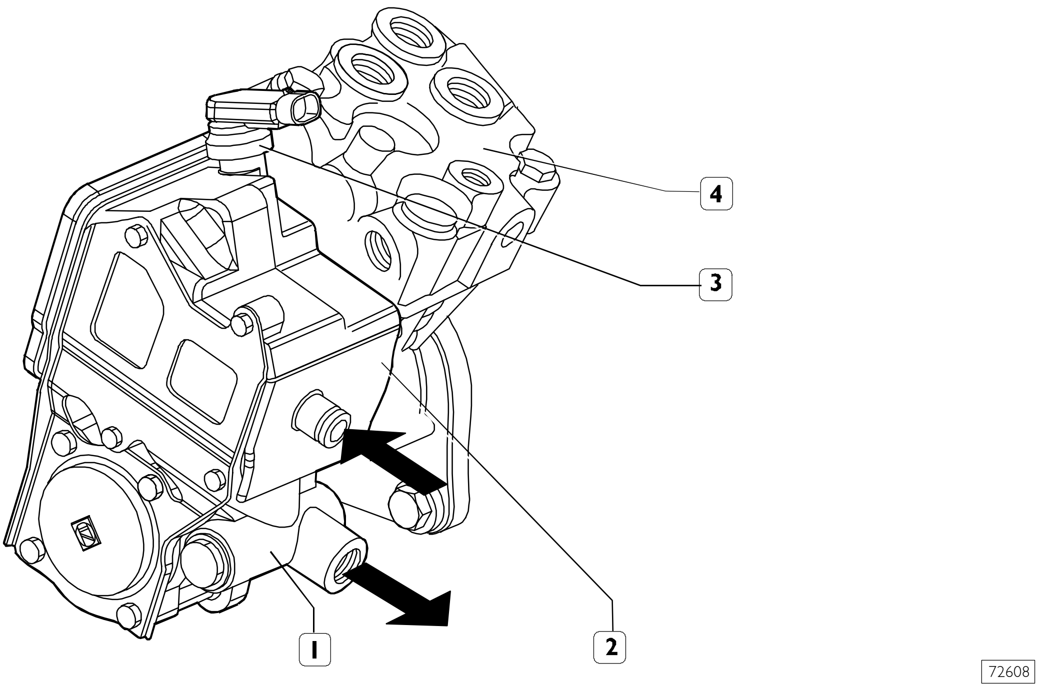
Figure 1



1. Hydraulic power steering – 2. Delivery piping – 3. Return piping – 4. Through-wall fitting on return piping – 5. Power steering pump with integrated tank – 6. Through-wall fitting on delivery piping.

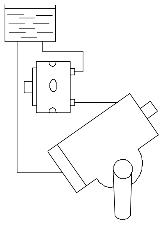
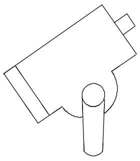
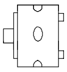
View of power steering pump assembled together with air compressor

Figure 2



1. Power steering pump – 2. Hydraulic power steering oil tank – 3. Oil insertion plug with level sensor – 4. Air compressor.

SPECIFICATIONS AND DATA

	Steering		Hydraulic		
	Hydraulic power steering (with ball circulation with embedded pressure limiting valve)		ZF 8095	ZF 8098	TRW/TAS 55
	Variable operating pressure		150 + 15	130 + 13	150 + 10
	Reduction ratio		19.6 : 1	22.2 to 26.2 : 1	20.4 : 1
	No. of revolutions/steering wheel		5.4	3.1	5.7
	Power steering pump with integrated tank and safety filter valve		ZF FN4 Integral		
	Min. number of revolutions	Revs/min	600		
	Max. number of revolutions	Revs/min	2700		
	Operating pressure	bar	max. 180		
	Flow rate	dm^3/min	16		
	Maximum operating temperature		100 ° C		
	Tutela GI/A oil It complies with ATF DEXRON II specification				

DIAGNOSTICS

Main hydraulic power steering operating anomalies:

1 – Hard steering in right and left steering;
2 - Hard steering only in left or right steering;
3 – Hard steering when the steering wheel is quickly rotated;
4 – When one steers, strong impacts occur on steering wheel;
5 – Torsional steering wheel vibrations;
6 – Excessive steering wheel clearance;
7 – Oil leakage;
8 – Insufficient circuit pressure.

1	HARD STEERING IN RIGHT AND LEFT STEERING

Insufficient system oil. — YES → Check level with running engine; top-up the oil till the upper level rod mark and drain the system.

NO

Presence of air in hydraulic circuit. — YES → Check suction pipe and pump shaft gasket seal and top-up the oil. Drain the system.

NO

(continues)

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Locked or clogged limiting valve.	YES →	Disassemble the valve, wash and check. The throttling holes must not be clogged.
NO ↓		
Insufficient oil pump flow rate	YES →	Replace the pump.
NO ↓		
Poorly-sliding spider joint.	YES →	Make the joint slidable alternatively moving it many times so that it can be slanted under its own weight.

2 HARD STEERING ONLY IN LEFT OR RIGHT STEERING

Inefficient internal gaskets.	YES →	Sent the steering to a ZF or TRW station.
NO ↓		
Wrong hydraulic center position (if the steering wheel is left free, the steering spontaneously goes to an extreme position).	YES →	Make the hydraulic power steering adjusted by a ZF or TRW station.

3 HARD STEERING WHEN THE STEERING WHEEL IS QUICKLY ROTATED

Clogge limiting valve.	YES →	Disassemble the valve, wash and clean.
NO ↓		
Insufficient hydraulic pump flow rate.	YES →	Revise or replace the hydraulic pump.
NO ↓		
Presence of air in steering system.	YES →	Check suction pipe seal in pump shaft gasket and top-up the oil. Drain the system.

4	WHEN ONE STEERS, STRONG IMPACTS OCCUR ON STEERING WHEEL

Cause		Remedy
Cardan joint clearance.	YES →	Replace the cardan joint.
NO ↓		
Internal hydraulic power steering failure.	YES →	Send the hydraulic power steering to a ZF or TRW station.
NO ↓		
Insufficient system oil.	YES →	Top-up the oil and drain the system.
NO ↓		
Wrong wheels attitude.	YES →	Carry out checks and adjustments according to characteristic data included in "FRONT AXLE" section.
NO ↓		
Unbalanced wheels.	YES →	Carry out the rebalancing according to the instructions included in chapter "Wheels and tires".
NO ↓		
Loosened steering tie-rod heads on levers.	YES →	Replace the possibly worn parts.
NO ↓		
Irregular hydraulic pump operation.	YES →	Replace the hydraulic pump.
NO ↓		
Oil blow-by from hydraulic power steering circuit fittings.	YES →	Check fittings gaskets efficiency replacing the worn ones.

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5 TORSIONAL STEERING WHEEL VIBRATIONS

Cause		Remedy
Unbalanced wheels.	YES →	Carry out the balancing following the instructions included in chapter "Wheels and tires".
NO ↓		
Wrong wheels attitude.	YES →	Carry out checks and adjustments according to characteristics data included in "FRONT AXLE" section.
NO ↓		
Presence of air in hydraulic system.	YES →	Check suction pipe and pump shaft gasket seal and top-up the oil. Drain the system..

6 EXCESSIVE STEERING WHEEL CLEARANCE

Cause		Remedy
Clearance in ball joints and/or slow elastic supports.	YES →	Secure the supports. Replace the ball joints.
NO ↓		
Clearance in cardan joint.	YES →	Replace the cardan joint.
NO ↓		
Internal hydraulic power steering failure.	YES →	Send the hydraulic power steering to a ZF or TRW station.

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7	**OIL LEAKAGE**

The tank cover is loosened. — YES → Secure the cover.

NO

Worn sealing gaskets. — YES → Replace worn sealing gaskets, top-up the oil and drain.

In any case it is necessary to establish where and why the hydraulic oil is lost, remove the reason and top-up the oil in the tank with running engine till the upper level rod mark.

8	**INSUFFICIENT CIRCUIT PRESSURE**

Irregular hydraulic pump operation. — YES → Revise or replace the hydraulic pump.

NO

Oil blow-by from circuit fittings. — YES → Check fittings gaskets efficiency replacing the worn ones.

NO

Insufficient tank oil level. — YES → Restore the level simultaneously carrying out the circuit drain.

NO

Oil blow-by from circuit fittings. — YES → Check fittings gaskets efficiency replacing the worn ones.

NO

Insufficient tank oil level. — YES → Restore the level simultaneously carrying out the circuit drain.

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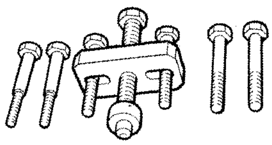
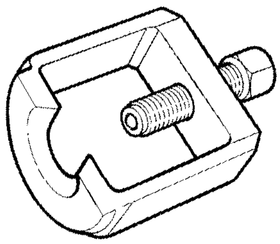
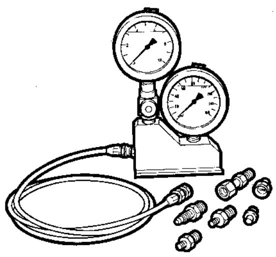
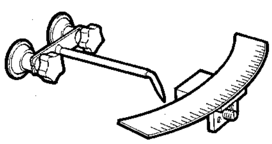
TIGHTENING TORQUES

PART	HYDRAULIC POWER STEERING	ZF 8095	ZF 8098	TRW/TAS 55
Screw for securing hydraulic power steering to support	Nm (kgm)	520 ± 52 (53 ± 5.3)	560 ± 17 (57 ± 1.7)	700 ± 3.5 (71 ± 0.3)
Nut for securing lever on shaft	Nm (kgm)	520 ± 52 (53 ± 5.3)	550 ± 55 (56 ± 5.6)	700 ± 3.5 (71 ± 0.3)
Screw for securing the support to chassis	Nm (kgm)	655 ± 65 (67 ± 6.6)	655 ± 65 (67 ± 6.6)	-
Nut for securing hydraulic steering limiter adjustment screws on hydraulic power steering	Nm (kgm)	15 ± 5 (1.5 ± 0.5)	15 ± 5 (1.5 ± 0.5)	75 ± 7.5 (7.3 ± 0.7)
Nut for securing M22x1.5 steering wheel	Nm (kgm)	73 ± 7 (7.4 ± 0.7)	73 ± 7 (7.4 ± 0.7)	73 ± 7 (7.4 ± 0.7)

TOOLS

TOOL No.		DENOMINATION
99347042		Driving steering wheel extractor.
99347068		Extractor for steering tie-rods head pins.
99374393		Tool with manometers for checking hydraulic ZF hydraulic power steering pressure.
99374398		Graded sector and index for checking steering wheel clearance (use with 99374393).

ZF HYDRAULIC POWER STEERING (8095-8098)

Description

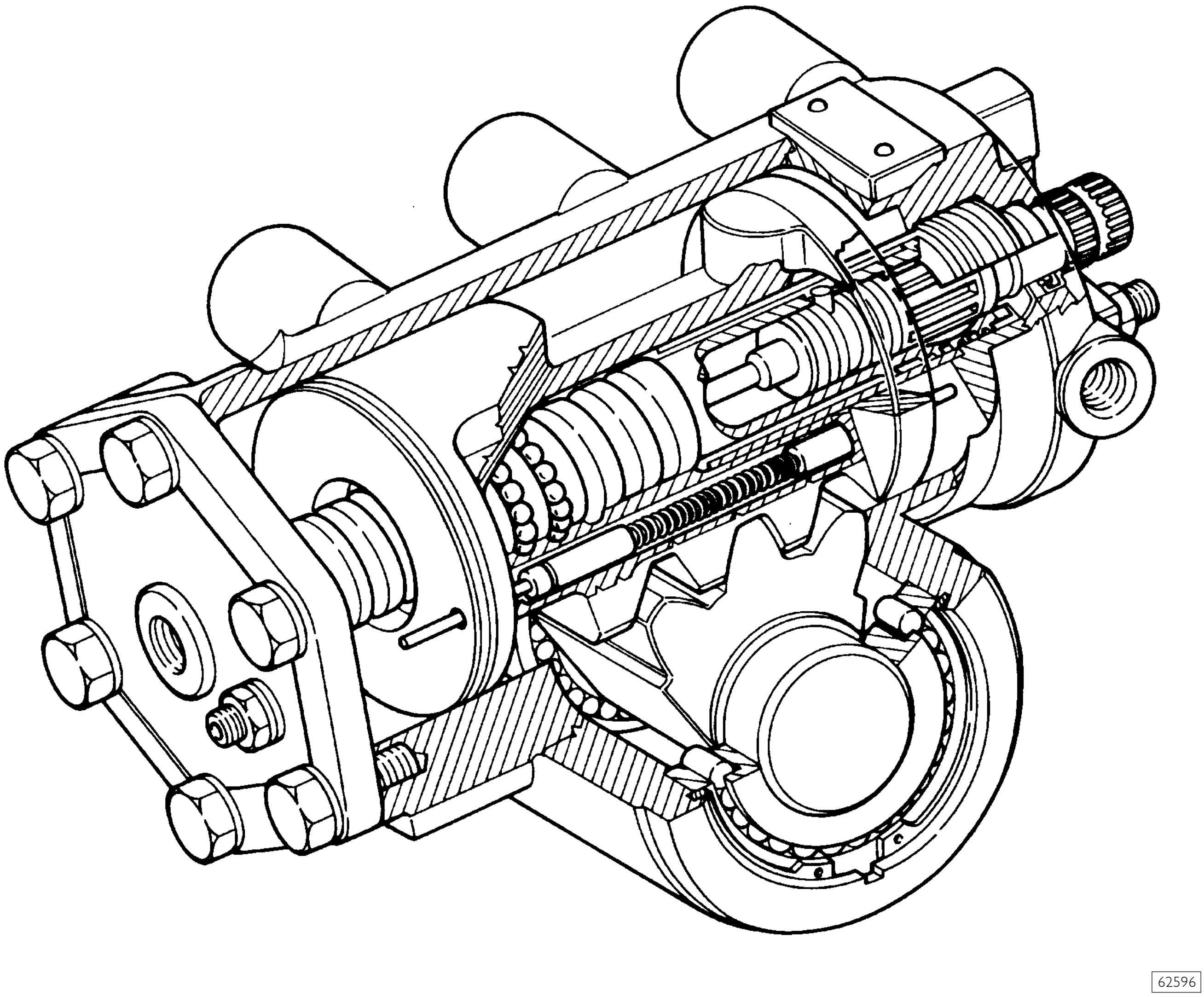
The ZF hydraulic power steering with ball circulation control and a compact shape, is mainly composed of a case and an embedded power steering mechanical part, of a control valve and an operating cylinder. As can be seen in Figure 4 and Figure 5, the rotating movement given to the steering wheel is transmitted without friction from power steering shaft to piston through an infinite sequence of balls and then transformed into an axial piston movement. The toothing of piston driven into case meshes into toothed-sector shaft toothing and makes it rotatingly move. The steering control arm fixed onto this shaft transmits the torque to wheel steering tie-rods.

This solely mechanical steering movement is servo-assisted by pressurised oil supplied by an engine-operated ZF pump.

The control valve is composed of rotating distributor, supported on rollers in the worm screw and equipped with six control grooves on perimeter and of worm screw end supported in the steering case and equipped with six control grooves as well.

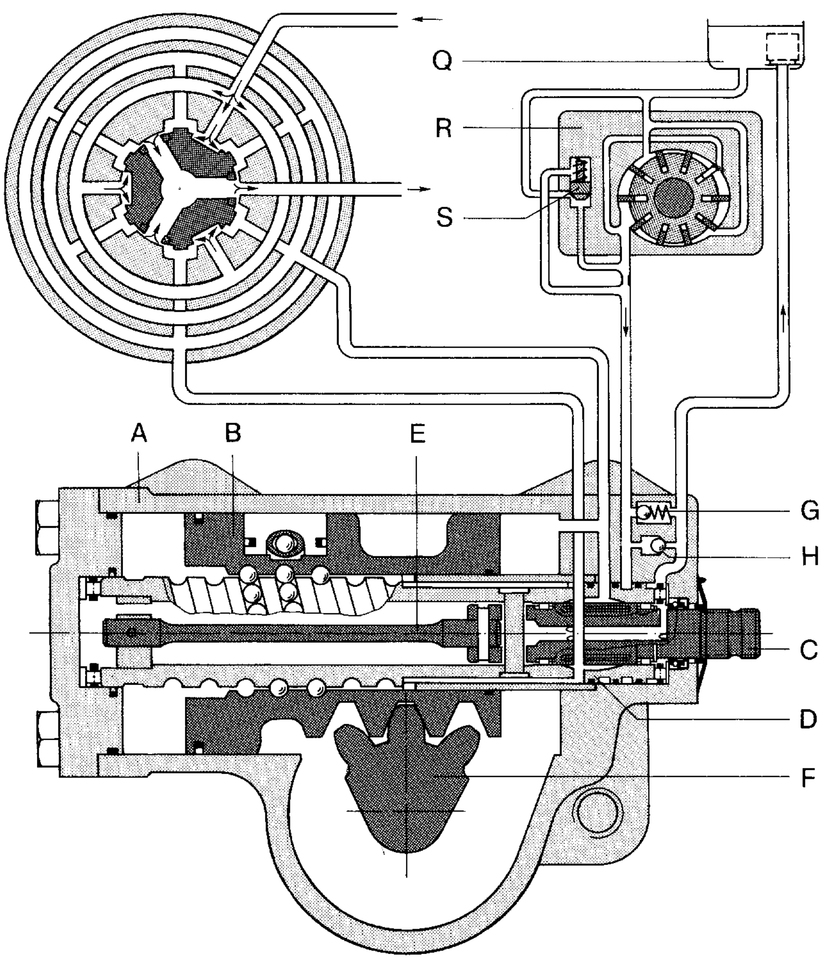
The rotating distributor at the same time operates also as lower connection element of steering shaft and rotates with the worm screw till the steering wheel is rotated.

Figure 3



HYDRAULIC POWER STEERING ZF-TYPE

Figure 4



CONTROL VALVE IN NEUTRAL POSITION
A. Case – B. Piston – C. Rotating distribution/steering shaft – D. Control case/worm screw – E. Torsion bar – F. Toothed-sector shaft – G. Pressure limiting valve – H. Re-suction valve – Q. Oil tank – R. ZF blade pump – S. Flow-rate limiting valve.

This synchronous rotary motion is due to the fact that the worm screw and the rotating distributor (C) are connected through a torsion bar (E, Figure 4) that keeps the control valve in a neutral position (rectilinear running) till the steering wheel is rotated.

When a torque is transmitted from steering wheel or steering wheels to worm screw, the torsion bar is subjected to a distortion in its elastic area, so that between rotating distributor (C) and worm screw end, that operates as control case (D), a relative movement occurs. This causes a distributor control grooves displacement with respect to worm screw ends grooves, so that the control valve passes from neutral position to operating position. The pressurised oil by the control valve (G) can now cross the open control grooves and penetrate into one of the two operating cylinder chambers, thereby assisting the steering movement through the pressure on one of piston surfaces.

If the hydraulic steering servoassistance is lacking, it is always possible to steer, even if with a higher effort on the steering wheel.

To avoid that with the whole hydraulic pressure it is possible to steer till the right and left limit stop and in some cases damage the driving tie-rods, the ZF-Servocom is equipped with hydraulic steering limiting (Figure 6).

A re-suction valve (H, Figure 4) is assembled into the drive case with which return circuit oil can be sucked when it is necessary to steer without hydraulic servoassistance.

Moreover, according to the driving system execution, a pump delivery pressure limiting valve is also assembled according to a pre-established maximum value.

In the operating drawings (Figure 4 and Figure 5) the control valve and oil flow are schematically shown. The valve (S) is shown in a transverse section, so that its operation and connection to cylinder chambers can be seen.

The pressurised oil coming from the pump flows into the central annular groove of the control case and reaches, through three radial holes, the arcuate control grooves of the rotary distributor.

The mutual position of these grooves and the worm screw end grooves allows, in a neutral valve position, the pressurised oil to pass through admission ports till it reaches the equally arcuate grooves in the control case. These latter ones are connected through radial holes with both operating cylinder chambers.

Therefore, in the control valve neutral position, the pressurised oil can penetrate into the two operating cylinder chambers and also into the three return circuit grooves of the rotary distributor and from there reflow into the oil tank.

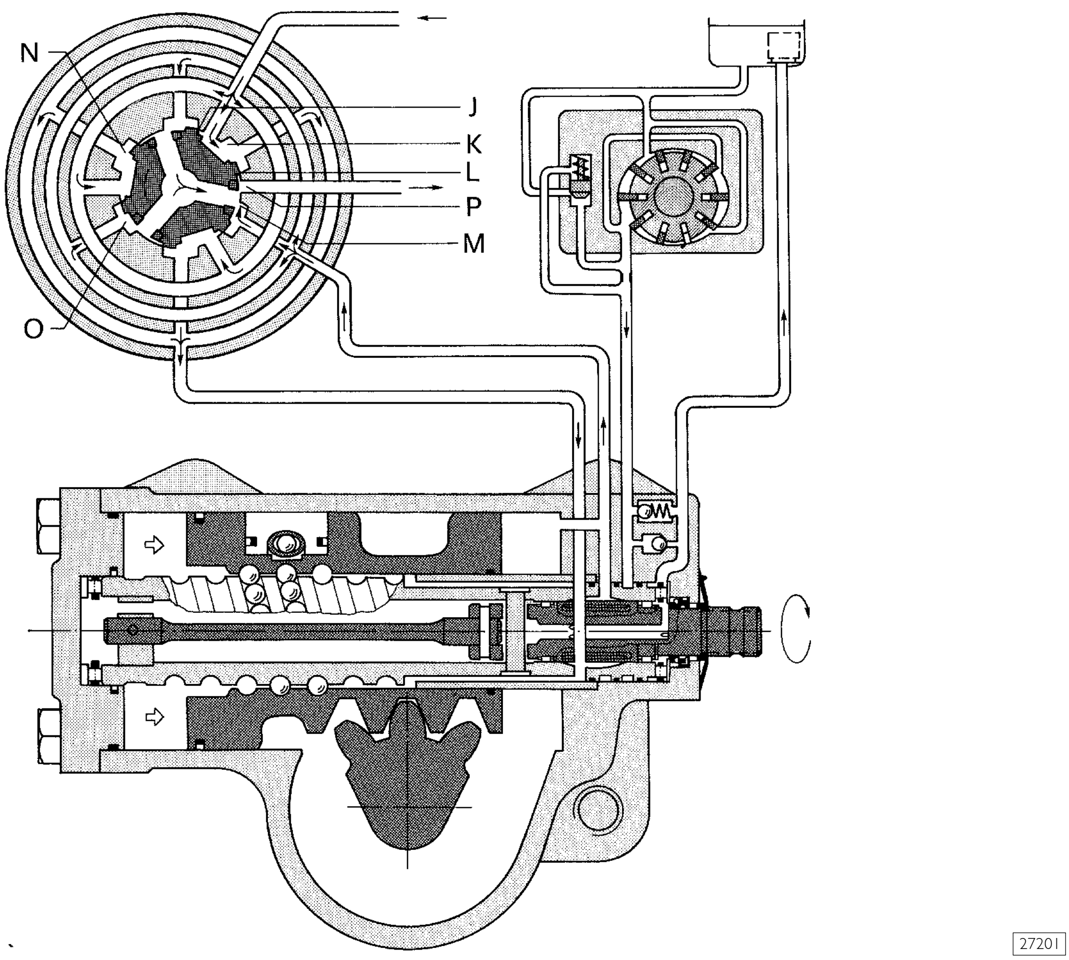
If the steering wheel is rotated rightwards, the rightward-threading piston moves rightward (Figure 5). Since this piston movement must be hydraulically servoassisted, the pressurised oil must penetrate into the left cylinder chamber. The three control grooves of the rotating distributor are displaced clockwise, so that the admission ports (K) are further opened to let the pressurised oil flow. The admission ports (J) are closed and stop the pressurised oil flow towards the axial grooves (O) of the control case.

Through the admission ports (K), the pressurised oil penetrates into the axial grooves (N) of the control case and from there, after having crossed the worm screw balls circulation threading, comes into the left cylinder chamber. The hydraulic servoassistance is then turned on, while the admission ports (I) closure prevents oil from returning into the tank. The oil being present in the right cylinder chamber is made go out and flows, through the open return ports (M), towards the return grooves (P) of the rotating distributor and returns, through its central hole, to the oil tank.

If the steering wheel is rotated leftwards (not shown), the operating cylinder piston is displaced leftwards. The distributor control grooves rotate counterclockwise. The pressurised oil penetrates through admission ports (J) into axial grooves (O) and then into right cylinder chamber.

The oil being present in the left cylinder chamber reflows into the tank through the ball circulation threading, the return ports (L), the return grooves (P) and the central rotating distributor hole.

Figure 5



CONTROL VALVE IN OPERATING POSITION FOR CLOCKWISE ROTATED STEERING WHEEL

J. Admission port – K. Admission port – L. Return port – M. Return port – N. Axial groove – O. Axial groove – P. Return groove.

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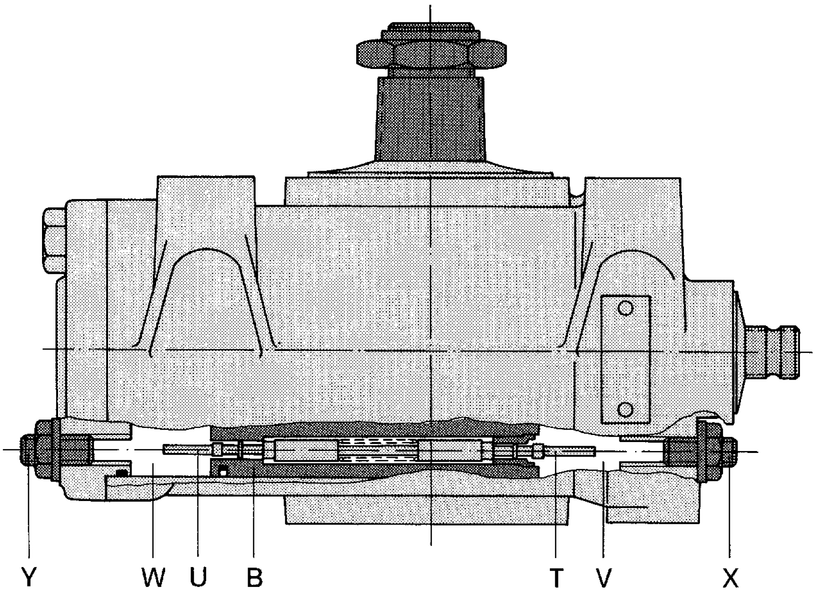
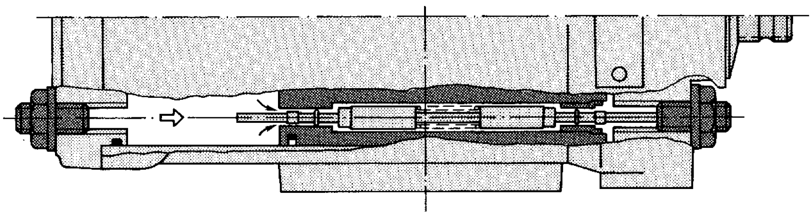
Figure 6



HYDRAULIC STEERING LIMITING (both steering limiting valves are closed)

T. Right steering limiting valve – U. Left steering limiting valve – V. Right cylinder chamber – W. Left cylinder chamber – X. Left adjustment screw – B. Piston – Y. Right adjustment screw.

Figure 7



PISTON RIGHTWARDS DISPLACEMENT (open steering limiting valves, very reduced oil pressure)

Hydraulic steering limiting

Two valves (T and U) are axially arranged in the piston (B, Figure 6) for steering limiting. They are equipped with small spring-loaded pistons, whose stems project from right and left front piston surfaces.

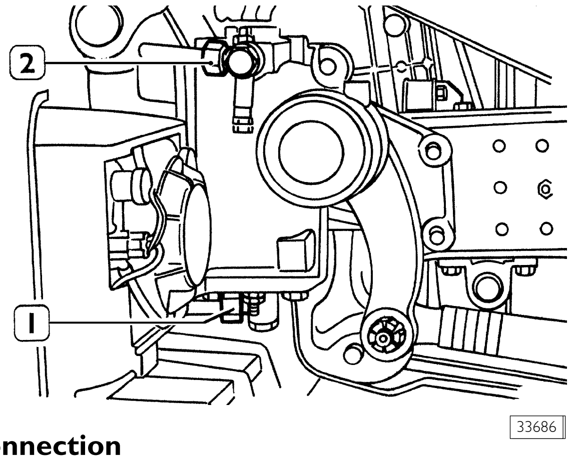
If the piston is rightwards or leftwards displaced along limit stop direction, the stems can reach the adjustment screws (X and Y) in the case and cover, and move. Both limiting valves remain closed till one of the stems touches the adjustment screw. If for example the piston is rightward displaced (Figure 7), the right steering limiting valve (T) is opened by screw (X) before the piston reaches the limit stop.

In such a way, the pressurised oil being present in the left operating cylinder chamber can penetrate into its right chamber, flowing around the displaced valve piston (U) and through the open right valve (T), and then reach the return circuit. If the piston is leftwards displaced, the valve (U) is opened after the pre-established stroke and the pressurised oil in the right cylinder chamber can flow into the return cylinder, thereby reducing the pressure into the circuit chamber.

When the steering limiting valve is open, hydraulic servoassistance is strongly reduced and the steering wheel can be rotated only with a higher effort till wheel or drive stop.

54130 HYDRAULIC POWER STEERING DISCONNECTION AND RECONNECTION (ZF 8095-8098)

Figure 8

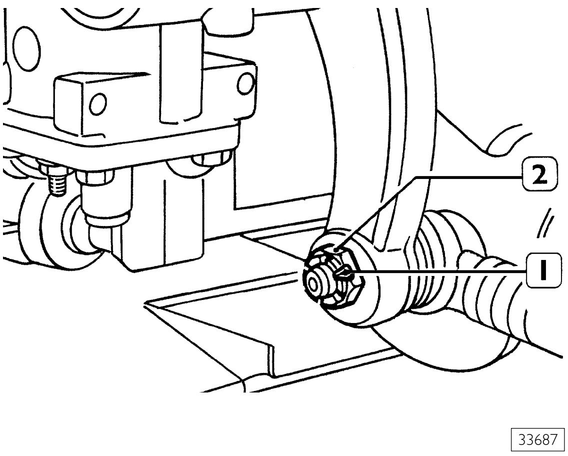


Disconnection

Place a vessel under the hydraulic power steering and remove cover from tank.

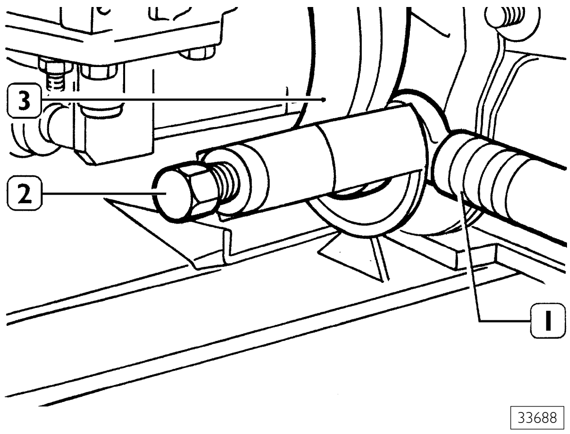
Unscrew fittings (1 and 2) and detach oil delivery and return pipings from hydraulic power steering.

Figure 9



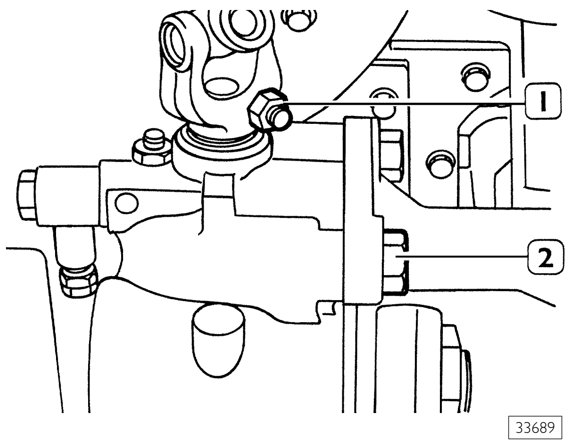
Remove split pin (1) and unscrew nut (2).

Figure 10



Through extractor 99347068 (2) detach tie-rod (1) from lever (3).

Figure 11



Unscrew screw (1) and disconnect connection joint. Unscrew screws (2) securing hydraulic power steering to support.

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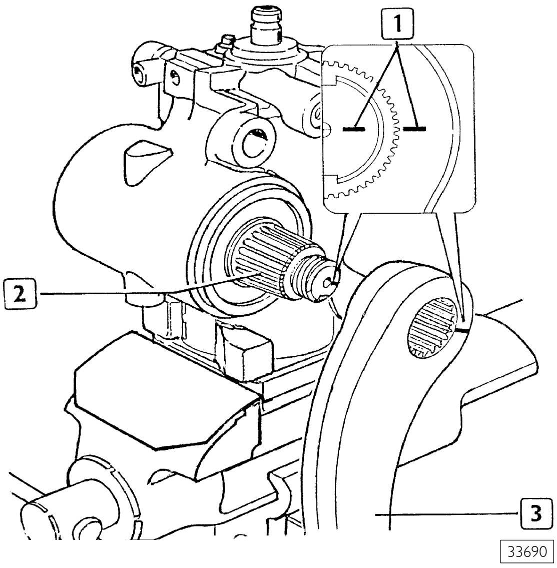
Reconnection

Suitably reverse the operations carried out for the disconnection; tighten the screws at the required tightening torques.

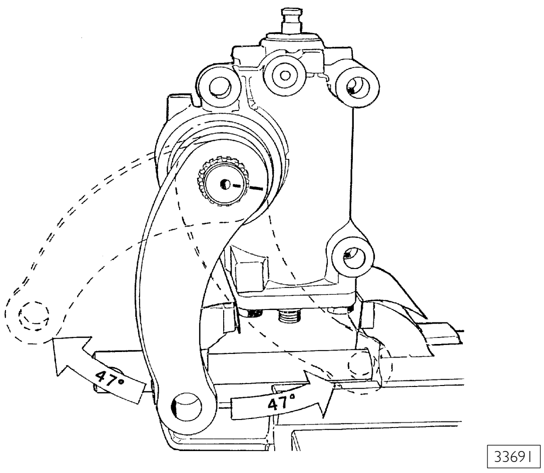
Having to replace the hydraulic power steering with a new one, before its assembling on the support, carry out the following operations.

Figure 12



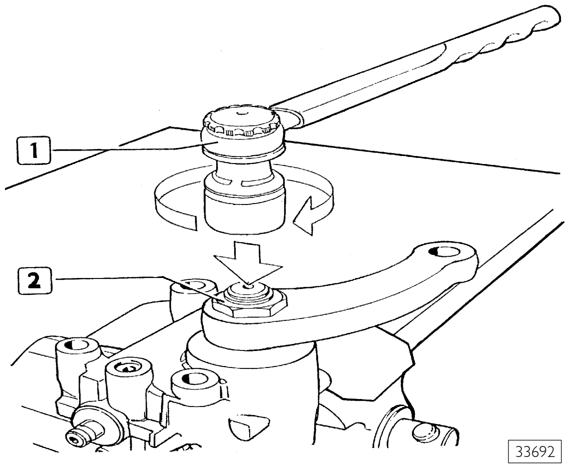
- secure the hydraulic power steering into a vice;
- assemble steering lever (3) making notches (1) align etched on drive shaft (2) and on lever (3);

Figure 13



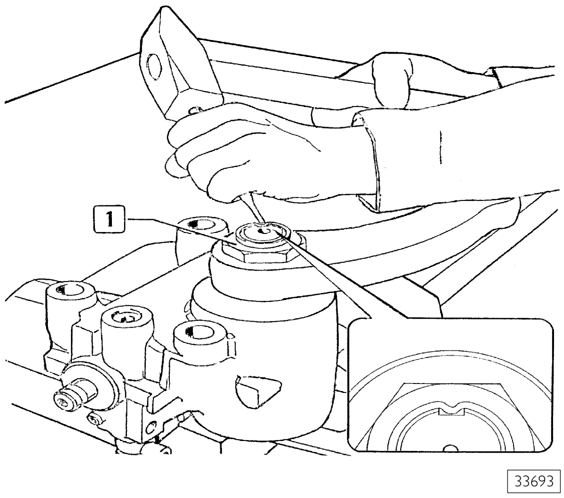
- Check angular lever excursion that must be equal to 47° in both directions;

Figure 14



- lock lever securing nut (2) through a dynamometric wrench (1) at the required torque.

Figure 15



- through a suitable punch, press nut collar (1).

Lubricate with oil all screws securing hydraulic power steering to support.

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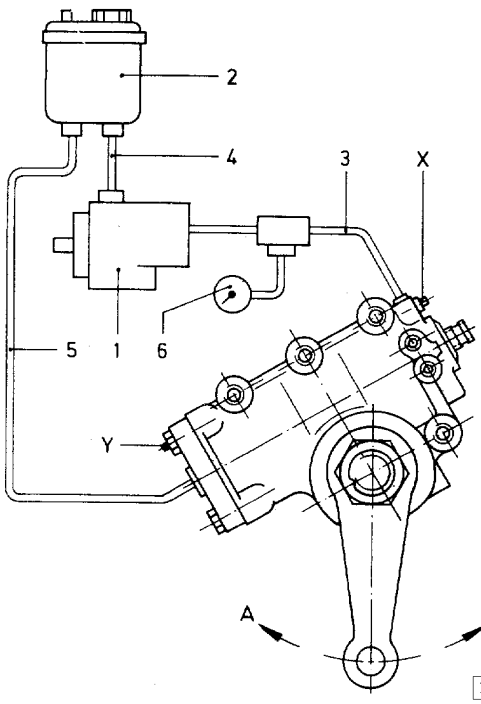
501430 HYDRAULIC STEERING LIMITER ADJUSTMENT

Figure 16



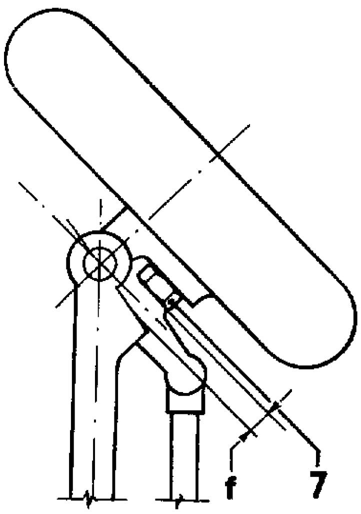
27204

1. Pump – 2. Tank – 3. Delivery piping – 4. Suction piping – 5. Reflow piping – 6. Manometers

X = Hydraulic steering limiting adjustment screw for rotating steering control arm along "A" direction.

Y = Hydraulic steering limiting adjustment screw for rotating steering control arm along "B" direction.

Figure 17



19587

f. Dimension (see table) for the spacer to be interposed between stops – 7. Stop

With the pair of manometers 99374393 already connected on hydraulic power steering delivery piping fitting, abut the front wheels onto rotating plates.

Place a spacer (f, Figure 16) of the shown thickness, see table enclosed below, between wheel stop parts (7).

f SPACER THICKNESS, WITHOUT CODE

	Left wheel	Right wheel
Front mechanical suspension		
No-loaded vehicle	3 mm	6 mm
Full-loaded vehicle	3 mm	3 mm
Front pneumatic suspension		
No-loaded or full-loaded vehicle	3 mm	3 mm

Always with front wheels on rotating plates, start the engine up and keep it at a speed ≤ 1550 revs/min.
Steer till the wheel stops against the spacer; then, go on steering the steering wheel for a few seconds exceeding in such a way the steering valve reaction force till the fixed stop is reached.
In such position the manometer will have to point out an oil pressure equal to 35 ÷ 50 bar.
In order to correct different values, the lock nut is unscrewed and the screw of the corresponding valve (X or Y, Figure 17) is screwed or unscrewed.
During such phase, it is necessary to let the steering wheel free in order to avoid undesired pressure increases.
Then close the lock nut at a torque of 30 ± 5 Nm (3 ± 0.5 kgm); to adjust the second wheel stop, proceed in a similar way.
When the hydraulic power steering moves to A (Figure 17), adjust valve (X), when it moves to B (Figure 17), adjust valve (Y).

When the shown pressure is greater than 50 bar, it is necessary to (clockwise) screw the corresponding steering limiting valve.
When the shown pressure is lower than 35 bar, it is necessary to (counterclockwise) unscrew the corresponding steering limiting valve. At the end of the adjustment, check again the pressure drops along the two steering directions.

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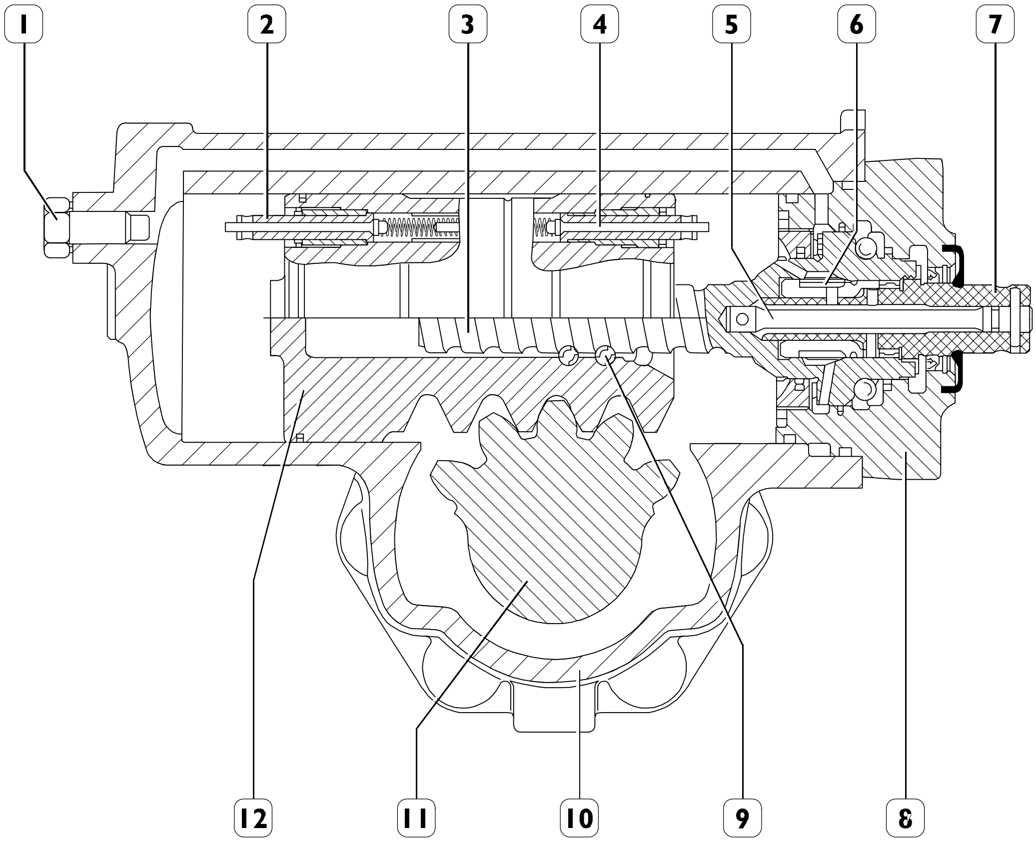
TRW TAS 55 HYDRAULIC POWER STEERING

Figure 18



1. Hydraulic steering limiting adjustment screw – 2. Hydraulic right steering limiting adjustment screw – 3. Worm screw – 4. Hydraulic left steering limiting adjustment screw – 5. Torsion bar – 6. Rotating distributor valve – 7. Entry shaft – 8. Cover – 9. Balls – 10. Hydraulic power steering case – 11. Outlet shaft – 12. Rack piston.

Description

The ball-circulation control hydraulic power steering is essentially composed of a case in which manual steering mechanism, an hydraulic cylinder controlled by a rotating distributor valve, and hydraulic steering and safety limiting valves are housed.

The rotary motion impressed to steering wheel is transmitted from inlet shaft (7) to worm screw (3), through the torsion bar (5).

The worm screw (3) in turn, being connected by means of a set of balls (9) to the rack piston (12), transforms the rotary motion into an axial motion of this latter one.

The piston rack toothing (12) meshes into the toothed-sector shaft toothing and impresses a rotary motion thereto. The steering control arm fixed on this shaft transmits the motion to the wheel steering tie-rods.

This only-mechanical steering movement is servoassisted by the pressurised oil supplied to an engine-actuated blade pump.

If when steering the wheels are subjected to violent impacts, the force created by the same ones is transmitted through outlet shaft (11) to rack piston (12) and from it to worm screw (3). The internal hydraulic power steering system makes the rotary distributor valve (6) send highly pressurised oil into the cylinder chamber where such pressure can fight and absorb the given impact force. In this way no recoils are generated on the steering wheel.

The hydraulic power steering is equipped with an automatic air drain valve.

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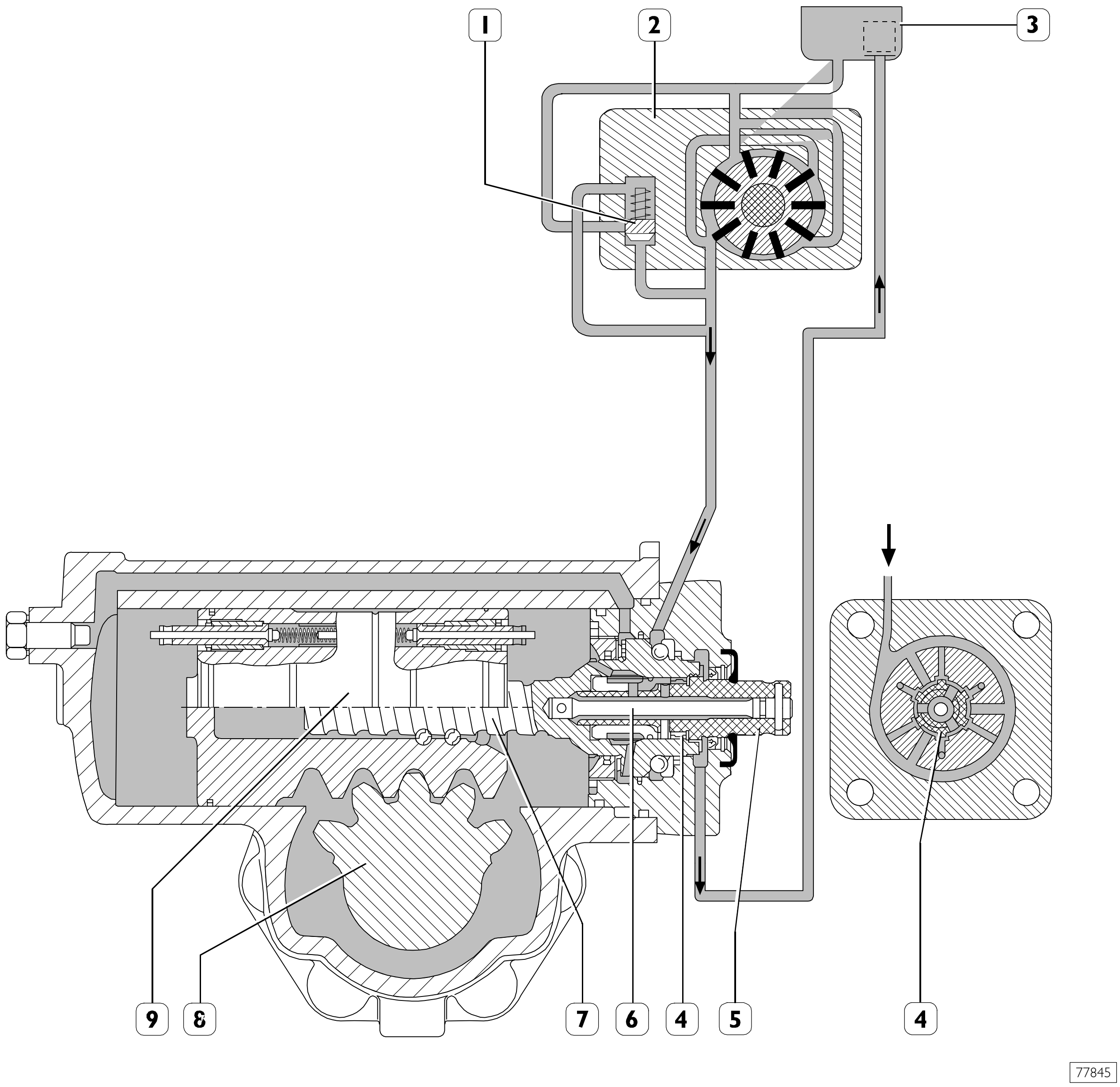
Rectilinear running neutral position

Figure 19

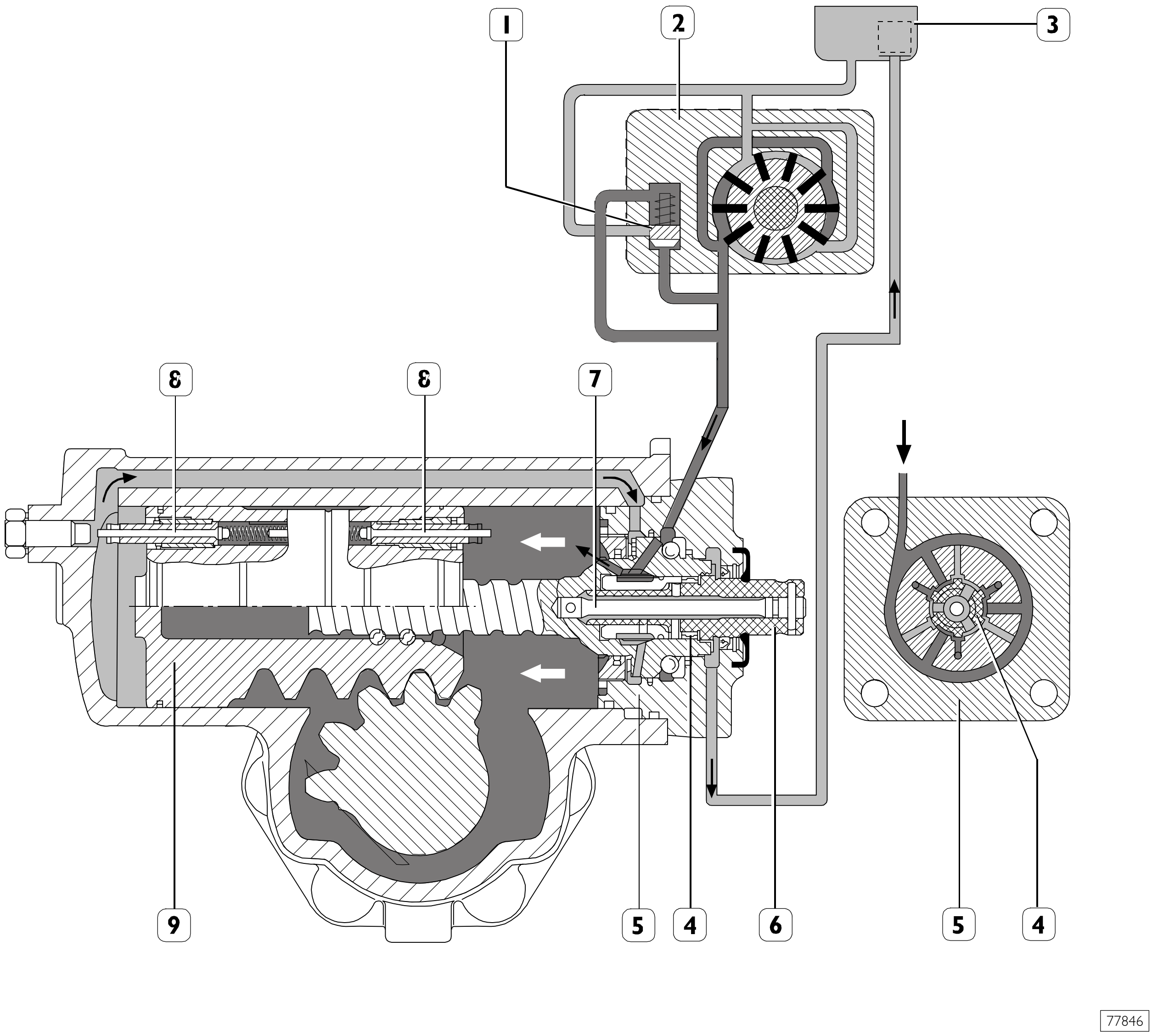


1. Flow rate limiting valve - 2. Blade oil pump - 3. Oil tank - 4. Rotary distributor valve - 5. Inlet shaft - 6. Torsion bar - 7. Worm screw - 8. Outlet shaft - 9. Rack piston.

The rotary distributor valve (4) is keyed-in on the torsion bar (6) connecting inlet shaft (5) to worm screw (7); under rectilinear running conditions, the valve (4) keeps open the communication between incoming oil canalisation from blade pump (2) and oil tank discharge (3) one.

Right steering position

Figure 20



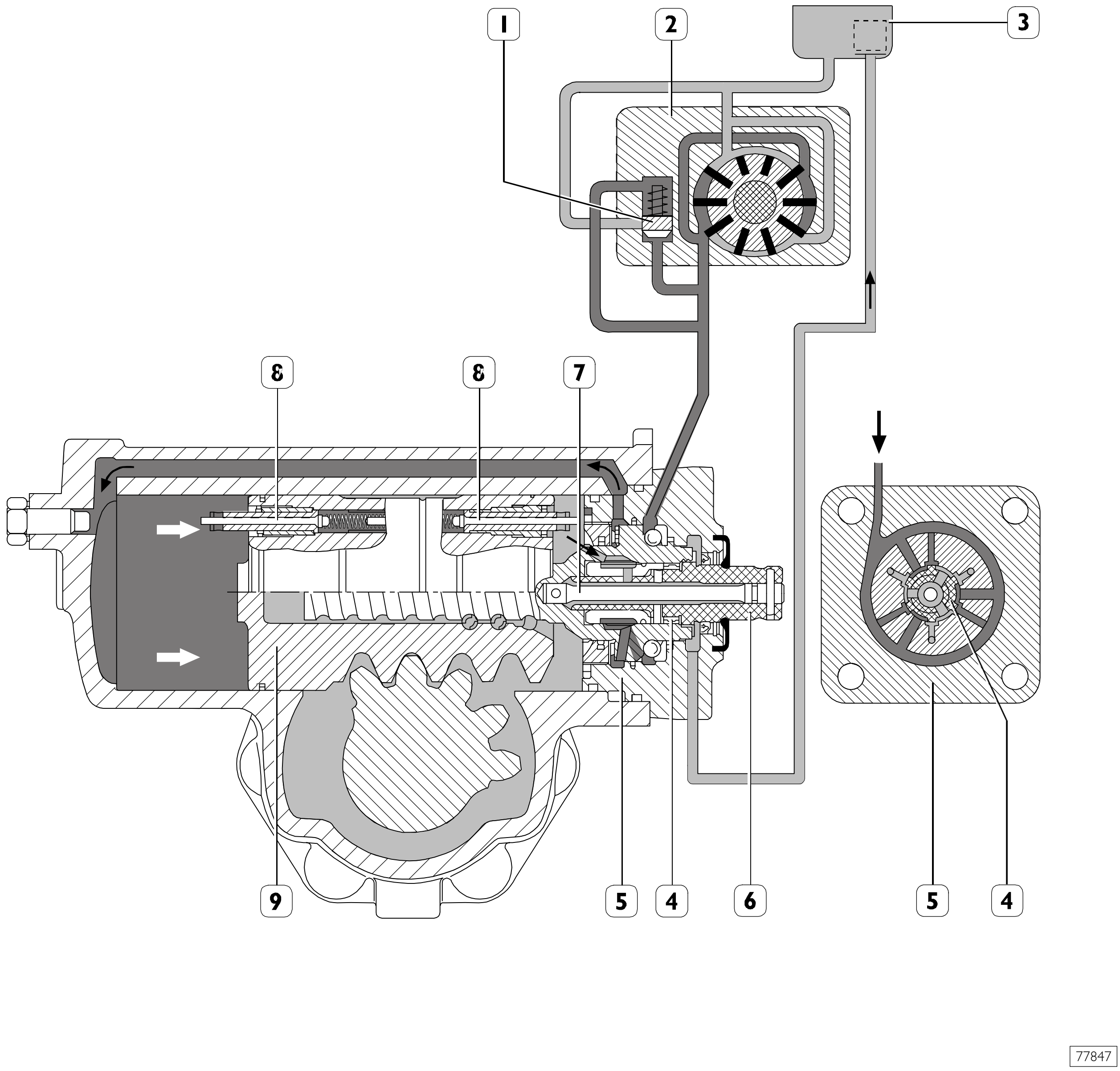
1. Flow rate limiting valve - 2. Blade oil pump - 3. Oil tank - 4. Rotary distributor vale - 5. Valve body - 6. Inlet shaft - 7. Torsion bar - 8. Hydraulic limiting valve - 9. Rack piston.

If when rotating the steering wheel the transmitted torque is lower that the steering wheels resisting torque, torsion bar (7) in its elastic area is subjected to a distortion, so that the rotary distributor (4) integral therewith rotates with respect to valve body (5), passing from neutral condition to operating condition. Consequently, by closing the discharge canalisation and opening the control one, the pressurised oil enters the cylinder chamber affected by steering, generating the axial displacement of the rack piston (9).

This hydraulic servoassistance action is kept till the hydraulic steering limiting valve (8) intervenes or the action on the steering wheel ceases that generated the torsion bar (7) distortion.
In this case, the rotary distributor (4) will be placed again in its neutral condition.
If the hydraulic servoassistance lacks, it is always possible to steer even if with a greater effort on the steering wheel.

Left steering position

Figure 21



1. Flow rate limiting valve - 2. Blade oil pump - 3. Oil tank - 4. Rotary distributor valve - 5. Valve body - 6. Inlet shaft - 7. Torsion bar - 8. Hydraulic limiting valve - 9. Rack piston.

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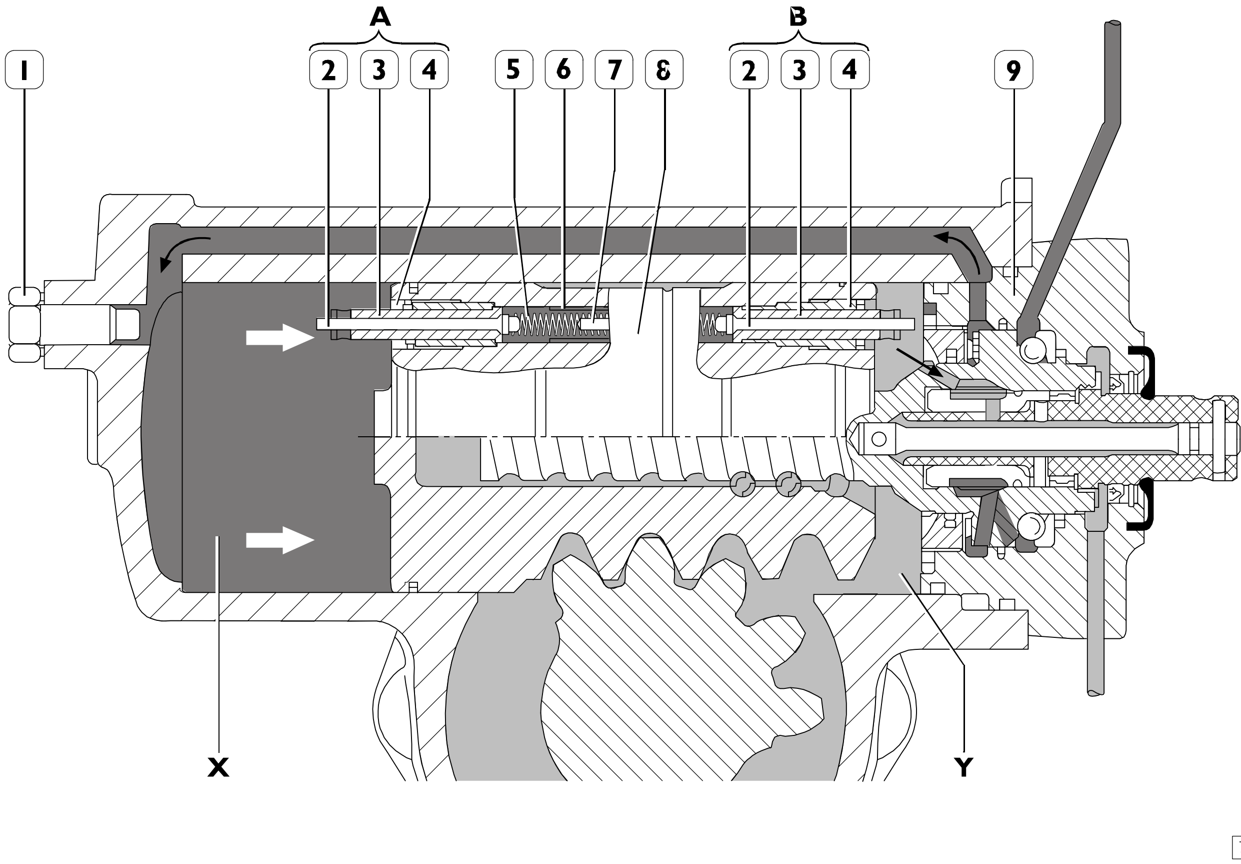
HYDRAULIC STEERING LIMITATION

Figure 22



1. Steering hydraulic limiting screw - A and B steering limiting valve - 2. Small piston - 3. Bush - 4. Valve body - 5. Spring - 6. Thrust sleeve - 7. Spacer pin - 8. Rack piston - 9. Cover - X. Left cylinder chamber - Y. Right cylinder chamber.

The two steering limiting valves **A** and **B** are housed in the rack piston (8) end.

They are composed of a valve body (4) inside which valve intervention adjustment bush (3) is placed, with a forced coupling, such valve in turn operating as small piston (2) seat. Small pistons (2) are kept in their closing position on bushes (3) by counter-spring (5). Valves **A** and **B** are kept closed till small pistons (2) stems are taken in contact by the rack piston displacement:

- ❑ with adjustment screw (1) if the displacement is towards the left;
- ❑ with cover (9) if the displacement is towards the right.

Consequently, the pressurised oil present in the affected chamber will pass through the valve **A** or **B** opening in the opposite chamber and from there it will be discharged into the tank.

⚠ The figure shows the left steering condition.

When the hydraulic limiting valve is open, the hydraulic servoassistance is highly reduced, and consequently it will be necessary to exert a higher force on the steering wheel in order to continue to steer till it stops.

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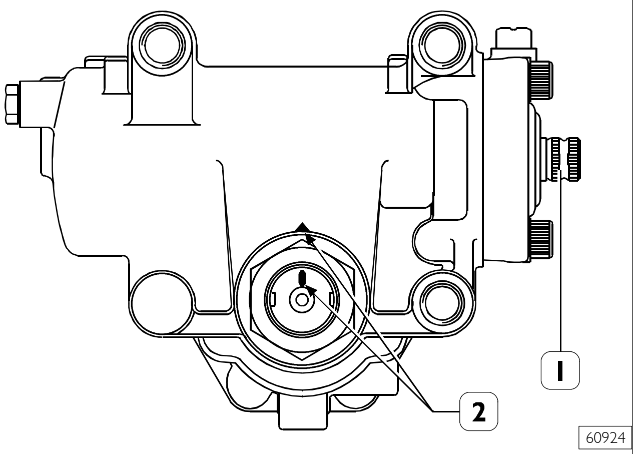
541430 HYDRAULIC POWER STEERING DISCONNECTION AND RECONNECTION (TRW TAS 55)

For disconnecting and reconnecting the TRW TAS 55 hydraulic power steering, comply with the procedure disclosed for ZF 8095 - ZF 8098 hydraulic power steering.

Automatic adjustment setting of hydraulic steering limitation for TRW TAS 55 hydraulic power steering

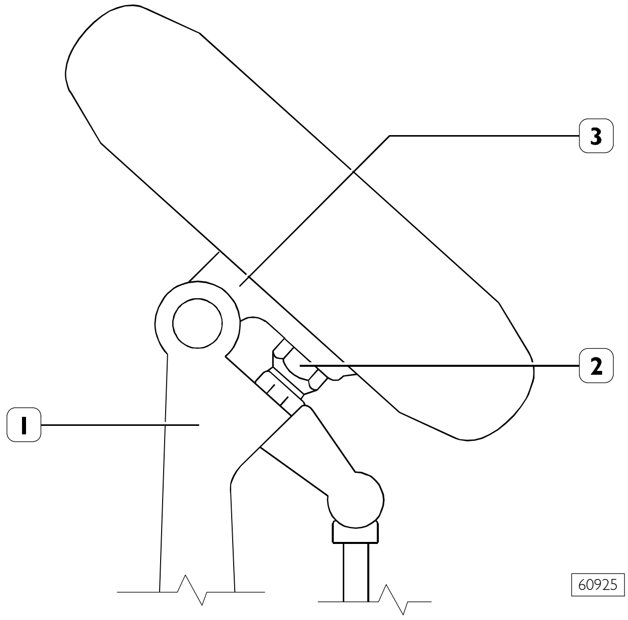
Figure 23



In case of an hydraulic power steering detached from the vehicle, the outlet shaft rotation must not exceed 29° (equal to 1.3 revolutions of the inlet shaft (1)) with respect to center drive position marked by references (2).

The adjustment is carried out after having assembled the hydraulic power steering on the vehicle, with unloaded vehicle and lifted front wheels. Moreover both right steering and left steering must be performed operating as follows.

Figure 24



Make sure that the gearbox is idle.
Start the engine up and keep it at a rotation speed that is ≤ 1500 revs/min.
Rotate the steering wheel along a direction, applying thereto a 34 Nm torque till the stop screw (2) assembled on the stub axle (3) is taken in contact with front axle (1).
In this way bush (4, Figure 18) will go back with respect to valve body (5, Figure 18) of affected steering limiting valve. The position that bush (4, Figure 18) will get will make the hydraulic pressure discharged inside the affected chamber before screw (2, Figure 18) comes in contact with front axle (1), safeguarding hydraulic system components.
Repeat the same procedure steering to the opposite side.

Automatic adjustment check

The automatic adjustment check is carried out with full-loaded vehicle moving and at low speed, both in right and in left steerings, operating as follows.
Rotate the steering wheel along a direction till the absence of hydraulic interlock is detected.
From this condition verify that the steering wheel rotation to reach the steering stop (screw (2) in contact with front axle (3)) is included between 60° and 120°.
Repeat the same procedure by steering along the opposite direction.
When detecting different values, operate as described in the following chapter "Manual hydraulic drops adjustment".

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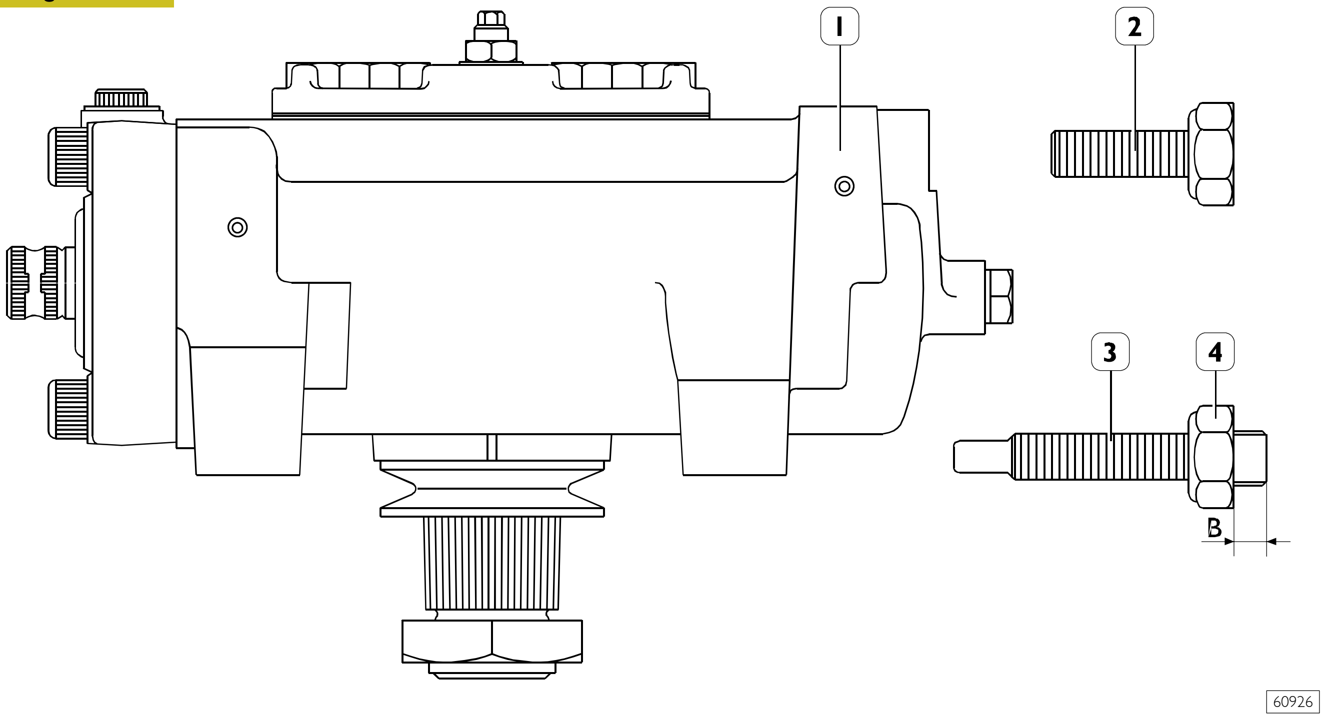
Hydraulic drops adjustment

Lift the vehicle from its front side, arrange the steering wheels under straight running conditions and verify that references (2, Figure 23) showing the drive center coincide.

> ⚠ The vehicle must be unloaded.

Figure 25



Arrange under the hydraulic power steering (1) next to screw (2) a vessel to collect the possible oil outflow, unscrew screw (2) itself and screw screw (3) equipped with spare part completed with nut (4).

> ⚠ Screw (3) must be screwed till distance B is 0 mm.

For left-drive vehicles, steer the wheels rightwards by applying to the steering wheel a torque that is ≤ 54 Nm (vice versa for right-hand drive), till stop screw (2, Figure 24) is taken in contact with front axle (1, Figure 24).
Take wheel in straight running conditions verifying that references (2, Figure 23) showing the drive center coincide.
Unscrew screw (3) so that distance B is 20-22 mm and lock nut (4) at the required torque.
Top-up the tank till the provided oil level is reached.

Make sure that gearbox is idle.
Start the engine up and keep it at a rotation speed that is ≤1500 revs/min.
Rotate the steering wheel by applying thereto a torque that is ≤ 34 Nm; leftwards for left-drive vehicles or vice versa for right-drive vehicles, till the steering stop is reached and keep it under such position.
Stop the engine.
Loosen nut (4) and screw, using a dynamometric wrench, screw (3) till a torque increase by 1.1 ÷ 2 Nm is detected.

> ⚠ When screwing screw (3) keep nut (4) unmoving.

Under the above condition, unscrew screw (3) by 2.5 revolutions and lock nut (4) at the required torque.
Carry out the automatic adjustment check as described in the related chapter.

501430 AIR DRAIN FROM HYDRAULIC POWER STEERING CIRCUIT

Carry out the air drain from hydraulic power steering circuit proceeding as follows:

- ❑ fill with required oil (TUTELA GI/A) the circuit tank;
- ❑ rotate the engine with the starter and top-up the oil continuously in order to avoid that the pump sucks air. Top-up the oil till its level does not go below the upper rod mark;
- ❑ start the engine up and rotate it at minimum speed checking that the oil level does not go below the upper rod sign;
- ❑ rotate the steering wheel many times from stop to stop so that air cannot go out of the hydraulic power steering cylinder till no air bubbles are noted incoming into the tank;
- ❑ accelerate the engine at its maximum, stop it and check that the oil level in the tank does not rise more than 1 ÷ 3 cm.

Hydraulic power steering oil level restoration

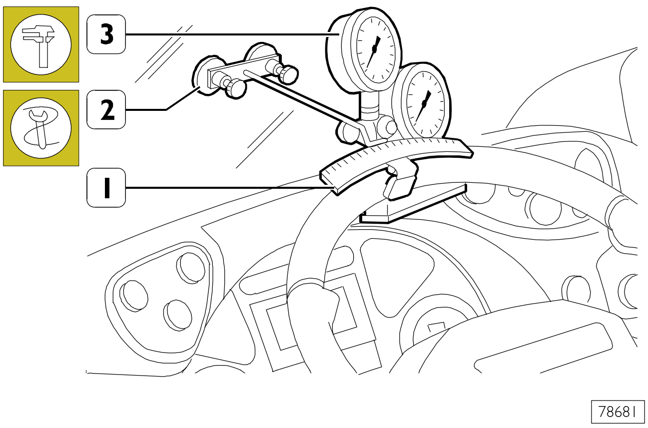
The oil level check must be carried out with **moving engine** verifying that the level corresponds to the "MAX" indication included on the tank side.

Under **off engine** conditions, the level, due to the backup of oil contained in the upper tank part, will be able to exceed the "MAX" indication by two millimeters.

501430 MEASURE OF DRIVE CASE CLEARANCES DETECTED ON STEERING WHEEL

Check that there are no mechanical clearances in the related connecting tie-rods.
Lock the left wheel under straight running position with suitable shims on coupling bar; lift the front axle.

Figure 26



Arrange on the windscreen, through a suction cup, a fixed index (2) and the millimeter sector (1) on the steering wheel. Arrange the pair of manometers 99374393 (3) from 0 to 10 and from 0 to 160 bar, mutually connected by means of a short-circuit valve.

Connect the piping of the pair of manometers on the hydraulic power steering oil delivery piping fitting.
Possibly restore the oil level.
Start the engine up at its minimum speed and read on the manometer from 0 to 10 bar the pressure value at that time.
Slowly rotate the steering wheel leftwards till the previously-read pressure value is increased by 1 bar, keep the steering wheel unmoving and mark on the millimeter scale 99374398 the reached value in mm.

Rotate the steering wheel rightwards till a 1 bar pressure increase is again obtained; read what the scale 99374398 is marking, sum the two left steering plus right steering values: the sum must not exceed 40 mm.
Lower the front axle.

MAXIMUM PRESSURE CHECK IN HYDRAULIC POWER STEERING SYSTEM

With the pair of manometers 99374393 already previously connected and the wheel on drive side locked with suitable shims, start the engine up at its minimum speed, steer along one direction with an effort of 10 ÷ 20 kg on the steering wheel and measure the pressure on the manometer from 0 to 160 bar.
Carry out the same operation by steering along the opposite direction; if the detected values are different from the required ones, search for their cause.

⚠ The maximum pressure value can be detected by the ZF or TRW plate applied onto the drive case.

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SECTION 11

Pneumatic System – Brakes

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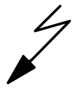
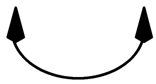
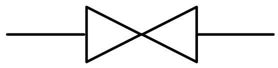
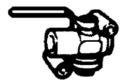
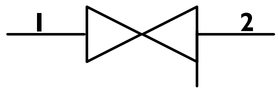
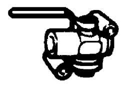
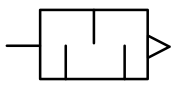
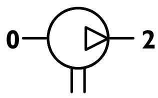
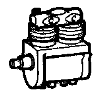
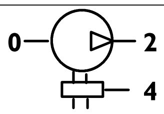
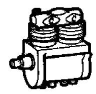
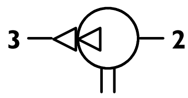
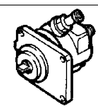
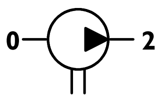
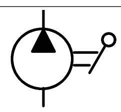
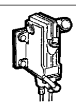
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (MISCELLANEOUS AND GENERATORS)

DENOMINATION	SYMBOL	
HYDRAULIC FLOW		
PNEUMATIC FLOW		
ELECTRIC DUCT		
POSSIBLE ROTATION		
CROSSING OF CONNECTED DUCTS		
PRESSURE CONTROL TAP		
QUICK CONNECTION FITTING		
COCK		
COCK WITH DISCHARGE		
SILENCER		
COMPRESSOR		
ENERGY SAVING COMPRESSOR		
VACUUM PUMP		
HYDRAULIC PUMP		
MANUAL HYDRAULIC PUMP		

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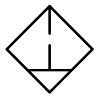
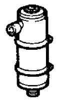
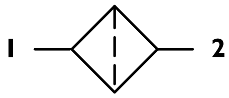
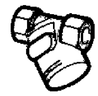
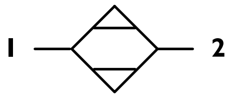
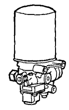
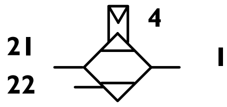
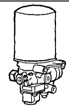
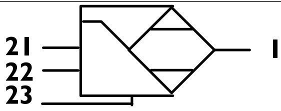
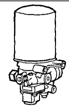
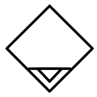
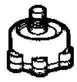
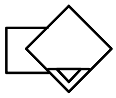
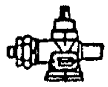
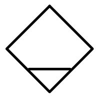
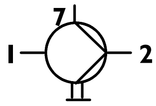
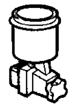
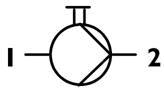
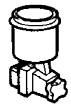
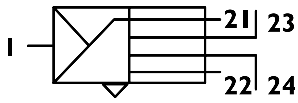
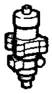
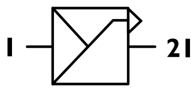
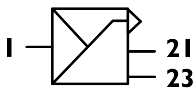
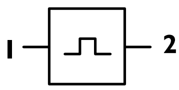
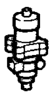
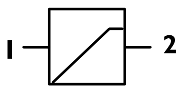
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
CONDENSATE SEPARATOR		
FILTER		
DRIER		
DRIER		
DRIER WITH INTEGRATED REGULATOR		
AUTOMATIC CONDENSATE DRAIN VALVE		
DRIVEN CONDENSATE DRAIN VALVE		
MANUAL CONDENSATE DRAIN VALVE		
DRIVEN ANTIFREEZER		
AUTOMATIC ANTIFREEZER		
PRESSURE REGULATOR WITH INDEPENDENT CIRCUIT		
PRESSURE REGULATOR		
PRESSURE REGULATOR		
PRESSURE REGULATOR (GOVERNOR)		
PRESSURE LIMITING VALVE		

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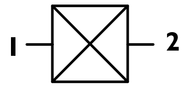
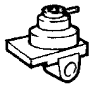
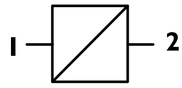
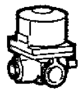
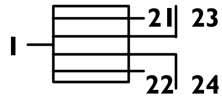
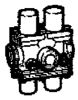
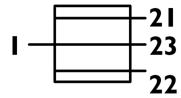
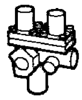
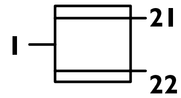
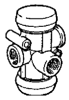
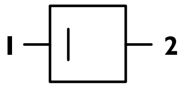
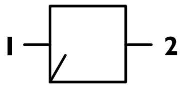
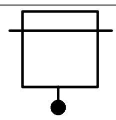
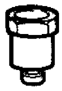
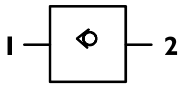
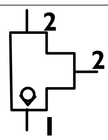
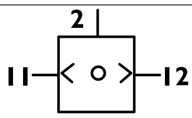
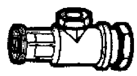
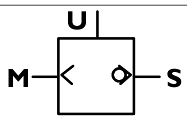
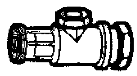
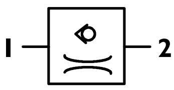
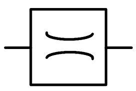
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
PROPORTIONAL REDUCTION VALVE		
ADAPTER VALVE		
4-CIRCUIT PROTECTION VALVE		
3-CIRCUIT PROTECTION VALVE		
2-CIRCUIT PROTECTION VALVE		
AIR INTAKE VALVE WITHOUT RETURN		
AIR INTAKE VALVE WITH LIMITED RETURN		
SAFETY VALVE		
CHECK VALVE		
CHECK VALVE		
DOUBLE STOP VALVE		
DOUBLE DIFFERENTIAL STOP VALVE		
THROTTLING VALVE WITH QUICK RETURN		
THROTTLING VALVE		

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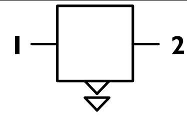
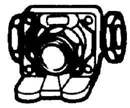
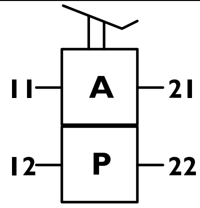
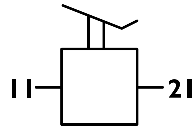
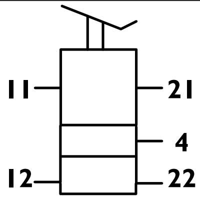
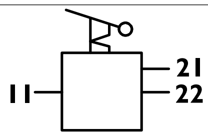
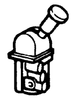
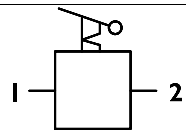
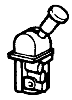
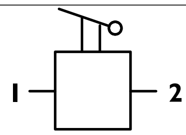
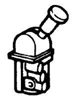
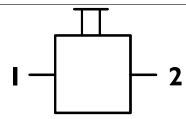
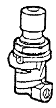
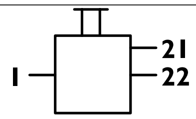
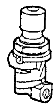
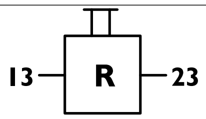
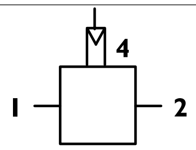
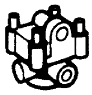
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
QUICK EXHAUST VALVE		
BRAKE CONTROL DISTRIBUTOR		
BRAKE CONTROL DISTRIBUTOR		
BRAKE CONTROL DISTRIBUTOR		
PARKING BRAKE CONTROL DISTRIBUTOR		
PARKING BRAKE CONTROL DISTRIBUTOR		
BRAKE DISTRIBUTOR		
CONTROL DISTRIBUTOR		
CONTROL DISTRIBUTOR		
DECELERATOR CONTROL DISTRIBUTOR		
SERVODISTRIBUTOR		

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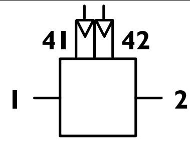
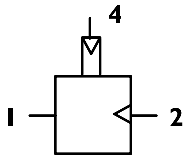
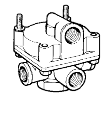
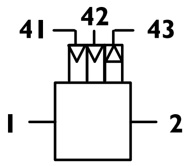
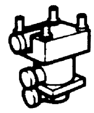
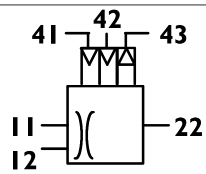
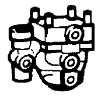
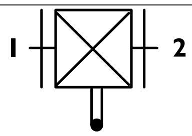
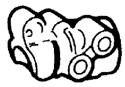
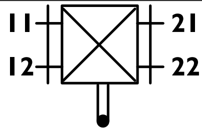
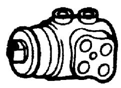
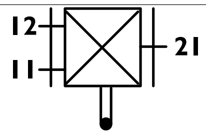
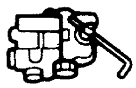
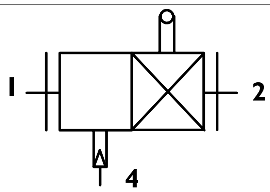
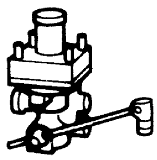
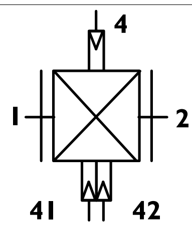
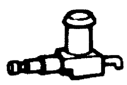
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
SERVODISTRIBUTOR		
SERVODISTRIBUTOR FOR MONO-DUCT		
TRAILER TRIPLE BRAKE CONTROL VALVE		
TRAILER TRIPLE BRAKE CONTROL VALVE WITH EMBEDDED SERVOSWITCH		
BRAKE CORRECTOR		
DOUBLE BRAKE CORRECTOR		
BRAKE CORRECTOR WITH BY-PASS		
BRAKE CORRECTOR WITH INTEGRATED RELAY		
BRAKE CORRECTOR WITH INTEGRATED RELAY WITH PNEUMATIC CONTROL		

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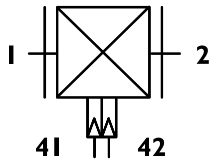
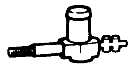
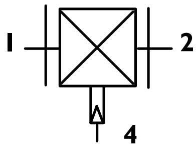
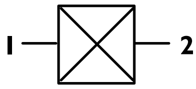
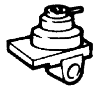
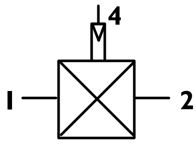
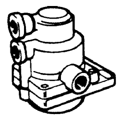
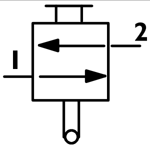
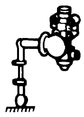
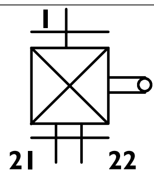
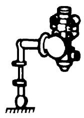
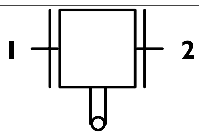
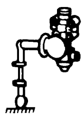
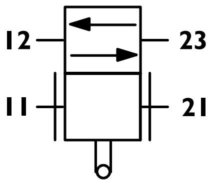
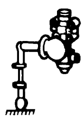
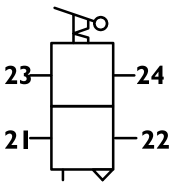
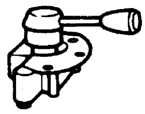
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
BRAKE CORRECTOR WITH PNEUMATIC CONTROL		
BRAKE CORRECTOR WITH PNEUMATIC CONTROL		
PROPORTIONAL REDUCTION VALVE		
INTERLOCKED PROPORTIONAL REDUCTION VALVE		
STROKE LIMITING VALVE		
LEVELLING VALVE		
LEVELLING VALVE		
LEVELLING VALVE WITH INTEGRATED STROKE LIMITER		
MANUAL SUSPENSION-LIFTING CONTROL VALVE		

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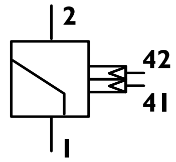
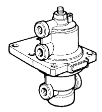
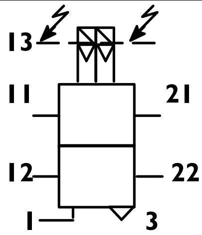
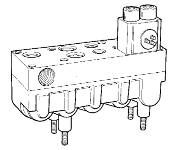
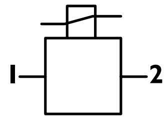
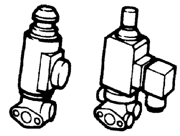
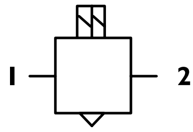
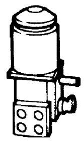
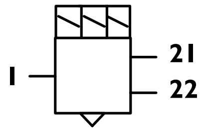
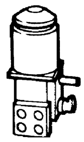
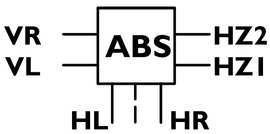
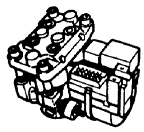
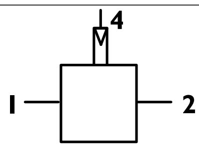
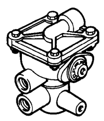
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (VALVES)

DENOMINATION	SYMBOL	
GRADUAL CONTROL VALVE		
MANUAL ELECTRIC CONTROL SUSPENSION CONTROL VALVE		
ELECTRO-PNEUMATIC VALVE		
ELECTRO-PNEUMATIC VALVE		
ELECTRO-PNEUMATIC VALVE		
HYDRAULIC ABS MODULATOR		
POWERING VALVE		

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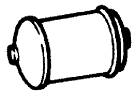
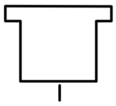
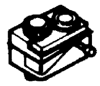
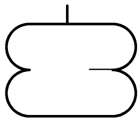
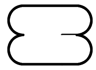
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (TANKS AND ACCUMULATORS)

DENOMINATION	SYMBOL	
COMPRESSED AIR TANK		
BRAKE FLUID TANK		
AIR SPRING		

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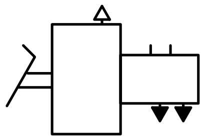
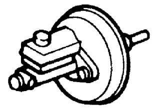
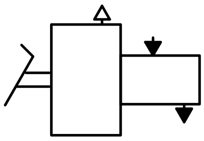
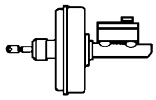
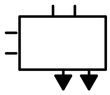
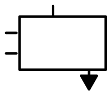
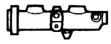
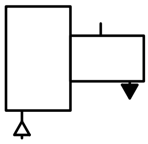
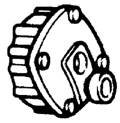
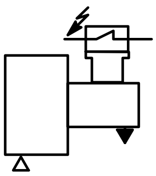
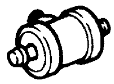
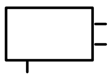
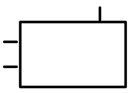
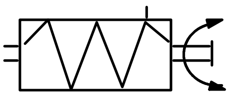
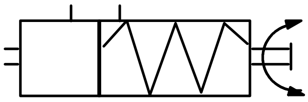
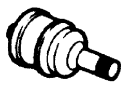
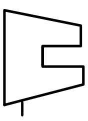
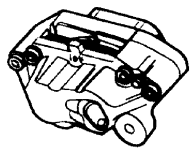
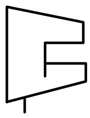
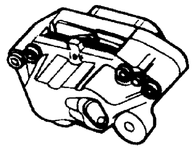
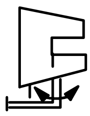
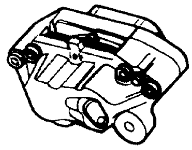
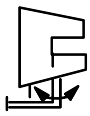
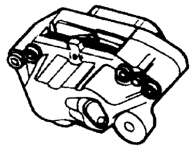
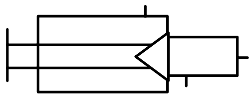
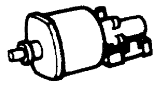
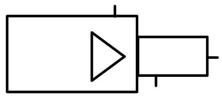
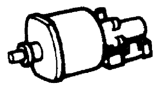
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (CONVERTERS, CYLINDERS AND CALIPERS)

DENOMINATION	SYMBOL	
VACUUM SERVOBRAKE		
VACUUM SERVOBRAKE		
DOUBLE CIRCUIT MASTER CYLINDER		
SIMPLE CIRCUIT MASTER CYLINDER		
PNEUMO-HYDRAULIC CONVERTER		
PNEUMO-HYDRAULIC CONVERTER		
HYDRAULIC BRAKE CYLINDER		
OPERATOR CYLINDER		
BRAKE CYLINDER		
SPRING CYLINDER		
COMBINED BRAKE CYLINDER		
FIXED DISC BRAKE CALIPER		

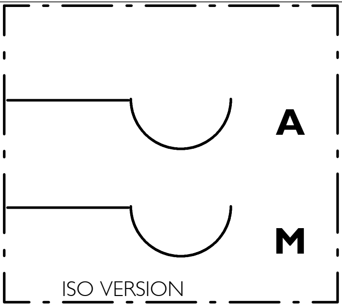
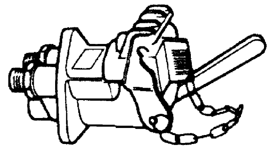
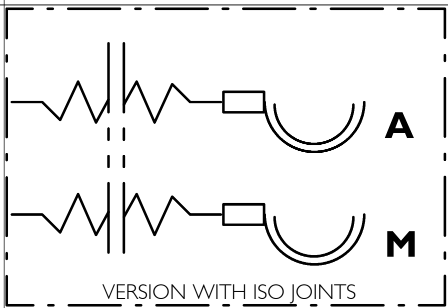
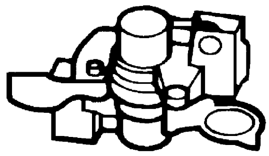
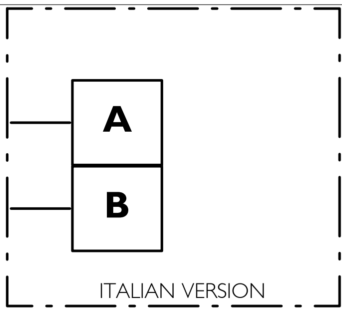
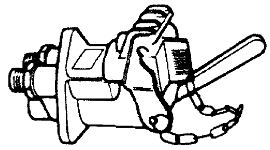
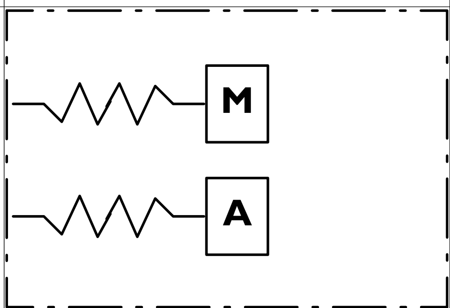
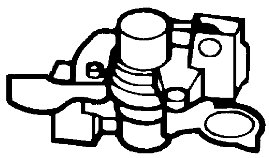
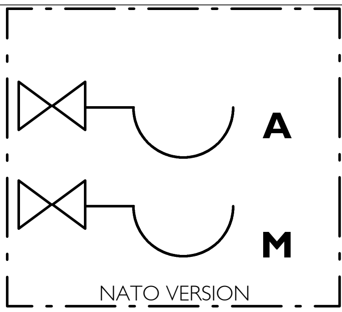
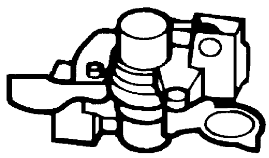
32790 32791

GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (CYLINDERS AND CALIPERS)

DENOMINATION	SYMBOL	
FLOATING DISC BRAKE CALIPER		
FLOATING DISC BRAKE CALIPER WITH PARKING		
MECHANICAL FLOATING DISC BRAKE CALIPER		
SERVOCLUTCH		
SERVOCLUTCH		

32791

GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (COUPLING HALF-JOINTS AND HEADS)

DENOMINATION	SYMBOL	
“ISO” HALF-COUPLING		
“ISO” HALF-COUPLING		
“CUNA” HALF-COUPLING		
“CUNA” HALF-COUPLING		
“NATO” HALF-COUPLING		

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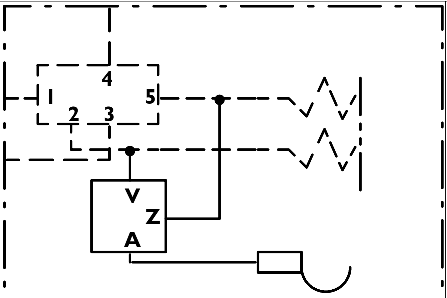
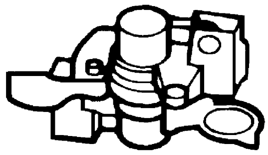
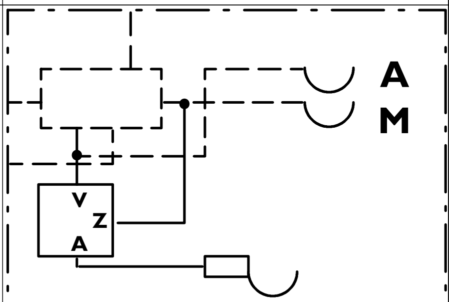
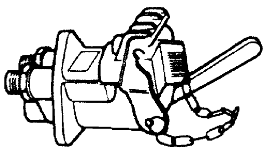
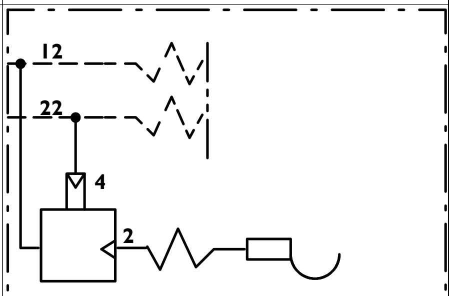
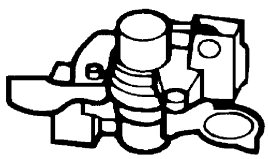
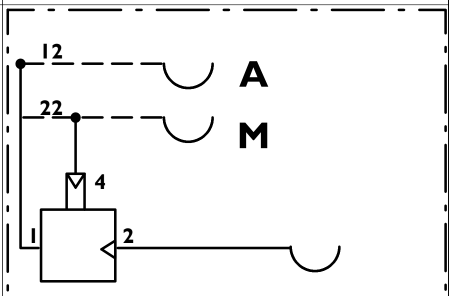
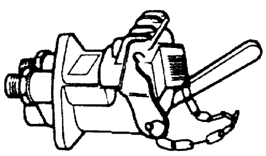
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (COUPLING HALF-JOINTS AND HEADS)

DENOMINATION	SYMBOL	
HALF-COUPLING	 VERSION WITH MONO-DUCT	
HALF-COUPLING	 VERSION WITH MONO-DUCT	
HALF-COUPLING	 VERSION WITH MONO-DUCT	
HALF-COUPLING	 VERSION WITH MONO-DUCT	

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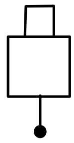
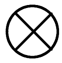
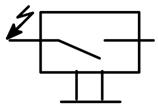
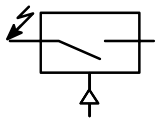
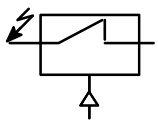
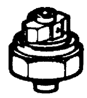
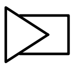
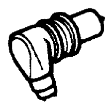
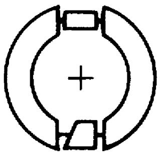
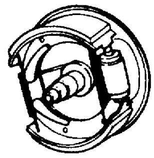
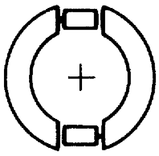
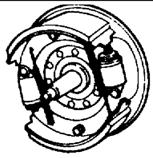
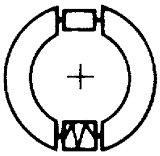
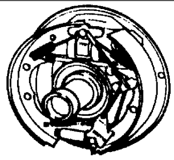
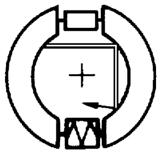
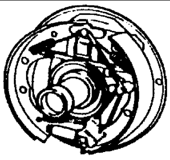
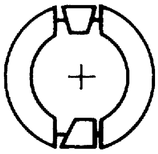
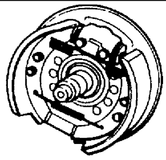
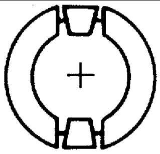
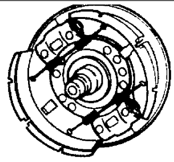
GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (SIGNALING DEVICES AND SWITCHES)

DENOMINATION	SYMBOL	
MANOMETER		
MANOMETER		
PRESSURE TRANSMITTER		
LAMP		
MECHANICAL CONTROL SWITCH		
PRESSURE SWITCH		
LOW PRESSURE SWITCH		
HOOTER		
SENSOR		

32794

GRAPHIC SYMBOLS FOR HYDROPNEUMATIC SYSTEMS DIAGRAMS (BRAKES)

DENOMINATION	SYMBOL	
SIMPLEX HYDRAULIC BRAKE		
DUPLEX HYDRAULIC BRAKE		
DOUBLE-SERVO HYDRAULIC BRAKE		
DOUBLE-SERVO HYDRAULIC BRAKE WITH PARKING		
SIMPLEX WEDGE BRAKE		
DOUBLE-DUPLEX WEDGE BRAKE		

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799512 PIPINGS AND FITTINGS

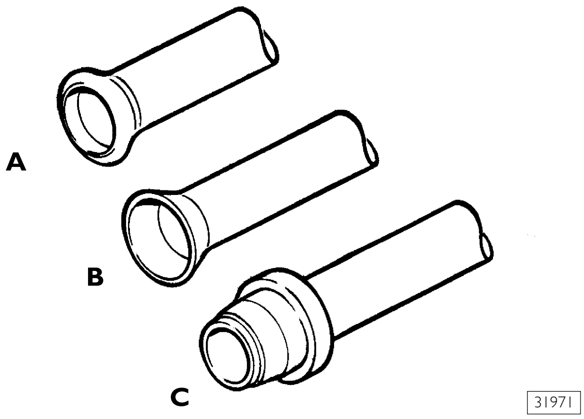
In general

Hydraulic system pipings for industrial vehicles are currently of two types:

- Flexible ones made of polyamide with single-layered or double-layered structure and in the following diameters (∅ 6-8-10-12-16 mm) equipped with spares in meters
- Rigid metal pipings in the following diameters (∅ 4.75-6.35-8-10-12 mm). Pipings from ∅ 4.75 to ∅ 10 mm are supplied as spares in straight 4-5-6 m crop ends, while those exceeding 10 mm are supplied as spares already cut, bent and reflanged.

Rigid pipings reflanging

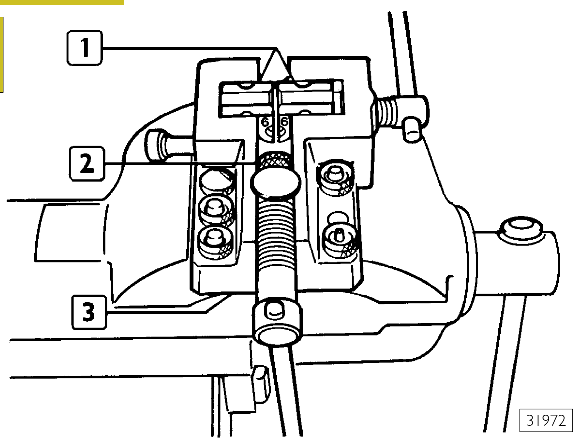
Figure 1



RIGID PIPINGS REFLANGING REPRESENTATION

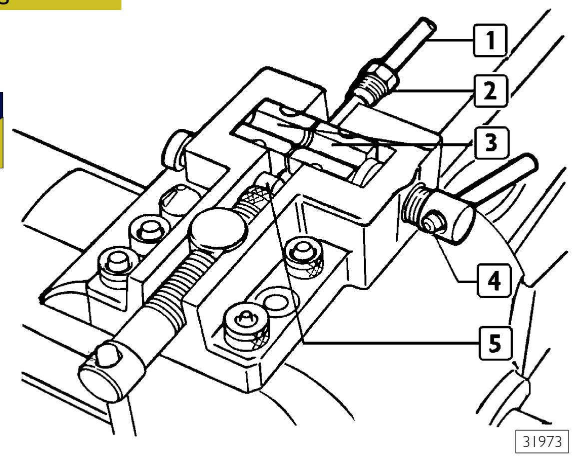
Reflanging type A

Figure 2



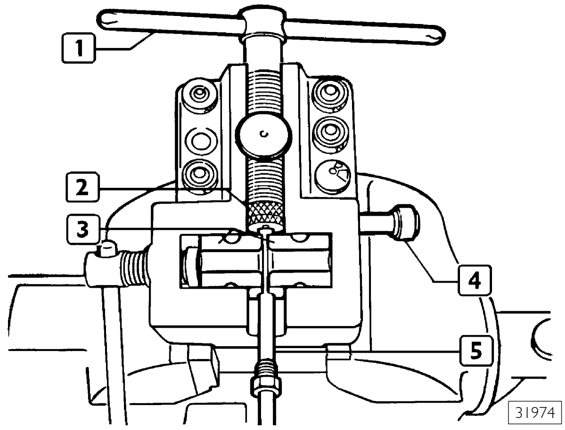
Arrange on a press 99386523 (3) small blocks (1) so that the punched numbers, showing the piping number to be worked, are facing the matrix die (2). The choice of the matrix die (2) depends on the diameter of the piping to be reflanged. Moreover, on every matrix die (2) the diameter of the piping is punched for which the same one can be used.

Figure 3



Burr piping (1), insert union (2) and place it between small blocks (3) abutting pin (5). Lock piping (1) with screw (4).

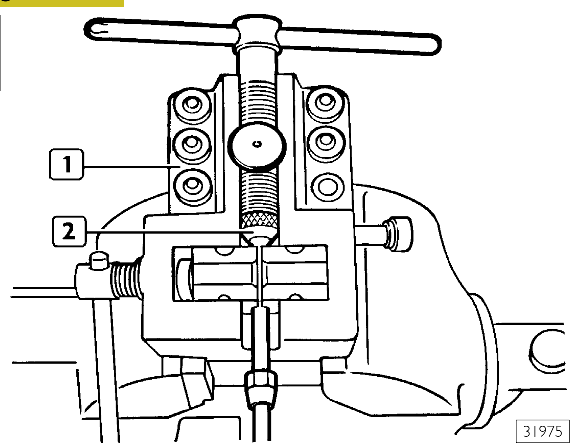
Figure 4



Take back pin (4) to its neutral position. Screw screw (1) till matrix die (2) comes to abut against small blocks (3) thereby shaping the piping (5) end.

Reflanging type B

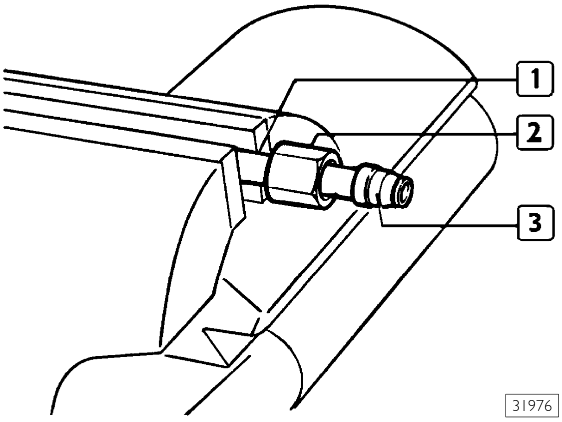
Figure 5



Assemble matrix die (2) on press 99386523 (1).
For the reflanging process comply with what has been stated above for reflanging type A.

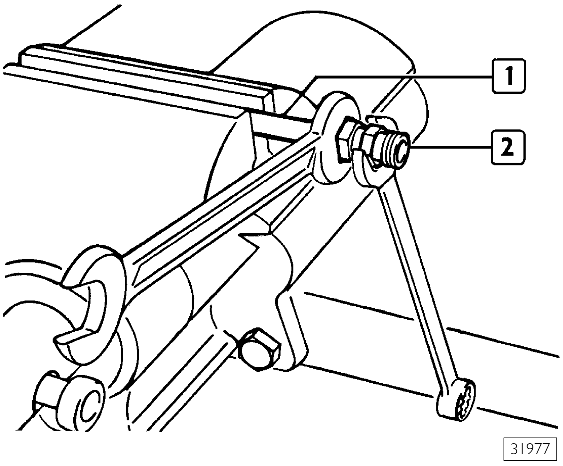
Reflanging type C

Figure 6



Key on piping (1) nut (2) and ring (3).

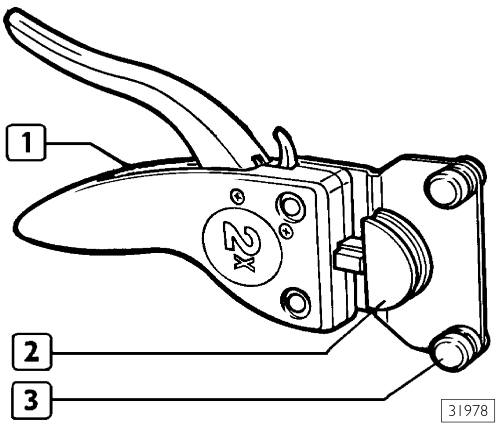
Figure 7



Assemble union (2) and tighten so that ring (3, Figure 6) is locked on piping (1).

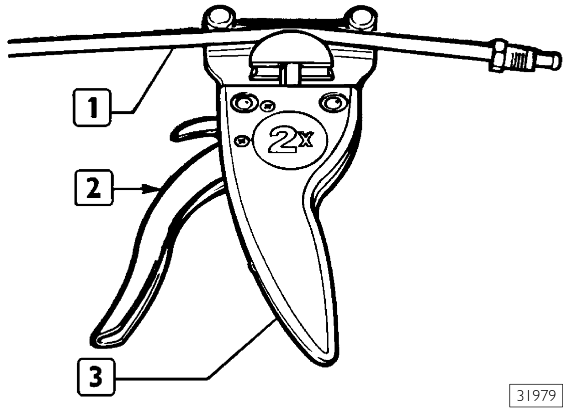
Rigid pipings bending

Figure 8



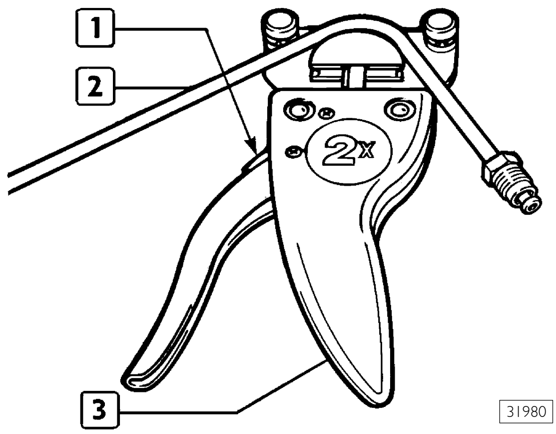
Assemble tool (1) 99386523 choosing parts (2) and (3) depending on the diameter of pipings to be bent.

Figure 9



Place piping (1) into tool (3) and operating on lever (2) bend the piping.

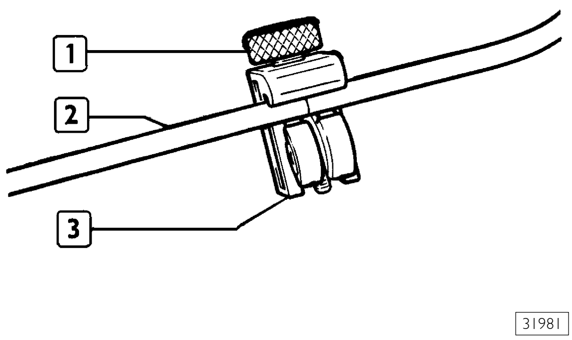
Figure 10



In order to free piping (2) from tool (3), operate on lever (1).

Rigid pipings cutting

Figure 11



Place piping (2) into tool (3) 99386523 and tighten screw (1). Keeping piping (2) still, rotate tool (3) till the piping is completely cut.

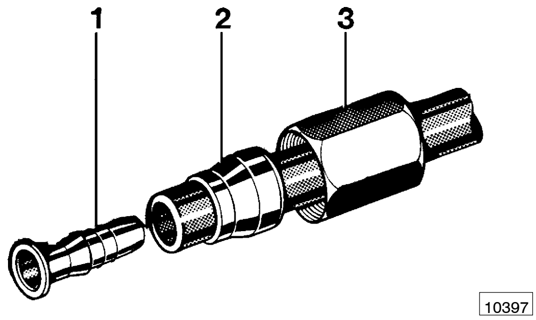
After having cut the piping, burr and shape the end as previously described.

Rotating tool (3) around piping (2), screw (1) is loosened. In order to completely cut the piping, it is then necessary to tighten screw (1) when it loosening.

Flexible pipings replacement with threaded fittings

Strictly comply with the following instructions:

Figure 12

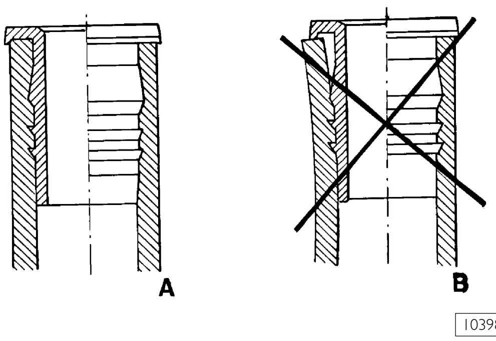


- ❑ Use homologated pipes only;
- ❑ Check the spare pipe status, on which no cracks, cuts or nickings must be detected;
- ❑ Cut the pipe at 90° with respect to the axis through a suitable pipe-cutting pliers 99387050 at the necessary length;

Insert on the pipe in the following order:

- ❑ nut (3), pressure ring (2) (its greater thickness must be facing nut (3) and reinforcement bush (1);
- ❑ the bush must be in perfect conditions (it must not have either distortions or hammering traces);

Figure 13



REINFORCEMENT BUSH ASSEMBLY
A = CORRECT ASSEMBLY
B = WRONG ASSEMBLY

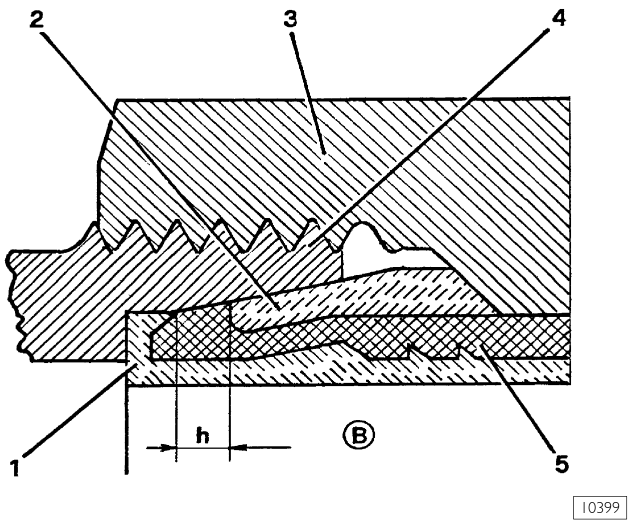
- ❑ Key the reinforcement bush with tool 99372219 guaranteeing the contact between its flange and the pipe end;
- ❑ make sure that the pipe end penetrates into the suitable rake groove obtained in the flange;
- ❑ Carry out abutment ring reflanging upon assembly on the vehicle or work bench on a fitting.
- ❑ The exerted pressure and the final distance from front pressure ring edge to reinforcement bush edge must be those mentioned in the table below.

In case of a bad assembly, use the pipe after having extracted bush and abutment ring.

	Pipe mm	Distance between bush edge and ring mm (*)	Assembly pressure N/mm²
Double-layered	6 x 1	1 to 1.5	0.040
	8 x 1	2 to 2.5	0.050
Single-layered	10 x 1.5	2 to 2.5	0.050
	12 x 1.6	2 to 2.5	0.060
	16 x 2.34	3 to 3.5	0.060

(*) See reference h, Figure 14.

Figure 14



1. Reinforcement bush - 2. Pressure ring - 3. Nut - 4. Fitting - 5. Pipe - h. Distance between bush edge and ring edge (see table).

Insert the thereby-prepared piping end into the fitting body till the reinforcement bush flange rests within the suitable seat:

- ❑ For closing the nut on the fitting, initially screw it manually and then complete the tightening with a suitable box wrench inserted into the dynamometric wrench, to be calibrated according to the required tightening torque.

Assembly of piping on vehicle is carried out by taking into account some important solutions:

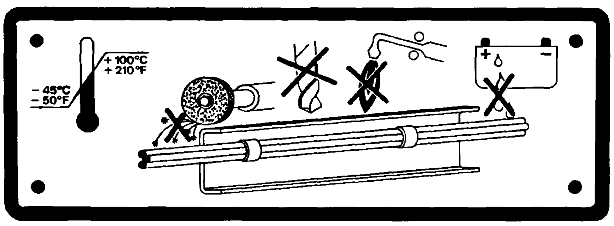
- ❑ Bendings must comply with minimum radiusses, in order to avoid throttlings;

Pipings diameter mm	Minimum bending radius mm
6 x 1	≈ 40
8 x 1	≈ 50
10 x 1.5	≈ 60
12 x 1.6	≈ 75
16 x 2.34	≈ 100

⚠ Make sure that pipings are not in contact with sharp edges or with cutting metallic parts or with heat sources, but that are distant therefrom by a minimum safety distance of 15 mm.

- ❑ Moreover, when crossing chassis longitudinal members or metallic parts, check that passage holes are coated with rubber fairlead rings and that these latter ones are in good conditions;
- ❑ Avoid that the pipe slides along cutting edges that would risk to create nickings;
- ❑ Having to fix the piping onto already existing ducts, take into account the supplementary heat to which it can be subjected (hydraulic power steering duct): in such case, the piping must be protected with guards;
- ❑ At the end of the connection, verify that the piping, between keying and securing, is not stretched, but must be slightly loosened to recover higher temperature variations, particularly for short lengths;
- ❑ Before assembling, accurately clean the pipings by blowing compressed air in order to guarantee system operation;

Figure 15



13132

- ❑ Protect the pipes in case of grinding or welding operations on the vehicle; for such purpose, an adhesive plate is applied in the cabin and shows the precautions to be observed with utmost care to avoid damages.

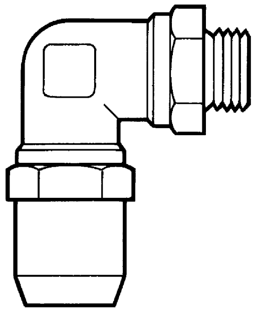
⚠ For better safety and work comfortability, it is advisable to detach the pipings during such operations.

At the end of the assembly, check the perfect seal of all gaskets (unions, fittings, etc.).

Flexible pipings replacement with quick connection fittings

Rotating fittings:

Figure 16

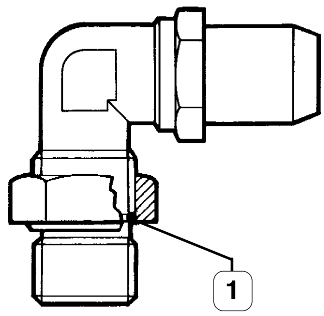


39306

Screw the fitting in the threaded seat provided on the pneumatic valve and lock it at the tightening torque shown in the table.

Swinging fittings:

Figure 17



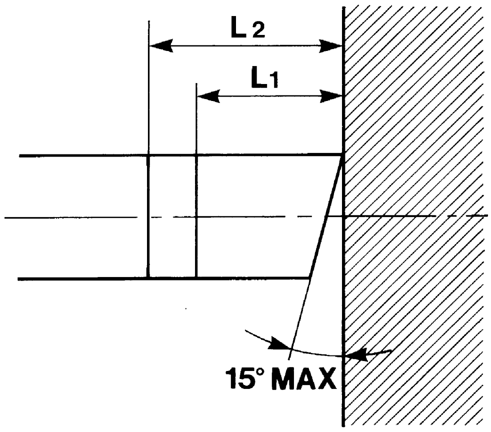
39307

- ❑ Check that the sealing ring (1) is into its suitable seat;
- ❑ screw the fitting till it is felt that the sealing gasket abuts onto the valve;
- ❑ adequately swing the fitting and keeping the swingable part still, lock the hexagonal nut at the tightening torque mentioned in the table.

Rotating and swinging fittings:

FITTING THREADING	TIGHTENIG TORQUE (Nm + 10%)
M 10 x 1.0 mm	22
M 12 x 1.5 mm	24
M 14 x 1.5 mm	28
M 16 x 1.5 mm	35
M 22 x 1.5 mm	40

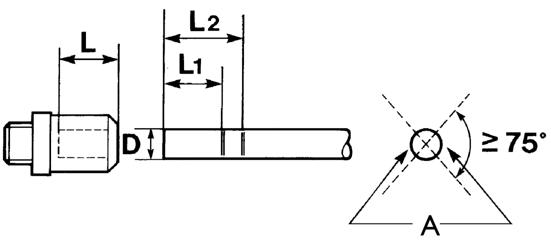
Figure 18



33977

- Use homologated pipes only;
- Check the spare pipe status, on which no cracks, cuts or nicking must be detected;
- Cut the pipe at 90° with a max 15° error with respect to the axis through the suitable pipe-cutting pliers 99387050 at the necessary length;

Figure 19



33976

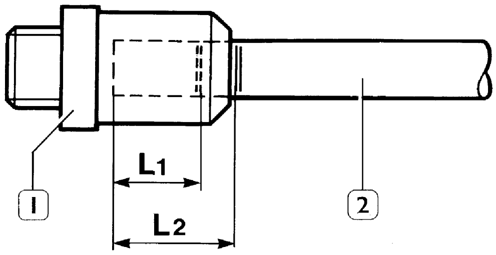
A = Marking to identify pipe end-of-stroke

- Strongly and indelibly mark with ink two reference notches on both diametrically-opposed pipe faces for an angle ≥ 75°, placed at the distances of L_1 and L_2 to guarantee a correct assembly.

> ⚠ Dimensions L_1 and L_2 change depending on the pipe diameter and must be measured from the longest pipe part (see Figure 18).

D (mm)	$L^{0}_{+0.5}$ (mm)	$L_1\ ^{-0.5}_{+1}$ (mm)	$L_2\ ^{-0.5}_{+1}$ (mm)
6	19.8	17	22
8	20.5	18	23
12	25	22	28
16	27.1	24	30

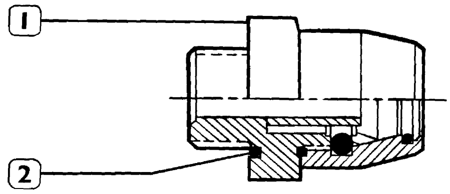
Figure 20



39308

- Manually insert pipe (2) into fitting (1), with a force varying from 30 to 120 N depending on pipe diameter, so that the notch L_1 is placed inside the fitting while the notch L_2 is visible.

Figure 21



33978

In case of disassembling of fittings (1) from pneumatic components, check the sealing ring (2) status, and if necessary replace it.

FITTING THREADING	SEALING RINGS DIMENSIONS
M 10 x 1.0	10.1 x 1.6
M 12 x 1.5	11.0 x 2.0
M 14 x 1.5	-
M 16 x 1.5	15.0 x 2.0
M 22 x 1.5	-

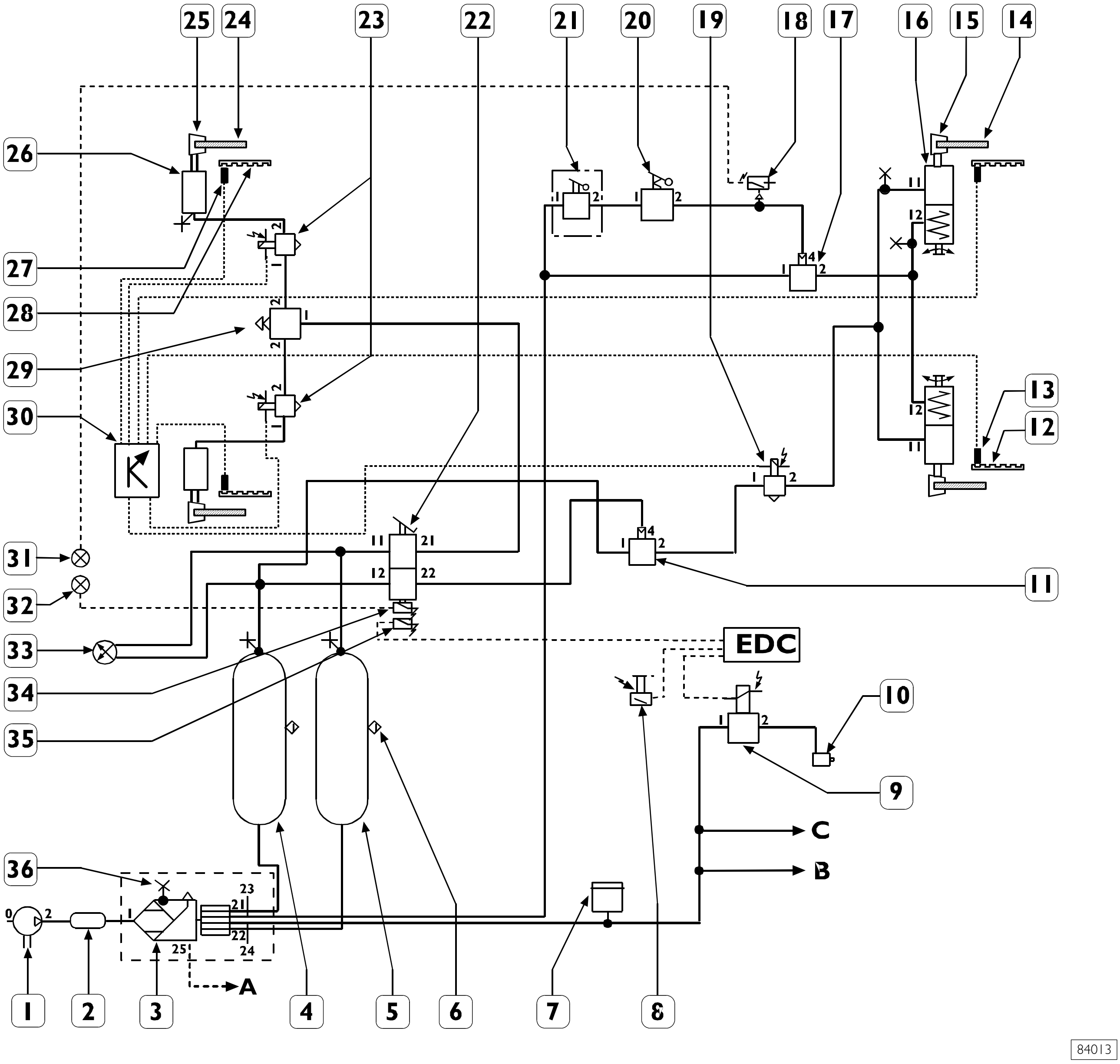
> ⚠ Every time a piping is detached from a quick connection fitting, it is necessary to replace the fitting itself. Quick connection fittings are supplied complete as spares.

> ⚠ Quick connection and threaded fittings, as well as flexible pipings used with quick connection fittings and flexible pipings used with threaded fittings, are not interchangeable.

BRAKING SYSTEM

Principle diagram for single vehicles (Models 110 EL.. - 120 EL..)

Figure 22



1. Single-cylinder 225 cm^3 (359 cm^3 optional) compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 15l front axle air tank - 6. Manual condensate exhaust valve - 7. Safety valve (optional) - 8. Engine brake control button - 9. Engine brake control solenoid valve - 10. Engine brake valve control cylinder - 11. Relay valve - 12. Phonic wheel - 13. Revolutions sensor - 14. Rear axle brake disc - 15. - Rear axle brake caliper - 16. Combined cylinder - 17. Parking relay valve - 18. Inserted parking brake signalling low pressure switch - 19. Rear axle ABS solenoid valve - 20. Manual parking control distributor - 21. Manual safety distributor (optional) - 22. Duplex distributor - 23. Front axle ABS solenoid valve - 24. Front axle brake disc - 25. Front axle brake caliper - 26. Front axle membrane cylinder - 27. Revolutions sensor - 28. Phonic wheel - 29. Quick discharge valve - 30. ABS electronic unit - 31. Parking brake luminous signaller - 32. STOP lights - 33. Front axle/rear axle manometer - 34. STOP lights relay control switch - 35. EDC inserted brake signalling switch - 36. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

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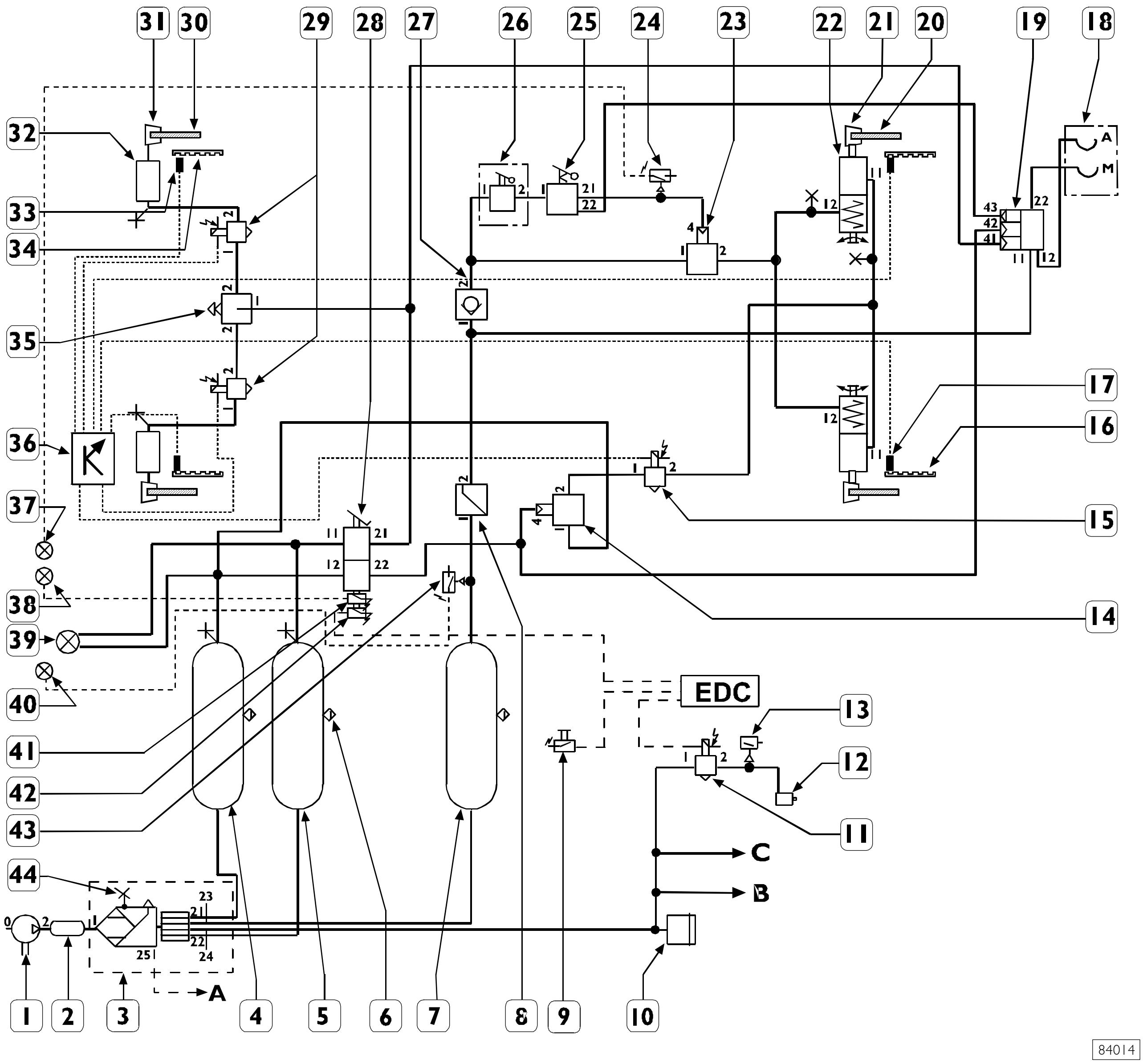
Principle diagram for vehicles adapted for towing (Models 110 EL.. - 120 EL..)

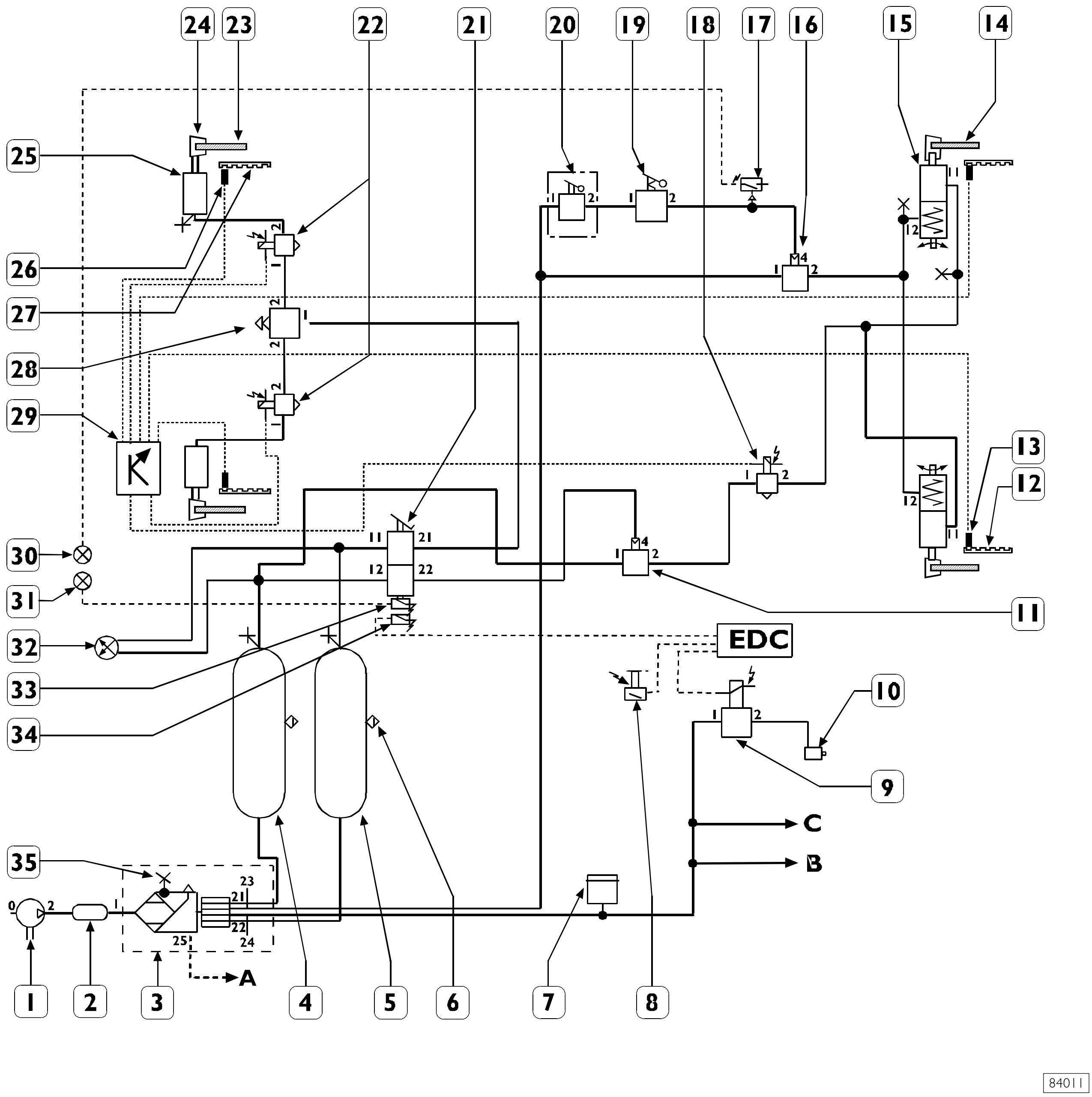
Figure 23



1. Single-cylinder 225 cm^3 (359 cm^3 optional) compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 15l front axle air tank – 5. 15l Axle air reservoir - 6. Manual condensate exhaust valve - 7. 15l trailer parking and reloading air tank - 8. Trailer system pressure reducer - 9. Engine brake control button - 10. Safety valve (optional) - 11. Engine brake control solenoid valve - 12. Engine brake valve control cylinder - 13. Trailer braking control pressure switch - 14. Relay valve - 15. Rear axle ABS solenoid valve - 16. Phonic wheel - 17. Revolutions sensor - 18. Trailer coupling half-joints - 19. Triple-control trailer servodistributor - 20. Rear axle brake disc - 21. - Rear axle brake caliper - 22. Combined cylinder - 23. Parking relay valve - 24. Inserted parking brake signalling low pressure switch - 25. Manual parking control distributor - 26. Manual safety distributor (optional) - 27. Unidirectional parking system valve - 28. Duplex distributor - 29. Front axle ABS solenoid valve - 30. Front axle brake disc - 31. Front axle brake caliper - 32. Front axle membrane cylinder - 33. Revolutions sensor - 34. Phonic wheel - 35. Quick discharge valve - 36. ABS electronic unit - 37. Parking brake luminous signaller - 38. STOP lights - 39. Front axle/rear axle manometer - 40. Trailer section low pressure luminous signaller (optional) - 41. STOP lights relay control switch - 42. EDC inserted brake signalling switch - 43. Trailer low pressure switch (optional) - 44. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

Principle diagram for single vehicles (Models 120 E.. - 130 E.. - 150 E..)

Figure 24



1. Single-cylinder 225 cm[3] (359 cm[3] optional) compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 15l front axle air tank - 5. 15l Axle air reservoir - 6. Manual condensate exhaust valve - 7. Safety valve (optional) - 8. Engine brake control button - 9. Engine brake control solenoid valve - 10. Engine brake valve control cylinder - 11. Relay valve - 12. Rear axle phonic wheel - 13. Revolutions sensor - 14. Rear axle drum brake - 15. - Rear axle combined cylinder - 16. Parking relay valve - 17. Inserted parking brake signalling low pressure switch - 18. Rear axle ABS solenoid valve - 19. Manual parking control distributor - 20. Manual safety distributor (optional) - 21. Duplex distributor - 22. Front axle ABS solenoid valve - 23. Front axle brake disc - 24. Front axle brake caliper - 25. Front axle membrane cylinder - 26. Revolutions sensor - 27. Phonic wheel - 28. Quick discharge valve (optional Proportional reduction valve) - 29. ABS electronic unit - 30. Parking brake luminous signaller - 31. STOP lights - 32. Front axle/rear axle manometer - 33. STOP lights relay control switch - 34. EDC inserted brake signalling switch - 35. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

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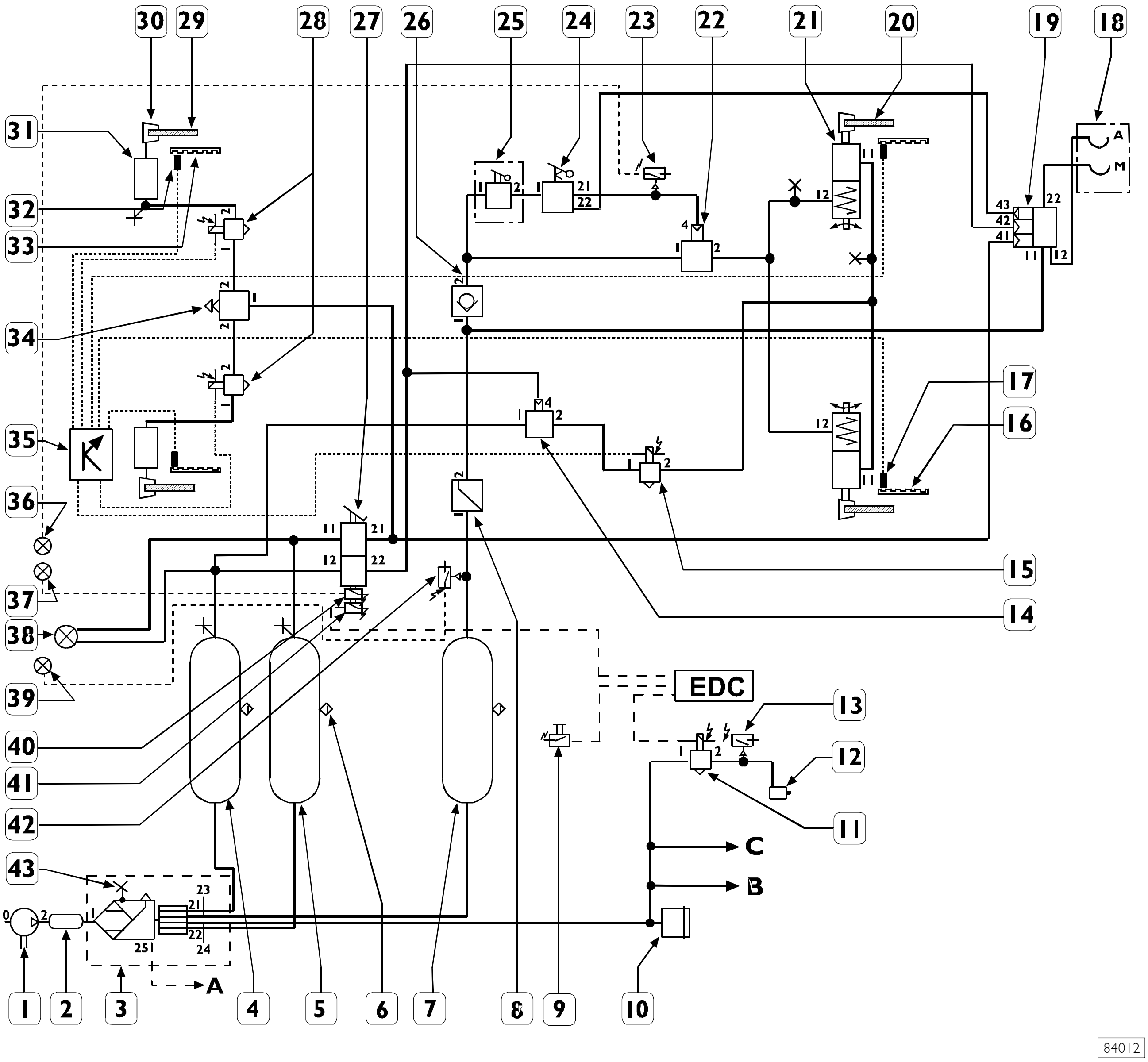
Principle diagram for vehicles adapted for towing (Models 120 E.. - 130 E.. - 150 E..)

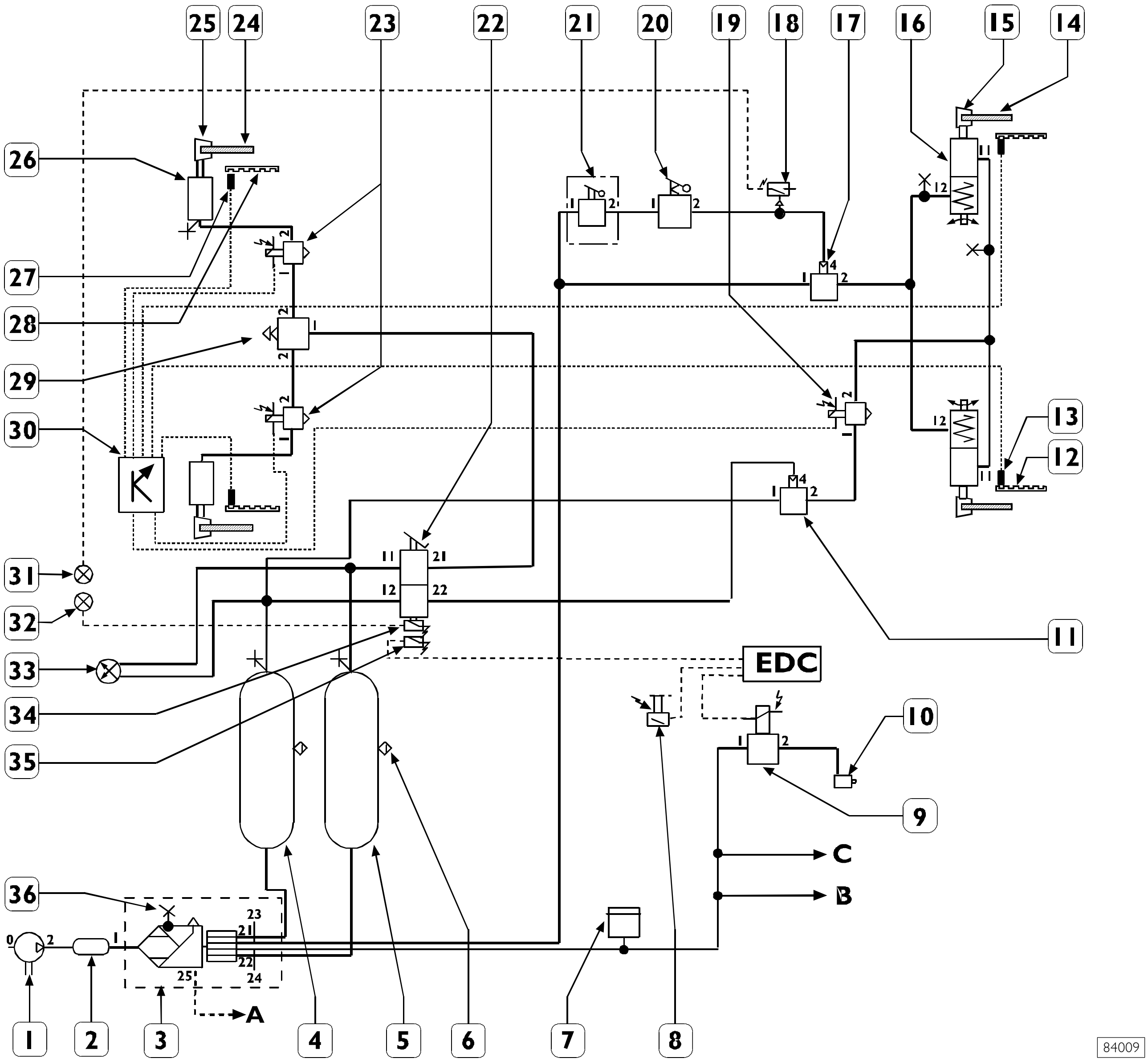
Figure 25



1. Single-cylinder 225 cm^3 (359 cm^3 optional) compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 15l rear axle air tank - 5. 15l front axle air tank - 6. Manual condensate exhaust valve - 7. 15l trailer parking and reloading air tank - 8. Trailer system pressure reducer - 9. Engine brake control button - 10. Safety valve (optional) - 11. Engine brake control solenoid valve - 12. Engine brake valve control cylinder - 13. Trailer braking control pressure switch (optional) - 14. Relay valve - 15. Rear axle ABS solenoid valve - 16. Phonic wheel - 17. Revolutions sensor - 18. Trailer coupling half-joints - 19. Triple-control trailer servodistributor - 20. Rear axle drum brake - 21. Rear axle combined brake cylinder - 22. Parking relay valve - 23. Inserted parking brake signalling low pressure switch - 24. Manual parking control distributor - 25. Manual safety distributor - 26. Unidirectional parking system valve - 27. Coaxial duplex distributor - 28. Front axle ABS solenoid valve - 29. Brake disc - 30. Front axle brake caliper - 31. Front axle membrane cylinder - 32. Revolutions sensor - 33. Phonic wheel - 34. Quick discharge valve (optional Proportional reduction valve) - 35. ABS electronic unit - 36. Parking brake luminous signaller - 37. STOP lights - 38. Front axle/rear axle manometer - 39. Trailer section low pressure luminous signaller (optional) - 40. STOP lights relay control switch - 41. EDC inserted brake signalling switch - 42. Trailer low pressure switch (optional) - 43. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

Principle diagram for single vehicles (Model 180 E..)

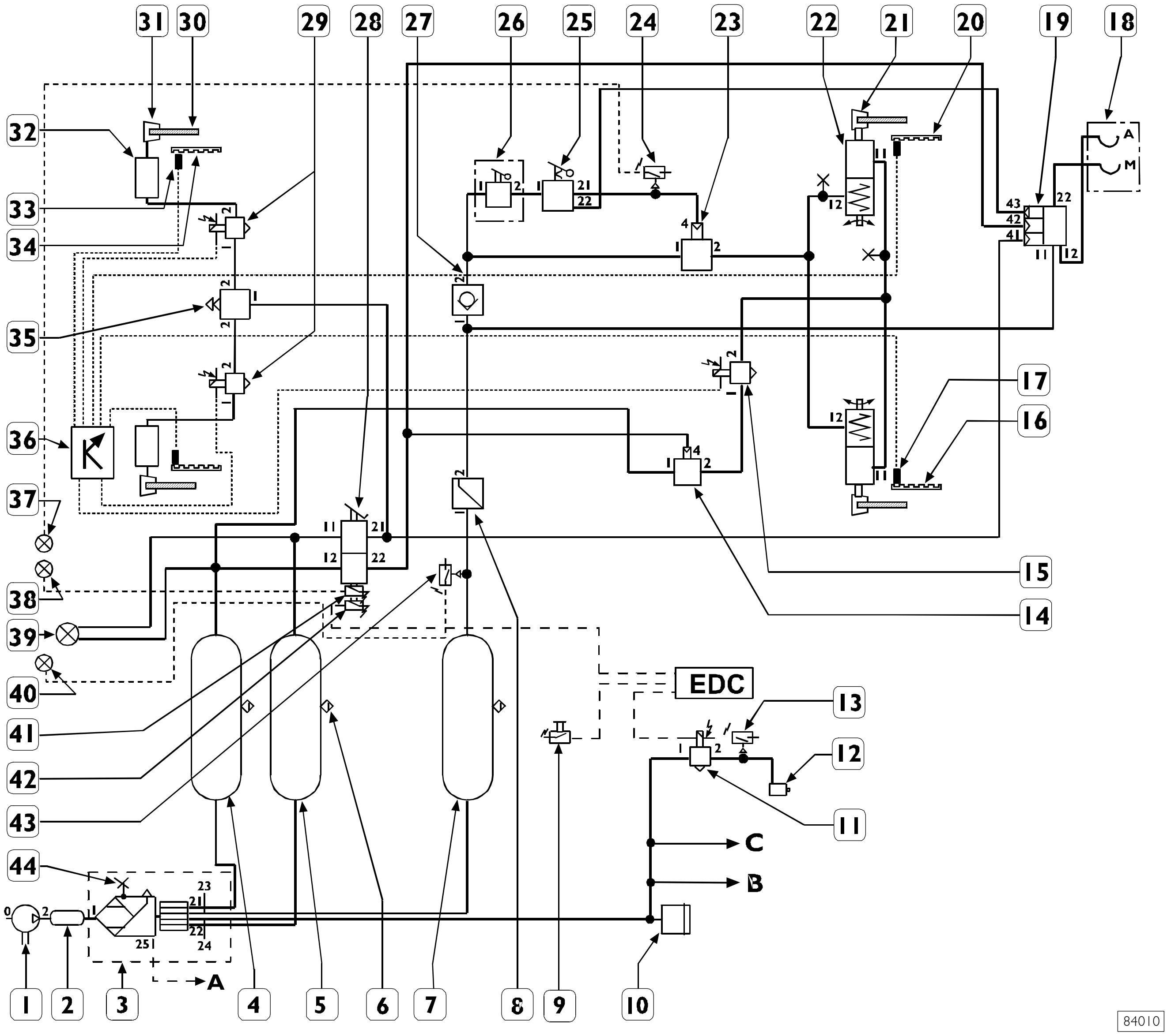
Figure 26



1. Single-cylinder 359 cm^3 compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 20l rear axle air tank - 5. 20l front axle air tank - 6. Manual condensate exhaust valve - 7. Safety valve (optional) - 8. Engine brake control button - 9. Engine brake control solenoid valve - 10. Engine brake valve control cylinder - 11. Relay valve - 12. Rear axle phonic wheel - 13. Revolutions sensor - 14. Rear axle brake disc - 15. Rear axle brake calliper - 16. - Rear axle combined cylinder - 17. Relay valve - 18. Inserted parking brake signalling low pressure switch - 19. Rear axle ABS solenoid valve - 20. Manual parking control distributor - 21. Manual safety distributor (optional) - 22. Duplex distributor - 23. Front axle ABS solenoid valve - 24. Front axle brake disc - 25. Front axle brake caliper - 26. Front axle membrane cylinder - 27. Revolutions sensor - 28. Front axle phonic wheel - 29. Quick discharge valve (optional Proportional reduction valve) - 30. ABS electronic unit - 31. Parking brake luminous signaller - 32. STOP lights - 33. Front axle/rear axle manometer - 34. STOP lights relay control switch - 35. EDC inserted brake signalling switch - 36. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

Principle diagram for vehicles adapted for towing (Model 180 E..)

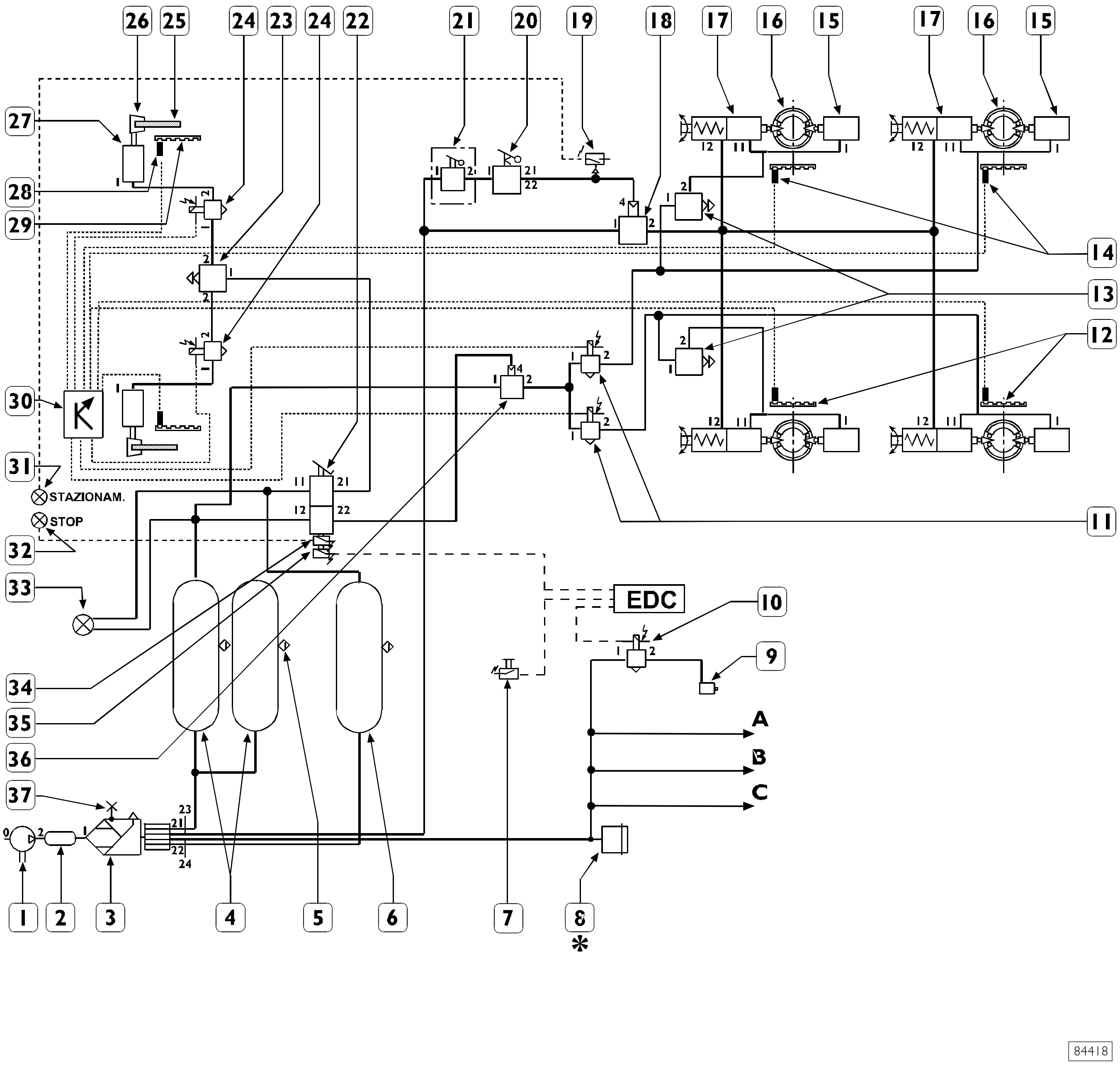
Figure 27



1. Single-cylinder 359 cm^3 compressor - 2. 0.26l silencer - 3. Air Processing Unit - 4. 20l rear axle air tank - 5. 20l front axle air tank - 6. Manual condensate exhaust valve - 7. 15l trailer parking and reloading air tank - 8. Trailer system pressure reducer - 9. Engine brake control button - 10. Safety valve (optional) - 11. Engine brake control solenoid valve - 12. Engine brake valve control cylinder - 13. Trailer braking control pressure switch (optional) - 14. Relay valve - 15. Rear axle ABS solenoid valve - 16. Phonic wheel - 17. Revolutions sensor - 18. Trailer coupling half-joints - 19. Triple-control trailer servodistributor - 20. Rear axle disc brake - 21. Rear axle drum brake - 22. Rear axle combined brake cylinder - 23. Relay valve - 24. Inserted parking brake signalling low pressure switch - 25. Manual parking control distributor - 26. Manual safety distributor (optional) - 27. Unidirectional parking system valve - 28. Duplex distributor - 29. Front axle ABS solenoid valve - 30. Front axle brake disc - 31. Front axle brake caliper - 32. Front axle membrane cylinder - 33. Revolutions sensor - 34. Phonic wheel - 35. Quick discharge valve - 36. ABS electronic unit - 37. Parking brake luminous signaller - 38. STOP lights - 39. Front axle/rear axle manometer - 40. Trailer section low pressure luminous signaller (optional) - 41. STOP lights relay control switch - 42. EDC inserted brake signalling switch - 43. Trailer low pressure switch (optional) - 44. Pneumatic control plug.
A. To pneumatic suspension system - B. To differential block - C. To gearbox control.

Principle diagram for single vehicles (Model 260E) (with Hendrickson suspensions)

Figure 28



1. Single-cylinder 225 cm^3 (359 cm^3 optional) compressor - 2. 0.261 silencer - 3. Air Processing Unit - 4. 20L + 20L axle air tank - 5. Manual condensate exhaust valve - 6. 20L front axle air tank - 7. Engine brake control button - 8. Safety valve (optional) - 9. Brake valve control cylinder - 10. Engine brake control solenoid valve - 11. Axle ABS solenoid valve - 12. Phonic wheel - 13. Quick-release valve - 14. Rear axle speed sensor - 15. Rear axle membrane brake cylinder - 16. Rear axle drum brake - 17. Rear axle combined brake cylinder - 18. Parking relay valve - 19. Inserted parking brake signalling low pressure switch 6.5 bar - 20. Manual parking control distributor - 21. Manual safety distributor (optional) - 22. Self-limited coaxial duplex distributor 7.6 ± 0.3 bar - 23. Quick-release valve - 24. Front axle ABS solenoid valve - 25. Front axle disc brake (diam. 430 mm or 436 mm) - 26. Front axle brake calliper - 27. Front axle membrane cylinder - 28. Front axle speed sensor - 29. Front axle phonic wheel - 30. ABS Electronic unit - 31. Parking brake luminous signaller - 32. STOP lights - 33. Front axle / rear axle manometer - 34. Stop light relay control switch - 35. EDC inserted brake signalling switch - 36. Relay valveBraking control - 37. Pneumatic control plug.

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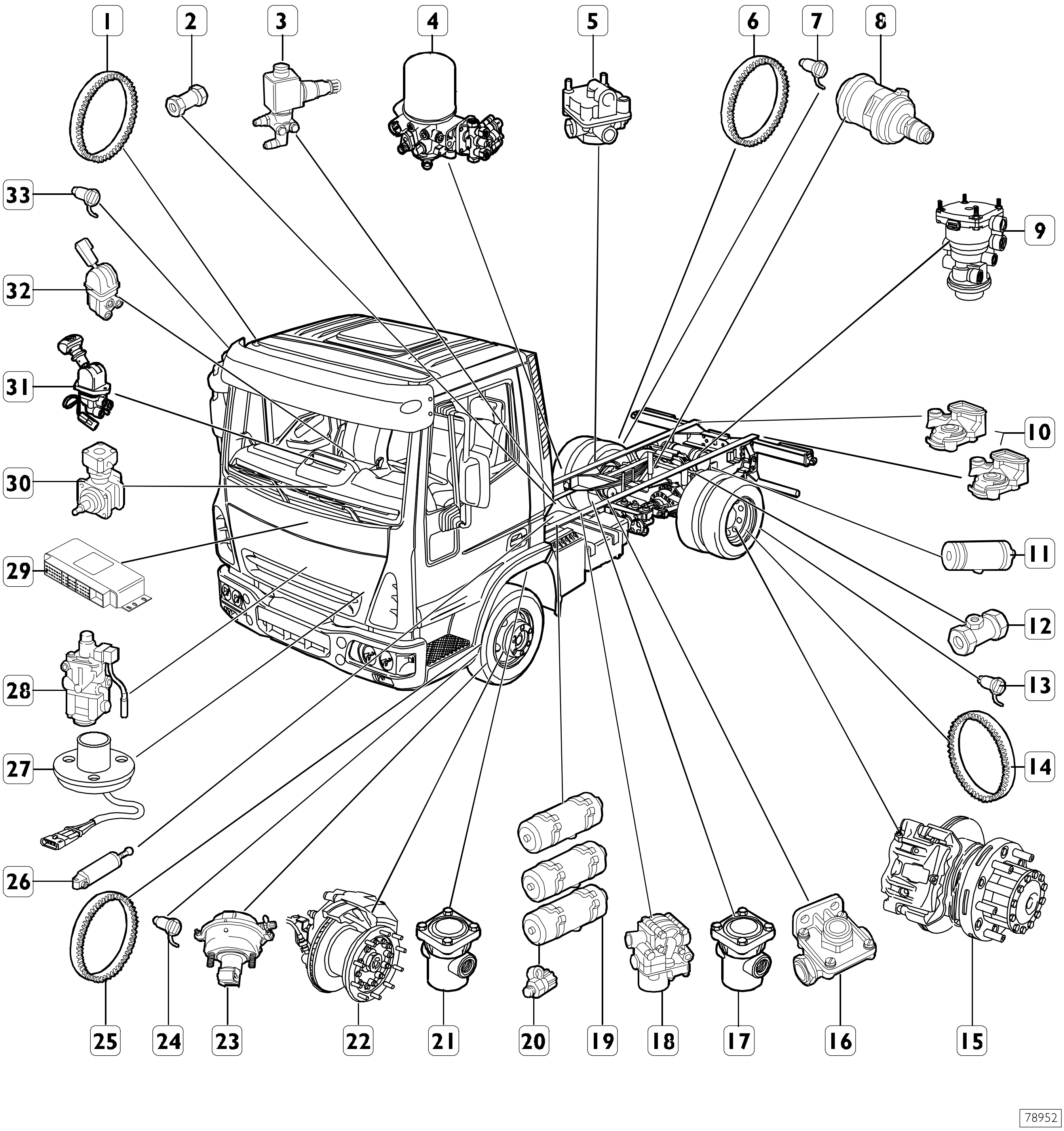
ARRANGEMENT ON A VEHICLE OF MAIN BRAKING SYSTEM COMPONENTS

Figure 29



1. Phonic wheel - 2. Check valve - 3. Engine brake solenoid valve - 4. A.P.U. - 5. Relay valve - 6. Phonic wheel - 7. Wheels revolution sensors - 8. Combined brake cylinder - 9. Triple-control servodistributor - 10. Coupling heads - 11. Parking - trailer braking tank - 12. Hydraulic pressure control plug - 13. Wheels revolutions sensor - 14. Phonic wheel - 15. Rear disc brake assembly - 16. Quick discharge valve - 17. Pressure relief valve - 18. Electro-pneumatic valve - 19. Air tanks - 20. Pressure control plug - 21. Pressure relief valve - 22. Front disc brake assembly - 23. Membrane brake cylinder - 24. Wheels revolutions sensor - 25. Phonic wheel - 26. Engine brake operating cylinder - 27. Engine brake control button - 28. Duplex distributor - 29. ABS elecronic unit - 30. Single-cylinder compressor - 31. Parking brake distributor - 32. Trailer slowing-down control distributor (optional) - 33. Wheels revolutions sensor.

DESCRIPTION

Service braking

With pedal, of the electrically-controlled pneumatic type, operating on all wheels and on trailer or semitrailer.
It is composed of two independent sections, one for activating front axle braking elements, the other section for activating rear axle braking elements.
A third section, interlocked with the two distributor sections, is provided for braking the trailer. The duplex distributor with electric transmitter checks the two independent sections and the trailer control servodistributor in turn checks the above interlocked section. The pneumatic system sectioning enables, in case of failure of a section, the efficiency of the other ones.

Safety braking

The safety braking allows reducing vehicle running speed and stop it in a safety space, also when a braking system failure occurs.
It must be meant as partial service braking that, due to the double circuit, anyway operates on one of the two axles.

Engine brake

The "engine brake" system, being of the electric type, is managed by the EDC unit. The exhaust brake can be controlled in different ways, which can be selected by means of the special switch available on the dashboard or the pedal on the floor to be used with the different types/conditions of the road.
Actuation can be controlled directly through the pedal available on the floor.
When the selector is set to position 1, the exhaust brake is linked to the accelerator pedal and is operated when the accelerator is released.
When the selector is set to position 2, engine brake/service brake are coupled, with operation starting from first pedal stroke length and keeping the position.
Every time the engine brake is inserted, the signalling panel warning light turns on.
The insertion of engine brake together with accelerator pedal disables all adjustment operations connected to Cruise Control.

Operation

Independently from the type of selection being set, the EDC electronic unit drives, through connector B pin 11, the engine brake solenoid valve.
This one, by switching its state from N.C. to N.O., allows the engine oil to flow to operating cylinder which, in turn, operating on the engine exhaust throttle valve, allows braking it.

Parking braking

It is composed of the pneumatic control of the manual distributor, of a spring cylinder that operates on rear wheel brakes by locking them.
This system, in case the supply is lacking, automatically brakes the vehicle.

BRAKES

Front brakes

Front brakes are of the disc type. Discs are keyed on wheel hubs and equipped with venting fins that allow lowering the high temperature that develops under the braking action.
Braking gaskets are equipped with a wear signaller connected to a warning light placed on the dashboard, which signals gasket wear.
ABS device phonic wheels are keyed-in on wheel hubs.

Front axle 5845

❑ type: WABCO (PERROT) PAN 17 - Ø 330x34

Front axle 5842/5 - 5851/5

❑ type: KNORR SB6 - Ø 377x45

Front axle 5871/5

❑ type: KNORR SN7 - Ø 432x45

Rear brakes

Rear brakes are:

❑ disc type on rear axle MS08-125, MS13-144, MS13-164 MS13-165

❑ Drum brakes on tandem axle SP 145 E

In drum brakes, every braking assembly is composed of a body in which adjustment, control pins and wedge units are housed.
Wedge units are actuated by cylinder stem in turn actuated by compressed air.
Wedge unit rollers along their stroke generate control pin expansion that, winning jaws return spring resistance, approach jaws to drum dampening the brakings. Adjustment and control pins are made integral with the brake body by two pins that are inserted in a side milling. When the braking action ceases, air pressure is lacking in the combined brake cylinder membrane section, and consequently the jaws return spring and wedge unit return spring actions take care of returning the wedge units into their starting position.
Braking gaskets are equipped with a wear signaller.
ABD device phonic wheels are an integral part of brake disc on H127E rear axle, while are keyed-in on wheel hubs in the other rear axles with drum brake.

Rear axle MS08-125

❑ type: WABCO (PERROT) PAN 17 - Ø 330x34

Rear axle MS10-144; MS10-164

❑ type: KNORR SN6 - Ø 377x45

Rear axle MS13-165

❑ type: KNORR SN7 - Ø 432x45

Rear axle SP145E

❑ type: Duoduplex - Ø 381x178

DIAGNOSTIC

Main brake system operating anomalies:

1 - Scarce or irregular system recharge;
2 - Scarce or irregular rear axle service braking;
3 - Scarce or irregular front axle service braking;
4 - Scarce or irregular trailer service braking;
5 - Scarce or lacking parking braking;
6 - Scarce or lacking trailer parking braking;
7 - Delayed parking unbraking;
8 - Delayed trailer parking unbraking;
9 - When braking the vehicle side-skids;
10 - Insufficient trailer slowing-down braking;
11 - Early braking gaskets wear;
12 - Turned-on brake system failure luminous signaller;
13 - Turned-on parking brake luminous signaller with hand lever in running position;
14 - Noisy brakes.

⚠ The complete diagnosis of electric and electronic components must be carried out through modus and IWT.

1	SCARCE OR IRREGULAR SYSTEM RECHARGE

Check		Action
Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient air compressor operation.	YES →	Revise or replace the air compressor.
NO ↓		
Inefficient A.P.U operation.	YES →	Revise or replace the A.P.U.

2	SCARCE OR IRREGULAR REAR AXLE SERVICE BRAKING

Check		Action
Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.

(continues)

Worn and/or vitrified braking gaskets.	YES	Revise or replace the braking gaskets.
NO		
Inefficient rear brakes operation.	YES	Revise the rear brakes.
NO		
Inefficient Duplex distributor operation.	YES	Revise or replace the Duplex distributor.
NO		
Inefficient brake cylinders operation.	YES	Revise or replace the brake cylinders.
NO		
Inefficient ABS solenoid valve operation.	YES	❑ Verify the electric wiring. ❑ Replace the ABS solenoid valve.
NO		
Inefficient automatic clearance recovering device operation.	YES	Replace the complete brake caliper.

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3 SCARCE OR IRREGULAR FRONT AXLE SERVICE BRAKING

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient Duplex distributor operation.	YES →	Revise or replace the Duplex distributor.
NO ↓		
Worn and/or vitrified braking gaskets.	YES →	Revise or replace the braking gaskets.
NO ↓		
Inefficient front brakes operation.	YES →	Revise the front brakes.
NO ↓		
Inefficient relay valve operation.	YES →	Revise or replace the relay valve.
NO ↓		
Inefficient membrane brake cylinders operation.	YES →	Revise the membrane brake cylinders.
NO ↓		
Inefficient automatic clearance recovering device operation.	YES →	Replace the complete brake caliper.

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Inefficient ABS solenoid valve operation.	YES →	❑ Verify the electric wiring. ❑ Replace the ABS solenoid valve.

4 SCARCE OR IRREGULAR TRAILER SERVICE BRAKING

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.
NO ↓		
Inefficient Duplex distributor operation.	YES →	Revise or replace the Duplex distributor.
NO ↓		
Inefficient A.P.U. operation.	YES →	Revise or replace the A.P.U.
NO ↓		
Worn and/or vitrified braking gaskets.	YES →	Revise or replace the braking gaskets.
NO ↓		
Inefficient trailer brakes operation.	YES →	Revise the trailer brakes.

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5	**SCARCE OR LACKING PARKING BRAKING**

Fault		Remedy
Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
↓ NO		
Inefficient combined brake cylinders operation.	YES →	Revise or replace the combined brake cylinders.
↓ NO		
Inefficient parking brake manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.
↓ NO		
Worn and/or vitrified braking gaskets.	YES →	Revise or replace the braking gaskets.
↓ NO		
Inefficient relay valve operation.	YES →	Revise or replace the relay valve.
↓ NO		
Inefficient rear brakes operation.	YES →	Revise the rear brakes.

6	**SCARCE OR LACKING TRAILER PARKING BRAKING**

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
↓ NO		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.
↓ NO		
Inefficient parking brake manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.
↓ NO		
Worn and/or vitrified trailer braking gaskets.	YES →	Revise or replace the trailer braking gaskets.
↓ NO		
Inefficient trailer brakes operation.	YES →	Revise the trailer brakes.
↓ NO		
Inefficient trailer control servodistributor operation.	YES →	❑ Verify the electric wiring. ❑ Replace the trailer control servodistributor.

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7	**DELAYED PARKING UNBRAKING**

Condition		Remedy
Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient relay valve operation.	YES →	Revise or replace the relay valve.
NO ↓		
Inefficient combined brake cylinders operation.	YES →	Revise or replace the combined brake cylinders.
NO ↓		
Inefficient parking brake manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.
NO ↓		
Inefficient rear brakes operation.	YES →	Revise the rear brakes.

8 DELAYED TRAILER PARKING UNBRAKING

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.
NO ↓		
Inefficient parking brake manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.
NO ↓		
Inefficient trailer brakes operation.	YES →	Revise the trailer brakes.

9 WHEN BRAKING THE VEHICLE SIDE-SKIDS

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient Duplex distributor operation.	YES →	Revise or replace the Duplex distributor.

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Inefficient front brakes operation.	YES →	Revise the front brakes.
↓ NO		
Inefficient rear brakes operation.	YES →	Revise the rear brakes.
↓ NO		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.

10 INSUFFICIENT TRAILER SLOWING-DOWN BRAKING

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
↓ NO		
Inefficient A.P.U. operation.	YES →	Revise or replace the A.P.U.
↓ NO		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.
↓ NO		
Inefficient manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.

11 EARLY BRAKING GASKETS WEAR

Inefficient Duplex distributor operation.	YES →	Revise or replace the Duplex distributor.
NO ↓		
Inefficient brakes operation.	YES →	Revise the brakes.
NO ↓		
Inefficient triple-control servodistributor operation.	YES →	Revise or replace the triple-control servodistributor.
NO ↓		
Inefficient relay valve operation.	YES →	Revise or replace the relay valve.

12 TURNED-ON BRAKE SYSTEM FAILURE LUMINOUS SIGNALLER

Pneumatic system pipings leakages or breakages.	YES →	Close or replace loosened or damaged fittings. Replace broken or damaged pipings.
NO ↓		
Inefficient A.P.U. operation.	YES →	Revise or replace the A.P.U.
NO ↓		
Wrong warning light electric circuit wiring.	YES →	Detect the wrong connection and restore the wiring.

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13 TURNED-ON PARKING BRAKE LUMINOUS SIGNALLER WITH HAND LEVER IN RUNNING POSITION

Cause		Remedy
Wrong warning light electric circuit wiring.	YES →	Detect the wrong connection and restore the wiring.
NO ↓		
Inefficient parking brake manual distributor (hand lever) operation.	YES →	Revise or replace the hand lever.
NO ↓		
Inefficient A.P.U. operation.	YES →	Revise or replace the A.P.U.

14 NOISY BRAKES

Cause		Remedy
Worn braking gaskets.	YES →	Replace the worn gaskets.
NO ↓		
Presence of foreign bodies between discs and braking gaskets (disc brakes).	YES →	Remove the foreign bodies between braking gaskets and discs.
NO ↓		
Uncentered brake discs (disc brakes).	YES →	Grind or replace the brake discs.
NO ↓		
Inefficient jaws return springs (drum brakes).	YES →	Revise the rear brakes.
NO ↓		
Excessive brake drums ovalisation within required tolerances (drum brakes).	YES →	Turn or if necessary replace the drums.

TIGHTENING TORQUES

PART	TORQUE Nm	(kgm)
Compressor		
Head clamping screws	27.5 ± 2.5	(2.8 ± 0.25)
Connecting rods caps clamping screws	13+3	(1.3+0.3)
Front brakes (Front axle 5845)		
Ring nut for securing wheel hub bearings	388.5 ± 18.5	(39.6 ± 1.8)
Cylindrical-head screw with embedded hexagon for bearings adjustment clamp	27.5 ± 2.5	(2.8 ± 0.2)
Self-locking hexagonal-head screw for securing brake calipers	188 ± 18	(19 ± 1.8)
Hexagonal-head screw for securing brake disc to wheel hub	40 ± 4	(4 ± 0.4)
Wheel hub cover*	106 ± 11	(10.8 ± 1.1)
Tapered threaded plug for wheel hub cover	55 ± 5	(5.5 ± 0.5)
Brake cylinder securing nut	195 ± 15	(19.8 ± 1.5)
Front brakes (Front axle 5842/5 - 5851/5)		
Ring nut for securing wheel hub bearings	388.5 ± 18.5	(39.6 ± 1.8)
Cylindrical-head screw with embedded hexagon for bearings adjustment clamp	27.5 ± 2.5	(2.8 ± 0.2)
Self-locking hexagonal-head screw for securing brake calipers	299.5	(30.6)
Hexagonal-head screw for securing brake disc to wheel hub	40 ± 4	(4 ± 0.4)
Wheel hub cover*	130 ± 10	(13 ± 1)
Tapered threaded plug for wheel hub cover	55 ± 5	(5.5 ± 0.5)
Brake cylinder securing nut	195 ± 15	(19.8 ± 1.5)
Front brakes (Front axle 5871/5)		
Ring nut for securing wheel hub bearings	515.5 ± 24.5	(52.5 ± 2.5)
Cylindrical-head screw with embedded hexagon for bearings adjustment clamp	27.5 ± 2.5	(2.8 ± 0.2)
Self-locking hexagonal-head screw for securing brake calipers	615.5 ± 61.5	(62.5 ± 6.2)
Hexagonal-head screw for securing brake disc to wheel hub	41 ± 4	(4 ± 0.4)
Wheel hub cover*	130 ± 10	(13 ± 1)
Tapered threaded plug for wheel hub cover	55 ± 5	(5.5 ± 0.5)
Brake cylinder securing nut	195 ± 15	(19.5 ± 1.5)

* Apply a bead of LOCTITE 574 sealant on the cover abutting surface by means of the special measuring device. Protect the threaded portion.

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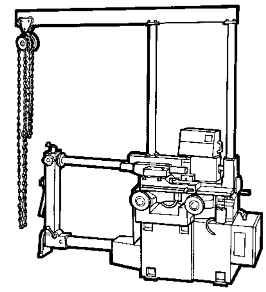
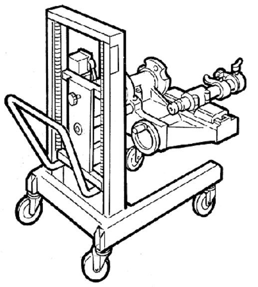
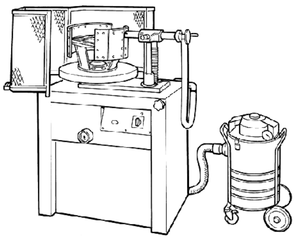
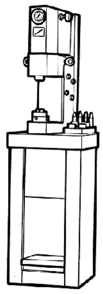
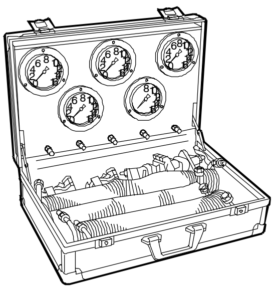
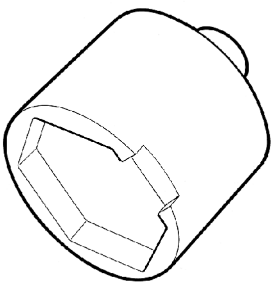
PART	TORQUE	
	Nm	(kgm)
Rear brakes (Rear axle MS08-125)		
Ring nut for securing wheel hub bearings	864.5 ± 86.5	(88.1 ± 8.8)
Self-locking screw for securing brake calipers	187 ± 19	(19 ± 1.9)
Screw for securing brake disc to wheel hub	40 ± 4	(4 ± 0.4)
Brake cylinder securing nut	195 ± 15	(19.8 ± 1.5)
Screw for securing half-shaft to wheel hub	150 ± 15	(15.2 ± 1.5)
Wheel securing nut	490 ± 50	(49.9 ± 5)
Manual unbraking screw	30^{+6}_{-0}	$3^{+0.6}_{-0}$
Rear brakes (Rear axles MS10-144; MS10-164)		
Brake caliper fastening screw	187 ± 19	(19 ± 1.9)
Screw fastening the brake disc to the wheel hub	40 ± 4	(4 ± 0.4)
Screw fastening the axle shaft to the wheel hub	150 ± 15	(15 ± 1.5)
Wheel hub bearing fastening ring	932 ± 98	(93 ± 9.8)
Wheel fastening nut	490 ± 50	(49.5 ± 5)
Rear brakes (Rear axles MS13-165)		
Screw fastening the brake disc to the wheel hub	281.5 ± 13.5	(28 ± 1.3)
Brake caliper support fastening screw	289.5 ± 14.5	(29 ± 1.5)
Wheel hub bearing fastening ring	932 ± 98	(93 ± 9.9)
Screw fastening the axle shaft to the wheel hub	262 ± 35	(26 ± 3.5)
Brake caliper fastening screw	738.5 ± 61.5	(74 ± 6)
Rear brakes (Rear axles SP145E)		
Wheel hub adjusting nut securing ring	392.3 ± 20	(40 ± 2)
Nut for brake support fastening screw	289.5 ± 14.5	(29 ± 1.5)
Wheel fastening nut	600^{+50}_{-20}	(60^{+5}_{-2})
Screw fastening the axle shaft to the wheel hub	232.4 ± 24.5	(23.2 ± 2.4)

TOOLS

TOOL No.		DENOMINATION
99301001		Grinder and turning machine for brake drums and discs
99301005		Brake discs grinding assembly
99301006		Brake jaws turning device
99305087		Riveting press
99305117		Pneumatic circuits control instruments
99354207		Wrench (94.5 mm) for wheel hub covers (for front axles 5842/5 - 5851/5 - 5871/5)

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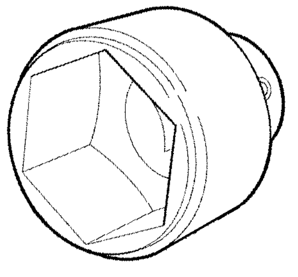
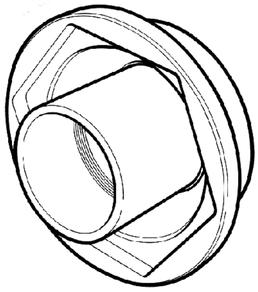
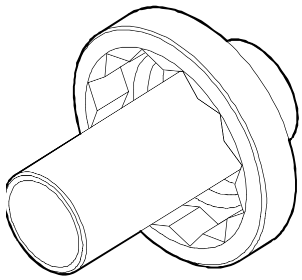
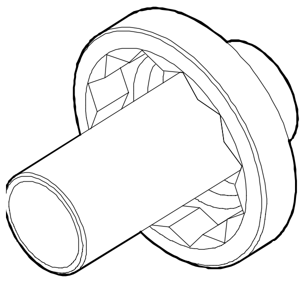
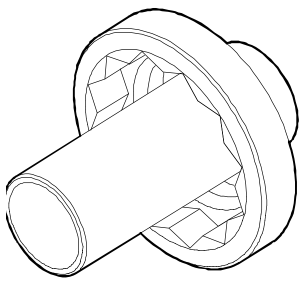
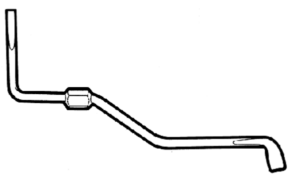
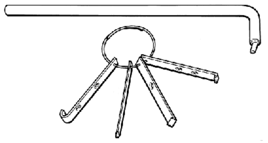
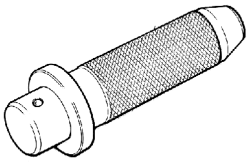
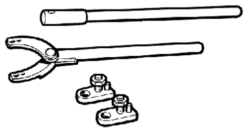
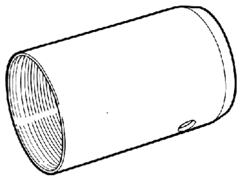
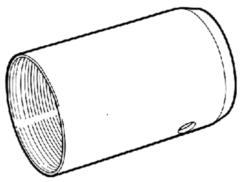
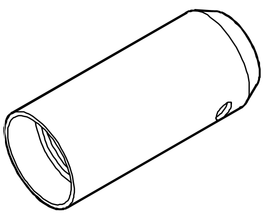
TOOLS

TOOL No.		DENOMINATION
99355038		Wrench (65 mm) for wheel hub cover (for front axle 5845) and for wheel hub bearings adjustment nut (for front axles 5842/5 - 5851/5) (use with 99370317)
99355167		Wrench (114 mm) for wheel hub bearings adjustment nut (for rear axles PR140E - PD145E)
99355177		Wrench (90 mm) for wheel hub bearings adjustment nut (for rear axle MS08-125)
99355180		Wrench (105 mm) for wheel hub bearings adjustment nut (for rear axle MS13-165)
99355182		Wrench (95 mm) for wheel hub bearings adjustment nut (for rear axle MS10-144; MS10-164)
99356001		Brake jaws adjustment wrench (for rear axle PR140E - PD145E)

TOOLS

TOOL No.		DENOMINATION
99363204		Gaskets removing tool
99370006		Handle for interchangeable beaters (for front axles 5845 - 5871/5)
99370317		Reaction lever with flanges check extension
99370700		Wheel hub assembling guide (for rear axle MS13-165)
99370711		Wheel hub assembling guide (for rear axle MS08-125)
99370712		Wheel hub assembling guide (for front axle 5845)

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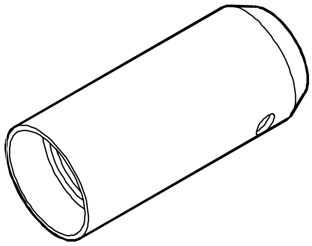
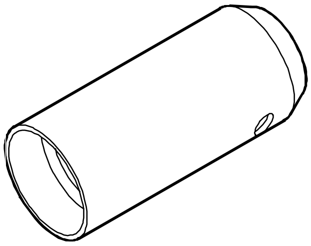
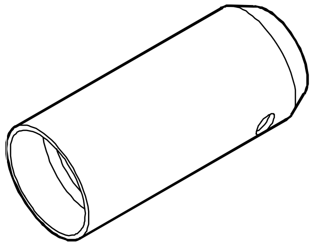
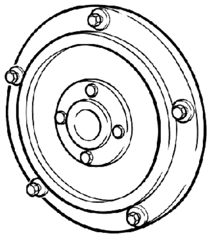
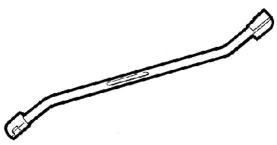
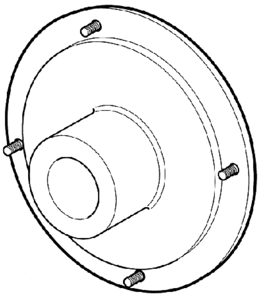
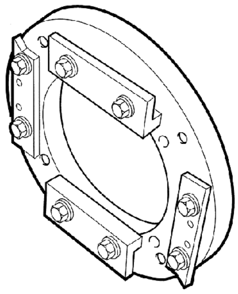
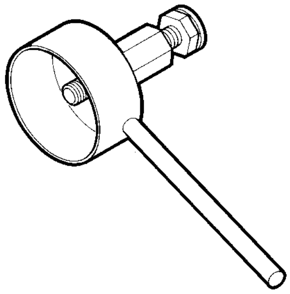
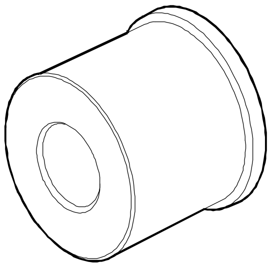
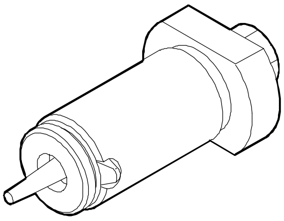
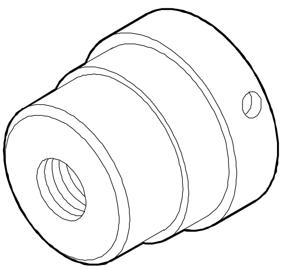
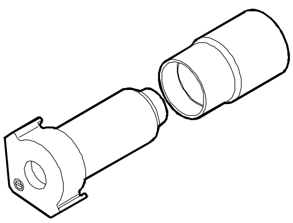
TOOLS		
TOOL No.		DENOMINATION
99370714		Wheel hub assembling guide (for front axles 5842/5 - 5851/5)
99370715		Wheel hub assembling guide (for front axle 5871/5)
99370719		Wheel hub assembling guide (for rear axles MS10-144; MS10-164)
99372213		Drum turning tool (use with 99301001) (for rear axle PR140E - PD145E)
99372217		Tools for disassembling and reassembling brake jaws check springs (for rear axle PR140E - PD145E)
99372228		Hub for placing disassembled floating jaws turning tools (to be used with 99301001) (for rear axle PR140E - PD145E)

TOOLS

TOOL No.		DENOMINATION
99372229		Tool for turning disassembled floating jaws (Stop-Master) (use with 99301001 and 99372228) (for rear axle PR140E - PD145E)
99372239		Tool for mounting the thrust presser with brake caliper protection
99372240		Tool for disassembling/re-assembling the brake caliper sliding collar guide bushings (to be used with 99372237)
99372242		Tool for countersinking the brake caliper sliding collar guide bushing
99372243		Tool for mounting the thrust presser inner gaskets (to be used with 99372239) and the brake caliper guide pin brass bushing (to be used with 99372240 and the screw of 99372237)
99372244		Tool for mounting the brake caliper guide pin rubber bushing (to be used with the screw of 99372237)

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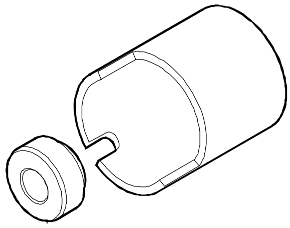
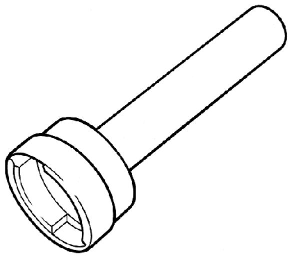
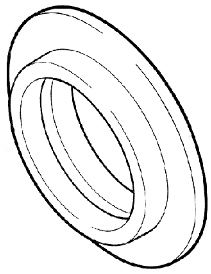
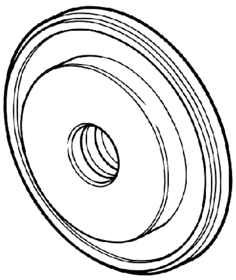
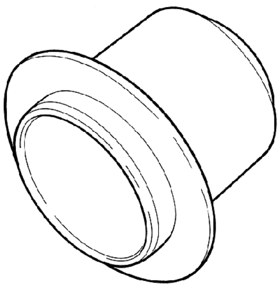
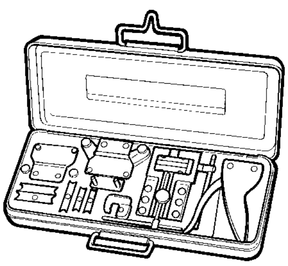
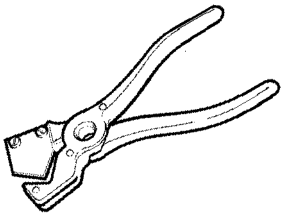
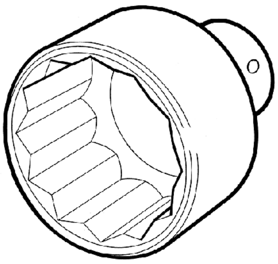
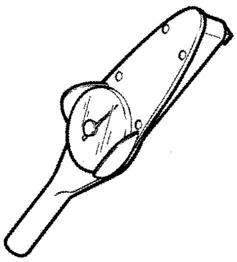
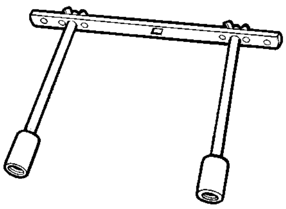
TOOLS

TOOL No.		DENOMINATION
99372245		Tool for disassembling the brake caliper guide pin rubber bushing (to be used with the screw of 99372237)
99373002		Coupler for mounting the wheel hub inner gasket (for rear axle PR140E - PD145E)
99374106		Keyer for assembling internal wheel hubs gasket (use with 99370005) (for rear axles PR140E - PD145E)
99374132		Keyer for assembling internal wheel hubs gasket (use with 99370006) (for front axle 5871/5)
99374233		Keyer for assembling internal wheel hubs gasket (for front axles 5842/5 - 5851/5)
99386523		Flanging machine for brake system pipings

TOOLS

TOOL No.		DENOMINATION
99387050		Cutting nippers for polyamide pipes
99388001		Wrench (80 mm) for wheel hub bearings adjustment nut (for front axle 5871/5)
99389819		Dynamometric wrench (0 - 10 Nm) with 1/4" square connection
99395026		Tool for checking hub rolling torque (use with dynamometric wrench)

SPECIFICATIONS AND DATA - PNEUMATIC SYSTEM

DENOMINATION	CHARACTERISTICS
Compressor	
❑ Type: KNORR	Single-cylinder
Displacement	225 cm^3
❑ Type: KNORR	Single-cylinder
Displacement	359 cm^3 (*)
(*) series-production on Full Pneumatic models - Optional on the other models	
A.P.U. (drier/4 ways)	
❑ Type: KNORR LA 8104/5/6/7	
Drier	
Disconnection pressure	11.0 ± 0.2 bar
Connection/disconnection pressure difference	0.7 + 0.6 bar
Safety valve opening pressure	13.0 + 4.0 bar
Heat resistance	max + 100° C
Operating temperature	-40° C ÷ +80° C
Supply voltage	24 V
Power	100W 24V
4-way protection valve	
Opening pressure section 21-22	≥ 7.5 bar
Opening pressure section 23-24	≤ 8.0 bar
Closing pressure section 21-22	6.5 ± 0.25 bar
Closing pressure section 23-24	≥ 6.5 bar
A.P.U. (drier/4 ways) (for vehicles RS)	
❑ Type: KNORR LA 8219/LA8220 - BOSCH 484460166/484460167	
Drier	
Disconnection pressure	11.0 ± 0.2 bar
Connection/disconnection pressure difference	0.7 + 0.7 bar
Safety valve opening pressure	15.5 ± 2 bar
Heat resistance	max + 80° C
Operating temperature	-40° C ÷ +65° C
Supply voltage	24 V
Power	100W 24V
4-way protection valve	
❑ Type: MARELLI VPS45A - WABCO 9347140190	
Opening pressure section 21-22	≤ 7.5 bar
Opening pressure section 23-24	≥ $7.5^{+0.5}_{+0.2}$ bar
Closing pressure section 21-22	6.5^{+1}_{-0} bar
Closing pressure section 23-24	6.5^{+1}_{-0} bar

DENOMINATION	CHARACTERISTICS
Air tanks	
Front axle	15 l
Rear axle	15 l
Trailer + parking (for vehicles adapted for towing)	20 l
Front axle (for vehicles adapted for towing and Models 180E..)	20 l
Rear axle (for vehicles adapted for towing and Models 180E..)	20 l
Manual discharge valve	
❑ Type: VOSS 520 899 750 0	
Maximum pressure	13 bar
❑ Type: TECKNOMATIK - TP 1609.00.00	
Maximum pressure	13 bar
Safety valve	
Calibration for models with mechanical suspension (optional)	12 ± 1.2 bar
Calibration for models with pneumatic suspension (optional)	12 ± 1.2 bar
Duplex distributor	
❑ Type: KNORR DX 65 A - DX 65 B	
Supply pressure	11 ± 0.2 bar
Self-limiting pressure	7.6 ± 0.3 bar
Pressure reducer (for vehicles adapted for towing)	
❑ Type: BENDIX HVSI AC 156 B	
Supply pressure	18 bar (max)
Output pressure	$8.5^{+0}_{-0.4}$ bar
Safety valve opening	10 ± 0.5 bar
❑ Type: WABCO 475 015 0310	
Supply pressure	11 bar
Output pressure	$8.5^{+0}_{-0.4}$ bar
Safety valve opening	11 bar (max)
Relay valve	
❑ Type: KNORR AC 574 AXY	10 + 0.2 bar
Maximum operating pressure	-40° ÷ 40°C
Check valve	
Maximum operating pressure	20 bar
Parking brake distributor (single vehicles)	
❑ Type: KNORR BREMSE DFR0208A	
Supply pressure	11 bar
Operating pressure	7.5 bar
Control lever excursion (discharging) with safety braking start (resistance point)	67°
Parking braking	73°

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DENOMINATION	CHARACTERISTICS
Parking brake distributor (vehicles adapted for towing)	
❑ Type: KNORR - BREMSE DPM 90 EY	
Supply and operating pressure	8.5 bar
Control lever excursion (discharging) with safety braking start (resistance point)	67°
Parking braking	73°
Control braking for supply check to trailer braking modulated servodistributor	86°
Parking brake safety distributor (upon request)	
❑ Type: WABCO 434 205 0300	
Maximum operating pressure	11 bar
Cylinder pressure (under which the supply is blocked)	$4^{+0}_{-0.6}$ bar
Quick discharge valve	
❑ Type: BENDIX HVSI KX 1294/2 - WABCO 973 500 006 0	
Max. operating pressure	10 bar
Triple-control servodistributor (for vehicles adapted for towing)	
❑ Type: KNORR - BREMSE AC 597 B	
Operating pressure	8.5 bar
Predominance	0.2 bar
Distributor intervention differential pressure (ducts 41-42)	$2.5^{+0.5}_{-0.3}$ bar
Maximum allowed pressure	12 bar
Moderate and automatic coupling heads	
❑ Type: BOSCH - KNORR - WABCO - ISO	
Operating pressure	7.5 bar
Pressure control plug valve	
❑ Type: RAUFOSS 623.7770 - FER.NA F103 087	
Max. operating pressure	12.5 bar
Membrane brake cylinder (for front axles - models 110 EL.. - 120 EL..)	
❑ Type 22: WABCO 423 110 711 0	
Max. operating pressure	10 bar

DENOMINATION	CHARACTERISTICS
Membrane brake cylinder (for front axles - models 120 E.. - 130 E..)	
❑ Type 14: KNORR IC 72563	
Max. operating pressure	10.7 bar
❑ Type 16: KNORR IC 72565	
Max. operating pressure	10.7 bar
❑ Type 18: KNORR IC 72231	
Max. operating pressure	10.7 bar
❑ Type 20: KNORR IC 72233	
Max. operating pressure	10.7 bar
Membrane brake cylinder (for front axles - models 150 E..)	
❑ Type 20: KNORR IC 72233	
Max. operating pressure	10.7 bar
❑ Type 22: KNORR IC 72235	
Max. operating pressure	10.7 bar
Membrane brake cylinder (for front axles - models 180 E..)	
❑ Type 24: KNORR IC 72237	
Max. operating pressure	10.7 bar
Membrane brake cylinder (for front axles - models 260 E..)	
❑ Type 24: KNORR IC 72237	
Max. operating pressure	10.7 bar
Combined brake cylinder (for rear axles - models 110 EL.. - 120 EL..)	
❑ Type 16/16: WABCO 925 424 839 0	
Max service brake operating pressure	10 bar
Max. parking brake operating pressure	8.5 bar
Spring load	6500 N
Combined brake cylinder (for rear axles - models 120 E.. - 130 E..)	
❑ Type 16/27: KNORR - BREMSE BS 8317/BS 8316	
Stroke	57 mm

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DENOMINATION	CHARACTERISTICS
Combined brake cylinder (for rear axles - models 150 E..)	
❑ Type 16/24 HFL3: KNORR - BREMSE BS 8320/BS 8321	
Stroke	57 mm
❑ Type 18/24 HFL3: KNORR - BREMSE BS 9364/BS 9365	
Stroke	57 mm
Combined brake cylinder (for rear axles - models 180 E..)	
❑ Type: 18/27: KNORR IC 68084	
Max service brake operating pressure	10.7 bar
Max. parking brake operating pressure	8.5 bar
Minimum stroke	64 mm
Combined brake cylinder (for rear axles - models 260 E..)	
❑ Type: 9/6000/180: BENDIX HVSE D7 5478	
Membrane brake cylinder (for rear axles - models 260 E..)	
❑ Type 9/187: BENDIX EF 90FY	
Barrel length	8.5 bar
Electronic unit for ABS/EBL system	
❑ Type: KNORR ES 1082-II/35431 - WABCO O 486 14 110 - B 486 104 073	
Supply voltage	22 ÷ 26 V
ABS/EBL system wheel anti-locking modulator	
❑ Type: KNORR IC65307	
Max. operating pressure	10 bar
❑ Type: WABCO 472 195 055 0	
Max. operating pressure	13 bar

SPECIFICATIONS AND DATA - BRAKES

FRONT AND REAR BRAKE CALIPERS AND DISCS	Front axle 5845 Rear axle MS08-125	Front axles 5851/5 - 5842/5 Rear axles MS10-144 MS10-164	Front axle 5871/5 Rear axle MS13-165
	Floating caliper PAN 17	Floating caliper SB6 - SN6	Floating caliper KNORR SN7
Brake calipers cylinders: - number - diameter ∅ mm	 - -	 2 -	 2 68
Braking gaskets thickness: - normal S mm - minimum allowed S mm	 19 2	 21 2	 21 2
Brake discs diameter ∅ mm	330	377	432
Brake discs thickness: - normal S mm - minimum allowed S mm	 34 ÷ 33.85 28	 45 41	 45 41
WHEEL HUBS			
Wheel hub bearings	UNIT BEARING	2, tapered-roller type (for front axles) UNIT BEARING (for rear axles)	
Front axle bearing rolling torque: Nm (kgm)	 - -	 3 (0.3)	 5 (0.54)
Wheel hubs clearance	Not adjustable (securing ring nut torque tightening)		
Oil for wheel hub bearings	Tutela SAE W 140/M DA		
Amount for every hub L* (Kg)	0.23 (0.2)	0.23 (0.2)	0.33 (0.3)

* The oil amounts refer to front axles; the amounts referring to rear axles will be specified in the next edition.

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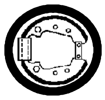
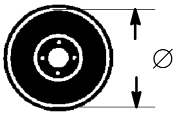
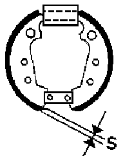
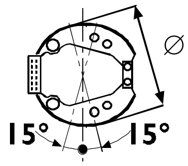
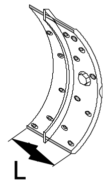
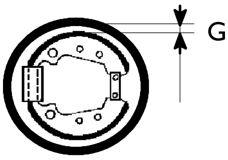
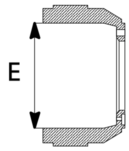
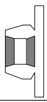
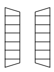
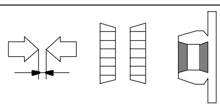
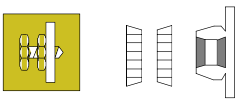
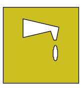
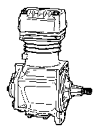
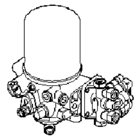
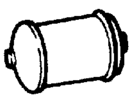
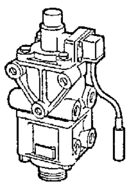
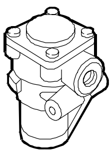
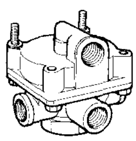
		TANDEM AXLE (Meritor SP 145 E)	
	**Rear drum brakes**	PD 145 E (R2468)	PR 140 E (R0868)
		INTERMEDIATE	REAR
	Drum diameter: - Rated ∅ mm - 1st increase ∅ mm - 2nd increase ∅ mm	380.9 to 381.1 382.9 to 383.1 384.9 to 385.1	
	Braking gaskets thickness: - Rated S mm - 1st increase S mm - 2nd increase S mm - Minimum allowed S mm	18 19 20 6.5 (in the area where a wear is signalled)	
	Braking gaskets diameter: - Rated ∅ mm - 1st increase ∅ mm - 2nd increase ∅ mm	378 to 380 380 to 382 382 to 384	
	Braking gaskets width L mm	177 to 178.6	
	Clearance between braking gaskets and drum: G mm	0.45 to 1.55	
	Maximum tapering error for drum diameter after turning E mm	0.04	
	**Rear wheel hubs**		
	Wheel hub bearings	2 with tapered rollers	
	Hub bearings and play	0 to 0.05 mm	
	Wheel hub and play	Adjustable through a ring nut	
	Axle oil TUTELA W140/M-DA with Hendrickson suspension Liters (kg)	16.2 (14.6)	12.2 (11)

CHECKS OF MAIN BRAKE SYSTEM COMPONENTS

Since the vehicle system is homologated according to European Code standards, it is mandatory to periodically check the efficiency of system and related components with device 99305117.
These checks must be carried out with unmoving vehicle, using the compressed air into the tanks, recharged, with started-up engine, by the compressor.

Always lock the vehicle, before any intervention. Periodically check the manometers by comparing them with a sample manometer.

DEVICE	DENOMINATION	INTERVENTIONS
	Compressor	Check of fittings tightening and compressor securing; make sure that cooling fins are not dirty.
	A.P.U. (Air Processing Unit)	Check by actuating a drain valve or by loosening a screw plug (with integrated drain hole), whether the air drier correctly operates. In this case air must go out of the tank without traces of condensate water.
	Air tanks Humid Front axle Rear axle Trailer + parking	Check of corrosion-preventing seal and protection. Discharge the condensate from tanks by operating on the drain valve.
	Duplex distributor	Completely press the pedal; when the action ceases, the pedal must immediately go back into its rest position. Pressure limiting: 7.6 ± 0.3 bar. Check that the pedal gasket is not worn, that brake control tie-rods are well tightened and lubricated, nor distorted. Check that lever housings are neither worn nor oxidised.
	Pressure relief valve	Check calibration pressure (see Characteristics and data table). Check its functionality.
	Relay valve	Check functionality and seal evaluating brake cylinders quick intervention.
	Engine brake control operating cylinder	Check functionality and seal.

(continues)

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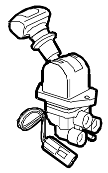
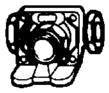
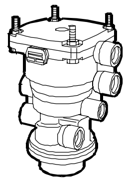
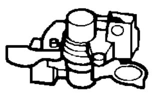
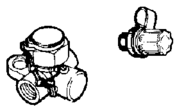
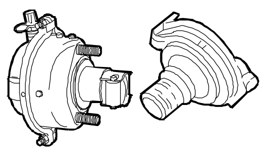
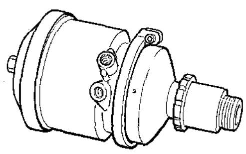
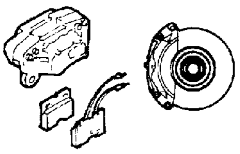
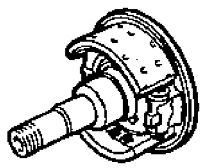
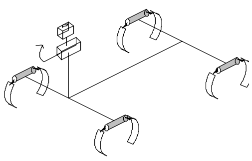
DEVICE	DENOMINATION	INTERVENTIONS
	Parking brake distributor Parking brake distributor (with control position)	Actuate the parking brake distributor till it snaps; the manometer inserted on the control plug must mark the pressure discharge down to 0 bar in 1 sec. Simultaneously at the automatic coupling joint duct, the manometer must show a pressure of 7.5 bar.
	Quick discharge valve	Check functionality and seal. Actuate the parking brake distributor, verify that the compressed air is quickly discharged from the circuit.
	Trailer braking triple-control servodistributor	Fill-in the tank. Connect a manometer to the automatic coupling head, and one to the moderate coupling head. At a pressure of 1 bar, sent by Duplex distributor, in the moderate coupling head a pressure from 0.8 to 1.5 bar must correspond. Carry out a total braking (unmoving vehicle). At the coupling head, the required braking pressure must be available or a pressure decreased by 0.5 bar. Insert the parking brake; at the moderate coupling head, the pressure must remain unchanged or decreased by 0.5 bar.
	Coupling heads	Check that there are no dirt or damages in coupling guides. At the end of the coupling, actuate the brake pedal and check seal and stability between coupling heads by inserting air at 7.5 bar. Check that there is no air leakage from coupling gaskets.
	Hydraulic or pneumatic pressure control plugs	Make sure that protection plugs are inserted, check that they are completely screwed.
	Membrane cylinder	Check securing, integrity and seal. The drain hole must be downwards oriented and must not be clogged.
	Combined cylinder	Check securing, integrity and seal. The drain hole must be downwards oriented and must not be clogged.

(continues)

DEVICE	DENOMINATION	INTERVENTIONS
	Disc brake caliper Brake disc Braking gaskets	Check braking gaskets wear status, brake disc scorings and wear, pistons efficiency, dust-guarding casing wear conditions.
	Drum brakes	When ceasing the pressure on the pedal, the jaws must quickly and smoothly go back on all wheels to their rest position. Check clearance between jaws and drum. Check braking gaskets thickness.
	Pipings and fittings	Make sure that metal pipings are in a perfect condition, without dents nor cracks; polyamide pipings must not show fissures, cuts or nickings. Make further sure that they are far from body and chassis cutting edges that could damage them. Check that all piping anchoring brackets are well secured; their loosening in fact causes vibrations with following danger of breakages. Verify that rubber and cloth pipes have not come in contact with oil or mineral grease, that are rubber solvents. Strongly press the brake pedal and check that pipes do not show swellings, that signals leakages from internal pipe. Check that there are no brake fluid leakages from various fittings, otherwise it will be necessary to completely tighten them, with the warning not to generate, during their closure, anomalous pipe torsions. In all mentioned cases, it is necessary to replace the related parts when there is even a minimum doubt about their efficiency. Apart from their conditions, it is advisable to replace the hoses after many kilometers or after a long period of vehicle use: this to avoid a sudden breakage due to ageing and fatigue.
	Pneumatic system seal with off engine under the disconnection pressure	This check is carried out on threaded fittings, inserting an air pressure not less than 5 bar into the system, laying rather dense soapy water on joints and fittings with a soft brush and observing that there are no leakages. An air loss is tolerated corresponding to a ∅ 25 mm soap bubble in 5 seconds, or anyway a max pressure drop within 10 min of 2% of disconnection pressure = 0.22 + 0.02 bar.
	Pneumatic system seal in the partial braking range with 3 bar	For 3 min the pressure must be kept stabilised in the pneumatic system. The check must be carried out with disconnected parking brake.

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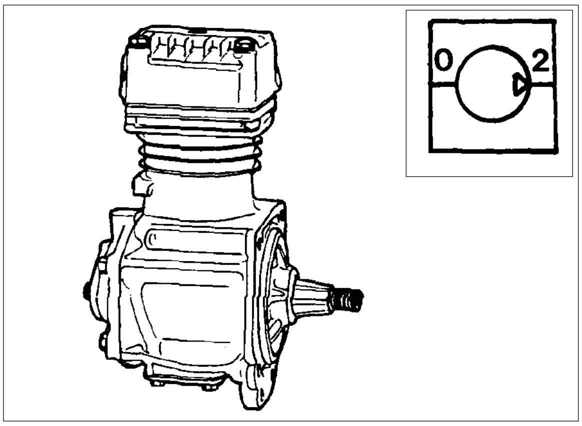
MAIN BRAKE SYSTEM COMPONENTS

790510 COMPRESSOR

❑ Knorr

Figure 30



30411

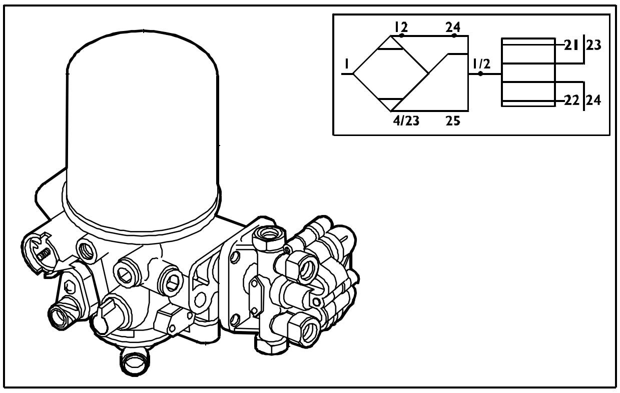
It produces the necessary compressed air for braking system and auxiliary services.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Oil leakages from flange, external side	Incorrect tightening torque.	Lock the screws according to the required values.
	Not perfectly plane flange body sealing surfaces.	Check sealing surfaces, replace faulty parts or take them back on a plane.
	Broken gasket.	Replace gasket.
	Damaged shaft gasket.	Replace gasket.
Oil leakage from the head	Worn scraper ring (it is noted because all the sealing seat is shining).	Replace the whole piston
	Faulty scraper ring assembling.	It must be assembled with the writing TOP toward the compressor head
	Scraper ring and elastic bands all on the same vertical line.	Assemble piston rings at 120° one form the other
	Scored or ovalised cylinder.	Grind the cylinder and assemble a greater piston
Total lack of compression	Deteriorated compression or suction valve.	Replace the worn parts.
	Elastic bands all on the same vertical line.	Assemble the bands at 120° one to the other.
	Holed piston or breakage of piston-related members.	Replace the complete piston.
	Damaged gaskets.	Replace the gaskets.
Scarce efficiency	Worn elastic bands.	Replace the piston (completed with elastic bands)
	Air leakage between cylinder and head.	Replace the gasket and lock the screws at the required tightening torque.
	Excessive clearance between piston and cylinder.	Grind the cylinder and assemble an increased piston.
	Carbonised oil particles between suction and compression valves.	Clean the valves.
Mechanical noise	Excessive clearance between connecting rod foot and pin, between pin and piston hole, between shaft and connecting rod head, between shaft and bushings and between flanges and shaft.	Check affected couplings tolerance.
	Excessive clearance between piston and cylinder.	Grind the cylinder and assemble an increased piston.
	Excessive fouling between piston and cylinder head caused by burnt oil.	Clean fouled parts and replace the valves.
Water blow-by	Scored and irregular head gasket or coupling planes.	Replace the faulty parts.

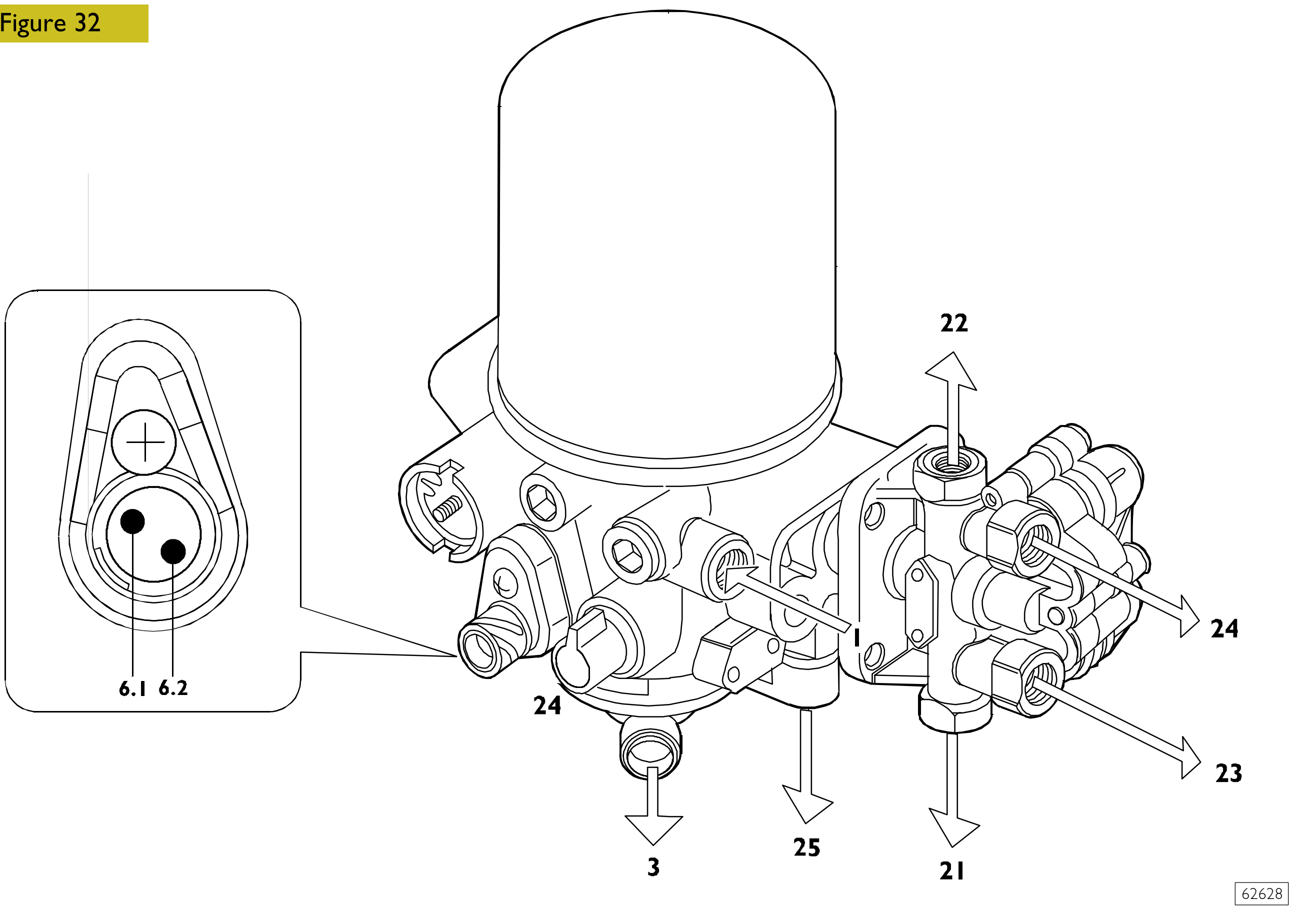
A.P.U. (Air Processing Unit)

Figure 31



Its task is keeping cleanness and correct humidity of air in the distribution system and keeping the necessary output pressure for operating the connected systems.
This component integrates the functions of four-way pressure regulator, pressure reducer for parking, services and trailer.

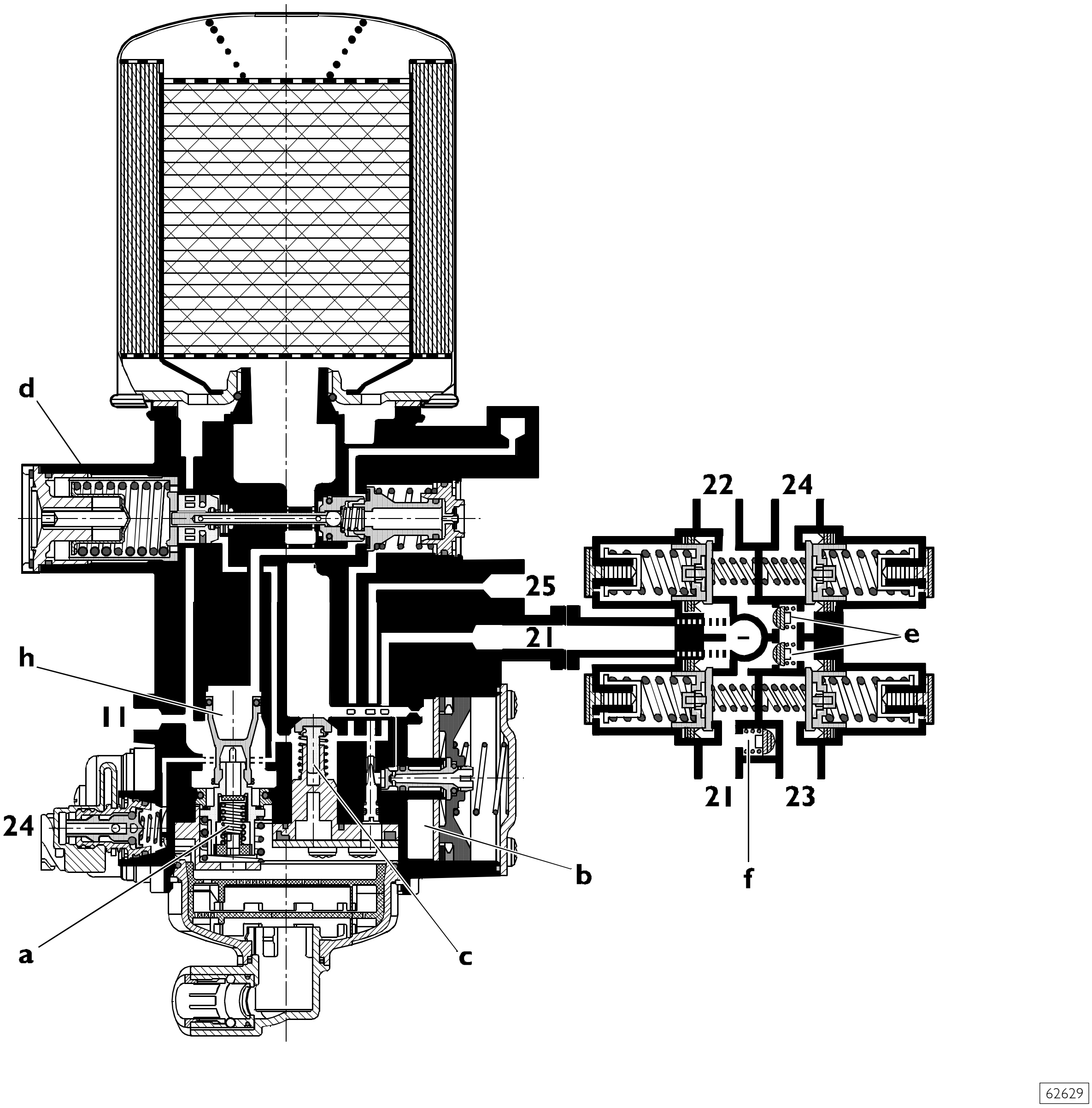
Figure 32



Pneumatic connections	Electric connections
Drier	6.1 - Negative for thermostatic resistance
1 - From compressor	
3 - Exhaust	
24 - To services	
25 - To pneumatic suspension	
4-way valve	
21 - To rear axle air tank	
22 - To front axle air tank	6.2 - Positive for thermostatic resistance
23 - To parking plus trailer air tank	
24 - To services	

Operation

Figure 33



Recharge phase:

The compressed air coming from the compressor through the supply fitting "11" is arranged on the safety valve "a" (calibrated at 13+4 bar) and through the suitable channel it reaches the drier filter.

Compressed air gives off, as it passes through the filter, its own moisture and feeds the timer "b" chamber through the calibrated hole. At the same time, it opens the unidirectional maintain valve "c", thus feeding the outlet 24 pressure intake, pressure regulator "d", pneumatic suspension circuit feed outlet 25 and, through outlet 21, the four-way protection valve. This valve will convey the air below the controlled-pressure valves of brake system outlets 21 and 22.

When a pressure of ≤ 7,5 bar is reached, the controlled-pressure valves will open, thus making it possible to feed the systems connected.

Simultaneously, through the two unidirectional valves "e", air can reach the controlled-pressure valve of the secondary sections.

The further pressure increase and reaching a pressure > 8 bar allow opening the controlled-pressure valves in the secondary sections and consequently supplying the outlets 23 and 24

(continues)

When reaching the regulator calibration pressure of 10.3 $^{+0.2}$ bar, there occurs the opening thereof and the consequent opening of discharge valve "h" that generates a pressure drop inside the drier and the unidirectional keeping valve "c" closure and the activation of the drier filter regeneration step. The slow pressure drop of the timer supply chamber allows the pressure return from systems for a time of about 20 seconds. The compressed air returning from systems, when passing through the filter, will guarantee its regeneration and will discharge itself in the atmosphere through vent 3.

Failure phase of duct 21

In case there is a failure to main four-way protection valve circuit, the component will behave as follows:

The pressure drop that affects outlet 21 creates a general pressure drop in the whole component till the closure pressure is reached (6.5 bar) for the controlled-pressure valve in the faulty section.
This pressure decrease also goes to the regulator "d" that by moving itself goes back to its recharge condition.
The pressure drop in duct 21 creates the displacement and discharge opening of the safety valve "f" for the parking duct, that discharges the protection valve duct 23. With moving vehicle, the parking cylinders supply will be guaranteed either by the manual self-limited distributor (single vehicles) or by closing the unidirectional valve (vehicles adapted for towing) avoiding the vehicle self-braking.

Under this failure condition, the possible connected trailer will instead be automatically braked.

The system recharge, ensured by the regulator intervention, will take back the pressure at the opening levels of the controlled-pressure valve of the faulty section (about 7.5 bar), guaranteeing this pressure in all other component outlets.

The possible failure of all other sections will guarantee that the faulty valve opening pressure is kept for the healthy sections.

! With any protection valve failure, the system supply is ensured at pressure levels that guarantee brake functionality but filter regeneration will not be ensured any more since this function is only activated when reaching the regulator triggering pressure.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Excessive amount of condensate in the circuit	Clogged filtering cartridge.	Replace the cartridge
The calibration pressure is not reached in the tank	Air leakage from safety valve. Worn sealing gaskets.	Revise the device replacing the worn parts Revise the device replacing the worn parts
Exhaust air leakage	Insufficient piston seal.	Revise the device replacing the worn parts
Air leakage next to plugs	Valve leakages in the four sections.	Revise the device replacing the worn parts.
Air leakage in case of section failure	Faulty non-return valve operation.	Revise the device replacing the worn parts, if necessary, or replace the device.

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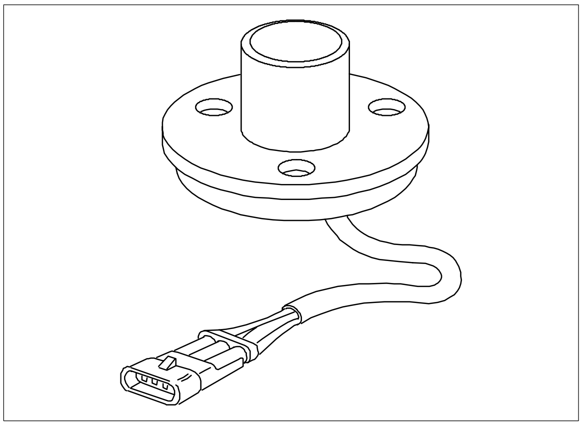
ENGINE BRAKE SWITCH

Figure 34

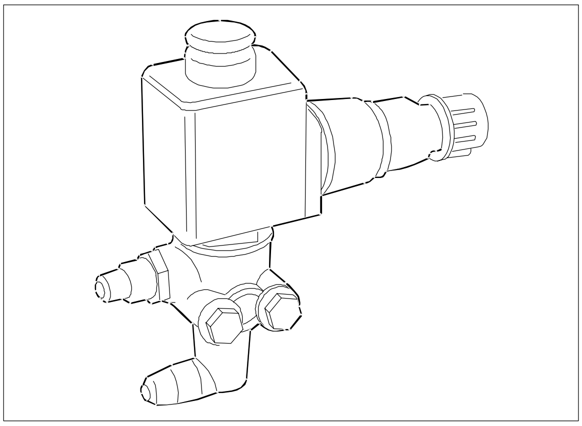


62372

It is a N.O. switch assembled on cabin floor. It provides a negative signal to the electronic unit for inserting the engine brake.

793336 ENGINE BRAKE SOLENOID VAL-VE

Figure 35

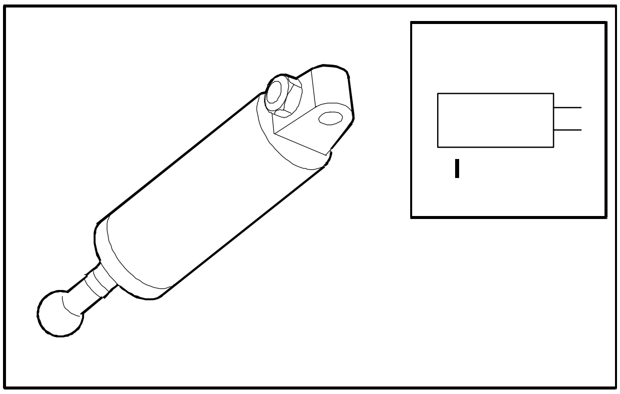


62382

It is an on/off solenoid valve of the N.C. type placed on the chassis.
This solenoid valve, driven by the unit, suitably supplies the engine brake control operating cylinder. A luminous signaller, placed on the dashboard, signals the engine brake insertion.

543730 ENGINE BRAKE CONTROL OPERATING CYLINDER

Figure 36

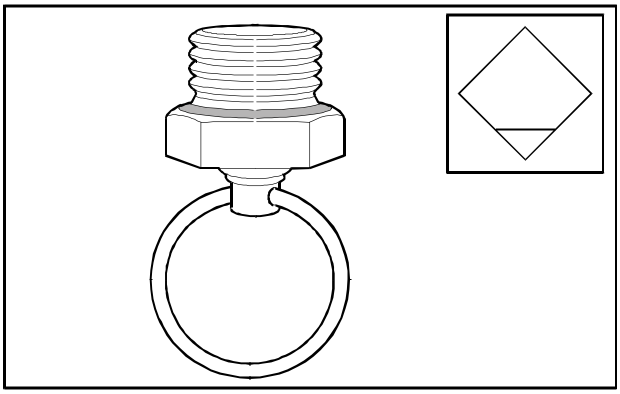


72658

The operating cylinder actuates the throttle valve clogging the engine exhaust gases duct.

MANUAL DISCHARGE VALVE

Figure 37

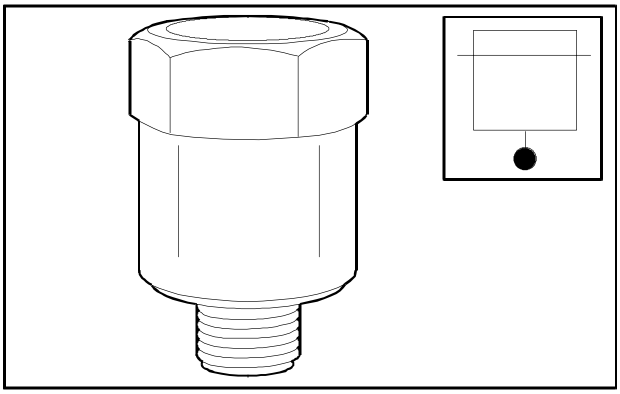


71957

This valve is assembled in tanks and its function is manually removing the possible condensate accumulated in the system tanks.

SAFETY VALVE (Optional)

Figure 38

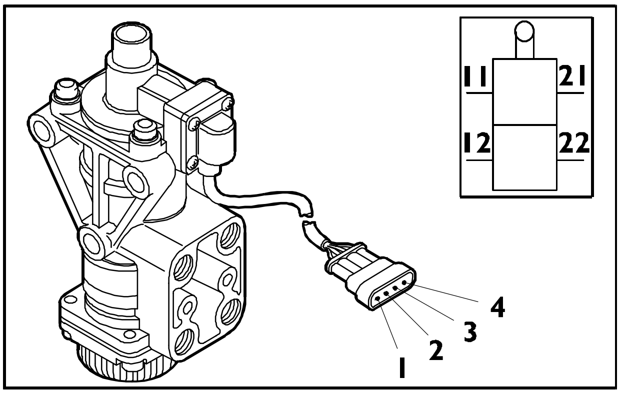


71959

It ensures the system limiting at a safety pressure in case of lack of pressure regulator operation.

793110 DUPLEX DISTRIBUTOR

Figure 39



62579

The device is divided into two independent sections whose adjustment members are controlled in parallel by a push rod that operates on an equalizer.

It takes air from tanks and delivers it to braking elements.

It is self-limited, that is, it limits air delivery at a maximum established pressure and therefore there occurs a higher energy availability and a constant maximum braking pressure independently from pressure oscillations in tanks.

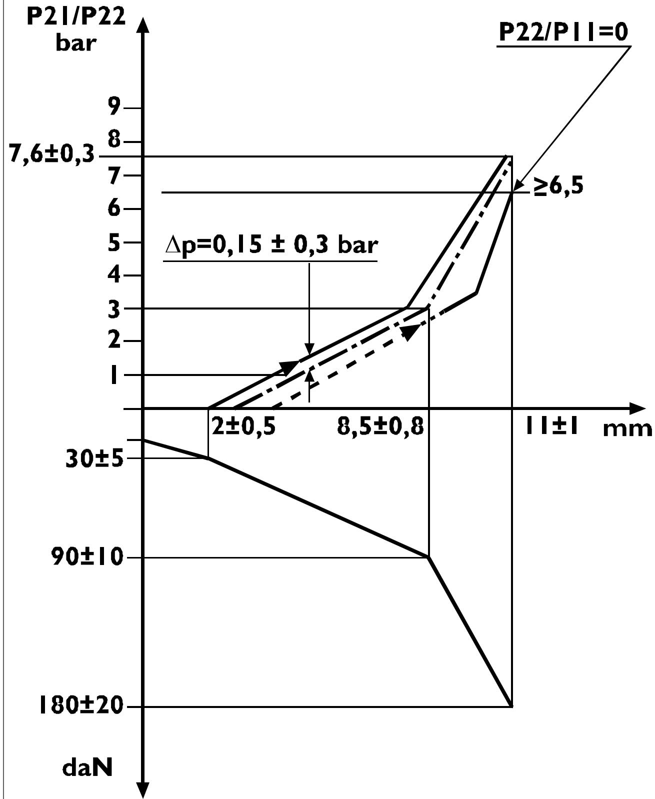
Pneumatic connections

11 - From rear axle air tank
12 - From front axle air tank
21 - To rear axle
22 - To front axle
3 - Discharge

Electric connections

1 - Free
2 - Positive for STOP lights/Body Controller
3 - Input positive
4 - EDC positive

Figure 40



71951

The diagram shows the characteristic distributor curve and the self-limitation value at 7.6 ± 0.3 bar.

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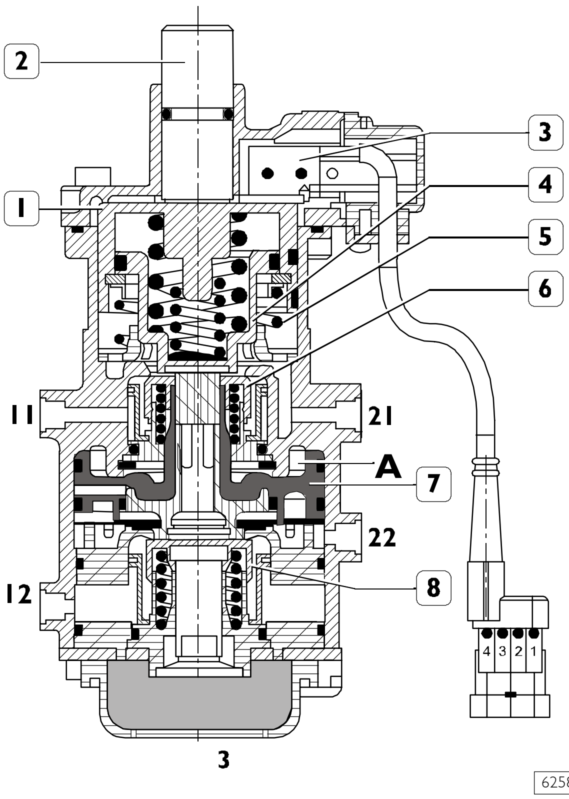
Figure 41



Under rest conditions, the exhaust is open, since spring (5) pushes the pistons assembly (upper valve seat) (1 and 4) upwards.
Valves (6 and 8) are in contact against their respective sealing seats and intercept the passage of air between air inlet fittings **11** and **12** and outlets **21** and **22**.
The lower valve seat piston (7) is at rest (running) with discharge **3** open.
By operating on the brake pedal, control push rod (2) and pistons assembly (1 and 4) are pushed downwards.

Piston push rod seat (4) initially closes the exhaust and afterwards opens upper valve (6). Compressed air, from fitting **11**, passes and supplies fitting **21**, rear axle and chamber **A**.

When in section **21** and chamber **A** a pressure value is reached of about 0.15 ÷ 0.3 bar, valve (8) is also opened due to the piston thrust effect.

Piston (7) abuts on valve (8), closes the exhaust and opens the passage between fitting **12** and fitting **22** that supplies the front vehicle section.

In case of failure in the control section **11-21**, the other one **12-22** intervenes only due to the mechanical thrust effect of upper pistons (1 and 4).

By completely operating on control push rod (2) (maximum stroke), the output pressure of the two sections **21** and **22** reaches 7.6 ± 0.3 bar that is the pressure self-limiting value.
In case of failure 0 (zero) bar in supply fitting **11**, by completely operating on control push rod (8) air must go out of fitting **22** till a pressure equal to or greater than 6.5 bar.

Such behaviour is guaranteed by the control push rod (2) mechanical thrust that abuts on piston (1); afterwards, piston (4) comes in contact with (7) and opens valve (8).

At a push rod (2) stroke of 0.5 ÷ 1.5 mm, the stop lights contacts are closed and the engine brake contacts are opened in microswitches (3).

Unbraking

By releasing the brake pedal, the control push rod (2) and the piston assembly (1 and 4) return upwards together with piston (7).

By going on releasing the brake pedal, the valves remain into their respective entry seats and afterwards the exhaust seats of pistons (4 and 7) are detached from valves and air flows to the atmosphere through exhaust **3**.

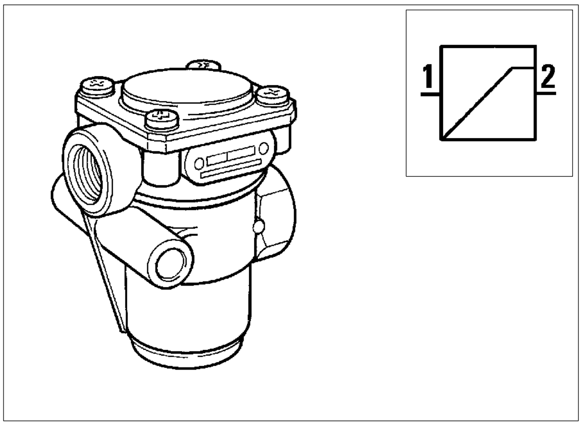
At the end of the release, also microswitches (3) return to their running position.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from discharge hole	Outlet ducts leakage for sealing gaskets wear.	Revise the device replacing the faulty parts.
Distributor with irregular self-limitation	Self-limitation higher or lower than the required one.	By operating on the suitable screw, calibrate the device.
Vibrations when braking	Springs wear.	Revise the device replacing the faulty parts.
	Air leakage caused by piston gaskets seal in the two sections.	Revise the device replacing the faulty parts.
Irregular stop lamp control switch operation	The electric circuit does not close.	Replace the switch.
	The electric circuit does not open.	Replace the switch.

793321 PRESSURE RELIEF VALVE

Figure 42



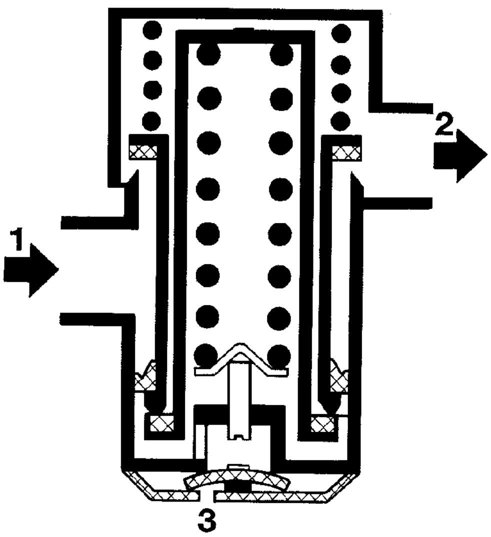
34953

Its function is stopping the compressed air flow to users when pressure in users reaches a certain (calibration) value.

Operation

- ❑ System supply

Figure 43

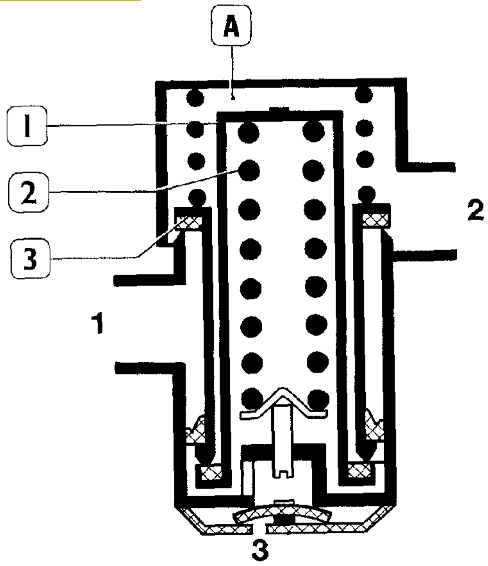


70118

Air incoming from tanks freely passes through the reducer from fitting **1** to fitting **2** till the calibration pressure is reached.

Pressure limitation

Figure 44



20046

When air contained into chamber (A) reaches the calibration values, it wins the force of spring (2) and pushes pistons (1 and 3) downwards stopping the supply.
If in fitting **2** the pre-established pressure is accidentally exceeded, the piston element goes on running downwards and valve (2) is opened for the necessary time for discharging, through hole **3**, the excessive pressure.

Bench calibration

Assemble the device on the test bench, and connect fittings **1** and **2** through pipings to manometers and supply. Adjust through an adjustment screw at the pressure value of $7.5^{0.3}_{-0}$ bar, and simultaneously check the perfect seal thereof.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Fitting 2 pressure different from calibration pressure	Uncalibrated valve. Sealing rings leakage. Faulty piston and related seat.	Calibrate the device. Revise the device replacing the damaged parts. Replace the device.

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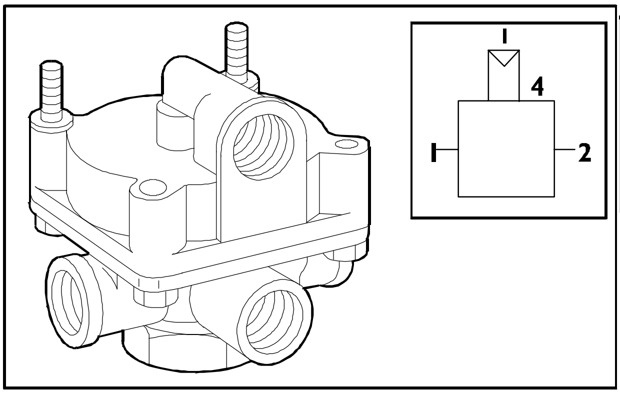
793331 RELAY VALVE

Figure 45



72659

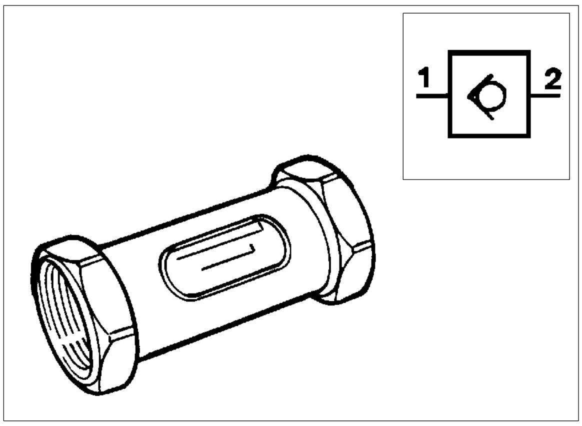
The device allows accelerating the compressed air discharge from combined cylinder section, thereby shortening the braking times.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from exhaust with discharging control duct	Leakage from entry or sealing rings.	Revise the device replacing the faulty parts.
Air leakage from exhaust with control duct supply	Leakage from piston gasket or discharge valve.	Revise the device replacing the faulty parts.

793319 CHECK VALVE

Figure 46

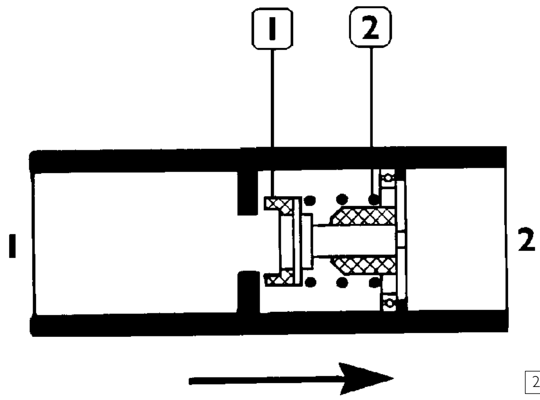


33987

It prevents the compressed air reflow from trailer tank.

Operation

Figure 47



25958

1. Complete valve - 2. Spring

It allows the passage of compressed air along the direction shown by the arrow placed on valve body, preventing its reflow.

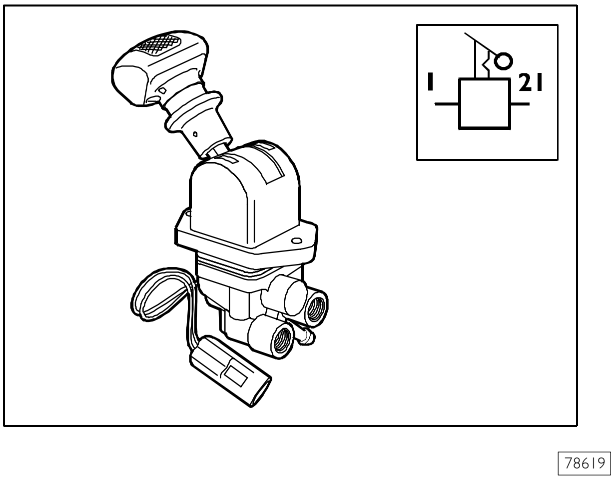
The valve is connected as follows:

1 - Supply

2 - Delivery

794310 PARKING BRAKE CONTROL MANUAL DISTRIBUTOR (Single vehicles)

Figure 48



The device, inserted in the tractor parking brake circuit, allows performing the vehicle safety and parking braking by discharging air contained in spring cylinders.

The device is connected as follows:

1 - From four-way protection valve;

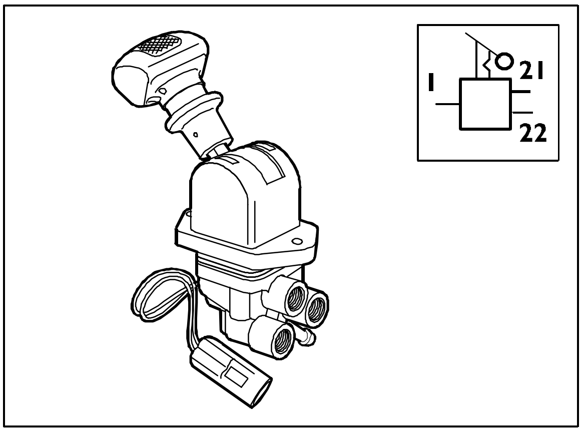
21 -To quick discharge valve upstream of spring cylinders.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from exhaust with distributor lever in unbraking position	Worn or faulty piston, discharge valve, sealing rings.	Carry out an accurate cleaning, making sure that the rubber parts and related seats are healthy. Revise the device replacing the faulty parts.
Air leakage from exhaust with distributor lever in safety or parking braking position	Faulty or deteriorated piston and related sealing ring.	Carry out an accurate cleaning and check of parts, revise the device replacing the faulty parts.
Air leakage from distributor control lever cover	Faulty or worn plate, gasket, sealing rings.	Carry out an accurate parts cleaning, check sealing surfaces and gasket, make sure that rubber part and related seats are healthy. Revise the device replacing faulty or worn parts, possibly restore union plane surfaces.
Difficult distributor control lever rotation	Interferences inside the distributor.	Carry out an accurate cleaning and check of all component parts. Revise the device replacing the faulty parts, when assembling moderately grease all sliding parts. If such failures or wears are detected that impair the operation, replace the complete device.

794310 PARKING BRAKE CONTROL MANUAL DISTRIBUTOR (Vehicles adapted for towing)

Figure 49



78618

The device allows performing the safety and parking braking of tractor and trailer.
The parking braking is mechanical for tractor and pneumatic for trailer.
The device further allows checking the braking tractor effect. Such operation is mandatory when the vehicle is parked under high slope conditions.

The device is connected as follows:

1 - From four-way protection valve

21 - To spring cylinders

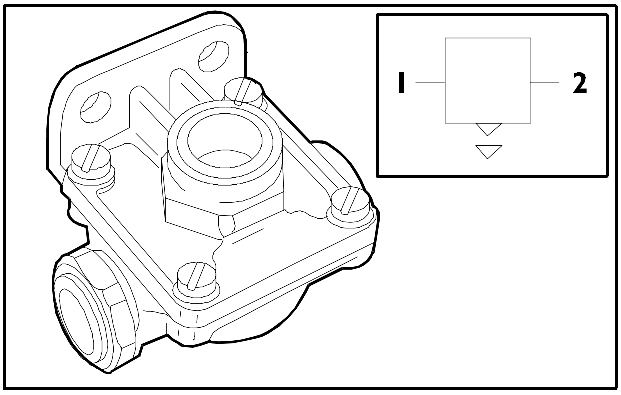
22 - To trailer braking triple-control servodistributor.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from exhaust with control lever:		
In unbraking position	Faulty valve (5), related seat or sealing ring	Check and revise the device, replacing the faulty parts. Accurately clean the various pieces composing it.
In braking position	Deteriorated valve (9), pistons (5), sealing rings and valve (7).	Check and revise the device, replacing the faulty parts. Accurately clean the various pieces composing it.
Difficult control lever rotation	Interference inside the distributor	Revise the device and wet all sliding parts.

QUICK DISCHARGE VALVE

Figure 50

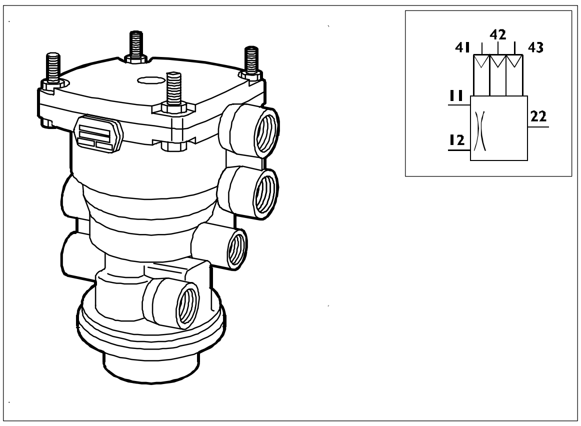


71952

Function of the component is discharging the compressed air from front axle membrane brake cylinders to obtain a quick unbraking.

793332 TRIPLE CONTROL SERVODISTRIBUTOR

Figure 51



62373

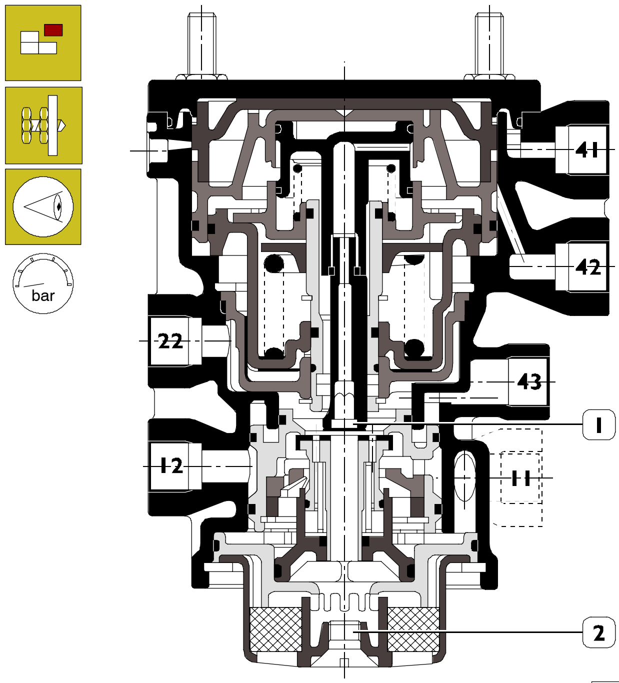
The device, controlled by the two independent tractor circuits in duplex distributor and spring brake circuit, controls trailer braking; moreover, a predominance adjusting device is provided that is placed outside the lower part.

The apparatus embeds a device that allows performing the trailer braking even in case of control duct failure.

Predominance adjustment

The apparatus is equipped with a predominance adjusting device.

Figure 52



60255

The operations to be carried out for adjusting the servodistributor predominance are performed in the following order:

- ❑ Unscrew screw (2) from silencer body.
- ❑ Insert a socket-head screw in the hole through silencer body and operate on the hexagonal body (1) hole.
- ❑ By CLOCKWISE rotating a predominance increase is obtained.
- ❑ By COUNTERCLOCKWISE rotating, a predominance decrease is obtained.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from exhaust under rest conditions	Sealing gaskets leakage. Faulty discharge valve and seat.	Revise the device replacing the faulty parts. Revise the device replacing the faulty parts.
Output pressures different from the established ones	Sealing gaskets air leakage. Worn or faulty pistons and seats. Yielded springs	Revise the device replacing the faulty parts. Revise the device replacing the faulty parts. Revise the device replacing the faulty parts.

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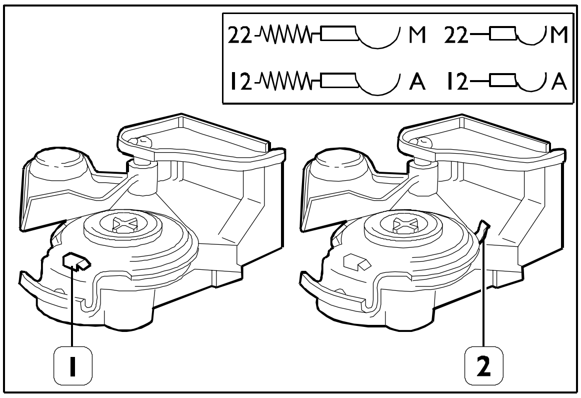
798510 COUPLING HEADS

- ❑ Moderate
- ❑ Automatic

Figure 53

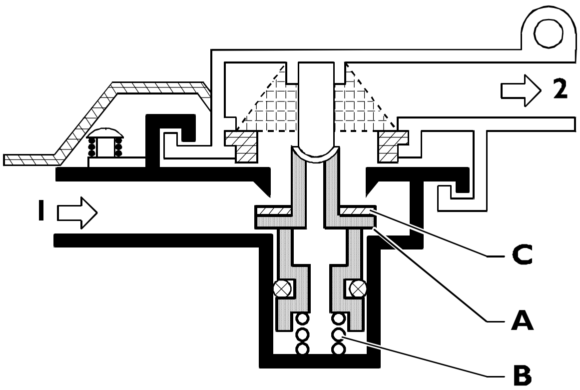


52871

The version for "Moderate" duct is equipped with a red cover and a safety projection (1), while the version for "Automatic" duct is equipped with a yellow cover and a lateral safety projection (2). The safety projections are used to avoid coupling errors.

Operation

Figure 54

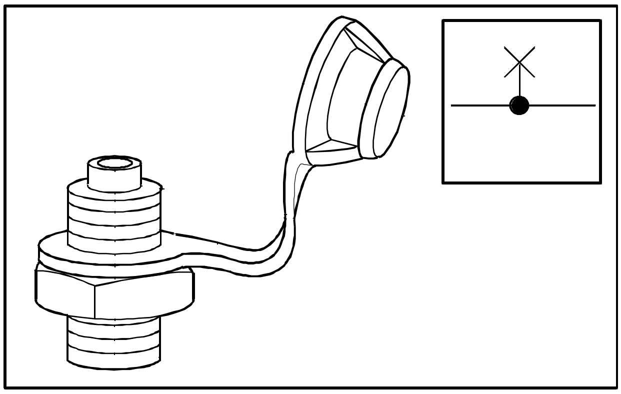


72657

The coupling operation consists in rotating a head with respect to the other (tractor trailer), guided by a rib that runs into a suitable guide till it locks. In this phase, seal gasket (C) pushes downwards the shutoff valve from the other head (A), by overcoming the resistance of spring (B). A communication is thereby opened between the two heads guaranteeing their seal. By uncoupling the heads, the valves are automatically closed guaranteeing their seal.

PRESSURE PLUG VALVE

Figure 55

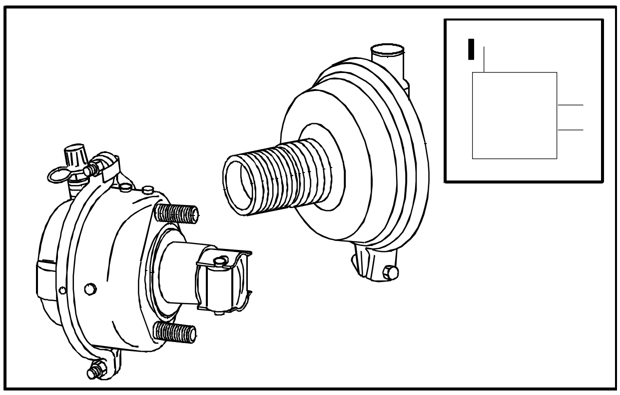


71953

Pressure plugs are inserted into pneumatic system pipings or tanks, in order to facilitate connecting diagnostics manometers.

794911 MEMBRANE BRAKE CYLINDER (for disc brakes and drum brakes)

Figure 56

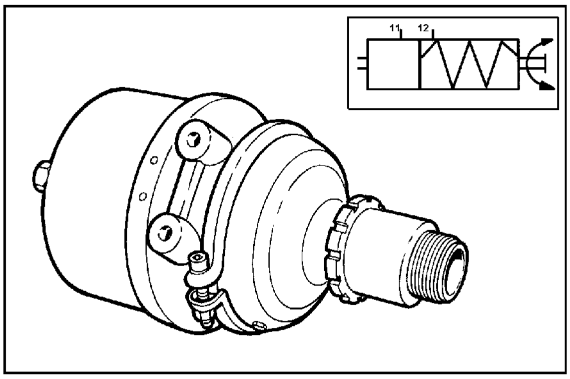


71954

The brake cylinder transmits the force impressed by the compressed air when operating the brake pedal to the mechanical service braking device.
In case of anomalies, it is necessary to replace the complete cylinder.

794922 COMBINED BRAKE CYLINDER

Figure 57

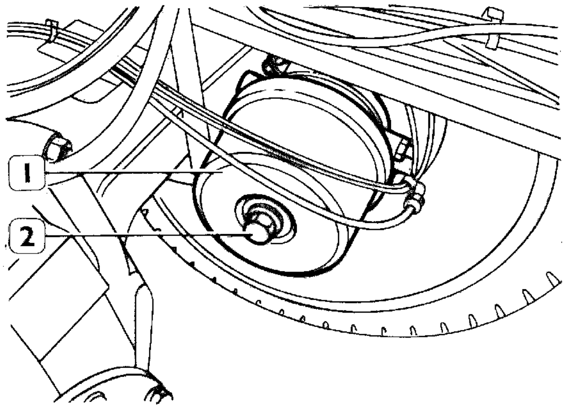


36744

The device is composed of two parts: a membrane part for service braking and a spring part for parking and emergency braking in case of braking system failure.

Combined cylinder emergency unbraking device

Figure 58

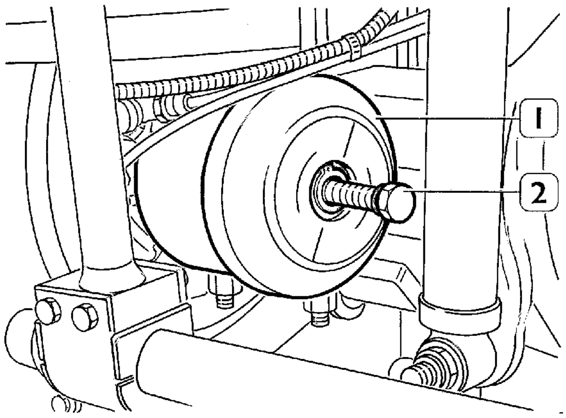


36745

When it is not possible to pneumatically supply the combined cylinder (1) spring section, it is possible to manually unbrake the vehicle to allow its towing. In order to unbrake the vehicle, it is necessary to unscrew screw (2) till its end of stroke.

Repair interventions

Figure 59



35721

Before detaching the combined cylinder (1) from the vehicle, perform the manual unbraking procedure of the combined cylinder by unscrewing screw (2) till its end of stroke.

! It is possible to disassemble only the membrane section.
In case of anomaly of the cylinder spring section, do not disassemble such part since the above operation could be dangerous for the operator.

! It is advisable, before proceeding with the disassembly, to accurately clean the external parts from earth and other impurities that by seeping inside could damage the cylinder.

Diagnostics

INCONVENIENCE	POSSIBLE REASON	REMEDY
Air leakage from exhaust or check band	Broken or holed membrane. Membrane lip breakage. Check band locking screws loosening.	Replace the membrane. Tighten the screw.
Air leakage from membrane section supply	Deterioration of parts composing the spring section.	Revise the device replacing the worn parts and if necessary replace the complete cylinder.
Braking force decrease during parking brakings	Spring breakage.	Replace the complete cylinder.

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ABS SYSTEM WITH EBL FUNCTION

"ABS" Anti-Lock Brake System

The system is able to avoid wheel locking, that could occur during the braking step, under any vehicle load condition and wheel-road bed friction coefficient condition, in order to guarantee better braking performances and a higher vehicle stability.

The system, controlled by an electronic unit, is activated at start-up and automatically operates for speeds greater than 5 km/h if, following a braking, one or more wheels tend to lock.
The ABS system is able to check the engine brake exclusion and the divider locking (if it exists).
These components are disconnected if the trend of one or more drive wheels to lock themselves is detected.
The reconnection automatically occurs when the ABS system action ceases.

"EBL" (Electronic Brake Limiter) anti-skid device

The "EBL" function checks the rear axle wheels "skid" by comparing it with the front axle wheels speed.

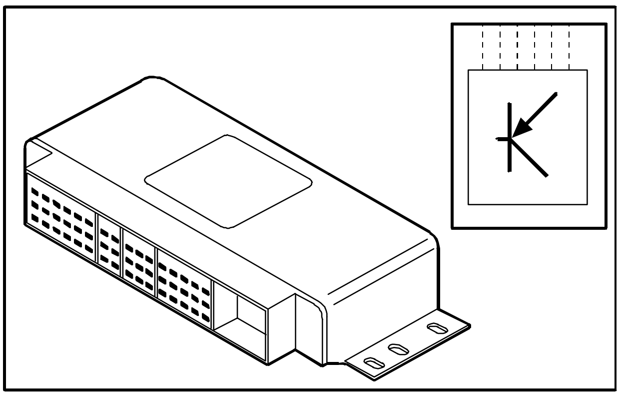
Depending on these values, the electronic control unit computes vehicle speed, deceleration and checks the presence of "skid" between rear axle wheels and front axle wheels.

The EBL function is activated (rear ABS modulators keep the imported pressure) when the driver applies an excessive braking force with respect to load conditions being present on the vehicle, in summary when skid thresholds on rear axle and vehicle deceleration thresholds are exceeded.

Data processed by the electronic control unit are wheel revolutions and braking pressure detected by the pressure sensor installed upstream of rear axle ABS modulators.

526711 ELECTRONIC UNIT

Figure 60



71955

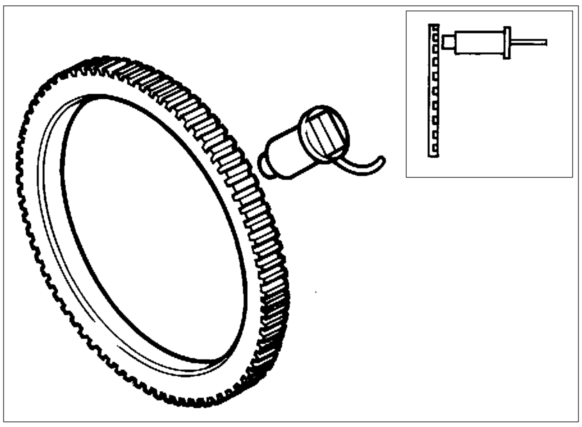
The electronic unit is the system brain. Its task is driving the system solenoid valves depending on signals measured by wheel revolutions sensors.

Operation

Every channel comprises four functional circuits: the first one is the input one, that receives analogue signals emitted by the sensor provided on the corresponding wheel, filters them from parasitic signals and converts them into digital information by means of cycle length measures. Then there is a main circuit, that consists in a microprocessor, that processes information received by the input circuit: it has a complex program that allows it to determine wheel acceleration and deceleration values, and to perform the logic combination of the various adjustment signals. If necessary it emits two control signals, that are sent to the corresponding electro-pneumatic valve through the third unit circuit, the control one, to adequately adjust the braking pressure.
The fourth and last circuit finally is the safety one, that takes care of verifying the efficiency of various system components. If an anomaly is detected, it takes care not only to inform the driver by turning on the suitable warning light on the dashboard, but also to automatically disconnect the whole ABS system leaving however the traditional braking system in efficiency.

526713 REVOLUTIONS SENSORS
526712 PHONIC WHEELS

Figure 61



35383

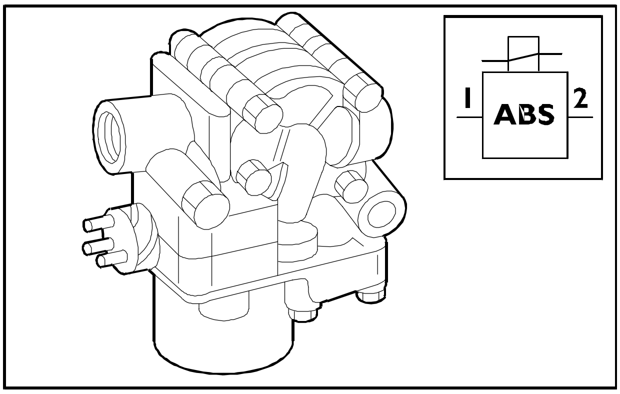
Task of revolutions sensors and phonic wheels is detecting revolutions of their respective wheels.

Operation

The phonic wheel is housed in the wheel hub and rotates at the same wheel speed. It generates alternate voltages by induction in the sensors, whose frequency is proportional to the rotation speed of the respective wheel. These voltage signals are transmitted to the unit to be adequately processed.
For every wheel a sensor and a phonic wheel are assembled. This arrangement allows driving during the adjustment an individual braking pressure for every wheel, optimising running stability and braking space.

526714 ELECTRO-PNEUMATIC VALVE

Figure 62



71956

Task of the electropneumatic valve is modulating the air pressure on front brake circuit.

The device is connected as follows:

1 - From duplex distributor

2 - To front circuit pneumohydraulic converter

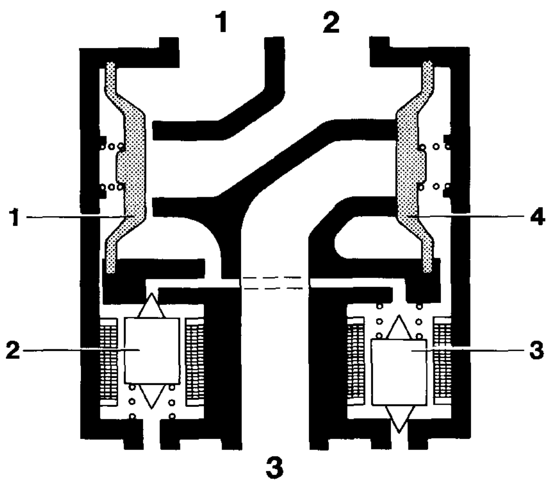
3 - Exhaust.

Operation

The electro-pneumatic valve modulates air pressure in the brake circuit according to the signals received from the electronic control unit in the three phases:

❑ Pressure increase

Figure 63

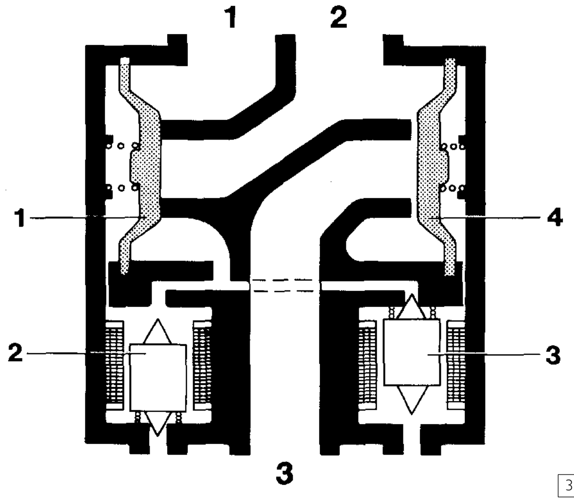


35380

The compressed air from the duplex distributor to duct **1** pushes membrane (1) outwards, thus allowing air to reach outlet **2** and, therefore, the brake cylinders; simultaneously, air is arranged behind the membrane (4) that closes the exhaust allowing to increase the pressure in the duct **2**.

❑ Pressure decrease

Figure 64



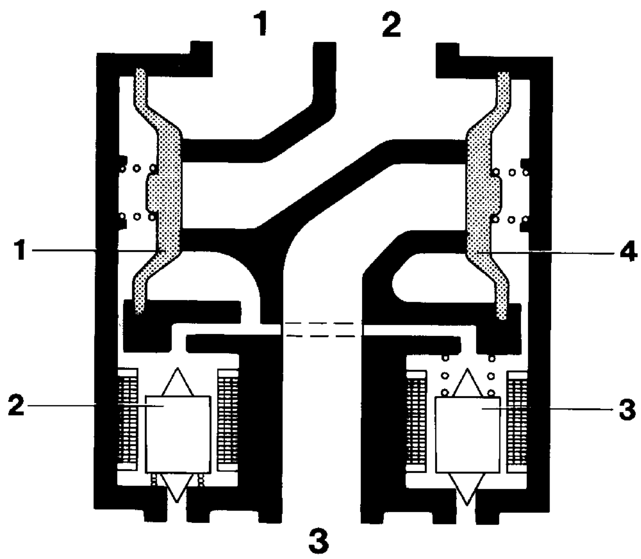
35381

The electronic unit detects the trend of wheel to be locked and intervenes sending a pulse to solenoid valves (2 and 3).

Solenoid valve (2) moves downwards while valve (3) moves upwards. Air contained behind the membrane (4) moves behind the membrane (1) that lock the supply. Membrane (4) moves outwards and allows air contained in duct **2** to be discharged to the atmosphere through duct **3** reducing pressure going out of the solenoid valve.

❑ Pressure keeping

Figure 65



35382

In this phase, the two solenoid valves are displaced downwards allowing air to be arranged behind the membranes (1 and 4) that, due to the greater operating surface, close both supply and exhaust, thereby keeping the previously-reached pressure value constant in duct **2** whichever the pressure exerted on the brake pedal.

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BRAKE REPAIRS MODELS ML 110 EL.. / 120 EL..)

5274 Front Brakes (Brake calipers of the PAN 17 type)

5272 Rear Brakes (Brake calipers of the PAN 17 type)

Description

The PAN 17 (PERROT-AXIAL-NEW) brake mechanically operates by means of a membrane brake cylinder if assembled on front axle, or of a spring brake cylinder if assembled on rear axle; the above cylinders are flanged to brake caliper body.

The brake caliper is of the floating type. It axially slides on guide pins (3 and 28) assembled on support (2) and braking gaskets (7 and 9), also subjected to axial movements, are kept inside the brake support (2) by a check fork (21). In this way the braking force is transmitted to abutment surfaces inside the support (2).

The brake caliper (17) is transversally placed inside the brake caliper (1), and its rotary movement, during the locking phase, ensures an optimum operation for the brake and a small hystheresis.

This type of brake is equipped with braking gaskets (7-9) with large wear volume in order to extend their replacement times.

The braking gasket replacement operation is made easier and quicker by this very model of caliper characterised by a radial type of opening.

In order to compensate for sliders wear, the actuator mechanism is provided with an infinitely-varying automatic adjustment device, whose action changes according to the applied force. This provides a constant clearance, independently from the level of use or application of the brake and together with a sturdy and rigid caliper structure, it ensures minimum actuator cylinder strokes, contributing to increase emergency braking safety coefficients.

With the direct brake cylinder assembly on caliper a very compact assembly is obtained with following chance of optimally using the device, that is the widest steering angle possible.

Brake locking system and brake operation

The brake cylinder (not shown in Figure 66 page 80) is flanged to cover (24) of brake caliper and its shoe is inserted into lever (17). Lever (17) and brake shaft are embedded one into the other and the same are supported by ball bearings (18 and 19).

The brake cylinder shoe under the pressurised air action moves the thrust element (13), which, winning the spring reaction (27), pushes through plate (10), the braking gasket (9) against the internal brake disc (8) side. At the same time, the thereby-exerted braking force is divided on the external brake disc (8) side through the action that cover (24) of brake caliper (1) exerts on braking gasket (7). When the braking action ceases, springs (27) take the whole mechanism to its original position.

Automatic braking gaskets wear recovering device

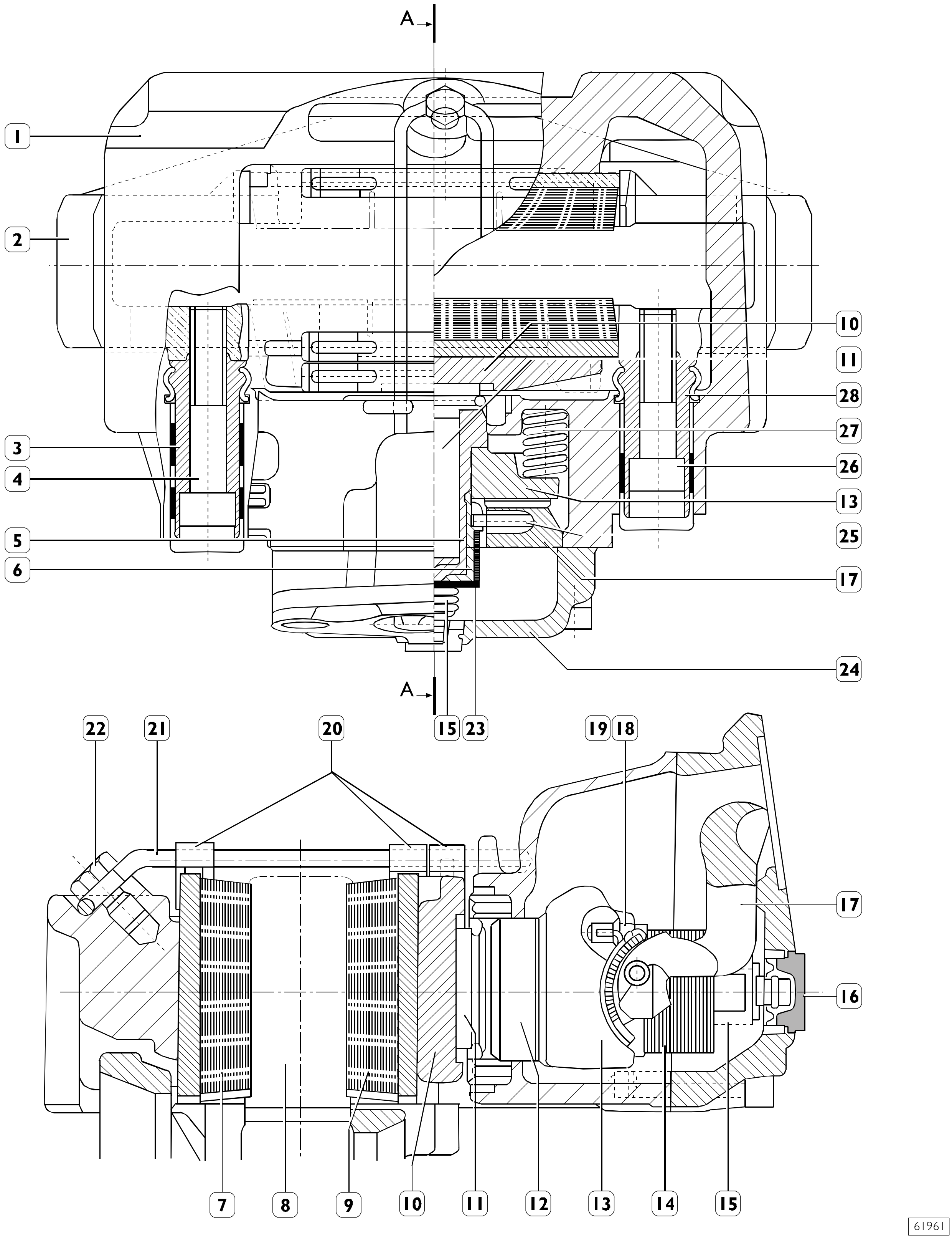
The braking gaskets wear recovering device is housed inside the thrust element (13).

Every time the lever (17) is actuated by the brake cylinder, the pin (25), assembled on it, performs an excursion in the axial groove of the return sleeve (5). The width of such excursion corresponds to the operating clearance between braking gaskets (7-9) and brake disc (8). If due to wear, the distance between braking gaskets (7-9) and brake disc (8) increases, lever (17) will have to perform a greater rotation to transmit the braking force, and consequently pin (25) integral therewith, once having reached the groove end due to the lever (17) overstroke effect, will rotate the return sleeve (5). Such rotary movement will be unidirectionally transmitted to driven sleeve (6) by spring (14). In turn, the driven sleeve (6) transmits the rotary motion to the adjustment nut (12) through a tapered coupling functioning as torsion regulator. This coupling is kept by the force that spring (15), abutting on washer (23), exerts on driven sleeve (6). Screw (11) is screwed in adjustment nut (12). On the screw (11) end, a groove is obtained in which the thrust plate (10) pin is inserted.

This connection, during adjustment nut (12) rotation, makes screw (11) unscrewed so that this latter one, operating on thrust plate (10), makes the slider advance, compensating the thickness lost by wear and approaching friction gaskets (7-9) to disc (8). If under the above conditions, the brake lever (17) is further rotated, the actuation force between adjustment nut (12) and thrust element (13) or between nut (12) and screw (11) will exceed the moment that can be transmitted and applied to nut (12) due to driven sleeve (6) torque limiter. This latter one, then, sliding with respect to the adjustment nut (12), will not generate any mechanism adjustment. In this way the adjustment device will not be activated if the load exerted thereon will exceed the spring (15) calibration value, safeguarding the system from damages.

When the braking action ceases, internal components are taken again into their original position from reaction springs (27). Pin (25) oppositely rotates the return sleeve (5) and by means of the unidirectional connection, the motion will not be transmitted to other adjustment devices that will be excluded by the rotary motion.

Figure 66

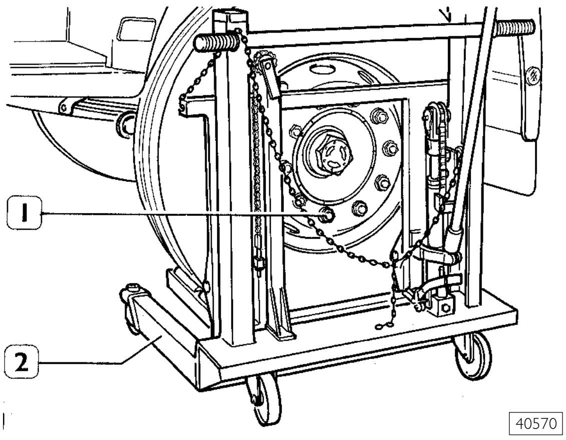


SECTION A-A

1. Brake caliper- 2. Braking gaskets support - 3. Guide pins - 4. Screw - 5. Return sleeve - 6. Driven sleeve - 7.Braking gasket - 8.Brake disc - 9. Braking gasket - 10. thrust plate - 11. Screw - 12. Adjustment nut - 13. Thrust element - 14. Spring - 15. Spring - 16. Plug - 17. Brake lever - 18. Ball bearing - 19. Ball bearing - 20. Small springs - 21. Fork - 22. Screw - 23. Washer - 24. Brake caliper cover - 25. Pin - 26. Screw - 27. Spring - 28. Guide pin.

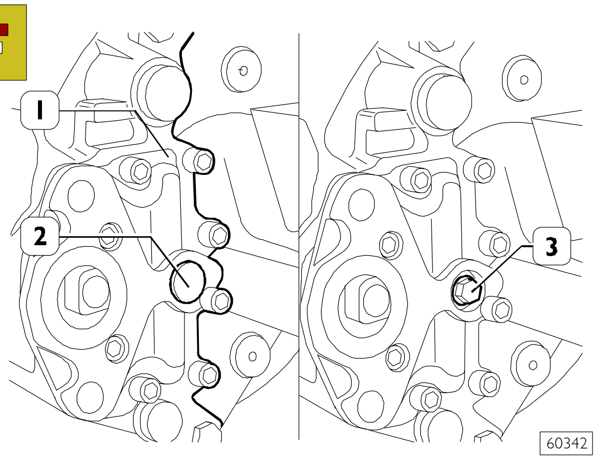
527420/527450 Efficiency check for braking gaskets/brake disc wear recovering device

Figure 67



Unscrew securing screws (1) and with hydraulic trolley 99321024 (2) detach the wheels.

Figure 68



Remove protection plug (2) from brake caliper (1).

Through a wrench rotate adjustment screw (3) clockwise by 1/2 revolutions increasing clearance between braking gaskets and disc.

Slightly actuate the brakes (braking pressure about 1 bar) for about 5 times, simultaneously verifying that the wrench rotates counterclockwise with small rotations till the required clearance (0.7 mm) is restored between disc and braking gaskets.

Otherwise, if the wrench does not rotate, rotates only upon the first application or even rotates forward and backward, this means that the device is faulty. It is then necessary to replace the complete caliper.

The angular wrench movement is reduced during the check operation.

At the end of the check and/or possible replacement of brake caliper, attach again the wheels tightening the nuts in the required sequence and tightening torque.

527417 Braking gaskets replacement

The below-described operations are referred to rear brakes and must be deemed as valid also for front brakes.

Arrange the vehicle on a plane ground and lock its rear wheels; loosen nuts (1, Figure 67) securing the front wheels.
With an hydraulic jack lift the vehicle from its front side and rest it on two support stands.
Unscrew securing nuts and with hydraulic trolley 99321024 (2, Figure 67) detach the wheels.

Verify the wear recovering device efficiency as described in the related chapter.

Disassemble braking gaskets as described in the chapter about Wheel hubs revision.

Replace all braking gaskets even if only one of them shows anomalies.

Remove dirt and rust around the braking disc edge with a scraper or an old screwdriver, resting on the caliper body, making disk (1) rotate.
End the work with abrasive cloth. Remove residuals by using a suction device or with canvasses and brush.
Do not use petrol or other petroleum derivatives that could create brake failures.
Use only denatured alcohol with methanol or isopropyl alcohol.
Accurately clean brake disc braking area surfaces.

Checks

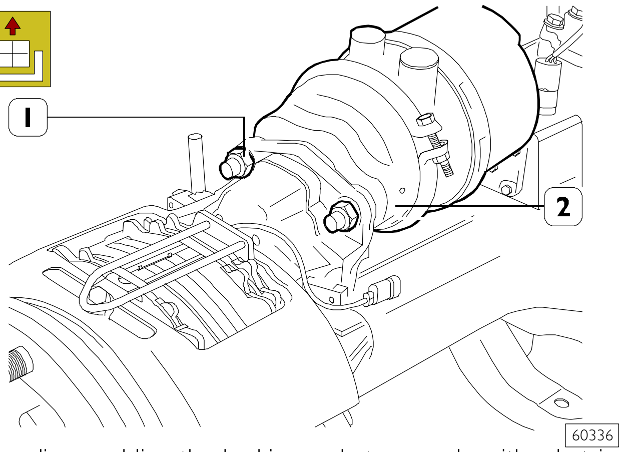
Visually check dust-guarding casings conditions; if they show distortions or breakages, it is necessary to replace them; such operation implies the need of disassembling the brake caliper, so that it is advisable to detach the brake caliper body completed with carrier plate for the complete revision.

Verify that the caliper freely rotates on its guides.
If anomalies are detected on one brake caliper only, it is advisable to proceed with the complete revision of both brake calipers.
Remove dirt from brake caliper using a metal brush and avoiding to damage dust-guarding casings.
Clean braking gaskets sliding surfaces.
Check brake disc conditions as described in the related chapter.
Check wear sensors conditions, and when detecting anomalies in them, in cables or leads, replace the support bracket completed with the above-listed parts.
For the assembling, reverse the disassembling operations, complying for securing the components, with the required tightening torques.

527413 Brake calipers disconnection and reconnection

Disconnection

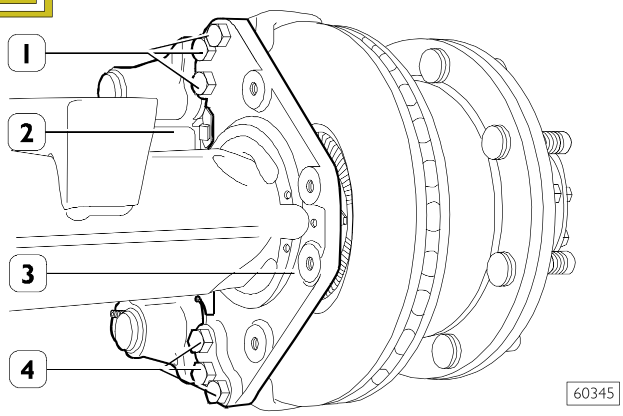
Figure 69



For disassembling the braking gaskets, comply with what is described in chapter about "Braking gaskets replacement".

> ! If the brake caliper disconnection-reconnection operation is related to rear axle assembled on a vehicle it is necessary to withdraw the brake cylinder (2) by unscrewing the screw placed on its rear side. Disconnect supply piping from brake cylinder (2). Remove nuts (1) and detach brake cylinder (2) from brake caliper.

Figure 70



Unscrew screws (1 and 4) and detach brake caliper (2) from rear axle case flange (3).

> ! Due to the type of brake caliper only and due to its weight, it is necessary to suitably support the brake caliper during disconnection and transport.

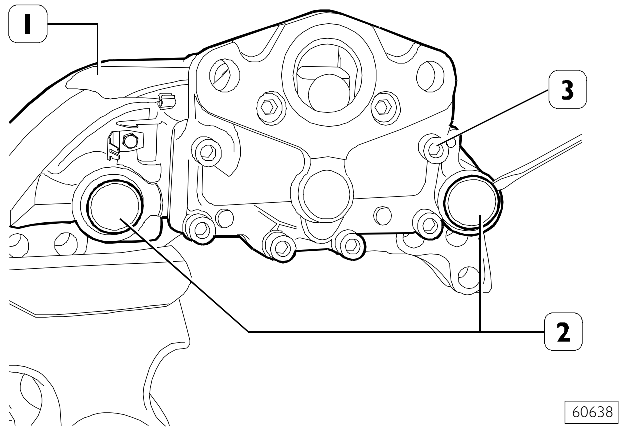
Reconnection

For the reconnection, reverse the operations performed for the disconnection and comply with the required tightening torques. At the end of reconnection operations, verify the wear recovering device efficiency as described in the related chapter.

527413 BRAKE CALIPERS REVISION

Disassembly

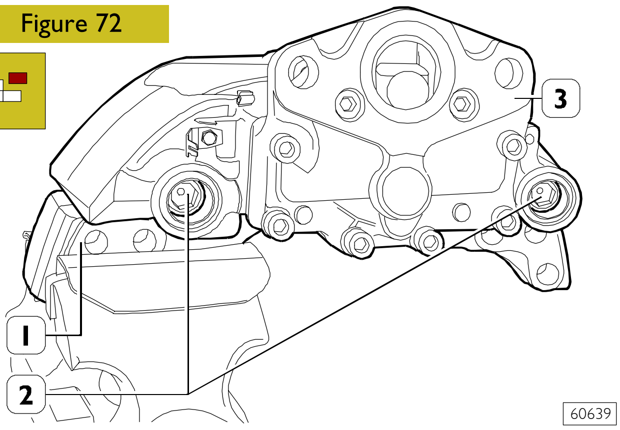
Figure 71



Take brake caliper (1) to bench and lock it in a vice. With a screwdriver remove small covers (2).

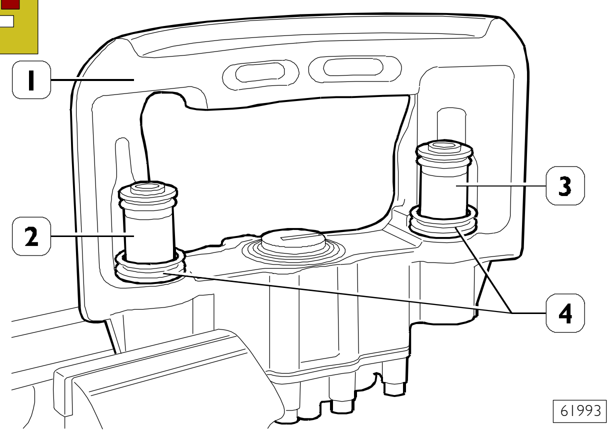
> ! Screws (3) must not be unscrewed.

Figure 72



Unscrew screws (2) and detach brake caliper (3) from support (1).

Figure 73



Withdraw guide pins (2 and 3) from brake caliper (1) and from protection casings (4).

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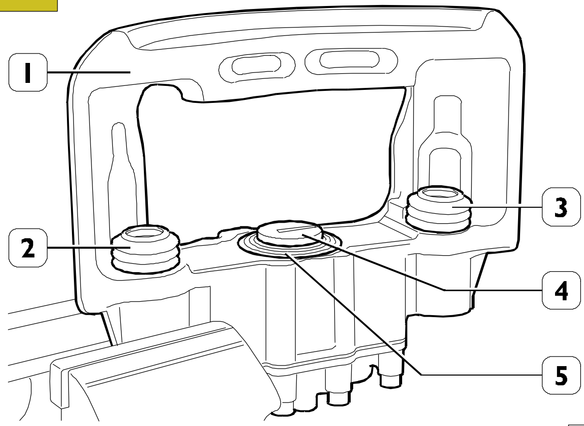
Figure 74

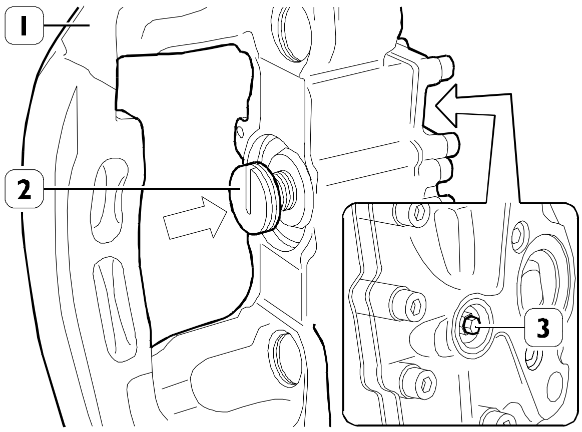


61994

Remove protection casings (2 and 3) from brake caliper (1).
Remove casing (5) from adjustment screw (4) and remove this latter one from brake caliper (1).

Check of component parts

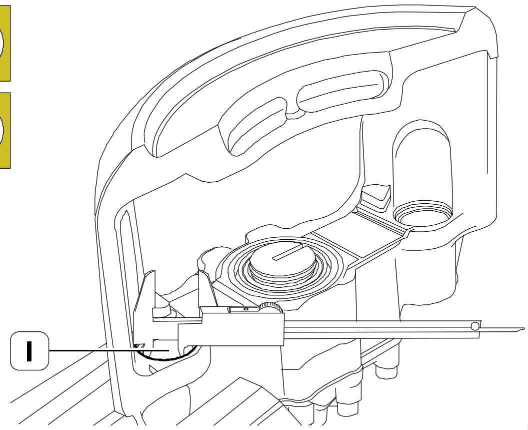
Figure 75



61995

Lock screw (2) rotation inserting in this latter one's groove (→) a screwdriver. From the opposite part to brake caliper (1), unscrew screw (3) to check its threading conditions.
When detecting anomalies, replace the complete brake caliper.
For washing the metal parts, use an hot water solution with Fiat LCD detergent.
By using a metal brush remove dirt from caliper body, then with a brush remove residuals and accurately clean guide pins and sliding bushes.
Proceed with an accurate blowing of the caliper body through a jet of compressed air.
With a canvas drenched with isopropyl alcohol or the like, accurately clean the sliding pins.

Figure 76



61996

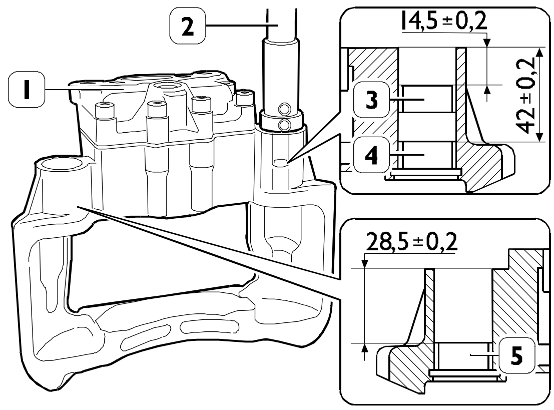
Check sliding pins and related bushes wear conditions on the brake caliper body, make sure that there are no wears or damages on sliding surfaces. Insert pins in bushes and verify their regular sliding, otherwise proceed with their replacement.
Measure bush (1) diameter in many points.

Replace all bushes even if only one of them is worn.

A regular braking very much depends on brake caliper sliding on guide pins.

Assembly

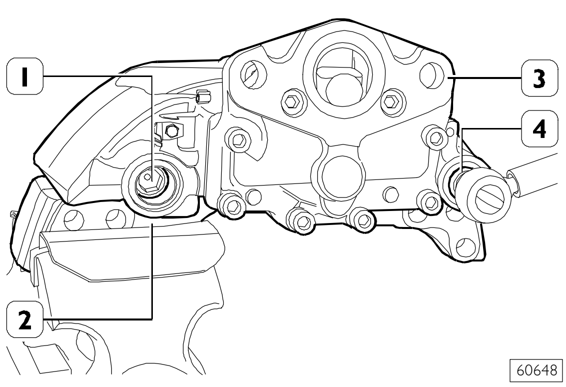
Figure 77



60644

With a beater (2) assemble bushes (3, 4 and 5) on brake caliper (1) placing them into this latter one at the heights mentioned in the figure. Fill with grease the room between assembled bushes (3 and 4).

Figure 78

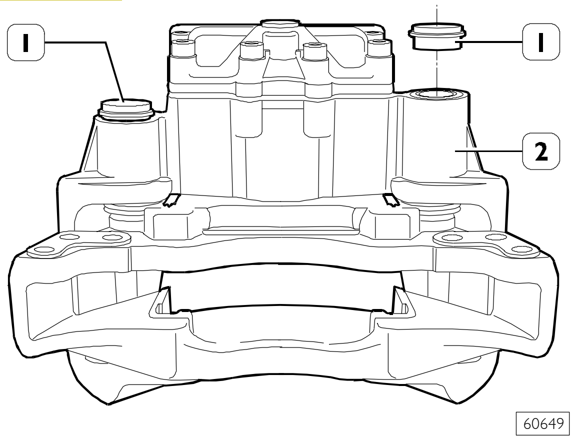


Place brake caliper (3) on support (2) so that sliding pins (10, Figure 79) are inserted in support seats (2). Screw new screws (1 and 4).

Tighten at the required torque long screw (4) and then short screw (1). Every time screws (1 and 4) are unscrewed or appear loosened during possible checks, it is necessary to replace them with other new ones.

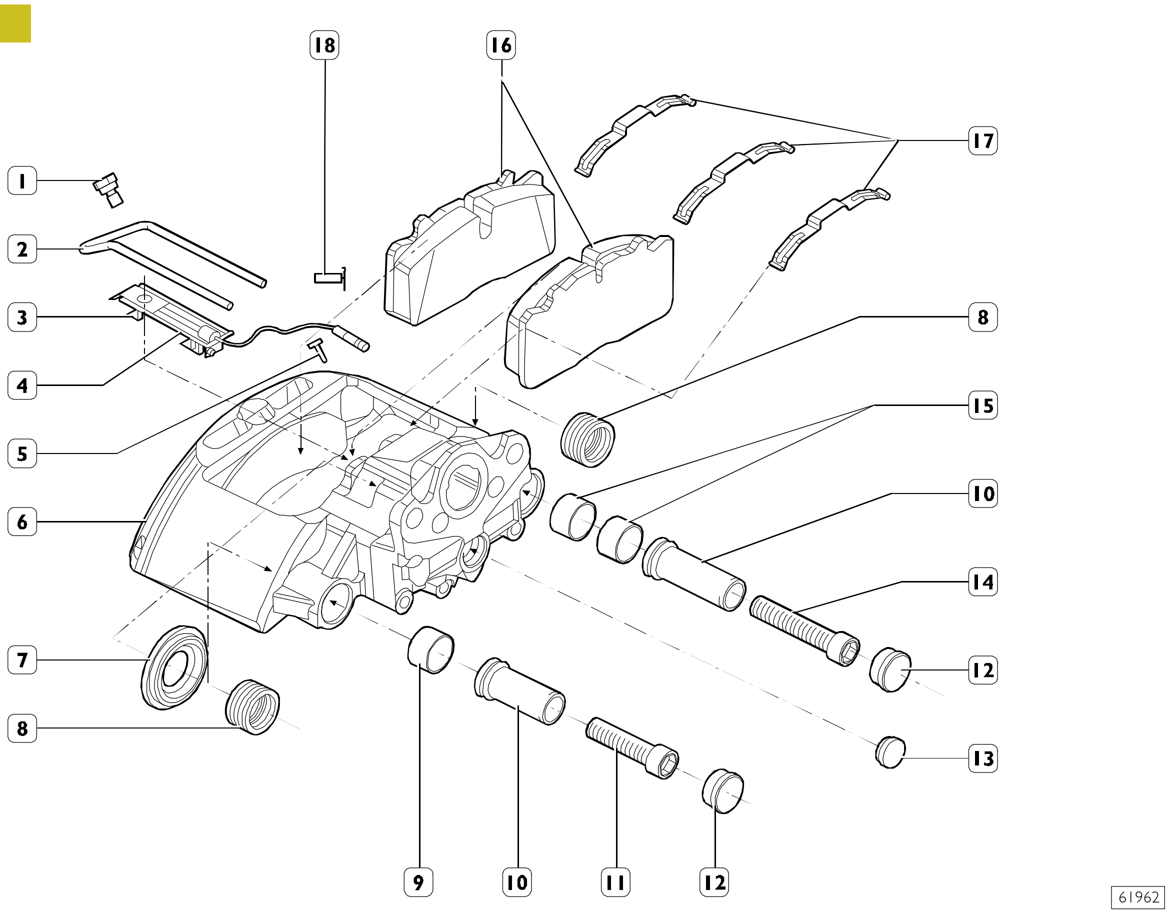
At the end verify that casings (7 and 8, Figure 79) are not damaged, and that brake caliper freely slides on pins, slightly and carefully lift casings (8, Figure 79) lip from sliding pins to discharge possible pressurised air formed inside them.

Figure 80



Assemble new plugs (1) into brake caliper (2) bushes housing holes.

Figure 79



REPLACEABLE PART COMPOSING THE BRAKE CALIPER
1. Screw* - 2. Braking gaskets check fork* - 3. Wear sensors - 4. Support completed with wear sensors - 5. Electric cable check spring - 6. Brake caliper - 7. Protection casing - 8. Protection casing - 9. Bush - 10. Sliding pin - 11. Screw* - 12. Plug* - 13. Plug* - 14. Screw* - 15. Bush - 16. Braking gaskets - 17. Small springs - 18. Connector support blade.

* The parts must be replaced upon every disassembly with new ones.

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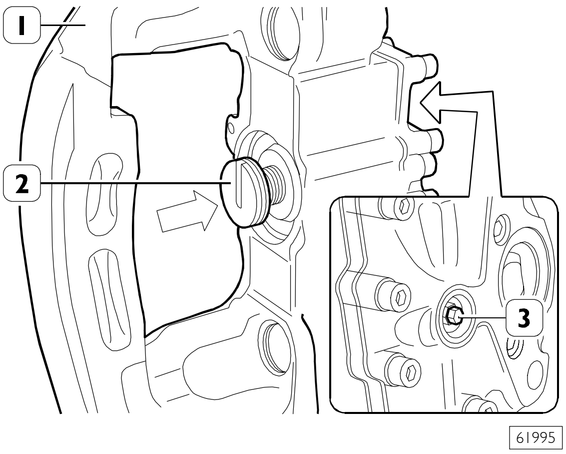
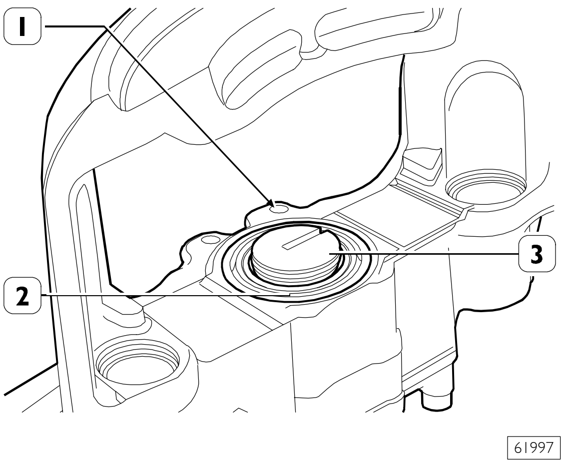
Figure 81



Grease screw (2) threading. Lock screw (2) rotation by inserting into this latter one's groove (→) a screwdriver. From the opposite part of brake caliper (1) screw screw (3) till the screw is placed in its starting stroke conditions.

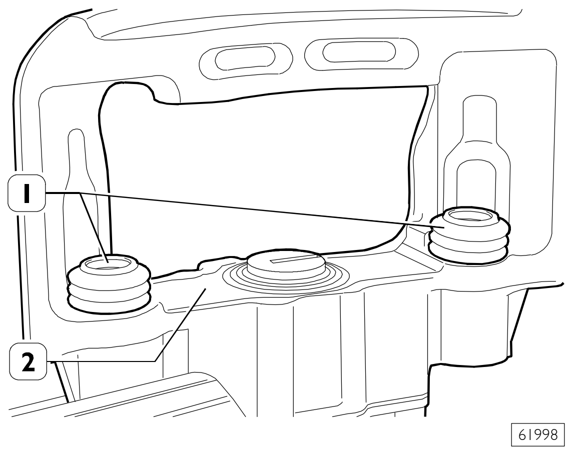
Figure 82



Assemble casing (2) into brake caliper (1) seat.
Insert internal casing (2) part into annular screw (3) groove.

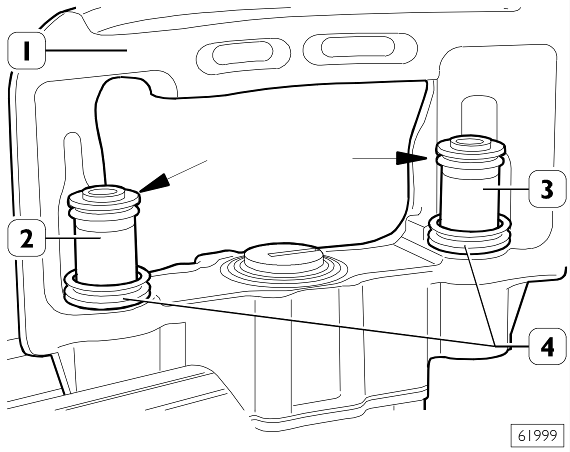
Assemble casing (2) with particular care. It is possible to replace the protection casing (2) without detaching brake caliper from assembly (rear axle/front axle) assembled on a vehicle, following the described procedures.

Figure 83



Lubricate protection casings (1) lip and insert them into related brake caliper (2) seats.

Figure 84

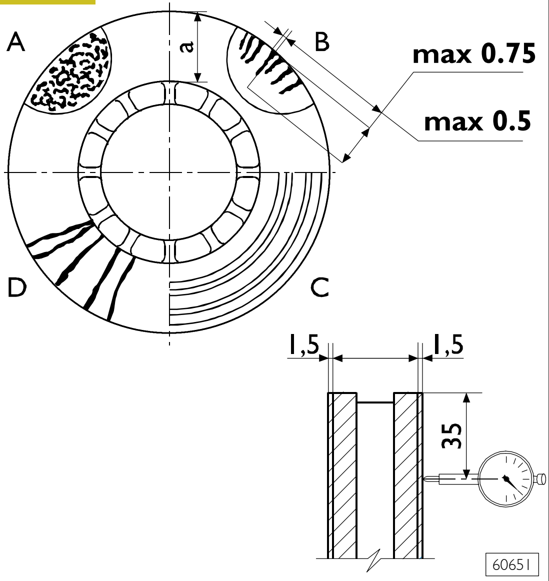


Lubricate sliding pins (2 and 3) and insert them into casings (4) and brake caliper (1).

Sliding pin (3) is of a greater length.
Arrange casings (4) lip into annular grooves (→) of sliding pins (2 and 3).

527411 BRAKE DISCS REVISION

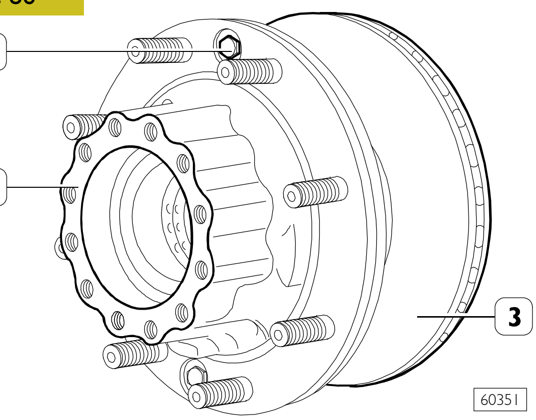
Figure 85



Examine the brake discs; they must not show breakages, and their surface must not show cracks densities greater than the one shown in sector **A**;

- radial cracks shown in sector **B** must not have a width greater than 0.75 mm and a depth greater than 0.5 mm;
- irregularities shown in sector **C** must not have a depth greater than 1.5 mm;
- transverse fissures on the whole braking surface as shown in sector **D** are not allowed;
- the orthogonality error measured at 35 mm from the peripheral circumference must not be greater than 0.15 mm.

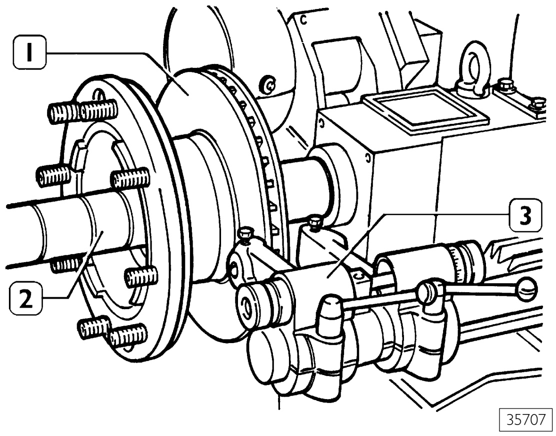
Figure 86



Examine the brake discs surfaces wear status.
When detecting different values from those included in characteristics and data table, perform brake discs turning and grinding operations, and if necessary replace them.
If it is necessary to replace them, it is advisable to replace both brake discs.
For disconnecting and reconnecting the brake disc (3), comply with procedures included in the chapter about "Wheel hubs revision".
Remove screws (1) and detach hub (2) from disc (3). Replace disc (3) and reassemble it following the reverse procedure to the previously-described one.

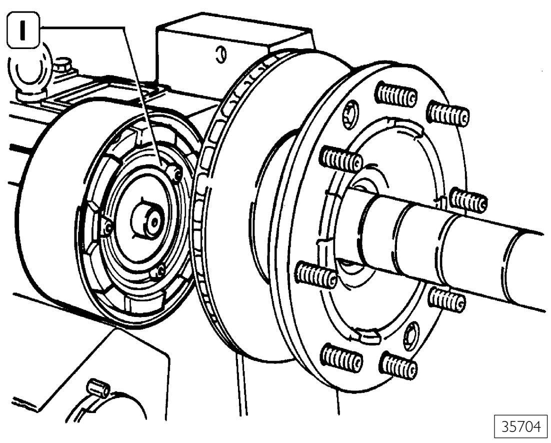
527411 Brake discs turning and grinding

Figure 87



Key-in on lathe 99301001 (2) shaft the brake disc (1) completed with hub;
key-in a series of spacers that remove axial assembly clearance, screw locking nut and apply lathe shaft support;
place tool-holder (3) axially with brake disc (1), then adjust tools depth;
proceed with brake disc (1) turning, operating on one or more removal passes, according to detected scoring.

Figure 88



Through lathe 99301001 proceed with grinding both brake disc working surfaces.

> ! During grinding operations, gradually proceed with the advancement of sectored spring, till turning residuals are totally removed.

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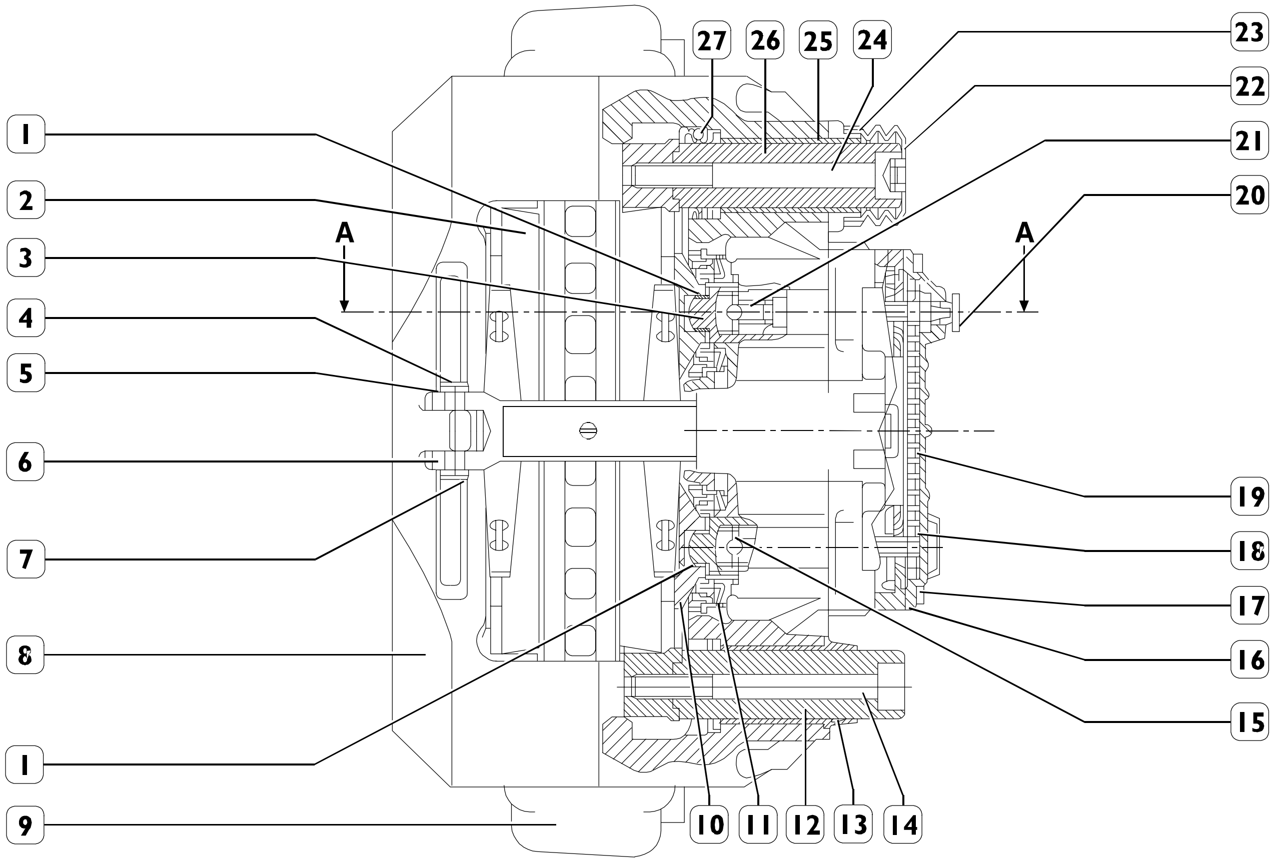
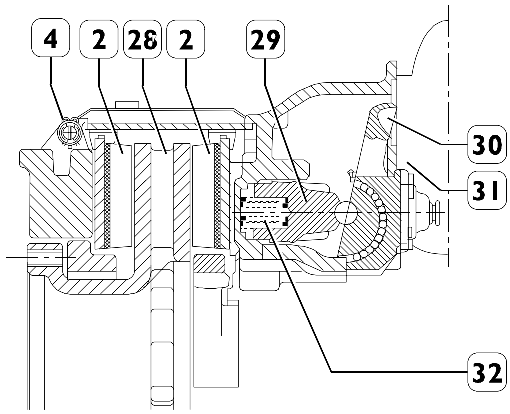
5274 BRAKE REPAIRING

Front brakes (Brake caliper KNORR SB6 type)

Figure 89



49151



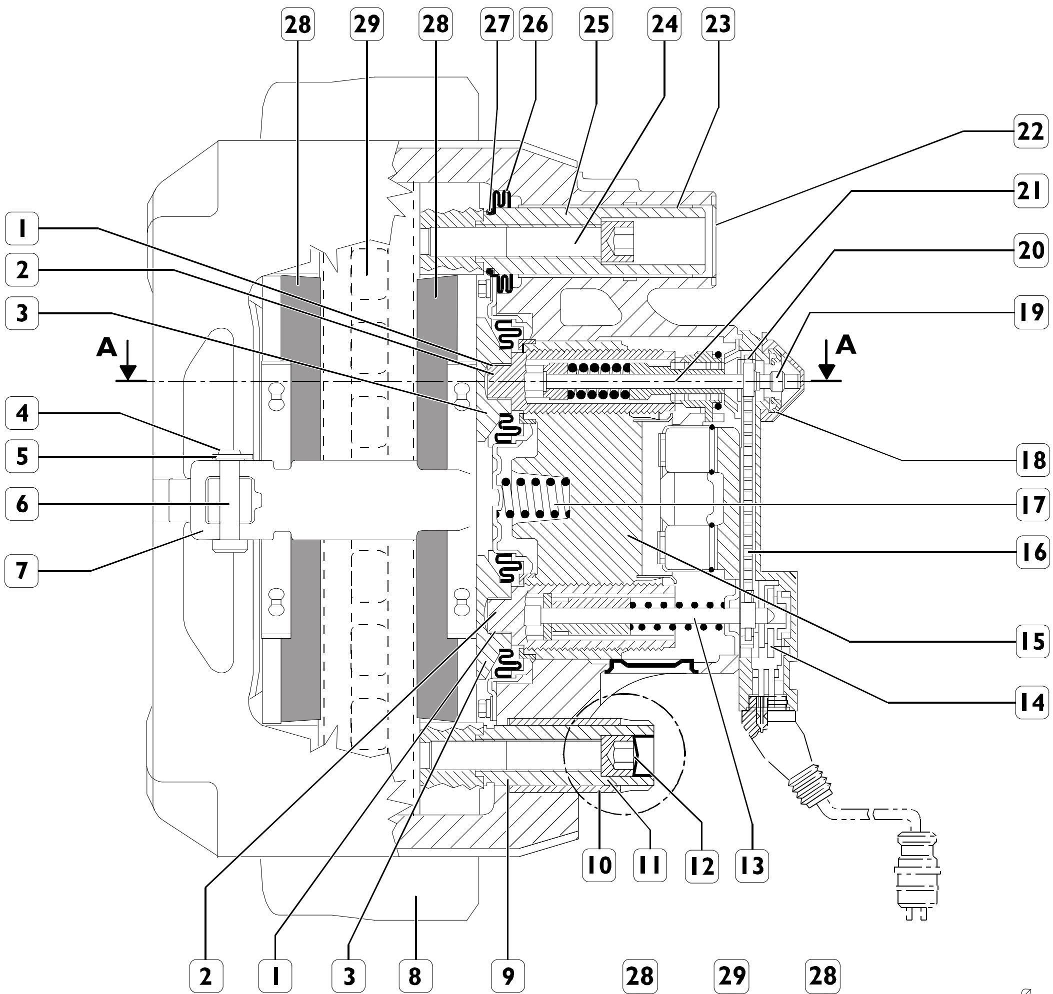
SECT. A-A

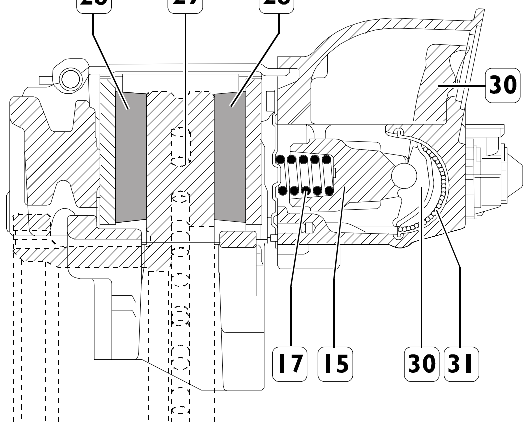
49152

1. Dry bush - 2. Braking gasket - 3. Threaded barrel - 4. Spring split pin - 5. Braking gaskets check plate - 6. Check plate - 7. Small pin - 8. Brake caliper - 9. Carrier plate - 10. Small piston - 11. Cap - 12. Sliding bush - 13. Rubber guide bush - 14. Sliding pin - 15. Dragging device - 16. Cover - 17. Screw - 18. Chain wheel disc - 19. Chain - 20. Plug - 21. Adjustment device - 22. Protection casing - 23. Securing band - 24. Sliding pin - 25. Brass guide bush - 26. Sliding bushing - 27. Internal protection - 28. Brake disc - 29. Rear axle - 30. Lever - 31. Membrane cylinder - 32. Pressure springs.

Front and rear brakes (Brake caliper KNORR SN6-SN7 type)

Figure 90





SEZ. AA

1. Dry bush - 2. Threaded hose - 3. Piston - 4. Washer - 5. Spring split pin - 6. Pin - 7. Retaining plate - 8. Supporting plate - 9. Guide pin - 10. Guide bush - 11. Sliding pin - 12. Plug - 13. Dragging device - 14. Wear sensor - 15. Rear axle - 16. Chain - 17. Spring- -18. Cover - 19. Adapter - 20. Chain gear - 21. Adjusting device- -22. Cover - 23. Brass bush - 24. Sliding pin - 25. Sliding bush - 26. Inner protection - 27. Ring - 28. Brake lining - 29. Brake disc body - 30. Lever - 31. Cam bearing.

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Operation (See previous figure)

Braking stage

During braking, the diaphragm cylinder rod presses down on the lever (30).
The force is transferred to the axle (15) by the bearing in an off - centered position (31)
Through the threaded sleeves (2) and pistons (3), the force is conveyed to the inner braking lining (28).
Once the play between brake linings (28) and brake disc (29) has been recovered, the force is conveyed to the outer brake lining (28), due to brake caliper displacement.
The brake linings (28) pressing on the brake disc (29) produce the braking power.

Releasing stage

As soon as the pressure on the brake is reduced, the pressure spring (17), the rear axle (15) along with threaded sleeves (2) and lever (32) go back to their original positions.

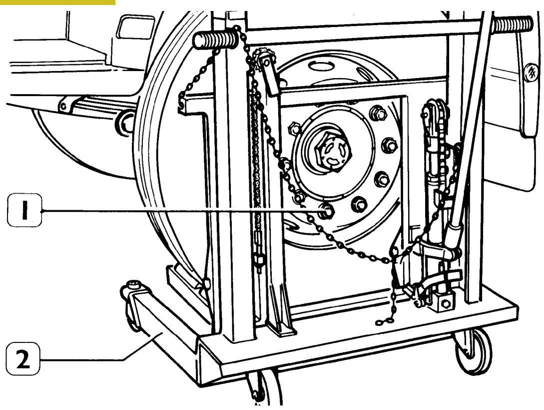
Automatic play recovery

The brake is equipped with automatic adjustment device, which keeps the operating play between brake linings and brake disc constant.
Every time the brake is operated, the adjustment device (21), which is integral with the lever (32), is automatically started.
If worn brake linings and brake discs increase the operating play, the adjustment device (21) and drag link (13) turn the threaded sleeves (2) so to recover said increase in play.
The operating clearance should be between 0.6 and 1.1 mm; lower clearances might cause overheating problems.

CHECKS

Checking the automatic play recovery system efficiency

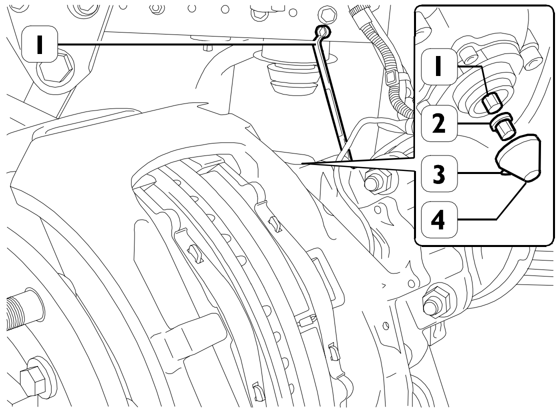
Figure 91



40570

Remove the lock nuts and wheels, using hydraulic stand 99321024 (1).

Figure 92

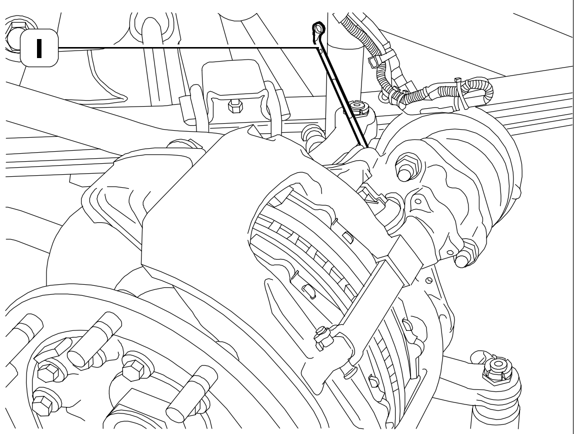


78622

Remove the plug (4) using the tab (3) and make sure the adapter is not lost.

Never turn the adjusting pinion (1) without fitting the adapter (2) first. If the adapter cut torque is overcome, the adapter gets broken.
Try again with a new adapter and if also in this case it gets broken, the caliper should be replaced because there is an inner damage.

Figure 93



60759

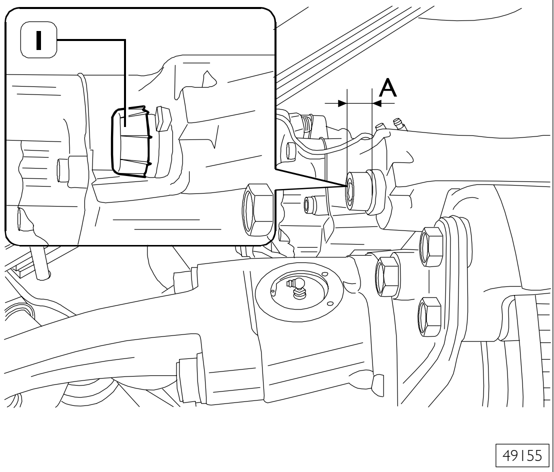
Using a suitable wrench (1), rotate the adjustment pinion counterclockwise by 2-3 with the adapter (2, Figure 92) installed turns, thus increasing the play between brake linings and brake disc.

Operate the brakes for about 5-10 times and make sure the wrench (1) moves clockwise with small increments, up to complete recover of play between braking linings and brake disc.

Otherwise, i.e. if the wrench does not turn, turns just once or turns in both directions, this means the automatic play recovery system is faulty. Replace the caliper, following the procedure given subsequently, then fit back the wheels.

Check of braking gaskets thickness

Figure 94



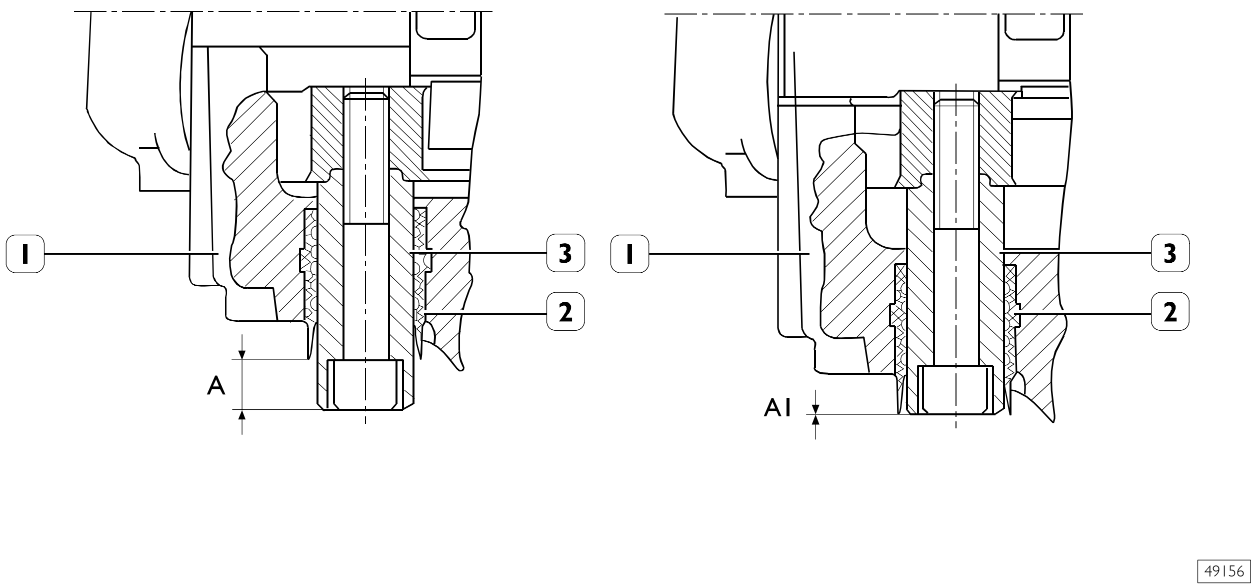
The operation can be performed with assembled wheels.

Remove protection cap (1) (available only on SB6 type calipers)

Verify that A is greater than 0 mm, for SB6 type calipers (Figure 95), or greater than 1 mm, for SN6 and SN7 types calipers (Figure 96).

Otherwise it is necessary to disassemble the wheels and proceed with an accurate check as described below.

Figure 95



SECTIONS ON SB6 BRAKE CALIPER

1. Brake caliper SB6 - 2. Rubber guide bush - 3. Sliding bushing
A. Sliding bushing position with new gaskets - A1. Sliding bushing position with worn braking gaskets (carry out an accurate check with disassembled wheels)

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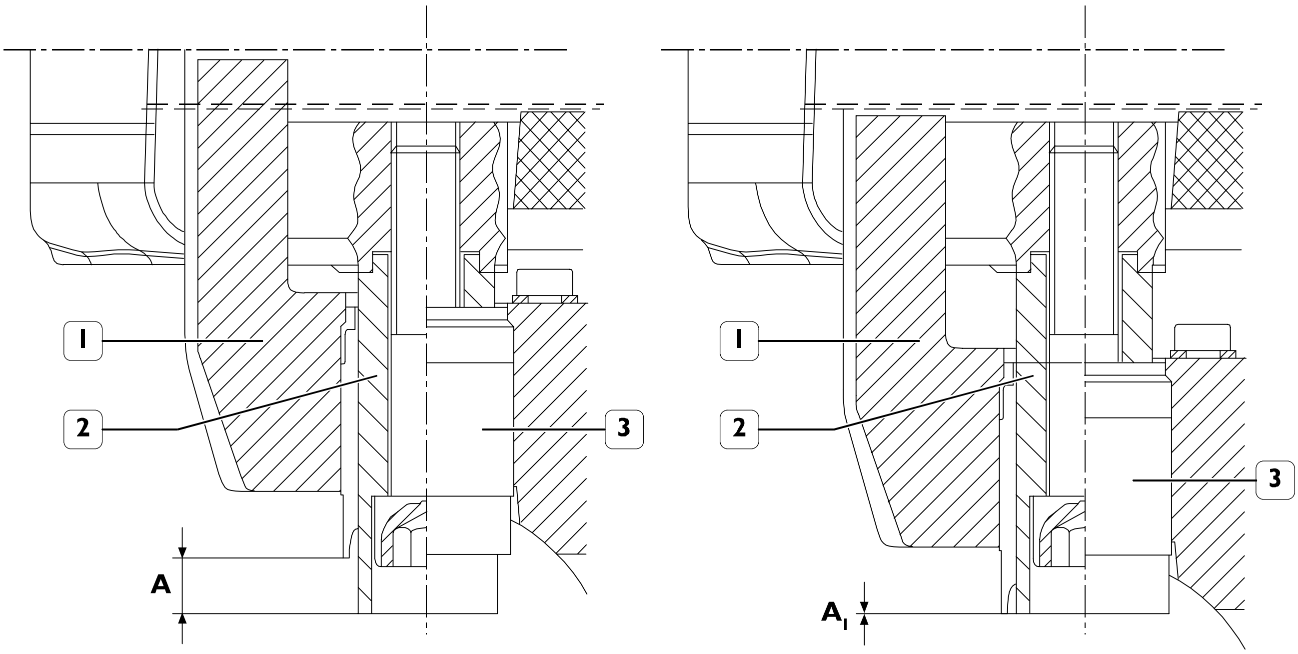
Figure 96



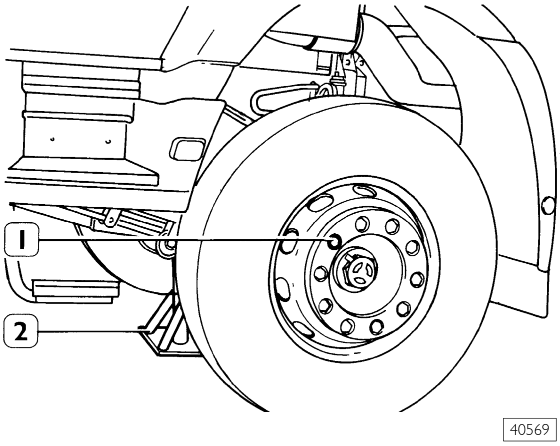
SECTIONS ON SN6/SN7 BRAKE CALIPER

1. Brake caliper - 2. Rubber guide bush - 3. Sliding bushing
A. Sliding bushing position with new gaskets - A1. Sliding bushing position with worn braking gaskets (carry out an accurate check with disassembled wheels)

REAR BRAKES REVISION

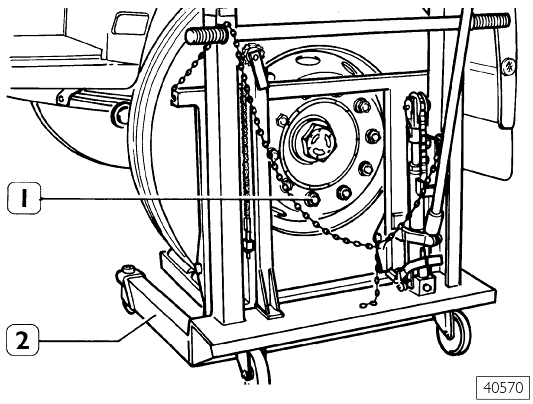
527417 Braking gaskets replacement

Figure 97



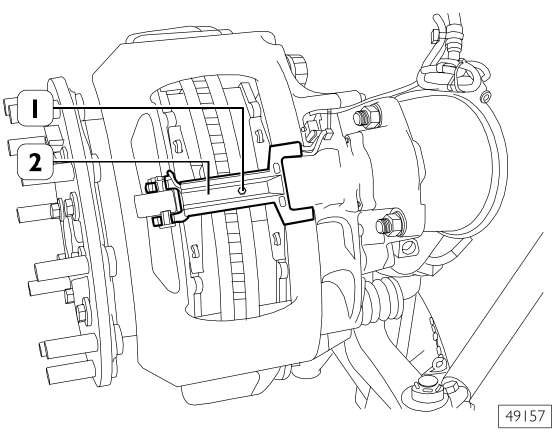
Arrange the vehicle on a plane ground and lock its rear wheels; loosen nuts (1) securing the front wheels.
With an hydraulic jack lift the vehicle from its front side and rest it on two support stands (2).

Figure 98



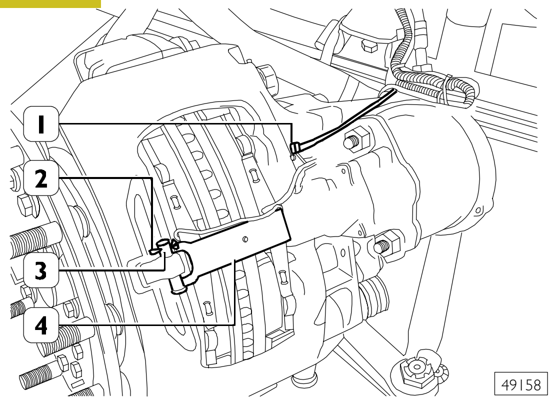
Unscrew securing nuts and with hydraulic trolley 99321024 (1) detach the wheels.

Figure 99



Remove screw (1) and plate (2) for checking wear sensor cables.

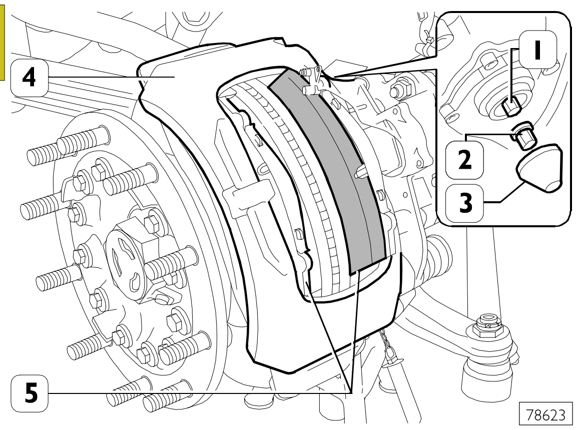
Figure 100



Remove and disconnect the electric connections (1) from the caliper body. Remove the split pin (2), pin (3) and plate (4) fastening the brake linings.

Do not fasten any lifting device on the plate (4).

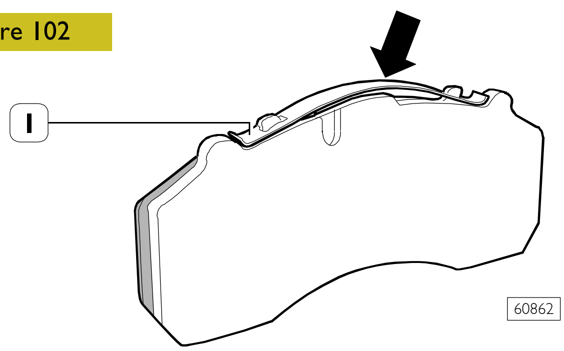
Figure 101



Remove cap (3), act on adjusting unit (1) with the adapter fitted, by means of a wrench, in a counter-clockwise direction, so as to make pistons go back into the caliper body, then remove braking gaskets (5) by properly floating caliper body (4).

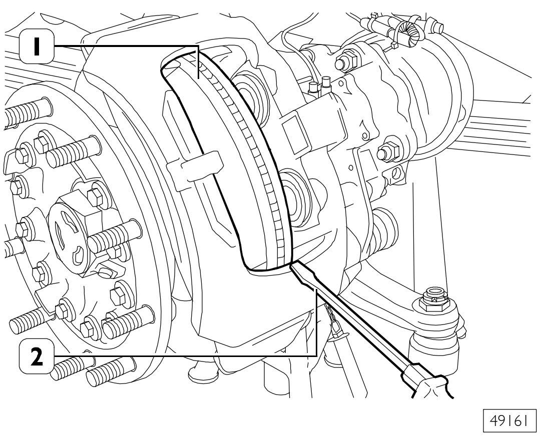
Never operate directly on the registration pinion (1) without having first of all fitted the adapter (2). If the cutting torque of the adapter is exceeded, this will break.
Test with a new adapter. If this also breaks, the caliper must be replaced because it is damaged.

Figure 102



Press (→) the spring (1) and remove it; replace it with a new one if necessary.

Figure 103

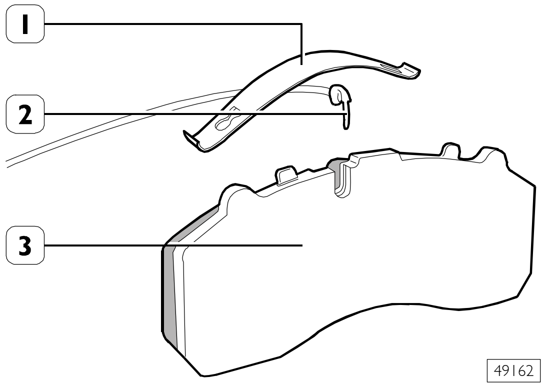


Remove dirt and rust around the braking disc edge with a scraper or an old screwdriver (2), resting on the caliper body, making disk (1) rotate.
End the work with abrasive cloth. Remove residuals by using a suction device or with canvasses and brush.
Do not use petrol or other petroleum derivatives that could create brake failures.
Use only denatured alcohol with methanol or isopropyl alcohol.
Accurately clean brake disc braking area surfaces.

Visually check dust-guarding casings conditions; if they show distortions or breakages, it is necessary to replace them; such operation implies the need of disassembling the brake caliper, so that it is advisable to detach the brake caliper body completed with carrier plate for the complete revision.

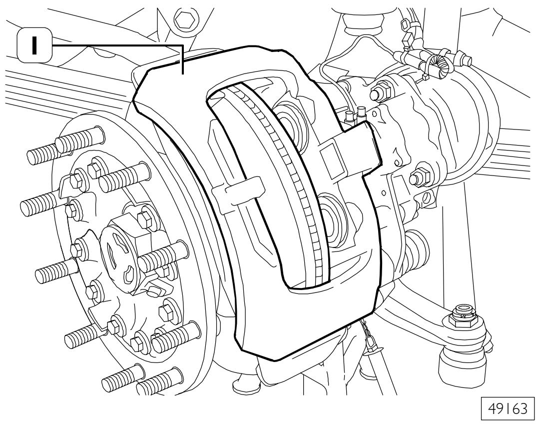
Verify that the caliper freely rotates on its guides.
If anomalies are detected on one brake caliper only, it is advisable to proceed with the complete revision of both brake calipers.
Remove dirt from brake caliper using a metal brush and avoiding to damage dust-guarding casings.
Clean braking gaskets sliding surfaces.
Check brake disc conditions and make sure that it is not corroded, scored or grooved. Slight surface cracks are acceptable, but it is necessary to go on grinding the brake disc as described in the related chapter, otherwise if worn, replace the brake disc.
If there occurs the need of replacing, it is advisable to replace both brake discs.
Check springs and wear sensors conditions, if necessary replace them.

Figure 104



Insert wear sensor (2) into its suitable seat on braking gasket (3).
Assemble spring (1) proceeding in reverse with respect to disassembling.

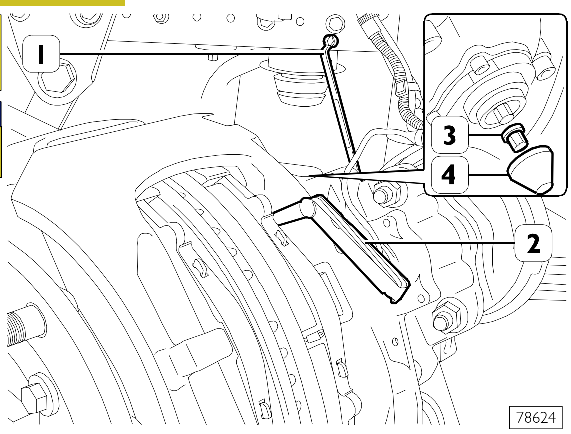
Figure 105



Insert new gaskets in brake caliper (1) and check that they freely slide into their own seats.

If it is necessary to replace the pair of braking gaskets, always replace a complete series of them for every axle.

Figure 106



Using the wrench (1), act on the adaptator retriever pin to get a play not lower than 0.7 mm between brake lining and brake disk, which can be measured using the thickness gauge (2). Replace the cover (4) and lubricate it with white grease RENOLIT HLT2.

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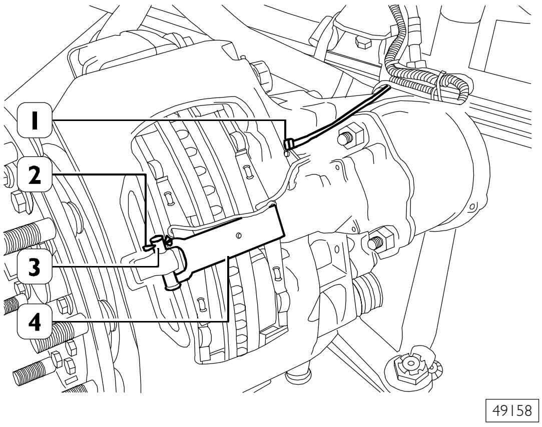
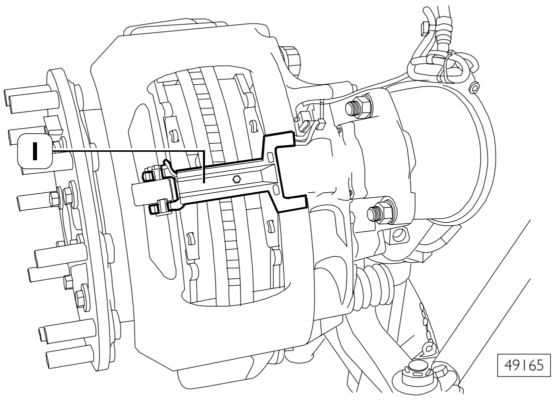
Make sure that the outer protecting plug and the seal ring are correctly fitted, in order to prevent water leaks inside the play automatic retriever.

Figure 107



Connect electric connection (1) and secure it to caliper body. Assemble plate (4), small pin (3) and split pin (2).

Figure 108

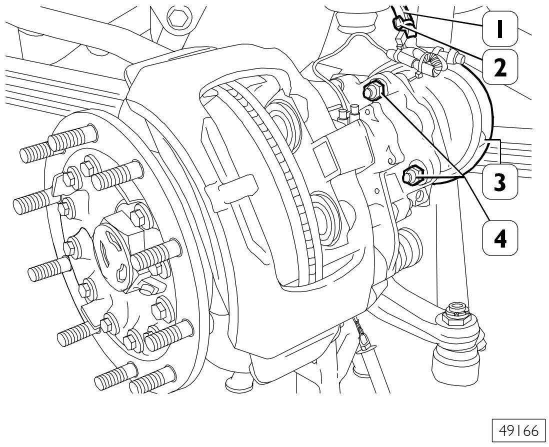


Assemble wear sensor cables checking plate (1).
Using hydraulic trolley 99321024, assemble the wheels. Lower the vehicle. Lock wheel rim securing nut at the required tightening torque.
Apply protection cup to wheel hubs.
Proceed as described on the opposite side.
After having ended the repairs on vehicle brakes, repeatedly actuate the brake pedal, with moving vehicle, along both running directions, thereby settling the braking gaskets.

527413 Brake calipers disconnection and reconnection

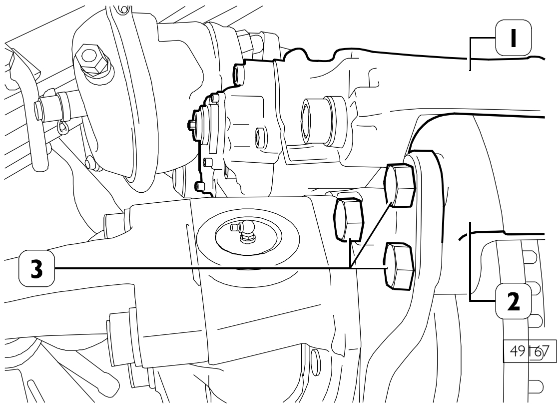
Disconnection

Figure 109



For disconnecting the braking gaskets, comply with what has been previously described in the paragraph about "Braking gaskets replacement". Remove clamps (2). Disconnect membrane cylinder supply piping (1).
Unscrew nuts (4) and remove membrane cylinder (3).

Figure 110



Remove screws (3) and detach brake caliper (1) completed with carrier plate (2).

Pay attention when disconnecting and transporting the caliper (1) since it is heavy and floating on the carrier plate (2).
Hold the caliper on its outer side only; never put your fingers between caliper (1) and support plate (2).

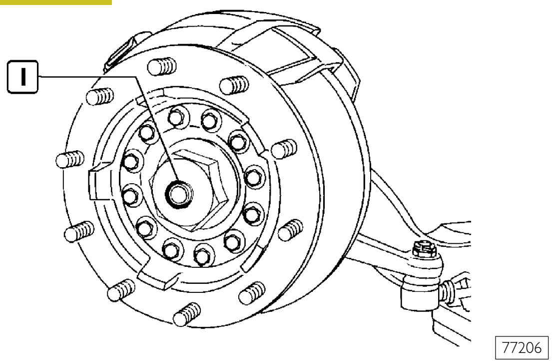
Reconnection

For reconnecting, reverse performed operations for disconnecting and comply with the required tightening torques.

520620 Wheel hubs disconnection and reconnection

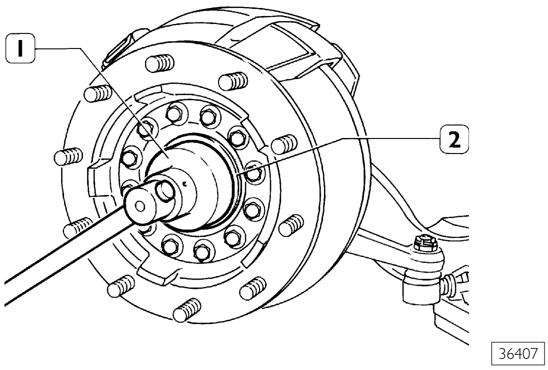
Disconnection

Figure 111



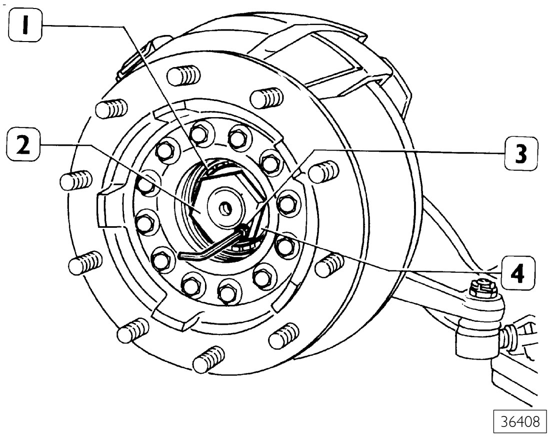
Rotate wheel hub so that screw plug (1) is taken downwards; unscrew the cap and drain oil in a special container.

Figure 112



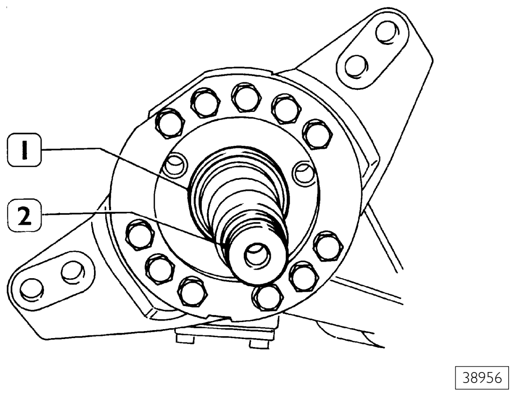
Suitably lock wheel hub rotation and with wrench 99354207 (1) unscrew oil cover (2), by draining residual oil in the special container provided.

Figure 113



Unscrew safety screw (3). With wrench 99388001 unscrew adjustment ring nut (2), withdraw washer (4), external bearing (1) and detach brake disc completed with wheel hub, spacer and internal bearing.

Figure 114



Visually check that gasket-holder ring (1) diameter is free from dents or accidental abrasions.
Replace internal wheel hubs gaskets and if necessary ring (1) complying with what is described in section about "Front axle".
Verify through adjustment ring nut that threading (2) is free from hardenings, otherwise take care of removing them with appropriate means.
Carry out the opposite braking assembly disassembling, keeping the components separate.

Reconnection

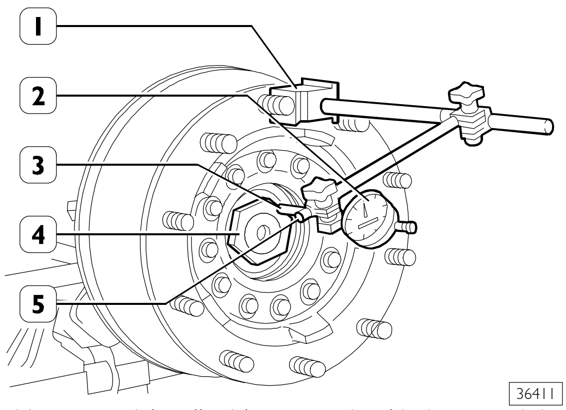
Make sure that surfaces of all parts inside the hub are accurately clean, free from slags and burrs.

Lubricate the bearings with SAE W 140/MDA oil.

Key-in wheel hub completed with brake disc on stub axle. Insert internal spacer on stub axle, then place external bearing and shoulder washer.

Screw and lock adjustment ring nut at the required torque.

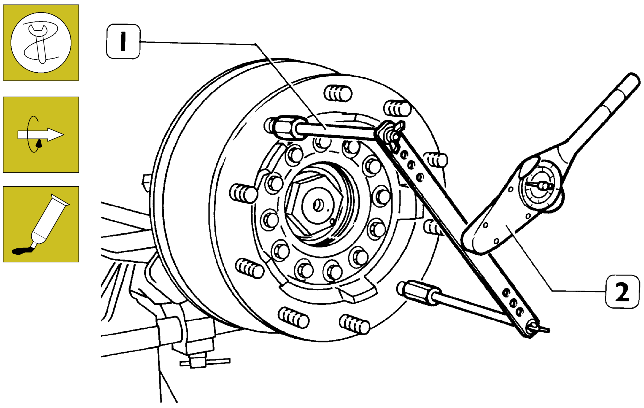
Figure 115



Settle with some axial mallet blows on wheel hub, rotate it in both directions to free bearing rollers. Apply magnetic base (1) completed with comparator (2) to wheel hub. Arrange comparator (3) rod perpendicular to stub axle tang.

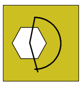
Reset the comparator with a pre-load of 1.5 ÷ 2 mm.
Axially move, with the help of a lever, the wheel hub and check that its axial clearance is 0.16 mm (maximum value).
After having obtained the provided axial clearance, lock adjustment ring nut (4) check screw (5) at the required torque.

Figure 116



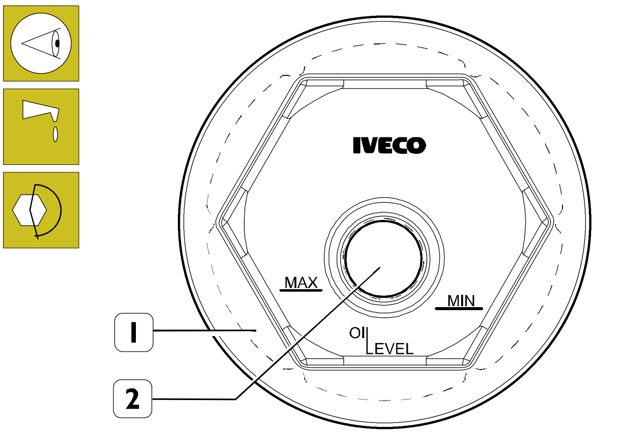
Apply tool (1) 99395026 on wheel hub stud bolts and use torque meter 99389819 (2) to check whether the wheel hub rolling torque is at the set value.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.



Tighten to torque the hub cover (1, Figure 117).

Figure 117

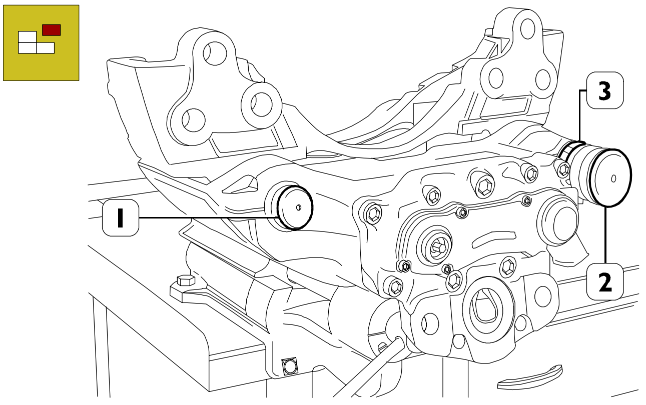


Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

527413 BRAKE CALIPERS REVISION TYPE SB6

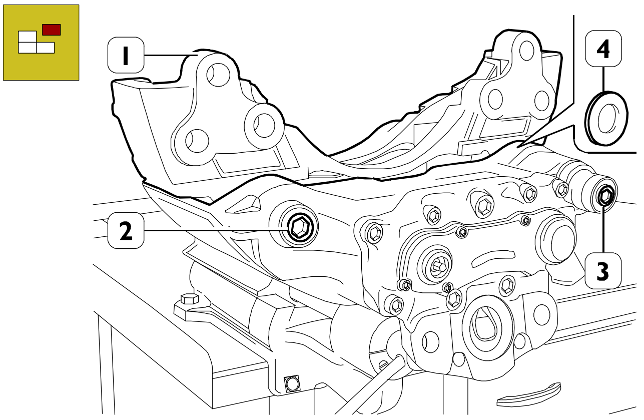
Disassembly

Figure 118



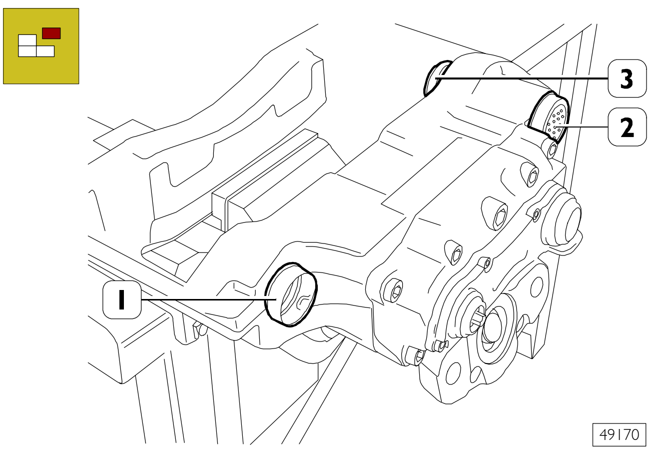
Take brake caliper to bench and lock it in a vice.
Remove clamp (3) and protection cups (1 and 2).

Figure 119



Remove sliding pins (2 and 3) and disassemble carried plate (1) recovering washer (4).

Figure 120



Disassemble protection casing (3), rubber bush (1) and through a suitable beater, brass bush (2).

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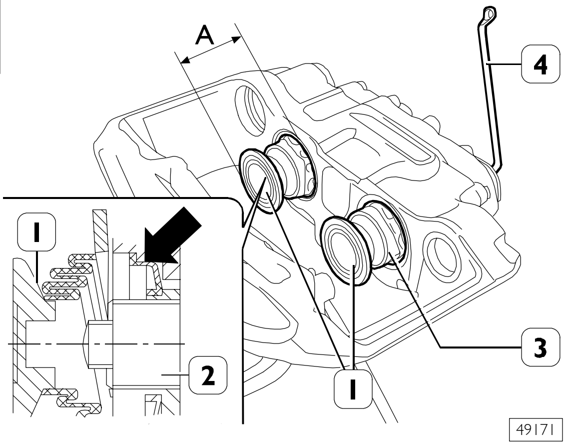
Figure 121



Through wrench (4), operate on clearance recovering device in order to make small piston (1) go out of caliper body for a maximum of 30 mm (dimension A).
Remove dust-guarding casing from caliper body and through a suitable lever remove small pistons (1) together with protection casings (3).

> Dimension A must absolutely not be exceeded since threaded barrels (2) are synchronised. If threaded barrels (2) perform an overstroke, they lose their synchronism and the brake caliper must be replaced.
> Internal brake caliper parts must absolutely not be disassembled.
> Therefore do not loosen or disassemble cover check screws.

Cleaning and check of component parts

For washing the metal parts, use an hot water solution with Fiat LCD detergent.
By using a metal brush, remove dirt from caliper body, then with a brush remove residuals and accurately clean guide pins and sliding bushes seats.
Through a synthetic brush with adequate sizes, remove grease residuals from sliding bushes seats.
Proceed with an accurate caliper body blowing through a compressed air jet.
With a canvas drenched with isopropyl alcohol or the like, accurately clean the sliding bushes.
Check wear conditions of sliding bushes and related seats on brake caliper body, make sure that there are no wears or damages on sliding surfaces.
Insert bushes in their seats, verify their regular sliding, otherwise proceed with their replacement, or restoration, if it is necessary, from seat on caliper body.

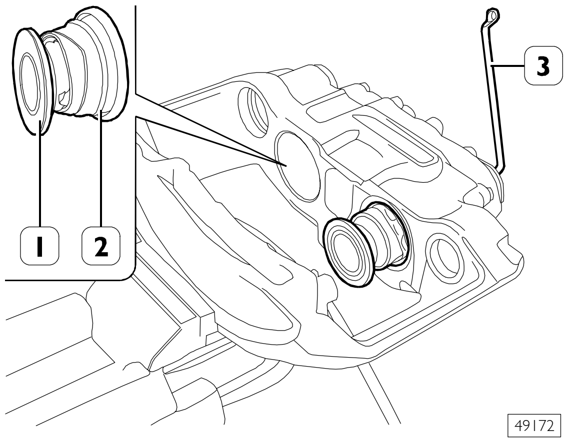
> A regular braking very much depends on brake caliper sliding on guide pins.

Check wear conditions of braking gaskets check pins and related safety springs; if they show distortions or wears, replace the parts that are deteriorated.
It is advisable to replace all rubber and plastic parts and brass bush, even if visually they do not show distortions or deteriorations.

Assembly

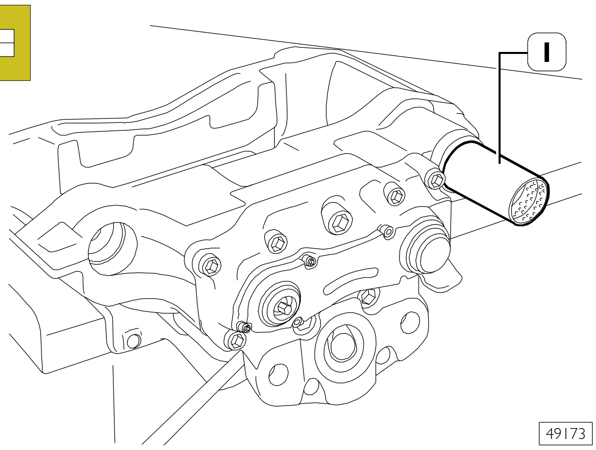
Make sure that all brake caliper components are perfectly clean; remove possible abrasive residuals with a canvas without hairs, drenched with isopropyl alcohol or the like.

Figure 122



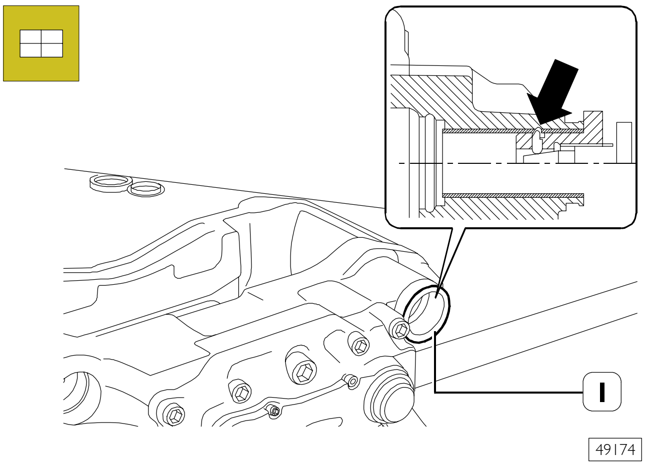
Through a suitable keyer, assemble small pistons (1) together with protection casings (2).
Through a wrench (3) operate on clearance recovering device in order to make small pistons (1) go back.

Figure 123



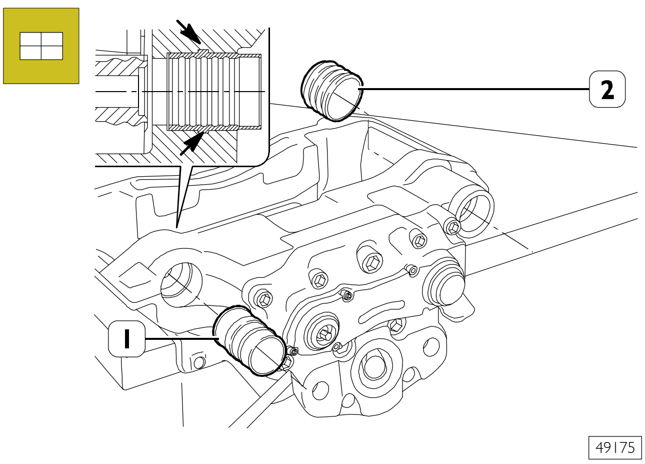
Through a suitable beater, assemble brass bush (1).

Figure 124



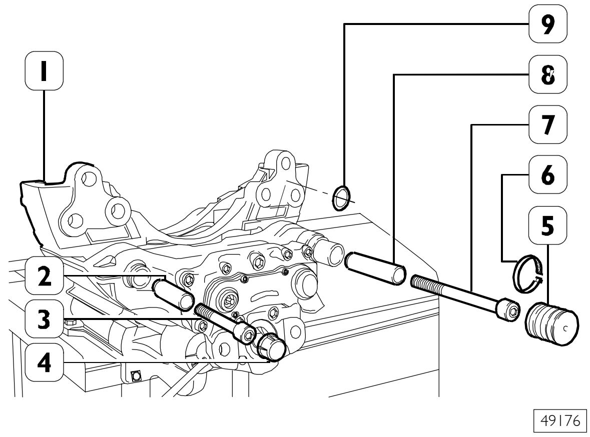
Through suitable toolings, carry out caulking in point (→), next to caliper body groove to avoid brass bush (1) displacements.
Verify that there are no burrs in bush seat, otherwise remove it.
Butter the bush with white RENOLIT HLT2 grease.

Figure 125



Assemble rubber bush (1) so that the external ring is placed in groove (→).
Butter the bush with SYNTHESO GL EPI green grease with synthetical base.
Assemble protection casing (2) making sure that its sealing lip is inserted into the suitable seat.

Figure 126

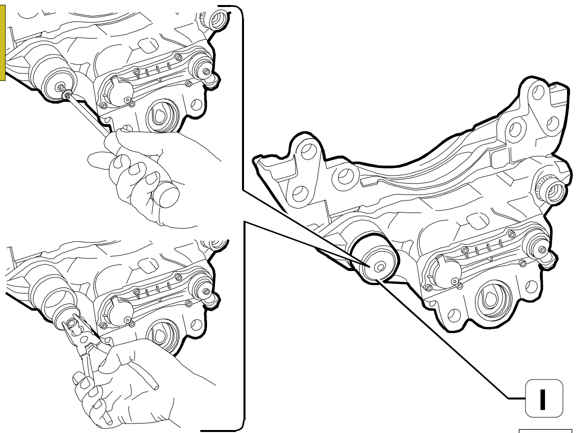


Insert sliding bushes (2 and 8).
Assemble carrier bracket (1), inserting washer (9), securing it with sliding pins (3 and 7) at the required torque.
Assemble: protection plug (4), protection casing (5) and secure it through a clamp (6).
Before assembling brake caliper on vehicle, make sure that it freely slides operating on plate (1) along both directions.

BRAKE CALIPER OVERHAUL TYPE SN6-SN7

Disassembly

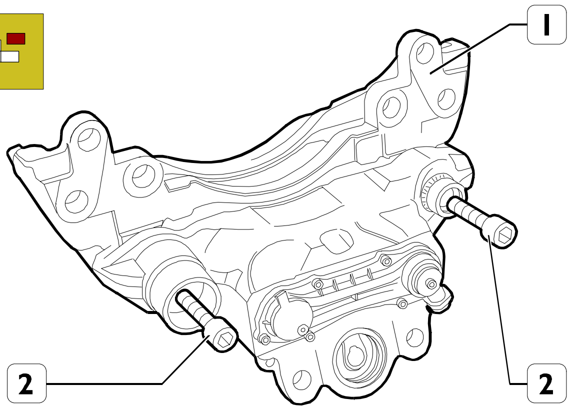
Figure 127



79121

Place the brake caliper on the bench and block it in a vice. Remove the cover (1) and make a hole in it with a Parker screw.

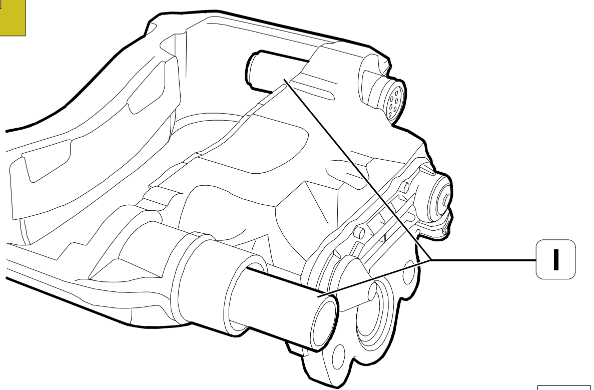
Figure 128



79122

Refit the supporting plate (1) and remove the fastening screws (2).

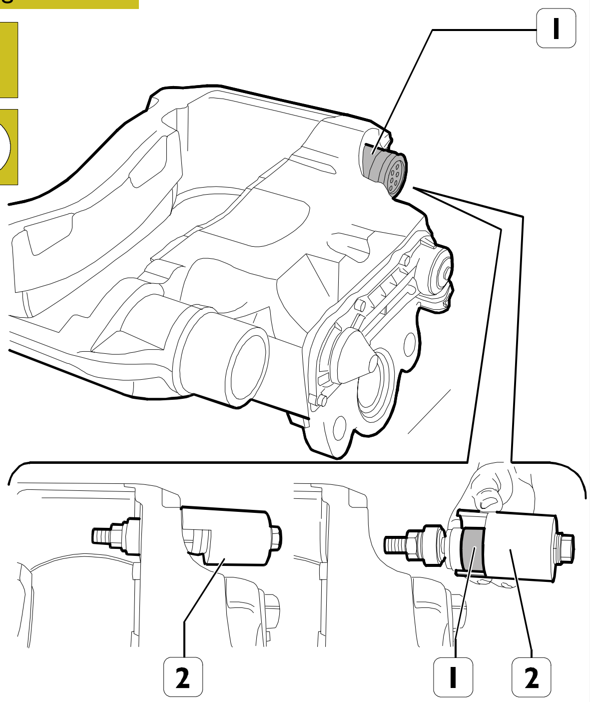
Figure 129



79123

Remove the sliding bushes (1).

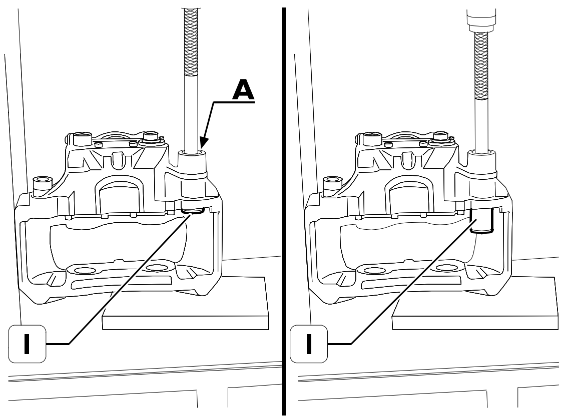
Figure 130



79124

Use tool 99372245 (2) (to be used with screw in tool 99372237) to disassemble the rubber sleeve (1).

Figure 131

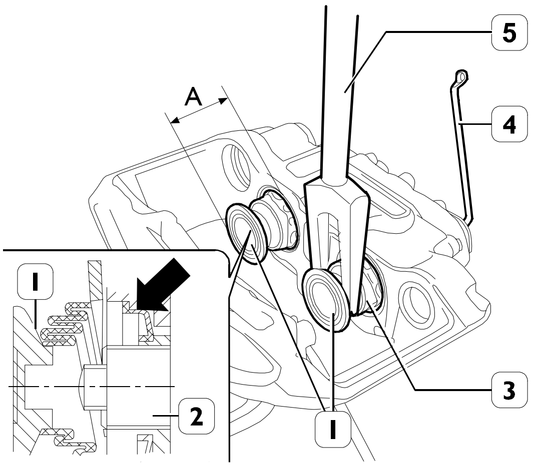


79125

Take the caliper to the press.

Insert the appropriate beater in the brass bush housing (1) (See arrow A). Use the press to remove the bush (1).

Figure 132



60742

Place the caliper on the bench and block it in a vice. Use the wrench (4) to operate the clearance recovery device so that the piston (1) comes out of the caliper body for a maximum of 30 mm (value A).
Take off the dust-guard from the caliper body and use tool 99372238 (5) to remove the thrust pressing devices (1) of the caliper together with the protection casings (3).

Value A must not be overcome because threaded hoses (2) are synchronised. If the threaded hoses (2) reach their over-travel, they loose synchronism and the brake caliper must be replaced. The brake caliper inner parts must never be removed.
For this reason you are recommended non to slacken or to remove the cover retaining screws..

Component part cleaning and check

To wash metal parts, use a solution of hot water with Fiat LCD detergent. Use a metal brush to remove dirt from the caliper body and then a little brush to remove the residuals and to clear accurately the guide pin and the sliding bush housings.

Use a synthetic brush with the right dimensions to remove the grease left on the sliding bush housings.

Clean the caliper body accurately with compressed air.

Use a piece of cloth soaked with isopropyl alcohol or similar to clean the sliding bushes accurately.

Check the wear conditions of the sliding bushes and their housings on the brake caliper body. Make sure they are not damaged or worn, especially the sliding surfaces. Fit the bushes in their housings and check they slide regularly.

Fit the bushes in their housings, check they slide correctly, otherwise replace or restore their housings on the caliper body, if needed.

Regular braking depends mainly on the brake caliper sliding on the guide pins.

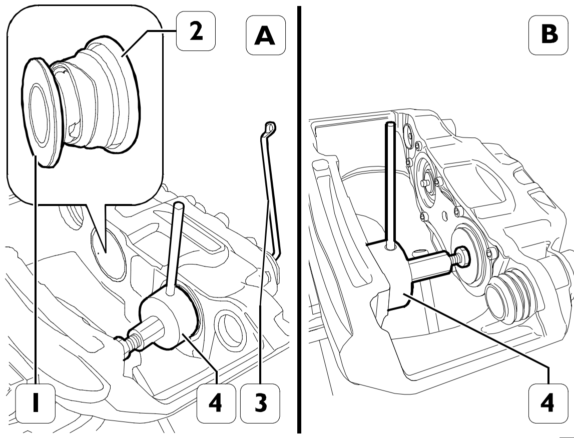
Check the wear conditions of the brake lining retaining pins and the related safety pins. If they are worn or damaged, replace the worn parts.

It is advisable to replace all rubber and plastic parts and the brass bush even if they do not seem damaged or worn at sight.

Assembly

Make sure all the brake caliper components are perfectly clean. Possible abrasive residuals should be removed with a cloth soaked in isopropyl alcohol or similar.

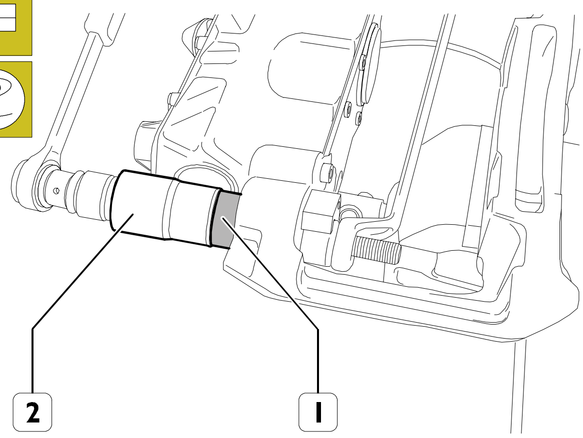
Figure 133



79126

Use tool 99372239 (4) (see figure A) to fit the protection casings (2). Use the same tool 99372239 (4) fitted on the other side (see figure B) to insert the pistons (1). Use a wrench (3) to act on play restorer, so as to make pistons (1) go back.

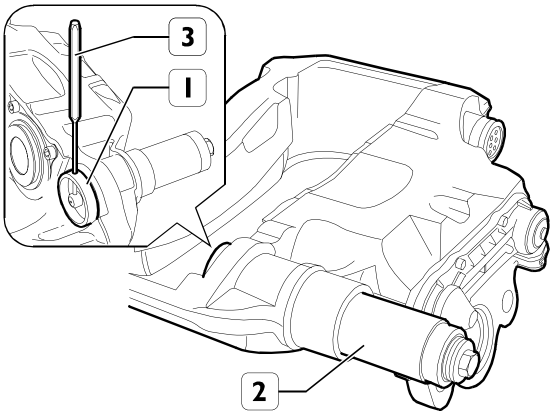
Figure 134



79127

Use tool 99372244 (2) (to be used with the screw in tool 99372237) to assemble the rubber sleeve (1).

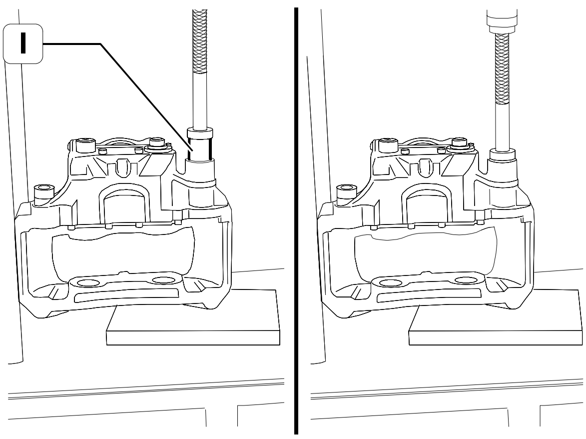
Figure 135



79128

Use tool 99372243 (1) (to be used with tool 99372240 and use screw in tool 99372237) to assemble the brass bush (2) in its seat, by blocking its rotation by means of a suitable tool (3) (punch or screwdriver).

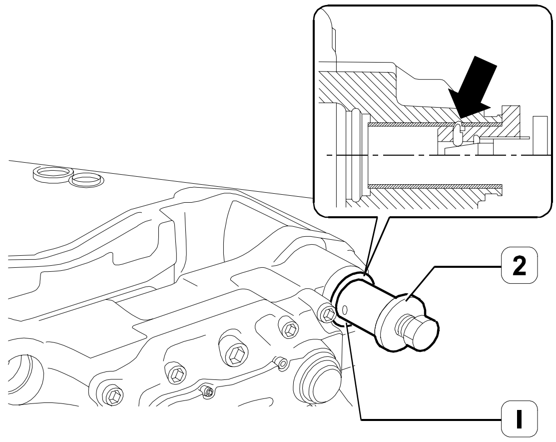
Figure 136



79129

Place the caliper under the press. Use the press to fit the brass bush (1) in its housing until is comes out of the lower side by 1 mm.

Figure 137

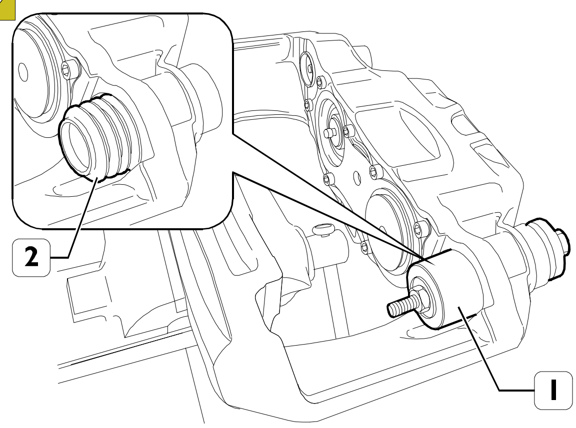


60745

Use the appropriate tool 99372242 (2) to carry out bruising in the point (→) next to the caliper body groove, in order to prevent the brass bush (1) from moving.

Make sure there are no burrs in the bush housing, otherwise remove them. Apply white grease RENOLIT HLT2 on the bush.

Figure 138



79130

Place the caliper on the bench and block it in the vice. Fit the protection casing (2) by means of tool (1) 99372237.

> ⚠ Reverse the removal order to fit the sliding bushes and the supporting plate.

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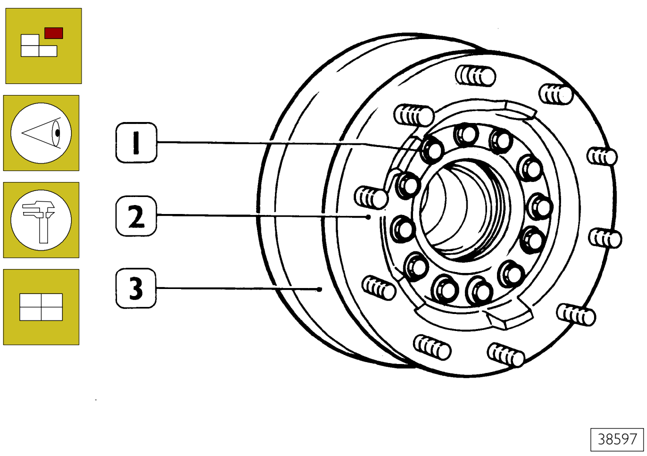
527411 REAR DISC BRAKES REVISION (12-18 t)

Overhaul the braking unit; disassemble and check the brake caliper by following the procedure described for front disc brakes.
Wheel hub disassembling will be described in the next edition.

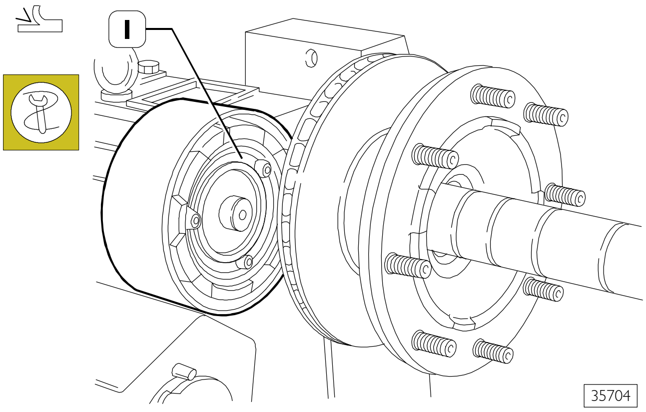
527411 BRAKE DISCS REVISION

Figure 139



Examine the brake discs surfaces wear status.
When detecting different values from those included in characteristics and data table, perform brake discs turning and grinding operations, and if necessary replace them.
Remove screws (1) and detach hub (2) from disc (3).
Replace disc (3) and reassemble it following the reverse procedure to the previously-described one.

Figure 140

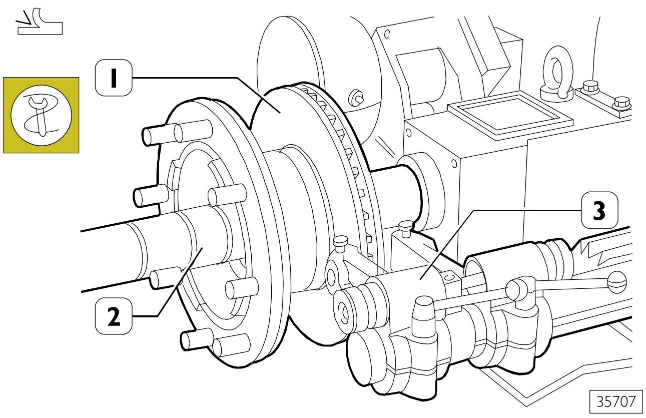


Through lathe 99301001 proceed with grinding both brake disc working surfaces.

During grinding operations, gradually proceed with the advancement of sectored spring, till turning residuals are totally removed.

527411 BRAKE DISCS TURNING AND GRINDING

Figure 141

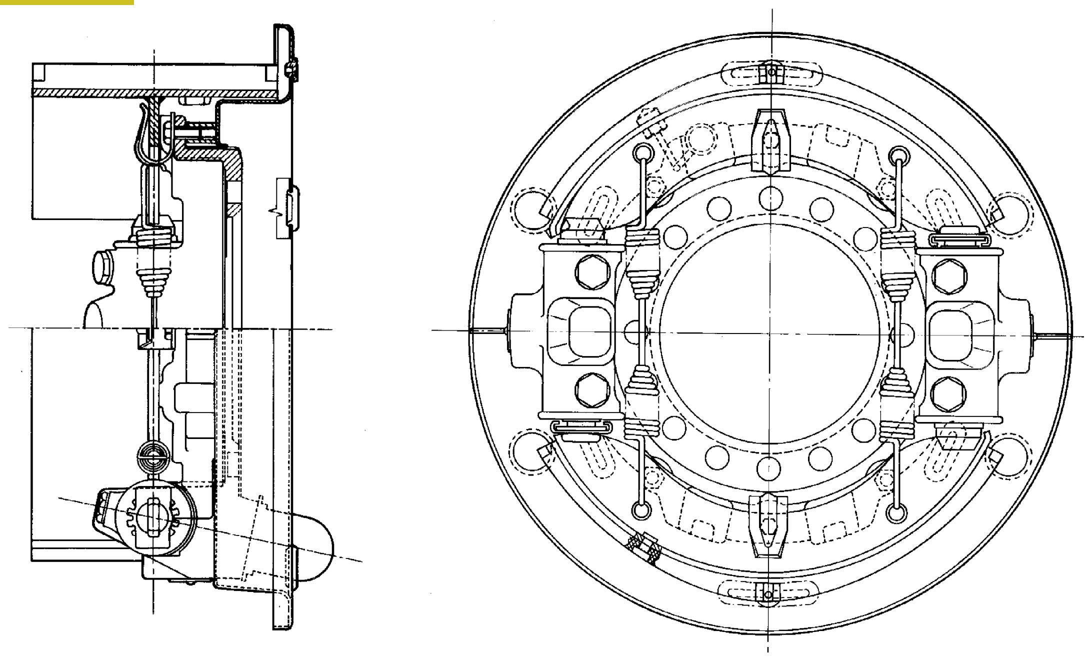


- Key-in on lathe 99301001 (2) shaft the brake disc (1) completed with hub;
- key-in a series of spacers on the shaft that remove axial assembly clearance, screw locking nut and apply lathe shaft support;
- place tool-holder (3) axially with brake disc (1), then adjust tools depth;
- proceed with brake disc (1) turning, operating on one or more removal passes, according to detected scoring.

Print 603.93.111

5272 REAR DRUM BRAKES - Model 260E28KE

Figure 142

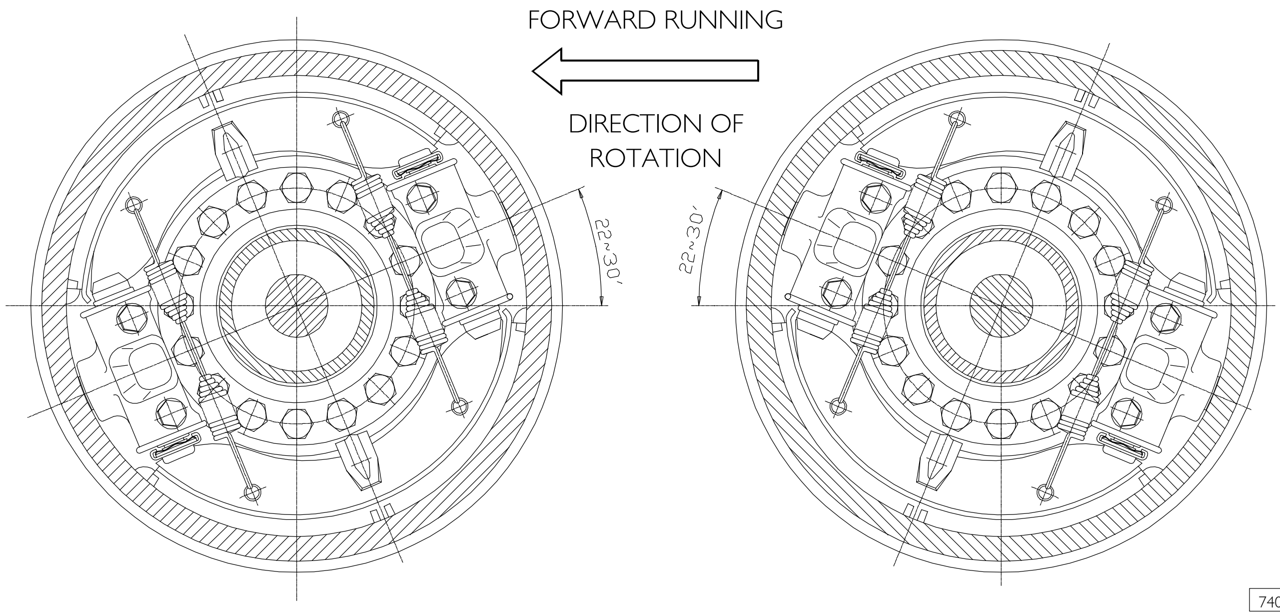


37490

DRUM BRAKES VIEW

Brake position with Hendrickson suspension

Figure 143

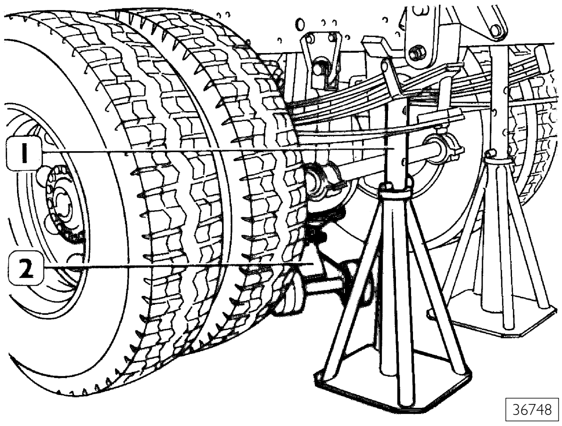


74059

INTERMEDIATE AXLE REAR AXLE

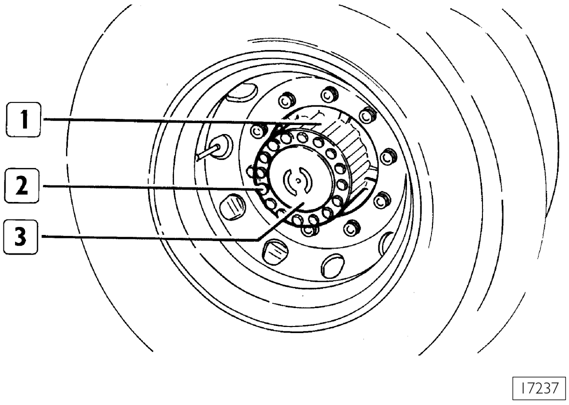
27230 REAR BRAKES REVISION (26 t)
Disassembly

Figure 144



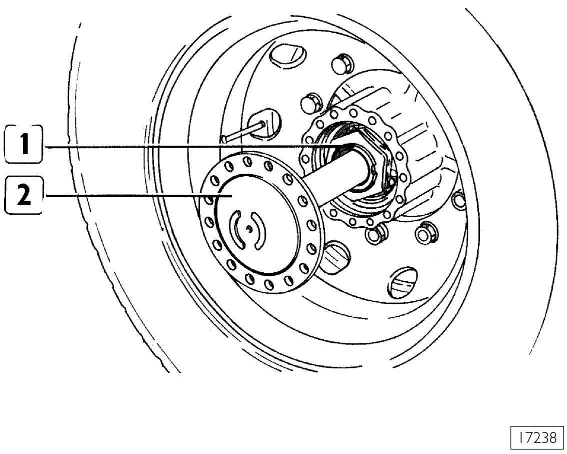
Arrange the vehicle on a plane ground. Take parking brake hand lever in running position, loosen rear half-shafts securing nuts. With an hydraulic jack (2) lift the vehicle from its rear side and rest it on suitable support stands (1).

Figure 145



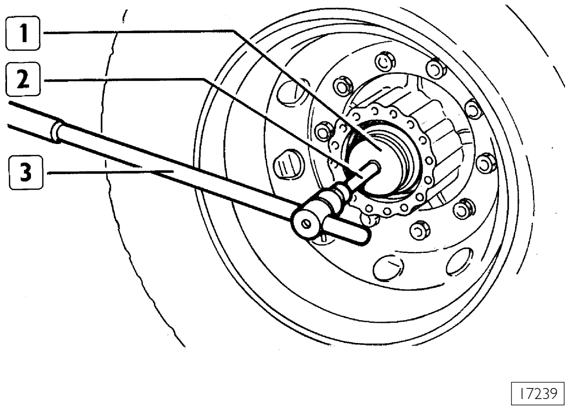
Unscrew screws (2).
Remove half-shaft flange (3) from wheel hub (1) union plane and discharge oil.

Figure 146



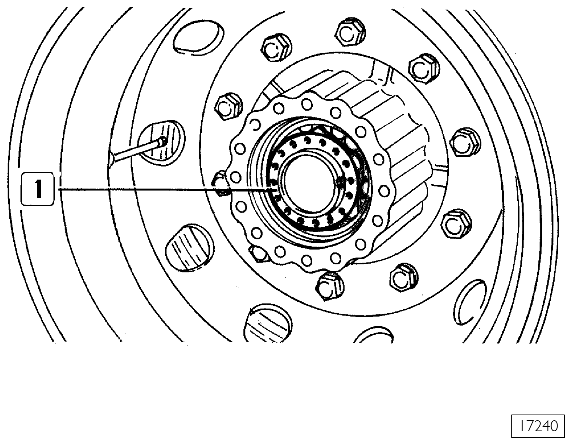
Withdraw half-shaft (2) from case (1).

Figure 147



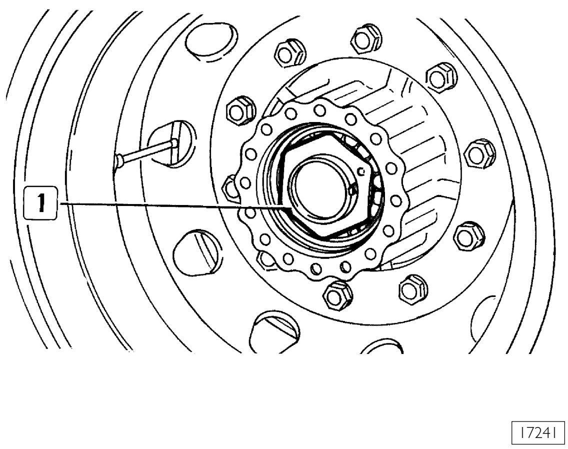
By using a wrench 99355167 (1), equipped with extension (2) and handle (3), disassemble locking ring nut for wheel hub bearings adjustment nut.

Figure 148



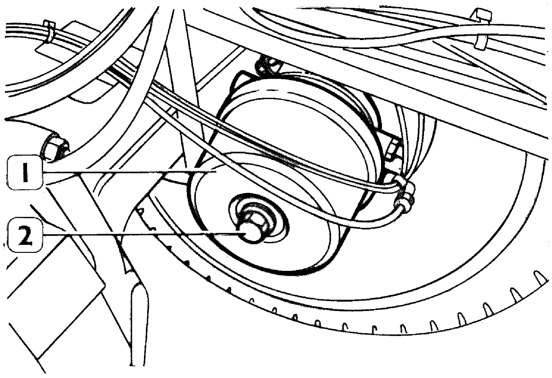
Extract safety washer (1).

Figure 149



Unscrew bearing adjustment nut (1) with the help of wrench 99355167.

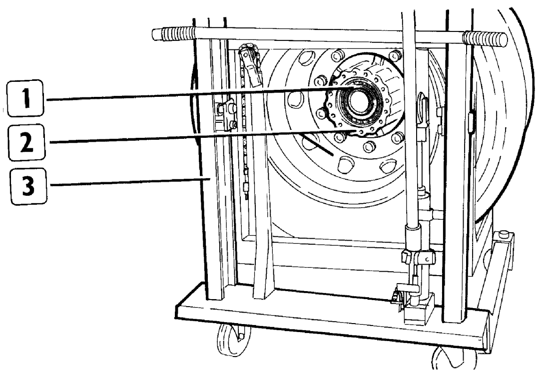
Figure 150



36745

Before detaching the complete wheels, completely unscrew manual unbraking screw (2) of combined cylinder (1).

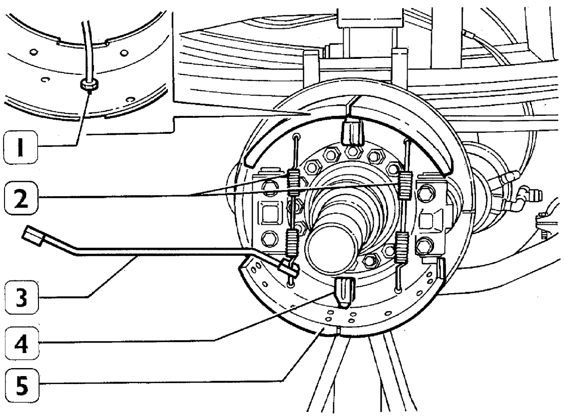
Figure 151



17243

By using hydraulic trolley 99321024 (3), detach wheel completed with drum (2) and bearing (1).

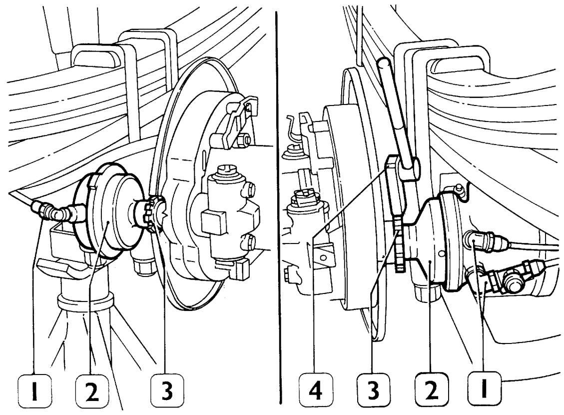
Figure 152



38352

With the help of tool 99372217 (3), detach jaws (4) checking springs (2); detach jaws (4) from check brackets (5) after having detached braking gaskets wear sensor (1).

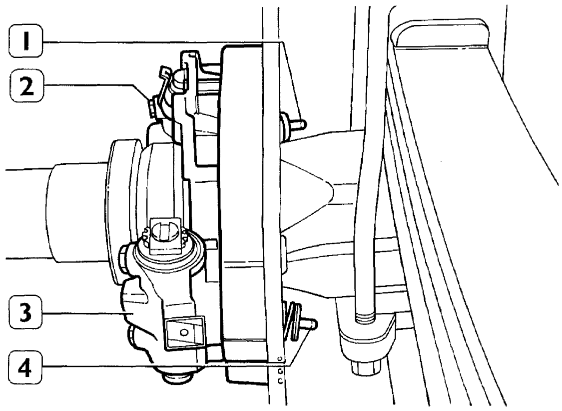
Figure 153



38704

Detach brake cylinders supply fittings (1). With wrench (4) 99356006 unlock ring nuts (3) and detach cylinders (2).

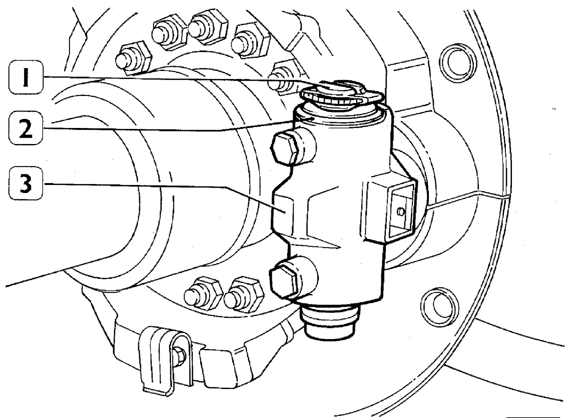
Figure 154



38354

Withdraw control wedge units (1 and 4) from brake body (2 and 3).

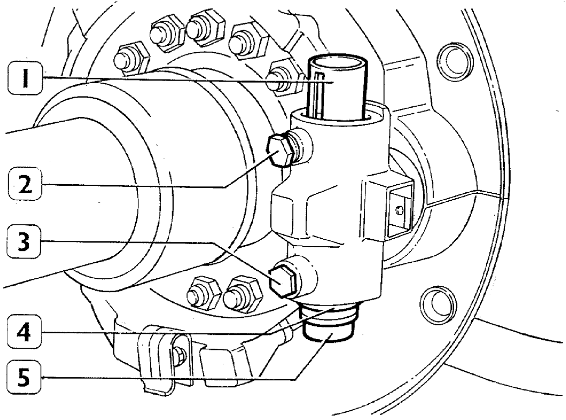
Figure 155



38355

With the help of a screwdriver, undrive metal ring (2) and withdraw complete adjustment unit (1) from brake body (3).

Figure 156



38356

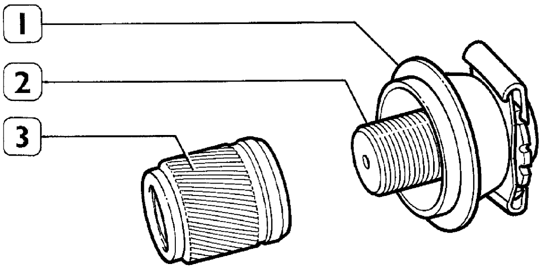
Unscrew guiding pin (2) from small piston (1) and extract the piston from the brake body. With a screwdriver, undrive metal ring (4).
Unscrew guiding pin (3) of thrust pin (5) and extract this latter one from brake body.

Proceed with disassembling the wheel completed with hub, and the whole braking unit on the opposite side, keeping the component parts separated.

Check of component parts

Examine the wear status of drums and braking joints: if they show scoring, braking surface damages, ovalities or eccentricity greater than 0.25 mm, they must be turned.
If braking gaskets show a thickness that is lower than the provided one, proceed with their replacement.
If the gasket braking surface shows traces of grease, it is necessary to discover the reason for grease or oil seepage into the braking unit, and then remove it.

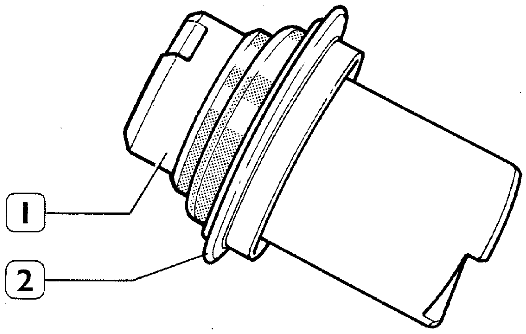
Figure 157



38357

Divide the automatic adjustment units.
Unscrew adjustment bushes (3) from adjustment pins (2), then withdraw sealing gaskets (1).
Verify the external helical toothing wear status of adjustment bushes, make sure of the regular sliding of bushes when screwing them on related adjustment pints.

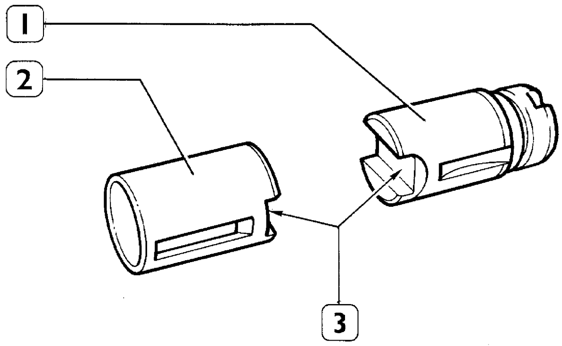
Figure 158



38358

Withdraw sealing gaskets (2) from thrust pins (1).
Accurately clean all single parts composing the braking assemblies.

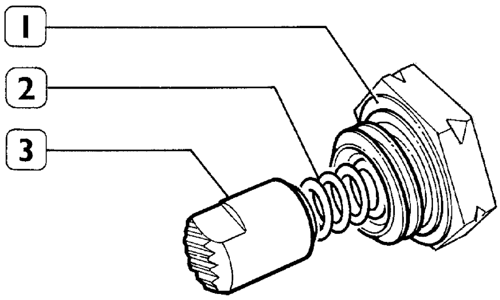
Figure 159



38359

Check the wear status of adjustment pins (2) and thrust pins (1) sliding surfaces, further check chutes (3) surfaces on which jaws opening control rollers operate.

Figure 160



38360

Check guide pins (3) toothing wear status, integrity of related compression springs (2) and copper washers (1).

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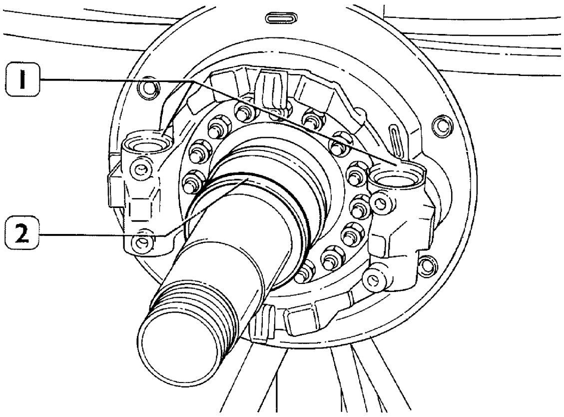
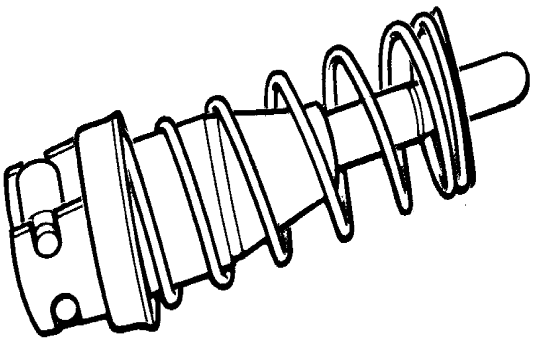
Figure 161



38361

Check wear status of seats on brake bodies (1); if they show scorings or excessive wears, replace anomalous brake bodies. Visually check ring (2) diameter, that is free from dents or accidental abrasions; if necessary replace it following the procedure described in the "Rear axle" section.
Replace internal wheel hub gaskets.

Figure 162



35713

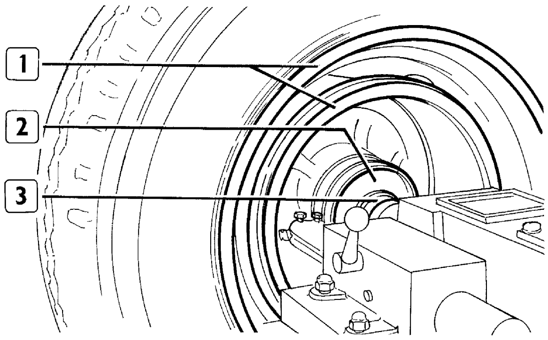
Check that wedge units easily slid and parts do not show abrasions.

In case of wear of parts composing wedge units, the complete wedge unit must be replaced.

527231 DRUM TURNING

Measure drum diameter by using a sliding gauge without angling the arms, measure the diameter in many points to establish ovality and wear status.

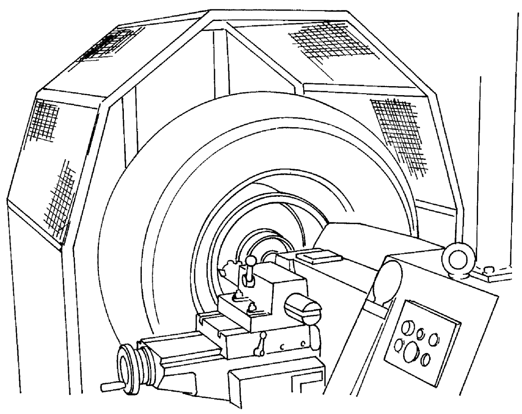
Figure 163



17252

Insert on lathe 99301001 shaft (3) the drum (1) completed with wheel centring it with suitable centring bushes.
Key-in on the shaft a series of spacers that remove axial assembly clearance, screw the locking nut and apply the lathe support.

Figure 164



17253

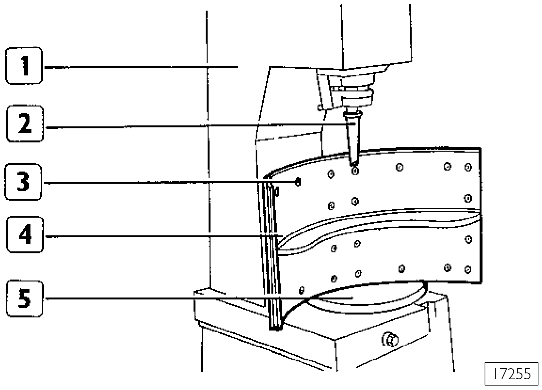
Carry out the turning operation by gradually operating till imperfections on drum braking surface are removed.
Disassemble complete wheel from lathe, carry out an accurate blowing operation on brake drum.

The maximum diameter increase allowed in drums is 4 mm. This limit must absolutely not be exceeded since braking effect and drum resistance characteristics would otherwise be impaired.

Couple adequate braking gaskets for every single drum depending on the increase. Every vehicle axle must be equipped with gaskets of the same type.

527233 BRAKING GASKETS REPLACEMENT

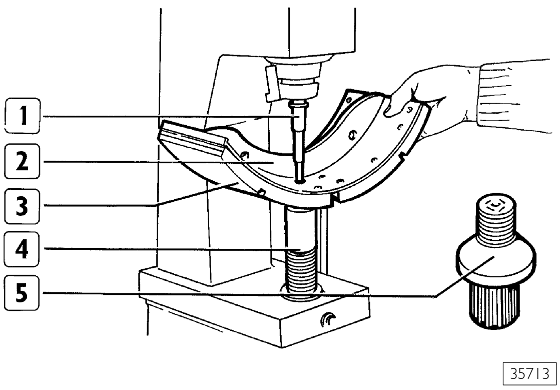
Figure 165



Carry out worn braking gaskets detachment from jaws by using the compressed air press 99305087 (1).
Place complete jaws (4) on adjustable abutment plat (5).
With chisel (2) inserted in press (1) operating head, shear rivets (3) heads.
Expel rivets from jaws.
Accurately clean the jaws by washing and blowing them.

> ! Visually check that jaws do not show cracks; if they are detected, replace anomalous jaws.

Figure 166

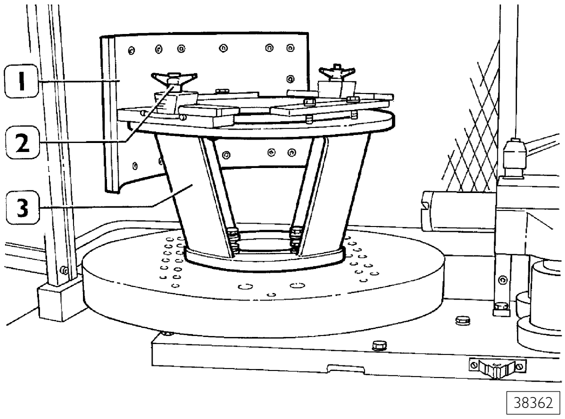


Apply on mobile press support (4) the abutment pin (5).
Proceed with nailing braking gaskets (3) on jaws (2) by using beater (1) inserted in press operating head.

> ! The correct execution of braking gaskets nailing is carried out starting from the center, and gradually extending it outside of braking sectors.

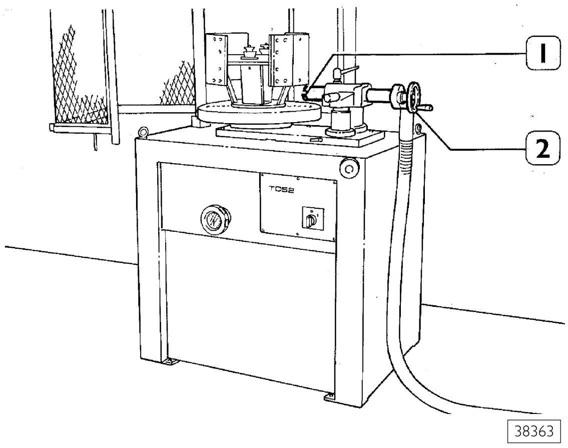
527233 BRAKING GASKETS TURNING

Figure 167



Assemble jaws (1) on table (3) of lathe 99301006, and lock them with handles (2).

Figure 168



Reset tool (1) operating on handwheel (2) and proceed with turning.

> ! Brake jaws turning can also be carried out by using tool 99372228 on lathe 99301001.

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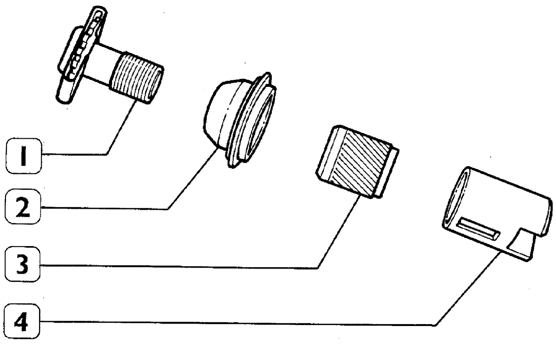
Assembly

Figure 169

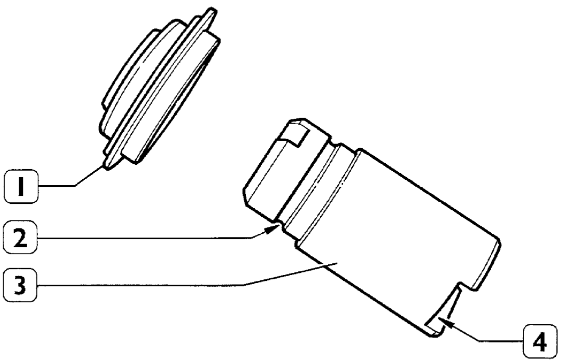


38364

Assemble sealing gaskets (2) on adjustment pins assemblies (1).
Grease pin (1) threading.
Completely screw adjustment bushes (3) and scrupulously grease these latter ones on external diameter.
Grease thrust pins (4) internal diameter.

During brakes maintenance interventions, replace sealing gaskets of adjustment and thrust pins.
For lubricating the components, use Rockwell RBSK 0253 grease.

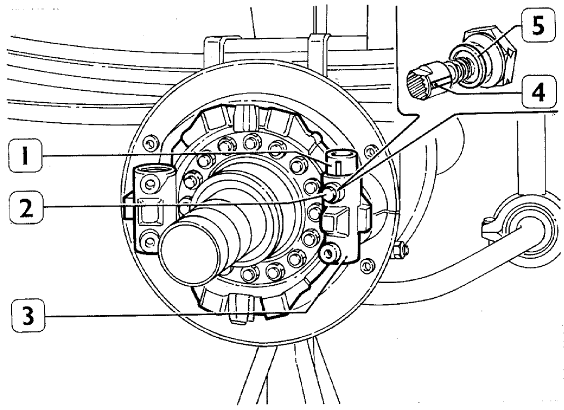
Figure 170



38365

Assemble seaking gaskets (1) on thrust pins (3); make sure of the correct gaskets profile insertion in thrust pins groove (2).
Grease pins (3) on sliding surface and on wedge (4) sliding chute.

Figure 171

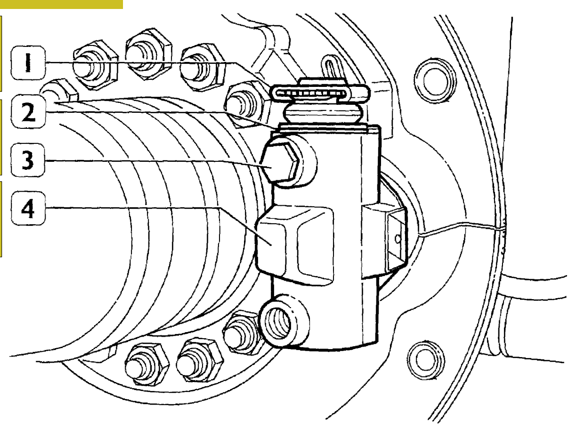


38366

Insert thrust pin (1) into brake body (3) seat so that the slot is facing the drive pin (2).
Grease and insert complete guide pin (2) into brake body seat (3); make sure that washer (5) is inserted and screw some turns.

Guide pin (2) must be assembled so that prong (4) slides into suitable brake body (3) hole slot.

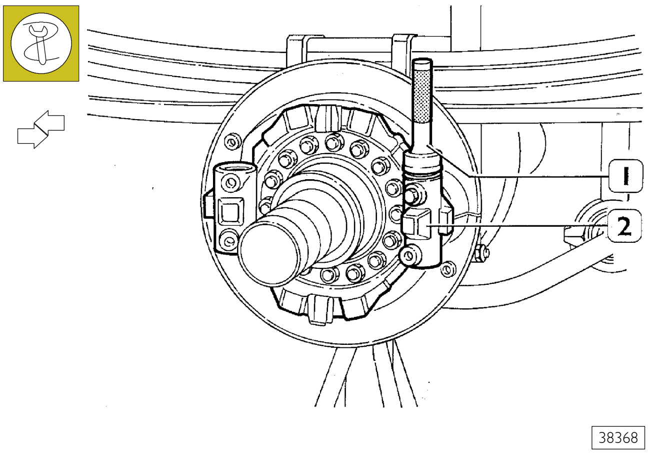
Figure 172



38367

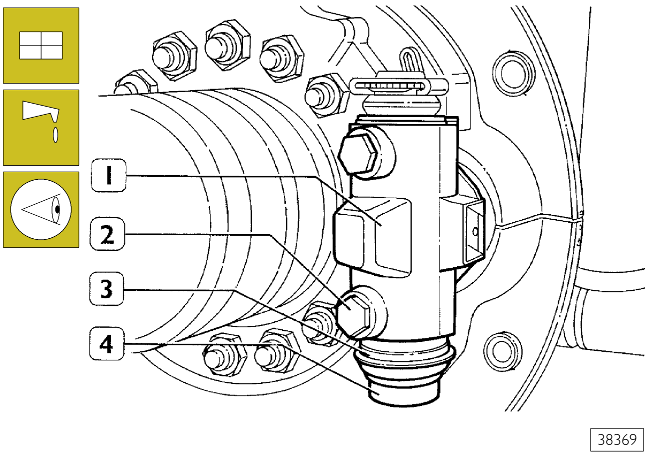
Insert automatic adjustment unit (1) into adjustment pin, fit sealing gasket (2) metal ring on brake body (4).
Lock guide pin (3) at the required torque.

Figure 173



By using keyer 99373002 (1), drive sealing gasket metal ring onto brake body (2).

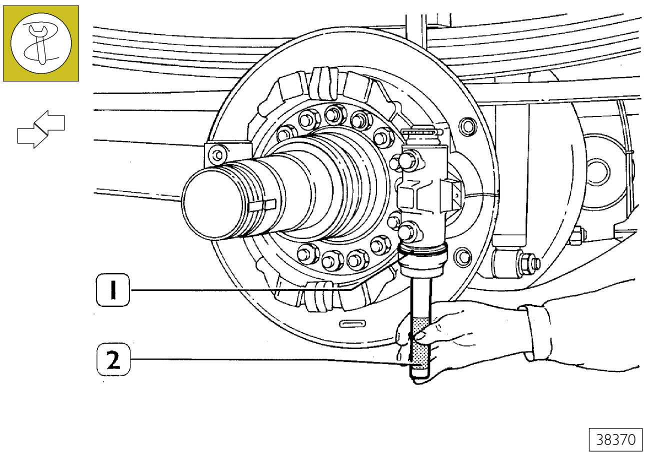
Figure 174



Insert thrust pin (4) into brake body (1) so that the notch is facing the guide pin (2) hole.
Grease and screw guide pin (2) at the required torque.

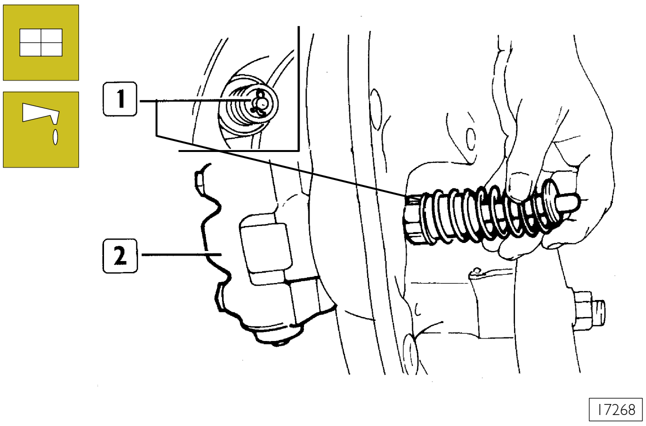
Before proceeding with assembling thrust pins (4), check the mark punched on them. Letter "R" (right) or "L" (left) shows that the brake belongs to right or left wheel.

Figure 175



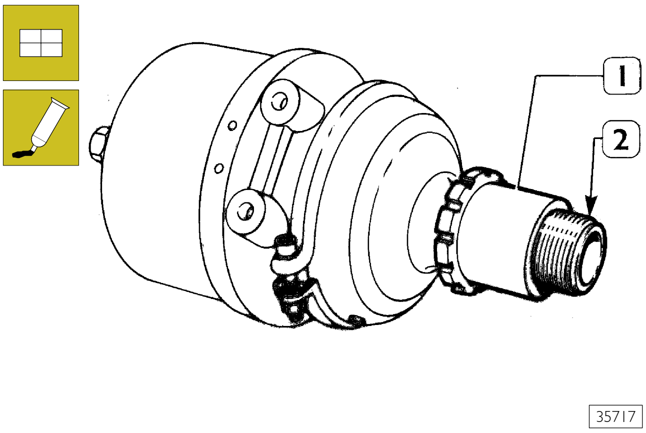
By using keyer 99373002 (2) drive the metal ring (1) of sealing gasket on brake body.
Proceed as described for assembling the other jaws opening control units.

Figure 176



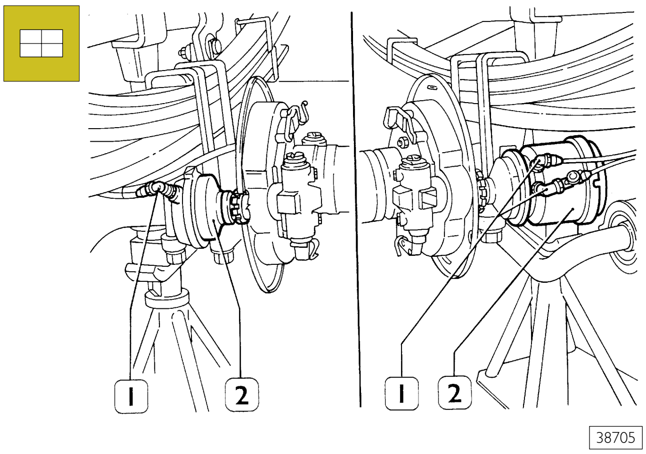
Abundantly grease wedge control units (1) and insert them into their own seat into brake body (2) so that wedge unit rollers rest on related thrust pins sliding races.

Figure 177



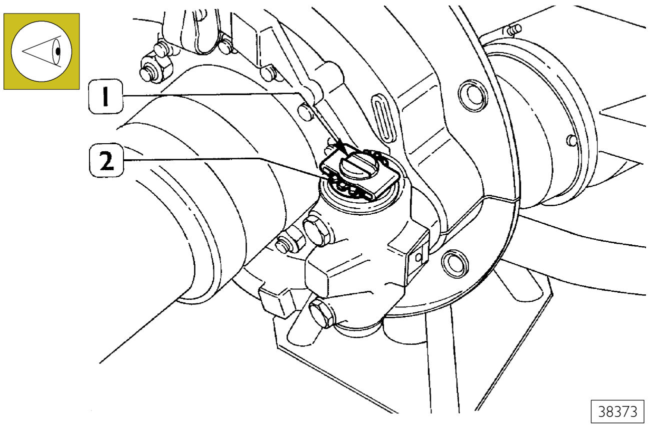
Manually screw ring nut (2) on barrel (1) till its end of stroke.
Apply non-hardenable sealing paste, LOCTITE 573 type, on first barrel threads.

Figure 178



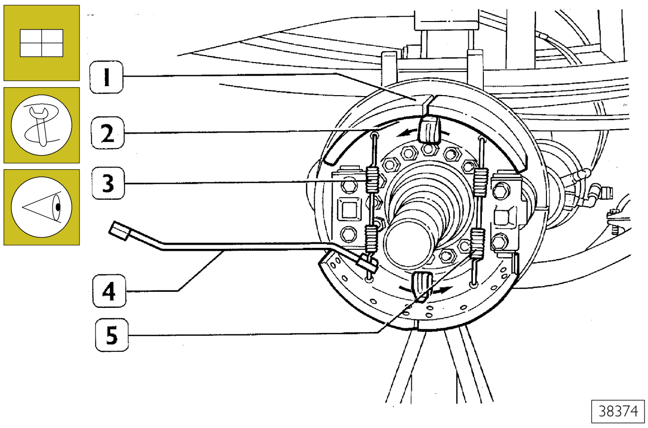
Completely screw brake cylinders (2) into their own seat so that supply fittings are in their original position and exhaust hole is open and facing downwards.
Connect brake cylinders supply pipings (1).

Figure 179



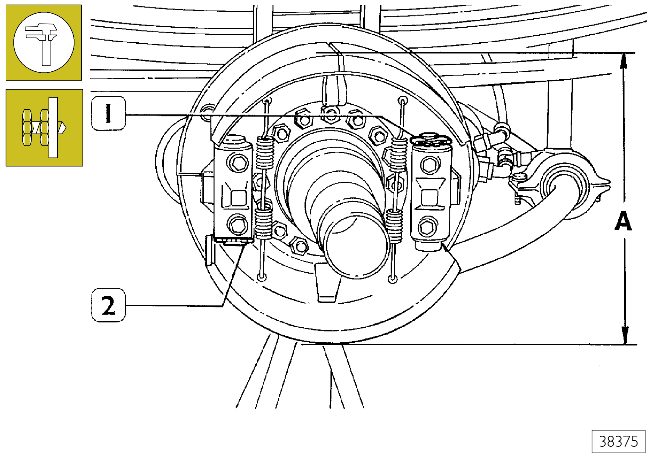
Completely screw adjustment unit (2), then unscrew by one revolution in order to give an initial adjustment for automatic recovery; place them so that notches (1) allow inserting the jaws.

Figure 180



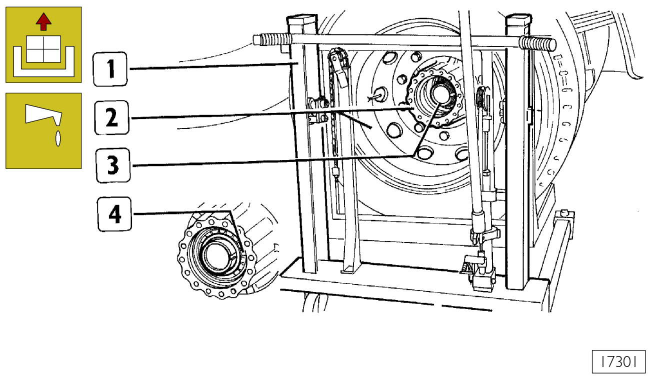
Assemble jaws (1) into their suitable seat so that the punched arrow (2) is oriented along the forward-running drum rotation direction.
Hook jaws return springs (3 and 5) using tool 99372217 (4).

Figure 181



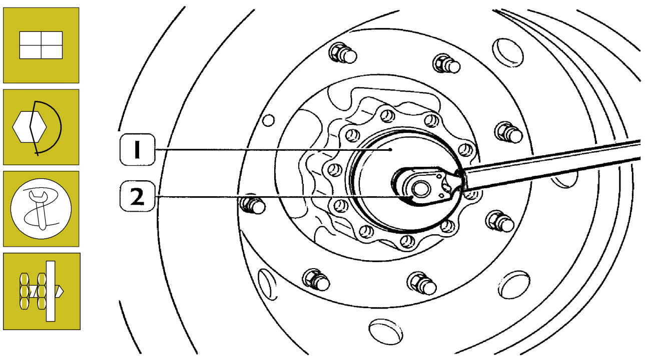
Operate on adjustment units (1 and 2) till a dimension (A) is obtained, measured with a gauge, that is by 2 mm lower than the one detected on the used drum.

Figure 182



Lubricate bearings seat on barrel (3) and wheel hub sealing ring with TUTELA W 140/MDA oil.
By using hydraulic trolley 99321024 (1), place complete wheel (2) so that internal hub diameter is perfectly centred on rear axle case barrel (3). Place tapered roller bearing (4) into wheel hub. Insert complete wheel till the end of its seat, taking care of aligning wheel hub with barrel (3) to avoid damaging sealing gaskets profiles.

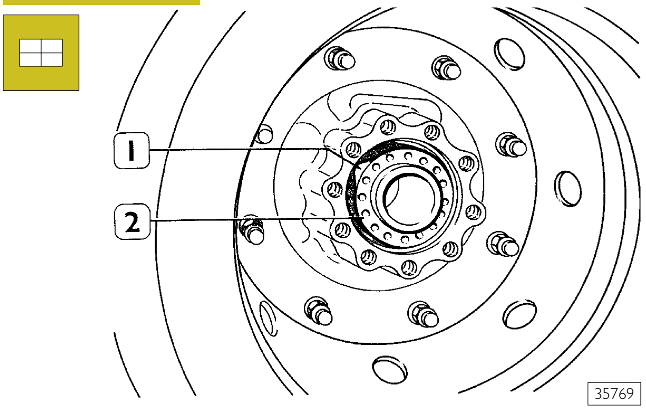
Figure 183



35768

Screw locking ring nut and tighten it through wrench 99355167 (1) and dynamometric wrench (2), tighten adjustment nut at a torque of 98 Nm (10 kgm); at the same time, rotate hub along the two directions.
Then loosen the nut down to a zero torque.
Further unscrew the nut till an axial clearance is obtained that is included between 0.20 and 0.30 mm, corresponding to an angular movement of about 1/6 of a revolution.

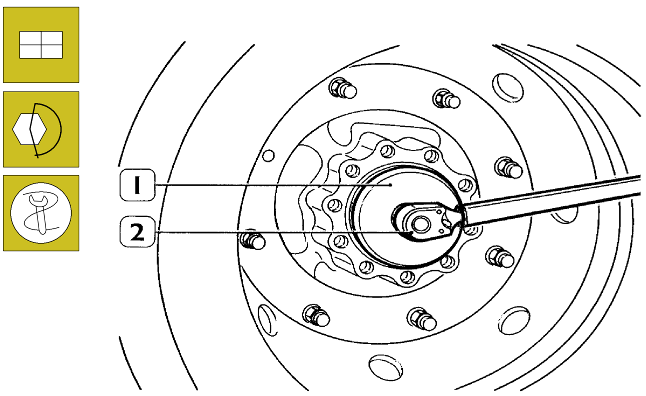
Figure 184



35769

Assemble the safety ring (2): if the nut (1) stop dowel does not coincide with one of the safety ring (2) holes, change nut (1) position taking also into account the clearance obtained in the previous operation.

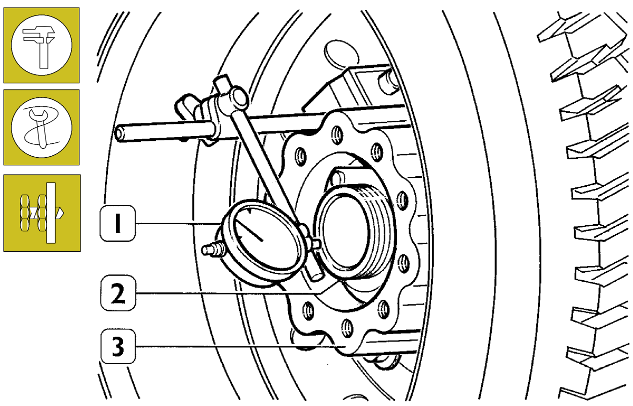
Figure 185



35768

Screw locking ring nut and tighten it through wrench 99355167 (1) and dynamometric wrench (2) at the required torque.

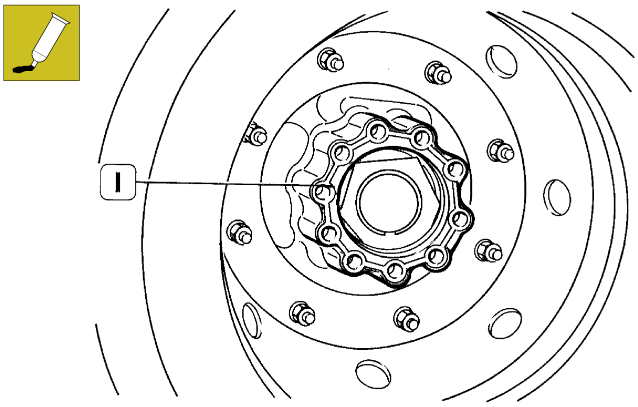
Figure 186



35770

Place comparator (1) with magnetic base on hub (3). Abut rod onto barrel (2) and check that maximum axial hub clearance is 0.05 mm.

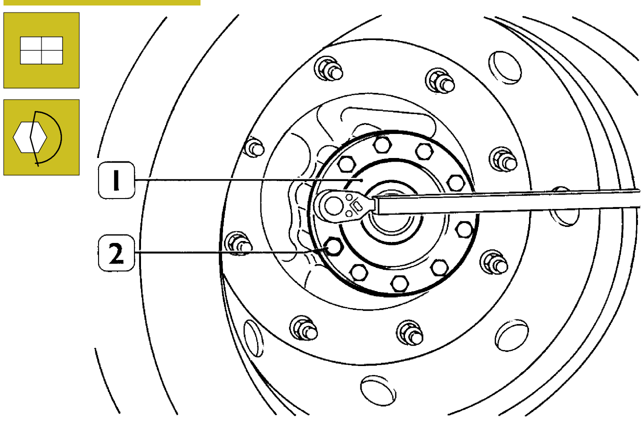
Figure 187



35771

Butter with hermetic type "B" the contact surface (1) between half-shaft and wheel hub.

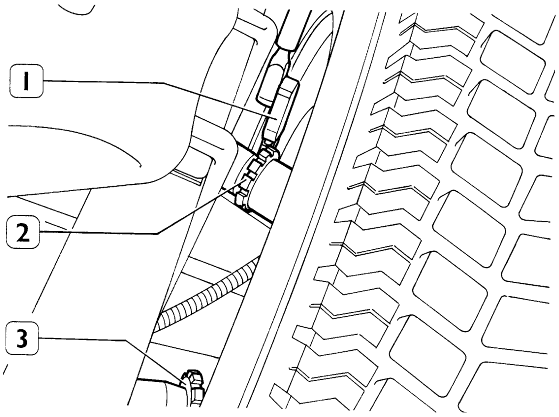
Figure 188



35772

Assemble half-shaft (1), insert securing screws (2) and tighten them at the required torque.

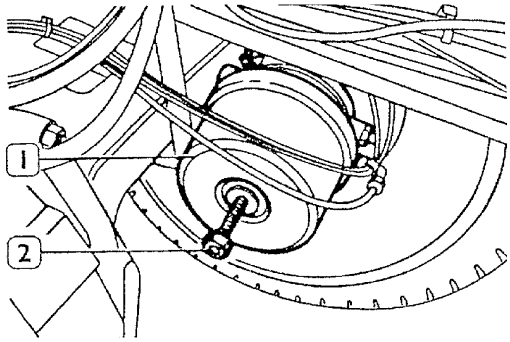
Figure 189



38706

Supply the brake cylinders operating on service brake. With wrench (1) 99356006, tighten combined brake cylinders securing ring nuts (2 and 3) at the required torque.

Figure 190



36765

Proceed with the assembly of opposite braking unit and restore rear axle oil level.
Restore operation of parking brake control cylinders (1), completely screwing screw (2) again.
Start the vehicle engine up for a sufficient time to carry out the system recharge.
Carry out repeated settling brakings of the braking and clearance recovery assembly between braking gaskets and drum with running vehicle.

SECTION 12

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5001 Chassis

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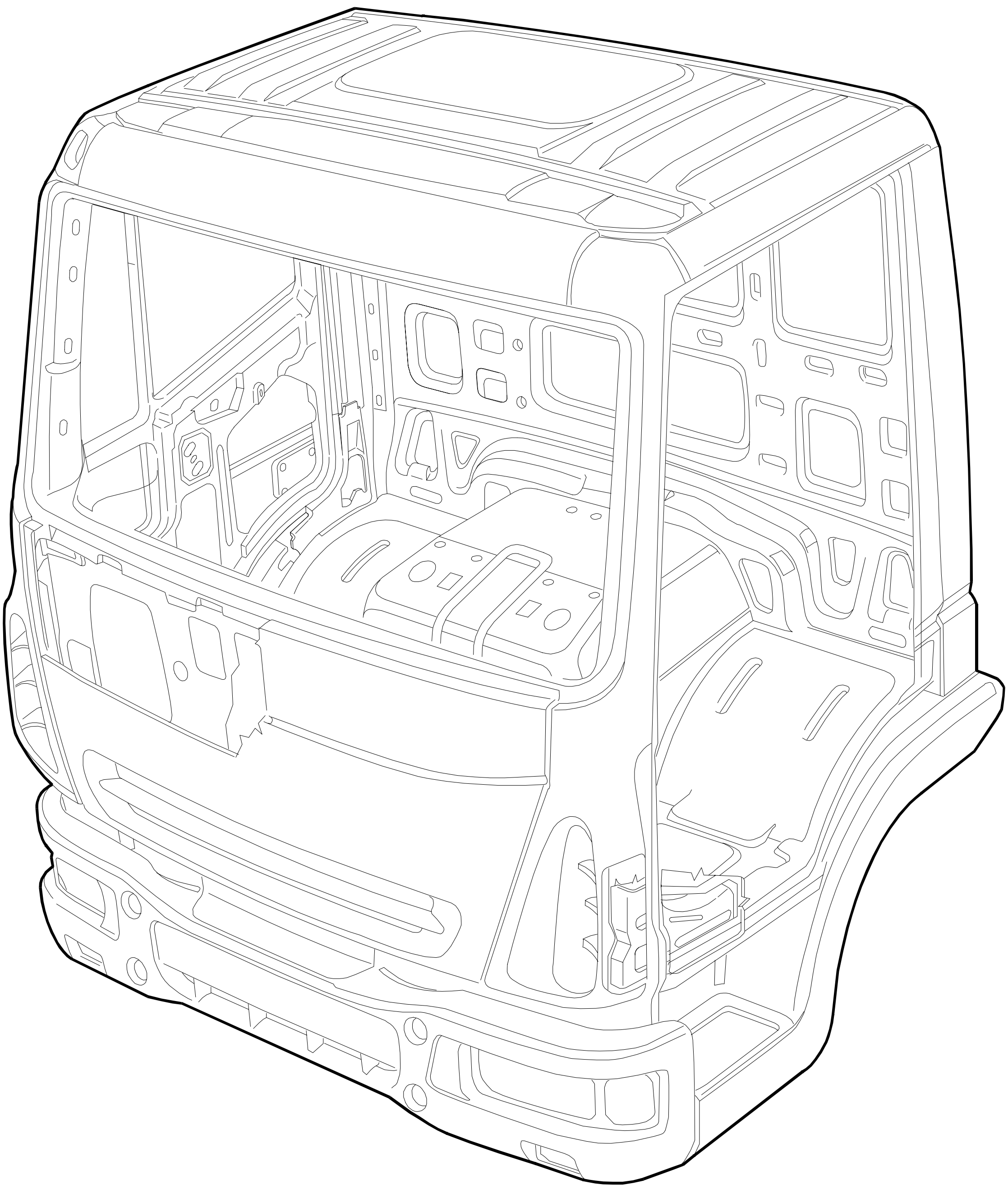
5501 CAB

General information

The cab is an advanced one, it can be tipped up hydraulically with a mechanical control.
Tilting angle 57°.
Pressed and welded steel framework, parts made of electro-galvanized sheet steel.
Sound deadening on the underbody and anticorrosion protection in the boxed compartments.
The cab suspension is mechanical.

Figure 1



78688

PROTECTIVE BODY TREATMENTS

Protective treatment

Figure 2

Double zinc plated sheets

Single zinc plated sheets

Elements in synthetic material

78692

The choice of materials comprising the body is geared to achieving an excellent quality standard so as to offer a product with lasting quality and performance.

The galvanizing is done according to different technological processes:

- Galvanic plating: the sheet metal is immersed or washed, depending on whether it is bi-galvanization or galvanization, in a salt bath providing a high level of surface finishing.

- Fire plating: the molten zinc gets deposited on the sheet metal by the effect of the heat. With this process, which is mainly used for the structural elements of the body, thicknesses of up to 20 microns can be reached, against 7 microns obtained with the galvanic process.

The wheel arches made of synthetic material also have an anti-corrosion function.

All the boxes are protected by using galvanized sheet steel that, after painting, are sprayed on the inside with waxy oil to prevent internal oxidation.

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Preparing the sheet metal (bonderizing)

After assembly, the body undergoes a range of treatments to cleanse it of grease, oxidation and to preserve it from corrosion.

The cycle comprises the following phases:

- Pre-degreasing: washing with an acid solution (deoxidine) to eliminate the oily substances on the metal.
- Degreasing: washing with a water-surfactant solution. This solution is sprayed at a temperature of approximately 60°C.
- Rinsing: this is done with industrial water to eliminate the alkaline residues.
- Activation: washing at ambient temperature with a titanium salt solution (exposing the crystals, "pickling").
- Phosphatizing: washing with zinc phosphates at a temperature of approximately 55°C. The electrolytic plating of these metals forms and multiplies the crystalline cores, creating a uniform and protective micro-crystalline layer on the body (decontamination).
- Passivating: washing with a chromium-based solution that provides an additional layer of protection and levelling of the crystals.
- Rinsing: using deionized water eliminates the residues of the previous solutions.
- Drying: in an oven at a temperature of approximately 110°C.

Applying the protective paint (electrophoresis)

Electrophoresis treatment is performed by dipping the body in a bath of an electro-conductive solution to which particles of paint have been added in suspension.

CHECKING THE GEOMETRY OF THE CHASSIS FRAME

Before doing any work it is wise to make sure that the chassis frame is perfectly level, that is with no deformation or stress due to the weight of the various assemblies.

GENERAL RULES FOR WORKING ON THE CHASSIS FRAME

The criteria for performing the work permitted by IVECO on the chassis frames are subordinate to observance of the following instructions:

- Welding on the flanges of the structural members and on the structural members of the chassis frame is strictly prohibited.
- Drilling the flanges of the structural members is not permitted.
- The characteristics of the chassis frame must not be altered without IVECO approval.

Preparing the chassis frame for maintenance, checking and repair work authorized by IVECO

Parts fitted on the chassis frame that are removed before checking and repairing the chassis frame must be suitably stored and protected.

Likewise, the wirings and terminal installations must be well positioned on the chassis frame to prevent damage (from any welding, painting or rubbing on the ground).

Protect the entire installation of the chassis frame, placing suitable protection on it for workers and operators to tread on.
Should welding be required, keep to the instructions.

Arc welding with weld material

The weld must be good for the effects of penetration with no cracks or inclusions and with a non-porous appearance.

The thickness of the weld material must be in proportion to the thickness of the material to weld and must be no less than 2 mm even after any grinding.

When making the weld beads, they must be parallel to the direction of the stress; transverse beads must be avoided.

For elements that bend, the weld must be located along the neutral area, with a bead width in proportion to the thickness of the sheet metal. For elements with axial compression, the weld must be made at the end and with a concave bead.

Sudden changes in cross-section due to weld accumulation must be avoided.

Spot welding

This must be workmanlike. Take special care over the setting of the device so as to make spot welds that ensure a fully efficient join. Avoid positioning spots near the edge of the parts to weld.

> ⚠ The areas of the chassis frame involved in welding must be thoroughly cleaned and, after welding, protected with two-component epoxy rust-proofing or another similar product, and with another coat of single- or two-component paint.

The earth cable of the welding system must be connected on the chassis frame as close as possible to the welding zone, and never near a rotating part (transmission, wheel hubs, etc.) nor above or under an assembly with moving parts (compressor, bearings, etc.).

Welding instructions

Before welding, which must be done so as to minimize the tension and deformation that may be created, remove the paint and carefully deoxidize the surfaces involved.

Classification of corresponding steels in the EU:

French standards A 35 501	German standards DIN 17 100	British standards BS 4360	American standards A S T M
E 24.2	R-St. 37.2	40 B	A 283 gr. D
E 26.3	St. 42.3	43 C	A 284 gr. C
E 36.4	St. 52.3	50 D	-
Italian standards UNI - 7070	**Swedish standards MNC - 810**	**Spanish standards UNE - 36 080**	**Belgian standards NBN 631**
Fe 37.B	13.12.00	A 360.B	AE 22B or AE24B
Fe 42.C	14.13.00	A 410.C	AE 26 C
Fe 52.D	21.34.01	A 510.D	AE 36 D

Bodybuilder work on the structural members of the IVECO chassis frame

No modification (lengthening, shortening, drilling and/or welding on a significant scale) is authorized to the frameworks of the IVECO chassis frame or warranty for the chassis frame is forfeit. If, when specifically requested in writing, IVECO Engineering authorizes specific work to be performed, there are some rules of a general nature to follow in designing and performing these operations that are stated on the following pages.

Drilling the chassis frame

When it is necessary to fit auxiliary parts or assemblies on the chassis frame, the existing holes made when making the chassis frame must, as a rule, be used.

Drilling the flanges of the vehicle's structural members is strictly prohibited.

In special cases (fitting brackets, angle sections, etc.) where it is necessary to make fresh holes, these must be made on the vertical rib of the structural member and must be carefully deburred and bored.

The new holes must not be made in the areas of greatest stress (such as the spring mountings for example) and of changes to the cross-section of the structural member.

The diameter of the holes must be suited to the thickness of the sheet metal; in no case may it exceed 15 mm. The distance from the axis of the holes from the edges of the structural member must be no less than 40 mm. In any case, the axes of the holes must be at a distance of no less than 50 mm from each other or from the existing holes. The holes must be staggered as shown in the figure.

When moving the crosspiece or spring mountings, their drilling patterns must be maintained.

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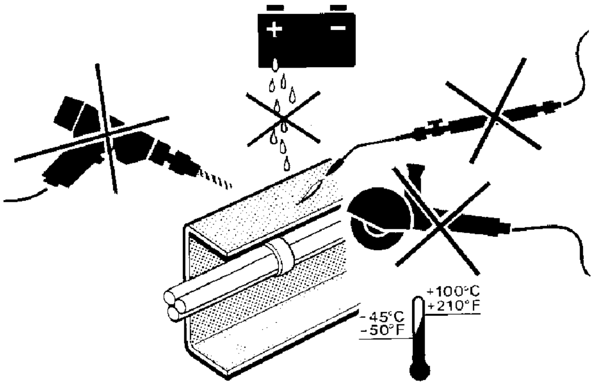
PRECAUTIONS

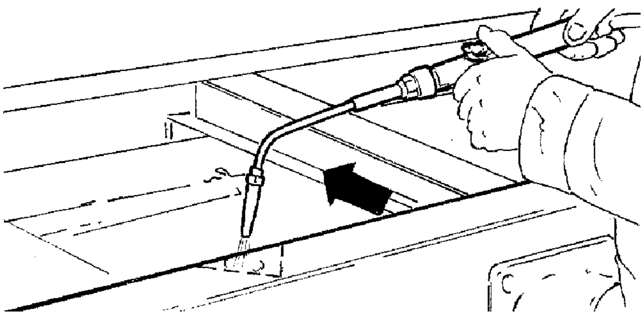
Figure 3



17358

During the work of welding, drilling, grinding, cutting near brake system piping, especially if this is made of plastic, and electric cables, take the appropriate precautions to protect them, contemplating their removal if required. All the parts of the chassis frame subject to reconditioning will need to be protected against oxidation and corrosion.
This protection and painting will need to be done carefully on all the parts concerned, as per any relevant instructions, methods and precautions of the paint manufacturers.

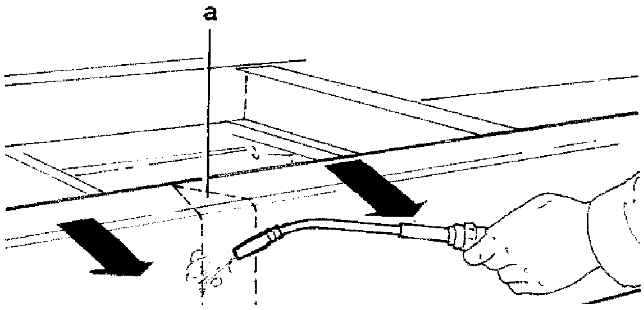
Figure 4



17359

The chassis frame is reconditioned by wedge heating the relevant part with a blowpipe.
During this operation the metal needs to turn cherry red, which corresponds to a temperature of 600 - 680 °C.
The heated points must undergo no further heating.
Let the treated parts cool slowly without using any water, compressed air or the like.

Figure 5

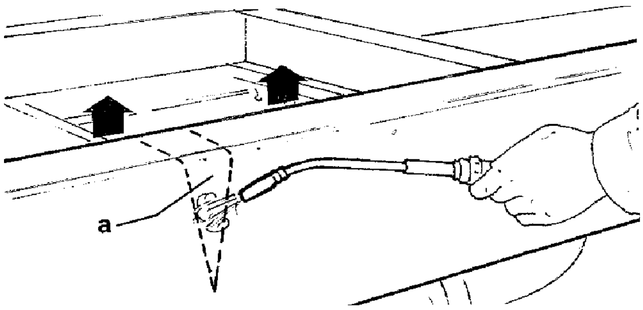


17360

Straighten the side bend of the chassis frame with wedge heating on the top and bottom waist of the part concerning the chassis frame.
The tip of the heating wedge has to lie in the direction of the required bend.

If the base of the two heating wedges is in the top plate of the structural member, then the plate also needs to be heated, but last.

Figure 6

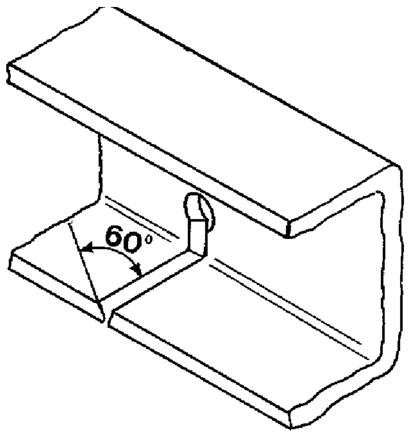


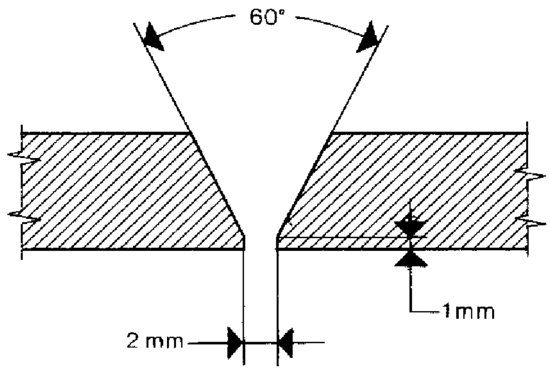
17361

Straighten the sag in the chassis frame downwards or upwards with wedge heating on the top plate of the structural member. In the case of downward bending, the base (a) of the heating wedge is at the bottom. In the case of upward bending, do the opposite.
The relevant bottom or top waist of the structural member has to be heated last in the area of the base of the heating wedge.

Welds on the chassis frame

Figure 7

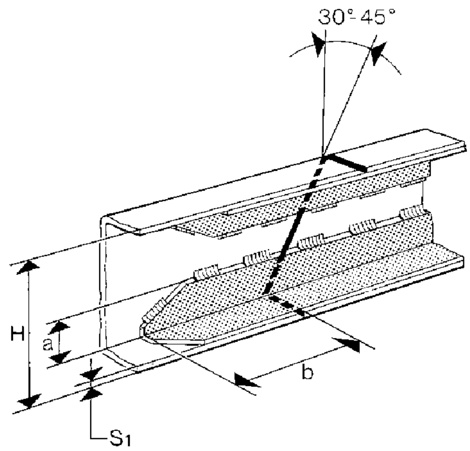


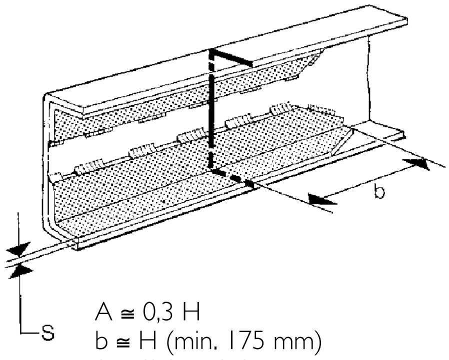


Before starting work, disconnect the negative battery terminal and connect the earth of the welding machine straight onto the piece to weld. Plastic pipes will need to be protected or removed.
Welds will have to be made solely by skilled, trained personnel, with suitable equipment and in workmanlike fashion.
Remove the paint and deoxidize the parts to weld. At the point of breakage, on the inside of the structural member and along the full length of the relevant section, make a V bevel of 60°.

⚠ No cuts are permitted on the structural members at areas of changes in profile or at points with a high concentration of stresses; additionally, the line of separation must not concern the holes already in the structural member.

Figure 8





A ≅ 0,3 H
b ≅ H (min. 175 mm)
S ≅ (0,8 ÷ 1) S1

Here we give the operating instructions for proper welding:

a) Heat all around the area to weld (except for QST E 420 material). Do the arc welding with several passes, using thoroughly dried basic electrodes, or MIG-MAG procedures with suitable weld material. Do not overload with current. The weld must have no edge cuts or dross.

b) Start back welding as specified in point (a).

c) Leave the structural members to cool slowly and evenly. It is not permissible to use jets of air or other means.

d) Grind off the excess material.

e) Apply angular steel strengthening, with the same specifications as the steel used in the chassis frame. The approximate minimum dimensions are given in the above illustrations. They are to be fixed solely on the vertical rib of the structural member and it is possible to use bead welding, dummy spots, screws or rivets. The cross section and length of the weld bead, the number and distribution of the dummy spots, screws or rivets must be suited to transmit the bending and cutting moments of the section. On completing the work, the part involved in welding must be effectively protected with rust proofing.

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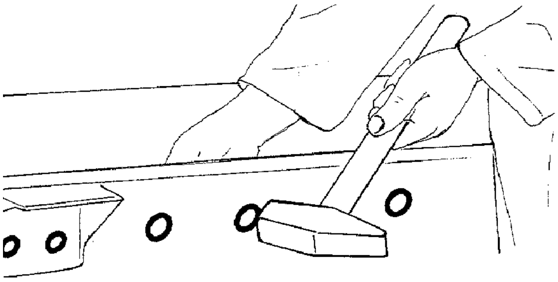
5001 CHASSIS FRAME REPAIRS AND CHECKS

Inspect the chassis frame, checking its alignment.
If already at this stage you detect any deformation you then need to free the relevant part of the chassis frame to help make an exact measurement.

Before the test you need to check all the parts that, with their imperfections, affect the exact measurements (for example, tyre pressure, weak or broken leaf springs, etc.).

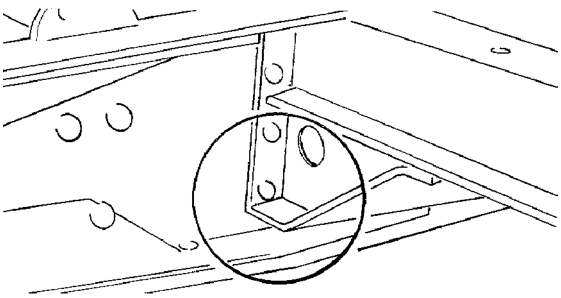
Figure 9



17344

Check the rivets by striking their heads with a mallet and touching the opposite side with your fingers.
Mark any loose rivets with paint to help identify them during the repair work.

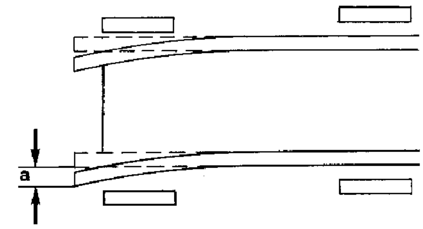
Figure 10



17345

Carefully check for any peeling or cracking all over the chassis frame, paying special attention to joints under great strain, such as: chassis frame cross members, brackets, mounts of leaf springs and chassis frame structural members.
Mark any peeled or cracked points straight away.

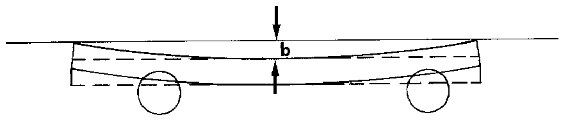
Figure 11



17347

Laterally permissible curvature of chassis frame
"a" = 3 mm/m

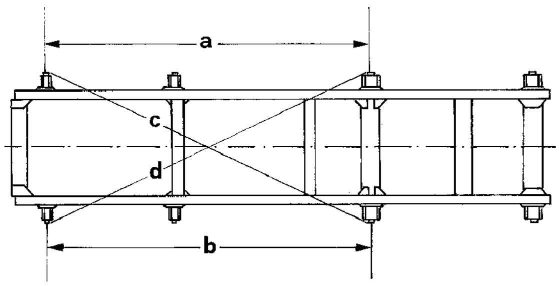
Figure 12



17348

Permissible curvature of chassis frame
"b" = 1 mm/m
Max. 10 mm.

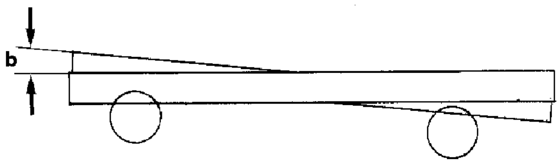
Figure 13



17349

Permissible difference between "a" and "b" = 3 mm.
With diagonal measurement between "c" and "d" = 6 mm.

Figure 14

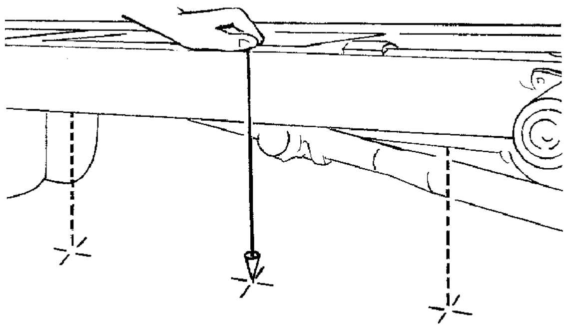


17350

Permissible torsion on the chassis frame
"b" = 1 mm each side.

Measuring the side bend of the chassis frame

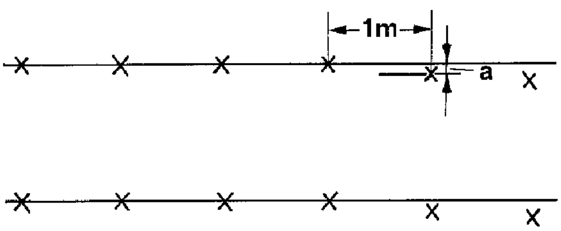
Figure 15



17351

To measure the side bend of the chassis frame you need to plumb the supporting surfaces starting with the two structural members at an interval of approximately 1 m.
The points obtained in this way need to be marked accurately on the floor.

Figure 16

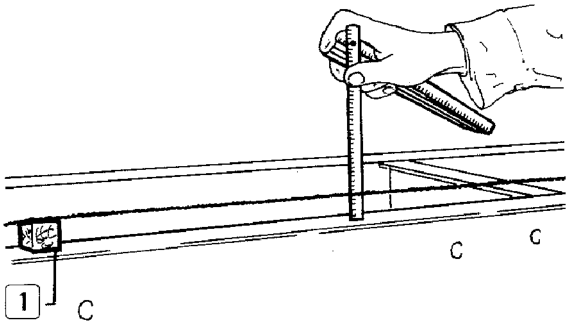


17352

To use the plumbed points you need to stretch out a string passing through the marked points in a line.
The points outside the line indicate the start and extent of the actual deformation (a).

Measuring the bend of the chassis frame downwards or upwards

Figure 17

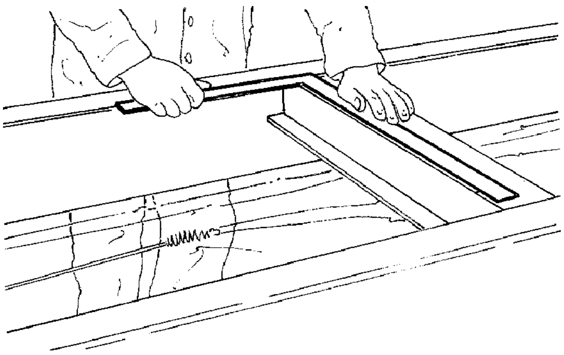


17353

Take two shims (1) of such a size that a string can be stretched along the full length from the straight portion of the bottom or top waist on the structural member of the chassis frame.
Measure the distance of the structural member from the string at 1-metre intervals. A different string distance indicates the position and extent of an actual bend in the structural member.

Measuring the movement of the chassis frame

Figure 18



17354

A movement of the chassis frame can be measured by means of a set square.
To do this, place the set square at 90° to the structural member of the chassis frame and check the squareness of the cross members of the chassis frame.

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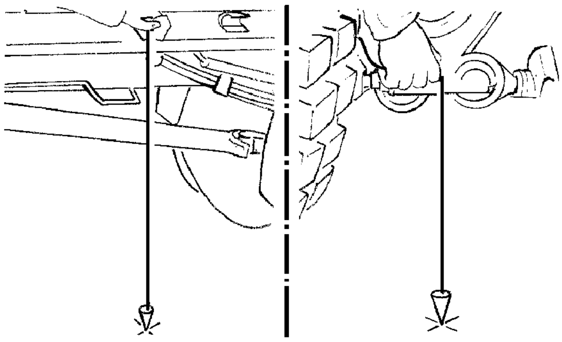
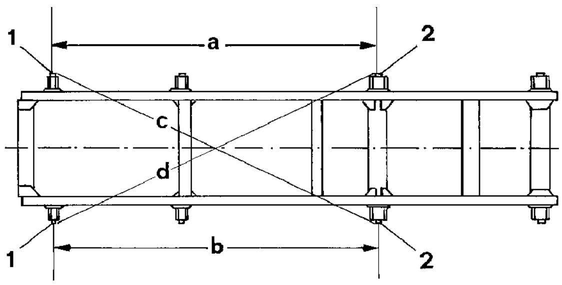
Figure 19



A movement in the position of the axes can be checked by making a diagonal measurement. To do this, plumb the centre of the front mount of the front suspension and the centre of the front support of the rear leaf spring on the flat supporting surface, on both sides.

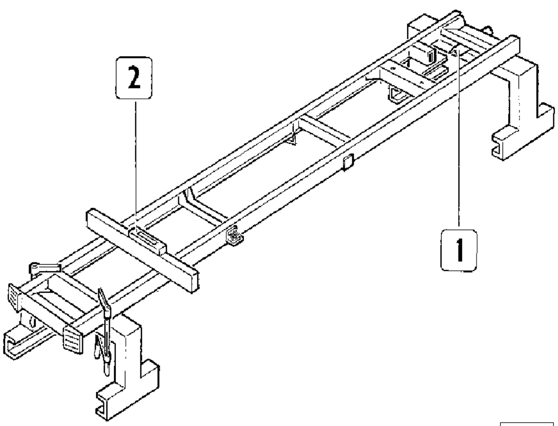
Figure 20



Firstly compare the distance of the points "a" and "b". Then make the diagonal measurement (distance "c" and "d") from point (1) in front to the right to point (2) behind to the left and the opposite.

Measuring the torsion of the chassis frame

Figure 21



A slight torsion can only be measured with the chassis frame freed of the cab and mechanical assemblies.
To do this check, proceed as follows:

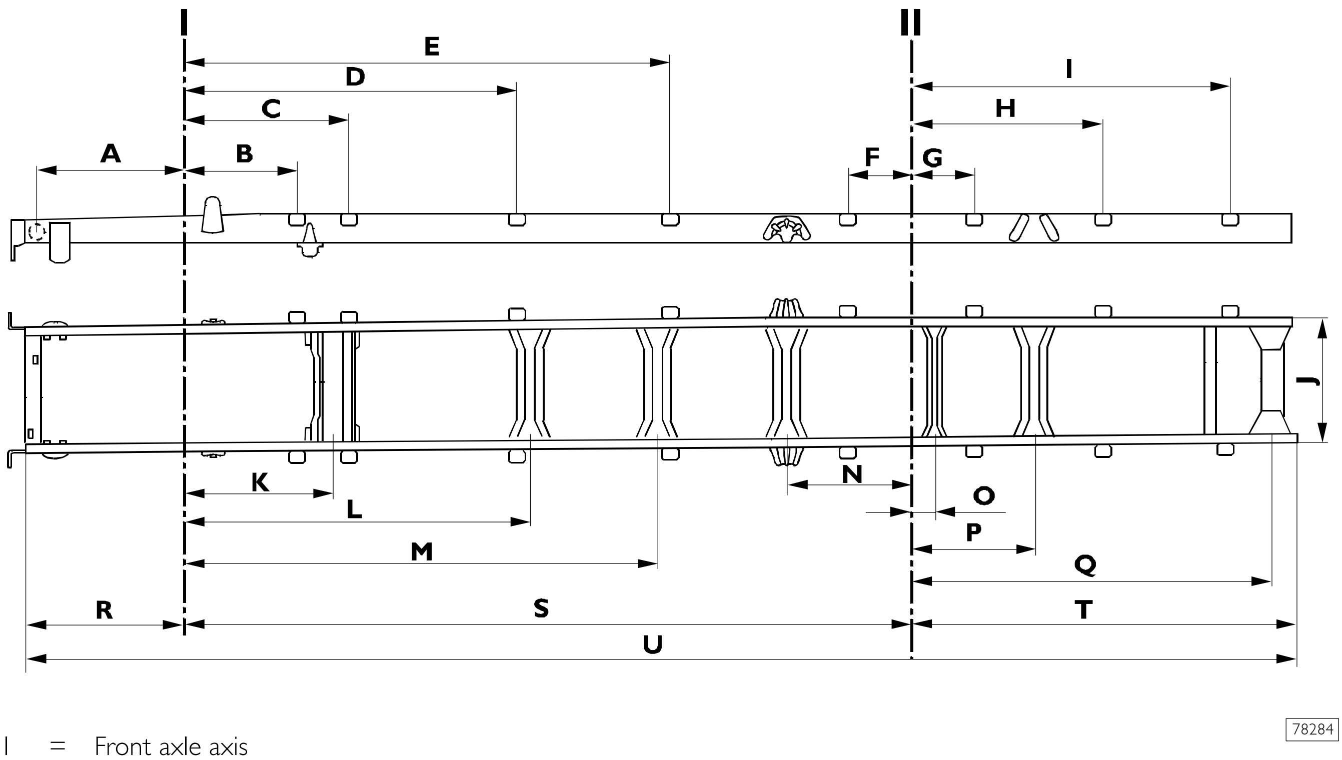
- ❑ set the chassis frame on two stands;
- ❑ using two clamps, secure one side of the chassis frame to the stand.
- ❑ position the other side of the chassis frame, in a central position under the rear cross member, on the knee of an L-shaped iron (1);
- ❑ set a rule crosswise and put a spirit level (2) on this, checking the reading.

At each check point you will need to have the same reading or the chassis frame is out of shape.

CHASSIS REFERENCE DIMENSIONS

Models: 120 (mechanic suspensions)

Figure 22



I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)					
	3105	3330	3690	4185	4455	4815
	1001.25	1001.25	1001.25	1001.25	1001.25	1001.25
B	720	720	720	720	720	720
C	1080	1080	1080	1080	1080	1080
D	1912.5	1912.5	2182.5	2182.5	2182.5	2182.5
E				2992.5	3262.5	3217.5
F	405	405	405	405	405	405
G	405	405	405	405	405	405
H						1260
I	990		1440	1755	1890	2115
J	840	840	840	840	840	840
K	967.5	967.5	967.5	967.5	967.5	967.5
L			2272.5	2272.5	2272.5	2272.5
M						3127.5
N	832.5	832.5	832.5	832.5	832.5	832.5
O	135	135	135	135	135	135
P	787.5	787.5	787.5	787.5	787.5	787.5
Q	1147.5		1665	1980	2115	2340
R	1080	1080	1080	1080	1080	1080
S	3105	3330	3690	4185	4455	4815
T	1313	1830	1830	2145	2280	2505
U	5498	6240	6600	7410	7815	8400

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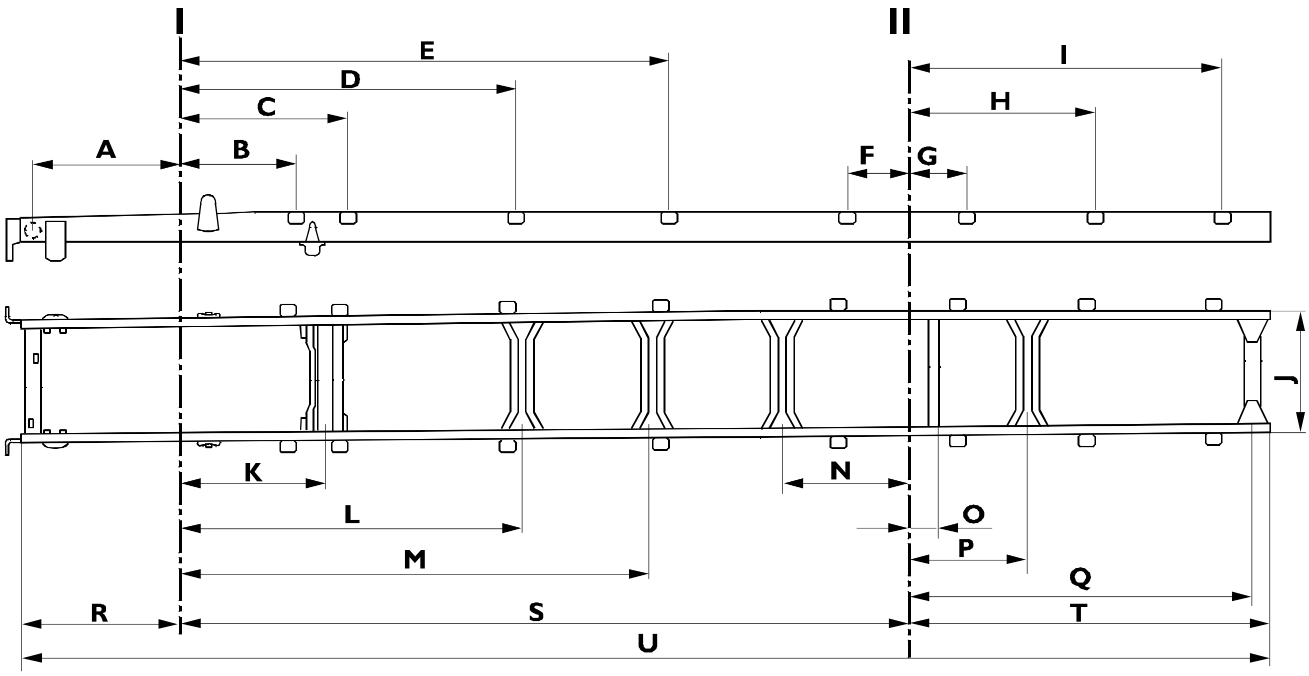
Models: 120 (pneumatic suspensions)

Figure 23



78285

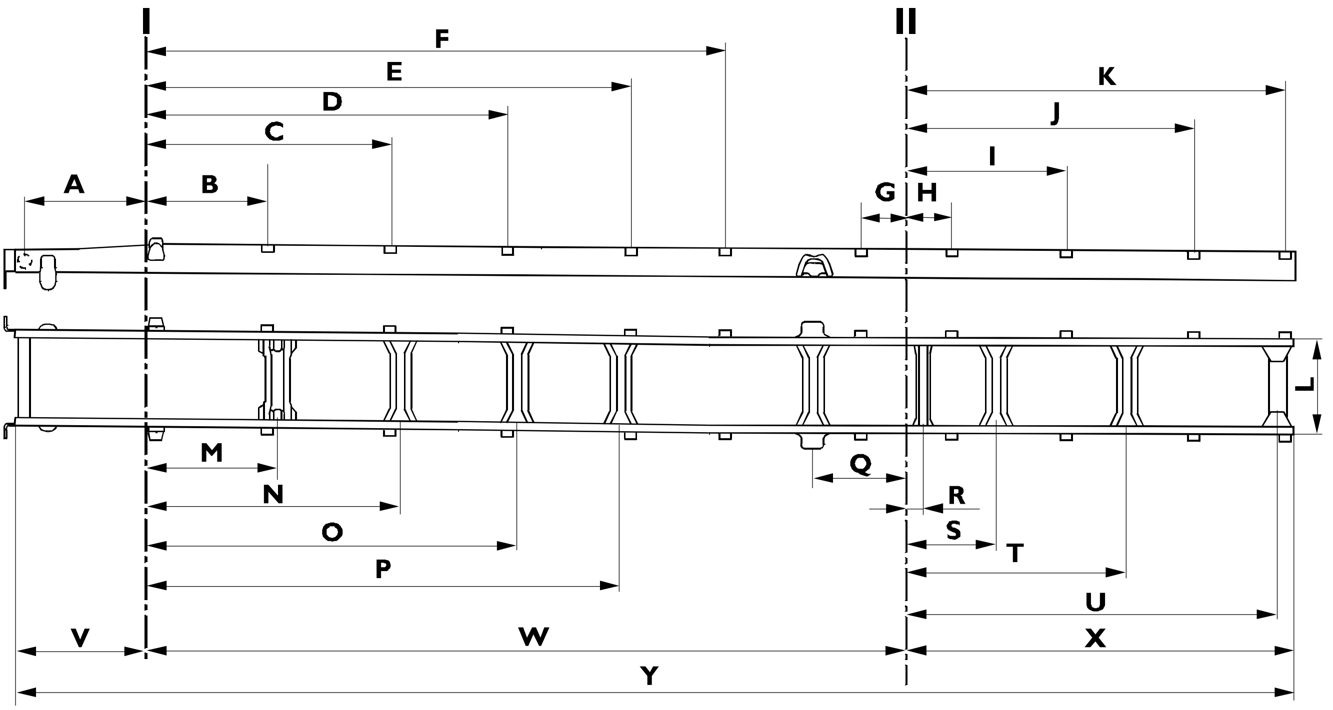
I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)					
	3105	**3330**	**3690**	**4185**	**4455**	**4815**
A	1001.25	1001.25	1001.25	1001.25	1001.25	1001.25
B	720	720	720	720	720	720
C	1080	1080	1080	1080	1080	1080
D	1912.5	1912.5	2182.5	2182.5	2182.5	2182.5
E				2992.5	3262.5	3217.5
F	405	405	405	405	405	405
G	405	405	405	405	405	405
H						1260
I	990		1440	1755	1890	2115
J	840	840	840	840	840	840
K	967.5	967.5	967.5	967.5	967.5	967.5
L			2272.5	2272.5	2272.5	2272.5
M						3127.5
N	832.5	832.5	832.5	832.5	832.5	832.5
O	202.5	202.5	202.5	202.5	202.5	202.5
P	787.5	787.5	787.5	787.5	787.5	787.5
Q	1147.5					
R	1080	1080	1080	1080	1080	1080
S	3105	3330	3690	4185	4455	4815
T	1313	1830	1830	2145	2280	2505
U	5498	6240	6600	7410	7815	8400

Models: 130 to 150 (mechanic suspensions)

Figure 24



I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)							
	3105	**3690**	**4185**	**4455**	**4815**	**5175**	**5670**	**6570**
A	1091.25	1091.25	1091.25	1091.25	1091.25	1091,25	1091,25	1091,25
B	697,5	1080	1080	1080	1080	1080	1080	1080
C	1732.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5
D			2970	3082.5	3397.5	3082.5	3217.5	3217.5
E						3960	4252.5	4297.5
F								5152.5
G	405	405	405	405	405	405	405	405
H	405	405	405	405	405	405	405	405
I							1282.5	1440
J			1170	1170	1170	1575	2092.5	2587.5
K	1215	1642.5	1957.5	2092.5	2362.5	2587.5	2902.5	3397.5
L	840	840	840	840	840	840	840	840
M	1170	1170	1170	1170	1170	1170	1170	1170
N		2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5
O					3307.5	3307.5	3307.5	3307.5
P								4207.5
Q	832.5	832.5	832.5	832.5	832.5	832.5	832.5	832.5
R	157.5	157.5	157.5	157.5	157.5	157.5	157.5	157.5
S	810	810	810	810	810	810	810	810
T						1372.5	1485	1980
U	1147,5	1575	1890	2025	2295	2520	2835	3330
V	1170	1170	1170	1170	1170	1170	1170	1170
W	3105	3690	4185	4455	4815	5175	5670	6570
X	1313	1740	2055	2190	2460	2685	3000	3495
Y	5588	6600	7410	7815	8445	9030	9840	11235

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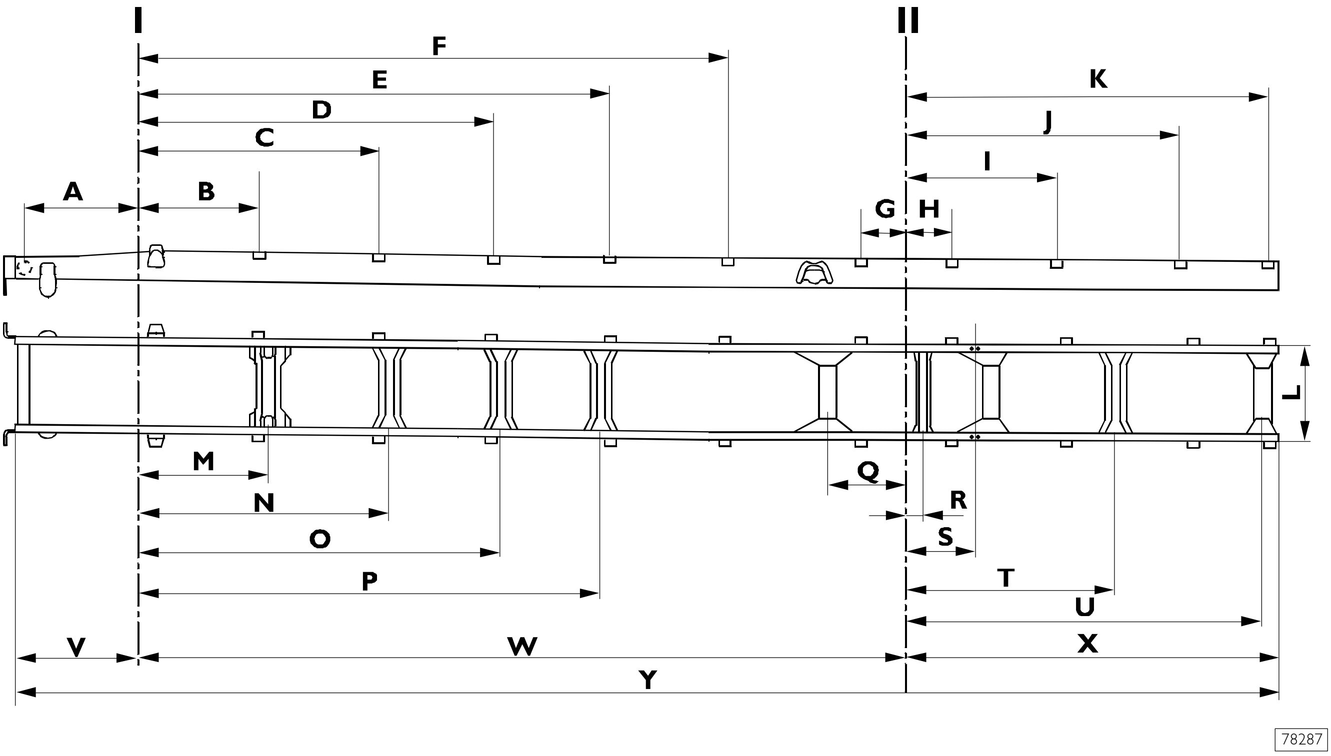
Models: 130 to 150 (pneumatic suspensions)

Figure 25



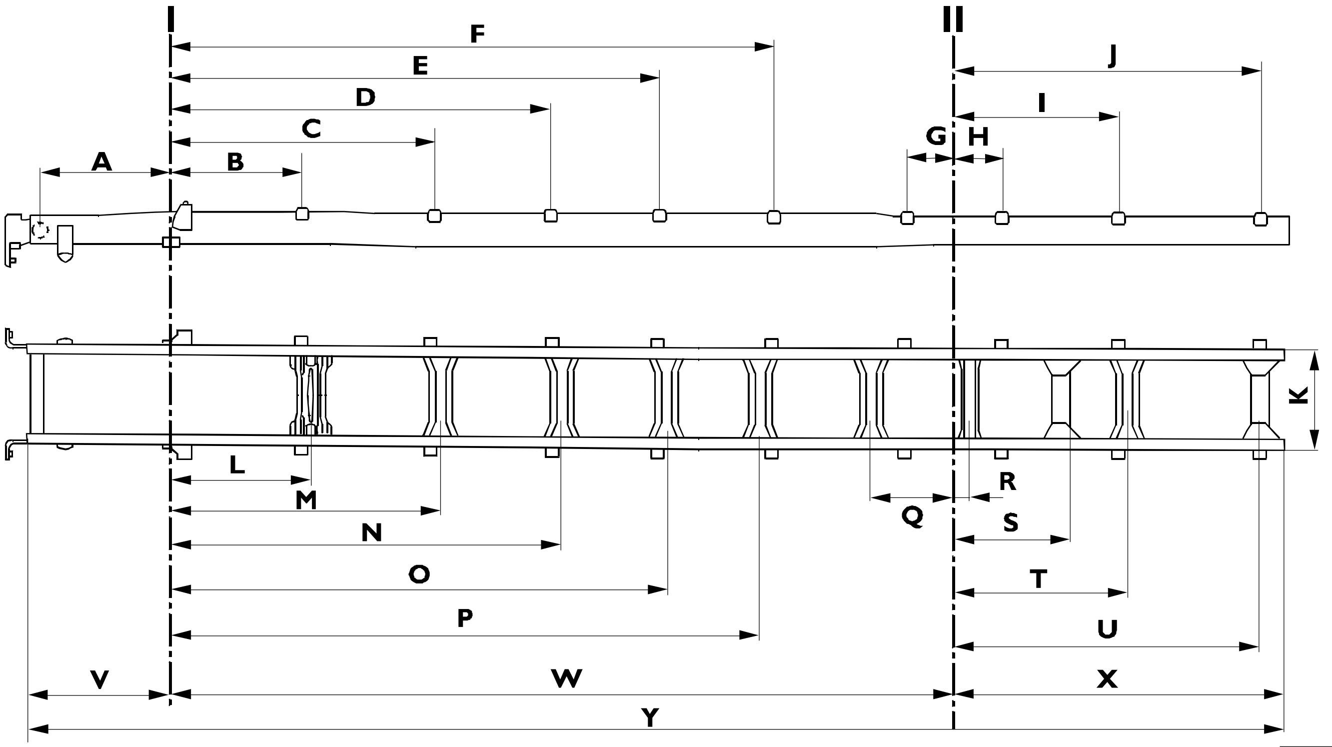
I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)							
	3105	**3690**	**4185**	**4455**	**4815**	**5175**	**5670**	**6570**
A	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25
B	697.5	1080	1080	1080	1080	1080	1080	1080
C	1732.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5
D			2970	3082.5	3397.5	3082.5	3217.5	3217.5
E						3960	4252.5	4297.5
F								5152.5
G	405	405	405	405	405	405	405	405
H	405	405	405	405	405	405	405	405
I							1282.5	1440
J			1170	1170	1170	1575	2092.5	2587.5
K	1215	1642.5	1957.5	2092.5	2362.5	2587.5	2902.5	3397.5
L	840	840	840	840	840	840	840	840
M	1170	1170	1170	1170	1170	1170	1170	1170
N		2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5
O					3307.5	3307.5	3307.5	3307.5
P								4207.5
Q	697.5	697.5	697.5	697.5	697.5	697.5	697.5	697.5
R	157.5	157.5	157.5	157.5	157.5	157.5	157.5	157.5
S	675	675	675	675	675	675	675	675
T						137.5	1485	1980
U	1147,5	1575	1890	2025	2295	2520	2835	3330
V	1170	1170	1170	1170	1170	1170	1170	1170
W	3105	3690	4185	4455	4815	5175	5670	6570
X	1313	1740	2055	2190	2460	2685	3000	3495
Y	5588	6600	7410	7815	8445	9030	9840	11235

Models: 180 (mechanic suspensions)

Figure 26



I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)							
	3690	4185	4590	4815	5175	5670	6210	6570
A	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25
B	1080	1080	1080	1080	1080	1080	1080	1080
C	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5
D		2970	3217.5	3217.5	3217.5	3217.5	3217.5	3217.5
E					3960	4252.5	4095	4095
F							4905	5062.5
G	405	405	405	405	405	405	405	405
H	405	405	405	405	405	405	405	405
I				1170	1170	1462.5	1417.5	1417.5
J	1032,5	1170	1507,5	1710	1980	2092.5	2092.5	2632.5
K	840	840	840	840	840	840	840	840
L	1170	1170	1170	1170	1170	1170	1170	1170
M	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5
N				3307.5	3307.5	3307.5	3307.5	3307.5
O							4185	4185
P								4972.5
Q	832.5	832.5	832.5	832.5	832.5	832.5	832.5	832.5
R	157.5	157.5	157.5	157.5	157.5	157.5	157.5	157.5
S		840	840	840	840	840	840	840
T								1507.5
U	902.5	1147.5	1504	1707	1977	2089	2089	2629
V	1170	1170	1170	1170	1170	1170	1170	1170
W	3690	4185	4590	4815	5175	5670	6210	6570
X	1133	1313	1650	1853	2123	2235	2235	2775
Y	5993	6668	7410	7838	8468	9075	9615	10515

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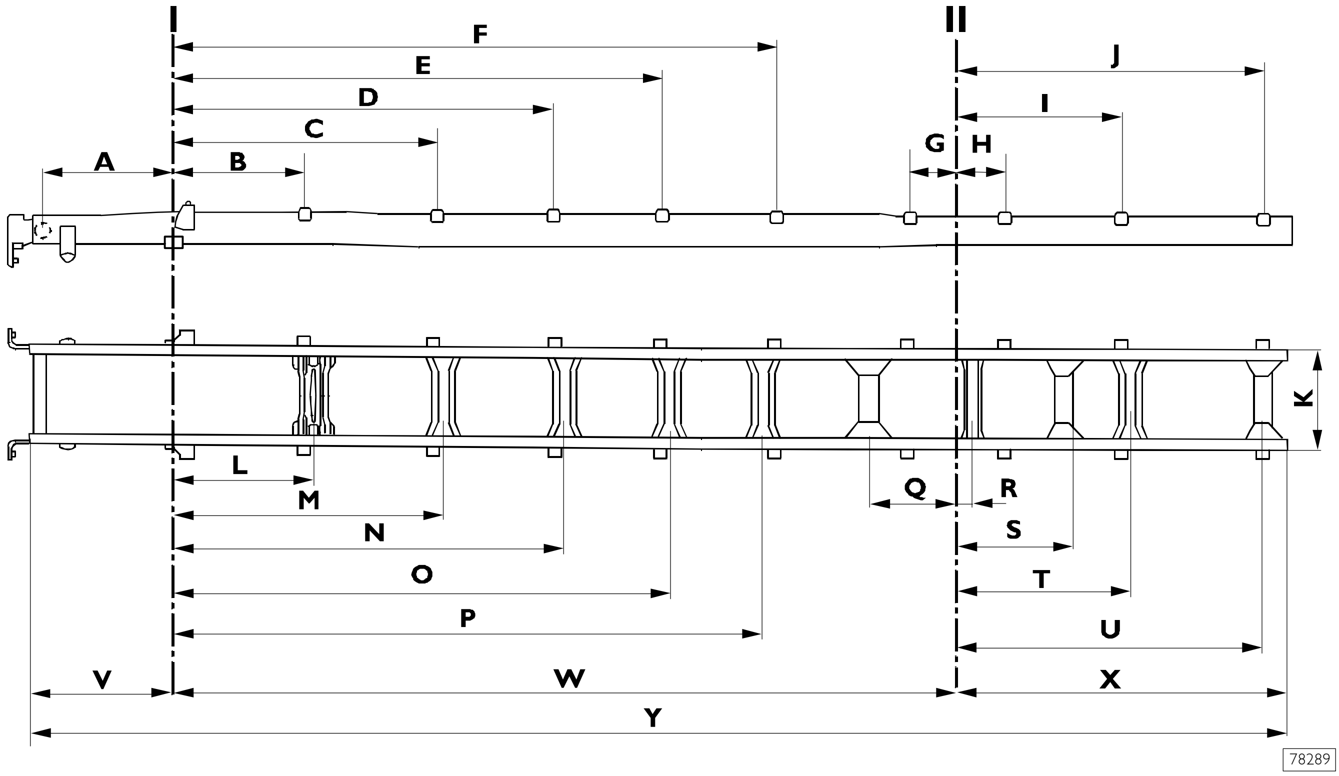
Models: 180 (pneumatic suspensions)

Figure 27



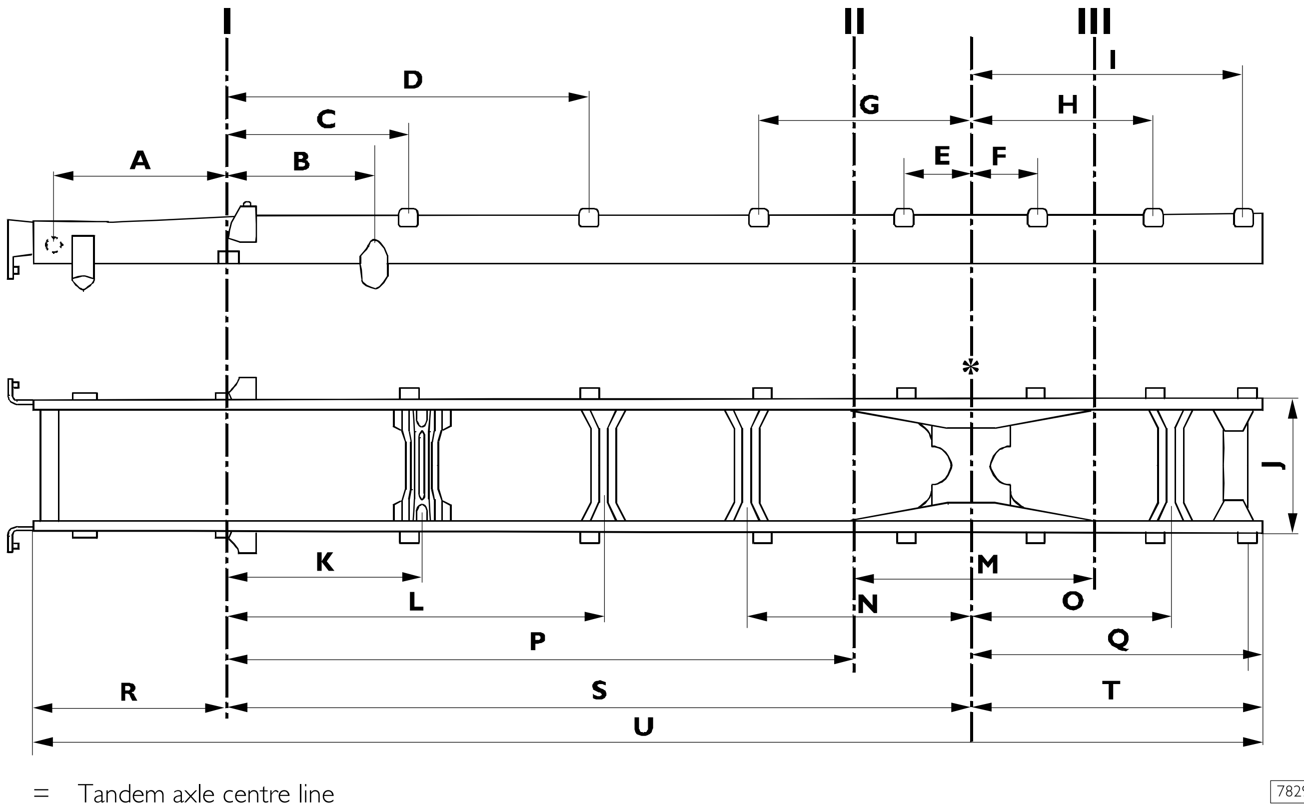
I = Front axle axis

II = Rear axle axis

Dimension (mm)	Wheel base (mm)							
	3690	**4185**	**4590**	**4815**	**5175**	**5670**	**6210**	**6570**
A	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25	1091.25
B	1080	1080	1080	1080	1080	1080	1080	1080
C	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5	2182.5
D		2970	3217,5	3397.5	3082.5	3217.5	3217.5	3217.5
E					3960	4252.5	4095	4095
F							4905	5062.5
G	405	405	405	405	405	405	405	405
H	405	405	405	405	405	405	405	405
I				1170	1170	1462.5	1417.5	1417.5
J	1032,5	1170	1507,5	1710	1980	2092.5	2092.5	2632.5
K	840	840	840	840	840	840	840	840
L	1170	1170	1170	1170	1170	1170	1170	1170
M	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5	2272.5
N				3307.5	3307.5	3307.5	3307.5	3307.5
O							4185	4185
P								4972.5
Q	697.5	697.5	697.5	697.5	697.5	697.5	697.5	697.5
R	157.5	157.5	157.5	157.5	157.5	157.5	157.5	157.5
S		906	906	906	906	906	906	906
T								1507.5
U	902.5	1147.5	1504	1707	1977	2089	2089	2629
V	1170	1170	1170	1170	1170	1170	1170	1170
W	3690	4185	4590	4815	5175	5670	6210	6570
X	1133	1313	1650	1853	2123	2235	2235	2775
Y	5993	6668	7410	7838	8468	9075	9615	10515

Models: 260 (Hendrikson suspensions)

Figure 28



* = Tandem axle centre line
I = Front axle centre line
II = Intermediate axle centre line
III = Rear axle centre line

Dimension (mm)	Wheel base (mm)	
	3824	**4186**
A	1091.25	1091.25
B	832.5	832.5
C	1080	1080
D	2182.5	2182.5
E	405	405
F	405	405
G	1282.5	1282.5
H	1102.5	1102.5
I	1652.5	1652.5
J	840	840
K	1170	1170
L	2272.5	2272.5
M	1380	1380
N	1372.5	1372.5
O	1192.5	1192.5
P	3824	4186
Q	1675	1675
R	1170	1170
S	4514	4876
T	1750	1750
U	7434	7796

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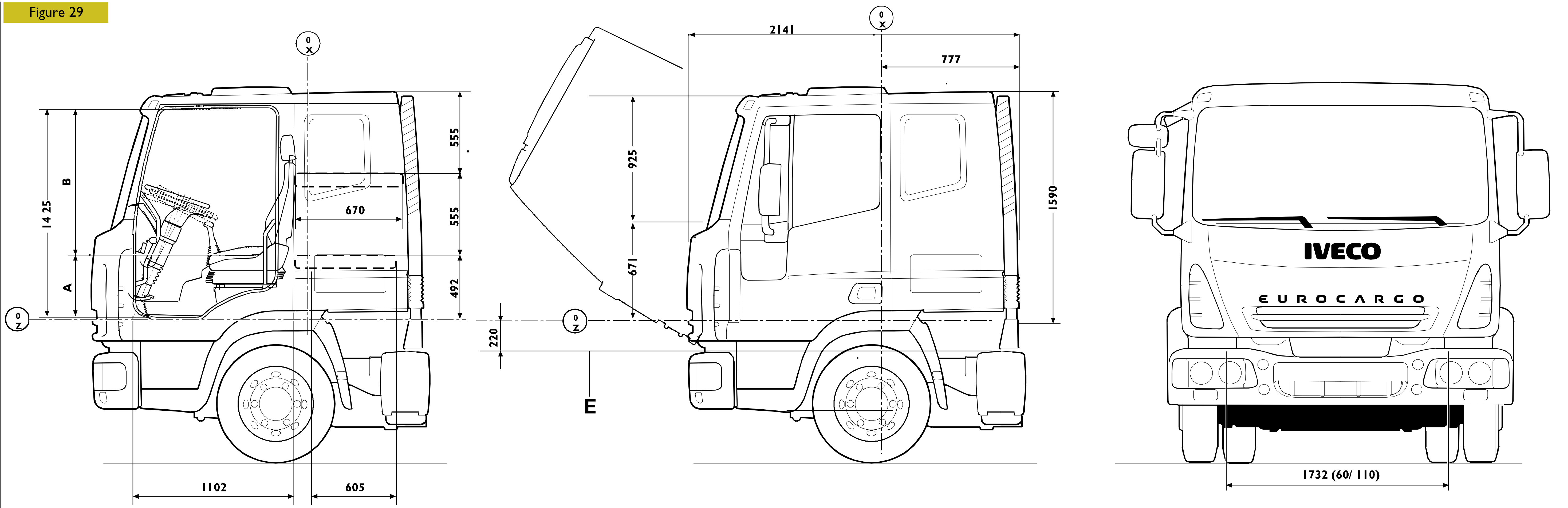
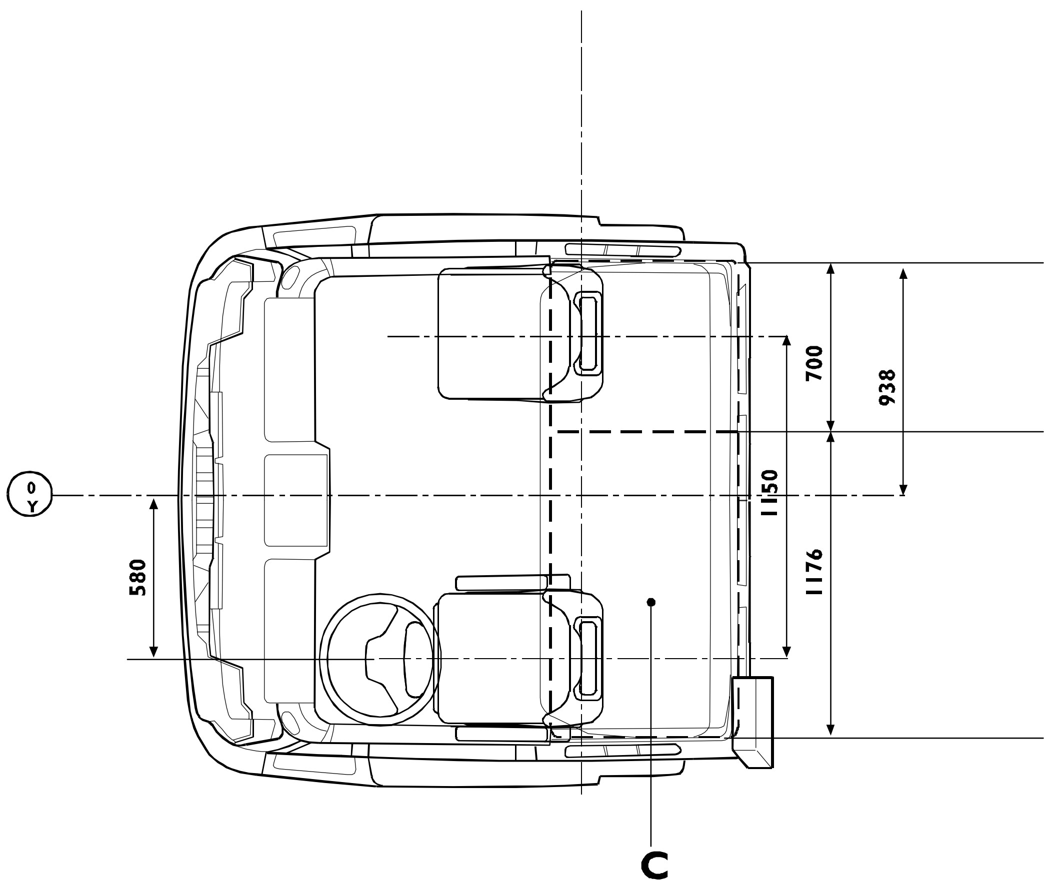
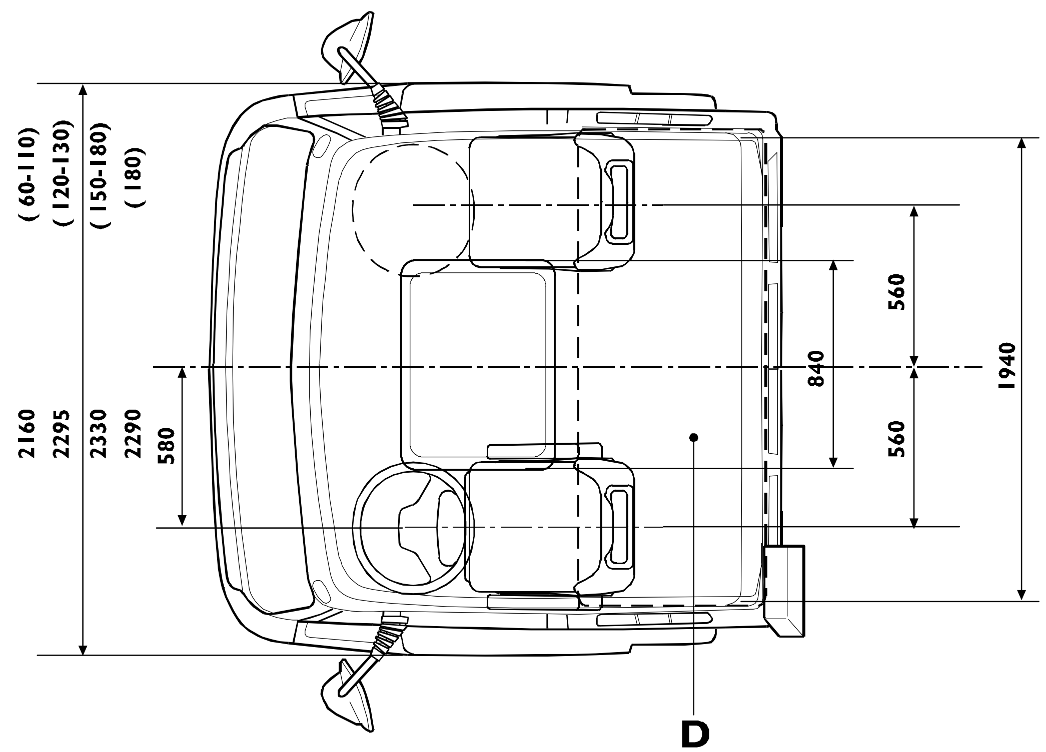
CAB GEOMETRY

Figure 29







	DRIVER'S SEAT	PASSENGER'S SEAT
A	440 - 455	440 - 465
B	1145 - 1160	1135 - 1160
C	LOWER BED	
D	UPPER BED	
E	CHASSIS INSIDE UPPER EDGE	

78693

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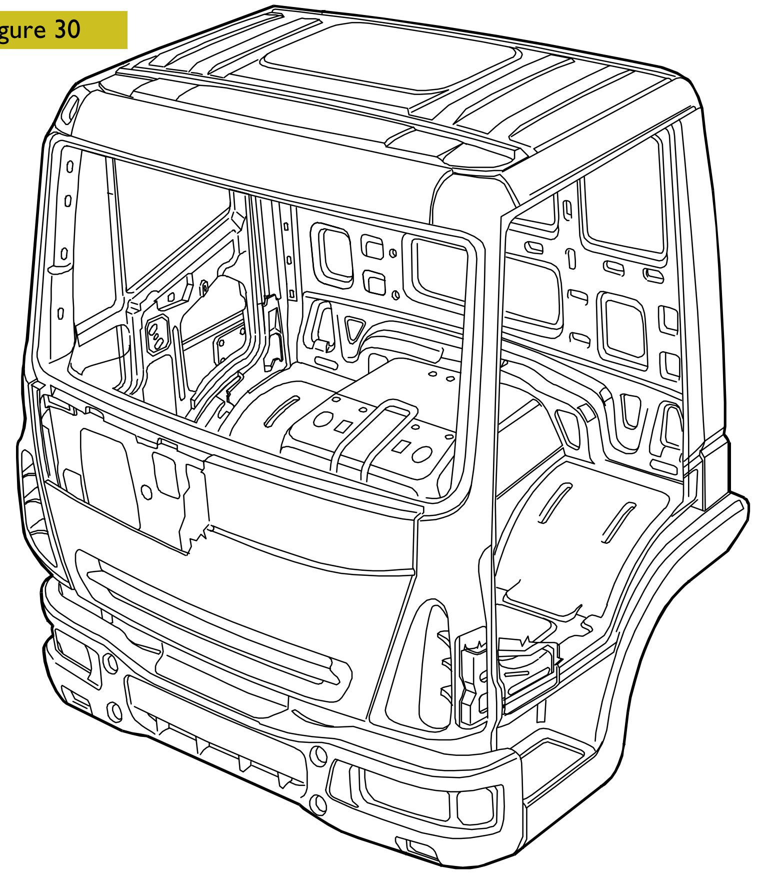
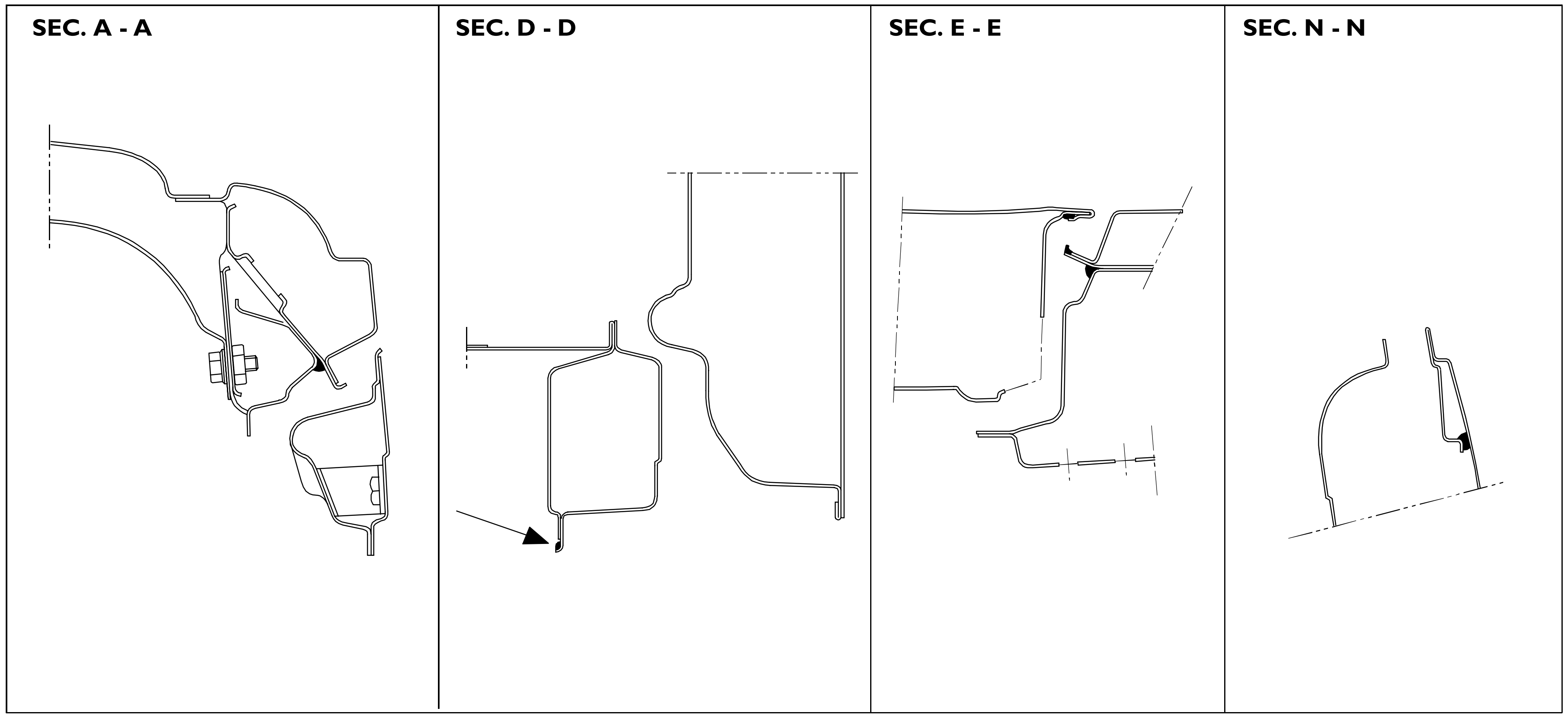
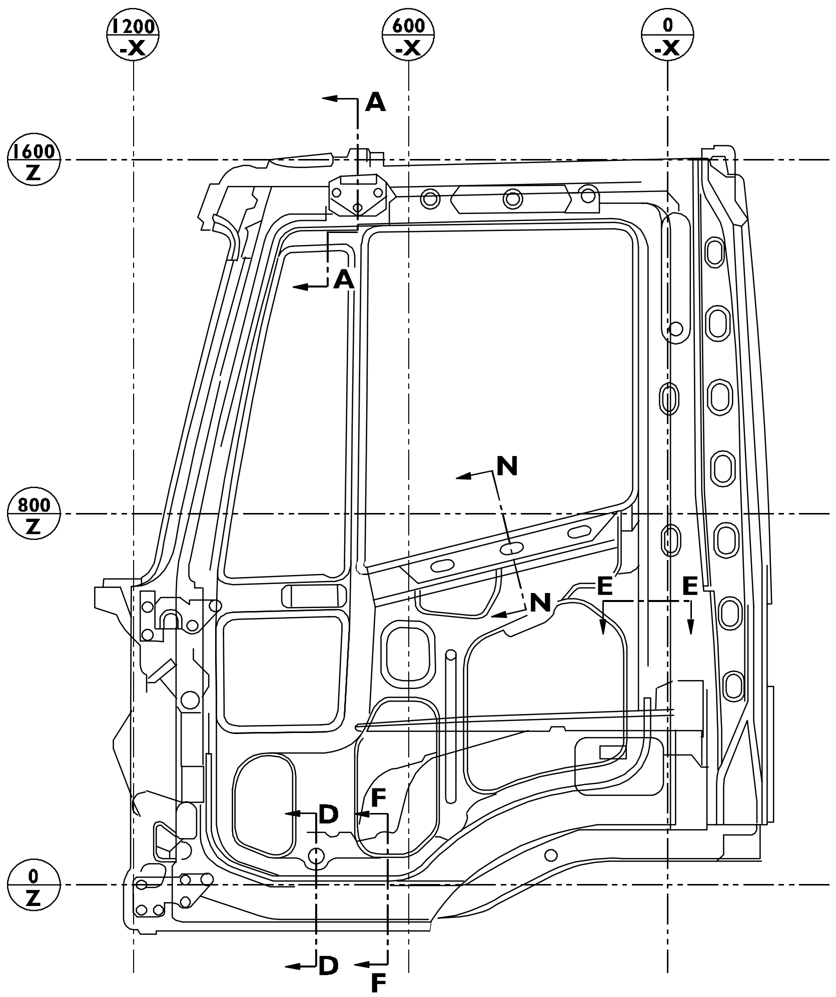
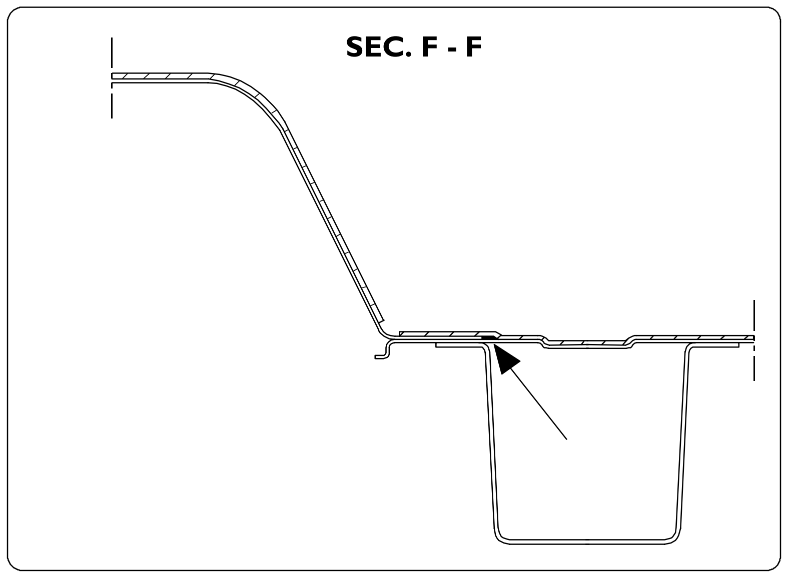
SEAL APPLICATION DIAGRAM

Figure 30









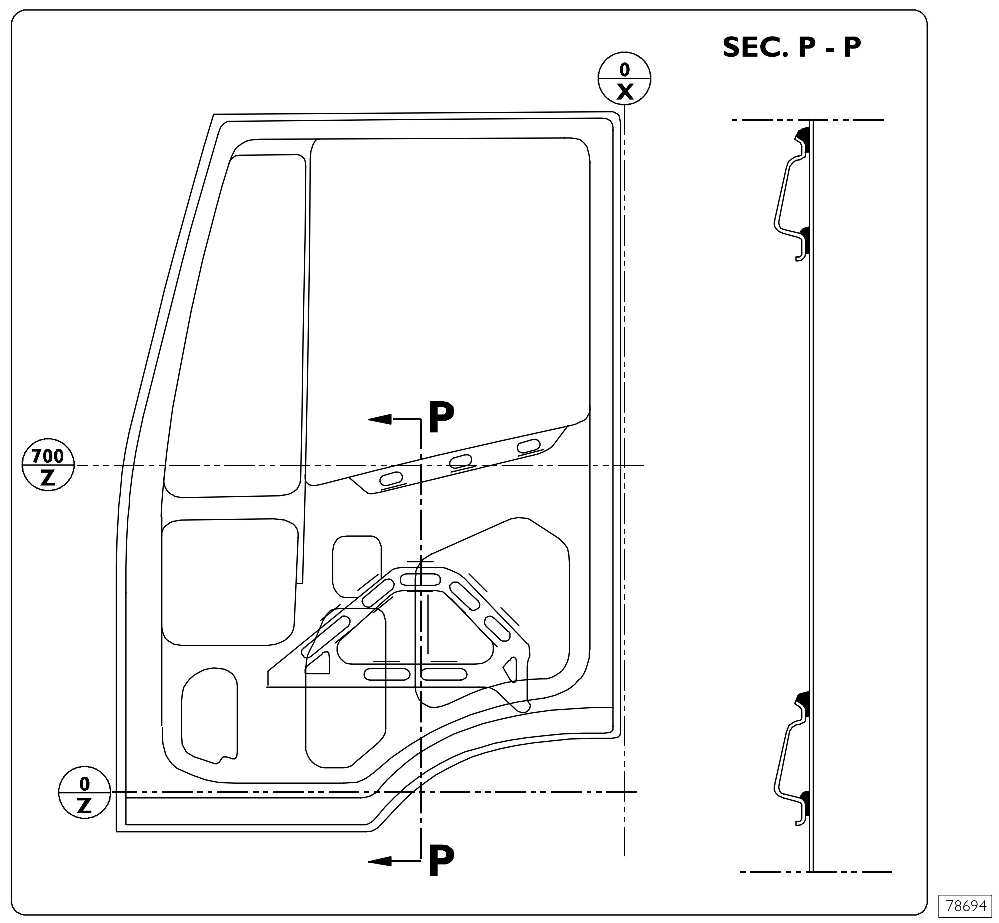


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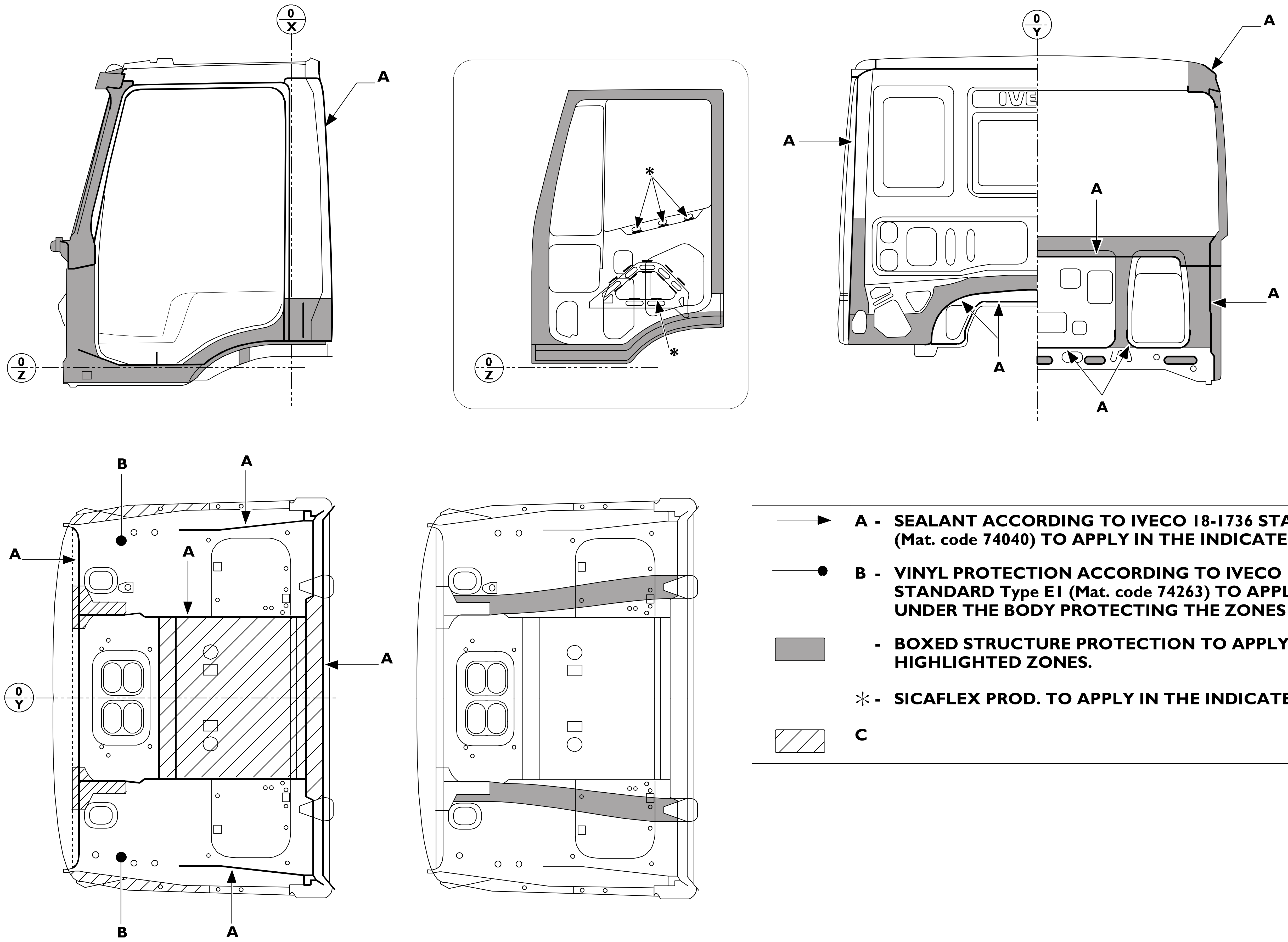
Figure 31

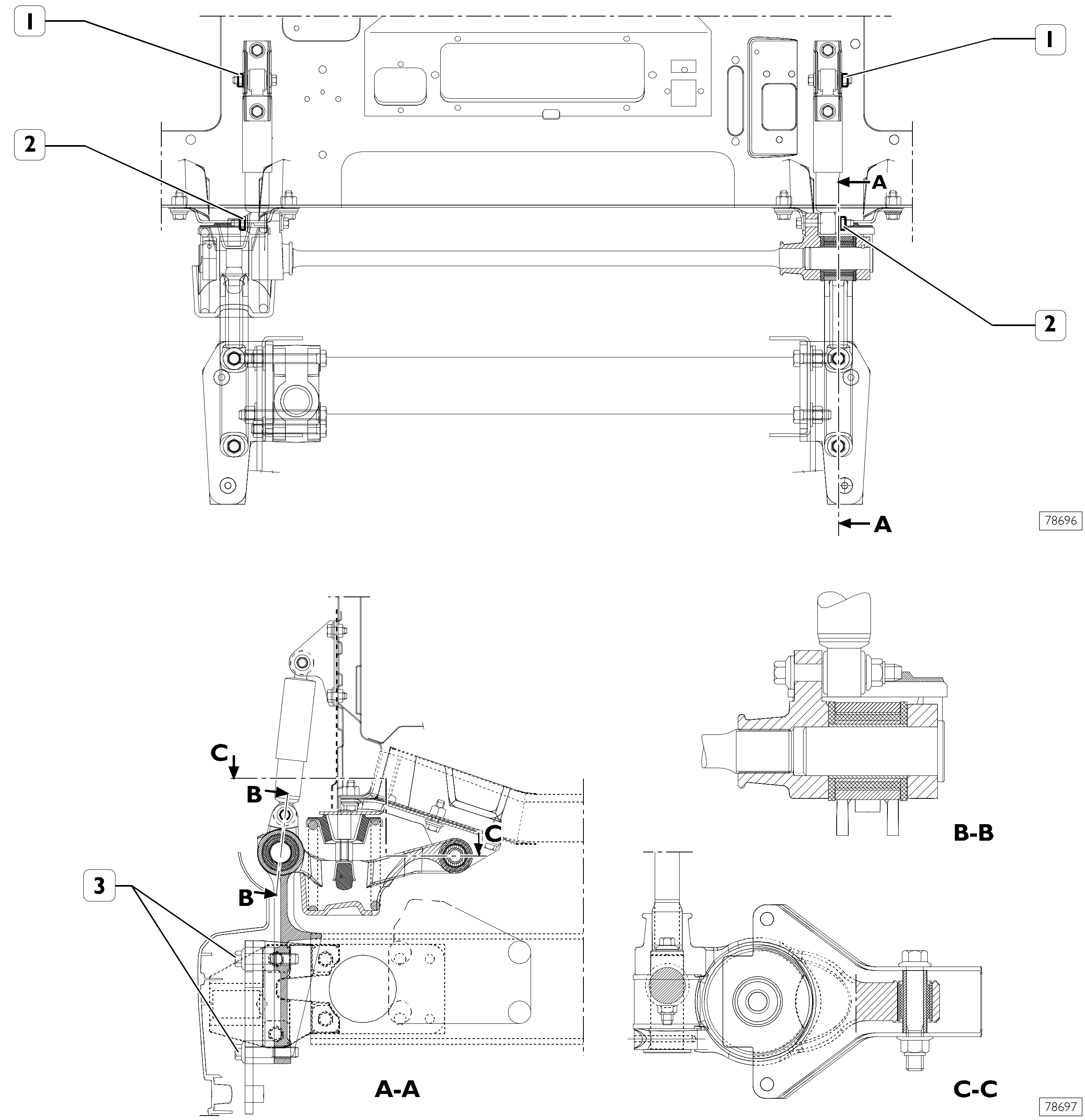


→	A -	SEALANT ACCORDING TO IVECO 18-1736 STANDARD Type A (Mat. code 74040) TO APPLY IN THE INDICATED ZONES.
—●	B -	VINYL PROTECTION ACCORDING TO IVECO 18-1654 STANDARD Type E1 (Mat. code 74263) TO APPLY UNDER THE BODY PROTECTING THE ZONES "C".
(grey)	-	BOXED STRUCTURE PROTECTION TO APPLY IN THE HIGHLIGHTED ZONES.
	* -	SICAFLEX PROD. TO APPLY IN THE INDICATED ZONES.
(hatched)	C	

Print 603.93.111

5542 CAB ANCHORINGCAB ANCHORING AND TIGHTENING TORQUES

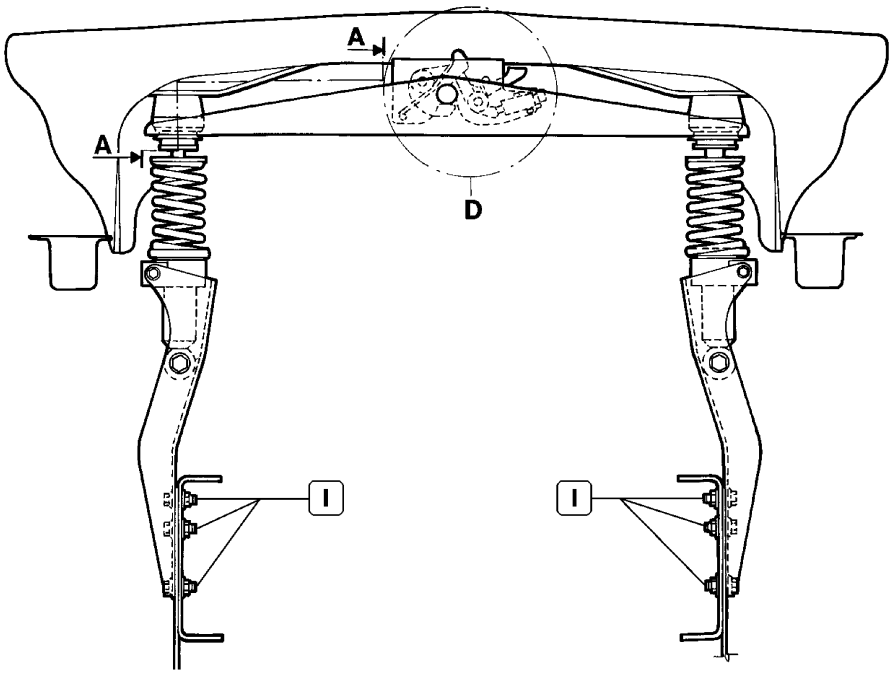
Figure 32

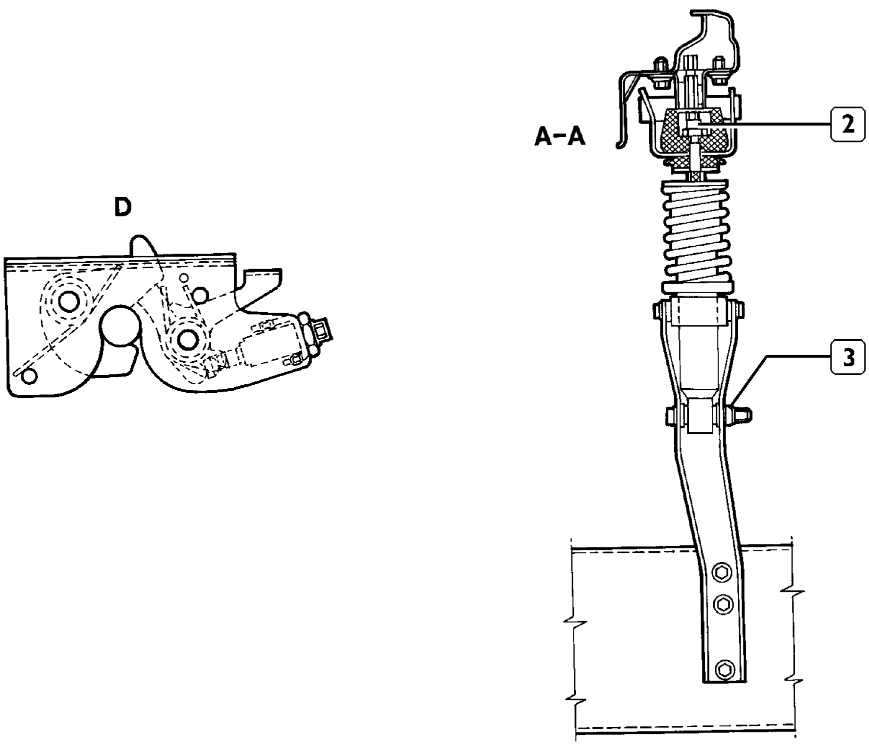


CAB FRONT SUSPENSION

PART		TORQUE Nm	(Kgm)
1	Hexagonal nut with flange for shock absorber upper fastening	122.5 ± 12.5	(12.2 ± 1.2)
2	Hexagonal nut for shock absorber lower fastening	122.5 ± 12.5	(12.2 ± 1.2)
3	Hexagonal screw with flange to secure bracket to cab on chassis side	296 ± 29	(29.6 ± 2.9)

Figure 33





SHORT CAB REAR SUSPENSION

PART		TORQUE	
		Nm	(Kgm)
1	Self-locking hexagonal nut with flange and hexagonal screw with flange to secure bracket to chassis	179 ± 18	(17.9 ± 1.8)
2	Self-locking hexagonal nut to secure shock absorber and elastic bumper to cross member on upper side	216.5 ± 21.5	(21.6 ± 2.1)
3	Self-locking nut and hexagonal screw for shock absorber fastening on lower side	189 ± 19	(18.9 ± 1.9)

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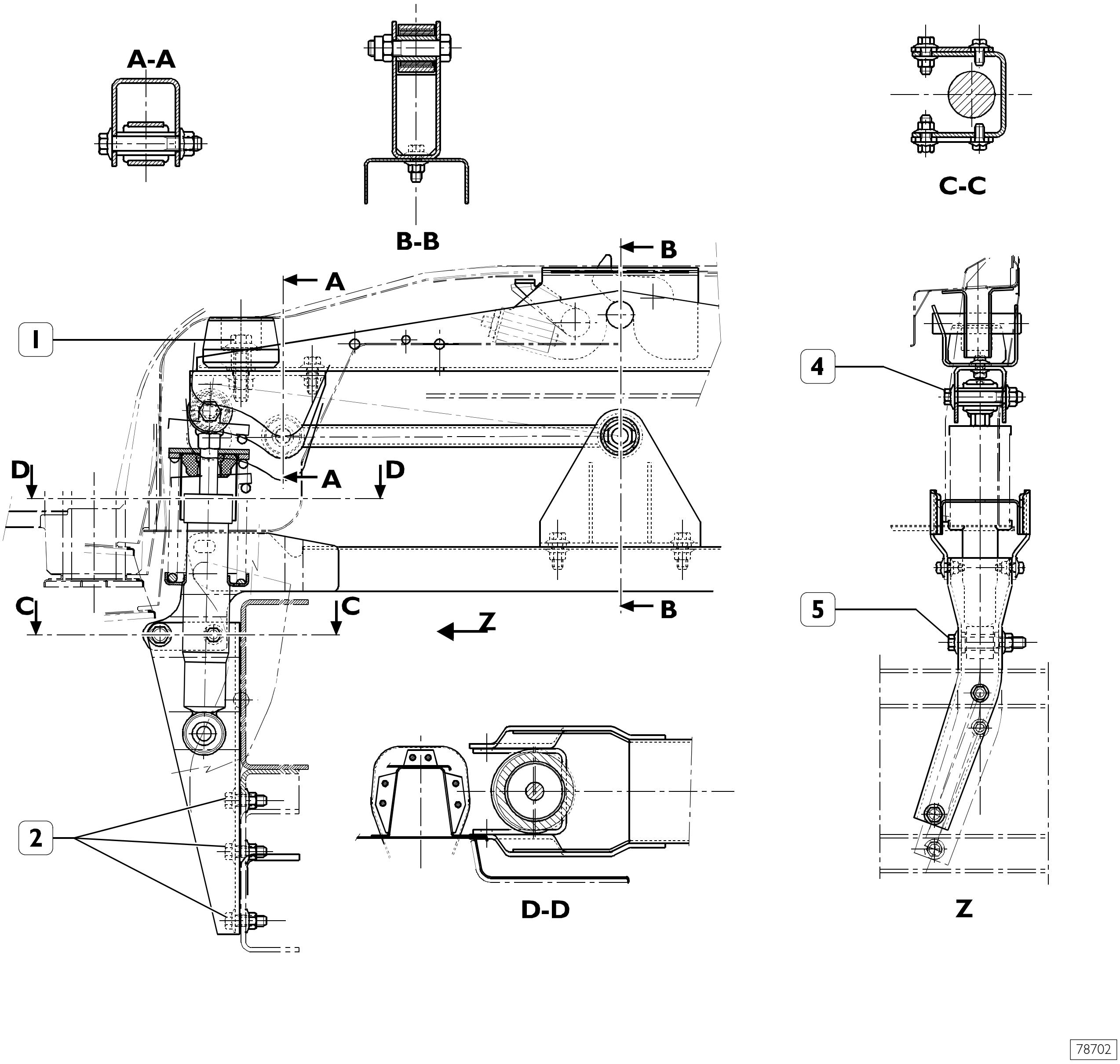
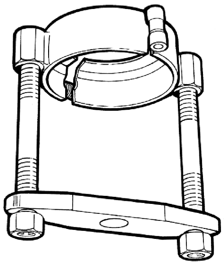
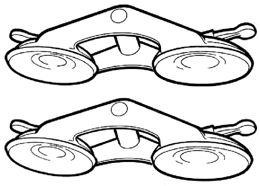
Figure 34



DOUBLE AND LONG CAB REAR SUSPENSION

PART		TORQUE	
		Nm	(Kgm)
1	Bumper securing screw	128 ± 52	(12,8 ± 5,2)
2	Screw to secure bracket to chassis	105 ± 21	(10,5 ± 2,1)
3	Screw to secure cross member connecting pipe	263 ± 53	(26,3 ± 5,3)
4	Screw to secure shock absorber	128 ± 52	(12,8 ± 5,2)

TOOLS

TOOL No.		DENOMINATION
99370147		Cab mechanic suspension spring check tool
99378031		Two-vacuum cup grip pair to lift windows

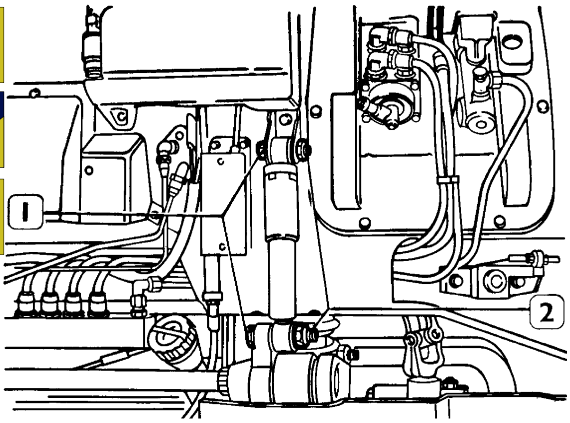
REPAIRS

5542 Cab anchoring

Repairs are limited to replacing broken parts.

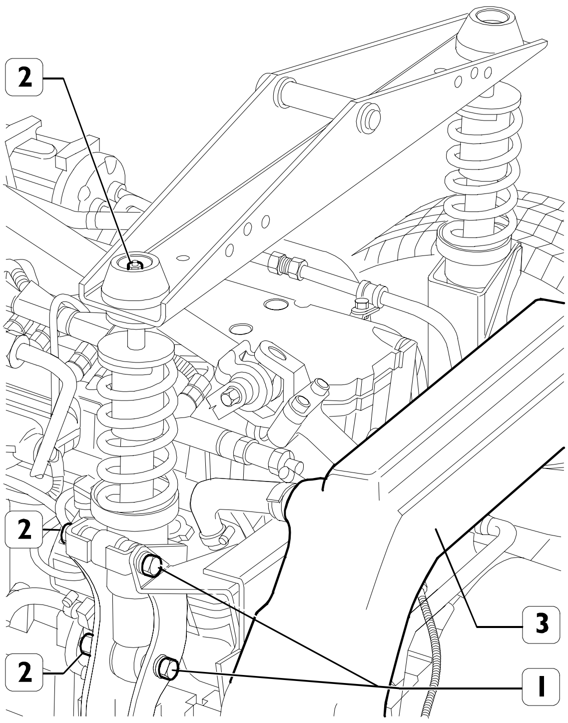
554243 Replacing cab suspension front and rear shock absorbers

Figure 35



41851

Figure 36



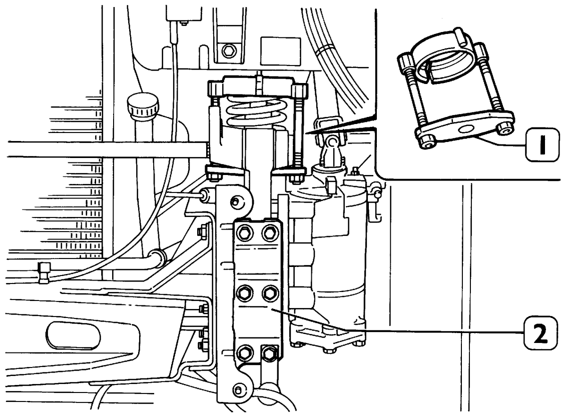
78706

In order to disassemble front shock absorbers (Figure 35), just unscrew nuts (2) end take out screws (1). In order to disassemble rear shock absorbers, it is needed to unscrew fastenings and dodge aspiration duct (3), as well as take out screws (1).

To fit them, carry out the above steps in the appropriate reverse order.

554215 Removing-refitting front mounts and cab stabilizer bar

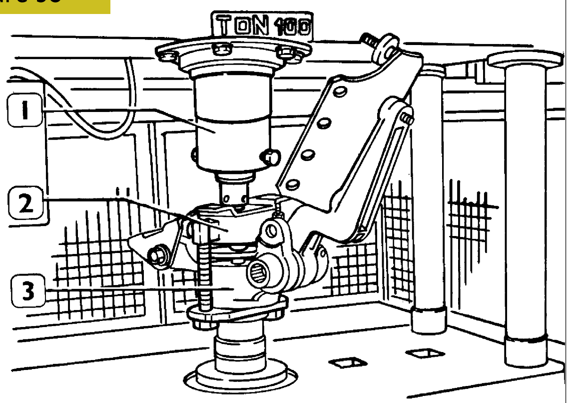
Figure 37



38600

Remove the bumper bar assembly.
Disconnect the shock absorber.
Support the cab with the specific prop.
Arrange the appropriate tool 99370147 (1) to compress the mount spring.
Unscrew the mount fixing screws.
Unscrew the screws fixing the top mount to the cab and the ones fixing the bracket (2) to the chassis frame. Then extract the mount together with the stabilizer bar.

Figure 38



33911

The tool (2) compressing the spring of the mount (3) is removed and refitted with a press (1).

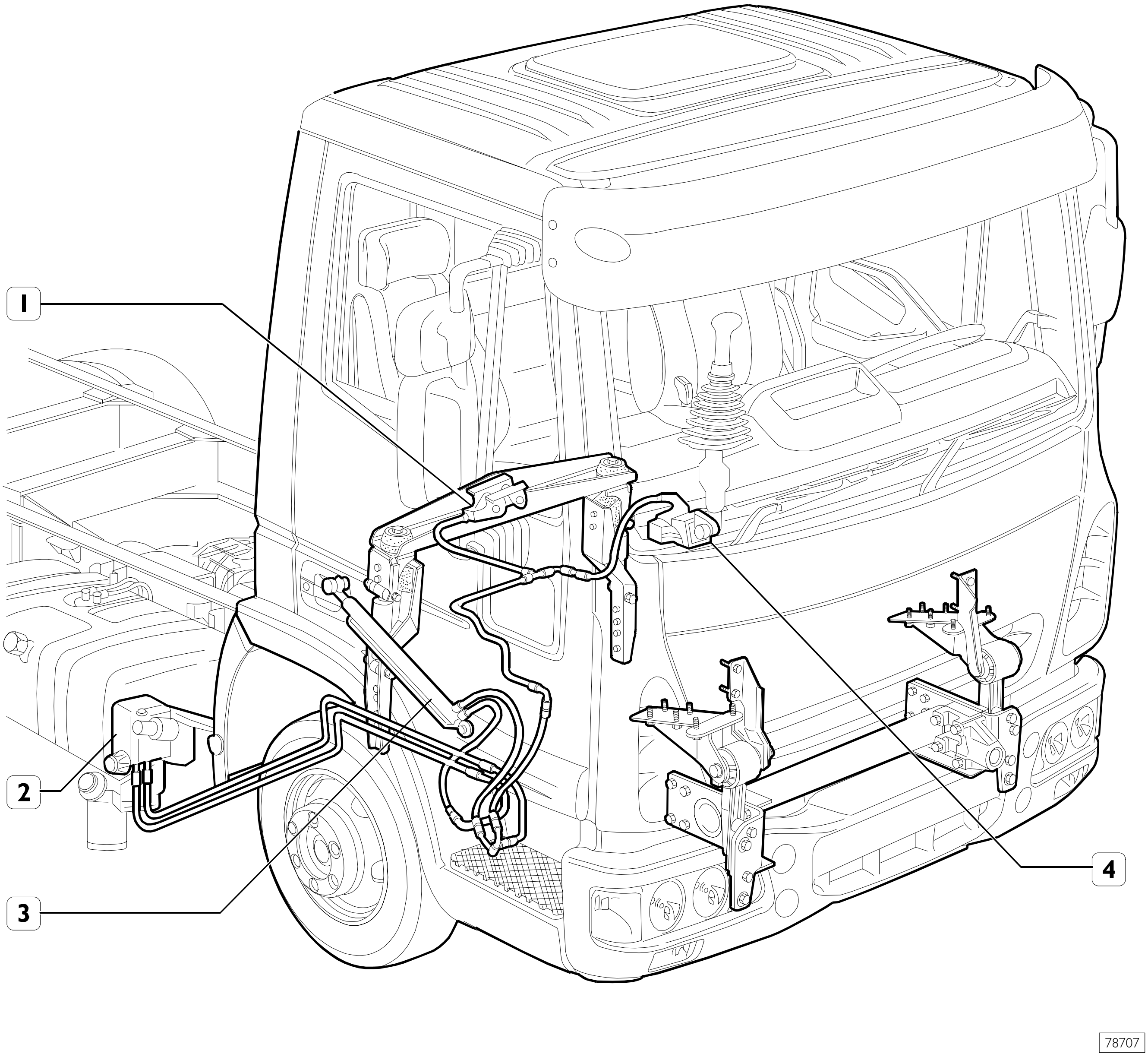
Replace all worn or broken parts.

For refitting, carry out the steps performed for removal in reverse order.

When mounting the stabilizer bar, grease the grooves of the bar with TUTELA Z2 grease to prevent noise and wear.

HYDRAULIC CAB LIFTING SYSTEM

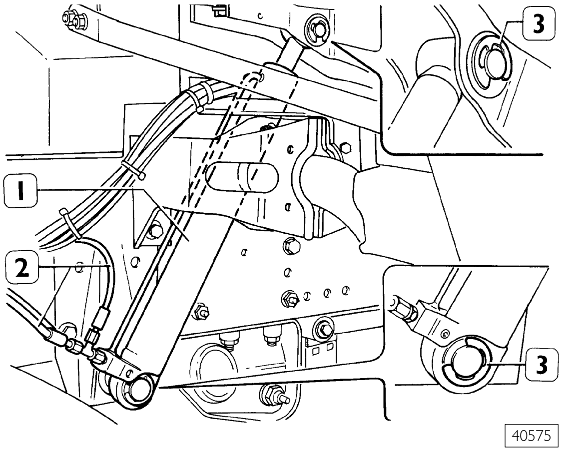
Figure 39



1. Lock - 2. Cab lifting pump - 3. Cab lifting cylinder - 4. Supporting box.

554255 Replacing hydraulic cylinder for cab tilting

Figure 40



Unscrew the oil fittings (3); unscrew the nuts (1) for the connecting pins and extract the cylinder (2).

> ! This operation has to be carried out with the cab lowered.

REPLACING WINDSCREEN WINDOW

General

New EuroCargo Tector windscreen windows observe the industrial standard which concerns fixed (glued) window fastening.

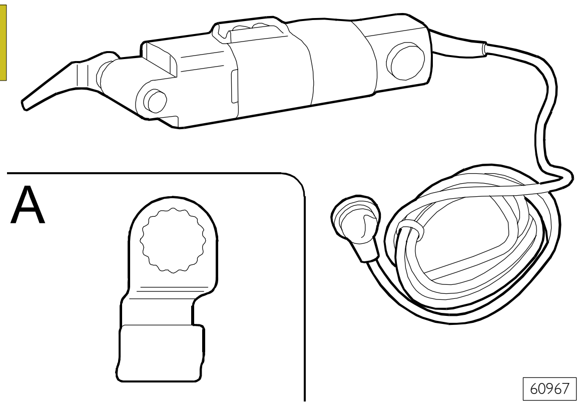
This is a great advantage, both in quality, because it assures perfect impermeableness and resistance to water, and in safety, because it makes structure more integral and lighter.

To detach the windscreen window, it can be operated with either a vibration cutter provided with a suitable cutting blade or harmonic wire.

> ! Do not use lubricants while cutting.
> Blades must be always sharp.

Vibration knife

Figure 41



A vibration cutter is made up of special shears and a suitable set of vibrating blades with a number of oscillations electrically adjustable.

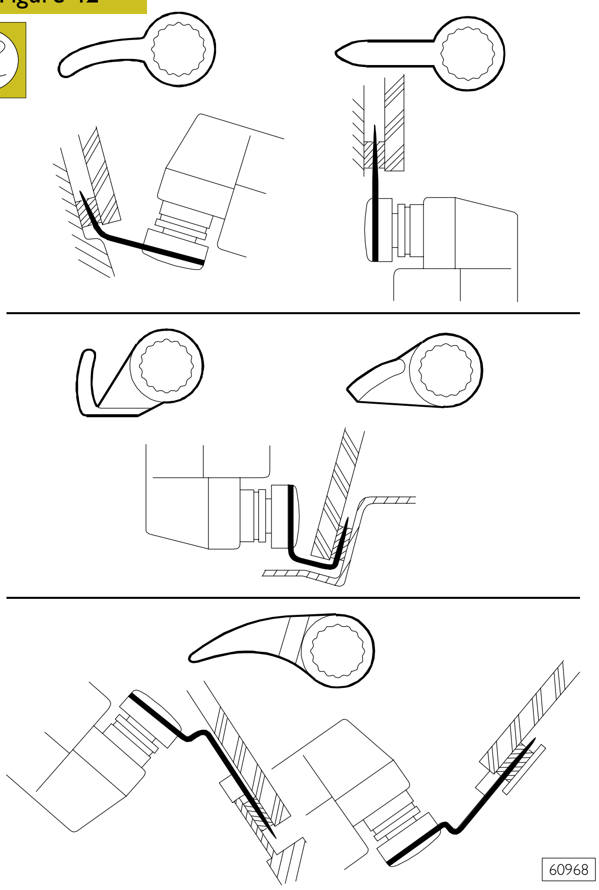
It can be used to cut polyurethane sealants.

It is important that, while cutting, the blade goes on parallel both to the window and body, in order to prevent the blade from breaking.

In order to prevent the shears from overheating, it is useful to adjust both advance and number of oscillations depending on use conditions.

In detail (A) it is shown the scraper to be applied to vibration shears to level sealant residue.

Figure 42

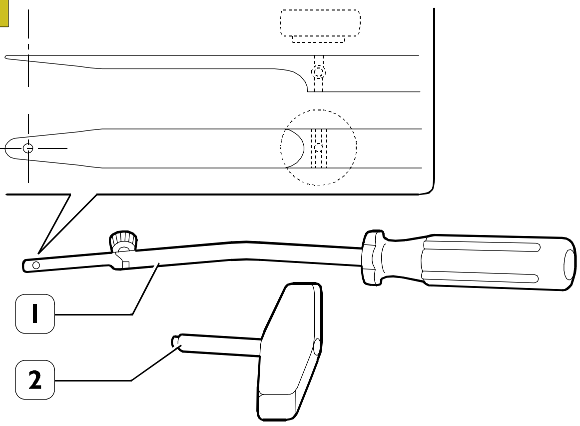


Examples of some situations occurring on cutting glued windows by matching blade type needed.

Harmonic wire

For cutting the sealant bead with the harmonic wire, it is necessary to use a tool as illustrated in Figure 44.

Figure 43



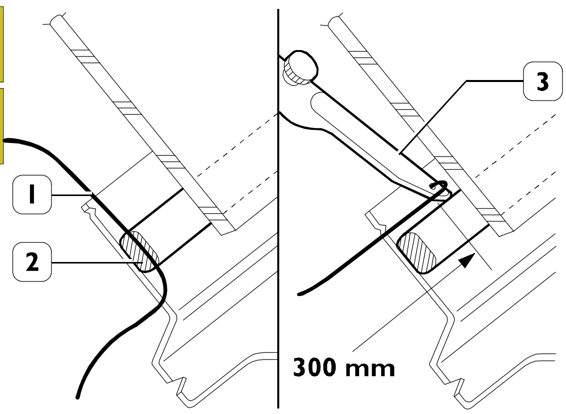
1. Check tool - 2. Draw handle

Removal (with harmonic wire)

Before performing windscreen detaching operation, it is needed to remove, from the vehicle, those components which would hinder operations or could suffer damage while executing these operations.

Before starting the cutting procedure, it is needed to protect, though an adhesive tape, the painted area, in order to avoid possible damages.

Figure 44

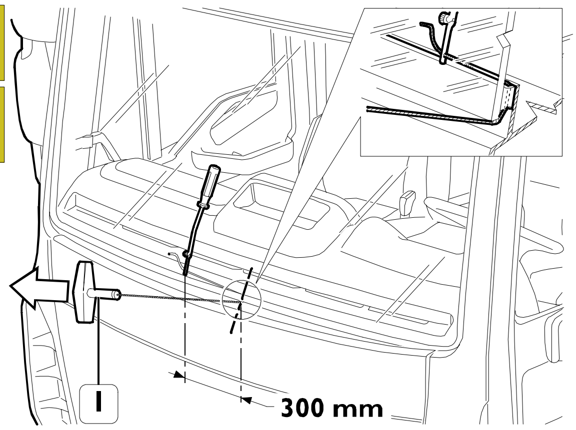


Cut a wire section about 500 mm long and, using a check tool (3), put in a wire end (1) through sealant bead (2), starting from windscreen window lower centre (see Figure 45).

Fix the wire end to check tool (3), operating inside the vehicle, and the other end to the draw handle outside the vehicle.

The inside operator has to point the check tool at sealant bead (2), about 300 mm from where wire (1) runs through.

Figure 45

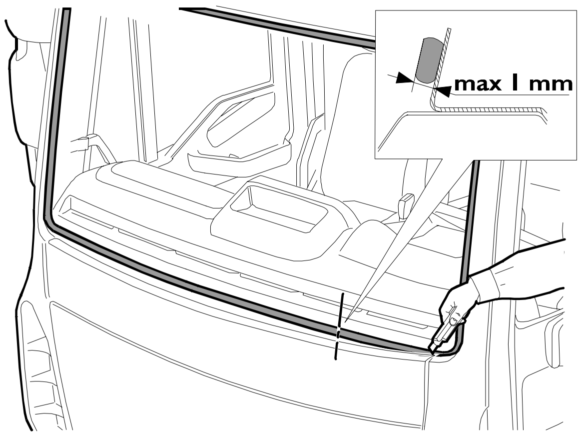


The other operator, who is outside the vehicle, has to pull the draw handle (1) while following the windscreen profile, and cut the sealant bead.

Repeat the operation for 300 mm sections throughout the profile, properly decreasing their length along the corners of the window, until a sealant bead complete cut is achieved, then remove the window using the vacuum cups.

Preparing the windscreen opening

Figure 46



By using a suitable blade, cut and level the windscreen opening sealant so as to leave 0.25 to 1 mm thickness in order not to scratch paint.

Remove sealant residue through compressed air, then degrease thoroughly with heptane and expendable paper.

The sealant film left on the windscreen opening will serve as a support for next gluing.

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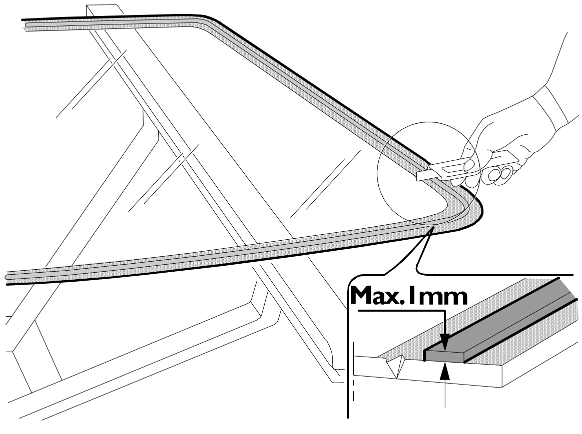
Preparing the windscreen

Figure 47

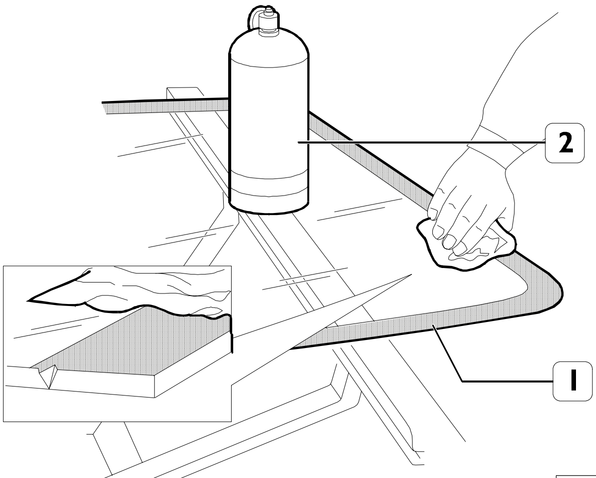


78710

In case of recovery of the original window detached:

- ❑ by using a suitable blade, cut and level the sealant bead trying to reduce thickness as much as possible. It is not necessary to take off the sealant thoroughly. Avoid to touch the surface of residual sealant. Pay attention not to damage the black silk screen on window perimeter.

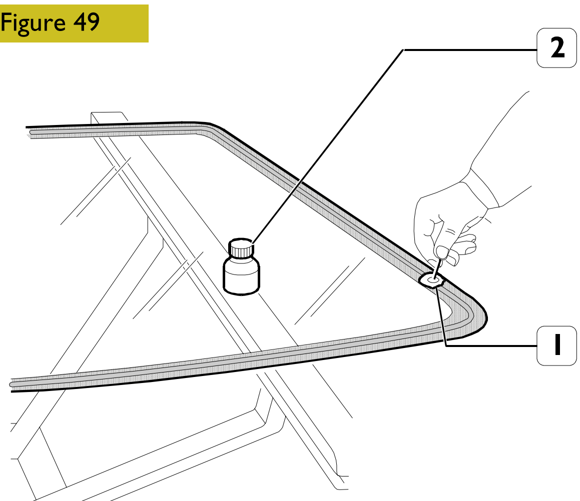
Figure 48



78712

Degrease windscreen silk screen portion (1) with heptane (2) and expendable paper.

Figure 49



78713

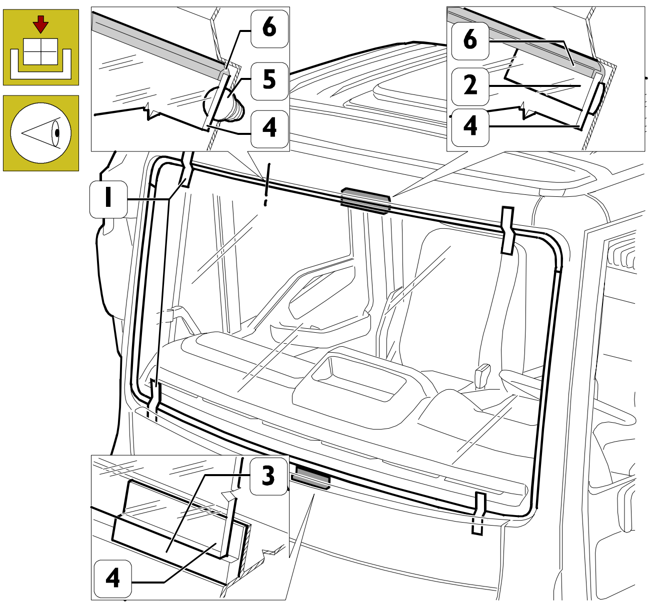
- ❑ Apply glass adhesion promoter (2) on silk screen portion by applicator (1).

> ⚠ In case of recovery of the windscreen window, it is not needed to apply the adhesion promoter on sealant left.

Wait 15 minutes before going on with operations, so as to let the adhesion promoter solvent evaporate.

Refitting

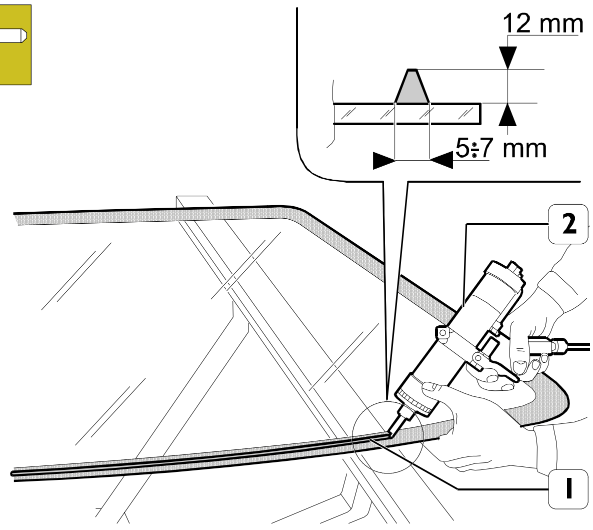
Figure 50



78711

Put in windscreen window (4) upper seal (6). Position plugs against horizontal sinking (5) on the windscreen window opening. Position pads against vertical (3) and horizontal (2) sinking. Make a test assembling and perfectly center the windscreen window. Once windscreen window centering has been completed, mark windscreen and seat mutual position with adhesive tape strips (1). Cut the adhesive tape strips and remove the windscreen.

Figure 51



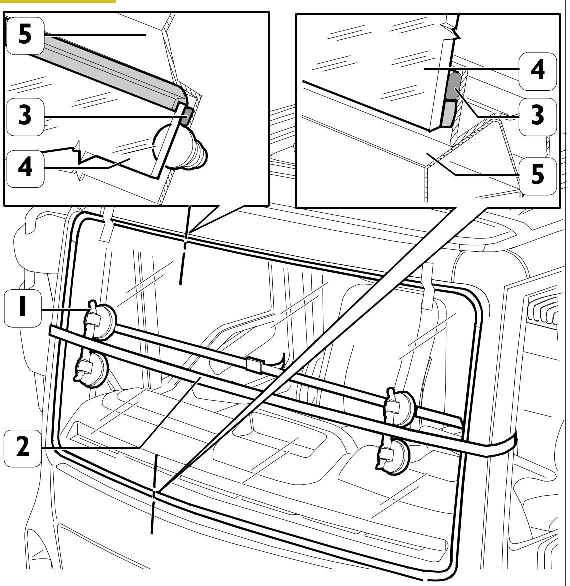
78714

Extrude a polyurethane adhesive bead (1) with air gun (2) along the windscreen perimeter as regularly as possible.

Start operation from the middle of the lower side and go on without interrupting throughout the windscreen perimeter.

Cut the adhesive cartridge spout in such a way that extrusion shape is a triangle with 5 x 7 mm base and 12 mm height.

Figure 52

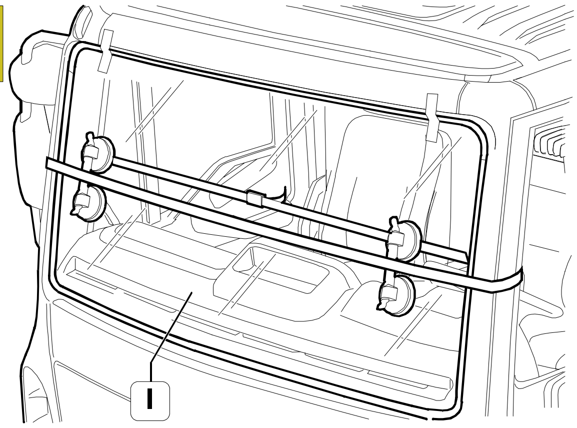


78715

By dedicated vacuum cups (1), place the windscreen in its seat immediately after applying sealant, then settle its position.

Position a belt (2) by using vacuum cups (1) as shims, then tension it in such a way that an even pressure is applied throughout the windscreen to the purpose of assuring correct matching among window (4), adhesive (3) and windscreen opening (5).

Figure 53



78716

Hold window (1) under pressure for at least 1 hour.

Before re-attaching previously detached portions, check for lack of infiltration points.

Apply suds with a sponge along the outer perimeter and blow compressed air from inside in order to highlight possible infiltration.

When bubbles are in, degrease affected portion and fill it with the adhesive.

Possible sealant overflowed portions inside can be removed, once the sealant has hardened, by cutting them with a blade and detaching them with a pair of pliers.

Pay attention not to damage silk screen on the window with the blade.

Re-attach detached portions and clean the window.

Do not move or deliver the vehicle before one hour and thirty minutes expired at 23.5 °C and 50% RU (Relative Humidity) climatic conditions.
When either temperature or humidity are lower, the dwell time has to be increased.

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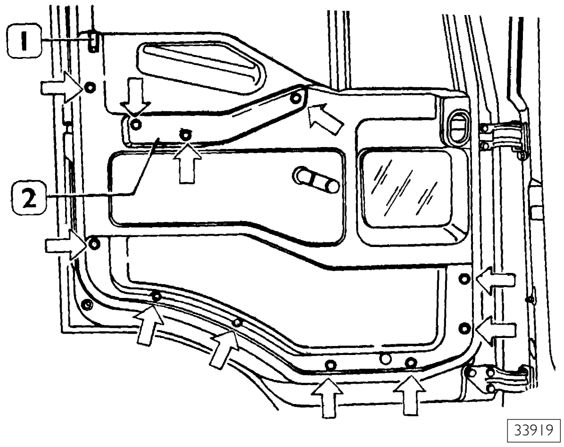
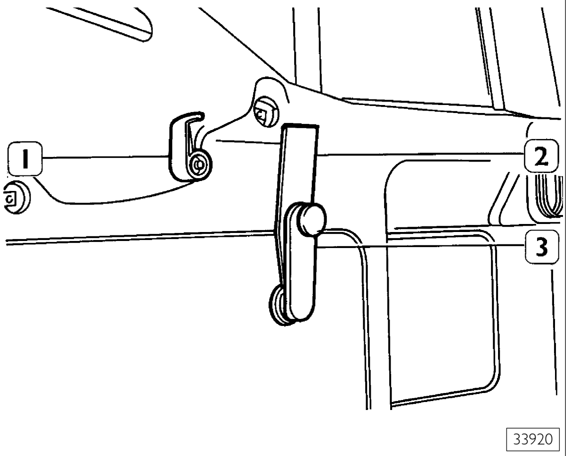
550740 Replacing the winding window

Figure 54



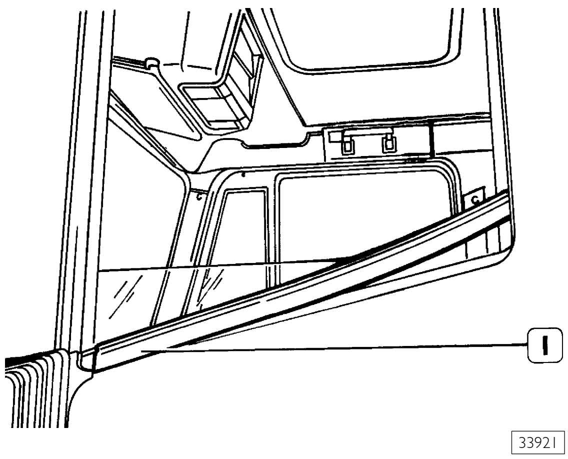
Take off the screw caps (arrows), unscrew the screws and extract the armrest (2). Remove the push-button (1).

Figure 55



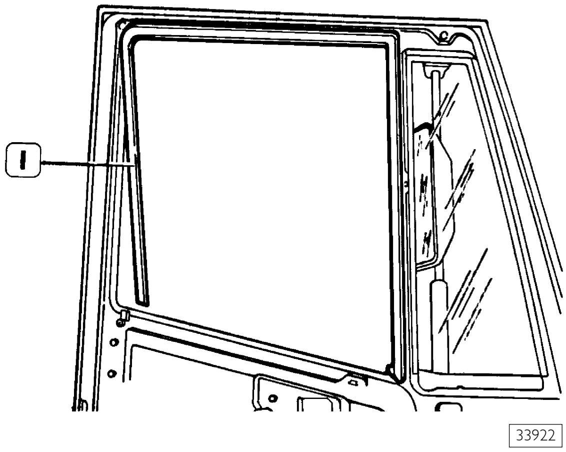
Using proper tool (2), take off the safety ring and dismount handle (3). Using the pliers, dismount handles (1). Remove the whole panel.

Figure 56



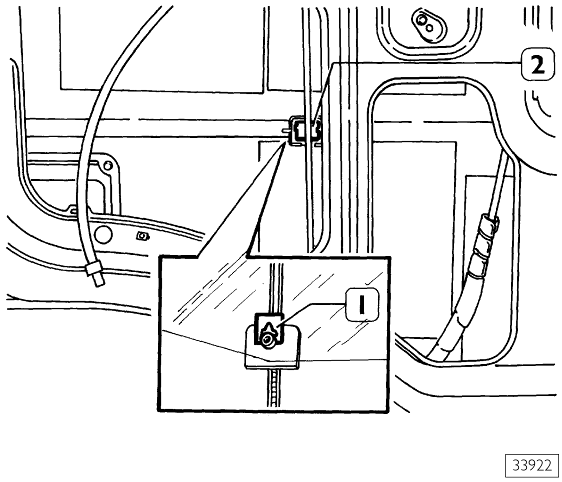
Lower the window, extract the internal and external seals (1).

Figure 57



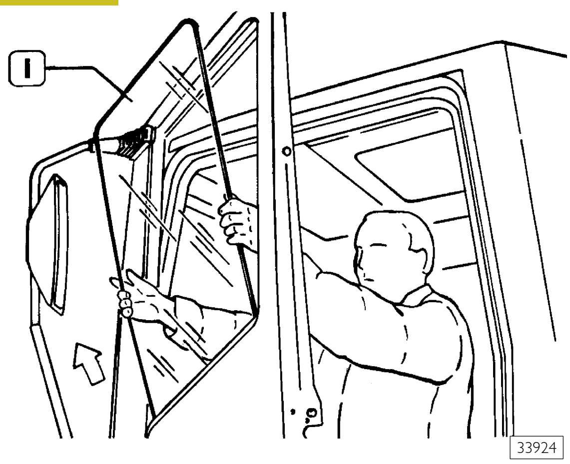
Extract the window guide seal (1).

Figure 58



Unhook the safety clip (1) from the lifting device (2).

Figure 59



Lift the window (1) and extract it from the top (arrow).

For refitting, simply carry out the steps described for removal in reverse order.

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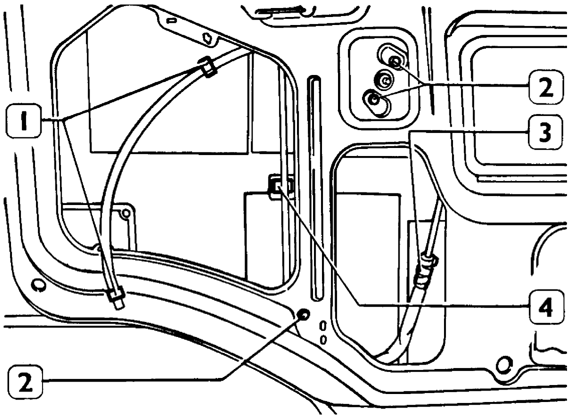
550730 Replacing the window winder

Take the inside trim off the door as described above.

Figure 60

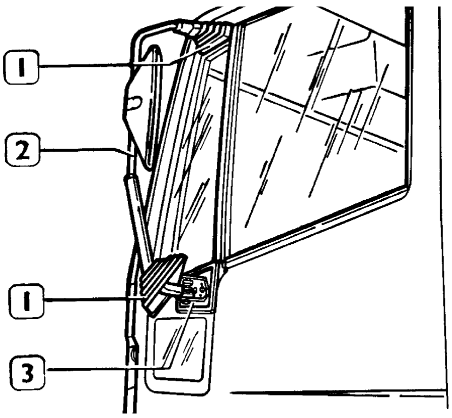


33925

Unhook the clips (1), unscrew the screws (2), unhook the window from its lifting device (4) and extract the window winder (3).
To fit it, carry out the steps described for removal in reverse order.

550478 Replacing the fixed window

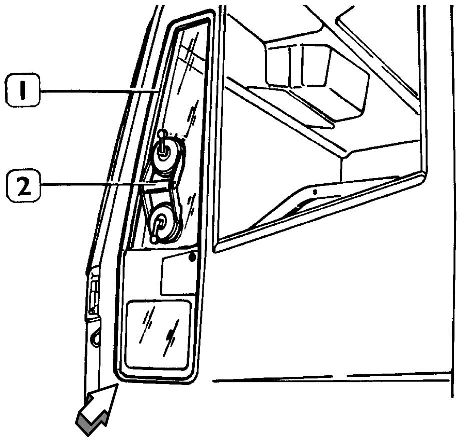
Figure 61



33926

Lift the shields (1), unscrew the screws and remove the rearview mirror (2). Take off the shield (3).
Remove the inside door trim.

Figure 62



33927

Extract the outside seal (1), apply the suction cup 99378031 (2).

> ⚠ Before starting to cut, you need to protect the paintwork with adhesive tape to prevent any damage.

Insert a suitable tool through the sealant by a corner (arrow) of the window.
Make the cut all along the perimeter. Remove the window with a suction cup handle (2).
Using a specific tool, level the bead of sealant remaining in the seat of the window in the door: clean with compressed air then fully degrease with heptane and disposable paper.

> ⚠ If refitting the window, it is necessary to remove the old sealant without damaging the screen- printed area of the window.

Position the window in its seat correctly, register its position and mark it with adhesive tape. Cut the tape and take out the window.

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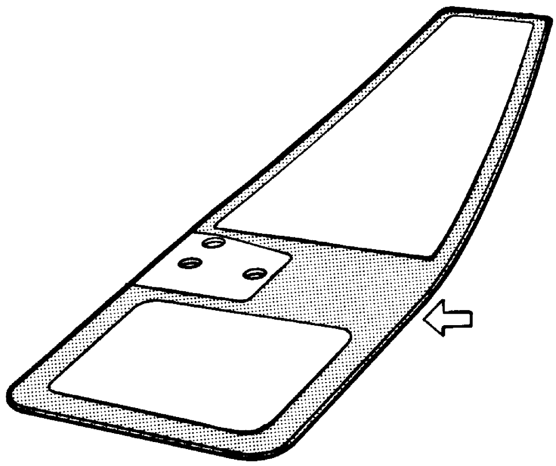
Figure 63



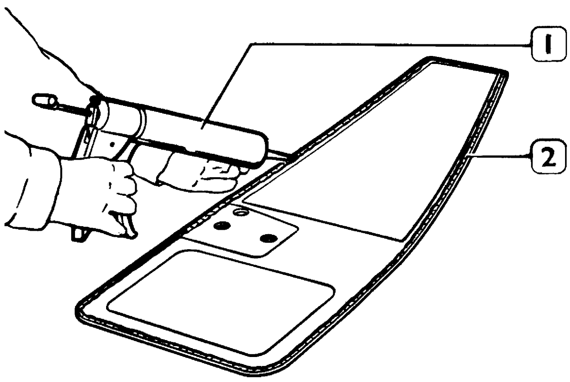
33928

Clean the screen-printed area (arrow) with a paper pad soaked in degreasing adhesion promoter.
Using a suitable pad, apply the glass primer taking care not to go outside the screen-printed area.

Leave the glass primer to dry at ambient temperature for at least 15 min. and anyhow for no longer than 24 hours.

Fit the seals on the inside of the door.
Fit the rubber seal on the window.

Figure 64

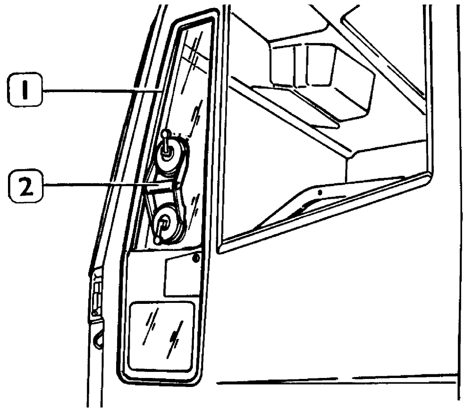


33929

Using an appropriate gun (1), apply the adhesive (2) on the window.

The bead of adhesive must be neither too big nor too small, and it must be continuous. In addition, the end portion must join the start in order to form a sealing ring.

Figure 65



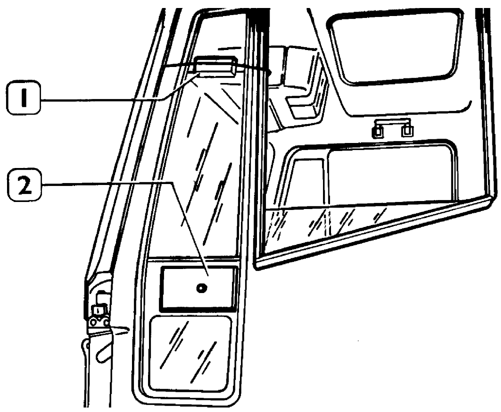
33921

Place the windscreen in its seat with the suction cup handle (2).

- ❑ Align the window with its housing bay, using the adhesive tape applied beforehand as a reference.

The window must be positioned within 15 minutes of applying the adhesive..

Figure 66



33930

Keep the window under pressure with two wooden plugs (1 - 2) positioned as shown in the figure.

It is necessary to wait at least 3 hours before moving the vehicle in the workshop.
For delivery to the customer, it is anyhow necessary to wait 24 hours.

Take out the plugs, fit the rearview mirror and the internal door trim back on.

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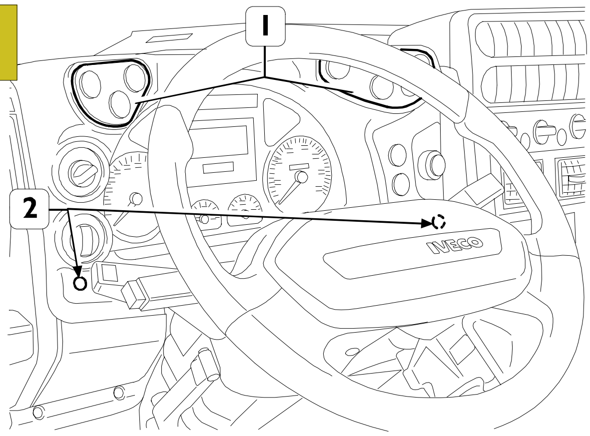
553710 INSTRUMENT PANEL

Removal

Before performing repair interventions, disconnect batteries and observe safety rules.

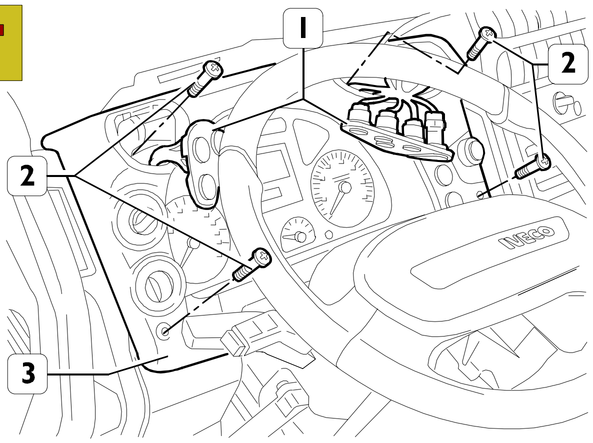
Figure 67



79610

- Pull plugs (2) out of the seat;
- operate on check tongues and remove switches (1) from their opening.

Figure 68

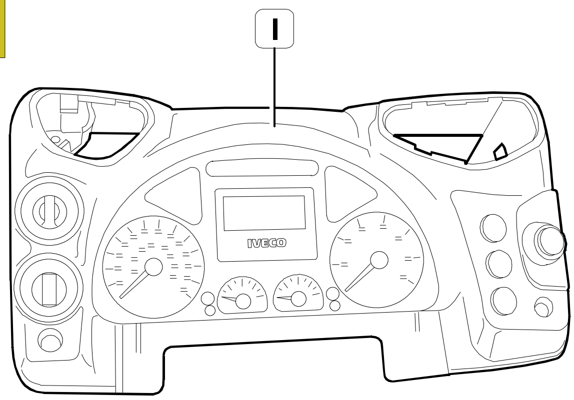


79611

- Disconnect electric connectors and remove switch (1) sets;
- unscrew instrument panel (3) securing screws (2).

Mark electric wiring harness to make re-attaching operations easier.

Figure 69



79612

- Detach instrument panel (1) from its seat.

Refitting

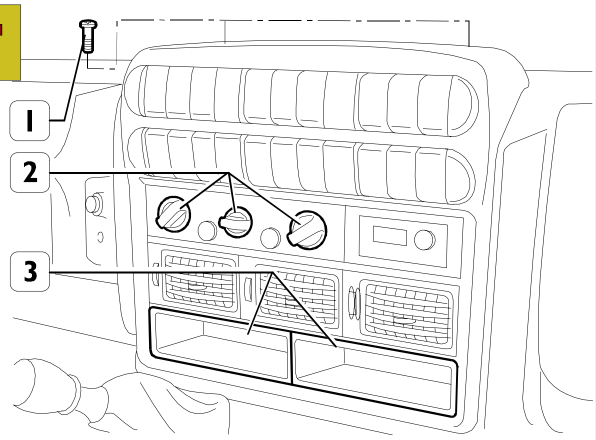
Perform re-attaching operations inverting described detaching operations.

553710 MIDDLE INSTRUMENT PANEL

Removal

Before performing repair interventions, disconnect batteries and observe safety rules.

Figure 70



79613

- Unscrew middle instrument panel securing screws (1);
- operate on check tongues and remove lower glove compartments (3) to access the screws underneath;
- remove the knobs (2) of air-conditioner controls in order to access the screw underneath.

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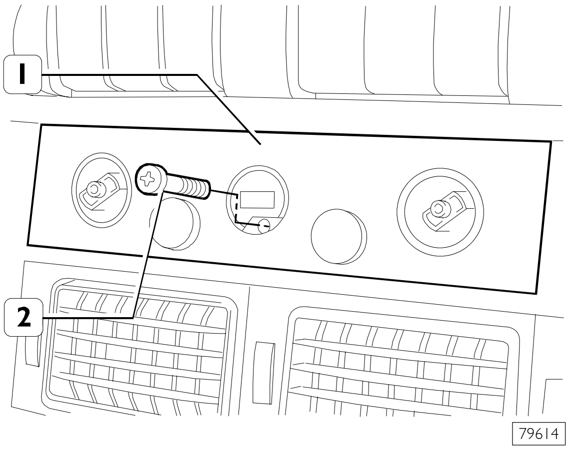
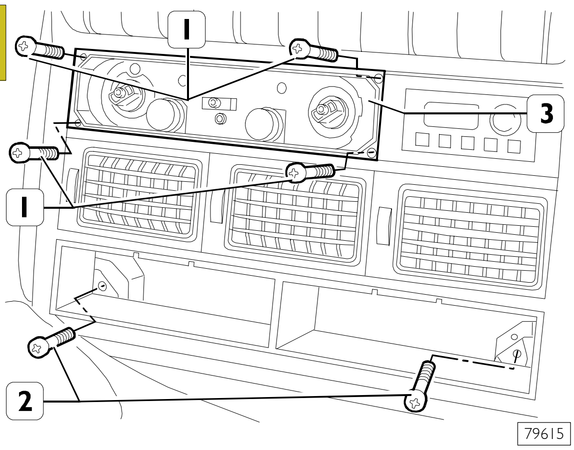
Figure 71



❑ Unscrew securing screw (2) and detach the panel of air-conditioner controls.

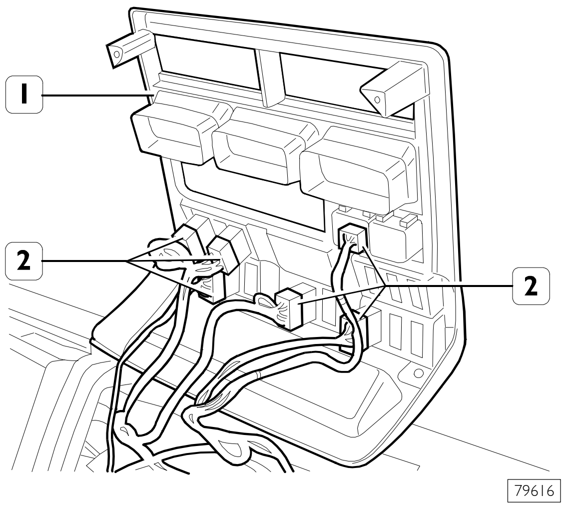
Figure 72



❑ Unscrew screws (1) securing the device of air-conditioner controls (3) to middle instrument panel;

❑ unscrew screws (2) securing the middle instrument panel on the lower side to the covering.

Figure 73

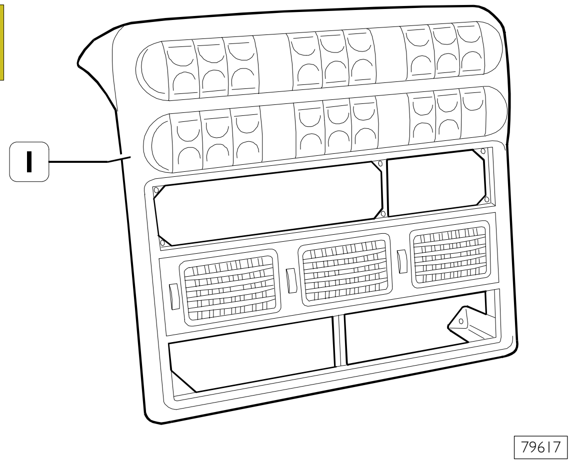


❑ Pull out middle instrument panel (1);

❑ disconnect electric connections (1).

Mark electric wiring harness to make re-attaching operations easier.

Figure 74



❑ Detach middle instrument panel (1) from the vehicle.

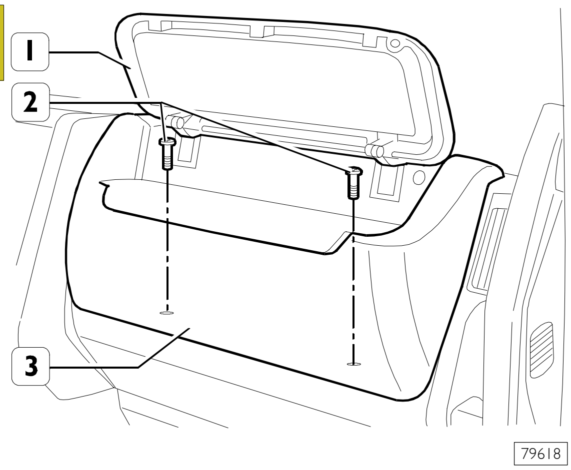
Refitting

Perform re-attaching operations inverting described detaching operations.

552211 INSTRUMENT PANEL COVERING

Removal

Figure 75



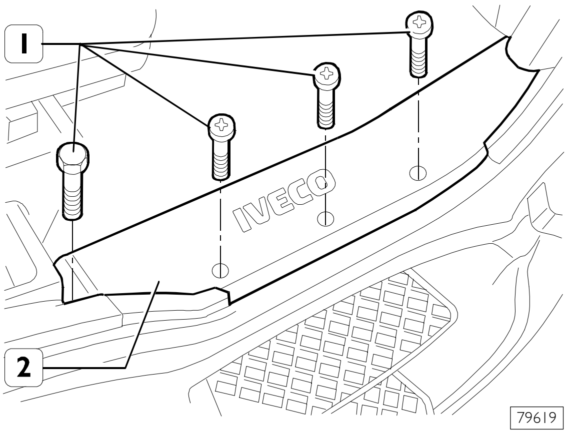
Perform detaching procedure:

❑ instrument panel (OP. 553710) and middle instrument panel;

❑ let off engine cooling water and drain conditioning system (if present);

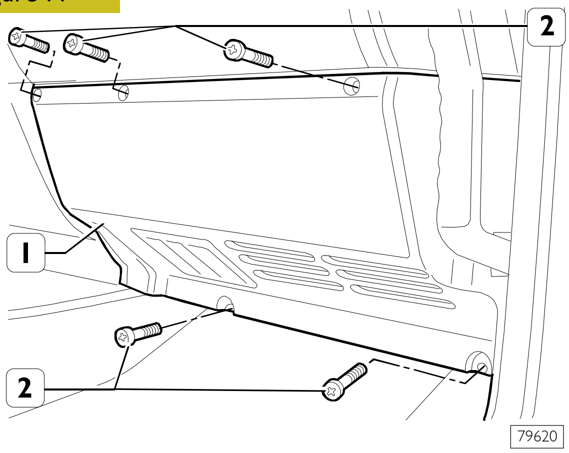
❑ lift lid (1), unscrew securing screws (2) and remove glove compartment from the vehicle (3).

Figure 76



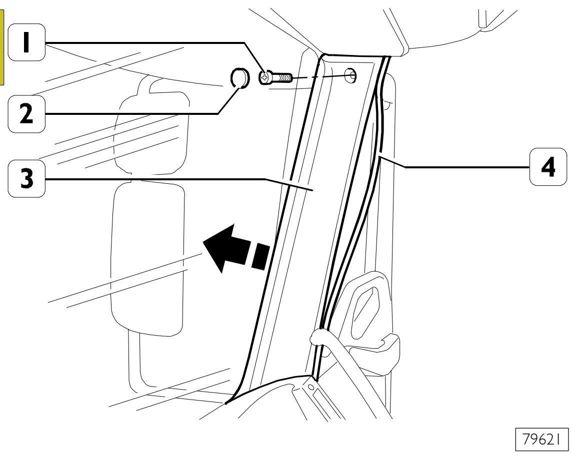
- ❑ Unscrew securing screws (1) and remove sill board (2) from both sides.

Figure 77



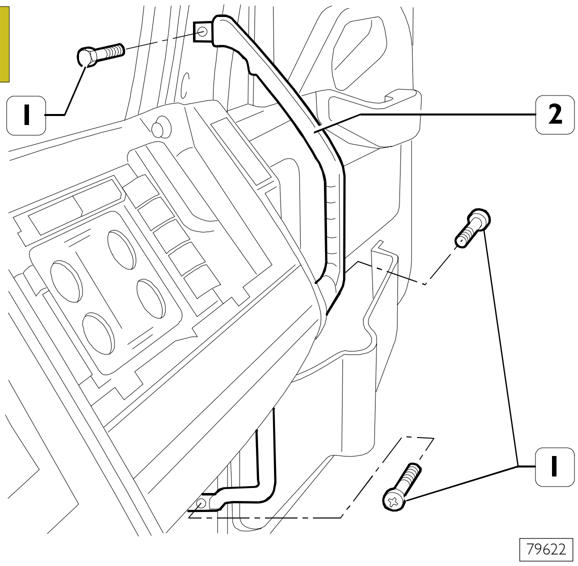
- ❑ Unscrew securing screws (2) and remove plastic coverings (1) under instrument panel (the figure shows one of coverings to be removed).

Figure 78



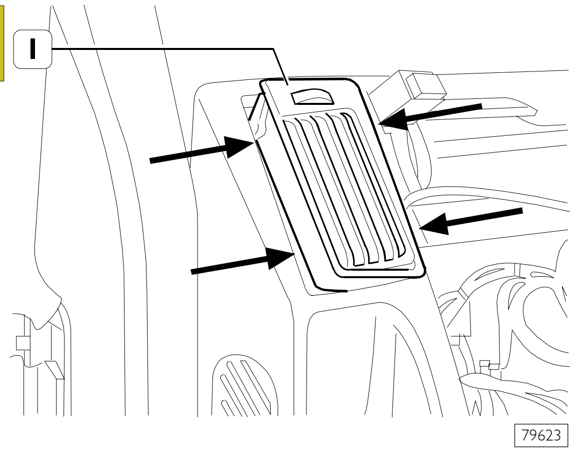
- ❑ Pull out door opening ring seal (4);
- ❑ pull out pressure plug (2) to access the screw underneath;
- ❑ unscrew securing screw (1);
- ❑ detach windscreen pillar covering (3) operating (from both sides) according to the direction of the arrow.

Figure 79



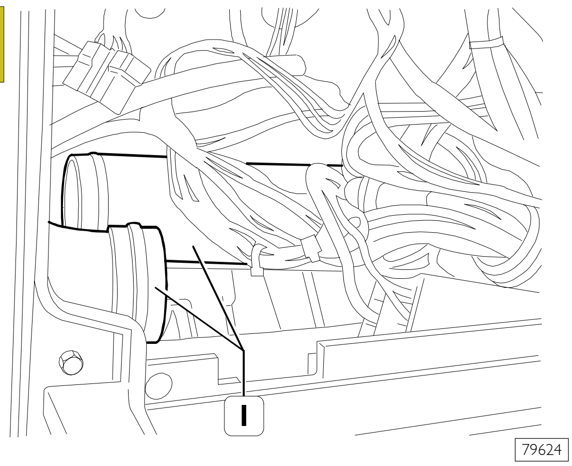
- ❑ Unscrew securing screw (1) an detach rising grip handle (2) from both sides.

Figure 80



- ❑ Operate on check tongues (←) and pull out air diffusion opening (1) from both sides.

Figure 81



- ❑ Operate from instrument panel opening, release, from check clamps, and detach piping (1) to deliver air to diffusion openings.

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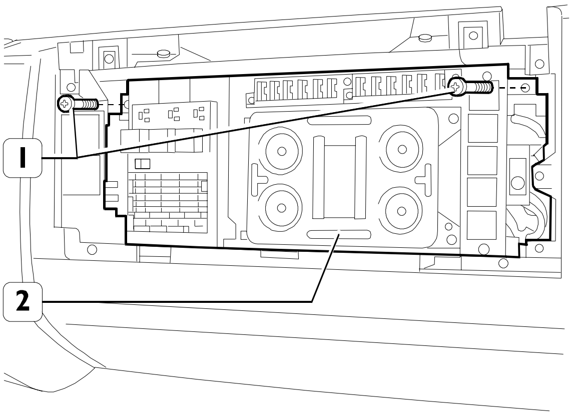
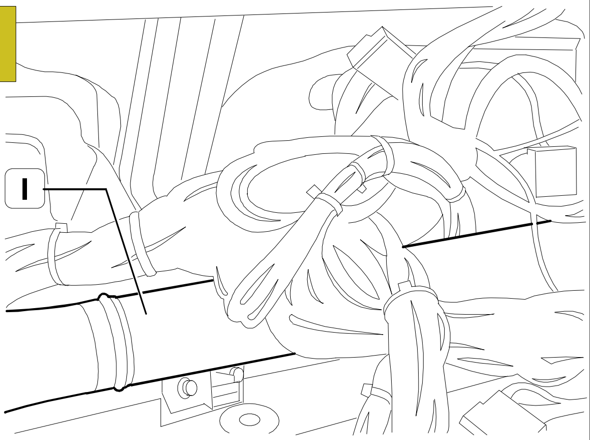
Figure 82



79625

- ❑ Unscrew Body Control securing screws (1);
- ❑ remove Body Control (2) and set aside.

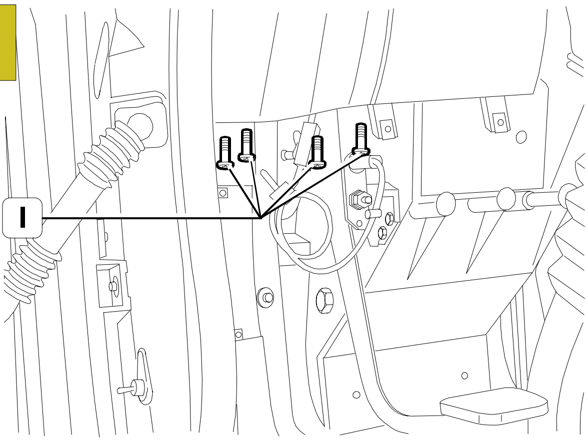
Figure 83



79626

- ❑ Operate from (Body Control) opening, disconnect and remove piping (1) to deliver air to diffusion openings.

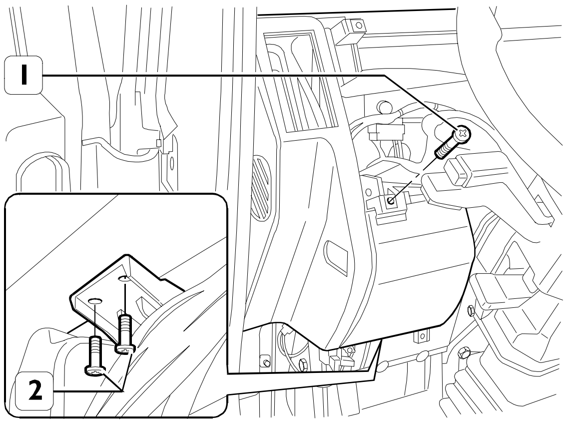
Figure 84



79627

- ❑ Unscrew side securing screws (1) from both sides of instrument panel covering the body.

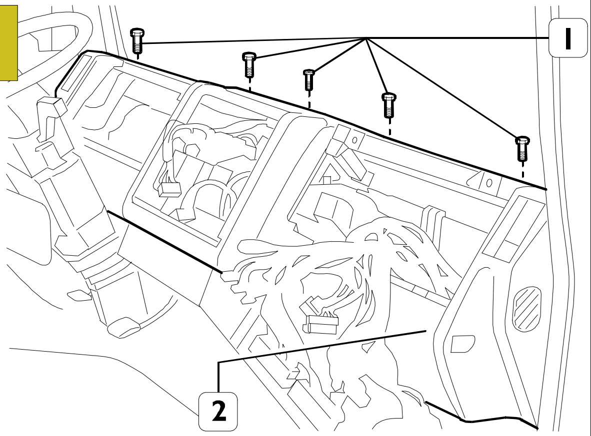
Figure 85



78628

- ❑ Unscrew instrument panel covering securing screws (1) in instrument board opening and screws (2) for fastening to support bracket.

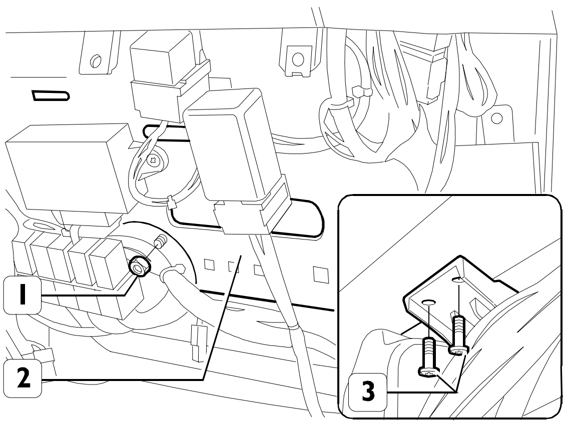
Figure 86



79629

- ❑ Unscrew instrument panel covering (2) upper securing screws (1) along windscreen edge perimeter.

Figure 87



79630

- ❑ Operate from Body Control lower side and unscrew securing nut (1), and set aside electric components support panel (2) to access fastening underneath;
- ❑ unscrew screws (3) securing instrument panel covering to support bracket.

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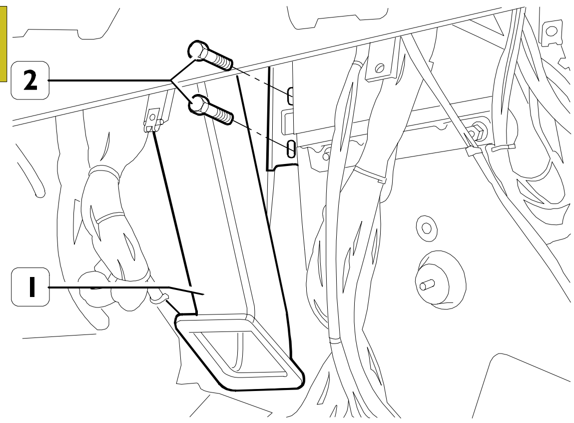
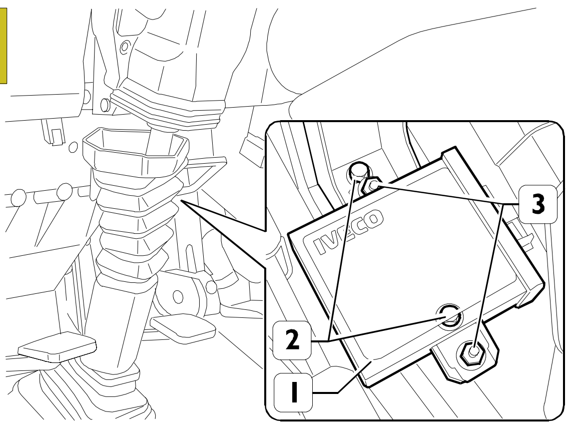
Figure 88



79631

- Unscrew screws (2) securing instrument panel support bracket located at air conveyor (1) side.

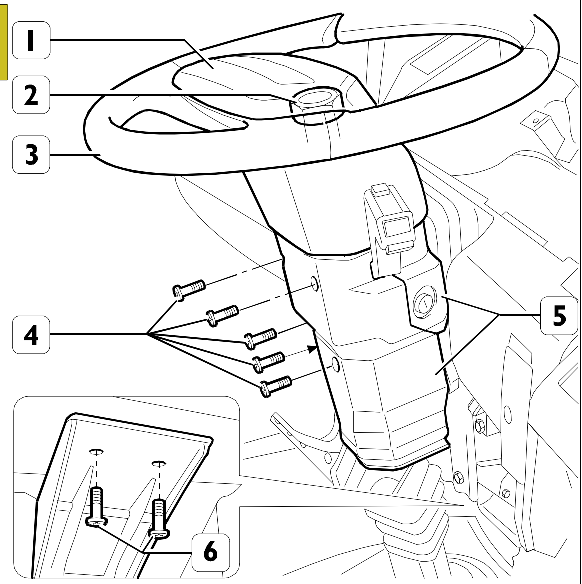
Figure 89



79632

- Unscrew securing nuts (3) and detachcode central unit (1);
- unscrew screws (2) of instrument panel bracket support to body.

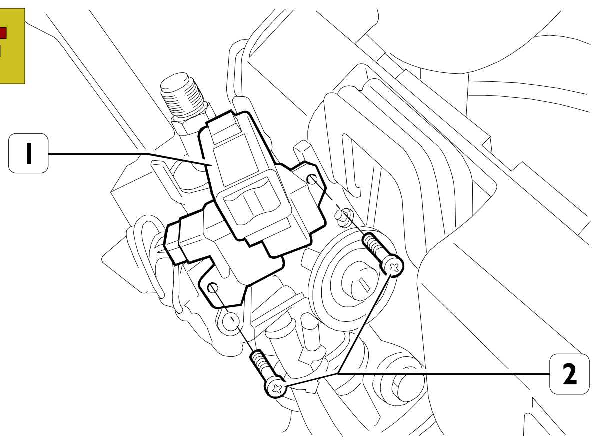
Figure 90



79633

- Pull out steering wheel hub cap (1);
- unscrew nut (2) and detach steering wheel (3);
- unscrew securing screws (4) and remove steering column covering (5);
- operating from steering column side, unscrew instrument panel support bracket securing screws (6) (see LENS).

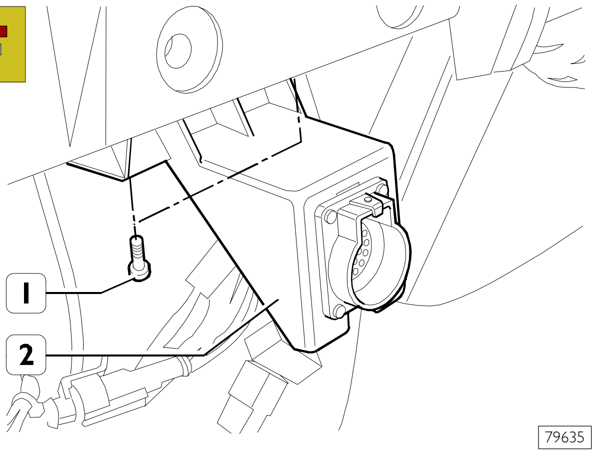
Figure 91



79634

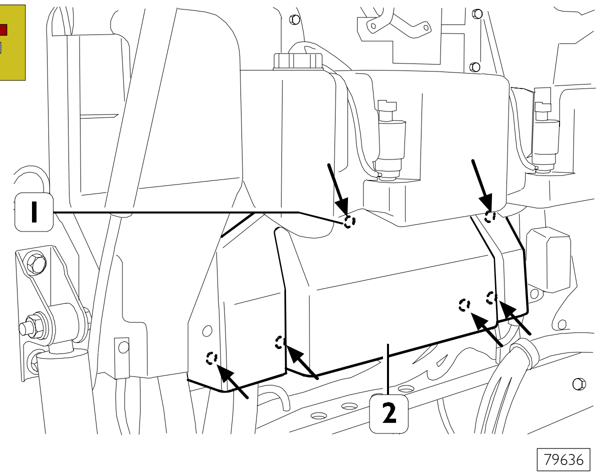
- Unscrew securing screws (2), disconnect electric connections and remove windscreen drive lever (1).

Figure 92



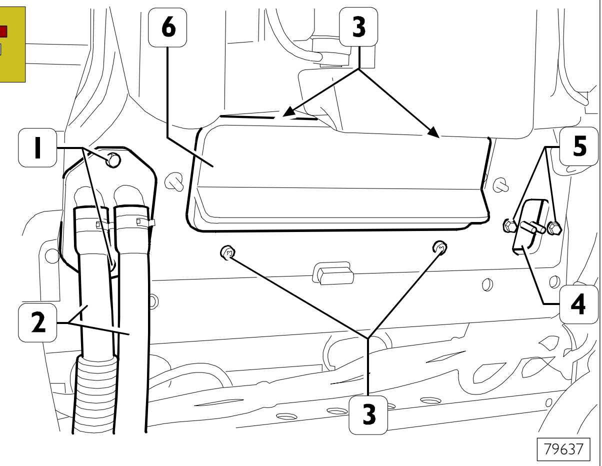
- Unscrew securing screws (1) and detach diagnosis socket (2).

Figure 93



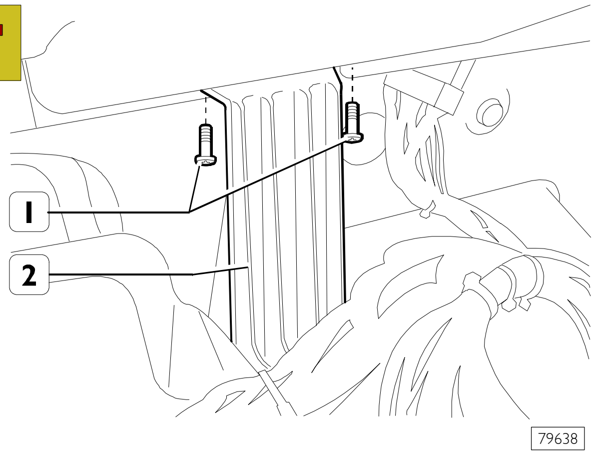
- Lift radiator cowling, unscrew securing screws (1) and detach guard (2).

Figure 94



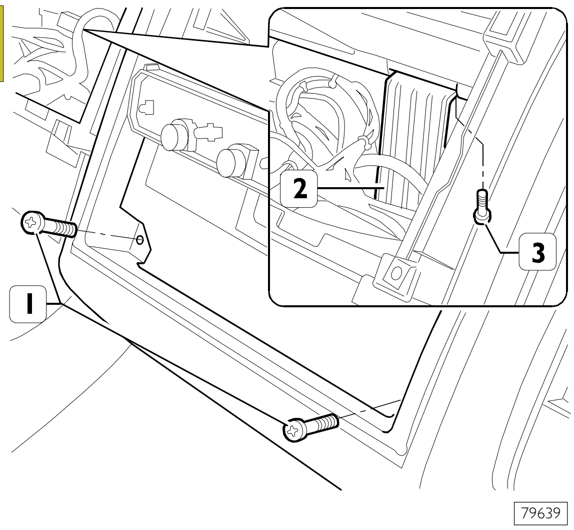
- Unscrew screws (3) securing conditioner (6) to cab front wall;
- unscrew expansion valve (4) securing screws (5);
- disconnect heater piping (2) and unscrew securing screws (1).

Figure 95



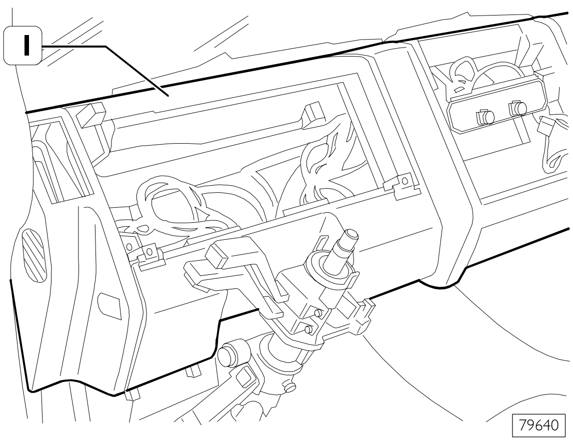
- Operate inside Body Control opening, unscrew instrument panel covering bracket (2) securing screws (1);
- remove door open light wiring harness;
- remove duct diffusing air to feet.

Figure 96



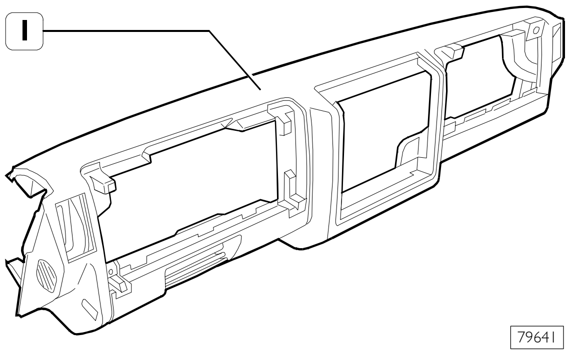
- Unscrew screws (1) securing heater to instrument panel;
- unscrew securing screws (3) and remove instrument panel support bracket (2) operating from instrument board opening (as shown in box);
- remove air duct from heater to instrument panel.

Figure 97



- With help from a second operator, properly detach instrument panel (1) covering from the vehicle.

Figure 98



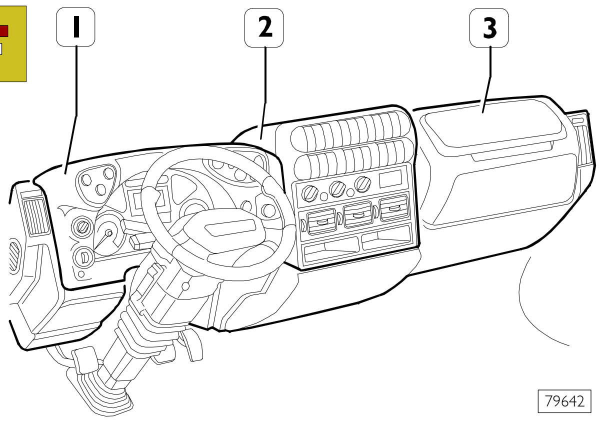
Refitting

Perform instrument panel (1) covering re-attaching operations properly inverting described detaching operations.

533210 HEATING AND VENTILATION

Removal

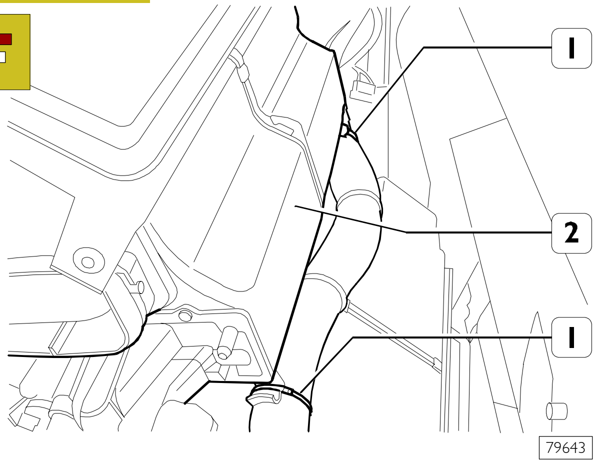
Figure 99



Perform detaching procedure on:

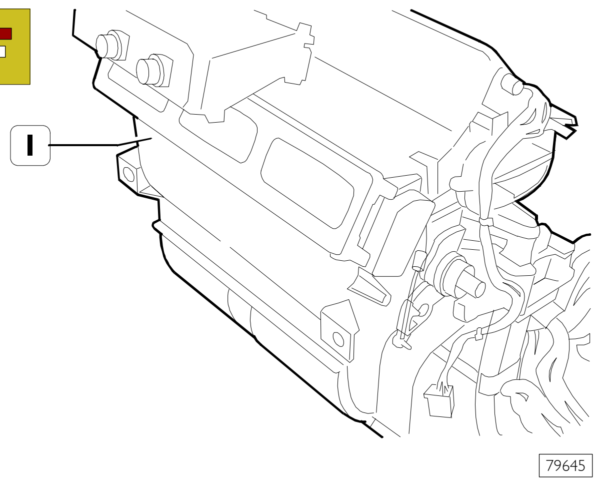
- instrument panel (1) (OP. 553710);
- middle instrument panel (2) (OP. 553710);
- instrument panel covering (3) (OP. 552211);
- remove interfering parts.

Figure 100



- Operate from heater (2) rear side and disconnect electric cable bundle check clamps (1).

Figure 101



- Remove vehicle heating and ventilation unit (1).

Refitting

Perform heating and ventilation unit re-attaching operations inverting described detaching operations.

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SECTION 13

Service plan

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EXTRA PLAN OPERATIONS	3
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EXTRA-PLAN OPERATIONS	4
SCHEDULED MAINTENANCE OPERATION	7
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EXTRA-PLAN MAINTENANCE	12
EP1 SERVICE	12
EP2 SERVICE	13
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SERVICING

Service plan

The checks, maintenance interventions and adjustments required at regular frequency on vehicle parts to ensure optimal working conditions are illustrated on the following pages.

The engine lubricant frequency in kilometres refers to a percentage of sulphur in fuel lower than 0.5%.
NOTE: halve the oil replacement frequency if fuel with a percentage of sulphur higher than 0.5% is used.

Engine lubricant oil - ACEA E5 (URANIA LD5)

- ❑ In the case lower class lubricant is used, for example ACEA E2 (Urania Turbo), halve the oil replacement frequency.
- ❑ Change the engine lubricant oil in any case every 12 months in the event of very low distance, less than 800 hours/80,000 kilometres per year.
- ❑ Change the transmission and axle oil at least once every two years in the event of very low yearly distances.
- ❑ Carry out the general greasing procedure at least once a year in the event of very low yearly distances.

SERVICE FREQUENCY

<table>
<tr><th>Type of use</th><th>M1</th><th>M2</th><th>M3</th><th>M4</th><th>EP1</th><th>EP2</th><th>EP3</th><th>EP4</th><th>EP5</th></tr>
<tr><td>Long distance hauls: national or international, mainly motorway</td><td>80,000 km/ 3200 hours</td><td>160,000 km/ 6400 hours</td><td>240,000 km/ 9600 hours</td><td>480,000 km/ 19200 hours</td><td rowspan="2">40,000 km</td><td rowspan="3">6 months</td><td rowspan="3">1 year</td><td rowspan="3">2 years</td><td rowspan="3">3 years</td></tr>
<tr><td>Short-to-medium distance hauls: regional or interregional</td><td>60,000 km/ 2400 hours</td><td>120,000 km/ 4800 hours</td><td></td><td>240,000 km/ 9600 hours</td></tr>
<tr><td>Demanding use, mainly in city traffic: tippers, compactors, road cleaning services, distribution, off-road.</td><td>40,000 km/ 1600 hours/ 1 year</td><td>80,000 km/ 3200 hours/ 2 years</td><td></td><td>160,000 km/ 6400 hours/ 4 years</td><td>800 hours</td></tr>
</table>

M1, M2, M3, M4: PLANNED SERVICE OPERATIONS

EP1, EP2, EP3, EP4, EP5: EXTRA PLAN OPERATIONS

EXTRA PLAN OPERATIONS

The Extra Plan (EP) operations are additional service interventions, which are complementary with respect to standard servicing, to be carried out at regular time or distance frequencies referred to options not fitted in all vehicles.

Extra plan operations (to be carried out possibly at the same time as a planned service operation)

EPI
EVERY 20,000 km or 800 hours - for urban or off-road use.
EVERY 40,000 km - for long, medium or short distance hauls.

- Change automatic transmission filter and oil.
- Remove-refit and clean automatic transmission oil breather.

EP2
EVERY 6 MONTHS - particularly at the beginning of spring

- Clean radiator curtain.

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EP3

EVERY YEAR

- Replace pneumatic system drier filter.

EVERY YEAR - **before winter**

- Check coolant density
- Replace supplementary heater fuel filter.

EVERY YEAR - **before summer**

- Check conditioner coolant conditions through the gauge.

EP4

EVERY TWO YEARS

- Replace air cleaner cartridge and clean container.
- Change engine coolant.

EP5

EVERY THREE YEARS

- Replace oil and bleed hydraulic clutch system.

SCHEDULED MAINTENANCE OPERATIONS

		M1	M2	M3	M4
-	Cab tilting, opening and closing radiator cowling engine guard disjoining – re-joining	●	●	●	●
-	Handling operations	●	●	●	
-	Functional testing on road	●	●	●	
-	Checking cooling system piping tightness	●	●	●	
-	General chassis greasing	●	●	●	●
1	Replacing blow – by filters	●	●	●	●
12	Checking clutch hydraulic system fluid level	●	●	●	●
10	Checking brake disks and shoe wear	●	●	●	●
5	Check of brake shoe wear (26t)	●	●	●	●
13	Checking headlight aiming		●		●
11	Checking steering articulated joint and steering column linkage		●		●
6	Replacing mechanical gearbox oil		●		●
9	Replacing axle hub oil		●		●
4	Replacing rear axle oil		●		●
7	Cleaning mechanical gearbox oil breather		●		●
3	Cleaning rear axle oil breather		●		●

EXTRA-PLAN OPERATIONS

		EP1	EP2	EP3	EP4	EP5
-	Replacing automatic gearbox filter and oil	●				
-	Disjoining–re-joining and cleaning automatic gearbox oil breather	●				
14	Cleaning radiator curtain		●			
2	Replacing pneumatic system dryer filter			●		
15	Checking engine coolant density			●		
8	Replacing cartridge and cleaning air filter container				●	
15	Replacing engine coolant				●	
12	Replacing oil and bleeding clutch hydraulic system					●

Figure 1

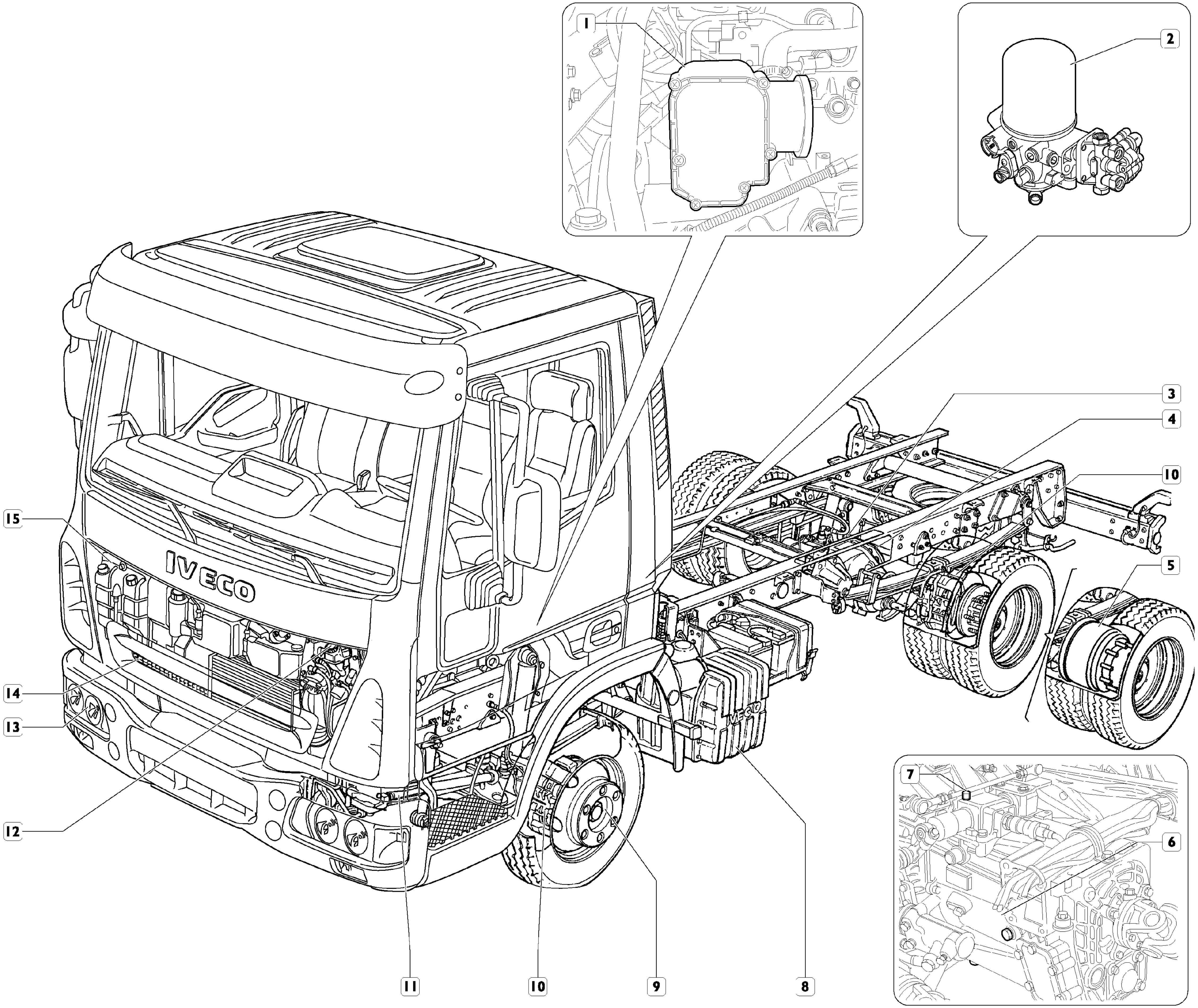
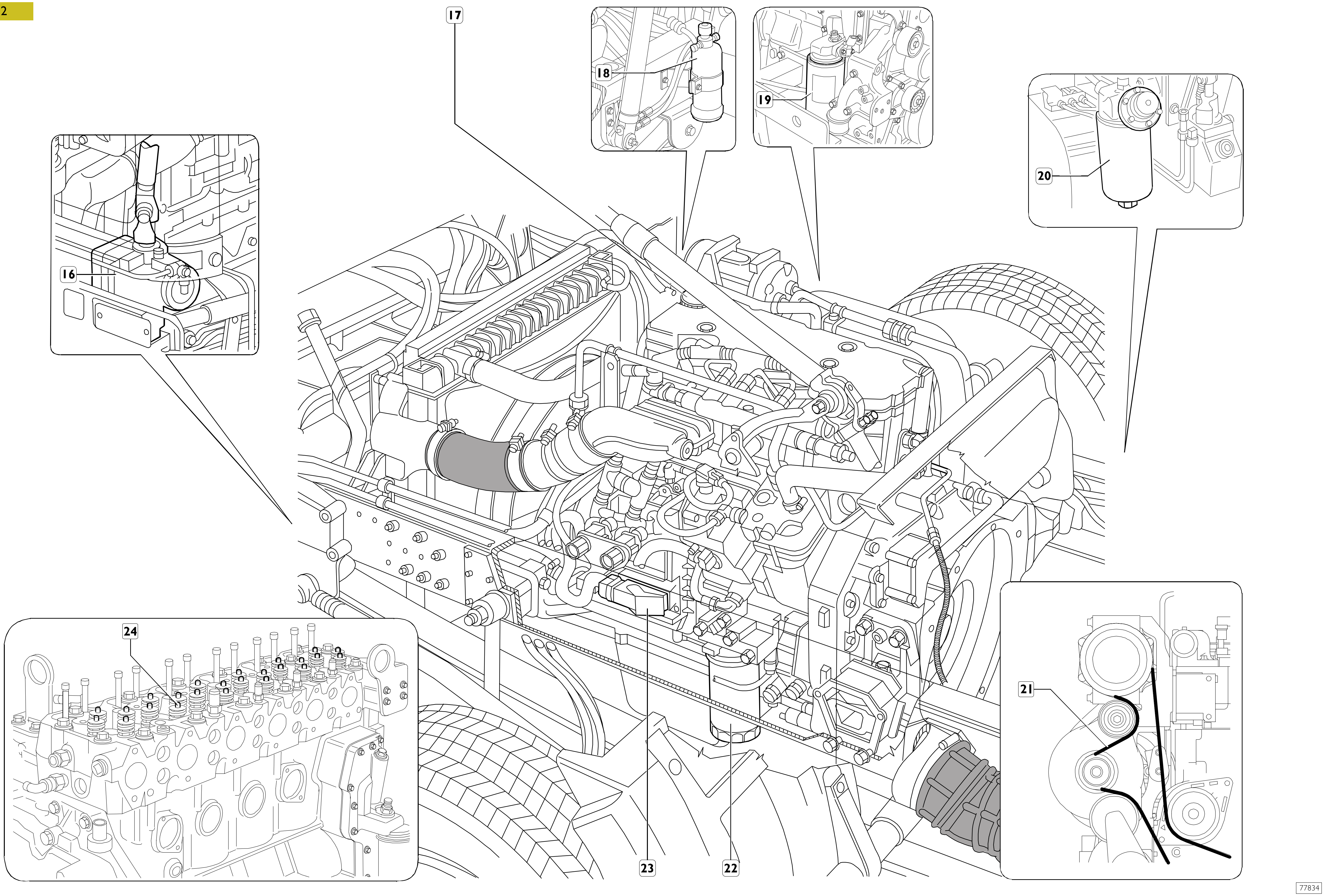


Figure 2



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SCHEDULED MAINTENANCE OPERATIONS

		M2	M2	M3	M4
17	Replacing engine oil	●	●	●	●
19	Replacing engine oil filter	●	●	●	●
21	Checking conditions of different control belts	●	●	●	●
22	Replacing fuel filter		●		●
20	Replacing fuel pre-filter		●		●
16	Checking steering box and support fixing		●		●
21	Replacing belts of different controls			●	●
24	Checking valve backlash and possible adjustments			●	●
23	Check-up engine EDC system by means of MODUS or IT 2000			●	●

EXTRA-PLAN OPERATIONS

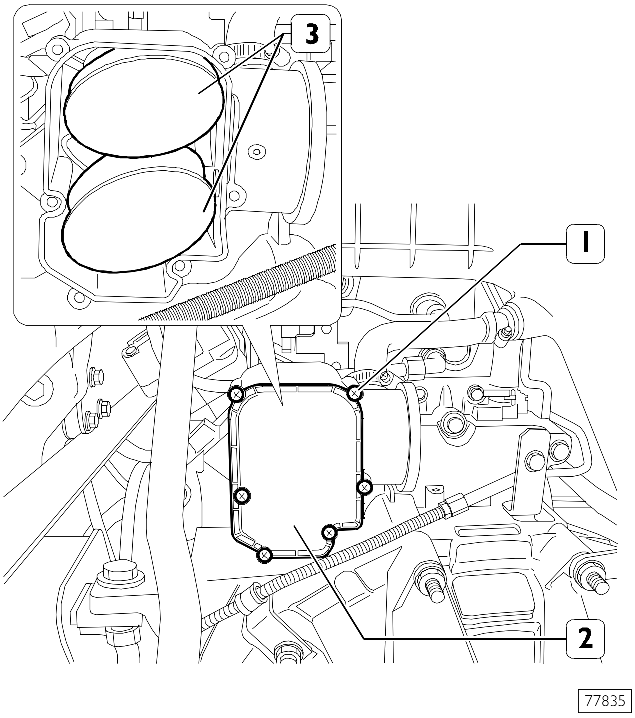
		EP1	EP2	EP3	EP4	EP5
18	Check conditioning system cooling fluid conditions by means of display.			●		
-	Replacing additional heater fuel filter			●		

M1 SERVICE

- **Handling operations**
- **Functional testing on road**
- **General chassis greasing**
- **Checking cooling system and hydraulic brake pipe seal**

1 – Replace the blow-by filters

Figure 3



Unscrew the 6 screws (1) and remove cover (2).

Remove blow-by filters (3).

Before assembling the new filters clean their housing.

5 - Checking wear of brake shoes (26 t)

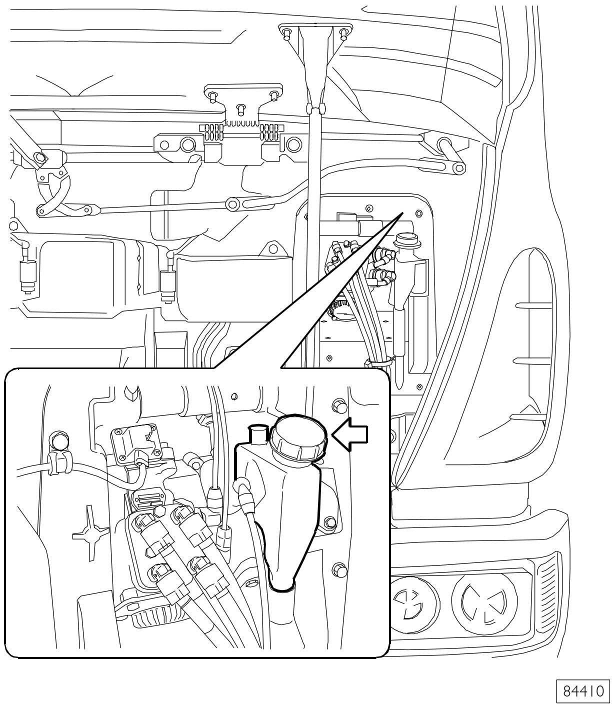
If you find too much wear, replace the worn components as described in the relevant section ''BRAKES''.

10 - Checking wear of discs, pads

If you find too much wear, replace the worn components as described in the relevant section ''BRAKES''.

12 - Check clutch hydraulic system fluid level

Figure 4



Check the level of the clutch fluid. Top it up if it is too low (see the fluids table in the GENERAL section).

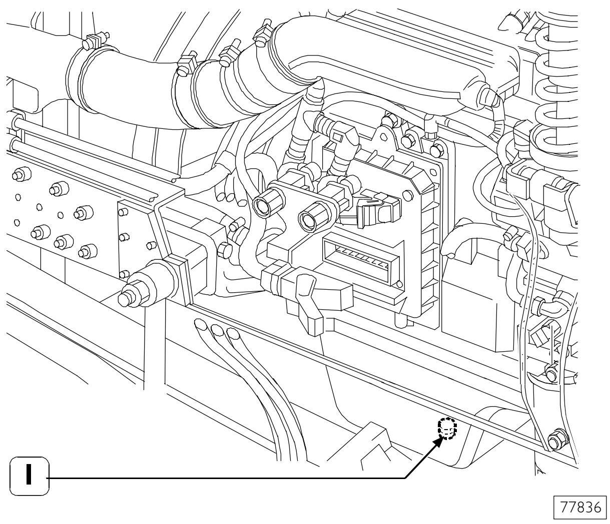
> ⚠ The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

17 - Changing engine oil

Take out the oil level dipstick .

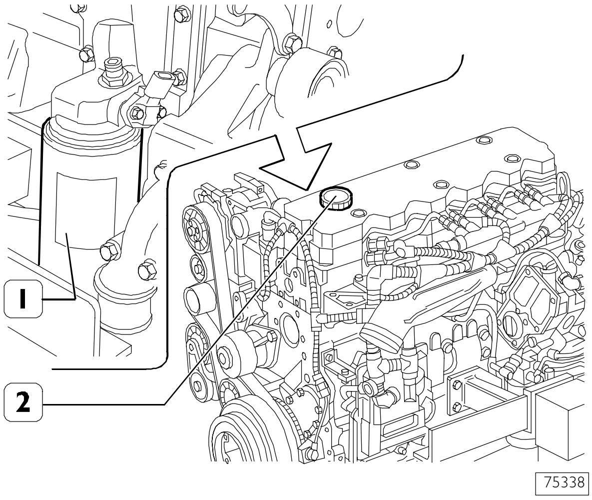
Remove the plug (1) from the oil sump and drain the engine oil off into a specific container.

Figure 5



19 - Changing engine oil filters

Figure 6



Remove the oil filter (1) with tool 99360314.

> ⚠ Before refitting the new cartridges, moisten the seal with engine oil.

Screw the oil filter (1) on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

Screw the plug back on under the sump and tighten it to the required torque.

Pour oil into the engine through the filling-pipe (2) of the required grade and quantity (see fluids table in the GENERAL section).

21 - Checking miscellaneous drive belts

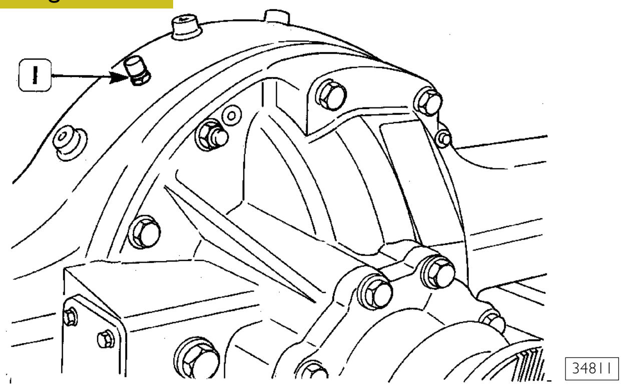
See that the belts are not worn or deteriorated; if they are, replace them as described under the relevant headings.

M2 SERVICE

> ⚠ The M2 service comprises the operations of the M1 service plus the ones listed here.

3 - Clean axle breather (26 t)

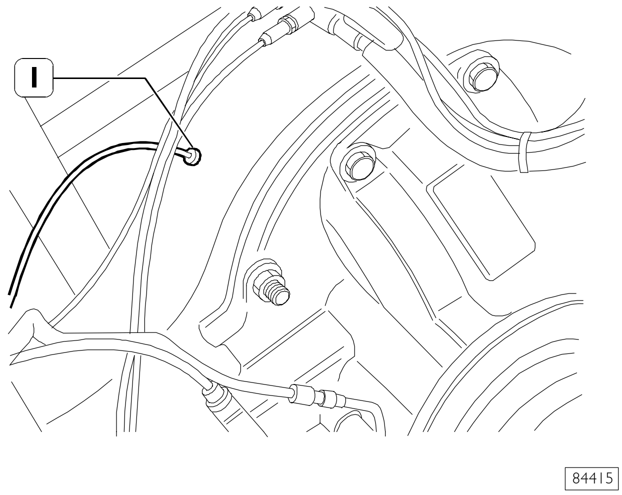
Figure 7



Remove the oil vapour breather (1) and clean it thoroughly. Mount it, making sure it is in the right position and tighten it to the prescribed torque.

3 - Clean axle breather (12-18 t)

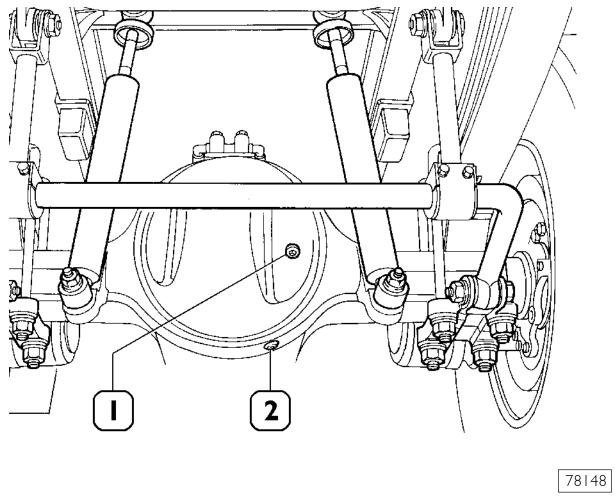
Figure 8



Remove the oil vapour breather (1) and clean it thoroughly. Mount it, making sure it is in the right position and tighten it to the prescribed torque.

4 - Changing rear axle oil

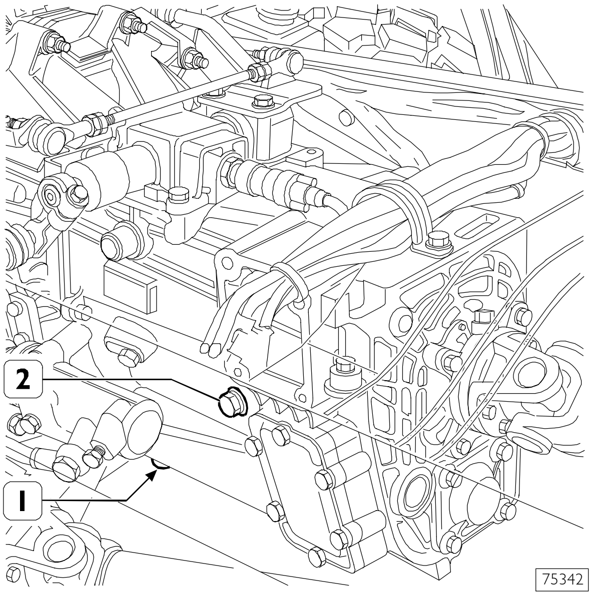
Figure 9



- ❑ With the axle warm, drain off the oil into a specific container by taking out the plug (2).
- ❑ Replenish with fresh oil through the hole closed by the plug (1) (see the FLUIDS section under the heading GENERAL INFORMATION).
- ❑ Clean the rear axle oil vapour breather.
- ❑ Tighten the plugs to the prescribed torque.

6 - Replace mechanical transmission oil

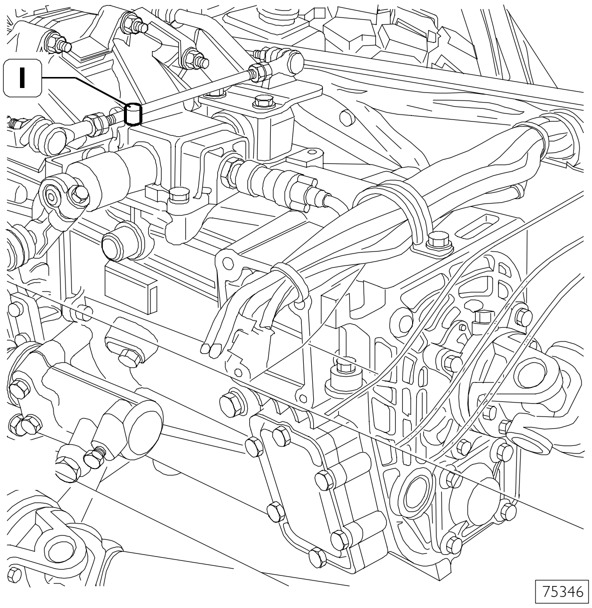
Figure 10



The lubricating oil must be drained off while it is warm. Place a container under the plug (1). Take out the plug and drain off the oil. Fit the plug (1) back on. Unscrew the filler cap (2) and replenish the gearbox with lubricating oil in the quantity and grade prescribed in the GENERAL INFORMATION section.

7 - Clean mechanical transmission oil breather

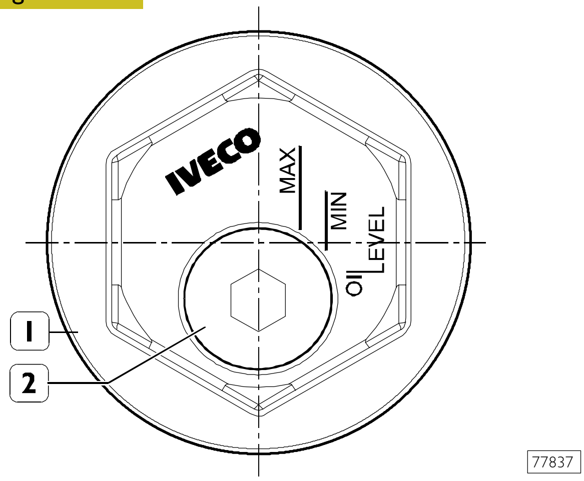
Figure 11



Remove the oil vapour breather (1) and clean it thoroughly. Mount it, making sure it is in the right position and tighten it to the prescribed torque.

9 - Replace hub oil (axle 5845)

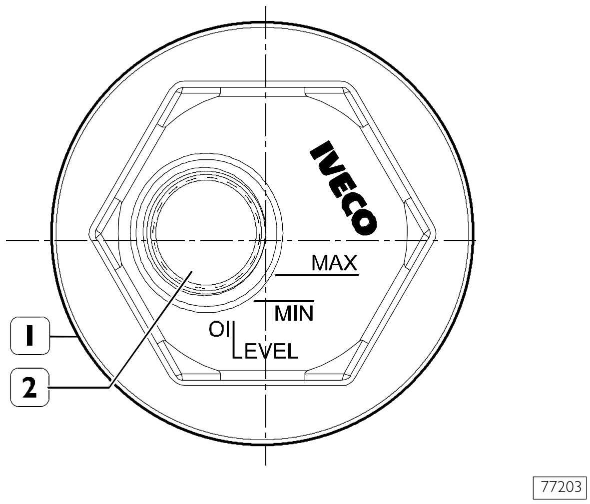
Figure 12



Replace oil as follows:

- ❑ Turn wheel hub until when the hub cover (1) is positioned as shown in Figure 12.
- ❑ Unscrew plug (2) and drain oil into a special container.
- ❑ Use a syringe to suck the remaining oil.

Figure 13



- ❑ Turn wheel hub until when the hub cover (1) is positioned as shown in Figure 12.
- ❑ Fill in the set quantity of new oil through filling hole (2) (see CHARACTERISTICS AND DATA).
- ❑ Screw back plug (2, Figure 12) to the set torque.

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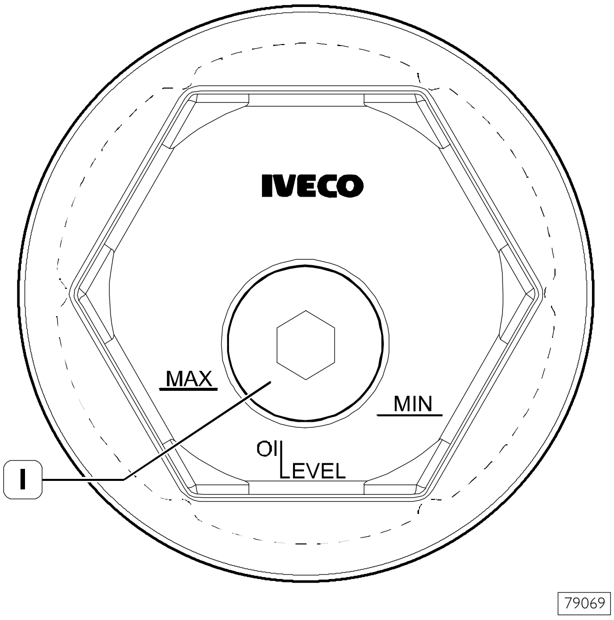
9 - Replace hub oil (axle 5842/5-5851/5-5871/5)

Figure 14



- ❑ Unscrew plug (1).
- ❑ Use a special syringe to suck.
- ❑ Fill in the set quantity of new oil through filling hole (see CHARACTERISTICS AND DATA).
- ❑ Screw back plug (1) to the set torque.

11 - Checking steering column articulation and linkage

Steering control linkage

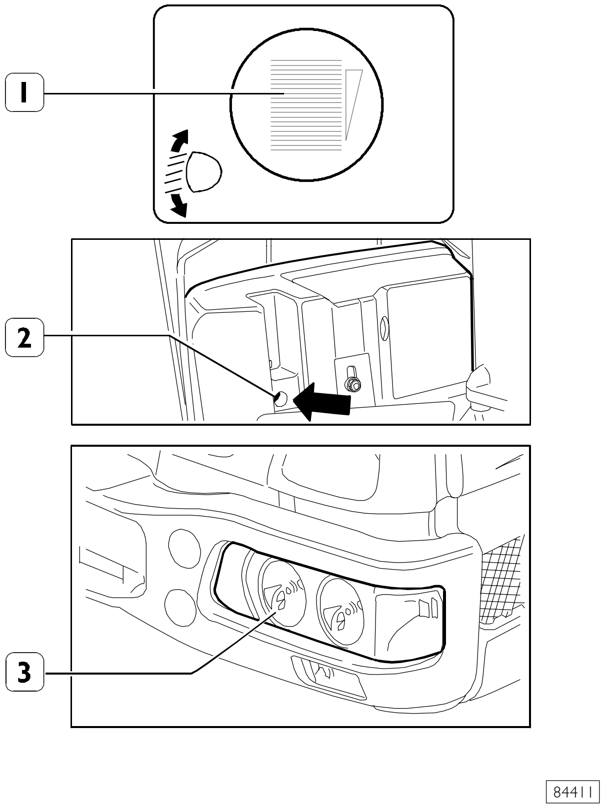
- ❑ Check that the screws and nuts fixing the clamps to the tie rods have not deteriorated and are tightened to the required torque.
- ❑ The tie rods must not be damaged and the threaded portion must be integral.

Ball joints

- ❑ Clean the ball joints of the tie rods.
- ❑ This must be done with dry rags or raw cotton; use no solvents.
- ❑ Check that the ball joints, in their components, have no points of corrosion with sections of depth greater than 1 mm. In particular, check the sheet metal cover close to the rolled section.
- ❑ Check the protective casing: it has to be secured to the body and to the pin of the articulation with the split ring and it must not turn.
- ❑ The casing must be neither deteriorated nor damaged.
- ❑ Manually crush the protective casings and check that lubricating grease comes out.
- ❑ Check that the nuts and split pins are not deteriorated.

13 - Checking headlight adjustment

Figure 15

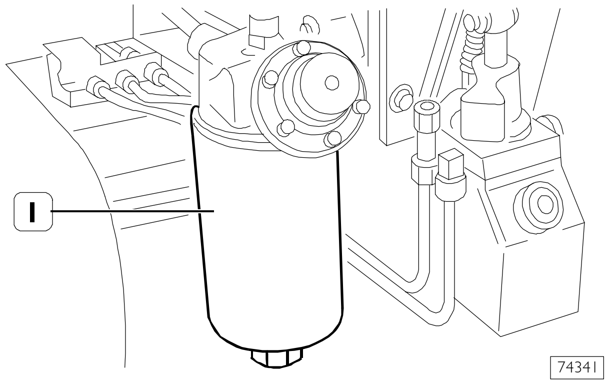


- ❑ Switch (1) for vertical adjustment of light beam (3) (available on the dashboard).
- ❑ With the cab tilted, act on screw (2) for horizontal adjustment of light beam (3).

16 - Checking steering box fixing and mounting

20 - Changing fuel pre-filter

Figure 16



Unscrew the pre-filter (1) and replace it.

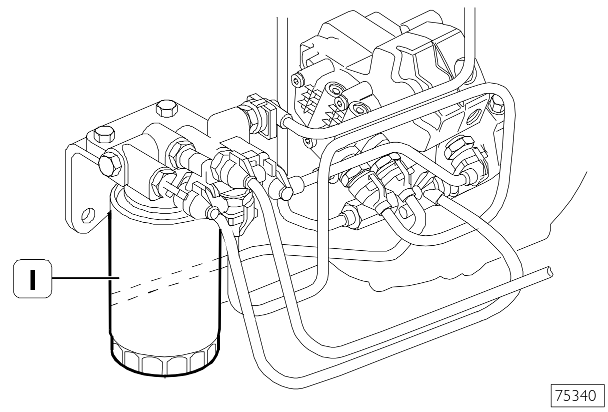
Before refitting the new cartridge, moisten the seal with diesel or engine oil.

Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

> ! When replacing the cartridge, it must not have been pre-filled. This is to prevent impurities getting into circulation that could damage the system components, injectors/pump.

22 - Changing fuel filter

Figure 17



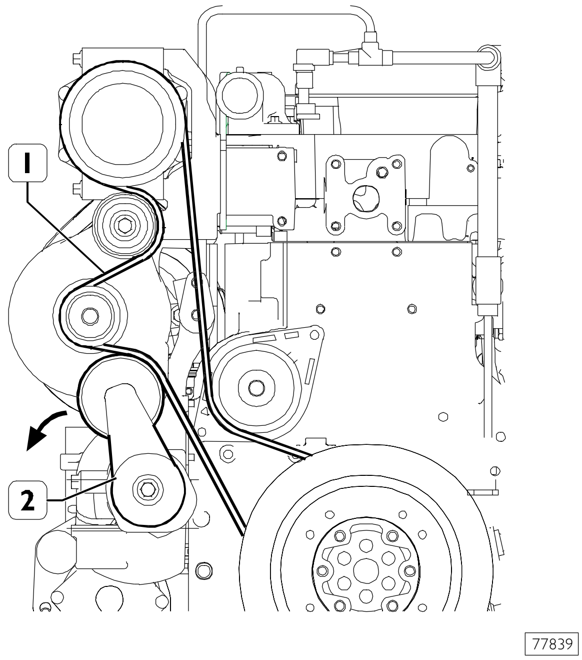
Remove the fuel filter (1) with tool 99360314.
Before refitting the new cartridge, moisten the seal with diesel or engine oil.
Screw the new one on by hand, taking care to check that the rubber seal and the mating surface are clean and in a perfect state of repair. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

M3 SERVICE

> ! The M3 service comprises the operations of the M1 and M2 services plus the ones listed here.

21 - Changing miscellaneous drive belts

Figure 18



To remove and fit the belt (1) back on, you need to use an appropriate tool on the tightener (2) in the direction shown by the arrow.

> ! The tighteners are automatic, so they are not to be adjusted after assembly.

23 - EDC system check-up using MODUS or IT2000

24 - Checking valve clearance and adjustment if necessary

To perform these operations correctly, proceed as described under "ENGINE" in the relevant section.

EXTRA-PLAN MAINTENANCE

EP1 SERVICE

- ❑ Replace filter and automatic transmission oil
- ❑ Disconnect – reconnect and clean automatic transmission oil breather

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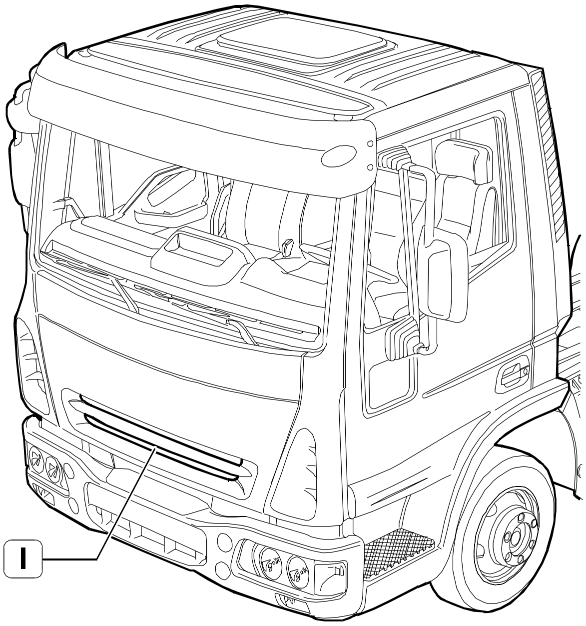
EP2 SERVICE

14 - Cleaning the radiator shade

Figure 19

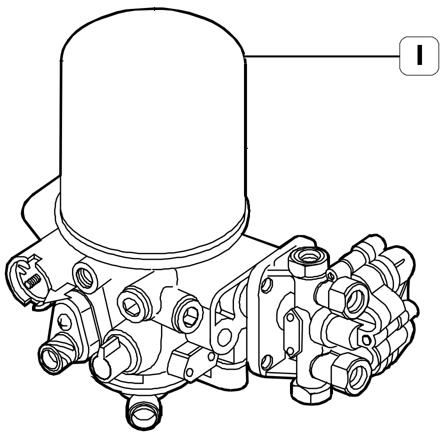


Remove any dirt from the radiator shade (1) to let air flow towards the radiator.

EP3 SERVICE

2 - Changing pneumatic system drier filter

Figure 20

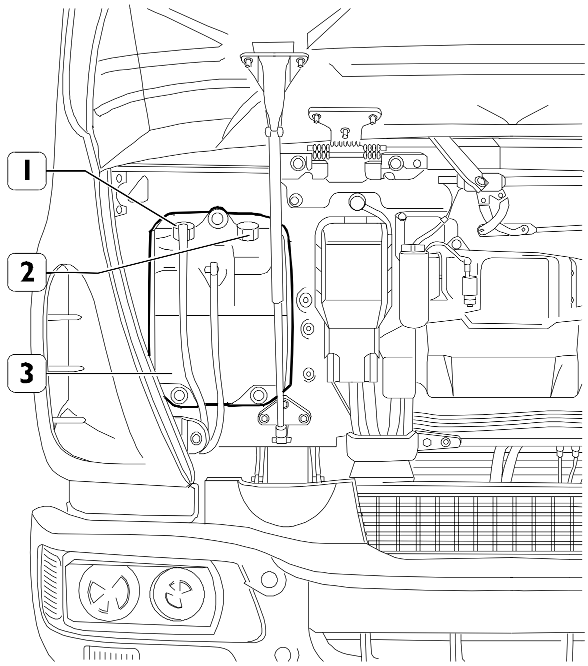


Discharge the pressure of the compressed air system.

Unscrew the drier filter (1) and change it; tighten it to the prescribed torque, checking there is no air leakage when pressure is restored.

15 - Checking density of antifreeze in the engine coolant

Figure 21



> ⚠ The plug (1) must never be taken out for any reason whatsoever.
> With the engine warm, the cooling system is in overpressure, therefore take care when taking off the cap (2).

Take off the cap (2) and draw off a sample of the coolant from the expansion tank (3) with the densimeter 99395858.

Depending on the temperature of the liquid, check the percentage of antifreeze in the liquid on the scale of the instrument. The percentage has to be higher than 40% and must not exceed 50%.

If necessary, restore the percentage of antifreeze, bearing in mind that the liquid needs to be replaced every 2 years.

> ⚠ For vehicles fitted with an additional heater, the percentage of antifreeze must never exceed 50%.

18 - Checking the state of the air-conditioning system refrigerant

Should gas be replaced, the quantity must be 1020 ± 20 g.

- ❑ Replace additional heater fuel filter.

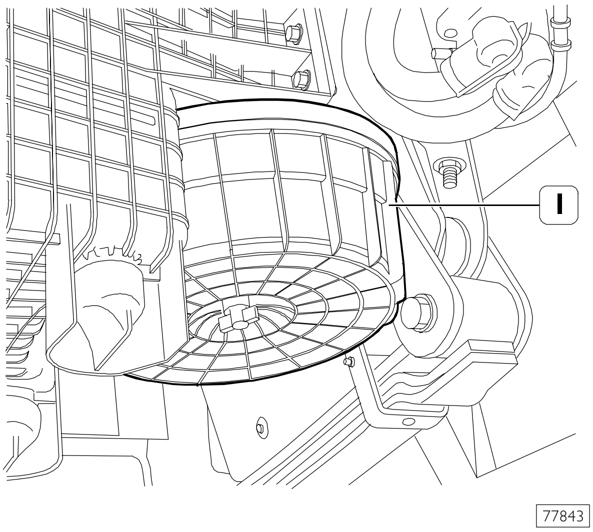
EP4 SERVICE

8 - Changing the cartridge of the dry air filter and cleaning its container (even if no clogging signalled)

Once a year (servicing with frequency in hours)

Once every two years (servicing with frequency in km)

Figure 22



- Operate on fastening/s and remove cover (1).
- Take the cartridge out of the air filter.

Before fitting the new cartridge, clean its housing thoroughly.

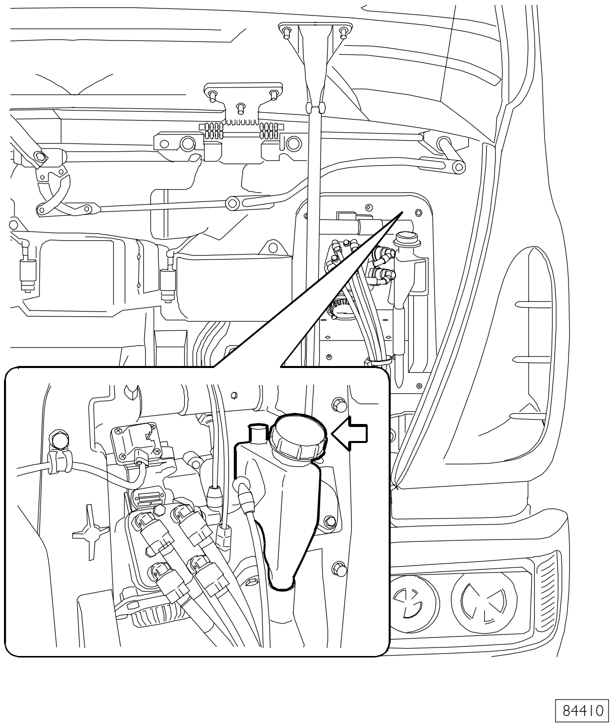
15 - Replace engine coolant

Carry out the procedure described under the relevant heading in the "ENGINE" section.

EP5 SERVICE

12 - Replace oil bleed clutch hydraulic system

Figure 23



Drain off the clutch control fluid and change it (see Fluids table in GENERAL section).

> ⚠ The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

Then proceed with air bleeding from the clutch control hydraulic circuit by suitably operating on the bleeding valve placed on the deaerator device operator cylinder 99306010.

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