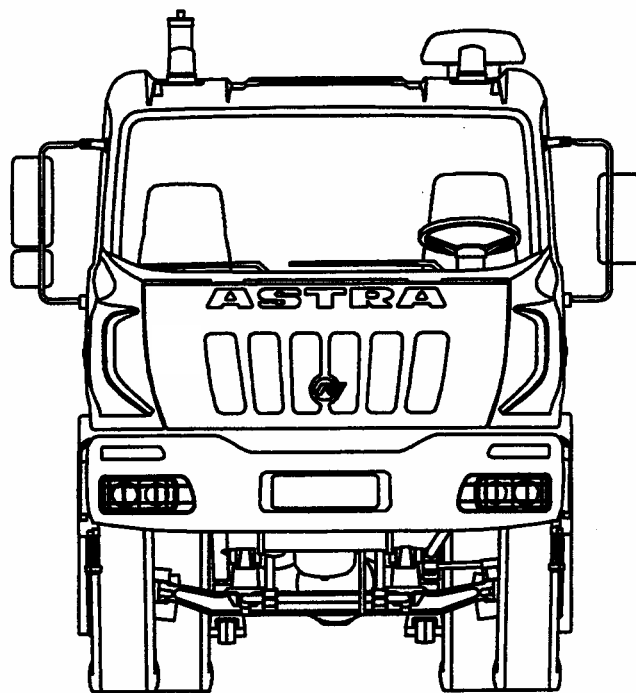


WORKSHOP MANUAL

H&DE **C**



The Company ASTRA VEICOLI INDUSTRIALI reserves the right to make any modifications to vehicles for technical or commercial reasons at any time; the information, descriptions and illustrations contained in this publication are therefore updated at the time of approval for printing.

This Workshop Manual deals with optional equipment which cannot be present on your vehicle, and alternative equipment as well (e.g. mechanical and automatic gearbox).

Moreover, the regulations in force in certain countries affect the standard equipment of the vehicle.

This publication could therefore contain information and illustrations not corresponding to the vehicle version provided on a particular market.

ASTRA Veicoli Industriali

Product Logistics

Via Caorsana, 79 - 29100 PIACENZA (Italy)

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INTRODUCTION

SECTION I

SECTION I

Introduction

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PREFACE

Definitions adopted in the current Manual

The Company ASTRA VEICOLI INDUSTRIALI, Via Caorsana, 79 - 29100 PIACENZA (Italy) is hereinafter called *Manufacturer*.

The current WORKSHOP MANUAL is hereinafter called *Manual*.

The equipment dealt with in the current Manual is hereinafter called *vehicle*.

The operator directly or indirectly involved in vehicle repair is hereinafter called *operator*.

Introduction

The current Manual applies essentially to authorised workshop technical staff.

This Manual provides technical information but cannot replace a thorough professional experience.

This Manual contains all data and information required to perform correct checking and setting up operations as well as repair and overhaul operations.

Read this Manual right through before performing any operation on the vehicle.

Compliance with the provided information and the use of the recommended tools guarantee correct repair and avoid damages to operators.

You will frequently see that parts of the text are highlighted as shown below:



Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause injury.



Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause damage to the vehicle.



Procedures, technical information and precautions which must be highlighted.



Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause environmental damages.

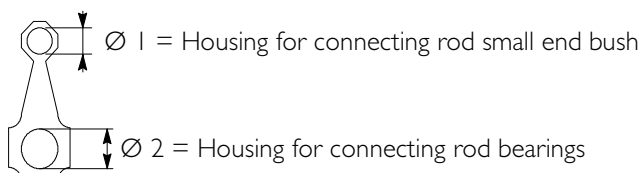
This Manual has been divided into Sections, each of which has a number and its relevant contents are indicated in the Index of Sections.

Each section features a main Unit (e.g.: engine, gears, etc.)

Where possible, the same sequence of procedures has been followed for easy reference.

Diagram and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with (see next page) instead of giving descriptions of some operations or procedures.

Example:



Tighten to torque
Tighten to torque + angular value

Graphs and symbols

	Removal Disconnection		Intake
	Re-fitting in place Connection		Exhaust
	Removal Dis-assembly		Operation
	Fitting in place Assembly	ρ	Compression ratio
	Driving torque		Tolerance Weight difference
	Driving torque + angular value		Rolling torque
	Press or Caulk		Replacement Original spare parts
	Regulation Adjustment		Rotation
	Caution Note		Angle Angular value
	Visual check Fitting position check		Preload
	Measurement Value to find Check		Number of revolutions
	Equipment		Temperature
	Face for machining Machine finish		Pressure
	Interference Strained assembly	$>$	Oversized Greater than .. Maximum, peak
	Thickness Clearance	$<$	Undersized Less than... Minimum
	Lubrication Damp Grease		Selection Classes Oversizing
	Sealant Adhesive		Temperature < 0° C Cold Winter
	Air bleeding		Temperature > 0° C Hot Summer

MEASURES (INTERNATIONAL SYSTEM)**Force in N (Newton)****Conversion:**

$$1 \text{ N} = 0,1019 \text{ kg}$$

$$1 \text{ kg} = 9,81 \text{ N}$$

Power in kW (kilowatt)

Other units in use:

HP (Horsepower)

Conversion:

$$1 \text{ kW} = 1,36 \text{ CV}$$

$$1 \text{ kW} = 1,34 \text{ HP}$$

$$1 \text{ CV} = 0,736 \text{ kW}$$

$$1 \text{ CV} = 0,986 \text{ HP}$$

$$1 \text{ HP} = 0,746 \text{ kW}$$

$$1 \text{ HP} = 1,014 \text{ CV}$$

Torque in Nm (Newton/metre)**Conversion:**

$$1 \text{ Nm} = 0,1019 \text{ kgm}$$

$$1 \text{ kgm} = 9,81 \text{ Nm}$$

$$1 \text{ kgm} = 10 \text{ Nm} *$$

Specific consumption in g/kWh (grams per kilowatt-hour)

Other unit in use:

g/CVh (grams per horsepower-hour)

Conversion:

$$1 \text{ g/kWh} = 0,736 \text{ g/CVh}$$

$$1 \text{ g/CVh} = 1,36 \text{ g/kWh}$$

Pressure in kPa (kilopascal)

Other units in use:

kg/cm² (kilograms per square centimeter)

Atm (metric atmosphere)

psi (pounds per square inch)

Conversion:

$$1 \text{ kg/cm}^2 = 1 \text{ Atm}$$

$$1 \text{ kg/cm}^2 = 98,1 \text{ kPa}$$

$$1 \text{ kg/cm}^2 = 0,981 \text{ bar}$$

$$1 \text{ kg/cm}^2 = 1 \text{ bar} *$$

$$1 \text{ kg/cm}^2 = 14,22 \text{ psi}$$

$$1 \text{ bar} = 100 \text{ kPa}$$

$$1 \text{ bar} = 1,02 \text{ kg/cm}^2$$

$$1 \text{ bar} = 14,51 \text{ psi}$$

$$1 \text{ psi} = 6,9 \text{ kPa}$$

$$1 \text{ psi} = 0,069 \text{ bar}$$

$$1 \text{ psi} = 0,0703 \text{ kg/cm}^2$$

$$1 \text{ kPa} = 0,145 \text{ psi}$$

$$1 \text{ kPa} = 0,0102 \text{ kg/cm}^2$$

$$1 \text{ kPa} = 0,01 \text{ bar}$$

Conversion values for British units

$$0,1 \text{ mm} = 3,937 \text{ mils}$$

$$1 \text{ mm} = 0,039 \text{ inch}$$

$$1 \text{ m} = 3,281 \text{ ft.}$$

$$1 \text{ km} = 0,621 \text{ miles}$$

$$1 \text{ cm}^3 = 0,061 \text{ cu. in.}$$

$$1 \text{ l} = 1,759 \text{ pts (0,88 imp.qts)}$$

$$1 \text{ bar} = 14,5038 \text{ psi}$$

$$1 \text{ g} = 0,035 \text{ oz. (0,564 dr.)}$$

$$1 \text{ kg} = 2,205 \text{ lbs.}$$

(in case of differences in temperature $1^\circ\text{C} = 1.8^\circ\text{F}$)

(*) Nm and bar are converted according to the ratios 10:1 and 1:1.

STANDARD TIGHTENING TORQUES

Screws and nuts with metric thread

Diameter x Pitch d x p (mm)	SCREW – CLASS 8.8				SCREW – CLASS 10.9				SCREW – CLASS 12.9			
	UN- COATE D	DACRO- MET GAL- VANISED	CADIUM PLATED	PHOSPHA- TE COA- TED	UN- COATE D	DACRO- MET GAL- VANISED	CADIUM PLATED	PHOSPHA- TE COATED	UN- COATE D	DACRO- MET GAL- VANISED	CADIUM PLATED	PHOSPHA- TE COATED
3 x 0,5	0,12	0,12	0,11	0,09	0,17	0,16	0,15	0,13	0,21	0,19	0,18	0,15
4 x 0,7	0,28	0,26	0,24	0,20	0,39	0,37	0,34	0,29	0,47	0,44	0,41	0,35
5 x 0,8	0,56	0,52	0,48	0,40	0,79	0,74	0,67	0,57	0,94	0,88	0,80	0,68
6 x 1	1,0	0,9	0,8	0,7	1,3	1,3	1,2	1,0	1,6	1,5	1,4	1,2
8 x 1,25	2,3	2,2	2,0	1,7	3,3	3,1	2,8	2,3	3,9	3,7	3,3	2,8
8 x 1	2,5	2,4	2,1	1,8	3,5	3,3	3,0	2,5	4,3	4,0	3,6	3,0
10 x 1,5	4,7	4,4	4,0	3,3	6,5	6,1	5,6	4,7	7,9	7,4	6,7	5,6
10 x 1,25	5,0	4,7	4,2	3,5	7,0	6,5	5,9	4,9	8,4	7,9	7,1	5,9
12 x 1,75	8,0	7,5	6,8	5,7	11,3	10,6	9,6	8,0	13,6	12,7	11,5	9,6
12 x 1,25	9,0	8,4	7,5	6,2	12,6	11,8	10,6	8,7	15,1	14,1	12,7	10,4
14 x 2	12,8	12,0	10,9	9,1	18,0	16,9	15,3	12,8	21,6	20,2	18,4	15,3
14 x 1,5	14,1	13,1	11,9	9,7	19,8	18,5	16,7	13,6	23,8	22,2	20,0	16,4
16 x 2	19,8	18,5	16,8	13,9	27,9	26,1	23,6	19,5	33,5	31,3	28,3	23,4
16 x 1,5	21,5	20,0	18,0	14,6	30,2	28,2	25,3	20,6	36,3	33,8	30,4	24,7
18 x 2,5	27,2	25,4	23,1	19,2	38,2	35,8	32,4	27,0	45,8	42,9	38,9	32,4
18 x 1,5	31,4	29,2	26,2	21,1	44,1	41,1	36,8	29,7	53,0	49,3	44,2	35,7
20 x 2,5	38,4	36,1	32,7	27,0	54,3	50,8	46,0	38,0	65,2	61,0	55,2	45,6
20 x 1,5	43,9	40,9	36,5	29,4	61,7	57,5	51,4	41,3	74,1	68,9	61,6	49,5
22 x 2,5	53,9	49,0	44,6	36,2	75,9	68,8	62,8	51,0	91,0	82,6	75,3	61,1
22 x 1,5	59,0	54,8	48,9	39,1	82,9	77,1	68,8	55,0	99,5	92,5	82,6	66,1
24 x 3	66,7	62,4	56,4	46,6	93,8	87,7	79,3	65,5	112,5	105,2	95,2	78,6
24 x 2	74,2	69,1	61,9	50,0	104,4	97,2	87,1	70,3	125,3	116,7	104,5	84,4
27 x 3	98,7	92,2	83,1	68,2	138,8	129,6	116,9	95,9	166,5	155,5	140,2	115,0
27 x 2	108,4	100,8	90,1	72,4	152,4	141,8	126,7	101,8	182,9	170,2	152,1	122,2
30 x 3,5	133,7	124,9	112,7	92,8	188,0	175,6	158,5	130,5	225,6	210,7	190,2	156,5
30 x 2	151,6	141,0	125,8	100,6	213,2	198,2	176,9	141,5	255,9	237,9	212,2	169,8
Maximum tightening torques for metric threads in daNm												

GENERAL SPECIFICATIONS

SECTION 2

SECTION 2

General specifications

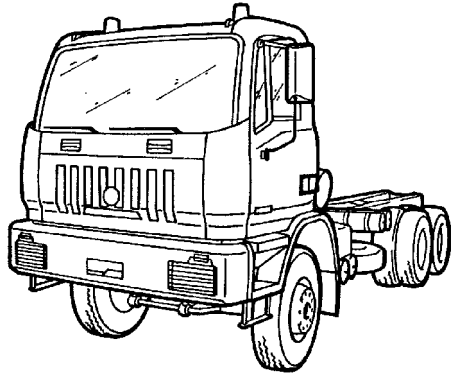
	Page
COMPOSITION OF THE MODEL	3
POSITION OF VEHICLE IDENTIFICATION DATA	4
☐ Model identification plate	4
☐ Chassis	4
☐ Manufacturer's plate	4
POSITION OF ASSEMBLY IDENTIFICATION DATA	6
☐ Engine	6
☐ Engine dependent power take-off	6
☐ Gearbox I 6 S I 620 TD	6
☐ Gearbox I 6 S 2320 TD	6
☐ Distributor-reducer (transfer)	7
☐ Front and rear drive axles	7
☐ Power steering boxes	8
☐ Cab	8
LUBRICANT AND HYDRAULIC FLUID TABLES	9

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UNITS \ MODELS				4x4		6x4		6x6		8x4	
				HD8 44.36	HD8 44.42	HD8 64.38	HD8 64.42	HD8 66.38	HD8 66.42	HD8 84.38	HD8 84.42
ENGINE	F3B WG (380 CV)			o		o		o		o	
	F3B VG (420 CV)				o		o		o		o
CLUTCH			Single disc 17"		o	o	o	o	o	o	o
MAN. GEAR BOX	MECHANICAL		ZF 16 S 1620TD	o		o		o		o	
			ZF 16 S 2320TD		o		o		o		o
TRANSFER			TC 1800	o				o			
			TC 2200		o				o		
AXLE			ASTRA 9820				o	o		o	o
FRONT DRIVE AXLE	1st FRONT		D 1385 AE 032/5985		o	o			o	o	
	SINGLE REAR		R 8284 B027 (451391/1)		o	o					
	TANDEM REAR		INTERMEDIATE R 9189 BB033 (453291)				o	o	o	o	o
			REAR R 8298 B052 (453291)				o	o	o	o	o
HYDRAULIC POWER STEERING			ZF 8098.955		o	o	o	o	o	o	
			ZF 8099.955								o
4x4 = Two axle vehicles with front axle and rear driving axle.											
6x4 = Three axle vehicles with two rear driving axles.											
6x6 = Three axle vehicles with front axle and two rear driving axles.											
8x4 = Four axle vehicles: first and second steering axles, third and fourth driving axles											

POSITION OF VEHICLE IDENTIFICATION DATA

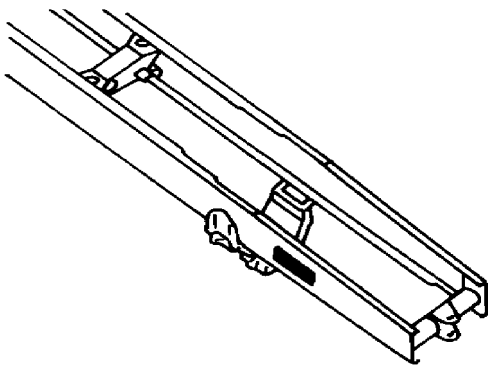
Figure 1



Model identification plate

Located on the side walls of the cab.

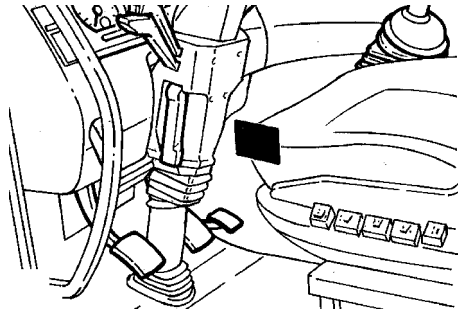
Figure 2



Chassis

Punch marked at the front end of the right-hand side member:
(see following page)

Figure 3



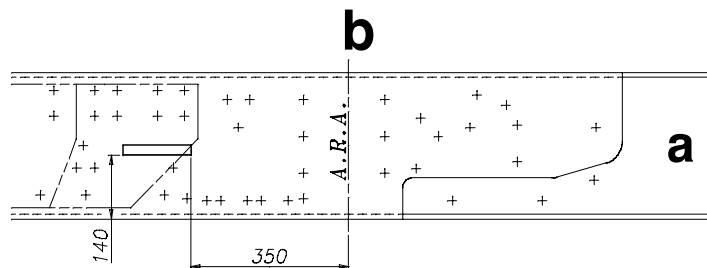
Manufacturer's plate

Data for vehicle identification according to EEC regulations, on the left-hand side of the engine cover:
(see following page)

Chassis punching

- 1) right side member – front end
- 2) rear axle – front leaf spring

Figure 4



Vehicle registration number

- 1) World-wide identification of manufacturers (Astra Veicoli Industriali S.p.A.)
- 2) Type of vehicle
- 3) Vehicle features
- 4) Year of construction: (Y=2000; I=2001; 2=2002; 3=2003; g=2009; A=2019; ecc.)
- 5) Production facility (P=Piacenza)
- 6) Chassis number

Figure 5

ZCNXXXXXXAP000000

(1) (2) (3) (4) (5) (6)

Vehicle identification plate

- 1) Type approval number markings
- 2) Vehicle chassis punch markings
- 3) Overall vehicle weight
- 4) Overall tractor + trailer/semitrailer weight
- 5) Maximum admissible weight 1st axle
- 6) Maximum admissible weight 2nd axle
- 7) Maximum admissible weight 3rd axle
- 8) Maximum admissible weight 4th axle
- 9) Maximum admissible weight on fifth wheel (tractor versions only)
- 10) Vehicle commercial denomination
- 11) Axle spacing
- 12) Engine type
- 13) Engine power
- 14) Number of axles
- 15) Grade of smoke

Figure 6

⊕ ASTRA VEICOLI INDUSTRIALI S.P.A. ⊕	
1	
2	
3	kg
4	kg
5	1- kg
6	2- kg
7	3- kg
8	4- kg
9	5- kg
10	Type N. of axles
11	Wheelbase Corrected absorption value
12	Engine type Engine power kW 13
Made in ITALY	
⊕ 9819 5350 ⊕	
ASTRA V.I.	

14

15

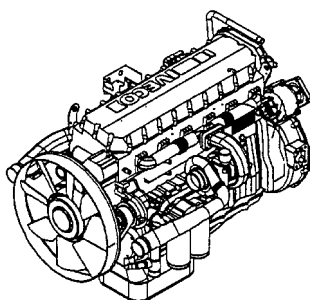
POSITION OF ASSEMBLY IDENTIFICATION DATA

Main assemblies mounted on vehicle are identified by a serial number which can be found on the concerned assembly in the positions shown on drawings.



Assembly identification data must always be indicated when ordering spare parts.

Figure 7

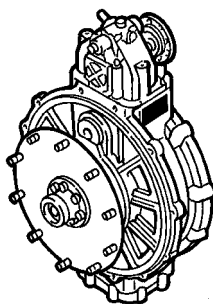


Engine

Engine type and serial number are shown on engine plate.

☐ engine F3BWG

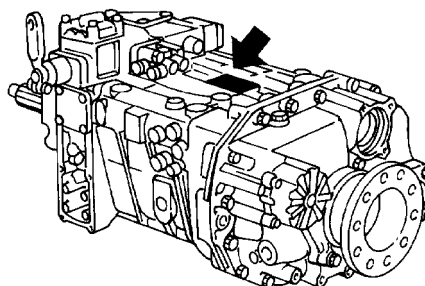
Figure 8



Engine dependent power take-off

Power take-off type and serial number are shown on power take-off box plate.

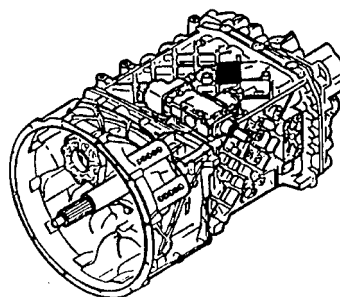
Figure 9



Gearbox I6S I620 TD

Gearbox type and serial number are shown on gearbox plate.

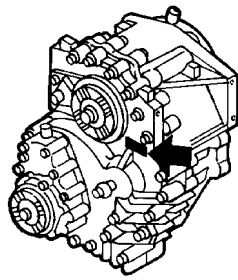
Figure 10



Gearbox I6S 2320 TD

Gearbox type and serial number are shown on gearbox plate.

Figure 11

**Distributor-reducer (transfer)**

Transfer type and serial number are shown on transfer case plate

Figure 12

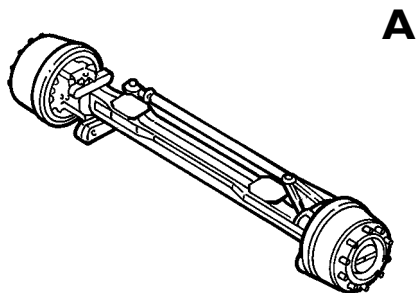


Figure 13

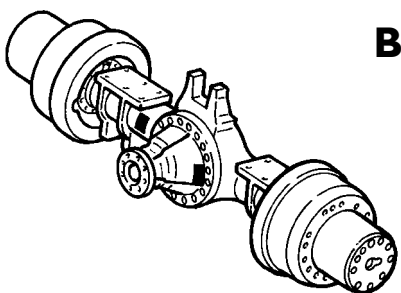


Figure 14

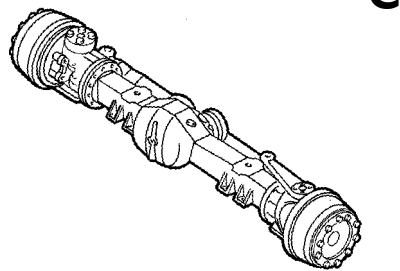
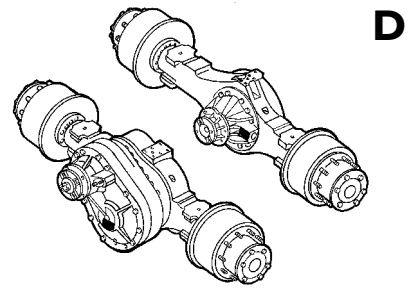


Figure 15

**Front and rear drive axles**

Axle type and serial number are shown on axle casing.

- ☐ axles (A)
- ☐ front axle (B)
- ☐ single rear axle (C)
- ☐ tandem rear axles

Figure 16

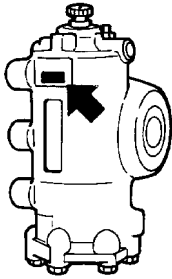
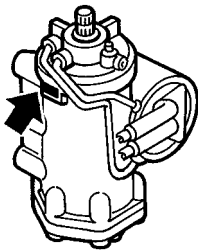
**A**

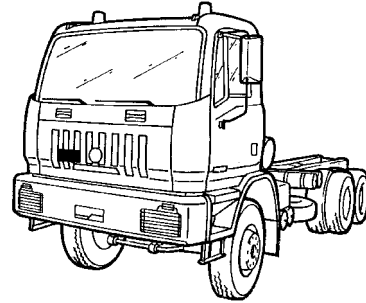
Figure 17

**B****Power steering boxes**

Power steering type and serial number are shown on power steering box plate.

- ☐ 2-axle and 3-axle vehicles (A)
- ☐ 4-axle vehicles (B)

Figure 18

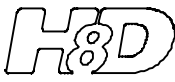
**Cab**

- ☐ Two-seater cab

LUBRICANT AND HYDRAULIC FLUID TABLES

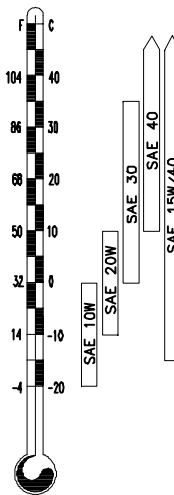


FL Italia





LUBRICANT AND HYDRAULIC FLUID TABLES

ORGAN TO BE LUBRICATED		QUANTITY KG LT		REPLACE HRS.	REQUESTED SPECIFICATIONS		RECOMMENDED LUBRICANTS	ENGINE OIL SAE GRADES
* ENGINE OIL SUMP (+ FILTRES)	ENGINE F2B	20,7 (+2,3)	23 (+2,5)	400	MIL-L-2104E lev. API CF4	ACEA E2	URANIA TURBO	
	ENGINE F3B	25,2 (+2,3)	28 (+2,5)	800 Each year	MIL-L-2104E lev. API CF	ACEA E3 e/o E5	URANIA LD5	
GEARBOX WITH ZF INTARDER		15,3	17	1600 Each year	IN ALTERNANCE WITH BOTH ENGINE			
GEARBOX WITH PTO ZF NMV221	16S2XXX	11,7	13		MIL-L-2104E lev.		URANIA ^c SAE 30	
GEARBOX WITH ZF INTARDER AND PTO ZF NMV221		16,7	18,5		MIL-L-2104 C/D/E		URANIA C	
GEARBOX WITH CONVERTER ZF WSK400	16 S 221		27,5		ATF DEXRON II D		TUTELA GI/A	
AUTOMATIC GEARBOX	6 HP 902	23,4	26		ZF TE-ML 02D		TUTELA TRUCK GEAR FE(SAE 75W80)	
SEMI-AUTOMATIC GEARBOX EUROTRONIC	12AS2301		12	240000 Km Every 2 years				
GEARBOX	16S1620	8,45	9,5	1600 Each year	MIL-L-2105 API GL 3		TUTELA ZC90 SAE 80W/90	
	16S2XXX	9,8	11					
INTEGRAL POWER TAKE-OFF		2,67	3					
TRANSFER	TC 1800	5,8	6,5	1600 Each year	ATF DEXRON II D		TUTELA GI/A	
	TC 2200	5,5	6,2					
FRONT AXLE		4,5	5	1600				
FRONT REDUCERS RACH		0,68	0,75		MIL-L-2105D API GL 5		TUTELA W140/M-DA SAE 85W/140	
INTERMEDIATE AXLES INCLUDING REDUCERS AND TRANSMISSION		24,6	27					
REAR AXLE INCLUDING FINAL DRIVE		14,6	16					
HYDRAULIC POWER STEERING	2/3 AXLES	7,4	8,5	4000	ATF DEXRON II D		TUTELA GI/A	
	4 AXLES	16,1	18					
CAB TILTING CONTROL		0,9	1	2400				
CLUTCH CIRCUIT		0,5	0,5	Each year	DOT4-NHTSA116 SAE J1703		TUTELA TRUCK DOT SPECIAL	
GENERAL GRESSING		—	—	100	N.L.G.I. 2		TUTELA MR2	

* For arctic climate (until -30°C) use URANIA FE 5W30 oil - Specification ACEA E4

▲ For arctic climate (until -30°C) use TUTELA LHM oil - Specification FIAT 9.55597 IVECO Std.18-1823

50041 8817

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ENGINE - F3B

SECTION 3

SECTION 3

Engine - F3B

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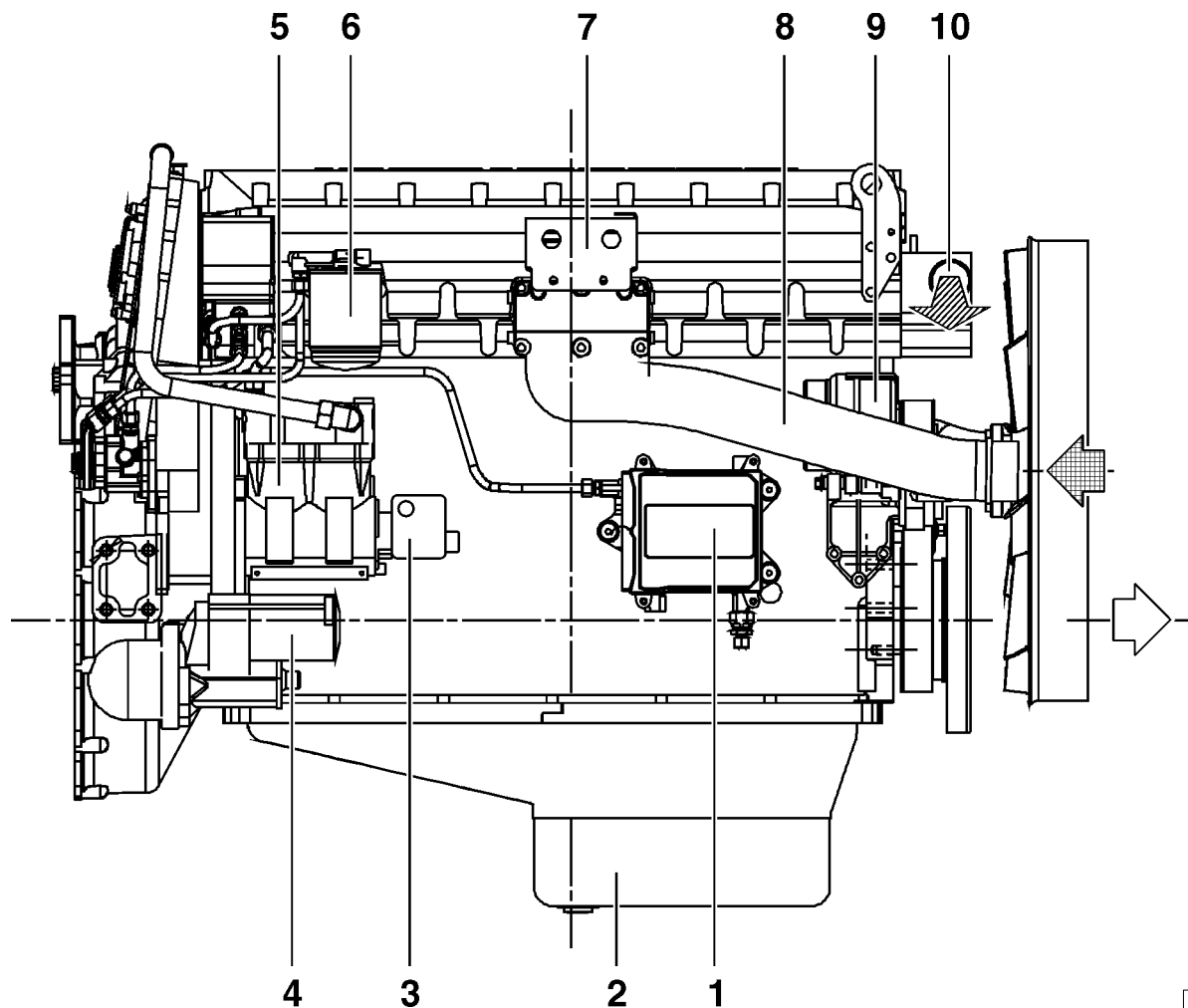
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VIEWS OF THE ENGINE

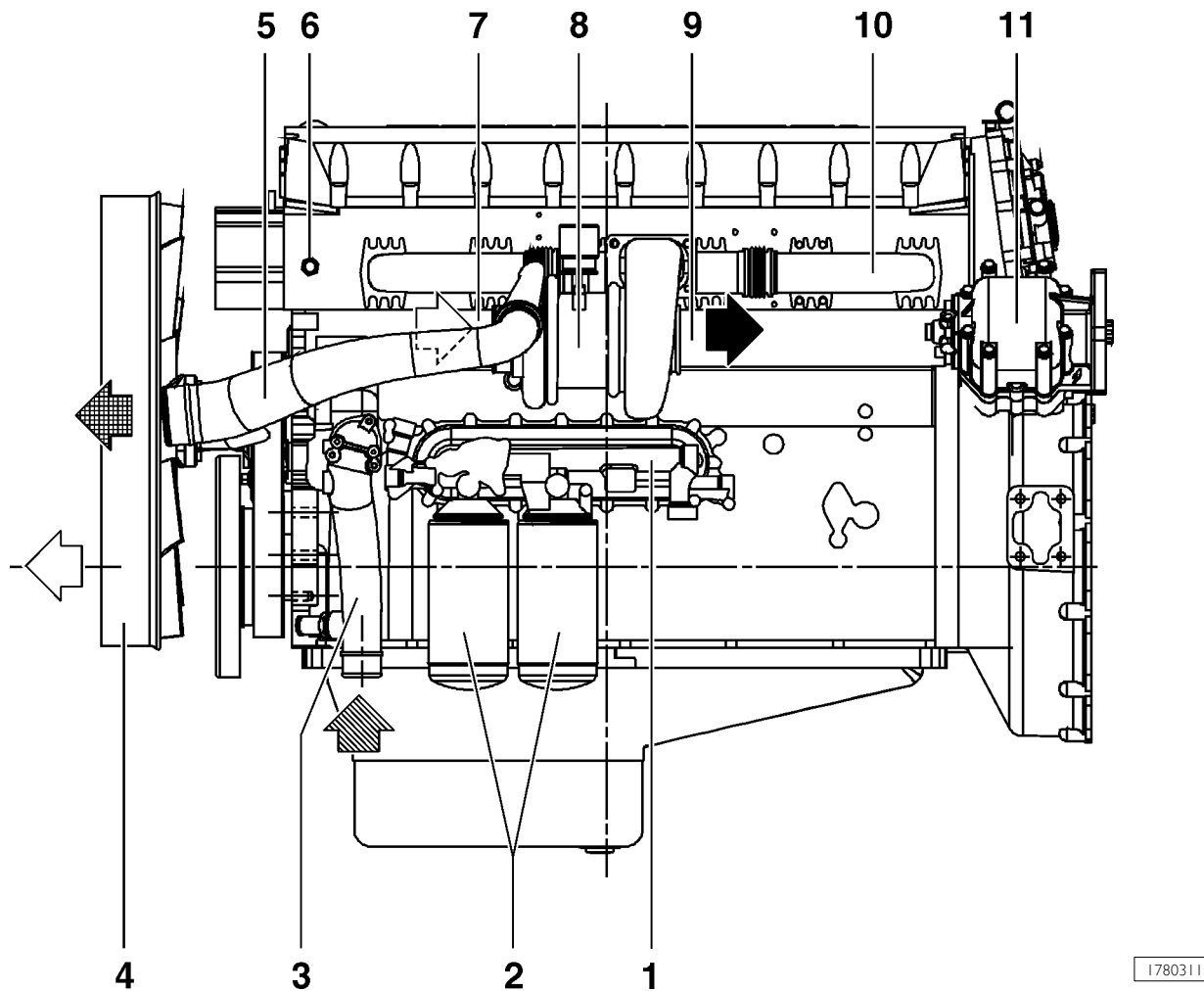
Figure 1



RIGHT SIDE

1. Engine control unit - 2. Oil sump - 3. Power steering pump on compressor - 4. Starting motor - 5. Air compressor - 6. Fuel filter on engine - 7. Engine stop and start controls - 8. Air return line from intercooler - 9. Alternator - 10. Water outlet to radiator

Figure 2

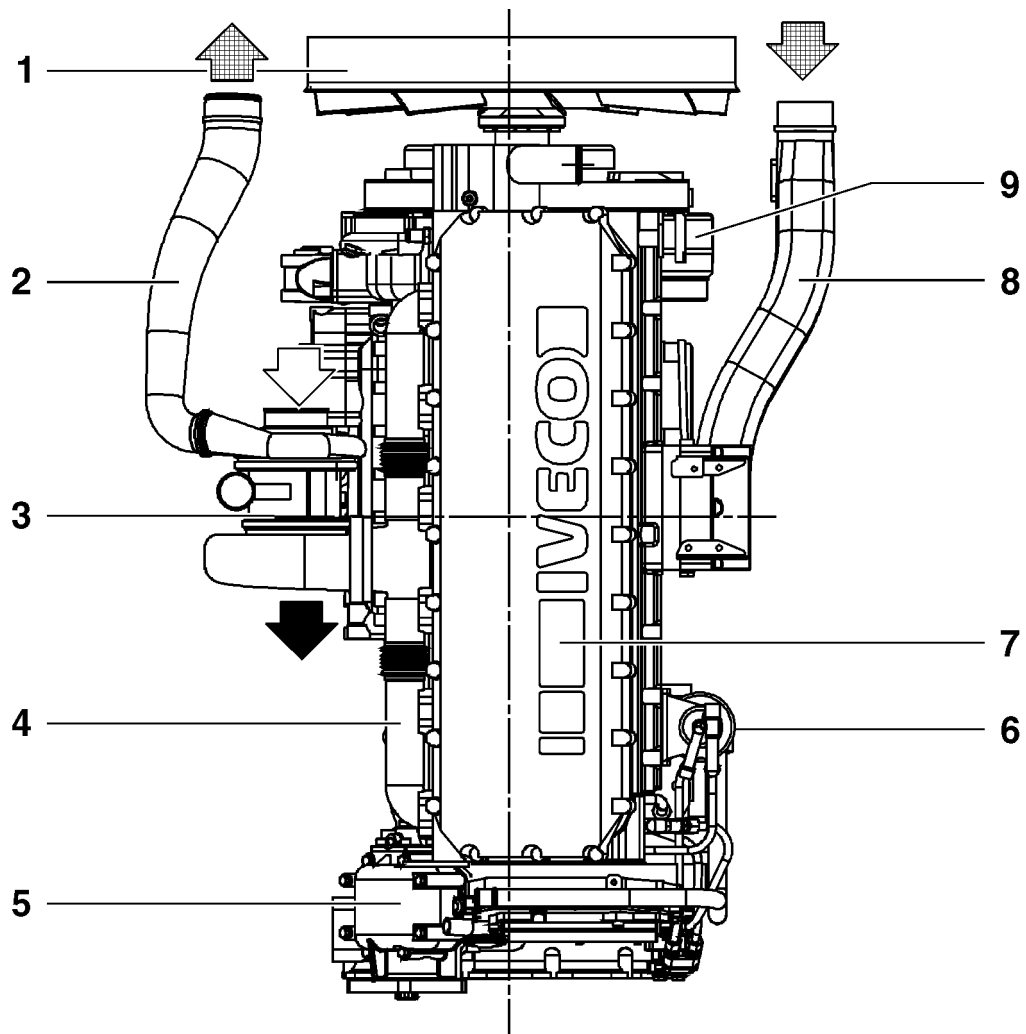


1780311

LEFT SIDE

1. Oil-water heat exchanger. - 2. Engine oil filter. - 3. Water delivery from radiator. - 4. Fan. - 5. Air delivery pipe to intercooler. - 6. Water delivery pipe to cab heater. - 7. Intake. - 8. Exhaust gas turbocompressor. - 9. Exhaust. - 10. Exhaust manifold. - 11. Power take-off (optional)

Figure 3

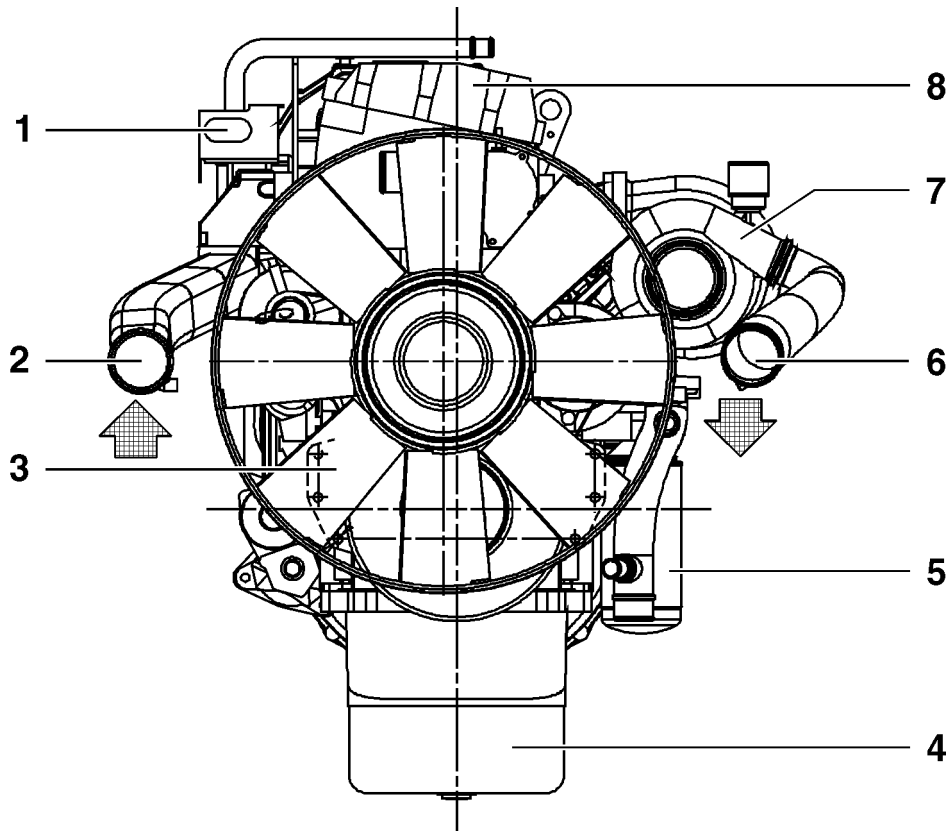


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TOP VIEW

1. Fan - 2. Air delivery pipe to intercooler - 3. Exhaust gas turbocompressor - 4. Exhaust manifold - 5. Power take-off (optional) - 6. Fuel filter on engine - 7. Distributor cap - 8. Air return pipe from intercooler - 9. Alternator

Figure 4

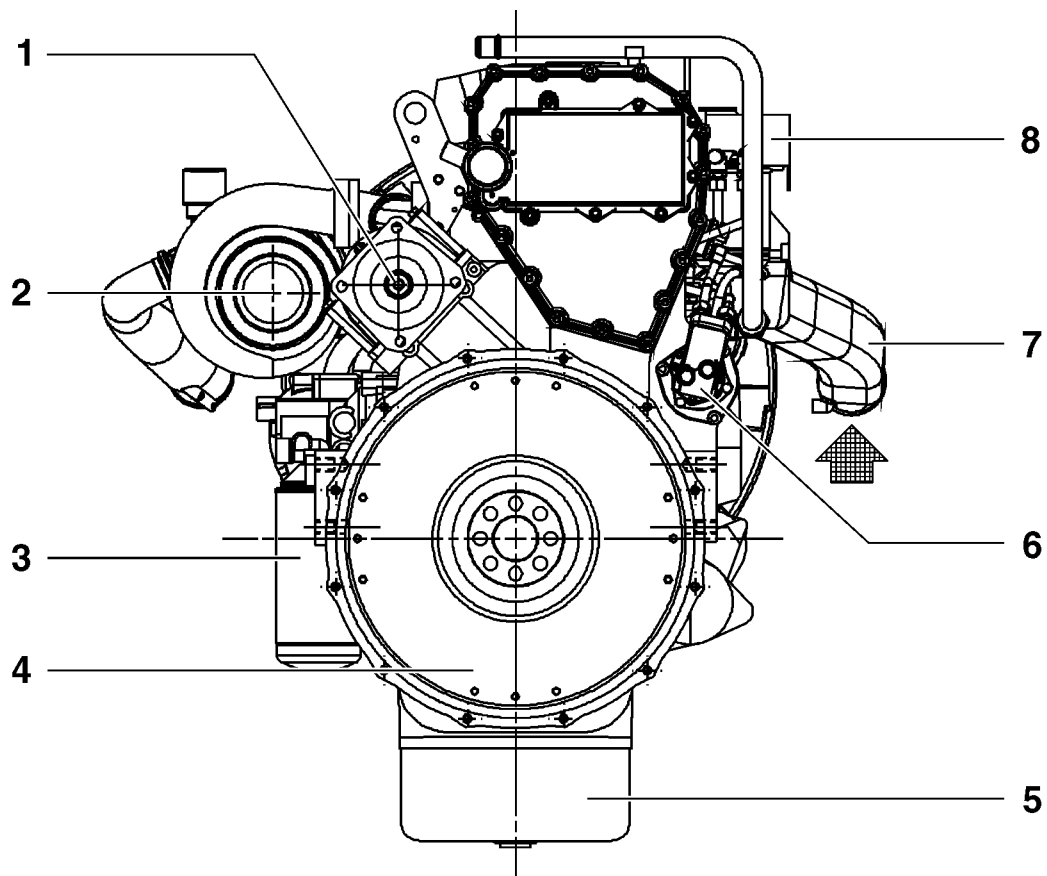


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FRONT VIEW

1. Engine start-stop command - 2. Air return pipe from intercooler - 3. Fan - 4. Oil sump - 5. Engine oil filter -
6. Air delivery pipe to intercooler - 7. Exhaust gas turbocompressor - 8. Distributor cap

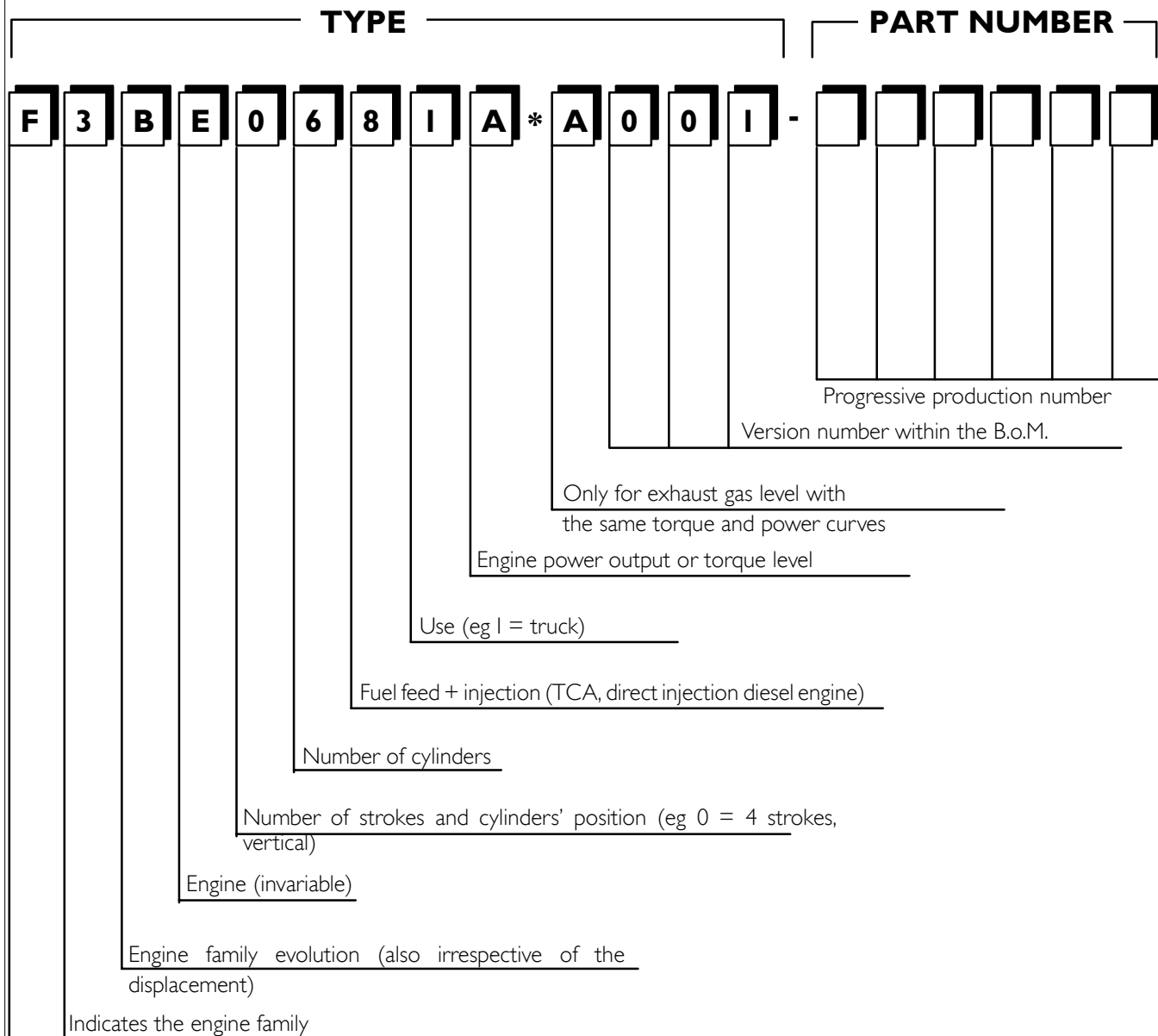
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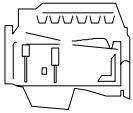
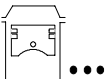
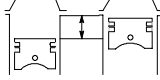
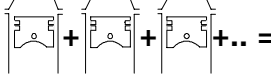
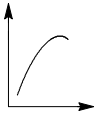
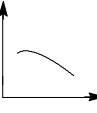
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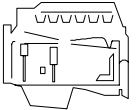
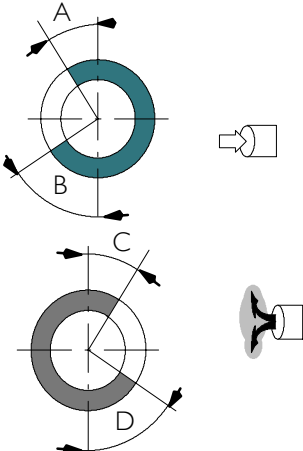
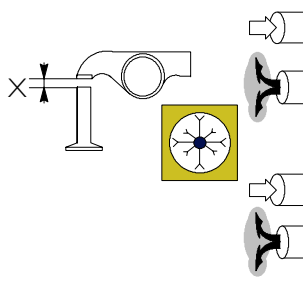
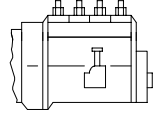
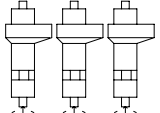
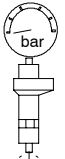
REAR VIEW

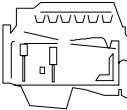
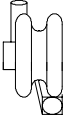
1. Power take-off (optional) - 2. Exhaust gas turbocompressor - 3. Engine oil filter - 4. Flywheel - 5. Oil sump - 6. Fuel pump - 7. Air return pipe from intercooler - 8. Engine start-stop command

TECHNICAL SPECIFICATION

GENERAL CHARACTERISTICS

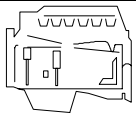
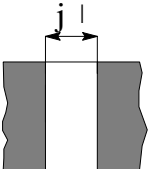
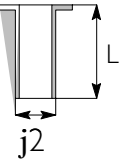
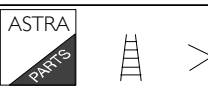
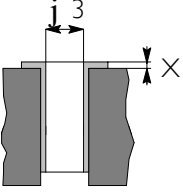
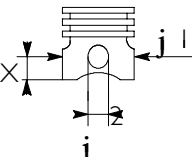
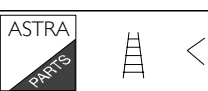
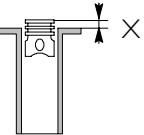
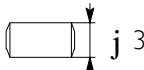
	Type	F3B		
	Cycle Feeding Injection	Diesel 4 strokes Turbocharged with aftercooler Direct		
	N. of cylinders	6 on-line		
	Diameter	mm	135	
	Stroke	mm	150	
	Total displacement	cm ³	12880	
	Compression ratio	16 ± 0.8		
	Max. power	kW (HP) rpm	WG	
	Max. power	kW (HP) rpm	284 380	313 420
	Max. power	kW (HP) rpm	1900	1900
	Max. power	kW (HP) rpm	1800 184 900 ÷ 1480	1900 194 900 ÷ 1500
	Engine idling speed, no load	rpm	600 ± 25	
	Maximum engine speed, no load	rpm	2400	

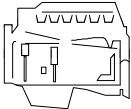
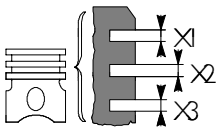
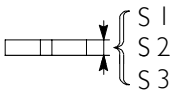
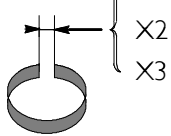
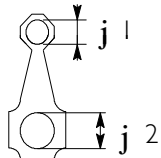
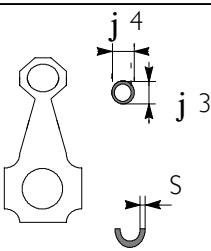
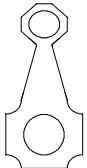
	Type	F3B	
	VALVE TIMING opens before T.D.C. A closes after B.D.C. B opens before B.D.C. D closes after T.D.C. C	17°	30°
	For timing check X { mm mm Running X { mm mm	—	—
	FEED	DIRECT INJECTION	
	Injection type Bosch	With electronically regulated injectors PDE 31 pump injectors controlled by overhead camshaft	
	Injection order	1 - 4 - 2 - 6 - 3 - 5	
	Injection pressure bar	1500	

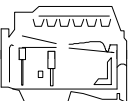
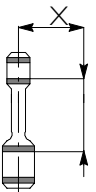
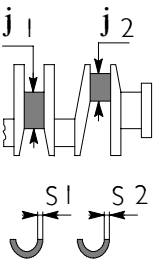
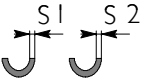
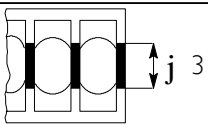
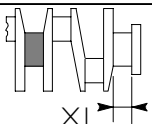
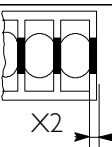
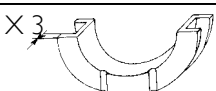
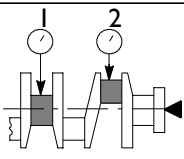
	Type	F3B WG
	SUPERCHARGING Turbocharger type	Holset Wastegate HX55W
COOLING	COOLING Water pump control Thermostat: starts to open: fully open:	By centrifugal pump, regulating thermostat, viscstatic fan, radiator and heat exchanger By belt N. 1 ~ 85 °C —
 	LUBRICATION Oil pressure, engine hot (100 °C ± 5 °C): at idling speed bar at maximum speed bar	Forced by gear pump, pressure control valve, oil filter 1.5 5
 Urania Turbo LD (according to ACEA and/or E5 standard) Urania Turbo (according to ACEA E2-96)	OIL FILLING (*)	
	Total capacity at 1st filling liters kg	35 25.5
	Capacity: - engine sump min level liters kg	20 18
	- engine sump max level liters kg	28 24,5
	- quantity in circulation that does not flow back to the engine sump liters kg	7 6.3
	- quantity contained in the cartridge filter (which has to be added to the cartridge filter refill) liters kg	3 2.7

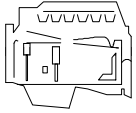
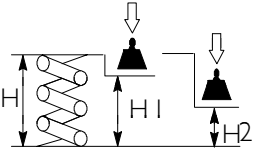
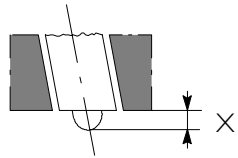
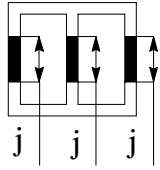
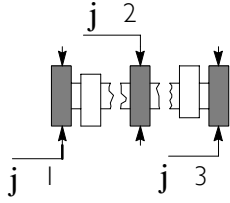
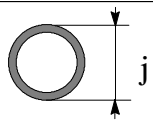
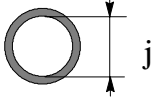
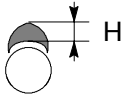
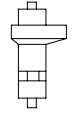
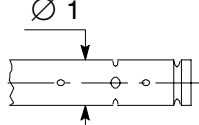
(*) For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

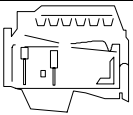
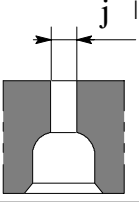
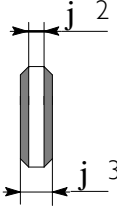
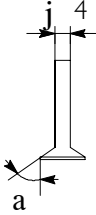
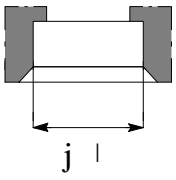
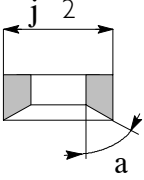
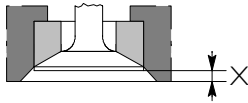
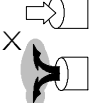
ASSEMBLY CLEARANCE DATA

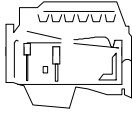
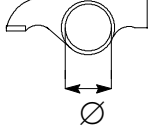
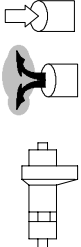
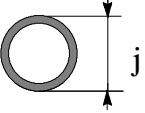
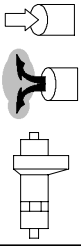
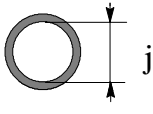
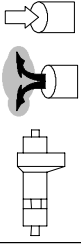
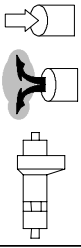
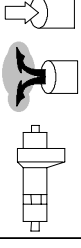
	Type	F3B
CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS		mm
	Cylinder sleeve bore upper Ø 1 lower	153.500 ÷ 153.525 152.000 ÷ 152.025
	Cylinder liners: outer diameter: upper Ø 2 lower length L	153.461 ÷ 153.486 151.890 ÷ 151.915 —
	Cylinder sleeve - crankcase bore upper lower	0.014 ÷ 0.039 0.085 ÷ 0.135
	Outside diameter Ø 2	—
	Cylinder sleeve inner diameter Ø 3A* inner diameter Ø 3B* Protrusion X	135.000 ÷ 135.013 135.011 ÷ 135.024 0.045 ÷ 0.075
* Available dia. class		
	Pistons: measuring dimension X outside diameter Ø 1 A* outside diameter Ø 1 B* pin bore Ø 2	20 134.881 ÷ 134.893 134.892 ÷ 134.894 54.010 ÷ 54.018
* available dia. class		
	Piston - cylinder sleeve inner diameter Ø 3A* inner diameter Ø 3B*	0.107 ÷ 0.132 0.107 ÷ 0.132
* available dia. class		
	Piston diameter Ø 1	—
	Pistons protrusion X	—
	Gudgeon pin Ø 3	53.994 ÷ 54.000
	Gudgeon pin - pin housing	0.010 to 0.024

		Type	F3B
			mm
	X1*		3.445 ÷ 3.475
	Piston ring grooves	X2	3.05 ÷ 3.07
		X3	5.02 ÷ 5.04
	*measured on Ø of 130 mm		
	Piston rings:		
	trapezoidal seal	S1*	3.296 ÷ 3.364
	lune seal	S2	2.970 ÷ 2.990
	milled scraper ring with slits and internal spring	S3	4.970 ÷ 4.990
*measured on Ø of 130 mm			
		1	0.081 ÷ 0.179
	Piston rings - grooves	2	0.060 ÷ 0.100
	Piston rings - grooves	3	0.030 ÷ 0.070
	 >	Piston rings	—
	X1		
	X2		0.40 ÷ 0.55
	X3		0.65 ÷ 0.80
			0.40 ÷ 0.75
	Small end bush housing	Ø1	59.000 ÷ 59.030
	Big end bearing housing	Ø2	
	Selection classes Ø2	1	94.000 ÷ 94.010
		2	94.011 ÷ 94.020
3		94.021 ÷ 94.030	
	Small end bush diameter outside	Ø4	59.085 ÷ 59.110
	inside	 Ø3	54.019 ÷ 54.035
	Big end bearing shell	S	
	Red		1.965 ÷ 1.975
	Green		1.976 ÷ 1.985
	Yellow		1.986 ÷ 1.995
	Small end bush - housing		0.055 ÷ 0.110
	Piston pin - bush		0.019 ÷ 0.041
	 >	Big end bearing shells	—
	Connecting rod weight		
	Class	A g	g. 4661 ÷ 4694
		B g	g. 4695 ÷ 4728
		C g	g. 4729 ÷ 4762

	Type	F3B	
		mm	
	Measuring dimension X	125	
	Max. connecting rod axis misalignment tolerance	0.08	
	Main journals Ø 1	99.970 ÷ 100.000	
	Crankpins Ø 2	89.970 ÷ 90.000	
	Main bearing shells	S1	
	Red	3.110 ÷ 3.120	
	Green	3.121 ÷ 3.130	
	Yellow	3.131 ÷ 3.140	
	Big end bearing shells	S2	
	Red	1.965 ÷ 1.975	
	Green	1.976 ÷ 1.985	
	Yellow	1.986 ÷ 1.995	
	Main bearing housings Ø 3	106.300 ÷ 106.330	
	Bearing shells - main journals	0.060 ÷ 0.100	
	Bearing shells - big ends	0.050 ÷ 0.090	
	Main bearing shells	-	
	Big end bearing shells	-	
	Main journal, thrust bearing X1	47.95 ÷ 48.00	
	Main bearing housing, thrust bearing X2	40.94 ÷ 40.99	
	Thrust washer halves X3	3.38 ÷ 3.43	
	Driving shaft shoulder	0.10 ÷ 0.30	
	Alignment	$\left\{ \begin{array}{l} \overline{\quad} - 1 \\ \bigcirc - 2 \\ \sphericalangle - 2 \end{array} \right.$	≤ 0.025
	Ovality		0.010
	Taper		0.010

	Type	F3B	
		mm	
	Valve outside spring height:		
	free height H	72.40	
	under a load of:		
	575 ± 28 N H1	58	
	1095 ± 54 N H2	45	
	Injector protrusion X	0.52 ÷ 1.34	
	Camshaft bush housing fitted in the cylinder head: 1 ⇒ 7 Ø	88.000 ÷ 88.030	
	Camshaft journal diameter: 1 ⇒ 7 Ø	82.950 ÷ 82.968	
	Camshaft bushing outer diameter: Ø	88.153 ÷ 88.183	
	Camshaft bushing inner diameter: Ø	83.018 ÷ 83.085	
	Bushings and housings in engine block	0.123 ÷ 0.183	
	Bushings and journals	0.050 ÷ 0.135	
	Cam lift:		9.231
			9.5607
			11.216
	Rocker shaft Ø 1	41.984 ÷ 42.000	

	Type	F3B
CYLINDER HEADS - VALVE TRAIN		mm
	Valve guide housings in cylinder head 	15.980 ÷ 15.997
	Valve guide 	10.015 ÷ 10.030 16.012 ÷ 16.025
	Valve guides - housings in the cylinder heads	0.015 ÷ 0.045
	Valve guide	-
	Valves:  Ø 4 α  Ø 4 α	9.960 ÷ 9.975 60° 30' ± 7' 30" 9.960 ÷ 9.975 45° 30' + 7' 30"
	Valve stem and its guide	0.040 ÷ 0.070
	Housing in head for valve seat  Ø 1  Ø 1	49.185 ÷ 49.220 46.985 ÷ 47.020
	Outside diameter of valve seat; angle of valve seat in cylinder head:  Ø 2 α  Ø 2 α	49.260 ÷ 49.275 60° - 30' 47.060 ÷ 47.075 45° - 30'
	Recessing of valve  X	0.54 ÷ 0.85 1.75 ÷ 2.05
	Between valve seat and head 	0.040 ÷ 0.090

 Type	F3B
	mm
Bushing housing in rocker arms  	$45.000 \div 45.016$ $59.000 \div 59.019$ $46.000 \div 46.016$
Bushing outer diameter for rocker arms:  	$45.090 \div 45.130$ $59.100 \div 59.140$ $46.066 \div 46.091$
Bushing inner diameter for rocker arms:  	$42.025 \div 42.041$ $56.030 \div 56.049$ $42.015 \div 42.071$
Between bushings and housings  	$0.074 \div 0.130$ $0.081 \div 0.140$ $0.050 \div 0.091$
Between rocker arms and shaft  	$0.025 \div 0.057$ $0.025 \div 0.057$ $0.015 \div 0.087$

DIAGNOSIS

Electrical faults and certain mechanical faults detected by the electronic control unit can be diagnosed by means of the Blink Code and diagnostic instruments.

Blink Code

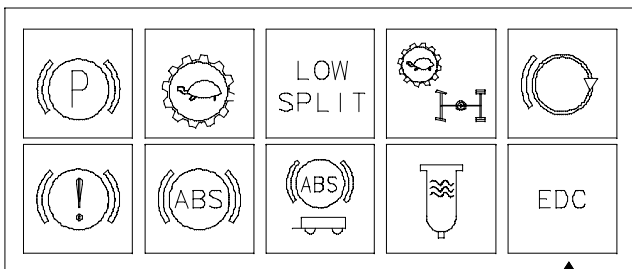
The EDC is designed to provide information on engine faults. The warning light comes on while the engine is running, to indicate a fault has occurred, which could be:

Warning light on	Serious fault Degraded system function
Warning light blinking	Very serious fault Degraded system function Loss of one or more safety functions and possible engine stop

Information on the type of fault is given in the form of a code by the EDC warning light consisting of a series of long or short blinks (the blink code).

To check the fault, use the diagnosis button located under the UCI compartment hatch, which has another EDC warning light operating in parallel with the one on the dashboard.

Figure 6



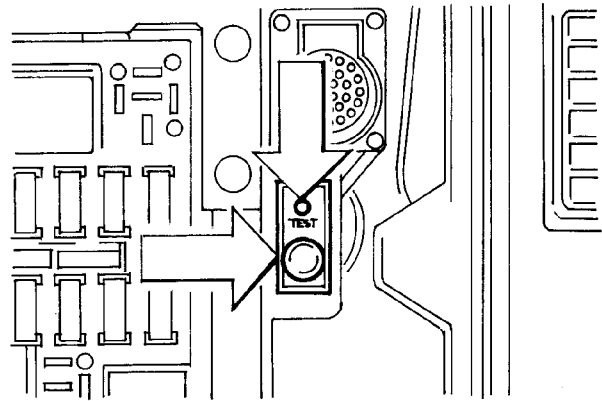
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DASHBOARD WARNING LIGHTS

Fault checking/identification procedure

- ☐ Stop vehicle and switch off engine (STOP);
- ☐ Turn key to RUN (warning lights on and engine off);
- ☐ Press diagnosis button and check that the EDC warning light blinks once;
- ☐ After a short interval during which the warning light remains off, it begins to blink initially at long intervals and then shorter.

Figure 7



6679

EDC DIAGNOSIS BUTTON

The fault code is explained in the following pages.

For example: code 1.4 means that the warning light has given one long blink and four short ones. The procedure should be repeated until the code of the first indicated fault is repeated again.

Fault memory cancellation procedure from drivers seat

- ☐ Press the Blink Code button (with key to stop);
- ☐ turn key to RUN holding down the button;
- ☐ Wait 5 seconds;
- ☐ Turn key to stop;
- ☐ Check cancellation by reading number by means of test button.

MS 6.2 EDC electronic control unit blink code table

Blink Code	EDC warning light *	Fault
VEHICLE AREA		
1.1	ON	Vehicle speed sensor
1.2	ON	Torque selector
1.3	OFF	Cruise control
1.4	ON	Accelerator pedal
1.5	OFF	Clutch pressure switch
1.6	ON	Brake pedal switch signal plausibility
1.7	OFF	Plausibility between brake / accelerator pedal
ENGINE AREA		
2.1	OFF	Water temperature sensor
2.2	OFF	Air temperature sensor
2.3	OFF	Fuel temperature sensor
2.4	ON	Turbo pressure sensor
2.5	OFF	(Control unit) ambient temperature sensor
2.6	ON	Engine braking switch signal
3.5	OFF	Battery voltage
TURBO AREA		
4.1	OFF	Turbo actuator pressure sensor
4.2	ON	Turbine revs sensor
4.3	ON	Turbine overspeed
4.4	ON	Turbo management (mechanical fault)
4.5	ON	VGT solenoid valve
4.6	BLINKING	Engine braking solenoid valve
INJECTORS		
5.1	ON	Cylinder 1 injector fault
5.4	ON	Cylinder 4 injector fault
5.2	ON	Cylinder 2 injector fault
5.6	ON	Cylinder 6 injector fault
5.3	ON	Cylinder 3 injector fault
5.5	ON	Cylinder 5 injector fault
ENGINE REVS SENSOR		
6.1	ON	Flywheel sensor
6.2	ON	Valve train sensor
6.4	OFF	Engine overspeed
INTERFACE WITH OTHER CONTROL UNITS		
7.1	OFF	P.W.M. ABS/ASR interface
7.2	OFF	CAN line
7.3	OFF	CAN line (ASR management)
7.4	OFF	CAN line (gearbox data management)
ENGINE CONTROL UNIT		
9.1	BLINKING	Faulty control unit
9.2	ON	EEPROM data incorrect
9.3	BLINKING	Immobilizer
9.4	ON	Main relay
9.5	ON	Engine stop procedure error
9.6	ON	Control unit data recording error

* Blink code warning light off
 Blink code warning light on
 Blink code warning light blinking

Slight fault
 Serious fault
 Very serious fault

DIAGNOSIS TOOLS

IT2000

Upper level diagnosis

Communicating with the control unit, this is able to carry out the following functions in detail:

- 1 SYSTEM DESCRIPTION
 - Explanation of MS 6.2 EDC system function, CONTROL UNIT PIN-OUT
- 2 CONTROL UNIT DATA READ-OUT
- 3 FAULT MEMORY READ-OUT
 - Intermittent/permanent fault discrimination
 - Details of fault, fault frequency, environmental conditions in which fault occurs
 - Repair guide
 - Diagram of circuit in question
 - Details on use of UNITESTER on system in question
- 4 PARAMETER READING
 - Measurable parameters
 - Status parameters
- 5 FAULT MEMORY CANCELLATION
- 6 ACTIVE DIAGNOSIS
 - Memorised data read-out
- 7 OTHER FAULTS
 - Information is provided as to how to identify faults not directly recognised by the control unit
- 8 PROGRAM GUIDE
 - Explanation about how to use the program
- 9 ENGINE TEST
 - Compression
 - Turbocompressor efficiency
 - Engine braking efficiency
 - Cylinder performance

CONTROL UNIT DIAGNOSIS

- 1 CONTROL UNIT DATA
- 2 FAULTS
 - Selection: fault area
 - Characteristics: design of component in question with photograph and electrical features
 - Circuit diagram: cable/pin-out/connector coding
 - Description: fault details, fault frequency, ambient conditions in which fault occurred
 - Intervention: repair guide with access to multimeter/oscilloscope function, integrated with use of system dedicated adapters
 - Cancellation: cancelling fault memory
- 3 PARAMETERS
 - Status parameters
 - Measurable parameters
- 4 ACTIVE DIAGNOSIS
 - Memorised data read-out
- 5 SYSTEM (description of function / PIN OUT / other faults not directly diagnosed by control unit)

ENGINE DIAGNOSIS (ENGINE TEST)

These tests are carried out directly and automatically by the tester; including engine start/stop cycles (except for vehicles undergoing first phase Field Test)

- Compression
- Turbocompressor efficiency
- Engine braking efficiency
- Cylinder performance

AUXILIARY FUNCTIONS

- TRADITIONAL ELECTRICAL SYSTEM DIAGNOSIS
- LOCATION OF CABLE BREAK / SHORT CIRCUIT
- COMPONENT TEST (RELAYS / DIODES / FUSES)

TROUBLESHOOTING

Introduction

An effective diagnosis can be made above all using the electronic diagnosis tools (IT2000) developed by Iveco.

When the vehicle arrives at the workshop, the information provided by the driver should be given due consideration, although the first thing to do is to connect the IT2000 and carry out a complete diagnosis:

- Fault memory reading
- Parameter reading
- Engine test
- Etc.

It is useful to print out the results, especially if Help Desk assistance is required.

In this case, note that the Help Desk may not accept requests for assistance based only on Blink Code.

The Blink Code is a tool that can be useful in certain cases (vehicle broken down on the road, no Modus/IWT/IT2000), but must not substitute diagnosis with the Iveco tools because the code only offers general indications.

Another factor important in troubleshooting is experience.

To get around a possible lack of experience of the repair mechanic with respect to this new electronic system (there being no previous systems of the kind to use as reference, the following pages offer a TROUBLESHOOTING GUIDE developed by Training in collaboration with the experts who designed and developed the MS 6.2 EDC control unit.

However, it has to be stressed that not even Troubleshooting can replace the IT2000, although it is an extra help in that it concentrates the experience of the people who have a profound knowledge of the system.

The Troubleshooting guide consists of two distinct sections:

- The first looks for mechanical faults with Blink Code and regards faults that can be directly identified by the MS6.3 control unit. These faults are mainly of an electrical – electronic nature;
- The second looks for mechanical faults by symptoms, and describes possible faults that cannot be recognised by the electronic control unit. These faults are mainly of a mechanical – hydraulic nature.

Troubleshooting does not substitute diagnosis with Iveco electronic diagnosis tools, but is intended as a supplement to the same.

TROUBLESHOOTING (BLINK CODE)

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
I.1	On	Defective vehicle speed sensor. Tachigraph not functioning. Faulty tachigraph needle behaviour	Vehicle speed no longer limited, can be surpassed in case of poor resistance to advancement. Juddering in high gears	Flight recorder detects long time at low speed. Check wiring, connections, component	Control unit replacement value: 5 kph
I.2	On	Defective multi-state switch. No reduction in Economy mode		Check wiring, connections, component	
(I.2)	(On)	Multi-state switch blocked in one position No switching between normal and economy operation	Remains in last selected mode	Check wiring, connections, component	
I.3	Off	Defective cruise control. No reaction after turning CC/PTO switches	Cruise Control / PTO not functioning	Check wiring, connections, component	Switch signals not plausible (pressed together)
I.4	On	Accelerator pedal: defective powering or signal not plausible. Idle at 1000 rpm and faulty engine reaction to accelerator pedal			Can be varied with warm engine by CC switch (Set + / Set -)
I.4	On	Accelerator pedal: defective powering or signal not plausible. Idle at 1000 rpm and faulty engine reaction to accelerator pedal			Can be varied with warm engine by CC switch (Set + / Set -)

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
1.5	Off	Defective clutch switch . CC/PTO not functioning	Juddering on gear change	Check wiring, connections, component	
1.6	On	Brake switch plausibility. No reaction after turning CC/PTO switch	Cruise control / PTO not functioning	Check wiring, connections, component	
1.7	Off	Accelerator pedal sensor / brake switch plausibility			No reaction from system
2.1	Off	Defective coolant temperature sensor. Excessive starting time in cold conditions	Greater combustion noise due to high injection advance	Active diagnosis of pre-heating element. Parameter reading. Check wiring, connections, component	Absence of overheating protection, replacement value = 0°C
2.2	Off	Turbo air temperature sensor defective	If sensor indicates lower temperature than real, error not memorised and engine achieves better performance but with black smoke	Parameter reading. Check wiring, connections, component	Replacement value = 20°C
2.3	Off	Defective fuel temperature sensor		Parameter reading. Check wiring, connections, component	No injection flow-rate correction, but driver does not notice. Replacement value = 970 mbar
2.4	On	Defective turbo pressure sensor: Reduced power	Temporary black smoke in significant quantities	Modus parameter reading: if replacement value appears at idle, fault is confirmed	

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
2.5	Off	Defective ambient pressure sensor		Contact Help Desk for control unit replacement because sensor built-in to the same	Less accurate VGT function at high altitude, but driver does not notice. Replacement value = 970 mbar
(2.6)	(On)	Engine braking command switches or selector switch. Engine brake not functioning in all three selected modes		Modus parameter reading. Check wiring, connections, component	
(2.6)	(On)	Engine braking switch blocked closed. Engine braking enabled only above 900 rpm		Active diagnosis of engine braking solenoid valve	Fuel injection interrupted by ECU, engine speed drops to 800 rpm, fuel injection again interrupted by ECU
(2.6)	(On)	Engine braking switch blocked open		Engine test on engine braking. Active diagnosis of engine braking solenoid valve	Engine braking functions when activated by Modus or by other two selection modes (accelerator – brake)
3.5	Off	Battery voltage too low or fault in voltage recognition	Possible pre-heating and starting problems	Test batteries	EDC operates with replacement value of 28V
4.1	Off	Faulty VGT pressure sensor capsule. Poor performance at low speeds and on acceleration	Possible reduction in engine braking power	Engine test: Check wiring, connections, component. Check arrival of compressed air to capsule. Check function of shut-off valve on chassis.	If capsule pressure increases during VGT test but, visually, the actuator does not move, it is seized.

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
4.1	Off	Rotating parts of turbo-compressor totally seized. Poor performance at low speeds and on acceleration	Reduced engine braking power	Engine test: engine check-up	Capsule memorises turbine revs sensor error; even if it functions correctly
(4.1)	(Off)	VGT command solenoid blocked or seized closed. Noise indicates faulty turbo behaviour (speed does not follow accelerator pedal)	Poor vehicle acceleration	Engine test: VGT. Turbine actuator active diagnosis	
(4.2)	(Off)	VGT mechanism blocked closed. Reduced power with engine speed below 1200 rpm.	Black smoke with normal function, after acceleration. Engine brake disengaged by control unit in braking mode with high engine speeds	Engine test: engine brake and VGT. Turbine actuator active diagnosis	Power reduced by control unit due to excessive turbine speed
4.2	On	Faulty turbo speed sensor. Reduced power and speed		Engine test: check wiring, connections, component	
4.3	On	Turbine overspeed or excessive turbo pressure. Reduced power	Poor engine brake efficiency	Engine test	Fuel flow reduction during turbine over-revving
4.4	On	VGT monitoring of control unit. Reduced power		Engine test	Deviation of VGT variable geometry beyond set thresholds

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
(4.1) (4.4)	(Off) (On)	No compressed air delivery to VGT valve or insufficient pressure. Poor performance at low speeds and in acceleration	Possible reduction in engine efficiency	Engine test: active diagnosis: turbine actuator. Check compressed air delivery to capsule. Check function of shut-off valve on chassis If not functioning check connections, wiring, component and passage. If shut-off valve functions, check air line from shut-off to capsule and line connection to capsule. Check mechanical efficiency of VGT command solenoid valve.	
(4.1) (4.4)	(Off) (On)	VGT mechanism in turbine blocked half open. Poor performance at low and medium speeds and in acceleration	Possible reduction in engine efficiency	Engine test: VGT, engine brake. Turbine actuator active diagnosis	If external VGT command mechanisms function but VGT test indicates fault, fault should be sought in turbo internal mechanisms.
4.5	On	Electrical problem with VGT solenoid valve. Significant power reduction at low speed and in acceleration	Reduction in engine braking efficiency	Engine test: Check wiring, connections and component	
4.6	Blinking	Engine brake solenoid valve. Engine brake not functioning		Engine test: check wiring, connections and component	If engine brake does not function with engine test, solenoid valve is not powered by vehicle wiring
5.x	On			Engine test (if fault is present): Check wiring, connections and component (header cable as well)	

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
6.1	On	Faulty flywheel sensor: Reduced engine speed and power	Engine start may take longer than usual	Modus fault memory reading. Check wiring, connections and component	
6.2	On	Camshaft sensor: Reduced engine power and speed	Engine start may take longer than usual	Modus fault memory reading Check wiring, connections and component	
(6.1 – 6.2)	(On)	Camshaft phonic wheel offset due to loose screws. Engine does not start or stops. Restart impossible.	Reduced power with motor running (after recommended intervention)	Disconnect camshaft sensor. If engine starts, taking longer than usual, phonic wheel is offset.	
6.4	Blinking	Engine has reached 3800 rpm (motoring) for any reason		Fault memory reading. Read flight recorder to confirm engine overspeed.	
7.1	Off	Two cable ABS/ASR interface problems ASR not functioning		Check vehicle wiring	
7.4	Off	CAN gearbox command interruption. Gearbox command does not function via CAN			
(9.1)	(Blinking)	Faulty EDC control unit Engine stops or does not start		Contact Help Desk for control unit replacement	No diagnosis possible. This error may not be memorised, depends on control unit condition.

BLINK CODE	EDC WARNING LIGHT	POSSIBLE CAUSE	POSSIBLE ANOMALIES	ADVISED TESTS OR INTERVENTIONS	NOTES
9.2	On	Faulty control unit (EEPROM memory). Reduced engine speed and power	Fault memory cancelled, diagnosis possible only for current faults	Contact Help Desk for possible replacement of control unit	
9.4	On	Main relay faulty or blocked closed. EDC lamp stays on when key turned to OFF but engine stops.	EDC power remains on after turning key to off, danger of flattening battery	Check wiring, connections and component	Fault is memorised only after subsequent starting
9.5	On	ECU power frequently interrupted (5 times): Main relay faulty or engine stop by battery cut-off switch.		Check main relay, wiring and component. Investigate possible driver habits regarding stopping engine without turning key	Problem solves only with subsequent switch-off procedure and correct data memorising.
9.6	On	ECU stop test fail. Reduced engine speed and power	Internal control unit test procedure to check power stages. Could memorise other errors related to various actuator power stages.	Contact Help Desk for possible replacement of control unit	

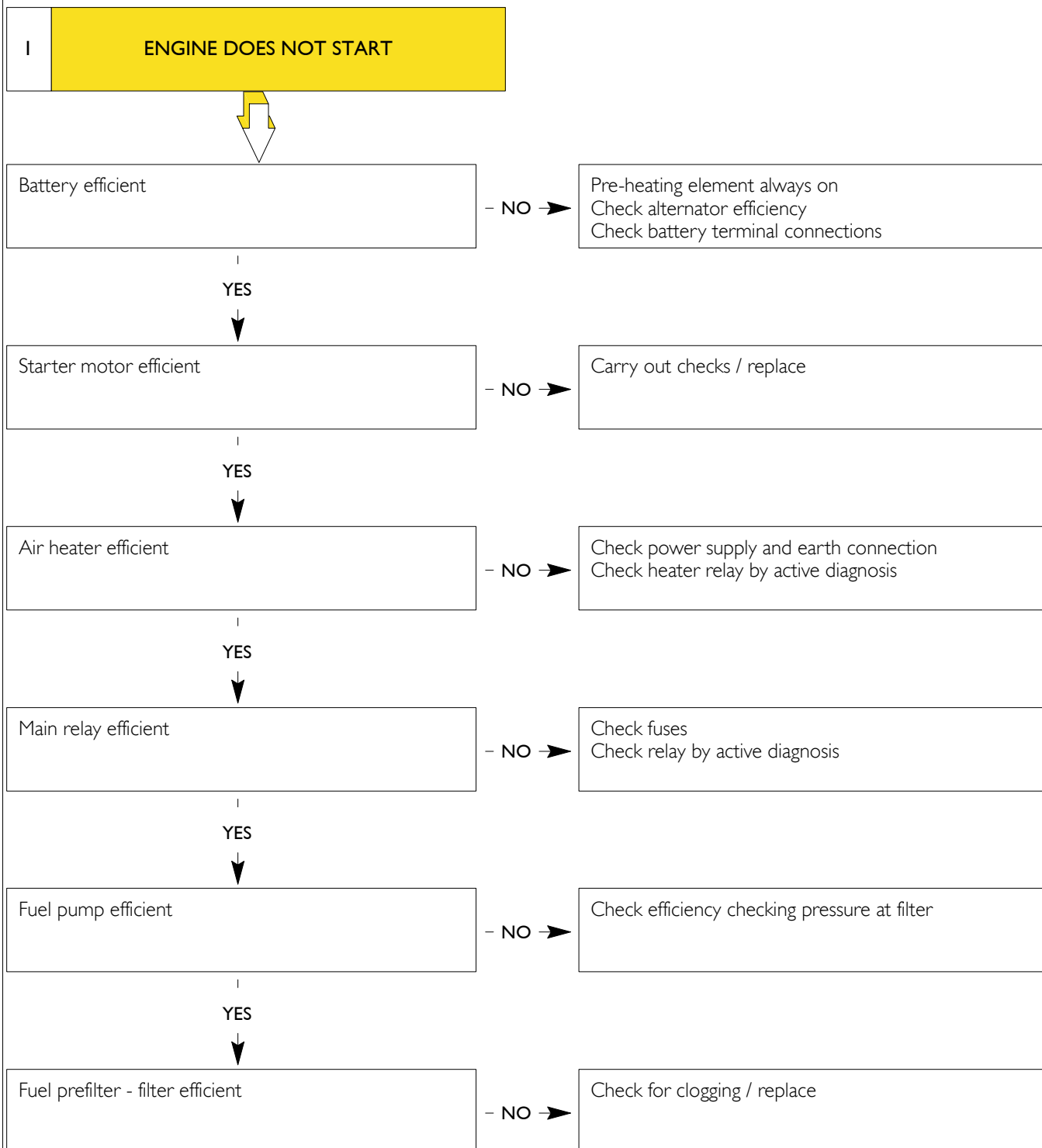
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TROUBLESHOOTING BY SYMPTOMS

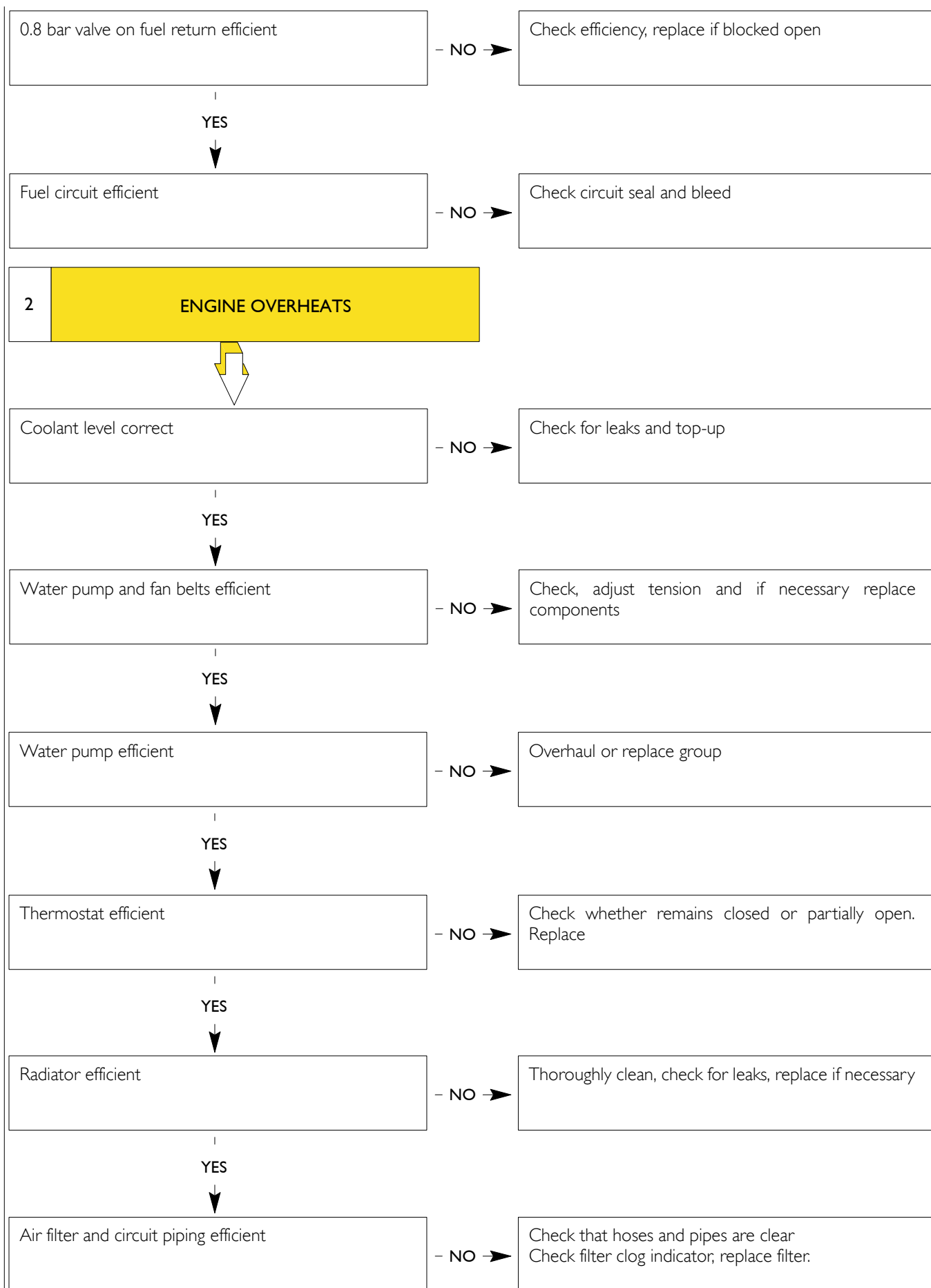
Main engine operating anomalies:

- 1 - The engine does not start;
- 2 - The engine is excessively heated;
- 3 - The engine lacks efficiency;
- 4 - The engine has grey smokes (tending to white);
- 5 - The engine has blue smokes;

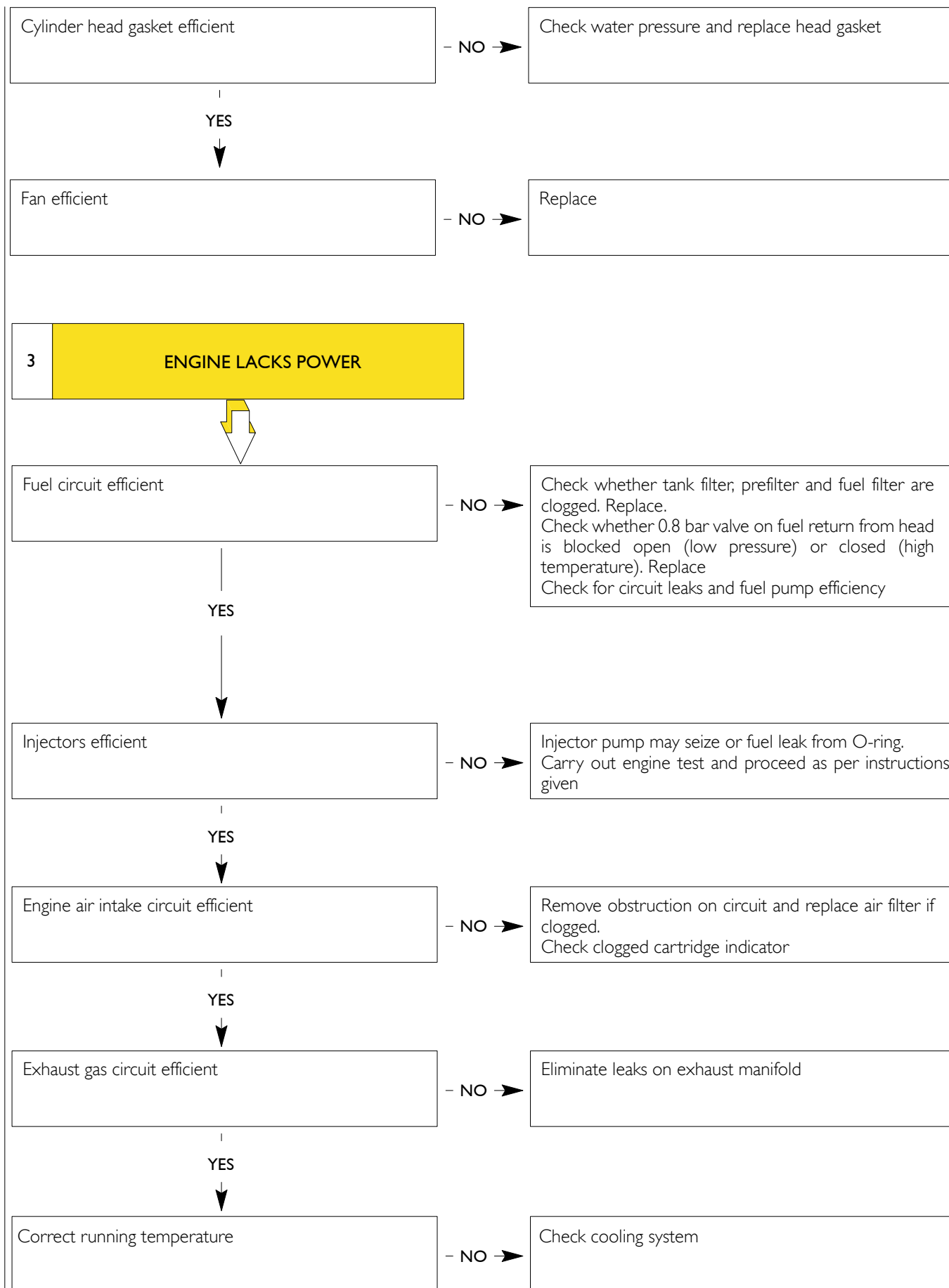
- 6 - Poor engine braking efficiency;
- 7 - The engine stops;
- 8 - Excessive fuel consumption;
- 9 - Excessive or insufficient oil pressure.



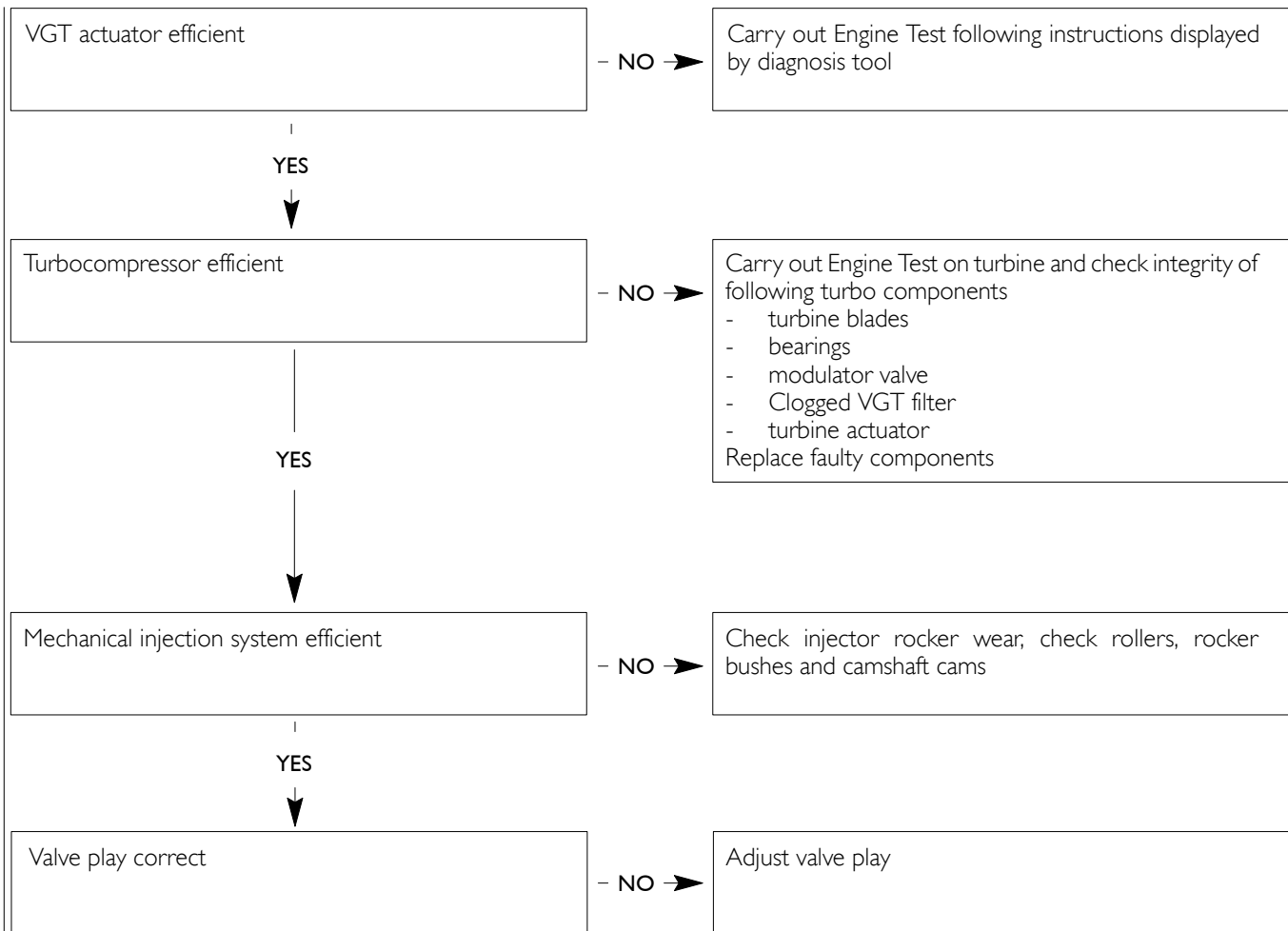
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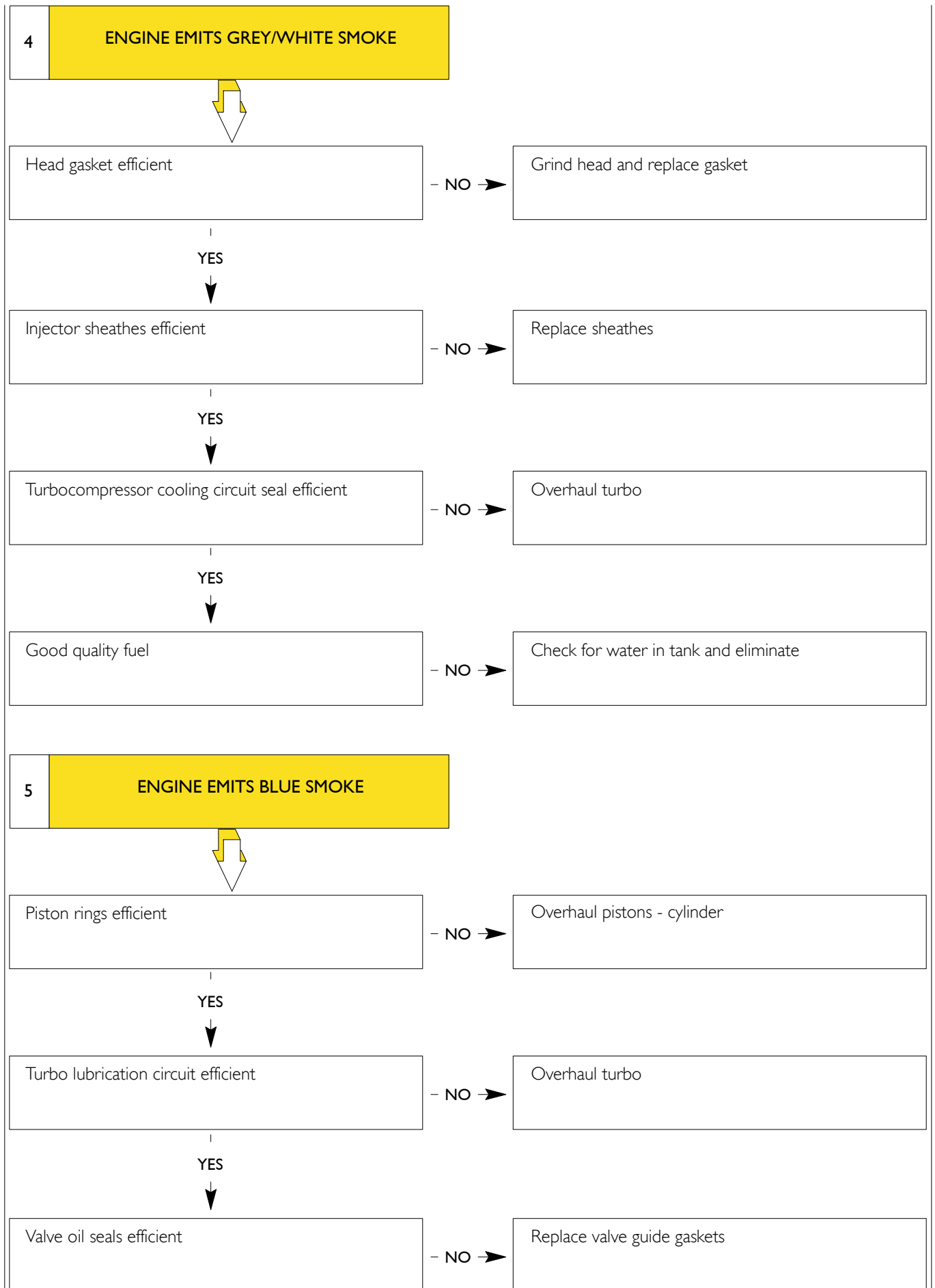


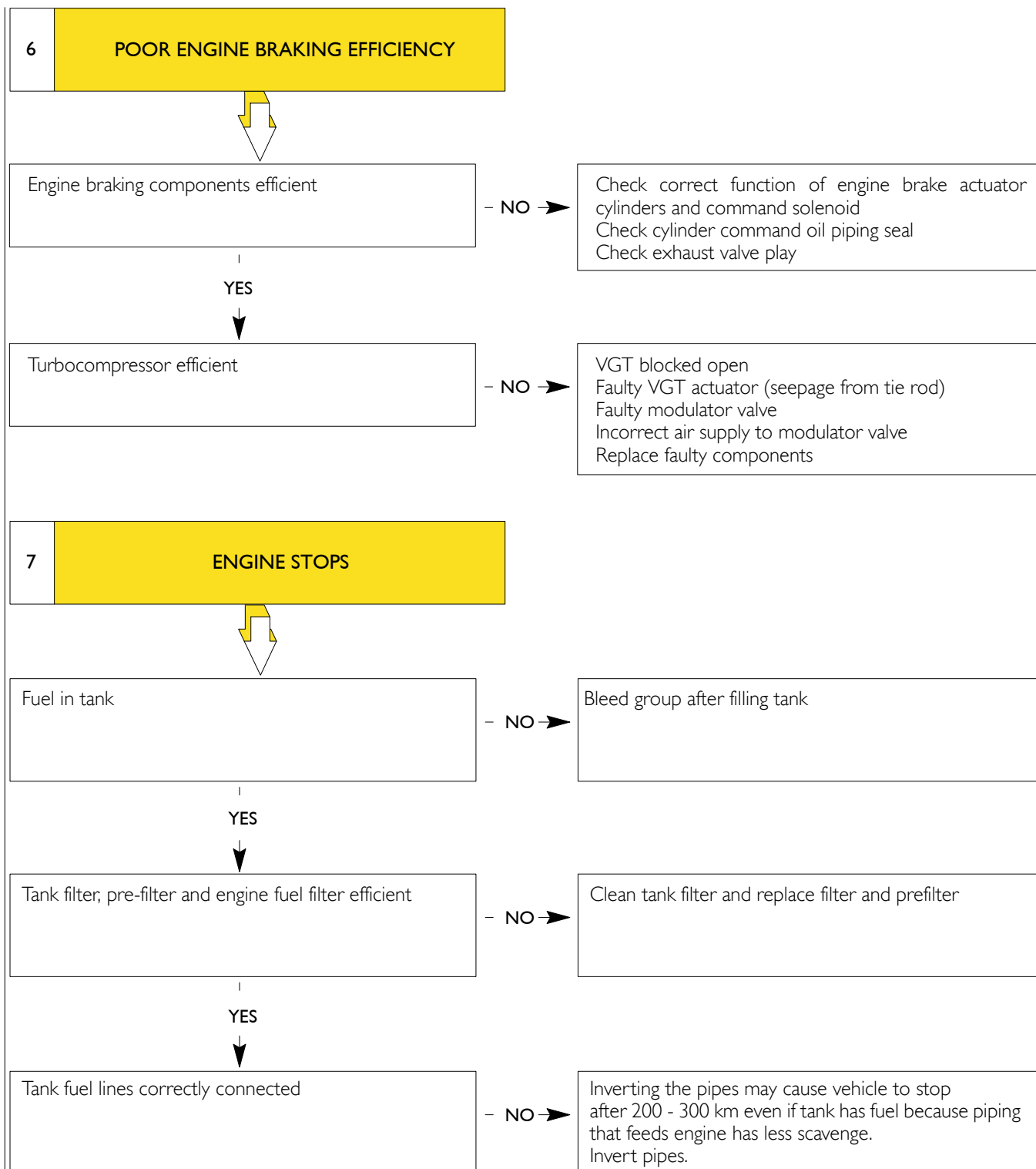
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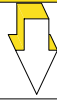
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8

EXCESSIVE FUEL CONSUMPTION

Air filter efficient

- NO →

Replace

YES



Tank and fuel lines efficient.

- NO →

Eliminate any leaks and replace worn parts

9

OIL PRESSURE INSUFFICIENT OR EXCESSIVE

Pressure regulator valve operates correctly

- NO →

Check and if necessary replace

YES



Oil pump and delivery piping efficient

- NO →

Check and if necessary replace.

YES



Main bearings and big ends efficient

- NO →

Replace bearings and if necessary grind crankshaft

YES



Engine oil SAE viscosity correct

- NO →

Change engine oil with suitable viscosity oil

TIGHTENING TORQUES

PART	TORQUE	
	Nm	kgm
Capscrews, undercrankcase to crankcase ♦		
Outside screws M12x1.75 First phase: preliminary tightening	30	(3)
Inner screws M 18x2 Second phase: preliminary tightening	120	(12)
Inner screws Third phase: angle locking		60°
Inner screws Fourth phase: angle locking		55°
Outer screws Fifth phase: angle locking		60°
Piston cooling nozzle union ♦	35±2	(3.5)
Heat exchanger fixing screws to the block ♦		
preliminary tightening	11.5±3.5	(1.15±0.35)
tightening	19±3	(1.9±0.3)
Spacer oil sump fixing screws to undercrankcase ♦	24,5±2,5	(2.4±0.25)
Fixing screws to oil sump ♦		
preliminary tightening	38	(3.8)
tightening	45	(4.5)
Gearbox fixing screws to the block M 12x1.75 ♦	63±7	(6.3)
Control unit fastening screws on engine block	24±2.5	(2.4±0.25)
Cylinder head fixing screws ♦		
First phase preliminary tightening	60	(6)
Second phase preliminary tightening	120	(12)
Third phase angle locking		90°
Fourth phase angle locking - screws 4 - 5 - 12 - 20 - 21		45°
Fourth phase angle locking - screws 1 - 2 - 3 - 6 - 7 - 8 - 9 - 10 - 11 14 - 15 - 16 - 17 - 18 - 19 - 22 23 - 24 - 25 - 26		65°
Rocker shaft fixing screws ♦		
First phase preliminary tightening	100	(10)
Second phase angle locking		60°
Lock nut for rocker adjustment screw ♦	39±5	(3.9±0.5)
Injector blocking brackets screws ♦	26	(2.6)
Plastic cover fastening screws	8.5±1.5	(0.85±0.15)
Shoulder plate fixing bolts to head ♦	19±3	(1.9±0.3)
Engine mounting bracket screws on head		
First phase pre-torque	120	(12)
Second phase tightening to angle		45°

- ♦ Lubricate with UTD oil before installation
- Lubricate with graphitized oil before installation

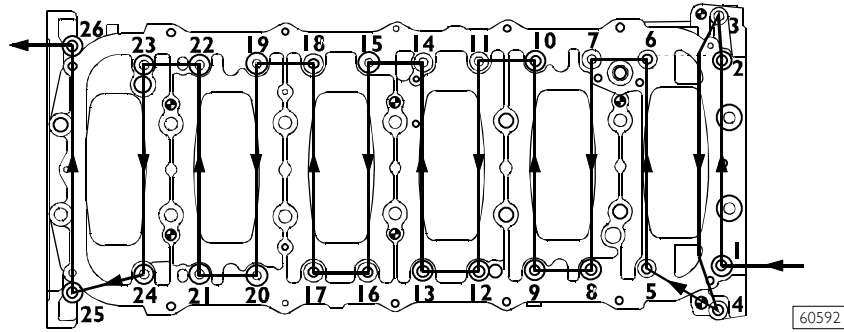
PART	TORQUE	
	Nm	(kgm)
Engine mounting bracket fastening screws on flywheel casing		
First phase pre-torque	100	(10)
Second phase tightening to angle	60°	
Camshaft cog fastening screws: ♦		
First phase pre-torque	60	(6)
Second phase tightening to angle	60°	
Phonic wheel fastening screws to camshaft cog	8,5±1,5	(0,85±0,15)
Exhaust manifold fastening screws: •		
pre-torque	32,5	(3,2)
full torque	45	(4,5)
Big end cap fastening screws ♦	19	(1,9)
Viti fissaggio cappello di biella : ♦		
Prima fase preserraggio	60	(6)
Seconda fase chiusura ad angolo	60°	
Big end cap fastening screws: ♦		
First phase pre-torque	120	(12)
Second phase tightening to angle	60°	
Third phase tightening to angle	30°	
Flywheel damper: ♦		
First phase pre-torque	70	(7)
Second phase tightening to angle	50°	
Intermediate gear pin fastening screws: ♦		
First phase pre-torque	30	(3)
Second phase tightening to angle	90°	
Link rod fastening screws for pulley wheel adjustment	24,5±2,5	(2,45±0,25)
Oil pump fastening screws	24,5±2,5	(2,45±0,25)
Crankshaft front gasket casing fastening screws	24,5±2,5	(2,45±0,25)
Fuel pump / filter bracket fastening screws	19	(1,9)
Control unit mounting screws	19±3	(1,9±0,3)
Turbocompressor screws and nuts •		
pre-torque	35	(3,5)
full torque	46	(4,6)
Vite fissaggio gruppo termostato	19±3	(1,9±0,3)
Viti fissaggio pompa acqua	25	(2,5)
Thermostat group fastening screws	30	(3)
Water pump fastening screws	30	(3)
Fan hub spacer fastening screws	100	(10)
Fan bracket engine block fastening screws	26±3	(2,6±0,3)
Air conditioner automatic belt tensioner fastening screws	50±5	(5±0,5)
Auxiliary organs fixed pulley engine block fastening screws	105±5	(10,5±0,5)
Starter motor fastening screws	74±4	(7,4±0,4)
Air heater fastening screws	30±3	(3±0,3)
Air compressor fastening screws	74±4	(7,4±0,4)

- ♦ Lubricate with UTD oil before installation
- Lubricate with graphitized oil before installation

- ◆ Lubricate with UTD oil before installation
- Lubricate with graphitized oil before installation

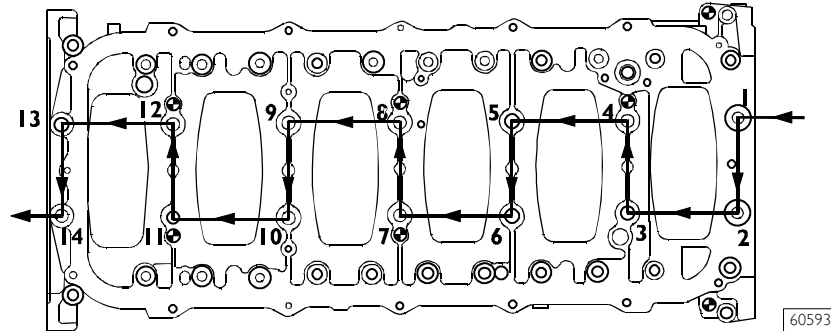
TIGHTENING ORDER OF GEARBOX TO ENGINE BLOCK FASTENING SCREWS**Figure 8**

FRONT SIDE



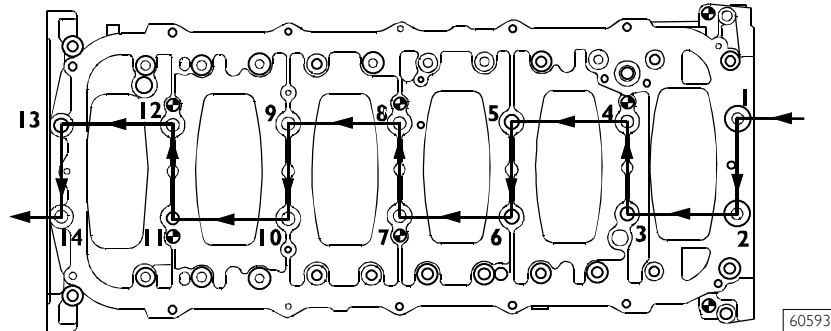
stage 1:
pretightening,
outer screws
30 Nm

FRONT SIDE



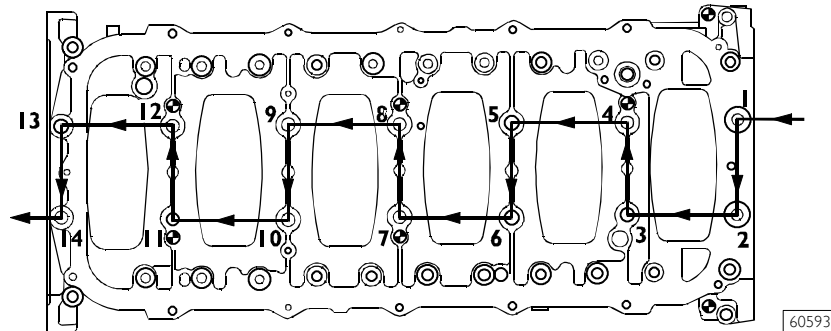
stage 2:
pretightening,
inner screws
120 Nm

FRONT SIDE



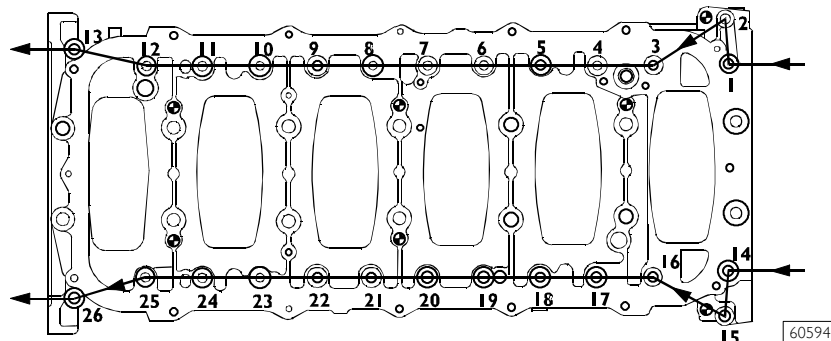
stage 3:
angle, inner
screws
60°

FRONT SIDE



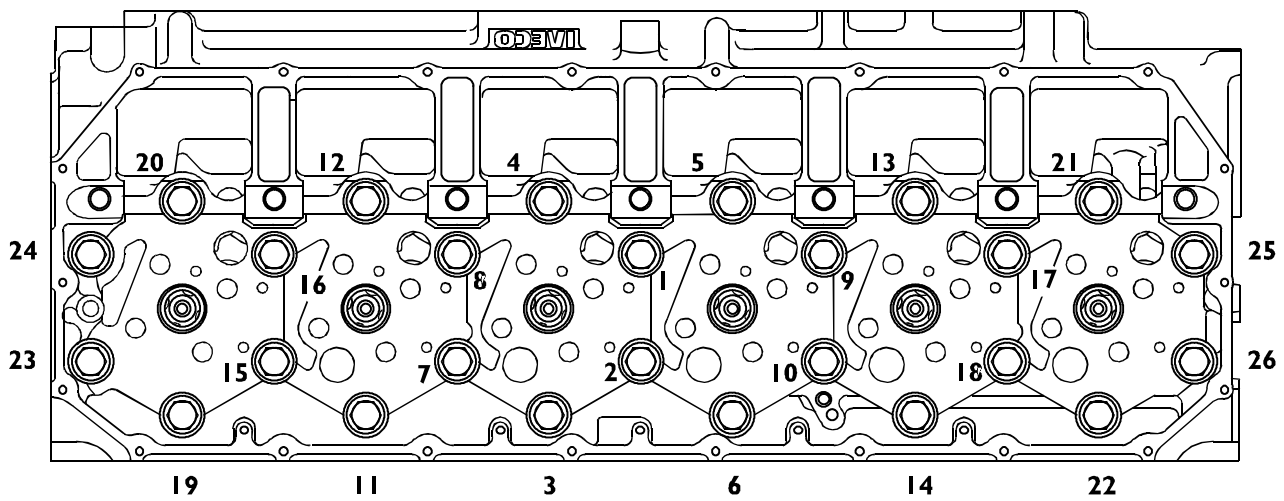
stage 4:
angle, inner
screws
55°

FRONT SIDE



stage 5:
angle, outer
screws
60°

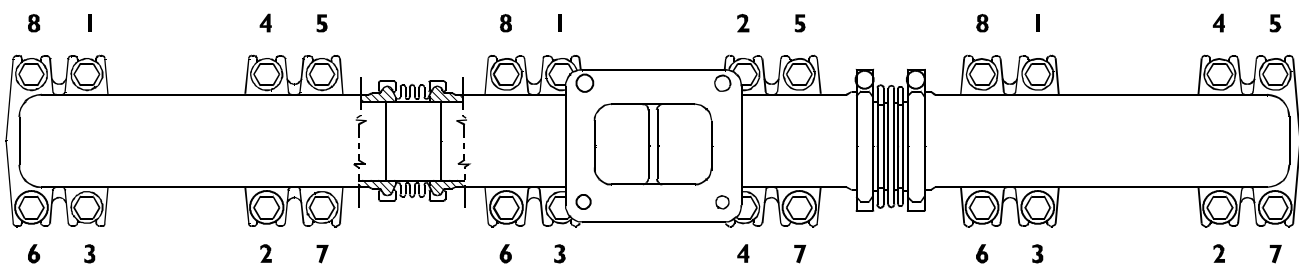
Figure 9



60580

DIAGRAM OF CYLINDER HEAD FIXING SCREWS TIGHTENING SEQUENCE

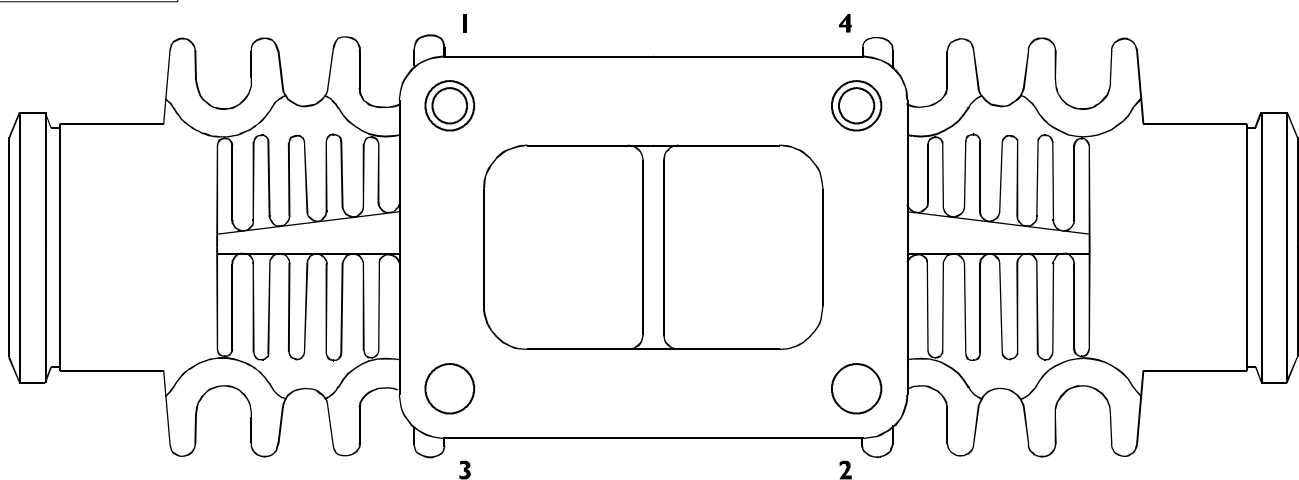
Figure 10



60581

DIAGRAM OF EXHAUST MANIFOLD FIXING SCREWS TIGHTENING SEQUENCE

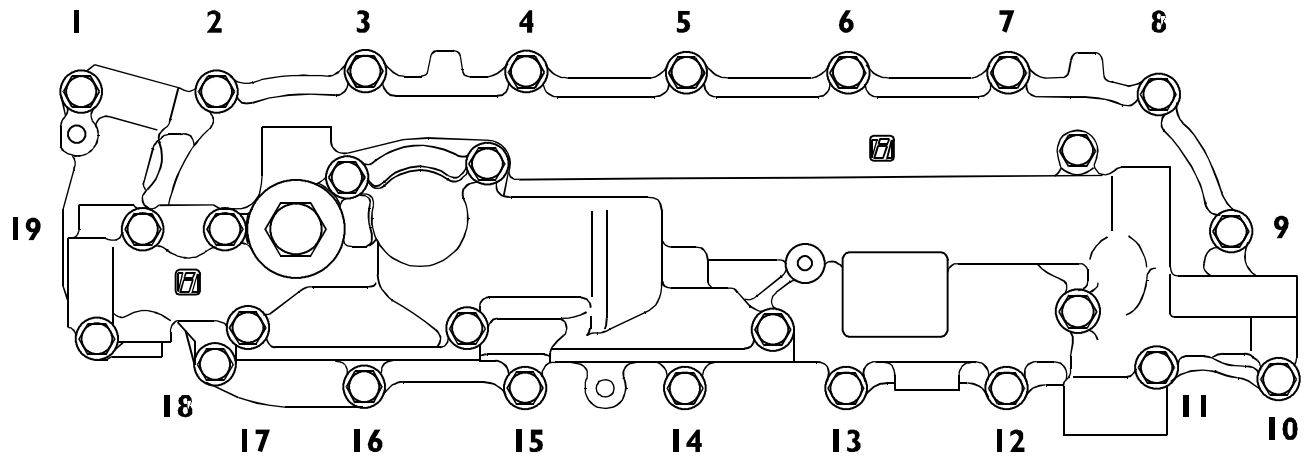
Figure 11



60582

DIAGRAM OF TURBOCHARGER FIXING SCREWS AND NUTS TIGHTENING SEQUENCE

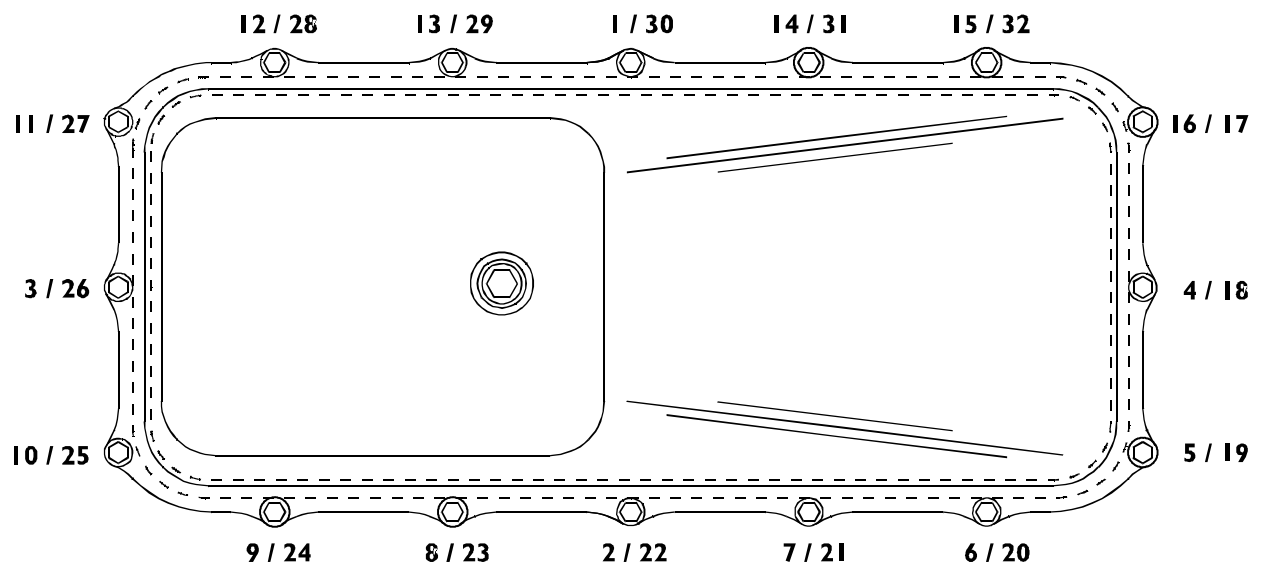
Figure 12



60666

DIAGRAM OF TIGHTENING SEQUENCE FOR HEAT EXCHANGER SCREWS

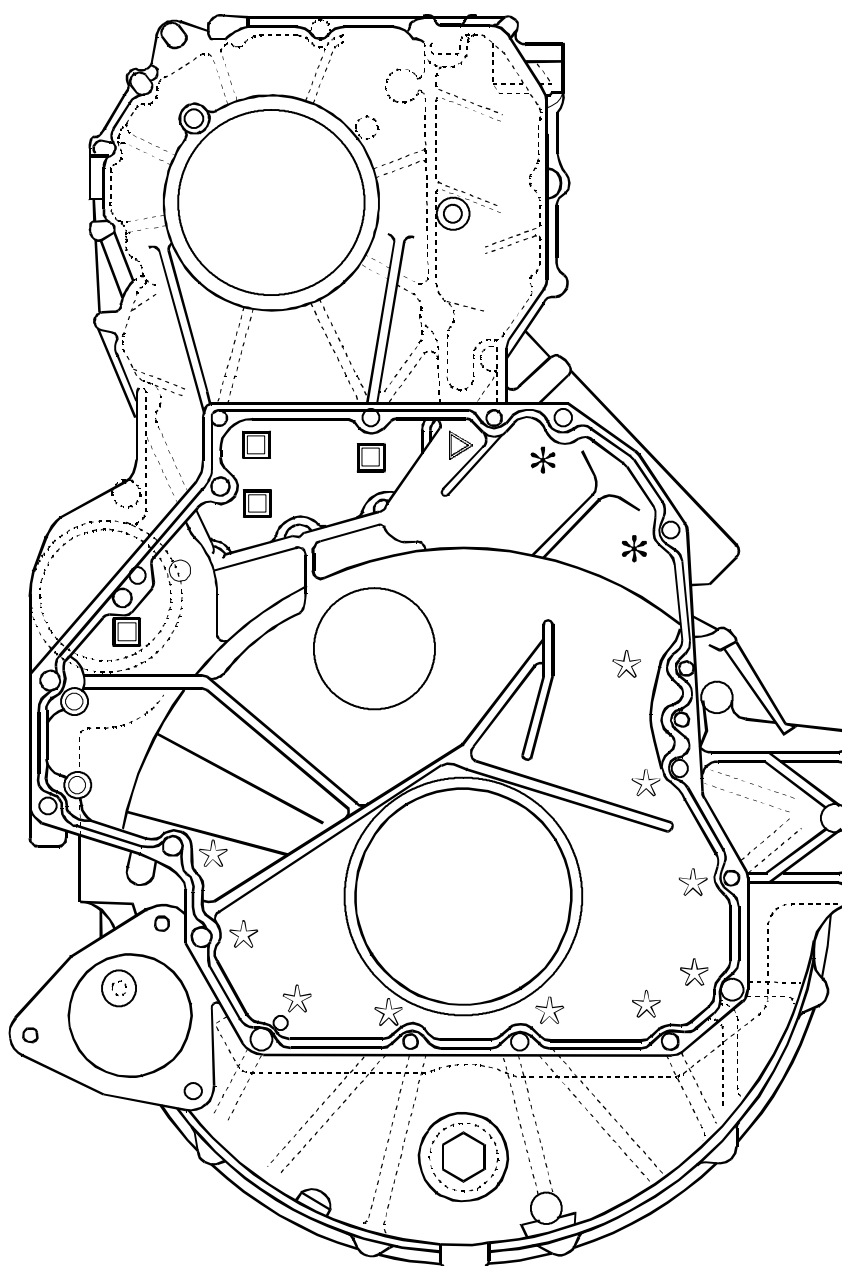
Figure 13



60583

DIAGRAM OF TIGHTENING SEQUENCE FOR ENGINE OIL SUMP SCREWS

Figure I4

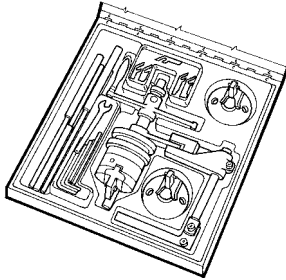
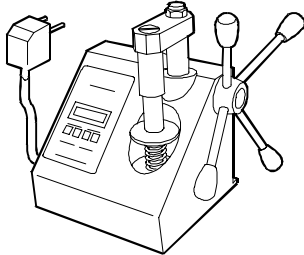
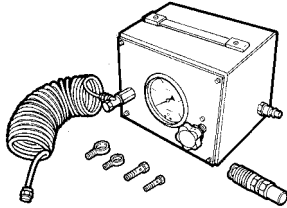
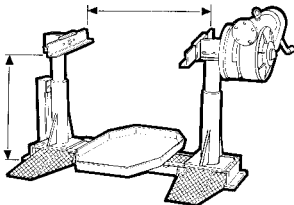
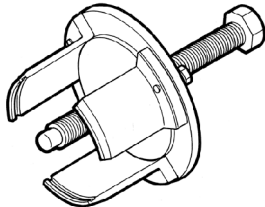
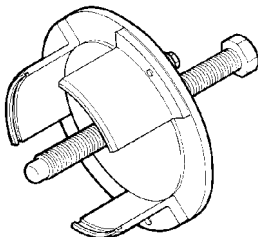


60633

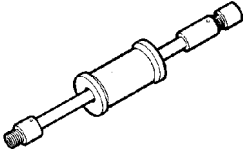
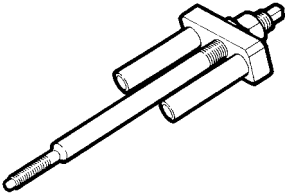
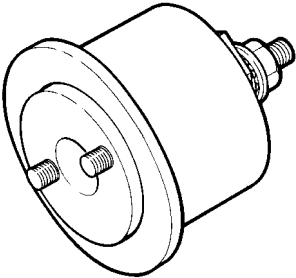
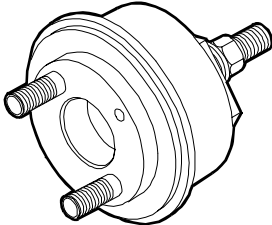
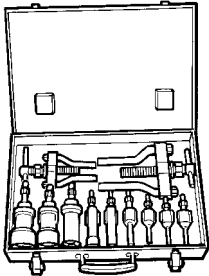
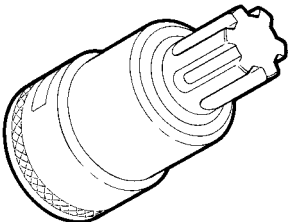
Tightening order

- ☆ no. 10 M12 × 1.75 × 100
- no. 2 M12 × 1.75 × 70
- no. 4 M12 × 1.75 × 35
- △ no. 1 M12 × 1.75 × 120
- * no. 2 M12 × 1.75 × 193

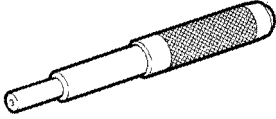
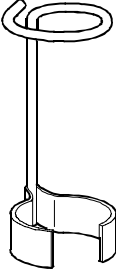
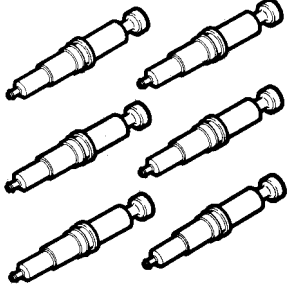
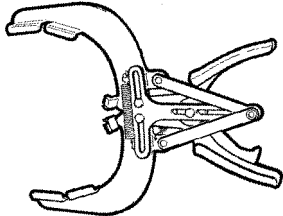
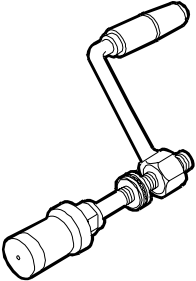
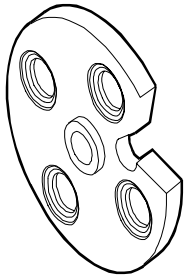
TOOLS

TOOL NO.	DESCRIPTION
99305019 	Full-optional tool-kit to rectify valve seat
99305047 	Rotary telescopic stand (range 2000 daN, torque 375 daNm)
99309002 	Tool for bench calibration of L.D.A device
99322230 	Rotary telescopic stand (range 2000 daN, torque 375 daN/m)
99340053 	Extractor for crankshaft front gasket
99340054 	Extractor for crankshaft rear gasket

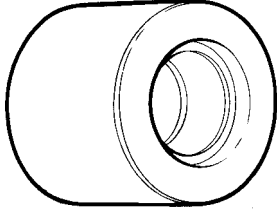
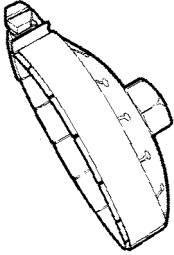
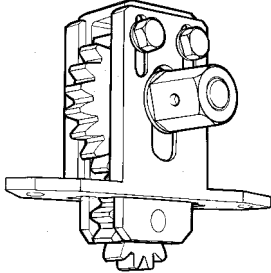
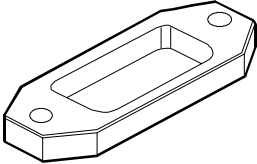
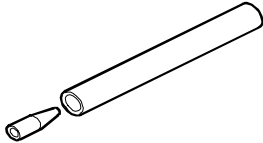
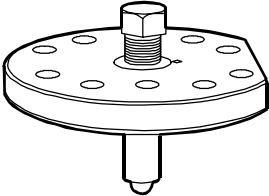
TOOLS

TOOL NO.	DESCRIPTION	
99340205		Percussion extractor
99342149		Extractor for injector-holder
99346250		Tool to install the crankshaft front gasket
99346251		Tool to install the crankshaft rear gasket
99348004		Universal extractor for 5 to 70 mm internal components
99350072		Box wrench for block junction bolts to the underblock

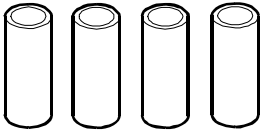
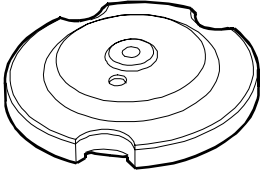
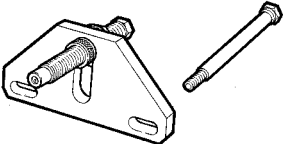
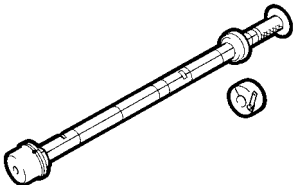
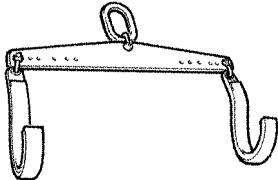
TOOLS

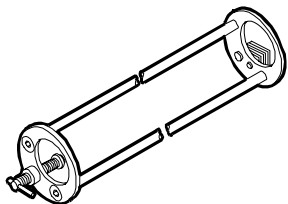
TOOL NO.		DESCRIPTION
99360143		Box wrench for block junction bolts to the underblock
99360144		Tools (12+6) for holding sliding blocks for rockers adjusting screws during disassembly reassembly rockers shaft
99360180		Injector housing protecting plugs (6)
99360184		Pliers for assembling and disassembling piston split rings (105-106 mm)
99360261		Tool to take down-fit engine valves (to be used with special plates)
99360263		Plate for take down-fit engine valves (to be used with 99360261)

TOOLS

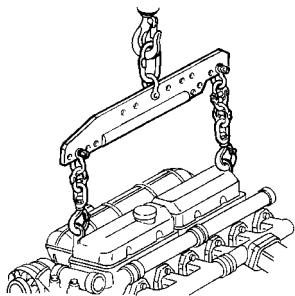
TOOL NO.	DESCRIPTION	
99360296		Tool to fit back valve guide (to be used with 99360143)
99360314		Tool to remove oil filter (engine)
99360321		Tool to rotate engine flywheel (to be used with 99360325)
99360325		Spacer (to be used with 99360321)
99360329		Tool to install gasket on valve guide
99360334		Compression tool for checking the protrusion of cylinder liners (to be used with 99370415-99395603 and special plates)

TOOLS

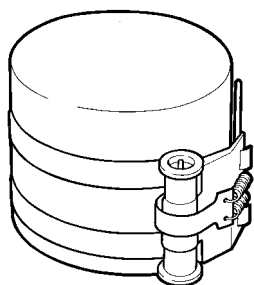
TOOL NO.	DESCRIPTION	
99360336		Spacer (to be used with 99360334)
99360338		Cylinder liner compression plate (to be used with 99360334-99360336)
99360351		Tool to stop engine flywheel
99360499		Tool to take down and fit back camshaft bushes
99360500		Tool to lift crankshaft
99360551		Bracket to take down and fit engine flywheel

TOOLS**TOOL NO.****DESCRIPTION****99360553**

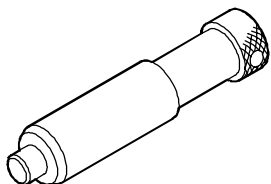
Tool for assembling and installing rocker arm shaft

99360585

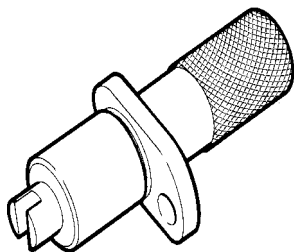
Swing hoist for engine disassembly assembly

99360605

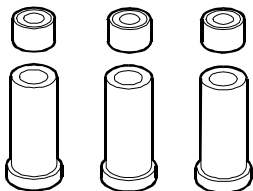
Belt to insert piston in cylinder liner (60 - 125 mm)

99360612

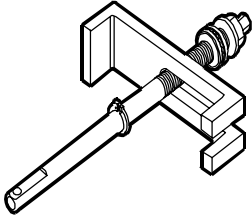
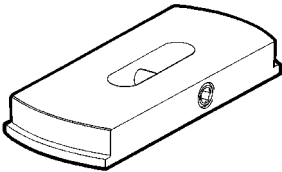
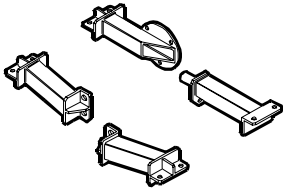
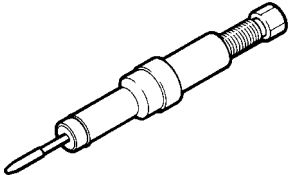
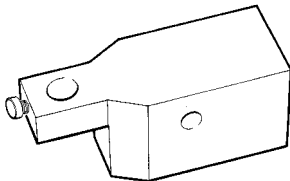
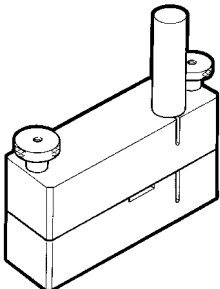
Tool for positioning engine P.M.S.

99360613

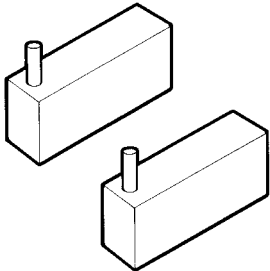
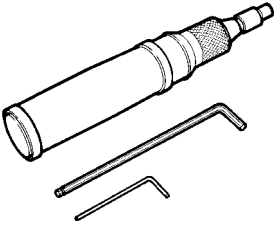
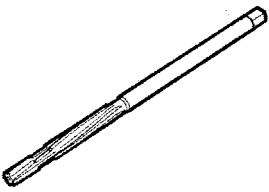
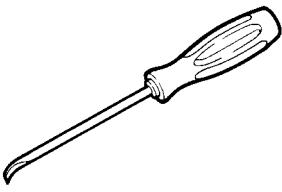
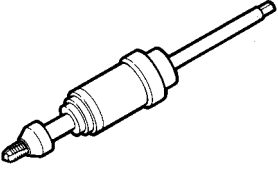
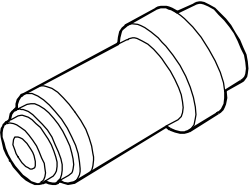
Tool for timing of phonic wheel on timing gear

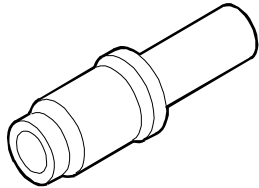
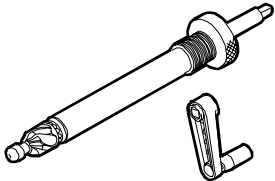
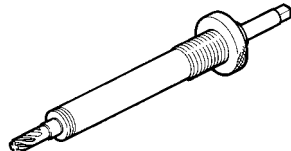
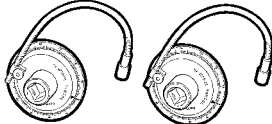
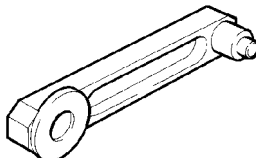
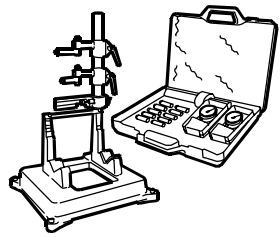
99360703

Tool to stop cylinder liners

TOOLS	
TOOL NO.	DESCRIPTION
99360706 	Tool to extract cylinder liners (to be used with specific rings)
99360728 	Ring (125 mm) (to be used with 99360706)
99361036 	Brackets fixing the engine to rotary stand 99322230
99365056 	Tool for injector holder heading
99370415 	Base supporting the dial gauge for checking cylinder liner protrusion (to be used with 99395603)
99378100 	Tool for printing engine identification plates (to be used with special punches)

TOOLS

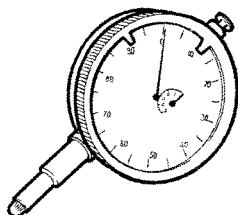
TOOL NO.	DESCRIPTION
99378101 99378102 99378103 99378104 99378105 99378106	 Punches (A,B,C,D,E,F) for printing engine identification plates (to be used with 99378100)
99389834	 Torque screwdriver for calibrating the injector solenoid valve connector check nut
99390330	 Valve guide sleeker
99390772	 Tool for removing injector holding case deposits
99390804	 Tool for threading injector holding cases to be extracted (to be used with 99390805)
99390805	 Guide bush (to be used with 99390804)

TOOLS	
TOOL NO.	DESCRIPTION
99394015 	Guide bush (to be used with 99394041 or 99394043)
99394041 	Cutter to rectify injector holder housing (to be used with 99394015)
99394043 	Reamer to rectify injector holder lower side (to be used with 99394015)
99395216 	Measuring pair for angular tightening with 1/2" and 3/4" square couplings
99395219 	Gauge for defining the distance between the centres of camshaft and transmission gear
99395363 	Complete square to check connecting rod squaring

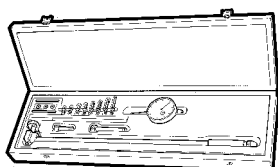
TOOLS

TOOL NO.

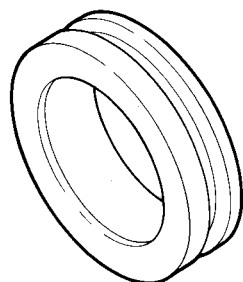
DESCRIPTION

99395603

Dial gauge (0 - 5 mm)

99395687

Reaming gauge (50 - 178 mm)

99396035

Centering ring of crankshaft front gasket cap

ENGINE REMOVAL - REPLACEMENT

Removal

To remove the engine group, proceed as follows:

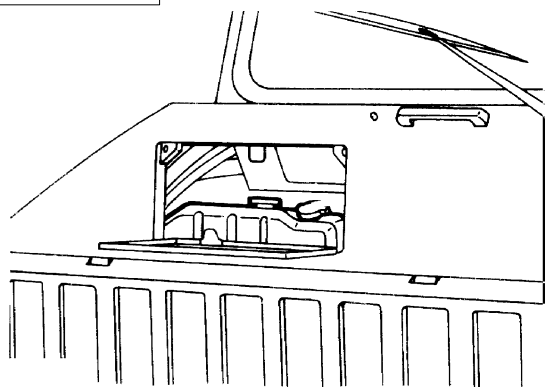
- ☐ Position the vehicle over a pit or on a vehicle lift;
- ☐ Open the battery casing and disconnect cables to eliminate any risk of short circuit.



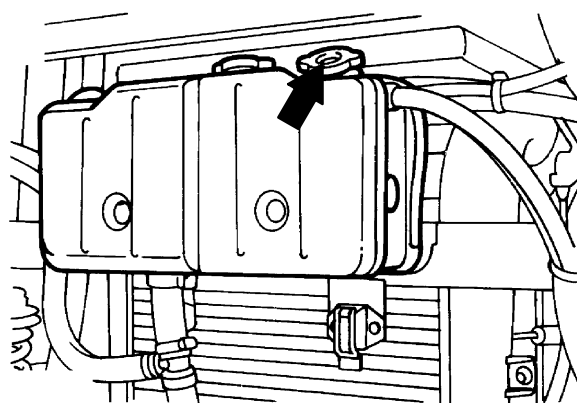
In case of special vehicle equipment, remove part or all of the fittings to permit access to elements for disconnection and the extraction of mechanical groups to be removed.

For these operations refer to the procedures provided by the manufacturer of the equipment.

Figure 15



178NM04



178NM03

(a) single-seat cab, (b) two-seat cab

- ☐ Open the filler cap (1) on the expansion chamber

- ☐ Proceed to drain the conditioning system



For these operations refer to the procedures provided by the system manufacturer.



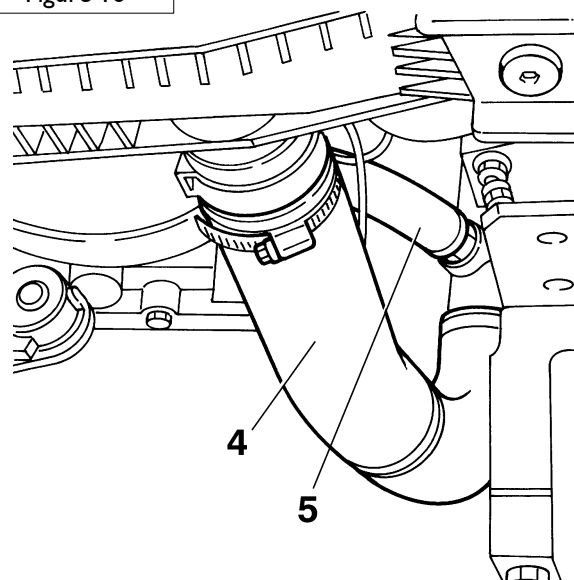
Do not discharge R134 fluid into the atmosphere. Even if its ozone impoverishment potential is zero, it is nevertheless a greenhouse gas.

Recovery and recycling of this substance is governed by legislation.

Always use approved refrigerant recovery and recharging equipment.

Do not mix different refrigerant fluids in the same equipment.

Figure 16



1780301

Place a suitable container under the engine and drain off the engine coolant by disconnecting the radiator hose from the pump (4).



It is forbidden to dispose of exhausted fluid incorrectly or via the public drainage system.

- ☐ It is forbidden to dispose of exhausted fluid incorrectly or via the public drainage system.
- ☐ Tip the cab.
- ☐ Disconnect all power take off electrical and pneumatic connections as indicated in SECTION 5 (only for versions with built-in power take off).
- ☐ Unscrew the propeller shaft flange screws and remove it as indicated in SECTION 10.

Figure 17

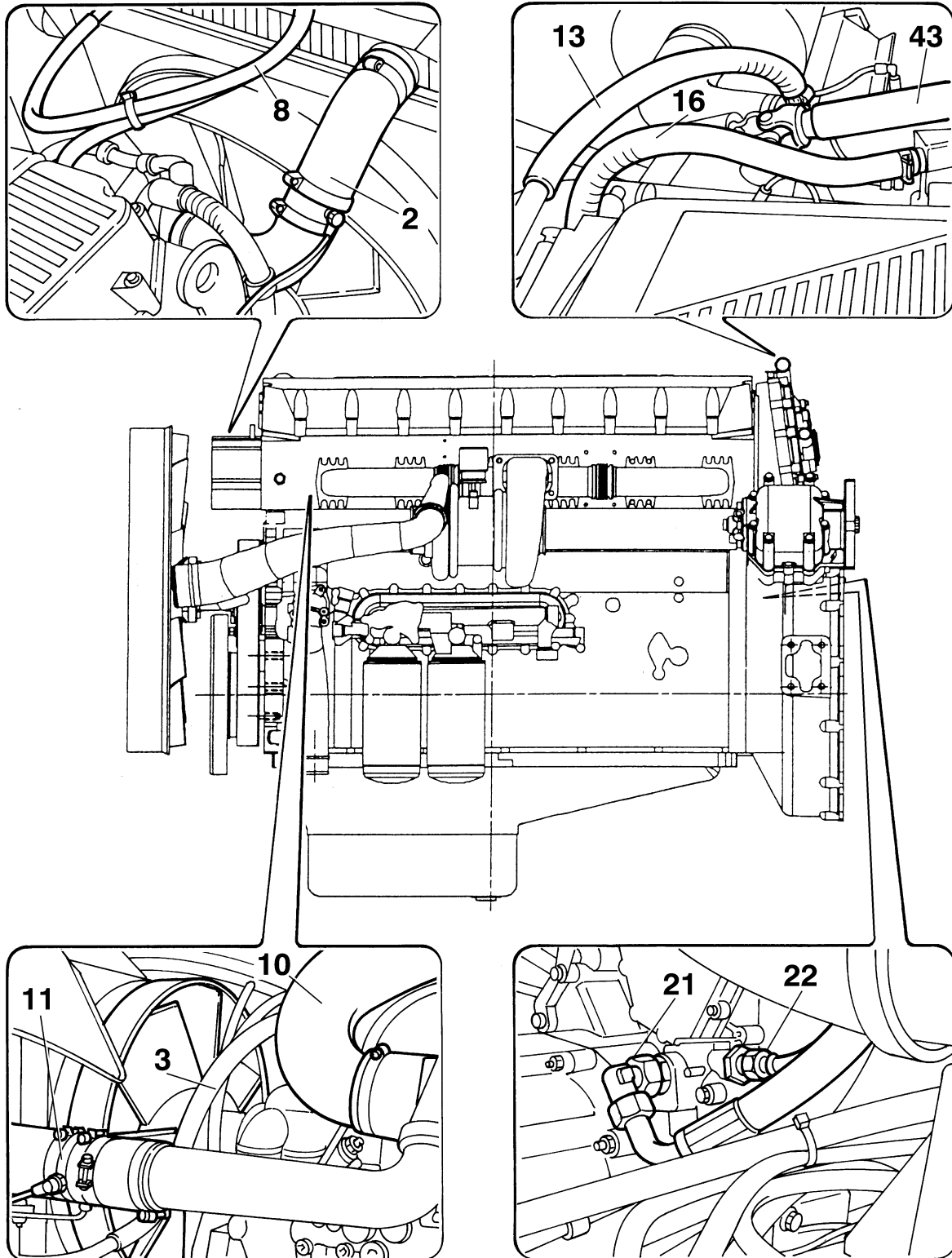
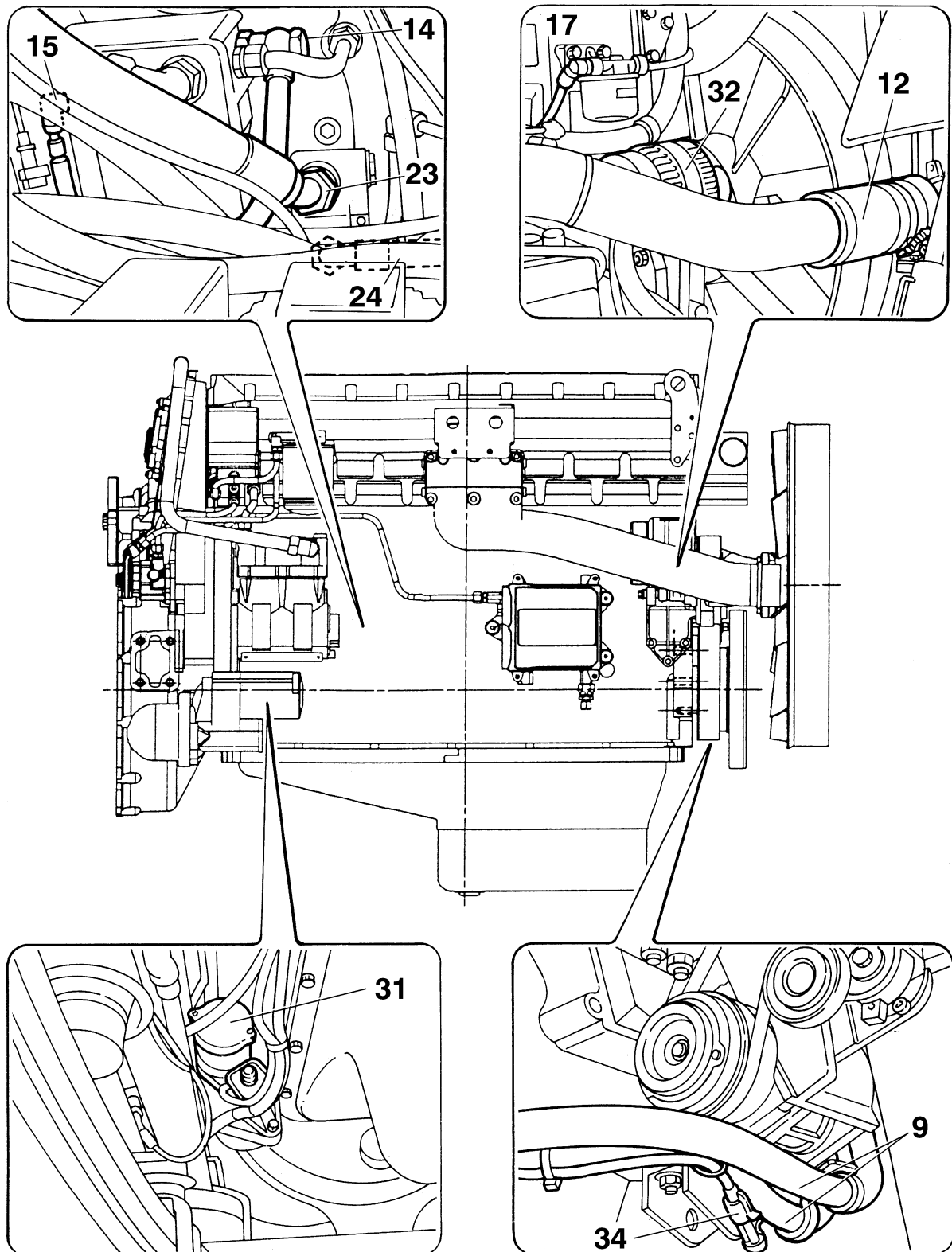


Figure 18

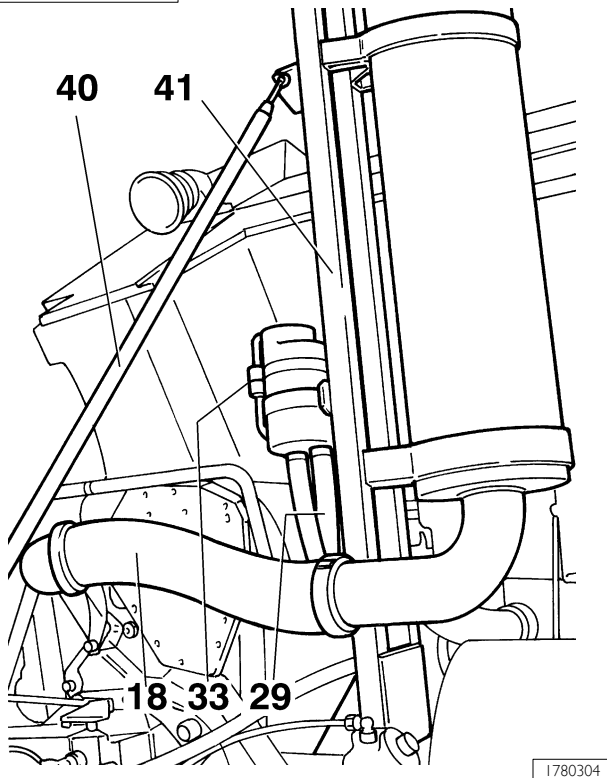


- ☐ Place a suitable container and drain the servo steering hydraulic fluid as indicated in SECTION 15;



It is forbidden to dispose of exhausted fluid incorrectly or via the public drainage system.

Figure 19



- ☐ Remove the exhaust pipe (18) from the turbogroup;

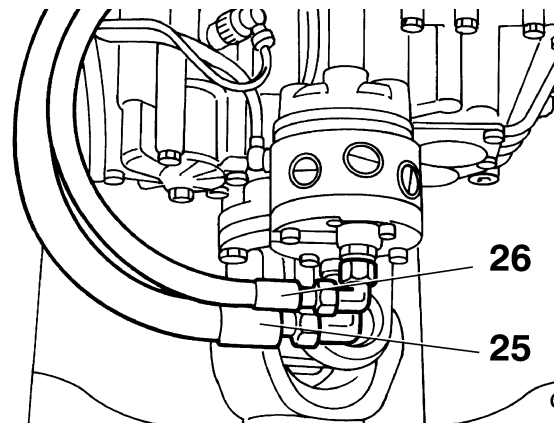
Two/three-axle versions

- ☐ Disconnect all hydraulic lines:
 - from the servo steering reservoir (29);
 - servo steering pump intake on compressor (23);
 - servo steering pump delivery on engine (24).

Four-axle versions

- ☐ Disconnect all hydraulic lines:
 - from the servo steering reservoir (29);
 - servo steering pump intake on engine (21);
 - servo steering pump delivery on engine (22);
 - servo steering pump intake on compressor (23);
 - servo steering pump delivery on engine (24);
 - servo steering pump intake (25) and delivery (26) on gearbox.

Figure 20



All versions:

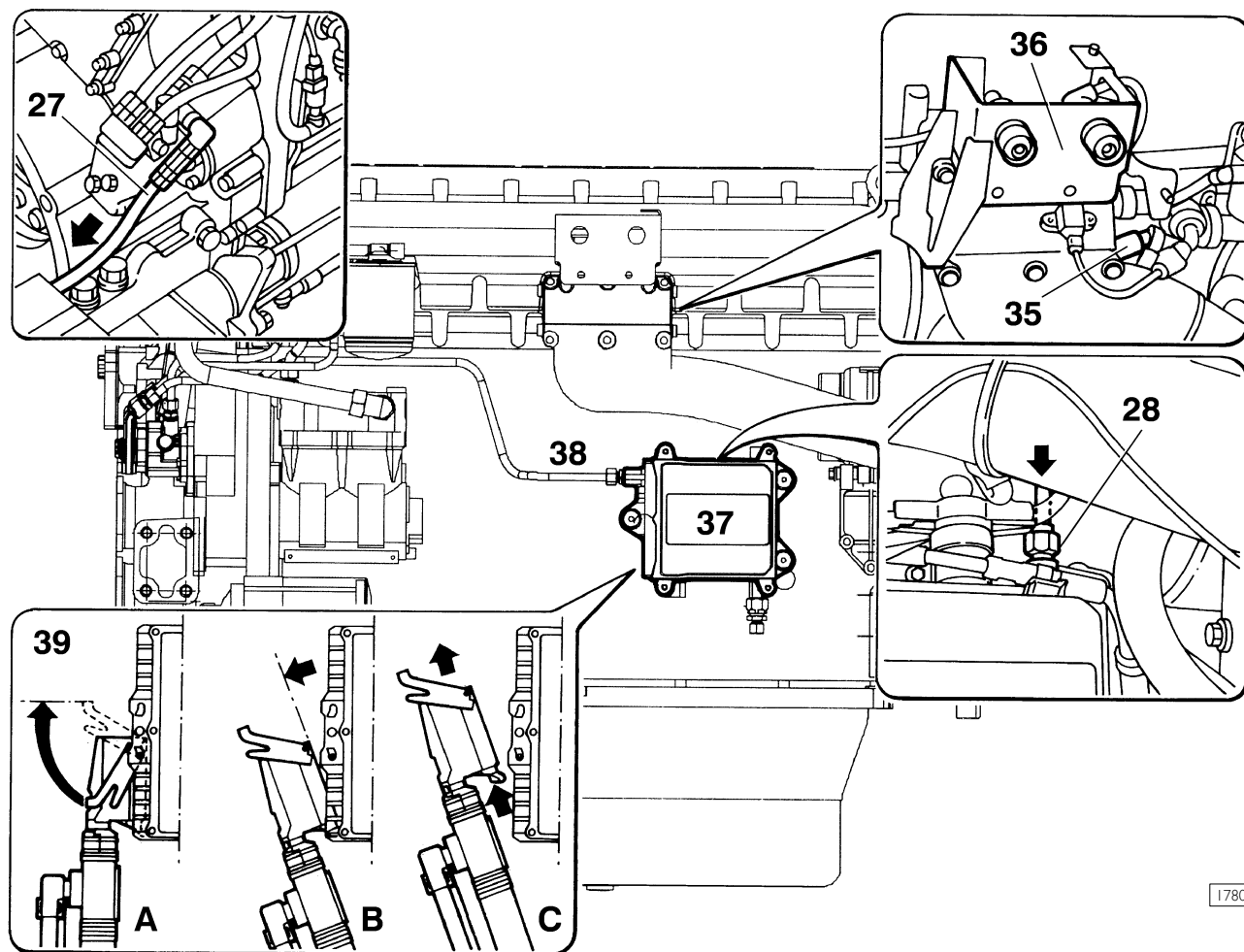
- ☐ Remove the stay (40) and mounting bracket (41) complete with exhaust silencer
- ☐ Disconnect all transmission electrical, pneumatic and hydraulic connections and proceed to remove the transmission group as indicated respectively in SECTION 6 (manual gearbox)
- ☐ Disconnect / remove engine coolant piping:
 - from thermostat to radiator (2);
 - from thermostat to cab heater (3);
 - from expansion chamber to intake pump (5);
 - vent pipe from engine to expansion chamber (8);



During this operation some residual coolant may leak from engine.

- ☐ Disconnect air conditioning system refrigerant fluid piping (9) from compressor;
- ☐ Remove air piping:
 - from air filter to turbogroup (10)
 - from turbogroup to intercooler (11)
 - from intercooler to intake manifold (12)
 - compressor intake (13);
 - compressor delivery (14);
 - tank - compressor connector (15);
 - engine breather (16);
 - waste-gate pilot (17) (VGT versions only);

Figure 21



1780306A

- ☐ Disconnect electrical connections:
 - from starter motor (31);
 - from alternator (32);
 - from servosteering oil level indicator (33);
 - from air conditioner compressor (34);
 - from diagnostics cable (35);
- ☐ Remove the start/stop button mounting (36) unscrewing fastenings;
- ☐ Disconnect the lower connector (39) of the engine control unit (36) proceeding as follows:
 - A. Lift the safety catch
 - B. Turn the connector to remove it from the control unit
 - C. lift the connector to free it from the attachment tooth.
- ☐ Disconnect the fastening clamps and tip the vehicle side harness so that it does not obstruct operations;
- ☐ Disconnect the following pipes:
 - fuel return (27);
 - Fuel supply (28);
- ☐ Remove the gearshift command lever (43) and associated mechanisms, fastening the rod to the cab;
- ☐ Remove the engine oil dipstick (not illustrated) from the radiator mounting;
- ☐ Attach suitable chains or cables to the engine mounting brackets, then bring them into tension using appropriate lifting gear;
- ☐ Check with extreme care that all elements have been disconnected and that all cable/piping and wiring clamps have been freed;
- ☐ Remove the front and rear elastic engine supports from both sides;
- ☐ Carefully lift the engine group extracting it from above, and place it on a suitable bench.



The upper connector (38) cannot be disconnected, except in the event of works on engine side wiring.

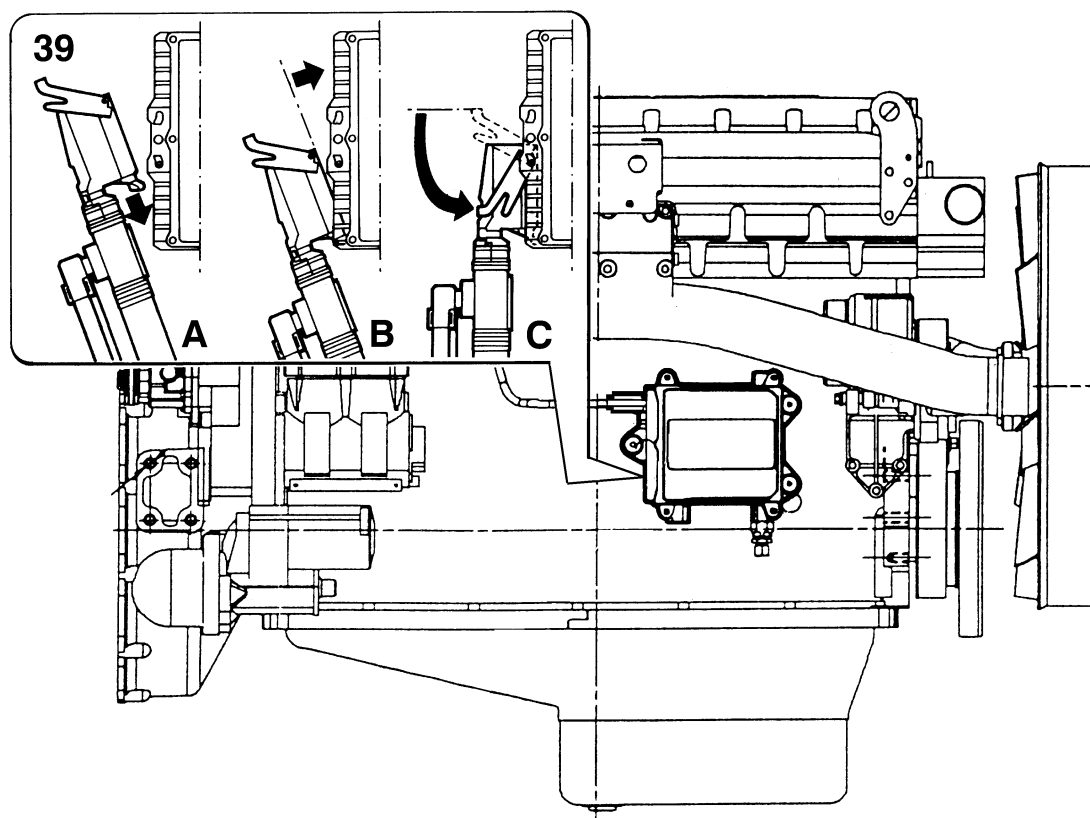
Replacement

To replace the engine group, follow the removal instructions in reverse order.

Pay special attention to the manoeuvres necessary for installing the group into the engine compartment and take the following precautions:

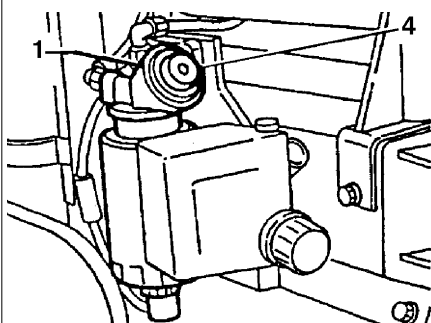
- ☐ Check the elastic engine group and gearbox supports. Replace them with new ones if any wear is evident;
- ☐ Check all exhaust piping components. Replace with new in case of wear.
- ☐ Tighten all fastenings to the specified torque.
- ☐ Fill the sump with the specified lubricant and check the level.
- ☐ Fill the cooling system with the specified coolant.
- ☐ Fill the servosteering hydraulic system with the specified fluid and subsequently start the engine and bleed the system as indicated in section 1.5.
- ☐ Connect the engine control unit lower connector (39) as follows:
 - A. Insert the attachment tooth into its seat.
 - B. Turn the connector to connect it to the control unit.
 - C. Lower the safety catch

Figure 22

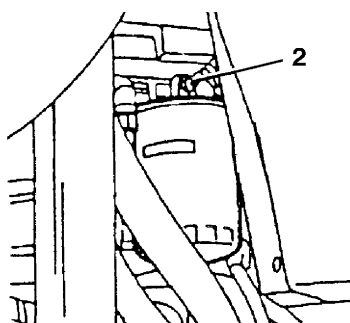


Bleeding air from supply system

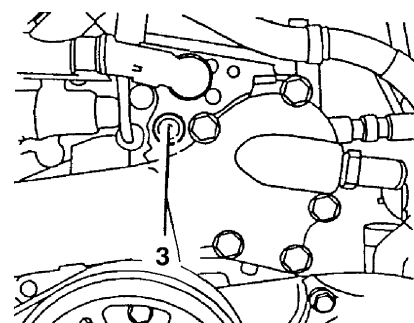
Figure 23



178NM117



178NM118



178NM119



Before starting the engine bleed any air from the fuel supply system, applying the dedicated pipes to the bleed points to allow the fuel to bleed into a recipient placed below:

- ☐ Bleed screw (1) located on pre-filter.
- ☐ Bleed screw (2), located on filter support.
- ☐ Bleed screw (3), located on front of cylinder head.
- ☐ Operate the pump (4) situated on the prefilter support until bubble-free fuel flows from the screw (1). Close the screw (1).
- ☐ Repeat the operation for screw 2.
- ☐ Repeat the operation for screw 3.



In all cases prevent fuel from soiling water pump/alternator drive belts.

Checks and controls



Start the engine and allow it to run at a speed slightly above idling and wait for the engine coolant to reach thermostat opening value, then check that:

- ☐ The absence of coolant leaks from the engine cooling circuit and cab heater hoses, tighten the respective collars if necessary.
- ☐ The absence of oil leaks from the cylinder head or rocker cover, between engine block and sump or from the various lubricant circuit pipes.
- ☐ The absence of air leaks from any disconnected compressed air system connections.
- ☐ Check that the dashboard warning lights function correctly along with any other equipment disconnected when engine was removed.

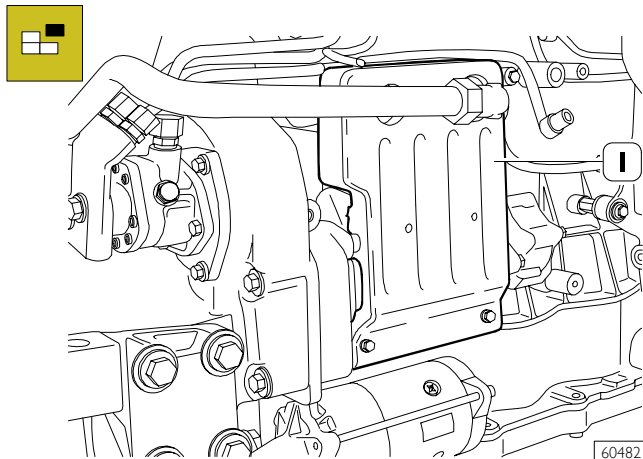
DISMANTLING THE ENGINE ON THE BENCH

Before fixing the engine on the rotary stand 99322230 remove the following components:

On the engine right-hand side

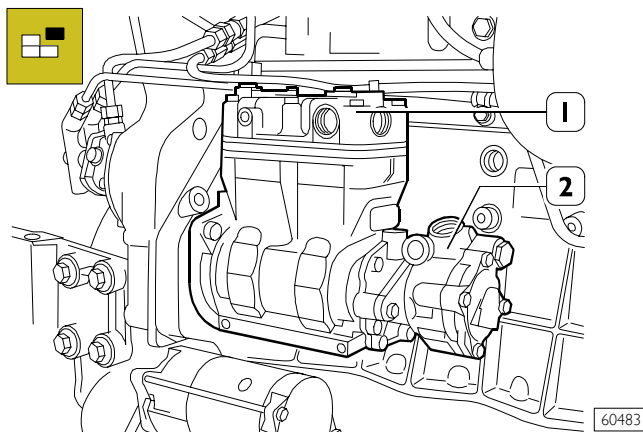
- diesel cartridge filter (1);
- power steering system tank (2);
- electric connections;

Figure 24



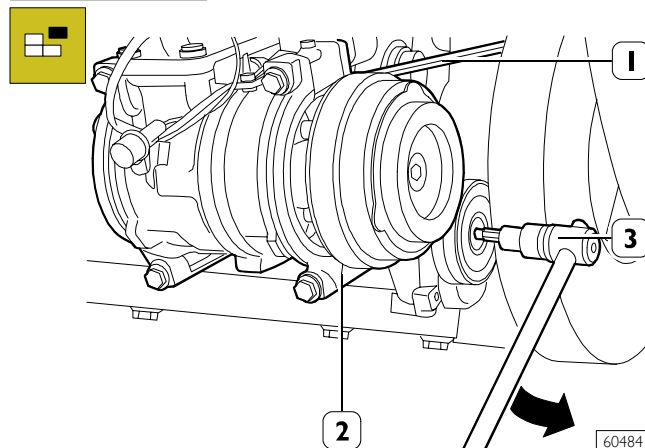
- soundproofing shield (1);
- all the pipes connecting the compressor;

Figure 25



- compressor (1) fitted with power steering pump (2);

Figure 26



- remove the air conditioner control belt (1) using a fit tool (3) and acting in the direction shown by the arrow;
- disassemble the air conditioner (2) fitted with the engine support;

On the engine left-hand side

- engine support (1)

Figure 27

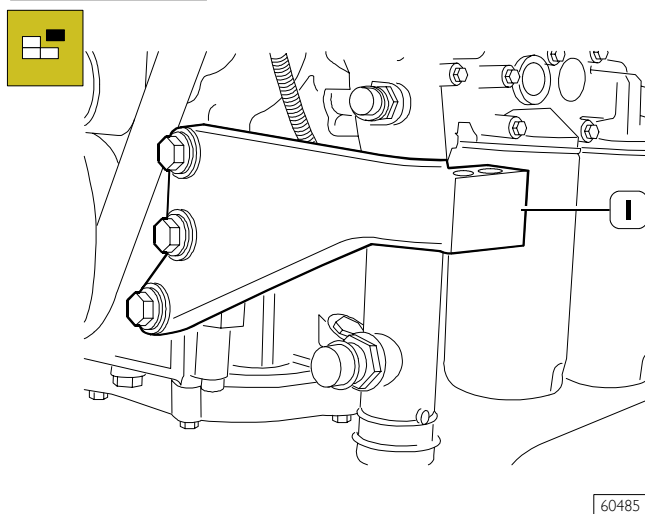
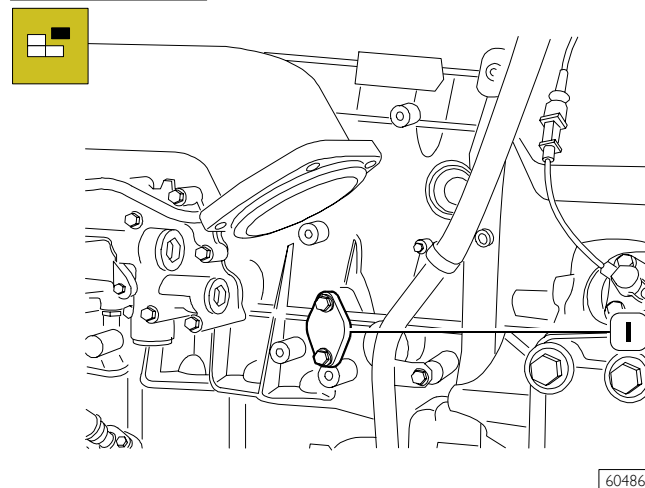
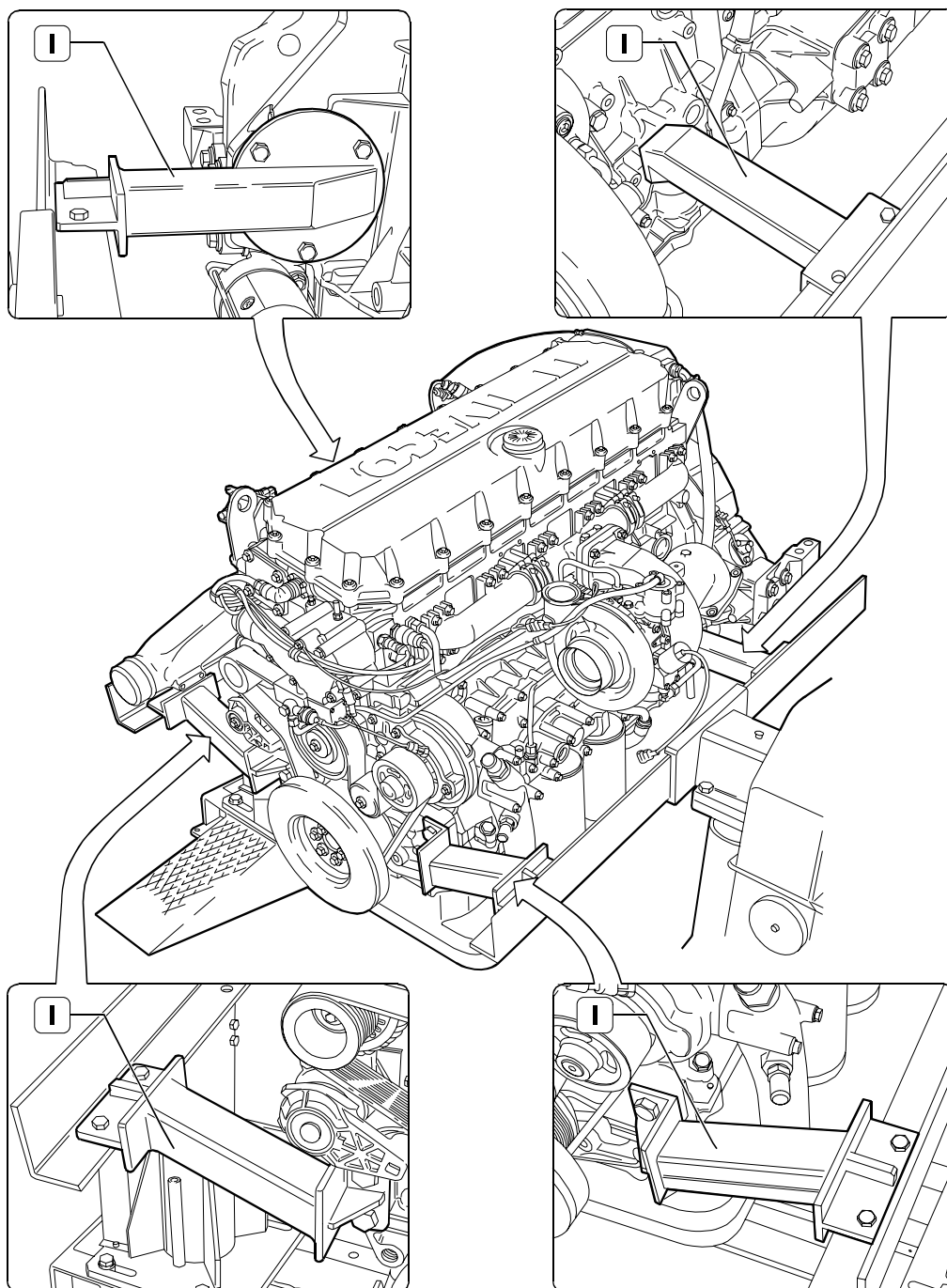


Figure 28



- oil pressure controlling valve (1);

Figure 29

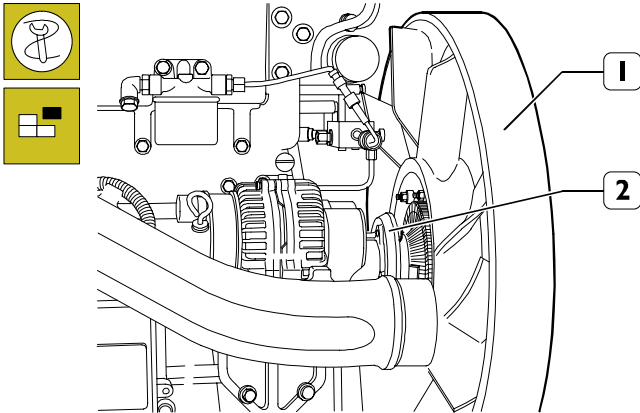


71700

Fix the engine to the rotary stand 99322230, by means of brackets 99361036 (I), remove the fan.

Remove all electrical wiring from the sensors and electric activators.

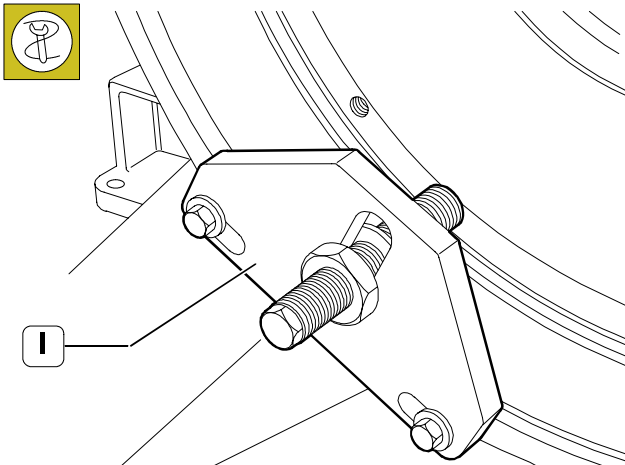
Figure 30



71701

Remove the fan (1) from the flange (2).

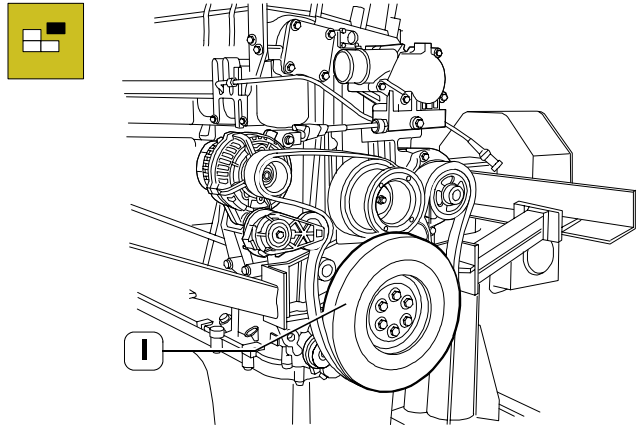
Figure 31



71702

Lock the engine flywheel using tool 99360351 (1).

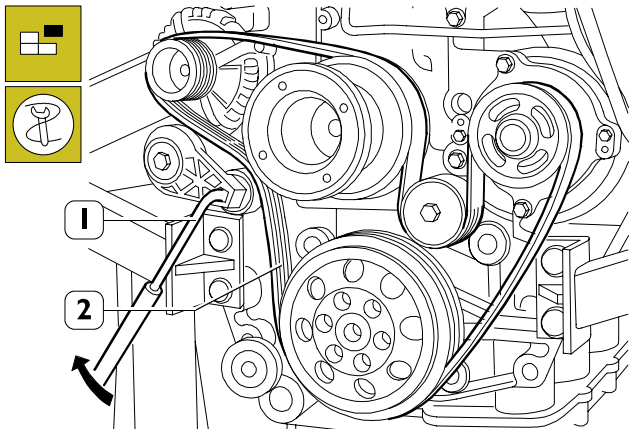
Figure 32



71703

Remove the flywheel pulley (1) by removing the six Allen screws.

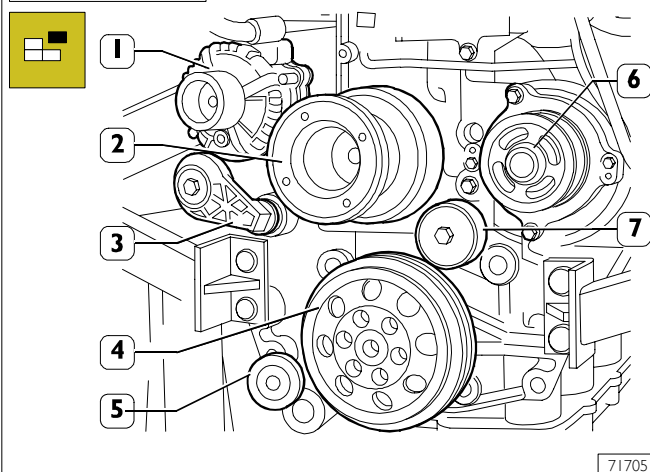
Figure 33



71704

Turning the specific tool (1) clockwise, remove the auxiliaries drive belt (2).

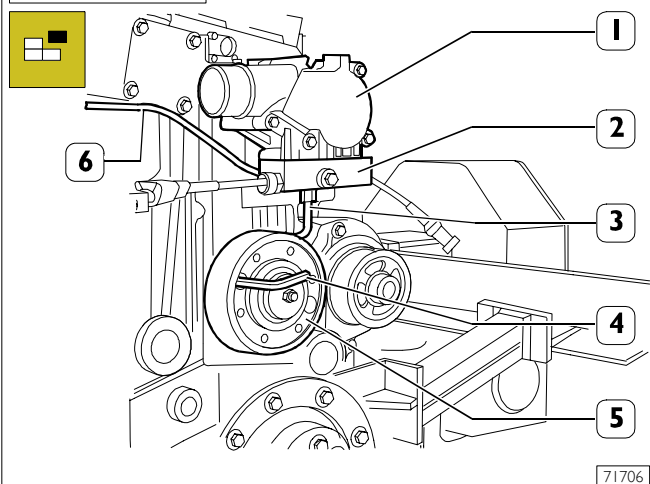
Figure 34



Remove the following parts:

- ☐ alternator (1)
- ☐ fan flange (2)
- ☐ automatic tensioner (3)
- ☐ crankshaft pulley (4)
- ☐ water pump (6)
- ☐ air conditioner drive belt tensioner (5)

Figure 35

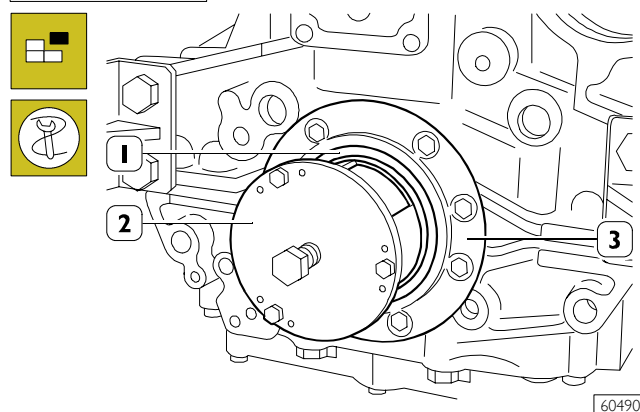


Disconnect the pipes (3 and 6) from the V.G.T. command solenoid valve.

Remove the thermostat group (1) complete with V.G.T command solenoid (2)

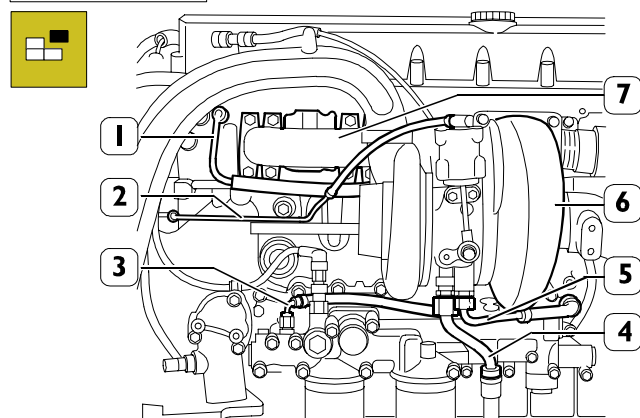
Remove the pulley (5) using the Allen key (4).

Figure 36



Apply extractor 99340053 (2) and remove the crankshaft oil seal. Remove the flange (3).

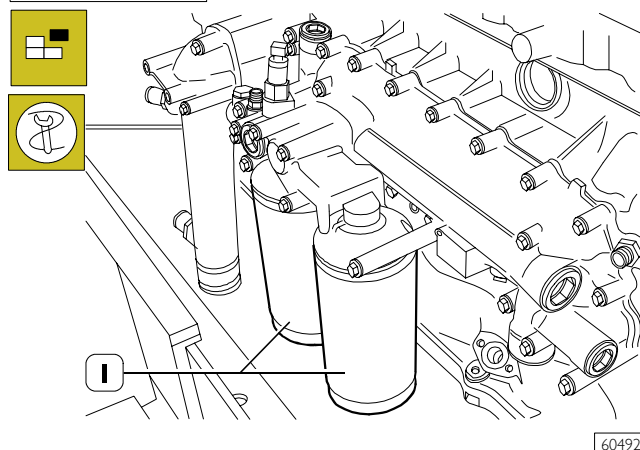
Figure 37



Remove the following parts:

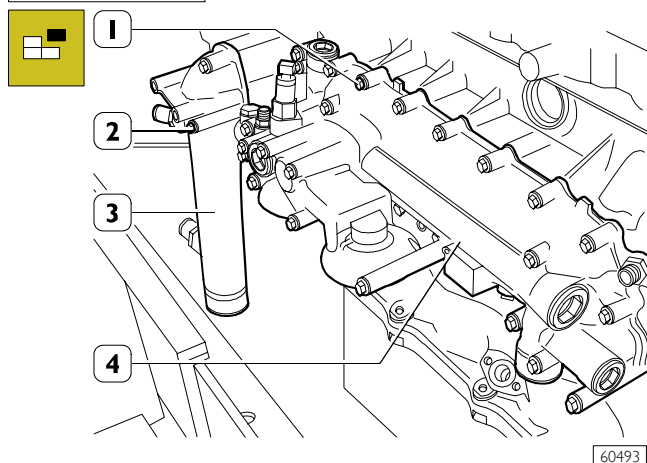
- ☐ Water delivery pipe (5)
- ☐ water return pipe (1)
- ☐ actuator command air piping (2)
- ☐ oil delivery pipe (3)
- ☐ oil return pipe (4)
- ☐ turbocompressor group (6)
- ☐ exhaust manifold (7).

Figure 38



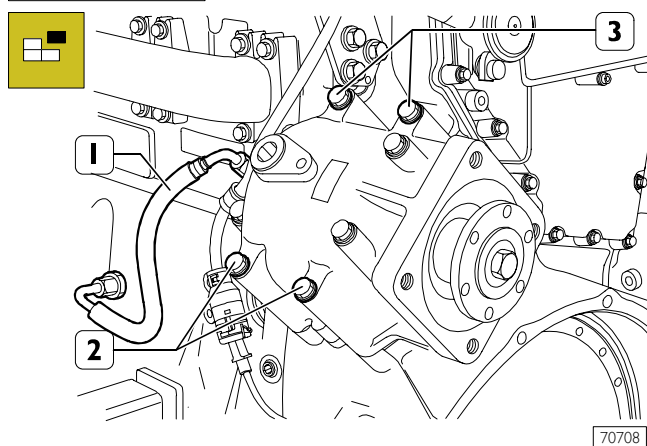
Unscrew the oil filter (1) using tool 99360314.

Figure 39



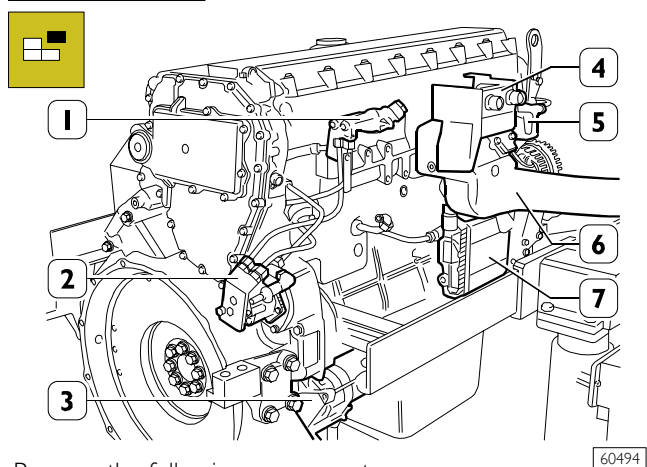
- Unscrew the screws (1) and remove the heat exchanger (4);
- unscrew the screws (2) and remove the water line (3).

Figure 40



- Unscrew the screws (1) and remove the heat exchanger (4);
- unscrew the screws (2) and remove the water line (3).

Figure 41

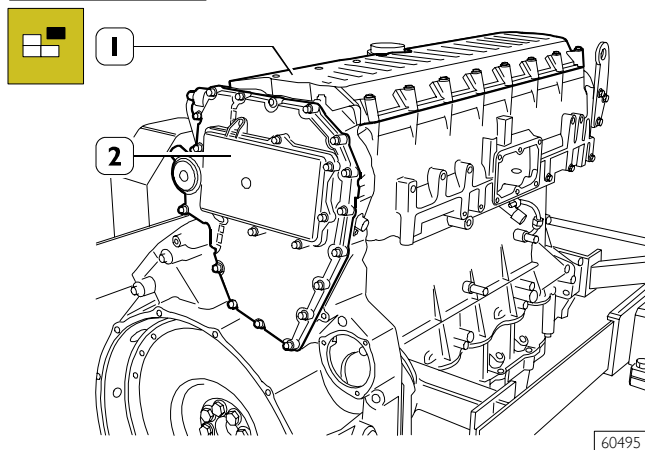


Remove the following components:

- fuel filter support (1);
- fuel pump (2) and lines;
- starter (3);
- engine starting button support (4);

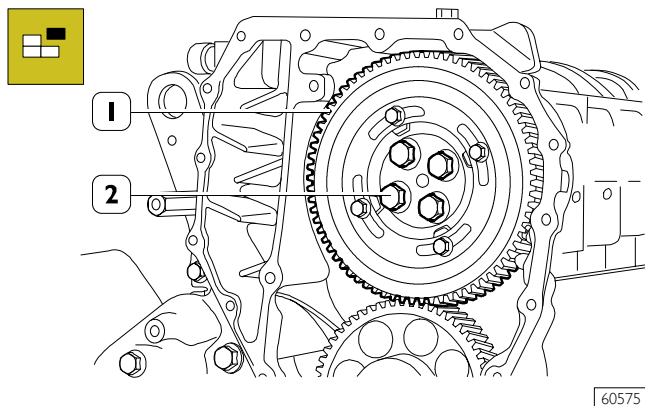
- PWN valve air filter (5);
- suction manifold (6) fitted with resistance for engine pre-heating;
- control unit (7).

Figure 42



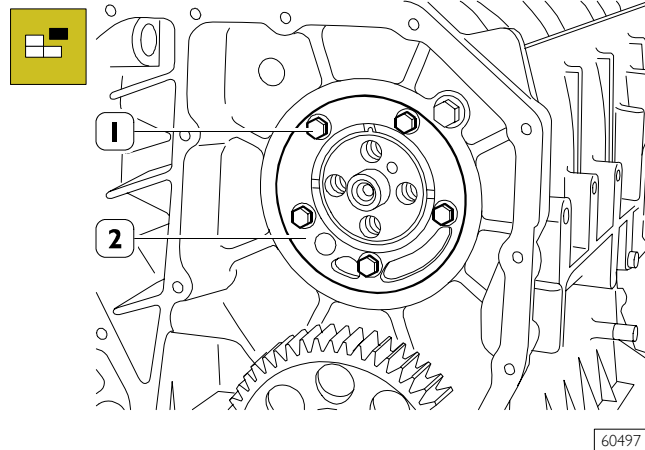
- Remove the rocker cover (1) and the timing gear cover (2)

Figure 43



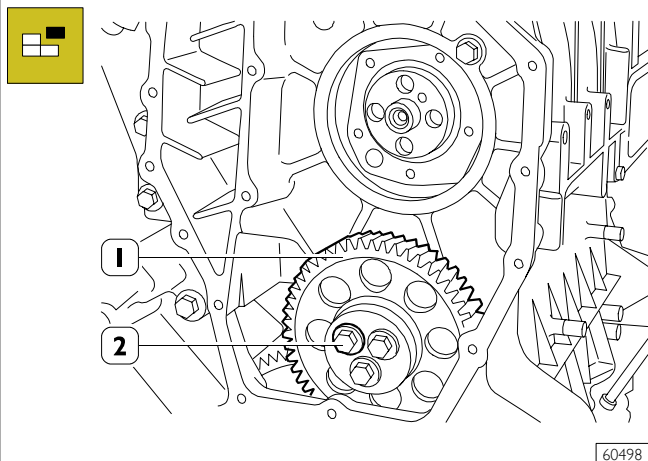
- Unscrew the screws (2) and remove the gear (1) fitted with phonic wheel.

Figure 44



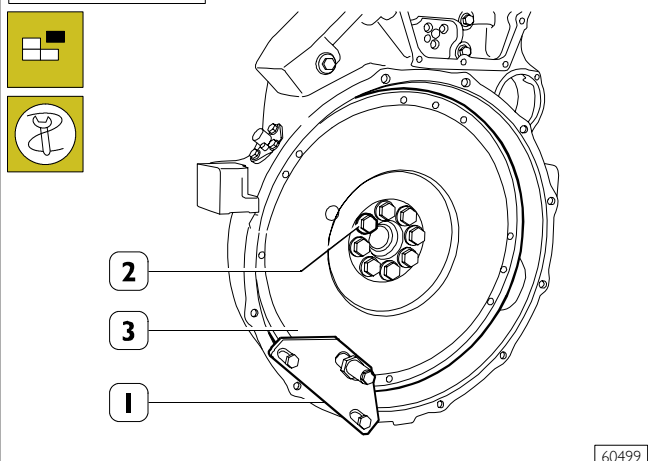
- Unscrew the screws (1); tighten one screw in a reaction hole and remove the shoulder plate (2), remove the sheet gasket.

Figure 45



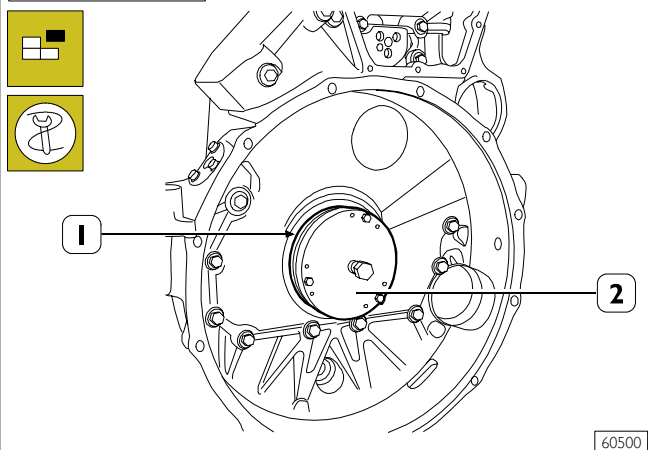
Unscrew the screws (1) and remove the transmission gear (2).

Figure 46



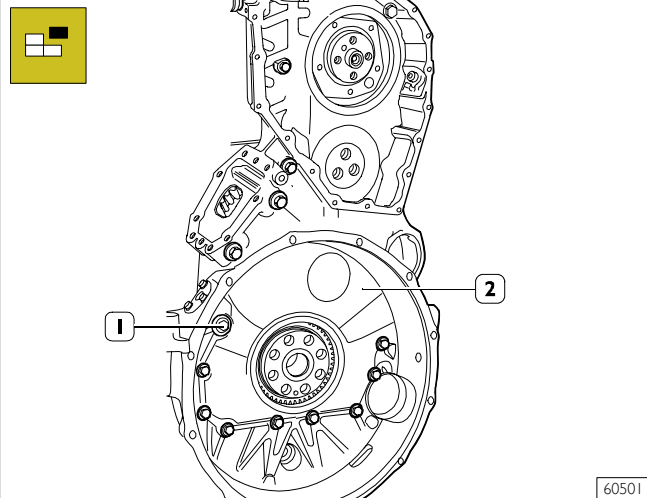
Stop the engine flywheel (3) rotation by means of tool 99360351 (1), unscrew the fixing screws (2) and remove the engine flywheel.

Figure 47



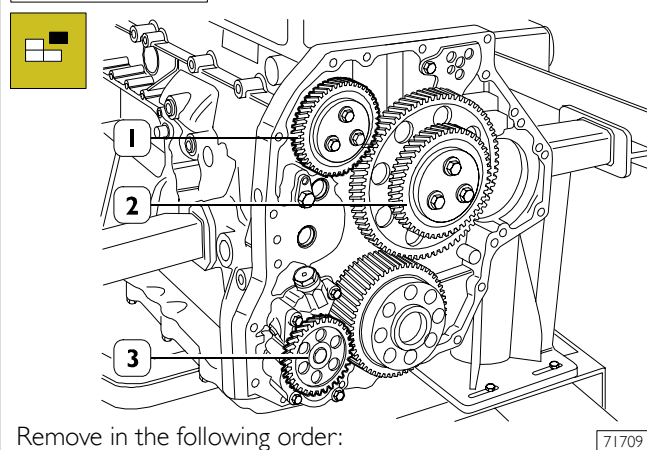
Apply the extractor 99340054 (2) and pull out the seal gasket (1).

Figure 48



Unscrew the screws (1) and take down the gearbox (2).

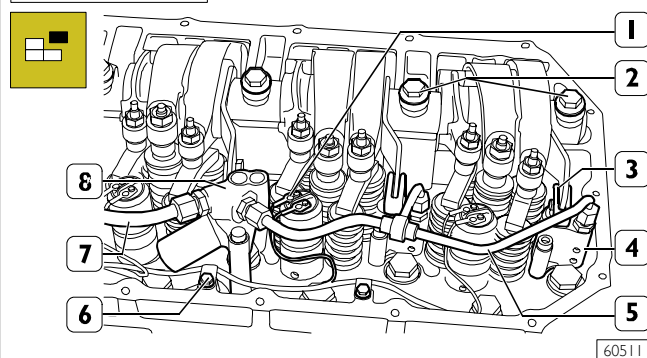
Figure 49



Remove in the following order:

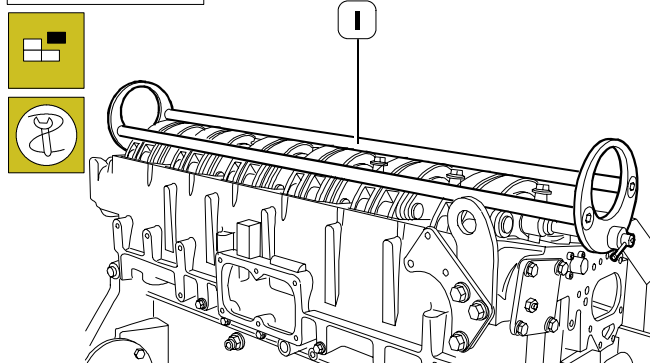
- ☐ The P.T.O. drive cog (1);
- ☐ The transmission cog (2);
- ☐ The oil pump cog (3).

Figure 50



- ☐ Remove the engine brake lever retaining springs (3).
- ☐ Unscrew screws (3) to remove injector electrical connections.
- ☐ Unscrew screws (6) fastening injector wiring to the head.
- ☐ Electrically disconnect the engine brake solenoid valve (8).
- ☐ Remove the engine brake cylinder (4) feeder pipes (5 and 7).
- ☐ Remove the rocker shaft fastening screws (2).
- ☐ Unscrew screws (6) to remove injector wiring from the head. The wiring must be removed from the front.

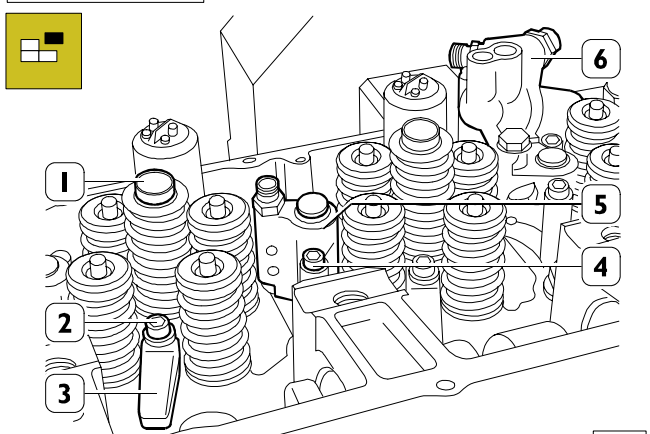
Figure 51



60512

Apply tool 99360553 (1) and remove the rocker arm shaft assembly.

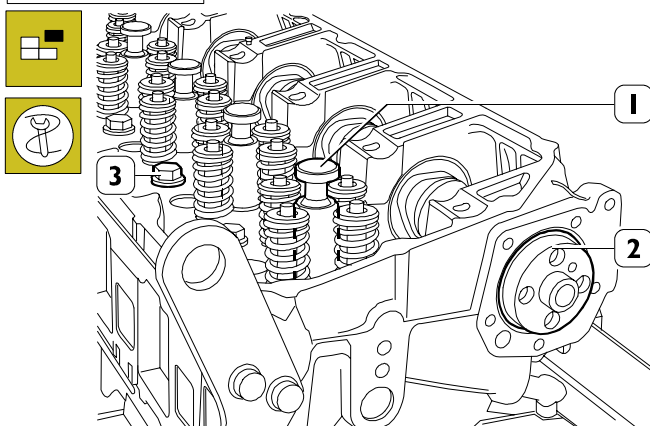
Figure 52



60513

- ☐ Unscrew the screws (2) fixing the brackets (3) and remove the injectors (1).
- ☐ Unscrew the screws (4) and remove the exhaust brake pins (5).
- ☐ Unscrew the screws and remove the slave cylinder (6).

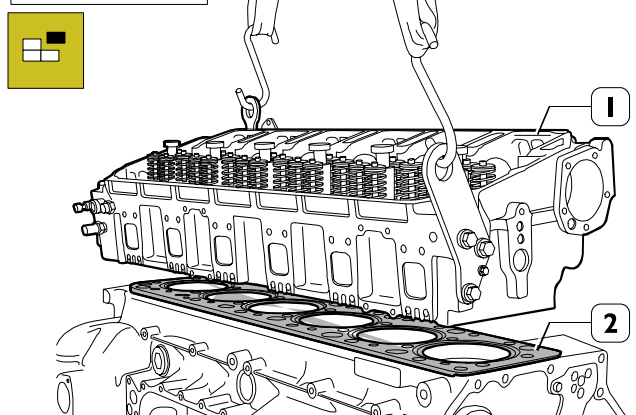
Figure 53



60514

- ☐ Fit the plugs 99360180 (1) instead of injectors.
- ☐ Remove the camshaft (2).
- ☐ Unscrew the fixing screws on the cylinder head (3).

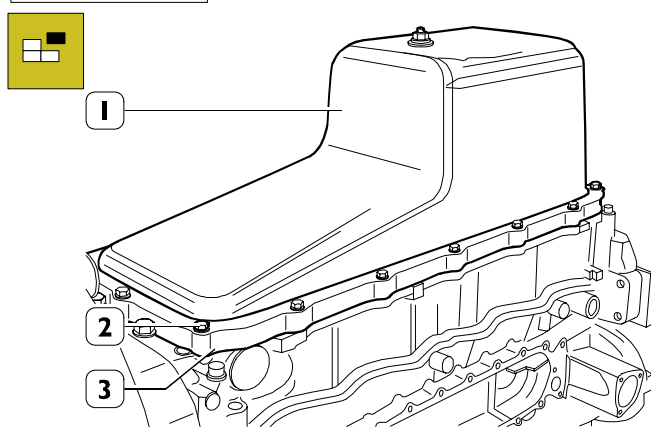
Figure 54



60515

- ☐ By means of metal ropes, lift the cylinder head (1).
- ☐ Remove the seal (2)

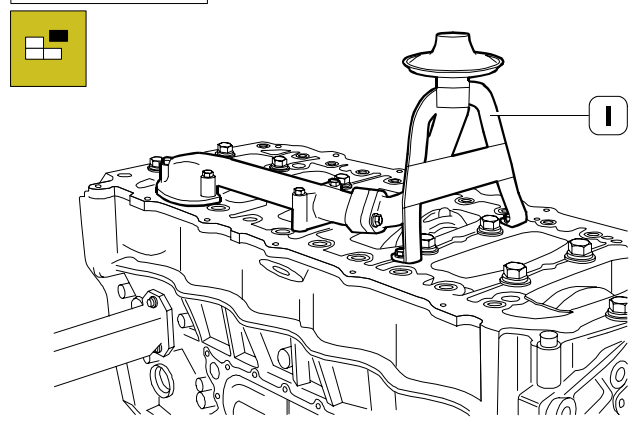
Figure 55



60516

Unscrew the screws (2) and remove the engine oil sump (1) fitted with spacer (3) and seal.

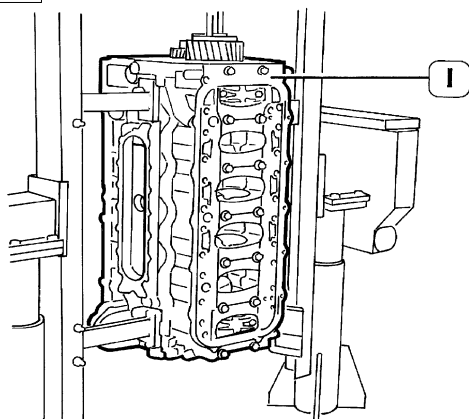
Figure 56



60517

Unscrew the screws and remove suction rose (1).

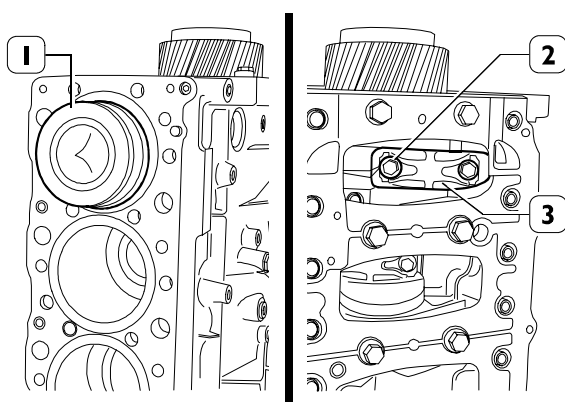
Figure 57



47574

Rotate the block (1) to the vertical position.

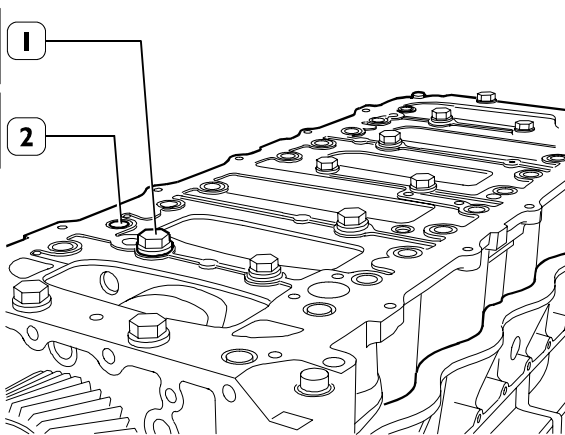
Figure 58



60518

Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston assembly from the upper side. Repeat these operations for the other pistons.

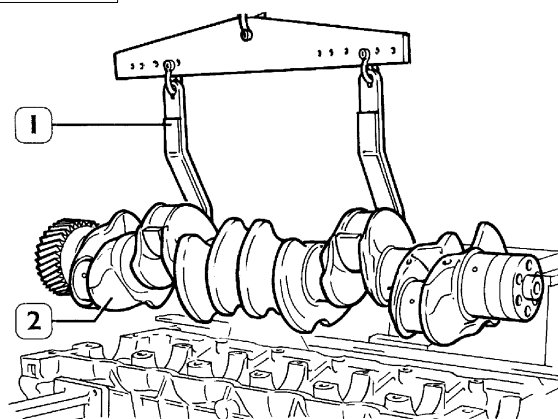
Figure 59



60519

By means of proper and splined wrenches, untighten the screws (1) and (2) and remove the under-block.

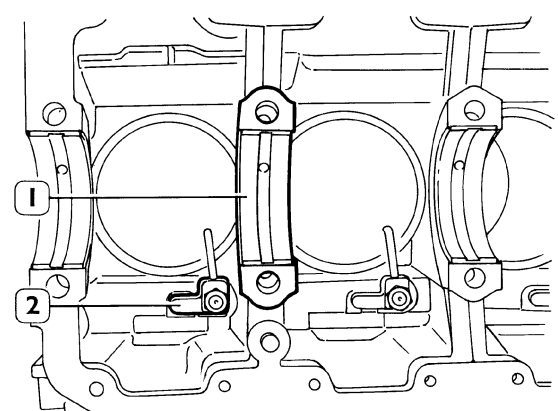
Figure 60



47570

Remove the crankshaft (2) by means of tool 99360500 (1).

Figure 61



47571

Remove the crankshaft half-bearings (1), untighten the screws and remove oil spray nozzles (2). Take down cylinder liners as specified in the relative paragraph.

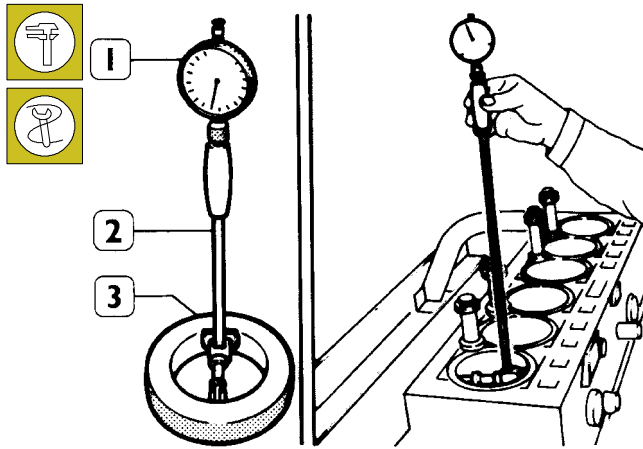


After disassembling the engine, thoroughly clean disassembled parts and check their integrity. Instructions for main checks and measures are given in the following pages, in order to determine whether the parts can be re-used.

REPAIR OPERATIONS

CYLINDER BLOCK Checks and measurements

Figure 62 (Demonstration)



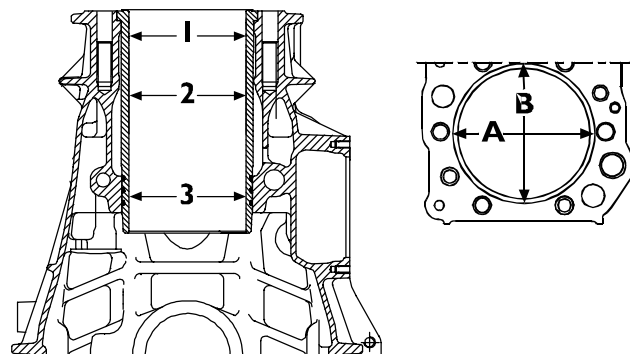
34994

Internal diameter of the cylinder liners is checked for ovalization, taper and wear, using a bore dial (1) centesimal gauge 99395687 (2) previously reset to ring gauge (3), diameter 135 mm.



If a 125 mm ring gauge is not available use a micrometer caliper.

Figure 63

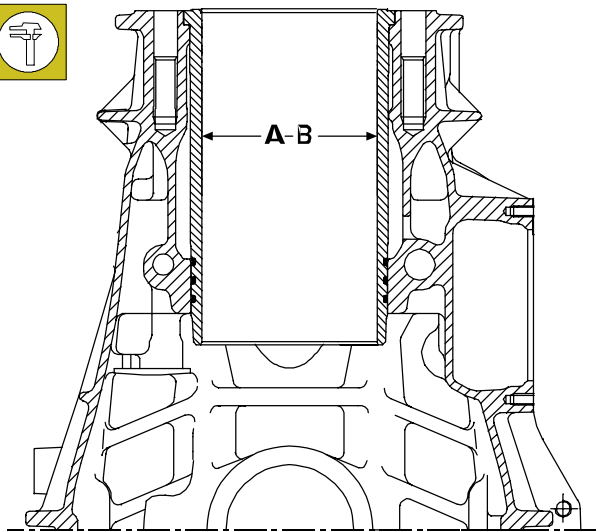


60596

- 1 = 1st measuring
- 2 = 2nd measuring
- 3 = 3rd measuring

Carry out measurements on each cylinder liner at three different levels and on two (A-B) surfaces, to one another perpendicular, as shown in NO TAG.

Figure 64



60595

A = Selection class $\varnothing$ 135.000 to 135.013 mm

B = Selection class $\varnothing$ 135.011 to 135.024 mm

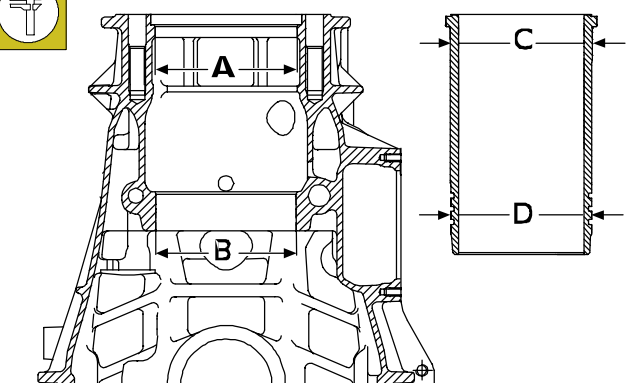
In case of maximum wear >0.150 mm or maximum ovalization >0.100 mm compared to the values indicated in the figure, the liners must be replaced as they cannot be ground, lapped or trued.



ASTRA
PARTS

Cylinder liners are equipped with spare parts with "A" selection class.

Figure 65



60597

A = $\varnothing$ 153.500 to 153.525 mm

B = $\varnothing$ 152.000 to 152.025 mm

C = $\varnothing$ 153.461 to 153.486 mm

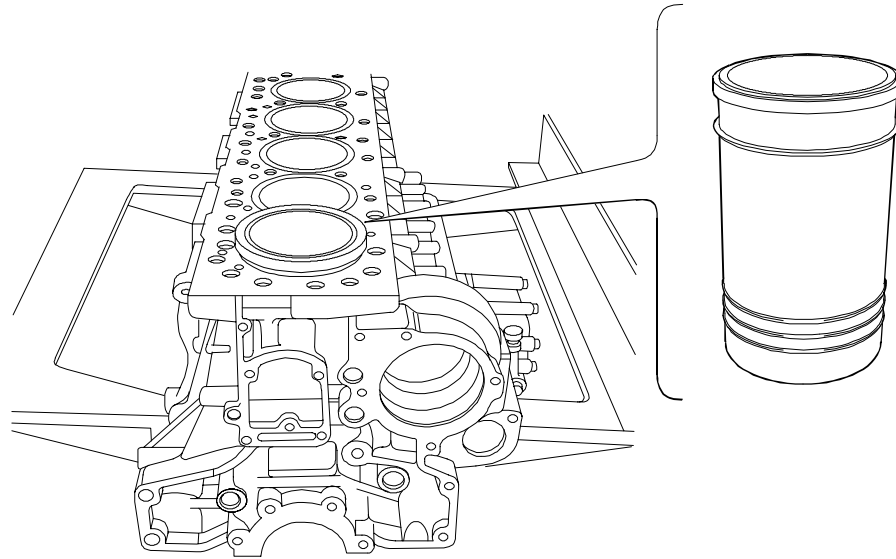
D = $\varnothing$ 151.890 to 151.915 mm

The figure shows the outer diameters of the cylinder liners and the relative seat inner diameters.

The cylinder liners can be extracted and installed several times in different seats, if necessary.

CYLINDER LINERS

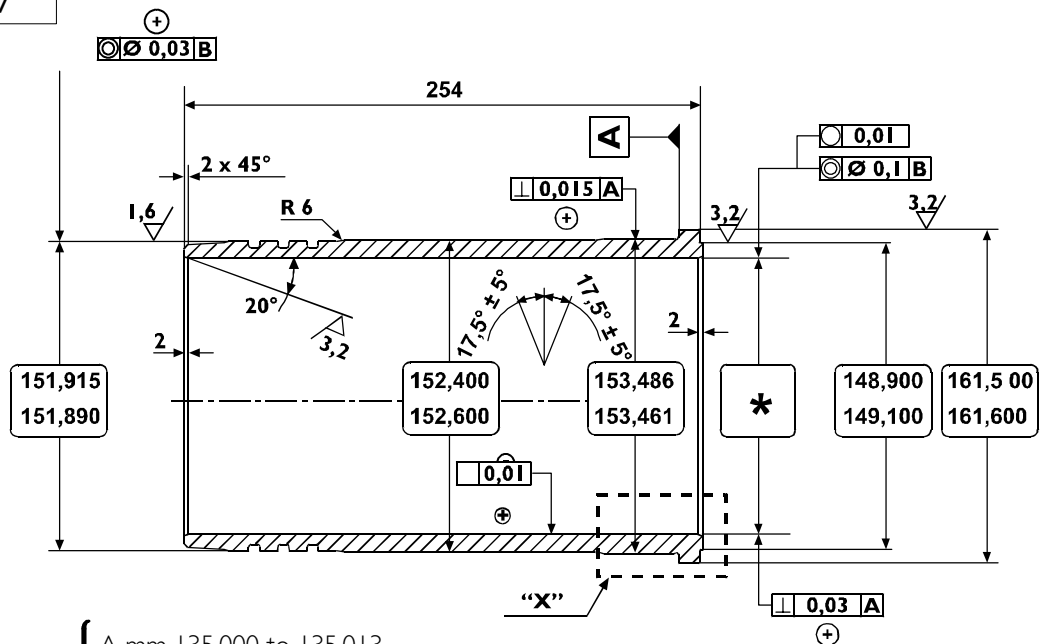
Figure 66



BLOCK WITH CYLINDER LINERS

60598

Figure 67



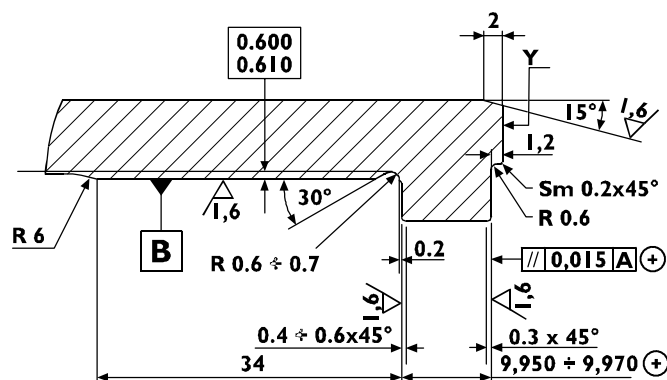
Selection class

{ A mm 135.000 to 135.013
 B mm 135.011 to 135.024

CYLINDER LINERS MAIN DATA

71710

Figure 68



DETAIL "X"

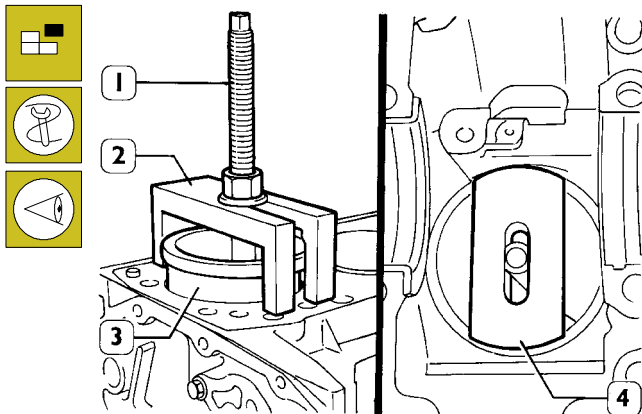
"Y" - Selection class marking area

71711

Replacing cylinder liners

Removal

Figure 69



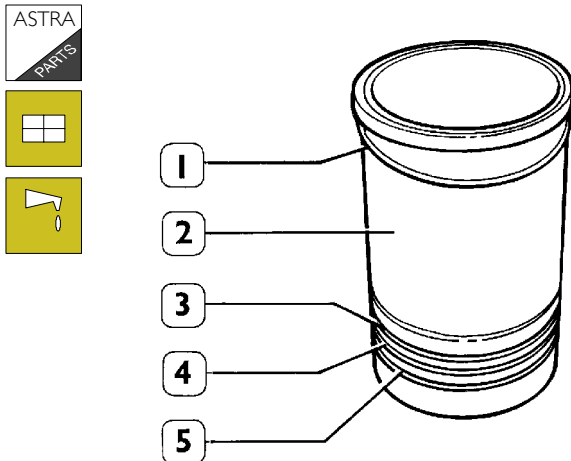
47577

Place details 99360706 (2) and plate 99360728 (4) as shown in the figure, by making sure that the plate (4) is properly placed on the cylinder liners.

Tighten the screw nut (1) and remove the cylinder liner (3) from the block.

Fitting and checking protrusion

Figure 70



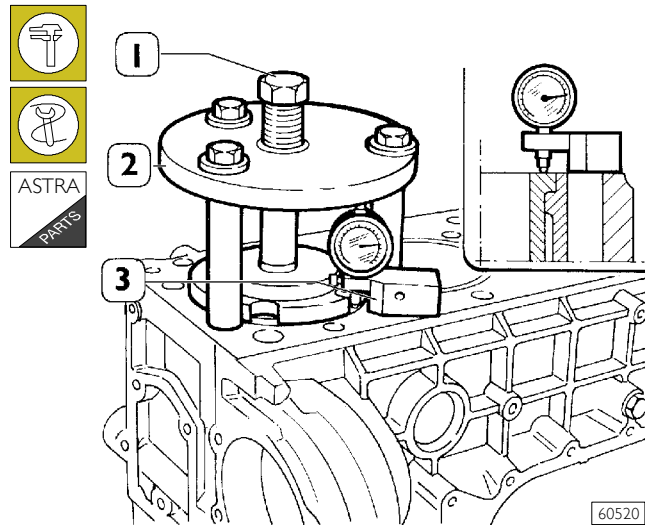
16798

Always replace water sealing rings (3, 4 and 5). Install the adjustment ring (1) on the cylinder liner (2); lubricate lower part of liner and install it in the cylinder unit using the proper tool.

ASTRA
PARTS

The adjustment ring (1) is supplied as spare parts in the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm - 0.14 mm.

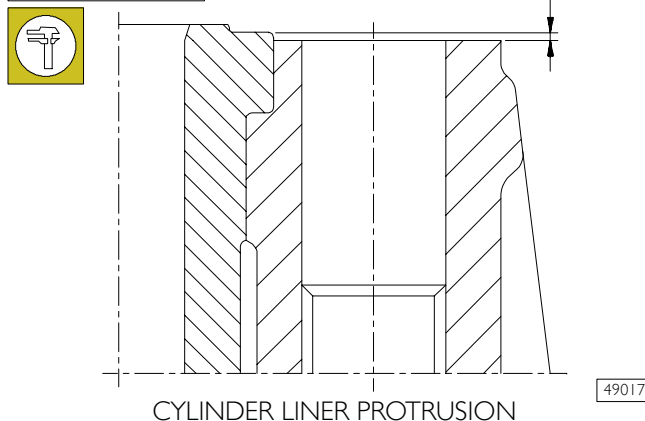
Figure 71



60520

Check the protrusion of the cylinder liners, using tool 99260472 (2) and tightening screw (1) to 225 Nm torque. Using comparator 99395603 provided with comparator base 99370415 (3) that the cylinder lining protrusion from the cylinder head surface is 0.045 - 0.075 mm (Figure 71). If not, replace the adjuster shim (1) (Figure 70) supplied in various thickness.

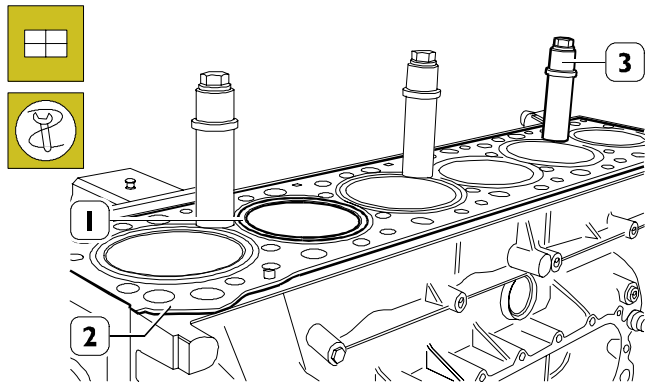
Figure 72



49017

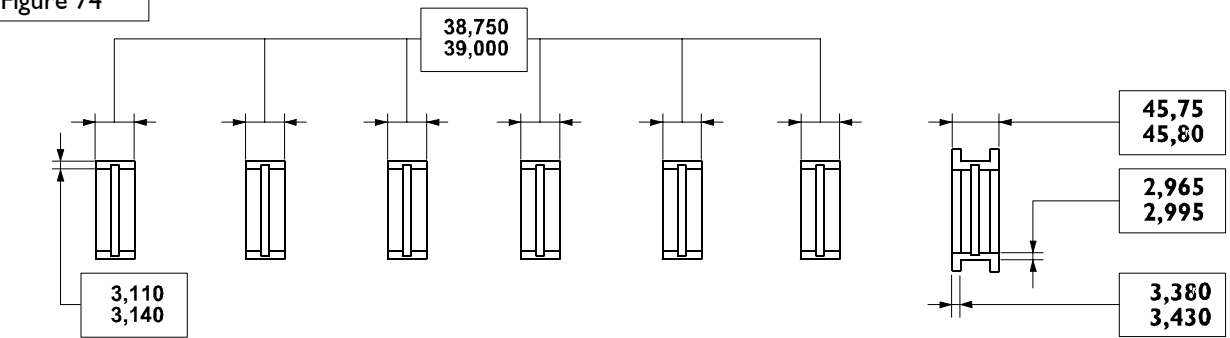
CYLINDER LINER PROTRUSION

Figure 73

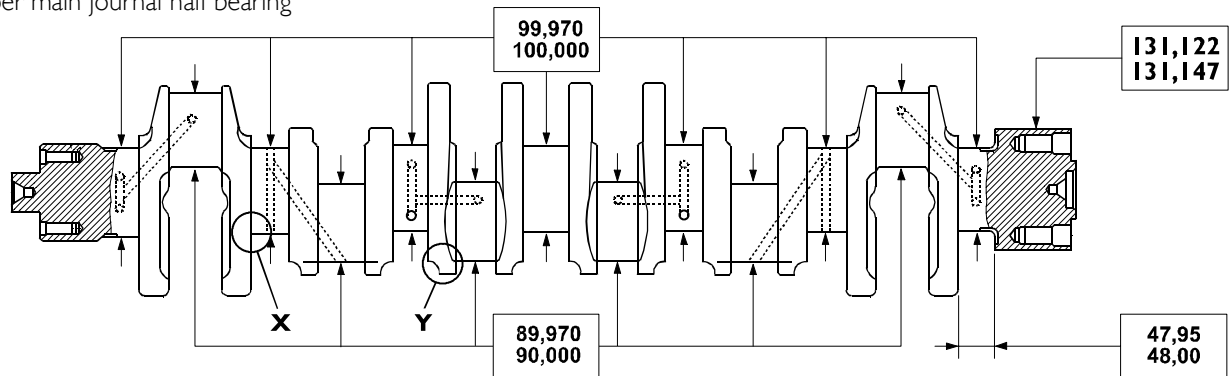


60521

When the installation is completed, block the cylinder liners (1) to the block (2) with studs 99360703 (3).

CRANKSHAFT**Figure 74**

Upper main journal half bearing

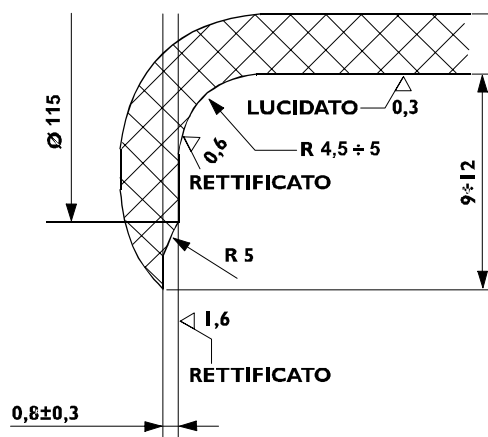


Lower main journal half bearings

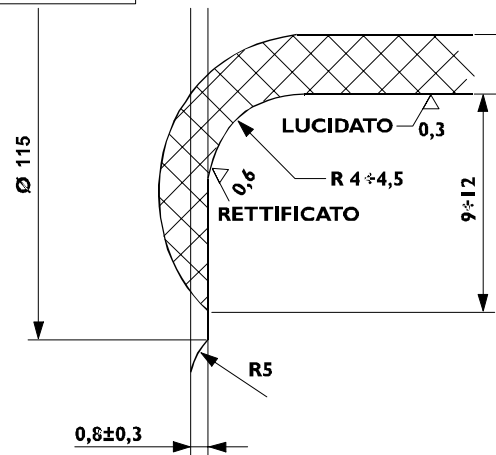
71712

MAIN DATA FOR THE CRANK SHAFT PINS AND THE HALF BEARINGS

Check the condition of the journals and the big end pins; there must no be signs of scoring, ovalization or excessive wear.
The data given refer to the normal diameter of the pins.

Figure 75

60603

X. Detail of main journals connections**Figure 76**

71713

Y. Detail of crank pins connections

All journals and crank pins must also be ground to the same undersizing class, in order to avoid any alteration to shaft balance.

36061

Choice of big end and main bearing half-shells



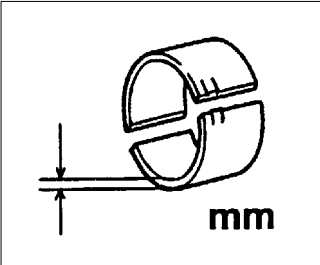
In order to obtain the clearance required, main half-bearings and big end half-bearings must be selected as specified below.

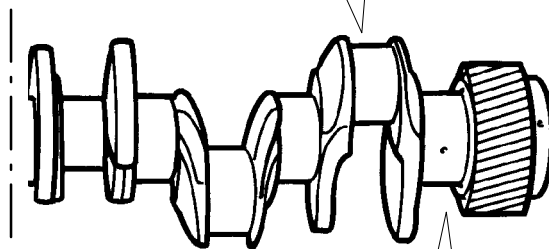
This operation makes it possible to identify the most suitable half-bearings for each journal (half-bearings can belong to different classes for the individual journals).

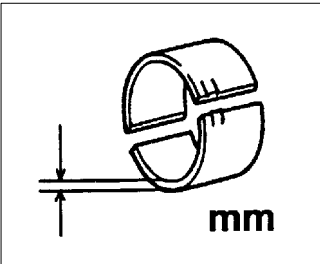
Depending on half-bearing thickness, tolerance classes are selected by colors (red-green-red/black-green/black).

Figure 80 shows the characteristics of main half-bearings and big end half-bearings supplied as spare parts in standard measures (STD) and admissible oversizing (+0.127, +0.254, +0.508).

Figure 80

Big end half-bearings		STD	+0.127	+0.254	+0.508
	red	1.965 to 1.975		2.092 to 2.102	2.219 to 2.229
	red/black		2.028 to 2.038		
	green	1.976 to 1.985		2.103 to 2.112	2.230 to 2.239
	green/black		2.039 to 2.048		



Main half-bearings		STD	+0.127	+0.254	+0.508
	red	3.110 to 3.120		3.237 to 3.247	3.364 to 3.374
	red/black		3.173 to 3.183		
	green	3.121 to 3.130			
	green/black		3.184 to 3.193		

DETERMINATION OF PRELIMINARY DATA FOR SELECTION

For each journal and crankpin, the following operations must be carried out:

JOURNALS:

- ☐ determine the diameter class of the block housing;
- ☐ determine the diameter class of the main journal;
- ☐ select half-bearing class to be installed.

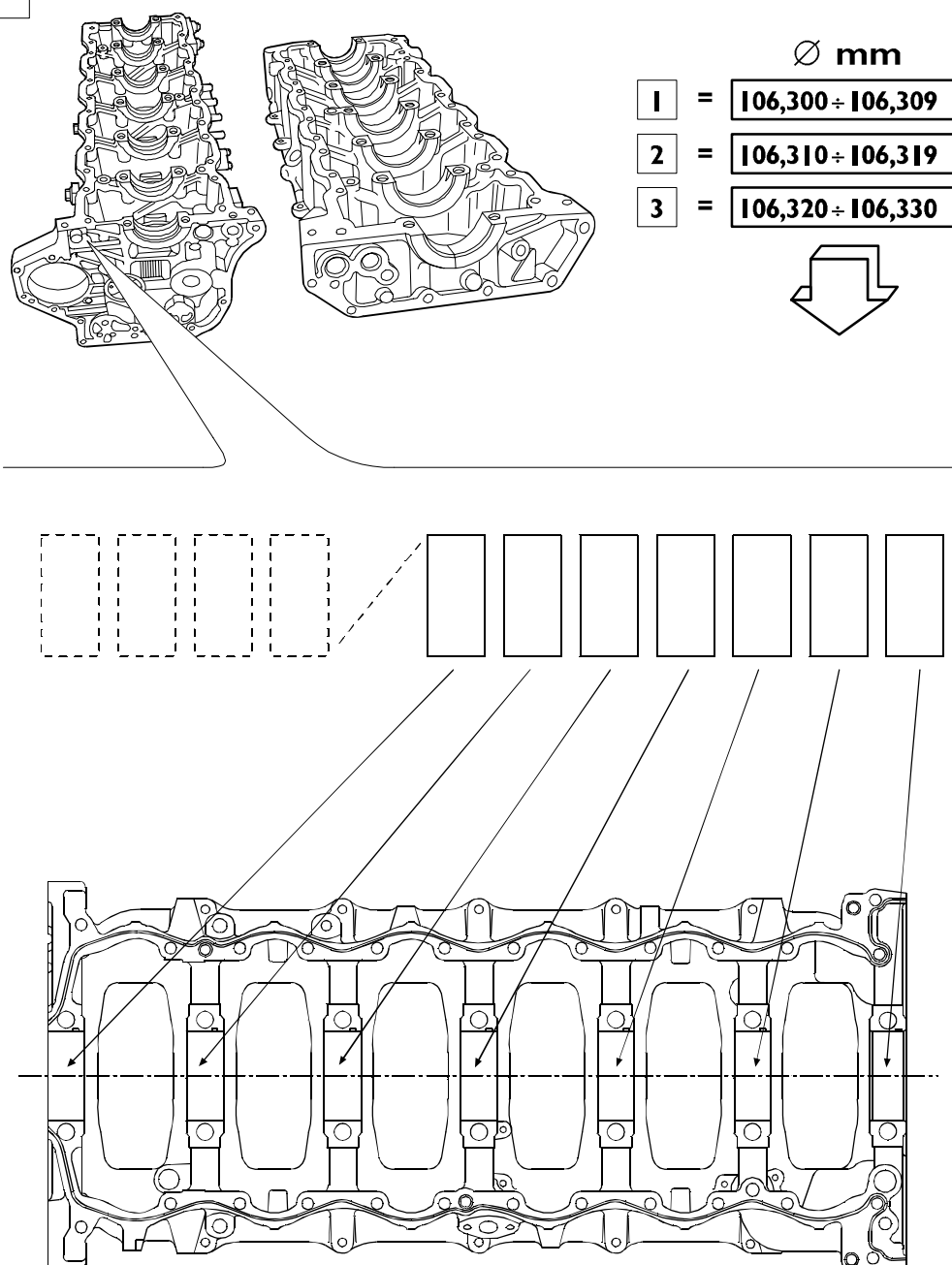
KRANKPINS:

- ☐ determine the diameter class of the connecting rod housing;
- ☐ determine the diameter class of the big end pin;
- ☐ select half-bearing class to be installed.

Two series of numbers are marked on the front side of the block, in the position specified (top).

- ☐ a four-digit number; representing the coupling number of block to the relevant underblock;
- ☐ each of the following seven digits represents the diameter class of the housing they refer to (bottom);
- ☐ each digit can be **1, 2 or 3**.

Figure 81



Definition of main journal and big end diameter class (journals with nominal diameter)

Three series of numbers are specified on the driving shaft, in the position specified.

- ☐ a five-digit number; representing the shaft serial number;
- ☐ under this number; on the left, a six-digit number refers to big end pins and is preceded by a single digit, which indicates pin status (I = STD = -0.127); each of the following six digits represents the diameter class of each big end pin it refers to (bottom);
- ☐ the seven-digit series, on the right, refers to the journals and is preceded by a single digit, which indicates journal status (I = STD = -0.127); each of the following seven digits represents the diameter class of the journal it refers to (bottom);

Figure 82

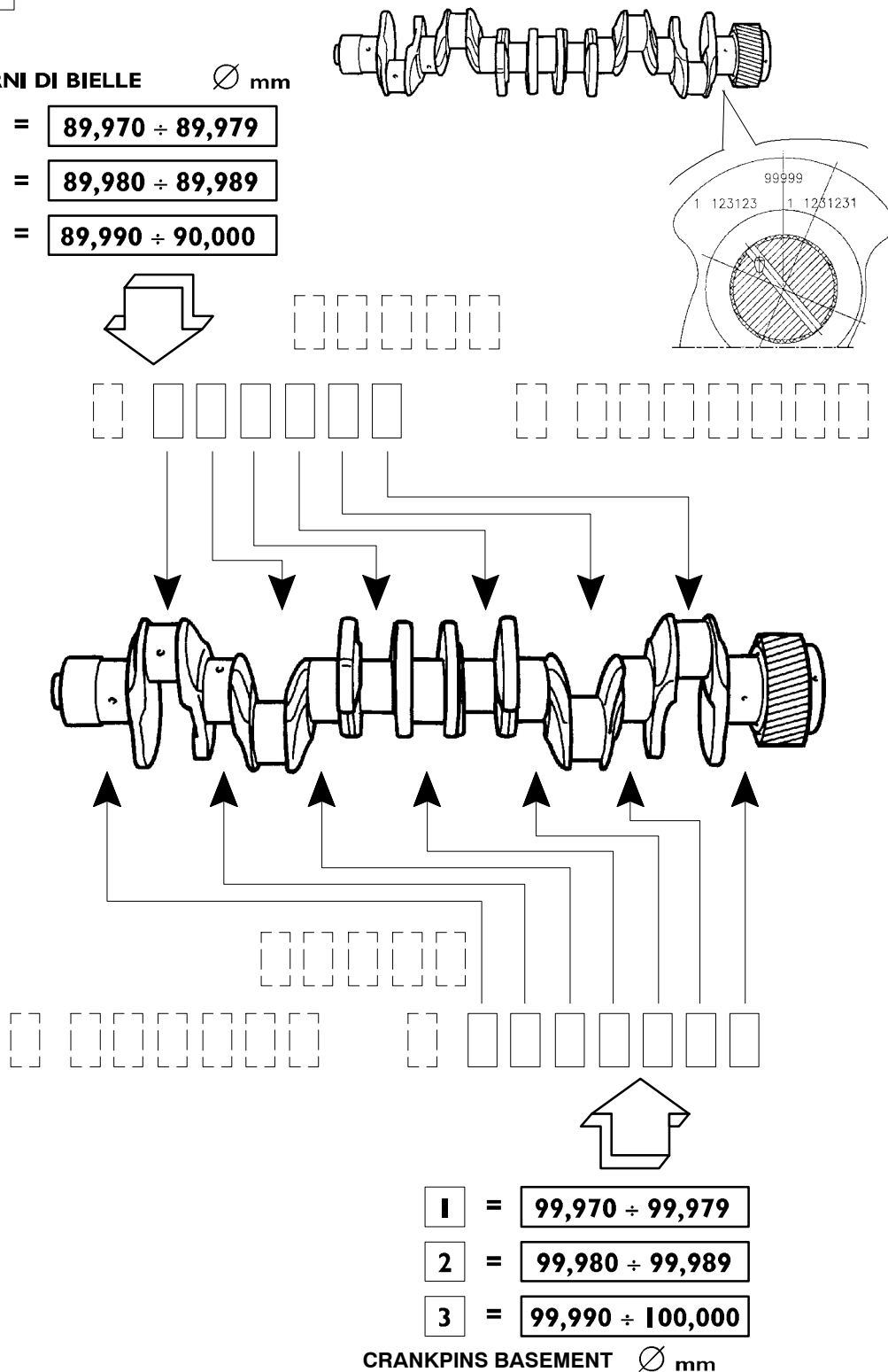
PERNI DI BIELLE

Ø mm

$$1 = 89,970 \div 89,979$$

$$2 = 89,980 \div 89,989$$

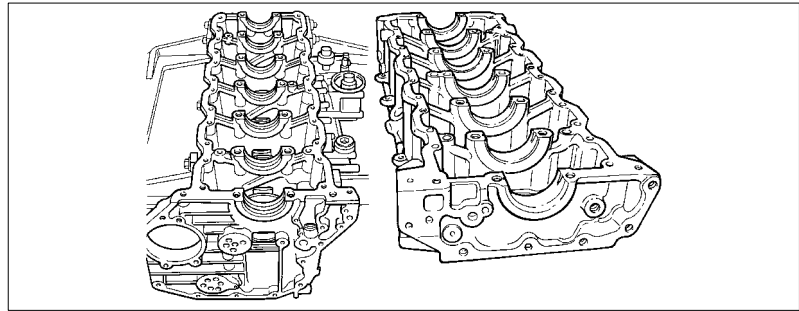
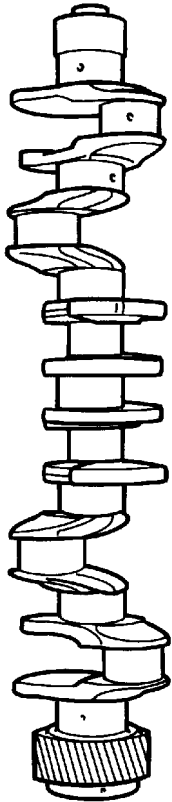
$$3 = 89,990 \div 90,000$$



Selection of main half-bearings

After detecting, for each journal, the necessary data on block and crankshaft, select the type of half-bearings to be used, in compliance with the following table:

Figure 83

STD.**1****2****3****1**

green

green

green

green

green

green

2

red

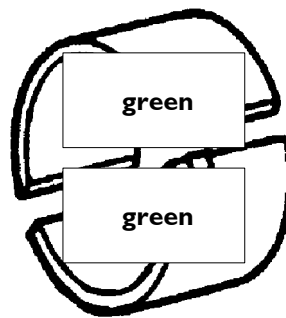
green

green

red

green

green

**3**

red

red

red

red

red

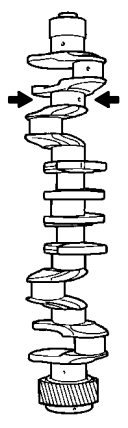
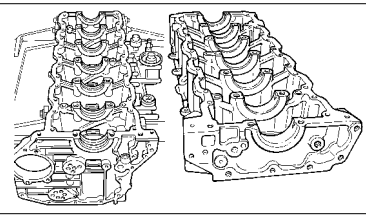
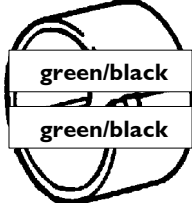
red

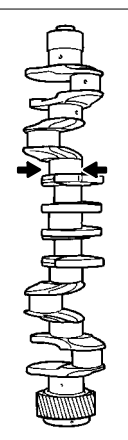
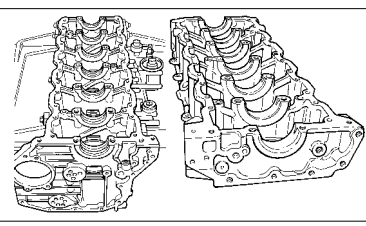
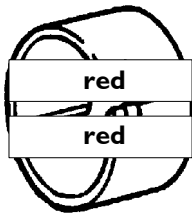
Selection of main half-bearings (rectified)

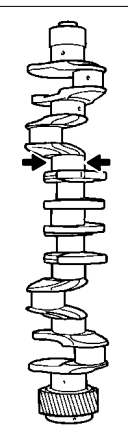
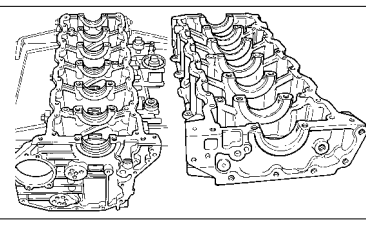
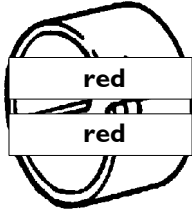
If the journals have been rectified, the procedure described cannot be applied.

In this case, make sure that the new diameter of the journals is as specified on the table and install the only half-bearing type required for this undersizing.

Figure 84

	red/black = mm 3.063 to 3.073 green/black = mm 3.074 to 3.083	-0.127		1	2	3
	82.783 82.792			green/black green/black	green/black green/black	green/black green/black
	82.793 82.802			red/black red/black		green/black green/black
82.803 82.813	red/black red/black	red/black red/black	green/black green/black			

	red = mm 3.127 to 3.137	-0.254		1	2	3
	82.666 82.686			red red		red red

	red = mm 3.254 to 3.264	-0.508		1	2	3
	82.412 82.432			red red		red red

Choice of big-end half-shells (standard diameter)

Three indications are marked on the connecting rod, in position "A"

Figure 85

1 Letter indicating the weight class

A = 4661 to 4694 g.

B = 4695 to 4728 g.

C = 4729 to 4762 g.

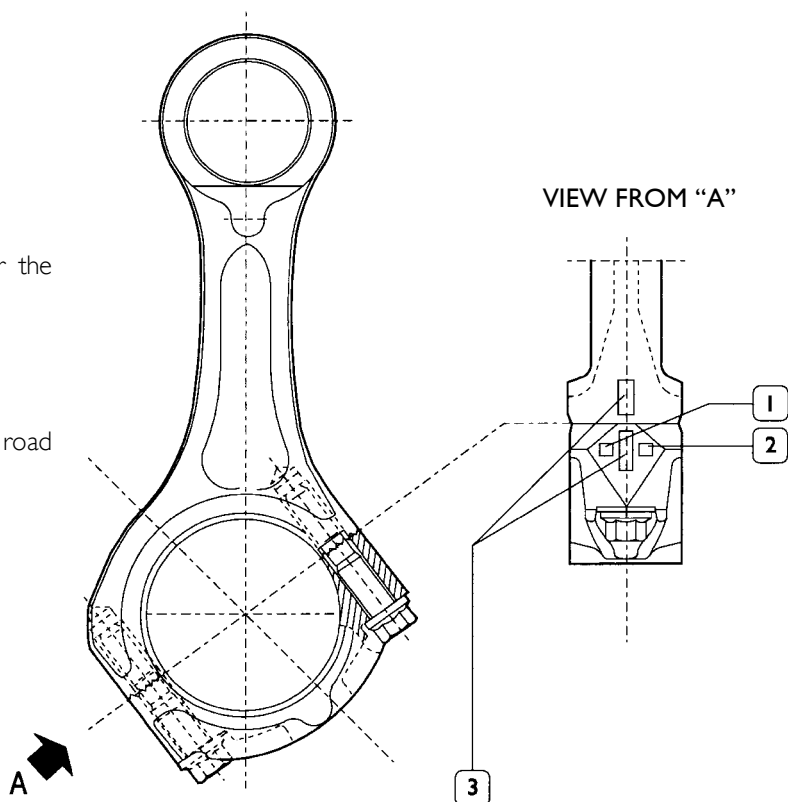
2 Number indicating the diameter selected for the housing of the big end bearing:

1 = 94.000 to 94.010 mm

2 = 94.011 to 94.020 mm

3 = 94.021 to 94.030 mm

3 Numbers identifying the cap-connecting rod coupling.



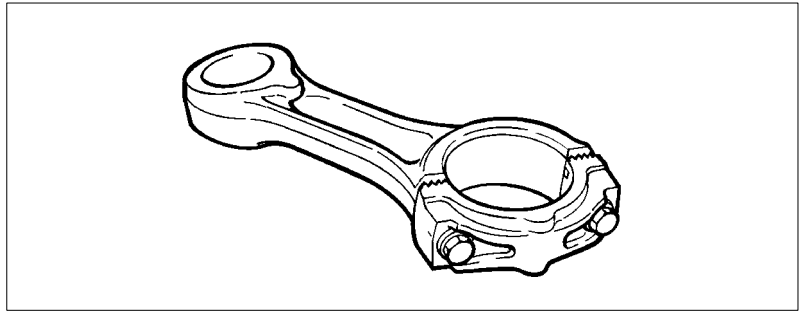
47557

The number specifying the diameter class of the half-bearing housing can be **1, 2** or **3**.

Determine the type of big end half-bearings to be installed on each pin by following the indications given in the table (Figure 86).

Figure 86

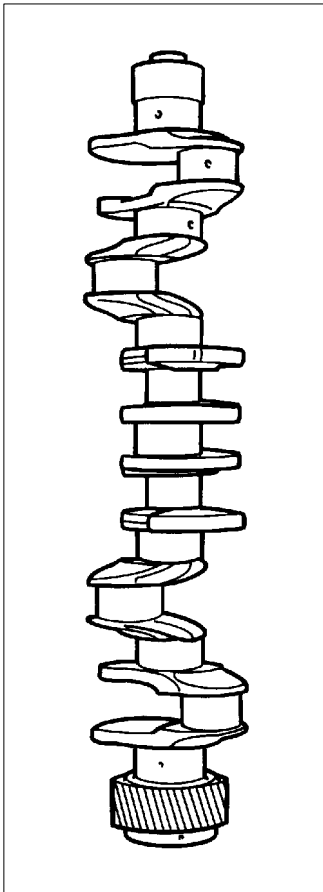
STD.



1

2

3



1

green

green

green

green

green

green

2

red

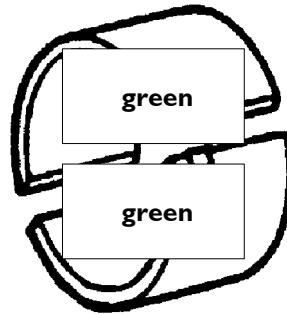
green

green

red

green

green



3

red

red

red

red

red

red

Choice of big-end half-shells (rectified)

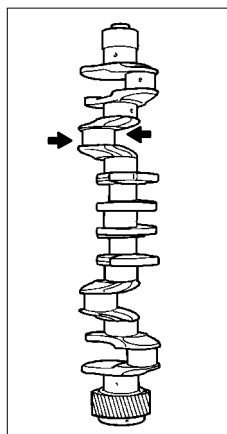
If pins have been rectified, the procedure described must be applied.

In this case, (for each undersizing) determine the tolerance field the new big end pins belong to, and install the half-bearings identified according to the relative table.

Figure 87

red/black =
mm 2.028 to 2.038

green/black =
mm 2.039 to 2.048

-0.127

72.788
72.797

1

green/black

green/black

72.798
72.807

2

red/black

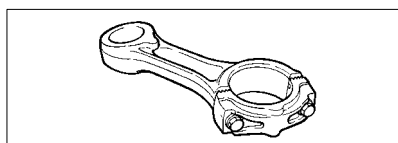
red/black

72.808
72.818

3

red/black

red/black

**1****2****3**

green/black

green/black

green/black

green/black

green/black

green/black

green/black

green/black

red/black

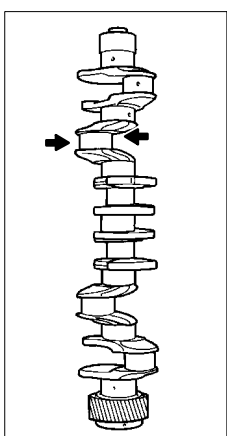
red/black

green/black

green/black

-0.254

red
mm 2.092 to 2.102
green =
mm 2.103 to 2.112



72.671
72.680

1

red

red

72.681
72.691

red

red

2

green

green

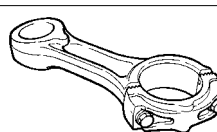
3

green

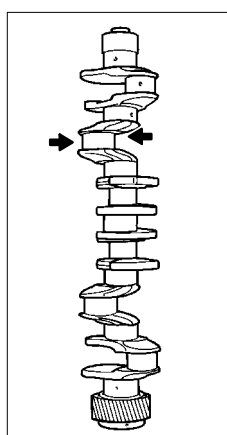
green

green

green

**-0.508**

red =
mm 2.219 to 2.229
green =
mm 2.230 to 2.239



72.417
72.426

1

red

red

72.427
72.437

red

red

2

green

green

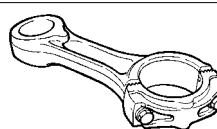
3

green

green

green

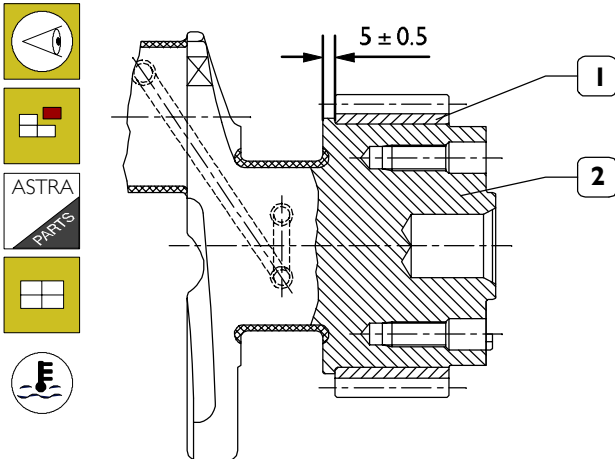
green



Replacing the timing control gear and the oil pump

Check that the teeth of the gears are not damaged or worn, otherwise remove them using the appropriate extractor.

Figure 88

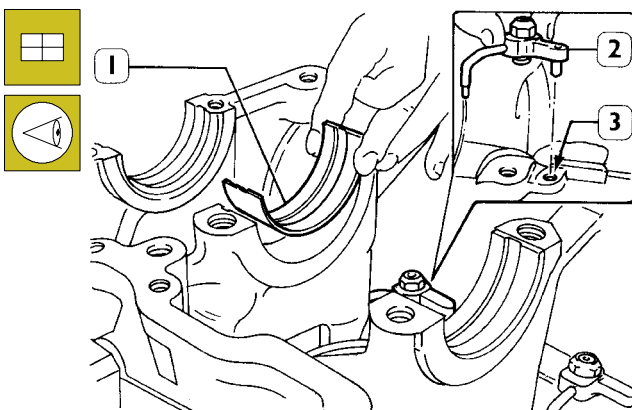


49020

When fitting the new gears (1) on the crankshaft (2), heat them for about 15 minutes in an oven at 180°C. Let them cool down after the installation.

Checking main journal installation clearance

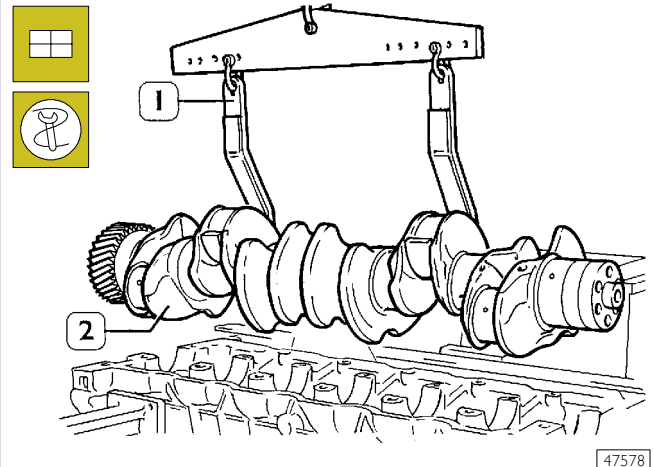
Figure 89



47579

Install the oil spray nozzles (2) and have the dowel coincide with the block hole (3).
Install the half-bearings (1) on the main bearings.

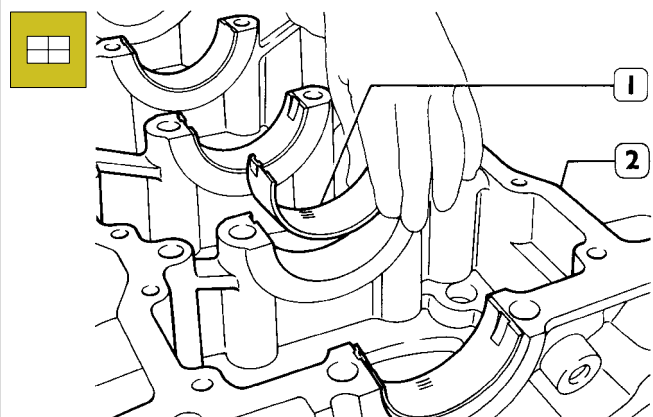
Figure 90



47578

Using pulley system and hook 99360500 (1), mount the crankshaft (2).

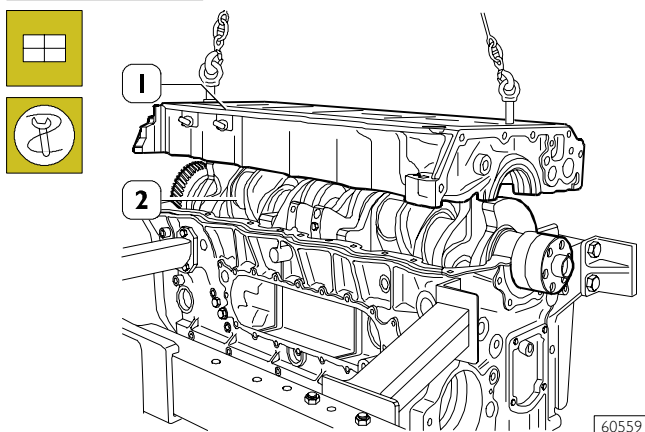
Figure 91



49021

Install the half-bearings (1) on the main bearings in the underblock (2).
Check the installation clearance between the main journals and the relative bearings as follows:

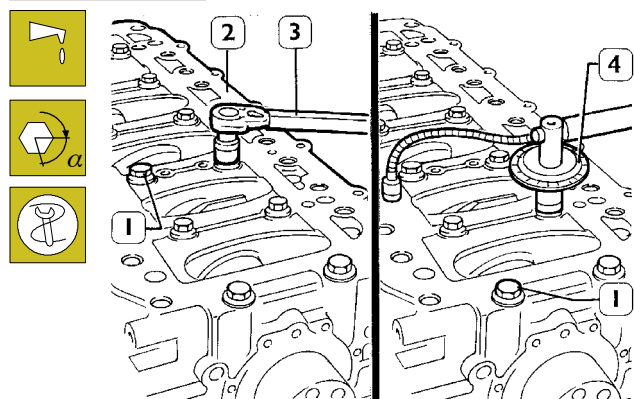
Figure 92



60559

Place a piece of calibrated wire on the journal of the crankshaft (2), parallel to the longitudinal axis; install the underblock (1), by hoist and appropriate hooks.

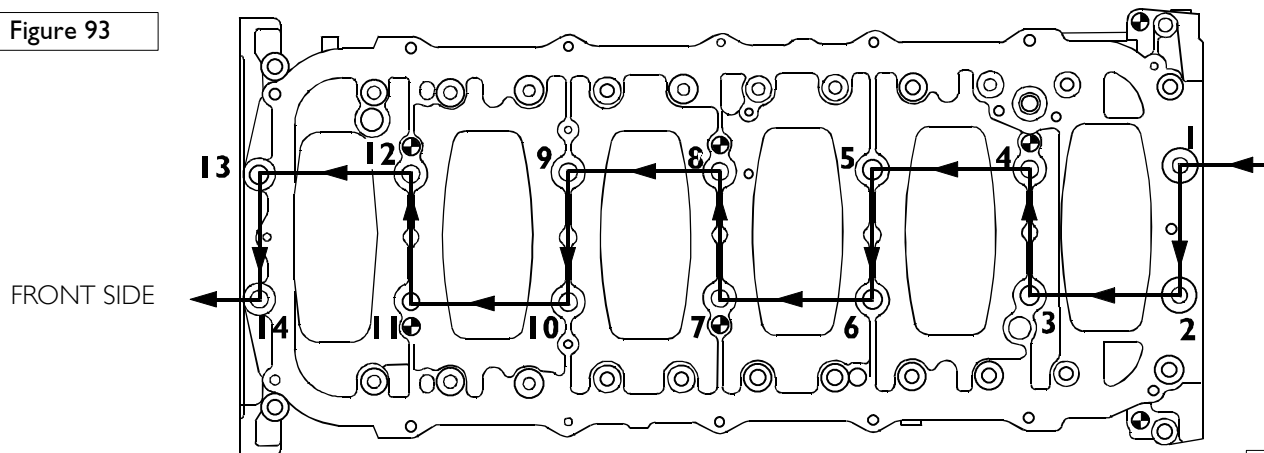
Figure 95



47578

☐ Lubricate inside screws (1) con UTD oil, and tighten them by dynamometric wrench to 140 Nm torque, thus with 60° angle closing, following the diagram.

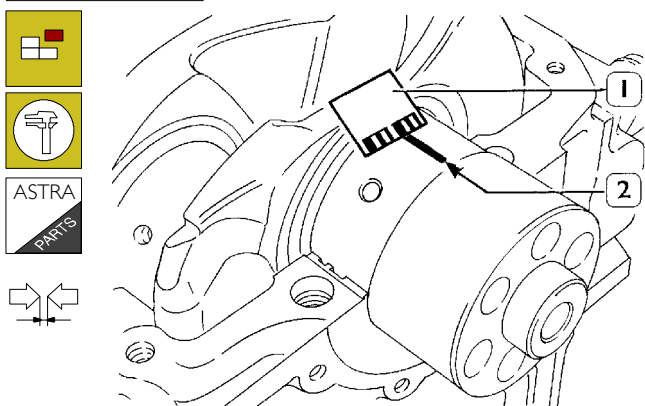
Figure 93



60593

DIAGRAM SHOWING THE TIGHTENING ORDER OF THE SCREWS FIXING THE LOWER UNDER-BLOCK TO THE BLOCK

Figure 94



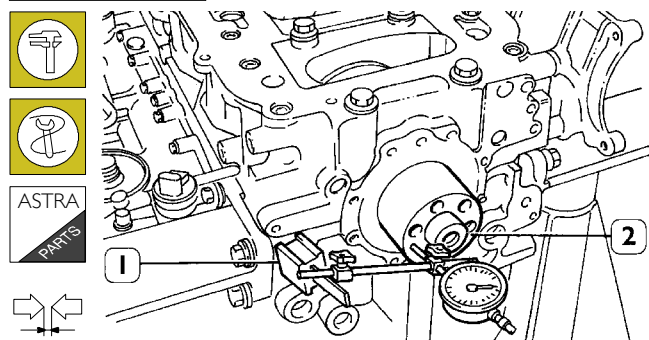
47579

☐ Remove the under-block

The clearance between the main bearings and the journals is obtained by comparing the calibrated wire length (2) at the maximum deflection point, with the calibrated scale on the coating (1) containing the calibrated wire (1). Numbers shown on the scale specify the clearance in coupling millimeters. If the clearance obtained is different from the clearance required, replace the half-bearings and repeat this check.

Checking crankshaft end float

Figure 96

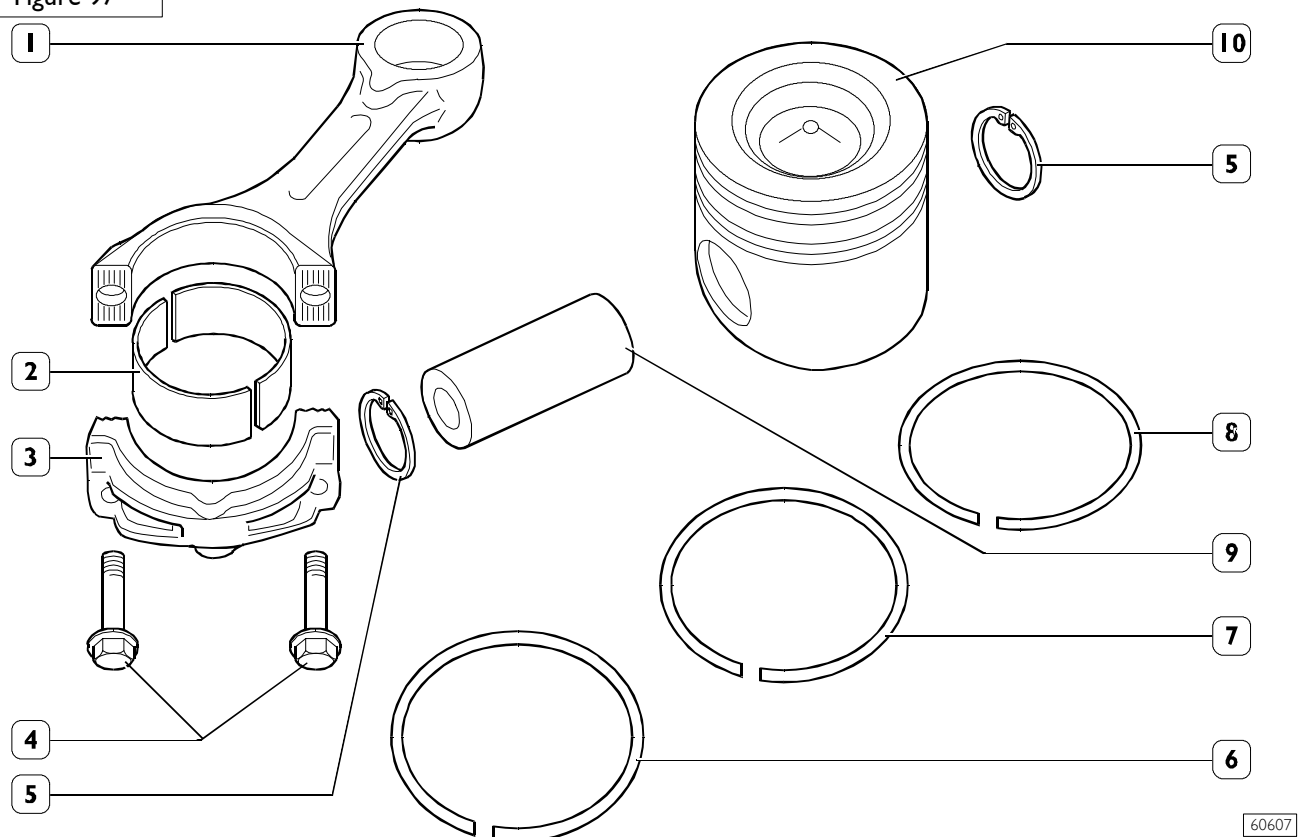


47588

End float is checked by placing a magnetic dial gauge (1) on the crankshaft (2), as shown in the figure. If the value obtained is higher than specified, replace the rear thrust half-bearings and repeat this check.

Piston-connecting rod assembly

Figure 97



PISTON CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Half bearings - 3. Connecting rod cap - 4. Cap fastening screws - 5. Split ring - 6. Scraper ring with spiral spring - 7. Bevel cut sealing ring - 8. Trapezoidal sealing ring - 9. Piston pin - 10. Piston

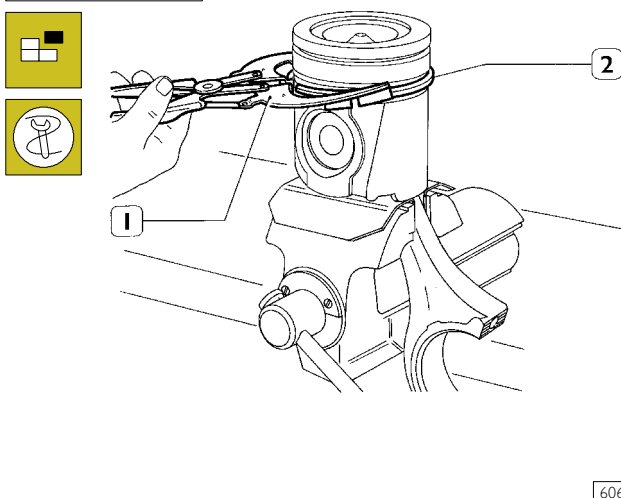
Make sure the piston does not show any trace of seizing, scoring, cracking; replace as necessary.

Pistons are equipped with three elastic rings: a sealing ring, a trapezoidal ring and a scraper ring.

Pistons are grouped into classes A and B for diameter.

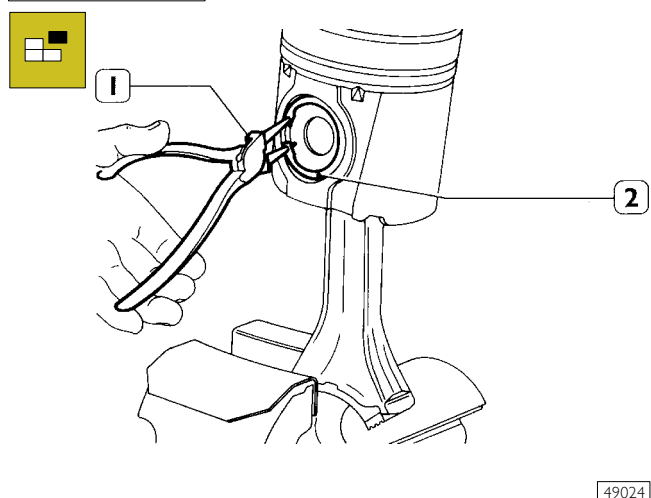
Removal

Figure 98



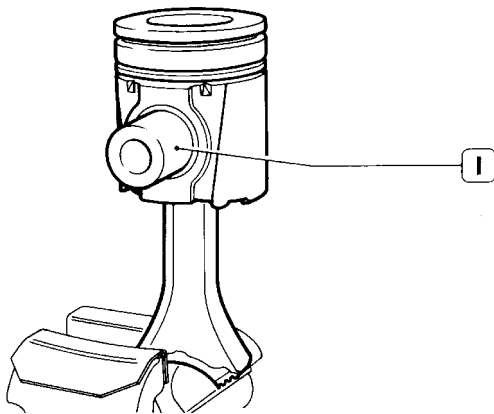
Removal of the piston split rings (2) using the pliers 99360184 (1).

Figure 99



Remove the piston pin split rings (2) using the round tipped pliers (1).

Figure 100

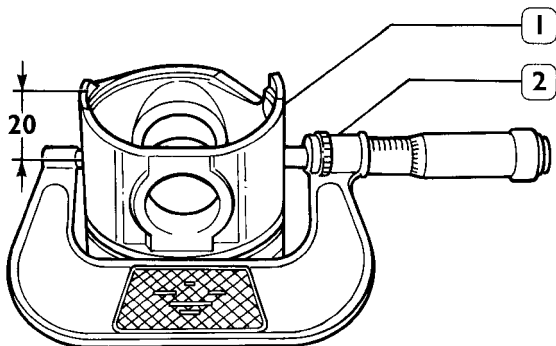


49025

Remove the piston pin (1).
If removal is difficult use the appropriate beater.

Measuring the diameter of the pistons

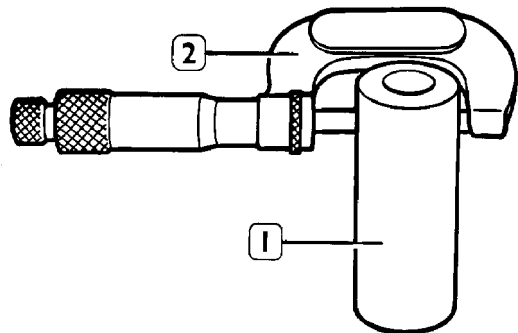
Figure 101



71714

Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance; the diameter should be measured at the specified value.

Figure 102

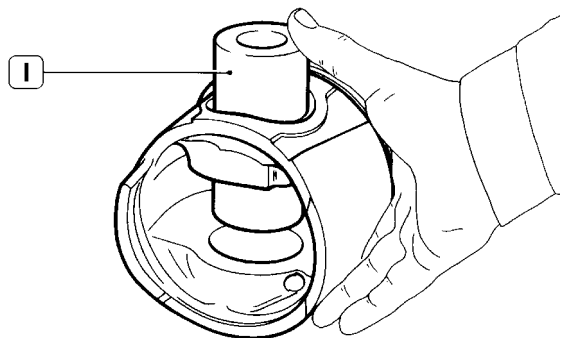


32618

Measuring the gudgeon pin diameter (1) with a micrometer (2).

Conditions for correct gudgeon pin-piston coupling

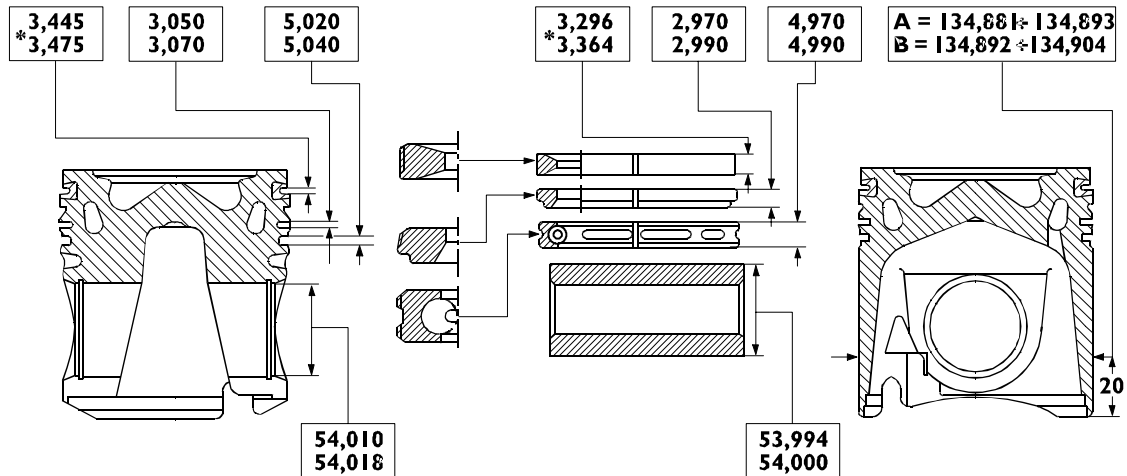
Figure 103



49026

Lubricate the pin (1) and the relevant housing on the piston hubs with engine oil; piston must be inserted with a slight finger pressure and it should not come out by gravity.

Figure I04



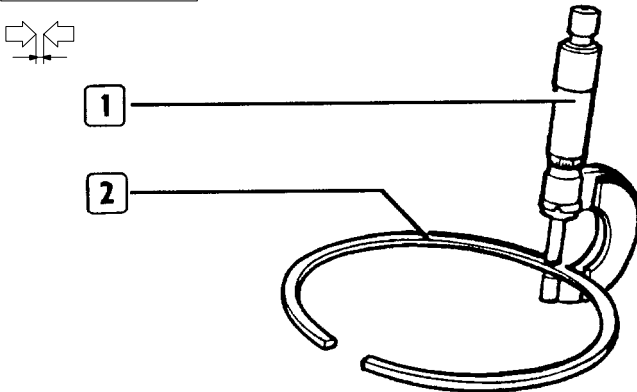
71715

MAIN DATA ON PISTONS, AND PISTONS RINGS

* Values are determined on $\varnothing$ of 130 mm.

Piston rings

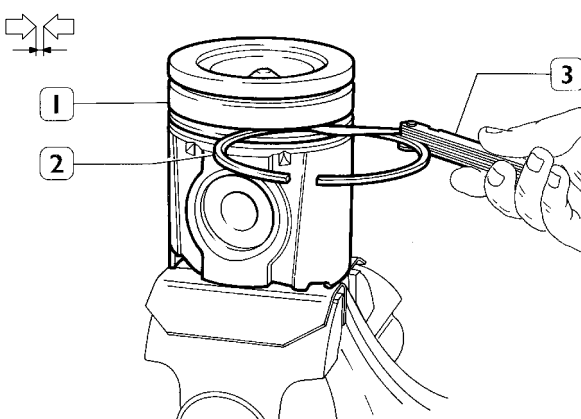
Figure I05



16552

Check the thickness of the piston ring (2) using a micrometer (1).

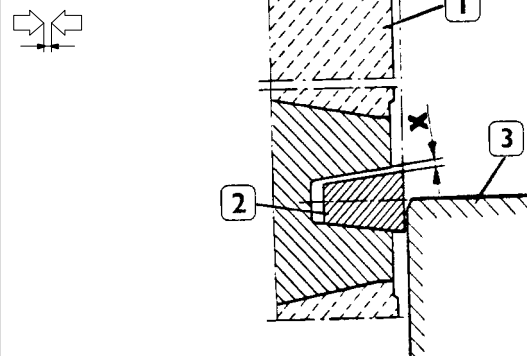
Figure I07



60610

Check the clearance between the sealing rings (2) and the relative piston housings (1) using a thickness gauge (3).

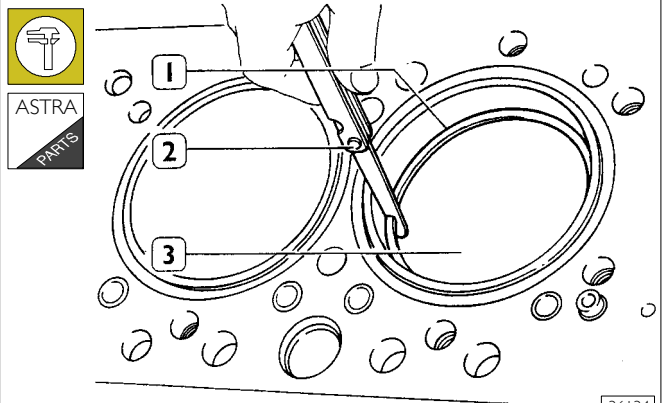
Figure I06



3513

The sealing ring (2) of the 1st cavity is trapezoidal. Clearance "X" between the sealing ring and its housing is measured by placing the piston (1) with its ring in the cylinder barrel (3), so that the sealing ring is half-projected out of the cylinder barrel.

Figure I08



36134

Check the opening between the ends of the sealing rings (1), using a thickness gauge (2), entered in the cylinder barrel (3). If the distance between ends is lower or higher than the value required, replace split rings.

Connecting rod

Figure 109

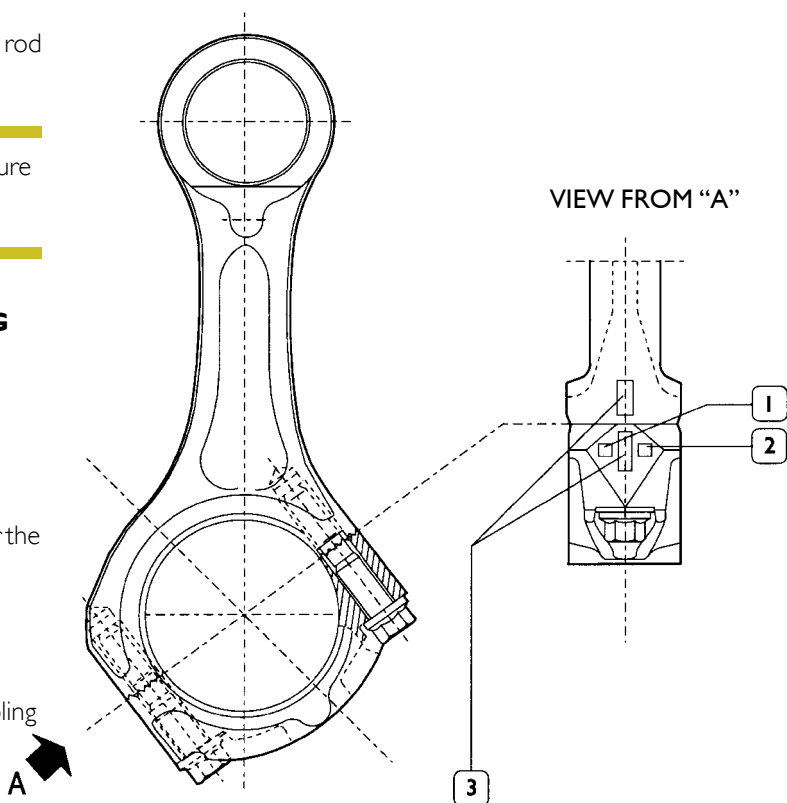
Data concerning the class section of connecting rod housing and weight are stamped on the big end.



When installing connecting rods, make sure they all belong to the same weight class.

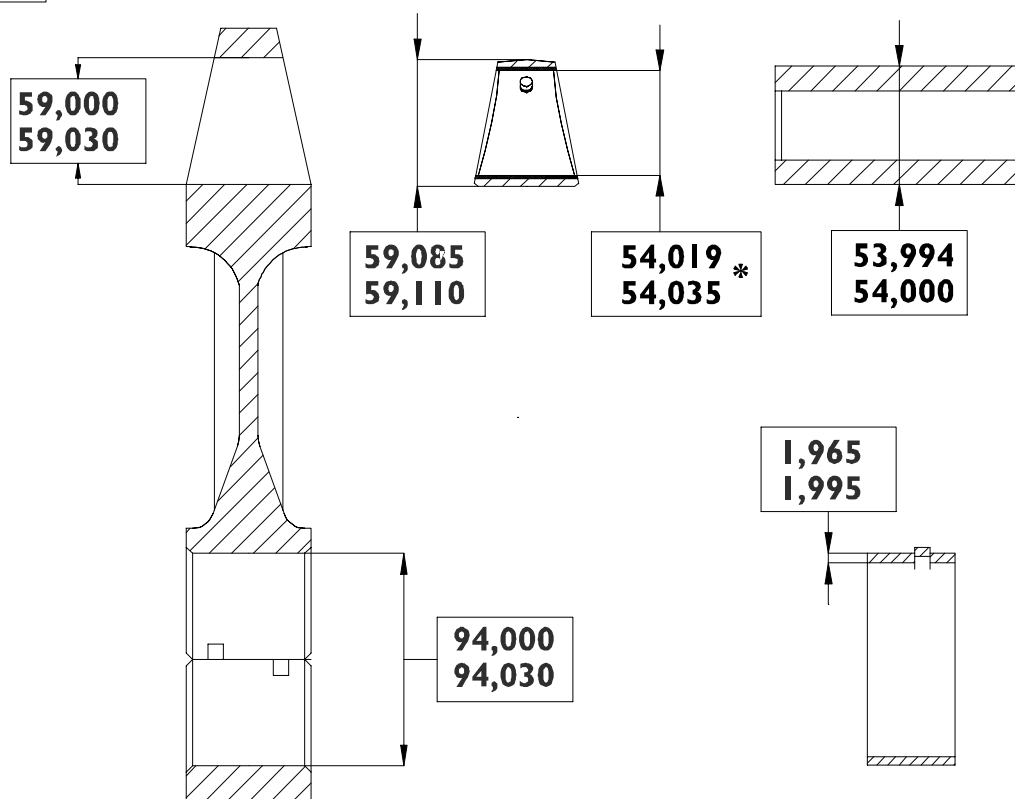
DIAGRAM OF THE CONNECTING ROD MARKS

- 1 Letter indicating the weight class:
 - A = 4661 to 4694 g.
 - B = 4695 to 4728 g.
 - C = 4729 to 4762 g.
- 2 Number indicating the selection of diameter for the big end bearing housing:
 - 1 = 94.000 to 94.010 mm
 - 2 = 94.011 to 94.020 mm
 - 3 = 94.021 to 94.030 mm
- 3 Numbers identifying cap-connecting rod coupling



47957

Figure 110



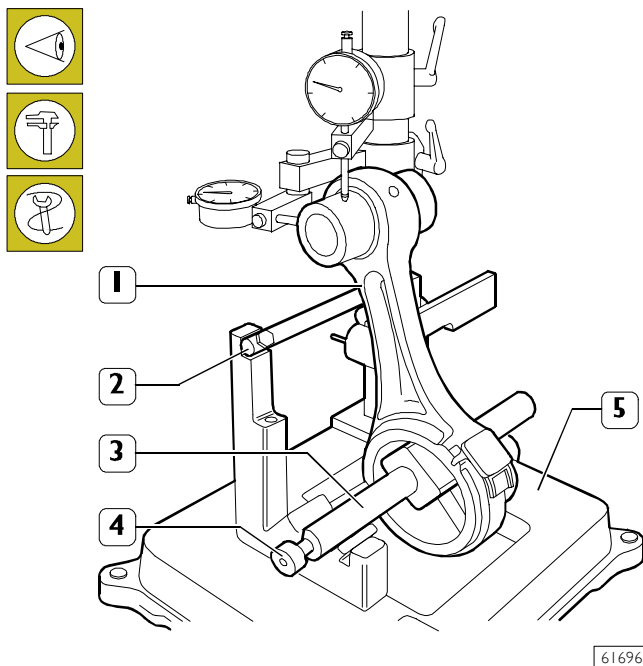
71716

MAIN DATA - BUSH, CONNECTING ROD, PIN AND HALF-BEARINGS

* Values to be obtained after installing the bush

Checking con-rods

Figure 111



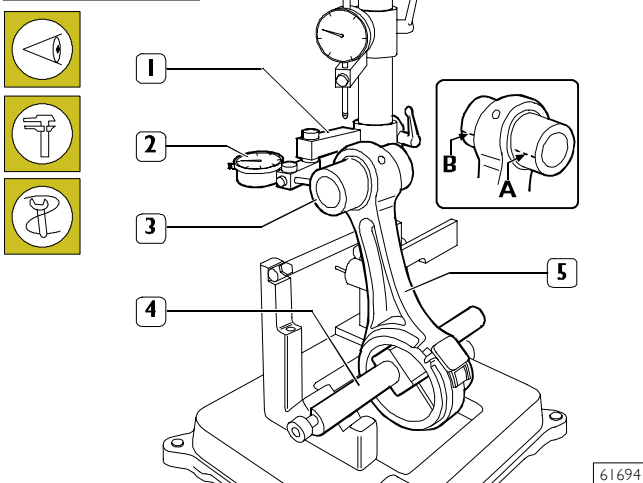
Check axis parallel

Proceed as follows to check con-rod parallel (1) using tool 99395363 (5)

- ☐ Fit the con-rod (1) to the chuck of tool 99395363 (5) and lock it with the screw (4).
- ☐ Set the chuck (3) on the V-shaped mountings and rest the con-rod (1) on the stopper bar (2).

Check con rod

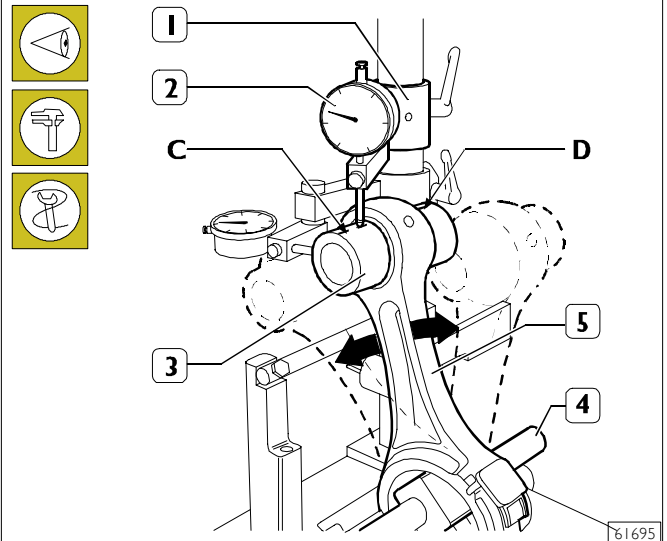
Figure 112



Check con-rod (5) twist by comparing two points of the gudgeon pin (3) (A and B), horizontal to the con-rod axis. Position the comparator support such that it applies a pre-load of ~ 0.5 mm on the pin (3) at point A and zero the comparator (2). Shift the chuck (4) with the con-rod (5) and check any shift of the pin (3) on the opposite side (B). The difference between A and B must not exceed 0.08 mm.

Con-rod bend

Figure 113



Check con-rod bend by comparing two points (C and D) of the gudgeon pin (3) on the vertical plane of the con-rod axis. Position the vertical support (1) of the comparator (2) such that the comparator rests on the gudgeon pin (3) at point C. Move the con-rod backward and forward to find the highest point of the gudgeon pin and zero the comparator at that point.

Move the chuck and con-rod (5) and repeat the operation on the opposite side of the pin at point D, and check the highest point. The difference between points C and D must not exceed 0.08 mm.

Assemble the con-rod and piston assembly.

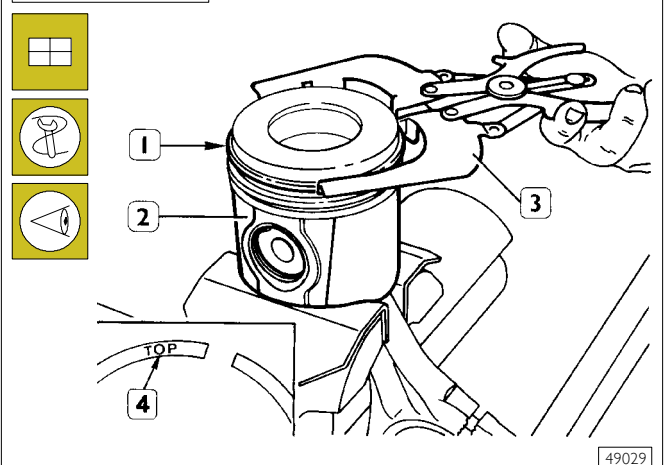
Follow removal instructions in reverse order to replace the assembly.



Con-rod bolts can be re-used until the diameter of the thread is less than 13.4 mm.

Fitting piston rings

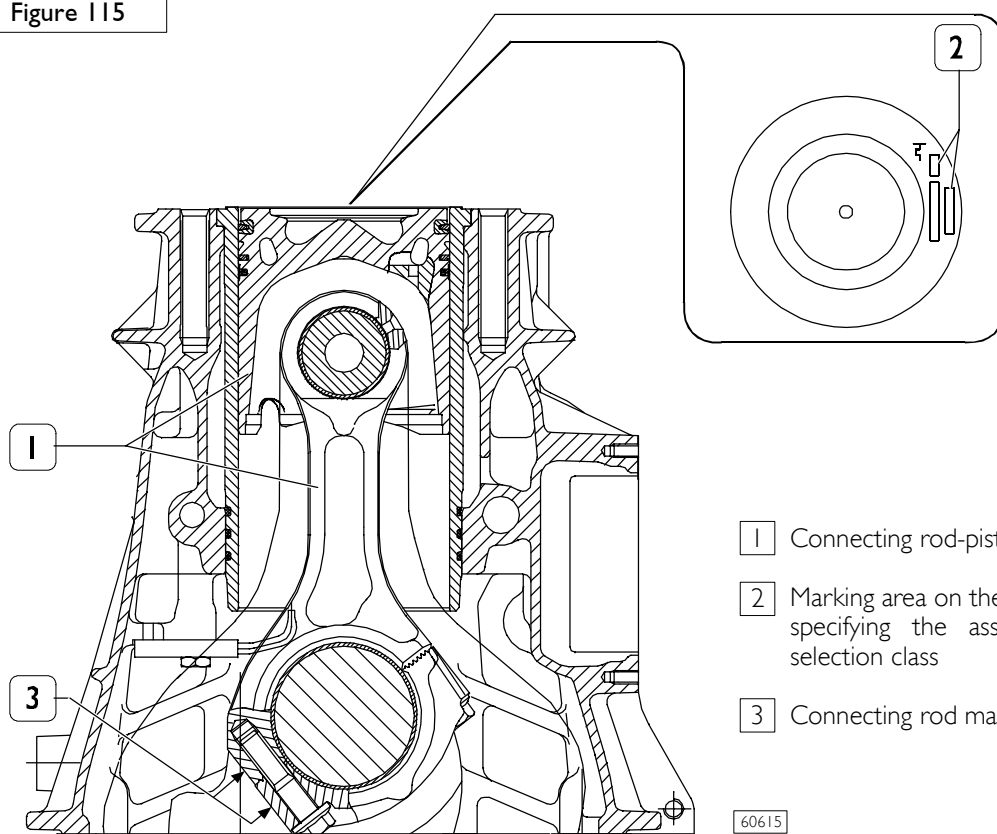
Figure 114



Use clamp 9936014 (3) to fit the rings (1) to the piston (2). The rings must be fitted with the marking "Top" (4) facing upwards. Orient the openings in the rings with an offset of 120° to each other.

Fitting connecting rod-piston assies in cylinder liners for checking fitting play

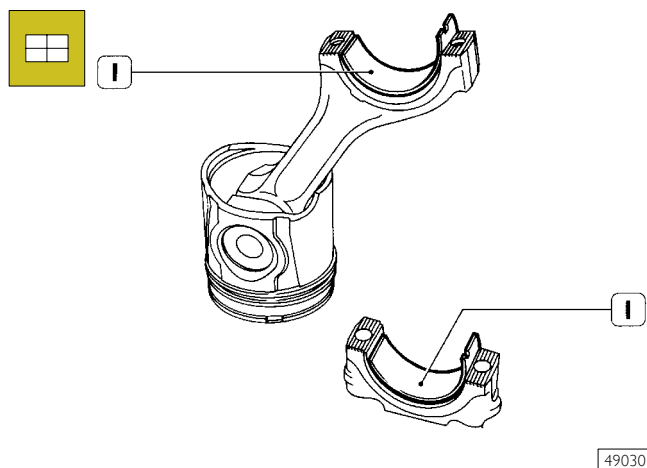
Figure 115



- 1 Connecting rod-piston assembly
- 2 Marking area on the piston crown of ideogram specifying the assembly position and the selection class
- 3 Connecting rod marking area (see Figure 109).

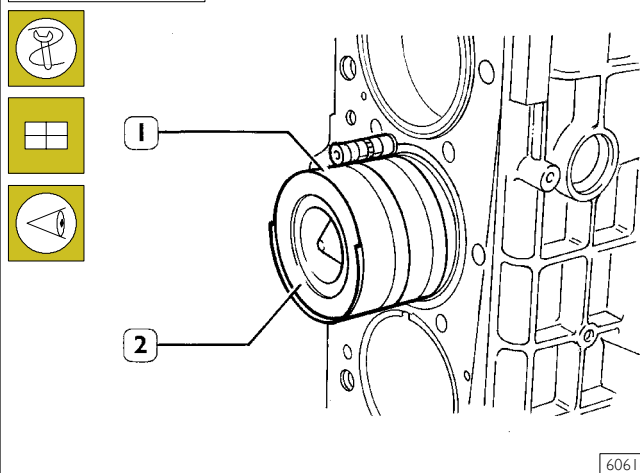
60615

Figure 116



Install half-bearings (1).

Figure 117



Fit the connecting rod-piston assemblies (1) into the piston liners (2) using band 99360605 (1, Figure 117). Check the following:

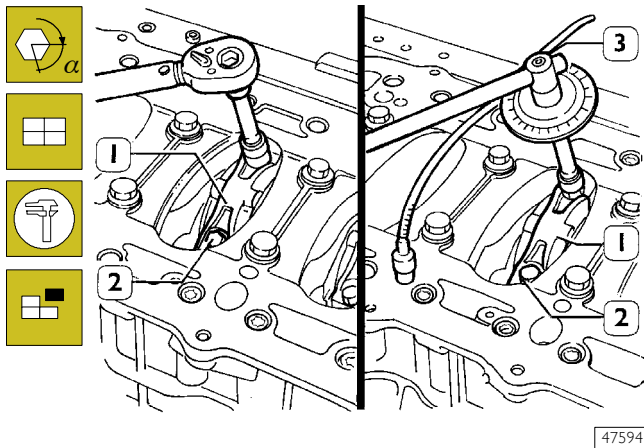
- ☐ the openings of the split rings are offset by 120° ;
- ☐ all pistons belong to the same class, A or B;
- ☐ ideogram stamped on the piston crown is placed toward the engine flywheel, or the cavity, on the piston cover, corresponds to the position of the oil spray nozzles.

Measuring big-end bearing play

To check the clearance proceed as follows:

Connect the connecting rods to the relative main journals, place a length of calibrated wire on the latter.

Figure 118



Install the connecting rod caps (1) with half-bearings; tighten the connecting rod cap fixing screws (2) to 60 Nm (6 kgm) torque. By tool 99395216 (3), tighten the screws further at 60° angle.

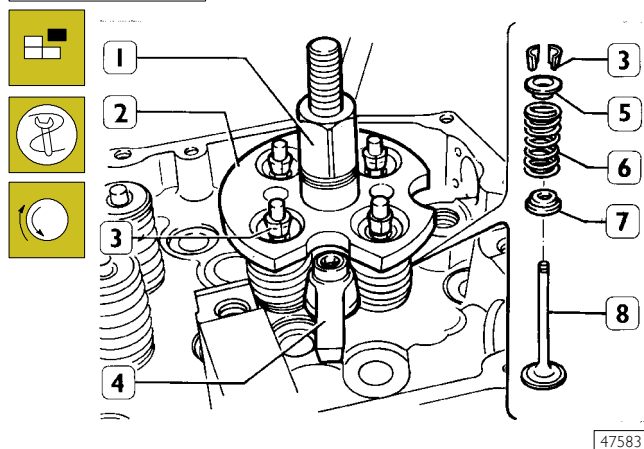
Remove the caps and check the clearance by comparing the width of the calibrated wire with the scale calibration on the envelope containing the wire.

Cylinder head

Before taking down the cylinder head, check the seal using the appropriate tool; in case of leakage replace the cylinder head.

Valve removal

Figure 119

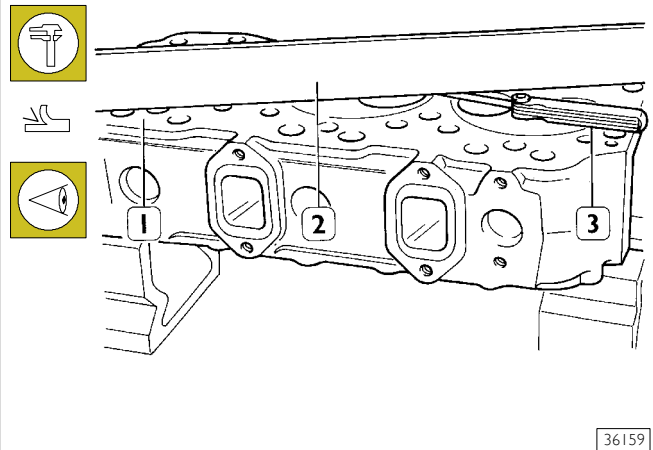


Install and fix tool 99360263 (2) with bracket (4); tighten by lever (1) until cotters are removed (3); remove the tool (2) and the upper plate (3), the spring (6) and the lower plate (7). Repeat the operation on all the valves. Turn the cylinder head upside down and remove the valves (8).

Checking the planarity of the head on the cylinder block

Figure 120

(Demonstration)



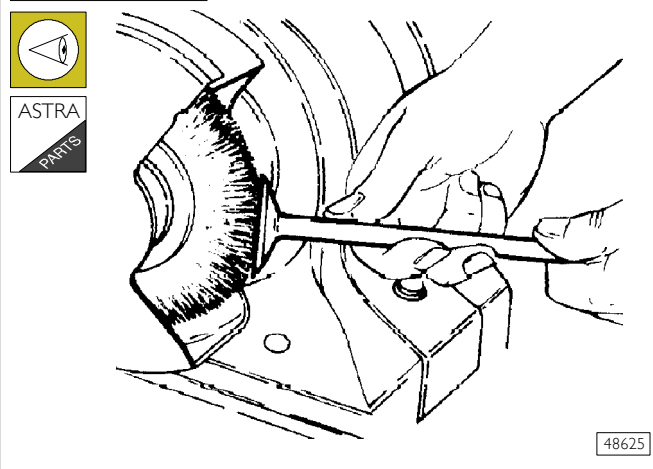
The planarity (1) is checked using a ruler (2) and a thickness gauge (3). If deformations exist, surface the head using proper surface grinder; the maximum amount of material to be removed is 0.2 mm.



After leveling, make sure that valve sinking and injector protrusion are as described in the relative paragraph.

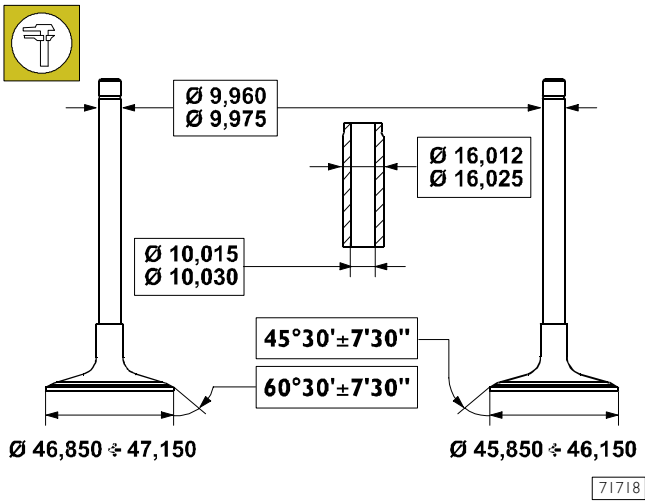
Removing deposits and checking the valves

Figure 121



Remove carbon deposits using the metal brush supplied. Check that the valves show no signs of seizure or cracking. Check the diameter of the valve stem using a micrometer and replace if necessary.

Figure 122

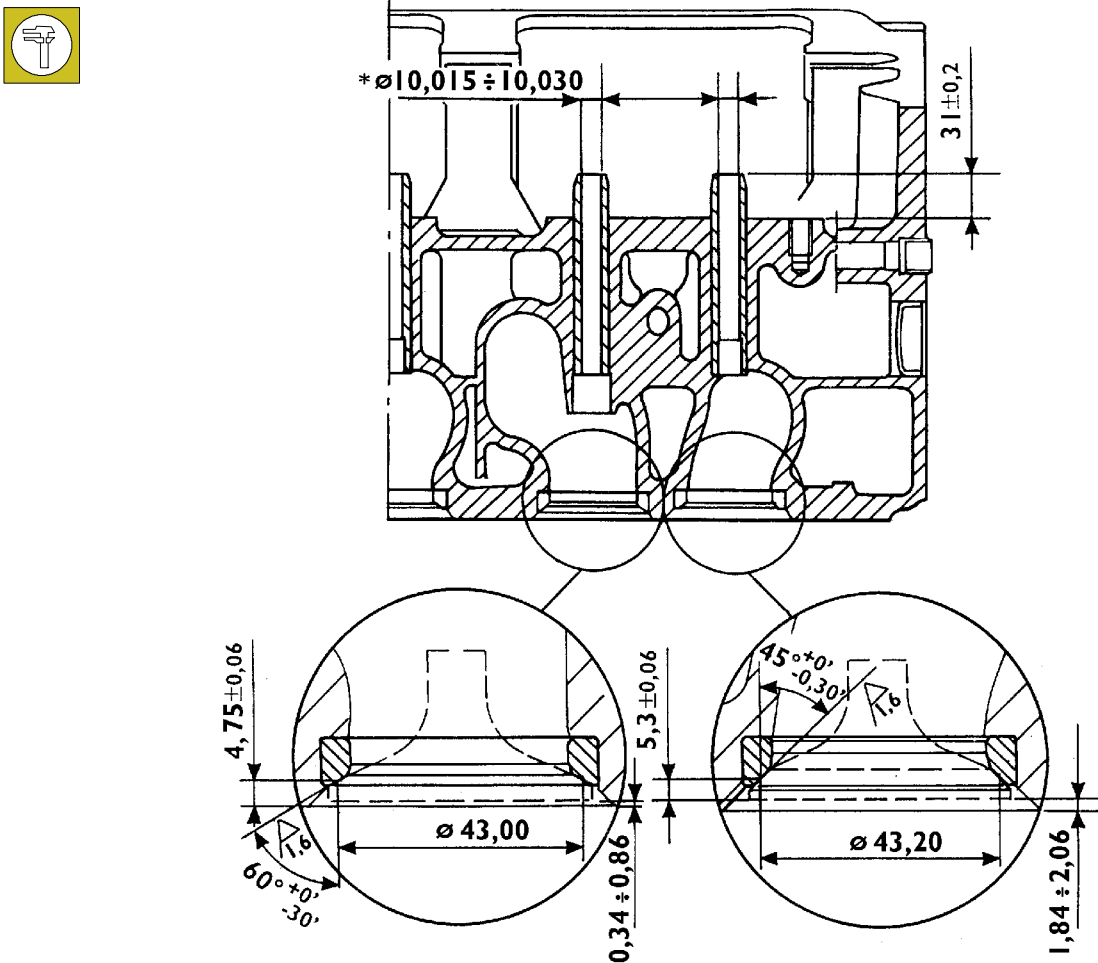


MAIN DATA - VALVES AND VALVE GUIDES

* Values to be obtained after installing the valve guides

Check, by means of a micrometer, that valve stem diameters are as specified; if necessary, grind the valves seat with a grinder, removing the minimum quantity of material.

Figure 123



INSTALLATION DIAGRAM FOR VALVE GUIDES AND VALVES

* Values to be obtained after installing the guide valves

71719

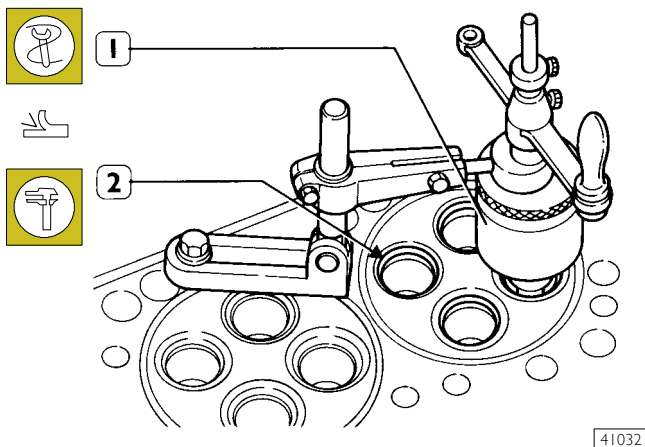
Replacing of valve guides

Remove valve guides by means of tool 99360143. Install by means of tool 99360143 equipped with part 99360296, which determines the exact installation position of valve guides into the cylinder heads; if they are not available, install the valve guides in the cylinder head so that they project out by mm 30.8 to 31.2. After installing the valve guides, smooth their holes with sleeker 99390330.

Replacing - Reaming the valve seats

To replace the valve seats, remove them using the appropriate tool.

Figure I24



Ream the valve seats (2) on cylinder head using tool 99305019 (1).



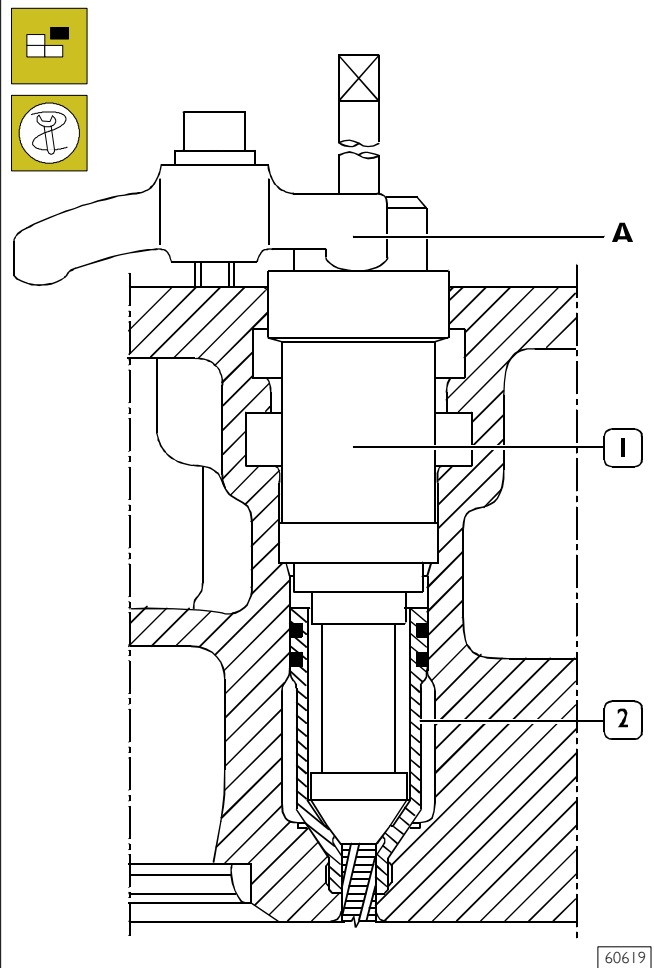
Valve seats must be reamed whenever valves or valve guides are replaced or ground.

After reaming the valve seats, use tool 99370415, to make sure that the valve position, with respect to the cylinder head surface, is the following:

- ☐ -0.54 to -0.85 mm (recessing) of exhaust valves;
- ☐ -1.75 to -2.05 mm (recessing) of discharge valves.

REPLACING INJECTOR HOLDER CASES Removal

Figure I25

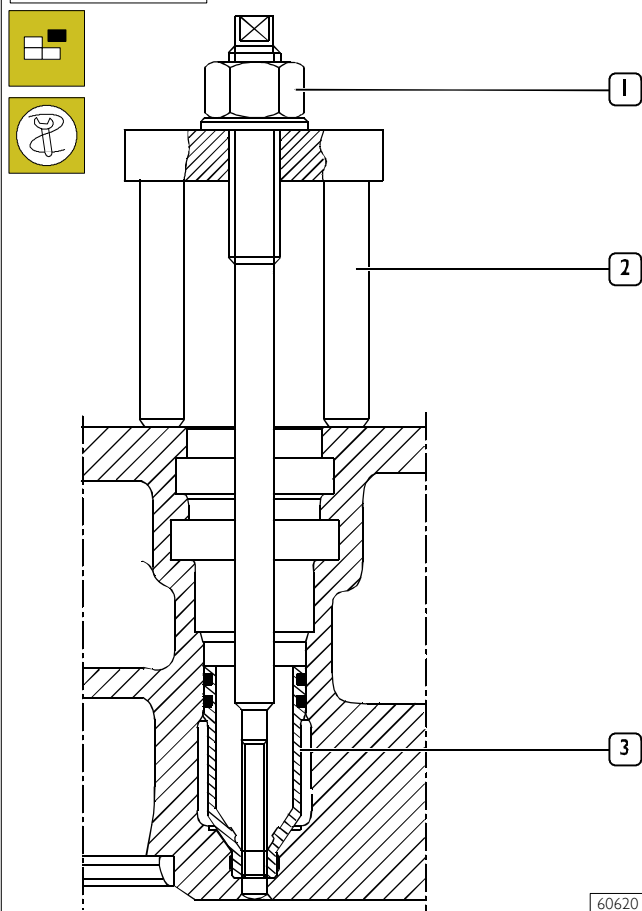


To replace the injector case (2), act as follows:

- ☐ thread the case (2) with tool 99390804 (1).

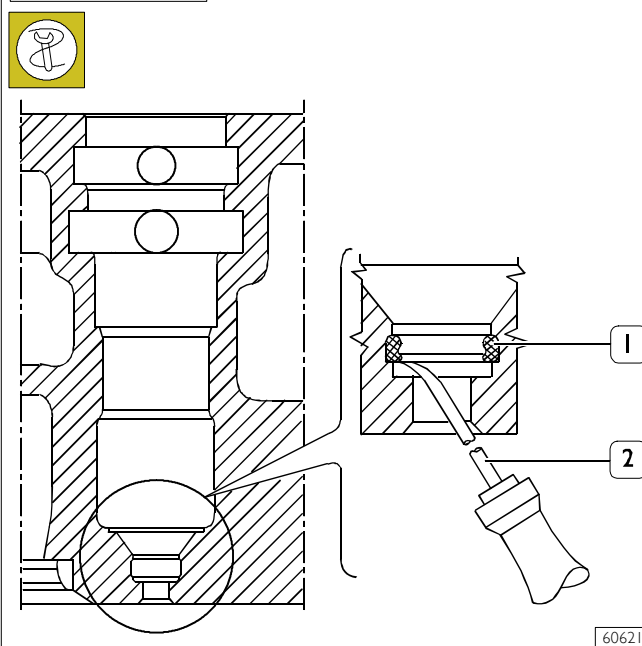
Carry out operations described in figs. I26-I28-I29-I30 by fixing tools to the cylinder head by means of bracket A.

Figure 126



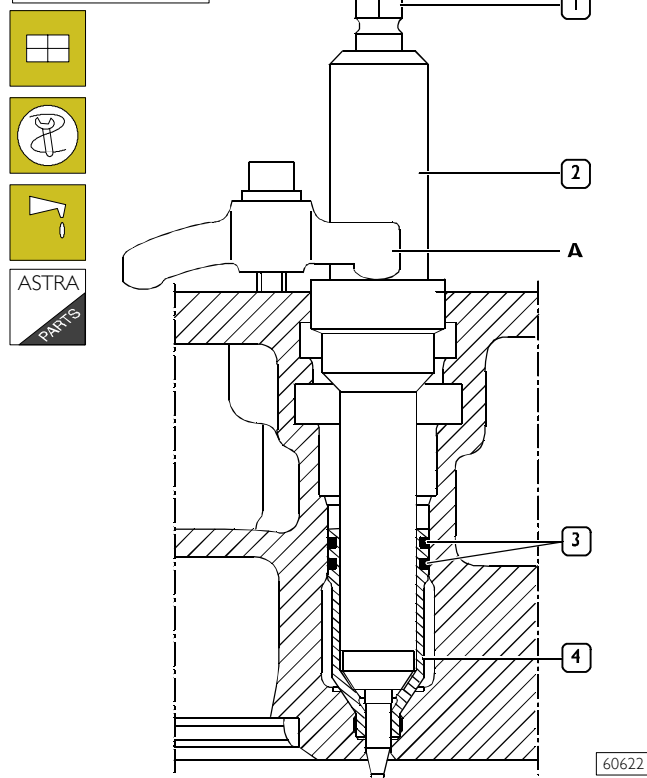
- Fasten extractor 99342149 (2) to case (3), by tightening the nut (1), and pull out the case from cylinder head.

Figure 127



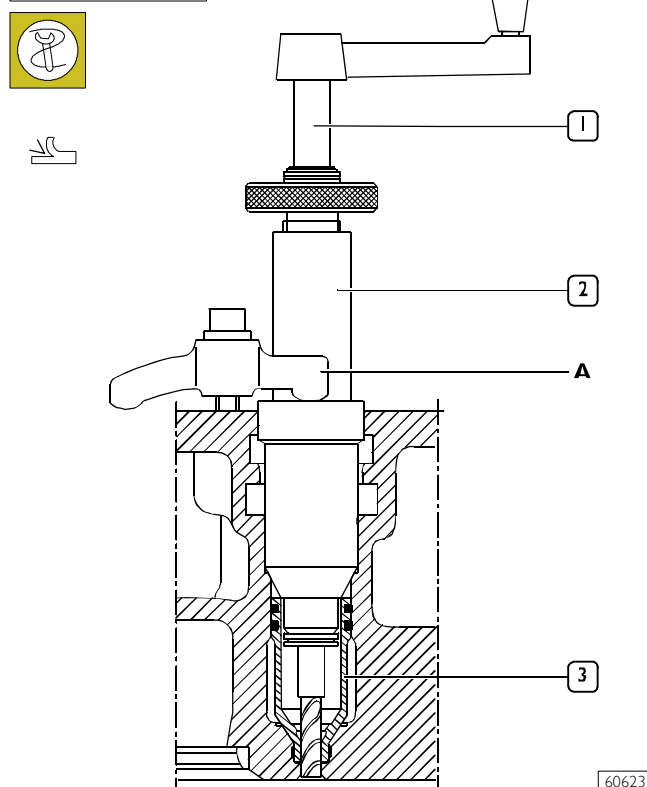
- Remove any residue (1), with tool 99390772 (2), from the cylinder head groove.

Figure 128



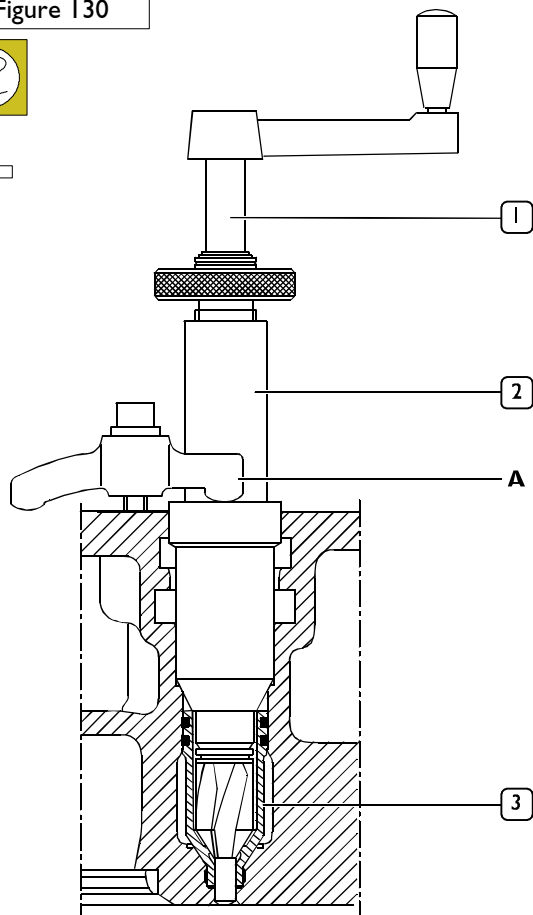
- Lubricate sealing rings (3) and fit them to the case (4); fix tool 99365056 (2) to the cylinder head by means of bracket A, install the new case, tighten the screw (1), upsetting the case lower part.

Figure 129



- Ream the case hole (3) with reamer 99394041 (1).

Figure I30

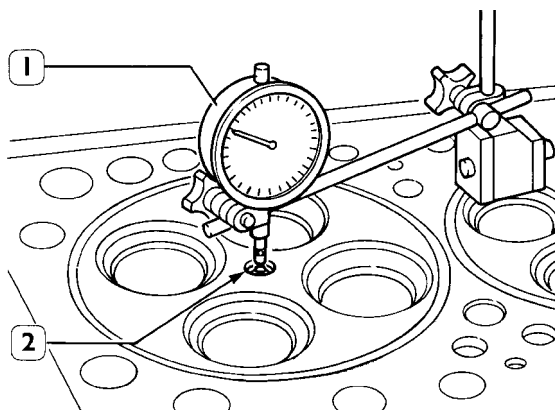


60624

- Using grinder 99394043 (1-2), ream the injector seat in the case (3).

Checking protrusion of injectors

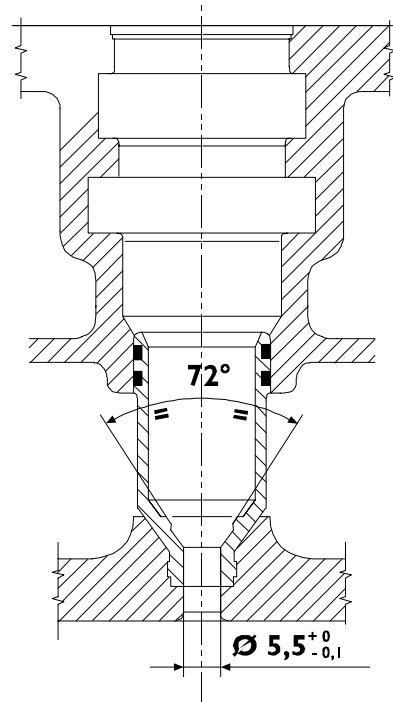
Figure I31



47585

Using dial gauge (1), check the protrusion of the injector (2) which must be 0.52 to 1.34 mm.

Figure I32



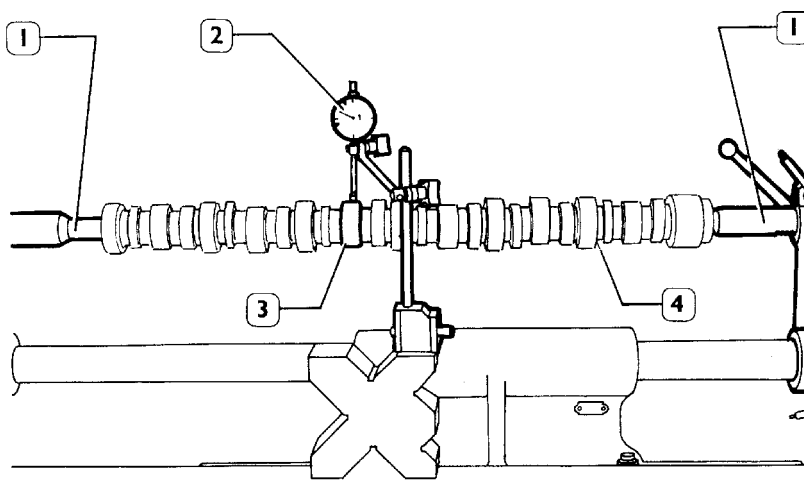
71720

INSTALLATION DIAGRAM FOR
INJECTOR CASE

Timing gear

Checking cam lift and pin alignment

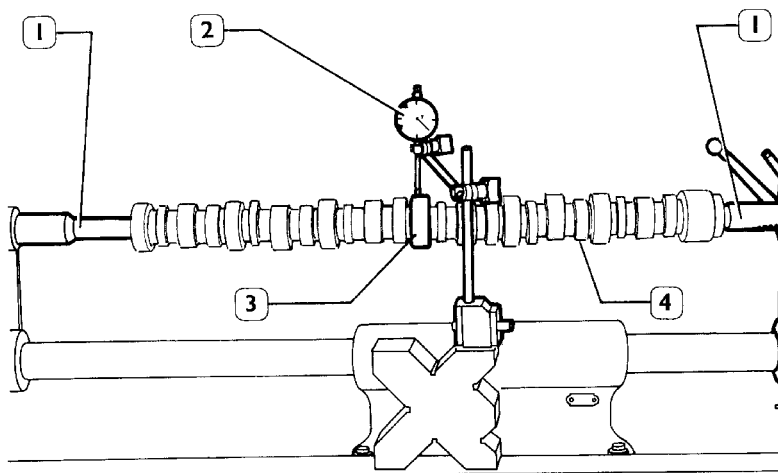
Figure I33



47506

Place the camshaft (4) on the tailstock (1) and check cam lift (3) using a centesimal gauge (2); values are shown in table on page 17.

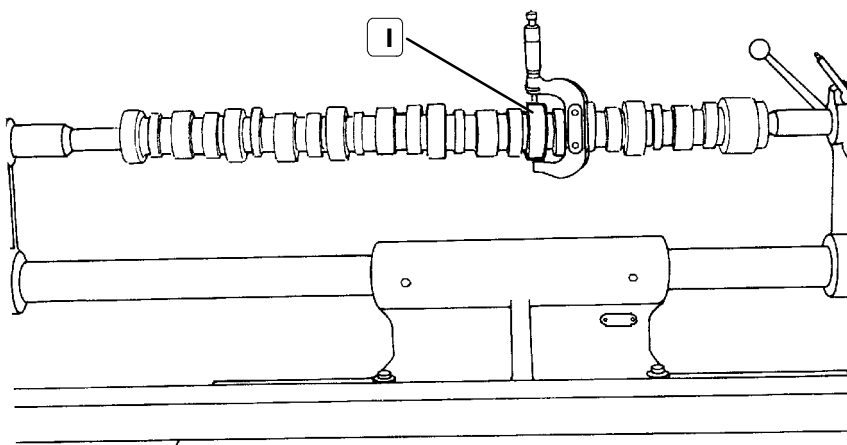
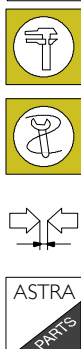
Figure I34



47507

When the camshaft (4) is on the tailstock (1), check alignment of supporting pin (3) using a centesimal gauge (2); it must not exceed 0.030 mm. If misalignment exceeds this value, replace the shaft.

Figure I35

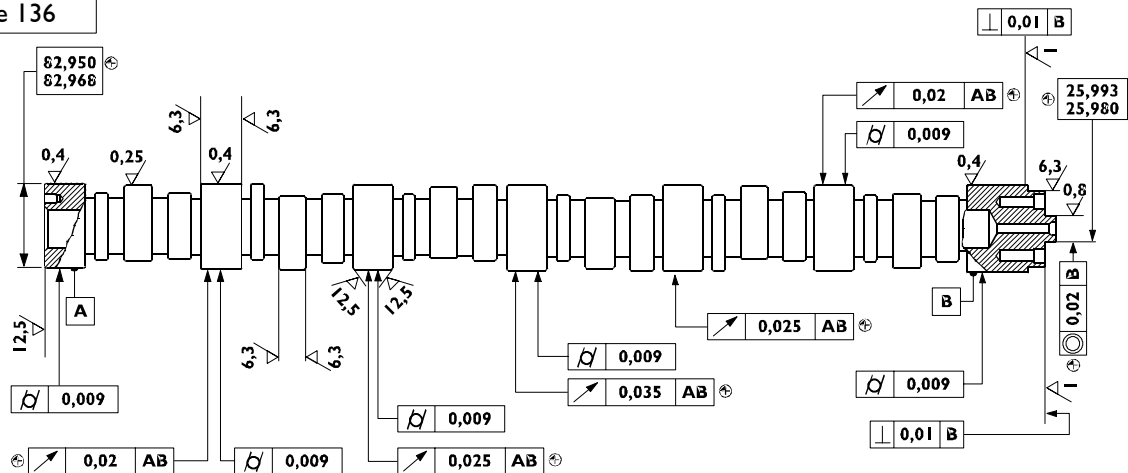


47505

In order to check installation clearance, measure bush inner diameter and camshaft pin (1) diameter; the real clearance is obtained by their difference.

If clearance exceeds 0.135 mm, replace bushes and, if necessary, the camshaft.

Figure I 36



60626

MAIN DATA - CAMSHAFT AND TOLERANCES

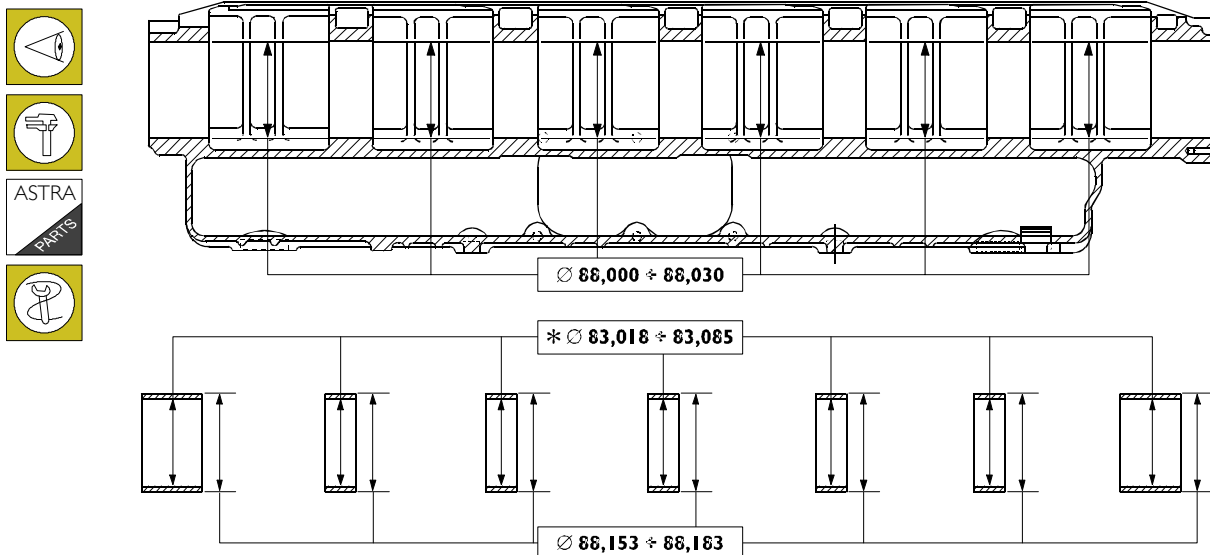
The surfaces of shaft supporting pin and cams must be extremely smooth; if you see any sign of seizing or scoring, replace the shaft and the relative bushes.

TOLERANCES	TOLERANCE CHARACTERISTIC	SYMBOL
ORIENTATION	Perpendicularity	$\perp$
POSITION	Concentricity or coaxial alignment	$\odot$
OSCILLATION	Circular oscillation	$\nearrow$
IMPORTANCE CLASS ASSIGNED TO PRODUCT CHARACTERISTICS		SYMBOL
CRITICAL		$\odot$
IMPORTANT		$\oplus$
SECONDARY		$\ominus$

Fitting the connecting rod-piston assembly into the piston liners

Bushes

Figure I 37



60627

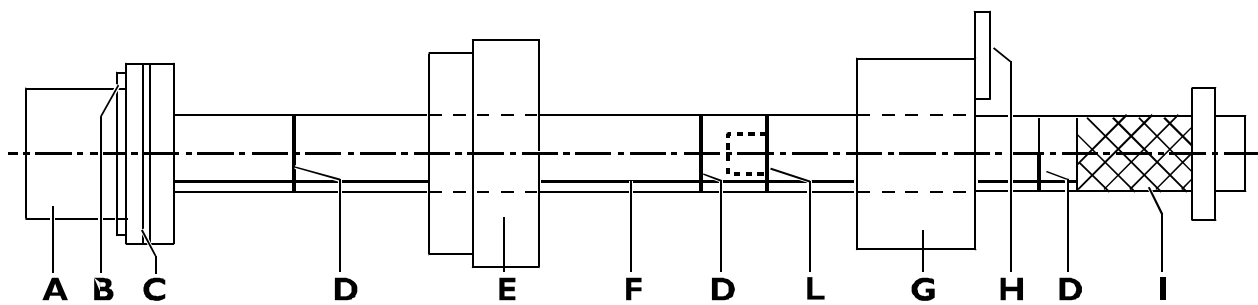
MAIN DATA OF CAMSHAFT BUSHES AND RELEVANT HOUSINGS ON CYLINDER HEAD.

* Bush inner diameter after installation

The bush surfaces must not show any sign of seizing or scoring; if they do replace them.

Measure the bush inner diameters with a baremeter and replace them, if the value measured exceeds the tolerance value. To take down and fit back the bushes, use the proper tool 99360499.

Figure 138

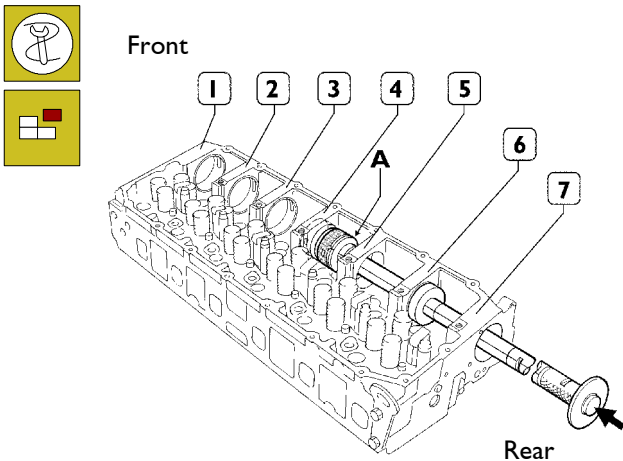


71721

- A = Beater with seat for bushes for insertion/removal
 B = Bush positioning pin
 C = Mark for correct insertion of seventh bush
 D = Mark for correct insertion of bushes 1, 2, 3, 4, 5 and 6 (yellow notches)
 E = Guide bush
 F = Guide line
 G = Guide bush to fasten to seventh bush support
 H = Cylinder head yellow bush fastening plate
 I = Grip
 L = Extension joint

Removal

Figure 139

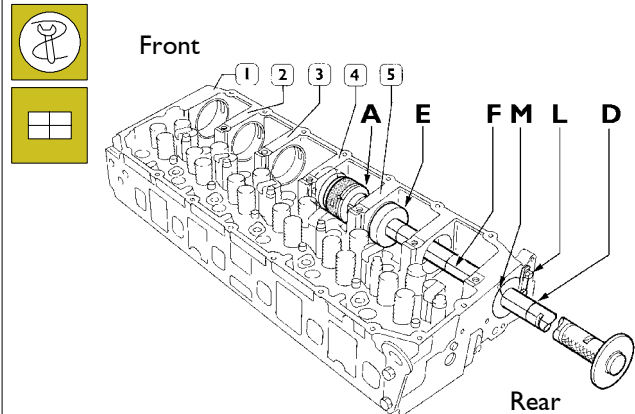


71725

The bush removal order is 7, 6, 5, 4, 3, 2, 1. The bushes are slipped out from the front side of their individual seats. Removal does not require the beater extension for bushes 5, 6 and 7 and use of the guide bush is not necessary. The extension is instead required for bushes 1, 2, 3 and 4, as well as the guide bush. Position the beater precisely during the removal operation.

Replacement

Figure 140



71722

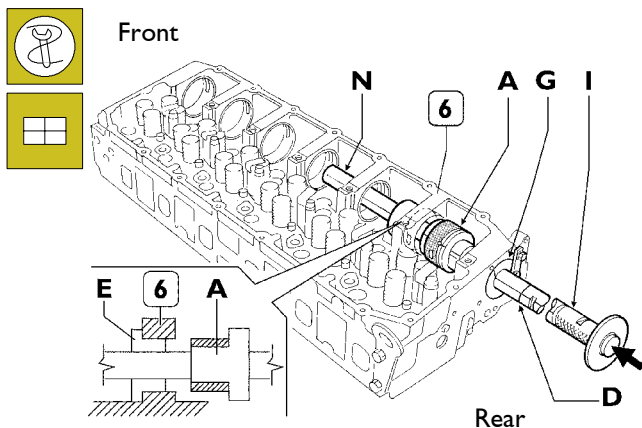
Fit the beater complete with extension.

To insert bushes 1, 2, 3, 4 and 5, proceed as follows:

1. Place the bush for insertion on the beater (A) lining up the pin (B) (Figure 138) with the seat on the bush.
2. Position the guide bush (E) and fasten the guide bush (G) (Figure 138) in the seat of the 7th bush by means of plate (H).
3. When inserting the bush, line up notches F and M. Doing so, when the bush is pushed in the lubrication hole on it is aligned with the oil hole in the seat.

The bush is fully inserted when the 1st yellow reference notch (D) is flush with the guide bush (G).

Figure I41

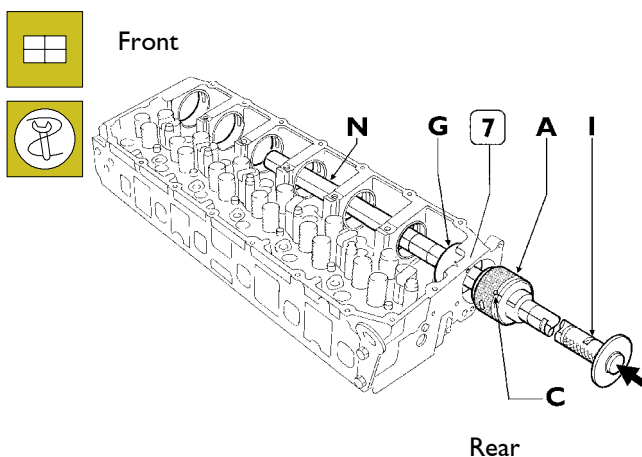


71723

To insert bush 6, proceed as follows:

- ☐ remove the grip (I) and the extension (N);
- ☐ position the extension (N) and the guide bush (E) as shown in the figure;
- ☐ repeat operations 1, 2 and 3.

Figure I42



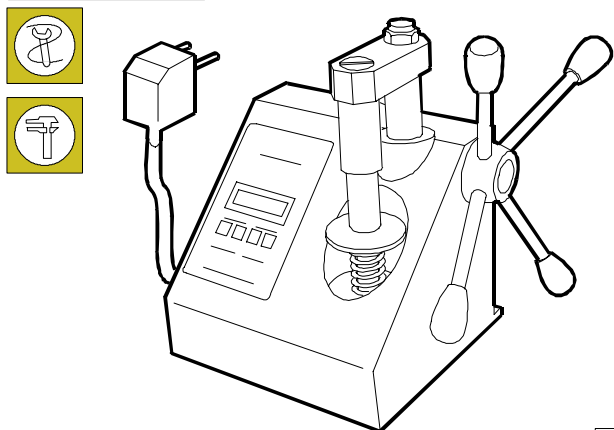
71724

To insert bush 7, proceed as follows:

- ☐ remove the grip (I) and the guide bush (G) fastened to the head (Figure I42);
- ☐ replace the guide G from the inner side as shown in the figure.
- ☐ Position the bush on the beater (A) and bring it toward its seat making sure the hole in the bush aligns with the lubrication hole in the head. Proceed to fit. The 7th bush is fully inserted when the reference mark (C) is flush with the bush seat.

Valve springs

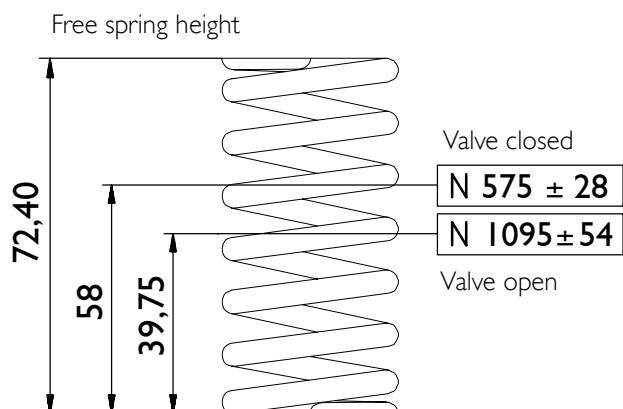
Figure I43



70000

Before installation, check valve spring flexibility using tool 99305047 and compare the loading and elastic deformation data with data referred to the new valves, shown in the following figure.

Figure I44

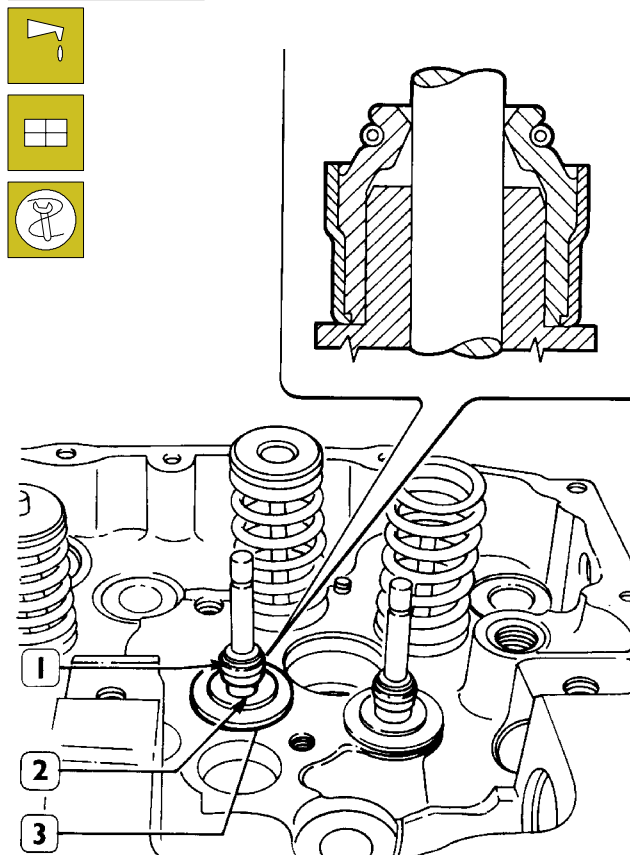


71726

MAIN DATA TO CONTROL EXHAUST AND DIS-
CHARGE VALVE SPRING

Fitting the valves and oil seal ring

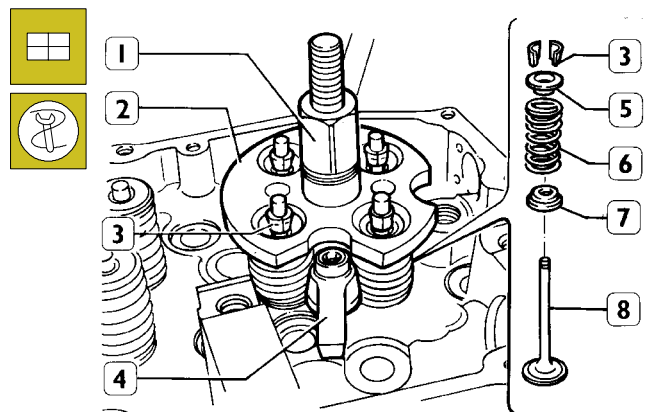
Figure I45



49033

Lubricate the valve stem and place the valves in the relevant valve guides; install the lower plates (3) using tool 99360329, fit the oil seal ring (1) on valve guides (2), then install the valves as shown:

Figure I46

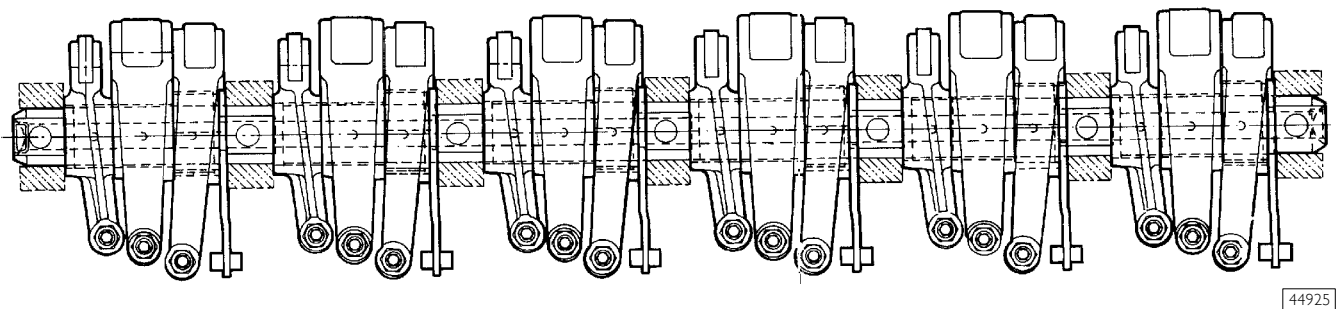


47583

- ☐ Fit springs (6) and the upper plate (5);
- ☐ apply tool 99360263 (2) and block it with bracket (4); tighten the lever (1) until cotters are installed (3), remove tool (2).

Rocker shaft

Figure 147



44925

The camshaft cams directly control rockers: 6 for injectors and 12 for valves.

Rockers slide directly on the cam profiles via rollers.

The other end acts on a bar directly supported by the two valves stems.

A pad is placed between the rocker adjusting screw and the bar.

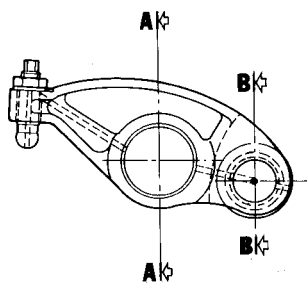
Two lubrication holes are obtained inside the rockers.

The rocker shaft practically covers the whole cylinder head; remove it to have access to all the underlying components.

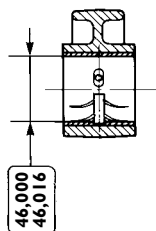
The length of the rocker shaft is practically the same as that of the cylinder head. It must be removed in order to remove all the components located beneath it.

ROCKERS

Figure 148



SECTION A-A



SECTION B-B

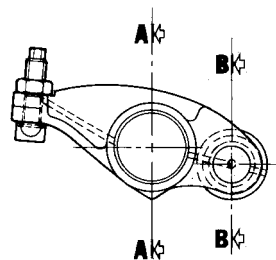


The bush surfaces must not show any trace of scoring or excessive wear; otherwise, replace bushes or the whole rocker.

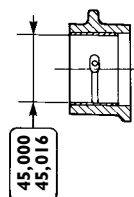
71728

PUMP INJECTOR ROCKER

Figure 149



SECTION A-A



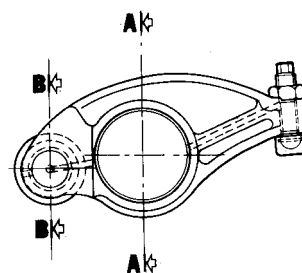
SECTION B-B



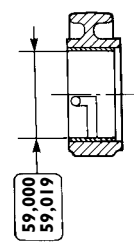
71729

EXHAUST VALVES ROCKER

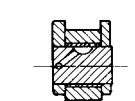
Figure 150



SECTION A-A



SECTION B-B



71730

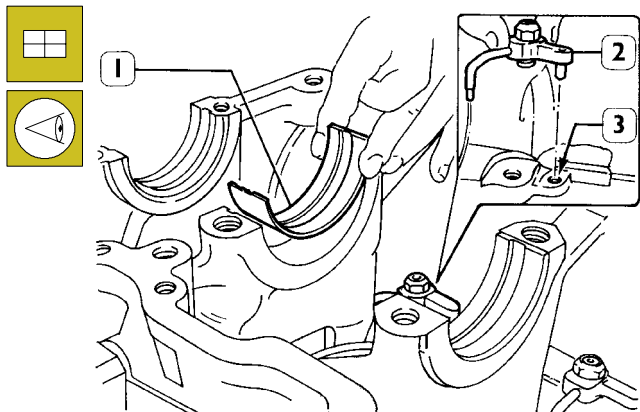
DISCHARGE VALVE ROCKER

ASSEMBLING THE ENGINE ON THE BENCH

Fix the engine block to the stand 99361036 by means of brackets 99322230.

Install the cylinder liners as described in the relevant paragraph.

Figure 151

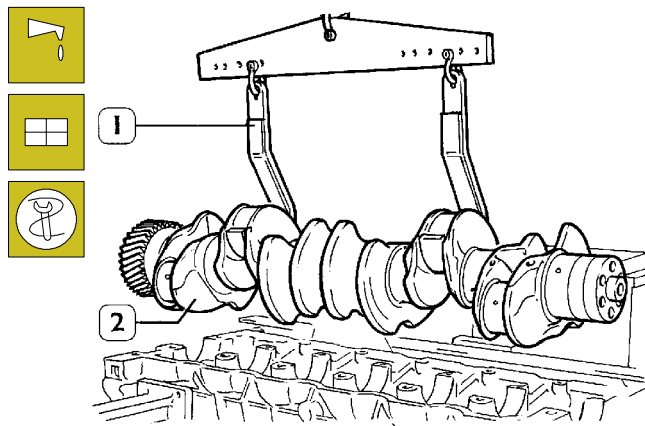


47586

Fit the oil spray nozzles (2), so that the dowel coincides with the block hole (3).

Place the half bearings (1) on the main bearings.

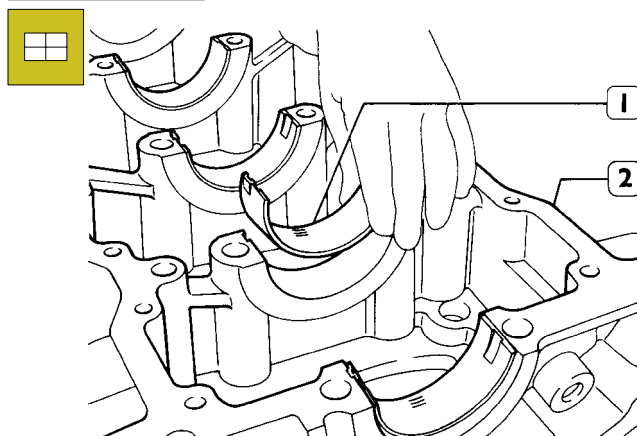
Figure 152



47570

Lubricate the half bearings, then install the crankshaft (2) by means of hoist and hook 99360500 (1).

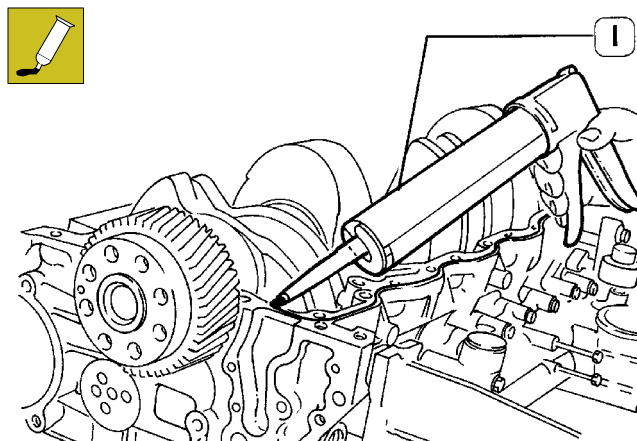
Figure 153



49021

Place the half-bearings (1) on the main bearings in the underblock (2).

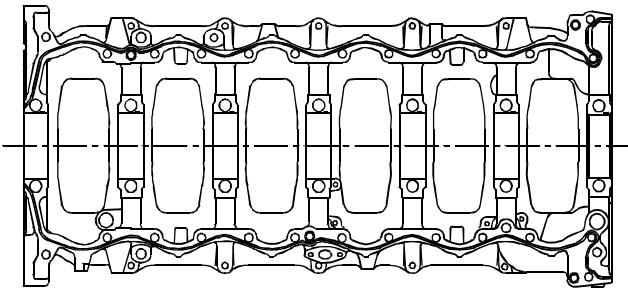
Figure 154



47595

By means of suitable equipment (1) apply silicone LOCTITE 5699 to the block, as shown in the figure.

Figure I55



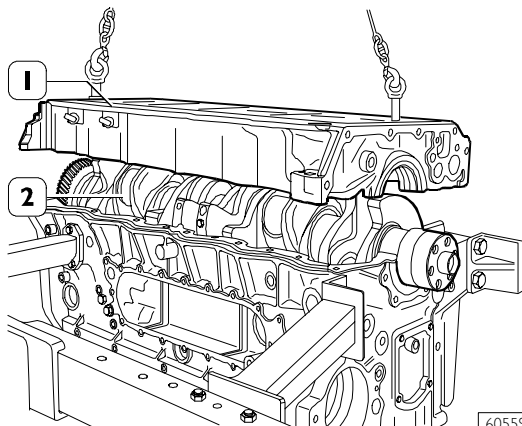
60632

Sealant application diagram



Fit the underblock within 10' of the application of the sealant.

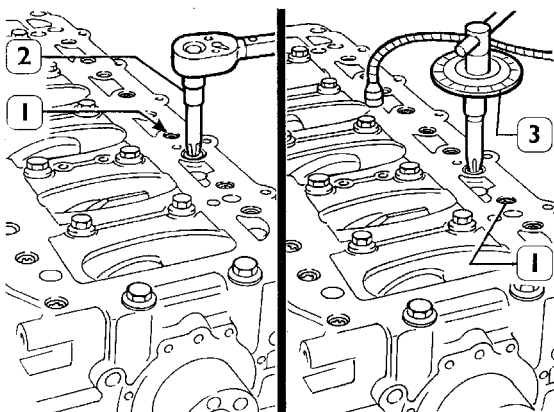
Figure I56



60559

Fit the underblock by means of a suitable hoist and hooks (1).

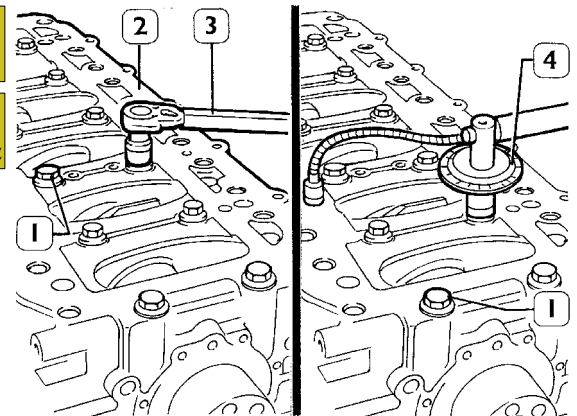
Figure I57



47581

Fit the underblock and, using a dynamometric wrench (2), close the splined outer screws (1) to 30 Nm torque, according to the diagram shown on page 83.

Figure I58

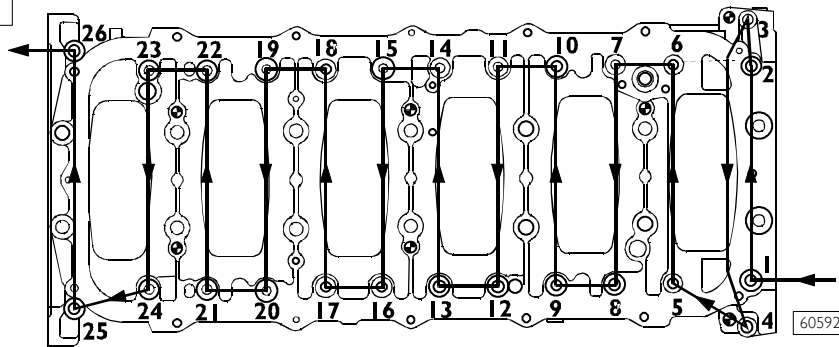


47579

Close the inner screws (1) to 120 Nm torque by means of a dynamometric wrench (3, Figure I58), then with two further angular phases $90^\circ + 45^\circ$, using tool 99395216 (4). Tighten again the outer screws (1, Figure I57) with 60° angular closing, using tool 99395216 (3, Figure I57).

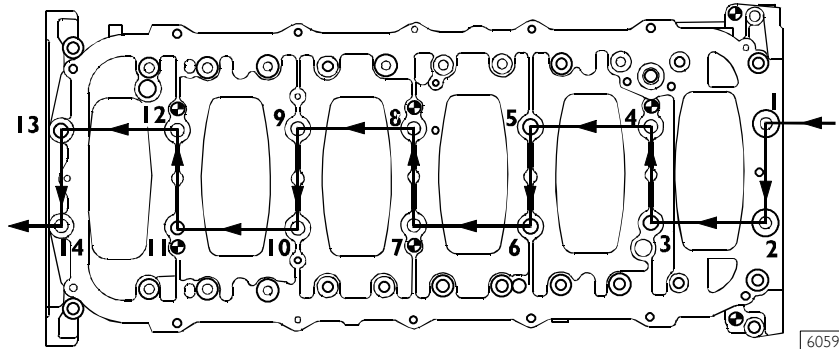
Figure 159

FRONT SIDE



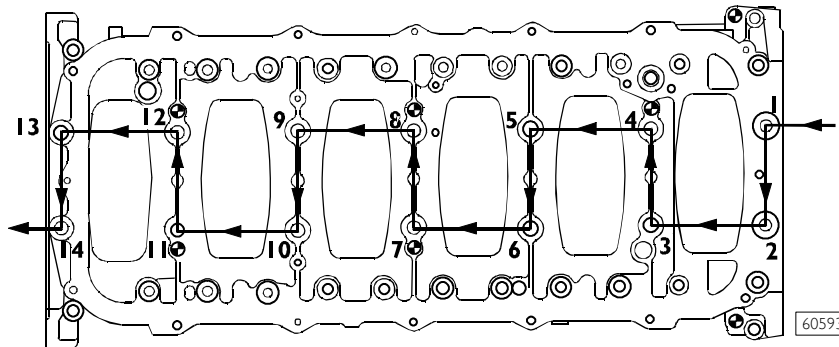
stage 1:
pretightening
outer screws
30 Nm)

FRONT SIDE



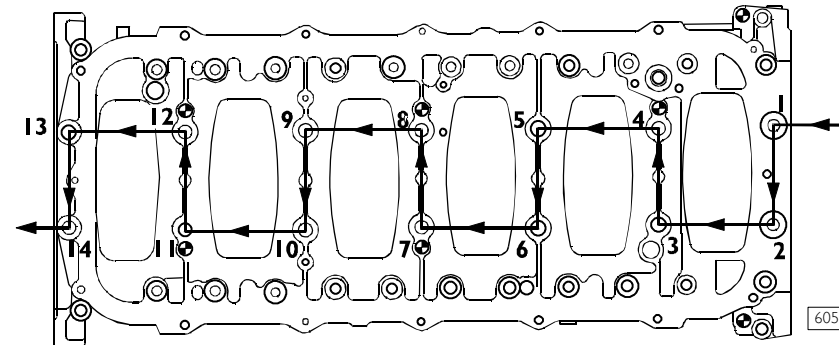
stage 2: pre-
tightenig
inner screws
120 Nm

FRONT SIDE



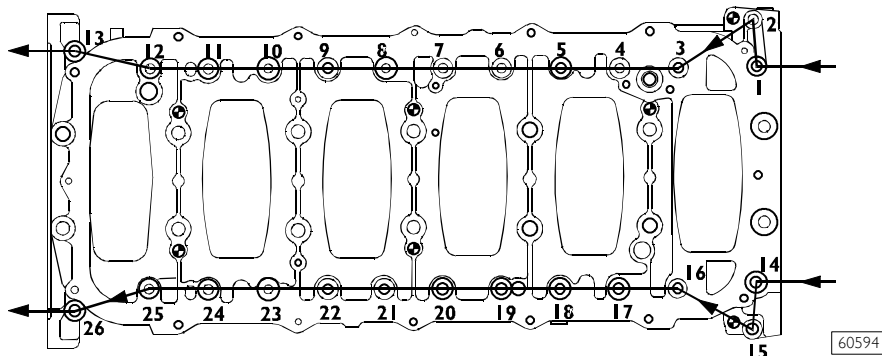
stage 3:
angle
inner
screws
60°

FRONT SIDE



stage 4:
angle
inner
screws
55°

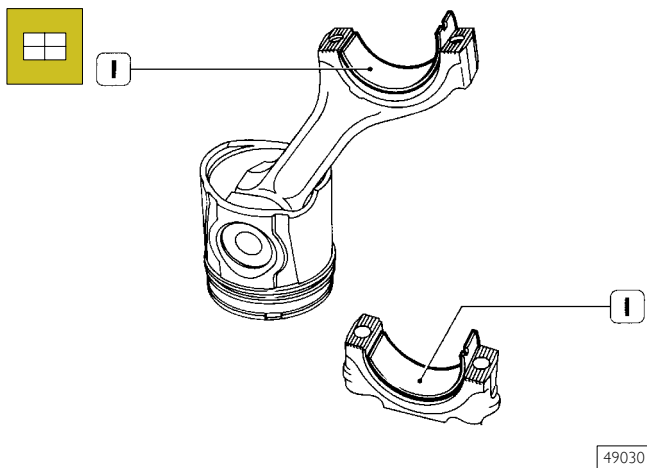
FRONT SIDE



stage 5:
angle
outer
screws
60°

DIAGRAM SHOWING TIGHTENING ORDER OF UNDER-CRANKCASE SECURING SCREWS

Figure I60

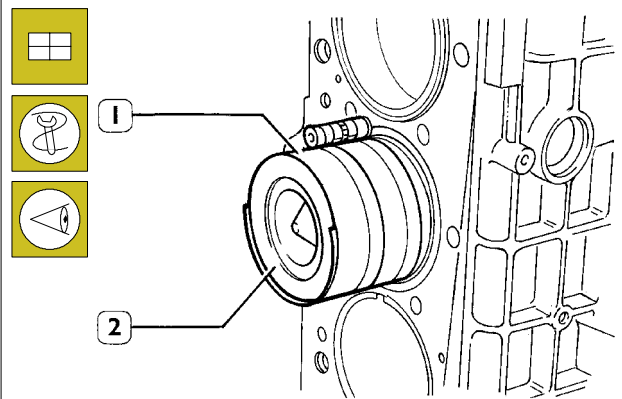


49030

Rotate the cylinder assembly placing it vertically.
Fit the half-bearings (1) on both the connecting rod and the cap.

Fitting the connecting rod-piston assembly into the cylinder liners

Figure I62

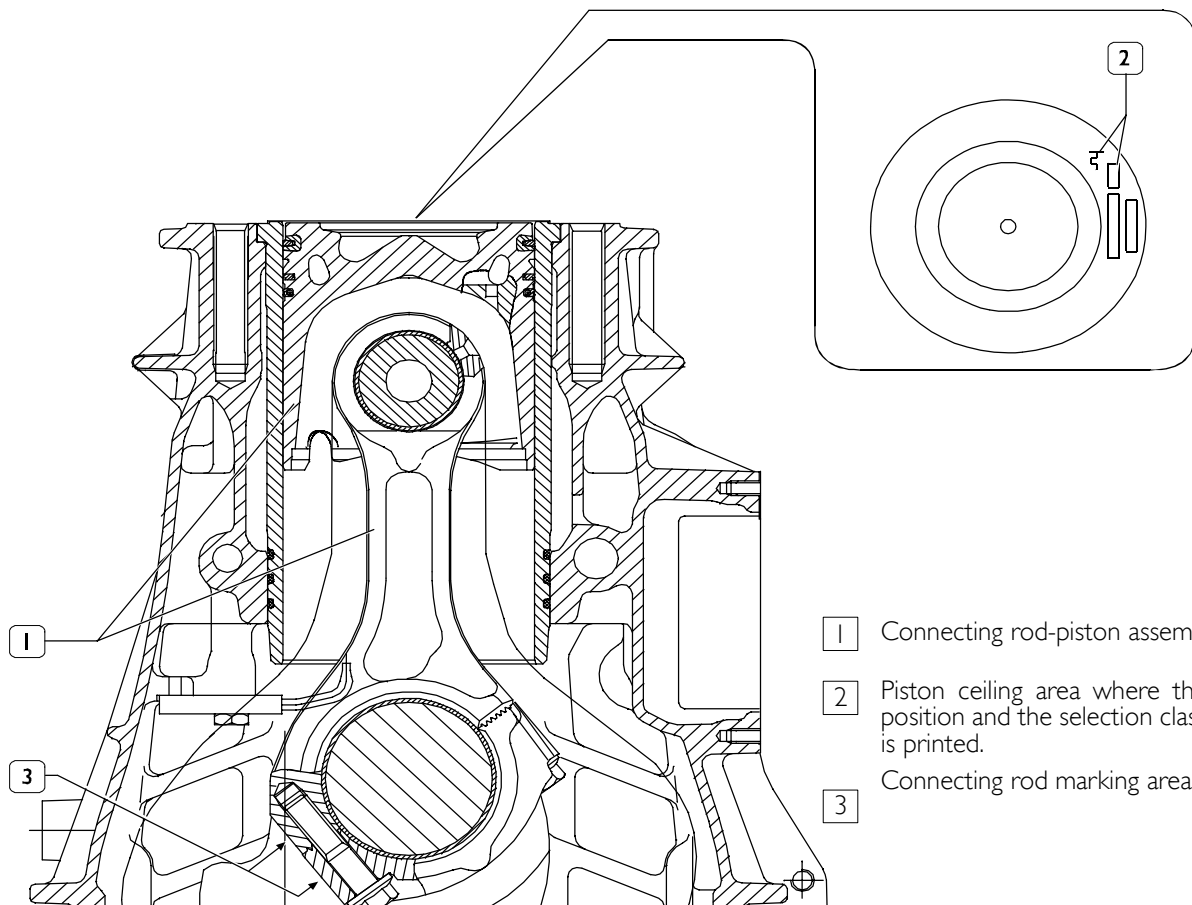


60616

Fit the connecting rod-piston assemblies (2) into the piston liners, using the band 99360605 (1). Check the following:

- ☐ the openings of the split rings are offset by 120°;
- ☐ all pistons belong to the same class, A or B;
- ☐ ideogram (2), stamped on the piston crown, is placed toward the engine flywheel, or the cavity, on the piston skirt, corresponds to the position of the oil spray nozzles

Figure I61

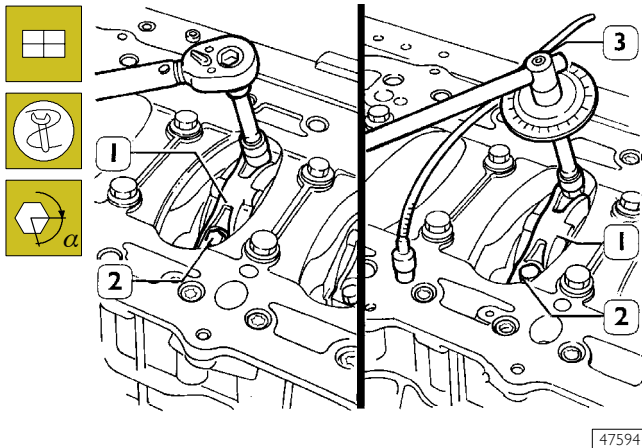


- ☐ Connecting rod-piston assembly
- ☐ Piston ceiling area where the assembly position and the selection class ideogram is printed.
- ☐ Connecting rod marking area

60615

Fitting the cylinder head

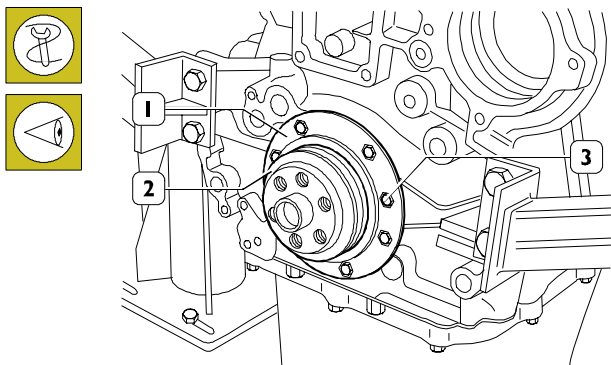
Figure I63



47594

Connect the connecting rods to the relative journals, fit the connection rod caps (1) with half bearings; tighten the fixing screws (2) of the connecting rod caps to 60 Nm torque (6 kgm). Using tool 99395216 (3), further tighten screws with 60° angle.

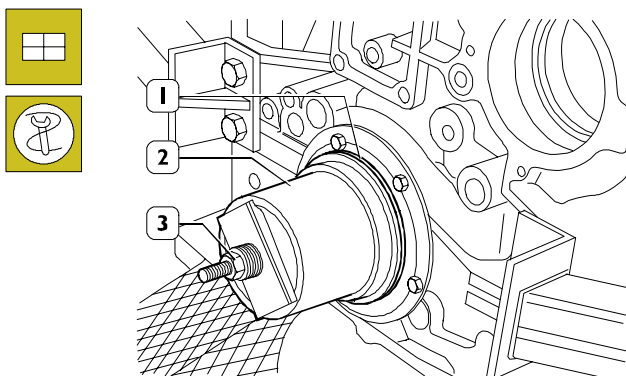
Figure I64



60563

By means of centering ring 99396035 (2), check the exact cover position (1), otherwise act as necessary and tighten the screws (3).

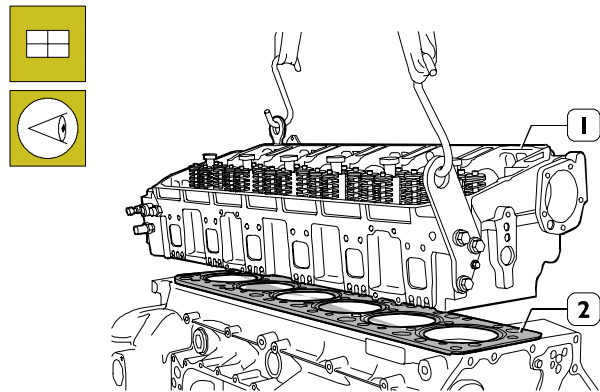
Figure I65



60564

Fit the sealing gasket (1), install the fitting tool 99346250 (2) and drive the sealing gasket (1) by screwing nut (3).

Figure I66

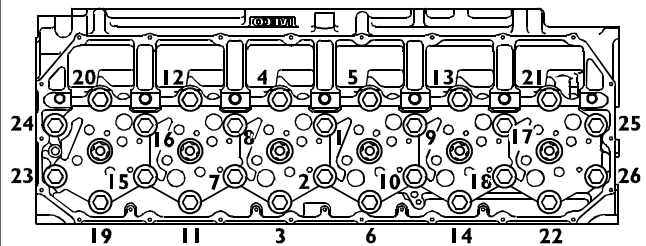


60515

Make sure that pistons 1-6 are exactly at the TDC. Place the sealing gasket (2) on the block.

Fit the cylinder head (1) and tighten screws as shown in figs. 91, 92 and 93.

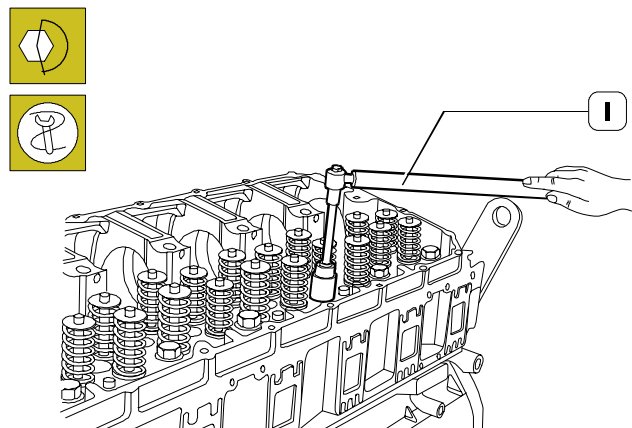
Figure I67



61270

Diagram showing the cylinder head fixing screws tightening order

Figure I68



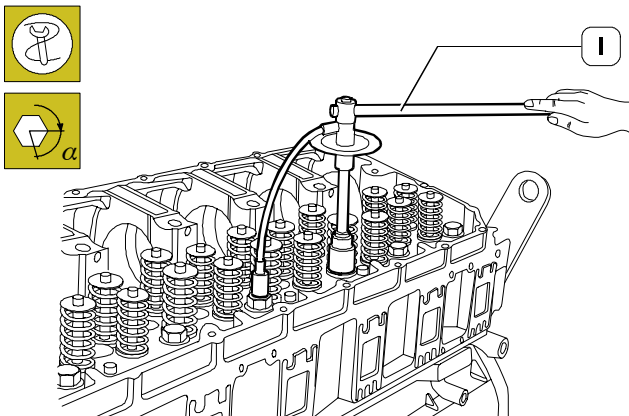
60565

□ Preliminary tightening by means of a dynamometric wrench (1):

1st phase: 60 Nm (6 kgm)

2nd phase: 120 Nm (12 kgm);

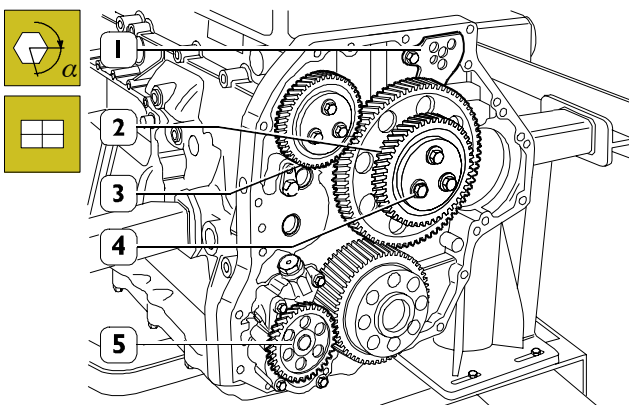
Figure 169



60566

- Angular tightening using tool 99395216 (1);
 3rd phase: 90° angle
 4th phase: 45° angle for screws 4, 5, 12, 13, 20, 21
 5th phase: 65° angle for screws 1, 2, 3, 6, 7, 8, 9, 10, 11.

Figure 170

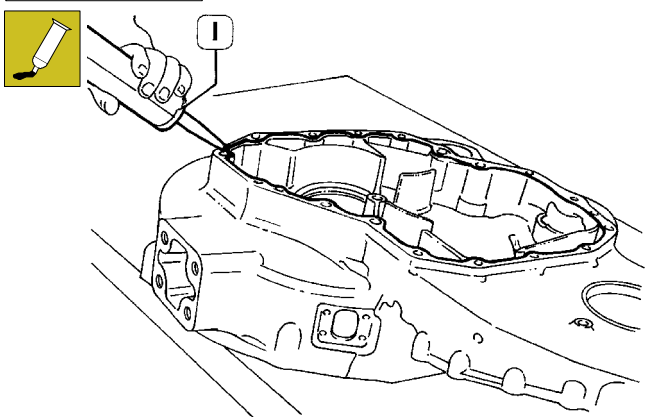


71773

Fit the oil pump (5), intermediate cogs (2) complete with P.T.O tie-rod (1) and drive cog (3)
 Tighten the screws (4) to the specified torque.

Replacing flywheel casing

Figure 171



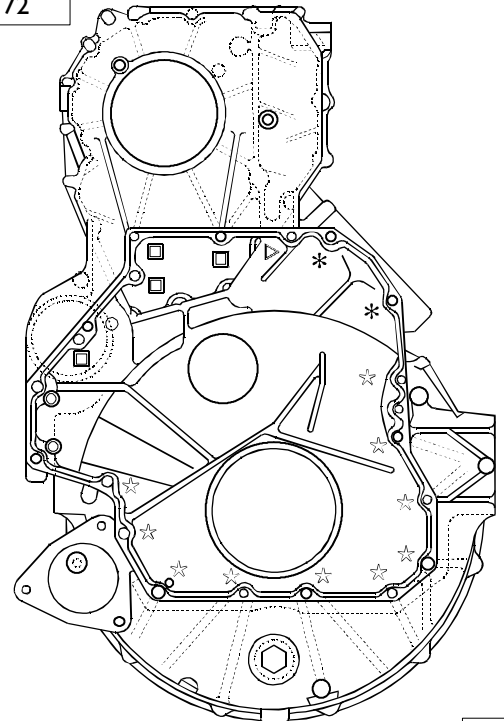
47592

Apply (as shown in the figure) sealant LOCTITE 5699 to the gear box using the proper equipment (1).



Install the gear box within 10' of the application of the sealant.

Figure 172

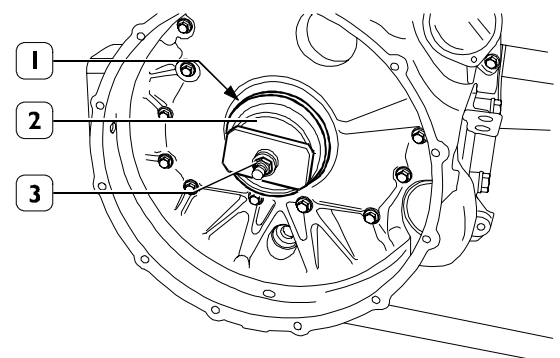


60633

Tighten the screws shown in the figure by means of a dynamometric wrench, in compliance with the following order and tightening torque:

- ☆ no. 10 M12 x 1.75 x 100 56 to 70 Nm
- no. 2 M12 x 1.75 x 70 56 to 70 Nm
- no. 4 M12 x 1.75 x 35 56 to 70 Nm
- △ no. 1 M12 x 1.75 x 120 56 to 70 Nm
- * no. 2 M12 x 1.75 x 193 56 to 70 Nm

Figure 173

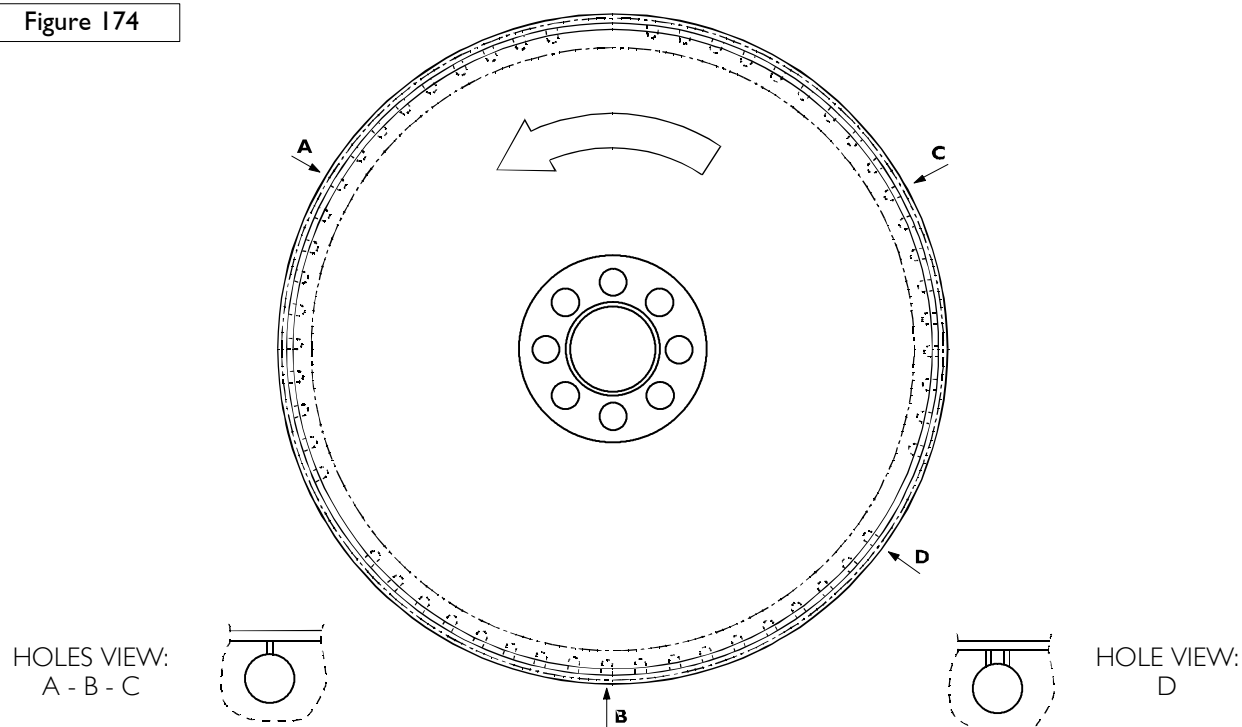


60568

Fit the sealing gasket (1), install the fitting tool 99346251 (2) and drive the sealing gasket by screwing the nut (3).

Replacing engine flywheel

Figure 174



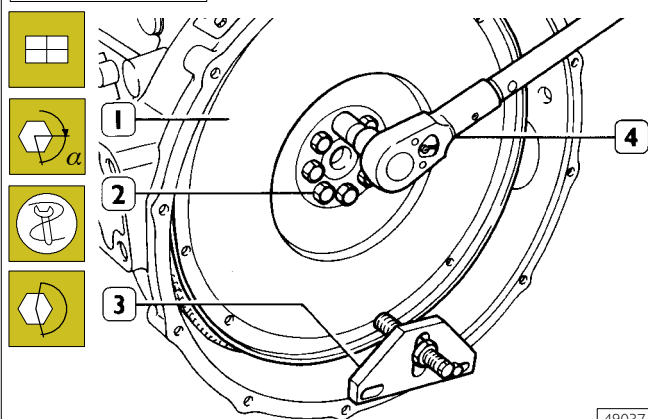
60668

DETAIL OF PISTON POSITION MARKS ON ENGINE FLYWHEEL

- A = Hole on the flywheel with 1 notch, corresponding to TDC of pistons 3-4.
- B = Hole on the flywheel with 1 notch, corresponding to TDC of pistons 1-6.

- C = Hole on the flywheel with 1 notch, corresponding to TDC of pistons 2-5
- D = Hole on the flywheel with 2 notches, corresponding to 54°.

Figure 175

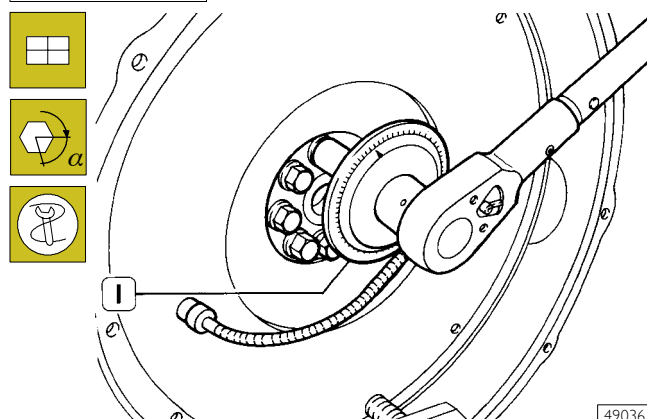


49037

Stop rotation using the tool 99360351 (3); tighten the screws (2) in three phases.

First phase: pre-torque at a 120 Nm (12 kgm) torque using a torque wrench (4).

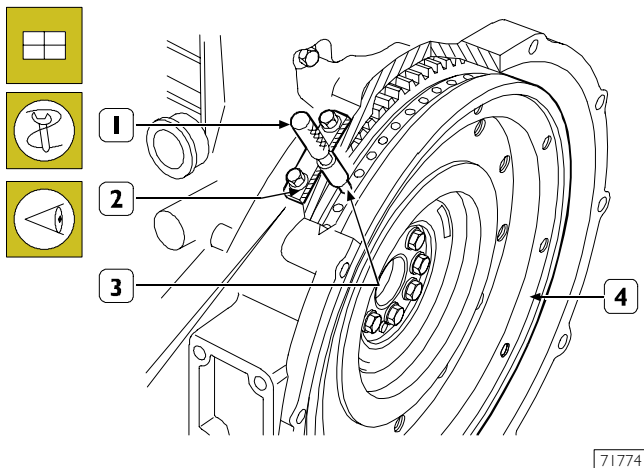
Figure 176



49036

Second and third phase: tighten at a 60° + 30° angle using the tool 99395216 (1).

Figure 177



71774

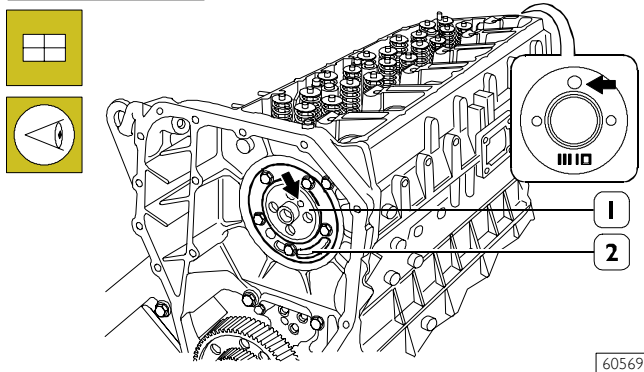
Position the crankshaft with pistons 1 and 6 at top dead centre (TDC).

At this position check when it is possible to see a notch and hole through the inspection hole located on the lower part of the flywheel casing, and fit pin 99360612 (1) into it (Figure 177).

If this situation does not occur, turn the engine slightly until it does.

Replacing camshaft, valves and injectors

Figure 178

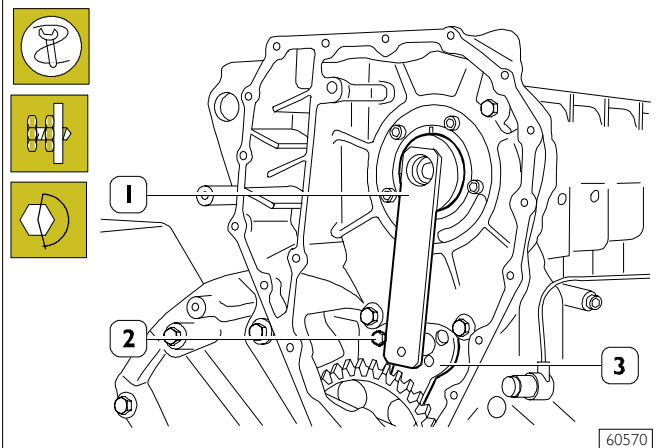


60569

□ Replace:

- the camshaft (1) positioning it according to the references () as shown in Figure 178. This operation simplifies subsequent camshaft timing
- The shoulder plate (2) with metal gasket.

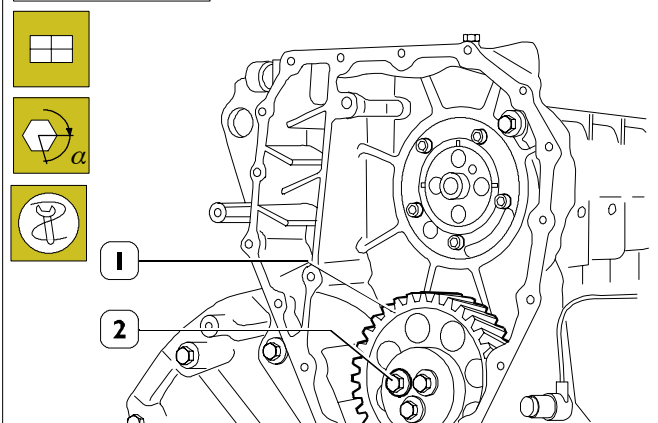
Figure 179



60570

- Fit the gauge 99395219 (1) and check and adjust the transmission gear connecting rod (3), tighten the screw (2) at the prescribed torque.

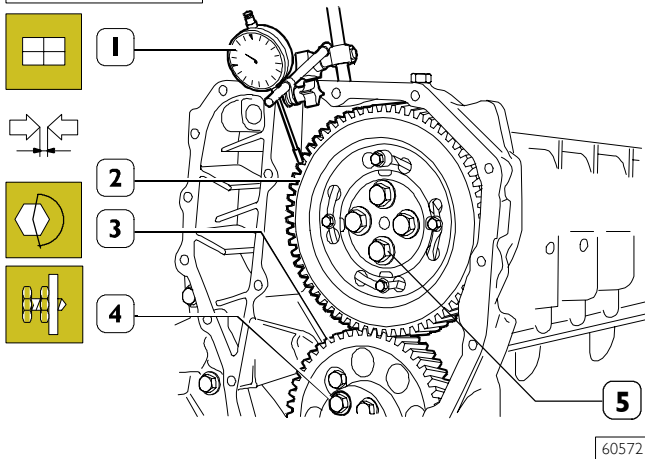
Figure 180



60571

- Refit the motion transmission gear (1) and secure the screws (2) to tightening torque 30 ± 3 Nm and then close at an angle of 90° with tool 99395216.

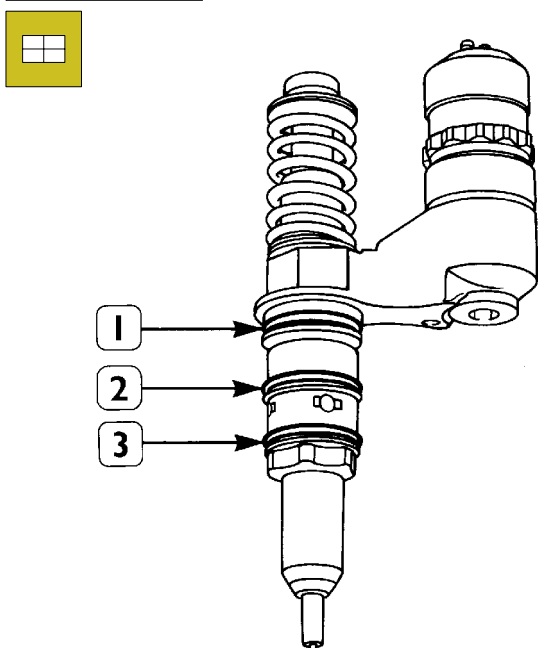
Figure 181



Fit back the gear (2), without fully tightening screws (5) on the camshaft and place it so that the 4 oval holes are centered with respect to the camshaft fixing holes. Using a magnetic gauge (1), make sure that the gear (2 and 3) clearance is 0.073 to 0.195 mm, otherwise adjust the clearance as follows:

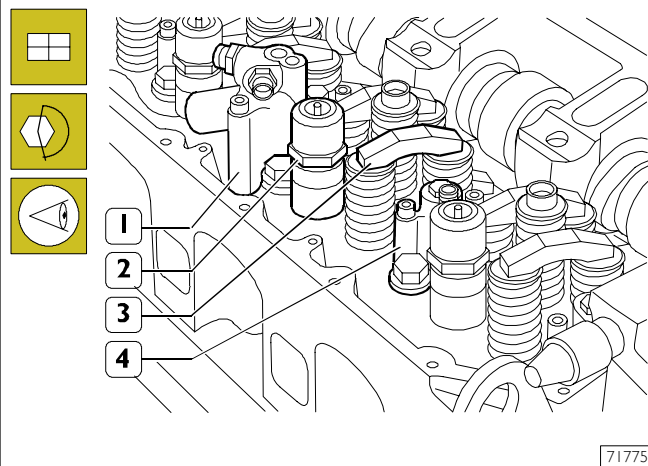
untighten screws (4) fixing transmission gear (3);
untighten screws (2, Figure 183) fixing the rod, move the rod (3, Figure 183) to obtain the required clearance;
Tighten the rod fixing screw (2, Figure 183) as well as the screws (4, NO TAG) fixing the gear to the prescribed torque.

Figure 182



Fit the sealing rings (1) (2) (3) on injectors.

Figure 183



Fit:

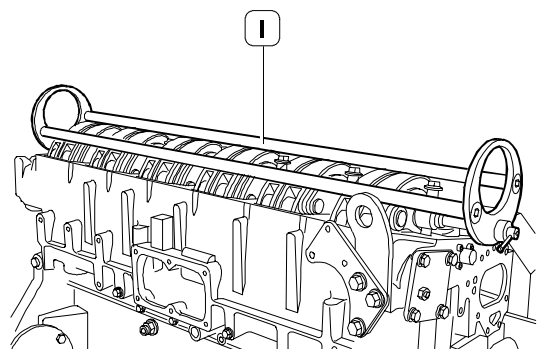
- ☐ the injectors (2) and tighten the bracket screws to 26 Nm using a torque wrench.
- ☐ The engine brake cylinders (1) and (4), tightening to torque of 19 Nm using a torque wrench.
- ☐ The valve bridge bars (4) with the larger hole on the same side

Replacing rocker shaft assembly

Figure 184



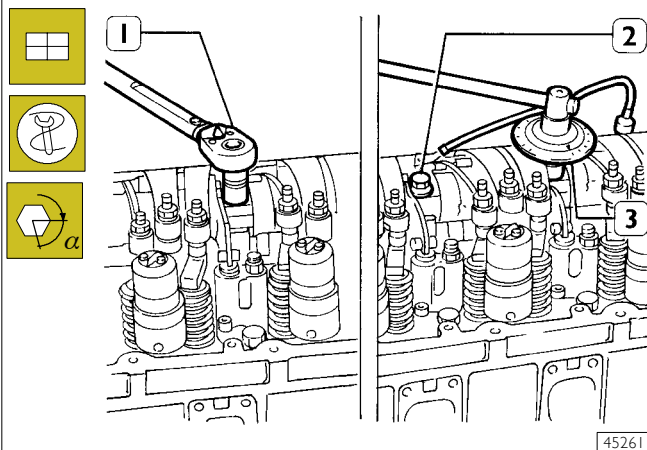
Before fitting back the rocker shaft assembly, make sure that all the adjusting screws have been completely unscrewed.



Apply tool 99360553 (1) and remove the rocker shaft assembly.

Timing the camshaft

Figure 185

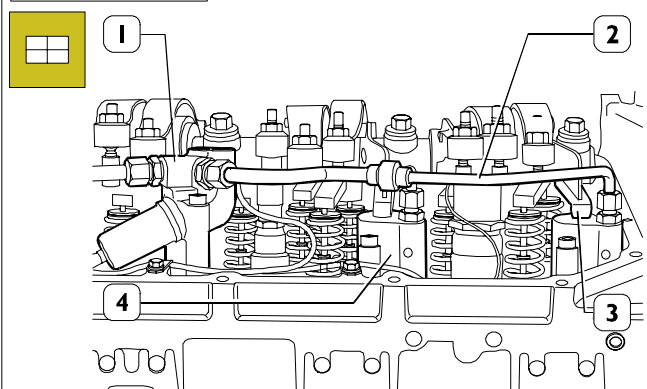


45261

Tighten the screws (2) fixing the rocker shaft as follows:

- ☐ 1st phase: tightening with a dynamometric wrench (1) to 100 Nm torque (10 kgm)
- ☐ 2nd phase: closing by means of tool 99395216 (3), with 60° angle.

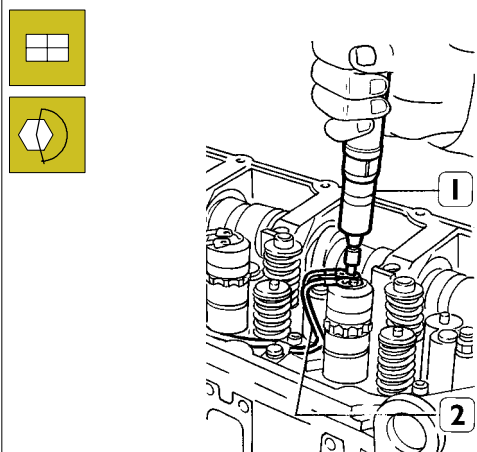
Figure 186



60574

- ☐ Assemble exhaust brake lever check springs (3)
- ☐ Connect piping (2) to the exhaust brake pins (4) and to the slave cylinder (1)

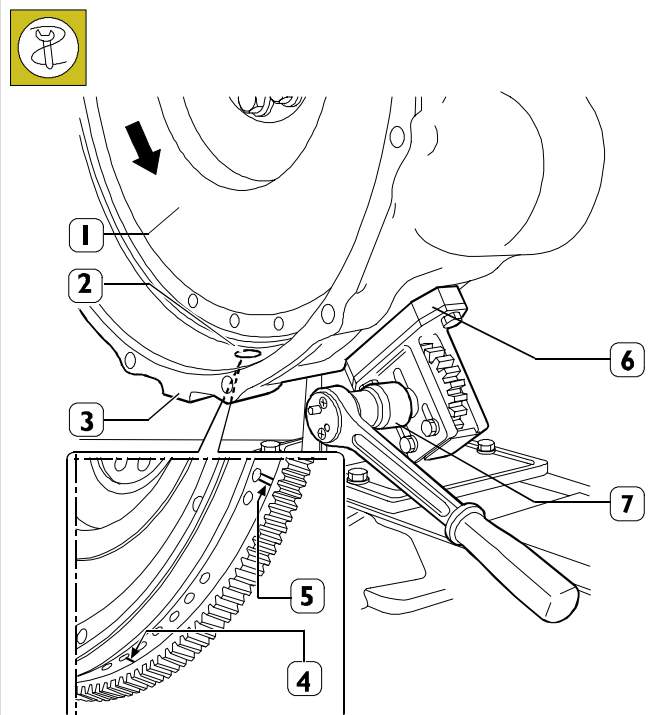
Figure 187



71777

Fit the wires fastening them to the injectors using a torque screwdriver (1) to a torque of 1.36 - 1.92 Nm.

Figure 188



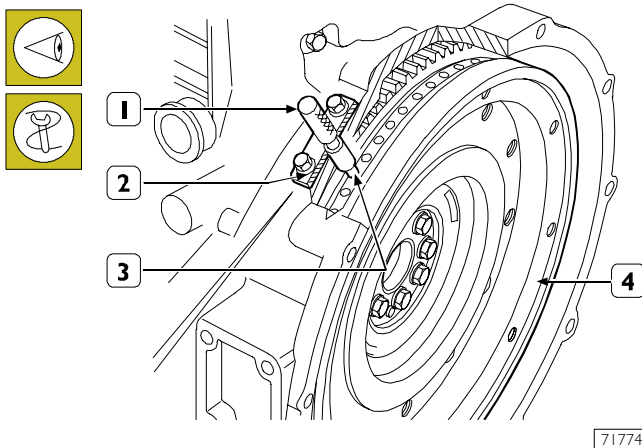
71776

Apply tool 99360321 (7) and shim 99360325 (6) to the gearbox.



The arrow indicates engine rotation direction. With the above tool, turn the flywheel (1) in the engine direction such that it brings piston 1 approximately to TDC on the firing stroke. This condition is realised when the hole with a notch (4) following the hole with two notches (5) present on the flywheel (1), appears in the inspection hole (2).

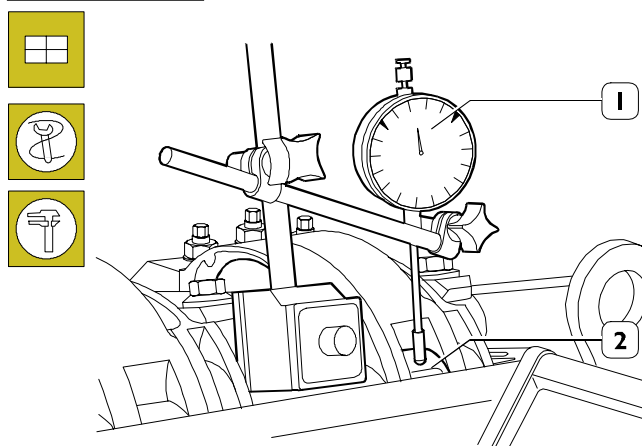
Figure 189



71774

The exact position of piston 1 at TDC is achieved in the previously described position, when tool 99360612 (1) fits into the hole (3) on the flywheel (4) through the engine revs sensor seat (2).

Figure 190



60573

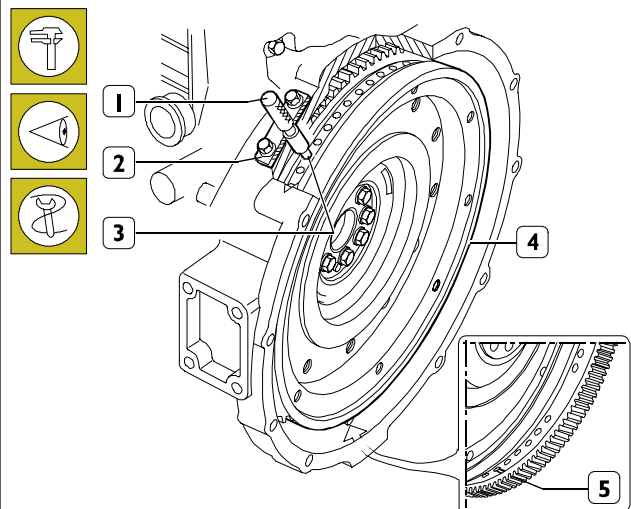
Position the magnetic dial gauge (1) with the stem on the roller (2) of the rocker controlling the injector of cylinder 1, and pre-load it 6 mm.

Using tool 99350321 (7) Figure 188, turn the crankshaft clockwise until the pointer on the gauge reaches the minimum value beyond which it cannot go.

Reset the dial gauge.

Turn the flywheel anti-clockwise until the gauge reads a lift value of 5.31 ± 0.05 mm for the camshaft cam.

Figure 191



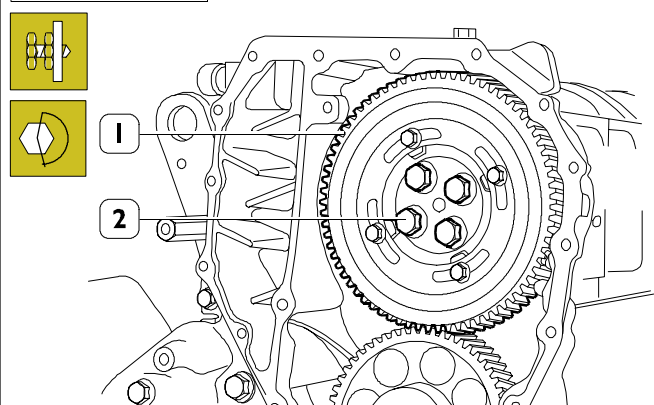
72436

The camshaft is timed if the following conditions are present when the cam lift values are 5.31 ± 0.05 mm:

1) the hole marked with double notch (5) can be seen through the inspection window;

2) tool 99360612 (1) can be inserted into hole (3) on the engine flywheel (4) through the seat (2) of the engine rpm sensor:

Figure 192



60575

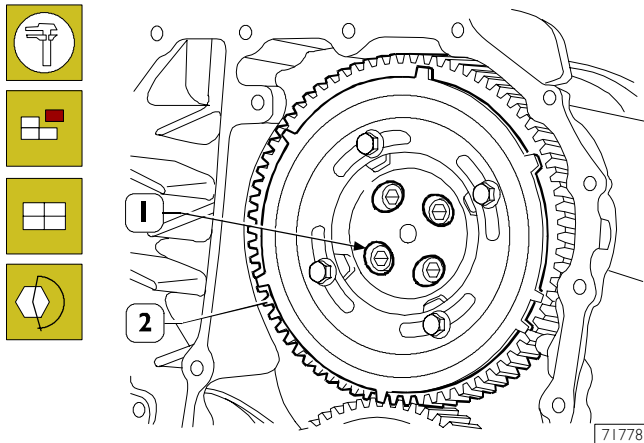
If the conditions illustrated in Figure 191 and specified in points 1 and 2 above do not exist, proceed as follows:

Loosen the screws (2) securing gear (1) to the camshaft and use the slots (1) on the gear.

Move the engine flywheel to obtain the conditions described in points 1 and 2, Figure 191, while keeping the cam lift value the same.

Lock the screws (2) and repeat the check already described. Tighten the screws (2) to the specified torque.

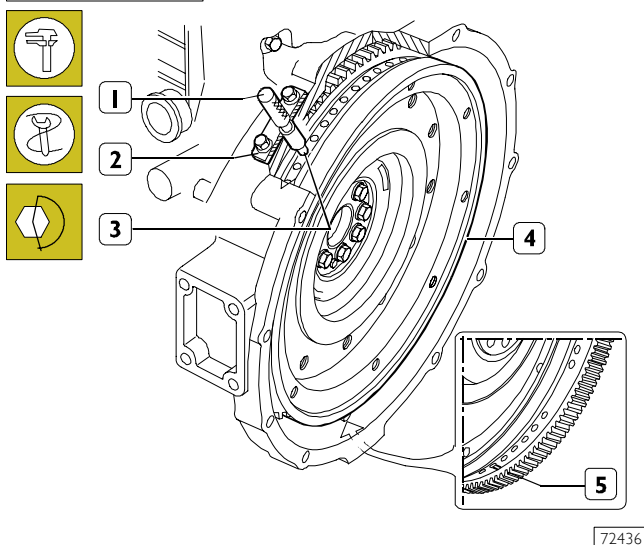
Figure 193



When adjustment in the slots (1) is not sufficient to recover timing offset and the camshaft rotates tight with the gear (2), to consequently vary the cam lift reference value, proceed as follows:

- ☐ Check that the screws (2, Figure 192) are tight.
- ☐ Rotate the flywheel by ca. $\frac{1}{2}$ a turn clockwise.
- ☐ Rotate the flywheel anticlockwise until a cam lift value of 5.31 ± 0.05 mm can be read on the comparator.
- ☐ Remove the screws (2, Figure 192) and remove the gear (2) from the camshaft.

Figure 194



Rotate the flywheel again to bring it into the following conditions:

- ☐ Double notch (5) visible through lower inspection hole.
- ☐ Tool 99360612 (1) fitted flush into the engine revs sensor seat (2) and (3).

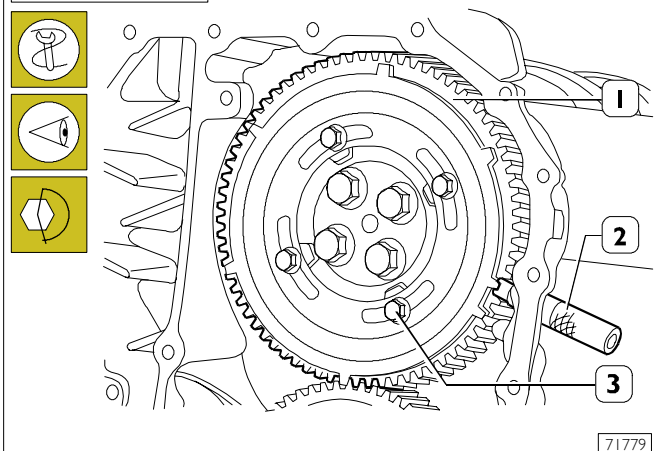
Fit the gear (2) Figure 193, with the 4 slotted holes centred with respect to the threaded holes in the camshaft tightening the screws to the specified torque.

Check the timing of the camshaft by first rotating the flywheel clockwise to fully drop the cam and then turning it anticlockwise until the comparator read 5.31 ± 0.05 .

Check the timing conditions described in Figure 191.

Timing the phonic wheel

Figure 195

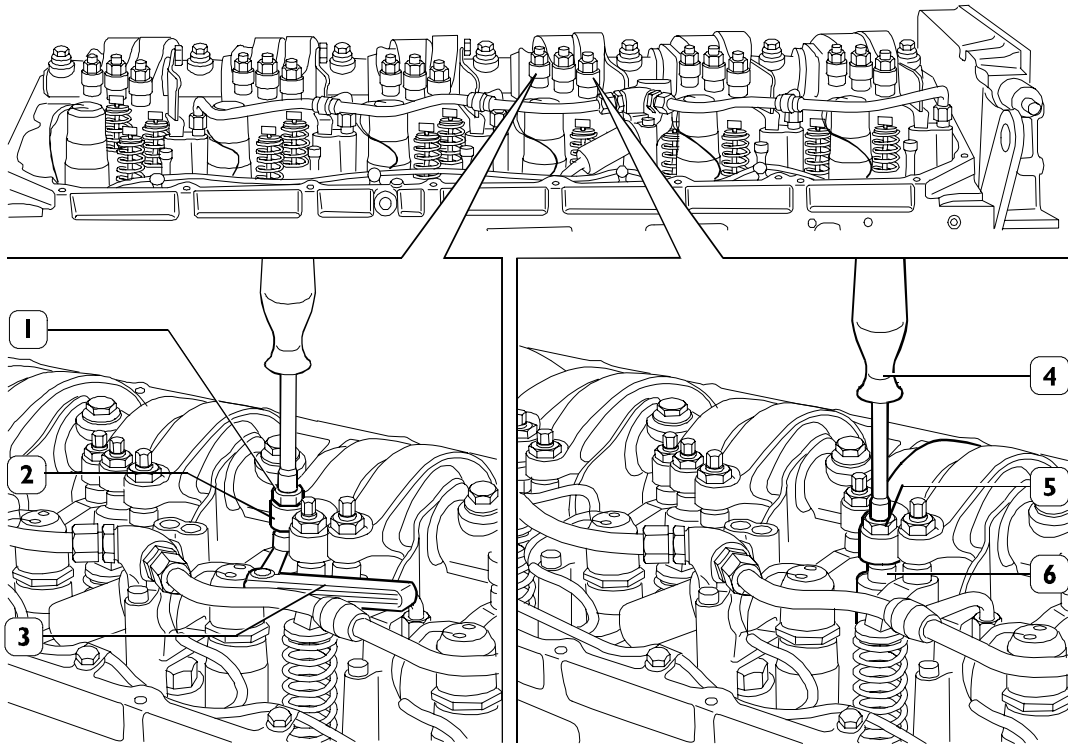


With the engine in timed conditions, check that pin 99360613 (2) positions itself on the marked tooth on the phonic wheel (1). If not, loosen the screws (3) and suitably orient the phonic wheel (1).

Tighten the screws (3) to the specified torque.

Adjusting the unload/intake rockers play and pump injector control rockers preload

Figure 196



60577

ADJUSTMENT OF INTAKE, EXHAUST AND INJECTION ROCKERS

The adjustment of clearance between the rockers and rods controlling the intake and exhaust valves, as well as the adjustment of pre-loading of the rockers controlling pump injectors, must be carried out carefully.

Take the cylinder where clearance must be adjusted to the bursting phase; its valves are closed while balancing the symmetric cylinder valves.

Symmetric cylinders are 1-6, 2-5 and 3-4.

In order to properly operate, follow these instructions and data specified on the table.

Adjustment of clearance between the rockers and rods controlling intake and exhaust valves:

- ☐ Using a polygonal wrench, loosen nut (1) locking the adjustment screw;
- ☐ Insert the thickness gauge blade (3);
- ☐ Tighten or untighten the adjustment screw with the appropriate wrench;
- ☐ Make sure that the gauge blade (3) can slide with a slight friction;
- ☐ Lock the nut (1), by blocking the adjustment screw.

Pre-loading of rockers controlling pump injectors:

- ☐ Using a polygonal wrench, loosen the nut locking the rocker adjustment screw (5) controlling the pump injector (6);

- ☐ Using an appropriate wrench (4), loosen the adjustment screw until the pumping element is at the end-of-stroke;
- ☐ Tighten the adjustment screw, with a dynamometric wrench, to 5 Nm tightening torque (0.5 kgm);
- ☐ Untighten the adjustment screw by 1/2 to 3/4 rotation;
- ☐ Tighten the locking nut.

FIRING ORDER 1-4-2-6-3-5

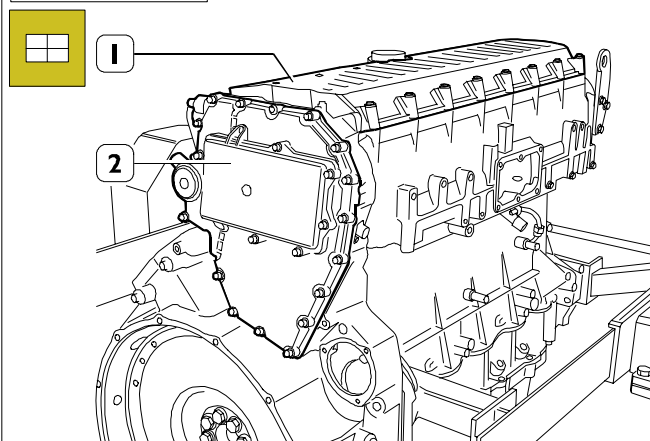
Clockwise start-up and rotation	Adjusting cylinder valve no.	Adjusting clearance of cylinder valve no.	Adjusting pre-loading of cylinder injector no.
1 and 6 at TDC	6	1	5
120°	3	4	1
120°	5	2	4
120°	1	6	2
120°	4	3	6
120°	2	5	3



In order to properly carry out the above-mentioned adjustments, follow the sequence specified in the table, checking the exact position in each rotation phase by means of pin 99360612, to be inserted in the 11th hole in each of the three sectors with 18 holes each.

COMPLETING ENGINE ASSEMBLY

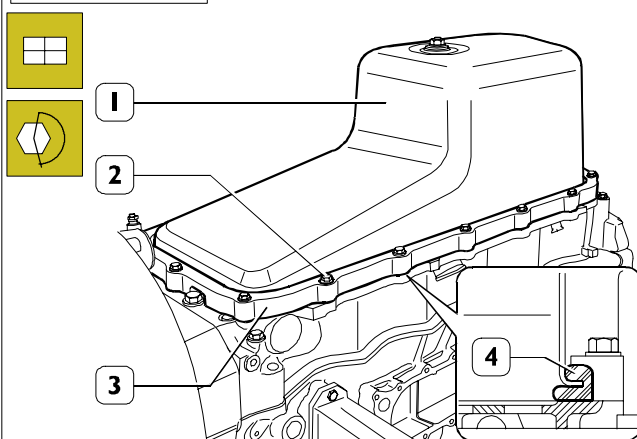
Figure 197



60495

- ☐ Assemble the rocker cover (1) and the timing gear cover (2)

Figure 198



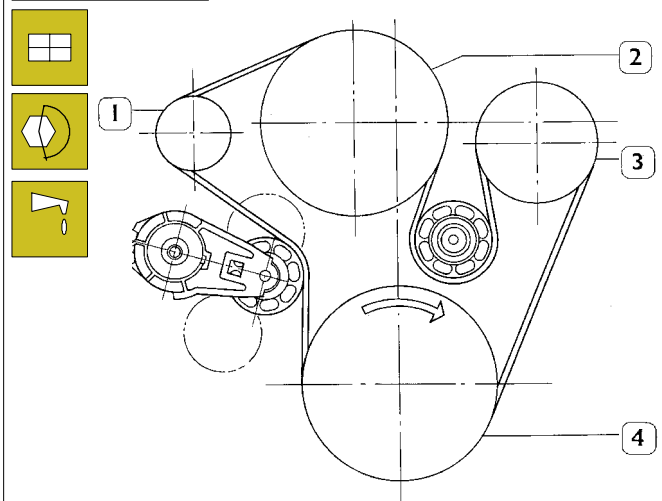
60665

- ☐ Fit the gasket (4) on the oil sump, position the spacer (3) and assemble the oil sump on the engine block tightening the screws (2) at the prescribed torque.

Complete the engine assembly by assembling or connecting the following components:

- ☐ thermostat unit
- ☐ automatic belt tightener, water pump, alternator;
- ☐ control belt.

Figure 199



60578

FAN - WATER PUMP - ALTERNATOR CONTROL BELT ASSEMBLY DIAGRAM

1. Alternator - 2. Fan - 3. Water pump - 4. Crankshaft

- ☐ damping flywheel;
- ☐ fan;
- ☐ starter;
- ☐ fuel pump;
- ☐ power steering system tank;
- ☐ fuel filter and line;
- ☐ pre-heating resistance;
- ☐ suction manifold;
- ☐ heat exchanger
- ☐ oil filter; lubricating gaskets;
- ☐ exhaust manifold;
- ☐ turbocharger and relevant water and oil lines;
- ☐ Power take off (P.T.O) and respective piping.



Turbocharger cooling water and lube oil piping unions must be tighten at a torque of:

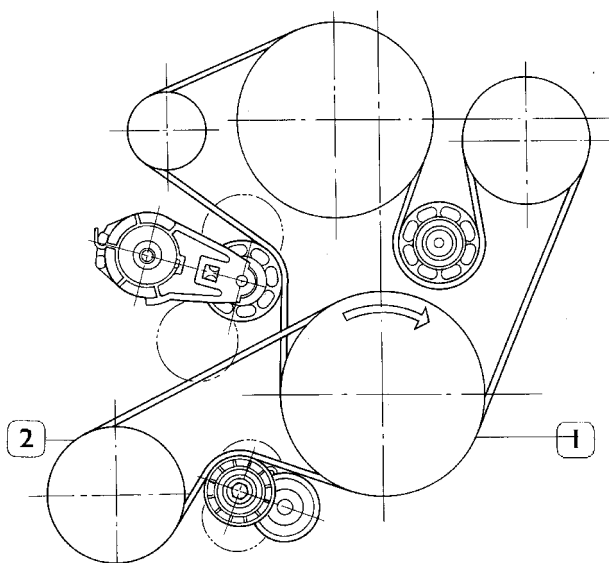
- ☐ 35 ± 5 Nm, water pipe unions;
- ☐ 55 ± 5 Nm, oil pipe female union;
- ☐ 20-25 Nm, oil pipe male union.

- ☐ Oil dipstick
- ☐ Electrical connections and dipstick
- ☐ Fill engine with specified quantity of oil
- ☐ Remove engine from rotary bench and remove engine mounting brackets (99361036)

Fit:

- ☐ Air conditioner automatic belt tensioner
- ☐ Drive belt

Figure 200

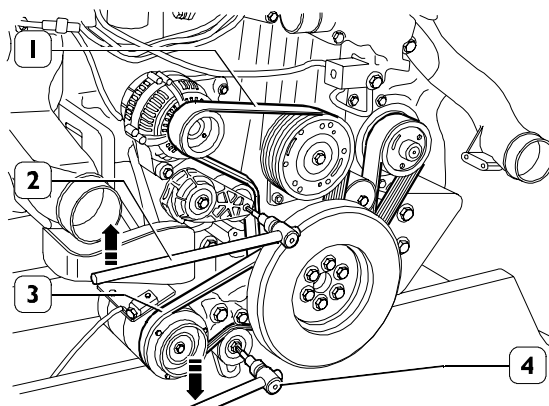


60579

COMPRESSOR CONTROL BELT ASSEMBLY DIAGRAM

1. Crankshaft - 2. Air conditioner compressor

Figure 201

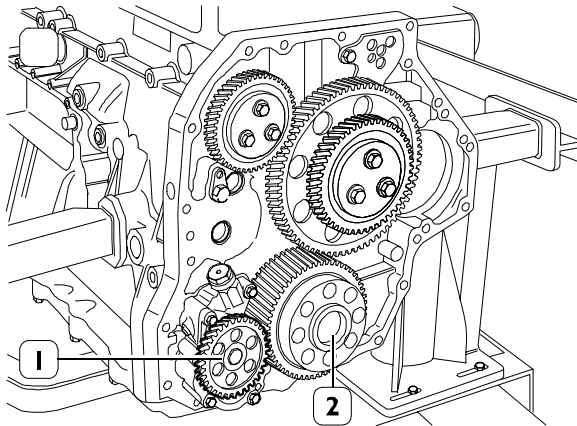


60667

When assembling the belts (1-3) operate on the belt tighteners using fit tools (2-4), acting in the direction shown by the arrows.



Belt tighteners are automatic and do not need further adjustment after assembly.

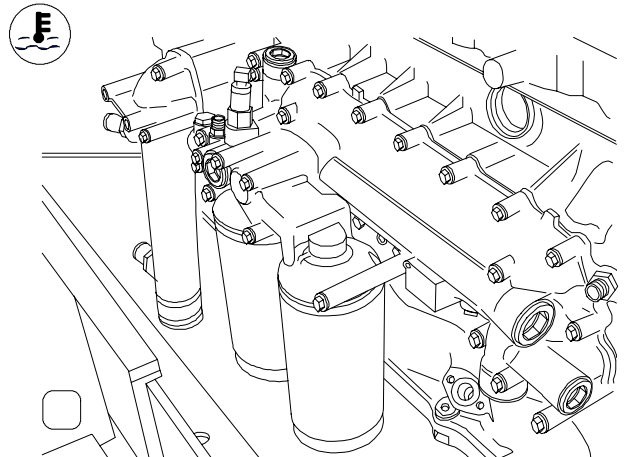
LUBRICATION**Figure 202**

71578

The forced-circulation lubrication is obtained by means of gear pump (1).

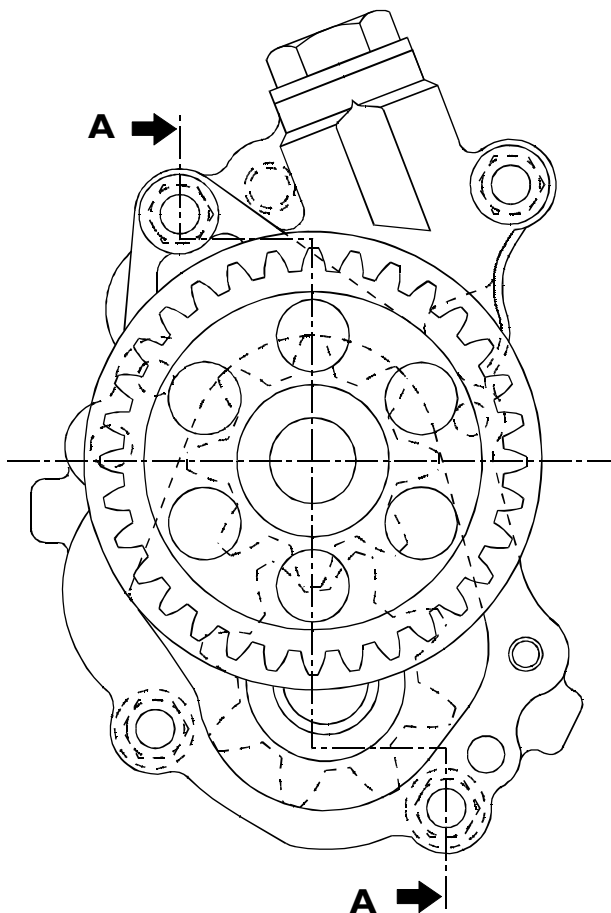
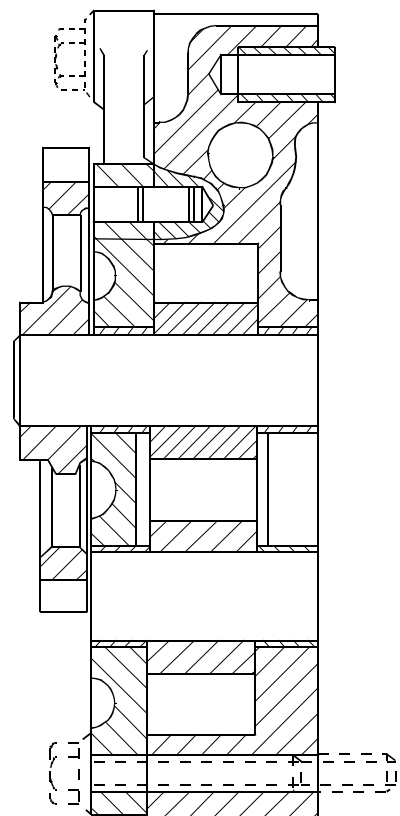
The pump is driven via the cog (1) by the crankshaft (2).

A heat exchanger and the oil filter are installed on the lubrication system.

Figure 203

60651

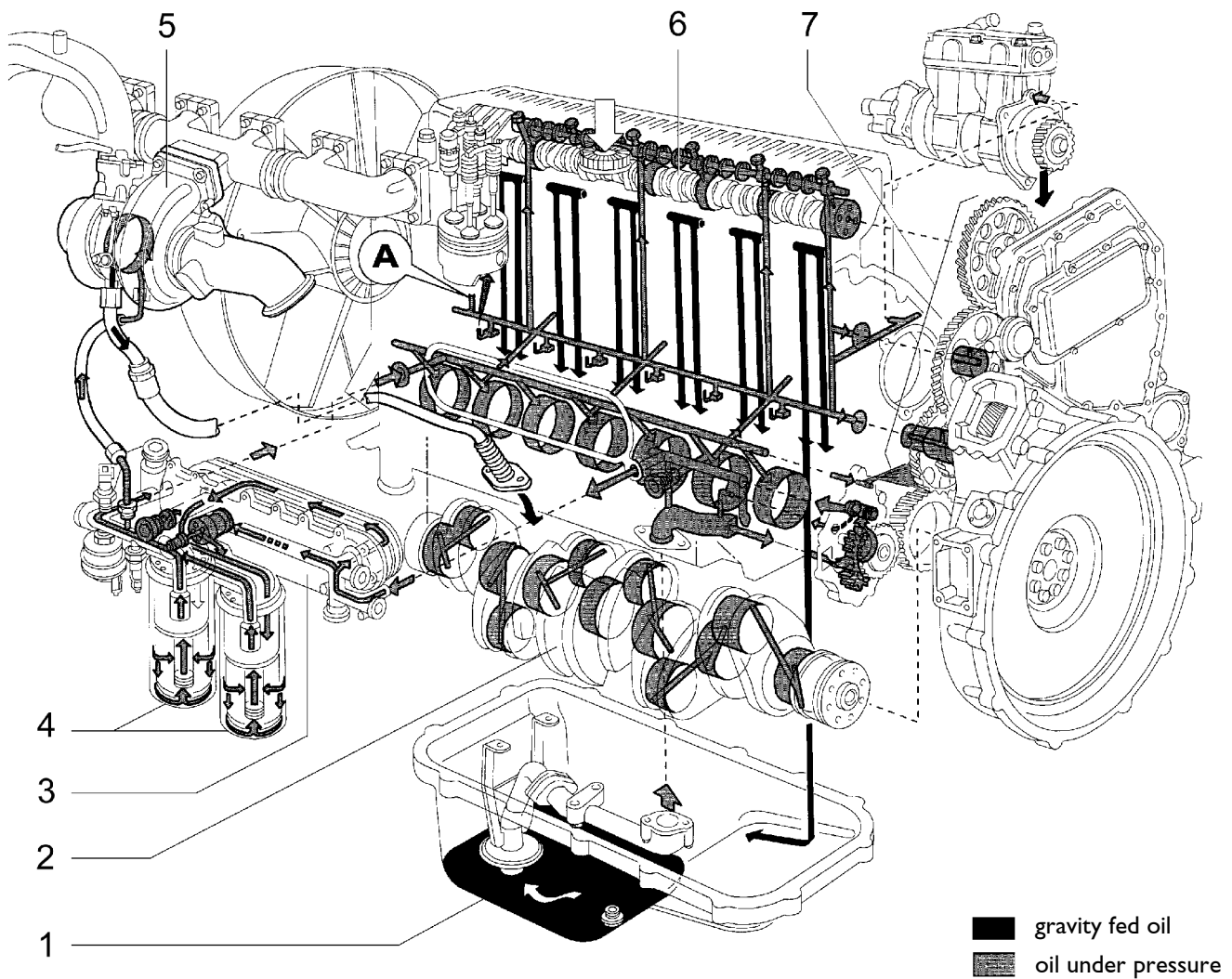
The heat exchanger houses the by-pass valve with opening pressure at 3 bar and the thermostatic valve that cuts-in when temperature exceeds 82.5°C.

Figure 204**SECTION B-B****OIL PUMP SECTION**

60628

Lubrication system outline

Figure 205

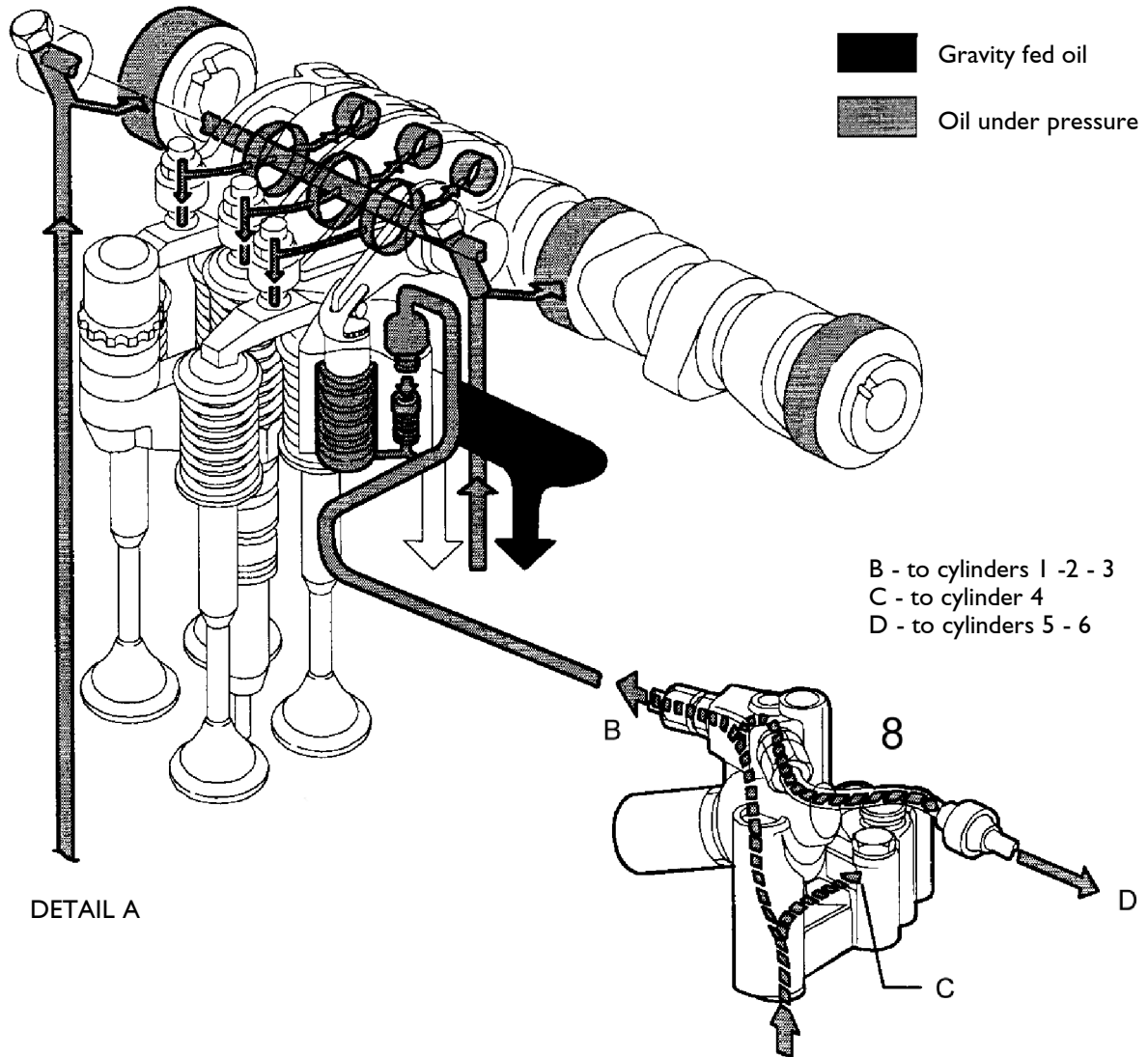


1780320

1. Oil sump. - 2. Crankshaft. - 3. Engine oil-water heat exchanger. - 4. Engine oil filter. - 5. Turbocompressor. - 6. Camshaft. - 7. Valve timing gears.

Lubrication system outline - Detail A

Figure 206

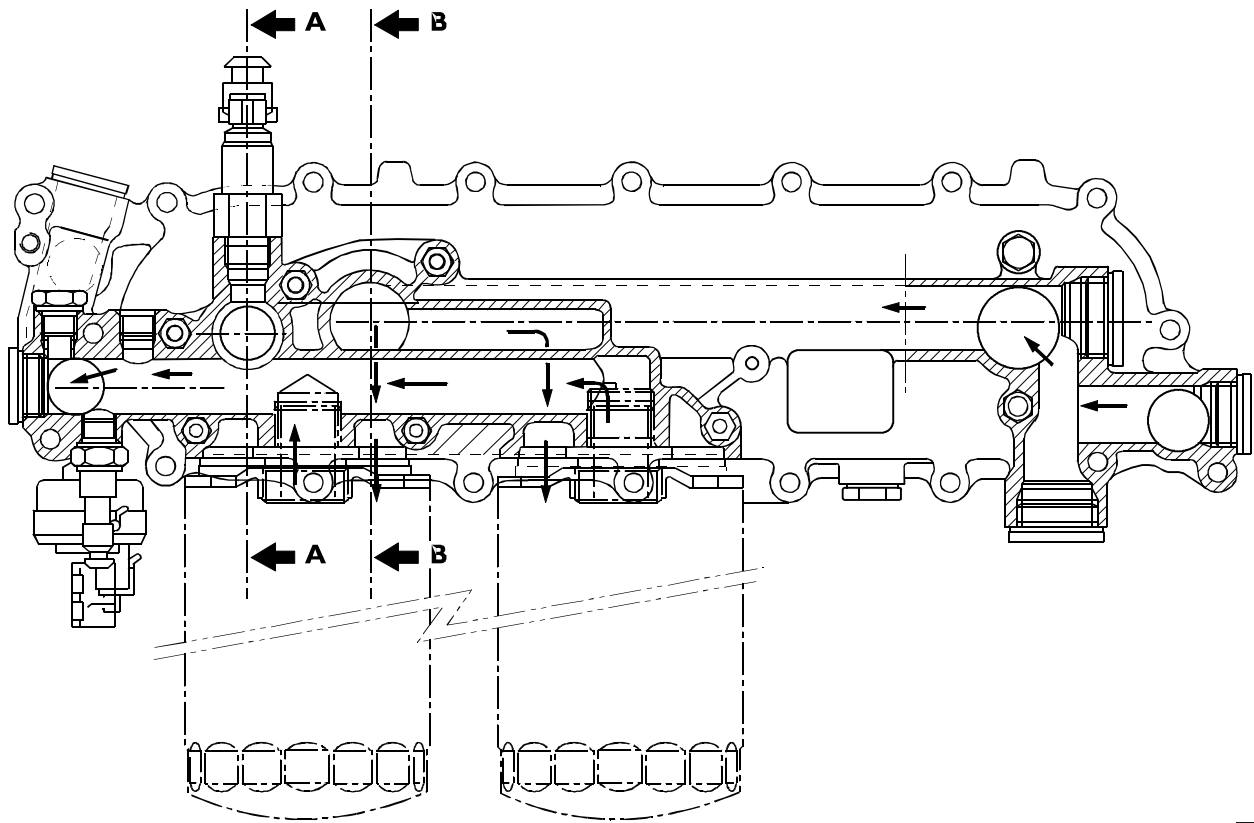


8. Engine brake solenoid valve with 4th cylinder command piston.

1780321

Heat exchanger

Figure 207

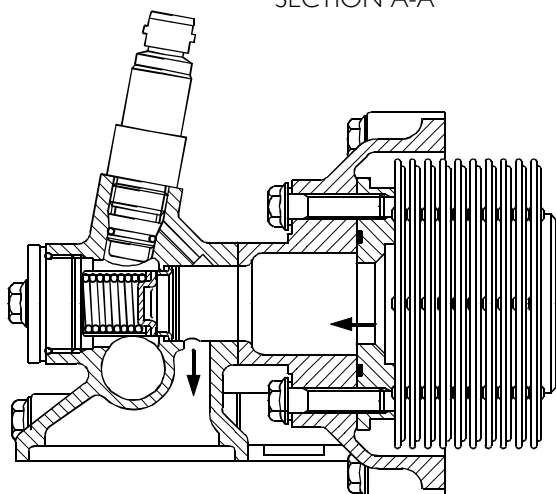


60629

HEAT EXCHANGER SECTION

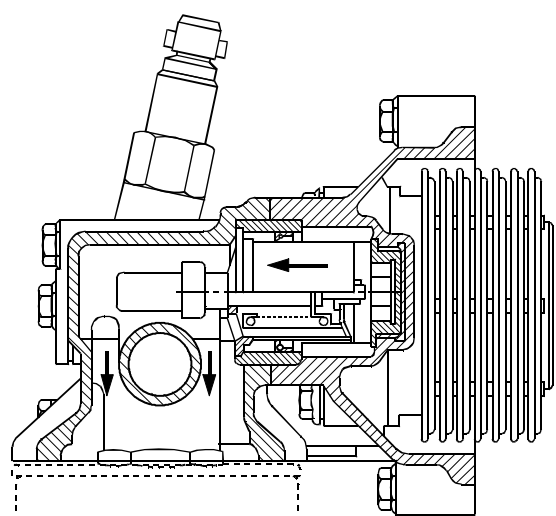
Figure 208

SECTION A-A



By-pass valve
Cut-in pressure 2 bar

SECTION B-B



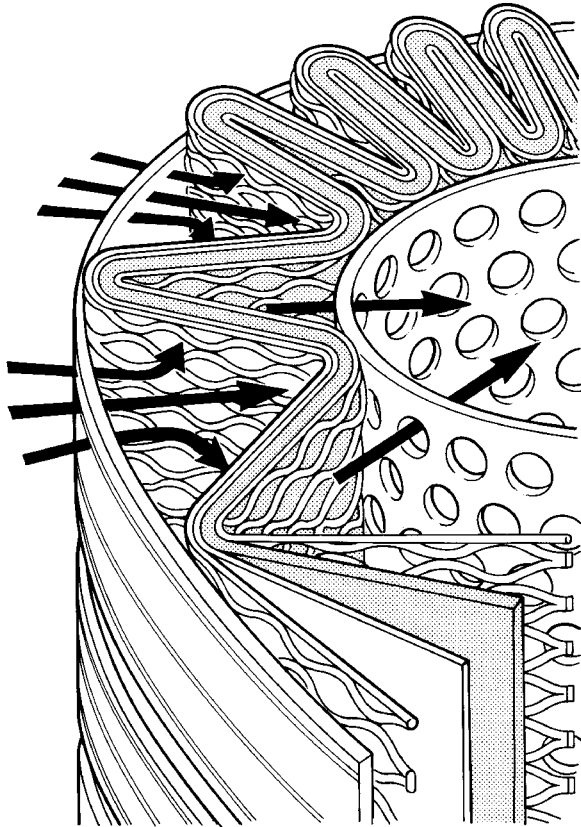
Thermostatic valve
Cut-in temperature $82 \pm 2^{\circ}\text{C}$

60630

Engine oil filter

This is a new-generation filter; ensuring much more accurate filtering, since it can block a higher quantity of particles of smaller dimensions compared to traditional filters, with paper filtering septum.

Figure 209



47447

Outside spiral wrapping

The filtering elements are strictly wrapped by a spiral, so that each fold is strongly fixed to the spiral. This means a uniform use of the septum, also under the toughest conditions, such as cold start-ups with high viscosity fluids and flow peaks. Moreover, a uniform distribution of flow is ensured through the whole length of the filtering elements; thus the loading loss is optimized, as well as its operating time.

Upstream support

In order to optimize flow distribution and filtering element stiffness, the filtering element is equipped with an exclusive support consisting of a strong nylon mesh and high-strength synthetic material.

Filtering septum

It consists of inert inorganic fibers, connected by exclusively manufactured resin to a shifting pore structure; it is exclusively manufactured following precise procedures and strict quality controls.

Downstream support

Thanks to the filtering septum and the strong nylon mesh, the septum strength is improved, especially useful during cold start-ups and long use periods. Filter performance is constant and reliable for the entire service life, on each element, regardless of operating conditions changes.

Structural parts

The O-rings equipping the filtering element ensure perfect sealing between the filtering element and the container; thus eliminating any bypass risk and keeping filter performance constant. Corrosion-proof bottom sides, as well as a solid metal core, complete the filtering element structure.

These highly filtering elements, adopted only in industrial process up to now, make it possible to:

- ☐ reduce engine components wear;
- ☐ preserve oil performance/characteristics, thus extending the period of time between replacements.

COOLING

Forced-circulation cooling is obtained by means of a centrifugal pump, controlled by the crankshaft through a Poli-V type belt.

Water circulation is regulated by a thermostat.

The radiator is vertical.



Check that the pump body has no cracks or water leaks. Otherwise replace the complete water pump. Check thermostat function. In case of doubt, replace the thermostat.

Water pump

Figure 210

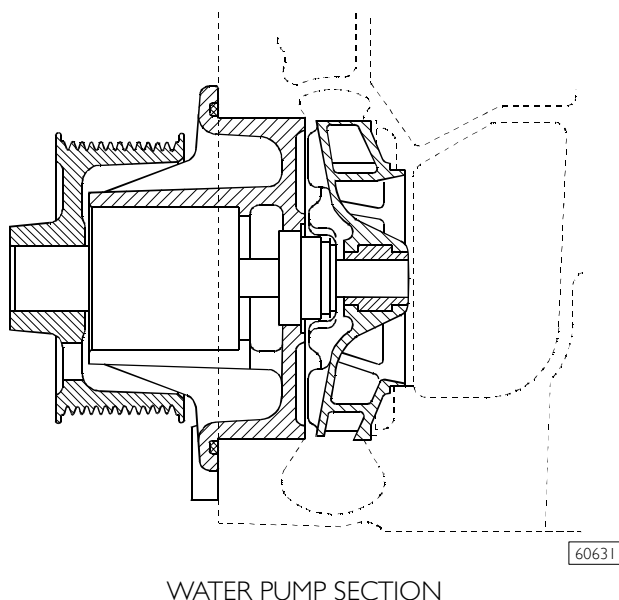
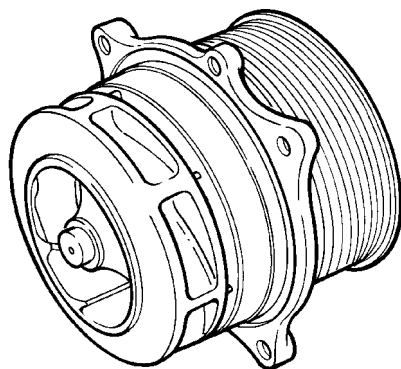
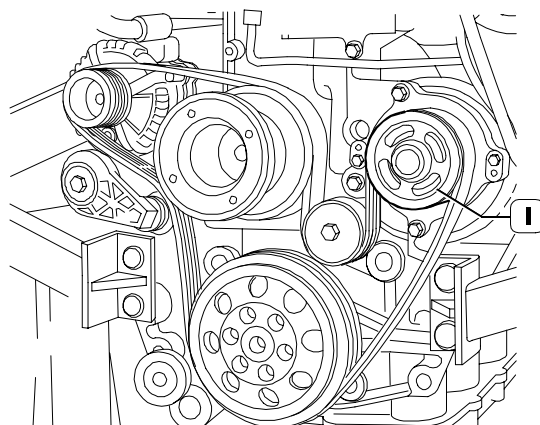


Figure 211



The water pump consists of: rotor, seal bearing and control pulley.

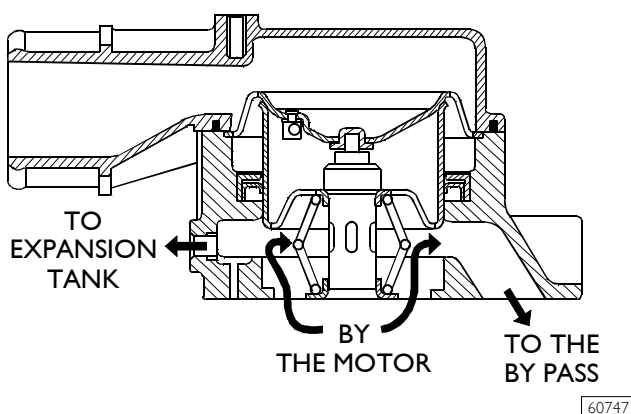
Figure 212



ENGINE WATER PUMP

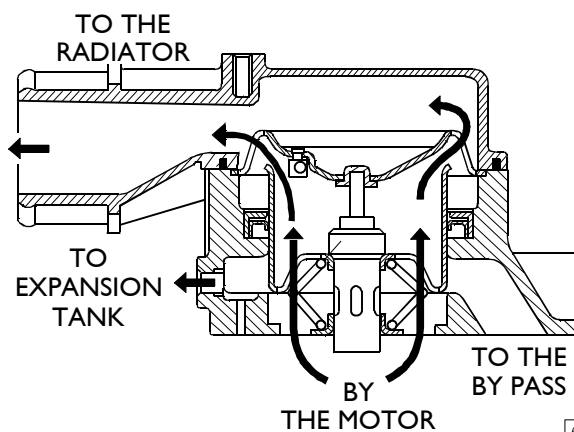
Thermostat operation view

Figure 213



Water circulating inside the engine

Figure 214

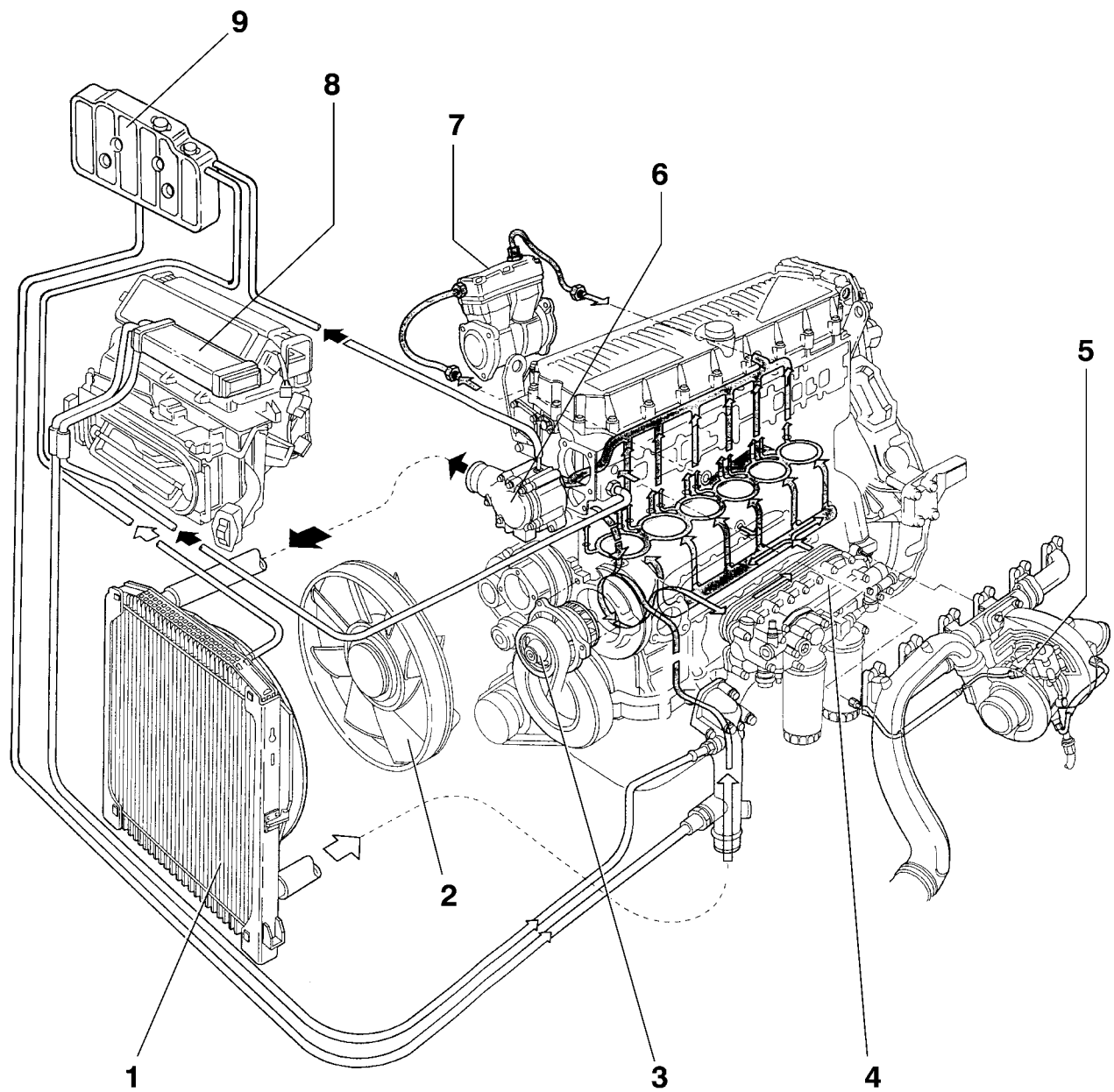


Water from the thermostat

Lubrication system outline

Standard version

Figure 215



1780322

1. Radiator. - 2. Fan. - 3. Water pump. - 4. Engine oil-water heat exchanger. - 5. Turbocompressor. - 6. Thermostat. - 7. Air compressor. - 8. Cab heater. - 9. Expansion chamber.

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Filling up the cooling system

Preliminary operation

For vehicles with driver seat heating or hand air-conditioning system:

- ☐ Turn on the tap of the warming liquid placed on the instrument board.

For vehicles with automatic air-conditioning system:

- ☐ Place the temperature control device in the driver's area on position HI.

For vehicles with a supplementary heating system:

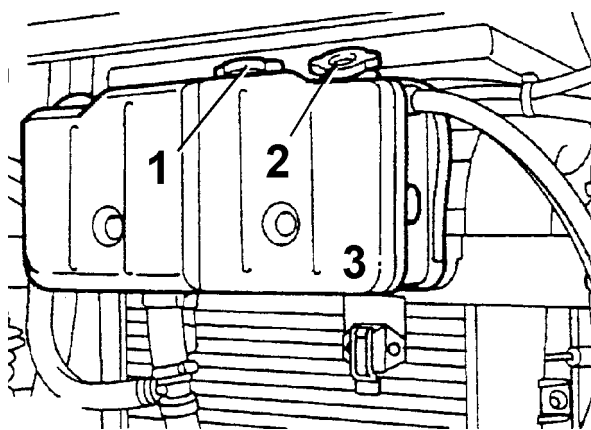
- ☐ This must be off.

Operations

Insert a sheet of cardboard between the radiator of the cooling liquid and the intercooler radiator, in order to shorten the time needed to reach the working temperature of the engine ($\sim 90^{\circ}\text{C}$).

Filling up the system

Figure 216



178315



GENERAL NOTICE

Filling up must be done when engine is cool.

The cap (1) cannot be removed.

In order to avoid air-bubbles in the system is recommended to pour out the liquid slowly (average quantity 8 Litre/Minute).

For vehicles with supplementary heating system, the percentage of glycol in the liquid cannot be higher than 50%.

After having followed all these instructions, proceed as follows:

- ☐ Remove cap (2) from the water cup (3);
- ☐ Fill in the cooling liquid into the water cup (3), till it is full.



Purging the air of the system



For vehicles with supplementary heating system

- ☐ Turn the heating device on.

- ☐ Start the engine and let the speed be a little higher than the minimum value for 5 minutes.



Should it happen, that the water cup during these minutes gets completely empty, stop the engine and fill in the cup more slowly than before. Start the engine once again.

- ☐ After 5 Minutes, if necessary fill in the water cup;
- ☐ Close the fillers of the water cup with the corresponding cap (2).

Bring the speed to the maximum value, so that the cooling liquid can reach more quickly the temperature for the maximum opening of the thermo-stat ($\sim 90^{\circ}\text{C}$) and this can be maintained, till all air has been purged by the system.

In order to check if air is still present, check if in the water cup foam or air bubbles are visible.

The maximum time needed to purge all air out is about 15 minutes after the thermo-stat has opened (it starts opening with $79^{\circ}\text{C} \pm 2^{\circ}\text{C}$).



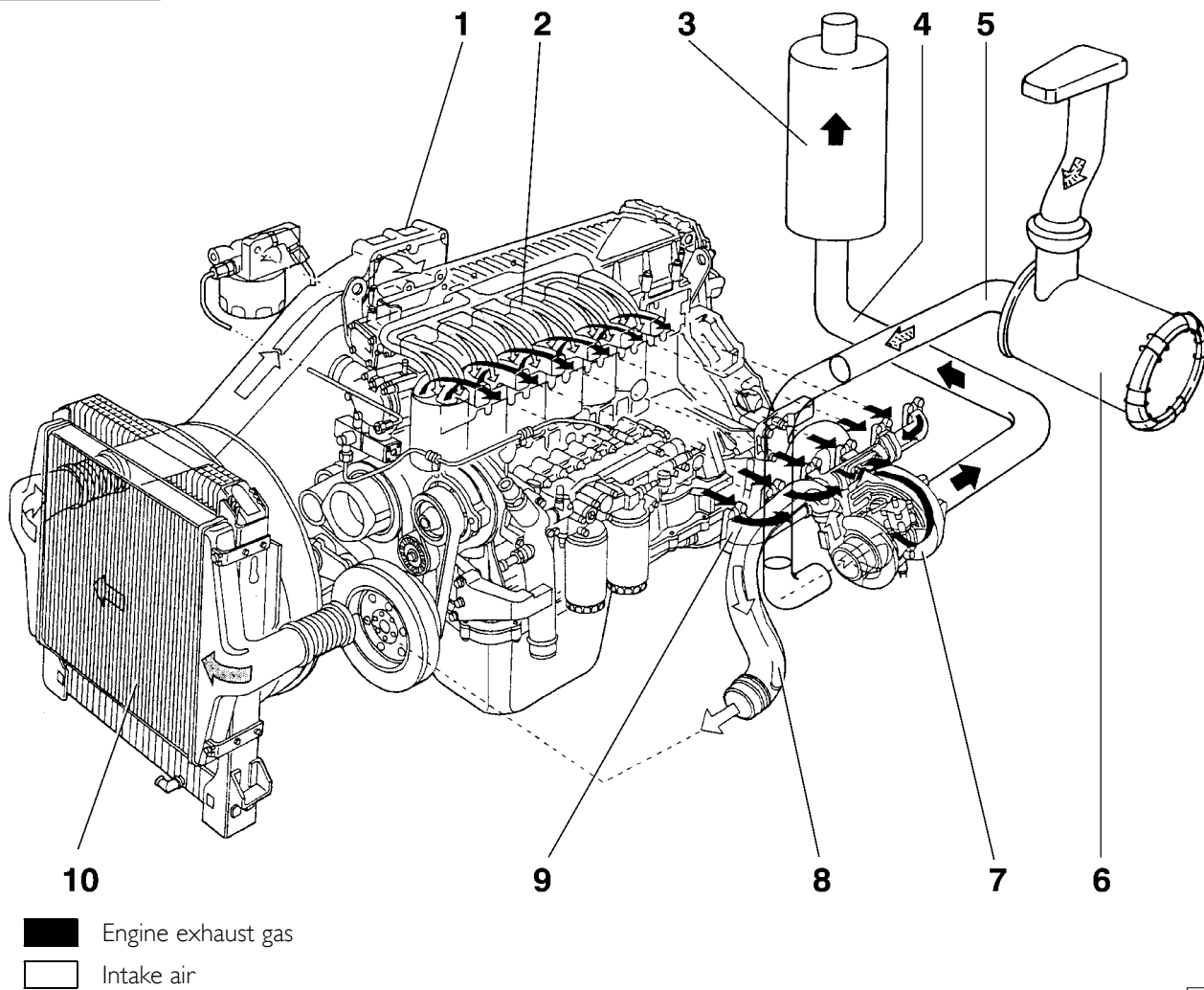
Do not remove the caps from the fillers of the water cup, till the liquid in the system is completely cool. If necessary, fill in only when the engine is cool.

This is to avoid:

- Burning the operators;**
- Damages to the engine, because the air is pressurised in the cooling system only if the engine is warmed up from a cold condition.**

TURBOCHARGING

Figure 217



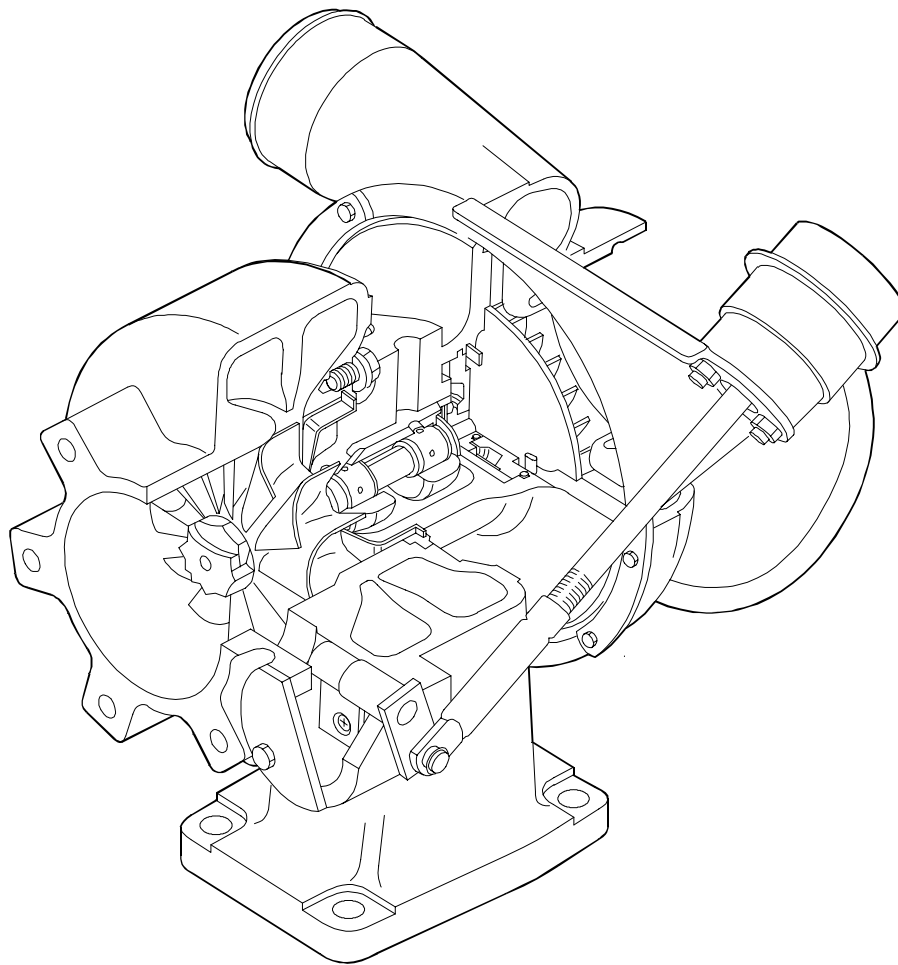
1780325

TURBOCHARGER AND EXHAUST SYSTEM OUTLINE

1. Air duct to intake manifold. - 2. Intake manifold - 3. Exhaust. - 4. Exhaust pipe - 5. Intake piping - 6. Air filter - 7. Turbocompressor - 8. Air duct to intercooler - 9. Exhaust manifold - 10. Intercooler.

HOLSET HX 50W (TURBINE WASTEGATE)

Figure 218

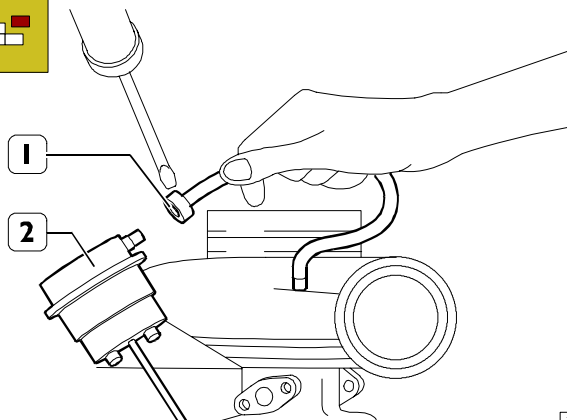


71766

PRESSURE LIMITER VALVE**Pressure limiter valve control and adjustment**

Remove the engine turbine and suitably fasten it to the bench.

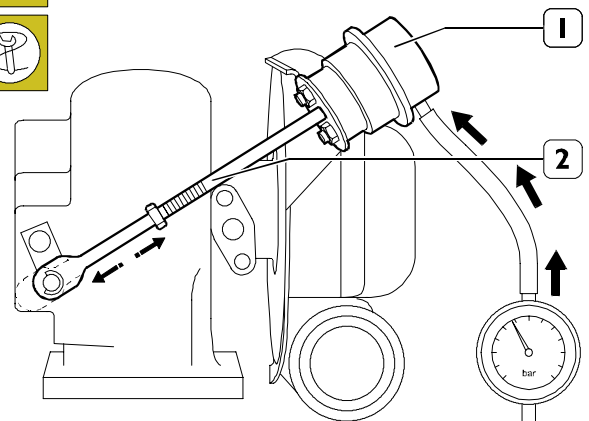
Figure 219



71767

Using screwdrivers, remove the air duct (1) of the actuator command (2).

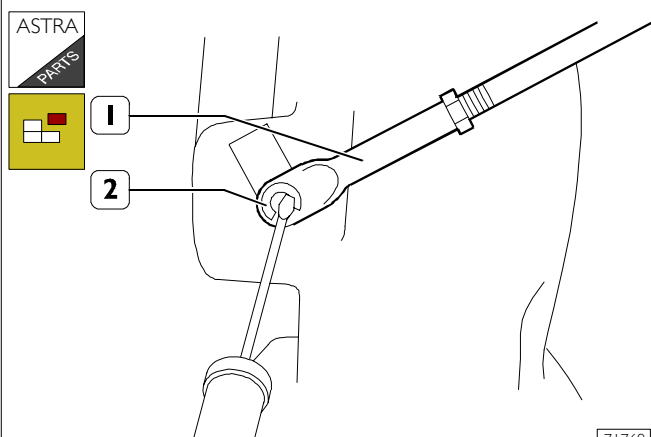
Figure 220



71768

Using tool 99309002, apply pressure variation from 0 to 3 bar to the actuator to verify shift of command rod (2).

Figure 221

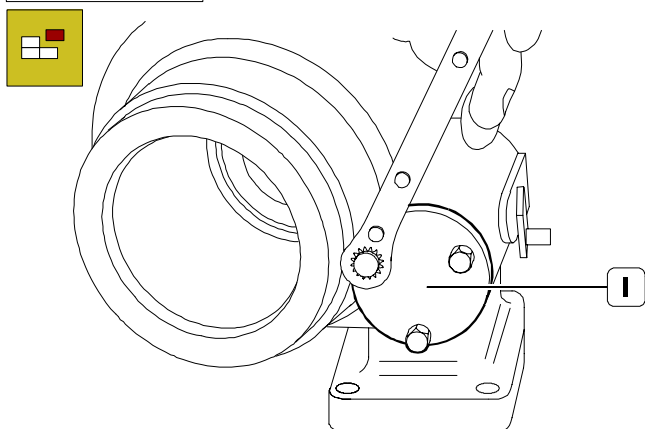


71769

If the actuator is jammed, disconnect the rod from the turbine removing the safety ring (2).

Apply slight pressure to the actuator (1) to check whether the rod is jammed. If so replace the actuator. Otherwise the cause of malfunction should be sought in the turbine internal mechanism.

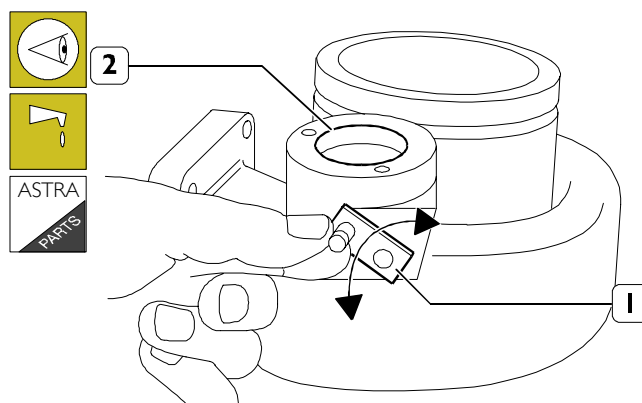
Figure 222



71770

Remove the cover (1) to inspect the turbine mechanism piloted by the actuator.

Figure 223



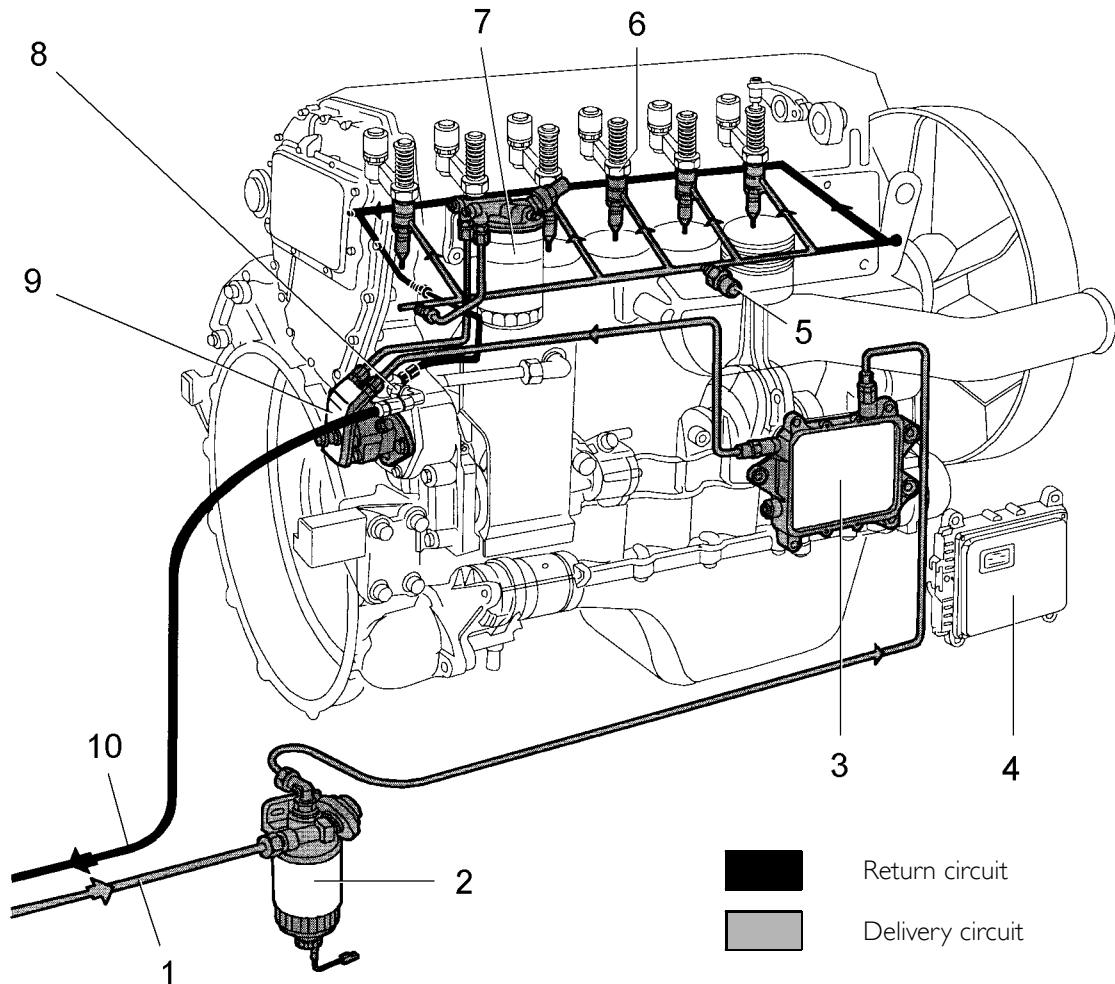
71771

Through the inspection hole (2) check that the internal lever-age command (1) is not stiff or jammed. If it is, lubricate it. If this does not solve the problem, replace the turbine.

FUEL FEED

Fuel feed is obtained by means of a pump, fuel filter and pre-filter; 6 pump-injectors controlled by the camshaft by means of rockers and by the electronic control unit.

Figure 224



1780326

FUEL SUPPLY SYSTEM OUTLINE

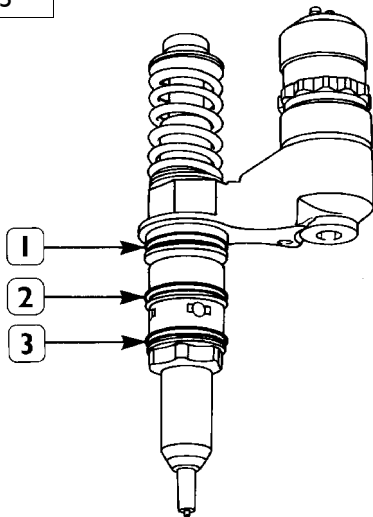
1. Fuel delivery. - 2. Prefilter. - 3. Fuel heat exchanger - 4. Engine Control Unit. - 5. Fuel temperature sensor - 6. Injector-pump. - 7. Filter. - 8. Pressure regulator - 9 Fuel pump - 10 Fuel return.

Pump-injector

The pump-injector consists of:

- ☐ pumping element;
- ☐ nozzle;
- ☐ solenoid valve;

Figure 225



44908

PUMP-INJECTOR

1. Diesel/oil seal ring - 2. Diesel/diesel seal ring -
3. Diesel/exhaust gas seal ring

Pumping element

The pumping element is controlled by a rocker which, in turn, is directly controlled by the cam of the camshaft.

The pumping element is able to ensure a high delivery pressure.

A spring controls its return stroke.

Nozzle

Workshops will only be authorised to make the diagnosis of the whole injection system and may not make operations inside the pump-injector, which may be replaced only.

A fit diagnostic program, included in the unit, will be able to control the operation of each injector (by disabling one of them at a time and controlling the delivery of the other five).

The diagnosis allows to tell electric faults from mechanical/hydraulic faults.

It indicates malfunctioning pump-injectors.

Therefore, it will be necessary to correctly interpret all the error messages issued by the unit.

Possible faults of the injectors will be solved by replacing them.

Solenoid valve

The solenoid, energised at each cycle active phase by means of a signal coming from the control unit, controls a slide valve which cuts off the pumping element delivery duct.

When the solenoid is not energised, the valve is open.

Fuel is pumped but flows back in the return duct at the normal transfer pressure of approx. 5 bars.

When the solenoid is energised, the valve is closed.

Fuel, which cannot flow back in the return duct, is pumped in the high pressure nozzle causing the lifting of the metering rod.

The quantity of injected fuel depends on the slide valve closing time and therefore on the solenoid energising time.

The solenoid valve is joined to the injector body and cannot be disassembled.

Two screws fixing the cables transmitting the signal coming from the control unit are fitted on the upper part.

In order to ensure the signal transmission, tighten the screws at a torque of 1.36 to 1.92 Nm (0.136 to 0.192 kgm) using a torque wrench.

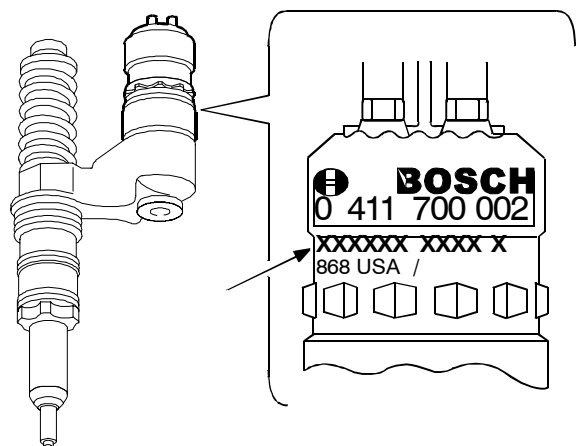
Replacing pump-injectors

The replacement of the injectors must be carried out very carefully (see description on pages 47-48 for disassembly).



If the operation is carried out with the motor assembled on the vehicle, discharge the fuel contained in the cylinder head ducts unscrewing the delivery and return unions on the cylinder head before disassembling the injectors.

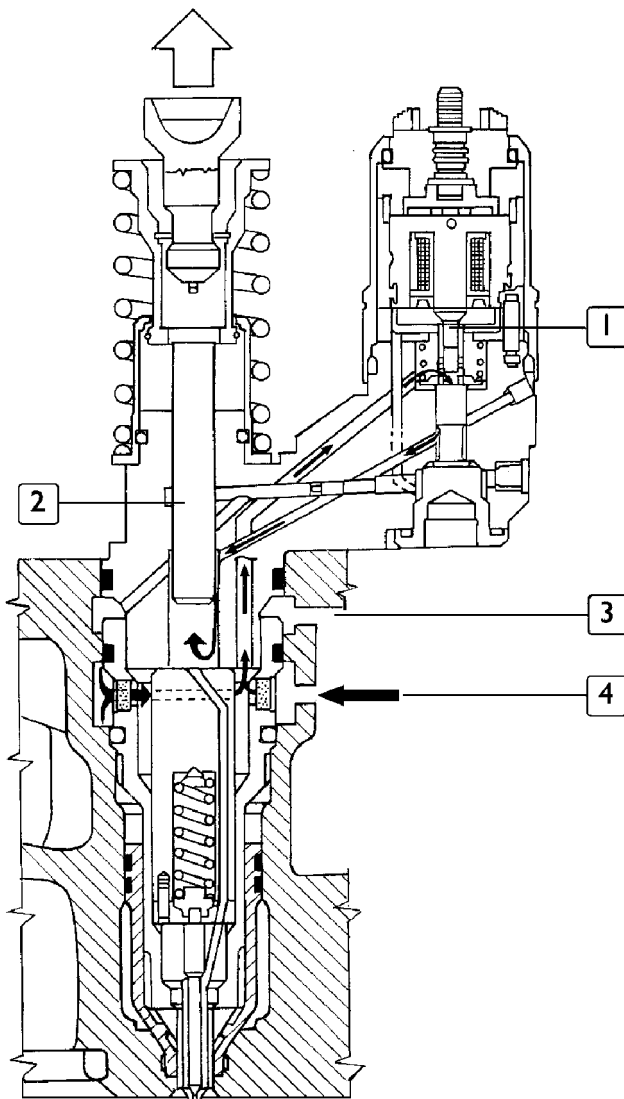
Figure 226



When rockers clearance is checked, it is important to check pump-injector pre-load

Injection phases

Figure 227



60669

1. Fuel valve
2. Pumping element
3. Fuel discharge
4. Filling and flowing back channel

Filling phase

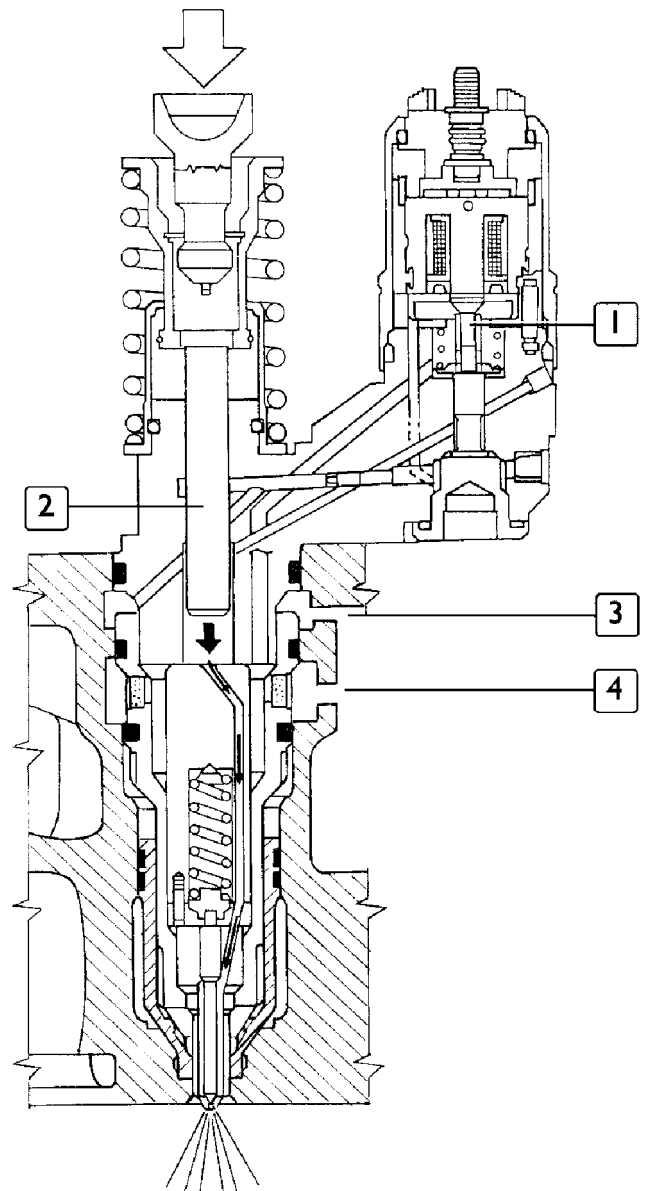
During the filling phase, the pumping element (2) moves to its upper position.

The highest cam position is passed and the rocker roller gets closer to the cam basic circle.

The fuel valve (1) is open and the fuel can flow into the injector from the lower channel (4) of the cylinder head.

The filling phase continues until the pumping element has reached its upper end-of-stroke position.

Figure 228



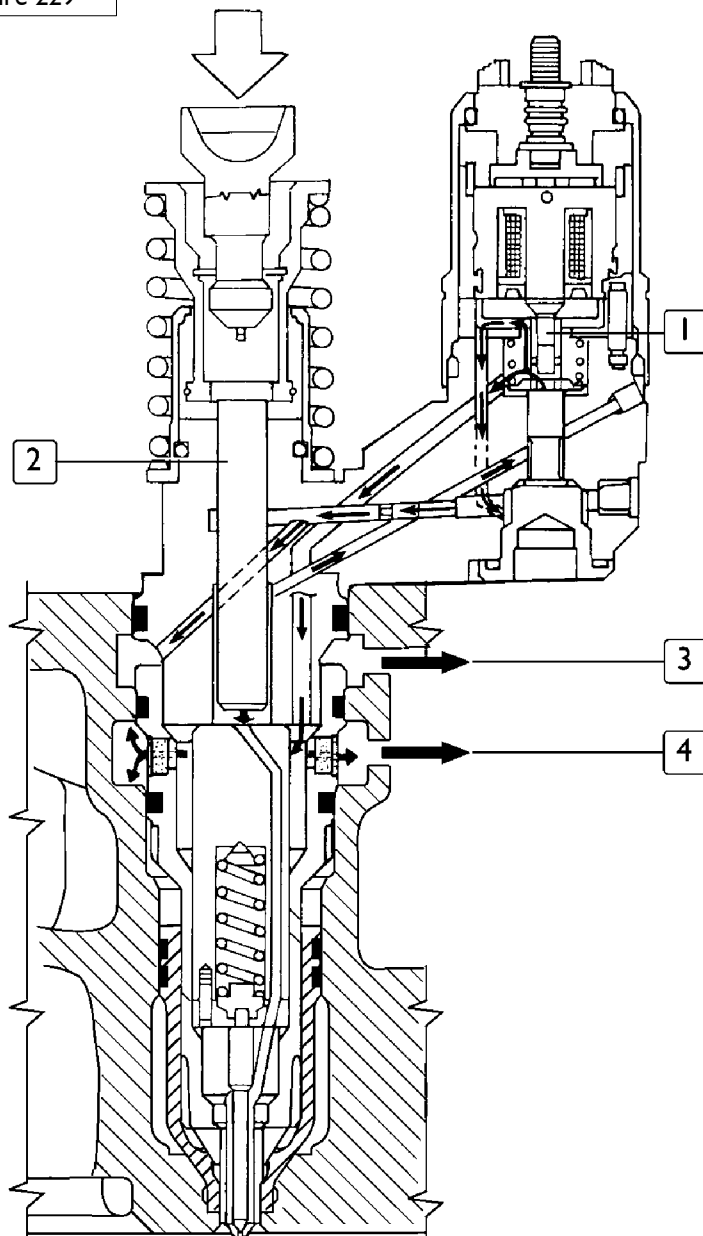
60670

1. Fuel valve
2. Pumping element
3. Fuel discharge
4. Filling and flowing back channel

Injection phase

The injection phase starts when, during the pumping element descending phase, the solenoid valve is energized and the fuel valve (1) closes. Delivery start time, properly processed by the electronic control unit, depends on engine operating conditions. Through the rocker, the cam continues to activate the pumping element (2) and the injection phase continues as long as the fuel valve is closed (1).

Figure 229



1. Fuel valve
2. Pumping element
3. Fuel discharge
4. Filling and flowing back channel

60671

Pressure reduction phase

Injection stops when the fuel valve (1) opens, during the pumping element descending phase, following the solenoid valve de-energizing.

The fuel flows back, through the open valve (1), the injector holes and the channel (4), into the cylinder head.

The solenoid valve energizing period, properly processed by the electronic control unit, is the injection duration (capacity) and depends on the engine operating conditions.

CLUTCH

SECTION 4

SECTION 4

Clutch

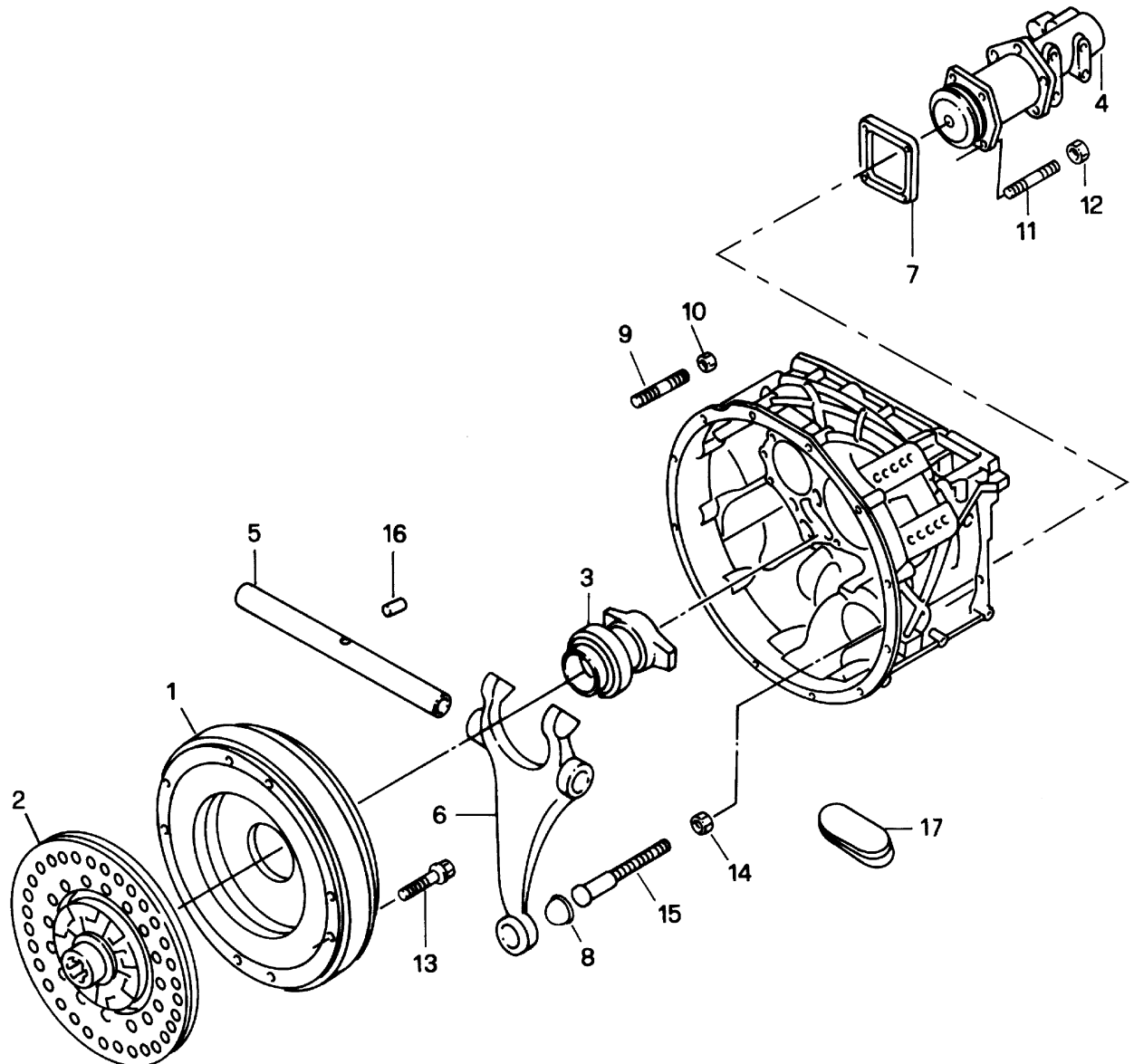
	Page
DESCRIPTION	3
☐ Hydraulic control	4
☐ Master cylinder	5
SPECIFICATIONS AND DATA	7
DIAGNOSTICS	9
☐ Hydraulic oil change	12
☐ Bleeding off air	12
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REMOVING-REFITTING COLLAR BEARING	15
REPLACING THE SUPPORT BEARING OF THE CLUTCH SHAFT	15
☐ Clutch pedal adjustment	16
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☐ Servoclutch adjustment	18
☐ Mounting servoclutch in clutch housing	19

Page left intentionally blank

DESCRIPTION

The clutch is the single plate dry type, with a pull type engagement mechanism and a diaphragm spring.

Figure 1



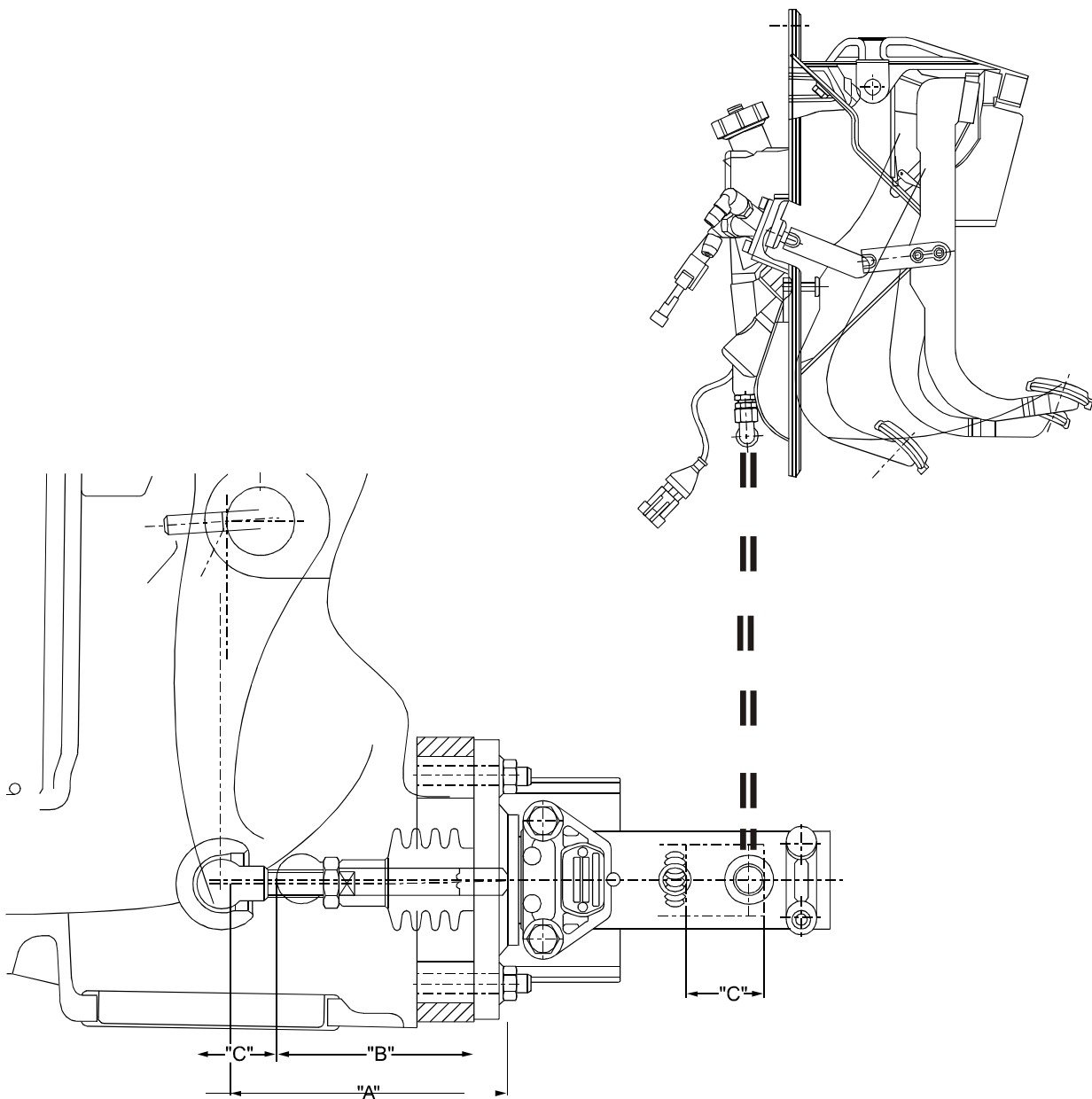
1. Thrust pad – 2. Clutch disc – 3. Collar bearing – 4. Servo-clutch – 5. Fork shaft – 6. Fork – 7. Spacer – 8. Ball joint –
9. Stud – 10. Nut – 11. Stud – 12. Nut – 13. Bolt – 14. Nut – 15. Rod – 16. Pin – 17. Plug

DESCRIPTION**Hydraulic control**

The hydraulic control comprises:

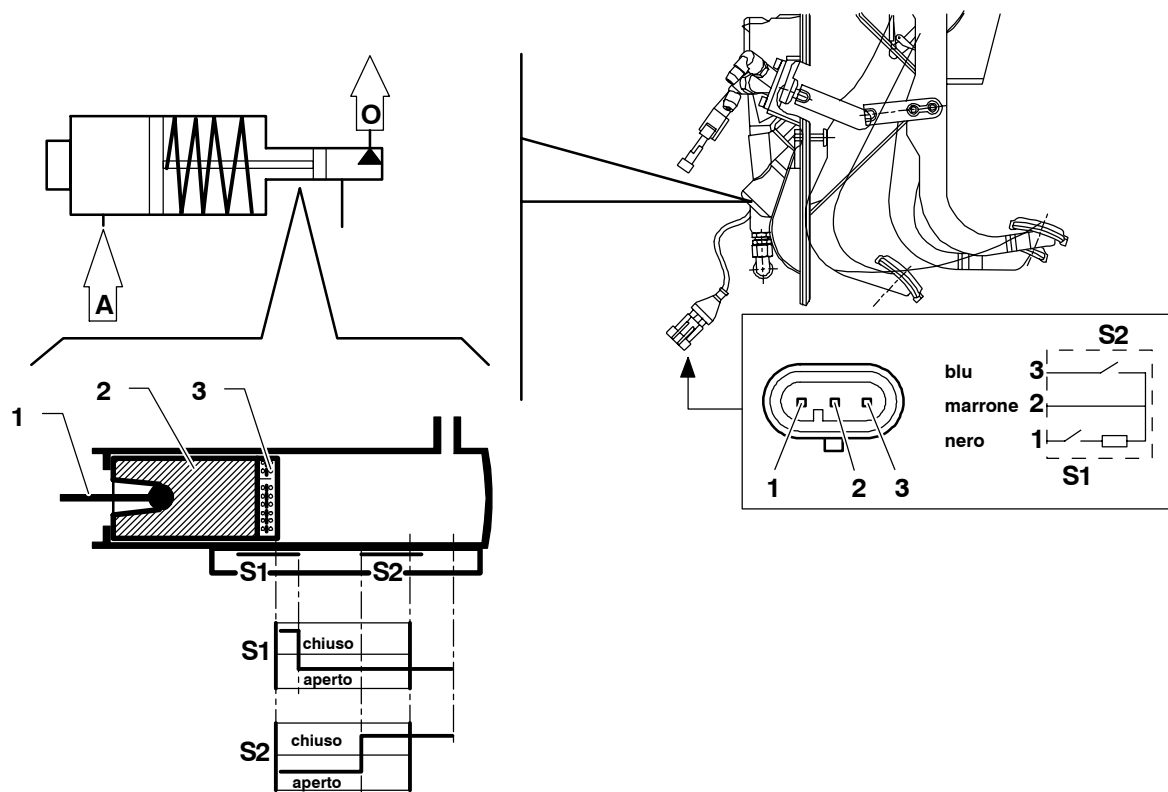
- a pneumohydraulic master cylinder built in to the pedal board with integrated reservoir;
- a hydraulic actuator located beneath the gearbox bell end;
- a connector pipe.

Figure 2



Master cylinder

Figure 3



27204002

Master cylinder circuit diagram

The following proximity (read) switches are mounted on the master cylinder:

- ☐ S1 (N.C. type), to disable the Cruise Control;
- ☐ S2 (N.O. type) for synchro protection.



Switch S2 is only present on vehicles with synchro protection type gearbox.

1. Push rod
2. Piston
3. Magnetic ring

- S1 Proximity switch for Cruise Control disable
- S2 Gearbox synchro protection proximity switch
- A Pneumatic pressure from distributor
- O Clutch servo hydraulic pressure

Switch S1 opens during the first part of the stroke: the signal to disable Cruise Control during gear shift is transmitted to the engine control system.

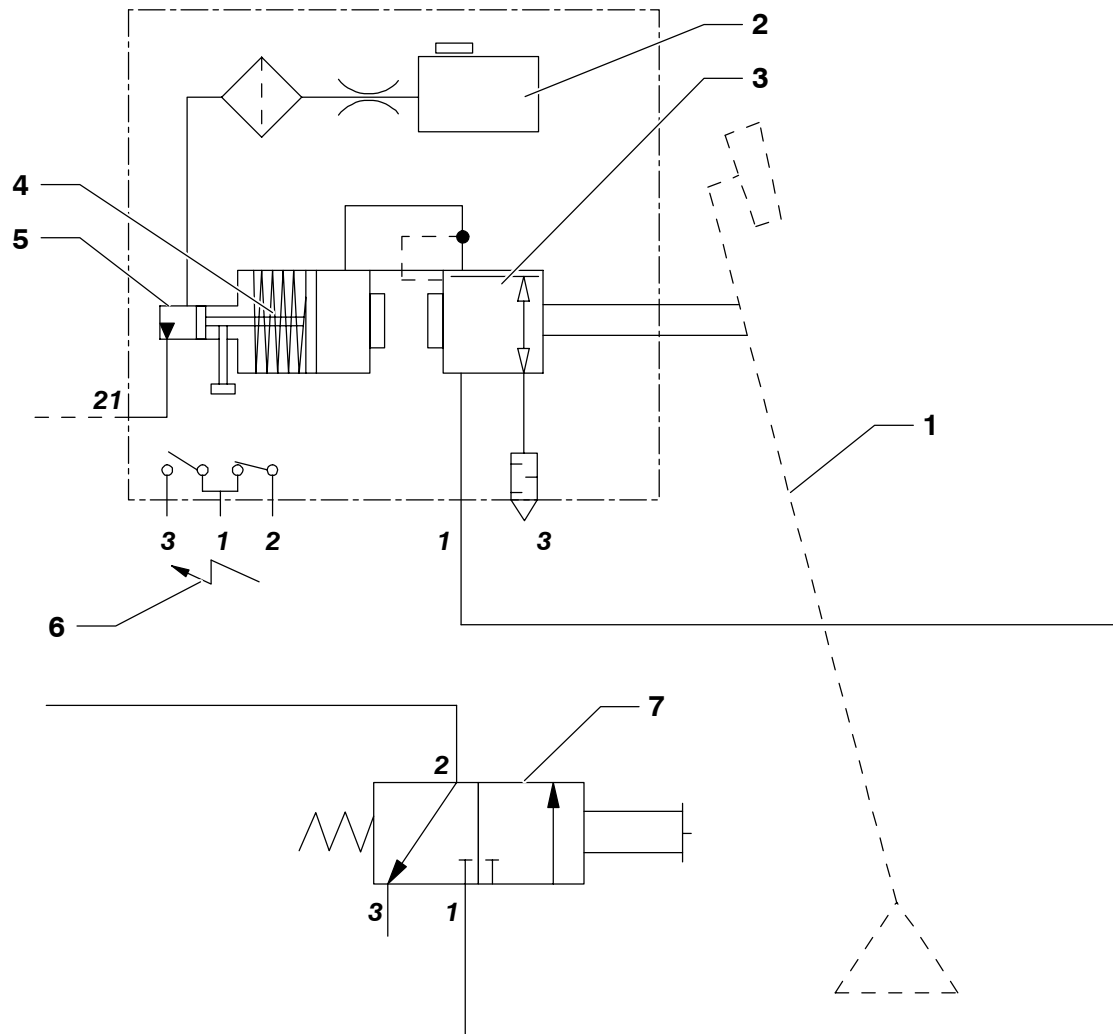
In the second part switch S2 closes to enable the servoshift control solenoid valve, to prevent gear shift with the clutch insufficiently depressed.



Switch S2 closes with 21.5 mm stroke of the piston (2), equal to 70% of the clutch pedal disengage stroke, corresponding to the point of intervention of the servoshift.

Hydropneumatic functional outline

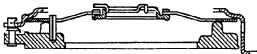
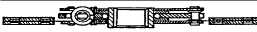
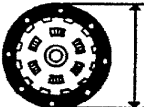
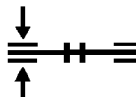
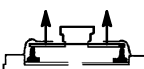
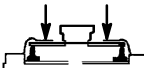
Figure 4



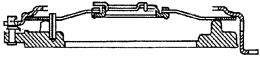
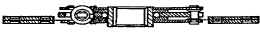
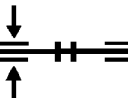
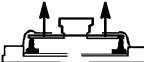
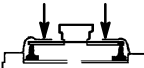
27204003

1. Clutch pedal – 2. Hydraulic oil reservoir – 3. Pneumatic distributor – 4. Pneumohydraulic servo actuator –
5. Master cylinder – 6. Switches S1 and S2 – 7- Splitter actuator pedal

SPECIFICATIONS AND DATA

15/16" CLUTCH		VALEO	BORG & BECK	FICHTEL & SACHS
	Type	Dry, single-plate		
	Engagement mechanism	"Pull" type with diaphragm spring		
	Driven plate	With friction facings		
	Driven plate hub	With damper springs		
	Ø External diameter of friction Facings mm	400	400	400 ± 1
	Ø Internal diameter of friction Facings mm	235	220	$220 + 1,5$
	Plate thickness (new) mm	$10 \pm 0,3$		
	Max. permitted driven plate mm	$\sim 0,2$		
	Withdrawal stroke mm	$12 + 2$		
	Wear stroke mm	$15 + 2$		
	Hydraulic control	Master cylinder with built-in oil reservoir-Slave cylinder with full driven plate self-adjustment		
	Oil type	-		

* For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

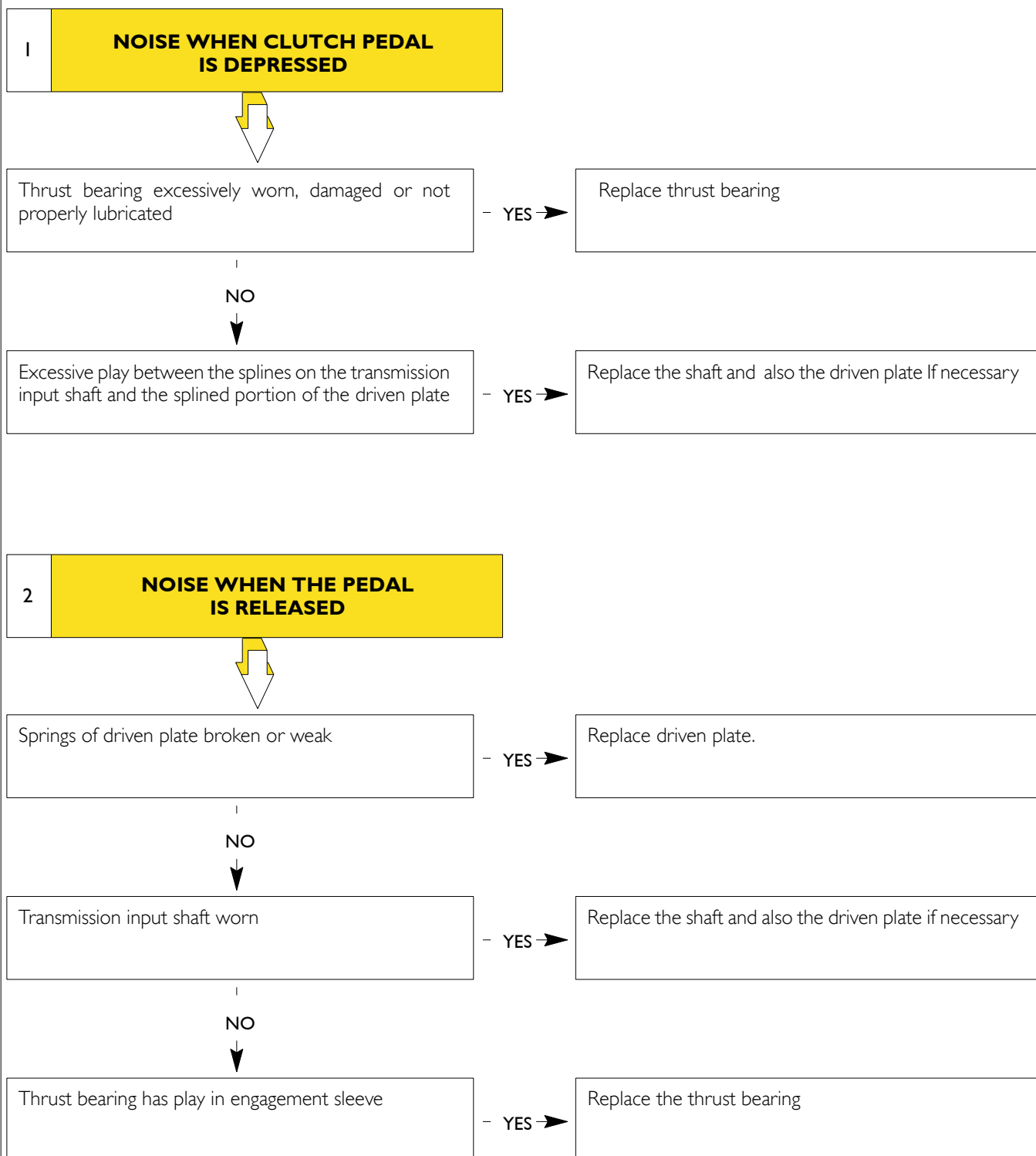
17" CLUTCH		VALEO	BORG & BECK	FICHTEL & SACHS
 Type		Dry, single-plate		
 Engagement mechanism		"Pull" type with diaphragm spring		
 Driven plate		With friction facings		
 Driven plate hub		With damper springs		
 Ø External diameter of friction Facings	mm	430	430	430 ± 1
 Ø Internal diameter of friction Facings	mm	242	240	240
 Plate thickness (new)	mm	$10 \pm 0,3$		
 Max. permitted driven plate	mm	$\sim 0,2$		
 Withdrawal stroke	mm	$12 + 2$		
 Wear stroke	mm	$15 + 2$		
 Hydraulic control		Master cylinder with built-in oil reservoir-Slave cylinder with full driven plate self-adjustment		
 Oil type		(*)		

* For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

DIAGNOSTICS

Main operating faults in the clutch :

- 1 - Noise when the clutch pedal is depressed.
- 2 - Noise when the pedal is released
- 3 - The clutch snatches
- 4 - The clutch does not disengage
- 5 - The clutch slips
- 6 - Abnormal wear of driven plate linings.



3

THE CLUTCH SNATCHES

Oil or grease on engine flywheel or on driven plate linings

- YES →

Eliminate the problem causing the contamination; clean flywheel thoroughly then replace driven plate

NO



Pressure plate distorted

- YES →

Replace the clutch.

NO



Uneven wear of friction linings due to run-out of driven plate

- YES →

Replace the driven plate.

NO



Diaphragm spring weak or fingers broken

- YES →

Replace the driven plate.

4

THE CLUTCH DOES NOT DISENGAGE

Oil or grease on driven plate linings.

- YES →

Replace the driven plate.

NO



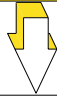
Transmission input spline damaged thus preventing driven plate from sliding

- YES →

Replace the shaft and also the driven plate if necessary

(continued)

5

THE CLUTCH SLIPS

Driven plate linings worn or burnt

- YES →

Replace the driven plate.

NO



Diaphragm spring weak or fingers broken

- YES →

Replace the clutch.

NO



Oil or grease on driven plate linings.

- YES →

Eliminate the problem causing the contamination and replace driven plate

6

**ABNORMAL WEAR OF
DRIVEN PLATE LININGS**

Driver resting his foot on the clutch pedal while driving

- YES →

Driver must avoid the harmful habit and rest his foot on the clutch pedal only when necessary

NO



Diaphragm spring with weakened or broken fingers

- YES →

Replace the clutch.

MAINTENANCE



Before carrying out any operation, check that all precautions have been taken and all aspects regarding safety of the personnel involved have been clarified. Read the related instructions given in SECTION 1 of this manual.

If in doubt, speak to a more experienced person. Respect all general recommendations for correct execution of maintenance works.

Hydraulic oil change



Exhausted oil and fluids must be collected and disposed of according to standards in force.



The fluid is corrosive: always wear protective gloves.

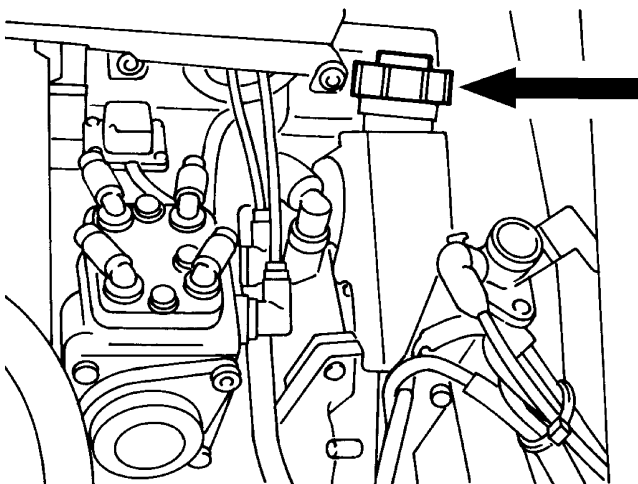


The fluid will corrode any paintwork it comes into contact with.

Use only the specified type of fluid for topping up.

Proceed as follows:

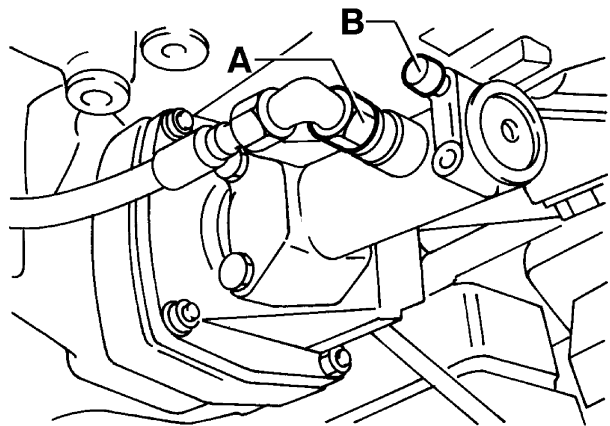
Figure 5



272NM003X

- ☐ arrange an adequately sized container underneath and then open the reservoir drain plug (arrow);

Figure 6



272NM004X

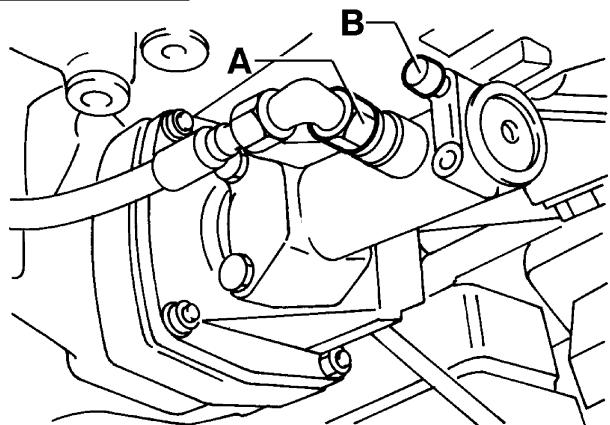
- ☐ Unscrew the drain pipe (A) and fully drain off the oil;
- ☐ replace the plug and fill to maximum oil level;
- ☐ proceed to bleed the system as instructed in the next paragraph.

Bleeding off air

Proceed as follows:

- ☐ check that fluid level in reservoir is at maximum;

Figure 7

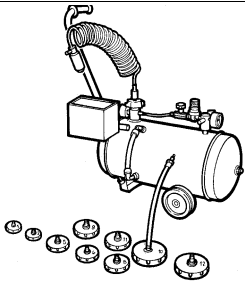
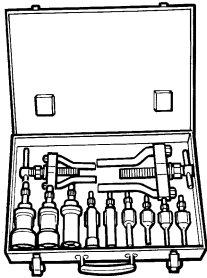
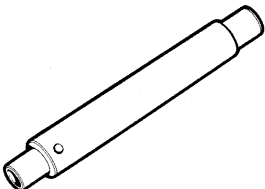
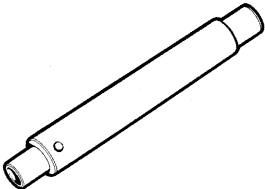
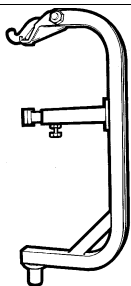


272NM004X

- ☐ using a section of transparent pipe, fit one end to the bleed valve (B) and the other end into a clean container;
- ☐ depress the clutch pedal and hold it down;
- ☐ loosen the upper bleed valve allowing oil and air bubbles to flow out, and close it after a few seconds;
- ☐ fully release the clutch pedal;
- ☐ repeat the operation until oil flows from the bleed valve without air bubbles.

TIGHTENING TORQUES

DETAIL	TORQUE	
	Nm	(kgm)
Disk pusher to flywheel M12 hex head flanged screw	65 ± 7	(6.5 ± 0.7)
M10 nut for clutch casing to crankcase fastening stud	46 ± 5	(4.6 ± 0.5)
M10x80 clutch casing to crankcase fastening stud	19 ± 2	(2 ± 0.2)

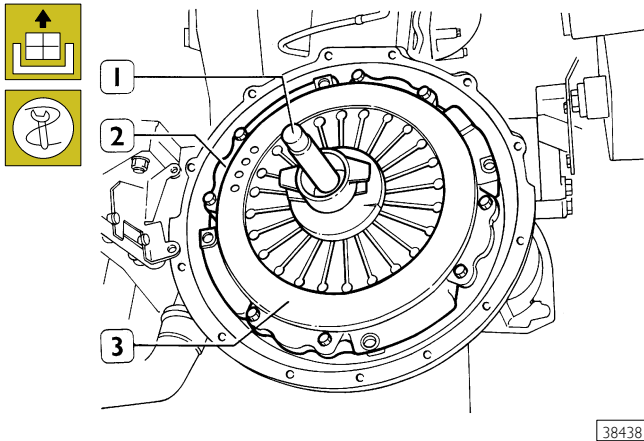
TOOLS	
TOOL NO.	DESCRIPTION
99306010 	Air remover for bleeding air from clutch control circuit
99348004 	Universal 5 to 70 mm internal extractor
99370264 	Guide pin for clutch disk centring
99370280 	Guide pin for clutch disk centring
99370547 	Suport for clutch group removal and replacement (to apply to hydraulic jack)

REMOVING AND REFITTING

Removal

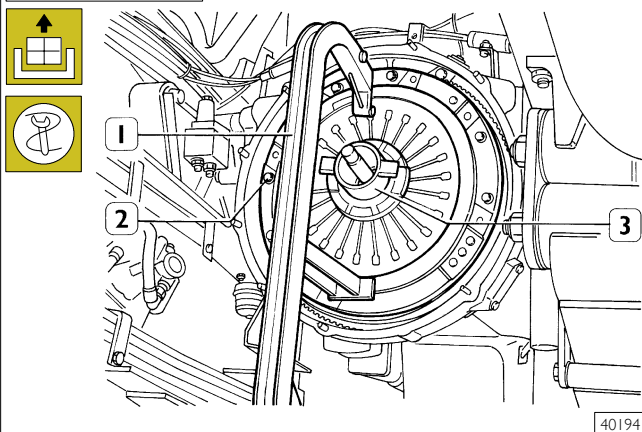
After removing the transmission input shaft and the transmission, as described in the sections, remove the clutch assembly as follows:

Figure 8



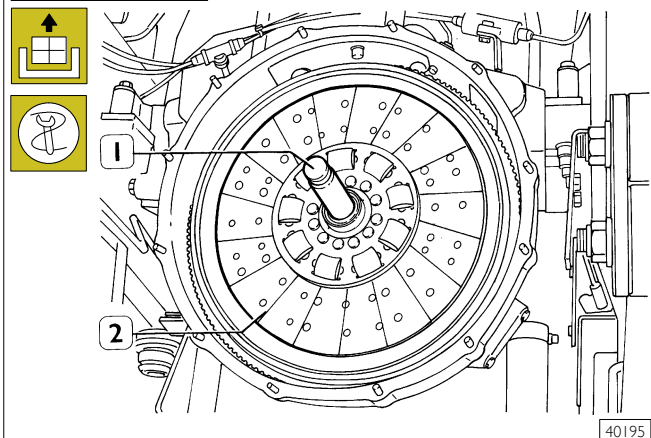
Insert clutch centring pin 99370280 (1) into the gearbox input shaft support bearing.

Figure 9



On the hydraulic jack fit support 99370547 (1) and apply it to the disk pusher (3). Unscrew the screws (2) and remove the disk pusher from the engine flywheel

Figure 10



Withdraw centring pin 99370280 (1) and at the same time take off driven plate (2).

Checks

Check the faying surface of the engine flywheel, it must not be excessively worn or scored, the teeth of the toothed crown must not be worn or broken, otherwise remove the engine flywheel and carry out the procedures described in section 2.

Check that there are no oil leaks, even of a slight entity, from the seal of the rear drive shaft; otherwise remove the flywheel and replace the sealing rings.

Check that the support bearing of the take up shaft on the gears fitted to the drive shaft are not worn or broken and if necessary replace them.

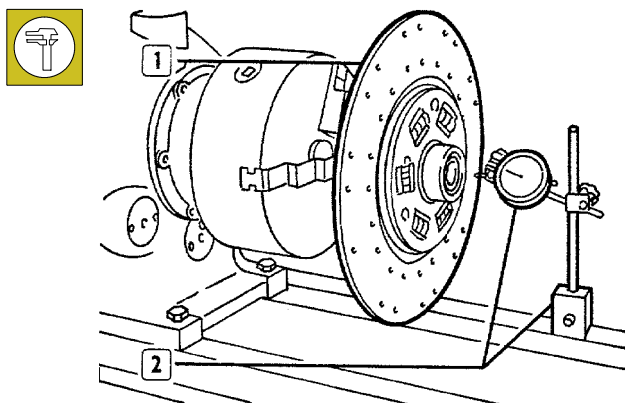
Check all parts for wear and damage.

The thrust pad must not be scored or excessively worn.

The driven gear should be replaced if any of the following problems is found:

- ☐ metal ring cracked or broken
- ☐ springs broken
- ☐ excessive wear in the grooves on the hub
- ☐ metal ring or hub springs loose
- ☐ excessive consumption of the seal
- ☐ considerable quantities of oil or grease on the friction seals

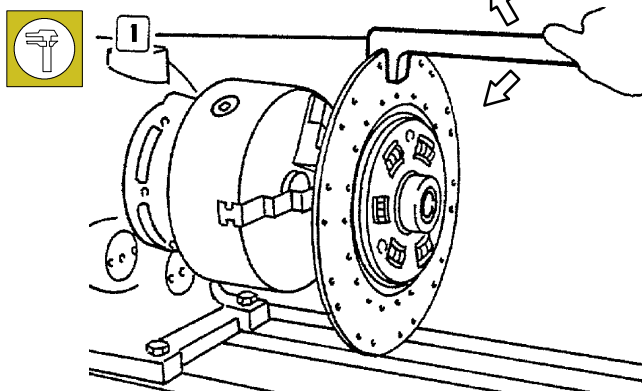
Figure 11



Before fitting a new driven plate, it should be checked for run-out as follows :

Mount the driven plate (1) in a lathe, then using a dial gauge with a magnetic base (2) check the surface of the disc for run-out. Maximum run-out permitted for the driven plate is 0.20 mm.

Figure 12



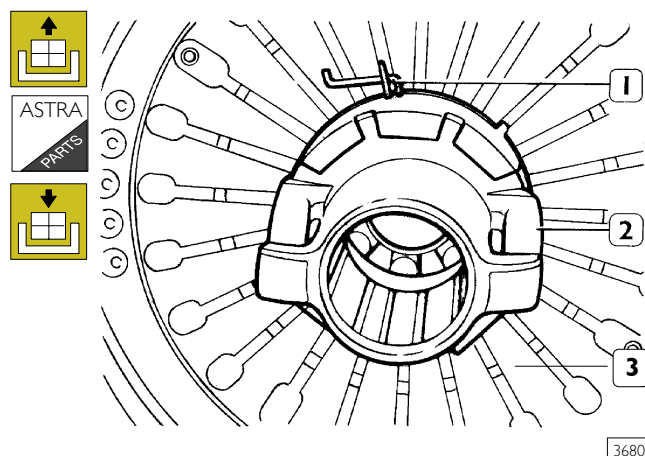
If the disc is out of line use a hook wrench (1) as in the figure.

Refitting

Follow the same procedures as for removal in reverse order and:

- ☐ carefully clean the faying surface of the flywheel disc using methylated spirit or petrol; if any slight scratches are noted remove an abrasive cloth.
- ☐ Position the driven disc, using the guide pin to obtain perfect centring and to avoid straining the hub when the gears are reconnected.
- ☐ using support 99370547 on the hydraulic jack, position the thrust pad on the flywheel fit the fixing screws and tighten them to the prescribed torque.
- ☐ reconnect the gears after spreading the grooved shaft with molybdenum disulphide "Molikote" grease

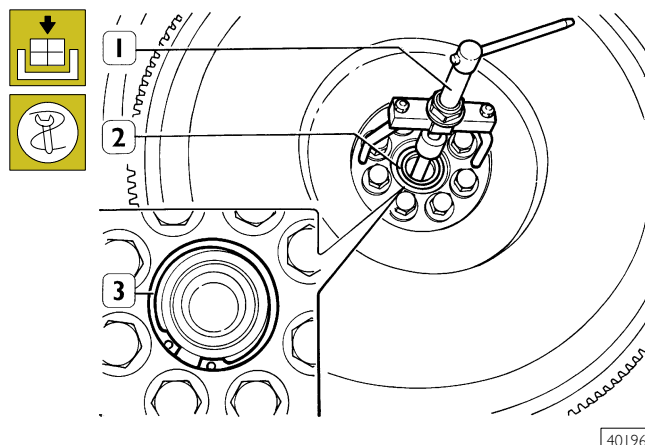
Figure 13



Use the appropriate pliers to open retaining circlip (1) and withdraw thrust bearing (2). Reverse order of operations to refit.

REPLACING THE SUPPORT BEARING OF THE CLUTCH SHAFT

Figure 14



Using the appropriate pliers remove the split ring (3). Using the universal extractor 99348004 (1) remove the bearing (2). For refitting use the appropriate beater. Refit the split ring.

Clutch pedal adjustment

Proceed as follows:

- ☐ Loosen the angle bracket bolts (4) without removing them.
- ☐ Place a spacer of predetermined thickness ($A = 1 \text{ mm}$) in front of the button (2) of the splitter control distributor.
- ☐ Bring the clutch pedal (5) into contact with the stop screw (1) and hold it down.

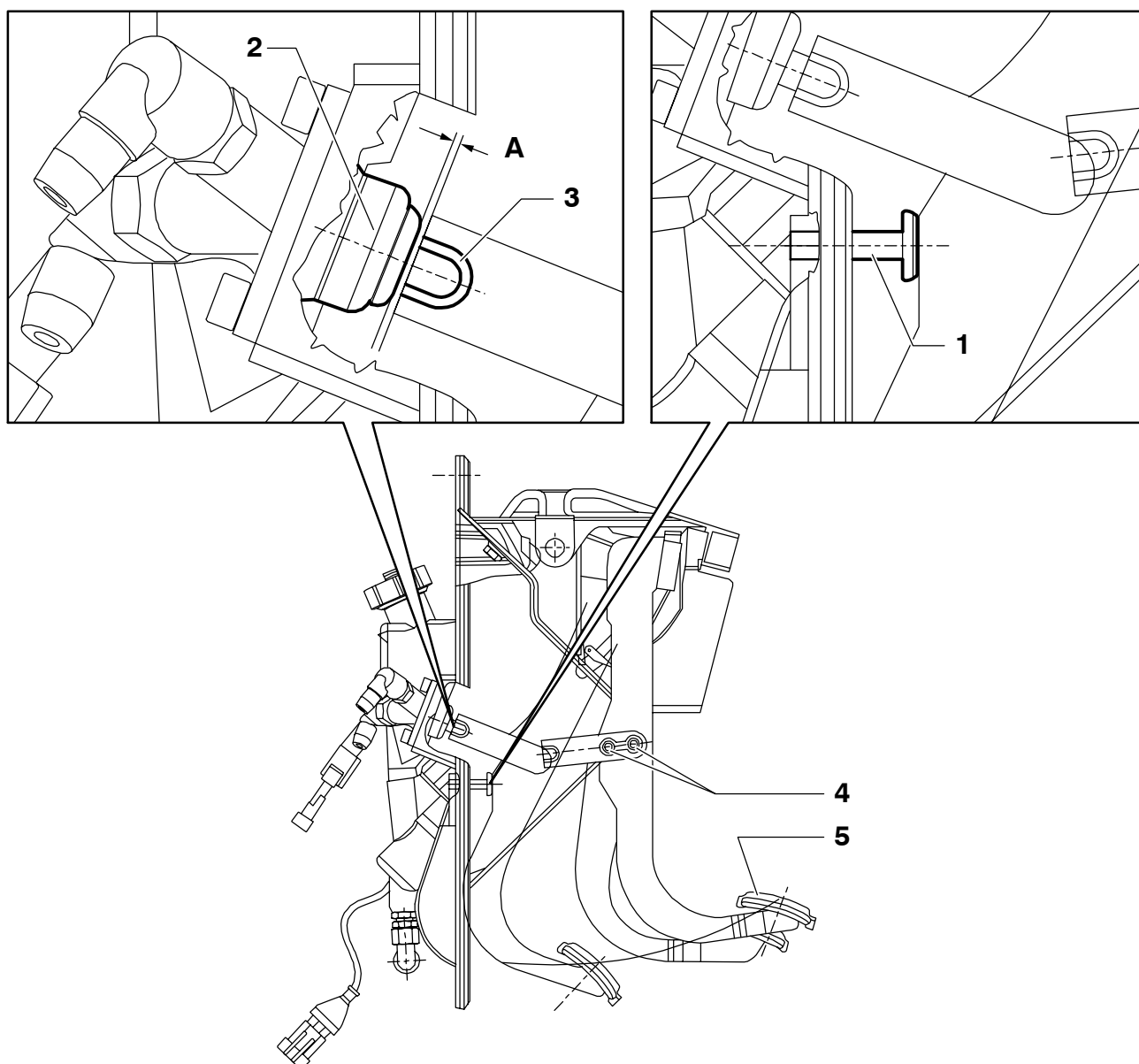
- ☐ Bring the angle bracket (3) into contact with the spacer.



Fitting the spacer prevents the splitter control distributor working as a stop for the clutch pedal.

- ☐ Tighten the angle bracket bolts (4).
- ☐ Release the clutch pedal (5).

Figure 15



Clutch actuator adjustment

Proceed as follows:

- ☐ measure the distance **A** between the bottom of the lever cavity and the servoclutch mounting plane.



The clutch lever must be in contact with the thrust bearing.

- ☐ press the spherical push-rod to its limit (arrow);
- ☐ loosen the lock nut and adjust push-rod position until obtaining the required distance **B**.

$$B = A - C \text{ mm}$$

C being the actuator excursion, according to clutch type:

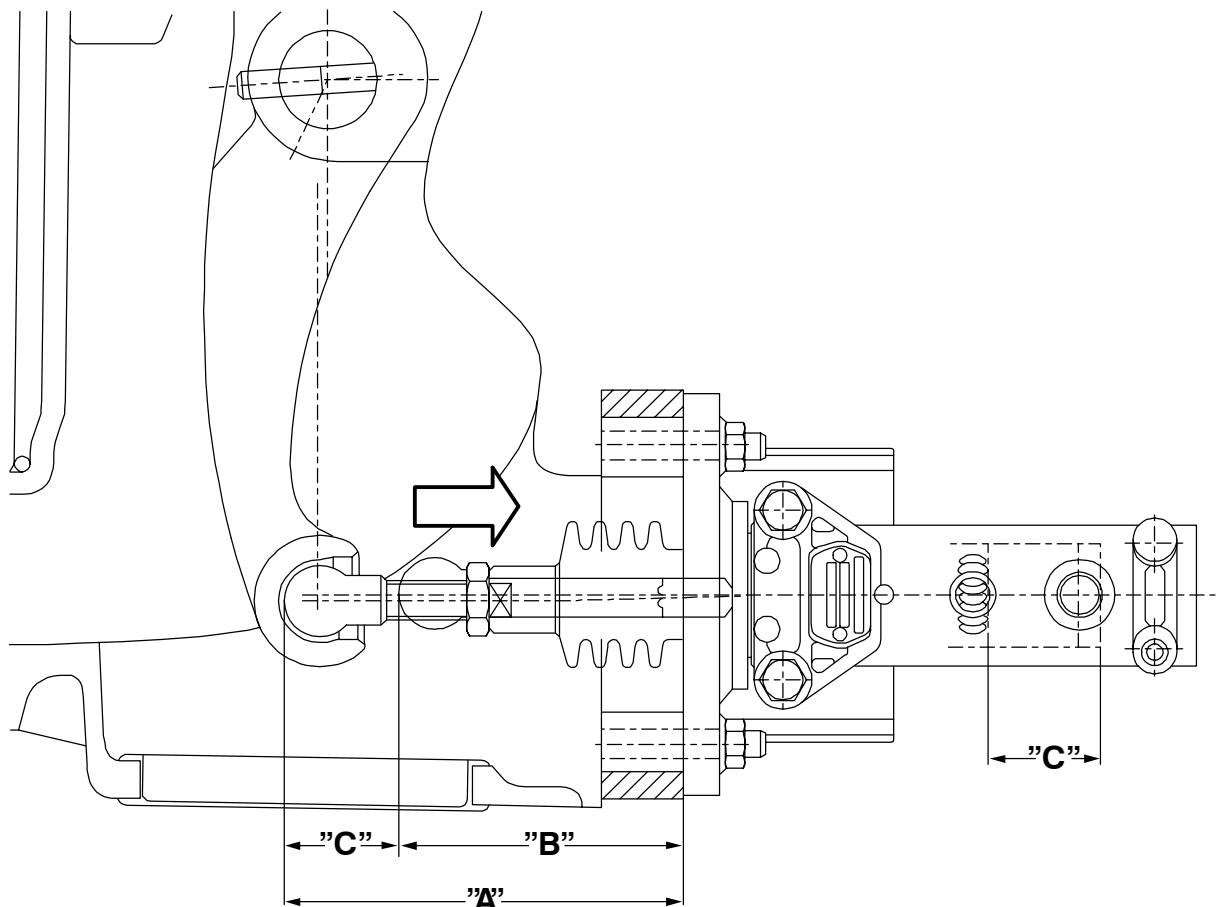
C = 25 mm (VALEO, BORG & BECK)

C = 33 mm (FICHTEL & SACHS).



Disk wear (90% of the lining) is indicated by a significant increase in load on the pedal during clutch disengagement.

Figure 16



Vehicles with robotic transmission

Servoclutch adjustment

Proceed as follows:

- ☐ Measure the distance **A** between the bottom of the lever cavity and the servoclutch mounting plane.



The clutch lever must be in contact with the thrust bearing.

- ☐ Adjust the push-rod **H** as below:

$$B = (A - 13,9 \text{ mm}) + 33 \text{ mm}$$

Where:

B = distance between the push rod **H** and the servoclutch mounting plane

A = distance between the bottom of the lever cavity and the servoclutch mounting plane.

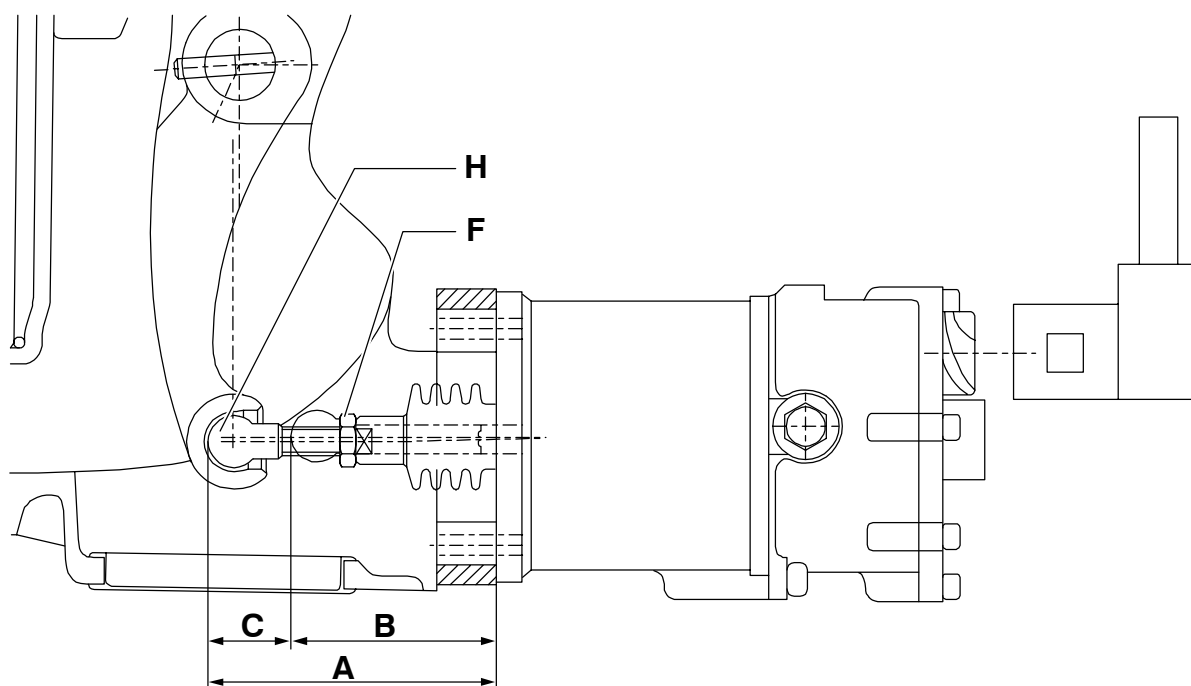
C = actuator stroke (33 mm)

- ☐ Tighten the lock nut **F**.



The clutch wear stroke at servoclutch (set in the transmission control unit) is 25 mm, which corresponds to disk wear of 2.5 mm (minimum guaranteed wear on clutch disk).

Figure 17



Mounting servoclutch in clutch housing

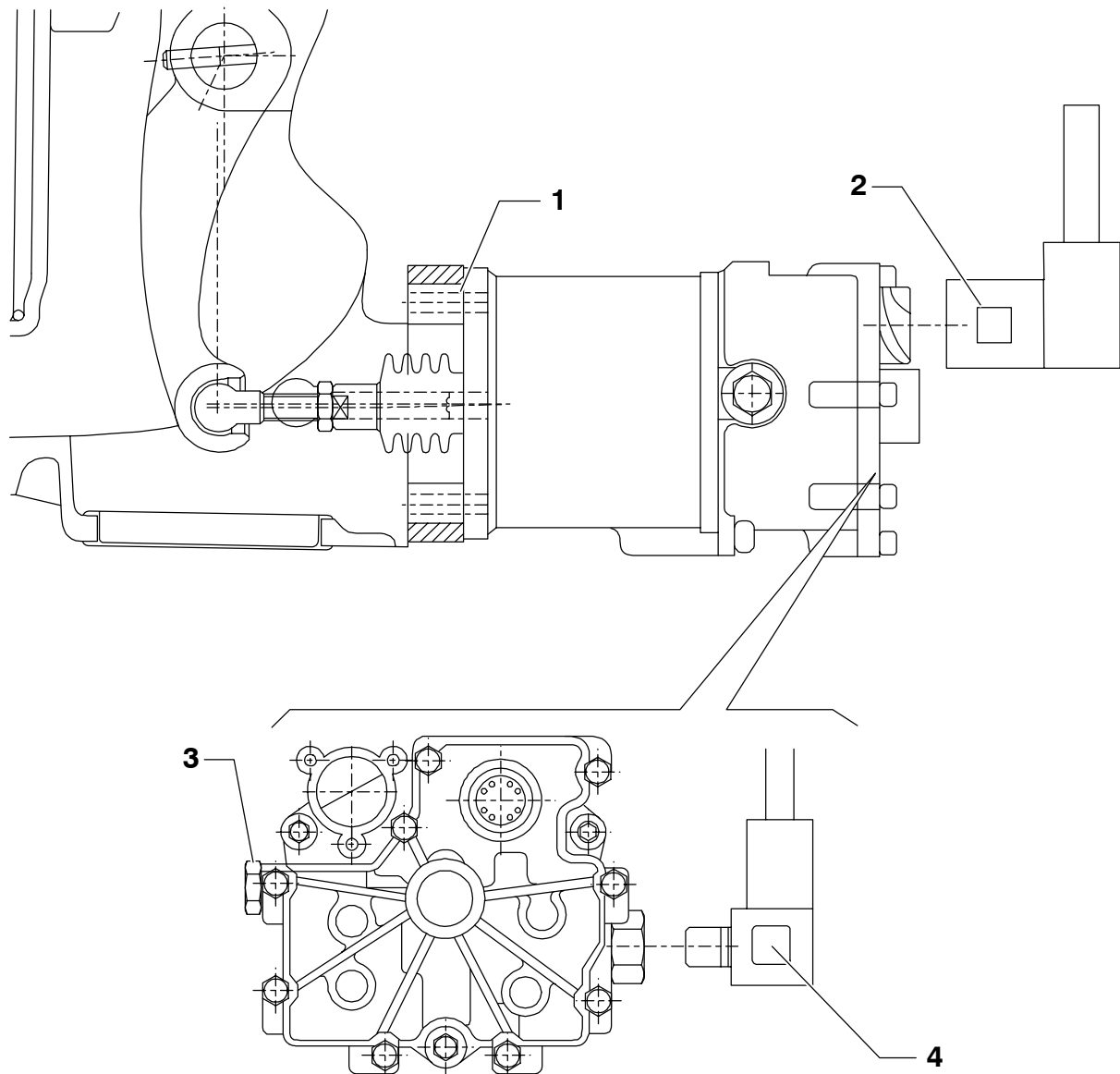
Proceed as follows:

- ☐ Unscrew the plug (3) from the inspection hole, to release air from the chamber.
- ☐ Manually bring the servoclutch piston backwards against the pressure of the internal spring
- ☐ Replace the cap (3) to lock the piston back.
- ☐ Fit the push rod in the lever cavity
- ☐ Mount the servoclutch and secure it with the four nuts (1).
- ☐ Unscrew the cap (3) and move the piston forward
- ☐ Retighten the cap (3).
- ☐ Connect the electrical connector (2) and the air delivery pipe (4)



Before connecting the air line check that the servoclutch is correctly fastened to the clutch housing.

Figure 18



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POWER TAKE-OFF

SECTION 5

SECTION 5

Power take off

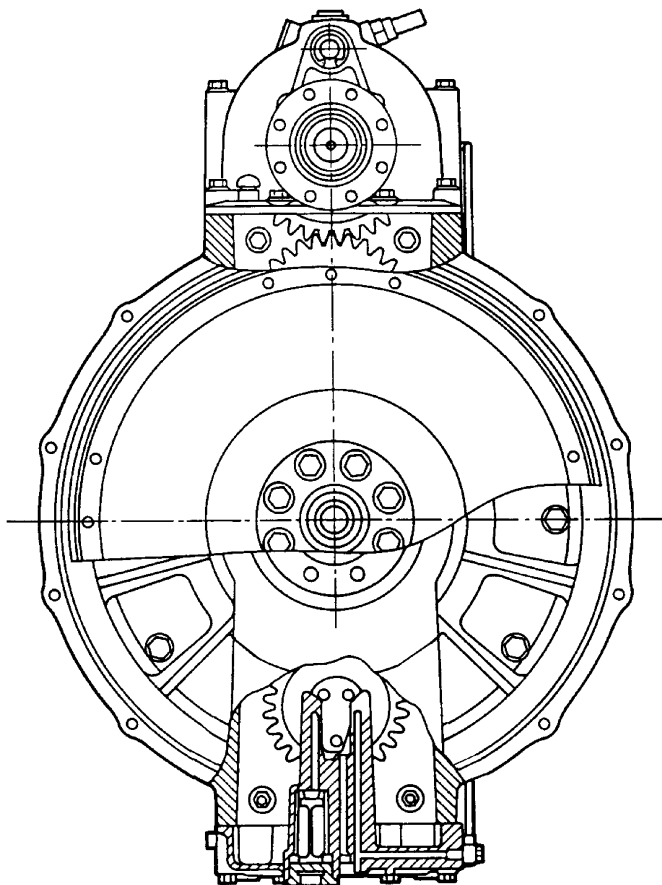
	Page
DESCRIPTION	3
☐ Operation	4
☐ Power take off disengaged	4
☐ Power take off engaged	5
FEATURES AND DATA	6
DRIVING TORQUES	7
TOOLS	8
SPECIAL MAINTENANCE	9
☐ Oil replacement	9
STRIPPING DOWN - REFITTING INTEGRAL POWER TAKE-OFF	10
☐ Stripping down	10
☐ Refitting	10
STRIP DOWN MAIN HOUSING	11
STRIP DOWN BEARING FOR SHAFT WITH TOOTHED CROWN	12
STRIP DOWN OUTPUT SHAFT	12
STRIP DOWN OIL PUMP	13
CLEANING AND CHECKING THE PARTS	14
FITTING	14
☐ Oil pump	14
☐ Fitting the bearings for shaft with toothed crown	14
☐ Output shaft unit	15
☐ Setting the taper bearings on the output shaft	16
☐ Fitting the main housing	17
☐ Setting the ball bearings	17

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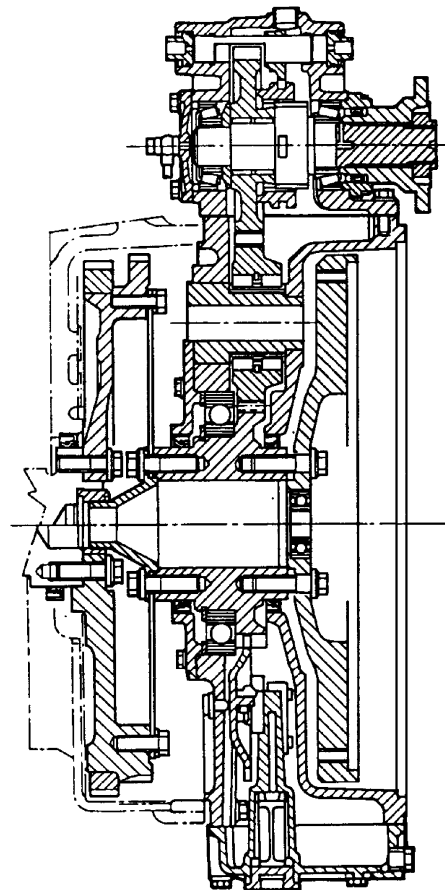
DESCRIPTION

The power take off is situated between the engine flywheel and the clutch assembly and is fitted with a non-synchronised pneumo-mechanical positive clutch to transfer the movement from the engine drive shaft to the pick up flange. Lubrication is ensured by an oil pump.

Figure 1



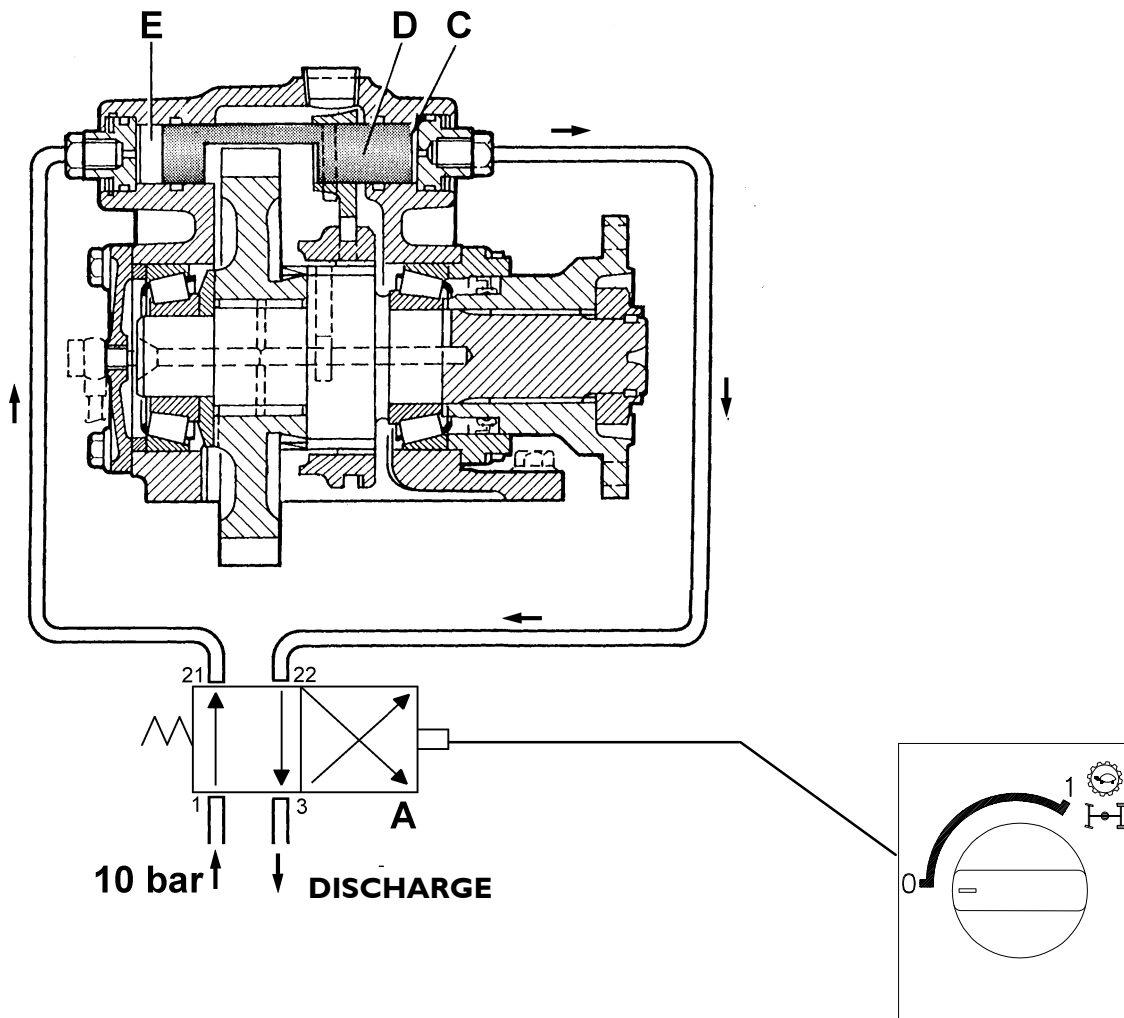
1780501



1780502

Operation

Figure 2

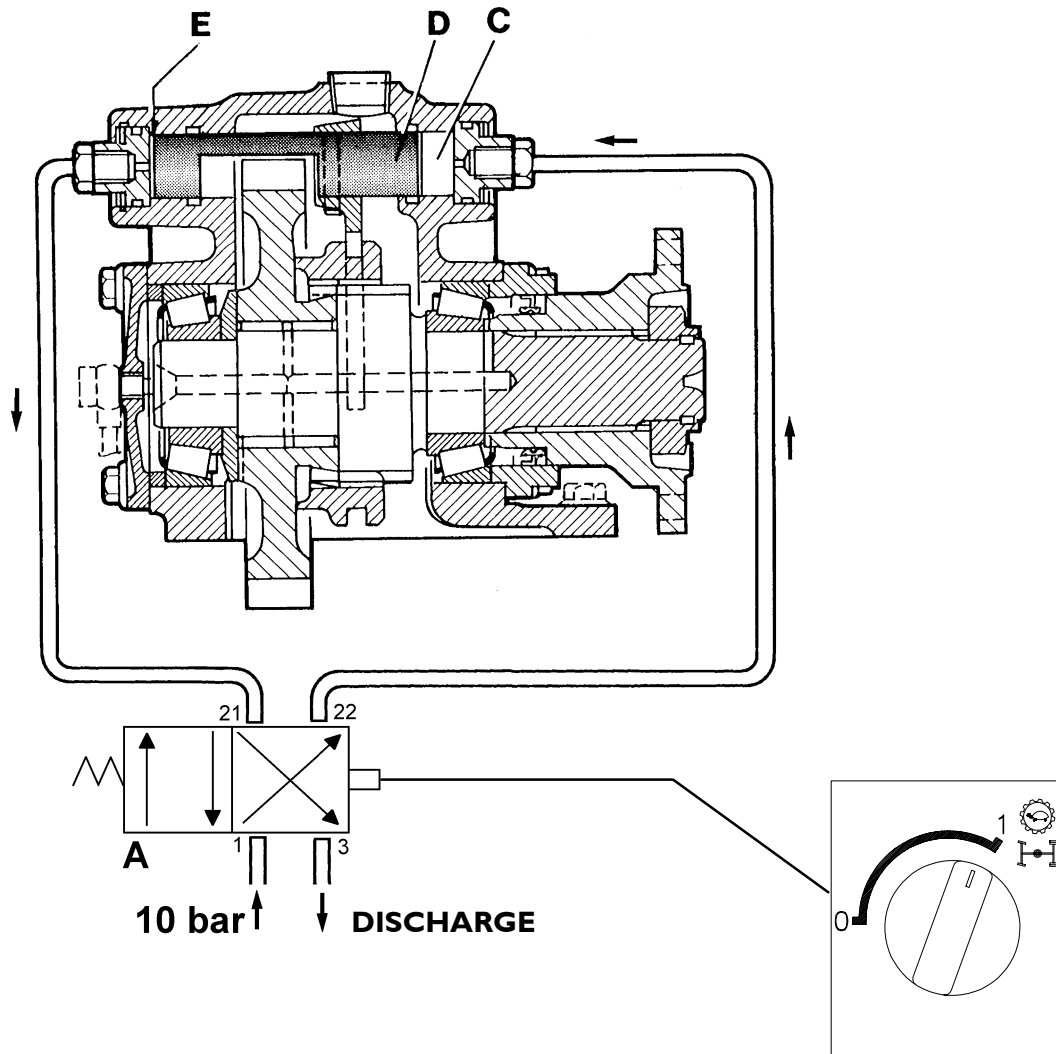


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Power take off disengaged

With the switch in position 0 (disengaged) the air taken in enters valve A by link (1), leaves by link (21) and passes through the pipes to chamber E, moving the control rod with fork D in power take off position disengaged. At the same time the air in chamber C passes through the piping to the link (22) and passes into the air by link (3).

Figure 3

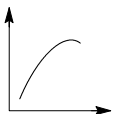
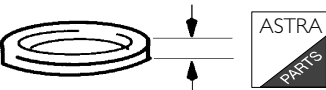
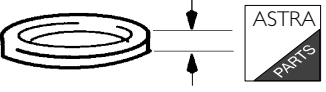
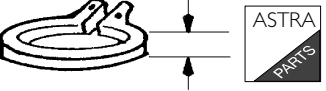


Power take off engaged

With the switch in position **I** (engaged) the air taken in through link (1) enters valve **A** leaves by link (22) and passes through the pipes to chamber **C**, moving the control rod with fork **D** in power take off position engaged.

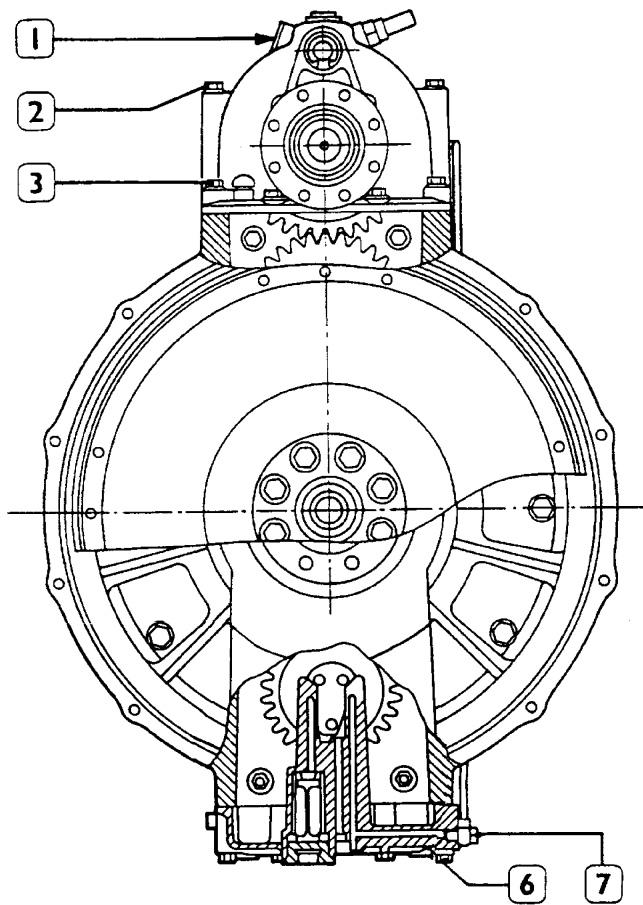
At the same time the air in chamber **E** passes through the piping to the link (21) into valve **A** and passes into the air by link (3).

FEATURES AND DATA

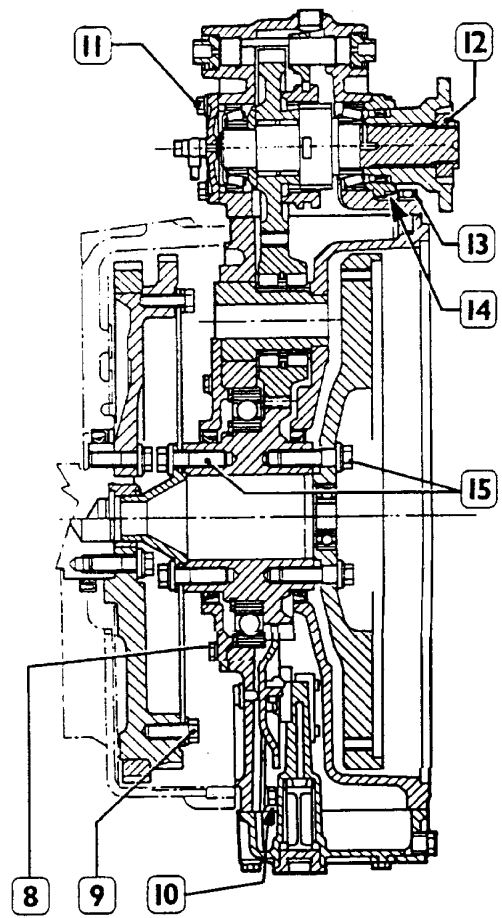
	Ratio revolutions - rpm	1 : 1,29
	Torque	900 Nm
	Direction of rotation	Same as engine
Type of engagement/release control		Electro - pneumatic
	Bearings for output shaft	2 tapered roller bearings
	Bearing settings	Using setting rings
	Distances setting rings	5,5 – 5,6 – 5,7 – 5,8 – 5,9 6 – 6,1 – 6,2 mm
	Bearing for control shaft	1 ball bearing
	Bearing settings	Using setting rings
	Thickness setting rings	3,95 – 4 – 4,05 – 4,10 – 4,15 – 4,20 4,25 – 4,30 mm
	Thickness safety split ring	3,60 – 3,65 – 3,70 – 3,80 3,85 – 3,90 mm
	Quantity (*)	

(*) For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

Figure 4



1780503



1780504

DRIVING TORQUES

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	Plug	27,5	2,75
2	Screws M 10 x 140	43	4,3
3	Screws	43	4,3
4	Pipe		
5	Screws		
6	Screws M 8 x 60	18	1,8
7	Joint	5,5	0,55
8	Screws for cover	22	2,2
9	Screws	82	8,2
10	Nut with flange for stud	29	2,9
11	Screws M 8 x 30	18	1,8
12	Nut M 33 x 1.5	380	38
13	Screws M 10 x 30	43	4,3
14	Screws M 8 x 30	18	1,8
15	Screws	*	*
	* The screws must be tightened in two stages 1 st stage pre-torque 2 nd stage to angle	95	9,5 60°

NB: Apply "LOCTITE 242e" to the plugs and joints in contact with the lubricant

TOOLS

TOOL NO.	DESCRIPTION
99322205	Revolving stand for unit overhaul
99341009	Pair of brackets (to be used with extractor 99341002)
99341015	Clamp
99341016	Grips (to be used with extractor 99341002)
99345049	Thrust block for extractors
99360503	Eyebolt
99363241	Output shaft adjusting plates
99370317	Reaction rod with flange holding extension
99395216	Angle tightening tool

SPECIAL MAINTENANCE

Oil replacement

Proceed as follows:

- ☐ unscrew the cap (1) and drain off the oil completely
- ☐ pour in new oil through the cap (2)
- ☐ having finished this operation, move the vehicle for about 5 minutes. Stop it on level ground.
- ☐ check the oil level through the screw (arrow), waiting until the oil has finished pouring out.



After the first 25 hours of use, it is necessary to clean the filter on the intake pipe. To do so, proceed as follows:

- take out the filter unscrewing the retaining cap (3), clean it with diesel oil and dry it with compressed air. If it is not in good condition replace it;
- check the gaskets and if necessary replace them.

Figure 5

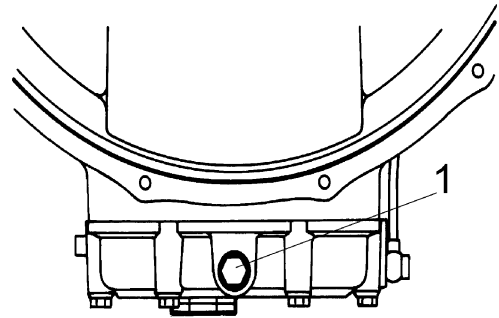


Figure 6

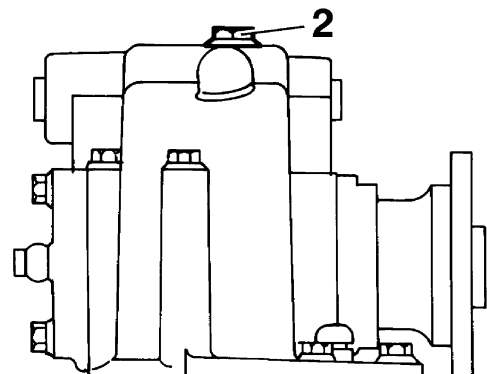
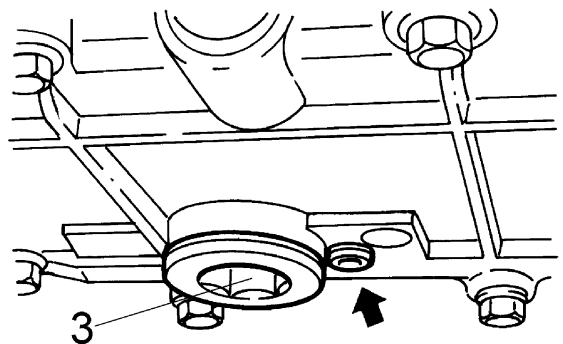


Figure 7



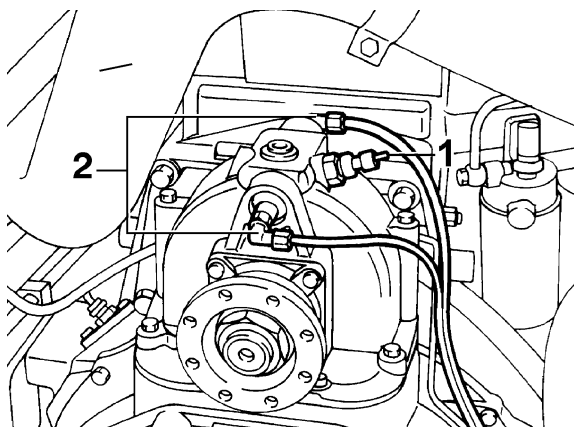
STRIPPING DOWN - REFITTING INTEGRAL POWER TAKE-OFF

Stripping down

To remove the power take-off unit proceed as follows:

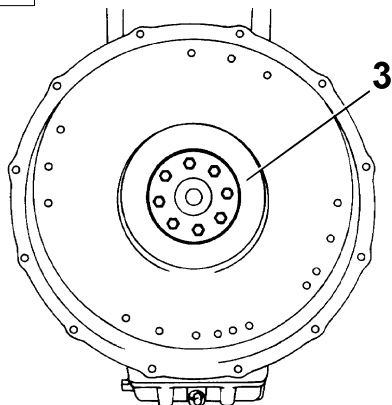
- ☐ set the vehicle on a pit or on a hoist;
- ☐ open the battery case and disconnect the cables to avoid short-circuits;

Figure 8



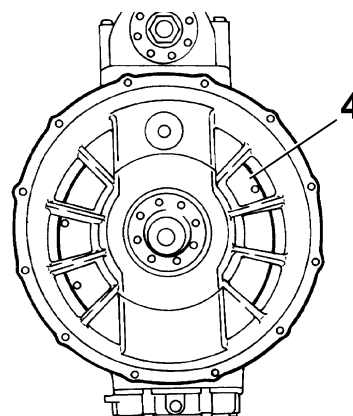
- ☐ disconnect the gearbox as described in Section 6;
- ☐ disconnect power take-off electrical (1) and pneumatic (2) connections;

Figure 9



- ☐ undo internal flywheel fixing screws and remove it;

Figure 10



- ☐ undo hub fixing screws (4) with engine flywheel, rotate the drive shaft to reach every screw;
- ☐ suitably support the unit, then undo engine connecting screws and remove the unit.

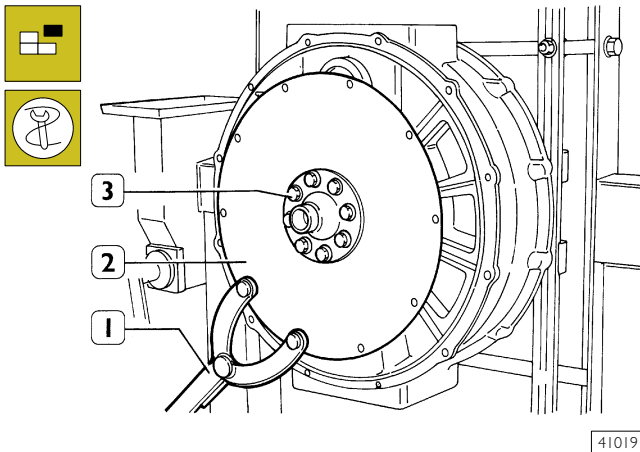
Refitting

Reverse the operations for removal.



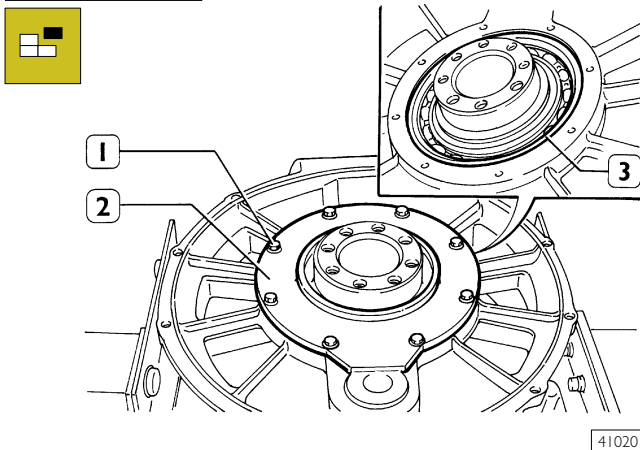
Before refitting the power take-off unit and the cover with oil pump spread surfaces with LOCTITE 510.

Plugs and screws in touch with oil shall be fitted with LOCTITE 242.

STRIP DOWN MAIN HOUSING**Figure 11**

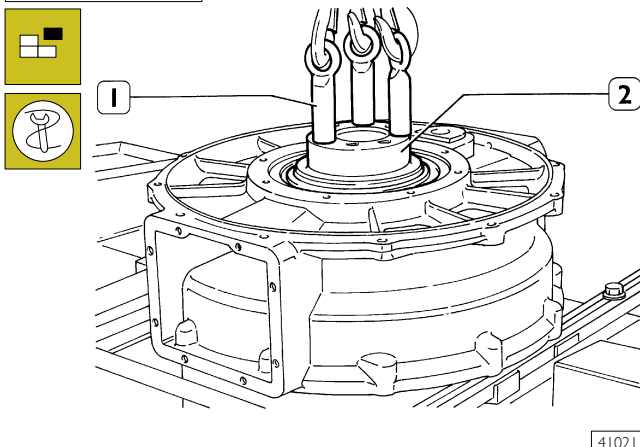
41019

Position the group on the rotating stand 99322205. Block the rotation of the plate joint (2) using the tool 99370317 (1) and the appropriate wrench loosen the retaining screws (3) remove the plate joint and the flange.

Figure 12

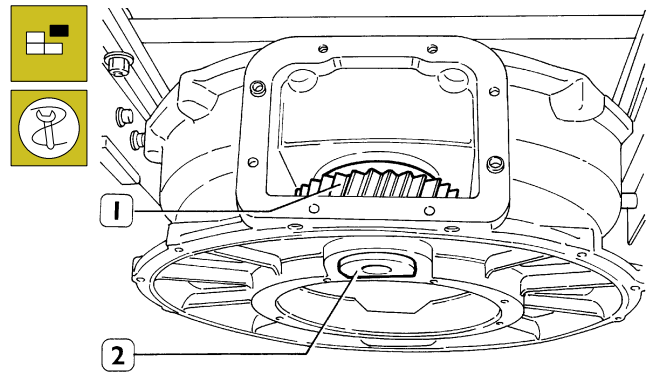
41020

Loosen the screws (1), remove the cover (2) complete with the choke ring and lift out the setting ring (3).

Figure 13

41021

Using tool 99360503 (1) and a hoist remove the shaft with toothed crown (2).

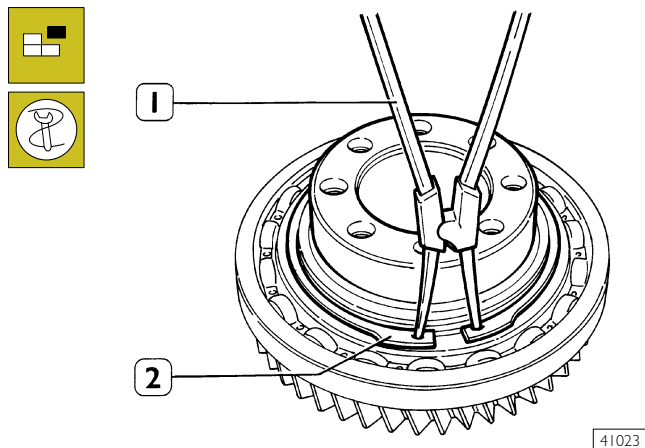
Figure 14

41022

Using the appropriate beater remove the shaft (2) and withdraw the return gear (1). Remove the choke ring from the housing.

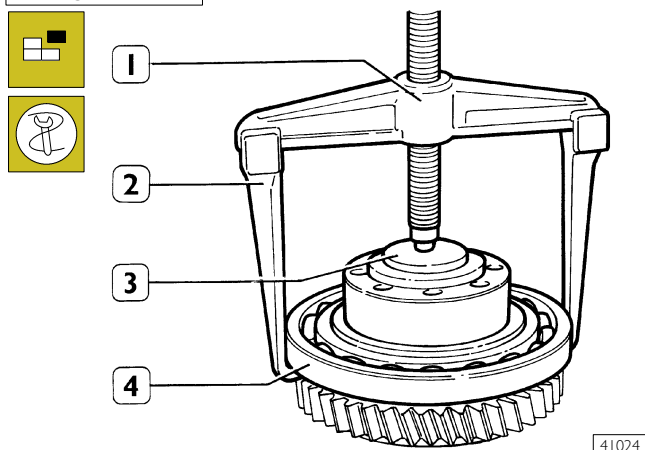
STRIP DOWN BEARING FOR SHAFT WITH TOOTHED CROWN

Figure 15



Using the appropriate pliers (1) remove the choke ring (2).

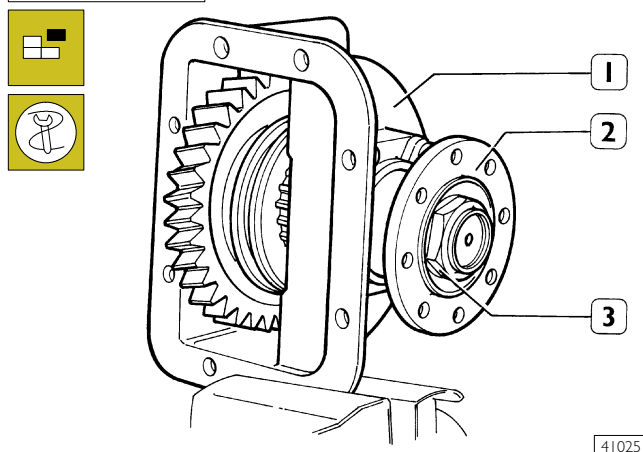
Figure 16



Remove the ball bearings (4) using tools 99341003 (1), 99341009 (2) and 99345049 (3).

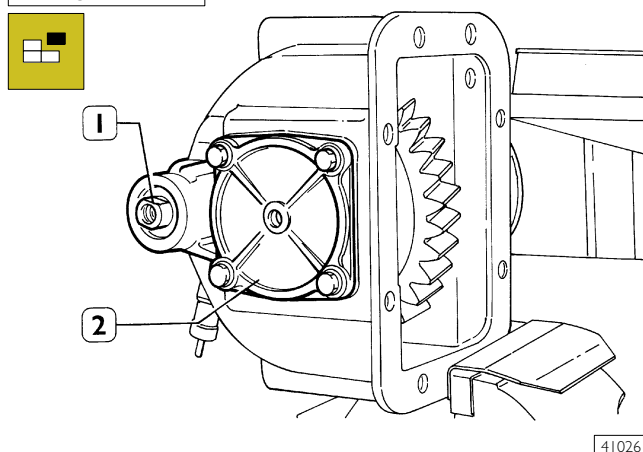
STRIP DOWN OUTPUT SHAFT

Figure 17



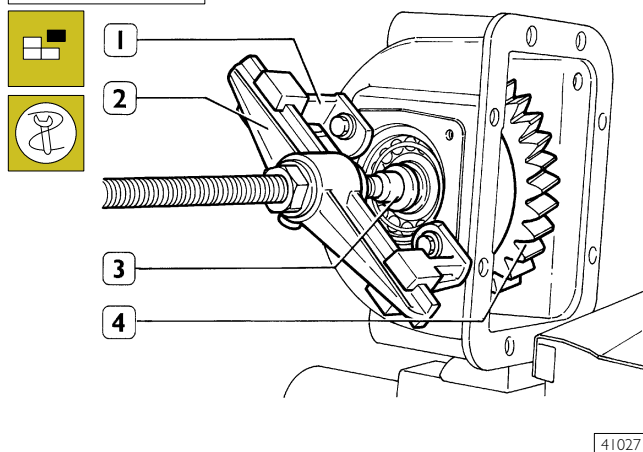
Position the group in a vice, unscrew the nut (3) remove the flange (2), loosen the screws and remove the cover (1).

Figure 18



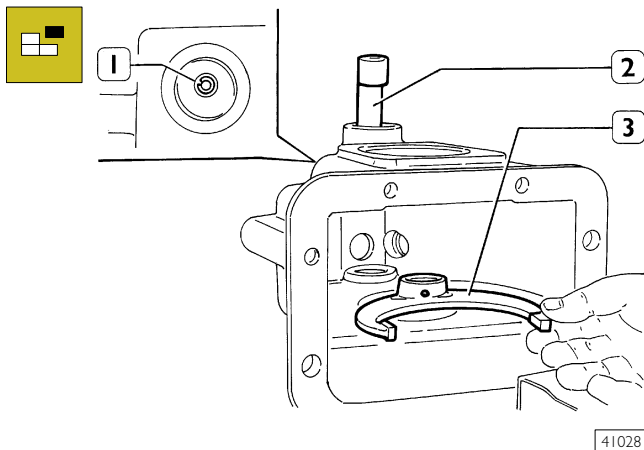
Loosen the screws and remove the cover (2); remove the setting ring. Remove the safety ring and the joint (1), unscrew the electrical sensor.

Figure 19



Fit tool 99341002 (2) and with tool 99341016 (1) withdraw the toothed shaft (3). Remove the gear: (4).

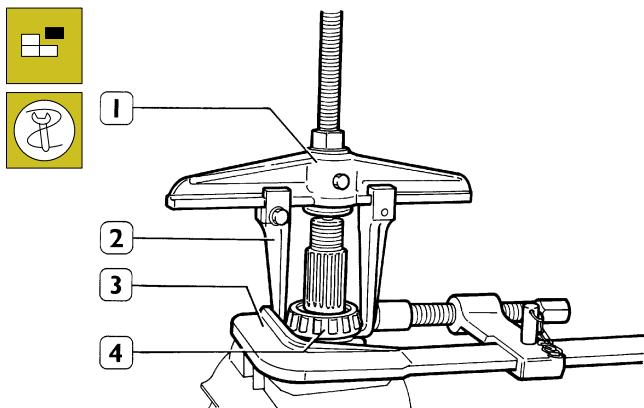
Figure 20



41028

Remove the spring cotter (1) remove the shaft (2) and the selector fork (3).

Figure 21

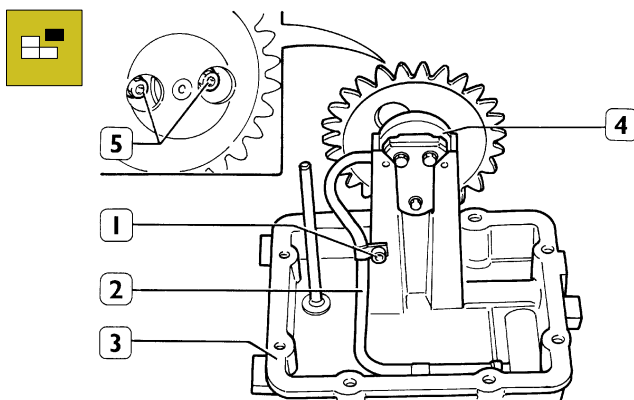


41029

Fit the transmission shaft in a vice and using tools 993441002 (1), 99341009 (2) and 99341015 (3) remove the taper bearings (4).

STRIP DOWN OIL PUMP

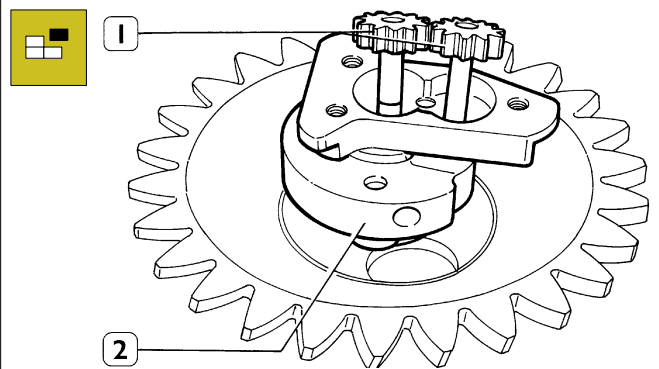
Figure 22



41030

Loosen the screws (1) holding the oil intake pipes (2), loosen the screws (5) holding the oil pump (4) and remove the cover (3).

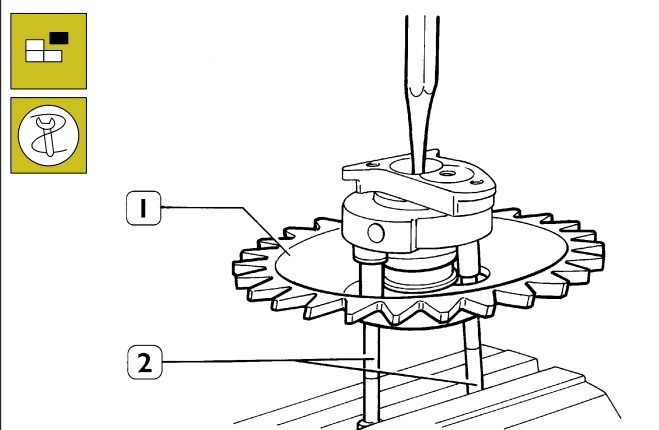
Figure 23



41031

Unscrew the three screws, remove the cover and withdraw the gears (1) of the oil pump (2).

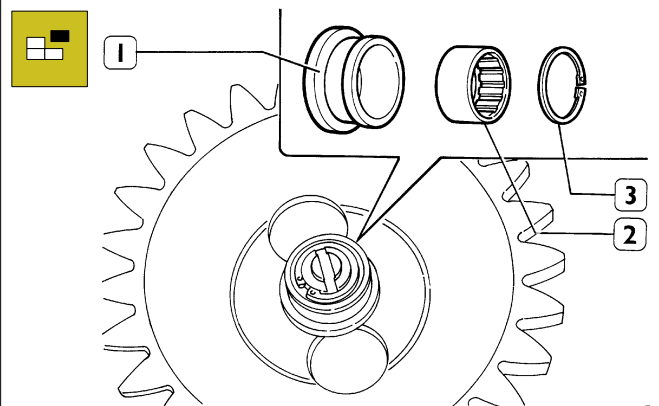
Figure 24



41032

Using the two pins (2) remove the gear (1) complete with support and bearing.

Figure 25



41033

Remove the support (1), the split ring (3) and the roller bearings (2) from the gear.

CLEANING AND CHECKING THE PARTS

When the strip down is completed immerse all the parts except for the bearings in wash tanks containing a solution of water and soda heated to $80 \pm 85^{\circ}\text{C}$ until all residues of lubricant dissolve.

Clean the parts thoroughly using a metal brush and a scraper, taking care not to damage them.

Repeat the wash and dry the parts using compressed air.

Using an electrical polishing machine with metal brushes eliminate all traces of sealant from the thread of the screws.

Clean the bearings in a petrol bath and use a paintbrush to remove all traces of lubricant.

Dry the bearings using compressed air - do not let the air roll the bearings.

Lubricate the bearings using the same oil as the gears.

Press the bearings down with one hand and roll them around, there must be no noise, and they must move smoothly.

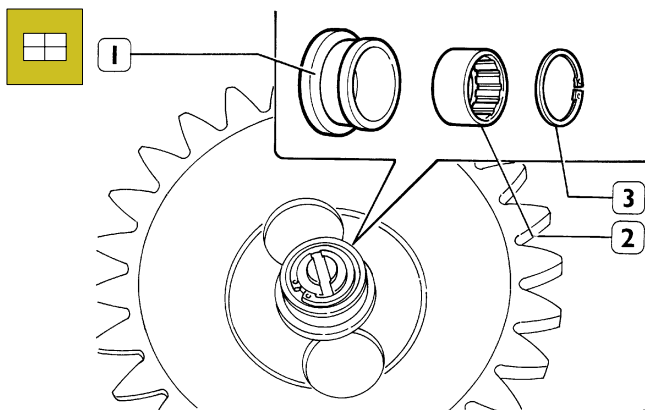
Check the rollers and respective cages, the external and internal tracks for wear.

Check all parts and decide whether they can be reused or must be replaced.

FITTING

Oil pump

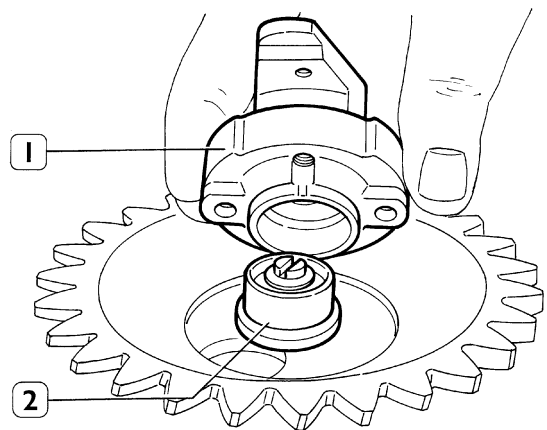
Figure 26



41033

Fit the roller bearings (2) on the gear, block them with the split ring (3) and fit the support (1).

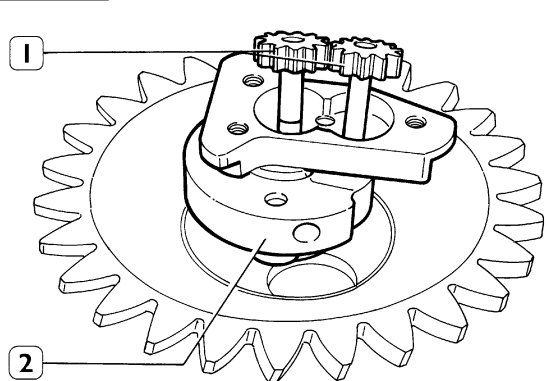
Figure 27



41034

Fit the support (2), the oil pump body (1).

Figure 28

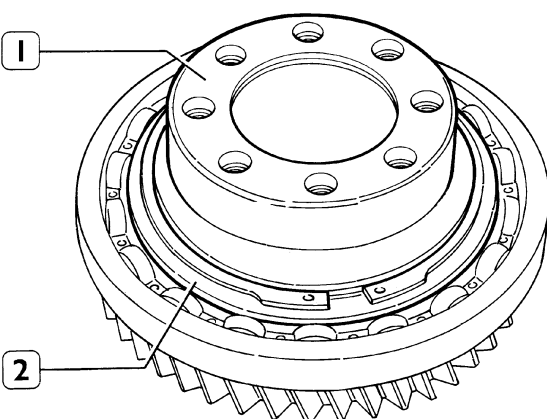


41031

Fit the gears (1) in the oil pump body (2) oil them and fit the cover, blocking the three screws to torque 0.7 ± 0.8 kg.

Fitting the bearings for shaft with toothed crown

Figure 29

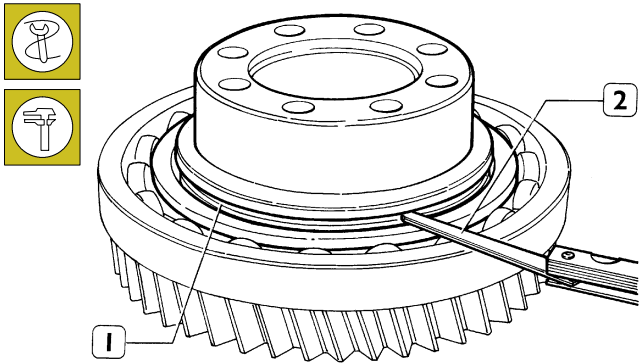


41035

Heat the inner ring of the bearing (2) to $\sim 80^{\circ}\text{C}$ and key it onto the shaft (1).

Allow it to cool before continuing work.

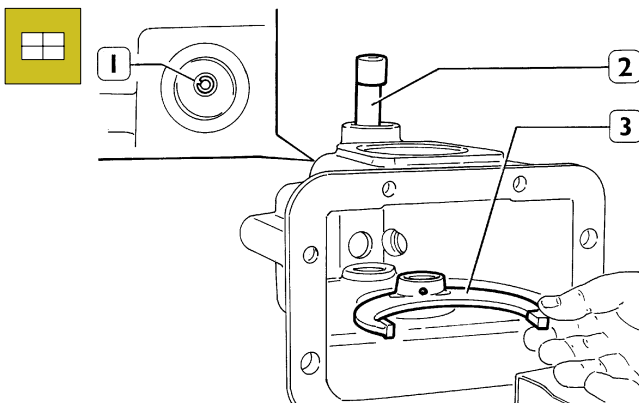
Figure 30



Using a feeler gauge (2) measure the play (1) between the bearing and the seat of the safety split ring and decide which of the safety split rings with allow the least possible play.

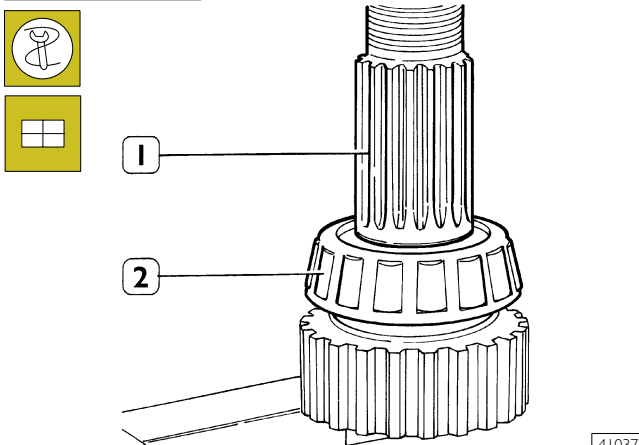
Output shaft unit

Figure 31



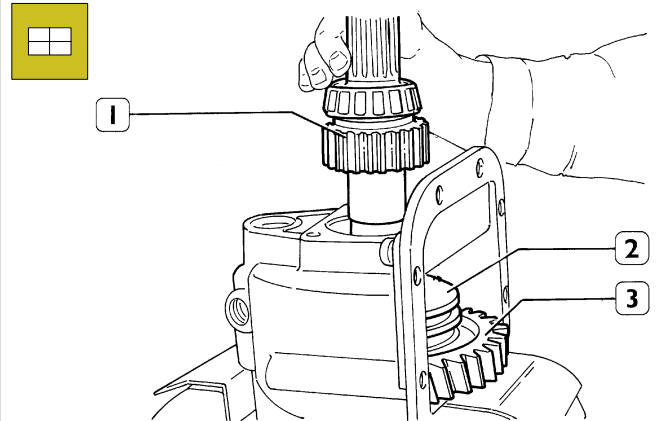
Fit the housing in a vice. Fit the fork (3), key on the shaft (2) and fit the spring cotter (1).

Figure 32



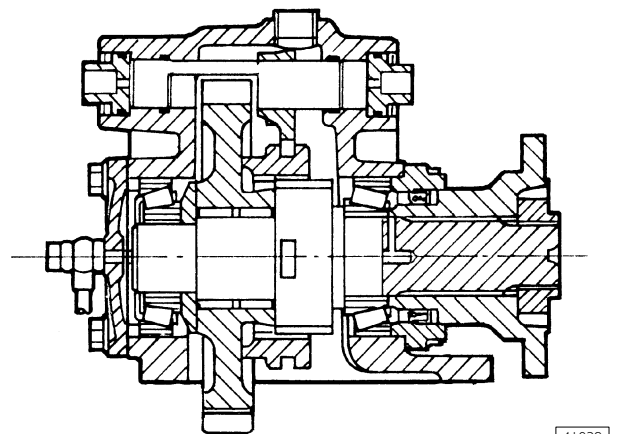
Heat the inner ring of the bearing (2) to 80°C and key it onto the transmission shaft (1).

Figure 33



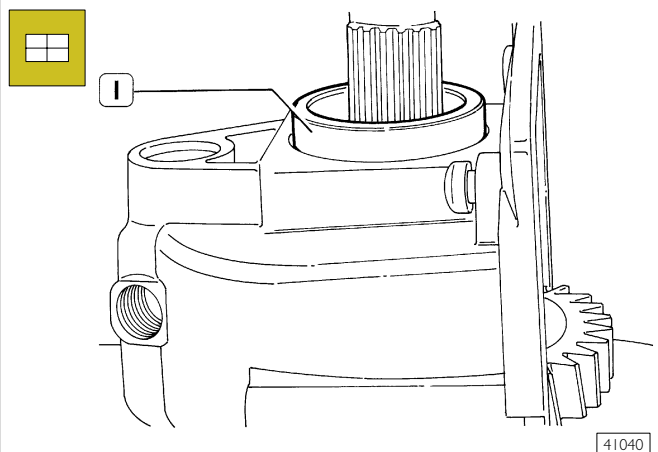
Fit the gear box (3) complete with collar (2) fit the transmission shaft (1).

Figure 34



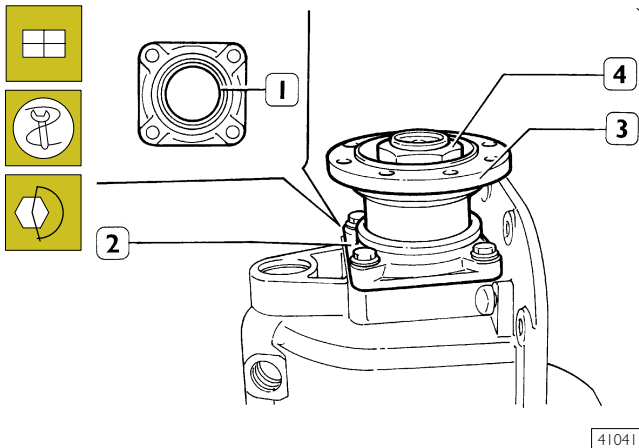
OUTPUT SHAFT UNIT SECTION

Figure 35



Fit the outer bearing ring (1).

Figure 36



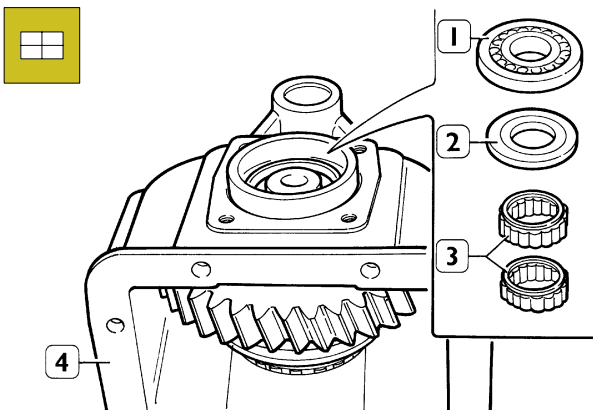
41041

Using the appropriate beater fit the choke ring (1) on the cover (2), apply LOCTITE 510 to the contact surfaces, fit the cover (2) and tighten the screws to torque 18 Nm; fit the flange (3) and tighten the nut (4) by hand.



The nut (4) must be tightened to torque 380 Nm (38 kgm) on the vehicle after linking up the output shaft unit.

Figure 37

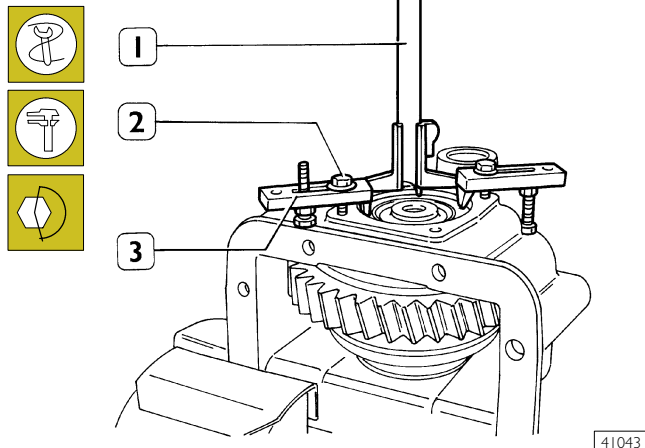


41042

Remove the housing (4) from the vice and turn it over; fit the roller bearings (3) on the shaft, the shoulder ring (2) and the taper bearings (1).

Setting the taper bearings on the output shaft

Figure 38



41043

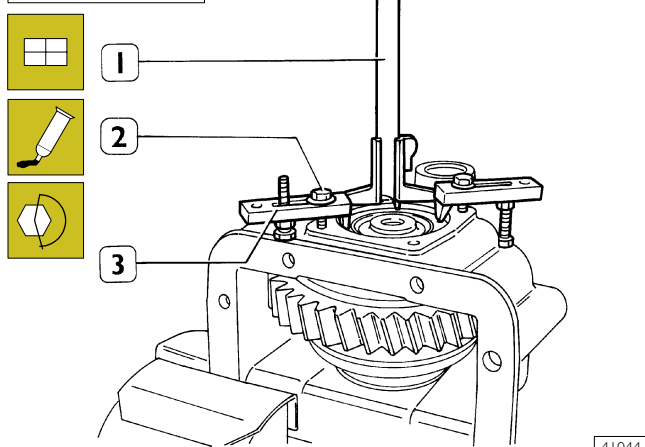
Fit the plates 99363241 (3) onto the outside ring of the bearing, tighten the screws (2) to torque 18 Nm (1.8 kgm) corresponding to an axial load of 250 kg, rotate the output shaft. Using a gauge (1) determine the distance between the contact surface and the outer ring of the bearing. The distance will correspond to the thickness of the setting ring.



The choice of the setting ring thickness must be approximate:

Example distance $6 \div 6.04 \text{ mm} = \text{setting ring } 6 \text{ mm}$
distance $6.05 \div 6.09 \text{ mm} = \text{setting ring } 6.1 \text{ mm}$

Figure 39



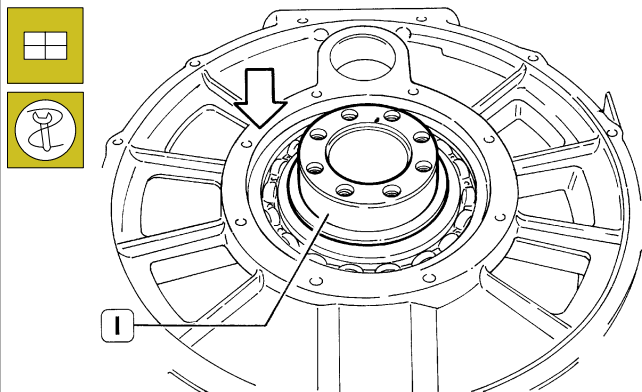
41044

Fit the setting ring (1), apply LOCTITE 510 sealant to the contact surface (2), fit the cover (3) and tighten the screws to torque 18 Nm (1.8 kgm)

Replace and fit the choke rings on the joints fit the safety split rings, screw on the transmitter (7).

Fitting the main housing

Figure 40

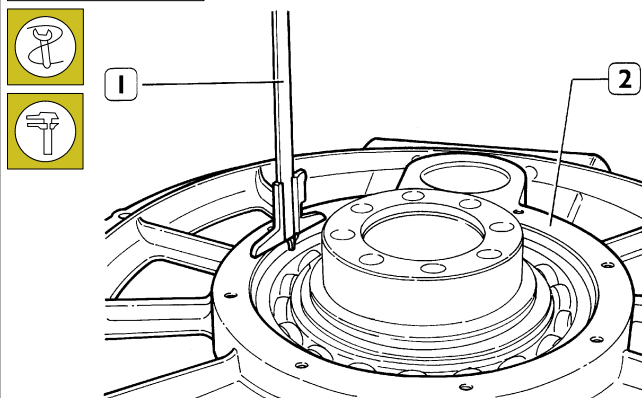


41045

Heat the seat (I) of the ball bearings slightly and fit the shaft with toothed crown (I) complete with bearings.

Setting the ball bearings

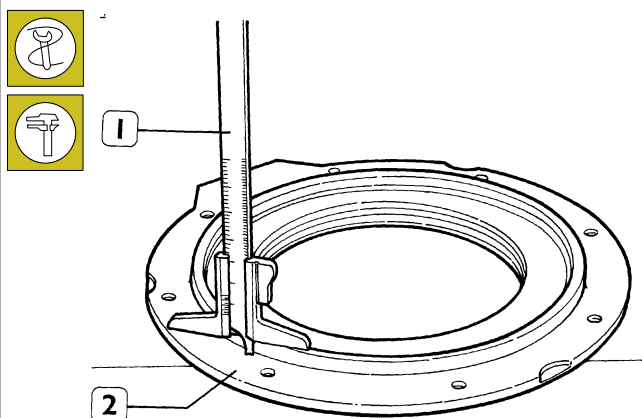
Figure 41



41046

Using a feeler gauge (I) determine the value (A, figure 39) on the main housing.

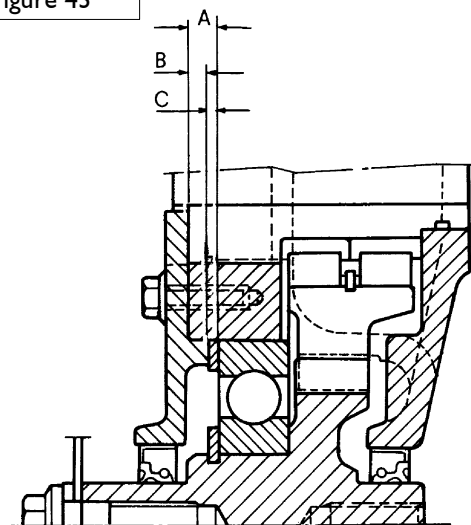
Figure 42



41047

Using a gauge (I) determine the value (B, figure 40) on the bearing cover (2).

Figure 43



41048

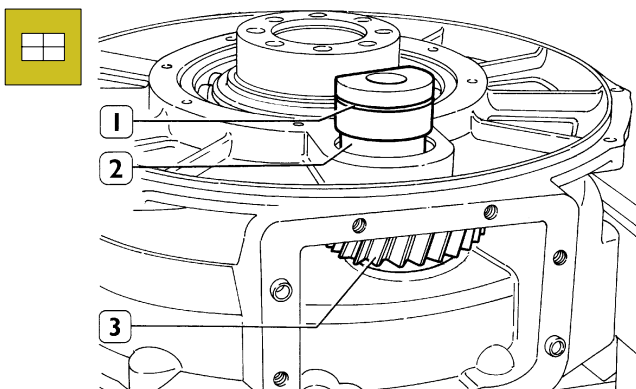
PARTIAL CROSS SECTION OF THE BEARING AND SHAFT WITH TOOTHED CROWN

The value "C" of the setting ring is given by the formula:
 $A - B = C$.



If the value "C" is equal to the nominal thickness of the setting ring (see table on page 6) fit the ring.
 If the value "C" is different fit a setting ring of a lower value.
 Example "C" = 4.14 mm ÷ 4.11, fit setting ring 4.1 mm.

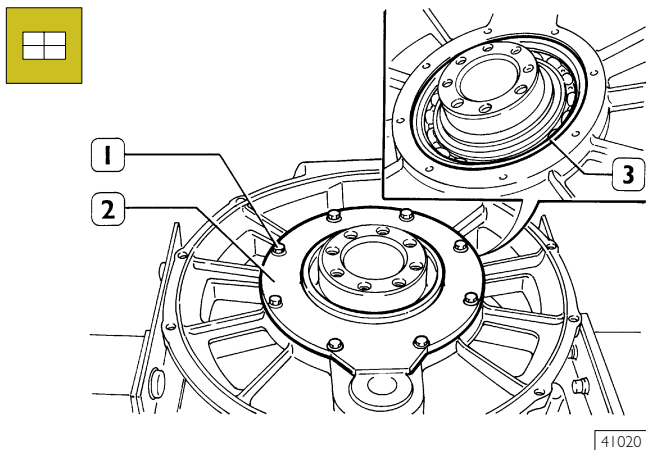
Figure 44



41049

Fit the return gear housing (3), replace the choke rings (1) and fit the gear housing (2).

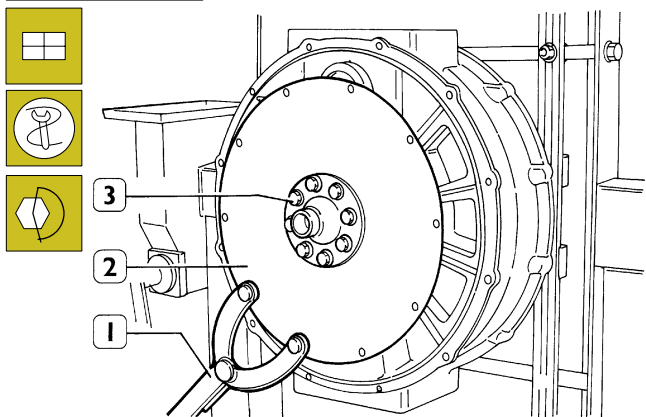
Figure 45



41020

Fit the setting ring (3), apply LOCTITE 510 sealant to the contact surface; fit the cover (2) complete with choke ring and tighten the screws to torque 22 Nm (2.2 kgm).

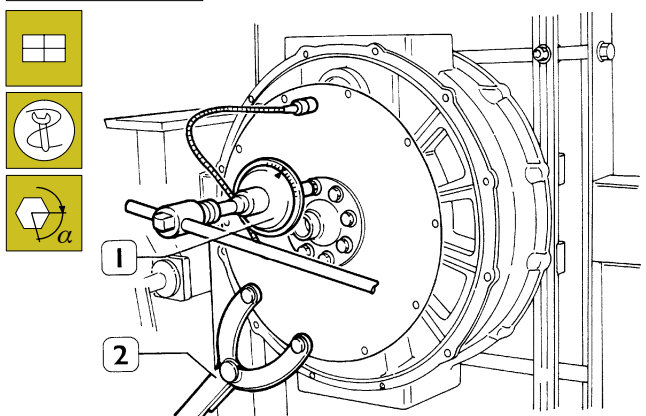
Figure 46



41019

Fit the plate joint (2) with the flange, block it using tool 99370317 (1) and tighten the screws to torque 95 Nm (9.5 kgm). 1st stage.

Figure 47



41050

Fit tool 99395216 (1) to a box spanner and tighten the screws by a further 60°, 2nd stage

MANUAL GEARBOX (ZF I6S I620 TD - ZF I6S 2320 TD)

SECTION 6

SECTION 6

Manual gearbox

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DESCRIPTION

The ZF I6S I620 and ZF I6S 2320 TD version consist of:

- ☐ a central box containing the primary shaft, drive input shaft, secondary shaft and the cogs of the four forward and one reverse gear;
- ☐ a rear casing containing the Epicyclical Reducer Group (G.R.E). The function of this is to double the number of forward gears by means of epicyclical gears with helical teeth.
This gives a range of gears that starting with four input ratios permits eight different output ratios (four normal ratio and four low ratio gears);
- ☐ a front casing containing the "splitter", that gives a further double selection for each of the eight forward gears and for the reverse gear.
The "splitter" halves the difference between two successive gears, effectively splitting each gear into a slow ratio (L = slow ratio) and a fast ratio (S = fast ratio).

These gearboxes therefore have a total of sixteen forward gears with finely scaled ratios, all engageable in succession, and two reverse gears.

The synchronisers are single cone type.

Lubrication is by means of a gear pump.

The double H type gear shift control is equipped with a pneumatically powered "servoshift" device to improve gear selection and engagement.

The servoshift is a device consisting of a mechanical/pneumatic functional unit and a dual action cylinder.

The advantages of this device are:

- ☐ gear selection and engagement more rapid and with less effort;
- ☐ it dampens the vibration of the control linkages, reducing noise;
- ☐ less strain to the synchronisers.

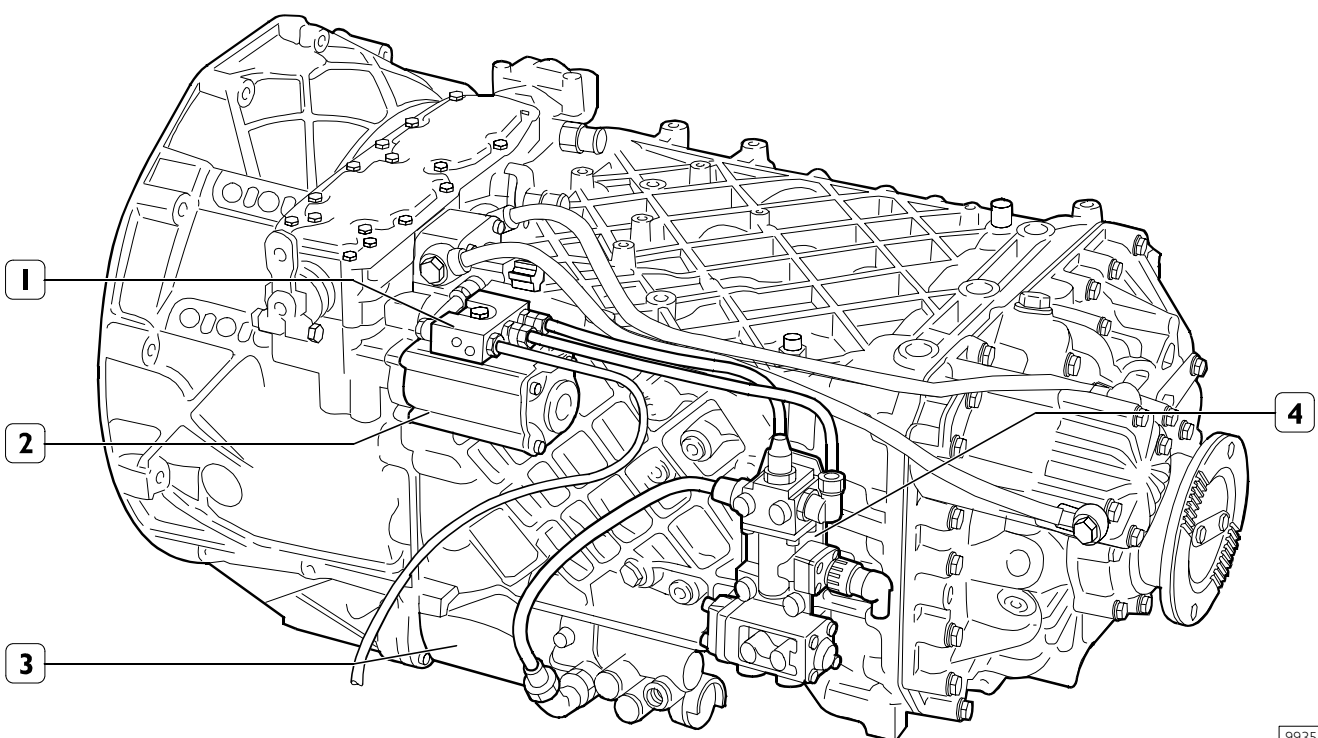
The device functions mechanically in case of pneumatic system failure.

The gearboxes mounted on vehicles with F3B engines are fitted with a synchro protection device.

This permits pneumatic power to the servoshift for gear engagement only after the clutch pedal has completed 70% of the disengagement stroke.

It consists of an electrovalve controlled by a proximity switch mounted on the clutch disengage master cylinder.

Figure 1

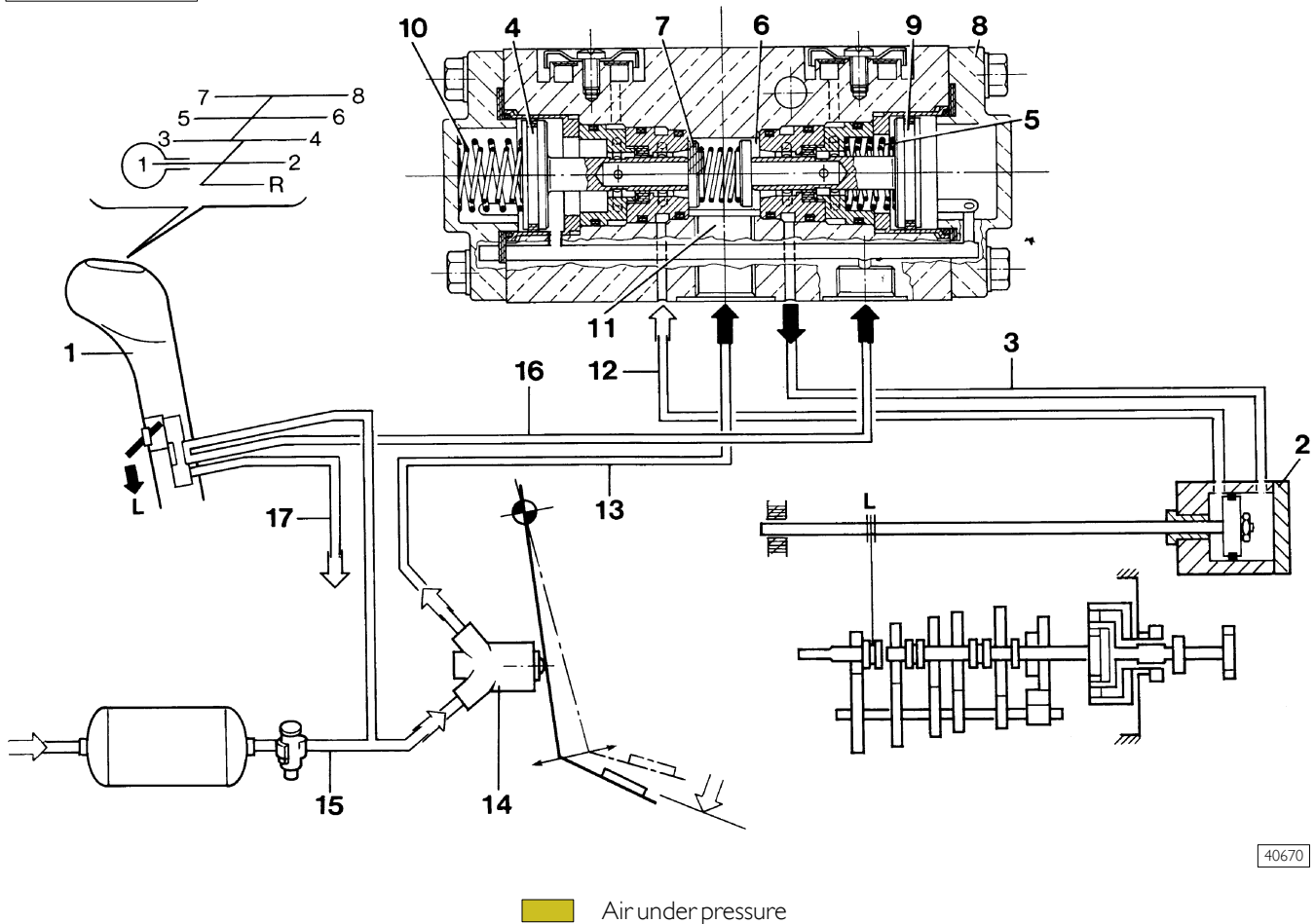


1. Distributor – 2. Servoshift – 3. Servoclutch – 4. *Servoshift power electrovalve

* only for vehicles with F3B engine

OPERATION SLOW RANGE

Figure 2



40670

PNEUMATIC DIAGRAM FOR SLOW RANGE PRESELECTION

The air coming from the tank, through the connecting pipe (15), feeds the control valve (14) and the preselector (1) at the same time.

Moving the preselector (1) downward (slow range) makes the air coming to the preselector (1) through the connecting pipe (16) feed the double acting valve (8). As it feeds the above valve (8), the air under pressure moves to the left the pistons (4 and 9). The move of pistons (4 and 9) enables the valve (7) returning to its seat and then releasing, via the connecting pipe (12), the air under pressure that was contained in the left chamber of the splitter control cylinder (2).

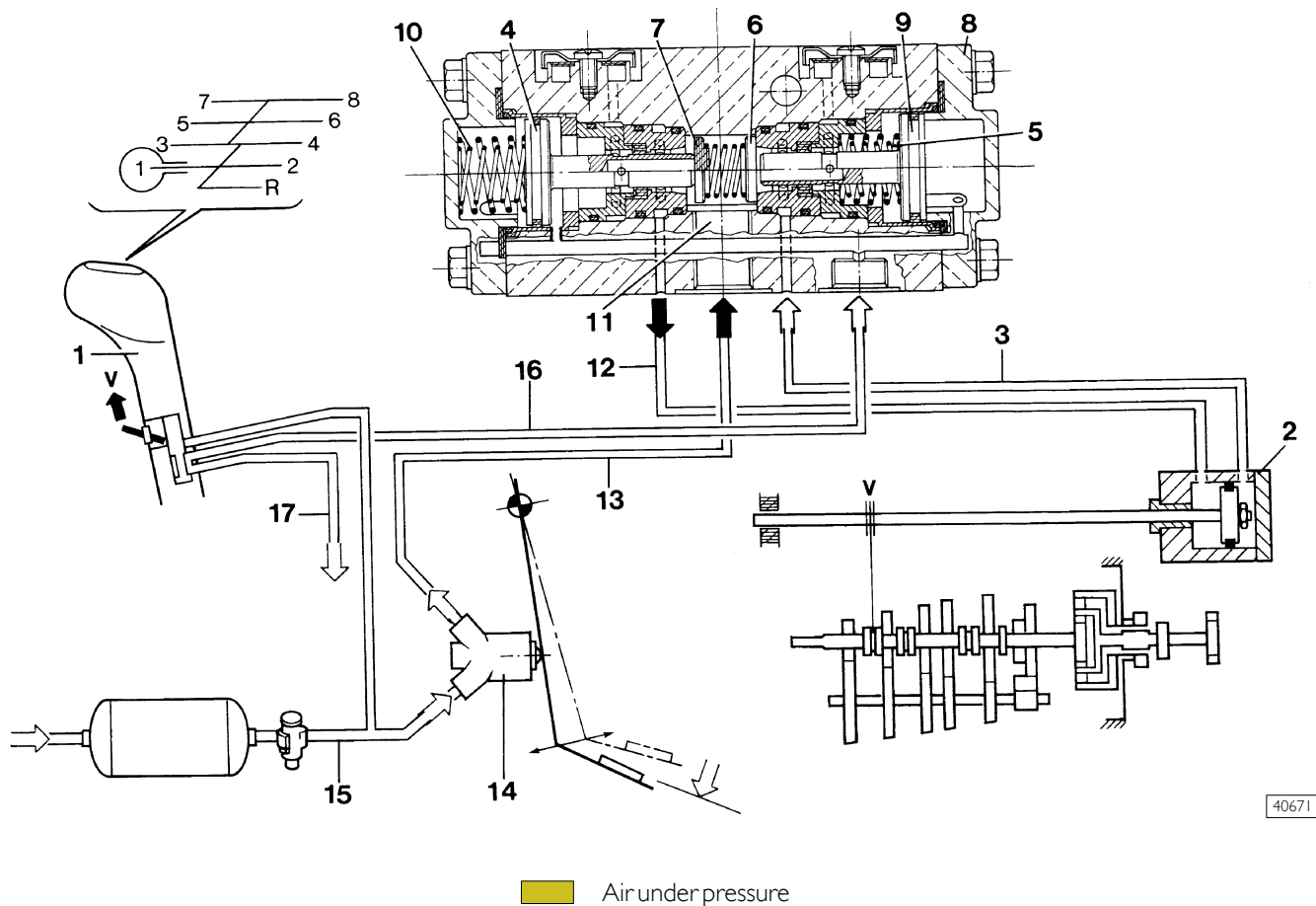
At the same time, valve (6) moves and opens the air ducting between the inlet duct (11) and the one (3) to connect the right chamber of the splitter cylinder (2).

Depressing the clutch pedal makes the air that comes to the control valve (14) through the connecting pipes (13) feed the double acting valve (8).

The air coming to the valve (8) goes through the inlet duct (11), it feeds, through the connecting pipe (3), the right chamber of the splitter cylinder (2) and moves the control piston to the left, thus engaging the slow range.

FAST RANGE

Figure 3



PNEUMATIC DIAGRAM FOR FAST RANGE PRESELECTION

The air coming from the tank, through the connecting pipe (15), feeds the control valve (14) and the preselector (1) at the same time.

Moving the preselector (1) upward (fast range) cuts the air flow between the feeding pipe (15) and the double acting valve (8), thus the connecting pipe (16) enters into communication with the exhaust pipe (17).

As a consequence of the air release from the double acting valve (8), the springs (10) and (5) move the pistons to the right. The move of pistons (4 and 9) enables the valve (6) returning to its seat and then releasing, via the connecting pipe (3), the

air that was contained in the left chamber of the splitter control cylinder (2).

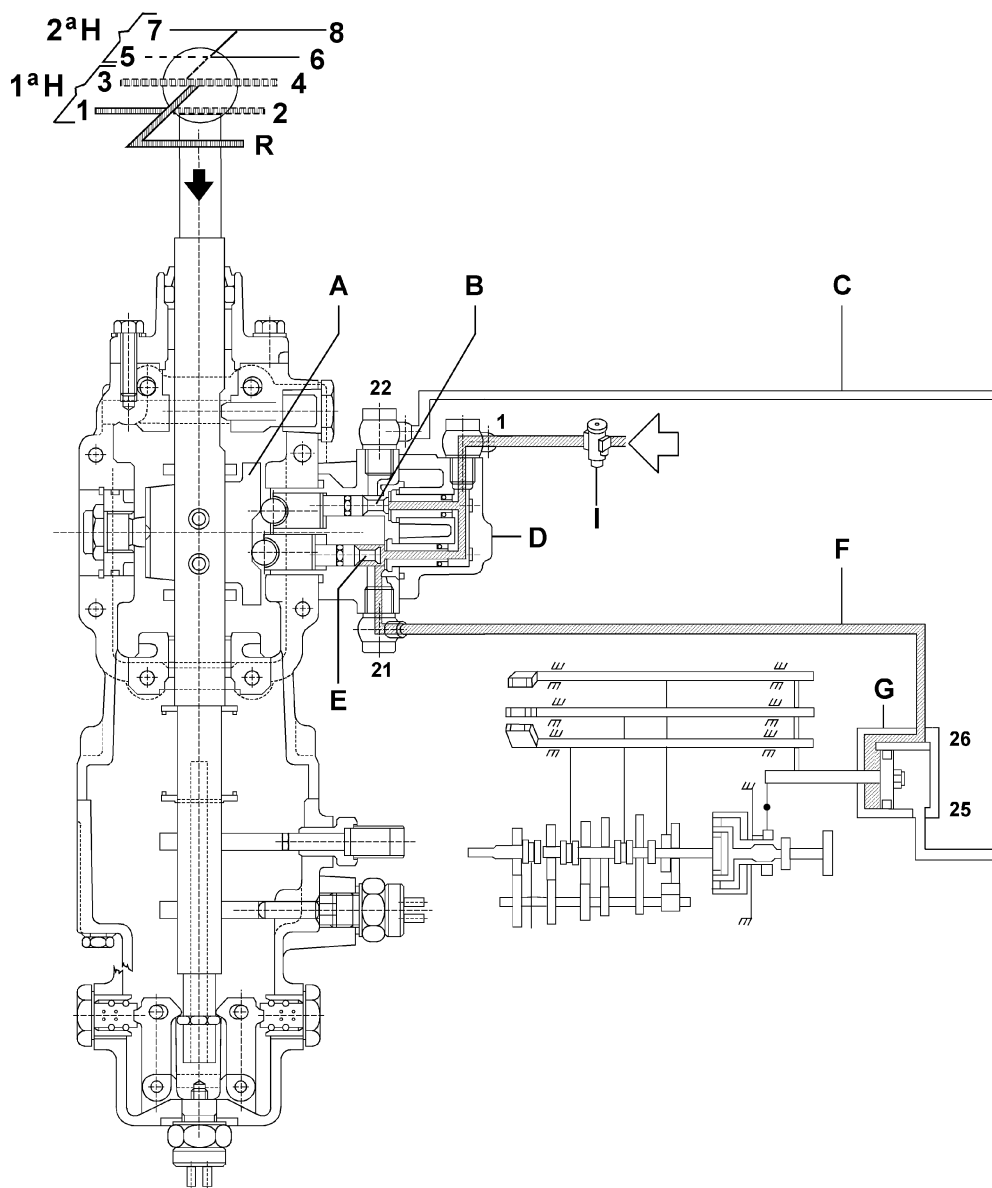
At the same time, valve (7) moves and opens the air ducting between the inlet duct (11) and the one (12) to connect the left chamber of the splitter cylinder (2).

Depressing the clutch pedal makes the air that comes to the control valve (14) through the connecting pipes (13) feed the double acting valve (8).

The air coming to the valve (8) goes through the inlet duct (11), it feeds, through the connecting pipe (12), the left chamber of the splitter cylinder (2) and moves the control piston to the left, thus engaging the fast range.

REDUCED GEARS

Figure 4



000084t

 Air under pressure

GRAPHIC REPRESENTATION OF THE PNEUMATIC SYSTEM TO CONTROL THE ENGAGEMENT OF REDUCED GEARS

The air coming from the tank, through the reduction unit, reaches the pressure of 9.5 bar, then it feeds the control valve (D). Now, if we move the control lever to reduced gear position, the body (A) integral with the gear control rod opens the valve (E) that feeds the cylinder (G) through the pipe (F). The piston of this cylinder, when moving to the right, controls the kinematic chain downstream, thus enabling the engagement of the selected gear.

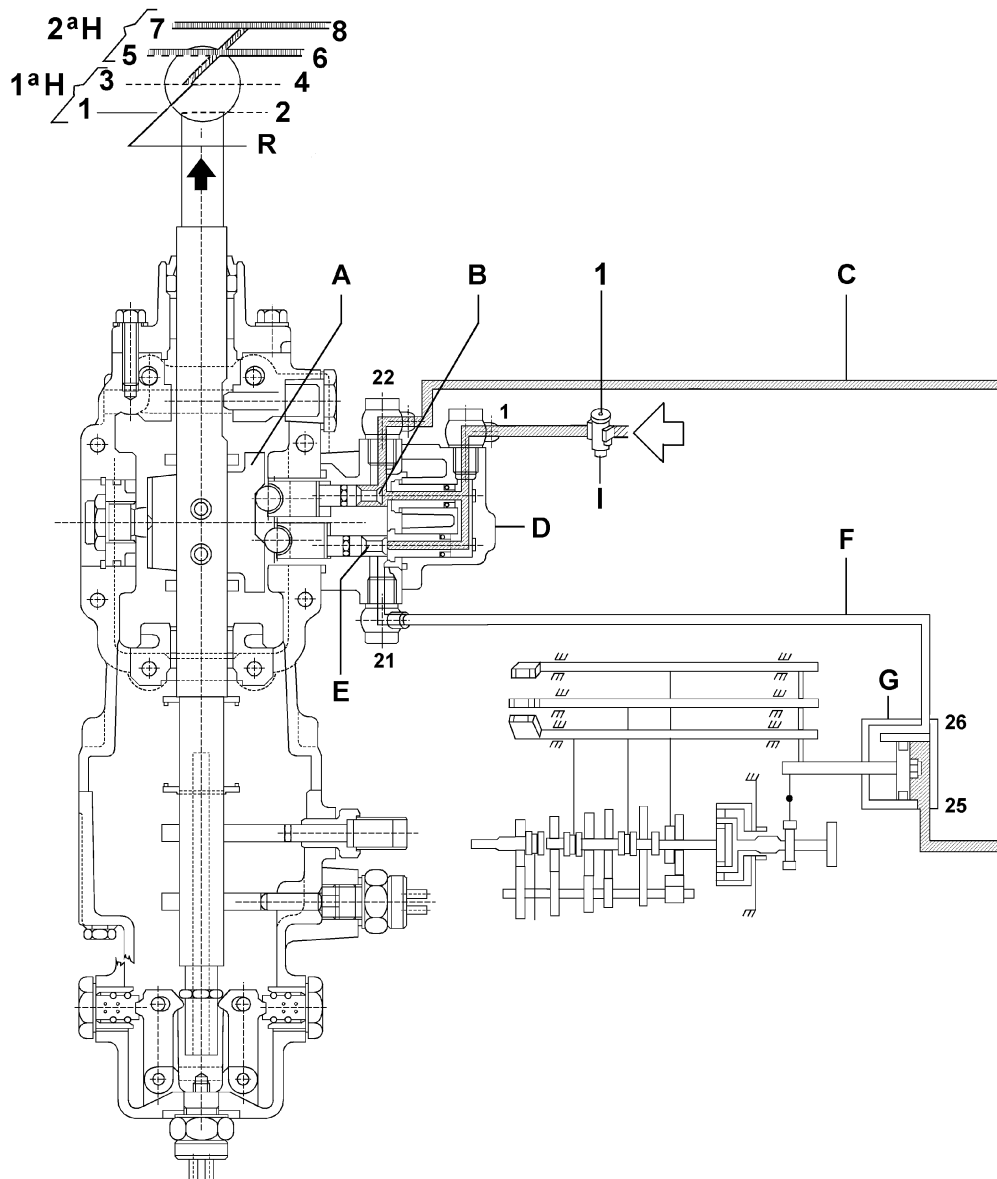
At the same time, the valve (B) of the control valve (D) closes, which enables the air coming from the pipe (C) to release to the atmosphere.



Reduced speeds can be selected in both fast and slow range according to the preselection position.

NORMAL GEARS

Figure 5



000085t

 Air under pressure

GRAPHIC REPRESENTATION OF THE PNEUMATIC SYSTEM TO CONTROL THE ENGAGEMENT OF NORMAL GEAR

The air coming from the tank, through the reduction unit, reaches the pressure of 9.5 bar, then it feeds the control valve (D). Now, if we move the control lever to normal gear position, the body (A) integral with the gear control rod opens the valve (B) that feeds the cylinder (G) through the pipe (C). The piston of this cylinder, when moving to the left, controls the kinematic chain downstream, thus enabling the engagement of the selected gear.

At the same time, the valve (E) of the control valve (D) closes, which enables the air coming from the pipe (F) to release to the atmosphere.



Normal speeds can be selected in both fast and slow range according to the preselection position.

Figure 6

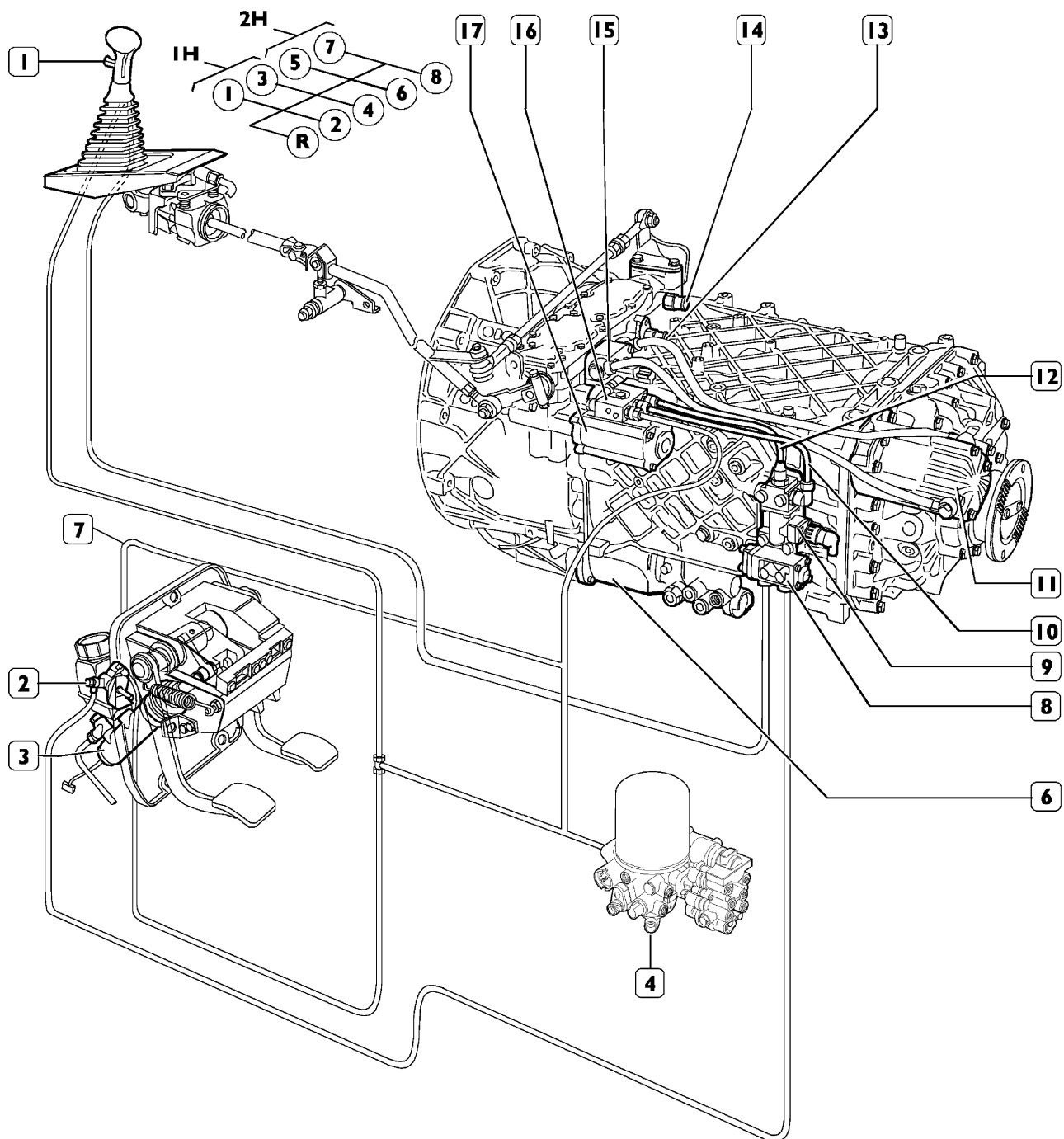


DIAGRAM OF PNEUMATIC COMMAND FOR GEARBOX WITH SERVOSHIFT

1. Splitter control selector - 2. Enable valve - 3. Master cylinder with proximity switch - 4. Pressure reducer - 5. Not used - 6. Clutch actuator - 7. Servoclutch feed pipe - 8. Two-way valve - 9. Electrovalve - 10. Pipe - 11. Epicyclic reducer group command cylinder - 12. Pipe - 13. Neutral indicator switch - 14. Pipe - 15. Command valve - 16. Distributor - 17. Servoshift

The splitter control (slow range gears – fast range gears) and the epicyclic reducer group control is pneumatic and built-in to the gearshift lever.

The selector (1) is used to preselect the L range (slow) and B range (fast) by means of the two-way control valve (8). These are engaged through the enable valve (2) when the clutch pedal is pressed.

The epicyclic group engages or disengages automatically when shifting from 1 H to 2 H and vice-versa.

When the gearbox is in neutral, the command cylinder (11) is actuated by pressurised air through the command valve (15).

Through the APU (4) the vehicle pneumatic system powers the distributor (16).

Through the pipe (10) the distributor (16) powers the electrovalve (9), which in turn powers the clutch actuator (6) through pipe (7), and the servoshift (17) through pipe (12), when enabled by the proximity switch mounted on the master cylinder (3). The proximity switch enables the electrovalve (9) when the clutch pedal has completed 70% of the clutch disengage stroke.

A switch (14) on the transmission control activates the reversing light when reverse gear is engaged. The neutral indicator switch (13) is on the transmission control cover. Another switch on the epicyclic reducer group command cylinder (11) switches on the warning light in the cabin (with turtle ideogram), when the epicyclic reducer is engaged.

Servoshift

The servoshift is a device consisting of a mechanical/pneumatic module and a double-acting cylinder.

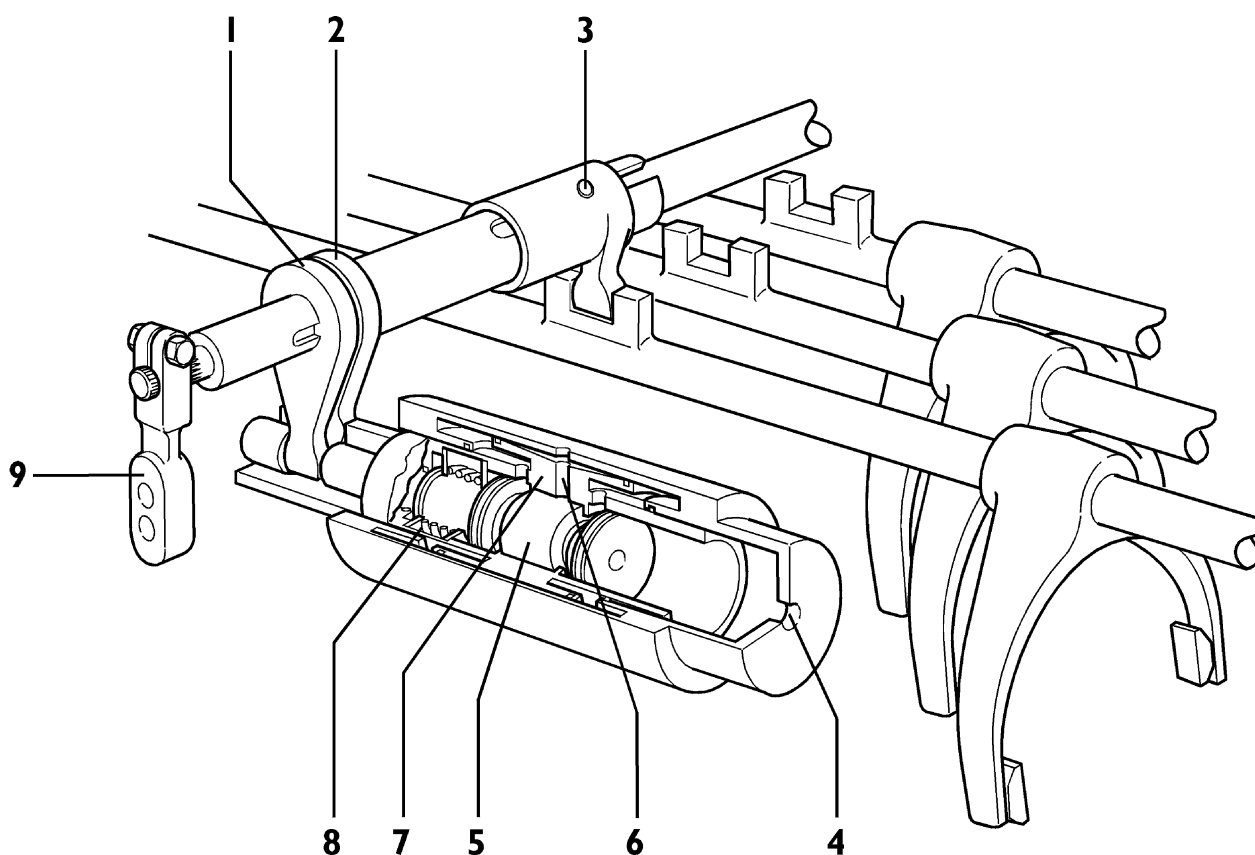
It operates during the engagement of the separate gears in the longitudinal movement of the gear control lever.

When the clutch is pressed to change gear, air under pressure is sent through the pneumatic servo clutch to the servoshift device inlet union (6).

The piston (5), moved by the valve control lever (1), feeds compressed air to the cylinder (7) which turns the gear engagement lever (2) in the same direction as the driver in the cab moves the tie-rod mounting lever (9) through the gear lever, making the axial movement of the gear engagement rod easier.

At the end of the useful stroke the discharge gap (4) is opened and the manoeuvre finishes, whilst a thrust spring (8) brings the device to neutral position.

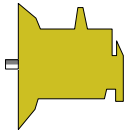
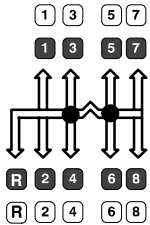
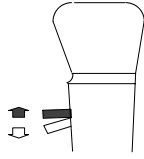
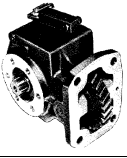
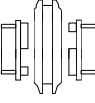
Figure 7



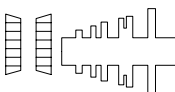
61225

1. Control valve lever - 2. Gear engagement lever - 3. Driving roller - 4. Exhaust union - 5. Piston - 6. Feed union - 7. Cylinder - 8. Thrust spring - 9. Gear tie-rod mounting lever.

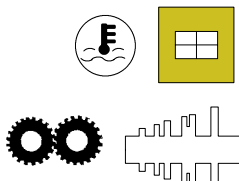
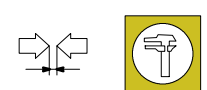
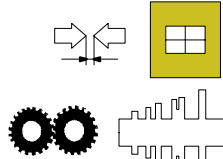
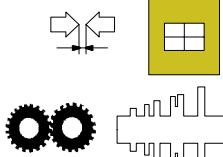
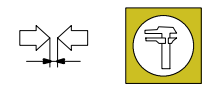
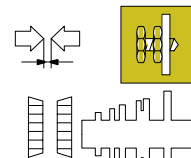
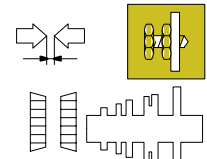
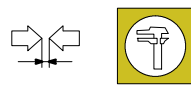
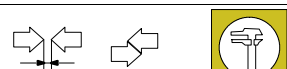
SPECIFICATIONS AND DATA

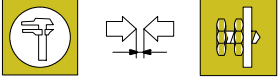
	Type	ZF 16 S 1620 TD	ZF 16 S 2320 TD
	Gears	16 Forward and 2 Reverse Gear	
	Control for 4 main speeds E.R.U* control Splitter control	Mechanical Pneumatic Pneumatic	
	PTO	On request	
	Gear engagement: Forward gear Gear change without servoshift Gear change with servoshift Reverse gear Anti gear-slip	Type BK single cone 1 st – 2 nd – 3 rd - 4 th -5 th - 6 th speed Quick coupling Sliding sleeves restrained by pawls and springs	
	Type of gears	Helical toothing	

E.R.U* = epicyclic reduction gear unit

		ZF 16 S 1620 TD	ZF 16 S 2320 TD																																																						
	Gear ratios: <table><tr><td>First</td><td>{ L</td><td>1 : 16.47</td></tr><tr><td></td><td>{ S</td><td>1 : 13.79</td></tr><tr><td>Second</td><td>{ L</td><td>1 : 11.32</td></tr><tr><td></td><td>{ S</td><td>1 : 9.48</td></tr><tr><td>Third</td><td>{ L</td><td>1 : 7.79</td></tr><tr><td></td><td>{ S</td><td>1 : 6.52</td></tr><tr><td>Fourth</td><td>{ L</td><td>1 : 5.48</td></tr><tr><td></td><td>{ S</td><td>1 : 4.58</td></tr><tr><td>Fifth</td><td>{ L</td><td>1 : 3.59</td></tr><tr><td></td><td>{ S</td><td>1 : 3.01</td></tr><tr><td>Sixth</td><td>{ L</td><td>1 : 2.47</td></tr><tr><td></td><td>{ S</td><td>1 : 2.07</td></tr><tr><td>Seventh</td><td>{ L</td><td>1 : 1.70</td></tr><tr><td></td><td>{ S</td><td>1 : 1.42</td></tr><tr><td>Eighth</td><td>{ L</td><td>1 : 1.20</td></tr><tr><td></td><td>{ S</td><td>1 : 1.00</td></tr><tr><td>Reverse</td><td>{ L</td><td>1 : 15.42</td></tr><tr><td></td><td>{ S</td><td>1 : 12.91</td></tr></table> (L = Slow speed F = Fast speed)	First	{ L	1 : 16.47		{ S	1 : 13.79	Second	{ L	1 : 11.32		{ S	1 : 9.48	Third	{ L	1 : 7.79		{ S	1 : 6.52	Fourth	{ L	1 : 5.48		{ S	1 : 4.58	Fifth	{ L	1 : 3.59		{ S	1 : 3.01	Sixth	{ L	1 : 2.47		{ S	1 : 2.07	Seventh	{ L	1 : 1.70		{ S	1 : 1.42	Eighth	{ L	1 : 1.20		{ S	1 : 1.00	Reverse	{ L	1 : 15.42		{ S	1 : 12.91		
First	{ L	1 : 16.47																																																							
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Reverse	{ L	1 : 15.42																																																							
	{ S	1 : 12.91																																																							
 (*)	Quantity (after revision,)	11 liter (9.8 kg)	13 liter (11.6 kg)																																																						
	Main and transmission shaft bearings	tapered rollers																																																							
 	Assembling temperature for output flange	70 °C Max.																																																							
   	Assembling temperature for transmission shaft gears	160 ÷ 180 °C																																																							

(*) See Section 2 - LUBRICANT AND HYDRAULIC FLUID TABLE for the required type of fluid.

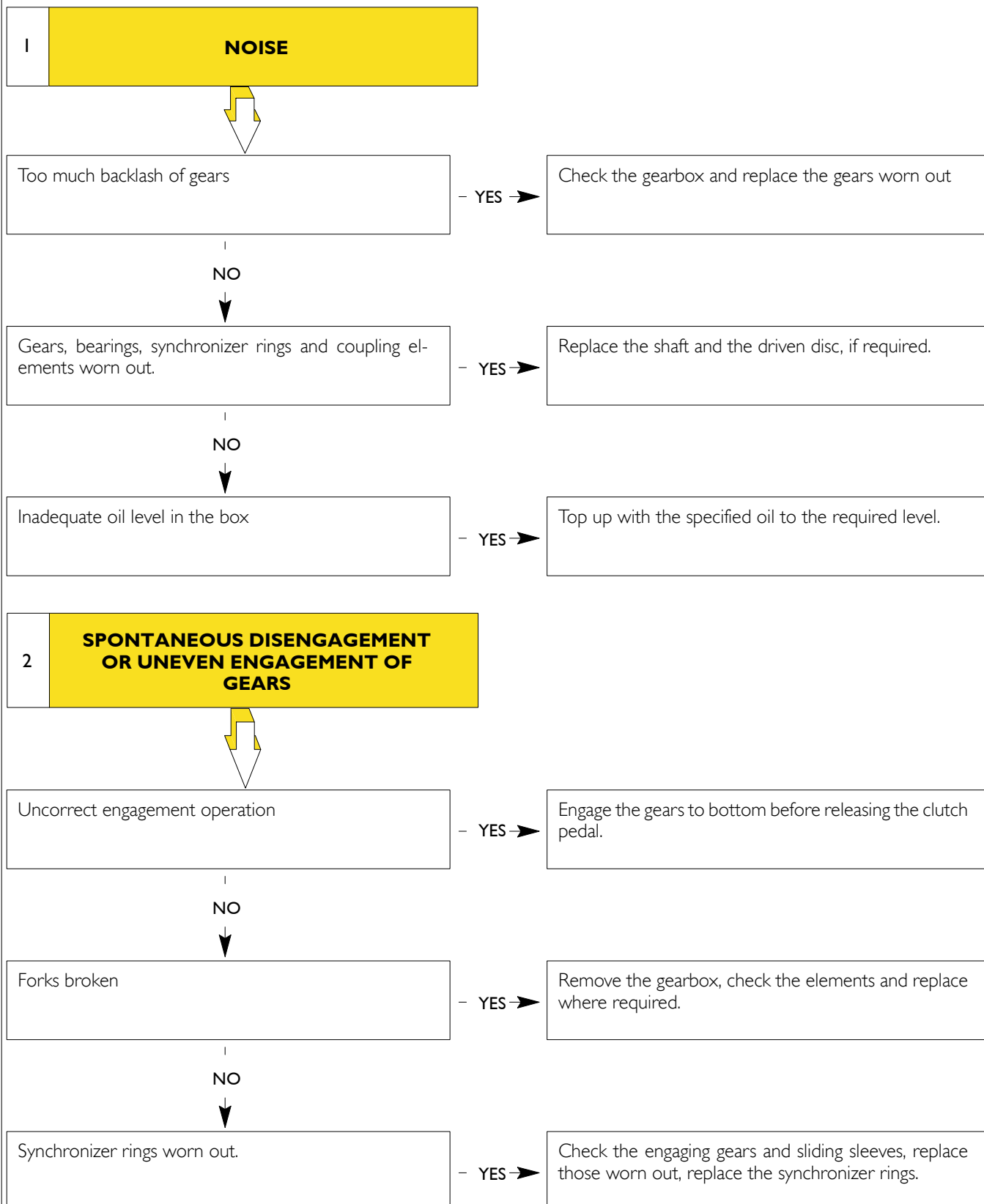
		ZF 16 S 1620 TD	ZF 16 S 2320 TD
	Assembling temperature for fixedhubs and main/transmission shaft bearings	100 °C	
	Axial backlash: bearing in the E.R.U* spider shaft split ring in the fixed hub of the E.R.U* split ring of the transmission shaft bearing	$0 \div 0.1 \text{ mm}$	
	Axial backlash for input shaft, first, 2nd and 3rd speed gear:	$> 0.2 \text{ mm}$	
	Axial backlash for 4th speed gear:	$> 0.05 \text{ mm}$	
	Axial backlash between spider shaft and planetary gears in the E.R.U*	$0.4 \div 1.3 \text{ mm}$	
	Axial backlash for the bearings in main and transmission shafts at input side.	$0.0 \div 0.1 \text{ mm}$	
	Axial backlash for the rear bearing split ring of the main shaft.	$0.0 \div 0.05 \text{ mm}$	
	Value to check wear of: synchronizing rings for: - 1st/2nd speed - 3rd/4th speed - E.R.U.*	1.5 mm to 50 Nm (5 kgm) 0.8 mm 1.2 mm	
	Axial backlash for the reverse speed transmission gear	$0.4 \div 1.5 \text{ mm}$	
	Axial backlash or preloading for the halfriings in main and driving shafts.	$- 0.05 \text{ to } + 0.05 \text{ mm}$	

		ZF 16 S 1620 TD	ZF 16 S 2320 TD
	Value to adjust clearance of the splitter control fork sliding shoes on the relevant sliding sleeve	94.1 mm	107.9 mm
	Clearance for the sliding shoes of forks in the seats in the moving sleeves.	0.6 ÷ 1.2 mm	
	Value to fit in place the two-lip retaining ring on the rear cover.	12.5 + 1.0 mm	

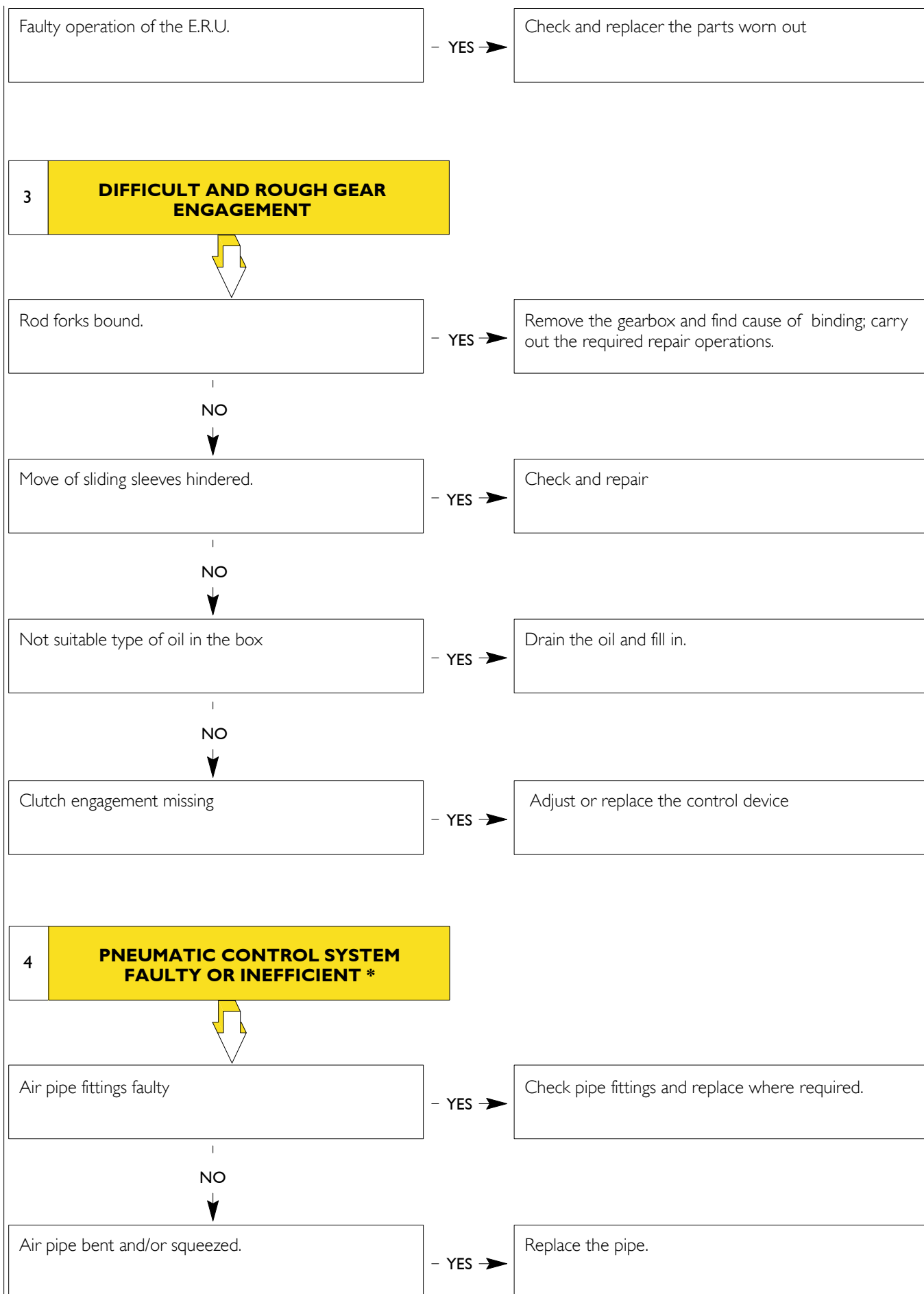
DIAGNOSTICS

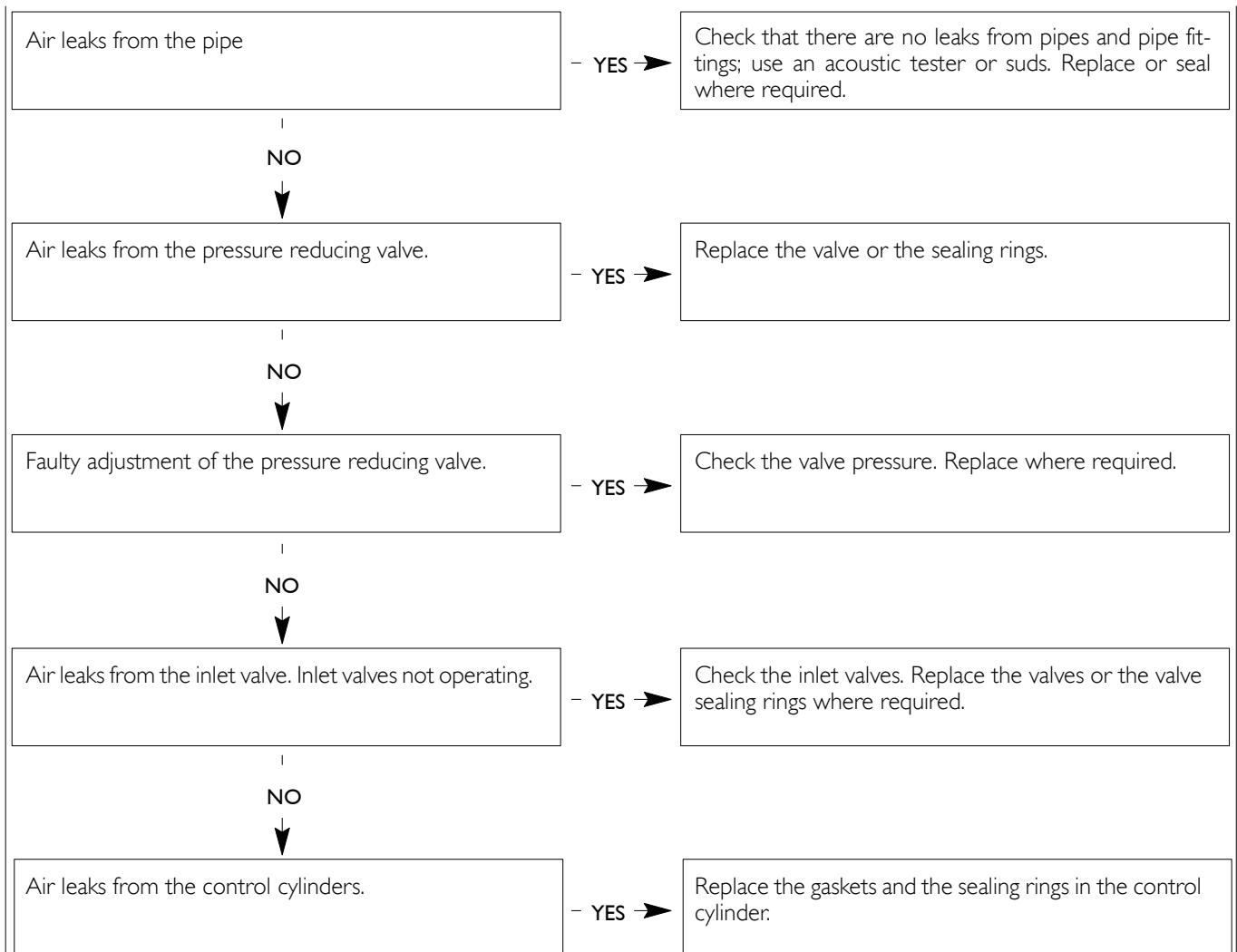
Main operating troubles of the gearbox are the following:

- 1 - Noise
- 2 - Spontaneous speed disengagement and uneven engagement
- 3 - Difficult and rough speed engagement
- 4 - Faulty or inefficient Pneumatic system



(continue)

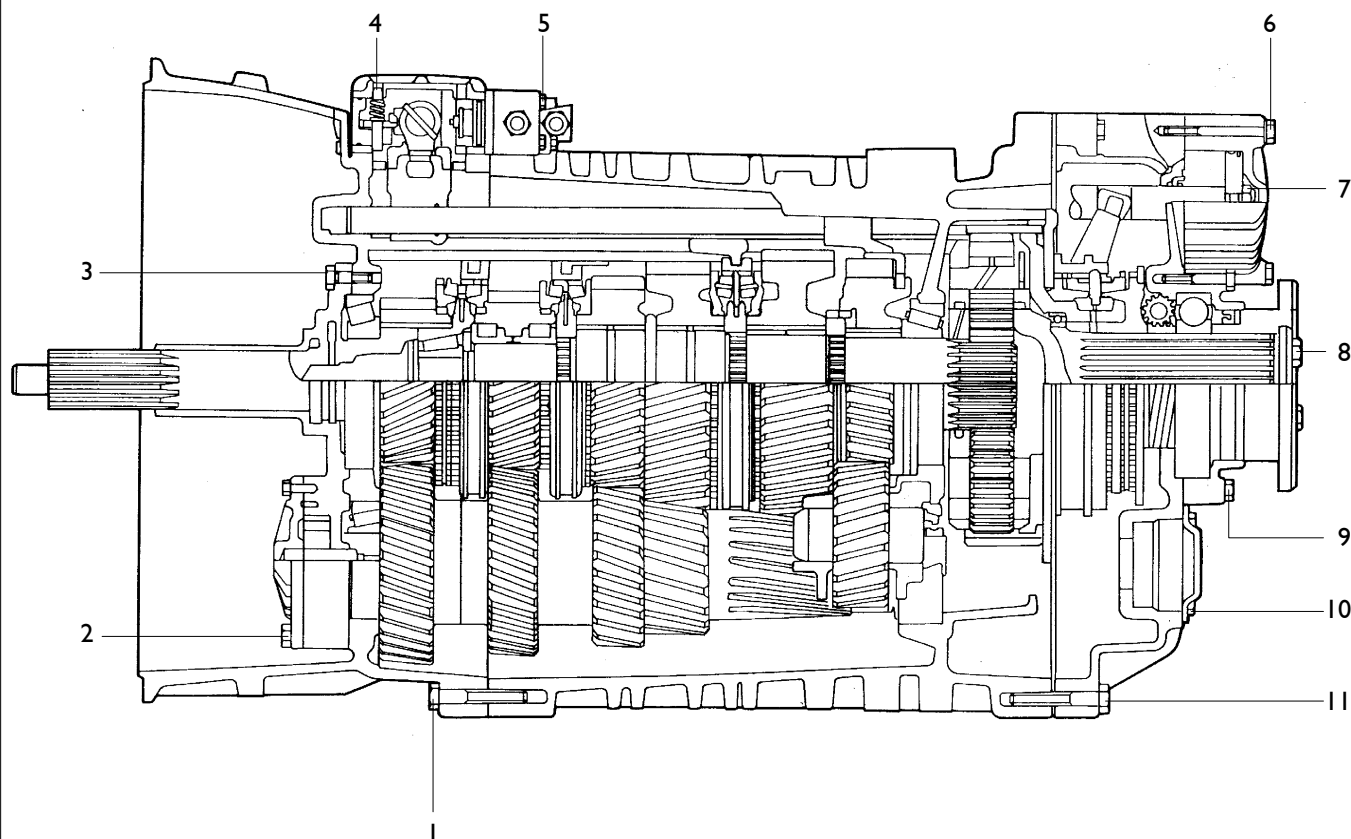




* Checks are to be carried out with the engine off and air tanks filled up.

TIGHTENING TORQUES

Figure 8



39402

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	Fastening screws for splitter box	49	4.9
2	Fastening screws for oil pump	46	4.6
3	Fastening screws for input shaft cover	46	4.6
4	Fastening screws for the gearbox	43	4.3
5	Fastening screws for the valve to the gearbox	23	2.3
6	Fastening screws for the E.R.U.* cylinder case	50	5.0
7	Self-locking nuts to secure splitter control rods and E.R.U.* to relevant pistons	150	15.0
8	Fastening screws for output flange	120	12.0
9	Fastening screws for rear cover	49	4.9
10	Fastening screws for power takeoff pre-arrangement cover:	79	7.9
11	Fastening screws for E.R.U.* case	49	4.9
	* E.R.U. = epicyclic reduction gear unit		
	◆ Apply "Loctite 241"		

	DESCRIPTION	TORQUE	
		Nm	Kgm
	Fastening screws for clutch thrust bearing control fork	150	15.0
	Securing screws:		
	- M 18 x 1.5	35	3.5
	- M 22 x 1.5	50	5
	- M 24 x 1.5	60	6
	Oil vapours vent	10	1
	Rod positioning push rods	50	5
	Screw for reverse gear shaft plate (if applied)	86	8.6
	Screw securing fork on splitter control rod	60	6
	Fastening screws for reverse speed gearbox lower cover	49	4.9
	Fastening screws for gearbox side cover	23	2.3
	Pipe fastening screws	35	3.5
	Oil draining plugs	80	8.0
	Oil draining plugs with magnetic filter	140	14.0
	Pulse sender	50	5.0
	Oil pump screws	46	4.6
	Switch on the control box	35	3.5
	Fastening screws for splitter control valve	9.5	0.9
	Nut for the screw to secure the lever to the gear selector rod	49	4.9
	Screw pin for the E.R.U* control fork	250◆	25◆
	* E.R.U = epicyclic reduction gear unit		
	◆ Apply "Loctite 241"		

TOOLS

TOOL NO.	DESCRIPTION
99322205	Revolving stand for overhaul of units
99322225	Holder (to use with stand 99322205)
99340205	Percussion puller
99341003	Puller
99341004	Puller
99341012	Pair of brackets
99341015	Clamp
99341019	Tie rods for grips
99341020	Tie rods for grips
99341021	Tie rods for grips
99341022	Grips
99341024	Grips
99341025	Grips
99345058	Thrust block for pullers
99345092	Thrust block for pullers
99347092	Pin to remove the dowels in the front and rear case of the gear box (to use with 99340205).
99360502	Rings to disassemble and re-assemble the reduction gear unit
99360515	Tool to remove and fit in place main shaft, transmission shaft and fork unit
99370006	Handle for interchangeable drivers.
99370007	Handle for interchangeable drivers
99370113	Driver to fit in place the gasket and/or bushes on the gear selection cover
99370415	Base for test indicator to adjust transmission shaft bearings (to use with 99370006).
99370420	Connecting implement to fit gasket in gearbox front cover (to use with 99370006).
99370449	Main shaft lifting hook.
99370450	Splitter control fork adjusting tool
99370465	Tool to secure safety plates.
99370629	Device to hold the gearbox during fitting into place/removal from the vehicle.
99371050	Brackets to hold the gearbox during overhaul (use with 99322205-99322225)
99374093	Driver to fit in place the outer tracks of bearings (use with 99370007).
99374221	Connecting implement to fit grommet on rear cover.
99374370	Connecting implement to fit in place the oil spreader to direct drive shaft (use with 99370006).
99395604	Gauge (0-10 mm).

GEARBOX REMOVAL - REFIT

Removal

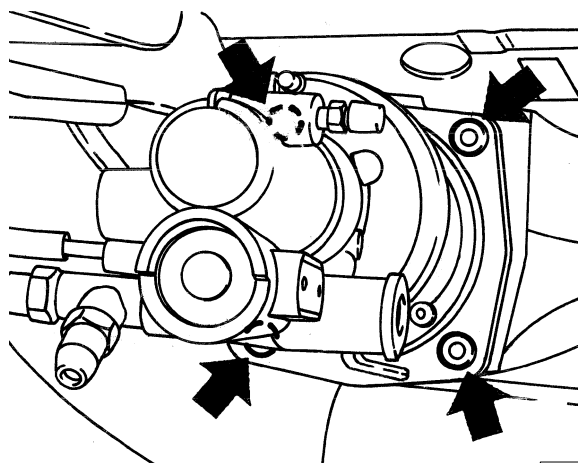
To remove the unit, proceed as follows:

- ☐ place the vehicle over a pit or on a car lift;
- ☐ open the battery box and disconnect the cables to avoid any risk of short-circuits;
- ☐ tip the cab;
- ☐ disconnect the power take off hydraulic and electrical connections and any relevant user mounted on the gearbox;
- ☐ unscrew the propeller shaft flange securing screws (14) and remove the shaft following the instructions in Section 10;
- ☐ prepare an appropriate container and drain off the power steering circuit following the instructions in Section 15 (only for the 4-axle version);
- ☐ disconnect the power steering oil delivery and return pipes from the auxiliary pump (25) (only for 4-axle version);



The disposal of waste or residual fluid on unauthorised sites or in the public sewer system is prohibited.

Figure 9



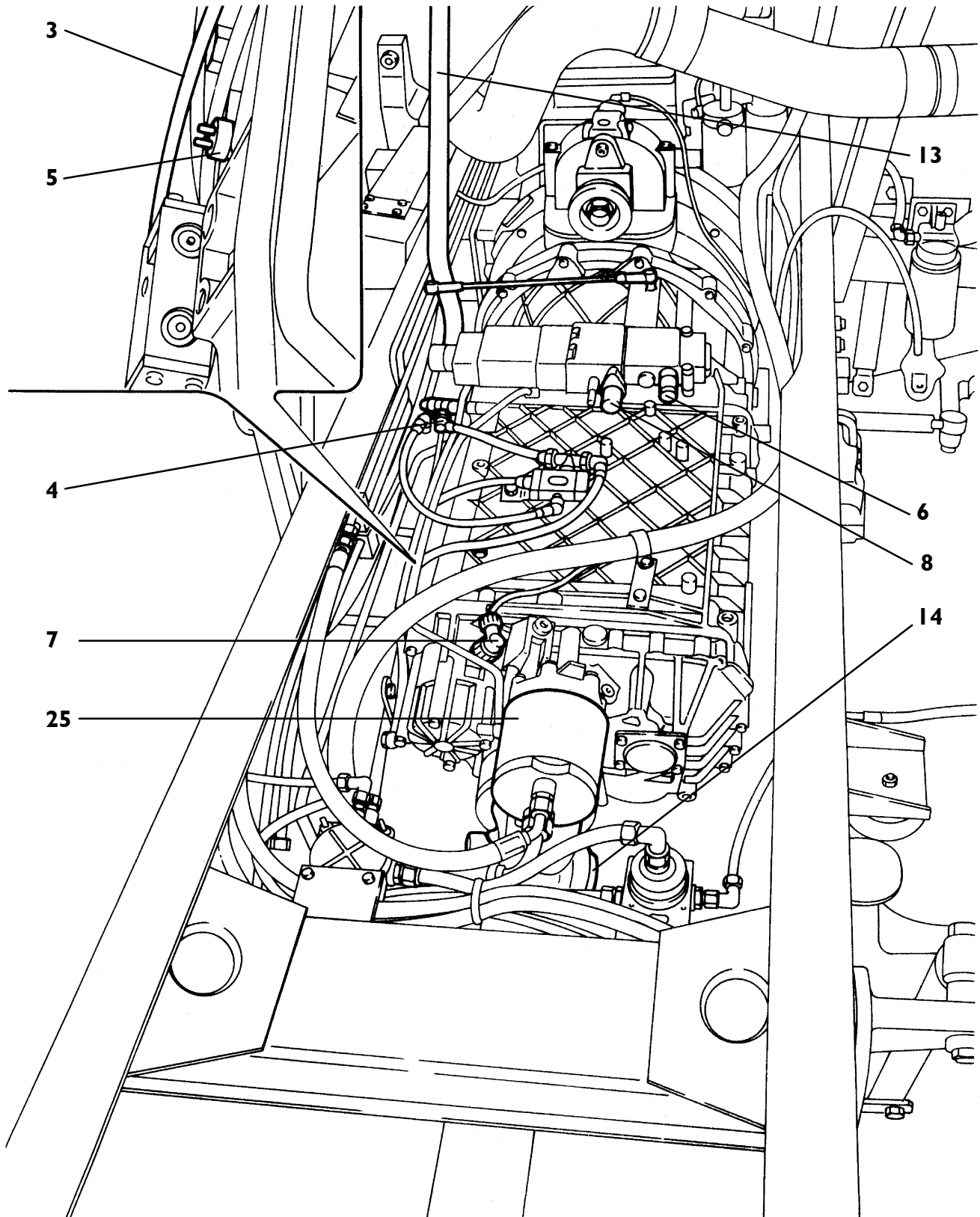
- ☐ unscrew the servo clutch securing screws (arrow) and remove it from the gearbox, securing it for the moment to the chassis;

- ☐ disconnect the gear selection linkage (13);
- ☐ disconnect the following pneumatic controls:
 - splitter control (3);
 - range selection control (4);
- ☐ disconnect the following electrical connections:
 - splitter ON indicator (5)
 - reverse gear switch (6)
 - slow gear range ON indicator (7)
 - idling position indicator (8);
- ☐ appropriately support the unit, then unscrew the screws securing it to the engine. Move the unit backwards to free the main shaft from the clutch and remove the unit from the bottom.

Refit

Repeat the removal operations in reverse order.

Figure 10



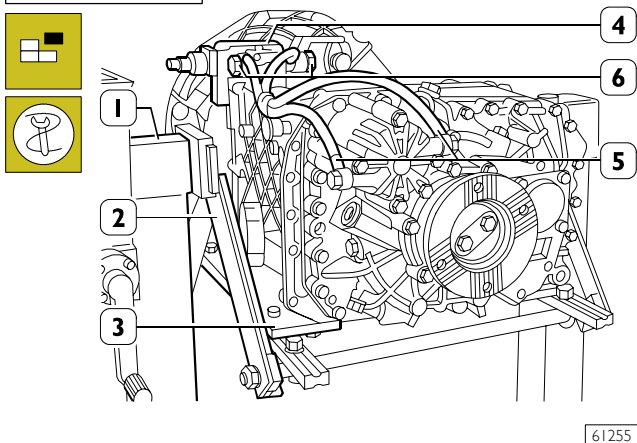
OVERHAULING OPERATIONS

Preliminary operations



The description that follows refers to the overhaul of gearbox ZF 16 S 151. Unless stated otherwise, this is also valid for gearbox ZF 16 S 221.

Figure 11



Thoroughly wash the gearbox externally and drain the oil off into an appropriate container.



To dispose of the lubricant and detergents attain to the specific standards.

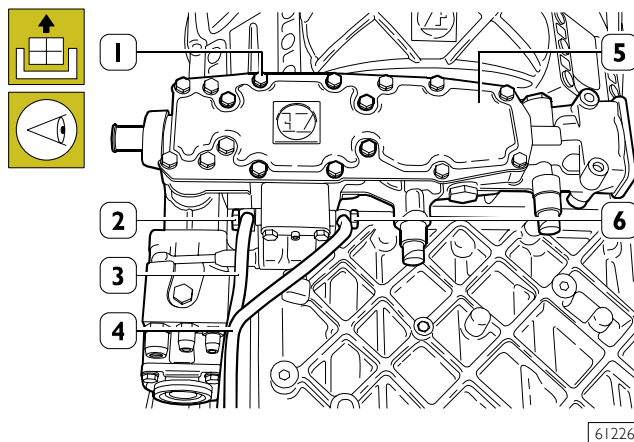
Apply supporting bracket 99371031 (3) to the unit. Use hooked cables and mobile hoist to place the assembly on revolving stand 99322205 (1) fitted with support 99322225 (2).



Correct tools are to be used for gearbox repair operations. In order to facilitate re-fitting operations, it is recommended that all parts are put down in disassembling order.

Removal gear command box

Figure 12

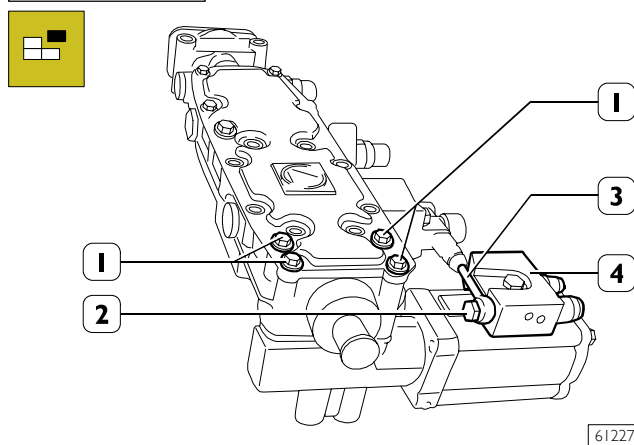


Mark the assembly positions of the pipes (3 and 4) and disconnect them from the gearshift box (5), unscrewing the unions (2 and 6) with the seal washers. Unscrew the securing screws (1) and remove the gearshift box (5) with the servo shift from the gearbox.



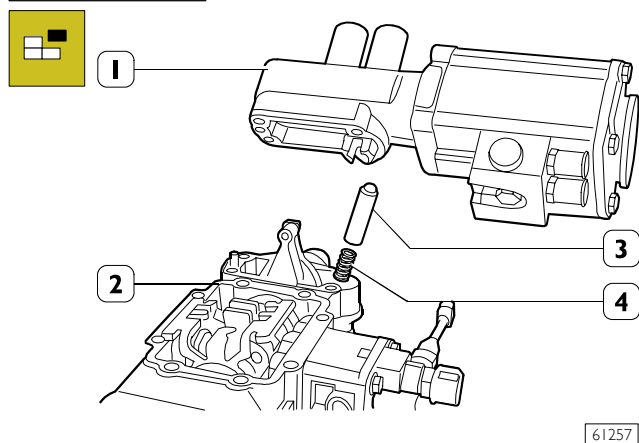
The servo shift device cannot be overhauled. If faults are found, replace it.

Figure 13



Unscrew the union (2) and disconnect the air hose (3) from the distributor (4).

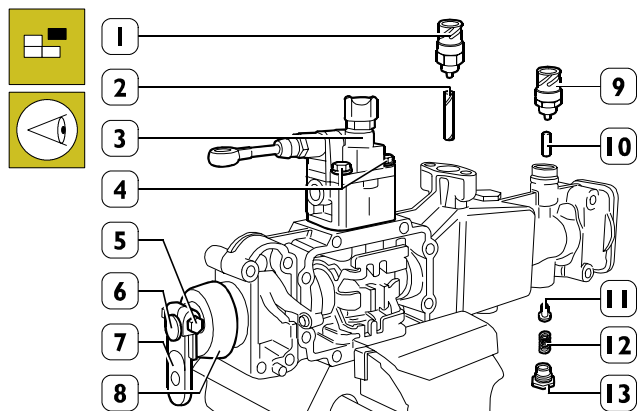
Figure 14



61257

Undo screws (1, figure 13) and remove the servoshift (1) from the gearshift box (2).
Remove push rod (3) with spring (4).

Figure 15

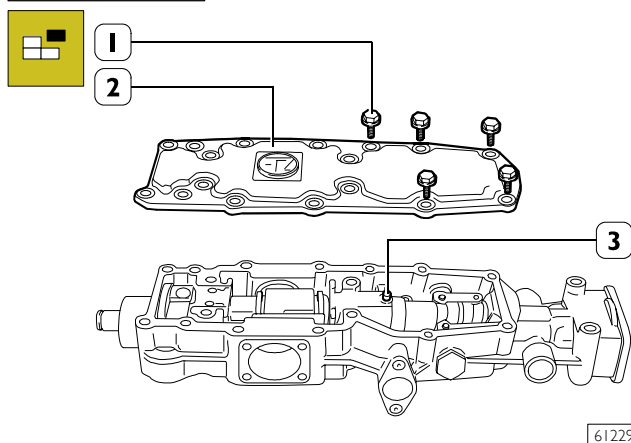


61228

Mark the assembly position of the lever (7) on the rod (6).
Loosen nut (5) and remove lever (7) from the rod (6).
Take out the cap (8).
Remove:

- ☐ valve (3) after removing screws (4);
- ☐ switches (1 and 9) with the washers and push rods (2 and 10);
- ☐ cap (13) with its washer, spring (12) and push rod (11).

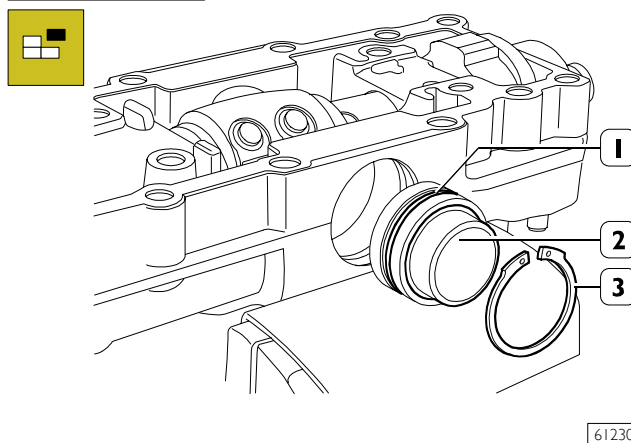
Figure 16



61229

Undo screws (1) and remove the upper cover (2). Take out the pin (3).

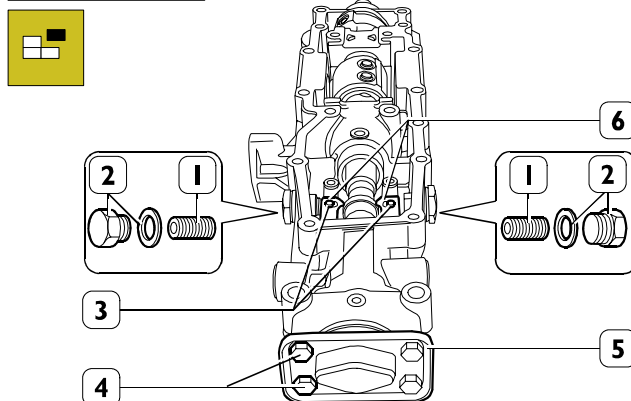
Figure 17



61230

Remove split ring (3) and take out the piston (2) and sealing ring (1).

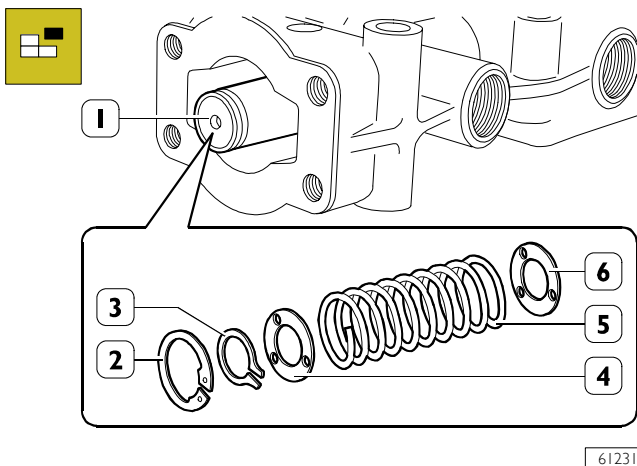
Figure 18



61259

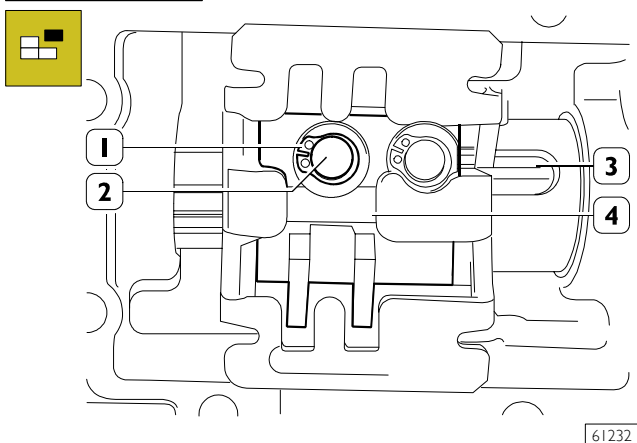
Unscrew the caps (2) with the washers, take out springs (1) and remove the levers (6).
If necessary remove the pins (3).
Undo the screws (4) and take off the cover (5).

Figure 19



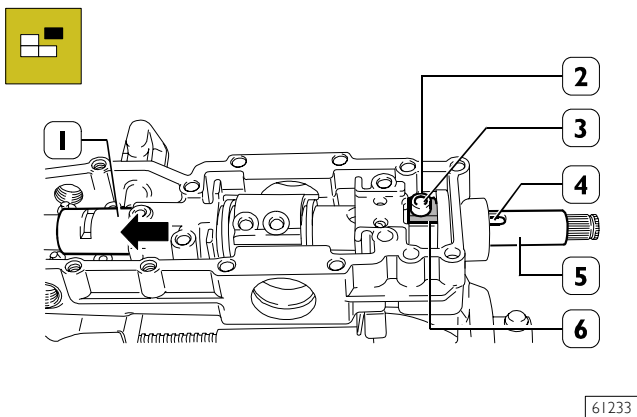
Take the split ring (2) from the rod (1). Hold the washer (4) to limit the action of the spring (5) and remove the split ring (3). Take out washer (4), spring (5) and washer (6).

Figure 20



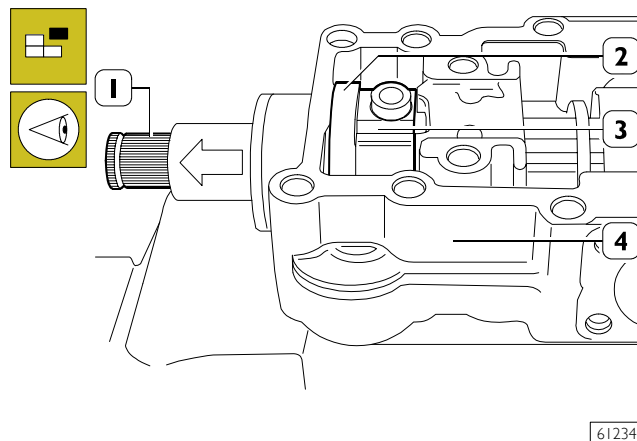
Remove the split rings (1) and take out the pins (2) that secure the actuator (4) to the rod (3).

Figure 21



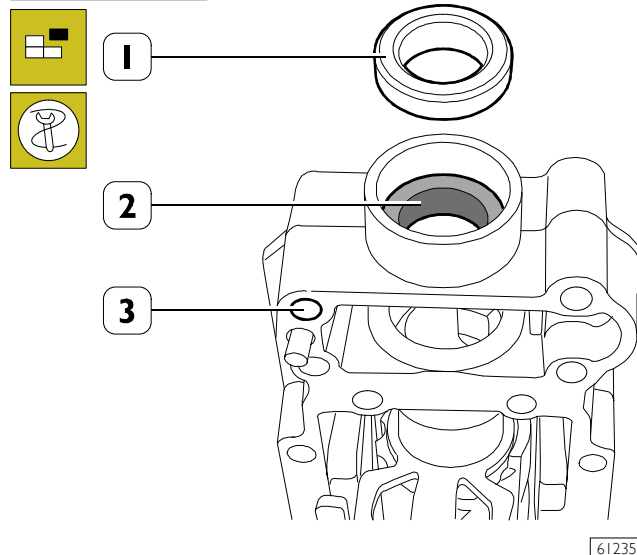
Move the pipe (1) in the direction of the arrow. Use a punch to knock on the top of the lever (6) to bring out the bearing (3) and pin (2), releasing the latter from the rod groove (5).

Figure 22



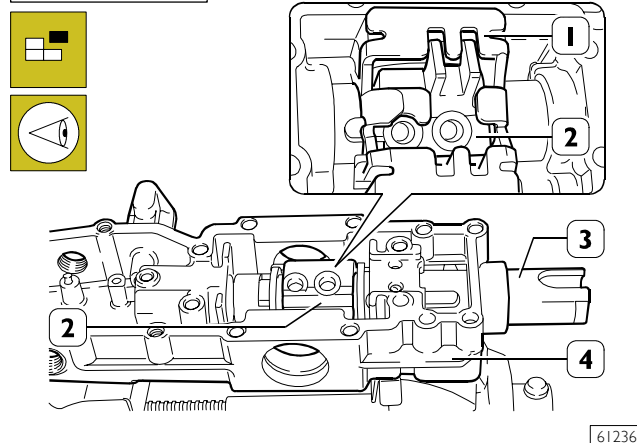
Mark the assembly positions of levers (2 and 3) and remove them from the box (4), taking out rod (1).

Figure 23



Using internal puller 99348004 take out bushing (2) and sealing ring (1) from the box (3).

Figure 24



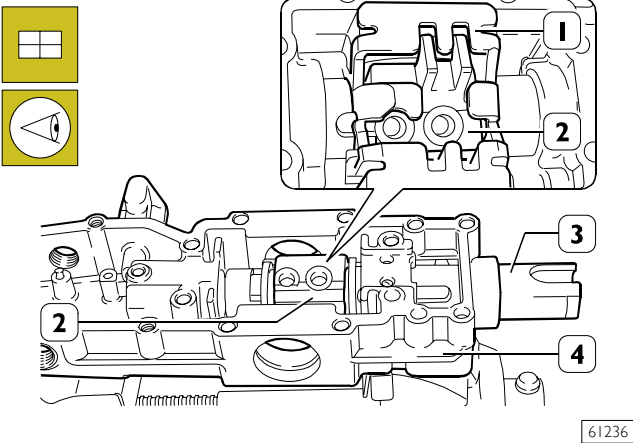
Mark the position of the locking element (1) and the actuator (2) then remove them from the box (4) after removing the pipe (3).

Refitting gear command box



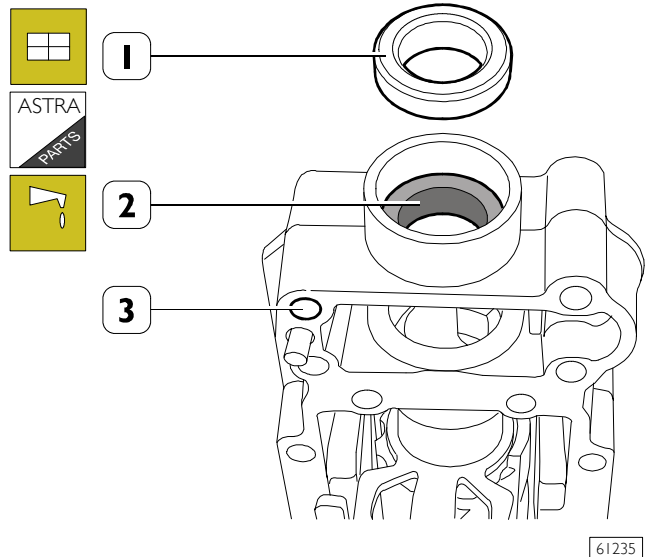
When assembling, always replace sealing elements with new ones, i.e.: rings, copper washers, flat gaskets, spring pins and needle bearings with their pins. Check that the springs are not damaged or worn.

Figure 25



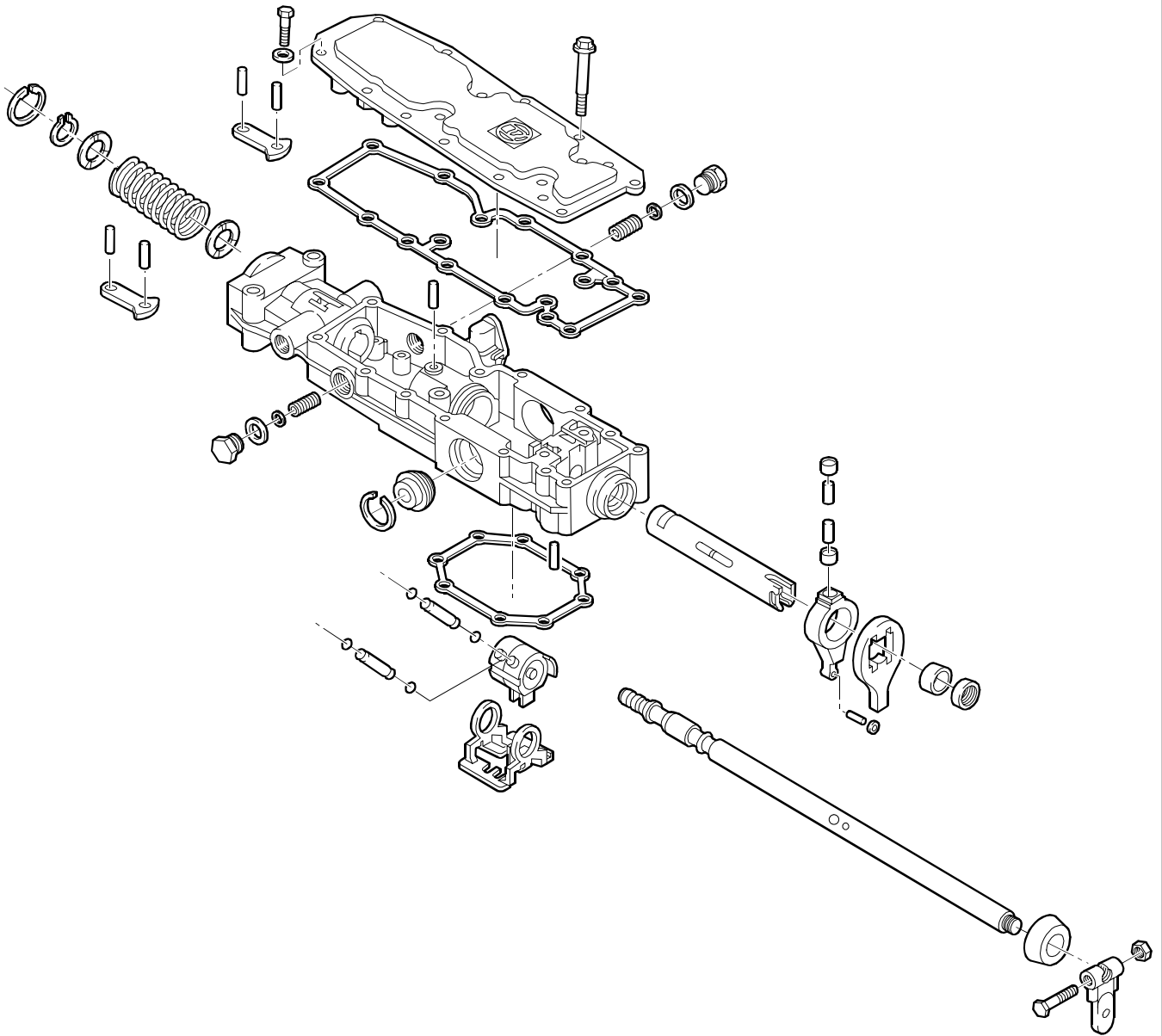
Fit the locking element (1) and actuator (2) in the box (4) as they were marked at disassembly and insert the pipe (3) into them.

Figure 26



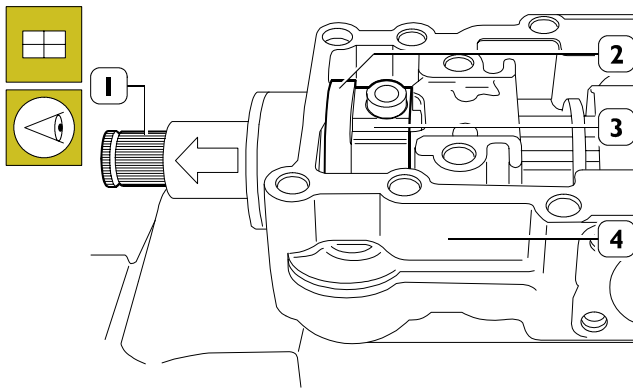
With a appropriate driver fit the bushing (2) in the box (3). Use the suitable tool to fir the sealing ring (1) into the box (3). Grease the inner part of the sealing ring (1).

Figure 27



GEARSHIFT

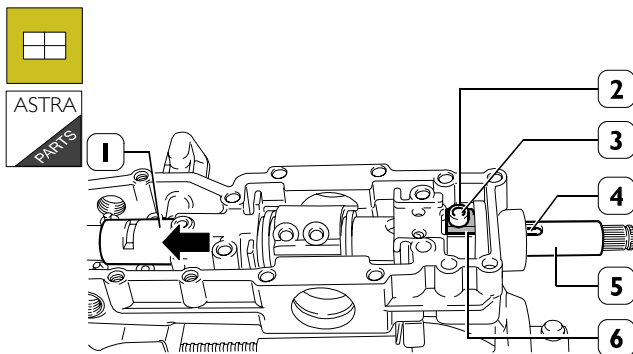
Figure 28



61234

Fit the levers (2 and 3) in the box as marked at disassembly then insert the rod (1).

Figure 29

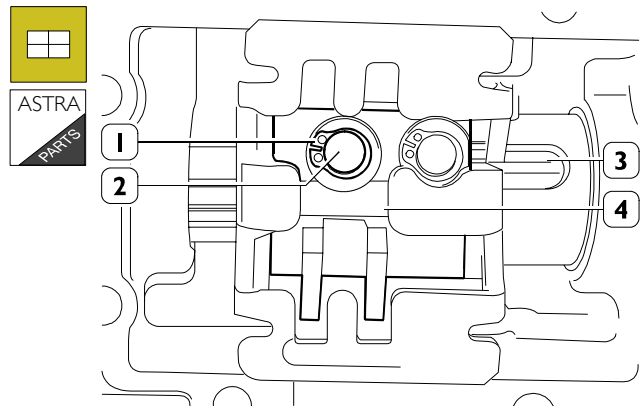


61233

Move the pipe (1) in the direction of the arrow. Fit a new needle bearing (3) and pin (2) on the lever (6). Position the rod (5) so that the groove (4) corresponds to the needle (3) and pin (2).

Resting the lever (6) on a flat surface, gently knock the bearing (3) and pin (2) so they are flush with the top of the lever (6) and are correctly inserted in the groove (4) of the rod (5).

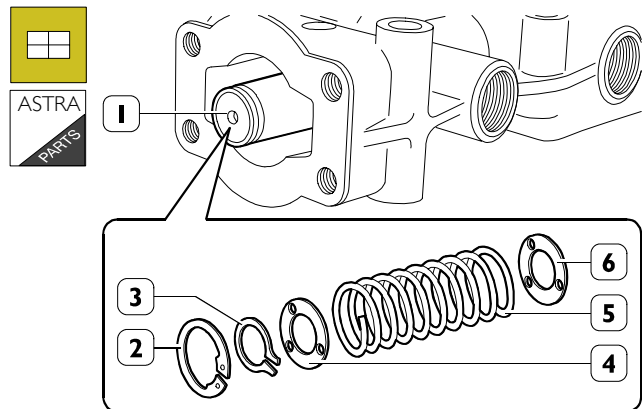
Figure 30



61232

Secure the actuator (4) to the rod (3) inserting the pins (3). Insert new split rings (1) on the pins.

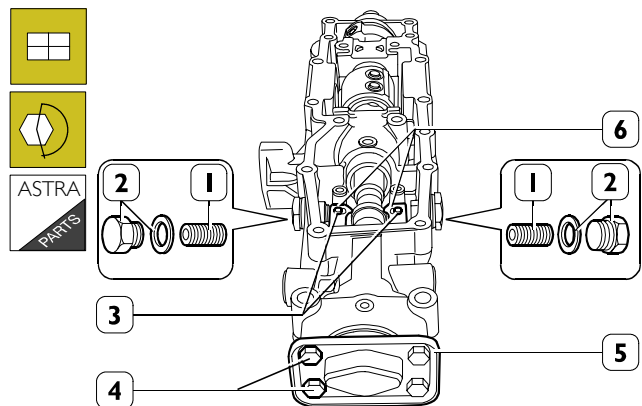
Figure 31



61231

Fit the washer (6), spring (5) and washer (4) on the rod (1) and fit a new split ring (3).
Fit a new split ring (2).

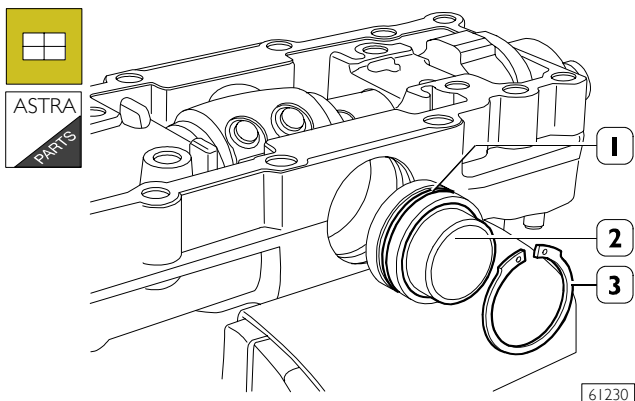
Figure 32



61259

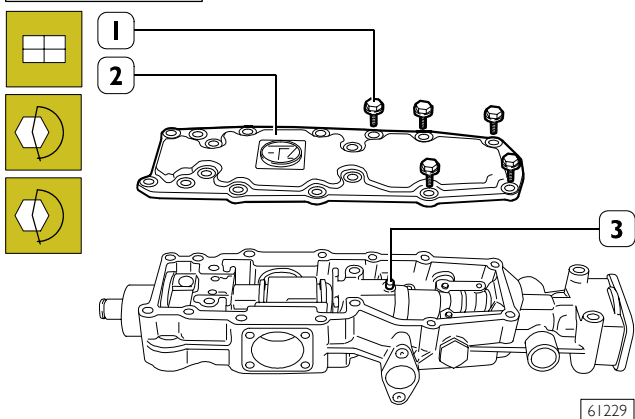
Assemble the cover (5) with a new gasket, insert the screws (4) and tighten to the specified torque.
Fit the levers (6) on the pins (3). Screw the caps (2) with new washers and the springs (1). Tighten to the specified torque.

Figure 33



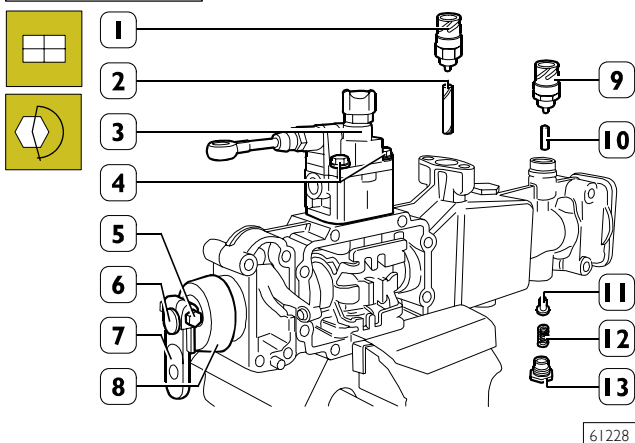
Fit a new sealing ring (1) on the piston (2). Fit the piston in the box and secure it with the split ring (3).

Figure 34



Insert the pin in the box (3). Assemble the upper cover (2) with a new gasket. Insert screws (1) and tighten to the specified torque.

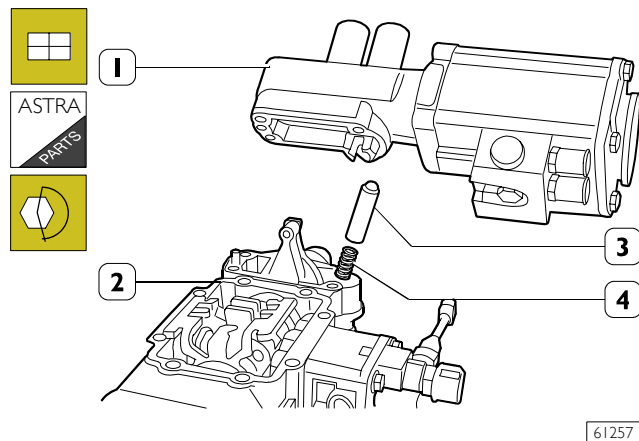
Figure 35



Complete the assembly of the gearshift refitting:

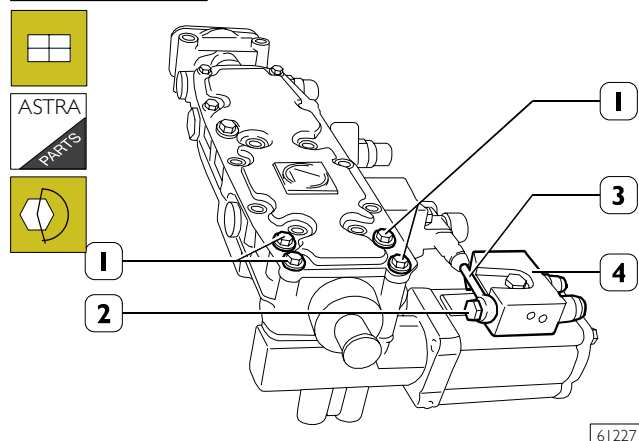
- ☐ push rod (11), spring (12), cap (13) with a new gasket;
- ☐ push rods (2 and 10), switches (1 and 9) with new washers;
- ☐ cap (8), lever (7) on rod (6) in the position marked at disassembly. Tighten nut (5) to the specified torque.

Figure 36



Fit the push rod (3) with the spring (4) in the box. Refit the servoshift (1) with a new gasket. Insert the screws (1, Figure 37) and tighten to the specified torque.

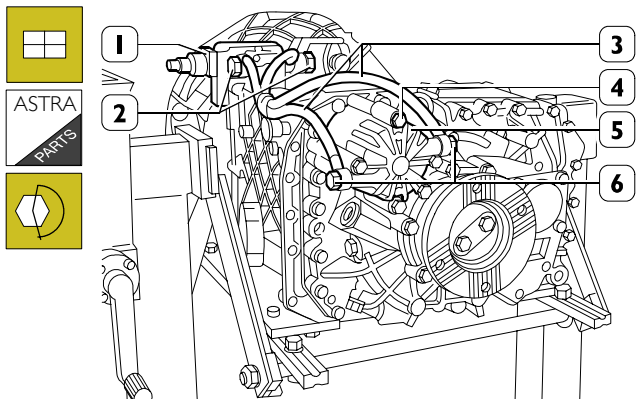
Figure 37



Connect the air hose (3) to the distributor (4) tightening the union (2) with new copper washers and tightening to the specified torque.

Epicyclic reduction unit (E.R.U.) removal

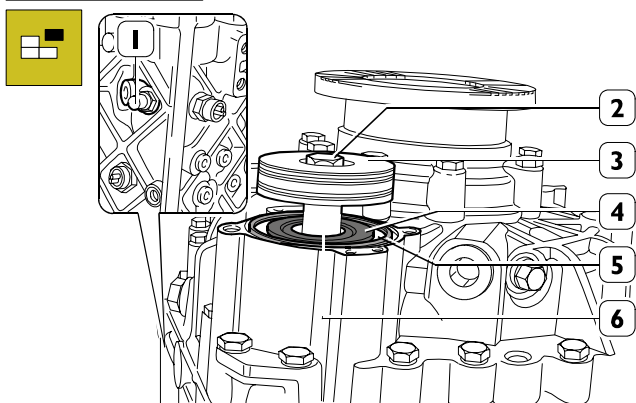
Figure 38



61174

Remove the gearshift (1) as described in the relevant section. Mark the assembly position of the pipes (3) on the E.R.U. control cylinder (5) then disconnect them unscrewing the unions (6) with their washers.

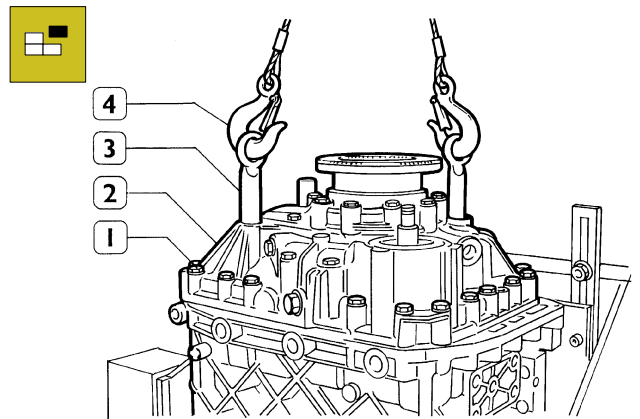
Figure 39



61175

Unscrew the nut (2) remove the piston (3) with the two sealing rings and anti-vibration ring from the E.R.U. control rod (6). Remove the sealing ring (5). Use a screwdriver to remove the gasket (4) from the rod (6). Unscrew the rod positioning push rod (1).

Figure 40



37312

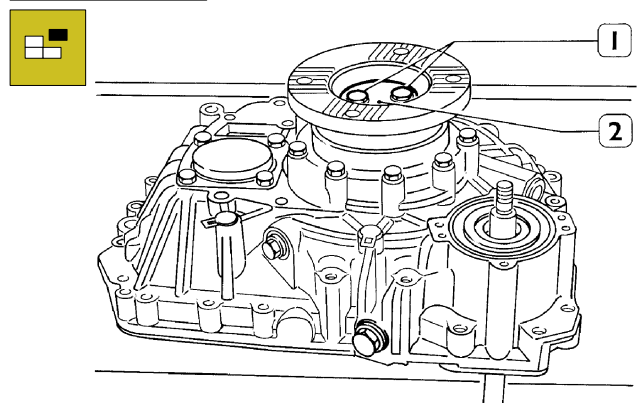
Undo the screws (1). Screw the eye bolts (3) onto the E.R.U. box. With hooks and a mobile hoist remove the E.R.U. (2) from the gearbox.

Disassembling the epicyclic reduction unit (E.R.U.)



The operations described and illustrated below refer to the disassembly for the straight tooth epicyclic reduction unit. Unless indicated otherwise, is also valid for the helical tooth type.

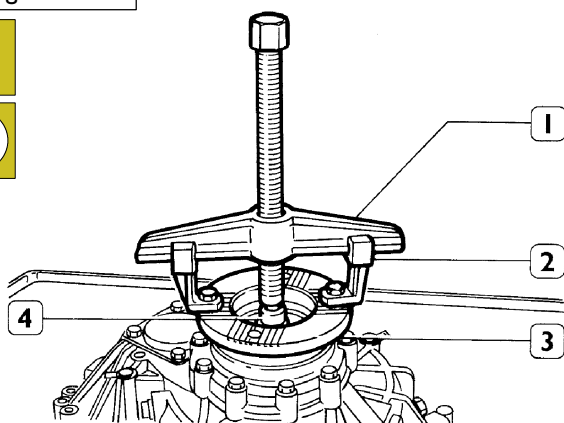
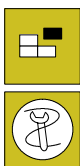
Figure 41



37329

Remove the safety plate, undo the two screws (1), remove the pressure disk (2) and the sealing ring underneath.

Figure 42

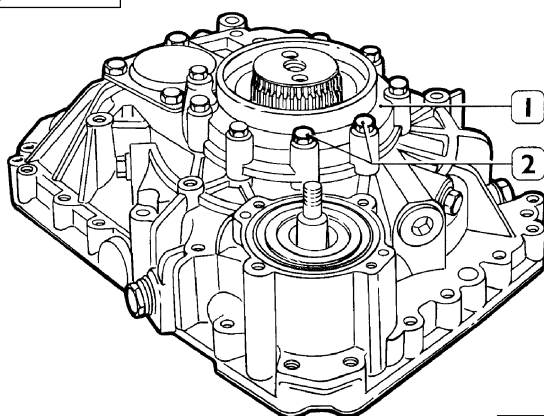


37330

With a puller consisting of:

- ☐ tie-rods (2);
- ☐ puller (1);
- ☐ thrust block 99345058 (4) pull out the output flange (3);

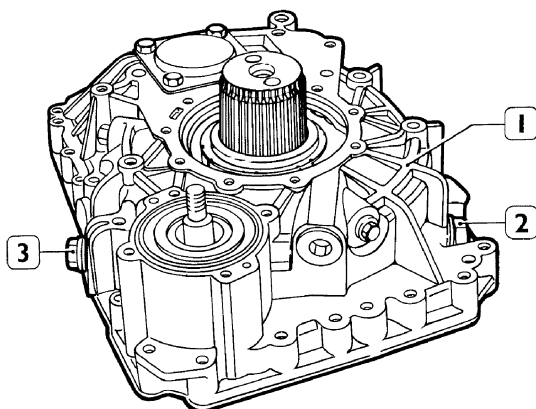
Figure 43



37331

Undo screws (2) take off cover (1) and remove the support bearing, adjusting ring and sealing ring from it.

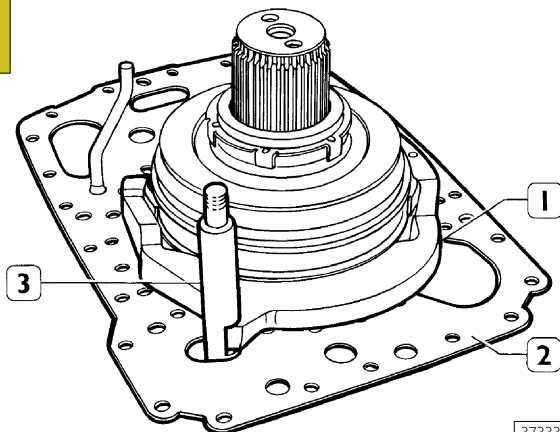
Figure 44



37332

Undo the screw pins (2 and 3) and remove the box (1) from the E.R.U.

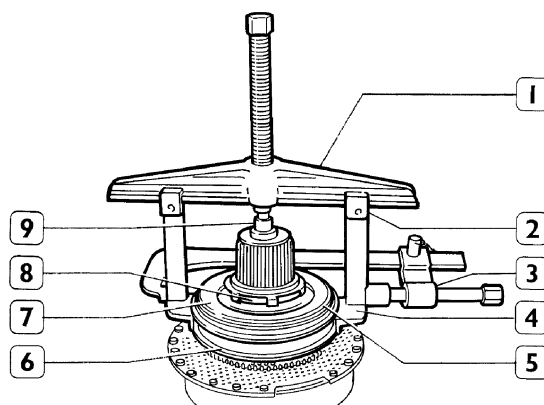
Figure 45



37333

Take out the rod (3), the fork (1) with the E.R.U. control shoes. Disassemble the intermediate plate (2).

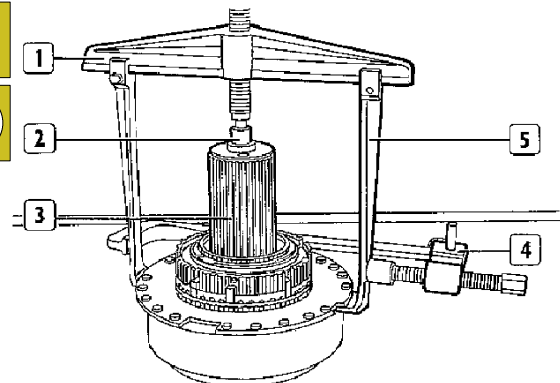
Figure 46



37334

Take out the phonic wheel (8), the sliding sleeve (6) with the springs and synchronising ring thrusts (5). Remove also the coupling vase (7) using a puller composed of: grips (4), tie-rods (2), puller (1) and thrust block 99345058 (9).

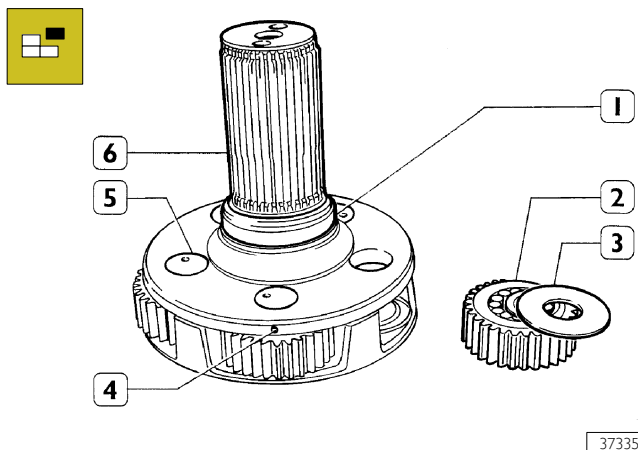
Figure 47



27444

Take out the spider shaft (3) using a puller composed of: grips (5), puller (1), thrust blocks 99345058 (2) and clamp (4).

Figure 48



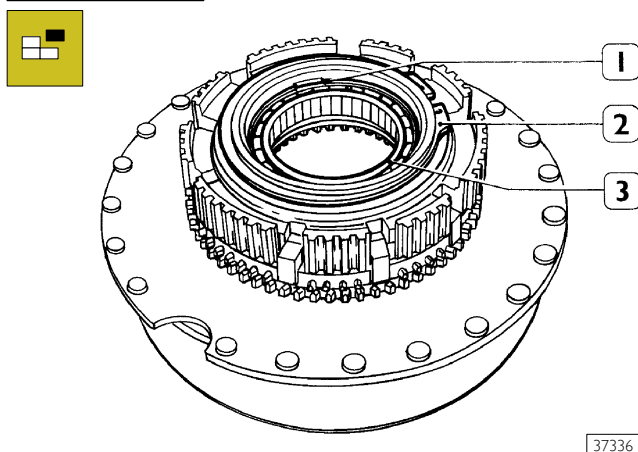
Take out the spacer (1) push the spring pins (4) into the pins (5) and with an appropriate driver knock out the pins (5) from the spider shaft (6).

Take out the spider shaft (6), the planetary gear (2) with shim rings (3) and roller bearings.



The shim ring (3) is not installed on the helical tooth version.

Figure 49



Remove the split ring (2) that restrains the fixed sleeve.

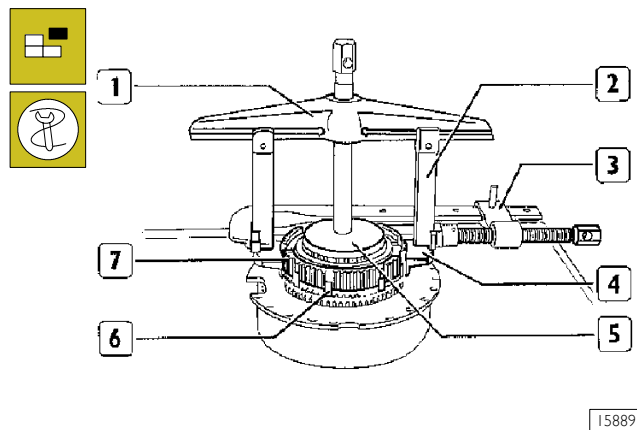
Only for straight tooth version:

Remove the split ring (1) and take out the ball bearings (3).



The helical teeth version has a thrust bearing (see Figure 53).

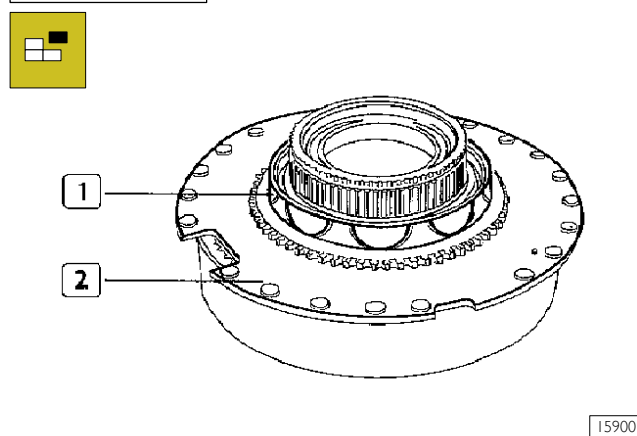
Figure 50



Remove the synchronising ring (6) and the fixed sleeve (7) using a puller consisting of:

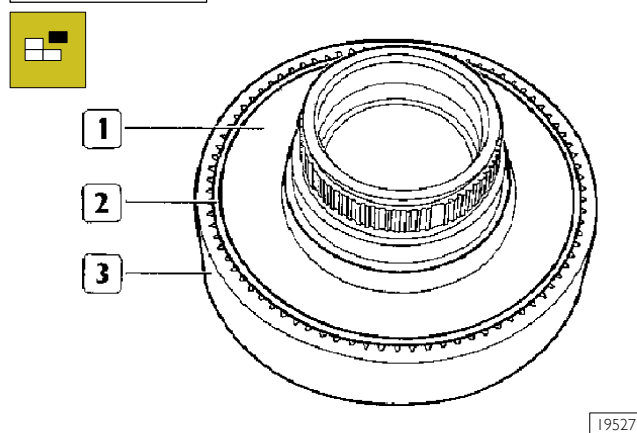
- ☐ grips (4);
- ☐ tie rods (2);
- ☐ puller (1);
- ☐ thrust block 99345092 (5);
- ☐ clamp (3).

Figure 51



Take out the coupling element (1) with the plate (2).

Figure 52



Remove the split ring (2) and separate the crown wheel (3) from the support (1).

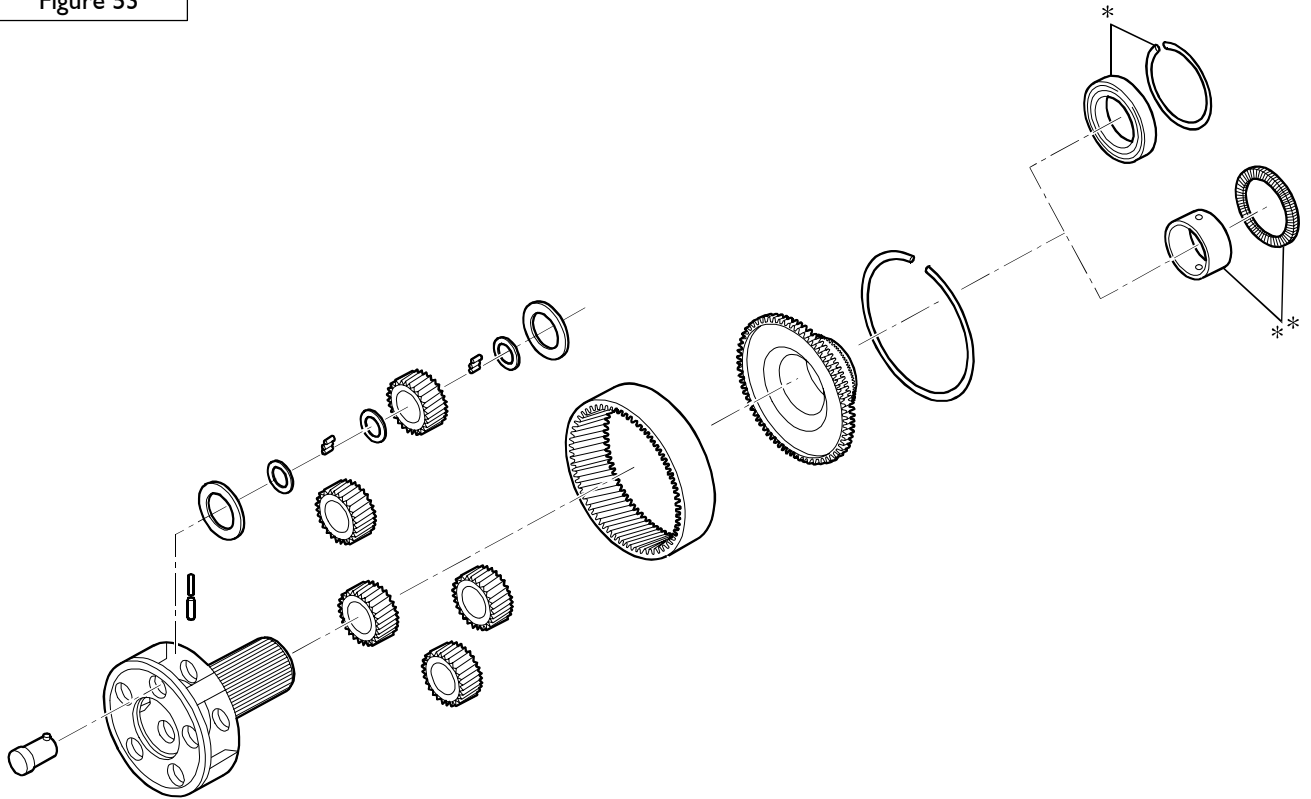
Assembling the epicyclic reduction unit (E.R.U.)

To assemble the epicyclic reduction unit follow the disassembly operations in reverse order.

The operations and assembly steps that require special tools, clearance checks, adjustments or special specifications are described below.

The tightening torques are given in the relevant table.

Figure 53



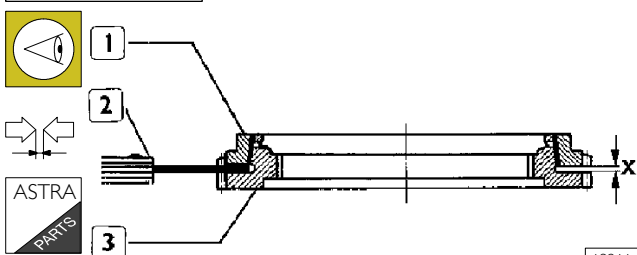
61176

BREAK-DOWN DRAWING OF EPICYCLIC REDUCTION UNIT COMPONENTS

* only straight tooth version

** only helical tooth version

Figure 54

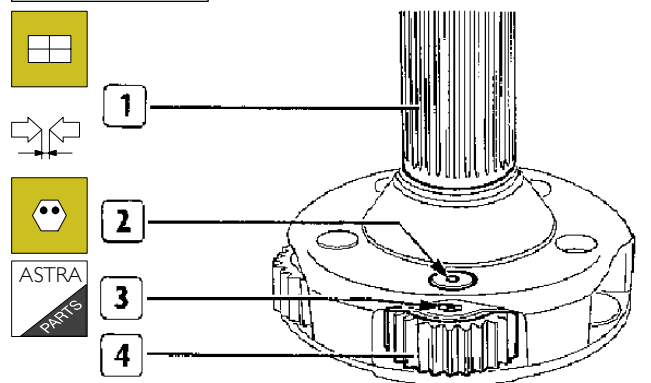


Before reassembling the synchronisers, check the wear on the synchronising rings (1) and the coupling elements (3); use a thickness gauge (2) to measure the distance between the synchronising ring (1) and the coupling element (3) in two opposite points. If the distance (X) found is less than 1.2 mm replace the synchronising ring (1) or the coupling element (3). Do not confuse the checked parts (it is better to mark them).



Heat the bearings inner ring and the sliding sleeve hub to about 100°C for roughly 15 minutes before assembly.

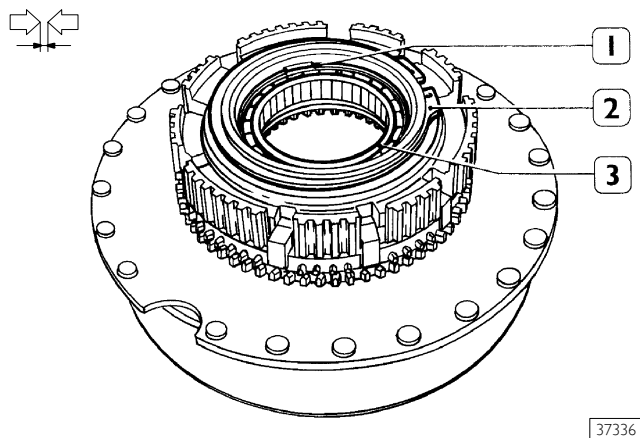
Figure 55



19529

Check that the end float between the spider (1) and the planetary gear (4) is between 0.40 and 1.30 mm. After checking the end float fit the bearing pins (2) in the spider (1) matching the "0" reference stamped on the pins with the holes (3) for the spring pins. Fit the spring pins in the holes (3) and calk them.

Figure 56



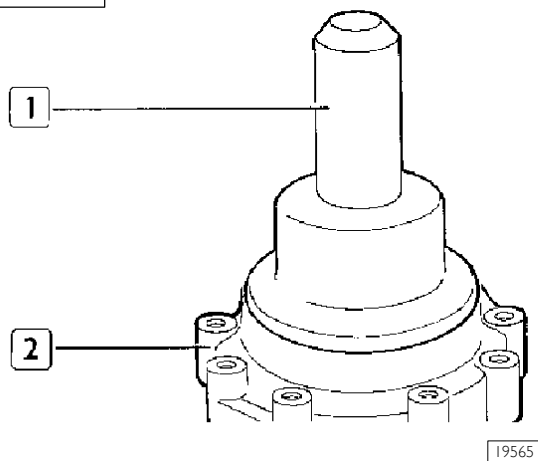
With a thickness gauge check the clearance between split ring (1) and bearing outer ring (3). The clearance should be between 0.0 to 0.1 mm.

Check also the clearance between split ring (2) and its seat. The clearance should be between 0.0 to 0.1 mm.



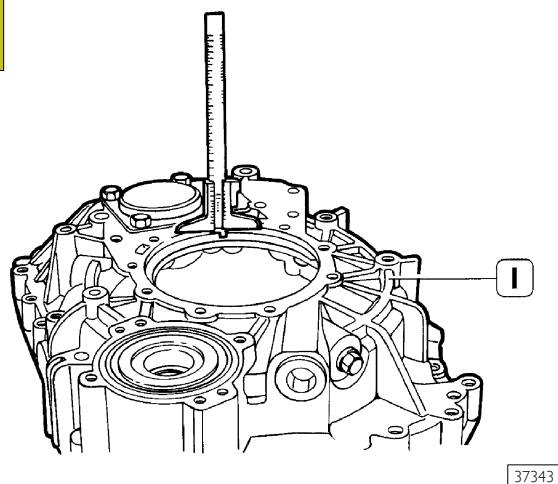
Split rings (1) and (2) are supplied as spares in different thicknesses.

Figure 57



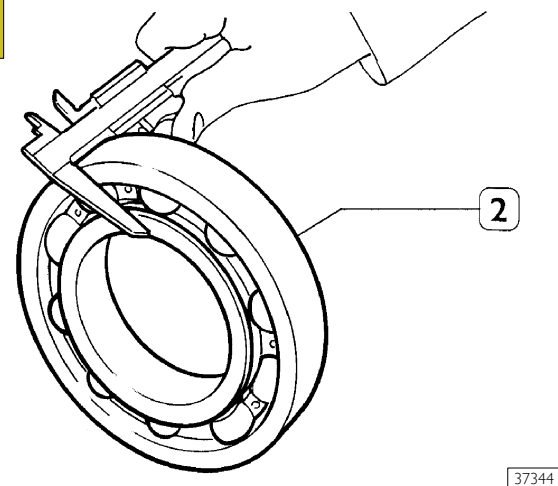
Using coupling device 99374221 (1) fit the sealing ring in the output flange cover (2).

Figure 58



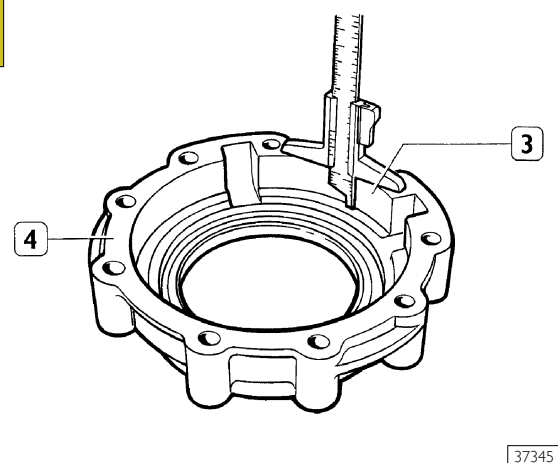
Measure the depth of the bearing seat in the E.R.U. box (1).

Figure 59



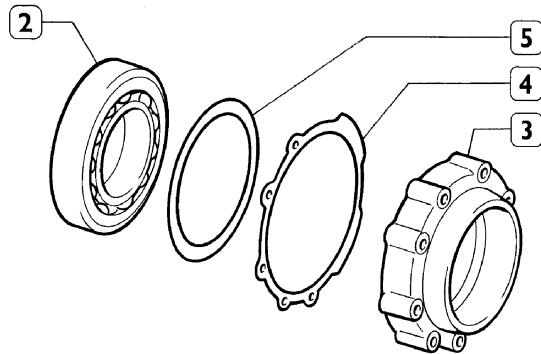
Measure the thickness of the bearing (2).

Figure 60



Measure the depth of the bearing seat in the cover (3) with the gasket (4).

Figure 61



37346

Determine the thickness of the adjusting ring (5) so that between the bearing (2) and the E.R.U. box (1) there is a clearance of 0.0 to 0.1 mm.

EXAMPLE	mm
☐ Depth of bearing seat in the box (1)	7.40 +
☐ Depth of bearing seat in the cover (3) with gasket (4)	23.00 =
☐ Total	30.40 -
☐ Bedding of the gasket (4)	0.05 =
☐ Total	30.35 -
☐ End float (0.0 to 0.1 mm) average value	0.05 =
☐ Total	30.30 -
☐ Bearing thickness	30.00 =
☐ Total	0.30

The thickness of the adjusting ring (5) shall be 0.30 mm.

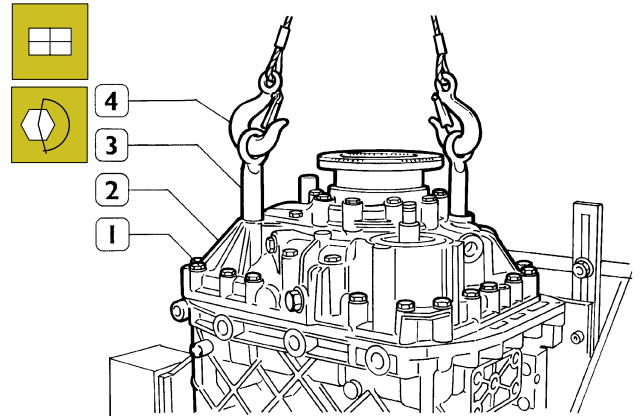
Refitting the epicyclic reduction unit (E.R.U.)

To refit the epicyclic reduction unit box, follow the removal instructions in reverse order.

Assembly operations that require special tools, clearance checks, adjustments or special specifications are described below.

The tightening torques are given in the relevant table.

Figure 62

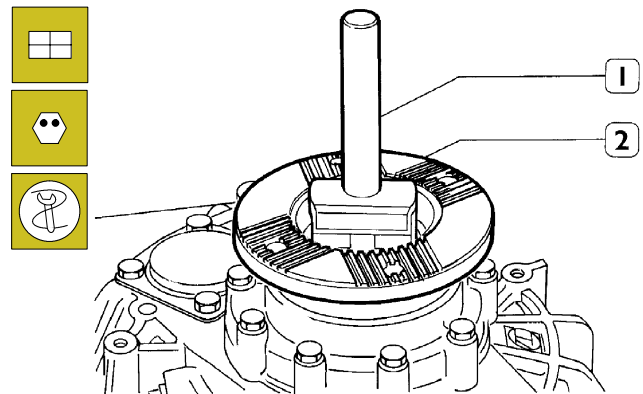


37312

Screw the eye bolts (3) onto the E.R.U. box (2). fit the cables with hooks (4) and with a mobile hoist assemble the E.R.U. on the gearbox.

Tighten the screws (1) to the specified torque.

Figure 63



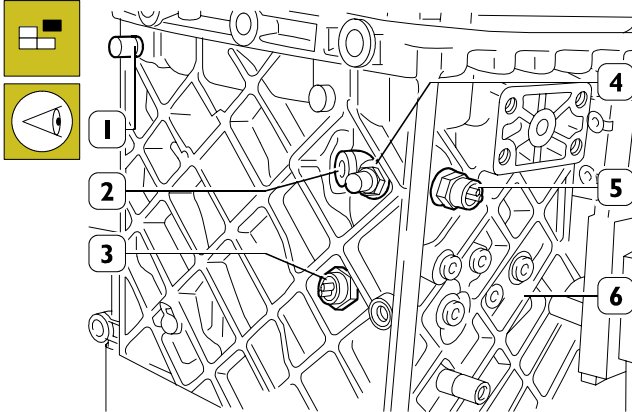
37359

After tightening the two output flange securing screws to the required torque, fit on the safety plate and secure it with tool 99370465 (1).

Remove the gearbox from the rotating stand and top up the oil level.

Disassembling the gearbox

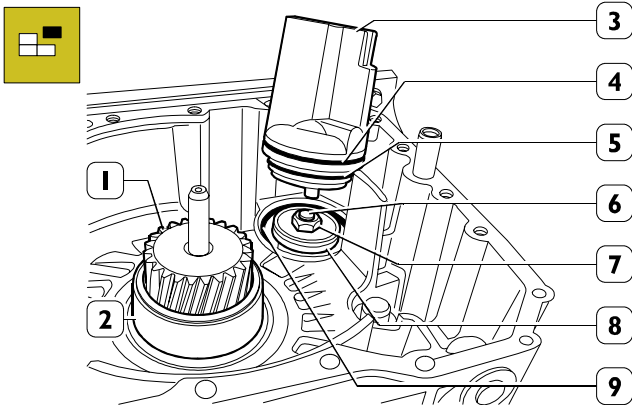
Figure 64



61207

Mark the assembly position of the switches (3), type 235N; (5), type 145N and remove them from the gearbox (6). Take off the oil vapours breather (1) and the cap (2).

Figure 65



61177

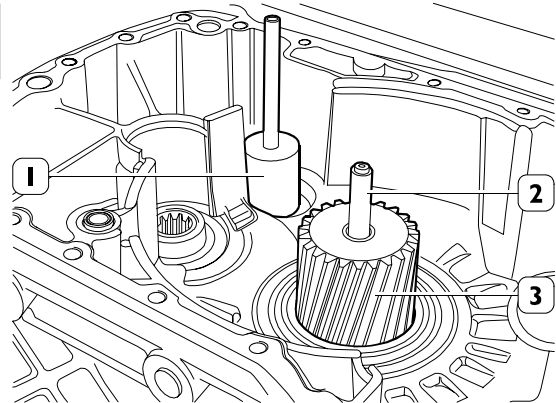
Disassemble the splitter control cylinder (3) with the sealing rings (4-5).



The cylinder (3) may have 3 sealing rings.

Remove the split ring (9). Unscrew nut (7) and remove the piston (8) from the rod (6).

Figure 66



61178

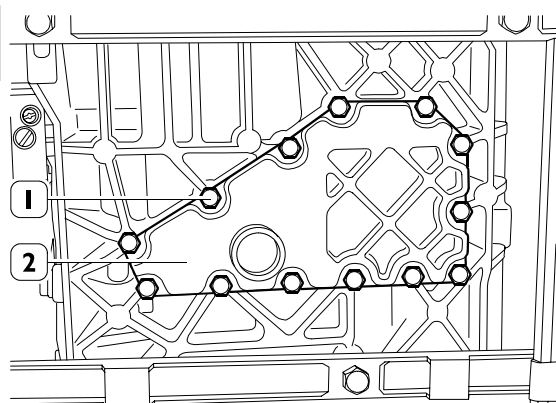
Take out the reverse gear shaft (1).



On certain gearboxes it is necessary to remove the screw securing the retaining plate to the gearbox to be able to remove the shaft.

Remove the pipe (2) from the main shaft (3).

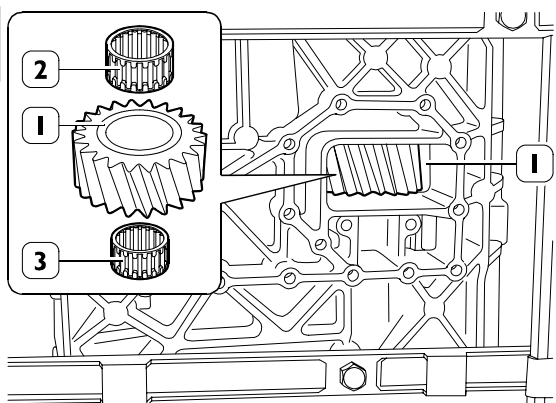
Figure 67



61179

Undo the screws (1) and take off the cover (2).

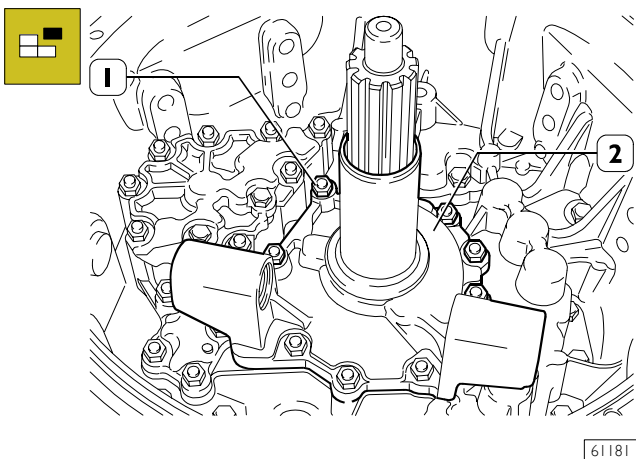
Figure 68



61180

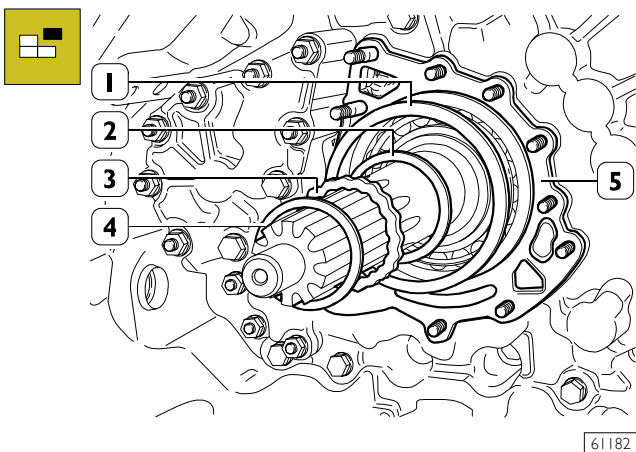
Remove the reverse transmission gear (1) with the needle bearings (2 and 3).

Figure 69



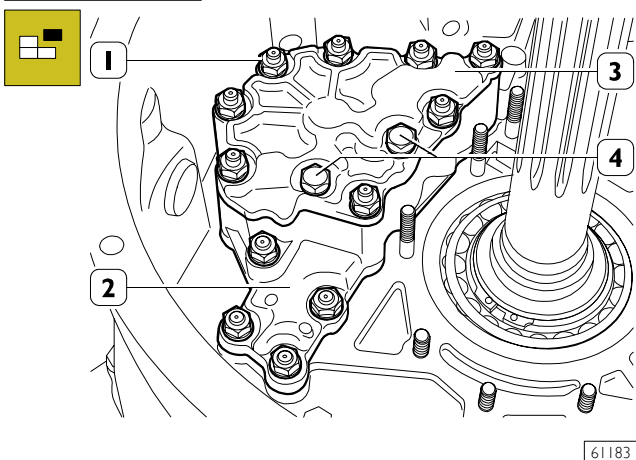
Unscrew the nuts (1) and remove the oil pump (2).

Figure 70



Remove thrust ring (4), spring (3) thrust ring (2), adjusting ring (1) and gasket (5).

Figure 71

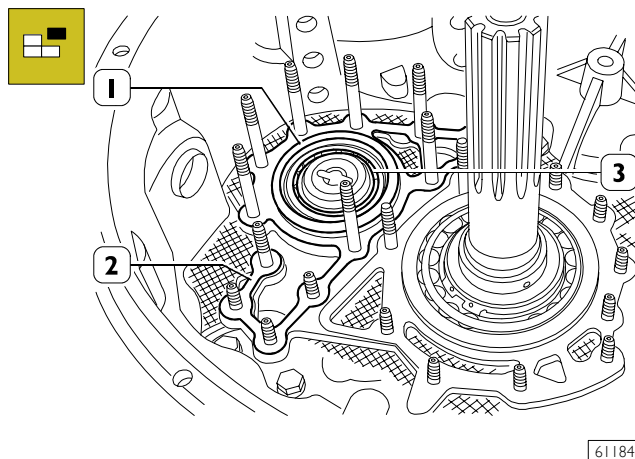


Unscrew nuts (1) and remove the input cover (2).



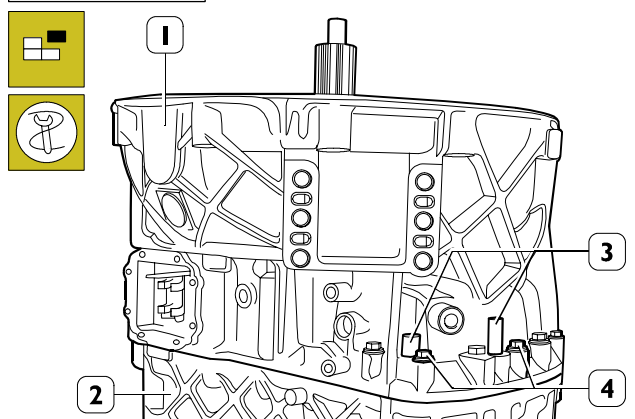
When removing the oil pump (2), do not undo screws (4). These screws secure the cover (3) to the pump casing and are to be unscrewed after the part has been removed, only for the oil pump overhaul.

Figure 72



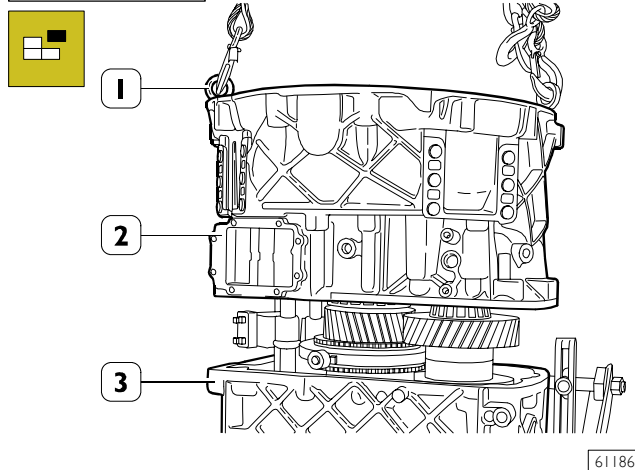
Remove the adjusting rings (1) from the taper roller bearing (3). Remove the gasket (2).

Figure 73



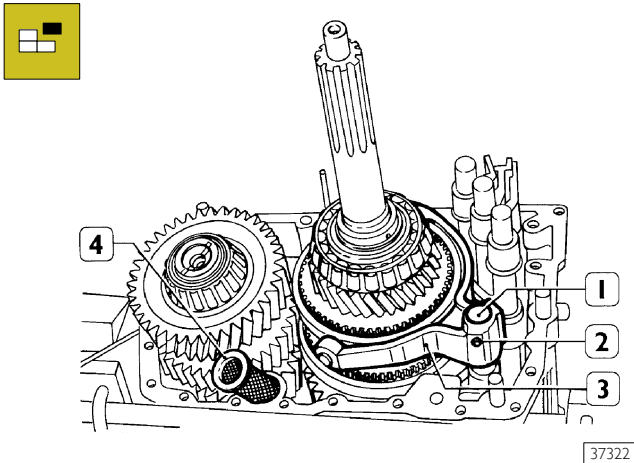
Using puller 99340205, take out the front cover (1) gearbox (2) centring pins (3). Undo screws (4) and nuts securing the front cover (1) to the gearbox (2).

Figure 74



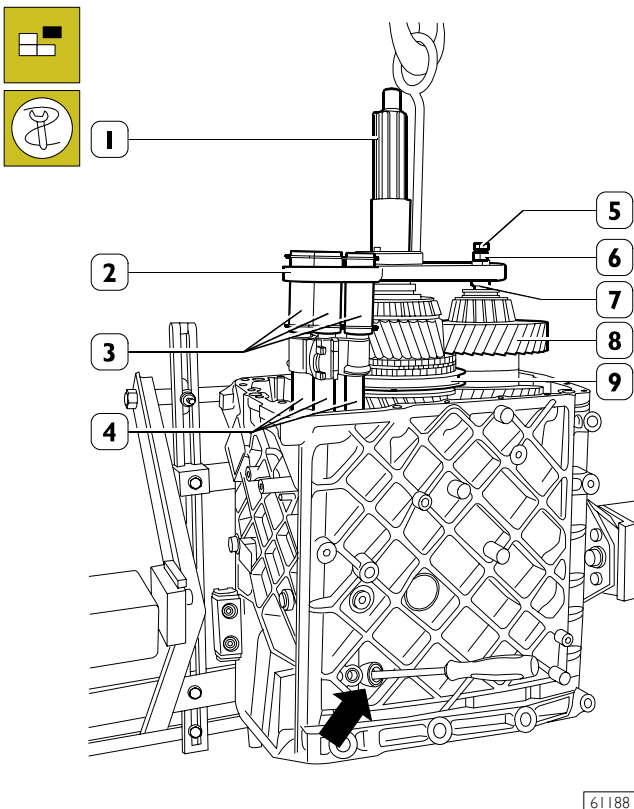
Apply appropriate hooks (1) to the front cover (2); with cables and hoist remove this from the gearbox (3).

Figure 75



Remove the oil filter (4) from the gearbox. Unscrew the two hex. head cap screws (2), take out the splitter control rod (1) and remove the relevant fork (3) with shoes from the sliding sleeve.

Figure 76



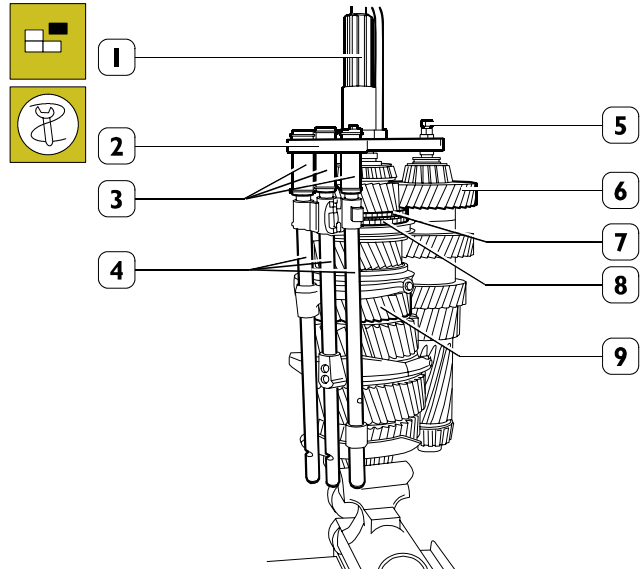
Fit tool 993605 15 (2) on the input shaft (1). Fit the sleeves (3) of the latter on the rods (4).

Tighten screw (5) of tool 993605 15 (2) into the transmission shaft (8), adjust nut (6) and threaded bushing (7) so that the transmission shaft (8) remains aligned to the main shaft (9) when withdrawn later:

Hook tool 993605 15 (2) to the hoist.

With a screwdriver inserted in the gearbox hole (→), push the bolt (2, Figure 78) to free the control rods (4) and at the same time withdraw the shafts-rods group from the gearbox.

Figure 77



Lock the main shaft (7) in a clamp.

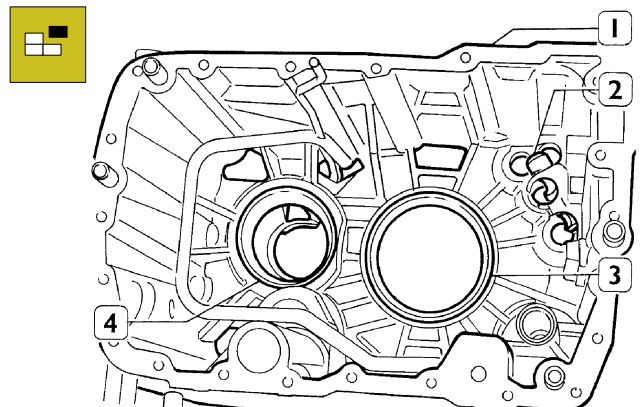
Undo screw (5) and remove the transmission shaft (6).

Raise the sleeves (3) from the rods (4) and remove the latter from the sliding sleeves.

Disassemble the input shaft (1) from the main shaft (9).

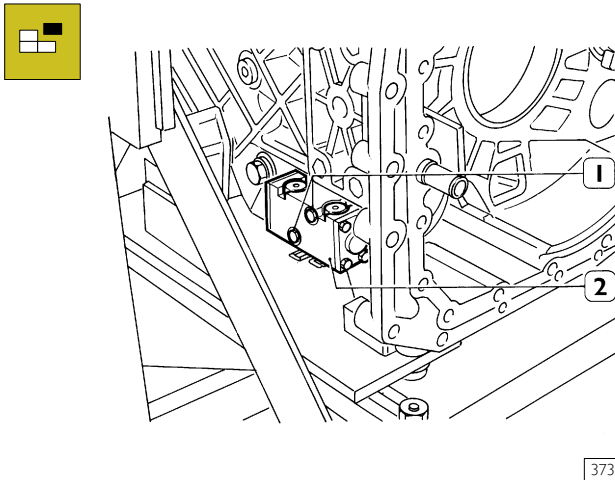
Disassemble the synchronising ring (8) and the coupling element (7).

Figure 78



Remove the gear bolt (2) with the spring from the gearbox. With an appropriate driver remove the two outer rings (3) and (4) of the support bearings on the E.R.U. side of the transmission and main shafts. Clean the lubricating oil delivery ducts with a jet of compressed air.

Figure 79



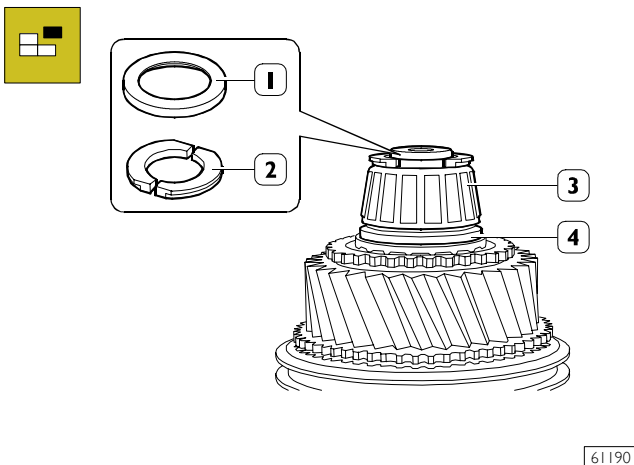
Undo the two screws (1) and remove the splitter control valve (2).



Do not disassemble the splitter control valve (2). If it is faulty, replace it.

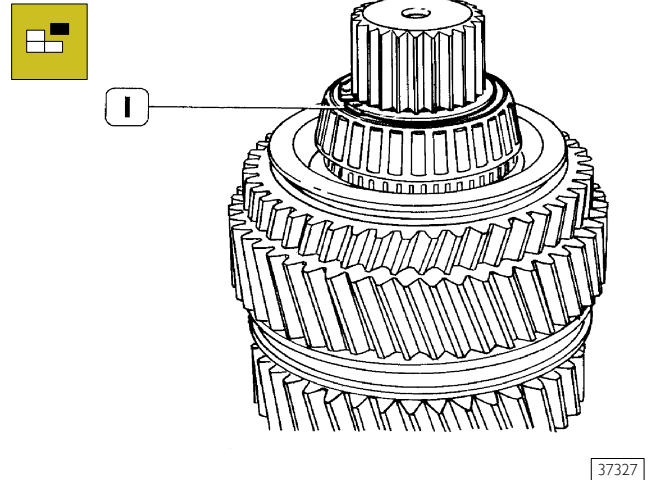
Disassembling the main shaft

Figure 80



Raise the dent on the retaining ring (1) and remove the half-rings (2). With an appropriate puller, remove the taper roller bearing inner ring (3). Take out the thrust ring (4).

Figure 81

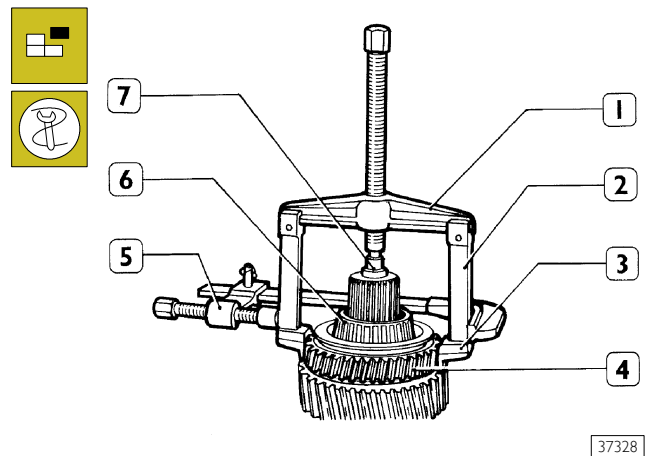


Turn over the main shaft in a clamp and remove the split ring (1).



The figure shows the main shaft in the version with straight tooth end.

Figure 82

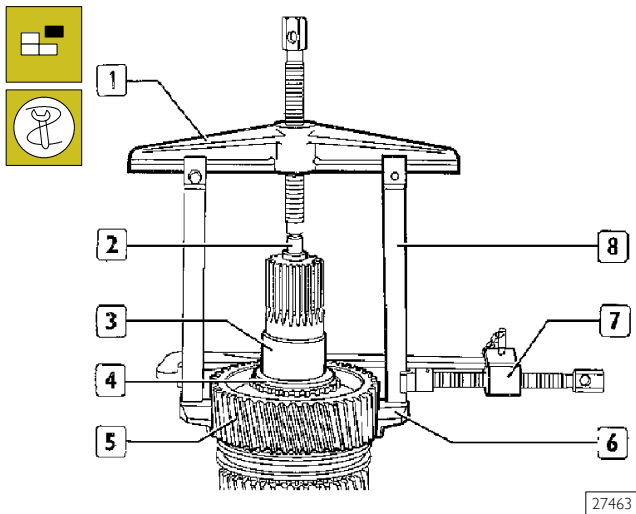


Remove the reverse gear (4) and inner ring (6) of support bearing E.R.U. side using a puller consisting of:

- ☐ grips (3);
- ☐ tie-rods (2);
- ☐ puller (1);
- ☐ thrust block 99345058 (7);
- ☐ clamp (5).

Take the needle bearing of the reverse gear (4) from the main shaft.

Figure 83

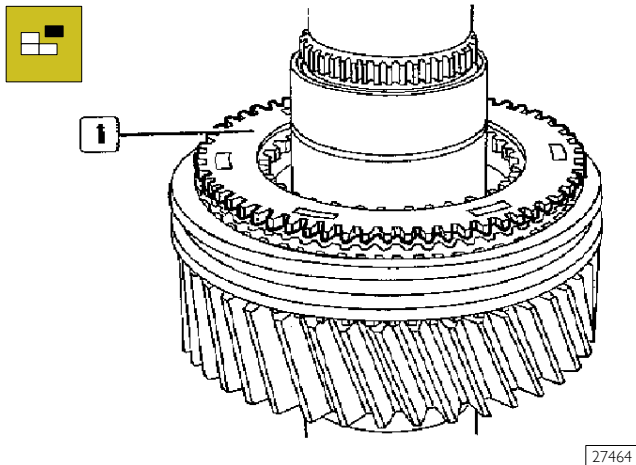


Remove the 1st speed gear (5), the coupling element (4) and the inner ring (3) of the reverse gear bearing using a puller consisting of:

- ☐ grips (6);
- ☐ tie-rods (8);
- ☐ puller (1);
- ☐ thrust block 99345058 (2);
- ☐ clamp (7).

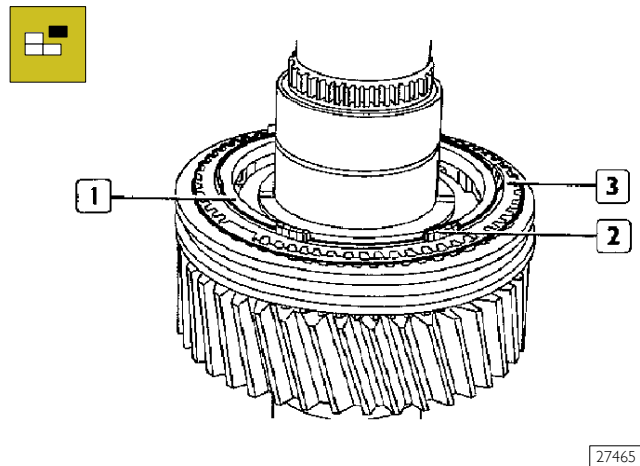
Remove the needle bearing of the 1st speed gear from the shaft.

Figure 84



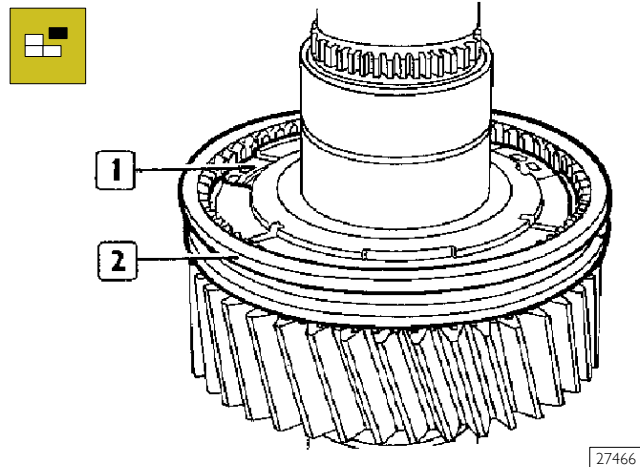
Take off the coupling element (1).

Figure 85



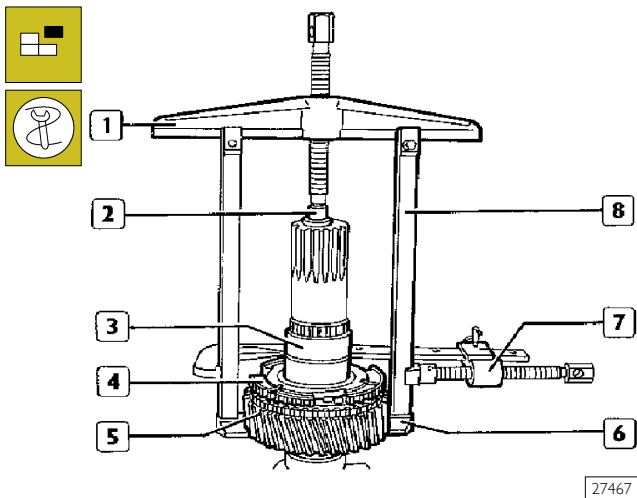
Remove the synchroniser ring from the main shaft (3).

Figure 86



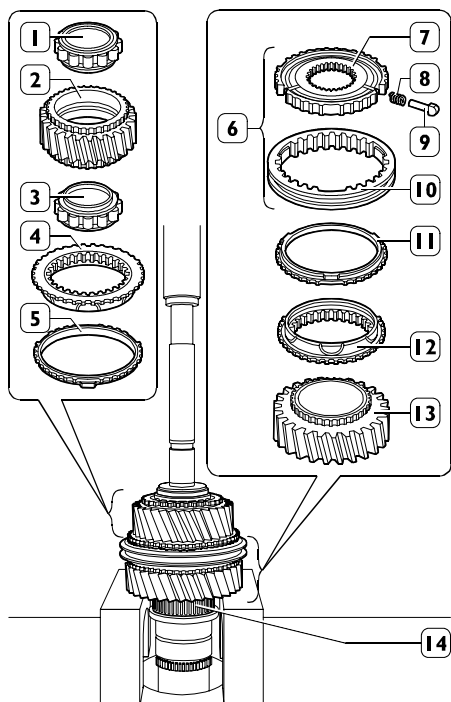
Take off the sliding sleeve (2) with springs and thrust elements and remove the three connecting blocks (1).

Figure 87



Extract the 2nd gear cog (5), the coupling body, friction ring, synchroniser ring, fixed connecting (4) sleeve and coupling (3) with a compound extractor.

Figure 88

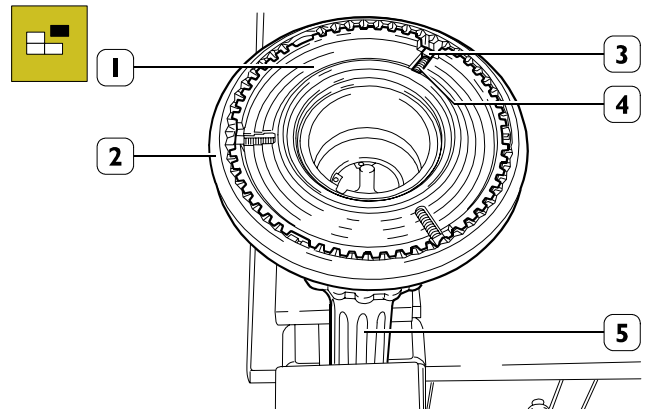


With a hydraulic press remove the 3rd speed gear (13), the coupling element (12), the synchronising ring (11), the synchronising unit (6), the synchronising ring (5), the coupling element (4), the roller bearing (3), the 4th speed gear (2) and the roller bearing (1) from the main shaft and withdraw the roller bearing (14).

Disassemble the synchronising unit (6). Remove the sliding sleeve (10) from the hub (7) taking care to recover the pins (9) and the springs (8). Lay these aside.

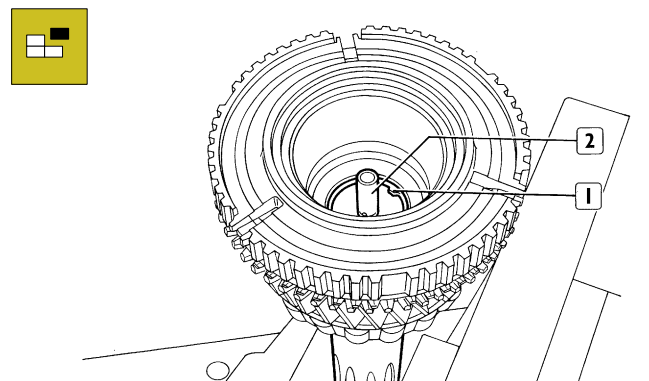
Disassembling the input shaft

Figure 89



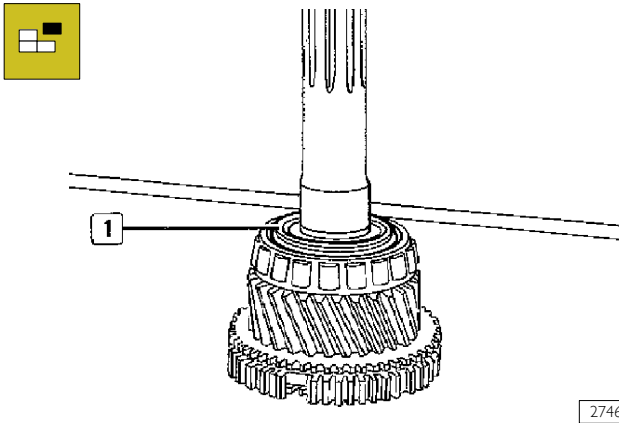
Lock the input shaft (5) in a clamp. Remove the sliding sleeve (2) from the hub (1), taking care to recover the pins (3) and springs (4). Lay these aside.

Figure 90



Remove the split ring (1) and remove the tube (2).

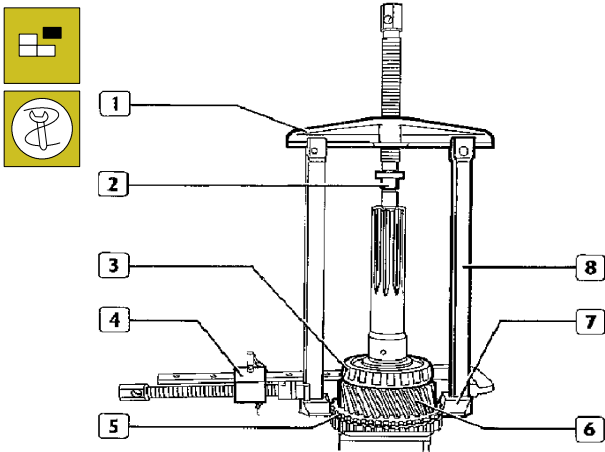
Figure 91



27469

Remove the retaining ring (1) and the splined ring underneath.

Figure 92

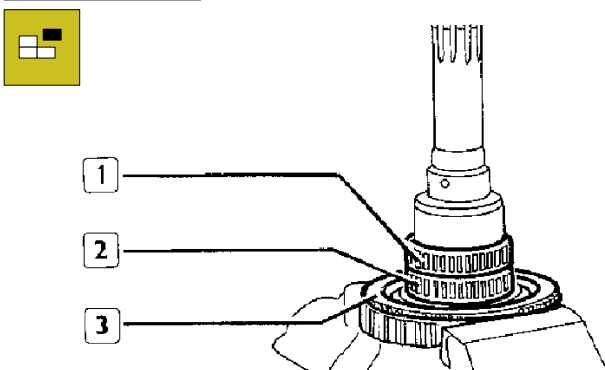


27470

Remove the coupling element (5), gear (6) and inner ring (3) of the input shaft bearing using a puller consisting of:

- ☐ grips (7);
- ☐ tie-rods (8);
- ☐ puller (1);
- ☐ thrust block 99345058 (2);
- ☐ clamp (4).

Figure 93

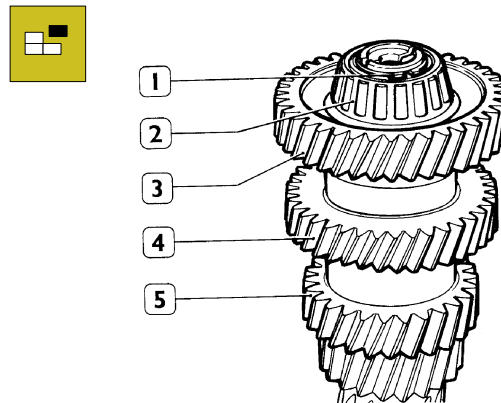


19525

Remove the bearings (1 and 2) and the synchronising ring (3).

Disassembling the transmission shaft

Figure 94



37326

Remove the split ring (1) and with an appropriate puller remove the inner ring (2) of the bearing on the splitter side. In the same way, after turning over the transmission shaft, remove the inner ring of the bearing on the E.R.U. side.



The two roller bearings of the transmission shaft are not interchangeable. Mark them and lay them aside separately to avoid confusing them when reassembling.



With a hydraulic press remove the gears (3rd, 4th and 5th) from the transmission shaft.

CHECKS

Gearbox

There should be no signs of cracks on the gearbox and its covers.

The contact surface between the gearbox and the covers should not be in any way damaged or warped. Remove any residual sealant from these surfaces.

The seats of the bearings, shafts and the gear control levers should not be damaged or badly worn.

Check that the holes, tubes and lubrication grooves are not obstructed by grease or foreign matter.

Hubs - sliding sleeves - forks

The grooves on the hubs and sliding sleeves are to be free of damage. The sliding sleeve is to slide freely on the hub. The sliding sleeve positioning blocks or pins are not to be damaged or worn. The sliding sleeve meshing teeth are to be undamaged. The forks are to be intact and the end float in the sleeve radial groove shall not be more than 0.6 to 1.2 mm.

Bearings

The roller bearings or the roller cages are to be in perfect condition with no signs of wear or overheating.

Shafts - gears

Bearing seats on the shafts are not to show signs of damage or wear. The gear teeth are not to show signs of damage or wear.

Synchronisers

To check the wear on the synchronising rings, proceed as follows:

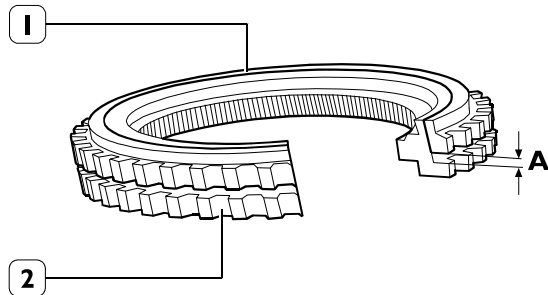


After checking, mark the synchronisers on their gears to avoid changing their position when reassembling.

- ☐ Visually check that the friction surface is not rippled.

Single cone synchronisers type BK

Figure 95



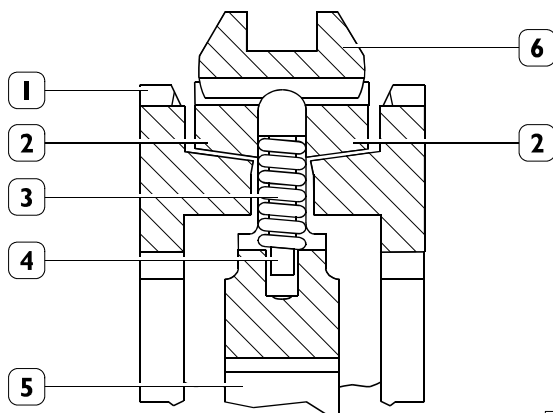
61193

Place the synchronising ring (1) on the coupling element (2). Turn the synchronising ring (1) so that it fits properly on the coupling element (2).

With a thickness gauge check distance A on two diametrically opposite points.

This is not to be less than 0.8 for the gears and splitter ;
- 1.2 for the epicyclic reduction unit.

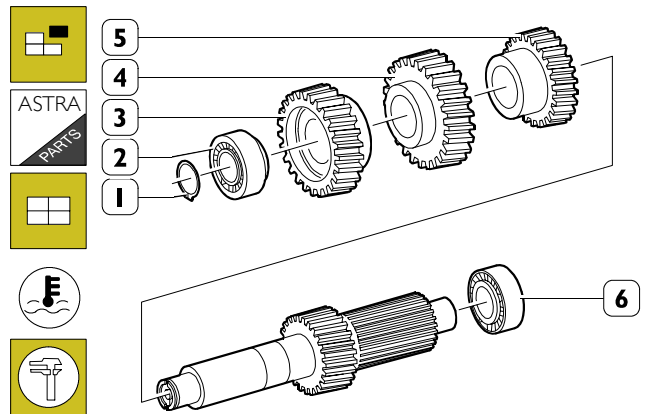
Figure 96



61194

1 - Coupling element; 2 - Synchronising ring;
3 - Compression spring; 4 - Pin; 5 - Synchroniser hub;
6 - Sliding sleeve.

Figure 97



61196

Heat the gears (5th, 4th and 3rd) to 150° - 180°C for about 15 minutes and with a press drive them onto the shaft.



When assembling, the inner rings of the taper roller bearings are to be heated beforehand at a temperature of 100°C for about 15 minutes.

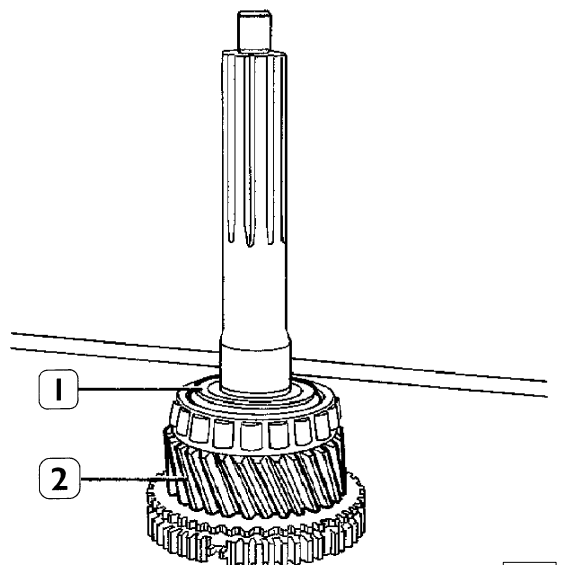
Assemble the inner ring of the bearing (2) splitter side and split ring (1): Check with a thickness gauge that the clearance between the split ring (1) and its seat is within 0.0 to 0.1 mm.

Assembling the input shaft

To assemble the input shaft, follow the instructions given for disassembly in reverse order.

Operations and assembly steps that require special tools, clearance checks, adjustments or special specifications are described below.

Figure 98



27479

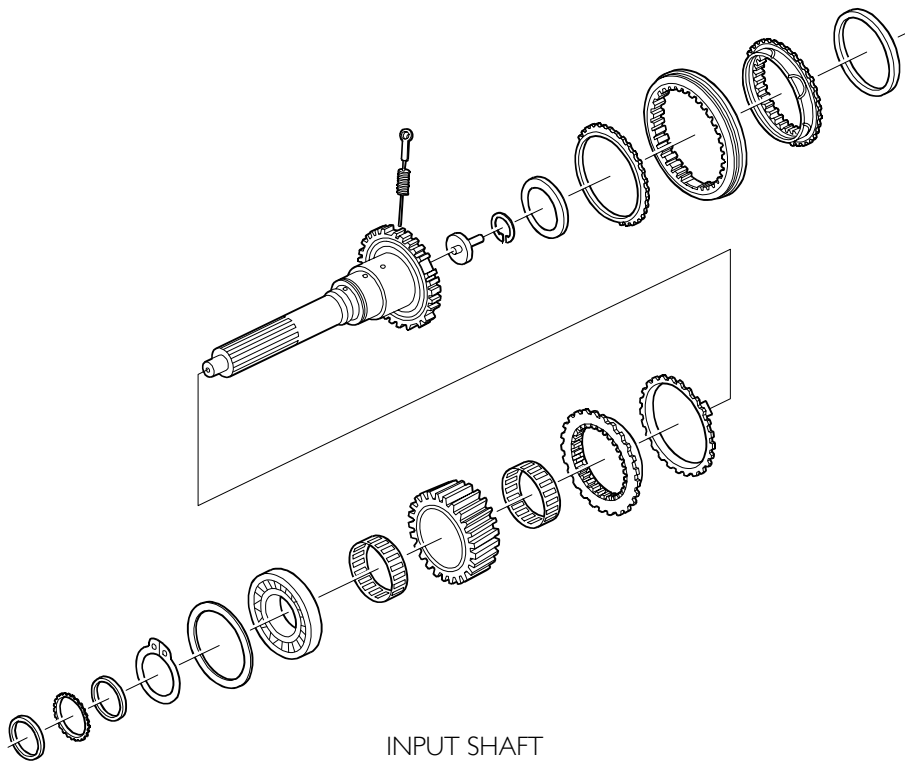
Use a thickness gauge to check the backlash on the input shaft (2): minimum backlash 0.2 mm.
Check the tolerance between the splined ring (1) and its seat.
This should be between - 0.05 to + 0.05 mm



The splined ring (1) is supplied as a spare part in different thicknesses.

After mounting the splined ring (1) fit the retaining ring onto it and dent in two points, diametrically opposite each other.

Figure 99



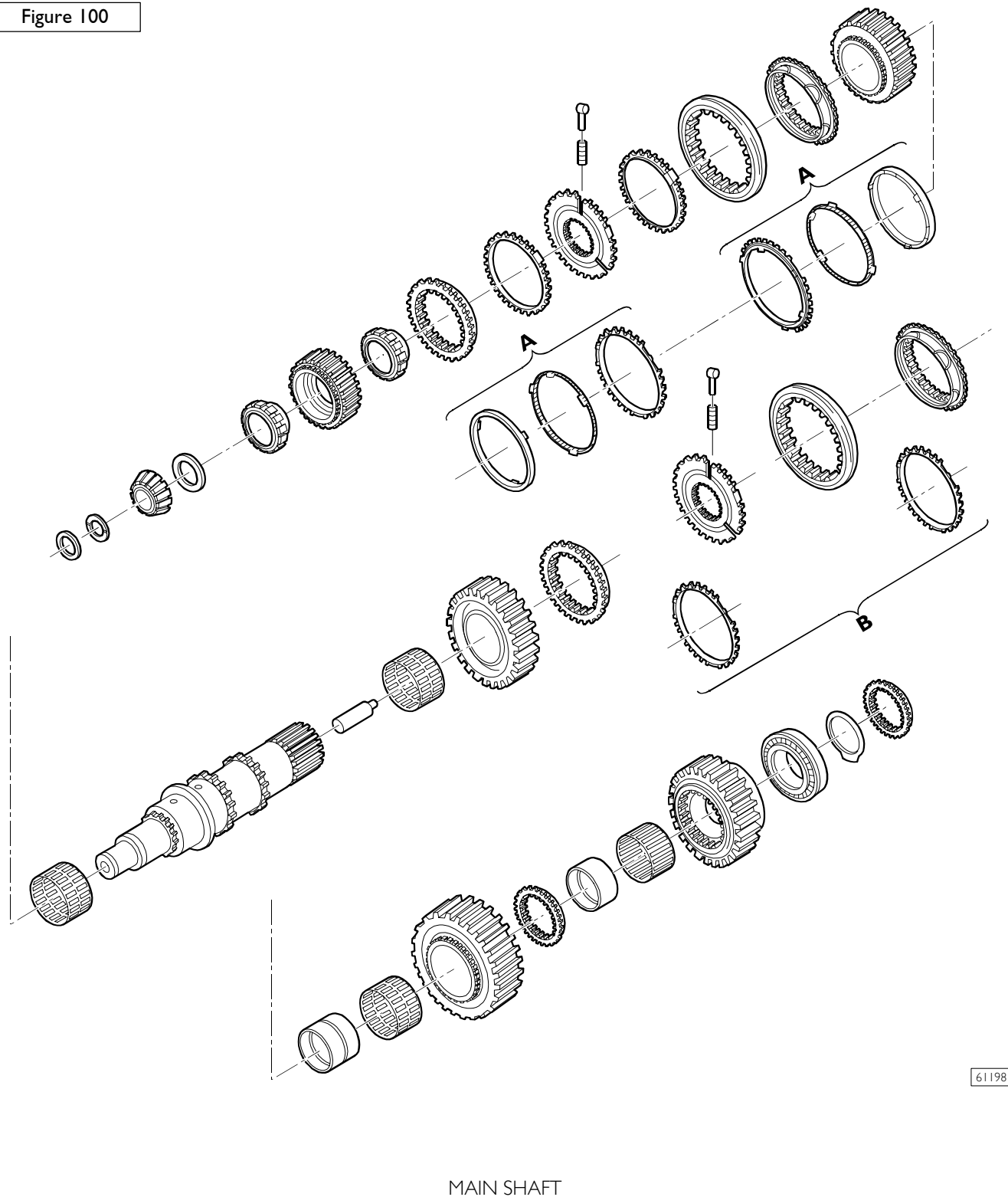
61197

Assembling the main shaft

To assemble the main shaft follow the instructions given for disassembly in reverse order.

Operations and assembly steps that require special tools, clearance checks, adjustments or special specifications are described below.

Figure 100



The main shaft is shown in the straight tooth version.



Before assembly heat:

- ☐ inner rings of bearings at approx. 100 °C;
- ☐ bushings, hubs for sliding sleeves and toothed ring to engage reverse gear at 120 °C;
- ☐ bearing seats on the box and cover A approx. 60°C.



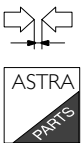
At assembly lubricate gear needle bearings.



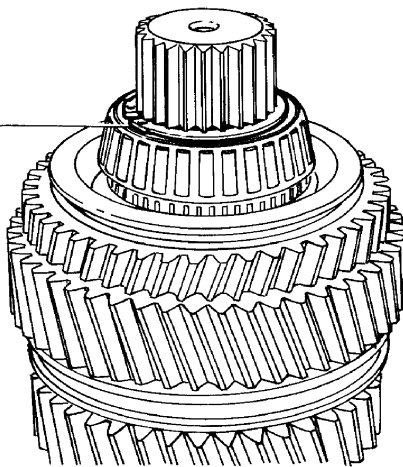
After gears have been assembled check the backlash which should be:

- ☐ 1st - 2nd gears : 0.2 mm;
- ☐ 4th gear : 0.05 mm;
- ☐ reverse gear : 0.4 - 1.15 mm.

Figure 101



I



37327



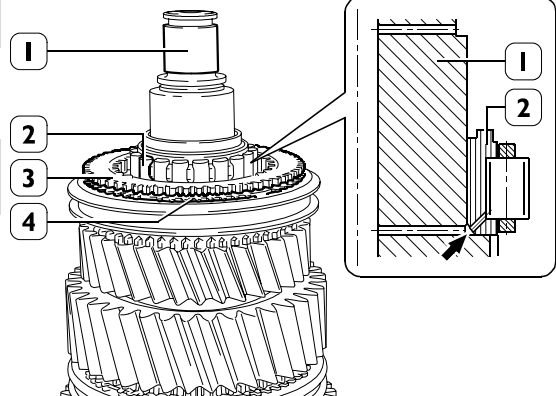
The main shaft is shown in the straight tooth version.

Use a thickness gauge to check the clearance between the split ring (1) and its seat. The clearance should be between 0.0 and 0.1 mm.



The split ring (1) is supplied as a spare part in difference thicknesses.

Figure 102



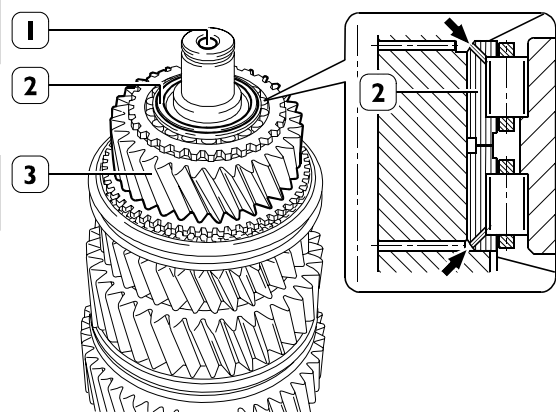
61199

Assemble the 4th gear as follows:

Heat the roller bearing (2) to 100 °C. Fit it on the main shaft (1) with the lubrication holes (→) positioned as shown in the figure. Leave to cool.

Assemble the synchronising ring (4) and the coupling element (3).

Figure 103

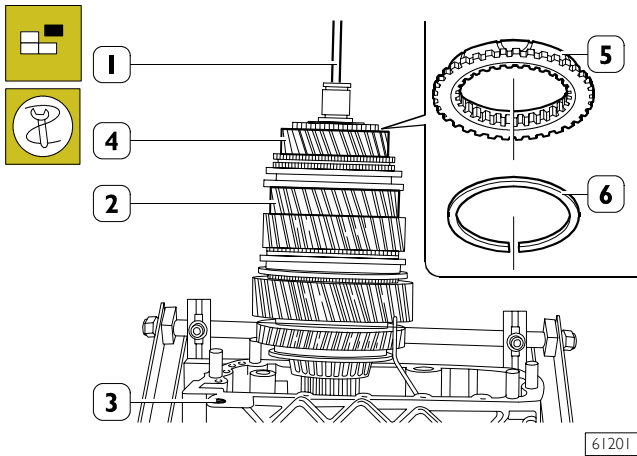


61200

Place the roller bearing (2), with the lubrication holes (→) as indicated in the figure, onto the 4th speed gear (3) then heat them to 100 °C and fit them assembled like this onto the main shaft (1).

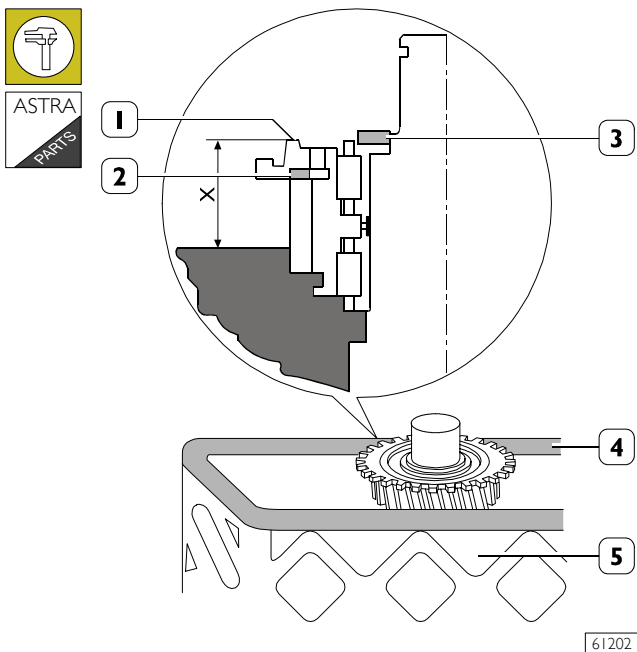
Adjusting the main shaft - version with straight tooth epicyclic reduction unit

Figure 104



Determine the thickness of the adjusting ring (6) of the coupling element (5) for the 4th gear (4) proceeding as follows:
Apply hook 99370449 (1) to the main shaft and with a mobile hoist mount the main shaft (2) in the gearbox (3).
Place the coupling element (5) with adjusting ring (6) on the 4th gear.

Figure 105



Place the gasket (4) on the gearbox (5). Measure distance X between the top of the coupling element (1) and the gasket (4) in several diametrically opposite points.

The average value of distance X should be:

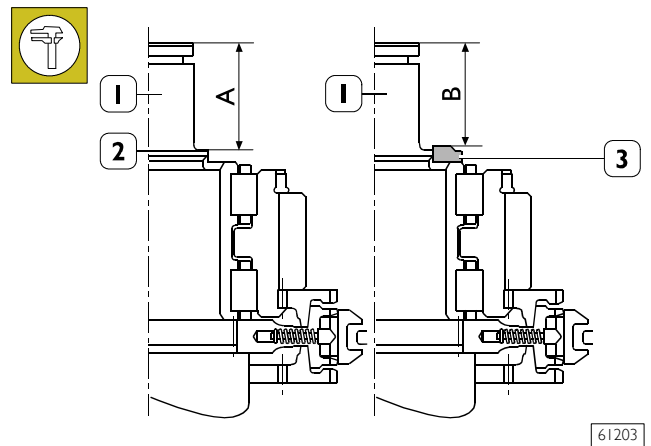
□ $32.2 +^{02}$ mm for gearbox 16 S 151;

□ $19.2 -^{05}$ mm for gearbox 16 S 221.

If a different value is found replace the adjusting ring (2) with another of appropriate thickness.

Adjusting the main shaft - version with helical tooth epicyclic reduction unit

Figure 106



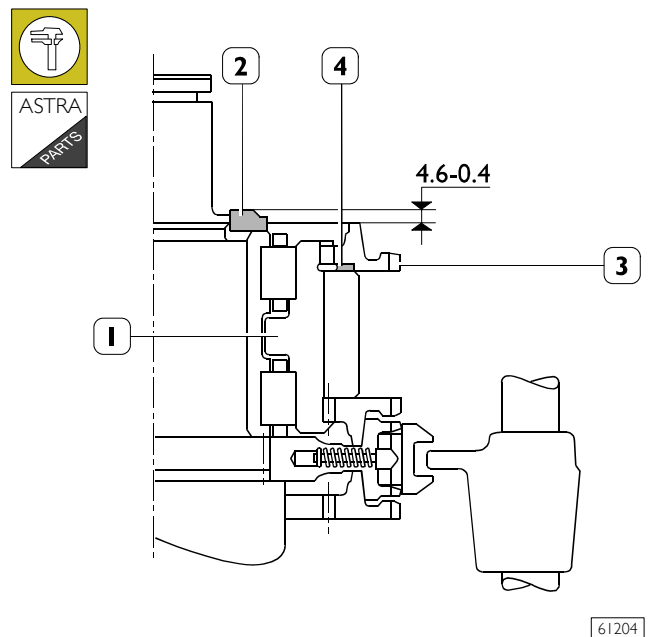
Determine the thickness of the adjusting ring (4, Figure 107) of the coupling element (3, Figure 107) for the 4th gear (4) proceeding as follows:

Measure distance A between the end of the shaft (1) and the taper roller bearing seat (2).

Fit the thrust ring (3) and measure distance B between this and the end of the main shaft (1).

The difference A - B is to be between +0.07 and -0.08 mm.

Figure 107



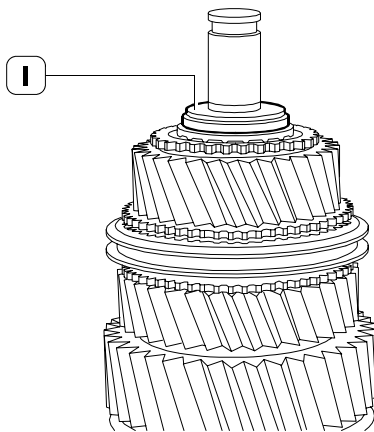
Place the coupling element (3) with adjusting ring (4) on the 4th speed gear.

Measure the distance between the top of the coupling element (3) and the thrust ring (2).

This should be 4.6 - 0.4 mm.

If a different value is found replace the adjusting ring (4) with another of appropriate thickness.

Figure 108

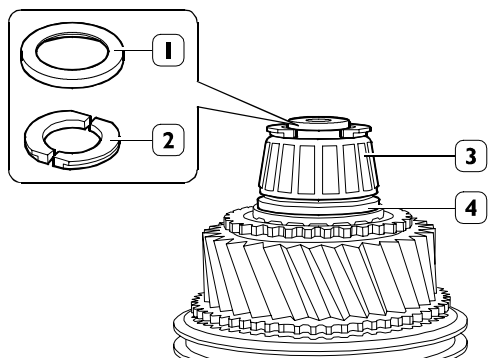


61205

Fit the thrust ring (1); the thickness is to be chosen according to the thickness of the adjusting ring (2, Figure 105 or 4, Figure 107) as indicated in the table below:

Adjusting ring (2, Figure 105 or 4, Figure 107)	Thrust washer (1, Figure 108)
3.2	7.5
3.4	7.7
3.6	7.9
3.8	8.1
4.0	8.3
4.2	8.5
4.4	8.7
4.6	-
4.8	-
5.0	-

Figure 109



61190

Fit the bearing (3) that was previously heated to 100 °C.
Fit the splined ring (2): its thickness is to obtain an end float in its seat of -0.05 to +0.05 mm.
Fit the retaining ring (1) and secure it on several equidistant points under the splined ring (2).

Assembling the gearbox

To assemble the gearbox follow the instructions given for disassembly in reverse order.

Operations and assembly steps that require special tools, clearance checks, adjustments or special specifications are described below.

The tightening torques are indicated in the specific table.



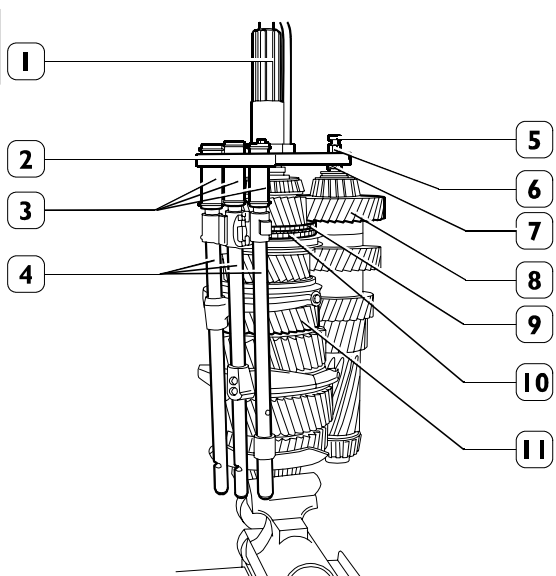
Rings, gaskets, ring nuts, split rings, safety plates, self locking screws which are found worn and all parts that are not perfectly efficient, are scored, indented or warped are to be replaced when assembling.

Flat gaskets are to be fitted in place dry, without sealing agent or grease.



Before fitting the two-lip sealing rings fill the gap between the two lips with TUTELA MR3.

Figure 110



61251

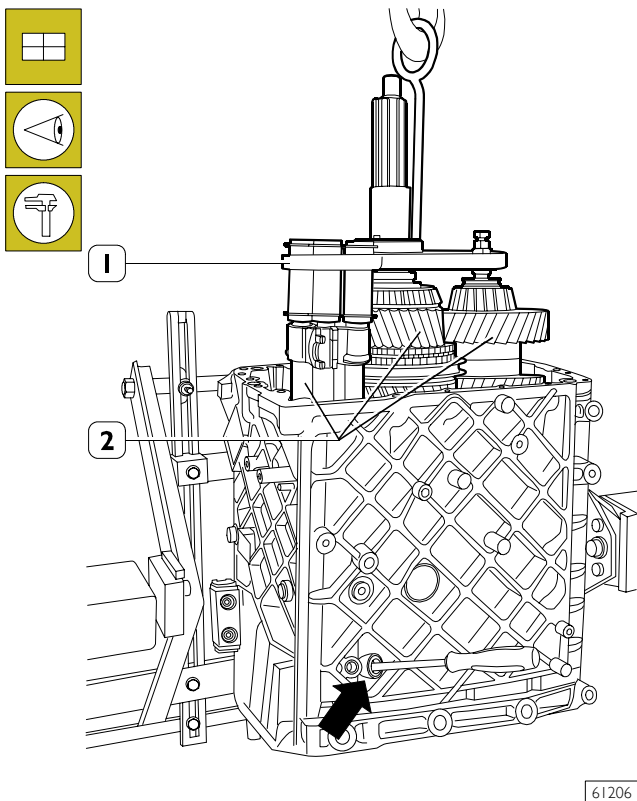
Lock the main shaft (1) in a clamp and fit onto it the coupling element (10) with adjusting ring and synchronising ring (9).

Assemble the input shaft (1).

Fit tool 993605 15 (2) onto the input shaft (1). Couple the transmission shaft (8) to the main shaft (11). Tighten screw (5) of tool 993605 15 (2) into the transmission shaft.

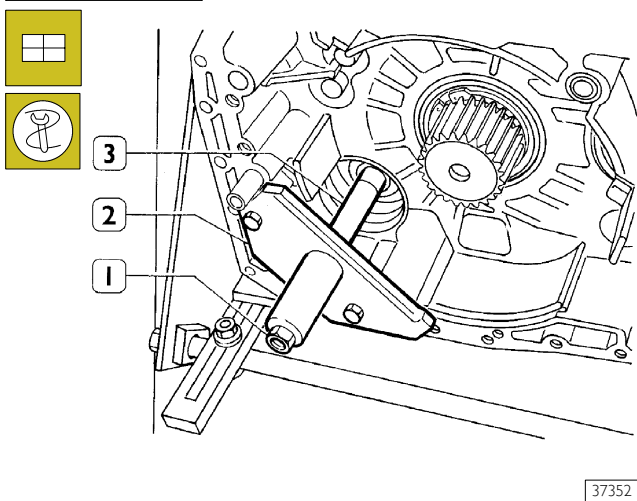
Adjust the nut (6) and threaded bushing (7) so that the transmission shaft (8) remains aligned with the main shaft (11). Fit the forks with the blocks, rods (4) onto the sliding sleeves. Place the sleeves (3) of tool 993605 15 (2) onto the rods (4).

Figure 111



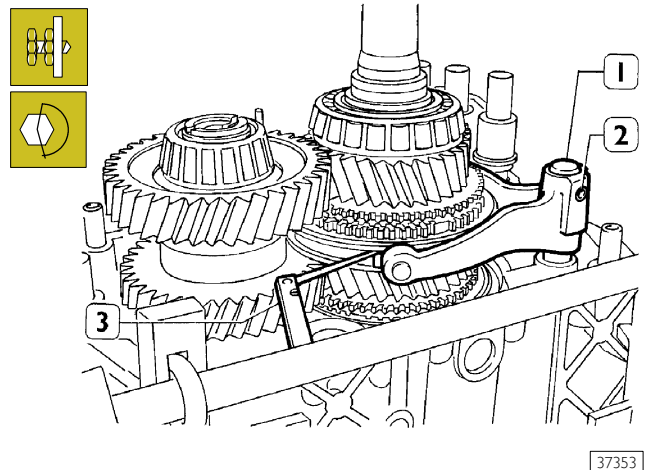
Hook the hoist to tool 993605 15 (1), lift the shafts-rods group (2) as it has been already assembled, and insert it in the gearbox. With a screwdriver inserted in the gearbox hole, push the gear bolt so that the rods can enter their respective housings. Remove tool 993605 15 (1).

Figure 112



Fit tool 99370450 (2) with spacer (3) onto the gearbox and insert the splitter fork control lever, locking it with nut (1).

Figure 113



Operating on the two hex head cap screws (2) position the splitter control fork (1) so that the two shoes (4) are centred in the groove of the sliding sleeve. Use a thickness gauge (3) to ensure centring.

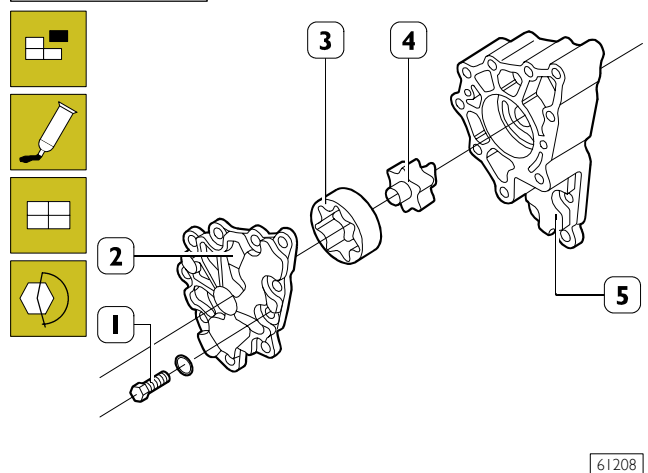
After adjustment tighten the two screws (2) to the specified torque.

Insert the splitter control stop screw onto the gearbox and tighten to the specified torque.

Remove the adjusting tool 99370450 (2, Figure 112) and the spacer (3) from the gearbox after loosening the nut (1).

Oil pump

Figure 114



To strip down the oil pump: undo the screws (1), remove the cover (2) from the pump casing (5) and take out the external rotor (3) and the internal rotor (4).

To reassemble, follow the steps in reverse order.

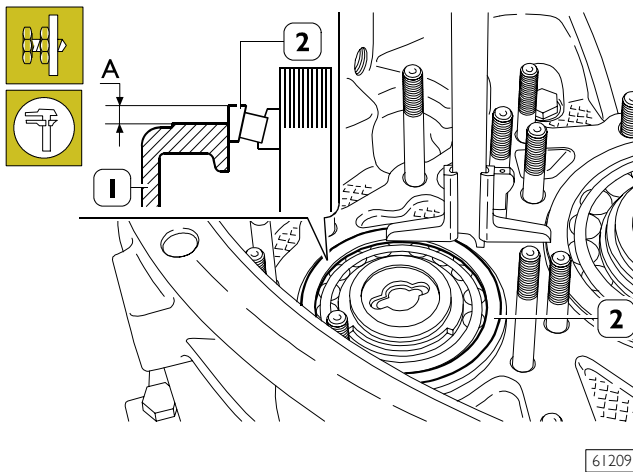


On the cover mounting surface (2) apply a thin film of LOCTITE 547.

Tighten the screws (1) to the specified torque.

Adjusting the transmission shaft end float

Figure 115

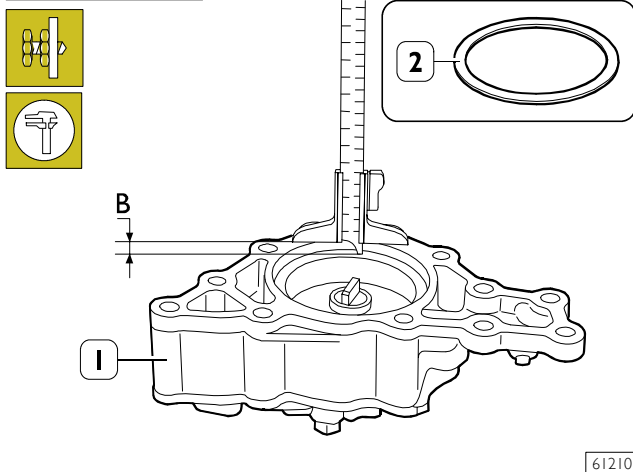


61209

To determine thickness **S** of adjusting rings (2, Figure 116) for the bearing (2) end float on the transmission shaft, proceed as follows:

- ☐ rotate the shafts and check that the bearing outer ring (2) rests without clearance on the bearing rollers;
- ☐ on two diametrically opposite points measure the distance between the front box surface (1) and the outer ring (2) value **A**.

Figure 116



61210

Measure the depth of the bearing seat (2, Figure 115) on the pump casing (1), value **B**.

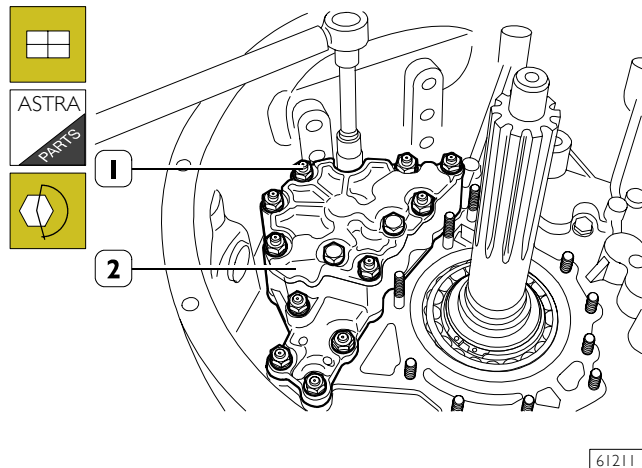
Thickness **S** of the adjusting ring (2) is determined by the following equation:

$$S = [B - (A - C)] - D$$

Where:

- ☐ **A** – B, measurements found;
- ☐ **C**, thickness of gasket;
- ☐ **D**, end float of 0 to 0.1 mm.

Figure 117



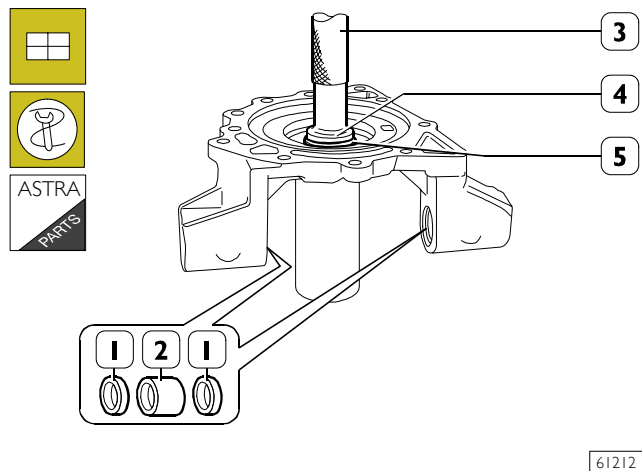
61211

Fit a new gasket on the front cover; fit the oil pump (2) with the adjusting ring (2, Figure 116).

Tighten the nuts (1) and tighten to the specified torque.

Input shaft cover

Figure 118



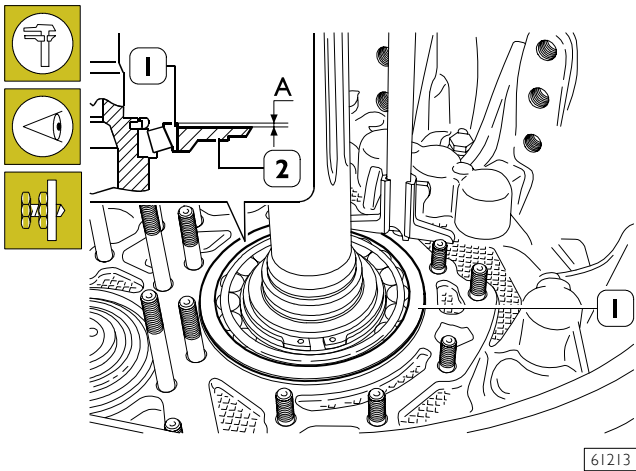
61212

To replace the sealing rings (1) and bushings (2), use standard tools for the removal-refitting.

For sealing ring (5) use connecting tool 99370420 (4) and handle 99370006 (3).

Adjusting the input shaft end float

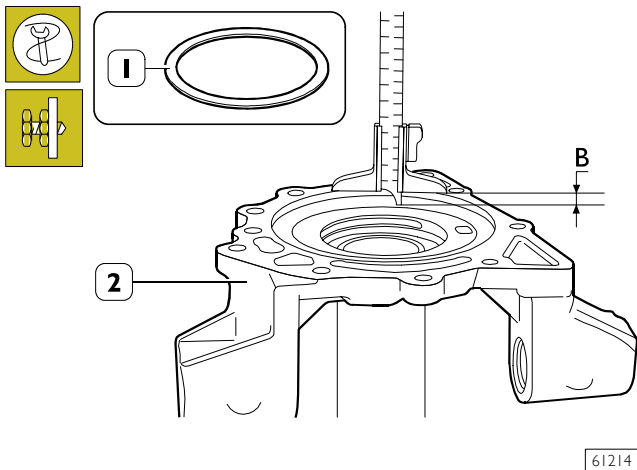
Figure 119



Determine thickness **S** of the input shaft bearing adjusting ring as follows:

- ☐ Rotate the input shaft and check that the outer ring (1) rests without backlash or pre-load on the bearing inner ring;
- ☐ measure the bearing (1) overhang from the front cover surface (2), value **A**;

Figure 120



- ☐ measure the depth of the bearing seat (1, Figure 119) on the cover (2), value **B**.

Thickness **S** of the adjusting ring (1) is determined by the following equation:

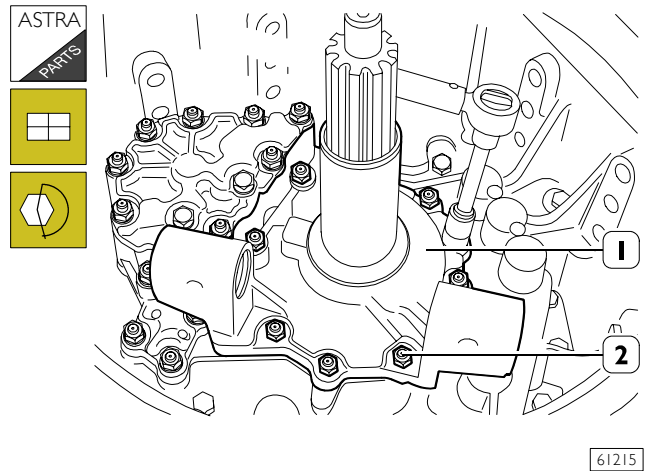
$$S = [B - (A - C)] - D$$

Where:

- ☐ **A – B**, measurements found;
- ☐ **C**, thickness of gasket;
- ☐ **D**, end float of 0 to 0.1 mm.

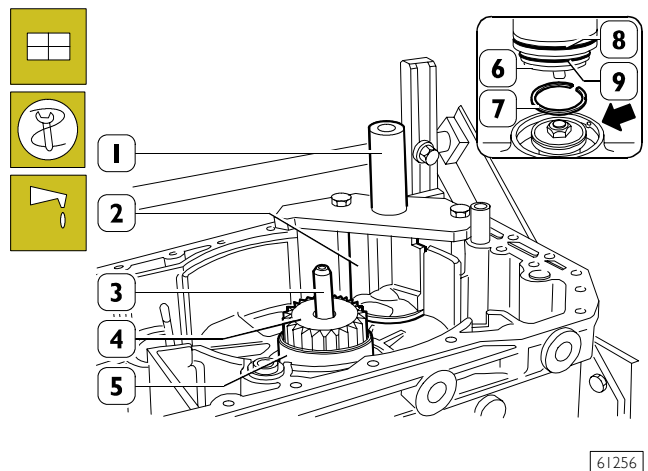
Completion

Figure 121



Place a new gasket on the front cover (1), assemble the cover (1) with the adjusting ring (1, Figure 120). Fit the nuts (2) and tighten to the specified torque.

Figure 122



Turn over the gearbox.
Fit the tube (3) in the main shaft.
Fit the spacer (5) on the main shaft (4) place the split ring (6) in the splitter control cylinder.



Position the ring split (7) to correspond to the hole (→).

Fit the sealing rings (8 and 9) onto the cylinder (6) and lubricate them.

Fit the cylinder (6) in the gearbox.

Fit tool 99370450 (1) onto the gearbox to keep the cylinder (6) in place. Feed the splitter control valve with compressed air (max. 6.8 bar) and listen to hear that the internal piston is operating and that there are no air leaks.

Remove tool 99370450 (1).

Refit the epicyclic reduction unit as described in the relevant section.

Fill the gearbox with the required quality and quantity of lubricating oil.

VERSIONS FITTED WITH INTARDER

This paragraph describes the differences in operation resulting from intarder application.

Refer to the basic configuration for whatever matter not explicitly specified.

DESCRIPTION

Intarder ZF is a hydrodynamic brake mounted on the gearshift output.

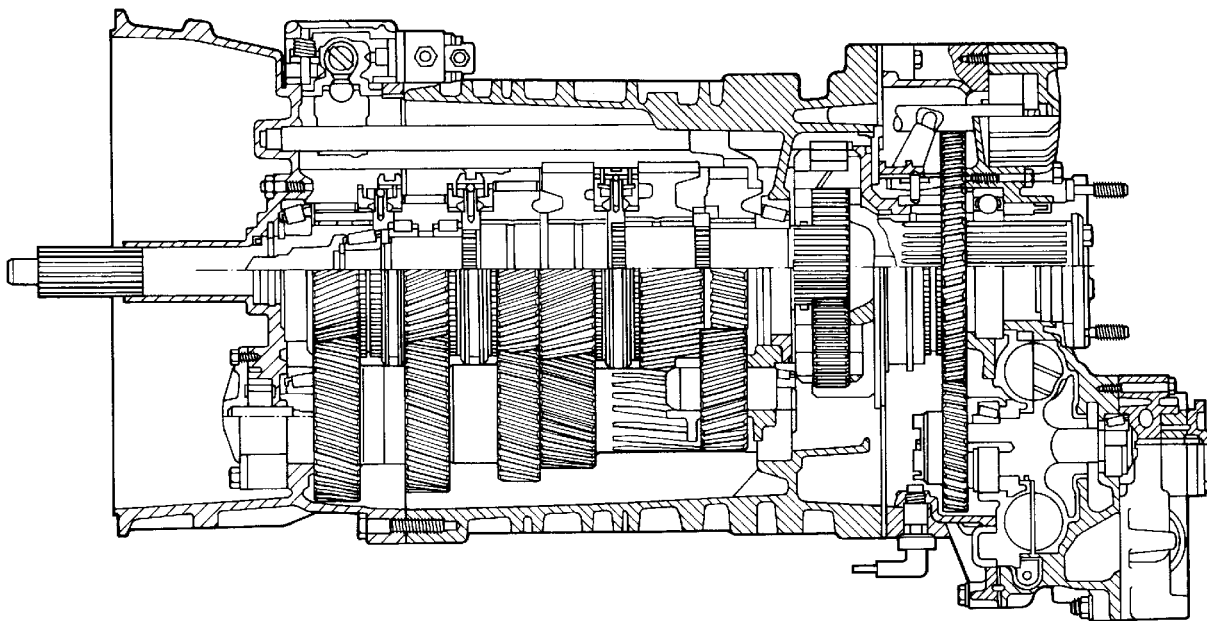
The braking effect is given by the oil contained in the retarder.

The rotor increases the speed of the oil coming into the retarder; which, when meeting the stator, is slowed down. This provokes an increase in oil temperature.

Oil is cooled down through a oil/water heat-exchanger connected to the cooling system of the vehicle. The braking torque deriving from this activity acts on the cinematic chain of the vehicle and slows it down.

Intarder is integrated to the ZF gearshifts.

Figure 123



44050

LONGITUDINAL SECTION OF THE GEARSHIFT IN THE INTARDER

GENERAL CHARACTERISTICS

		Gear ZF 16 S 151	Gear ZF 16 S 221
	REFUELING *		
	Quantity (after revision, gear and retarder completely empty)	17	20.5
		15.3	18.5

* See Section 2 - LUBRICANT AND HYDRAULIC FLUID TABLE for the required type of fluid.

TIGHTENING TORQUES

PIECE	TORQUE	
	Nm	Kgm
Assembling nuts of the heat-exchangers in the rear half-box*	62	6.2
Securing screw of the heat-exchanger in the rear half-box (M8)*	23	2.3

* Versions with built-in heat exchanger

TOOLS

TOOL NUMBER	NAME
99340030	Extractor to work hydraulically to dismount the gear to control the Intarder (use with 99341033 - 99341034 - 99345058).
99341009	Brackets pair.
99341018	Brackets pair with hole.
99341033	Hydraulic unit with 17.5 tons for extractor.
99341034	Hydraulic pump with 50 tons.
99342143	Punch to extract the grub in the rear and front gear boxes (use with 99340205).
99370047	Tool for the pre-loading of the bearings to check consistence on the rotor shaft.
99370048	Centring plate of the rotor shaft on the Intarder box.
99370465	Tool to flatten the safety plates.
99370629	Bench for connecting and disconnecting the gearshift.
99389819	Spanner (0 to 10 Nm) with 1/4" connection.

STRIPPING DOWN - REFITTING GEARBOX

Versions with separate exchanger

Removal

- ☐ To remove the unit proceed as described for standard versions up to servo-clutch draining out;
- ☐ Then drain out engine coolant circuit as described in Section 3;



The disposal of waste or residual fluid in unauthorised sites or in the public sewer system is prohibited.

- ☐ Disconnect coolant delivery (23) and return (24) pipes;



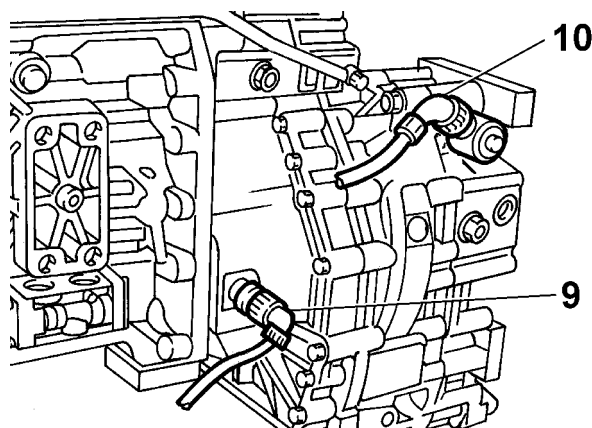
During these operations, coolant leak from pipes can take place.

- ☐ Prepare a suitable container; open gearbox oil drain plug and drain out the gearbox;
- ☐ Disconnect intarder oil delivery (21) and return (22) pipes from oil-water exchanger;



During these operations, oil leak from exchanger or pipes can take place.

Figure 124

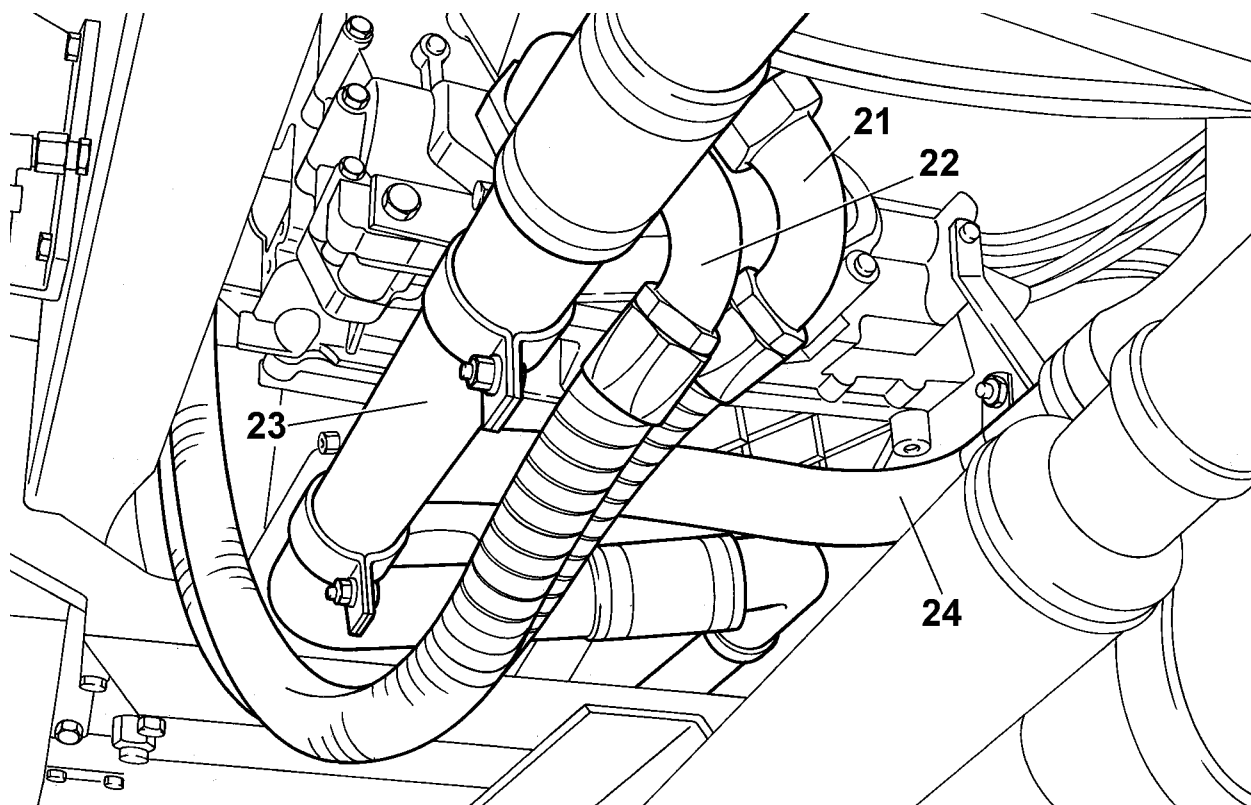


- ☐ Disconnect electrical connections (9) and (10) from in-tarder housing and then proceed as described for standard versions.

Refitting

To refit, follow the removal operations in reverse order.

Figure 125



Versions with built-in exchanger

Removal

- ☐ To remove the unit proceed as described for standard versions up to servo-clutch draining out;
- ☐ Then drain out engine coolant circuit as described in Section 3;



The disposal of waste or residual fluid in unauthorised sites or in the public sewer system is prohibited.

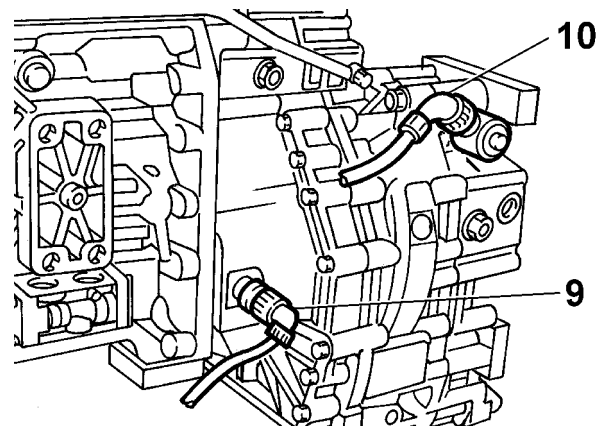
- ☐ Disconnect coolant delivery (23) and return (24) pipes;



During these operations, oil leak from exchanger or pipes can take place.

- ☐ Disconnect pneumatic (17) and electric (18) connection from exchanger (26);

Figure 126

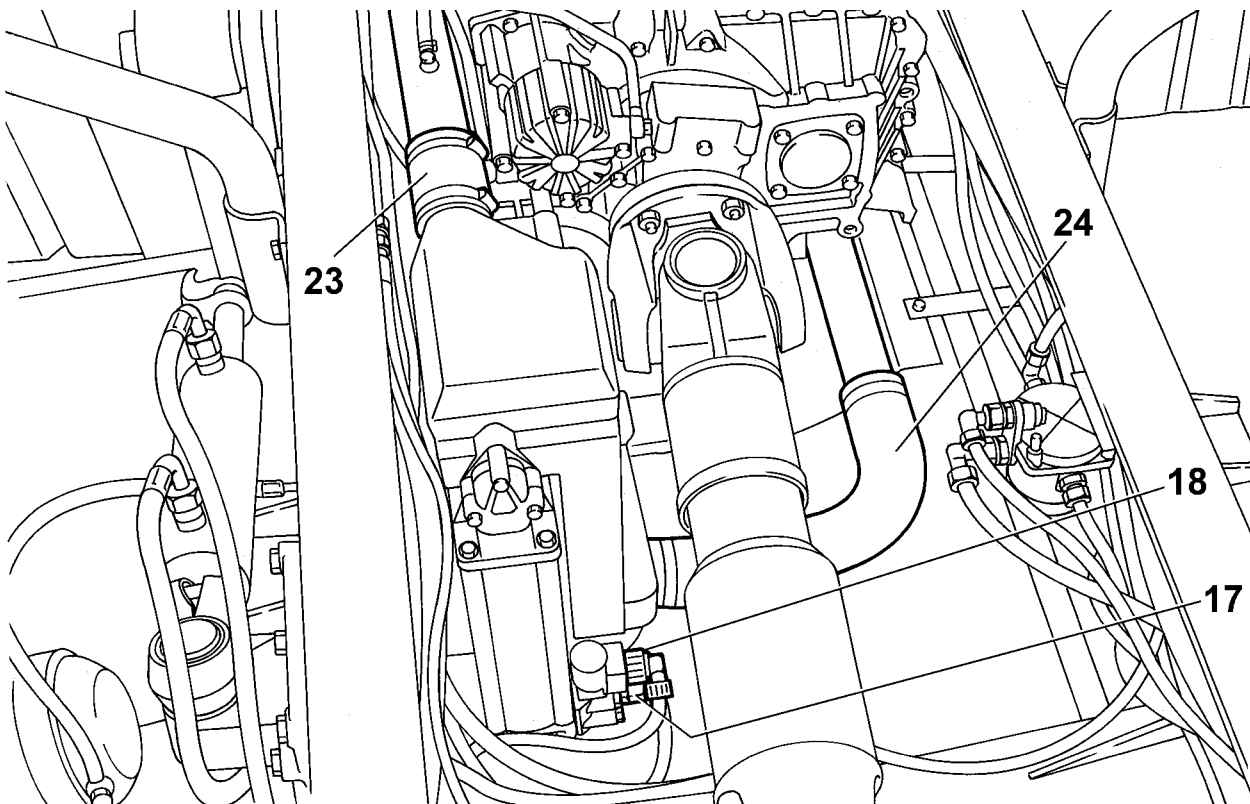


- ☐ Disconnect electrical connections (9) and (10) from in-tarder housing and then proceed as described for standard versions.

Refitting

To refit, follow the removal operations in reverse order.

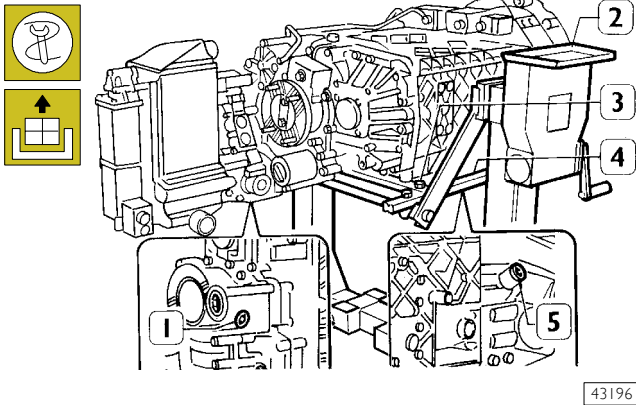
Figure 127



REPAIR OPERATIONS

Removing the hydraulic retarder

Figure 128

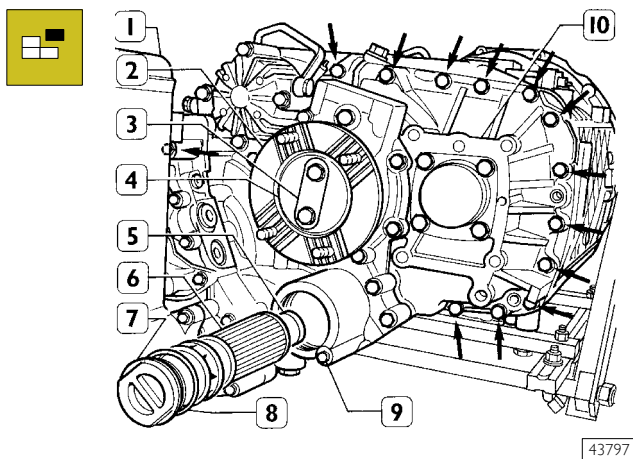


Apply supporting brackets 99371050 (3) to the group. Using cables with hooks and mobile hoist, place the assembly on the revolving stand 99322205 (2) with its support 99322225 (4).

Remove the cap (5) and drain off the lubrication oil from the gearshift.

Remove the cap (1) and drain the lubricating oil from the hydraulic retarder.

Figure 129



Raise the first covering of the safety plate (3) and then remove the plate.

Remove the securing screws of the output flange (2), the plate (4) and the sealing ring underneath.

Remove screw (9) and take out: cap (7) with sealing ring (8), oil filter (6) and magnet (5).

Place the gearshift vertical.

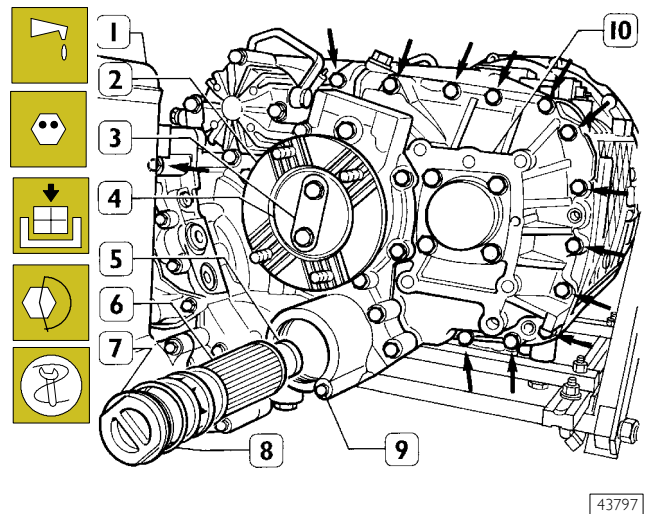
Remove the screws (→) securing the hydraulic retarder (1) to the epicyclic reduction unit (10). Harness the heat exchanger with ropes and with a hydraulic hoist remove the hydraulic retarder (1) from the epicyclic reduction unit (10).



Recover the adjusting rings from the stator and from the bearing seat of the epicyclic group shaft.

Refitting the hydraulic retarder

Figure 130



Fit the adjusting rings on the E.R.U. support bearings and the hydraulic retarder.

Refit the hydraulic retarder (1) on the E.R.U. box (10), tightening the screws (→) to the specified torque.

Mount the magnet (5), the oil filter (6), the cap (7) with the sealing ring (8) and tighten the screws (9) to the specified torque.

Fit the flange (2) on the E.R.U. shaft

Lubricate the sealing ring and mount it.

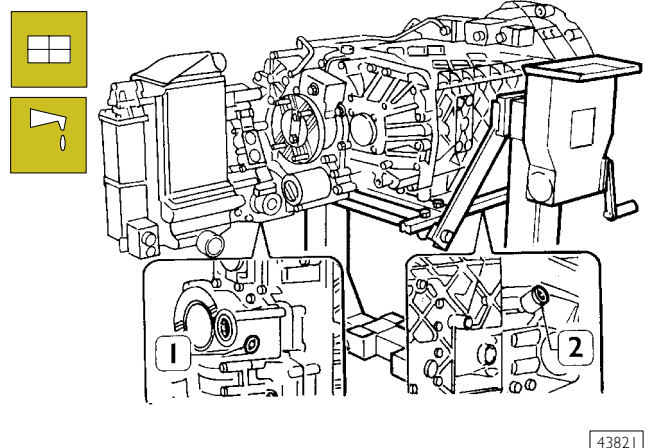
Fit in place the retaining plate (4) and tighten the screws to the specified torque.

Insert the screws in the safety plate (3) and secure with tool 99370465.



Replace sealing elements with new ones.

Figure 131

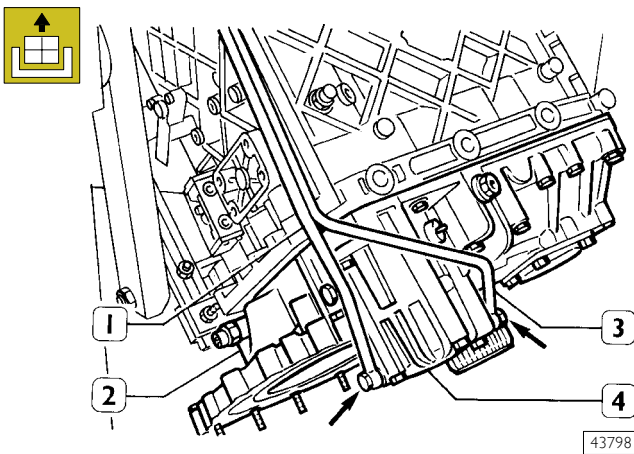


Mount the outlet cap (1) of the retarder and the oil drain cap of the gearshift.

Fill the unit with the quantity and quality of oil specified.

Removing the epicyclic reduction unit (E.R.U.)

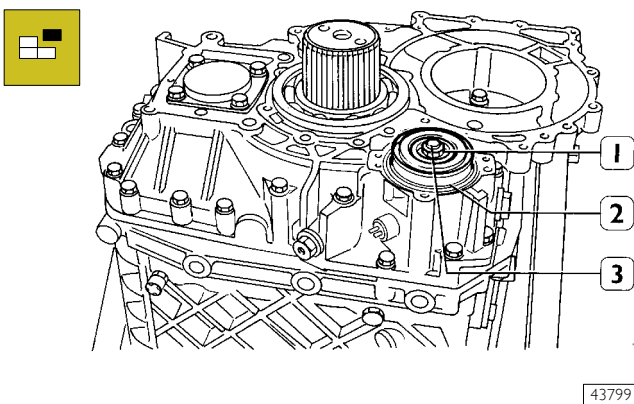
Figure 132



Remove the hydraulic retarder as described in the relevant section.

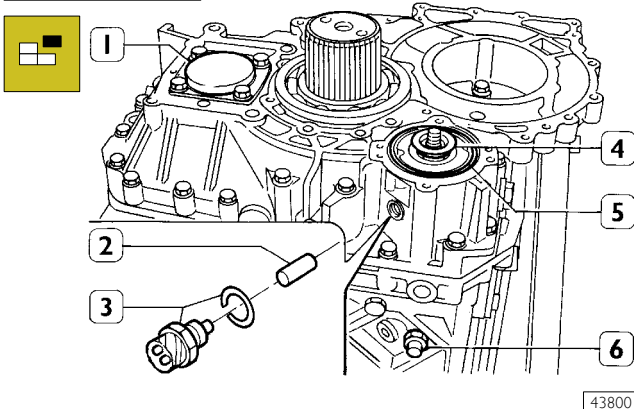
Remove the unions (→) and disconnect the pipes (1 and 3) from the cylinder (4). Remove the cylinder (4) from the E.R.U. box (2).

Figure 133



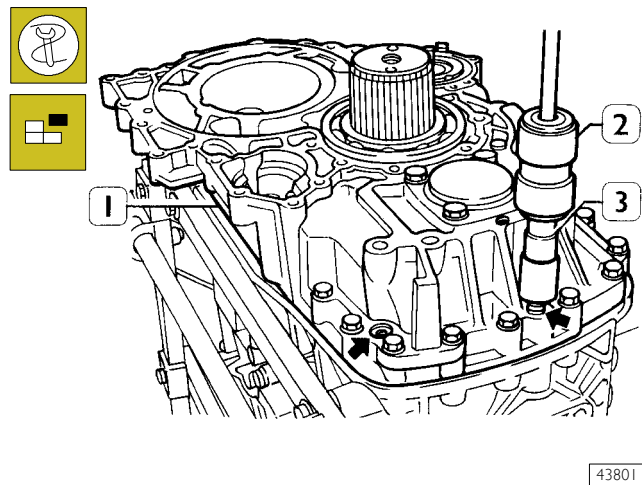
Remove the nut (1) and withdraw the piston (2) from the rod (3).

Figure 134



Remove from the E.R.U. box (1): sealing ring (5), gasket (4), switch (3), push rod (2) and blocking pin (6).

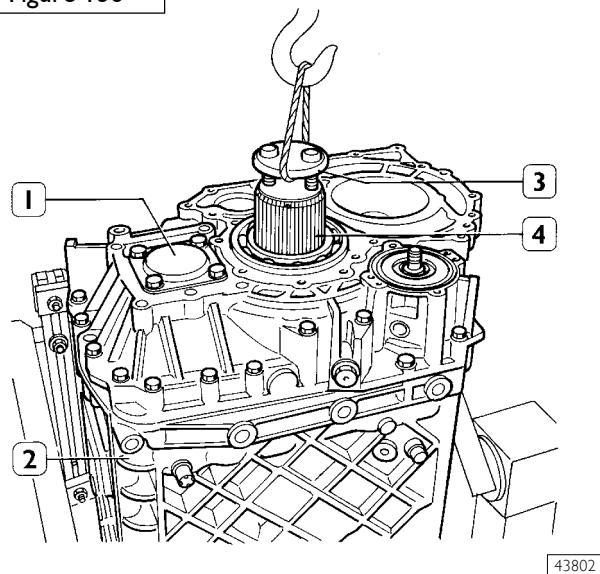
Figure 135



Use percussion puller 99340205 (2) and part 99342143 (2) to remove two of the three centring pins from the E.R.U. box (1).

The arrows indicate the external pins to remove, there is a third pin inside.

Figure 136



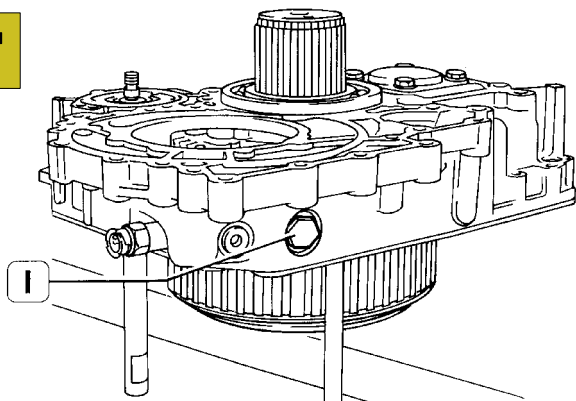
Remove the screws securing the E.R.U. box (1) to the gear box (2). With two screws fasten the retaining plate (3) to the shaft (4). With a rope and hydraulic lifter remove the E.R.U. box (1) from the gear box (2).

Disassembling the epicyclic reduction unit (E.R.U.)



The following procedures refer to the disassembly and assembly operations of the helical tooth epicyclic reduction unit (E.R.U.) that differ from those described for gearshifts without retarder.

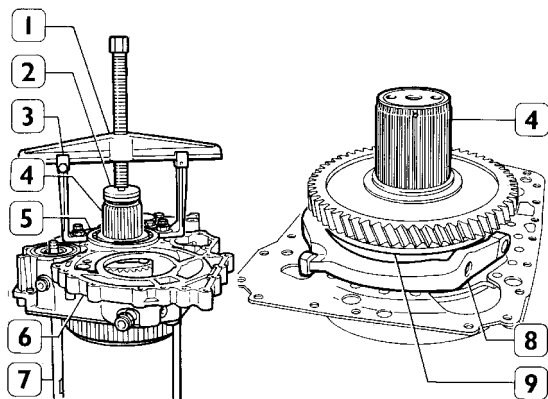
Figure I37



43803

Place the epicyclic reduction unit (2) on the workbench and remove the pins (1) of the fork joints (8, Figure I38).

Figure I38



36804

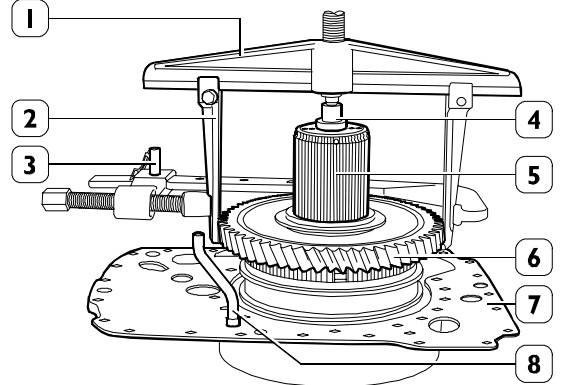
Apply a puller consisting of : puller (1), tie-rods (3) and block (2) to the E.R.U. box as shown in the figure and take out the bearing (5) and the box (6) from the E.R.U. shaft (4).



During this operation, hold the rod (7) tight and withdraw it from the box (6) after the rod is free of the fork (8).

Remove the fork (8) with the blocks from the sliding sleeve (9).

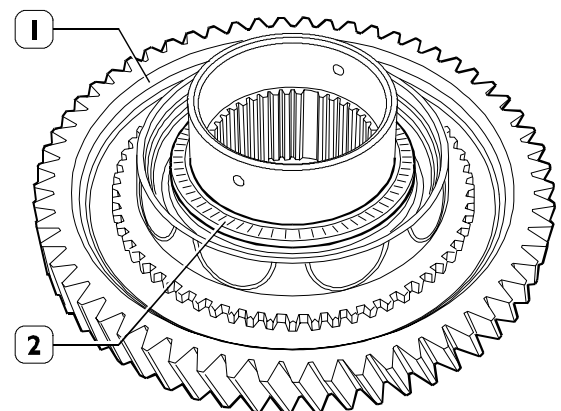
Figure I39



61216

With a puller consisting of: puller (1), brackets (2), element (4) and clamp (3) remove the gear (6) from the E.R.U. shaft (5). Remove the plate (7) with the lubrication tube (8).

Figure I40



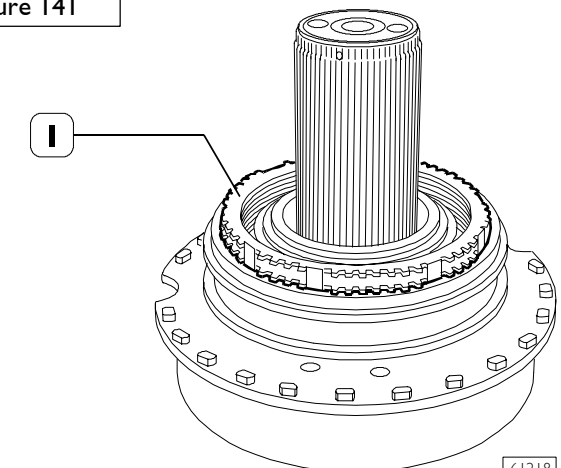
61217



Only for helical tooth version.

Remove the bearing (2) from the gear (1).

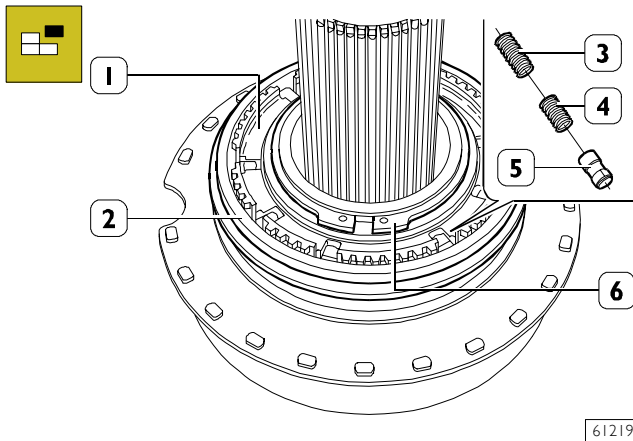
Figure I41



61218

Remove the synchronising ring (1) from the sliding sleeve hub.

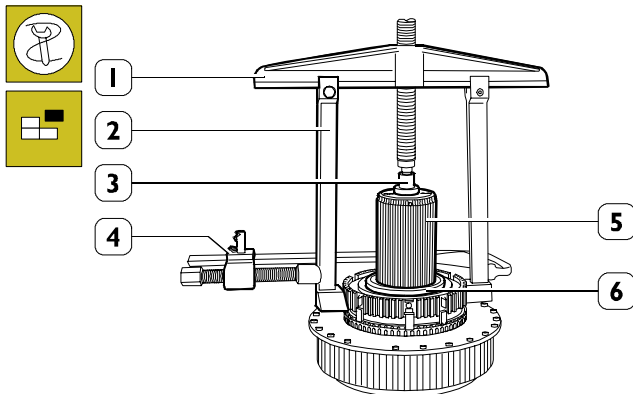
Figure I42



61219

Taking care that the blocks (5) and springs (3 and 4) do not come out of the hub (1), remove the sliding sleeve (1) from the latter; remove the split ring (6).

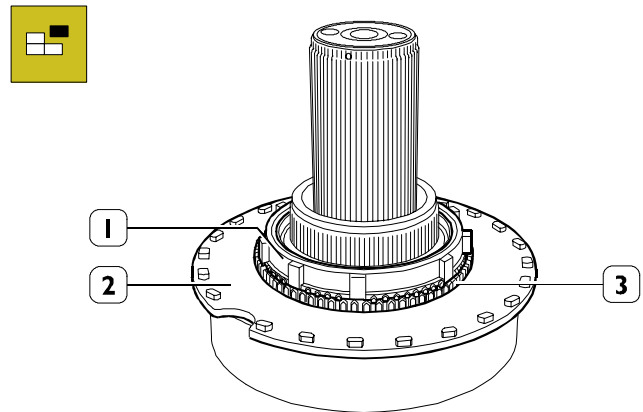
Figure I43



61252

With a puller consisting of : puller (1), brackets (2) thrusting element (3) and clamp (4) remove the sliding sleeve hub (6) from the E.R.U. shaft (5).

Figure I44

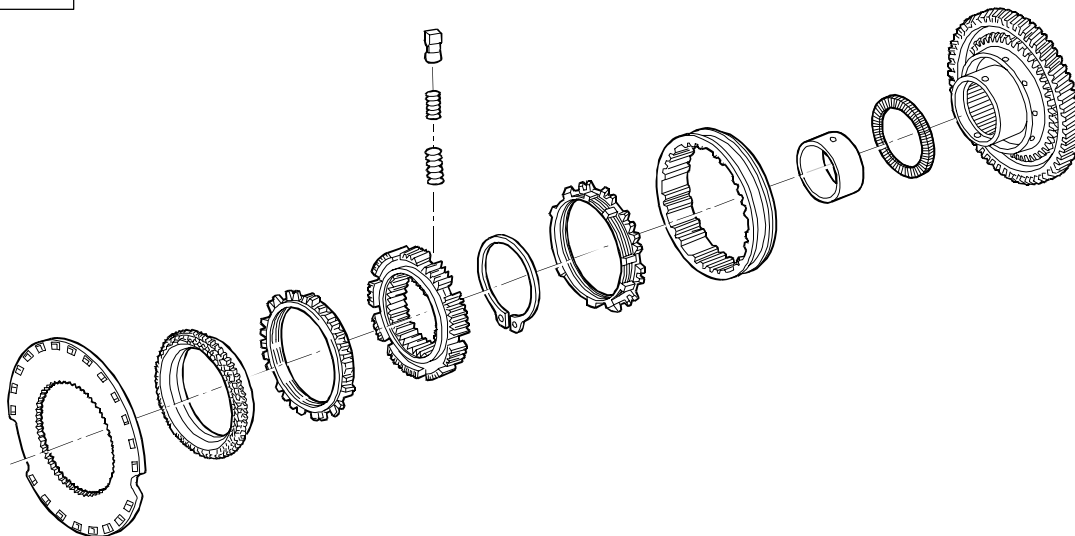


61220

Remove the synchronising ring (1) and the coupling element (3) with the plate (2).

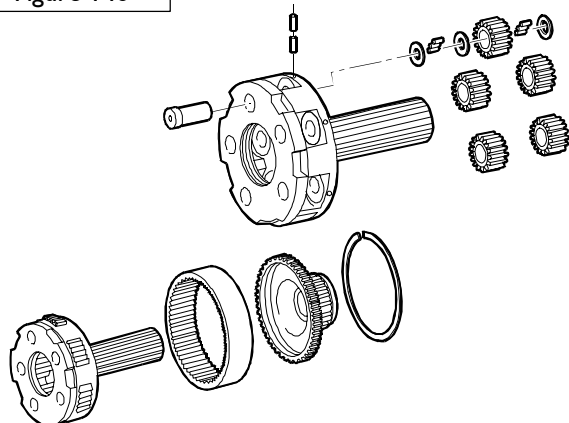
Levering under the coupling element (3) take this out from the plate (2).

Figure I45



61221

Figure 146

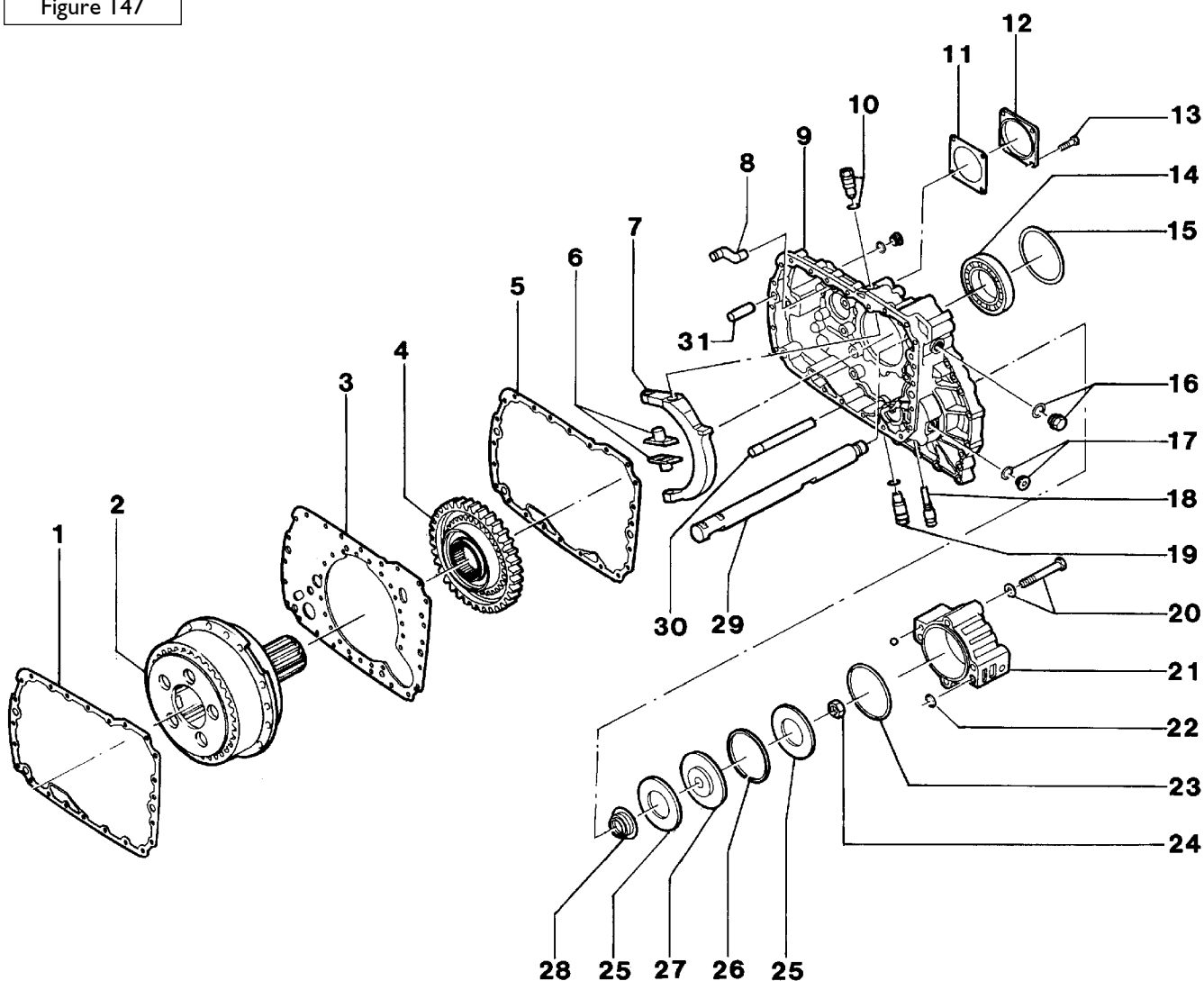


61253

Epicyclic reduction unit components

Strip down the epicyclic reduction unit as described for gearshift without retarder.

Figure 147

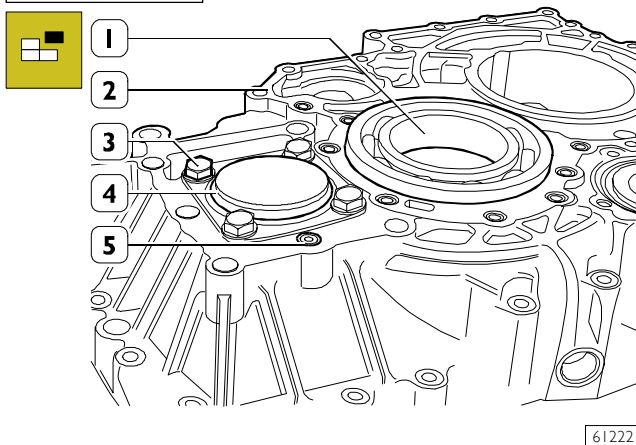


43807

E.R.U. CONTROL AND BOX COMPONENTS

1. Gasket - 2. E.R.U. - 3. Plate - 4. Gear - 5. Gasket - 6. Shoes - 7. Fork - 8. Spraying pipe - 9. E.R.U. box - 10.-
 11. Gasket - 12. Cover - 13. Screw - 14. Ball bearing - 15. Adjusting ring - 16. Cap with gasket - 17. Cap with gasket -
 18. Sensor - 19. Fork joint screw with washer - 20. Screw with washer - 21. Cylinder - 22. Sealing ring - 23. Sealing ring -
 24. Nut - 25. Sealing ring - 26. Spacer ring - 27. Piston - 28. Sealing ring - 29. Rod - 30. Pipe - 31. Pin.

Figure 148



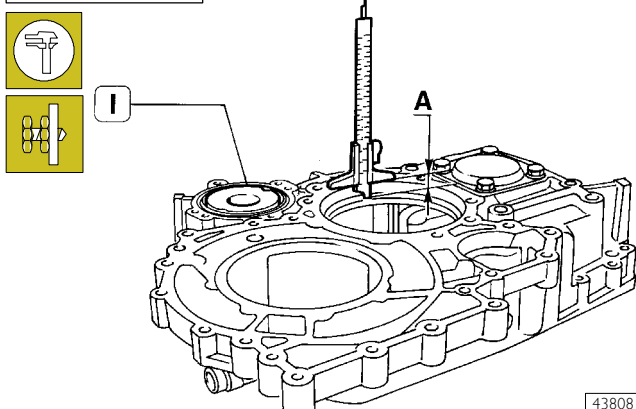
61222

Remove the ball bearing (1) from the E.R.U. box (2).
Undo screws (3) and remove the cover (4)
Undo the screw (5).

Assembling the epicyclic reduction unit (E.R.U.)

To assemble the epicyclic reduction unit follow the disassembly operations in reverse order.
Operations and assembly steps that require special tools, clearance checks, adjustments or special specifications are described below.

Figure 149

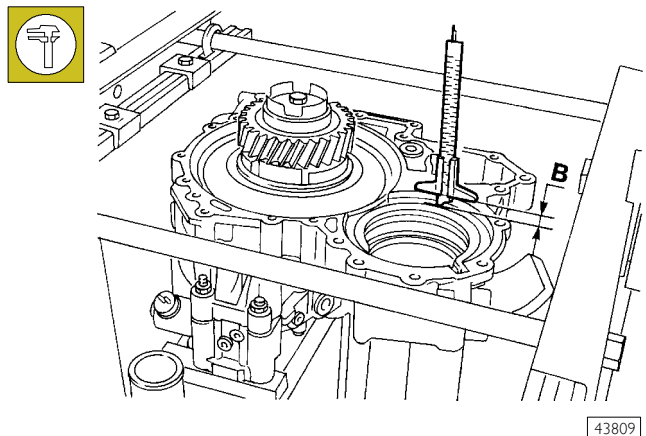


43808

To determine thickness S of the end float adjusting ring on the E.R.U. ball bearing, proceed as follows:

- ☐ measure the depth of the bearing seat in the E.R.U. box (I): value A.

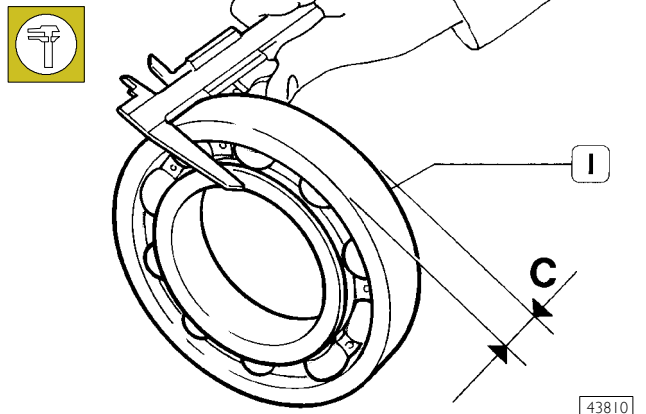
Figure 150



43809

Measure the depth of the bearing seat in the retarder: value B.

Figure 151



43810

- ☐ measure the thickness of the bearing (I): value C;
- ☐ measure the thickness of the gasket between retarder and E.R.U. box: value D.

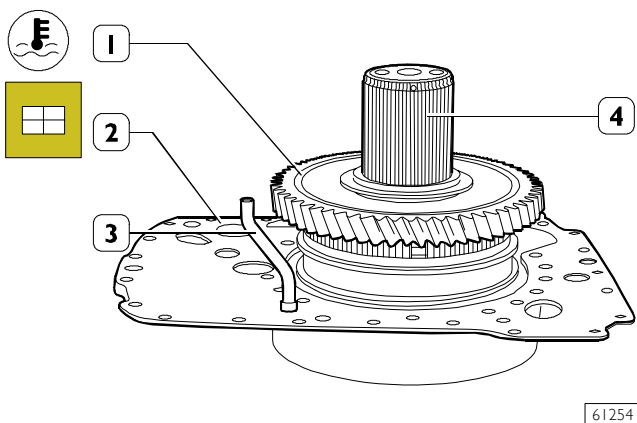
Thickness S of the adjusting ring to be fitted between the ball bearing and the retarder is obtained from this equation:

$$S = [(A + B + D) - C] - Y$$

where:

- ☐ A - B - C - D = values found in the previous measurements;
- ☐ Y = 0.1 mm end float of ball bearing (0.00 to 0.10 mm)

Figure I 52



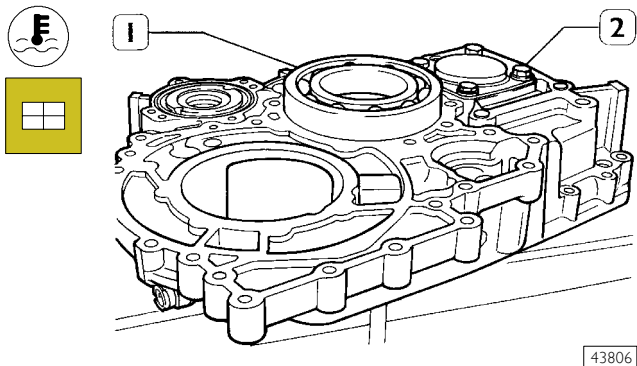
61254

Place the plate (2) with pipe (3) on the E.R.U. (3).



Warm the gear (1) to a temperature of 160 °C for not more than 10 seconds.
Fit the gear (1) on the E.R.U. shaft (3).

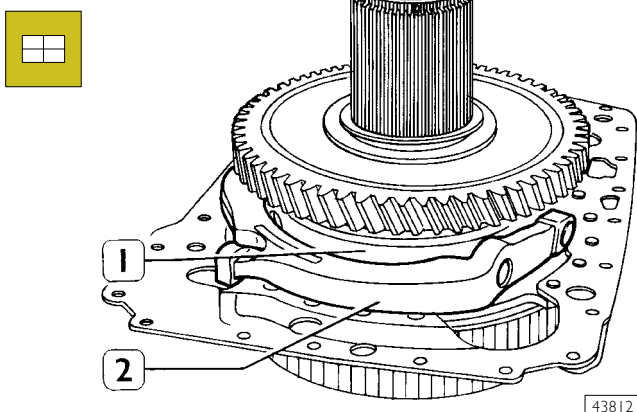
Figure I 53



43806

Warm the ball bearing seat (1) on the E.R.U. box (2) to ~60°C and mount the ball bearing (1).

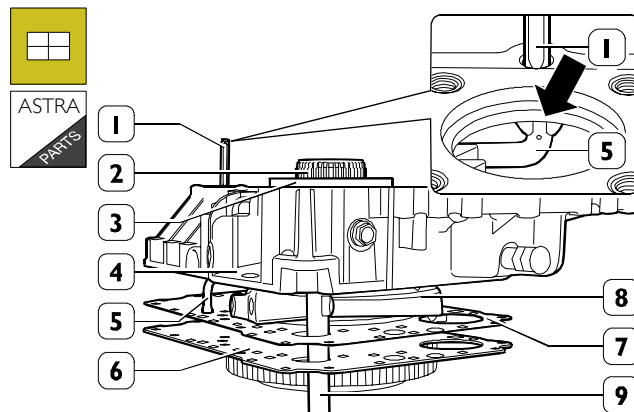
Figure I 54



43812

Arrange the fork (2) with its blocks on the sliding sleeve (1).

Figure I 55



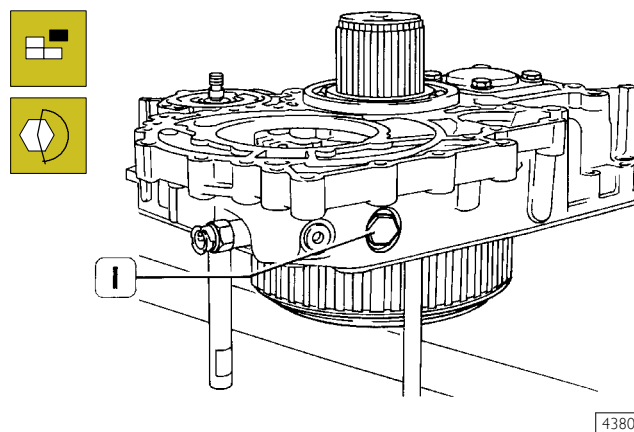
61223

Fit a new gasket (7) on the plate (6).
Partially mount the ball bearing (3) with the box (4) on the E.R.U. shaft (2).
Insert the rod (7) in its seat in the box (4).
Place the fork (8) in the cut of the rod (9) and keeping this in position finish mounting the ball bearing (3) on the shaft (2).



When mounting the ball bearing (3) use a punch (1) to guide the pipe (5) so that it goes into its seat (→) in the box (4).

Figure I 56

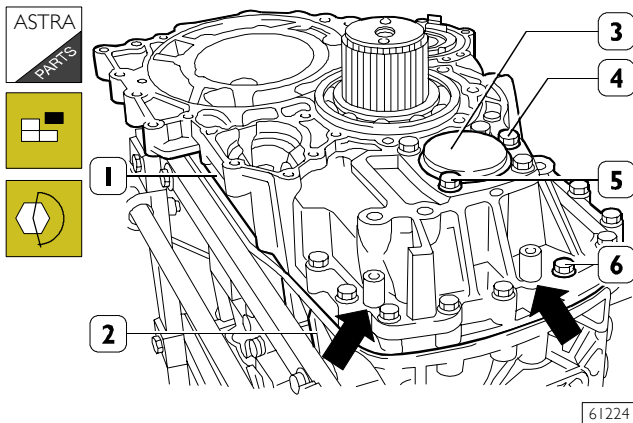


43803

Secure the fork (5, Figure I 55) to the box with the pins (1) and tighten them to the specified torque.

Refitting the epicyclic reduction unit (E.R.U)

Figure 157



61224

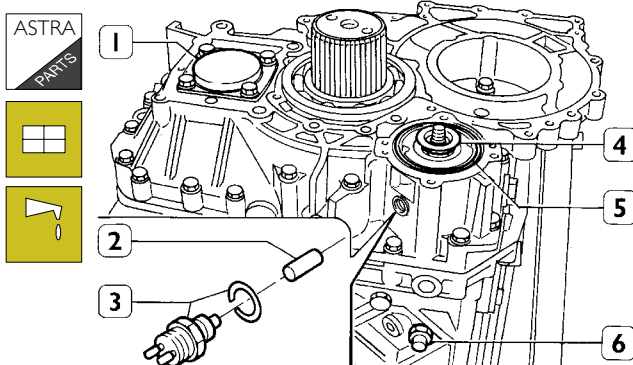
Fit a new gasket on the gearbox (2) and refit the E.R.U. box (1).

Fit the two centring pins (→) and tighten the securing screws to the specified torque.

Fit the cover (3) with a new gasket and tighten the screws (5) to the specified torque.

Tighten the cap (4).

Figure 158

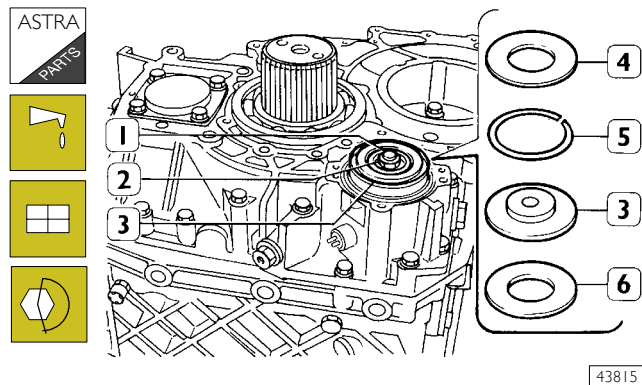


43800

Insert the push rod (2) in the gearbox and mount the switch (3) with the washer. Mount the blocking pin (6).

Lubricate the sealing ring (5), the gasket (4) and fit them on the box (1).

Figure 159

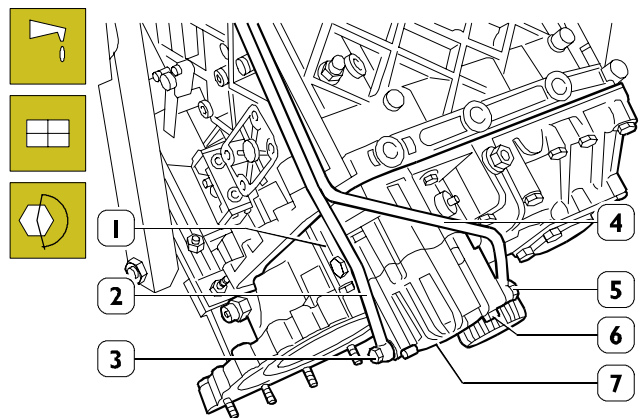


43815

Replace the sealing rings (4 and 6), the spacer ring (5) of the piston (3) and lubricate them.

Fit the piston (3) on the rod and tighten the nut (2) to the specified torque.

Figure 160



61271

Lubricate inside the cylinder (7), mount it on the box (1) and tighten the securing screws (6) to the specified torque.

Connect the pipes (2 and 4) to the cylinder (7), tighten the unions (3 and 5) with new sealing washers to the specified torque.

Refit the hydraulic retarder and fill the group with the quantity and quality of oil prescribed.

REDUCTION GEAR UNIT TCI800

SECTION 9.1

SECTION 9.1

Reduction gear unit TCI800

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☐ Transmission of motion pictorial diagram: off road	7
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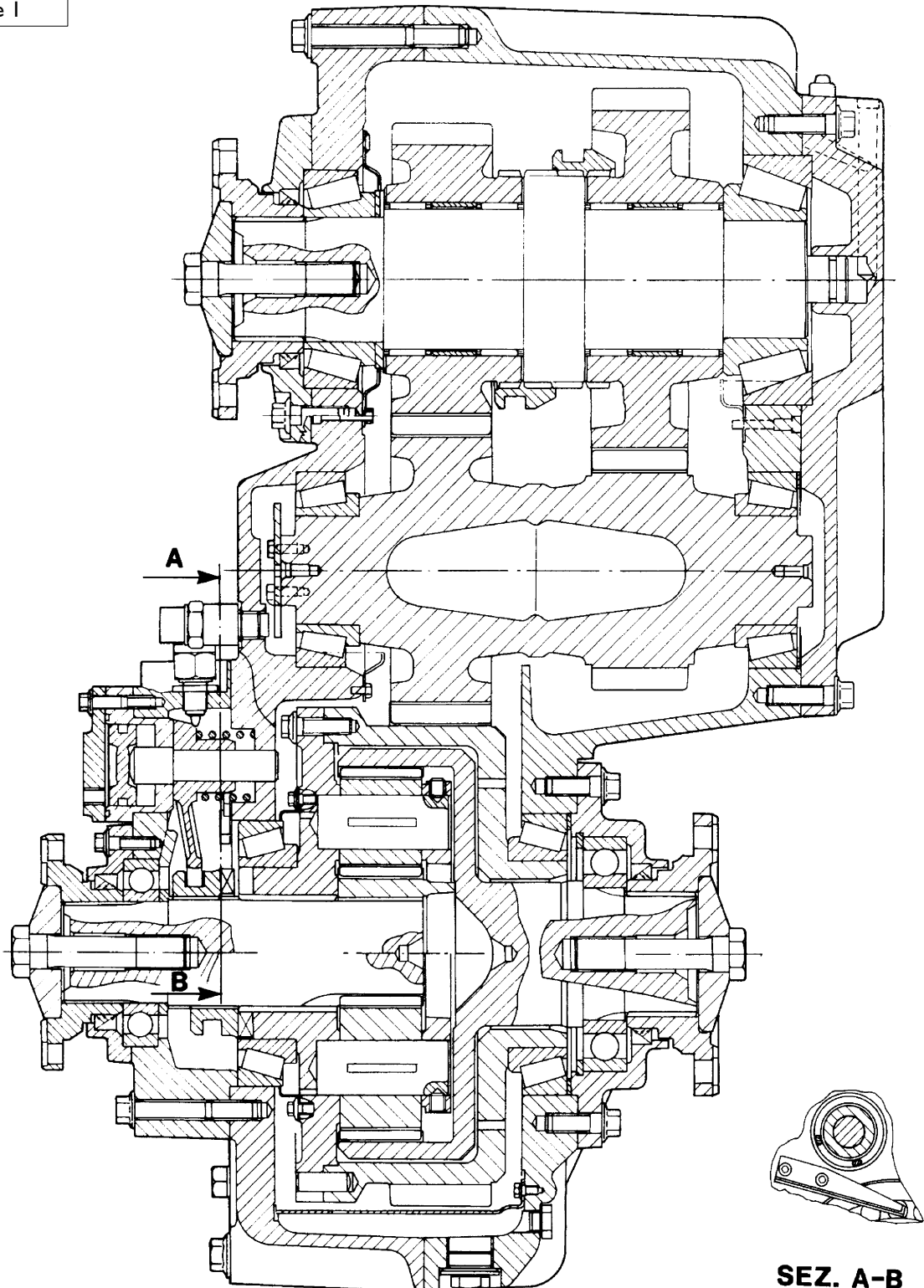
DESCRIPTION

The TC 1800 reduction gear unit is located between the gear-box and the intermediate axle. It consists of a set of constant mesh helical spur gears. These gears are fitted on three shafts: input shaft, countershaft and driving shaft.

A toothed sliding sleeve on the input shaft engages the normal and reduced gears.

The differential torque reduction gear for the front and rear axles and the differential reduction gear locking device are fitted on the driving shaft.

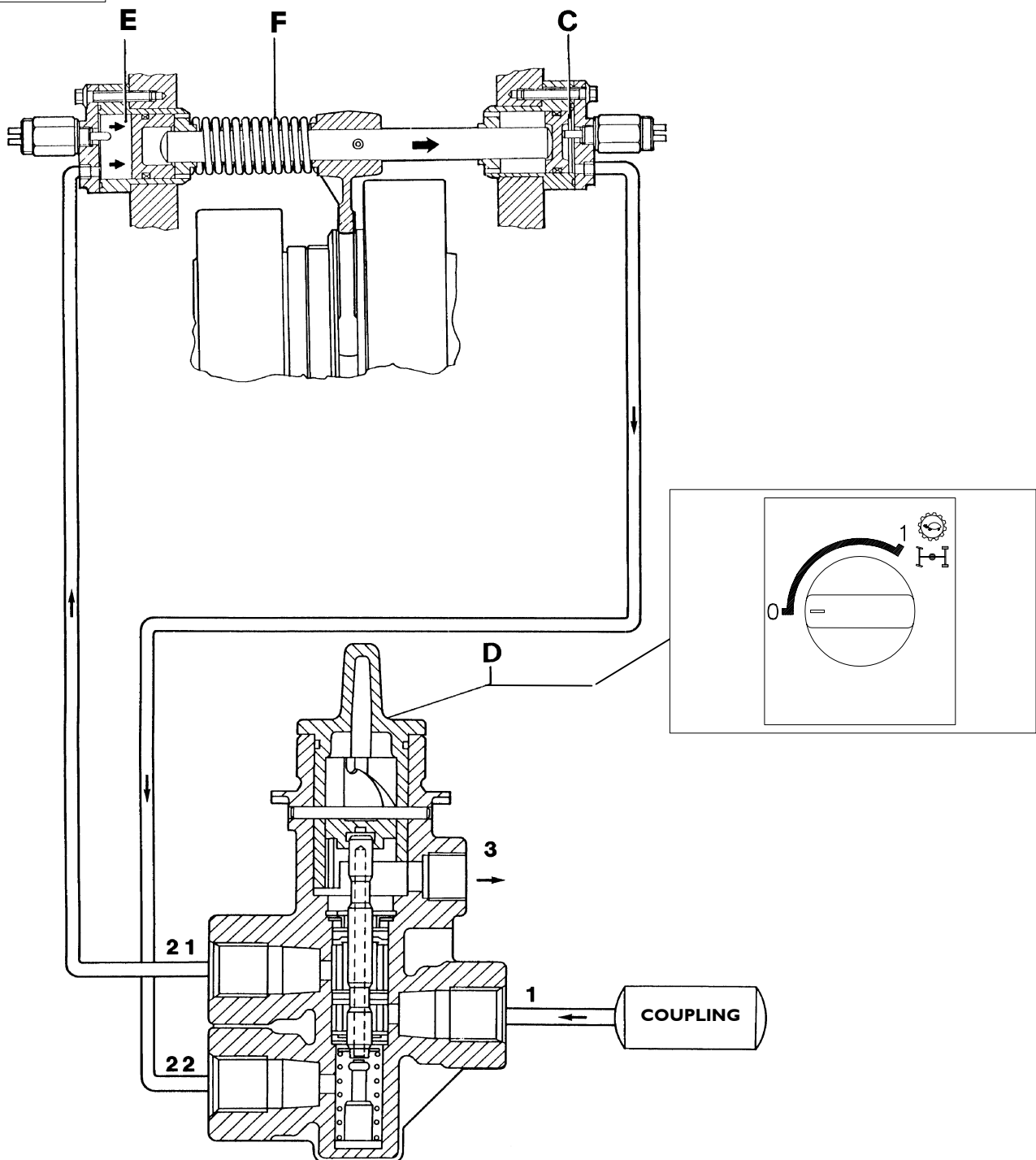
Figure 1



LONGITUDINAL SECTIONAL VIEW THROUGH THE REDUCTION GEAR UNIT

On-road

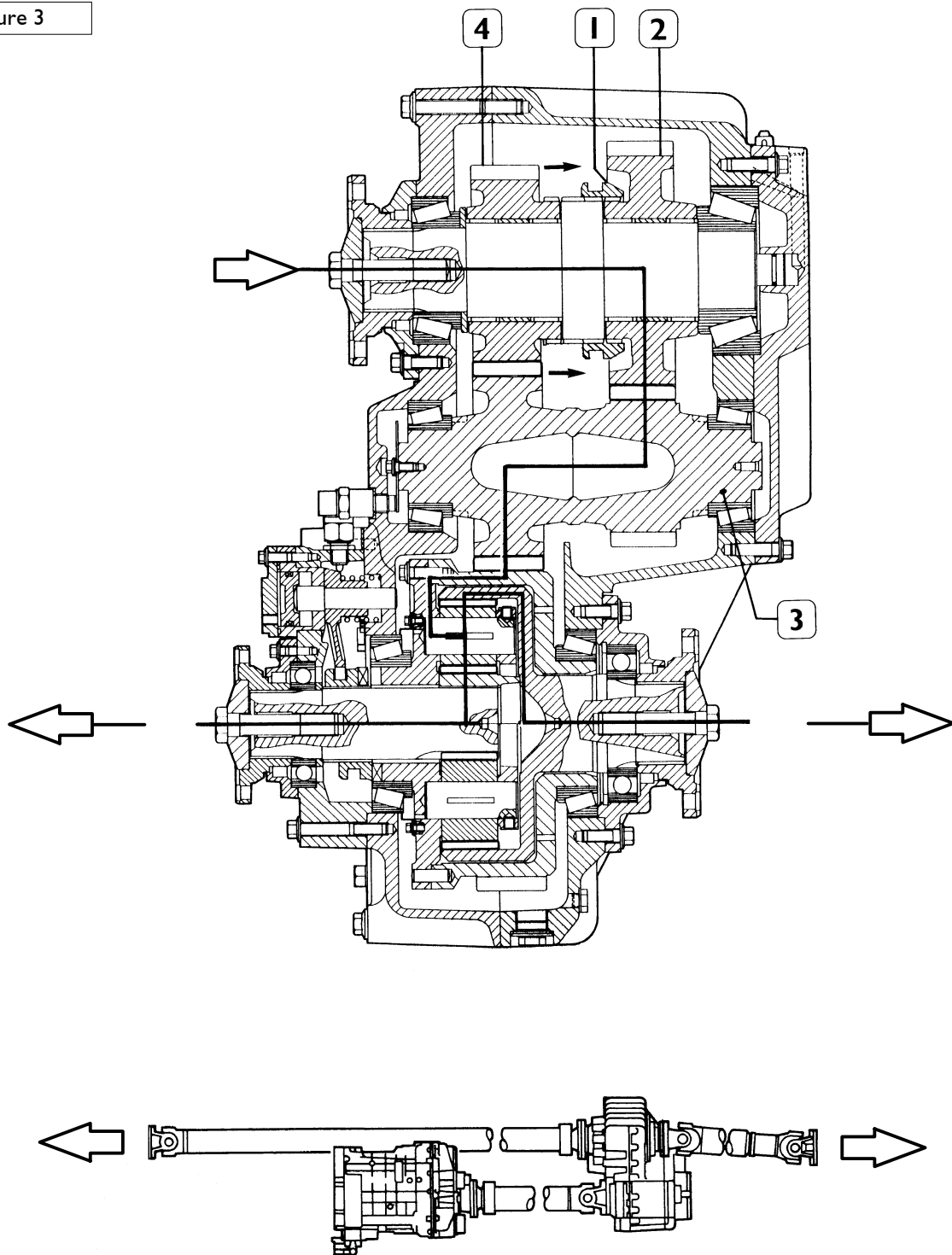
Figure 2



CONTROL KNOB "D" SET ON 0

With control knob "D" set on **0**, the incoming air to coupling **1** passes through the valve and comes out through coupling **21**, and by feeding chamber **E** causes the piston displacement to its end of stroke.

Spring **F** holds the fork and sleeve in the on-road gear ratio setting.
The air in chamber **C** is discharged through coupling **3**.

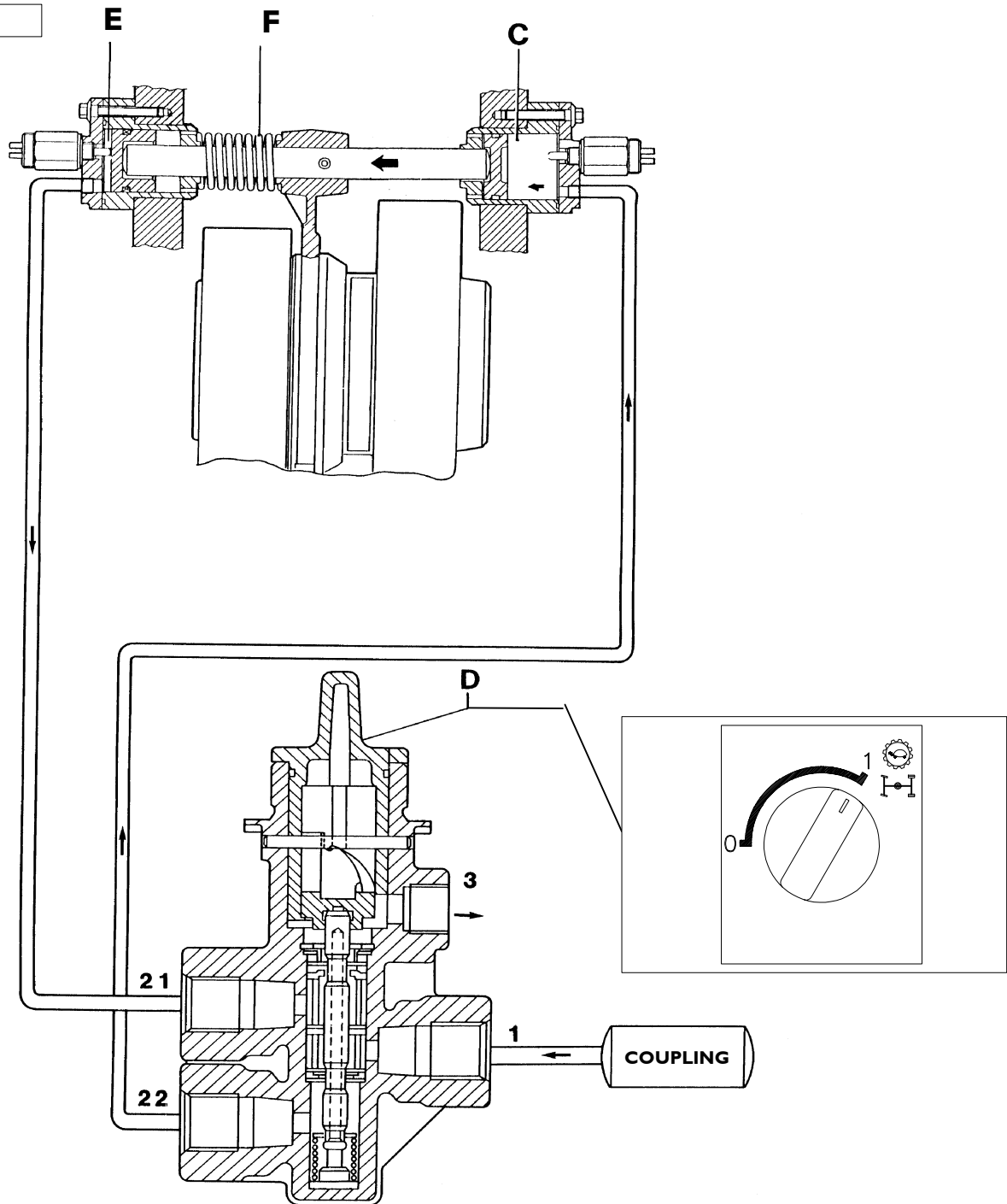
Transmission of motion pictorial diagram: on-road**Figure 3**

Sleeve (1) moves in the direction indicated by the arrow, meshing the gear (2) on the input shaft.

The motion is transmitted through the countershaft (3).

Off road

Figure 4



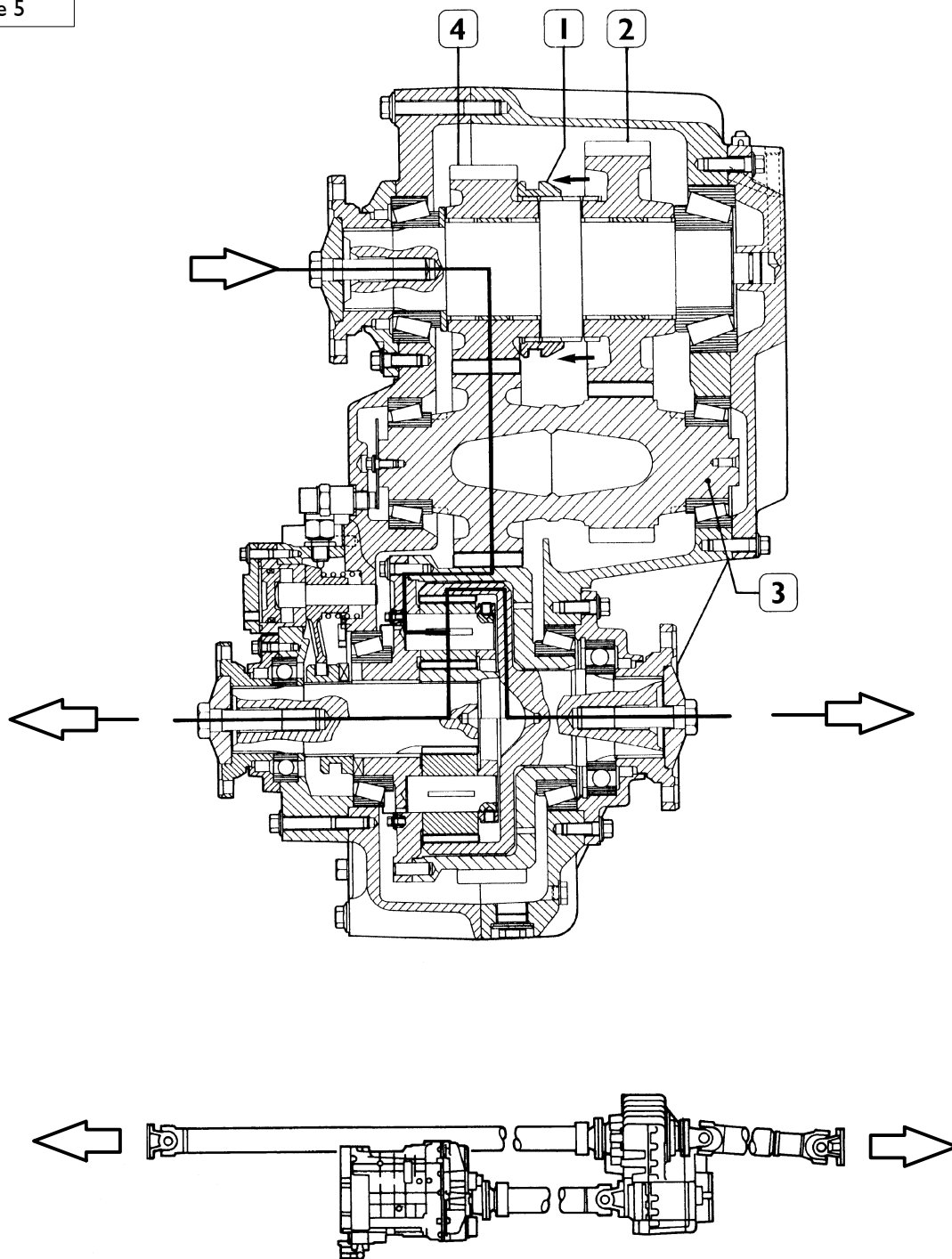
CONTROL KNOB "D" SET ON I

With control knob "D" set on I, the incoming air to coupling I passes through the valve and comes out through coupling 22, and by feeding chamber C causes the piston displacement to its end of stroke.

The fork and sleeve are set on off-road gear ratio setting. The air in chamber E is discharged through coupling 3.

Transmission of motion pictorial diagram: off-road

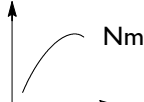
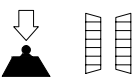
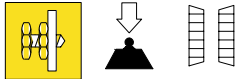
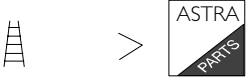
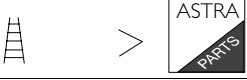
Figure 5



Sleeve (1) moves in the direction indicated by the arrow, meshing the gear (2) on the input shaft.

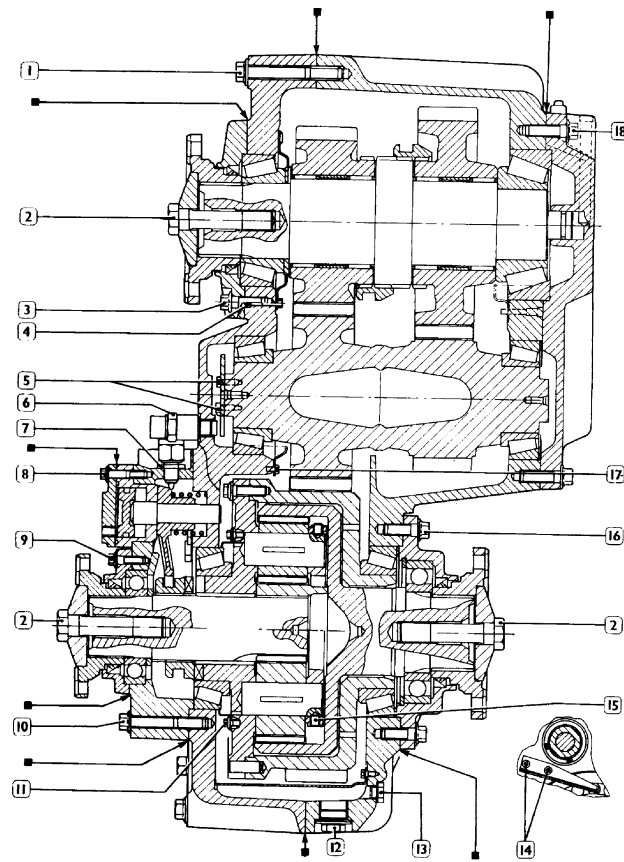
The motion is transmitted through the countershaft (3).

SPECIFICATIONS AND DATA

		TC 1800	
	Gears	Constant mesh helical gears	
	Transmission ratios normal (on road) reduced (off road)	1 : 1 1 : 1,6	
	Maximum input torque	18.000	
	Torque reduction	1 : 4	
	Bearings preload for: input shaft countershaft driving shaft	0,10 ÷ 0,15	0,05 ÷ 0,10
	Bearings preload adjustment	Through adjusting rings	
	Thickness of adjusting rings	1-1, 1-1,2-1,3-1,4-1,5-1,6-1,7-1,8-1,9 1-1,6-1,7-1,8-1,9-2,0-2,1-2,2-2,3-2,4-2,5 1-1, 1-1,2-1,3-1,4-1,5-1,6-1,7-1,8-1,9-2	
	Thickness of adjusting rings for pulse transmitter	1 - 1,5 mm 1 - 1,5	
	Quantity (*) kg (liter)	5,6 (6,2)	

(*) For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

Figure 6



39472

TIGHTENING TORQUES

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	M14 screw	92 ± 9	9,2 ± 0,9
2	M22 × 1,5 pin	500 ± 50	50 ± 5
3	M12 screw	58 ± 6	5,8 ± 0,6
4	M6 screw	10	1
5	M6 screw	10	1
6	Pulse transmitter	45 ± 5	4,5 ± 0,5
7	Nut	45 ± 5	4,5 ± 0,5
8	M8 screw	19 ± 2	1,9 ± 0,2
9	M10 screw	45 ± 5	4,5 ± 0,5
10	M12 screw	58 ± 6	5,8 ± 0,6
11*	M6 screw	7	0,7
12	Screw plug	100 ± 10	10 ± 1
13*	Screw	4,5	0,45
14	Screw plug	60 ± 6	6 ± 0,6
15*	Set screw	33 ± 3	3,3 ± 0,3
16	M12 screw	58 ± 6	5,8 ± 0,6
17	Screw	5	0,5
18	M12 screw	58 ± 6	5,8 ± 0,6

* Apply LOCTITE AVX

■ Apply LOCTITE 510

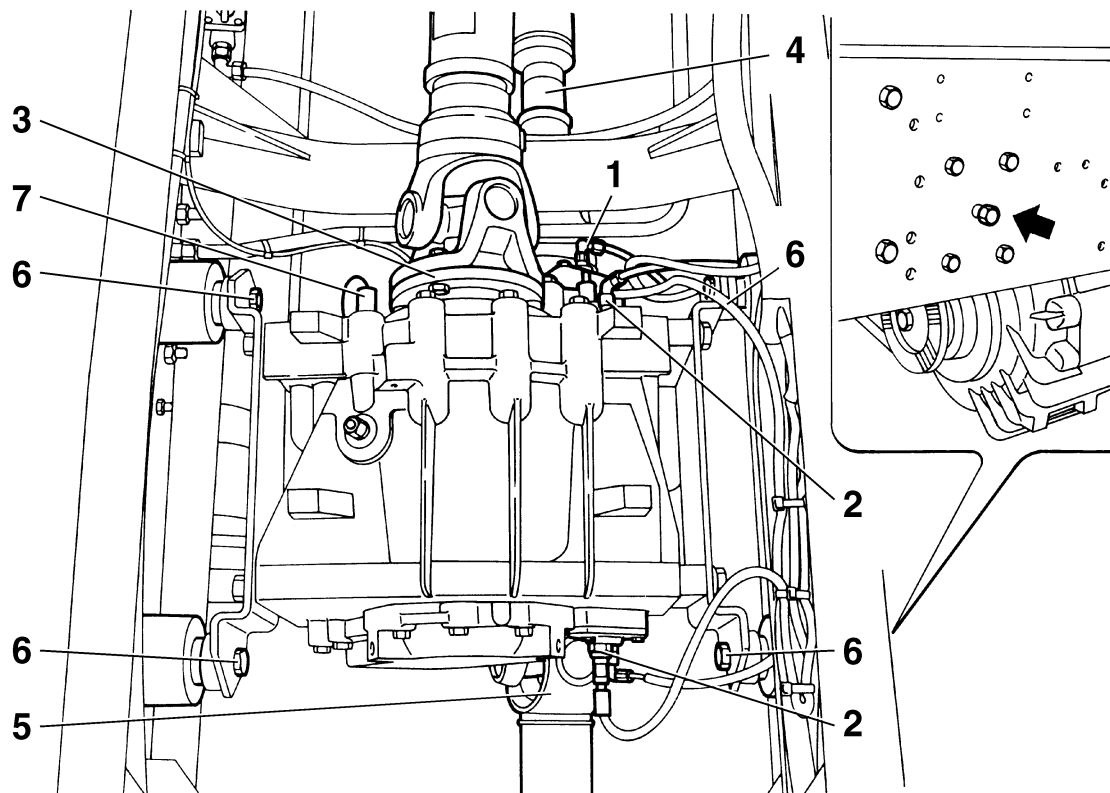
TOOLS

TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99340205	Percussion puller
99341003	Simple effect axle
99341009	Pair of brackets
99341015	Clamp
99342143	Puller pin to remove planetary gear pins from epicyclic unit of transmission unit (to be used with 99340205)
99345049	Counter block for pullers
99345056	Counter block for pullers
99360502	Rings to remove and fit in place the transmission unit halfbox
99366067	M8 hooks (2) to remove and fit in place the transmission unit intermediate shaft
99370006	Handle for interchangeable beaters
99370317	Lever and relevant extension bar for flange stop
99370565	Element to fit the gasket in front driving shaft cover of transmission unit (to be used with 99370006)
99370362	Eye bolt (2) to remove and fit in place transmission unit epicyclic assembly
99370631	Stand to hold transmission unit during removal and fitting in place
99371051	Bracket to hold transmission unit during overhaul (to be used with 99322205)
99374253	Element to fit the gasket in input shaft cover, and transmission unit rear driving shaft (to be used with 99370006)
99389821	Dynamometric wrench (0-70 Nm) with square 3/8" coupling

STRIPPING DOWN - REFITTING THE REDUCTION GEAR UNIT

Stripping down

Figure 7



To remove the reduction gear unit proceed as follows:

- ☐ set the vehicle on a pit or on a hoist;
- ☐ open the battery case and disconnect the cables to avoid short-circuits;



The disposal of waste or residual fluid in unauthorised sites or in the public sewer system is prohibited.

- ☐ disconnect reduction gear unit electrical and pneumatic connections (1);
- ☐ disconnect reduction gear unit electrical and pneumatic connections (2);
- ☐ disconnect odometer cable (7) after removing the sealing;
- ☐ undo the screws fixing the input shaft flange (3), front output shaft flange (4) and rear output shaft flange (5) and secure temporarily the shafts to the chassis to avoid interference during next operations;

- ☐ disconnect hydraulic pipes from servo-clutch auxiliary pump (8);
- ☐ position a hydraulic lifting device under the transfer and remove the connecting screws to the four supporting pads (6);
- ☐ screw one screw to each pad as shown by the arrow to press the pad and enable unit removal;
- ☐ lower the hydraulic lifting device and remove the transfer from the bottom.

Refitting

Reverse the operations for removal.

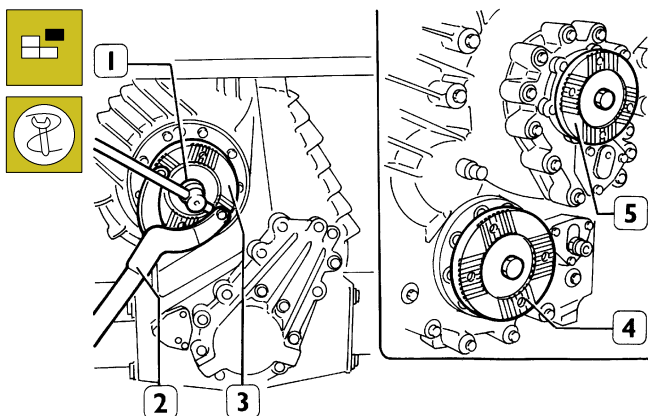


When refitting, drain out power steering hydraulic circuit as described in Section 15.

DISASSEMBLING THE REDUCTION GEAR UNIT AT THE BENCH

Set the reduction gear unit on rotary stand 99322205 with brackets 99371051, unscrew the plugs and drain the oil. Unscrew the pulse transmitter and the 3 indicator switches.

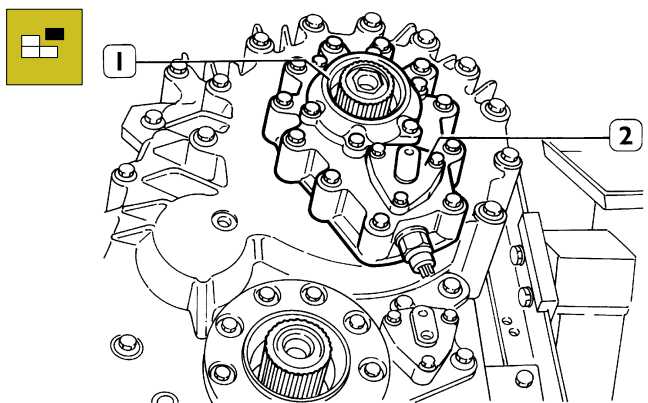
Figure 8



39870

Lock rotation offlange (3) through lever 99370317 (2), use a suitable socket wrench (1) to remove the retaining screw and remove the flange; repeat the same operation for the flanges (4- 5) on the opposite side.

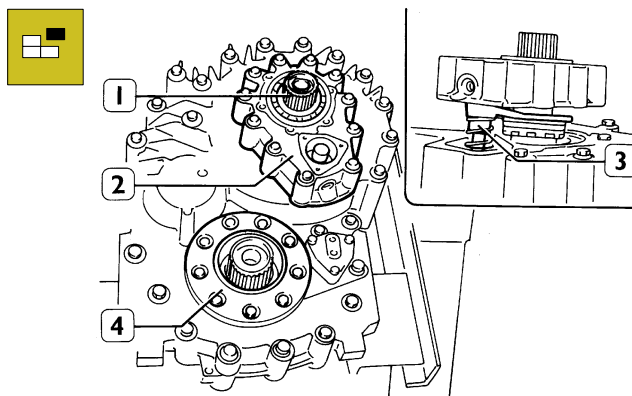
Figure 9



39871

Remove the 6 screws and the cover (1) with its seal ring; remove the 3 screws and cover (2) with reduction gear engagement piston.

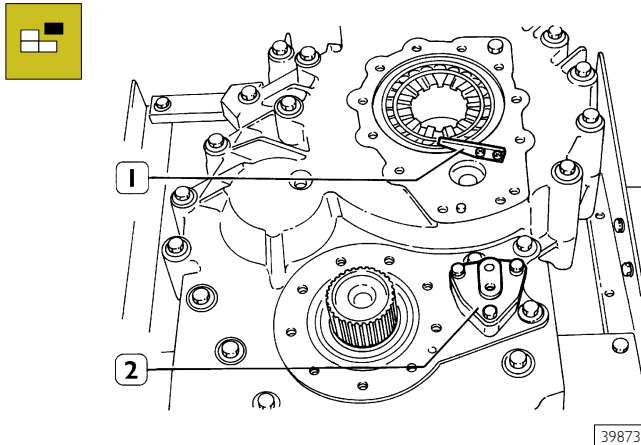
Figure 10



39872

Remove the 11 screws and take away cover (2) together with reduction gear engagement control shaft (1) and fork (3); remove the 9 screws and remove cover (4) with its seal ring.

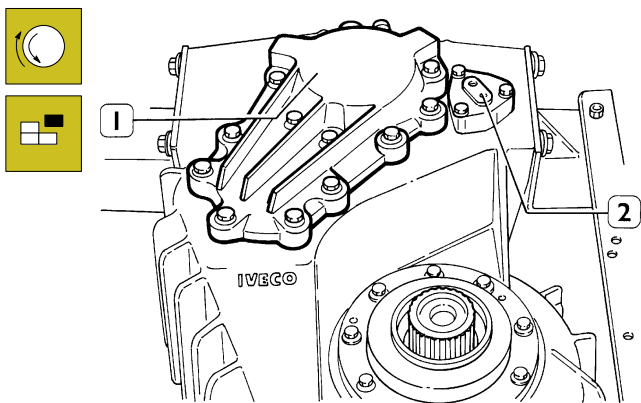
Figure 11



39873

Remove the 3 screws and take away cover (2) with control piston and withdraw the internal spring; use a socket wrench for the screws and remove the safety plate (1).

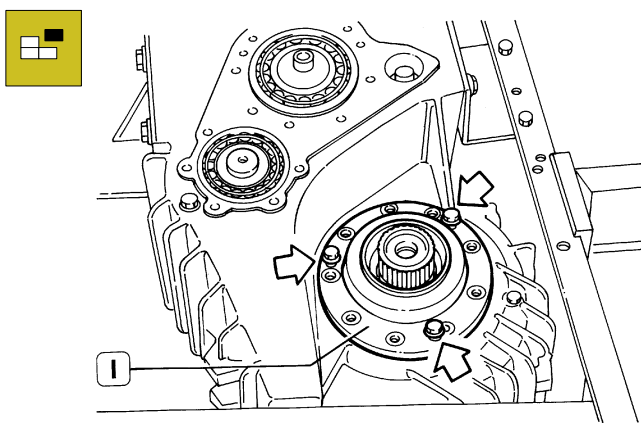
Figure 12



39874

Rotate the unit 180 degrees. Remove the 3 screws and take away cover (2) with piston rod; remove the 14 screws and take away the cover (1). Remove the adjusting rings.

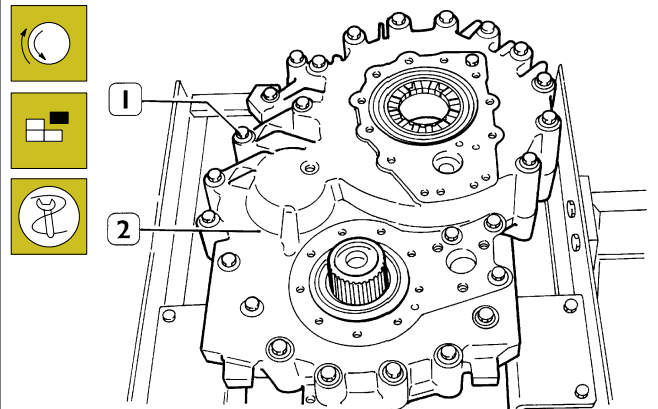
Figure 13



39875

Remove the 9 screws, then fit 3 counteracting screws into the holes indicated by the arrows, take away the cover (1) and remove the adjusting rings.

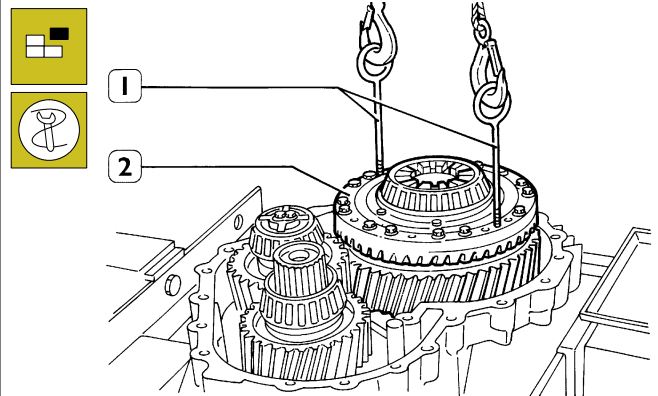
Figure 14



39876

Rotate the unit 180°. Remove screws (1) and with a hoist and ropes take away the housing (2).

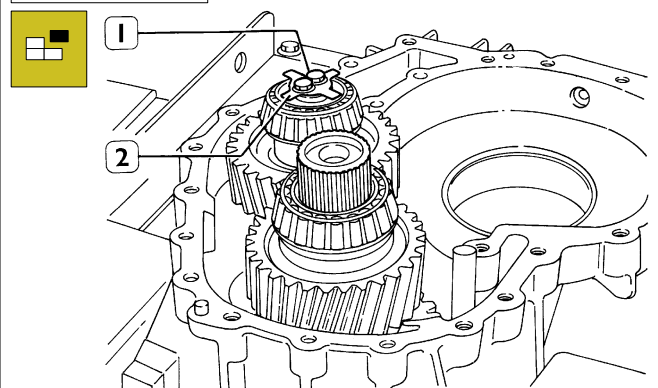
Figure 15



39877

Use eye bolt 99370565 (1), ropes and lifting device to withdraw the epicyclic reduction gear (2) from the housing.

Figure 16

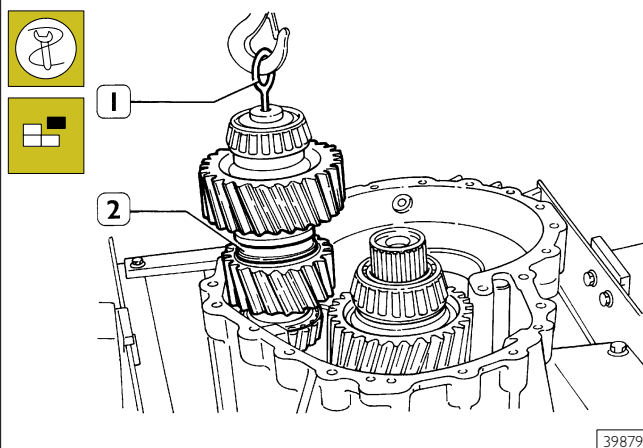


39878

Up to No. 535: undo the sole screw (1) and remove the phonic wheel (2).

From No. 536: straighten the safety plate, undo the two screws (1) and remove the phonic wheel (2).

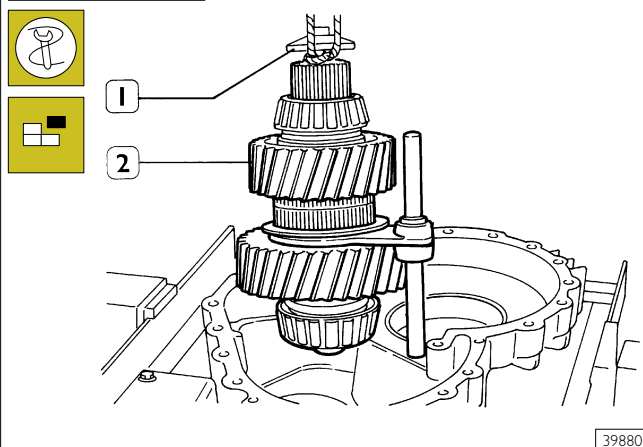
Figure 17



39879

Using eye bolt 99366067 (1) rope and lifting device, release the countershaft (2) from the housing.

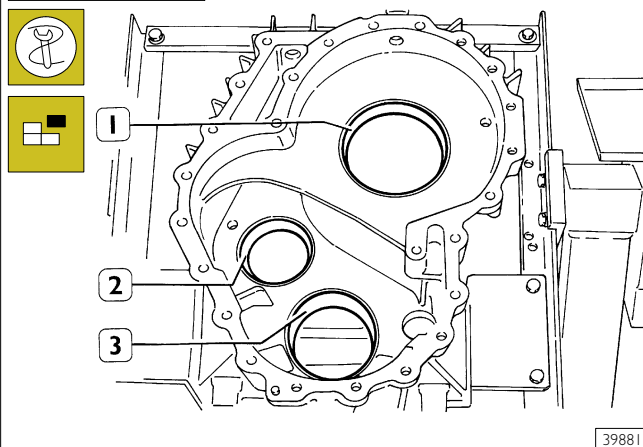
Figure 18



39880

Screw the relevant screw and washer (1) onto the input shaft (2), use a rope and lifting device to withdraw the shaft (2) and control fork from the housing.

Figure 19

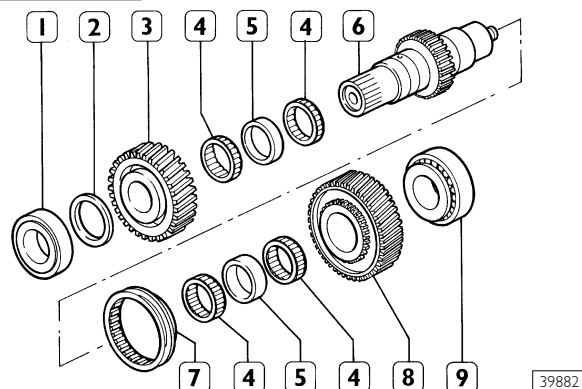


39881

Using a suitable beater, remove the bearing outer rings (1-2-3).

DIS-ASSEMBLING THE INPUT SHAFT

Figure 20



39882

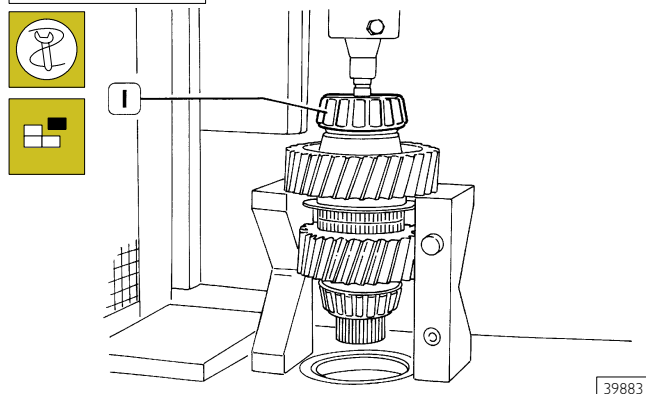
INPUT SHAFT COMPONENTS

1. Bearing - 2. Spacer ring - 3. Gear - 4. Roller bearings - 5. Spacer ring - 6. Shaft - 7. Sliding sleeve - 8. Gear - 9. Bearing



To dis-assemble the bearings (1, figure 22 and 23) it is necessary to use a hydraulic press.

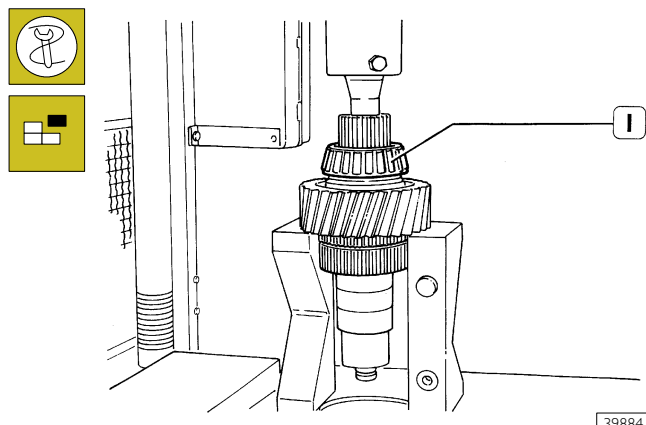
Figure 21



39883

Having withdrawn the bearing (1) manually withdraw the gear (8, figure 21), roller bearings (4), spacer ring (5) and sliding sleeve (7).

Figure 22

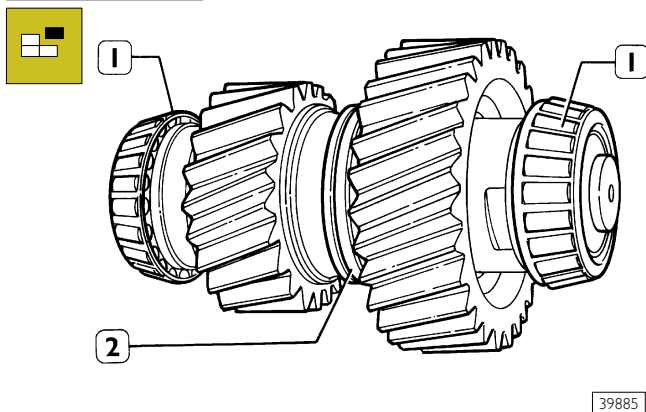


39884

Remove bearing (1) and take away the spacer ring (2, figure 21), gear (3), roller bearings (4) and spacer ring (5).

DIS-ASSEMBLING THE COUNTERSHAFT

Figure 23

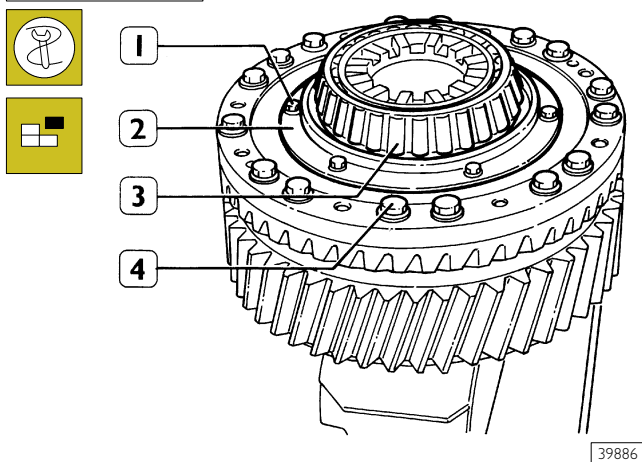


39885

The removal of the bearings (1) from the countershaft (2) is a destructive operation.

DIS-ASSEMBLING THE EPICYCLIC REDUCTION GEAR

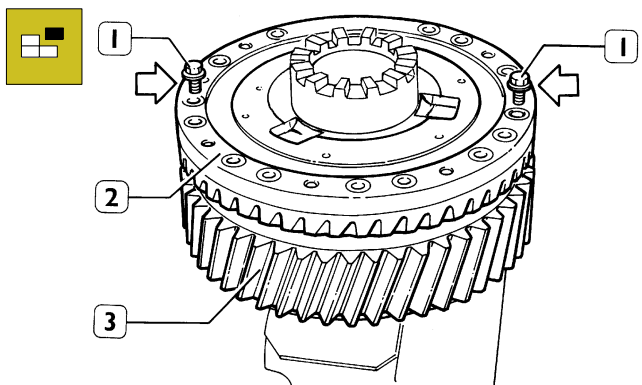
Figure 24



39886

Remove screws (1) and take away the splash guardring (2), then using the appropriate puller remove the bearing (3), remove the screws (4).

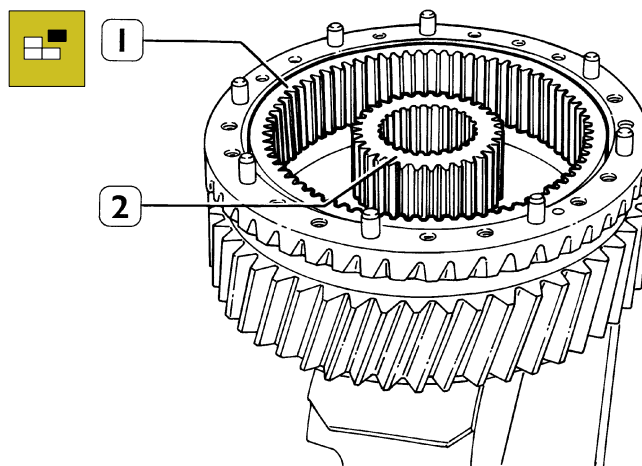
Figure 25



39887

Using the 2 screws (1) in the holes indicated by the arrows, take the planetary gear carrier (2) away from the crown wheel (3).

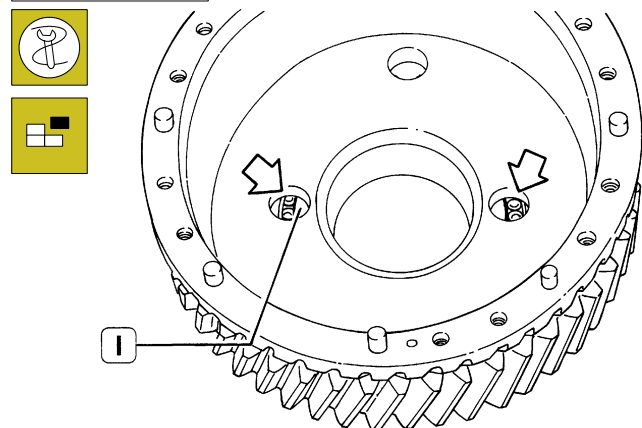
Figure 26



39888

Remove the planetary gear (2) and take away the driving shaft (1).

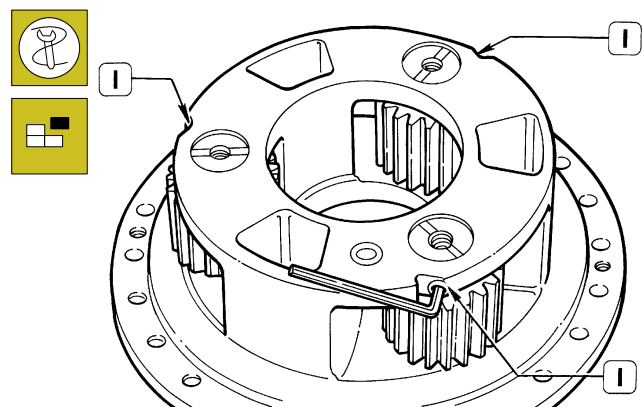
Figure 27



39889

Using the suitable beater remove bearing (1) from the holes indicated by the arrows.

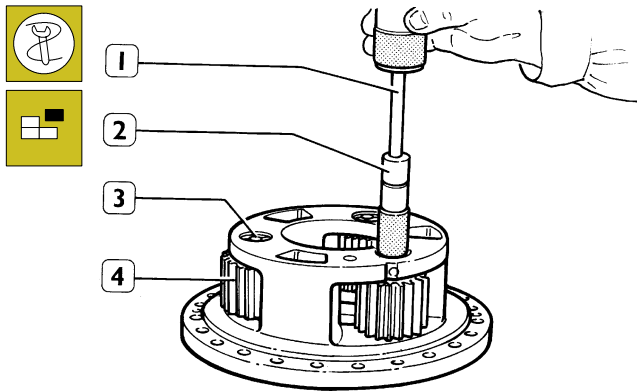
Figure 28



39890

Use a socket wrench to remove the 3 securing set screws (1).

Figure 29

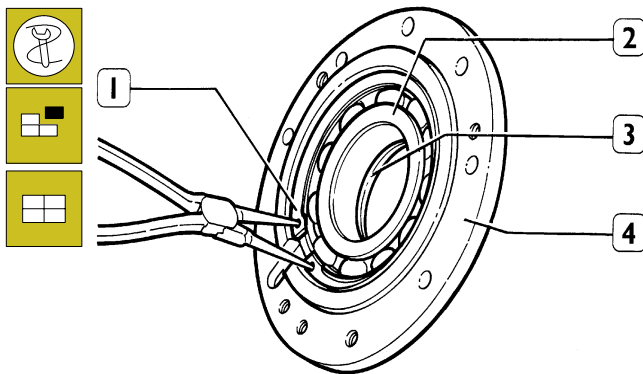


39891

Use percussion puller 99340205 (1) with pin 99342143 (2) to remove the shafts (3) for the gears (4).

REPLACING THE SEAL RINGS ON THE DRIVING SHAFT COVERS

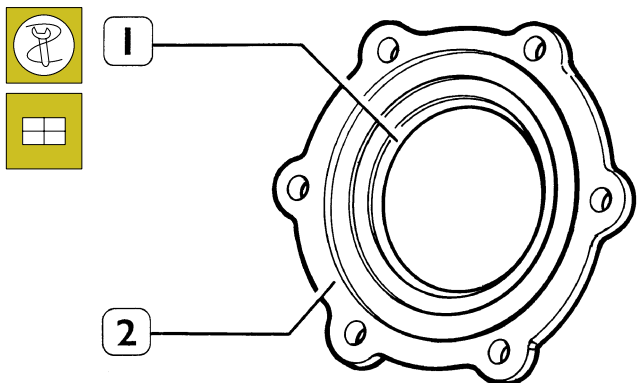
Figure 30



39892

To replace the seal ring (3) on cover (4) of the rear driving shaft, remove the locking ring (1) and withdraw the bearing (2). To fit the seal ring (3) in place, use tool 99374253.

Figure 31



39893

To fit seal ring (1) on front driving shaft cover (2), use tool 99370362.

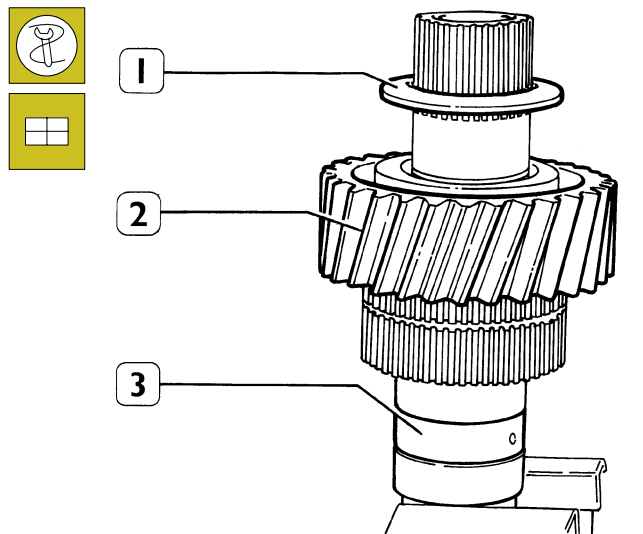
CLEAN OUT AND CHECK

After the reduction gear unit has been removed, carefully clean all the parts.

Check that there are no signs of wear, seizure or cracking. Seal rings and gaskets should always be replaced before re-fitting in place.

FITTING IN PLACE THE INPUT SHAFT

Figure 32



39894

Clamp the shaft (3, Figure 33) in a vice, fit in place the roller bearings (4, Figure 34), with spacer (5, Figure 34), connect the gear (2, Figure 33) with the meshing tooth towards the sliding sleeve, fit the spacer ring (1, Figure 33).

Heat the roller bearing inner ring (1, Figure 34) to 80 °C - 90 °C and fit it on the shaft.

Figure 33

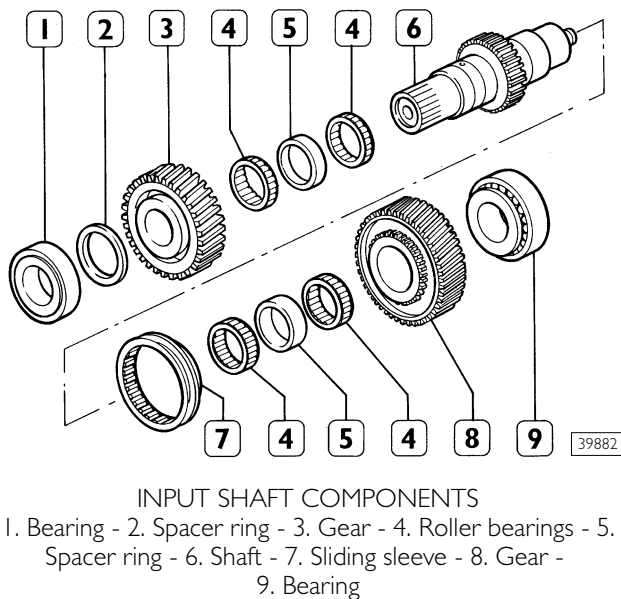
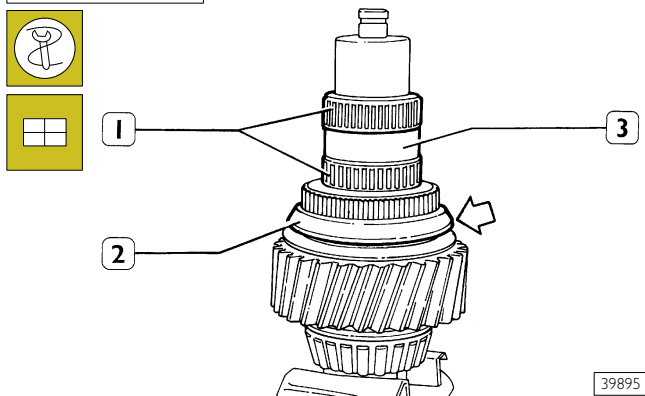


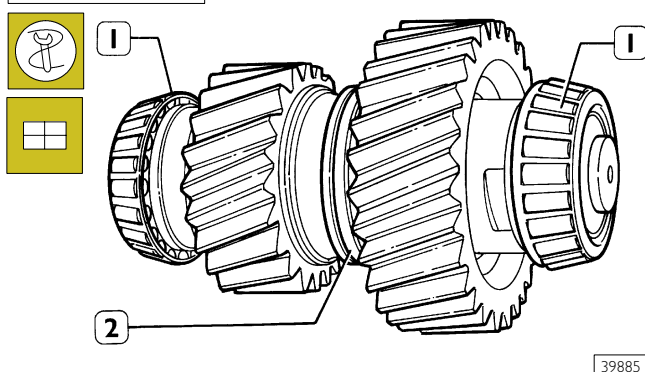
Figure 34



Turn the shaft over and clamp it in a vice.
Fit in place the sliding sleeve (2) with the flare (arrow) facing upward; fit the roller bearings (1) and spacer (3).
Fit in place the gear (8, figure 34) with the meshing toothset towards the sliding sleeve.
Heat to 80 °C to 90 °C the roller bearing inner ring (9, Figure 34) and fit onto the shaft.

FITTING IN PLACE THE COUNTERSHAFT

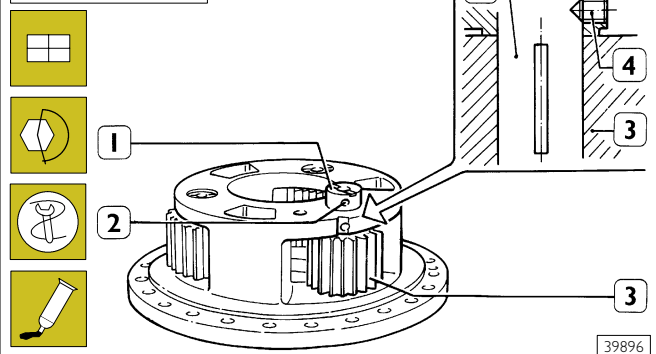
Figure 35



After heating the inner rings to 80 °C to 90 °C, fit the bearings (1) onto the shaft (2).

FITTING IN PLACE THE EPICYCLIC REDUCTION GEAR UNIT

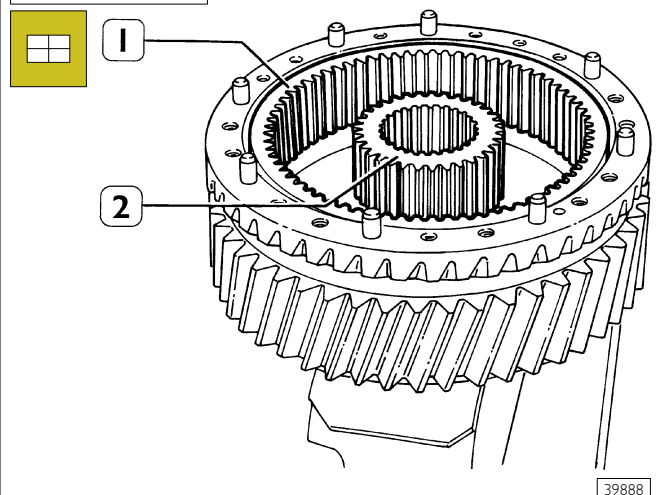
Figure 36



Fit the gears (3) onto the planetary gear carrier; connect the spindle (1) so that the hollow (2) coincides with the set screw hole (4). Apply LOCTITE AVX to the set screw (4) and lock it to a torque of 44 ± 4 Nm. Repeat the operation for the other spindles.

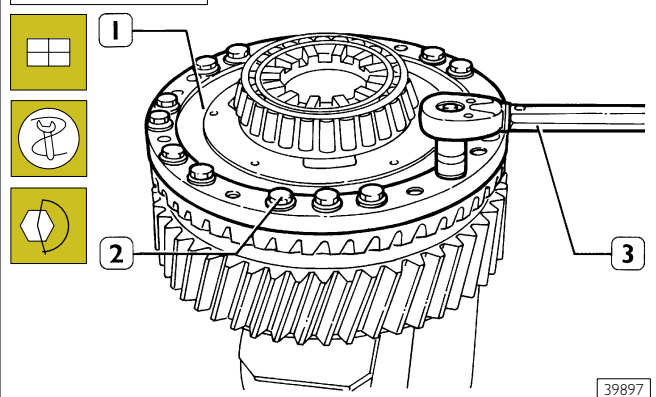
Turn the planetary gears carrier over and, after heating the inner ring to 80 °C to 90 °C, fit the bearing in place.

Figure 37



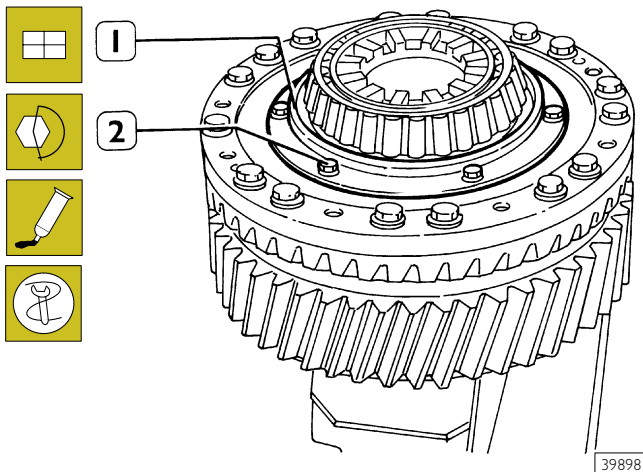
Fit the driving shaft, the planetary gear (2) on the crown wheel (1) and clamp the unit in a vice.

Figure 38



Fit in place the completed planetary gears carrier (1) coinciding the reference pins, tighten screws (2) and lock them with a dynamometric wrench (3) to the prescribed torque.
Turn the unit over and after heating the inner ring of the bearing to 80 °C to 90 °C, fit it in place.

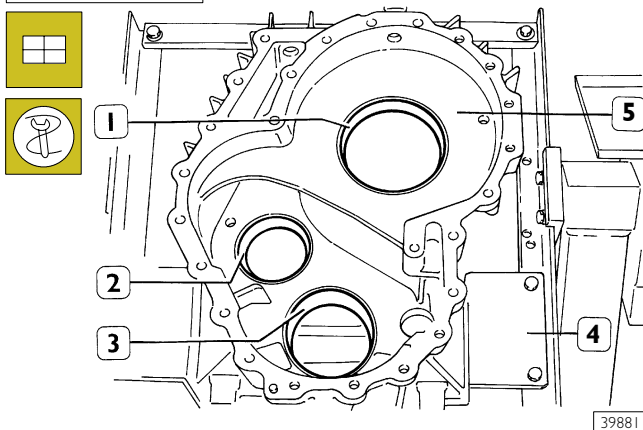
Figure 39



Fit in place the splash guard (1), apply LOCTITE AVX to the screws (2) and tighten them to a torque of 7 ± 1 Nm. Turn the unit over and fit the bearing after heating the inner ring to 80 °C to 90 °C.

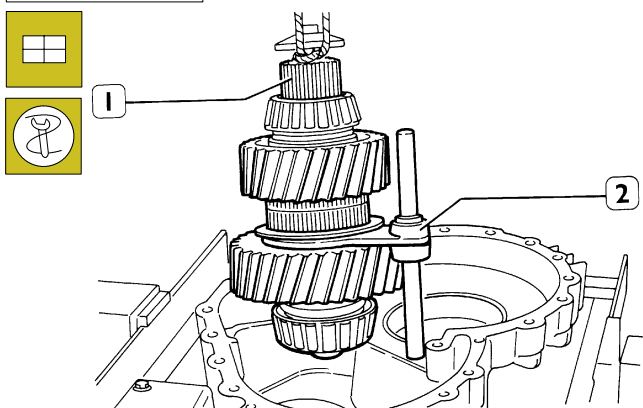
ASSEMBLING THE REDUCTION GEAR UNIT AT THE BENCH

Figure 40



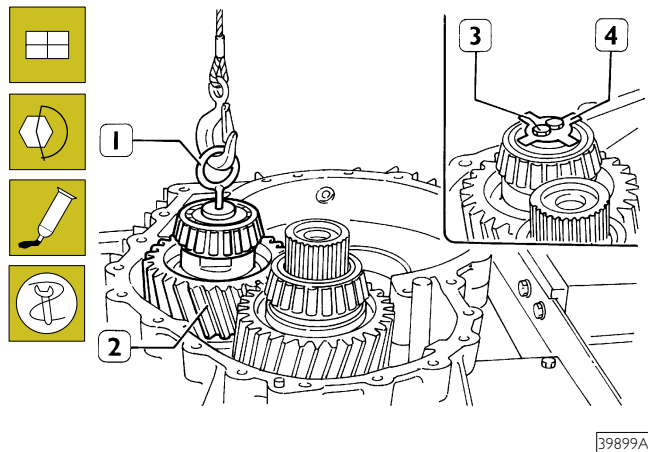
Set the housing (5) on stand 99322205 using brackets 9937105 (4); use the appropriate beater to fit the bearing outer rings (1-2-3).

Figure 41



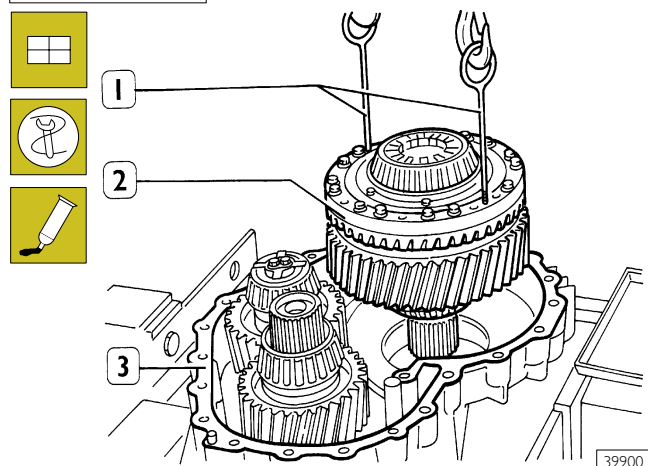
Using a rope and truck lift fit the input shaft (1) with the control fork (2) into the housing.

Figure 42



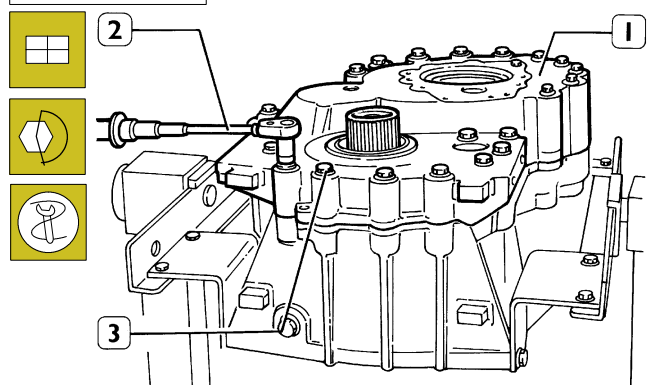
Use eye bolt 99366067 (1) to fit into place the countershaft (2). Up to No. 535: fit in place the phonic wheel (4), apply LOCTITE AVX to the sole screw (3) and tighten to the specified torque. From No. 536: fit in place the phonic wheel (4), the safety plate and tighten the screws (3) to the specified torque, bend the safety plate.

Figure 43



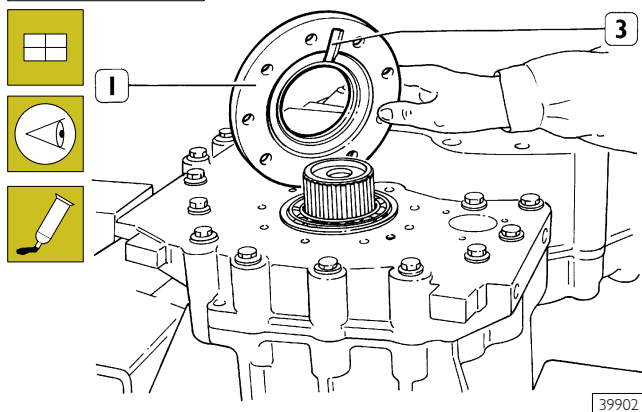
Use eye bolt 99370565 (1) to fit the epicyclic reduction gear (2) into the housing. Fit gasket (3) in the housing.

Figure 44



Fit in place the housing (1) and use a dynamometric wrench (2) to tighten the screws (3) to the specified torque.

Figure 45

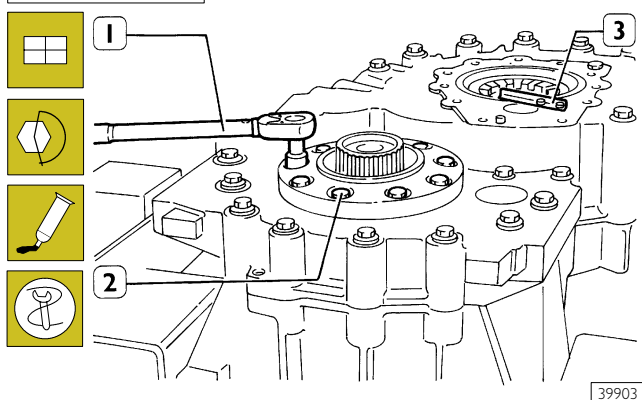


Fit in place the gasket (2), fit the cover (1) with its seal ring.



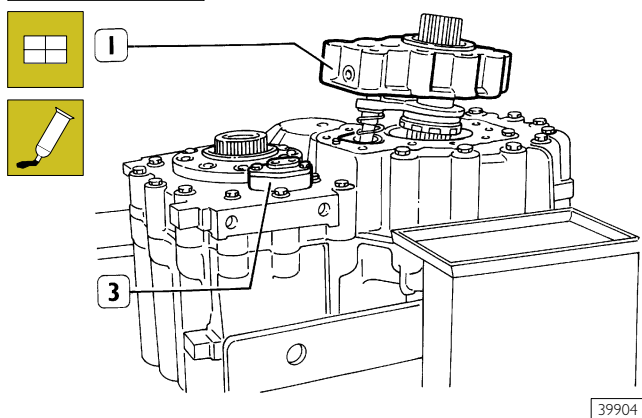
The oil passage (3) must be in the position shown in the figure.

Figure 46



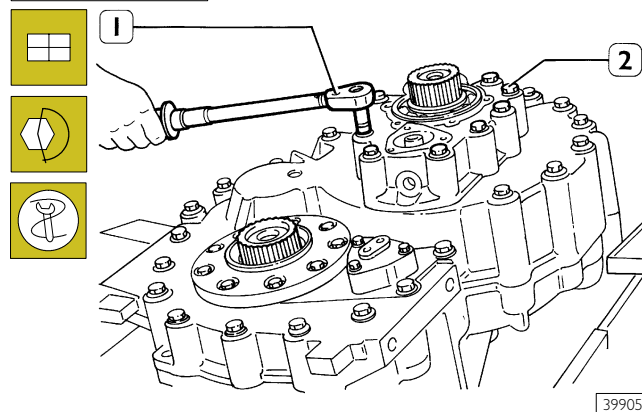
Lock the cover screws (2) with a dynamometric wrench (1) to a torque of 50 ± 5 Nm. Set the locking plate (3) in position, apply LOCTIT AVX to the screws and tighten them to a torque of 4.5 Nm.

Figure 47



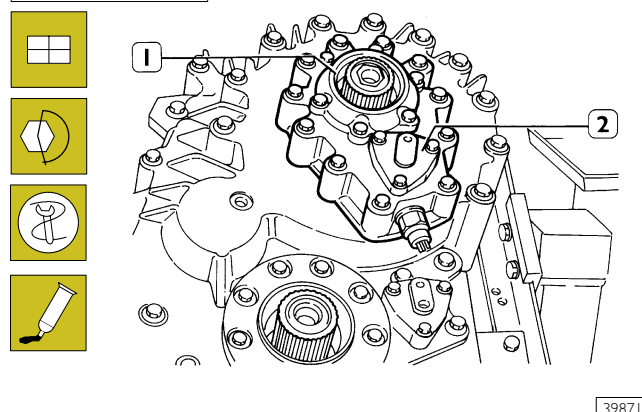
Fit in place the cover (3) with the control piston and internal spring. Fit the gasket (2) and cover (1) together with the shaft and reduction gear control fork.

Figure 48



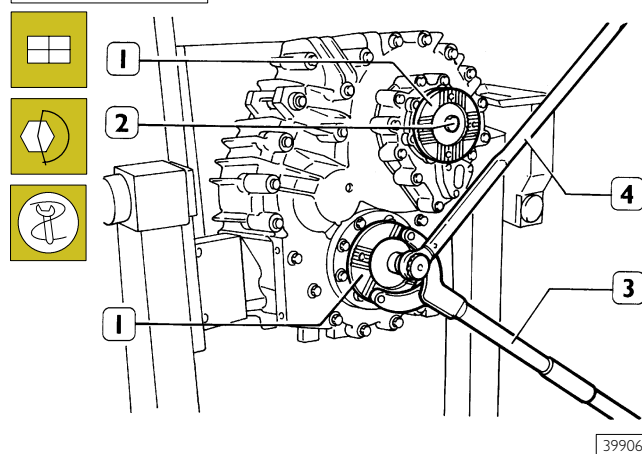
Use a dynamometric wrench (1) to tighten the screws (2) to a torque of 78 ± 8 Nm.

Figure 49



Fit in place the cover (2) with the control piston. Set the gaskets in place, fit cover (1) and tighten the screws to a torque of 30 ± 3 Nm.

Figure 50



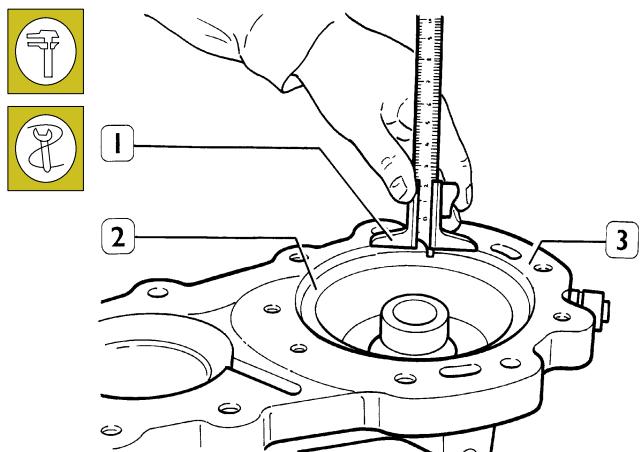
Connect the two flanges (1) fit the washers and with a lever (3) and dynamometric wrench (4) tighten screws (2) to a torque of 500 ± 50 Nm.

ADJUSTMENTS

Shaft bearings pre-load adjustment

INPUT SHAFT

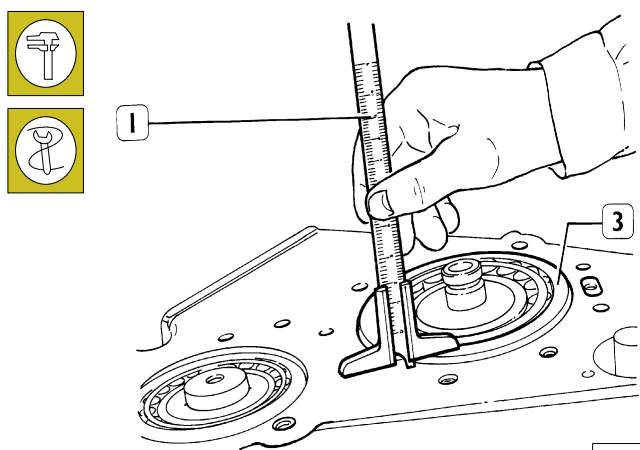
Figure 51



39907

- With a caliper (1), find the depth of the seat (2) for the bearing on the cover (3):

Figure 52



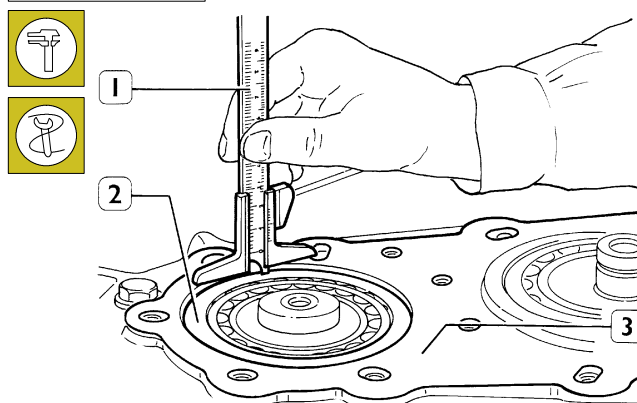
39908

- Set the gasket (2) on the housing and use a caliper (1) to find the protrusion between bearing outer ring (3) and gasket (2).

The difference between these two measurements is the adjusting ring shim; add 0.10 to 0.15 mm (preload) to the value obtained.

COUNTERSHAFT

Figure 53

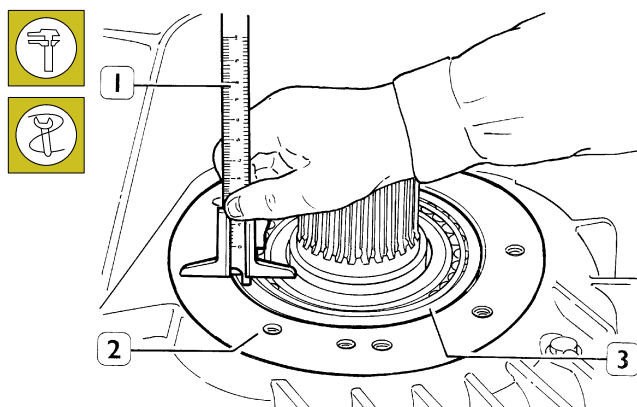


39909

- Use a caliper (1) to find the distance between the gasket (3) on the housing and bearing outer ring (2). Add the specified preload to this value.

DRIVING SHAFT

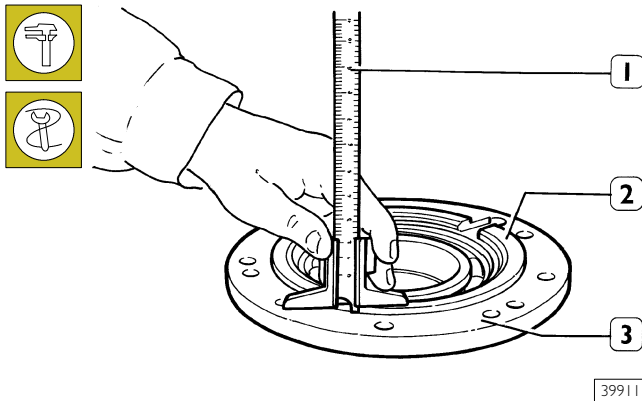
Figure 54



39910

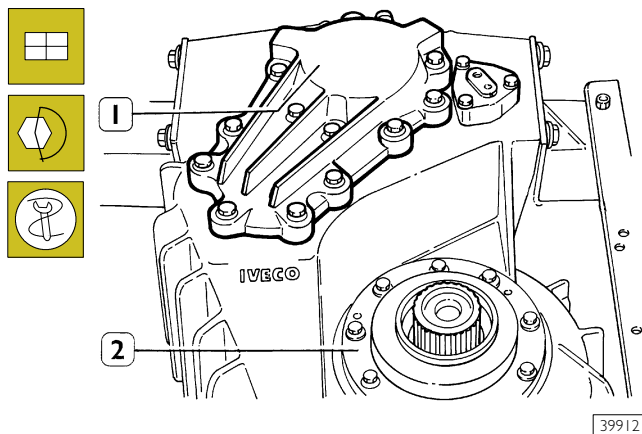
- Fit the gasket (2) in the housing, use a caliper to find the the depth of the bearing outer ring (3) in relation to the face with the gasket.

Figure 55



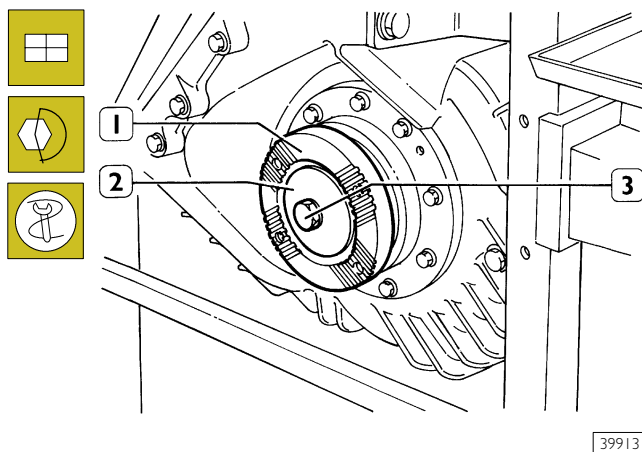
- Use a caliper (1) to find the distance between the outer edge of the bearing collar (2) and the cover face (3). The difference between these two measurements is the value for the adjusting ring; add 0.10 to 0.15 mm (preload) to this value.

Figure 56



Fit the adjusting rings, assemble the covers (1-2) and tighten the screws to a torque of 50 ± 5 Nm.

Figure 57



Connect the flange (1), fit washer (2) using a lever and dynamometric wrench tighten the screw (3) to a torque of 500 ± 50 Nm.

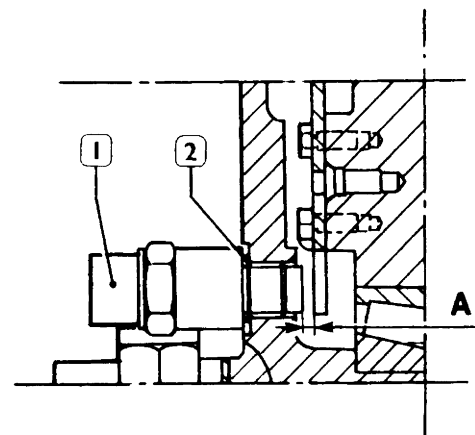
Fit the indication switch and the pulse transmitter and adjust as described in the following paragraphs.

Indication switch adjustment

Screw on the switch to electric contacts closing, screw on once and then tighten the lock nut to the prescribed torque.

Pulse transmitter adjustment

Figure 58



Select the adjusting ring (2) to obtain A equal to 2 - 2,8 mm when fitting the pulse transmitter (1).

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REDUCTION GEAR UNIT TC2200

SECTION 9.2

SECTION 9.2

Reduction gear unit TC2200

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☐ Off road	6
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ADJUSTMENT	20
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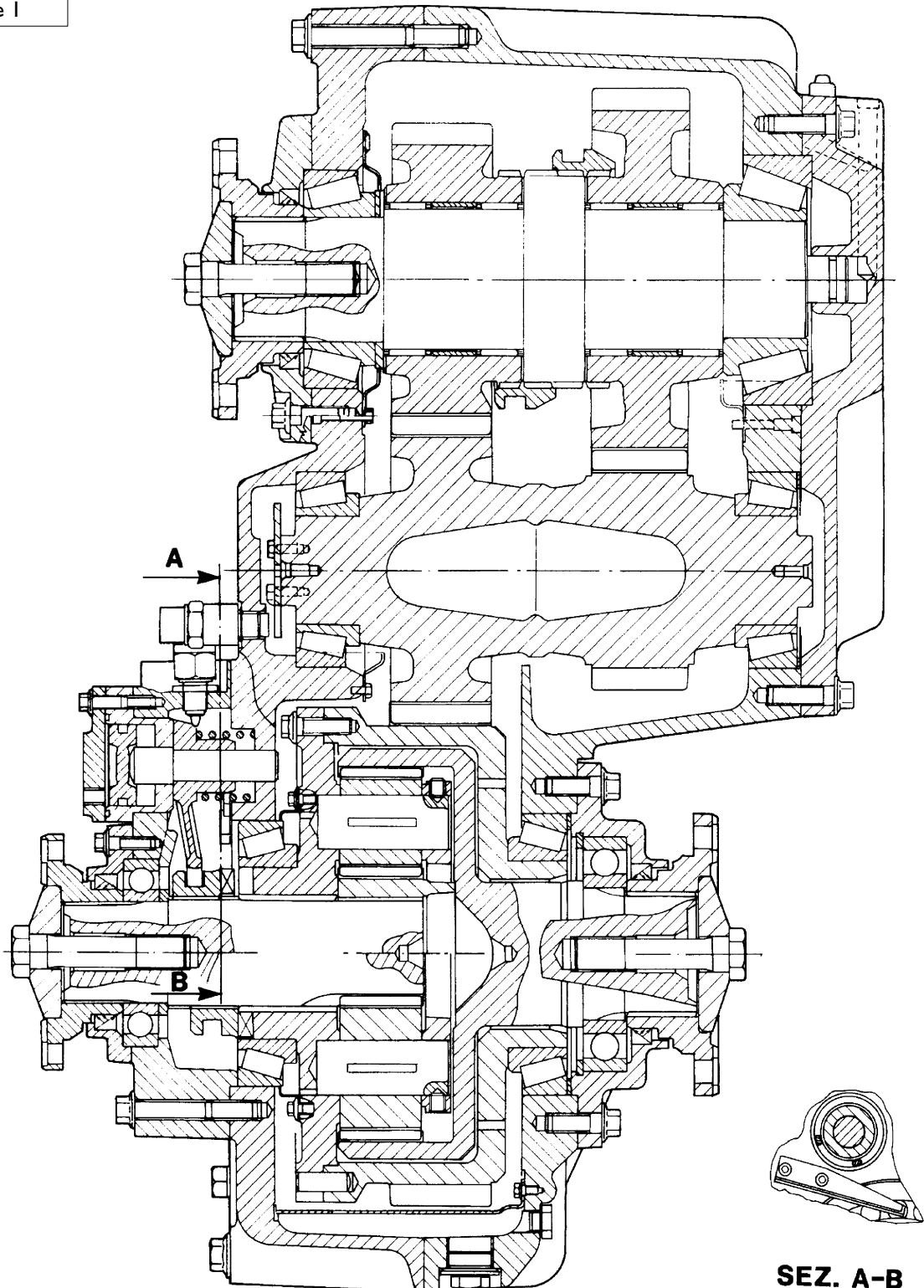
DESCRIPTION

The TC 1800 reduction gear unit is located between the gear-box and the intermediate axle. It consists of a set of constant mesh helical spur gears. These gears are fitted on three shafts: input shaft, countershaft and driving shaft.

A toothed sliding sleeve on the input shaft engages the normal and reduced gears.

The differential torque reduction gear for the front and rear axles and the differential reduction gear locking device are fitted on the driving shaft.

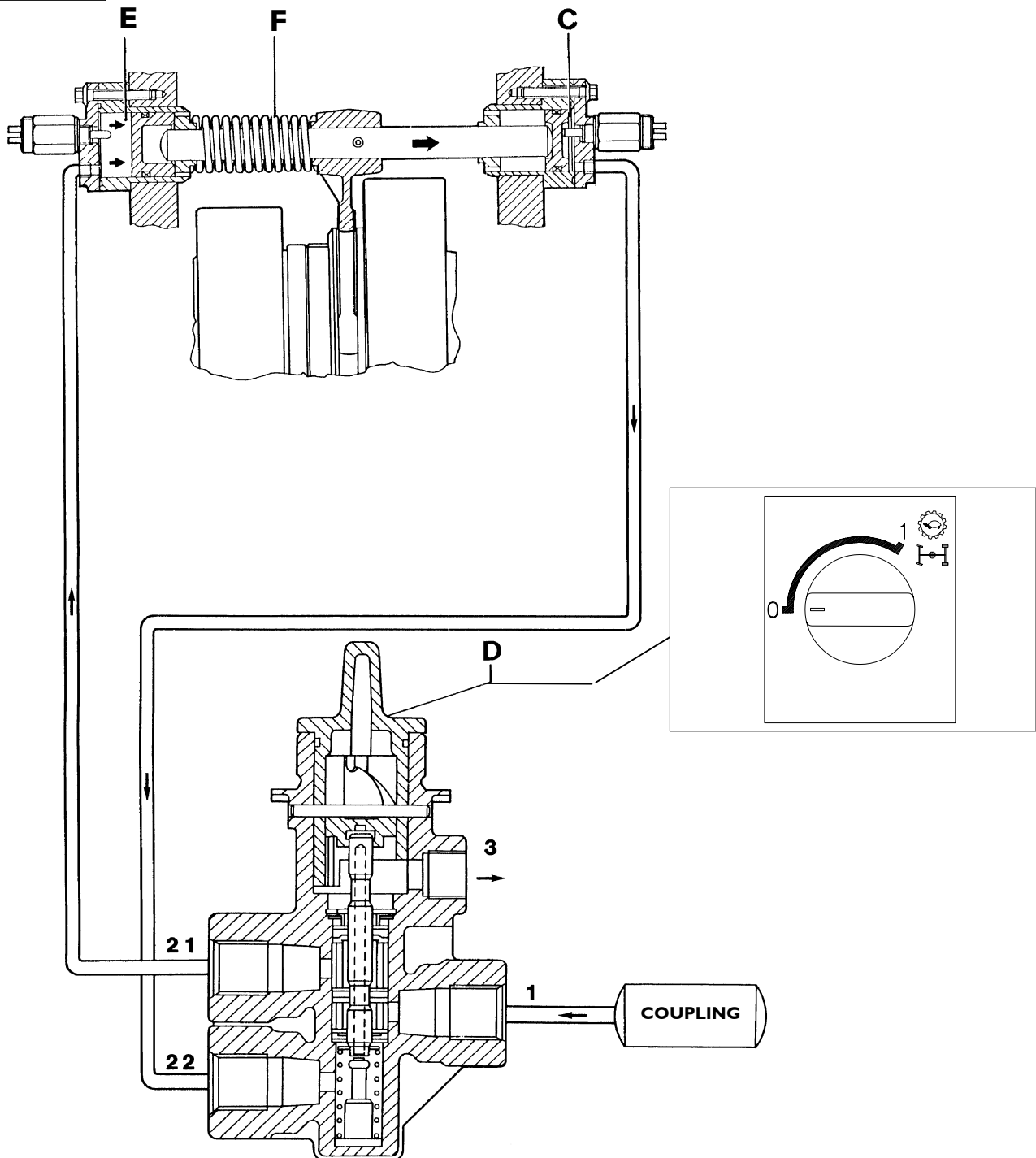
Figure 1



LONGITUDINAL SECTIONAL VIEW THROUGH THE REDUCTION GEAR UNIT

On-road

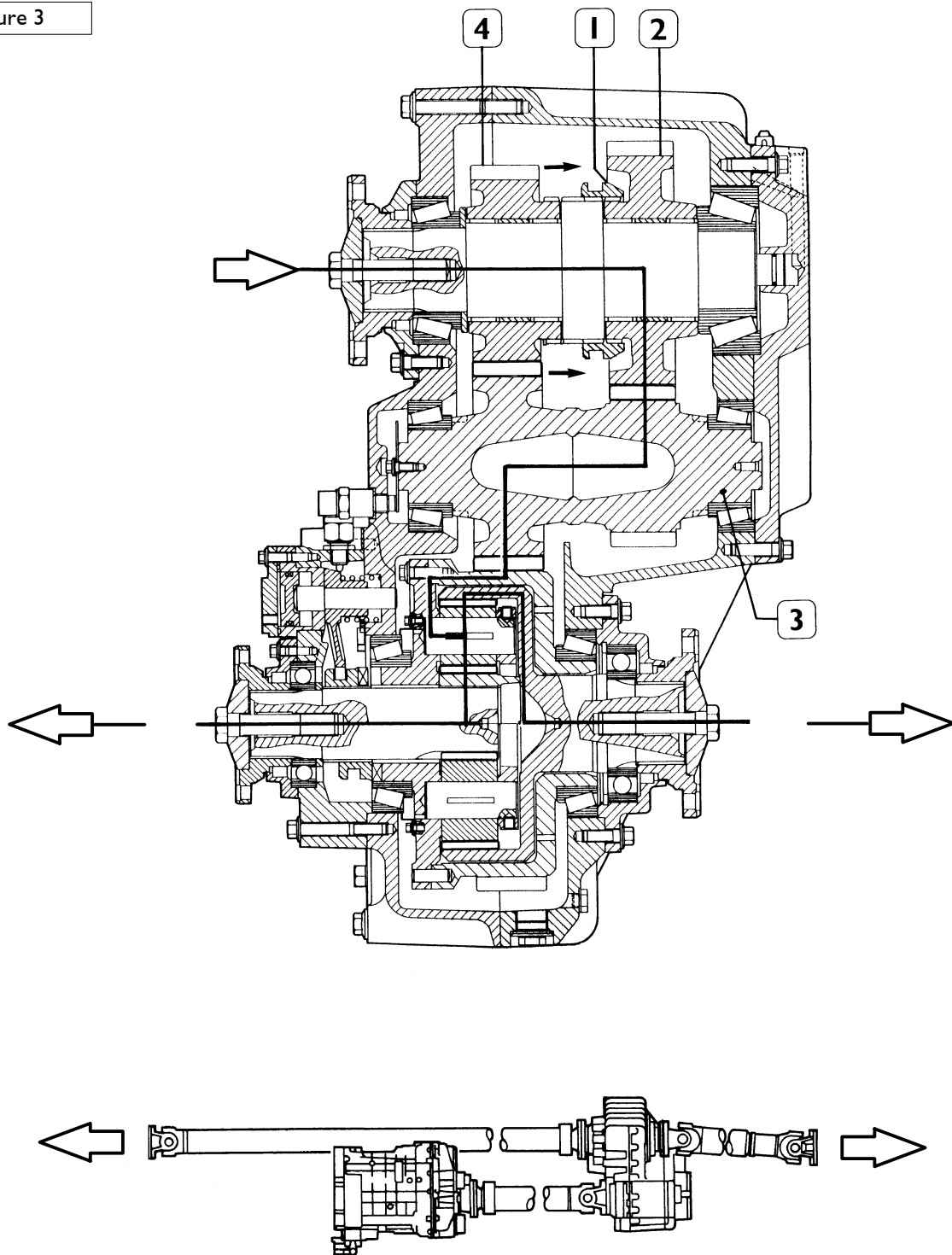
Figure 2



CONTROL KNOB "D" SET ON 0

With control knob "D" set on 0, the incoming air to coupling 1 passes through the valve and comes out through coupling 21, and by feeding chamber E causes the piston displacement to its end of stroke.

Spring F holds the fork and sleeve in the on-road gear ratio setting.
The air in chamber C is discharged through coupling 3.

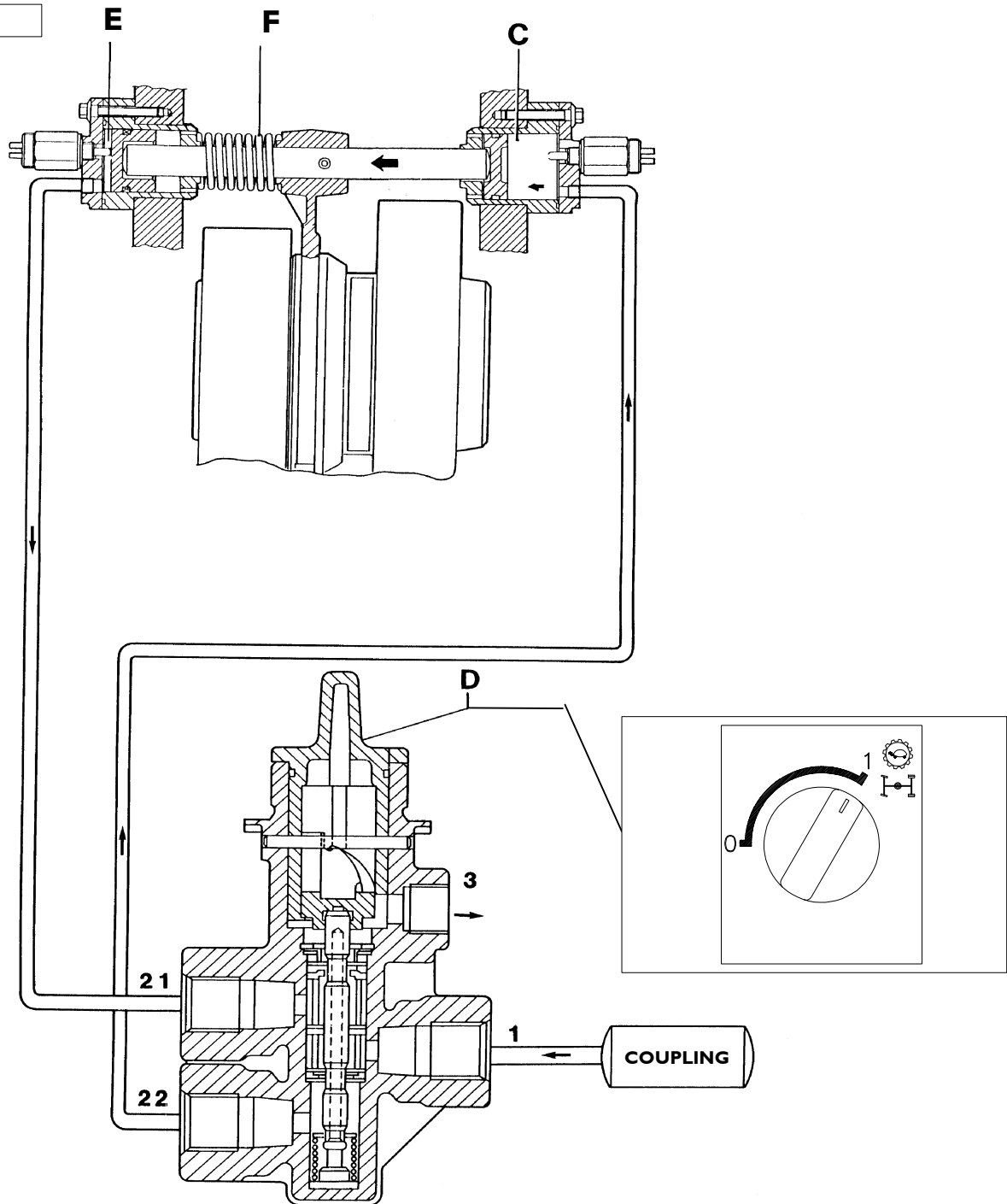
Transmission of motion pictorial diagram: on-road**Figure 3**

Sleeve (1) moves in the direction indicated by the arrow, meshing the gear (2) on the input shaft.

The motion is transmitted through the countershaft (3).

Off road

Figure 4



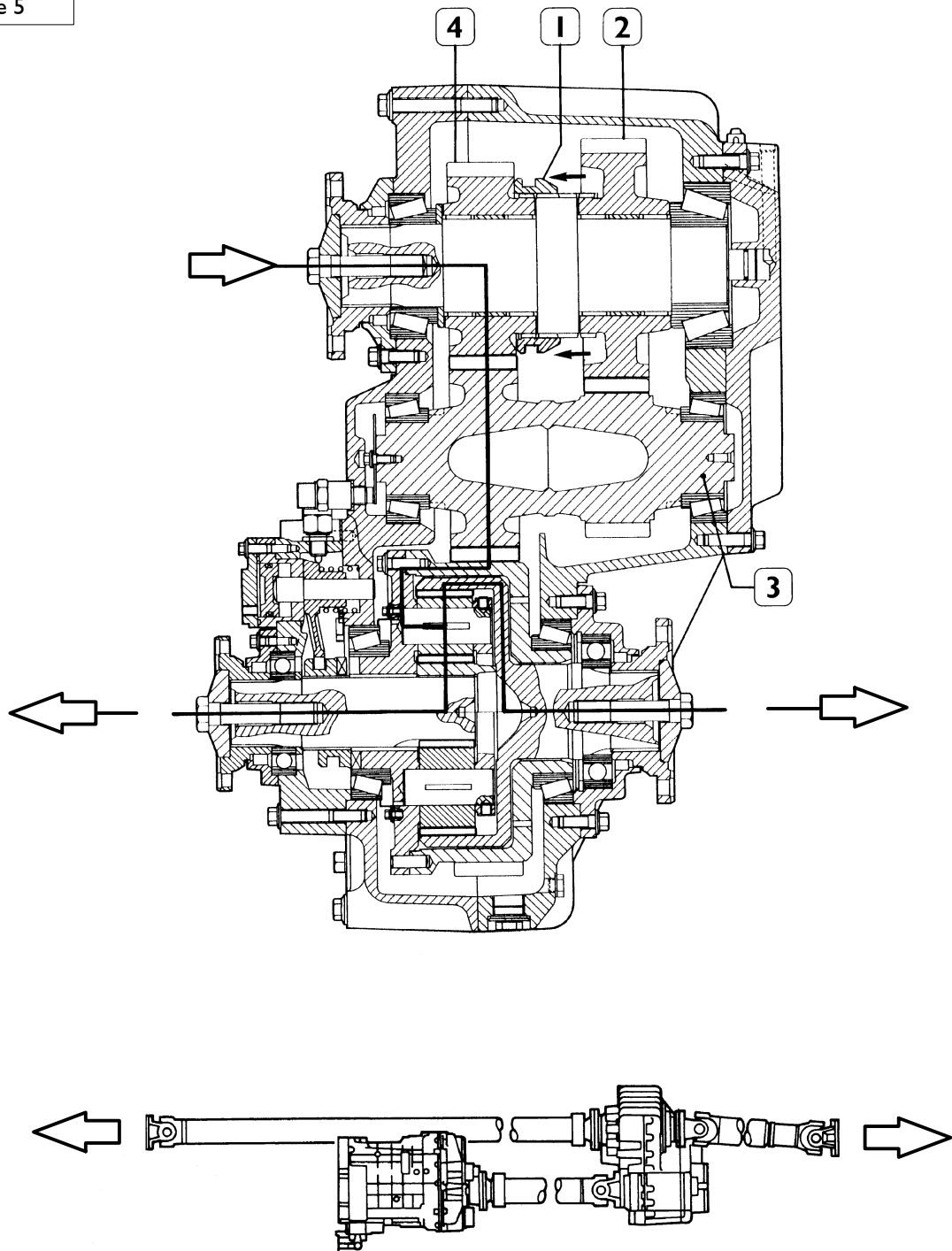
CONTROL KNOB "D" SET ON I

With control knob "D" set on I, the incoming air to coupling I passes through the valve and comes out through coupling 22, and by feeding chamber C causes the piston displacement to its end of stroke.

The fork and sleeve are set on off-road gear ratio setting. The air in chamber E is discharged through coupling 3.

Transmission of motion pictorial diagram: off-road

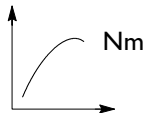
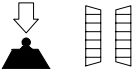
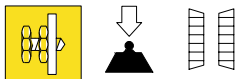
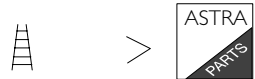
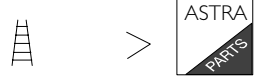
Figure 5



Sleeve (1) moves in the direction indicated by the arrow, meshing the gear (2) on the input shaft.

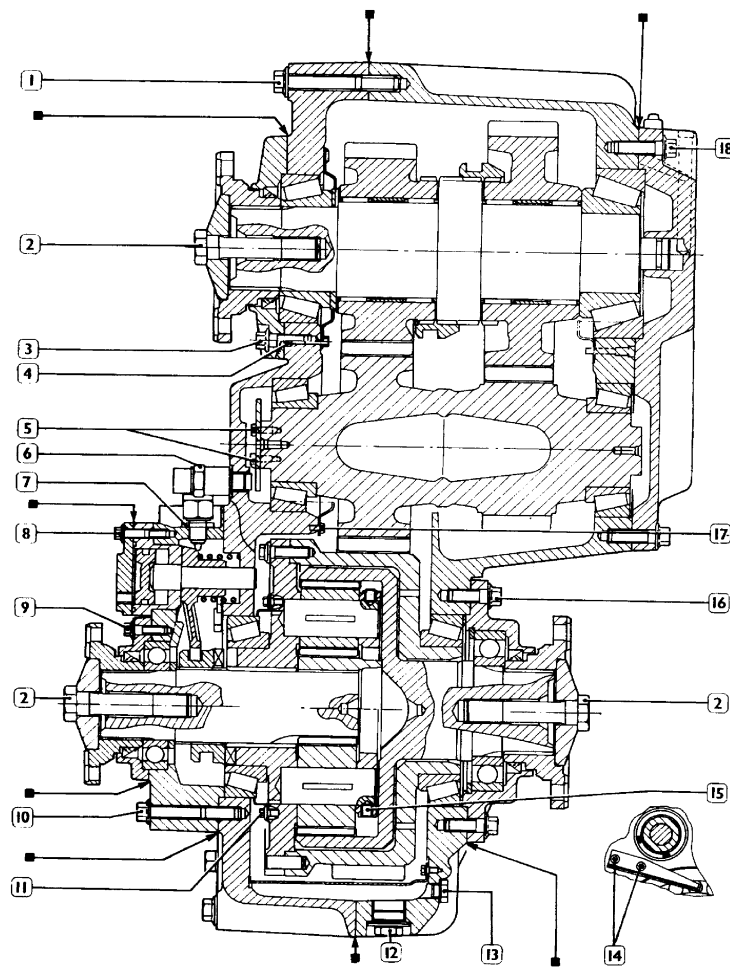
The motion is transmitted through the countershaft (3).

SPECIFICATIONS AND DATA

REDUCTION GEAR UNIT	TYPE	TC 2200
	Gears	Constant mesh helical gears
	Transmission ratios normal (on road) reduced (off road)	1 : 1 1 : 1,6
	Maximum input torque	22.000 Nm
	Torque reduction	1 : 4
	Bearings preload for: input shaft countershaft driving shaft	0,05 ÷ 0,10 mm
	Bearings preload adjustment	Through adjusting rings
	Thickness of adjusting rings	1-1,1-1,2-1,3-1,4-1,5-1,6-1,7-1,8-1,9 mm 1-1,6-1,7-1,8-1,9-2,0-2,1-2,2-2,3-2,4-2,5 mm 1-1,1-1,2-1,3-1,4-1,5-1,6-1,7-1,8-1,9-2 mm
	Thickness of adjusting rings for pulse transmitter	1 - 1,5 mm 1 - 1,5
	Quantity (*) kg (liter)	5,6 (6,2)

(*) For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

Figure 6



39472

TIGHTENING TORQUES

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	M14 screw	92 ± 9	9,2 ± 0,9
2	M22 x 1.5 pin	500 ± 50	50 ± 5
3	M12 screw	58 ± 6	5,8 ± 0,6
4	M6 screw	10	1
5	M6 screw	10	1
6	Pulse transmitter	45 ± 5	4,5 ± 0,5
7	Nut	45 ± 5	4,5 ± 0,5
8	M8 screw	19 ± 2	1,9 ± 0,2
9	M10 screw	45 ± 5	4,5 ± 0,5
10	M12 screw	58 ± 6	5,8 ± 0,6
11*	M6 screw	7	0,7
12	Screw plug	100 ± 10	10 ± 1
13*	Screw	4,5	0,45
14	Screw plug	60 ± 6	6 ± 0,6
15*	Set screw	33 ± 3	3,3 ± 0,3
16	M12 screw	58 ± 6	5,8 ± 0,6
17	Screw	5	0,5
18	M12 screw	58 ± 6	5,8 ± 0,6

* Apply LOCTITE AVX

■ Apply LOCTITE 510

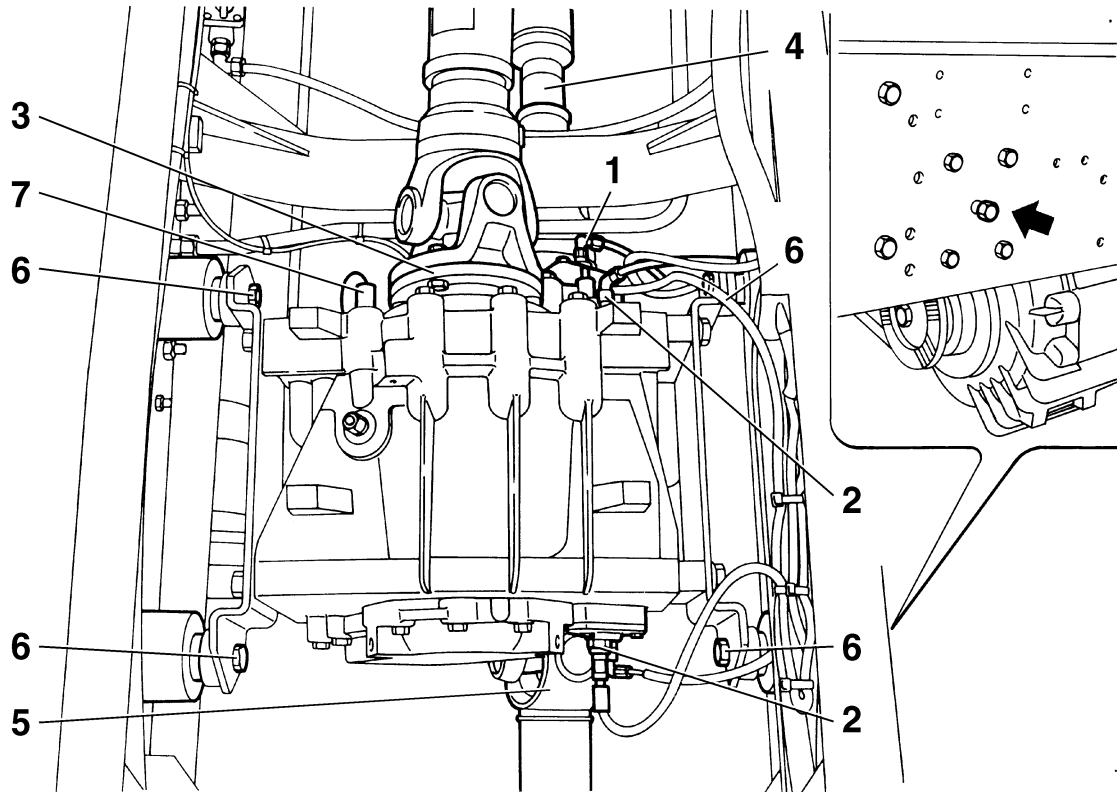
TOOLS

TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99340205	Percussion puller
99341003	Simple effect axle
99341009	Pair of brackets
99341015	Clamp
99342143	Puller pin to remove planetary gear pins from epicyclic unit of transmission unit (to be used with 99340205)
99345049	Counter block for pullers
99345056	Counter block for pullers
99360502	Rings to remove and fit in place the transmission unit halfbox
99366067	M8 hooks (2) to remove and fit in place the transmission unit intermediate shaft
99370006	Handle for interchangeable beaters
99370317	Lever and relevant extension bar for flange stop
99370565	Element to fit the gasket in front driving shaft cover of transmission unit (to be used with 99370006)
99370362	Eye bolt (2) to remove and fit in place transmission unit epicyclic assembly
99370631	Stand to hold transmission unit during removal and fitting in place
99371051	Bracket to hold transmission unit during overhaul (to be used with 99322205)
99374253	Element to fit the gasket in input shaft cover, and transmission unit rear driving shaft (to be used with 99370006)
99389821	Dynamometric wrench (0-70 Nm) with square 3/8" coupling

STRIPPING DOWN - REFITTING THE REDUCTION GEAR UNIT

Stripping down

Figure 7



To remove the reduction gear unit proceed as follows:

- ☐ set the vehicle on a pit or on a hoist;
- ☐ open the battery case and disconnect the cables to avoid short-circuits;



The disposal of waste or residual fluid in unauthorised sites or in the public sewer system is prohibited.

- ☐ disconnect reduction gear unit electrical and pneumatic connections (1);
- ☐ disconnect reduction gear unit electrical and pneumatic connections (2);
- ☐ disconnect odometer cable (7) after removing the sealing;
- ☐ undo the screws fixing the input shaft flange (3), front output shaft flange (4) and rear output shaft flange (5) and secure temporarily the shafts to the chassis to avoid interference during next operations;

- ☐ disconnect hydraulic pipes from servo-clutch auxiliary pump (8);
- ☐ position a hydraulic lifting device under the transfer and remove the connecting screws to the four supporting pads (6);
- ☐ screw one screw to each pad as shown by the arrow to press the pad and enable unit removal;
- ☐ lower the hydraulic lifting device and remove the transfer from the bottom.

Refitting

Reverse the operations for removal.

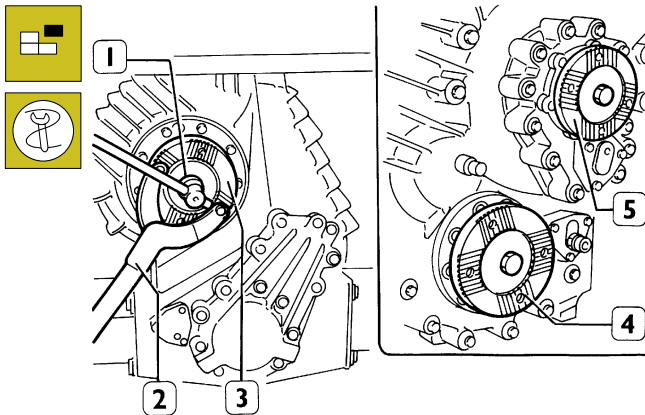


When refitting, drain out power steering hydraulic circuit as described in Section 15.

DISASSEMBLING THE REDUCTION GEAR UNIT AT THE BENCH

Set the reduction gear unit on rotary stand 99322205 with brackets 99371051, unscrew the plugs and drain the oil. Unscrew the pulse transmitter and the indicator switches.

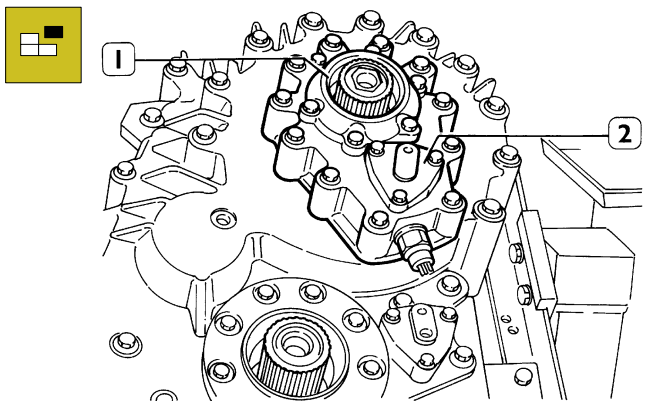
Figure 8



39870

Lock roation offlange (3) through lever 99370317 (2), use a suitable socket wrench (1) to remove the retaining screw and remove the flange; repeat the same operation for the flanges (4- 5) on the opposite side.

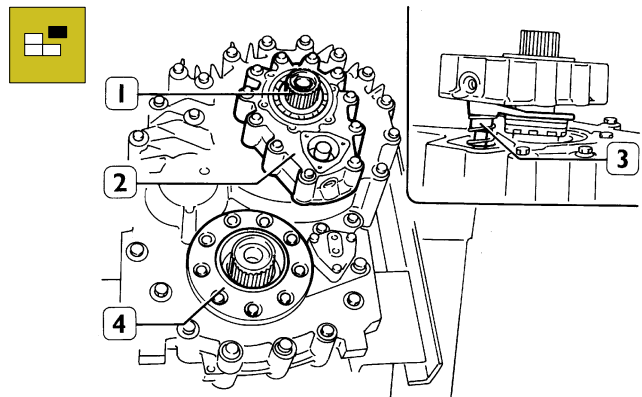
Figure 9



39871

Remove the 6 screws and the cover (1) with its seal ring; remove the 3 screws and cover (2) with reduction gear engagement piston.

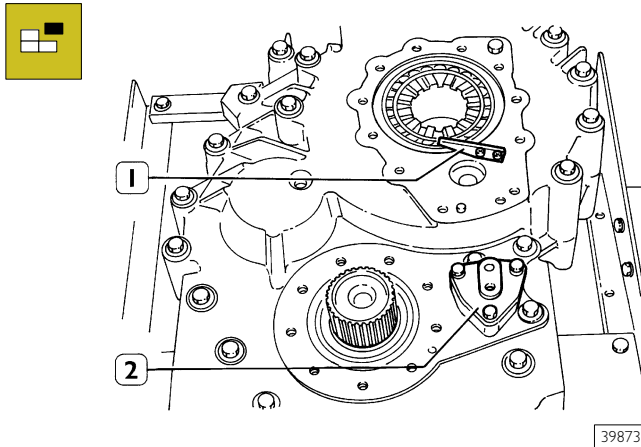
Figure 10



39872

Remove the 11 screws and take away cover (2) together with reduction gear engagement control shaft (1) and fork (3); remove the 9 screws and remove cover (4) with its seal ring.

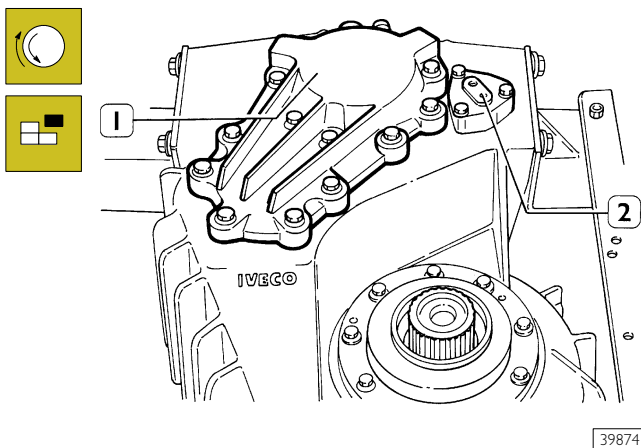
Figure 11



39873

Remove the 3 screws and take away cover (2) with control piston and withdraw the internal spring; use a socket wrench for the screws and remove the safety plate (1).

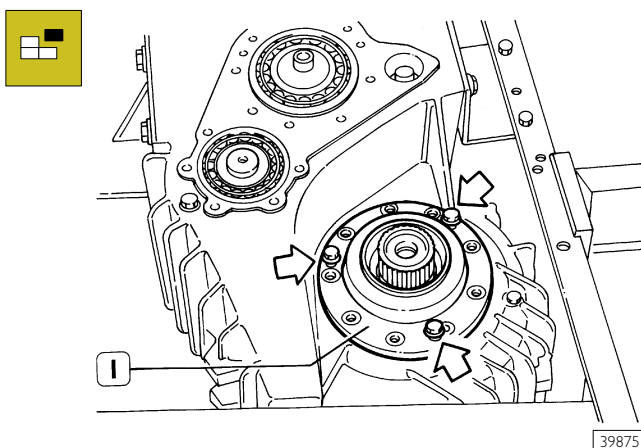
Figure 12



39874

Rotate the unit 180°. Remove the 3 screws and take away cover (2) with piston rod; remove the 14 screws and take away the cover (1). Remove the adjusting rings.

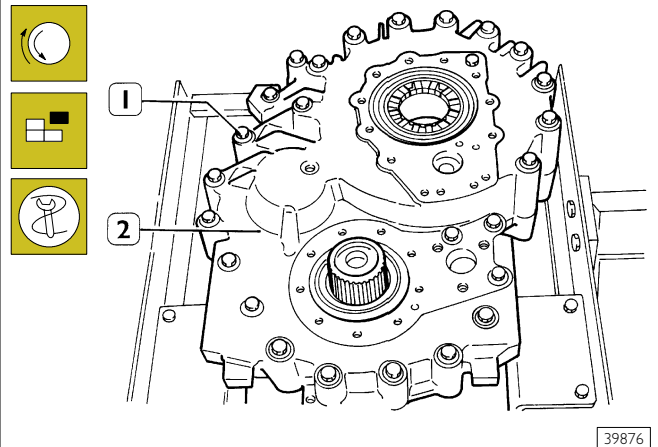
Figure 13



39875

Remove the 9 screws, then fit 3 counteracting screws into the holes indicated by the arrows, take away the cover (1) and remove the adjusting rings.

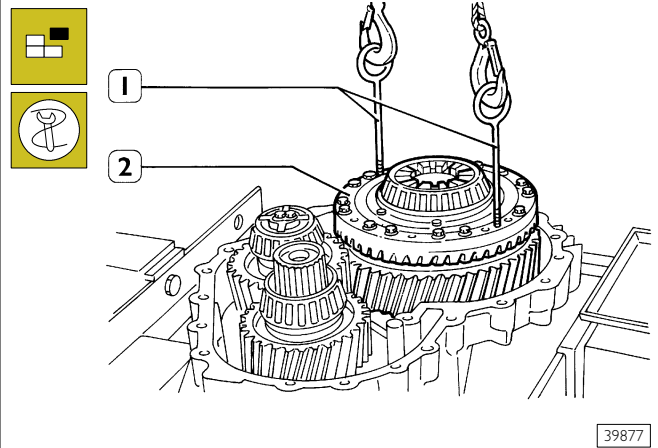
Figure 14



39876

Rotate the unit 180°. Remove screws (1) and with a hoist and ropes take away the housing (2).

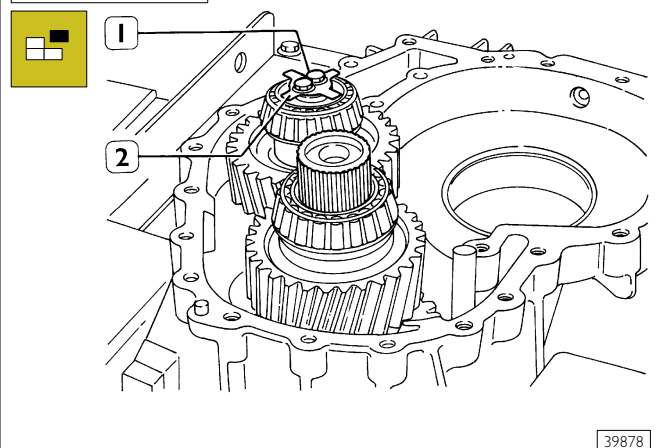
Figure 15



39877

Use eye bolt 99370565 (1), ropes and lifting device to withdraw the epicyclic reduction gear (2) from the housing.

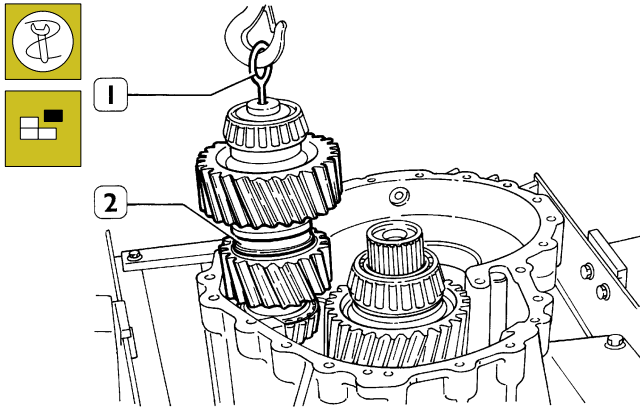
Figure 16



39878

Remove screw (1) and phonic wheel (2)

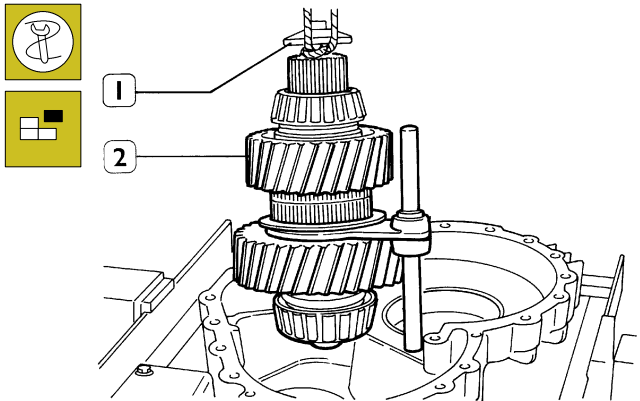
Figure 17



39879

Using eye bolt 99366067 (1) rope and lifting device, release the countershaft (2) from the housing.

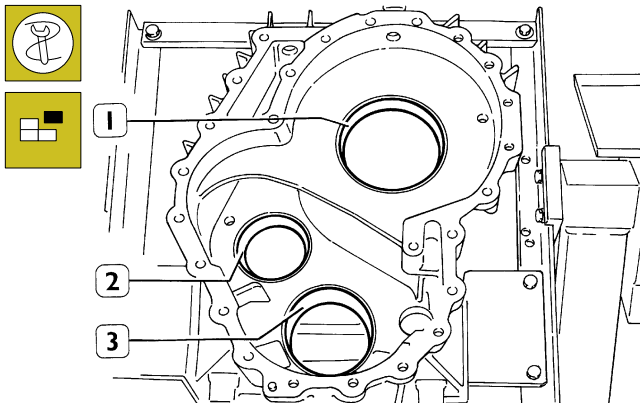
Figure 18



39880

Screw the relevant screw and washer (1) onto the input shaft, use a rope and lifting device to withdraw the shaft (2) and control fork from the housing.

Figure 19

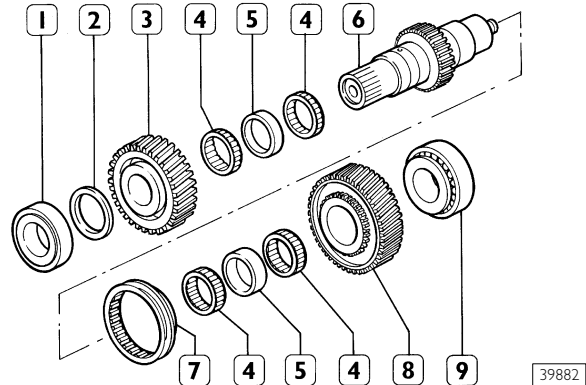


39881

Using a suitable beater, remove the bearing outer rings (1-2-3).

DIS-ASSEMBLING THE INPUT SHAFT

Figure 20



39882

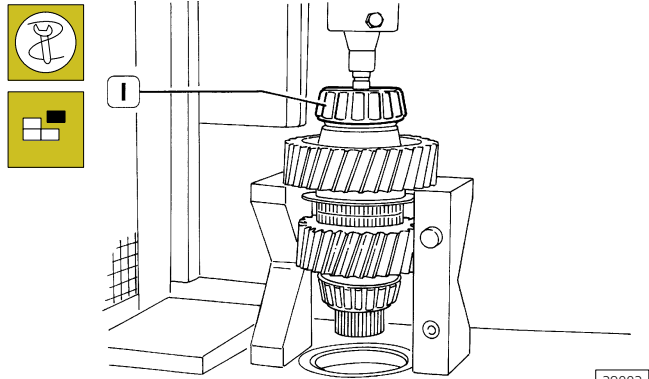
INPUT SHAFT COMPONENTS

1. Bearing - 2. Spacer ring - 3. Gear - 4. Roller bearings - 5. Spacer ring - 6. Shaft - 7. Sliding sleeve - 8. Gear - 9. Bearing



To dis-assemble the bearings (1, figure 21 and 22) it is necessary to use a hydraulic press.

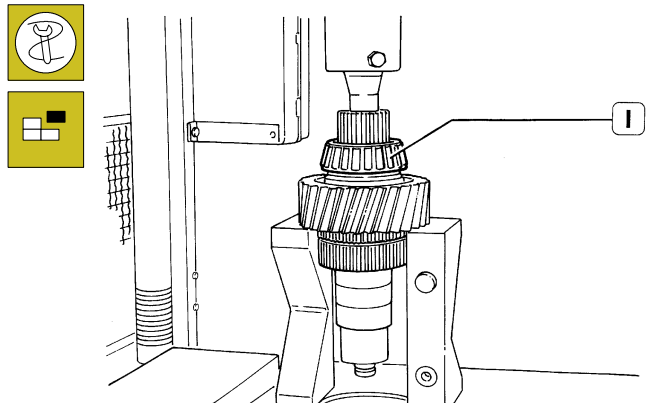
Figure 21



39883

Having withdrawn the bearing (1) manually withdraw the gear (8, figure 20), roller bearings (4), spacer ring (5) and sliding sleeve (7).

Figure 22

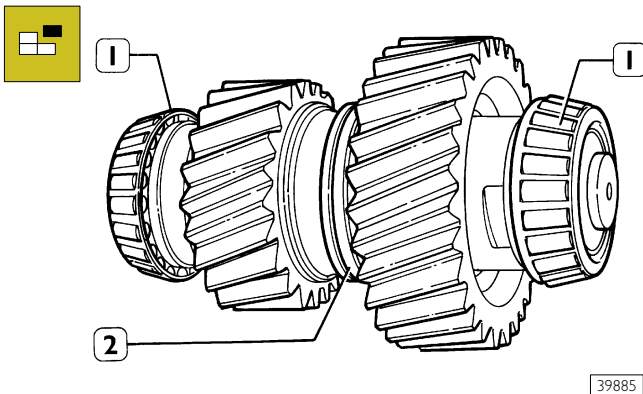


39884

Remove bearing (1) and take away the spacer ring (2, figure 20), gear (3), roller bearings (4) and spacer ring (5).

DIS-ASSEMBLING THE COUNTERSHAFT

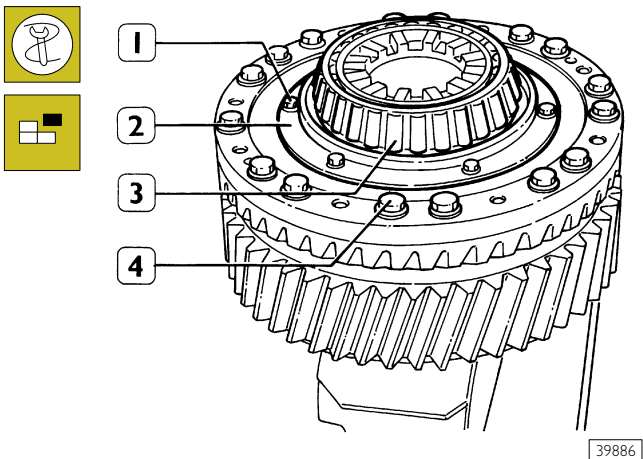
Figure 23



The removal of the bearings (1) from the countershaft (2) is a destructive operation.

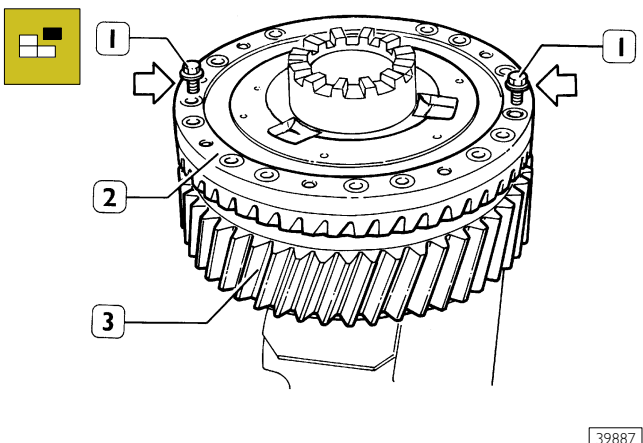
DIS-ASSEMBLING THE EPICYCLIC REDUCTION GEAR

Figure 24



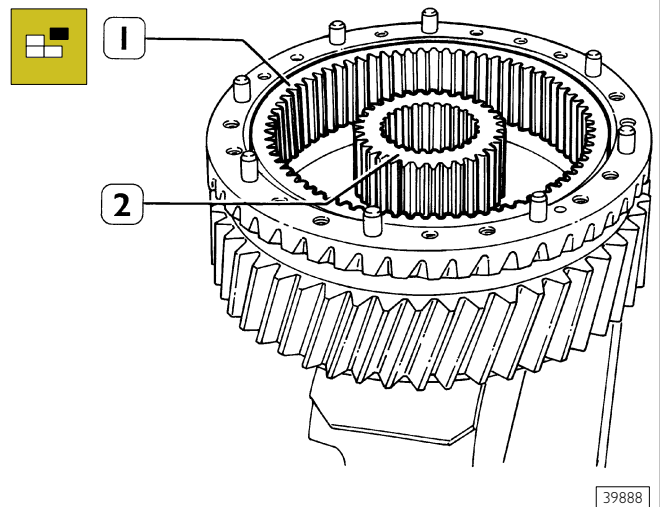
Remove screws (1) and take away the splash guardring (2), then using the appropriate puller remove the bearing (3), remove the screws (4).

Figure 25



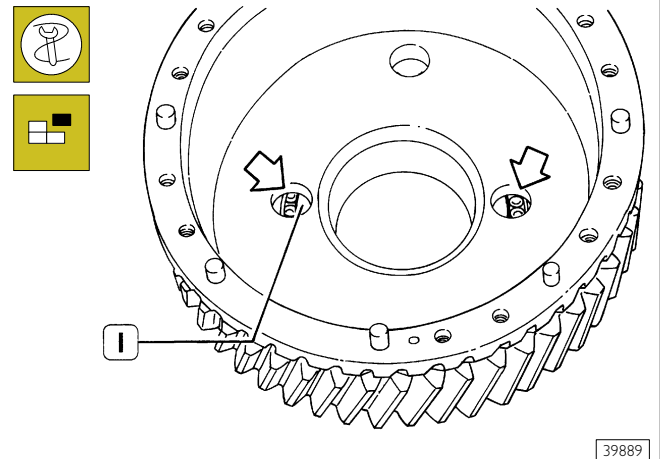
Using the 2 screws (1) in the holes indicated by the arrows, take the planetary gear carrier (2) away from the crown wheel (3).

Figure 26



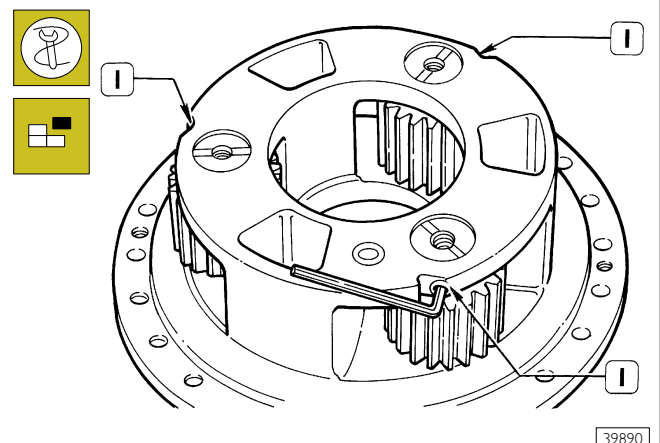
Remove the planetary gear (2) and take away the driving shaft (1).

Figure 27



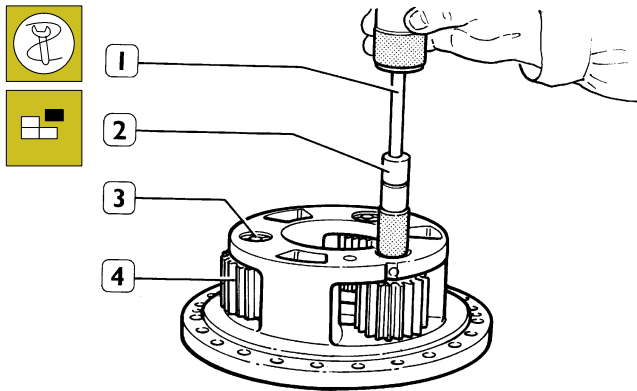
Using the suitable beater remove bearing (1) from the holes indicated by the arrows.

Figure 28



Use a socket wrench to remove the 3 securing set screws (1).

Figure 29

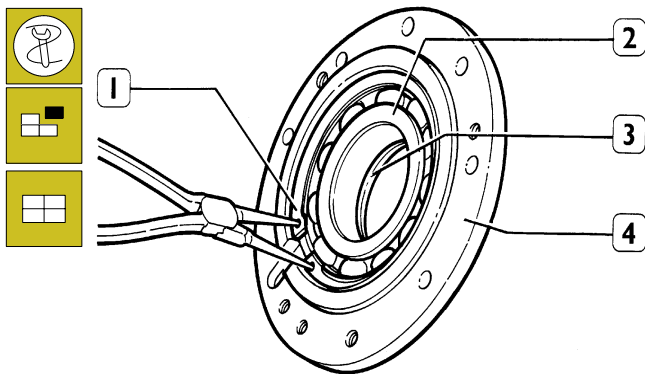


39891

Use percussion puller 99340205 (1) with pin 99342143 (2) to remove the shafts (3) for the gears (4).

REPLACING THE SEAL RINGS ON THE DRIVING SHAFT COVERS

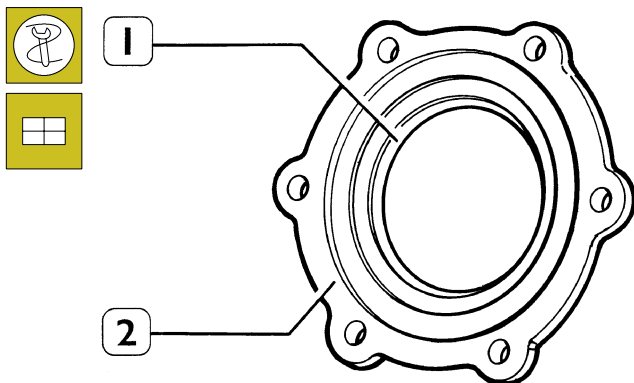
Figure 30



39892

To replace the seal ring (3) on cover (4) of the rear driving shaft, remove the locking ring (1) and withdraw the bearing (2). To fit the seal ring (3) in place, use tool 99374253.

Figure 31



39893

To fit seal ring (1) on front driving shaft cover (2), use tool 99370362.

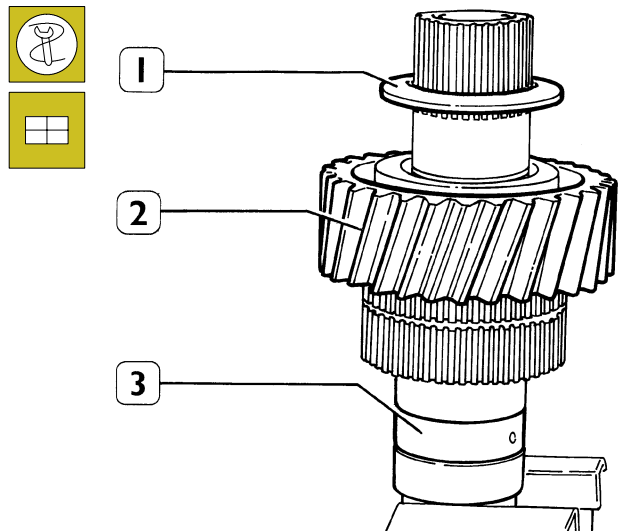
CLEAN OUT AND CHECK

After the reduction gear unit has been removed, carefully clean all the parts.

Check that there are no signs of wear, seizure or cracking. Seal rings and gaskets should always be replaced before re-fitting in place.

FITTING IN PLACE THE INPUT SHAFT

Figure 32

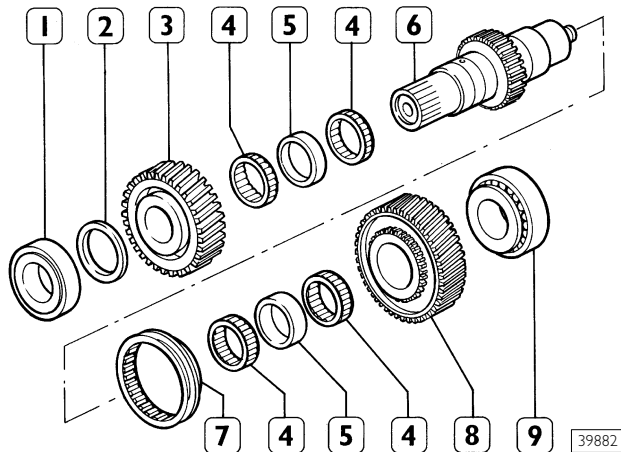


39894

Clamp the shaft (3, Figure 32) in a vice, fit in place the roller bearings (4, Figure 33), with spacer (5, Figure 33), connect the gear (2, Figure 32) with the meshing tooth towards the sliding sleeve, fit the spacer ring (1, Figure 32).

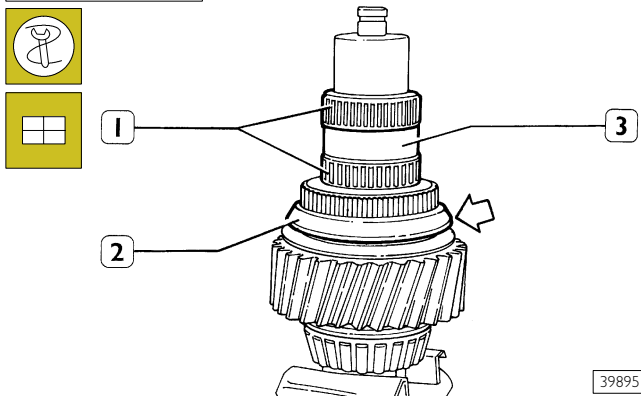
Heat the roller bearing inner ring (1, Figure 33) to 80 °C - 90 °C and fit it on the shaft.

Figure 33

**INPUT SHAFT COMPONENTS**

1. Bearing - 2. Spacer ring - 3. Gear - 4. Roller bearings - 5. Spacer ring - 6. Shaft - 7. Sliding sleeve - 8. Gear - 9. Bearing

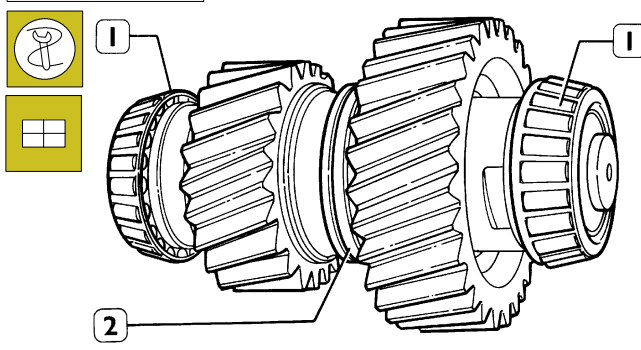
Figure 34



Turn the shaft over and clamp it in a vice.
Fit in place the sliding sleeve (2) with the flare (arrow) facing upward; fit the roller bearings (1) and spacer (3).
Fit in place the gear (8, figure 33) with the meshing toothset towards the sliding sleeve.
Heat to 80 °C - 90 °C the roller bearing inner ring (9, Figure 33) and fit onto the shaft.

FITTING IN PLACE THE COUNTERSHAFT

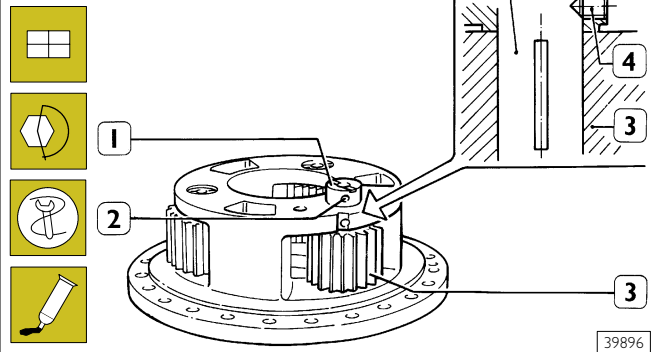
Figure 35



After heating the inner rings to 80° - 90 °C, fit the bearings (1) onto the shaft (2).

FITTING IN PLACE THE EPICYCLIC REDUCTION GEAR UNIT

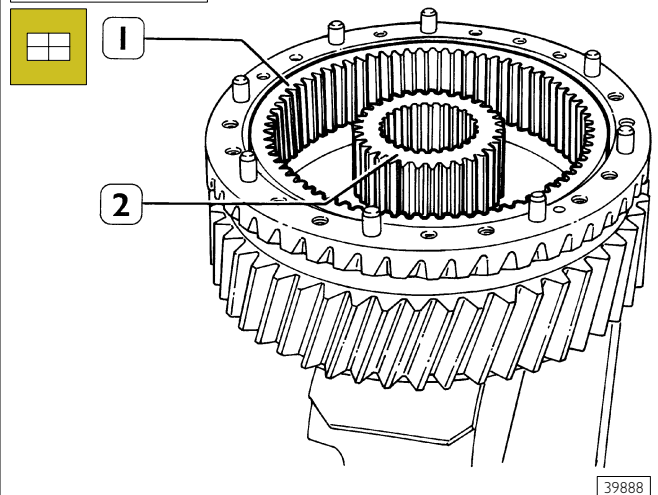
Figure 36



Fit the gears (3) onto the planetary gear carrier, connect the spindle (1) so that the hollow (2) coincides with the set screw hole (4). Apply LOCTITE AVX to the set screw (4) and lock it to a torque of 44 ± 4 Nm. Repeat the operation for the other spindles.

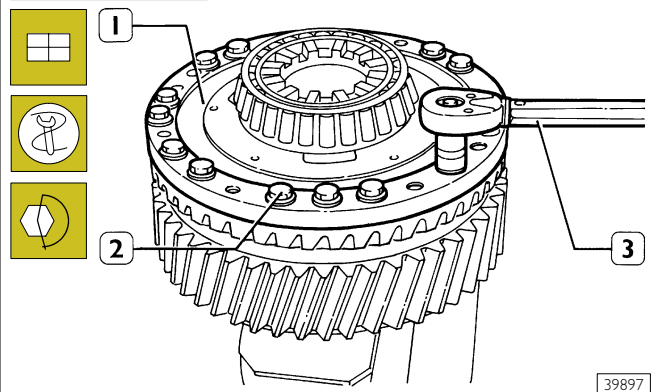
Turn the planetary gears carrier over and, after heating the inner ring to 80 °C - 90 °C, fit the bearing in place.

Figure 37



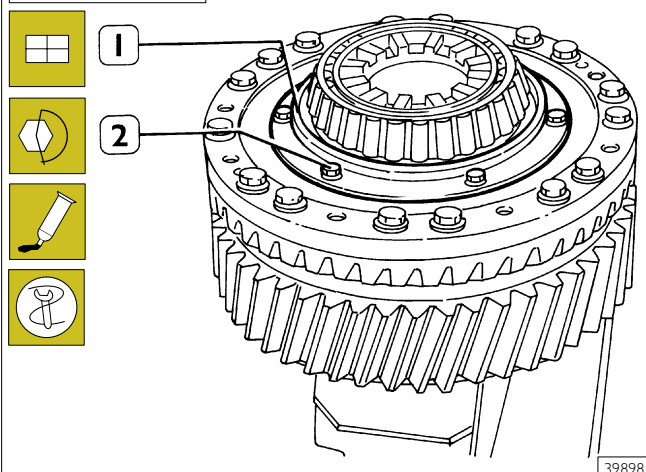
Fit the driving shaft, the planetary gear (2) on the crown wheel (1) and clamp the unit in a vice.

Figure 38



Fit in place the completed planetary gears carrier (1) coinciding the reference pins, tighten screws (2) and lock them with a dynamometric wrench (3) to the prescribed torque.
Turn the unit over and after heating the inner ring of the bearing to 80 °C - 90 °C, fit it in place.

Figure 39

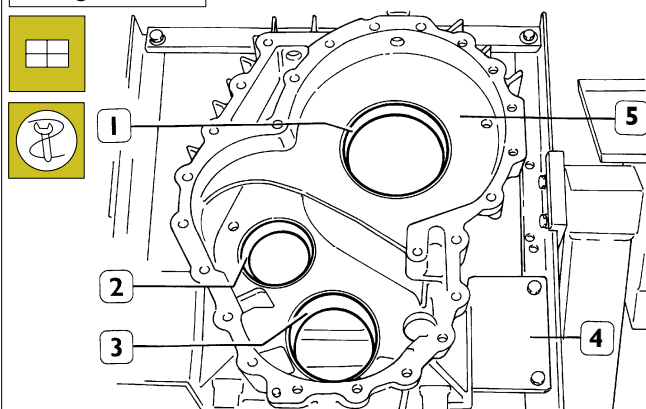


39898

Fit in place the splash guard (1), apply LOCTITE AVX to the screws (2) and tighten them to a torque of 7 ± 1 Nm. Turn the unit over and fit the bearing after heating the inner ring to $80^\circ\text{C} - 90^\circ\text{C}$.

ASSEMBLING THE REDUCTION GEAR UNIT AT THE BENCH

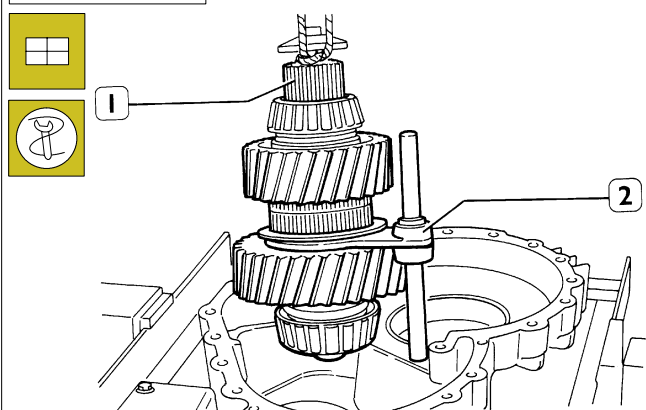
Figure 40



39881

Set the housing (5) on stand 99322205 using brackets 9937105 (4); use the appropriate beater to fit the bearing outer rings (1-2-3).

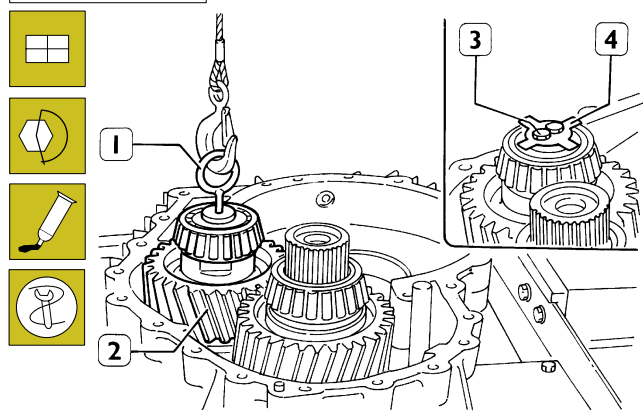
Figure 41



39899

Using a rope and truck lift fit the input shaft (1) with the control fork (2) into the housing.

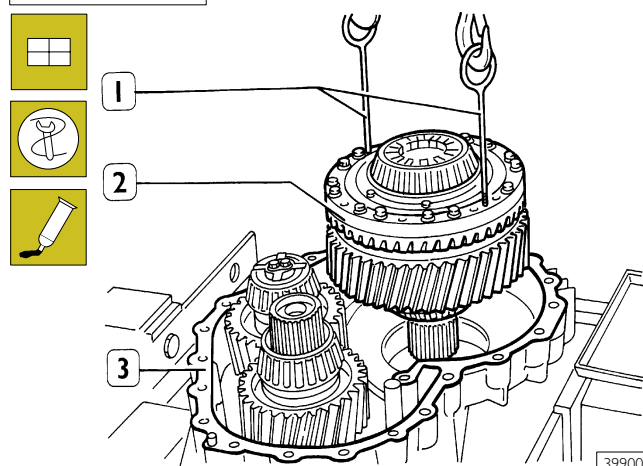
Figure 42



39899A

Use eye bolt 99366067 (1) to fit into place the countershaft (2). fit in place the phonic wheel (4), the safety plate and tighten the screws (3) to the specified torque, bend the safety plate.

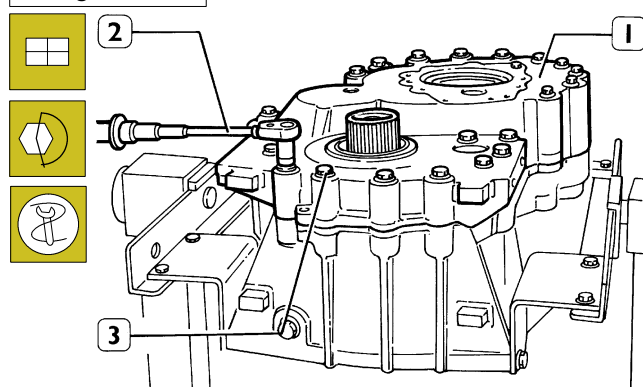
Figure 43



39900

Use eye bolt 99370565 (1) to fit the epicyclic reduction gear (2) into the housing. Fit gasket (3) in the housing.

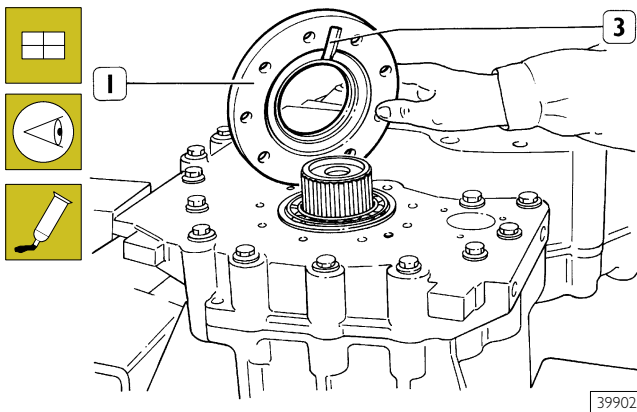
Figure 44



39901

Fit in place the housing (1) and use a dynamometric wrench (2) to tighten the screws (3) to the specified torque.

Figure 45

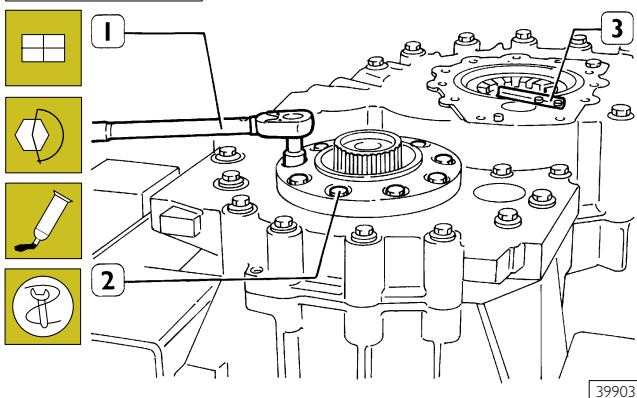


Fit in place the gasket, fit the cover (1) with its seal ring.



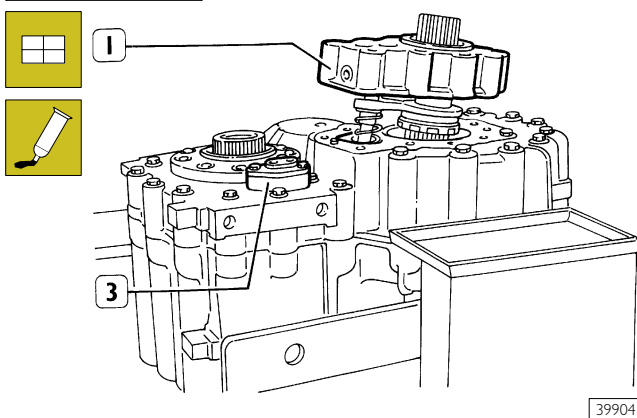
The oil passage (3) must be in the position shown in the figure.

Figure 46



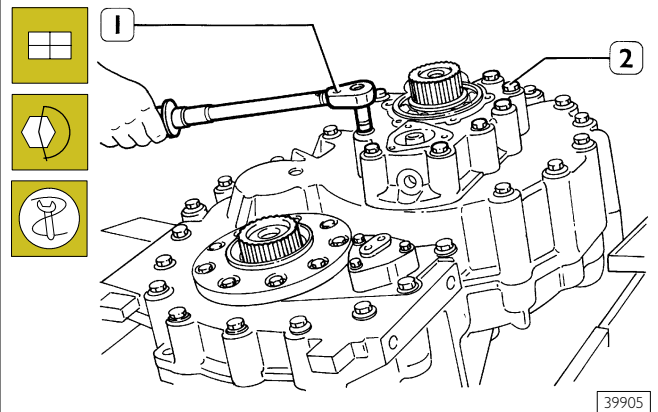
Lock the cover screws (2) with a dynamometric wrench (1) to a torque of 50 ± 5 Nm. Set the locking plate (3) in position, apply LOCTIT AVX to the screws and tighten them to a torque of 4.5 Nm.

Figure 47



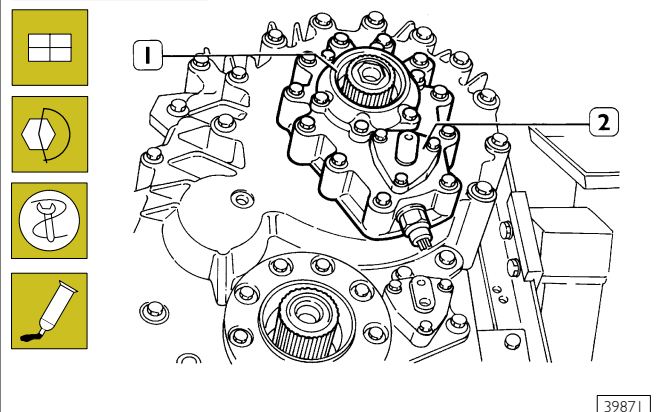
Fit in place the cover (3) with the control piston and internal spring. Fit the gasket and cover (1) together with the shaft and reduction gear control fork.

Figure 48



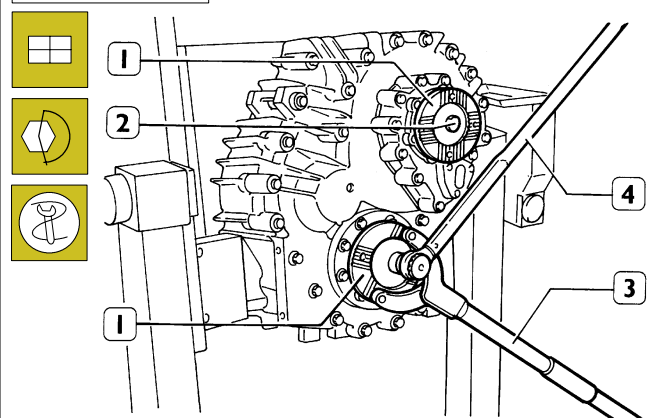
Use a dynamometric wrench (1) to tighten the screws (2) to a torque of 78 ± 8 Nm.

Figure 49



Fit in place the cover (2) with the control piston. Set the gaskets in place, fit cover (1) and tighten the screws to a torque of 30 ± 3 Nm.

Figure 50



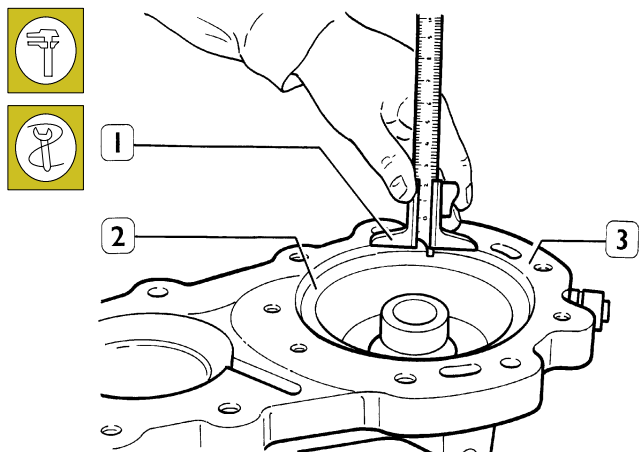
Connect the two flanges (1) fit the washers and with a lever (3) and dynamometric wrench (4) tighten screws (2) to a torque of 500 ± 50 Nm.

ADJUSTMENTS

Shaft bearings pre-load adjustment

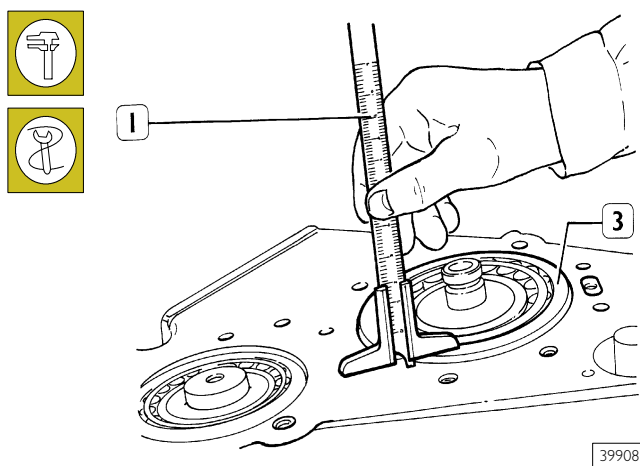
INPUT SHAFT

Figure 51



- With a caliper (1), find the depth of the seat (2) for the bearing on the cover (3):

Figure 52

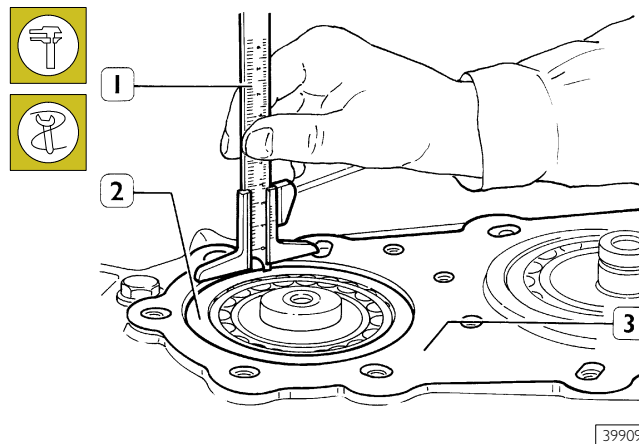


- Set the gasket (2) on the housing, and use a caliper (1) to find the protrusion between bearing outer ring (3) and gasket (2).

The difference between these two measurements is the adjusting ring shim; add 0.10 to 0.15 mm (preload) to the value obtained.

COUNTERSHAFT

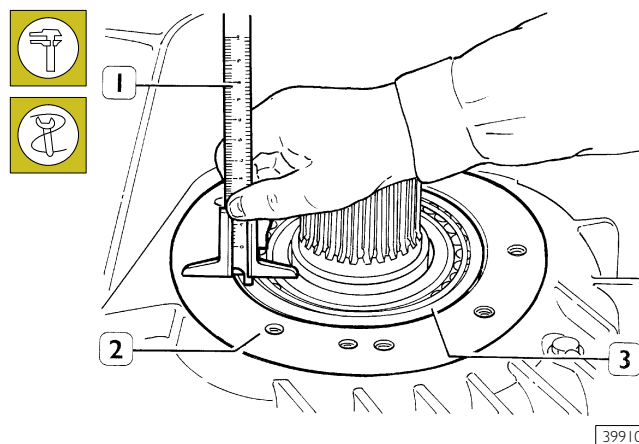
Figure 53



- Use a caliper (1) to find the distance between the gasket (3) on the housing and bearing outer ring (2). Add the specified preload to this value.

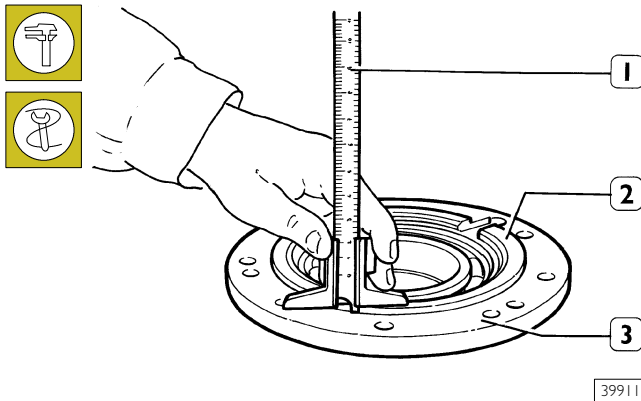
DRIVING SHAFT

Figure 54



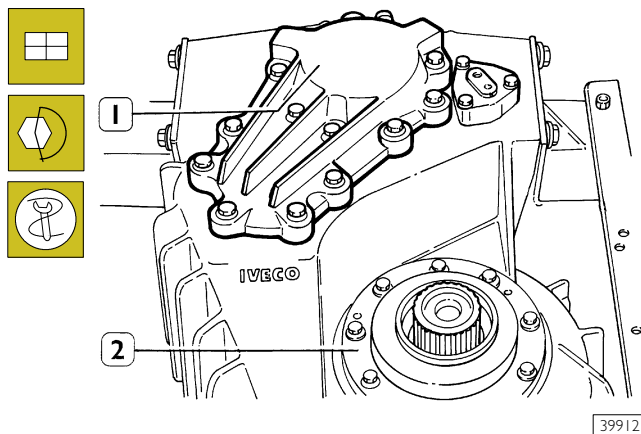
- Use a caliper (1) to find the distance between the outer edge of the bearing collar (2) and the cover face (3).

Figure 55



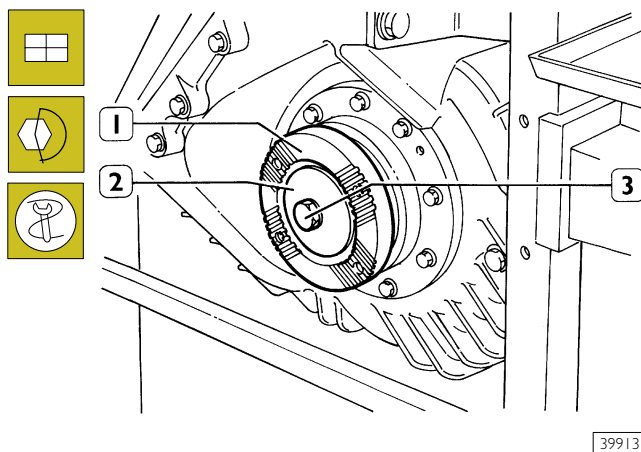
- Use a caliper (1) to find the distance between the outer edge of the bearing collar (2) and the cover face (3). The difference between these two measurements is the value for the adjusting ring; add 0.10 to 0.15 mm (preload) to this value.

Figure 56



Fit the adjusting rings, assemble the covers (1-2) and tighten the screws to a torque of 50 ± 5 Nm.

Figure 57



Connect the flange (1), fit washer (2) using a lever and dynamometric wrench tighten the screw (3) to a torque of 500 ± 50 Nm.

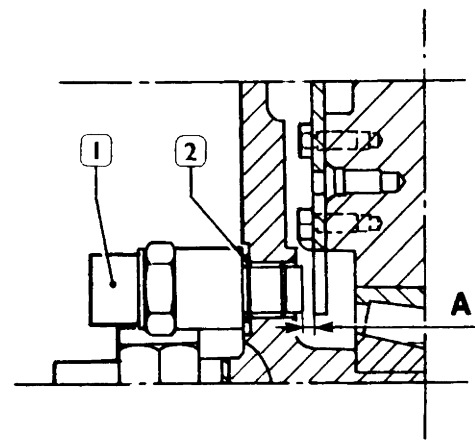
Fit the indication switch and the pulse transmitter and adjust as described in the following paragraphs.

Indication switch adjustment

Screw on the switch to electric contacts closing, screw on once and then tighten the lock nut to the prescribed torque.

Pulse transmitter adjustment

Figure 58



Select the adjusting ring (2) to obtain A equal to 2 - 2,8 mm when fitting the pulse transmitter (1).

Tighten oil drain plugs.
Fill the unit with the specified oil.

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PROPELLER SHAFTS

SECTION 10

SECTION 10**Propeller shafts**

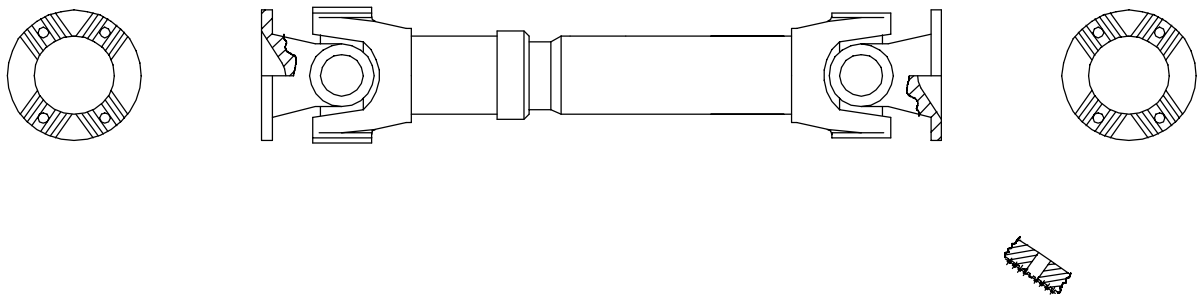
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☐ Removing	9
☐ Cleaning	9
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☐ Assembling	10
CHECKING THE PROPELLER SHAFTS ON THE VEHICLE	10

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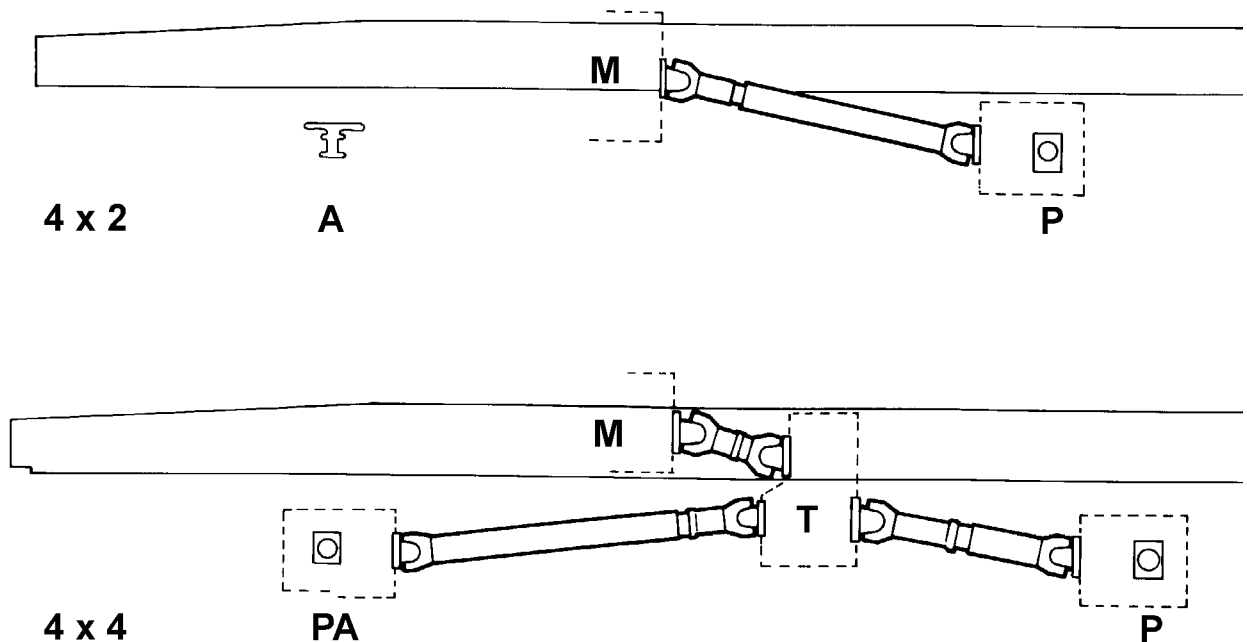
DESCRIPTION

The transmission of motion from the engine-gear unit to the reduction gear unit (if any) and to axle/s is done through the propeller shaft (which may be a single section, or two or three sections with floating support). This is connected to the ends through universal joints.

The front end of the propeller shaft, besides the universal joint, features a splined sliding sleeve that enables the shaft to vary its length to absorb any drive axial displacement, due to rear axle rocking.

Figure 1

PROPELLER SHAFT

2-axle vehicles**Figure 2**

3-axle vehicles

Figure 3

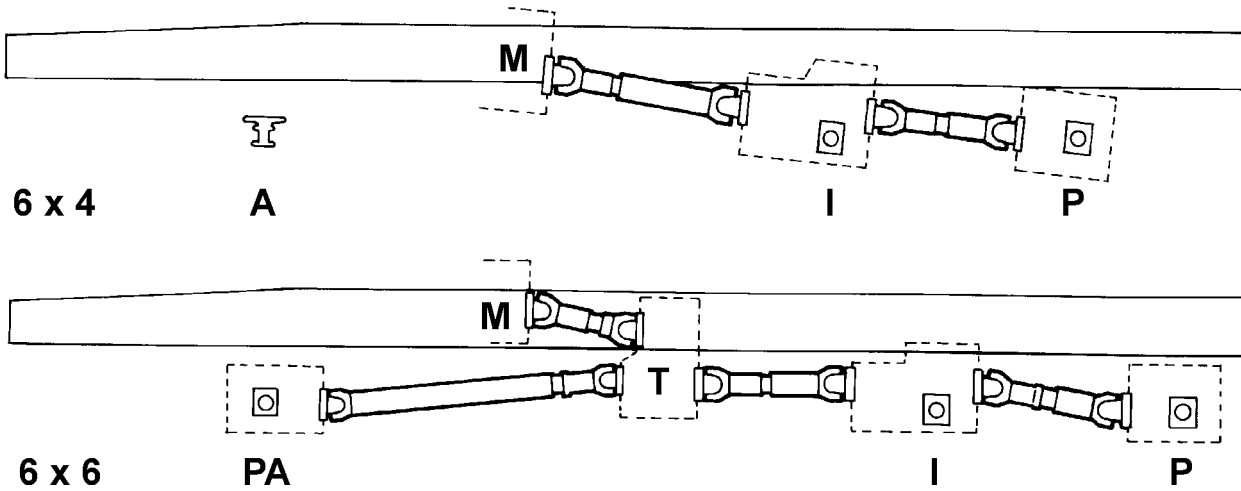
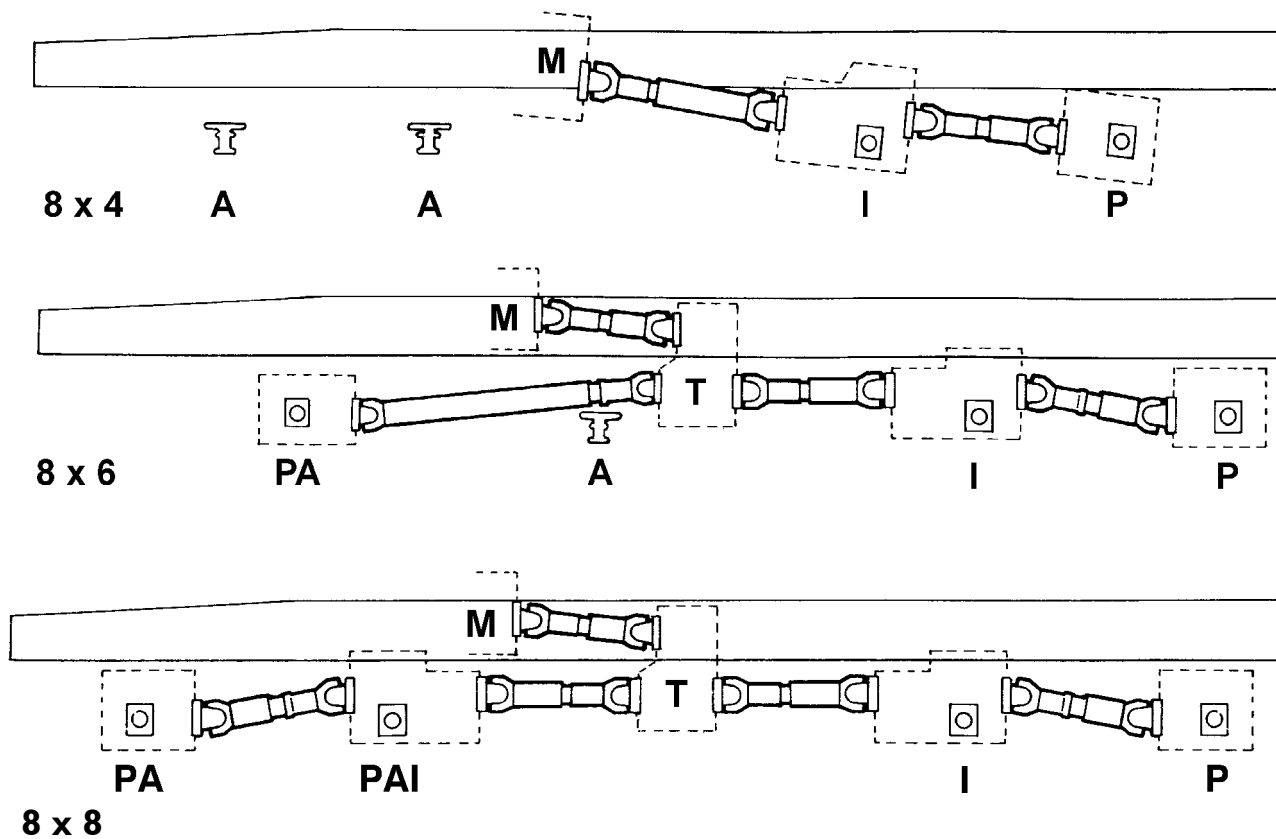
**4-axle vehicles**

Figure 4

M = engine-gear unit
T = transfer
A = axle

PA = front axle
I = intermediate axle
P = rear axle



DIAGNOSTIC

Propeller shaft operation faults:

I - Driving noise and vibrations

I

DRIVING NOISE AND VIBRATION

Shaft strain

- YES →

Replace the shaft

NO



Shaft is out of balance

- YES →

Check balancing and determine the points where balancing counterweights are to be welded

NO



Spline excessive slack

- YES →

Replace the shaft

NO



Screws and nuts to fasten the shaft to the sleeves on the gearbox or the rear axle are loose

- YES →

Check accurately, then tighten loose screws and nuts; if necessary replace any damaged parts.

NO



Propeller shaft universal joints are seized or badly worn

- YES →

Overhaul or replace the universal joints.

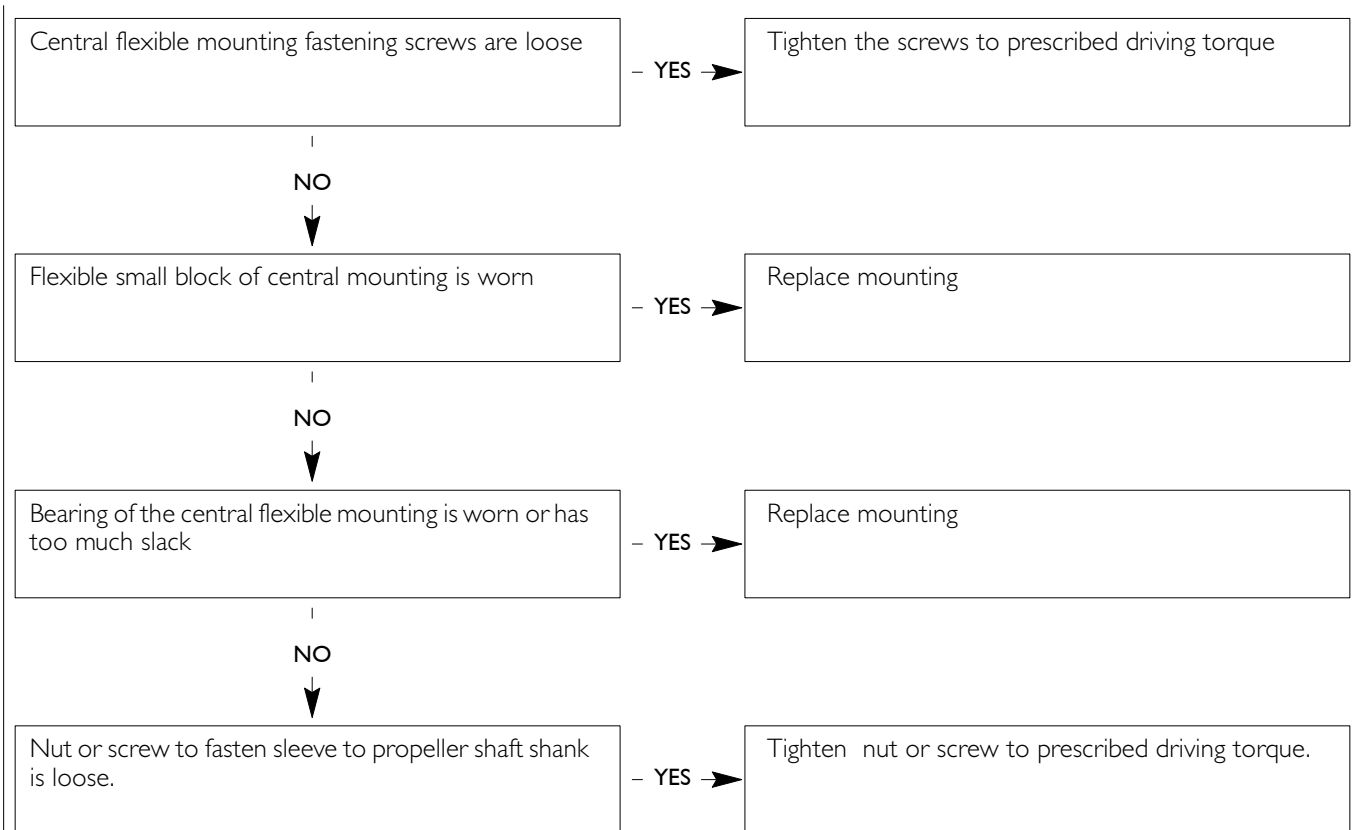
NO



Insufficient lubrication

- YES →

Lubricate through the specific greasers.

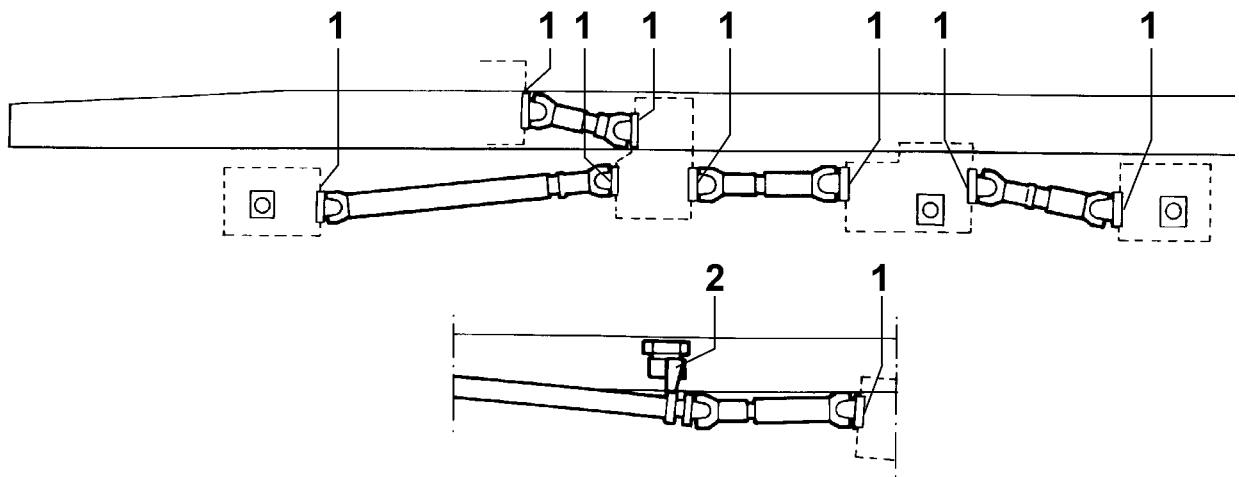


TIGHTENING TORQUES



The figure below shows the most complex version and stands valid for every type.

Figure 5



DESCRIPTION		TORQUE	
		Nm	kgm
1. Nut for Flange to propeller shaft fastening screw	(M12 nut thread) (M14 nut thread)	120 190	(12) (19)
2. Nut for bolt fixing propeller shaft flange		146,5	(14,6)

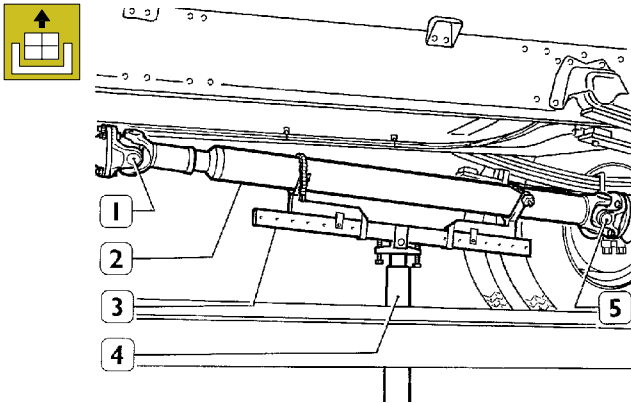
TOOLS

TOOL NO.	DESCRIPTION
99370618	Support to hold propeller shaft during removal and re-fitting in place

REMOVING AND RE-FITTING IN REPAIR OPERATIONS

Place the vehicle on a flat ground and operate the parking brake.

Figure 6



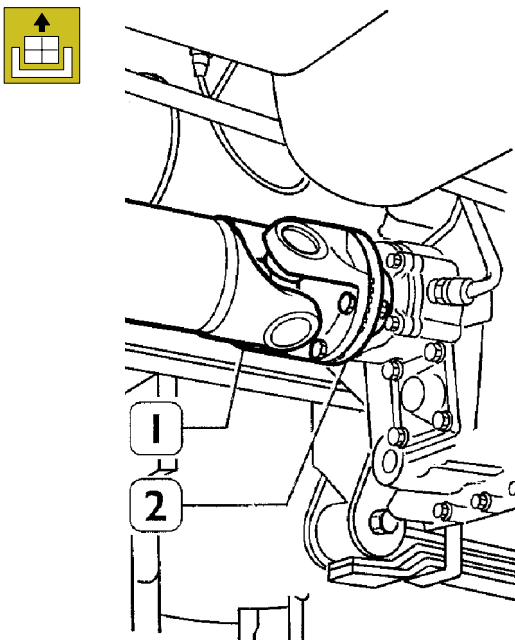
38027

Place a hydraulic jack (4) fitted with support 99370618 (3) underneath the rear propeller shaft (2).

Disconnect the propeller shaft (2) from the rear axle and the flexible support by unscrewing the flange fastening screws and nuts (1 and 5).

Lower the hydraulic jack completely, thus removing the propeller shaft.

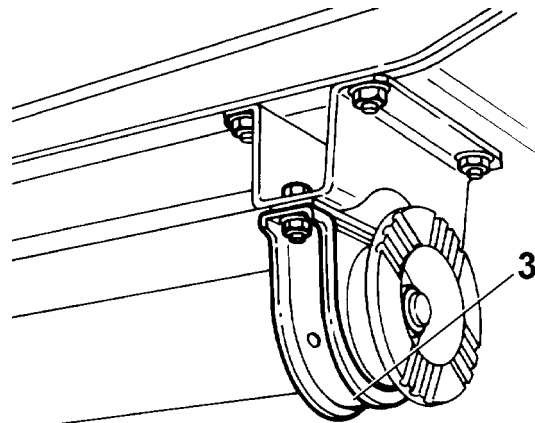
Figure 7



38028

Repeat the same operations for the other propeller shafts (1) disconnecting them from the flange (2) of the connected units.

Figure 8



Remove the idle gear, if any.

To refit in place, follow the steps given for the removal in reverse.

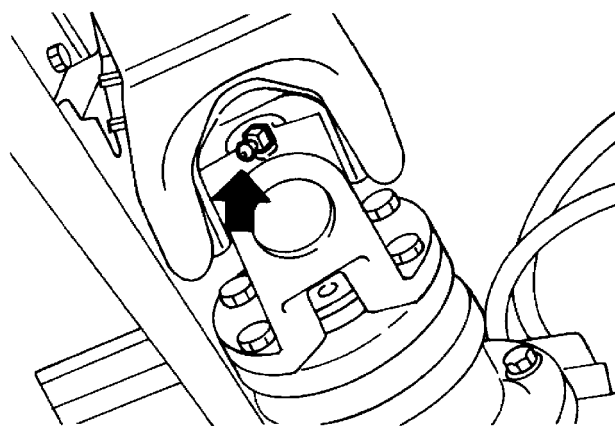


A tightening torque lower than the specified one causes stress on the threaded component which can separate from the body to which it is tightened; a tightening torque higher than the specified one causes excessive distortion of the parts being in touch.



When fitting the propeller shaft assembly on vehicle, take care to position the side with internal keying (sliding fork sleeve) on unit drive output side.

Figure 9



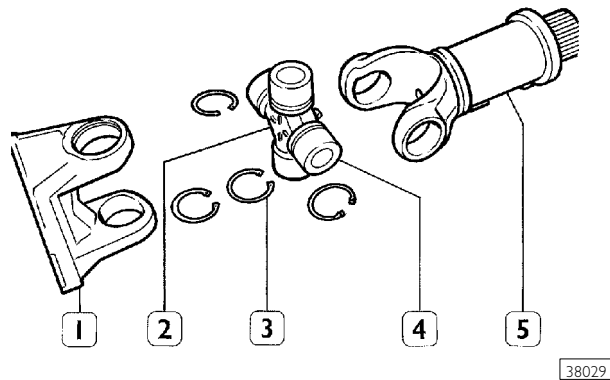
Then, grease the propeller shaft through the grease nipples of a greasing pump.

Check for grease leaking from sealing rings which indicate thorough greasing.

UNIVERSAL JOINT

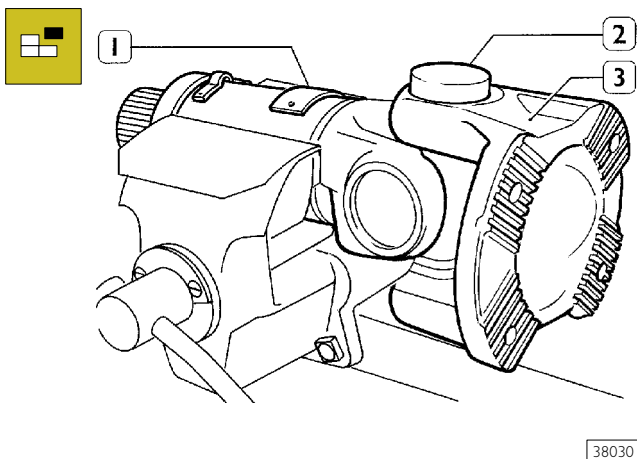
Removing

Figure 10



UNIVERSAL JOINT COMPONENTS
1. Fork – 2. Spider – 3. Circlips – 4. Bearings – 5. Sliding sleeve

Figure 11



Clamp the universal joint (1) in a vice.

Punch the sliding sleeve and the main components to obtain reference marks to be followed for correct alignment during assembling.

Using suitable pliers remove the circlips (3, Figure 10).

Use a hammer to beat the fork (3, Figure 11) until the bearing (2) starts to come out from its housing, i.e. when the spider interferes with the fork.

Turn the part over and repeat the above operations.

Manually remove one of the two bearings (2).

Remove the fork (3) and use a punch to remove the other bearing.

Repeat this procedure to remove the bearings from the other fork and free the spider.

To disassemble the opposite joint, repeat the operations described previously.

Cleaning

Wash removed parts with oil or petrol keeping parts immersed for the time necessary to remove any particles of hardened grease.

Clean accurately every part by hard bristle brush and dry with compressed air jet.

Checks

Propeller shafts are supplied ready for use.

They are balanced statically and dynamically; it is however possible to check correct static balancing and eccentricity during complete overhaul.

Perform the following operations:

- ☐ position the propeller shaft on a centering tester;
- ☐ turn the shaft around its own axis and with a dial gauge previously set to zero, check that eccentricity of the propeller shaft on the central tubular part is not over 0.5 mm;
- ☐ move the dial gauge towards the ends of the propeller shaft;
- ☐ eccentricity must not exceed 0.3 mm;
- ☐ should higher values than the specified one be found, straighten and balance the shaft by means of suitable press and equipment, these operations shall be carried out by skilled workers.

The plates welded to the propeller shafts are balancing plates.

Should these plates be missing, the shaft must be balanced again.

Inspect the splines for wear and check whether the tubular part of the shaft shows weld defects or cracks; replace the propeller shaft if it has any crack, wear or distortion.

Check whether forks show cracks, wear or distortions.

Slight notches or burrs can be removed by an abrasive stone.

Check spiders, these must not show cracks.

Needle bearing pins must not show scratches or wear signs.



Using a propeller shaft not balanced correctly or in defective conditions, causes vibrations which can become unacceptable in certain cases, and **can be extremely dangerous** for the units but also for the driver since breaking of the propeller shaft can result in disastrous effects.

Assembling

To dis-assemble the opposite joint, repeat the operations described above.

Insert the spider into the joint fork and in the fork-sleeve. Fit in place the bearings with the rollers on the spider pins, then fit the circlips.



When assembling the spiders, take special care to the correct fitting of circlips in their housings.

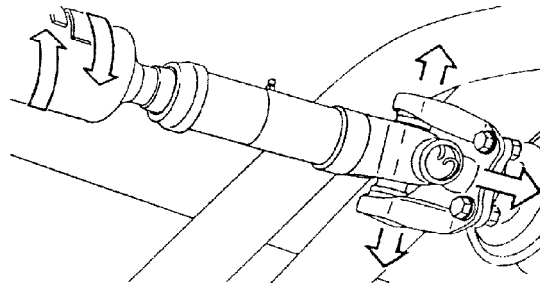
When fitting the shaft, check also that alignment reference marks, performed before disassembling, coincide perfectly.



A wrong connection can result in noisy propeller shaft and can cause wear or damages to the whole drive line.

CHECKING THE PROPELLER SHAFTS ON THE VEHICLE

Figure 12



23808

The propeller shafts are supplied by the manufacturer as units ready for assembly.

They are statically and dynamically balanced.

The plates welded to the propeller shafts are counterweights. If the plates are missing the shaft must be re-balanced.

Operating on the propeller shaft and at the same time, in the opposite direction, on the sliding sleeve (arrows) check that there is not too much slack between the splines.

Operating on the sleeve forks (arrow) check that the spiders are not worn; if they are, replace them as described above.

AXLE

SECTION II

SECTION 11

Axle

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☐ Kingpin holes camber angle check using gauge 99305111	13
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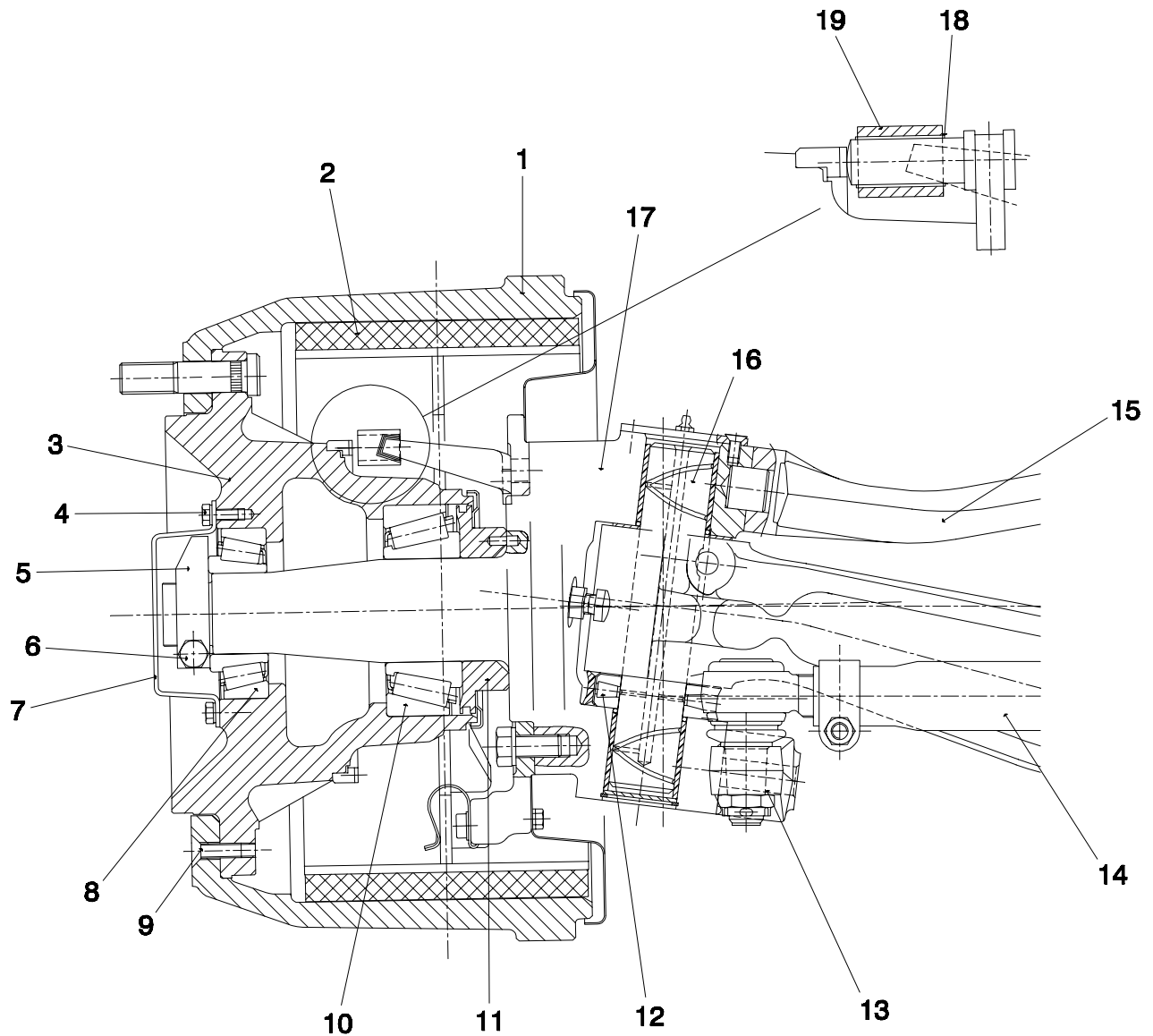
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DESCRIPTION

The front axle is constructed in high tensile pressed steel, with double "T" end section where the stub axles are joined. The stub axle articulation takes place through taper pins built in the axle body, and through four bronze driven roller bearings in the overhang holes of the stub axle.

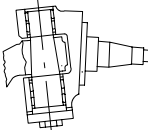
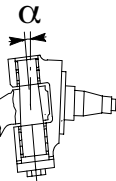
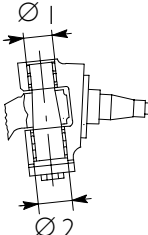
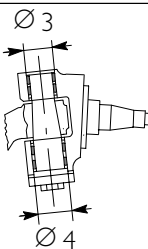
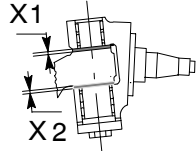
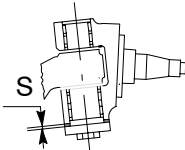
The wheel hubs are supported by two "set right" taper roller bearings, oil lubricated, fitted on the stub axle shank. Adjustment is performed through threaded ring nuts.

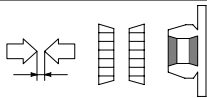
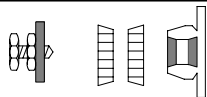
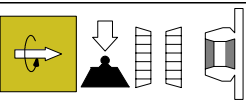
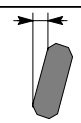
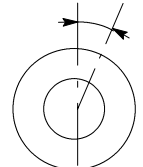
Figure 1



1. Brake drum – 2. Brake shoe – 3. Hub – 4. Hub cover fixing screw – 5. Bearing ring – 6. Bearing ring locking screw – 7. Hub cover – 8. Front taper roller bearing – 9. Brake drum fixing screw – 10. Rear taper roller bearing – 11. Bearing ring – 12. Kingpin axial taper roller bearing – 13. Ball joint – 14. Steering arm – 15. Axle – 16. Kingpin – 17. Stub axle – 18. ABS sensor (if any) – 19. ABS phonic wheel (if any)

CHARACTERISTICS AND DATA

	Type of axle	ASTRA 9820	
	SWIVEL AXLE PINS		
	Inclination of swivel pin housings	7°	
	Diameter of roller bearing housings on the swivel axle - upper housing Ø 1 - lower housing Ø 2	mm mm	52,5 ÷ 52,53 52,5 ÷ 52,53
	Outside diameter of roller bearings for swivel axle - upper bearings Ø 3 - lower bearings Ø 4	mm mm	52,67 ÷ 52,75 52,67 ÷ 52,75
	Swivel axle bearings	mm	0,14 ÷ 0,25
	Play between axle and upper facing of swivel axle X1 Clearance between axle and lower facing of swivel axle X2	mm mm	0,10 0
	Shims to adjust X1, X2		
	 > 0,25 mm	S	mm 0,8 - 1,0 - 1,2

Type of axle	ASTRA 9820	
 WHEEL HUBS		
 Wheel hub bearings	2, taper rollers	
 Wheel hub bearing end play	mm	max 0,16
 Wheel hub play adjustment	using adjustment ring nut	
 Rolling torque Bearing preloading	da Nm 0,50 max.	
 Oil for wheel hub bearings	Tutela W 140/M DA	
Quantity per hub Litres (kg)	0,35 (0,32)	
 WHEEL GEOMETRY		
 Camber angle (vehicle with static load)	1°	
 Castor angle (vehicle with static load)	+ 3°	

DIAGNOSTIC

Main possible faults:

- 1 - Wheels hard to steer;
- 2 - wheel shimmy;
- 3 - wheel rolling noise.

I WHEEL HARD TO STEER

Front axle not perfectly aligned

- YES →

Re-align correctly and tighten leaf spring U-bolt nuts to the specified torque.

NO



Incorrect wheel toe-in

- YES →

Re-adjust front wheel toe-in.

NO



Incorrect tyre pressure

- YES →

Inflate tyres to specified pressure.

NO



Insufficient lubrication of kingpin

- YES →

Lubricate accurately.

NO



Incorrect steering knuckle to axle mating

- YES →

Re-adjust accurately to specified limits.

NO



Parts concerned with steering knuckle rotation on kingpin inefficient

- YES →

Check all parts and replace as required.

2

WHEEL SHIMMY

Wheel caster incorrect

- YES →

Check axle assembly, repair and change distorted parts as required.

NO



Front axle not perfectly aligned

- YES →

Re-align correctly and tighten leaf spring U-bolt nuts to the specified torque.

YES

NO



Incorrect wheel toe-in

- YES →

Re-adjust correctly.

NO



Inefficient steering linkage ball joint

- YES →

Change defective parts.

NO



Incorrect wheel hub bearing play

- YES →

Re-adjust end play after changing parts as required.

NO

Wheels incorrectly centered:
rim not centered, distorted
tyre fitted to wrong rim

- YES →

Change the faulty rim..
Deflate and centre tyre on rim.

NO



Wheels incorrectly balanced

- YES →

Carry out wheel balancing.

3 **WHEEL ROLLING NOISE**



Inadequate wheel hub bearing lubrication

- YES →

Restore a sufficient packing of grease in hubs.

NO



Inefficient wheel hub bearings

- YES →

Change damaged bearing and re-adjust end play.

NO



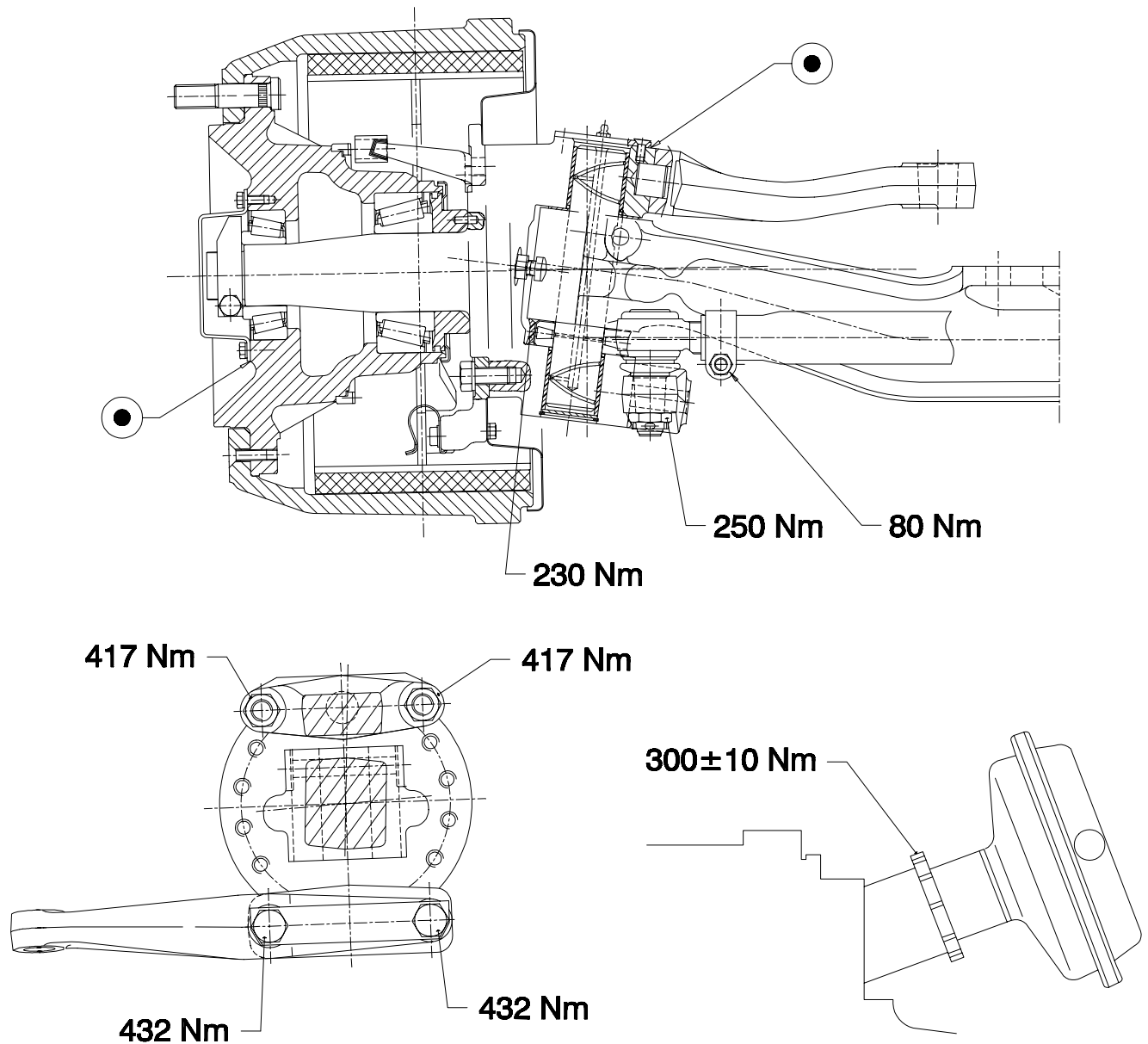
Incorrect mating between kingpin and needle bearings

- YES →

Check and change deteriorated parts as required.

TIGHTENING TORQUE

Figure 2



● Assemble applying LOCTITE 510

TOOLS

TOOL NO.	DESCRIPTION
99305111	Device for axle testing
99321024	Hydraulic truck to remove and re-fit in place the wheels
99322215	Stand for axle testing
99347068	Puller for drag link kingpins
99389819	Dynamometric wrench
99395026	Tool for testing hubs rolling torque (to be used with 99389819)
99370593	Stand
0/72068	Tool for stripping down and refitting stub axle bushings

REMOVING AND REFITTING THE AXLE

Removal

To remove the axle proceed as follows:

- ☐ place the vehicle on a flat ground and suitably lock the rear wheels;
- ☐ loosen both front wheel fastening nuts;
- ☐ using a hydraulic jack lift the front of the vehicle and rest it on two stands;
- ☐ remove both front wheels;
- ☐ disconnect ABS transmitter electrical cables from both sides (only vehicles provided with ABS);
- ☐ disconnect brake air delivery pneumatic connections (4) from both sides,
- ☐ disconnect the steering rod unscrewing the joint fitting securing nut (11);

- ☐ remove the bolts (7) fixing the stabilizer bar to the axle and rotate it downwards;
- ☐ set a hydraulic jack fitted with tool 99370617 under the axle;
- ☐ unscrew the nuts (9) from both sides, lift the leaf spring fixing brackets (10), lower the axle and take away the leaf spring.

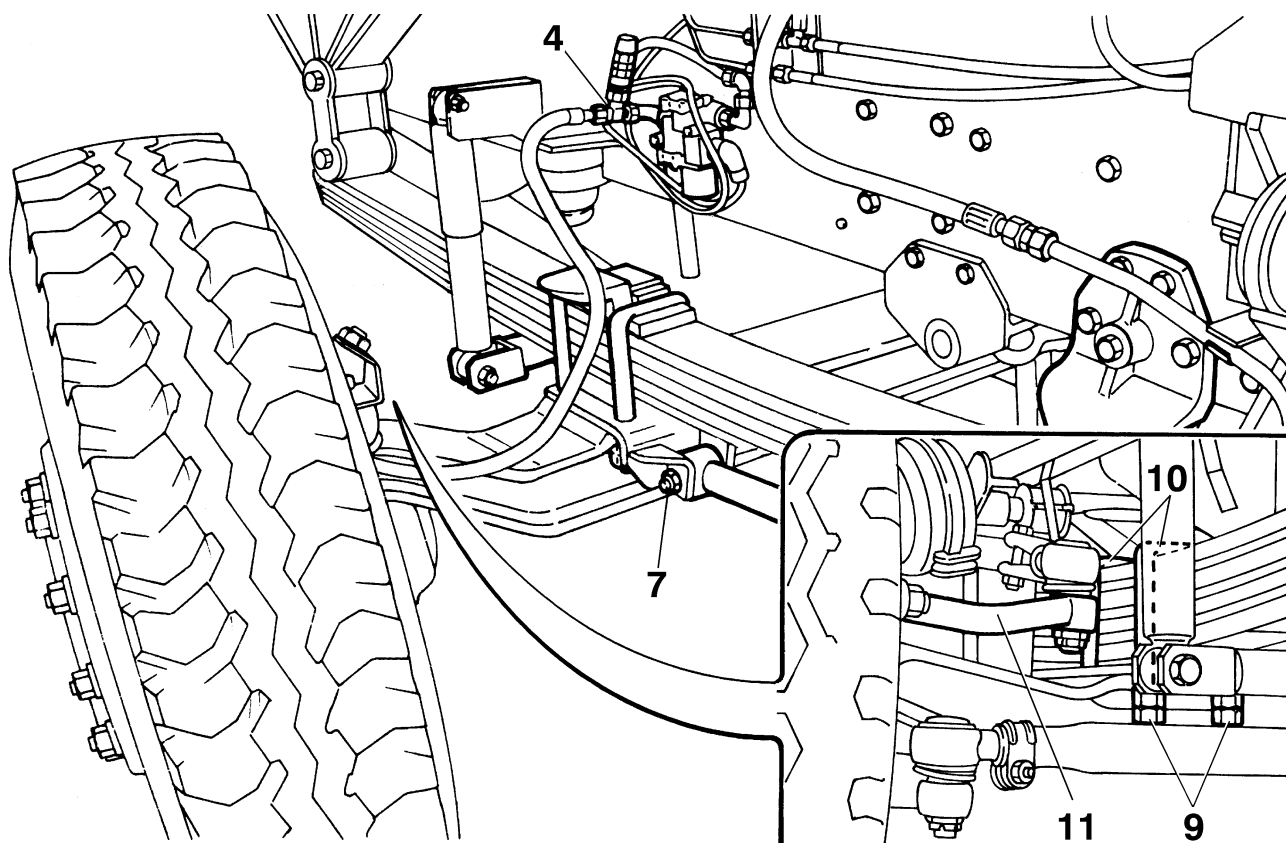
Refitting

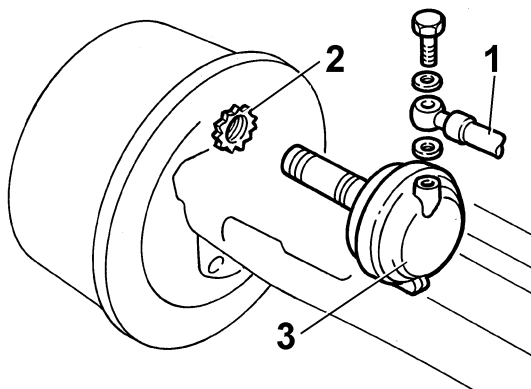
To refit, follow the removal operations in reverse order.



When refitting, check front wheel toe-in as described in Section 15.

Figure 3



DISASSEMBLING**Figure 4**

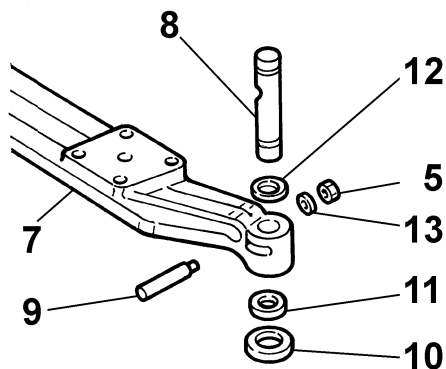
Disassemble the brake drum (1) from the hub, and then remove the cover. Loosen block locking bolt (6) and the block (5); then take out the hub (3) and the outer bearing (8). Use a universal puller if required; take out the inner bearing (10) and the spacer (11) complete with grease guard seals from stub axle (17).

Continue disassembling removing the diaphragm-type brake booster connecting pipe (1), loosen the ring nut (2), then remove the diaphragm-type brake booster and take out the wedge acting on brake shoes.

Remove brake block fixing screws and take away the entire brake block. Disconnect the track rod (14) and levers thereof from stub axle.

Remove the upper plate, the seeger ring and the plate.

Loosen nut (5) and remove the lockpin (9) from the kingpin. Use a beater to take out the kingpin (8) from its housing and remove it. Should this operation be difficult, use a press to remove the kingpin (8).

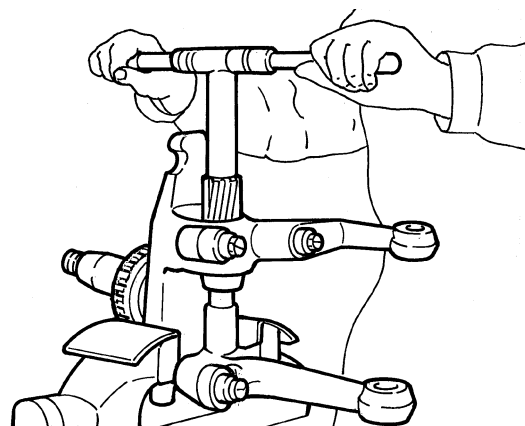
Figure 5**CHECKING DISASSEMBLED PARTS**

Clean disassembled parts accurately.

Check clearance between pin and stub axle bushing. Should the clearance value found be higher than 0.25 mm, check whether wearing affects the pin only (replace it) or also the bushing. If the bushing is worn, replace it.

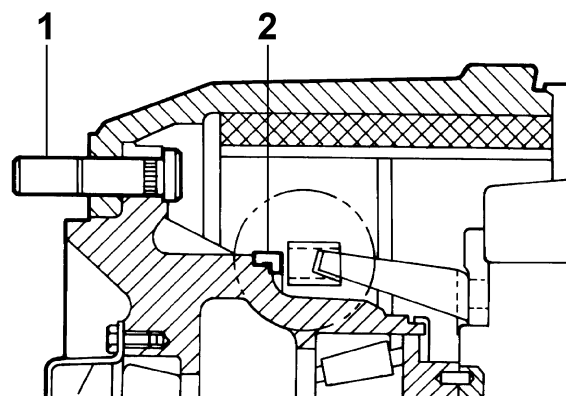
To replace bushings use a press and tool 0/72068.

Ream, if required, after fitting the bushings (Figure 7).

Figure 6

When replacing the wheel studs (1) check whether stud head supporting surface is free from slags and burrs. Fit studs applying a load not exceeding 2500 kg and check whether there is no clearance between hub surface and screw under-head.

To replace ABS phonic wheel, heat ring (2) to 150 °C and fit it down accurately.

Figure 7

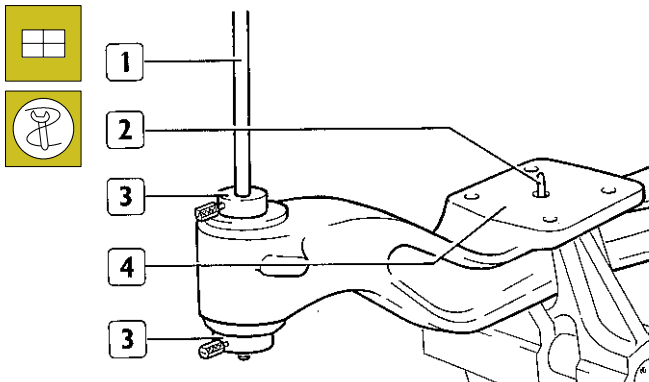
AXLE BODY CHECKS AND MEASUREMENTS

Leaf spring contact surfaces check using gauge 99305111

Set the two rods (1) with the cones (3) in the kingpin holes; press down the cones and lock them in position with the screws on the rod.

Insert the two set screws (2) in the seats on the leaf spring contact surface.

Figure 8

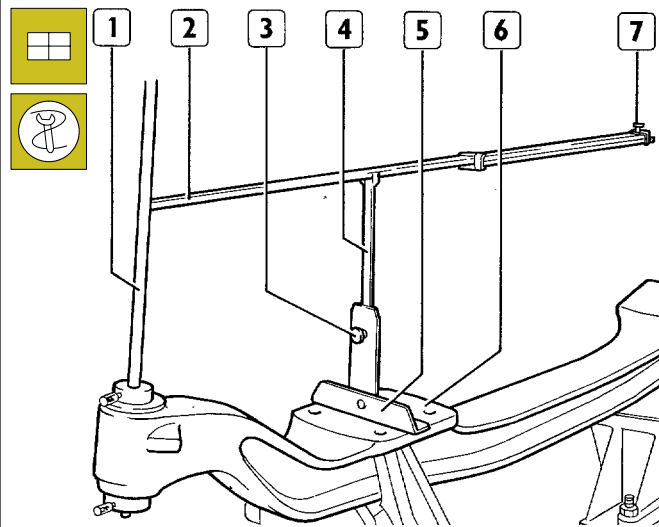


Set the bases (5, figure 10) with goniometers on the surfaces (6) and insert the set screws.



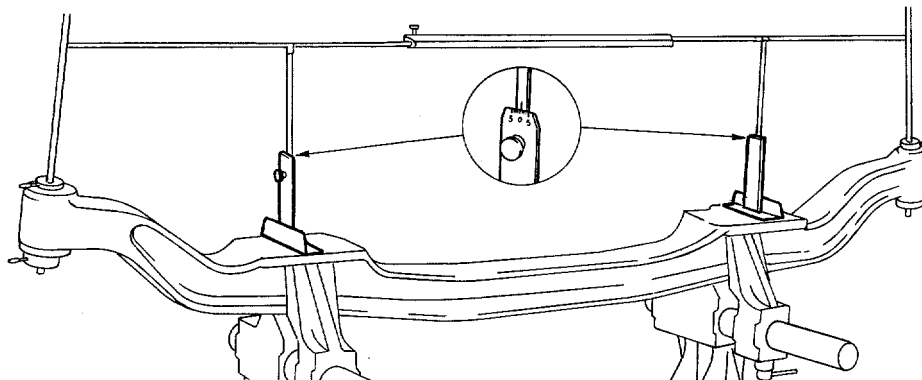
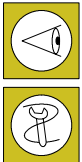
Before placing the bases with the goniometers, make sure that there is no paint or roughness on the contact surfaces.

Figure 9



Set the sliding bar (2) on the goniometer rods (4), adjusting the length so that the shaped ends remain inserted in the rods (1). Lock the clamp screw (7) and the screws (3) that fasten the goniometer to the rods (4).

Figure 10



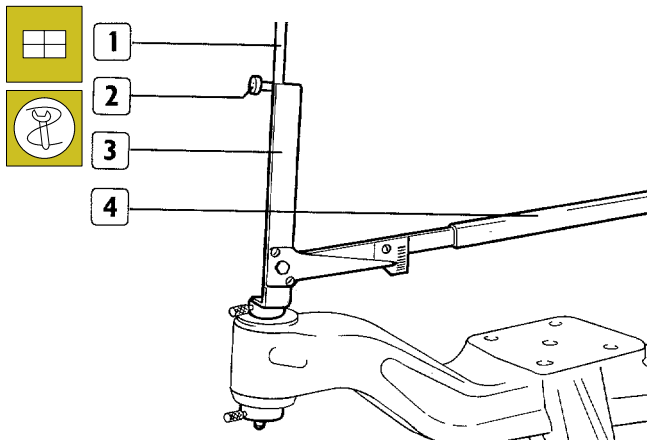
Check for deviation angles on the goniometer scaled sections indicated by the arrows.

The goniometer indicators do not indicate any angular displacement when the planarity of the leaf spring contact

surface with reference to the stub axle pin holes is correct. Remove the sliding bar and the bases with goniometer.

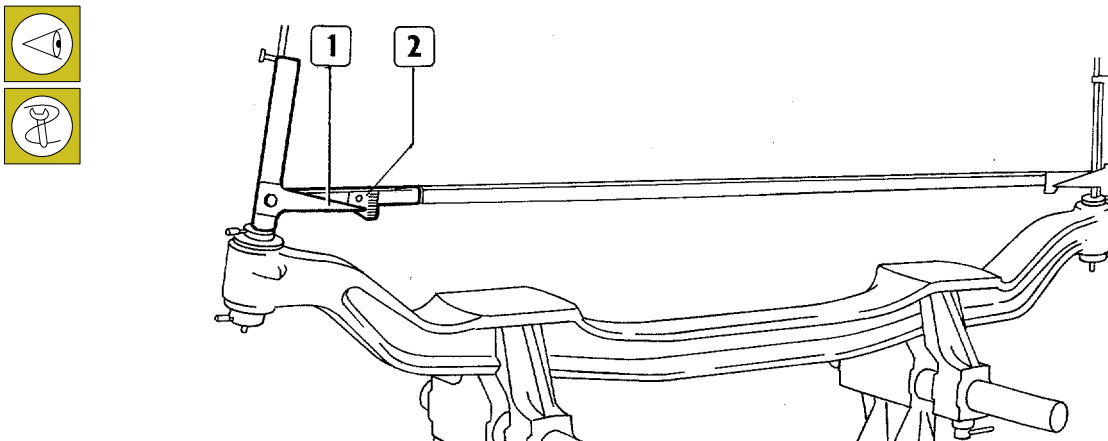
Checking inclination of kingpin boss bores with gauge 99305111

Figure 11

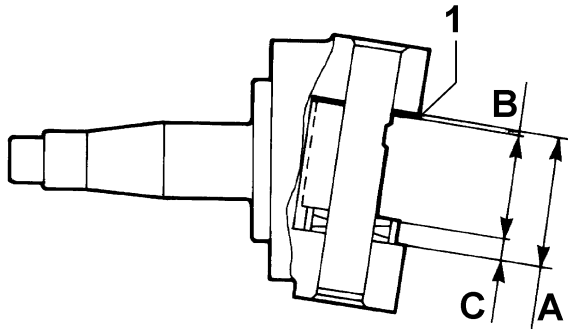


Set the supports (3) with goniometers on the rods (1) and slightly turn the screws (2) without locking them. Insert the coupling track rod (4) and tighten the screws (2) that fasten the supports in the rods (1)

Figure 12



Read the kingpin holes camber angle value in the relevant scaled sectors (2) according to the indicators (1).

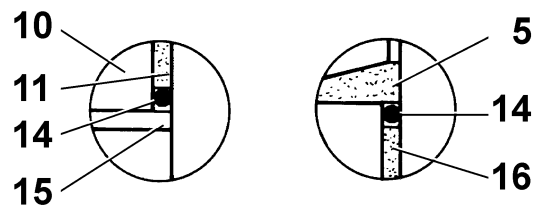
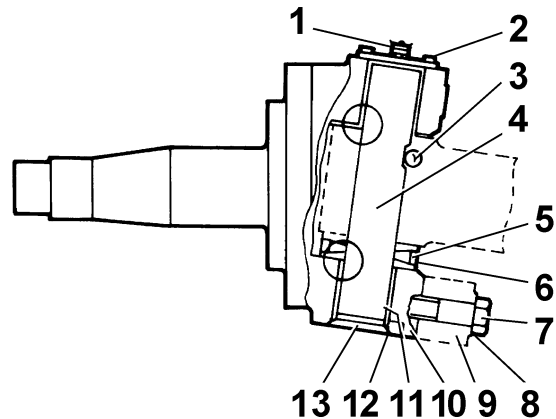
REFITTING**Figure 13**

Before refitting the kingpin, it is essential to find the thickness of the shims (1) to be inserted between stub axle overhang holes and axle eye. Proceed as follows (Figure 14):

- ☐ find the distance between the two stub axle bushing housings (value "A").
- ☐ find axle eye thickness (value "B") and thrust bearing thickness (value "C").

Shims to be inserted between axle and stub axle shall be equal to:

$$S = A - (B + C) - 0.10 \text{ [mm]}$$

Figure 14

1. Screw – 2. Cover – 3. Kingpin taper lockpin – 4. Kingpin – 5. Taper roller bearing – 6. Bearing protection – 7. Screw – 8. Catch – 9. Lever – 10. Bracket – 11. Bushing – 12. Seeger ring – 13. Cap – 14. O-ring – 15. Shim – 16. Bushing

Insert the O-rings (14) laying on bushings (11 and 16) into kingpin housing. Grease the O-rings and the bushings.

Couple axle kingpin inserting in the lower part the thrust bearing complete with dust cover, and in the upper part the previously selected shims.

Insert the central pin so as to make the notch and the axle hole coincide to fit the taper pin (3).

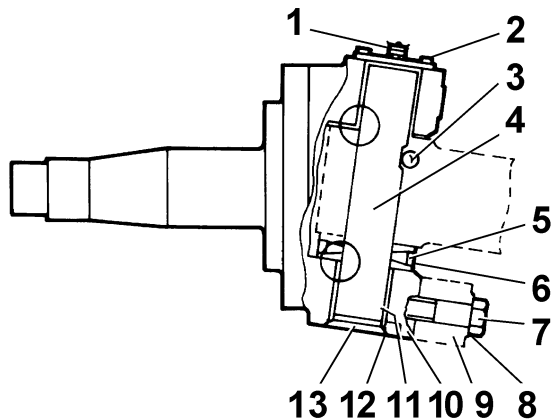
Insert taper lockpin (9, Figure 6) and tighten the nut (5, Figure 6) to 80 Nm; then use a hammer to beat the non-threaded side to fit down the pin into its housing perfectly.

Tighten the nut again to 122.5 Nm torque.



Direct the chamfer towards the kingpin when inserting the lockpin.

Figure 15



After refitting, use a thickness gauge to check whether clearance between axle and stub axle is 0.05/0.25 mm.

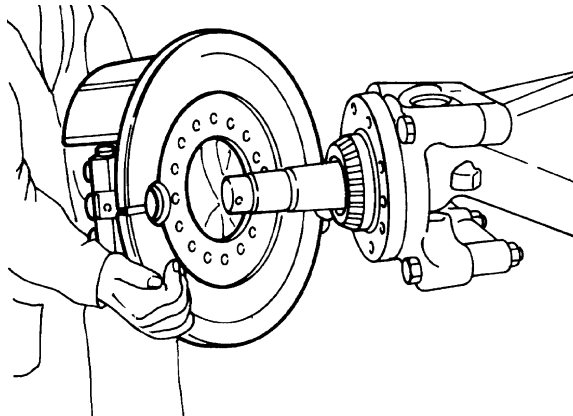


Lift the stub axle with a hydraulic jack to facilitate checking.

Fit the plate (2).

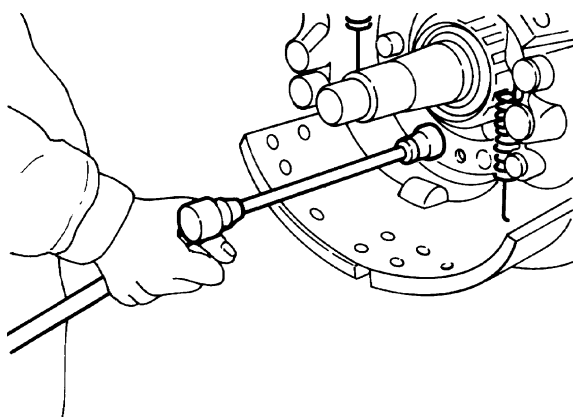
Insert cap (13) and lock it with the seeger ring (12). On the lower side of the stub axle, tighten the screws (7) of the drag link levers (9) to 432 Nm torque and lock them with the safety catch (8).

Figure 16



Fit the brake block on the stub axle.

Figure 17



Tighten the screws to 230 Nm torque.



See the "Brake" section for setting the brake block.

Fit the spacer ring (11, Figure 1) with the grease seals taking care to insert the pin.

Heat the bearing (10, Figure 1) to 80°C and insert it on the stub axle until coming in touch with the spacer.



Prepare the wheel hub separately.

Fit down bearing outer rings on hub internal shoulders. Fit the ten knurled studs (1) into the holes, and check whether every stud head touches the bottom of its relevant housing.

Fill hub internal compartment with approx. 1 kg of Agip MU/3 grease or equivalent in compliance with MIL NLGI-3 Specification.

Smear with the same type of grease the inner bearing needles and fit the hub on the stub axle.



Do not cause damages to the grease guard seals during this operation.

Mount the outer bearing (8, Figure 1) smearing the needles with a slight coat of grease; screw and tighten the block (5, Figure 1) until feeling a slight resistance of the hub when it is turned manually.

When tightening the block it is necessary to rotate the hub and strike slightly the bearings to enable their correct positioning. Unscrew the block, 20° - 30°.

Tighten block locking bolt (6, Figure 1) to 130 - 144 Nm torque.

Check axial clearance, it must be falling between 0.044 and 0.220 mm.

Fit hub cover (7, Figure 1) and the gasket after filling with grease.

Fit brake drum (1, Figure 1) on the hub screwing the fixing screws.

Fit the diaphragm-type brake booster and connect brake air ducts.

Fit wheels and tighten the nuts to the prescribed torque.



After fitting a new stub axle or overhaul interventions on the forecarriage, check steering mechanical stop adjustment on both parts as described in Section 15.

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FRONT DRIVE AXLE

SECTION 12.1

SECTION 12.1

Front drive axle

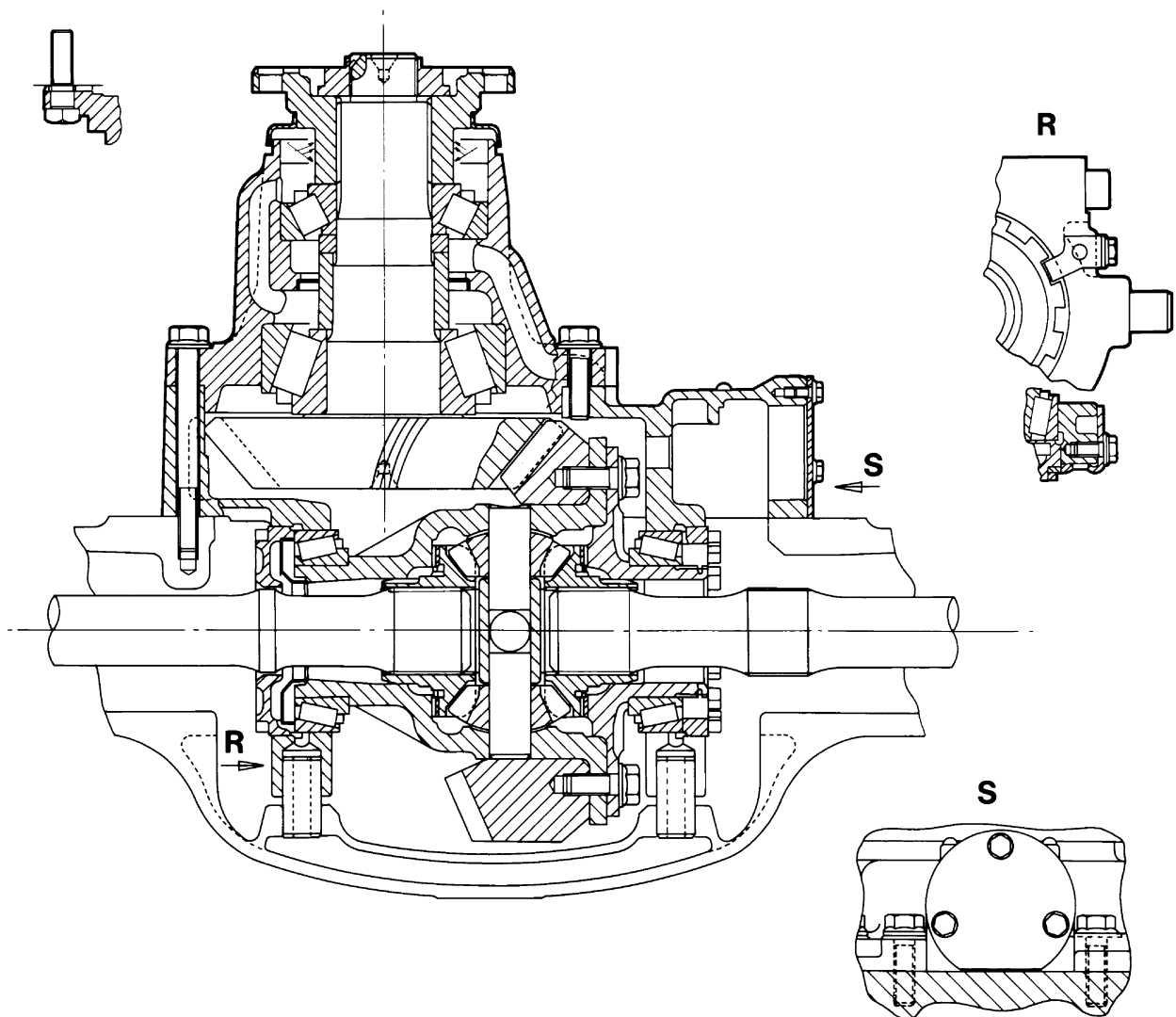
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DESCRIPTION

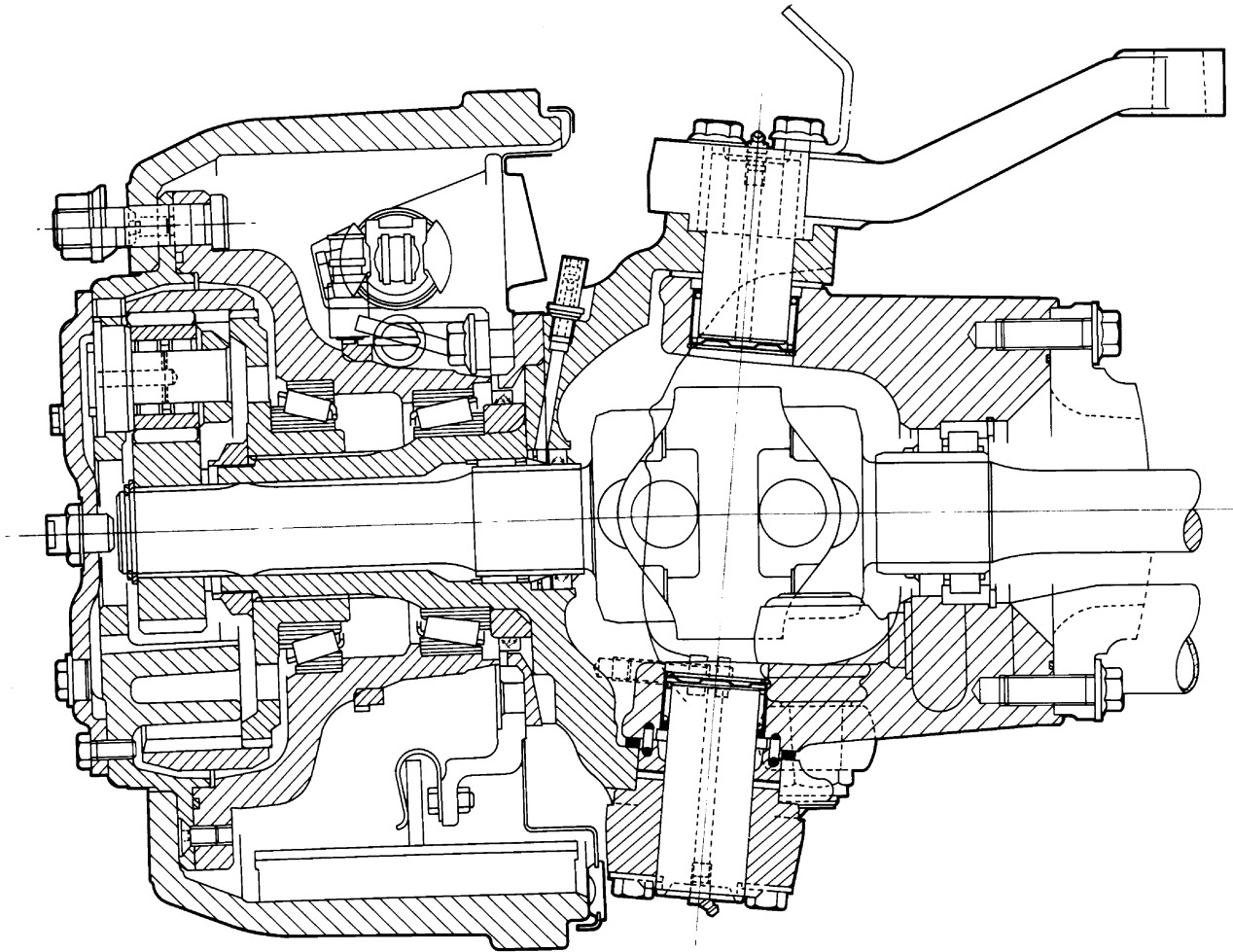
The axle is double reduction bearing type. The first reduction is obtained from the pinion-ring bevel gear unit, the second through an epicyclic unit in the wheel hubs. The differential housing, with ring bevel gear, is supported by two taper roller bearings that can be adjusted through two threaded ring nuts.

The pinion is supported by two taper roller bearings and adjustment is through adjustment rings. The half shafts coming from the differential transmit the rotation to the epicyclic gears by means of constant velocity joints. Two flanges fitted to the end of the axle casing permit the stub axles movement.

Figure 1

39386

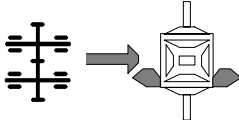
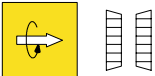
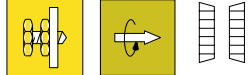
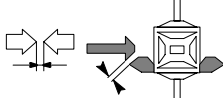
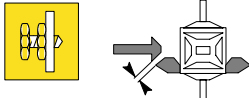
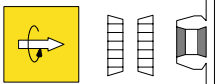
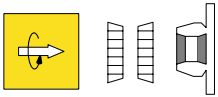
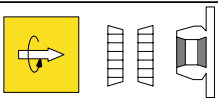
Figure 2



39387

LONGITUDINAL PICTORIAL SECTION OF WHEEL HUB AND EPICYCLIC REDUCTION GEAR

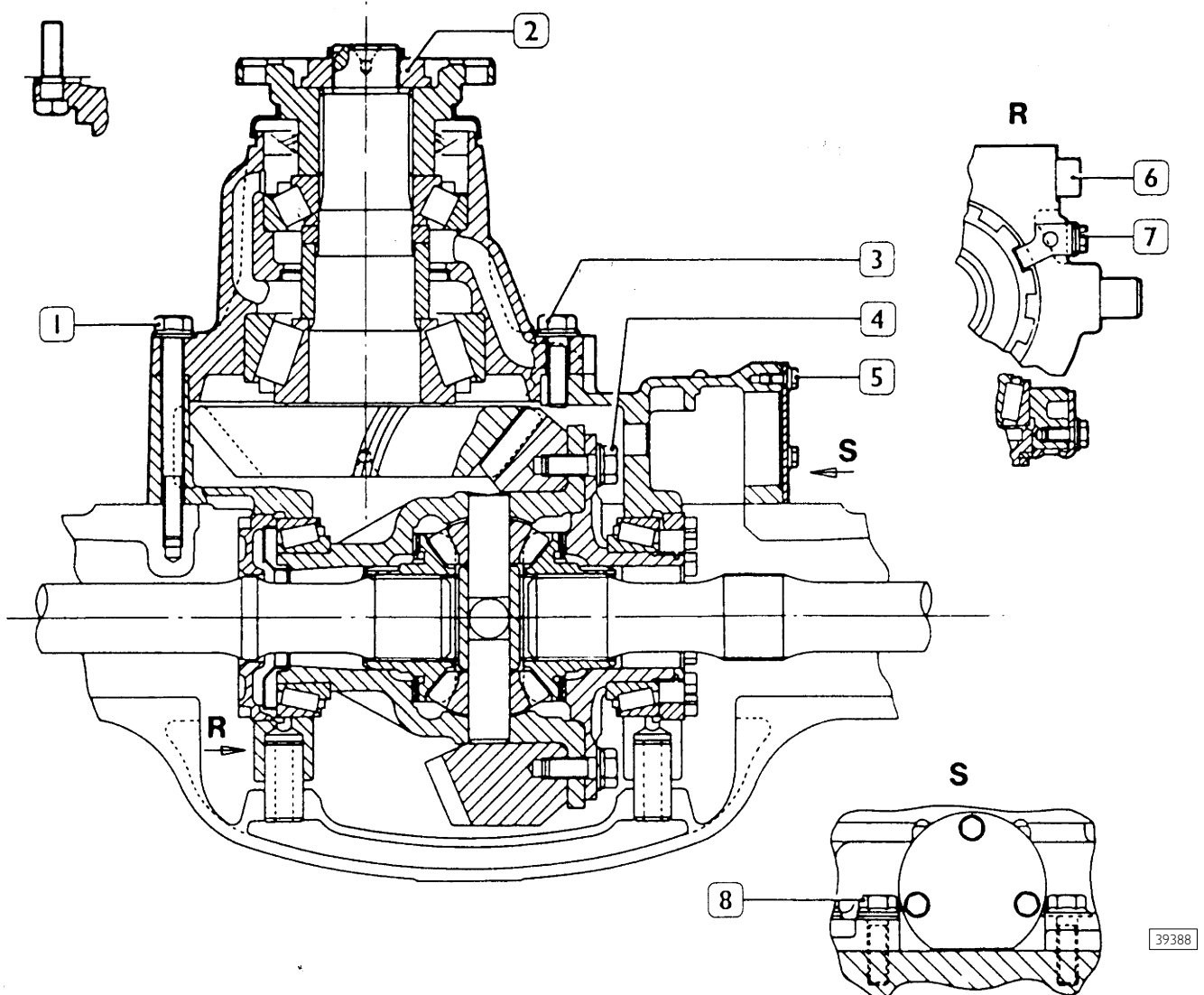
SPECIFICATIONS AND DATA

	Axle type: Bearing with double reduction	ASTRA 5985/2D (IVECO D 1385 AG001)
	Bevel drive pinion bearings	2 taper roller
	Final bevel gear ratio	21/40 (1,905) 19/33 (1,737) 23/36 (1,565) 28/37 (1,321) 27/32 (1,185)
	Epicyclic reduction gear ratio on the wheels	3,2
	Bevel pinion bearings rolling torque without seal ring Nm	6÷8
	Bevel pinion bearings rolling torque adjustment	through adjustment rings
	Thickness of adjustment rings for bevel pinion bearings mm	10 – 10,02 – 10,04 – 10,06 – 10,08 – 10,10 – 10,12 – 10,14 – 10,16 – 10,18 – 10,20 – 10,22 – 10,24 – 10,26 – 10,28 – 10,30 – 10,32 – 10,34 – 10,36 – 10,38 – 10,40 – 10,42 – 10,44 – 10,46 – 10,48 – 10,50 – 10,52 – 10,54 – 10,56 – 10,58 – 10,60
	Thickness of adjustment rings for bevel pinion fitting with reference to the ring bevel gear mm	0,2 – 0,3 – 0,5 – 1
	Backlash between pinion and ring bevel gear mm	0,18±0,23
	Adjustment of backlash between pinion and ring bevel gear	Through ring nuts
	WHEEL HUBS	
	Wheel hub bearings	Two with taper rollers
	Rolling torque of wheel hub bearings: new bearings with surface protection Nm	3 + (7,5÷9)
	Rolling torque of wheel hub bearings: Run-in bearings and new lubricated seal rings Nm	3 + (4÷5)
	Rolling torque of wheel hub bearings: Run-in bearings and seal rings Nm	3 + (3÷4)
	Half-shaft end play mm	0,5 ÷ 1

 (*) Oil for wheel hub bearings	5 (4,5)
 (*) Quantity per hub Litres (kg) Bevel drive pinion bearings	0,75 (0,68)
 WHEEL GEOMETRY	
 Wheel camber angle (vehicle with static load)	—
 Wheel caster angle (vehicle with static load)	1° 30'
 Wheel toe-in (vehicle with static load)	$B = A - (0 \div 3 \text{ mm})$
 KING PINS	
 King pin camber	5°
 Thickness of adjustment rings between axle and stub axle upper shim   	1,75 – 2,00 – 2,25 – 2,50 – 2,75 – 3,00 3,25 – 3,50 X1 mm

(*) For the correct type of fluid, see section 2 - HYDRAULIC FLUID AND LUBRICANTS TABLE

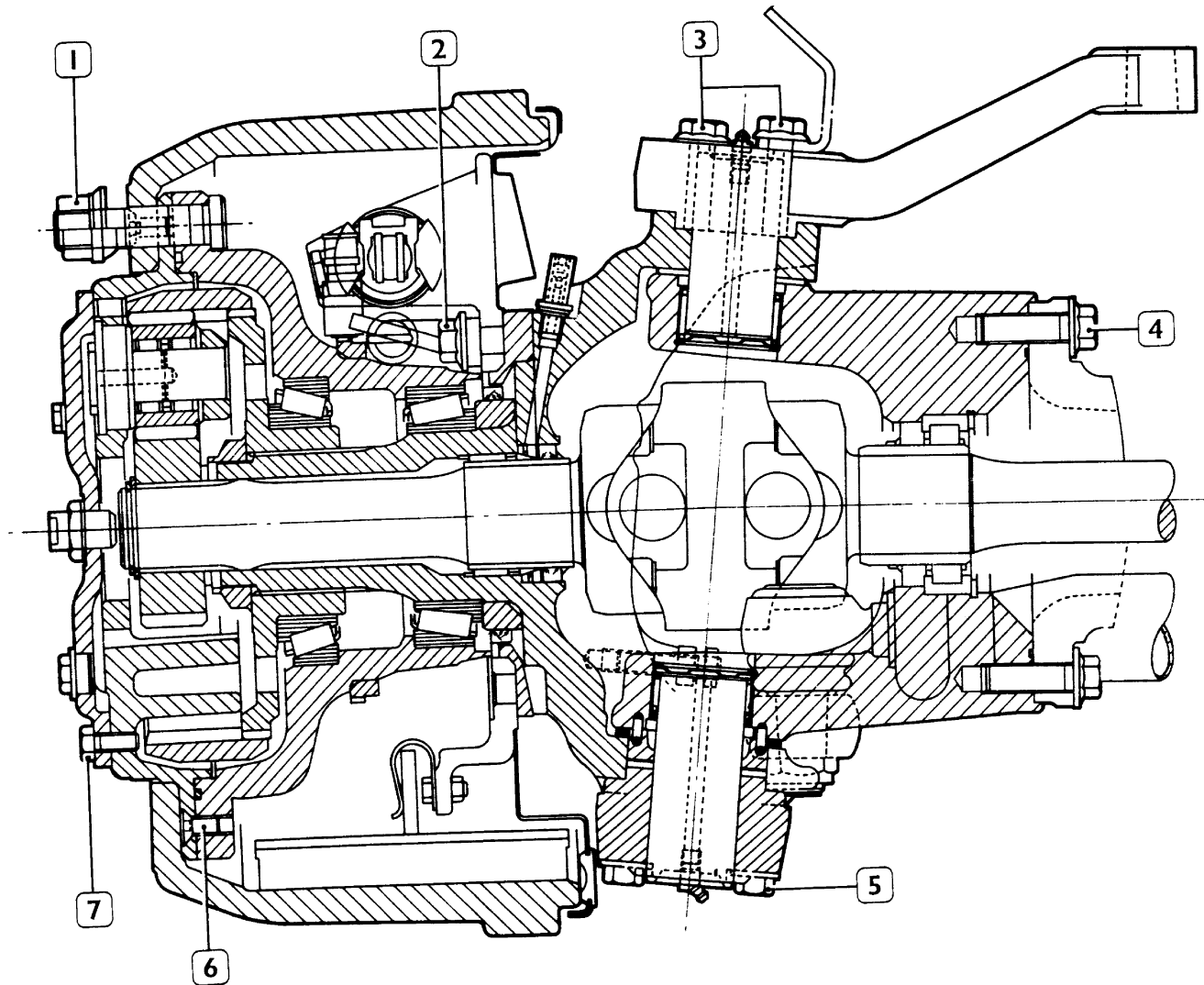
Figure 3



DRIVING TORQUES

COMPONENT	TORQUE	
	Nm	Kgm
1 Differential housing to axle casing fastening screw	180 ± 10	18 ± 1
2 Bevel pinion locking nut	700 ± 50	70 ± 5
3 Bevel pinion support to differential housing fastening screw	180 ± 10	18 ± 1
4 Ring bevel gear to gear housing fastening screw	180 ± 10	18 ± 1
5 Screw with flange	14 ± 2	1,4 ± 0,2
6 Bearing supports fastening screw ◇	180 ± 10	18 ± 1
7 Self-locking screw for safety plate	51 ± 5	5,1 ± 0,5
8 Screw with toothed flange	180 ± 10	18 ± 1
◇ Apply LOCTIT AVX		

Figure 4



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DRIVING TORQUES

COMPONENT	TORQUE	
	Nm	Kgm
1 Wheel fastening nut	650	65
2 Brake support fastening screw	360	36
3 Fastening screw for steering drop arm pin	230	23
4 Stub axle support fastening screw	360	36
5 Fastening screw	230	23
6 Support fastening screw	25	2,5
7 Cover fastening screw	49	4,9

TOOLS

TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99322215	Stand for axle testing
99322225	Unit holder (to be mounted on stand 99322205)
99345049	Counter block for pullers
99345053	Counter block for pullers
99347068	Puller for drag link pivots
99348001	Puller with locking device
99348004	Universal puller for internal diameters 5 - 70 mm
99354207	Wrench (94.5 mm) for wheel hub bearing adjustment nut
99355025	Wrench for differential gearcase bearing adjustment ring nut
99355081	Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99357111	Pliers for brake shoe return spring
99370006	Handle for interchangeable beaters
99370007	Handle for interchangeable beaters
99370258	Beater to remove - fit in place the roller bearings in the kingpin axle fork (to be used with 99370006)
99370317	Lever and relevant extension bar
99370509	Hook to remove differential gearcase half box
99370616	Support to hold differential during removal/re-fitting in place
99370617	Support to hold axles during removal/re-fitting in place
99370133	Tool to lock differential cap angle
99374093	Beater to fit in place bearings outer tracks (91-134) (to be used with 99370007)
99374094	Beater to fit in place bearings outer tracks (134-215) (to be used with 99370007)
99374233	Element to fit in place the differential bevel pinion gasket
99374369	Beater to fit the roller bearing in the stub axle (to be used with 99370006)
99373371	Element to fit in place roller bearings and seal ring on axle fork (to be used with 99370006)
99374377	Element to fit in place the internal wheel hubgasket
99374390	Element to fit the seal ring in the stub axle (to be used with 99370006)
99389819	Dynamometric wrench 0 to 10 kgm connection 1/4"
99389821	Dynamometric wrench 0 to 70 kgm connection 3/8"
99395026	Tool to check hubs rolling torque (to be used with dynamometric wrench)
99395027	Tool to find proper differential bevel pinion adjustment shims (to be used with 99395603)
99395603	Dial gauge (0-5 mm)

DIAGNOSTICS

Main axle faults:

- 1 - Wheel hubs noisy
- 2 - Noise
- 3 - Noise at release
- 4 - Noise during acceleration
- 5 - Cornering noise

1**WHEEL HUBS NOISY**

Insufficient lubrication

- YES ➔

Check there are no leaks from gaskets or the axle casing and top up oil to correct level.

NO



Wheel hub bearings inefficient

- YES ➔

Remove the hub and replace inefficient parts.

NO



Bad adjustment of wheel hub bearings

- YES ➔

Adjust bearings

NO



Half-shaft splines to fit planetary gears of epicyclic gears are worn

- YES ➔

Overhaul and replace worn or damaged parts

2**NOISE**

Lubricating oil level low

- YES ➔

Check there are no leaks from gaskets or axle casing and top up to correct level

NO



Half shaft splines to fit the differential crown wheels damaged

- YES ➔

Overhaul the axle and replace worn or damaged parts.

Bad adjustment of hub bearings

– YES →

Adjust the bearings backlash.

NO
↓

Bad adjustment or wear on differential gears or bearings

– YES →

Locate the trouble and overhaul the unit.

3

NOISE AT RELEASE



Improper fitting backlash between pinion and ring bevel gear

– YES →

Remove the gear housing inspection cover and adjust backlash between pinion and ring bevel gear.

4

NOISE DURING ACCELERATION



Insufficient lubrication

– YES →

Check that there are no leaks from the gaskets or the casing and top up to the correct level.

NO
↓

Gear housing bearings badly set or deteriorated

– YES →

Overhaul the unit.

NO
↓

Bad tooth contact between pinion and ring bevel gear

– YES →

Adjust the contact.

5

CORNERING NOISE



Improper backlash between planetary gears and crown wheels.

– YES →

Overhaul or replace the unit.

REMOVING - REFITTING THE FRONT DRIVE AXLE

Removal

To remove the front drive axle proceed as follows:

- ☐ place the vehicle on a flat ground and suitably lock the rear wheels;
- ☐ loosen both front wheel fastening nuts;
- ☐ using a hydraulic jack lift the front of the vehicle and rest it on two stands;
- ☐ remove both front wheels;
- ☐ disconnect ABS transmitter electrical cables from both sides (only vehicles provided with ABS);
- ☐ disconnect brake air delivery pneumatic connections (4) from both sides,
- ☐ disconnect the steering rod unscrewing the joint fitting securing nut (11);

- ☐ undo the screws fixing the propeller shaft flange (6), and secure temporarily the shaft to the chassis to avoid interference during next operations;
- ☐ remove the bolts (7) fixing the stabilizer bar to the axle and rotate it downwards;
- ☐ set a hydraulic jack fitted with tool 99370617 under the axle;
- ☐ unscrew the nuts (9) from both sides, lift the leaf spring fixing brackets (10), lower the axle and take away the leaf spring.

Refitting

To refit, follow the removal operations in reverse order.



When refitting, check front wheel toe-in as described in Section 15.

Figure 5

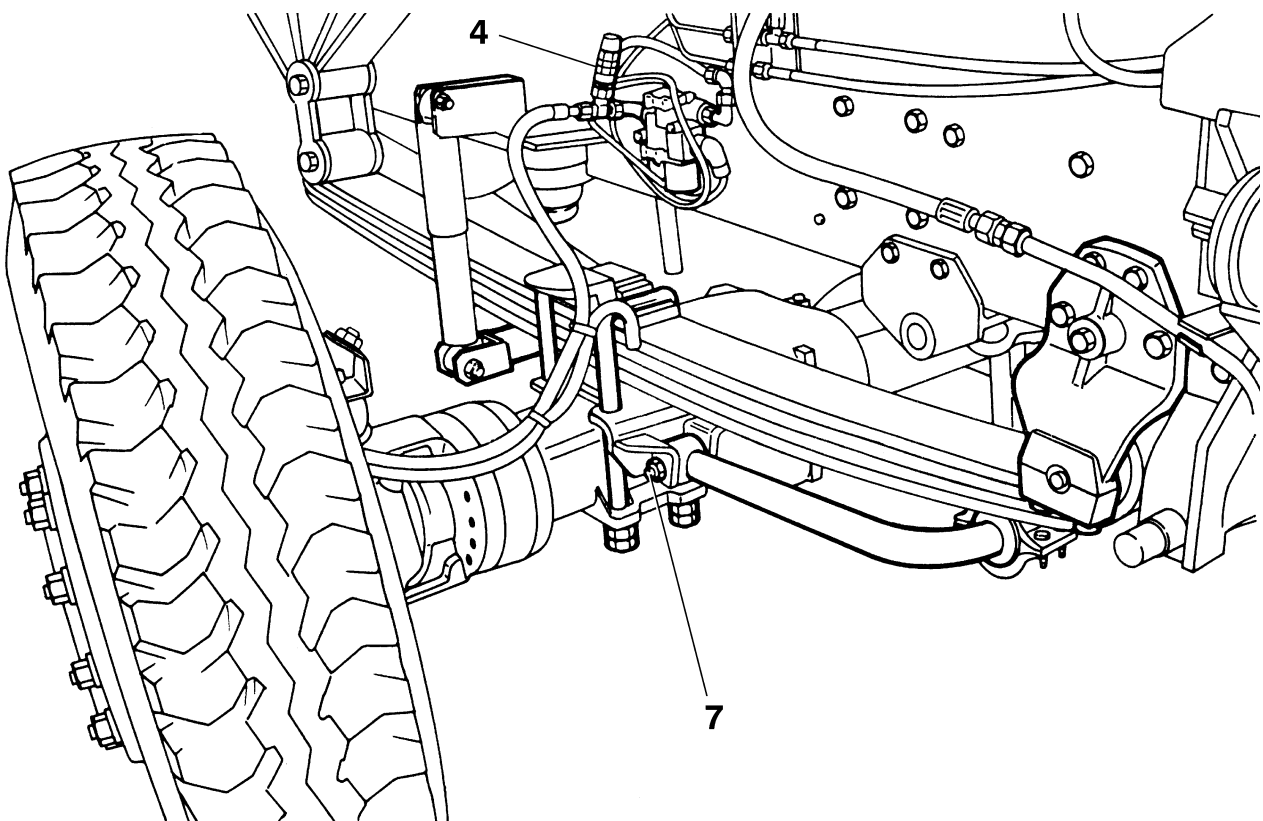
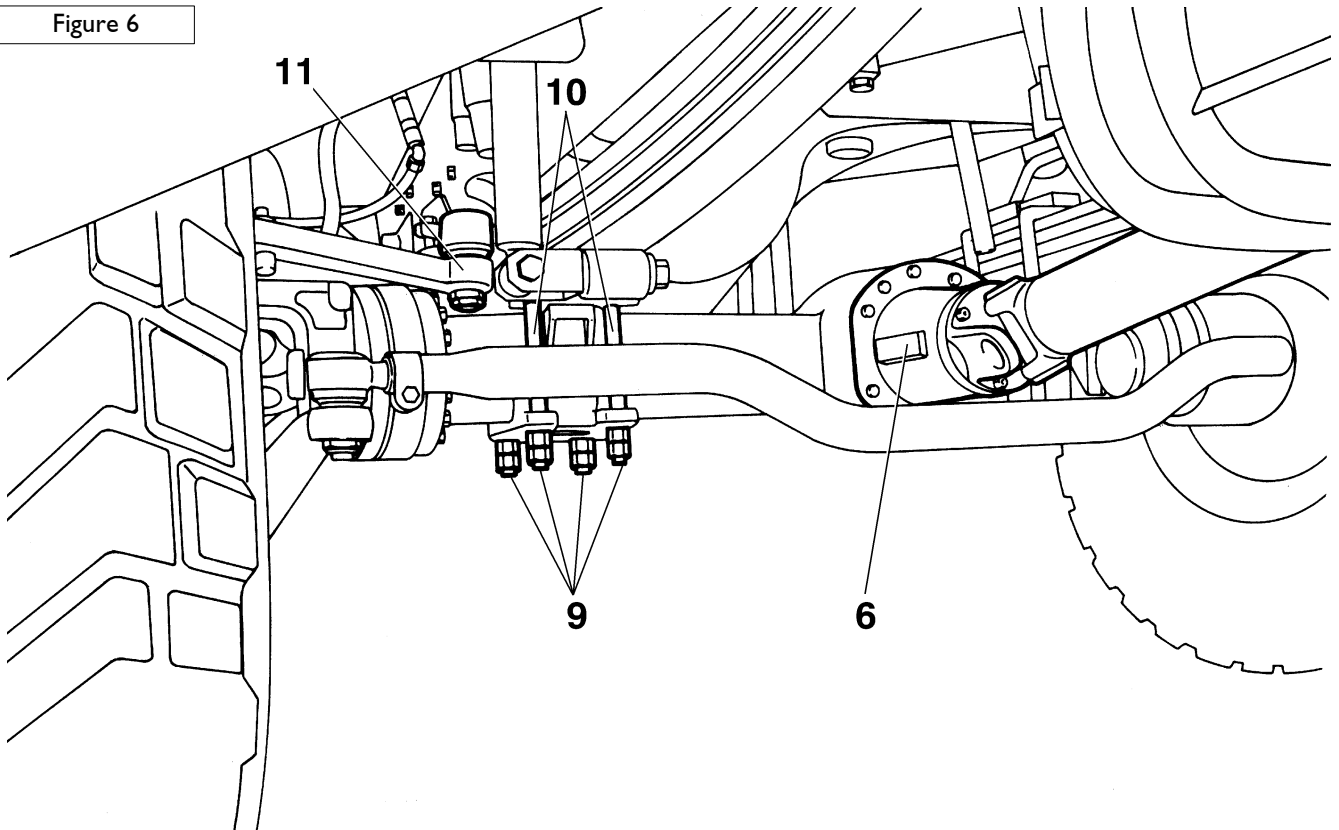
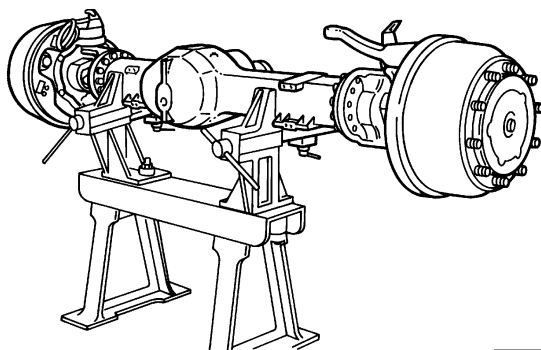


Figure 6



REPAIRING THE AXLE AND WHEEL HUBS

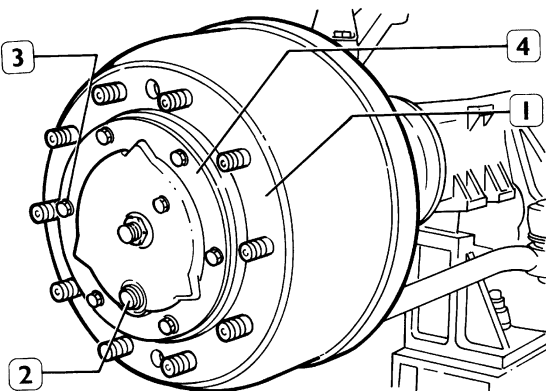
Figure 7



39481

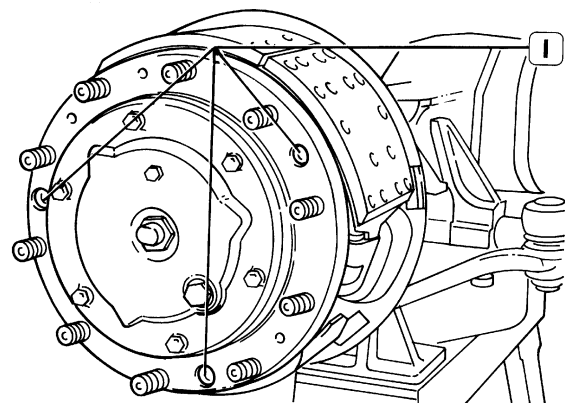
Set the axle on stand 99322205 for overhauling.

Figure 8



39482

Figure 9



39483

Loosen the three hexagonal socket head screws (1) and remove them.

Set the wheel hub (1) so that the oil drainage plug (2) is turned downwards.

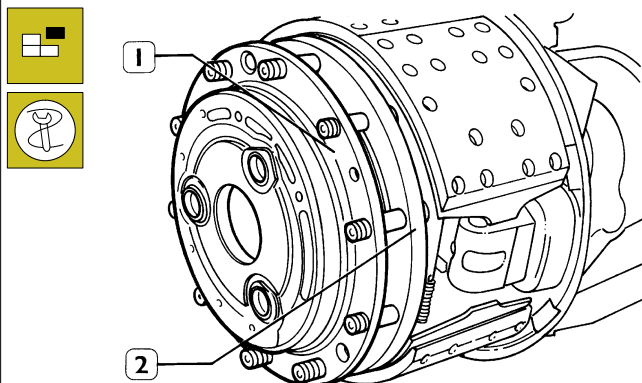
Unscrew and drain the oil from the unit into a container.

For easier drainage, remove a screw (3) from the cover (4).

Unscrew the cap on the axle housing and drain the differential unit oil into a suitable container.

After the oil has been drained off, screw the plugs into the drainage holes by hand.

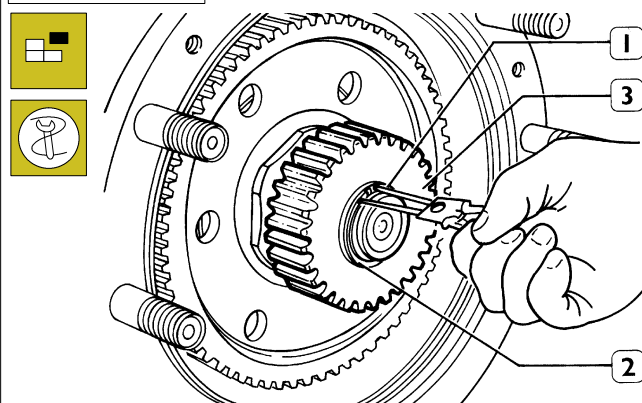
Figure 10



39484

Using a suitable tool separate the planetary gear support (1) from the hub (2) then remove it, taking care that the crown wheel integral with the planetary gears does not slip out.

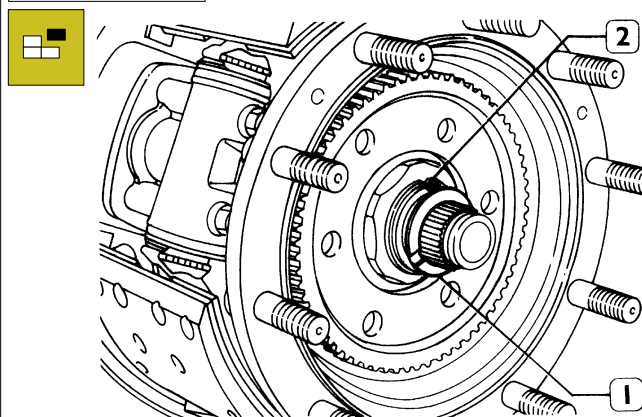
Figure 11



39485

Move the half-axle outwards.
Remove the circlip (2) and the spacer; remove the gear (3)

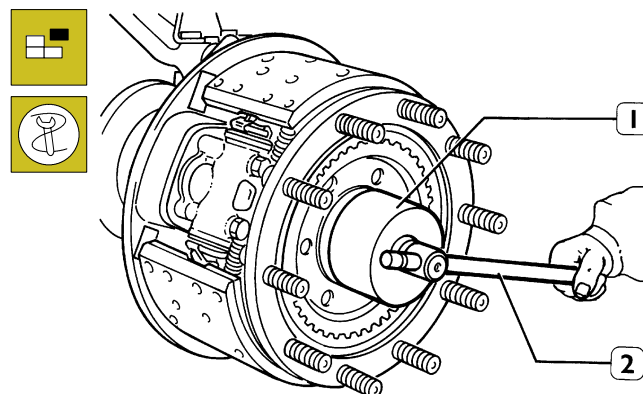
Figure 12



39486

Withdraw the shim ring (1).
Use the appropriate tool to remove the nut dent (2)

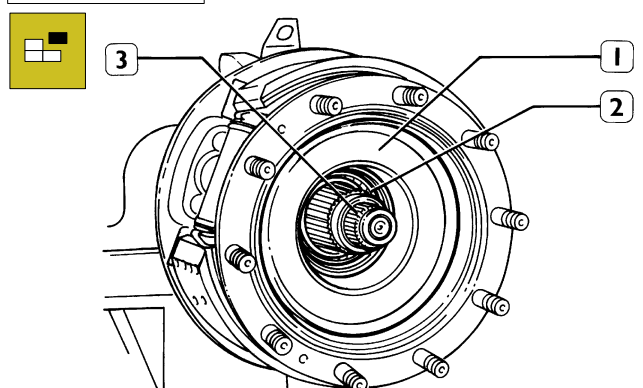
Figure 13



39487

Using wrench 99354207 (1) unscrew the nut (2, figure 12).
Remove the crown wheel gear carrier (56, figure 25) together with the bearing inner ring located behind it.

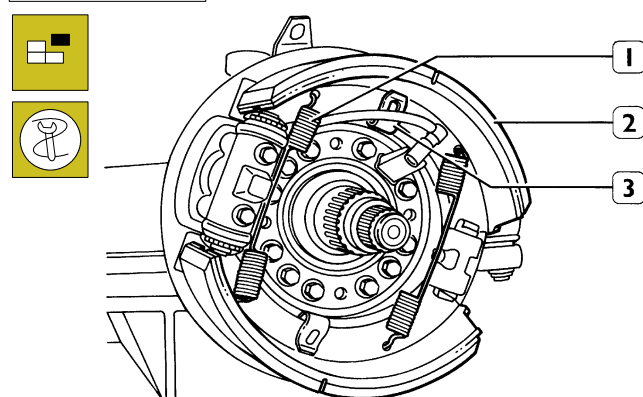
Figure 14



39488

Remove the wheel hub (1) and bearing (2) from the stub axle (3).

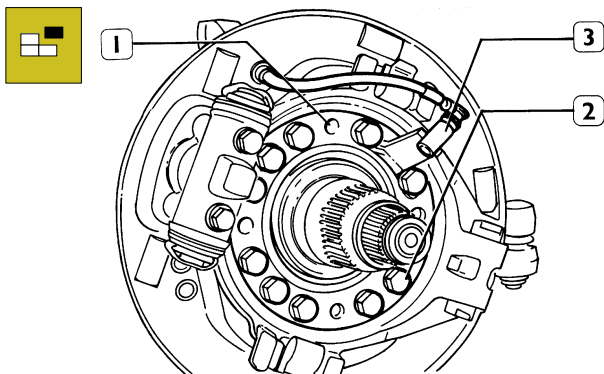
Figure 15



39489

Using the relevant pliers, release the shoe return springs (2).
Always release first the spring where the shoe (1) rests on the adjustment unit.
Withdraw both shoes from the stop brackets (3) moving them up and down.

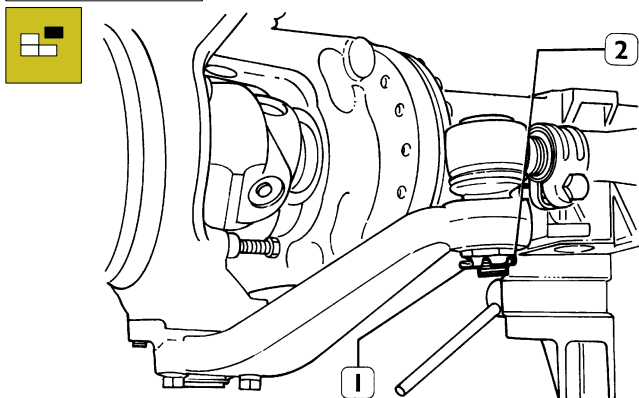
Figure 16



39490

Release the screws (2) from the brake carrier (1) and remove it together with the guards. Withdraw the ABS brakes sensor (3).

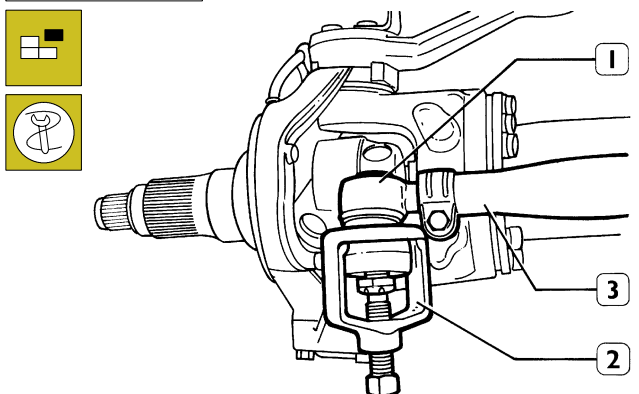
Figure 17



39491

Remove the split pin (1) and unscrew the nut (2) by a few threads without removing it completely.

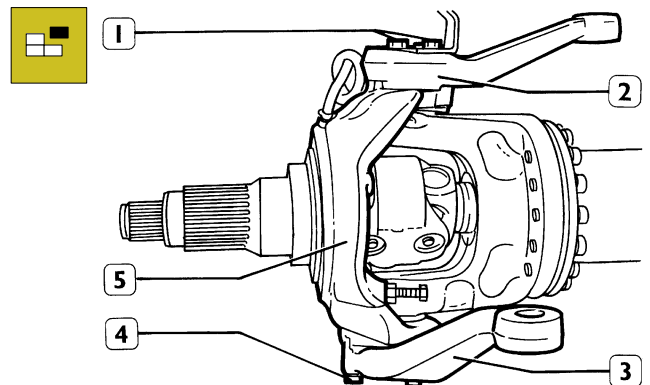
Figure 18



39492

Apply puller 99347068 (2) and remove the stub axle kingpin. Remove the track rod (3).

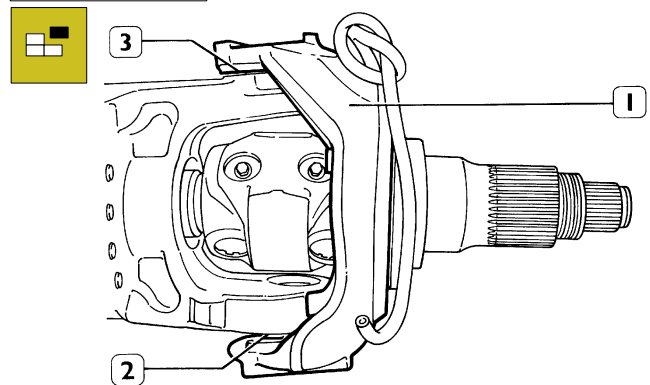
Figure 19



39493

Unscrew the screws (1-4) that fasten the pin (2) and lever (3). Withdraw pin (2) and lever (3) from their housings on the stub axle (5).

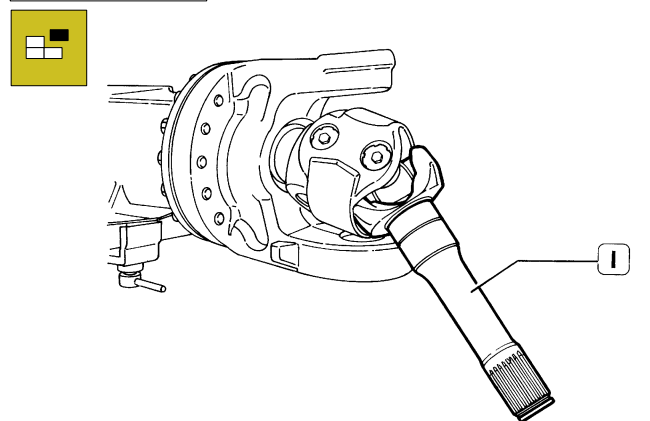
Figure 20



39494

Remove the stub axle (1) and set aside spacer rings (3) and (2).

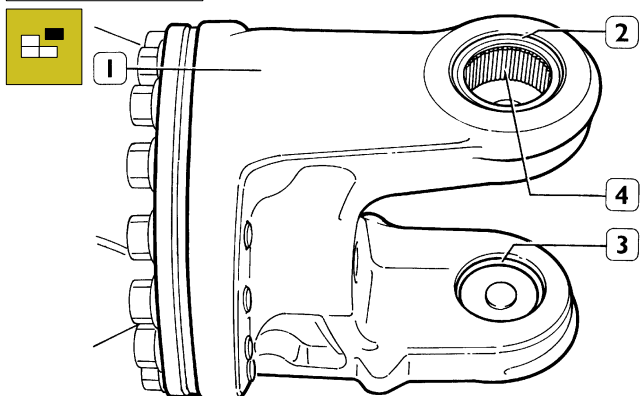
Figure 21



39495

Remove the half-axle (1)

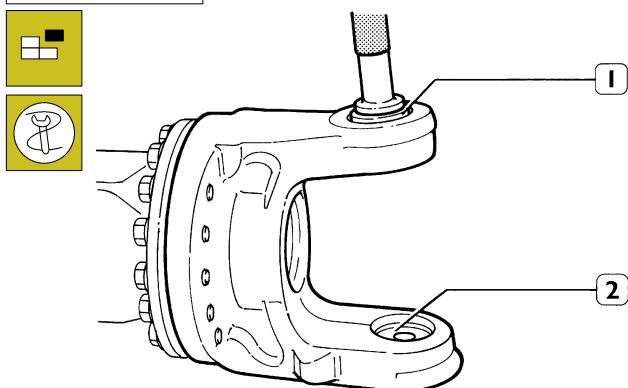
Figure 22



39496

Remove the seal ring (2) and check rings (3) from the fork (1).

Figure 23

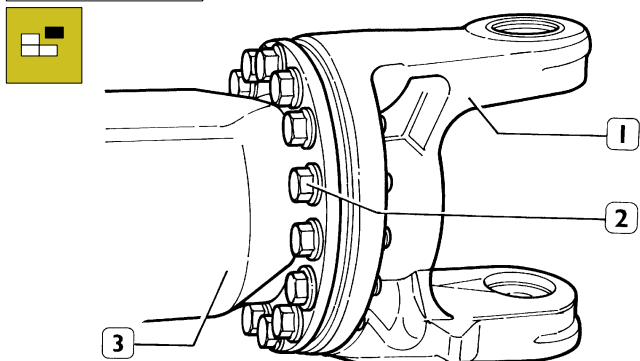


39497

Remove the gasket (1)

Remove the bearings (4, figure 22) from their seats using handle 99370006 and beater 99370258.

Figure 24

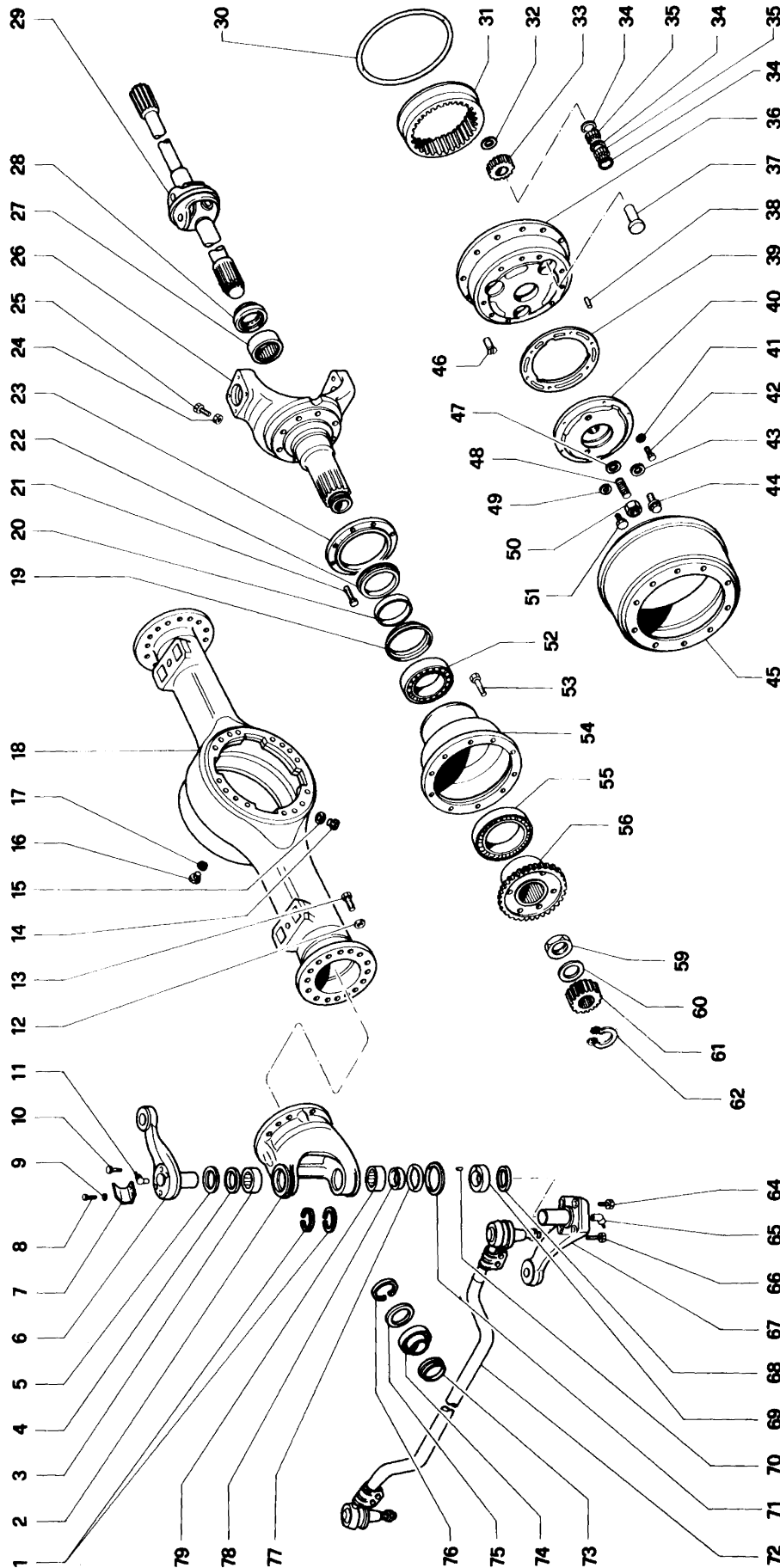


39498

Release the screws (2) then remove the fork (1) from the axle casing (3).

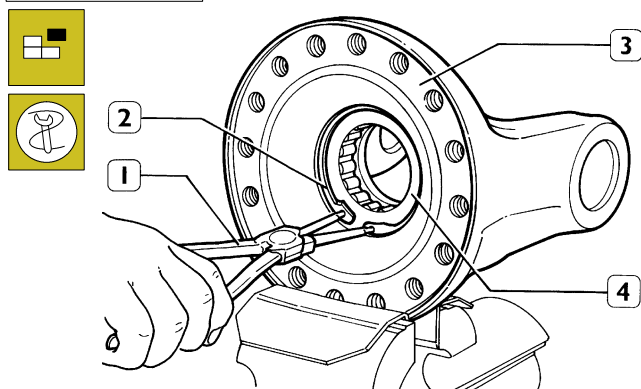
Repeat the same operations for the hub on the other side.

Figure 25



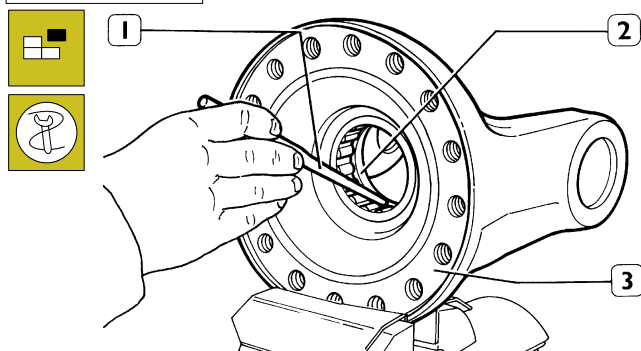
FRONT DRIVE AXLE AND LATERAL REDUCTION UNIT COMPONENTS

1. Split rings - 2. Fork support - 3. Roller bearing - 4. Seal ring - 5. Adjustment ring - 6. Steering drop arm - 7. Bracket - 8. Arm fastening screw - 9. Washer - 10. Arm fastening screw - 11. Greasing nipple - 12. Washer - 13. Fork support fastening screw - 14. Oil drain plug - 15. Sealing washer - 16. Oil inlet plug - 17. Sealing washer - 18. Axle casing - 19. Seal ring - 20. Sliding ring - 21. Brake support fastening screw - 22. Shim - 23. Baffle ring - 24. Adjustment nut - 25. Steering stop screw - 26. Stub axle - 27. Needle bearing - 28. Seal ring - 29. Half-axle with constant velocity joint - 30. Seal ring - 31. Crown washer - 32. Shim washer - 33. Crown wheels - 34. Shim rings - 35. Bearing needles - 36. Planetary gear carrier - 37. Bearing pin - 38. Dowel pin - 39. Gasket - 40. Crown wheels carrier cover - 41. Washer - 42. Cover fastening screw - 43. Sealing washer - 44. Oil inlet plug - 45. Brake drum - 46. Crown wheels carrier fastening screw - 47. Sealing washer - 48. Spacer screw - 49. Sealing washer - 50. Lock nut - 51. Oil level plug - 52. Taper roller bearing - 53. Wheel fastening screw - 54. Wheel hub - 55. Taper roller bearing - 56. Supporting ring - 69. Spacer ring - 70. Stop pin - 71. Safety ring - 72. Track rod - 73. Seal ring - 74. Needle bearing - 75. Support ring - 76. Circlip - 77. Seal ring - 78. Seal ring - 79. Needle bearing

Removing the fork support**Figure 26**

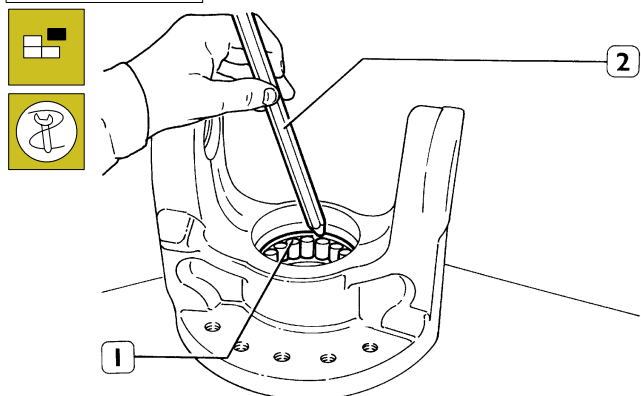
39499

Using the specific pliers (1) remove the check ring (2) and support ring (4) under the fork support (3).

Figure 27

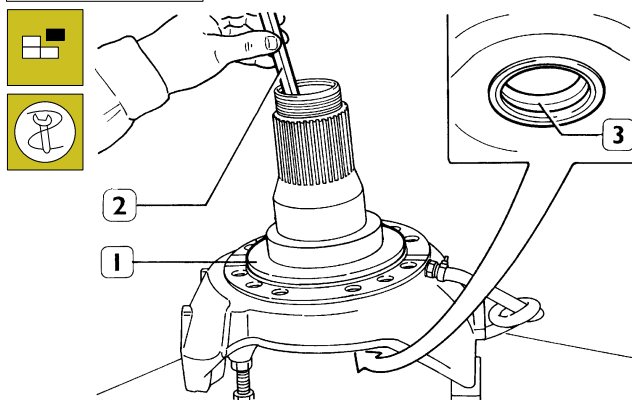
39500

Using a beater (1) eject the seal ring (2) from the fork support (3).

Figure 28

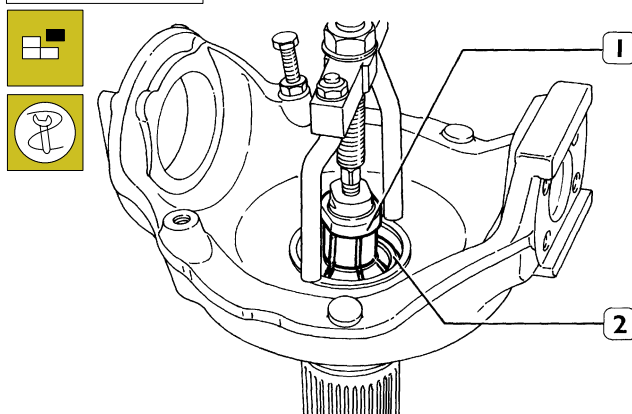
39501

Remove the roller bearing (1) using the suitable beater (2).

Removing the stub axle**Figure 29**

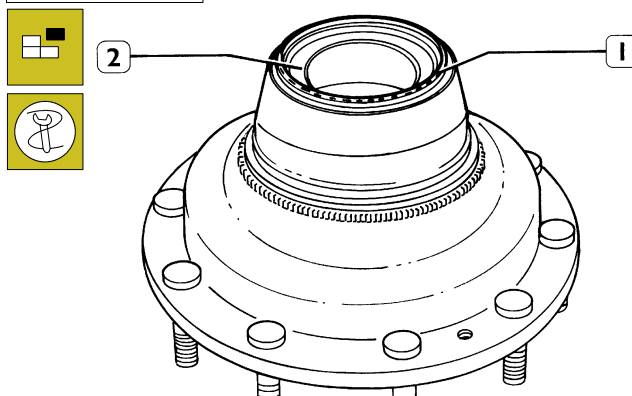
39502

Using the suitable beater (2), remove the seal ring (3) from the stub axle (1).

Figure 30

39503

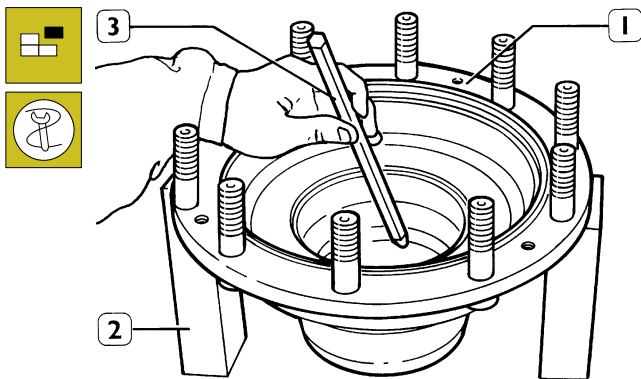
Remove the split ring. Using puller 99348004 (1), remove the bearing (2).

Figure 31

39504

Remove the seal ring (1). Use the appropriate beater to remove the bearing outer ring (2).

Figure 32

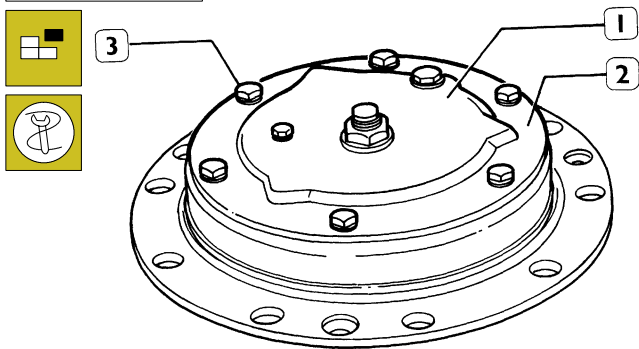


39505

Place the wheel hub (1) on two stands (2) and using a beater (3) remove the bearing outer ring with its gasket.

Removing the epicyclic reduction gear

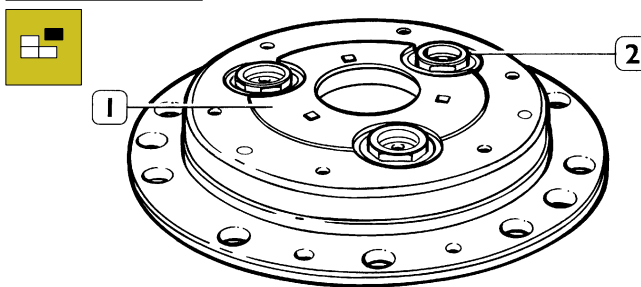
Figure 33



39506

Remove the screws (3), then with a beater, separate the cover (1) from the planetary gear carrier (2).

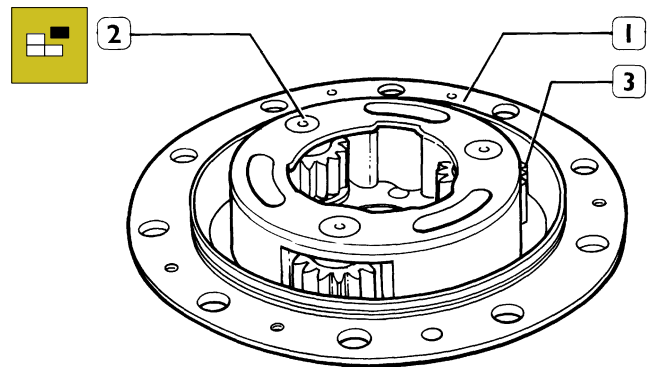
Figure 34



39507

Turn over the carrier (1) holding the pins (2) in their seats.

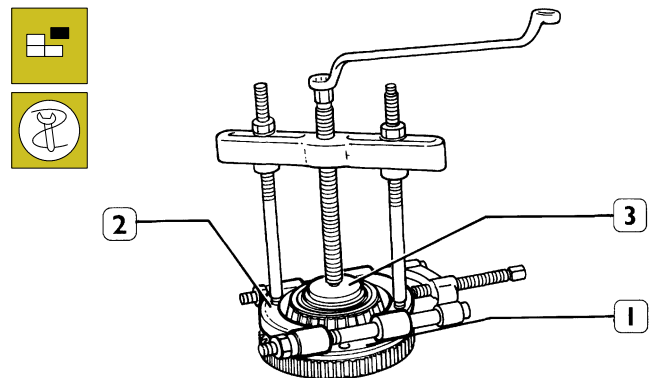
Figure 35



39508

Withdraw the pins (2) from the carrier (1) together with the gears (3) and the shims.

Figure 36



39510

Using puller 99348001 and counteracting block (3) 99345049, remove the bearing from the ring bevel gear carrier (1).

CLEAN-OUT AND CHECKS

After the unit has been dis-assembled, dip all the parts, except the bearings, in a washing tank containing a soda and water solution heated to a temperature of 80 - 85 °C to dissolve all the lubricant residue.

Use a metal brush and scraper to remove any deposits, residue from gaskets, Loctite or sealant that has remained between the connecting plates, taking care not to damage them.

Wash again and dry the parts with compressed air.

At the bench, with an electric metal brush, remove any Loctite or sealant remaining in the screw threads.

To clean the bearings properly, place them in a petroleum bath and use a brush to remove any lubricant residue.

Dry the bearings with compressed air making sure that the air jet does not cause the bearings to rotate.

Lubricate the bearings with the same type of oil as for the epicyclic unit.

Keeping the bearings pressed with one hand and at the same time turning them slightly in both directions, check that there is no roughness or noise as they slide.

Carefully check that the rollers and their cages, the outer tracks and raceways are not worn.

Check all the parts to decide whether they can be re-used or must be replaced. Special attention must be given to the axle casing, the fork supports and the stub axles; make sure there are no signs of cracking or other faults.

Any parts that show signs of wear must be replaced.

Check the wheel fastening bolts; if any strain or damage to the threads is seen, replace, using the press to remove them and fit in place the new parts. After fitting, check that the orthogonality tolerance does not exceed 0.3 mm.

CHECKING THE AXLE CASING CAMBER ANGLE AND CASTER ANGLE

To find the camber angle, device 99305 I I I is used, following this procedure:

- Set the two supports (1, figure 37), together with the centering cones (5), in the stub axle housings and lock the cones on their supports;
- Set up the gauge and read the camber values on the relevant goniometers (2).

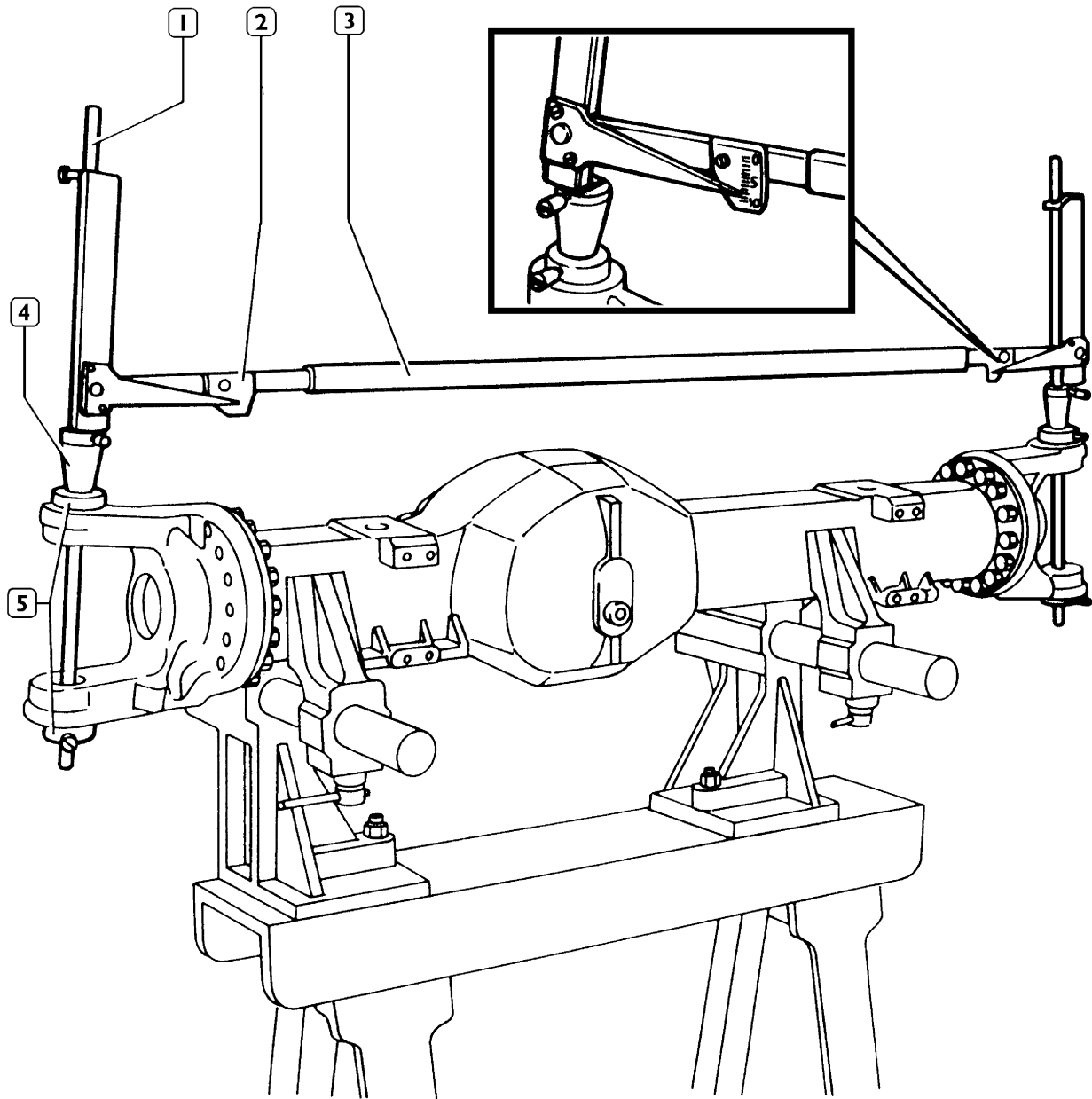
The camber angle of the holes must be 5°

Check the flatness of the contact surfaces for the leaf springs. Device 99305 I I I is used to find the caster angle, following the procedure described below:

- Insert the two centering pins (4, figure 38) on the leaf spring contact surfaces;
- Using the centering pins, set up the two goniometers (2) on the leaf spring contact surfaces;
- Set up the cross bar (1) on the supports (3) and goniometers (2) then read the relevant caster values on the goniometers.

The axle caster angle must be 1° 30'

Figure 37

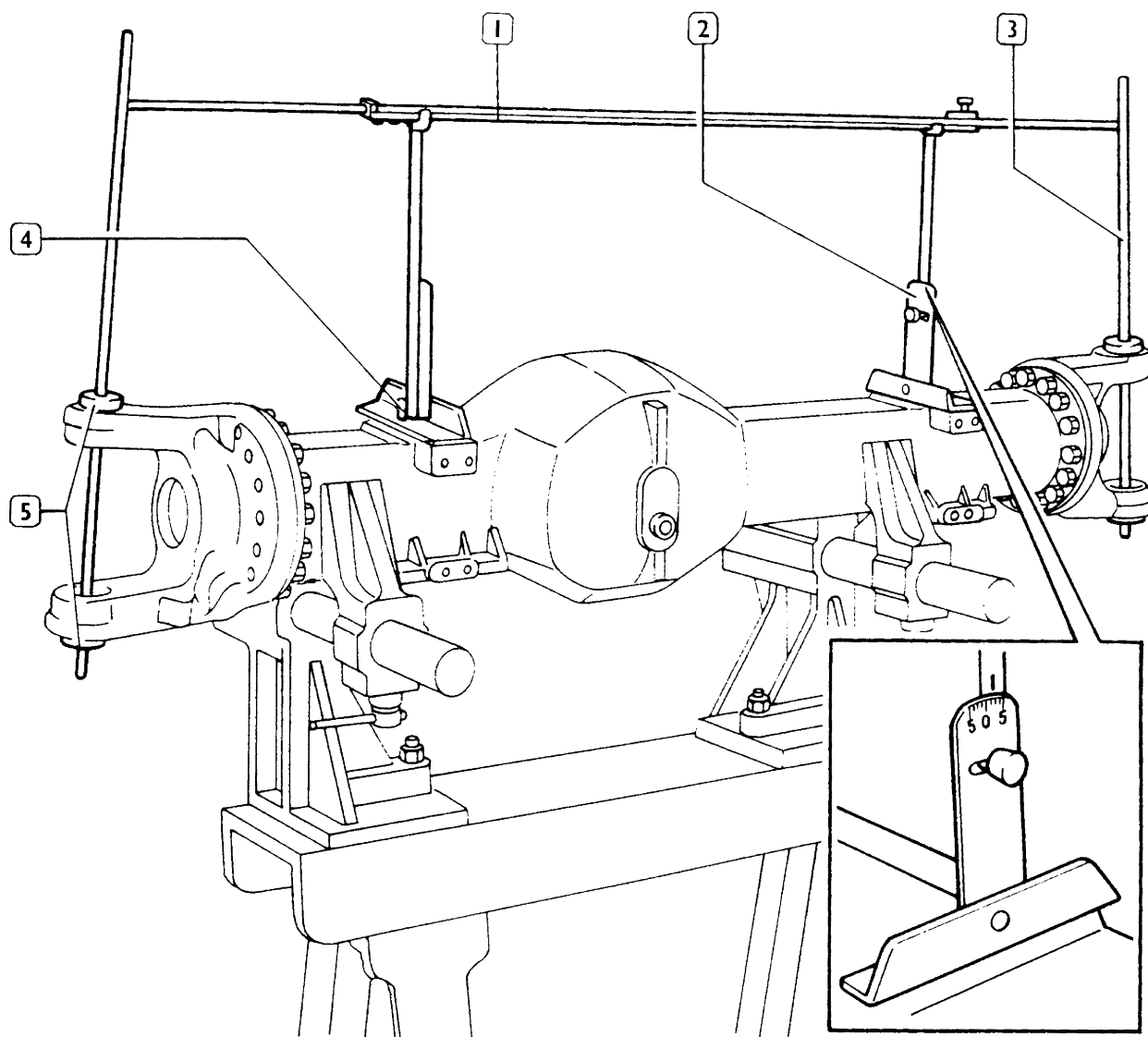


39593

CAMBER ANGLE CHECK

1. Support - 2. Goniometer - 3. Cross bar - 4. Centering cones - 5. Spacer

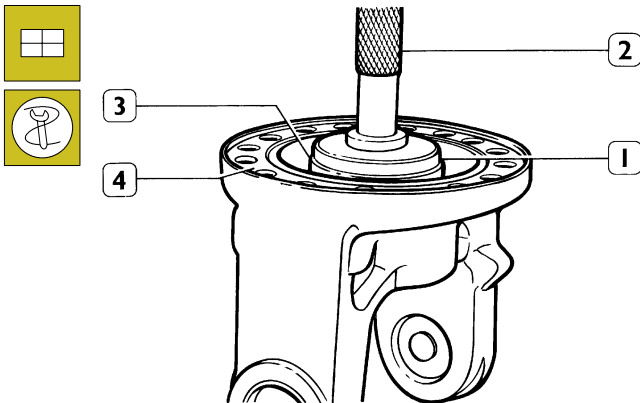
Figure 38



39594

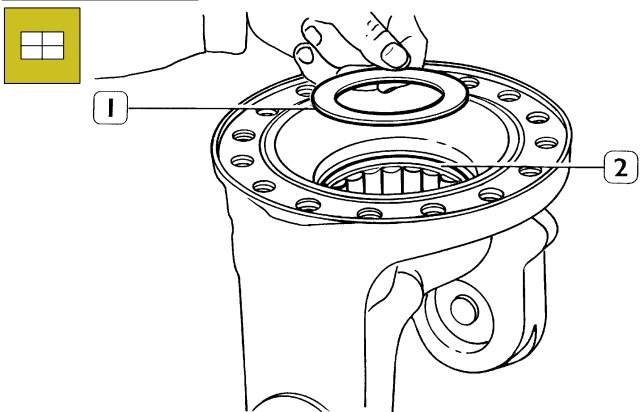
CASTER ANGLE CHECK

1. Cross bar - 2. Goniometer - 3. Support - 4. Centering pin - 5. Spacer

Fitting in place the fork support**Figure 39**

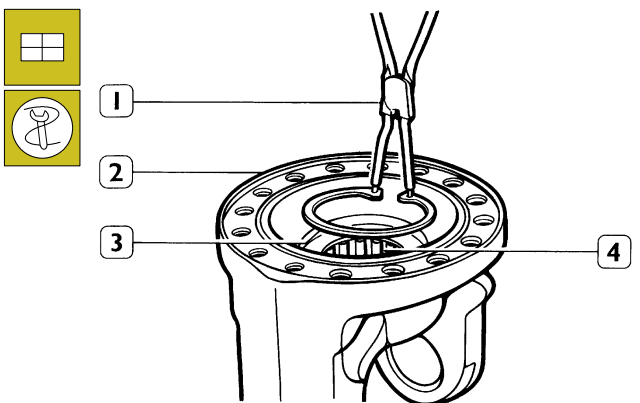
39511

Using beater 99374370 (1) and handle 99370006 (2) fit the roller bearing (3) in its housing in the fork support (4).

Figure 40

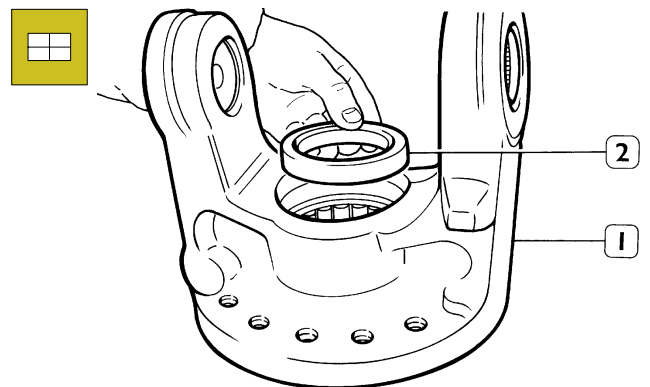
39512

Fit the spacer (1) in the fork support housing (2).

Figure 41

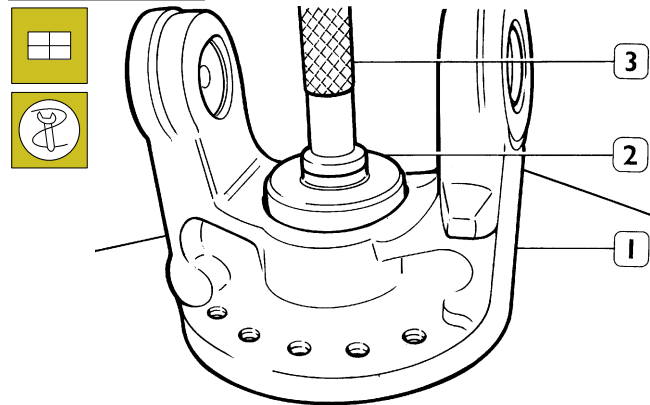
39513

Using the specific pliers (1), fit in place the check ring (3) in the fork support housing (2).

Figure 42

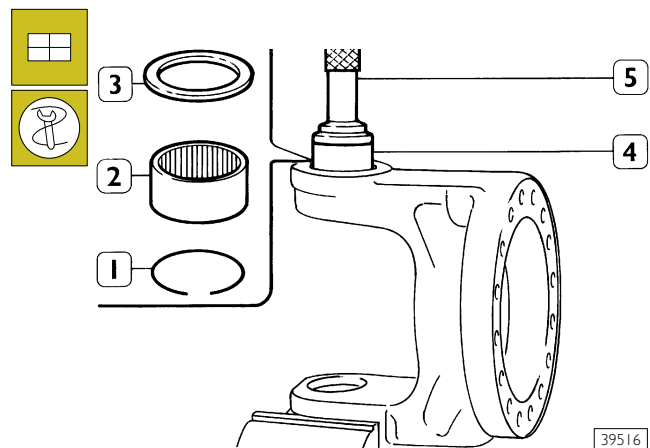
39514

Turn over the support (1) and fit in place the sealing gasket (2).

Figure 43

39515

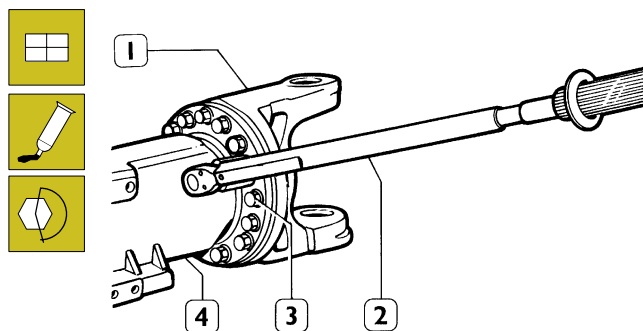
Using connection device 9937437 (2) and handle 99370006 (3), fit the gasket in the fork support housing (1).

Figure 44

39516

Fit in place the split ring (1). Using beater 99370258 (4) and handle 99370006 (5) fit the split ring (1) to contact the needle bearing (2); fit in place the seal ring (3). Repeat the same operations for the other side.

Figure 45



39517

Spread Loctite AVX on the coupling surfaces of the fork support (1) and the axle casing (4), then fit in place the support, taking care that the boss for the steering mechanical end of stroke is in its correct position.

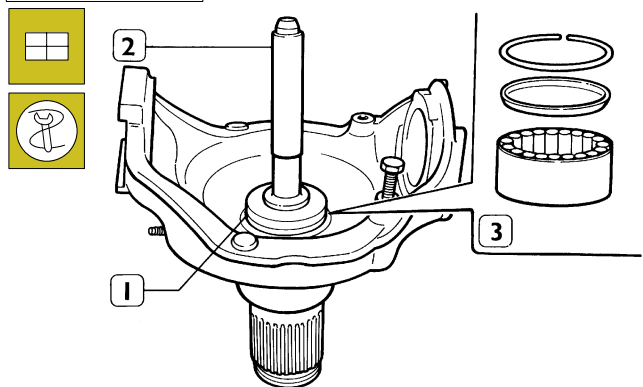
Align the holes for the fastening screws.

Spread Loctite AVX on the screw threads (3) and screw them to make contact, working on them in progressive order.

Use a dynamometric wrench to tighten the screws to the prescribed torque.

Fitting in place the stub axle

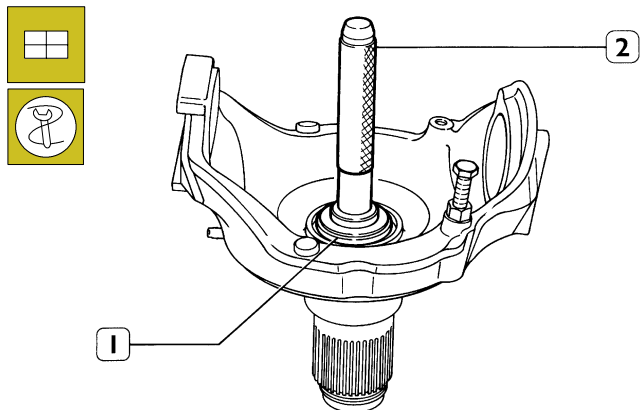
Figure 46



39518

Using beater 99374369 (1) and handle 99370006 (2) fit in place the roller bearing (3) with the cap and split ring.

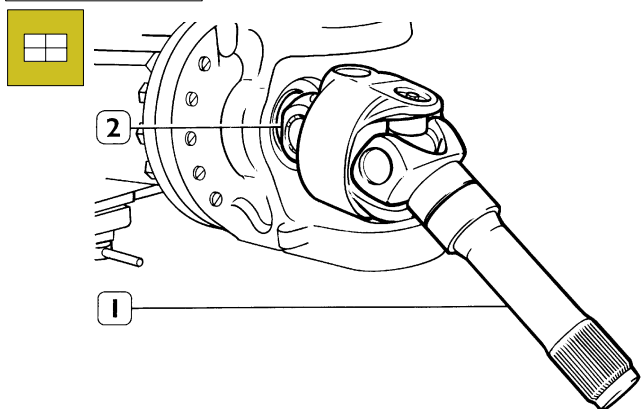
Figure 47



39518

Using beater 99374390 and handle (2) fit the seal ring (1) in the stub axle housing.

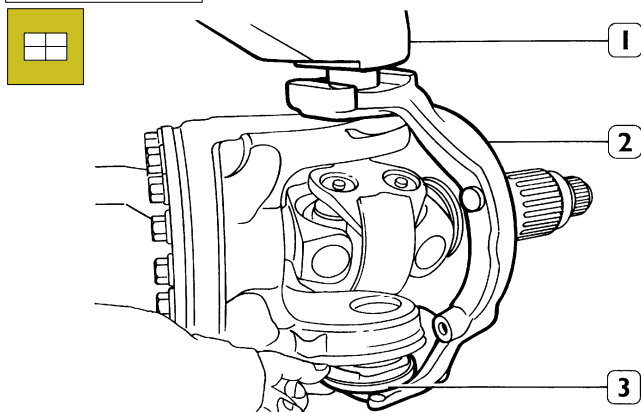
Figure 48



39519

Lubricate the bearing inner ring (2) then insert the half-shaft (1) taking care not to damage the seal ring.

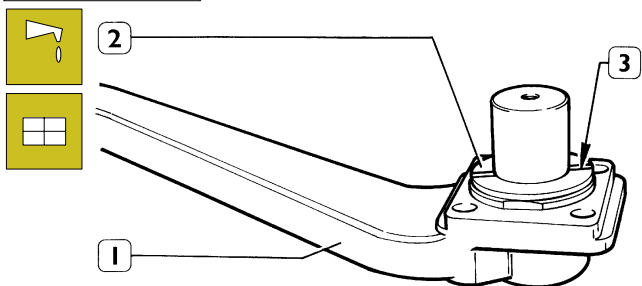
Figure 49



39520

Fit in place the stub axle (2) and momentarily insert the upper pin (1) and shim (3).

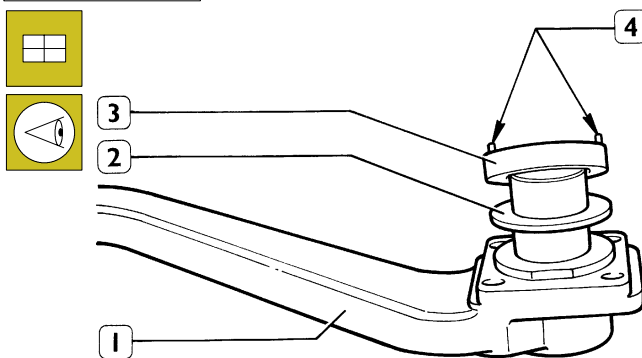
Figure 50



39521

Grease the collar (2) and fit it in place on the steering (1) in the position indicated by the arrow (3).

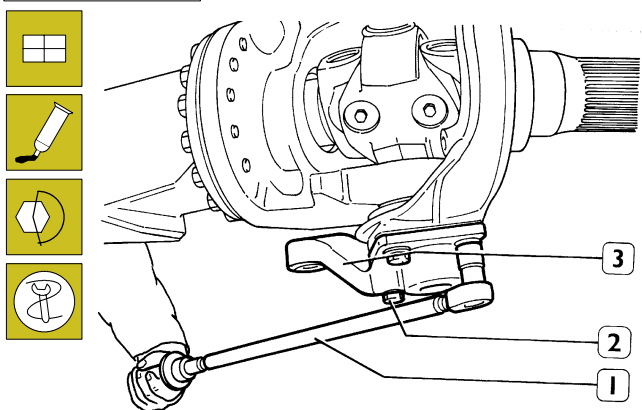
Figure 51



39522

Fit in place the spacer (3) positioning the pins (4) as shown; fit in place the seal ring in the safety ring and insert it between the fork support and the stub axle.

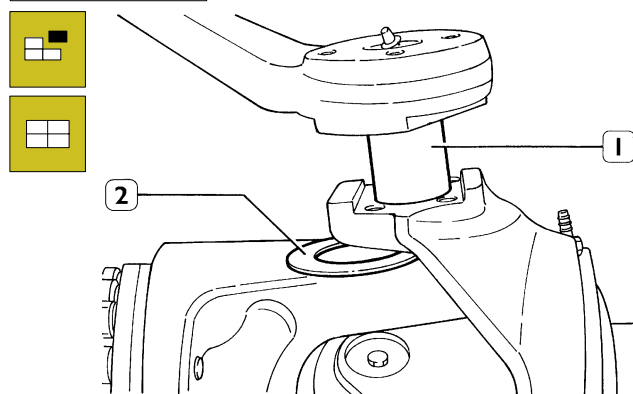
Figure 52



39523

Fit in place the arm (3) in the stub axle. Spread Loctite AVX on the screw threads (2) then tighten them with a dynamometric wrench (1) to a torque of 230 Nm (23 Kgm)

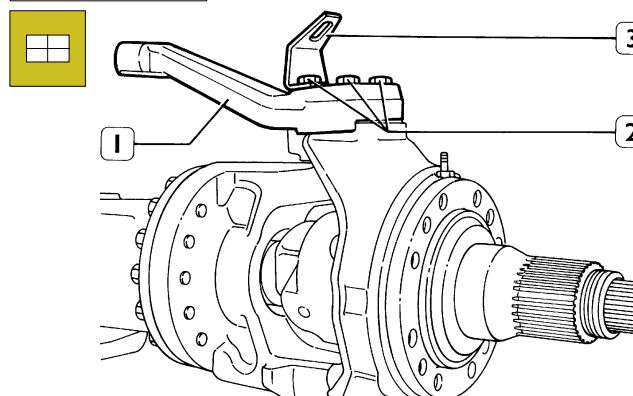
Figure 53



39524

Partially withdraw the upper pin (1) and insert the adjusting ring (2).

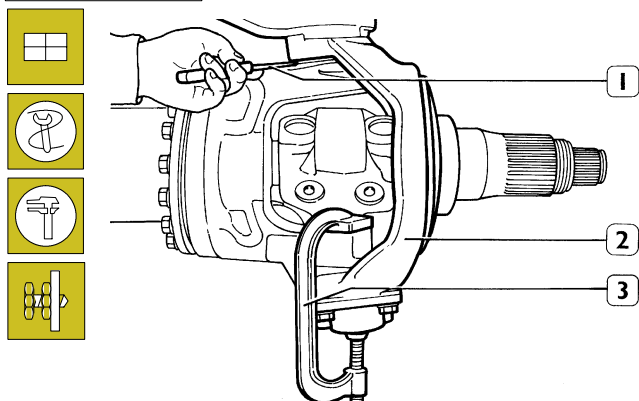
Figure 54



39525

Insert the upper pin (1). Fit in place the brake air hoses coupling bracket (3) and lock it withscrews (2).

Figure 55



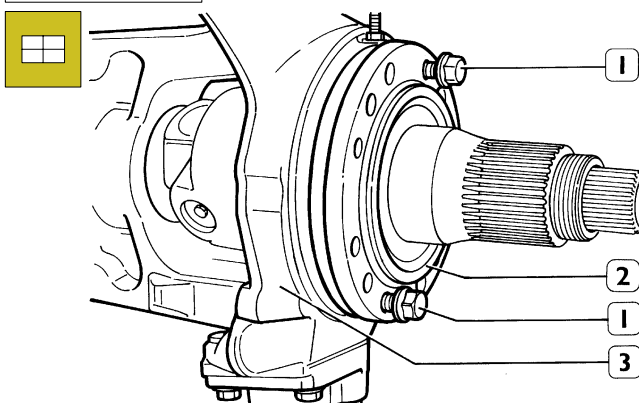
39526

Fit a vice (3) to lift the stub axle (2); check there is no backlash using a feeler gauge (1).

If backlash is found, replace the ring with another of an adequate thickness to eliminate the backlash.

Remove the upper pin fastening screws, apply Loctite to them and re-fit them in place, tightening to a torque of 230 Nm (23 kgm).

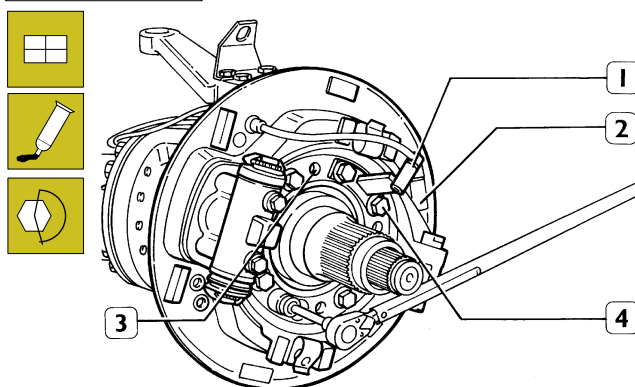
Figure 56



39527

Using two screws (1), fit the flange (2) on the stub axle (3) with the oil drainage notch downwards.

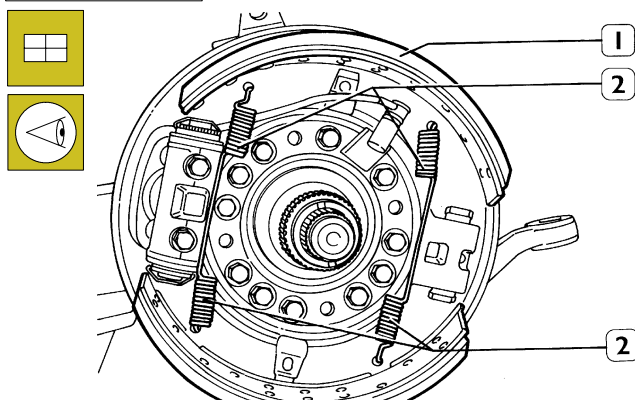
Figure 57



39528

Fit in place the brake housing (3) and its guard (2) on the stub axle; use Loctite AVX on the screws (4) and tighten them to a torque of 360 Nm. Fit in place the ABS sensor (1).

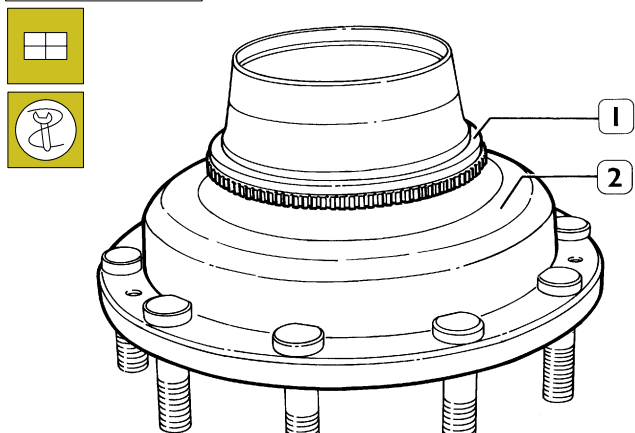
Figure 58



39529

Fit in place the shoes (1) so that the embossed arrow is in the forward driving direction; latch the return springs (2).

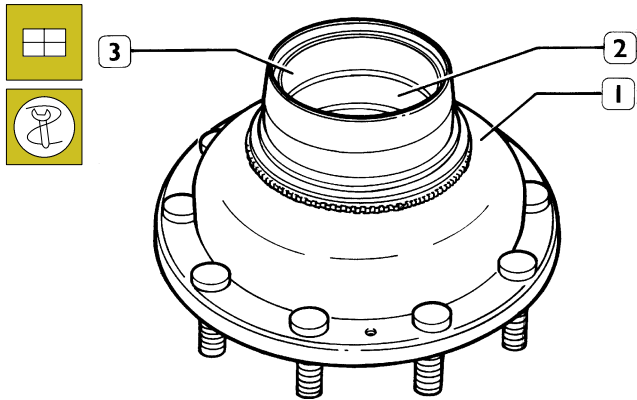
Figure 59



39530

Slightly heat the phonic wheel (1) and fit it in place on the wheel hub (2)

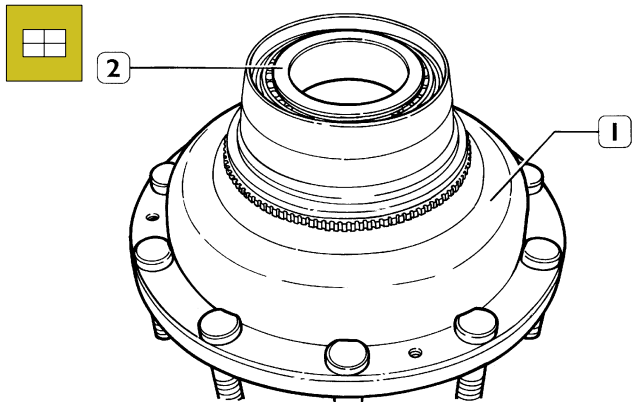
Figure 60



39531

Use beater 99374094 to fit in place the bearing outer rings (2 and 3) on the wheel hub (1).

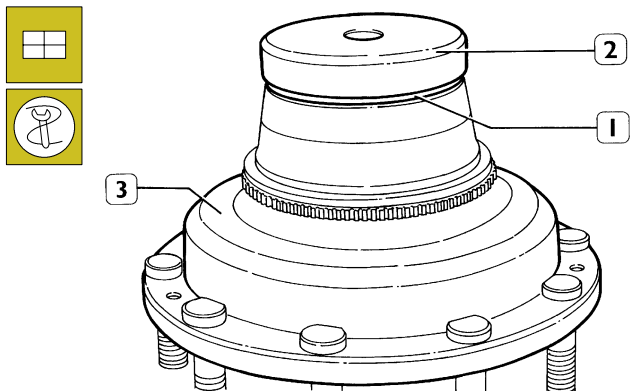
Figure 61



39532

Insert the outer bearing inner ring (2) on the wheel hub (1)

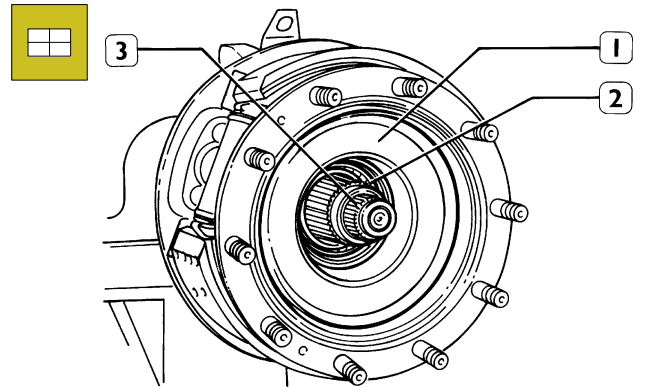
Figure 62



39533

Using element 99374377 (2) fit in place the sealing gasket (1) on the wheel hub (3).

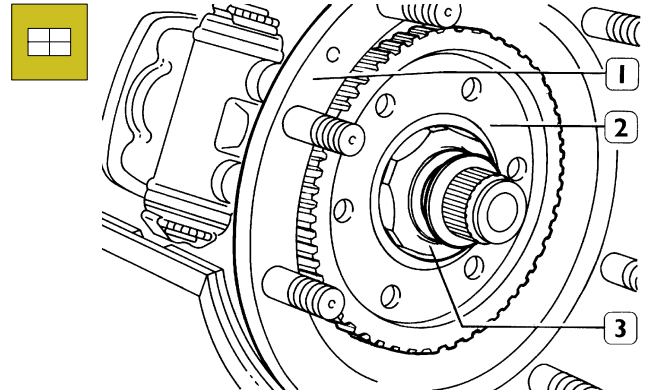
Figure 63



39488

Fit in place the wheel hub (3) on the stub axle shank (2)

Figure 64



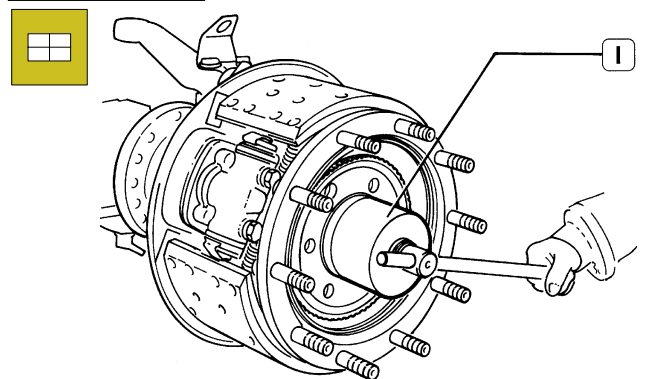
39534

Fit in place the ring bevel gear-carrier (2) on the hub (1) together with the relevant bearing, screw it to contact the nut (3).



The oil passage milling on the ring bevel gear carrier (2) must be set in a perpendicular position in the lower part.

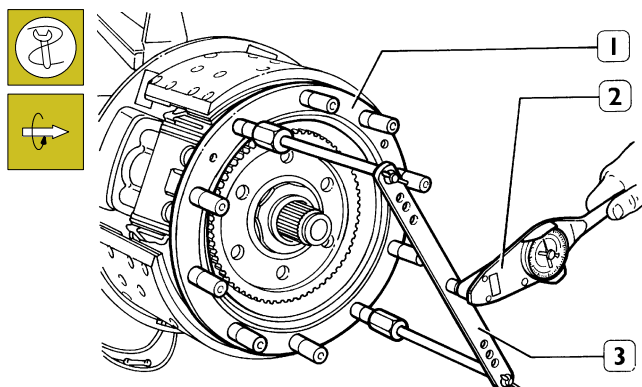
Figure 65



39535

Using wrench 99345207 (1) lock the wheel hub nut until the assembly rotates with difficulty. Use a teflon hammer on the hub to settle the bearings in position.

Figure 66



39536

Apply tool 99389819 (3) to the wheel hub (1) and use a dynamometric wrench (2) to rotate it.

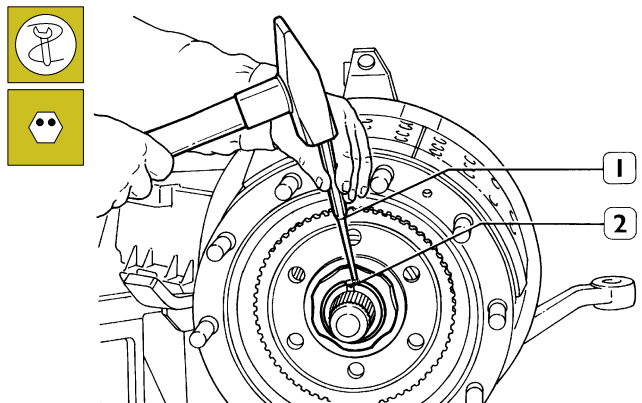
Set the dynamometric wrench indicator (2) to zero then make one wheel hub turn at about $25 \div 30$ r.p.m.

Find the rolling torque on the instrument scale indicator.

This value should correspond to that given in the SPECIFICATIONS AND DATA table on page 5.

If the values do not coincide, loosen or tighten the nut to obtain the required value.

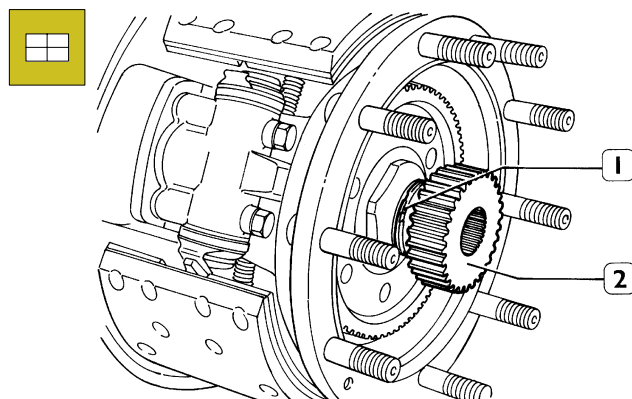
Figure 67



39537

Fit the shoulder ring (1) and the circlip (2) on the half shaft, using the appropriate pliers.

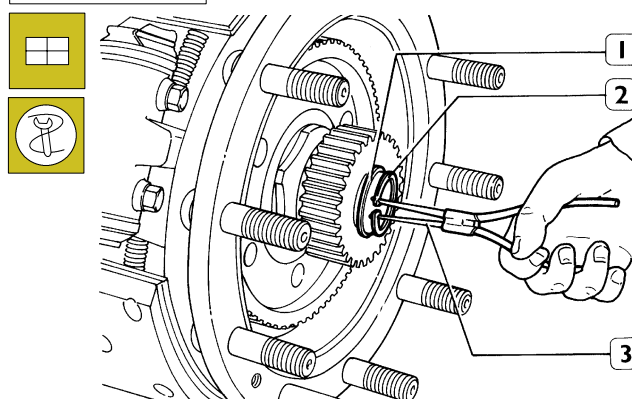
Figure 68



39538

Fit in place the shoulder ring (1), then the planetary gear (2)

Figure 69

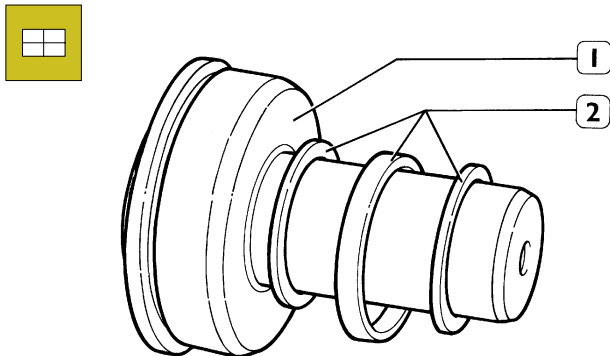


39539

Fit the shoulder ring (1) and the circlip (2) on the half shaft, using the appropriate pliers.

Fitting in place the epicyclic reduction gear support

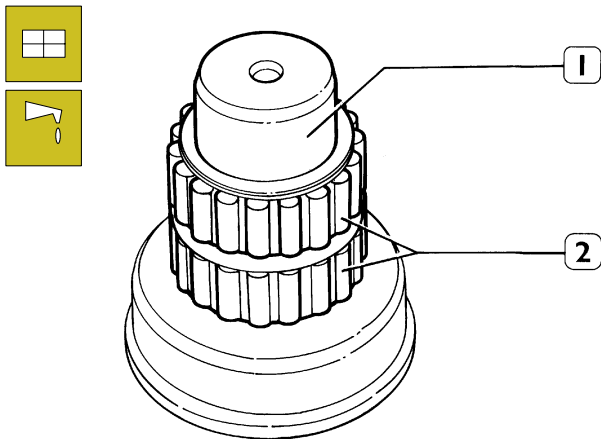
Figure 70



39541

Fit the shim rings (2) on the pin (1)

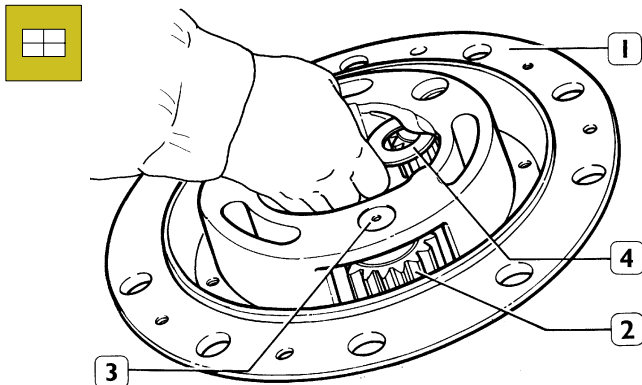
Figure 71



39542

Grease and fit in place the rollers (2) on the pin (1)

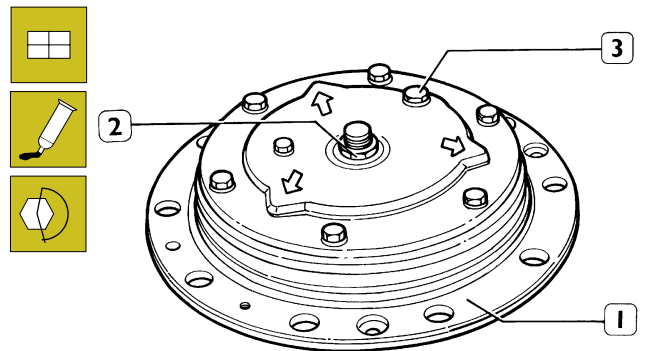
Figure 72



39543

Insert the gears (2), the spacer washers (4) and pins (3) into the support (1)

Figure 73



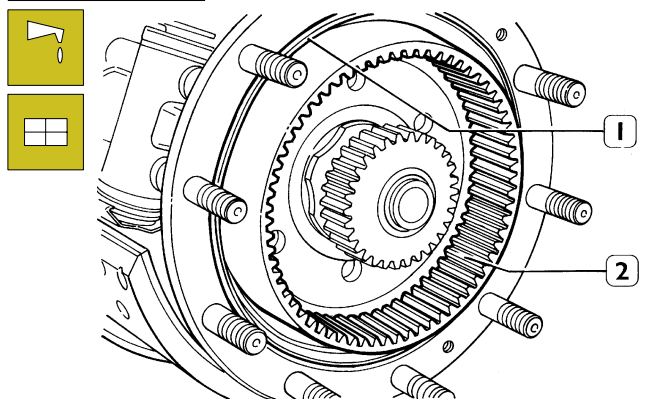
39544

Spread sealant on the two coupling surfaces of the support cover (1), fit in place the seal gasket and place the cover so that the spaces indicated by the arrows coincide with the pins.

To make this operation easier, before fitting the gasket, position the pins according to the seats on the cover, then fit in place the gasket.

Tighten the fastening screws to a torque of 25 Nm (2.5 kgm). Loosen nut (2) and unscrew some threads of the screw (3)

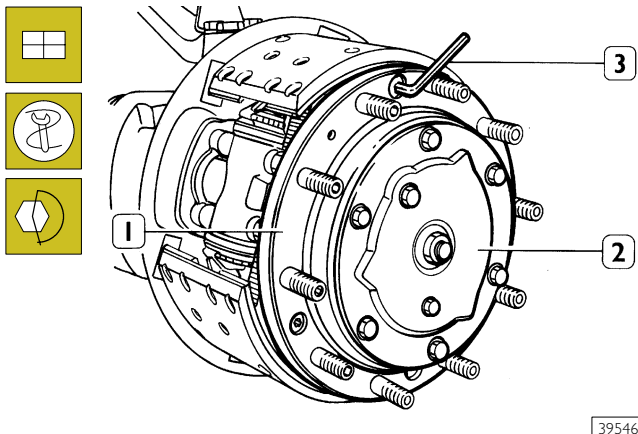
Figure 74



39545

Fit in place the ring bevel gear (2) with the outer chamfer toward the operator. Grease the split ring (1) and fit it in its housing.

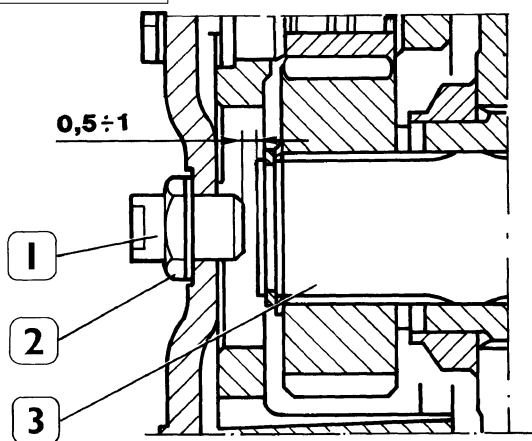
Figure 75



39546

Fit in place the planetary gear carrier (2) on the wheel hub (1). Using a socket wrench (3) screw down the three hexagonal socket head screws and tighten them to a torque of 25 Nm (2.5 kgm).

Figure 76



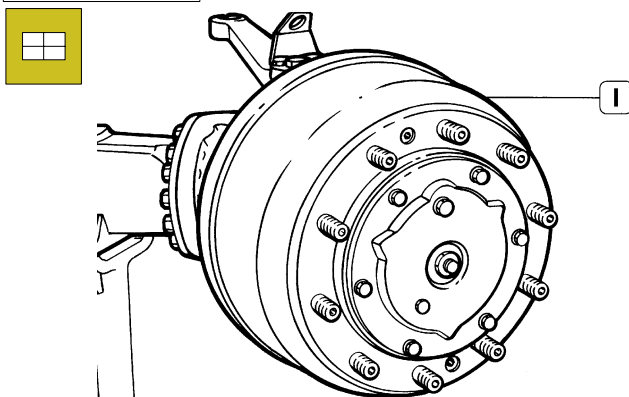
39705

Tighten the screw (1) to bring it into contact with the half axle (3), then unscrew by $1/3 \div 1/2$ a turn to obtain the assembly clearance ($0,5 \div 1$ mm).

Lock the nut (2)

The washer must be replaced whenever the half-axes end play is adjusted.

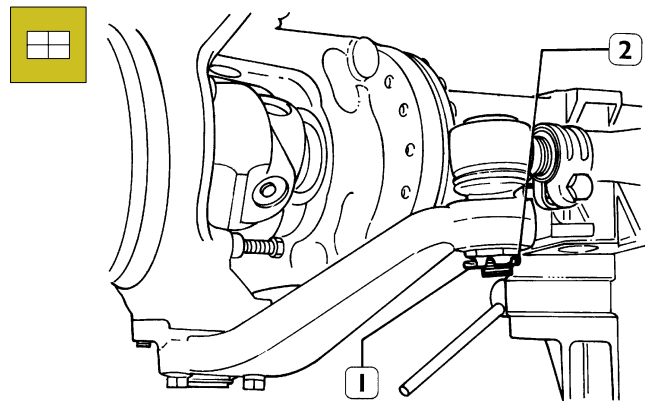
Figure 77



39547

Fit in place the brake drum (1) on the wheel hub and lock it with the two screws.

Figure 78



39491

Fit in place the track rod, tighten the nut (1) to the prescribed torque, fit the split pin (2) and bend it.

GREASING THE STUB AXLE PINS

Using a suitable grease pump, fill the grease nipples.

Continue with the grease pump until the pressure of the grease, after the needle bearing housings are filled, overcomes the sealing edges of the rings and seeps out through the spaces between the stub axle post and the fork support.

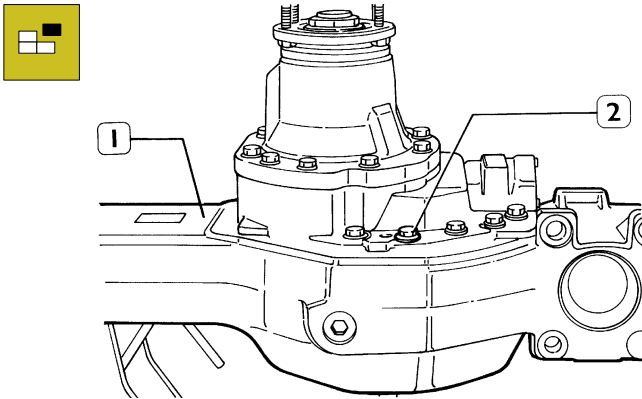
Remove the excess grease.

EPICYCLIC UNITS LUBRICATION

Through the inlet hole on the cover, fill the epicyclic unit with approx 0.75 lt (0.68 kg) of prescribed oil.

REMOVING THE DIFFERENTIAL (with axle on stand 99322215)

Figure 79

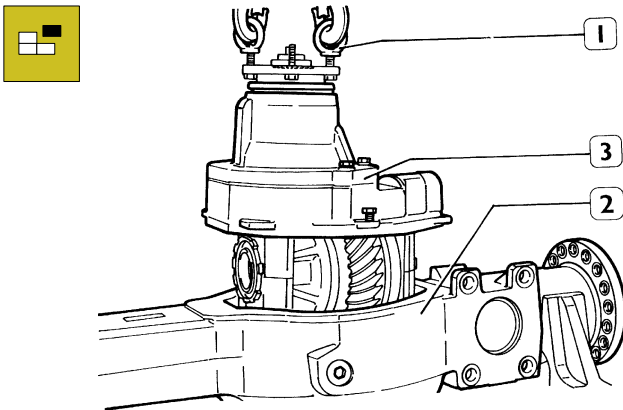


39548

Set the axle casing (1) as shown in the figure and withdraw the half shafts.

Unscrew the differential housing fastening screws (2).

Figure 80



39549

Fasten two eye-bolts (1) to the differential output flange. Using suitable lifting equipment and ropes remove the differential (3) from the axle casing (2).

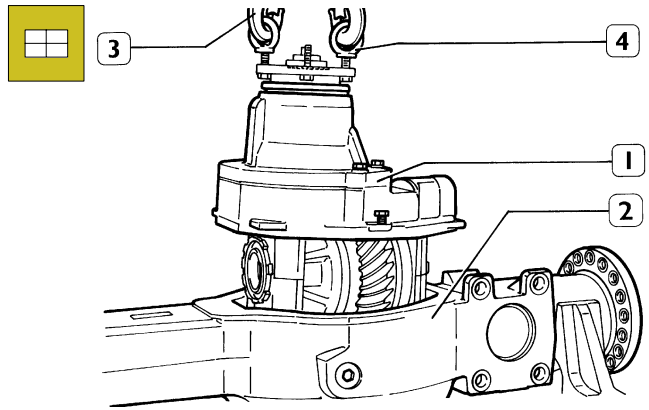
Axle casing check

The axle casing alignment must be checked since any deformation will cause straining and noise (see page 18).

RE-FITTING IN PLACE THE DIFFERENTIAL (with axle on stand 99322215)

To keep in place the seal ring between the axle casing and the differential housing, moisten it with a little grease. Spread Loctite 573 on the coupling surfaces of the axle casing (2) and the differential housing (1).

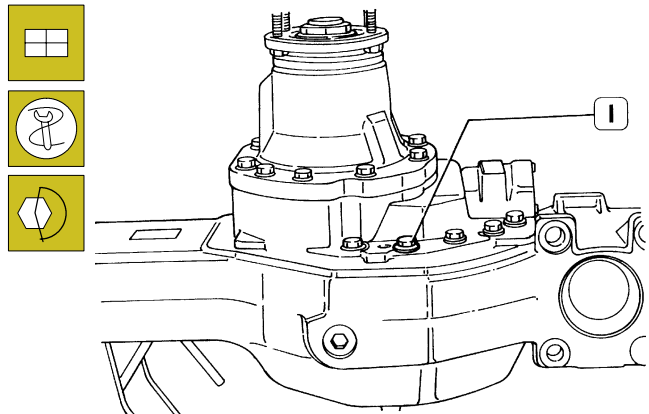
Figure 81



39550

Using mobile hydraulic lifting equipment and ropes with hooks (3-4) place the differential housing (1) in the axle casing (2).

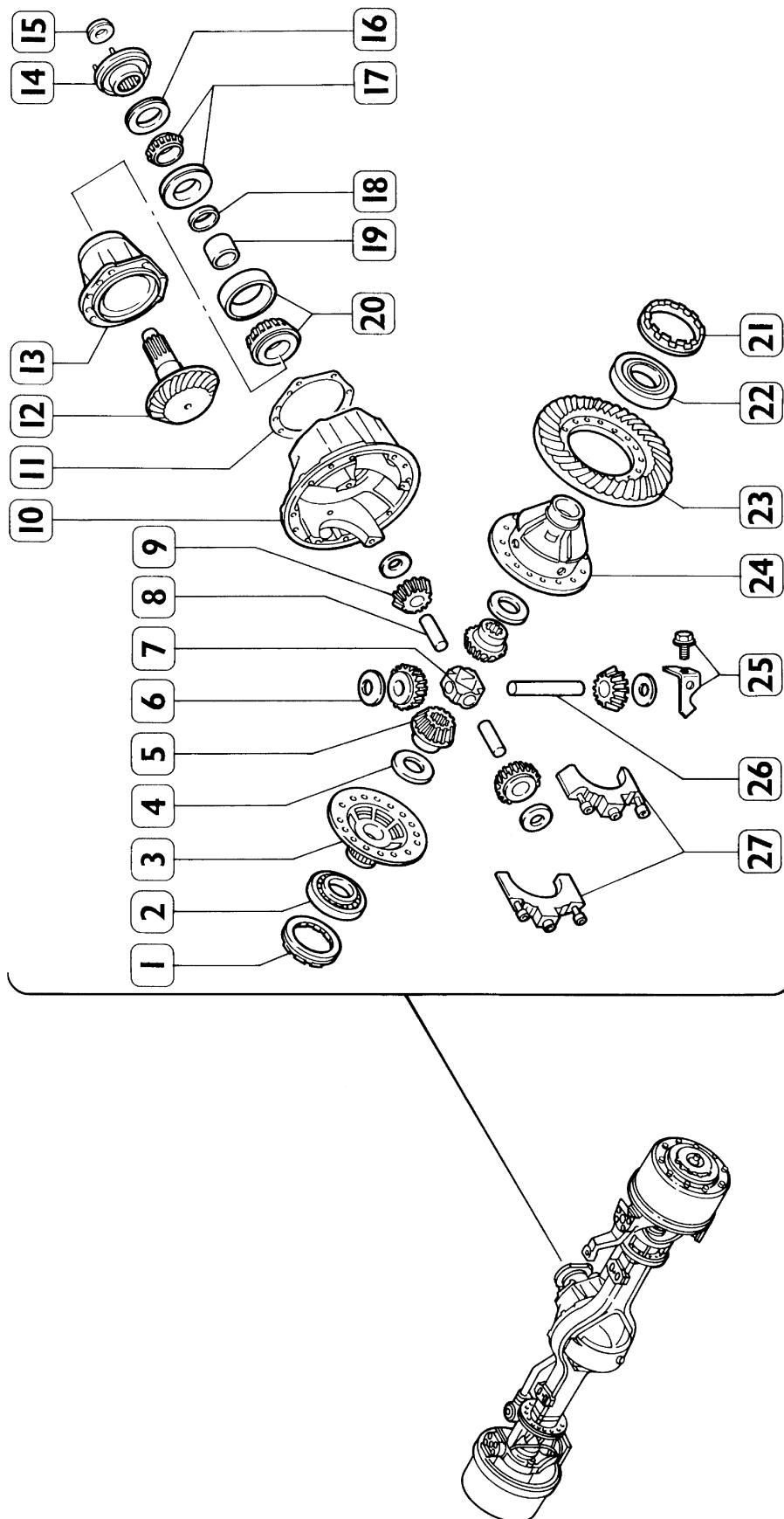
Figure 82



39551

Insert the screws (1) and tighten them with a dynamometric wrench to the prescribed torque.

Figure 83



39613

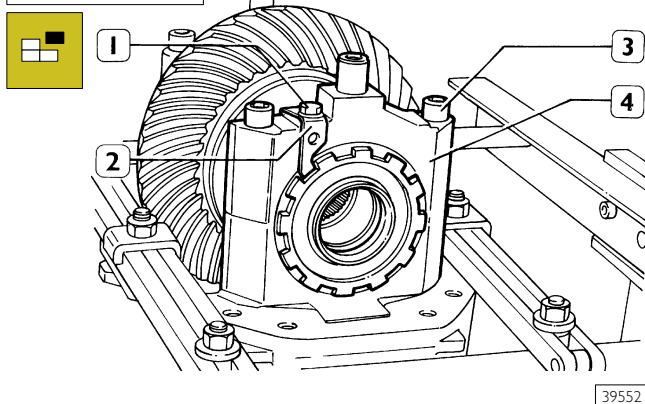
DIFFERENTIAL COMPONENTS

1. Ring nut - 2. Bearing - 3. Gear housing cover - 4. Shoulder washer - 5. Crown wheel - 6. Washer - 7. Spider - 8. Short pin - 9. Planetary gear - 10. Differential housing
 11. Adjusting shim - 12. Pinion - 13. Pinion support - 14. Flange - 15. Nut - 16. Seal ring - 17. Bearing - 18. Adjusting ring - 19. Spacer - 20. Bearing - 21. Ring nut -
 22. Bearing - 23. Crown wheel - 24. Gear housing - 25. Plate and screw - 26. Long pin - 27. Caps

REPAIRING THE DIFFERENTIAL

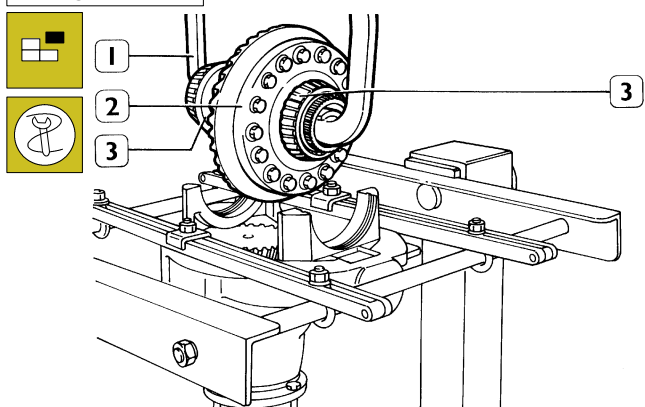
Removal

Figure 84



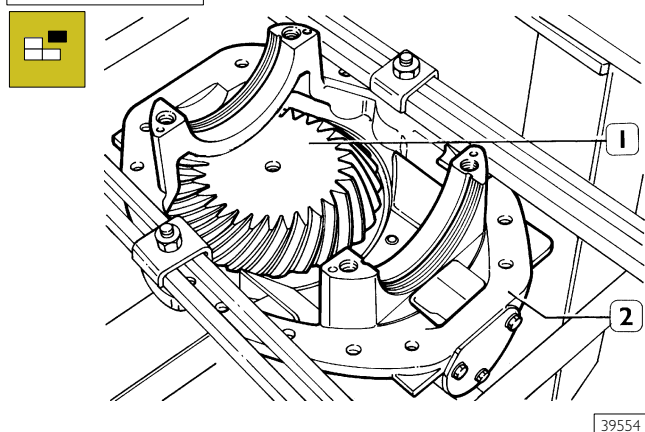
Remove screw (1) and take away the safety plate (2). Remove screws (3) and take away the caps (4). Remove the ring nuts.

Figure 85



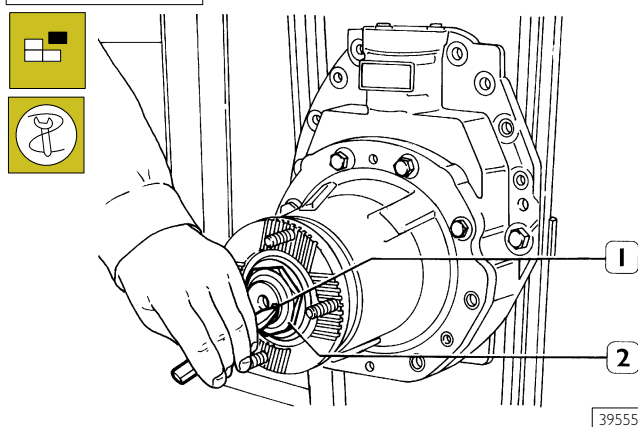
By means of the hook (1) lift the gear housing (2) with the relevant bearings (3).

Figure 86



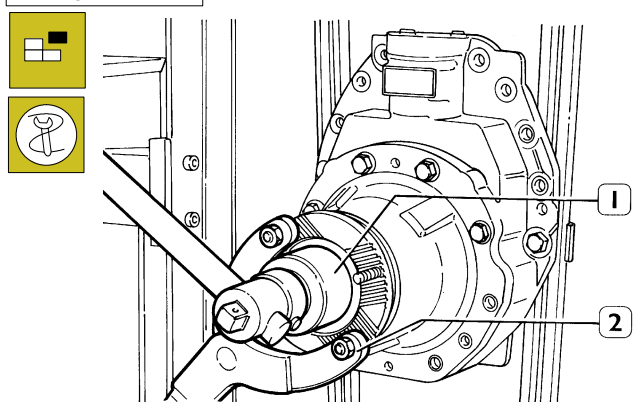
View of pinion (1) from inside the differential housing (2)

Figure 87



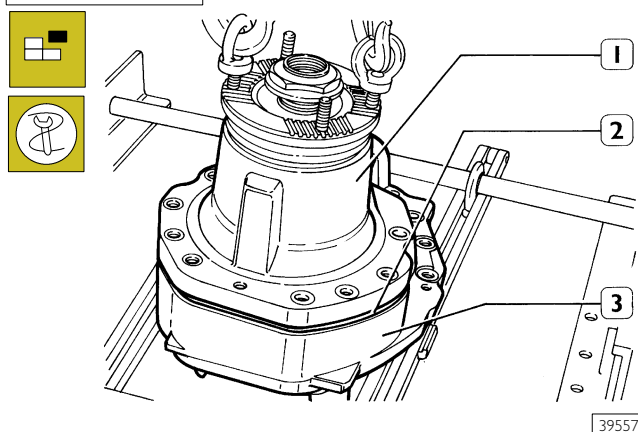
Using the appropriate beater, remove the dents (1) and unscrew the nut (2) as described below.

Figure 88



Lock the coupling flange rotation with lever 99370317 (2) and using socket wrench 99355081 (1) loosen the flange fastening nut.

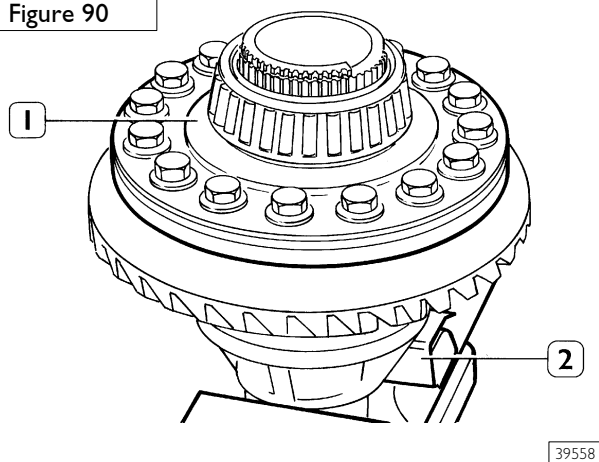
Figure 89



Remove the screws that fasten the bevel gear carrier to the differential housing. Withdraw the carrier (1) with the bevel gear from the differential housing (3); remove the pinion-crown wheel shims (2)

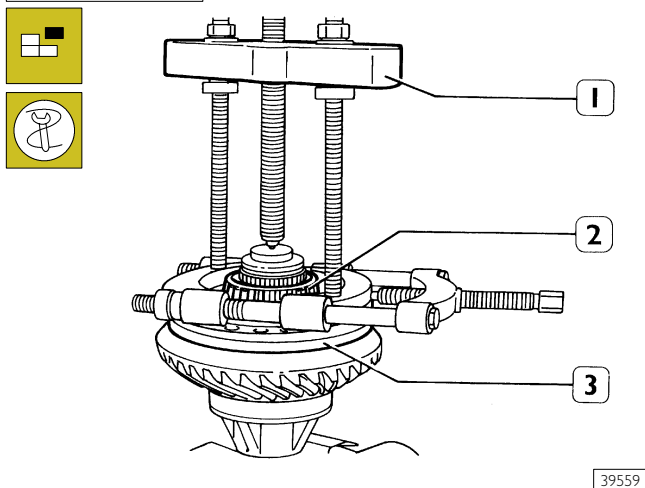
Removing the gear housing

Figure 90



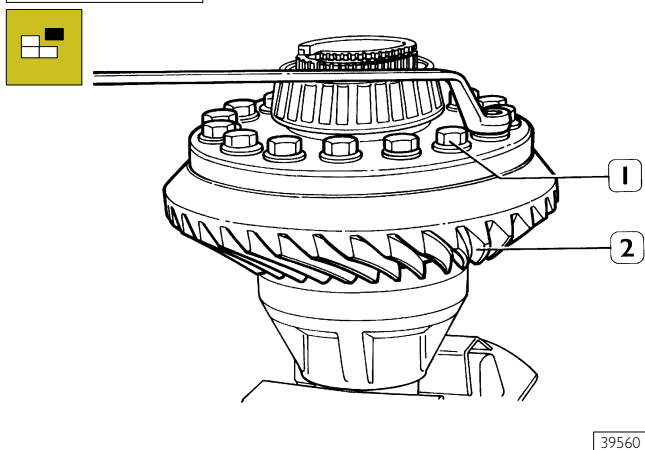
Set the gear housing (1) in a vice (2)

Figure 91



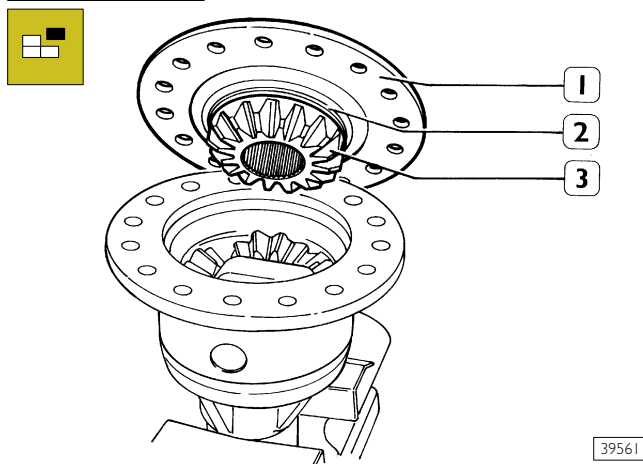
Using puller 9934801 (1) extract the bearing (2) on toothed side from the gear housing (3).

Figure 92



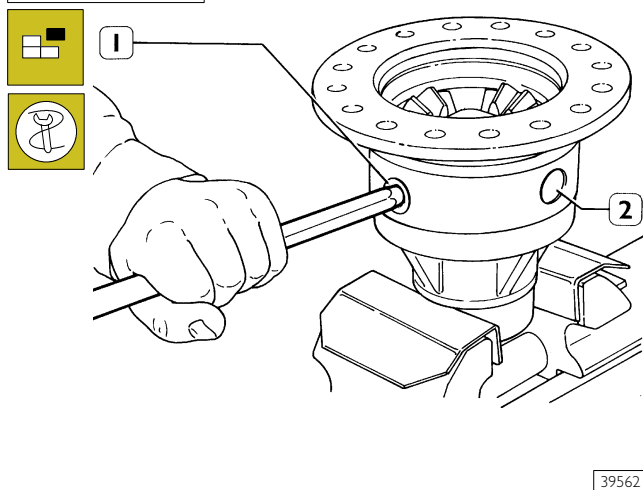
Remove the screws (1)
Use the suitable beater to release the bevel gear (2)

Figure 93



Remove the gear housing cover (1).
Take out the crown wheel (3) with its shoulder washer (2)

Figure 94



Use a beater to draw out the long pin (1), then the two short pins (2)

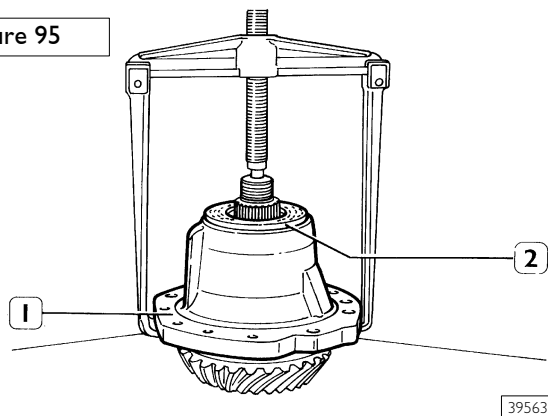


The exact position of the pins is indicated on the spider by a long stripe for the long pin and two short stripes for the short pins.

Remove the spider and the four planetary gear wheels with the shoulder washers.
Remove the crown wheel and shoulder washer

Removing the bevel pinion support

Figure 95

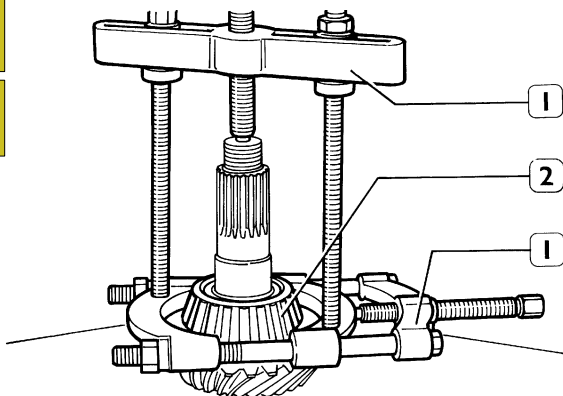


39563

Using the suitable puller set up as shown in the figure, remove the bevel pinion, bearing and adjustment ring from the support (1)

Draw out the seal ring (2)

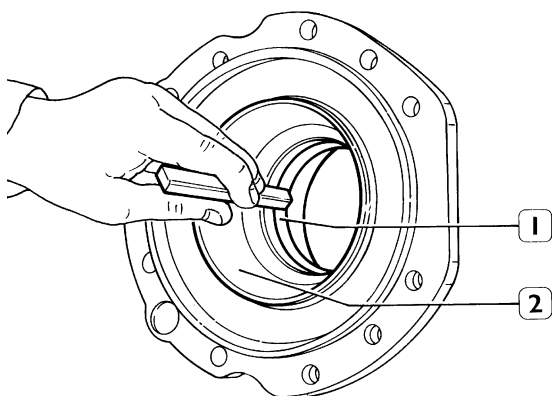
Figure 96



39564

Using puller 99348001 (1) remove the bearing (2) from the bevel gear.

Figure 97



39565

Using a beater, release the front and intermediate bearing outer rings (1 and 2) from the support.

Remove the oil baffle.

Checking the differential components

Carefully clean all the differential components.

Lubricate the bearings and rotate the roller cage freely, this rotation should be regular with no stiffening. Check the contact surfaces of the bevel gear and the stop plate of the half box to ensure that the crown wheel adheres properly. Any deformation of these surfaces will cause the vibration of the fastening screws jeopardizing the unit functioning.



Carefully clean all the threads to ensure accurate adjustments and exact driving torques.

Check that the splined section for the flange connection onto the pinion is not worn. If it is, replace it.

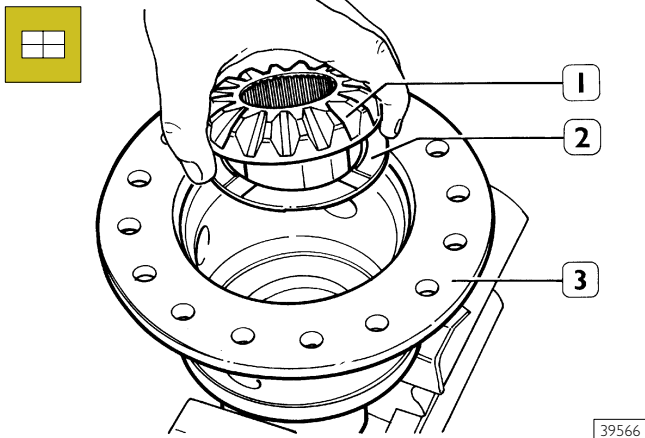


If it is necessary to replace the crown or the pinion, both elements must be changed as they are supplied in pairs.

Check the planetary gears and their shoulder washers, the spider and the crown wheels with their shoulder washers. All sealing elements and lock washers must be replaced with new ones.

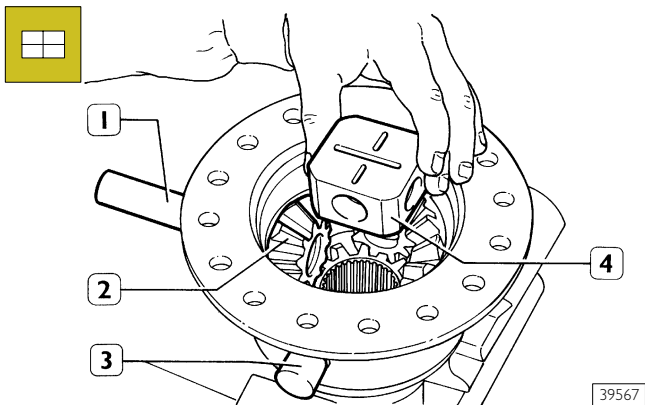
Fitting in place the gear housing

Figure 98



Set the gear housing (3) on a suitable support, fit the crown wheel (1) in its seat with its shoulder ring (2)

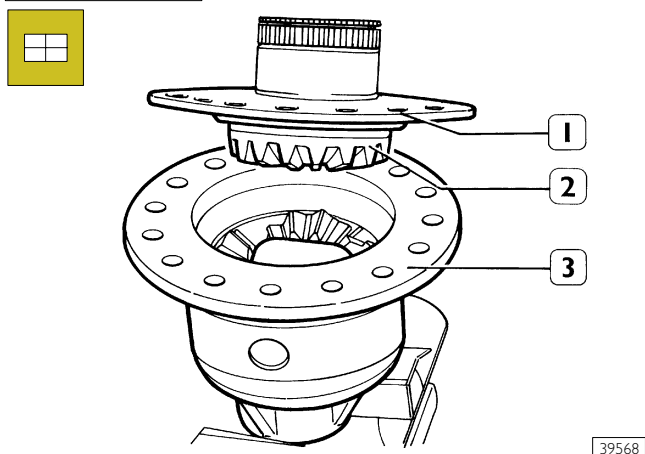
Figure 99



Fit in place the 4 planetary gears (2) and shoulder rings, then fit in place the spider (4). Insert the long pin (1) and two short pins (3).

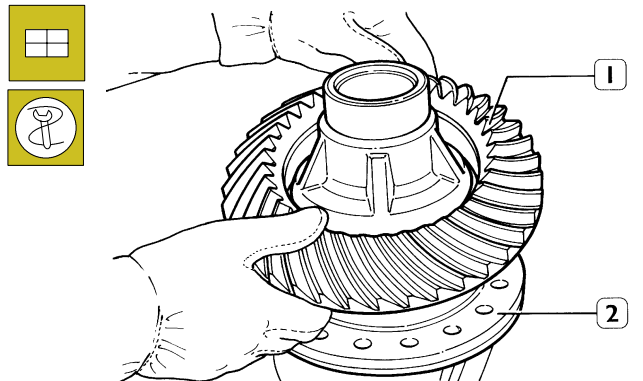
The correct positions for the pins are marked on the spider (4) by a long stripe for the long pin and two short stripes for the short pins.

Figure 100



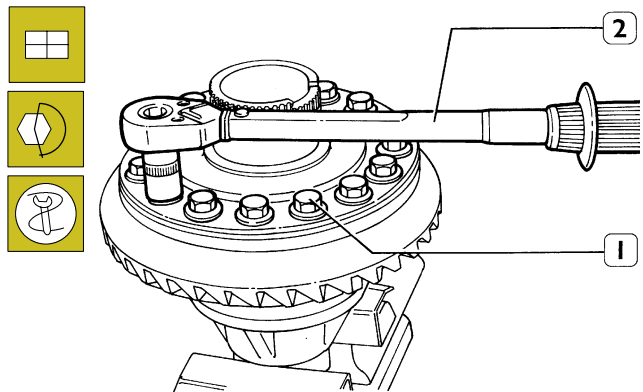
Set the crown wheel (2) with its shoulder ring on the planetary gears. Fit in place the cover (1) on the gear housing (3) making sure that the fastening screw holes coincide.

Figure 101



Heat the bevel gear (1) to approx 80°C, fit it into its seat on the gear housing (2) and lock it immediately by means of two fastening screws.

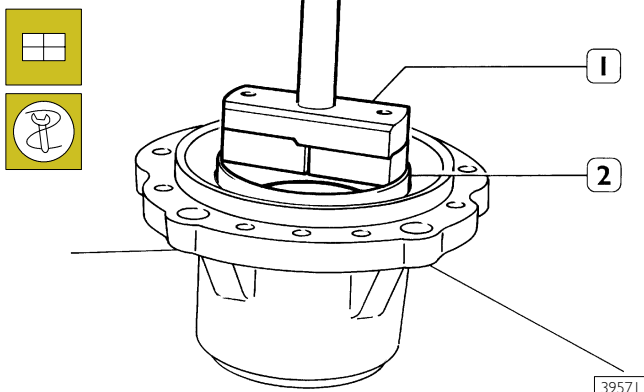
Figure 102



Fit in place the other screws (1) and tighten them with a dynamometric wrench (2) to a torque of 300 Nm. Heat the support bearings and fit them in place on the gear housing.

Fitting in place the bevel pinion support

Figure 103

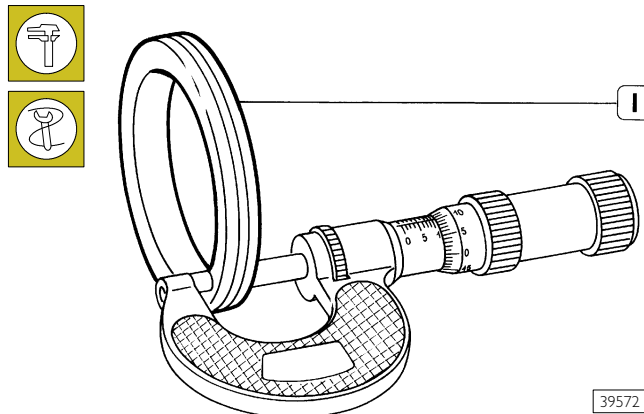


39571

Fit a new oil baffle in the pinion support. Using beater 99374093 (1) drive completely into their seats the outer ring (2) for the front bearing and with beater 99374094 the outer ring for the rear bearing.

PROCEDURE TO DETERMINE THE ADJUSTMENT RING SHIM FOR THE BEVEL GEAR ROLLING TORQUE

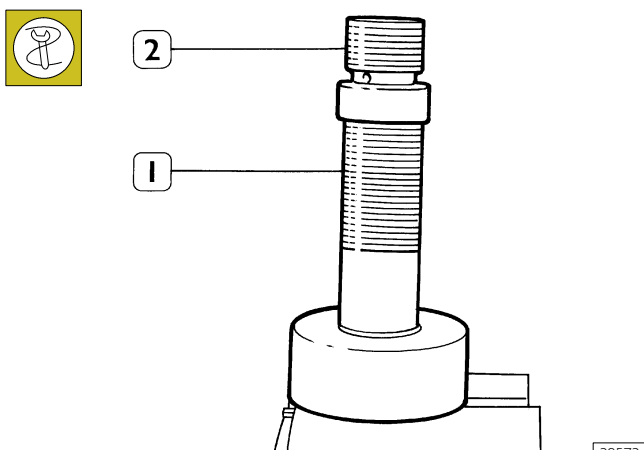
Figure 104



39572

Measure the thickness of the adjustment ring (1) that has been removed and make a note of the value (value A).

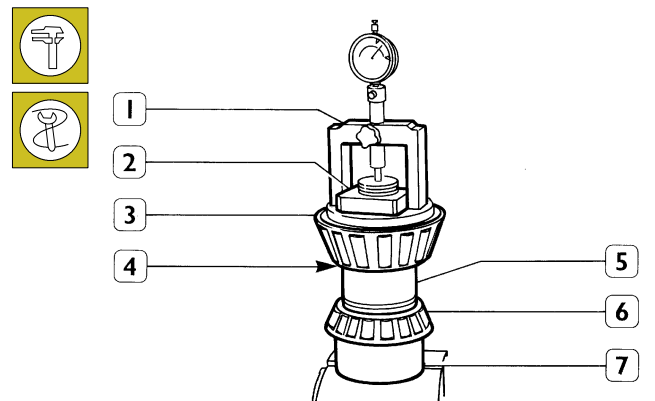
Figure 105



39573

Tighten tool 99395027 (1) and its extension bar (2) in a vice

Figure 106



39574

Onto tool 99395027, fit in place:

- ☐ pinion side bearing (6)
- ☐ spacer ring (5), the previously measured adjustment ring (4) and bearing (3).

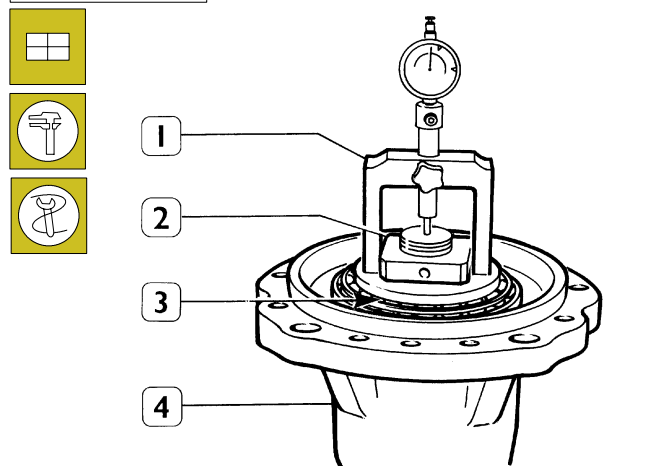
Screw on the ring nut (2) and lock it tight.

On the bearing (3), set element (1) of tool 99395027 (1) equipped with a dial gauge and set the gauge to zero on the end of the tool (7).

Now remove from the tool (7):

- ☐ element (1),
- ☐ ring nut (2),
- ☐ bearing (3),
- ☐ adjustment ring (4).

Figure 107

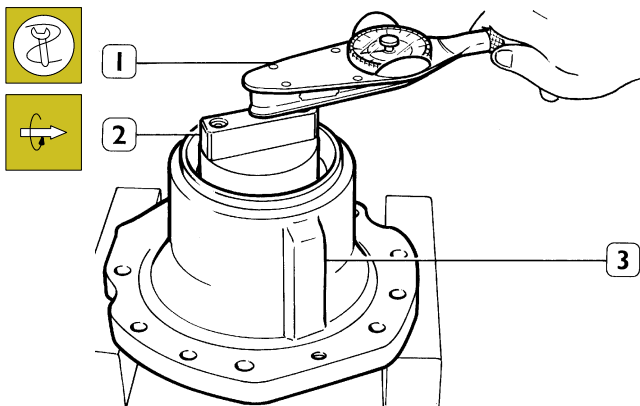


39575

Set the support (4, figure 105) on the bearing (6, figure 104) then fit in place the bearing (3).

Tighten the ring nut (2) by hand. Check the rolling torque as indicated in figure 108.

Figure 108



39576

Set the complete support (3) on two parallel bars; using the dynamometric wrench (1) mounted on the equipment (2) find the rolling torque that should result:

□ $6 \div 8 \text{ Nm}$; if it is not so, operate on the ring nut (2, figure 106)

Once again place the part (1, fig. 107), with the dial gauge set to zero, on the bearing (3, fig. 107) to find any deviation (value B).

The adjusting ring thickness **S** is obtained from the following formula:

$$S = A - (\pm B) + C$$

where:

A = thickness of adjusting ring fitted to reset the dial gauge

B = deviation found

C = 0.05 mm coefficient that takes into account the bearings dilatation caused by the assembly interference on the bevel gear

First example:

A = 13.12 mm
B = + 0.13 mm
C = 0.05 mm

$$S = 13,12 - (+ 0,13) + 0,05 =$$

$$S = 13,12 - 0,13 + 0,05 = 13.04 \text{ mm.}$$

Second example

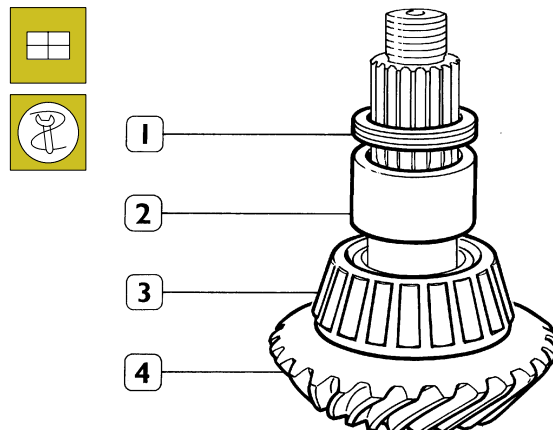
A = 13.12 mm
B = - 0.13 mm
C = 0.05 mm

$$S = 13,12 - (- 0,13) + 0,05 =$$

$$S = 13,12 + 0,13 + 0,05 = 13.30 \text{ mm.}$$

Remove the parts from tool 99395027.

Figure 109



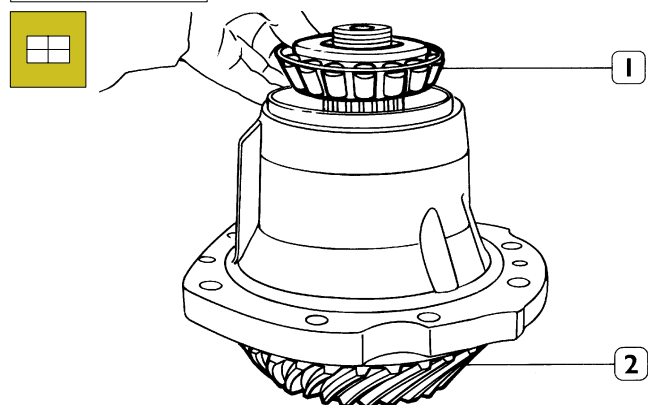
39577

Heat the bearing (3) and connect it to the bevel pinion (4). Fit in place the spacer (2).

Fit in place an adjustment ring (1) that has the same thickness as previously noted and set it on the bevel gear.

Fit in place the support with the bearing outer rings on the bevel gear.

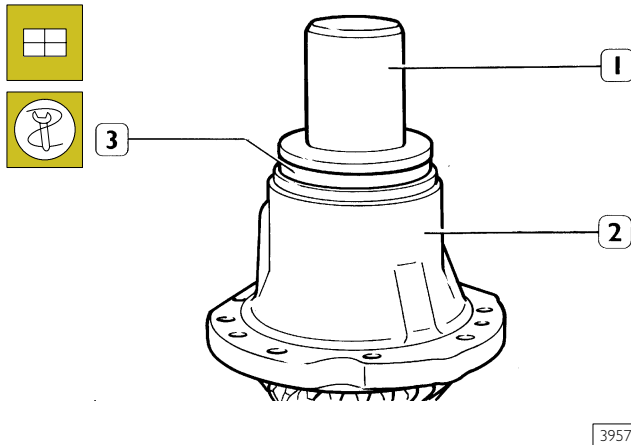
Figure 110



39578

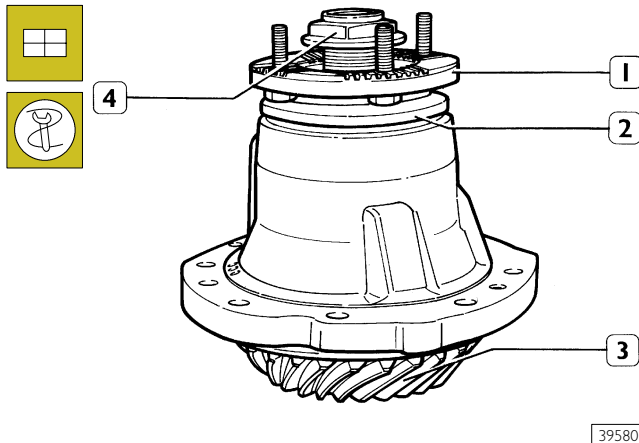
Heat the bearing (1) and using the beater, fit it into its seat on the bevel gear (2).

Figure 111



Using connecting device 99374233 (1) fit in place the new gasket (3) on the support (2). The gasket spares are supplied prelubricated and with grease between the lips.

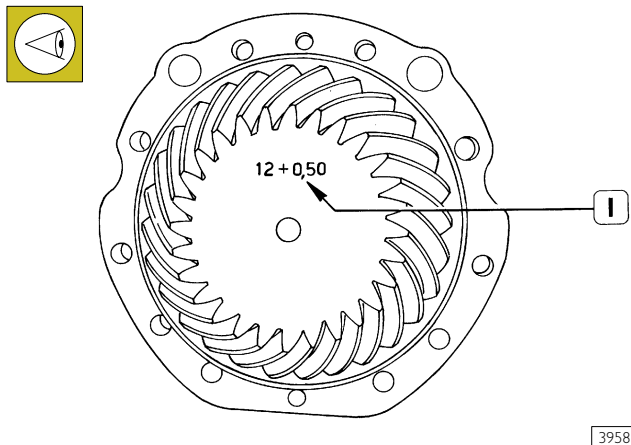
Figure 112



Set the coupling flange (1) and baffle (2) on the splined area of the bevel gear (3). Using a suitable beater fit it tightly. Tighten the nut (4) momentarily.

Fitting in place the differential housing

Figure 113



Before fitting in place the bevel gear carrier on the differential housing, check the value (1) engraved on the bevel pinion; consulting the table in figure 114 the thickness of the adjusting

ring to be placed between the support and the housing is obtained.

Example:

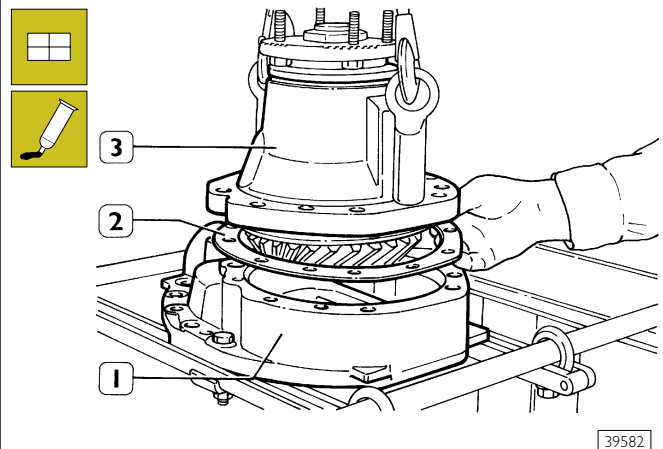
if the reference value (1) engraved on the pinion is + 0.50, the thickness of the adjusting ring must be 1 mm.

Figure 114

Values engraved on the bevel gear	Total thickness of adjusting rings
0	0,5
0,1	0,6
0,2	0,7
0,3	0,8
0,4	0,9
0,5	1,0
0,6	1,1
0,7	1,2
0,8	1,3
0,9	1,4
1,0	1,5

TABLE TO DETERMINE THICKNESS OF THE ADJUSTING RING SET IN THE BEVEL GEAR

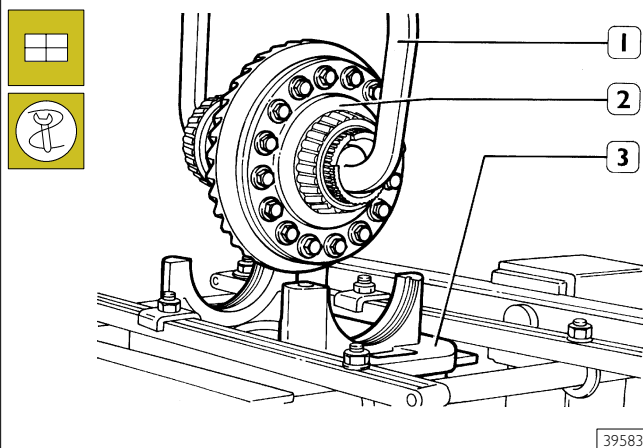
Figure 115



Carefully spread LOCTITE 573 on the contact surface (1); fit in place the adjusting ring (2) and using eye bolts and ropes fit the completed bevel gear support (3) on the differential housing.

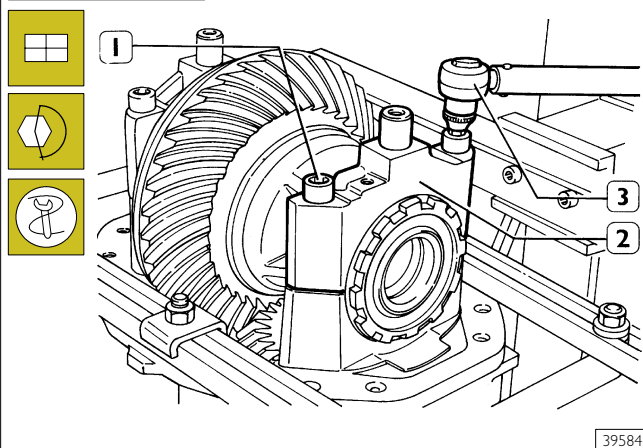
Tighten the fastening screws to the prescribed torque.

Figure 116



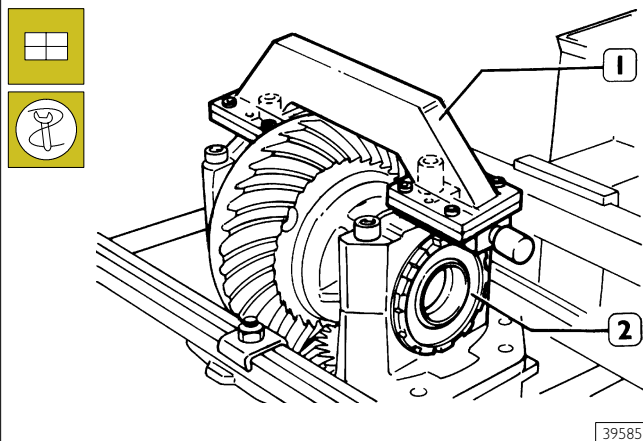
Using the specific hook (1) lift the previously assembled gearcase (2) and set it on the differential housing (3)

Figure 117



Fit in place the bearing outer rings. Fit the caps (2) and tighten, but not completely, the screws (1). Fit in place the adjusting ring nuts checking that they can be screwed easily; with a dynamometric wrench (3) lock the screws to the prescribed torque.

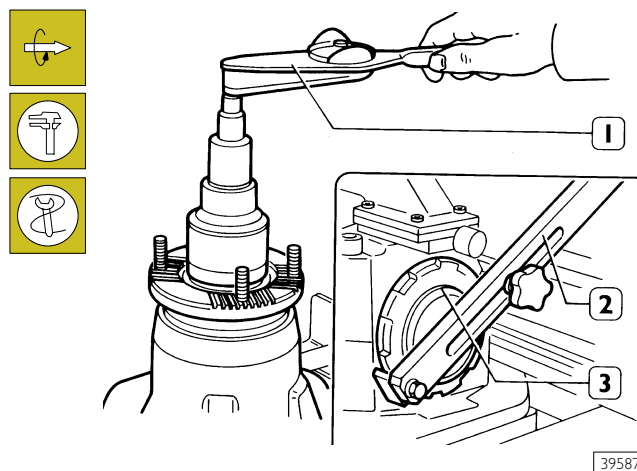
Figure 118



Set tool 99370133 (1) as shown in the figure to prevent excessive angle variation of the caps during adjustment.

Adjusting the gear housing bearings rolling torque

Figure 119



The rolling torque adjustment for the gear housing bearings is obtained measuring the total rolling torque.

Using torque wrench 99389819 (1) and appropriate socket wrench, find the prescribed rolling torque, operating on the bearing adjustment nuts with wrench 99355025 (2)

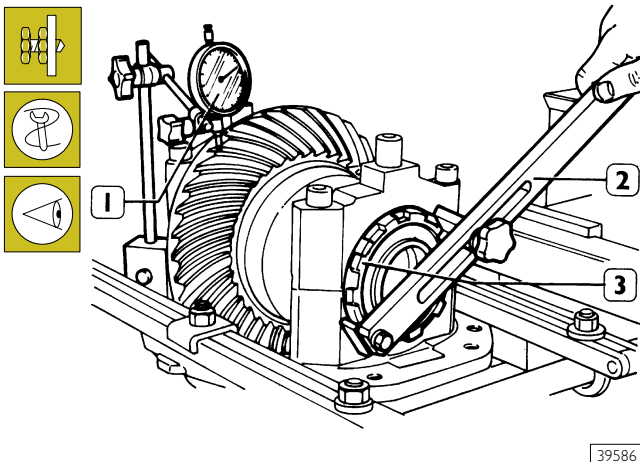
Find from the table below the rolling torque value (this value varies according to the bevel gear pair ratio) and perform adjustment.

No. teeth	Ratio	Total rolling torque Nm
27/32	1,185	$a + (2,5 \div 4,2)$
28/37	1,321	$a + (2,3 \div 3,8)$
21/40	1,905	$a + (1,6 \div 2,1)$
19/33	1,737	$a + (1,7 \div 2,3)$
23/36	1,565	$a + (1,9 \div 2,6)$

$$a = 3 \div 4 \text{ Nm}$$

Adjusting the end play between pinion and bevel gear pair

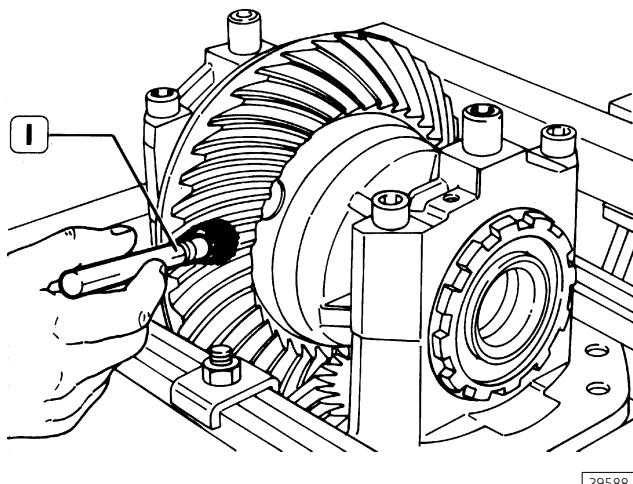
Figure I20



Adjust the end play between the pinion-crown wheel teeth, to obtain 0.18 ± 0.23 mm. The procedure is as follows:

- ☐ Set the dial gauge (1) with magnetic base as shown in the figure;
- ☐ using wrench 99355205 (2) tighten the bearing adjustment ring nuts (3) and loosen by the same amount the ring nut on the opposite side. Taking this precaution the rolling torque that has been previously adjusted is maintained.

Figure I21



Using a brush (1) apply a thin coating of lead oxide on the crown wheel teeth.

Turn the pinion and find the contact mark between the pinion teeth and the crown wheel teeth.

The figures that follow show the possible contact points and how to correct any errors.

Figure I22

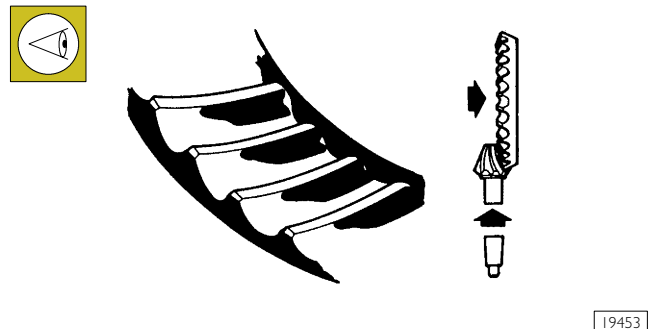


The pinion is too deeply set, therefore it requires further adjustment.

To adjust the exact pinion position, shims must be added under the pinion support to obtain an exact contact.

A slight internal crown wheel movement may be necessary to maintain the exact nominal value.

Figure I23

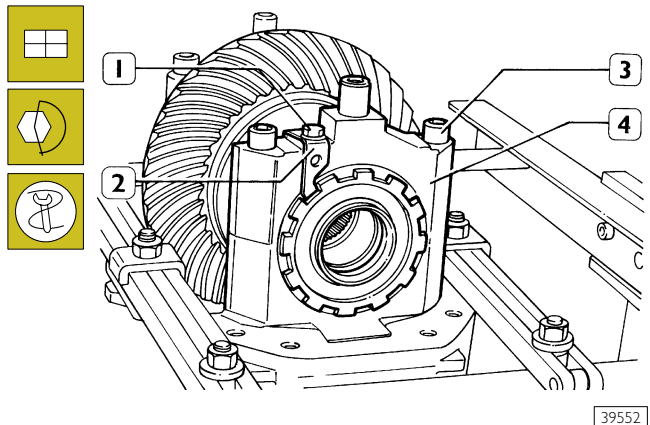


The pinion is too far out, therefore it requires further adjustment.

To adjust the exact pinion position, shims must be removed from under the pinion support to obtain an exact contact.

A slight external crown wheel movement may be necessary to maintain the exact nominal value.

Figure I24



Fit the plate (2) and tighten the fastening screws to the prescribed torque.

If the plate (2) does not fit into the ring nut groove (3) slightly rotate the ring nut until the two parts match. Carry out the same procedure on the other side.

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SINGLE REAR AXLE

SECTION 12.3

SECTION 12.3

Single rear axle

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DESCRIPTION

The rear axle is a double reduction type: the first reduction is by means of the pinion - ring bevel gear unit and the second is obtained through an epicyclic unit in the wheel hubs.

The differential housing, with the ring bevel gear, is supported by two taper roller bearings that can be adjusted through two threaded ring nuts.

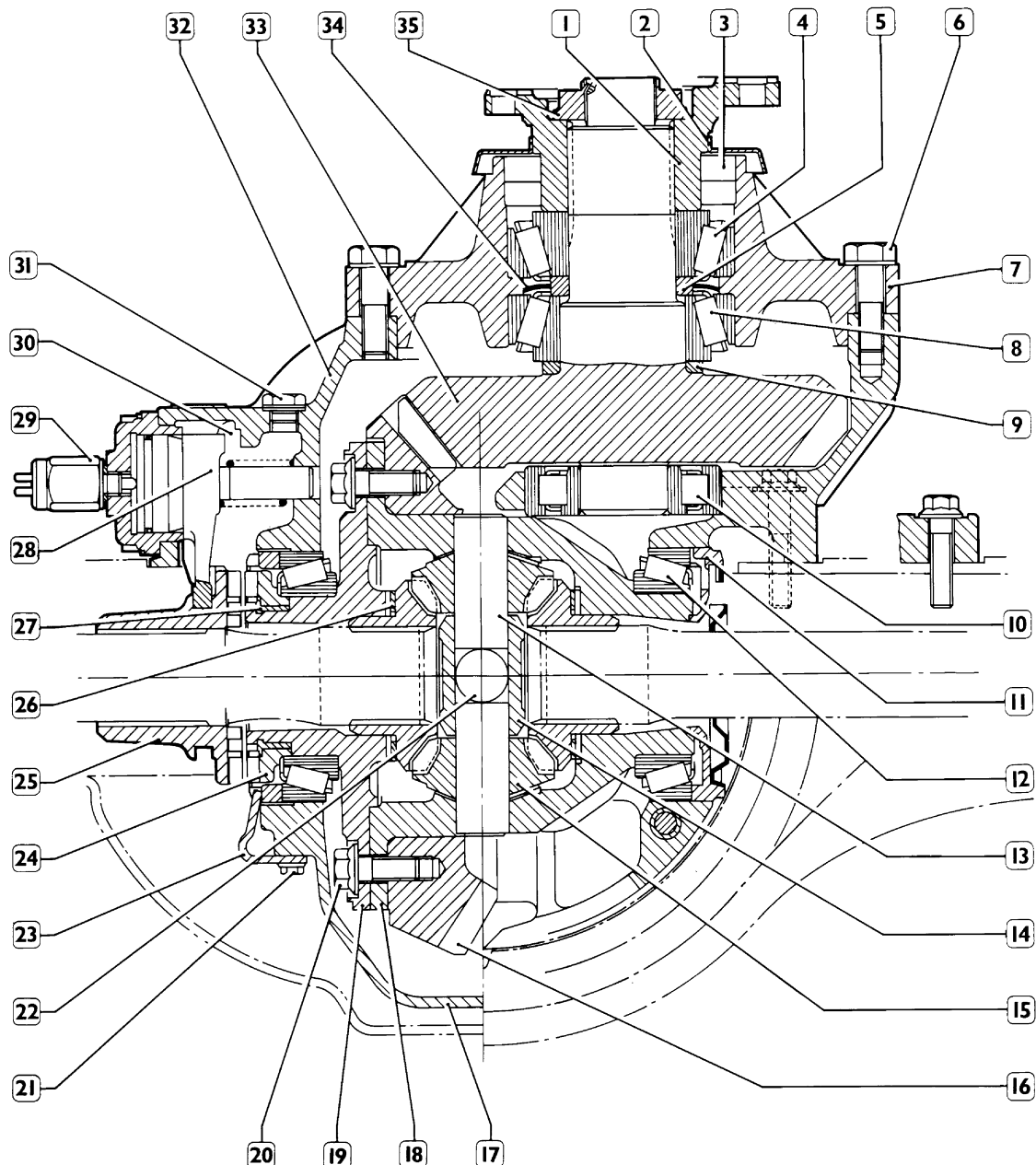
The pinion is supported by two taper roller bearings and a third straight roller bearing.

The bevel pinion unit is adjusted through adjusting rings that are fitted between the two taper roller bearings.

The axle is equipped with a pneumatically controlled device to lock the differential.

The half shafts coming from the differential transmit the motion to the epicyclic gears.

Figure 1

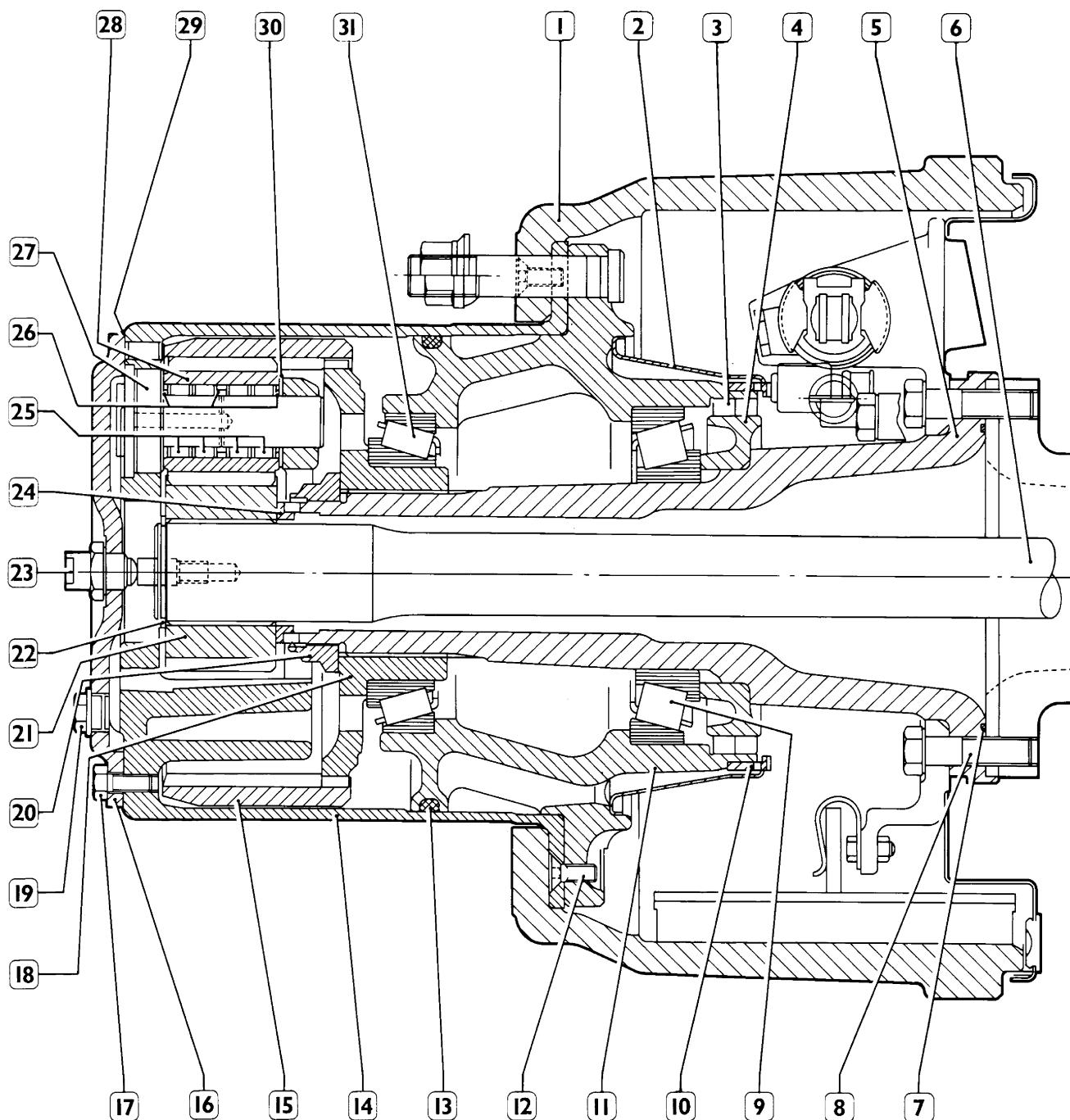


39381

PICTORIAL CROSS SECTION OF THE DIFFERENTIAL

1. Coupling flange - 2. Oil seal - 3. Outer seal ring - 4. Front bearing - 5. Adjusting ring - 6. Screw - 7. Bevel pinion support - 8. Intermediate bearing - 9. Adjusting ring - 10. Rear bearing - 11. Adjusting ring nut - 12. Differential housing bearing - 13. Short pin - 14. Spider - 15. Planetary gear - 16. Crown wheel - 17. Cover - 18. Gear housing - 19. Cover - 20. Screw - 21. Screw - 22. Long pin - 23. Safety plate - 24. Engaging sleeve - 25. Sliding sleeve - 26. Shoulder washer - 27. Split ring - 28. Engaging fork - 29. Transmitter - 30. Spring - 31. Plug - 32. Differential housing - 33. Taper pinion - 34. Oil baffle - 35. Lock nut

Figure 2

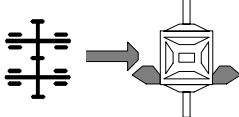
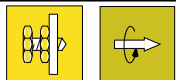
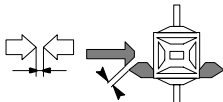
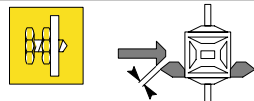
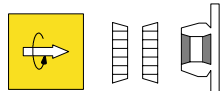
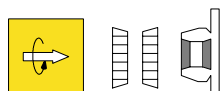
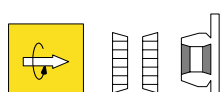


39382

PICTORIAL CROSS SECTION OF EPICYCLIC REDUCTION GEAR AND WHEEL HUB (45139)

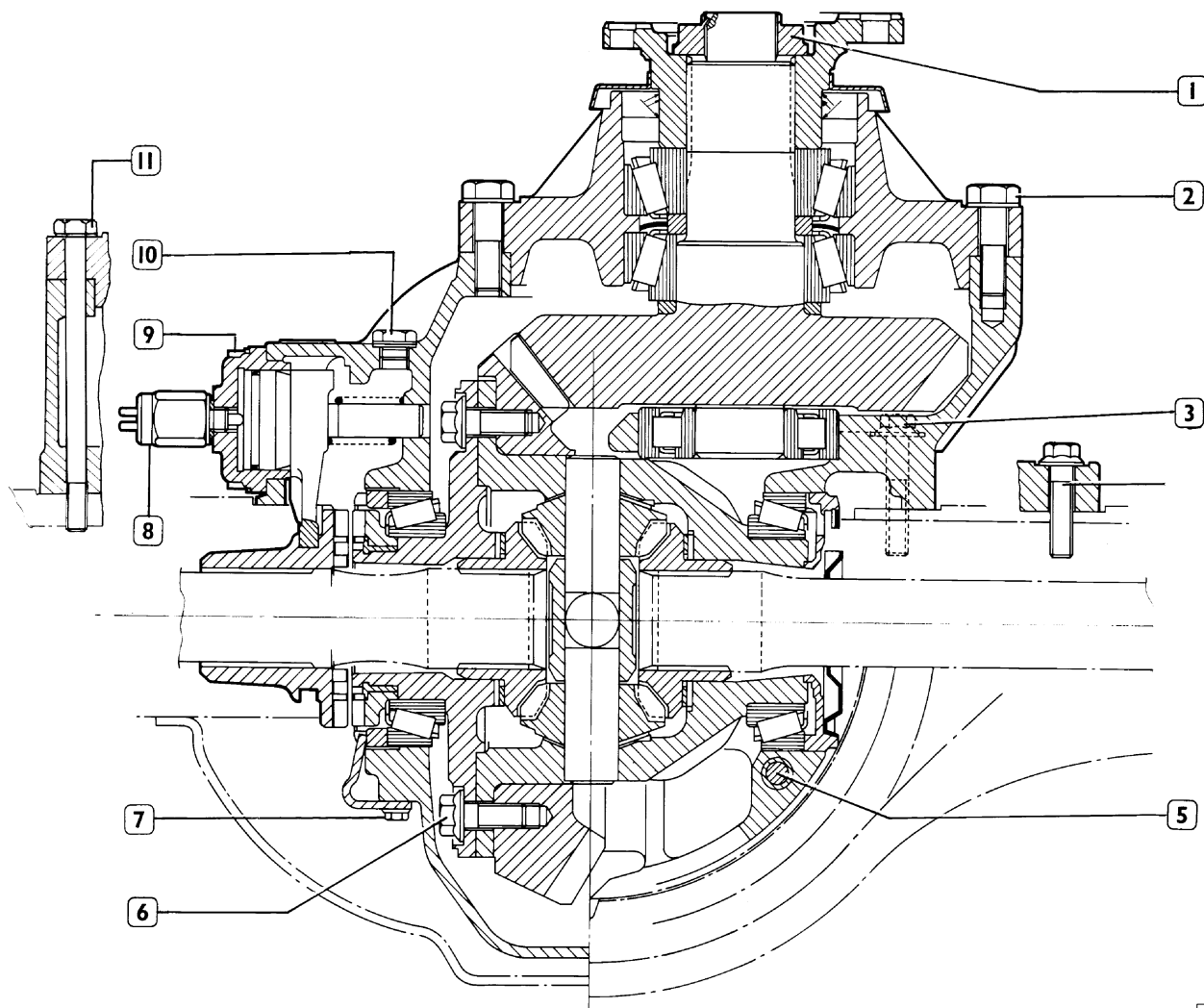
1. - Brake drum - 2. Oil manifold - 3. Seal ring - 4. Intermediate ring for sealing rings - 5. Bearing shaft - 6. Half shaft - 7. Seal ring - 8. Screw - 9. Bearing - 10. Phonic wheel - 11. Wheel hub - 12. Screw - 13. Seal ring - 14. Planetary gear support - 15. Crown wheel - 16. Cover - 17. Screw - 18. Crown wheel carrier - 19. Plug - 20. Collar nut - 21. Planetary gear - 22. Circlip - 23. Spacer screw - 24. Spacer ring - 25. Planetary gear needles - 26. Spacer rings - 27. Pin - 28. Planetary gear - 29. Gasket - 30. Spacer washer - 31. Bearing

SPECIFICATIONS AND DATA

	Type of axle: Bearing with double reduction, differential is locked through pneumatic control and reduction gear unit	ASTRA 451391/2D (IVECO R 8284 D005)
	Bearings for bevel pinion	2, with taper rollers and 1 with straight rollers
	Reduction bevel gear pair ratio	21/40 (1,905) 19/33 (1,737) 23/36 (1,565) 28/37 (1,321) 27/32 (1,185)
	Epicyclic reduction gear ratio on the wheels	3,2
	Bevel pinion bearings rolling torque without gasket Nm	1,5 ÷ 3,5
	Bevel pinion bearings rolling torque adjustment	through adjustment rings
	 Thickness of adjustment rings for bevel pinion bearings rolling torque mm	10 – 10,02 – 10,04 – 10,06 – 10,08 – 10,10 – 10,12 – 10,14 – 10,16 – 10,18 – 10,20 – 10,22 – 10,24 – 10,26 – 10,28 – 10,30 – 10,32 – 10,34 – 10,36 – 10,38 – 10,40 – 10,42 – 10,44 – 10,46 – 10,48 – 10,50
	 Thickness of adjustment rings for bevel pinion fitting with reference to the crown wheel mm	3,6 – 3,7 – 3,8 – 3,9 – 4,0 – 4,1 – 4,2 – 4,3 – 4,4 – 4,5 – 4,6
	Backlash between pinion and crown wheel mm	21/40 0,20–0,28 19/33 0,25–0,33 23/36 0,20–0,29 28/37 0,20–0,28 27/32 0,20–0,30
	Bevel pinion to crown wheel backlash adjustment	Through ring nuts
	WHEEL HUBS	2, taper roller
	Wheel hub bearings	Two with taper rollers
	Rolling torque of wheel hub bearings: new bearings with surface protection Nm	3 Nm + (12 ÷ 16 Nm)
	Rolling torque of wheel hub bearings: Run-in bearings and new lubricated seal rings Nm	3 Nm + (5 ÷ 7 Nm)
	Rolling torque of wheel hub bearings: Run-in bearings and seal rings Nm	3 Nm + (2,5 ÷ 4,5Nm)
	Half-shaft end play mm	0,5 ÷ 1

TIGHTENING TORQUES

Figure 3

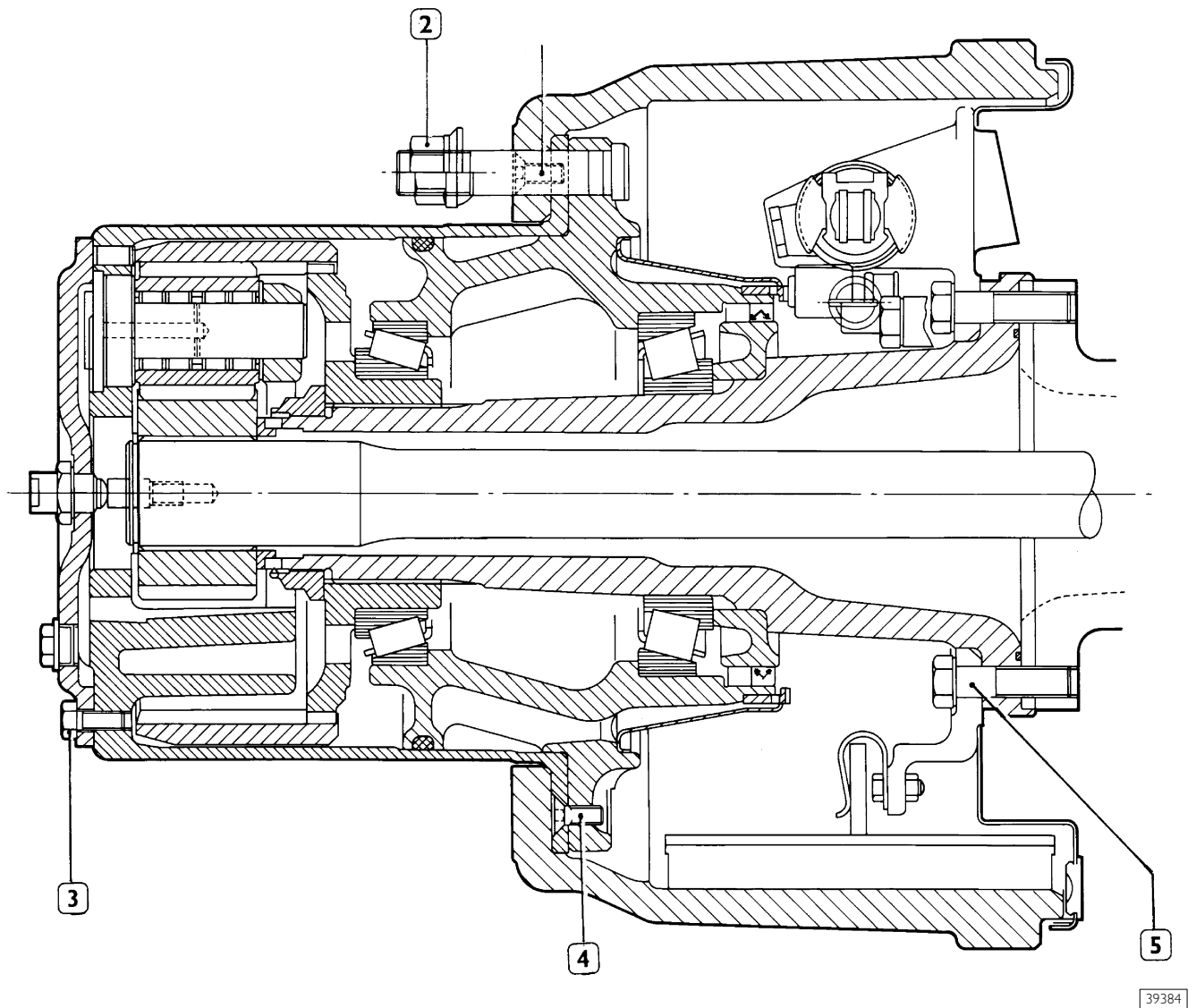


39383

COMPONENT		TORQUE	
		Nm	Kgm
1	Bevel pinion locking nut	700 ± 50	70 ± 5
2	Bevel pinion support to differential housing fastening screw	165 ± 15	16,5 ± 1,5
3	Differential housing to axle casing fastening screw	160 ± 10	16 ± 1
4	Differential housing to axle casing fastening screw ●	160 ± 10	16 ± 1
5	Bevel pinion support to differential housing fastening screw ◆	280 ± 15	28 ± 1,5
6	Ring bevel gear to gear housing fastening screw	300 ± 10	30 ± 1
7	Safety plate to gear housing cover fastening screw	60 ± 6	6 ± 0,6
8	Pressure switch	61 ± 6	6,1 ± 0,6
9	Hexagonal socket head screw for control cylinder	25 ± 2	2,5 ± 0,2
10	Oil intake plug	40 ± 4	4 ± 0,5
11	Self locking screw	120 ± 10	12 ± 1
● Apply LOCTITE AVX			
◆ Spread LOCTITE 573 sealant			

TIGHTENING TORQUES

Figure 4



COMPONENT	TORQUE	
	Nm	Kgm
1 Drum flathead screw	25 ± 3	$2,5 \pm 0,3$
2 Wheel nut	$565 \div 690$	$56,5 \div 69$
3 Cover to crown wheel support fastening screw ●	50 ± 5	$5 \pm 0,5$
4 Flathead screw	25 ± 3	$2,5 \pm 0,3$
5 Bearing sleeve screw ◆	280 ± 15	$28 \pm 1,5$
● Apply LOCTITE AVX ◆ Spread Hylomar SQ 32IM sealant		

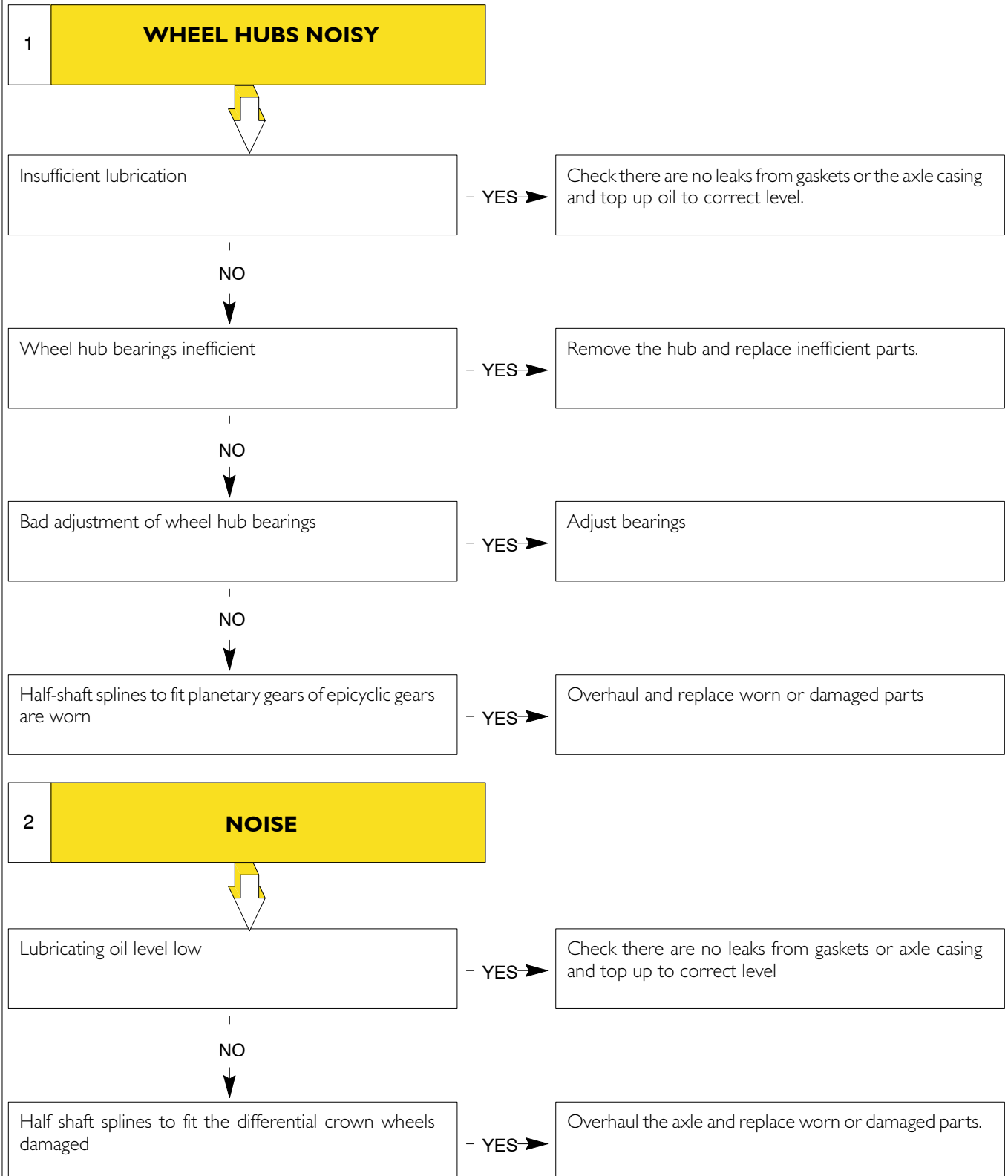
TOOLS

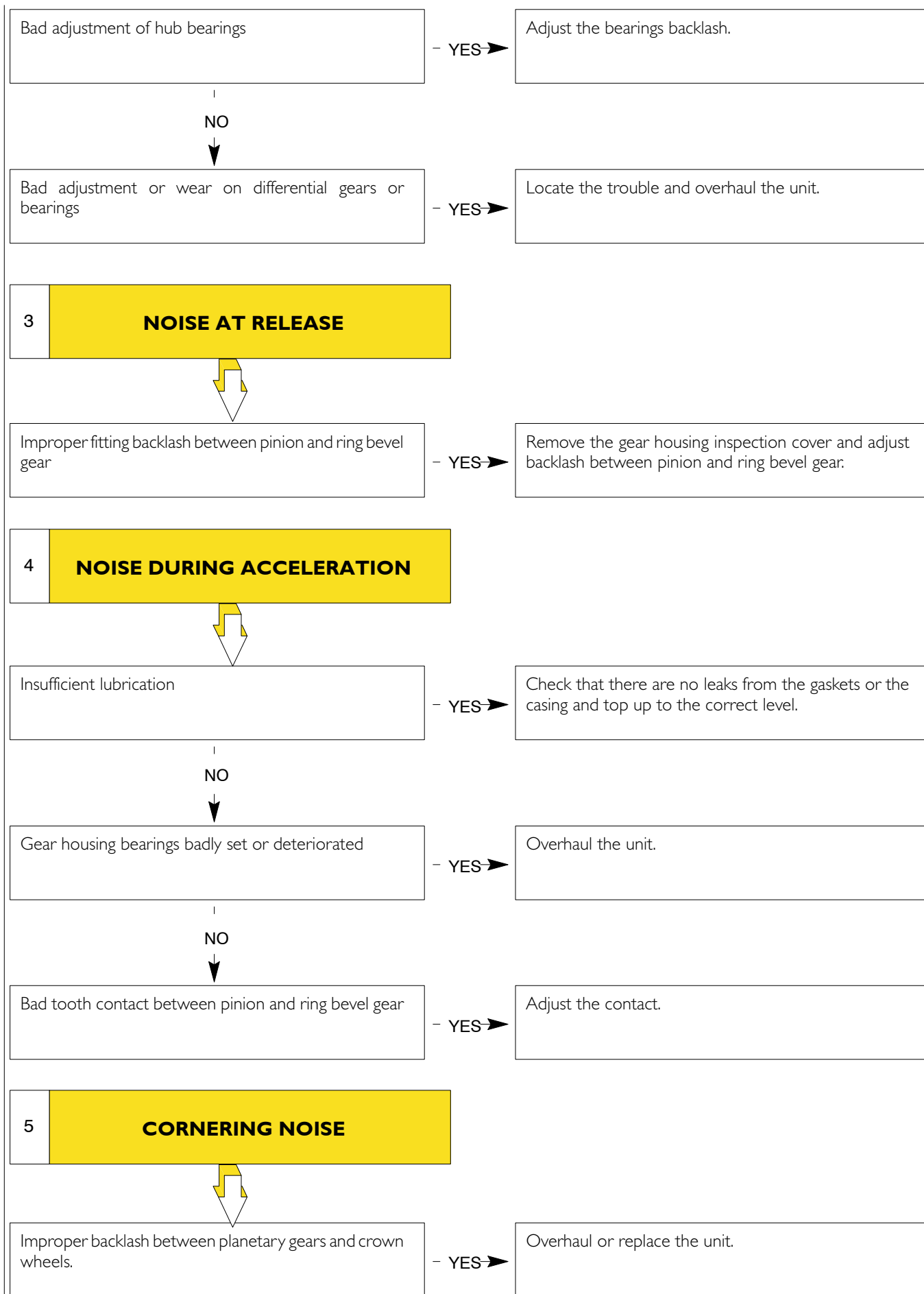
TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99322215	Stand to overhaul axles
99322225	Unit support (to use on stand 99322205)
99341003	Puller
99341015	Clamp
99341023	Grips
99345055	Counter block for pullers
99354001	Wrench for differential gearcase bearing adjustment ring nut
99354207	Wrench (94.5 mm) for wheel hubs bearing adjustment nut
99355081	Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99356001	Wrench for wheel brake shoes adjustment
99357111	Pliers for brake shoes return spring
99370005	Handle for interchangeable beaters
99370006	Handle for interchangeable beaters
99370007	Handle for interchangeable beaters
99370317	Lever and relevant extension bar to retain flange
99370509	Hook to remove differential gearcase half box
99370616	Support to hold differential gear during removal/re-fitting in place
99370617	Universal support to hold axles during removal/re-fitting in place
99371022	Pair of brackets to hold differential during overhaul (to be used with 99322205 and 99322225)
99372213	Tool for brake drum turning (to be used with 9930100)
99374013	Element to fit in place the differential bevel pinion gasket (to be used with 99370006)
99374025	Element to fit in place the wheel hub internal gasket (to be used with 99370005)
99374093	Beater to fit in place bearings outer tracks (91 -134) (to be used with 99370007)
99374094	Beater to fit in place bearings outer tracks (134-215) (to be used with 99370007)
99374451	Equipment for half shafts removal/re-fitting in place
99389819	Dynamometric wrench 0 to 10 kgm connection 1/4"
99389821	Dynamometric wrench 0 to 70 kgm connection 3/8"
99395026	Tool to check hubs rolling torque (to be used with dynamometric wrench)
99395027	Tool to find proper differential bevel pinion adjustment shims (to be used with 99395603)
99395603	Dial gauge (0-5 mm)

DIAGNOSTICS

Main axle faults:

- 1 - Wheel hubs noisy
- 2 - Noise
- 3 - Noise at release
- 4 - Noise during acceleration
- 5 - Cornering noise

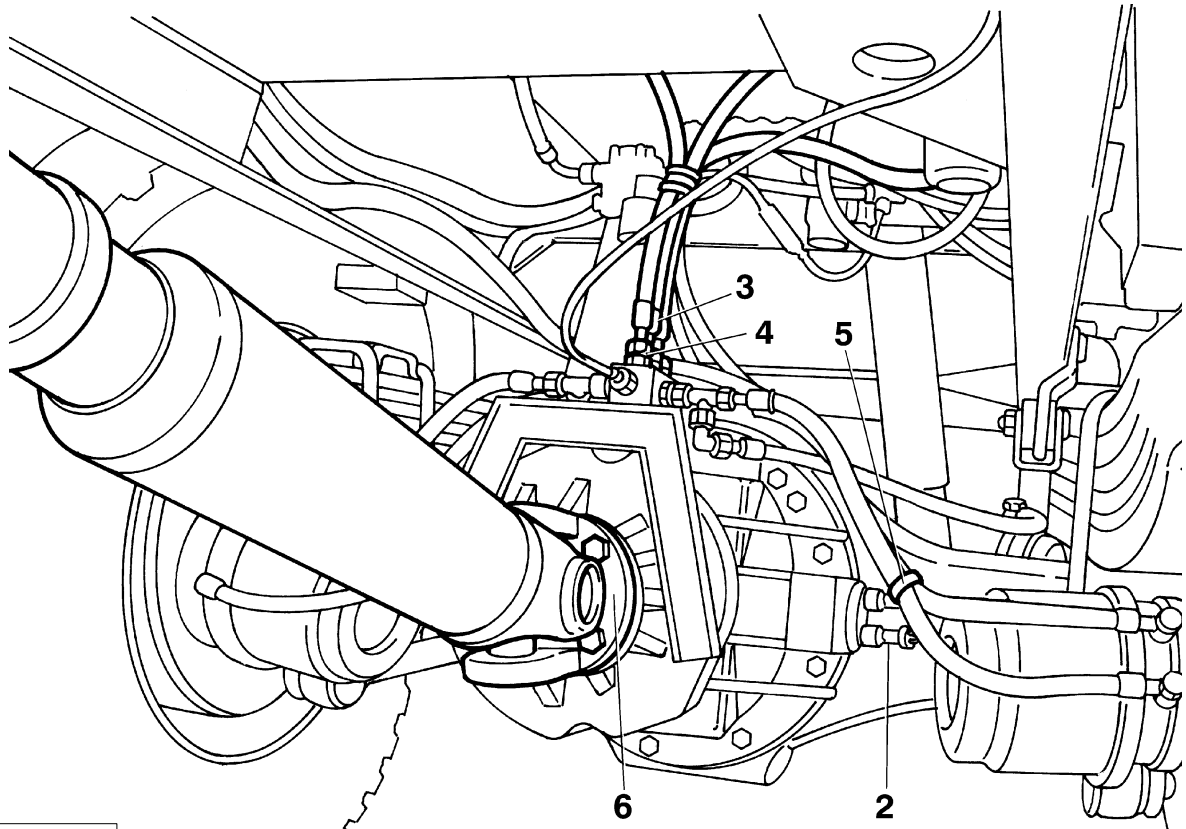
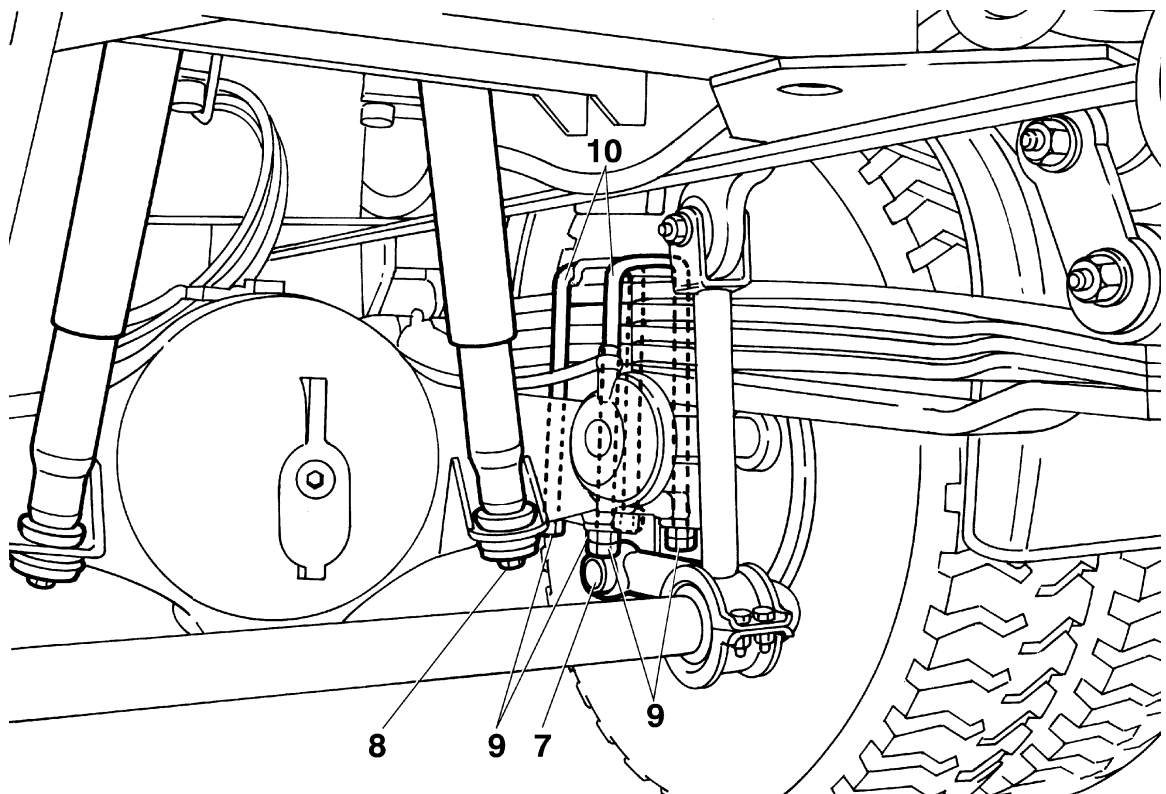




REMOVING - REFITTING THE REAR AXLE**Removal**

To remove the rear axle proceed as follows:

- ☐ place the vehicle on a flat ground and suitably lock the front wheels;
- ☐ loosen both rear wheel fastening nuts;
- ☐ using a hydraulic jack lift the rear part of the vehicle and rest it on two stands;

Figure 5**Figure 6**

17812301

17812302

- ☐ remove both rear wheels;
- ☐ disconnect ABS transmitter electrical cables from both sides (only vehicles provided with ABS);
- ☐ disconnect the electrical cable (2) for the differential led;
- ☐ disconnect the pneumatic connections for parking brake (3), brake air delivery (4) and differential locking (5);
- ☐ remove braking control rod (11);
- ☐ undo the screws fixing the propeller shaft flange (6), and secure temporarily the shaft to the chassis to avoid interference during next operations;
- ☐ remove the bolts (7) fixing the stabilizer bar to the rear axle and rotate it downwards;
- ☐ unscrew the nuts (8) fixing the shock absorbers to the rear axle;
- ☐ set a hydraulic jack fitted with tool 99370617 under the rear axle;
- ☐ unscrew the nuts (9) from both sides and lift the leaf spring fixing brackets (10) then, lower the axle and take away the leaf spring.

Refitting

To refit, follow the removal operations in reverse order.

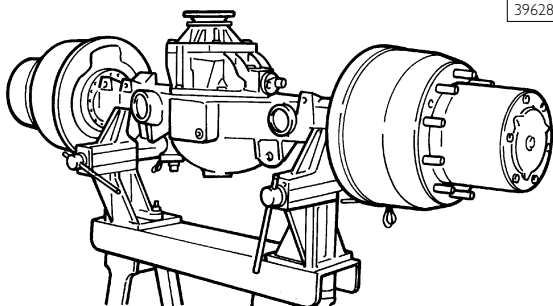
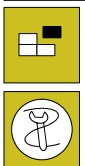
REAR AXLE ASSEMBLY OVERHAUL OPERATIONS



The removal and re-fitting into place operations for the half-shafts, drums and brake shoes, air bleeder, wheel hubs differential and epicyclic gears can all be carried out with the units fitted on the vehicle.

Before setting the axle assembly on the stand to overhaul, unscrew the axle casing lower plug todrain the oil.

Figure 7

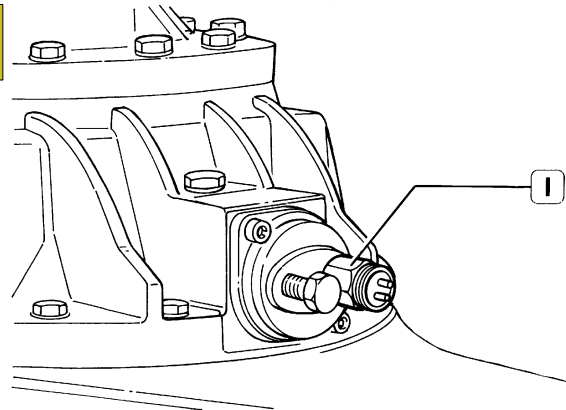


39628

39627

Set the whole axle assembly on stand 99322215.

Figure 9



Lock the sliding sleeve of the differential locking device with a screw.

To do this, remove the threaded coupling from the control cylinder and in its place (1) fit a screw (M14 x 1.5).

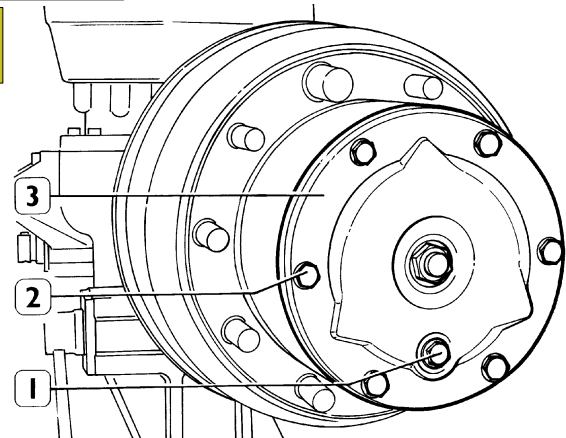
At the same time, turn the axle mechanism so that the sliding sleeve and engagement sleeve are engaged. This will prevent accidental movement of the sleeve while removing the half-shaft.



Place a vessel under the wheel hub to collect the oil.

REMOVING THE EPICYCLIC REDUCTION GEAR

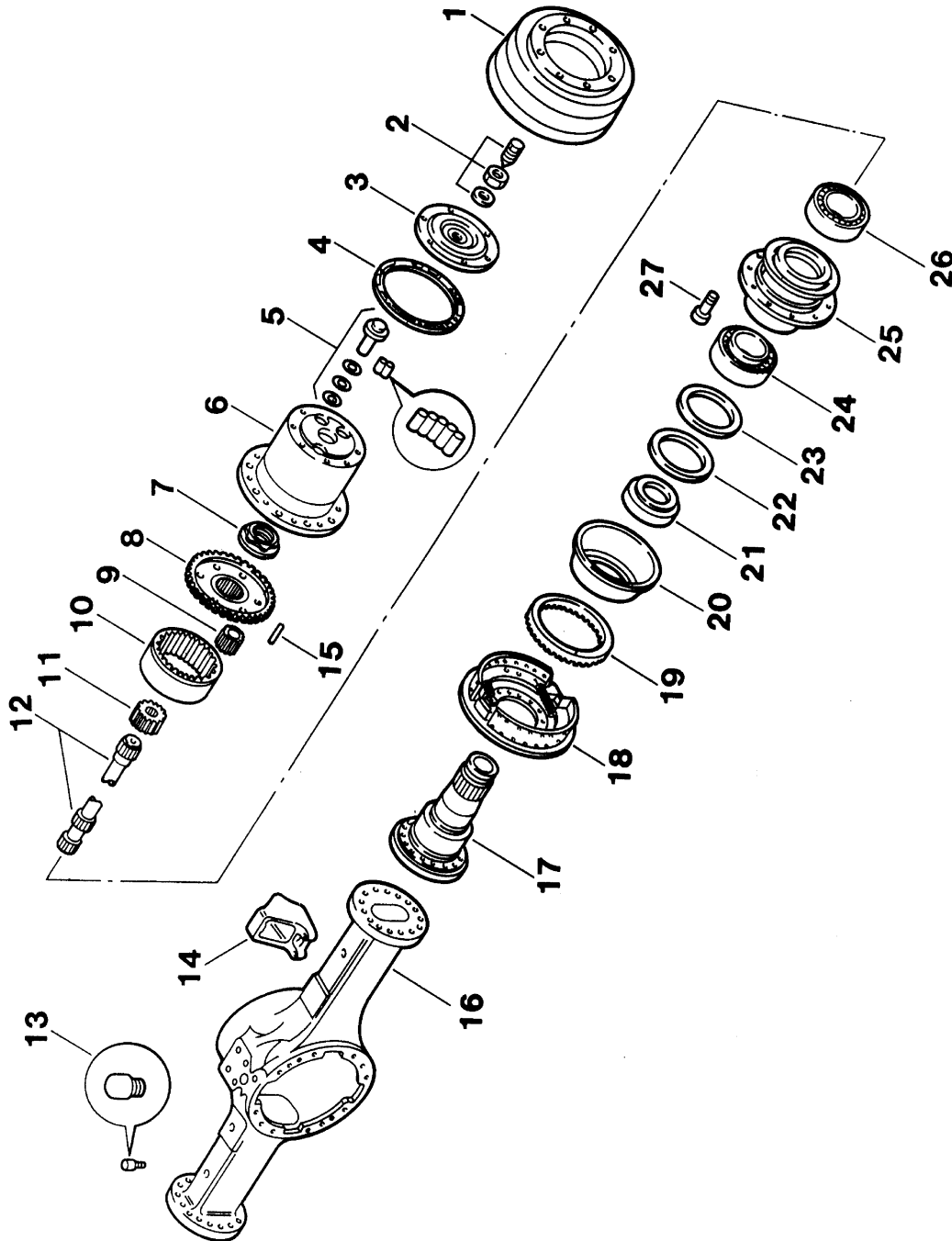
Figure 8



40053

Remove the screws (2); remove the cover (3) and collect the oil.

Figure 10

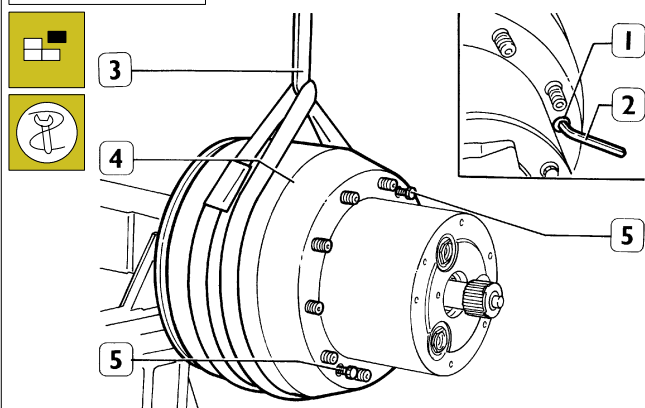


40430

WHEEL HUB COMPONENTS

1. Brake drum - 2. Adjusting screw and nut - 3. Cover - 4. Gasket - 5. Planetary gear carrier - 6. Planetary gear pin and rollers - 7. Adjusting nut - 8. Crown wheel carrier - 9. Planetary wheel - 10. Crown wheel gear - 11. Crown wheel gear - 12. Half-shaft - 13. Bleeder - 14. Bracket - 15. Supporting pin - 16. Axle casing - 17. Braking unit - 18. Bearing - 19. Phonic wheel - 20. Oil cup - 21. Supporting ring - 22. Seal ring - 23. Seal ring - 24. Bearing - 25. Wheel hub - 26. Bearing - 27. Bolt

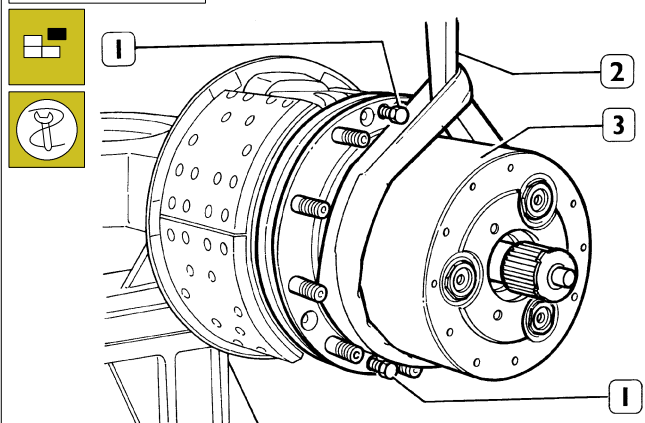
Figure 11



40338

Using a socket wrench (2) unscrew the two drum retaining screws (1); replace them with counteracting screws (5), tighten to remove the drum (4) from the hub, then take it away with a rope (3) and lifting equipment.

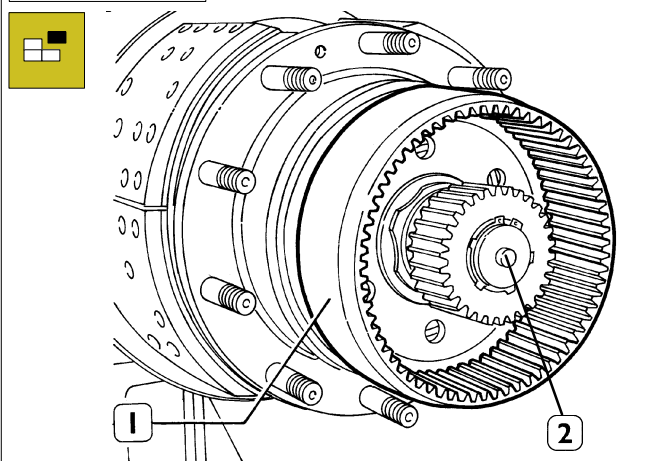
Figure 12



40054

Remove the 3 retaining screws from the planetary gear support (3); insert the counteracting screws (1) and using a rope (2) remove the support (3).

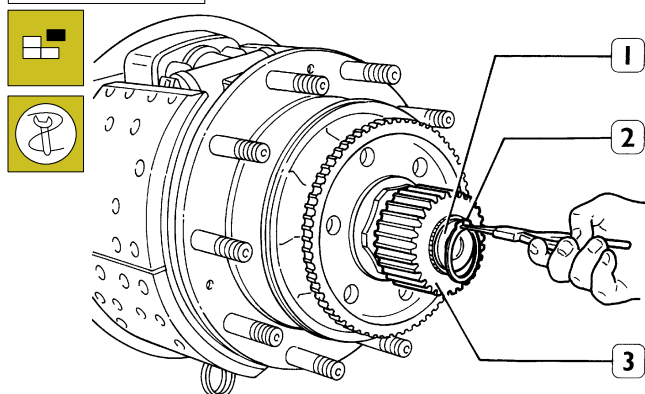
Figure 13



40055

Withdraw the crown wheel (1) from the crown wheel carrier. Take out the shoulder pin (2).

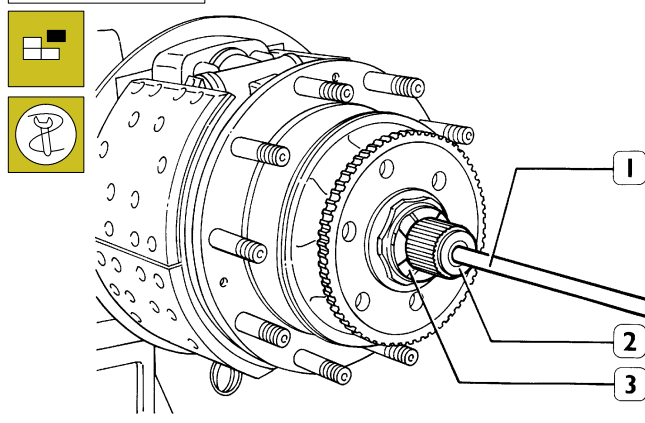
Figure 14



39635

Use appropriate pliers to remove the circlip (2) withdraw the planetary gear (3) from the half-shaft (1).

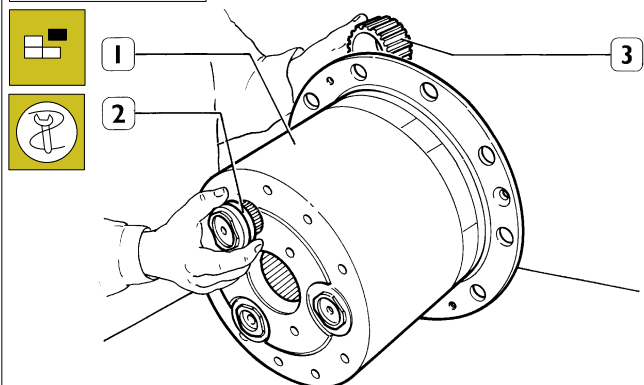
Figure 15



39636

Screw tool 9937445 (1) into the shoulder pin seat and remove the half shaft (2) from the bearing shaft. Remove the spacer ring (3).

Figure 16

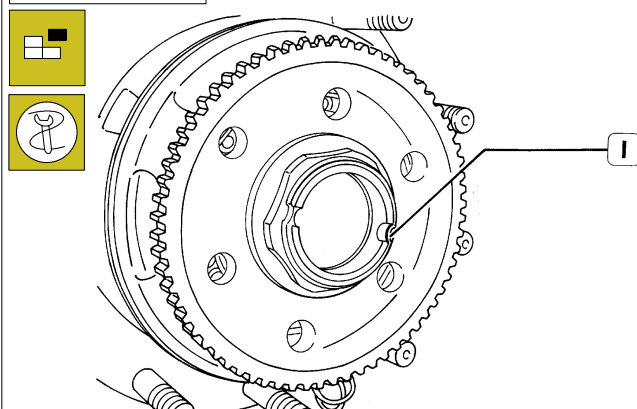


40056

Remove the pins (2) from the planetary gear support (1). Remove the planetary gears (3) from the support (1) and set aside the needles and spacer rings.

Removing the wheel hubs

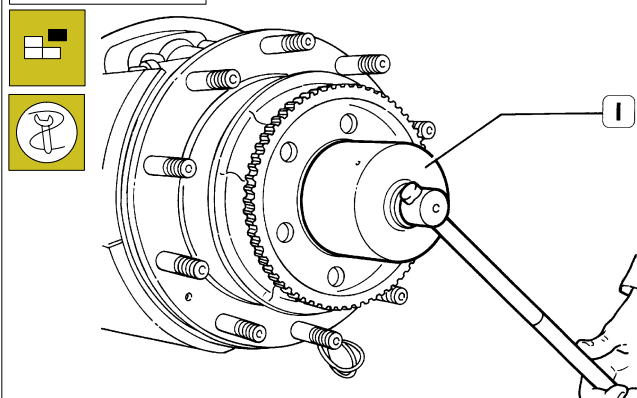
Figure 17



39637

Using a suitable punch straighten the dents (1) on the adjusting nut.

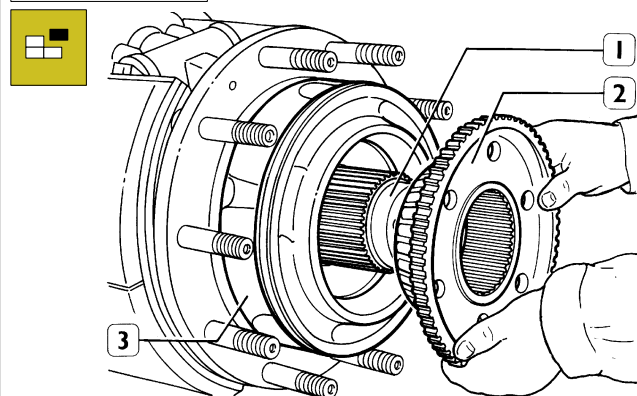
Figure 18



39638

Using socket wrench 99354207 (1) unscrew the adjusting nut.

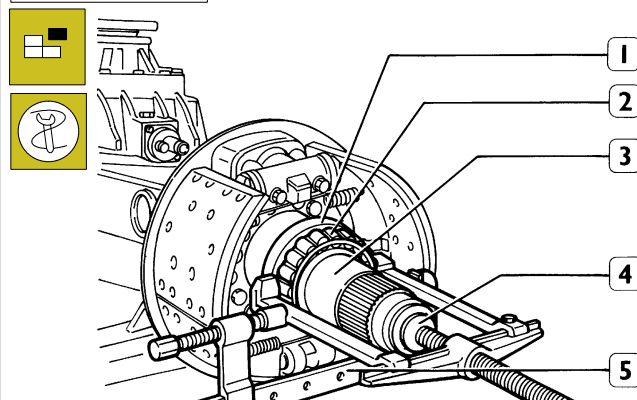
Figure 19



39639

Withdraw the bearing shaft (1), the crown wheel carrier (2) with the relevant bearing and complete wheel hub (3).

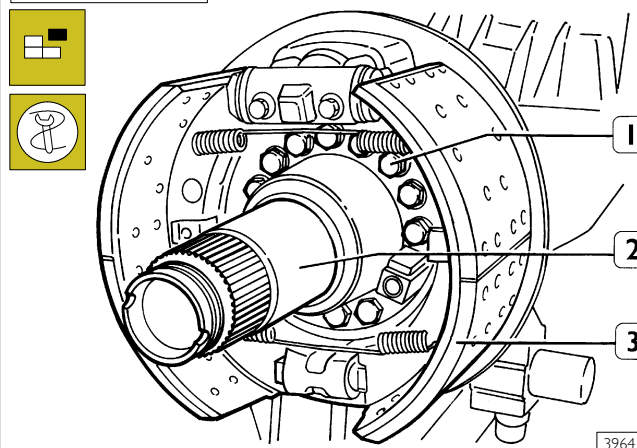
Figure 20



39640

Using a puller; clamp (5) and counter block 99345055 (4), remove the gasket ring (1) and taper roller bearing (2) from the bearing shaft (3).

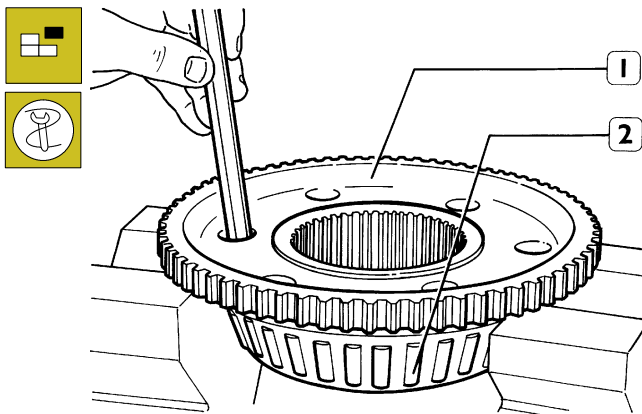
Figure 21



39641

Check the bearing shaft (2) and if it is damaged, replace it. Using tool 99372217, release the brake shoes (3) and after unscrewing the hexagonal screws (1) locked with LOCTITE, remove the brake carrier plate with the bearing shaft.

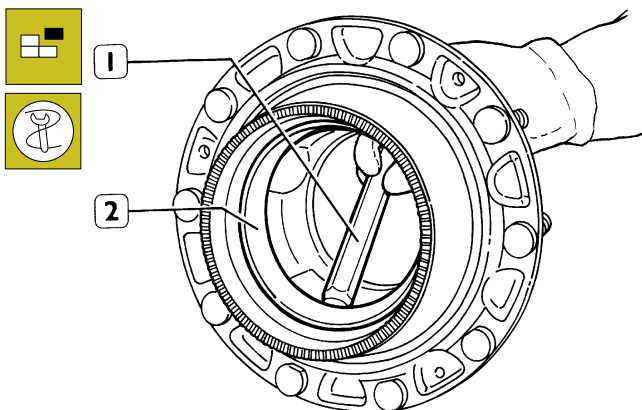
Figure 22



39642

With a suitable beater fitted in the holes on the crown wheel carrier, remove the outer taper roller bearing (2) from the crown wheel carrier (1).

Figure 23



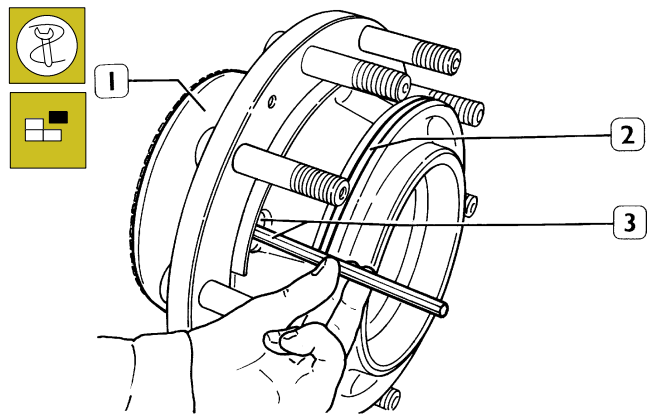
39643

Use a bronze beater (1) to drive out the inner bearing outer ring (2).

The seal ring will come away with it.

In the same way extract the outer bearing outer ring. If necessary remove the phonic wheel.

Figure 24



39644

Check the oil manifold (1) and if it is damaged, replace it. To do this, extract it with a suitable beater inserted through the hub slots (3). Remove the shaped seal ring (2).

WHEEL HUBS AND EPICYCLIC REDUCTION GEAR COMPONENTS CHECK

Carefully clean the wheel hub components. Check the half shafts to ensure they are not strained. If necessary straighten the half shafts under a hydraulic press. If the results obtained are not satisfactory, replace the half-shafts. Check the wheel bolts, if the threads are strained or damaged, replace them under the press. After fitting in place check that the orthogonality error does not exceed 0.3 mm.

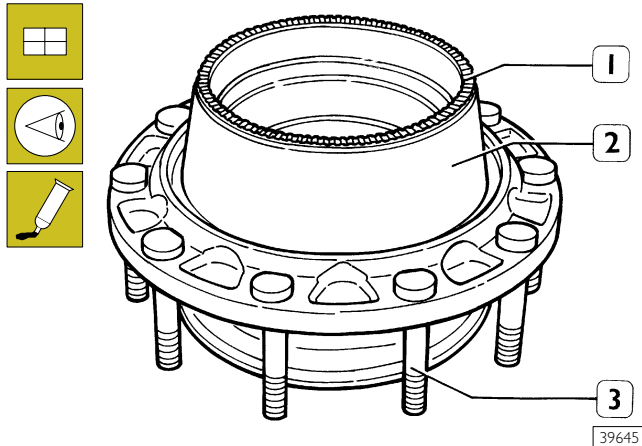
Lubricate the bearings and turn the roller cage freely; the rotation must be even with no signs of stiffness. Check the threads on the bearing adjustment nut and the bearing shafts; if necessary replace the nuts. Check the oil manifold, if it is damaged replace it. All seal elements must be replaced with new ones. Carefully clean all the epicyclic gear components. Visually check the teeth of the crown wheel carrier, the crown wheel, the planetary wheels and planetary gear.

Check the spacer rings, bearing needles and support pins.

Replace any worn or damaged parts.

FITTING IN PLACE THE WHEEL HUBS

Figure 25



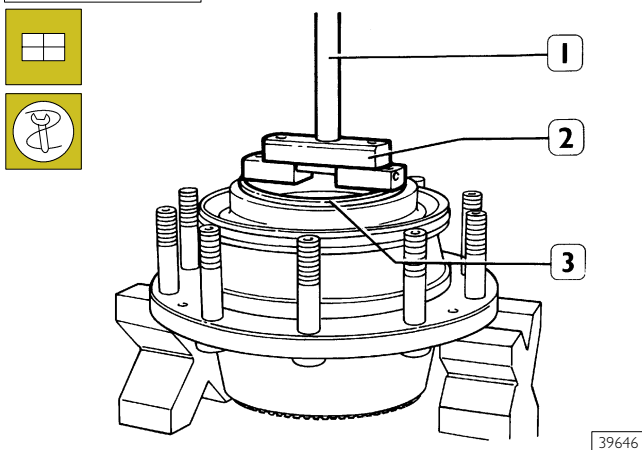
If the bolts (3) require replacement, before fitting in place the new bolts make sure that the contact surface of the bolt head is free of swarf, burrs and dents.

After the bolts have been driven in, check that they are perfectly flush on the hub and that the orthogonality error does not exceed 0.3 mm.

If it is necessary to replace the oil cup (2) before fitting in place the new one, spread LOCTITE 573 sealant on the hub to cup coupling surfaces and on the cup housing on the hub.

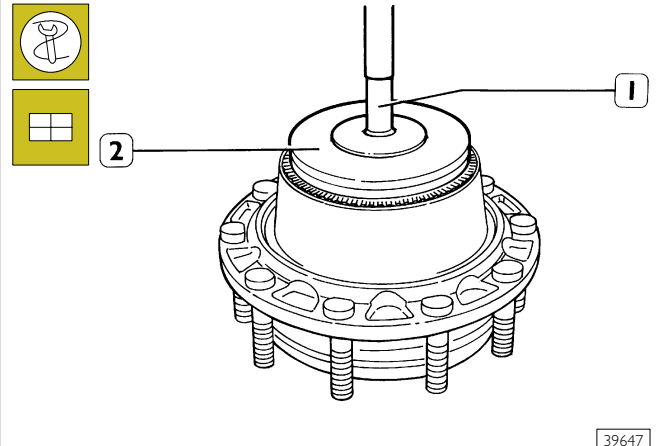
Re-fit in place the phonic wheel (1) making sure, after fitting, that the phonic wheel rests perfectly on the hub seat. Use a dial gauge to check that the phonic wheel orthogonality error is not over 0.2mm.

Figure 26



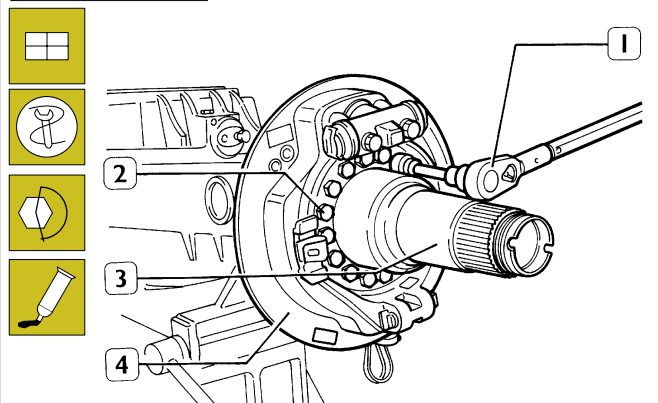
Use beater 99374093 (2) to drive in the outer bearing outer ring (3) (under the press) leaving approx 5 mm of the stroke; finish driving in by hand using handle 99370007 (1).

Figure 27



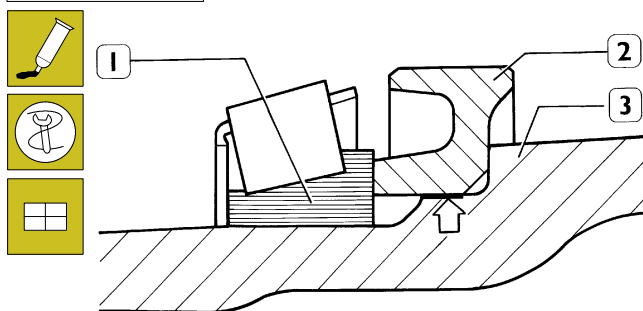
Using tool 99374025 (2) with the relevant intermediate ring and handle 99370005 (1) drive the internal seal ring into its housing. Use the same tool but without the intermediate ring to fit the external seal ring.

Figure 28



Place the seal ring on the bearing shaft, spread LOCTITE AVX on the coupling surfaces between the axle casing and bearing shaft. Fit in place the bearing shaft (3) with the brake carrier plate (4) and dust guard plate. Apply LOCTITE AVX to the screws (2) and with a dynamometric wrench (1) tighten them to a torque of 280 ± 15 Nm.

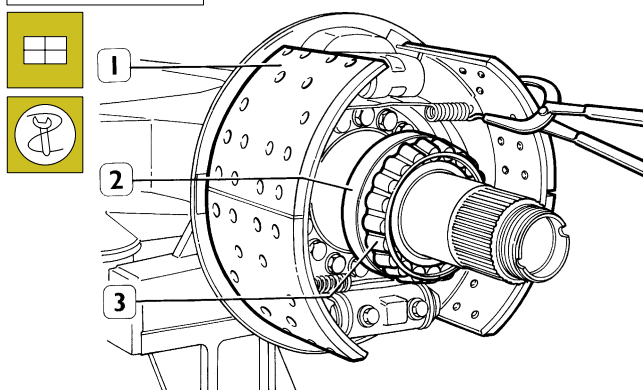
Figure 29



40375

Spread Hylomar SQ32IM sealant on the bearing shaft (3) ring (2) housing (⇒) for the seal rings. Heat the ring (2) and fit it on the bearing shaft (3). Heat the taper roller bearing inner ring (1) to approx 100°C and fit it on the bearing shaft.

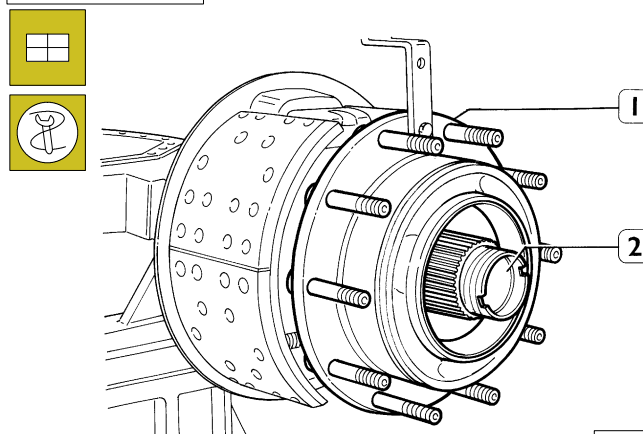
Figure 30



40067

Re-fit in place the brake shoe (1) using tool 99372217.

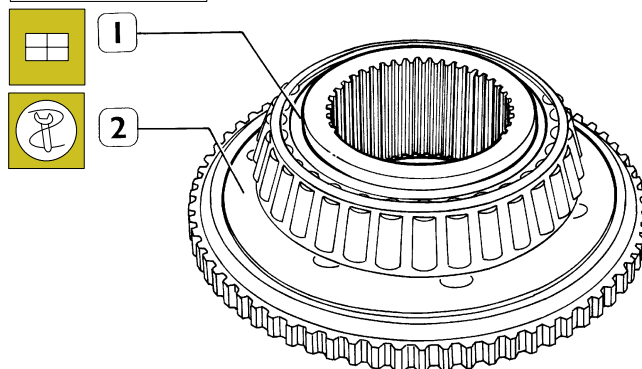
Figure 31



40068

Using the suitable tool set the complete hub (1) on the bearing shaft (2)

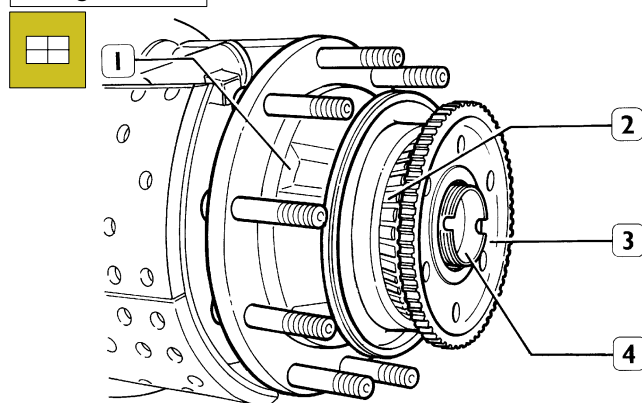
Figure 32



40377

Heat the taper roller bearing (1) to approx 100°C and with a suitable beater drive it into its seat on the crown wheel carrier (2).

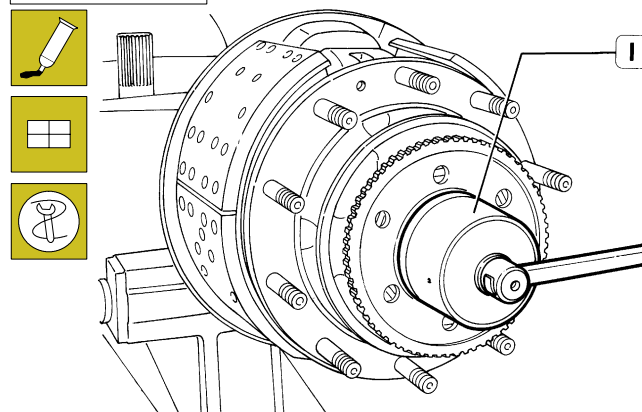
Figure 33



39650

Connect the crown wheel carrier (3) with its relevant taper roller bearing (2) onto the bearing shaft (4).

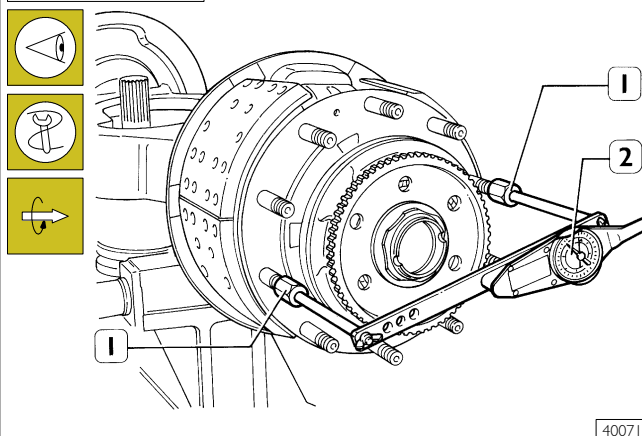
Figure 34



40070

Apply a thin coating of Molycote on the adjusting nut contact surface, screw, then tighten with wrench 99354207 (1) until it becomes difficult to turn the hub. Release the hub by axially hammering it in both directions.

Figure 35



40071

Set up tool (1) 99395026 and with a torque wrench (2) find the wheel hub rolling torque.

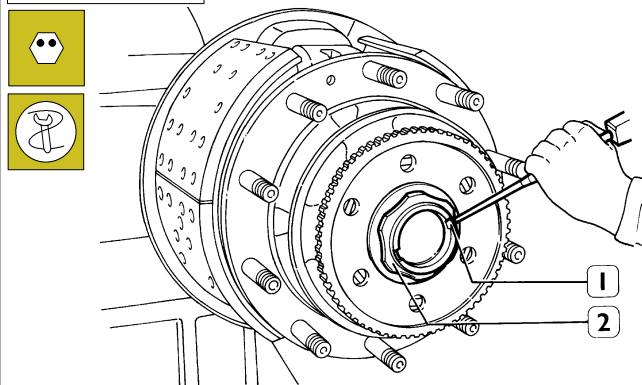


When finding the hub rolling torque the hub rotation must not exceed 40 r.p.m.

The hub rolling torque values vary according to the following conditions:

- ☐ new bearings with surface protection $3 + (12 \div 16)$ Nm
- ☐ run-in bearings and new lubricated seal rings $3 + (5 \div 7)$ Nm
- ☐ run-in bearings and seal rings $3 + (2.5 \div 4.5)$ Nm

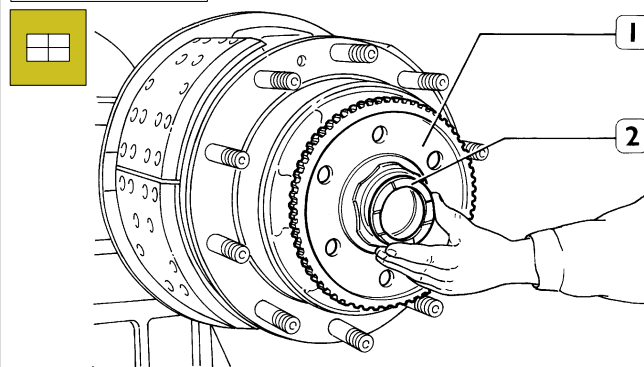
Figure 36



40072

Having obtained the prescribed rolling torque, use a suitable punch to dent the adjusting nut (2) in the two specific grooves on the bearing shaft (1).

Figure 37

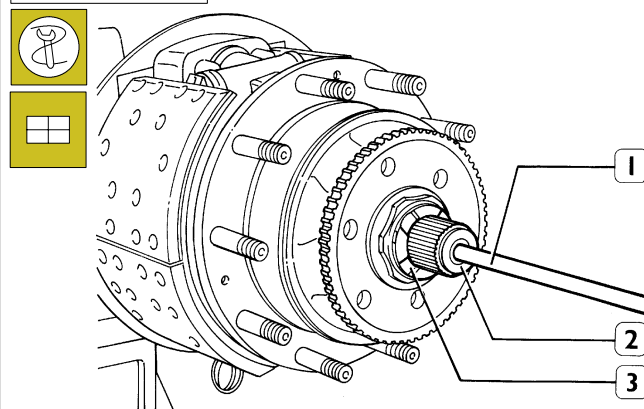


40069

Fit the spacer ring (2) in the bearing shaft.

Fitting in place the epicyclic reduction gear

Figure 38



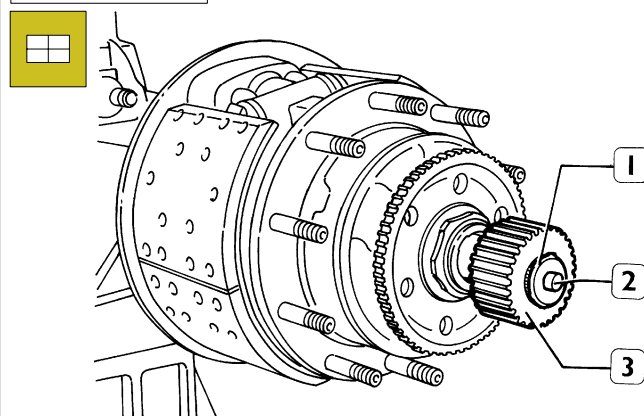
39636

Use tool 9937445 (1) to insert the half shaft (2) into the bearing shaft (3)



The double toothed short half shaft is to be fitted in the bearing shaft on the differential locking side.

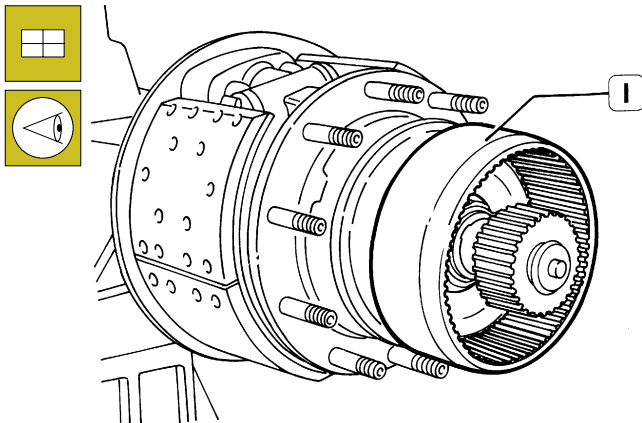
Figure 39



39653

Place the planetary gear (3) on the splined section of the half shaft and the circlip (1) in its seat. Force the shoulder pin (1) into its seat in the half shaft.

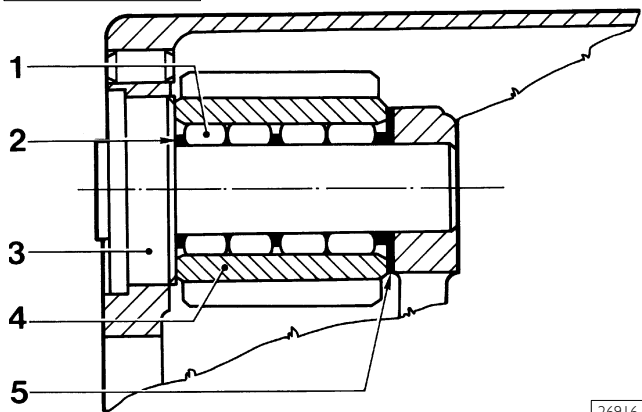
Figure 40



39654

Position the crown wheel (1) with the chamfer directed outwards, then place it on the crown wheel carrier.

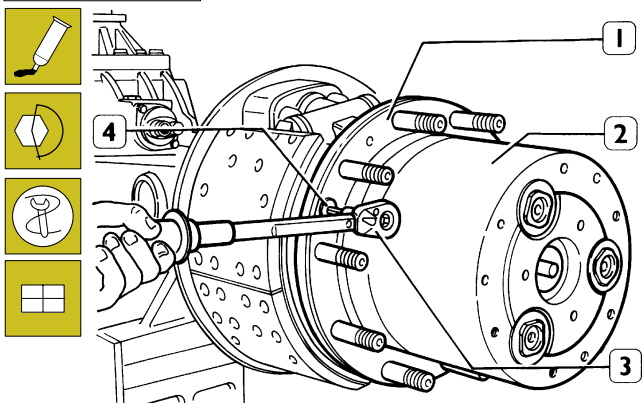
Figure 41



26916

Grease the needles (1) arrange them with three spacer rings (2) in the planetary gear (4) as shown in the figure. Insert the planetary gear (4) and spacer washer (5) in the planetary gear carrier support. Insert the pin (3) from the cover side pushing it down to the bottom of its seat. Repeat the same operation for the other two planetary gears.

Figure 42

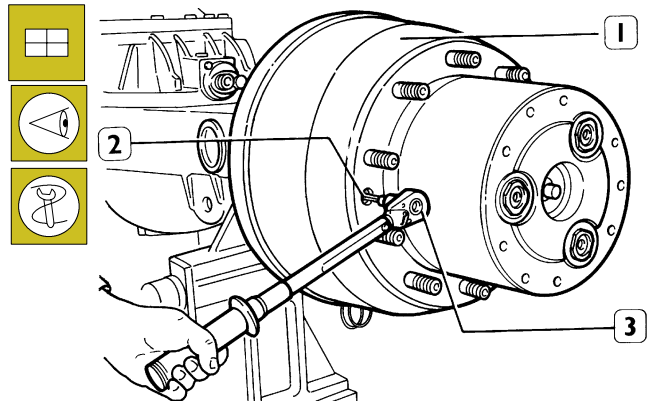


39655

Spread a thin coating of Hylomar SQ 321 M or Reinzoplast sealant on the contact surfaces of the planetary gear support (2) and the wheel hub (1)

Push the planetary gear support (2) onto the hub, for easier tooth meshing, move the coupling flange alternately in the two directions. Take care that the holes to fasten the planetary gear support to the hub coincide. Insert the three flathead screws (4) and tighten them with a dynamometric wrench (3) to the torque of 25 ± 3 Nm.

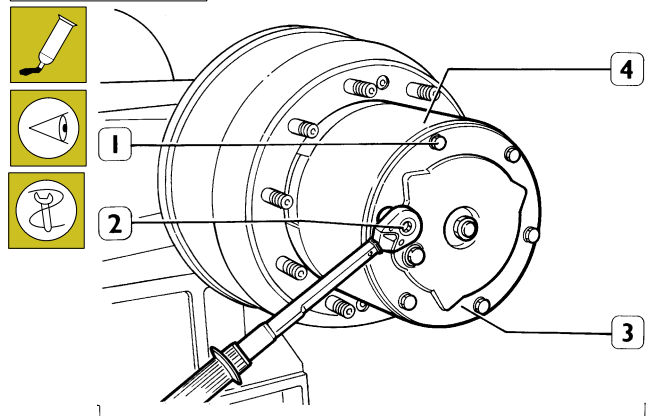
Figure 43



39656

Fit the brake drum (1) onto the planetary gear support. Fasten the brake drum with the two flathead screws (2) tightening them with dynamometric wrench (3) to the torque of 25 ± 3 Nm.

Figure 44



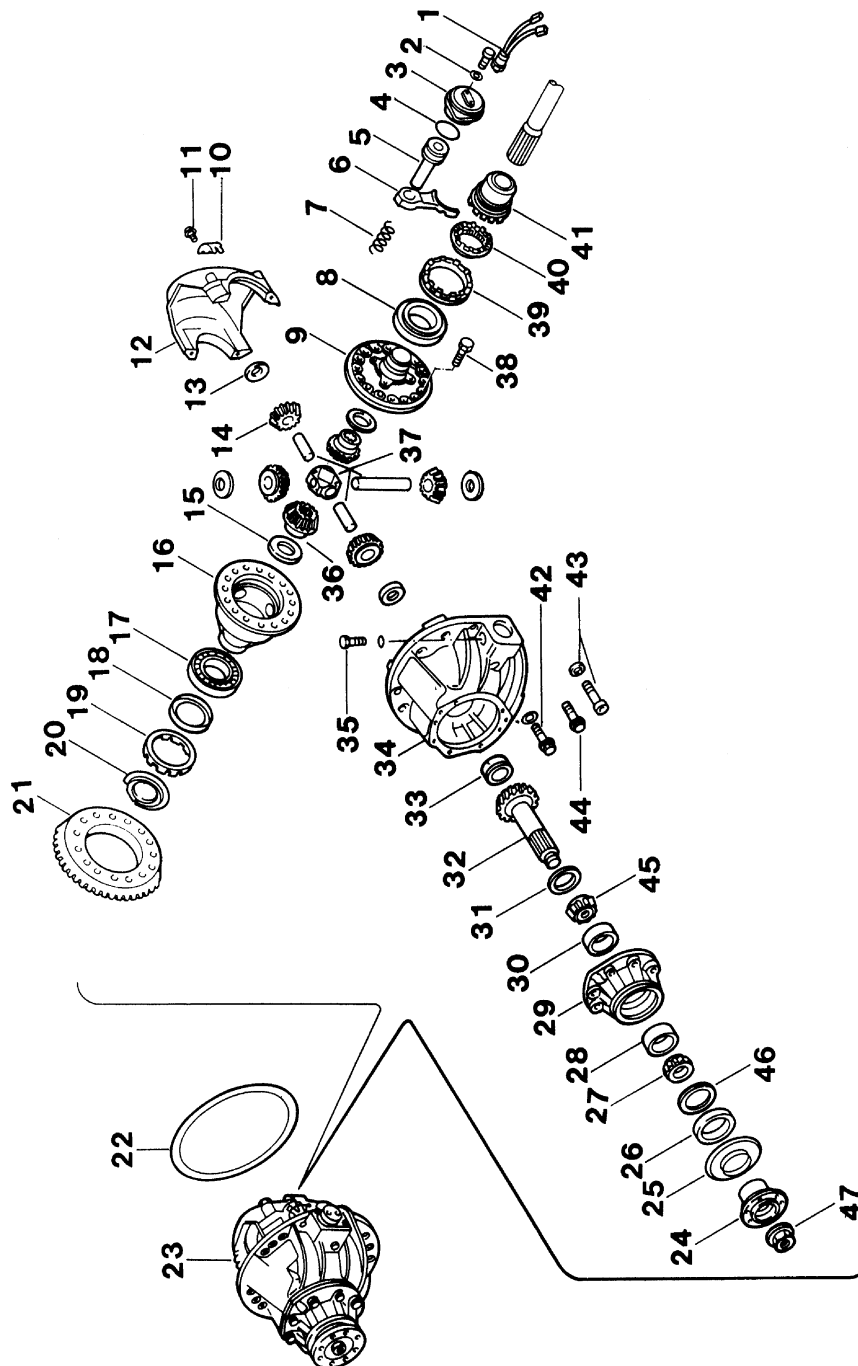
40073

Spread a thin coating of Hylomar SQ 321 M sealant on the contact surfaces of the cover (3) and the planetary gear support (4).

Position the cover so that the pin chamfers coincide with the notches in the cover.

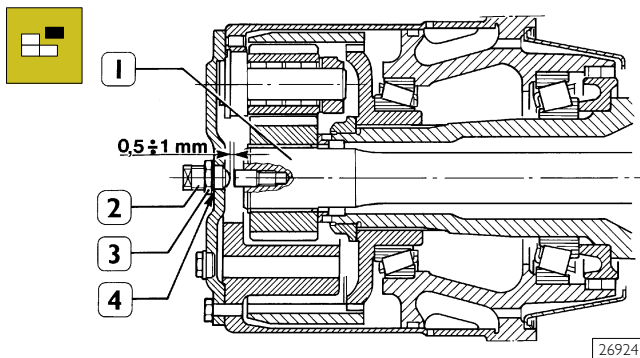
Spread sealant paste on the threads of the screws (1) and with dynamometric wrench (2) tighten to a torque of 50 ± 5 Nm.

40431



1. Electric transmitter - 2. Seal and union ring - 3. Cover - 4. Seal ring - 5. Piston - 6. Fork - 7. Spring - 8. Bearing - 9. Cover - 10. Plate - 11. Screw - 12. Cover - 13. Washer - 15. Shoulder washer - 16. Half-box - 17. Bearing - 18. Ring - 19. Ring nut - 20. Oil baffle - 21. Crown wheel - 22. Seal ring - 23. Differential unit - 24. Flange - 25. Dust guard - 26. Seal ring - 27. 28. Bearing - 29. Pinion support - 30. 45. Bearing - 31. Adjusting ring - 32. Pinion - 33. Bearing - 34. Box - 35. Screw - 36. Crown Wheel - 37. Pins and spider - 38. Screw - 39. Ring nut - 40. Sleeve - 41. Sliding sleeve - 42. Screw - 43. Screw - 44. Screw - 46. Rin - 47. Nut

Figure 51



The half shaft (1) end play is to be between 0.5 and 1 mm. To obtain this, tighten the adjusting screw (2) to its stop, then come back by half a turn and lock it with the hexagonal nut (3).

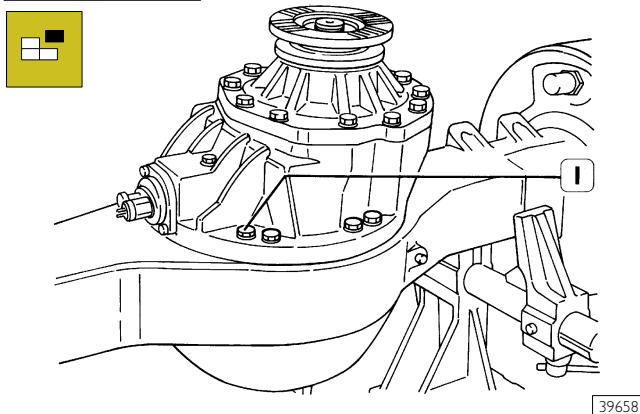


The flat surface of the hexagonal nut should be directed towards the seal ring (4).

REMOVAL AND RE-FITTING IN PLACE THE DIFFERENTIAL

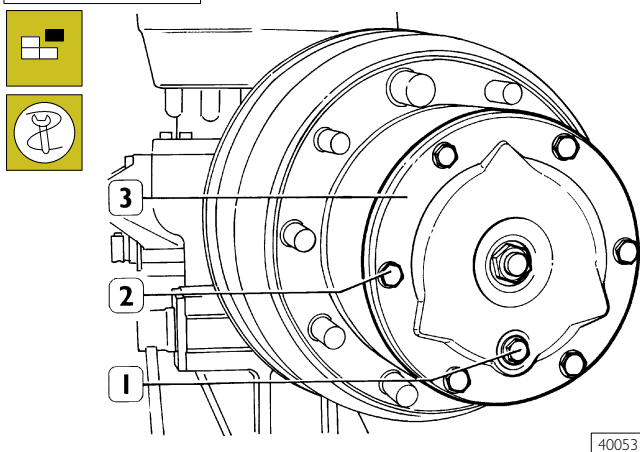
Removal

Figure 46



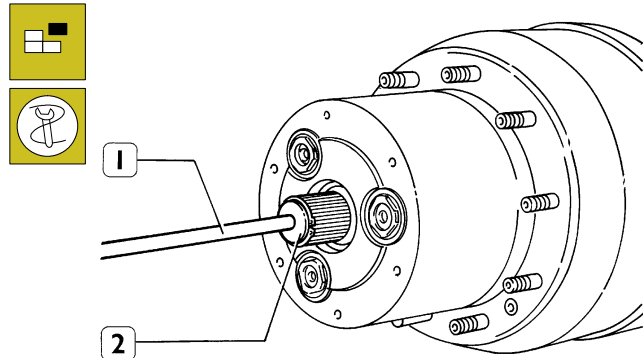
Remove the screws (1) fastening the differential housing to the axle casing. Remove the cap screws and hexagonal socket screws.

Figure 47



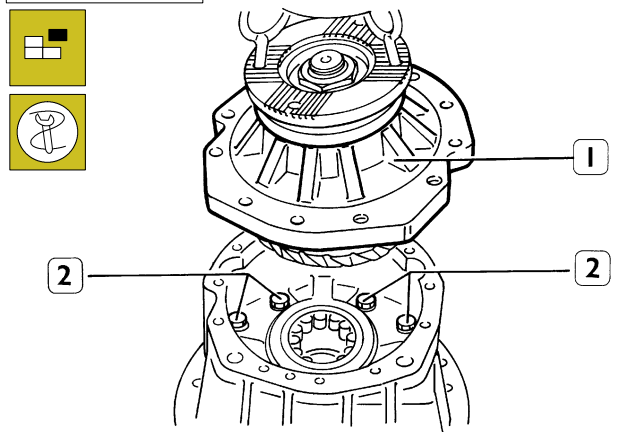
Screw on the oil intake cap (1). Move one of the cover (3) hex screws (2) to a low position and unscrew it. Drain the oil from the epicyclic gears on the wheels.

Figure 48



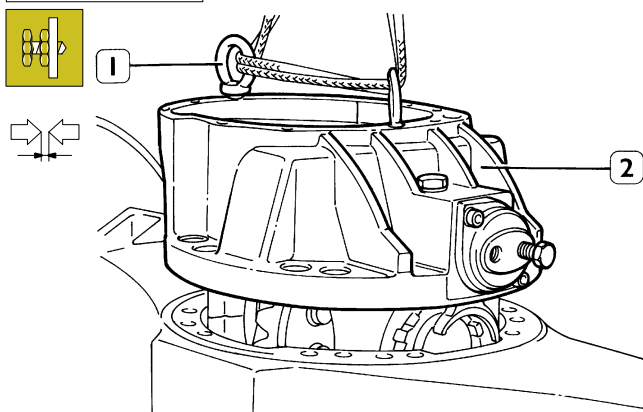
Fit tool 9937445 (1) into the shoulder pin seat threads and withdraw the half-shaft (2) from the bearing shaft

Figure 49



Using the specific eye hooks and a rope, lift the pinion support (1) and remove the four differential housing screws (2).

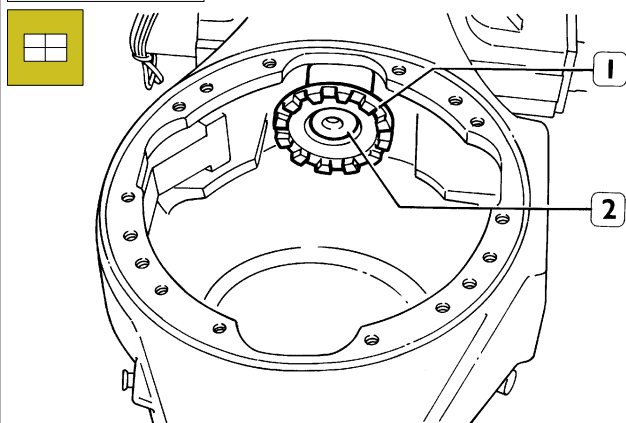
Figure 50



Using the specific eye hooks (1) and a rope, lift the differential housing (2).

Re-fitting in place

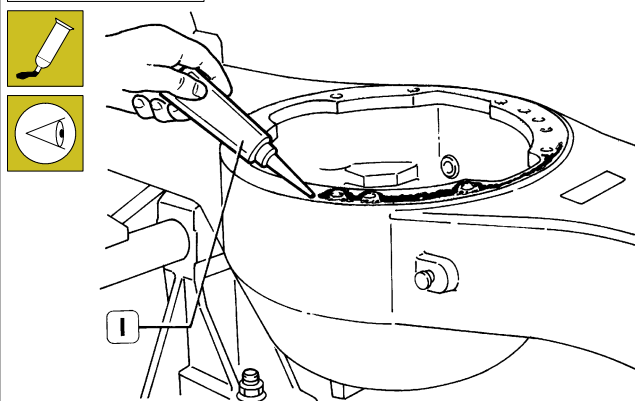
Figure 52



39662

Fit in place the sliding sleeve (1) on the double-tooth half-shaft (2).

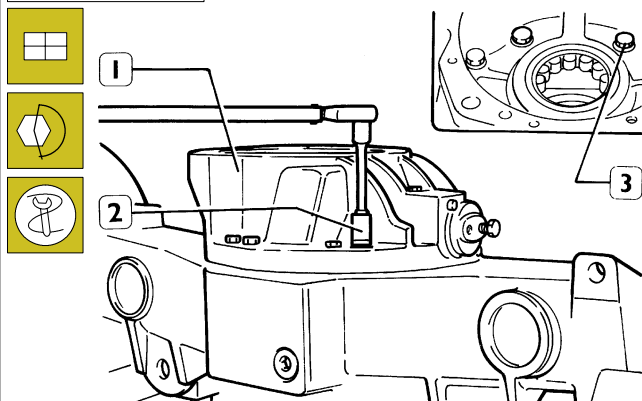
Figure 53



39663

Spread LOCTITE AVX on the contact surface (1). When fitting in place the differential housing it is important to make sure that the differential locking engagement fork is correctly positioned in the sliding sleeve seat.

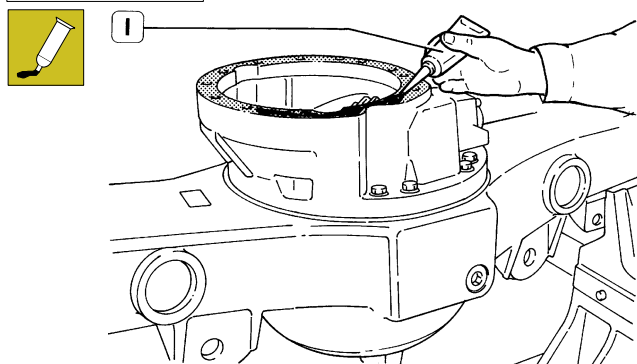
Figure 54



39664

Set the seal ring and fit in place the differential housing (1). Using a dynamometric wrench tighten the external (2) and internal (3) screws to the prescribed torque.

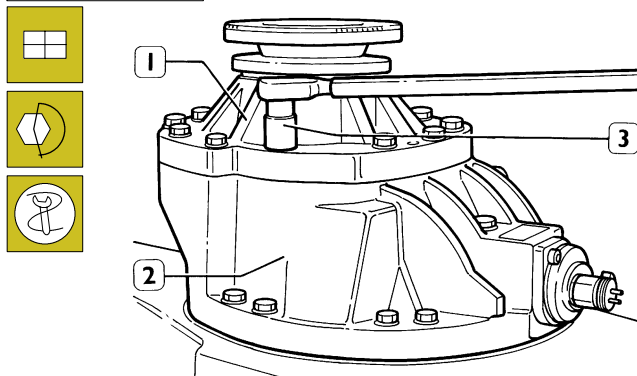
Figure 55



39665

Spread LOCTITE 573 on the contact surface (1).

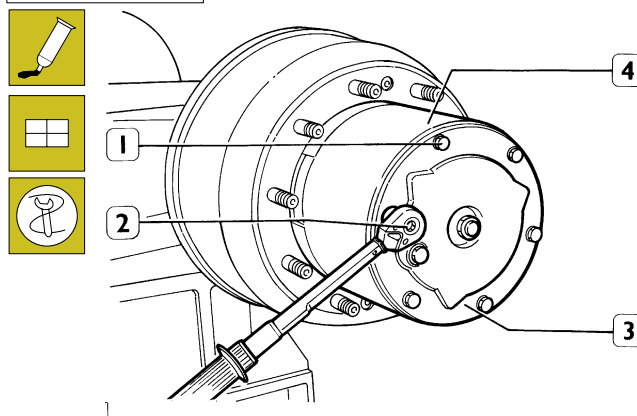
Figure 56



39666

Set the bevel pinion support (1) on the differential housing (2). Use dynamometric wrench (3) to tighten the screws to the prescribed torque.

Figure 57

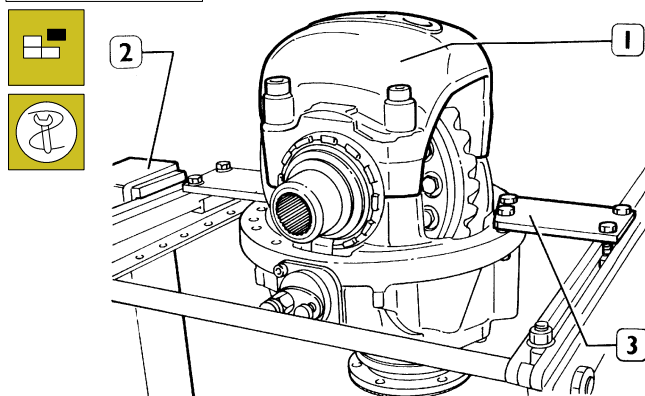


40073

Spread a thin coating of Hylomar SQ 321 M sealant paste on the contact surfaces of the cover (3) and the crown wheel support (4). Position the cover so that the pin chamfers coincide with the notches in the cover. Spread sealant paste on the screw (1) threads and with a dynamometric wrench (2) tighten to the prescribed torque.

REMOVING THE DIFFERENTIAL HOUSING

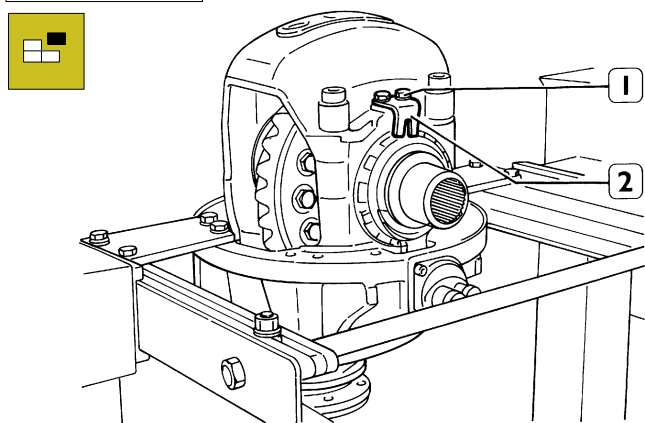
Figure 58



39667

Set the complete differential housing, with the gear housing cover (1) upwards, on rotary stand 99322205 (2) fitted with support 99322228 and pair of brackets 99371022 (3).

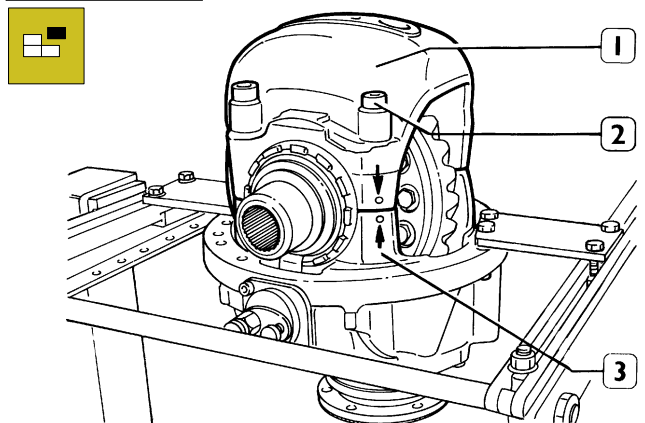
Figure 59



39668

Remove the screws (1) then the safety plate (2). Carry out the same operation on the other side.

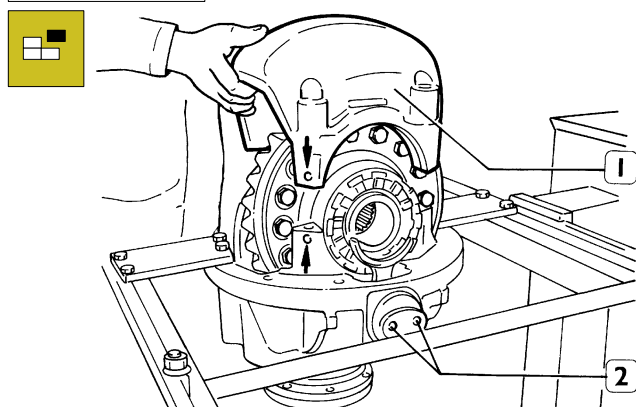
Figure 60



39669

Mark the cover (1) position with reference to the differential housing (3) $\Rightarrow \Leftarrow$.
Remove the cover fastening screws (2) (locked with LOC-TITE).

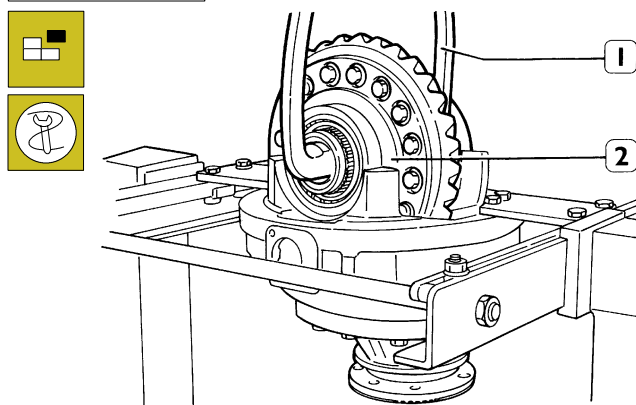
Figure 61



39670

Lift the gear housing cover (1).

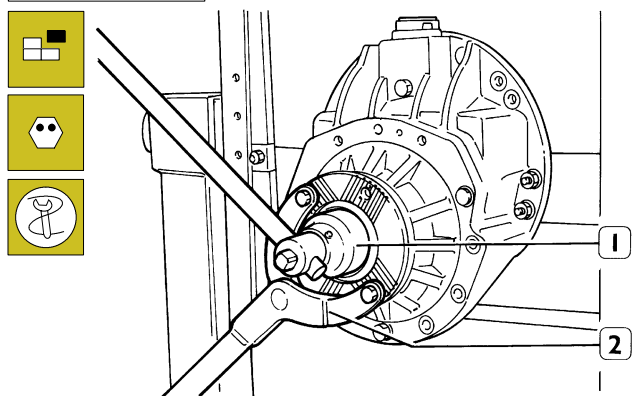
Figure 62



39671

Use hook 99370509 (1) to lift the gear housing (2) with the relevant taper roller bearings and bearing outer rings.

Figure 63



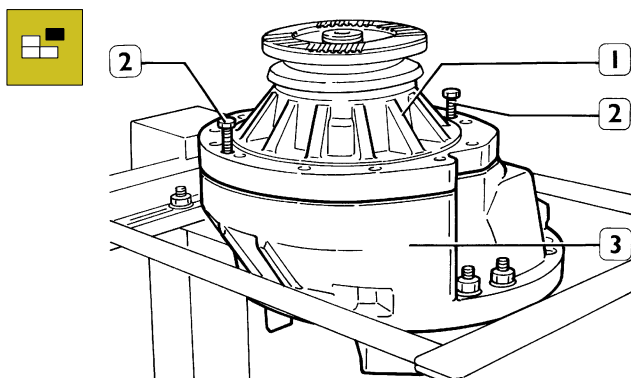
39672

Rotate the differential housing by 90°.

Remove the adjusting nut dent.

Apply the counter lever 993701317 (2) to the coupling flange, with socket wrench 9935508 (1) loosen the lock nut.

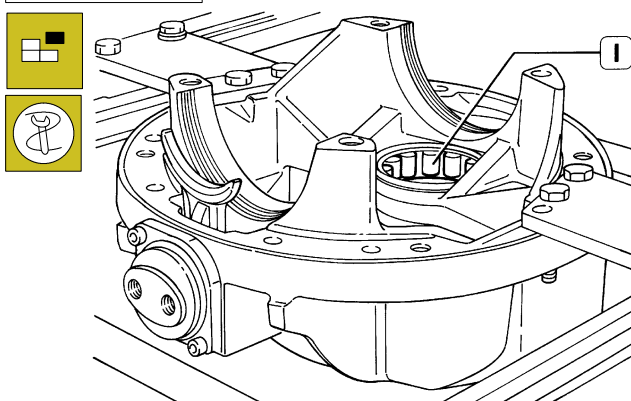
Figure 64



39673

Remove the screws and washers fastening the bevel pinion support (1) to the differential housing (3). Insert the counter-acting screws (2) and take out the complete differential housing support.

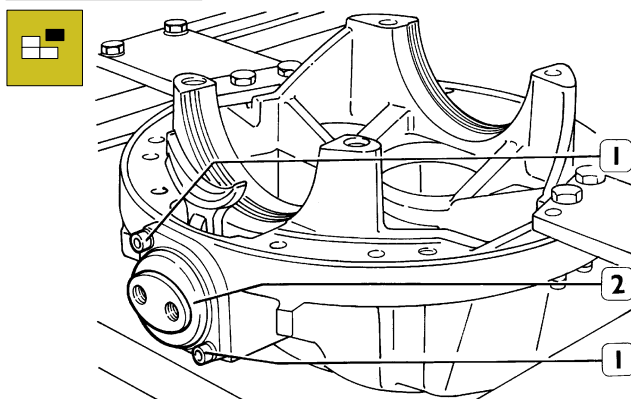
Figure 65



39674

Use a beater to expel the bevel pinion straight roller bearing (1) from its seat in the differential housing.

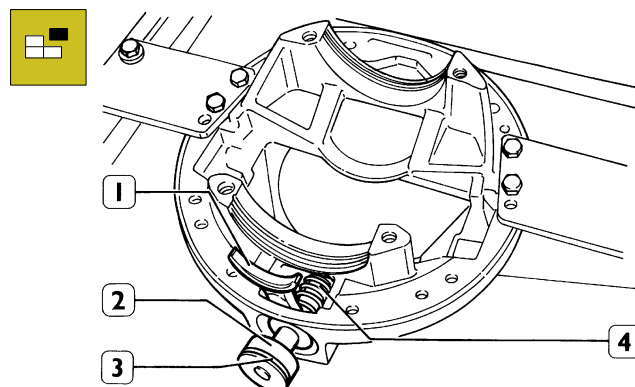
Figure 66



39675

Remove the two hexagonal socket head screws (1) and remove the differential locking device control cylinder (2).

Figure 67

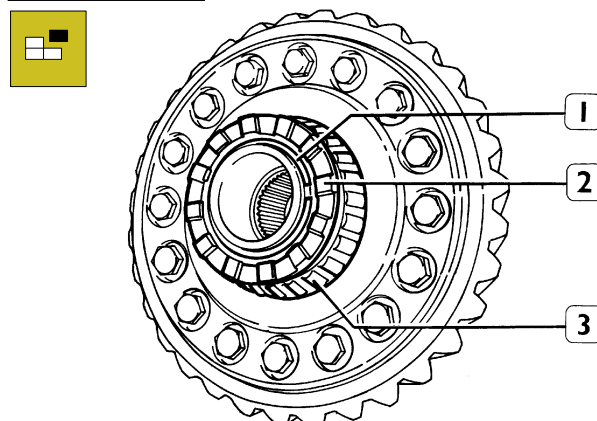


39676

Withdraw the control piston (2) with the seal ring (3), engagement fork (1) and compression spring (4).

REMOVING THE GEAR HOUSING

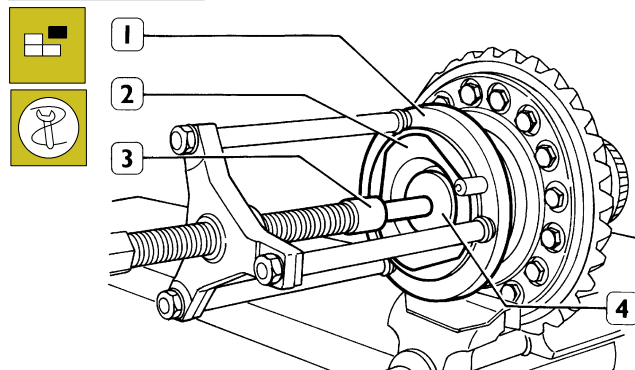
Figure 68



39677

Remove the split ring (1) and take away the differential locking device engagement sleeve (3) from the gear housing cover (2).

Figure 69

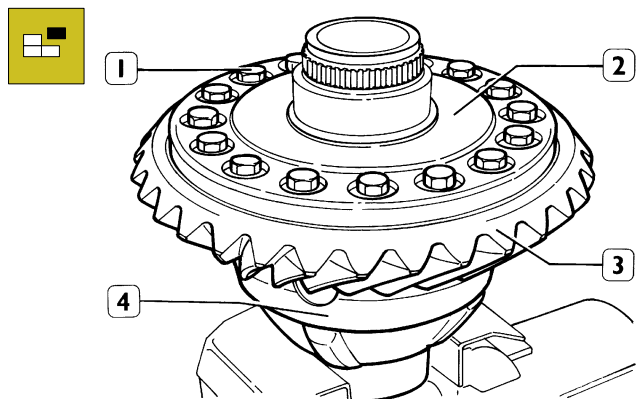


39678

Using puller 99347101 (1) equipped with a pair of gripping rings 99347182 (2), extension bar 99347361 (3) and counter block 99345055 (4), take out the taper roller bearing from the gear housing.

Repeat the same operation on the other side.

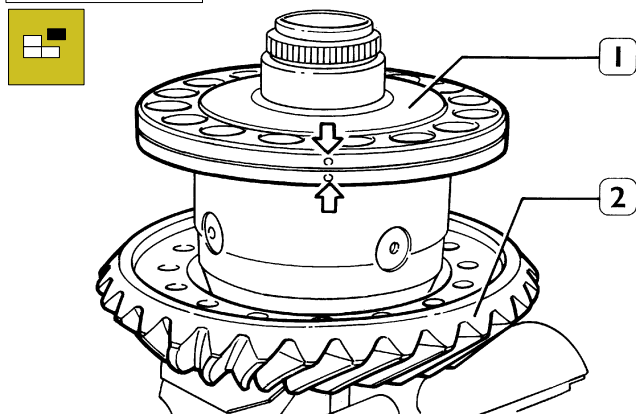
Figure 70



39679

Unscrew and remove the screws (1) that fasten the ring bevel gear (3) and cover (2) to the half-box (4).

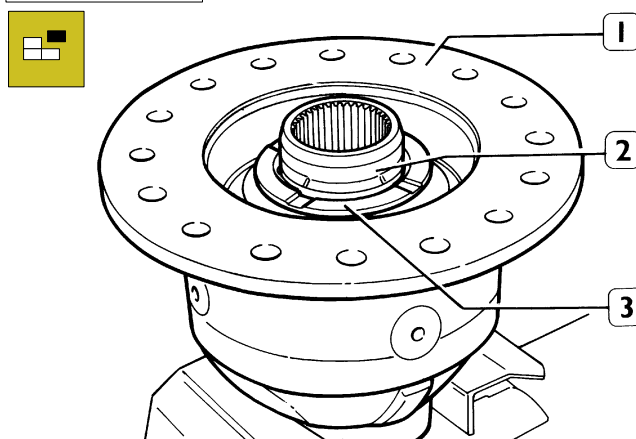
Figure 71



39680

Mark the cover and gear housing ($\Rightarrow \Leftarrow$). Remove the gear housing cover (1) and release the ring bevel gear (2)

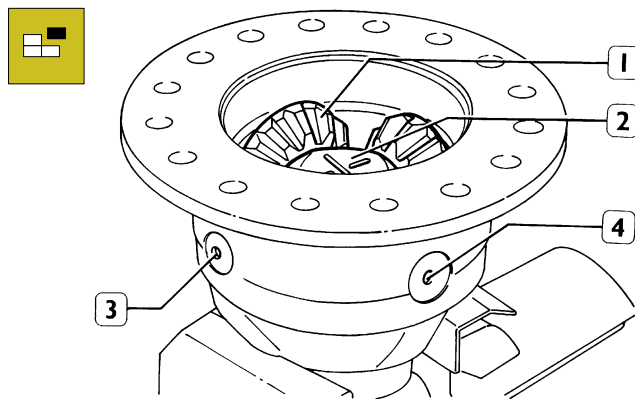
Figure 72



39681

Remove the crown wheel (2) with the relevant shoulder washer (3) from the gear housing (1).

Figure 73



39682

Use a beater to remove the long pin (4) then the two short pins (3).



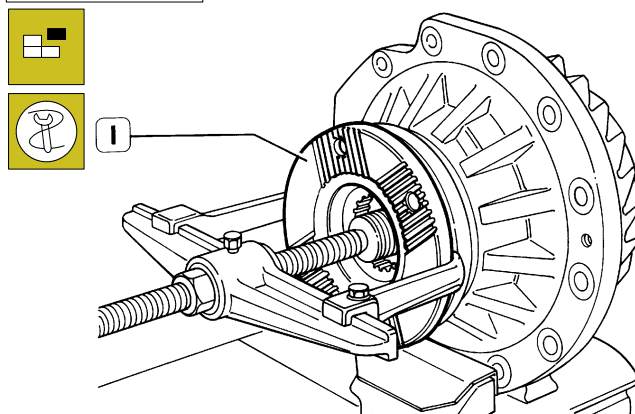
The exact position of the pins is marked on the spider (2) by a long stripe for the long pin and two short stripes for the short pins.

Remove the spider (2) and 4 planetary gears (1) with the shoulder washers.

Remove the crown wheel and shoulder washer.

REMOVING THE BEVEL PINION SUPPORT

Figure 74

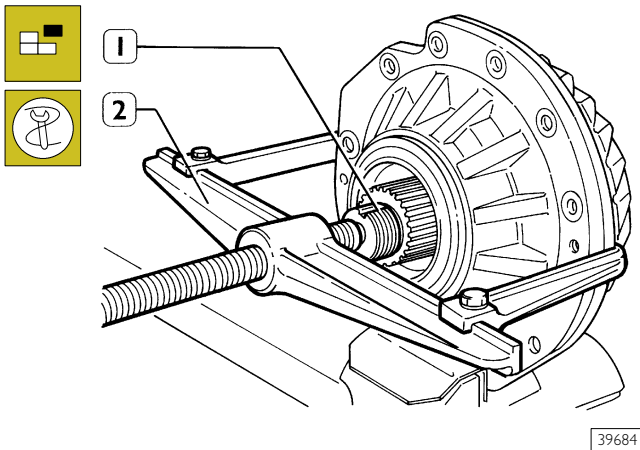


39683

Remove the previously loosened lock nut and the coupling flange (1).

If the flange removal is difficult, use a universal puller.

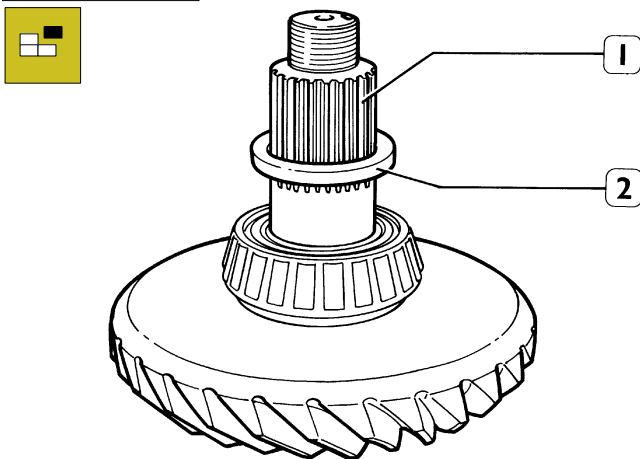
Figure 75



39684

Take out the bevel pinion (1) with intermediate bearing and adjusting ring from the support. It is suggested to use a press for this operation, but if this is not possible, use a puller (2)

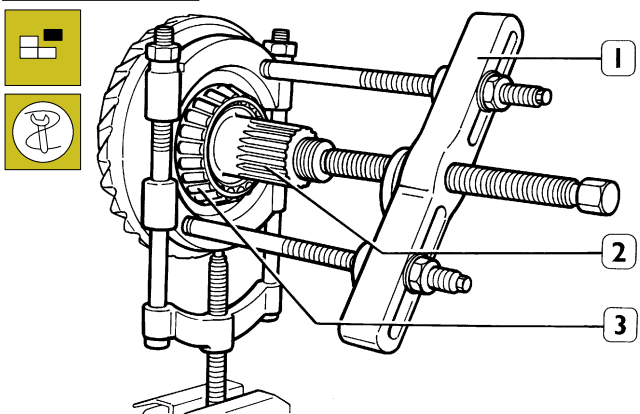
Figure 76



39685

Remove the bearing adjusting nut (2) from the bevel pinion (1).

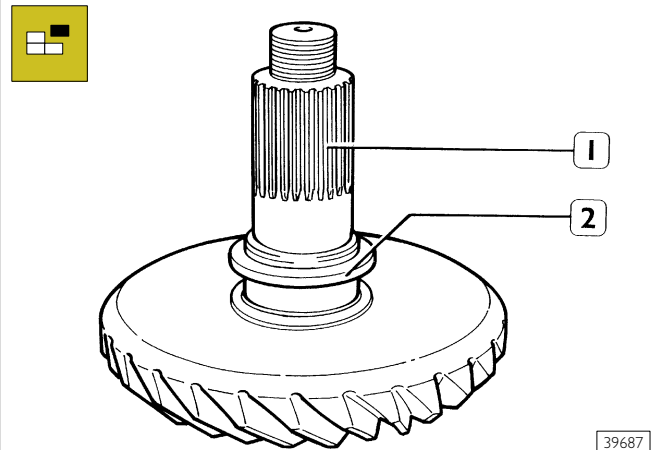
Figure 77



39686

With a universal puller 99348001 (1) remove the intermediate taper roller bearing (3) from the bevel pinion (2).

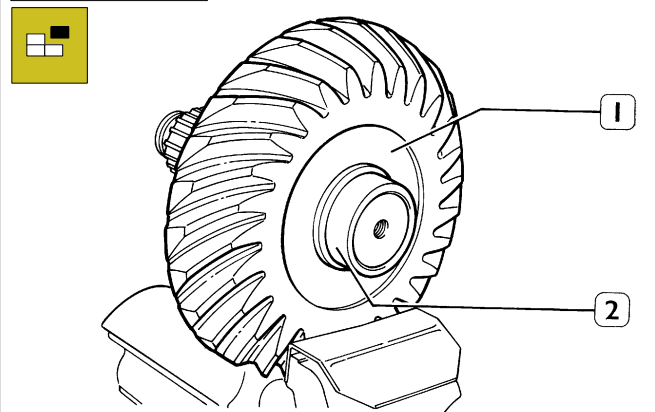
Figure 78



39687

Withdraw the pinion location adjusting ring (2) from the bevel pinion (1)

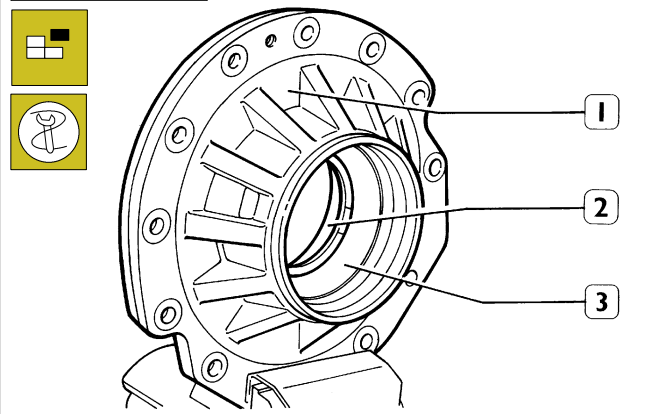
Figure 79



39688

Remove the rear straight roller bearing inner ring (2) from the bevel pinion (1). This is a destructive operation.

Figure 80



39689

Use a beater to take out the front and intermediate bearings outer rings (3 and 2) from the support (1).

DIFFERENTIAL COMPONENTS CHECK

Carefully clean all the differential components. Lubricate the bearings and rotate the roller cage freely. The rotation must be even and without signs of stiffness.



Carefully clean all the threads in order to obtain exact adjustments and accurate driving torques.

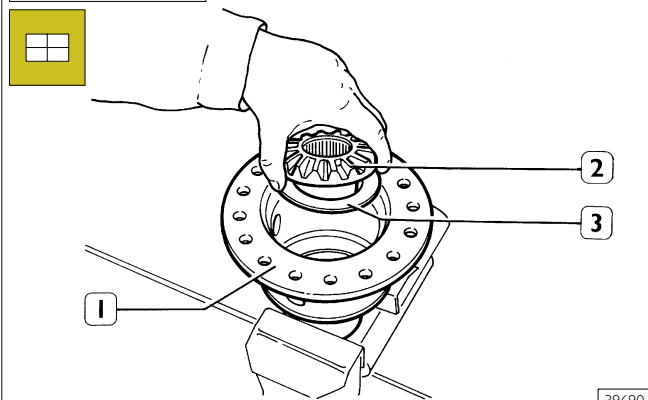
Check that the splined section for flange-pinion connection is not badly worn, if it is, replace the pinion.



When replacing the crown wheel or pinion it is necessary to replace both parts since they are supplied in pairs.

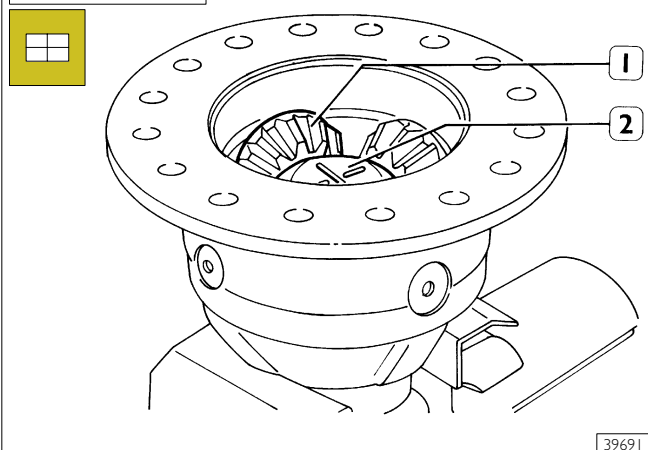
FITTING IN PLACE THE GEAR HOUSING

Figure 81



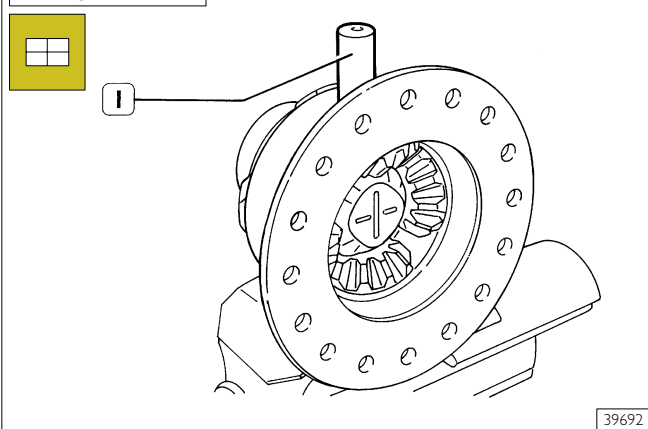
Lock the gear housing (1) in a vice and set the crown wheel (2) with shoulder ring (3) in its housing.

Figure 82



Set the 4 planetary gears (1) with the shoulder washers and fit in the spider (2).

Figure 83

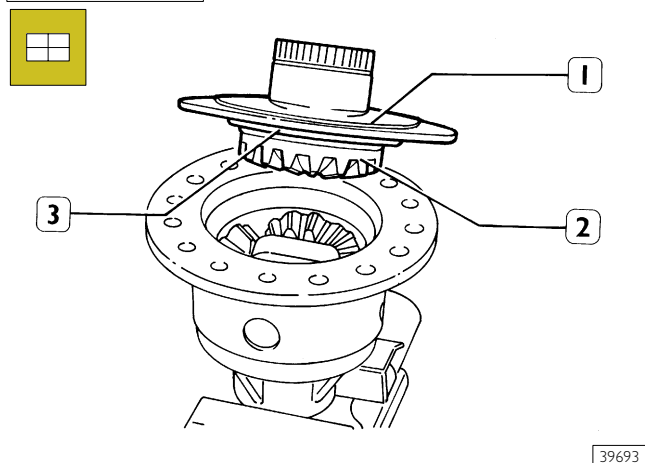


Insert the long pin (1) and two short pins.



The long (through) pin is inserted first. The exact position of the pins is marked on the spider (2) by a long stripe for the long pin and two short stripes for the short pins.

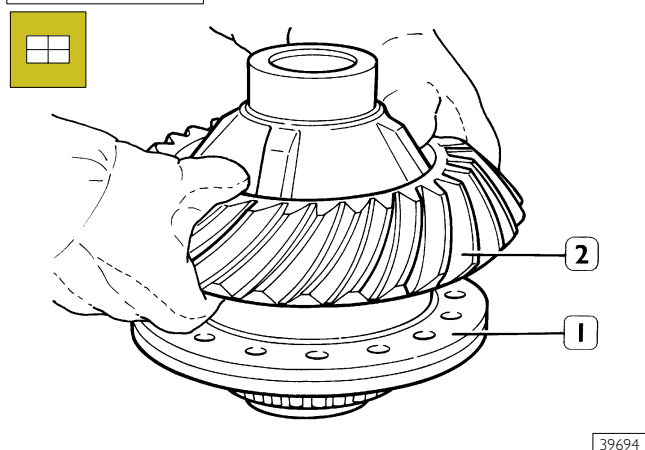
Figure 84



Set the crown wheel (2) with its shoulder washer (3) on the planetary gears.

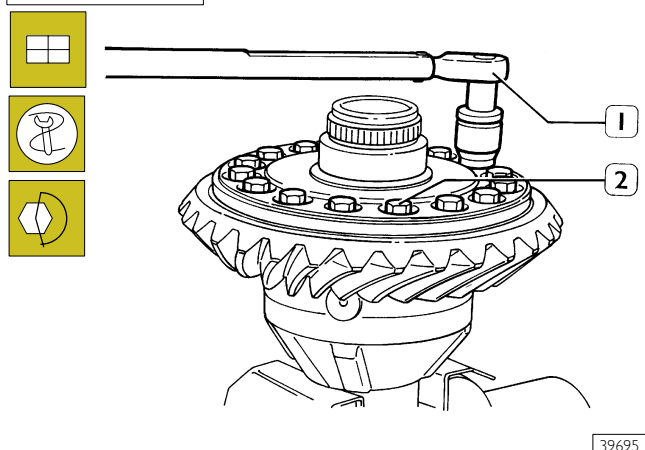
Fit in place the cover (1) on the housing matching the marking made before removal.

Figure 85



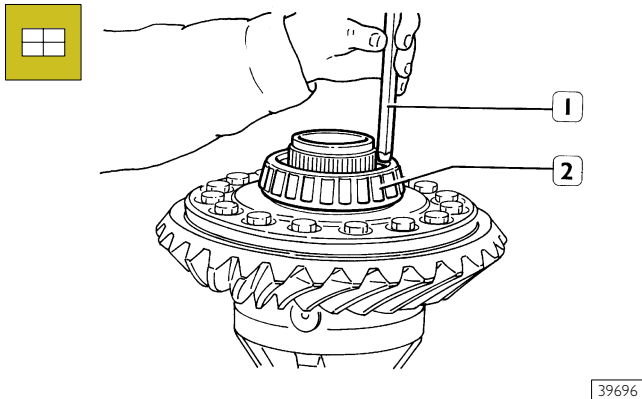
Heat the bevel ring gear (2) to approx. 80°C, fit it in its housing on the gear housing (1) and lock it immediately with two fastening screws.

Figure 86



Insert the rest of the fastening screws (2) and with a dynamometric wrench (1) tighten them to a torque of 300 ± 10 Nm (30 ± 1 kgm).

Figure 87

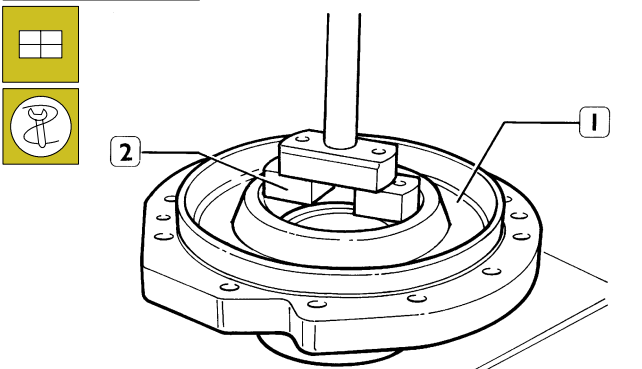


39696

Heat the bearing (2) to a temperature of 100°C for approx. 15 minutes then drive it in the gear housing cover using a suitable beater (1). Repeat this operation on the other side.

FITTING IN PLACE THE BEVEL PINION SUPPORT

Figure 88

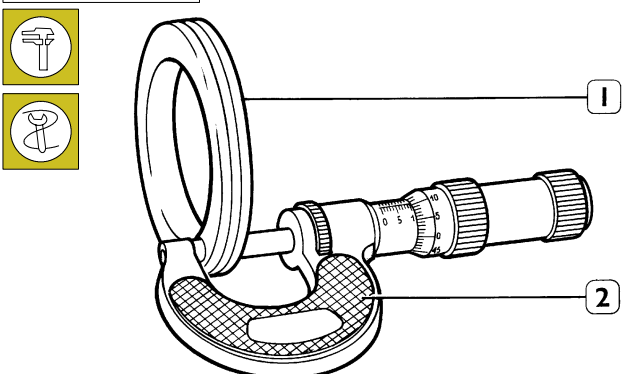


39697

Connect a new oil baffle to the pinion support (1). Use beater 99374093 (2) to drive the intermediate bearing outer ring and the front bearing outer ring right down into their seats.

Procedure to determine the thickness of the bevel pinion rolling torque adjusting ring

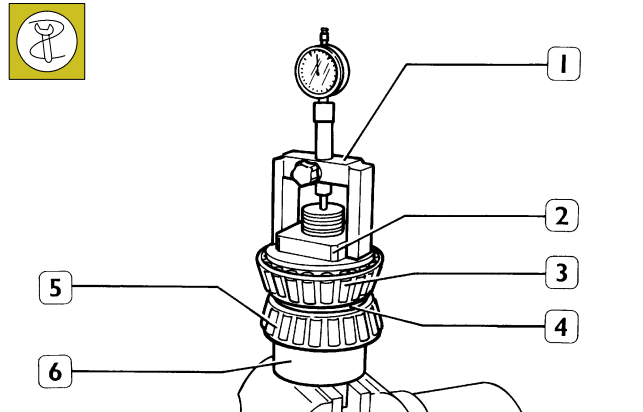
Figure 89



39572

Measure the thickness of the removed adjusting ring (1) and make a note of the value (value A).

Figure 90



39698

Fit tool 99395027 (6) in a vice and place on it:

- ☐ the pinion side bearing (5)
- ☐ adjusting ring (4), already measured, and bearing (3)

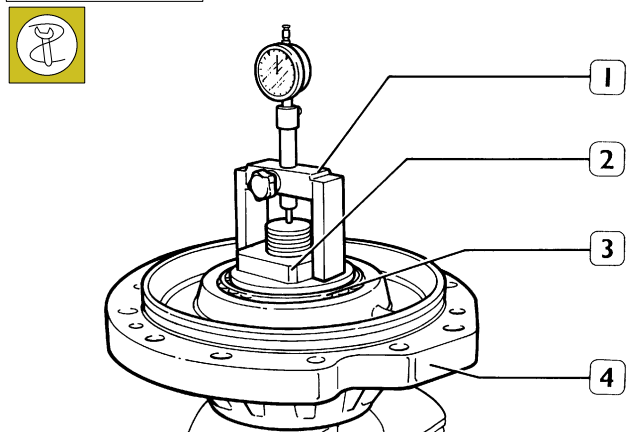
Screw the ring nut (2) and lock it tightly.

Position the dial gauge fitted to element (1) of tool 99395027 (6) on the bearing (3) and set the gauge to zero on the end of the tool (6).

Remove from the tool (6):

- ☐ element (1)
- ☐ ring nut (2)
- ☐ bearing (3)
- ☐ adjusting ring (4)

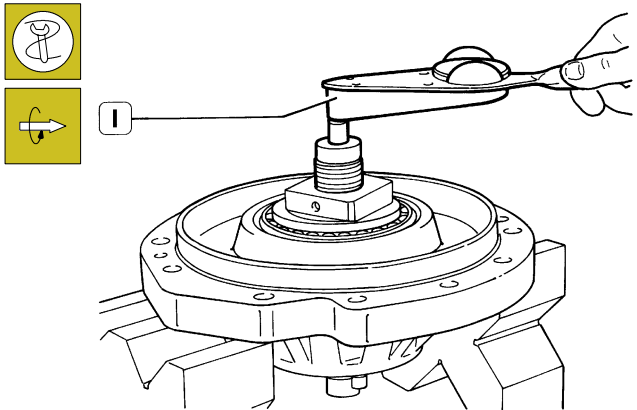
Figure 91



39699

Set the support (4, figure 91) on the bearing (5, figure 90); set bearing (3) on the support. Manually tighten the ring nut (2) and check the rolling torque as indicated in figure 92.

Figure 92



39700

Set the complete support on 2 parallel bars and with a dynamometric wrench (1) applied on tool 99395027 find the rolling torque which should be 1.5 to 3.5 Nm. If this is not so operate on the ring nut (2, figure 91). Place element (1, figure 91) with the dial gauge set to zero, on the bearing (3) and find the deviation, if any (value B)

Adjusting ring thickness "S" is obtained through the following formula:

$$S = A - (B) + C$$

where:

A = Thickness of adjusting ring fitted to set the dial gauge to zero;

B = Deviation value found;

C = 0.05 mm coefficient that takes into account the bearings dilation cause by assembling interference on the bevel pinion;

First example

$$A = 13.12 \text{ mm}$$

$$B = + 0.13 \text{ mm}$$

$$C = 0.05 \text{ mm}$$

$$S = 13.12 - (+ 0.13) + 0.05 =$$

$$S = 13.12 - 0.13 + 0.05 = 13.04 \text{ mm.}$$

Second example

$$A = 13.12 \text{ mm}$$

$$B = - 0.13 \text{ mm}$$

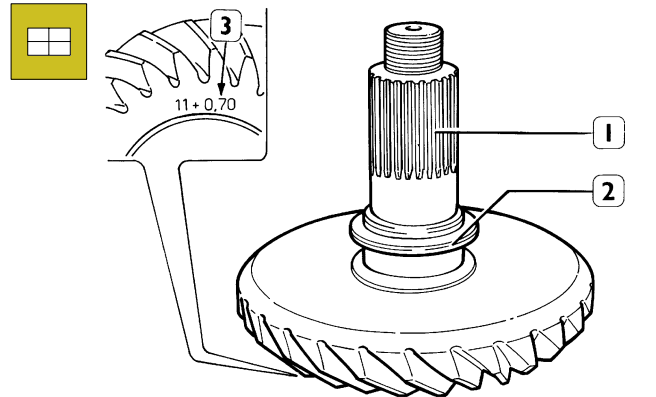
$$C = 0.05 \text{ mm}$$

$$S = 13.12 - (- 0.13) + 0.05 =$$

$$S = 13.12 + 0.13 + 0.05 = 13.35 \text{ mm.}$$

Remove the elements from tool 9939507.

Figure 93



39701

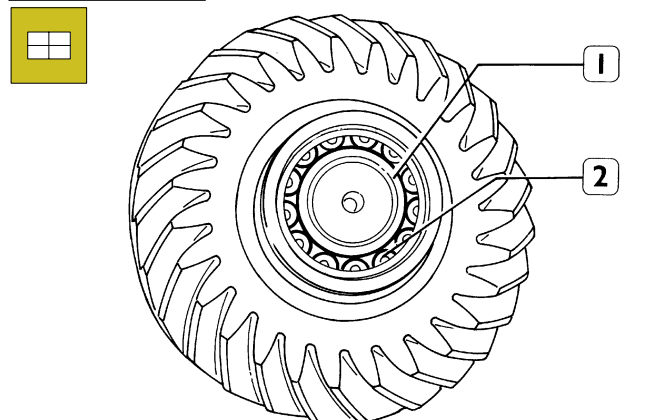
On the bevel pinion (1) fit in place the adjusting ring (2) to set the pinion with reference to the crown wheel and the chamfer directed downwards. The thickness of the adjusting ring depends on the reference value (3) engraved on the bevel pinion.

Figure 94

Value engraved on pinion	Adjusting ring thickness
0	4,6
0,1	4,5
0,2	4,4
0,3	4,3
0,4	4,2
0,5	4,1
0,6	4,0
0,7	3,9
0,8	3,8
0,9	3,7
1,0	3,6

Table to determine the thickness of adjusting rings, bevel pinion position with reference to the crown wheel.

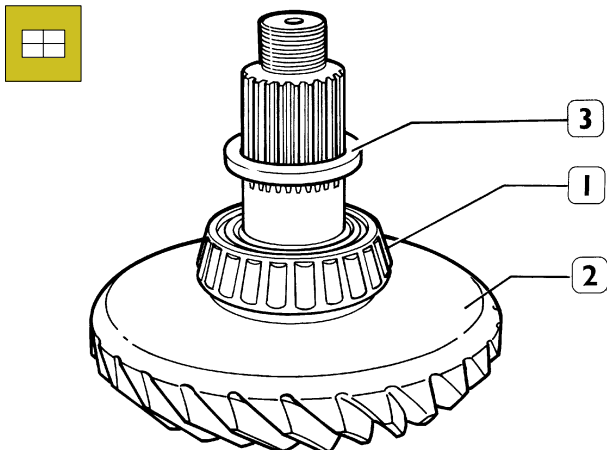
Figure 95



39702

Heat the rear straight roller bearing (2) inner ring (1) to a temperature of 100°C and fit in place on the bevel pinion.

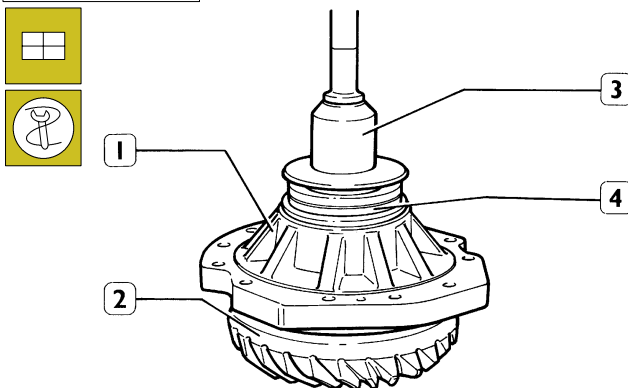
Figure 96



39703

Heat the intermediate bearing (1) to approx. 100°C and fit in place on the bevel pinion (2).
Fit in place the adjusting ring (3) with the proper thickness.

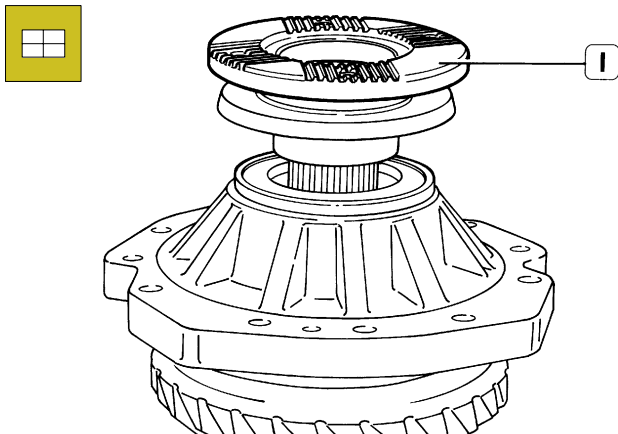
Figure 97



39704

Fit in place the support (1), already assembled, on the bevel pinion (2). Fit in place the front bearing. With a connection device (3) fit in place the oil seal ring (4)

Figure 98

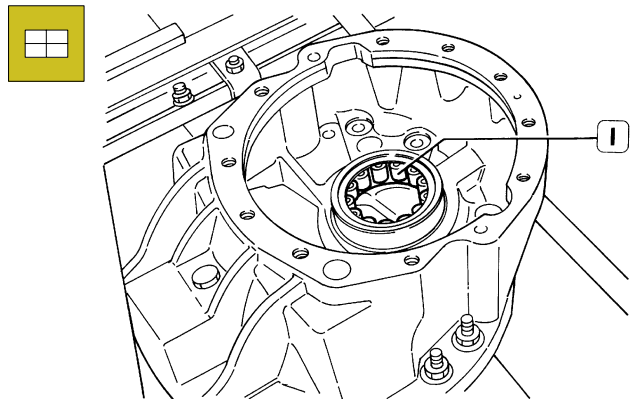


39705

Fit in place the coupling flange (1) using a suitable beater, then manually tighten the lock nut.

FITTING IN PLACE THE DIFFERENTIAL HOUSING

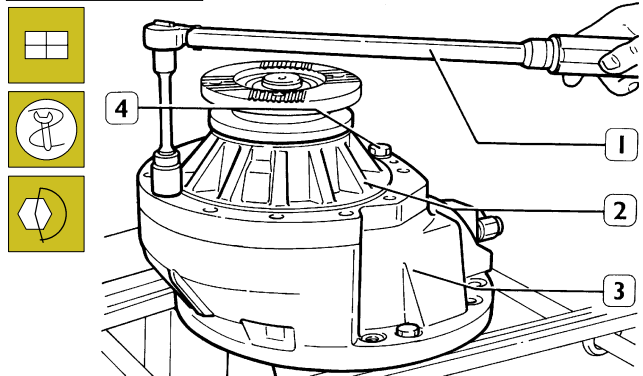
Figure 99



39706

Use a beater to drive the rear straight roller bearing (1) into its seat in the differential housing.

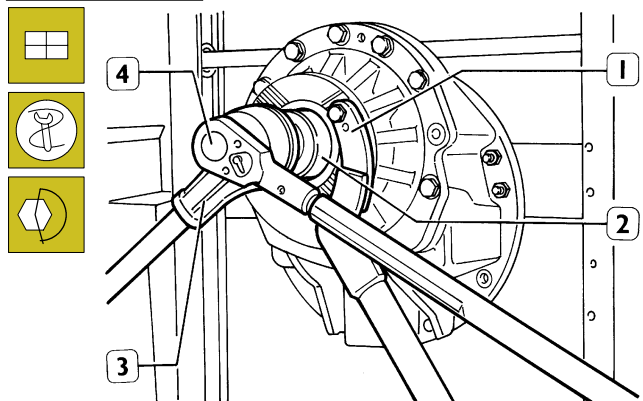
Figure 100



39707

Fit in place on the differential housing (3) the already assembled bevel pinion support (2), insert 2 screws (4) with spring washers in diametrically opposite positions. With a dynamometric wrench (1) tighten them to a torque of 160 ± 10 Nm (16 ± 1 kgm).

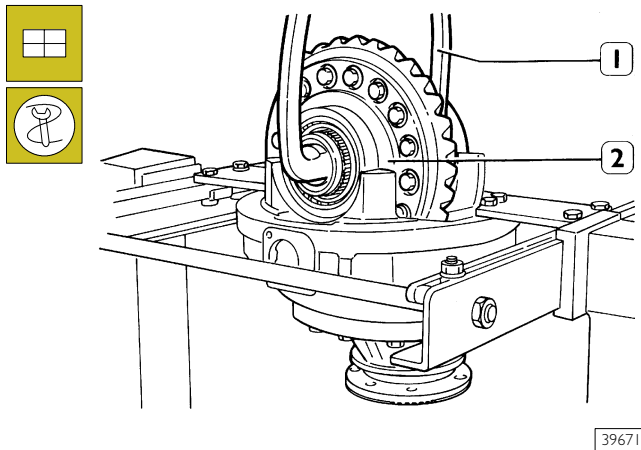
Figure 101



39708

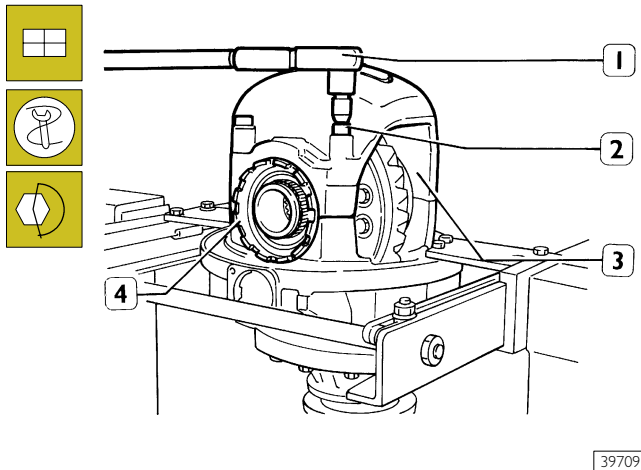
Lock the coupling flange rotation with counter lever 99370317 (1) and using socket wrench 99355081, multiplier (3) and dynamometric wrench (4) tighten the lock nut to a torque of 700 ± 50 Nm (70 ± 5 kgm).

Figure 102



With hook (1) 99370509 set the gear housing (2) with the relevant roller bearings on the differential housing.

Figure 103

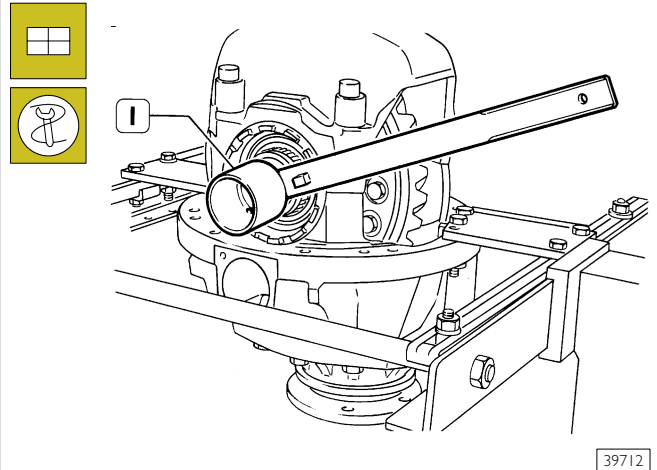


Fit in place the cover (3) matching the marks made when removing, slightly lock the screws (2) and check that the adjusting ring nuts (4) can be screwed without difficulty. Remove the screws (2), spread LOCTITE AVX on the threads and with a dynamometric wrench (1) tighten them to a torque of 280 ± 15 Nm.

Adjusting the rolling torque of the gear housing bearings

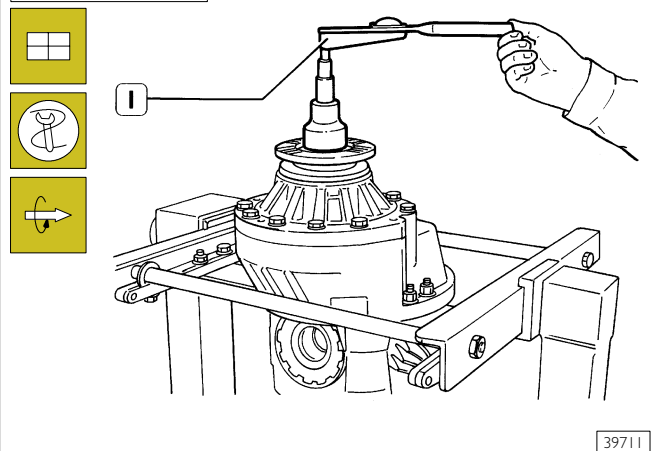
The rolling torque adjustment of gear housing bearings is obtained by measuring the total rolling torque. Find in the table in figure 103 the total rolling torque value (this value varies according to the bevel pair ratio).

Figure 104



Using torque wrench 99389819 (1) and appropriate socket wrench find the prescribed rolling torque, operating on the bearing adjustment ring nuts (figure 104), through wrench 99354001 (1).

Figure 105



Find from the table below the rolling torque value (this value varies according to the bevel gear pair ratio) and perform adjustment.

Teeth No.	Ratio	Total rolling torque Nm
27/32	1,185	$a+(2,5\div 4,2)$
28/37	1,321	$a+(2,3\div 3,8)$
21/40	1,905	$a+(1,6-2,1)$
19/33	1,737	$a+(1,7-2,3)$
23/36	1,565	$a+(1,9-2,6)$

$$a = 3\div 4 \text{ Nm}$$

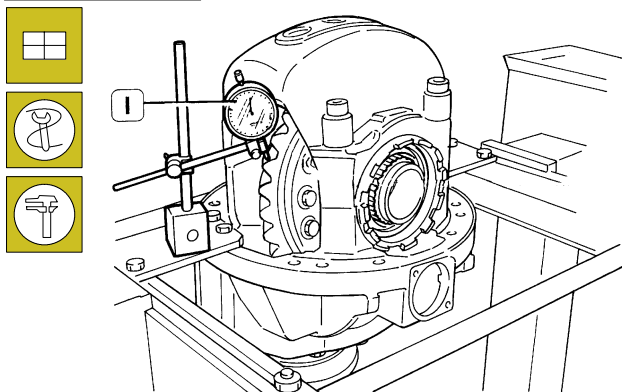
Total rolling torque Nm

Adjust the backlash between the teeth of the bevel pair operating as follows:

- ☐ Find the clearance value between the teeth; this varies according to the bevel pair ratio;

No. Teeth	Ratio	Clearance between teeth
21/40	1,905	$0,20 \div 0,28$
19/33	1,737	$0,25 \div 0,33$
23/36	1,565	$0,20 \div 0,29$
28/37	1,321	$0,20 \div 0,28$
27/32	1,185	$0,20 \div 0,30$

Figure 106

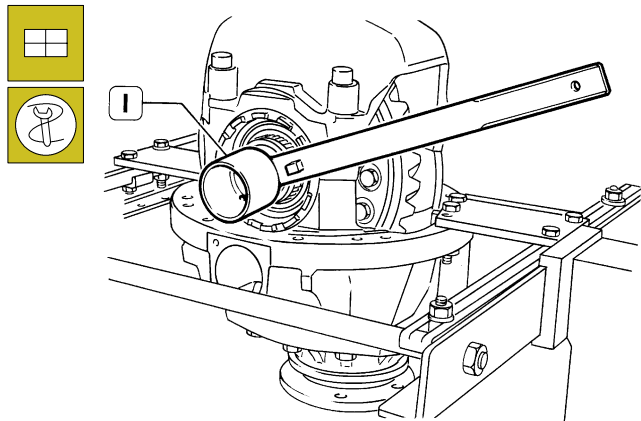


39710

- ☐ Set the dial gauge (1) with magnetic base as shown in the figure
- ☐ Lock the bevel pinion rotation through counter lever 99370317; reverse the crown wheel rotation and with the dial gauge find the backlash between the teeth of the two gears.

If it is not satisfactory, operate on the adjusting ring nuts using wrench 99354001 (1, figure 107)

Figure 107

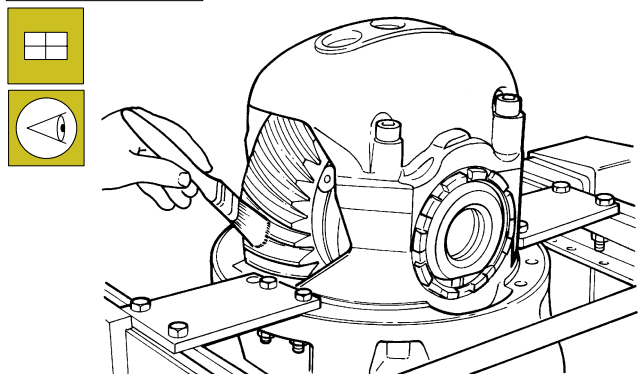


39711

To avoid altering the previously obtained rolling torque when adjusting the backlash between the teeth of the pinion and crown wheel, the adjusting ring nut can be tightened using wrench 99354001 (1) by the same amount as the ring nut on the other side has been loosened.

After the adjustment has been completed, check that the two ring nuts permit the mounting of the safety plates.

Figure 108



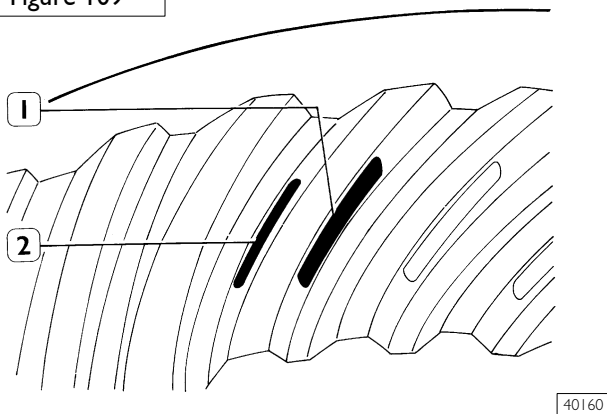
39704

Using a brush apply a thin coating of lead oxide to the crown wheel teeth.

Rotate the pinion and find the pinion teeth contact marks on the crown wheel teeth.

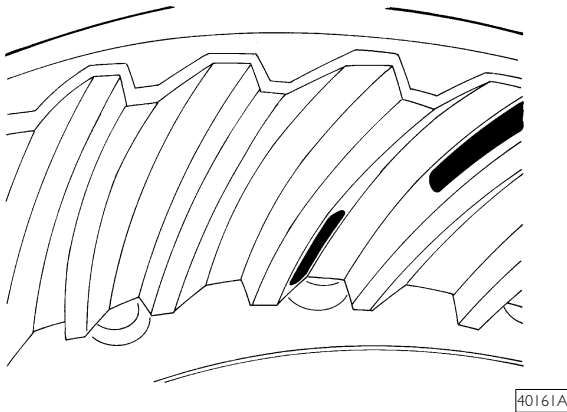
The figures that follow indicate possible contact points and how to correct any errors.

Figure 109



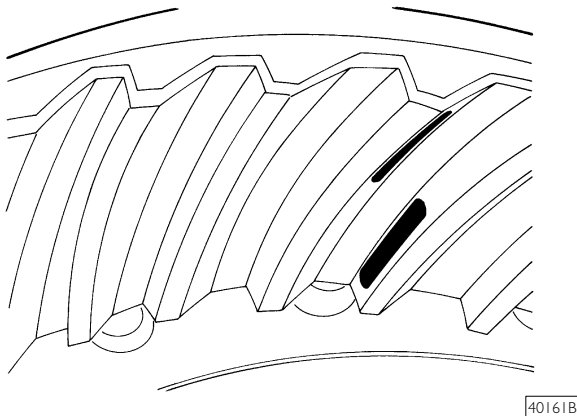
The lead oxide should mark both the drawn surface (1) and the thrusting surface (2) approximately along the centreline of the tooth width. Without load, both meshing areas that contact are slightly displaced with reference to the crown wheel outer diameter.

Figure 110



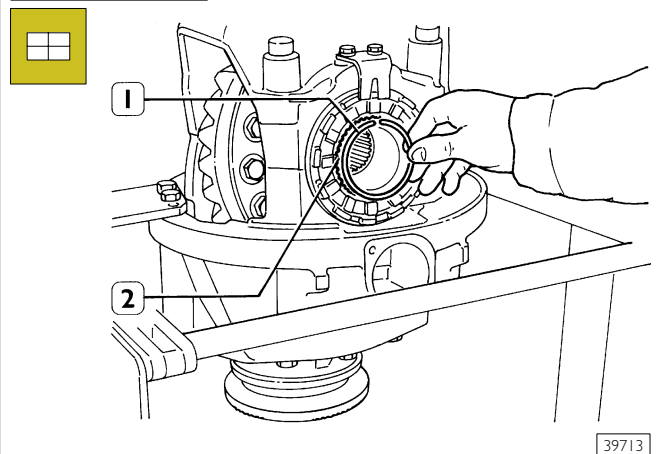
If the mark on the drawn surface (toward the outer diameter) and on the thrusting surface (toward the inner diameter) is displaced, this means that the pinion is too near the crown wheel.
- Cure: Increase the shim of the adjusting ring between the intermediate bearing and the bevel pinion

Figure 111



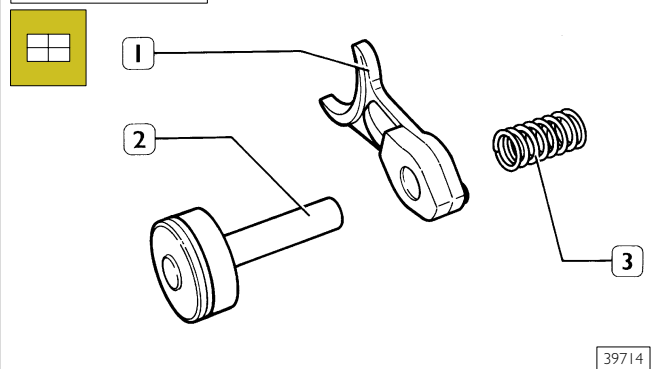
If the mark on the drawn surface is displaced towards the inner diameter and the mark on the thrusting surface is displaced towards the crown outer diameter; this means that the pinion is too far from the crown wheel axis.
Cure - reduce the shim of the adjusting ring between the intermediate bearing and the bevel pinion.

Figure 112



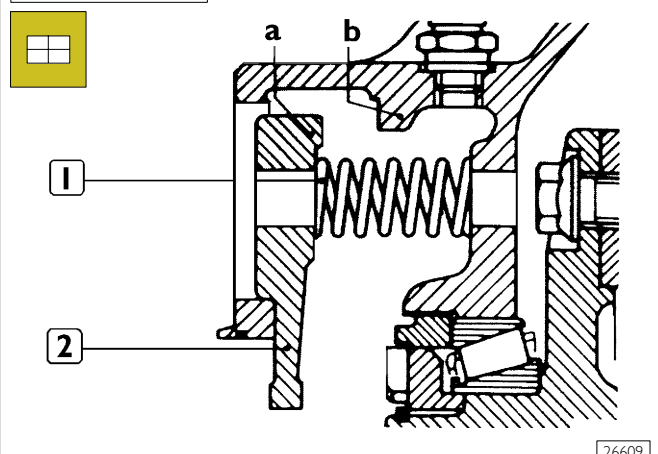
Fit in place the engaging sleeve (1) on the gear housing teeth and using a screwdriver fit the split ring (2) into its groove.

Figure 113

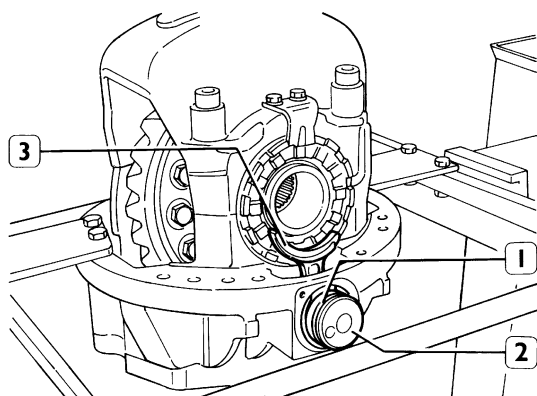


Fit in place the differential locking device assembly composed of the control cylinder, piston (2), engaging fork (1) and compression spring (3).

Figure 114



Insert the compression spring (1) in the differential housing. Fit in place the engaging fork (2) so that the stop at the end of stroke (a) corresponds to the end of stroke (b) on the differential housing.



39715

5° Spread LOCTITE 573 on the contact surface, re-fit into place the pinion support and tighten the screws to the prescribed torque.

INTERMEDIATE AXLE IN TANDEM

SECTION 12.4

SECTION 12.4

Intermediate axle in tandem

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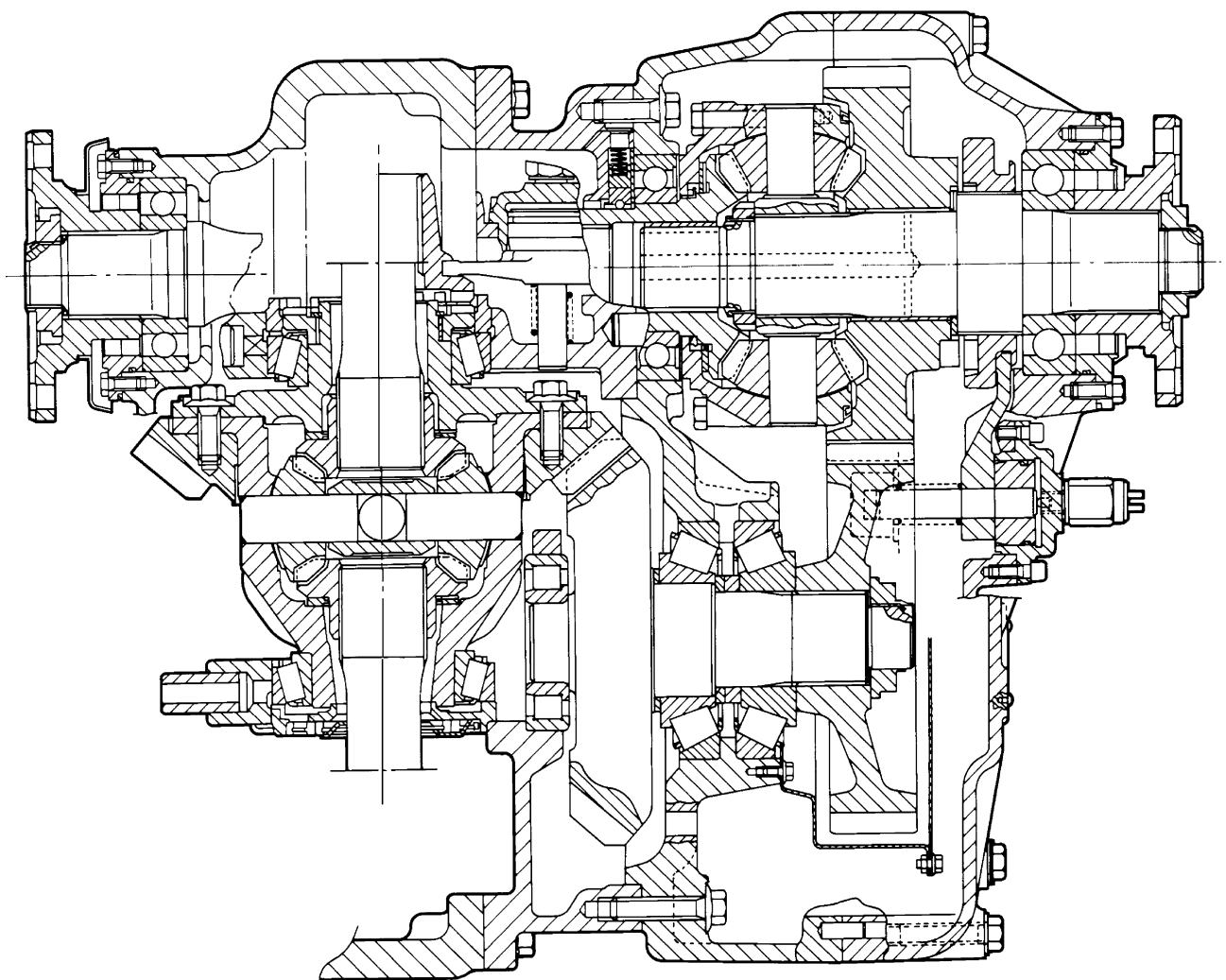
DESCRIPTION

The intermediate axle is a double reduction type. The first reduction is obtained through the pinion-ring bevel gear; the second through an epicyclic unit in the wheel hubs.

A reduction gear unit on the intermediate axle transmits the driving torque between the two axles.

The axle has a pneumatic device to lock the differential and another to lock the reduction gear unit.

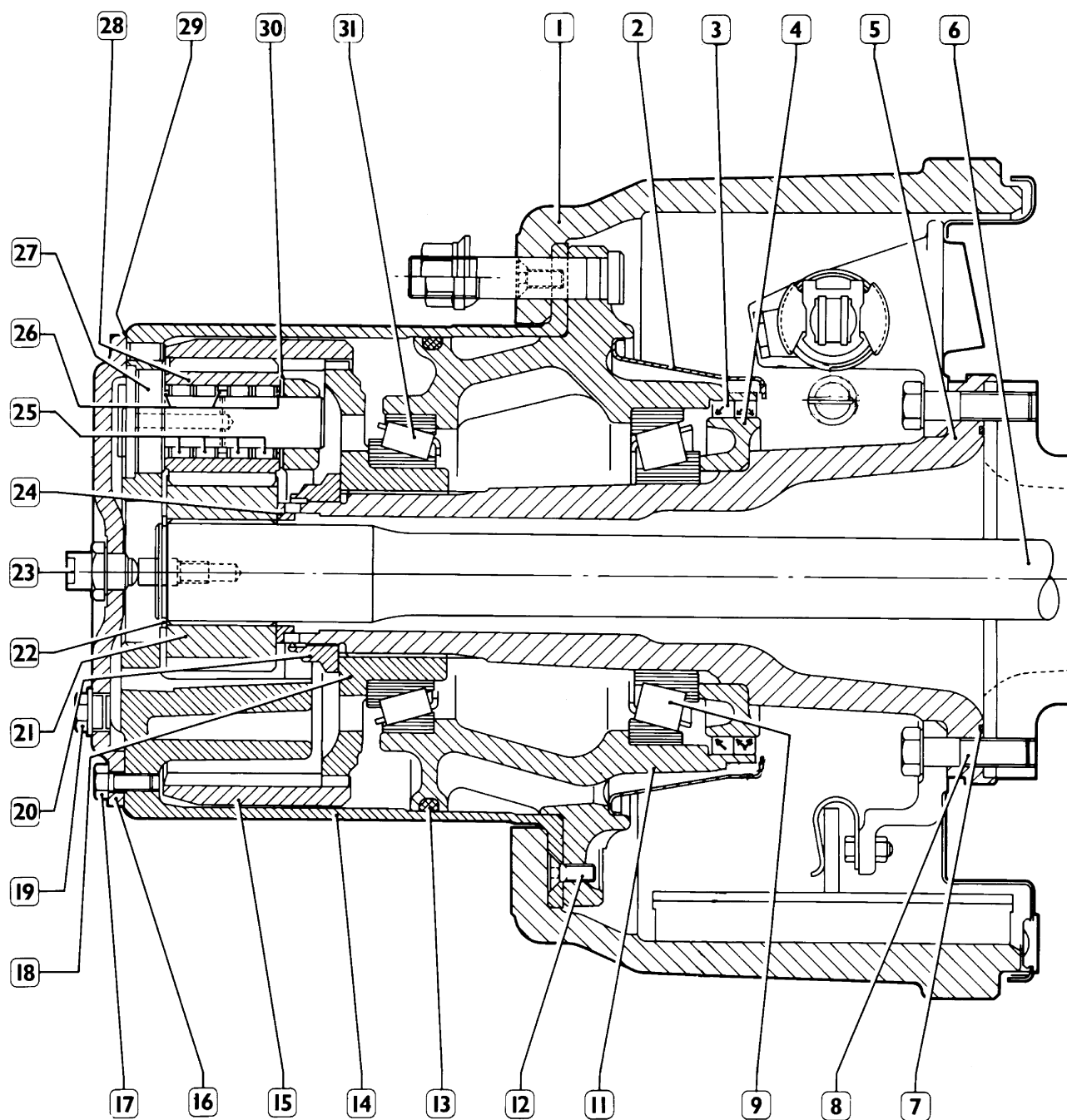
Figure 1



39385A

LONGITUDINAL PICTORIAL SECTION OF DIFFERENTIAL REDUCTION GEAR UNIT

Figure 2



40379

CROSS SECTION OF EPICYCLIC REDUCTION GEAR AND WHEEL HUB (45139)

1. Brake drum - 2. Oil manifold - 3. Seal rings - 4. Intermediate ring for sealing gasket - 5. Bearing shaft - 6. Half-shaft - 7. Seal ring - 8. Screw - 9. Bearing - 11. Wheel hub - 12. Screw - 13. Seal ring - 14. Planetary gear carrier - 15. Crown wheel - 16. Cover - 17. Screw - 18. Crown wheel carrier - 19. Plug - 20. Collar nut - 21. Planetary gear - 22. Circlip - 23. Spacer screw - 24. Spacer ring - 25. Needles for planetary gear - 26. Spacer rings - 27. Support pin - 28. Planetary gear - 29. Gasket - 30. Spacer - 31. Bearing

SPECIFICATIONS AND DATA

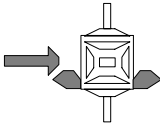
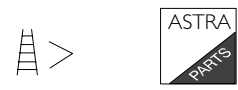
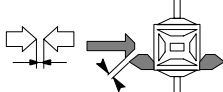
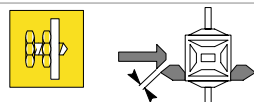
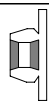
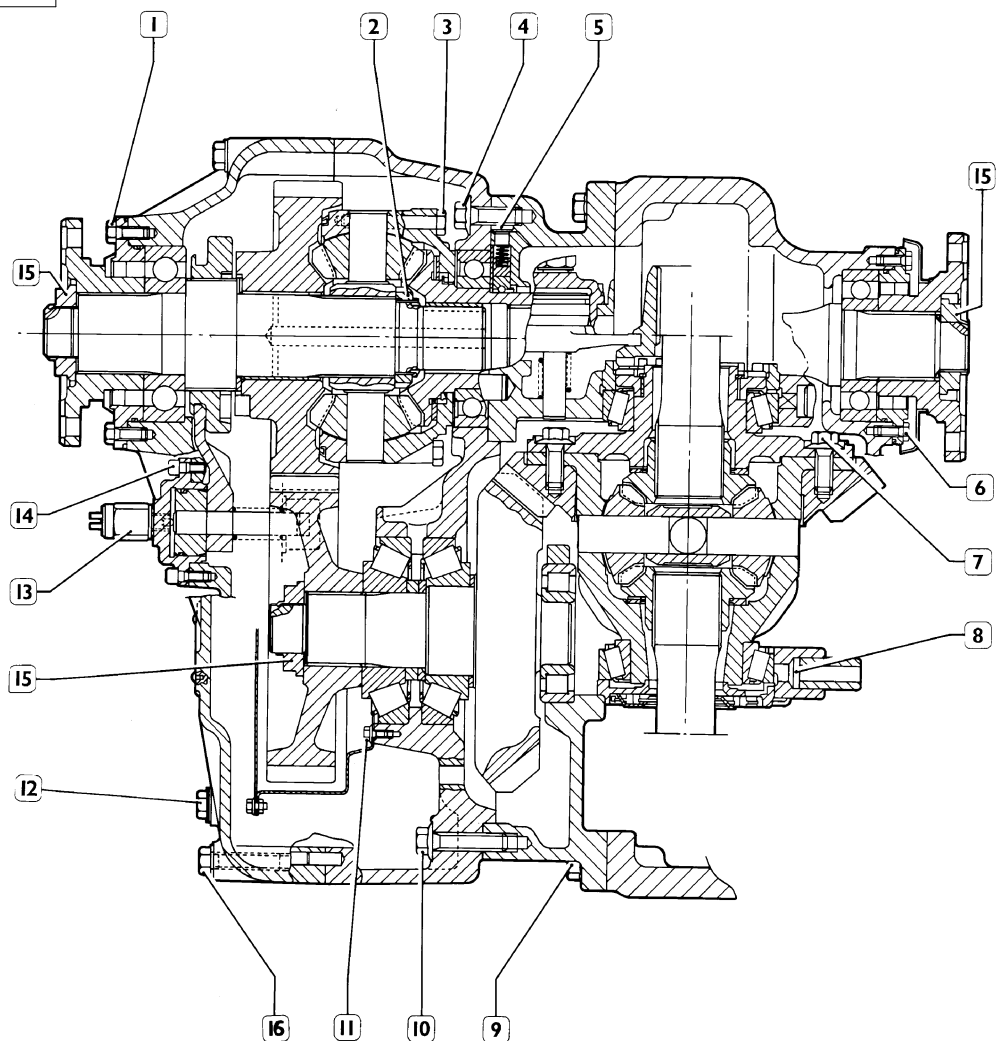
	Type of axle: Bearing with single reduction, differential is locked through pneumatic control and reduction gear unit	ASTRA 453291/2D (IVECO R 9189 D'001)
	Bearings for bevel pinion	2, with taper rollers and 1 with straight rollers
	Reduction bevel gear pair ratio	23/36 (1,565) - 19/33 (1,737) - 21/40 (1,905)
	Epicyclic reduction gear ratio on the wheels	3,2
	Bevel pinion bearings rolling torque Nm	1,5 ÷ 3,5
	Bevel pinion bearings rolling torque adjustment	through adjustment rings
	Thickness of adjustment rings for bevel pinion bearings rolling torque mm	10-10,02-10,04-10,06-10,08-10,10-10,12-10,14-10,16-10,18-10,20-10,22-10,24-10,26-10,28-10,30-10,32-10,34-10,36-10,38-10,40-10,42-10,44-10,46-10,48-10,50
	Thickness of adjustment rings for bevel pinion fitting with reference to the crown wheel mm	3,6-3,7-3,8-3,9-4,0-4,1-4,2-4,3-4,4-4,5-4,6
	Backlash between pinion and crown wheel mm	$23/36 (1,565) = 0,20 \div 0,29$ $19/33 (1,737) = 0,25 \div 0,33$ $21/40 (1,905) = 0,20 \div 0,28$
	Adjustment of backlash between pinion and crown wheel	Through ring
	WHEEL HUBS	
	Wheel hub bearings	Two with taper rollers
	Rolling torque of wheel hub bearings: new bearings with surface protection Nm	3 + (12 ÷ 16)
	Rolling torque of wheel hub bearings: run-in bearings and new lubricated seal rings Nm	3 + (5 ÷ 7)
	Rolling torque of wheel hub bearings: run-in bearings and seal rings Nm	3 + (2,5 ÷ 4,5)
	Half-shaft end play mm	0,5 ÷ 1

Figure 3

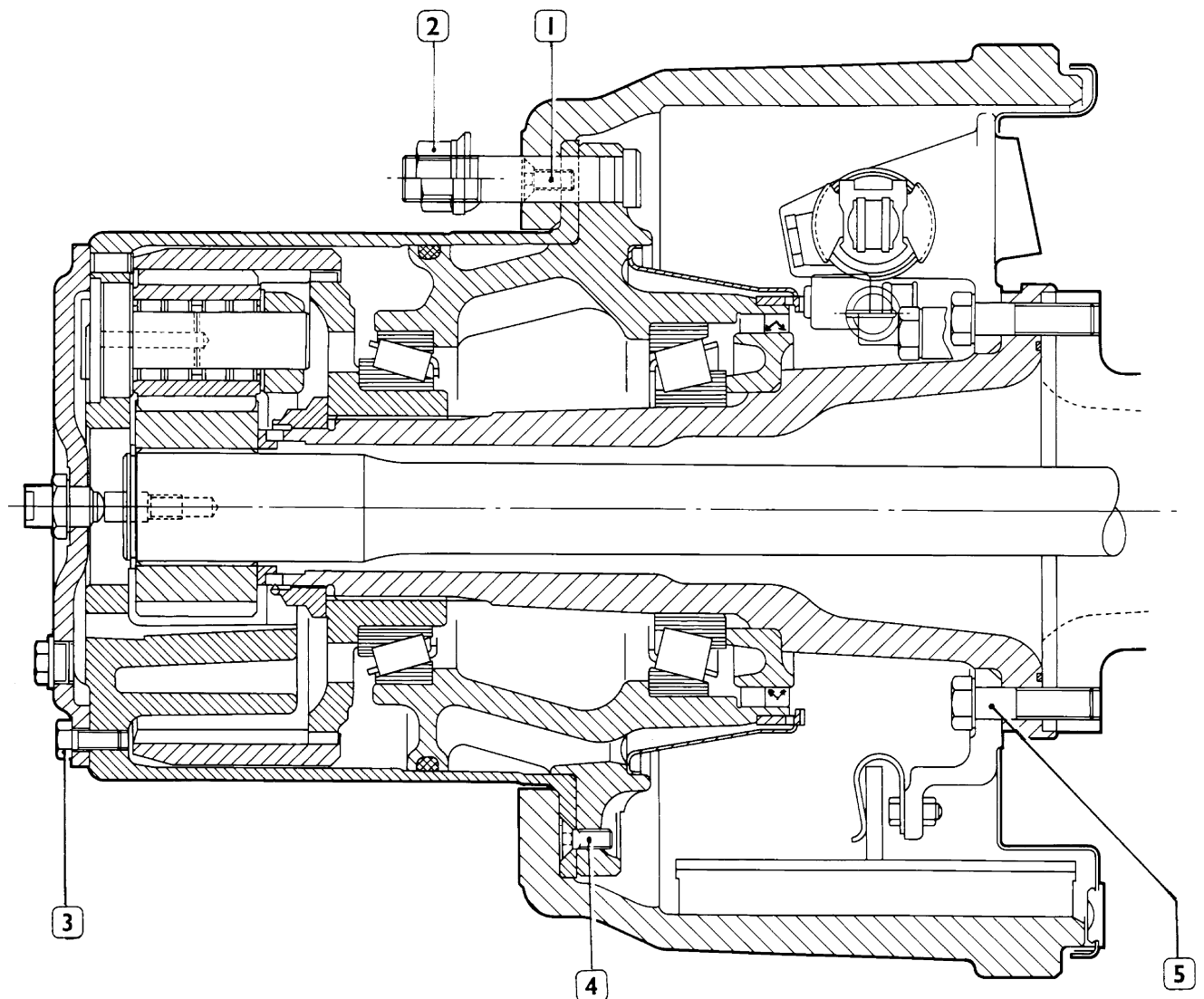


39385

TIGHTENING TORQUES

	COMPONENT	TORQUE	
		Nm	Kgm
1	Hexagonal socket head screw for cover	62 ± 6	$6,2 \pm 0,6$
2	Ring nut	230 ± 20	23 ± 2
3	Hexagonal socket head screw	67 ± 8	$6,7 \pm 0,8$
4	Self-locking screw	260 ± 25	$26 \pm 2,5$
5	Threaded plug M12x1.5	21 ± 2	$2 \pm 0,2$
6	Hexagonal socket head screw for cover	33 ± 3	$3 \pm 0,3$
7	Self-locking screw	300 ± 10	30 ± 1
8	Self-locking screw to fasten safety plate	51 ± 5	$5 \pm 0,5$
9	Self-locking screw	260 ± 25	$26 \pm 2,5$
10	Self-locking screw	260 ± 25	$26 \pm 2,5$
11	Self-locking screw to fasten oil drain	16 ± 2	$1,6 \pm 0,2$
12	Threaded plug	110 ± 10	11 ± 1
13	Transmitter	66 ± 1	$6,6 \pm 0,1$
14	Cap screw	25 ± 2	$2,5 \pm 0,2$
15	Self-locking nut	700 ± 50	70 ± 5
16	Screw for cover	182,5	18,2
*	Caps to gear housing M16 fastening screw	270 ± 10	27 ± 1

Figure 4



39384

	COMPONENT	TORQUE	
		Nm	Kgm
1	Flathead screw to fasten drum	25 ± 3	$2,5 \pm 0,3$
2	Wheel fastening nut	650	65
3	Planetary gear carrier to cover fastening screw ●	50 ± 5	$5 \pm 0,5$
4	Flathead screw	25 ± 3	$2,5 \pm 0,3$
5	Supporting sleeve fastening screw ◆	280 ± 15	$28 \pm 1,5$
	● Use LOCTIT AVX to lock ◆ Spread Hylomar SQ 321M sealant		

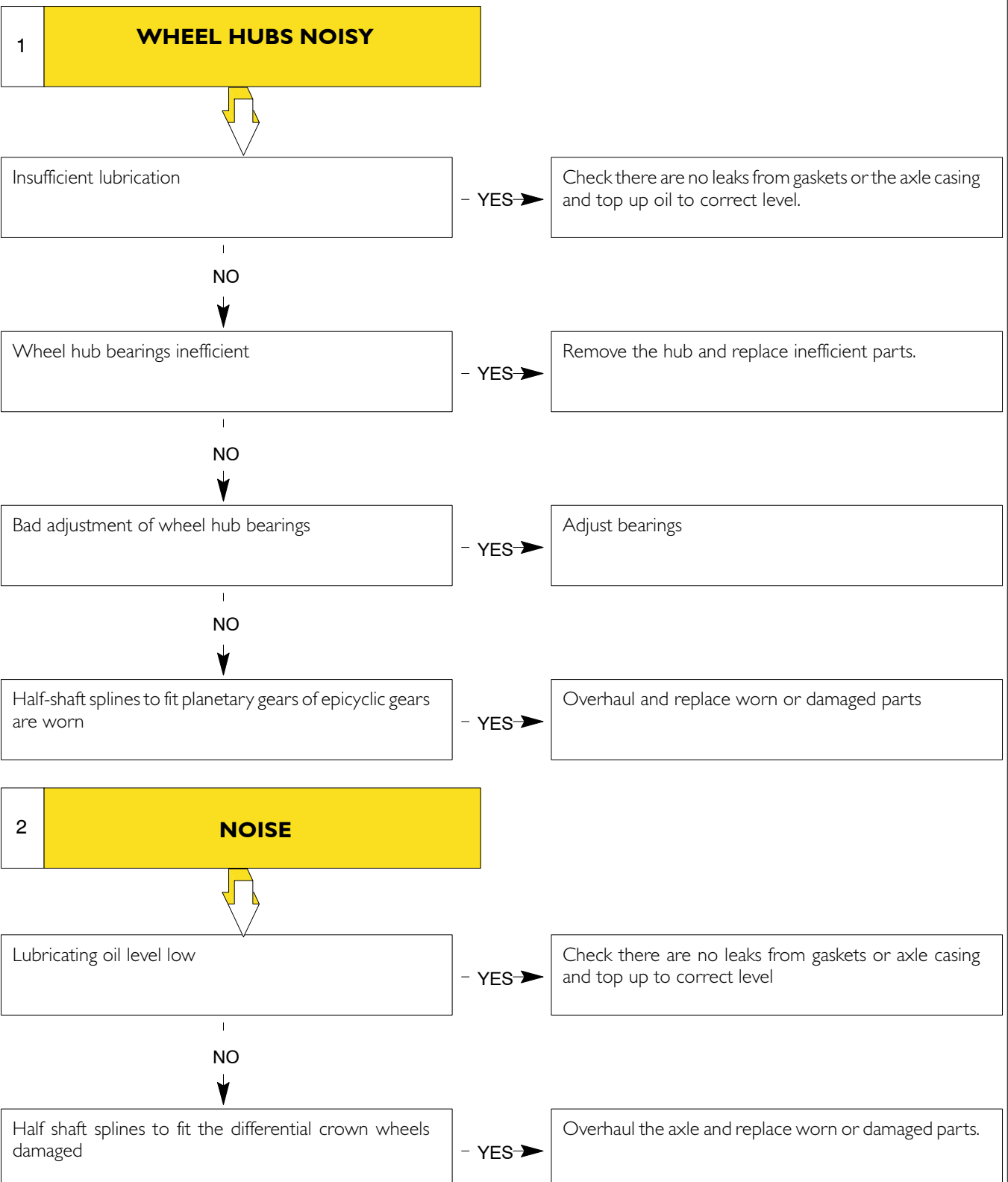
TOOLS

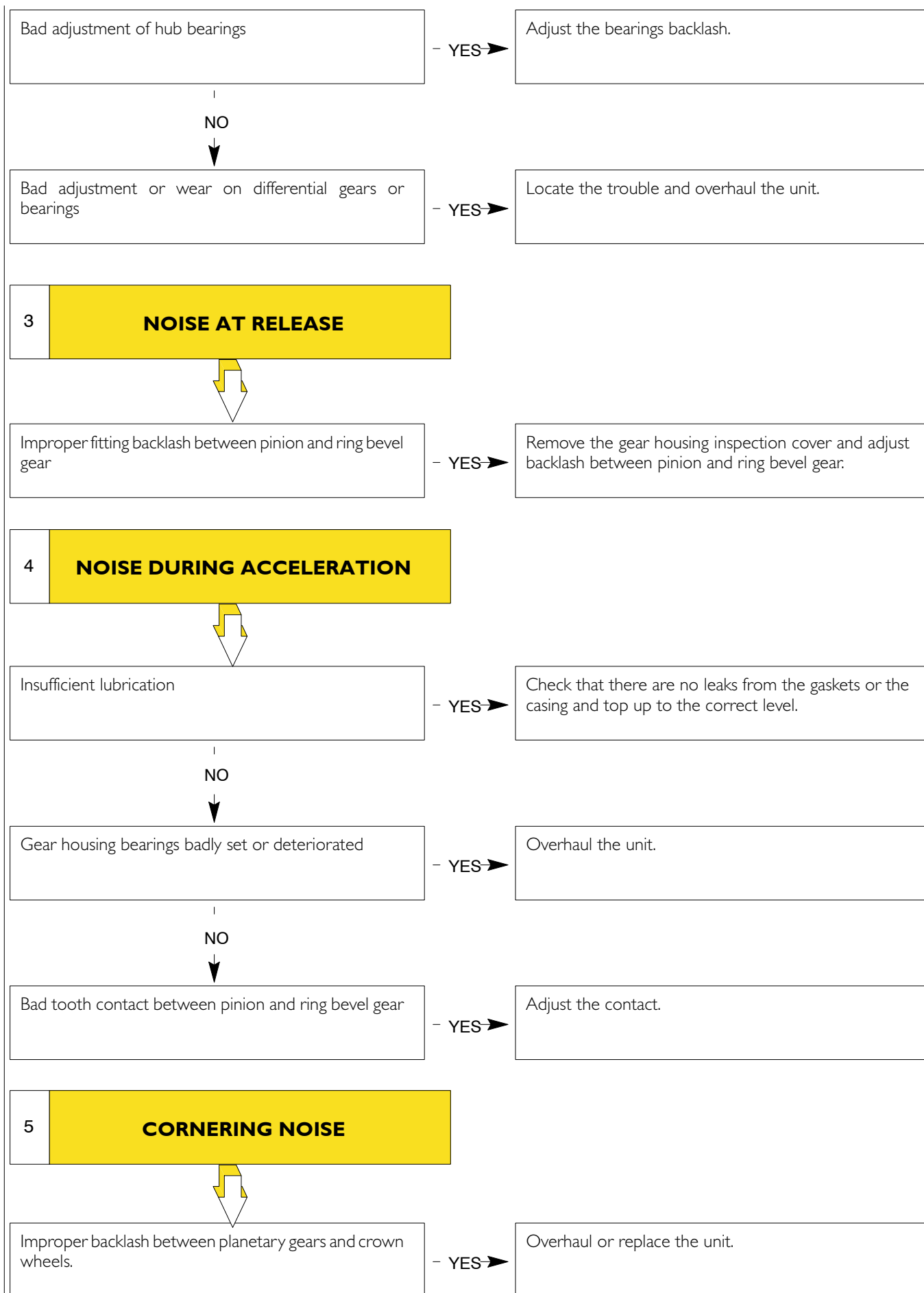
TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99322225	Unit holder (to be mounted on stand 99322205)
99341003	Puller
99341017	Pair of brackets with holes
99345053	Counter block for pullers
99354001	Wrench for differential gearcase bearing adjustment ring nut
99355081	Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99355121	Wrench for reduction gear unit main shaft ring nut
99363310	Tool for spur gear stop on reduction gear bevel pinion
99370005	Handle for interchangeable beaters
99370007	Handle for interchangeable beaters
99370122	Beater to fit in place the crown wheel bushes in the reduction gear main shaft
99370133	Tool to lock differential cap angle
99370217	Lever and relevant extension bar
99370509	Hook to remove differential gearcase half box
99370630	Support to hold reduction gear unit during removal/re-fitting in place
99374013	Element to fit in place the differential bevel pinion gasket (to be used with 99370006)
99374094	Beater to fit in place bearings outer tracks (134-215) (to be used with 99370007)
99374233	Element to fit in place seal ring on reduction gear unit driving shaft
99374235	Element to fit in place front seal ring on reduction gear unit crown wheel main shaft
99374272	Element to fit in place rear seal ring on reduction gear unit crown wheel main shaft (to be used with 99370006)
99389816	Torque multiplier (x4) with square input coupling 3/4" output 1" (max. 2745 Nm)
99389819	Dynamometric wrench 0 to 10 kgm connection 1/4"
99389821	Dynamometric wrench 0 to 70 kgm connection 3/8"
99395026	Tool to check hubs rolling torque (to be used with dynamometric wrench)
99395027	Tool to find proper differential bevel pinion adjustment shims (to be used with 99395603)
99395603	Dial gauge (0-5 mm)

DIAGNOSTIC

Main axle faults:

- 1 - Wheel hubs noisy
- 2 - Noise
- 3 - Noise at release
- 4 - Noise during acceleration
- 5 - Cornering noise





REMOVING - REFITTING THE INTERMEDIATE AXLE

Removal

To remove the intermediate axle proceed as follows:

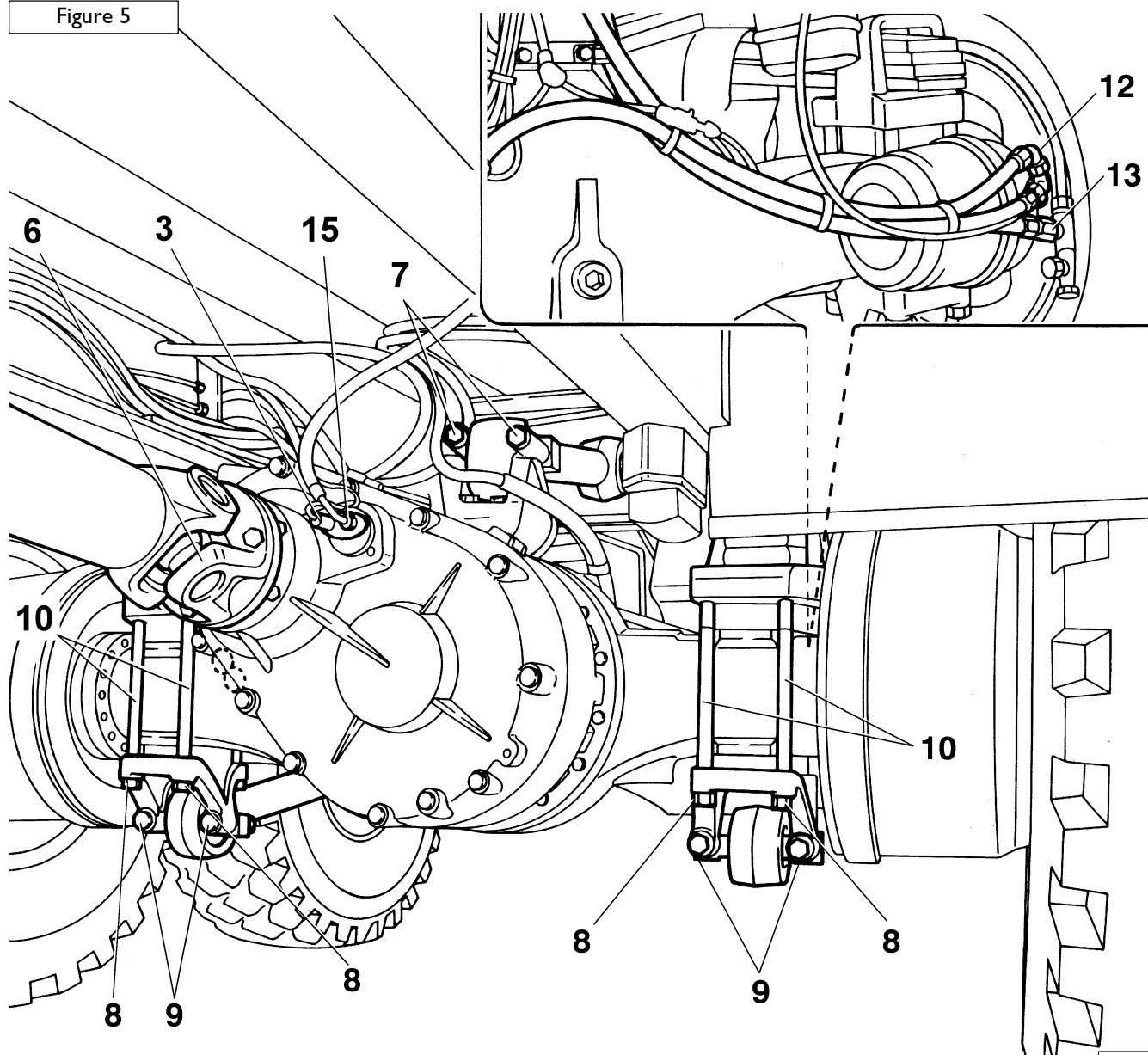
- ☐ place the vehicle on a flat ground and suitably lock the front wheels;
- ☐ loosen both rear wheel fastening nuts;
- ☐ using a hydraulic jack lift the rear part of the vehicle and rest it on two stands;
- ☐ remove both rear wheels;
- ☐ disconnect the electrical cable (2) for the differential led and the electrical cable (3) for the led signalling the differential connection between axles;
- ☐ disconnect the pneumatic connections for parking brake (12), brake air delivery (13), differential locking (14) and differential locking between axles (15);

- ☐ undo the screws fixing the flange to input (6) and output (not shown) propeller shaft and secure temporarily the shafts to the chassis to avoid interference during next operations;
- ☐ remove the bolts (7) fixing the axle securing upper rod;
- ☐ unscrew the bolts (8) fixing the axle securing lower rod from both sides;
- ☐ set a hydraulic jack fitted with tool 99370617 under the axle;
- ☐ unscrew the nuts (9) from both sides and lift the leaf spring fixing brackets (10) then, lower the axle and take away the leaf spring.

Refitting

To refit, follow the removal operations in reverse order.

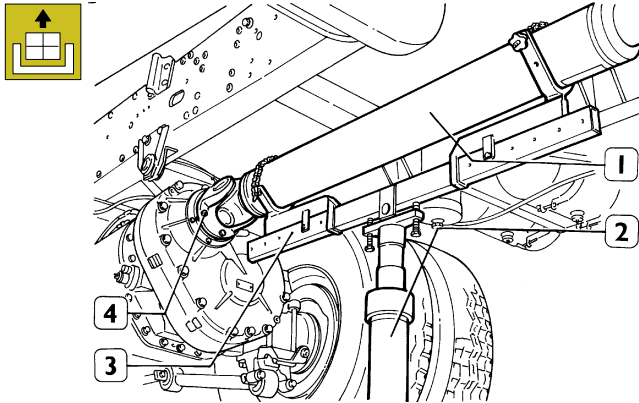
Figure 5



REMOVAL-RE-FITTING IN PLACE THE DIFFERENTIAL-REDUCTION GEAR UNIT (with axle on vehicle)

Removal

Figure 6



Set a hydraulic jack (2) equipped with support 99370618 (3) under the propeller shaft (1)

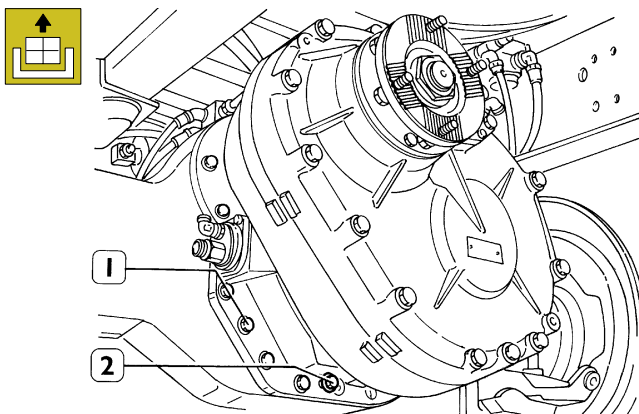
Unscrew the flange (4) screws and nuts to release the propeller shaft (1) from the intermediate axle.

Lower the hydraulic jack completely, thus removing the propeller shaft.

Disconnect the air hoses and electrical connections from the differential locking control and the reduction gear unit control. Unscrew the bottom plug and drain the oil.

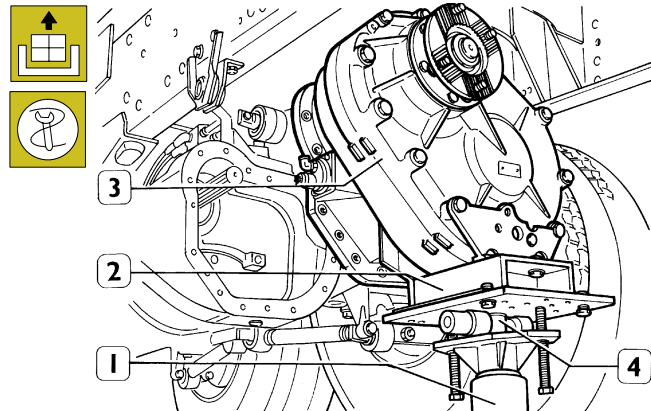
Draw out the half shafts as described in the relevant section.

Figure 7



In the two threaded holes (⇒), insert two suitable screws to act as puller for the differential-reduction gear unit.

Figure 8



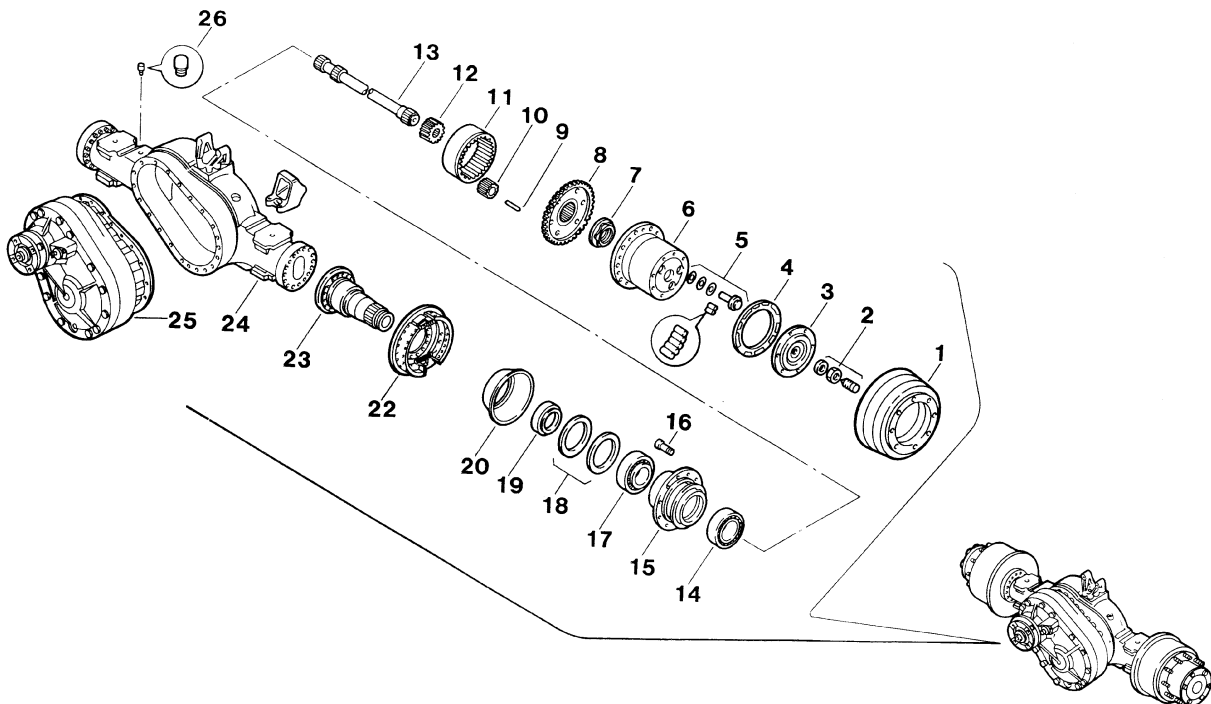
Using the hydraulic jack (1) place bracket 99370630(2) with device 99370329 (4) underneath the differential-reduction gear unit (3); remove the fastening screws, tighten the two counteracting screws to pull out the unit from the axle casing.

Re-fitting

Repeat the removal operations in reverse, taking the following precautions:

- ☐ Clean with care and spread LOCITE 573 on the contact surfaces of the differential housing and the half-shaft covers, replace the seal gaskets;
- ☐ check that the differential locking control fork engages on the sleeve;
- ☐ tighten all screws to prescribed torque;
- ☐ connect air hoses and electric cables;
- ☐ restore the oil in axle housing.

Figure 9



40409

WHEEL HUB COMPONENTS

1. Brake drum – 2. Adjusting nut and screw – 3. Cover – 4. Gasket – 5. Planetary gear pin and rollers – 6. Planetary gear carrier – 7. Adjusting nut – 8. Crown wheel carrier – 9. Shoulder pin – 10. Planetary gear – 11. Crown wheel – 12. Crown wheel gear – 13. Half-shaft – 14. Bearing – 15. Wheel hub – 16. Bolt – 17. Bearing – 18. Seal ring – 19. Support ring – 20. Oil cup – 22. Brake assembly – 23. Bearing shaft – 24. Axle casing – 25. Differential-reduction gear unit assembly – 26. Bleeder

INTERMEDIATE AXLE ASSEMBLY REPAIR OPERATIONS

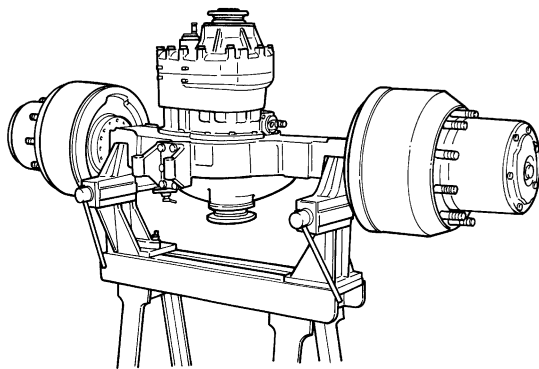
Removal



The removal/re-fitting in place operations on the half-shafts - brake drums and shoes - air bleeder - differential reduction gear unit - wheel hubs and epicyclic reduction gears can all be carried out with the unit fitted on the vehicle.

Before setting the axle assembly on the stand to overhaul, unscrew the bottom plug on the axle casing and drain the oil.

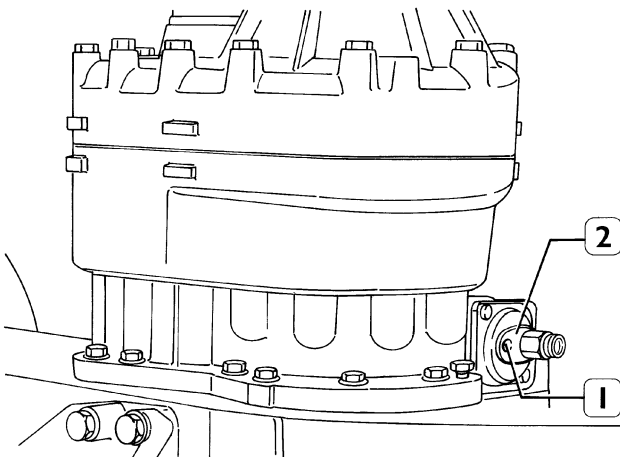
Figure 10



40052

Set up the axle assembly on stand 99322215.

Figure 11



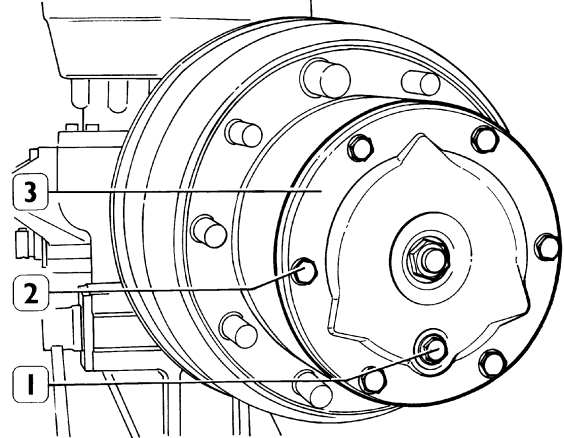
40337

Lock the sliding sleeve of the differential locking device with a screw.

To do this, remove the threaded coupling from the control cylinder (2) and in its place (1) fit a screw (M14x1.5). At the same time, turn the axle mechanism to obtain the engagement between the sliding sleeve and the engaging sleeve; this will prevent accidental movement of the sleeve while removing the half-shaft.

Removing the epicyclic reduction unit

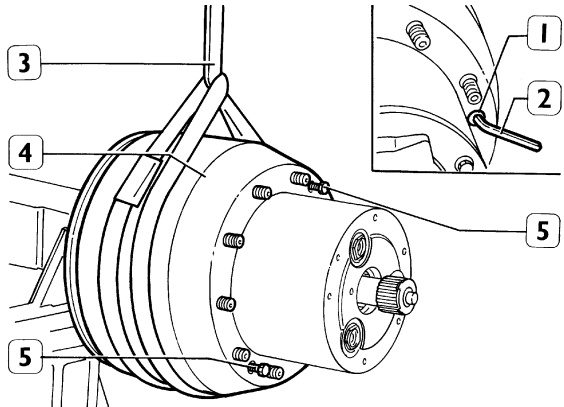
Figure 12



40053

Place a container under the wheel hub. Remove the screws (2); remove the cover (3) and collect the oil.

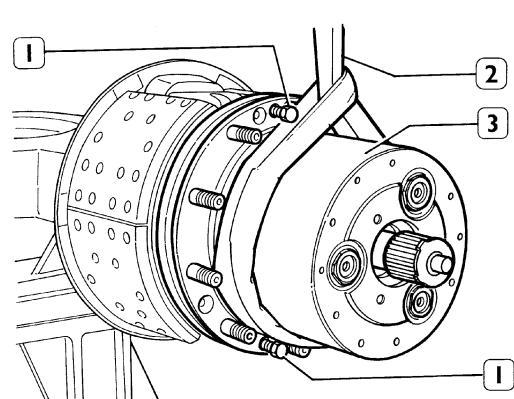
Figure 13



40338

Using a socket wrench (2) remove the 2 drum stop screws (1); fit the counteracting screws (5) in their place, tighten them, releasing the drum (4) from the hub, then with a rope (3) and lifting device, remove it.

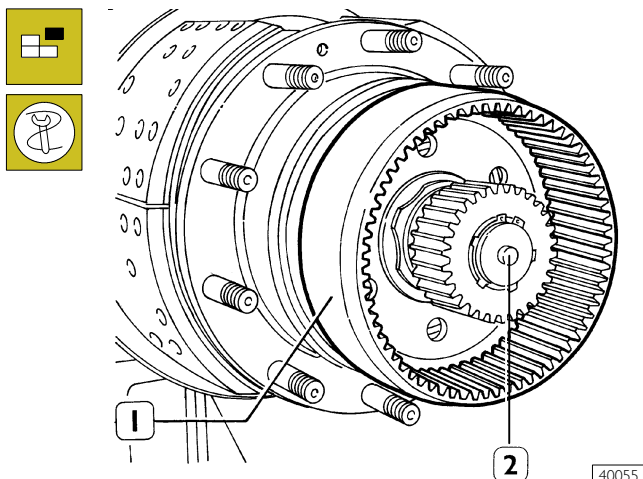
Figure 14



40054

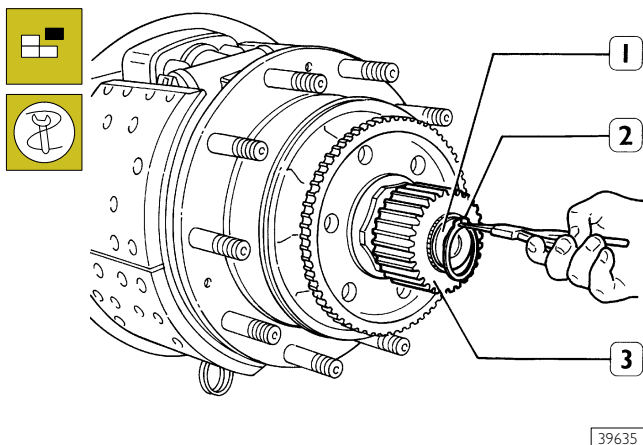
Remove the 3 planetary gear carrier stop screws (3); tighten the counteracting screws (1) and use a rope (2) to remove the carrier (3).

Figure 15



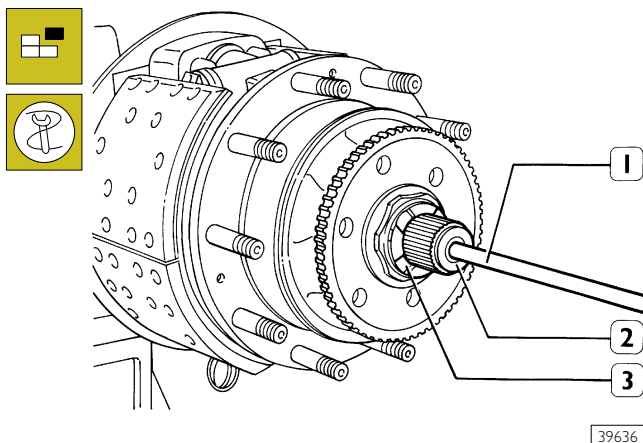
Draw out the crown wheel (1) from the crown carrier.
Remove the shoulder pin (2)

Figure 16



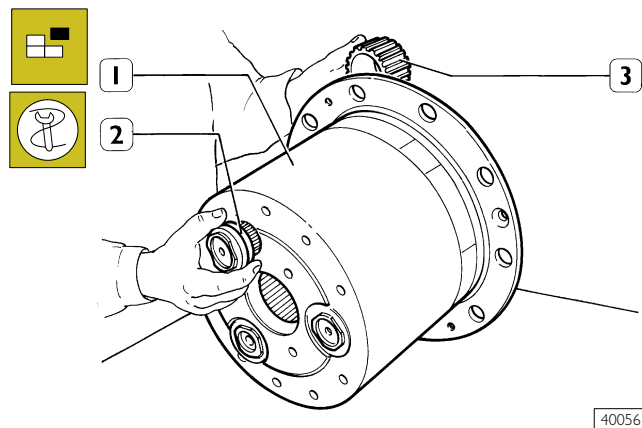
Using suitable pliers remove the circlip (2), withdraw the planetary gear (3) from the half-shaft (1).

Figure 17



Screw tool 99374451 (1) into the shoulder pin seat and withdraw the half-shaft (2) from the bearing shaft.
Remove the spacer ring (3)

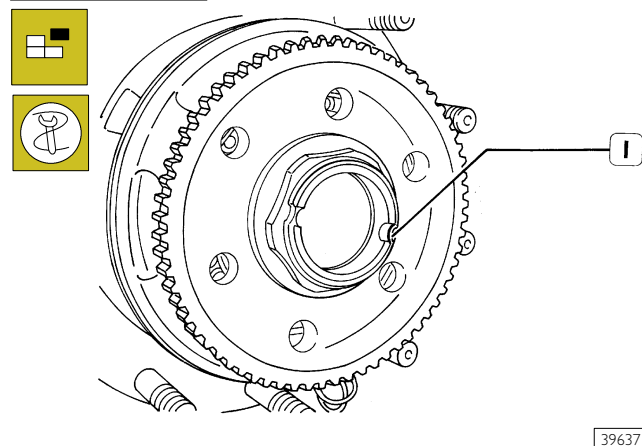
Figure 18



Extract the support pins (2) from the planetary carrier (1).
Remove the planetary gears (3) from the support (1) and recover the needles and spacer rings.

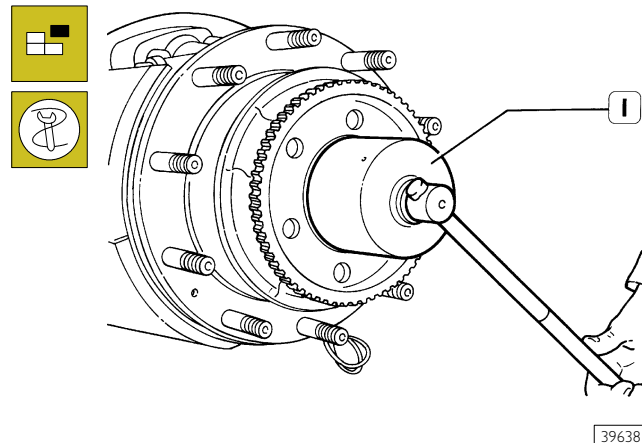
Removing the wheel hubs

Figure 19



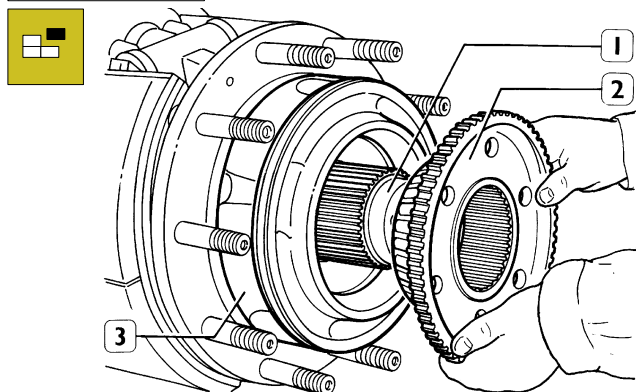
Using a suitable punch straighten the dents (1) on the adjusting nuts.

Figure 20



Using socket wrench 99354207 (1) unscrew the adjusting nut.

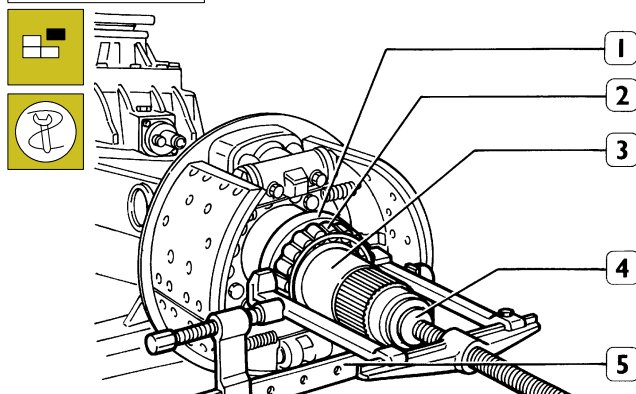
Figure 21



39639

Withdraw the bearing shaft (1), the crown wheel carrier (2) with relevant bearing and wheel hub (3)

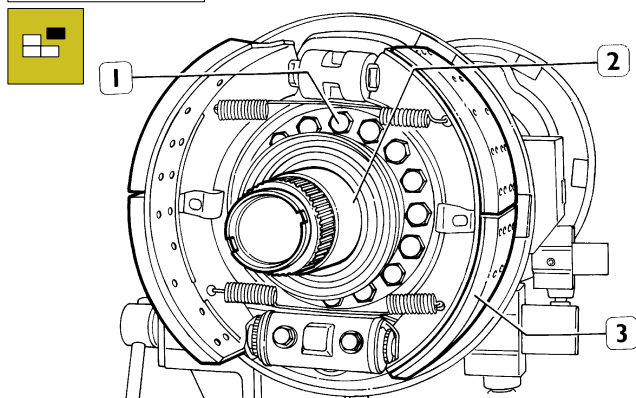
Figure 22



39640

Using a puller and clamp (5) and counteracting block 99345055 (4), remove the gasket ring (1) with the taper roller bearing (2) from the bearing shaft (3).

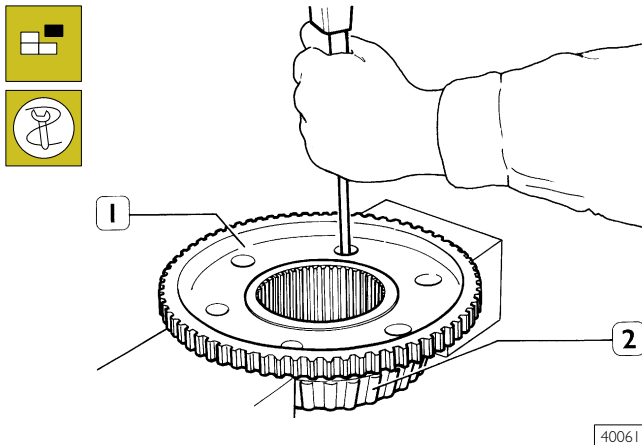
Figure 23



40060

Check the bearing shaft (2) and if it is damaged replace it. Use the suitable tool to release the brake shoes (3) and after unscrewing the hexagonal screws (1) glued with LOCTITE, remove the brake carrier plate with bearing shaft.

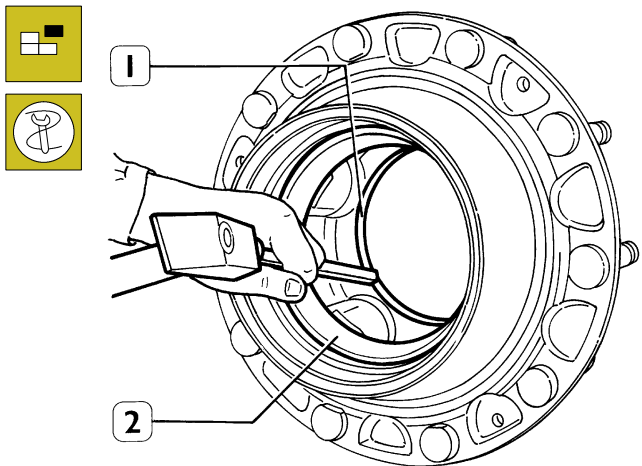
Figure 24



40061

Using the appropriate beater fitted through the 3 holes on the crown carrier, eject the outer taper roller bearing (2) from the crown wheel carrier (1).

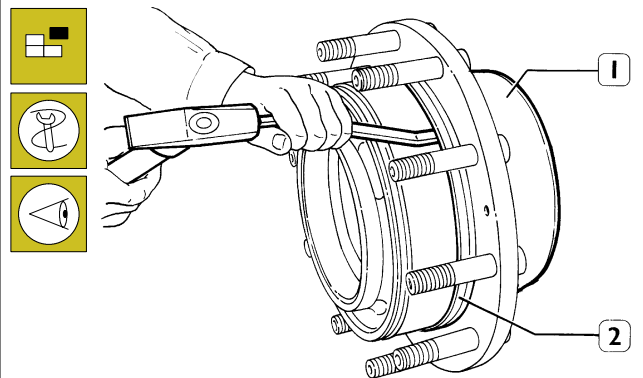
Figure 25



40062

Using the appropriate tools, eject the outer and inner seal rings from the wheel hub. Use a bronze beater to release the cups (2 and 1) for the inner and outer bearings from the wheel hub.

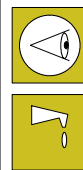
Figure 26



40063

Check the oil manifold (1) and if it is damaged, replace it. Use a beater inserted through the hub slots (2) to eject it.

Checks on the wheel hubs and epicyclic reduction gear components



Carefully clean the wheel hub components. Check the half-shafts to ensure they are not strained. If necessary straighten the half-shafts on a hydraulic press; if this operation does not give satisfactory results, replace them. Check the wheel fastening bolts; if they are strained or the threads are damaged, replace them. After fitting in place check under the press that the orthogonality error does not exceed 0.3 mm.

Lubricate the bearings and rotate the roller cage freely, the rotation must be even with no stiffness.

Check the hub bearing adjustment nuts and the threads on the bearing shafts; if necessary replace the nuts. Check the oil manifold, if it is damaged, replace it.

All sealing elements must be replaced with new ones.

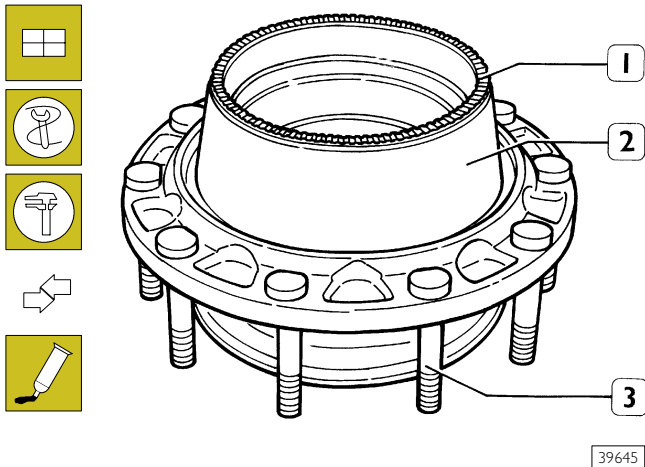
Carefully clean all the epicyclic reduction gear components. Make a visual check on the crown wheel teeth, the crown, the planetary wheels and planetary gears.

Check the spacer rings, shims, bearing rollers and support pins.

If any of these components are damaged or worn, replace them.

Fitting in place the wheel hubs

Figure 27

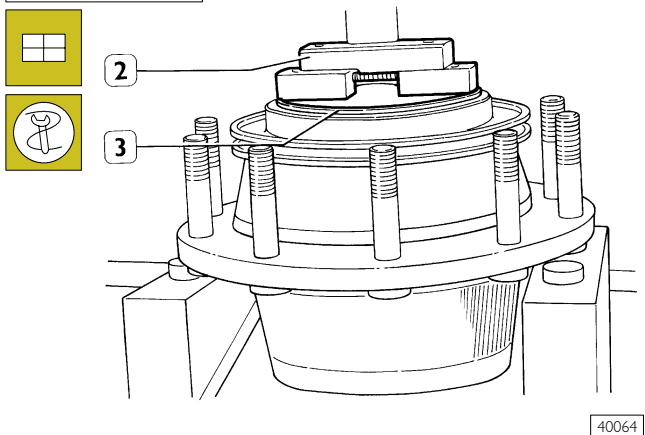


If it is necessary to replace the bolts (3), before fitting in place the new ones, check that the bolt head contact surface is free from swarf, burrs and dents.

After driving in the bolts, check that they are perfectly flush with the hub and that the orthogonality error does not exceed 0.3 mm.

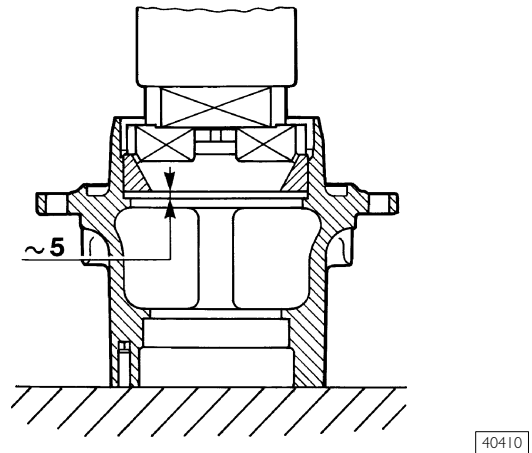
When replacing the oil cup (1), before fitting in place the new one, spread LOCTITE 573 on the contact surface between the hub and the cup housing.

Figure 28



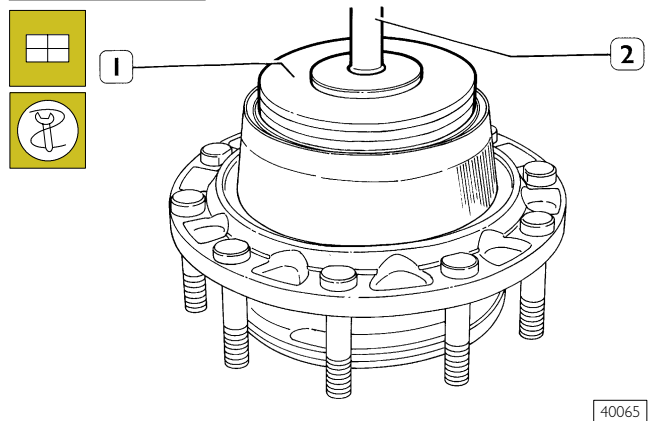
Using beater 99374094 (2) to fit (under the press) the outer ring of the outer bearing (3) leaving it approx 5 mm from the stop plate.

Figure 29



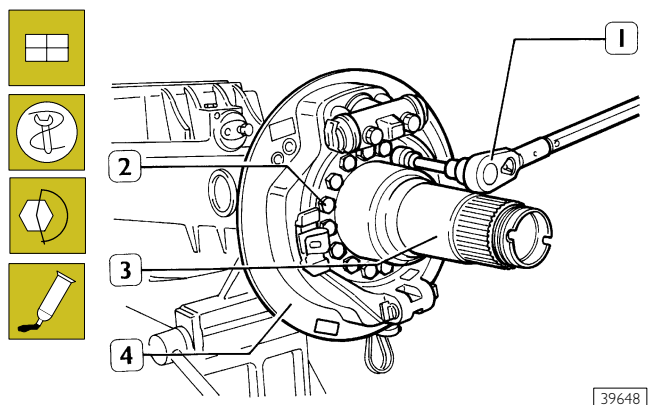
Finish driving in by hand, using handle 99370007. Repeat the operation for the outer ring of the inner bearing.

Figure 30



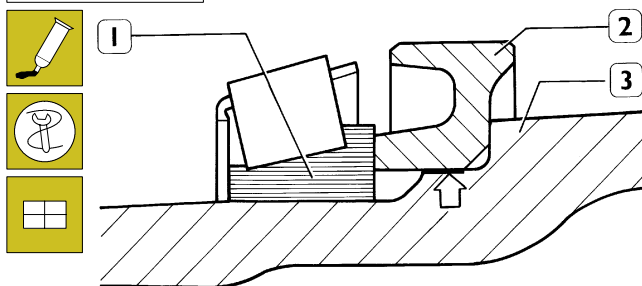
Use element 99374025 (1) with intermediate ring and handle 99370005 (2) to fit the internal seal ring. Fit the external seal ring using the same element but without the intermediate ring.

Figure 31



Set the seal ring on the bearing shaft, spread LOCTITE AVX on the contacting areas between the axle housing and bearing shaft. Fit in place the bearing shaft (3) with the brake carrier plate (4) and dust guard disk. Apply LOCTITE AVX to the screws (2) then lock them with a dynamometric wrench (1) to a torque of 280 ± 15 Nm.

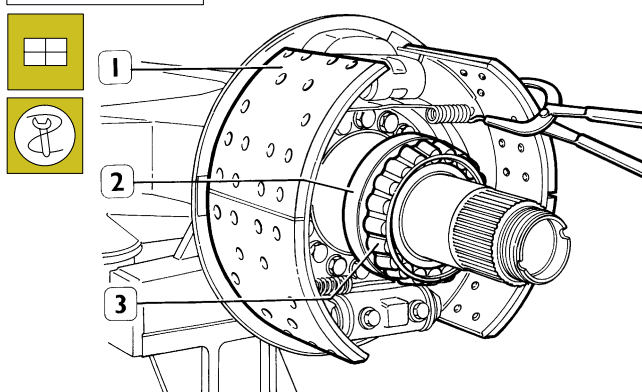
Figure 32



40375

Spread Hylomar SQ32IM sealer on the bearing shaft (3) seal ring (2) seat (⇒). Heat the ring (2) and connect it on the bearing shaft (3). Heat the taper roller bearing inner ring (1) to approx. 100°C and fit it on the bearing shaft.

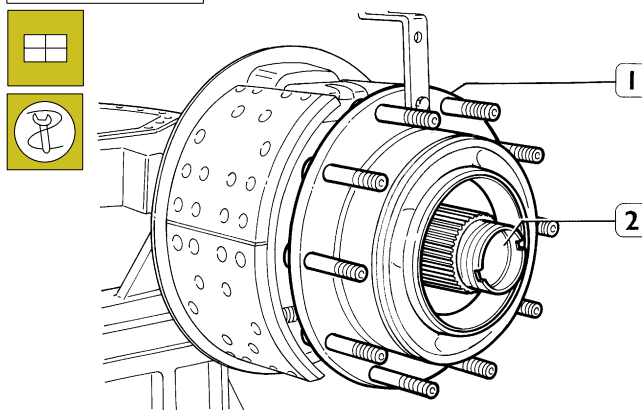
Figure 33



40067

Re-fit in place the brake shoes (1) using tool 99372217.

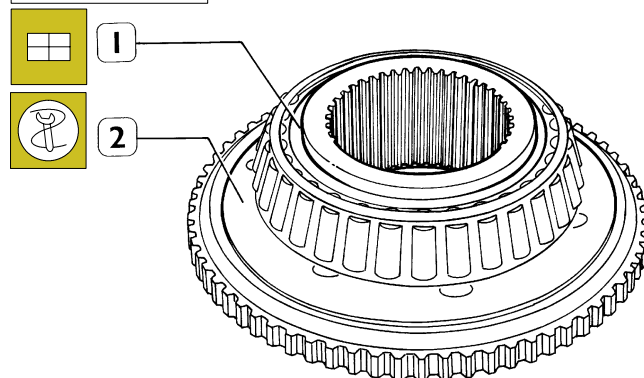
Figure 34



40068

Using the suitable tool set the complete hub (1) on the bearing shaft (2).

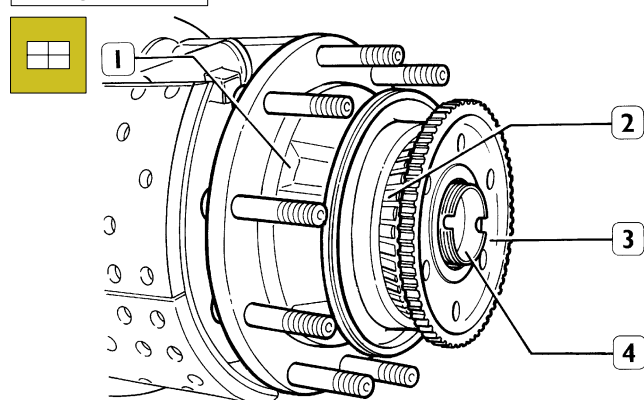
Figure 35



40377

Heat the taper roller bearing (1) to approx. 100°C and use a suitable beater to fit it in its seat on the crown wheel carrier (2)

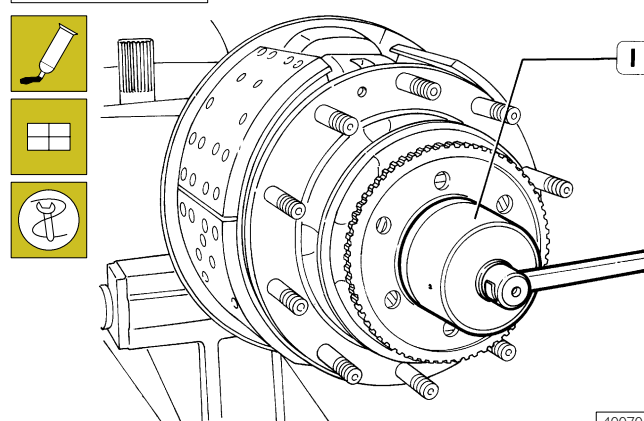
Figure 36



39650

Connect the crown carrier (3) with the taper roller bearing (2) on the bearing shaft (4)

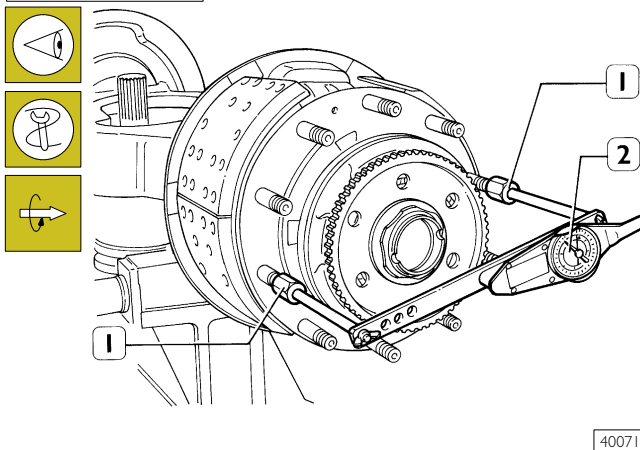
Figure 37



40070

Apply a thin coating of Molycote to the adjusting nut contact surfaces, fit in the nut and use wrench 99354207 (1) to tighten until it becomes difficult to turn the hub. Release the hub by hammering it axially in both directions.

Figure 38



Set up equipment 99395026 (1) and with a torque wrench (2) find the rolling torque of the wheel hub

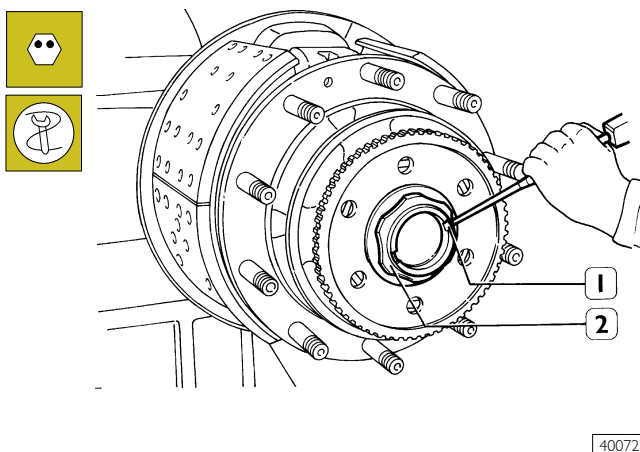


During the operation to find the rolling torque of the wheel hub, the rotation must not exceed 40 r.p.m.

The hub rolling torque values vary according to the following conditions:

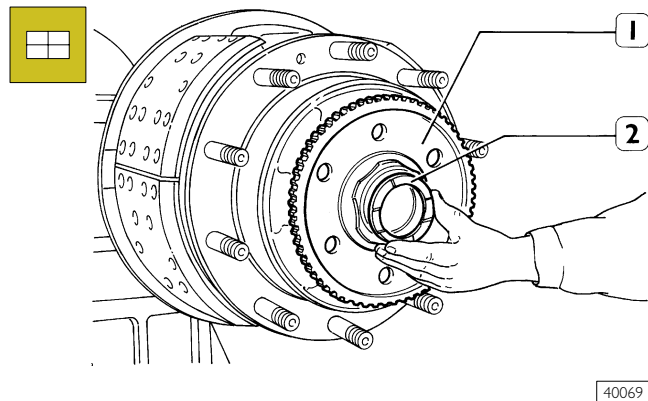
- | | |
|--|---------------------------------|
| ☐ new bearings with surface protection | $3 + (12 \div 16) \text{ Nm}$ |
| ☐ run-in bearings and new lubricated seal rings | $3 + (5 \div 7) \text{ Nm}$ |
| ☐ run-in bearings and seal rings | $3 + (2,5 \div 4,5) \text{ Nm}$ |

Figure 39



After the specified rolling torque has been obtained, use an appropriate punch to dent the adjusting nut (2) in the grooves on the bearing shaft (1)

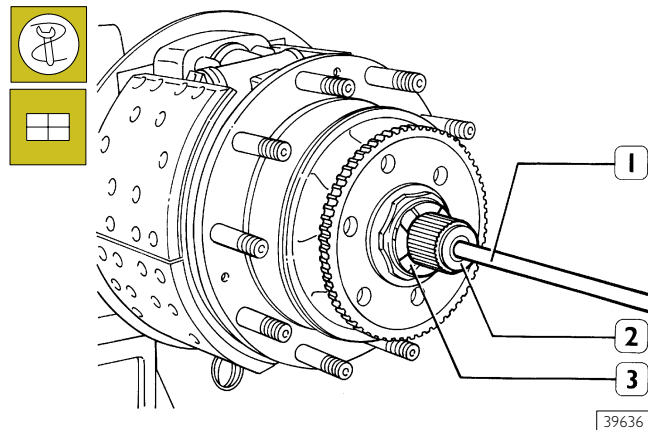
Figure 40



Fit the spacer ring (2) in the bearing shaft

Fitting in place the epicyclic reduction unit

Figure 41

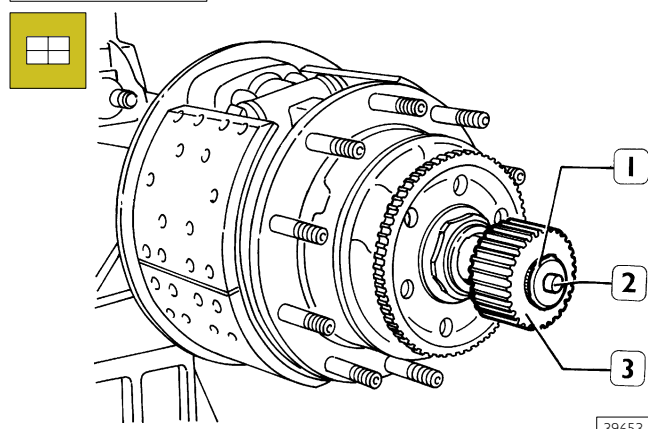


Using tool 99374451 (1) fit the half-shaft (2) in the bearing shaft (3)



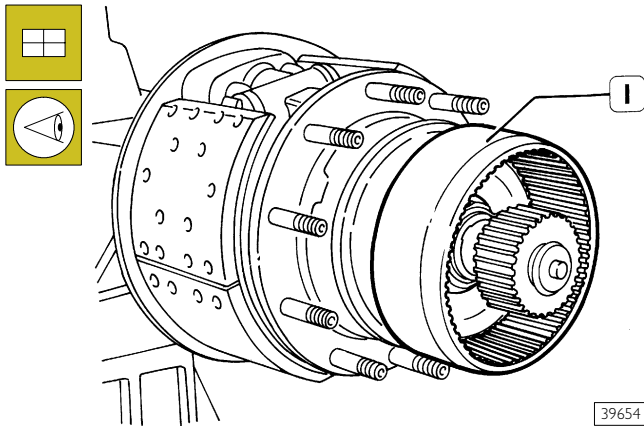
Fit the short half-shaft with twin teeth in the bearing shaft on the differential locking side.

Figure 42



Set the planetary gear (3) on the splined section of the half-shaft and the circlip (1) in its seat. Force the shoulder pin (2) into its seat on the half-shaft.

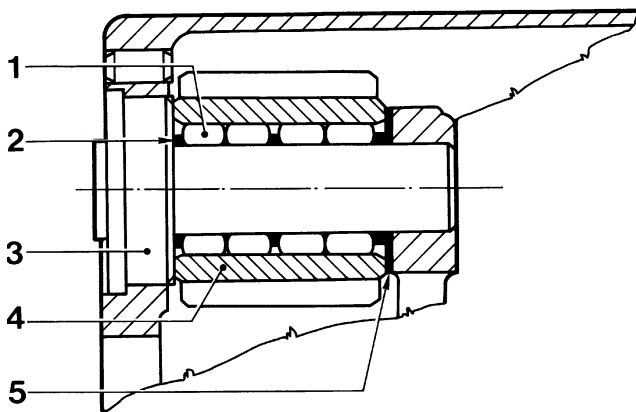
Figure 43



39654

Position the crown wheel (1) with the chamfer outwards then set it on the crown wheel carrier.

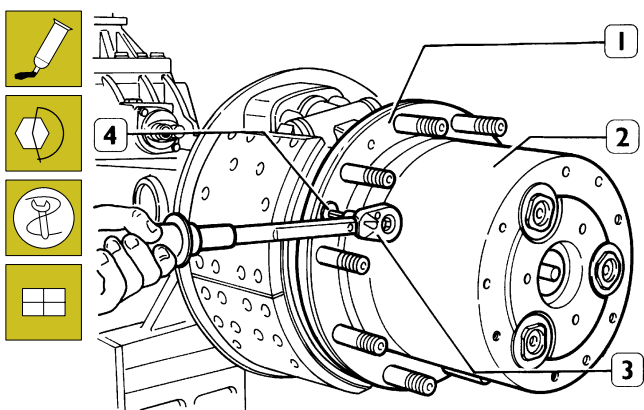
Figure 44



26916

Grease the needles (1) set them with three spacer rings (2) in the planetary gear (4) as shown in the figure. Insert the planetary wheel (4) and the spacer washer (5) in the planetary carrier support. Insert the support pin (3) from the cover side, pushing it fully into its seat. Repeat the same operation for the other two planetary gear units.

Figure 45



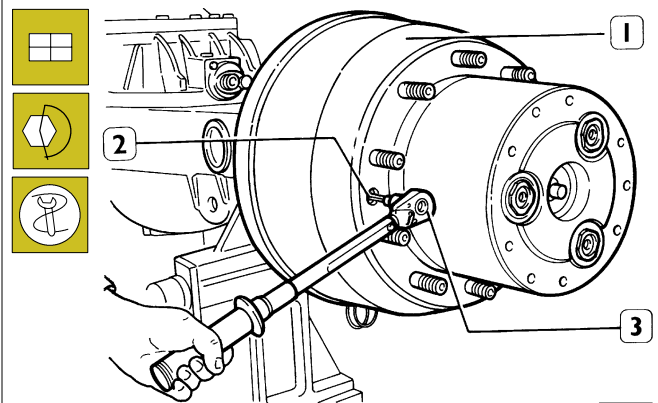
39655

Spread a thin coating of Hylomar SQ 321 M or Reinzoplast sealant paste on the planetary gear support (2) and wheel hub (1) contact surfaces.

Push the planetary gear support (2) onto the hub; to mesh the teeth more easily, move the coupling flange alternately in both directions. Take care that the holes to fasten the planetary supports to the hub coincide.

Insert the three flathead screws (4) and tighten with a dynamometric wrench (3) to a torque of 25 ± 3 Nm.

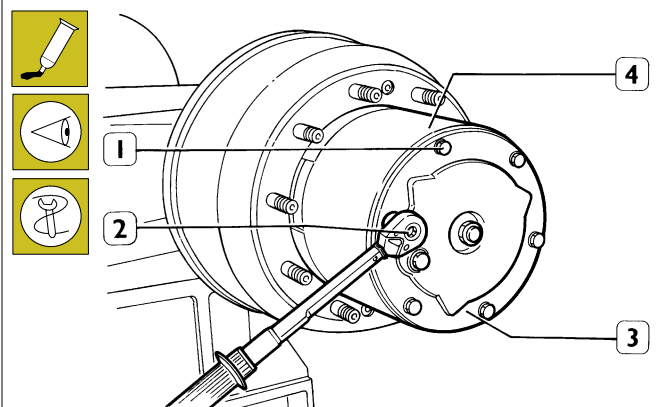
Figure 46



39656

Fit in place the brake drum (1) on the planetary gear support. Clamp down the brake drum with the two flathead screws (2) and use a dynamometric wrench (3) to obtain a torque of 25 ± 3 Nm.

Figure 47



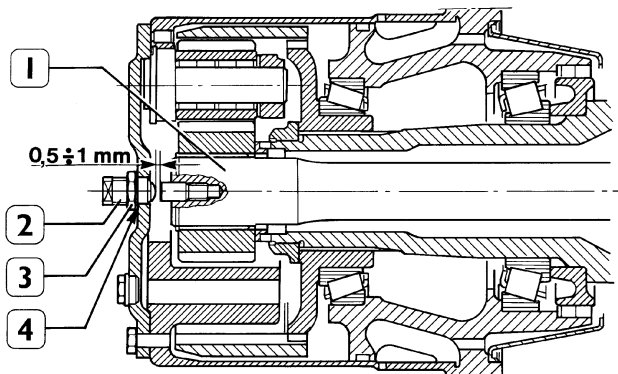
40073

Spread a thin coating of Hylomar SQ 321 M sealant paste on the contact surfaces of the cover (3) and the planetary gear support (4).

Position the cover so that the support pin chamfers coincide with the cover grooves.

Apply sealant paste to the screw (1) threads and tighten the screws with a dynamometric wrench (2) to a torque of 50 ± 5 Nm.

Figure 48



26924

The half-shaft (1) end play should be within the range of 0.5 - 1 mm.

To adjust, tighten the adjusting screw (2) to the stop then return half a turn and lock it with the hexagonal nut (3)



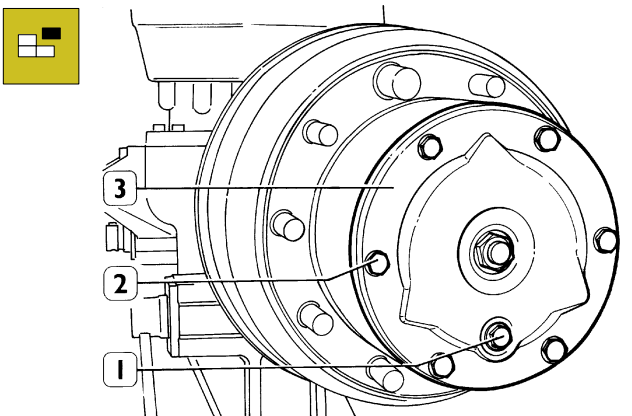
The flat surface of the hexagonal nut must be directed toward the seal ring (4).

REMOVAL-RE-FITTING IN PLACE OF THE DIFFERENTIAL-REDUCTION GEAR UNIT (with axle on stand 99322215)

Removal

Place the axle assembly on stand 99322215

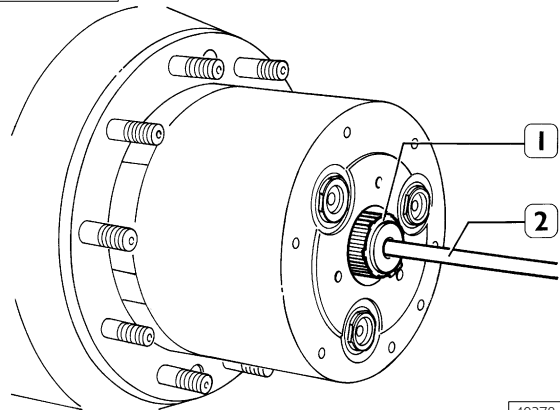
Figure 49



40053

Place a container under the wheel hub; remove the screws (2) and the cover (3), collect the oil.

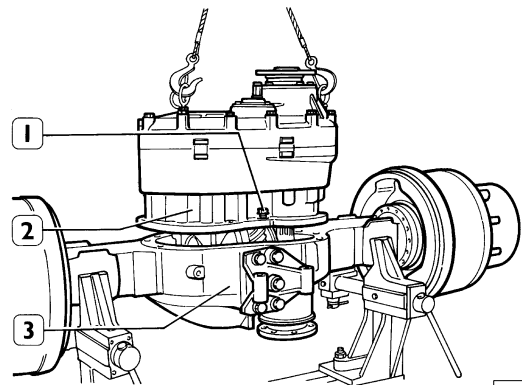
Figure 50



40378

Remove the shoulder pin and fit tool 9937445 I (2) in its place, partially withdraw the half-shaft (1). Repeat the operation on the other side.

Figure 51



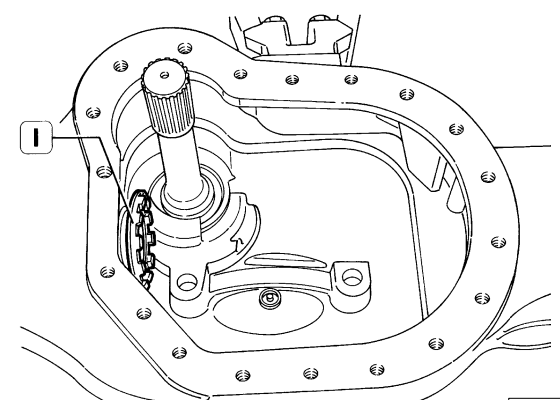
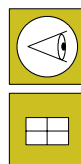
40074

Remove the screws that fasten the differential-reduction gear unit (2) to the axle casing (3), tighten the counteracting screws (1). With lifting device, eye bolts and steel ropes withdraw the unit from the axle casing.

Re-fitting in place

To re-fit in place, follow the removal steps in the reverse order taking the following precautions:

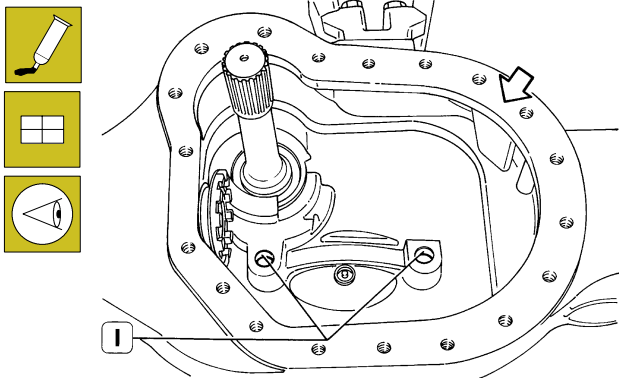
Figure 52



40075

to engage the differential locking, the sliding sleeve (1) must be placed on the twin-tooth half-shaft.

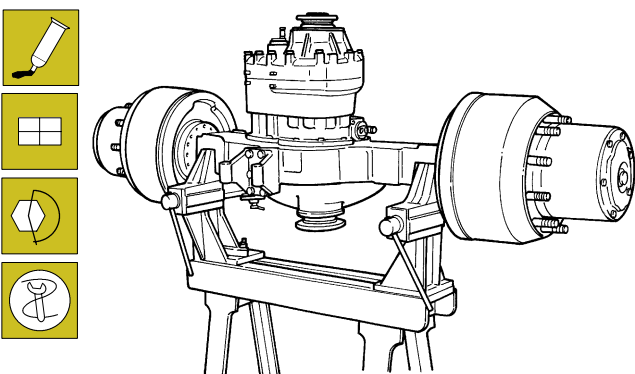
Figure 53



40076

- clean carefully, spread LOCTITE 573 on the contact surface (⇒), position the differential-reduction gear unit taking care that the fork engages the sleeve (1, Figure 52) and that the centering pins enter into the holes (1, figure 53)

Figure 54



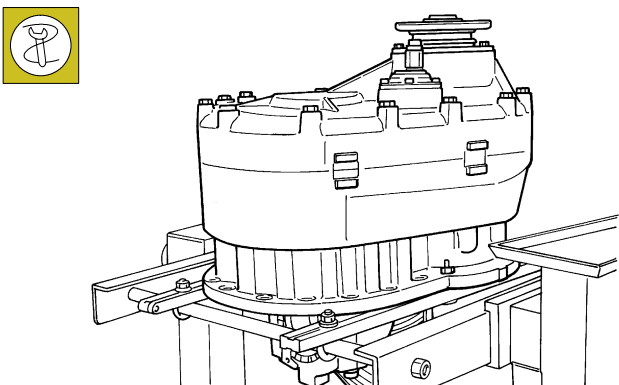
40052

- spread LOCTITE 573 on the thread and the contact surface of the screws, tighten them with a dynamometric wrench to a torque of 260 ± 25 Nm.
- re-fit in place the half shafts and shoulder pins; fit in place the cover using LOCTITE 573 and tighten the screws to the prescribed torques. Adjust the half-shafts backlash as described in figure 48.

DIFFERENTIAL-REDUCTION GEAR UNIT REPAIR OPERATIONS

Removal

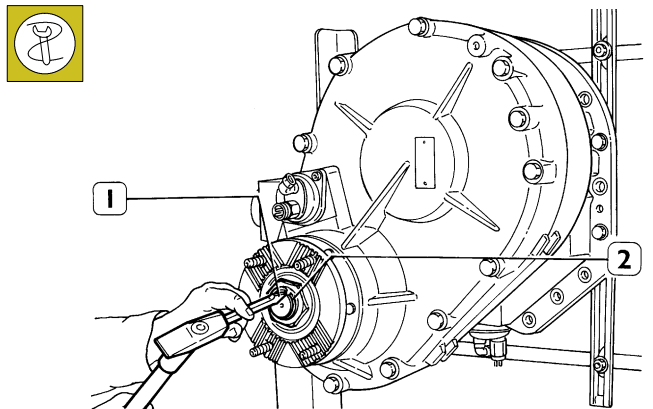
Figure 55



40099

Place the differential-reduction gear unit assembly on stand 99322205 with appropriate brackets

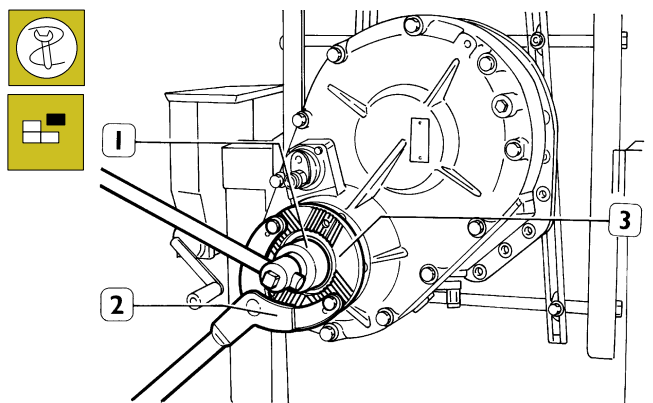
Figure 58



40116

Using a suitable punch (1) remove the dent from the nut (2)

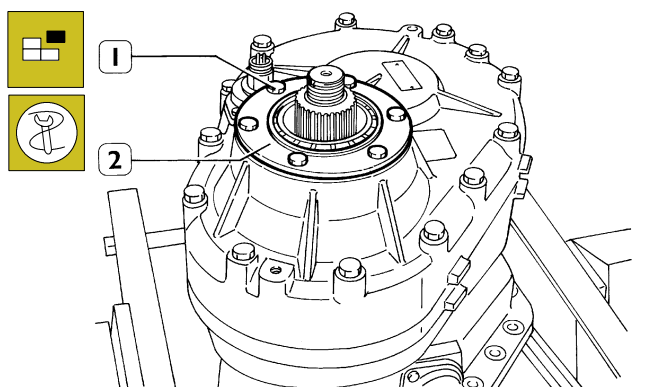
Figure 56



40117

With counteracting lever 99370317 (2) and socket wrench 99355081 (1) unscrew the locking nuts and withdraw the coupling flange (3)

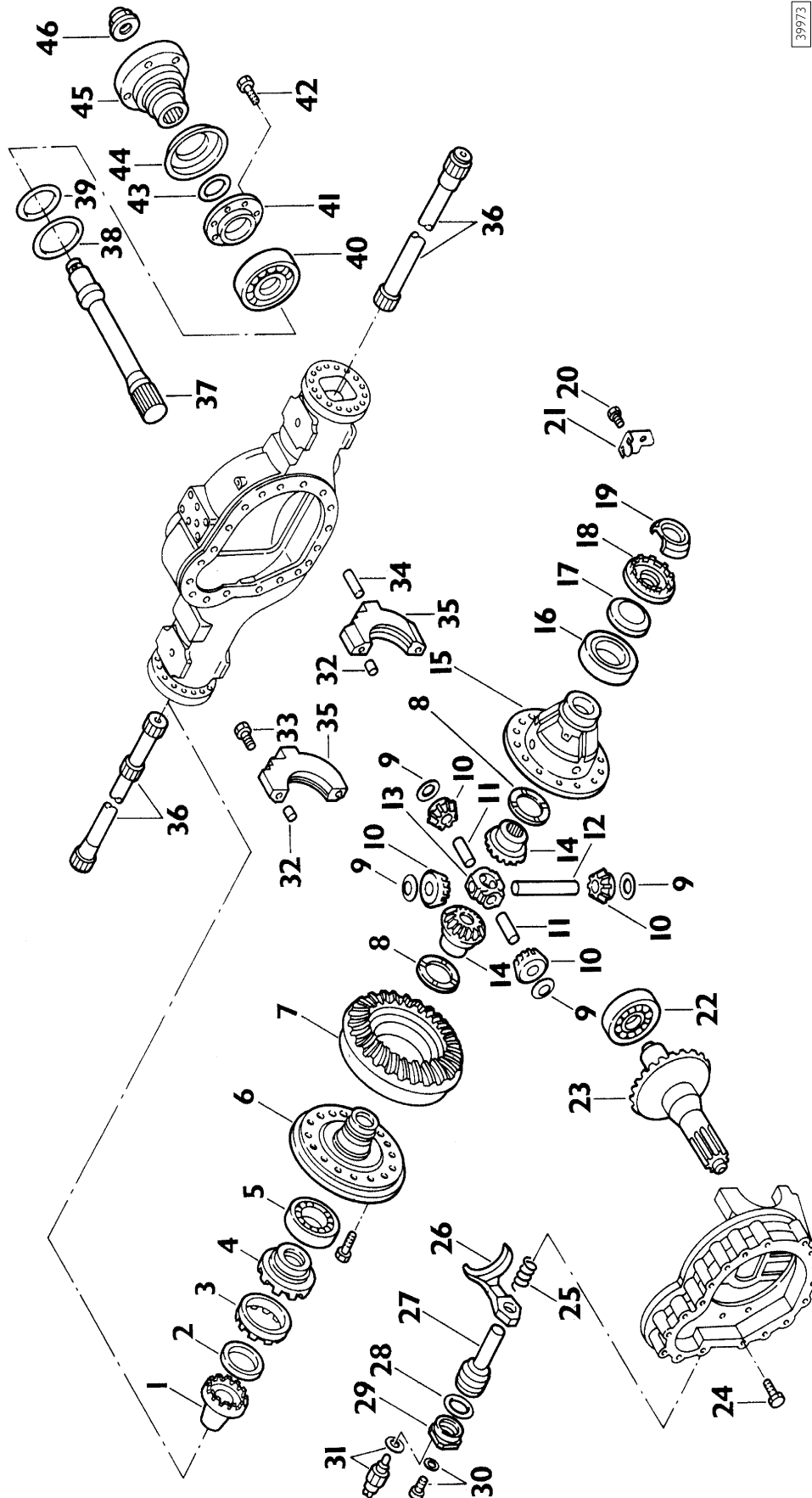
Figure 57



40118

Remove the screws (1) and the cover (2) together with its seal ring.
Remove the reduction gear unit control cover.

Figure 59

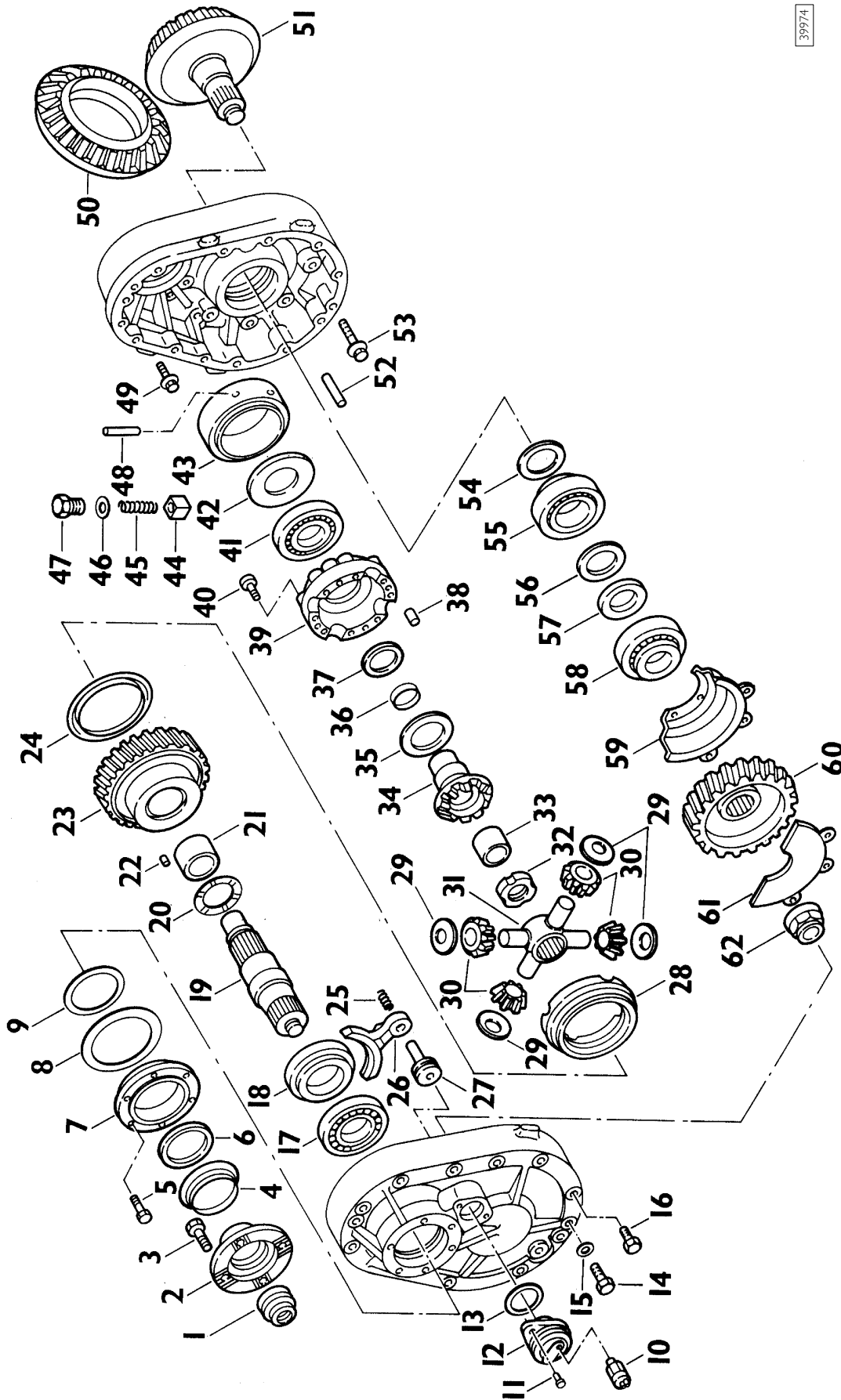


39973

DIFFERENTIAL COMPONENTS

1. sleeve - 2. ring - 3. Ring nut - 4. Ring nut - 5. Bearing - 6. cover - 7. Crown wheel - 8. Washer - 9. Collar - 10. Planetary wheel - 11. Pin - 12. Pin - 13. Spider - 14. Planetary wheel - 15. Gear housing - 16. Bearing - 17. Oil seal - 18. Ring nut - 20. Screw - 21. Plate - 22. Bearing - 23. Pinion - 24. Screw - 25. Spring - 26. Fork - 27. Piston - 28. Ring - 29. Cover - 30. Screw - 31. Switch - 32. Pin - 33. Screw - 34. Pin - 35. Caps - 36. Half shaft - 37. Shaft - 38. Seal ring - 39. Seal ring - 40. Bearing - 41. Cover - 42. Screw - 43. Seal ring - 44. Splashguard - 45. Control side flange - 46. Nut

Figure 60

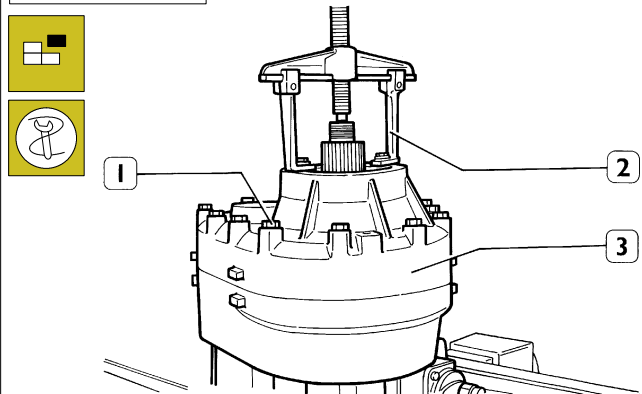


39974

DIFFERENTIAL-REDUCTION GEAR UNIT COMPONENTS

- 1. Nut - 2. Control side flange - 3. Hex screw - 4. Splash guard - 5. Screw - 6. Sealing gasket - 7. Cover - 8. Seal ring - 9. Seal ring - 10. Switch - 11. Pin - 12. Cover - 13. Ring - 14. Plug - 15. Ring - 16. Screw - 17. Bearing - 18. Sleeve - 19. Shaft - 20. Washer - 21. Bush - 22. Pin - 23. Gear - 24. Seal ring - 25. Spring - 26. Fork - 27. Piston - 28. Half-box - 29. Washer - 30. Planetary wheels - 31. Spider - 32. Ring nut - 33. Bush - 34. Crown wheel gear - 35. Washer - 36. Oil seal - 37. Seal ring - 38. Pin - 39. Half-box - 40. Screw - 41. Bearing - 42. Washer - 43. Eccentric ring - 44. Adjusting piston - 45. Compressed spring - 46. Ring - 47. Threaded plug - 48. Pin - 49. Self-locking screw - 50. Crown wheel - 51. Pinion - 52. Pin - 53. Self-lock ring screw - 54. Shim - 55. Bearing - 56. Shim - 57. Shim - 58. Bearing - 59. Oil drain - 60. Gear - 61. Oil drain cover - 62. Nut

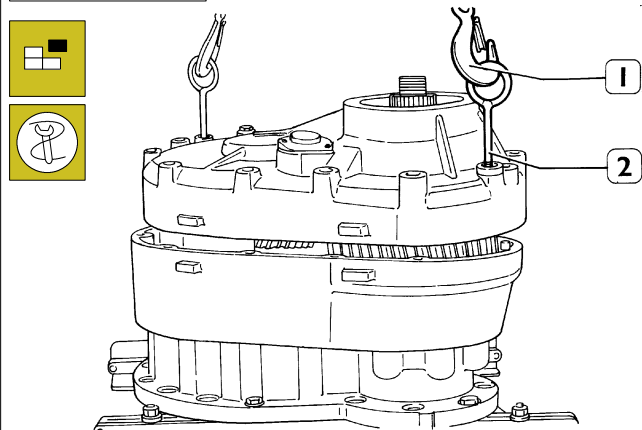
Figure 61



40119

Remove the cover screws (1), using puller (2) lift the cover (3) to withdraw the bearing from the shaft.

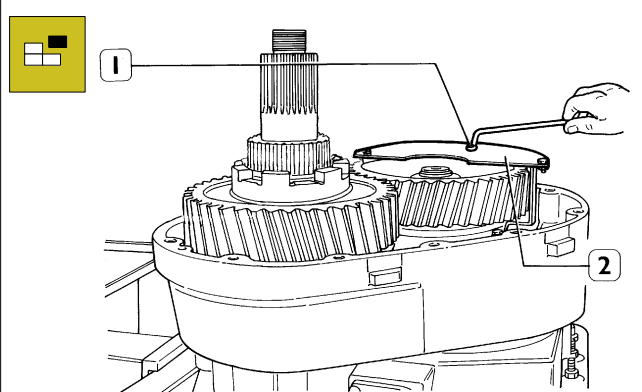
Figure 62



40120

Using eye bolts (2) and hooks with ropes (1) remove the cover. Move the reduction gear unit locking engagement fork to avoid damaging it.

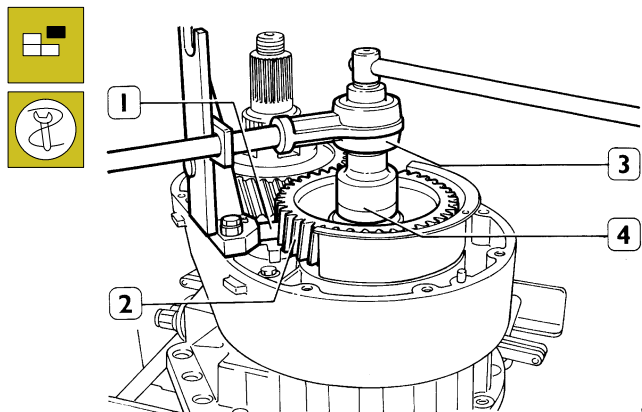
Figure 63



40121

Remove the screws (1) and take away the upper part of the oil drain (2)

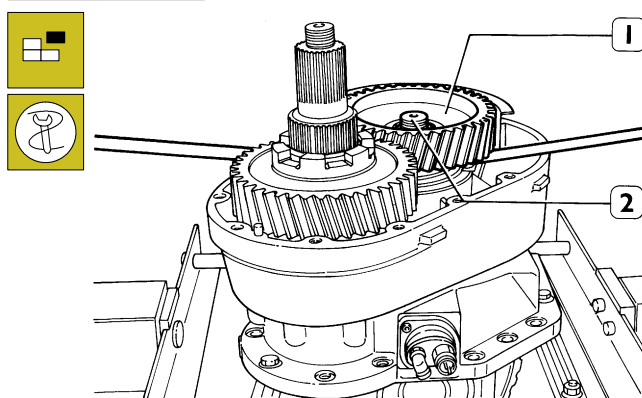
Figure 64



40122

Remove the dents on the gear nut (2)
Apply tool 99363310 (1) to lock the gear rotation (2); with multiplier 99389816 (3) and socket wrench 99355081 (4) unscrew the securing nut.

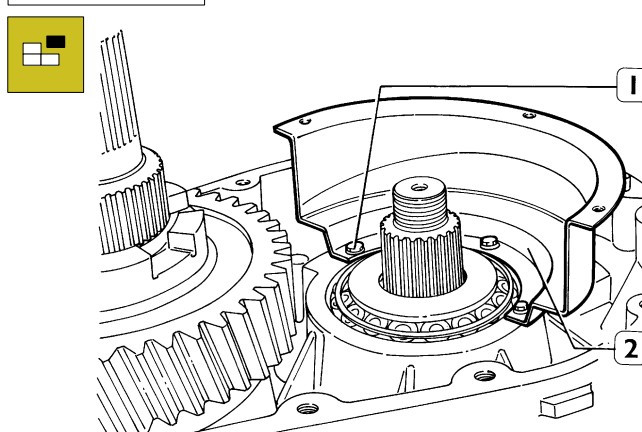
Figure 65



40114

Using two levers, withdraw the idle gear (1) from the bevel pinion (2)

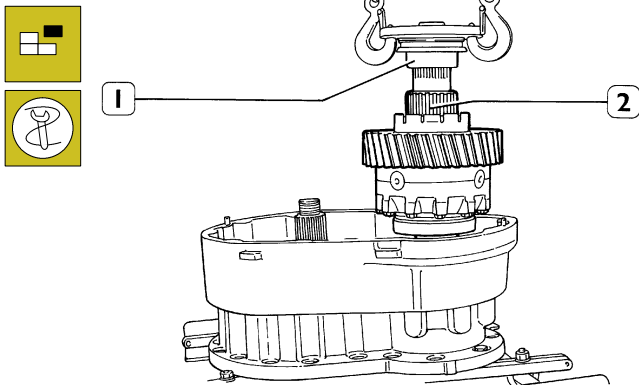
Figure 66



40115

Remove the three screws (1) and then the oil drain (2).

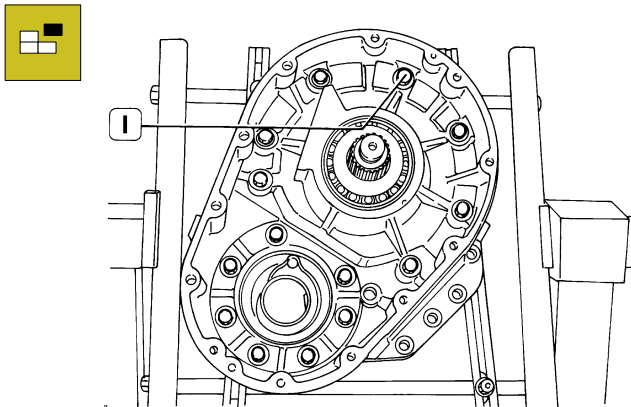
Figure 67



40116

Re-fit the flange (1) and fasten it with the nut, using hooks and ropes lift the differential-reduction gear unit (2)

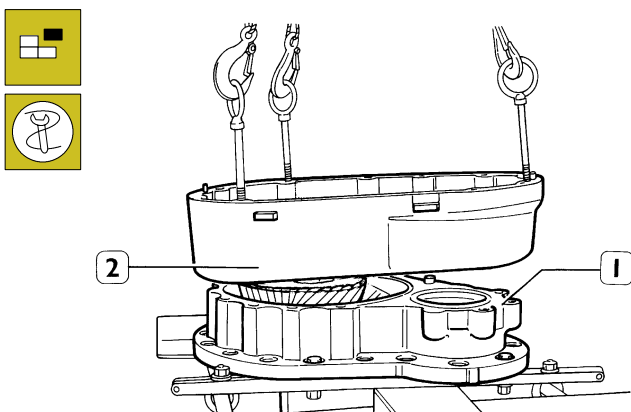
Figure 68



40117A

Remove the 14 screws (1) that fasten the half-shaft to the differential housing

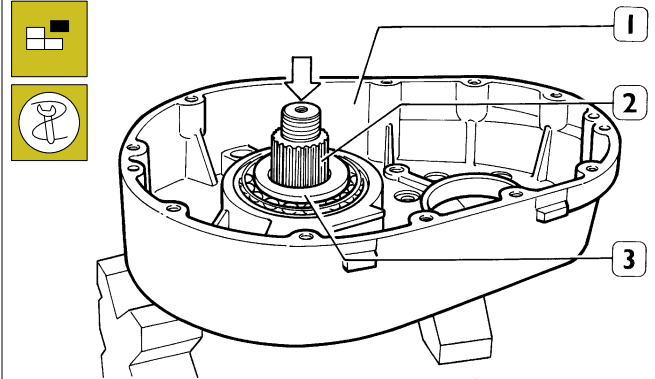
Figure 69



40119A

Using eye bolts, hooks and ropes lift and remove the half-box (2) with the bevel pinion from the differential housing (1).

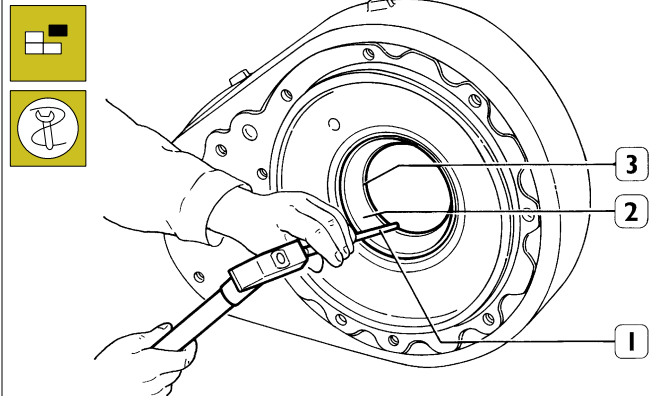
Figure 70



40376

Rest the half-box (1) on two parallel bars, using an appropriate beater remove the bevel pinion (2); remove the taper roller bearing (3).

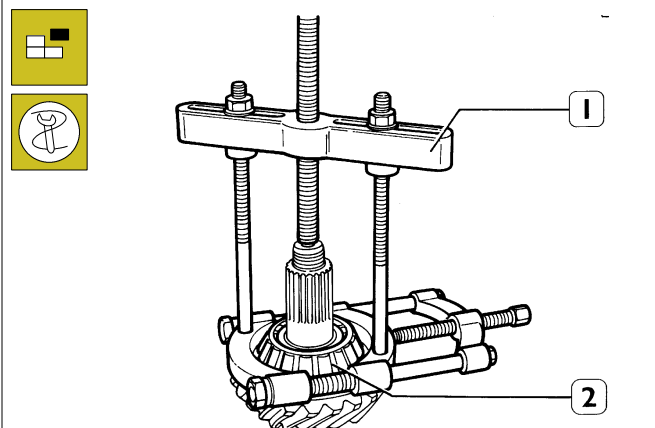
Figure 71



40079

Using an appropriate beater (1) expel the taper roller bearing outer rings (2-3) from the half-box

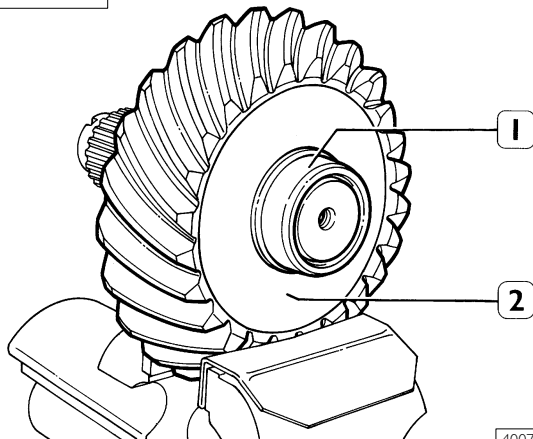
Figure 72



470077

Using puller 99348001 (1) remove the intermediate bearing (2) from the bevel pinion.

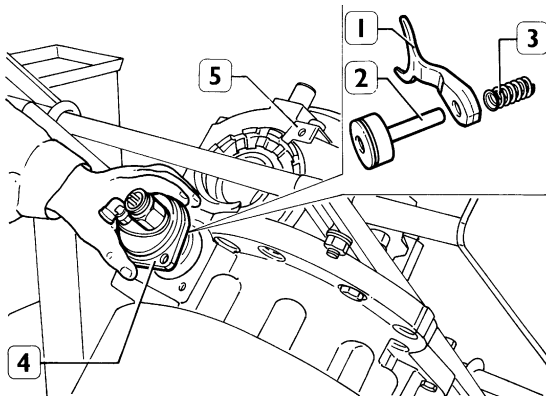
Figure 73



40078

Using suitable equipment remove the rear bearing inner ring (1) from the bevel pinion (2). This is a destructive operation.

Figure 74

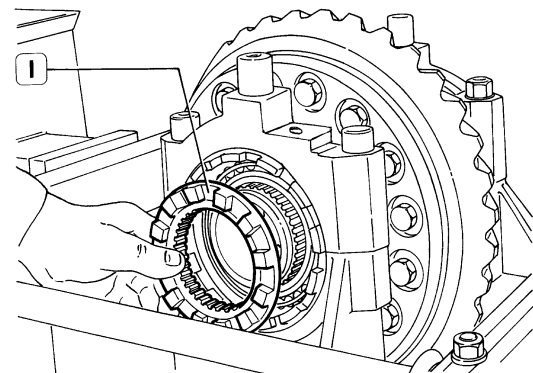


40113

Rotate the stand 180°

Remove the two screws, then the cover (4), the piston (2), the fork (1) and the spring (3). Remove the screw and take away the safety plate (5).

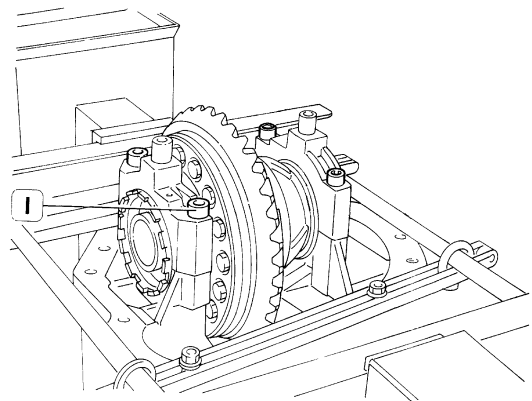
Figure 75



40111A

Remove the circlip and withdraw the differential locking sleeve (1). Mark the assembly position of the caps with reference to the differential housing.

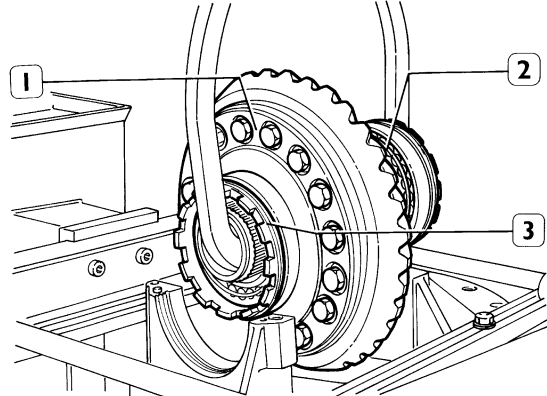
Figure 76



40102

Slightly loosen the adjusting ring nuts. Remove the screws (1) locked with LOCTITE, remove the caps.

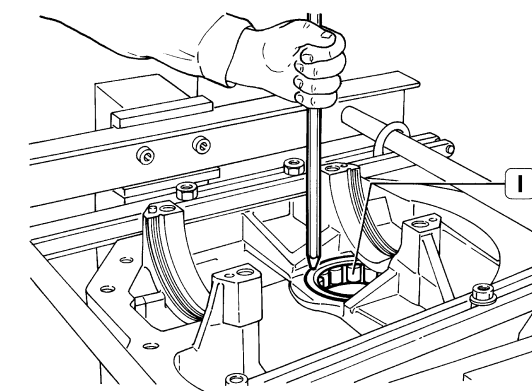
Figure 77



40108

Using a suitable hook remove the gear housing (1) with its bearings (2) and adjusting ring nut (3)

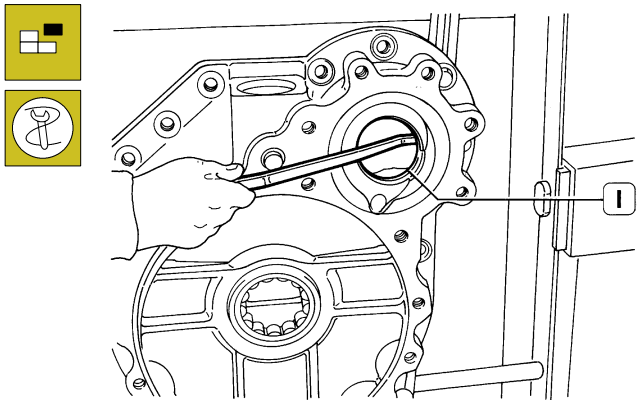
Figure 78



40104

Using a beater extract the bevel pinion roller bearing (1) from its seat on the differential housing.

Figure 79

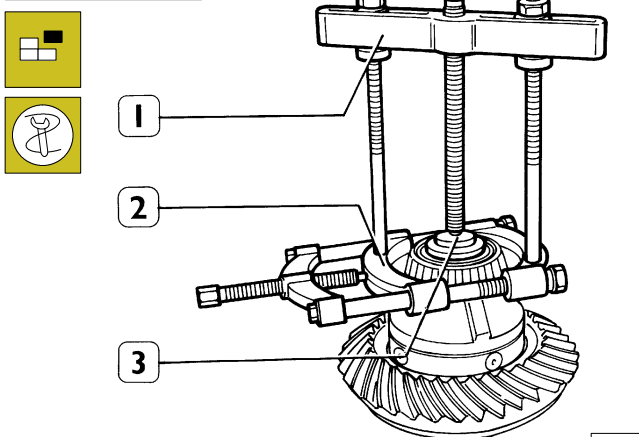


40105

Using the appropriate tool, remove the seal ring (1). Take away the metal plate and the oil pump.

Removing the gear housing

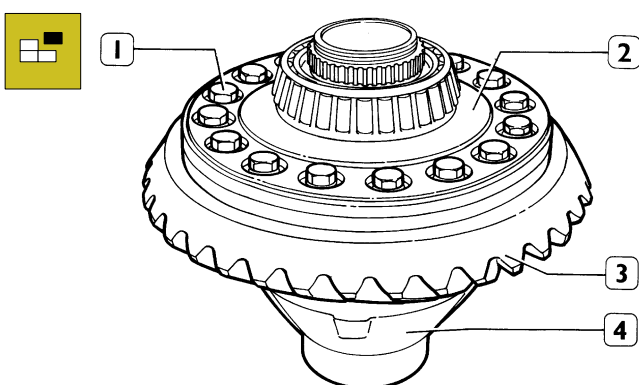
Figure 80



40086

Using puller 99348001 (1-2) and counteracting block 99345055 (3) remove the bearing and taper rollers from the gear housing. Repeat this operation on the other side.

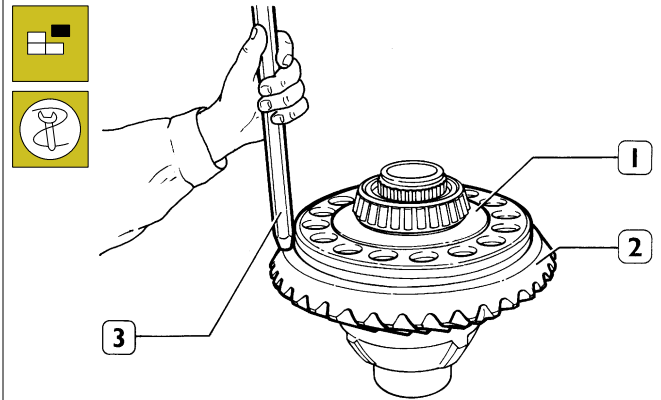
Figure 81



40087

Loosen and remove the screws (1) that fasten the ring bevel gear (3) and cover (2) to the half-box (4)

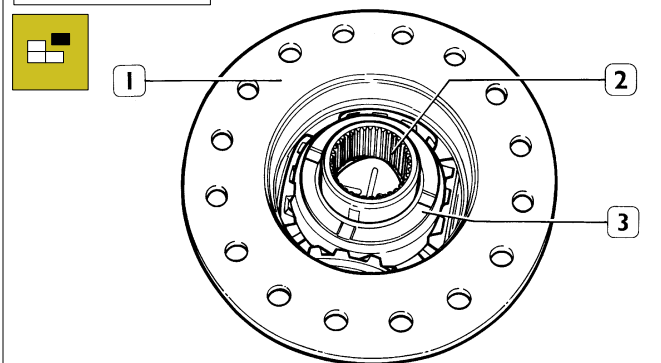
Figure 82



40088

Mark the cover and the gear housing. Remove the gear housing cover (1) and release the ring bevel gear (2) with a suitable beater (3).

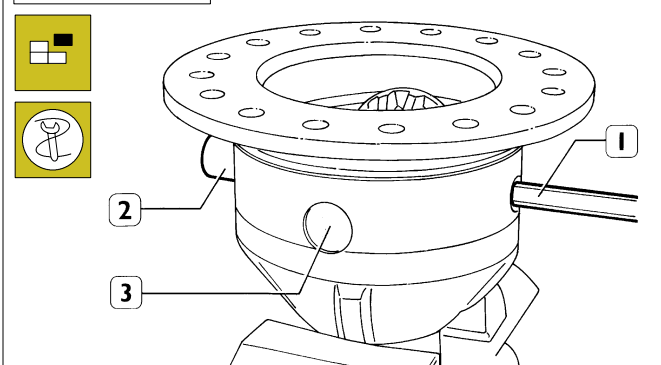
Figure 83



40089

Remove the crown wheel gear (2) and shoulder washer (3) from the gear housing (1).

Figure 84



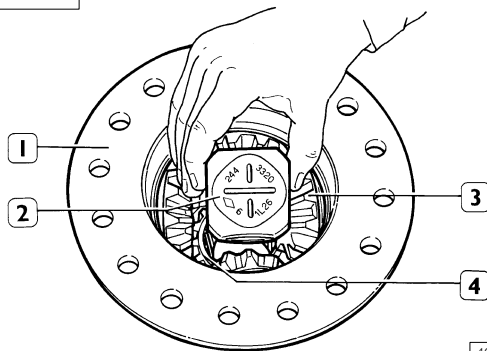
400910

Using a suitable beater (1) first withdraw the long pin (2), then the two short pins (3).



The exact position of the pins is marked on the spider (2, figure 85) by a long stripe for the long pin and two short stripes for the short pins.

Figure 85

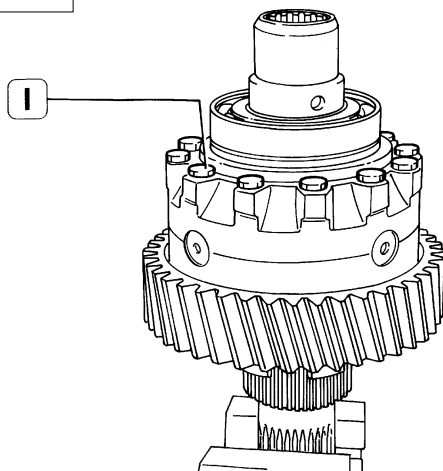
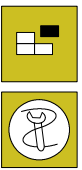


40091

Remove the spider (2), the planetary gears (3) together with the shoulder washer and crown wheel (4) from the gear housing.

Removing the differential-reduction gear unit

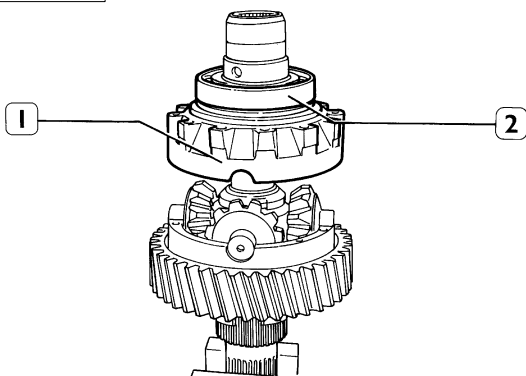
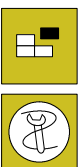
Figure 86



40135

Set the differential- reduction gear unit in a vice, remove the screws (1)

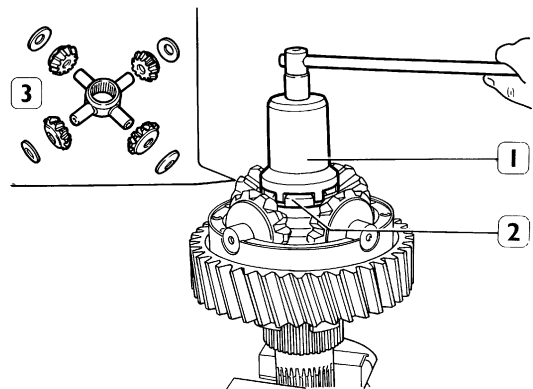
Figure 87



40136

Remove the half-boxes (1) and relevant bearing (2).

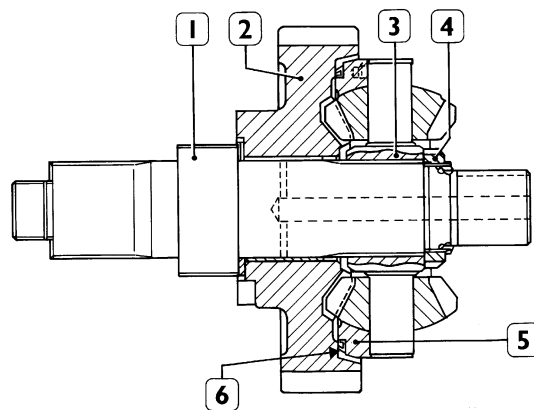
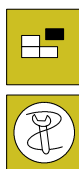
Figure 88



40138

Using a suitable punch remove the dent from the ring nut (2). Using wrench 99355 121 (1) unscrew the ring nut (2), remove the spider (3), planetary wheels and shoulder washers.

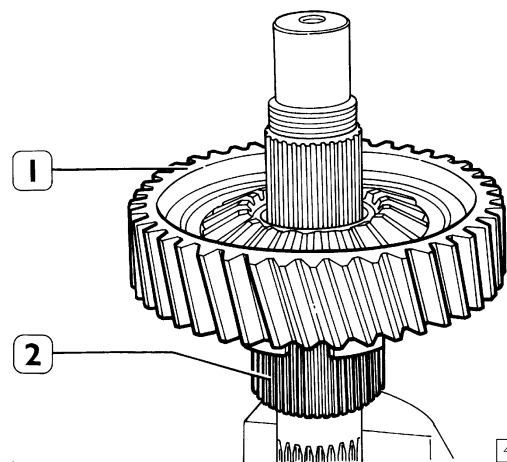
Figure 89



40139

1. Input shaft - 2. Driving gear - 3. Spider - 4. Ring nut - 5. Differential half box - 6. Seal ring

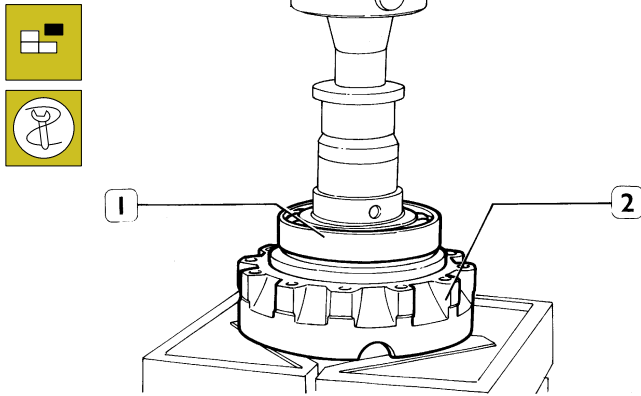
Figure 90



40140

Withdraw the driving gear (1) from the input shaft (2), remove the shoulder ring.

Figure 91



40137

With a hydraulic press withdraw the bearing (1) from the half-box (2) operating on the crown wheel gear

Checks on differential-reduction gear unit components

Clean and carefully check the individual components, replacing any that are strained. Replace all the seal rings.



If it should be necessary to replace the crown or the pinion, both parts have to be replaced since they are supplied as a pair.



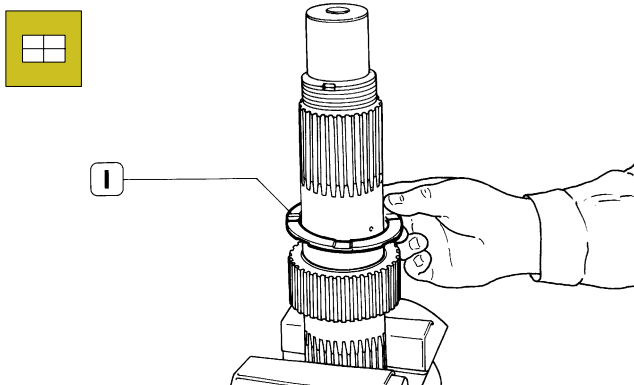
If it should be necessary to replace the crown or the pinion, both parts have to be replaced since they are supplied as a pair.



Check the bushes on the driven gear and in the crown wheel. If they are strained, replace them using a press.

REFITTING THE DIFFERENTIAL-REDUCTION GEAR UNIT

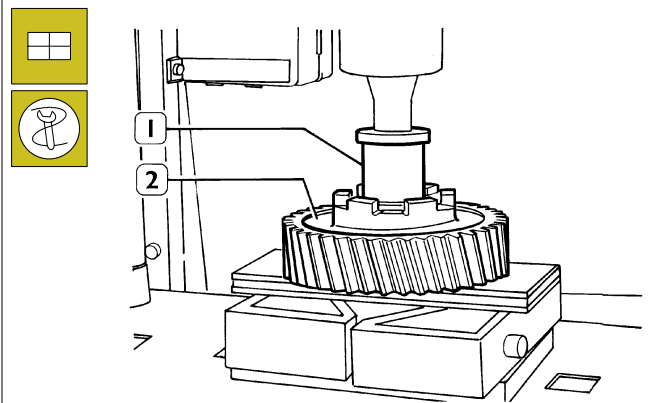
Figure 92



40141

Place the input shaft in a vice, fit in place the shoulder ring (1)

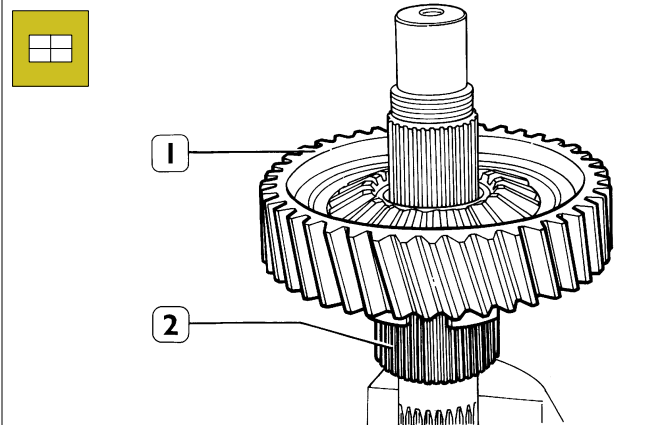
Figure 93



40411

If the bush has been removed, fit it in place in the idle gear (2) using the appropriate tool (1).

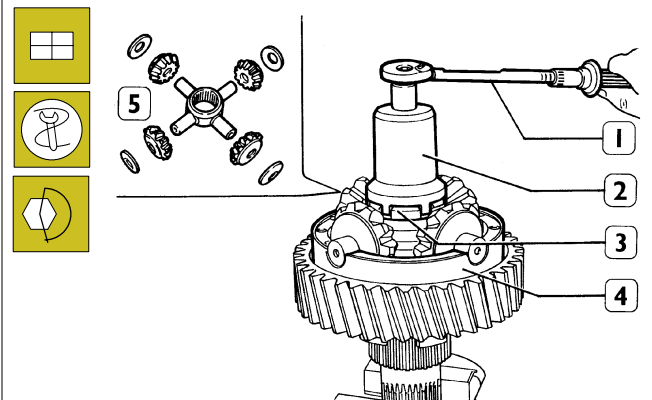
Figure 94



40140

Fit in place the idle gear (1) on the input shaft (2).

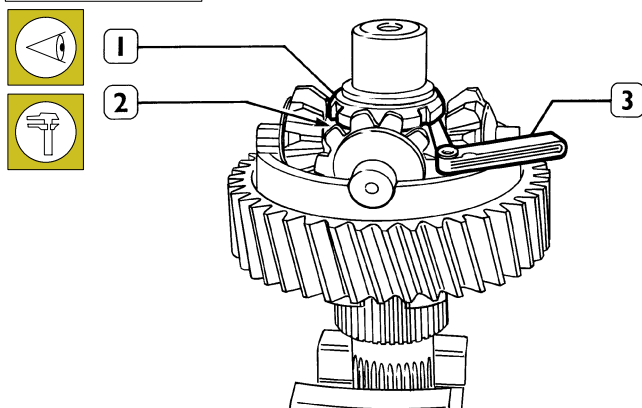
Figure 95



40138

Fit in place the half box (4) and its seal ring
Fit in place the spider (5) and its planetary wheels. With wrench 99355121 (2) and dynamometric wrench (1) tighten the ring nut (3) to a torque of 230 ± 20 Nm

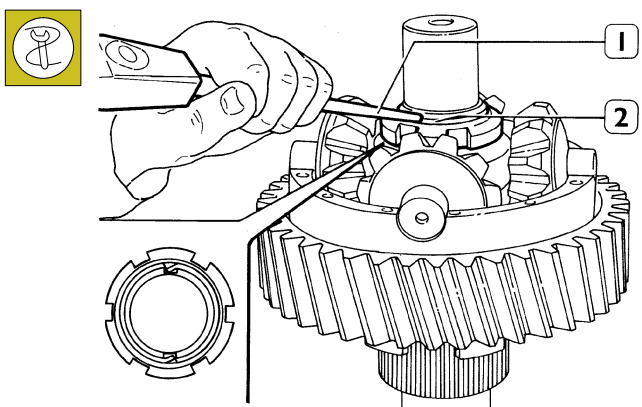
Figure 96



40142

After locking the ring nut (1) use a feeler gauge (3) to check that there is a clearance of 0.1 mm between the ring nut (1) and spider (2). If this is not so, replace the relevant parts.

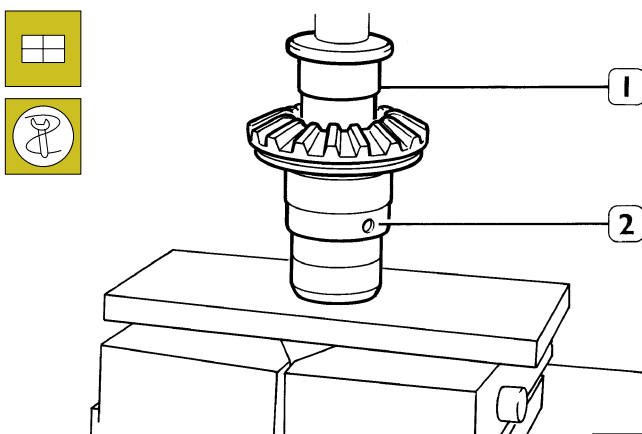
Figure 97



40143

Using a suitable punch (1) dent the ring nut (2) as shown in the detail

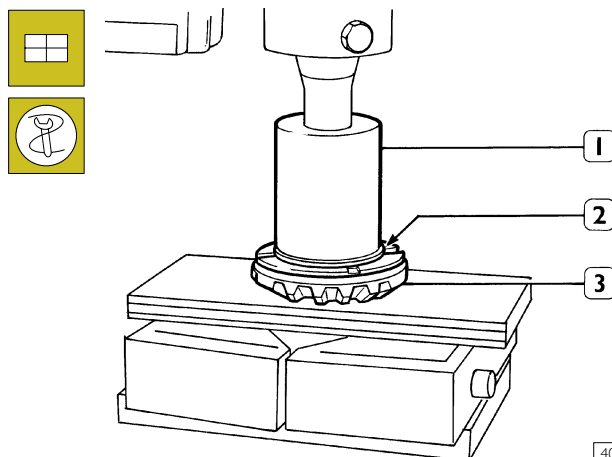
Figure 98



40412

With the suitable connection element (1) and press, fit in place the bush in the crown wheel gear (2)

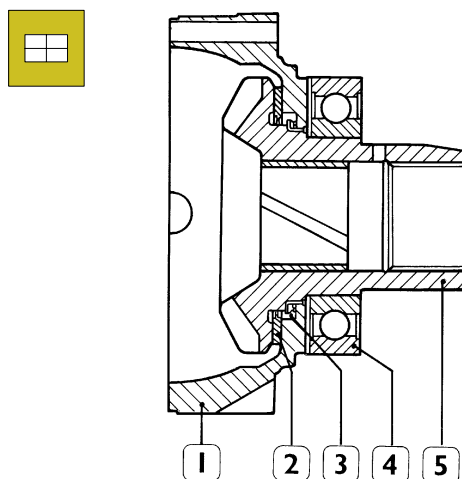
Figure 99



40413

Fit in place the shoulder ring on the crown wheel gear (3), then using the appropriate tool (1) fit in place the seal ring (2)

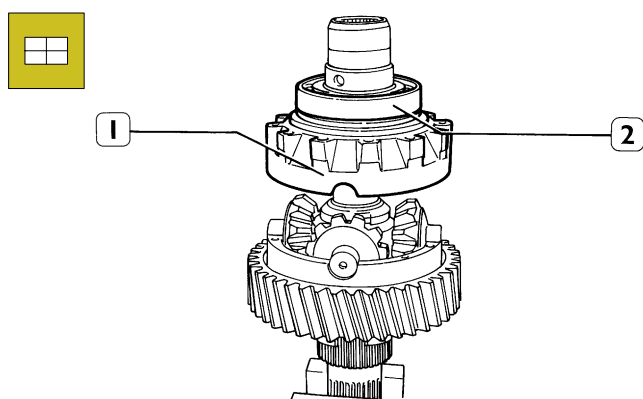
Figure 100



40414

In the half-box (1), fit in place the crown wheel (5) then fit the ball bearing (4) on the crown wheel.

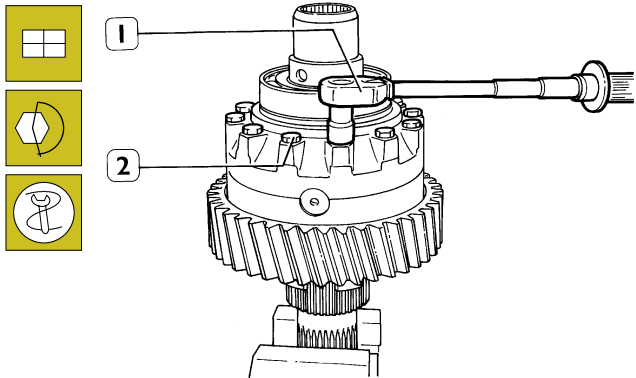
Figure 101



40136

On the lower half-box fit in place the half-box assembly (1) with its relevant bearing (2) and crown wheel

Figure 102

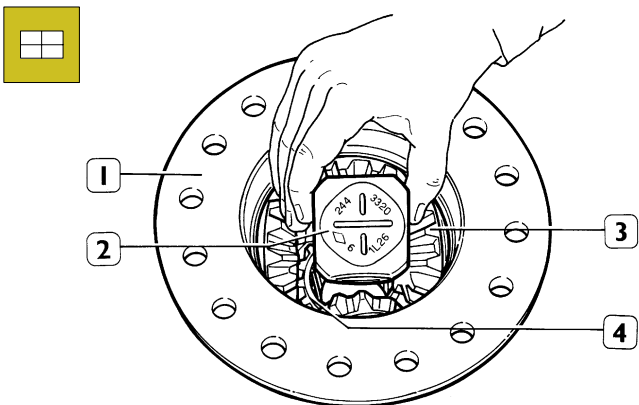


40144

Tighten the fastening screws (2) and with the dynamometric wrench (1) lock them to a torque of 67 ± 8 Nm

Fitting in place the gear housing

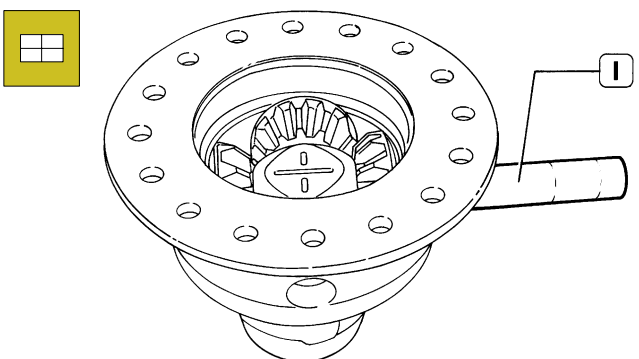
Figure 103



40091

Place the gear housing (1) on a suitable stand, fit the crown wheel (4) in its seat with its shoulder ring. Fit in place the 4 planetary wheels (3) and shoulder rings then insert the spider (2).

Figure 104



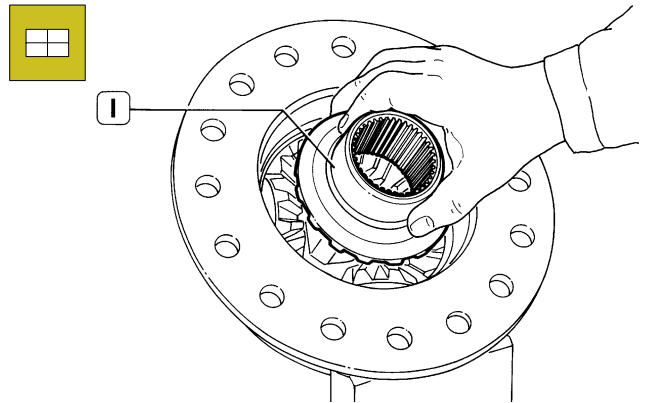
40092

Insert the long pin (1) and the two short pins



The long pin (through pin) must be inserted first. The exact position of the pins is marked on the spider by a long stripe for the long pin and two short stripes for the short pins.

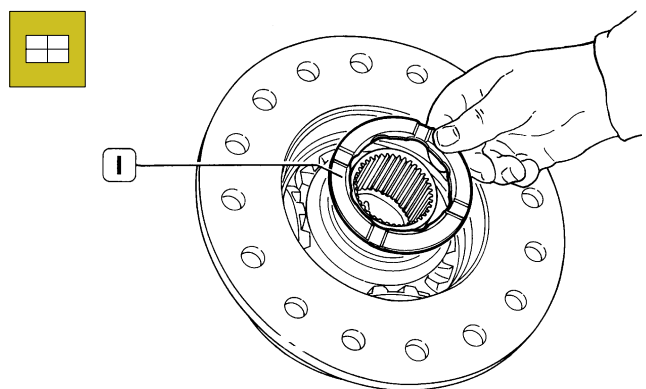
Figure 105



40093

Fit in place the crown wheel (1)

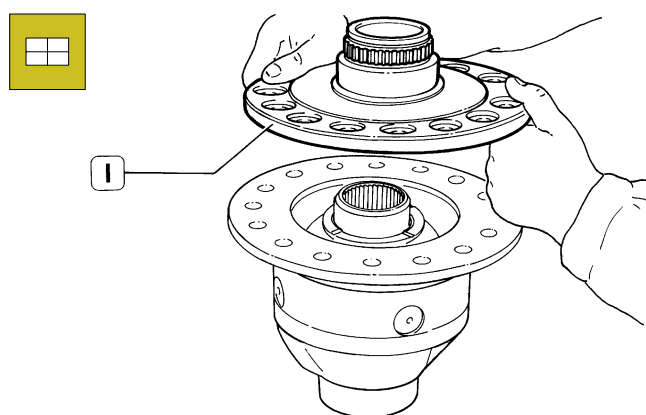
Figure 106



40094

Fit in place the shoulder washer (1)

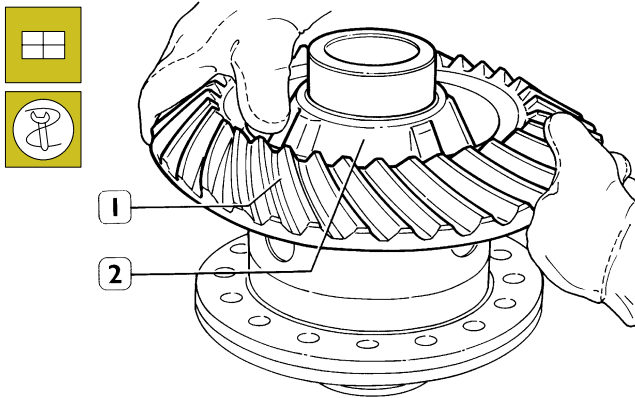
Figure 107



40095

Fit in place the gear housing cover (1).

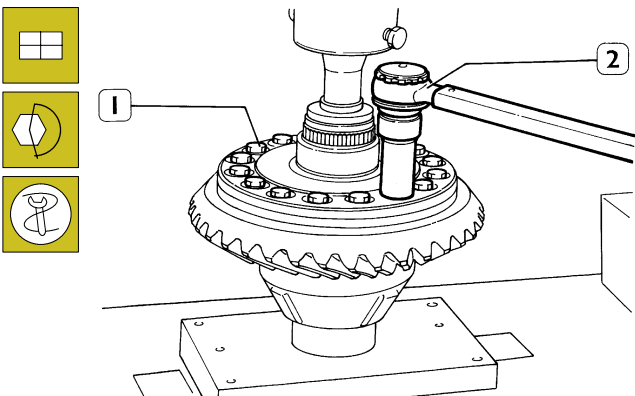
Figure 108



40096

Heat the crown wheel (1) to 80 °C, fit it in place in its seat in the gear housing (2) and lock it immediately with two screws.

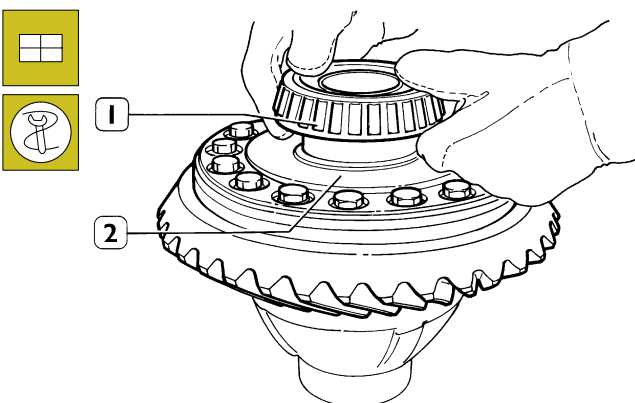
Figure 109



40097

Insert the other screws (1); lock the gear housing rotation through the press and with a dynamometric wrench (2) tighten the screws (1) to a torque of 300 ± 10 Nm.

Figure 110

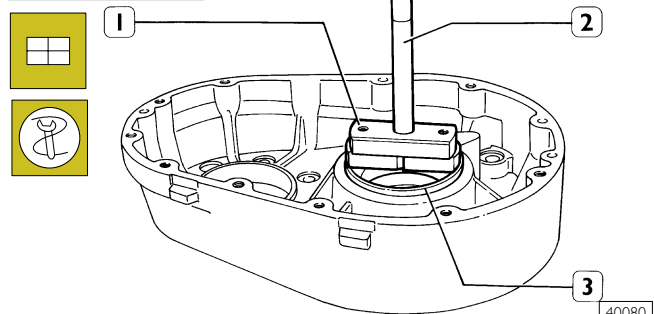


40098

Heat the bearing (1) for about 15 minutes at a temperature of approx 100 °C and fit it in place on the gear housing (2). Repeat the same operation on the other side.

Fitting in place the bevel pinion housing

Figure 111

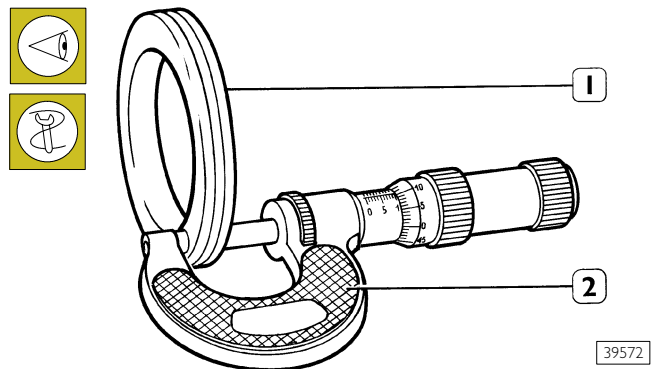


40080

Drive fully into their seats the intermediate and external bearing outer rings (3) using beater 99374094 (1) and handle 99370007 (2).

Procedure to determine the adjusting ring thickness for the bevel pinion rolling torque

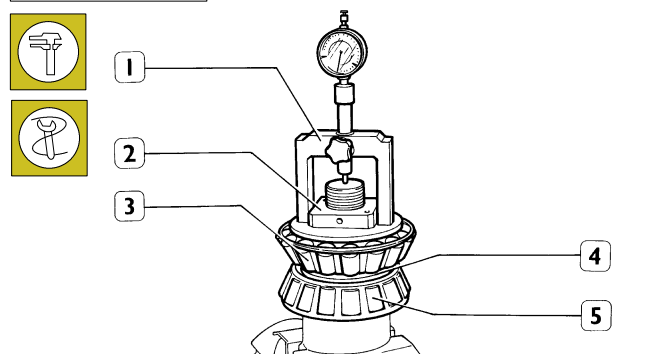
Figure 112



39572

With a micrometer (2) measure the adjusting ring (1) thickness found when removed and make a note of the value (value A).

Figure 113



40083

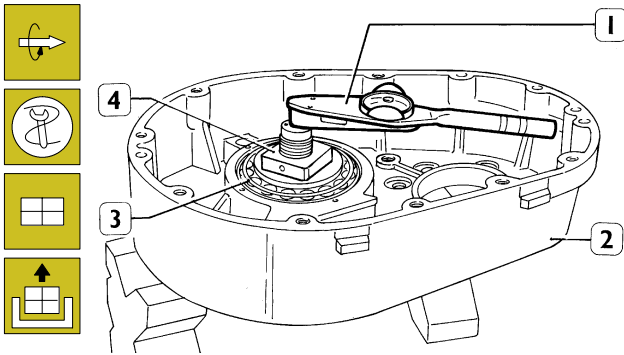
Fit tool 99395027 in a vice and place on it:

- ☐ the pinion side bearing (5)
- ☐ Adjusting ring (4), already measured, the spacer and bearing (3)

Screw the ring nut (2) and lock it tightly. Position the dial gauge fitted to element (1) of tool 99395027 on the bearing and set the gauge to zero on the end of the tool. Remove from the tool:

- ☐ element (1), ring nut (2), bearing (3) adjusting ring (4) and the spacer.

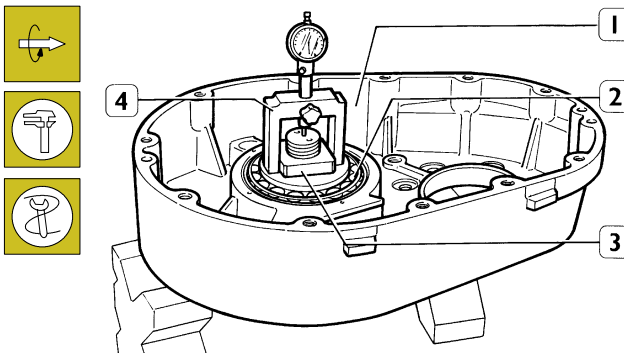
Figure 114



40085

In the half-box (2) set tool 989395027 with the bearing (5, figure 113), position the bearing (3, figure 114). Manually tighten the ring nut (4) and check the rolling torque with a dynamometer (1). It should be 1.5 - 3.5 Nm; if it is not, adjust through the ring nut (4).

Figure 115



40084

Set up element (4) again with the dial gauge already set to zero on the bearing (2) and find the deviation, if any (value B). Remove the elements from tool 99395027.

Adjusting ring thickness "S" is obtained through the following formula:

$$S = A - (\pm B) + C$$

where:

A = Thickness of adjusting ring fitted to set the dial gauge to zero;

B = Deviation value found;

C = 0.05 mm coefficient that takes into account the bearings dilation cause by assembling interference on the bevel pinion;

First example

$$A = 13.12 \text{ mm}$$

$$B = + 0.13 \text{ mm}$$

$$C = 0.05 \text{ mm}$$

$$S = 13.12 - (+ 0.13) + 0.05 =$$

$$S = 13.12 - 0.13 + 0.05 = 13.04 \text{ mm.}$$

Second example

$$A = 13.12 \text{ mm}$$

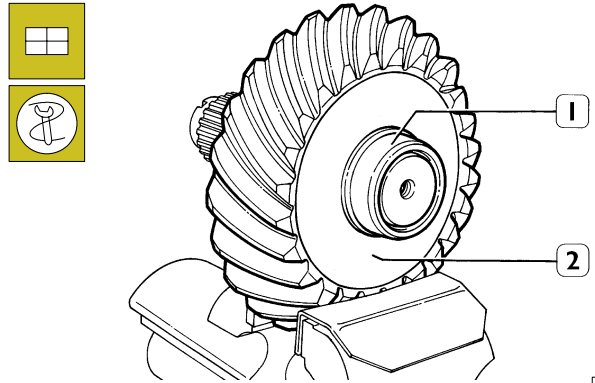
$$B = - 0.13 \text{ mm}$$

$$C = 0.05 \text{ mm}$$

$$S = 13.12 - (-0.13) + 0.05 =$$

$$S = 13.12 + 0.13 + 0.05 = 13.35 \text{ mm}$$

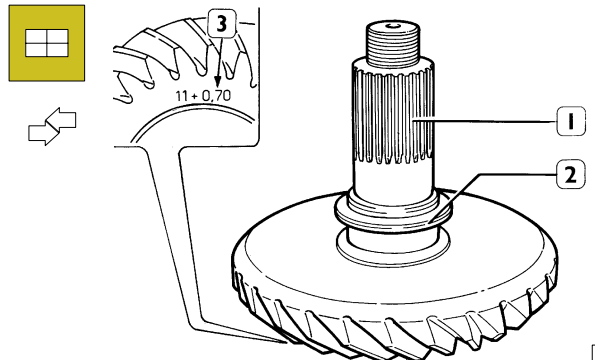
Figure 116



40078

Heat the rear bearing inner ring (1) and connect it to the bevel pinion (2)

Figure 117



39701

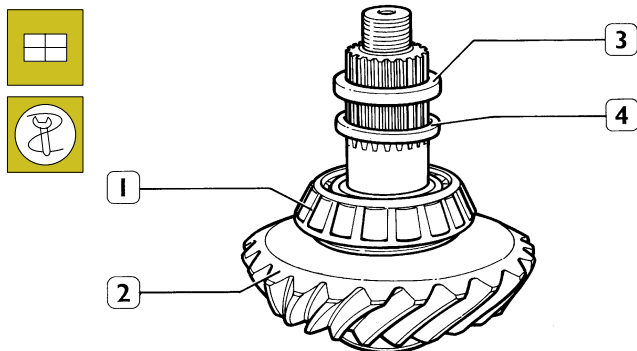
On the bevel pinion (1) fit in place the adjusting ring (2) to set the pinion with reference to the crown wheel placing the chamfer downwards. The thickness of the adjusting ring depends on the reference value (3) engraved on the bevel pinion. See table in figure 118

Figure 118

Value engraved on pinion	Adjusting ring thickness
0	4,6
0,1	4,5
0,2	4,4
0,3	4,3
0,4	4,2
0,5	4,1
0,6	4,0
0,7	3,9
0,8	3,8
0,9	3,7
1,0	3,6

Table to determine the thickness of adjusting rings, bevel pinion position with reference to the crown wheel.

Figure 119

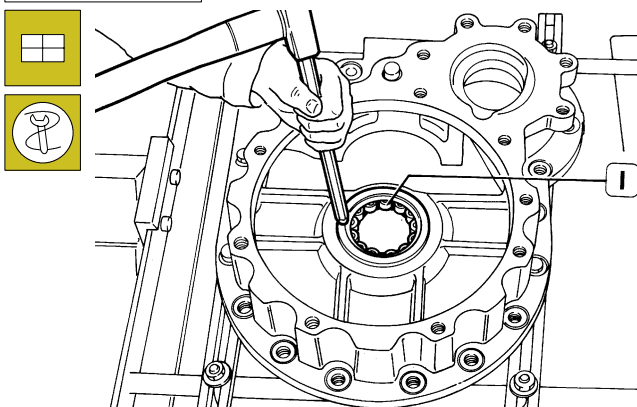


40082

Heat the intermediate bearing (1) to approx. 100°C and fit in place on the bevel pinion (2).
Fit in place the spacer ring (4) and an adjusting ring (3) with the previously found thickness.

Fitting in place the differential housing

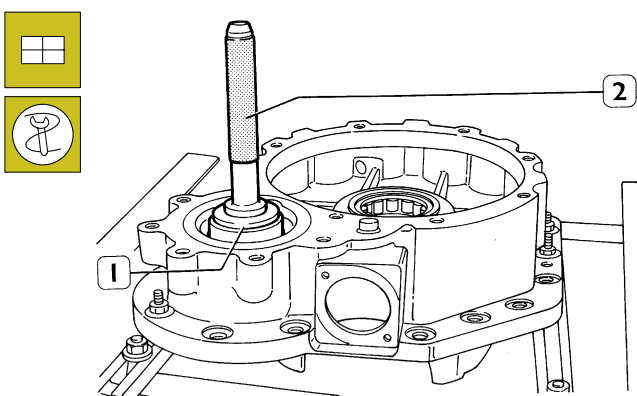
Figure 120



40106

Set up the differential housing on a stand, using a suitable beater fit in place the roller bearing (1)

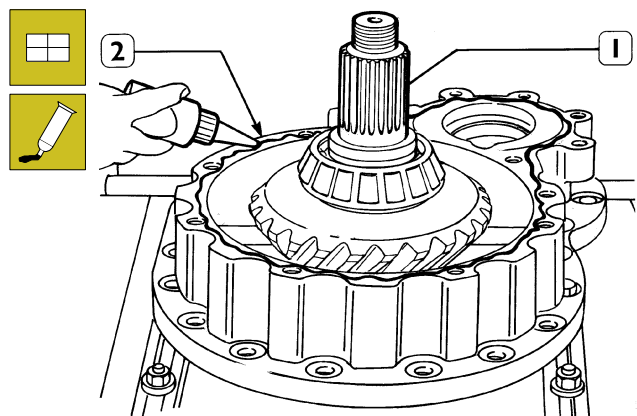
Figure 121



40107

Using element 99374372 (1) and handle 99370006 (2) fit in place the seal ring.

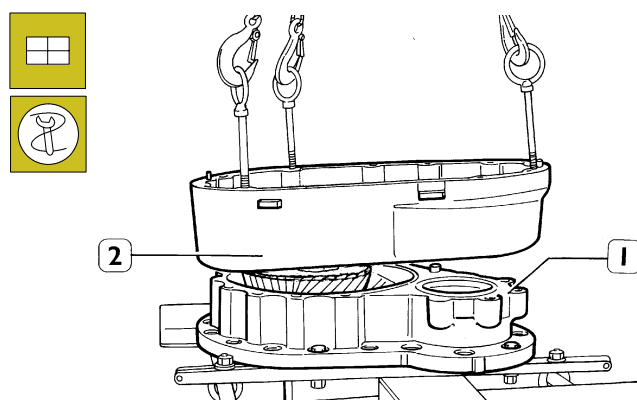
Figure 122



40415

Fit the bevel pinion (1) on the roller bearing (1) figure 119).
Spread LOCTITE 573 (2) on the contact surface.

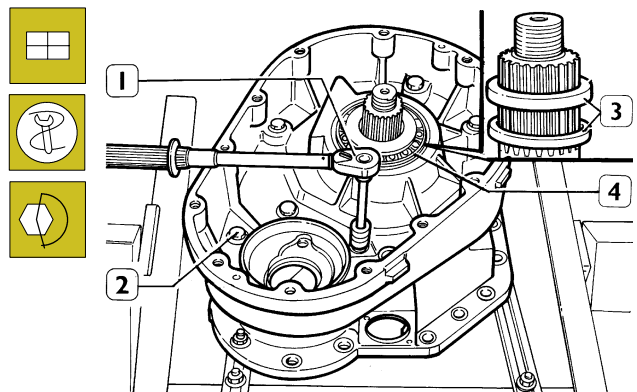
Figure 123



40119A

Lift and fit in place the half-box (2) on the differential housing (1)

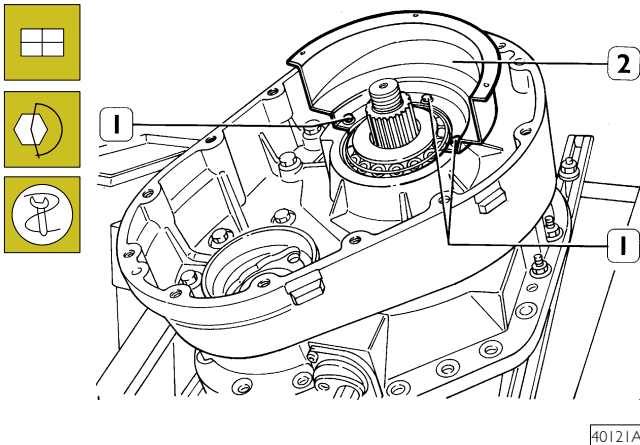
Figure 124



40120A

Use a dynamometric wrench (1) to tighten the screws (2) to a torque of 260 ± 25 Nm. Heat the bearing (4) and connect it on the bevel pinion.

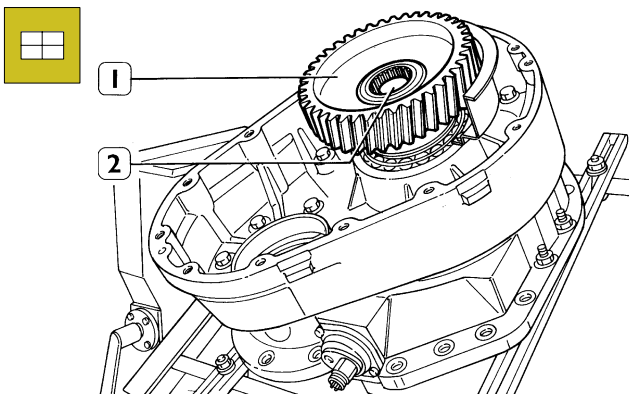
Figure 125



40121A

Fit in place the oil drain (2), locking it with the screws (1) to a torque of 16 ± 2 Nm

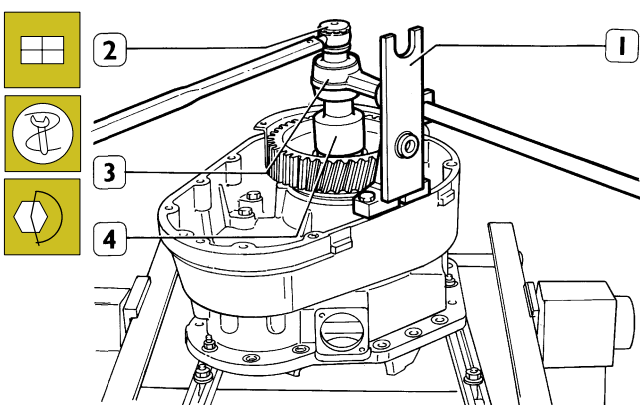
Figure 126



40122A

Fit in place the driven gear (1) on the bevel pinion (2)

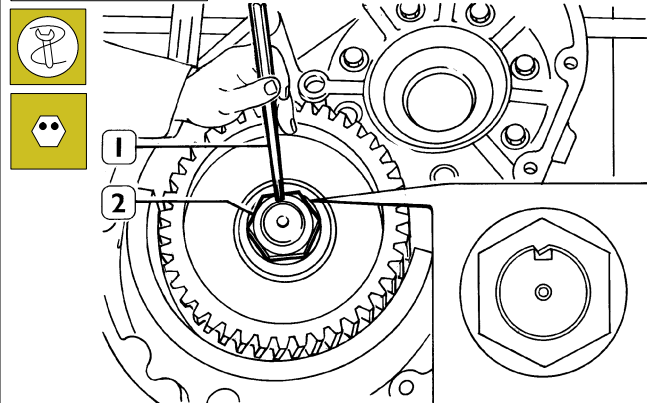
Figure 127



40123

Set up tool 99363310 (1) and with socket wrench 99355081 (4), multiplier 99389816 (3) and dynamometric wrench (2) tighten the driven gear nut to a torque of 700 ± 50 Nm

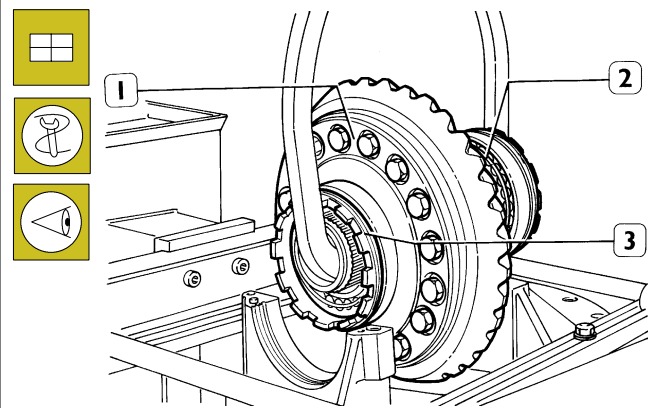
Figure 128



40416

Using a suitable beater (1) dent the driven gear nut (2)

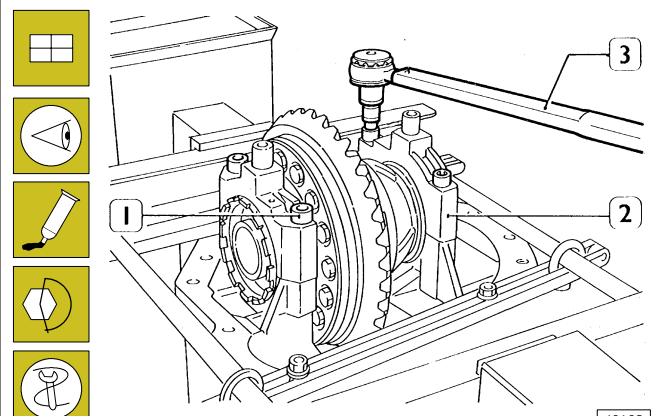
Figure 129



40108

Using an appropriate hook, lift the gear housing (1) together with bearings (2) and adjusting ring nuts (3). Set it on the differential housing. Carefully arrange the adjusting ring nuts on the threads of the differential housing.

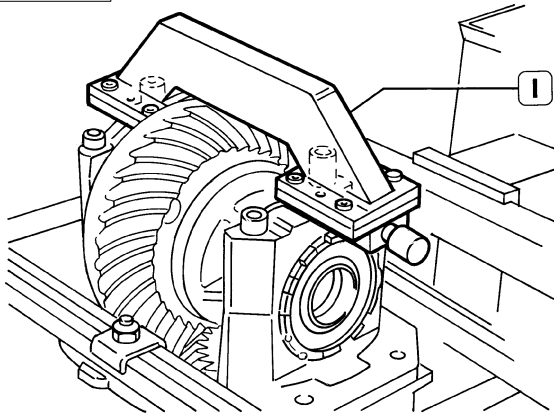
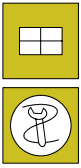
Figure 130



40109

Fit in place the caps (2), insert the screws (1) for the moment and check that the adjusting ring nuts screw in easily. Remove the screws one by one, spread LOCTITE AVX on the thread then tighten them with a dynamometric wrench (3) to a torque of 270 ± 10 Nm.

Figure 131

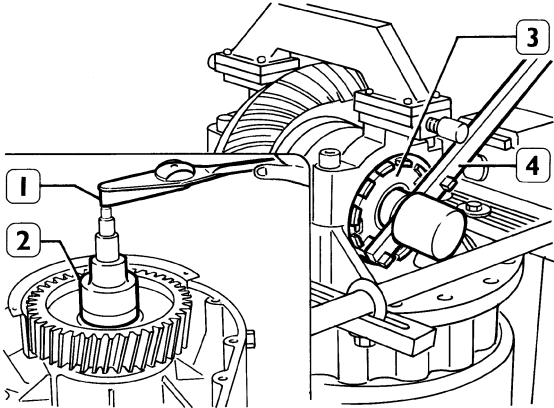
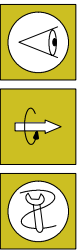


39585

Set up tool 99370133 (1) as shown in the figure to avoid angle deviation of the caps during adjustment

Adjusting the rolling torque for the gear housing bearings

Figure 132



40417

Gear housing bearings rolling torque adjustment is obtained by measuring the total rolling torque.

Find in the table, the total rolling torque value (this value varies according to the bevel pair ratio).

Using torque wrench 99354001 (1) and appropriate socket wrench (2) find the prescribed rolling torque, operating on the bearing adjustment ring nuts (3), through wrench 99354001 (4).

from the following table find the rolling torque total value; this varies according to the bevel pair ratio;

No. teeth	Ratio	Rolling torque total Nm
21/40	1,905	3,1 ÷ 6,1
19/33	1,737	3,3 ÷ 6,4
23/36	1,565	3,4 ÷ 6,7

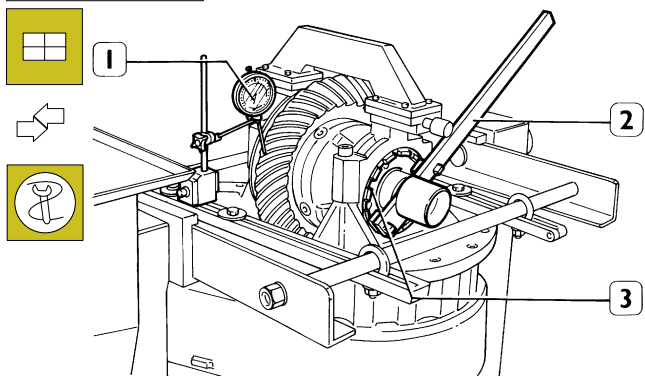
Adjusting the end play between bevel gear pair and pinion

Adjust the backlash between the teeth of the bevel pair pinion-crown wheel operating as follows:

- ☐ From the table in figure 133 find the backlash value between the teeth; this varies according to the bevel pair ratio;

No. teeth	Ratio	Backlash between teeth
21/40	1,905	0,20 ÷ 0,28
19/33	1,737	0,25 ÷ 0,33
23/36	1,565	0,20 ÷ 0,29

Figure 133



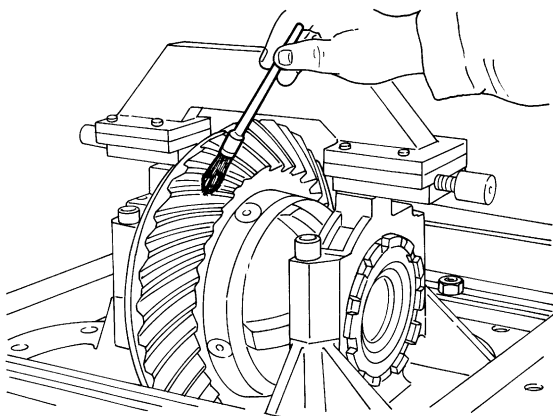
40114A

- ☐ Set the dial gauge (1) with magnetic base as shown in figure 133.
- ☐ Lock the bevel pinion rotation and rotate alternatively the crown wheel; with the dial gauge (1) find the backlash between the teeth of the two gears.
If it is not satisfactory, operate on the adjusting ring nuts (3) using wrench 99354001 (2)

To leave the previously obtained rolling torque unaltered, when adjusting the backlash between the teeth of the pinion and crown wheel, the adjusting ring nut can be tightened using wrench 99354001 in the same proportion as the ring nut on the other side has been loosened.

After the adjustment has been completed, check that the two adjusting ring nuts permit the mounting of the safety plates.

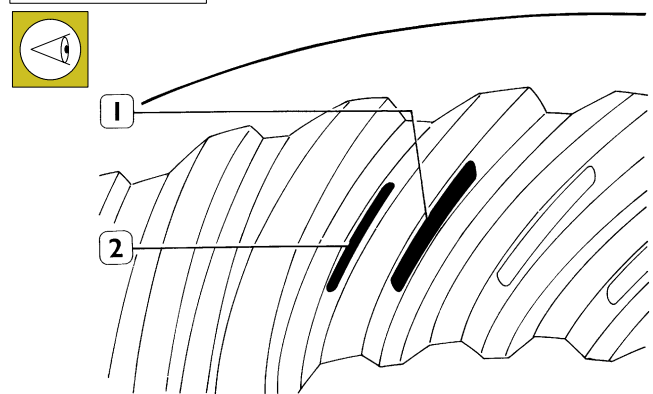
Figure 134



40159

Using a brush apply a thin coating of lead oxide to the crown wheel teeth.
Rotate the crown wheel in both directions.

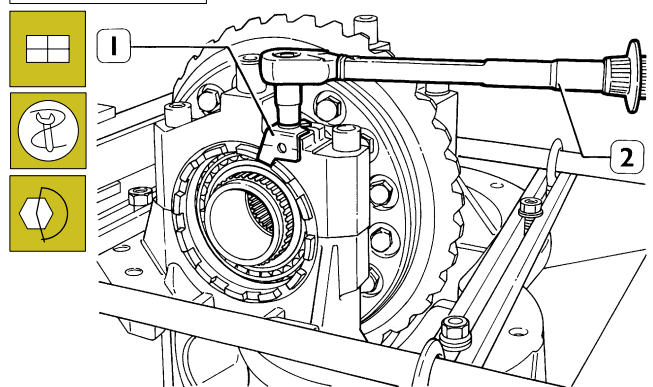
Figure 135



40160

The lead oxide should mark both the drawn surface (1) and the thrusting surface (2) approximately along the centreline of the tooth width. Without load, both meshing areas that contact are slightly displaced with reference to the crown wheel outer diameter.

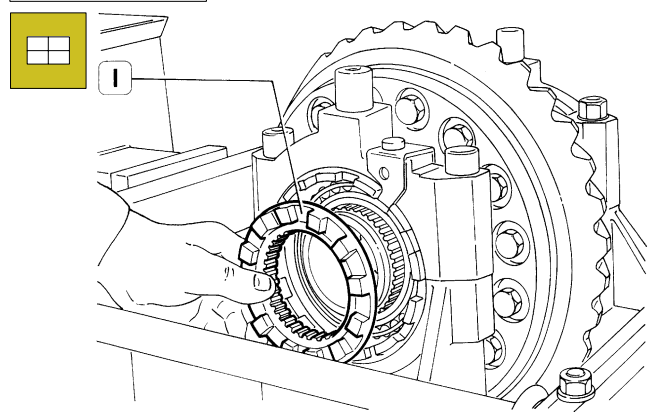
Figure 136



40110

Fit in place the safety plates (1); tighten the screws with dynamometric wrench (2) to a torque of 51 ± 5 Nm.

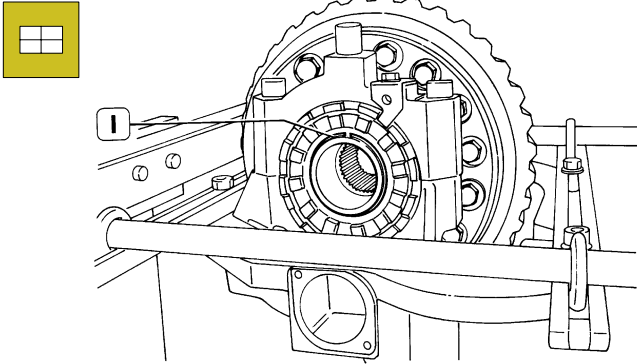
Figure 137



40111

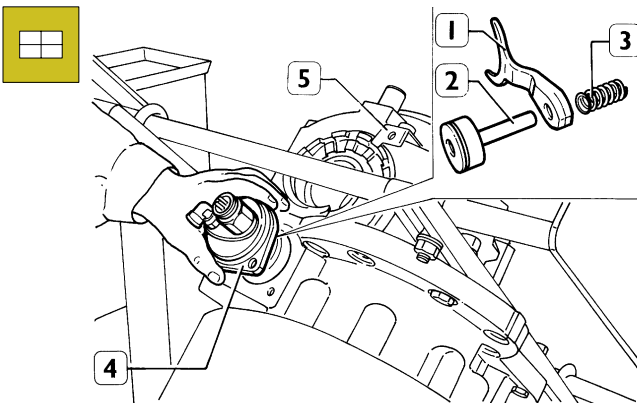
Fit in place the differential locking sleeve (1)

Figure 138



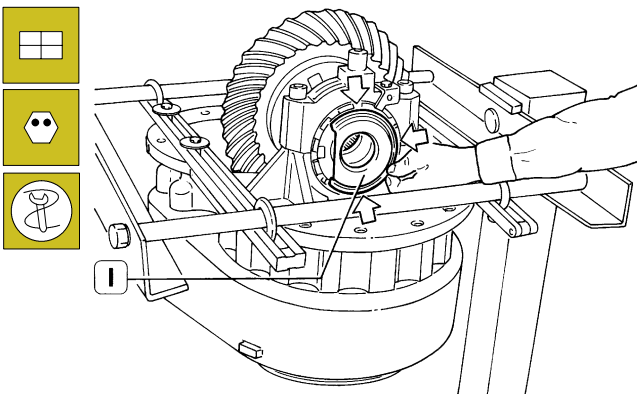
Hold it in position by means of the circlip (1)

Figure 139



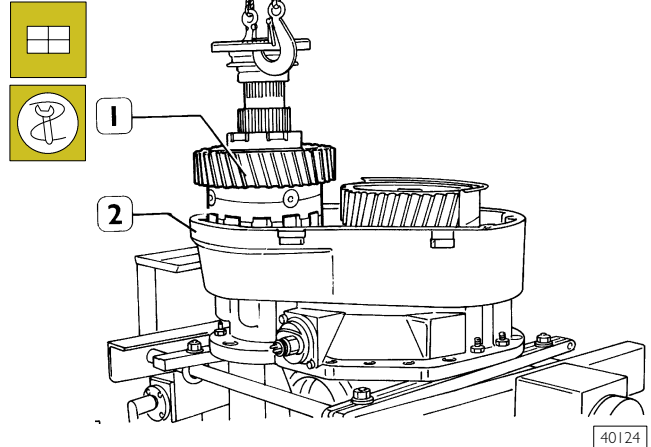
Fit in place the differential locking engagement assembly (1-2-3-4) and tighten the fastening screws to a torque of 25 ± 2 Nm

Figure 140



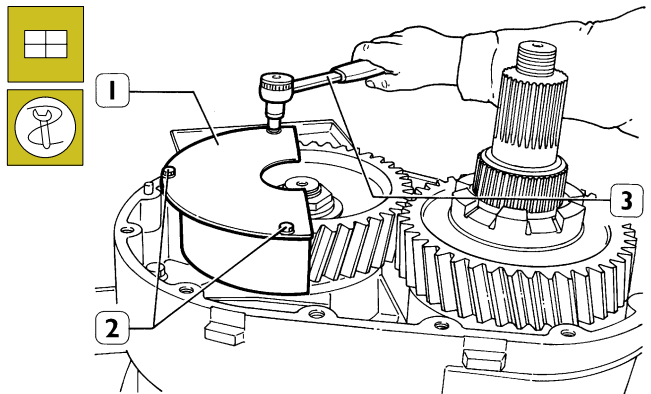
Fit in place the oil baffle (1) vertically as shown in figure 140. Dent the three points indicated by the arrows to ensure there is no counter rotation.

Figure 141



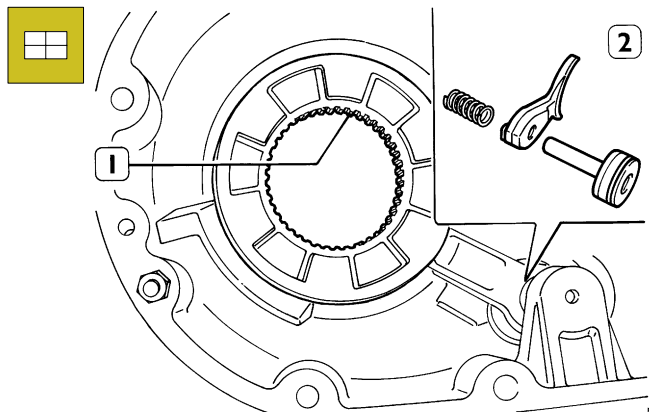
Fit in place the differential-reduction gear unit (1) in the half-box (2)

Figure 142



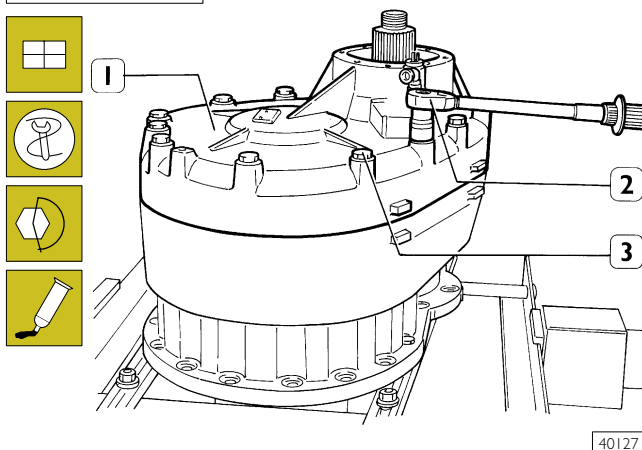
Fit in place the upper part (1) of the oil drain, lock the screws (2) with a wrench (3).

Figure 143



In the internal part of the cover fit in place the sliding sleeve (1) and the control assembly (2)

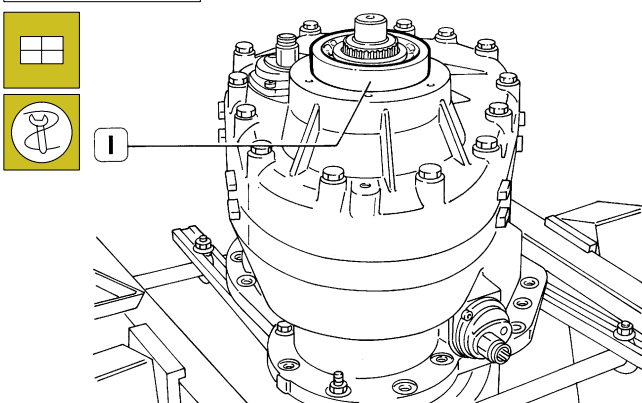
Figure 144



40127

Spread LOCTITE AVX on the contact surface.
Fit in place the cover (1) and using a dynamometric wrench (2) tighten the screws (3) to a torque of 182.5 Nm

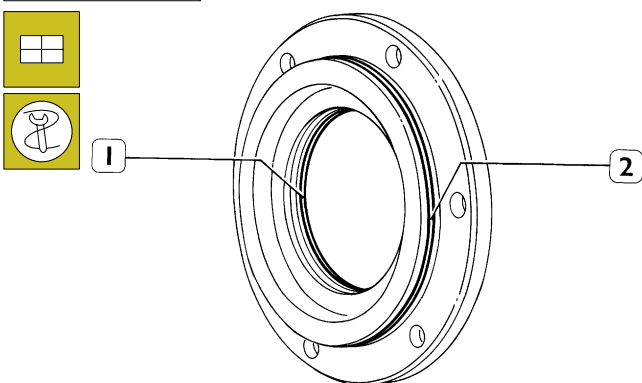
Figure 145



40128

Using an appropriate beater, fit in place the input shaft ball bearing (1)

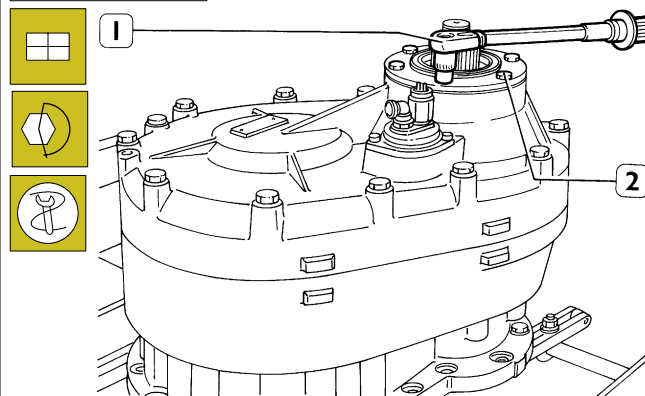
Figure 146



40129

Using element 99374233 fit in place the seal ring (1) in the cover; replace the seal ring (2).

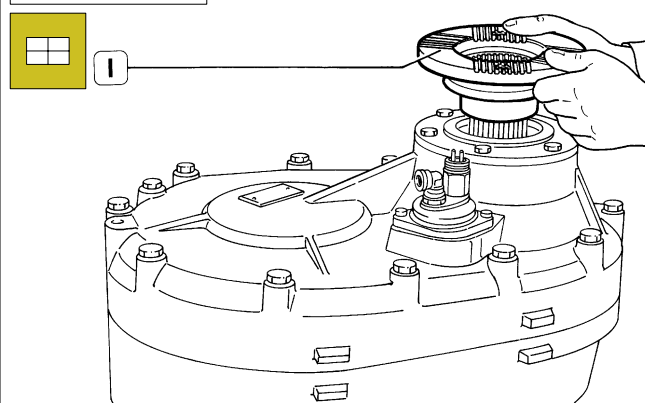
Figure 147



40131

Fit in place the cover and with dynamometric wrench (1) tighten the screws (2) to a torque of 62 ± 6 Nm

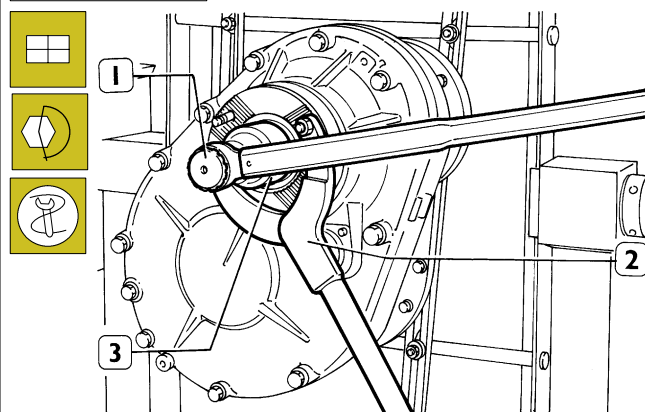
Figure 148



40132

Fit in place the flange (1) on the input shaft

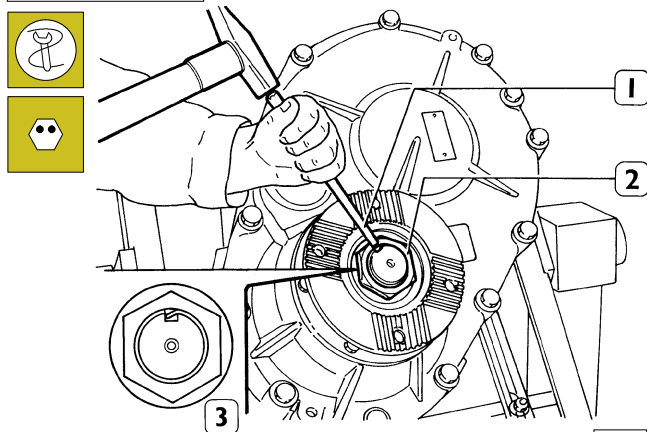
Figure 149



40133

Rotate the unit, screw the nut and with dynamometric wrench (1), counteracting lever (2) and socket wrench 99355081 (3) tighten the nut to a torque of 700 ± 50 Nm

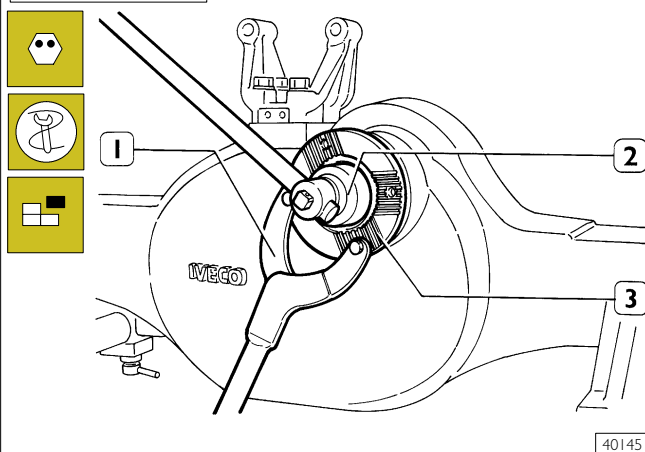
Figure 150



Using an appropriate punch (1) dent the nut (2) as shown in the detail (3)

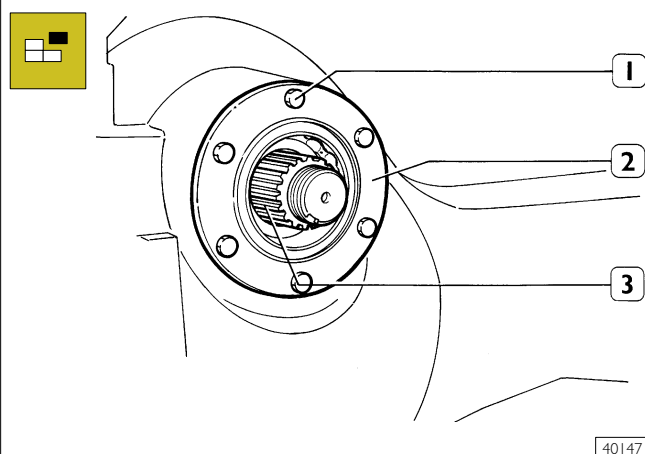
DRIVING SHAFT Removal

Figure 151



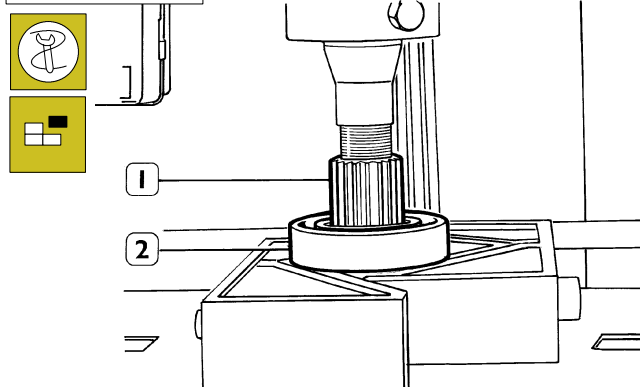
Remove the denting from the flange lock nut (3). Set up the counteracting lever (1) and using socket wrench 99355081 (2) unscrew the nut. Withdraw the flange (3)

Figure 152



Remove screws (1), remove the cover (2) and withdraw the driving shaft (3) and bearing.

Figure 153



With a press extract the ball bearing (2) from the driving shaft (1)

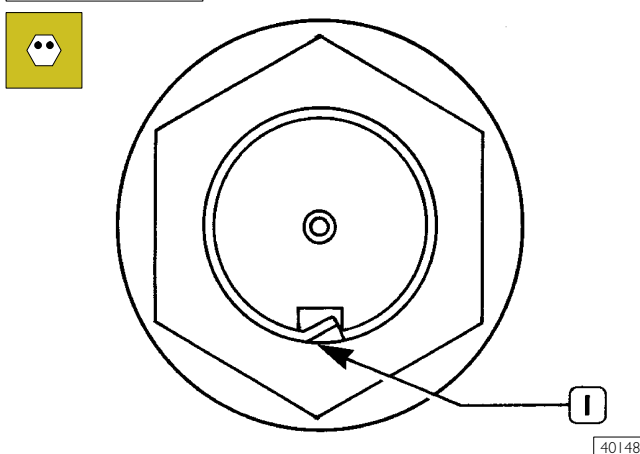
Checking components

Clean and check all the driving shaft components replacing any that are strained or broken. Always replace the seal rings.

Re-fitting in place

To re-fit in place, follow the removal instructions in reverse, denting (1) the nut as shown in figure 154.

Figure 154



REAR AXLE IN TANDEM

SECTION 12.5

SECTION 12.5

Rear axle in tandem

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DESCRIPTION

The rear axle is a double reduction type: the first reduction is by means of the pinion - ring bevel gear unit and the second is obtained through an epicyclic unit in the wheel hubs.

The differential housing, with the ring bevel gear, is supported by two taper roller bearings that can be adjusted through two threaded ring nuts.

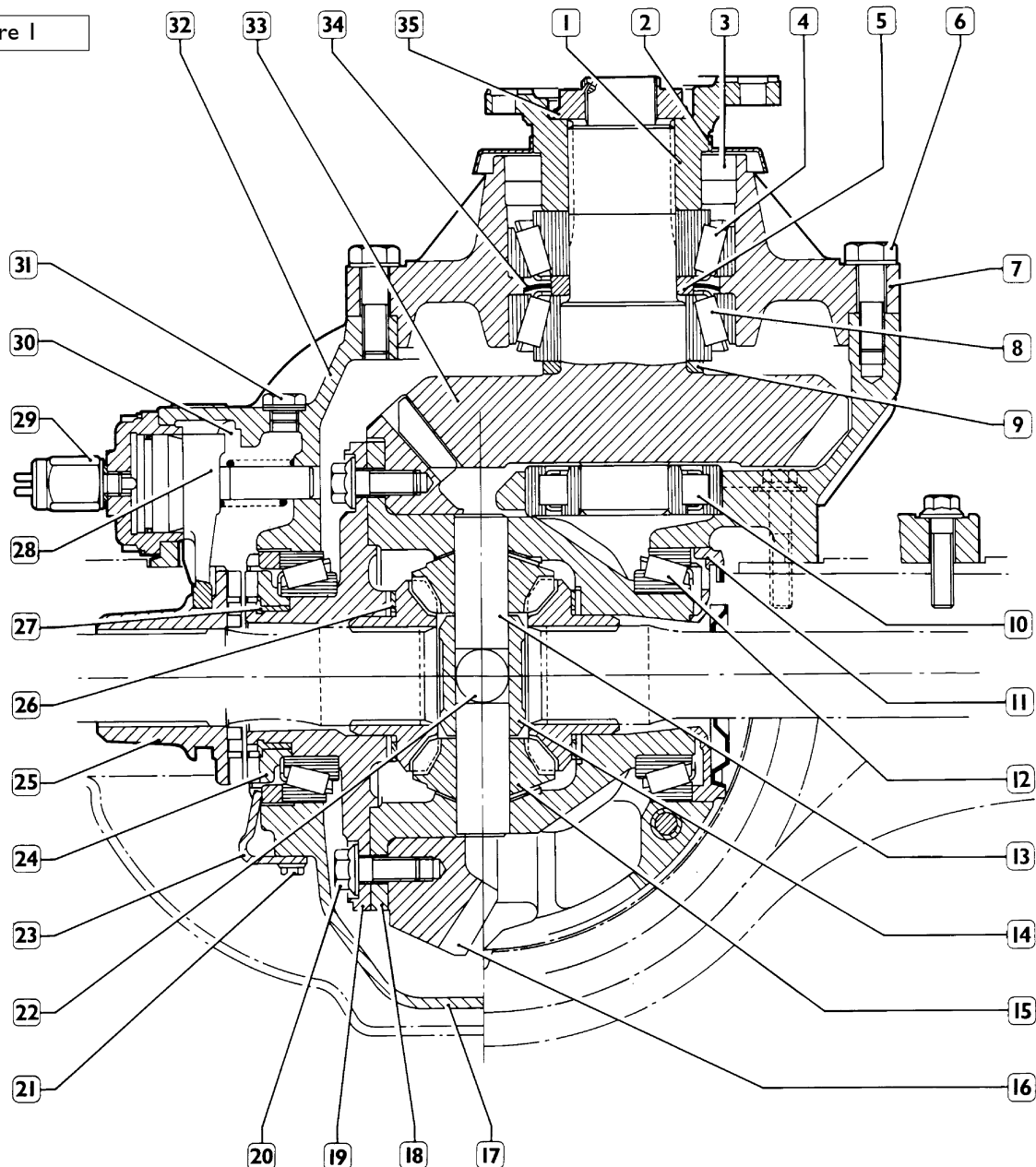
The pinion is supported by two taper roller bearings and a third straight roller bearing.

The bevel pinion unit is adjusted through adjusting rings that are fitted between the two taper roller bearings.

The axle is equipped with a pneumatically controlled device to lock the differential.

The half shafts coming from the differential transmit the motion to the epicyclic gears.

Figure 1

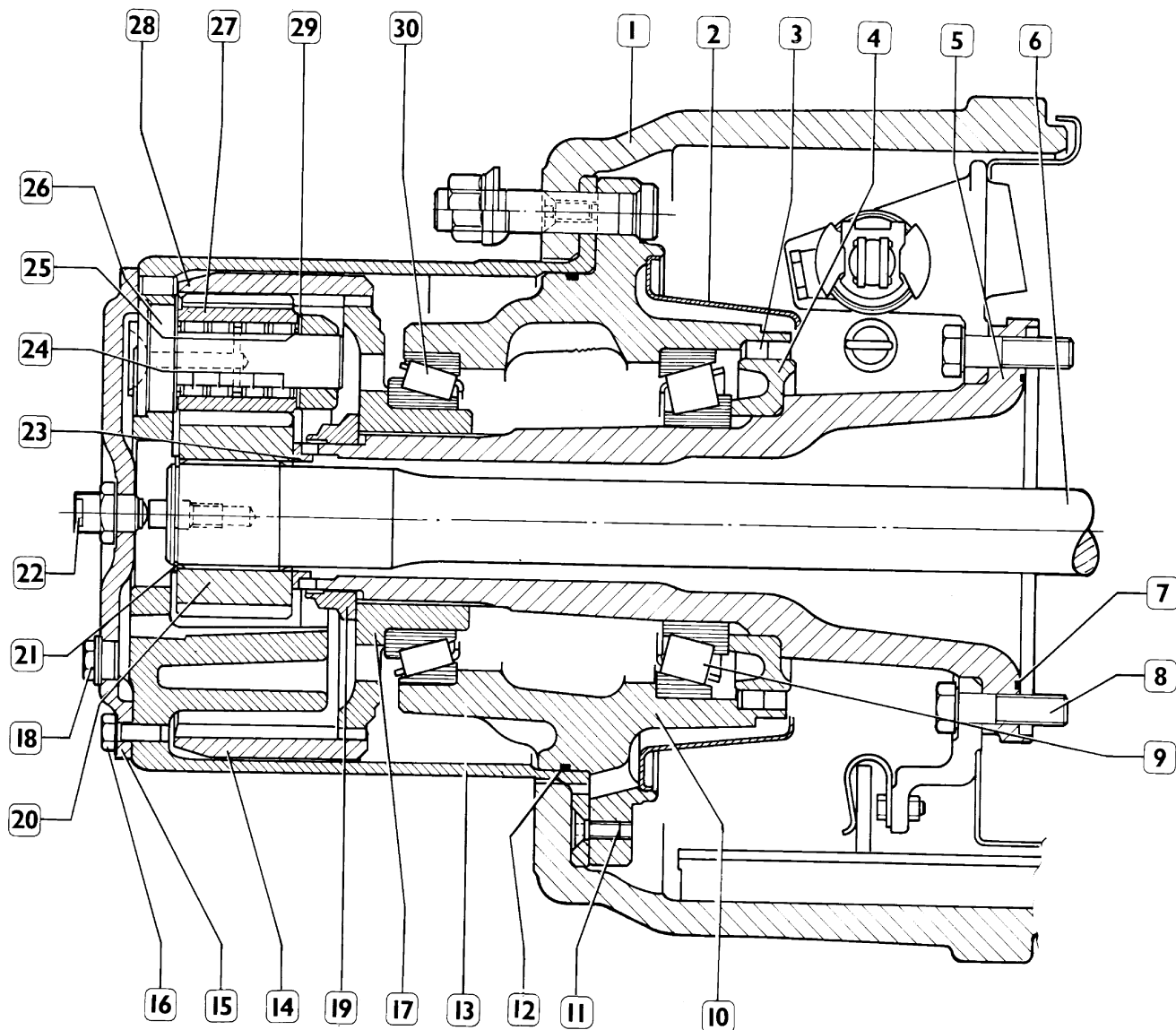


39381

PICTORIAL CROSS SECTION OF THE DIFFERENTIAL

1. Coupling flange - 2.Oil seal - 3. Outer seal ring - 4. Front bearing - 5. Adjusting ring - 6. Screw - 7. Bevel pinion support - 8. Intermediate bearing - 9. Adjusting ring - 10. Rear bearing - 11. Adjusting ring nut - 12. Differential housing bearing - 13. Short pin - 14. Spider - 15. Planetary gear - 16. Crown wheel - 17. Cover - 18. Gear housing - 19. Cover - 20. Screw - 21. Screw - 22. Long pin - 23. Safety plate - 24. Engaging sleeve - 25. Sliding sleeve - 26. Shoulder washer - 27. Split ring - 28. Engaging fork - 29. Transmitter - 30. Spring - 31. Plug - 32. Differential housing - 33. Taper pinion - 34. Oil baffle - 35. Lock nut

Figure 2



39907

PICTORIAL CROSS SECTION OF EPICYCLIC REDUCTION GEAR AND WHEEL HUB

1. Brake drum - 2. Oil manifold - 3. Seal rings - 4. Intermediate ring for sealing rings - 5. Bearing shaft - 6. Half shaft - 7. Seal ring - 8. Screw - 9. Bearing - 10. Wheel hub - 11. Screw - 12. Seal ring - 13. Planetary gear support - 14. Crown wheel - 15. Cover - 16. Screw - 17. Crown wheel carrier - 18. Plug - 19. Collar nut - 20. Planetary gear - 21. Circlip - 22. Spacer screw - 23. Spacer ring - 24. Planetary gear needles - 25. Spacer rings - 26. Pin - 27. Planetary gear - 28. Gasket - 29. Spacer washer - 30. Bearing

SPECIFICATIONS AND DATA

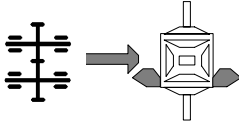
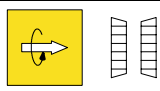
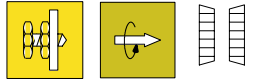
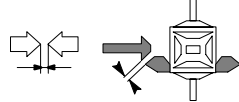
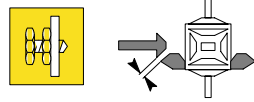
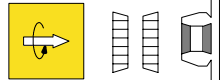
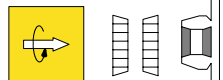
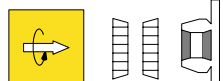
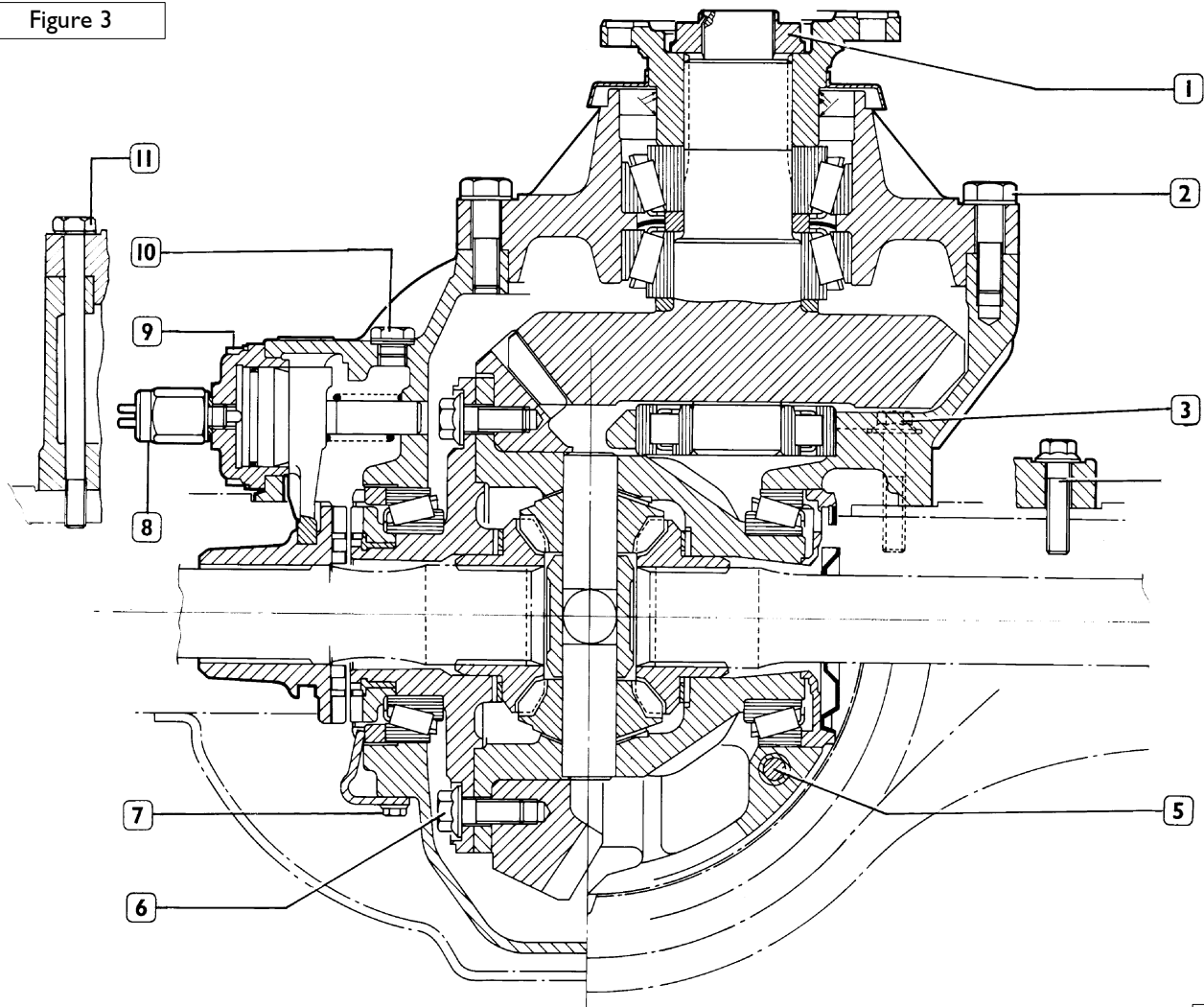
	Type of axle: Bearing with double reduction, differential is locked through pneumatic control and reduction gear unit	ASTRA 453291/2D (IVECO R 8298 D001)
	Bearings for bevel pinion	2, with taper rollers and 1 with straight rollers
	Reduction bevel gear pair ratio	23/36 (1,565) - 19/33 (1,737) - 21/40 (1,905)
	Epicyclic reduction gear ratio on the wheels	3,2
	Bevel pinion bearings rolling torque without gasket Nm	1,5 ÷ 3,5
	Bevel pinion bearings rolling torque adjustment	through adjustment rings
	 Thickness of adjustment rings for bevel pinion bearings rolling torque mm	10 - 10,02 - 10,04 - 10,06 - 10,08 - 10,10 - 10,12 - 10,14 - 10,16 - 10,18 - 10,20 - 10,22 - 10,24 - 10,26 - 10,28 - 10,30 - 10,32 - 10,34 - 10,36 - 10,38 - 10,40 - 10,42 - 10,44 - 10,46 - 10,48 - 10,50
	 Thickness of adjustment rings for bevel pinion fitting with reference to the crown wheel mm	3,6 - 3,7 - 3,8 - 3,9 - 4,0 - 4,1 - 4,2 - 4,3 - 4,4 - 4,5 - 4,6
	Backlash between pinion and crown wheel mm	23/36 (1,565) = 0,20 ÷ 0,29 19/33 (1,737) = 0,25 ÷ 0,33 21/40 (1,905) = 0,20 ÷ 0,28
		Through ring nuts
	WHEEL HUBS	
	Wheel hub bearings	Two with taper rollers
	Rolling torque of wheel hub bearings: new bearings with surface protection Nm	3 + (12 ÷ 16)
	Rolling torque of wheel hub bearings: new bearings with surface protection Nm	3 + (5 ÷ 7)
	Rolling torque of wheel hub bearings: Run-in bearings and seal rings Nm	3 + (2,5 ÷ 4,5)
	Half-shaft end play mm	0,5 ÷ 1

Figure 3

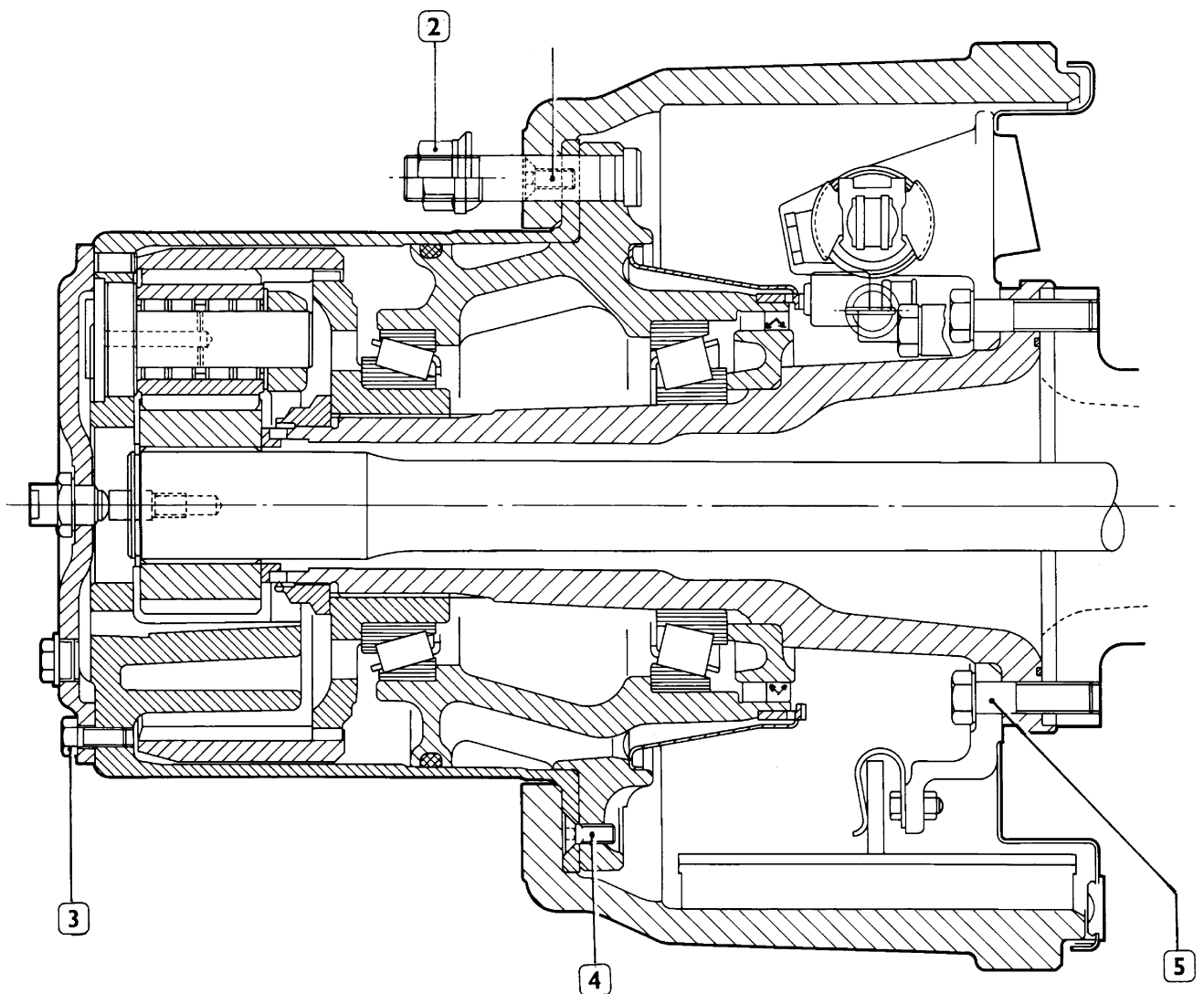


39383

TIGHTENING TORQUES

COMPONENT	TORQUE	
	Nm	Kgm
1 Bevel pinion locking nut	700 ± 50	70 ± 5
2 Bevel pinion support to differential housing fastening screw	165 ± 15	16,5 ± 1,5
3 Differential housing to axle casing fastening screw	160 ± 10	16 ± 1
4 Differential housing to axle casing fastening screw ●	160 ± 10	16 ± 1
5 Bevel pinion support to differential housing fastening screw ◆	280 ± 15	28 ± 1,5
6 Ring bevel gear to gear housing fastening screw	300 ± 10	30 ± 1
7 Safety plate to gear housing cover fastening screw	60 ± 6	6 ± 0,6
8 Pressure switch	61 ± 6	6,1 ± 0,6
9 Hexagonal socket head screw for control cylinder	25 ± 2	2,5 ± 0,2
10 Oil intake plug	40 ± 4	4 ± 0,5
11 Self locking screw	120 ± 10	12 ± 1
● Apply LOCTITE AVX ◆ Spread LOCTITE 573 sealant		

Figure 4



39384

COMPONENT		TORQUE	
		Nm	Kgm
1	Drum flathead screw	25 ± 3	$2,5 \pm 0,3$
2	Wheel nut	650	65
3	Cover to crown wheel support fastening screw ●	50 ± 5	$5 \pm 0,5$
4	Flathead screw	25 ± 3	$2,5 \pm 0,3$
5	Bearing sleeve screw ◆	280 ± 15	$28 \pm 1,5$
● Apply LOCTITE AVX			
◆ Spread Hylomar SQ 32IM sealant			

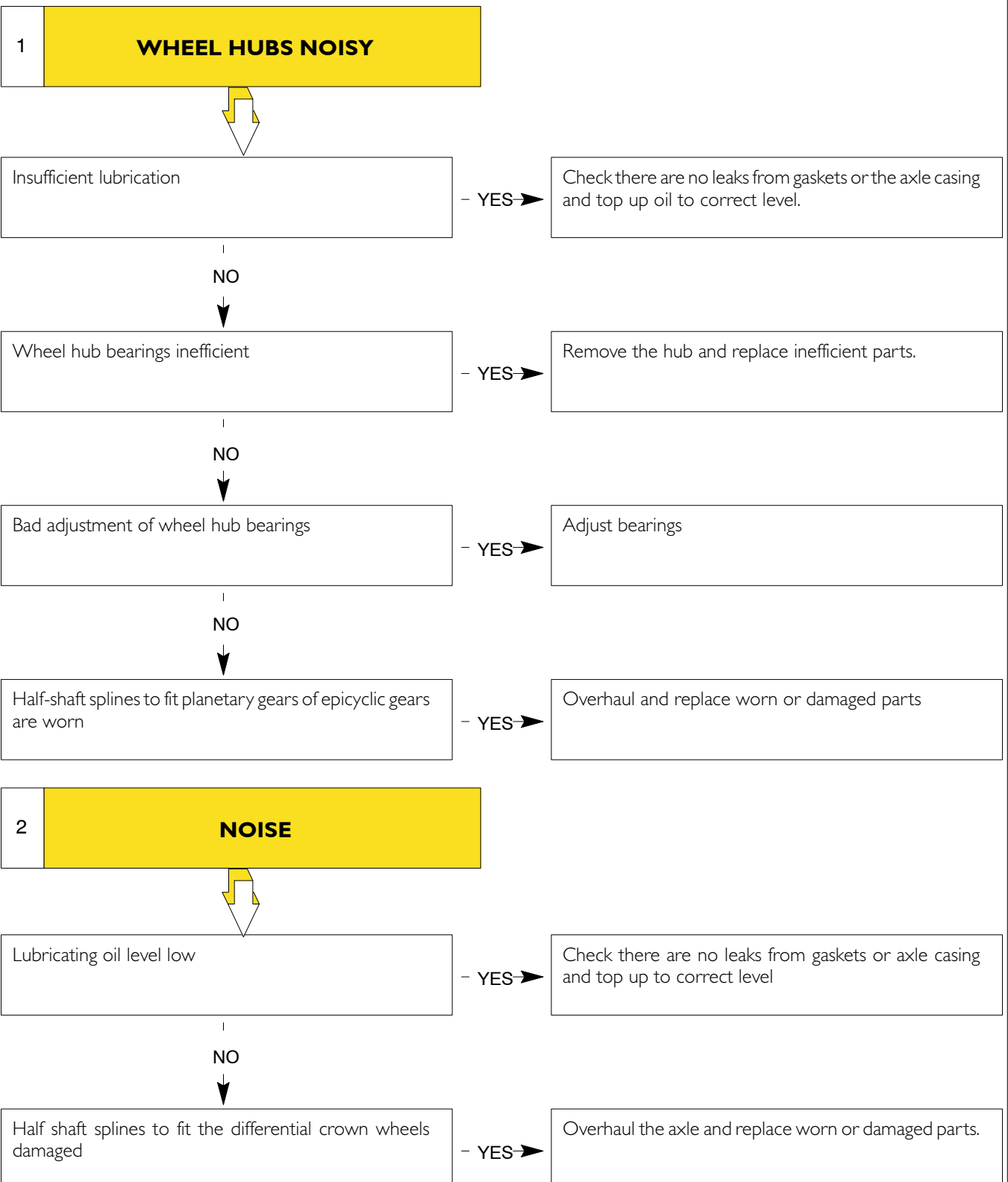
TOOLS

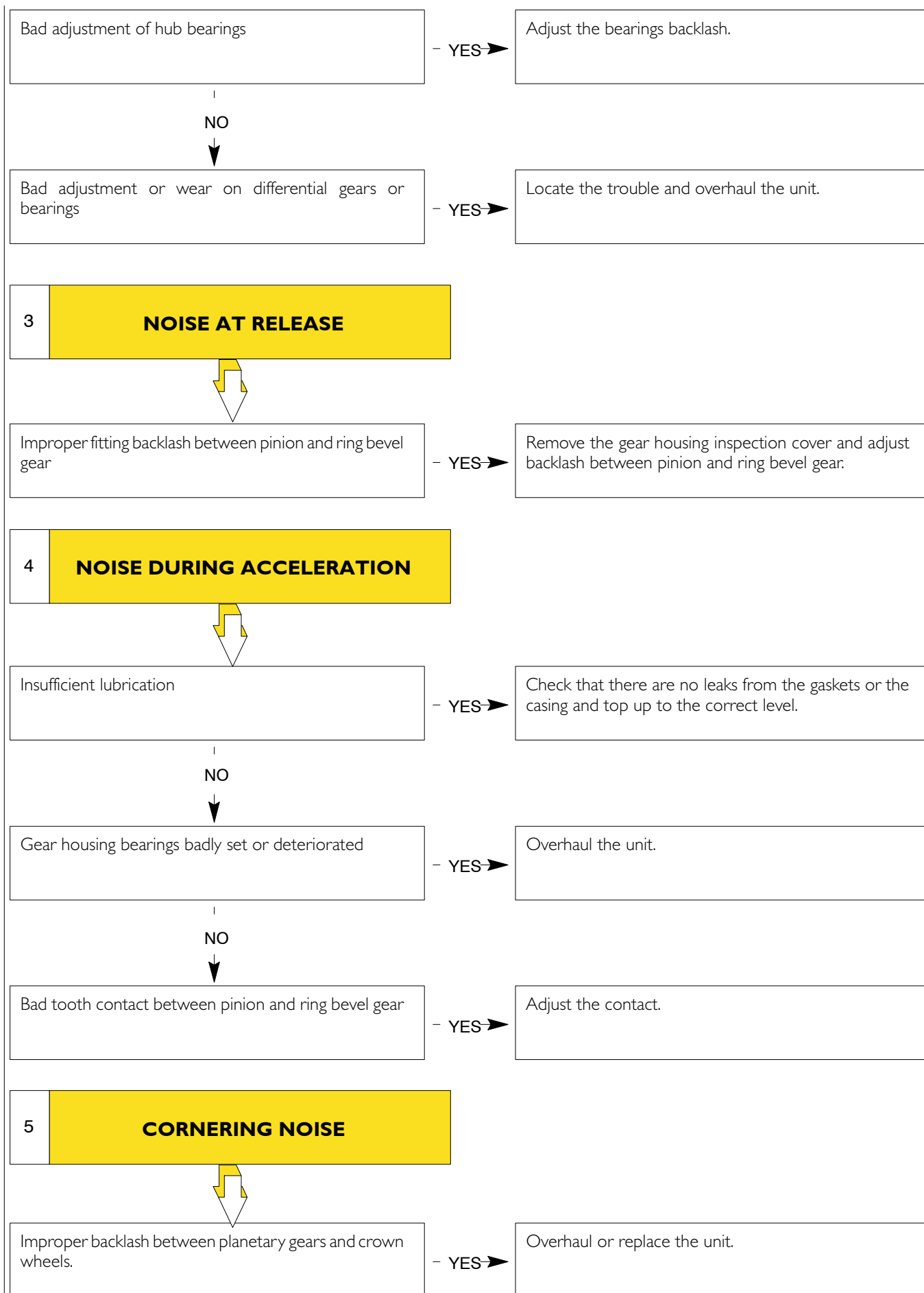
TOOL NO.	DESCRIPTION
99305121	Hot air operated equipment
99322205	Rotary stand for unit overhaul
99322215	Stand to overhaul axles
99322225	Unit support (to use on stand 99322205)
99341003	Puller
99341015	Clamp
99341023	Grips
99345055	Counter block for pullers
99354001	Wrench for differential gearcase bearing adjustment ring nut
99354207	Wrench (94.5 mm) for wheel hubs bearing adjustment nut
99355081	Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99356001	Wrench for wheel brake shoes adjustment
99357111	Pliers for brake shoes return spring
99370005	Handle for interchangeable beaters
99370006	Handle for interchangeable beaters
99370007	Handle for interchangeable beaters
99370317	Lever and relevant extension bar to retain flange
99370509	Hook to remove differential gearcase half box
99370616	Support to hold differential gear during removal/re-fitting in place
99370617	Universal support to hold axles during removal/re-fitting in place
99371022	Pair of brackets to hold differential during overhaul (to be used with 99322205 and 99322225)
99372213	Tool for brake drum turning (to be used with 9930100)
99374013	Element to fit in place the differential bevel pinion gasket (to be used with 99370006)
99374025	Element to fit in place the wheel hub internal gasket (to be used with 99370005)
99374093	Beater to fit in place bearings outer tracks (91 -134) (to be used with 99370007)
99374094	Beater to fit in place bearings outer tracks (134-215) (to be used with 99370007)
99374451	Equipment for half shafts removal/re-fitting in place
99389819	Dynamometric wrench 0 to 10 kgm connection 1/4"
99389821	Dynamometric wrench 0 to 70 kgm connection 3/8"
99395026	Tool to check hubs rolling torque (to be used with dynamometric wrench)
99395027	Tool to find proper differential bevel pinion adjustment shims (to be used with 99395603)
99395603	Dial gauge (0-5 mm)

DIAGNOSTICS

Main axle faults:

- 1 - Wheel hubs noisy
- 2 - Noise
- 3 - Noise at release
- 4 - Noise during acceleration
- 5 - Cornering noise





REMOVING - REFITTING THE REAR AXLE Removal

To remove the rear axle proceed as follows:

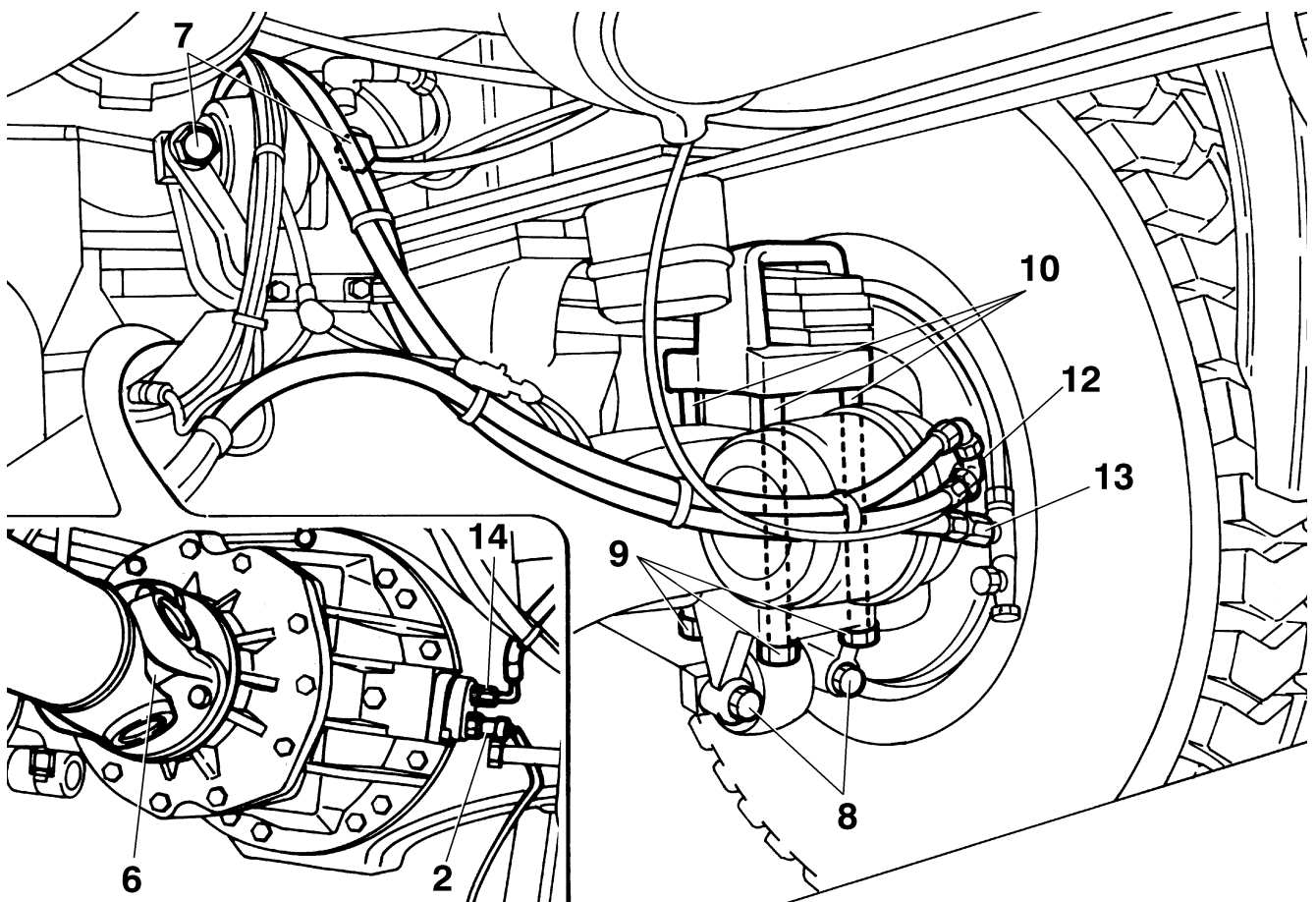
- ☐ place the vehicle on a flat ground and suitably lock the front wheels;
- ☐ loosen both rear wheel fastening nuts;
- ☐ using a hydraulic jack lift the rear part of the vehicle and rest it on two stands;
- ☐ remove both rear wheels;
- ☐ disconnect ABS transmitter electrical cables from both sides (only vehicles provided with ABS);
- ☐ disconnect the electrical cable (2) for the differential led;
- ☐ disconnect the pneumatic connections for parking brake (12), brake air delivery (13), differential locking (14);

- ☐ remove braking control lever rod (11);
- ☐ undo the screws fixing the propeller shaft flange (6), and secure temporarily the shaft to the chassis to avoid interference during next operations;
- ☐ remove the bolts (7) fixing the axle securing upper rod;
- ☐ unscrew the bolts (8) fixing the axle securing lower rod from both sides;
- ☐ set a hydraulic jack fitted with tool 99370617 under the axle;
- ☐ unscrew the nuts (9) from both sides and lift the leaf spring fixing brackets (10) then, lower the axle and take away the leaf spring.

Refitting

To refit, follow the removal operations in reverse order.

Figure 5



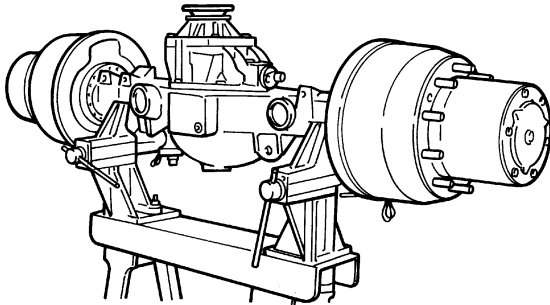
REAR AXLE ASSEMBLY REPAIR OPERATIONS



The removal and re-fitting into place operations for the half-shafts, drums and brake shoes, air bleeder, wheel hubs differential and epicyclic gears can all be carried out with the units fitted on the vehicle.

Before setting the axle assembly on the stand to overhaul, unscrew the axle casing lower plug to drain the oil.

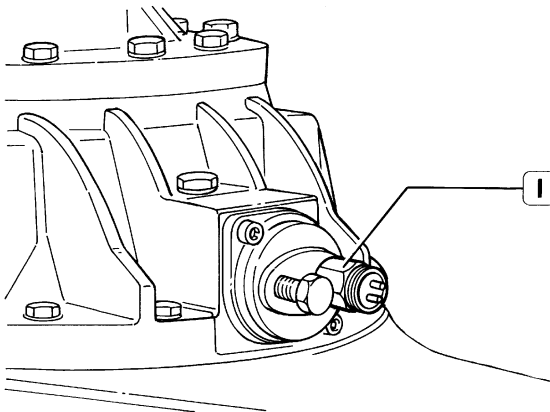
Figure 6



39627

Set the whole axle assembly on stand 99322215.

Figure 7



39628

Lock the sliding sleeve of the differential locking device with a screw.

To do this, remove the threaded coupling from the control cylinder and in its place (I) fit a screw (M14 x 1.5).

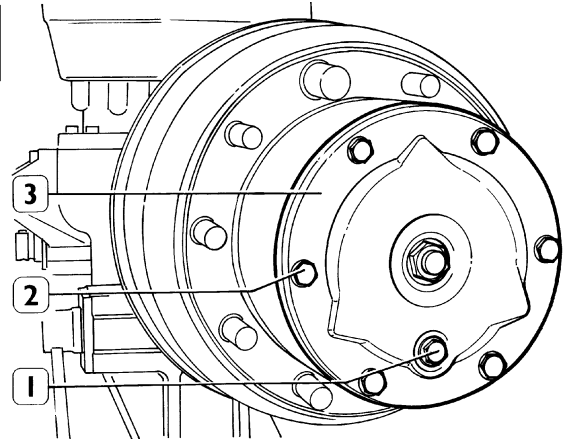
At the same time, turn the axle mechanism so that the sliding sleeve and engagement sleeve are engaged. This will prevent accidental movement of the sleeve while removing the half-shaft.



Place a vessel under the wheel hub to collect the oil.

Removing the epicyclic reduction unit

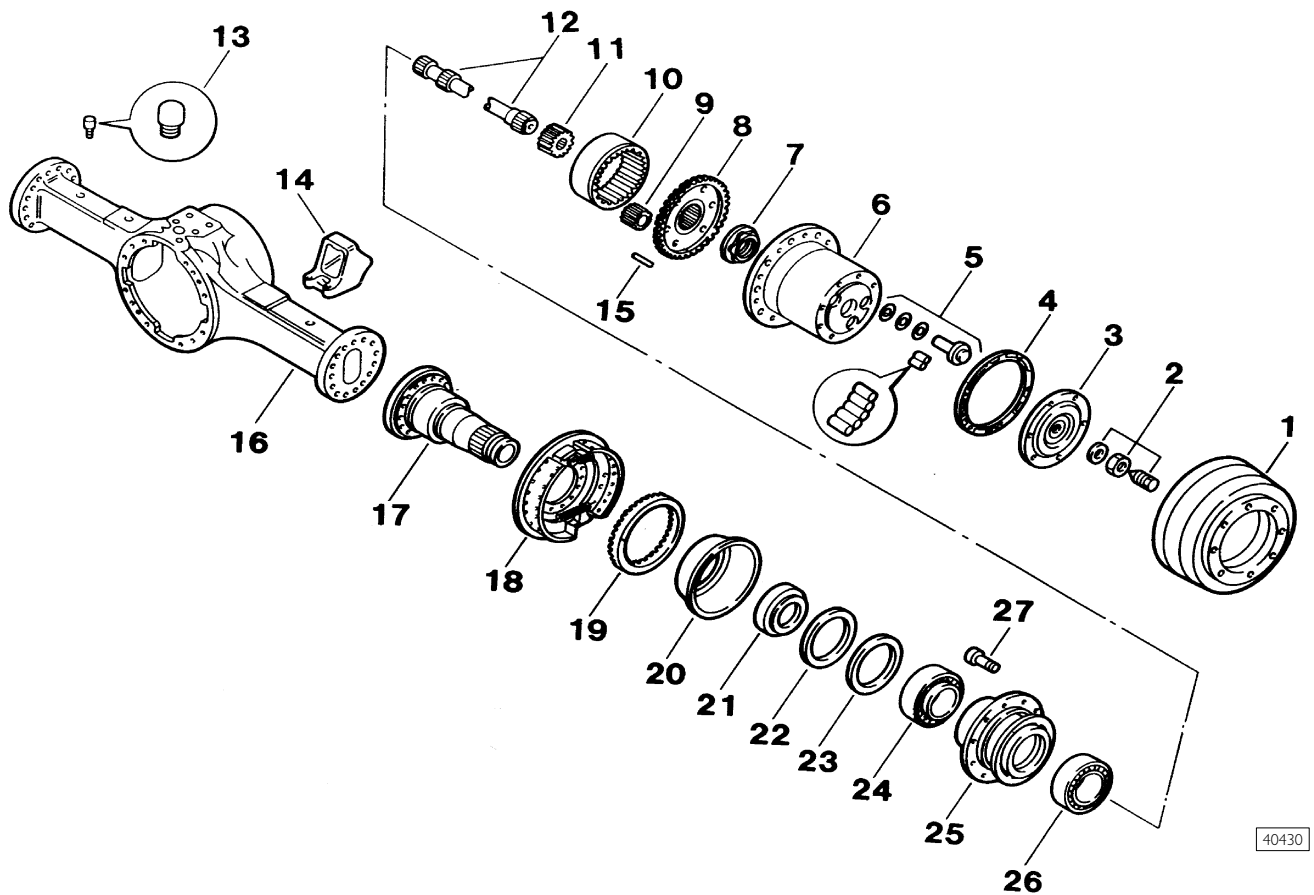
Figure 8



40053

Remove the screws (2); remove the cover (3) and collect the oil.

Figure 9

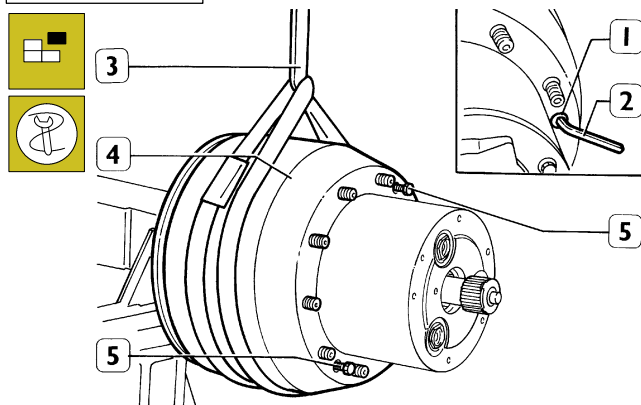


40430

WHEEL HUB COMPONENTS

1. Brake drum – 2. Adjusting screw and nut – 3. Cover – 4. Gasket – 5. planetary gear pin and rollers – 6. Planetary gear carrier – 7. Adjusting nut – 8. Crown wheel carrier – 9. Planetary wheel – 10. Crown wheel – 11. Crown wheel gear – 12. Half-shaft – 13. Bleeder – 14. Bracket – 15. Shoulder pin – 16. Axle casing – 17. Bearing shaft – 18. Braking unit – 19. Phonic wheel – 20. Oil cup – 21. Supporting ring – 22. Seal ring – 23. Seal ring – 24. Bearing – 25. Wheel hub – 26. Bearing – 27. Bolt

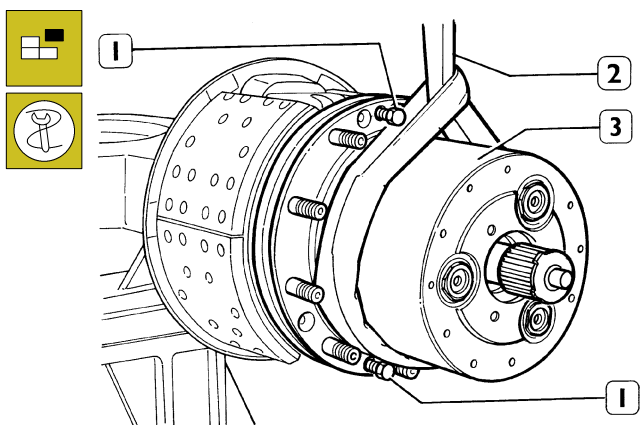
Figure 10



40338

Using a socket wrench (2) unscrew the two drum retaining screws (1); replace them with counteracting screws (5), tighten to remove the drum (4) from the hub, then take it away with a rope (3) and lifting equipment.

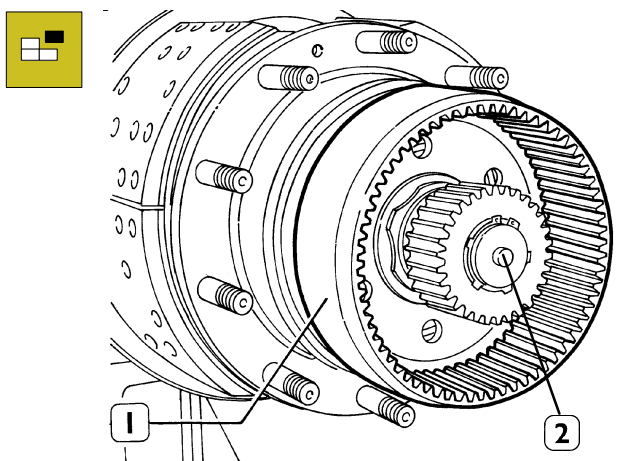
Figure 11



40054

Remove the 3 retaining screws from the planetary gear support (3); insert the counteracting screws (1) and using a rope (2) remove the support (3)

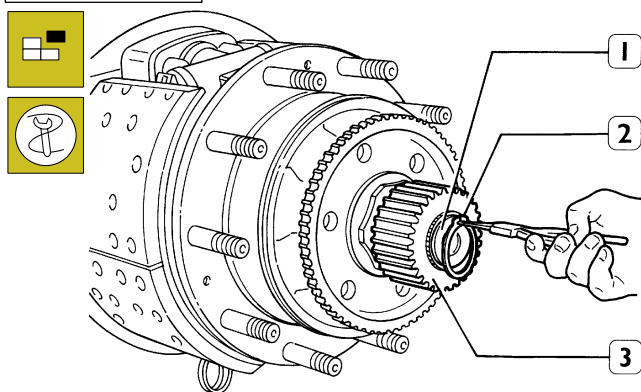
Figure 12



40055

Withdraw the crown wheel (1) from the crown wheel carrier. Take out the shoulder pin (2)

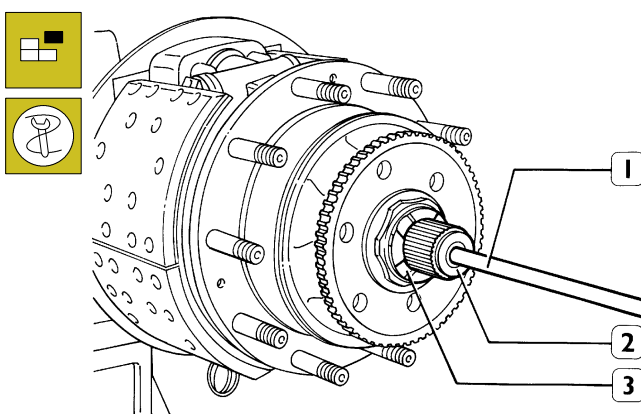
Figure 13



39635

Use appropriate pliers to remove the circlip (2) withdraw the planetary gear (3) from the half-shaft (1).

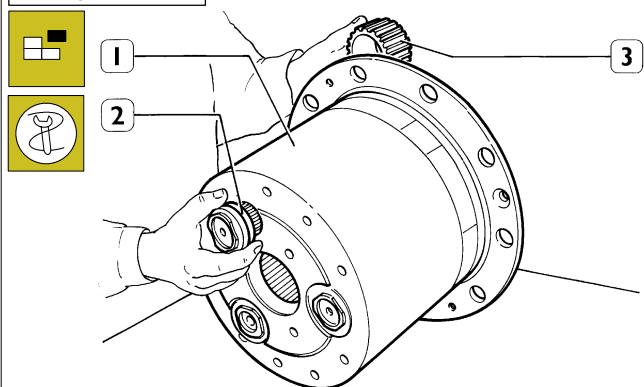
Figure 14



39636

Screw tool 9937445 (1) into the shoulder pin seat and remove the half shaft (2) from the bearing shaft. Remove the spacer ring (3)

Figure 15

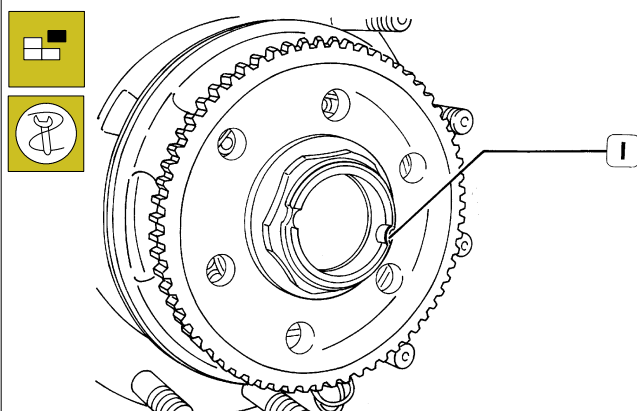


40056

Remove the pins (2) from the planetary gear support (1). Remove the planetary gears (3) from the support (1) and set aside the needles and spacer rings.

Removing the wheel hubs

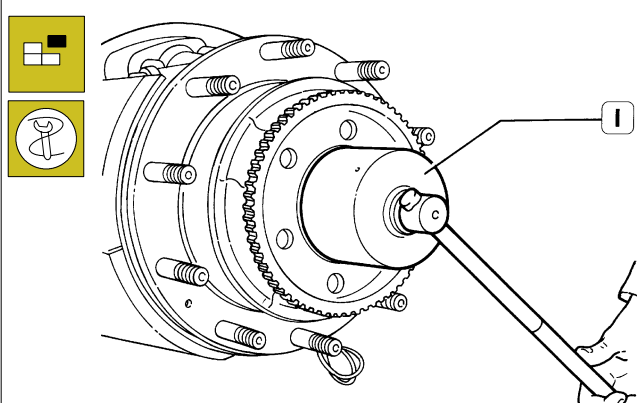
Figure 16



39637

Using a suitable punch straighten the dents (1) on the adjusting nut.

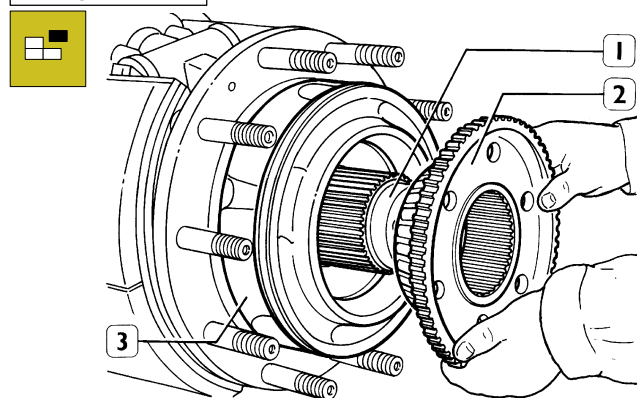
Figure 17



39638

Using socket wrench 99354207 (1) unscrew the adjusting nut.

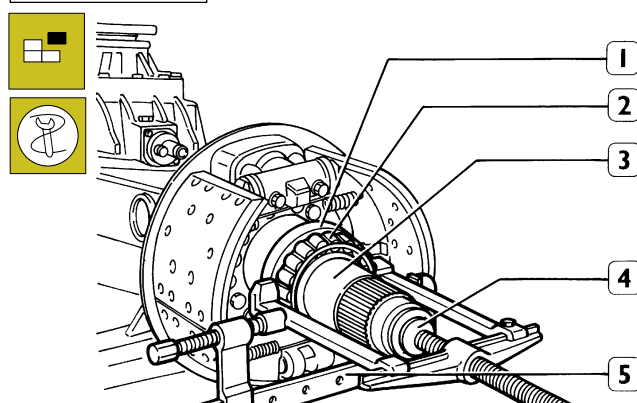
Figure 18



39639

Withdraw the bearing shaft (1), the crown wheel carrier (2) with the relevant bearing and complete wheel hub (3).

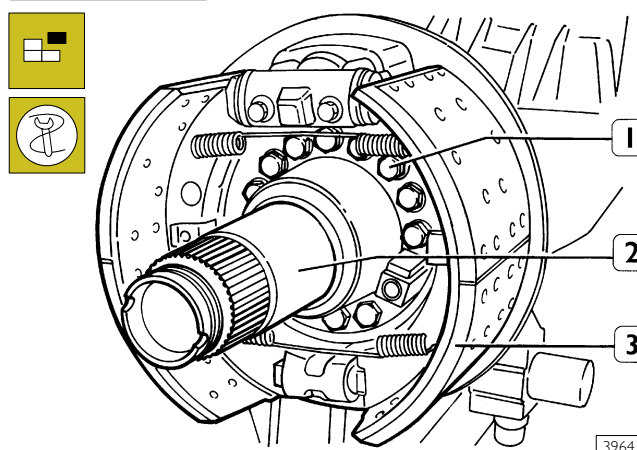
Figure 19



39640

Using a puller, clamp (5) and counter block 99345055 (4), remove the gasket ring (1) and taper roller bearing (2) from the bearing shaft (3).

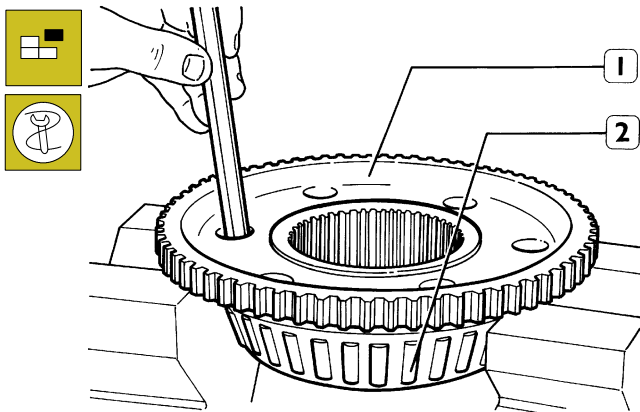
Figure 20



39641

Check the bearing shaft (2) and if it is damaged, replace it. Using tool 99372217, release the brake shoes (3) and after unscrewing the hexagonal screws (1) locked with LOCTITE, remove the brake carrier plate with the bearing shaft.

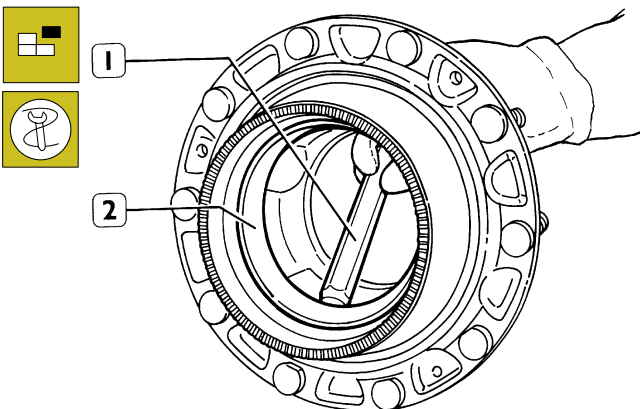
Figure 21



39642

With a suitable beater fitted in the holes on the crown wheel carrier, remove the outer taper roller bearing (2) from the crown wheel carrier (1).

Figure 22



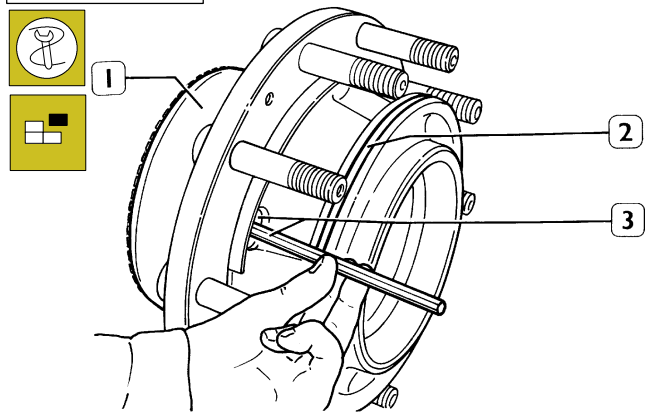
39643

Use a bronze beater (1) to drive out the inner bearing outer ring (2).

The seal ring will come away with it.

In the same way extract the outer bearing outer ring. If necessary remove the phonic wheel.

Figure 23



39644

Check the oil manifold (1) and if it is damaged, replace it. To do this, extract it with a suitable beater inserted through the hub slots (3). Remove the shaped seal ring (2).

WHEEL HUBS AND EPICYCLIC REDUCTION GEAR COMPONENTS CHECK



Carefully clean the wheel hub components. Check the half shafts to ensure they are not strained. If necessary straighten the half shafts under a hydraulic press. If the results obtained are not satisfactory, replace the half-shafts. Check the wheel bolts, if the threads are strained or damaged, replace them under the press. After fitting in place check that the orthogonality error does not exceed 0.3 mm.



Lubricate the bearings and turn the roller cage freely; the rotation must be even with no signs of stiffness. Check the threads on the bearing adjustment nut and the bearing shafts; if necessary replace the nuts. Check the oil manifold, if it is damaged replace it. All seal elements must be replaced with new ones.

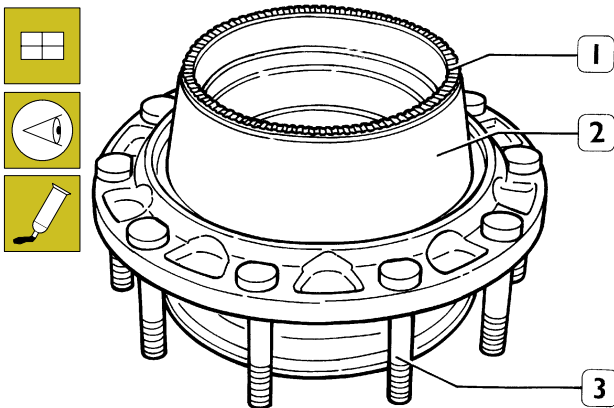
Carefully clean all the epicyclic gear components. Visually check the teeth of the crown wheel carrier, the crown wheel, the planetary wheels and planetary gear.

Check the spacer rings, bearing needles and support pins.

Replace any worn or damaged parts.

Fitting in place the wheel hubs

Figure 24



39645

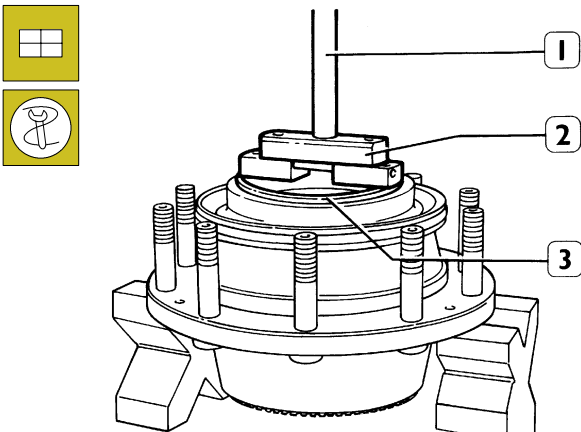
If the bolts (3) require replacement, before fitting in place the new bolts make sure that the contact surface of the bolt head is free of swarf, burrs and dents.

After the bolts have been driven in, check that they are perfectly flush on the hub and that the orthogonality error does not exceed 0.3 mm.

If it is necessary to replace the oil cup (2) before fitting in place the new one, spread LOCTITE 573 sealant on the hub to cup coupling surfaces and on the cup housing on the hub.

Re-fit in place the phonic wheel (1) making sure, after fitting, that the phonic wheel rests perfectly on the hub seat. Use a dial gauge to check that the phonic wheel orthogonality error is not over 0.2mm.

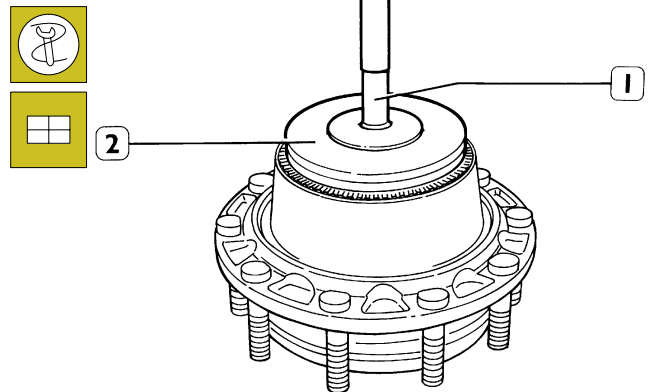
Figure 25



39646

Use beater 99374093 (2) to drive in the outer bearing outer ring (3) (under the press) leaving approx 5 mm of the stroke; finish driving in by hand using handle 99370007 (1).

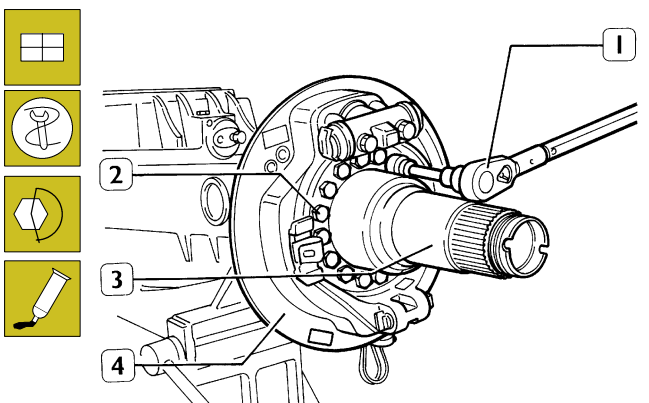
Figure 26



39647

Using tool 99374025 (2) with the relevant intermediate ring and handle 99370005 (1) drive the internal seal ring into its housing. Use the same tool but without the intermediate ring to fit the external seal ring.

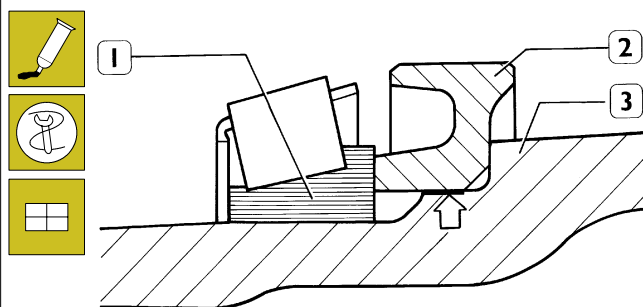
Figure 27



39648

Set the seal ring on the bearing shaft, spread LOCTITE AVX on the contacting areas between the axle housing and bearing shaft. Fit in place the bearing shaft (3) with the brake carrier plate (4) and dust guard disk. Apply LOCTITE AVX to the screws (2) then lock them with a dynamometric wrench (1) to a torque of 280 ± 15 Nm.

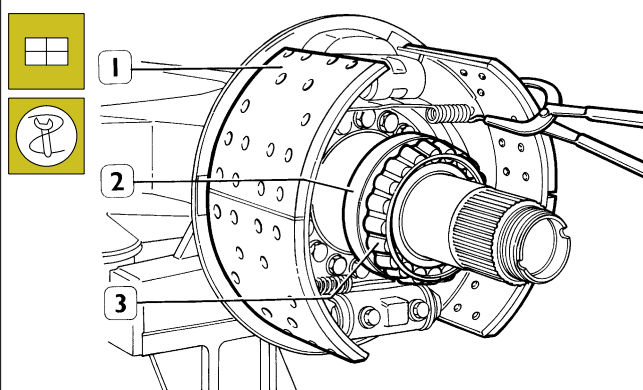
Figure 28



40375

Spread Hylomar SQ32IM sealant on the bearing shaft (3) ring (2) housing (⇒) for the seal rings. Heat the ring (2) and fit it on the bearing shaft (3). Heat the taper roller bearing inner ring (1) to approx 100°C and fit it on the bearing shaft.

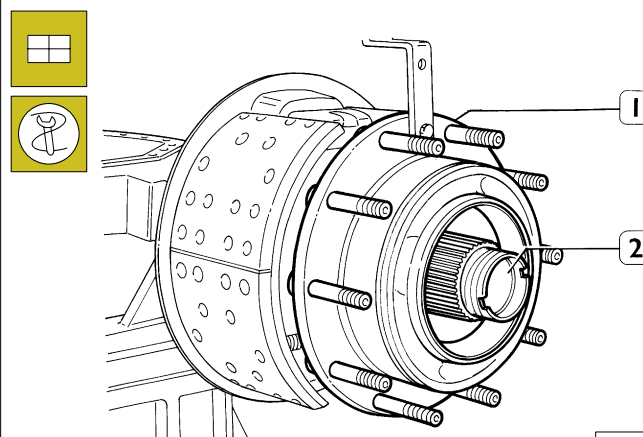
Figure 29



40067

Re-fit in place the brake shoe (1) using tool 99372217.

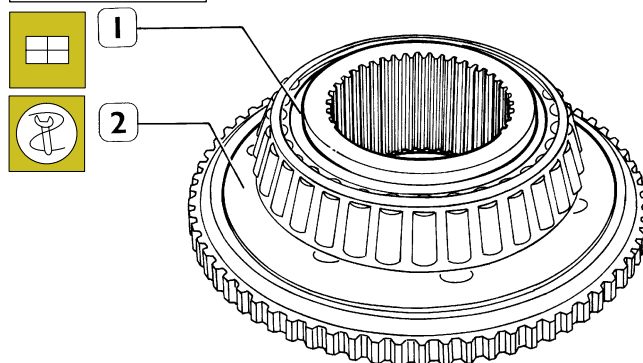
Figure 30



40068

Using the suitable tool set the complete hub (1) on the bearing shaft (2)

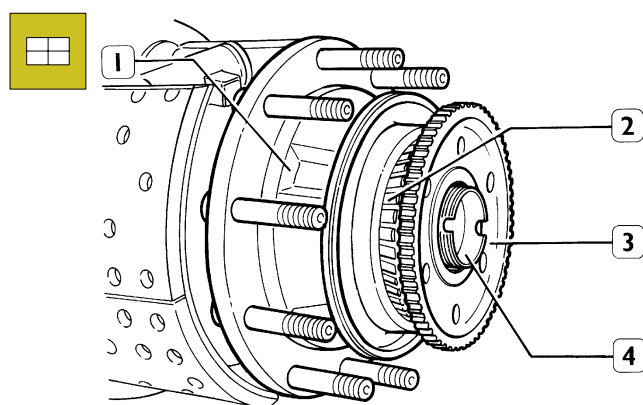
Figure 31



40377

Heat the taper roller bearing (1) to approx 100°C and with a suitable beater drive it into its seat on the crown wheel carrier (2).

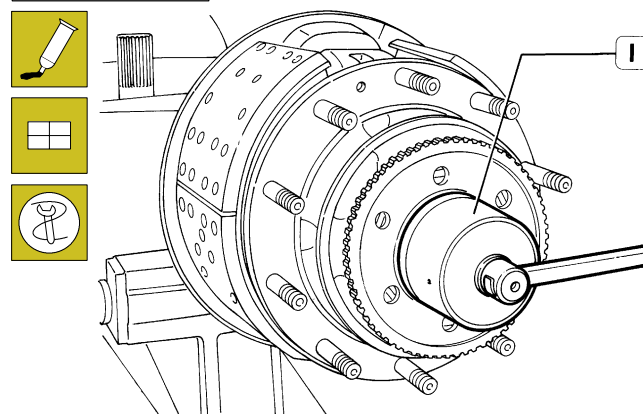
Figure 32



39650

Connect the crown wheel carrier (3) with its relevant taper roller bearing (2) onto the bearing shaft (4).

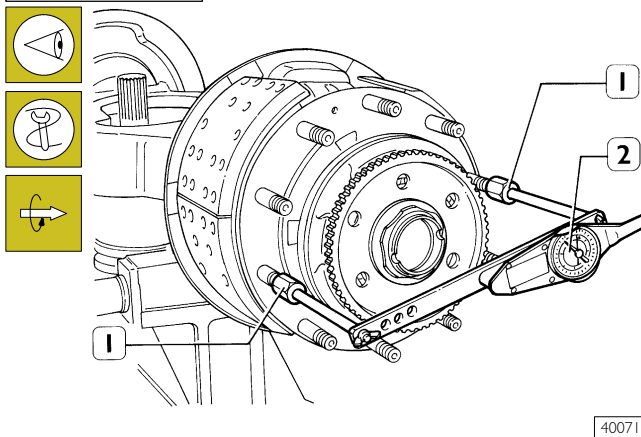
Figure 33



40070

Apply a thin coating of Molycote on the adjusting nut contact surface, screw, then tighten with wrench 99354207 (1) until it becomes difficult to turn the hub. Release the hub by axially hammering it in both directions.

Figure 34



40071

Set up tool (1) 99395026 and with a torque wrench (2) find the wheel hub rolling torque.

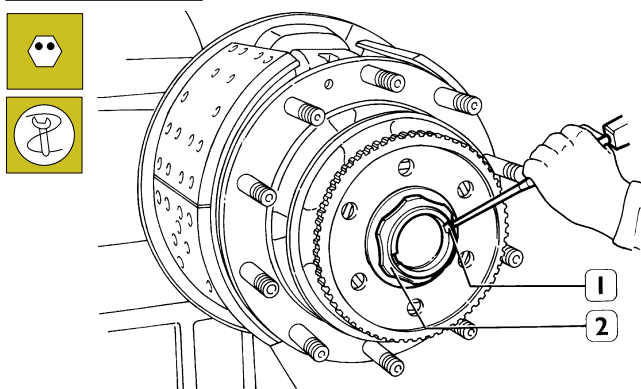


When finding the hub rolling torque the hub rotation must not exceed 40 r.p.m.

The hub rolling torque values vary according to the following conditions:

- ☐ new bearings with surface protection $3 + (12 \div 16)$ Nm
- ☐ run-in bearings and new lubricated seal rings $3 + (5 \div 7)$ Nm
- ☐ run-in bearings and seal rings $3 + (2.5 \div 4.5)$ Nm

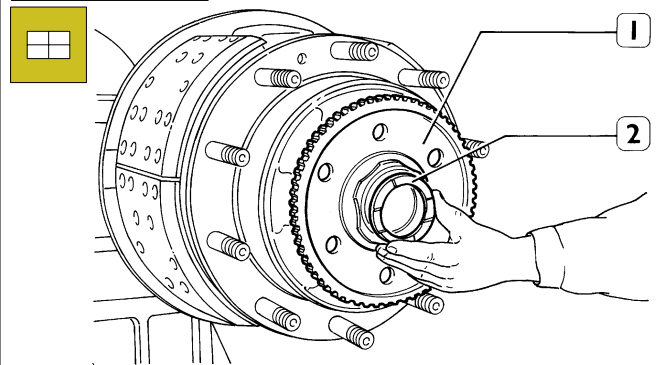
Figure 35



40072

Having obtained the prescribed rolling torque, use a suitable punch to dent the adjusting nut (2) in the two specific grooves on the bearing shaft (1).

Figure 36

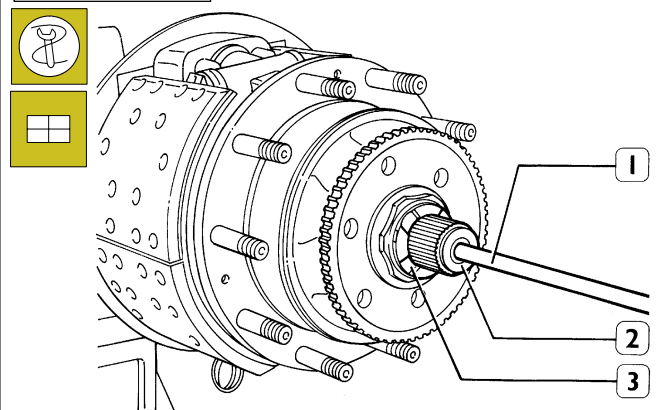


40069

Fit the spacer ring (2) in the bearing shaft.

Fitting in place the epicyclic reduction unit

Figure 37



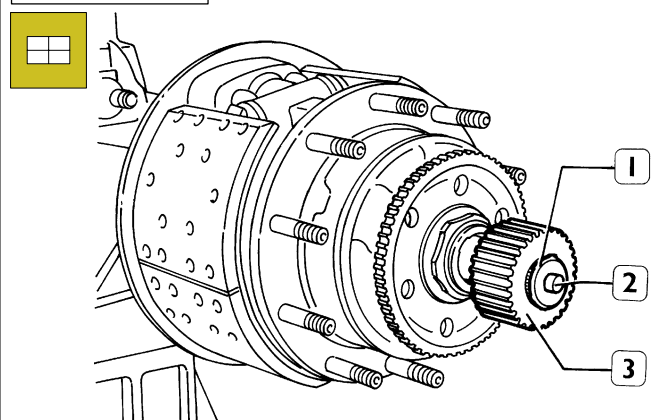
39636

Use tool 99374451 (1) to insert the half shaft (2) into the bearing shaft (3)



The double toothed short half shaft is to be fitted in the bearing shaft on the differential locking side.

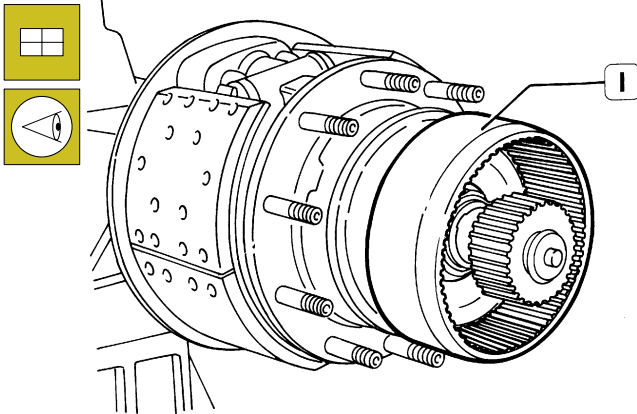
Figure 38



39653

Place the planetary gear (3) on the splined section of the half shaft and the circlip (1) in its seat. Force the shoulder pin into its seat in the half shaft.

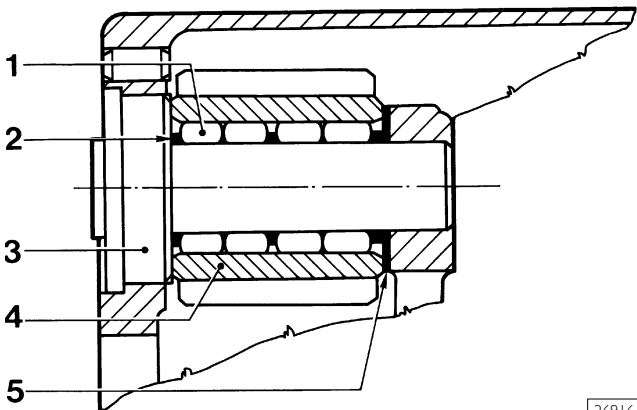
Figure 39



39654

Position the crown wheel (1) with the chamfer directed outwards, then place it on the crown wheel carrier.

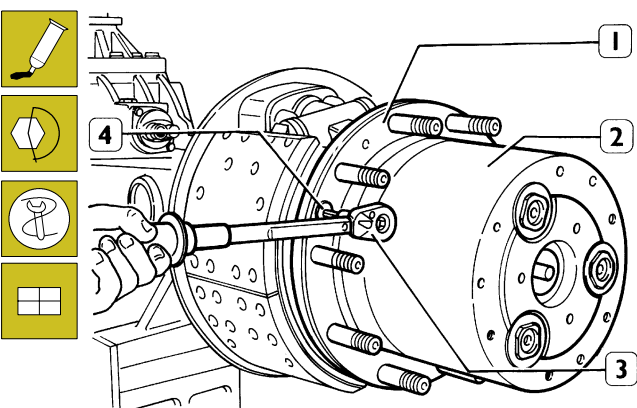
Figure 40



26916

Grease the needles (1) arrange them with three spacer rings (2) in the planetary gear (4) as shown in the figure. Insert the planetary gear (4) and spacer washer (5) in the planetary gear carrier support. Insert the pin (3) from the cover side pushing it down to the bottom of its seat. Repeat the same operation for the other two planetary gears.

Figure 41



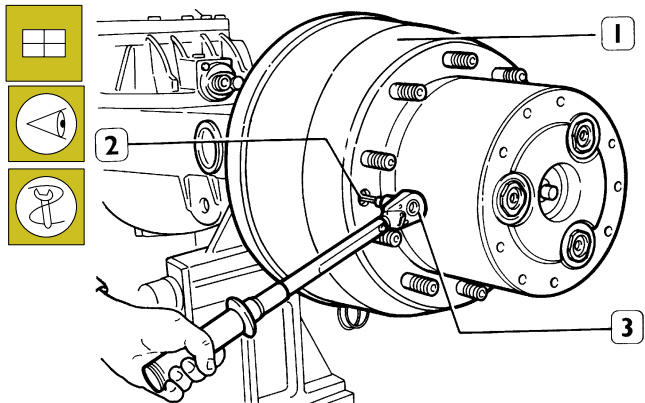
39655

Spread a thin coating of Hylomar SQ 321 M or Reinzoplast sealant on the contact surfaces of the planetary gear support (2) and the wheel hub (1)

Push the planetary gear support (2) onto the hub, for easier tooth meshing, move the coupling flange alternately in the two directions. Take care that the holes to fasten the planetary gear support to the hub coincide.

Insert the three flathead screws (4) and tighten them with a dynamometric wrench (3) to the torque of 25 ± 3 Nm.

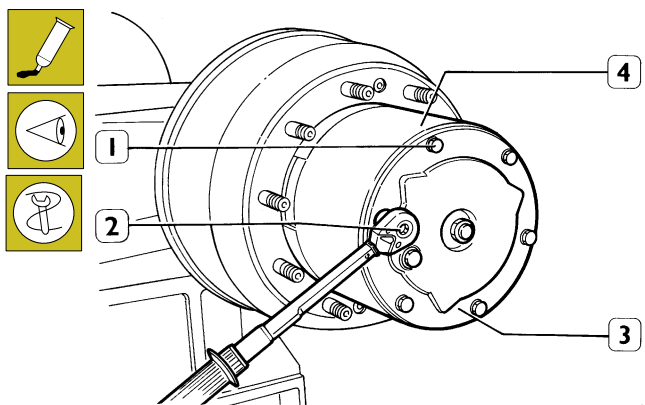
Figure 42



39656

Fit the brake drum (1) onto the planetary gear support. Fasten the brake drum with the two flathead screws (2) tightening them with dynamometric wrench (3) to the torque of 25 ± 3 Nm.

Figure 43



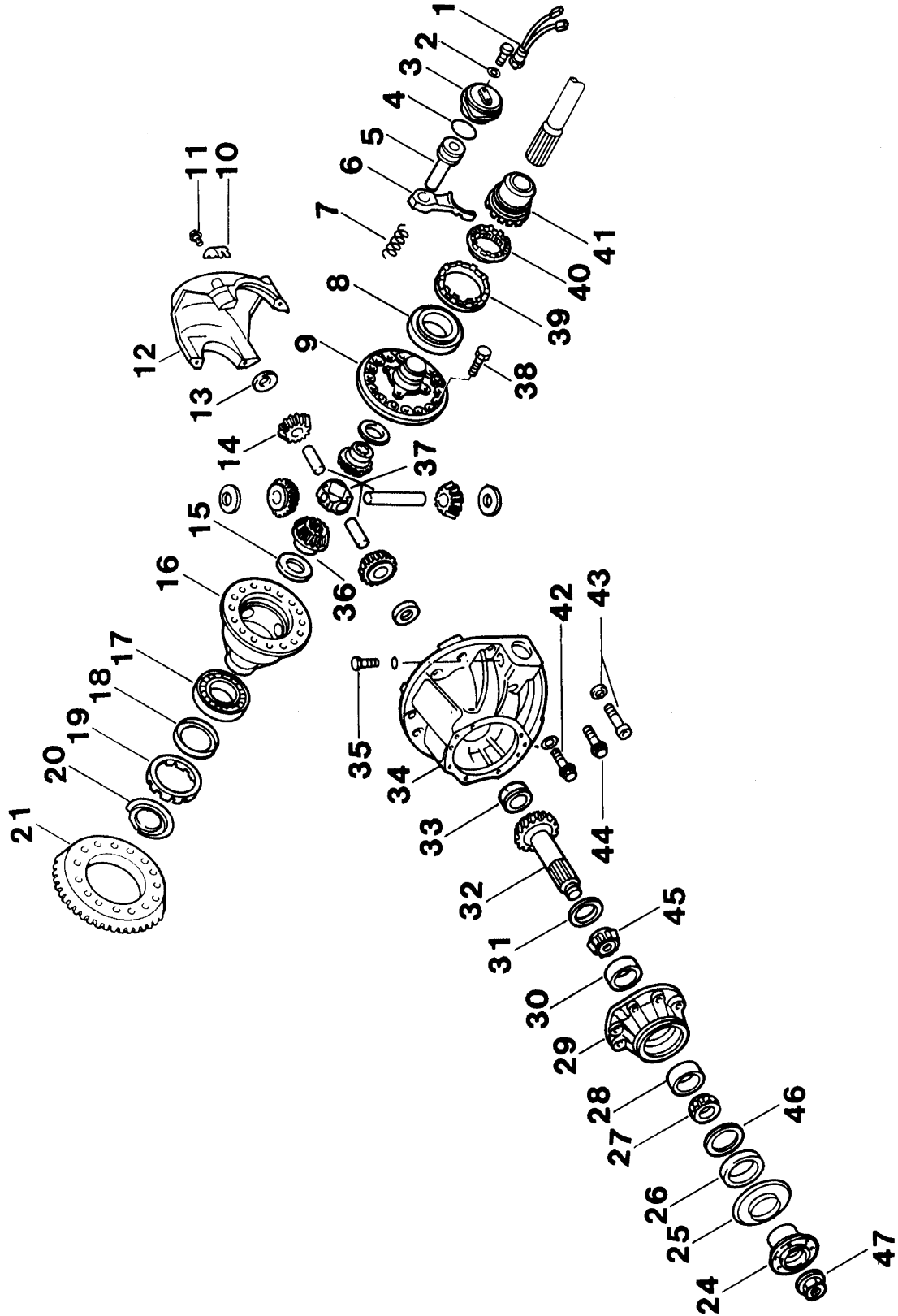
40073

Spread a thin coating of Hylomar SQ 321 M sealant on the contact surfaces of the cover (3) and the planetary gear support (4).

Position the cover so that the pin chamfers coincide with the notches in the cover.

Spread sealant paste on the threads of the screws (1) and with dynamometric wrench (2) tighten to a torque of 50 ± 5 Nm.

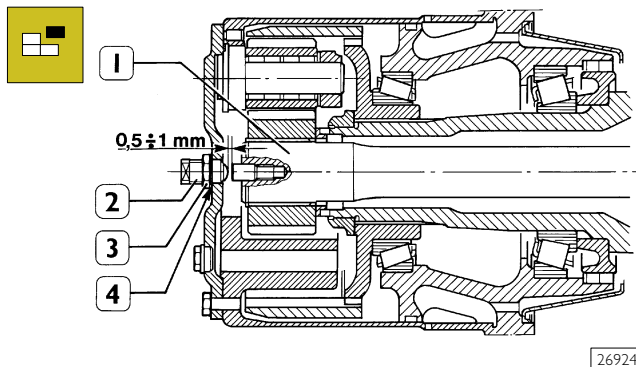
Figure 44



DIFFERENTIAL UNIT COMPONENTS

1. Electric transmitter - 2. Seal and union ring - 3. Cover - 4. Seal ring - 5. Piston - 6. Fork - 7. Spring - 8. Bearing - 9. Cover - 10. Plate - 11. Screw - 12. Cover - 13. Washer - 15. Shoulder washer - 16. Half-box - 17. Bearing - 18. Ring - 19. Ring nut - 20. Oil baffle - 21. Crown wheel - 22. Seal ring - 23. Differential unit - 24. Flange - 25. Dust guard - 26. Seal ring - 27. 28. Bearing - 29. Pinion support - 30. 45. Bearing - 31. Adjusting ring - 32. Pinion - 33. Bearing - 34. Box - 35. Screw - 36. Crown Wheel - 37. Pins and spider - 38. Screw - 39. Ring nut - 40. Sleeve - 41. Sliding sleeve - 42. Screw - 43. Screw - 44. Screw - 46. Ring - 47. Nut

Figure 45



26924

The half shaft (1) end play is to be between 0.5 and 1 mm. To obtain this, tighten the adjusting screw (2) to its stop, then come back by half a turn and lock it with the hexagonal nut (3).

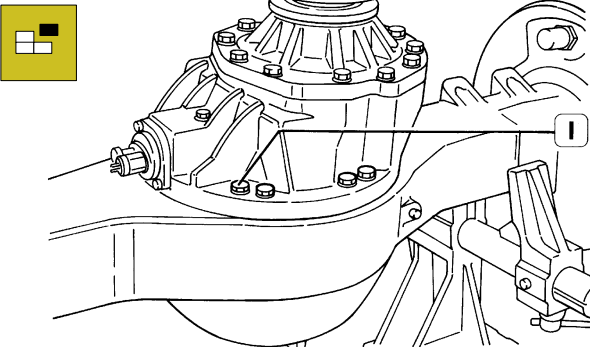


The flat surface of the hexagonal nut should be directed towards the seal ring (4).

REMOVAL AND RE-FITTING IN PLACE THE DIFFERENTIAL

Removal

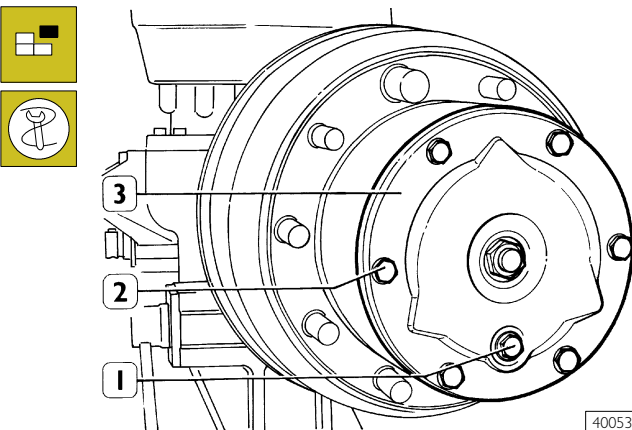
Figure 46



39658

Remove the screws (1) fastening the differential housing to the axle casing. Remove the cap screws and hexagonal socket

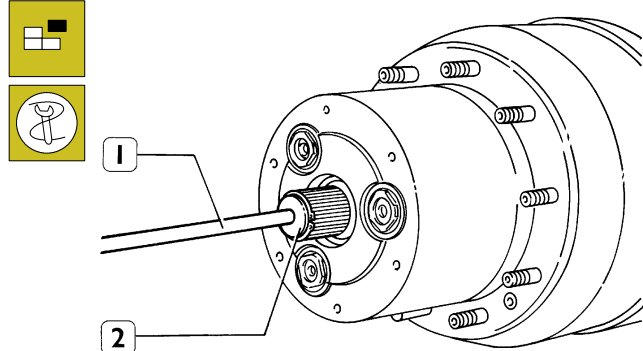
Figure 47



40053

Screw on the oil intake cap (1). Move one of the cover (3) hex screws (2) to a low position and unscrew it. Drain the oil from the epicyclic gears on the wheels.

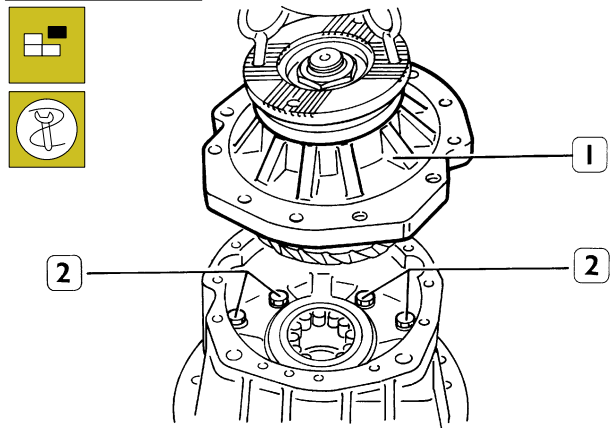
Figure 50



39659

Fit tool 9937445 (1) into the shoulder pin seat threads and withdraw the half-shaft (2) from the bearing shaft

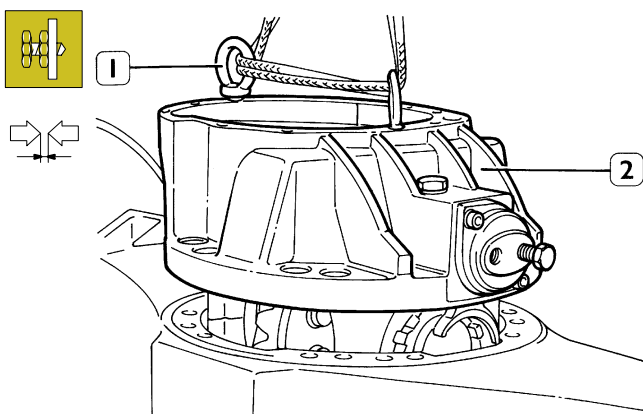
Figure 49



39660

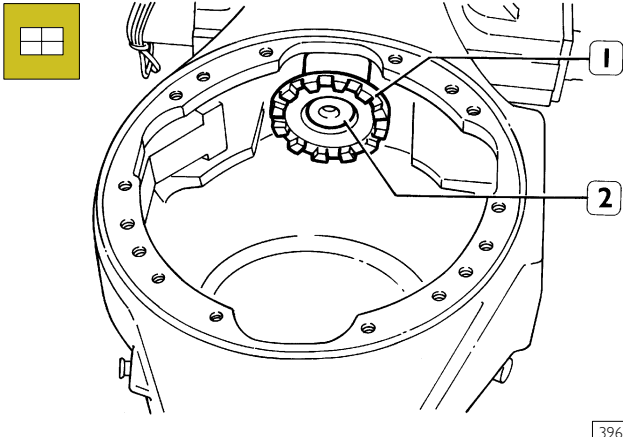
Using the specific eye hooks and a rope, lift the pinion support (1) and remove the four differential housing screws (2).

Figure 48



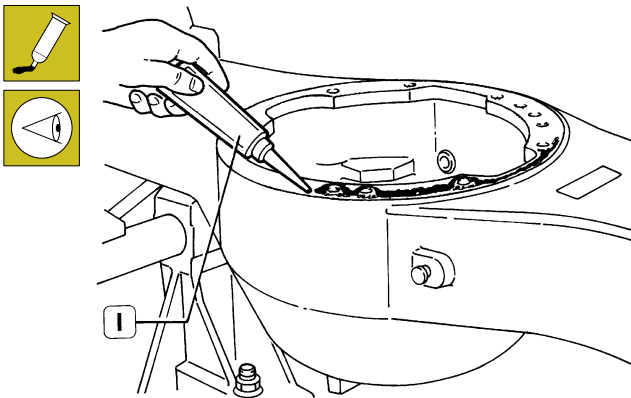
39661

Using the specific eye hooks (1) and a rope, lift the differential housing (2).

Re-fitting**Figure 51**

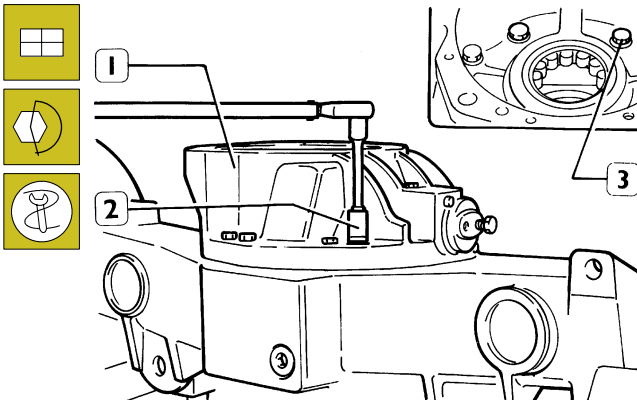
39662

Fit in place the sliding sleeve (1) on the double-tooth half-shaft (2)

Figure 52

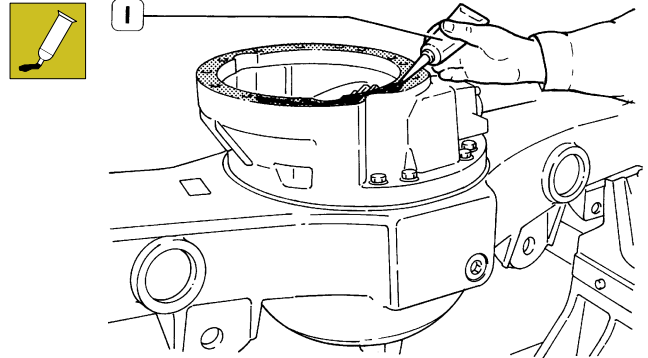
39663

Spread LOCTITE AVX on the contact surface (1). When fitting in place the differential housing it is important to make sure that the differential locking engagement fork is correctly positioned in the sliding sleeve seat.

Figure 53

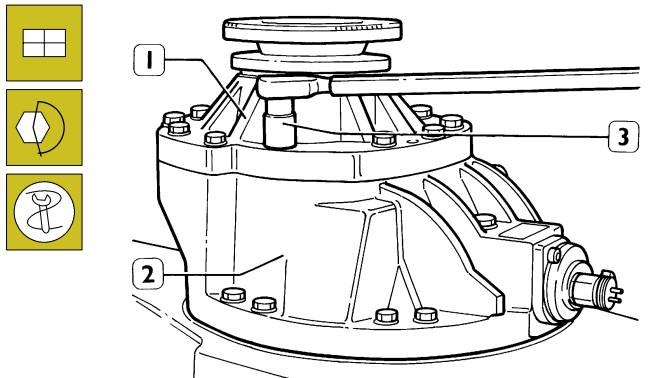
39664

Set the seal ring and fit in place the differential housing (1). Using a dynamometric wrench tighten the external (2) and internal (3) screws to the prescribed torque.

Figure 54

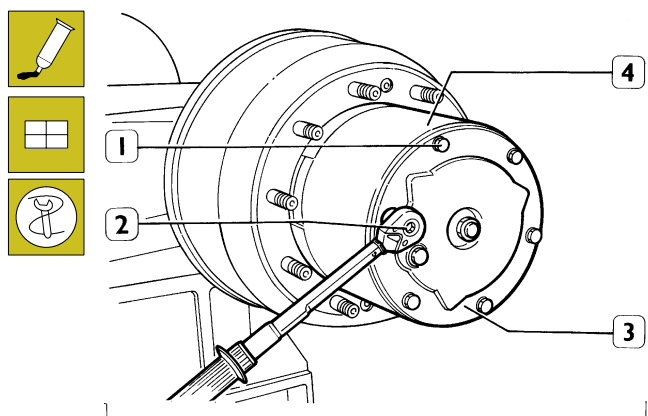
39665

Spread LOCTITE 573 on the contact surface (1)

Figure 55

39666

Set the bevel pinion support (1) on the differential housing (2). Use dynamometric wrench (3) to tighten the screws to the prescribed torque.

Figure 56

40073

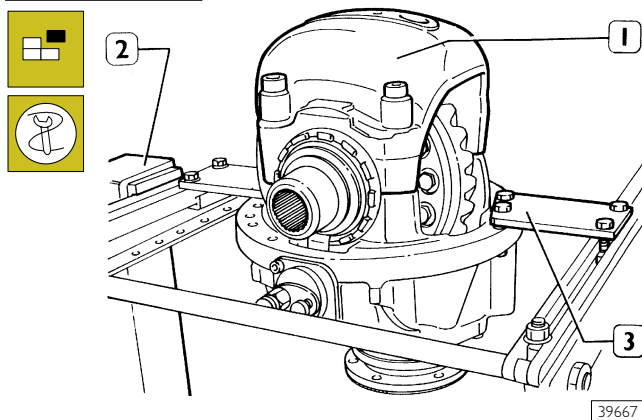
Spread a thin coating of Hylomar SQ 321 M sealant paste on the contact surfaces of the cover (3) and the crown wheel support (4). Position the cover so that the pin chamfers coincide with the notches in the cover.

Spread sealant paste on the screw (1) threads and with a dynamometric wrench (2) tighten to the prescribed torque.

DIFFERENTIAL REPAIR OPERATIONS

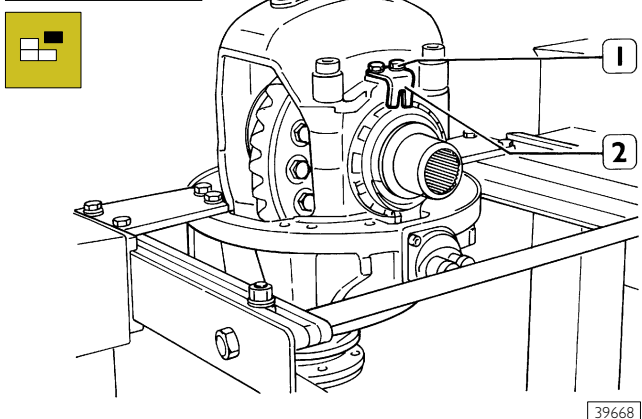
Removing the differential housing

Figure 57



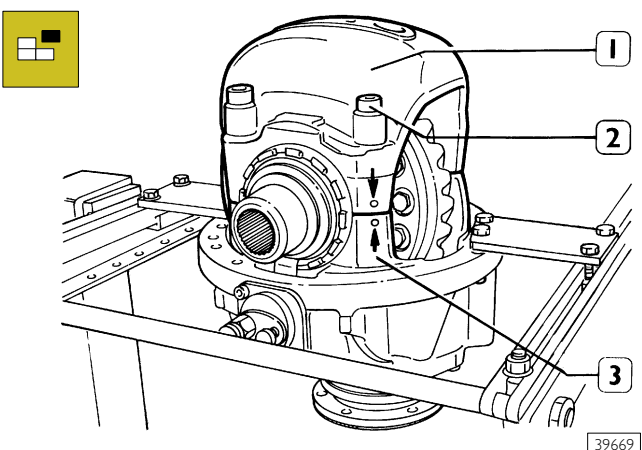
Set the complete differential housing, with the gear housing cover (1) upwards, on rotary stand 99322205 (2) fitted with support 99322228 and pair of brackets 99371022 (3).

Figure 58



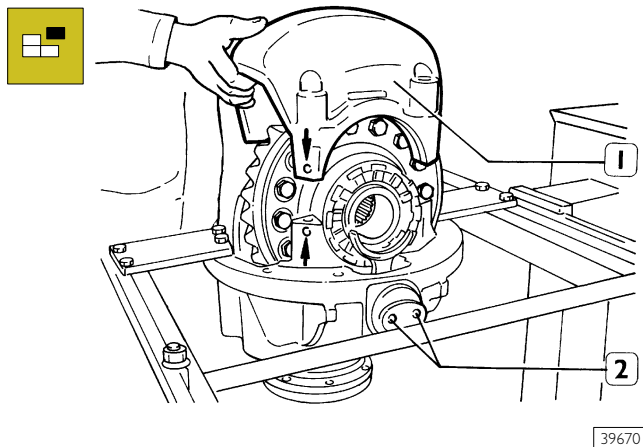
Remove the screws (1) then the safety plate (2). Carry out the same operation on the other side.

Figure 59



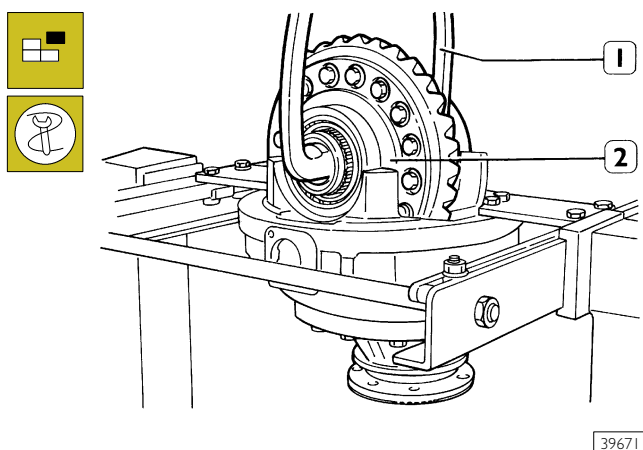
Mark the cover (1) position with reference to the differential housing (3) ⇒ ⇐.
Remove the cover fastening screws (2) (locked with LOC-TITE).

Figure 60



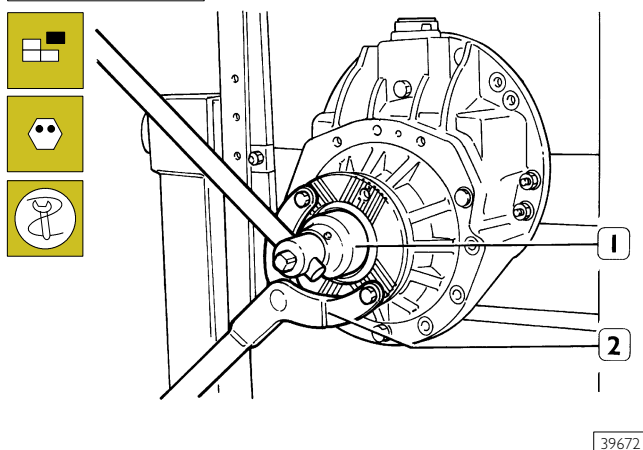
Lift the gear housing cover (1).

Figure 61



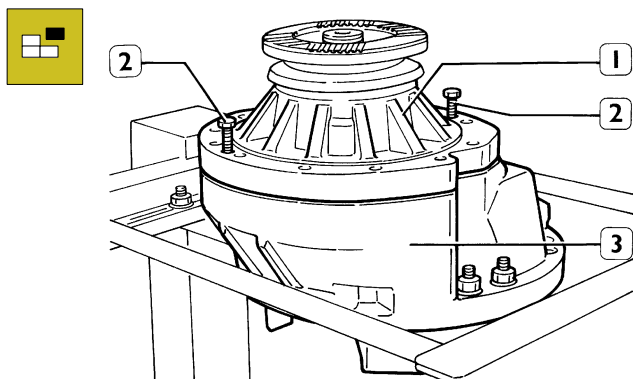
Use hook 99370509 (1) to lift the gear housing (2) with the relevant taper roller bearings and bearing outer rings.

Figure 62



Rotate the differential housing by 90°.
Remove the adjusting nut dent.
Apply the counter lever 993701317 (2) to the coupling flange, with socket wrench 99355081 (1) loosen the lock nut.

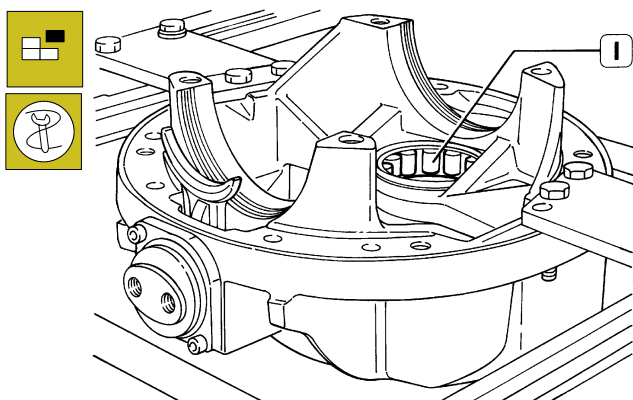
Figure 63



39673

Remove the screws and washers fastening the bevel pinion support (1) to the differential housing (3). Insert the counter-acting screws (2) and take out the complete differential housing support.

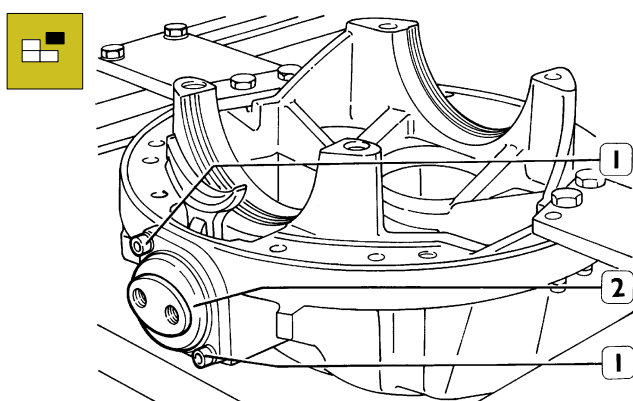
Figure 64



39674

Use a beater to expel the bevel pinion straight roller bearing (1) from its seat in the differential housing.

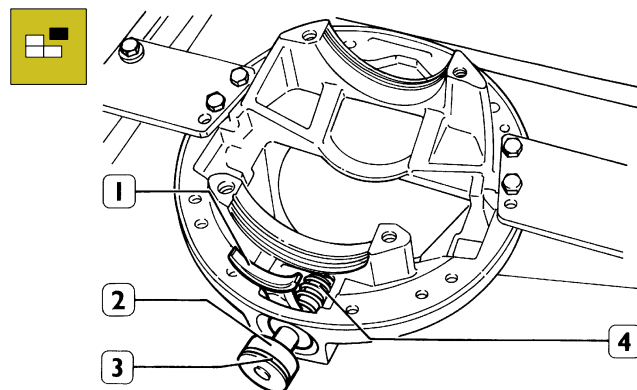
Figure 65



39675

Remove the two hexagonal socket head screws (1) and remove the differential locking device control cylinder (2).

Figure 66

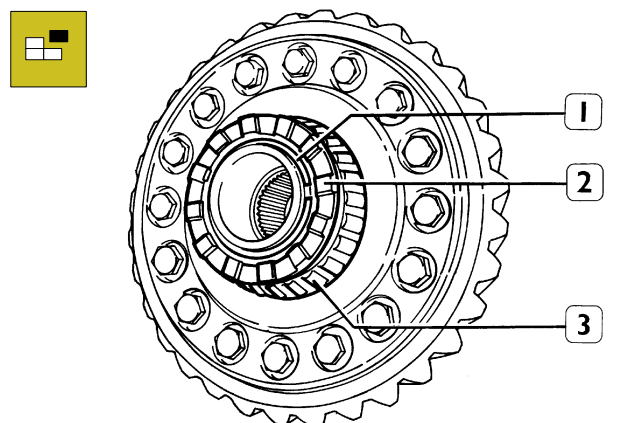


39676

Withdraw the control piston (2) with the seal ring (3), engagement fork (1) and compression spring (4).

Removing the gear housing

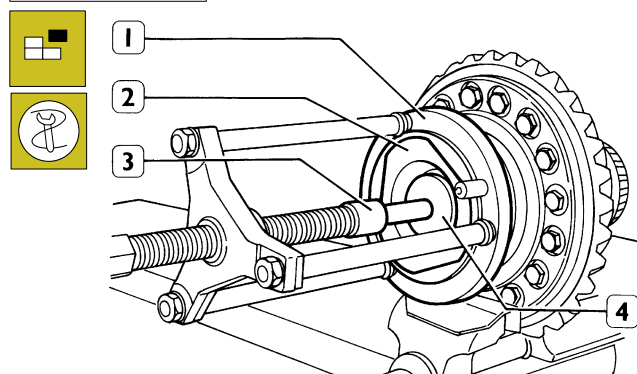
Figure 67



39677

Remove the split ring (1) and take away the differential locking device engagement sleeve (3) from the gear housing cover (2).

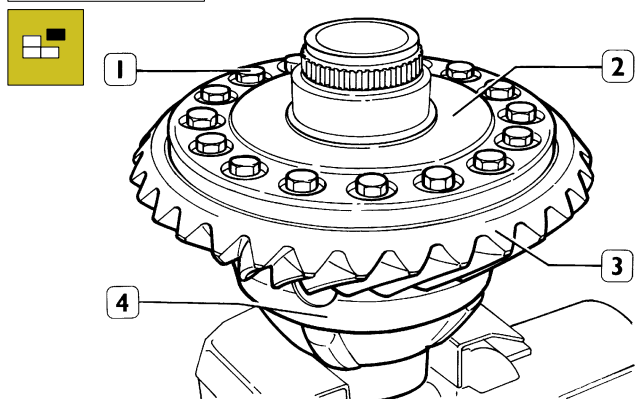
Figure 68



39678

Using puller 99347101 (1) equipped with a pair of gripping rings 99347182 (2), extension bar 99347361 (3) and counter block 99345055 (4), take out the taper roller bearing from the gear housing. Repeat the same operation on the other side.

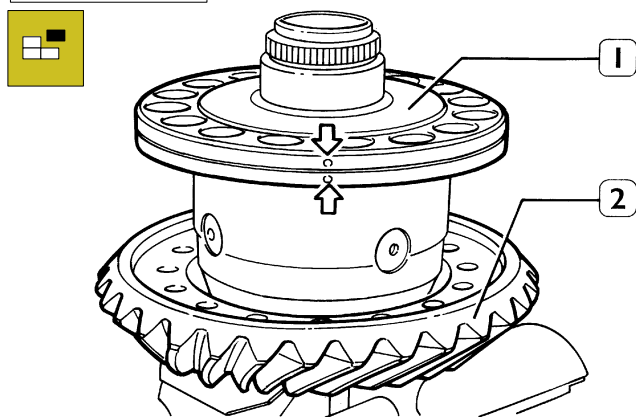
Figure 69



39679

Unscrew and remove the screws (1) that fasten the ring bevel gear (3) and cover (2) to the half-box (4).

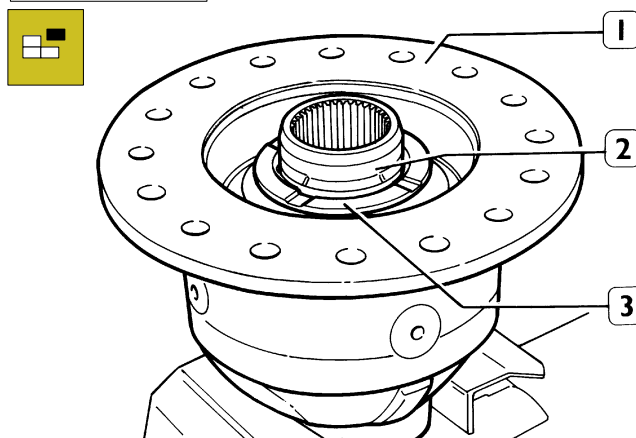
Figure 70



39680

Mark the cover and gear housing ($\Rightarrow \Leftarrow$). Remove the gear housing cover (1) and release the ring bevel gear (2)

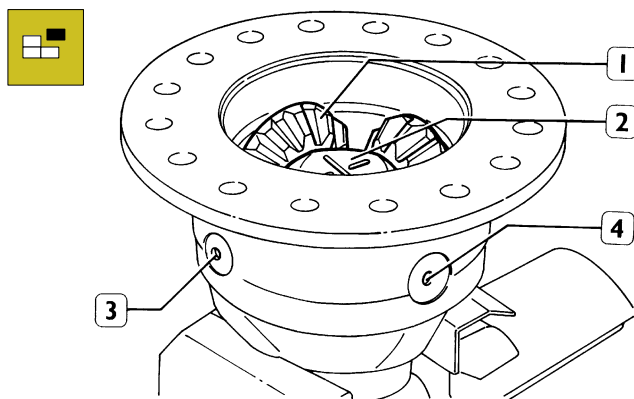
Figure 71



39681

Remove the crown wheel (2) with the relevant shoulder washer (3) from the gear housing (1).

Figure 72



39682

Use a beater to remove the long pin (4) then the two short pins (3).

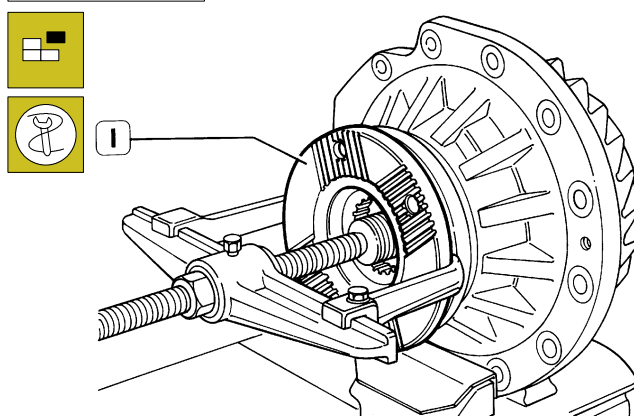


The exact position of the pins is marked on the spider (2) by a long stripe for the long pin and two short stripes for the short pins.

Remove the spider (2) and 4 planetary gears (1) with the shoulder washers.
Remove the crown wheel and shoulder washer.

Removing the bevel pinion support

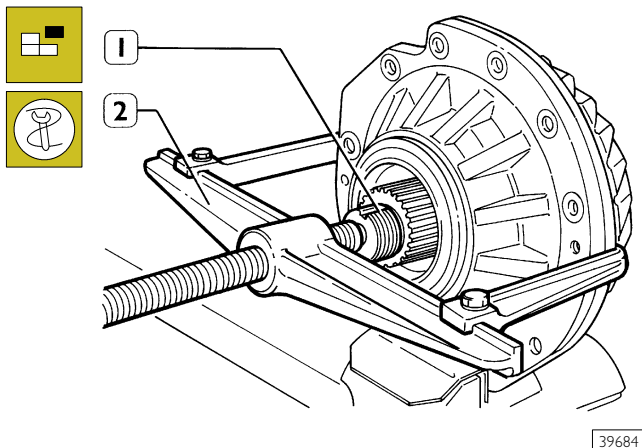
Figure 73



39683

Remove the previously loosened lock nut and the coupling flange (1).
If the flange removal is difficult, use a universal puller.

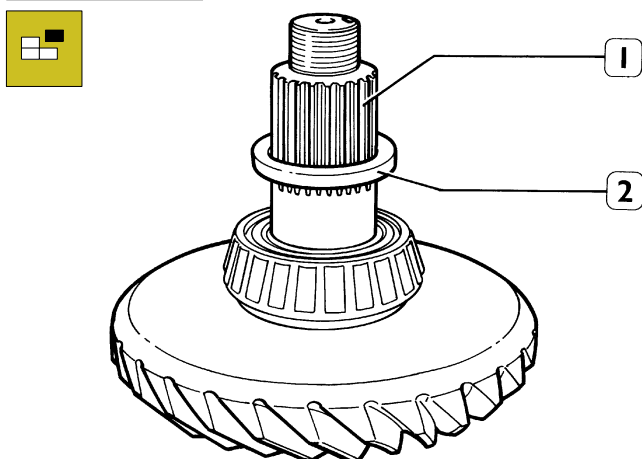
Figure 74



39684

Take out the bevel pinion (1) with intermediate bearing and adjusting ring from the support. It is suggested to use a press for this operation, but if this is not possible, use a puller (2)

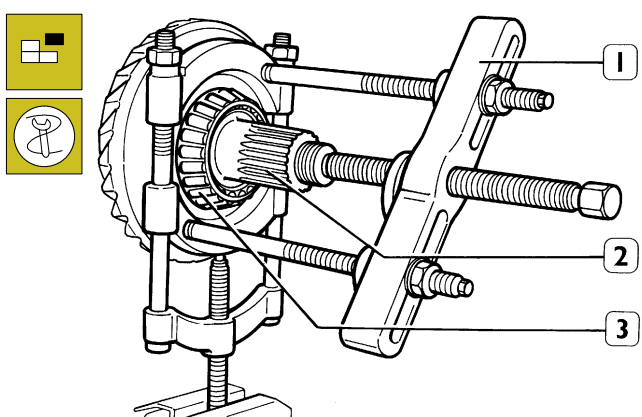
Figure 75



39685

Remove the bearing adjusting nut (2) from the bevel pinion (1).

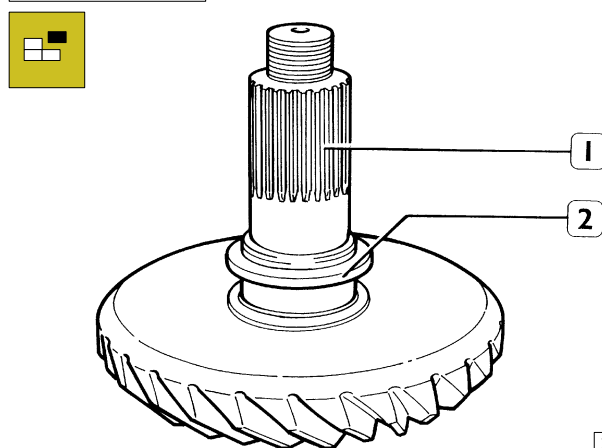
Figure 76



39686

With a universal puller 99348001 (1) remove the intermediate taper roller bearing (3) from the bevel pinion (2).

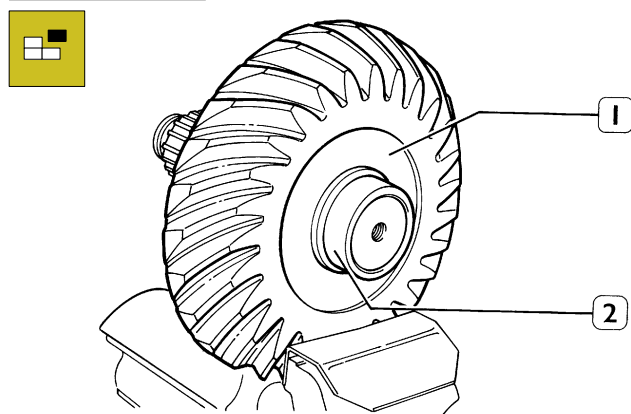
Figure 77



39687

Withdraw the pinion location adjusting ring (2) from the bevel pinion (1)

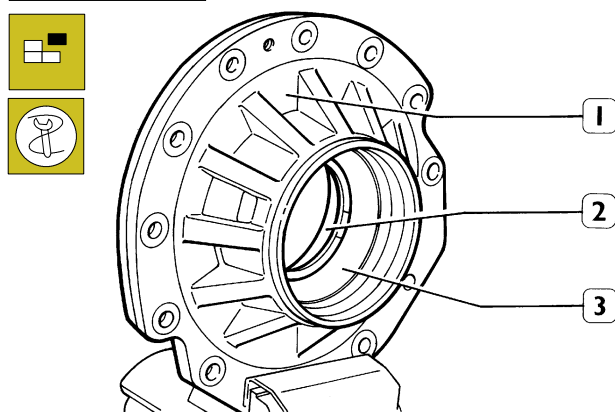
Figure 78



39688

Remove the rear straight roller bearing inner ring (2) from the bevel pinion (1). This is a destructive operation.

Figure 79



39689

Use a beater to take out the front and intermediate bearings outer rings (3 and 2) from the support (1).

Differential components check

Carefully clean all the differential components. Lubricate the bearings and rotate the roller cage freely. The rotation must be even and without signs of stiffness.



Carefully clean all the threads in order to obtain exact adjustments and accurate driving torques.

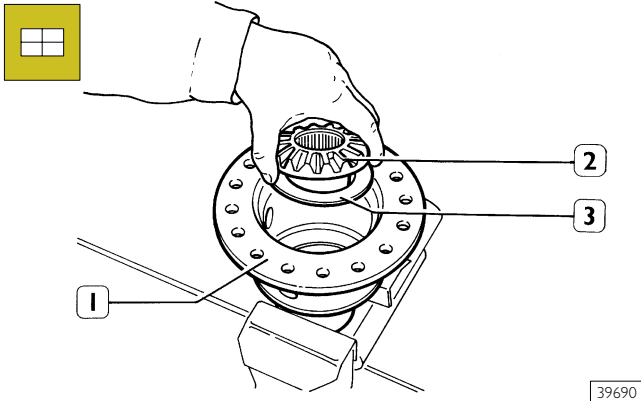
Check that the splined section for flange-pinion connection is not badly worn, if it is, replace the pinion.



When replacing the crown wheel or pinion it is necessary to replace both parts since they are supplied in pairs.

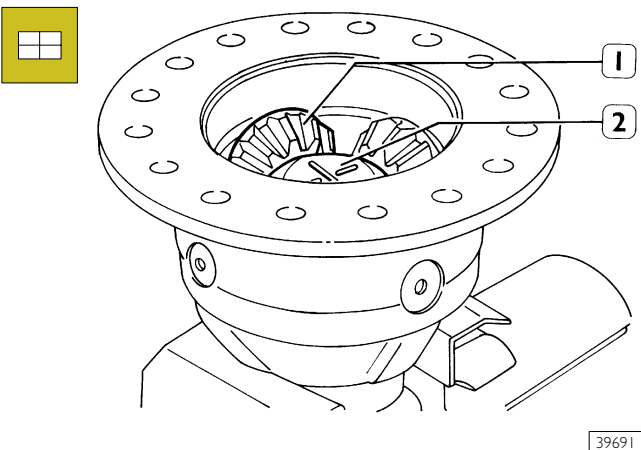
Fitting in place the gear housing

Figure 80



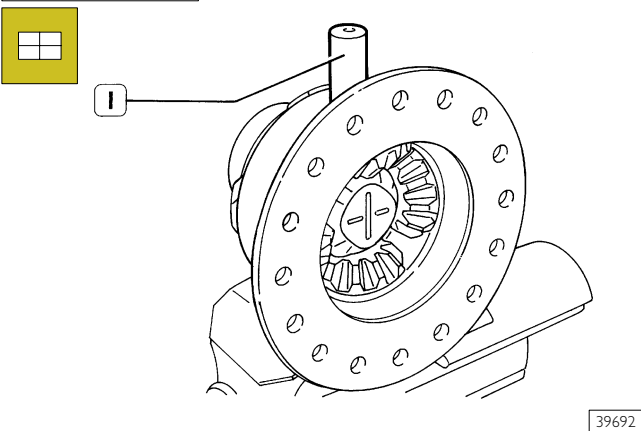
Lock the gear housing (1) in a vice and set the crown wheel (2) with shoulder ring (3) in its housing.

Figure 81



Set the 4 planetary gears (1) with the shoulder washers and fit in the spider (2).

Figure 82

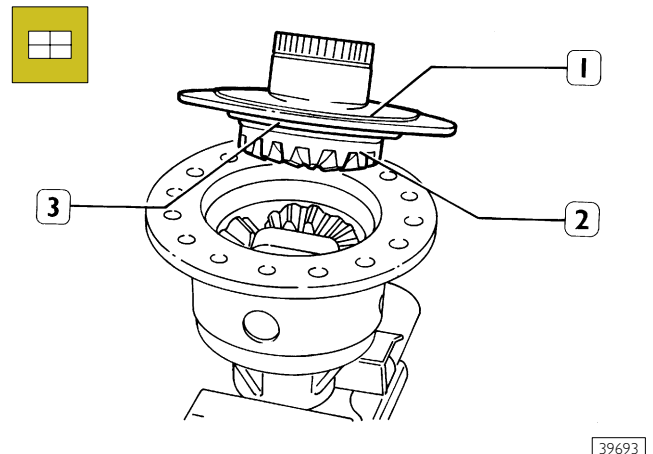


Insert the long pin (1) and two short pins.



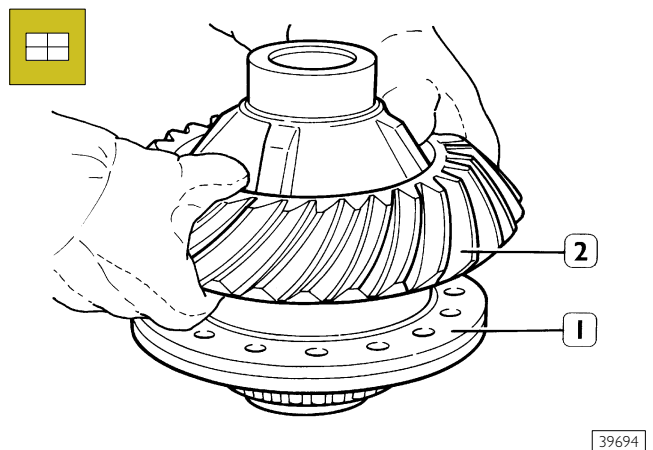
The long (through) pin is inserted first. The exact position of the pins is marked on the spider (2) by a long stripe for the long pin and two short stripes for the short pins.

Figure 83



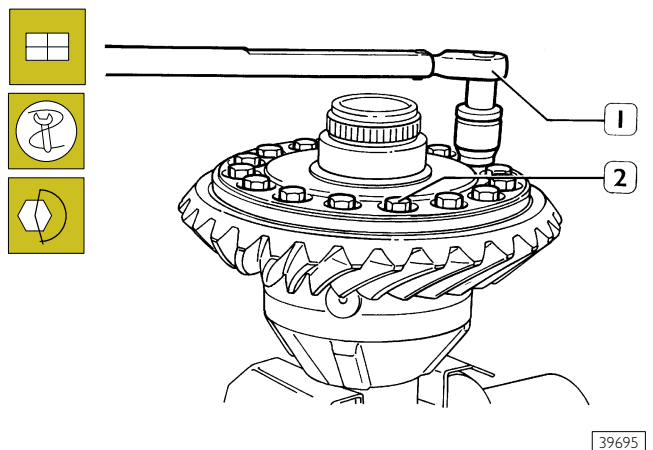
Set the crown wheel (2) with its shoulder washer (3) on the planetary gears. Fit in place the cover (1) on the housing matching the marking made before removal.

Figure 84



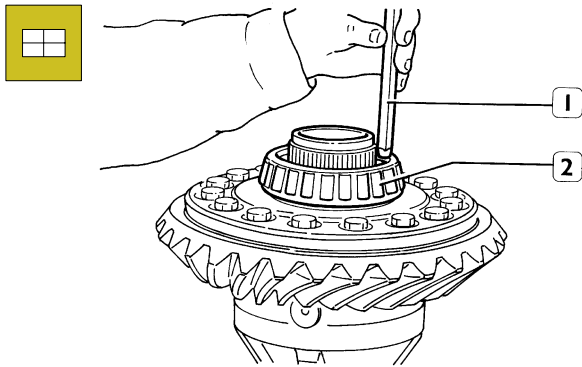
Heat the bevel ring gear (2) to approx. 80°C, fit it in its housing on the gear housing (1) and lock it immediately with two fastening screws.

Figure 85



Insert the rest of the fastening screws (2) and with a dynamometric wrench (1) tighten them to a torque of 300 ± 10 Nm (30 ± 1 kgm).

Figure 86

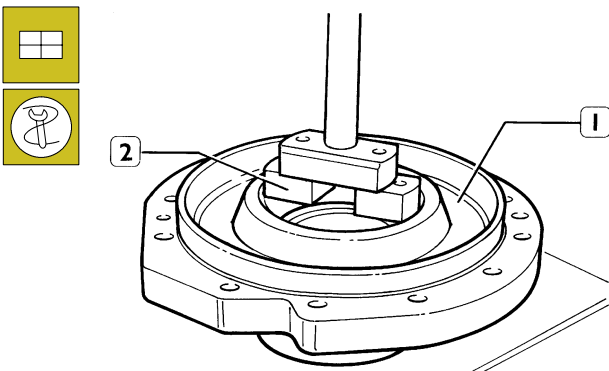


39696

Heat the bearing (2) to a temperature of 100°C for approx. 15 minutes then drive it in the gear housing cover using a suitable beater (1). Repeat this operation on the other side.

Fitting in place the bevel pinion support

Figure 87

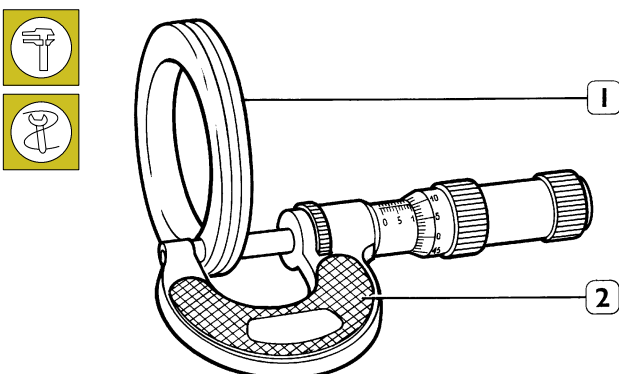


39697

Connect a new oil baffle to the pinion support (1). Use beater 99374093 (2) to drive the intermediate bearing outer ring and the front bearing outer ring right down into their seats.

Procedure to determine the thickness of the bevel pinion rolling torque adjusting ring

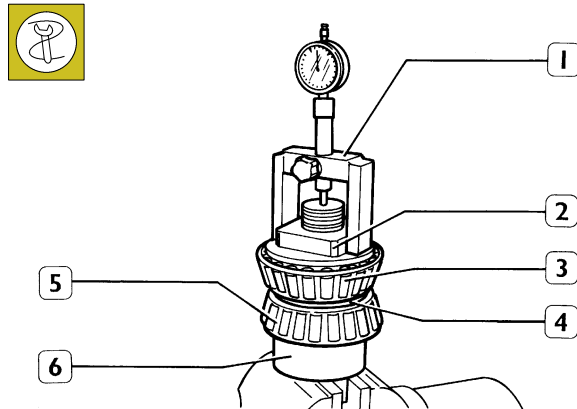
Figure 88



39572

Measure the thickness of the removed adjusting ring (1) and make a note of the value (value A).

Figure 89



39698

Fit tool 99395027 (6) in a vice and place on it:

- ☐ the pinion side bearing (5)
- ☐ adjusting ring (4), already measured, and bearing (3)

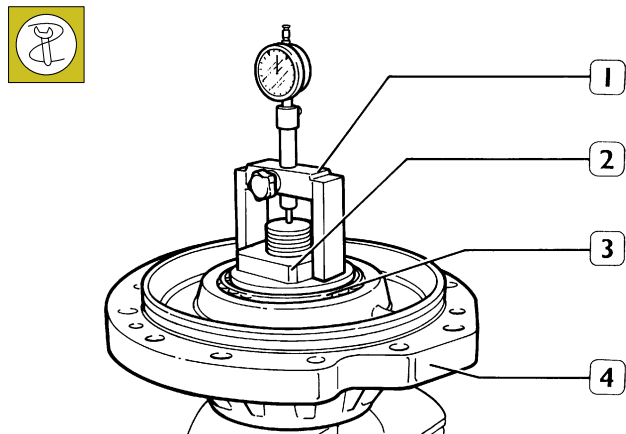
Screw the ring nut (2) and lock it tightly.

Position the dial gauge fitted to element (1) of tool 99395027 (6) on the bearing (3) and set the gauge to zero on the end of the tool (6).

Remove from the tool (6):

- ☐ element (1)
- ☐ ring nut (2)
- ☐ bearing (3)
- ☐ adjusting ring (4)

Figure 90

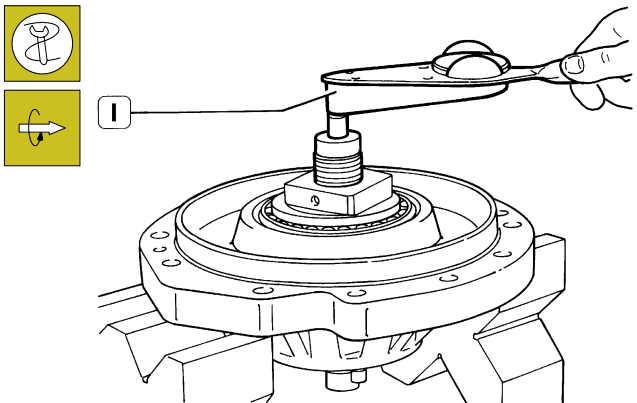


39699

Set the support (4, figure 90) on the bearing (5, figure 89); set bearing (3) on the support.

Manually tighten the ring nut (2) and check the rolling torque as indicated in figure 91.

Figure 91



39700

Set the complete support on 2 parallel bars and with a dynamometric wrench (1) applied on tool 99395027 find the rolling torque which should be 1.5 to 3.5 Nm. If this is not so operate on the ring nut (2, figure 90). Place element (1, figure 89) with the dial gauge set to zero, on the bearing (3) and find the deviation, if any (value B)

Adjusting ring thickness "S" is obtained through the following formula:

$$S = A - (B) + C$$

where:

A = Thickness of adjusting ring fitted to set the dial gauge to zero;

B = Deviation value found;

C = 0.05 mm coefficient that takes into account the bearings dilation cause by assembling interference on the bevel pinion;

First example

A = 13.12 mm
B = + 0.13 mm
C = 0.05 mm

$$S = 13.12 - (+ 0.13) + 0.05 =$$

$$S = 13.12 - 0.13 + 0.05 = 13.04 \text{ mm.}$$

Second example

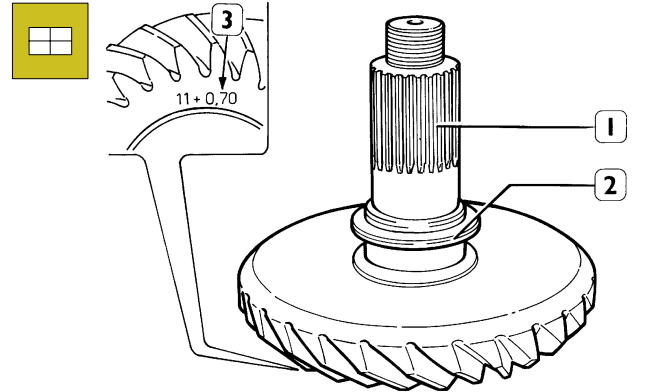
A = 13.12 mm
B = - 0.13 mm
C = 0.05 mm

$$S = 13.12 - (- 0.13) + 0.05 =$$

$$S = 13.12 + 0.13 + 0.05 = 13.35 \text{ mm.}$$

Remove the elements from tool 9939507.

Figure 92



39701

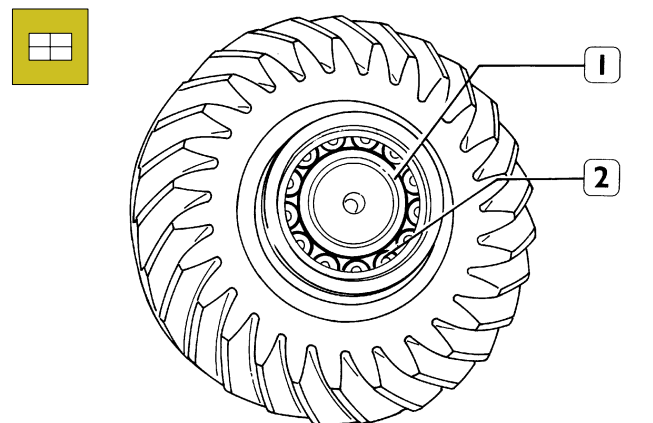
On the bevel pinion (1) fit in place the adjusting ring (2) to set the pinion with reference to the crown wheel and the chamfer directed downwards. The thickness of the adjusting ring depends on the reference value (3) engraved on the bevel pinion.

Figure 93

Value engraved on pinion	Adjusting ring thickness
0	4,6
0,1	4,5
0,2	4,4
0,3	4,3
0,4	4,2
0,5	4,1
0,6	4,0
0,7	3,9
0,8	3,8
0,9	3,7
1,0	3,6

Table to determine the thickness of adjusting rings, bevel pinion position with reference to the crown wheel.

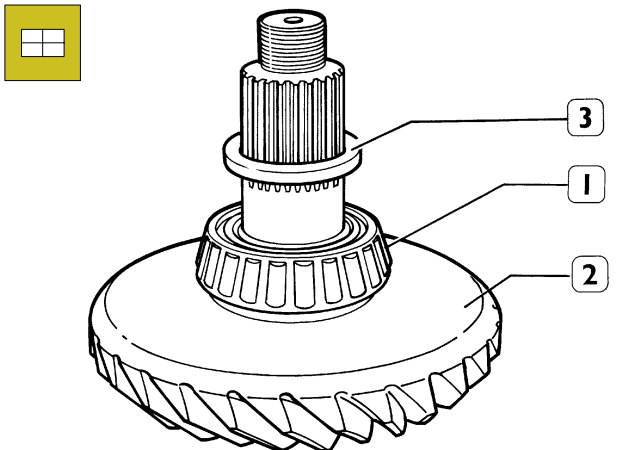
Figure 94



39702

Heat the rear straight roller bearing (2) inner ring (1) to a temperature of 100°C and fit in place on the bevel pinion.

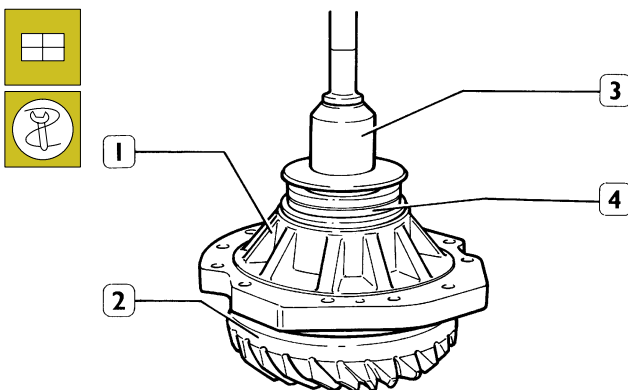
Figure 95



39703

Heat the intermediate bearing (1) to approx. 100°C and fit in place on the bevel pinion (2).
Fit in place the adjusting ring (3) with the proper thickness.

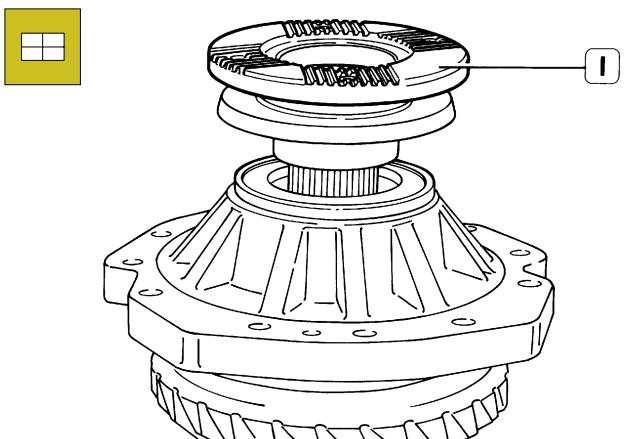
Figure 96



39704

Fit in place the support (1), already assembled, on the bevel pinion (2). Fit in place the front bearing. With a connection device (3) fit in place the oil seal ring (4).

Figure 97

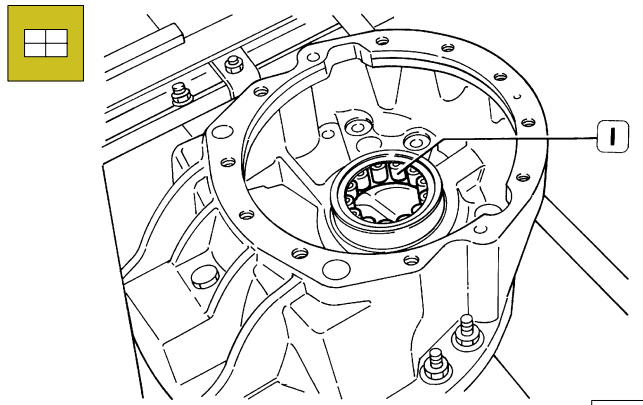


39705

Fit in place the coupling flange (1) using a suitable beater, then manually tighten the lock nut.

Fitting in place the differential housing

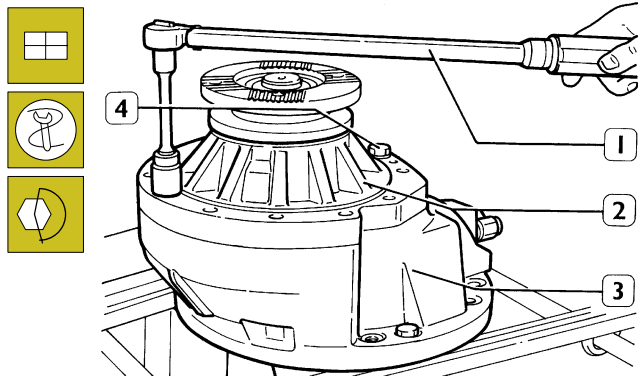
Figure 98



39706

Use a beater to drive the rear straight roller bearing into its seat in the differential housing.

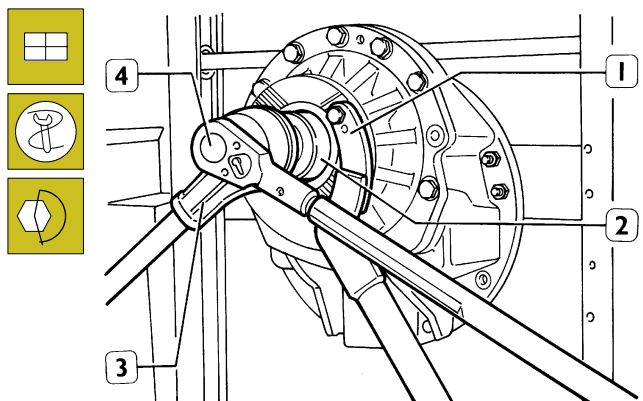
Figure 99



39707

Fit in place on the differential housing (3) the already assembled bevel pinion support (2), insert 2 screws (4) with spring washers in diametrically opposite positions. With a dynamometric wrench (1) tighten them to a torque of 160 ± 10 Nm (16 ± 1 kgm).

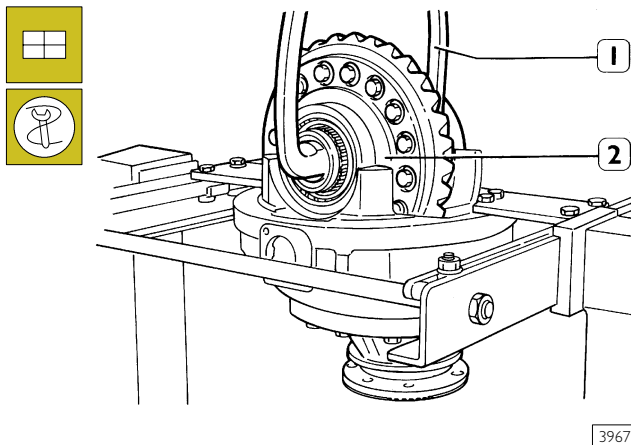
Figure 100



39708

Lock the coupling flange rotation with counter lever 99370317 (1) and using socket wrench 9935508, multiplier (3) and dynamometric wrench (4) tighten the lock nut to a torque of 700 ± 50 Nm (70 ± 5 kgm).

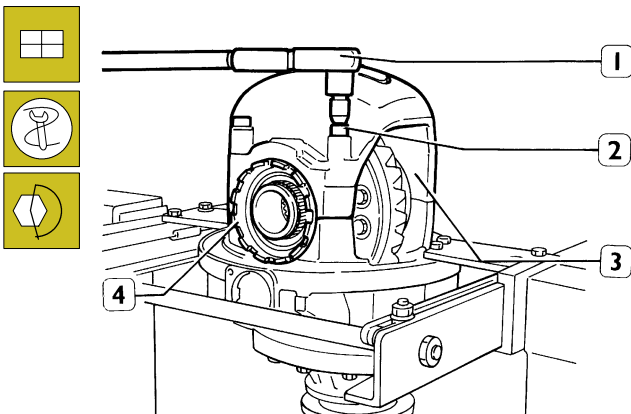
Figure 101



39671

With hook (1) 99370509 set the gear housing (2) with the relevant roller bearings on the differential housing.

Figure 102



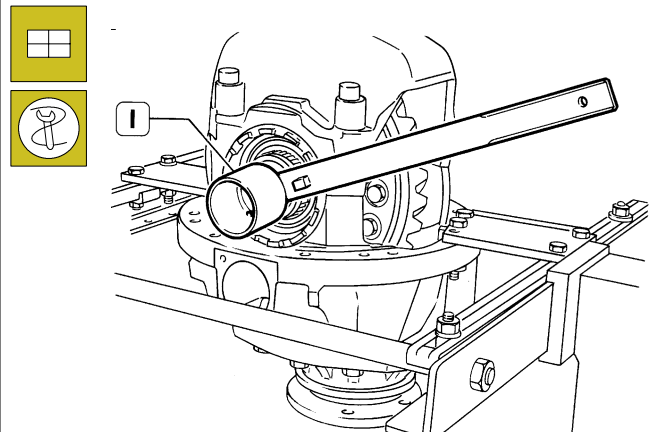
39709

Fit in place the cover (3) matching the marks made when removing, slightly lock the screws (2) and check that the adjusting ring nuts (4) can be screwed without difficulty. Remove the screws (2), spread LOCTITE AVX on the threads and with a dynamometric wrench (1) tighten them to a torque of 280 ± 15 Nm.

Adjusting the rolling torque of the gear housing bearings

The rolling torque adjustment of gear housing bearings is obtained by measuring the total rolling torque.

Figure 103



39712

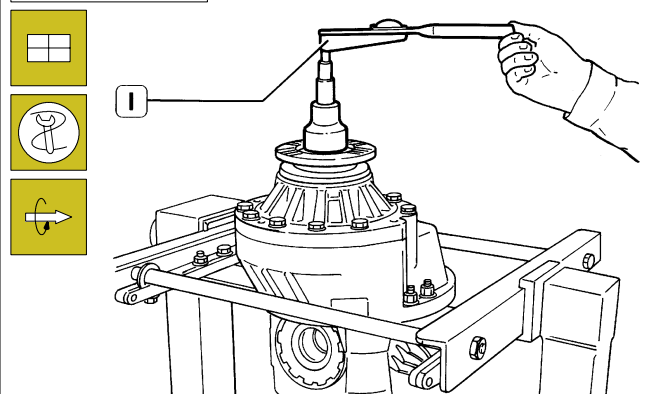
Using torque wrench 99389819 (1) and appropriate socket wrench find the prescribed rolling torque, operating on the bearing adjustment ring nuts, through wrench 99354001 (1).

Find in the table the total rolling torque value (this value varies according to the bevel pair ratio).

No. teeth	Ratio	Rolling torque Total Nm
21/40	1,905	$a + 11,5 - 2,51$
19/33	1,737	$a + 11,6 - 2,61$
23/36	1,565	$a + 11,9 - 3,21$

$$a = 3 \div 4 \text{ Nm}$$

Figure 104



39711

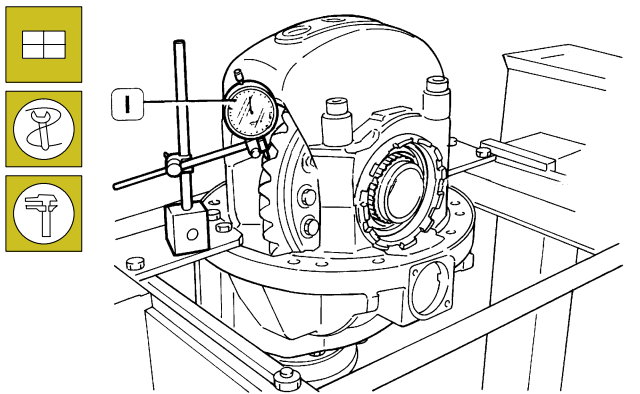
Adjusting the end play between bevel gear pair and pinion

Adjust the backlash between the teeth of the bevel pair operating as follows:

- ☐ Find the clearance value between the teeth; this varies according to the bevel pair ratio;

No. Teeth	Ratio	Clearance between teeth
21/40	1,905	$0,20 \div 0,28$
19/33	1,737	$0,25 \div 0,33$
23/36	1,565	$0,20 \div 0,29$

Figure 105

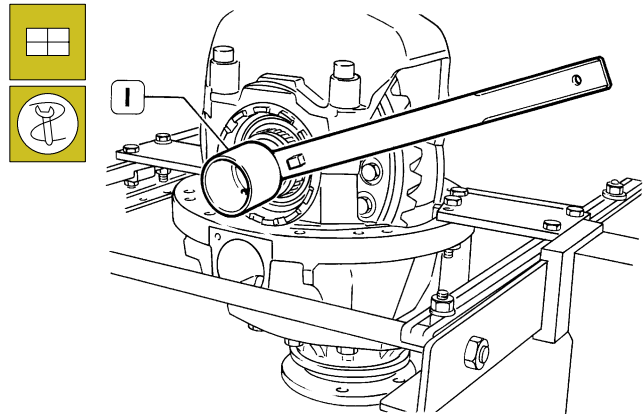


39710

- ☐ Set the dial gauge (1) with magnetic base as shown in the figure
- ☐ Lock the bevel pinion rotation through counter lever 99370317; reverse the crown wheel rotation and with the dial gauge find the backlash between the teeth of the two gears.

If it is not satisfactory, operate on the adjusting ring nuts using wrench 99354001 (1, figure 106)

Figure 106

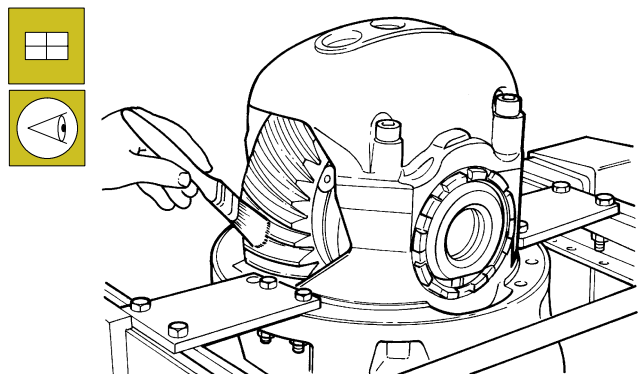


39711

To avoid altering the previously obtained rolling torque when adjusting the backlash between the teeth of the pinion and crown wheel, the adjusting ring nut can be tightened using wrench 99354001 (1) by the same amount as the ring nut on the other side has been loosened.

After the adjustment has been completed, check that the two ring nuts permit the mounting of the safety plates.

Figure 107



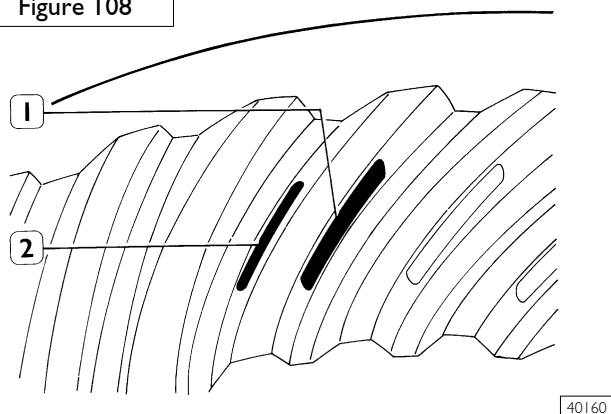
39704

Using a brush apply a thin coating of lead oxide to the crown wheel teeth.

Rotate the pinion and find the pinion teeth contact marks on the crown wheel teeth.

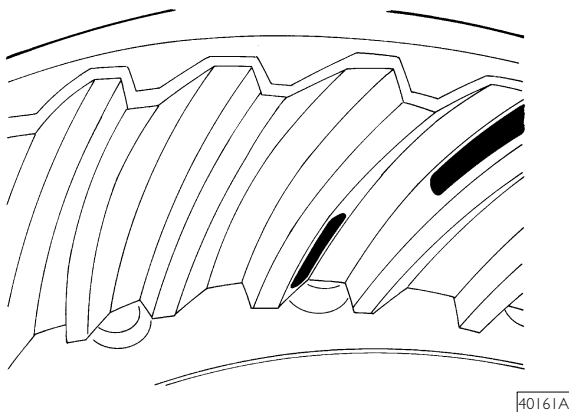
The figures that follow indicate possible contact points and how to correct any errors.

Figure 108



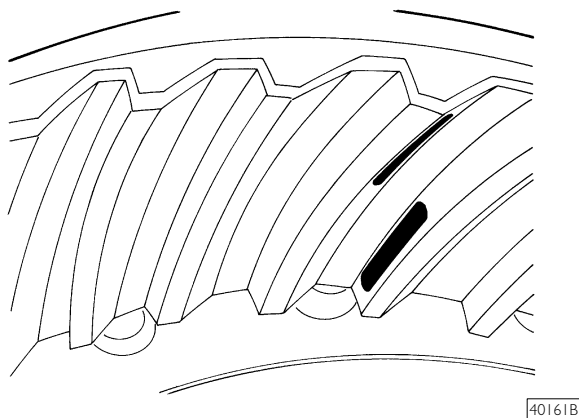
The lead oxide should mark both the drawn surface (1) and the thrusting surface (2) approximately along the centreline of the tooth width. Without load, both meshing areas that contact are slightly displaced with reference to the crown wheel outer diameter.

Figure 109



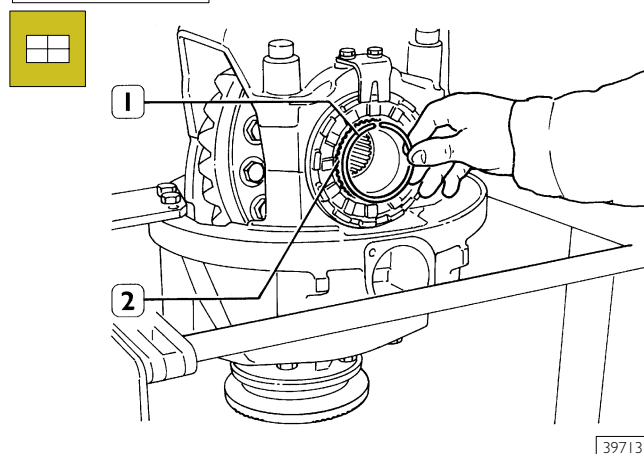
If the mark on the drawn surface (toward the outer diameter) and on the thrusting surface (toward the inner diameter) is displaced, this means that the pinion is too near the crown wheel.
- Cure: Increase the shim of the adjusting ring between the intermediate bearing and the bevel pinion

Figure 110



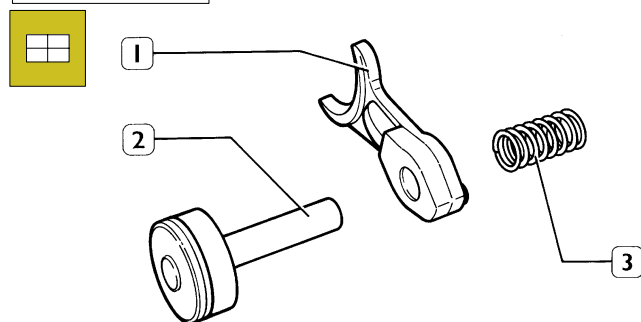
If the mark on the drawn surface is displaced towards the inner diameter and the mark on the thrusting surface is displaced towards the crown outer diameter, this means that the pinion is too far from the crown wheel axis.
Cure - reduce the shim of the adjusting ring between the intermediate bearing and the bevel pinion.

Figure 111



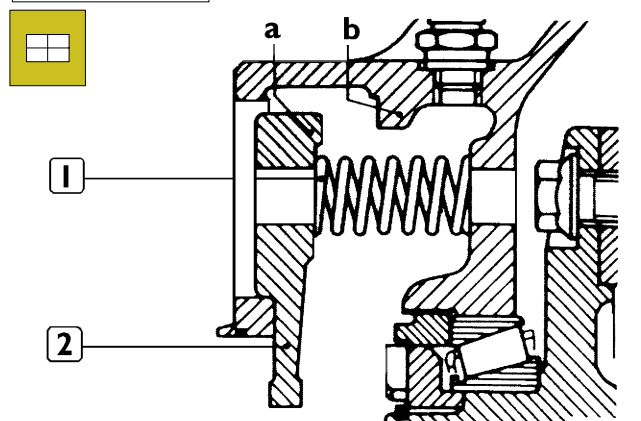
Fit in place the engaging sleeve (1) on the gear housing teeth and using a screwdriver fit the split ring (2) into its groove.

Figure 112



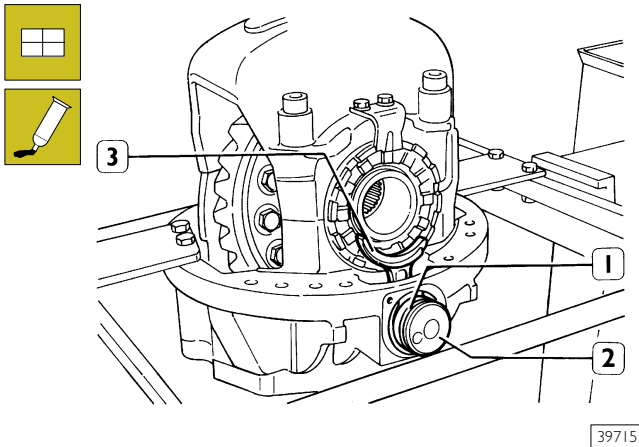
Fit in place the differential locking device assembly composed of the control cylinder; piston (2), engaging fork (1) and compression spring (3).

Figure 113



Insert the compression spring (1) in the differential housing. Fit in place the engaging fork (2) so that the stop at the end of stroke (a) corresponds to the end of stroke (b) on the differential housing.

Figure 114



Fit in place a new seal ring (1) on the control piston (2) and grease it.

Insert the control piston (2) into the engaging fork (3) in the compression spring, then in the specific hole in the differential housing.

Remove the bevel pinion support again.

Fitting in place the differential in the axle casing

1° Fit in place the sliding sleeve on the half-shaft

2° Fit in place the gear housing taking care that the control fork fits into the sliding sleeve spline

3° Tighten the screw and at the same time push the half shaft so that the sliding sleeve fits into the engaging sleeve on the differential

4° Apply LOCTITE 573 to the thread and under the screw heads then tighten with a dynamometric wrench to the prescribed torque

5° Spread LOCTITE 573 on the contact surface, re-fit into place the pinion support and tighten the screws to the prescribed torque.

BRAKES

SECTION 13.1

SECTION 13.1

Brakes

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SETTING THE BRAKE PEDAL	15
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DESCRIPTION

The vehicle is fitted with drum brakes.

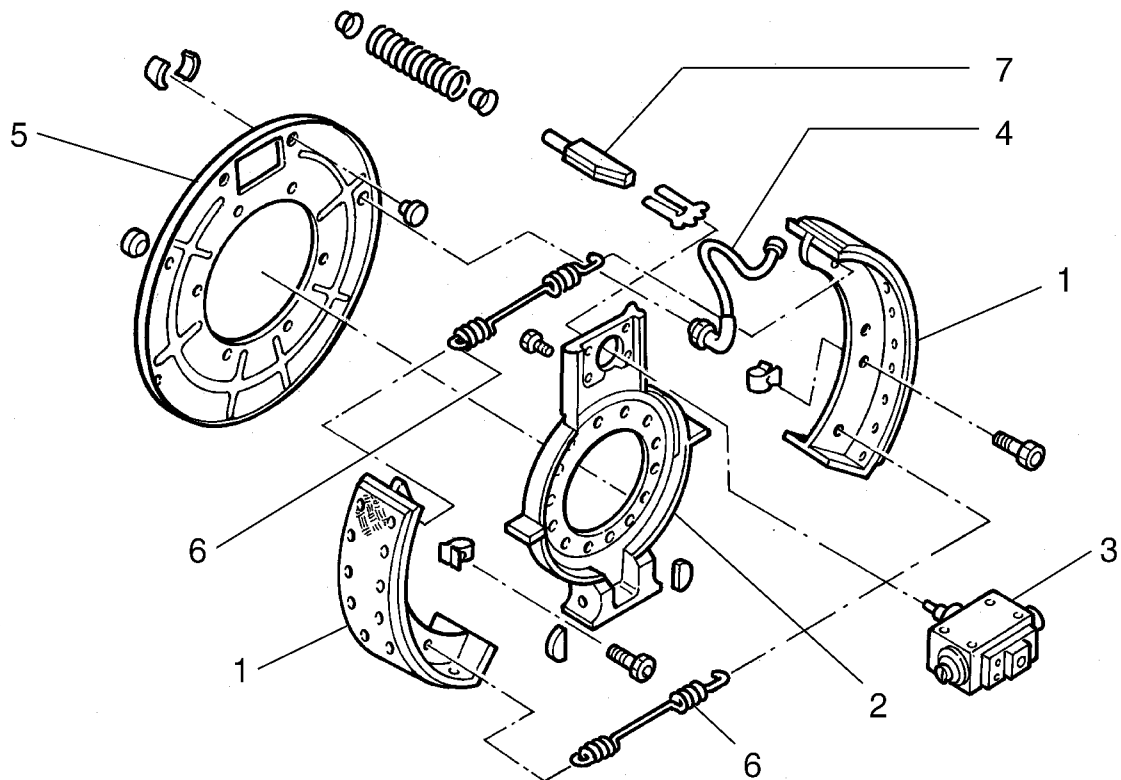
Each brake unit features a housing that contains the adjusting pins, control pins and wedge elements. The wedges are activated by the cylinder rods which, in their turn, are activated by the compressed air.

The stroke of the wedge unit rollers causes the control pins to expand, thus overcoming the resistance of the shoe return

spring so that the shoes approach the drum and actuate the braking.

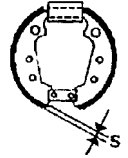
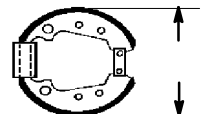
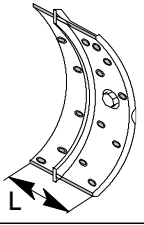
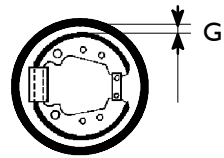
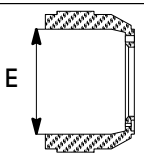
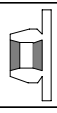
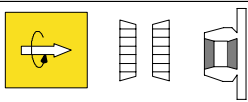
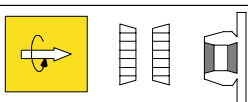
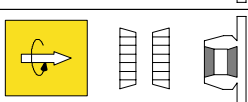
The adjusting and control pins are integrated into the brake housing by means of two pins inserted in a side milling. When the brake is released, since the air pressure in the diaphragm section of the brake cylinders becomes insufficient, the wedge unit returns to its original position.

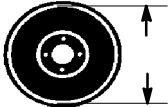
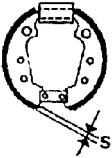
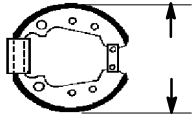
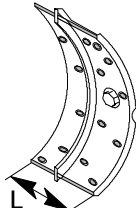
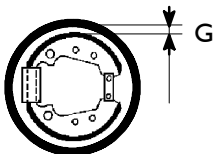
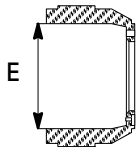
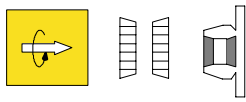
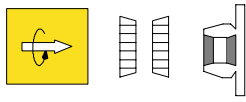
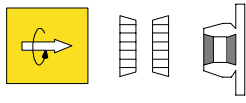
Figure 1

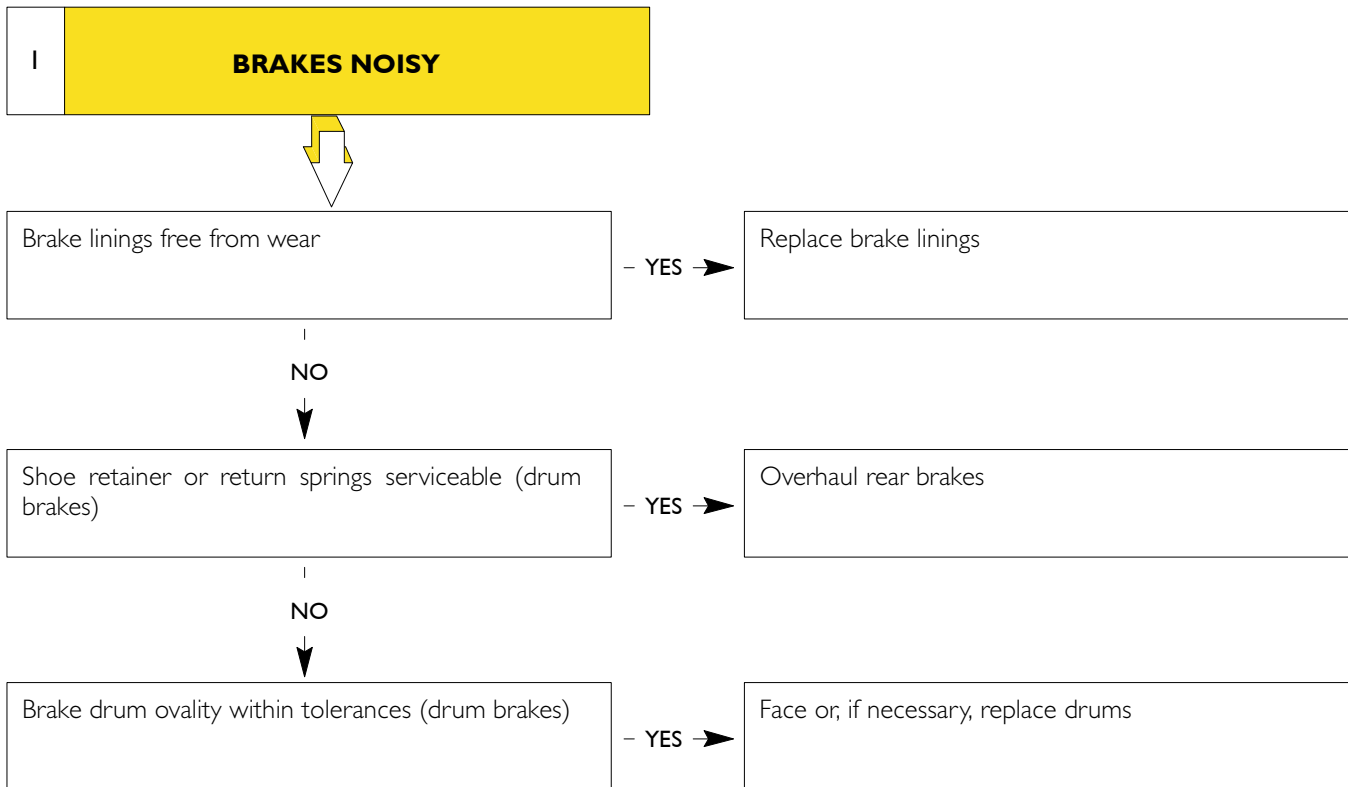


1. Friction linings – 2. Brake shoe carrier – 3. Thrust pin casing – 4. Pneumatic control – 5. Dust cover – 6. Return springs –
7. Wedge units

SPECIFICATIONS AND DATA

FRONT AXLES BRAKES		DRUM BRAKES
	Drum diameter: - nominal $\varnothing$ mm - 1st oversize $\varnothing$ mm - 2nd oversize $\varnothing$ mm	410 ÷ 410,4 412 414
	Brake lining thickness: - Nominal S mm - 1st oversizing S mm - 2nd oversizing S mm - Minimum admitted S_{l*} mm	21,1 22,1 23,1 4,7
* In correspondence to the last rivet of the shoe with wear-out sensor, on the side opposite the cylinder		
	Brake lining diameter: - nominal $\varnothing$ mm - 1st oversize $\varnothing$ mm - 2nd oversize $\varnothing$ mm	407,5 ÷ 409 409,5 ÷ 411 411,5 ÷ 413
	Brake lining width: L mm	180
	Clearance between brake linings and drum G mm	0,5 ÷ 1,45
	Max. error of concentricity of drum diameter after skimming E mm	0,04
	WHEEL HUBS	
	Wheel hub bearings	2, taper roller bearings
	Wheel hub bearing rolling torque new bearings with surface protection Nm	3 Nm + (7,5 ÷ 9 Nm)
	Wheel hub bearing rolling torque run-in bearings and new lubricated seal rings Nm	3 Nm + (4 ÷ 5 Nm)
	Wheel hub bearing rolling torque run-in bearings and seal rings Nm	3 Nm + (3 ÷ 4 Nm)
	Half shaft end play mm	0,5 ÷ 1

REAR AXLES BRAKES		DRUM BRAKES
	Drum diameter: - nominal $\varnothing$ mm - 1st oversize $\varnothing$ mm - 2nd oversize $\varnothing$ mm	$410 \div 410,4$ 412 414
	Brake lining thickness: - Nominal S mm - 1st oversizing S mm - 2nd oversizing S mm - Minimum admitted S_1^* mm	21,1 22,1 23,1 4,7
* In correspondence to the last rivet of the shoe with wear-out sensor, on the side opposite the cylinder		
	Brake lining diameter: - nominal $\varnothing$ mm - 1st oversize $\varnothing$ mm - 2nd oversize $\varnothing$ mm	$407,5 \div 409$ $409,5 \div 411$ $411,5 \div 413$
	Brake lining width: L mm	200
	Clearance between brake linings and drum G mm	$0,5 \div 1,45$
	Max. error of concentricity of drum diameter after skimming E mm	0,04
	WHEEL HUBS	
	Wheel hub bearings	2 taper roller bearings
	Wheel hub bearing rolling torque new bearings with surface protection Nm	$3 \text{ Nm} + (12 \div 16 \text{ Nm})$
	Wheel hub bearing rolling torque run-in bearings and new lubricated seal rings Nm	$3 \text{ Nm} + (5 \div 7 \text{ Nm})$
	Wheel hub bearing rolling torque run-in bearings and seal rings Nm	$3 \text{ Nm} + (2,5 \div 4,5 \text{ Nm})$
	Half shaft end play mm	$0,5 \div 1$

DIAGNOSTIC

For further information on brake system and components diagnostic procedure see Section 16 "Pneumatic system - brakes".

TIGHTENING TORQUES

DESCRIPTION	TORQUE	
	Nm (Kgm)	
Front drum brakes		
Wheel fastening nut	25 ± 3 (2,5 ± 0,3)	
Drum to reducer fastening screws	650	(65)
Rear drum brakes		
Wheel fastening nut	25 ± 3 (2,5 ± 0,3)	
Drum to reducer fastening screws	650	(65)

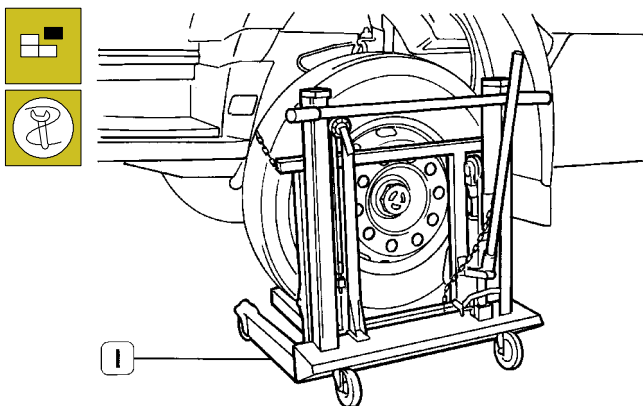
TOOLS

TOOL NO.	DESCRIPTION
99301001	Drum lathe and relevant accessories
99301006	Brake shoe turning equipment
99305087	Riveting press
99305117	Checking equipment for air circuits
99321024	Hydraulic trolley for removing and refitting wheels
99345030	Bridge for dismantling/refitting combined brake actuators
99345037	Element for dismantling/refitting combined brake actuators (use with 99345030)
99345094	Base for removal and re-fitting in place spring brake cylinders (to be used with 99345030 - 99345095)
99345095	Elements to use with 99345094
99356001	Wrench for brake shoes adjustment
99356606	Wrench for removal and re-fitting in place combined brake cylinders ring nut
99357111	Pliers for assembling shoe return springs
99372213	Brake drum turning tool (use with 99301002)

FRONT BRAKES

Removal

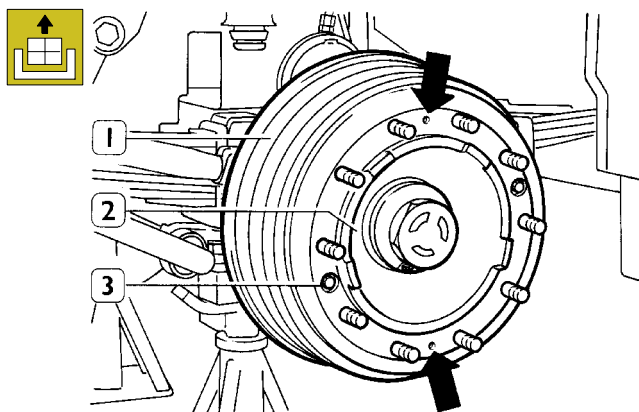
Figure 2



40864

Place the vehicle on flat ground; remove the wheel nut covers and loosen the nuts. Lift the front of the vehicle and rest it on suitable stands. Place hydraulic truck 99321024 (1) under the wheels. Remove the nuts and the wheels.

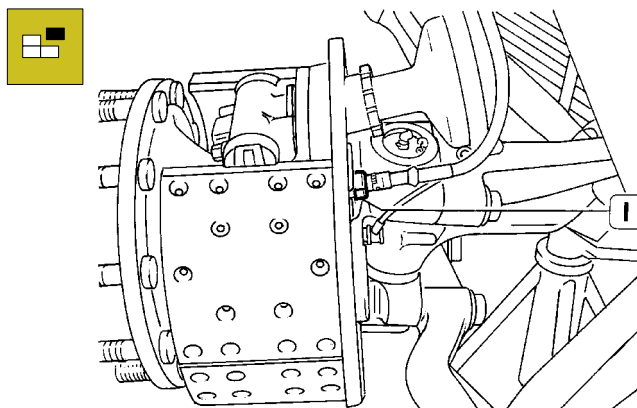
Figure 3



40865

Remove the brake drum (1) to wheel hub (2) fastening screws (3); lock two appropriate screws in the drum holes (⇒) and remove this from the wheel hub.

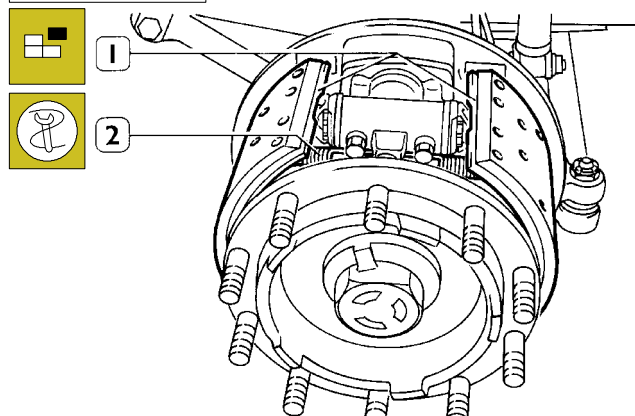
Figure 4



40866

Disconnect the brake lining wear indicator cable electrical connection (1).

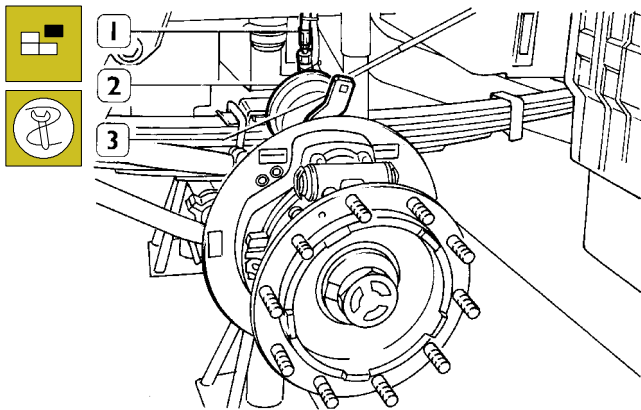
Figure 5



40867

Unhook the shoe (1) return springs (2) using pliers 99357111. Remove the shoes (1) releasing the brake linings wear indicator cable from the brake-carrier plate clamps and withdraw the cable.

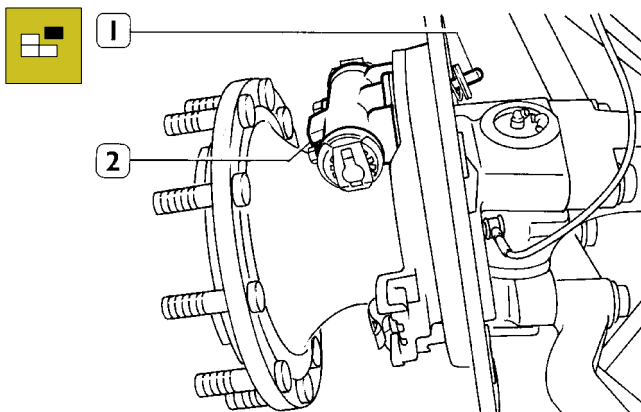
Figure 6



40868

Disconnect the brake cylinder (2) feeding pipes (1). Using wrench 99356006 (3) loosen the ring nuts and remove the brake cylinder (2).

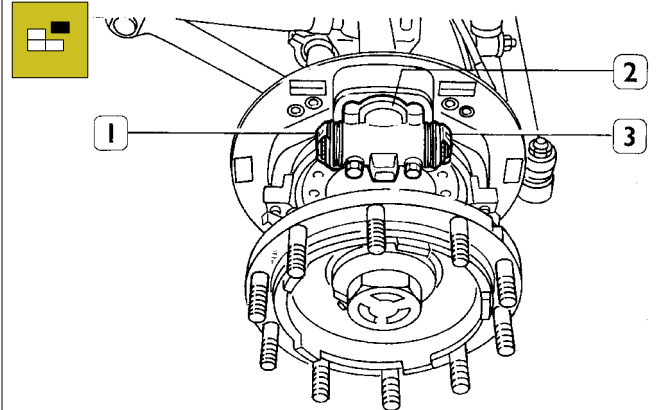
Figure 7



40869

Take away the wedge units (1) controlling the brake housing (2).

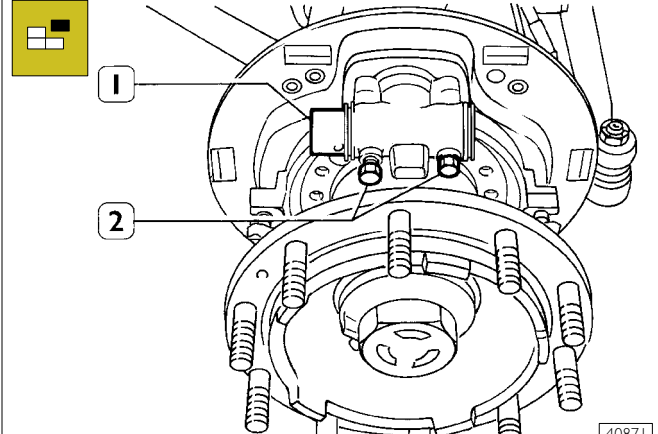
Figure 8



40870

Take away the wedge units (1) controlling the brake housing (2).

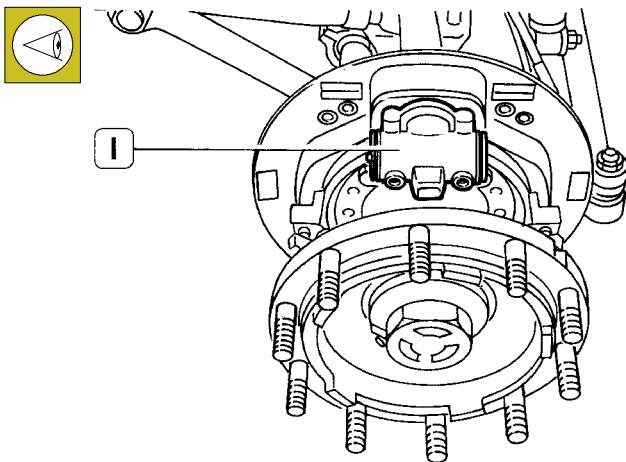
Figure 9



40871

Remove the guide screws (2) and remove the thrust pins (1) with the adjustment bushes and relevant springs. Remove the opposite brake unit.

Figure 10



40872

Check the wear on the pin seats of the brake housing (1), if they are scored or very worn replace the faulty brake housings.

Check the wear on the drums to decide whether they can be re-used.

Measure the drum diameters with a gauge without bending the arms.

Measure the diameter in several points to establish the ovality and wear, also taking into consideration the depth of scores on the braking surface.

Allowed tolerance for ovality and/or eccentricity is 0.25 mm

If the braking surface scoring or wear cannot be repaired by turning, or if there are evident signs of overheating, replace the drum (see Specifications and data table).

Check the conditions of the brake shoes, if they are cracked replace them.

If the brake lining surfaces show signs of grease, find the cause and remove it.

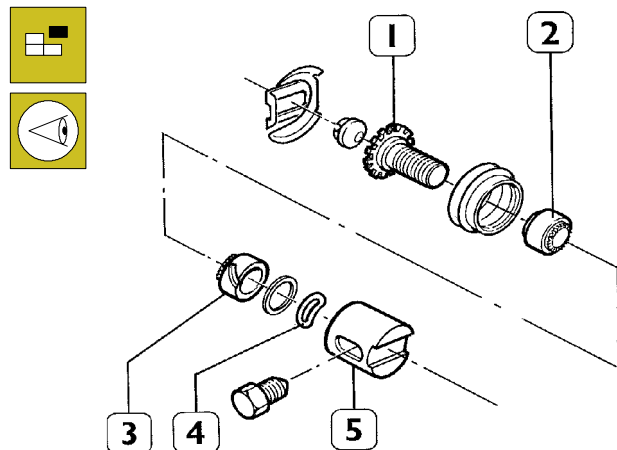
The minimum thickness admitted for the brake linings is 4.7 mm, measured at the last rivet of the shoe with the wear sensor on the side opposite the cylinder.

If a value that is under, or only just over the specified thickness, replace.

Check the integrity and/or efficiency of the brake lining wear indicator cable.

Check the integrity and/or efficiency of the shoe return springs.

Figure 11



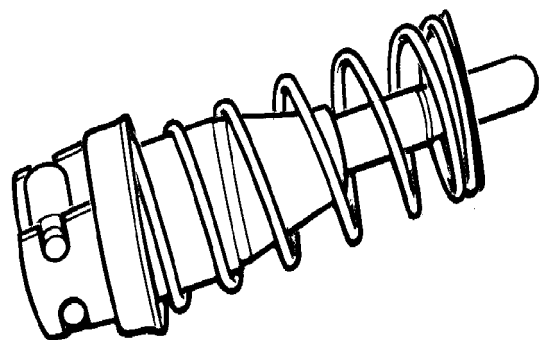
35711

Dis-assemble the automatic adjustment unit.

Carefully clean all the components of the braking unit. Check the wear on the adjusting bush teeth (2 and 3), ascertain that the bushes (2) slide freely screwing them on the relevant adjusting pins (1).

Check the condition of the springs (4) and thrust pins (5).

Figure 12



35713

Check that the wedge units slide easily and that there are no abrasions.

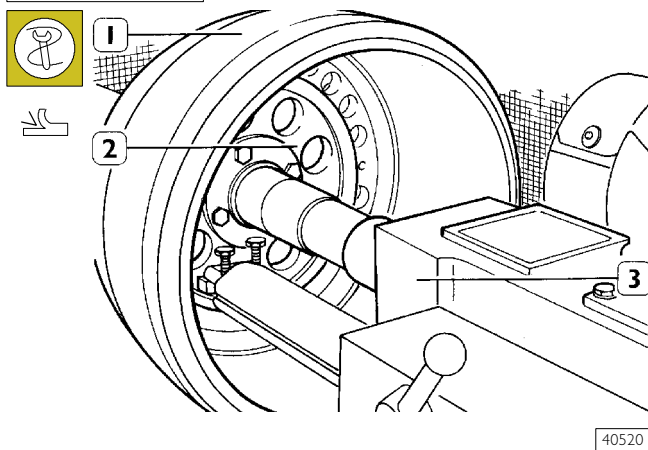


If wear is found on the wedge components the complete unit must be replaced.

Drum turning

Measure the drum diameters using a gauge without bending the arms, find the diameter in several points to establish the ovality and wear.

Figure 13



Fit tool 99372213 (2) into the brake drum.
Fit this combined unit onto the lathe shaft 99301001 (3).
Fit a set of spacers on the shaft to remove unit end play, tighten the lock nut and place the lathe support.
Fit the antivibration band on the brake drum.
Turn the drums by stages, removing the amount of material necessary to correct the imperfections found.
After turning remove the drum brake and carefully clean it.



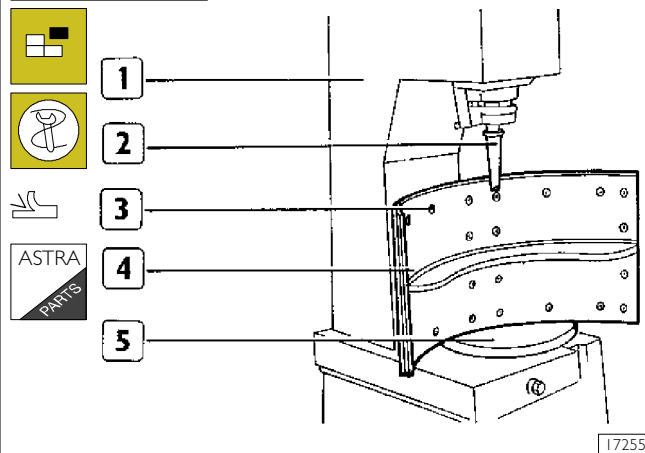
The maximum diametral oversizing admitted for the drum is indicated on the drum itself.
This limit must not for any reason be exceeded as it would jeopardize the braking effect and the drum resistance characteristics.



Couple the brake linings suitable for each drum according to the oversizing.
Each vehicle axle must be fitted with linings of the same type.

Replacing brake linings

Figure 14



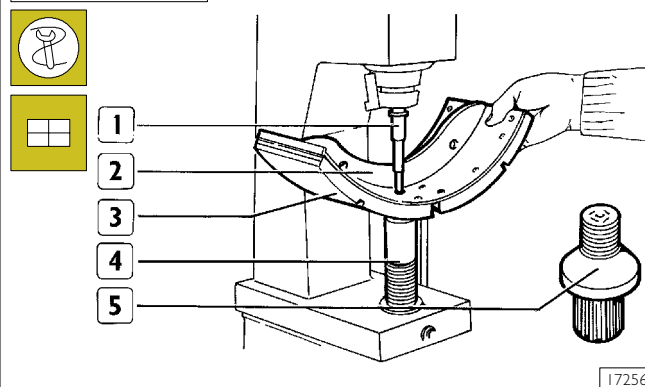
Remove the worn brake linings from the shoes with compressed air press 99305087 (1).



Remove the brake lining wear indicator cable from the lower shoes.

Set the complete shoes (4) on an adjustable stand (5).
With a chisel (2) in the press tooling head (1) shear the rivet heads (3).
Eject the rivets from the shoes.
Carefully wash and blow the shoes to clean them.

Figure 15



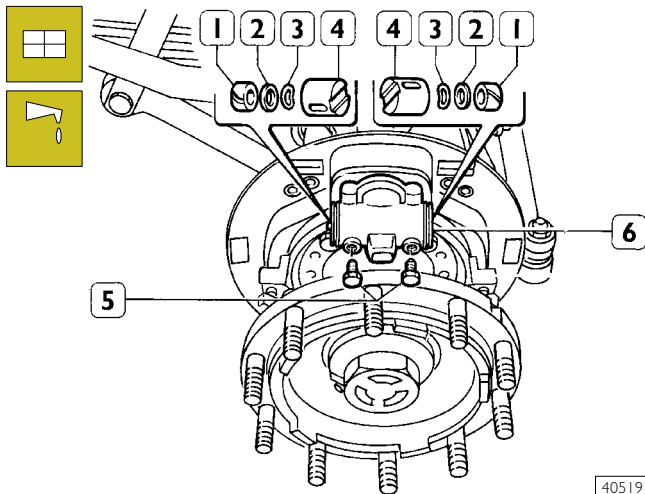
Set the contact pin (5) on the press moving support (4).
Rivet the brake linings (3) onto the shoes (2) with the beater (1) fitted in the press tooling head.



To rivet the brake linings correctly start in the centre, gradually extending to the braking sectors.

Fitting in place

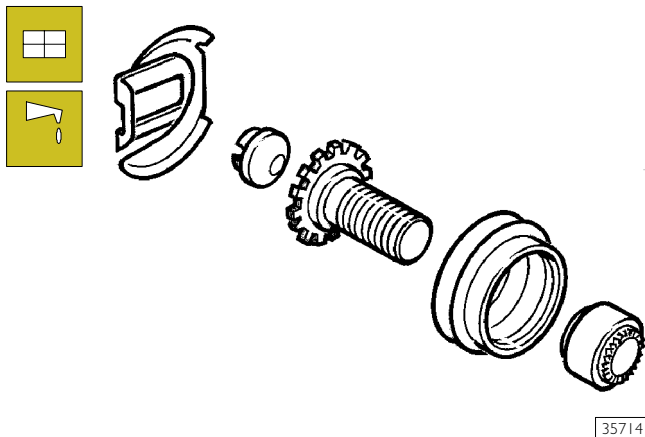
Figure 16



Grease components (1,2 and 3) and fit them, in sequence, in the thrust pin (4).

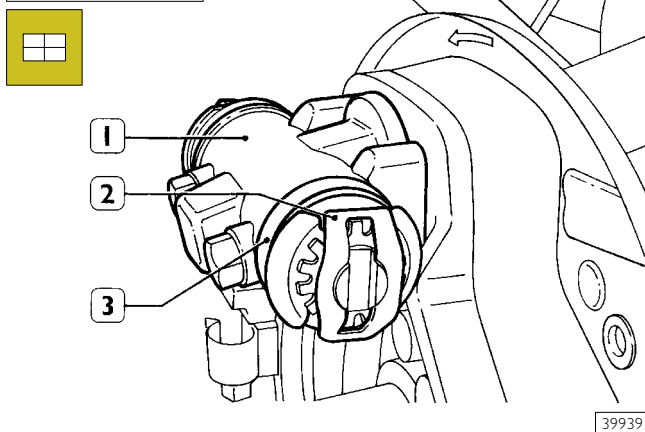
Grease the interior of the brake housing (6) and fit in place the thrust pins (4) restraining them through the guide pins (5).

Figure 17



Fit together the adjusting unit thoroughly greasing the sliding surfaces.

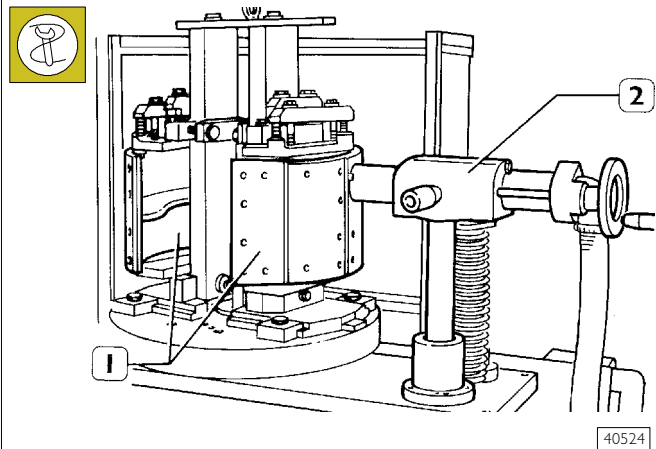
Figure 18



Fit the adjusting units (2) into the brake housing (1) placing the clasp as shown in the figure.

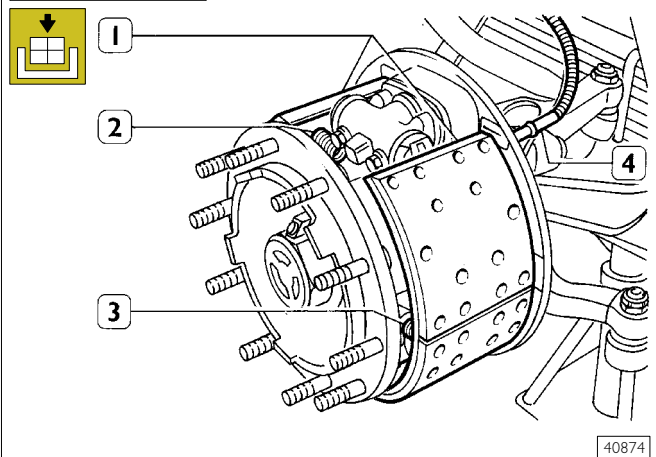
Fit in place the protection housing (3) in the brake housing groove (1).

Figure 19



Using tool 99301006 (2) turn the brake linings (1).

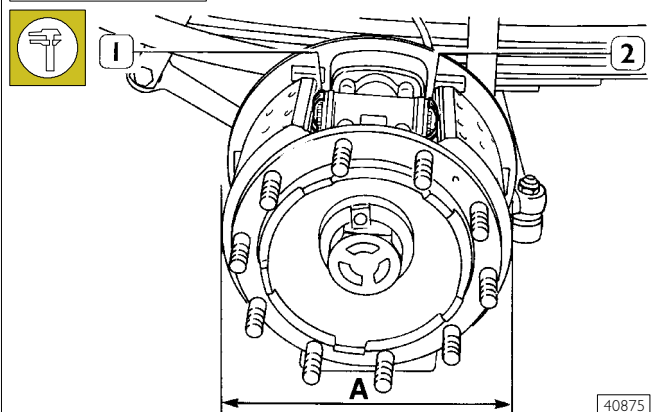
Figure 20



Fit the brake lining wear indicator cable in the clamp and in the brake carrier plate hole.

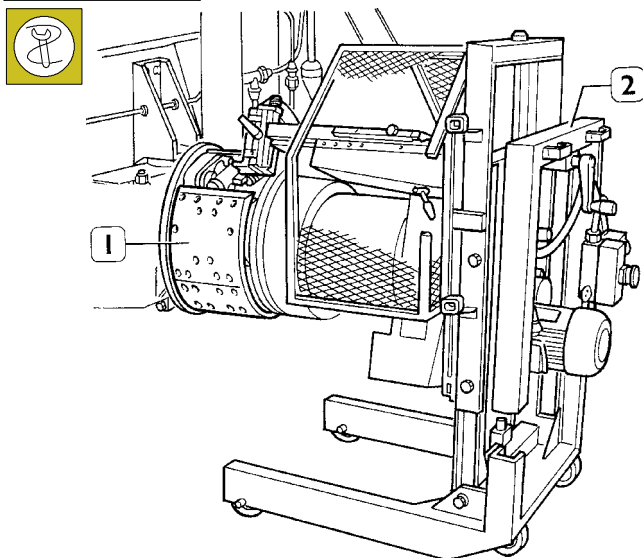
Fit in place the shoes (1) and hookup the return springs (2 and 3). Electrically connect (4) the wear indicator.

Figure 21



Loosen the adjusting units (1 and 2) equally to obtain that diameter A is 2 mm less than the diameter of the drum brake to be fitted.

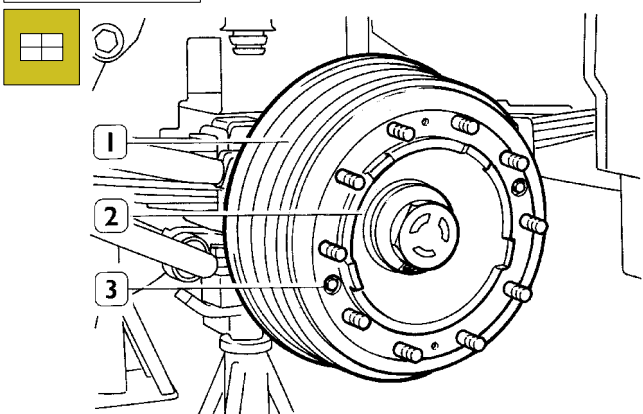
Figure 22



40876

Having tool 99305079 (2) available instead of 99301006 (2, figure 19) turn the brake linings (1)

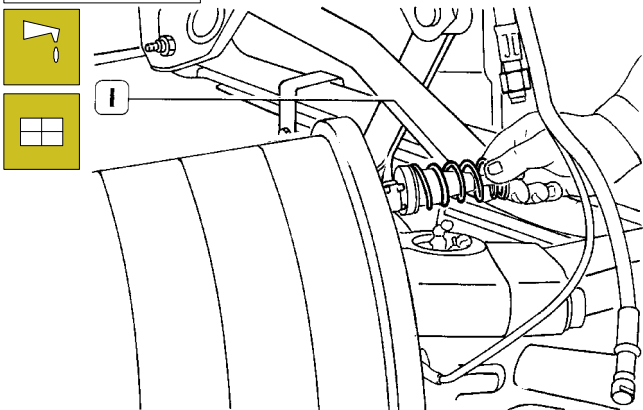
Figure 23



40877

Fit in place the brake drum (1) and fasten it to the wheel hub (2) with the screws (3).

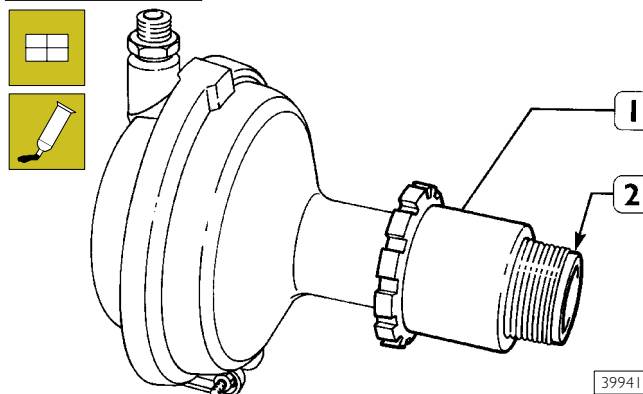
Figure 24



40878

Generously grease the wedge control units (1) and fit them in their seats on the brake housing so that the wedge unit rollers rest in the thrust pin raceways.

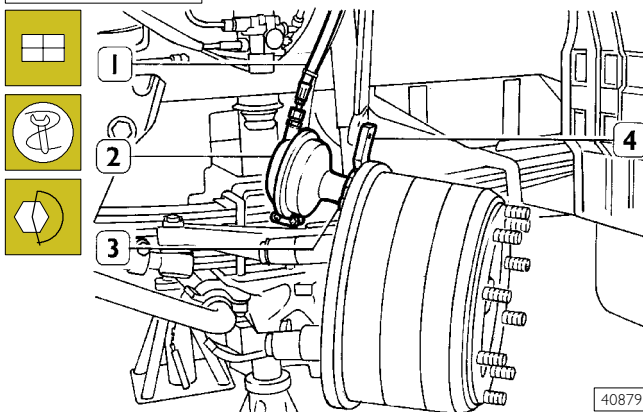
Figure 25



39941

Tighten the ring nut (1) by hand onto the shaft (2) to the end of its stroke. Spread non hardening sealant paste LOCTITE 573 on the three pin threads of the shaft (2).

Figure 26

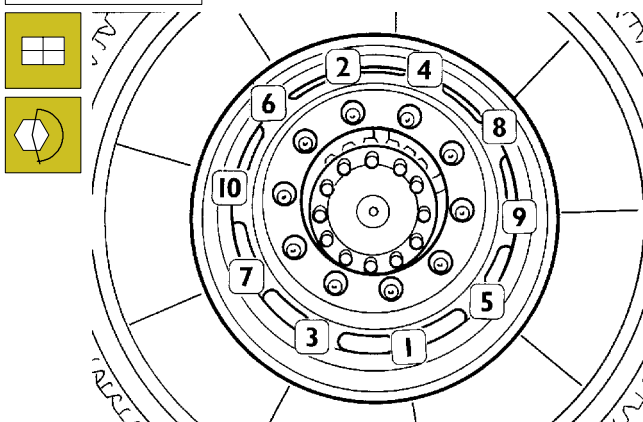


40879

Screw the cylinder (2) right down into its seat. Check that the feed coupling holes are in the same position as before removal, if they are not, loosen the cylinder (2) and connect the feed pipes (1).

Feed the cylinder through the service brake and with wrench 99356006 (4) tighten the ring nut (3) to the prescribed torque.

Figure 27



40564

Fit in place the wheels and tighten the nuts to the prescribed torque in the sequence shown in the figure.

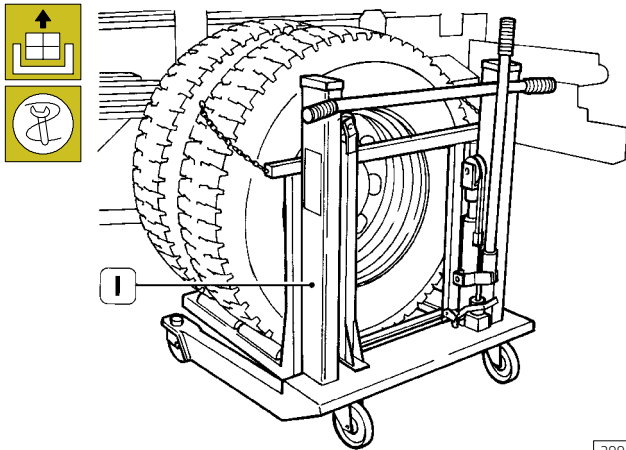
Fit in place the other braking unit.

Start up the engine for sufficient time to recharge the system. Brake several times to settle the braking unit and to recover the slack between the brake linings and the drum with the vehicle running.

REAR BRAKES

Removal

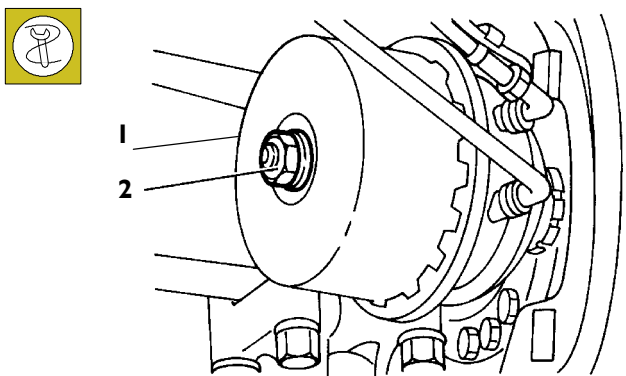
Figure 28



39950

Place the vehicle on flat ground. Bring the parking brake hand lever into running position, loosen the rear wheel nuts. Using a hydraulic jack lift the rear of the vehicle and rest it on suitable stands. Using hydraulic truck 99321024 (1) remove the wheels.

Figure 29



39951

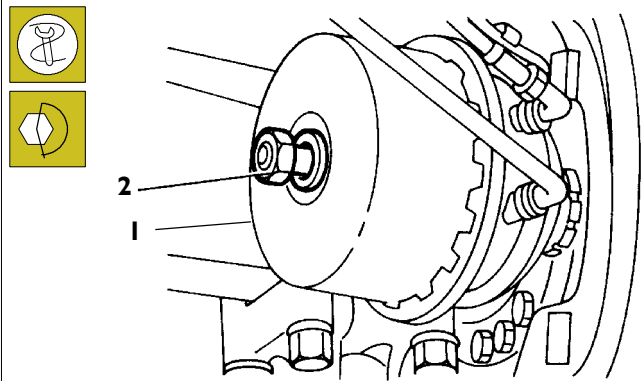
Completely unscrew the manual braking release screw (2) of the combined cylinder (1).



Overhaul the braking unit following the instructions given for the front brakes, unless stated otherwise.

Fitting in place

Figure 30

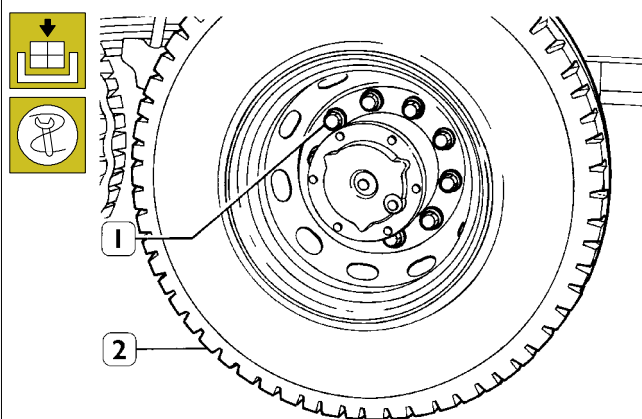


39954

After the brake unit has been overhauled and re-fitted in place, fit in place the cylinder (1) following the instructions given for the front brake cylinder.

Feed the cylinder (1) through the service brake and tighten the ring nut to the prescribed torque using wrench 99356006. Restore parking brake control cylinder (1) operation, fully tightening the screw (2).

Figure 31



39955

Fit in place the wheels (2) lock the nuts (1) to the prescribed torque.

Fit in place the other braking unit.

Start up the engine for sufficient time to recharge the system. Brake several times to settle the braking units and to recover the slack between the brake linings and the drum with the vehicle running.

SETTING THE BRAKE PEDAL

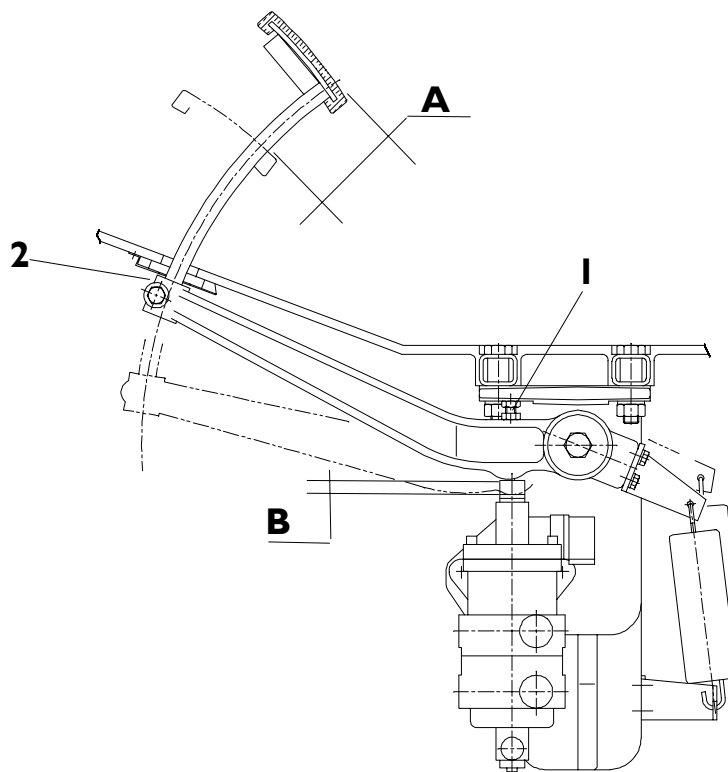
Floor pedal unit

Adjust the stop screw (1) to avoid the pedal (in rest position) and the cab floor being in touch in point (2).

Brake pedal stroke (dimension A) = 77 mm

Brake distributor stroke (dimension B) = 11 mm

Figure 32



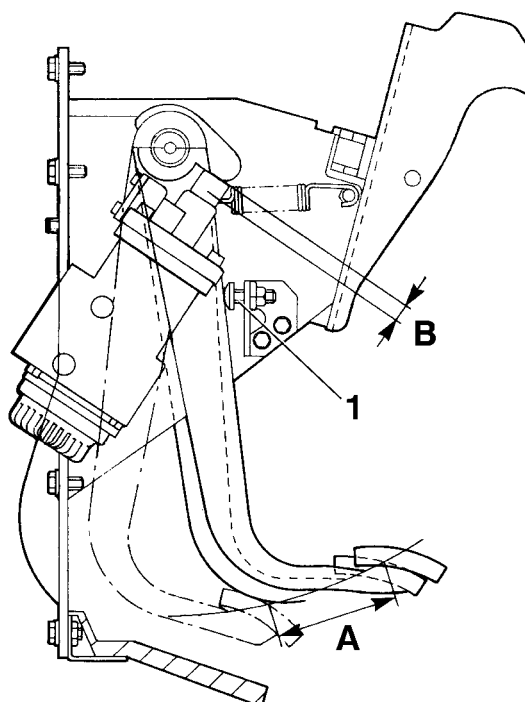
Hanging pedal unit

Set the screw (1) to dimension C = 23.5 mm; the prescribed brake distributor stroke (dimension B) must correspond to this value. Adjust the stop push rod (2) to have the brake distributor not depressed with brake pedal in rest position.

Brake pedal stroke (dimension A) = 97 mm

Brake distributor stroke (dimension B) = 11 mm

Figure 33



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WHEELS AND TYRES

SECTION 13.2

SECTION 13.2

Wheels and tyres

	Page
DESCRIPTION	3
SPECIFICATIONS AND DATA	3
TIGHTENING TORQUES	3
TOOLS	3
CHECKS AND REQUIREMENTS	4
WHEEL STATIC BALANCING	4
CORRECTING RESIDUAL STATIC IMBALANCE	5
TYRE PRESSURE	5
☐ How tyre behaviour depends on pressure	6

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DESCRIPTION

The wheel rim represents the rigid structure of the wheel and is identified by the following dimensions :

- ☐ diameter of the rim, measured at the base of the circumferential groove (that is, on the surface on which the air chamber rests)
- ☐ width of the circumferential groove in the wheel rim (that is, the distance between the surfaces on which the cover rests)

The tyre has the following functions :

- ☐ to absorb the greater part of the jolts caused by roughness of the road surface by utilising the elasticity of air

- ☐ to generate on the ground the motive force supplied by the engine necessary for the vehicle to move
- ☐ to ensure the maximum grip and stability of contact between the tyre and the road, with satisfactory life
- ☐ to withstand the forces generated by sudden braking, hard acceleration and by the thrust of centrifugal force on bends
- ☐ to ensure the stability of the vehicle even at high speeds; to ensure the steerability of the vehicle
- ☐ to ensure vehicle directional control.

SPECIFICATIONS AND DATA

Standard

Tyres	Rims
3R22,5 MICHELIN 156/150 G tubeless / PIRELLI 156/150 K (154/150L) tubeless	9,00 – 22,5"

Optional

Tyres	Rims
1200R20 MICHELIN 156/150G / PIRELLI 157/153F20PR	8,0V – 20"
315/80R22,5 MICHELIN 156/150 K tubeless / PIRELLI 156/150 K tubeless	9,00 – 22,5"
12.00 R 24"	8,0 – 24"
14.00 R 20"	10,0 – 20"

Tyre inflation pressure data

Tyres	13R22,5 156/150 G tubeless	12.00R20 156/150 G	315/80R22,5 156/150 G	12.00 R 24	14.00 R 20
Inflation pressure [bar]	8,00	8,50	8,50	7,50	6,50
Limit mass admitted [kg] (s)	8000	8000	8000	8000	8000
(g)	13000	13000	13000	13000	13000

(s) = single tyres

(g) = twin tyres

This table enables, with the vehicle in running position, to identify the correct operating pressure according to the type of adopted tyres and the loads acting on the axles.

TIGHTENING TORQUES

DESCRIPTION	TORQUE	
	Nm	kgm
Wheel fixing screws	650	6,6

TOOLS

TOOL	DESCRIPTION
99305037	Electronic unit for balancing the front wheels on the vehicle

CHECKS AND REQUIREMENTS

Wheels shall be checked periodically, e.g. when changing a tyre.

The driver shall perform the following operations accurately:

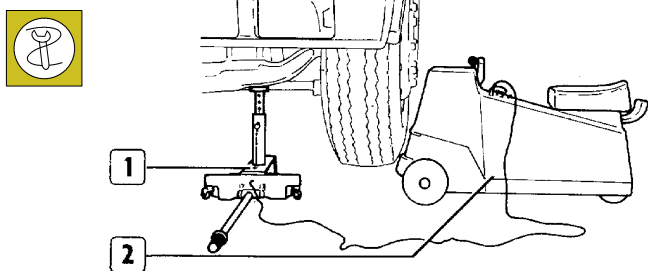
- ☐ Clean the coupling surfaces when removing a wheel from the vehicle.
- ☐ Inspect the rim, along its whole circumference, and the disk using special care to hub centering and fixing area.
- ☐ Check absence of defects, wear, corrosion or cracks which can impair wheel reliable performances.
- ☐ Check whether all surfaces are correctly and suitably protected, especially tyre and vehicle faying surfaces. Repaint, if required, after removing surface oxidation, if any and after suitable priming avoiding excessive paint application in the coupling areas.

Only minor repairs (e.g. removal of scratches or dents), apart the above mentioned surface protection resetting, can be performed on steel wheels. In case of serious damages the wheel shall be repaired by skilled workers only, since tyre removal and refitting when are not performed correctly can be dangerous for the driver.

Never repair rims or disks by welding or adding material to restore wheel geometry since these areas which are already affected by wear due to running stress, will break in a short time.

WHEEL STATIC BALANCING

Figure 2

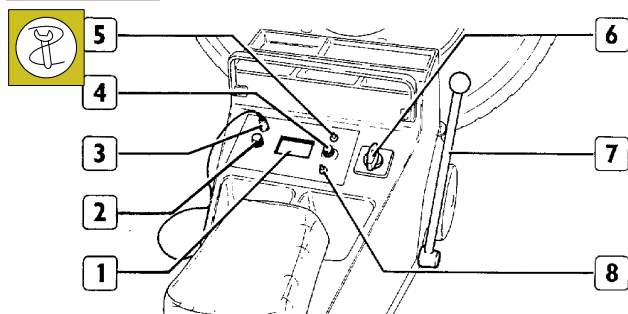


The front wheels can be balanced on the vehicle using the electronic unit 99305037; this has the great advantage of balancing the wheel together with the other rotating masses.

The operation must be carried out as follows :

- ☐ Raise the front of the vehicle and make sure that the wheels rotate freely
- ☐ Position the imbalance detector (1) under the axle close to the wheel being examined, arranging the height so that the spin-up wheel of unit 99305037 (2) is in contact with the tyre; position a support stand under the opposite side of the axle and lower the hydraulic jack

Figure 2



- ☐ Connect the cable (3) of the imbalance detector to unit 99305037
- ☐ Make a reference mark on the tyre by drawing a radial mark with chalk or using a strip of gummed paper
- ☐ Turn switch (2) to the static balancing position and sensitivity switch (4) to notch no. 5 on the graduated scale
- ☐ Turn on switch (5) for instrument light (1) and strobe lamp switch (8).
- ☐ Turn the spin-up switch (6) of unit 99305037 to the first speed position so as to make the wheel rotate.

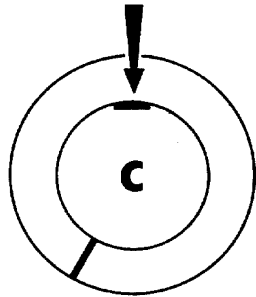
Turn up the spin switch (6) to the second speed and place the balancing machine against the tyre.

While the wheel is being spun, it will be found that the stroboscopic effect on the wheel will make the reference mark appear stationary; the pointer of the instrument (1), moving from the value zero, reaches a maximum value on the scale and then returns to zero.

When the pointer has begun to fall back, withdraw the balancing machine, turn off the spin-up switch (6) completely and brake the motor by means of the brake lever (7). The wheel continues to revolve due to inertia and the reference mark made on the tyre moves; the point to which the reference mark has moved should therefore be noted.

Read off from the instrument (1) the value shown by the pointer; multiply it by 10, giving the value of the balance weight to be fitted to the rim.

Figure 3



16998

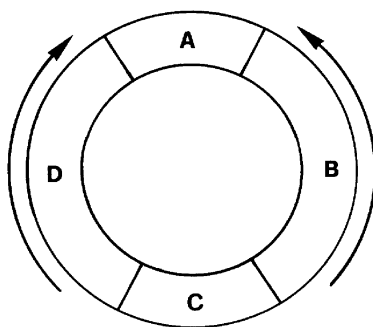
Fit the balance weight calculated in this way as shown in the figure. If during the test, the pointer of the instrument (1, fig. 2) remains in the green area of the box, the wheel is balanced.



If the weight required to balance the wheel is more than 600 - 800 grammes, divide the weight in half and position the two parts so formed with one half on the inside and one half on the outside of the rim, making sure that they are in the same position.

CORRECTING RESIDUAL STATIC IMBALANCE

Figure 4



23885

To correct the residual imbalance, repeat the operations already carried out above; depending to the new reading on the instrument (1, fig. 2), refer to the diagram in figure 4 and proceed as follows to adjust :

- ☐ If the weight is in the zone marked with the letter A, this means that it is too light, and in that case weight must be added as indicated by the instrument (1, fig. 2).
- ☐ If the weight is in the bottom zone marked with the letter C, this means that it is too heavy and in that case the weight must be reduced as shown by the measuring instrument.
- ☐ If the weight is found to be in the zones marked with the letters B or D, do not remove or add any weight but instead move it 5 cm upwards in the direction of the arrows, see figure 4.

TYRE PRESSURE

The tyre pressures must be checked with the tyres cold. Take great care that the pressure is correct since, if it is higher than required, a harsh ride and excessive wear of the centre of the tread will result, while if it is lower, the load is not distributed over the whole tread but is concentrated at either side, causing premature wear of these areas and also damaging the internal structure of the tyre.

Unequal pressures between tyres affects the driving stability of the vehicle and impairs operating safety.

Abnormal wear of the tyres may appear in various areas of the tyre treads.

How tyre behaviour depends on pressure

Schematic views to demonstrate how tyre behaviour and performance depends on pressure.



(The value shown inside each tyre indicates the level of pressure of the tyre, while the efficiency relates to the life of the tyre.)

Figure 5

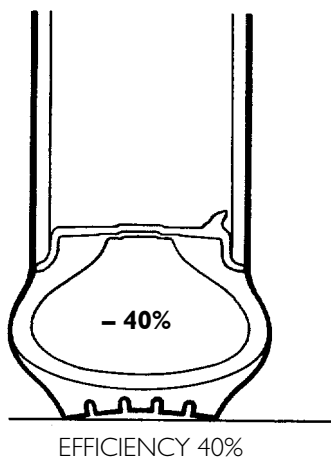


Figure 6

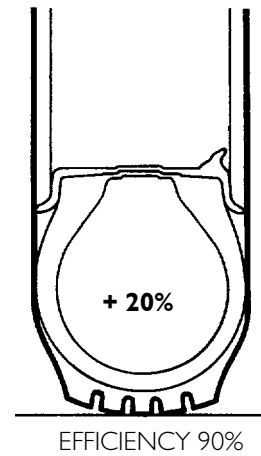
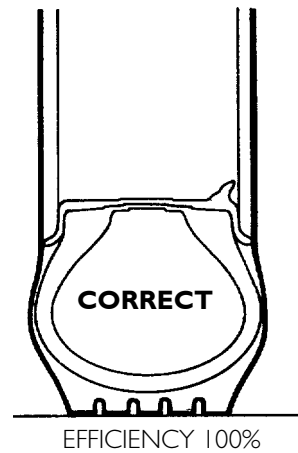


Figure 7



FRONT SUSPENSIONS

SECTION 14.1

SECTION 14.1

Front suspensions

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☐ 2nd axle suspension	4
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☐ Noise	5
☐ Changes in braking effect	5
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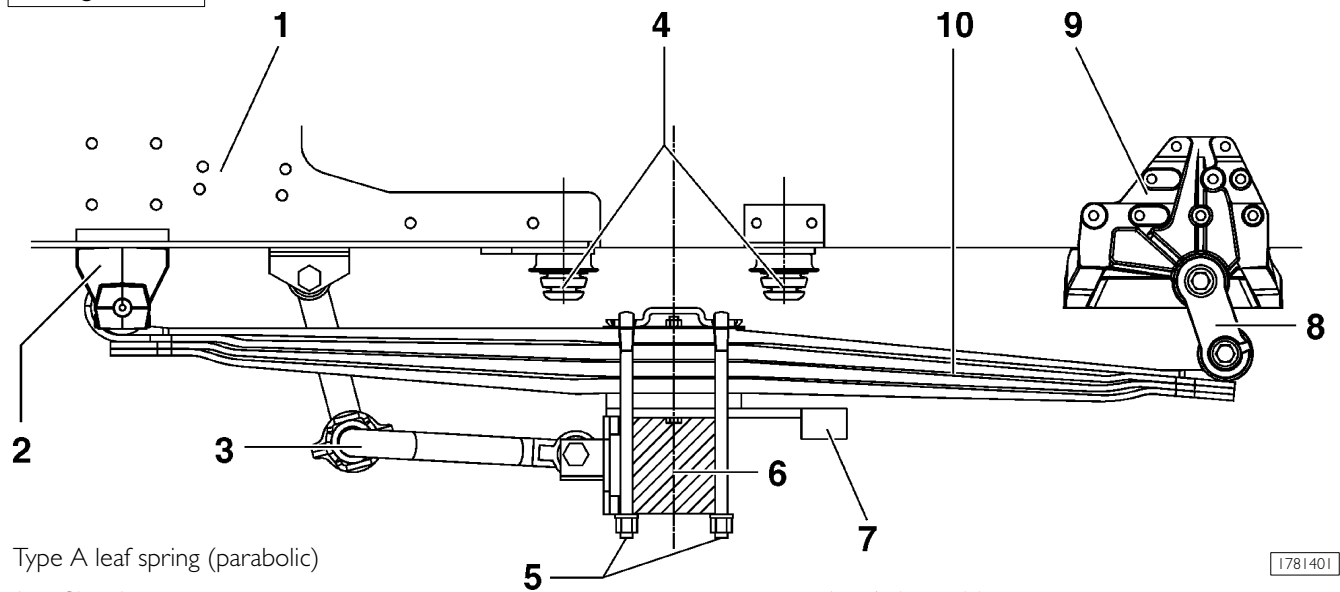
DESCRIPTION**1st axle suspension**

The suspension system is comprised of a pair of longitudinally arranged single action leaf springs, supplemented by a pair of dual action hydraulic telescope shock absorbers and two excursion limit elastic buffers for each spring.

The suspension is also fitted with a roll bar to control vehicle inclination when cornering.

There are two possible types of leaf spring:

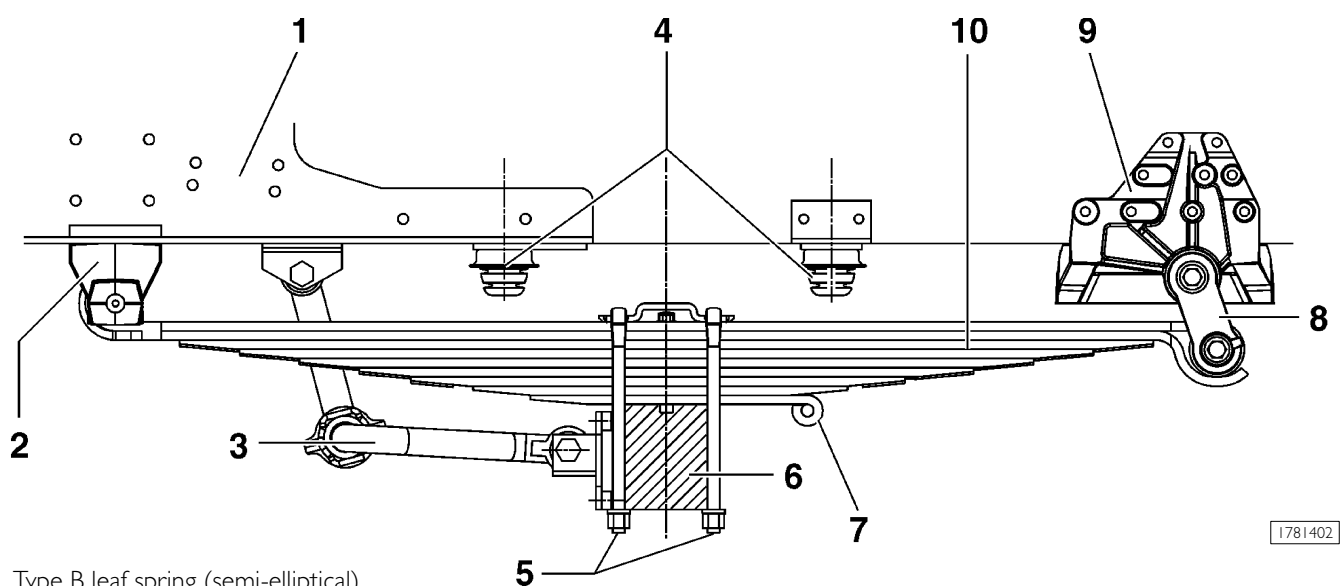
- ☐ Type A, parabolic spring, standard.
- ☐ Type B, semi-elliptical spring, on request.

Figure 1

Type A leaf spring (parabolic)

- | | |
|--------------------------|----------------------------|
| 1. Chassis | 6. Axle or drive |
| 2. Spring front mounting | 7. Shock absorber mounting |
| 3. Roll bar | 8. Shackle |
| 4. Buffer | 9. Spring rear mounting |
| 5. Anchor stirrup | 10. Spring |

1781401



Type B leaf spring (semi-elliptical)

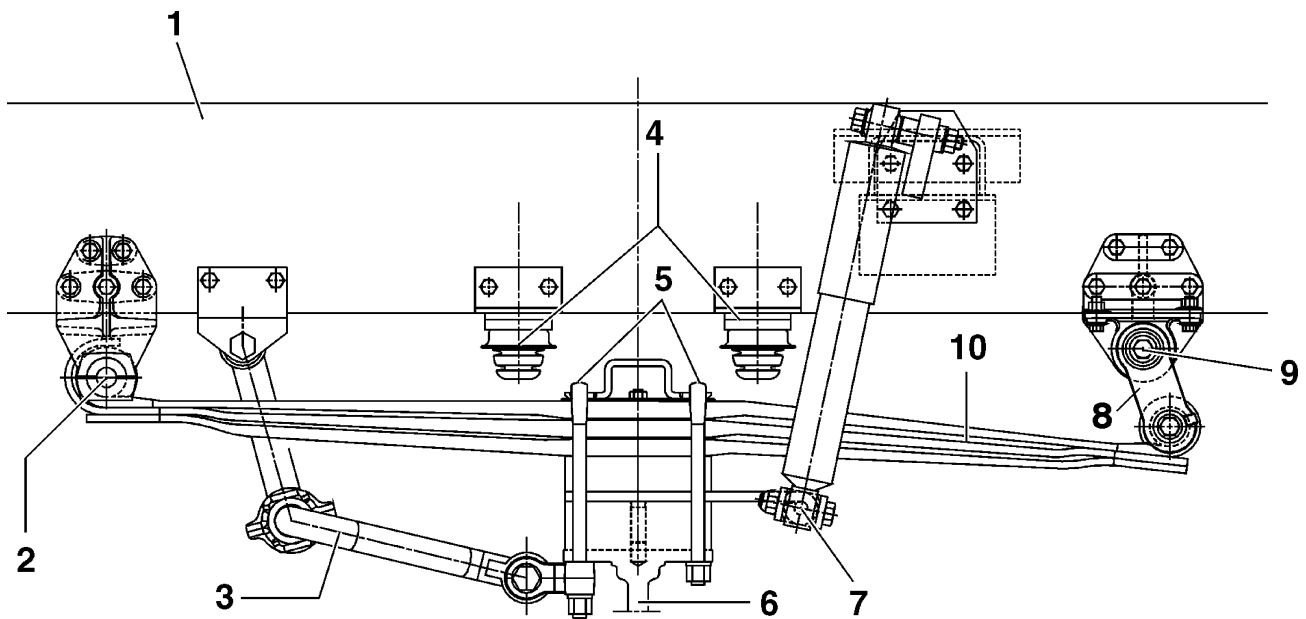
- | | |
|--------------------------|----------------------------|
| 1. Chassis | 6. Axle or drive |
| 2. Spring front mounting | 7. Shock absorber mounting |
| 3. Roll bar | 8. Shackle |
| 4. Buffer | 9. Spring rear mounting |
| 5. Anchor stirrup | 10. Spring |

1781402

2nd axle suspension

The suspension system is comprised of a pair of longitudinally arranged single action leaf springs. It is supplemented by a pair of dual action hydraulic telescope shock absorbers and two excursion limit elastic buffers for each spring. The leaf springs are parabolic

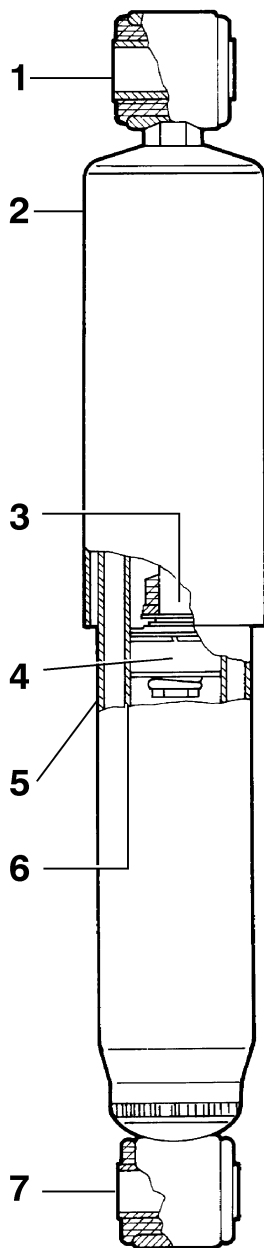
Figure 2



1781403

Hydraulic shock absorbers

Figure 3



The hydraulic shock absorbers are of the telescopic double acting type.

These shock absorbers are also defined "direct acting" since their braking action is directly performed on the suspension elements without levers.

They are fitted with thermostatically controlled valves, thus ensuring that there are no noticeable differences in their performance, even following sharp changes in temperature.

Shock absorbers are divided into three different parts:

1. the cylinder part located above the piston (always filled with oil);
2. the cylinder part located under the piston (always filled with oil);
3. the oil reserve, i.e. the compartment between the cylinders (5 and 6) (never completely filled with oil).

During the bouncing stage, i.e. when the shock absorber extends, the oil pushed by the piston (4) passes through the compartment, from the upper part of the piston to the lower part of the cylinder.

During the compression stage, i.e. when the shock absorber lengthens and piston goes downwards, the oil located under the piston passes directly to the upper part of the cylinder.

For oil passing from one part of the piston to the other, a forcing pressure intervenes acting on the piston and opposing piston movement thus causing suspension braking.

Noise

This defect, which is often laid to shock absorbers, can have different origins. It is therefore recommended to inspect suspensions carefully, including shock absorber connections to chassis or leaf spring.

Check whether no shock absorber part is in "metallic" touch with the leaf spring or the chassis.

Shock absorber dust protection distortion, due to wheel rotation, or short oil due to accidental leaks, can cause noise; in this case the shock absorber must be replaced.

Changes in braking effect

A change in the braking effect can take place accidentally.

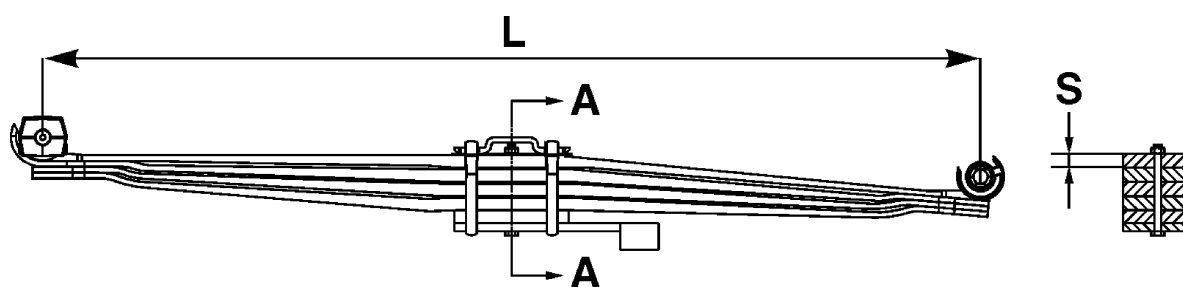
The decrease of the braking effect can be due to breakage of internal parts, short oil or jams.

Replace the shock absorber in any case.

CHARACTERISTICS AND SPECIFICATIONS**Leaf springs**

Vehicle	Type A spring (parabolic)					
	Mounting		Spring characteristics			
	bearing	bush	leafs	thickness [mm]	length [mm]	Flexibility [mm/kN]
2-axle	standard	on request	4	24	1800	3.001
3-axle	standard	on request	4	24	1800	3.001
4-axle	standard	on request	3	26	1600	2.155
1st axle	standard	on request	3	26	1600	2.155
2nd axle	standard	on request	3	26	1600	2.155

Vehicle	Type B spring (semielliptical)					
	Mounting		Spring characteristics			
	bearing	bush	leafs	thickness [mm]	length [mm]	Flexibility [mm/kN]
2-axle	standard	-	10	15	1800	2.679
3-axle	standard	-	10	15	1800	2.679
4-axle	-	-	-	-	-	-
1st axle	-	-	-	-	-	-
2nd axle	-	-	-	-	-	-



1781404

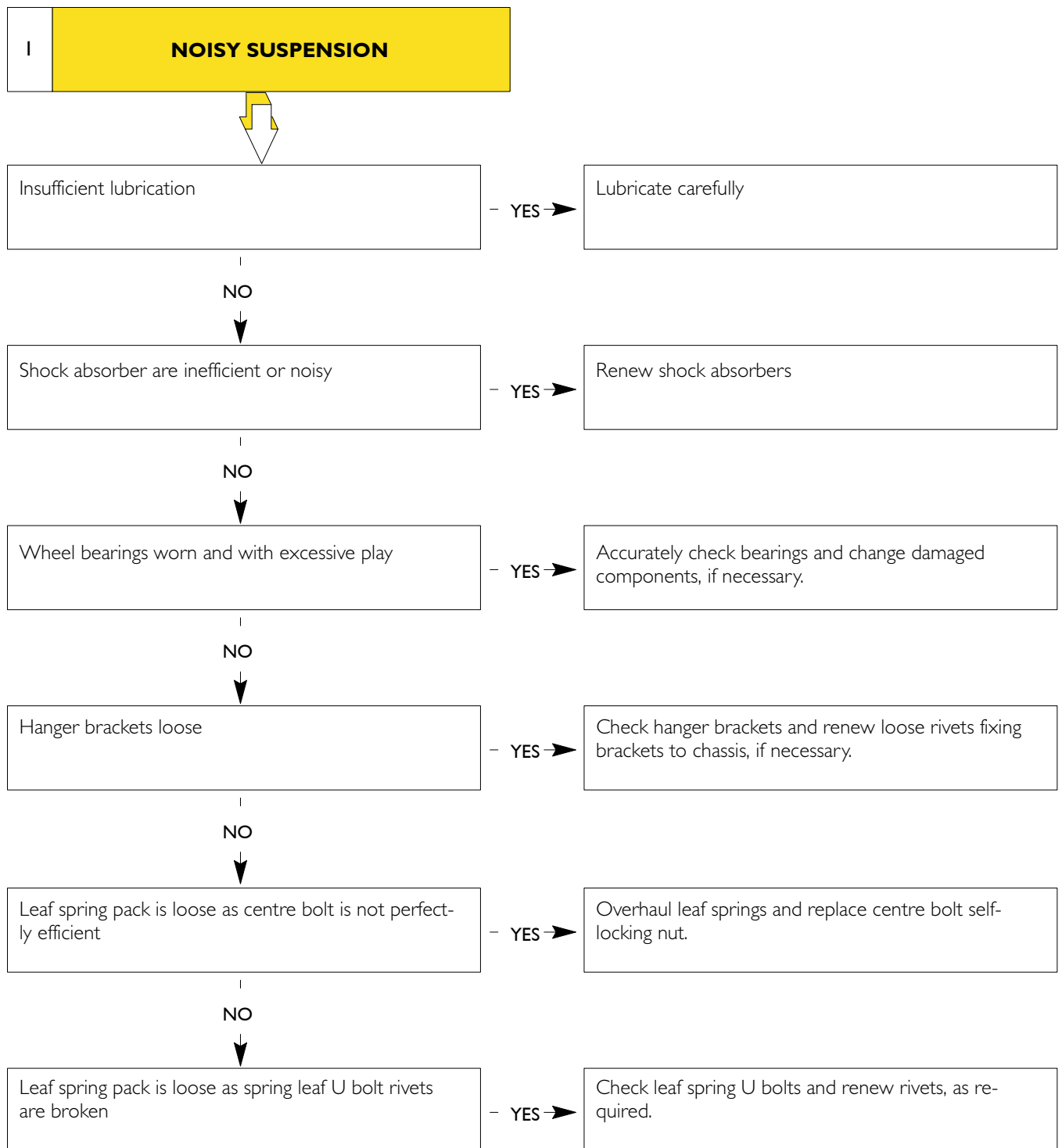
SHOCK ABSORBERS

Vehicle	
open	650 ± 3
closed	427 ± 3
stroke	223

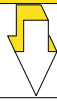
DIAGNOSTICS

Main possible defects:

- | | |
|---|---|
| 1 - Noisy suspension; | 3 - Excessive suspension flexibility; |
| 2 - The vehicle tends to drift to one side; | 4 - Squeaking, knocking and noisiness in general. |



2

THE VEHICLE TENDS TO DRIFT TO ONE SIDE

Tyre pressure incorrect

- YES →

Check and accurately inflate tyres to the prescribed pressure.

NO



Incorrect front wheel geometry

- YES →

Check and correct wheel geometry.

NO



Incorrect front wheel bearing adjustment

- YES →

Adjust bearing play

NO



Inefficient hydraulic shock absorbers

- YES →

Dismantle shock absorbers and service or replace them.

NO



Efficient leaf spring

- YES →

Overhaul the leaf spring and carry out replacements where necessary.

NO



Correct vehicle loading

- YES →

Check the load and arrange it evenly over the loading area.

3

EXCESSIVE SUSPENSION FLEXIBILITY

Spring centre pin broken

- YES →

Replace the part.

NO



Spring leaves inefficient

- YES →

Overhaul the spring and replace those parts which cannot be used or, if necessary, the complete spring.

4

SQUEAKING, KNOCKING AND NOISINESS IN GENERAL

Incorrect fastening of leaf spring mountings

- YES →

Check mountings and if necessary replace the rivets fastening the spring to the frame that are loose.

NO



Leaf spring pack is loose as central fastening pin is broken

- YES →

Overhaul leaf spring and replace central pin and self-locking nut.

NO



Leaf spring pack is loose as fixing rivets for spring U bolts are not efficient

- YES →

Check leaf spring locking U bolts and change fixing rivets.

NO



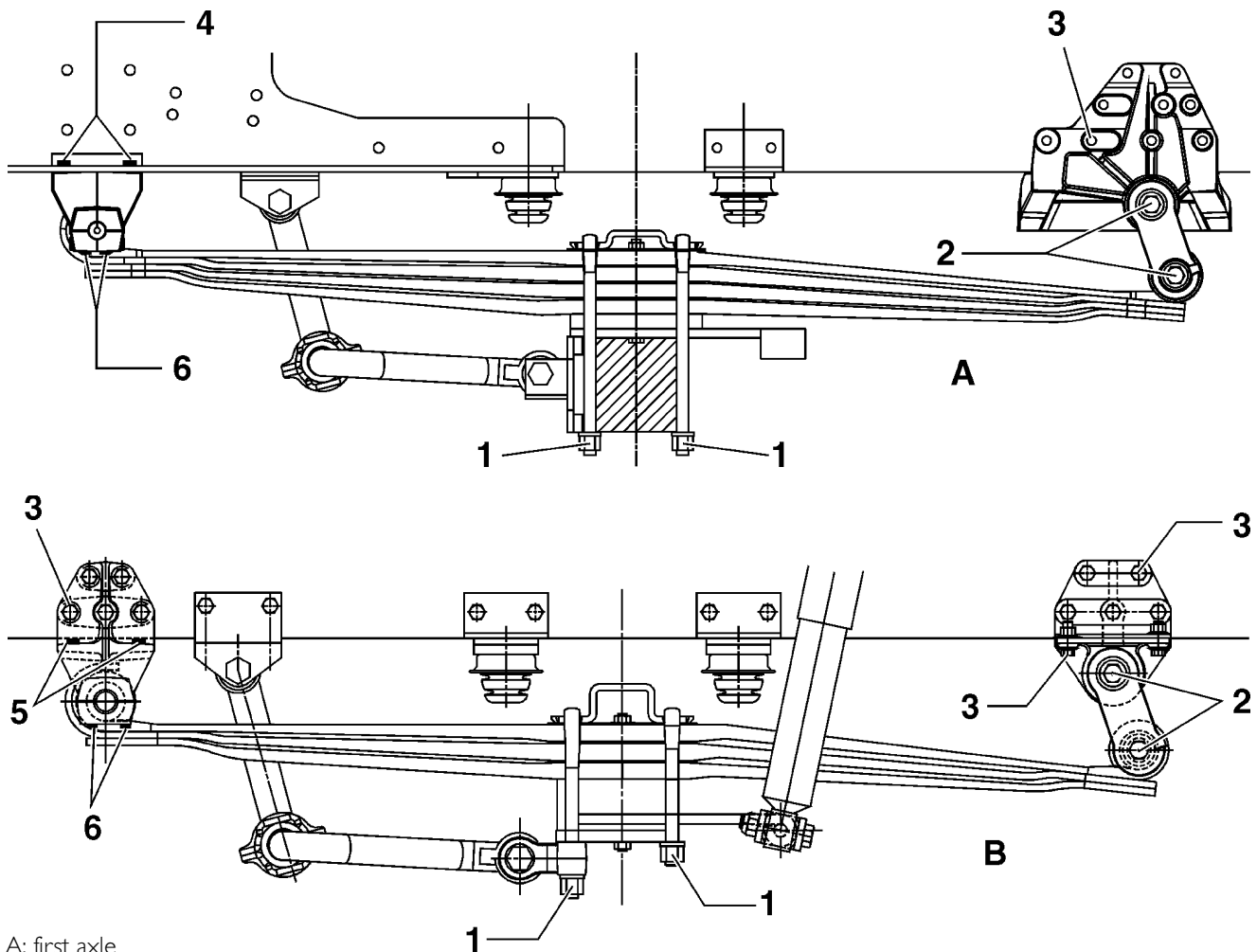
Wheel bearings worn with excessive play

- YES →

Carefully check the bearings and, if necessary, replace any damaged parts.
Adjust the wheel bearing play.

TIGHTENING TORQUES

Figure 4



A: first axle
B: second axle

1781405

PART	TORQUE	
	Nm	(Kgm)
1. Leaf spring retaining stirrup nuts	485	49
2. Shackle pin fastening bolts	625	64
3. Shackle screws on chassis	190	19
4. First axle front mounting screws	210	21
5. Second axle front mounting screws	150	15
6. Leaf spring pin cap fastening screws	130	13

TOOLS

TOOL NO.	DESCRIPTION
99306064	Trolley for leaf spring support during removal-replacement
99321024	Trolley for wheel removal

LEAF SPRING REMOVAL-REPLACEMENT (AXLE)

Removal

To remove one of the front leaf springs, proceed as follows:

- ☐ Park the vehicle in a flat area and lock the rear wheels;
- ☐ Loosen the wheel nuts of the corresponding front wheel;
- ☐ Lift the front of the vehicle with a hydraulic jack and rest it on the two support stands;
- ☐ Remove the front wheel;
- ☐ Remove the stabiliser bar bolts (7) from both sides of the axle end and rotate it downwards;
- ☐ Unscrew the shock absorber nut (8);
- ☐ Unscrew the front leaf spring mounting (2) lower cap screws (1);

- ☐ Remove the upper and lower leaf spring shackle plate bolts (3);
- ☐ Remove the spring anchor plates (4);
- ☐ Unscrew the nuts (9) and remove the leaf spring fastening stirrup (10);
- ☐ Lower the axle with the hydraulic jack in order to remove the centring pin and extract the leaf spring.

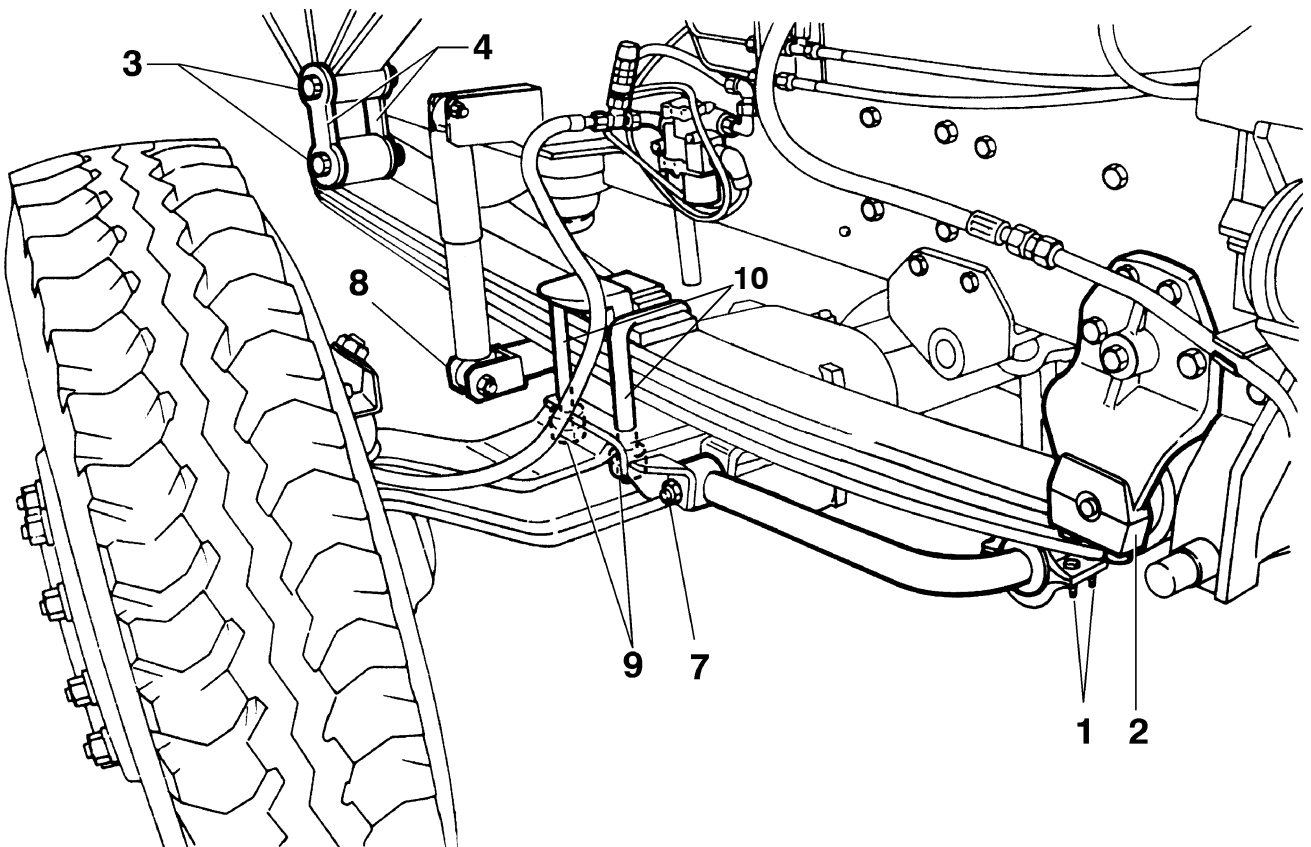
Replacement

Repeat the removal operations in reverse order.



Once the springs are replaced, carry out wheel the convergence check described in Section 15.

Figure 5



LEAF SPRING REMOVAL-REPLACEMENT (DRIVE AXLE)

Removal

To remove one of the front leaf springs, proceed as follows:

- ☐ Park the vehicle in a flat area and lock the rear wheels
- ☐ Loosen the wheel nuts of the corresponding front wheel
- ☐ Lift the front of the vehicle with a hydraulic jack and rest it on the two support stands
- ☐ Remove the front wheel
- ☐ Remove the stabiliser bar bolts (7) from both sides of the axle side and rotate it downwards
- ☐ Unscrew the shock absorber nut (8)
- ☐ Unscrew the front leaf spring mounting (2) lower cap screws (1)

- ☐ Remove the upper and lower leaf spring shackle plate bolts (3)
- ☐ Remove the spring anchor plates (4)
- ☐ Remove the spring anchor plates (4)
- ☐ Unscrew the nuts (9) and remove the leaf spring fastening stirrup (10)
- ☐ Lower the axle with the hydraulic jack in order to remove the centring pin and extract the leaf spring.

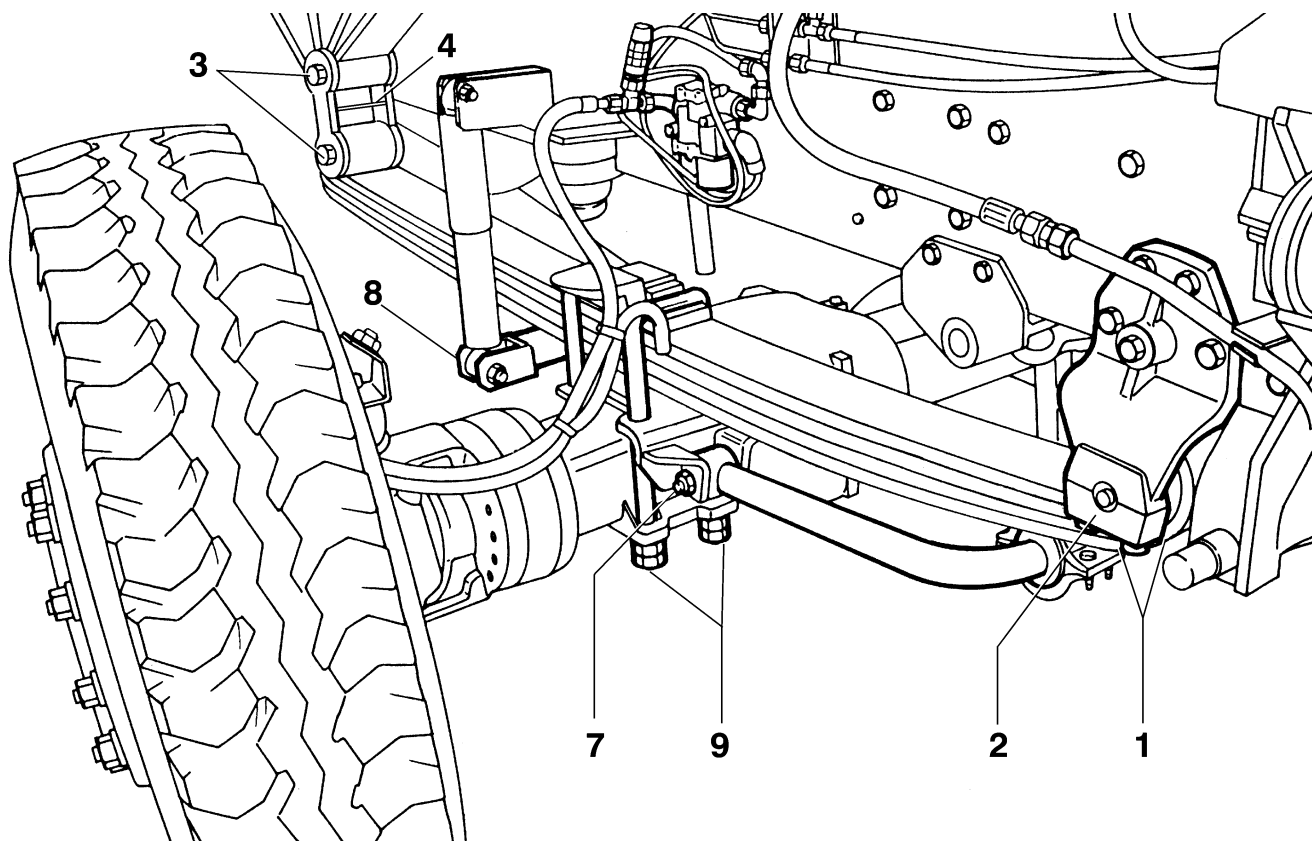
Replacement

Repeat the removal operations in reverse order



Once the springs are replaced, carry out wheel the convergence check described in Section 15.

Figure 6



REPAIR OPERATIONS



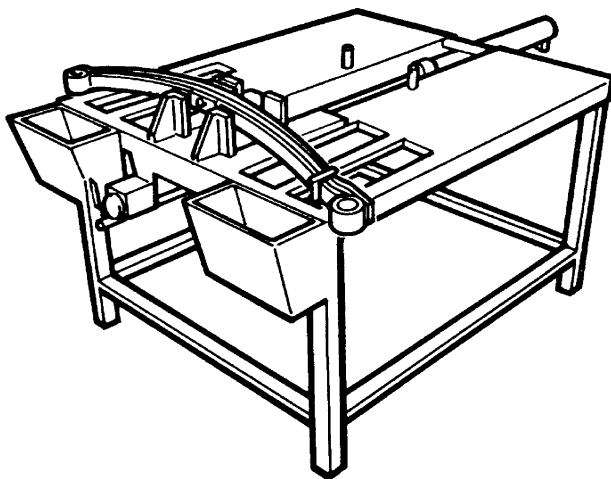
Leaves are not to be replaced if the faulty spring is made up of less than three leaves.



The remaining leaves of the faulty spring that need not be replaced must not have visible scores or any shape deformation that could compromise the conformity to the working drawing.

Removing the rear leaf spring

Figure 7



38745



Set the leaf spring in the vice on the bench (15) clamping it near the central pin. Remove the relevant nut and withdraw the central coupling pin. Unscrew the nuts that lock the side brackets then remove the brackets. The individual leaves that make up the leaf spring will now be free.

Checks



Use diesel or a suitable solvent to clean all the components.

Fitting in place the leaf spring



Ensure that the leaf contact surfaces are perfectly clean and smooth.



Place together the leaves that form the pack, setting the relevant spacers between them and aligning the central holes for the insertion of the coupling pin.



Lock the leaves between the vice clamps and insert the central pin into the side coupling clips, and locking with the relevant nut.

The clips must be locked so that they keep the leaves aligned, but without obstructing the movement. After assembly, use a punch to fit the central pin and clip pins so that they are securely locked.



At every overhaul operation the spring centre pin and the side clip pins and nuts are always to be replaced.



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REAR SUSPENSIONS

SECTION 14.2

SECTION 14.2

Rear suspensions

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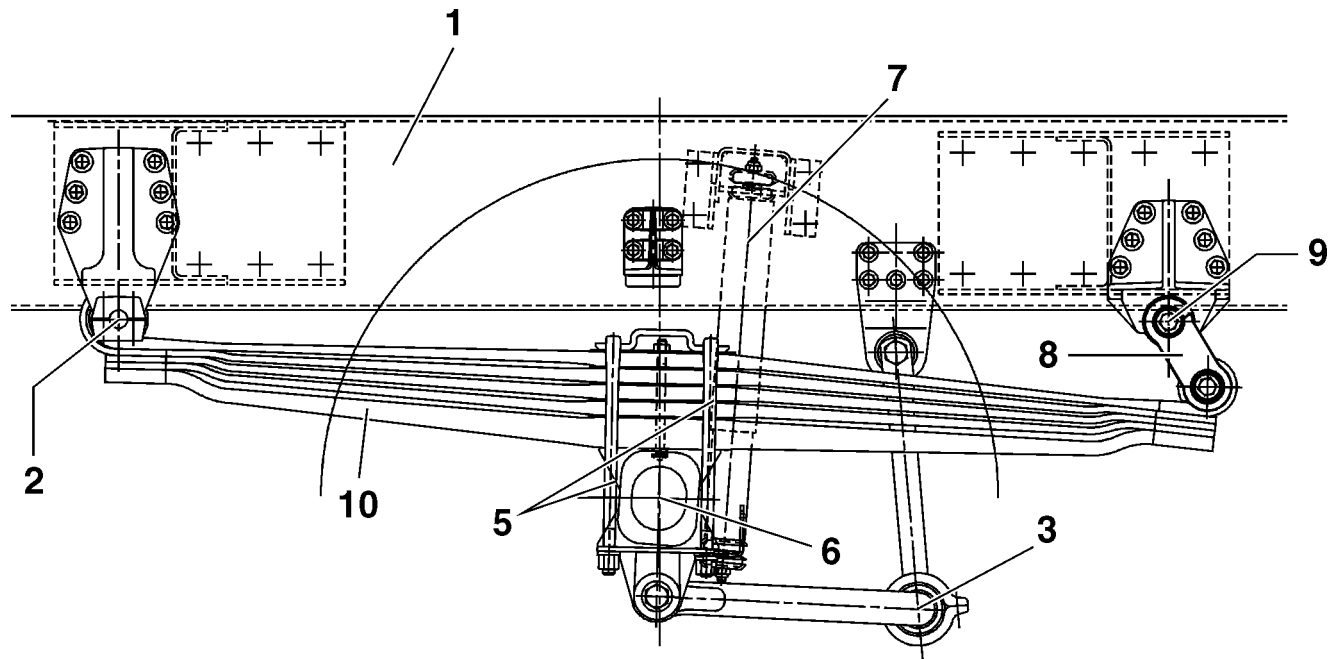
DESCRIPTION**2-axle vehicle suspension**

The suspension system is comprised of a pair of longitudinally arranged single action leaf springs.

It is supplemented by a pair of dual action hydraulic telescope shock absorbers.

The suspension is also fitted with a roll bar to control vehicle inclination when cornering.

Figure 1



1781410

- 1 - Chassis. - 2. Spring front mounting. - 3. Roll bar. - 4. Not used. - 5. Anchor stirrups. - 6. Drive shaft or axle. - 7. Shock absorber. - 8. Shackle. - 9. Spring rear mounting. - 10 Spring.

3 and 4-axle vehicle suspension

The suspension system is comprised of a pair of longitudinally arranged single action leaf springs, which serve both axles of the tandem.

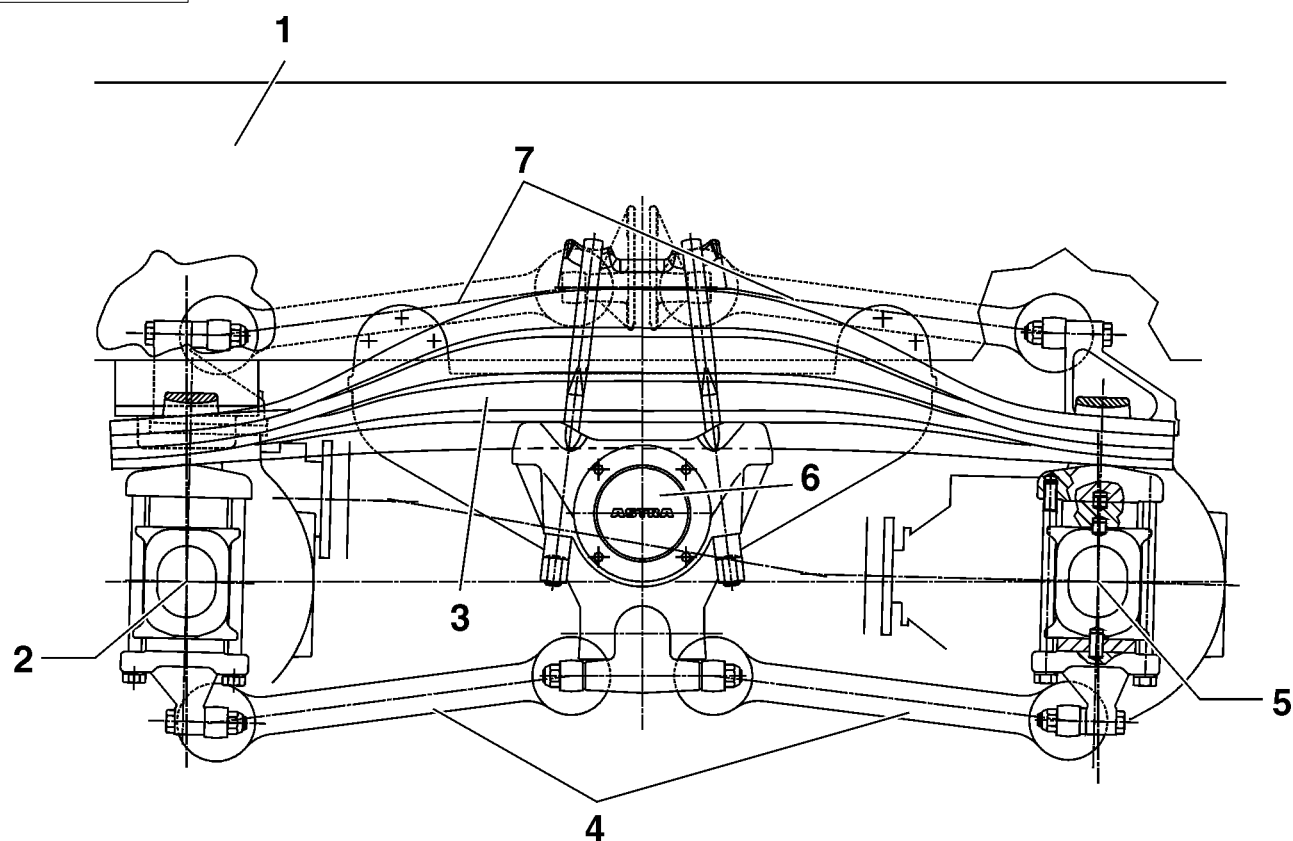
The spring oscillates around a central pin, and the extremities of the springs slide on the axles themselves.

The suspension also has reaction bars between the axles and a central support for axial thrust control in braking and acceleration.

There are two possible types of leaf spring:

- ☐ Type A, parabolic spring, standard.
- ☐ Type B, semi-elliptical spring, on request.

Figure 2

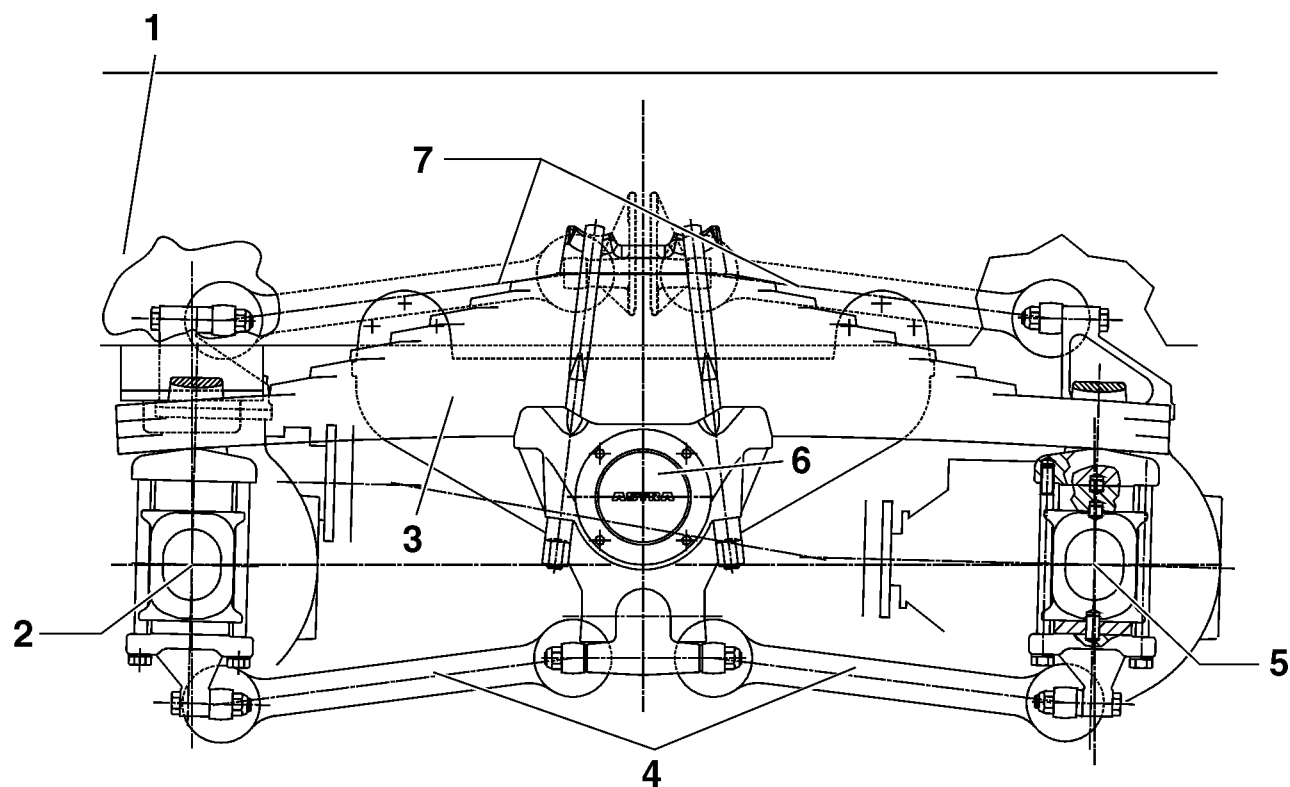


1781411

Type A leaf springs (parabolic)

- 1 - Chassis. - 2. Front tandem axle. - 3. Spring. - 4. Lower reaction bars. - 5. Rear tandem axle. - 6. Centre carriage. - 7. Upper reaction bars.

Figure 3



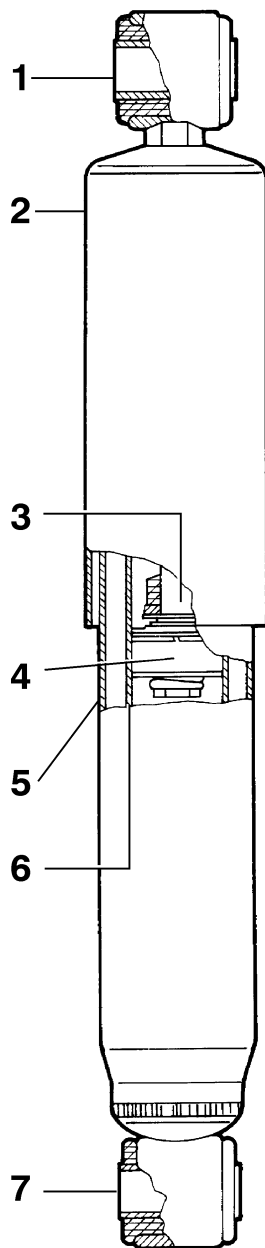
1781411

Type B leaf springs (semielliptical)

1 - Chassis. - 2. Front tandem axle. - 3. Spring. - 4. Lower reaction bars. - 5. Rear tandem axle. - 6. Centre carriage. - 7. Upper reaction bars

Hydraulic shock absorbers

Figure 4



The hydraulic shock absorbers are of the telescopic double acting type.

These shock absorbers are also defined "direct acting" since their braking action is directly performed on the suspension elements without levers.

They are fitted with thermostatically controlled valves, thus ensuring that there are no noticeable differences in their performance, even following sharp changes in temperature.

Shock absorbers are divided into three different parts:

1. the cylinder part located above the piston (always filled with oil);
2. the cylinder part located under the piston (always filled with oil);
3. the oil reserve, i.e. the compartment between the cylinders (5 and 6) (never completely filled with oil).

During the bouncing stage, i.e. when the shock absorber extends, the oil pushed by the piston (4) passes through the compartment, from the upper part of the piston to the lower part of the cylinder.

During the compression stage, i.e. when the shock absorber lengthens and piston goes downwards, the oil located under the piston passes directly to the upper part of the cylinder.

For oil passing from one part of the piston to the other, a forcing pressure intervenes acting on the piston and opposing piston movement thus causing suspension braking.

Noise

This defect, which is often laid to shock absorbers, can have different origins. It is therefore recommended to inspect suspensions carefully, including shock absorber connections to chassis or leaf spring.

Check whether no shock absorber part is in "metallic" touch with the leaf spring or the chassis.

Shock absorber dust protection distortion, due to wheel rotation, or short oil due to accidental leaks, can cause noise; in this case the shock absorber must be replaced.

Changes in braking effect

A change in the braking effect can take place accidentally.

The decrease of the braking effect can be due to breakage of internal parts, short oil or jams.

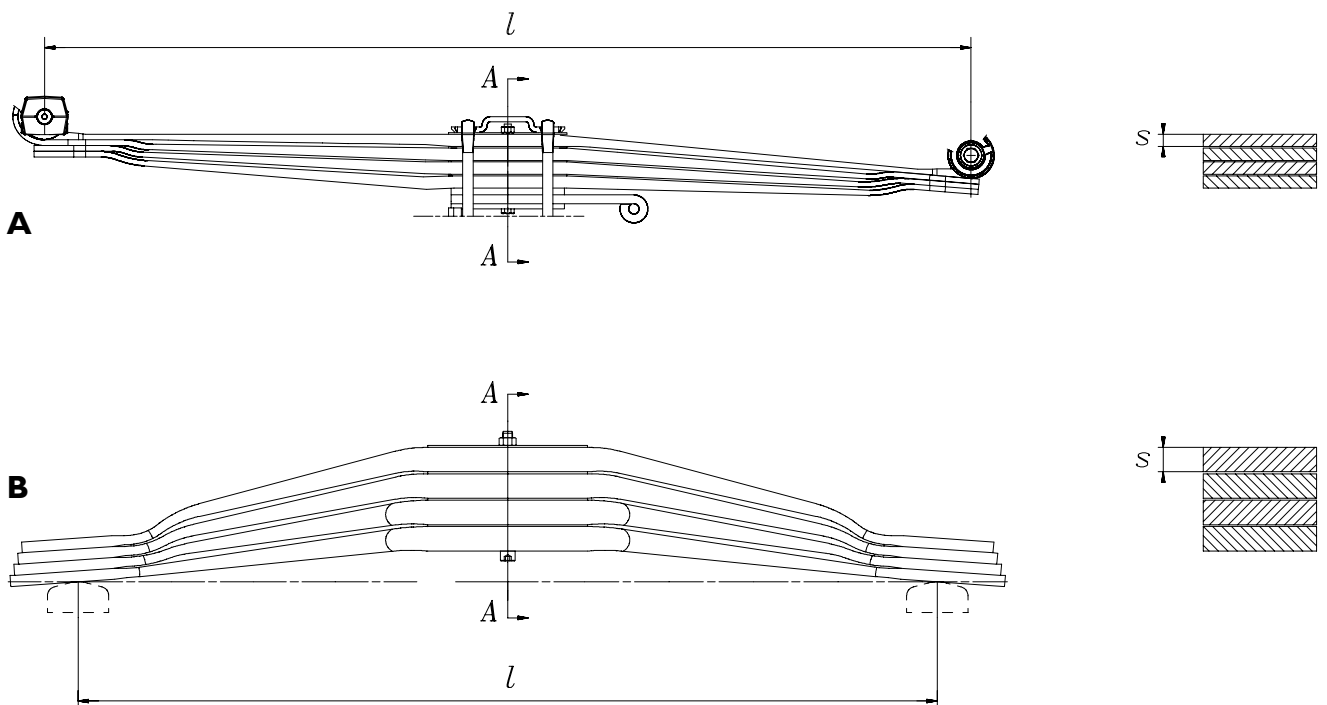
Replace the shock absorber in any case.

SPECIFICATIONS AND DATA

Leaf springs

Vehicle	Type A spring (parabolic)					
	Mounting		Spring characteristics			
	bearing	bush	leafs	thickness [mm]	length [mm]	Flexibility [mm/kN]
2-axle	standard	on request	4	24	1800	0.865
			1	50		
3-axle	-	-	4	40	1400	0.228
4-axle	-	-	4	40	1400	0.228

Vehicle	Type B spring (semielliptical)					
	Mounting		Spring characteristics			
	bearing	bush	leafs	thickness [mm]	length [mm]	Flexibility [mm/kN]
2-axle	-	-	-	-	-	-
3-axle	-	-	10	25	1400	0.229
4-axle	-	-	1400	25	1400	0.229



A: 2-axle

B: 3 and 4-axle

1781404B

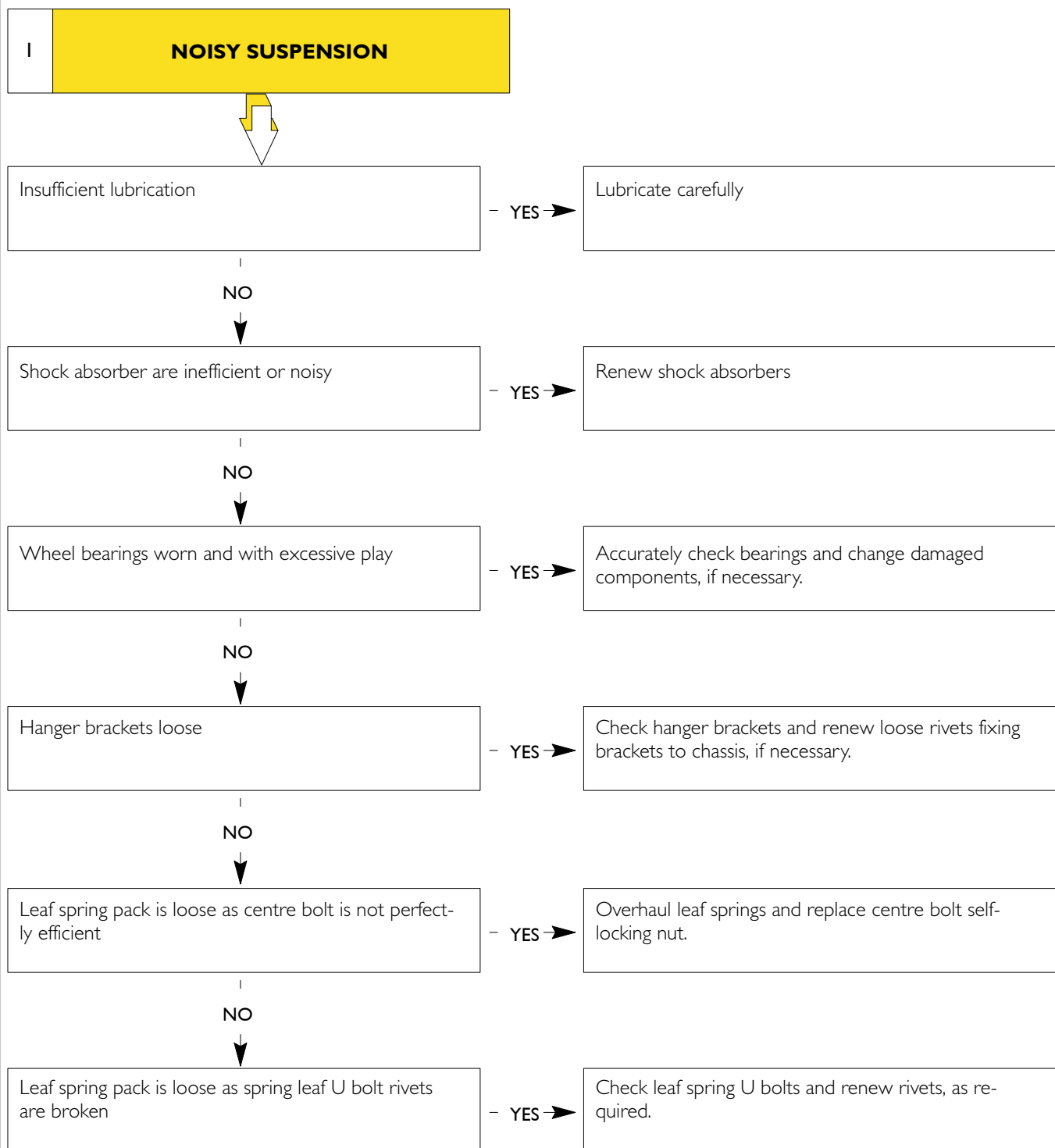
SHOCK ABSORBERS

Vehicle	
open	650 ± 3
closed	427 ± 3
stroke	223

DIAGNOSTICS

Main possible defects:

- | | |
|--|--|
| <ul style="list-style-type: none"> 1 - Noisy suspension; 2 - The vehicle tends to drift to one side: | <ul style="list-style-type: none"> 3 - Excessive suspension flexibility; 4 - Squeaking, knocking and noisiness in general. |
|--|--|



2

THE VEHICLE TENDS TO DRIFT TO ONE SIDE

Tyre pressure incorrect

- YES →

Check and accurately inflate tyres to the prescribed pressure.

NO



Incorrect front wheel geometry

- YES →

Check and correct wheel geometry.

NO



Incorrect front wheel bearing adjustment

- YES →

Adjust bearing play

NO



Inefficient hydraulic shock absorbers

- YES →

Dismantle shock absorbers and service or replace them.

NO



Efficient leaf spring

- YES →

Overhaul the leaf spring and carry out replacements where necessary.

NO



Correct vehicle loading

- YES →

Check the load and arrange it evenly over the loading area.

3

EXCESSIVE SUSPENSION FLEXIBILITY

Spring centre pin broken

- YES →

Replace the part.

NO



Spring leaves inefficient

- YES →

Overhaul the spring and replace those parts which cannot be used or, if necessary, the complete spring.

4

SQUEAKING, KNOCKING AND NOISINESS IN GENERAL

Incorrect fastening of leaf spring mountings

- YES →

Check mountings and if necessary replace the rivets fastening the spring to the frame that are loose.

NO



Leaf spring pack is loose as central fastening pin is broken

- YES →

Overhaul leaf spring and replace central pin and self-locking nut.

NO



Leaf spring pack is loose as fixing rivets for spring U bolts are not efficient

- YES →

Check leaf spring locking U bolts and change fixing rivets.

NO



Wheel bearings worn with excessive play

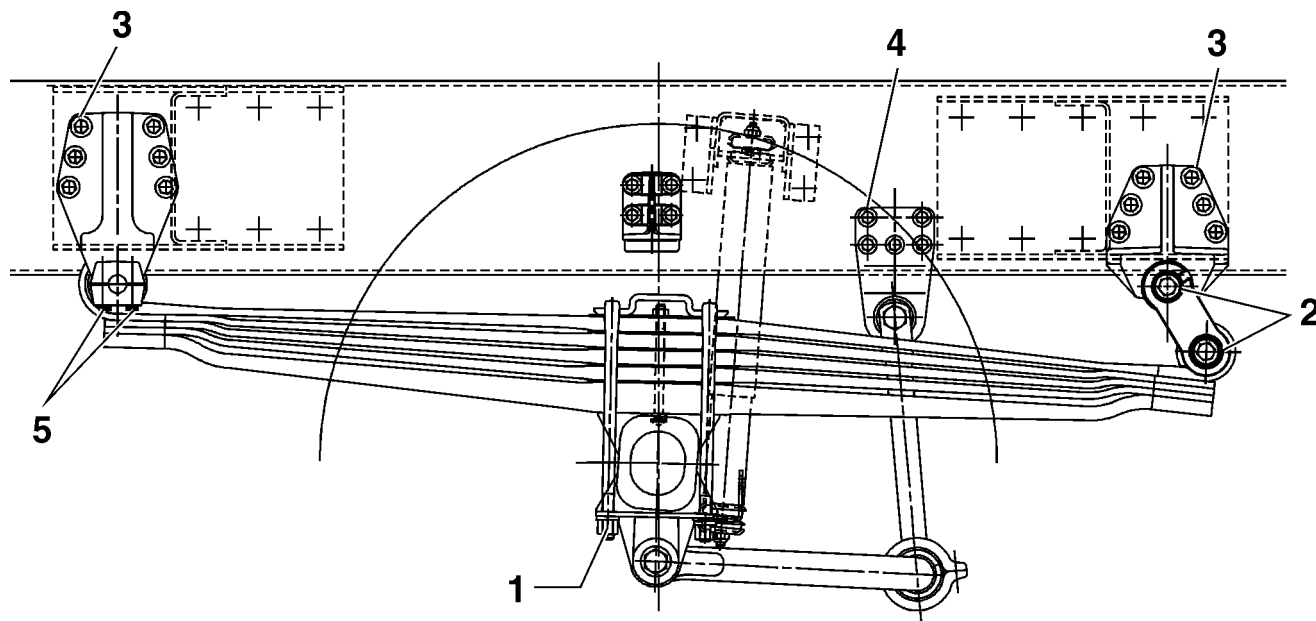
- YES →

Carefully check the bearings and, if necessary, replace any damaged parts.
Adjust the wheel bearing play.

TIGHTENING TORQUES

2-axle vehicles

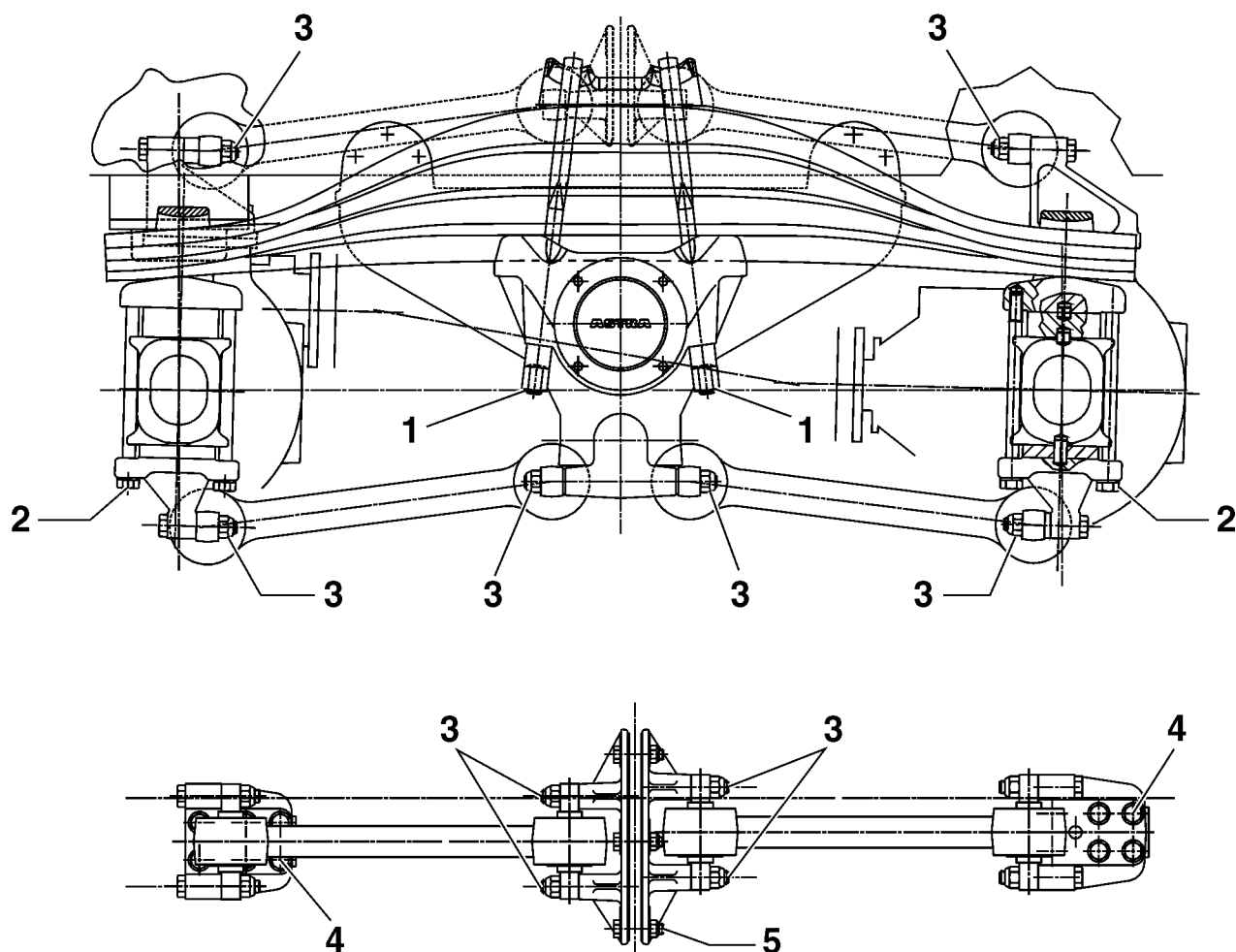
Figure 5



1781413

Front suspension

PART	TORQUE	
	Nm	(Kgm)
1. Leaf spring retaining stirrup nuts	485	50
2. Shackle pin fastening bolts	625	65
3. Spring mounting screws on chassis	310	32
4. Roll bar mounting screws	180	19
5. Leaf spring pin cap fastening screws	130	13,5

3 and 4-axle vehicles**Figure 6**

1781414

Front suspension

PART	TORQUE	
	Nm	(Kgm)
1. Leaf spring retaining stirrup nuts	855	88
2. Retaining stirrup bolts at axle	390	40
3. Reaction bar fastening bolts	600	62
4. Reaction bar screws on chassis	380	39
5. Central reaction bar fastening bolts	250	25.5

TOOLS

TOOL NO.	DESCRIPTION
99306064	Trolley for leaf spring support during removal-replacement
99321024	Trolley for wheel removal
0/72512	Oscillating central carriage locking ring pre-assembly support

LEAF SPRING REMOVAL-REPLACEMENT (2-axle vehicles)**Removal**

To remove one of the rear leaf springs, proceed as follows:

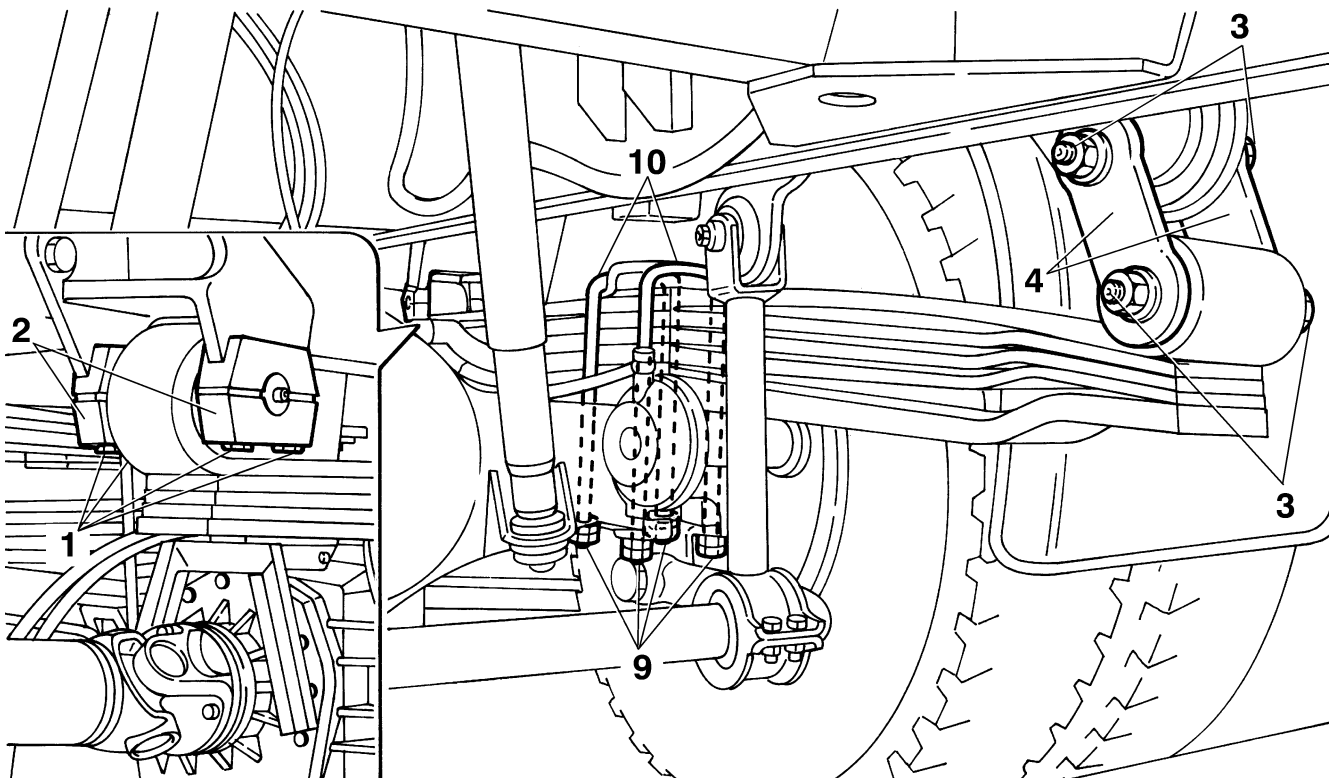
- ☐ Park the vehicle in a flat area and lock the front wheels
- ☐ Loosen the wheel nuts of the corresponding rear wheel
- ☐ Lift the front of the vehicle with a hydraulic jack and rest it on the two support stands
- ☐ Remove the rear wheel
- ☐ Unscrew the leaf spring front mounting (2) lower cap screws (1)

- ☐ Remove the upper and lower leaf spring shackle plate bolts (3)
- ☐ Remove the spring anchor plates (4)
- ☐ Unscrew the nuts (9) and remove the leaf spring fastening stirrup (10)
- ☐ Lower the axle with the hydraulic jack in order to remove the centring pin and extract the leaf spring.

Replacement

Repeat the removal operations in reverse order

Figure 7



REMOVING - REFITTING THE LEAF SPRING (3-axle and 4-axle vehicles)

Removal

To remove the leaf spring proceed as follows:

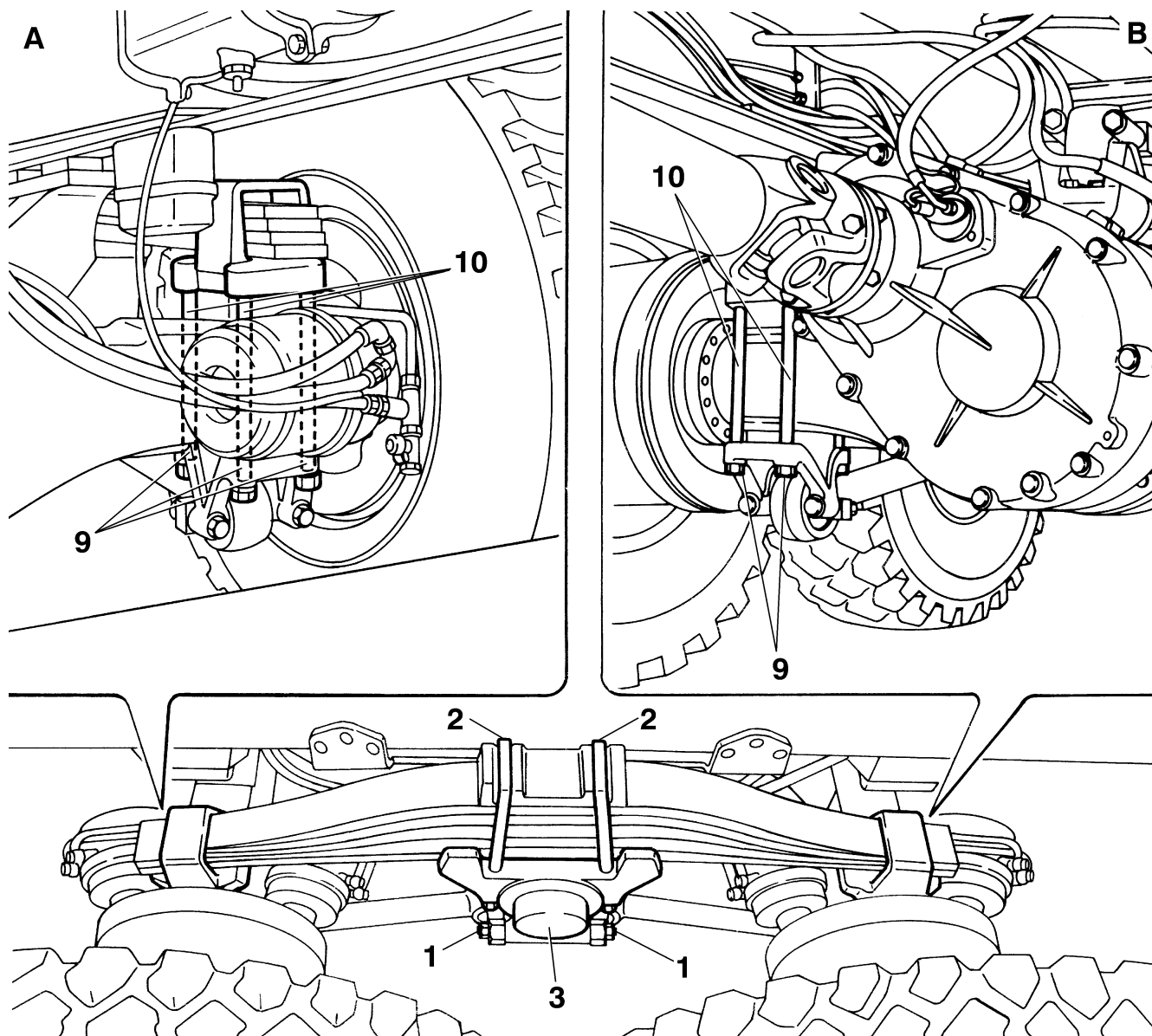
- ☐ place the vehicle on a flat ground and suitably lock the front wheels;
- ☐ loosen rear wheel fastening nuts on the side of the leaf spring to be replaced;
- ☐ using a hydraulic jack lift the rear part of the vehicle (side of leaf spring to be replaced) and rest it on two stands;
- ☐ remove both rear wheels;

- ☐ unscrew nuts (9) and lift leaf spring fixing brackets (10) on rear axle (A) and intermediate axle (B);
- ☐ unscrew nuts (1) and take away the brackets (2) fixing the leaf spring to the floating support (3);
- ☐ operate the hydraulic jack and lower the rear axle to take away the dowel and remove the leaf spring by suitable movements.

Replacement

To refit, follow the removal operations in reverse order.

Figure 8



REPAIR OPERATIONS



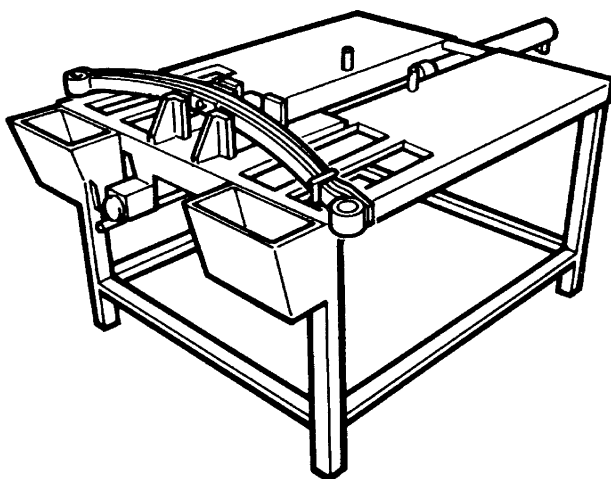
Leaves are not to be replaced if the faulty spring is made up of less than three leaves.



The remaining leaves of the faulty spring that need not be replaced must not have visible scores or any shape deformation that could compromise the conformity to the working drawing.

Removing the rear leaf spring

Figure 9



38745



Set the leaf spring in the vice on the bench (15) clamping it near the central pin. Remove the relevant nut and withdraw the central coupling pin. The individual leaves that make up the leaf spring will now be free.

Checks



Use diesel or a suitable solvent to clean all the components.

Fitting in place the leaf springs



Ensure that the leaf contact surfaces are perfectly clean and smooth.



Place together the leaves that form the pack, setting the relevant spacers between them and aligning the central holes for the insertion of the coupling pin.



Lock the leaves between the vice clamps and insert the central pin into the side coupling clips, and locking with the relevant nut.

After assembly, use a punch to fit the central pin and clip pins so that they are securely locked.

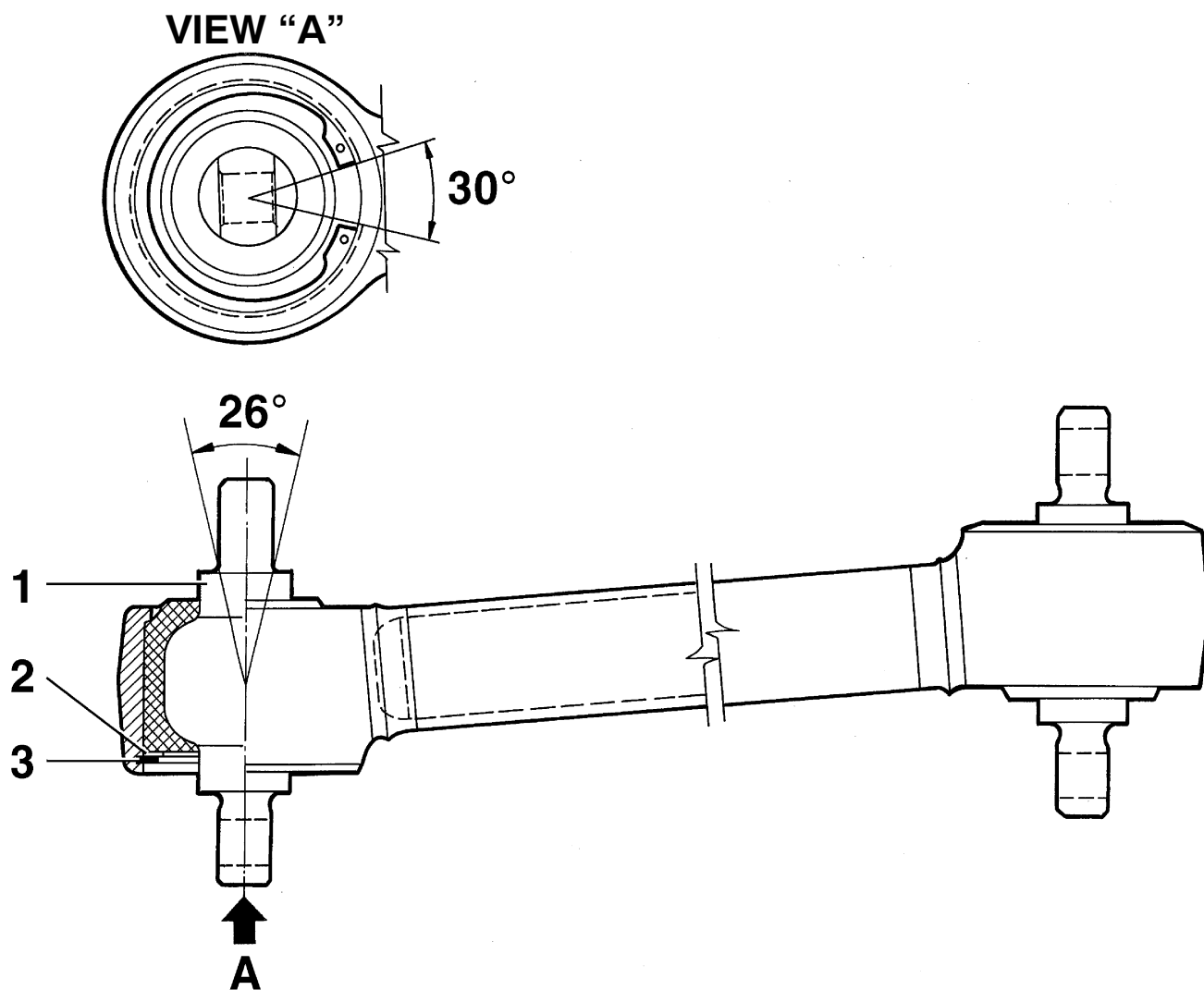


At every overhaul operation the spring centre pin with related absorber nut.



REPLACING THE FLOATING ARM PIN (3-axle and 4-axle vehicles)

Figure 10

**Removal**

With a press and a suitable beater compress the flexible part of the pin (1) to enable the removal of the split ring (3) and the ring (2) underneath with the relevant pliers. Remove the pin (1) from the floating arm.

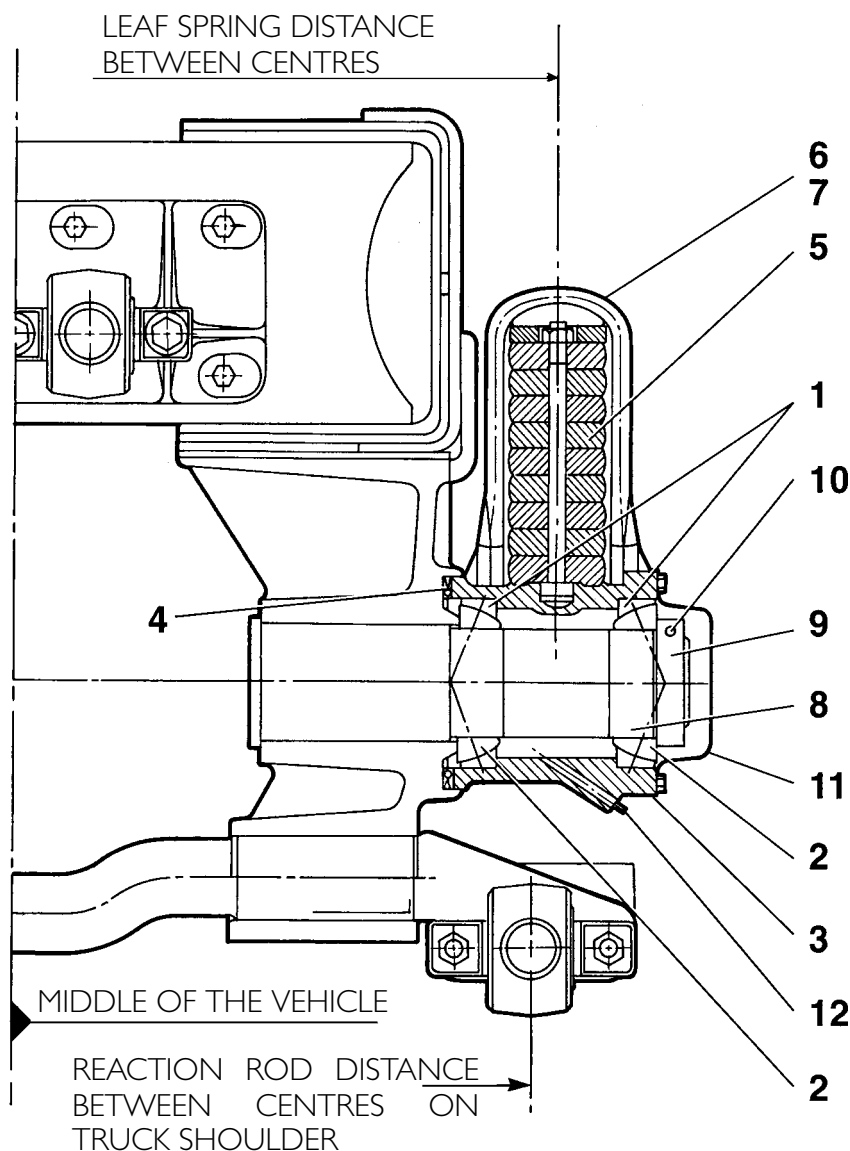
Fitting in place

Reverse the removal instructions but remember that the flexible pin (1) contact surface must be 90° from the floating arm longitudinal axis and the split ring opening (3) is to be positioned as shown in the figure detail.

REFITTING AND ADJUSTING THE FLOATING SUPPORT (3-axle and 4-axle vehicles)

- ☐ put the races (1) of the ball supports (2) on the floating support (3) and fit the sealing gasket (4);
- ☐ fit the leaf spring (5) on the floating support and tighten gradually and evenly the leaf spring fixing brackets (6 and 7) to the required torque;
- ☐ set internal ball support race (2) on truck pin (8), fit the floating support and set the external ball support race (2) on truck pin. Both ball support races must be hot-assembled (Temp. =80° - 100°);
- ☐ take service ring nut (9) (tool 0/72511 for 1st type truck pin, tool 0/72512 for 2nd type truck pin), and tighten it to remove floating support end play;
- ☐ replace the service ring nut with the clamp ring nut, put it in touch with the floating support and then loosen it $18 \pm 3^\circ$, check whether the end play is 0.1 ± 0.05 mm;
- ☐ ring nut (9) must be fitted with strong thread-locker extra-quick LOCTITE 270. (Extra-quick LOCTITE 601 as an alternative);
- ☐ the floating support must be rotated manually, otherwise the above operations shall be repeated;
- ☐ tighten ring nut screw (10) to 32 Nm torque. Screw (10) must be fitted with average thread-locker extra-quick LOCTITE 242. Fit the cap (11) filled with grease, then grease using the grease nipple (12) until grease is coming out from the sealing gasket (4)

Figure 11



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STEERING SYSTEM

SECTION 15

SECTION 15

Steering system

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DESCRIPTION**2-axle and 3-axle vehicles**

The provided steering system is of the power steering type.

Purpose of this type of system is to reduce the driver's efforts on the steering wheel to obtain vehicle steering.

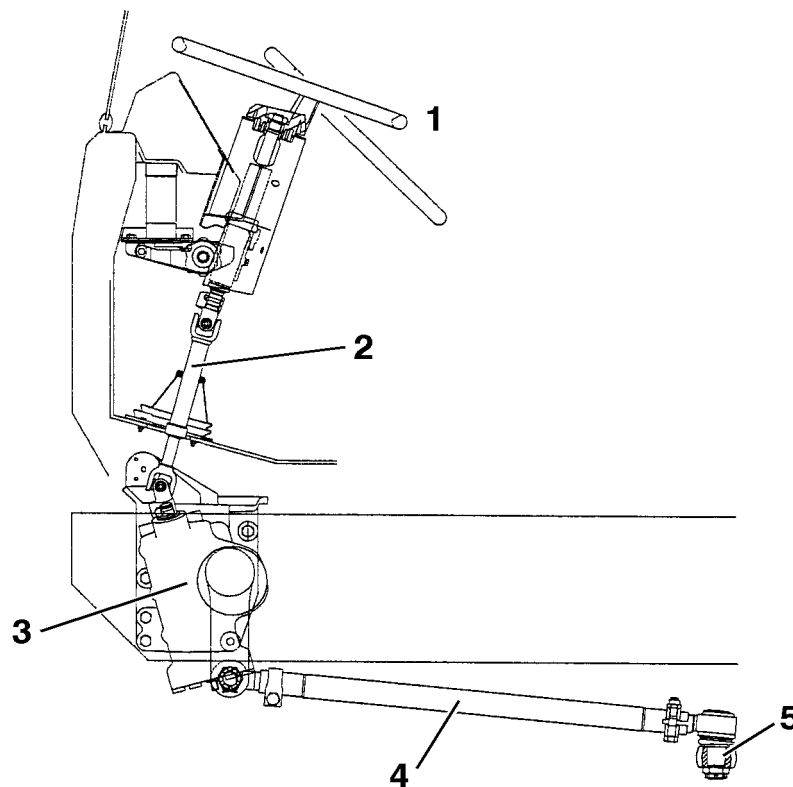
The steering wheel (500 mm diameter) operates the ZF power steering, which performs a direct mechanical connection with

the steering lever on the left wheel hub which operates the right-hand wheel through the quadrilateral steering links.

The power steering is controlled by a pump fitted on the engine and supplied by a tank.

A pressure relief valve protects the system against excess pressure.

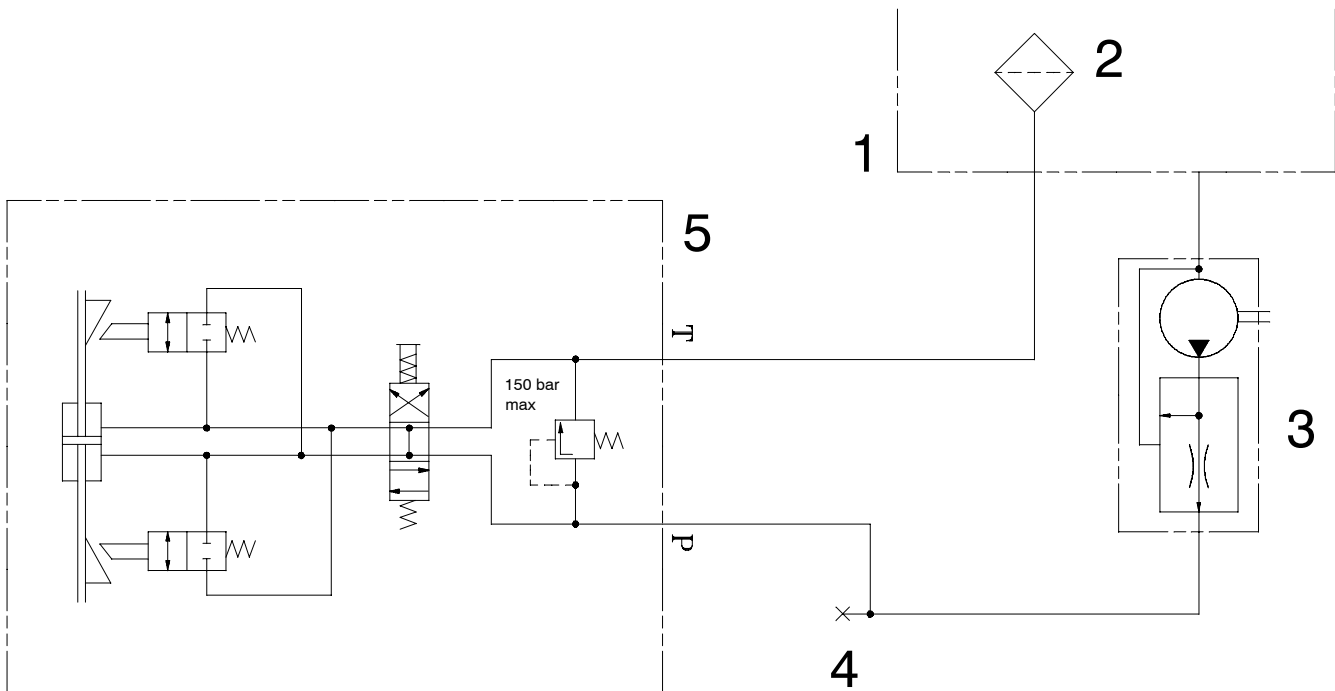
Figure 1



1. Steering wheel - 2. Steering column - 3. Steering box - 4. Steering link - 5. Steering knuckle lever head

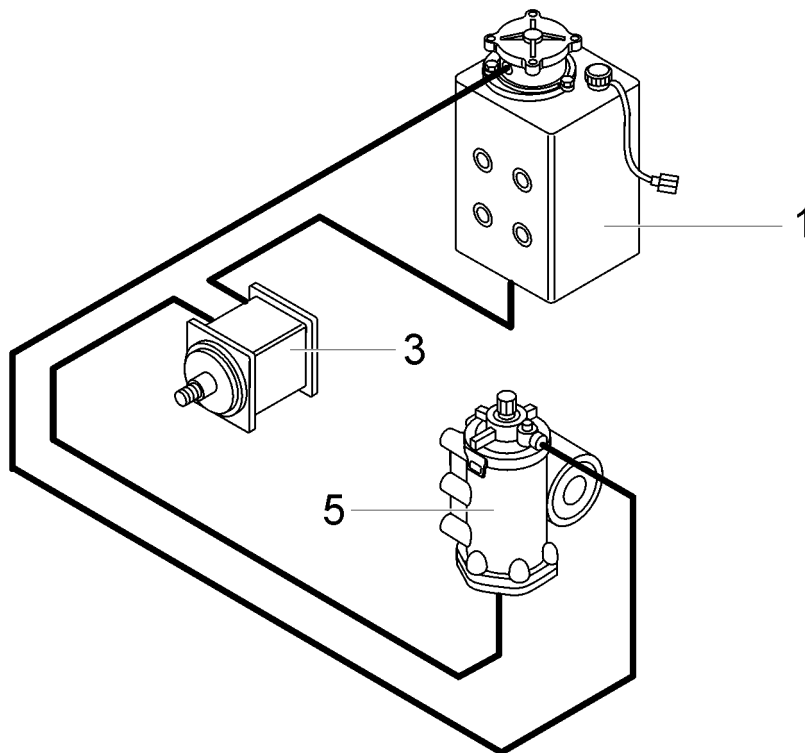
2 and 3-axle vehicle hydraulic servosteering system

Diagram



1781509

Illustration



1. Reservoir. - 2. Filter. - 3. Pump. - 4. Tester connection. - 5. Servosteering unit.

1781508

4-axle vehicles

The provided steering system is of the power steering type.

Purpose of this type of system is to reduce the driver's efforts on the steering wheel to obtain vehicle steering.

Mechanical steering, hydraulically assisted, operating on 1st and 2nd axle wheels.

The steering wheel (500 mm diameter) operates the ZF power steering, which performs a direct mechanical connection with the steering lever on the left wheel hub of the 1st axle and, through transmission, with the steering lever on the left wheel hub of the 2nd axle which operate the other two wheels by means of the two quadrilateral steering links.

This operation is assisted by two hydraulic cylinders:

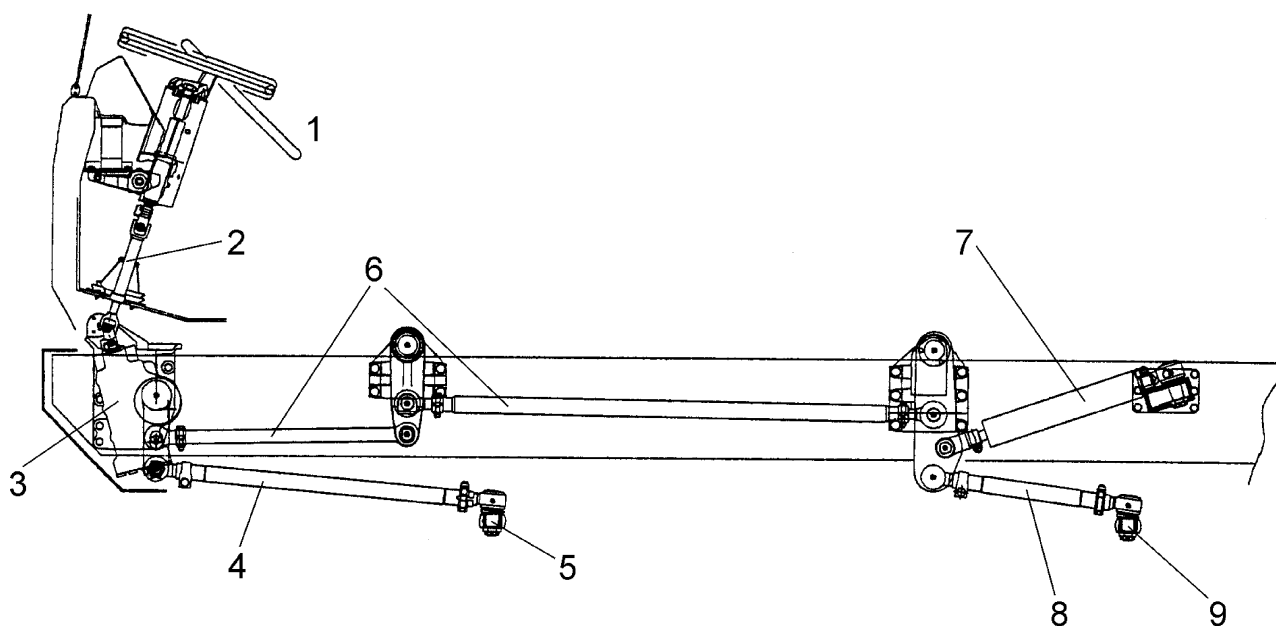
- ☐ the first cylinder is housed in the power steering and works on the first axle;
- ☐ the second cylinder is fitted separately and works on the second axle.

The power steering is controlled by two main pumps fitted on the engine and one emergency pump fitted on transmission.

The system is provided with two tanks connected with each other and feeding the three pumps.

A pressure relief valve protects the system against excess pressure.

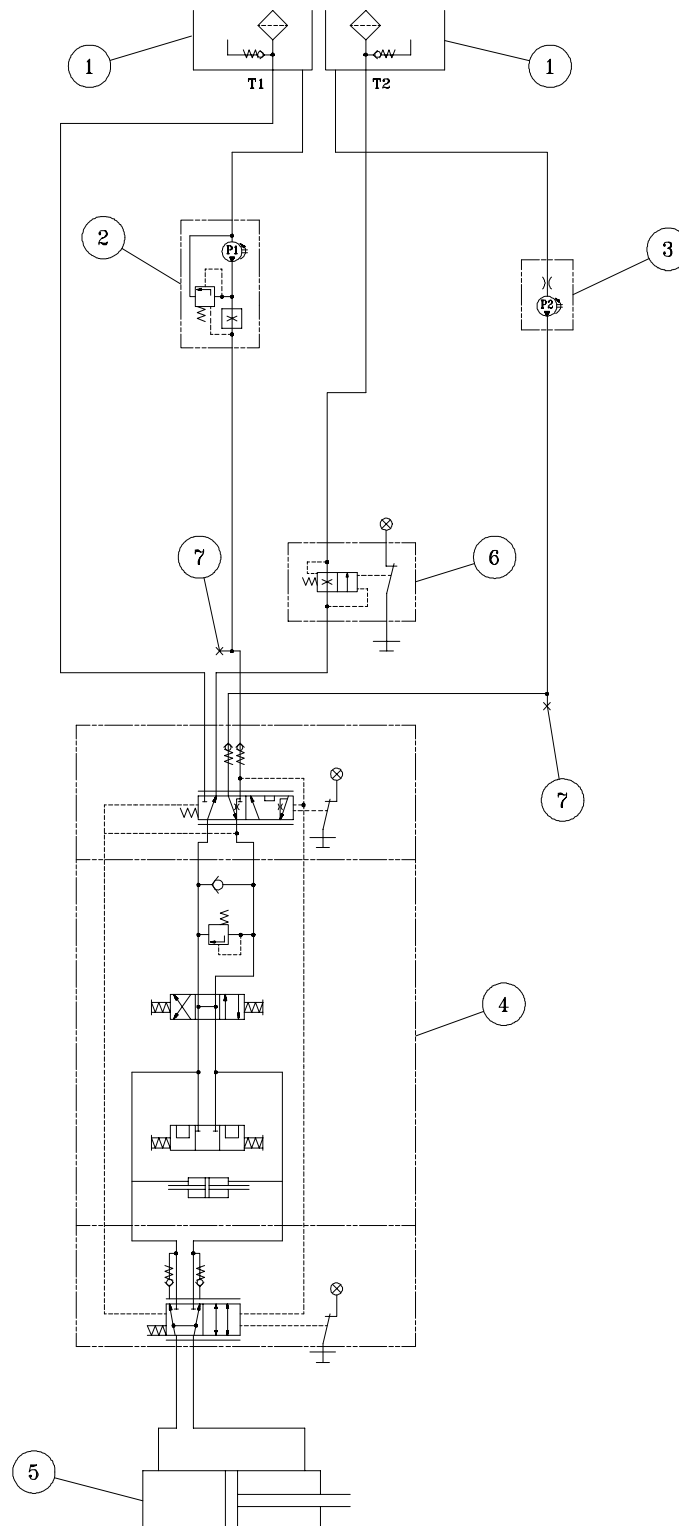
Figure 2



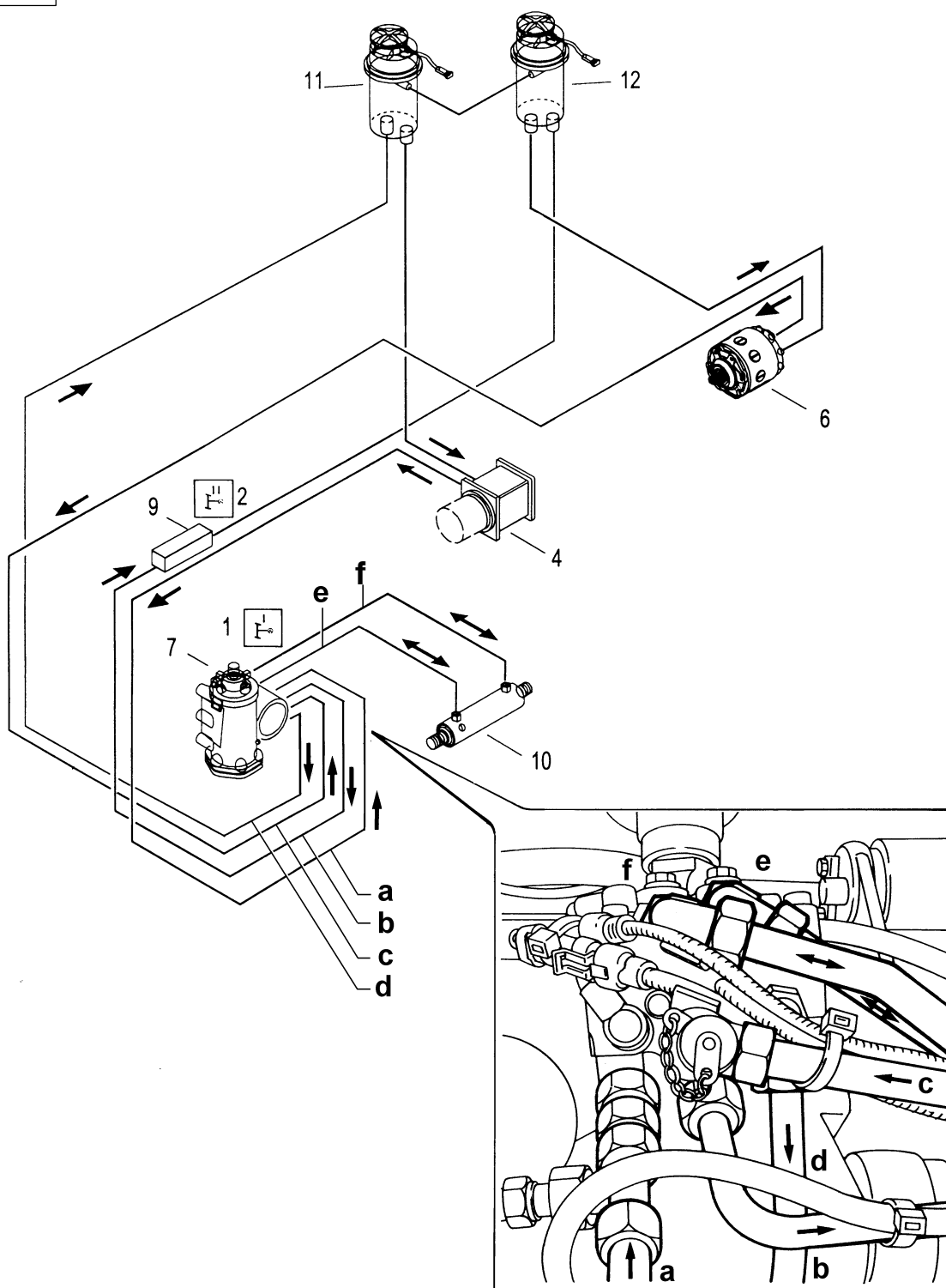
2151501

1. Steering wheel - 2. Steering column - 3. Steering box - 4. Steering rod - 5. First axle stub - 6. Second axle control linkages - 7. Second axle steering cylinder - 8. Steering cylinder rod - 9. Second axle stub

4-axle vehicle hydraulic power steering system



1. Power steering fluid reservoir - 2. Vane pump (on compressor) - 3. Piston pump (on transmission) - 4. Power steering (working pressure 140+14 bar) - 5. Operator cylinder - 6. Flow indicator - 7. Test connector

Scheme**Figure 3**

1. Main circuit failure warning light - 2. Secondary circuit failure warning light - 3. Not used -
 4. Paddle pump on compressor - 5. Not used - 6. Piston pump on driveline - 7. Power steering - 8. Not used -
 9. Flow indicator - 10. Operator cylinder - 11. Reservoir - 12. Reservoir

Power steering - 2 axles and 3 axles vehicles

The power steering is ball bearing mounted and essentially consists of the steering box and the mechanical part of the steering line, a command valve and an operating cylinder.

Rotation of the steering wheel is transmitted friction-free by the bearing mounted steering column and then transformed into axial movement of the piston.

The teeth of the piston in the box engage with the teeth of the sector type shaft, rotating the shaft.

The steering rod linked to this shaft transfers torque to the steering linkages on the wheel.

This exclusively mechanical steering action is assisted by pressurised oil delivered by a pump driven by the engine.

The command valve consists of a rotary distributor, supported by rollers in the worm screw and with six command grooves on the perimeter; the end of the worm screw supported in the steering box and with equally as many command grooves.

The rotary distributor also serves as the lower connection of the shaft from the box and turns with the worm screw when the steering wheel is turned.

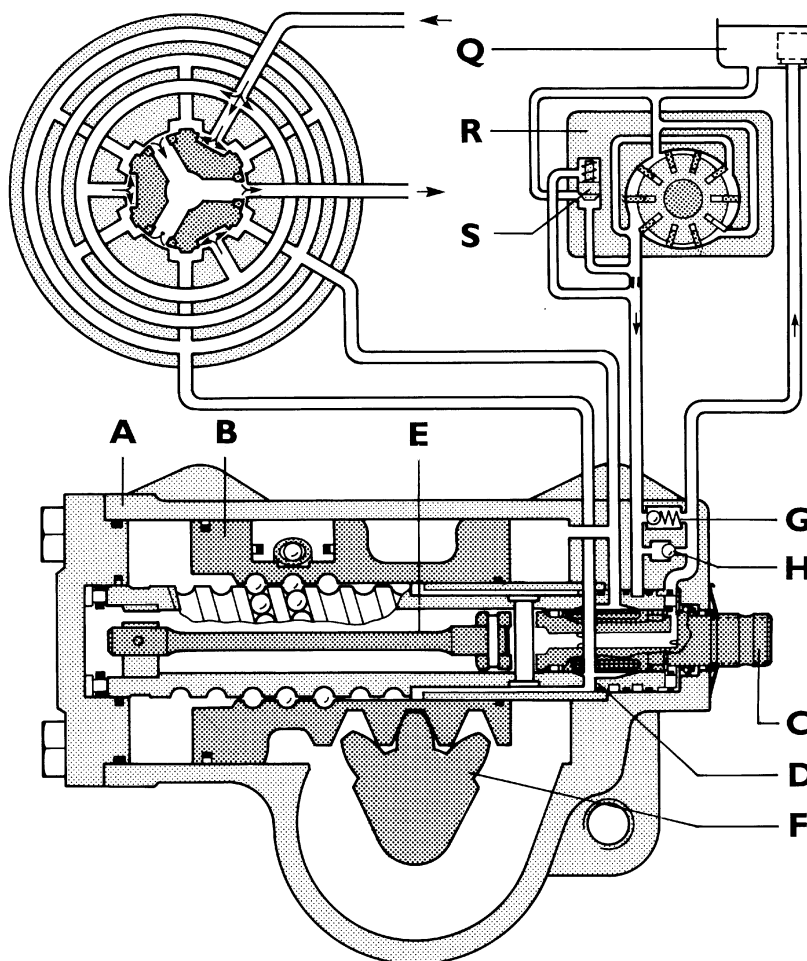
This synchronous rotary motion is due to the fact that the worm screw (D) and the rotary distributor (C) are connected by a torque bar (E) that holds the command valve in neutral position (driving straight) until the wheel is turned.

When torque is applied to the steering wheel or by the wheels to the worm screw, elastic deformation is applied to the torque bar undergoing elastic deformation, creating a relative motion between the rotary distributor (C) and the end of the worm screw (D) that serves as command box.

This shifts the distributor command grooves with respect to those on the end of the worm screw shifting the command valve from neutral position to operative.

The pressurised oil at the command valve (G) is now free to pass through the open command grooves and penetrate one of the two operator cylinder chambers, assisting the steering manoeuvre through pressure on the piston surface.

Figure 4



- A. Box - B. Piston - C. Rotary distributor/steering shaft - D. command box/worm screw -
 E. Torque bar - F. Toothed sector output shaft - G. Pressure regulator valve -
 H. Re-intake valve - Q. Oil tank - R. Paddle pump - S. Flow rate regulator valve

Power steering - 4 axles vehicles

The power steering is ball bearing mounted and essentially consists of the steering box and the mechanical part of the steering line, a command valve and an operating cylinder.

Rotation of the steering wheel is transmitted by the bearing mounted steering column (E) through a worm screw (H) and then transformed into axial movement of the piston (D).

The teeth of the piston in the box engage with the teeth of the sector type shaft (G), rotating the shaft

The steering rod linked to this shaft transfers torque to the steering linkages on the wheel.

This exclusively mechanical steering action is assisted by pressurised oil delivered by a pump (A) driven by the engine.

There is also an emergency pump (O) driven by the driveline.

The command valve consists of a rotary distributor, supported by rollers in the worm screw and with six command grooves on the perimeter; the end of the worm screw supported in the steering box and likewise with equally as many command grooves.

The rotary distributor also serves as the lower connection of the shaft from the box and turns with the worm screw when the steering wheel is turned.

This synchronous rotary motion is due to the fact that the worm screw (H) and the rotary distributor (E) are connected by a torque bar (I) that holds the command valve in neutral position (driving straight) until the wheel is turned.

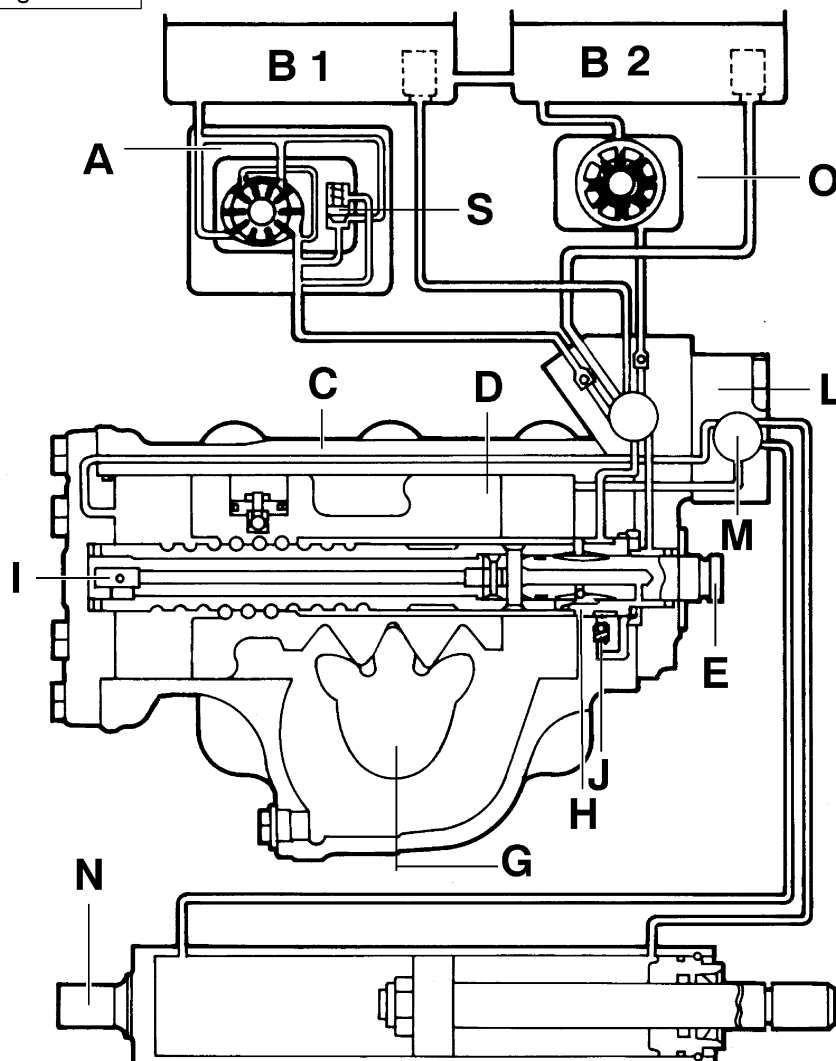
When torque is applied to the steering wheel or by the wheels to the worm screw, the torque bar undergoes elastic deformation, creating a relative motion between the rotary distributor (E) and the end of the worm screw (H) that serves as command box.

This shifts the distributor command grooves with respect to those on the end of the worm screw shifting the command valve from neutral position to operative.

The pressurised oil at the command valve is now free to pass through the open command grooves and penetrate one of the two operator cylinder chambers, assisting the steering manoeuvre through pressure on the piston surface (D).

This pressure is also delivered through the distributor valve to the second steering axle operator cylinder (N).

Figure 5



- A. Main pump
- B1. Oil reservoir
- B2. Oil reservoir
- C. Box
- D. Piston
- E. Rotary distributor/ steering column
- G. Output shaft segment toothed
- H. Command box/worm screw
- I. Torque bar
- J. Limiter valve pressure
- L. Distributor valve
- N. Operator cylinder
- O. Emergency pump
- S. Limiter valve flow-rate

Steering hydraulic limitation

Steering regulation is achieved by two valves "T" and "U" axially arranged in piston "B". These are fitted with spring loaded actuators pistons with stems protruding from the front right and left surfaces of the piston itself.

When the piston move right or left toward the limit the stems come into contact with shift bushes "Y" and "X" in the box and in the cover and consequently compress. Both regulation valves remain closed until one of the stems touches the shift bush. If for example the piston shifts right for "left turn" the right steering limit valve "T" is opened by bush "Y" before the piston can reach the limit stop.

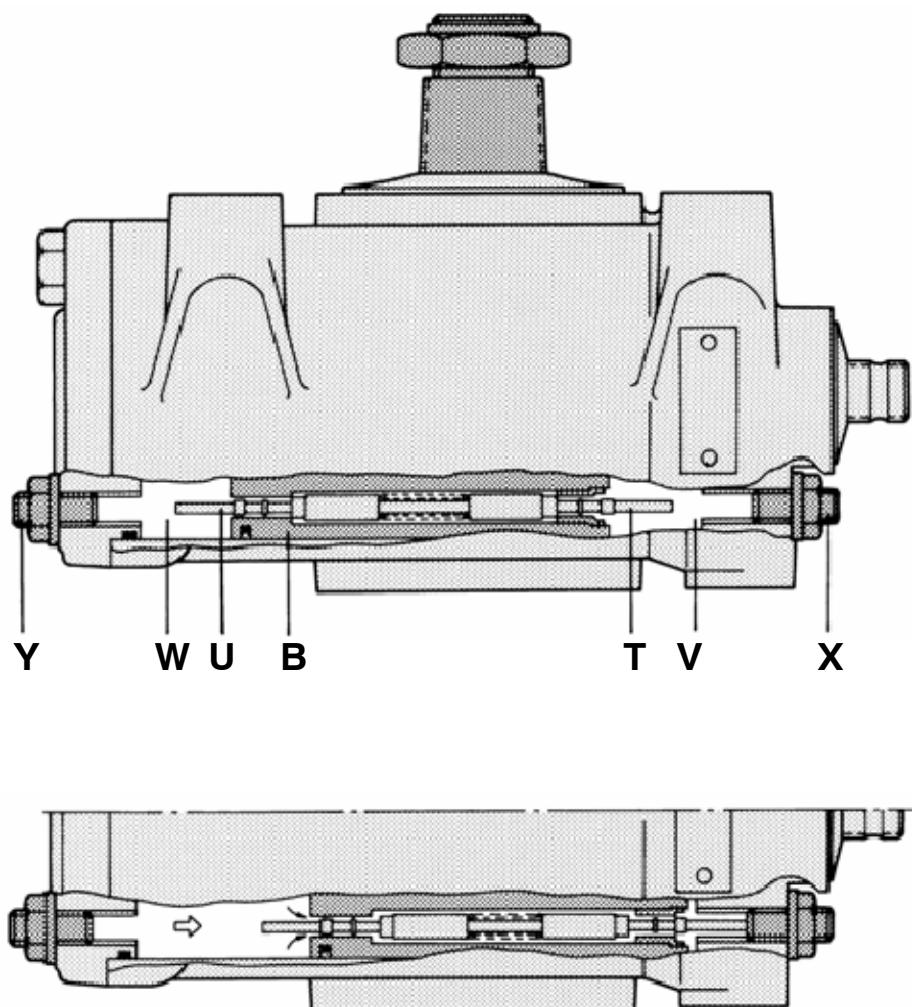
In this way pressurised oil present in the operator cylinder left chamber can penetrate into the right chamber, flowing around

the piston shifted by valve "U" and through open right valve "T" to reach the return circuit.

If the piston is moved to the left for "right steering", valve "U" opens after the predetermined stroke and the pressurised oil in the right chamber of the cylinder flows into the cylinder to reach the return circuit, reducing pressure in the circuit chamber.

When the steering regulator valve is open, hydraulic servo power is significantly reduced and the steering wheel can only be turned by applying greater force up to the steering or wheel limit

Figure 6



B. Piston - T. Right steering limit valve - U. Left steering limit valve - V. Cylinder right chamber - W. Cylinder left chamber - X. left adjuster screw - Y. right adjuster screw

Automatic steering regulation



With the automatic steering limit regulation device, manual adjustment of hydraulic limit is no longer necessary.

Steering regulation is achieved by two valves "T" and "U" axially arranged in piston "B". These are fitted with spring loaded actuators pistons with stems protruding from the front right and left surfaces of the piston itself.

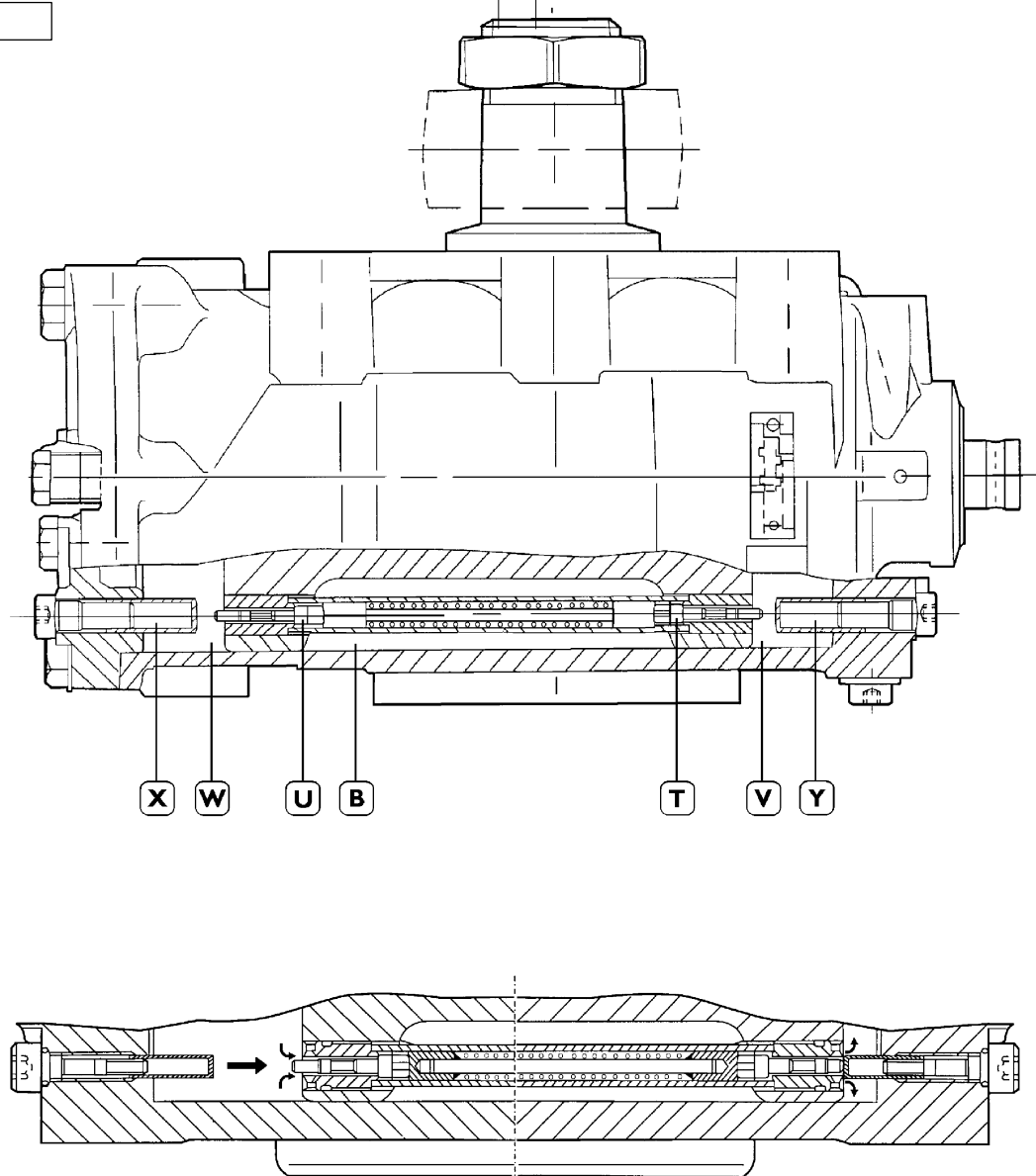
When the piston moves right or left toward the limit the stems come into contact with shift bushes "Y" and "X" in the box and in the cover and consequently compress. Both regulation valves remain closed until one of the stems touches the shift bush.

If for example the piston shifts right for "left turn" the right steering limit valve "T" is opened by bush "Y" before the piston can reach the limit stop.

In this way pressurised oil present in the operator cylinder left chamber can penetrate into the right chamber, flowing around the piston shifted by valve "U" and through open right valve "T" to reach the return circuit.

When the steering regulator valve is open, hydraulic servo power is significantly reduced and the steering wheel can only be turned by applying greater force up to the steering or wheel limit

Figure 7



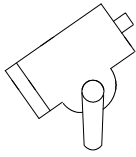
B - Piston - T - Right steering limit regulator valve - U - Left steering limit regulator valve -
V - Cylinder right chamber - W - Cylinder left chamber - X - Left adjuster screw -
Y - Right adjuster screw

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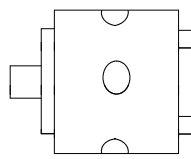
SPECIFICATIONS AND DATA

2 and 3 axle vehicles

POWER STEERING

	TYPE	ZF 8098 bearing mounted with built-in pressure regulator valve
	Working pressure bar	150 ⁺¹⁵
	Variable reduction ratio	Steering centre 22.2: 1 Full steering 26.2: 1

POWER STEERING PUMP

	TYPE	BOSCH GEAR PUMP
	Nº rpm minimum rpm	3000
	Maximum pressure bar	190
	Flow rate dm ³ /l'	16

Steering angle and toe-in - 2 and 3 axle vehicles

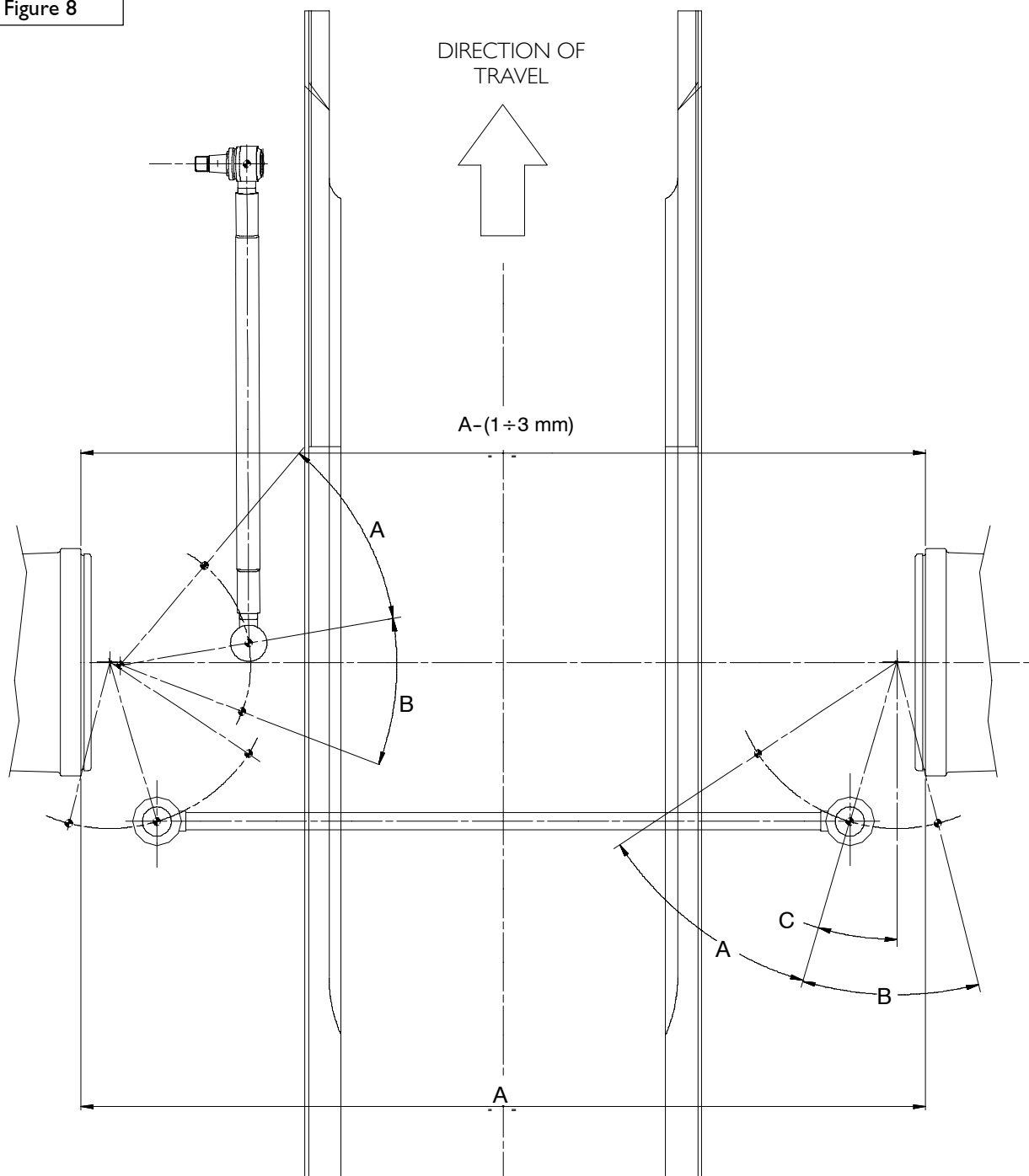
6x4 vehicles

tyres	angles	A	B	C
13 R 22,5		45°	35°30'	12°52'
12.00.20		45°	35°30'	12°52'
315/80		45°	35°30'	12°52'
12.00.24		40°	32°42'	12°52'
14.00.20		40°	32°42'	12°52'

4x4 and 6x6 vehicles

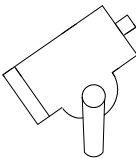
tyres	angles	A	B	C
13 R 22,5		45°	33°02'	16°23'
12.00.20		45°	33°02'	16°23'
315/80		45°	33°02'	16°23'
12.00.24		40°	30°45'	16°23'
14.00.20		40°	30°45'	16°23'

Figure 8

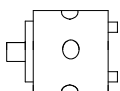


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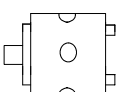
Hydraulic system - 4 axle vehicles**HYDRAULIC STEERING**

	Type	ZF 8099 Bearing mounted, dual circuit with pressure regulator valve
	Working pressure bar	140 ⁺¹⁴
	Variable reduction ratio	Steering centre 22,2:1 Maximum lock 26,2:1

POWER STEERING PUMP on compressor

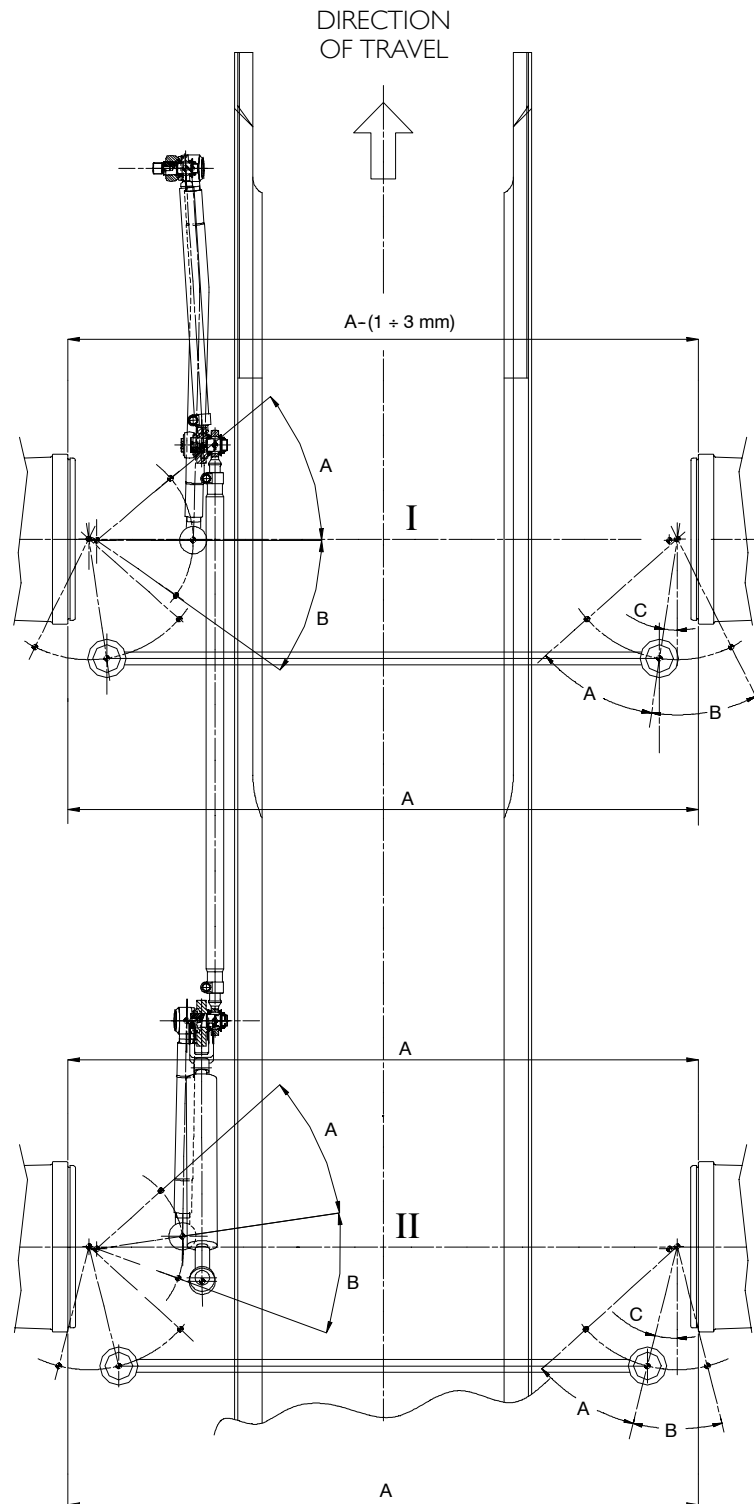
	Type	ZF Paddle type
	Minimum speed rpm/min	500
	Maximum speed rpm/min	3000
	Maximum pressure bar	165
	Flow-rate dm ³ /min	25

POWER STEERING PUMP on gearbox (auxiliary)

	Type	ZF Piston type
	Minimum speed rpm/min	4500
	Maximum pressure bar	180
	Flow-rate dm ³ /min	16

Steering angle and toe-in - 4 axle vehicles

Figure 9



2151505

FIRST AXLE/AXLE SET STEERING ANGLE

8x4 vehicles

tyres angles	A	B	C
13 R 22,5	45°	35°30'	12°52'
12.00.20	45°	35°30'	12°52'
315/80	45°	35°30'	12°52'
12.00.24	40°	32°42'	12°52'
14.00.20	40°	32°42'	12°52'

SECOND AXLE/AXLE SET STEERING ANGLE

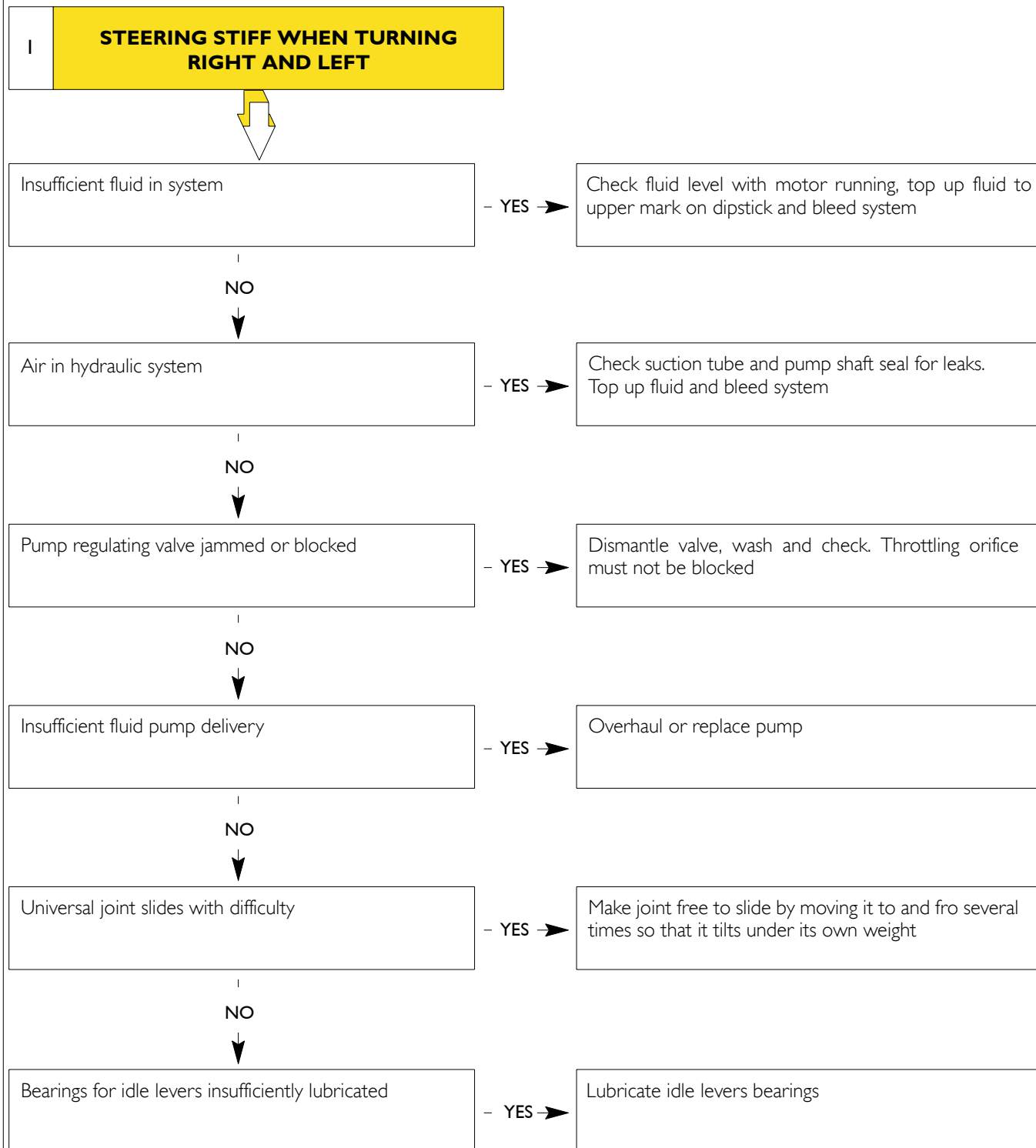
8x4 vehicles

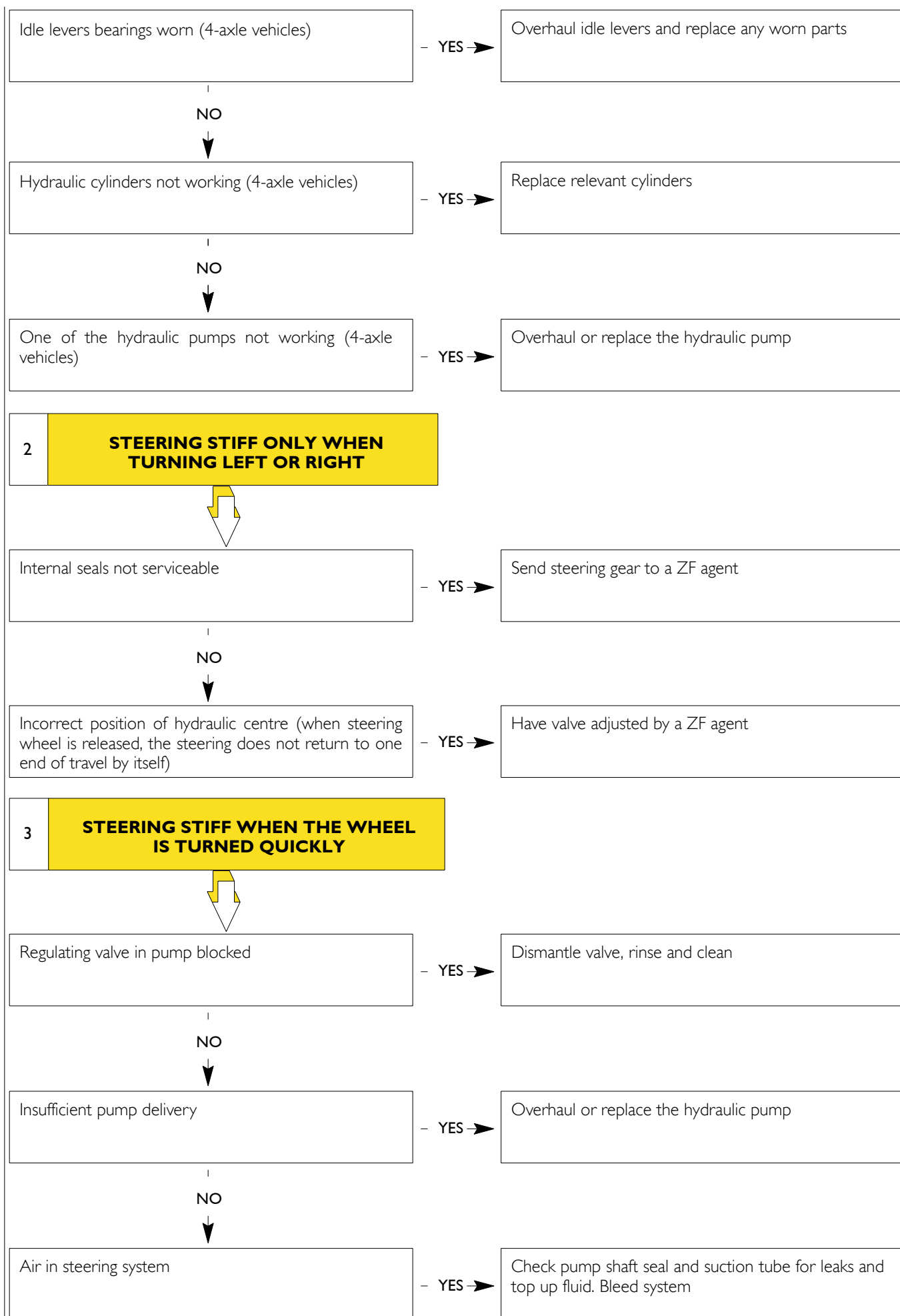
tyres angles	A	B	C
13 R 22,5	35°48'	26°49'	19°59'
12.00.20	35°48'	26°49'	19°59'
315/80	35°48'	26°49'	19°59'
12.00.24	32°07'	24°56'	19°59'
14.00.20	32°07'	24°56'	19°59'

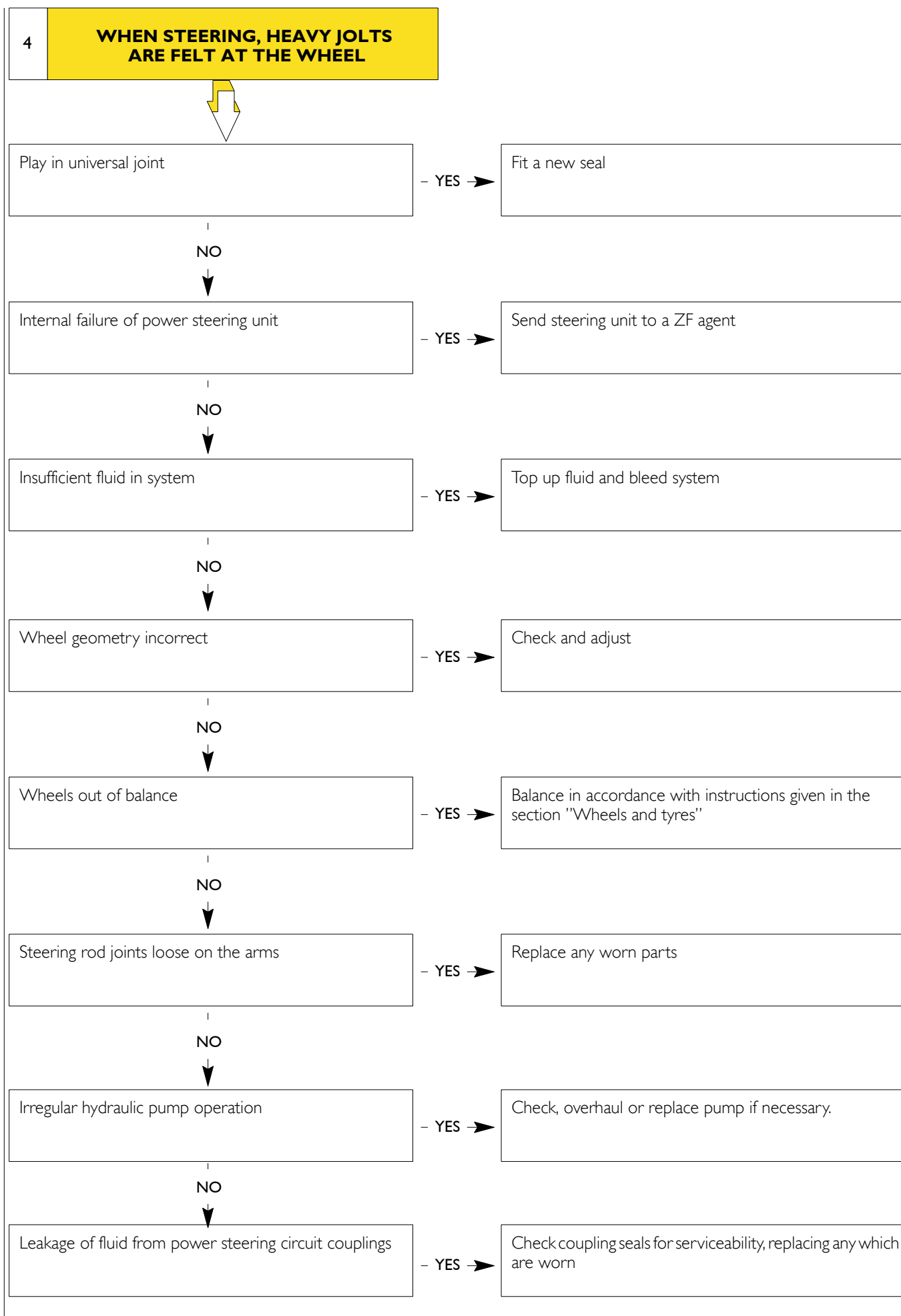
DIAGNOSTICS

Main power steering operating faults :

- | | |
|--|---|
| 1 - Steering stiff when turning right and left | 5 - Torsional vibration of the steering wheel |
| 2 - Steering stiff only when turning left or right | 6 - Excessive play at the steering wheel |
| 3 - Steering stiff when the wheel is turned quickly | 7 - Loss of fluid |
| 4 - When steering, heavy jolts are felt at the wheel | 8 - Insufficient pressure in the circuit |







5

TORSIONAL VIBRATION OF THE STEERING WHEEL

Wheels out of balance

- YES →

Balance in accordance with instructions given in the section "Wheels and tyres"

NO



Front wheels geometry incorrect

- YES →

Adjust in accordance with characteristic data given in relevant section

NO



Air in hydraulic system

- YES →

Check pump shaft seal and suction tube for leaks. Top up fluid and bleed system

6

EXCESSIVE PLAY AT THE STEERING WHEEL

Clearance in ball joints and/or flexible supports loose

- YES →

Replace ball joints

NO



Play in universal joint

- YES →

Replace universal joint

NO



Internal failure of power steering unit

- YES →

Send power steering unit to a ZF agent

7

LOSS OF FLUID

Tank cover not secured

- YES →

Secure cover

NO



Deterioration of gaskets and seals

- YES →

Replace, top up fluid and bleed

In every case it is necessary to establish where and why hydraulic fluid is being lost, eliminate the cause and, with the engine running, top up fluid to upper mark on dipstick.

8

**INSUFFICIENT PRESSURE
IN THE CIRCUIT**

Pump not operating correctly

- YES →

Overhaul or replace hydraulic pump

NO



Fluid leaking from couplings in power steering circuit

- YES →

Check coupling seals for serviceability, replacing any which are worn

NO



Insufficient fluid level in the tank

- YES →

Top up level and bleed circuit

NO



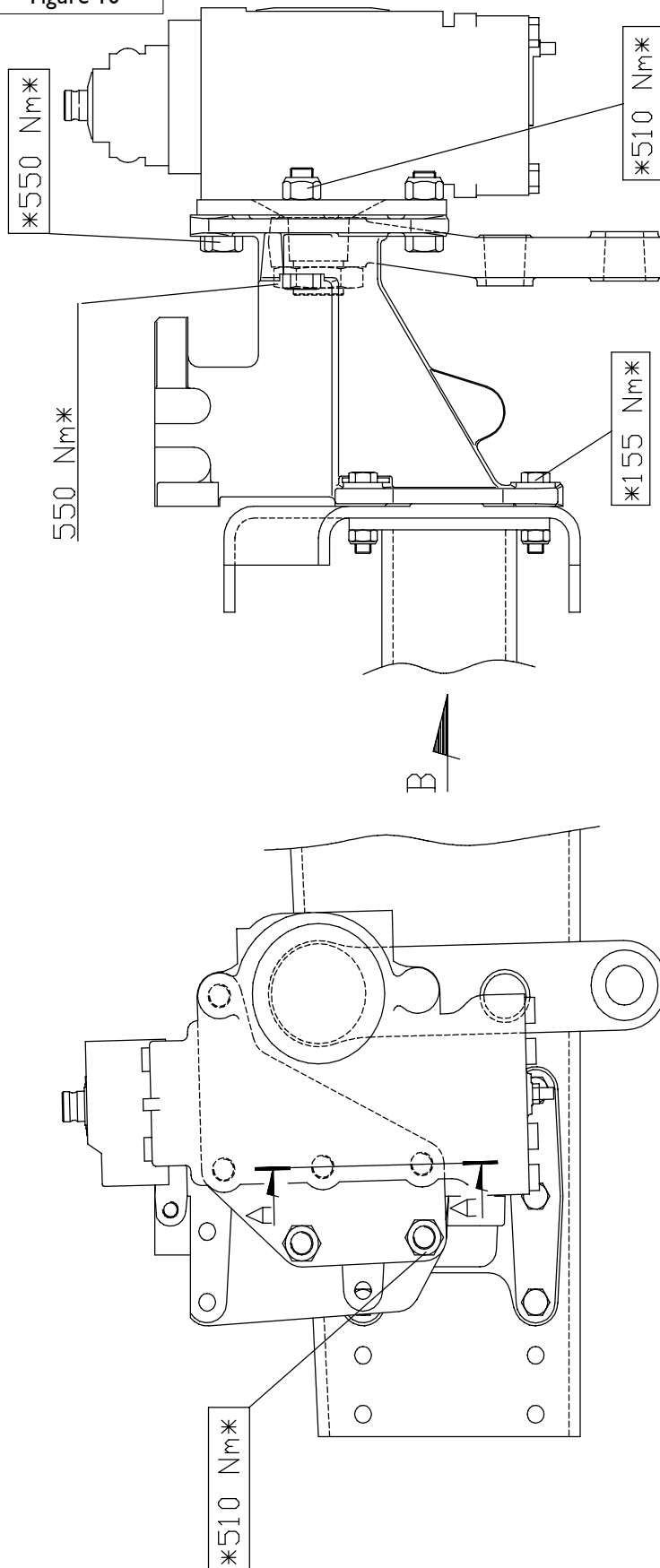
Fluid leaking from gaskets in hydraulic circuit (4-axle vehicles)

- YES →

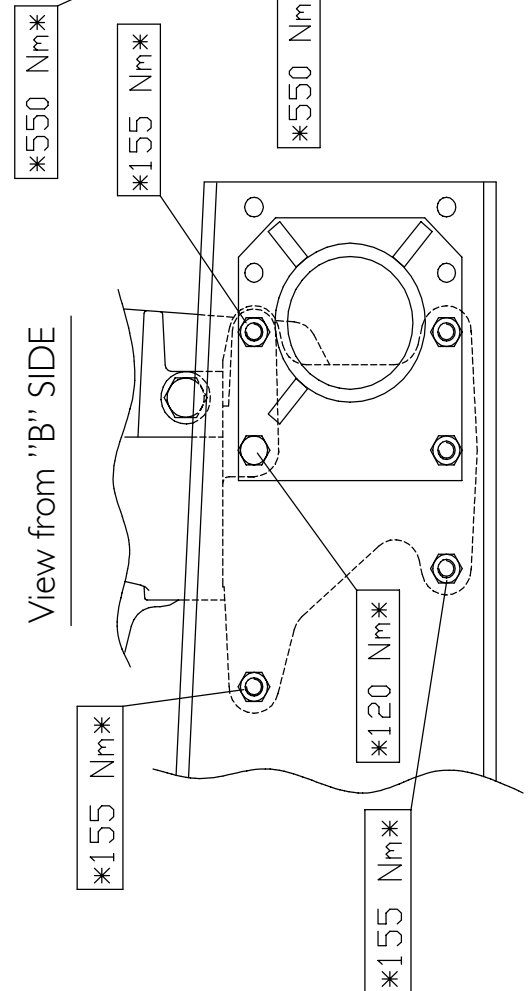
Replace faulty cylinder

TIGHTENING TORQUES **Power steering box**

Figure 10



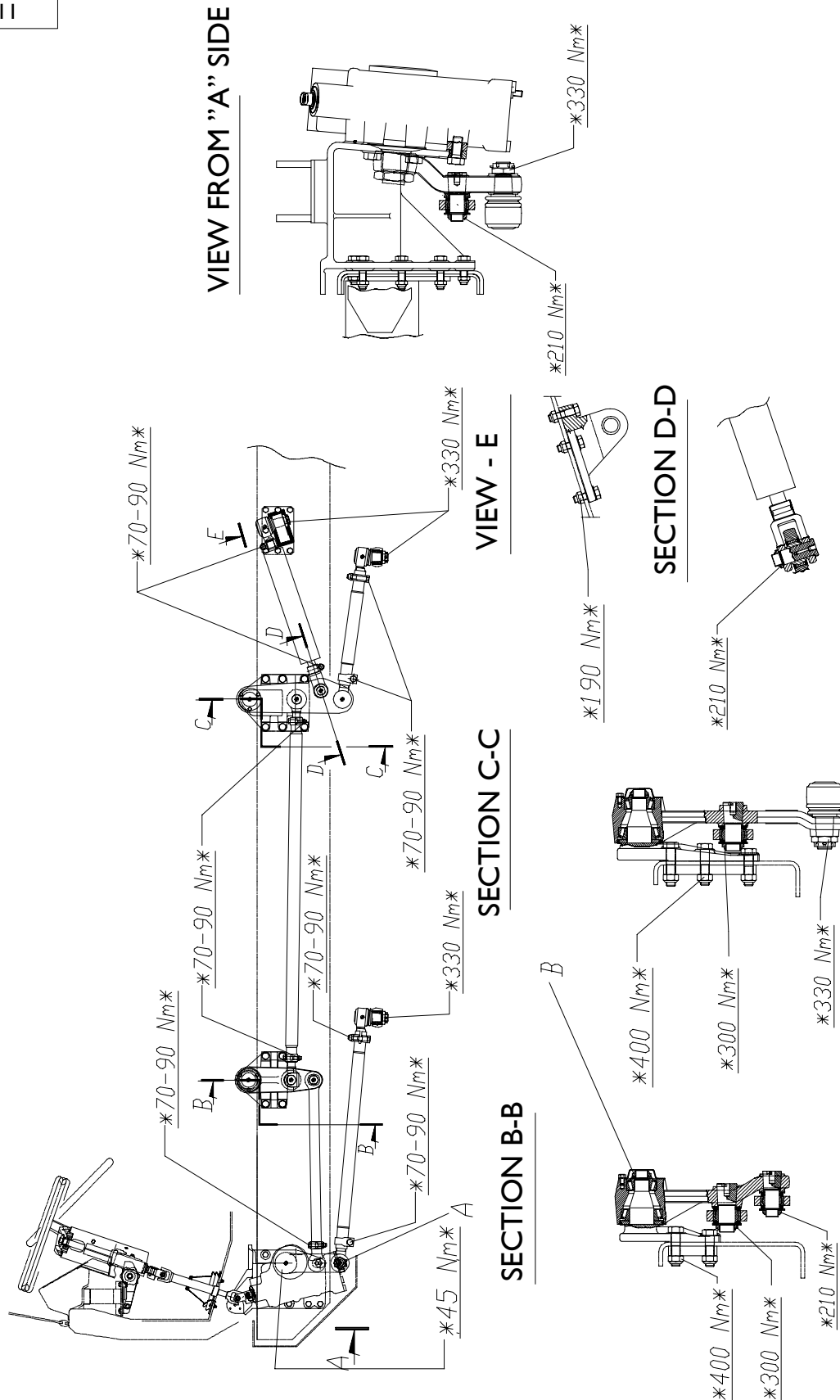
SECTION A-A



Linkage

- Check for split pins correct assembling. Should the notch be not coinciding with the hole at the required torque, continue tightening until fitting the split pin.
- Tighten the ring nut to 50 Nm, turning the lever to stop the bearings.

Figure 11



TOOLS

TOOL NO.	DESCRIPTION
99347068	Puller for drag link pivots
99370006	Interchangeable handle for beaters
0/7205 I	Kit for testing steering system hydraulic pressure
99374399	Expanders to lock the wheel in straight running position

STEERING BOX REMOVAL-REPLACEMENT 2 and 3-axle vehicles

Removal

Proceed as follows:

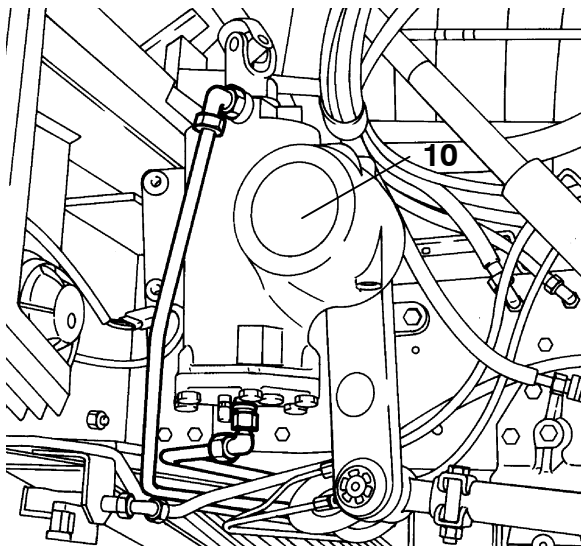
- ☐ Drain the servosteering hydraulic circuit as described below:



It is strictly forbidden to dispose of exhausted fluid incorrectly or in the municipal sewer system.

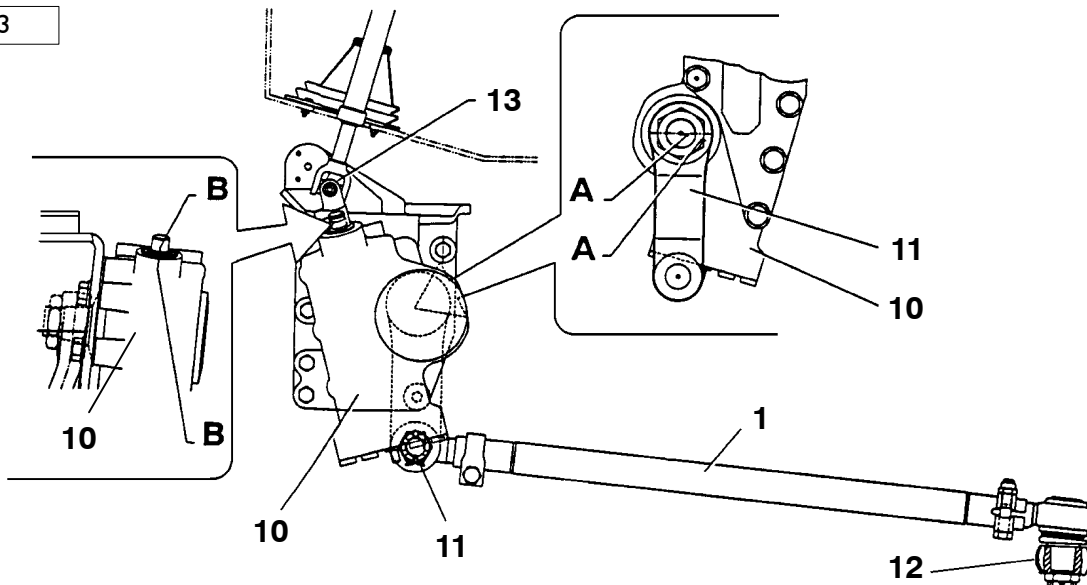
- ☐ Disconnect the delivery pipe to the reservoir (a) and return pipe from the pump (b);
- ☐ Disconnect the steering column joint (13);
- ☐ Unscrew the connector bolt to disconnect the steering lever (11) from the steering bar (1);
- ☐ Support the steering box (10) and remove the fastening bolts.

Figure 12



1781501

Figure 13



1781502

- ☐ Disconnect the steering column joint (13);
- ☐ Unscrew the respective connector bolts from the steering bar (1) and tie bar (4) to disconnect the steering lever;
- ☐ Support the steering box (10) and remove the fastening bolts.

Replacement

Proceed as follows:

- ☐ Fit the steering box (10) to its mounting bracket, tightening the bolts to the specified torque;
- ☐ Set the steering lever (11) such that the notches A-A and B-B coincide perfectly;
- ☐ Position the tyres for straight driving, observing the convergence value given in the tables given later on;
- ☐ Adjust the length of the tie bar (1) until it is possible to insert the heads into the respective seats of the steering lever (11) and axle (12) without altering the position of the seats and without forcing, then tighten the fastening clamps to the specified torque;
- ☐ Proceed to connect the steering column joint (13), taking care to centre the steering wheel;
- ☐ Reconnect the hydraulic lines;
- ☐ Fill and bleed the hydraulic circuit as described later;
- ☐ Check the excursion limit settings as described later (only for versions with hydraulic steering limiter).

4-axle vehicles

Removal

Proceed as follows:

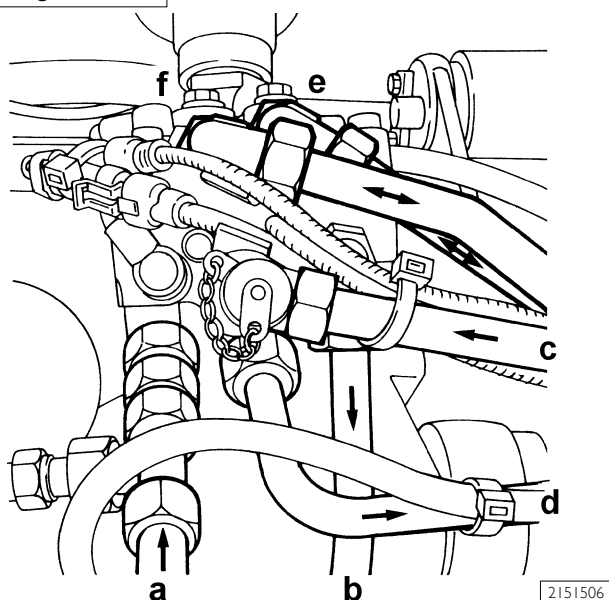
- ☐ drain the steering hydraulic circuit as instructed below



It is strictly forbidden to dispose of exhausted fluid incorrectly or in the municipal sewer system.

- ☐ disconnect the hydraulic lines:
 - a delivery from main pump
 - b return to reservoir
 - a delivery from auxiliary pump
 - d return to reservoir
 - e to second axle cylinder
 - f to second axle cylinder

Figure 14



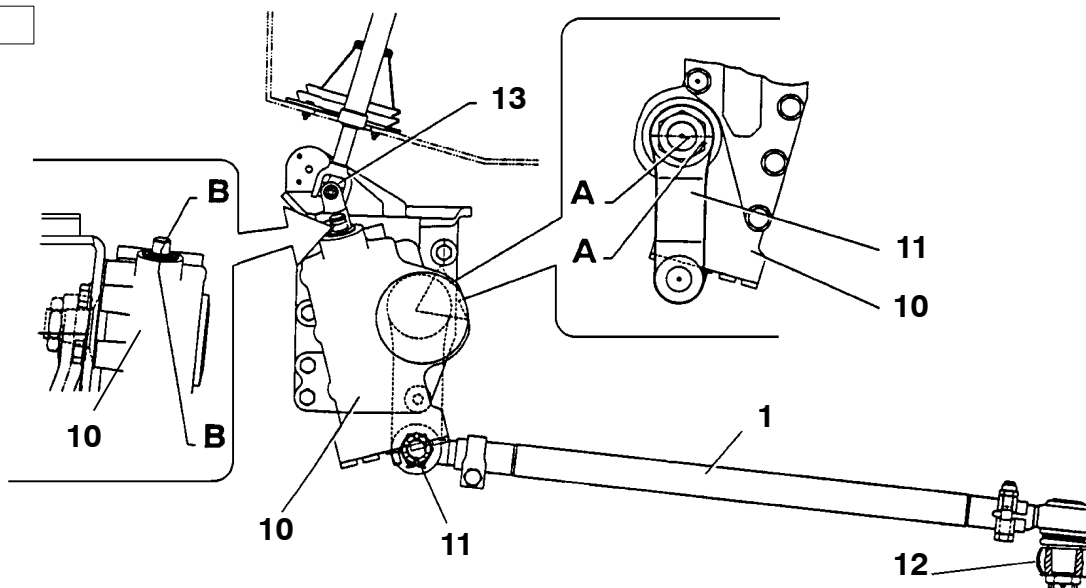
- ☐ disconnect the steering column joint (13);
- ☐ disconnect the steering lever (11) from the steering rod (1) and track rod (4) removing the corresponding bolts;
- ☐ suitably support the steering box (10) and remove it by removing the nuts.

Replacement

Proceed as follows:

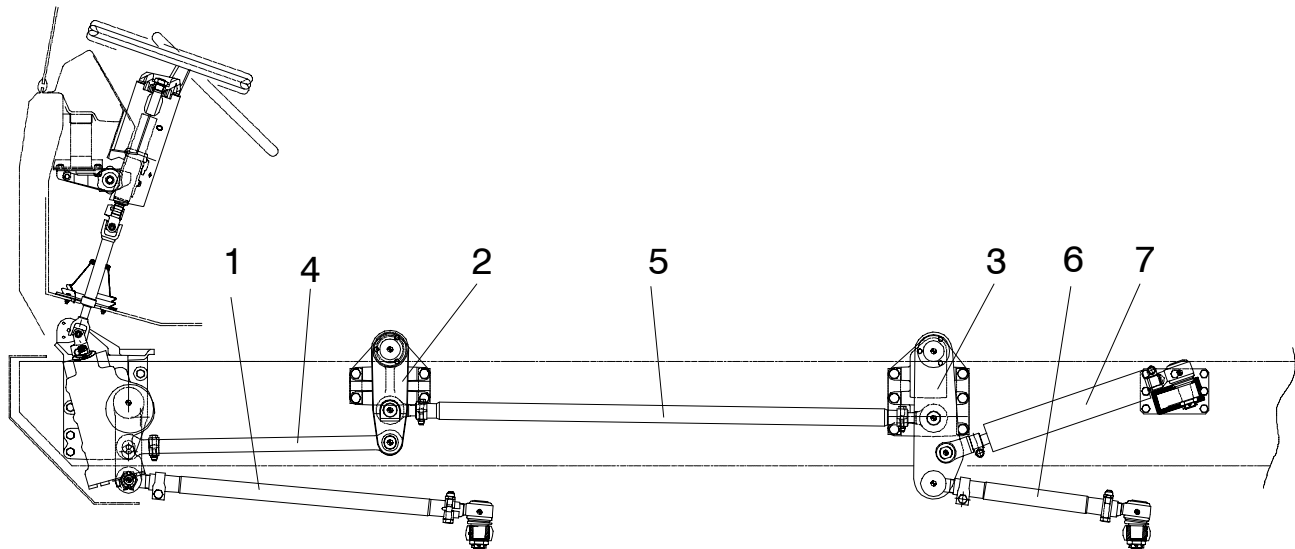
- ☐ fit the steering box (10) on the corresponding support bracket tightening the nuts to the specified torque;
- ☐ arrange the steering lever (11) such that the notches A-A and B-B coincide perfectly;
- ☐ position the tyres for straight running respecting the toe-in value as indicated in the tables given below;
- ☐ adjust the length of the steering rod (1) and link (4) as more specifically instructed in the following paragraph, then tighten the clamps to the specified torque;
- ☐ then connect the steering column joint (13), carefully centring the steering wheel;
- ☐ connect the hydraulic lines;
- ☐ fill and bleed the circuit as instructed below;

Figure 15

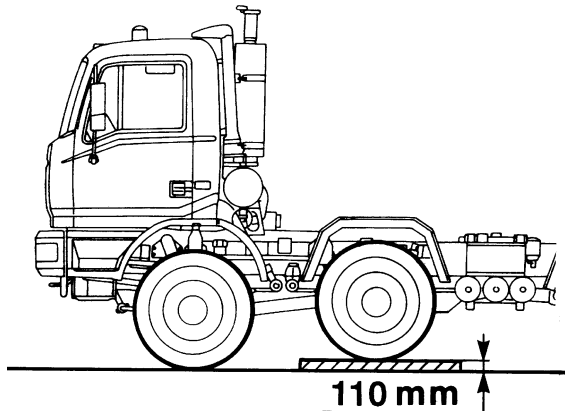


FITTING STEERING LINKS - 4-AXLE VEHICLES

Figure 16



STEERING LINKAGE



1471501

Set vehicle on level ground, in chassis configuration, after climbing a 110 mm step with the second axle.

Disconnect the steering links (1), (4), (5) and (6) and the cylinder (7) from the relevant levers.

First axle

Check for correct power steering installation and lever positioning (see power steering removal-refitting).

Set wheels in straight running position, observing the specified toe-in value and adjusting the length of the quadrilateral steering link (see front wheel toe-in check).

Then, adjust steering link (1) length to enable heads fitting into power steering and axle levers, without modifying lever position.

Second axle

Line-up wheels in straight running position and adjust the length of the quadrilateral steering link.

Position the transmission levers (2) and (3) with vertical axis.

Then, adjust the length of the different steering links (4), (5) and (6) and cylinder (7) to enable joints, fork and heads fitting into the relevant seats on the levers, without modifying lever positions.

KINGPINS

Visual inspections

Clean drag link kingpins.

Check components for damages or cracks.

Replace if damaged.

Check steering link clamp screws and nuts for wear and correct tightening torque; steering links shall not be damaged or deformed.

Replace if damaged.

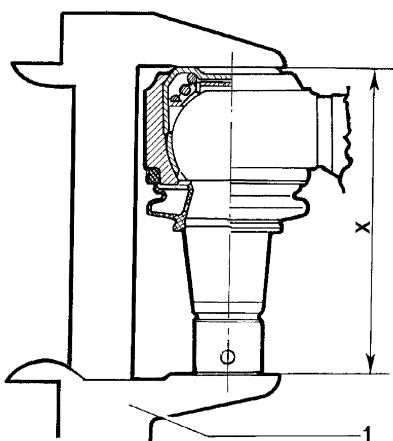
Clearance check

Do not lift the vehicle.

Find distance "X" with a gauge, with the vehicle set in straight running position.

Repeat this measurement in full steering position, left-hand (X1) and right-hand (X2); write down found values.

Figure 17



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Calculate clearance "A" by the following formula:

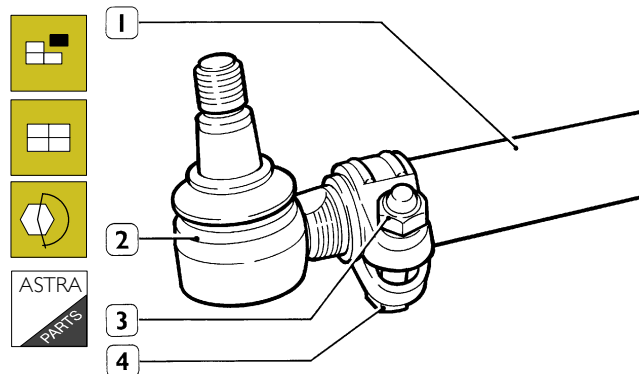
$$A = B - X$$

where B is the highest value obtained from X1 and X2.

Replace the kingpin if this value exceeds 2 mm.

Replacement

Figure 18



33007

Lock screw (4), loosen nut (3) and unscrew the drag link (1) joint (2).

Screw the joint into the drag link and lock it in this position tightening the locking nut to the required torque.



To facilitate drag link refitting and wheel toe-in adjustment, record the number of turns required to unscrew each joint in order to screw the new joints with the same number of turns.



Refit the drag link.



Check and adjust front wheel toe-in if necessary.

CHANGING HYDRAULIC FLUID



When filling and bleeding, the pump must operate at the lowest speed possible.

Draining

Proceed as follows:

- ☐ Raise the vehicle until the front wheels leave the ground;
- ☐ Position a container with adequate capacity and disconnect the delivery (1) and return (2) lines from the steering box. Remove the reservoir filler cap;
- ☐ With the engine stopped turn the steering wheel from one excursion limit to the other until fluid stops draining out;
- ☐ Reconnect the hydraulic lines.

Filling



All the operations listed below must be carried out in scrupulously clean conditions to prevent foreign matter falling into the fluid during filling.

Proceed as follows (with the vehicle raised):

- ☐ Completely fill the hydraulic fluid reservoir;
- ☐ With the engine stopped, turn the steering wheel from one excursion limit to the other while topping up the reservoir and proceed until the fluid level stabilises;
- ☐ Using the starter motor, operate the steering pump in order to fill the circuit with fluid. Since the level will quickly drop during this operation, keep pouring fluid into the reservoir; **MAKING ABSOLUTELY SURE** that no air is drawn in;
- ☐ When the fluid level remains constant between the two notches on the dipstick, the engine can be started.

Bleeding

- ☐ Turn the steering wheel from one excursion limit to the other with the engine idling to bleed any remaining air bubbles from the system.



The fluid level must be continually monitored during this operation. If the above instructions have been correctly followed, when the engine is stopped the fluid level must not exceed the upper notch by more than ½ cm, nor should it emulsify suddenly. This phenomenon indicates a strong presence of air in the circuit due to incorrect filling.

- A: 2-axle and 3-axle vehicles
B: 4-axle vehicles

Figure 19

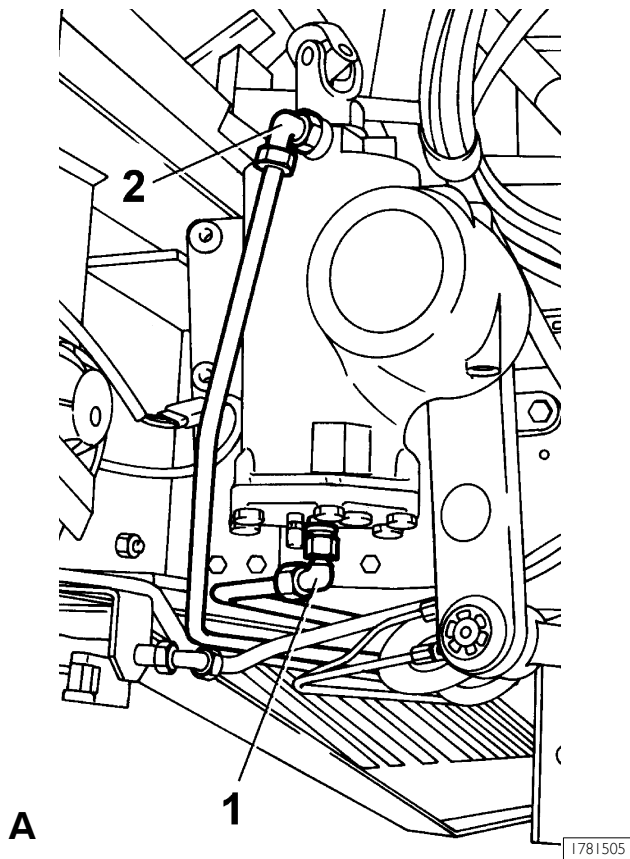
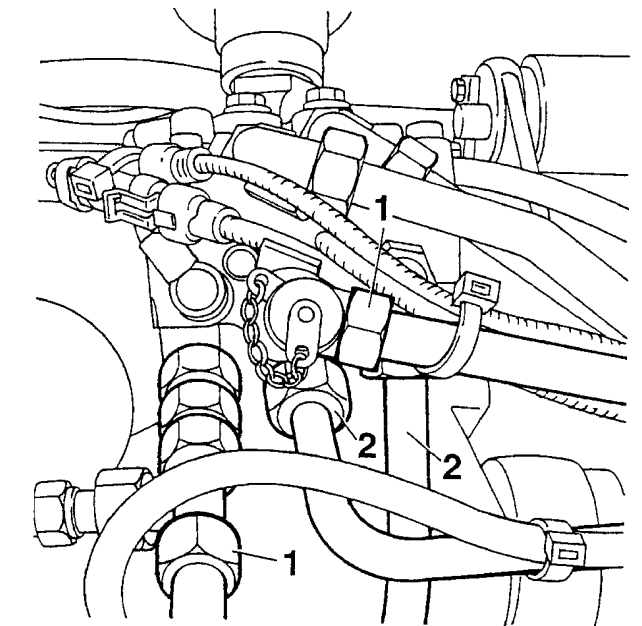


Figure 20



CHECKING WHEEL TOE-IN



Before checking the toe-in ensure that:
the vehicle is on a level surface and unladen;
the tyres are inflated to the correct pressure.

Proceed as follows:

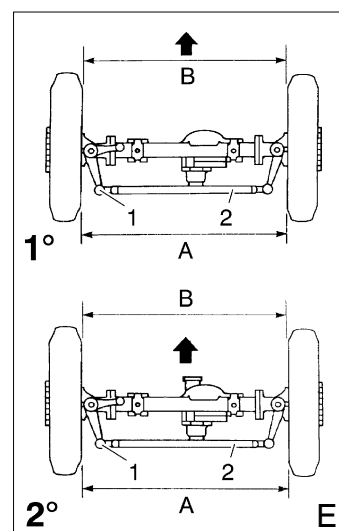
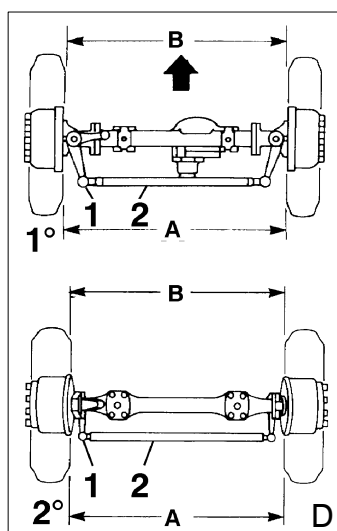
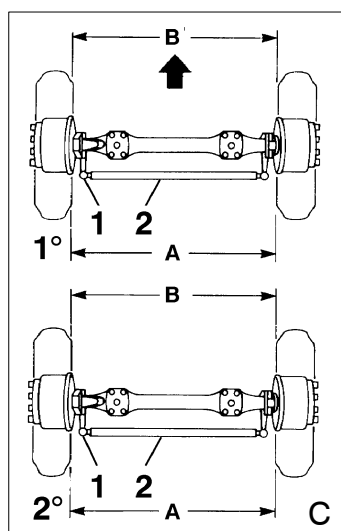
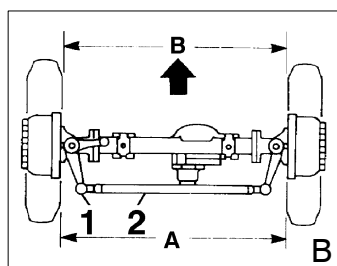
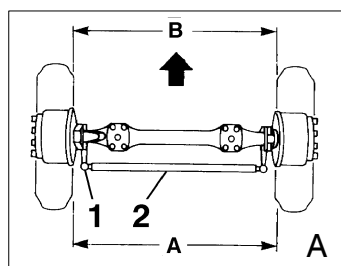
- ☐ set the wheels so that they are pointing forwards;
- ☐ check that the distances A and B measured along the centreline of the rims at the same height from the ground, correspond to the specified values:

If this is not the case, adjust as follows:

- ☐ loosen the bolts securing the ball joints (1) to the coupling rod (2);
- ☐ remove ball joint from lower steering lever;
- ☐ turn the rod right or left just enough to obtain the measurement required;
- ☐ tighten the bolts securing the ball joints;
- ☐ move the vehicle straight forwards or backwards by at least one turn of wheels, and check toe-in again.

Reference	Vehicle	Forecarriage	Measure
A	2-axle - 3-axle vehicles	axle set	$B = A - (1 / 3 \text{ mm})$
B	2-axle - 3-axle vehicles	axle	$B = A - (1 / 3 \text{ mm})$
C	4-axle vehicles	1st axle set	$B = A - (1 / 3 \text{ mm})$
		2nd axle set	$B = A$
D	4-axle vehicles	1st axle	$B = A - (1 / 3 \text{ mm})$
		2nd axle set	$B = A$
E	4-axle vehicles	1st axle	$B = A - (1 / 3 \text{ mm})$
		2nd axle	$B = A$

Figure 21



ADJUSTING HYDRAULIC STEERING MODULATION DEVICES AND CHECKING MECHANICAL STOPS

2-axle and 3-axle vehicles



This power steering system is fitted with automatic hydraulic steering modulation device. Hence, with disassembled power steering or disconnected linkage, it shall be controlled in both directions without hydraulic assistance and to 33° steering lever max. angle and ≤ 10 N force measured on the steering wheel (steering wheel diameter: 500 mm).



Described procedure must be performed after wheel toe-in adjustment.

Proceed as follows:

- ☐ operate with unladen vehicle;
- ☐ set each front wheel on a turntable;
- ☐ connect gauge 99374393 on power steering pump delivery pipe connection as shown in the diagram;



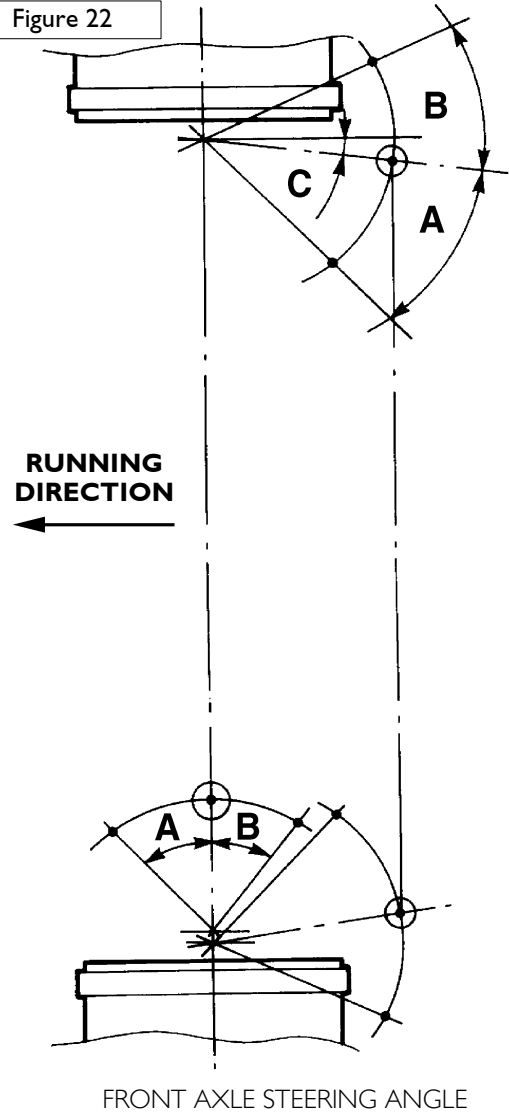
The new steering box (spare part) is adjusted to the max. steering angle. For this reason, when replacing the steering box with a new one (spare part), adjustment must be performed by **SCREWING** the adjusting screws only to avoid removal from their seats due to hydraulic operating pressure.

- ☐ start engine and run it to approx. 1500 rpm by the hand accelerator control;
- ☐ steer until the gauge indicates a pressure drop due to power steering hydraulic stop intervention (which must take place before mechanical stop intervention); in this position the steering geometry shall comply with the specified angle values.



Should the mechanical stop be intervening before the hydraulic one, stop steering to avoid damages to the stop and to the pump components (130 bar max. pressure) and reset a suitable clearance to perform adjustment.

Figure 22



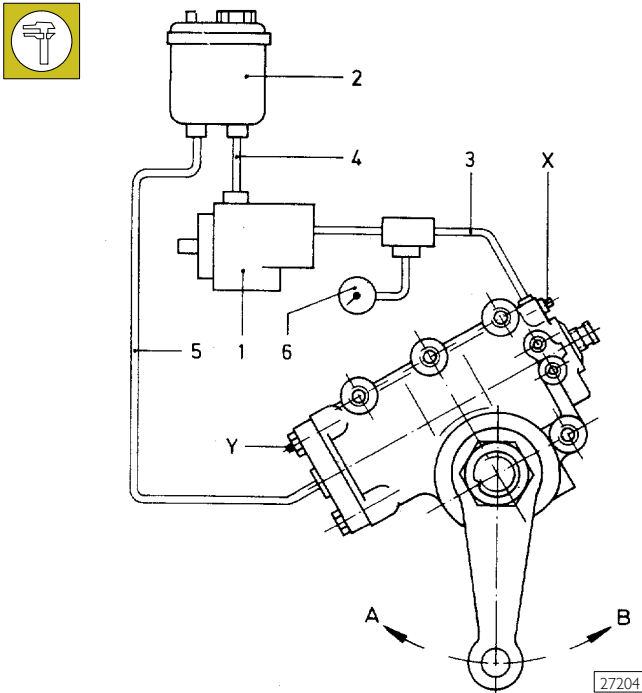
6x4 vehicles

tyres	A	B	C
angles			
13 R 22,5	45°	35°30'	12°52'
12.00.20	45°	35°30'	12°52'
315/80	45°	35°30'	12°52'
12.00.24	40°	32°42'	12°52'
14.00.20	40°	32°42'	12°52'

4x4 and 6x6 vehicles

tyres	A	B	C
angles			
13 R 22,5	45°	33°02'	16°23'
12.00.20	45°	33°02'	16°23'
315/80	45°	33°02'	16°23'
12.00.24	40°	30°45'	16°23'
14.00.20	40°	30°45'	16°23'

Figure 23



1 Pump - 2 Reservoir - 3 Delivery pipe - 4 Suction pipe -
5 Return pipe - 6 Pressure gauges

X = hydraulic steering limiter adjusting screw for rotation in
direction A of steering control arm.

Y = hydraulic steering limiter adjusting screw for rotation in
direction B of steering control arm.

- ☐ If these values are not found, proceed with adjustment operating respectively:
on screw X for rotation in direction A of the steering arm;
on screw Y for rotation in direction B of the steering arm.

When the required angle has been obtained but the pressure drop has not took place yet, screw (clockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

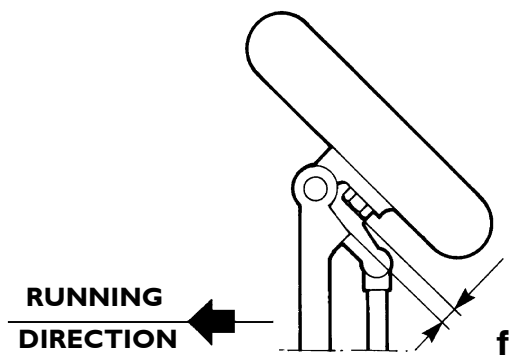
When the required angle is not obtained but the pressure drop has already took place, unscrew (anticlockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

- ☐ Tighten then the lock nut to 30 ± 5 Nm (3 ± 0.5 kg); proceed in the same way to adjust the wheel stop on the opposite side.
- ☐ Once the hydraulic steering modulating device is adjusted, check whether, when steering down in both directions up to hydraulic pressure drop, distance "f" between axle and setscrew on wheel hub is falling within the specified values.

$$f = 1,5 \div 2 \text{ (mm)}$$

Adjust the setscrews if these values are not found.

Figure 24



Checking the steering hydraulic modulation device with the vehicle running

The steering hydraulic modulation check is made with the vehicle in full load condition, running at low speed.

Turn the steering wheel until the hydraulic servocontrol no longer operates.

In this position it should still be possible to turn the steering wheel to reach the striker plate between the wheel stop components; if it is not possible, adjust again.

4-axle vehicles



This power steering system is fitted with automatic hydraulic steering modulation device. Hence, with disassembled power steering or disconnected linkage, it shall be controlled in both directions without hydraulic assistance and to 33° steering lever max. angle and ≤ 10 N force measured on the steering wheel (steering wheel diameter: 500 mm).



Described procedure must be performed after wheel toe-in adjustment.

Proceed as follows:

- ☐ operate with unladen vehicle;
- ☐ set each front wheel on a turntable.

First axle

- ☐ connect a gauge to the delivery pipe connection of the power steering servo circuit 1;



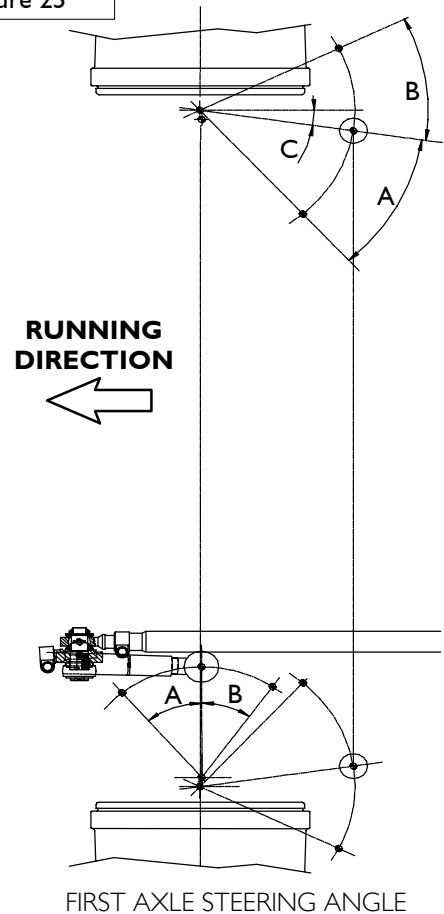
The new steering box (spare part) is adjusted to the max. steering angle. For this reason, when replacing the steering box with a new one (spare part), adjustment must be performed by SCREWING the adjusting screws only to avoid removal from their seats due to hydraulic operating pressure.

- ☐ start engine and run it to approx. 1500 rpm by the hand accelerator control;
- ☐ steer until the gauge indicates a pressure drop due to power steering hydraulic stop intervention (which must take place before mechanical stop intervention); in this position the steering geometry shall comply with the specified angle values.



Should the mechanical stop be intervening before the hydraulic one, stop steering to avoid damages to the stop and to the pump components (150 bar max. pressure) and reset a suitable clearance to perform adjustment.

Figure 25

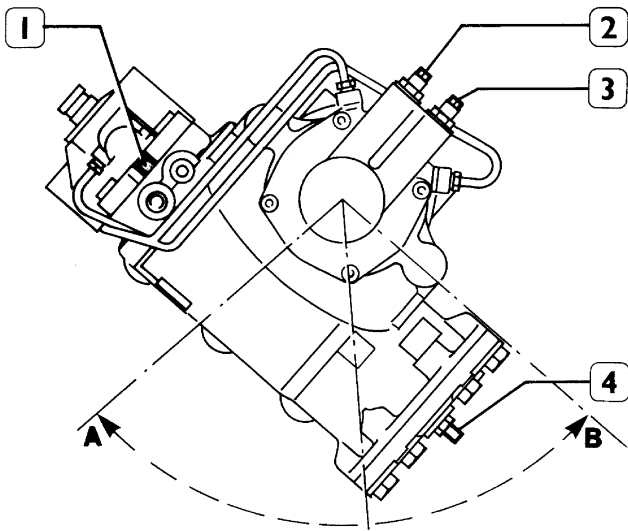


FIRST AXLE STEERING ANGLE

8x4 vehicles

tyres	A	B	C
angles			
13 R 22,5	45°	35°30'	12°52'
12.00.20	45°	35°30'	12°52'
315/80	45°	35°30'	12°52'
12.00.24	40°	32°42'	12°52'
14.00.20	40°	32°42'	12°52'

Figure 26



- 1 - Hydraulic steering limiter adjusting screw for rotation in direction "A" of steering control arm (power steering servo circuit 1).
- 2 - Hydraulic steering limiter adjusting screw for rotation in direction "B" of steering control arm (operating cylinder servo circuit 2).
- 3 - Hydraulic steering limiter adjusting screw for rotation in direction "A" of steering control arm (operating cylinder servo circuit 2).
- 4 - Hydraulic steering limiter adjusting screw for rotation in direction "B" of steering control arm (power steering servo circuit 1).

- ☐ If these values are not found, proceed with adjustment operating respectively:
on screw 1 for rotation in direction A of the steering arm;
on screw 4 for rotation in direction B of the steering arm.

When the required angle has been obtained but the pressure drop has not took place yet, screw (clockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

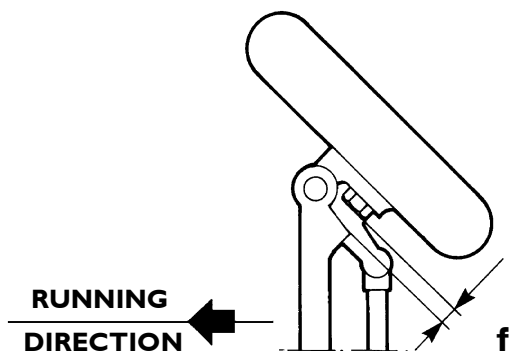
When the required angle is not obtained but the pressure drop has already took place, unscrew (anticlockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

- ☐ Tighten then the lock nut to 30 ± 5 Nm (3 ± 0.5 kg); proceed in the same way to adjust the wheel stop on the opposite side.
- ☐ Once the hydraulic steering modulating device is adjusted, check whether, when steering down in both directions up to hydraulic pressure drop, distance "f" between axle and setscrew on wheel hub is falling within the specified values.

$$f = 1,5 \div 2 \text{ (mm)}$$

Adjust the setscrews if these values are not found.

Figure 27

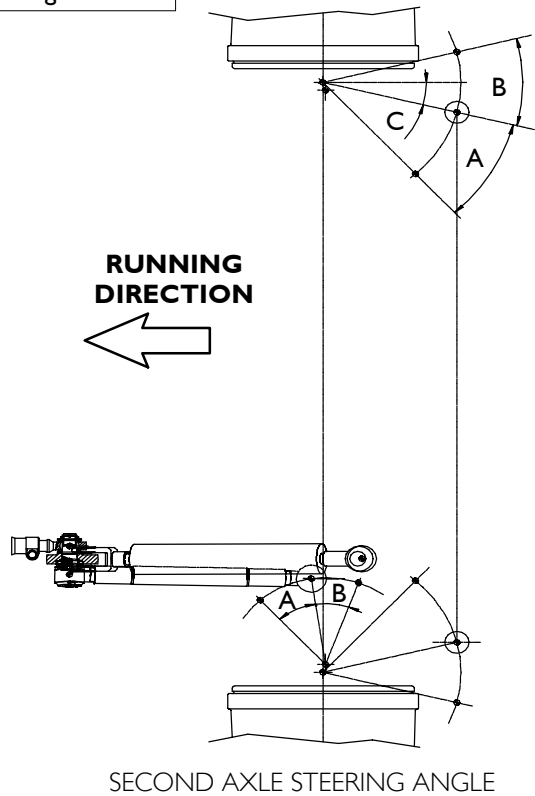


Second axle

Connect the gauge to the delivery pipe of the operating cylinder servo circuit 2.

- ☐ steer until the gauge indicates a pressure drop due to power steering hydraulic stop intervention (which must take place before mechanical stop intervention); in this position the steering geometry shall comply with the specified angle values.

Figure 28

**8x4 vehicles**

tyres	angles	A	B	C
13 R 22,5		35°48'	26°49'	19°59'
12.00.20		35°48'	26°49'	19°59'
315/80		35°48'	26°49'	19°59'
12.00.24		32°07'	24°56'	19°59'
14.00.20		32°07'	24°56'	19°59'

- ☐ If these values are not found, proceed with adjustment operating respectively:
on screw X for rotation in direction A of the steering arm;
on screw Y for rotation in direction B of the steering arm.

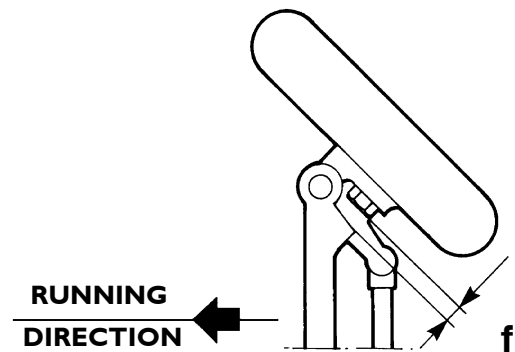
When the required angle has been obtained but the pressure drop has not taken place yet, screw (clockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

When the required angle is not obtained but the pressure drop has already taken place, unscrew (anticlockwise) the corresponding steering modulating valve until obtaining the correct adjustment.

- ☐ Tighten then the lock nut to 30 ± 5 Nm (3 ± 0.5 kg); proceed in the same way to adjust the wheel stop on the opposite side.
- ☐ Once the hydraulic steering modulating device is adjusted, check whether, when steering down in both directions up to hydraulic pressure drop, distance "f" between axle and setscrew on wheel hub is falling within the specified values.

Adjust the setscrews if these values are not found.

Figure 29

**Checking the steering hydraulic modulation device with the vehicle running**

The steering hydraulic modulation check is made with the vehicle in full load condition, running at low speed.

Turn the steering wheel until the hydraulic servocontrol no longer operates.

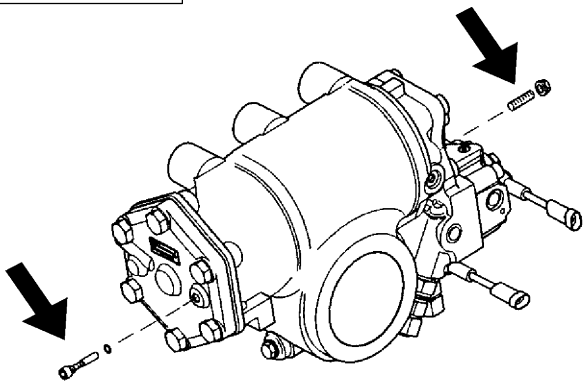
In this position it should still be possible to turn the steering wheel to reach the striker plate between the wheel stop components; if it is not possible, adjust again.

AUTOMATIC STEERING LIMITER ADJUSTMENT



This power steering is fitted with automatic full lock angle limitation. It is absolutely essential that the angular shift of the lever on the steering box BEFORE mounting and/or during adjustment of steering and track rods DOES NOT EXCEED the maximum angular shift reachable AFTER adjustment of hydraulic pressure limitation, because otherwise pressure would not reduce at steering limit due to the altered positioning of the bushes.

Figure 30



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However, if this should happen the adjuster bushes MUST be replaced with new ones (ZF N° 8098 230 102).

For the same reason, if a further reduction to the originally set steering angle is required, new adjuster bushes must be fitted (ZF N° 8098 230 102). An increase in the steering angle is instead always possible.

Proceed as follows:

- ☐ work with the vehicle unladen;
- ☐ position each of the vehicle front wheels on a revolving platform;
- ☐ Fit and adjust the steering rods and limit stops for the axles to the specified steering angle values;
- ☐ adjust front wheel toe-in;
- ☐ start the engine and leave it idling:
if necessary increase speed by means of the throttle;
- ☐ fully and slowly turn the steering wheel in both directions to reach max steering angle or up to the limit for the axle.



Check that the limit for the axle is effectively reached, otherwise hydraulic power steering power will be significantly reduced before reaching the limit.

It is possible to make a check as follows:

- ☐ insert a pressure gauge (end scale minimum 200 bar) on the check socket on the delivery pipe a between pump and power steering;
- ☐ turn the steering wheel applying torque of 50 ± 20 N m (corresponding to 200 ± 80 N on steering wheel with diameter 500 mm) up to the limit set for the axle;
- ☐ the pressure value must be between the limits of 35 and 70 bar.

if pressure is too high, the adjuster bushes must be replaced with new ones, and the adjustment operation repeated.

In case of excessively low pressure, check hydraulic system function and seal.

PNEUMATIC SYSTEM - BRAKES

SECTION 16

SECTION 16

Pneumatic system - brakes

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DESCRIPTION

Service braking

Pneumatically controlled pedal type, operating on all the wheels and the trailer.

It features two separate sections, one to activate the front axle braking components, the other for the rear axle components. A third section, assisting the two distributor sections, brakes the trailer.

The duplex distributor controls the two separate sections and the triple control servo distributor that in its turn controls the third section.

Should a failure occur in one section, the pneumatic system sectioning enables the others to operate efficiently.

Emergency braking

This is combined with the parking braking. The double circuit system enables the braking of one axle even when there is a failure in the braking of the other axle, by means of the service brake pedal and the parking hand lever.

Slow-down braking

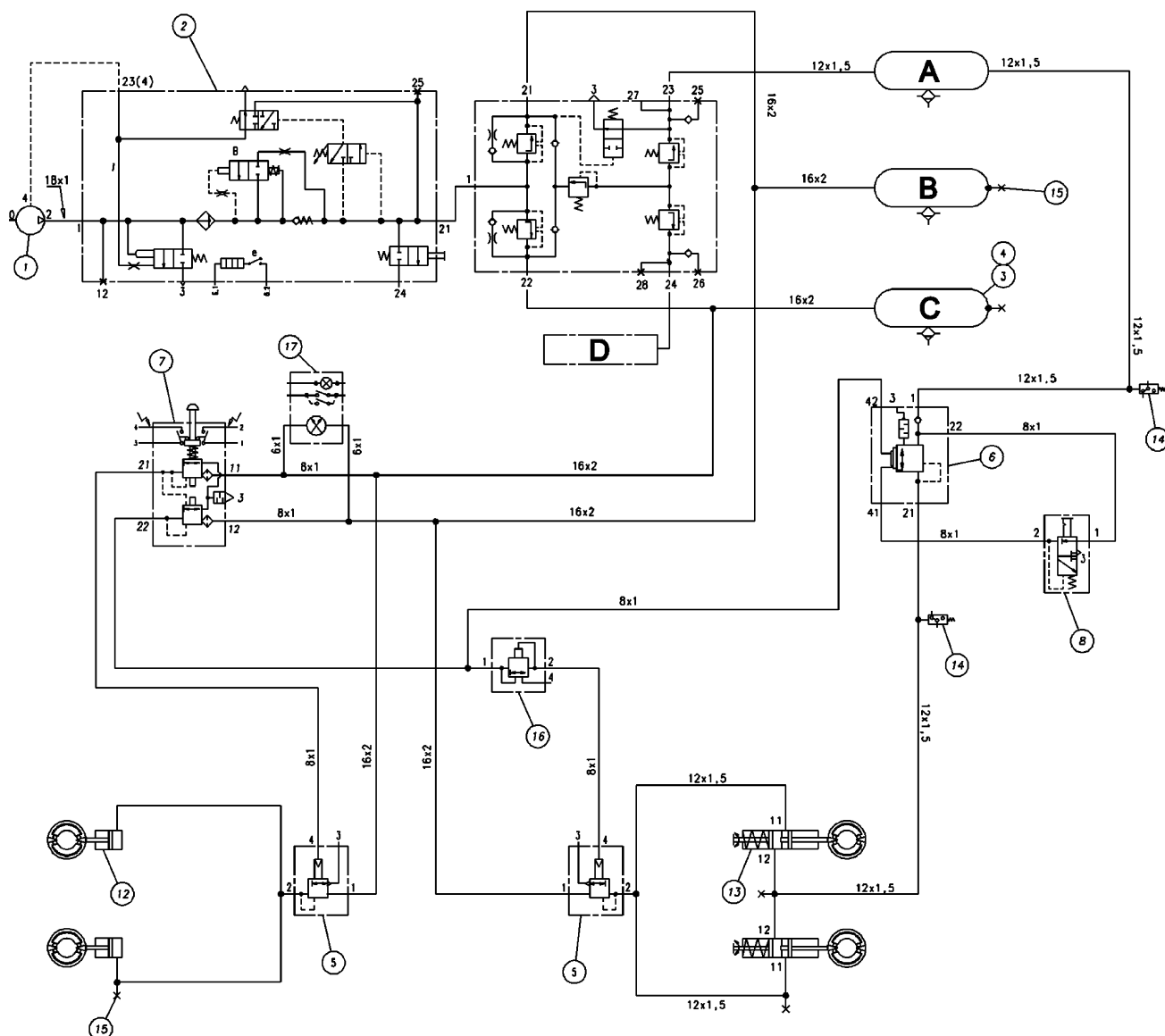
This is obtained by the annulling of the injection pump and at the same time the temporary closure of the throttle valve on the discharge manifold through the separate pedal control.

Parking braking

This is mechanical and actuated through the hand distributor set at the end of its stroke. It operates on the rear wheels of the tractor discharging the air from the spring section of the pneumatic cylinder and the servo distributor control section, thus locking the trailer or semi-trailer wheels.

From the driver's seat it is possible to check whether the trailer is able, with the trailer brakes released, to ensure the efficiency of the combined tractor-trailer parking brake.

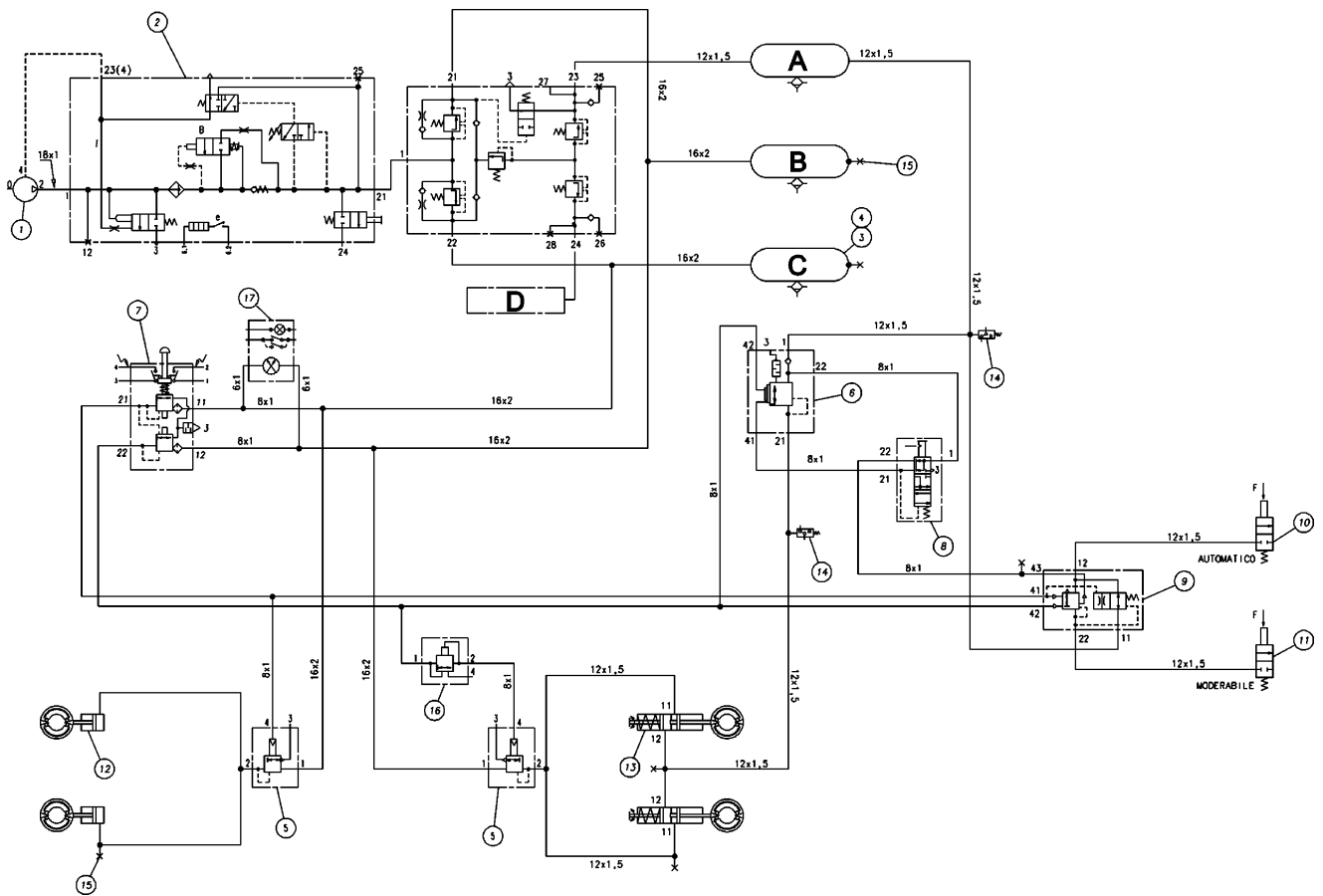
BRAKING SYSTEM DIAGRAM 4x4 vehicles without tow hook



- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticompound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Not used
- 10 Not used
- 11 Not used
- 12 Brake cylinder (22"x 180) 4x4
- 13 Combined brake cylinder (16"x 190/7300N)
- 14 Pressure switch (6.6 bar)
- 15 Test union
- 16 Pressure control
- 17 Pressure gauge (6.5 bar)

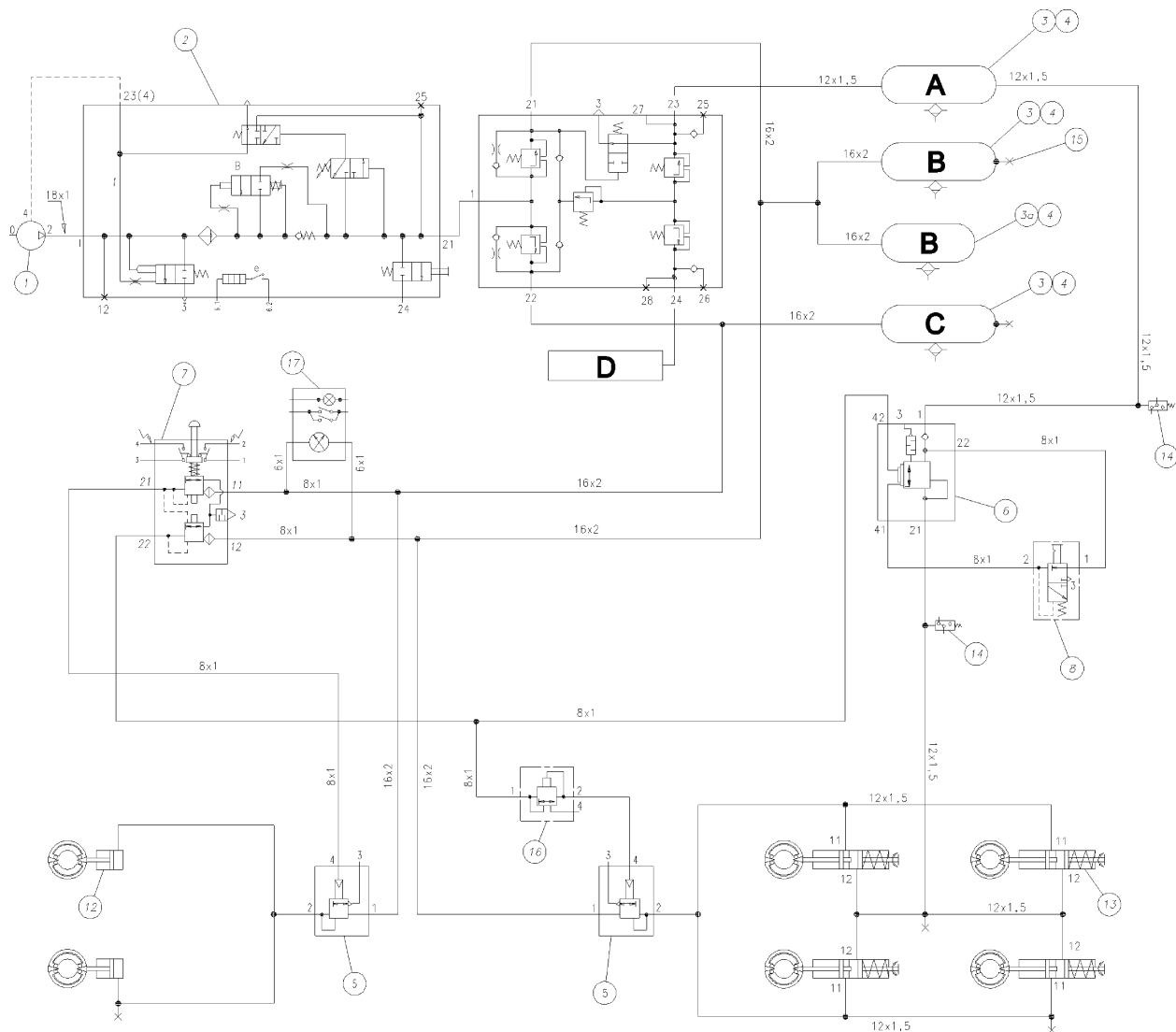
- A = Hand brake
- B = Rear
- C = Front
- D = Services

BRAKING SYSTEM DIAGRAM 4x4 vehicles with tow hook



- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticompound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Trailer brake control valve (pred 0.2)
- 10 Adjustable coupling head
- 11 Automatic coupling head
- 12 Brake cylinder (22"x 180) 4x4
- 13 Combined brake cylinder (Chassis) (16"x190/7300N)
- 13 Combined brake cylinder (Tractor) (20"x190/7300N)
- 14 Pressure switch (6.6 bar)
- 15 Test union
- 16 Pressure control
- 17 Pressure gauge (6.5 bar)

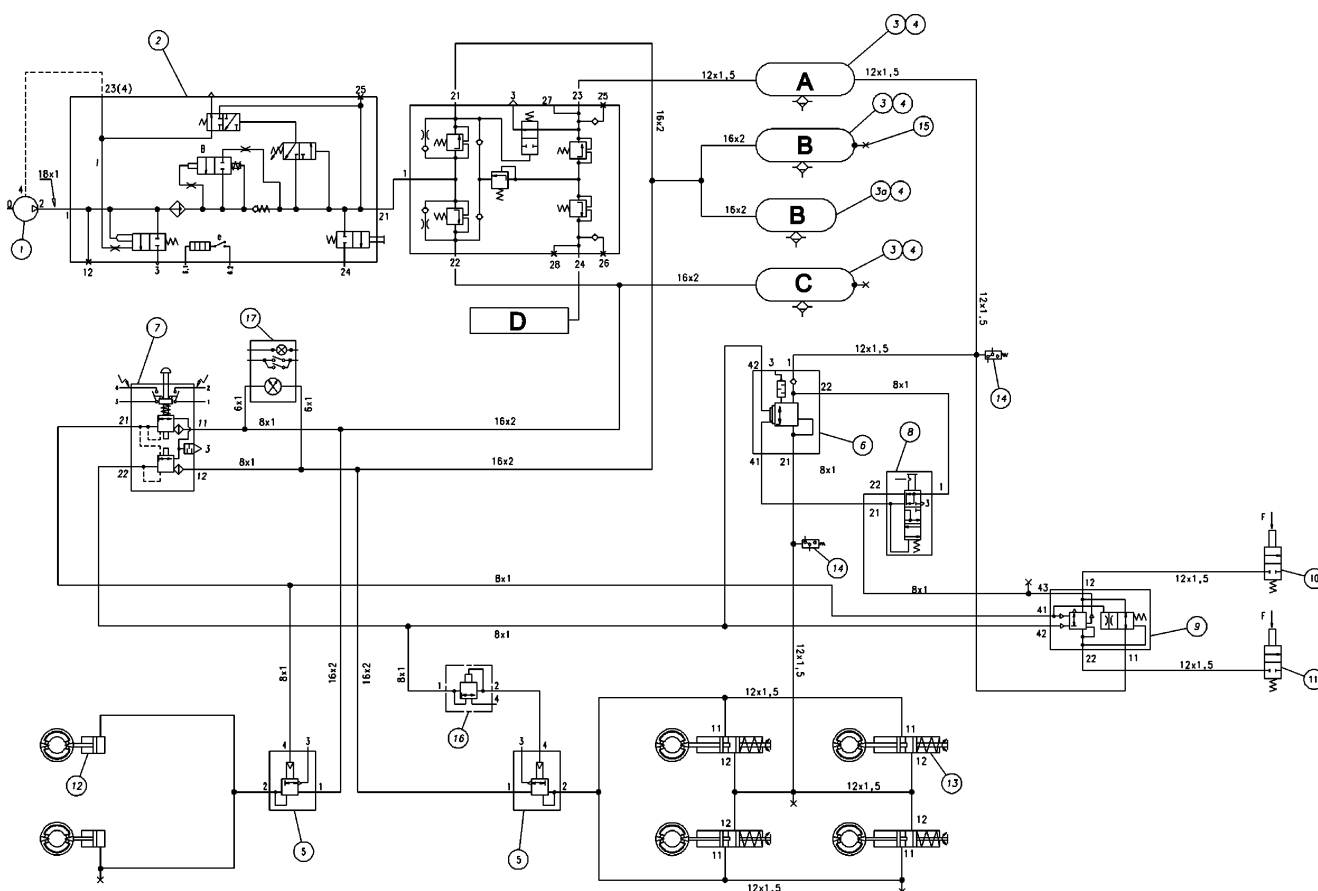
- A = Hand brake
B = Rear
C = Front
D = Services

BRAKING SYSTEM DIAGRAM**6x4 and 6x6 vehicles without tow hook**

- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 3a Tank (20 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticompound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Not used
- 10 Not used
- 11 Not used
- 12 Brake cylinder (24"x 275) 6x4
- 12 Brake cylinder (24"x 180) 6x6
- 13 Combined brake cylinder (24"x190 / 7300N)
- 14 Pressure switch (6.6 bar)
- 15 Test union
- 16 Pressure control
- 17 Pressure gauge (6.5 bar)

- A = Hand brake
- B = Rear
- C = Front
- D = Services

BRAKING SYSTEM DIAGRAM 6x4 and 6x6 vehicles with tow hook

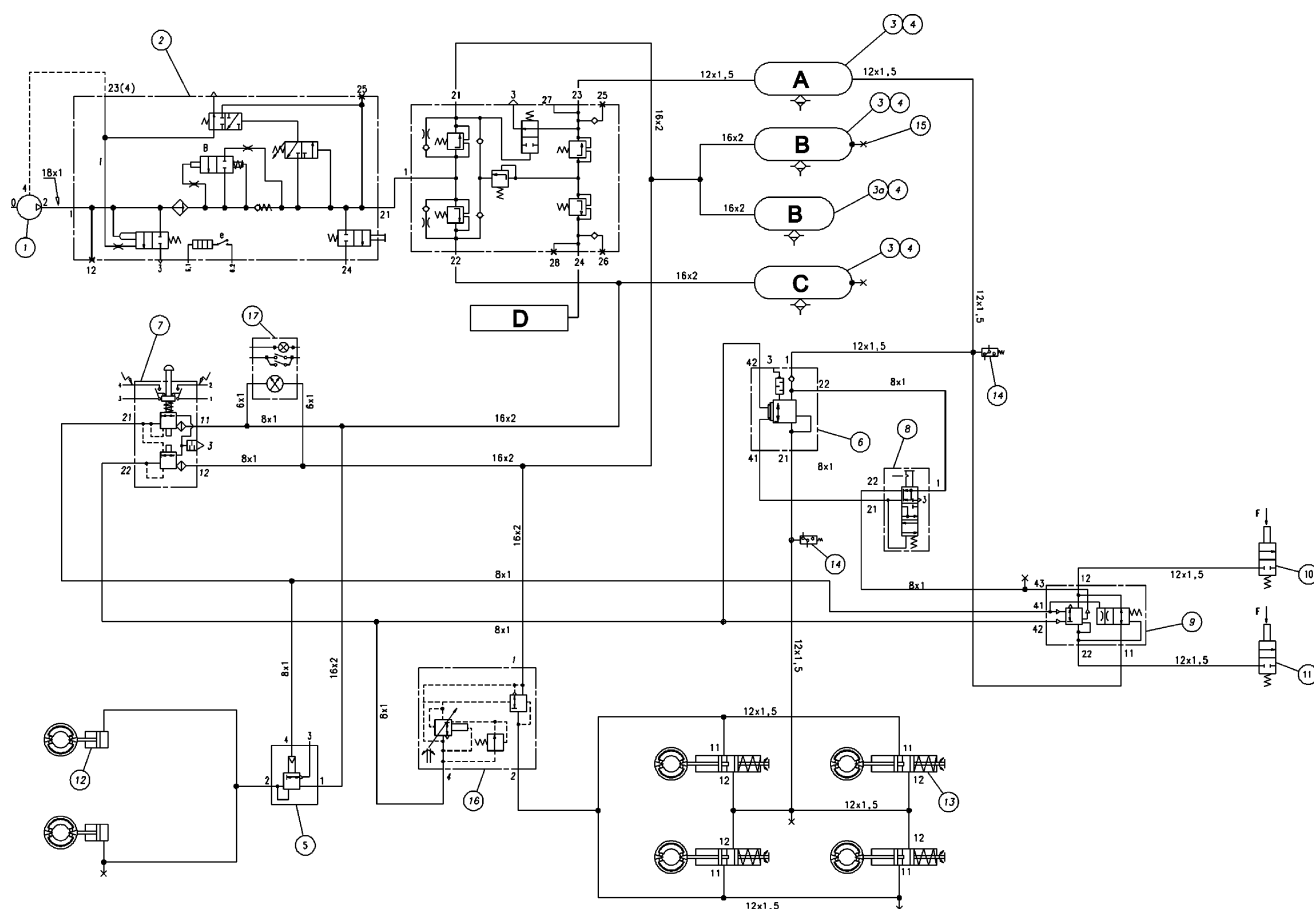


- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 3a Tank (20 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticomound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Trailer brake control valve (pred 0.2)
- 10 Adjustable coupling head
- 11 Automatic coupling head
- 12 Brake cylinder (24"x 275) 6x4
- 12 Brake cylinder (24"x 180) 6x6
- 13 Combined brake cylinder (24"x190/7300N)
- 14 Pressure switch (6.6 bar)
- 15 Test union
- 16 Pressure control
- 17 Pressure gauge (6.5 bar)

- A = Hand brake
- B = Rear
- C = Front
- D = Services

BRAKING SYSTEM DIAGRAM

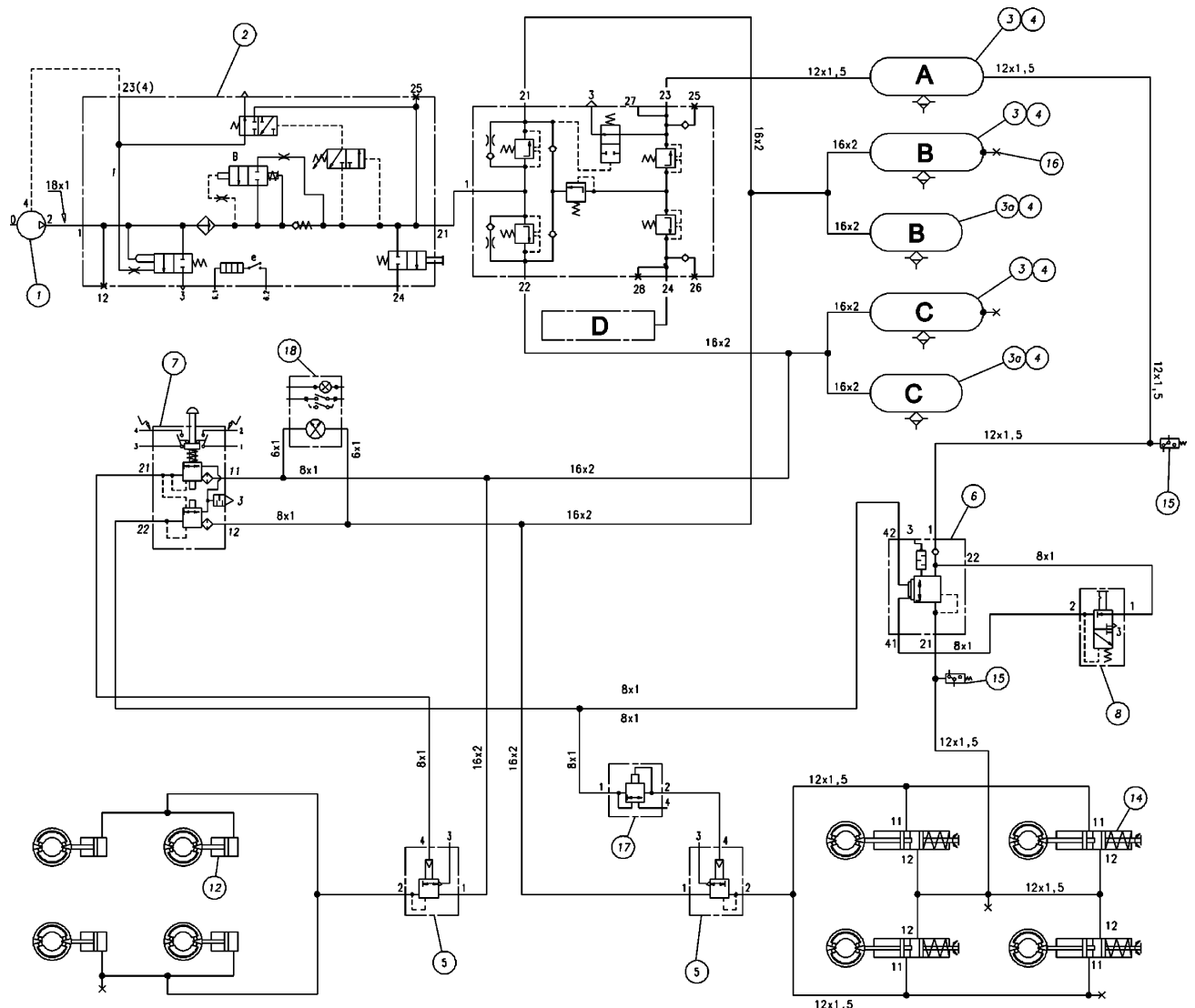
6x4T and 6x6T vehicles with tow hook



- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 3a Tank (20 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticomound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Trailer brake control valve (pred 0.2)
- 10 Adjustable coupling head
- 11 Automatic coupling head
- 12 Brake cylinder (24" x 275) 6x4
- 12 Brake cylinder (24" x 180) 6x6
- 13 Combined brake cylinder (24" x 190 / 7300N)
- 14 Pressure switch (6.6 bar)
- 15 Test union
- 16 Pressure control
- 17 Pressure gauge (6.5 bar)

- A = Hand brake
 B = Rear
 C = Front
 D = Services

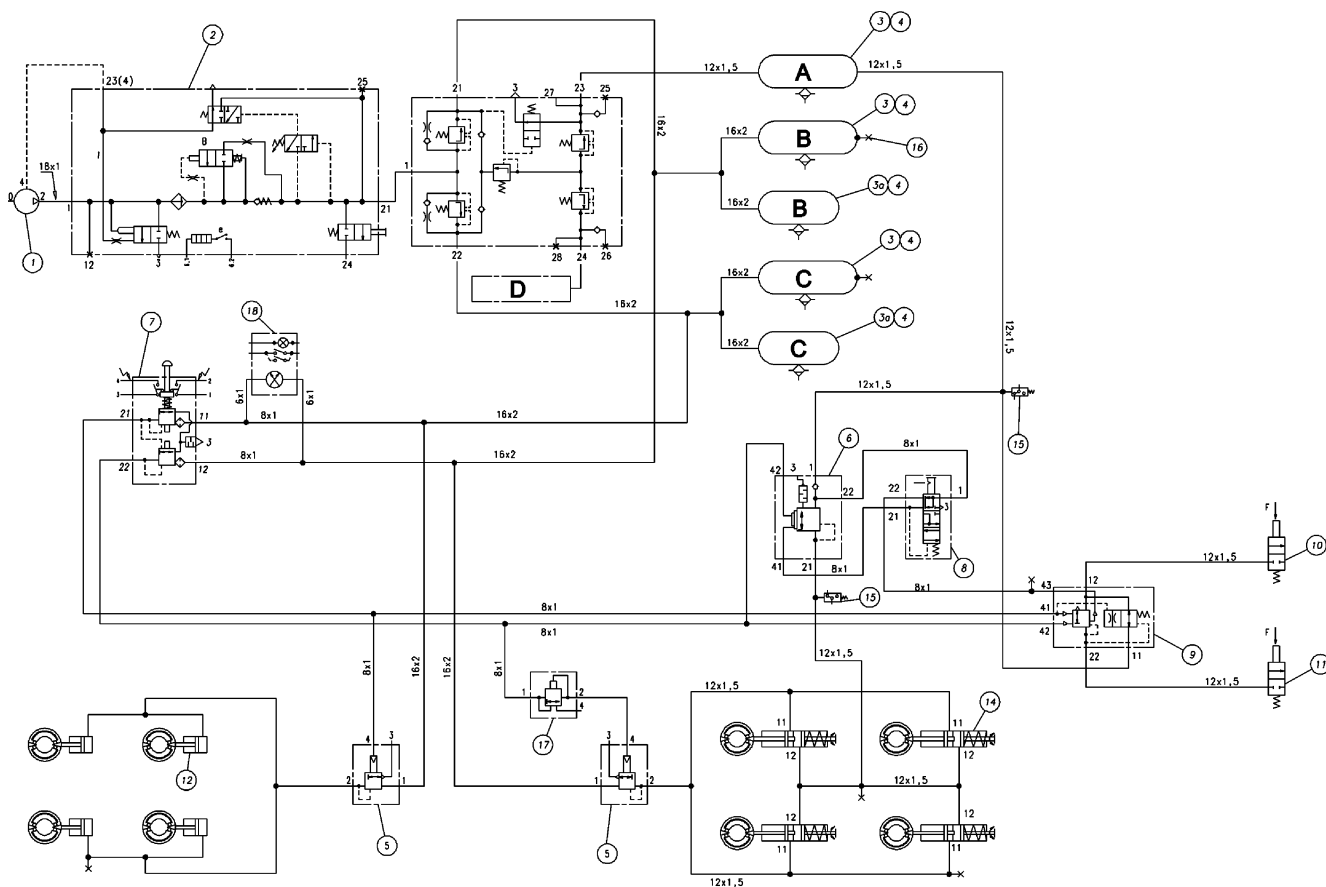
BRAKING SYSTEM DIAGRAM 8x4 vehicles without tow hook



- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 3a Tank (20 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticomound relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Not used
- 10 Not used
- 11 Not used
- 12 Brake cylinder (24"x 275) 8x4
- 13 Not used
- 14 Combined brake cylinder (16"x190/7300N)
- 15 Pressure switch (6.6 bar)
- 16 Test union
- 17 Pressure control
- 18 Pressure gauge (6.5 bar)

- A = Hand brake
B = Rear
C = Front
D = Services

BRAKING SYSTEM DIAGRAM 8x4 vehicles with tow hook



- 1 Air compressor
- 2 Air drier
- 3 Tank (30 l)
- 3a Tank (20 l)
- 4 Condensation drain valve
- 5 Relay valve
- 6 Anticomponent relay valve
- 7 Duplex distributor 7.6 bar
- 8 RVM cock
- 9 Trailer brake control valve (pred 0.5)
- 10 Adjustable coupling head
- 11 Automatic coupling head
- 12 Brake cylinder (24"x 275) 8x4
- 13 Not used
- 14 Combined brake cylinder (16"x 190/7300N)
- 15 Pressure switch (6.6 bar)
- 16 Test union
- 17 Pressure control
- 18 Pressure gauge (6.5 bar)

- A = Hand brake
B = Rear
C = Front
D = Services

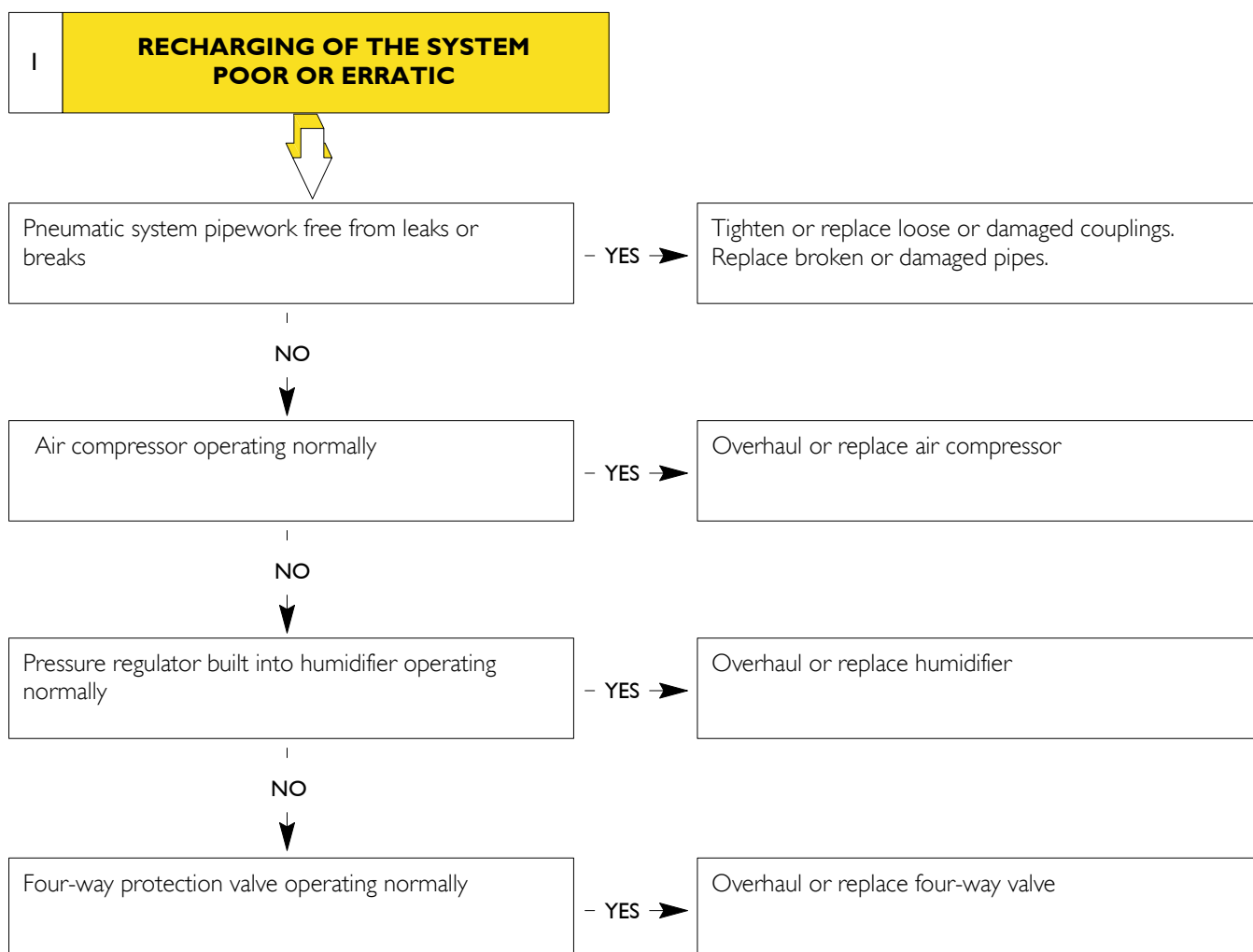
- 1 Valve (splitter enabling)
- 2 Midiservo
- 3 Valve (PTO flywheel control)
- 4 Valve (PTO gearbox control)
- 5 Valve (transfer control)
- 6 Valve (locking control)

- 1 Valve (splitter enabling)
- 2 Midiservo
- 3 Valve (PTO flywheel control)
- 4 Valve (PTO gearbox control)
- 5 Valve (transfer control)
- 6 Valve (locking control)

DIAGNOSTICS

Main operating faults in the brake system :

- | | |
|--|---|
| <ul style="list-style-type: none"> 1 - Recharging of the system poor or erratic 2 - Rear axle service braking poor or erratic 3 - Front axle service braking poor or erratic 4 - Trailer service braking poor or erratic 5 - Parking brake poor or inoperative 6 - Parking braking on trailer poor or inoperative 7 - Parking brake slow to release | <ul style="list-style-type: none"> 8 - Trailer parking brake slow to release 9 - Vehicle skids when braking 10 - Inefficient retarder braking on trailer 11 - Rapid brake lining wear 12 - Brake system failure warning light comes on 13 - Parking brake warning light on with lever in drive position |
|--|---|



2

**SERVICE BRAKING ON REAR AXLE
POOR OR ERRATIC**

Pneumatic system pipework free from leaks or cracks

- YES →

Tighten or replace loose or damaged couplings,
Replace broken or damaged pipes.

NO



Load proportioning valve operating normally

- YES →

Adjust or overhaul load proportioning valve and re-
place if necessary

NO



Brake linings free from wear and/or glazing

- YES →

Overhaul or replace brake linings

NO



Rear brake assembly operating normally

- YES →

Overhaul rear brake assembly

NO



Duplex control valve operating normally

- YES →

Overhaul or replace duplex control valve

NO



Brake cylinders operating normally

- YES →

Overhaul or replace brake cylinders

3

**FRONT AXLE SERVICE BRAKING
POOR OR ERRATIC**

Pipework free from leaks or breaks

- YES →

Tighten or replace loose or damaged couplings.
Replace broken or damaged pipesNO
↓

Duplex control valve operating normally

- YES →

Overhaul or replace duplex control valve

NO
↓

Brake linings free from wear and/or glazing

- YES →

Overhaul or replace brake linings

NO
↓

Front brakes operating normally

- YES →

Overhaul front brakes

NO
↓

Diaphragm brake cylinders operating normally

- YES →

Overhaul or replace diaphragm brake cylinders

4

**TRAILER SERVICE BRAKING
POOR OR ERRATIC**

Pipework free from leaks or breaks

- YES →

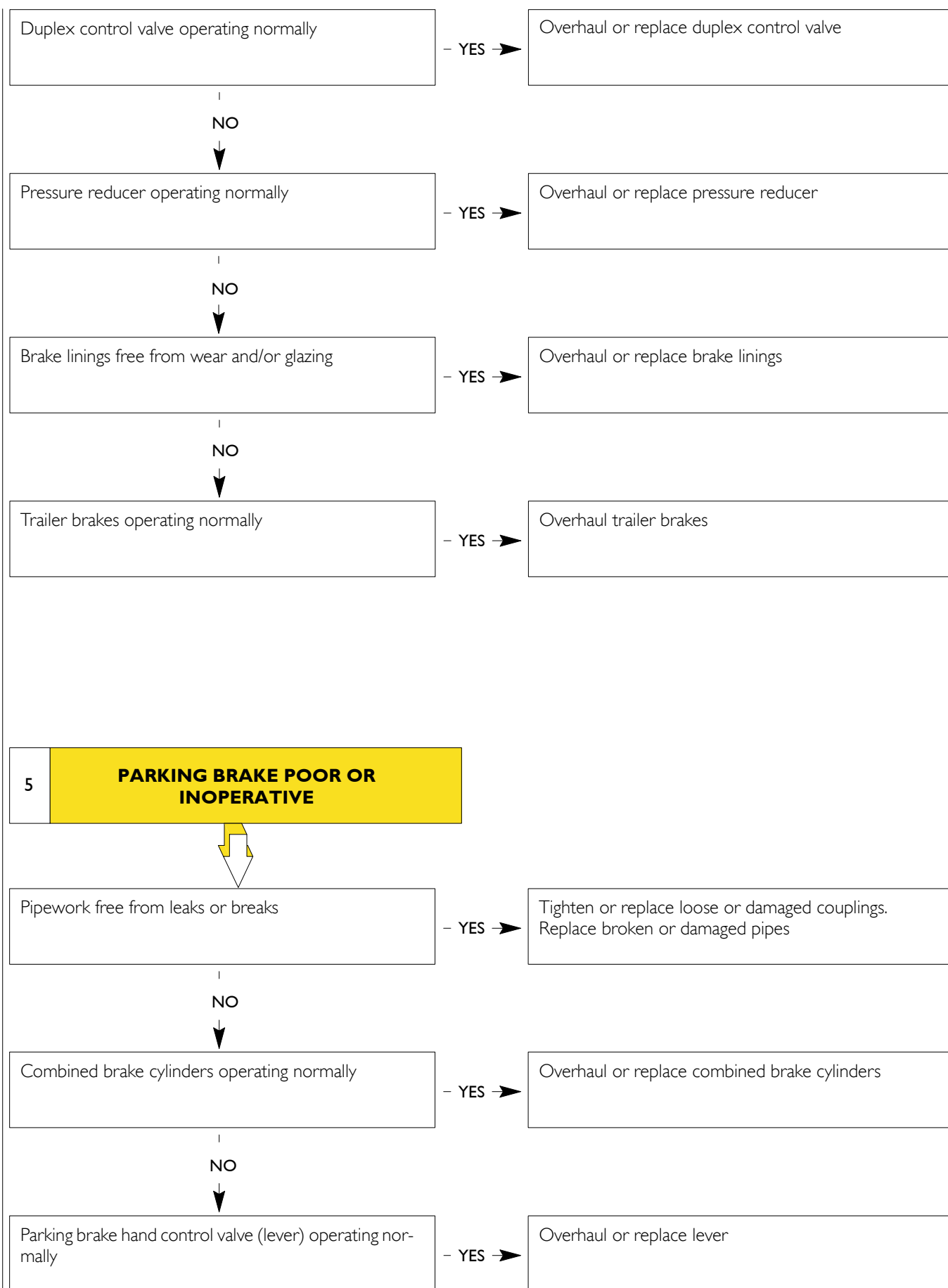
Tighten or replace loose or damaged couplings.
Replace broken or damaged pipesNO
↓

Triple action servo control valve operating normally

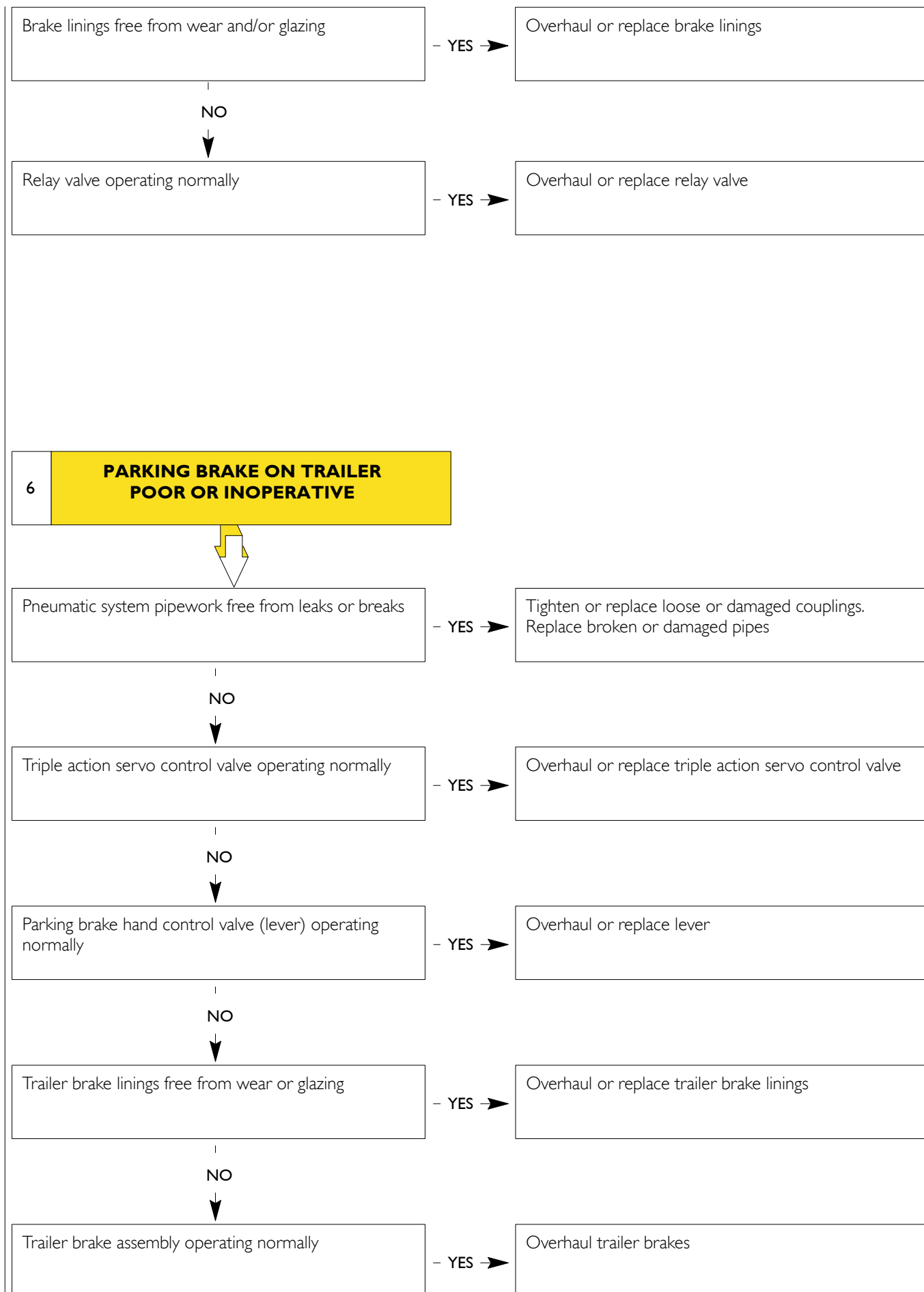
- YES →

Overhaul or replace triple action servo control valve

(continued)



(continued)



7

PARKING BRAKE SLOW TO RELEASE

Pipework free from leaks or breaks

- YES →

Tighten or replace loose or damaged couplings.
Replace broken or damaged pipes.

NO



Relay valve operating normally

- YES →

Overhaul or replace relay valve

NO



Combined brake cylinders operating normally

- YES →

Overhaul or replace combined brake cylinders

NO



Parking brake hand control valve (lever) operating normally

- YES →

Overhaul or replace lever

NO



Rear brake assembly operating normally

- YES →

Overhaul rear brakes

8

TRAILER PARKING BRAKE SLOW TO RELEASE

Pipework free from leaks or breaks

- YES →

Tighten or replace loose or damaged couplings.
Replace broken or damaged pipes

NO



Triple action servo control valve operating normally

- YES →

Overhaul or replace triple action servo control valve

(continued)

Parking brake hand control valve (lever) operating normally

– YES →

Overhaul or replace lever

NO

Trailer brakes operating normally

– YES →

Overhaul trailer brakes

9

VEHICLE SKIDS WHEN BRAKING



Pipework free from breaks or leaks

– YES →

Tighten or replace loose or damaged connections.
Replace broken or damaged pipes

NO

Duplex control valve operating normally

– YES →

Overhaul or replace Duplex control valve

NO

Load proportioning valve operating normally

– YES →

Adjust, overhaul and if necessary replace load proportioning valve

NO

Front brake assembly operating normally

– YES →

Overhaul front brakes

NO

Rear brake assembly operating normally

– YES →

Overhaul rear brakes

NO

Triple-action control valve operating normally

– YES →

Overhaul or replace triple action control valve

10

**INEFFICIENT RETARDER
BRAKING ON TRAILER**

Pipework free from leaks or breaks

- YES →

Tighten or replace loose or damaged couplings.
Replace broken or damaged pipesNO
↓

Pressure reducer operating normally

- YES →

Overhaul or replace pressure reducer

NO
↓

Triple action control valve operating normally

- YES →

Overhaul or replace triple action control valve

NO
↓

Hand control valve (lever) operating normally

- YES →

Overhaul or replace lever

11

RAPID BRAKE LINING WEAR

Duplex control valve operating normally

- YES →

Overhaul or replace duplex control valve

NO
↓

Load proportioning valve operating normally

- YES →

Adjust, overhaul and if necessary replace load proportioning valve

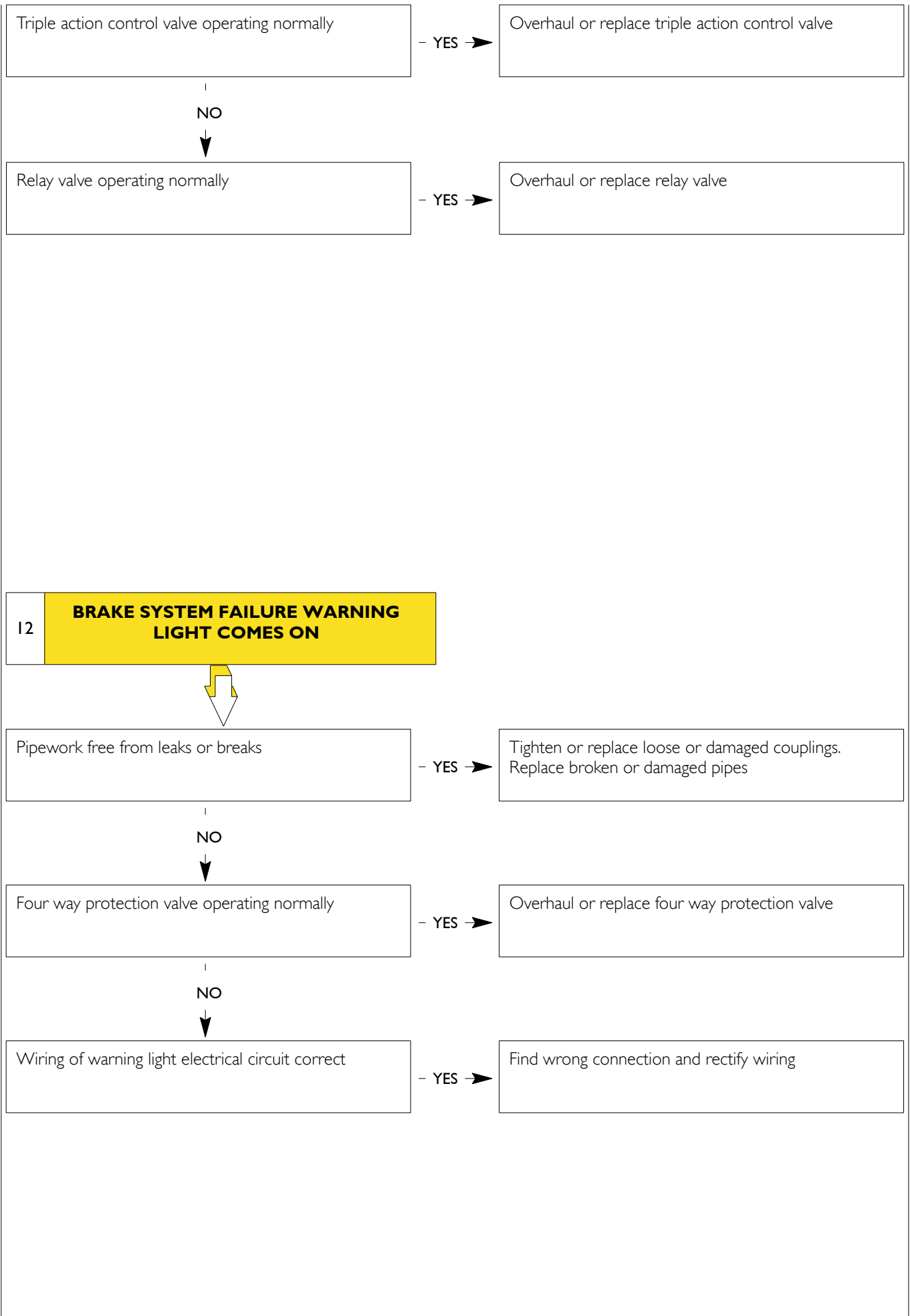
NO
↓

Brake assemblies operating normally

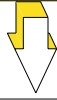
- YES →

Overhaul brakes

(continued)



13

**PARKING BRAKE WARNING LAMP ON
WITH HANDLE IN RUNNING POSITION**

Wiring of warning light electrical circuit correct

- YES →

Find wrong connection and rectify wiring

NO



Parking brake hand control valve (lever) operating normally

- YES →

Overhaul or replace lever

NO



Pressure reducer operating normally

- YES →

Overhaul or replace pressure reducer

TIGHTENING TORQUES

DESCRIPTION	TORQUE	
	Nm (Kgm)	
Compressor		
Pulley fastening nuts		190 ± 10 (19 ± 1)
Screws to fasten head on 250 cu.cm Bendix compressor	cover to head check screws	24 ± 1 (2,4 ± 0,1)
	head fastening screws	42,5 ± 2,5 (4,3 ± 0,2)
Combined cylinder (actuator)		
Brake cylinder ring nut		314,5 ± 31,5 (32 ± 3,2)
Nuts for spring section to diaphragm section retaining clamp		10 ± 1 (1 ± 0,1)
Screw for manually operated brake release		15 ± ²⁰ ₀ (1,5 ± ² ₀)
Diaphragm brake cylinder (for drum brakes)		
Brake cylinder ring nut		314,5 ± 31,5 (32 ± 3,2)
Nuts for spring section to diaphragm section retaining clamp		10 ± 1 (1 ± 0,1)

TOOLS

TOOL NO.	DESCRIPTION
99356606	Wrench for removal and re-fitting in place combined brake cylinders ring nut
99387050	Cutting nippers for polyamide hoses
99395216	Pair of protractors for angle tightening

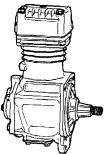
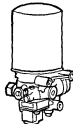
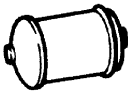
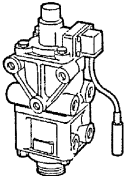
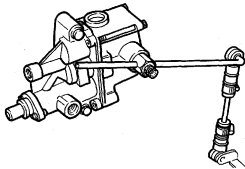
BRAKING SYSTEM MAIN COMPONENTS CHECK

Since the vehicle system is approved according to European road code standards, it is necessary that the efficiency and components are periodically checked using tool 99305117.

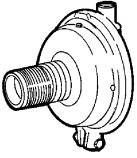
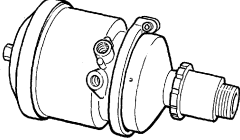
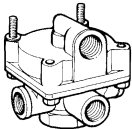
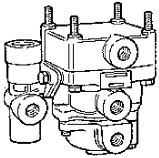
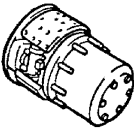
The checks are carried out with the vehicle at a standstill, using compressed air from the tanks, recharged, with the engine running, by the compressor:

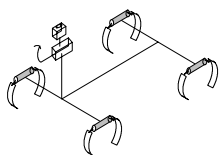


Always check the vehicle before any intervention. Periodically check the gauges by comparison with a sample gauge.

DEVICE	DESIGNATION	CHECKS
	Compressor	Check the tightness of fittings and that the compressor is securely fastened. Make sure the cooling fins are not dirty.
	Drier (optional)	Operate on a bleeder valve or loosen a screwed plug (with integrated bleeder hole) to check that the air drier is operating correctly. The air should come from the tank with no signs of condensate water.
	Air tanks for : Front axle Rear axle Parking+trailer Services Regeneration	Check the seal and anti-rust protection. Discharge the condensate from the tanks through the bleeder valve
	Four way safety valve	Check : Maximum opening pressure 8 bar Static closing pressure 6.5 bar
	Duplex distributor	Press the pedal to the end of its stroke, releasing the pedal it should return immediately to its home position. Pressure restriction 7.6 ± 0.3 bar Check that the pedal gasket is not worn, that the brake control rods are well secured and lubricated with no strain. Check that the lever housings are not worn or oxidized.
	Pneumatic pressure control socket	Ensure that the protection plugs are inserted
	Parking brake distributor (with checking position)	Operate on the parking brake distributor until it triggers, the gauge on the control socket is to indicate the pressure discharge 0 bar in 1 second. The automatic coupling joint pipe and the gauge are to indicate at the same time a pressure of 8.5 bar
	Engine brake control pedal distributor	Check functioning and seal
	Braking control	The plate indicates all the set values to be compared to those found when checking and adjusting.

(cont'd)

	Diaphragm cylinder	Check fastening, integrity and seal The bleeder hole should be directed downwards and not clogged
	Combined cylinder	Check fastening, integrity and seal. The bleeder hole should be directed downwards and not clogged
	Relay valve	Check operation and seal assessing the speed of brake cylinder activation
	Engine brake control operator cylinder	Check operation and seal
	Pressure reducer	Check set pressure (see specifications and data table) Check operation
	Triple control servo distributor for trailer braking, with incorporated modulated power steering	Fill the tank. Connect a gauge to the automatic coupling head and to a variable coupling head. At a pressure of 1 bar, coming from the duplex distributor, the variable coupling head should have a pressure between 0.8 and 1.5 bar. Make a full braking (vehicle at a standstill). Prescribed pressure must result at the coupling head, or a pressure that is 0.5 bar less. Activate the parking brake; at the variable coupling head the pressure should remain the same, or reduced by 0.5 bar.
	Coupling heads	Check there is no dirt or damage on the coupling guides. After coupling, operate the brake pedal and check the seal and stability between the coupling heads when delivering air at 7.5 bar. Check there are no air leaks from the coupling gaskets.
	Rear drum brakes	Releasing the pedal the shoes should return quickly and evenly to home position. Check backlash between shoes and drum. Check thickness of brake linings.

**Pipes and fittings**

Ensure that metal pipes are in perfect condition, with no dents or cracks. Polyamide hoses must have no cracks, cuts or scores. Also make sure that they are not near sharp edges of the bodywork or chassis that could damage them. Check that all the brackets fastening the pipes are securely fixed - loose fastenings cause vibrations that could give rise to breakages. Check that polyamide hoses are not in contact with oil or mineral grease, rubber solvents. Press hard on the brake pedal and check that the pipes are not blown. Check there are no leaks from fittings, otherwise tighten them fully, taking care when tightening not to cause irregular pipe torsion. In all the above cases the parts are to be replaced if there is a minimum of doubt as to their efficiency. Apart from their condition, it is recommended to replace hoses after considerable mileage, or after a period of long vehicle use. This will avoid sudden breakages due to age and fatigue.

Pneumatic system seal with engine off below the starting pressure

This check is made on threaded couplings. Deliver air at a pressure of not less than 5 bar and spread quite thick soapy water on the joints and couplings using a soft brush, then observe carefully for signs of leaks. An air leak is within tolerance if it corresponds to a soap bubble with a diameter of 25 mm in 5 seconds, or a pressure drop within 10 minutes amounting to 2% of the disengagement pressure (0.22 ± 0.02 bar).

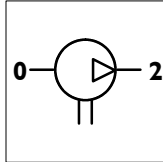
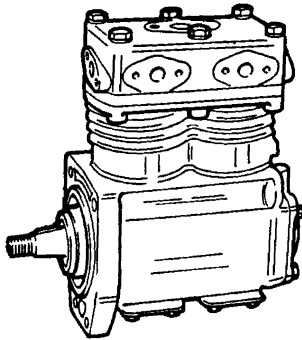
Pneumatic system seal in partial braking range with 3 bar.

For 3 minutes the pressure must remain stabilized in the pneumatic system. The check is made with the parking brake deactivated.

BRAKING SYSTEM MAIN COMPONENTS

Compressor

Figure 1

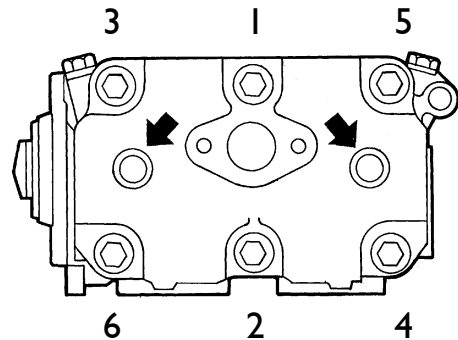


304111

Produces sufficient compressed air to feed the braking system and ancillary services.

Head locking screw torques

Figure 2



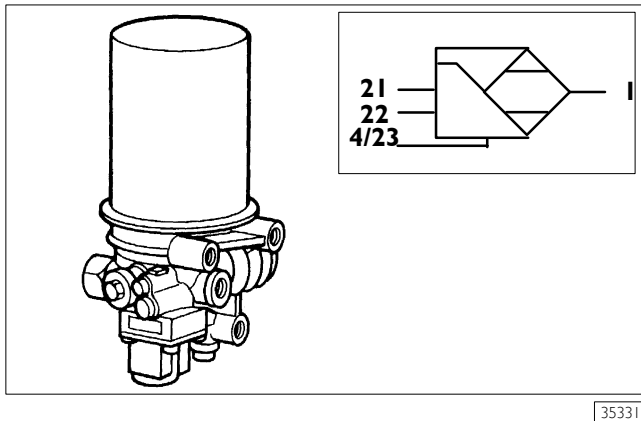
Following the sequence indicated in the figure tighten the cylinder head fastening screws to the prescribed torque. Tighten cylinder head cover fastening screws (arrow) to the prescribed torque.

Diagnostic

TROUBLE	POSSIBLE CAUSES	CURE
Oil leakage from flange on outer side	Incorrect driving torque	Tighten the screws to the prescribed values
	Flange body sealing surface not perfectly flat	Check the sealing surfaces, replace faulty parts or straighten them
	Broken gasket	Replace the gasket
	Shaft gasket damaged	Replace the gasket
Oil leakage from head	Damaged scraper ring (this can be seen because the whole seal seat is shiny)	Replace the entire piston
	Scraper ring is badly fitted	Fit in place with the TOP inscription turned towards the compressor head
	Scraper rings and piston rings are all on the same vertical line.	Fit in place at 120° with reference to each other
	Scored or ovalized cylinder	Grind the cylinder and fit a bigger piston
No compression at all	Deteriorated compression or intake valve	Replace the faulty parts
	Piston rings are all on the same vertical line	Fit the rings at 120° with reference to each other
	Piston perforated or piston elements broken	Replace the entire piston
	Damaged gasket	Replace the gaskets
	Energy-saving device set on open during charging stage.	Replace the cylinder heads
Poor efficiency	Worn piston rings	Replace the piston (and piston rings)
	Air leakage between cylinder and head	Replace the gasket and tighten the screws to the prescribed torque
	Deteriorated energy saving unit, intake or compression valves	Replace the faulty parts
	Too much backlash between piston and cylinder	Grind the cylinder and fit a bigger piston
	Particles of carbonized oil between the intake and compression valves	Clean the valves
Mechanical noises	Too much backlash between small end and pin, between pin and piston hole, between shaft and big end, between shaft and bronze caps and between flanges and shaft.	Check the tolerances of the couplings involved
	Too much backlash between piston and cylinder	Grind the cylinder and fit a bigger piston
	Excessive deposits between piston and cylinder head caused by burnt oil.	Clean the incrustations and replace the valves
Water seepage	Head gasket or contact surfaces scored and uneven.	Replace the faulty parts

Drier

Figure 3



35331

The drier reduces the humidity content of the compressed air coming from the compressor to prevent condensate accumulating in the system. The compressed air flows through a granular material and the condensate water is absorbed by its crystalline structure. After the regulator triggers the air in the regenerating tank regenerates the material absorbed.

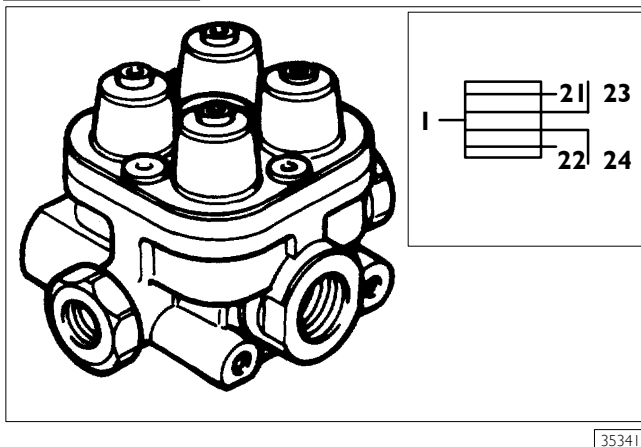
The unit features three main parts: a cartridge containing the absorbent material, a control section and a pressure regulator which, besides regulating the functioning of the entire system, also switches the unit from "Drying" to "Regeneration".

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Too much condensate in the circuit	Clogged filter cartridge	Replace the cartridge
The set pressure is not reached in the tank	Air leaking from safety valve	Overhaul the equipment and replace worn components
	Worn sealing gaskets	Overhaul the equipment and replace worn components
Air loss at discharge	Piston seal is insufficient	Overhaul the equipment and replace worn components

Four-way safety valve

Figure 4



35341

The unit ensures that the compressor, in the case of a fault in one section, charges the tanks connected to the operational sections with a pressure equal to the set pressure of the faulty section.

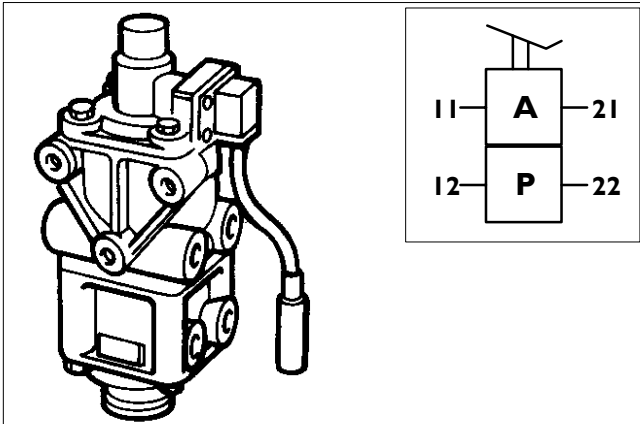
The unit has four similar valve units.

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Air leakage around the plugs	Leakage in the four valve sections	Overhaul the unit and replace worn components
Air leakage when there is a faulty section	Check valves are faulty	Overhaul the unit and replace worn components, if necessary replace the unit

Duplex distributor

Figure 5



33545

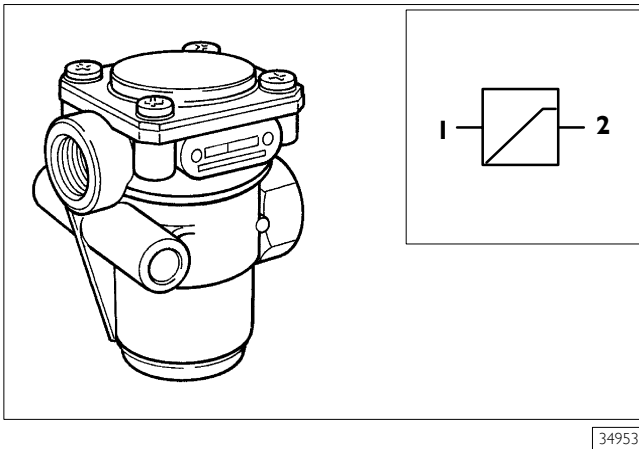
Takes the air from the tank and distributes it to the braking elements. It is autorestrictive i.e. it limits the air output to an established maximum pressure and as a result there is a greater availability of energy and a maximum constant braking pressure regardless of the pressure variations in the tanks. On vehicles fitted out as trucks duplex distributors are fitted to correct the braking force of the front axle elements according to the corrections made by the braking control.

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Air escapes from the discharge hole	Leaks from outlet ducts due to wear on seal gaskets	Overhaul the device and replace worn components
Irregular autorestriction of distributor	Auto restriction higher or lower than required	Adjust the device through the relevant screw
Vibrations when braking	Worn springs Air leaks due to piston gasket seals in the two sections	Overhaul the device and replace faulty components Overhaul the device and replace faulty components
Irregular operation of stop lamp control switch	The electric circuit does not close The electric circuit does not open	Replace the switch Replace the switch

Pressure reducer

Figure 6



34953

Cuts off the compressed air flow to the user when the pressure in the latter reaches a determined value (set point).

Setting at the bench

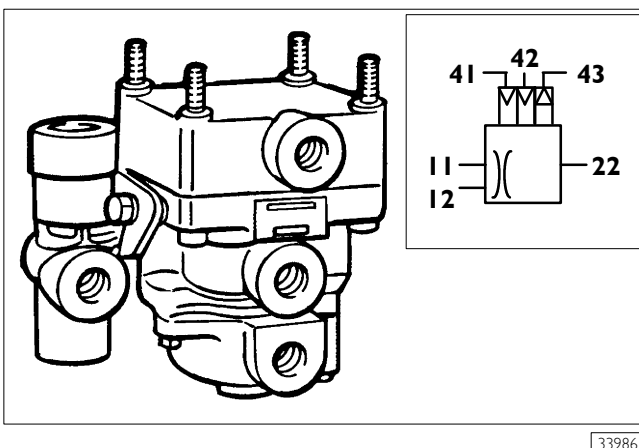
Set the element on the test bench and connect fittings **1** and **2** through the pipes to the gauge and the air supply. Correct to the prescribed value through the adjusting screw and at the same time check the perfect seal of the unit.

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Pressure at the outlet fitting is different to the set value	Valve not adjusted properly Leaks from the seal rings Faulty piston and relevant seat	Adjust the unit Overhaul the unit replacing damaged components Replace the unit

Triple control servo distributor

Figure 7



33986

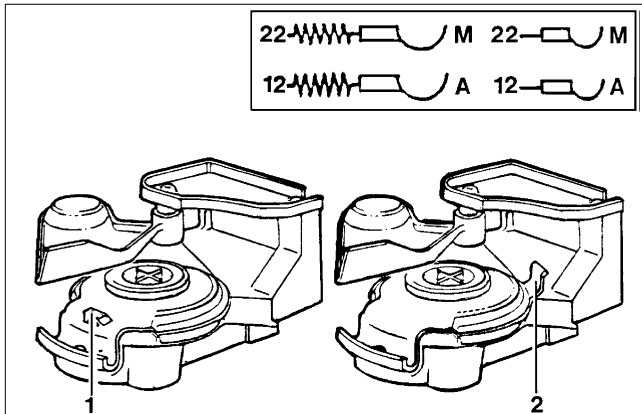
The unit, controlled by two separate circuits of the duplex distributor and the tractor spring brake circuit, controls the trailer braking. It is also equipped with a predominance regulating device fitted on the lower external part. The unit incorporates a device to actuate the trailer brake should there be a fault in the control pipe.

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Air leakage from exhaust when in resting condition	Leaks from sealing gaskets. Faulty exhaust valve and valve seat	Overhaul the unit and replace faulty components Overhaul the unit and replace faulty components
Outlet pressures are different from the established values	Air leakage from sealing gaskets Worn or faulty pistons and seats Strained springs	Overhaul the unit and replace faulty components Overhaul the unit and replace faulty components Overhaul the unit and replace faulty components

Coupling heads

Figure 8

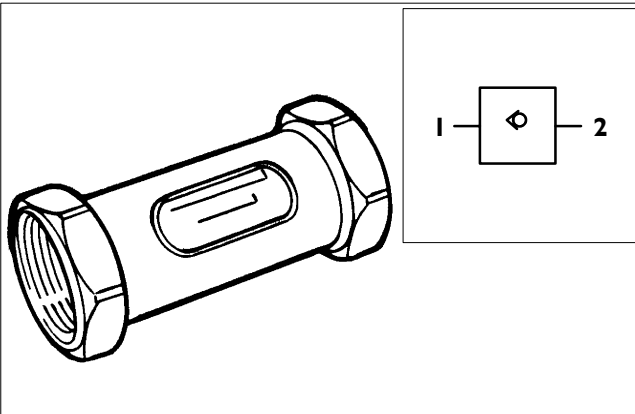


20082

The version for the "Automatic" pipe has a yellow cover and a side safety ridge (2). The safety ridges serve to prevent improper coupling.

Check valve

Figure 10



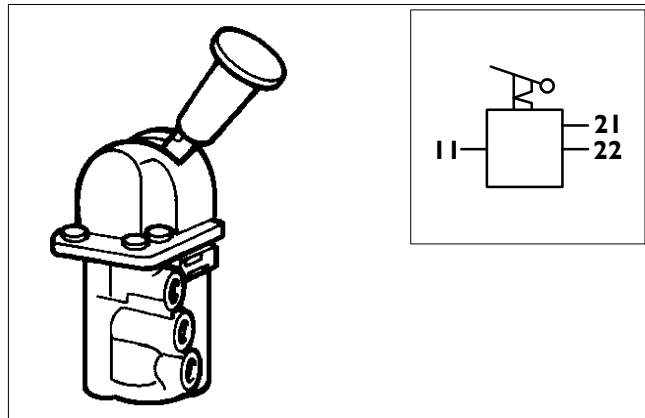
35352

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Air escapes from the exhaust with control lever In braking release position In braking position	Faulty exhaust valve, relevant seat or seal ring Worn control valve, seal rings and component control valve	Check and overhaul the unit, replace faulty components. Carefully clean the components. Check and overhaul the unit, replace faulty components. Carefully clean the components.
It is difficult to turn the control lever	Interference inside the distributor	Overhaul the unit and moisten all the sliding parts.

Parking brakes control hand distributor

Figure 9



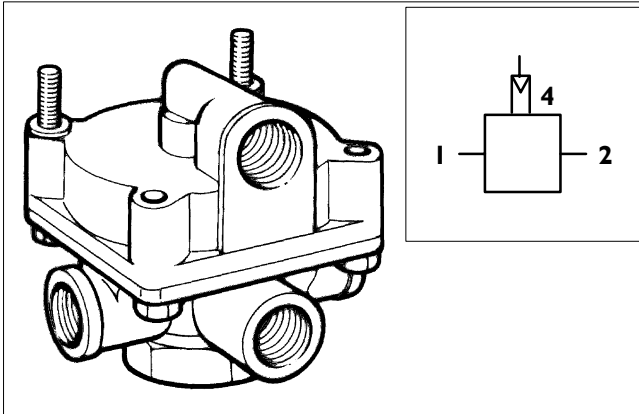
33987

The device enables emergency and parking braking of the tractor and the trailer.
The device also enables the checking of the tractor braking effect. This operation is necessary when the vehicle is parked on very steep roads.

Enables the compressed air to flow in the direction of the arrow marked on the housing and prevents reflux.

Relay valves

Figure 11



36743

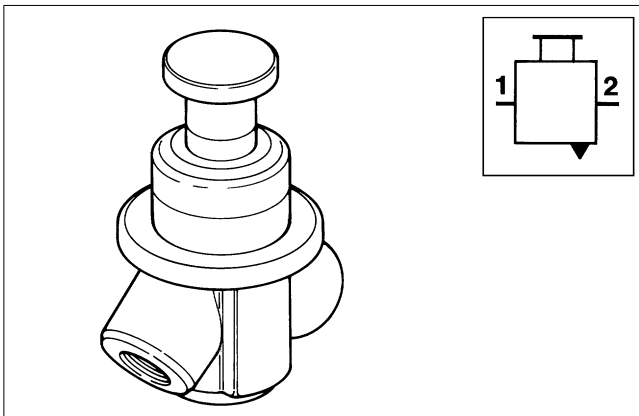
To accelerate the compressed air discharge from the combined cylinder section, thus shortening the braking time.

Diagnostic

PROBLEM	POSSIBLE CAUSE	REMEDY
Air leakage from exhaust with control pipe in discharge condition	Leakage from the delivery or from the seal rings	Overhaul the unit and replace faulty components
Air escapes from the discharge with supply in the control pipe	Leakage from the piston seal rings or from the exhaust valve	Overhaul the unit and replace the faulty parts

Engine brake control pedal valve

Figure 12

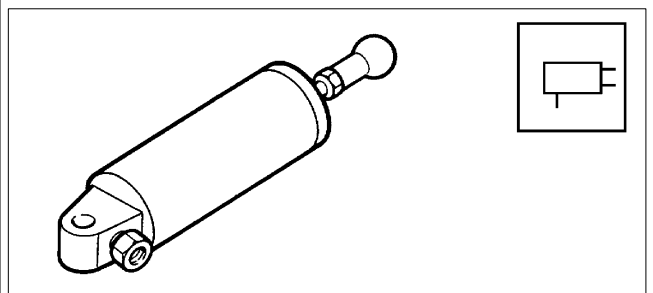


40341

This is an automatic distributor that can be activated from the driver's seat. It is fitted in the operator elements control of the engine brake

Engine brake control operator cylinder

Figure 13

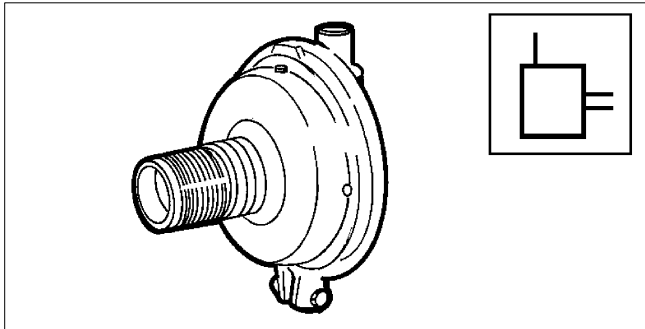


40563

This activates the throttle valve that shuts the engine gas exhaust pipe

Diaphragm brake cylinder

Figure 14

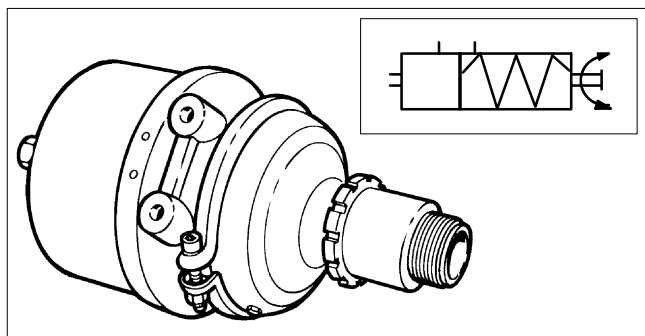


35798

The unit transmits the force impressed by the compressed air when the brake pedal is pressed to the mechanical service braking device. In the case of failure the complete cylinder is to be replaced.

Combined brake cylinder

Figure 15

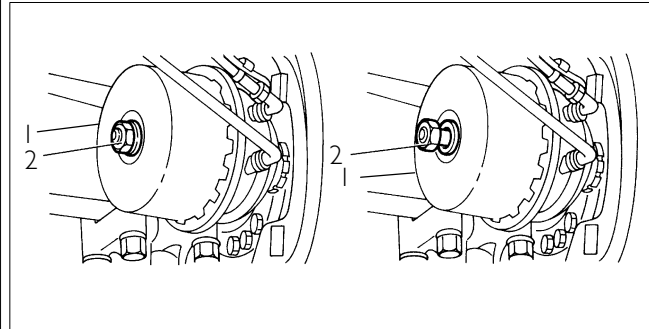


36744

This unit features two parts: one with diaphragm for service braking and one with spring for the parking and emergency braking in the case of failure in the brake system.

Diagnostic**Combined cylinder emergency relief device**

Figure 16

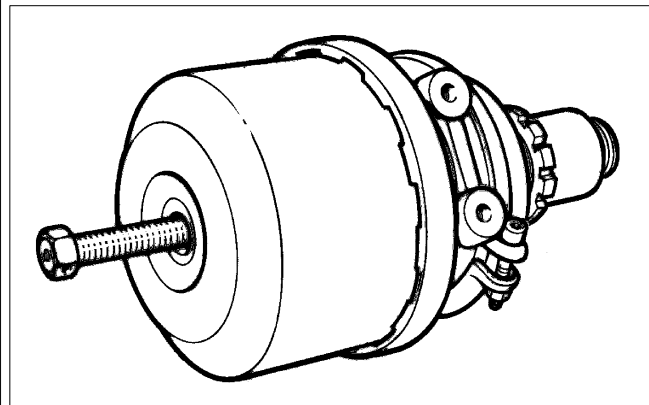


36745

If it is not possible to pneumatically feed the spring section of the combined cylinder (1) it is possible to manually release the braking to permit towing. To release the brake loosen the screw (2) to the end of its stroke.

Repair operations

Figure 17



36476

Before removing the combined cylinder from the vehicle manually release the braking of the combined cylinder as described above.



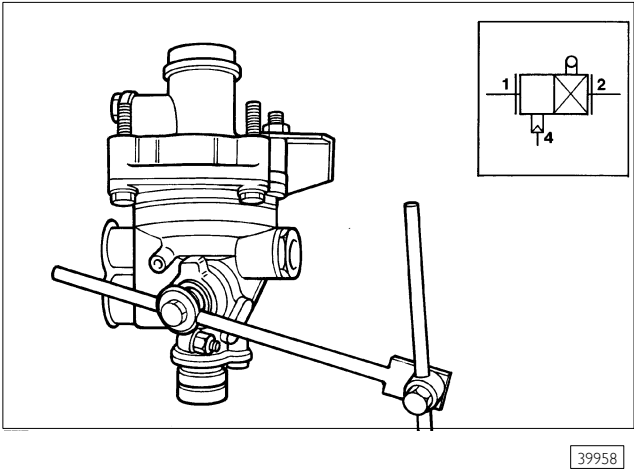
It is recommended, before removal, to carefully clean mud or other impurities from external parts as these could damage the cylinder if they were to infiltrate into it.

Overhaul the unit paying attention to the force produced by the internal spring.

PROBLEM	POSSIBLE CAUSE	REMEDY
Air escapes from the exhaust or from the check ring.	Perforated or broken diaphragm Diaphragm lip broken Check ring fastening screws have become loose	Replace the diaphragm Tighten the screws
Air escapes from the diaphragm section feed	Spring section components are strained	Overhaul the unit and replace worn components

Braking control

Figure 18



The component automatically regulates the pressure sent by the duplex distributor to the brake cylinders according to the cargo on the rear axle

Diagnostic

FAULT	POSSIBLE CAUSE	REMEDY
Air leak from outlet during braking	Control piston seals worn	Overhaul the unit and replace worn parts
	Outlet valve or seats defective	Overhaul the unit and replace worn parts
Air leak from connections	Tightening torques not as prescribed	Tighten connections to specified torque

Adjusting the load sensing valve on the vehicle



For braking control adjustment, all the braking components must be in perfect working order. In case of modifications on the suspensions for special outfitting, a new plate is necessary with the values suitably corrected.

To avoid wheel pulling or locking when braking, the device must be checked and if necessary adjusted at regular intervals. This is done by checking that the pressure values are those indicated on the plate applied in the cab.

Figure 19

ASTRA Veicoli Industriali

VEICOLO TIPO...

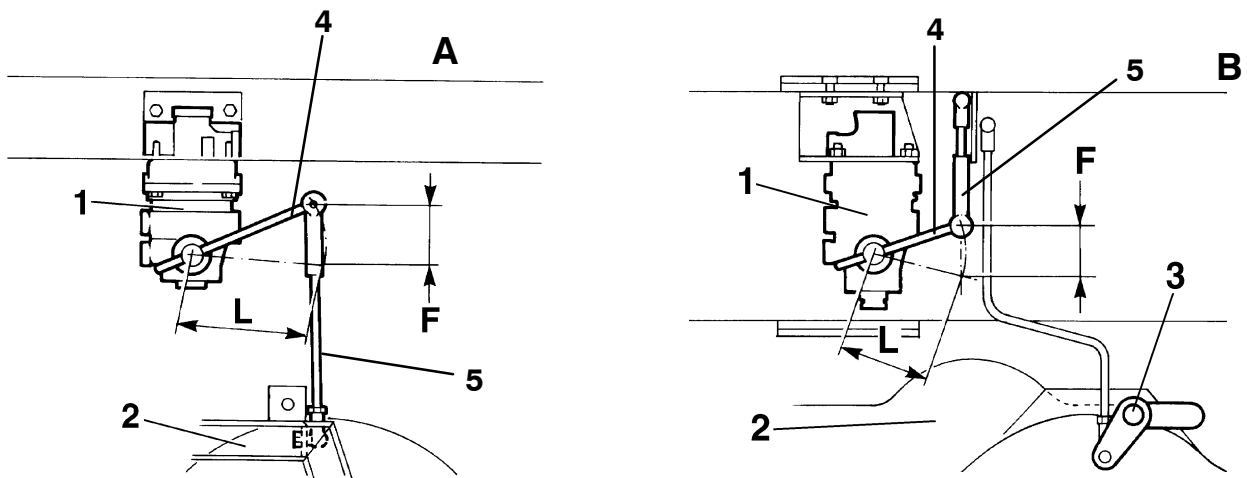
	Carico asse posteriore kg	Pressione in entrata bar	Pressione in uscita bar
CARICO	(3)	(4)	(5)
SCARICO cabina	(6)	(7)	(8)
SCARICO carrozzato			

F mm (1)
L mm (2)

See the table below for numerical values.

Vehicle	Rear leaf spring	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8
4 x 2	—	75	150	13000	7,6 ± 0,2	7,6 ± 0,2	3300	7,3 ± 0,2	5,2 ± 0,2
4 x 2T	—	67	120	12000	7,6 ± 0,2	7,6 ± 0,2	2500	7,6 ± 0,2	5,2 ± 0,2
4 x 4	—	67	130	13000	7,6 ± 0,2	7,6 ± 0,2	—	7,3 ± 0,2	3,7 ± 0,2
6 x 4	8 LEAVES	55	110	26000	7,6 ± 0,3	7,3 ± 0,3	6550	7,6 ± 0,3	2,2 ± 0,3
6 x 4	9 LEAVES	50	115	26000	7,6 ± 0,3	7,3 ± 0,3	6550	7,6 ± 0,3	2,2 ± 0,3
6 x 4T	8 LEAVES	60	95	26000	7,6 ± 0,2	7,6 ± 0,2	4695	7,6 ± 0,2	2,2 ± 0,2
6 x 4T	9 LEAVES	55	85	26000	7,6 ± 0,2	7,6 ± 0,2	4695	7,6 ± 0,2	2,2 ± 0,2
6 x 6	8 LEAVES	55	110	26000	7,6 ± 0,3	7,3 ± 0,3	6700	7,6 ± 0,3	2,2 ± 0,3
6 x 6	9 or 10 LEAVES	50	115	26000	7,6 ± 0,3	7,3 ± 0,3	6340	7,6 ± 0,3	2,2 ± 0,3
6 x 6T (66.38T 66.42T)	8 LEAVES	60	95	26000	7,3 ± 0,2	7,3 ± 0,2	4905	7,3 ± 0,2	2,2 ± 0,2
6 x 6T (66.38T 66.42T)	9 or 10 LEAVES	55	85	26000	7,3 ± 0,2	7,3 ± 0,2	4905	7,3 ± 0,2	2,2 ± 0,2
6 x 6T (66.45T 66.52T)	8 LEAVES	60	95	26000	7,6 ± 0,2	7,6 ± 0,2	4905	7,6 ± 0,2	2,2 ± 0,2
6 x 6T (66.45T 66.52T)	9 LEAVES	55	85	26000	7,6 ± 0,2	7,6 ± 0,2	4905	7,6 ± 0,2	2,2 ± 0,2
8 x 4	8 LEAVES	55	100	26000	7,6 ± 0,2	7,3 ± 0,2	6100	7,6 ± 0,2	2,2 ± 0,2
8 x 4	9 LEAVES	50	90	26000	7,6 ± 0,2	7,3 ± 0,2	6100	7,6 ± 0,2	2,2 ± 0,2
8 x 6	8 LEAVES	65	100	26000	7,6 ± 0,3	7,3 ± 0,3	6100	7,6 ± 0,3	2,2 ± 0,3
8 x 6	9 LEAVES	51	90	26000	7,6 ± 0,3	7,3 ± 0,3	6100	7,6 ± 0,3	2,2 ± 0,3

Figure 20



1. Braking control – 2. Rear lens – 3. Tandem axle connecting rod – 4. Lever – 5. Control rod – A. 2-axle vehicles – B. 3-axle and 4-axle vehicles

To adjust the braking control proceed as follows:

- ☐ Check that the length (L) of the lever (4) matches the value indicated on the plate. If it does not, replace it;
- ☐ connect a gauge before the braking control;
- ☐ connect a gauge after the braking control;
- ☐ connect a gauge to the front brake cylinders pressure socket;
- ☐ fill the tanks to the pressure that triggers the regulator;
- ☐ progressively press the brake pedal until the specified pressure is obtained at the braking control inlet;
- ☐ find the outlet pressure from the braking control and compare it with the value on the plate;
- ☐ modify, if necessary, the regulation by adjusting the length of the control rod (5);
- ☐ check that the incoming pressure to the front axle matches the values on the plate, otherwise check the efficiency of the Duplex distributor;



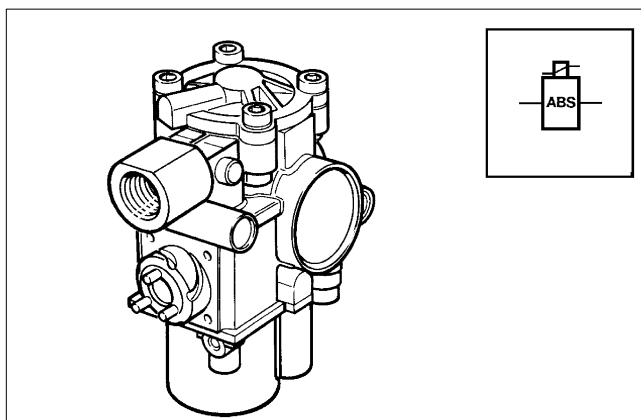
Never modify the rod adjustment when the circuit is under pressure.

Make the check with a progressive increase in pressure.

- ☐ to have an accurate adjustment it is opportune to artificially create the various intermediate load conditions and find the values;
- ☐ remove the control rods from the axle braking control, lift it for its entire stroke and simulate full load conditions
- ☐ under these conditions find the outlet pressure that is to match the value on the plate, otherwise overhaul the braking control.

Brake anti-lock distributor

Figure 21

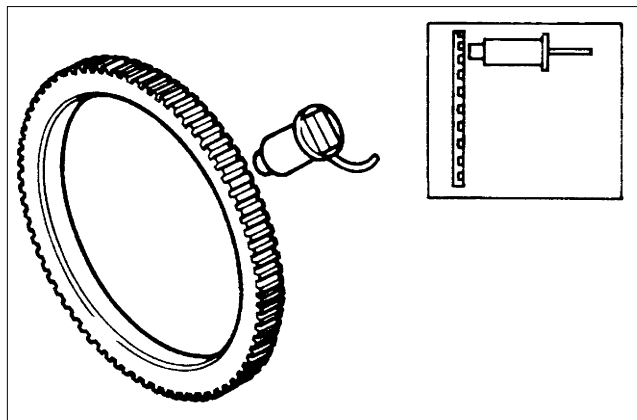


35805

This component modulates the air pressure in the brake circuit. When the electronic control unit detects a wheel with a tendency to lock, the valve intercepts the brake cylinder feed, thus preventing the wheel locking.

**Rpm sensors
Phonic wheels**

Figure 22



35385

The revolutions sensors and phonic wheels find the revolutions of the respective wheels.

The phonic wheel is housed on the wheel hub and turns at the same speed as the wheel. It generates in the sensors, by induction, alternate voltages having a frequency that is proportional to the rotation speed of the wheel.

These voltage signals are transmitted to the electronic control unit for processing. Each wheel has a sensor and a phonic wheel installed. This enables individual adjustment of the braking pressure for each wheel, thus perfecting the driving stability and braking space.

PIPES AND COUPLINGS

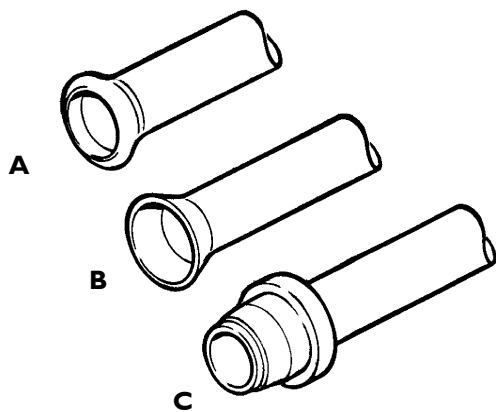
General

The pipes in the braking systems of commercial vehicles are currently of two types :

- ❑ Flexible nylon hose with single or two-ply structure and in the following diameters (Ø 6, 8, 10, 12, 16 mm) supplied as spares by the metre.
- ❑ Rigid metal pipe of the following diameters (Ø 4.75, 6.35, 8, 10, 12 mm). Piping from Ø 4.75 to Ø 10 mm is supplied as spares in straight lengths of 4, 5, 6 m, while those which are over 10 mm diam are supplied as spares ready cut, bent and flared.

End forming on rigid pipes

Figure 23

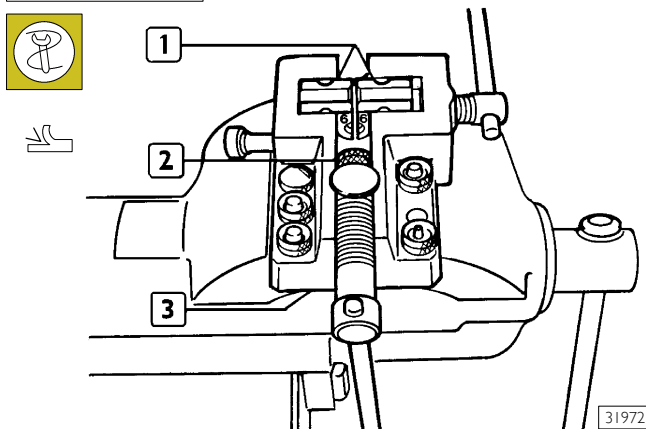


31971

TYPES OF END FORMING ON RIGID PIPES

A Type end forming

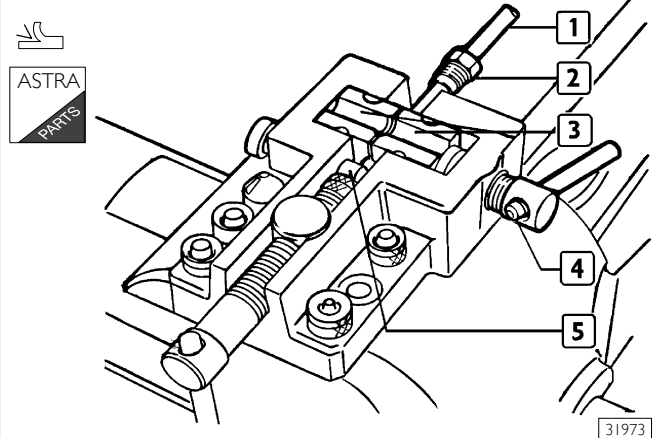
Figure 24



31972

Position on press 99386523 (3) the blocks (1) so that the stamped numbers indicating the diameter of the piping to be worked are facing towards the die (2). The choice of die depends on the diameter of the pipe to be worked. And the diameter for which it may be used is stamped on every die (2).

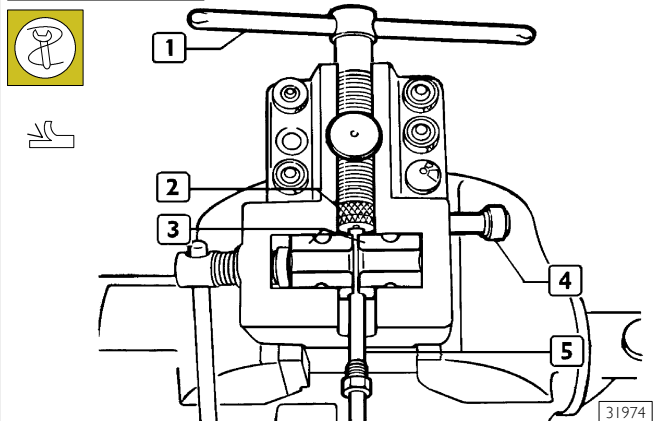
Figure 25



31973

Deburr pipe (1), insert union fitting (2) onto it and position it between blocks (3) bearing against pin (5). Lock pipe (1) with screw (4).

Figure 26

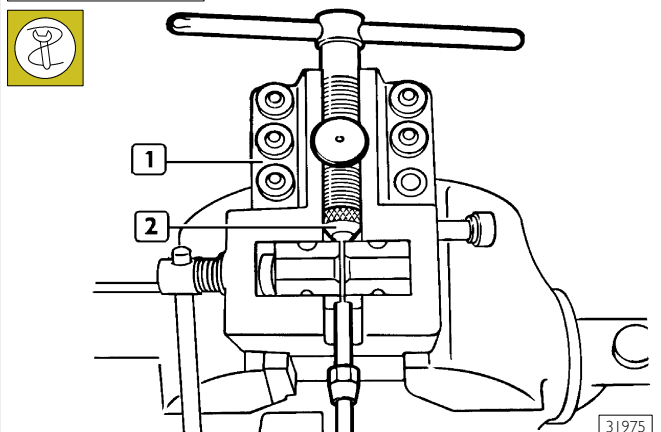


31974

Move pin (4) to neutral position. Screw up screw (1) until die (2) comes up against blocks (3), thus forming the end of pipe (5).

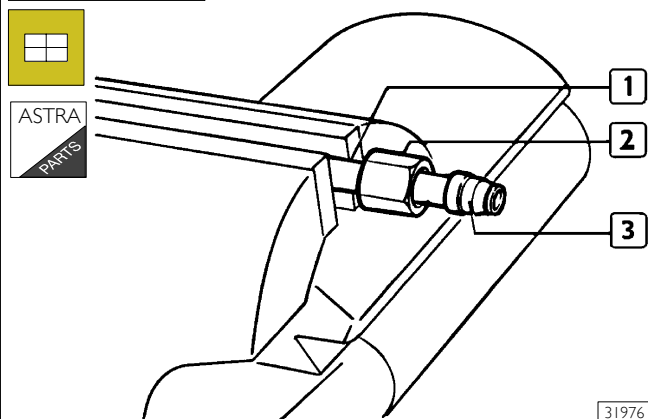
B Type end forming

Figure 27



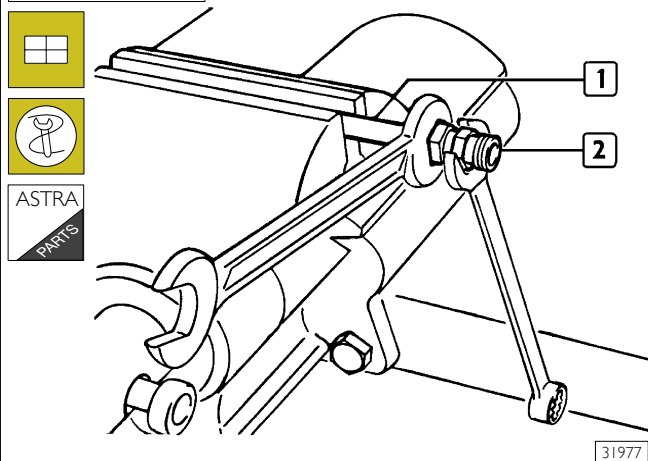
31975

Fit die (2) to press 99386523 (1). For end forming process, follow the directions given above for A type end forming.

C Type end forming**Figure 28**

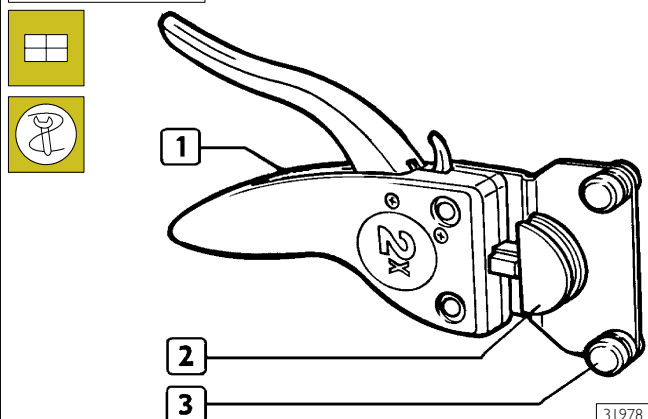
31976

Install nut (2) and ring (3) onto piping (1).

Figure 29

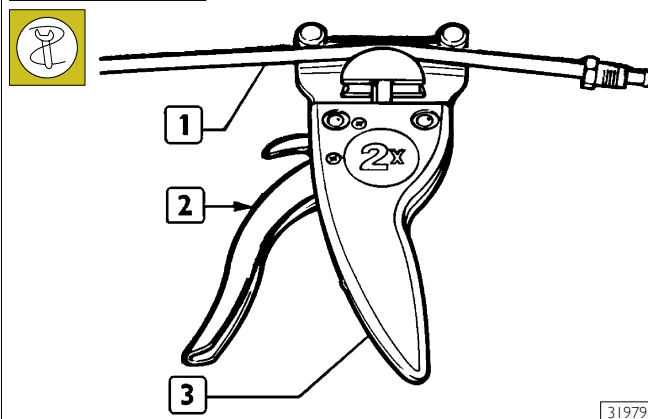
31977

Fit union (2) and tighten so that the olive (3, fig. 6) is locked onto the pipe (1).

Bending rigid pipes**Figure 30**

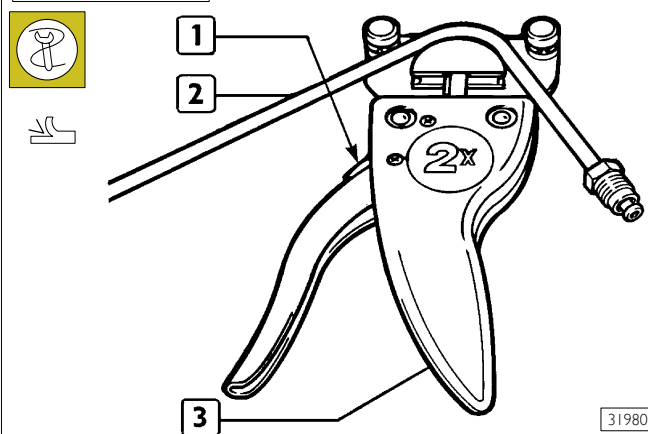
31978

Assemble tool (1) 99386523, choosing parts (2) and (3) according to the diameter of the pipe to be bent.

Figure 31

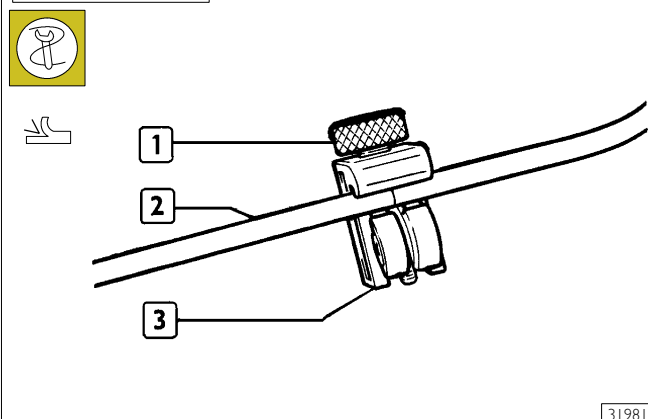
31979

Position pipe (1) in tool (3) and bend pipe by pressing lever (2).

Figure 32

31980

To release pipe (2) from tool (3), press catch (1).

Cutting rigid pipes**Figure 33**

31981

Position pipe (2) in tool (3) 99386523 and tighten screw (1). Holding pipe (2) stationary, rotate tool (3) until pipe is completely cut.

After cutting the pipe, deburr and proceed to form the end as described previously.

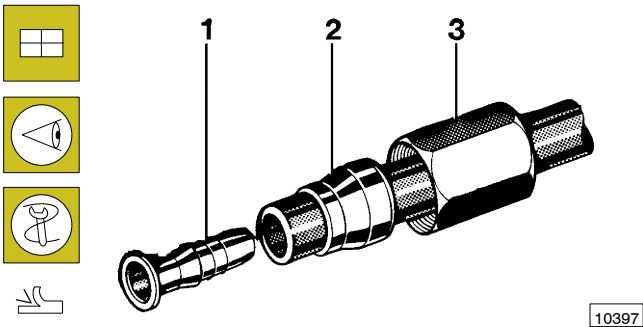


When tool (3) is rotated around pipe (2), screw (1) loosens. To cut the pipe completely, it is therefore necessary to tighten the screw (1) as and when it becomes loose.

Replacing flexible hoses with threaded couplings

Carefully follow the instructions below:

Figure 34



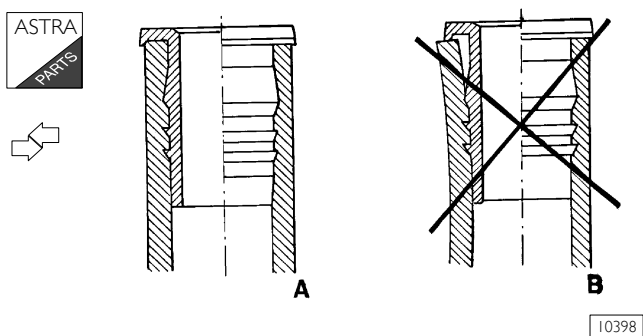
10397

- ☐ Use only approved hose
- ☐ Check the condition of the replacement hose; there must be no cracks, cuts or incisions on it.
- ☐ Cut the pipe to the required length, cutting at 90° to the centreline using appropriate pipe cutting pliers 99387050.

Thread onto the pipe, in the order given:

- ☐ nut (3), compression ring (2) (larger thickness towards the nut (3)) and reinforcing bush (1);
- ☐ bush must be in perfect condition (it must not show any distortion or signs of hammering).

Figure 35



10398

FITTING REINFORCING BUSH

A = CORRECT METHOD OF FITTING

B = INCORRECT METHOD OF FITTING

- ☐ Install reinforcing bush using tool 99372219, ensuring that there is contact between its flange and the end of the hose;
- ☐ make sure that the end of the hose fits into the raked groove in the flange.

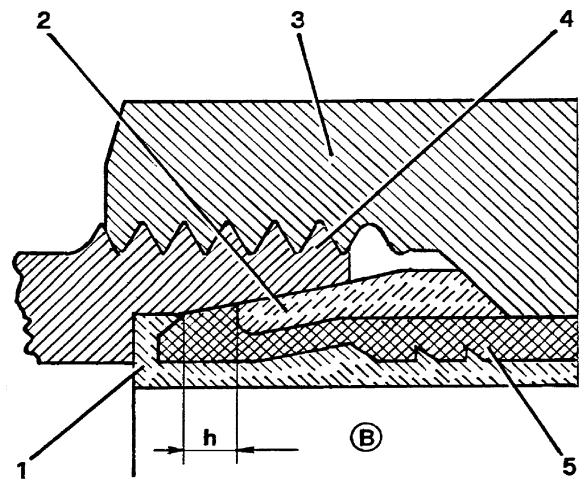
- ☐ End-form the seating bush, on fitting to the vehicle or on the work bench, to a union.
- ☐ The pressure exerted and the final distance of the front edge of the compression ring from that of the reinforcing bush must be the value listed in the schedule as given in the table.



If the fittings are badly assembled, do not re-use the hose after extracting the bush and seating ring.

	Pipe mm	Distance "h" between edge of bush and ring mm	Assembly pressure N/mm ²
Single layer	6 x 1	from 1 to 1,5	0,040
	8 x 1	from 2 to 2,5	0,050
Double layer	10 x 1,5	from 2 to 2,5	0,050
	12 x 1,6	from 2 to 2,5	0,060
	16 x 2,34	from 3 to 3,5	0,060

Figure 36



10399

1. Reinforcing bush - 2. Compression ring - 3. Nut - 4. Union
5. Hose - h. Distance between edge of bush and edge of ring
(see table).

Insert the end of the hose prepared in this way into the union body until reinforcing bush flange bears against seating;

- ☐ To tighten nut onto union, first of all screw in by hand and then complete tightening using a polygon wrench fitted on the torque wrench, to be set according to the specified tightening torque.

When fitting the hose to the vehicle, some important points requiring care should be borne in mind :

- ☐ Bends must comply with minimum radii, so as to avoid constrictions:

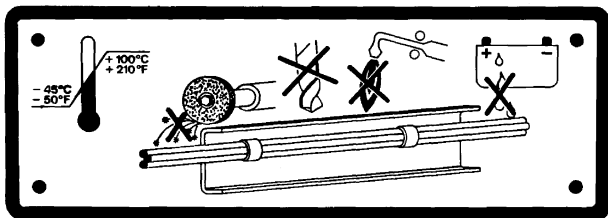
Diameter of pipe mm	Minimum radius of curvature mm
6 x 1	≈ 40
8 x 1	≈ 50
10 x 1,5	≈ 60
12 x 1,6	≈ 75
16 x 2,34	≈ 100



Make sure that the hoses are not in contact with sharp edges or with sharp metal parts or sources of heat, but are at a minimum safety distance of 15 mm from these.

- ☐ When hoses run through chassis members or metal parts, make sure that the holes through which they pass are fitted with rubber grommets and that these are in good condition.
- ☐ Avoid sliding the hose along sharp edges which might cause cuts.
- ☐ Where the hose has to be attached to existing pipework, take account of the additional heat to which it may be subjected (power steering pipework); in this case, the hose must be protected with shields.
- ☐ When the hose has been connected, check that it is not under tension between the attachment points, instead leaving it slightly slack to take up the more substantial variations in temperature, especially for short lengths.
- ☐ Before fitting, thoroughly clean the hoses by blowing compressed air through them to safeguard operation of the system.

Figure 37



13132

- ☐ Protect the hoses if grinding or welding operations are carried out on the vehicle; a notice is fitted in the cabin indicating the precautions to be observed carefully to avoid damage.

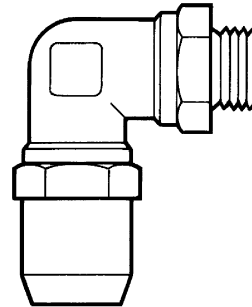


For greater safety and convenience in working, it is advisable to remove the hoses during these operations.

When fitting is finished, check that all seals (unions, couplings etc.) are completely free from leaks.

Replacing flexible hoses with quick-connection couplings

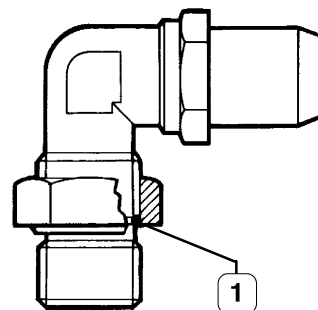
Figure 38



39306

Screw the coupling into the threaded seating provided on the air valve and tighten it to the tightening torque indicated in the table.

Figure 39

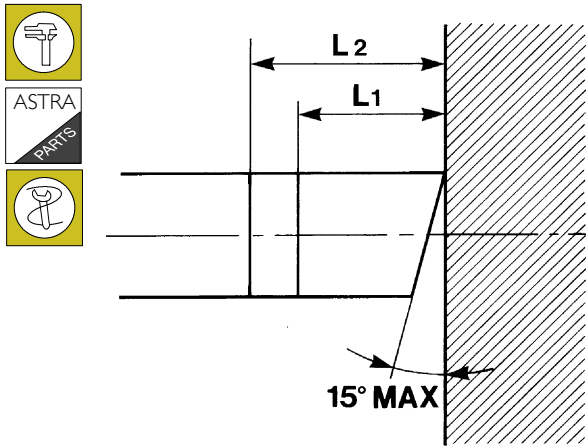


39307

- ☐ Use approved hose only.
- ☐ Check condition of replacement hose; there must be no cracks, cuts or incisions on it.
- ☐ Cut hose to required length, cutting at 90° with a max error of 15° with respect to the centreline using appropriate pipe cutting pliers 99387050.

THREADING	TIGHTENING 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

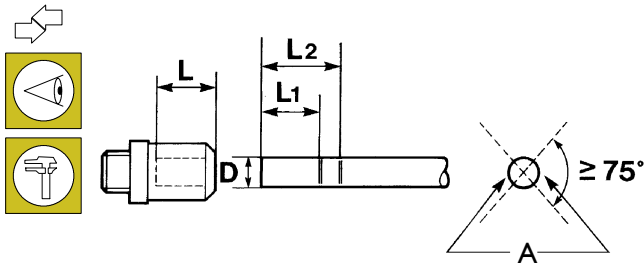
Figure 40



33977

- ☐ Only use approved type-tested hoses;
- ☐ Check the condition of the new hose to ensure it has no cracks, cuts or scores;
- ☐ Cut the hose at 90°, maximum error 15°, with reference to the axis. Use pipe-cutter pliers 99387050 to cut to the required length;

Figure 41



33976

A = Mark to identify end of tube travel

- ☐ Use indelible ink to mark clearly two reference marks on both diametrically opposite faces of the pipe at an angle of $\geq 75^\circ$, set at distances L_1 and L_2 , to ensure correct fitting in place.

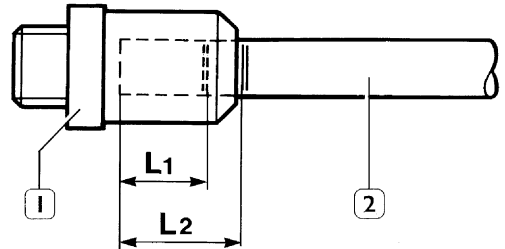


L_1 and L_2 vary according to the diameter of the hose and are to be measured at the longer part of the hose.

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

Rpm sensor phonic wheel

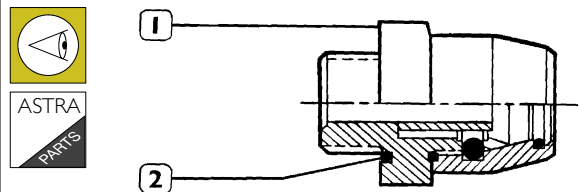
Figure 42



33908

- ☐ Insert the hose (2) by hand into the coupling (1), with a force between 30 and 120 N according to the hose diameter, so that reference mark L_1 is inside the hose whereas L_2 remains visible.

Figure 43



33978

- ☐ When removing couplings (1) from pneumatic components, check the condition of the seal ring (2) and if necessary replace it.

COUPLING THREAD	SEAL 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	—



Whenever a hose is removed from a quick connection coupling, the coupling itself must be replaced. Spare quick connection couplings are supplied complete.



Quick release and threaded couplings are not interchangeable. This also applies to flexible hoses used with quick release couplings and flexible hoses used with threaded couplings.

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ELECTRICAL SYSTEM

SECTION 17

SECTION 17

Electrical system

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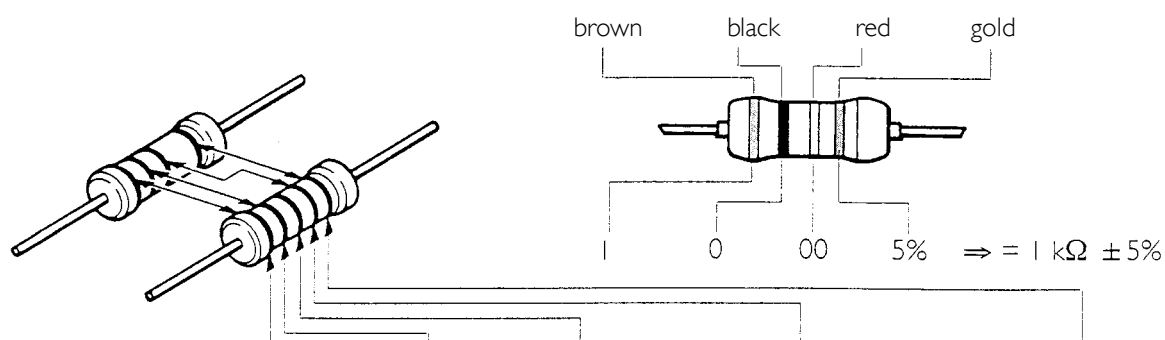
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TECHNICAL DATA**International System Units (S.I.)**

Value	Symbol	Unit	Symbol
plane angle	α, β	radian	rad
solid angle	Ω	steradian	sr
LENGTH	L, l	meter	m
area, surface	S, s	square meter	m ²
volume	V	cubic meter	m ³
TIME	t	second	s
angular velocity	ω	radian per second	rad/s
frequency	f	hertz	Hz
spinning frequency	n	(second) ⁻¹	s ⁻¹
velocity	v	meter per second	m/s
acceleration	γ, g	squared meter per second	m/s ²
MASS	M, m	kilogram	kg
volume mass	ρ, μ	kilogram per cubic meter	kg/m ³
force	F	newton	N
moment of a force/torque	M, T	newton-meter	Nm
energy, work	W	joule	J
power	P	watt	W
pressure	p	pascal	Pa, N/m ²
TEMPERATURE (thermodynamic)	Θ, T	kelvin	K
Celsius temperature	θ, t	Celsius degree	°C
temperature range	$\Theta, \Delta\Theta$	kelvin	K
heat quantity	W	joule	J
mass heat capacity	c	joule per kilo per kelvin	J/kg · k
CURRENT INTENSITY	I	ampere	A
quantity of electricity	Q	coulomb	C
electric field	E	volt per meter	V/m
voltage, d.d.p., f.e.m.	U, E	volt	V
capacity	C	farad	F
current density	J	ampere per square meter	A/m ²
resistance	R	ohm	Ω
conductance	G	siemens	S, A/V
resistivity	ρ	ohm-meter	Wm
magnetic excitation	H	ampere per meter	A/m
magnetic field	B	tesla	T
magnetomotive force	F	ampere (turn)	A
magnetic moment	M	squared ampere per meter	Am ²
magnetic flux	Φ, φ	weber	Ωb
inductance	L, M	henry	H
LUMINOUS INTENSITY	I	candle	cd
luminous flux	E	lumen	lm
irradiance	F	lux	lux

Main elements - Resistivity and temperature coefficient

Substance	$\rho (\Omega \cdot m)$	$\alpha (^\circ C)^{-1}$
Conductors		
Aluminium	2.83×10^{-8}	0.0039
Copper	1.69×10^{-8}	0.00393
Gold	2.44×10^{-8}	0.0034
Iron (0 °C)	8.85×10^{-8}	0.0050
Nickel	7.24×10^{-8}	0.006
Silver (0 °C)	1.47×10^{-8}	0.0038
Mercury	95.8×10^{-8}	0.00089
Tungsten	5.51×10^{-8}	0.0045
Costantan (60% Cu, 40% Ni)	44.0×10^{-8}	0.0000
Nichrome	100.0×10^{-8}	0.0004
Semiconductors		
Germanium (pure)	0.450	-0.048
Germanium (5 ppm As)	0.011	
Silicon (pure)	640.0	-0.075
Silicon (100 ppm As)	0.003	
NaCl (saturated solution)	0.044	-0.005
Insulators		
Amber	5.0×10^{14}	
Glass	$10^{10} \div 10^{14}$	
Mica	$10^{11} \div 10^{15}$	
Quartz	7.5×10^{17}	
Wood	$10^8 \div 10^{11}$	

Resistor colour codes

Colour code	1° ring	2° ring	3° ring	Multiplier	Tolerance
Silver					$\pm 10\%$
Gold					$\pm 5\%$
Black		0	0	1	$\pm 20\%$
Brown	1	1	1	10	$\pm 1\%$
Red	2	2	2	10^2	$\pm 2\%$
Orange	3	3	3	10^3	
Yellow	4	4	4	10^4	
Green	5	5	5	10^5	
Blue	6	6	6		
Violet	7	7	7		
Grey	8	8			
White	9	9			

Wires - Composition and characteristics**CU 0.5****CU 1****CU 2.5****CU 4****CU6**

**Composition and characteristics of low tension copper wires on vehicle electrical system
(CUNA standards)**

Section(mm ²)	0.5	1	1.5	2.5	4	6	10	16	25	35	50	70	95	120
Max continuous current (A)	6	11	14	20	28	37	53	75	100	125	160	200	240	280
No. of strands x No. of wires	1x16	1x14	1x21	1x35	1x56	1x84	1x19	1x19	19x14	19x14	19x21	19x30	37x19	37x27
Wire diameter	0.20	0.30	0.30	0.30	0.30	0.30	0.83	1.04	0.35	0.40	0.40	0.40	0.40	0.40
d	0.90	1.30	1.60	2	2.60	3.20	4.80	5	7.30	9.20	10.6	12.6	14.8	16.5
Nominal thickness	0.70	0.70	0.80	0.85	0.95	0.95	1.05	1.85	1.40	1.40	1.60	1.80	2	2
Max diameter	2.40	2.80	3.35	3.80	4.60	5.20	7.10	9.00	10.3	12.2	14.0	16.4	19.0	20.7
Min diameter	2.20	2.60	3.15	3.60	4.40	5.00	6.70	8.60	9.90	11.8	13.6	16.0	18.6	20.3
Theoretical resistance at 20 °C Ω/km	37.5	18.3	12.4	7.53	4.68	3.15	1.76	1.11	0.75	0.53	0.37	0.26	0.19	0.15

GENERAL INSTRUCTIONS

General precautions



NEVER DISCONNECT THE BATTERIES OR OPEN THE KNIFE SWITCH WITH THE EXTERNAL-COMBUSTION ENGINE STARTED.

NEVER START UP THE ENGINE WITHOUT HAVING CONNECTED THE BATTERIES PERMANENTLY.

- ☐ Before carrying out any servicing operation on the vehicle, chock the wheels securely to prevent the truck from moving on its own.
- ☐ Starting from the engine compartment should only be performed with the cab securely fixed in its maximum opening position, parking brake on, transmission in neutral, wheels properly chocked.
- ☐ Avoid aiming water/other fluid jets at the rear bulkhead junction block.
- ☐ Do not use quick charging devices to start the engine. Engine starting should be performed only by means of separate batteries or a suitable trolley.
- ☐ While performing electrical welding on the chassis, disconnect connectors from electronic control modules and disconnect the terminals from the battery.
- ☐ In case of fuse change, in order to avoid damages to electric plant of the vehicle, use fuses only of the same power as indicated by the producer.
- ☐ Check for exact battery terminal polarity during start up from auxiliary truck.
- ☐ When disconnecting the batteries from the system, always disconnect first the chassis ground cable of the negative battery terminal.
- ☐ Check system perfect insulation before disconnecting the batteries.
- ☐ Incorrect supply voltage polarisation of the electronic control modules (e.g. incorrect battery polarisation) can cause module breakage.
- ☐ Add a fly-fuse between the negative battery terminal and the chassis ground cable during troubleshooting of a circuit fault (main current switch connected).
- ☐ Disconnect the ground cable from the negative battery terminal before removing electronic components.
- ☐ Electrical measurements on electronic components must be performed using suitable instruments only.
- ☐ Do not power electronic control unit components with vehicle voltage rating.
- ☐ Ensure that electronic device wirings (length, type of wire, location, shielding continuity, if required, grounding, etc.) comply with the ASTRA system and that wirings are suitably reset after overhauling or repair operations.
- ☐ Disconnect the batteries from the system during recharging with external equipment.
- ☐ Disconnect the external battery charger from the civil network before removing its plug-in contacts from the battery terminals.
- ☐ Never connect or disconnect cable connector from electronic control modules with powered supply.
- ☐ Remove the electronic control modules when operations involve temperatures exceeding 80°C (drying oven).
- ☐ During the connection stage, screw connector flap nuts (temperature and pressure sensors, etc.) to the prescribed torque only.
- ☐ Measurements on electronic modules controlling plugs, plug connections and electrical component connections can be only performed on suitable test lines with proper plugs and bushes.
Never use improper tools such as metallic wires, screwdrivers, clips and equivalent.
Short circuits can occur and plug connections could be damaged causing successive contact troubles.



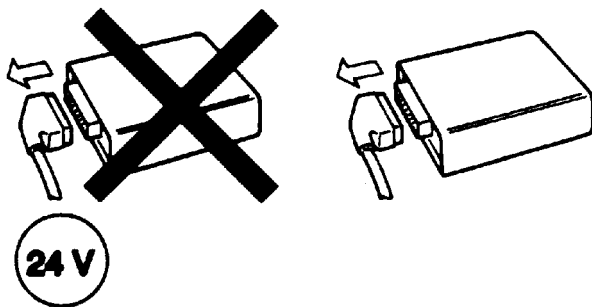
ALWAYS DISCONNECT THE BATTERIES AND CONNECTORS FROM ELECTRONIC CONTROL MODULES WHEN PERFORMING ELECTRIC WELDING OPERATIONS ON THE VEHICLE.



Before replacing a fuse, check always the cause of its blowout. Circuit operation can be reset only after having removed the fault.

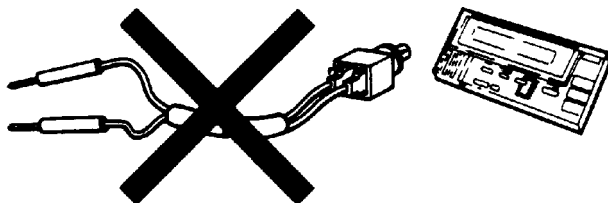
General precautions for electronic components

Figure 1



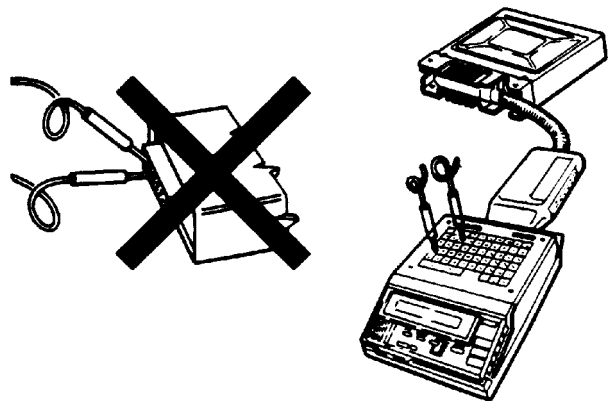
- ☐ Insulate the system before disconnecting the connector from an electronic module.
- ☐ Never cause sparks to check if the circuit is powered.
- ☐ Do not touch connector plugs of electronic modules with your hands.

Figure 2



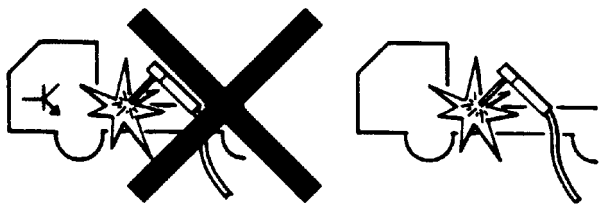
- ☐ Never use a test lamp to check circuit continuity, use suitable testers only.
- ☐ Do not power electronic control unit components with vehicle voltage rating.
- ☐ Ensure that electronic device wirings (length, type of wire, location, shielding continuity, if required, grounding, etc.) comply with the ASTRA system and that wirings are suitably reset after overhauling or repair operations.
- ☐ To avoid damage to electronics on board the vehicle, ensure the wiring pertaining to additional equipment follows a different route.
- ☐ Use ASTRA original spare parts only,

Figure 3



- ☐ Do not fit tester prods into electronic module connector plugs.
- ☐ Measurements shall be performed with multimeter.
- ☐ Do not install additional electric and/or electronic equipment not provided by ASTRA or by the local laws.
- ☐ Do not connect negative components of additional equipment to negative components of electronic modules.

Figure 4



- ☐ When performing electric welding on the vehicle, disconnect electronic modules and/or disconnect the power cable from positive battery terminal and connect it to chassis ground.
- ☐ Remove electronic components and modules for painting baking.

THE CONCEPT OF EARTH AND ELECTROMAGNETIC COMPATIBILITY

The standard system is traditionally a single-pole system. The body, chassis, metal container of electromechanical components act as equipotential return conductor to the generator; since any point of the metal structure or any unisolated negative terminal is at the same potential or EARTH. This is why the earth has been chosen as the reference for the entire system, conventionally giving it a rating of 0.

For obvious constructive reasons, different earth points scattered over the vehicle according to the location of the components, influence the system in the negative network.

Ideally, all the equipment should be connected to only **one** earth point to warrant a clearly defined earth reference, especially for the electronic devices.

Due to the above-mentioned reasons, the **supply earth** or system earth characterised by strong direct current intensity ($> 1\text{ A}$ for electromechanical components) must be distinguished from the **analogue earth** characterised by wave shapes at determinate frequencies and with very small current intensities (mA, μA) of the electronic/numerical systems.

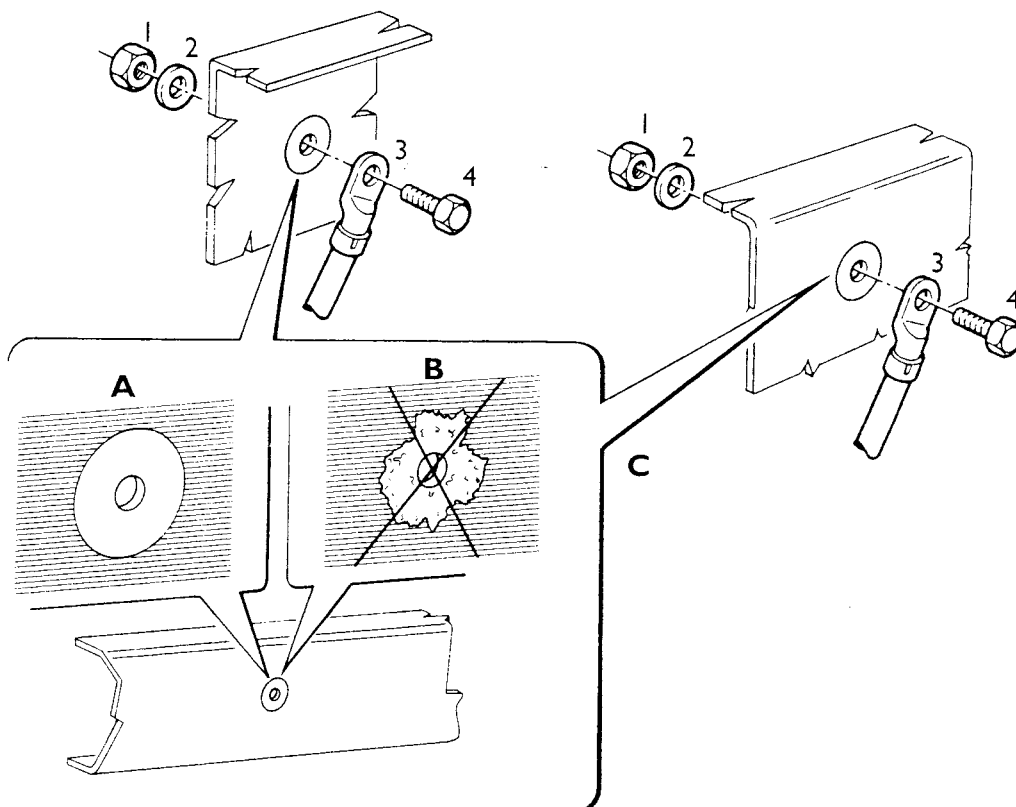
The definition of signal earth or analogue earth depends on the sensitivity of the electronic systems to EMC (electromagnetic compatibility) since parasite signals induce malfunctioning and/or deterioration of the actual systems (as they are emitted by systems on board and/or outside the vehicle).

In order to minimise continuous or transient disturbances or interferences caused by parasite radiations, it is of the **utmost importance** to follow the warnings given on next page, always bearing in mind that the soundness of the reference plan or system earth depends on the excellent conduction features (contact resistance tending to zero) in each of its connecting points.

To sum up we can say that earth intended as equipotential electric conductor, i.e. as potential reference of all the electric/electronic components on board, is subdivided into system earth and analogue earth.

The earth points in this system are established by the manufacturer. They must obviously be free from paint, oxidation, traces of grease or dust etc. Particular attention should be paid to the efficiency of battery and starter motor earth points.

Figure 5



EARTH POINTS AND CONTACT EFFICIENCY

- A. Efficient earth point - B. Inefficient earth point - C. Fastening sequence
1. Nut - 2. Washer - 3. Wire terminal - 4. Screw

Practical hints

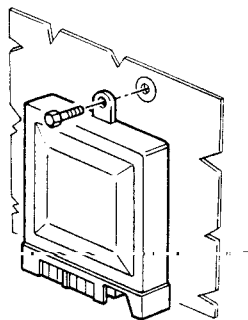
Connection between a component and an earthing point must be as short as possible. Conductors converging in an earthing point (cab and/or chassis) must be star-connected between themselves accurately avoiding overlappings in order to minimise contact resistance (Fig. 6, ref. B).



As regards electronic components, the following instructions must be strictly observed.

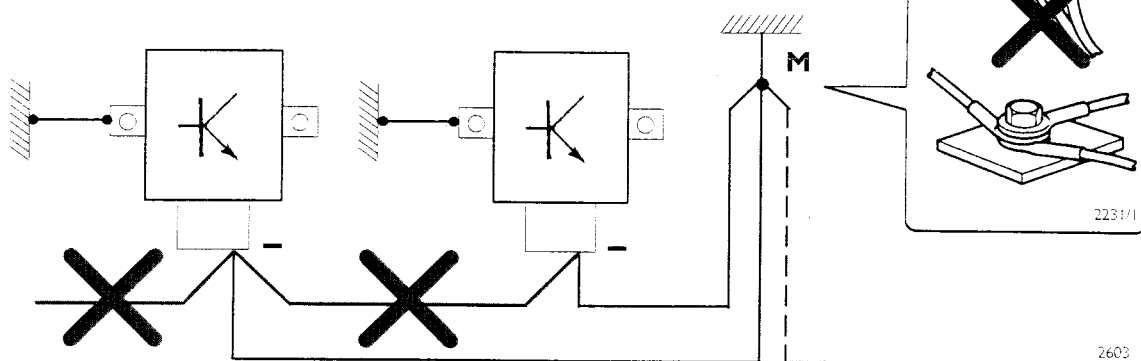
- ☐ The electronic control modules/units fitted with a metal casing are to be connected to the system earth by means of a screw or bolt (Fig. 6, ref. A).
- ☐ Conductors related to analogue earth must have optimum isolation characteristics both between themselves and as regards the system earth.
- ☐ Negative conductors isolated from control units must be connected to a system earth point (set by the manufacturer) and to the battery negative terminal. Avoid serial or chain connections (Fig. 6, ref. B).
- ☐ Each end of the braided wire must make electric contact with the system components. Only one of the braided wire ends is connected to the system earth. The unbraided section (Fig. 6, d dimension in ref. C) (cable connectors) must be as short as possible.
- ☐ Cable looms must be parallel to the reference plane, that is to say attached to the chassis/cab structure (Fig. 6, ref. D).
- ☐ Bodybuilders installing auxiliary systems must take great care when performing connections to the system earth. The new wires must not run alongside the wiring system already installed on the vehicle.

Figure 6

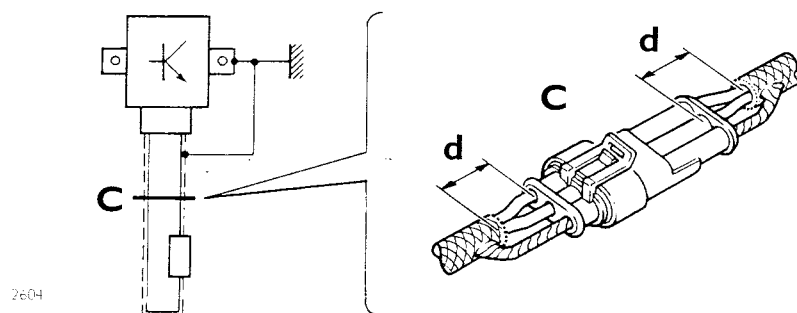
A

FASTENING CONTROL UNIT BY MEANS OF A SCREW

2602

B

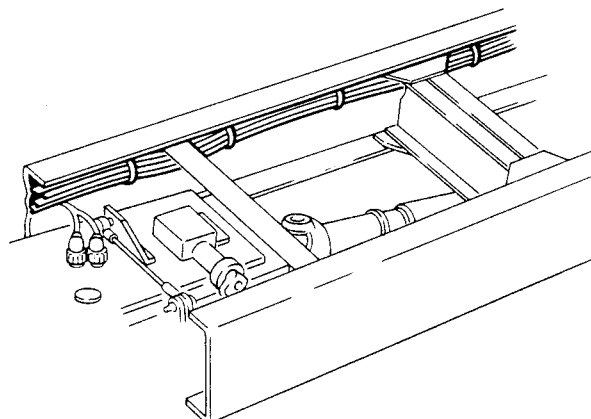
2603

STAR CONNECTION OF NEGATIVE CABLES TO **M** SYSTEM EARTH**C**

2604

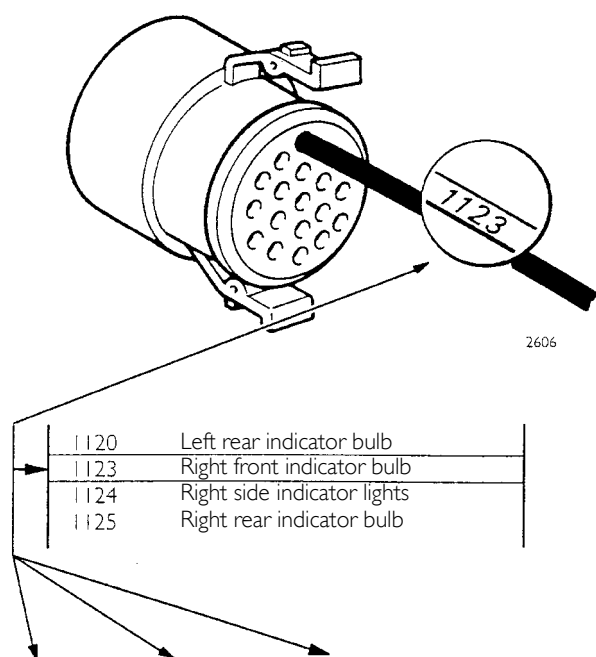
2231

SHIELDING OF THE CABLE OF AN ELECTRONIC COMPONENT BY MEANS OF A BRAIDED WIRE - C. CONNECTOR - d. GAP → 0

D

2605

CABLE LOOMS ASSEMBLED ALONG CHASSIS SIDE MEMBERS

CABLE COLOUR CODES

CODE	COLOUR	BASIC FUNCTION
1111	Light blue	Optical and audible signals
2222	White	Illumination by headlights
3333	Yellow	Parking lights/side marker lamps
4444	Grey	Internal lighting

IDENTIFICATION OF THE ELECTRIC FUNCTION BY THE CABLE COLOUR CODE

To enable its practical application, the wiring system has been split into ten main functions (associated with ten cable colours), each of them including more specific functions. Each function is identified by a four-figure code number:

Obviously, each function includes more specific sub-functions.

The first number indicates the basic function of the cable and identifies always the basic colour of the cable (the matching of number and colour is indicated in the table on the side).

The other numbers identify the specific function of the cable:

Summing up, we can say that:

- ☐ a number consisting of four identical figures indicates a main function and a single-colour cable;
- ☐ a number consistin of four partially or totally different figures indicates a specific function.

No.	Code	Colour	Function
1	1111	Light blue	Optical and audible signals
2	2222	White	Illumination by headlights
3	3333	Yellow	Parking lights/side marker lights
4	4444	Grey	Internal lighting
5	5555	Orange	Optical signals, engine operation and measuring instruments
6	6666	Violet	Optical signals
7	7777	Red	Main supply and pertaining accessories not excluded by the ignition switch
8	8888	Green	Secondary supply and pertaining accessories not excluded by the ignition switch
9	9999	Pink	Electrically-operated mechanical components
10	0000	Brown	Earth

4 - DIGIT CABLE COLOUR CODES

0300	6-diode self-rectifying alternator
0000	General earth
0001	Radio set insulated earth
0002	Hazard lights earth
0003	Earth of ceiling lamp switch on device (door post switch)
0004	UNIC project: parking lights insulated earth (dangerous cargo vehicles)
0005	Earth of trailer brake/exhaust brake interlock relay
0006	Earth of rheostat connected optical indicators
0007	Earth of stop rerequest optical indicator switch off relay
0008	Earth of starter motor relay
0009	Earth of windshield wiper unit fixed stop
0010	Earth of ceiling lamp switch on device (switch/lamp)
0011	Earth of rear door open optical indicator
0012	Earth of main current relay
0013	Earth of exhaust brake enablement relay
0014	Earth of ventilation motors operation relay
0015	Earth of auxiliary heater water recirculating pump motor
0016	Earth of relay for windshield heater/defroster operation (water auxiliary heater)
0017	Earth of front door open optical indicator
0018	Hydraulic braking system signal
0019	Earth of MS6 control unit terminal 8
0020	Earth of heater mirror relay excitation device (relay control unit)
0021	Insulated earth of MS6 control unit terminal 25
0022	Auxiliary heater insulated earth
0023	Earth of flasher light optical indicators
0024	Earth of optical indicators connected to lamp test pushbutton
0025	Earth of emergency optical indicator (central safety unit)
0027	Terminal 85 of Retarder/ABS operation relay
0028	KICKDOWN signal
0030	Earth supply for engine rpm diagnosis sensor no. 1 (n=1/1) and engine rpm electronic sensor
0031	Earth supply for engine rpm diagnosis sensor no. 2 (n=1/1)
0032	Earth supply for engine rpm diagnosis sensor (n=1/2 injection pump)
0033	Hydraulic brake solenoid valve control
0034	Hydraulic brake reducing solenoid valve control
0035	Thermometric switch controlling relais for gas oil heating
0036	Earth of centre door open relay
0037	Earth of belt warning lamp excitation relay
0038	Earth of key rotation inhibiting solenoid valve
0040	Cross differential lock switch off control
0041	Cross differential lock switch on control
0043	Insulated earth on exhaust brake control circuit
0044	Earth of belt control warning lamp
0045	Insulated earth for exhaust brake "R2" resistor

0048	ASR cut off
0049	ABS cut off
0050	General earth, analogue signal
0051	ABS n° 1 control relay
0052	ABS n° 2 control relay
0055	Insulated earth of rear axle switch
0058	Insulated negative for electronic tachograph sender unit
0059	Speed limiter solenoid valve turn off signal (transmission in neutral)
0060	Earth cable after Z diode for dashboard warning lights dimmer (Military Vehicles)
0061	Earth cable for warning lamp supply (Military Vehicles) (warning lamp dimming via 7 diode)
0066	Earth of tachograph clock
0067	Earth of engine operation relay (automatic clutch)
0068	Earth of starting enablement relay from automatic clutch control unit
0069	Earth of reversing lights relay from automatic clutch control unit
0070	Earth of automatic clutch warning lamp supply relay
0071	Earth of automatic clutch control unit buzzer
0072	Earth of automatic clutch position sensor
0073	Earth of accelerator pedal sensor (automatic clutch)
0074	Earth of transmission lever position sensor (automatic clutch)
0076	Electrical battery disconnecter relay self-excitation coil return
0078	Alternator D+ after power diode
0081	Negative to terminal 30 of exhaust brake control relay (service brake)
0082	Negative to terminal 30 of exhaust brake control relay (accelerator pedal)
0084	Automatic clutch actuator solenoid valve (earth)
0085	Earth of automatic clutch control unit from door pushbuttons
0090	Earth from sensor to "EGR " control unit
0092	Earth of starting safety unit (cab tilted up or engine compartment door open) (BUS)
0093	Earth of starting safety relay
0094	Earth of preheating operation enablement relay
0095	Earth of remote rev-up enablement relay (cab tilted)
0096	Earth of cab lock optical indicator after the diode
0097	Earth of electronic horn
0098	Automatic chassis lubrication system control after the pushbutton
0100	Earth of semiautomatic transmission display
0101	Earth of speed sensor (input) (semiautomatic transmission)
0102	Earth of speed sensor braided wire (input) (semiautomatic transmission)
0103	Earth of speed sensor braided wire (output) (semiautomatic transmission)
0104	Earth of speed sensor (output) (semiautomatic transmission)
0105	Earth of display braided wire (semiautomatic transmission)
0106	Earth of accelerator pedal position sensor (semiautomatic transmission)
0107	Earth of semiautomatic transmission diagnosis equipment
0110	Earth of transmission solenoid valve unit (semiautomatic transmission)
0111	Earth of splitter gears solenoid valve unit (semiautomatic transmission)
0112	Earth of transmission brake solenoid valve (semiautomatic transmission)

0114	Earth of solenoid valve for keeping clutch released (semiautomatic transmission)
0115	Earth of engaged gear speed unit sensor (semiautomatic transmission)
0116	Earth engaged gear sensor (semiautomatic transmission)
0119	Exhaust brake on signal to semiautomatic transmission gear selector
0121	Earth of injection pump actuator power increasing (semiautomatic transmission)
0131	Rear power take-off control signal (semiautomatic transmission)
0132	Side power take-off control signal (semiautomatic transmission)
0133	Brake pedal depressed signal to semiautomatic transmission gear selector
0135	Insulated earth for exhaust brake on warning lamp
0140	EDC needle lift sensor return
0143	Driver's door open signal to semiautomatic transmission gear selector
0150	EDC control unit component return connection
0151	Engine stop supply (EDC)
0155	Earth of EDC MS6 main relay
0156	Fault diagnosis request pushbutton (EDC)
0157	Earth from accelerator pedal to MS6 control unit
0159	Accelerator pedal idling switch (EDC)
0160	Signal from clutch switch (EDC)
0165	Earth of supercharging pressure sensor (EDC)
0170	Earth of valve gear cam rpm sensor (EDC)
0175	Earth of fuel temperature sensor (EDC)
0309	Hydraulic retarder temperature sensor earth signal
0310	Hydraulic retarder solenoid valve return signal
0315	Hydraulic retarder cutoff with ABS on
0350	Insulated earth from relay to Martin horn compressor (Fire-Fighting vehicles)
0351	Insulated earth from switch to urban/suburban centre electronic alarm signal (Fire Fighting vehicles)
0400	Earth of ECAS chassis level control sensors
0446	Enablement of hydraulic pump turn on relay with pressure below 30 bar during axle lower stage
0450	Supply from hydraulic pump thermal switch (axle raising)
0503	Thermal switch earth supply for cab interior temperature thermostat with water temperature over 50 °C (auxiliary heater)
0504	Fan relay earth control (1st speed) via adjustable thermal switch for cab interior temperature thermostat (auxiliary heater)
0550	Earth of potentiometer and sensor servomotors (AGND) (air-conditioning system)
0555	Fan earth (air-conditioning system)
0562	Earth of floor area air delivery servomotor (-FOOT) (air-conditioning system)
0564	Earth of windshield defrosting air delivery servomotor (-DEF) (air-conditioning system)
0566	Earth of air intake/recirculation servomotor (-RYC) (air-conditioning system)
0568	Earth of air mixing servomotor (-MIX) (air-conditioning system)
0610	Earth (n° 1) of ceiling lamp operation from switch
0611	Earth (n° 2) of ceiling lamp operation from switch
1100	Connection between IVECO CONTROL control units (2nd/3rd level)
1101	Supply of semiautomatic transmission failure bell
1103	From turn signal switch to Rh control unit
1104	Supply of Hostess bell

- I 105 Supply of stop request
- I 109 From turn signal switch to Lh control unit
- I 110 Supply of flasher lights reversing switch
- I 111 Supply of turn signal flasher lights (common circuits)
- I 112 Optical indicator; tractor turn signal flasher lights
- I 113 Supply of hazard lights relay (terminal 30)
- I 114 Optical indicator; hazard flasher lights
- I 115 Supply of rotary beacon
- I 116 Horn supply
- I 117 Connection between cab control unit and stop signal switch
- I 118 Optical indicator; trailer turn signal flasher lights
- I 119 Supply of electrical/air horns
- I 120 Tail lh turn signal light
- I 123 Front rh turn signal light
- I 124 Rh turn signal side repeater - Not controlled
- I 125 Tail rh turn signal light
- I 126 Lh turn signal side repeater - Not controlled
- I 129 Front lh turn signal light
- I 133 Horn, road, electropneumatic: from switch to horn
- I 139 Supply of stop request/Hostess bell enablement switch
- I 144 Layshaft max rpm buzzer (ES)
- I 146 Excitation of hazard/turn signal lights switching relay
- I 147 Hazard lights relay
- I 150 IVECO CONTROL: Tail parking light/STOP/rear fog lights (tractor lh-side)
- I 151 IVECO CONTROL: Front lh parking light/front rh maker light (tractor)
- I 152 IVECO CONTROL: Tail parking light/ STOP/rear fog lights (tractor rh-side)
- I 153 IVECO CONTROL: Number plate light
- I 154 IVECO CONTROL: Front rh parking light/front lh maker light (tractor)
- I 155 IVECO CONTROL: Tractor alarm
- I 156 IVECO CONTROL: Trailer alarm
- I 163 Safety horn
- I 167 Supply from ABS infomodul AK position (12V trailer socket ABS infomodul)
- I 168 Supply of trailer 12V stop light before the diode (ABS infomodul)
- I 169 Supply of trailer stop light before the diode (12V trailer socket ABS infomodul)
- I 170 From flasher light to control unit (front/rear lh circuits)
- I 171 Stop lights cable after BO light switch (lh terminal 54) (Military vehicles)
- I 172 Tail rh stop signal
- I 173 ABS/INFO/Module stop lights / IVECO CONTROL stop lights
- I 175 Supply of stop lights signal
- I 176 Stop lights relay control
- I 177 Tail lh stop signal
- I 178 From flasher light to control unit (Front/rear rh circuits)
- I 179 Trailer stop lights
- I 180 Trailer rear lh turn signal light

1183	Loudspeaker rh channel (-)
1184	Loudspeaker rh channel (+)
1185	Trailer rear rh turn signal light
1186	Loudspeaker lh channel (-)
1188	Loudspeaker lh channel (+)
1193	Diagnosis L line (retarder control unit)
1194	Diagnosis L line (air suspension control unit)
1195	Diagnosis L line (auxiliary heater control unit)
1196	Diagnosis L line (air-conditioning system control unit)
1197	Diagnosis L line (automatic transmission control unit)
1198	Diagnosis L line (MS6 control unit)
1199	Diagnosis L line (ABS/speed limiter control unit)
1351	Front lh rotary beacon (Fire-Fighting vehicles)
1352	Front rh rotary beacon (Fire-Fighting vehicles)
1355	Low-tone horn (Fire-Fighting vehicles)
1356	High-tone horn (Fire-Fighting vehicles)
1358	Auxiliary turn signal light on superstructure rear lh-side (Fire-Fighting vehicles)
1359	Auxiliary turn signal light on superstructure rear rh-side (Fire-Fighting vehicles)
1361	Rear lh rotary beacon (Fire-Fighting vehicles)
1362	Rear rh rotary beacon (Fire-Fighting vehicles)
2200	Supply of lh/rh high beam headlights (from switch to fuses)
2201	Supply of lh/rh low beam headlights (from switch to fuses)
2203	Supply of flasher light (from switch to fuses)
2204	Flasher light control
2219	Supply of lh high beam headlight
2220	Dual reversing switch
2221	Supply of rh high beam headlight
2222	—
2223	Supply of rh low beam headlight
2224	Supply of loading lamp
2226	Supply of reversing light
2227	Supply of reversing light (control unit - headlight)
2228	Supply of fog lamps
2229	Supply of auxiliary driving headlights
2231	Supply of rh low beam headlight
2235	Supply of exterior lighting switch
2237	Supply of high/low beam headlights: from exterior lighting switch to control unit
2239	Supply of high/low beam headlights: from control unit to headlight switch
2246	Supply of BO lights
2268	Supply of reversing light switch
2269	Supply of auxiliary driving light switch
2280	Rear fog light relay control
2281	Supply of rear fog lamp before the fuse
2283	Supply of rear fog lamp (after the fuse or general)

- 2284 Supply of rear fog lamp with fog lights on
- 2285 Optical indicator; high beam lights
- 2286 Supply of tractor rear fog light (after IVECO Control)
- 2287 Optical indicator; rear fog lights
- 2288 Optical indicator; rear fog lights (only as a connection after the diode, if fitted)
- 2289 Fog lamp relay control
- 2293 Diagnosis "K" line (retarder control unit)
- 2294 Diagnosis "K" line (air suspension control unit)
- 2295 Diagnosis "K" line (auxiliary heater control unit)
- 2296 Diagnosis "K" line (air-conditioning system control unit)
- 2297 Diagnosis "K" line (automatic transmission control unit)
- 2298 Diagnosis "K" line ("MS6" control unit)
- 2299 Diagnosis "K" line (ABS/speed limiter control unit)
- 2351 Work lamp after the fuse (Fire-Fighting vehicles)
- 3300 General lh supply for IVECO Control control unit after the fuse
- 3301 General rh supply for IVECO Control control unit after the fuse
- 3302 Excitation of rear parking fog light relays / Fog lights switch on device
- 3304 Supply of front lh parking/marker light after IVECO Control control unit
- 3305 Supply of rear lh parking light after IVECO Control control unit
- 3306 Supply of rear lh trailer parking light after IVECO Control control unit
- 3307 Supply of number plate light after IVECO Control control unit
- 3308 Supply of rear lh/rh marker lights after IVECO Control control unit
- 3314 Supply of front rh parking/marker light after IVECO Control control unit
- 3315 Supply of rear rh parking light after IVECO Control control unit
- 3316 Supply of rear rh trailer parking light after IVECO Control control unit
- 3330 Front rh parking, rear lh, trailer rh lights. Front lh marker light (Germany and Italy). Rh marker light (France and Sweden). Rh number plate light
- 3331 UNIC project: Rh marker light, Side lh gabarit light (France). Rear lh gabarit light (tractor France). Rear rh marker and parking light. Number plate light (trailer)
- 3332 UNIC project: Lh marker light, Side rh gabarit light (France). Rear lh gabarit light (tractor France). Rear lh marker and parking light. Number plate light (trailer)
- 3333 Parking lights (common circuits)
- 3334 Front rh and rear lh parking lights. Rh number plate light. Rh marker light (*)
- 3335 Front lh and rear rh parking lights. Lh number plate light. Lh marker light. Trailer insulated lights (socket 4 on trailer auxiliary coupling joint) (*)
- 3337 Number plate box light
- 3338 Front lh parking, rh rear, lh trailer light. Front rh marker light (Germany and Italy). Lh marker light (France and Sweden). Lh number plate lights
- 3339 Front lh parking, rh rear, lh trailer light. Front rh marker light (Germany and Italy). Lh marker light (France and Sweden). Lh number plate lights
- 3347 Tail BO parking light
- 3348 BO stop lights
- 3349 Auxiliary tail BO headlight (NATO vehicles)
- 3350 Supply to terminals 58 of fuse box from relay (Fire-fighting vehicles)
- 3354 Excitation of terminal 58 relays (Fire-fighting vehicles)
- 3377 Trunk or luggage compartment light (exceptional use)

3380	General supply for parking lights (control unit - switch)
3390	General supply for parkign and marker lights
3391	UNIC project: Common supply for parking lights (*)
3397	EOL data entering line (automatic transmission control unit)
4101	Supply of display lighting (semiautomatic transmission)
4400	Supply of interior lighting switch no. 1 (bus)
4401	Supply of interior lighting switch no. 2 (bus)
4402	Switch no. 1: 1st lamp series (bus)
4403	Switch no. 1: 2nd lamp series (bus)
4405	Switch no. 2: 1st lamp series (bus)
4406	Switch no. 2: 2nd lamp series (bus)
4407	Engine compartment lighting
4408	Front door steps lighting
4409	Rear door steps lighting
4411	Optical indicator, general lighting on
4413	Centre door steps lighting
4418	Trucks: ceiling lamp illumination via separate switch no.
4420	Supply of ashtray light
4421	Supply of blue lights and driver's light switches
4422	Supply of blue lights (passengers)
4423	Supply of driver's light
4440	Supply of reading lamp (passengers)
4441	Trucks: ceiling lamp illumination via separate switch no. 1
4442	Supply of dashboard symbol lighting
4443	Supply of cigar lighter light
4444	Instrument panel lighting after the rheostat (or switch)
4445	Supply of door steps lighting
4447	Under hood compartment lighting
4448	Tool compartment lighting
4449	Trunk or luggage compartment lighting
5102	Speed sensor signal (input) (semiautomatic transmission)
5103	Speed sensor signal (output) (semiautomatic transmission)
5104	Supply of speed sensor signal (output) (semiautomatic transmission)
5106	Supply of accelerator pedal position sensor (semiautomatic transmission)
5107	Signal for accelerator pedal position sensor (semiautomatic transmission)
5109	Signal for accelerator pedal idling switch (semiautomatic transmission)
5110	Supply for accelerator pedal idling switch (semiautomatic transmission)
5111	Supply of "KickDown" switch (semiautomatic transmission)
5112	Signal for "KickDown" switch (semiautomatic transmission)
5113	Signal from speed sensor amplifier (semiautomatic transmission)
5115	Signal for engaged gear speed group (semiautomatic transmission)
5116	Signal for engaged gear sensor (semiautomatic transmission)
5118	TRISTATE signal (automatic transmission)
5150	Alternator "W" contact (EDC)

5151	Air temperature sensor (EDC)
5152	Supercharging pressure sensor signal (EDC)
5153	Supply of supercharging pressure sensor signal (EDC)
5154	Water temperature sensor (EDC)
5155	EDC speed pulse (tachograph B7)
5157	Accelerator pedal sensor signal (EDC)
5158	Supply of accelerator pedal sensor (EDC)
5160	Enablement to EDC control unit programming
5161	Accelerator pedal position control (EDC)
5309	Supply of hydraulic retarder temperature sensor
5410	Signal for chassis levelling control (ECAS front axle system)
5421	Signal for Rh chassis levelling control (ECAS rear axle system)
5422	Signal for Lh chassis levelling control (ECAS rear axle system)
5441	Signal for Rh pressure sensor (ECAS lift axle system)
5442	Signal for Lh pressure sensor (ECAS lift axle system)
5443	Signal for Rh pressure sensor (ECAS axle system)
5444	Signal for Lh pressure sensor (ECAS axle system)
5500	Injection pump potentiometer (EGR)
5501	Optical indicator, crankcase high temperature
5503	Optical indicator, oil min pressure
5504	Optical indicator, oil max temperature
5505	Engine oil level sensor
5506	Engine oil level sensor
5507	Oil pressure sender unit
5508	Supply positive for engine oil pressure sender unit
5510	Adaptor to repeater tachometer signal
5511	Electronic tachometer sender unit - supply
5512	Electronic rev counter sender unit - supply
5513	Electronic tachometer sender unit - signal or supply of tachometer signal
5514	Electronic tachograph sender unit - supply
5516	Electronic tachograph sender unit (reversed signal)
5517	Electronic tachograph sender unit - speed signal
5518	Electronic tachograph sender unit - distance covered signal
5519	Electronic rev counter sender unit (signal) and signal from speedometer switch (mechanical rev counter)
5520	Optical indicator, min coolant level
5521	Warning lamp, windshield tank fluid level
5523	Crankcase temperature thermometer sender unit
5525	Warning lamp, power steering fluid
5527	Min coolant level sender unit
5528	Optical indicator, max water temperature
5530	Warning lamp, water in prefilter
5532	External temperature sensor
5535	Warning lamp, EDC system failure
5540	Speed pulse from tachograph

5541	Speed pulse from signal repeater
5542	Speed pulse from signal repeater to diagnostic socket
5550	Oil temperature sender unit
5551	Engine overspeed indicator (optical and sound signal)
5552	Water temperature sender unit
5553	Optical indicator, preheating on
5555	Optical indicator, min fuel level
5556	Warning lamp, engine oil level
5557	Fuel level indicator (single-pole device)
5558	Signal from control unit to engine oil level indicator
5559	Transmission oil temperature sender unit
5561	Air pressure sender unit (rear brakes)
5562	Air pressure sender unit (front brakes)
5568	Air pressure sender unit (emergency brake)
5570	Front lh wheel sensor (ABS system)
5571	Front rh wheel sensor (ABS system)
5572	Rear lh wheel sensor (ABS system)
5573	Rear rh wheel sensor (ABS system)
5577	Pre/after-heating control sensor
5580	EGR absolute barometric pressure sensor
5581	Supply from EGR control unit
5584	Signal cable for engine rpm diagnosis no. 1 sensor (n=1/1) and engine rpm electronic sensor
5585	Signal cable for engine rpm diagnosis no. 2 sensor (n=1/1)
5586	Signal cable for engine rpm diagnosis sensor (n=1/2 on injection pump)
5588	Voltage adjusted according to engine oil level indicator
5590	Supply of fuel pressure sensor (EDC)
5591	Signal for fuel pressure sensor (EDC)
5592	Fuel temperature signal (EDC)
5595	EGR control unit diagnosis
5598	Automatic chassis lubrication system sensor
5600	Signal, automatic clutch accumulator fluid low pressure sensor
5601	Signal, automatic clutch accumulator fluid high pressure sensor
5602	Signal from automatic clutch position sensor
5603	Signal from automatic clutch transmission position sensor (forward position)
5604	Signal from automatic clutch transmission position sensor (backward position)
5605	Signal from automatic clutch transmission position sensor (common)
5606	Signal from accelerator pedal sensor (automatic clutch)
5607	Signal from gearshift lever position sensor (automatic clutch) (position X)
5608	Signal from gearshift lever position sensor (automatic clutch) (position Y)
5609	Signal from gearshift lever position sensor (automatic clutch) (position NA)
5610	Signal from hood position sensor (automatic clutch) (common)
5611	Signal from hood position sensor (automatic clutch) (position NC)
5612	Cruise Control signal from automatic clutch control unit
5613	Signal from EDC accelerator pedal (automatic clutch control unit)

5614	Engine rpm signal from EDC (automatic clutch control unit)
5615	Signal from engine rpm sensor (automatic clutch control unit)
6000	Warning lamp, electronic accelerator
6001	Warning lamp, chassis lowering system
6002	Lamp test
6003	Warning lamp, door II (centre) open before diode
6005	ABS on warning lamp
6007	Warning lamp, electronic suspension levelling unit
6008	Warning lamp, air suspension failure
6011	Warning lamp, rear axle air suspension pressure
6012	Warning lamp, front brake shoe wear before diode
6013	Warning lamp, rear brake shoe wear before diode
6014	Intermittent warning lamp, stop request
6022	Warning lamp, front brake wear (control unit warning device)
6023	Warning lamp, rear brake wear (control unit warning device)
6100	Supply of display (semiautomatic transmission)
6101	Display "Data" line (semiautomatic transmission)
6102	Display "Clock" line (semiautomatic transmission)
6103	Warning lamp, air pressure signal (semiautomatic transmission)
6104	"TX" diagnosis line (semiautomatic transmission)
6105	"RX" diagnosis line (semiautomatic transmission)
6106	Data diagnosis line (semiautomatic transmission)
6107	Supply of diagnostic equipment (semiautomatic transmission)
6108	ISO-CAN H connection (semiautomatic transmission control unit)
6109	ISO-CAN L connection (semiautomatic transmission control unit)
6118	LIMP-HOME signal (semiautomatic transmission)
6131	Return signal, rear power take-off (semiautomatic transmission)
6132	Return signal, side power take-off (semiautomatic transmission)
6301	Warning lamp, hydraulic retarder on
6350	Warning lamp, tool compartment door open (Fire-Fighting vehicles)
6351	Warning lamp, front lh rotary beacon (Fire-Fighting vehicles)
6352	Warning lamp, front rh rotary beacon (Fire-Fighting vehicles)
6353	Warning lamp prearrangement (Fire-Fighting vehicles)
6354	Warning lamp prearrangement (Fire-Fighting vehicles)
6355	Warning lamp, power take-off on (Fire-Fighting vehicles)
6356	Warning lamp, extended work projector telescopic support or protruding stabilizer struts (Fire-Fighting vehicles)
6357	Warning lamp, water pump on (Fire-Fighting vehicles)
6358	Warning lamp, 220V alternator on (Fire-Fighting vehicles)
6359	Warning lamp, winch on (Fire-Fighting vehicles)
6361	Warning lamp, rear lh rotary beacon (Fire-Fighting vehicles)
6362	Warning lamp, rear rh rotary beacon (Fire-Fighting vehicles)
6401	Warning lamp, low air pressure (air suspension system)
6402	CLOCK line, ECAS suspension system button strip
6403	DATA line, ECAS suspension system button strip

6440	Warning lamp, axle up
6460	Warning lamp, assistance to starting on
6490	Warning lamp, 3rd steering axle in operation
6499	Warning lamp, 3rd steering axle system locked
6500	Warning lamp supply, auxiliary heater failure
6600	Optical indicator, front door open
6601	Optical indicator, transmission drive on
6602	Warning lamp, all-wheel drive on
6603	Optical indicator, transfer case differential lock
6604	Optical indicator, TELMA retarder
6605	Optical indicator supply, auxiliary heater on
6607	Optical indicator, tilted body
6608	Optical indicator, rotary beacon
6609	Warning lamp, door I (front) open before diode
6611	Optical indicator, clutch wear
6612	Connection between relays, stop request optical indicator on/off
6613	Optical indicator, brake system failure (general)
6614	Optical indicator, air/water/oil repeater
6615	Optical indicator, refrigerator on
6616	Warning lamp, heated windshield
6617	Optical indicator, heating on (KHD motor)
6618	Optical indicator, oil filter restriction (engine compartment ventilation hydraulic circuit)
6619	Optical indicator, thermal glass, front headlight cluster
6620	Control unit, cross differential lock (terminal 4)
6621	Control unit, cross differential lock (terminal 2)
6622	Optical indicator, forced ventilation
6623	Optical indicator, brake lining pre-wear condition
6624	Optical indicator, rear door open
6627	Optical indicator, exhaust brake on
6628	Warning lamp, automatic snow chains on
6629	Optical indicator, stop request
6633	Optical indicator, interior heating
6634	Optical indicator, interior heating motors
6635	Optical indicator, engine compartment ventilation failure
6637	Optical indicator, alternator charge (before diode)
6640	Warning lamp, automatic clutch system failure
6644	Optical indicator, auxiliary alternator charge
6645	Warning lamp, reading lights
6647	Warning lamp supply, centre door open signal
6651	Warning lamp, rear axle brake fluid level
6652	Optical indicator, heated rearview mirror
6655	Optical indicator, auxiliary heater
6657	Warning lamp, FREON compressor on
6658	Optical indicator, stop brake

6659	Warning lamp, cross differential lock (front)
6660	Optical indicator, cross differential lock
6661	Optical indicator, brake fluid min level
6662	Optical indicator, hand brake
6663	Optical indicator, air cleaner restriction
6664	Optical indicator, front axle brake lining wear
6665	Warning lamp, front axle air suspension pressure
6666	Optical indicator, cab unlatched
6667	Optical indicator, general/rear axle brake lining wear
6668	Optical indicator, coupling joint hitched up
6669	Buzzer, engine sound alarm signal
6670	Warning lamp, tractor ABS/CEF failure
6671	Warning lamp, trailer ABS failure
6672	Warning lamp, ASR/speed limiter failure
6675	Warning lamp, trailer ABS disconnected
6677	Optical indicator, ICP (hydraulic brake system malfunction)
6679	Warning lamp, FREON compressor off
6680	Optical indicator, rear brake system min air pressure
6681	Warning lamp, stop request before diode
6682	Optical indicator, parking brake system min air pressure
6683	Optical indicator, air suspension min air pressure
6684	Optical indicator, front brake system min air pressure
6685	Warning lamp, transfer case, neutral position
6687	Warning lamp, chassis raising system
6688	Warning lamp supply, splitter gear engaged
6689	Optical indicator, trailer brake system min air pressure
6693	Optical indicator, converter oil pressure
6694	Optical indicator, vehicle front raising system
6695	Optical indicator, vehicle rear raising system
6698	Warning lamp, automatic chassis lubrication system failure
6699	Warning lamp supply, high transmission oil temperature
7000	Relay excitation, front/rear interior heating motors (1st/2nd speed)
7001	Relay excitation, front/rear interior heating motors (internal speed)
7002	Supply of front/rear interior heating motors (1st/2nd speed after relay)
7003	Supply of front/rear interior heating motors (internal speed after relay)
7004	Supply of auxiliary heating system (partially open)
7005	Supply of auxiliary heating system (fully open)
7009	Supply of relay for battery charging warning lamp
7010	Supply of hatch opening control
7011	Supply of hatch closing control
7017	Supply of EDC through end-of-line programming control switch
7050	Signal switch, transmission in neutral
7073	Supply of relay for electrical battery disconnect after diode
7076	Self-excitation supply, electrical battery disconnect relay coil

7150	Supply of EDC/MS6 system from main relay
7152	Supply of preheating switch on relay
7155	Supply of MS6 system from main relay
7350	Supply of rotary beacon relay/alarm switch (Fire-Fighting vehicles)
7351	Supply of amperometric relay from control relay for switching on front rotary beacon (Fire-Fighting vehicles)
7352	Supply of front rotary beacon relay/supply of rear rotary beacon switch from alarm switch (Fire-Fighting vehicles)
7355	Supply of Fiamm/Martin horn relay (Fire-Fighting vehicles)
7356	Supply of Fiamm/Martin horn relay (Fire-Fighting vehicles)
7357	Supply of radioreceiver set switch from fuse (Fire-Fighting vehicles)
7358	Supply of radioreceiver set from switch (Fire-Fighting vehicles)
7359	Supply of outlet from fuse (Fire-Fighting vehicles)
7361	Supply of rear rotary beacon amperometric relay from control relay (Fire-Fighting vehicles)
7362	Supply of rear rotary beacon amperometric relay from alarm relay (Fire-Fighting vehicles)
7440	Supply of lift axle system after the fuse
7502	Supply of cab and/or engine heating switches (auxiliary heater)
7503	Cab heating control after diode
7504	Supply of fan relay (1st speed)
7505	Supply of fan relay (2nd speed)
7506	Auxiliary heater control with microswitch connection on heating cock control lever
7507	Cab heating control
7508	Auxiliary heating control after engine heating switch
7509	Auxiliary heating control after cab heating switch
7510	Supply of auxiliary heater control signal
7511	Supply of electronic pulse generator for auxiliary heater incandescence plug
7515	Supply of auxiliary heater thermal sensor
7516	Supply of auxiliary heater flame sensor
7519	Supply of auxiliary heater failure warning lamp after diodes
7520	Supply of cab interior temperature sensor
7550	Supply of air-conditioning switching system
7551	Supply of air-conditioning system fan
7552	Supply of TOP FLAP door opening relay
7553	Supply of TOP FLAP door closing relay
7554	Supply of fan governor control unit (TGMV) (air-conditioning system)
7555	Supply of fan governor control unit (GMV) (air-conditioning system)
7556	Battery isolating switch relay control (air-conditioning system)
7560	Supply of servomotor potentiometer (VPOT) (air-conditioning system)
7561	Servomotor potentiometer signal for air delivery to floor area (PFOOT) (air-conditioning system)
7562	Supply of servomotor for air delivery to floor area (+FOOT) (air-conditioning system)
7563	Servomotor potentiometer signal for air delivery to windshield defroster unit (PDEF) (air-conditioning system)
7564	Supply of servomotor for air delivery to windshield defroster unit (+DEF) (air-conditioning system)
7565	Servomotor potentiometer signal for air recirculation/external air intake (PRYC) (air-conditioning system)
7566	Supply of servomotor for air recirculation/external air intake (+RYC) (air-conditioning system)

7567	"Air mixing" servomotor potentiometer signal (air-conditioning system)
7568	Supply of "air mixing" (+ MIX) servomotor (air-conditioning system)
7571	Water temperature sensor signal (TAS) (air-conditioning system)
7572	Water temperature sensor signal (TEVAP) (air-conditioning system)
7573	External temperature sensor signal (TEXT) (air-conditioning system)
7574	Sun radiation sensor signal (SUNLOAD) (air-conditioning system)
7590	Supply of ventilation system (air-conditioning system)
7591	Supply fan ON position with air-conditioning system turned on
7600	Supply of automatic clutch system
7601	Supply of automatic clutch motor
7700	Connection for CI auxiliary heater control unit and air-conditioning system switch (supply of water temperature adjusting device)
7701	Supply for rotary beacon amperometric relay
7702	Relay excitation for auxiliary heater compensation tank filling motor
7703	12V positive after diod (radio supply)
7704	Radio amplifier supply
7705	Supply of auxiliary heater ignition plug
7706	Supply of interior heating motors (front)
7707	Supply before ABS fuse
7708	Auxiliary heater supply
7709	Supply of interior heating motors (rear)
7710	Supply of ABS control unit after relay no. 1
7711	Supply of windshield defrosting and heating motor
7715	Stop request signal resetting control
7720	Supply of ABS control unit after relay no. 2
7721	Cigar lighter supply
7722	Supply of cab heating air blower motor (auxiliary heater)
7724	Supply of ignition key (positive after fuse)
7725	Positive cable for connection of timer clock terminal to control relay
7726	Connection cable for air-conditioning system switch off relay (auxiliary heater on)
7728	Flasher light supply
7729	Assisted cab tilting relay control
7730	Cab tilting hydraulic pump supply (assited cab tilting system)
7731	Excitation positive before the ignition key
7733	Supply of fuel heater
7734	Supply of fuel heating before the fuse
7735	Supply of refrigerator motor
7736	Supply of air temperature thermostat (auxiliary heater)
7741	Supply of steering column antitheft coil
7744	Supply of engine compartment ventilation switch on control
7745	Supply of engine ventilation motor
7746	Supply of retarder relay through switch
7750	Supply from V4 branch point to EDC control switch relay
7751	Supply of remote engine rev up device after relay NO contact
7752	Supply of EDC control after relay NC contact

7753	Supply of heated fuel settler prefilter
7755	Supply of retarder relay terminal r (after the diode)
7756	Charge signal relay excitation (separate regulator alternator)
7759	Positive cable after air-conditioning system switch to timer clock
7766	Supply of comburent air pump and ignition coil motor (auxiliary heater)
7768	Tachograph continuous supply
7770	Positive after drop-out resistance or 12V positive before the diode (radio supply)
7771	Positive before amperometer
7772	Positive after fuse
7773	Generator/alternator excitation
7774	Horn supply (from switches to fuse)
7775	Auxiliary heater supply via switch
7776	Battery switch separate supply (dangerous cargo vehicles)
7777	Battery direct positive (unprotected)
7778	Optical indicator, generator/alternator charge
7779	Indicator, auxiliary heater switch off relay via control units
7780	Alternator D+ after diode
7781	Optical indicator supply, timer, electronic control unit, preheating/water temperature thermostats (auxiliary heater) (BUS temperature 65/70 °C)
7783	Supply of auxiliary fuel pump and fuel control solenoid valve (auxiliary heater)
7784	Supply of 80/85 °C water temperature thermostat (auxiliary heater)
7785	Supply of water circulation pump motor (auxiliary heater)
7786	Independent heating water pump enablement device
7788	Supply of preheating thermostat (auxiliary heater)
7789	Optical indicator, alternator charge (separate regulator alternator)
7790	Trailer socket supply after fuse (TMP USERS)
7791	GCR control electronic supply combined with emergency cutoff after fuse
7792	Fuel delivery booster solenoid before the fuse
7793	General supply, interior heating motors (front/rear) before relay
7794	Fuel delivery booster solenoid before the fuse
7798	Supply of automatic chassis lubrication system after fuse
7799	Supply of 1st/2nd speed/full speed relay excitation before control switch
8000	Supply of optical indicator test circuit
8001	Supply of interior aeration motor (centre) - Air expulsion
8002	No. 1 connection between side rh power window switches
8003	No. 1 connection between side lh power window switches
8004	Supply of electric heater switch (switch relay)
8005	Supply of engine preheating resistor signal
8006	Supply of front headlight cluster glass heating
8007	Supply of interior heating motors and forced ventilation switches
8008	Electrofan supply (4th speed)
8009	Supply of air-conditioning system relay
8010	Supply of speed limiting device without the fuse
8011	Supply of switch for internal aeration motors
8012	Supply of stop request optical indicator switch off relay

8013	Supply of fuel boost electromagnet
8014	Supply of chassis raising system
8015	Supply of chassis lowering system
8016	Brake wear cable (rear sensors)
8019	Supply of evaporator motors switch on relays
8020	Supply of windshield heating
8022	Supply of evaporator motors
8023	Supply of forced ventilation system relays
8024	Flasher light relay control
8025	Terminal I5 dilayed switch off relay, battery disconnecter cutoff (GCR)
8026	Reversing light relay excitation cable
8027	Automatic light relay excitation cable
8028	Jumper on speed limiter control unit for unlimited engine rpm function
8029	Relay excitation cable (starting with transmission in neutral)
8030	Gear uncoupling relay excitation (speed limiting device)
8031	Supply for driver's seat heating
8032	Supply for co-driver's seat heating
8033	Supply of relay for TELMA retarder relay (stage 3)
8034	Reverse gear enablement cable (automatic transmission)
8035	Relay excitation for holding GCR alive
8037	Supply from ignition switch terminal 50 for inhibiting vehicle starting with engine running
8044	Supply of TELMA retarder relay, stage 4
8045	GCR relay excitation via ignition switch
8046	Time relay excitation (heated windshield)
8047	Control of vehicle running signal relay (hydraulic braking system)
8048	Cruise Control switch off relay with retarder on
8050	Transmission in neutral signal switch
8051	Supply of "MS6" control unit + I5 after the relay
8059	Supply of speed limiter solenoid valve switch off relay (during gear shifting)
8060	Positive cable after Z diode for instrument light/pilot light dimmer (Military vehicles)
8061	Positive cable for warning lamp supply (dimmed light switching enabled via Z diode) (Military vehicles)
8062	Supply of instrument lights (dimmed light switching enabled via Z diode) (Military vehicles)
8087	Supply of miscellaneous components after relay
8101	Supply of semiautomatic transmission after fuse
8102	Neutral switch supply after fuse (semiautomatic transmission)
8103	Supply of semiautomatic transmission after fuse
8104	Neutral switch signal (starting inhibiting device semiautomatic transmission)
8105	Neutral switch supply (starting inhibiting device semiautomatic transmission)
8106	Neutral switch signal (starting inhibiting device after diode unit)
8107	Supply of air low pressure switch (semiautomatic transmission)
8108	Gear increase signal from semiautomatic transmission gearshift lever
8109	Gear decrease signal from semiautomatic transmission gearshift lever
8110	Supply of gear selector switch (semiautomatic transmission)
8111	Reverse gear engagement signal from gear selector device (semiautomatic transmission)

- 8112 Supply of clutch position switch (semiautomatic transmission)
- 8113 Clutch position switch signal (semiautomatic transmission)
- 8114 Retarder signal (semiautomatic transmission)
- 8115 Connection from speed group switch to engaged gear switch (semiautomatic transmission)
- 8116 Engaged gear signal (semiautomatic transmission)
- 8118 Engaged speed group signal (semiautomatic transmission)
- 8119 LIMP HOME supply (semiautomatic transmission)
- 8120 Signal from exhaust brake switch (semiautomatic transmission)
- 8123 Neutral position signal from direction preselector (semiautomatic transmission)
- 8124 Neutral position signal from direction preselector to semiautomatic transmission gear selector
- 8125 Forward gear signal from automatic transmission direction preselector
- 8131 Supply of rear power take-off relay (semiautomatic transmission)
- 8132 Supply of side power take-off relay (semiautomatic transmission)
- 8141 Signal to ABS system (PBM/PWM) (semiautomatic transmission)
- 8142 Signal to ABS system (MPS/MUX) (semiautomatic transmission)
- 8149 Supply of reverse gear relay (semiautomatic transmission)
- 8150 EDC supply
- 8151 EDC control unit interface signal to other electronic systems (PBM)
- 8152 EDC control unit interface signal to other electronic systems (MPS)
- 8153 Signal from primary stop light switch (EDC)
- 8154 Signal from Cruise Control cutoff switch (EDC)
- 8155 Signal from Cruise Control operation switch (EDC)
- 8156 Signal from Cruise Control speed reducing switch (EDC)
- 8157 Signal from Cruise Control speed increasing switch (EDC)
- 8158 Signal from secondary stop light switch (EDC)
- 8159 Signal from exhaust brake switch (EDC)
- 8161 EDC supply after Cruise Control cutoff relay
- 8162 Engine rpm increase switch with air-conditioning on (EDC)
- 8163 Connection to 3-lever pressure switch (air-conditioning system)
- 8164 EDC supply after engine stopping relay
- 8170 Supply of MS6 control unit + I5 from interconnection unit to relay
- 8300 Supply of hydraulic retarder system
- 8350 Supply from control relay to terminal I5 of fuse box (Fire-Fighting vehicles)
- 8351 Sound alarm instrument after fuse (Fire-Fighting vehicles)
- 8352 Control of sound alarm instrument (Fire-Fighting vehicles)
- 8353 Dual tone horn control (Fire-Fighting vehicles)
- 8354 Excitation of Martin horn relay (Fire-Fighting vehicles)
- 8355 Supply of terminal I5 of users after fuses (Fire-Fighting vehicles)
- 8356 Excitation of relay, terminal I5 (Fire-Fighting vehicles)
- 8357 Supply of power take-off switch hour counter (Fire-Fighting vehicles)
- 8358 Supply of MS6 control unit, terminal 20, before clutch switch
- 8360 Solenoid valve (+I5) supply (VGT turbine air pipe lock)
- 8361 Frequency converter (+I5) supply (VGT turbine)
- 8362 Supply of "MS6" control unit (terminal 31) before brake pedal switch

- 8402 Supply of electronic suspension levelling system (non-travelling condition)
- 8410 Control of front axle electronic suspension levelling system (travelling condition)
- 8411 Excitation of front axle self-levelling electronic suspension system (travelling condition)
- 8420 Control of rear axle electronic suspension levelling system (travelling condition)
- 8421 Excitation of rear axle self-levelling electronic suspension system (travelling condition)
- 8422 Supply of chassis rear lowering system
- 8423 Control of rear axle stroke stop relay
- 8439 Supply of axle lifting relay (speed < 2 km/h)
- 8440 Supply of axle lifting system after fuse
- 8441 Supply of axle lifting system after pushbutton
- 8442 Supply of axle lowering system after pushbutton
- 8443 Supply of 11 ton axle lifting system pressure switch
- 8444 Supply of axle lifting system after tachometer switch
- 8445 Supply of axle lifting/lowering switch
- 8446 Supply of axle lowering relay
- 8447 Supply of axle lifting relay
- 8448 Supply of axle lifting/lowering relay
- 8449 Axle lifting supply after relay
- 8450 Supply of hydraulic pump relay (lift axle system)
- 8451 Hydraulic pump cutoff signal from pressure switch (lift axle system)
- 8452 Supply of hydraulic pump system (lift axle system)
- 8453 Signal after 11 ton pressure switch (lift axle system)
- 8454 Signal after 11 ton pressure switch after diode (lift axle system)
- 8455 Supply after time relay with less than 11 tons
- 8456 Supply of axle lowering relay from chassis levelling system during lowering stroke
- 8457 Supply of air solenoid valve reversal relay during axle lowering stroke
- 8460 Supply of starting assistance device after pushbutton
- 8461 Supply of starting assistance function after time relay
- 8462 Starting assistance relay enablement with less than 13 tons
- 8463 Supply of starting assistance relay
- 8464 Starting assistance cutoff device
- 8465 Starting assistance relay cutoff device
- 8466 Supply of starting assistance device at a speed of ≥ 25 km/h
- 8468 Starting assistance cutoff at a speed of ≥ 25 km/h
- 8469 Starting assistance relay self-excitation
- 8490 Supply of 3rd steering axle system
- 8491 Signal from front axle straight driving position switch
- 8492 Signal from rear axle straight driving position switch
- 8493 3rd steering axle signal relay automatic supply
- 8494 Supply of 3rd steering axle relay after tachometer switch
- 8495 3rd steering axle hydraulic control (axle down)
- 8496 Supply of hydraulically-controlled 3rd steering axle relay in straight-ahead driving position (straight wheels)
- 8497 Hydraulically-controlled 3rd steering axle control (steered front axle condition)
- 8501 Ignition key-controlled supply after relay (independent heating)

8591	Supply from mean pressure switch for fan number of revolutions control (air conditioning)
8600	Supply of automatic clutch system
8601	Relay/buzzer supply from automatic clutch control unit
8602	Supply of automatic clutch position sensor
8603	Supply of accelerator pedal position sensor (automatic clutch)
8604	Supply of gear shift lever position sensor (automatic clutch)
8700	Instrument operation enablement (alternator output)
8710	+15 supply prearrangement (external bodybuilders (max = 10 A)
8800	Exhaust brake solenoid valve enablement switch
8801	Supply of de-aeration door opening relay (windshield defrosting external air inlet door open)
8802	Excitation of ignition key-assisted services relay
8803	Supply cable for miscellaneous services after BO light switch (terminal 49)
8804	Supply of draft tube ventilation motors
8805	Supply of permanent tube ventilation motors
8806	Supply of main lh rearview mirror aiming motor
8807	Supply before the fuse (ABS)
8808	Supply of main lh rearview mirror aiming motor (vertical direction)
8809	Supply of main lh rearview mirror aiming motor (endwise direction)
8810	Levelling system supply after fuse
8811	Supply of draft tube ventilation motor switch on relay
8812	Electronic suspension levelling control (travelling condition)
8813	Windshield wiper unit (8-function switch)
8814	Brake wear (return from interconnecting box to cab control unit and sensor connection)
8815	Supply of GCR relay
8816	Supply of trailer ABS from infomodule
8817	Supply of infomodule RK line (ABS)
8818	Supply of infomodule RK line (ABS)
8819	Heated mirror relay excitation
8820	Supply of headlamp wiping unit from relay
8821	Supply of headlamp wiping unit from electric pump
8822	Windshield wiper unit intermittent supply
8823	Supply of headlamp wiping unit
8824	Supply of permanent tube ventilation motor turn on relay
8825	Supply of forced ventilation switch off relay (high speed)
8826	Headlamp wiping unit: connection between motors
8827	Supply of brake oil pump relay
8828	Supply of brake oil pump
8829	Control of heated mirror and/or mirror aiming after fuse
8830	Supply of heated rearview mirrors
8831	Supply (15) of water in prefilter signal
8832	Excitation of fuel heating relay
8833	Supply of relays for front interior heating motors or relais for supply of water circulation pump motor and water/oil exchanger solenoid valve
8834	Relay supply for rear interior heating motors
8835	Supply of front interior aeration/air intake motor

- 8836 Supply of parking rearview mirror aiming motor (driver's opposite side)
- 8837 Fuel heating relay temperature switch
- 8838 Supply of parking rearview mirror aiming motor (vertical direction driver's opposite side)
- 8839 Supply of parking rearview mirror aiming motor (endwise direction driver's opposite side)
- 8841 Supply of wide-angle rearview mirror aiming motor (driver's side)
- 8842 Supply of wide-angle rearview mirror aiming motor (vertical direction driver's side)
- 8843 Supply of wide-angle rearview mirror aiming motor (endwise direction driver's side)
- 8844 Supply of front interior aeration/air ejection motor
- 8845 Supply of centre interior aeration/air intake motor
- 8847 Supply of ABS/speed limiting device after fuse
- 8848 Supply of injection pump ignition timer (KB)
- 8849 Supply of contact key-assisted services and cutoff of various components during starting stage
- 8850 Relay excitation for cutoff of various components during starting stage
- 8851 Supply of wide-angle rearview mirror aiming motor (driver's opposite side)
- 8852 Supply of wide-angle rearview mirror aiming motor (vertical direction driver's opposite side)
- 8853 Supply of wide-angle rearview mirror aiming motor (endwise direction driver's opposite side)
- 8855 Supply of rear interior aeration/air intake motor
- 8856 Supply of rear interior aeration/air ejection motor
- 8857 Supply of main rh rearview mirror aiming motor
- 8858 Supply of main rh rearview mirror aiming motor (vertical direction)
- 8859 Supply of main rh rearview mirror aiming motor (endwise direction)
- 8860 Supply of KHD motor motor preheating
- 8861 Supply of side power window control
- 8862 Connection no. 2 between side rh power window switches
- 8863 Supply of side power window motor
- 8864 Supply of trim adjuster motor
- 8865 Return cable from side power window motor
- 8866 Positive from TELMA retarder
- 8867 Connection no. 2 between side lh power window switches
- 8869 Supply of key antirotation electromagnet
- 8870 Start preheating supply after fuse
- 8871 Supply of vehicle operation testing instruments after fuse
- 8872 Flasher light centre supply after fuse
- 8873 Windshield wipers fixed stop
- 8874 Supply of hydraulic prebrake solenoid valves after fuse
- 8875 Start preheating supply before fuse
- 8876 Supply of engine operation testing instruments after fuse
- 8877 Connection for windshield wipers intermittent operation and switch
- 8878 Supply of ERG control unit
- 8879 Supply of servoassisted components after fuse
- 8880 Supply of windshield wiper unit motor - separate fuse
- 8881 Supply of windshield wiper unit motor - high speed
- 8882 Supply of windshield wiper unit motor - low speed
- 8883 Supply of air-conditioning system motor - high speed

8884	Supply of air-conditioning system motor - low speed
8885	Supply of heating relay
8886	Supply of windshield washer pump
8887	Supply of general services before fuse
8888	Starter motor electromagnet or relay
8889	Supply of trailer brake control relay
8890	Supply of trailer prebrake solenoid valve
8891	Supply of windshield defroster and heater switch (fuse + switch or fuse + relay)
8892	Under cab engine starting
8893	Relay excitation for water recirculating pump during auxiliary heter starting stage
8894	Supply of TELMA retarder foot/hand control selecting switch
8895	Travelling signal relay control (hydraulic braking system)
8898	Supply of automatic chassis lubrication system after fuse
8899	Supply of 12V/24V radio set
9000	Supply of center door opening solenoid valve
9002	Supply of spring cylinder emergency release solenoid valve
9003	Gear selector relay excitation
9004	Gear selector relay supply
9005	Connection line between non-series connected exhaust switch and brake pedal switch
9006	Connection line between safety switch and rear door reopening pressure pushbutton
9007	Automatic transmission control
9008	Automatic transmission supply
9010	Door no. 2 (centre) relay control
9011	Connection from terminal 30 of electronic accelerator control unit to terminal 3 of accelerator pedal sender unit and actuator terminal 1
9012	Connection from terminal 21 of electronic accelerator control unit to terminal 6 of accelerator pedal sender unit
9014	Connection from terminal 15 of electronic accelerator control unit to terminal 2 of accelerator pedal sender unit
9015	Connection from terminal 17 of electronic accelerator control unit to terminal 4 of accelerator pedal sender unit and actuator terminal 4
9016	Connection from terminal 16 of electronic accelerator control unit to actuator terminal 3
9017	Connection from terminal 11 of electronic accelerator control unit to terminal 5 of accelerator pedal sender unit and actuator terminal 5
9018	Connection from terminal 22 of electronic accelerator control unit to actuator terminal 2
9022	Connection from terminal 1 of electronic accelerator control unit to actuator terminal 2 (engine)
9023	Connection from terminal 10 of electronic accelerator control unit to actuator terminal 1 (engine)
9027	Transfer case valve supply line after door 1 pushbutton
9028	Transfer case valve supply line after door 2 pushbutton
9031	Service brake solenoid valve supply
9040	Front axle levelling solenoid valve 1 control
9050	Rear axle levelling solenoid valve 1 control
9058	Pre-resistor supply for speed limiter proportional solenoid valves
9060	Dump solenoid valve supply for speed limiter gear uncoupling
9061	Modulating solenoid valve supply (MV1) (speed limiting device)
9062	Modulating solenoid valve supply (MV2) (speed limiting device)

- 9101 Supply of transmission solenoid valve unit (no. 1) (semiautomatic transmission)
- 9102 Supply of transmission solenoid valve unit (no. 2) (semiautomatic transmission)
- 9103 Supply of transmission solenoid valve unit (no. 3) (semiautomatic transmission)
- 9104 Supply of transmission solenoid valve unit (no. 4) (semiautomatic transmission)
- 9105 Supply of transmission solenoid valve unit (no. 5) (semiautomatic transmission)
- 9106 Supply of transmission solenoid valve unit (no. 6) (semiautomatic transmission)
- 9108 Supply of transmission solenoid valve unit (no. 8) (semiautomatic transmission)
- 9109 Supply of "A" splitter gear solenoid valve unit (semiautomatic transmission)
- 9110 Supply of "B" splitter gear solenoid valve unit (semiautomatic transmission)
- 9112 Supply of transmission brake solenoid valve (semiautomatic transmission)
- 9113 Supply of transmission solenoid valve unit (no. 13) (semiautomatic transmission)
- 9114 Supply of clutch release holding solenoid valve (semiautomatic transmission)
- 9115 Exhaust brake disengagement signal (semiautomatic transmission)
- 9116 Supply of clutch signal solenoid valve (semiautomatic transmission)
- 9117 Engine negative on injection pump actuator (semiautomatic transmission)
- 9118 Engine positive on injection pump actuator (semiautomatic transmission)
- 9119 Limit switch signal on injection pump actuator (semiautomatic transmission)
- 9120 Supply of limit switch signal on injection pump actuator (semiautomatic transmission)
- 9121 Boost supply on injection pump actuator (semiautomatic transmission)
- 9122 Boost signal on injection pump actuator (semiautomatic transmission)
- 9131 Supply of power take-off solenoid valve (semiautomatic transmission)
- 9132 Supply of side power take-off solenoid valve (semiautomatic transmission)
- 9150 EDC pump rod position sensor (terminal 1)
- 9151 EDC injection pump rod stroke signal
- 9152 Engine rpm sender unit (EDC)
- 9153 EDC pump rod position sensor (terminal 5)
- 9154 Common EDC pump rod position sensor
- 9155 Emergency engine stopping solenoid valve (EDC)
- 9156 Injection pump fuel delivery actuator (EDC)
- 9157 Injection pump advance check electromagnet (EDC)
- 9158 Injector internal needle lift sensor (EDC)
- 9165 MS4/MS6 brake signal (engine rev up from ground enablement)
- 9301 Position 1 control (hydraulic retarder)
- 9302 Position 2 control (hydraulic retarder)
- 9303 Position 3 control (hydraulic retarder)
- 9304 Position 4 control (hydraulic retarder)
- 9305 Position 5 control (hydraulic retarder)
- 9306 Position 6 control (hydraulic retarder)
- 9307 Supply from lever switch pushbutton (hydraulic retarder)
- 9308 Supply of lever switch pushbutton (hydraulic retarder)
- 9310 Supply of hydraulic retarder operation solenoid valve
- 9311 Supply of oil accumulator solenoid valve (hydraulic retarder)
- 9402 Supply of chassis levelling solenoid valves II (travelling condition)
- 9410 Supply of chassis front lowering I/II solenoid valves

- 9413 Supply of front axle ECAS solenoid valve
- 9420 Supply of chassis rear lowering I/II solenoid valves
- 9422 Solenoid valve II control (rear axle chassis levelling control - travelling condition)
- 9423 Supply of rear axle ECAS solenoid valve unit
- 9424 Supply of rear axle ECAS solenoid valve unit (rh valve)
- 9425 Supply of rear axle ECAS solenoid valve unit (lh valve)
- 9440 Supply of lift axle lowering solenoid valve
- 9441 Supply of cantilever lifting solenoid valve
- 9442 Supply of cantilever lowering solenoid valve
- 9443 Supply of axle lifting solenoid valve (air discharge from springs)
- 9444 Supply from solenoid valve relay for operation of air pressure-controlled valves
- 9445 Supply of solenoid valve for operation of air pressure-controlled valves
- 9446 Supply of ECAS rear axle solenoid valve unit (air discharge from rh rear air spring)
- 9447 Supply of ECAS rear axle solenoid valve unit (air discharge from lh rear air spring)
- 9460 Supply of solenoid valve for starting assistance cutoff over 13 tons
- 9490 Supply of 3rd steering axle solenoid valve unit
- 9498 Hydraulic steering axle operation control (front axle steered and speed > 45 km/h)
- 9499 Supply of 3rd steering axle lock solenoid valve
- 9506 Solenoid valve supply for stopping engine circuit water circulation with auxiliary heater on
- 9507 Solenoid valve supply for switching from engine circuit water circulation to auxiliary cab heating
- 9551 Time valve (1) supply (air-conditioning system)
- 9552 Time valve (2) supply (air-conditioning system)
- 9570 TOP-FLAP motor supply from relay (air-conditioning system)
- 9571 TOP-FLAP motor supply from microswitch (manually-controlled air-conditioning system)
- 9590 Electrofan supply (air-conditioning system)
- 9591 Fan motor low speed control (air-conditioning system)
- 9601 Supply of automatic clutch motor after relay
- 9602 Automatic clutch actuator solenoid valve (supply)
- 9900 Front doors opening solenoid valve supply
- 9902 Rear doors opening solenoid valve supply
- 9903 Engine stopping control
- 9905 "MS6" control unit supply (+15) on/off relay coil control
- 9906 Engine stopping control from Main Current Switch
- 9907 Starting enablement switch
- 9910 TELMA retarder supply: 2nd position
- 9911 Supply of TELMA control switch
- 9912 TELMA retarder supply: 4th position
- 9913 TELMA retarder supply: 1st position
- 9914 Supply of permanent ventilation duct door solenoid valve
- 9915 Supply of auxiliary retarder cutoff with ABS on
- 9916 TELMA retarder supply: 3rd position
- 9917 EDC supply cutoff
- 9918 Supply of front rh wheel "AV" solenoid valve (ABS system)
- 9920 Supply of front rh wheel "EV" solenoid valve (ABS system)

- 9921 Supply of front lh wheel "EV" solenoid valve (ABS system)
- 9922 Supply of water/oil heat exchanger solenoid valve
- 9923 3rd axle lifting control
- 9924 Injector supply (EDC)
- 9925 Pressure regulator (EDC)
- 9926 Supply of permanent aeration duct 1/3 door opening solenoid valve
- 9928 Supply of rear rh wheel "AV" solenoid valve (ABS system)
- 9929 Supply of rear lh wheel "AV" solenoid valve (ABS system)
- 9930 Supply of rear rh wheel "EV" solenoid valve (ABS system)
- 9931 Supply of rear lh wheel "EV" solenoid valve (ABS system)
- 9932 Valve gear cam rpm sensor (EDC)
- 9933 Supply of electromagnetic clutch control relay
- 9934 Headlight aiming control device
- 9935 Headlight aiming control device (position C)
- 9936 Headlight aiming control device (position B)
- 9937 Headlight aiming control device (position A)
- 9938 1st supply, outside air intake door actuator and relevant warning lamp
- 9940 TELMA retarder relay box control: 2nd position
- 9942 TELMA retarder relay box control: 4th position
- 9943 TELMA retarder relay box control: 1st position
- 9944 Connection, electronic accelerator control unit terminal 18 to retarder control unit terminal 3
- 9946 TELMA retarder relay box control: 3rd position
- 9948 2nd supply, outside air intake door actuator and relevant warning lamp
- 9950 Trailer brake control solenoid valve (Germany) (trailer 7th current outlet pole)
- 9951 Differential lock solenoid valve supply
- 9952 Solenoid valve 1 supply, front axle levelling control
- 9953 Solenoid valve 2 supply, front axle levelling control
- 9954 Drive control solenoid valve supply
- 9955 Connection, electronic accelerator control unit terminal 26 to ABS/ASR control unit terminal 14
- 9956 Connection, electronic accelerator control unit terminal 27 to ABS/ASR control unit terminal 12
- 9957 Connection, electronic accelerator control unit terminal 28 to ABS/ASR control unit terminal 30
- 9958 Two-speed AR rear axle relay control
- 9959 Gas recirculation solenoid valve control (EGR)
- 9960 Engine rpm reducing solenoid valve (ASR or speed limiting device)
- 9961 ASR rh side solenoid valve
- 9962 ASR lh side solenoid valve
- 9963 Hydraulic converter on
- 9966 Supply of engine stopping and/or exhaust brake solenoid valve
- 9967 Supply of exhaust brake cutoff solenoid valve (ABS)
- 9968 Speed limiting device
- 9970 Speed limiting device (supply +15)
- 9971 Supply of solenoid valve for preventing jumps between speeds
- 9972 Supply of fuel delivery solenoid valve
- 9973 Supply of splitter control solenoid valve (normal gears)

- 9974 Supply of solenoid valve for preventing line jumps on the same level (ZF transmission)
- 9976 Pressure switch to be operated while shifting from normal to splitter gears
- 9977 Supply of hydraulic prebrake solenoid valve
- 9978 Supply of solenoid valve for adjusting fuel delivery according to altitude
- 9980 Vehicle air suspension system control (front)
- 9981 Vehicle air suspension system control (rear)
- 9982 Supply of rear axle levelling control solenoid valve no. 1
- 9983 Supply of front axle levelling control solenoid valve no. 2
- 9985 Tachograph - speed limiter realy
- 9988 Supply of accelerator lock solenoid valve
- 9990 Solenoid valve control, de-aeration duct door
- 9991 Vehicle speed induction sensor
- 9992 Supply of transmission splitter unit control
- 9993 Electromagnetic clutch supply (air-conditioning system)
- 9994 Solenoid valve control, draft tube door
- 9996 Pulse control (2-speed rear axle)
- 9997 Supply of splitter unit solenoid valve (splitter gears)
- 9999 —

(*) Dangerous cargo vehicles

4-DIGIT COMPONENT CODES

X3	On-board wiring junction block, automatic transmission
X4	On-board wiring junction block, automatic transmission
0012	Coupling
0013	6-way coupling, air-conditioning system
0015	Ashtray light
0047	Warning lamp, emergency gear engagement
0300	6-diode self-rectifying alternator
0301	9-diode self-rectifying alternator
0302	Self-rectifying alternator with voltage regulator
0600	Electronic voltage regulator for 6-diode alternator
0601	Electronic voltage regulator for 9-diode alternator
0602	Electronic voltage regulator integral to the alternator
0630	Voltage regulator overvoltage protection device
0800	Starter motor
0830	Device for inhibiting vehicle starting with engine running and starting repetition
I200	Motor for windscreen defrosting heater
I201	Motor for internal aerators
I202	Motor for engine compartment ventilation
I203	Motor for forced ventilation
I204	Motor for rh power window
I205	Motor for refrigerator
I206	Motor for internal heater
I207	Motor for ventilation of permanent duct
I208	Motor for ventilation of draft duct
I209	Motor for vehicle front internal heating
I210	Motor for vehicle rear internal heating
I211	Motor for air-conditioner evaporator
I212	Motor for air-conditioner capacitor
I213	Motor for driver's place ventilation
I214	Motor for driver's place heating
I215	Motor for driver's place defrosting/heating
I216	Motor for lh power window
I217	Motor for external air intake door/windscreen defrosting recirculation/driver's heating
I218	Motor for adjustable rearview mirrors
I219	Motor for ventilation of transmission oil radiator
I220	Motor for water circulation pump
I221	Swing door motor
I222	Motor for braking circuit oil pump
I223	Motor for front drive axle differential lock
I224	Motor for windscreen power blind
I225	Motor for headlight alignment control actuator
I226	Motor for added axle hydraulic pump

1227	Motor for cab tilting hydraulic pump
1228	Motor for sunroof
1229	Automatic chassis lubrication system component
1230	Modulating valve Roof-hatch motor
1231	Rear flap motor
1232	Motor for rear air expulsion flap
1400	Ignition distributor
1500	Ignition coil
1900	Spark plugs
2000	12V starting battery
2200	Volute electromagnetic horn
2201	Electronic horn
2202	Diaphragm electromagnetic horn
2203	Horn
2230	Electrodistributor for air horns
2400	Hydraulic braking and exhaust brake foot switch
2401	Telma retarder foot switch
2402	Load sensing switch under accelerator pedal
2403	Brake pedal valve 3-phase switch
2404	Retarder foot switch
2405	Sender unit on electronic accelerator pedal
2406	Accelerator pedal sender unit (AVS)
2500	Charging signal relay
2501	General Current Relay
2502	Combined isolator switch/relay
2503	Telma retarder control unit
2504	Delayed opening relay for keeping GCR (*) energized
2505	GCR with automatic circuit breaker
2506	Electronic relay for radiator water level signal0
2507	Relay with delayed NC contact for de-energizing GCR with engine off and safety devices turned on
2508	Relay for sound-controlled direction indicator light
2509	Relay for switching on rotary beacons
2510	Starting relay
2511	Pre-heating relay
2512	Rich mixture control relay
2513	Relay for high/low beam lights
2514	Relay for key reverse rotation inhibitor electromagnetic control
2515	Relay for accelerator lock while the vehicle is hydraulically operated
2516	Relay for trailer exhaust brake solenoid valve
2517	Relay for Webasto heater
2518	Relay for Webasto heater w/lamp
2519	Actuator for tractor/trailer direction indicator lights
2520	Actuator for hazard/direction indicator lights

2521	Relay for energizing General Current Relay
2522	Relay for exhaust brake solenoid valve
2523	Relay for engine compartment ventilation
2524	Relay for GCR cutoff
2525	Relay for enabling connection of rear fog lamps with high beam lights on
2526	Relay for air-conditioning system
2527	Relay for fog lights and for allowing connection of rear fog lights
2528	Relay for allowing excitation of 6-diode self-rectifying alternator
2529	Relay for capacitor motor
2530	Relay for internal heating motors
2531	Relay for loading light
2532	Relay for headlight wiping/washing unit
2533	Relay for rotating beacons
2534	Relay for lamp test
2535	Relay for cab tilted and gear engaged sound signal
2536	Relay for connection of water recirculation pump during vehicle starting
2537	Relay for allowing direct drive at low speed
2538	Relay for stopping vehicle with doors open
2539	Relay for connection of stop request w/lamp
2540	Relay for hazard lights
2541	Actuator for tractor/trailer right direction indicator lights
2542	Actuator for tractor /trailer left direction indicator lights
2543	Relay for fog lamps and for allowing connection of rear fog lamps
2544	Relay for connection of stop request w/lamp
2545	Relay for stopping vehicle and closing doors
2546	Relay for lamp test
2547	Relay for allowing gear engagement with brake pedal fully depressed
2548	Relay for connection of parking and low beam lights with running
2549	Relay for connection of electrical retarder
2550	Relay for fog headlights
2551	Relay for windscreen defrosting by means of Webasto heater
2552	Relay for headlamp washer/wiper unit
2553	Relay for switching on low beam lights with high beams on
2554	Flasher light relay
2555	Relay for allowing connection of rear fog lamps with high beam lights on
2556	Relay for connection of main generator w/lamp and for allowing connection of air-conditioning system with engine running
2557	Relay for remote starting with cab uncoupled and for starting from driving place with cab coupled up
2558	Relay for allowing remote starting with cab uncoupled
2559	Relay for 2-speed rear axle or 2x5 speed transmission
2560	Relay for turning off stop request w/lamp with doors open
2561	Relay for turning off direction indicator flasher light in emergency condition
2562	Relay for allowing connection of exhaust brake solenoid valve
2563	Relay for allowing connection of air-conditioning system with engine running

- 2564 Relay for stop request single-tone bell
- 2565 Relay for turning off fog lamps with high beam lights on
- 2566 Relay for light black-out
- 2567 Relay for turning off fog lamps with low beam lights on
- 2568 Relay for allowing engine remote starting
- 2569 Relay for turning off forced ventilation at high speed
- 2570 Relay for turning off Webasto from safety control unit
- 2571 Relay for turning off GCR with ignition key and/or external lights on
- 2572 Relay for opening deaeration door with outside air intake door open
- 2573 Relay for inhibiting exhaust brake connection while the vehicle is hydraulically operated
- 2574 Relay for inhibiting defroster connection by means of ignition key with Webasto on
- 2575 Relay for stopping engine with gears engaged and low air pressure in suspension system
- 2576 Relay for inhibiting door opening with vehicle running
- 2577 Speed limiter relay
- 2578 Relay for allowing reverse gear engagement with vehicle stationary
- 2579 Relay for fan belt broken w/lamp and buzzer
- 2580 Relay for connection of ventilation motors in permanent duct
- 2581 Relay for connection of ventilation motors in diffuser duct
- 2582 Relay for connection of interior/front heating motors/1st speed
- 2583 Relay for connection of interior/rear heating motors/2nd speed
- 2584 Engine stopping relay
- 2585 Relay for de-energizing alternator with GCR open
- 2586 Relay for inhibiting exterior lighting with GCR open and battery+ earthed
- 2587 Relay for enablement of vehicle starting with transmission in neutral
- 2588 Relay for turning on stop request signal light
- 2589 Relay for keeping no.2588 above energized
- 2590 Relay for connection of rear fog lamps with low beam lights on
- 2591 Relay for tachograph supply
- 2592 Relay for starting from ground with parking brake on and from cab with engine door closed
- 2593 Relay for turning on interior lighting
- 2594 Relay for turning on interior lighting with safety control on
- 2595 Relay for engaging normal/splitter gears
- 2596 Relay for keeping Webasto earthed with isolator switch off
- 2597 Relay for inhibiting gear engagement with air suspensions unloaded
- 2598 Relay for connection of number plate lights
- 2599 Relay for supply of Webasto heater through the timer
- 2601 Relay for connection of foul air intake motors
- 2602 Relay for connection of foul air intake motors
- 2603 Relay for connection of foul air intake motors
- 2604 Relay for connection of air expulsion front flap motors
- 2605 Relay for connection of air expulsion rear flap motors
- 2606 Service relay for rear outside air intake flaps when air-conditioning system is set in operation
- 2607 Delayed closing relay for rear outside air intake flaps when air-conditioning system is set in operation
- 2608 Relay for turning off air intake motors when air-conditioning system is set in operation

2609	Relay for allowing connection of internal heating
2610	Relay for allowing connection of conditioned air
2613	Relay
2614	Relay
2615	Relay for enablement of forced ventilation
2616	Relay for enablement of forced ventilation and conditioned air with engine running
2617	Relay for enablement of ventilation
2618	Relay for enablement of individual ventilation
2619	Relay for allowing connection of ventilation motors in 1st speed (40 A)
2620	Relay for allowing connection of ventilation motors in 1st speed (40 A)
2621	Relay for allowing connection of ventilation motors in 1st speed (40 A)
2622	Relay for allowing connection of ventilation motors in 2nd speed (40 A)
2623	Relay for allowing connection of ventilation motors in 2nd speed (40 A)
2624	Relay for allowing connection of ventilation motors in 2nd speed (40 A)
2625	Relay for connection of individual ventilation motors (40A)
2626	Relay for allowing air intake through the ventilation control device
2627	Relay for allowing rear outside air intake flaps (minimum opening)
2628	Relay for connection of rear internal flap motors
2629	Relay for connection of A/C capacitor motors
2630	Relay for connection of A/C capacitor motors
2631	Relay for connection of A/C capacitor motors
2632	Relay for connection of A/C capacitor motors
2633	Relay for connection of A/C capacitor motors
2634	Relay for switching on compressor
2635	Relay for switching on compressor
2636	Compressor enablement relay
2637	Compressor enablement relay
2638	Relay for electric heater smog control
2640	Relay, solenoid valve for stopping water delivery to electric heater compartment
2642	Relay, solenoid valve for stopping water delivery to electric heater compartment
2644	Relay, solenoid valve for stopping water delivery to electric heater compartment
2800	Fuel enrichment jet solenoid
2801	Key rotation inhibiting solenoid
2802	Engine stopping electromagnet
2803	Electric starter electromagnet
2804	Electromagnet for engaged gear signal on clutch pedal (AVS)
2909	Hitched up cab component (E15) for rh/lh roof rotary beacon
3000	Driving and traffic beam headlight
3001	Front headlight cluster (driving and traffic/parking and turn signal lights/thermal glass)
3002	Driving and traffic beam with built-in parking light
3003	High beam light Parking lights
3004	Front headlight cluster (driving and traffic/parking and turn signal lights/trim control)
3005A	Low/high beam light with parking light (low beam)

3005B	Low/high beam light with parking light (high beam)
3005C	Low/high beam light with parking light (parking)
3005E	Headlight alignment control actuator
3030	Fog headlight
3031	Blackout light
3032	Snowplough light
3033	Front headlight cluster (driving lights, fog lights)
3100	Front/side turn signal repeater
3200	Front parking and turn signal light
3201	Front parking light
3202	Front turn signal light
3203	Front marker light
3204	Front marker/turn signal side repeater
3220	Front BO light
3221	Front BO marker light
3222	Rotary beacon
3300	Side parking and turn signal light
3301	Side turn signal light
3302	Auxiliary turn signal light (max 42W)
3303	Side turn signal and gabarit light
3305	Side headlight system -side parking light
3400	Tail headlight cluster (parking/turn signal/stop)
3401	Tail headlight cluster (parking/turn signal/stop/reverse)
3402	Tail headlight cluster (BO parking/stop)
3403	Tail headlight cluster (parking/turn signal/stop/reverse/rear fog)
3404	Tail headlight cluster (parking/turn signal/stop/reverse/rear fog/number plate)
3405	Tail headlight cluster (parking/stop/number plate)
3406	Tail headlight cluster (parking/stop)
3407	Tail headlight cluster (parking/turn signal/stop/rear fog)
3408	Tail headlight cluster (parking/turn signal/stop/rear fog/number plate)
3409	Tail headlight cluster (BO parking/stop/turn signal)
3410	Tail parking light
3411	Tail stop light
3412	Tail turn signal light
3414	Tail lamp / turn indicator light / stop light / backup light / fog guard lights /clearance light / number plate light
3415	Tail lamp / turn indicator light / stop light / backup light / fog guard lights /clearance light / number plate light
3420	Tail marker light
3421	Loading lamp
3422	Reversing light
3423	Tail fog light
3424	BO tail marker light
3425	BO tail cross light

3426	BO stop light
3500	Number plate light
3600	Cab interior ceiling lamp
3601	Cab rear ceiling lamp
3602	Bunk ceiling lamp
3603	Steps spotlight
3604	Engine compartment spotlight
3605	Luggage compartment light
3606	Driver's place ceiling lamp
3607	Blue lights ceiling lamp
3608	Interior incandescence ceiling lamp
3609	Reading lamp
3610	Map light
3611	Interior incandescence ceiling lamp
3612	Route sign fluorescent ceiling light
3613	Front door steps spotlight
3614	Centre door steps spotlight
3615	Rear door steps spotlight
3616	Route sign ceiling light
3617	Cab interior swivel spotlight
3618	Conductor's seat spotlight
3619	Engine oil level spotlight
3620	Cab interior swivel spotlight
3621	Blue/normal light ceiling lamp
3622	Tooling compartment roof lamp
3700	Front/rear marker light
3701	Front marker light
3702	Front/rear marker light
3703	Front/rear identification light
3704	Rear marker light
3705	Side marker light
3900	Symbol light
3901	Instrument light
3902	Stop request signal light (centre door)
3903	Stop request signal light (front door)
3904	Gear shift lever symbol light
3905	Heater lever symbol light
3906	EXIT sign light
3907	Cigar lighter light
4000	Dual-purpose mechanical tachometer
4001	Dual-purpose mechanical tachometer with high speed warning lamp
4002	Electronic tachometer
4010	Daily mechanical tachograph (1 driver/EEC)
4011	Daily mechanical tachograph (2 drivers/EEC)

4012	Daily mechanical tachograph (1 driver/EEC)
4013	Daily mechanical tachograph (2 drivers/EEC)
4014	Weekly mechanical tachograph (2 drivers/EEC)
4015	1-driver mechanical tachograph with speed limiter current outlet
4016	Mechanical tachograph with speed limiter current outlet with high speed warning lamp
4030	Sender unit for electronic tachometer
4031	Sender unit for electronic tachograph
4040	Signal amplifier for speed pulse
4041	Signal converter for tachometer
4042	Electronic adapter for tachometer
4043	Reduction unit for tachograph (dangerous cargo vehicles)
4100	Mechanic mile counter with double odometer
4101	Mechanic mile counter with double odometer and warning lamp signaling dangerous speed
4102	Electronic mile counter
4110	Daily mechanical mile tachograph (1 driver/EEC)
4111	Daily mechanical mile tachograph (2 drivers/EEC)
4200	Engine oil pressure gauge
4201	Brake system air pressure gauge
4202	Engine oil pressure gauge with built-in w/lamp
4203	Front brake system air pressure gauge with built-in w/lamp
4204	Rear brake system air pressure gauge with built-in w/lamp
4205	Dual-reading front/rear brake system air pressure gauge
4206	Front brake system air pressure gauge
4207	Rear brake system air pressure gauge
4208	Dual-reading front brake system air pressure gauge
4209	Dual-reading rear brake system air pressure gauge
4210	Absolute pressure gauge (EGR)
4230	Sender unit for front brake system air pressure gauge
4231	Sender unit for rear brake system air pressure gauge
4232	Sender unit for engine oil pressure gauge
4233	Sender unit for brake system air pressure gauge
4234	Sender unit for front brake system moderate air pressure gauge
4235	Sender unit for rear brake system moderate air pressure gauge
4236	Absolute pressure sensor (EGR)
4237	Static sender unit, engine oil pressure gauge
4400	Fuel level indicator
4401	Fuel level indicator with built-in w/lamp
4410	Engine oil level indicator
4415	Engine oil topup indicator
4500	Control, fuel level indicator
4501	Control, fuel level indicator with w/lamp contact
4510	Control, engine oil level indicator
4520	Control, brake fluid level indicator
4521	Control, clutch fluid level indicator

4522	Control, windshield washing fluid level indicator
4523	Control, radiator water level indicator
4524	Control, power steering oil level indicator
4525	Control, rear brake fluid level indicator
4526	Control, front brake fluid level indicator
4527	Control, power steering oil level indicator (3rd axle)
4530	Control, reserve reservoir water level indicator
4538	Sender unit, engine oil pressure gauges
4700	Thermometer, engine coolant temperature
4701	Thermometer, converter oil temperature
4702	Thermometer, crankcase temperature
4703	Thermometer, engine coolant temperature with built-in w/lamp
4704	Thermometer, transmission oil temperature
4705	Thermometer, engine oil temperature with built-in w/lamp
4710	Thermometer, external temperature
4716	Quartz clock
4717	Digital clock
4730	Sender unit, engine coolant temperature thermometer
4731	Sender unit, crankcase temperature thermometer
4732	Sender unit, converter oil temperature thermometer
4733	Sender unit, engine oil temperature thermometer
4734	Sender unit, transmission oil temperature thermometer
4736	Sender unit, external temperature thermometer
4737	Engine coolant temperature (EGR)
4800	Mechanical rev counter
4801	Mechanical rev counter module with engine overspeeding signalling device
4802	Electronic rev counter module
4803	Mechanical rev counter module with engine overspeeding signalling device
4804	Electronic rpm meter
4805	Mechanical rpm meter
4806	Electronic rpm meter with built-in instrument light dimmer
4830	Sender unit, electronic rpm meter
4831	Rpm meter inductive sender unit
4832	T.D.C. electromagnetic sensor
4833	Rpm sensor (AVS)
4834	Engine rpm fault diagnosis sensor ($n=1/1$)
4835	Engine rpm fault diagnosis sensor ($n=1/2$ on injection pump)
4836	Output rpm sensor (AVS)
4900	Battery charge indicator
4901	Power unit operation hour counter
4902	Compressor operation hour counter
4903	Inclinometer
4904	Voltmeter
5000	Combined module, FIAT engine vehicles

5001	Combined module, KHD engine vehicles
5002	Instrument module, FIAT engine vehicles
5003	Instrument module, KHD engine vehicles
5004	Combined module, medium weight FIAT engine vehicles
5005	Combined module, medium weight KHD engine vehicles
5020	Switch, central emergency unit control
5030	9-reading multiple instrument
5141	Switch, power take-off on
5200	Switch, windshield defrosting electric heater
5201	Switch, Webasto heater
5202	Switch, heated rearview mirrors
5203	Switch, fog lights
5204	Switch, rear fog lights
5205	Switch, loading lamp
5206	Switch, fuel boost device and preheating
5207	Switch, stop request enablement
5208	Switch, internal aerators
5209	Switch, exhaust brake enablement
5210	Switch, vehicle front raising system
5211	Switch, vehicle rear raising system
5212	Switch, front headlight cluster thermal lens
5213	Switch, rotary beacons
5214	Switch, refrigerator
5215	Switch, driver's light
5216	Switch, blue internal lights
5217	Switch, heating from engine
5218	Switch, reading lights
5219	Switch, forced ventilation
5220	Switch, internal heating
5221	Switch, rear interior heating
5222	Switch, air-conditioning system control
5223	Switch, power take-off
5224	Switch, driver's place ventilation
5225	Switch, windshield
5226	Switch, external lights
5227	Switch, release of vehicle operation with doors open
5228	Switch, conductor's place light
5229	Switch, interior lighting
5230	Switch, front brake system air pressure
5231	Switch, rear brake system air pressure
5232	Switch, engine oil pressure
5233	Switch, parking brake on
5234	Switch, hydraulic drive
5235	Switch, trailer exhaust brake

- 5236 Switch, converter oil pressure
- 5237 Switch, air suspension system failure
- 5238 Switch, body tilted
- 5239 Switch, brake system failure
- 5240 Switch, air cleaner restriction
- 5242 Switch, brake system pressure drop
- 5243 Switch, 2x5 transmission or 2-speed rear axle (gear shift lever)
- 5244 Enablement switch, low air pressure circuit
- 5245 Enablement switch, high air pressure circuit
- 5246 Switch activated on its own when shifting from normal to splitter gears
- 5247 Switch, partial/total centre axle unload solenoid valve
- 5248 Switch, exhaust brake on
- 5249 Switch, transmission low air pressure
- 5250 Switch, reversing light
- 5251 Switch, trailer uncoupled
- 5252 Switch, cab unlatched (hydraulic control)
- 5253 Switch, cab unlatched (mechanical control)
- 5254 Switch, accelerator lock prearrangement (hydraulic drive)
- 5255 Enablement switch, hydraulic braking system and exhaust brake
- 5256 Switch, stop
- 5257 Switch, cab interior lighting
- 5258 Switch, start inhibiting from engine compartment with gear engaged
- 5259 Switch, cross differential lock
- 5260 Switch, longitudinal differential lock
- 5261 Switch, clutch control device, 2x5 speed transmission
- 5262 Switch, front door open
- 5263 Switch, rear door open
- 5264 Enablement switch, normal/splitter gears
- 5265 Enablement switch, internal aerator
- 5266 Switch, engine compartment light
- 5267 Switch, luggage compartment light
- 5268 Switch, exhaust brake
- 5269 Enablement switch, exhaust brake (transmission)
- 5270 Switch, power take-off on
- 5271 Switch, speed limiting device (4th speed)
- 5272 Enablement switch, 2-speed rear axle, electrical load sensing valve
- 5273 Switch, clutch wear
- 5274 Enablement switch, exhaust brake (under clutch pedal)
- 5275 Switch, speed limiting device (splitter gears)
- 5276 Switch, fan belt broken
- 5277 Switch, start inhibiting from engine compartment with parking brake off
- 5278 Switch, transmission in neutral
- 5279 Enablement switch, gear engagement
- 5280 Main current switch

- 5281 Speedometer switch, high switch w/lamp
- 5282 Speedometer switch, engine overspeeding bell
- 5283 Thermometer switch, engine coolant temperature
- 5284 Thermometer switch, engine oil temperature
- 5285 Thermometer switch, crankcase temperature
- 5286 Thermometer switch, converter oil temperature
- 5287 Thermometer switch, engine compartment ventilation system failure
- 5288 Thermometer switch for switching on engine compartment ventilation system
- 5289 Thermometer switch, recirculation water temperature
- 5290 Speed switch, Telma retarder connection enablement
Speed switch, driver's door lock enablement
- 5291 Thermometer switch, interior heating motors
- 5292 Speedometer switch, exhaust brake enablement
- 5293 Speedometer switch, ventilation cutoff at high speed
- 5294 Thermometer switch, front interior heating motors
- 5295 Thermometer switch, rear interior heating motors
- 5296 Switch, internal aerators control
- 5297 Thermometer switch, transmission oil temperature
- 5298 Thermometer switch, fan belt broken
- 5299 Thermometer switch, transmission oil cooling motor
- 5300 Pushbutton, warning lamp test
- 5301 Pushbutton, headlight wiping/washing unit
- 5302 Pushbutton, antiskid operation check
- 5303 Pushbutton, engine stopping
- 5304 Pushbutton, windshield washing unit
- 5305 Pushbutton, headlight washing unit
- 5306 Pushbutton for side window resistors
- 5307 Pushbutton for allowing engagement of reverse gear
- 5308 Pushbutton for right door window with built-in w/lamp
- 5309 Pushbutton for headlamp washer unit with built-in w/lamp
- 5310 Pushbutton for preventing gear engagement with low air pressure in suspension system
Pushbutton, gear engagement enablement
- 5311 Pushbutton with built-in w/lamp for allowing engine starting with ether
- 5312 Pushbutton for engine starting with ether
- 5313 Pushbutton for vehicle starting bell
- 5314 Pushbutton for service door mechanical lock resetting solenoid valve
- 5315 Pushbutton for windscreen power blind
- 5316 Pushbutton for vehicle alignment control (travelling condition)
- 5317 Pushbutton for added axle lifting/lowering system
- 5318 Pushbutton, starting assistance
- 5319 Pushbutton for luggage compartment doors
- 5320 Dual pushbutton for vehicle raising (front)
- 5321 Dual pushbutton for vehicle raising (rear)
- 5322 Sunroof pushbutton

- 5323 MEMORY/OFF switch
- 5324 Speed increase/decrease switch (EDC)
- 5325 'RESET'/ 'TEST' pushbutton, centralized and additional lubrication
- 5326 Dual pushbutton for centralized door closing system
- 5327 Roller blind component
- 5330 Pushbutton for engine preheating and starting selector switch
- 5331 Pushbutton for engine starting from engine compartment
- 5332 Pushbutton for stopping engine from engine compartment
- 5333 Pushbutton for stopping swing door motor (clockwise)
- 5334 Pushbutton for stopping swing door motor (counterclockwise)
- 5335 Pushbutton, G.C.R. closing
- 5336 Pushbutton, G.C.R. opening
- 5337 Pushbutton for front door control with built-in w/lamp
- 5338 Pushbutton for rear door control with built-in w/lamp
- 5339 Pushbutton for refilling compensation tank through water recirculating pump
- 5340 Stop request pushbutton
- 5341 Hostess call pushbutton
- 5342 Pushbutton for electropneumatic horns
- 5343 Power window pushbutton
- 5344 Pushbutton for de-energizing G.C.R. and connecting alternator D+ to earth
- 5345 Pushbutton for centre door control with built-in w/lamp
- 5346 Multiple lamp test pushbutton
- 5347 Pushbutton for supply of key reverse rotation inhibitor solenoid with G.C.R. open
- 5348 Front door pushbutton
- 5349 Centre door pushbutton
- 5350 Rear door pushbutton
- 5351 Pushbutton for control of rear door from conductor's place
- 5352 Pushbutton for control of front door from outside
- 5353 Pushbutton for closing G.C.R. and earthing of delayed G.C.R. cutout relay
- 5354 Pushbutton for preheating and rich mixture control
- 5355 Pushbutton panel for automatic transmission gear control
- 5356 Pushbutton for lh power window
- 5357 Pushbutton for control of front door with symbol light
- 5358 Pushbutton for control of centre door with symbol light
- 5359 Pushbutton for control of rear door with symbol light
- 5360 Pushbutton for display of engine oil level
- 5361 N.O. safety pushbutton for swing door system
- 5362 N.C. safety pushbutton for swing door system
- 5363 Pushbutton panel for swing door system
- 5364 Pushbutton for enabling vehicle operation with doors open
- 5365 Pushbutton for fault diagnosis with chassis levelling adjustment control
- 5366 Pushbutton for energizing exhaust brake cutout relay at low speed
- 5367 Pushbutton for cab tilting servo system
- 5368 Pushbutton, EDC fault diagnosis TEST

5369	Pushbutton, front grille open signal, cab tilting servo system
5370	Pushbutton, engine stopping from engine compartment Front left-hand side pushbutton, driver's light
5380	Rear flap limit switch
5400	Switch for external air intake door motor
5401	Switch for complete bus sign motor
5402	Switch for high/low/flasher lights
5410	Key switch for normal/reduced gear engagement solenoid valve
5411	General current switch
5412	Stop signal switch
5413	Switch for parking brake w/lamp and vehicle operation with doors open
5420	8-function steering column switch
5421	4-function steering column switch
5422	5-function steering column switch
5423	6-function steering column switch
5500	Electric/air horn switch
5501	MAX/MIN Webasto heater switch
5502	Automatic/manual Telma retarder connection switch
5503	Interior lighting switch
5504	Forced ventilation and air-conditioning switch
5505	Switch for hazard lights with built-in w/lamp
5506	Windscreen wiper switch
5507	Switch for turning on external lights with G.C.R. off
5508	Switch for controlling front door from inside/outside
5509	Switch for controlling rear door from driver's/conductor's place
5510	Switch for fog lights and release of rear fog lights
5511	Switch with built-in w/lamp, fog lights and rear fog lights enablement
5512	Driver's ventilation switch
5513	Retarder connection switch
5514	Exterior lighting switch
5515	Hazard lights switch
5516	2-function switch: a) direction indicator lights b) horn pushbutton
5517	2-function switch: a) windscreen wipers b) windscreen washer unit
5518	Normal/blue interior lighting switch
5519	Blackout light switch
5520	Safety unit switch
5521	Adjustable rearview mirror switch
5522	Driver's place heating switch
5523	Switch, headlight trim control
5524	Air-operated emergency battery disconnect, dangerous cargo vehicles (France)
5525	Switch for disconnection of G.C.R. and earthing of alternator D+
5526	Switch for disconnecting G.C.R. and de-energizing alternator
5530	Automatic transmission switch
5535	Switch for headlamp alignment adjustment device

5540	Switch, blue lights and overhead luggage compartment lights
5600	Ignition switch
5601	Ignition switch, steering lock
5602	Ignition switch, starting and preheating device
5603	Ignition switch , starting/preheating/steering lock
5604	Ignition switch for allowing starting with doors closed
5620	Starting lever switch
5621	Starting and preheating lever switch
5630	Lever switch for connection of Telma retarder with 2-light intensity level w/lamp
5631	Telma retarder lever switch
5632	Heating system lever switch
5633	Ventilation system lever switch
5634	Retarder lever switch
5635	E-GAS lever switch
5730	5-function steering column unit
5800	36-optical indicator panel
5801	36-optical indicator panel (MD custom-made)
5802	36-optical indicator panel (FIAT custom-made)
5803	10-optical indicator panel (lights/engine/cab tilting)
5804	10-optical indicator panel (brakes/engine)
5805	10-optical indicator panel (transmission/miscellaneous applications)
5815	Optical indicator panel (military vehicles)
5817	Trapdoor opening w/lamp
5818	Luggage compartment door w/lamp
5819	Lubrication w/lamp
5820	Tractor antiskid system failure w/lamp
5821	Battery charging failure w/lamp
5822	Preheating w/lamp
5823	Brake lining pre-wear w/lamp
5824	Brake lining total wear w/lamp
5825	Clutch wear w/lamp
5826	Engine oil temperature w/lamp
5827	Air suspension system failure w/lamp
5828	Brake system failure w/lamp
5829	Parking brake engaged w/lamp
5830	Engine coolant/engine oil/brake air pressure w/lamp repeater
5831	Air cleaner restriction w/lamp
5832	General lighting on w/lamp
5833	Stop requestw/lamp
5834	Tractor turn signal on lights w/lamp
5835	Trailer turn signal on lights w/lamp
5836	Hazard lights on w/lamp
5837	Heated rearview mirror w/lamp
5838	Vehicle front raising w/lamp

5839	Vehicle rear raising w/lamp
5840	Refrigerator w/lamp
5841	Forced ventilation w/lamp
5842	Heating through KHD engine w/lamp
5843	Webasto heating system w/lamp
5844	Telma retarder on w/lamp
5845	Rear fog light w/lamp
5846	High beam lights on w/lamp
5847	Exhaust brake w/lamp
5848	Front headlight cluster heated lens w/lamp
5849	Interior heating w/lamp
5850	Engine compartment ventilation system failure w/lamp
5851	Internal aeration motors w/lamp
5852	Auxiliary generator failure w/lamp
5853	Doors open w/lamp
5854	Engine oil temperature w/lamp
5855	Driver's ventilation w/lamp
5856	Windscreen defrosting heater w/lamp
5857	Engine oil pressure w/lamp
5858	Front brake air pressure w/lamp
5859	Rear brake air pressure w/lamp
5860	Transmission oil low pressure w/lamp
5861	Transmission oil pressure w/lamp
5862	Transmission oil pressure w/lamp
5863	Transmission in neutral w/lamp
5864	Air suspension system failure w/lamp repeater
5865	Engine oil pressure w/lamp repeater
5866	Brake air pressure w/lamp repeater
5867	Air-conditioner cooling system failure w/lamp
5868	Air-conditioner cooling system regular operation w/lamp
5869	Air-conditioning system w/lamp
5870	Front door w/lamp
5871	Centre door w/lamp
5872	Rear door w/lamp
5873	Doors open w/lamp repeater
5874	Brake lining wear/parking brake failure w/lamp
5875	Brake system pressure drop w/lamp (ICP)
5876	Brake fluid level w/lamp
5877	Power take-off w/lamp
5878	Cab unlatched w/lamp
5879	G.C.R. automatic opening w/lamp
5880	Engine coolant temperature w/lamp
5881	Front left air suspension pressure w/lamp
5882	Front right air suspension pressure w/lamp

- 5883 Rear air suspension pressure w/lamp
- 5884 W/lamp for vehicle operation with doors open
- 5885 Driver's place ventilation w/lamp
- 5886 Windscreen defroster/driver's place heating w/lamp
- 5887 Radiator water level w/lamp
- 5888 Side window resistor w/lamp
- 5889 Engine compartment door w/lamp
- 5890 Vehicle raising w/lamp
- 5891 3rd axle up w/lamp
- 5892 Tilted body w/lamp
- 5893 Differential lock warning lamp
- 5894 Fan belt broken w/lamp
- 5895 Normal/splitter gears w/lamp
- 5896 Hydraulic converter brake w/lamp
- 5897 G.C.R. closed w/lamp
- 5898 Rotating beacons on w/lamp
- 5899 Cross differential lock w/lamp
- 5900 Direction indicator/hazard flasher light, double load
- 5901 Direction indicator/hazard flasher light, single load
- 5902 Bimetal direction indicator flasher light
- 5903 Bimetal emergency flasher light
- 5920 Bimetal front brake air pressure flasher light
- 5921 Bimetal rear brake air pressure flasher light
- 5922 Bimetal door opening flasher light repeater
- 5923 Seat belt circuit flasher light
- 5924 Bimetal water/oil/air flasher light repeater
- 5925 Booked stop flasher light
- 5926 Parking brake flasher light
- 5930 Windscreen wiper unit intermittent operation
- 6100 8-diode 12-way connector
- 6101 7-diode 12-way connector
- 6102 7-diode 12 way connector
- 6103 3-diode 5 way connector
- 6104 3-diode connector with common positive (1A)
- 6105 3-diode connector with common negative (1A)
- 6106 8-diode 12-way connector
- 6107 3-diode connector with common positive (3A)
- 6108 4-diode 7-way connector
- 6109 3-diode connector for cab/ground starting system
- 6110 4-diode connector for holding GCR energized
- 6111 4-diode holder container with common negative
- 6112 6A 1-diode holder container
- 6113 1A 1-diode holder container
- 6114 1-zener diode holder container

- 6115 2-diode holder container with common cathode
- 6116 4-diode 8-way holder container
- 6117 3A 1-diode holder container
- 6120 Preheating on signalling resistor
- 6121 Engine coolant temperature indicator compensating resistance
- 6122 Instrument light electronic dimmer
- 6123 Optical indicator electronic dimmer
- 6124 Heated rearview mirror
- 6125 Optical indicator and instrument light electronic dimmer
- 6126 Light instrument rheostat
- 6127 Current limiting resistance, tachograph supply
- 6128 Crankcase temperature indicator compensating resistance
- 6129 Thermal starter drop resistance
- 6130 Side window resistance
- 6131 12 V charging system drop resistance
- 6332 Current limiting resistance, thermal starter supply
- 6133 Resistance for driver's place ventilation motor
- 6134 Resistance for windscreen defroster motor
- 6135 Adjustable heated rearview mirror
- 6136 Heated adjustable rearview mirror and mirror washer unit
- 6137 Load increase resistance for side direction indicator lights
- 6138 Evaporator 2nd speed regulation rheostat
- 6139 Fuel heating resistance
- 6140 KSB ignition timer variable resistance
- 6141 Wide-angle heated rearview mirror
- 6142 Heated rearview mirror for wheels
- 6143 Wide-angle heated adjustable rearview mirror
- 6144 Adjustable heated parking rearview mirror
- 6145 Resistance for fuel filter heating
- 6146 Parallel resistance, battery charging failure
- 6147 Fuel preheating thermoresistance
- 6148 Driver's seat heating thermoresistance
- 6149 Co-driver's seat heating thermoresistance
- 6150 Diode preventing current return to solenoid valve for deaeration channel door
- 6151 Diode preventing current return to solenoid valve for permanent channel door (1/3 opening)
- 6152 Diode preventing current return to solenoid valve for water/oil heat exchanger
- 6153 Diodepreventing demagnetization of instruments and indicators
- 6154 Current return-preventing diode for front brake air pressure w/lamp
- 6155 Current return-preventing diode for rear brake air pressure w/lamp
- 6156 Current return-preventing diode for front door w/lamp
- 6157 Current return-preventing diode for centre door w/lamp
- 6158 Current return-preventing diode for rear door w/lamp
- 6159 Current return-preventing diode for cab unlatched w/lamp
- 6160 Diode for protection device

6161	Diode for keeping G.C.R. energized with heating system on
6162	Current return-preventing diode for battery charging failure w/lamp
6163	Neutral signal return-preventing diode upon operation of the emergency switch (automatic transmission)
6180	100 microfarad capacitor; delayed relay dump
6181	Capacitor for reduction of speed signal noise pulses
6190	Fuel heating thermoline
6191	Pre-resistor; windshield heating time relay
6192	Windshield heating thermoresistor
6193	Diodes resistors- rheostat, ASR proportioning solenoid valve (speed limiting device)
6194	Diodes resistors- temperature sensor replacer rheostat, pre-heating system
6400	Windshield washer electric pump
6401	Headlight washer electric pump
6500	FIAT type windscreen wiper unit
6501	Windshileld wiper unit (European type)
6502	Headlight wiper unit
6800	Radio receiver set
6801	Loudspeaker
6802	Antenna
6803	Radio receiver set - Tape recorder
6804	Preamplifier
6805	Microphone
6806	24V/12V power supply
6807	Amplifier - Power pack
6808	Microphone (driver)
6809	Microphone (hostess)
6810	Junction block, monitor/video camera supply
6820	Radio interference suppressor
6830	City Band transreceiver
7000	16 fuse carrier
7001	16 fuse carrier
7002	80A 1 power fuse carrier
7003	16A 2 power fuse carrier
7004	6 fuse carrier
7005	6 fuse carrier
7006	6 fuse carrier
7007	6 fuse carrier
7008	6 fuse carrier
7009	6 fuse carrier
7010	6 fuse carrier
7011	6 fuse carrier
7012	8 fuse carrier
7013	8 fuse carrier
7014	1 fuse carrier
7015	1 fuse carrier (10 A)

7016	10 fuse carrier
7017	10 fuse carrier
7018	12 fuse carrier
7019	12 fuse carrier
7020	2-way power fuse carrier (50 A)
7021	2-way power fuse carrier (1x25 A / 1x50 A)
7030	1-way fuse carrier (16 A)
7031	1-way fuse carrier (8 A)
7032	1-way fuse carrier (3 A)
7033	1-way fuse carrier (25 A)
7034	1-way fuse carrier (5 A)
7035	1-way fuse carrier (25 A)
7036	1-way fuse carrier (10 A)
7037	1-way fuse carrier (7.5 A)
7038	1-way fuse carrier (15 A)
7050	Automatic magnetothermal cutout
7060	6-way automatic switch carrier
7061	6-way automatic switch carrier
7062	6-way automatic switch carrier
7063	6-way automatic switch carrier
7064	6-way automatic switch carrier
7065	6-way automatic switch carrier
7066	6-way automatic switch carrier
7067	6-way automatic switch carrier
7068	6-way thermal cutout carrier
7069	6-way thermal cutout carrier
7070	6-way thermal cutout carrier
7071	6-way thermal cutout carrier
7072	6-way thermal cutout carrier
7073	6-way thermal cutout carrier
7074	6-way thermal cutout carrier
7075	6-way thermal cutout carrier
7200	Unipolar current outlet
7201	7-pole standard connector for electrical connection to trailer
7202	Auxiliary 7-pole standard connector for electrical connection to trailer
7203	Bipolar connector for 9-diode alternator harness knife switch with built-in RTE
7204	12-pole connector for electrical connection to trailer
7205	Remote starting bipolar current outlet
7206	Unipolar current outlet for infrared ray equipment
7207	7-pole connector for 12 V connection to trailer
7208	Bipolar current outlet
7209	Trailer-to-tractor antiskid coupling joint
7210	19-pole connector for tractor-to-trailer connection
7211	28-pole connector for tractor-to-trailer connection

7212	Fault diagnosis connector for ABS
7213	13-pole connector for tractor-to-trailer connection (dangerous cargo vehicles)
7215	15-pole tractor-to-trailer connector
7216	Hostess light
7500	Central Interconnecting Unit
7505	Air horn control unit
7520	Front terminal board
7521	Centre terminal board
7522	Shunt terminal board
7800	Fuel delivery solenoid valve
7801	Solenoid valve for engaging normal and reduced speeds
7802	Solenoid valve for load sensing valve emergency operation with air suspension system failure
7803	Solenoid valve for accelerator lock (hydraulic drive)
7804	Solenoid valve for holding direct drive and hydraulic braking control
7805	Exhaust brake solenoid valve
7806	Fuel regulation solenoid valve (high altitude)
7807	Solenoid valve for connection of fuel tank to atmosphere (thermostarter)
7808	Front door solenoid valve
7809	Rear door solenoid valve
7810	Solenoid valve for engaging normal speeds
7811	Solenoid valve for engaging reduced speeds
7812	Solenoid valve, vehicle front raising system
7813	Solenoid valve, vehicle rear raising system
7814	Solenoid valve for horns
7815	Water - oil heat exchanger solenoid valve
7816	Cross differential lock solenoid valve
7817	Longitudinal differential lock solenoid valve
7818	Speed limiter solenoid valve
7819	Power takeoff solenoid valve
7820	Bell for engine overrevving
7821	Bell for front brake system low air pressure
7822	Bell for rear brake system low air pressure
7823	Bell for stop request
7824	Single-tone bell for hostess call
7825	Bell for fan belt broken
7826	Bell for G.C.R. open
7827	Single-tone bell for stop request
7828	Bell for transmission oil/engine coolant high temperature
7829	Bell forenginecoolant temperature/brake system air pressure/transmission oil
7830	Bell for seat belts unfastened
7831	Bell for maximum speed with all-wheel drive on
7832	Bell for layshaft overrevving with easyshift
7833	Bell for hostess call
7834	Vehicle lowering bell

7835	Bell for faulty trailer air compressor system
7836	24V thermostarter
7837	19 V preheating plugs
7838	12 V preheating plugs
7839	12 thermal starter
7840	Preheating sender
7846	Cigar lighter
7847	Fuel delivery electronic regulator (adjusts delivery to exhaust gas temperature)
7848	Thermocouple for exhaust gas temperature electronic regulator
7849	Vacuum indicator for fuel regulator solenoid valve (high altitude)
7850	Fluorescent ceiling spotlight for interior lighting
7851	Electrical load sensing valve for 2-speed rear axle
7852	Converter for interior lighting fluorescent light
7853	Fluorescent lamp converter for sign lighting
7854	Ceiling spotlight for sign lighting
7860	Solenoid valve for antipollution device (EGR)
7861	Solenoid valve for KSB device
7862	Solenoid valve for engine oil top up
7863	Solenoid valve for chassis automatic lubrication system pump
7870	Solenoid valve for low speed reducer unit
7871	Solenoid valve for high speed reducer unit
7872	Solenoid valve for two-speed rear axle
7873	Solenoid valve for permanent channel door
7874	Solenoid valve for diffuser channel door (1/3 opening)
7875	Solenoid valve for diffuser channel door
7876	Solenoid valve for deaeration channel door
7877	Solenoid valve for preventing jumps between speeds
7878	Solenoid valve for preventing line jumps
7879	Solenoid valve for partial/total centre axle unloading
7880	Solenoid valve for antiskid system
7881	Solenoid valve for allowing gear engagement
7882	Solenoid valve for hydraulic braking
7883	Solenoid valve for stopping vehicle with doors open
7884	Solenoid valve for centre door
7885	Solenoid valve for discharging air with forward gear engaged
7886	Engine stopping solenoid valve
7887	Solenoid valve for vehicle raising
7888	Solenoid valve for reverse gear clutch brake "action on the little surface of the piston"
7889	Solenoid valve for reverse gear clutch brake "action on the big surface of the piston"
7890	Solenoid valve for epicyclic train brake incorporating the turbine rotor
7891	Solenoid valve for pump wheel brake
7892	Solenoid valve for converter exhaust valve
7893	Solenoid valve for engaging input clutch
7894	Solenoid valve for engaging direct drive clutch

7895	Solenoid valve for reducing oil pressure
7896	Solenoid valve for differential lock
7897	Centre door limiting solenoid valve
7898	Centre door control solenoid valve
7899	Front door limiting solenoid valve
8000	ZF transmission
8001	Antiskid device
8002	Water Webasto heater
8003	Air Webasto heater
8004	Windshield defrosting electric heater unit
8005	Telma retarder
8006	Radio equipment
8007	Air-conditioning system
8008	Hydraulic converter
8009	Automatic transmission
8010	Drier
8011	EDC injection pump
8013	Compressor
8200	Water boiler
8205	Air boiler
8210	Metering device
8215	Electronic control unit
8219	Independent heater, electronic control and signalling unit
8220	Mechanical timer
8221	Electronic timer
8222	Ambient thermostat
8223	Webasto switch
8224	Preselector clock (independent heater)
8225	Auxiliary fuel pump
8230	Ignition coil
8235	Time solenoid valve (TV), heater water recirculation
8236	Time solenoid valve (TV), by-pass water recirculation
8240	Independent heating microswitch (water recirculation open)
8241	Independent heating microswitch (water recirculation open)
8250	Air-conditioning system control unit
8251	Ambient thermostat control unit
8252	Potentiometer control for setting electronic thermostat temperature
8253	Electronic thermostat temperature sensor
8254	Air-conditioning system control and signalling unit
8255	Air-conditioning system thermostat and switch
8260	Electromagnetic pulley
8261	Min pressure switches (drier filter)
8262	Max pressure switches (drier filter)
8265	Actuator for air-conditioning doors

8266	Switch with built-in w/lamps for door actuator
8270	Air-conditioning system microswitch (water recirculation closed)
8275	External temperature sensor (automatic air-conditioning system)
8276	Sun radiation sensor (automatic air-conditioning system)
8500	Brake shoe wear control unit
8501	Brake shoe wear sensors
8502	ZF transmission electronic control unit
8503	Vehicle speed inductive sensor
8504	Antiskid system control unit
8505	Antiskid system electronic control unit
8506	Antiskid system sensors
8507	Speed limiting device electronic control unit
8508	Speed limiter gearmotor
8509	Speed limiter frequency generator
8510	Automatic circuit breaker for G.C.R. cutout
8511	Route sign control unit
8512	Front bus number indicator
8513	Side bus number indicator
8514	Automatic transmission electronic control unit
8515	Preheating system electronic control unit
8516	Ticket punching machine
8517	Vehicle stationary signalling device
8518	Vehicle speed sender
8519	Amperometric transformer for automatic G.C.R. circuit breaker
8520	12 V charging system device
8521	12 V system for trailer supply
8522	Service hour counter
8523	Rich mixture control unit
8524	Radiator water level electronic control unit
8525	Radiator water level signalling sensor
8526	Engine oil level electronic control unit
8527	Radiophone
8528	Pre/after heating control unit
8529	Antiskid safety electronic control unit
8530	Antiskid information electronic control unit (infomodul)
8531	Water in fuel filter electronic control unit
8532	Water in fuel filter signalling sensor
8533	Engine supply load sender
8534	Swing door control unit
8535	Retarder electronic control unit
8536	Air pressure sender for retarder control unit
8537	Oil pressure sender for retarder control unit
8538	Retarder control unit water temperature sender
8539	Adjustable rearview mirror control

8540	Differential lock control unit
8541	Front axle break lining wear circuit sensors
8542	Rear axle break lining wear circuit sensors
8543	IVECO Control display
8544	IVECO Control electronic control unit (tractor)
8545	IVECO control electronic control unit (trailer)
8546	Control unit for turning on low voltage low beam lights
8547	Failure signalling control unit with bell
8548	Electronic accelerator actuator motor
8549	Electronic accelerator control unit
8550	Chassis levelling control unit
8551	Rear axle stroke sender with chassis levelling adjustment unit
8552	Front axle left-hand side stroke sender with chassis levelling adjustment unit
8553	Front axle right-hand side stroke sender with chassis levelling adjustment unit
8554	Layshaft inductive sender
8555	Cooling fan adjustment control unit (hydrostatic)
8556	Cooling fan adjustment thermistor
8557	Antipollution device control unit (EGR)
8558	Tachograph signal amplifier
8559	Cardan shaft rpm inductive sender
8560	Cardan shaft rpm signal amplifier
8561	Rear axle brake system cooling fluid temperature control unit
8562	Automatic chassis lubrication system control unit
8563	Engine oil automatic topup control unit
8564	Drive axle lh pressure sensor (ECAS)
8565	Drive axle rh pressure sensor (ECAS) Min/Max pressure switch (compressor no. 1)
8566	Lift axle lh pressure sensor (ECAS) Min/Max pressure switch (compressor no. 2)
8567	Lift axle rh pressure sensor (ECAS)
8568	ECAS remote control
8569	Electronic accelerator motor (AVS)
8570	EDC control unit
8571	Accelerator load sensor (EDC)
8572	Coolant temperature sensor (EDC)
8573	Turboblower air temperature sensor (EDC)
8574	Turboblower air pressure sensor (EDC)
8575	Roller blind motor electronic control unit
8576	Steering system oil hydraulic flow indicator (1st circuit) Steered wheels sensor
8577	Steering system oil hydraulic flow indicator (2nd circuit)
8581	ECAS component, 6x2c chassis levelling control
8582	ECAS component, 6x2c chassis levelling control
8583	ECAS component, 6x2c chassis levelling control

8601	Centralized door locking unit component
8602	Engine compartment high temperature control unit
8603	Engine compartment high temperature sensor Check and control unit, centralized lubrication
8610	Single-tone electronic control unit
9000	Retarder w/lamp
9001	W/lamp for gear engaged with low air pressure in suspension system
9002	Engine compartment temperature w/lamp
9003	Fuel reserve w/lamp
9004	Ticket punching machine w/lamp
9005	Radiophone w/lamp
9006	Signs on w/lamp
9007	After heating w/lamp
9008	Engine overrevving w/lamp
9009	Seat belts unfastened w/lamp
9010	Trailr antiskid w/lamp
9011	Trailer without antiskid w/lamp
9012	Air filter restriction w/lamp
9013	Crankcase high temperature w/lamp
9014	Water in fuel filter w/lamp
9015	Stop brake w/lamp
9016	Complete bus sign displayed w/lamp
9017	Clutch fluid level w/lamp
9018	Pre/after heating w/lamp
9019	Braking circuit low oil pressure w/lamp
9020	Front axle brake lining wear w/lamp
9021	Rear axle brake lining wear w/lamp
9022	Power steering circuit failure w/lamp
9023	Radio receiver w/lamp
9024	Rear axle steering wheels locked w/lamp
9025	Second power steering circuit failure w/lamp
9026	Parking brake air pressure w/lamp
9027	Driver's place heating w/lamp
9028	Loading light w/lamp
9029	Front suspension air pressure w/lamp
9030	Vehicle lowering w/lamp
9031	Antiskid on w/lamp
9032	All-wheel drive w/lamp
9033	Rear door w/lamp
9034	Fuel heating w/lamp
9035	Max speed with all-wheel drive on w/lamp
9036	Fuel heating w/lamp
9037	Electronic accelerator alarm w/lamp
9038	ASR w/lamp

9039	Chassis levelling adjustment failure w/lamp
9040	Irregular level w/lamp (ELF)
9041	Reading lights on w/lamp
9042	Transmission oil filter restriction w/lamp
9043	Alarm intermittent operation w/lamp
9044	Windshield washing fluid level w/lamp
9045	Doors closed w/lamp
9046	Brake pressure w/lamp
9047	Traffic beam headlight w/lamp
9048	Front axle w/lamp (ELF)
9049	Rear axle with ELF w/lamp
9050	Brake fluid w/lamp
9051	Speed limiter failure w/lamp
9052	Starting assistance w/lamp (3rd axle unloading)
9053	W/lamp, cistern rail, dangerous cargo vehicles (France)
9054	Trailer air compressor system failure w/lamp
9055	3rd axle hydraulic steering system w/lamp
9056	Speed limiter failuer w/lamp
9057	Snow chains w/lamp
9058	Auxiliary heater failure w/lamp
9060	Air suspension pressure w/lamp
9061	Automatic chassis lubrication system on w/lamp
9062	Automatic chassis lubrication system failure w/lamp
9200	Switch for cross differential lock
9201	Switch for instrument light
9202	Switch for allowing direct drive at low speed
9203	Switch for vehicle operation with doors close
9204	Switch for windscreen defroster or driver's place heating
9205	Switch for driver's place heating
9206	Vehicle raising switch
9207	Switch for hydraulic braking cutout
9208	Switch with built-in w/lamp for preheating and rich mixture control
9209	Switch with built-in w/lamp for loading light
9210	Switch with built-in w/lamp for rear fog light
9211	Switch for side heated window
9212	Switch with built-in w/lamp for power takeoff
9213	Switch with built-in w/lamp for heated rearview mirrors
9214	Switch with built-in w/lamp for Webasto heater
9215	Switch for brake spring cylinder actuator solenoid valve
9216	Switch for route signs
9217	Switch for route sign light with symbol lighting lamp
9218	Switch for cutting out gear engagement inhibiting device with low air pressure in suspension system
9219	Switch for snowplough headlights
9220	Switch for cutout of rich mixture control solenoid

9221	Switch for swivel interior lighting ceiling spotlight
9222	Switch with built-in w/lamp for windscreen defrosting heater
9223	Switch with built-in w/lamp for instrument lighting
9224	Switch with built-in w/lamp for fog lights
9225	Switch with built-in w/lamp for auxiliary headlights
9226	Switch for ticket punching machine
9227	Radiophone switch
9228	Switch for route signs
9229	Switch with built-in w/lamp for electric starter and preheating
9230	Switch for transmission oil low pressure
9231	Switch for transmission oil high pressure
9232	Switch for odometer cutout
9233	Switch for cutout of cooling gas pressure failure electromagnetic pulley
9234	Switch for low air pressure in front suspension system
9235	Switch for signalling trailer parking brake engaged
9236	Switch for signalling low air pressure in left front suspension
9237	Switch for signalling low air pressure in right front suspension
9238	Switch for signalling low air pressure in rear suspension
9239	Switch, high gear engagement not available during braking and stop light illumination
9240	Switch, 3rd axle up
9241	Switch for turning on front door step light
9242	Switch for turning on centre door step light
9243	Switch for turning on rear door step light
9244	Switch for centre door limiting solenoid valve
9245	Switch for front door limiting solenoid valve
9246	Safety switch for front door reverse operation
9247	Safety switch for rear door reverse operation
9248	Stop signalling switch
9249	Switch for gear disengagement with low pressure in air suspension system (setting value lower than specified)
9250	Switch for gear disengagement with low pressure in air suspension system (setting value higher than specified)
9251	Switch for front door low air pressure
9252	Switch for centre door low air pressure
9253	Switch for allowing gear engagement with brake pedal fully depressed
9254	Switch for oil filter restriction
9255	Safety switch for preventing retarder operation when air inlet setting value is higher than specified
9256	Switch for connection of braking circuit oil pump
9257	Switch for low air pressure in braking circuit
9258	Switch, power steering circuit malfunction
9259	Switch for low air pressure in parking brake circuit
9260	Switch for stop/hydraulic braking/exhaust brake signal
9261	Switch for cutout of exhaust brake with low engine rpm rate
9262	Switch for centre door opening

- 9263 Switch for earthing of speed limiter control unit with clutch pedal fully depressed
- 9264 Switch for air exhaust with forward gear engaged
- 9265 Switch for preventing starting from cab with engine compartment door open and light on
- 9266 Switch for front door open/step light on/general lighting
- 9267 Switch, front door open/steps light illumination/general lighting enablement
- 9268 Switch for rear door open/rear step light on
- 9269 Switch for turning engine off with gears engaged and engine compartment door open
- 9270 Switch for differential lock on
- 9271 Exhaust brake control switch (under brake pedal)
- 9272 Safety switch for front door reopening
- 9273 Safety switch for centre door reopening
- 9274 Kickdown solenoid valve switch (hydraulic converter)
- 9275 Switch for outside air door motor/windscreen defrosting recirculation system/driver's seat heating
- 9276 Switch for preventing starting with gears engaged
- 9277 Switch for signalling front wheel lining wear
- 9278 Switch for stopping gear engagement with rear door open
- 9279 Engine overrevving signalling switch
- 9280 Switch for signalling rear wheel lining wear
- 9281 Switch for signalling seat belts unfastened
- 9282 Switch for allowing starting and turning on of reversing lights
Switch, engine compartment spotlight
- 9283 Switch for preventing engine starting with engine compartment door open
Switch, engine compartment spotlight
- 9284 Switch for brake system failure
- 9285 Switch for speed limiter cutout with transmission in neutral
- 9286 Switch for signalling hand brake cylinder end of stroke
- 9287 Switch for signalling front brake converter cylinder end of stroke
- 9288 Switch for signalling rear brake converter cylinder end of stroke
- 9289 Switch for signalling all-wheel drive on
- 9290 Key switch for preventing engine starting from engine compartment
- 9291 Switch for stop brake solenoid valve
- 9292 Switch for preventing gear engagement from transmission in neutral position with high rpm rate
- 9293 Speedometer switch for signalling maximum speed with all-wheel drive on
- 9294 Thermometer switch, fuel heating
- 9295 Pressure increase sensing switch with N connection for door control unit
- 9296 Thermometer switch, preheating control unit
- 9297 AVS emergency switch
- 9298 Switch for cutout of centralized lubrication control unit
- 9299 Temperature switch for KSB ignition timer
Switch, luggage compartment centralized control
- 9300 Safety switch, General Current Relay cutoff
- 9301 Switch for tank filling safety control device
Engaged gear display (AVS)
- 9302 3rd axle raising switch
- 9303 Radio receiver set control switch

- 9304 Dashboard supply switch
- 9305 Switch for turning on marker lights
- 9306 Switch for front route sign lighting
- 9307 Switch for locking rear axle steering wheels
- 9308 Switch for cutout of 2nd power steering circuit
- 9309 Switch for auxiliary headlights
- 9310 Switch for turning on internal aeration motors
- 9311 Switch for vehicle lowering
- 9312 Switch for front driving axle differential lock motor
- 9315 Switch with built-in w/lamp for turning on rotating beacons
- 9316 Switch for fault diagnosis with ABS
- 9317 Protection device against any transfer; when transporting dangerous goods
- 9318 Clutch switch with easyshift
- 9319 Speed switch with easyshift
- 9320 Switch for allowing connection of exhaust brake
- 9321 Switch with built-in w/lamp for allowing connection of exhaust brake
- 9322 AVS drive switch
- 9323 AVS clutch switch
- 9324 E-GAS/EDC clutch switch
Switch for enablement of gear engagement with brake pedal fully depressed
- 9325 Switch for preventing engine starting with engine compartment door open
- 9326 Switch for allowing connection of current outlet
- 9327 Switch for switching from external air intake to internal recirculation (smog)
- 9328 Switch, cab independent heating
- 9329 Switch, engine independent heating
- 9330 Switch for connection of retarder and stop lights
- 9331 Switch for fuel filter restriction
- 9332 Switch for releasing safety device
- 9333 Switch for transmission oil filter restriction
- 9334 Switch for releasing centre door safety device
- 9335 Switch for releasing front door safety device
- 9336 6 bar retarder switch
- 9337 13.5 bar retarder switch
- 9338 Switch for low air pressure in ELF system (5.5 bar)
- 9339 Switch for switching from 3rd axle upwards to downwards stroke or vice-versa with a load of 11.5 tons on axles
- 9340 Pressure gauge switch for switching off 3rd axle lifting stroke
- 9341 Switch for measuring vehicle raising actuator pressure
- 9342 Pressure gauge switch, 3rd axle air spring pressure
- 9343 Pressure gauge switch, 3rd steering axle in straight ahead driving position
- 9344 Pressure gauge switch for switching on 3rd steering axle lifting hydraulic pump
- 9345 Pressure gauge switch for switching off 3rd steering axle lifting hydraulic pump
- 9346 Pressure gauge switch for switching off 3rd steering axle hydraulic circuit

- 9347 Pressure gauge switch for enablement of 3rd axle lifting function (hydraulic circuit under pressure and ignition switch on)
- 9348 Pressure gauge switch for signalling trailer air compressor system failure
- 9349 Switch, stop lights (EDC)
- 9350 Switch, exhaust brake (EDC)
- 9351 Pressure gauge switch for trailer slowdown brake (stop lights control)
- 9352 Switch, automatic snow chains
- 9353 Switch, exhaust brake (AVS)
- 9354 Pressure gauge switch, 3rd axle lifting system, hydraulic circuit lowering phase
- 9360 Switch for turning on centre door step spotlights
- 9361 Switch for turning on rear door step spotlights
- 9362 Switch for signalling front differential lock
- 9363 Switch for signalling rear differential lock
- 9364 Switch for reduced speed range
- 9365 Switch for spring cylinder failure
- 9366 Switch for exhaust brake cutout with accelerator at idling speed
- 9367 Switch for exhaust brake cutout with clutch on
- 9368 Clutch switch (AVS)
- 9369 Neutral switch
- 9370 Speedometer switch for allowing gear engagement
- 9371 Switch for signalling speed group (AVS)
- 9372 Switch, engaged gear (AVS)
- 9373 Switch, 16-speed GV transmission (AVS)
- 9374 Accelerator idling speed switch
- 9375 Front converter cylinder switch
- 9376 Rear converter cylinder switch
- 9377 Speedometer switch for disconnection of vehicle levelling adjustment unit and connection of travelling function
- 9378 3rd axle (lift) disconnection speedometer switch
EMS switch while the air-conditioning system is turned on
- 9379 3rd axle (steer) disconnection speedometer switch
- 9380 Switch, axle straight ahead driving position
- 9381 4-output speedometer switch (3/10/45/not used km/h)
- 9382 Kick-down switch (AVS)
Accelerator pedal switch, retarder cutoff
- 9383 Chassis automatic lubrication system check limit switch
- 9384 Retarder cutoff switch under accelerator pedal
- 9385 Switch for inhibiting engine starting with engine compartment door open
- 9386 Sunroof switch
- 9386 Roof hatch switch
- 9387 Engaged gear transmission switch (EASYSHIFT)
- 9388 Clutch switch (EASYSHIFT)
- 9389 Driving switch (EASYSHIFT)
- 9390 Switch for connection of driver's seat heating
- 9391 Fuel heating switch

- 9392 ASR cutoff switch
- 9393 ABS cutodd switch (off-road vehicles)
- 9394 Switch for fule circuit heating (Thermoline) with connection check
- 9398 Retarder cutoof switch under accelerator pedal
Signal switch, electronic suspension low pressure
- 9399 RETARDER switch on/off switch under accelerator pedal
- 9400 Tempomat pushbutton, MEMORY/OFF functions
- 9401 Tempomat pushbutton, Fast/Slow functions
- 9420 Switch for signaling tooling compartment opening
- 9461 Cab tilting component, electrohydraulic pump
- 9470 Thermal switch for fule circuit heating (Thermoline)
- 9500 Delayed opening NO contact relay, headlight washing system
- 9501 Delayed contact relay for exhaust brake with automatic transmission
- 9502 Delayed contact relay for speed limiter
- 9503 Timed relay for automatic air-conditioning system by-pass solenoid valve
Delayed excitation switch, stop request or hostess call bell
- 9504 Time relay, starting assistance (3rd axle unloading)
- 9505 Time relay, windshield heating
- 9506 Relay, 3rd axle lowering delayed pulse with axle load over 11 tons
- 9507 Electronic relay, auxiliary heater plug
- 9508 Delayed cutoff relay, engine stopping solenoid valve
- 9510 Relay for switching on step light with doors open and external lights on
- 9511 Relay for connection of windscreen defroster/driver's place ventilation
- 9512 Relay for automatic transmission electronics
- 9513 Relay for switch on stop lights
- 9514 Reversing light relay
- 9515 Reverse gear engagement relay
- 9516 Flasher light relay
- 9517 Relay for connection of water circulation pump motor and water - oil heat exchanger
- 9518 Relay for regulation of recirculation water temperature
- 9519 Relay for turning on parking lights and allowing connection of fog/rear fog lights
- 9520 Relay for keeping gears engaged with low air pressure in suspension system
- 9521 Relay for inhibiting engagement of high speeds while braking is performed
- 9522 Relay for connection/disconnection of transmission hydraulic retarder
- 9523 Relay for interior heating motors (1st speed)
- 9524 Relay for interior heating motors (2nd speed)
- 9525 Relay for keeping rear door open w/lamp on
- 9526 Relay for allowing operation of Webasto heater through the timer unit
- 9527 Relay for allowing connection of air-conditioning system with Webasto on
- 9528 Relay for prearrangement of air-conditioning system control
- 9529 Relay for connection of hazard light w/lamp with safety systems on
- 9530 Fog lamp relay
- 9531 Relay for connection of stop lights and exhaust brake with Telma retarder on
- 9532 Relay for supply of key-interlockd services through battery positive
Relay, trip computer level 1

	Relay, EDC electronic control unit supply
	Relay, 15/50A terminal
9533	Rich mixture control relay
9534	Relay for stopping engine with gears engaged and low air pressure in suspension system
9535	Relay for connection of low beam lights
9536	Relay for connection of high beam lights
9537	Relay for electromagnetic pulley
9538	Relay for auxiliary headlights
9539	Relay for earthing of hazard light w/lamp with safety system on
9540	Relay for preventing de-energizing of G.C.R with ignition key on
9541	Relay for current antireturn through battery charge w/lamp (handling batteries off)
9542	Relay for connection of marker lights
9543	Relay for seat belt circuit
9544	Relay for inhibiting gear engagement with vehicle stationary and low air pressure in suspension system
9545	Relay for allowing gear engagement with brake pedal fully depressed
9546	Horn relay
9547	Relay for hydraulic braking reducing solenoid valve
9548	Relay for connection of external lights with safety system on
9549	Relay for braking circuit oil pump
9550	Relay for inhibiting operation of rear fog lamps with flasher light on
9551	Retarder connection relay (3rd step)
9552	Retarder connection relay (4th step)
9553	Relay for connection of exhaust brake with electric retarder on
9554	Relay for earthing of alternator D+
9555	Relay for allowing switching on of step lights/route signs/instruments with key on
9556	Relay for allowing remote starting with gears engaged
9557	Relay for gear engagement at high speed (all safety devices are cut out)
9558	Relay for inhibiting gear engagement with alarm w/lamp on
9559	Relay for inhibiting gear engagement when correct sequence is not available
9560	Exhaust brake relay
9561	Relay for connection of snowplough headlights
9562	Relay for allowing connection of rear fog lamps with fog lamps and/or headlights on
9563	Relay for releasing vehicle locking device with doors open
9564	Relay for connection of booked stop indicator and disconnection of stop request bell
9565	Relay for de-activation of Webasto preheating and connection of main earthing point at beginning of combustion
9566	Relay for switching on direction indicator w/lamp with lamp test on
9567	Relay for switching on hazard light w/lamp with lamp test on
9568	Speed control relay
9569	Relay for holding D+ earthing (G.C.R. cutoff and engine running)
9570	Relay for releasing vehicle locking device with doors open and parking brake engaged
9571	Relay for inhibiting current return to 30 of G.C.R. through engine stopping pushbutton with safety device switch on
9572	Relay for switching off low beam lights with high beams on
9573	Relay for switching off High/Low beam lights with fog lights on
9574	Relay for switching off rear fog lamps with high beam lights on

9575	Relay for enabling switching on of day lights Relay for keeping the engine at idling speed while gears are engaged
9576	Relay for allowing connection of parking lights with engine off
9577	Relay for preventing gear engagement with engine high rpm rate and/or alarm w/lamp on
9578	Relay for illumination of gear engagement key
9579	Relay for preventing gear engagement with safety devices
9580	Headlight control relay
9581	Relay for connection and check of brake lining wear w/lamp
9582	Relay for connection of key reverse rotation inhibitor solenoid and day lights
9583	Relay for connection of fog lamps and disconnection of day lights
9584	Relay for connection of fog lamps and disconnection of high/low beam lights
9585	Relay for electric retarder cutout with antiskid on
9586	Relay for preventing gear engagement from pushbutton panel
9587	Relay for allowing connection of parking lights with engine off
9588	Relay for connection of low voltage low beam lights
9589	Relay for connection of stop lights
9590	Relay for supply of automatic transmission control unit
9591	Relay for Webasto cutout and connecton of emergency w/lamp with safety switch on
9592	Relay for connection of failure bell control unit with engine running
9593	Relay for earthing of D+ with safety control on or G.C.R. off
9594	Relay for setting vehicle in "running" order through terminal 50
9595	Relay for holding 3rd axle lifting function energized
9596	Relay for holding 3rd axle system on
9597	Relay for switching on electric heater (1st speed)
9598	Relay for switching on electric heater (2nd speed)
9599	Relay for enablement of electric heater with terminal 15/a on
9600	Emergency combined battery disconnecter relay
9609	Time relay for delayed disconnecting of the ride recorder
9610	Relay for connection of hazard w/lamp
9611	Relay for connection of failure bell control unit with engine running
9612	Relay for connection of internal ventilation motors
9613	Relay for connection of internal aeration motors
9614	Relay for connection of electric retarder (stage 1 and 2)
9615	Relay for brake air pressure solenoid valve
9616	Relay for allowing front differential lock
9617	Relay for fuel heating
9618	Relay for inhibiting engine starting from engine compartment with gears engaged
9619	Relay for preventing gear engagement while the vehicle is accelerating or transmission is in neutral
9620	Power take-off relay
9621	Relay for sensor cutout in case of a failure in the opposite sensor
9622	Relay for switching on reading lights
9623	Relay for switching on internal lights (stage 1)
9624	Relay for switching on internal lights (stage 2)
9626	Relay, KSB solenoid valve Relay, turn signal/hazard lights actuator Relay, electrical battery disconnecter

9627	Relay, vehicle chassis levelling on front axle side (travelling position)
9628	Relay, vehicle chassis levelling on rear axle side (travelling position)
9629	Relay, speed limiter, uncoupling while gears are engaged
9630	Relay, trailer stop lights, parking brake on
9631	Relay for holding front/rear axle in travelling position
9632	Relay for holding 3rd axle lifting hydraulic pump between coupling /uncoupling stage
9633	Relay for switching on 3rd axle lifting hydraulic pump
9634	Relay for fuel heating circuit
9635	Relay for pump control with independent heating off
9636	Relay for heated rearview mirror
9637	Relay, terminal 15a (contact key interlocked-general services and user cutoff during starting stage)
9638	Relay, independent heating with battery disconnecter on
9639	Relay, cab tilting servomechanism
9640	Relay for antiskid connection w/lamp
9641	Relay for switching off retarder with antiskid on
9642	Relay for switching on low beams lights (low voltage) Relay, retarder cutoff with ABS on
9643	Relay for connection of low voltage low beam lights
9644	Relay for switching on brake system failure w/lamp
9645	Relay for rear brake shoe wear signal
9646	Relay for exhaust brake cutout with low rpm rate Relay, horns
9647	Relay for stopping engine with transmission in neutral
9648	Relay for doors closed w/lamp
9649	Relay for rear axle with ELF w/lamp
9650	Relay for ABS failure w/lamp
9651	Relay for Girling brake system failure w/lamp
9652	Relay for switching off low beam lights with parking lights on
9653	Relay for switching off day lights with fog lights on
9654	Relay for switching off 3rd axle lifting phase
9655	Relay, large/small water recirculation solenoid valve Relay for reducing EMS operation stroke while braking is performed
9656	Relay for switching off lift axle system with starting assistance (axle unloading on)
9657	Relay, open engine water recirculation solenoid valve, engine running
9658	Relay, trailer slowdown brake (stop lights)
9659	Relay for switching off reversing light, BO circuit on
9660	Relay, antiskid no. 1
9661	Relay, antiskid no. 2
9662	Relay for retarder supply
9663	Relay for connection of hazard lights with safety control on
9664	Relay for connection of low beam lights with engine running
9665	Relay for connection of low beam lights
9666	Relay for preventing current return through generator w/lamp with battery cutout
9667	Relay for pedal contact switch (from stop lights to retarder)
9668	Relay for door control
9669	Relay for ALV with ABS/ASR

9670	Relay, speed governor on Relay, engine test EDC
9671	Relay for holding vehicle chassis levelling adjustment (front axle travelling side) with switch in stop position
9672	Relay for holding vehicle chassis levelling adjustment (rear axle travelling side) with switch in stop position
9673	Relay for holding chassis levelling adjustment in travelling condition with front axle switch on either upwards or downwards position only
9674	Relay for holding chassis levelling adjustment in travelling condition with rear axle switch on either upwards or downwards position only
9675	Relay, 3rd axle lowering
9676	Relay, front/rear axle straight ahead travelling position
9677	Relay for switching 3rd axle from lifting to lowering stage or vice-versa
9678	Relay, actuator bellows breather valves (3rd axle lifting)
9679	Relay for holding 3rd axle system off
9680	Relay for disconnection of engine/transmission assembly timer with engine off
9681	Relay for disconnection of w/lamps with blackout circuit on
9682	Relay for enablement starting assistance with 13 ton load on rear axle
9683	Relay for rear steering axle level adjustment during lowering stroke
9684	Relay for engine stopping cutoff solenoid valve (ignition on)
9685	Relay, lift axle lowering phase automatic holding relay
9686	Relay, speed limiting device
9688	Relay, EDC system cutoff
9690	Relay for holding starting assistance function (3rd axle unloading)
9691	Relay, 3rd axle lowering after starting assistance function (i.e. after 3rd axle unloading)
9692	Relay for switching from battery positive after battery disconnecter to lh terminal 58 (dangerous cargo vehicles/France)
9693	Relay for switching from battery positive after battery disconnecter to rh terminal 58 (dangerous cargo vehicles/France)
9694	Relay for switching from earth connection after battery disconnection to battery negative insulated earth
9695	Relay for switching from outdoor air intake to internal recirculation system (smog)
9696	Relay for switching on air-conditioning system for a short time
9697	Relay for switching on electric heater (1st and 2nd speed)
9698	Relay for w/lamp dimming with blackout circuit on
9699	Relay for w/lamp and instrument light dimmer with blackout circuit on Kick-down relay
9700	Relay for switching off 3rd steering axle hydraulic steering system over 45 km/h (EDC protection polarized relay)
9701	Relay, heated air drier - Relay for switching off 3rd steering axle hydraulic steering system over 45 km/h
9702	Relay for switching on air drier
9703	Relay for reverse gear signal
9704	Relay for starter motor with clutch on
9705	Relay for switching off exhaust brake
9706	Relay for holding stop lights (longitudinal differential lock switch solenoid valve with ABS on)
9707	Relay for switching off automatic air-conditioning system while engine is turned off/on
9708	Relay for switching on cab heating
9709	Relay for switching on 3rd axle system (raising stage)
9710	Relay for switching on hydraulic pump (hydraulic lowering pressure below 20 bar)
9711	Relay for switching on 3rd axle raising system when rear axle lowering control signal comes on

- 9712 Relay for switching on engine stopping timer for a short time while ignition is switched off (terminal 15)
- 9713 Relay for switching off IVECO CONTROL with BO circuit on
- 9714 Relay for signalling engine coolant partial recirculation to control unit
- 9715 Relay for holding chassis self-levelling function with vehicle running
- 9716 Relay for lift axle quick air feed or quick breather valve during lowering phase
- 9717 Relay, breather valve during lift axle lowering phase
- 9718 Relay for stopping rear axle levelling control in travelling position (STOP) with axle load over 1.3 tons
- 9719 Relay for enabling starting assistance signal with chassis levelling in travelling position
- 9720 Load relay, windshield heating
Relay, steered wheels sensor
- 9721 Relay for stopping power take-off switch on relay with engine running
- 9722 Relay for stopping starter motor with engine running
- 9723 Relay for cutting off associated components when main current switch is turned off
- 9724 Relay for switching on neutral position signal, terminal 15 (automatic transmission)
Relay, SAMT, LIMP-HOME
- 9725 Relay for 3rd axle hydraulic steering system axle down
- 9726 Hold relay, 3rd steering axle centering signal cut off with front axle wheel in straight ahead driving position
- 9727 Hold relay, starting assistance cut off, self-holding system at a speed equal to or greater than 25 Km/h
- 9728 Instrument light relay
Relay, trip computer level 1
- 9729 Relay for switching on incandescence resistance (thermostate)
- 9730 Relay for switching on 3rd steering axle solenoid valve unit
- 9731 Enablement relay for turning on 3rd axle lifting system pushbutton (speed less than 2 Km/h)
- 9732 Relay for turning off turn signal/hazard lights when B.O system is turned on
- 9733 Relay for turning off steps and cab interior lights when B.O system is turned on
- 9734 Relay for positioning 3rd steering axle in straight ahead driving position (axle up)
- 9735 Hold relay, General Current Relay
- 9736 Relay, terminal D+
- 9737 Relay, fuel supply opening with fuel circuit on
- 9743 Relay for fuel circuit heating (Thermoline)
- 9749 Relay for switching over motor incandescence thermostat to dynamic resistance, in case of quick heating of the additional heating over the timer.
- 9800 Front door test solenoid valve
- 9801 Solenoid valve for releasing brake cylinder spring actuators
- 9802 Kickdown solenoid valve (hydraulic converter)
- 9803 Transmission control solenoid valve
- 9804 Solenoid valve for retarder graduated braking
- 9805 Solenoid valve for reducing hydraulic braking
- 9806 Retarder control solenoid valve
- 9807 Solenoid valve for resetting service door mechanical lock device
- 9808 Solenoid valve for limiting retarder operation in 1st/2nd/reversing gear
- 9809 Vehicle lowering solenoid valve
- 9810 ASR with ABS + ASR solenoid valve
- 9811 Chassis levelling solenoid valve
- 9812 Cooling fan solenoid valve
- 9813 EASYSHIFT solenoid valve unit

9814	Solenoid valve for inhibiting gear engagement while the vehicle is accelerating and transmission is in neutral
9815	Solenoid valve for stopping AVS solenoid valves block
9816	Solenoid valve, clutch assistance (AVS)
9817	Retarder solenoid valve assembly
9818	Solenoid valve for reducing engine rpm (AVS)
9819	Solenoid valve, retarder oil accumulator
9820	Solenoid valve unit (ELF)
9821	ELF solenoid valve
9822	Retarder proportional solenoid valve
9823	Speed limiter pressure modulator solenoid valve assembly
9824	Speed limiter quick exhaust solenoid valve
9825	Solenoid valve for locking added steering wheels in reverse gear
9826	Solenoid valve for opening air circuit to vehicle raising actuator bellows
9827	Solenoid valve for opening air circuit to 3rd axle air suspension springs
9828	Solenoid valve unit, 3rd axle hydraulic steering system
9829	Solenoid valve for opening hydraulic circuit (i.e. 3rd axle lowering)
9830	Solenoid valve, 3rd axle lowering system
9831	Solenoid valve, associated rear wheel braking with ASR on
9832	Solenoid valve for switching from large to small water circuit and vice-versa
9833	Solenoid valve for switching off added axle raising phase (added axle unloading/starting assistance) with more than 13 ton load on rear axle
9834	Solenoid valve, engine coolant circuit off
9835	Solenoid valve for reducing air pressure in 3rd axle braking system with ABS on
9836	Quick-breather solenoid valve for gear uncoupling with speed limiter on
9837	Pressure modulator for stopping speed limiter solenoid valves
9838	Solenoid valve unit, rear axle, chassis levelling system
9839	Solenoid valve, clutch response signal (automatic transmission)
9840	Brake solenoid valve (AVS)
9841	Solenoid valve unit, automatic transmission splitter unit
9842	Solenoid valve, exhaust brake
9843	Quick-breather valve, rear axle air springs
9844	Solenoid valve, 3/2-way valve, lift axle air control system
9845	Solenoid valve for stopping longitudinal differential lock with ABS and all-wheel drive on
9900	Automatic gear selection control unit (AVS)
9901	Engaged rear display (AVS)
9902	Fuel filter heating temperature switch
9919	Control unit enabling engine starting and gear engagement, ZF automatic transmission
9951	ABS/ASR fault diagnosis jack
9953	E-GAS/EMS fault diagnosis pushbutton
9954	3-way connection block, E-GAS/edc diagnosis
9955	Retarder cutout main switch
9956	Electronic suspension system fault diagnosis jack
TEST	3-pole connector for connection to IVECO Tester (ISO K/L line)
TEST	Fault diagnosis connector (ISO K/L line)

5-DIGIT COMPONENT CODES

03000	Self-rectifying alternator with built-in voltage regulator
03001	Self-rectifying alternator
03002	Auxiliary self-rectifying alternator with built-in voltage regulator
06000	Electronic voltage regulator
06001	Electromechanical voltage regulator
06010	Overvoltage protection device (RTE)
08000	Starter motor
12000	Motor; electric heater and windshield defrosting
12001	Motor; internal aerators
12002	Motor; engine compartment ventilation
12003	Motor; forced ventilation
12004	Motor; driver's place ventilation
12005	Motor; driver's place heating
12006	Motor; adjustable mirrors
12007	Motor; switn door
12008	Motor; brake fluid pump
12009	Motor; interior heating
12010	Motor; rh door closing
12011	Motor; lh door closing
12012	Compressor; air-conditioning system
12013	Electric fan; capacitor cooling
12014	Motor; dust expulsion
12015	Motor for outside air intake door
12016	Motor; air ejection
12017	Motor for vehicle raising pump
12018	Motor; radiator ventilation
12019	Motor; cab tilting
12020	Motor; engine oil cooling
12021	Motor for centralized lubrication pump
12022	Motor; electronic accelerator (automatic transmission)
12023	Motor; window shade
12024	Motor for added axle hydraulic pump
12025	Motor; power take-off
12026	Motor; winch control
14000	Ignition distributor
15000	Ignition coil
19000	Spark plug
19005	Thermostarter
19010	Preheating plug
20000	Starting battery
22000	Horn
22001	Horn

22002	Air horn control unit
19015	Carburettor
22005	Two-tone horn
22031	Hostess bell
22032	Bell, engine coolant temperature/brake air pressure/engine oil pressure
22033	Bell for vehicle raising system failure
22034	Bell for front differential lock on
22035	Bell for trailer braking system failure
22036	Bell for automatic transmission failure
22037	Bell for parking brake 60% on
22038	Bell for engine coolant and transmission oil temperature
22040	Bell for automatic clutch failure
24000	Foot switch, electrical retarder
24001	Switch under accelerator pedal, load sensor
24002	Foot switch, retarder
24003	Foot switch, retarder
24004	Automatic transmission accelerator pedal sender
25000	Relay, rear fog lights enablement with low beam lights on
25001	Relay, rotary beacons
25002	Relay, parking and low beam lights with engine running
25003	Relay, fog lights
25004	Relay, flasher light
25005	Relay for switching off fog lights with low beam lights off
25006	Relay for switching on stop lights
25007	Relay for switching on reversing lights
25008	Relay for switching on low beam lights
25009	Relay for switching on high beam lights
25010	Relay for switching on auxiliary high beam lights
25011	Relay for switching on marker lights
25012	Relay for switching on fog lights and switching off day lights
25013	Relay for switching off low beam lights with high beams on
25014	Relay for enablement of parking lights with engine off
25015	Relay for switching off low beam lights with engine off
25016	Relay for inhibiting switching on of day lights with engine off and ignition key on
25017	Relay for switching on dipped lights
25018	Relay for switching off low/high beam lights with fog lamps on
25019	Relay for switching off- day lights with fog lamps on
25020	Relay for switching on trailer stop lights
25021	Relay for allowing connection of blackout lights
25022	Relay for optical indicator blackout with blackout lights on
25023	Relay for switching off low beam lights with parking lights on
25024	Relay for enablement of day lights
25025	Relay for switching earth (after the G.C.R.) to battery insulated earth
25026	Amperometric relay for checking rotating beacons

25027	Relay for switching battery positive after the G.C.R. to trailer external lights on left-hand side
25028	Relay for switching battery positive after the G.C.R. to trailer external lights on right-hand side
25029	Relay for cutoff of IVECO Control with blackout light circuit on
25030	Reverse gear relay
25031	Relay for auxiliary heater timer lighting
25032	Relay for turning off direction indicator lights/hazard lights with blackout lights on
25033	Relay for switching on BO lights
25034	Relay for switching on rear fog lights
25035	Relay for switching on external lights
25040	Relay for load cutoff while switching on BO lights
25086	Amperometric relay, auxiliary rotary beacon
25100	Relay, trailer exhaust brake solenoid valve
25101	Relay, exhaust brake solenoid valve
25102	Relay, retarder supply
25103	Relay, brake system failure warning lamp
25104	Relay for switching off retarder and/or exhaust brake with ABS on
25105	Relay for switching off ABS sensor in the event of a failure in the opposite sensor
25106	Relay for switching on Tractor ABS failure warning lamp
25107	Relay for switching on ABS information control unit
25108	Relay for retarder connection (stage 1 and 2)
25109	Relay for retarder connection (stage 3)
25110	Relay for retarder connection (stage 4)
25111	Relay unit, retarder control
25112	Relay for cutout of longitudinal differential lock with ABS on
25113	Relay for connection of stop lights while the trailer is slowing down
25114	Relay for allowing switching on of stop lights with parking brake engaged
25115	Relay for cutting off the exhaust brake through the automatic transmission
25116	Relay, exhaust brake control via service brake
25117	Relay, exhaust brake control via accelerator pedal
25118	Relay, brake pedal depressed signal
25119	Relay, exhaust brake on signal
25120	Relay, exhaust brake control with electrical retarder on
25121	Relay, Bowden cable failure signal
25200	Starting relay
25201	Relay, preheating
25202	Relay, G.C.R. energizing
25203	Relay, G.C.R. opening
25204	Relay, remote starting enablement, cab unlatched
25205	Relay, engine stopping
25206	Relay, rich mixture control
25207	Relay, alternator D+ earthing
25208	Relay, remote start enablement, gear engaged
25209	Relay for cutting off various components during starting stage
25210	Relay, starting enablement with transmission in neutral

- 25211 Relay with delayed opening contact for keeping G.C.R energized
- 25212 Relay with delayed closing contact for keeping RTE energized
- 25213 Relay for supply of users connected to ignition switch through battery positive
- 25214 Relay for fuel pipe heating
- 25215 Relay for inhibiting starting from engine compartment with gears engaged
- 25216 Relay for cutout of engine stopping solenoid valve with ignition key on
- 25217 Relay for temporary connection of engine stopping solenoid valve timer with ignition key off
- 25218 Relay for starting with clutch on
- 25219 Relay for user cutout with G.C.R. off
- 25220 Relay for allowing engine starting with antitheft device on
- 25221 Relay for connection of pre/after heating w/lamp
- 25222 Relay for allowing connection of thermal starter
- 25223 Relay for allowing connection of thermal starter fuel tank with atmosphere
- 25224 Relay for inhibiting starter operation with engine running
- 25225 Relay for allowing starting from cab with transmission in neutral or clutch pedal fully pressed
- 25226 Relay, G.C.R. energizing from inside the cab
- 25227 Relay, G.C.R. de-energizing with doors open
- 25228 Relay for switching on dashboard
- 25229 Starting inhibitor relay
- 25230 Relay, engine preheating solenoid valve
- 25300 Relay, auxiliary heater
- 25301 Relay, engine compartment ventilation
- 25302 Relay, interior ventilation
- 25303 Internal ventilation relay
- 25304 Internal aeration relay
- 25305 Relay for auxiliary heater cutout with safety control on
- 25306 Relay for electric heater and windscreen defroster
- 25307 Relay for air-conditioning compressor
- 25398 Relay for capacitor cooling fan (low speed)
- 25309 Relay for connection of engine coolant heater plugs
- 25310 Relay for allowing connection of internal heating with power load inhibiting relay
- 25311 Relay for rear external air intake door
- 25312 Relay for front air ejection door
- 25313 Relay for allowing forced ventilation with internal heating off
- 25314 Air ejection relay
- 25315 Relay for allowing air ejection with engine running and switch enabled
- 25316 Relay for allowing forced ventilation with engine running
- 25317 Relay for allowing air ejection with engine running
- 25318 Engine oil cooling relay
- 25319 Relay for large/small recirculation solenoid valve
- 25320 Relay for radiator fans
- 25321 Relay for connection of auxiliary heater (1st/2nd speed)
- 25322 Relay for connection of auxiliary heater (1st speed)
- 25323 Relay for connection of auxiliary heater (2nd speed)

- 25324 Relay for connection of auxiliary heater with G.C.R. on
- 25325 Relay for engine coolant recirculation (open with engine running)
- 25326 Relay for temporary connection of air-conditioning system
- 25327 Relay for connection of air-conditioning system
- 25328 Relay for temporary connection of air-conditioning system compressor during engine starting
- 25329 Relay for capacitor cooling fan maximum speed
- 25330 Relay for cutting out air-conditioner when engine is turned off
- 25331 Relay for allowing connection of auxiliary heater
- 25332 Relay for connection of air-conditioning system
- 25333 Relay for connection of cab heating
- 25334 Relay for connection of auxiliary heater water pump
- 25335 Relay for water circulation pump cutoff with G.C.R. open
- 25336 Relay for engine cooling electromagnetic joint
- 25337 Relay for disconnecting air-conditioning system compressor
- 25400 Relay, hazard lights
- 25401 Relay, hazard lights with safety control device on
- 25402 Relay, hazard/turn signal lights
- 25403 Relay for auxiliary rear right direction indicator light
- 25404 Relay for auxiliary rear left direction indicator light
- 25405 Relay, emergency warning light
- 25500 Relay for switching on vehicle lock device with doors open
- 25501 Relay for switching off vehicle lock device with doors open
- 25502 Relay for connection of doors closed w/lamp
- 25503 Relay for cutout of stop request w/lamp with doors open
- 25504 Relay for connection of stop request w/lamp with doors open
- 25505 Relay, rear door locking device
- 25506 Relay, interior lighting/front door opening/light level no.2 interlock
- 25600 Relay enabling gear engagement with brake pedal totally depressed
- 25601 Relay enabling reverse gear engagement with vehicle stationary
- 25602 Relay inhibiting gear engagement with vehicle stationary and low air pressure in suspension system
- 25603 Speed control relay
- 25604 Relay for connection of transmission power takeoff w/lamp
- 25605 Relay for allowing starting with transmission in neutral
- 25606 Relay for automatic transmission
- 25607 Relay, power take-off no. 1 signal
- 25608 Relay, power take-off no. 2 signal
- 25609 Relay, automatic transmission in neutral when ignition switch is turned on
- 25610 Relay for reverse gear signal
- 25611 Relay for allowing engine starting with clutch on
- 25612 Relay for engagement of normal/splitter gears
- 25613 Relay, neutral signal with brake pedal fully depressed
- 25614 Relay, connection of neutral position signal to terminal 15 (automatic transmission)
- 25615 Relay, gear selector earthing with driver's door open
- 25616 Relay, automatic transmission failure signal

25617	Relay, engine starting from engine compartment
25618	Relay, engaged gear signal Relay, transmission hydraulic retarder on/off system
25619	Relay, air suspension low pressure
25800	Relay, key rotation inhibitor electromagnet (engine running)
25801	Relay, lamp test
25802	Relay, single-tone bell, stop request
25803	Relay, interior lighting
25804	Relay, interior lighting (safety control device on)
25805	Relay, horns
25806	Relay, miscellaneous lighting enablement (ignition key on)
25807	Relay for switching on stop request signs and switching off stop request bell
25808	Relay, front differential lock enablement
25809	Relay, speed limiter
25810	Relay, fuel heating circuit
25811	Relay, ignition timer (KSB)
25812	Relay, windscreen wiper unit
25813	Relay, heated rearview mirrors
25814	Relay for switching off power unit operation hour counter with engine off
25815	Relay for connection of vehicle raising system failure w/lamp
25816	Relay for connection of vehicle raising system failure w/lamp (incorrect level)
25817	Relay, settler heating circuit
25818	Relay, heated windshield
25819	Relay for connection of reading spotlights
25820	Relay, vehicle levelling (front suspension system)
25821	Relay, brake fluid level w/lamp
25822	Relay for 3rd axle lowering
25823	Relay for keeping 3rd axle up
25824	Relay for raising 3rd axle with associated air springs under pressure
25825	Prefilter heating relay
25826	Relay for switching 3rd axle raising/lowering functions
25827	Relay for cutout of 3rd axle raising stage
25828	Relay for keeping connection of 3rd axle raising pump between cutin and cutout stages
25829	Relay for setting front/rear axle in straight ahead running position
25830	Relay for holding front suspension alignment (control in stop position)
25831	Relay, rear suspension levelling control system
25832	Relay for holding rear suspension alignment (control in stop position)
25833	Relay for holding rear suspension alignment (control in lifting/lowering position)
25834	Relay for holding front suspension alignment (control in lifting/lowering position)
25835	Relay for holding front/rear axle in straight ahead running position
25836	Relay for allowing turret rotation with pilot's trap door open
25837	Relay for connection of fuel pump
25838	Relay for connection of winch remote control device
25839	Relay for allowing connection of 4th axle locking and steering solenoid valve

- 25840 Relay for front axle system failure w/lamp
- 25841 Relay for rear axle system failure w/lamp
- 25842 Relay for allowing connection of rear differential lock
- 25843 Relay for 3rd axle raising pump
- 25844 Relay for connection of carburetion check control unit
- 25845 Relay for slow speed range w/lamp
- 25846 Relay for fast speed range w/lamp
- 25847 Relay for cab tilting motor
- 25848 Relay for connection of 3rd axle lifting actuator bellows breather valves
- 25849 Relay for allowing connection of speed limiter
- 25850 Speed limiter relay
- 25851 Relay for allowing cutout of 3rd axle raising stage with load > 13 tons
- 25852 Relay for allowing starting assistance with load < 13 tons
- 25853 Relay for cutout of 3rd axle hydraulic steering with speed over 45 k.p.h.
- 25854 Relay for slow/fast speed range switching signal
- 25855 Relay for connection of engine oil topup pump
- 25856 Relay for connection of brake system air drier
- 25857 Relay for speed governor cutout
- 25858 Relay for EDC connection
- 25859 Relay for lowering 3rd axle after starting assistance
- 25860 Relay for 3rd axle cutout with starting assistance
- 25861 Relay for keeping 3rd axle disconnected
- 25862 Relay for keeping starting assistance device in operation
- 25863 Relay for allowing 3rd axle lowering after starting assistance
- 25864 Reverse polarity preventing relay
- 25865 Relay for terminal 15
- 25866 Relay for terminal 58
- 25867 Relay for two-tone horns
- 25868 Relay for power steering failure w/lamp
- 25869 Delayed relay for lowering 3rd axle with load > 11 tons
- 25870 3rd axle raising relay
- 25871 Relay for connection of 3rd axle raising pump with pressure < 20 bar
- 25872 Relay for raising 3rd axle while rear suspensions are being lowered
- 25873 Relay for allowing connection of torque splitter power take-off
- 25874 Relay for connection of power loads with engine running
- 25875 Relay for connecting chassis to battery negative with antitheft device on
- 25876 Relay for allowing connection of torque splitter power takeoff with parking brake on
- 25877 Relay for automatic clutch w/lamp
- 25878 Automatic clutch connection relay
- 25879 Relay for allowing connection of total power takeoff with engine off
- 25880 Relay for connection of transmission power takeoff w/lamp
- 25881 Relay for switching off 3rd axle lowering function during starting stage
- 25882 Relay for brake pedal signal to EDC control unit
- 25883 Relay for switching off Cruise Control with retarder on

- 25884 Suspension raising relay
- 25885 Relay for allowing connection of starting assistance with chassis alignment in running order
- 25886 Relay for controlling 3rd axle quick exhaust valves during lowering stage
- 25887 Relay for switching 3rd axle air delivery valves during lowering stage
- 25888 Relay for allowing connection of starting assistance
- 25889 Relay for turning off speed limiter while gears are engaged
- 25890 Relay for connection of 3rd axle w/lamp
- 25891 Relay for allowing connection of speed limiter with key on
- 25892 Relay, transfer case power take-off w/lamp
- 25893 Relay for connection of total power takeoff
- 25894 Relay for connection of power loads with key on
- 25895 Relay for connection of trip computer light
- 25896 Relay for allowing starting assistance with speed <60 km/h
- 25897 Relay for connection of side transmission power takeoff
- 25898 Relay for connection of rear transmission power takeoff
- 25899 Relay, load cutoff with battery disconnecting switch open
- 25900 General Current Relay
- 25901 General Current Relay with automatic circuit breaker
- 25902 Air cutoff mechanical General Current Relay
- 25903 EDC cutoff relay
- 25904 Relay, release of 3rd axle lifting system
- 25905 Relay for holding lock of 3rd axle lifting system
- 25906 Relay for turning engine off in the case of POWER PACK failure
- 25907 Relay, radiator fluid level w/lamp
- 25908 Relay, hydraulic steering with axle down
- 25909 Relay for holding wheel centering inhibitor (axle in straight ahead driving position)
- 25910 Relay for turning on hydraulic steering system solenoid valves
- 25911 Relay for straight ahead driving position (steered axle up)
- 25912 Relay, 3rd axle lifting ($V < 2$ KM/H)
- 25913 Relay, differential lock enablement
- 25914 Relay, engine rev up from ground enablement
- 25915 Relay, cab unlatched signal enablement
- 25916 Relay, fireproof hatch control
- 25917 Relay, bilge pump
- 25918 Relay for gas system supply
- 25919 Relay, vehicle running enablement
- 25920 Relay for turning on gas system with transmission in neutral
- 25921 Relay, gas system solenoid valve enablement
- 25922 Relay, remote brake pedal operation enablement
- 25923 Relay for switching on windshield wiper unit in 2nd speed
- 25924 Relay for turning on EDC (main relay)
- 25925 Relay for switching on rear differential lock
- 25926 Relay for enablement of suspension lifting and stopping of suspension lowering function
- 25927 Relay for enablement of suspension lowering and stopping of suspension lifting function

25928	Relay, rear window heating
25930	Relay,G.C.R. opening with engine off and safety system on
25931	Delayed relay for switching on speed limiting device
25932	Delayed opening relay, headlight washing system
25933	Starting assistance time relay
25934	Delayed opening relay for engine stopping solenoid valve
25935	Electronic relay for auxiliary heater plug
25936	Heated windscreen time relay
25937	Time relay for connection of 3rd axle raising hydraulic pump
25938	Delayed opening relay, wheel centering when engine is switched off
25939	Delayed relay for switching off speed limiter with clutch pedal down
25941	Relay, video camera/open front door interlock
28000	Electromagnet, enriched fuel delivery
28001	Key rotation inhibitor electromagnet
28002	Engine stopping electromagnet
28003	Electromagnet for rear axle braking system coolant recirculation pump
28004	Electromagnet for air-conditioner compressor clutch
30000	High/low beam headlight
30001	High/low beam headlight with parking light
30002	Low beam headlight with parking/driving lights and headlight alignment unit
30003	High/low beam light wiht parking light and headlight alignment unit
30010	Low beam light
30011	Fog headlight
30012	BO headlight
30100	Headlight alignment unit actuator
31000	Front/side turn signal light
32000	Front parking/turn signal light
32001	Front parking light
32002	Front turn signal light
32003	Front BO parking light
32004	Front blackout parking and direction indicator light
32005	Front marker light
32006	Front side marker lamp
32010	Rotary beacon
33000	Front parking and direction indicator light
33001	Turn signal side repeater
33002	Auxialiry turn signal light
33003	Side marker lamp
33004	Side marker lamp
34000	Rear headlight cluster
34001	BO rear headlight cluster
34005	Rear parking light
34006	Rear turn signal light
34007	Stop light

34008	Reversing light
34009	Rear fog light
34010	Rear BO parking light
34011	Fifth-wheel light
34012	Cross BO headlight
34013	Side marker lamp
35000	Number plate light
37000	Front/rear marker light
37001	Front marker light
37002	Rear marker light
37003	Front/rear marker light
37004	Front/rear identification light
37005	Side marker light
39000	Cab interior ceiling lamp
39001	Cab rear ceiling lamp
39002	Bunk ceiling lamp
39003	Steps spotlight
39004	Engine compartment spotlight
39005	Luggage compartment spotlight
39006	Driver's place spotlight
39007	Blue light ceiling lamp
39008	Incandescence interior ceiling lamp
39009	Reading light
39010	Map light
39011	Fluorescent interior ceiling lamp
39012	Route signs fluorescent ceiling lamp
39013	Route signs ceiling lamp
39014	Front door steps spotlight
39015	Centre door steps spotlight
39016	Rear door steps spotlight
39017	Cab interior swivel spotlight
39018	Conductor's place ceiling lamp
39019	Blue/normal interior ceiling lamp
39020	Cigar lighter light
39021	Instrument light
39022	Cab interior swivel spotlight
39023	Light pipe lamp
39024	Booked stop ceiling spotlight
39025	Rear door ceiling spotlight
39026	Side door ceiling spotlight
39027	Bunk ceiling spotlight
39030	Lamp, cab side compartment lighting
39050	Support, fluorescent interior lighting converter
39051	Converter, fluorescent interior lighting

39052	Converter, route signs fluorescent lamps
39053	Support, fluorescent route signs lighting converter
40000	Mechanical tachometer
40001	Electronic tachometer
40002	Electronic tachometer with clock
40010	Mechanical tachograph
40011	Electronic tachograph
40012	Mechanical tachograph with speed limiter current outlet
40013	Electronic tachograph with speed limiter current outlet
40030	Electronic tachometer sender unit
40031	Electronic tachograph sender unit
40032	Tachometer/tachograph sender unit
40033	Tachograph and speedometer sender (EDC)
40035	Electronic tachometer adaptor with fixed constant
40036	Electronic tachograph signal repeater
40037	Tachograph signal converter
40038	Speedometer signal converter
40045	Vehicle speed sensor
40046	Inductive type chassis height sensor (rear axle)
40047	Inductive type chassis height sensor (front axle)
40060	Voltage dropper unit, tachograph, TMP vehicles
42000	Pressure gauge, engine oil pressure
42001	Pressure gauge with built-in w/lamp, engine oil pressure
42002	Pressure gauge, front brake air pressure
42003	Pressure gauge, rear brake air pressure
42004	Pressure gauge with built-in w/lamp, front brake air pressure
42005	Pressure gauge with built-in w/lamp, rear brake air pressure
42006	Double-reading pressure gauge, front brake air pressure
42007	Double-reading pressure gauge, rear brake air pressure
42008	Pressure gauge, front/rear brake air pressure
42009	Air pressure gauge for front tyres
42010	Air pressure gauge for rear tyres
42011	Double-reading pressure gauge, front/rear brake air pressure
42012	Pressure gauge,brake oil pressure
42013	Pressure gauge, methane gas pressure
42030	Sender unit, engine oil pressure gauge
42031	Sender unit, front brake air pressure gauge
42032	Sender unit, rear brake air pressure gauge
42033	Sender unit, front brake graduated pressure gauge
42034	Sender unit, rear brake graduated pressure gauge
42035	Absolute pressure sensor
42036	Sender unit, front tyre air pressure gauge
42037	Sender unit, rear tyre air pressure gauge
42038	Sender unit, air delivery (2) pressure gauge

42039	Sender unit, intake air pressure gauge
42040	Sender unit, air delivery (I) pressure gauge
42041	Sender unit, brake oil pressure gauge
42042	Transducer, methane gas pressure gauge
42045	Sender unit for outdoor temperature gauge
42050	Front axle stroke sender unit (with chassis levelling adjustment unit)
42051	Left axle stroke sender unit (with chassis levelling adjustment unit)
42052	Right axle stroke sender unit (with chassis levelling adjustment unit)
42100	Switch, front brake air pressure signal
42101	Switch, rear brake air pressure signal
42102	Switch, parking brake signal
42103	Switch, exhaust brake-interlocked trailer brake
42104	Switch, brake system failure signal
42105	Switch, exhaust brake signal
42106	Switch stop signal
42107	Switch, parking brake pressure signal
42108	Switch for trailer retarder signal
42109	Safety switch for braking system low air pressure
42110	Safety switch for braking system high air pressure
42111	Switch for stop light check with EDC on
42112	Switch, stop light test (EDC on)
42113	Exhaust brake switch (EDC)
42114	Exhaust brake switch (automatic transmission)
42115	Parking brake on (60 %) signalling switch
42200	Switch, air suspension failure signal
42201	Switch, front air suspension failure signal
42202	Switch, rear air suspension failure signal
42203	Switch, front rh air suspension failure signal
42204	Switch, front lh air suspension failure signal
42205	Hydraulic circuit switch for 3rd axle raising system
42206	Left drive axle switch for 3rd axle raising system
42207	Right drive axle switch for 3rd axle raising system
42208	Left lift axle switch for 3rd axle raising system
42209	Right lift axle switch for 3rd axle raising system
42250	Switch, transmission air pressure signal
42251	Switch, gear disengagement with low air suspension pressure
42252	Switch for enabling gear engagement with brake pedal fully depressed
42253	Automatic transmission low air pressure signalling switch
42350	Switch, body tilted
42351	Switch, air cleaner restriction
42352	Switch, transmission power take-off signal
42353	Switch, 3rd axle up signal
42354	Switch for air suspension system failure
42355	Switch for front door safety lock device

- 42356 Switch for rear door safety lock device
- 42357 Switch for front door limiting solenoid valve
- 42358 Switch for rear door limiting solenoid valve
- 42359 Safety switch for front door reverse operation (closing direction only)
- 42360 Safety switch for rear door reverse operation (closing direction only)
- 42361 Pressure increase sensing switch with N connection for door control unit
- 42362 Switch for starting assistance solenoid valve
- 42363 Switch for changing 3rd axle raising/lowering functions with load > 11.5 tons
- 42364 Switch for cutout of 3rd axle raising function
- 42365 Switch for detecting 3rd axle air spring pressure
- 42366 Switch for setting 3rd steering axle in straight ahead travelling position
- 42367 Air-conditioner switch
- 42368 Pressurization signalling switch
- 42369 Switch for signalling low pressure in services
- 42370 Fan oil filter restriction signalling switch
- 42371 Switch for detecting 3rd axle raising actuator pressure
- 42372 Switch for detecting pressure overload in rear springs
- 42373 Switch for allowing 3rd axle raising with air pressure in hydraulic circuit and key on
- 42374 EDC clutch switch
- 42375 Switch for drier filter minimum pressure
- 42376 Switch for drier filter maximum pressure
- 42377 Switch for connection of 3rd axle raising system hydraulic pump
- 42378 Switch for cutout of 3rd axle raising system hydraulic pump
- 42379 Switch for allowing connection of transmission power take-off
- 42380 3rd axle raising system switch located in hydraulic lowering circuit
- 42381 Drive axle switch for switching 3rd axle lifting/lowering stroke
- 42382 3rd axle switch for switching lifting/lowering stroke
- 42383 Switch, front door steps light
- 42384 Switch, centre door steps light
- 42385 Switch, rear door steps light
- 42386 Switch, NBC low pressure signal
- 42387 Switch, fire-fighting cylinders pressure signal
- 42388 Switch, differential lock signal
- 42500 Switch, brake oil pressure signal
- 42550 Switch, engine oil pressure signal
Engine oil reservoir level switch
- 42551 Switch, oil filter restriction signal
- 42600 Switch, transmission oil low pressure signal
- 42601 Switch, transmission oil high pressure signal
- 42602 Switch, cooling fluid low pressure signal
- 42603 Switch, cooling fluid high pressure signal
- 42604 Power steering oil pressure signalling switch
- 42605 Converter oil pressure signalling switch
- 42606 Coolant average pressure signalling switch

42607	Centralized lubrication pump switch
44000	Fuel level indicator
44001	Fuel level indicator with built-in w/lamp
44002	Engine oil level indicator
44030	Sender unit, fuel level indicator
44031	Sender unit, fuel level indicator with w/lamp contact
44032	Engine oil indicator control
44033	Brake fluid level indicator control
44034	Clutch fluid level indicator control
44035	Windshield fluid level indicator control
44036	Radiator waterlevel indicator control
44037	Power steering fluid level indicator control
44038	Front brake fluid level indicator control
44039	Rear brake fluid level indicator control
44040	Headlight washer fluid level indicator control
44041	Engine oil high level indicator control
44042	Transmission oil level indicator control
44043	Engine oil level sender unit
44044	Engine oil low level indicator control
47000	Clock
47010	Thermometer, engine coolant temperature
47011	Thermometer, engine coolant temperature with built-in w/lamp
47012	Thermometer, transmission oil temperature
47013	Thermometer, engine oil temperature
47014	Thermometer, engine oil temperature with built-in w/lamp
47015	Thermometer, external temperature
47030	Sender unit, thermometer, engine coolant temperature
47031	Sender unit, thermometer, transmission oil temperature
47032	Sender unit, thermometer, engine oil temperature
47033	Sender unit, thermometer, external temperature
47034	Engine coolant temperature sensor (EGR)
47035	Engine coolant temperature sensor
47036	Engine coolant temperature sensor for preheating system
47037	Engine coolant temperature sensor for engine cooling system
47038	Exhaust gas temperature sensor
47039	Battery tank temperature sensor
47040	Intake air temperature sensor
47041	Water temperature sender for retarder control unit
47042	Fuel temperature sensor
47100	Switch, engine coolant high temperature signal
47101	Switch, engine oil temperature signal
47102	Switch, engine compartment ventilation failure signal
47103	Switch for switching on engine compartment ventilation system
47104	Switch for switching on engine cooling electromagnetic joint

47105	Switch, preheating system
47106	Switch, fuel heating
47107	Switch, forced ventilation
47108	Switch, settler heating
47109	Switch, ignition timer (KSB)
47110	Switch, engine coolant high temperature signal (retarder system)
47111	Temperature gauge switch, fuel pipe heating enablement
47150	Switch, transmission oil high temperature signal
47200	Switch, brake system air drier resistor
47201	Switch for signalling brake fluid circulation pump failure
47202	Switch for signalling high coolant temperature in rear axle braking system
47203	Switch, outdoor temperature
47204	Switch for allowing internal heating with engine coolant temperature $\geq 60^{\circ}\text{C}$
47205	Converter oil high temperature signalling switch
47206	Switch for turning off 3rd axle lifting pump
47207	Switch/sender unit, engine water temperature indicator
48000	Mechanical rev counter
48001	Electronic rev counter
48030	Electronic rev counter sender unit
48031	T.D.C. sensor
48032	Crankshaft pulse sender (diagnostic system)
48033	Flywheel pulse sender (diagnostic system)
48034	Rev counter sender unit signal amplifier
48035	Engine rpm sensor
48036	Engine rpm sensor signal amplifier
48037	Automatic transmission input rpm sensor
48038	Automatic transmission sender unit on accelerator pedal
48039	T.D.C. sensor (vehicles with EGR)
48040	Automatic transmission output rpm sensor
48041	Engine rpm sensor (fault diagnosis)
48042	Engine rpm sensor (on timing gear)
48043	Turbocharger speed sensor
48044	Km odometer sensor
48045	Injector inductive sensor
49000	Battery charge indicator
49001	Amperometer
49002	Hour counter
49003	Wheel direction indicator
49004	Inclinometer
49005	Voltmeter
49006	Air delivery measuring device with temperature sender unit
49007	Km odometer (LCD)
49030	Sender unit, wheel direction indicator
49031	Sender unit, turret direction indicator

50000	IVECO Control display panel
50001	Self-diagnosis combined module
50002	Engaged gear display (automatic transmission)
50010	Display control unit (SIB)
50011	Minidream control unit (SIB)
50012	CRT monitor (SIB)
50013	Keyboard (SIB)
52000	Switch, windshield defrosting electric heater
52001	Switch with built-in w/lamp, windshield defrosting electric heater
52002	Switch, auxiliary heater
52003	Switch with built-in w/lamp, auxiliary heater
52004	Switch, heated rearview mirrors
52005	Switch with built-in w/lamp, heated rearview mirrors
52006	Switch, rear fog light
52007	Switch with built-in w/lamp, rear fog light
52008	Switch, fifth-wheel light
52009	Switch with built-in w/lamp, fifth-wheel light
52010	Switch, preheating and fuel rich mixture unit
52011	Switch with built-in w/lamp, preheating and fuel rich mixture unit
52012	Switch, stop request enablement
52013	Switch, internal aerators
52014	Switch, vehicle raising system
52015	Switch, rotary beacons
52016	Switch, driver's light
52017	Switch, interior blue lights
52018	Switch, reading lights
52019	Switch, power take-off
52020	Switch with built-in w/lamp, power take-off
52021	Switch, interior lighting
52022	Switch, route sign lights
52023	Switch, auxiliary headlights
52024	Switch with built-in w/lamp, auxiliary headlights
52025	Switch, ticket punching machine
52026	Switch, radiophone
52027	Switch, route signs
52028	Switch, antistarting from engine compartment
52029	Switch, safety centre unit
52030	Switch, interior heating
52031	Vehicle raising switch with built-in w/lamp
52032	Vehicle lowering switch with built-in w/lamp
52033	Refrigerator switch with built-in w/lamp
52034	Switch with built-in w/lamp for fluorescent interior lights
52035	Switch with built-in w/lamp, rotary beacons
52306	Switch with built-in w/lamp, heated windshield

- 52037 Front axle air suspension switch
- 52038 Rear axle air suspension switch
- 52039 Switch for closing G.C.R.
- 52040 Switch for engaging bilge pump
- 52041 Switch for allowing turret rotation
- 52042 Switch for switching on instrument and w/lamp control board
- 52043 Switch for turning on pressurization
- 52044 Switch for engaging differential lock
- 52045 Switch for engaging all-wheel drive
- 52046 Switch for engaging 4th axle lock
- 52047 Switch for retarder cutoff
- 52048 Switch for retarder cutoff (from brake pedal)
- 52049 Switch with built-in w/lamp for increasing engine idling speed
- 52050 Switch with built-in w/lamp for allowing stop request
- 52051 Switch with built-in w/lamp for sign lighting
- 52052 Switch with built-in w/lamp for centralized lubrication
- 52053 Switch with built-in w/lamp for engine independent heating
- 52054 Switch for connection of rotating beacons and horn stand-by
- 52055 Switch with built-in warning lamp for turning on the radio through the voltage dropper unit
- 52056 Switch with built-in w/lamp for ASR cutout
- 52057 Switch with built-in w/lamp for ABS cutout
- 52058 Switch with built-in w/lamp for fuel pipe heating
- 52059 Automatic transmission speed selector
- 52060 Switch with built-in w/lamp for turning on air-conditioning system in 2nd speed
- 52061 Switch with built-in w/lamp, winch operation
- 52062 Switch for release of starter motor
- 52063 Switch with built-in w/lamp, engine ventilation cutoff
- 52064 Switch, BO lights
- 52065 Switch, semi-BO headlight
- 52066 Switch, BO headlight
- 52067 Switch with built-in w/lamp, parking lights
- 52068 Switch for end-of-line (E.O.L.) programming
- 52069 EDC fault diagnosis switch
- 52070 Switch for engaging side power takeoff
- 52071 Switch for engaging rear power takeoff
- 52072 Automatic transmission speed selector during limp-home operation
- 52073 Switch for engaging limp-home operation with automatic transmission
- 52074 Switch for engaging torque splitter power takeoff
- 52075 Switch for opening General Current Relay
- 52076 Switch, internal air ejection
- 52077 Switch, Economy function
- 52078 Switch, fog lights
- 52079 Switch, stop brake solenoid valve
- 52080 Switch with built-in w/lamp, low beam lights

- 52081 Switch, gas system solenoid valves enablement
- 52082 Switch with built-in w/lamp, fog lights
- 52083 Switch with built-in w/lamp, hazard lights
- 52084 Switch with built-in warning lamp for turning on rear differential lock device
- 52090 Suspension levelling switch (ECAS)
- 52091 Switch with built-in warning lamp for turning on rear window heating
- 52200 Air/electrical horn switch
- 52201 Manual/automatic electric retarder switch
- 52202 Switch for operating front door from inside/outside
- 52203 Switch for engaging NBC
- 52204 Switch for air-conditioning system
- 52205 Switch for selecting air-conditioner speed
- 52206 Switch for engaging winch
- 52207 Switch for blackout lights
- 52208 Switch for high/low beam lights
- 52209 Switch with built-in w/lamp for retarder cutoff
- 52210 Switch with built-in w/lamp for retarder cutoff (from brake pedal)
- 52211 Switch for impulse or continuous two-tone cycle
- 52212 Switch for horn (city/extra city bus use)
- 52213 Switch for 1st driver/2nd driver
- 52214 Switch for normal/splitter gear engagement solenoid valves
- 53215 Switch with built-in w/lamps for switching on: A) engine preheating B) Interior heating
- 52216 Switch for turning on heater with built-in w/lamps for : A) On B) Malfunction
- 52217 Switch for turning on power take-off from cab inside/outside
- 52218 Switch, Cruise Control operation from cab inside/outside
- 52300 Interior lighting switch
- 52301 Hazard lights switch
- 52302 Switch with built-in w/lamp, hazard lights
- 52303 Windshield wiper switch
- 52304 Switch, fog lights and rear fog lights enablement
- 52305 Switch, driver's seat ventilation
- 52306 Switch, retarder
- 52307 Switch, exterior lighting
- 52308 Switch, normal/blue interior lights
- 52309 Switch, BO lights
- 52310 Switch, adjustable mirrors
- 52311 Switch with built-in w/lamp, aerators
- 52312 Switch, headlight alignment control
- 52313 Switch, vehicle lifting/lowering system
- 52314 Switch, front axle air suspension system
- 52315 Switch, rear axle air suspension system
- 52316 Switch, 3rd axle raising/lowering system
- 52317 Switch, BO headlight
- 52318 Switch with built-in w/lamp for interior heating

52319	Switch with built-in w/lamp for air ejection
52320	Switch with built-in w/lamp for 3rd axle raising/lowering system
52321	Switch with built-in w/lamp for fog lights and rear fog lights enablement
52322	Switch with built-in w/lamp for front axle air suspension
52323	Switch with built-in w/lamp, front axle air suspension
52324	Switch, exhaust brake prearrangement
52325	Switch for turning on interior lighting from bunk
52500	Ignition key switch, services
52501	Ignition key switch, starting and preheating-interlocked services
52502	Ignition key switch, starting-interlocked services
52520	Lever switch, starting
52521	Lever switch, starting and preheating
52522	Lever switch for engaging electric retarder
52523	Foot switch for engaging electric retarder
52524	Lever switch for engaging hydraulic retarder
52525	Foot switch, hydraulic retarder
52600	General Current Relay
52601	Air cutoff mechanical main current switch, TMP vehicles
53000	Switch, lamp test
53001	Switch, headlight wiper/washer unit
53002	Switch, engine stopping
53003	Switch, windshield washer unit
53004	Switch, headlight washer unit
53005	Switch with built-in w/lamp, headlight washer unit
53006	Switch, starting from engine compartment
53007	Switch, engine stopping from engine compartment
53008	Switch for closing General Current Relay
53009	Switch for opening General Current Relay
53010	Switch, front door
53011	Switch with built-in w/lamp, front door
53012	Switch, centre door
53013	Switch with built-in w/lamp, centre door
53014	Switch, rear door
53015	Switch with built-in w/lamp, rear door
53016	Switch stop request
53017	Switch, hostess call
53018	Switch for opening General Current Relay and earthing of alternator D+
53019	Switch for operating front door from outside
53020	Switch, engine oil level display
53021	Switch, vehicle operation enablement with doors open
53022	Switch, front differential lock
53023	Switch for closing General Current Relay
53024	Switch for headlamp washer unit
53025	Fault diagnosis switch for vehicle raising/lowering system

53026	Engine stopping switch
53027	Sun roof switch
53028	Switch for vehicle running function
53029	Switch for 3rd axle raising system
53030	Switch for starting assistance
53032	Alternator resetting switch
53033	Engine starting switch
53034	Fire-fighting system resetting switch
53035	Switch for enabling fire-fighting cylinders
53036	Switch for engaging tyre inflating system
53037	Switch for turning off tyre inflating system
53038	Switch for checking tyre inflating system
53039	Switch for engaging rear differential lock
53040	Switch for assisted cab tilting system
53041	Switch for checking EDC system
53042	Switch with built-in w/lamp for ABS cutout
53043	Switch for chassis automatic lubrication system
53044	Switch, engine rev up from ground
53045	Switch, display drier devices
53046	Switch with built-in w/lamp for firing smoke-dischargers
53047	Switch for unwinding winch rope
53048	Switch for unwinding winch rope
53049	Switch for gas system control unit diagnosis (Deltec)
53051	Suspension lifting switch
53052	Suspension lowering switch
53053	Test pushbutton coupling, automatic transmission
53300	Switch, power window on driver's side
53301	Speed control button strip, automatic transmission
53302	Switch, power window on passenger's side
53303	Button strip, swing-sliding door opening
53304	Switch for front axle air suspension
53305	Switch for rear axle air suspension
53306	Switch for sunroof motor
53307	Switch for winch winding control
53308	Switch for winch winding remote control
53309	Switch for 3rd axle raising system
53310	Switch for engaging transmission total power takeoff
53311	Switch for controlling window blind
53312	Switch box, Cruise Control device
53313	Switch with built-in w/lamp, rear fog lights
53500	Switch for signalling engine compartment door open
53501	Switch, stop signal
53502	Switch, door open signal
53502	Switch, reversing lights

- 53504 Switch for signalling front differential lock
- 53505 Switch for signalling rear differential lock
- 53506 Switch for signalling all-wheel drive engaged
- 53507 Switch for signalling splitter gears engaged
- 53508 Switch for preventing engine starting with gear engaged and reversing light on
- 53509 Switch, interior lighting
- 53510 Switch, steps light
- 53511 Switch, cab unlatched signal
- 53512 Switch for preventing engine starting with parking brake off
- 53513 Switch, max permitted speed signal
- 53514 Limit switch, front brake system converter cylinder
- 53515 Limit switch, rear brake system converter cylinder
- 53516 Switch for turning off speed limiter with transmission in neutral
- 53517 Switch, cross differential lock signal
- 53518 Switch for turning on luggage compartment spotlights
- 53519 Switch for turning on engine compartement spotlights
- 53520 Switch for engaging exhaust brake
- 53521 Switch for signalling longitudinal differential lock
- 53522 Switch for signalling front door open and steps light on
- 53523 Switch for signalling rear door open and steps light on
- 53524 Safety switch for front door reopening
- 53525 Safety switch for centre door reopening
- 53526 Safety switch for rear door reopening
- 53527 Switch for rich mixture control w/lamp
- 53528 Switch for signalling front axles correctly aligned
- 53529 Switch for signalling 4th axle correctly aligned
- 53530 Switch for signalling all-wheel drive
- 53531 Switch for signalling parking brake engaged
- 53532 Kickdown switch
- 53533 Switch for engaging engine idling speed
- 53534 Switch for retarder cutout (from accelerator pedal)
- 53535 Switch for signalling fast gears engaged
- 53536 Switch for signalling transmission power takeoff engaged
- 53537 Switch for 3rd added axle differential lock engaged
- 53538 Tilted body signalling switch
- 53539 Switch for signalling automatic snow chains engaged
- 53540 Clutch control switch for 2x5 transmission
- 53541 Switch for allowing cab tilting with grille open
- 53542 Trapdoor open signalling switch
- 53543 Switch for volumetric sensor cutout
- 53544 Switch for signalling automatic transmission conditioning system on
- 53545 Transmission in neutral signalling switch
- 53546 Switch for gear engagement with hood closed
- 53547 Switch for secondary signal from brake pedal to EDC control uni

- 53548 Switch for exhaust brake cutoff with accelerator at idling speed
- 53549 Electronic accelerator clutch switch
- 53550 Switch for gear engagement and running direction (automatic transmission)
- 53551 Switch for signalling torque splitter in neutral
- 53552 Switch for signalling transfer case power takeoff engaged
- 53553 Switch for setting front axle in straight ahead driving position
- 53554 Switch for signalling hand brake cylinder failure
- 53555 Switch for inhibiting engine remote starting with gears engaged
- 53556 Automatic transmission clutch switch
- 53557 Exhaust brake switch (automatic transmission)
- 53558 "Speed group" signalling switch (automatic transmission)
- 53559 Engaged gear switch (automatic transmission)
- 53560 Transmission in neutral signalling switch (automatic transmission)
- 53561 Automatic transmission emergency switch
- 53562 16-speed GV automatic transmission switch
- 53563 Gear switch (automatic transmission)
- 53564 Switch for engine antistarting device with gears engaged
- 53565 Switch, brake pedal fully depressed signal
- 53566 Switch for signalling accelerator pedal fully pressed
- 53567 Switch for signalling side power takeoff engaged
- 53568 Switch for signalling rear power takeoff engaged
- 53569 Switch, exhaust brake off signal
- 53570 Switch, front door opening signal
- 53571 Switch, centre door opening signal
- 53572 Switch, rear door opening signal
- 53573 Switch, door unlocked signal
- 53574 Switch, intermediate speed engagement
- 53575 Limit switch for turning off gas system with fuel door open
- 53377 Switch, Bowden cable failure signal
- 53578 Switch, door open signal
- 53800 Switch, stop signal
- 53801 Switch, cross differential lock (Rockwell rear axles)
- 53802 Switch for signalling Rockwell axle differential lock engaged (3rd axle)
- 53803 EDC control switch (speed control)
- 53804 EDC control switch (speed data storage)
- 53900 Switch for controlling 3rd axle raising/lowering system
- 53905 Switch with built-in w/lamp for 3rd axle raising/lowering system
- 54000 General Current Switch
- 54030 4-function steering wheel switch
- 54031 5-function steering wheel switch
- 54032 8-function steering wheel switch
- 54033 6-function steering wheel switch
- 55000 Speedometer switch, electric retarder enablement
- 55001 Speedometer switch, exhaust brake enablement

55002	Speedometer switch, air suspension system enablement
55003	Speedometer switch, pneumatic suspension system enablement
55004	Speedometer switch, 3rd axle raising cutoff
55005	Speedometer switch, 3rd steering axle cutoff
55006	Speedometer switch for turning on dust ejection motor
55007	Speedometer switch, 4th axle lock enablement
55008	Speedometer switch, longitudinal differential lock enablement
55009	Multiple speedometer switch
55010	Electronic switch for two-tone horn
55011	Speedometer switch for allowing engagement of rear differential lock
58000	Warning lamp, general lighting on
58001	Warning lamp, rear fog light on
58002	Warning lamp, high beam lights on
58003	Warning lamp, rotating beacons on
58004	Low beam lights on w/lamp
58006	Led signalling failure in front right parking light/tractor front right marker light
58007	Led signalling failure in front left parking light/tractor front left marker light
58008	Led signalling tractor number plate light failure
58009	Led signalling failure in rear right parking light/right stop light/rear right fog lamp/tractor rear right marker light
58010	Led signalling failure in rear left parking light/left stop light/rear left fog lamp/tractor rear left marker light
58011	Led signalling failure in parking/marker/stop/rear fog/trailer number plate lights
58012	Led signalling general lighting efficiency
58050	Warning lamp, brake lining pre-wear
58051	Warning lamp, brake lining wear
58052	Warning lamp, brake system failure
58053	Warning lamp, parking brake engaged
58054	Warning lamp, electrical retarder on
58055	Warning lamp, exhaust brake on
58056	Warning lamp, front brake system pressure
58057	Warning lamp, rear brake system pressure
58058	Warning lamp, brake fluid level
58059	Warning lamp, retarder on
58060	Warning lamp, parking brake pressure
58061	Warning lamp, ABS failure
58062	Warning lamp, front axle brake lining wear
58063	Warning lamp, rear axle brake lining wear
58064	Warning lamp, trailer ABS failure
58065	Warning lamp, trailer/tractor ABS disconnected
58066	Warning lamp, ASR failure
58067	Warning lamp, brake fluid pump failure
58068	Warning lamp, rear axle brake coolant high temperature
58069	Warning lamp, ASR/speed limiter
58070	Warning lamp, speed limiter failure

58071	Front axle brake system failure w/lamp
58072	Rear axle brake system failure w/lamp
58073	Trailer brake system failure w/lamp
58974	Parking brake engaged w/lamp
58075	Brake sysetm pressure drop w/lamp (ICP)
58076	Stop brake w/lamp
58077	Brak system oil pressure w/lamp
58092	Front axle brake lining wear signalling led
58093	Rear axle brake lining wear signalling led
58098	Insufficient brake fluid level signalling led
58100	Warning lamp, battery charge failure
58101	Warning lamp, preheating on
58102	Warning lamp, engine oil high temperature
58103	Warning lamp, air cleaner restriction
58104	Warning lamp, engine oil low pressure
58105	Warning lamp, engine coolant high temperature
58106	Warning lamp, radiator water level
58107	Warning lamp,after-heating on
58108	Warning lamp, oil filter restriction
58109	Warning lamp, fuel heating on
58110	Warning lamp, preheating on
58111	Battery charging failure w/lamp (auxiliary alternator)
58112	Rich mixture control w/lamp
58113	Fan oil filter restriction w/lamp
58114	Warning lamp, battery isolator switch open
58115	Warning lamp, engine coolant low temperature
58116	Warning lamp for A) engine coolant level B) engine coolant high temperature
58117	Warning lamp for A) engine oil low pressure B) engine oil high temperature
58136	Low radiator water level signalling led
58150	Warning lamp, forced ventilation on
58151	Auxiliary heating system w/lamp
58152	Warning lamp, interior heating on
58153	Warning lamp, driver's place ventilation on
58154	Warning lamp, windshield defrosting electric heater on
58155	Warning lamp, air-conditioning systemon
58156	Warning lamp, NBC low pressure
58157	Warning lamp, NBC filter restriction
58158	Warning lamp, NBC filter on
58160	Dual optical indicator module with led
58165	Auxiliary heater failure w/lamp
58200	Warning lamp, tractor turn signal lights on
58201	Warning lamp, trailer turn signal lights on
58202	Warning lamp, hazard lights on
58250	Warning lamp, suspension system failure

58251	Warning lamp, low pressure in front lh air suspension system
58252	Warning lamp, low pressure in front rh air suspension system
58253	Warning lamp, low pressure in rear air suspension system
58254	Warning lamp, low pressure in air suspension system
58255	Warning lamp, suspension system not in "running" condition
58300	Warning lamp, doors open
58301	Warning lamp, front door open
58302	Warning lamp, centre door open
58303	Warning lamp, rear door open
58304	Warning lamp repeater, doors open
58305	Warning lamp, vehicle starting enablement with door open
58306	Warning lamp, doors closed
58310	Warning lamp, pilot's hatch unlocked
58311	Warning lamp, rear door unlocked
58350	Warning lamp, transmission oil temperature (high)
58351	Warning lamp, transmission air pressure (low)
58352	Warning lamp, transmission oil pressure (low)
58353	Warning lamp, transmission oil pressure (high)
58354	Warning lamp, transmission in neutral
58355	Low transmission oil level w/lamp
58356	Automatic transmission failure w/lamp
58357	Test warning lamp, automatic transmission
58360	Automatic clutch failure w/lamp
58400	Warning lamp, clutch wear
58401	Warning lamp repeater, brake system/engine oil low pressure, engine coolant high temperature
58402	Warning lamp, stop request
58403	Warning lamp, heated rearview mirrors on
58404	Warning lamp, vehicle raising system
58405	Warning lamp, vehicle front raising system
58406	Warning lamp, vehicle rear raising system
58407	Warning lamp, refrigerator on
58408	Warning lamp, transmission side power take-off on
58409	Warning lamp, cab unlatched
58410	Warning lamp, engine compartment door open
58411	Warning lamp, 3rd axle up
58412	Warning lamp, body tilted
58413	Warning lamp, differential lock
58414	Warning lamp, cross differential lock
58415	Warning lamp, longitudinal differential lock
58416	Warning lamp, fuel reserve
58417	Warning lamp, ticket punching machine on
58418	Warning lamp, radiophone on
58419	Warning lamp, route signs on
58420	Warning lamp, water in fuel pre-filter

58421	Warning lamp, rear door open
58422	Warning lamp, rear differential lock
58423	Warning lamp, front differential lock
58424	Warning lamp, all-wheel drive on
58425	Warning lamp, max speed with all-wheel drive on
58426	Warning lamp, splitter gears on
58427	Warning lamp, max permitted speed
58428	Warning lamp, power steering fluid level
58429	Warning lamp, windscreen washer fluid level
58430	Warning lamp, engine oil level
58431	Starting assistance w/lamp
58432	Vehicle raising system failure w/lamp
58433	Warning lamp, vehicle raising system malfunction
58434	Engine overrevving w/lamp
58435	EDC system failure w/lamp
58436	E-GAS system failure w/lamp
58437	Fault repeater w/lamp
58438	Carburetion checking system failure w/lamp
58439	Fast gears engaged w/lamp
58440	3rd steering axle w/lamp
58441	Transmission rear power takeoff w/lamp
58442	Automatic chassis lubrication w/lamp
58443	Automatic chassis lubrication failure w/lamp
58444	Engine oil topup w/lamp
58445	Automatic snow chains w/lamp
58846	Tool compartment open w/lamp
58447	Telescopic rest (work headlamp) extended w/lamp
58448	Stabilizer struts protruding w/lamp
58449	Transmission centre power takeoff w/lamp
58450	Fire-extinguisher fluid pump w/lamp
58451	220 V alternator w/lamp
58452	Winch on w/lamp
58453	Led signalling trailer power module off
58454	Led signalling trailer power module on
58455	Rail up w/lamp
58456	Torque splitter in neutral w/lamp
58457	Torque splitter power takeoff w/lamp
58458	Transmission front power takeoff w/lamp
58459	Antitheft device signalling led
58460	Rotating beacon w/lamp
58461	Cylinder empty w/lamp
58462	Fire w/lamp
58463	Warning lamp A) Fire B) Cylinder empty
58464	Warning lamp, gas system control unit diagnosis (GAC)

58465	Warning lamp, gas system control unit diagnosis (DELTE)
58466	Economy Power on/ Oil topup warning led
58700	Led, battery charging failure
58701	Led, EDC failure
58702	Led, preheating on
58703	Led, ABS failure
58704	Led, ASR on
58705	Led, AIRBAG failure
58706	Led, rear fog lamp on
58707	Led, tractor turn signal lights on
58708	Led, hazard lights on
58709	Led, trailer turn signal lights on
58710	Led, water in fuel prefilter
58711	Led, retarder on
58713	Led, ECAS system failure
58714	Led, emergency handle pulled on
58715	Led, PTO on
58716	Led, ACS on
58717	Led, Immobilizer on
58718	Brake system failure warning led
58719	Led, parking brake on
58720	Led, radiator water level
58721	Led, transmission oil temperature (high)
58722	Led, engine oil pressure (low)
58723	Led, handle locked
58724	Led, door open
58725	Led, air cleaner restriction
58726	Led, front axle failure
58727	Led, rear axle signal
58728	Led, power steering fluid level
58729	Led, windscreen washer fluid
58730	Led, engine oil level
58731	Led, seat heating on
58732	Led, external lights on
58733	EGR failure warning led
58734	EDB failure warning led
58900	36-optical indicator panel
58901	18-optical indicator panel
58902	10-optical indicator panel
58903	10-optical indicator panel
58904	10-optical indicator panel
58905	10-optical indicator panel
58906	10-optical indicator panel for braking system and miscellaneous components

58907	10-optical indicator panel with speed limiting device, noABS (Europe)
58908	10-optical indicator panel with speed limiting device (Extra-European countries)
58909	32-optical indicator panel
58910	6-optical indicator panel
58911	5-optical indicator panel
58912	5-optical indicator panel for fire-fighting system
58913	9-optical indicator panel
58914	1-optical indicator panel plus instrument lighting control
58915	2-optical indicator panel
58916	10-optical indicator panel for vehicles fitted with electronic suspension system
58917	31-optical indicator panel plus instruments
58918	32-optical indicator panel plus instruments
59000	Electronic flasher light, turn signal/hazard light - single load
59001	Electronic flasher light, turn signal/hazard light - double load
59030	Flasher light, water/oil/air repeater signal
59031	Flasher light, door opening repeater signal
59032	Flasher light, stop request signal
59033	Flasher light, parking brake w/lamp
59100	Windshield wiper unit intermittent operation
59200	Timer for tyre inflation system
59201	Timer for engine ventilation cutoff
59202	Timer for interior compartment ventilation
59203	Timer for turning on winch solenoid valve
61000	1A 3-diode holder container (2 with common cathode)
61001	1A 3-diode holder container (2 with common anode)
61002	3A 3-diode holder container (2 with common cathode)
61003	1A 4-diode holder container (2 with common anode)
61004	1A 4-diode holder container (2 with common cathode)
61005	1A 1-diode holder container
61006	1 resistance and 1A 55-diode holder container
61007	1 resistance and 1A 46-diode holder container
61008	1 resistance and 1A 39-diode holder container
61009	6A 1-diode holder container
61010	1-diode holde container for preventing return of neutral signal when the emergency switch is operated
61011	3A 1-diode holder container
61012	1A 23-diode holder container
61013	1A 51-diode holder container with lamp test relay
61014	1A 20-diode holder container
61100	Compensation resistance, engine coolant excessive temperature (danger)
61101	Resistance, fuel heating
61102	Rheostat for antipollution device (EGR)
61103	Variable resistance for ignition timer control (KSB)
61104	Resistance, brake system air drier
61105	Rheostat for vehicle raising/lowering system

61106	Resistance, heated windshield system
61107	Resistance, settler heating
61108	Current limiting resistance, heated windshield system
61109	Resistance, alternator self-energizing
61110	Resistance for prefilter heating and fuel settler
61111	Resistance for blackout headlight
61112	3-resistance holder container for hydraulic retarder
61113	3-resistance holder container for EDC system
61114	Resistance for fuel pipe heating
61115	Current limiting resistance for tachograph
61116	Resistance for engaging capacitor cooling fan 1st speed
61117	Resistance for engine water heating
61118	Resistance for engaging thermal starter with auxiliary heater on
61119	Resistance for engine air heating
61120	Resistance for speed limiter solenoid valve
61121	Resistance for engine preheating
61122	2-resistance holder container for exhaust brake
61123	4-resistor holding container, Economy Power and PTO
61200	Instrument light electronic dimmer
61201	Optical indicators electronic dimmer
61202	Instrument light and optical indicators electronic dimmer
61203	Instrument light rheostat
61210	Capacitor for relay delayed cutout
61211	Capacitor for reducing tachograph noise
61212	Capacitor for reducing alternator D+ noise
64000	Windshield washer electric pump
64001	Electromagnetic pump for rear axle braking system coolant recirculation
64002	Bilge pump
64003	Fuel pump
64004	Engine oil topup pump
65000	Windshield wiper unit
66000	Headlight wiper unit
66005	Headlight washer pump
66010	Headlight washer unit timer
68000	Radioreceiver set
68001	Loudspeaker
68002	Antenna
68003	Preamplifier
68004	Microphone
68005	24V/12V Power pack
68006	Radio noise suppressor
68007	City Band
68010	** Transreceiver set
68011	Interphone system switch box

68012	Interphone headset, microphone, breastset
70000	6-fuse holder
70001	8-fuse holder
70002	10-fuse holder
70003	12-fuse holder
70004	14-fuse holder
70005	16-fuse holder
70050	1-way 3A fuse holder
70051	1-way 5A fuse holder
70052	1-way 8A fuse holder
70053	1-way 16A fuse holder
70054	1-way 25A fuse holder
70055	1-way 7.5A fuse holder
70056	1-way 10A fuse holder
70057	1-way 15A fuse holder
70058	1-way 20A fuse holder
70059	1-way 4A fuse holder
70060	1-way 40A fuse holder
70061	1-way 30A fuse holder
70062	1-way 100A fuse holder
70063	1-way 150A fuse holder
70064	1-way 60A fuse holder
70065	1-way 50A fuse holder
70080	6-way magnetothermal cutout carrier
70081	6-way magnetothermal cutout carrier
70082	6-way magnetothermal cutout carrier
70083	6-way magnetothermal cutout carrier
70084	6-way magnetothermal cutout carrier
70085	6-way magnetothermal cutout carrier
70086	6-way magnetothermal cutout carrier
70087	6-way magnetothermal cutout carrier
70088	6-way magnetothermal cutout carrier
70100	Automatic magnetothermal cutout
70101	Automatic thermal switch
72000	Standard 7-pole coupling for electrical connection to trailer
72001	Auxiliary 7-pole coupling for electrical connection to trailer
72002	12-pole coupling for electrical connection to trailer
72003	Standard 7-pole coupling for 12V electrical connection to trailer
72004	19-pole coupling for electrical connection to trailer
72005	28-pole coupling for electrical connection to trailer
72006	7-pole coupling for ABS tractor/trailer electrical connection
72007	9-pole coupling for electrical connection to ground diagnostic equipment
72008	3-pole/38-pole connection, fault diagnosis with IVECO Tester
72009	4-pole coupling for connection to carburetion testing fault diagnosis equipment

72010	15-pole coupling for electrical connection to trailer
72011	5-pole coupling for electrical connection with air-conditioner/heater
72012	16-pole coupling for connection with automatic transmission
72013	24-pole coupling for transmission connection (automatic transmission)
72014	5-pole coupling for automatic transmission diagnostics
72015	Auxiliary 7-pole coupling for 12V connection to trailer
72016	13-pole coupling for 12V connection to trailer
72017	Automatic transmission 37-pole coupling
72018	Clutch 10-pole electrical coupling connector (automatic transmission)
72019	Gear actuators 19-pole electrical coupling connector (automatic transmission)
72020	1-way coupling for end-of-line programming
72021	Ground diagnostic equipment 30-pole electrical coupling connector
72022	Remote engine starting 2-pole electrical coupling connector
72023	2-pole coupling, multiplex line
72024	2-pole coupling, PWM line
72025	Current outlet
72050	Unipolar current outlet
72051	Bipolar current outlet
72052	Remote engine starting bipolar current outlet
72053	2A current outlet
72054	6A current outlet
72055	Bipolar current outlet for work headlight
72056	Bipolar current outlet for battery charging equipment
72057	220V/16A 2-pole + earth current outlet
75000	Central Interconnecting Unit
75005	1 fuse and 5 relay holder control unit
75006	2 fuse and 5 relay holder control unit
75007	1 fuse and 1 relay holder control unit
75010	Rear terminal strip
78000	Solenoid valve for connection of fuel tank to atmosphere (thermostarter)
78001	Engine stopping solenoid valve
78002	Carburettor cutoff solenoid valve
78003	Cutoff system partialising solenoid valve
78004	Carburettor breather solenoid valve
78005	Carburetion testing solenoid valve
78006	Engine cooling partialising solenoid valve
78007	Fuel inhibitor solenoid valve (in case of a failure in EDC system)
78008	Engine slowdown solenoid valve
78009	Turbine circuit closing solenoid valve
78010	Engine idling speed intercepting solenoid valve
78011	CUT OFF control solenoid valve
78012	Methane system gas reducer solenoid valve
78013	Pressure regulator solenoid valve
78014	Engine preheating solenoid valve

78015	Solenoid valve, radial jet pump
78050	Exhaust brake control solenoid valve
78051	Hydraulic braking system solenoid valve
78052	ABS system solenoid valve
78053	ASR control solenoid valve
78054	Solenoid valve for engaging retarder
78055	Solenoid valve for retarder oil accumulator
78100	Front door control solenoid valve
78101	Centre door control solenoid valve
78102	Rear door control solenoid valve
78103	Solenoid valve for vehicle lock with doors open
78104	Front door travel limiting solenoid valve
78105	Rear door travel limiting solenoid valve
78106	Front door control solenoid valve
78107	Rear door control solenoid valve
78150	Solenoid valve for normal/splitter gear engagement
78151	Solenoid valve for quick clutch engagement
78152	Solenoid valve for slow clutch engagement
78153	Solenoid valve for quick clutch release
78154	Solenoid valve for slow clutch release
78155	Solenoid valve for longitudinal differential lock
78160	Quick breather solenoid valve for gear uncoupling with speed limiter device
78163	Solenoid valve assembly for automatic transmission
78164	Solenoid valve for clutch response signal (automatic transmission)
78165	Solenoid valve for solenoid valve cutoff (automatic transmission)
78166	Solenoid valve for clutch support (automatic transmission)
78167	Brake/transmission solenoid valve (automatic transmission)
78168	Clutch solenoid valve
78169	Solenoid valve assembly for splitter unit (automatic transmission)
78170	Solenoid valve for inertia brake
78171	Solenoid valve for splitter control
78172	Solenoid valve for gear selection
78173	Solenoid valve for gear engagement
78174	Solenoid valve for engaging normal gears
78175	Solenoid valve for engaging splitter gears
78176	Solenoid valve for automatic transmission air control
78177	Solenoid valve for pump wheel clutch control
78178	Solenoid valve for direct drive clutch control
78179	Solenoid valve for reverse gear and converter brake control
78180	Pressure reducer solenoid valve
78181	Converter exhaust solenoid valve
78200	Vehicle raising solenoid valve
78201	Vehicle front raising solenoid valve
78202	Vehicle rear raising solenoid valve

78203	Solenoid valve for horns
78204	Differential lock solenoid valve
78205	Cross differential lock solenoid valve
78206	Longitudinal differential lock solenoid valve
78207	Speed limiting device solenoid valve
78208	Transmission total power take-off solenoid valve
78209	Solenoid valve for antipollution devices (EGR)
78210	Solenoid valve for front axle air suspension system
78211	Solenoid valve for rear axle air suspension system
78212	Solenoid valve for opening air circuit of 3rd axle air suspension springs
78213	Solenoid valve for opening hydraulic circuit (3rd axle lowering system)
78214	Engine testing solenoid valve
78215	Solenoid valve for total/partial 3rd axle unloading
78216	Solenoid valve assembly for 3rd axle hydraulic steering system
78217	Solenoid valve for cooling/heating fluid control
78218	Winch enabling solenoid valve
78219	Solenoid valve for engaging tyre inflating system
78220	Solenoid valve for checking tyre inflation
78221	Solenoid valve for locking 4th axle
78222	Solenoid valve for enabling 4th axle steering function
78223	Solenoid valve for engine ventilation cutoff
78224	Solenoid valve for winch winding/unwinding
78225	Solenoid valve for fire extinguisher cylinders Solenoid valve, condensate drainage
78226	Solenoid valve for engaging front-wheel drive
78227	Solenoid valve for radiator water recirculation
78228	Solenoid valve for heating system
78229	Solenoid valve for snooperscope washer unit
78230	Solenoid valve for snooperscope drier unit
78231	Solenoid valve for pressurization
78232	Solenoid valve for connecting air circuit with raising system actuator bellows
78233	Vehicle raising solenoid valve assembly
78234	Engine oil topup solenoid valve
78235	Solenoid valve for engine/cab water recirculation
78236	Solenoid valve for cab water recirculation
78237	Solenoid valve for water recirculation with engine off
78238	Rear axle solenoid valve assembly for chassis alignment
78239	Front axle solenoid valve assembly for chassis alignment
78240	Solenoid valve for quick rear suspension unloading
78241	Solenoid valve for inhibiting starting assistance with more than 13 tons on rear axle
78242	Front axle electropneumatic distributor
78243	Electropneumatic distributor
78244	Transfer case power take-off enablement solenoid valve
78245	Solenoid valve for switching off transmission total power take-off

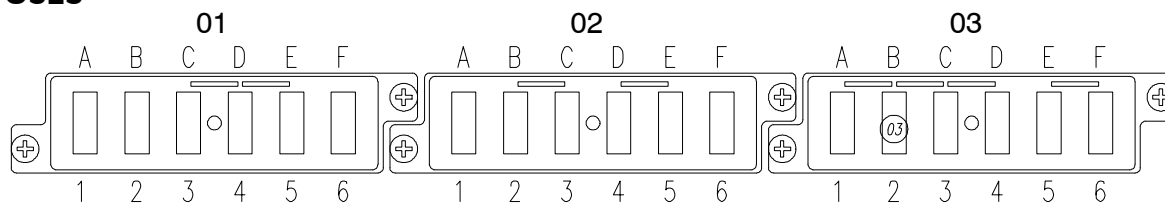
78246	Solenoid valve for disengaging longitudinal differential lock
78247	Solenoid valve for electronic injection
78248	Solenoid valve for variable geometry turbine control
78249	Solenoid valve for 3rd axle air-operated valves
78250	Solenoid valve for 3rd axle lowering
78251	Solenoid valve for engaging transmission side power take-off
78252	Solenoid valve for engaging transmission rear power takeoff
78253	Solenoid valve for holding transfer case in neutral position with power take-off on
78254	Gas sytem control solenoid valve
78256	Solenoid valve, Waste Gate unit
80000	Power window motor on driver's opposite side
80001	Power window motor on driver's side
82000	Windshield defroster unit
82005	Auxiliary air heater
82010	Air-conditioning system electronic control unit
82025	Front differential engaging device
84000	Water boiler
84001	Air boiler
84005	Auxiliary heater electronic control unit
84006	Auxiliary heater control unit
84008	Hand-operated air-conditioner thermostat
84009	Internal temperature sensor
84010	Metering device
84011	Air-conditioning system control unit
84012	Timer
84013	Ambient thermostat
84014	Auxiliary fuel pump
84015	Ignition coil
84016	Control switch
84017	Electronic timer
84018	Heater water pump
84019	Electromagnetic pulley
84020	Outdoor temperature sensor
85000	Cigar lighter
85003	Heated rearview mirror (trailer)
85004	Heated rearview mirrot (wheel)
85005	Heated rearview mirror
85006	Electrically-adjusted heated rearview mirror (main)
85007	Electrically-adjusted heated rearview mirror (draw up)
85008	Electrically-adjusted heated rearview mirror (wide angle)
85010	Rearview mirror control
85015	Ticket punch machine
85020	Electronic regulator, fuel delivery depending on exhaust gas temperature
85021	Thermocouple, electronic regulator

85022	Electromagnetic joint, engine cooling
85023	Electrical key lock
85026	Current outlet voltage dropper unit (2A max)
85027	Current outlet voltage dropper unit (6A max)
85028	Rear differential lock device
85029	Servomotor device for E-GAS system
85030	Accelerator pedal position transducer
85031	Voltage dropper unit for current outlet (11 A max)
85032	Voltage dropper unit for tachograph
85033	12 V trailer voltage dropper unit
85034	Differential lock control lever
85035	Air-suspended seat (driver's side)
85036	Heated air-suspended seat (driver's side)
85037	Air-suspended seat (driver's opposite side)
85038	Heated air-suspended seat (driver's opposite side)
85040	Sunroof motor with built-in switch
85041	Smoke discharger pipe
85045	3rd axle raising hydraulic pump
85050	Pump actuator (automatic transmission)
85051	Automatic transmission actuator
85053	Automatic transmission input rpm sensor
85054	Automatic transmission output rpm sensor
85055	Load sender unit (automatic transmission)
85056	Accelerator pedal sender unit (automatic transmission)
85057	Vehicle speed inductive sensor (automatic transmission)
85058	Automatic transmission
85059	Gear engaged signalling sensor
85060	Selector position signalling sensor
85061	Speed range signalling sensor
85062	Splitter on signalling sensor
85065	Remote control for aligning suspensions and raising 3rd axle
85066	Relay for adjusting self-levelling suspension system
85070	Speed inductive sensor, gas system
85071	Actuator, gas system
85072	Mixer valve, gas system
85073	Electronic ignition, gas system
85074	Engine rpm inductive sensor, gas system
85075	Engine idling speed governor, gas system
85076	WASTEGATE valve, gas system
85077	Intake manifold pressure sensor, gas system
85078	Throttle valve position sensor, gas system
85079	Engine coolant temperature sensor, gas system
85080	External air temperature sensor, gas system
85081	LAMBDA sensor, gas system

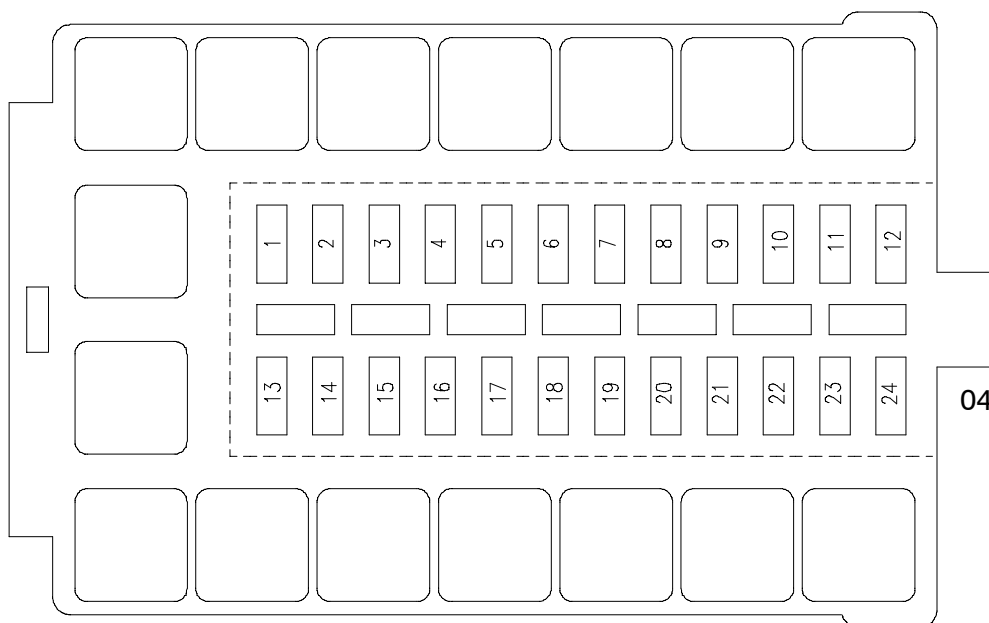
85100	Solenoid group, electric retarder
85110	Automatic clutch control unit
85111	Accelerator load sensor (automatic clutch)
85112	Motor for automatic clutch accumulator unit
85113	Solenoid valve for automatic clutch
85114	Gear shift lever sensor (automatic clutch)
85115	Transmission selector position sensor (automatic clutch)
85116	Clutch position sensor (automatic clutch)
85117	Low accumulator fluid pressure sensor (automatic clutch)
85118	Clutch position sensor
85130	Antitheft device control unit
85131	Volumetric sensor
85132	Antitheft device self-supplying syren
85150	EDC control unit
85151	EDC injection pump
85152	Accelerator load sensor (EDC)
85153	Coolant temperature sensor (EDC)
85154	Turbofan air temperature sensor (EDC)
85155	Turbofan air temperature sensor, (EDC)
85156	Turbofan air pressure temperature sensor, (EDC)
85157	Pressure adjustment sensor
85158	Turbine prechamber air pressure sensor (EDC)
85159	Air pressure sensor after the turbine (EDC)
85160	Chassis alignment control device
85165	Fuel consumption measuring device
86000	Electronic control unit, brake shoe wear circuit
86001	Sensors, brake shoe wear circuit
86002	Sensors, front brake shoe wear circuit
86003	Sensors, rear brake shoe wear circuit
86004	Electronic control unit, automatic transmission
86005	Vehicle speed inductive sensor
86006	Electronic control unit, preheating system
86007	Electronic control unit, radiator water level
86008	Sensor, radiator water level
86009	Electronic control unit, engine oil level
86010	Sensor, engine oil level
86011	Electronic control unit, pre/after-heating system
86012	Electronic control unit, water in fuel pre-filter
86013	Sensor, water in fuel filter
86014	Control unit, swing-sliding door opening device
86015	Electronic control unit, retarder
86016	Control unit, differential lock
86017	Electronic control unit, IVECOControl (tractor)
86018	Electronic control unit, IVECOControl (trailer)

86019	Electronic control unit, high beam lights dimmer
86020	Antipollution device control unit (EGR)
86021	Heated rearview mirror control unit
86022	Rear axle braking system fluid temperature control unit
86023	Vehicle raising/lowering control unit
86024	Electric retarder control unit
86025	Speed limiter control unit
86026	Carburettor control unit
86027	Injection pump control unit
86028	Electronic control unit, trip computer
86029	Electronic control unit, centralized door closign system
86030	Sensor, sun radiation
86031	Sensor, dust and external air intake closing
86032	Control unit, sound signal, w/lamp signal repeater failure
86033	Accelerator control unit (E-GAS)
86034	Vehicle raising sensors
86035	Ignition control unit
86036	Control unit for measuring oxygen in exhaust gas (lamda sensor)
86037	Engine cooling control unit
86038	Control unit for automatic chassis lubrication system
86039	Control unit for automatic gear selection
86040	Control unit for signalling water in fuel filter (EDC)
86041	Frequency/voltage electronic converter
86042	Vehicle fleet control unit
86043	Inductive sensor, rear door closed signal
86044	Electronic control unit, rear fog lights
86045	Electronic control unit, warning lamp test
86050	Tachograph voltage dropper unit
86051	Voltage dropper unit
86060	Air bag and pretightener electronic control unit
86061	Air bag
86062	Pretightener
86100	NBC system control unit
86101	Fire-fighting system control unit
86102	Fire-fighting system auxiliary control unit
86103	Turret rotation control unit
86104	Pilot repeater control unit
86105	Tank commander repeater control unit
86106	Thermal starter w/lamp control unit
86107	Winch control unit
86108	Carburation control unit
86109	Engine oil topup control unit
86110	Automatic transmission control unit (on transmission)
86111	Alarm repeater control unit

86112	Gas system test and control unit (GAC)
86113	Gas system test and control unit (DELTEC)
86300	Flame sensor
86301	Sensor for winch rope wound up
86302	Sensor for winch rope unwound
86303	Sensor for winch rope winding check
86304	Sensor for injector position check (EDC)
86306	Atmospheric pressure detecting sensor
88000	Electronic control unit, ABS system
88001	Sensor, ABS system
88002	Electronic control unit, information, ABS system
88003	Relay and solenoid valve unit (ABS)
89000	Food heater
89010	Chafing-dish

FUSES

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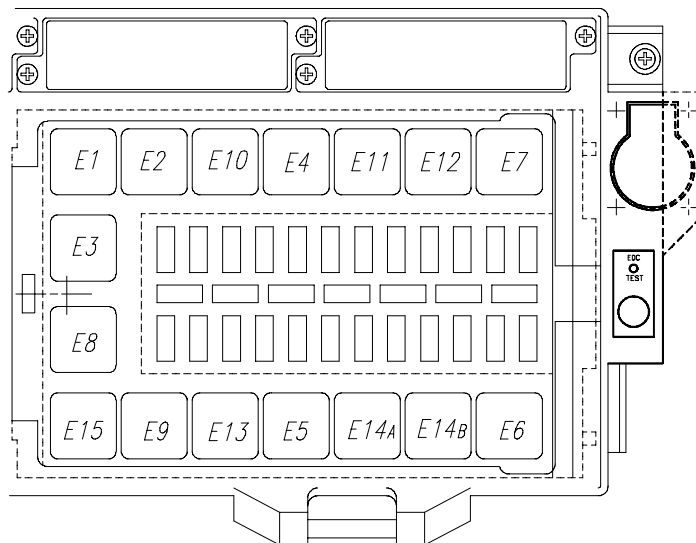


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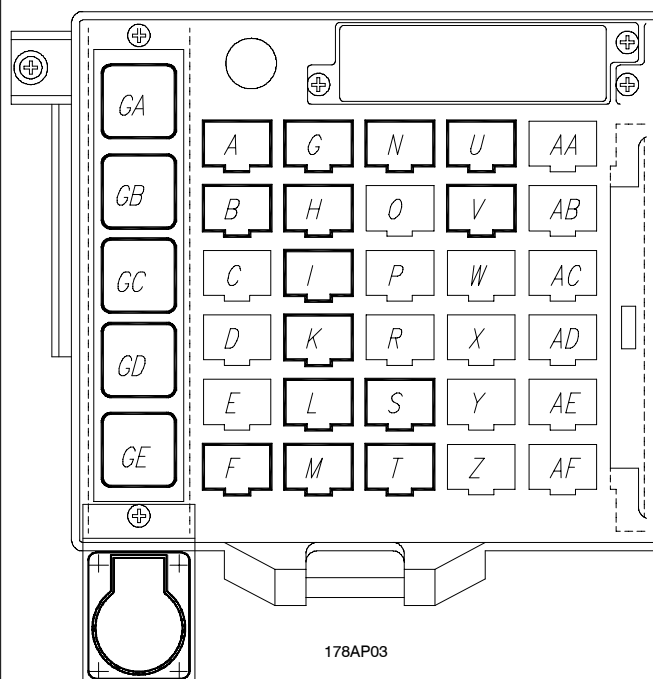
	Pos.	Function	Amp.
01	1	Air conditioning/heated rear window	10.0
	2	Fridge	5.0
	3		
	4		
	5		
	6		
02	1		
	2		
	3	Key operated switch	5.0
	4	EDC	15.0
	5		
	6		
03	1		
	2	Heated Diesel fuel prefilter	15.0
	3		
	4		
	5		
	6	EDC	20.0

	Pos.	Function	Amp.
04	01	Lights, front headlight, L parking/panel illumination	7.5
	02	Lights, front headlight, R parking/headlight washer	7.5
	03	Dipped headlights/high beam control	3.0
	04	L dipped headlights	5.0
	05	L high beam	5.0
	06	R dipped headlight	7.5
	07	R high beam	7.5
	08		
	09	Rear fog light	5.0
	10		
	11	Horns	10.0
	12	Brake air dryer	5.0
	13	Battery charger/automatic glowplug warning light	3.0
	14	Warning light tester	3.0
	15	Windscreen wiper/timer	7.5
	16	Hazard warning lights	10.0
	17	L, R indicators	7.5
	18	Stop lights	7.5
	19	Reversing light	7.5
	20	Tachograph	3.0
	21	Cigar lighter/interior light	10.0
	22	Rotating lights	10.0
	23	Window winder/press. aria condotta autom. rim.	20.0
	24	Fan heater	15.0

REMOTE SWITCHES

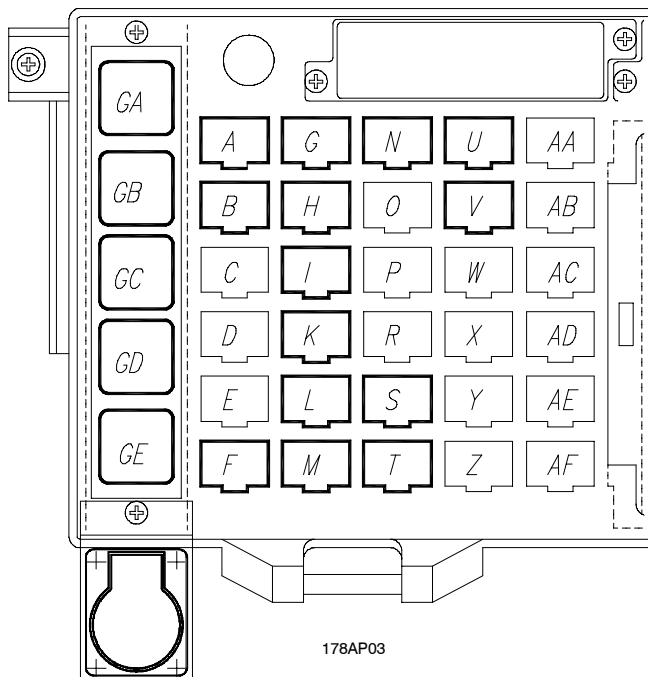
178AP04

Pos.	Function	Code
E1	Starter relay	25200
E2	Dipped headlights	25013
E3	Remote switch for 15A terminal	25209
E4	Flasher	25004
E5		
E6	Stop lights	25006
E7		
E8	Diode holder	61000
E9	Windscreen wiper timer	59100
E15	Anti-starting system	25204
E10	High beams	25009
E11		
E12	Horns	25805
E13		
E14A		
E14B		



178AP03

Pos.	Function	Code
A	Prefilter heater remote switch	25817
B	D+ remote switch	25874
C	TGC anti-detach remote switch (ADR and not)	25930
D	TGC enabled warning light relay switch (ADR)	25740
E	Diodes for TGC anti-detach remote switch (ADR and not)	61004
F	EDC remote switch terminal 15	25858
G		
H		
I	Hour meter remote switch	25814
K	Neutral starting remote switch	25605
L	Rear fog light on remote switch	25034
M	Engine EDC off remote switch	25903
N	Air conditioning remote switch	25332
O		
P		
R		
S	PTO parametr. resistors	61125
T	Engine braking button resistor	61122 B
U	Engine braking resistor	61122
V	Interior light diode holder	61002
W		
X		
Y		
Z		

REMOTE SWITCHES

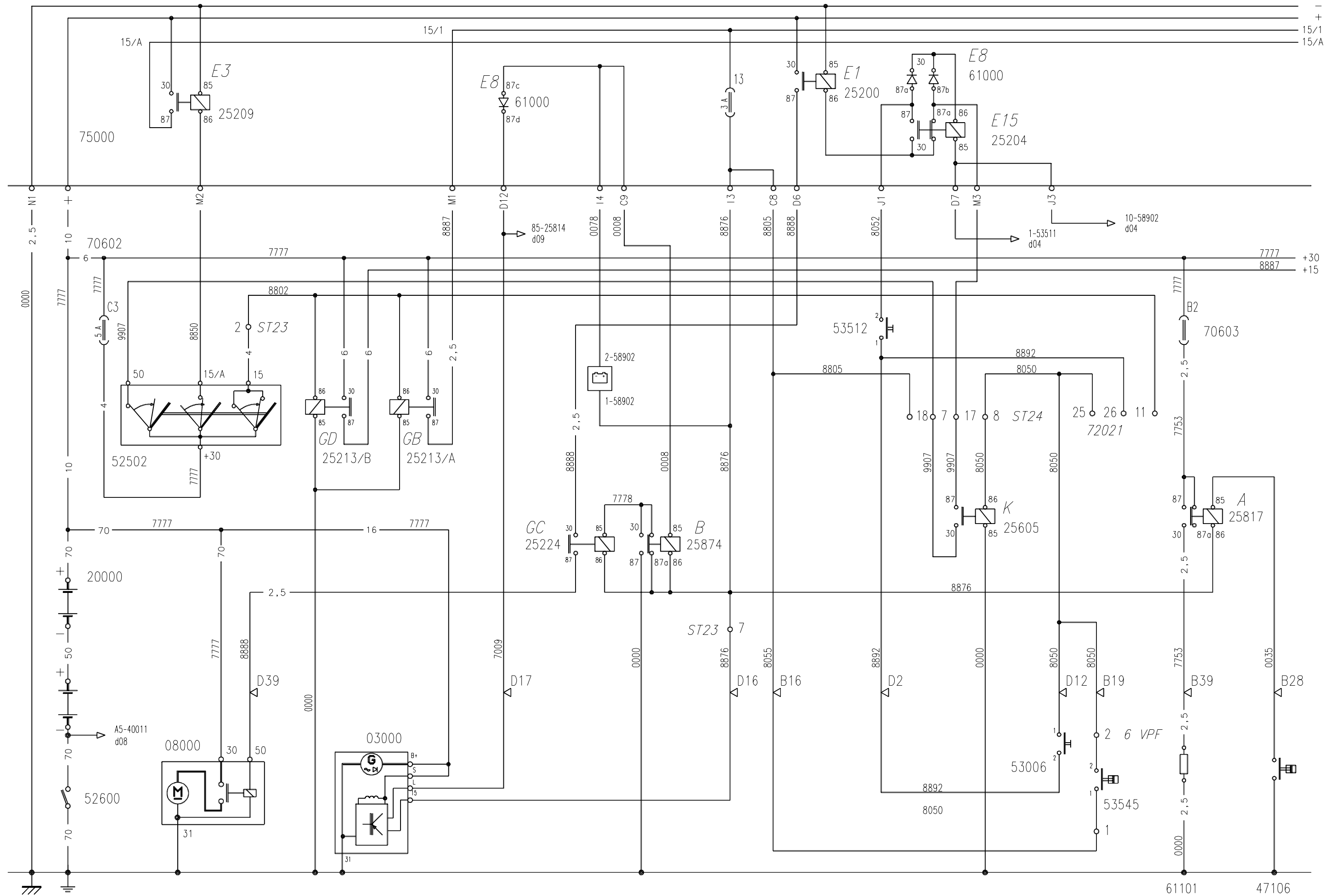
Pos.	Function	Code
GA	Servosteering fluid level electronic inverter	25868
GB	I5/50A terminal remote switch	25213 A
GC	Engine running anti-starting system 40A	25224
GD	I5/50A terminal remote switch	25213 B
GE	EDC general remote switch	25924

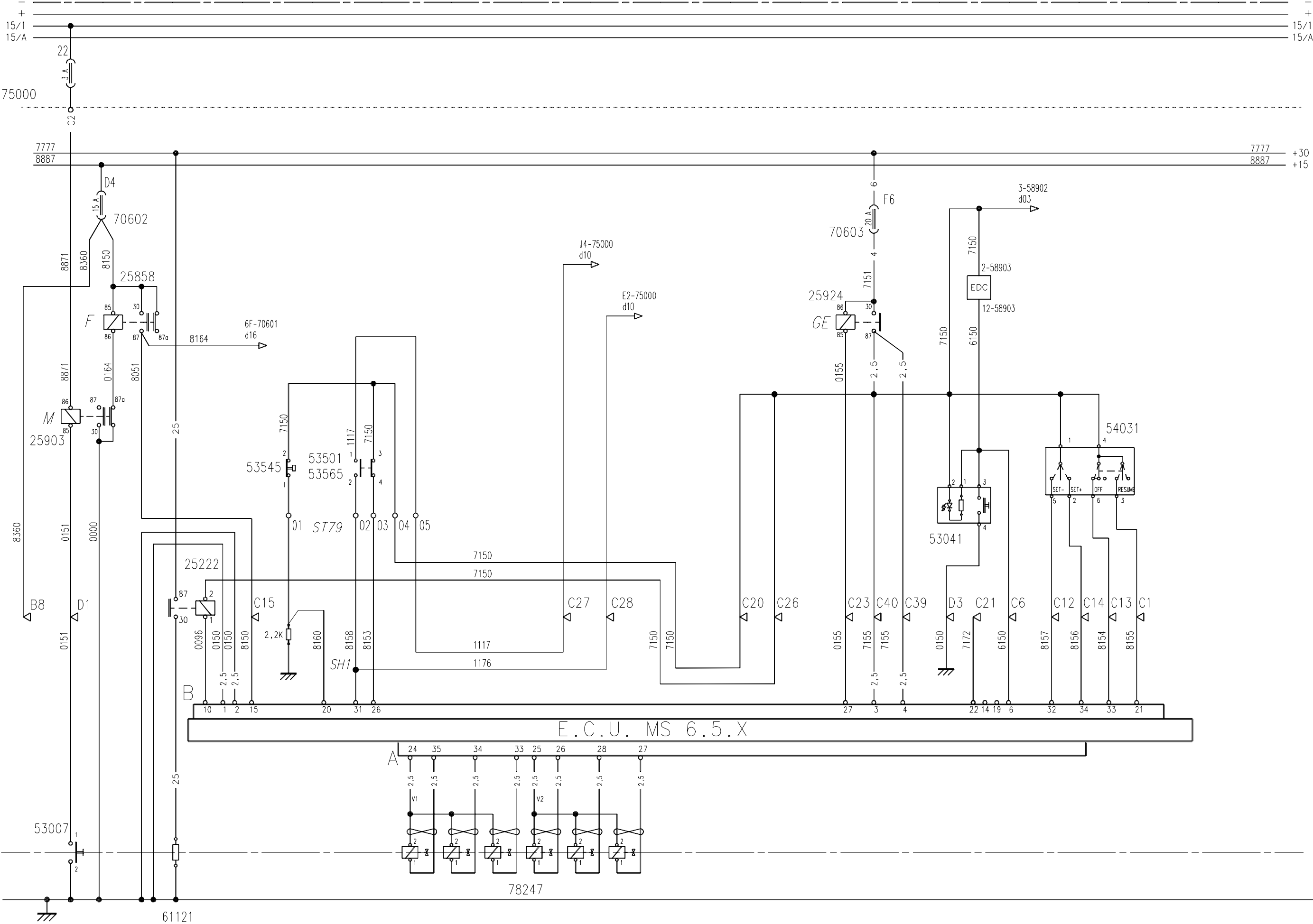
Pos.	Function	Code
AA	+ set adjustment relay switch	
AB	- set adjustment relay switch	
AC	Engine external switch-off remote switch	
AD	Engine external start remote switch (handbrake)	
AE	PTO I parameter setting	
AF	PTO2 parameter setting	

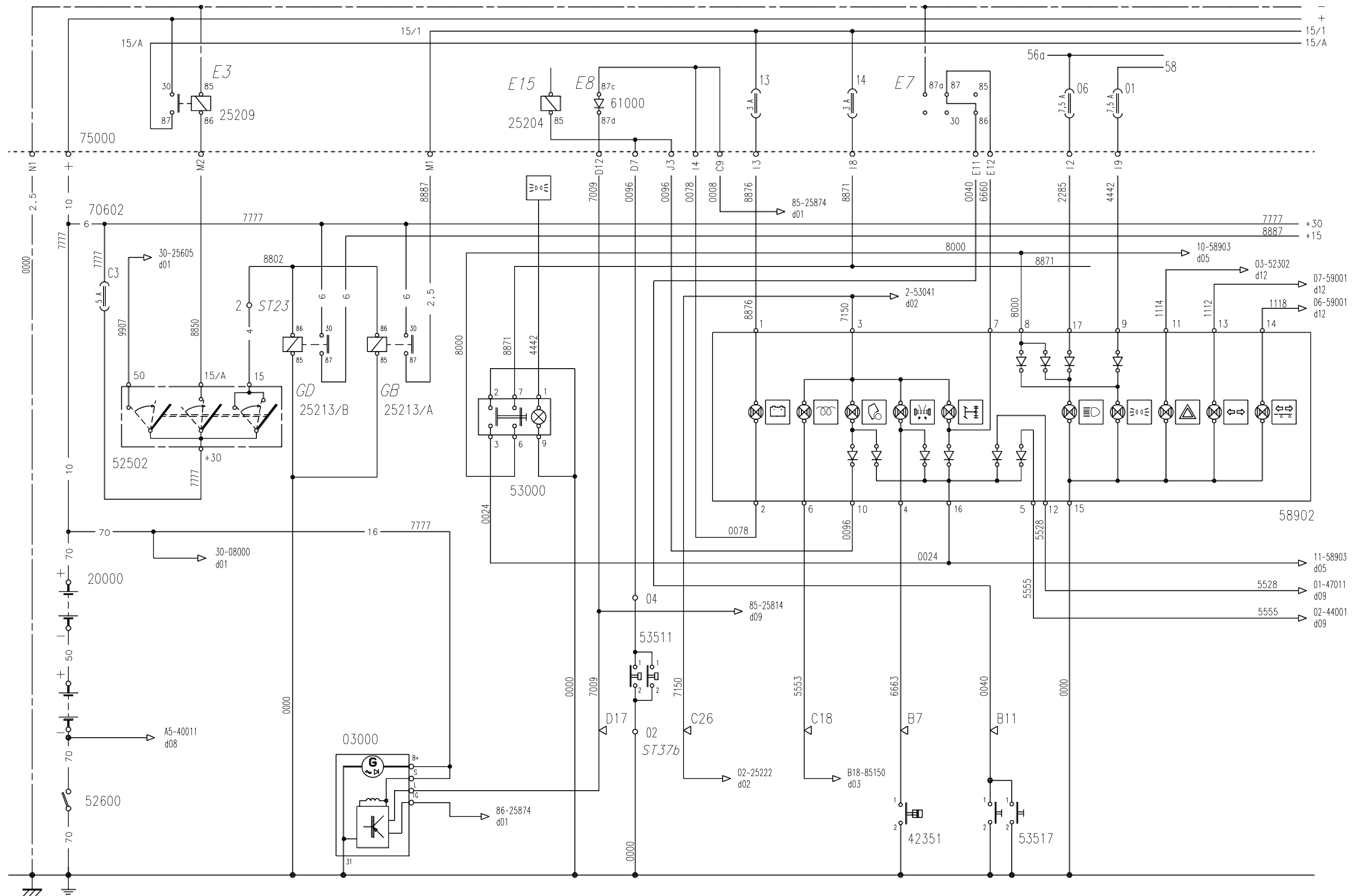
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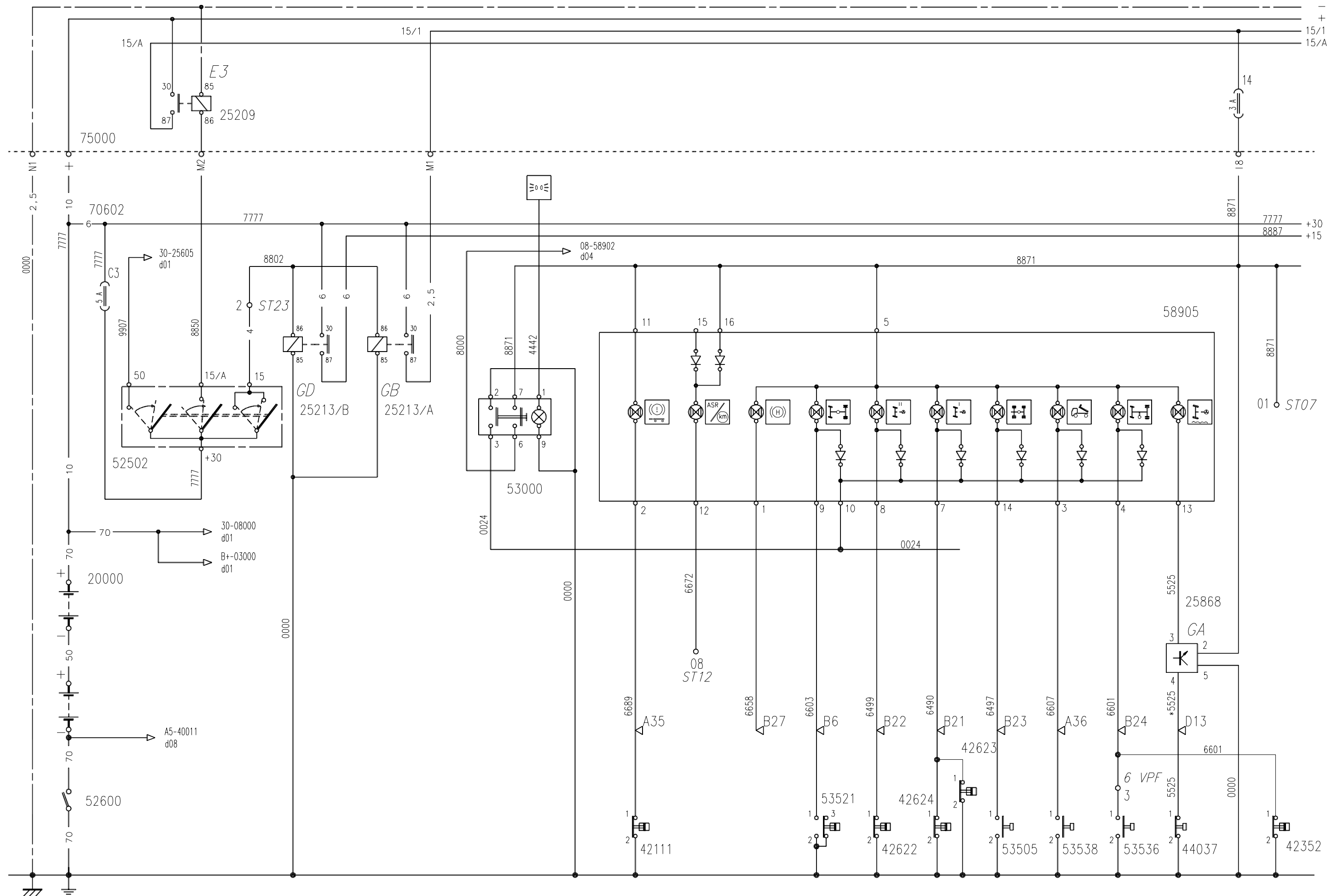
ELECTRICAL SYSTEM DIAGRAMS

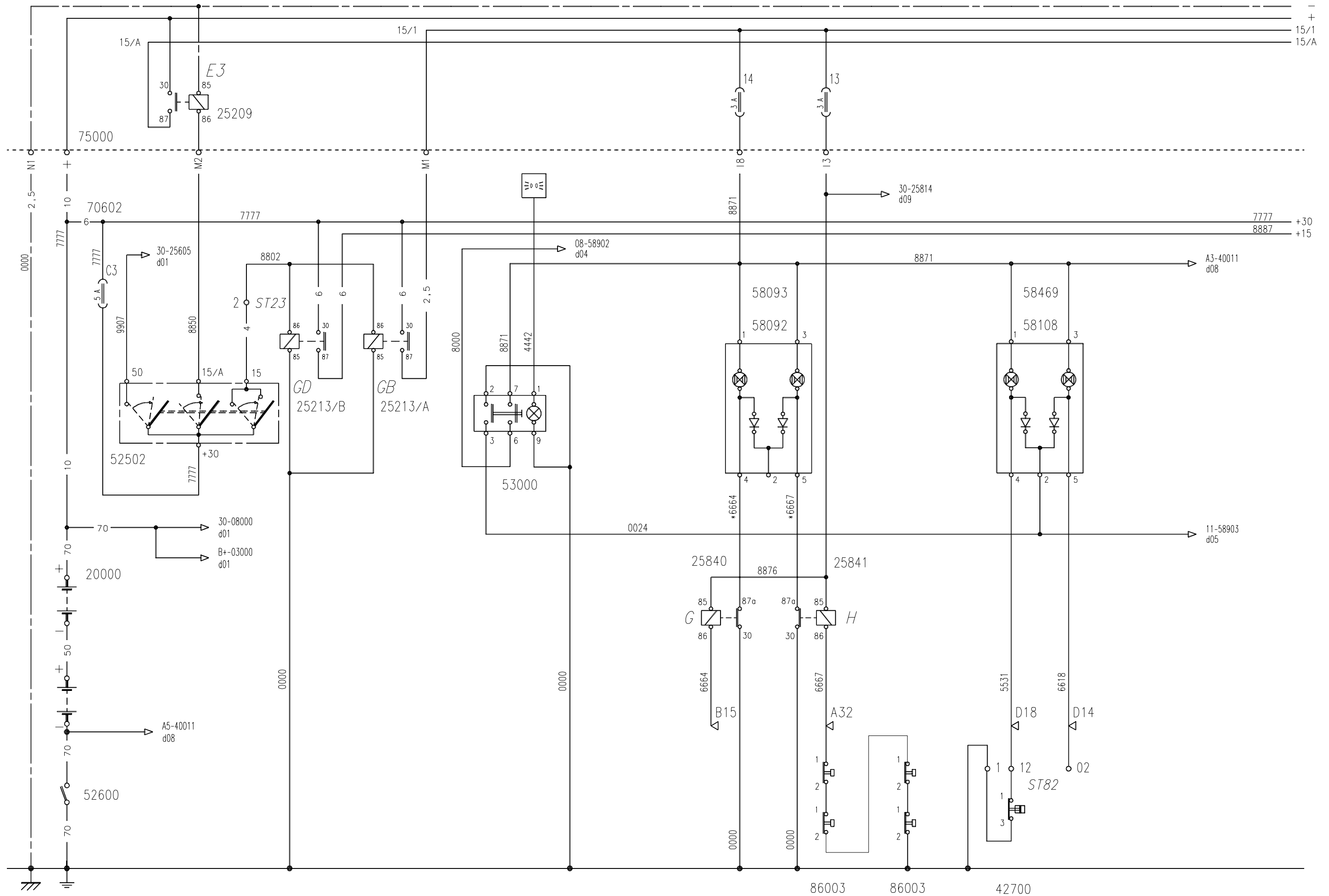
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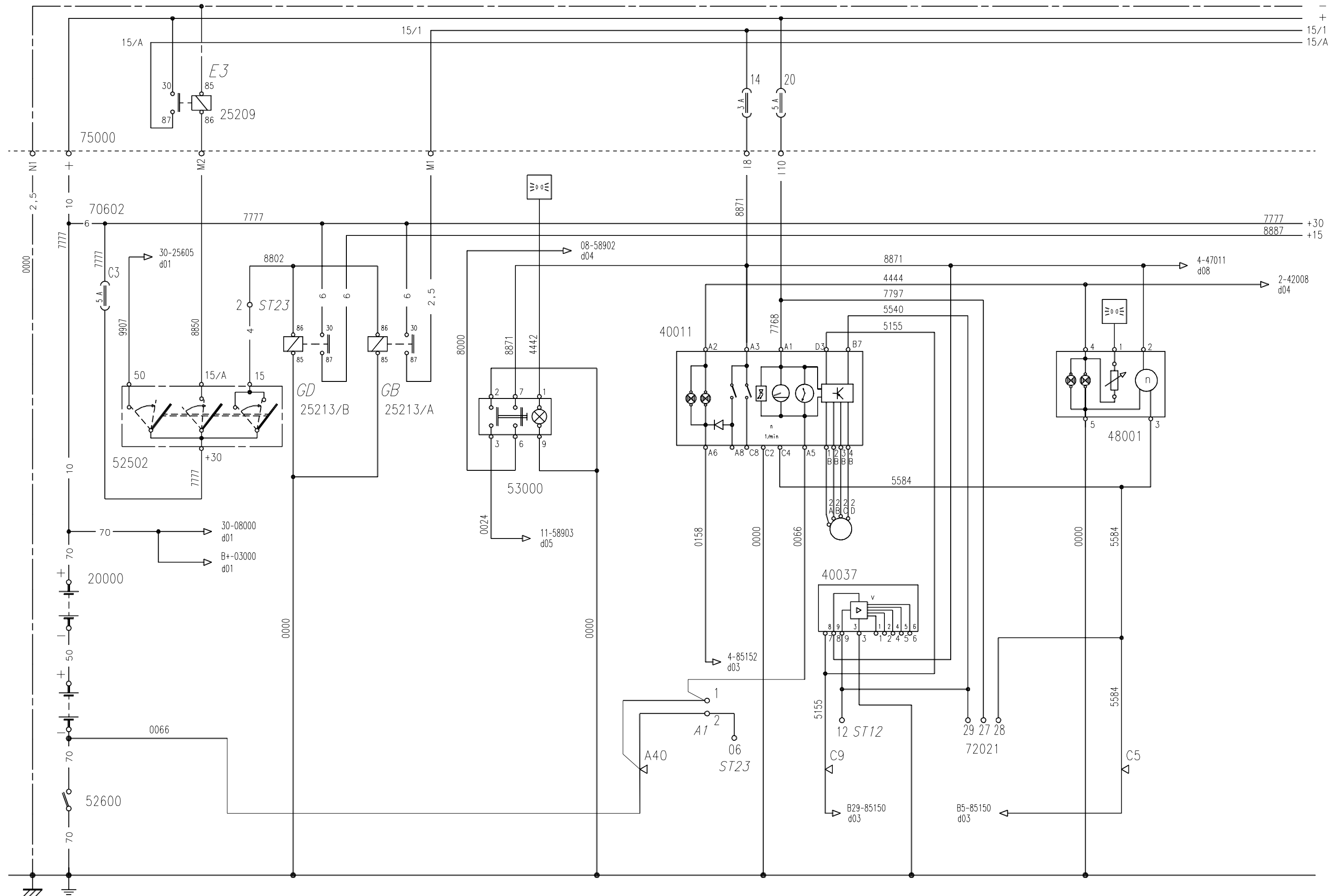


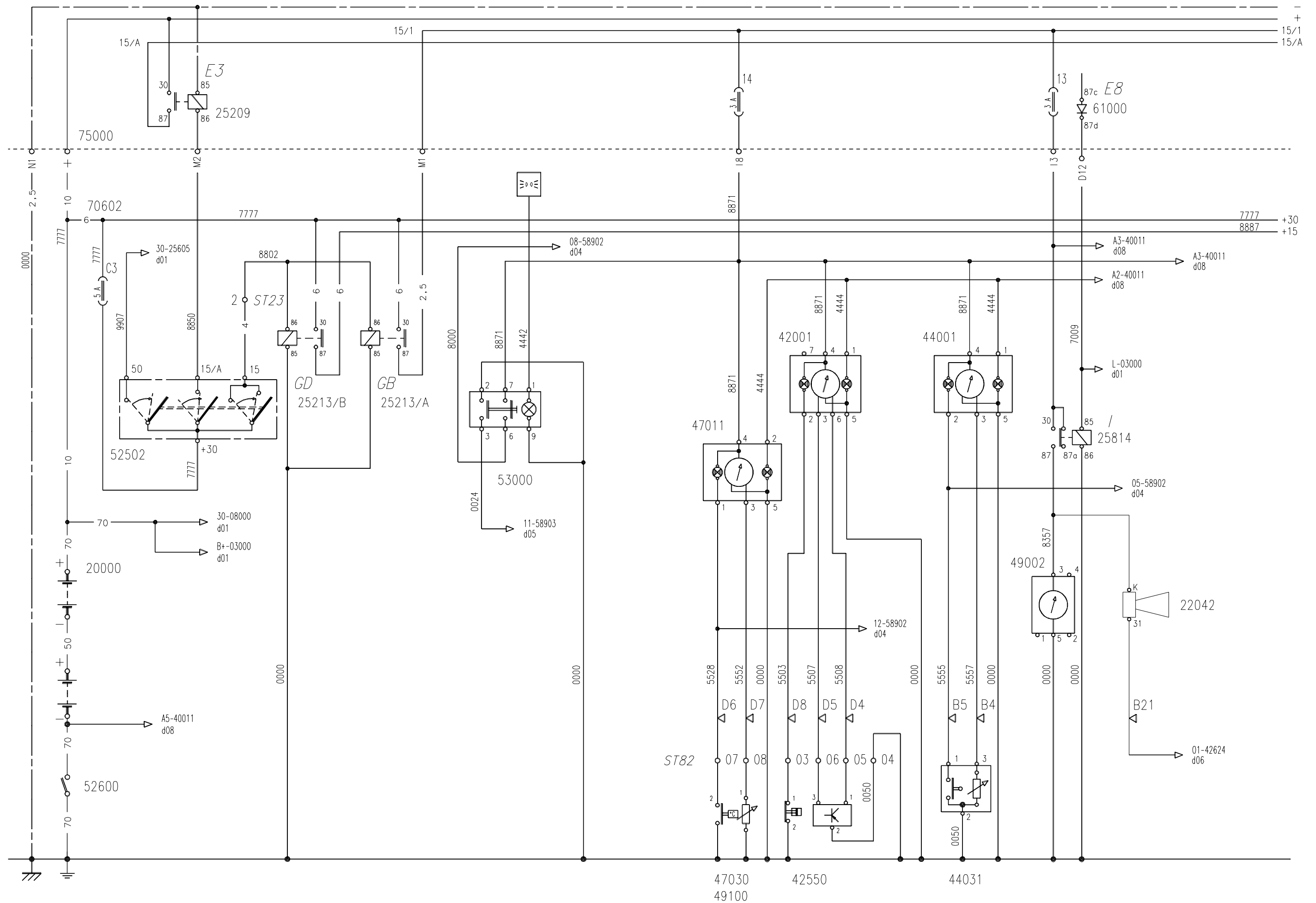


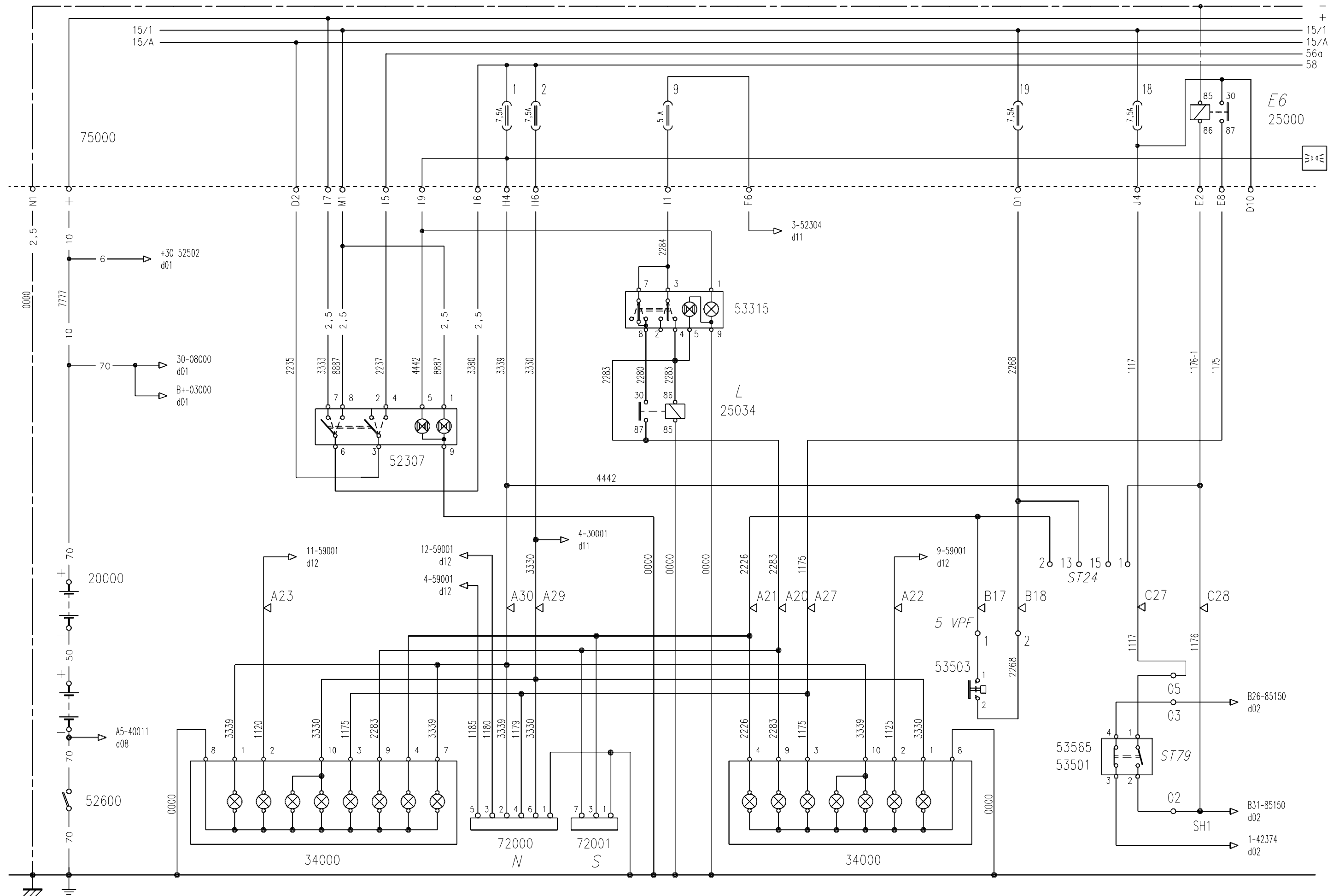


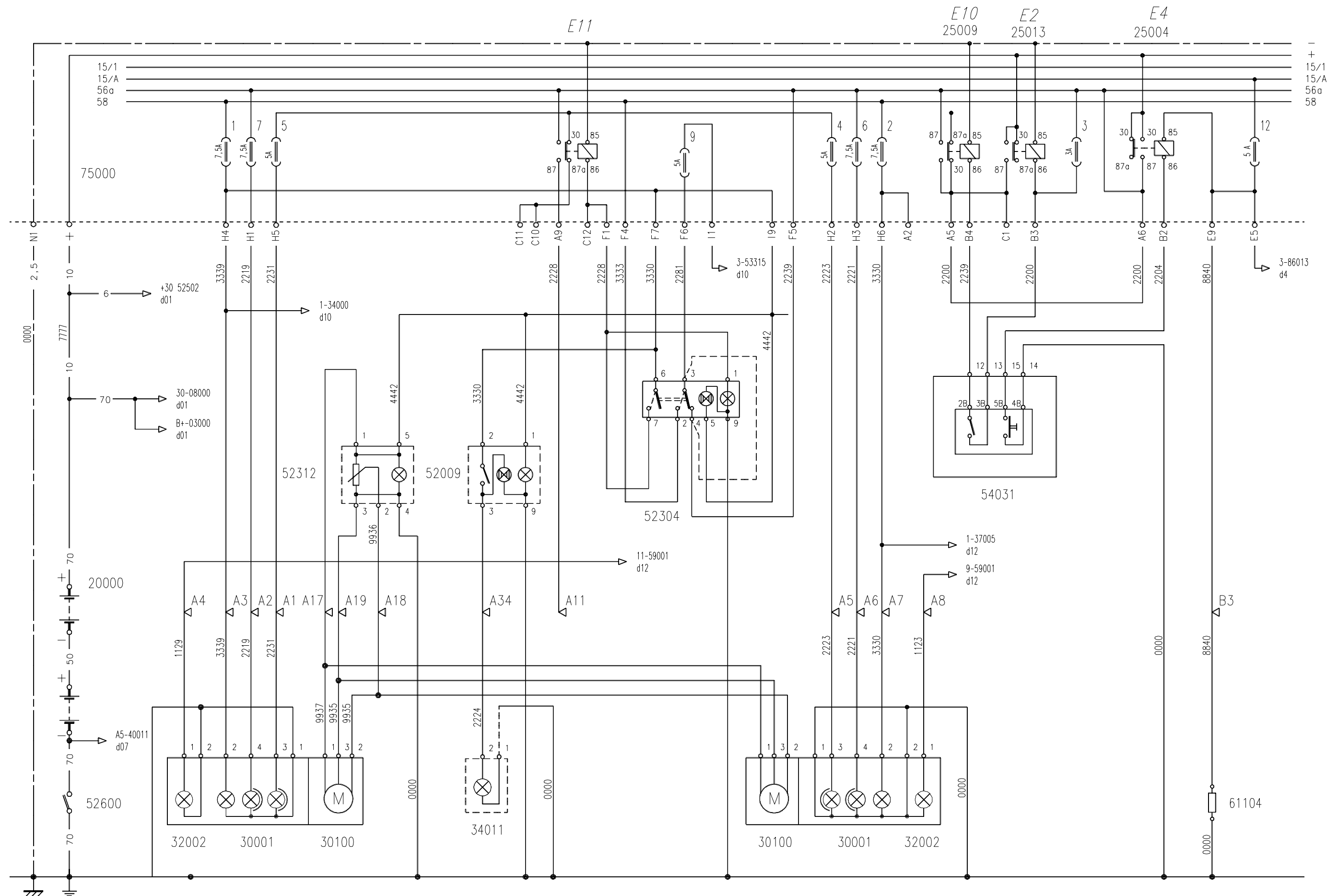


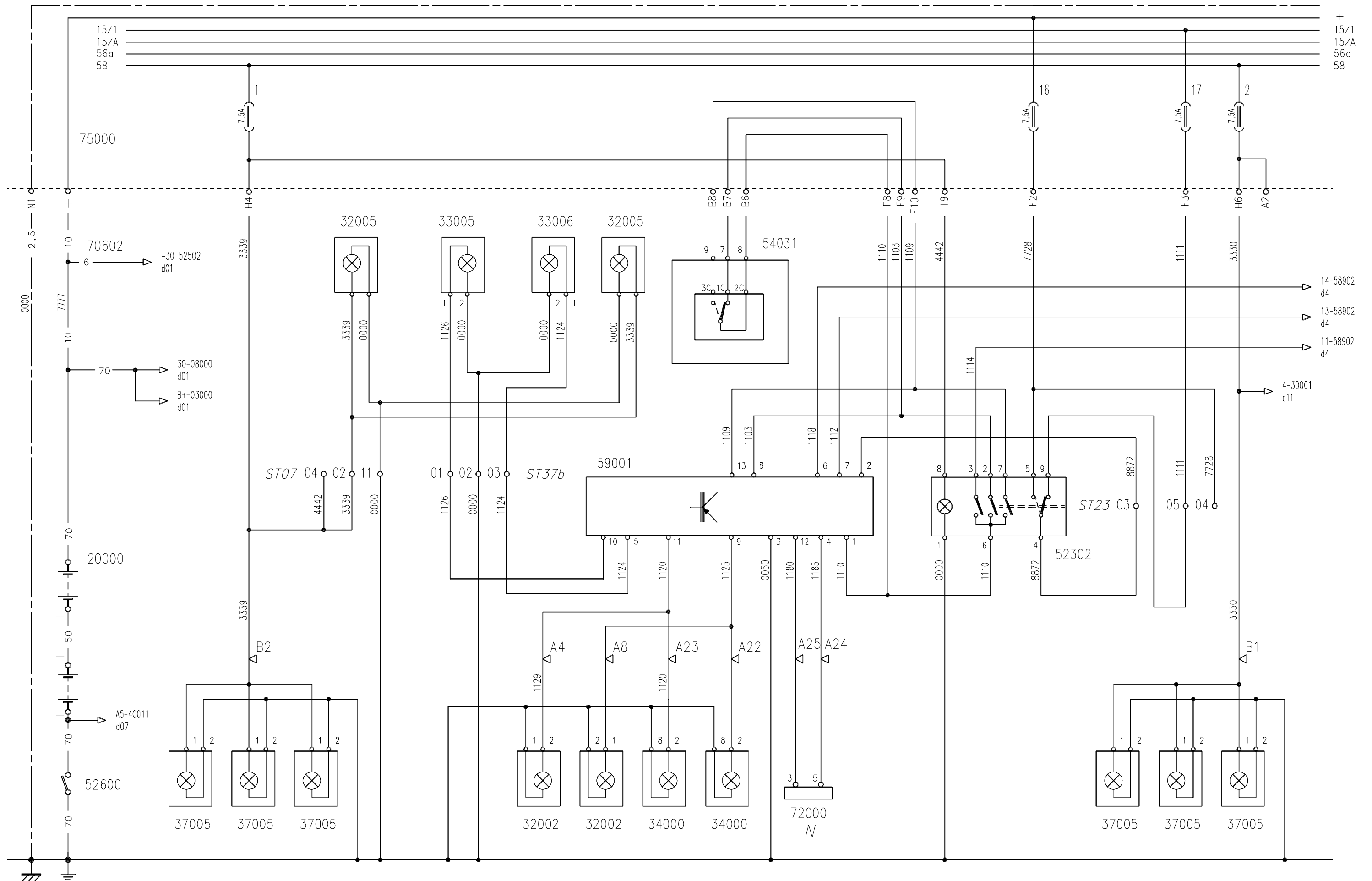


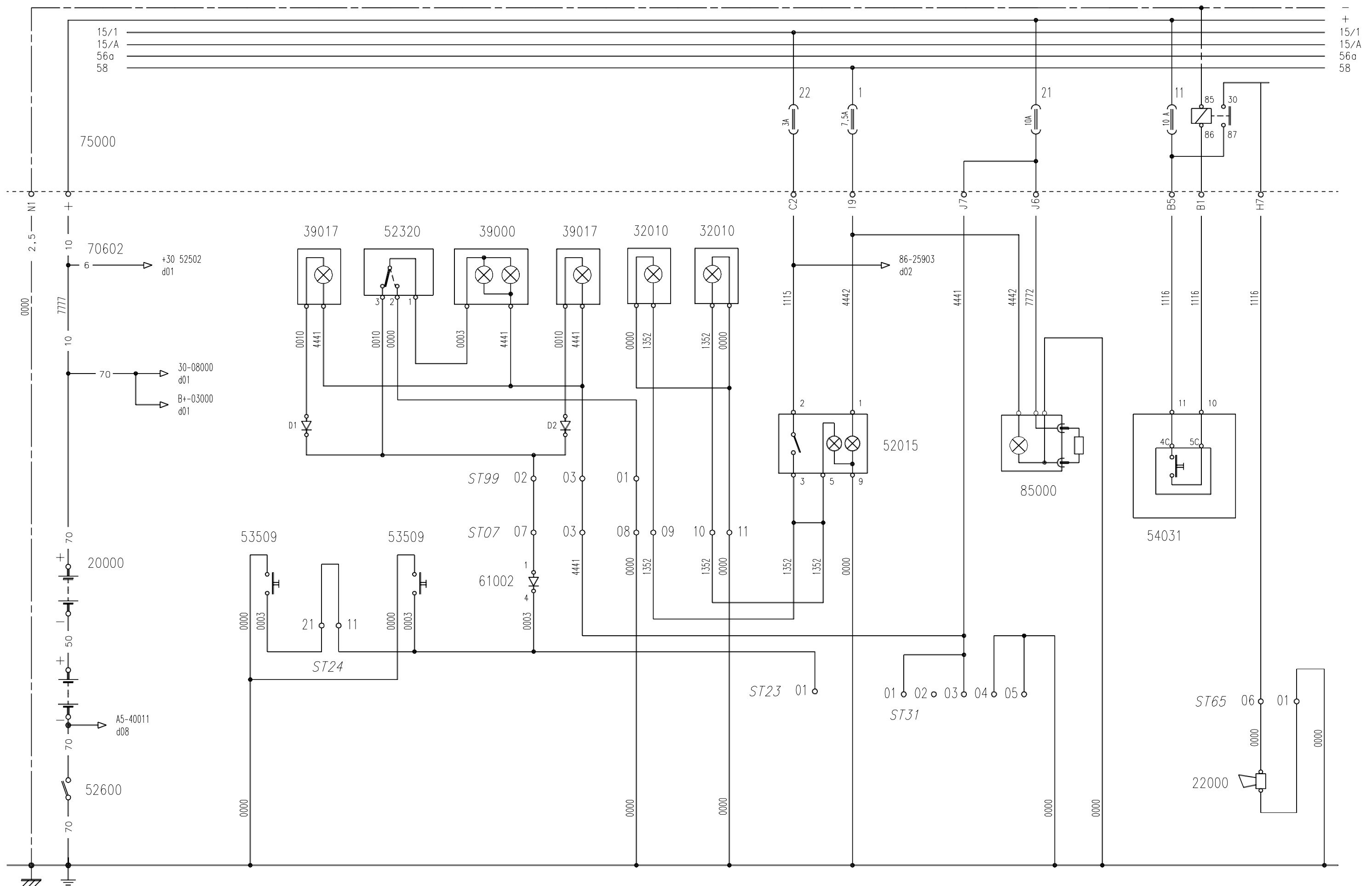


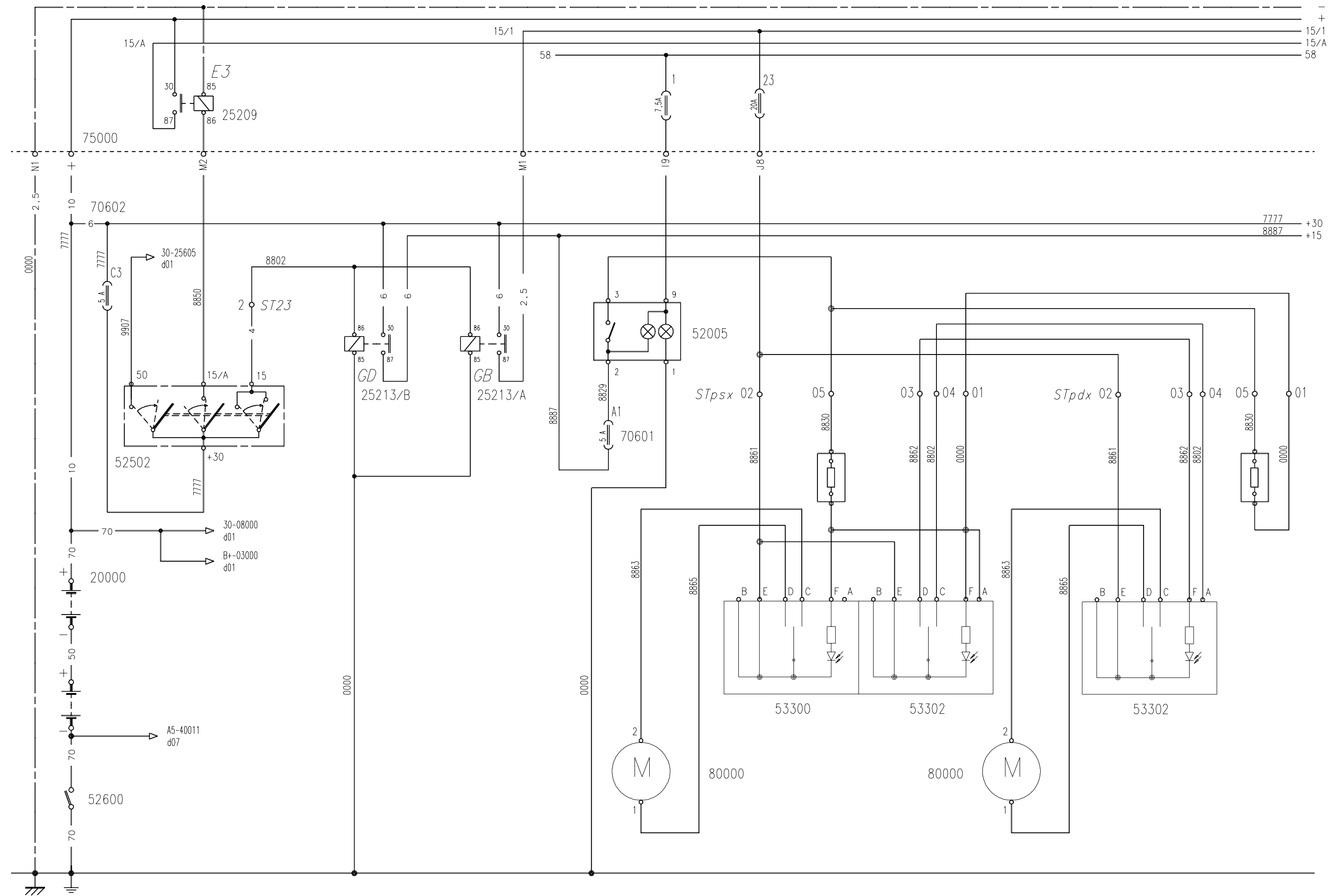


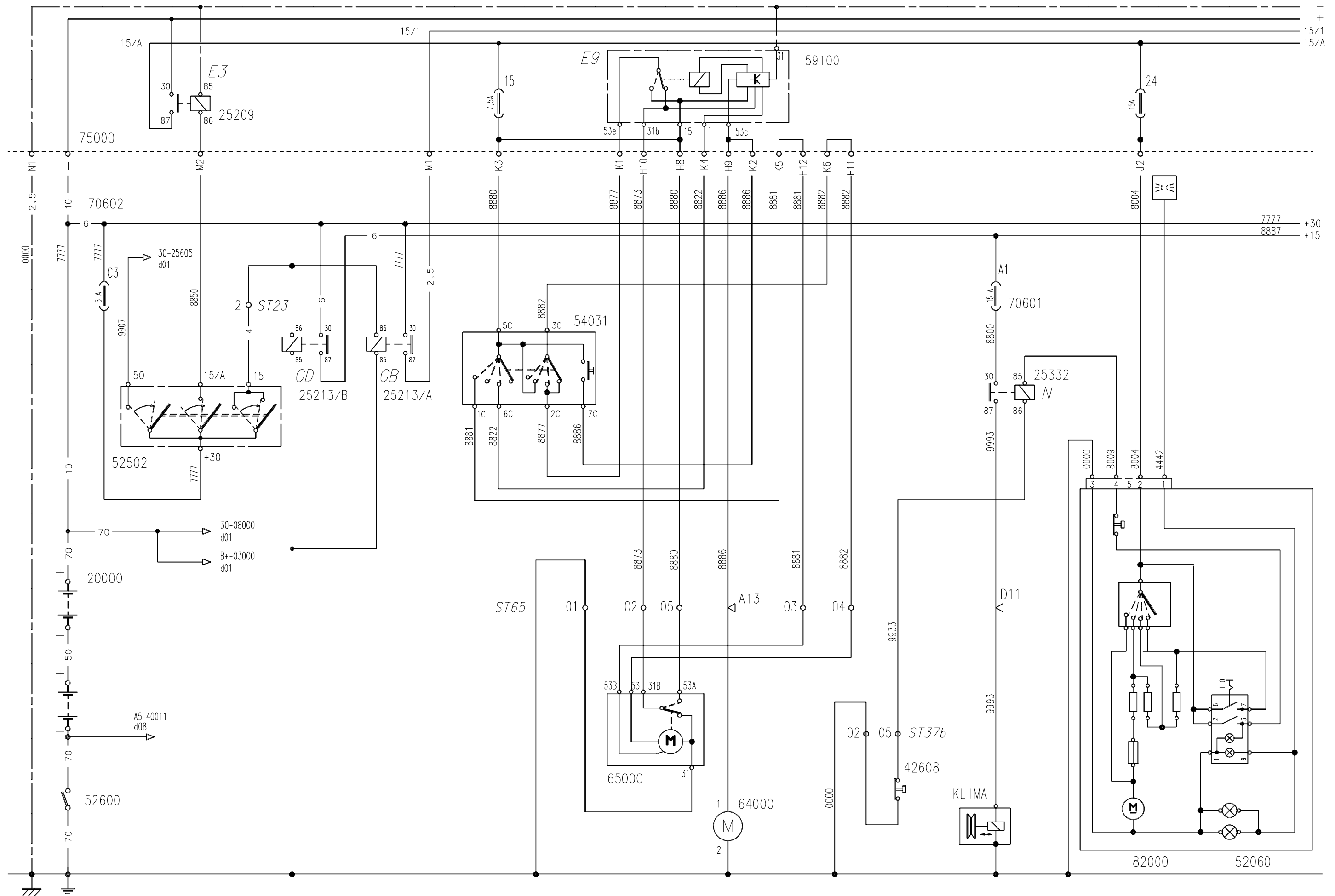












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CAB AND CHASSIS

SECTION 18

SECTION 18

Cab and chassis

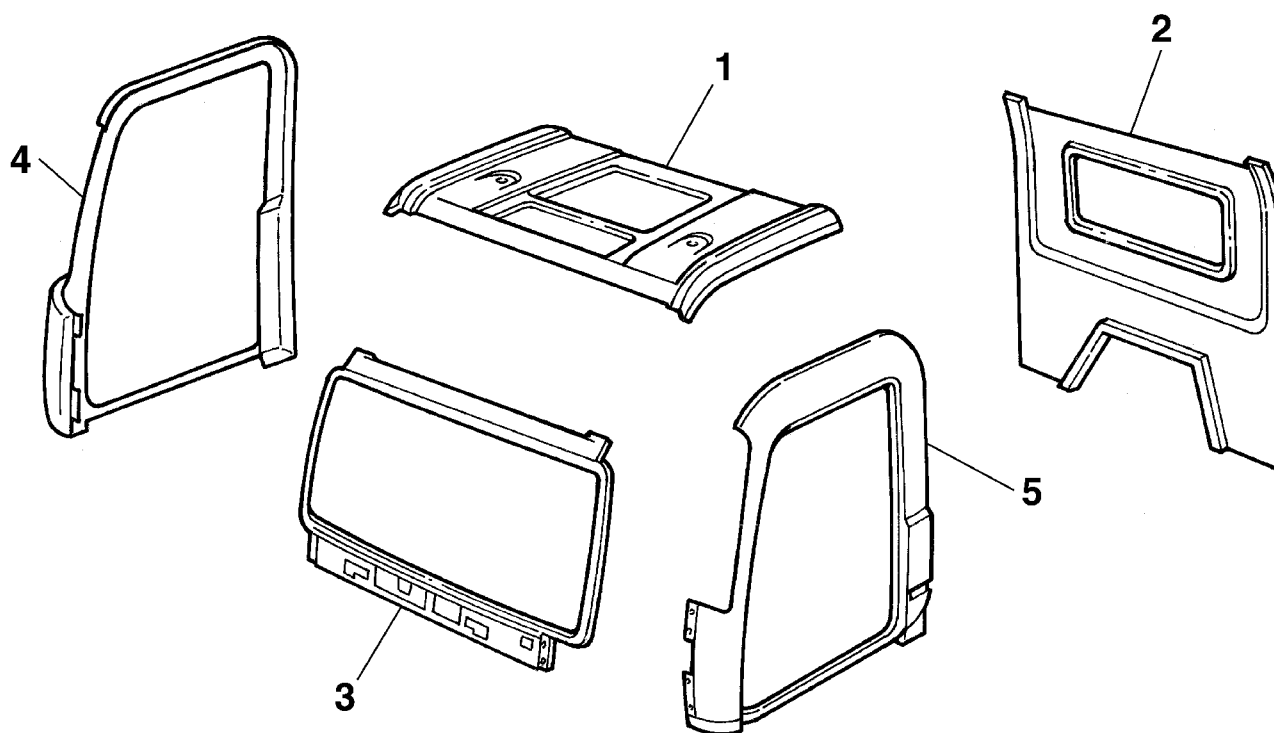
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DESCRIPTION

The vehicle cab consists of several parts in fibreglass-reinforced plastic glued to each other and to a metal frame with polyurethane two-component structural adhesive.

Figure 1



1. roof - 2. rear panel - 3. front panel - 4. right side panel - 5. left side panel

CAB REPAIR

Introduction

Repairs that can be made on the cab are two basic types:

- ☐ surface repairs, regarding damage that has not, or has entirely damaged the whole thickness of the cab wall;
- ☐ structural repairs, regarding serious damage or perforation of the cab wall.

When checking it is therefore necessary to carefully inspect the body area involved in the impact externally, but above all, internally, after removing the internal trims, to verify the extent of the damage and to proceed accordingly.

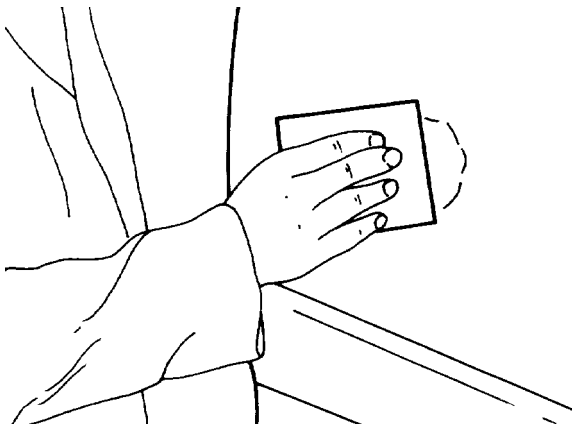


Zones where the fibreglass-reinforced plastic has been broken will be torn, with the glass frayed and above all of a lighter colour in the area around the breakage (this can only be seen from inside, where there is no paint).

Surface repairs

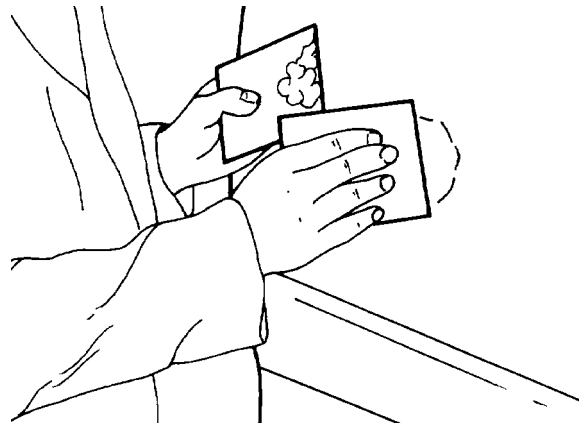
Proceed as follows:

Figure 2



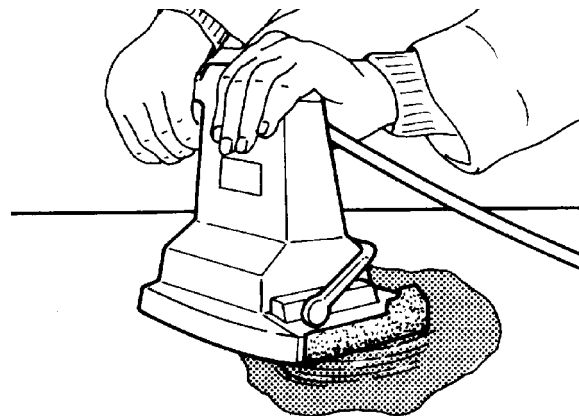
- ☐ de-grease the treated surface then pass sandpaper over the damaged part to roughen the bottom and the edges;
- ☐ prepare the special stopper; mixing with the catalyst in the percentages indicated by the manufacturer;

Figure 3



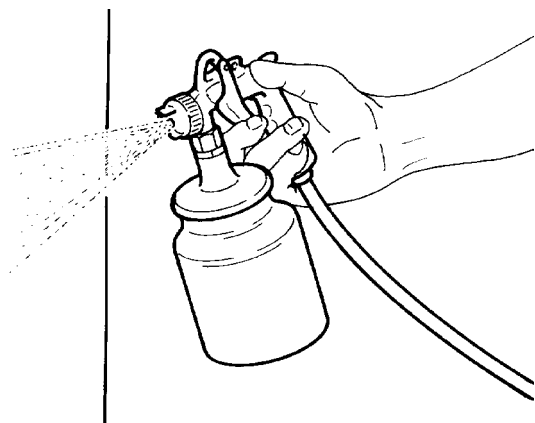
- ☐ apply the stopper, taking care to completely fill the damaged part and to avoid the forming of air bubbles;
- ☐ allow to dry until it has completely hardened;

Figure 4



- ☐ rub down to remove the excess stopper; smooth with emery paper and water until a smooth surface is obtained;

Figure 5



- ☐ paint and polish following the usual rules for car bodies.

Structural repairs

It is common knowledge that fibreglass-reinforced plastic has high mechanical resistance and deformation from impacts is almost non-existent. As a consequence, if the cab is hit, the part that receives the impact may be perforated, but the damage is always very confined because there is no surrounding plastic deformation.

Therefore to repair the cab it is necessary to cut away the damaged part and replace it with an identical piece obtained from a spare part.

Proceed as follows:

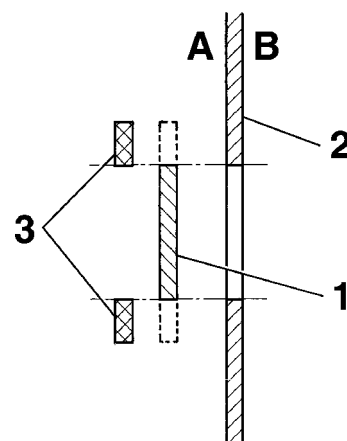
- ☐ assess which are the areas with serious damage to ask for the parts to be replaced completely or from which the parts to be replaced are to be obtained;

Figure 6



- ☐ with a jig saw and/or an abrasive grinding wheel, cut the part surrounding the break following as far as possible the body panel joints and/or the level variation lines (edges) so as to obtain a reasonably regular opening, remove any burrs and uneven cutting;
- ☐ carefully remove the residue of the previous adhesive from any points touching the metal frame;
- ☐ if the metal supporting frame has been damaged, this has to be restored to its original condition by cutting away the damaged parts and oxyacetylene welding the new parts, after carefully checking positioning and alignment;
- ☐ the replaced metal parts must be painted before continuing with the repairs on the body;

Figure 7

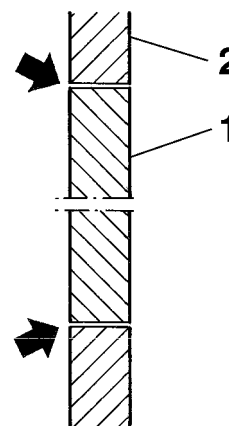


A: cab exterior

B: cab interior

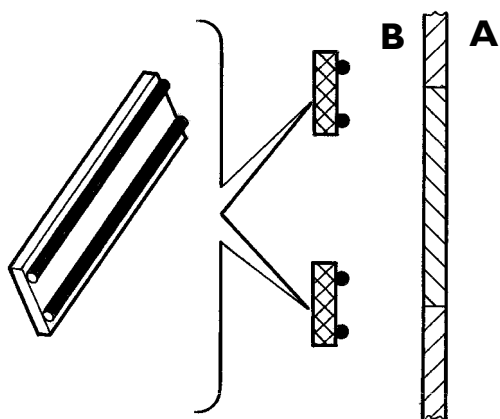
- ☐ prepare the new part (1) to be welded to the body (2) cutting it from spare parts; where the shape of the opening to be closed allows it, it is best to cut the edge about ten centimetres wider than necessary so as to obtain one or more panel strips (3) to use for support and reinforcement in the joining areas;
- ☐ thoroughly degrease the parts to be joined using a specific product;

Figure 8



- ☐ position the new part (1) taking great care over the alignments, bringing together with the body (2) using suitable equipment (clamps, adhesive tape, rods and push rods);

Figure 9



A: cab exterior

B: cab interior

- ☐ on the inner part of the prepared strips, apply two seams (arrow) of the specific polyurethane two-component structural adhesive using the special application tool; apply adhesive also on any points that contact the metal frame;

- ☐ if an entire part of the cab has to be replaced - (1) roof, (2) rear panel, 3) side panel, (4) front panel - the adhesive seam must be applied in the areas shown in the figures below:

Figure 11

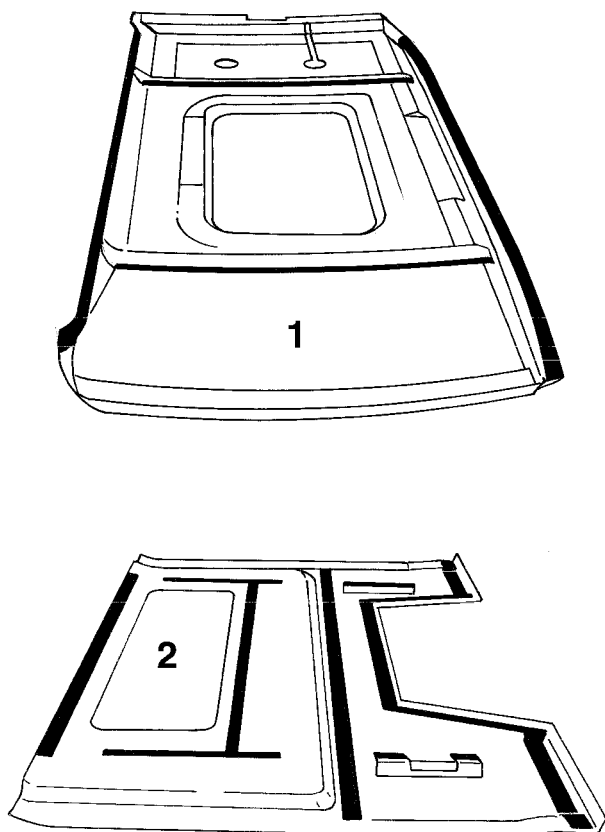
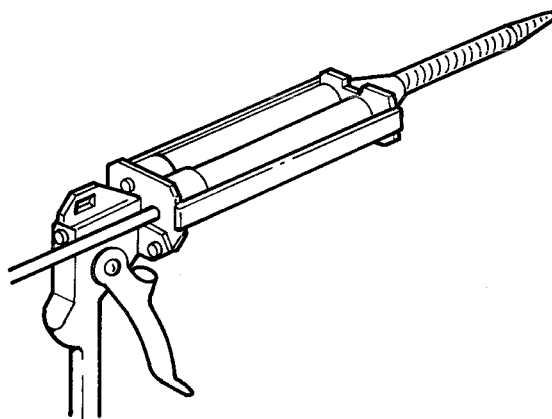


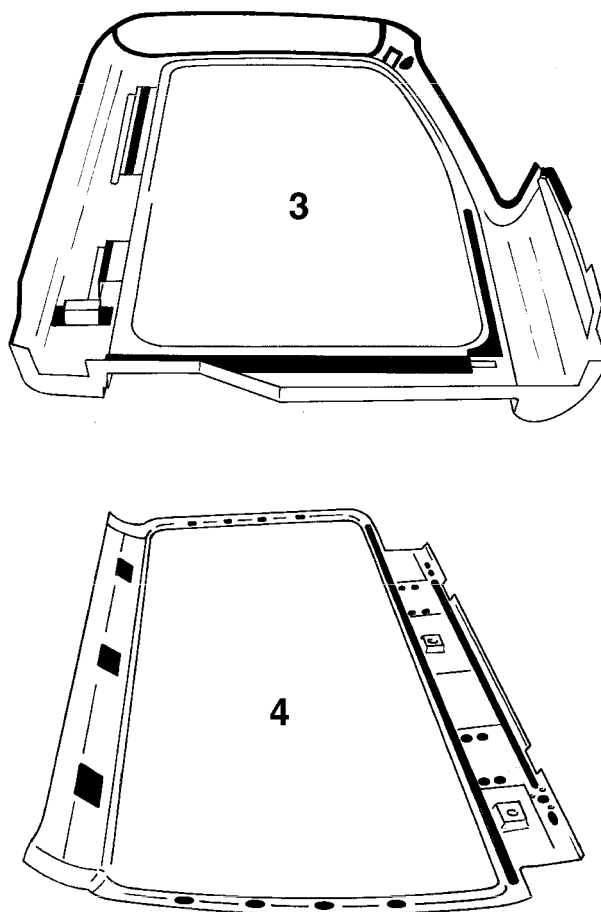
Figure 10



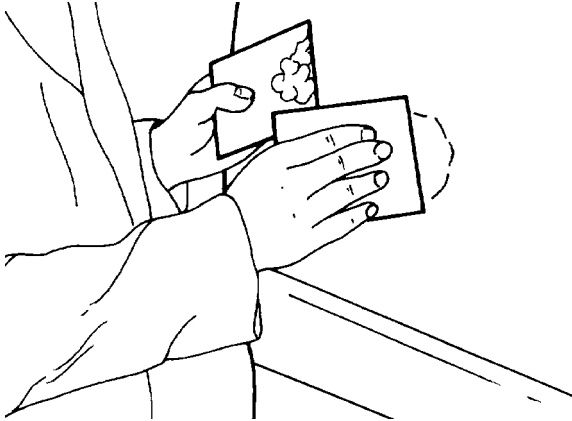
supplier : GURIT-ESSEX

product: BETAMATE 2K - 160 ml cartons

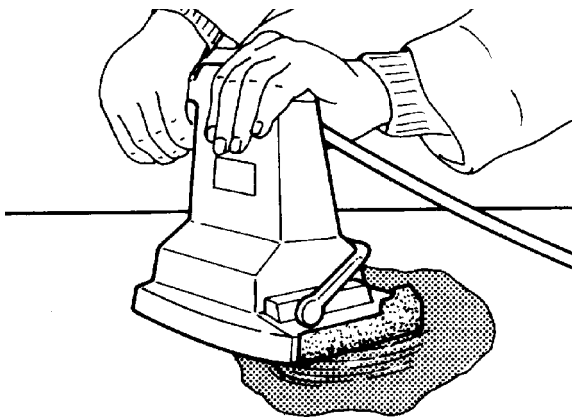
- ☐ fit the strips in place and keep them in position with suitable tools (clamps, rods, push rods);
- ☐ wait until the adhesive has dried completely: it is best to wait 24 hours;



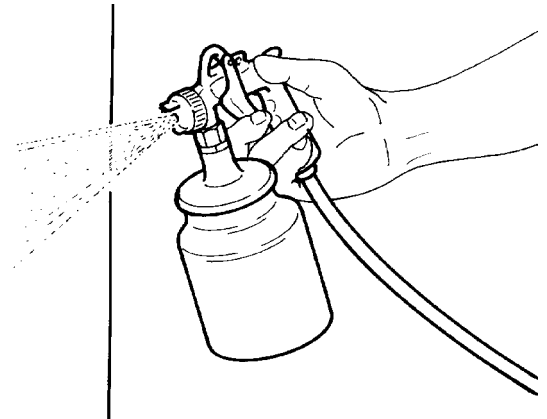
- ☐ when completely dried, remove the supports and tools used to keep the new part in position;
- ☐ prepare the special stopper, mixing with the catalyst in the percentages indicated by the manufacturer;

Figure 12

- ☐ apply the stopper; taking care to completely fill the remaining cracks and any imperfections;
- ☐ allow to dry until it is completely hardened;

Figure 13

- ☐ rub down the excess stopper; smooth with emery paper and water to obtain a smooth surface;

Figure 14

- ☐ paint and polish following the usual rules for car bodies.

CHASSIS

SPECIFICATIONS

Chassis

The chassis transmits load weight and component weight to springs and axles. It absorbs the stresses produced during running, e.g. flexure, thrust and torsional force, tensile stress and vibrations.

Chassis conditions are therefore essential for vehicle operation. Inspect the chassis at regular intervals to check that chassis and members thereof are free from cracks or damages, that bolts and rivets are well tightened especially in the areas submitted to stress, i.e. on leaf spring supports, on drive support, on cross members and tow hook.

Every crack or distortion of the chassis seriously impairs chassis resistance to operating stress.

The negative consequences often result in an axial displacement which has negative effects on the driving performances and causes earlier tyre wear.

Any additional hole drilled inadequately in the connection points with other components can be the starting cause of serious damages to the chassis.

This also applies to any interference with other parts or to pits due to rust, since these can increase notch sensitivity and favour crack formation.

Auxiliary chassis

Substructures are connected to the chassis by means of an assembling chassis destined to avoid load being bearing on certain points instead of being distributed uniformly.

The auxiliary chassis is made up in such a way as to not impair chassis twisting capability.

REPAIR OPERATIONS CHECKS

Visually check the chassis controlling the alignment. If deformations can be seen, free the relevant part of the chassis for easier measurement.



Before checking, ascertain that all members that could, with their imperfections, influence the exact measurement readings (for example, tyre inflation pressure, weak or broken leaf springs and so forth) are efficient.

Modifying the chassis

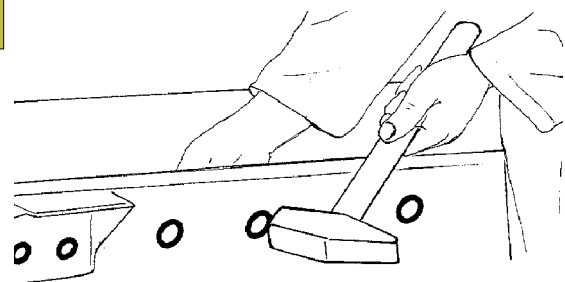
The following modifications can be performed only after written consent by our plant:

- ☐ wheel base modification;
- ☐ chassis cantilever extension;
- ☐ driving-steering system modification;
- ☐ leaf springs modification or addition of auxiliary supporting elements;
- ☐ holes or welding on the chassis;
- ☐ power unit or driving parts modifications;
- ☐ exhaust gas system modification;
- ☐ steering axles or driving axles assembling.



The above mentioned modifications can impair vehicle soundness and can also be dangerous for the driver; it is therefore recommended to observe strictly our directions.

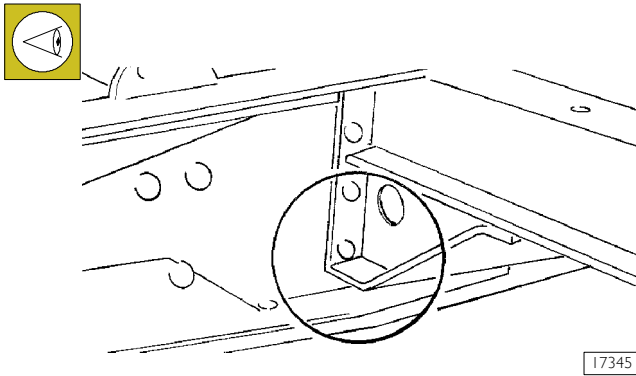
Figure 15



17344

Check the tightness of rivets by hammering the rivet heads and touching the opposite side with the fingers. Mark any loose rivets with paint in order to find them easily when making the repair operations.

Figure 16



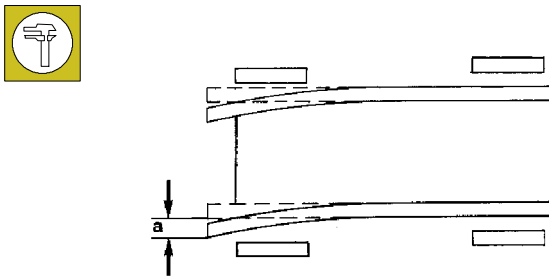
17345

Carefully check the entire chassis for cracks paying special attention to highly stressed coupling points between chassis cross members, brackets, leaf spring supports and chassis side members.

Mark immediately any cracked spots.

Mark immediately any cracked spots.

Figure 17



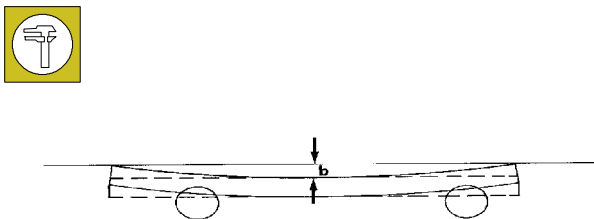
17347

Chassis lateral bending check.

Chassis lateral bending admitted

"a" = 3 mm/m

Figure 18



17348

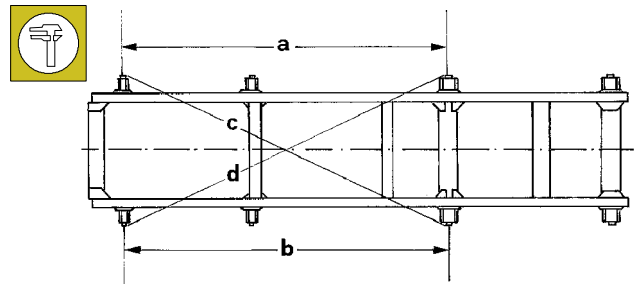
Chassis bending check.

Chassis bending admitted

"b" = 1 mm/m

Maximum 10 mm

Figure 19



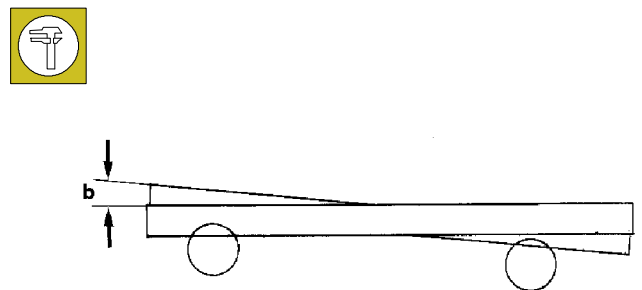
17349

Chassis alignment check.

Admitted difference between "a" and "b" = 3mm

With diagonal measurement from "c" and "d" = 6 mm

Figure 20



17350

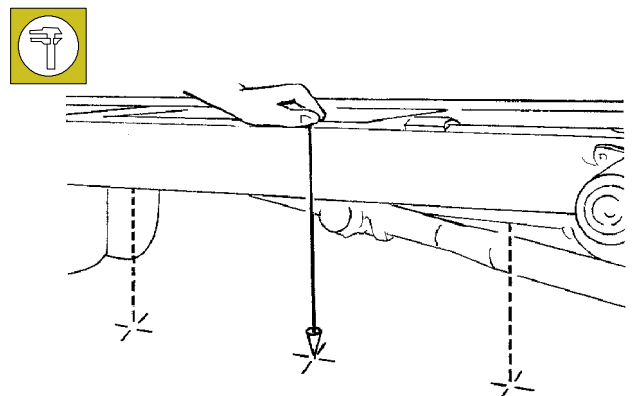
Chassis twist check.

Chassis twist admitted

"b" = each side 1 mm

Finding chassis lateral bending

Figure 21

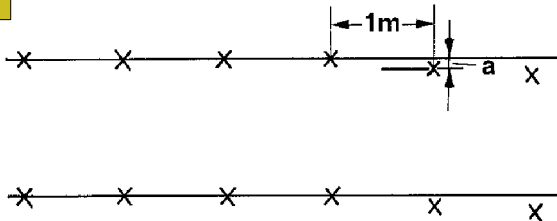


17351

To find the chassis lateral bending plumb the bearing surfaces starting from the two side members at intervals of approx. 1 m.

The points obtained must be carefully marked on the floor:

Figure 22



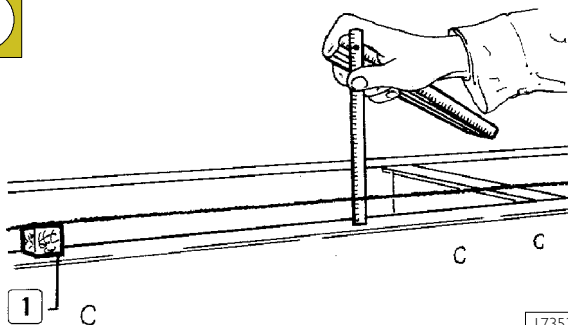
17352

In order to use the plumbed points, stretch a cord through the aligned points marked.

The points that are not aligned indicate the beginning and the entity of the actual strain (a, Figure 22).

Finding chassis bending up and down

Figure 23



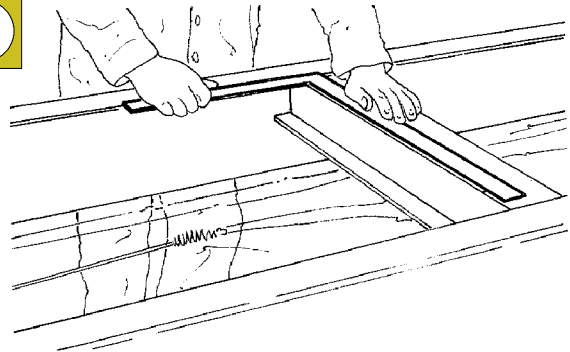
17353

Use two shims (1, Figure 23) of the same thickness and of a size that permits a cord to be stretched through the straight length of the lower or upper edge plate of the side member.

Measure the distance of the side member from the cord at 1 metre intervals. Different cord distance shows position and entity of actual side member bending.

Finding chassis displacement

Figure 24



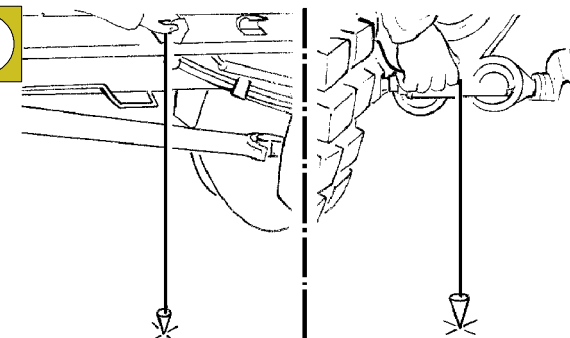
17354

Chassis displacement may be found by using a square.

To this purpose set the square at 90° to the chassis side member and check the orthogonality of chassis cross members.

Axle position

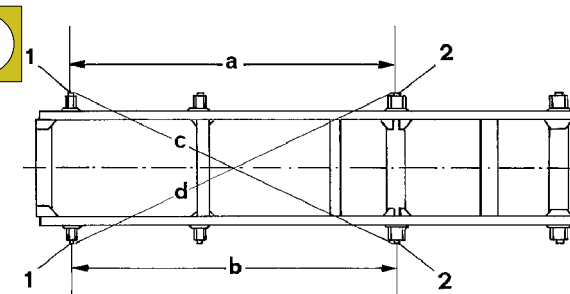
Figure 25



17355

A displacement of the axle positions may be checked by diagonal measuring. To this purpose plumb to the flat bearing surface, on both sides, the centre of the front suspension front support and the centre of the rear leaf spring front support.

Figure 26

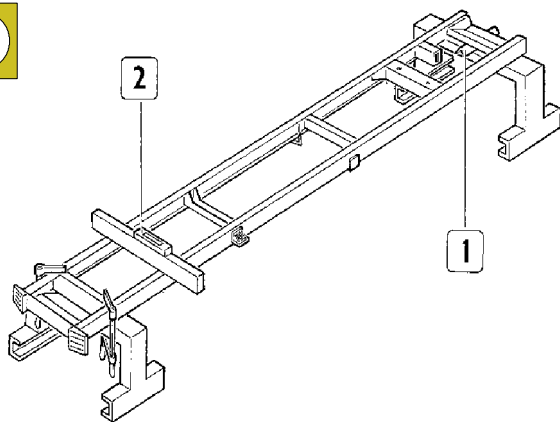


17356

First compare the distance of points "a" and "b". Then carry out diagonal measuring (distance "c" and "d") from point (2, Figure 26) on the front to the right and point (1, Figure 26) on the rear to the left and in the opposite directions.

Finding chassis twist

Figure 27



17357

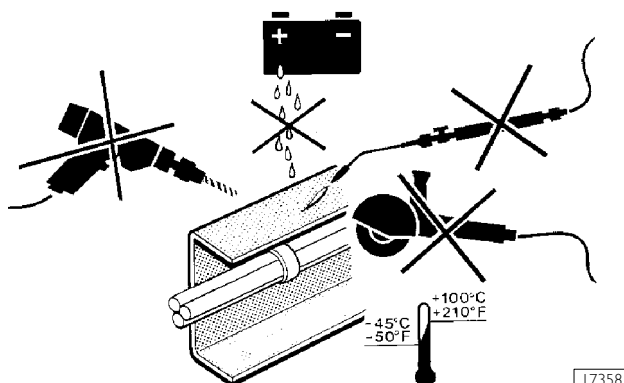
Slight torsion may only be detected with the cab and mechanical units removed. To make the check, proceed as follows:

- ☐ place the chassis on two stands;
- ☐ fasten one side of the chassis to the stand with two clamps;
- ☐ set the other side of the chassis on the knee of an "L" iron (1, Figure 27) in central position under the rear cross member;
- ☐ place a ruler in cross position and a spirit level (2, Figure 27) on the ruler and check the readings.

The same value should result at each check point, otherwise the chassis is deformed.

PRECAUTIONS

Figure 28

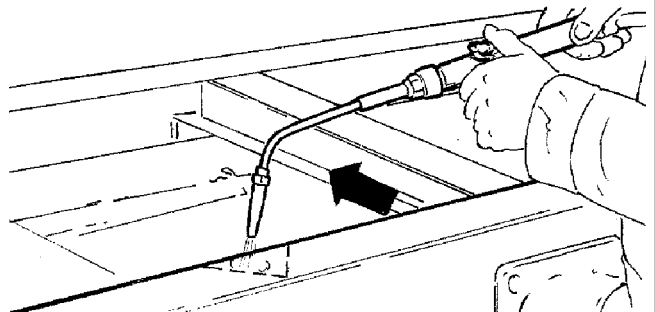


17358

When welding, drilling, grinding or cutting near the pipes of the braking system, especially near plastic parts or electrical wiring, take adequate precautions to protect them, and if necessary, remove them. All parts of the chassis that are re-conditioned are to be protected from oxidation and corrosion.

Protection and painting operations are to be carried out accurately on all the parts involved, following any instructions, methods, and preventive precautions indicated by the paint manufacturers.

Figure 29



17359

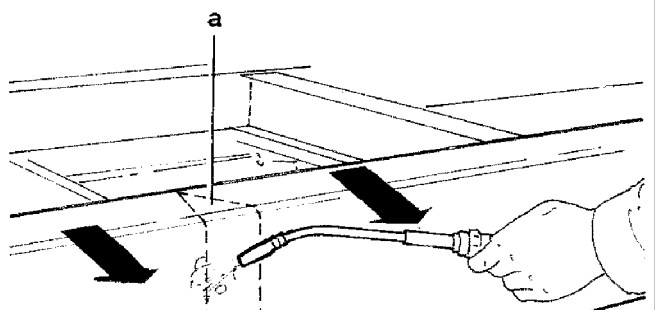
The chassis reconditioning is obtained by wedge heating the part concerned with a torch.

During this operation the metal must become cherry red coinciding with a temperature ranging between 600 and 680°C.

The points already heated must not be re-heated.

Let the heated points cool slowly without using water, compressed air or other cooling agents.

Figure 30



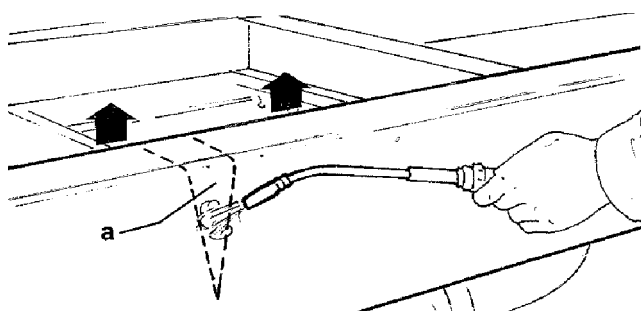
17360

Straighten chassis lateral bending by wedge heating the upper and lower edge of the chassis length concerned.

The wedge point must be in the desired bending direction.

If the base (a, Figure 30) of the two wedges is on the upper edge plate of the side member, the plate must also be heated, but last.

Figure 31



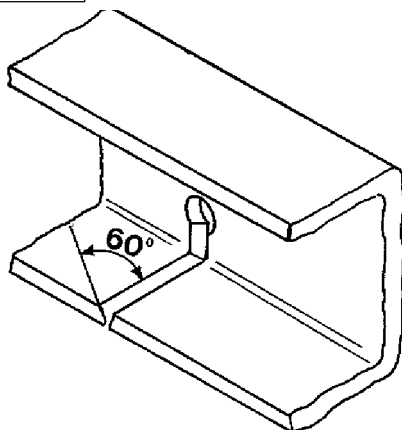
17361

Straighten the chassis up or down bending by wedge heating the upper edge plate of the side member. When bending down, the base of the wedge (a) is down, for up bending the base is up.

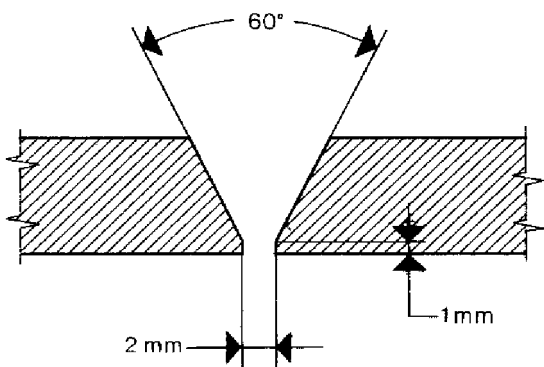
The relevant lower or upper edge plate of the side member is to be heated last in the area where the wedge base lays.

Welds on the chassis

Figure 32



17362



17363

Before starting to weld, remove the negative battery terminal and connect the welding machine earth directly on the part to be welded. Plastic hoses must be protected or removed. Excellent workmanship is essential and welding shall only be carried out by skilled and trained operators using suitable

equipment.

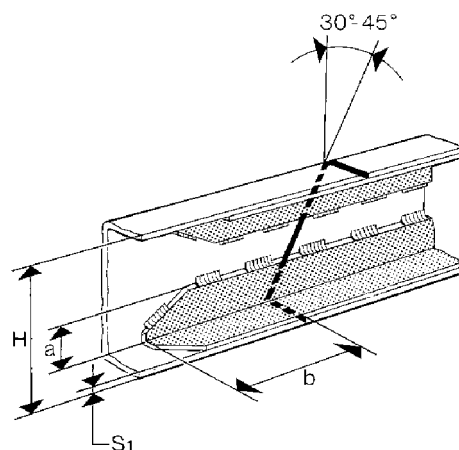
Strip off the paint and remove rust from the parts to be welded.

Make a V chamfer of 60° on the broken point in the inner part of the side member along the entire length concerned.

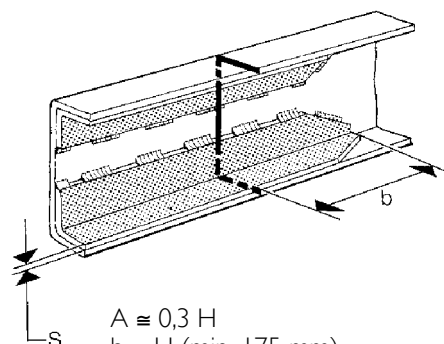


No cuts are admitted on the side members in areas where the profile changes or in the points subject to heavy stress, moreover, the parting line is not to involve any holes on the side member.

Figure 33



17364



17365

$$A \approx 0,3 H$$

$$b \approx H \text{ (min. 175 mm)}$$

$$S \approx (0,8 \div 1) S1$$

$$A \approx 0,3 H$$

$$b \approx H \text{ (min. 175 mm)}$$

$$S \approx (0,8 \div 1) S1$$

The operating instructions for correct welding are given here below:

- heat the areas to be welded (except material QST E 420); arc weld with several passes using basic electrodes suitably dried, or MIG-MAG weld with proper welding material. Avoid current overloads; welding must have no marginal indentation or slags;
- re-weld on the back, as specified in point (a, Figure 33);

- c) allow to cool slowly and evenly. Cooling with air jets or other means is not allowed;
- d) grind surface to remove excess material;
- e) apply steel stiffening angle irons having the same characteristics as the chassis; minimum suggested dimensions are indicated in the figures above. They are only to be fixed to the vertical length of the side member; and welding seams, false spots, nails or screws may be used. Welding seam section and length, number and distribution of false spots, screws or nails must be suitable to transmit moments of flexure and shearing stress of the section. When the job has been completed the welded part must be protected with rust preventer paint.