Daily Euro 4

REPAIR MANUAL

MECHANICAL
ELECTRIC/ELECTRONIC

IVECO

"This document provides data, characteristics, instructions and methodology to perform repair interventions on the vehicle and its components.

Anyhow, this document is addressed to qualified and specialised personnel. Iveco commercial and assistance network personnel as well as all Iveco authorised points of assistance are specifically qualified and equipped to perform the repair interventions that are indicated in this document.

Before performing any intervention, check to have available the document relating to the vehicle model on which the intervention is being performed and also make sure that all accident prevention devices, such as, as a rough guide, goggles, helmet, gloves, shoes, as well as work tooling, lifting and transport tooling, etc., are available and efficient, and further make sure that the vehicle is put such a way that an intervention can be made in safety conditions.

Making interventions strictly observing the indications given here, as well as using specific tooling indicated, assures a correct repair intervention, execution timing observance and operators' safety.

Each repair intervention must be finalised to the recovery of functionality, efficiency and safety conditions that are provided by Iveco.
Each intervention, on the vehicle, that is finalised to a modification, alteration or else, which is not authorised by Iveco, involves the exclusion of any responsibility for Iveco, and, in particular, where the vehicle is covered by a guarantee, each such intervention involves an immediate lapse of the guarantee.

Responsibility for Iveco in repair intervention execution is excluded.

Iveco is available to provide all clarifications necessary to make interventions, as well as to provide indications in cases and situations not included in this document.

Data and information contained in this document could result not to be updated owing to modifications made by Iveco at any moment for technical or commercial reasons, or because of the need to adapt the vehicle to law requirements in different countries.

In the case of a difference between what contained here and what actually found on the vehicle, please contact Iveco network before making any intervention."

The data contained in this publication might fail to reflect the latest changes which the Manufacturer may introduce at any time, for technical or sales purposes, or to meet the requirements of local legislation.

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PRELIMINARY REMARKS

Manuals for repairs are split into Sections, each one of which is marked by a numeral; the contents of these sections are indicated in the general table of contents.
Each section is generally dedicated to a main Unit (e.g.: engine, gearbox, electric system, etc.).
Sections with mechanical contents include technical data, tightening torque collections, tool lists, connections – disconnections of units to/from the vehicle, overhauls at the bench and relating troubleshooting.
On the electric/electronic system section there are the descriptions of the electric network and vehicle electronic systems, electric schemes, components electric characteristics, components codes and troubleshooting relating to the central units specific of the electric system.
The manual uses proper symbols in its descriptions; the purpose of these symbols is to classify contained information. In particular, there have been defined a set of symbols to classify warnings and a set for assistance operations.

SYMBOLS - WARNINGS

Danger for persons
Missing or incomplete observance of these prescriptions can cause serious danger for persons' safety.

Danger of serious damage for the vehicle
Partial or complete non observance of these prescriptions can cause serious damages to the vehicle and sometimes guarantee lapse too.

General danger
It includes the dangers of above described signals.

Environment protection
It indicates correct behaviour in order that vehicle use is environmentally friendly as much as possible.

NOTE It indicates an additional explanation for a piece of information.

SYMBOLS - ASSISTANCE OPERATIONS

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

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

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PRODUCT CODE

Each title or subtitle concerning operations being performed is preceded by a six-figure number named PRODUCT CODE. This number represents the **PRODUCT CODE** referred to by the repair operation contained in both REPAIR TIMES and TROUBLE CODE document.
As a quick reference there are shown below the guide lines to read this code (see Repair Timing, too).

Product Code:

PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT	PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT
5 0			**7 6**		

The first and second figures identify the PRODUCT within motor vehicle.

Example :

Product	50	=	Vehicle chassis;
Product	52	=	Axles;
Product	53	=	Transmission;
Product	76	=	Electric ssystem.

Unit Code:

PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT	PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT
	0 1			**0 3**	

The third and fourth figures identify the UNIT within the PRODUCT.

Example :

Product	50	=	Vehicle chassis;
Unit	01	=	Chassis;
Unit	02	=	Bumpers;
Unit	03	=	Alternator.

Sub-assembly Code:

PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT	PRODUCT	UNIT	SUB-ASSEMBLY COMPONENT
		4 0			**1 3**

The fifth and sixth figures exactly identify the SUB-ASSEMBLY and Component of a Unit within a PRODUCT.

Example :

Product	50	=	Vehicle chassis;
Unit	01	=	Chassis;
Sub-assembly	40	=	Chassis cross members;
Sub-assembly	13	=	Rotor.

GENERAL WARNINGS

!

Warnings shown cannot be representative of all danger situations possibly occurring. Therefore, it is suggested to contact immediate superiors where a danger situation occurs which is not described.

Use both specific and general-purpose toolings according to the prescriptions contained in respective use and maintenance handbooks. Check use state and suitability of tools not subjected to regular check.

The manual handling of loads must be assessed in advance because it also depends, besides weight, on its size and on the path.

Handling by mechanical means must be with hoisters proper as for weight as well as for shape and volume. Hoisters, ropes and hooks used must contain clear indications on maximum carrying capacity acceptable. The use of said means is compulsorily permitted to authorised personnel only. Stay duly clear of the load, and, anyhow, never under it.

In disassembling operations, always observe provided prescriptions; prevent mechanical parts being taken out from accidentally striking workshop personnel.

Workshop jobs performed in pairs must always be performed in maximum safety; avoid operations which could be dangerous for the co-operator because of lack of visibility or of his/her not correct position.

Keep personnel not authorised to operations clear of working area.

Learn operation and safety knowledge necessary relating to the vehicle prior to each intervention on it. Scrupulously observe all safety warnings on the vehicle. Apply suitable signals for the vehicles being repaired. Once the repair intervention has been completed, before starting up the vehicle, perform all checks indicated on paragraph "Controls care of user" of Use and Maintenance handbook.

In lack of visibility in operating from the vehicle, charge a person on the ground with assistance. Do not leave unmanned a vehicle in motion during repair interventions.

Keep the vehicle stationary by proper chocks.

In the case of an intervention on a vehicle lifted from the ground, check the vehicle to be quite steady on special support stands and, in the case of lifting by means of a lift, check manual/automatic safeties to be activated.

When it is necessary to perform an intervention on methane-fed vehicles, observe the indications contained inside the document, as well as all specific safety regulations provided.

Only remove radiator cap when the engine is cold by cautiously unscrewing it in order to let system residual pressure out.

Inflammable fuel and all inflammable fluids and liquids must be handled with care, according to what contained on harmful materials 12-point cards. Refuelling must be performed outdoors with the engine off, avoiding lit cigarettes, free flames or sparks in order to prevent sudden fires/bursts. Adequately store inflammable, corrosive and polluting fluids and liquids according to what provided by regulations in force. Compulsorily avoid to use food containers to store harmful liquids. Avoid to drill or bore pressurised containers, and throw cloths impregnated with inflammable substances into suitable containers.

Worn out, damaged or consumable parts must be replaced by Iveco original spares.

During workshop activity, always keep the work place clean; timely clear or clean floors from accidental liquid or oil spots. Electric sockets and electric equipment necessary to perform repair interventions must meet safety rules.

For every intervention on vehicle hydraulic, pneumatic, conditioning and AIR - BAG systems, scrupulously observe indications specified in relating manual sections.

GENERAL WARNINGS

Put on, where required by the intervention, garments and protections provided in accident prevention rules; contact with moving parts can cause serious injuries. Use suitable, preferably tight-fitted garments, and avoid to use jewels, scarves, etc.

Do not leave the engine in motion at workshop locations not provided with a pipe to scavenge exhaust gas outside.

Avoid to breathe fumes coming from heating or from paint welding because they can cause damages to health; operate outdoors or in suitably ventilated areas. Put on proper inspirator if paint powder is present.

Avoid contact with hot water or steam coming from the engine, radiator and pipings because they could cause serious burns. Avoid direct contact with liquids and fluids present in vehicle systems; where an accidental contact has occurred, refer to 12-point cards for provisions to make.

Clean units or assemblies detached from the vehicle and carefully check their integrity before overhaul. Tidy up detached or disassembled parts with their securing elements (screws, nuts, etc.) into special containers.

Check for the integrity of the parts which prevent screws from being unscrewed: broken washers, dowels, clips, etc. Self-locking nuts with an insert made of nylon must always be replaced.

Avoid contact of rubber parts with diesel oil, petrol or other not compatible substances.

Before washing under pressure mechanical parts, protect electric connectors, and central units, if present.

Tightening screws and nuts must always be according to prescriptions; IVECO commercial and assistance network is available to give all clarifications necessary to perform repair interventions not provided in this document.

Before welding:

- Disconnect all electronic central units, take power cable off battery positive terminal (connect it to chassis bonding) and detach connectors.
- Remove paint by using proper solvents or paint removers and clean relevant surfices with soap and water.
- Await about 15 minutes before welding.
- Equip with suitable fire resistant protections to protect hoses or other components where fluids or other materials flow which may catch fire easily on welding.

Should the vehicle be subjected to temperatures exceeding 80°C (dryer ovens), disassemble drive electronic central units.

The disposal of all liquids and fluids must be performed with full observance of specific rules in force.

GENERAL WARNINGS ON THE ELECTRIC SYSTEM

If an intervention has to be made on the electric/electronic system, disconnect batteries from the system; in this case, always disconnect, as a first one, the chassis bonding cable from batteries negative terminal.

Before connecting the batteries to the system, make sure that the system is well isolated.

Disconnect the external recharging apparatus from the public utility network before taking apparatus pins off battery terminals.

Do not cause sparks to be generated in checking if the circuit is energised.

Do not use a test lamp in checking circuit continuity, but only use proper control apparatuses.

Make sure that the electronic devices wiring harnesses (length, lead type, location, strapping, connection to screening braiding, bonding, etc.) comply with IVECO system and are carefully recovered after repair or maintenance interventions.

Measurements in drive electronic central units, plugged connections and electric connections to components can only be made on proper testing lines with special plugs and plug bushes. Never use improper means like wires, screwdrivers, clips and the like in order to avoid the danger of causing a short circuit, as well as of damaging plugged connections, which would later cause contact problems.

To start up the engine, do not use fast chargers. Start up must only be performed with either separate batteries or special truck.

A wrong polarisation of supply voltage in drive electronic central units (for instance, a wrong polarisation of batteries) can cause them to be destroyed.

Disconnect the batteries from the system during their recharging with an external apparatus.

On connecting, only screw up connector (temperature sensors, pressure sensors etc.) nuts at prescribed tightening torque.

Before disconnecting the junction connector from an electronic central unit, isolate the system.

Do not directly supply electronic central units servo components at nominal vehicle voltage.

Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Once the intervention on the electric system has been completed, recover connectors and wiring harnesses according to original arrangement.

Key memorisation procedures are influenced by electromagnetic jamming (mobile phones, etc.). Therefore, during key memorisation:

1. Pay attention that jamming sources are not present in the cab or near the keys.
2. Keys not insered in the panel must be at least 1 meter away.

NOTE Connectors present must be seen from cable side. Connectors views contained in the manual are representative of cable side.

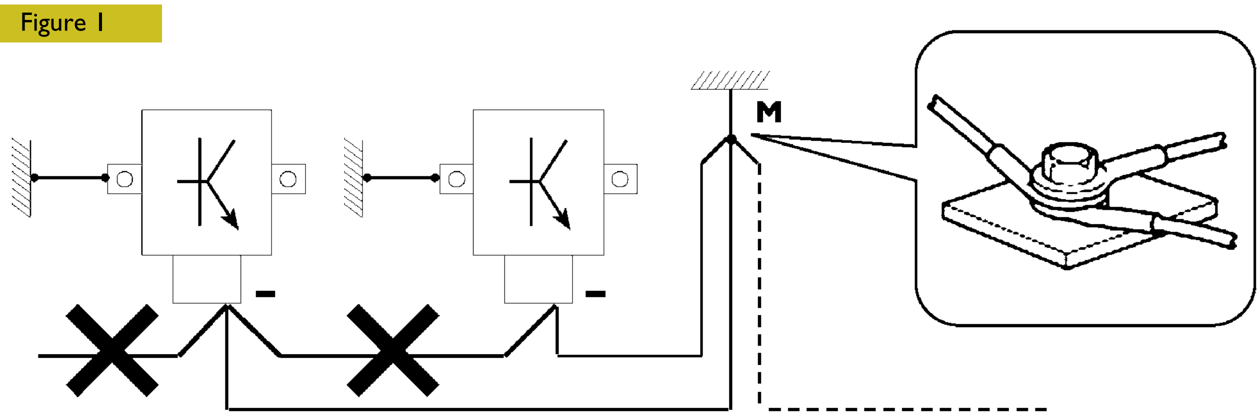
Bonding and screening

Negative leads connected to a system bonded point must be both as short and possible and "star"-connected to each other, trying then to have their centering tidily and properly made (Figure 1, re. M).

Further, following warnings are to be compulsorily observed for electronic components:

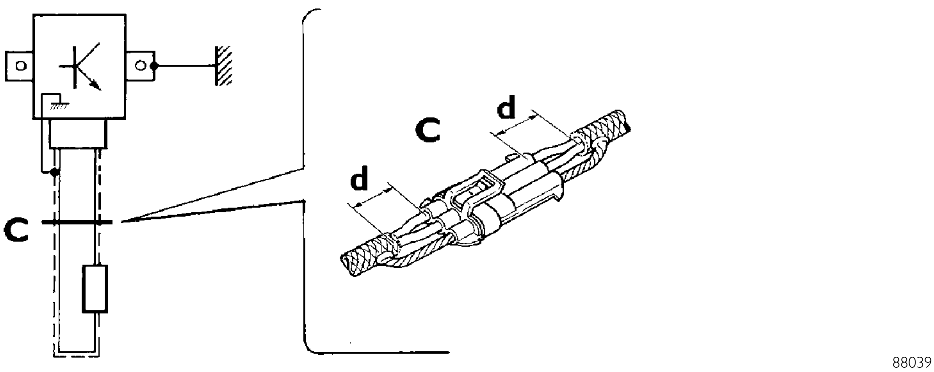
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative terminal.
- Analog bonding (sensors), although not connected to battery negative system/terminal bonding, must have optimal isolation. Consequently, particularly considered must be parasitic resistances in lugs: oxidising, clinching defects, etc.
- Screened circuits braiding must only electrically contact the end towards the central unit entered by the signal (Figure 2).
- If junction connectors are present, unscreened section **d**, near them, must be as short as possible (Figure 2).
- Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Figure 1



1. NEGATIVE CABLES "STAR" CONNECTION TO SYSTEM BONDING **M**

Figure 2



2. SCREENING THROUGH METALLIC BRAIDING OF A CABLE TO AN ELECTRONIC COMPONENT – **C.** CONNECTOR
d. DISTANCE → 0

OPTIONAL ELECTRICAL AND MECHANICAL PARTS INSTALLATIONS

Accessories mounting, additions and modifications on the vehicle are to be performed complying with IVECO mounting instructions (specific document "Instructions for transformation and preparation" is available at Assistance Network workshops).
It is reminded that, especially about the electric system, several electric sockets are provided for as series (or optional) sockets in order to simplify and normalise the electrical intervention that is care of preparation personnel.
For any exception to mounting instructions, IVECO's authorisation is necessary.
Lack of observance of above described prescriptions involves guarantee lapse.

It is absolutely forbidden to make modifications or connections to electric central units wiring harnesses; in particular, the data interconnection line between central units (CAN line) is to be considered inviolable.

CONVERSIONS BETWEEN THE MAIN UNITS OF MEASUREMENT OF THE INTERNATIONAL SYSTEM AND MOST USED DERIVED QUANTITIES

Power

1 kW	=	1.36 metric HP
1 kW	=	1.34 HP
1 metric HP	=	0.736 kW
1 metric HP	=	0.986 HP
1 HP	=	0.746 kW
1 HP	=	1.014 metric HP

Torque

1 Nm	=	0.1019 kgm
1 kgm	=	9.81 Nm

Revolutions per time unit

1 rad/s	=	1 rpm x 0.1046
1 rpm	=	1 rad/s x 9.5602

Pressure

1 bar	=	1.02 kg/cm^2
1 kg/cm^2	=	0.981 bar
1 bar	=	10^5 Pa

Where accuracy is not particularly needed:

- Nm unit is for the sake of simplicity converted into kgm according to ratio 10:1

1 kgm = 10 Nm;

- bar unit is for the sake of simplicity converted into kg/cm^2 according to ratio 1:1

1 kg/cm^2 = 1 bar.

Temperature

0° C = 32° F
1° C = (1 x 1.8 + 32) ° F

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Base – March 2006

UPDATE DATA

Section	Description	Page	Revision date

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INDEX OF SECTIONS

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SECTION 1

General

Page

IDENTIFICATION DATA

Vehicle identification plate

Plate legend

1) Approval number
2) Chassis number
3) PTT - Total weight on ground
4) MTC - Total combined weight
5) Max. weight permitted on the front axle
6) Max. weight permitted on the rear axle
7) Specific indication of type
8) Wheelbase (mm)
9) Type of engine
10) Engine rating
11) Permitted smoke level
12) Place of manufacture
13) Number of vehicle axles

Figure 1

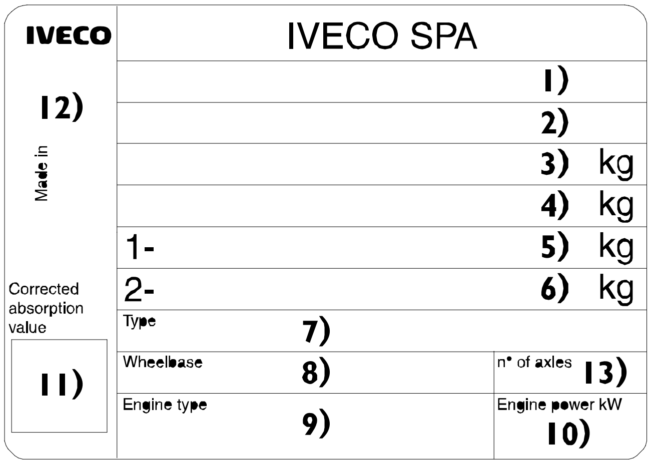

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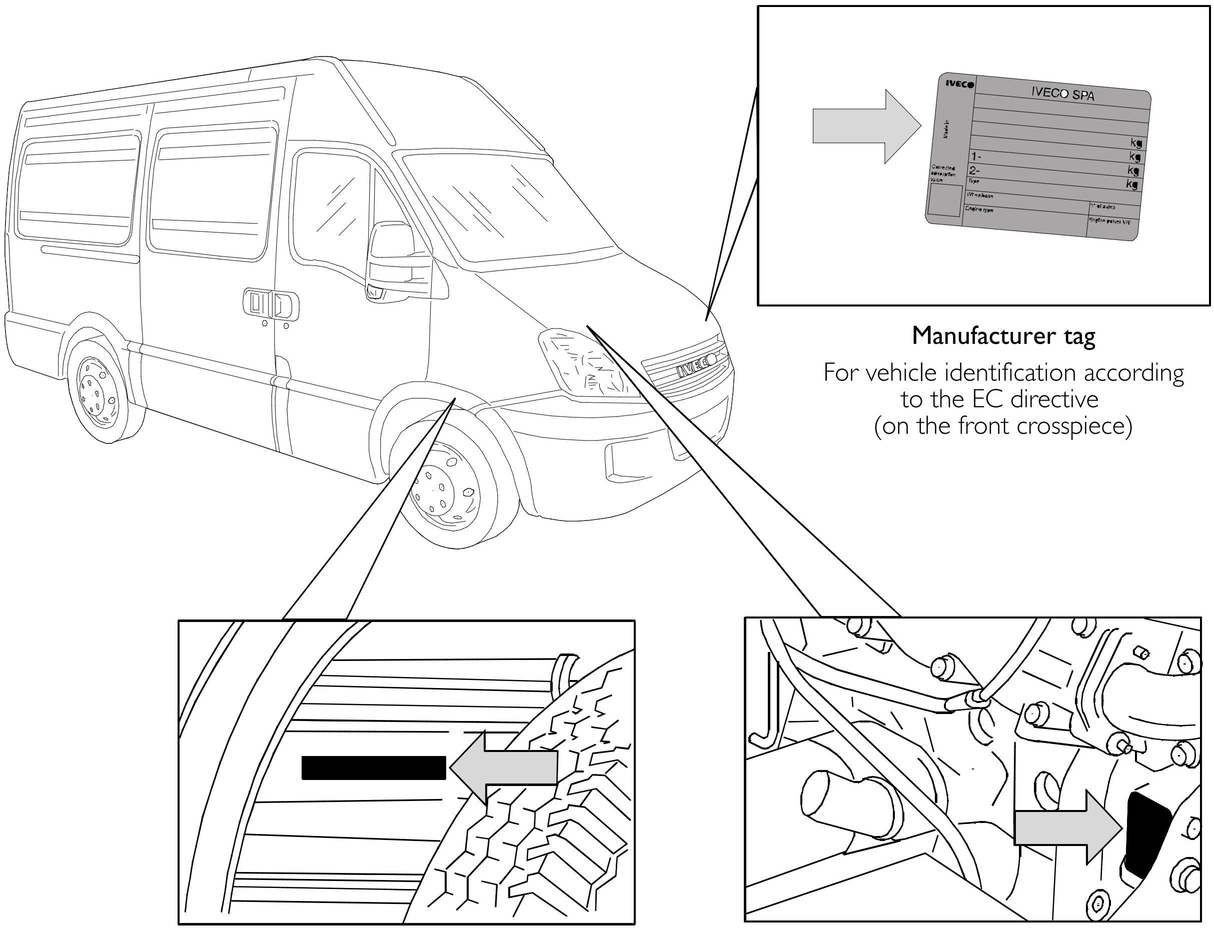
Figure 2



Manufacturer tag

For vehicle identification according to the EC directive (on the front crosspiece)

Chassis

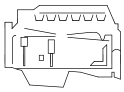
Stamping (at the front on the chassis right-hand side-member)

Engine

Stamping (on the right side on the engine base)

108533

COMPOSITION OF MODELS

ASSEMBLIES	MODELS		29 L 10	29 L 12	29 L 14	35 S 10	35 S 12	35 S 14	35 S 18	35 C 10	35 C 12	35 C 14	35 C 15	35 C 18	40 C 10	40 C 12	40 C 15	40 C 18
	F1AE0481A*A - F1AE0481A*B (OPT. DPF) 96 CV		o			o				o					o			
	F1AE0481G*A - F1AE0481G*B (OPT. DPF) 116 CV			o			o				o					o		
	F1AE0481H*A - F1AE0481H*B (OPT. DPF) 136 CV				o			o				o						
	F1CE0481F*A - F1CE0481F*B (OPT. DPF) 146 CV												o				o	
	F1CE0481F*C (DPF series) 146 CV																	
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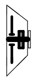	Single disk 9" 1/4		o	o		o	o			o	o				o	o		
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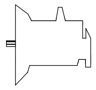	ZF 5 S300		□	□	□	□	□	□		□	□	□			□	□		
	ZF 6 S400 O.D.								□				□	□			□	□
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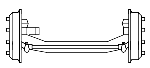	5817		o	o	o	o	o	o	o									
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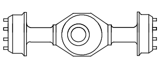	NDA R.S.		o	o	o	o	o	o	o									
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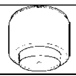
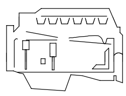
	450517/2																	
Rack-and-pinion	Powered steering		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
	FRONT MECHANICAL SUSPENSIONS: independent with transverse leaf spring (MK3)		o	o	o	o	o	o	o		o	o	o	o				
	independent with torsion bars									(•)	(•)	(•)	(•)	(•)	o	o	o	o
	REAR MECHANICAL SUSPENSIONS:	Parabolic	o	o	o	o	o	o	o	◇	◇	◇	◇	◇	◇	◇	◇	◇
		- single leaf	o	o	o	o	o	o	o									
		- reinforced	o	o	o	o	o	o	o									
		Semi-elliptical								⁘	⁘	⁘	⁘	⁘	⁘	⁘	⁘	⁘
		Semi-elliptic with leaf spring								◆	◆	◆	◆	◆	◆	◆	◆	◆
	REAR AIR SUSPENSIONS		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

O.D. = Over Drive
(•) Optional extra (with max load of 1900 kg)
o Standard
• with ZF 6 S 400 A O.D. gearbox
□ Alternative
◙ Vehicles with front suspension with transverse leaf spring
◈ Vehicles with front suspension with torsion bars
◆ Chassis cabs only, as an alternative

⁘ Standard on chassis cabs, Alternatively on Vans – Chassis Cowls and Cut Aways
◇ Standard on Vans, Chassis Cowls and Cut Aways – Alternatively on Chassis Cabs
S Single rear wheels
L Light with single rear wheels
C Twin rear wheels

COMPOSITION OF MODELS

ASSEMBLIES	MODELS	45 C 15	45 C 18	50 C 15	50 C 18	60 C 15	60 C 18	65 C 15	65 C 18
	F1AE0481A*A - F1AE0481A*B (OPT. DPF) 96 CV								
	F1AE0481G*A - F1AE0481G*B (OPT. DPF) 116 CV								
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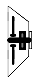	Single disk 9" 1/4								
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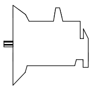	ZF 5 S300								
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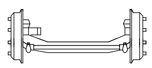	5817								
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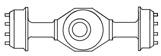
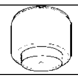
	NDA R.S.								
	NDA R.G.								
	450511	o	o	o	o				
	450517/2					o	o	o	o
Rack-and-pinion	Power steering	o	o	o	o	o	o	o	o
	FRONT MECHANICAL SUSPENSIONS: independent with transverse leaf spring (MK3)								
	independent with torsion bars	o	o	o	o	o	o	o	o
	Parabolic	◇	◇	◇	◇	◇	◇	◇	◇
	- single leaf								
	- reinforced								
	Semi-elliptical	∷	∷	∷	∷	∷	∷	∷	∷
	Semi-elliptic with leaf spring	◆	◆	◆	◆	◆	◆	◆	◆
	REAR AIR SUSPENSIONS	□	□	□	□	□	□	□	□

O.D. = Over Drive
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◙ Vehicles with front suspension with transverse leaf spring
◈ Vehicles with front suspension with torsion bars
◆ Chassis cabs only, as an alternative
∷ Standard on chassis cabs, Alternatively on Vans – Chassis Cowls and Cut Aways
◇ Standard on Vans, Chassis Cowls and Cut Aways – Alternatively on Chassis Cabs
S Single rear wheels
L Light with single rear wheels
C Twin rear wheels

ALPHANUMERICAL CODING FOR VEHICLE IDENTIFICATION

CUSTOMIZED VEHICLE (V.P.)

MARKET VEHICLE (V.M.)

STANDARD VEHICLE (V.C.B.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14

RANGE

1	2	3	4	5	6	7	8	9	10	11	12	13	14

A → **LIGHT ROAD VEHICLES**

PROGRAMMING FAMILY

1	2	3	4	5	6	7	8	9	10	11	12	13	14

A	T 25C	29 L	**CHASSIS CABS AND DERIVATIVES**
B	T 30C	35 S	
C	T 35C	35 C	
D	T 40C	40 C	
E	T 50C	50 C 45 C	
F	T 65C	60 C 65 C	

PROGRAMMING FAMILY

1	2	3	4	5	6	7	8	9	10	11	12	13	14

H	T 25V	29 L	VANS AND DERIVATIVES
K	T 30V	35 C	
J	T 35V	35 C	
L	T 40V	40 C	
M	T 50V	50 C 45 C	
N	T 65V	60 C 65 C	

ENGINE

1	2	3	4	5	6	7	8	9	10	11	12	13	14

A → F1A E4 LD - 96 CV

B → F1A E4 LD - 116 CV

C → F1A E4 LD - 136 CV

D → F1C E4 HD - 146 CV

E → F1C E4 HD - 176 CV

E4 = Euro 4
LD = Light Duty
HD = Heavy Duty

SUSPENSION

1	2	3	4	5	6	7	8	9	10	11	12	13	14

A Mechanical suspension: front with transverse leaf spring.
B Mechanical suspension: front with torsion bars.
C Mechanical front suspension with transverse leaf spring – rear air suspension.
D Mechanical front suspension with torsion bars – rear air suspension.

VERSION

1	2	3	4	5	6	7	8	9	10	11	12	13	14

1	**CHASSIS CAB**	**29 L10** (•) **- 29 L12** (•) **- 29 L14 (•)** **35 S10** (•) **- 35 S12** (•) **- 35 S14** (•) **- 35 S18** (•) **35 C10** (•) **- 35 C12** (•) **- 35 C15** (•) **- 35 C18** (•) **40 C10** (•) **- 40 C15** (•) **- 40 C18** (•) **45 C15** (•) - **50 C15** (•) **- 50 C18** (•) **60 C15** (•) **- 60 C18** (•) **65 C15** (•) **- 65 C18** (•)
6	**CHASSIS CAB 6 + 1**	**29 L10 D** (•) **- 29 L12 D** (•) **- 29 L14 D** (•) **-** **35 S10 D** (•) - **35 S12 D** (•) **- 35 S14 D** (•) **-** **35 S18 D** (•) **- 35 C10 D** (•) **- 35 C12 D** (•) **-** **35 C15 D** (•) - **35 C18 D** (•) **- 40 C10 D** (•) **-** **40 C12 D** (•) **- 45 C15 D** (•) **- 45 C18 D** (•) **50 C18 D** (•) - **60 C15 D** (•) **- 60 C18 D** (•) **-** **65 C15 D** (•) **- 65 C18 D** (•)
0	**CHASSIS COWL**	**35 S12 CC** (•) **- 35 S 14 CC** (•) **- 35 S18 CC** (•) **-** **35 C12 CC** (•) **- 35 C15 CC** (•) - **35 C18 CC** (•) **-** **40 C12 CC - 40 C15 CC** (•) **- 40 C18 CC** (•) **45 C15 CC - 45 C18 CC** (•) **50 C15 CC** (•) **- 50 C18 CC** (•) **60 C18 CC** (•) **- 65 C18 CC** (•)
R	**CHASSIS COWL SHORT**	**35 S12 CCR** (•) - **35 S14 CCR** (•) **- 35 S18 CCR**(•) **35 C12 CCR** (•) **- 35 C15 CCR** (•) **- 35C18CCR**(•) **40 C12 CCR** (•) **- 40 C15 CCR** (•) - **40C18CCR**(•) **45 C15 CCR** (•) **- 45 C18 CCR** (•) **50 C15 CCR** (•) **- 50 C18 CCR** (•) **60 C18 CCR** (•) **- 65 C18 CCR** (•)

(•) Also available in the A (automatic transmission) and /P (pneumatic rear suspensions) versions.

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VERSION

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14

A	**CUT-AWAY**	**35 C10 CA** (•) **- 35 C12 CA** (•) **40 C10 CA** (•) **- 40 C12 CA** (•) **45 C18 CA** (•) **- 50 C18 CA** (•) **60 C18 CA** (•) **- 65 C18 CA** (•)
4	**VAN**	**29 L10 V** (•) **- 29 L12 V** (•) **- 29 L14 V** (•) **35 S10 V** (•) **- 35 S12 V** (•) **- 35 S14 V** (•) **35 S18 V** (•) **35 C10 V** (•) **- 35 C12 V** (•) **- 35 C15 V** (•) **35 C18 V** (•) **40 C12 V** (•) **- 40 C15 V** (•) **- 40 C18 V** (•) **45 C15 V** (•) **- 45 C18 V** (•) **50 C15 V** (•) **- 50 C18 V** (•) **60 C15 V** (•) **- 60 C18 V** (•) **65 C15 V** (•) **- 65 C18 V** (•)
V	**SEMI-GLAZE D VAN**	**29 L10 SV** (•) **- 29 L12 SV** (•) **- 29 L14 SV** (•) **35 S10 SV** (•) **- 35 S12 SV** (•) **- 35 S14 SV** (•) **-** **35 S18 SV** (•) **35 C10 SV** (•) **- 35 C12 SV** (•) **- 35 C15 SV** (•) - **35 C18 SV** (•) **40 C10 SV** (•) **- 40 C12 SV** (•) **- 40 C15 SV** (•) **-** **40 C18 SV** (•) **-** **45 C15 SV** (•) **- 45 C18 SV** (•) **50 C15 SV** (•) **- 50 C18 SV** (•)
U	**VENDOR VERSION CITY VAN**	**35 S12 CV** (•) **- 35 S14 CV** (•) **35 C12 CV** (•) **- 40 C12 CV -** **45 C15 CV** (•) - **45 C18 CV** (•) **50 C15 CV** (•) **- 50 C18 CV** (•)
5	**COMBI**	**29 L14 C** (•) **- 35 S14 C** (•)
8	**CAMPER**	**35 S14** (•) **- 35 S18** (•) **35 C14** (•) **- 35 C18** (•)
9	**CHASSIS-COWL SHORT VERSION FOR CAMPER VAN**	**35 S14 CCRC** (•) **- 35 S18 CCRC -** **35 C14 CCRC** (•) **- 35 C18 CCRC**

(•) Also available in the A (automatic transmission) and /P (pneumatic rear suspensions) versions.

WHEELBASE

1	2	3	4	5	6	7	8	9	10	11	12	13	14

1 **3000 mm (T25C - T30C - T35C - T40C - T25V - T30V - T35V - T40V - T50V)**

2 **3000 L mm (T25V - T30V - T35V - T40V - T50V)**

3 **3300 mm (T25V - T30V - T35V - T40V - T50V)**

4 **3450 mm (T25C - T30C - T35C - T40C - T50C - T65C)**

5 **3750 mm (T30C - T35C - T40C - T50C - T65C)**

6 **3950 L mm (T30V - T35V - T40V - T50V - T65V)**

7 **4100 mm (T35C - T40C)**

8 **4350 mm (T50C - T65C)**

9 **4750 mm (T50C - T65C)**

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GEARBOX

1 2 3 4 5 6 7 8 9 10 11 12 13 14

A **5 SPEED** **(5 S 300)**

B **6 SPEED** **(6 S 400 O.D.)**

C **6 SPEED** **(6 S 400 A O.D.)**

A Automated
O.D. Over Drive

DRIVE – INTERNAL HEIGHT OF LOADING BAY

1 2 3 4 5 6 7 8 9 10 11 12 13 14

LEFT-HAND DRIVE
(T25C - T30C - T35C - T40C - T50C) — 1

LEFT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_1 = 1545 mm
(T25V - T30V - T35V - T40V - T50V) — 1

LEFT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_2 = 1900 mm
(T25V - T30V - T35V - T40V - T50V) — 2

LEFT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_3 = 2100 mm
(T30V - T35V - T40V - T50V) — 3

RIGHT-HAND DRIVE
(T25C - T30C - T35C - T40C - T50C) — A

RIGHT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_1 = 1545 mm
(T25V - T30V - T35V - T40V - T50V) — A

RIGHT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_2 = 1900 mm
(T25V - T30V - T35V - T40V - T50V) — B

RIGHT-HAND DRIVE AND INTERNAL HEIGHT OF LOADING BAY H_3 = 2100 mm
(T30V - T35V - T40V - T50V - T65V) — C

MANDATORY MARKET OPTIONAL EXTRAS

1 2 3 4 5 6 7 8 9 10 11 12 13 14

OPTIONAL EXTRAS REQUIRED BY THE CUSTOMER

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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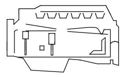
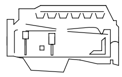
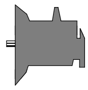
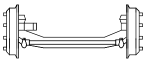
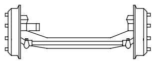
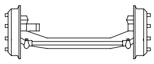
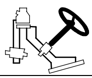
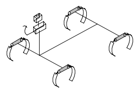
REPLENISHING FLUIDS

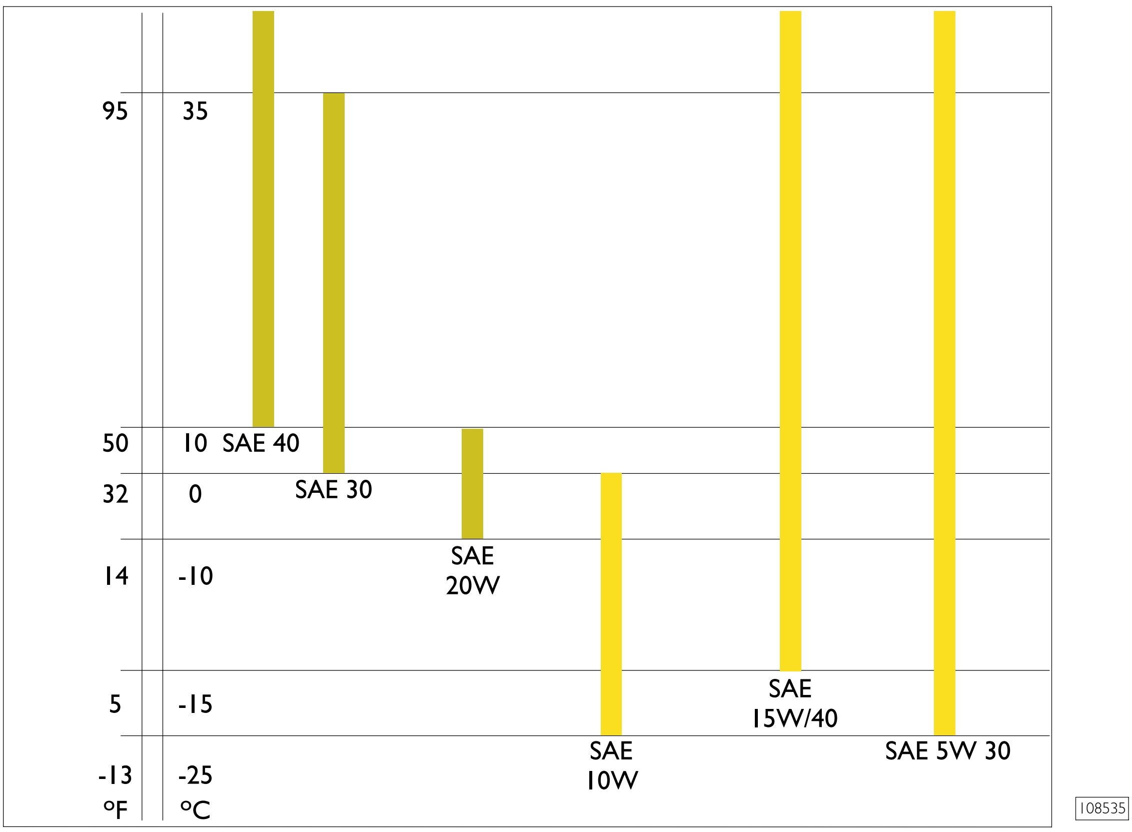
IVECO RECOMMENDED LUBRICANTS		PARTS TO BE REPLENISHED	Quantity Litres	Quantity kg
Urania Daily Urania LD 5		Quantity of oil in circulation in the cartridge filter and heat exchanger	1.4	1.23
		Total dry engine capacity	5.7	5.02
		Sump capacity: - max level - min level	 4.3 3	 3.78 2.65
		Quantity of oil in circulation in the cartridge filter and heat exchanger	1	0.88
		Total dry engine capacity	7.6	6.79
		Sump capacity: - max level - min level	 6.6 4.29	 5.81 3.78
Max. gradient negotiable by vehicle uphill/downhill with oil at minimum level 30%				
Tutela TRUCK GEARLITE		Gearbox ZF 5S 300	2	1.8
		ZF 6S 400 O.D.	2.2	1.98
		ZF 6S 400 A O.D.	2.7	2.43
		Front axle:		
		5817	-	-
		5818	-	-
		5819	-	-
		5823	-	-
		Rear axles:		
Tutela W140/M-DA (SAE 80W90)		NDA R.S.	1.35	1.21
Tutela W90/M-DA (SAE 80W90)		NDA R.G.	1.35	1.21
Tutela W140/M-DA (SAE 85W140)		450511	1.9	1.65
Tutela W140/M-DA (SAE 85W140)		450517/2	3	2.7
Tutela GI/A		Power steering	1.4	1.3
Tutela TRUCK DOT SPECIAL		Brake circuit	1.11	1
Arexons DP1		Windscreen washer	5	4.5
Paraflu11 *		Cooling system	9	-

* = Protective anti-freeze (concentration 50%, freezing point –35°C)

International lubricant description	FL Group products
Engine oil meets specifications: ACEA B5 with synthetic base SAE 5W30 ACEA E3/E5 with mineral base SAE 15W40	Urania Daily Urania LD5
Differential and wheel hub oil meets specifications: API GL-5 with mineral base SAE 85W140 API GL-5 with mineral base SAE 80W90	Tutela W 140/M - DA (1) Tutela W 90/M - DA (2)
Mechanical gearbox oil containing non-EP anti-wear additives Meets specification API GL 4 SAE 75W80	Tutela Truck Gearlite
Hydrostatic transmission and power steering oil Meets specifications: ATF-DEXRON II D	Tutela GI/A
General-purpose grease lithium soap based grease N.L.G.I. fluidity no. 2	Tutela MR 2
Specific grease for wheel hubs and bearings lithium soap based grease N.L.G.I. fluidity no. 3	Tutela MR 3
Hydraulic brake and clutch control fluid In conformity with N.H.T.S.A. standards No. 116, ISO 4925 Standard SAE J 1703, IVECO STANDARD 18-1820	Tutela TRUCK DOT SPECIAL
Windscreen washer liquid Mixture of spirits, water and surfactants CUNA NC 956-11	Tutela Professional SC 35
Concentrated protective radiator fluid ethylene glycol based containing corrosion inhibitors, in conformity with Iveco Standard 18-1830	Paraflu[11] (3)

(1) Hot or temperate climate
(2) Specific for cold climes.
(3) 100% Paraflu to be diluted with water to 50%

Figure 3



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SECTION 2

5401 Engine

Page

F1A Engine

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MAIN OPERATIONS ON ENGINE MOUNTED ON VEHICLE

Keep to the following instructions before doing any work on the engine involving components of the fuel supply system.

- Before doing any work on the engine, perform the engine/vehicle fault diagnosis with specific IVECO diagnosis equipment and print out the results.
- Replacement of the MS6.3 or EDC 16control unit must be authorized by the **Help Desk.** Replacing operation requires reprogramming as described in specific section.
- Following components in feed system cannot be overhauled but have to be replaced: pressure relief valve, if present, fuel pressure sensor, hydraulic accumulator, complete CP1H high pressure feed pump, pressure control valve, electric injectors.
- All the parts of the Common Rail system are packaged by the supplier in sheets of oiled paper and are stored in cardboard boxes. They must therefore be protected against moisture and unpacked just prior to assembly.
- The greatest care must be taken over the cleanliness of parts, making sure that when handling or assembling (starting with straightforward filter and pre-filter replacement) no dirt of foreign bodies can get inside. For this reason, the plugs protecting the hydraulic parts and sensors must be removed just prior to positioning in their seats.
- Take care over the direction of assembly for all electrical connections.
- All threaded connections must be tightened to the prescribed torque.
- All the quick-coupling connectors (on the engine they are found on the high-pressure pump and on the diesel drain manifold) must be fully inserted. To drive them out, press on the tabs at the base of the connectors.

Electro-injector

None of the couplings/unions/nuts on the injector body may be handled. It is neither necessary nor permitted to dismantle the nozzle body or the electromagnet.
If working on the high-pressure pipe, the hexagon on the injector side must be kept stationary with a wrench.
Before working on pipes, make sure the injector is stationary in its seat on the cylinder head.
When assembling/disassembling the injector drain, the retaining spring must not be removed from its seat in the injector: pushing the spring towards the engine and applying a vertical force on the connector frees the recirculation. When assembling, rest the recirculation connector in its seat and apply a vertical force while keeping the retaining spring pressed in the direction of the engine. Fitting in has to be easy.
Replacing one or more electrical injectors requires central unit programming as described in specific section.

CP1H High-pressure pump

If working on the high-pressure pipe, the hexagon on the pump side must be kept stationary with a wrench.
Before working on the high-pressure pipe, make sure the pump is secured in its seat.

High-pressure pipes

Each high-pressure pipe must be replaced after disassembly operations.
The couplings must be tightened or loosened with the injectors, hydraulic accumulator (rail) and high-pressure pump well secured and taking care to keep the hexagon on the component side stationary, space permitting.

Hydraulic accumulator (rail) and accessories

The pressure sensor can be assembled five consecutive times; after that, it must be replaced. They must be lubricated with a thin layer of oil before being mounted..
Replacing the sensor requires central unit programming as described in specific section.

Service procedures to be performed after replacing high-pressure feeding system and/or exhaust gas post-treatment system components

To ensure correct operation of the engine, the CP1 control unit 16 stores, in the memory non-labile area, the information relative to the engine parameters originally set or acquired during engine operation.

As a result, after any of the operations below is carried out:

- replacing one or several injectors,
- replacing all the injectors,
- replacing the air flow meter,
- replacing the hydraulic accumulator pressure sensor (common rail),
- replacing the EDC control unit 16;
- changing the engine oil,
- replacing the D.P.F. catalyst,
- replacing the filter differential pressure (Dp) sensor,
- replacing any significant component as regards emission levels,
- performing forced regeneration,

the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, and the replacement procedure for the concerned component shall be performed, in accordance with the indications of the diagnosis instruments used.

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540110 POWER UNIT REMOVAL/REFITTING

Removal

Place the vehicle on the pit or auto lift.

Lift the engine hood (28), undo the fastening screws (28) and then remove the hood; remove supporting rod (30).

Disconnect negative cable (11) and positive cable (4) from battery (10), then remove the latter from the engine compartment.

Disconnect electric connections (5, 7, 8 and 9) and engine cable (6) from the EDC control unit, then release the engine cable from the straps securing the same to the cab.

Unhook cable (31) from the hood opening control devices.

Disconnect front headlamp electric connections (12).

Remove screws (19), then take off cover (18).

Remove fastening screws (32), then take off headlamp inserts (13).

NOTE Do not change the assembly position of headlamp insert (13) threaded bush (14, detail **D**).

Remove the screws and/or fastening nuts, then remove crosspiece (33).

Remove the screws and/or fastening nuts, then remove bumper (17).

Remove expansion tank (3) cap (2).

Act as follows, from under the vehicle (see figure 4):

- undo fastening screws (8 and 10), then remove lower side guards (11);
- undo fastening screws (15), then remove lower central guard (12).

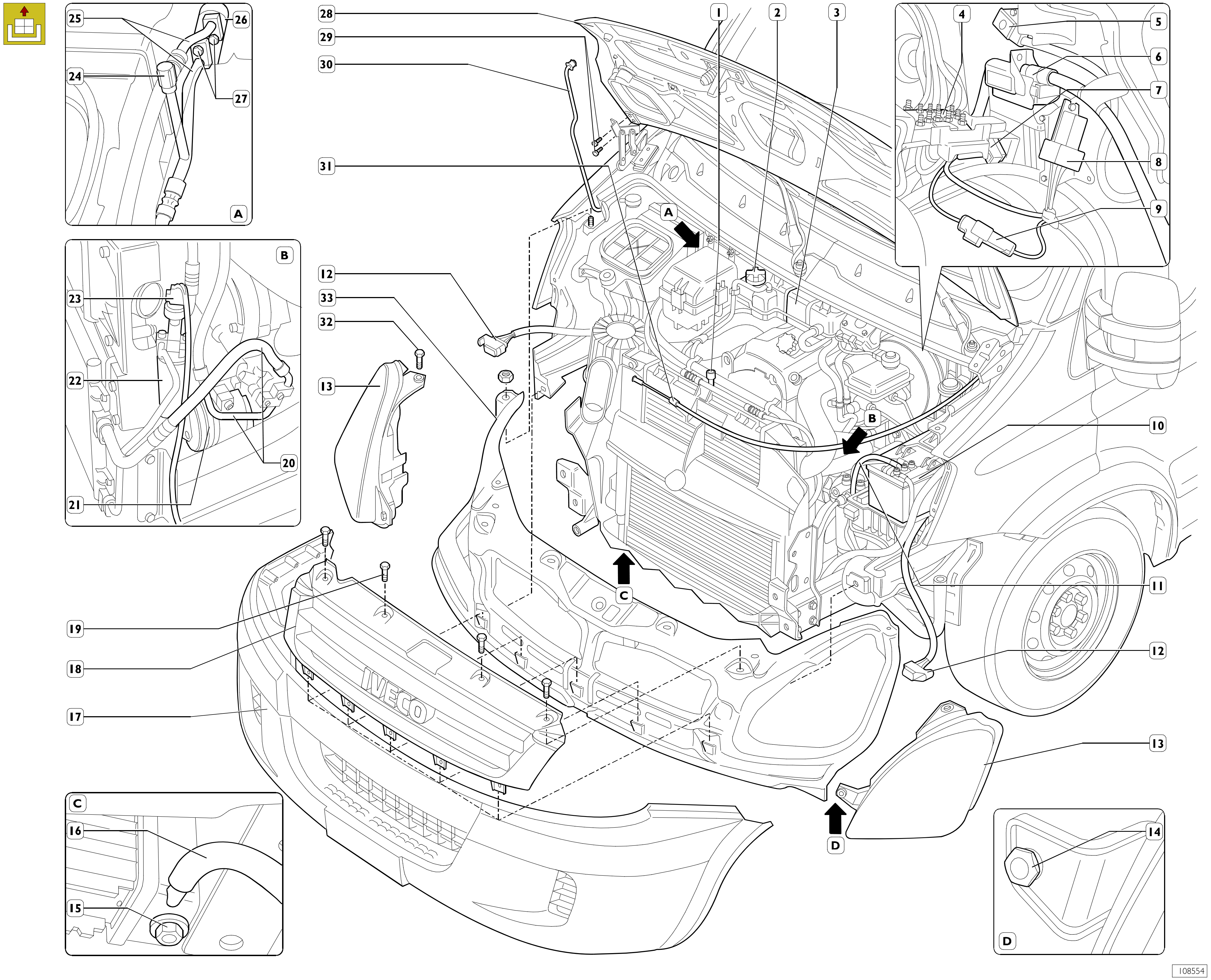
Apply a tube (16) to radiator pipe union (detail **C**), then unscrew cap (15) and drain the coolant into a suitable container.

NOTE If the vehicle is equipped with a cab air-conditioning unit, proceed as follows.

- Fit the unit 99309146 pipes to connections (1) and (24), then blow the gas off the air-conditioning system as described in the respective charter of the "Bodywork and chassis" section.
- Disconnect electric connection (23) from drying filter pressure switch (22).
- Disconnect pipes (20) from air-conditioner compressor (21).
- Ruts (27), then disconnect pipes (25) from expansion valve connector (26).

NOTE Seal the air-conditioning unit pipes and their respective mounts, to prevent moisture and impurities from penetrating into the system.

Figure 1



Remove nuts (23), then properly place remote-control switch/fuse holder (22) aside.

Disconnect pipe (21) from the heat exchanger and the turboblower.

Disconnect pipe (13) from the heat exchanger and the throttle valve assembly.

NOTE Properly obstruct the turboblower air outlet to avoid casual penetration of foreign bodies into the turboblower and, therefore, damage to the latter.

Disconnect or remove the coolant pipes:

- (14), from thermostat (11);
- (15), from engine oil heat exchanger (10);
- (19), from pipe (17);
- (18), from radiator (16);
- (20), from the cylinder head.

Remove fastening screws (12), then remove the radiator/heat exchanger assembly together with the condenser-drying filter, pipes and air conveyor (if any).

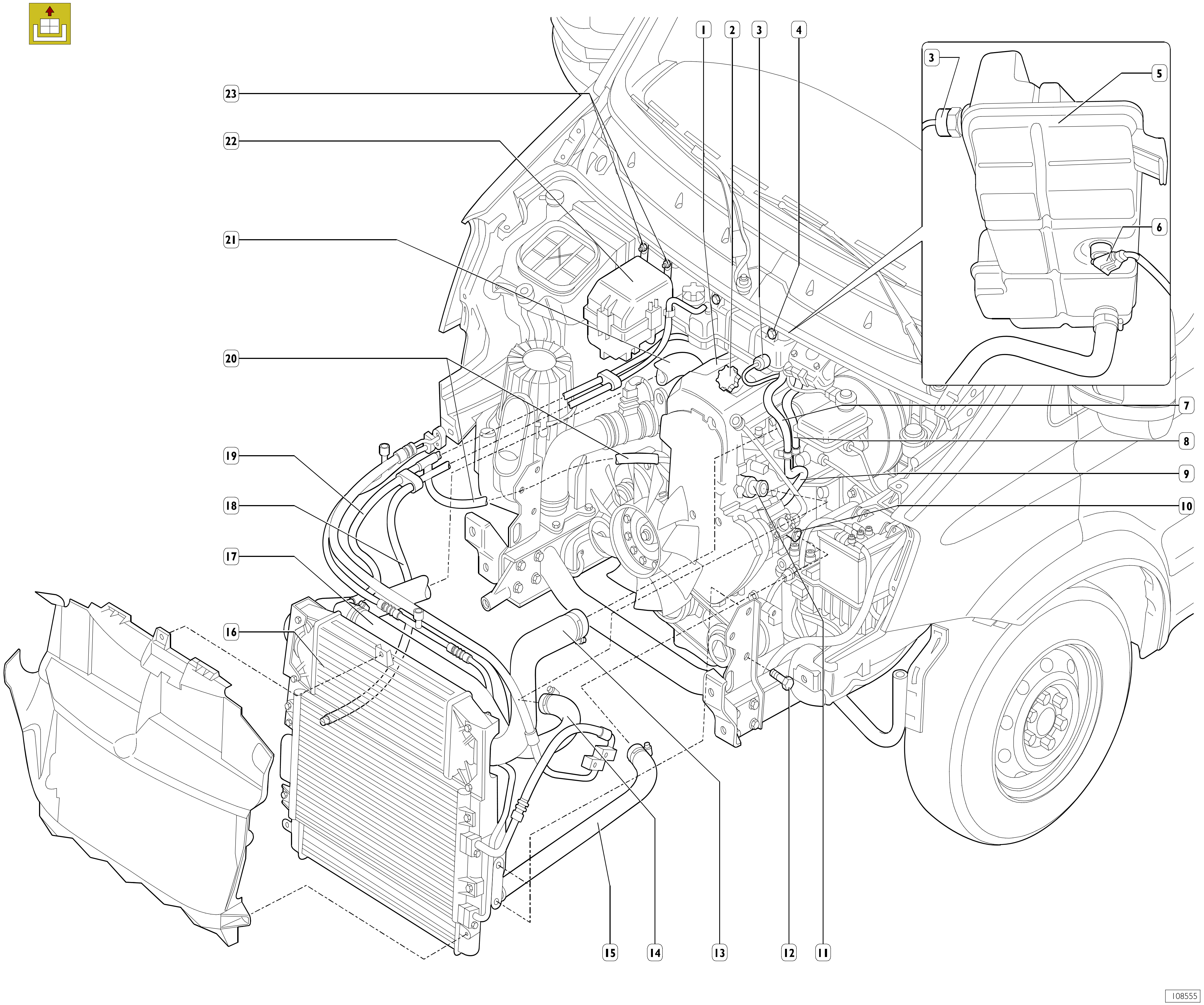
Remove oil filling cap (2), then take sound-proofing cover (1) off.

Disconnect tank (5) pressure sensor electric connection (3).

Remove tank (5) fastening nuts (4), then take the tank off the wall.

Disconnect electric connection (6) of the level sensor placed under tank (5).

Figure 2



Disconnect cab heater pipe (23) from E.G.R. exchanger outlet pipe (22).

Disconnect:

- vacuum pipe (27) from the E.G.R. valve;
- pipe (1), from coalescence filter (25);
- pipe (21), from pipe (19).

Disconnect electric connection (15) from air flow meter (16). Remove air pipes (14 and 19), together with air flow meter (16), from turboblower (20) and air filter (13).

NOTE Properly obstruct the turboblower air outlet to avoid casual penetration of foreign bodies into the turboblower.

Disconnect the electric connection from VGT solenoid valve (12, only 136 HP engine).

Disconnect the electric connection from EGR solenoid valve (11).

Disconnect the electric connections (18) from alternator (17).

Disconnect the electric connection from oil level sensor (26).

Disconnect the fuel pipes (3) from the low-pressure pipe assembly.

Disconnect the electric connection (6) from air-conditioner compressor (8).

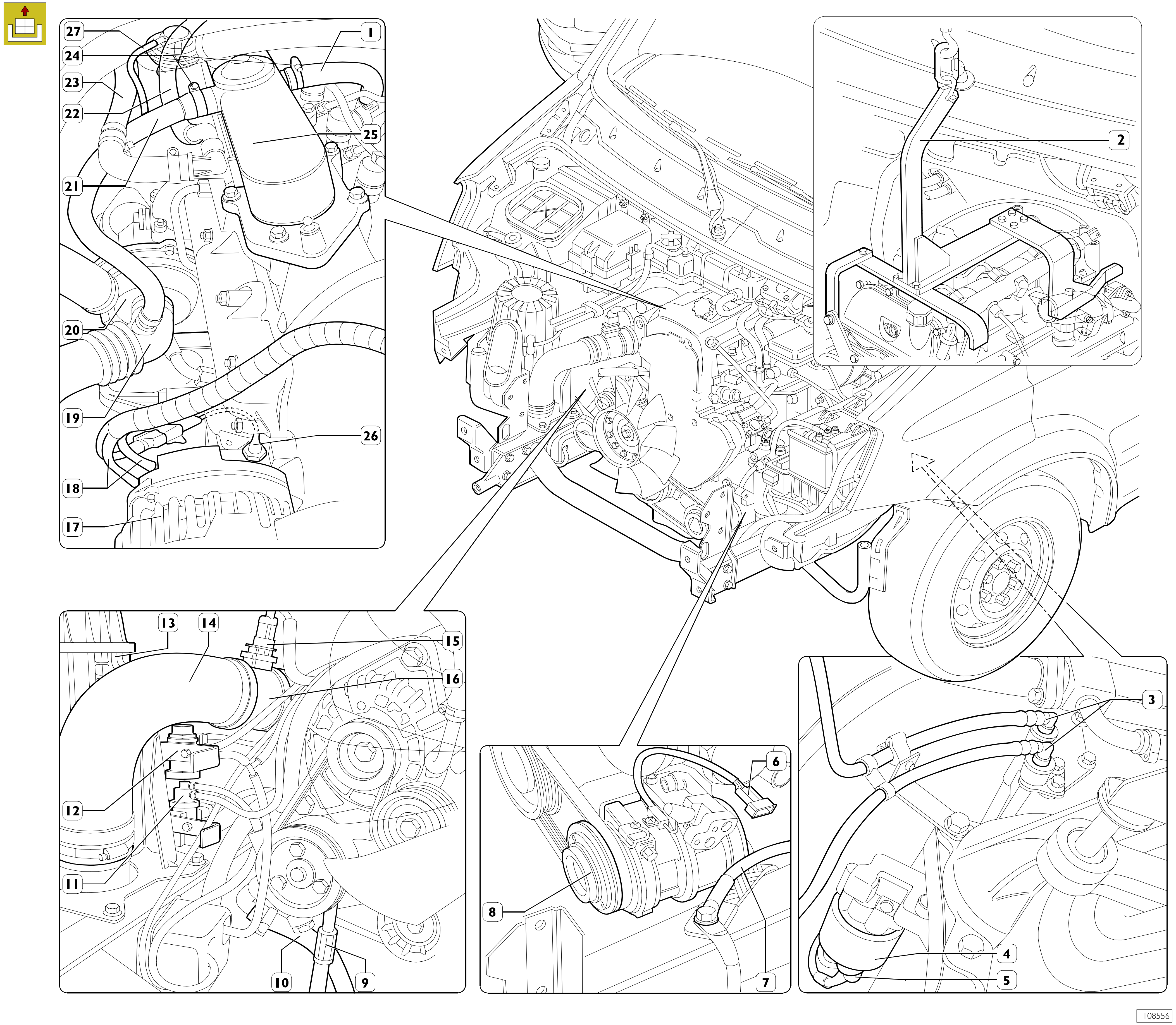
Disconnect the electric connection (5) from starting motor (4).

Place a container under the power steering pump to recover the system oil, then disconnect oil inlet and delivery pipes (9) and (10).

Disconnect the engine ground cable (7).

Apply tool 99360544 (2) to the engine brackets to remove the engine from its own compartment and slightly pull the same

Figure 3



Act from under the vehicle:

- to disconnect jointed heads (17) of lever shift control cables (16);
- selection cable (max. pull-out load: 250 N - max. pull-in load: 60 N);
- engagement cable (max. pull-out load: 100 N - max. pull-in load: 80 N).

Use a suitable screwdriver to open out flexible cable fins (18) so that the pawls are disengaged from the support.

Undo fastening screws (22), move clutch control cylinder (23) together with its bracket and properly secure it to the chassis.

Remove the sealing from ring (1), then unscrew the same and disconnect the speed indicator control cable.

Disconnect electric connection (2) (on 96/116 HP engines) or (4) (on 136 HP engines) or (26) (on automatic transmissions) from the reversing light switch.

NOTE In case of vehicles equipped with automatic transmission, disconnect gearbox-chassis cable connector (27) from the control unit.

Disconnect exhaust pipe (9) from the turboblower outlet pipe.

Disconnect vacuum pipe (29) from VGT actuator (28, only 136 HP engine).

Put a jack under the gearbox to support it.

Disconnect the bracket supporting the gearbox on the rear crosspiece by undoing the four screws (5).

Unscrew the fixing screws (6) and remove the crosspiece (7) supporting the gearbox complete with the gearbox/support bracket.

Remove nuts (14) securing elastic supports (13) to the chassis.

Remove bolts (3) securing drive shaft (4) to the gearbox; remove, if necessary, screws (24) securing elastic support (25) to the chassis, then properly secure the drive shaft to the chassis.

Take the jack out from under the gearbox.

Lift the engine assembly and take it out of the engine bay.

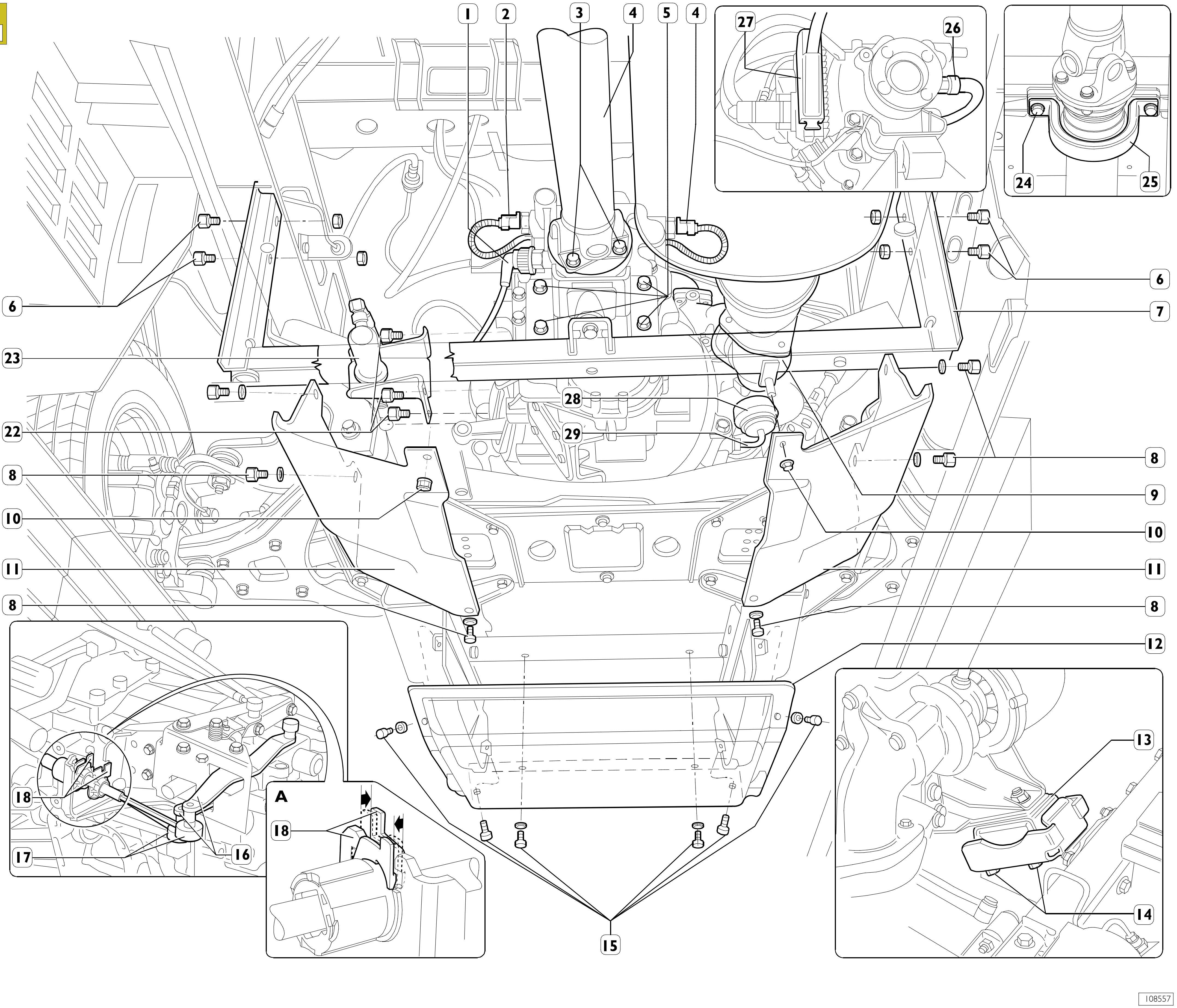
NOTE The power unit must be removed from the engine compartment with the greatest care, to avoid damaging the remaining parts on the vehicle, in particular the steering box oil pipes.

If it is necessary to detach the gearbox from the engine, take out the fixing screws and remove the starter motor.

Take out the fixing screws and detach the gearbox from the engine.

NOTE As far as automatic transmission is concerned, strictly adhere to the operations described in the relevant chapter in the "Gearbox" section.

Figure 4



Refitting

To refit the engine assembly, carry out the operations described for removal in reverse order, following these instructions:

- ❑ Before refitting the gearbox to the engine, it is necessary to remove the pressure plate bearing from the diaphragm spring by opening out the retaining circlip.
  Fit the pressure plate bearing on the sleeve of the drive input shaft cover, connecting it to the clutch release lever. Spread the gearbox input shaft with Molikote molybdenum disulphide grease.
  As regards the 5 S 300 - 6 S 400 O.D. gearbox units, proceed as follows.
  Engage a gear to let the main shaft turn, rotating the propeller shaft connecting flange. Push the gearbox fully in so that the pressure plate bearing couples with the diaphragm spring correctly.
  As regards the 6 S 400 O.D. gearbox units, follow the procedures described in the specific chapter.
- ❑ Pay special attention to the operations needed to install the engine assembly in the engine bay.
- ❑ Check the conditions of the coolant pipes or sleeves and of the air ducts. Replace them if they show any sign of deterioration.
- ❑ Check the flexible mountings of the assemblies: engine and gearbox. Replace them if they show any sign of deterioration.
- ❑ Check that the exhaust pipe members have not deteriorated and are not about to deteriorate. If this is so, replace them along with the flexible parts for securing them.
- ❑ Tighten the screws or nuts to the required torque.
- ❑ Meticulously check the state of the vacuum pipe. It must show no sign of cracking, cutting, scoring or of being crushed. Replace it if there is any doubt at all about its soundness. When mounting it, make sure the pipe does not come into contact with sharp metal parts or corners or with any particularly hot parts. In addition, after assembly, the pipe must have no bends or constrictions, its radius of curvature should be broad and it must be secured to the vacuum pump fitting with a suitable clamp.
- ❑ make sure that fuel pipes rapid engagement fittings are accurately clean, and result to have been fully inserted and not going to be disconnected after their being connected to relating engagement unions.
- ❑ Fill the cooling system with coolant.
- ❑ Fill the hydraulic power steering circuit and bleed the air as described under the relevant heading.
- ❑ Check the level of oil in the engine and gearbox.
- ❑ recharge climate control system (if present) as described in chapter relating to section "Body and chassis";
- ❑ check the inclination of light from headlights, if needed.

NOTE When positioning the engine in the engine bay, take special care not to damage the top pipe of the power steering and the soundproof-heatproof cladding of the engine bay.
Once positioned, meticulously check that the top pipe of the power steering is sound.
Before using it again, check that the power steering oil and coolant contain no impurities. If they do, filter with suitable mesh filters. For any topping up, refer to the REPLENISHING FLUIDS table in the "GENERAL" section.

Checks and tests

Start up engine, leave running at a speed slightly in excess of idle speed and wait for coolant to heat sufficiently to open thermostat. Then check the following:

- ❑ no coolant leaks from coolant hose and cab interior heating hose connection sleeves. Tighten hose clips, if necessary;
- ❑ no oil leaks from between cover and cylinder head, oil sump and crankcase, oil filter and housing, heat exchanger and crankcase or from lubrication circuit lines;
- ❑ no fuel leaks from injection pump and injector lines. Tighten fittings if necessary;
- ❑ check that injection pump control linkage allows the flow regulation to perform its full travel in both directions. Otherwise adjust the travel by acting on nuts (1-2, Fig. 6);
- ❑ check that the engine shut-off device is working properly;
- ❑ check that the indicator lights on the instrument panel and relating to the devices disconnected when the engine was removed are working properly.

501430 Power steering system air bleed

Check the level of oil in the tank and top it up if necessary.
Lift the vehicle at the front, start up the engine and let it idle for some time.
Check there is no oil leakage from the hydraulic circuit and check the level in the tank.
Slowly turn the steering wheel in both directions of steering so that the air in the hydraulic system comes out.
Check the level of oil in the tank again and top up if necessary.

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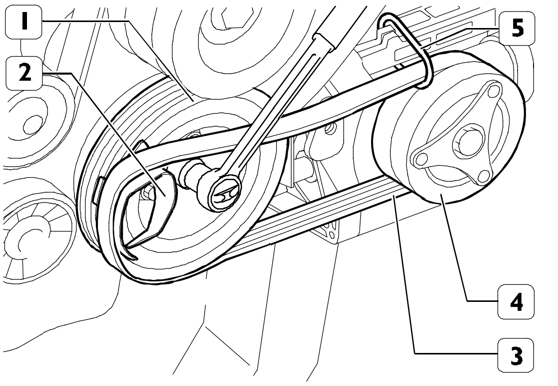
REPLACING BELTS

543910 Replacing air-conditioning compressor drive belt

Disassembly

Figure 5



90155

Cut elastic belt (3), as it cannot be reused.

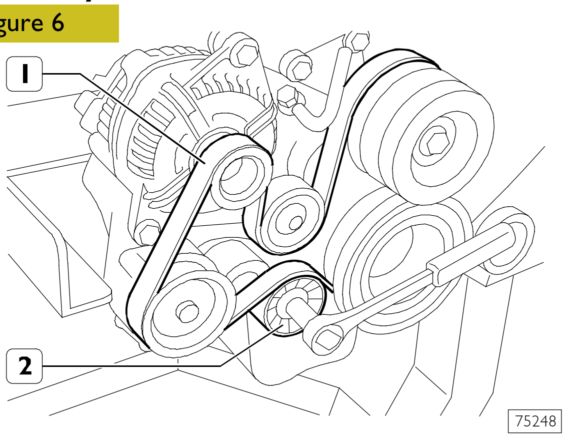
Assembly

Fit the flexible belt (3) equipped with tool 99360191 (2) on the pulley (4) and apply the tool on the pulley (1).
Fit the drive ring (5) on the flexible belt (3) and fasten the ring on the compressor support.
Turn the drive shaft clockwise until the belt fits perfectly on the pulley (1).

543910 Power steering pump-alternator belt replacement

Disassembly

Figure 6



75248

Disassemble the compressor drive belt, if there is one, as described under the relevant heading.
Slacken off the tension of the belt (1) using a specific wrench on the automatic tightener (2) and remove the belt.

Assembly

Mount the drive belt (1) taking care to position its ribs correctly in the respective races of the pulleys.
Release the automatic tightener (2). Turn the crankshaft by one turn to settle the belt.
Mount the compressor drive belt, if there is one, and adjust the tension as described under the relevant heading.
Fit the middle soundproofing guard back on.

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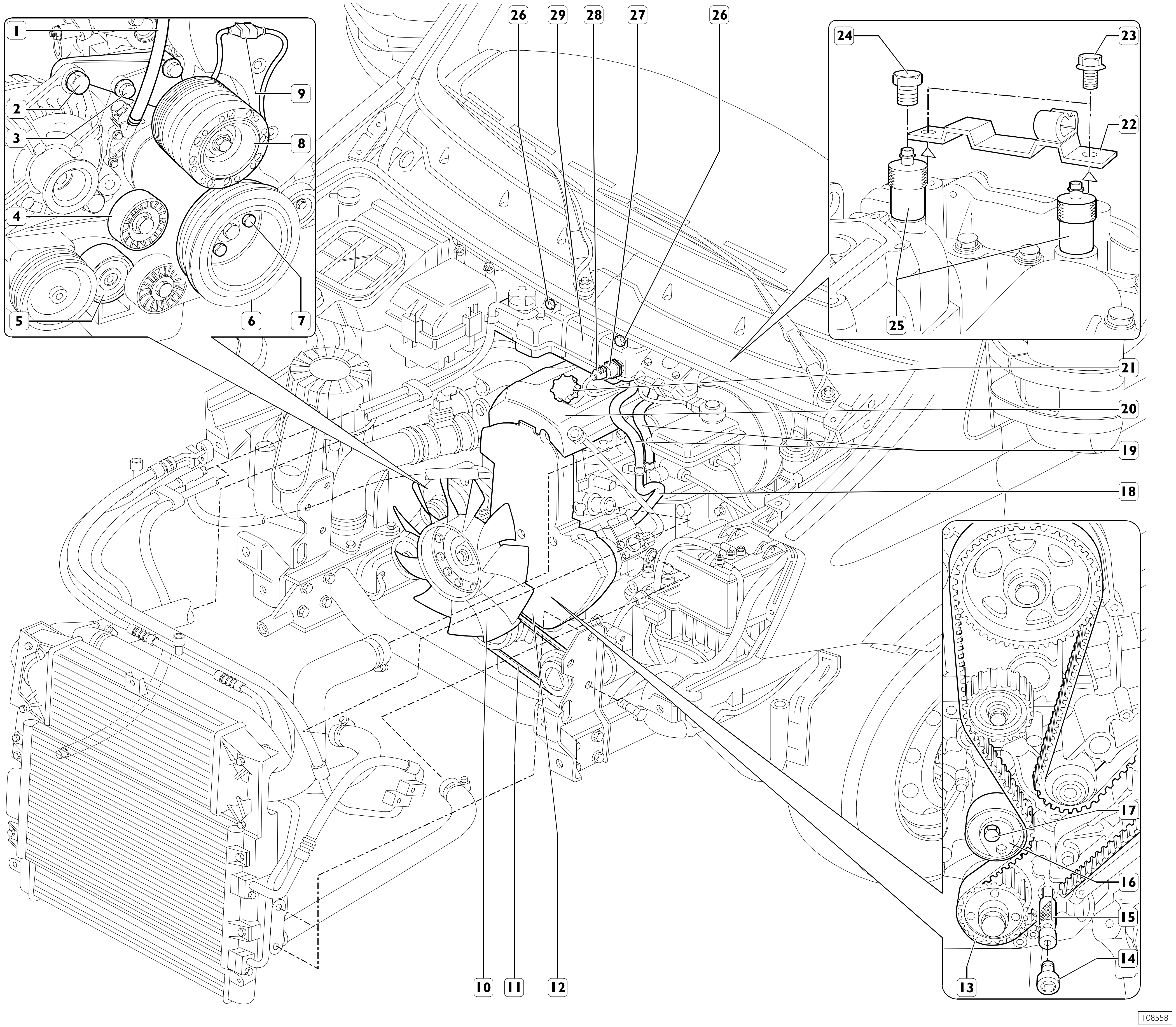
541257 Replacing timing drive belt

Disassembly

Remove, by following the power unit detachment procedures, the radiator assembly together with the heat exchanger and the drying filter condenser (if any), then place it aside properly.

Remove the air-conditioner compressor drive belt (11) (if there is one) and the water pump / alternator drive belt as described under the relevant headings.
Remove the fan (10) from the electromagnetic coupling (8).
Disconnect the electrical connection (9) from the electromagnetic coupling (8).
Take out the fixing screws (2) and (3) and remove the mounting together with the electromagnetic coupling (8).
Take out the screws and remove the fixed tightener (4) and the automatic tightener (5).
Remove screws (7), then disassemble pulley (6).
Remove the wiring from the timing cover (12) and dismantle this.
Take off the cap (2) and remove the soundproofing cover (20).
Disassemble valve gear cover (12).
Disconnect the pipes (19) from the pipe (18).
Disconnect the electric connection (28) from sensor (27).
Take out the fixing screws (26) and remove the expansion tank (29); disconnect the electrical connection for the level indicator from the expansion tank and put the tank (29) aside appropriately.
Take out the screws (23) and remove the bracket (22) fixing the soundproofing cover (20).
Remove the plugs (24) from the overhead and the plug (14) from the oil pump – vacuum pump assembly mounting.
Turn the crankshaft clockwise so as to be able to insert the pins 99360614 (25) through the holes in the plugs (24) into the relevant holes of the camshafts and pin 99360615 (15) through the hole in the plug (14) into the crankshaft.
Loosen the screw (17) securing the automatic tightener (16) and remove the timing belt (13).

Figure 7



Assembling

NOTE Only for the engines featuring intake valve distributing shafts with tapered shank (full section).
Insert tool 99360608 (8) into the hole of the toothed pulley (7) and into the corresponding hole of the overhead to prevent changing the assembly position of the toothed pulley (7) in the following operations.
Loosen the screw (9) fixing the toothed pulley (7) and, using tool 99340028, drive the pulley (7) out of the camshaft.

Turn the automatic tightener (1) clockwise, positioning it as shown in frame **A**.
Turn the timing belt (10) as shown in the figure observing the precautions below.

Do not bend the timing belt. Arrows indicating the direction of assembly of the timing belt on the engine are shown on the back of the belt. The arrows must correspond to the direction of rotation of the belt and the notches must coincide with those on the pulley (7) and the gear (12).

NOTE Only for the engines featuring intake valve distributing shafts with tapered shank (full section).
If required to fit the timing belt (10) on the pulley (7), remove tool 99360608 (8) and turn the pulley (7) clockwise by no more than half a pulley tooth.

Keeping the screw (2) stationary and using a suitable wrench on the hexagon of the plate (3) of the tightener, turn it anticlockwise to cover the reference hole (5) located on the fixed portion of the tightener (see frame **B**).
In the above conditions, tighten the fixing screw (2) to a torque of 36 ± 4 Nm.
Tighten screw (9) to the torque values below:

- screw (9) securing pulley (7) to the distributing shaft with tapered shank (full section): 90 Nm;
- screw (9) securing pulley (7) to the distributing shaft with cylindrical shank (hollow section): 130 Nm.

Remove the tools 99360614 (6) and 99360615 (11) for the timing.
Turn the engine in its direction of rotation by 8 turns to be able to put the tools (6) and (11) back in to do the timing.

In these conditions, the notches of the timing belt (10) must coincide with those of the pulley (7) and the gear (12).

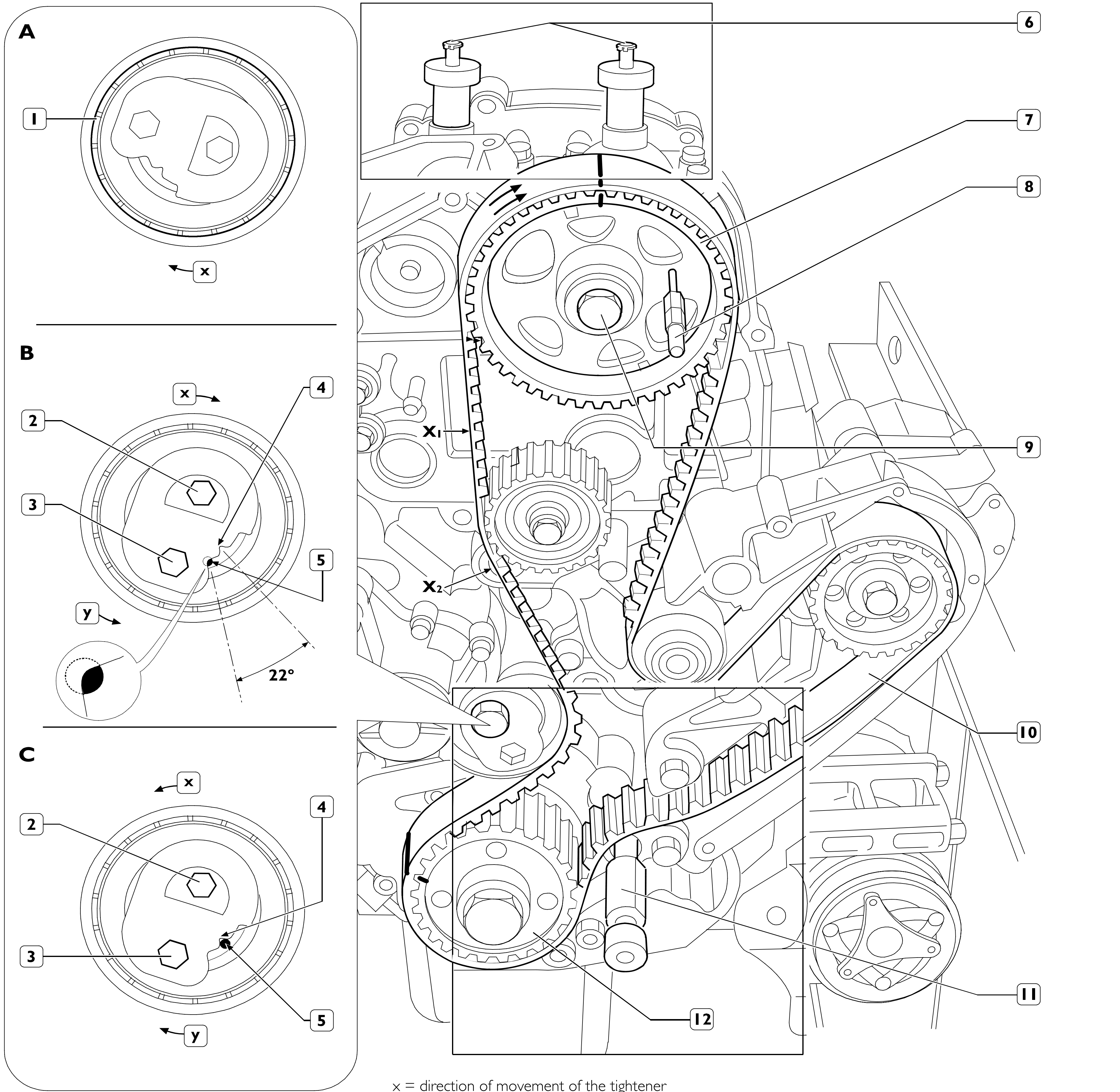
NOTE Do not turn the engine in the opposite direction; if, on turning the engine, you pass the point for inserting the tools (6) and (11), turn the engine clockwise by another two turns.

See frame C: holding the tightener plate (3) stationary with the wrench inserted in its hexagon, loosen the fixing screw (2).
Keeping the fixing screw (2) stationary, turn the plate (3) clockwise until its reference mark Λ (4) coincides with the reference hole (5) of the fixed portion of the tightener.
In the above conditions, tighten the screw (2) to a torque of 36 ± 4 Nm.

Rotate the engine by two turns in its direction of rotation until the point of tool 99360615 (1) engagement into the drive shaft is reached. When this point is exceeded, the drive shaft shall be rotated by two more turns. Verify, under the above conditions, that reference hole (5) is found within index (4) as represented in box **C**; otherwise, the aforesaid operations shall be repeated.

After assembly, the belt (10) tension measured using tool 99395849 must be as follows in the following points: X, 212 ± 12 Hz - X_2, 178 ± 10 Hz.
Then complete assembly by carrying out the steps described for disassembly in reverse order.

Figure 8



x = direction of movement of the tightener
y = direction of rotation of the wrench

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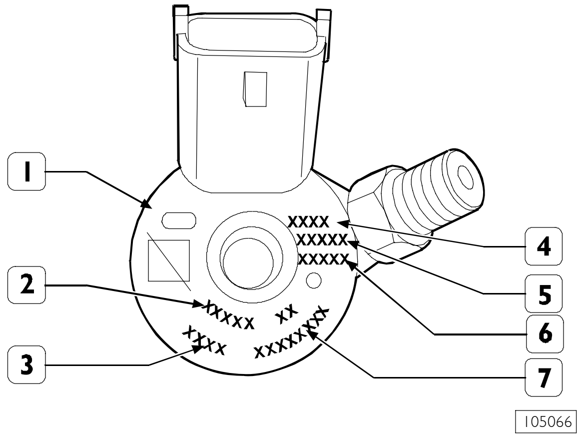
755010 REPLACING THE ELECTRIC INJECTORS

Figure 9



1. IMA Matrix code- 2. Bosch spare part no.-
3. IMA code in clear - 4. Iveco spare part no. - 5. Code -
6. Series no. - 7. Production date

Electrical injectors are not assigned any more to classes Min (01) - Med (02) - Max (03); therefore, flow rate deviations from design values are detected, during final check step, by the manufacturer on each single injector and printed with I.M.A. (Injector Menge Abgleichung) [Injector Quantity Offset] code on injector magnet.

At engine production plant, I.M.A. code is read on line from an automatic reading station, converted into bar code, printed on engine identification label and applied on the engine itself.

At vehicles production plant, at line end, E.D.C. 16 central unit is programmed automatically reading the engine identification label.

Figure 10

numero	codice OCR iniettore
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

numero	codice OCR iniettore
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
I	I
J	J
K	K
L	L
M	M
N	N
O	O

numero	codice OCR iniettore
P	P
Q	Q
R	R
S	S
T	T
U	U
V	V
W	W
Y	Y
Z	Z

105067

Conversion table of OCR characters into ARIAL characters

At assistance, code written in clear has to be used (3, Figure 9) for central unit replacement and reprogramming procedures.

In the table there is shown the conversion of OCR characters into Arial characters.

When electrical injectors mounted on the vehicle must be replaced, meet following warnings:

- where electrical injectors are dismounted and do not need to be replaced, their mounting position has to be noted down in order to remount them later in the same position; this is done to avoid to reprogram the central unit;
- after replacing one or more injectors, the central unit has to be reprogrammed;
- before mounting a new electrical injector, note down IMA code printed on the injector, because the code is difficult to read after the injector has been mounted;
- where the central unit is replaced, reprogram the new central unit with the IMA codes of the electrical injectors mounted on the engine and copy down the rectification coefficients (ZFC) of replaced central unit; where it is not possible, they must be reset and self-learning process must be started up again.

During engine running, EDC 16 central unit performs some checks on electrical injectors minimum flow rate.

In certain conditions (overrun: vehicle deceleration with pedal released) an increasing (very small) fuel quantity starting from zero is injected and its effect on engine rotation smoothness is observed.

Injection start threshold is detected and stored by the central unit.

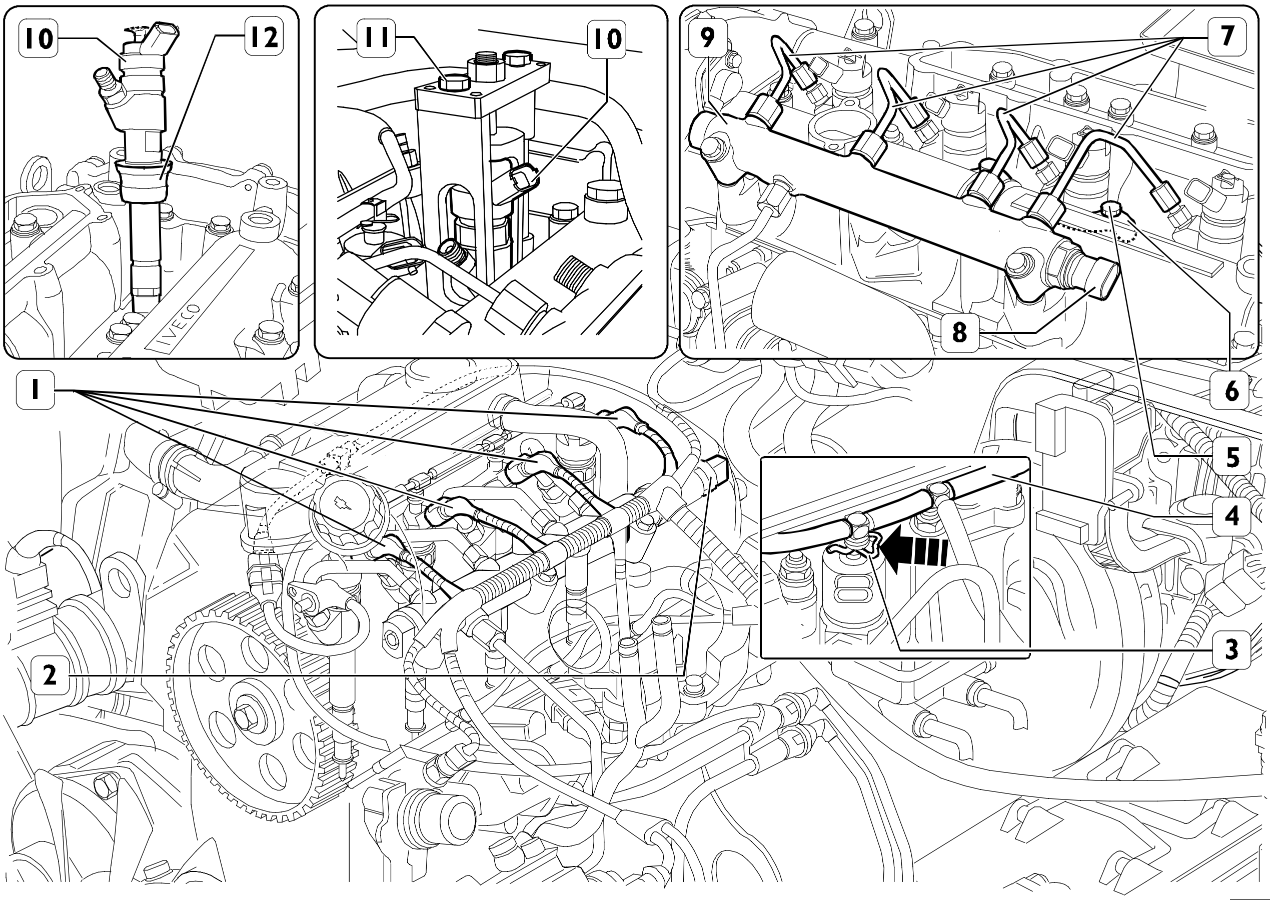
This self-learning process is carried out on each single cylinder.

Therefore, replacing an electrical injector involves the need of reprogramming the central unit by entering the IMA codes of new electrical injectors and resetting the rectification factors (ZFC) of the cylinder considered.

Replacing all electrical injectors extends the need of resetting to all the rectification coefficients (ZFC) of each single electrical injector.

Figure 11

Removal



Partly drain the coolant off from the radiator.
Remove the plug (21, Figure 9) and detach the soundproofing cover (20, Figure 9).
Disconnect the pipes (19, Figure 9) from the pipe (18, Figure 9).
Remove fastening screws (26, Figure 9), then take off expansion tank (29, Figure 9) and disconnect level gauge electric connections (6, figure 7) and sensor (27) electric connections (28, figure 7) from the expansion tank.
Disconnect the pipe (20, Figure 12) from the coalescence filter (1, Figure 12).
Disconnect the electrical connections (1) from the electro-injectors (10) and (2) from the fuel pressure sensor (8).
Press the springs (3) in the direction shown by the arrow and disconnect the fittings of the pipe (4) to recover fuel from the electro-injectors (10).
Disconnect the fuel pipes (7) from the electro-injectors (10) and from the hydraulic accumulator (9).
Take out the screws (6) and the brackets (5) fixing the electro-injectors (10) to the cylinder head.
Using tool 99342153 (11) extract the electro-injectors (10) from the overhead.

Refitting

Thoroughly clean the seat of the electro-injectors, taking care no foreign bodies get into the cylinder barrels.
Fit a fresh gasket (12) onto the electro-injector (10) and fit this in the overhead.

Complete assembly by carrying out the operations described for disassembly in reverse order, taking the following precautions:

- With each disassembly, the fuel pipes must be replaced with fresh ones.
- Tighten the nuts, screws and fittings to the prescribed torque.
- To tighten the fittings of the fuel pipes, use the wrench in the 99317915 series and the torque wrench 99389829.
- After assembly, replenish the coolant as described under the relevant heading.

Check assembly of the timing sensor as described under the relevant heading.

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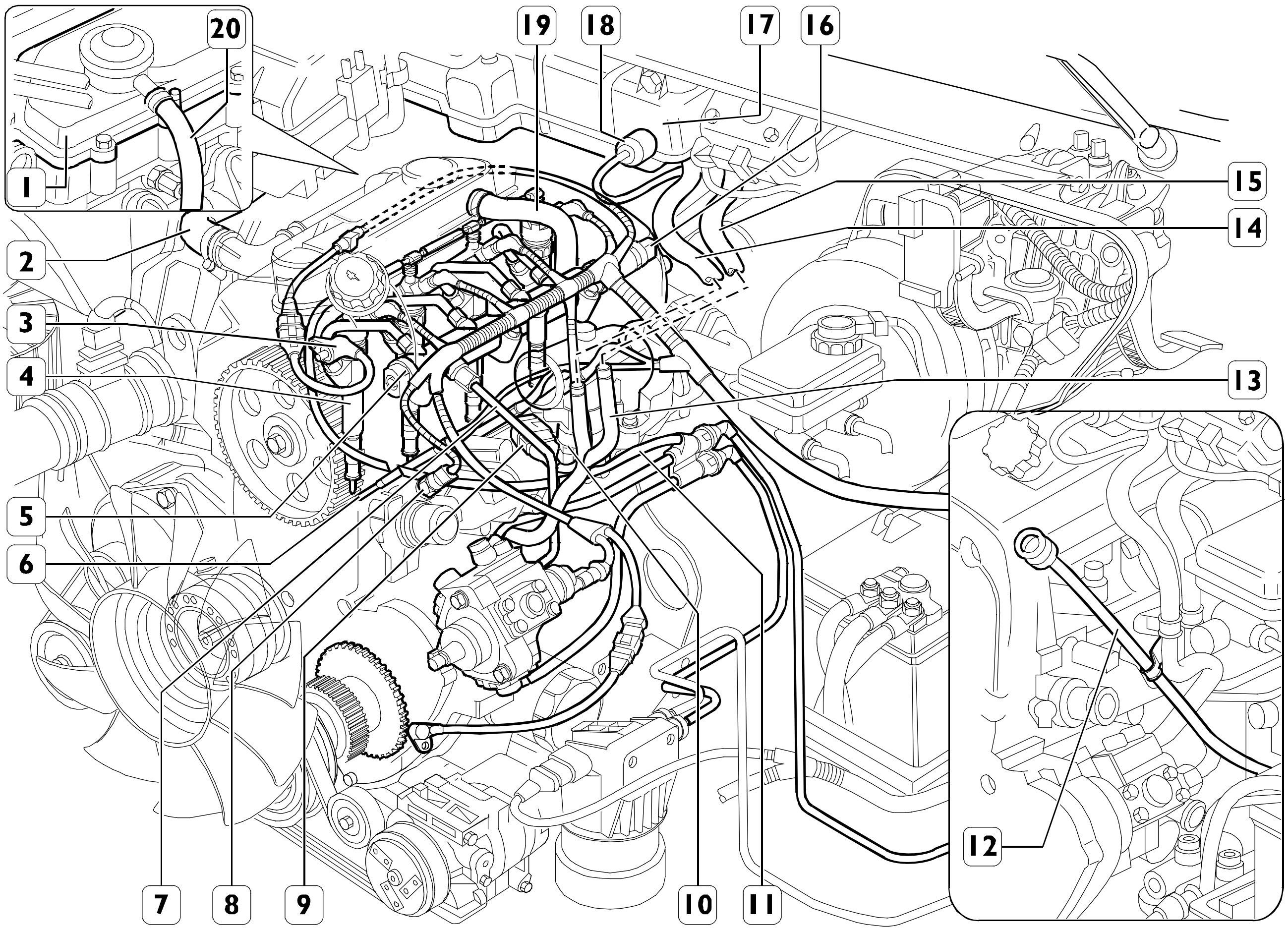
540610 CYLINDER HEAD REMOVAL AND REFITTING

Figure 12



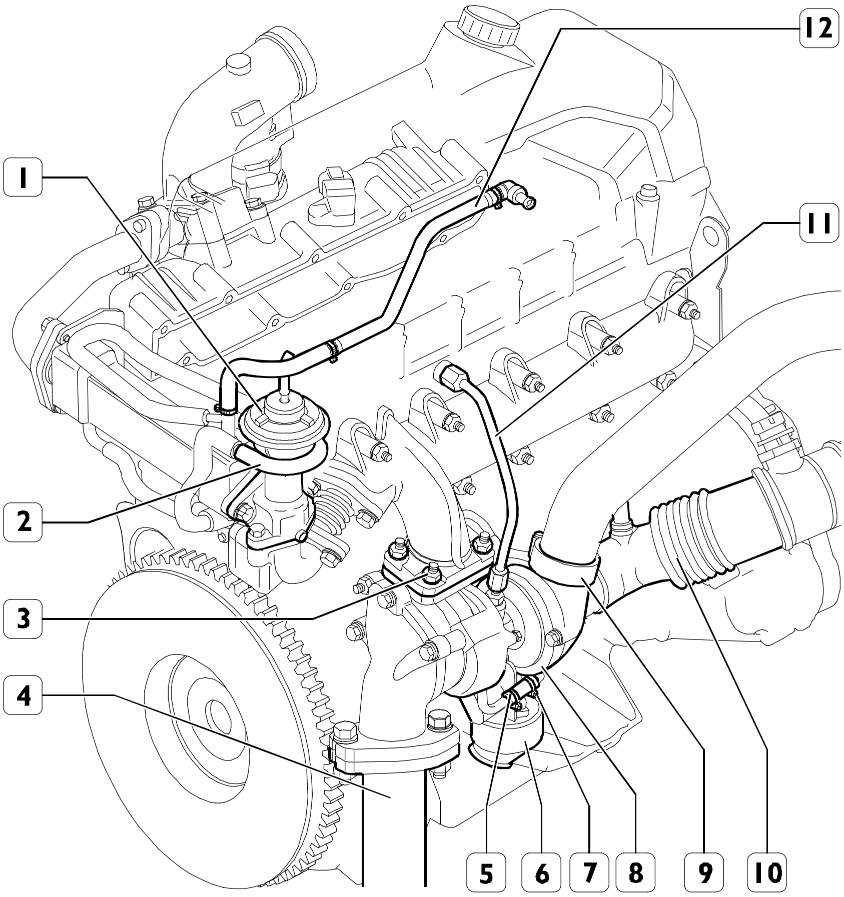
108560

Removal

Take off the camshaft drive belt, as described in the respective chapter (operation 541257).
Disconnect coolant pipes (15) and (14) from pipe (13).
Disconnect the electric connection from pressure sensor (18).
Remove the fastening screws, then take off expansion tank (17) by disconnecting from the latter the electric connection from the level sensor.
Remove oil dipstick pipe (12) from the inlet manifold.
Disconnect oil vapour pipes (20) and (19) from coalescence filter (1), then remove the latter from the overhead.
Disconnect pipe (2) from the heat exchanger engine coolant outlet pipe.

Take off electric injectors (4), as described in the "Replacing the electric injectors" chapter (operation 775010).
Disconnect the electric connections from phase sensor (3), water temperature sensor (8), air pressure/temperature sensor (9), preheating plugs (6), throttle valve assembly actuator (10), fuel pressure sensor (16).
Take fuel pipe (7) off hydraulic accumulator (5), high-pressure pump and inlet manifold.

Figure 13



Loosen clamp (9), then take the air conveyor off.
Take air suction sleeve (10) off turboblower (8).
Disconnect the oil pipe (11) from the cylinder head and from the turbocharger (8).
Loosen the clamp (7) and disconnect the oil pipe (5) from the crankcase union.
Take out the screws and disconnect the exhaust pipe (4) from the turbocharger (8).
Take off the nuts (3) and remove the turbocharger (8) with its gasket from the exhaust manifold.

NOTE Close the turbocharger air outlet/inlet appropriately to prevent foreign bodies accidentally getting inside and damaging it.

Disconnect the vacuum pipes from E.G.R. valve (2) and turboblower (if any) actuator (6).

Take out the screws and remove the overhead together with the pins 99360614.

NOTE The pins 99360614 applied so as not to alter the timing after removing the timing belt must be removed from the overhead only if this is to be removed.

Take off the overhead gasket.
Take out the tappets and carefully put them aside.
Using the bushing 99355041, take out the glow plugs.
Take out the screws fixing the cylinder head and detach this from the crankcase.
Remove the cylinder head gasket.

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Refitting

Refitting requires carrying out the operations for removal in reverse order, while taking the following precautions:
Check that the timing tools:

- 99360614 (6, Figure 13) and 99360608 (8, Figure 13) are inserted in the overhead;
- 99360615 (11, Figure 13) is inserted in the crankcase as described in "Replacing timing belt."

Check that the mating surfaces of the cylinder head and crankcase are clean.
Keep the cylinder head gasket clean.
Position the cylinder head gasket with the lettering "TOP" facing the cylinder head.

NOTE It is essential to keep the gasket sealed in its package until just before assembly.

Mount the cylinder head. Insert the screws and tighten them, in three successive stages, following the order and method shown in the following figure.

NOTE The angle closure is done with tool 99395216.

Figure 14

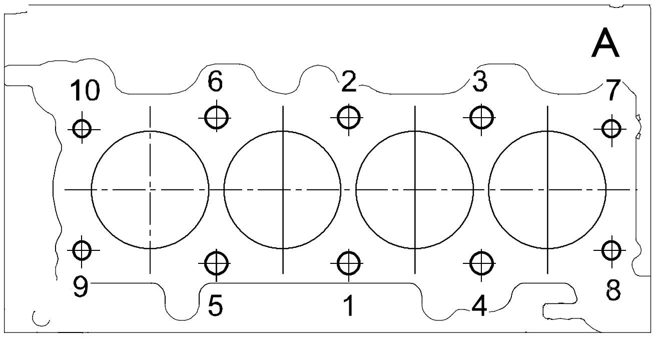


Diagram of the tightening sequence for the cylinder head fixing screws:

- ❑ 1st phase: pre-tightening with torque wrench
  - screws 1-2-3-4-5-6 to a torque of 100 ±5 Nm;
  - screws 7-8-9-10 to a torque of 50 ±2.5 Nm.
- ❑ 2nd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.
- ❑ 3rd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.

A = flywheel side.

- Tighten the screws and nuts to the prescribed torque.
- The seals and gaskets must not be reused, but replaced with new ones.

NOTE If the engine has run for a period equivalent to = 25,000 km, the toothed timing drive belt must be replaced with a fresh one, no matter what its state of wear.

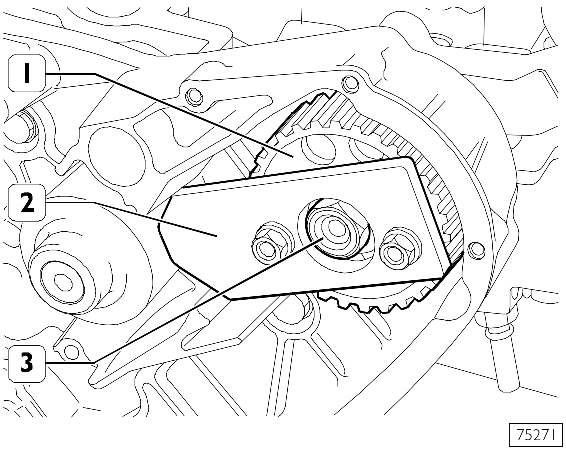
To tighten the glow plugs, use the bushing 99355041 and torque wrench 99389819.

771010 REPLACING HIGH-PRESSURE PUMP CPH1

Removal

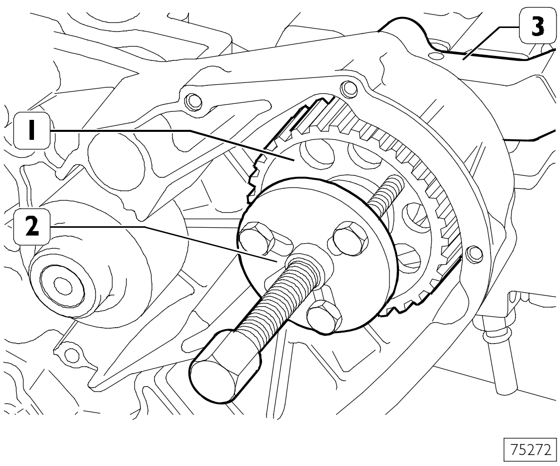
Remove the timing drive belt, as described in the relevant chapter (operation 541257).
Disconnect the following items:
- electric connection from the pressure sensor;
- fuel pipes from the high-pressure pump.

Figure 15



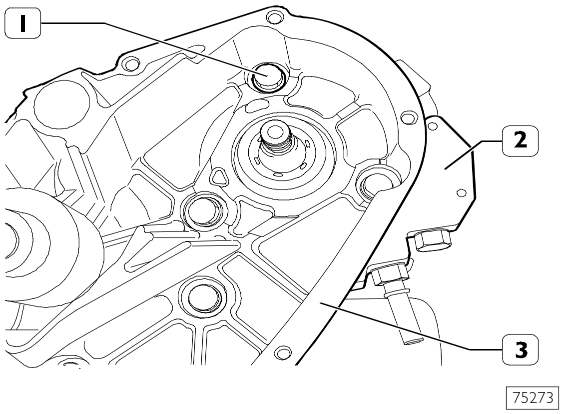
Lock rotation of the high-pressure pump gear (1) by applying tool SP. 2263 (2) as illustrated in the figure. Remove the nut (3) and take out the tool (2).

Figure 16



Using tool 99340035 (2) applied as shown in the figure, extract the gear (1) from the shaft of the high-pressure pump (3).

Figure 17



Take out the screws (1) and remove the high-pressure pump (2) from the water pump mounting (3).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. In particular, take care of the following: replace the seal rings, gaskets and high-pressure pipe with new parts; tighten the nuts, screws and fittings to the specified torque values.

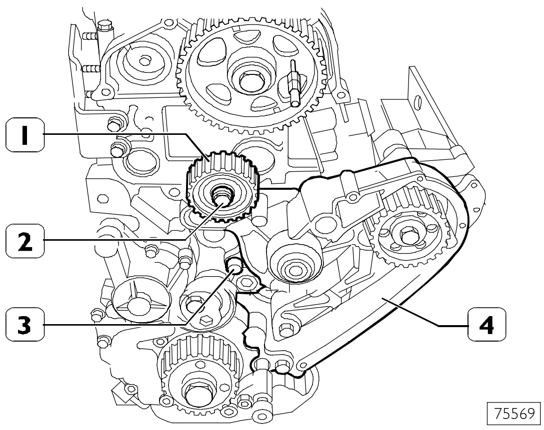
NOTE If the engine has run for a period equivalent to = 25,000 km, the toothed timing drive belt must be replaced with a fresh one, no matter what its state of wear.

543210 REPLACING WATER PUMP

Removal

Remove the high-pressure pump as described under the relevant heading.

Figure 18



Take out the screw (2) and remove the fixed tightener (1). Take out the screws (3) and remove the water pump mounting (4).

Refitting

Fit two new seals on the water pump and fit it back on the crankcase, carrying out the operations described for removal in reverse order and tightening the screws or nuts to the prescribed torque.

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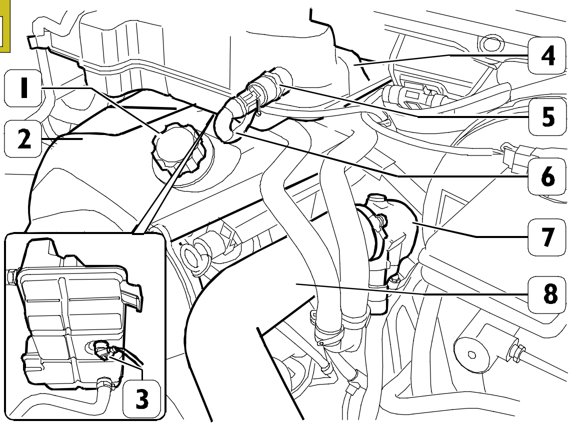
THROTTLE VALVE ASSEMBLY REMOVAL-REFITTING

Removal

Figure 19



108562

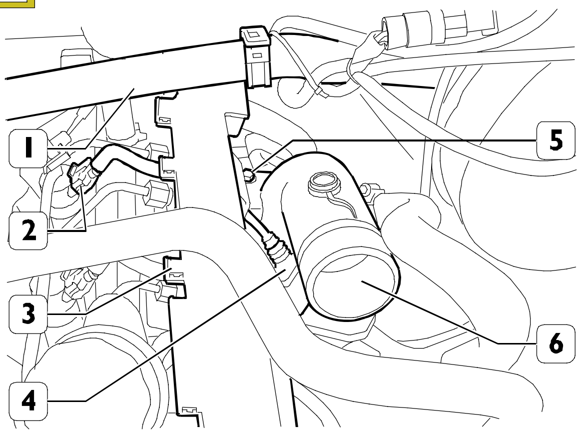
Remove oil filling plug (1) and take off sound deadening cover (2).

Loosen clamp and disconnect air tube (8) from radiator and throttle valve assembly (7).

Disconnect electrical connection (6) from pressure switch (5).

Remove expansion tank (4), disconnect electrical connection (3) from the level sensor placed under the tank and put the tank on one side.

Figure 20



108563

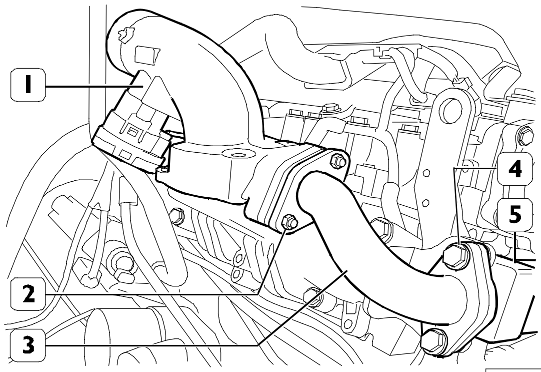
Release engine cable (1) from the fastening clamps

Disconnect electric connections (2) from the electric injectors, then move channel (3) aside.

Disconnect electric connection (4) from throttle valve assembly actuator (6).

Remove screws (5) securing throttle valve assembly (6) to the inlet manifold.

Figure 21



108564

Remove nuts (2) securing pipe (3) to throttle valve assembly (1).

Loosen screws (4) securing pipe (3) to heat exchanger (5), then take throttle valve assembly (1) off the inlet manifold.

Refitting

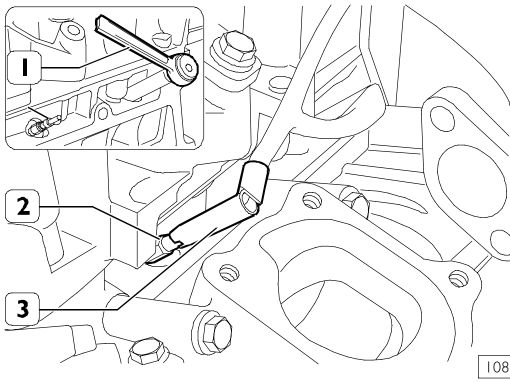
For refitting, reverse the operations described for disconnection observing following warnings:

- ❑ replace gasket by new parts;
- ❑ tighten nuts and screws at prescribed torque.

PREHEATING PLUG REMOVAL/REFITTING

Removal

Figure 22



108565

Take off the throttle valve assembly, as described in the respective chapter.

Disconnect electric connections (3) from preheating plugs (2).

Use wrench SP 2275 (1) to take off preheating plugs (2).

Refitting

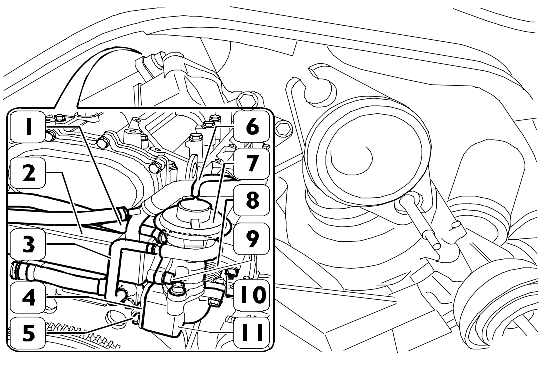
For refitting, reverse the operations described for disconnection observing following warnings:

- ❑ replace gasket by new parts;
- ❑ tighten nuts and screws at prescribed torque.

5407 E.G.R. VALVE REMOVAL/REFITTING

Removal

Figure 23



108566

Partially drain the engine coolant.

Take the full exhaust pipe off the engine and the chassis, as described in the respective chapter.

Loosen the clamps, then disconnect coolant pipes (1 and 3) from E.G.R. valve (7).

Disconnect vacuum pipe (6) from E.G.R. valve (7).

Remove fastening screws (5-9-10), then remove E.G.R. valve (7), together with elbow (11), from heat exchanger (2), pipe (8) from bracket (4).

Refitting

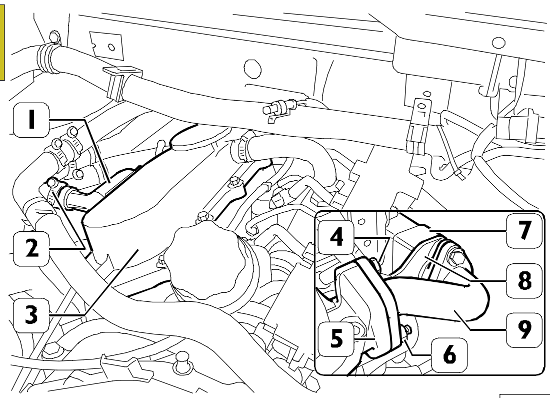
For refitting, reverse the operations described for disconnection observing following warnings:

- ❑ replace gasket by new parts;
- ❑ tighten nuts and screws at prescribed torque.
- ❑ fill expansion tank with coolant.

HEAT EXCHANGER REMOVAL/REFITTING

Removal

Figure 24



108623

Act from inside the engine compartment to take off the cylinder head sound-proofing cover.

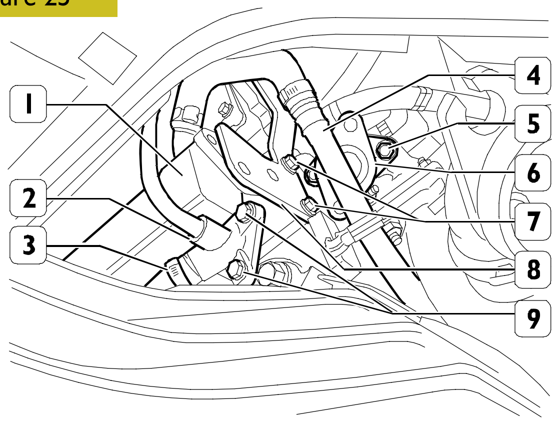
Disconnect cab heater coolant pipe (2) from the similar E.G.R. valve outlet pipe (1).

Remove the nut, then take the pipe off coalescence paper filter (3).

Remove nut (4) used for upper securing of throttle valve assembly (5) connecting pipe (9) to heat exchanger (7). Lower fastening nut (6) shall be removed from under the vehicle.

Act from under the vehicle to remove the heat exchanger supporting and engine lifting bracket (8) fastening screws.

Figure 25



108624

Take off the E.G.R. valve, as described in the respective chapter.

Loosen connecting pipe (6) fastening nuts (5) in order to make screws (7) able to be accessed.

Remove screws (7), then take off engine lifting bracket (8). Remove screws (9), take pipe union (2) off the cylinder head, then take off heat exchanger (1) together with pipes (3 and 4) and pipe union (2).

Refitting

For refitting, reverse the operations described for disconnection observing following warnings:

- ❑ replace gasket by new parts;
- ❑ tighten nuts and screws at prescribed torque.
- ❑ fill expansion tank with coolant.

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BURNT GAS EXHAUST SYSTEM

Description

The following exhaust systems are available on light-duty (LD) vehicles with a total weight on ground (P.T.T.) of up to 2,840 kg:

- two standard exhaust systems:
  - F1A engines: single-monolith catalyst;
  - F1C engines: double-monolith catalyst;
- the catalyst may be equipped with an optional continuous-regeneration particulate filter (DPF).

The standard exhaust system is made up of three components:

A. system length with hose;
B. Oxicat catalyst;
C. silencer.

The exhaust system is made by two different manufacturers: CorTubi and ArvinMeritor (ArM). The components of both systems cannot be interchanged with each other.

507130 OXICAT - OXYDIZER CATALYST

Description

The oxidizing catalyst (1) is a post-treatment device for exhaust gases. It is used to oxidize CO, HC transforming them into carbon dioxide (CO_2) and steam (H_2O).

This catalyst also treats saturated and aromatic hydrocarbons forming part of the particulate, such as the carbon in the form of soot, metals, water and sulphur compounds that are exhausted.

The cylindrical-shaped catalyst consists of a ceramic honeycomb monolith whose cells are platinum-impregnated, a catalyzing substance of oxidation reactions. Its total volumetric capacity is equal to 600 cm^3 with a density of 400 cells per square inch.

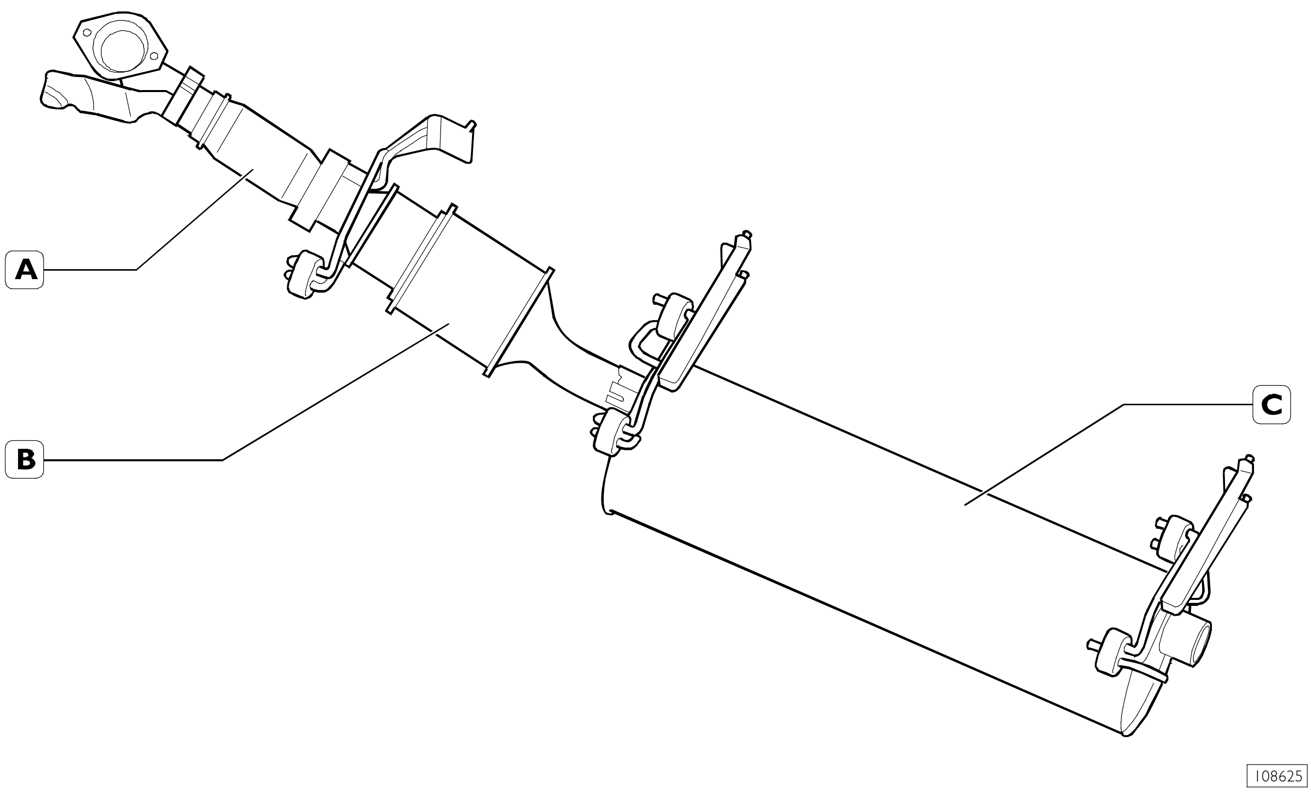
The exhaust gases passing through the cells heat the catalyst, converting the pollutants into inert compounds.

The chemical oxidation reaction of CO, HC and of the particulate is efficient with temperatures ranging between 200°C ÷350°C.

With temperatures higher than 350°C it starts oxidizing the sulphur contained in the diesel oil, generating sulphur dioxide (SO_2) and sulphur trioxide (SO_3), which are the cause of acid rain.

Correct catalyst sizing enables limiting the temperature, obtaining the greatest percentage of conversion of polluting emissions, while reducing the freezing of sulphur compounds.

Figure 26

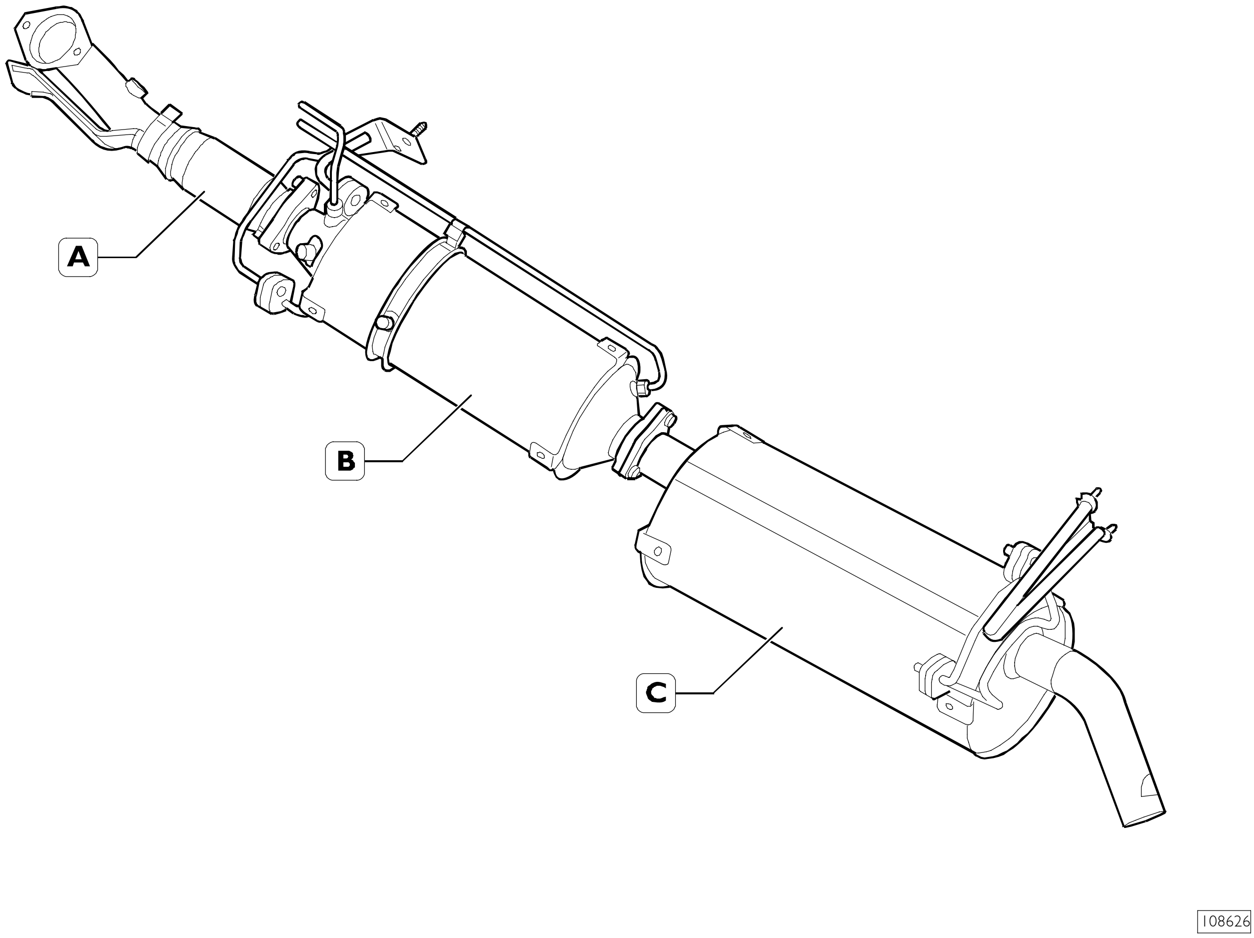


The optional exhaust system is made up of three components:

A. system length with hose;
B. catalyst with particulate filter (DPF);
C. silencer

This system is manufactured by ArvinMeritor (ArM).

Figure 27



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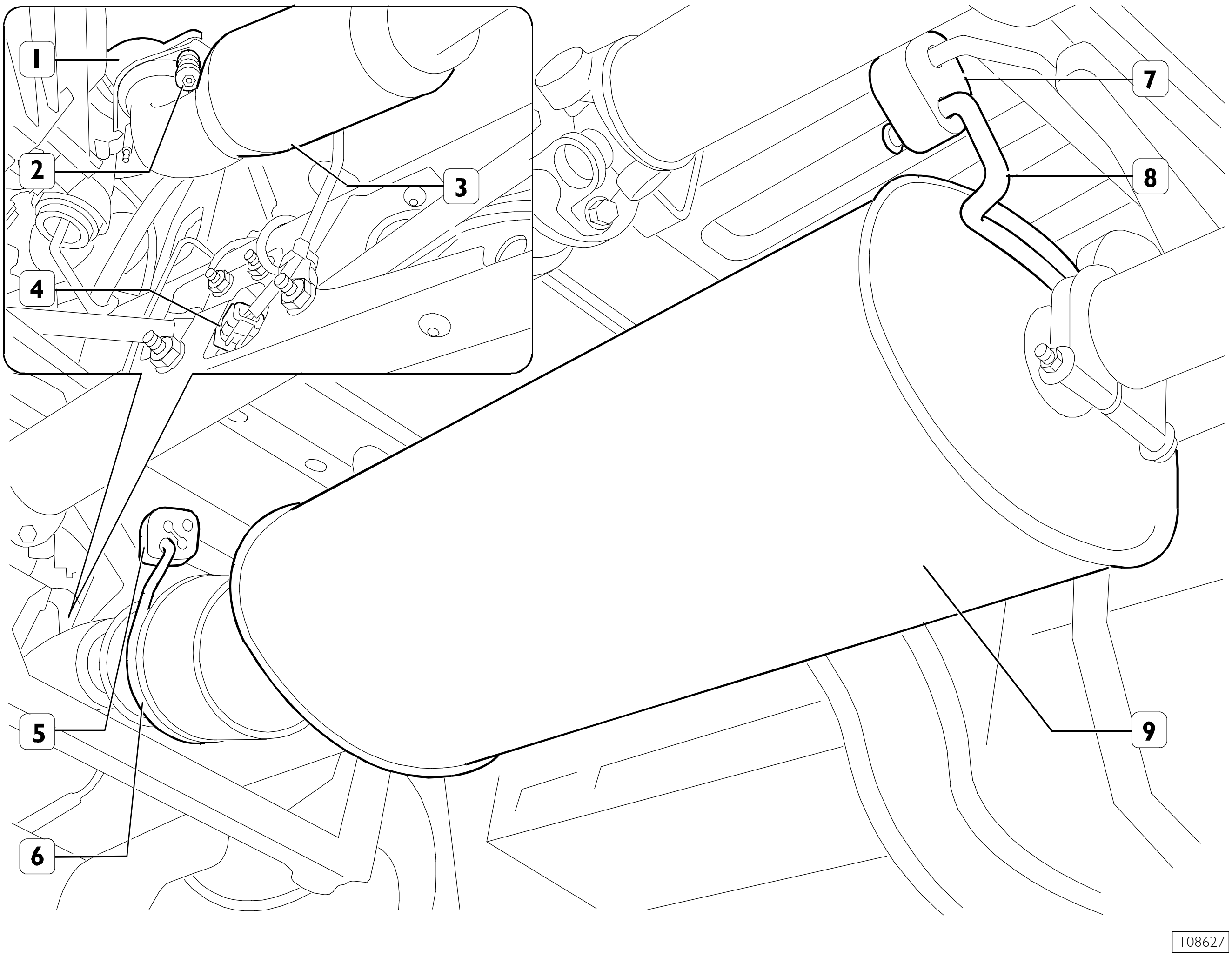
EXHAUST PIPE ASSEMBLY REMOVAL/REFITTING

Figure 28



Removal

Place the vehicle on a pit or auto lift.

Disconnect oxygen sensor electric connection (4).

Remove fasteners (2), then disconnect exhaust pipe terminal (3) from turboblower flange (1).

Properly support the assembly, then use a suitable lever to release supporting hooks (6 and 8) from elastic dowels (5 and 7) and take the assembly off the vehicle.

Take the assembly components apart, by loosening the retaining clamps.

Refitting

For refitting, reverse the operations described for disconnection observing following warnings:

- check the conditions of the elastic dowels, taking care to replace the defective ones (if any);
- replace gasket by new parts;
- tighten nuts and screws at prescribed torque.

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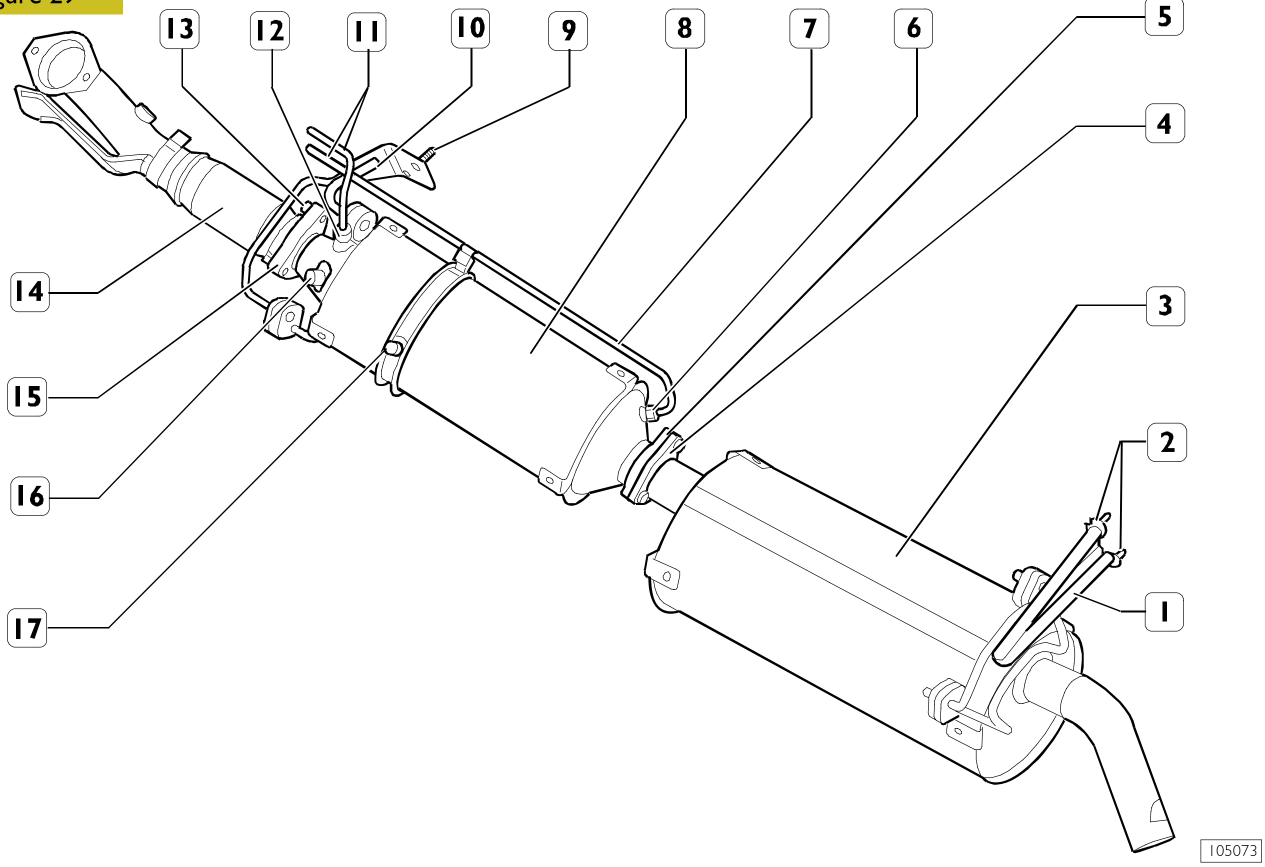
REMOVAL/REFITTING OF EXHAUST PIPE ASSEMBLY COMPONENTS (SYSTEMS EQUIPPED WITH D.P.F. CATALYST)

Figure 29



Exhaust silencer removal

Place the vehicle on a pit or auto lift.

Carry out the following operations by acting from under the vehicle:

- unscrew nuts (2) securing silencer (3) supporting bracket (1) to the vehicle chassis;
- unscrew and remove fastening screws (4) of flanges (5) connecting exhaust silencer (3) and D.P.F. particulate filter (8);
- remove exhaust silencer (3).

D.P.F. catalyst removal

- unscrew and remove the exhaust gas temperature sensors at the catalyst inlet (16) and outlet (17);
- unscrew to disconnect couplings (6 and 12) securing rigid pipes (7 and 11) running to the pressure sensor to D.P.F. catalyst (8);
- properly secure D.P.F. catalyst (8) to the vehicle chassis;
- unscrew nuts (9) securing D.P.F. catalyst (8) filter supporting bracket (10) to the vehicle chassis;
- unscrew and remove fastening screws (13) of flanges (15) connecting D.P.F. catalyst (8) filter to the exhaust gas outlet pipe from turbine (14);
- remove D.P.F. catalyst (8) filter.

Refitting

For refitting, reverse the operations described for disconnection observing following warnings:

- check the conditions of the elastic dowels, taking care to replace the defective ones (if any);
- replace gasket by new parts;
- tighten nuts and screws at prescribed torque.

After the operation has been completed, and in the event that either the D.P.F. catalyst or the differential sensor (delta-p) needs replacing, follow the instructions given in the respective chapters.

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507130 Replacing D.P.F. catalyst

Replacing D.P.F. catalyst needs that all the counters of below indicated parameters are reset in the central unit, as:

- particulate quantity in new filter is zero, so, if particulate quantity is not reset, filter regeneration will start even if it is not necessary;
- quantity of accumulated ashes is zero, so, if ashes counter is not reset, regeneration frequency will be greater than needed, consequently increasing fuel consumption, and particulate filter thermal fatigue; and, in extreme cases, there will be an unnecessary request to refill engine oil;
- post-injected fuel quantity is zero, so, if post-injected fuel counter is not reset, there may be an early request to refill engine oil.

NOTE Where both DPF catalyst is replaced and engine oil is refilled, resetting post-injected fuel counter is not necessary.

- regeneration status: regeneration unnecessary, in progress, interrupted, resumed;
- miles covered and times from last complete regeneration;
- differential pressure (delta-p) sensor drift self-rectification;
- oxidiser catalyst drift; consequently, if catalyst ageing function is not reset, quantities of unnecessary post-injections might be present.

The meters used to evaluate the above-mentioned parameters can be reset by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the DPF catalyst replacement procedure, in accordance with the instructions given by the diagnosis instruments.

540743 Replacing differential sensor (delta-p)

Pressure difference between gas pressure at catalyst module inlet and gas pressure at ceramic walls filter outlet is converted into a voltage signal (Vout) by pressure sensor.

During engine running, E.D.C. 16 central unit performs checks on differential pressure sensor drift and calculates engine compensation and running values, and corrects them. Consequently, after replacing the sensor, it is necessary to reset rectification coefficients.

The meters used to evaluate the above-mentioned parameters can be reset by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the differential sensor replacement procedure, in accordance with the instructions given by the diagnosis instruments.

ENGINE VIEWS

Figure 30

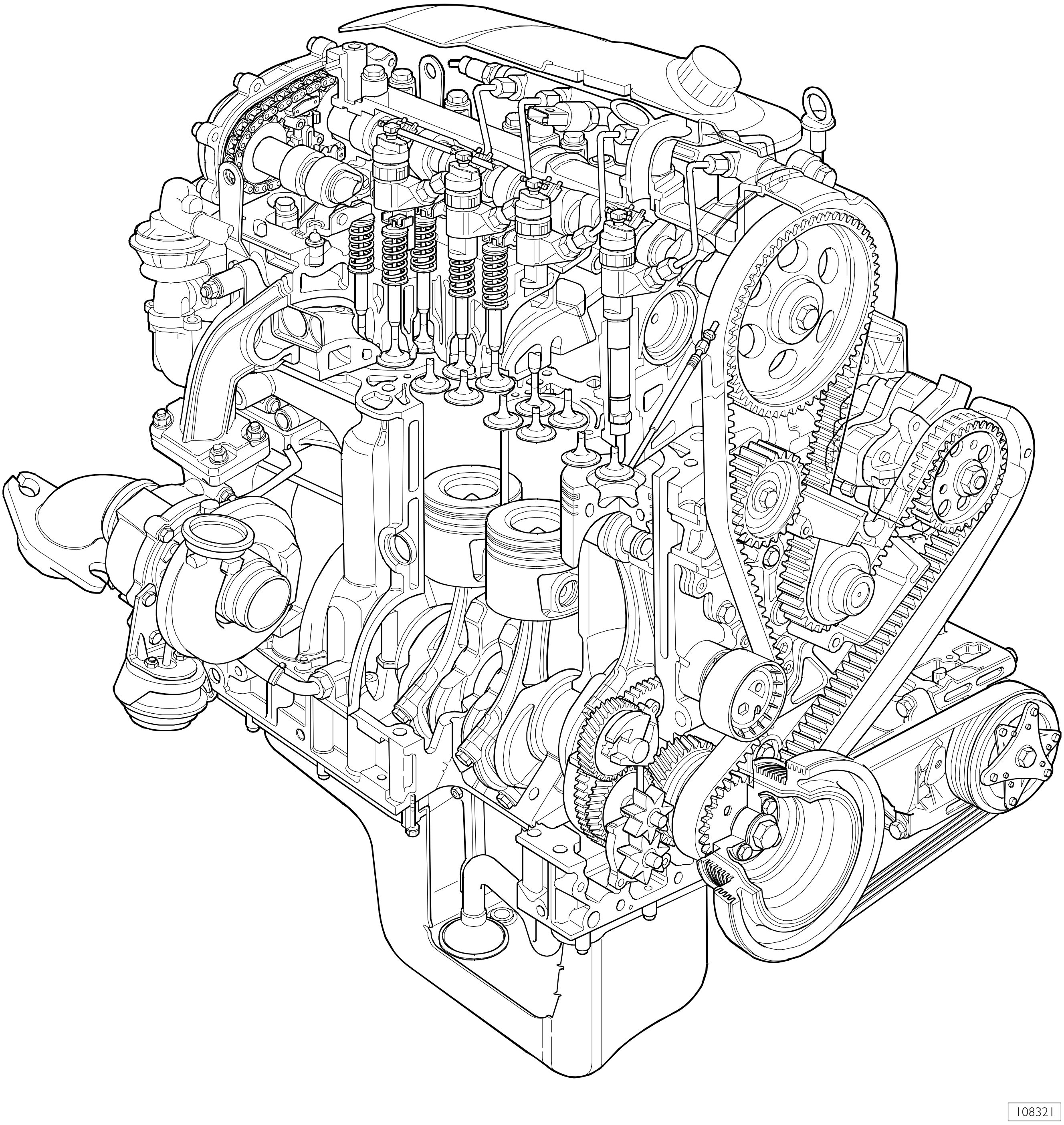
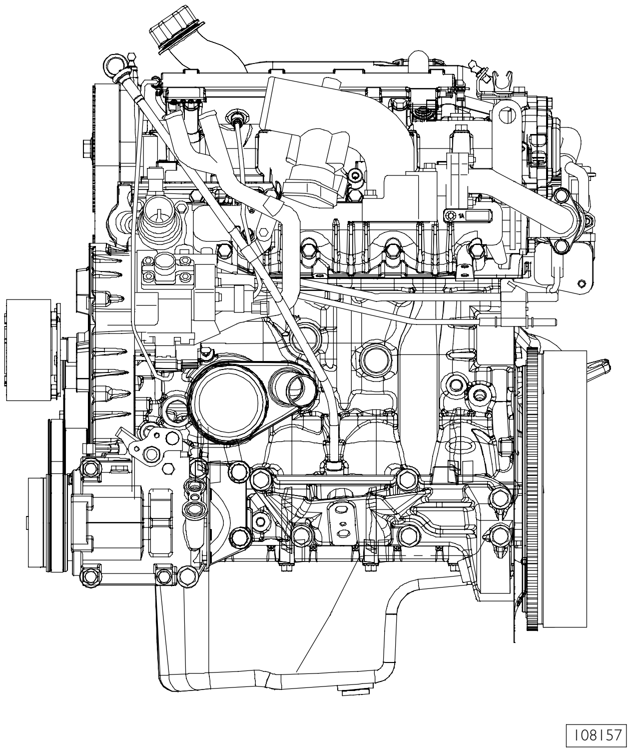
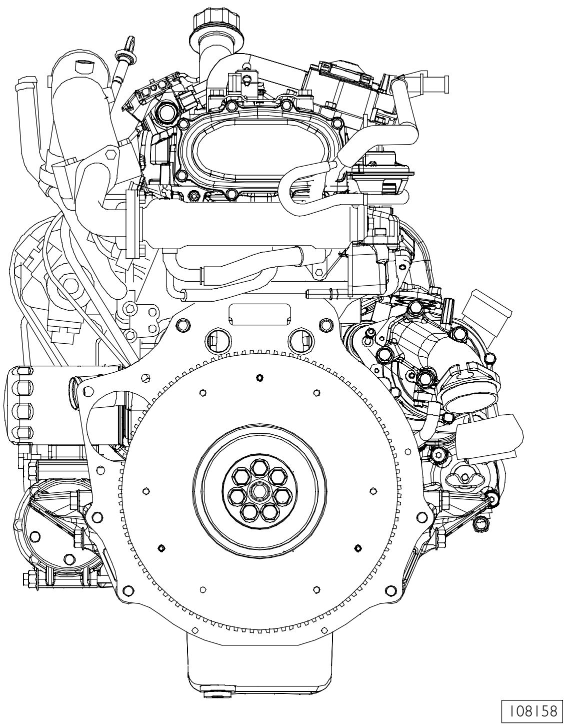


Figure 31



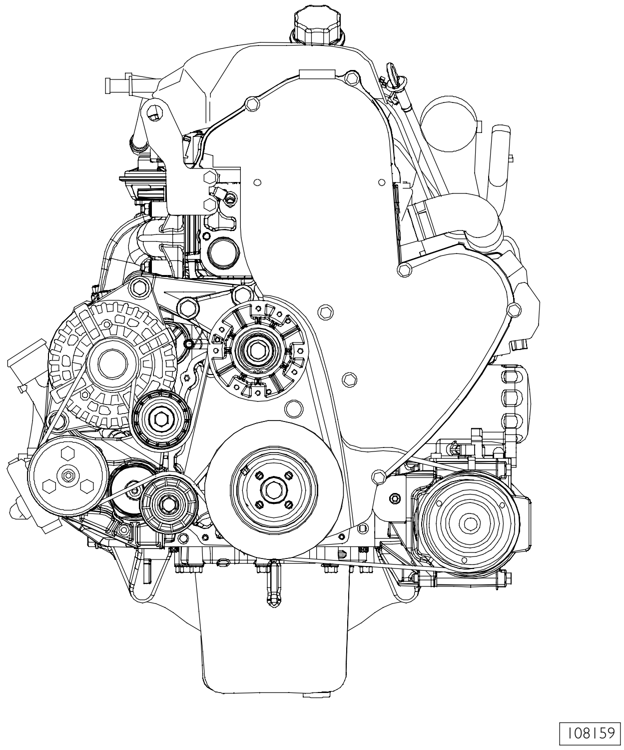
LEFT-HAND SIDE VIEW

Figure 32



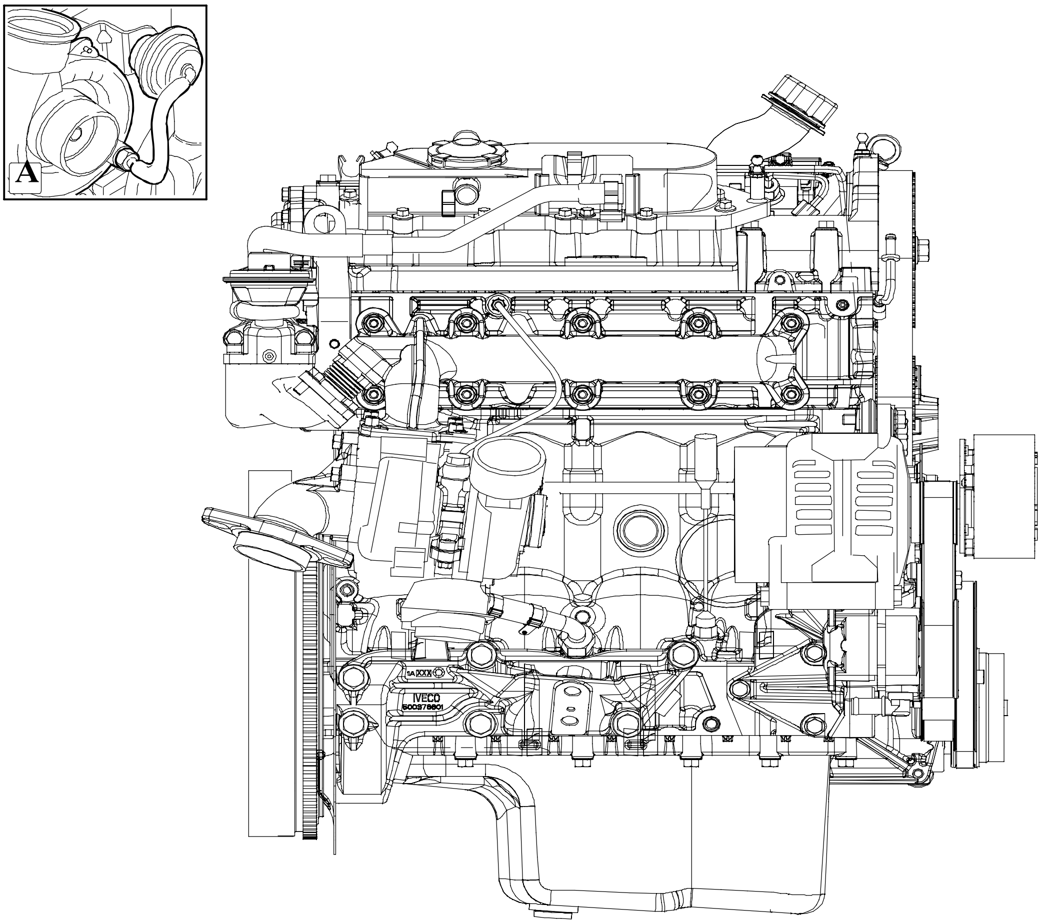
REAR VIEW

Figure 33



FRONT VIEW

Figure 34

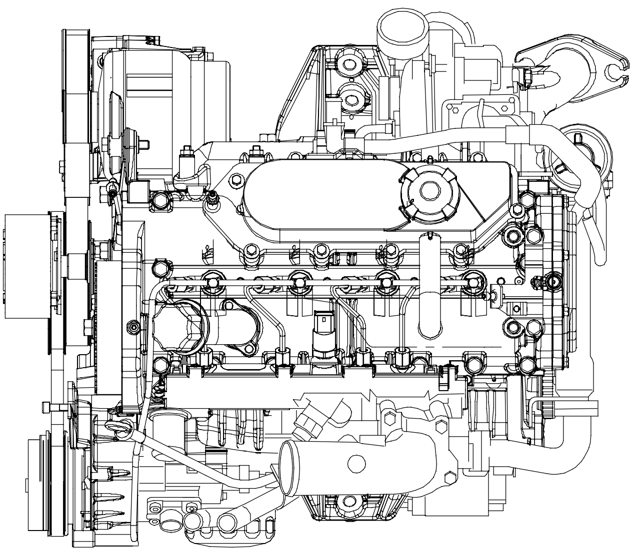


108160

RIGHT-HAND SIDE VIEW

A. Turbocharger with pressure relief valve (Waste-Gate, ENGINES 96/116 HP)

Figure 35



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TOP VIEW

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EMISSIONS

Gas emissions

The engines conform to the Euro 4 standards on gas emissions (measurement on engine bench according to ECE 15 + EUDC cycle), with the following limits fixed by the ESC and ELR 1999/96-2001/27 standards:

level B:

-	CO (carbon monoxide)	0,74 g/km
-	NOx (nitrogen oxide)	0,39 g/km
-	HC (unburnt hydrocarbons) + NOX (nitric oxide)	0,46 g/km
-	Particulate	0,06 g/km

Test fuel: CEC RTF 73-T90. 5 = 0.05%.

Smokiness

The engines conform to the limits of smokiness required with the following exhaust smoke values:

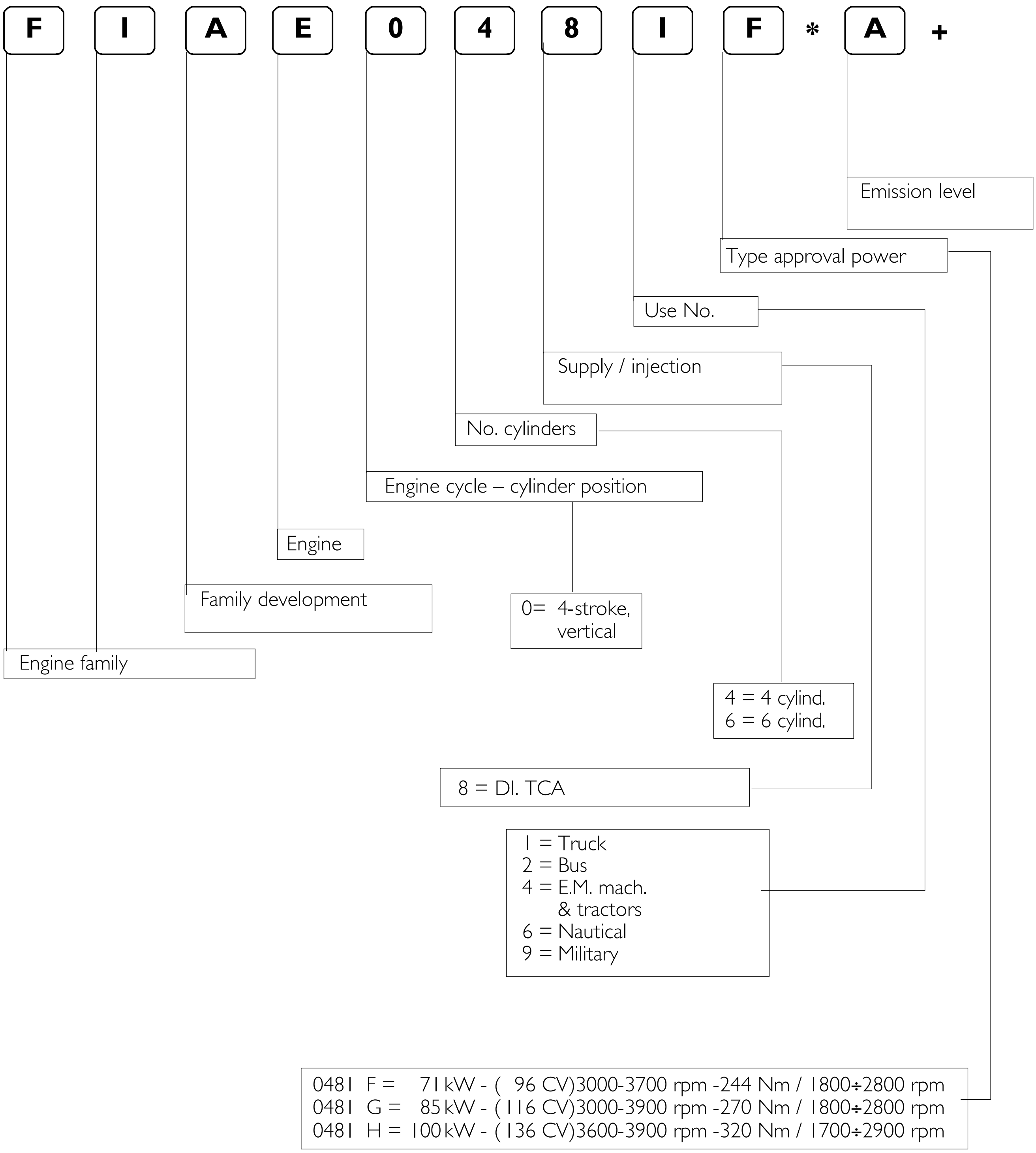
Maximum power (Bosch BSU opacimeter degrees)	1.5
Maximum torque (Bosch BSU opacimeter degrees)	1.5

Noise emissions

Maximum mean noise level, Lpa, of the standard engines measured according to ISO Std. 3745 (microphones at 1 m from the engine surfaces):

Idling	(800 rpm)	72 dBA
At the maximum torque		84 dB A
Full power	(3800 rpm)	93 dBA.

ENGINE IDENTIFICATION CODE



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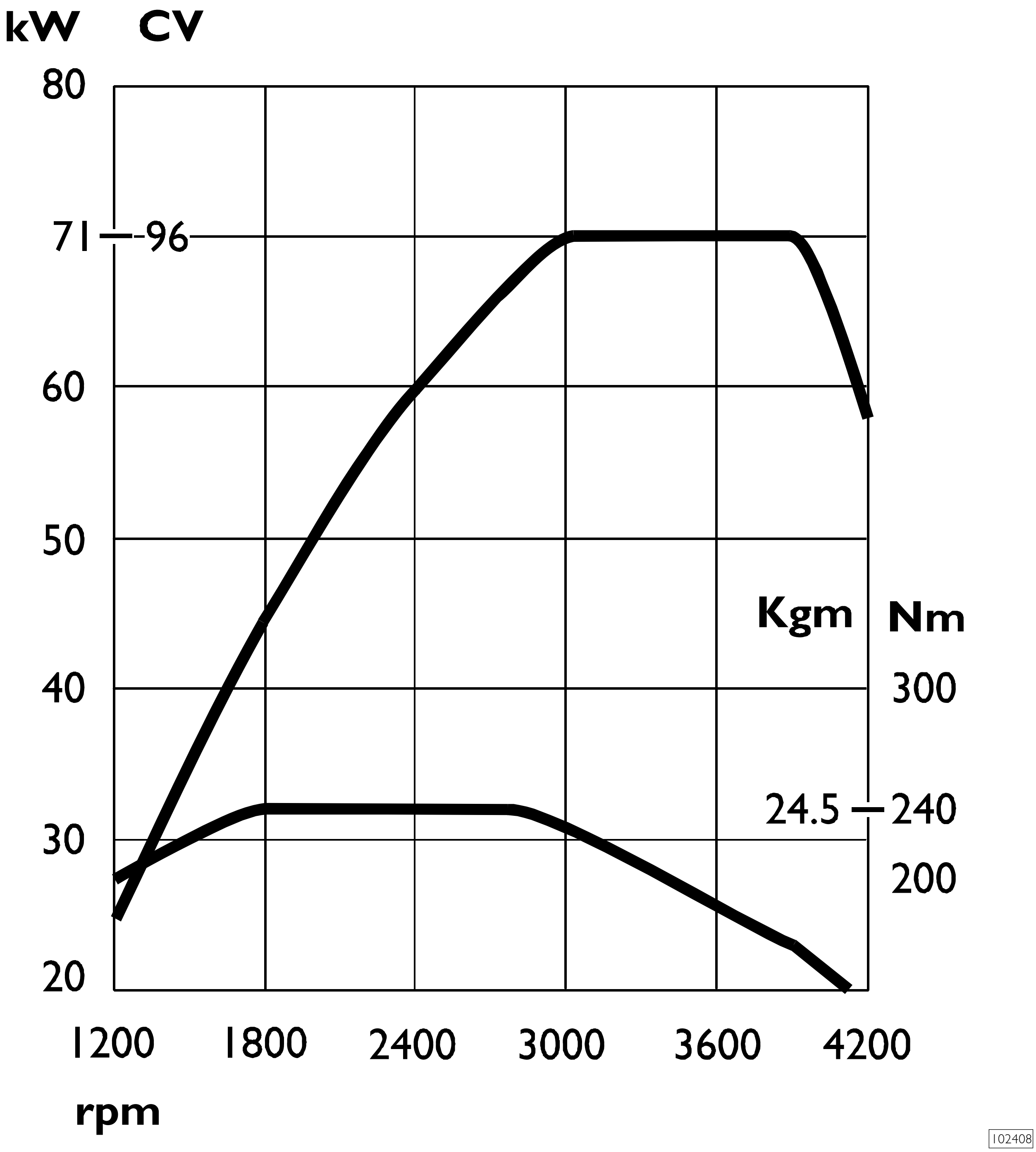
CHARACTERISTIC CURVES

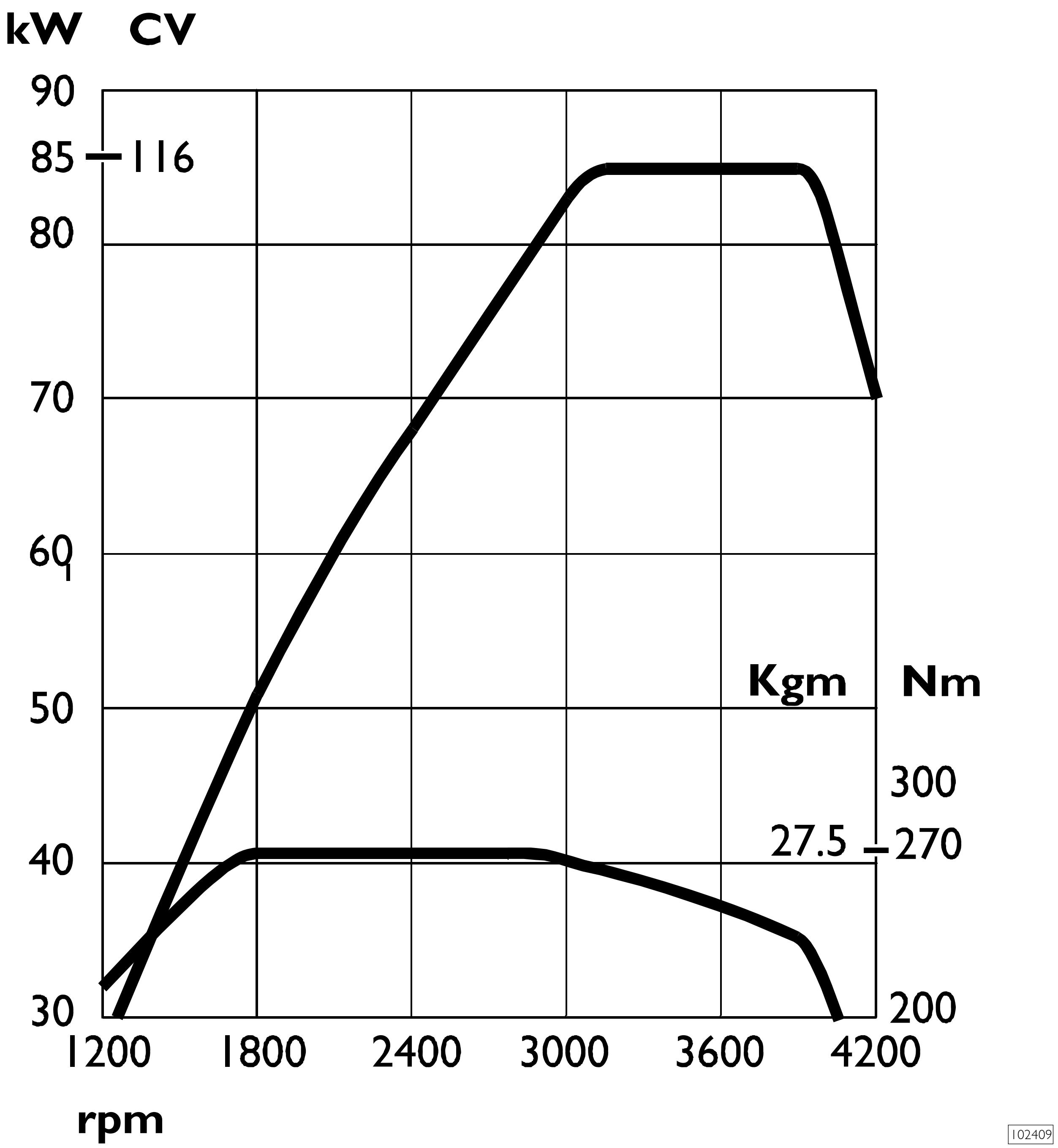
Figure 36



CHARACTERISTIC CURVES OF ENGINE F1AE0481F

Max OUTPUT 71 kW	**96 HP**	**at 3000÷3700 rpm**
Max TORQUE 240 Nm	**24.4 kgm**	**at 1800÷2800 rpm**

Figure 37



CHARACTERISTIC CURVES OF ENGINE F1AE0481G

Max OUTPUT 85 kW	**116 HP**	**at 3000÷3900 rpm**
Max TORQUE 270 Nm	**27.5 kgm**	**at 1800÷2800 rpm**

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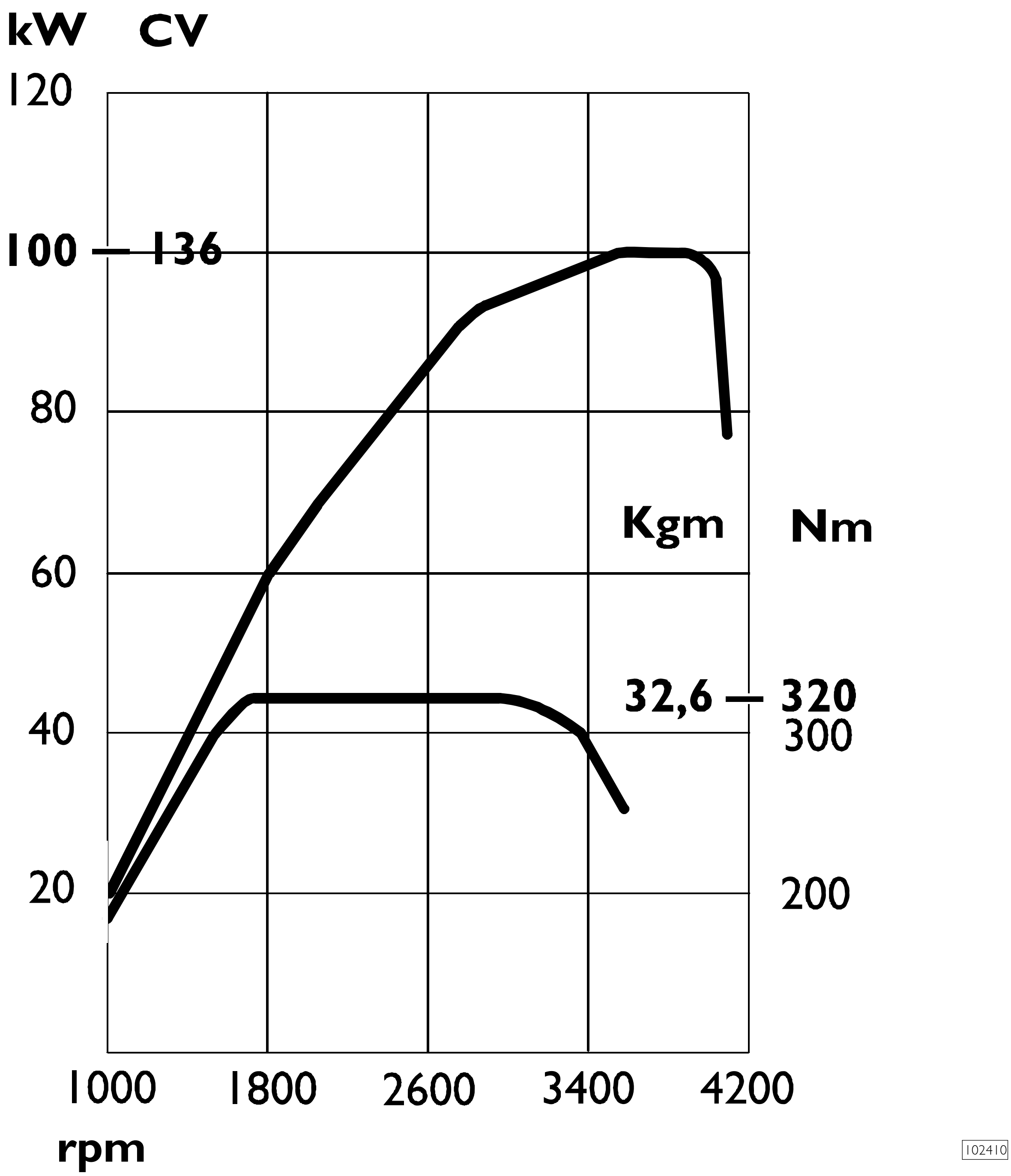
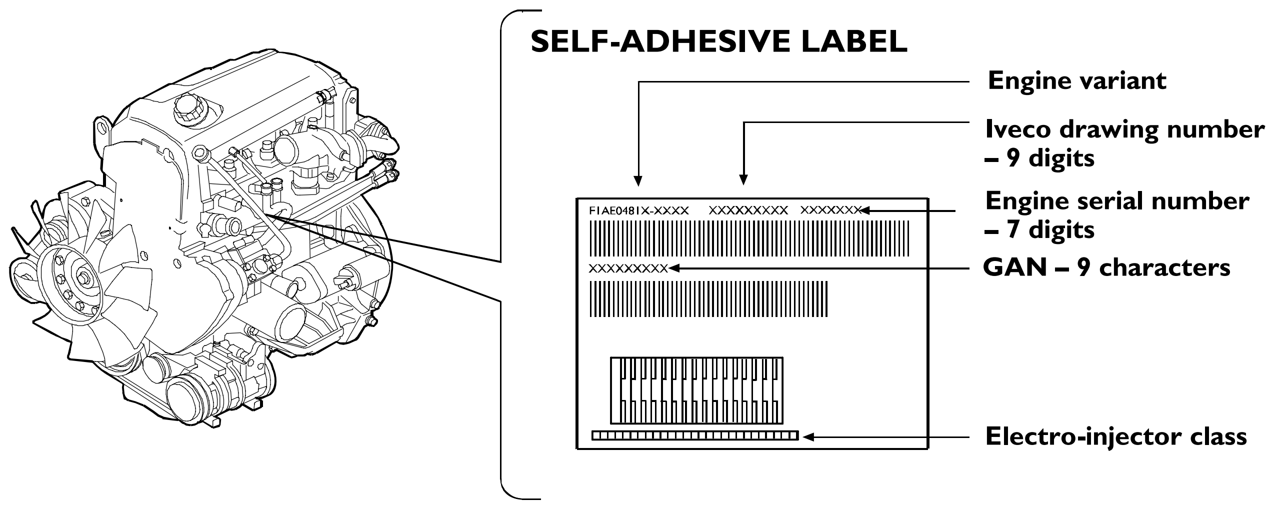
Figure 38



CHARACTERISTIC CURVES OF ENGINE F1AE0481H

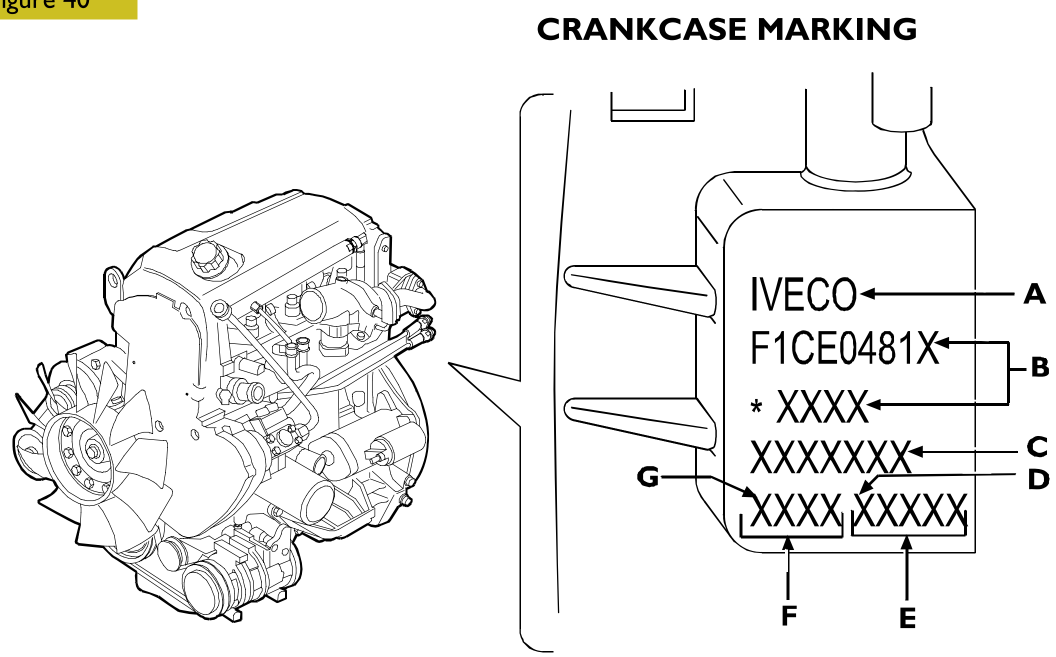
Max OUTPUT 100 kW	**136 HP**	**at 3600÷3900 rpm**
Max TORQUE 320 Nm	**31.6 kgm**	**at 1700÷2900 rpm**

Figure 39



108448

Figure 40



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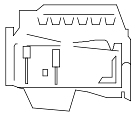
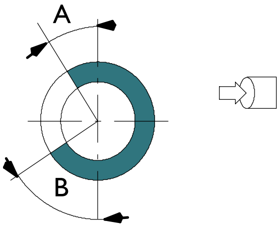
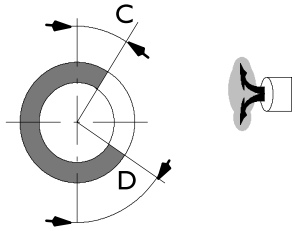
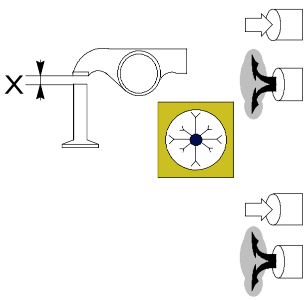
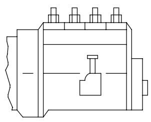
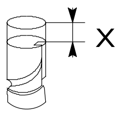
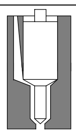
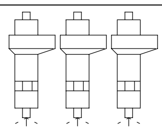
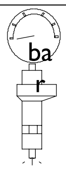
	EXAMPLE
A = IVECO trademark	IVECO
B = IVECO name of engine variant **	F1AE0481A * A001
C = Engine serial number	1359862
D = 1st digit, main journal no. 1 (engine front)	
E = Main bearing selection diameters	12345
F = Barrel selection diameters	1234
G = 1st digit, cylinder no. 1 (engine front)	

(**) Data obtainable from "XZ" engine ordering number information

GENERAL SPECIFICATIONS

Type		F1AE0481 F	F1AE0481 G	F1AE0481 H
Cycle		Diesel 4 strokes		
Supply		Turbocharged with intercooler		
Injection		Direct		
Number of cylinder		4 in line		
Bore	mm	88		
Stroke	mm	94		
Total displacement	cm^3	2300		
Compression ratio		18		
Maximum power	kW (HP)	71 (96)	85 (116)	100 (136)
	rpm	3900	3900	3900
Maximum torque	kW (HP)	240 (24.4)	270 (27.5)	310 (31.6)
	rpm	1800 ÷ 3200	1800 ÷ 3150	1800
Slow running of engine with no load	rpm	800		
Fast idling speed of engine with no load	rpm	4600		
Pressure at T.D.C.	*bar	20 ÷ 26		
Minimum permissible pressure at T.D.C.	*bar	16		

(*) The pressure is measured by setting the engine turning with the aid of just the starter motor, with an oil temperature of 40 – 50°C.

	Type		F1AE0481 F	F1AE0481 G	F1AE0481 H
	TIMING SYSTEM				
	Start before T.D.C.	A	14°		
	end after B.D.C.	B	27°		
	Start before T.D.C.	D	54°		
	end after B.D.C.	C	10°		
	For timing check				
	X	mm	-		
		mm	-		
	Operation				
	X	mm	-		
		mm	-		
	SUPPLY		High pressure fuel feed system BOSCH EDC16 Composed of CP1 high-pressure pump, electro-injectors, hydraulic accumulator (rail), EDC control unit, pressure and temperature sensors		
	Pump setting With piston no.1 at T.D.C.		-		
	Start of delivery	mm	-		
	Electro-injectors type		BOSCH CR1 2-2		
	Injection sequence		1- 3 - 4 - 2		
	Injection pressure	bar	1600		

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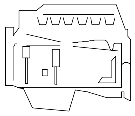
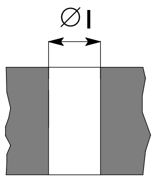
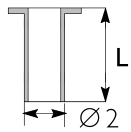
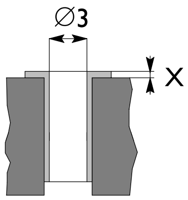
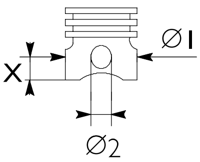
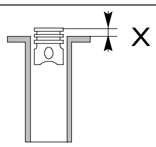
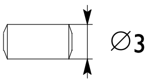
Type		F1AE0481 F	F1AE0481 G	F1AE0481 H
TURBOCHARGING		With intercooler		
Turbocharger type		KKK K03-2074-CCB 5.88		Garrett GT17
Turbocharger shaft radial play		-		-
Turbocharger shaft end float		-		-
Maximum stroke of pressure relief valve opening	mm	3.35 ±0.5		-
Pressure corresponding to the maximum stroke	bar	1.6 ±0.005		-
Actuator calibration:				
-vacuum: 0 mmHg — valve fully open		-		-
- vacuum: 0.2 bar — valve travel	mm	-		2 ÷ 4
-vacuum: 0.64 bar — valve travel	mm	-		10.5 ÷ 12.5
LUBRICATION		forced by gear pump, pressure relief valve, oil filter with integral cartridge with total filtering		
Oil pressure with engine hot (100°C ±5°C):				
at idling speed	bar	≥0.6		
at top speed	bar	4		
COOLING		by centrifugal pump, thermostat for adjustment, coolant temperature, fan with electromagnetic coupling, radiator, heat exchanger		
Water pump control:		by belt		
Thermostat:		N. I.		
start of opening:		82 ±2°C		
FLUIDS				
Urania Daily / Urania LD 5 — Capacity: engine sump at minimum level	liters / kg	3 / 2.65		
engine sump at maximum level	litres / kg	4.3 / 3.78		
quantity of oil for first filling	liters / kg	5.3 / 5.02		

ASSEMBLY DATA – CLEARANCES

	Type		F1AE0481 F	F1AE0481 G	F1AE0481 H
CYLINDER ASSEMBLY AND CRANK MEMBERS			mm		
	Cylinder liners:	Ø 1	88.002 ÷ 88.022		
	Cylinder liners: outside diameter length	 Ø L	- - -		
	Cylinder liners – crankcase seats (interference)		-		
>	Outside diameter	Ø 2	-		
	Cylinder liners: (protrusion from bottom of crankcase) inside diameter	 Ø 3	- -		
	Pistons: supplied as spares type measurement outside diameter seat for pin	 X Ø 1 Ø 2	MAHLE MONDIAL 8 87.896 ÷ 87.910 31.003 ÷ 31.009		
	Piston - cylinder sleeve		0.092 ÷ 0.126		
<	Piston diameter	Ø 1	0.4		
	Piston protrusion from crankcase	X	0.3 ÷ 0.6		
	Piston gudgeon pin	Ø 3	30.990 ÷ 30.996		
	Piston gudgeon pin – pin seat		0.07 ÷ 0.019		

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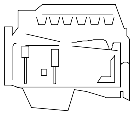
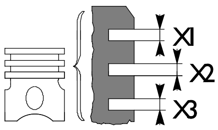
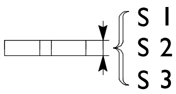
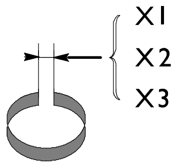
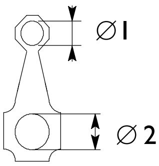
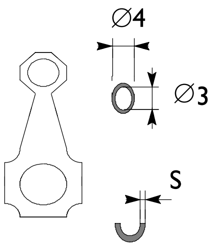
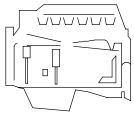
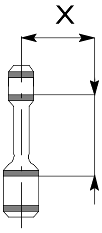
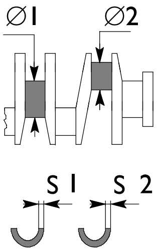
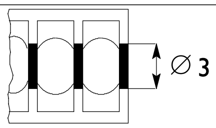
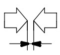
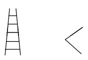
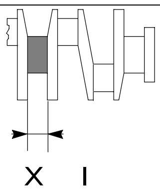
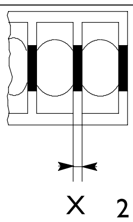
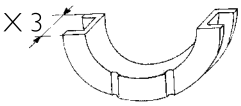
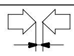
	Type	F1AE0481 F	F1AE0481 G	F1AE0481 H
				
CYLINDER ASSEMBLY AND CRANK MEMBERS		mm		
	Type of piston	MAHLE MONDIAL		
	Piston ring slots X1*	2.200 ÷ 2.230		
	X2	2.050 ÷ 2.070		
	X3	2.540 ÷ 2.560		
	* measured on Ø of 85 mm			
	Piston rings: S 1*	2.068 ÷ 2.097		
	S 2	1.970 ÷ 1.990		
	S 3	2.470 ÷ 2.490		
	* Measured at 2.5 mm from the outer diameter			
	Piston rings – slots 1	0.103 ÷ 0.162		
	2	0.060 ÷ 0.100		
	3	0.050 ÷ 0.090		
IVECO PARTS	Piston rings	0.4		
	Piston ring end opening in cylinder liner:			
	X1	0.20 ÷ 0.35		
	X2	0.60 ÷ 0.80		
	X3	0.25 ÷ 0.50		
	Small end bushing seat Ø 1	34.460 ÷ 34.490		
	Connecting rod bearing seat* Ø 2	62.833 ÷ 62.841		
	* connecting rod supplied as spare part			
	Small end bushing diameter			
	outside Ø 4	34.560 ÷ 34.585		
	inside Ø 3	31.010 ÷ 31.020		
	Big end bearing shells supplied as spare part S	-		
	Small end bushing – seat (interference)	0.07 ÷ 0.125		
	Piston gudgeon pin – bushing	0.014 ÷ 0.030		
IVECO PARTS	Big end bearing shells	0.254 - 0.508		

		FIAE0481 F	FIAE0481 G	FIAE0481 H
	Type	FIAE0481 F	FIAE0481 G	FIAE0481 H
CYLINDER ASSEMBLY AND CRANK MEMBERS		mm		
	Measurement X Maximum error on alignment of connecting rod axes =	125 0.09		
	Main journals Ø 1 No. 1-2-3-4 No. 5 Crankpins Ø 2 Main bearing shells S1* Big end bearing shells S2* * supplied as spare parts	71.182 ÷ 71,208 76.182 ÷ 76.208 59.015 ÷ 59.038 2.165 ÷ 2.174 1.883 ÷ 1.892		
	Main bearing housings Ø 3 No. 1-2-3-4 No. 5	75.588 ÷ 75.614 80.588 ÷ 80,614		
	Bearing shells - main journals	0.032 ÷ 0.102		
	Bearing shells – crankpins	0.035 ÷ 0.083		
IVECO PARTS 	Main bearing shells Big end bearing shells	0.254 - 0.508 0.254 - .,508		
	Main journal for shoulder X 1	31.020 ÷ 31.170		
	Main bearing housing for shoulder X 2	25.790 ÷ 25.840		
	Half thrust washers X 3	30.810 ÷ 30.960		
	Crankshaft shoulder	0.060 ÷ 0.260		

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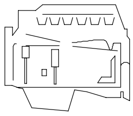
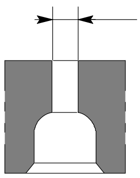
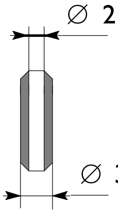
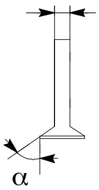
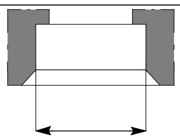
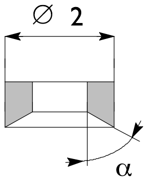
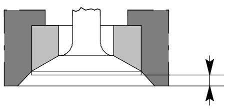
<table>
<tr><td></td><td>Type</td><td>F1AE0481 F</td><td>F1AE0481 G</td><td>F1AE0481 H</td></tr>
<tr><td colspan="2">CYLINDER HEAD – TIMING SYSTEM</td><td colspan="3">mm</td></tr>
<tr><td>Ø 1
</td><td>Guide valve seats
on cylinder head Ø1</td><td colspan="3">9.980 ÷ 10.000</td></tr>
<tr><td>
</td><td>Valve guide Ø 2
Ø 3</td><td colspan="3">6.023 ÷ 6.038
10.028 ÷ 10.039</td></tr>
<tr><td></td><td>Valve guides and seats on head
(interference)</td><td colspan="3">0.028 ÷ 0.059</td></tr>
<tr><td>IVECO PARTS ></td><td>Valve guides</td><td colspan="3">0.05 - 0.10 - 0.25</td></tr>
<tr><td>
</td><td>Valves:
Ø 4
α
Ø 4
α</td><td colspan="3">5.975 ÷ 6.000
44°45' ±7.5'
5.975 ÷ 5.990
44°45' ±7.5'</td></tr>
<tr><td></td><td>Valve stem and relevant guide</td><td colspan="3">0.023 ÷ 0.063
0.033 ÷ 0.063</td></tr>
<tr><td>
</td><td>Seat on head for valve seat:
Ø1
Ø1</td><td colspan="3">31.390 ÷ 31.415
31.390 ÷ 31.415</td></tr>
<tr><td>
</td><td>Outside diameter of valve seats; angle of valve seats on cylinder head:
Ø 2
α
Ø 2
α</td><td colspan="3">31.495 ÷ 31.510
44.5° ±5'
31.495 ÷ 31.510
44.5° ±5'</td></tr>
<tr><td>
</td><td>Recessing X
X</td><td colspan="3">0.5 ÷ 0.8
0.5 ÷ 0.8</td></tr>
</table>

Type		F1AE0481 F	F1AE0481 G	F1AE0481 H
CYLINDER HEAD – TIMING SYSTEM		mm		
Between valve seat and head		0.08 - 0.12 0.08 - 0.12		
Valve seats		-		
Valve spring height: free height under a load of: N243 ± 12 N533 ± 24	 H H1 H2	 54 45 35		
Injector protrusion	X	2.77 ÷ 3.23		
Seats for tappets on cylinder head	normal ∅	12.016 ÷ 12.034		
Normal diameter tappets		11.988 ÷ 12.000		
Between tappets and seats		0.016 ÷ 0.046		
Camshaft pin seats in cylinder overhead 1 ⇒ 7	 ∅ 1 ∅ 2 ∅ 3	 48.987 ÷ 49.013 46.987 ÷ 47.013 35.987 ÷ 36.013		
Camshaft bearing journals	∅ 1 ∅ 2 ∅ 3	48.925 ÷ 48.950 46.925 ÷ 46.950 35.925 ÷ 35.950		
Supporting pins and seats		0.037 ÷ 0.088		
Useful cam height	H H	3.811 4.230		

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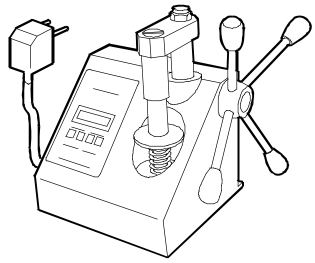
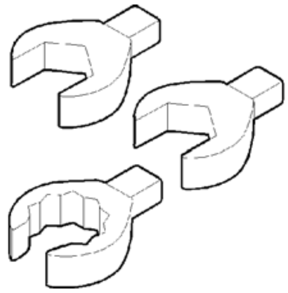
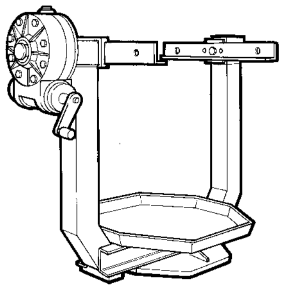
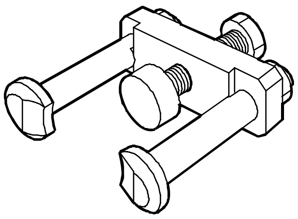
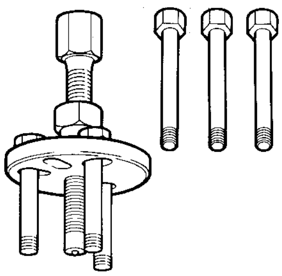
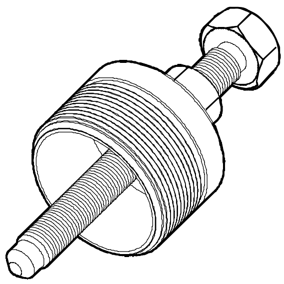
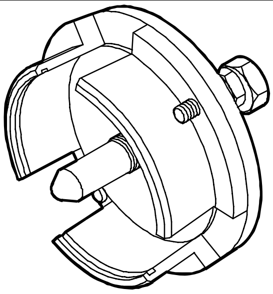
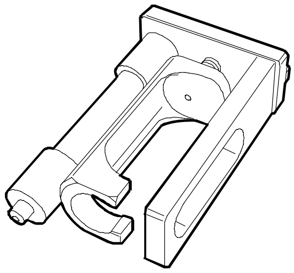
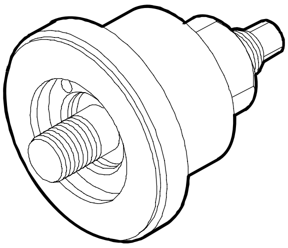
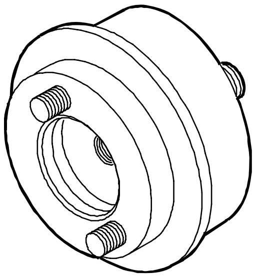
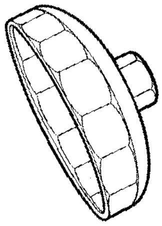
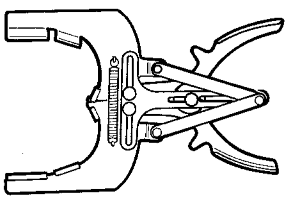
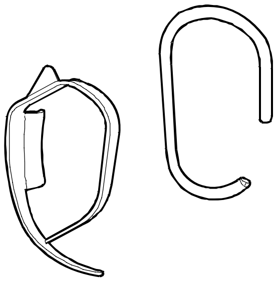
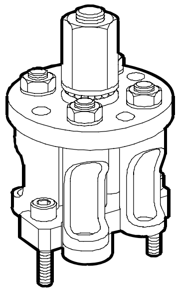
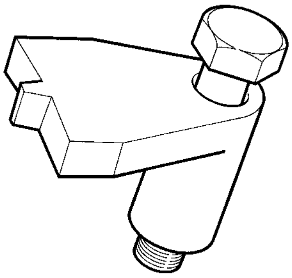
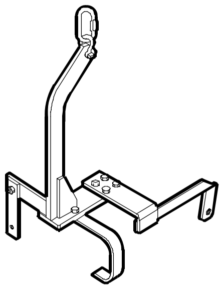
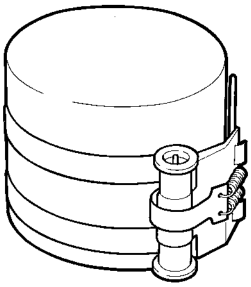
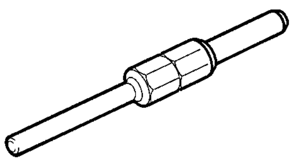
TOOLS

TOOL NO.		DESCRIPTION
99305047		Appliance to check spring loads
99317915		Set of six box-type wrenches (14-17-19 mm)
99322205		Rotary telescopic stand for overhauling assemblies (capacity 700 daN, torque 120 daN/m)
99340028		Extractor for camshaft pulley
99340035		High-pressure pump toothed pulley extractor
99340059		Tool to remove crankshaft front gasket

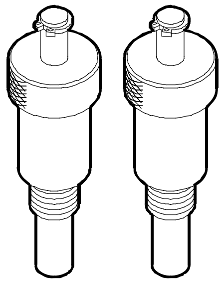
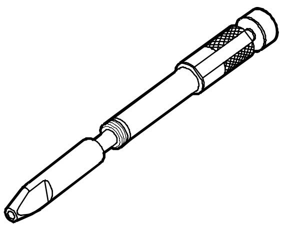
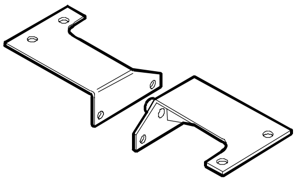
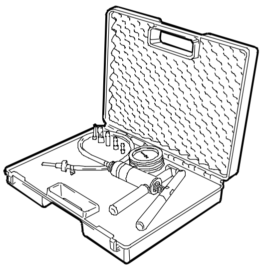
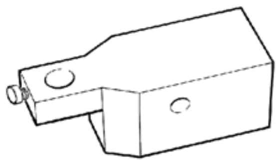
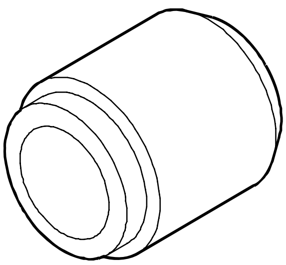
TOOLS

TOOL NO.		DESCRIPTION
99340058		Tool to remove crankshaft rear gasket
99342153		Tool to extract injectors
99346254		Keying device for mounting crankshaft front gasket
99346255		Keying device for mounting crankshaft rear gasket
99360076		Tool to remove cartridge filters
99360183		Pliers for mounting rings on engine pistons

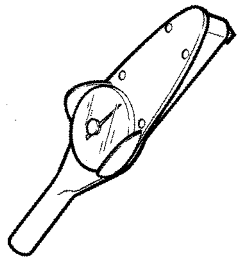
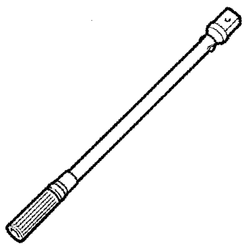
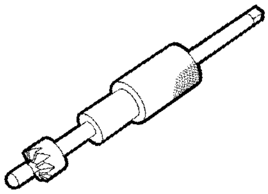
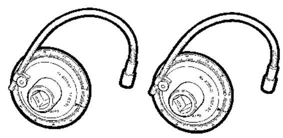
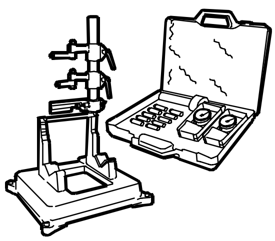
TOOLS

TOOL NO.		DESCRIPTION
99360191		Guide for flexible belt
99360260		Tool for removing and refitting engine valves
99360306		Tool to retain engine flywheel
99360544		Arm for removing and refitting engine
99360605		Band to insert standard and oversized pistons into the cylinders
99360608		Tool for positioning timing gear

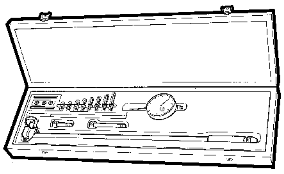
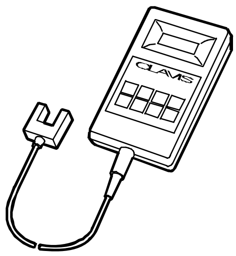
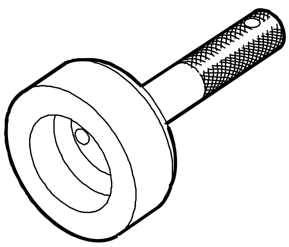
TOOLS

TOOL NO.		DESCRIPTION
99360614		Tool (2) for camshaft timing
99360615		Tool for crankshaft timing
99361038		Brackets securing engine to rotary stand 99322205
99367121		Manual pump to measure pressure and vacuum
99370415		Comparator holder base
99374458		Keying device for mounting oil seal gasket on camshaft front cover

TOOLS

TOOL NO.		DESCRIPTION
99389819		Torque wrench (0-10 Nm) with square 1/4” connection
99389829		9x12 coupling torque wrench (5-60 Nm)
99394038		Milling cutter to regrind injector seat (8140.63 engine excluded)
99395216		Pair of meters for angular tightening with square 1/2” and 3/4” connection
99395363		Complete square to check for connecting rod distortion
99395603		Comparator (0-5 mm)

TOOLS

TOOL NO.		DESCRIPTION
99395687		Bore meter (50 – 178 mm)
99395849		Device for checking belt tension (frequency from 10.0 to 600 Hz)
99396037		Centring ring for crankshaft front gasket cover

EXPERIMENTAL TOOLS

This section shows the working drawings for the experimental tools (S.P.) used in overhauling the engine described in this section, which may be made by the repair shops.

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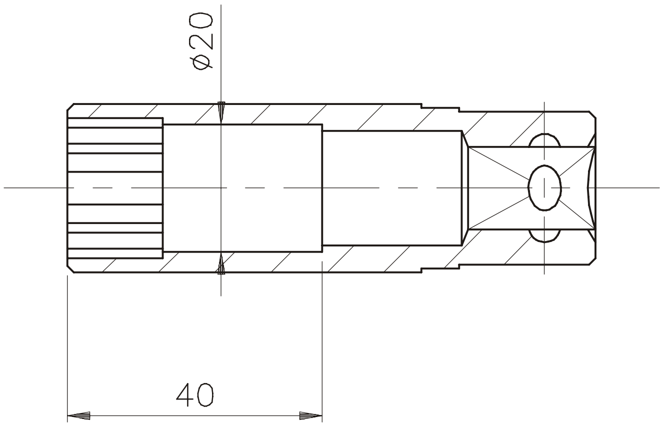
VARIA DA ART. COMMERCIALE USAG cod.235L 1/2" – Ch.19

SOLO PER QUANTO INDICATO



Modification:

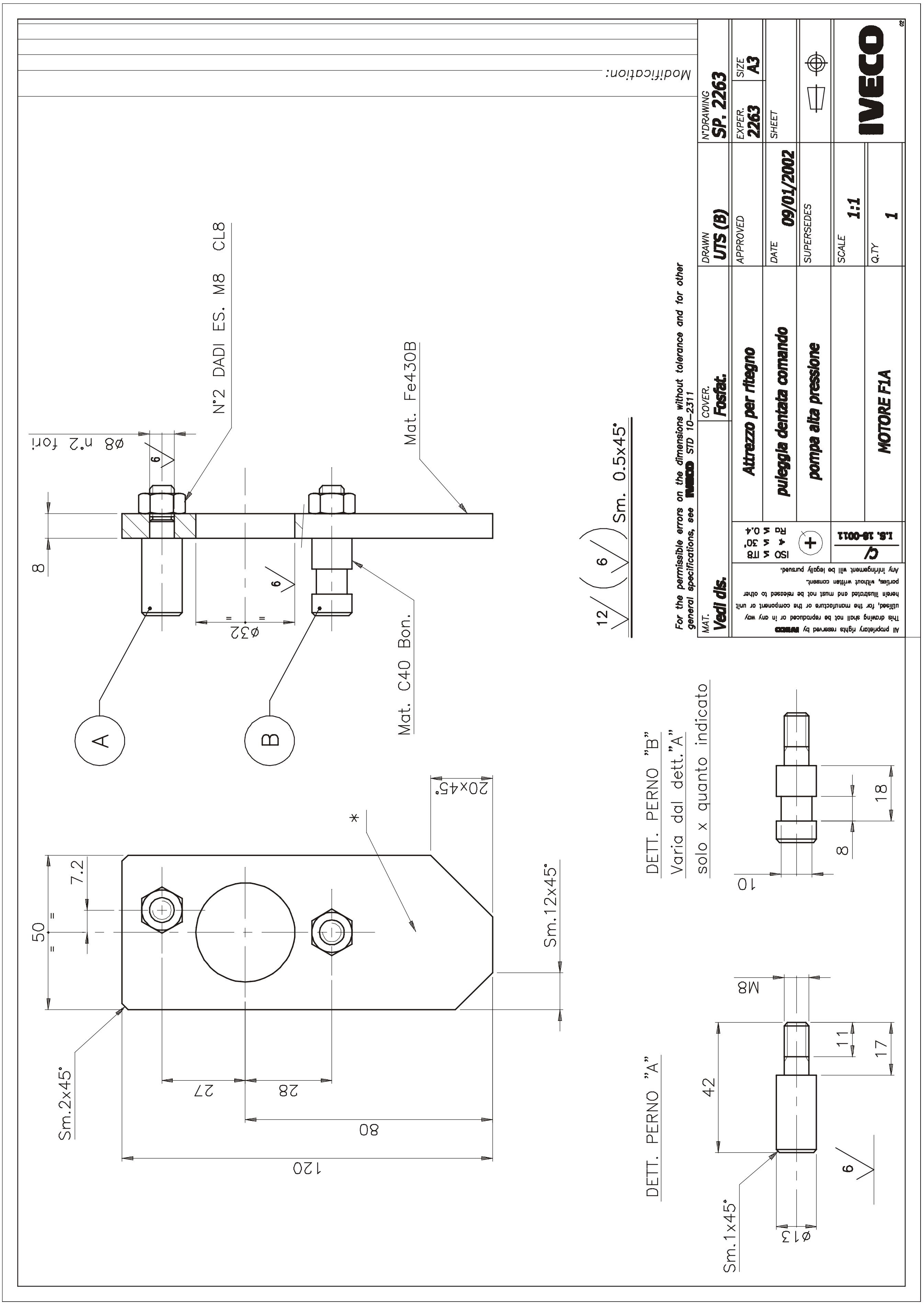
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

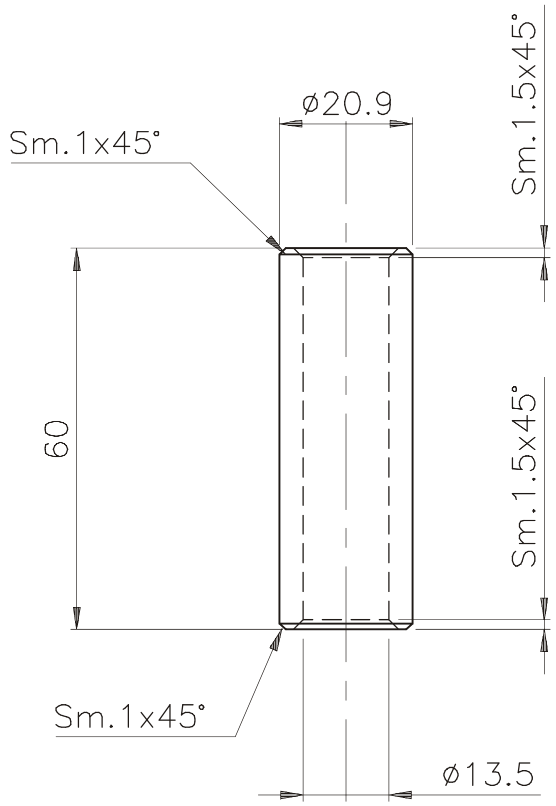
MAT. /	COVER. /	DRAWN **UTS (B)**	N°DRAWING **SP. 2262**
Chiave poligonale (19mm)		APPROVED	EXPER. **2262** / SIZE **A4**
per sensore pompa acqua		DATE **19/06/2001**	SHEET
		SUPERSEDES	
		SCALE **1:1**	IVECO
MOTORE F1A		Q.TY **1**	

ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

02


Modification:
N°DRAWING SP. 2263
EXPER. 2263
SIZE A3
SHEET
IVECO
DRAWN UTS (B)
APPROVED
DATE 09/01/2002
SUPERSEDES
SCALE 1:1
Q.TY 1
MAT. Vedi dis.
COVER. Fosfat.
Attrezzo per ritegno
puleggia dentata comando
pompa alta pressione
MOTORE F1A
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
N°2 DADI ES. M8 CL8
ø8 n°2 fori
Mat. Fe430B
Mat. C40 Bon.
Sm. 0.5x45°
ø32
20x45°
Sm.12x45°
Sm.2x45°
Sm.1x45°
DETT. PERNO "A"
DETT. PERNO "B"
Varia dal dett. "A"
solo x quanto indicato
M8
ø13
120
80
27
28
50
7.2
42
11
17
18
8
10



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT.	COVER.	DRAWN	N°DRAWING
Pom / Nylon	/	UTS (B)	SP. 2264

ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4

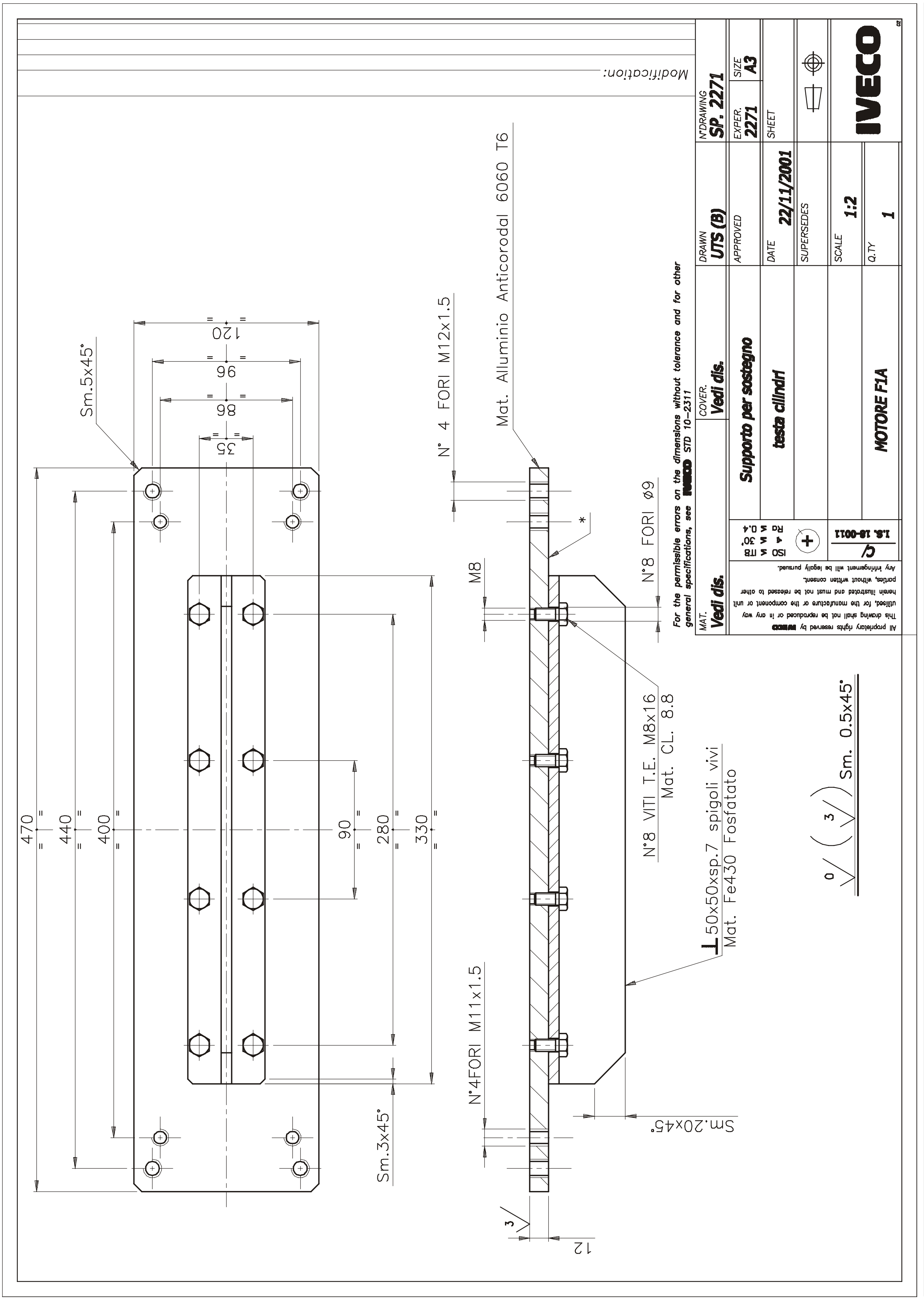
Perni di centraggio sovratesta
e per piantaggio guarnizione
guida valvole

MOTORE F1A

C/
I.S. 18-0011

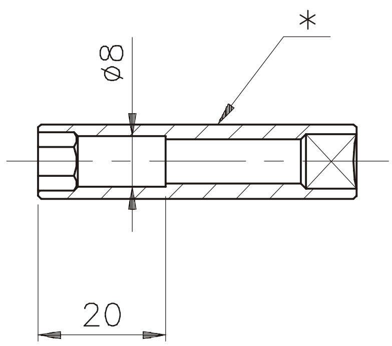
APPROVED	EXPER. 2264	SIZE A4
DATE 19/06/2001	SHEET	
SUPERSEDES		
SCALE 1:1	IVECO	
Q.TY 2		

02


Modification:
Mat. Alluminio Anticorodal 6060 T6
N° 4 FORI M12x1.5
N°8 FORI Ø9
N°8 VITI T.E. M8x16
Mat. CL. 8.8
⊥50x50xsp.7 spigoli vivi
Mat. Fe430 Fosfatato
N°4FORI M11x1.5
Sm.5x45°
Sm.3x45°
Sm.20x45°
Sm. 0.5x45°
MAT. Vedi dis.
COVER. Vedi dis.
Supporto per sostegno
testa cilindri
MOTORE F1A
DRAWN UTS (B)
APPROVED
DATE 22/11/2001
SUPERSEDES
SCALE 1:2
Q.TY 1
N°DRAWING SP. 2271
EXPER. 2271
SIZE A3
SHEET
IVECO

VARIA DA ART. COMMERCIALE USAG cod.235EL 1/4" – Ch.8

SOLO PER QUANTO INDICATO



6

Sm. 0.5x45°

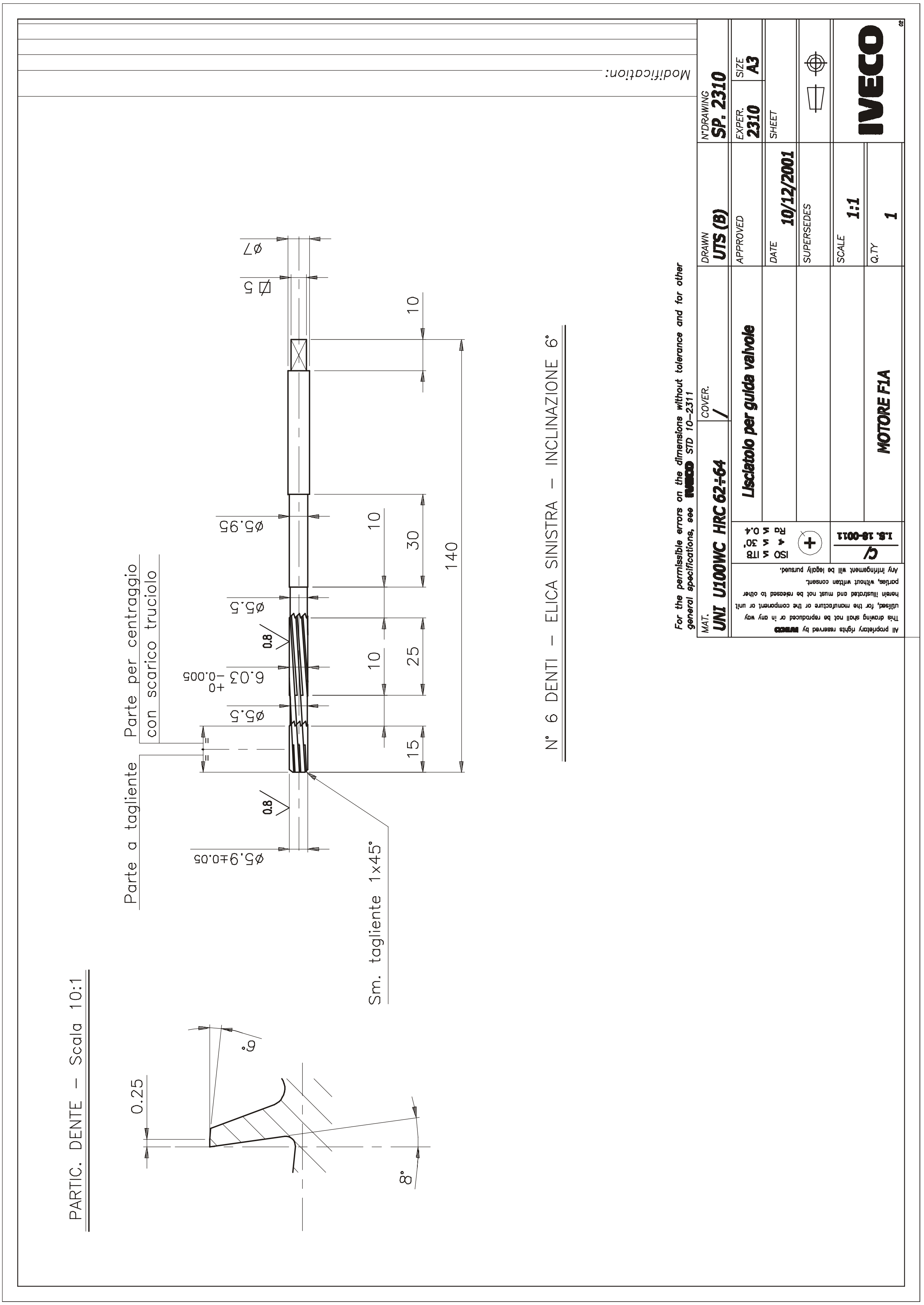
Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO *STD 10–2311*

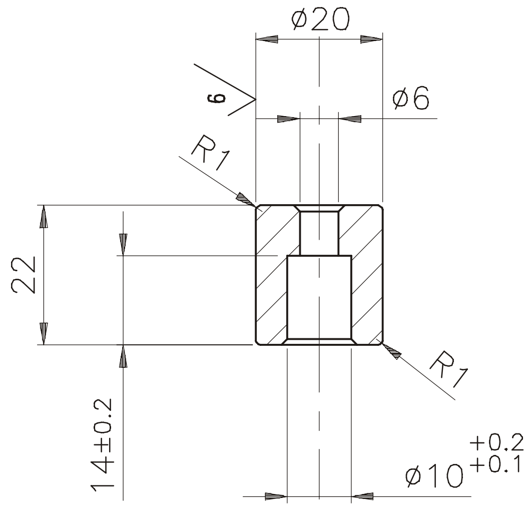
MAT.	COVER.	DRAWN	N°DRAWING
/	/	UTS (B)	SP. 2275

ISO ≤ IT8 ∢ ≤ 30' Ra ≤ 0.4	**Bussola (8 mm) per montaggio/ smontaggio candelette**	APPROVED	EXPER. **2275** SIZE **A4**
		DATE **25/07/2001**	SHEET
		SUPERSEDES	
C/ I.S. 18-0011	**MOTORE F1A**	SCALE **1:1** Q.TY **1**	IVECO

02



Print 603.93.651



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT.	COVER.	DRAWN	N°DRAWING
39NiCrMo3 Bon.	Fosfat.	UTS (B)	SP. 2311

ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

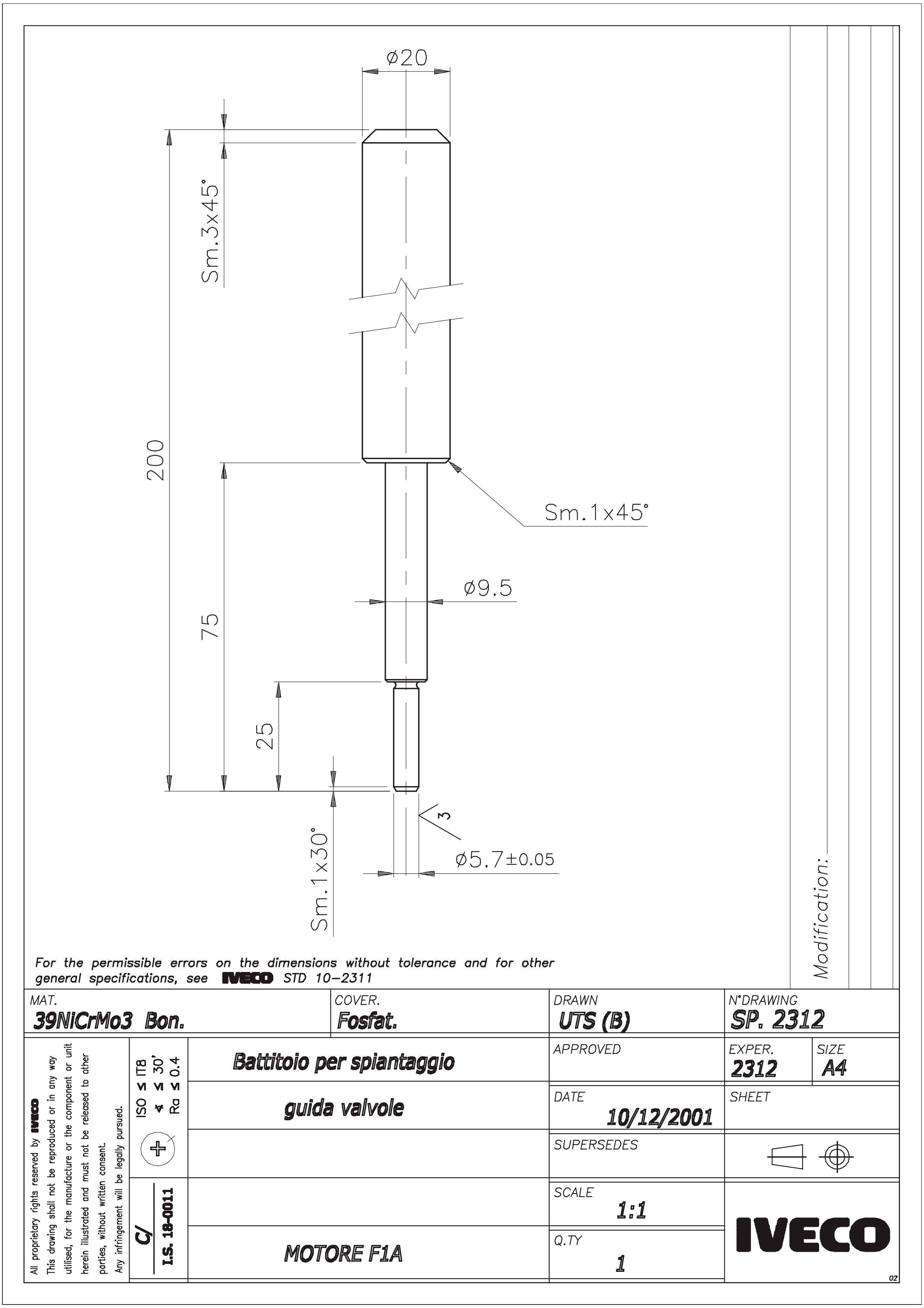
Battitoio per piantaggio

guida valvole

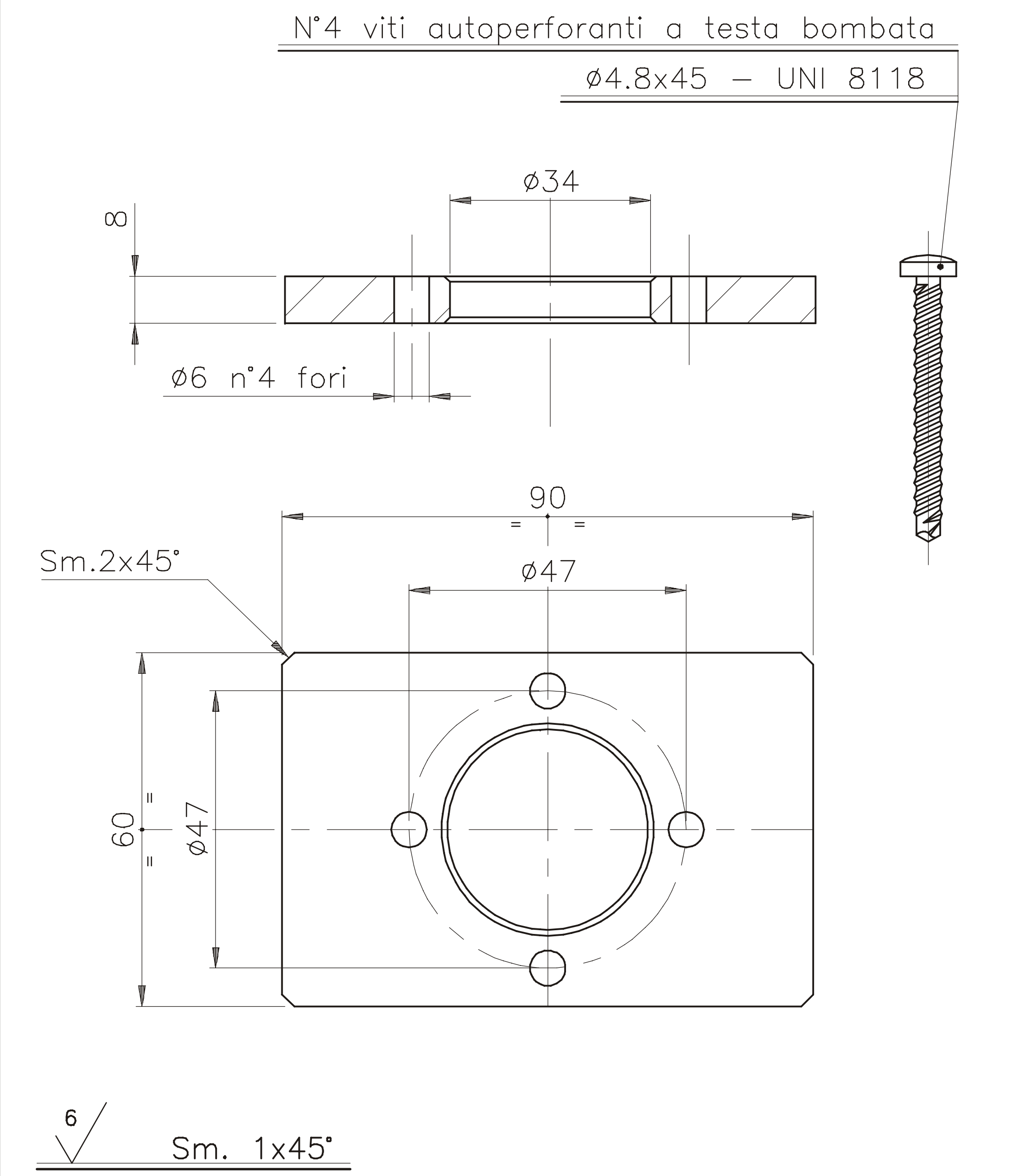
(usare con sp. 2312)

MOTORE F1A

APPROVED	EXPER. 2311 / SIZE A4
DATE 10/12/2001	SHEET
SUPERSEDES	
SCALE 1:1	IVECO
Q.TY 1	02



ø20
Sm.3x45°
200
Sm.1x45°
ø9.5
75
25
Sm.1x30°
3
ø5.7±0.05
Modification:
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
MAT.
39NiCrMo3 Bon.
COVER.
Fosfat.
DRAWN
UTS (B)
N°DRAWING
SP. 2312
All proprietary rights reserved by IVECO
This drawing shall not be reproduced or in any way utilised, for the manufacture or the component or unit herein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4
Battitoio per spiantaggio
guida valvole
APPROVED
EXPER.
2312
SIZE
A4
DATE
10/12/2001
SHEET
SUPERSEDES
C/
I.S. 18-0011
SCALE
1:1
Q.TY
1
MOTORE F1A
IVECO
02

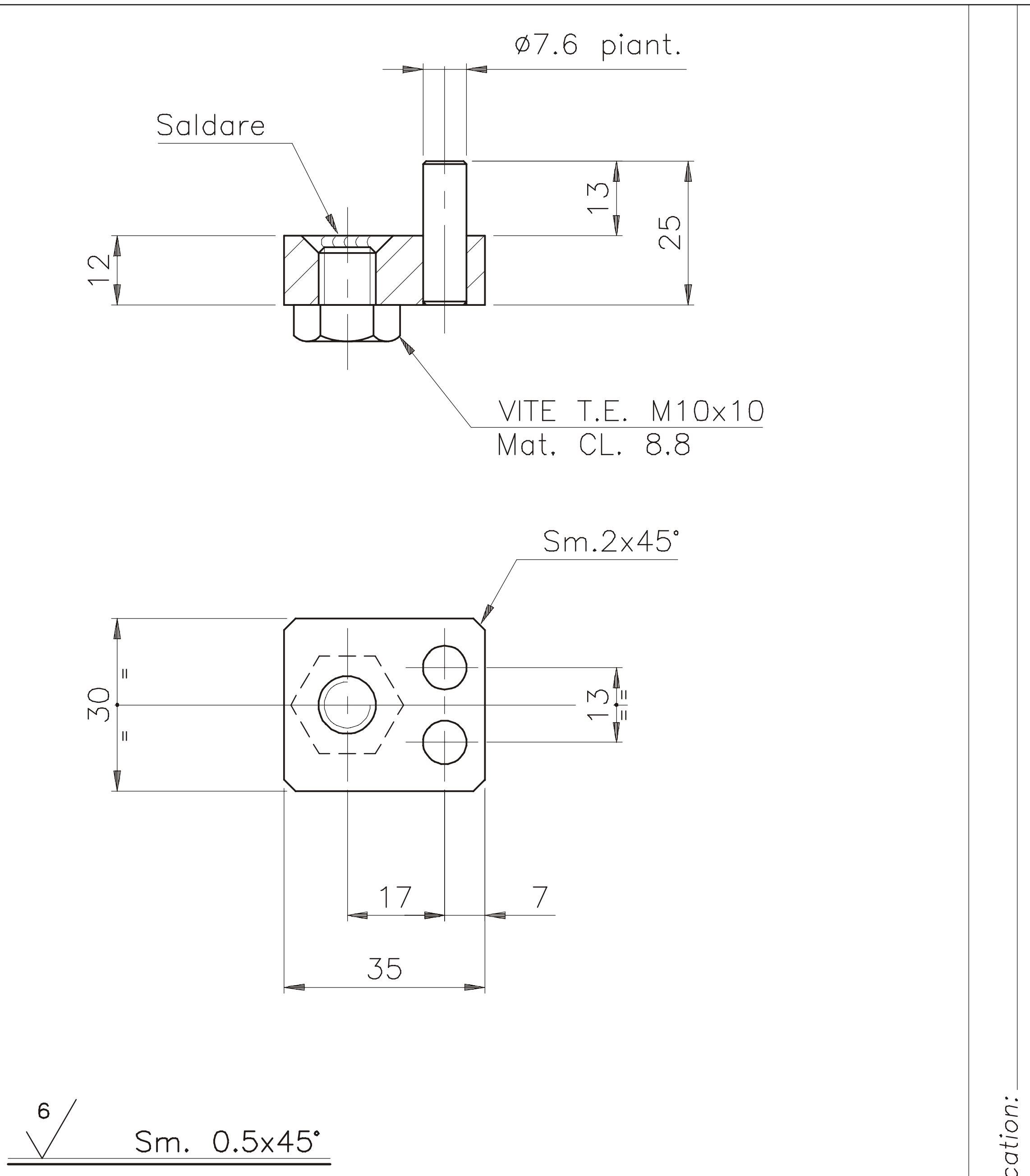


For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT. **Fe430B**	COVER. **Fosfat.**	DRAWN **UTS (B)**	N°DRAWING **SP. 2325**
Attrezzo per estrazione		APPROVED	EXPER. **2325** / SIZE **A4**
guarnizione albero distribuzione		DATE **01/02/2002**	SHEET
		SUPERSEDES	
		SCALE **1:1**	IVECO
MOTORE F1A		Q.TY **1**	02

ISO ≤ IT8 / ∢ ≤ 30' / Ra ≤ 0.4

C/ I.S. 18-0011



For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311

MAT. **C40 Bon.**

COVER. **Fosfat.**

DRAWN **UTS (B)**

N°DRAWING **SP.2341**

ISO ≤ ITB
∡ ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

Chiave per tensionamento tenditore cinghia compressore condizionatore

MOTORE F1A

APPROVED

DATE **05/03/2002**

SUPERSEDES

SCALE **1:1**

Q.TY **1**

EXPER. **2341**

SIZE **A4**

SHEET

IVECO

02

TIGHTENING TORQUE

PART	TORQUE	
	Nm	kgm
Cylinder head central fixing screw M14x1.5		
first phase: pre-tightening	100	9.8
second phase: angle	90°	
third phase: angle	90°	
Cylinder head side fixing screw M14x1.5		
first phase: pre-tightening	50	4.9
second phase: angle	60°	
third phase: angle	60°	
Hex screw with flange M8x1.25 L 40 fixing overhead	25	2.5
Hex screw with flange M8x1.25 L 77 fixing overhead	25	2.5
Central base fastening screw M11x1.25		
first phase: pre-tightening	50 ± 5	5 ± 0.5
second phase: angle	60° ± 2.5°	
third phase: angle	60° ± 2.5°	
Outer base fastening screw M8x1,5	26	2.6
Connecting rod cap fixing screw		
first phase: pre-tightening	40	4
second phase: angle	60°	
Hex screw with flange M12x1.25 L 43 fixing engine flywheel		
first phase: pre-tightening	30	3
second phase: angle	90°	
Cylindrical socket head screw fixing phonic wheel to crankshaft	15	1.5
Nozzle union	25	2.5
Tapered threaded socket plug R 3/8" x 10 oil circuit	22	2.2
Water drain plug M14x1.50 L 10	25	2.5
Union on crankcase for oil return from turbocharger R 3/8"	50	5
Screw M6x1 fixing suction strainer	10	1
Male threaded socket plug M28x1.5	100	10
Hex screw with flange M8x1.5 L 35 fixing frame retaining oil sump	25	2.5
Hex screw with flange M6x1 L30 fixing frame retaining oil sump	10	1
Hex screw with flange M6x1 L25 fixing frame retaining oil sump	10	1
Tapered threaded socket plug M6x1x8.5*	2	0.2
Male threaded plug with O-ring M22x1.5 L16	50 ±10	5 ±1
Hex screw with flange M6x1 L20 fixing oil vacuum pump assembly	10	1
Hex screw with flange M6x1 L50 fixing oil vacuum pump assembly	10	1
Oil filter cartridge M22x1.5 L7	25	2.5
Union fixing heat exchanger M22x1.5	80 ±5	7.8 ±0.5
Hex screw with flange M12x1.25 L55 fixing toothed pulley controlling timing system	130	13
Hex screw with flange M18x1.5 L78 fixing pulley on crankshaft	300	30
Hex screw with flange M8x1.25 L45 fixing pulley on damper	30	3
Hex screw with flange M8x1.25 L60 fixing automatic tightener	36	3.6
High pressure pump gear fastening hex nut with flange M14x1.5	70	6.9
Hex screw with flange for complete guide pulley roller for timing belt M8x1.25 L45	25	2.5

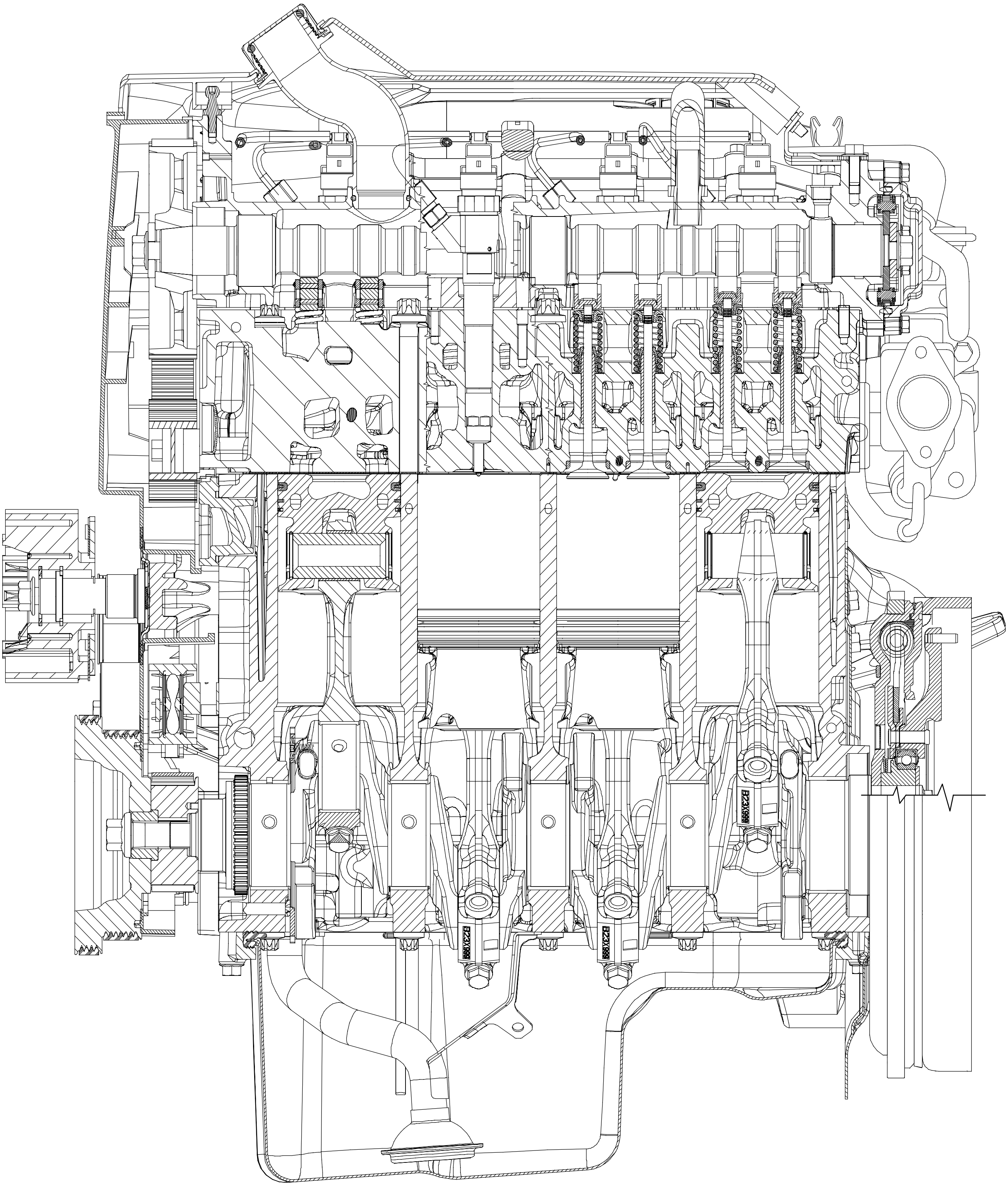
* Apply Loctite on the thread.

PART	TORQUE	
	Nm	kgm
Tapered threaded socket plug R 3/8" x 10	29	2.9
Tapered threaded socket plug R 1/8" x 8	7	0.7
Tapered threaded socket plug R 1/4" x 9	9	0.9
Hex screw with flange M12x1.25 L35 fixing gear for camshaft chain	115	11.5
Hex screw with flange M6x1 L25 fixing chain cover	10	1
Hex screw with flange M6x1 L35 automatic tightener	10	1
Threaded plug M14x1.5 L10	30	3
Ball joint fastening screw M6x1x9	10	1
Hex screw with split washer and flat washer fixing water pump M8x1.25 L28	25	2.5
Hex screw with split washer and flat washer fixing water pump M6x1 L20	10	1
Flanged screw M8x1.25 fixing water outlet union	25	2.5
Flanged screw M8x1.25 fixing piezometric tube on intake manifold	25	2.5
Flanged nut M8x1.25 fixing piezometric tube on bracket	18	1.8
Self-tapping screw L16 fixing bracket on coalescence filter cover	6	0.6
Flanged screw M6x1x16 fixing piezometric tube	10	1
Self-tapping flanged screw L14 fixing piezometric tube on front cover	2	0,2
Coupling M10x1x10 fixing vapour outlet	12	1.2
Hex screw with flange M8x1.25 L25 fixing thermostat	25	2.5
Hex screw with flange M8x1.25 L100 fixing air-conditioner compressor	25	2.5
Hex screw with flange M8x1.25 L120 fixing air-conditioner compressor	25	2.5
Hex screw with flange M8x1.25 L50 fixing air-conditioner compressor mounting	25	2.5
Hex screw fixing bottom of alternator M10x1.25 L40 and M10x1.5 L50	50	5
Hex screw fixing top of alternator M10x1.25 L40	-	-
Hex screw with flange M10x1,25 for complete guide pulley roller for timing belt M10x1.25 L50	40	4
Allen head screw fixing automatic tightener M8x1.25 L65	25	2.5
Hex screw with flange M8x1.25 L45 fixing pulley on damper	30	3
Screw plug with washer M12x1.5 L20	30	3
Vacuum pump coupling M10x1 on oil vacuum pump assembly	10	1
Flanged screw M6x1x27 fixing timing cover	7.5	0.7
Hex screw with flange M6x1 L27 fixing coalescence filter assembly	10	1
Screw M6x1 L12 fixing sump blow-by oil drain pipes	10	1
Union M20x1.5 blow-by breather socket	35	3.5
Hex screw with flange M8x1.25 L90 fixing intake manifold	30	3
Flanged nut M8x1.25 fixing exhaust manifold	25	2.5
Flanged screw M6x1 fixing oil fillpipe	10	1
Flanged screw M8x1.25 fixing oil dipstick pipe	28	2.8
Glow plug M8x1.25	8 ÷ 11	0.8 ÷ 1.1
High-pressure injection system		
Hex screw with flange fixing hydraulic accumulator M8x1.25 L50	28	2.8
Screw M8x1.25 L30 fixing high-pressure pump	25	2.5
Screw M8x1.25 fixing bracket anchoring fuel delivery pipe	25	2.5
Hex screw fixing electro-injector retaining bracket	28	2.8
Hex screw with flange fixing low-pressure fuel pipes M6x1 L30	10	1

* With Loctite.

PART	TORQUE	
	Nm	kgm
Pipe fitting M12x1.5 to secure electric injectors side and high pressure pump side piping (welded hydraulic accumulator)	25 ± 2	2.5 ± 0.2
Pipe fitting M14x1.5 to secure hydraulic accumulator side piping (welded hydraulic accumulator)	19 ± 0.2	1.9 ± 0.2
Union M12x1.5 for fixing fuel pipes	25	2.5
Flanged screw M12x1.5 fixing water temperature sensor	30	3
Flanged screw M6x1 fixing air temperature sensor	10	1
Flanged screw M6x1 fixing engine speed sensor	10	1
Socket-head screw M6x1 fixing timing sensor	10	1
Cylindrical socket-head screw M6x1 for V-clamp	8	0.8
Nut M8x1.25 fixing turbocharger	25	2.5
Flanged screw (M8x1.25) for turboblower gas outlet pipe fastening	25	2.5
Fitting R1/4" for pipe delivering oil to turbocharger	40	4
Nut (M14x1.5) for fastening the oil delivery pipe to the turboblower	40	4
Pipe union (M12x1.5) for fastening the oil delivery pipe to the turboblower	35	3.5
Fitting M22x1.5 for oil return pipe from turbocharger	45	4.5
Flanged screw fixing oil return pipe from turbocharger	10	1
Hex screw with flange M8x1.25 L40 fixing power steering pump	25	2.5
TE flanged screw (M8x1.25) for power steering pump pulley fastening	25	2.5
Hex screw with flange M12x1.25 L155 fixing electromagnetic coupling mounting	90	9
Hex screw with flange M8x1.25 L20 fixing manoeuvring hooks	25	2.5
Flanged screws M10x1.25 fixing engine mounts	50	5
Oil level sensor M12x1.25	25	2.5
Thermometric switch/transmitter M16x1.5	25	2.5
Oil pressure switch M14x1.5	40	4
Cylindrical socket-head screw M8x1.25 fixing E.G.R. valve	25	2.5
Flanged screw M8x1.25 fixing E.G.R. heat exchanger	25	2.5
Flanged nut M8x1.25 fixing elbow	25	2.5
Compensator fastening nut M8x1.25	25	2.5
Oil pressure regulation valve cap	100	10
Power unit suspension		
Screw (M8x16) securing the elastic dowel to the gearbox cross-member	23.5±2.5	2.3±0.2
Nut (M12) securing the gearbox cross-member to the chassis	92±9	9.2±0.9
Nut (M12) securing the engine supports to the elastic dowels	49±4	4.9±0.4
Nut (M12) securing the gearbox bracket onto the rear cross-member elastic dowel	49±4	4.9±0.4
Locknut (M10) with flange, securing the engine supports to the chassis	52.5±5.5	5.2±0.5
Screw (M10x30) securing the gearbox support to the gearshift	46.5±4.5	4.6±0.4

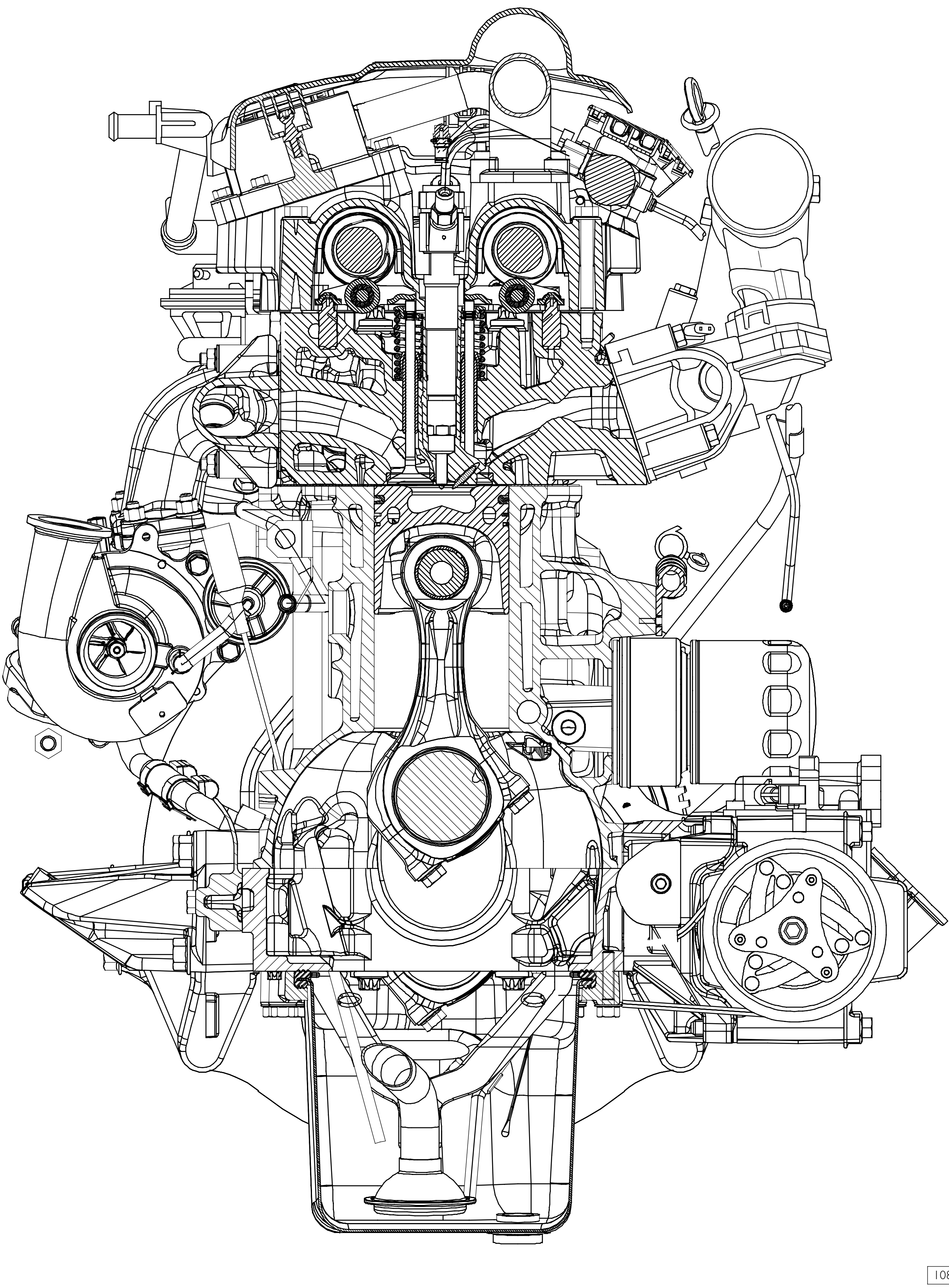
Figure 41



108442

LONGITUDINAL CROSS-SECTION OF ENGINE

Figure 42

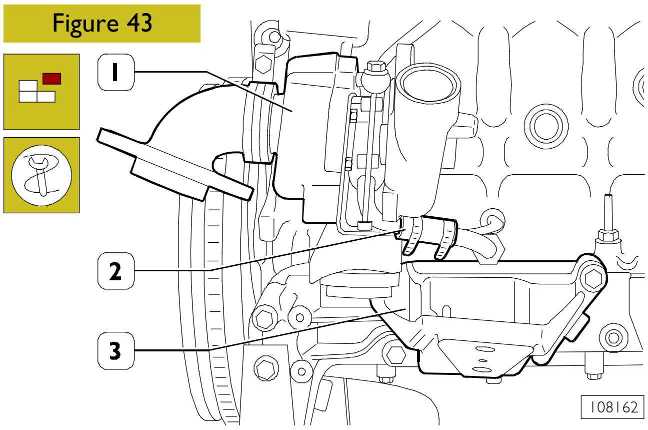


TRANSVERSE CROSS-SECTION OF ENGINE

OVERHAULING ENGINE

540110 DISASSEMBLING THE ENGINE AT THE BENCH

Figure 43



To be able to fit the brackets 99361038 onto the crankcase to secure the engine to the stand for overhauling, it is necessary to remove the left and right engine mounts (3) and disconnect the oil pipe (2) from the turbocharger (1) and from the crankcase.

NOTE Block the turbocharger air/exhaust gas inlets and outlets to prevent foreign bodies getting inside.

Fit the brackets 99361038 (9) to the crankcase and use these to secure the engine to the rotary stand 99322205 (6). Drain the oil from the engine by removing the plug from the oil sump.

Take off the fan (if any) from electromagnetic joint.

If the following parts have not already been removed, do so now:

- ❑ oil filling cap (1);
- ❑ sound-proofing cover (2);
- ❑ engine cable complete with raceway (13) by disconnecting the electric connections of the same from:
  - electric injector (3);
  - preheating plugs (5)
  - hydraulic accumulator pressure sensor (14);
  - throttle valve actuator (11);
  - inlet manifold air pressure/temperature sensor (12);
  - revs sensor (8);
  - high-pressure pump pressure regulator (10);
  - phase sensor (4)
  - thermostat cooling temperature sensor (7).

Figure 44

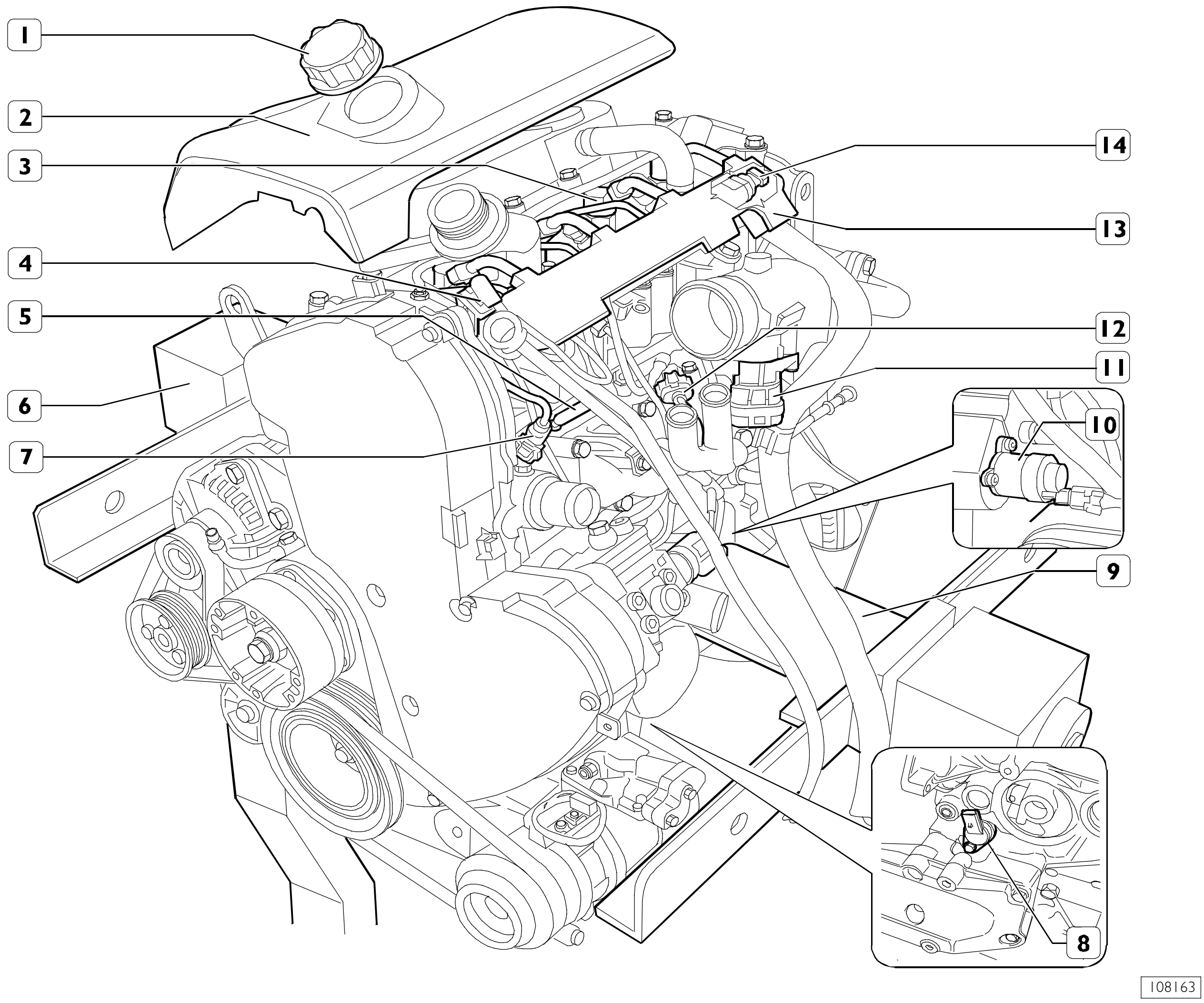
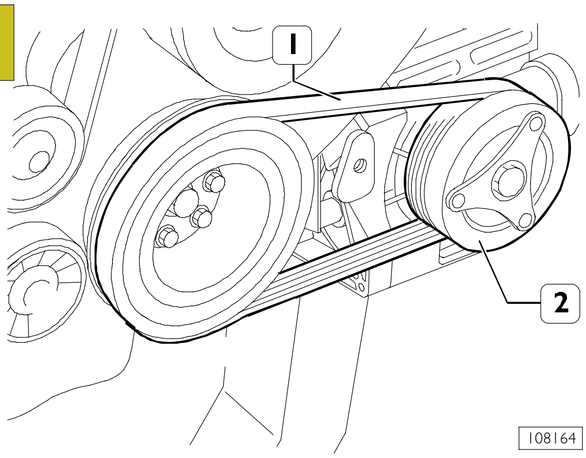
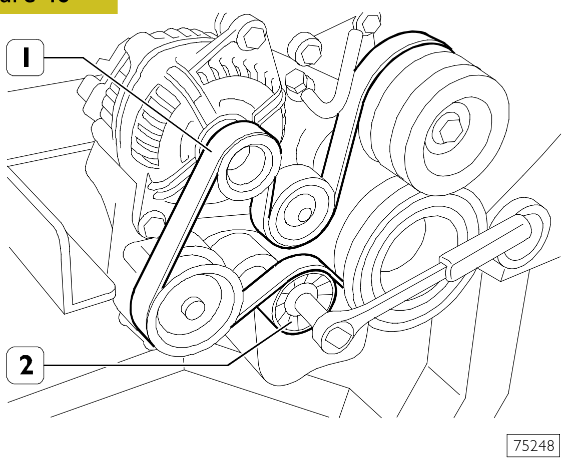


Figure 45



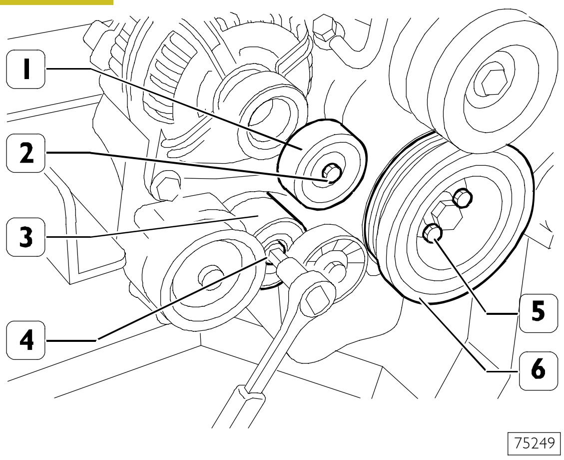
Cut compressor (2) drive elastic belt (1),as it cannot be reused.

Figure 46



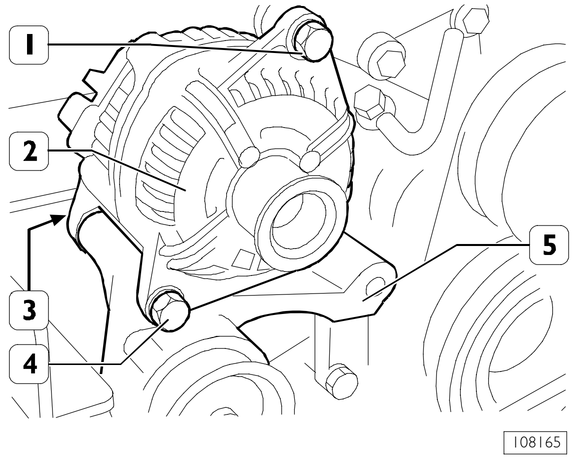
Using the specific wrench on the automatic tightener (2), slacken the tension of the belt (1) and remove it.

Figure 47



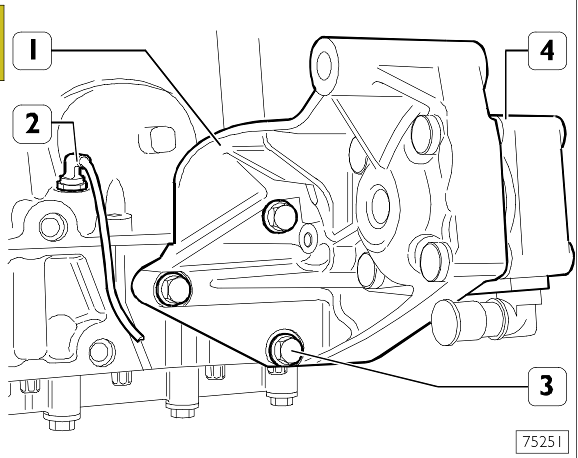
Take out the screw (4) and remove the automatic tightener (3). Take out the screw (2) and remove the fixed tightener (1). Take out the screws (5) and remove the pulley (6).

Figure 48



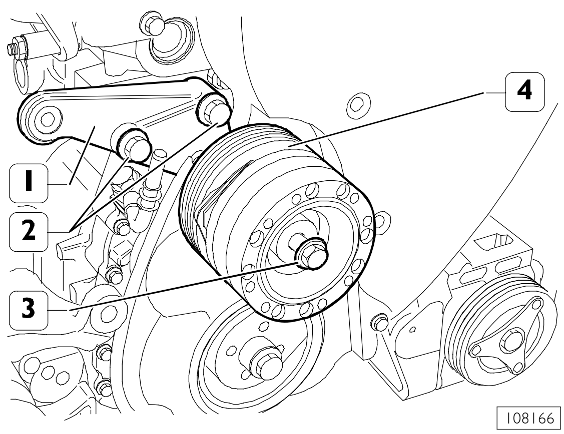
Take out the bolt (1), the bottom screws (3 and 4) and remove the alternator (2) from the mounting (5).

Figure 49



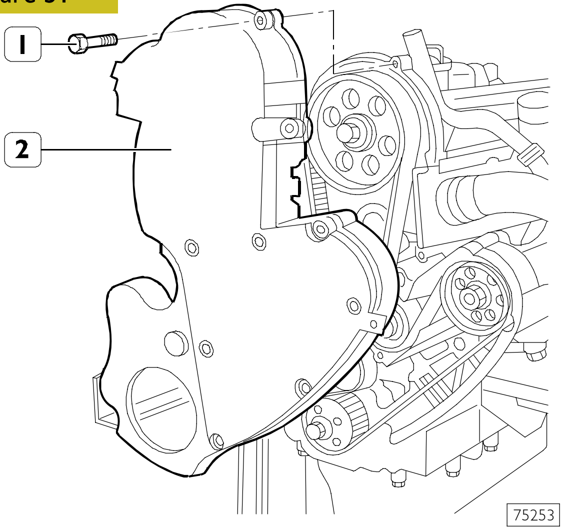
Take out the screw (3) and remove the mounting (1) of the power steering pump (4). Using a suitable wrench, remove the oil level sensor (2).

Figure 50



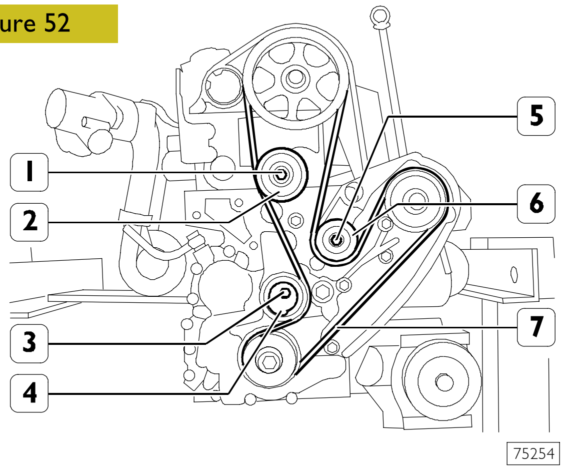
Take out the screws (2) and (3) and remove the mounting (1) together with the electromagnetic coupling (4).

Figure 51



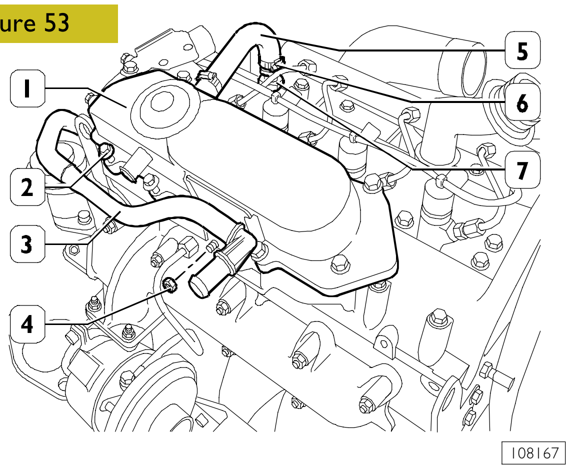
Take out the screws (1) and remove the timing cover (2).

Figure 52



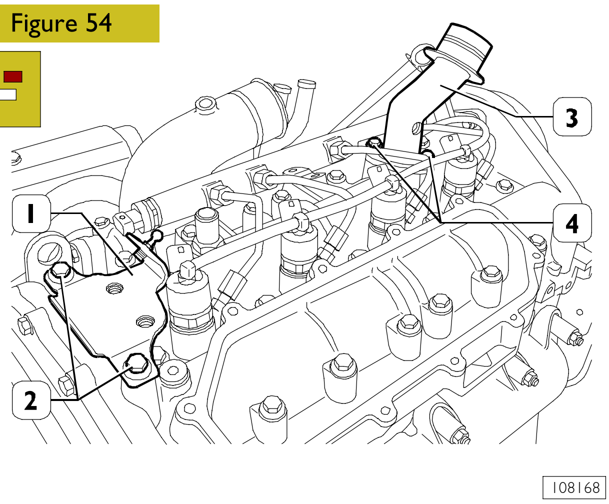
Take out the screw (3) and remove the tightener (4).
Take out the screws (1) and (5) and remove the gears (2) and (6). Remove the toothed belt (7).

Figure 53



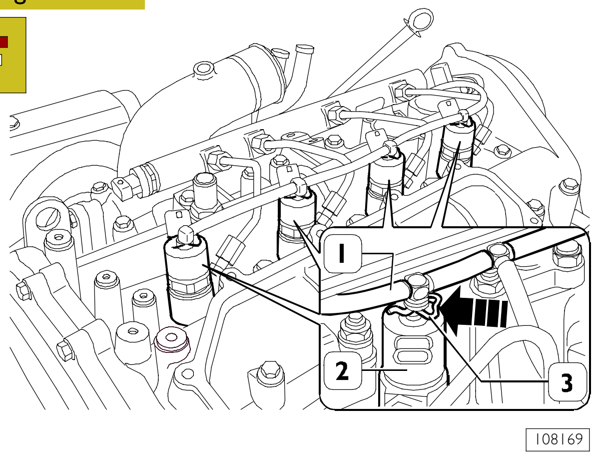
Loosen clamp (6), then disconnect pipe (5) from pipe union (7).
Remove nut (4), then remove pipe (3) from filter (1).
Undo screws (2), then remove coalescence filter (1).

Figure 54



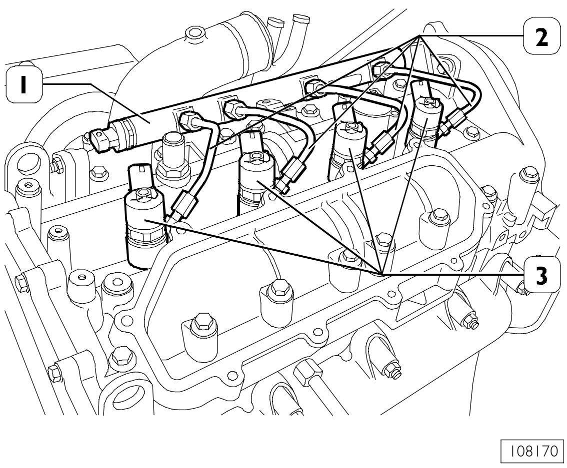
Remove screws (2),then take bracket (1) off.
Remove screws (4), then take oil filling pipe union (3) off.

Figure 55



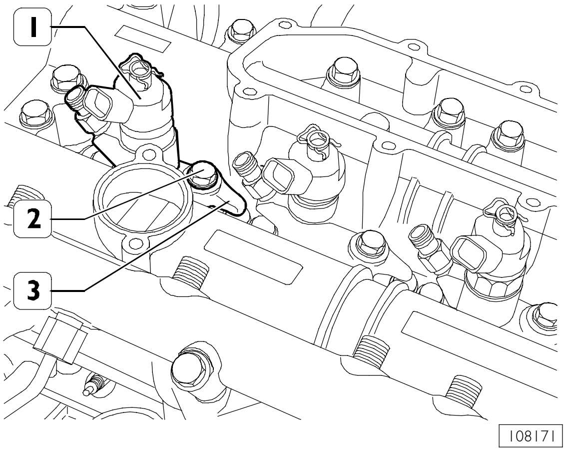
Press the springs (3) in the direction shown by the arrow and disconnect the fittings of the pipe (1) recovering fuel from the electro-injectors (2).

Figure 56



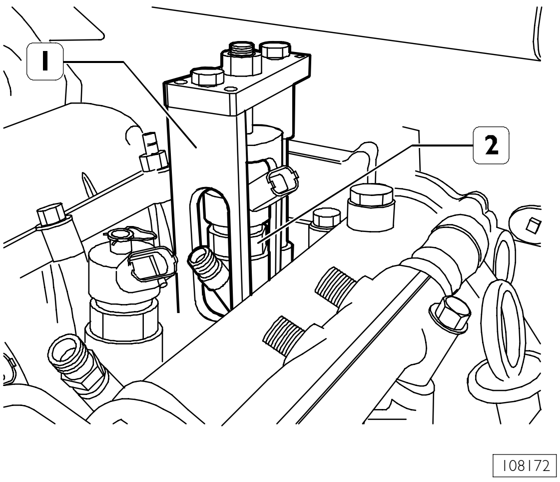
Disconnect the fuel pipes (2) from the electro-injectors (3) and from the hydraulic accumulator (1) (rail).

Figure 57



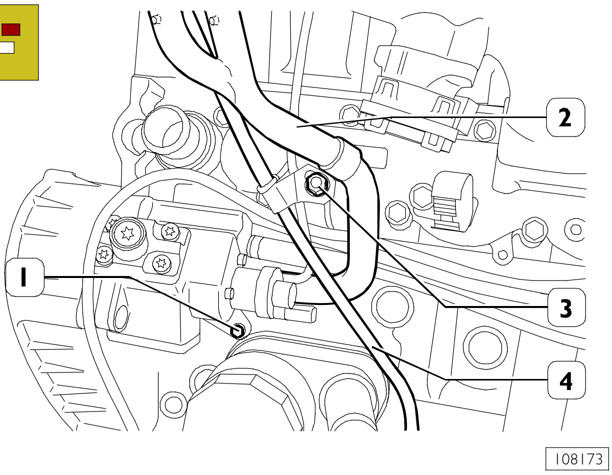
Take out the screws (2) and the brackets (3) fixing the electro-injectors (1) to the cylinder overhead.

Figure 58



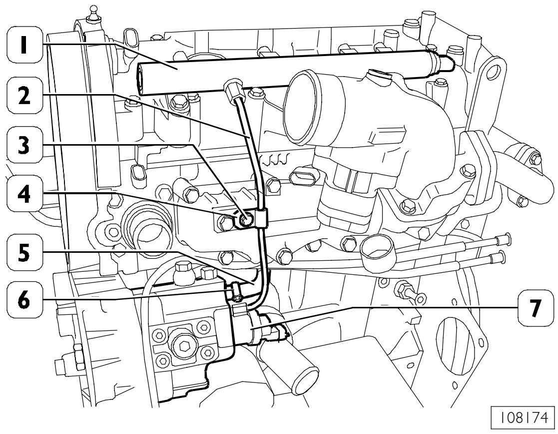
Using tool 99342153 (1) extract the electro-injectors (2) from the overhead.

Figure 59



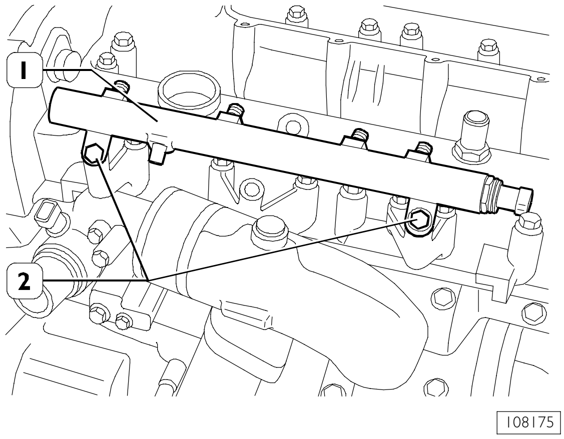
Remove screw (1) and nut (3), then remove pipe (2).
Take oil dipstick pipe (4) out of the engine base.

Figure 60



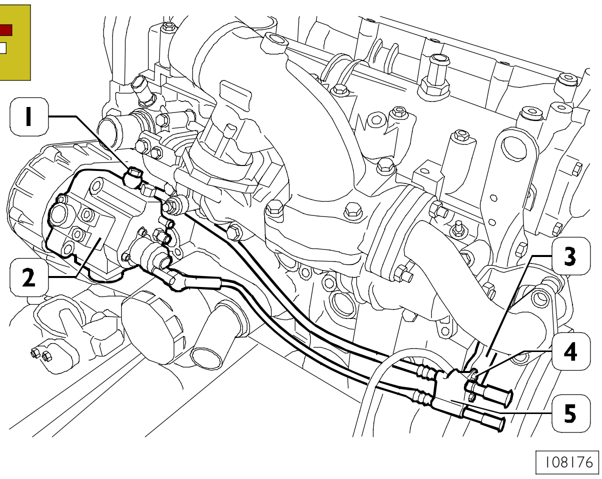
Loosen clamp (6), then disconnect fuel pipe (5) from high-pressure pump (7).
Remove screw (3) securing pipe (2) retaining bracket (4) to the inlet manifold.
Disconnect pipe (2) from hydraulic accumulator (1) and high-pressure pump (7).

Figure 61



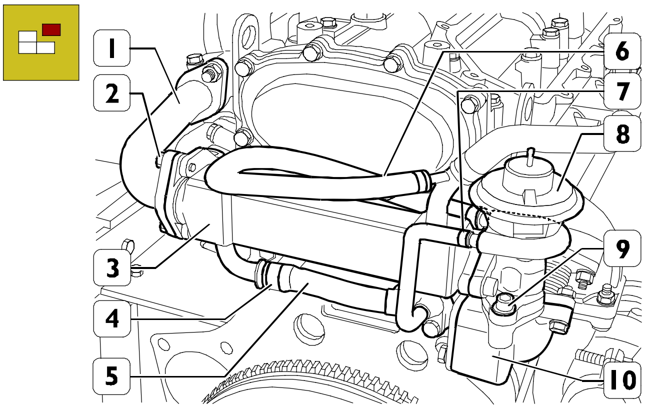
Take out the screws (1) and remove the hydraulic accumulator (2).

Figure 62



Remove screws (4), then disconnect low-pressure pipes (5) from bracket (3).
Remove coupling (1), then disconnect pipes (5) from high-pressure pump (2).

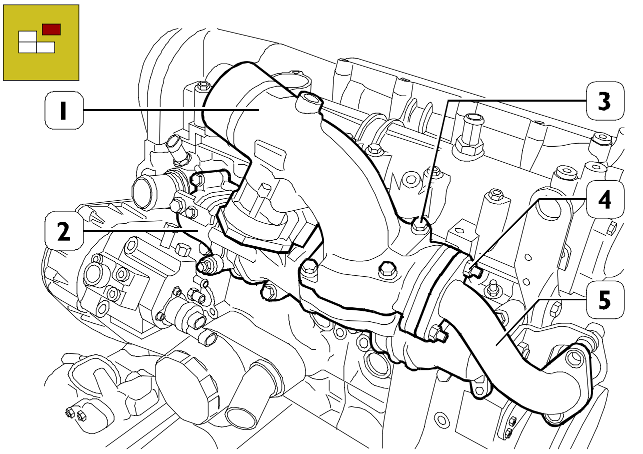
Figure 63



108177

Loosen clamp (7), then disconnect pipe (6) from EGR valve (8).
Loosen clamp (4), then disconnect pipe (5) from heat exchanger (3).
Remove screws (2 and 9), then disconnect heat exchanger (3, with its respective gaskets), together with EGE valve (8), from pipe (1) and elbow (10).

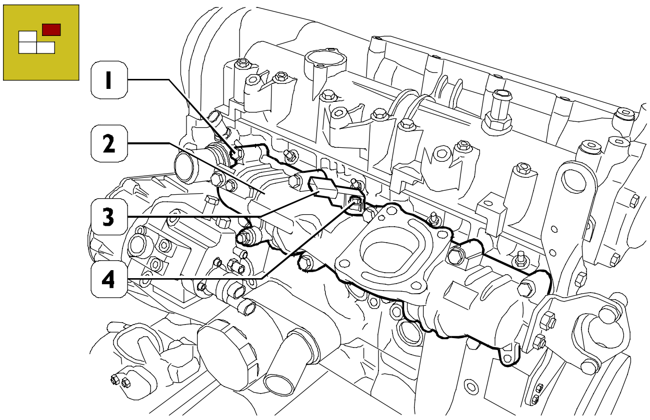
Figure 64



108178

Remove nuts (4), then take pipe (5), together with its gasket, off throttle valve assembly (1).
Remove screws (3), then take throttle valve assembly (1), together with its gasket, off inlet manifold (2).

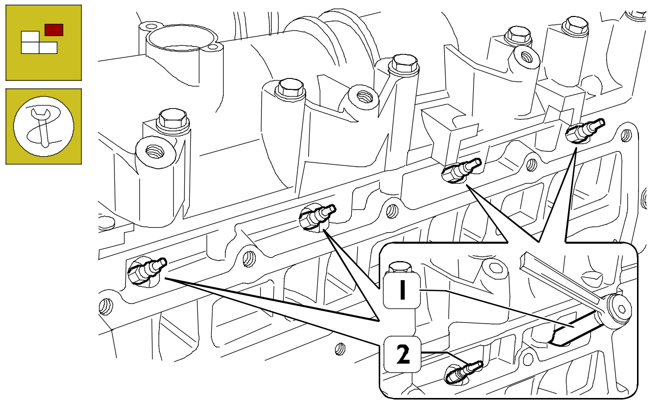
Figure 65



108179

Remove screw (4), then disassemble air pressure/temperature sensor (3).
Remove screws (1), then take off inlet manifold (2) together with its gasket.

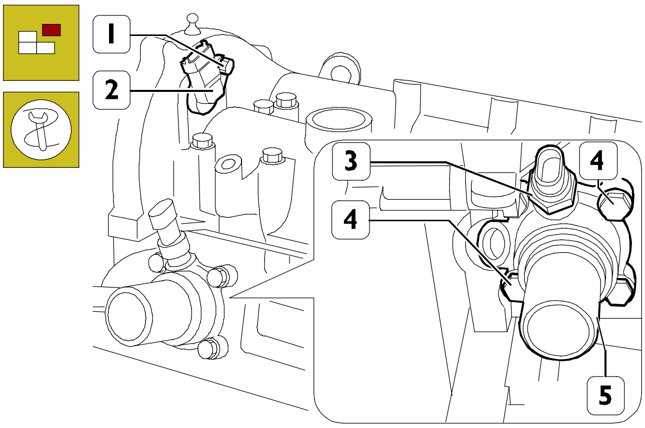
Figure 66



108180

Use wrench SP. 2275 (1) to disassemble preheating plugs (2).

Figure 67



108181

Remove nut (1), then take off phase sensor (2). Use a suitable wrench to take off temperature sensor (3).
Remove screws (4), then take off thermostat case (5).

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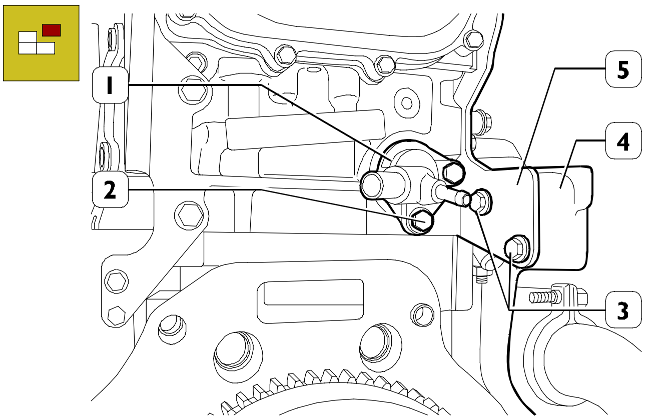
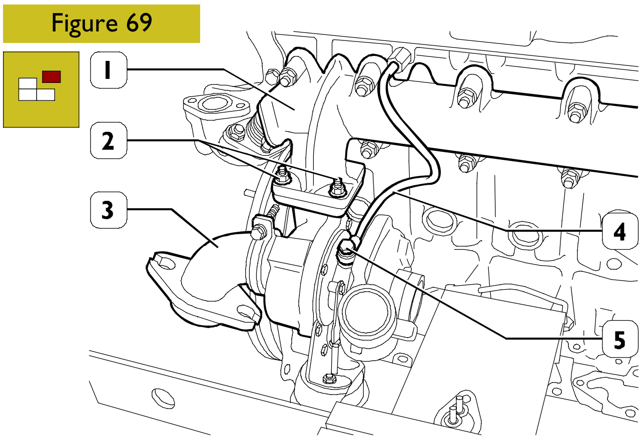
Figure 68



108182

Remove screw (2), then take off pipe union (1).
Remove screws (3) securing elbow (4) to bracket (5).

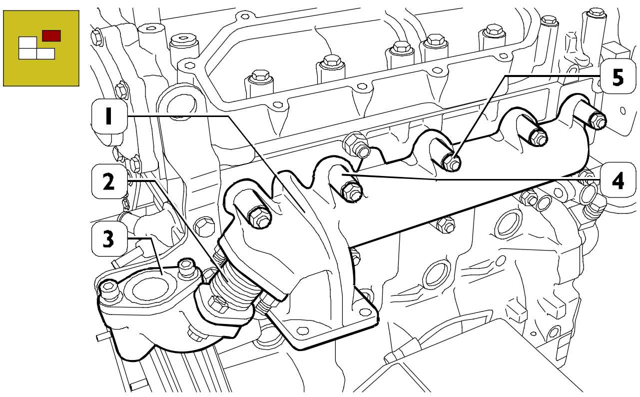
Figure 69



108183

Remove coupling (5).
Disconnect oil pipe (4) from the cylinder head coupling and turboblower (3) coupling.
Remove nuts (2), then take turboblower (3), together with its gasket, off exhaust manifold (1).

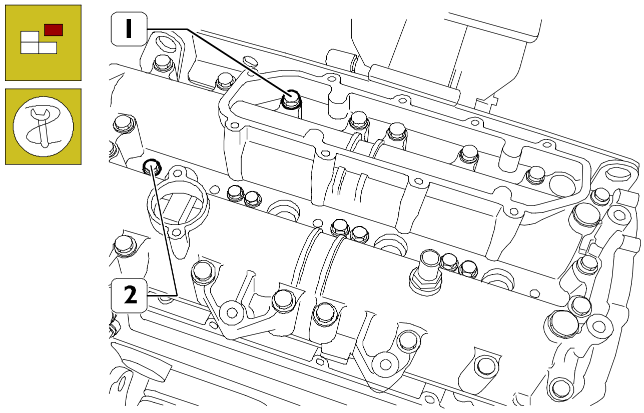
Figure 70



108184

Remove nuts (5) and spacers (4), then take off exhaust manifold (1) together with its gasket, complete with pipe (2) and elbow (3).

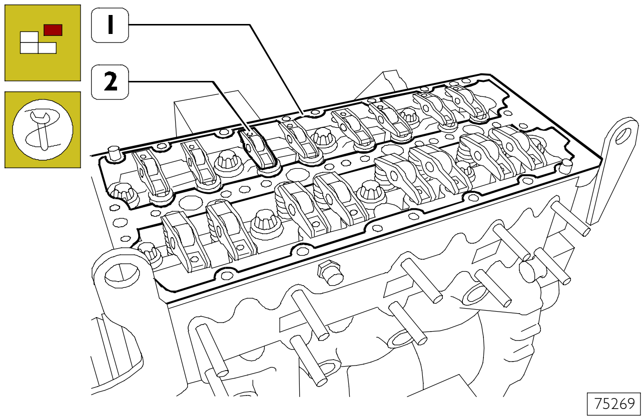
Figure 71



108185

Take out the screws (1) and remove the overhead (2).

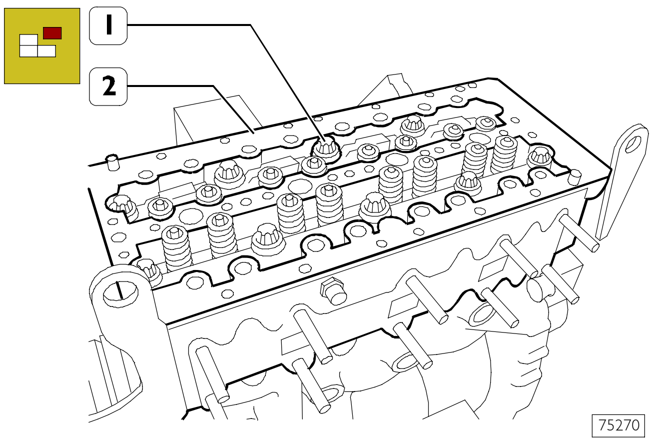
Figure 72



75269

Take off the gasket (1) and remove the hydraulic tappets together with the rocker arms (2).

Figure 73

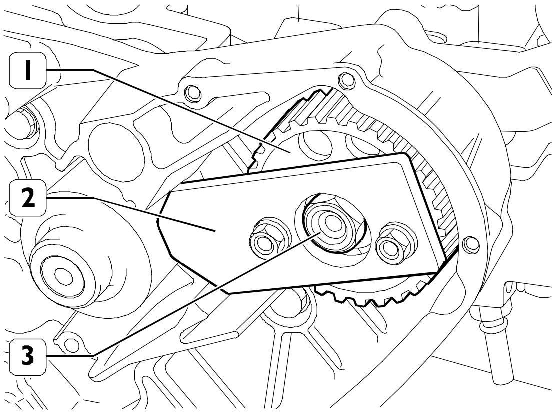


75270

Take out the screws (1) and remove the cylinder head (2).

NOTE Check the protrusion of the pistons as described under the relevant heading to check the possibility of facing the crankcase if it has deformed.

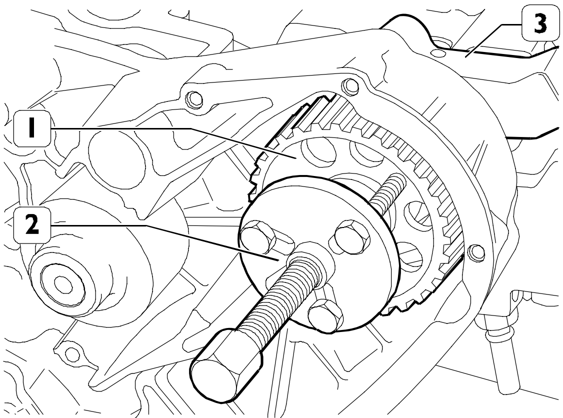
Figure 74



75271

Block rotation of the high-pressure pump gear (1) by applying tool SP 2263 (2) as shown in the figure. Take off the nut (3) and remove the tool (2).

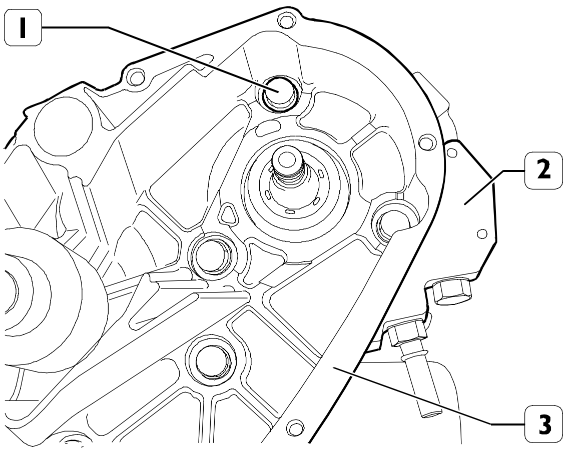
Figure 75



75272

Using tool 99340035 (2), applied as in the figure, extract the gear (1) from the shaft of the high-pressure pump (3).

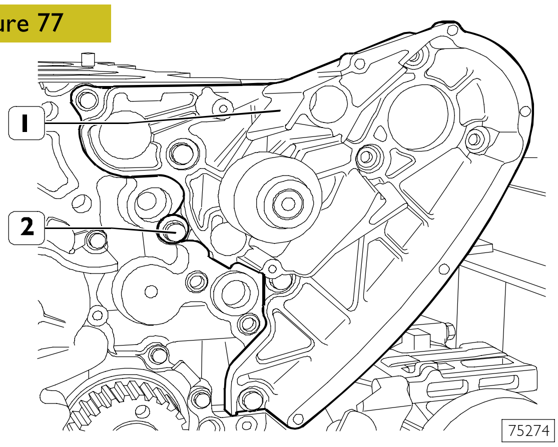
Figure 76



75273

Take out the screws (1) and remove the high-pressure pump (2) from the water pump mounting (3).

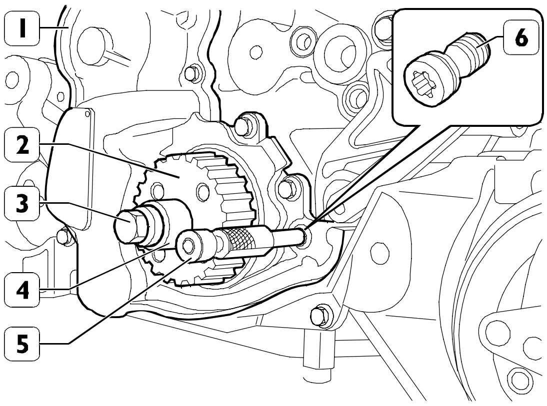
Figure 77



75274

Take out the screws (1) and remove the water pump assembly (2).

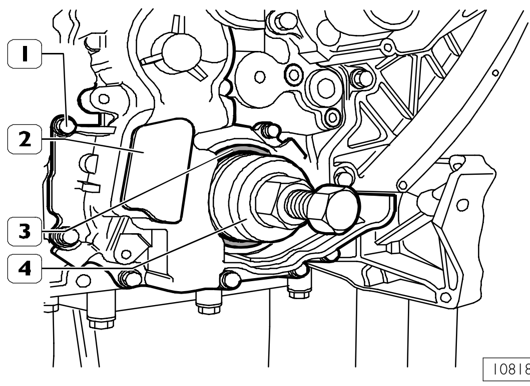
Figure 78



75275

Remove the plug (6) from the oil pump – vacuum pump assembly (1).
Position the crankshaft so as to be able to insert tool 99360615 (5) into its hole through the hole in the plug (6) and block rotation of the crankshaft.
Take out the screw (3) with the spacer (4) beneath and remove the gear (2).

Figure 79



108186

Take out the screws (1) and remove the oil pump – vacuum pump assembly (2).

NOTE Tool 99340059 (4) is used to take seal ring (3) off cover (2) when the engine is fitted to the vehicle.

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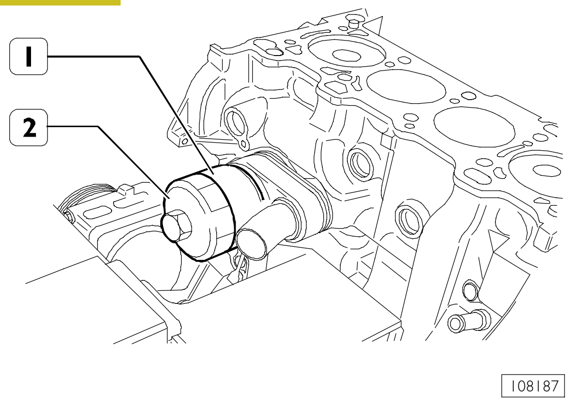
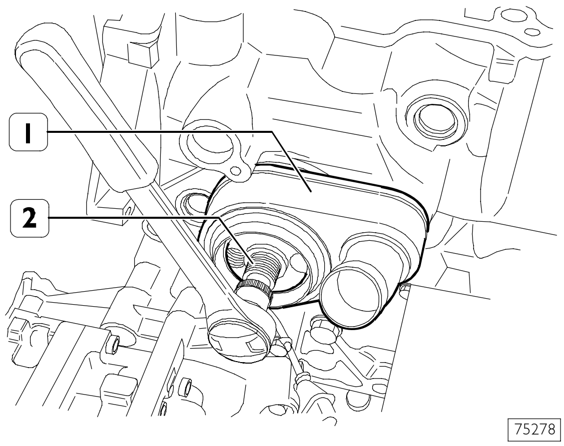
Figure 80



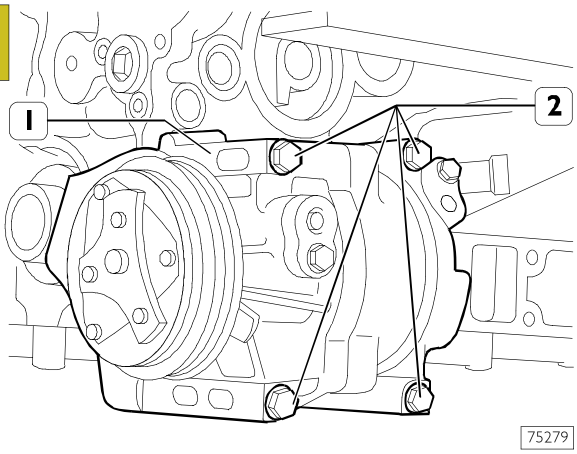
Using tool 99360076 (2), remove the oil filter (1).

Figure 81



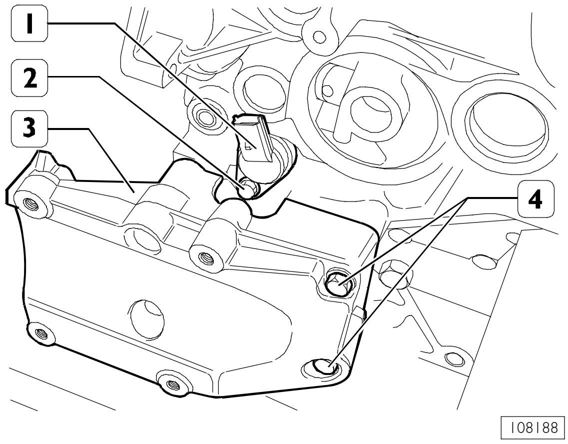
Take out the coupling (2) and remove the heat exchanger (1).

Figure 82



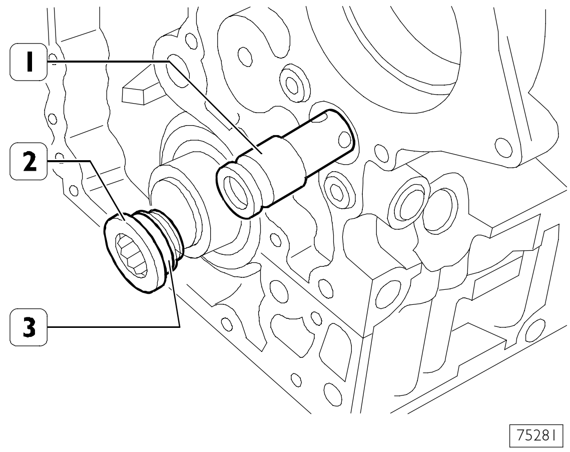
Take out the screws (2) and remove the air-conditioner compressor (1) (if applicable).

Figure 83



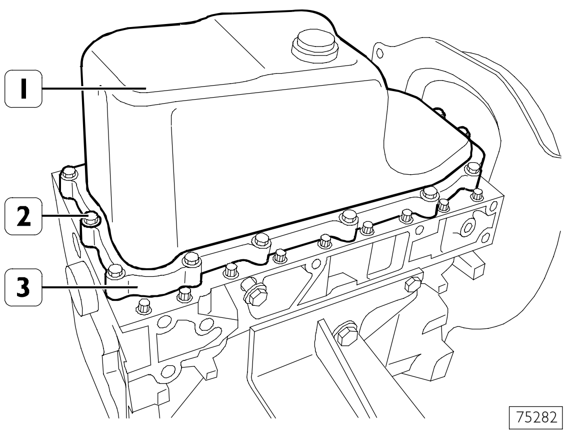
Take out the screw (2) and remove the speed sensor (1). Take out the screws (4) and remove the compressor mounting (3).

Figure 84



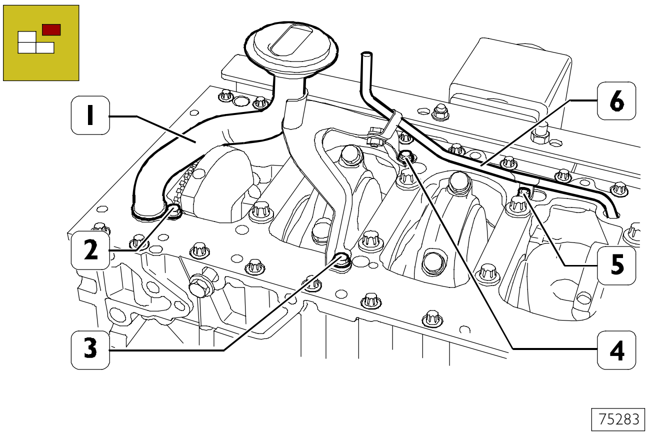
Take out the plug (2) with the seal (3) and extract the oil pressure control valve (1).

Figure 85



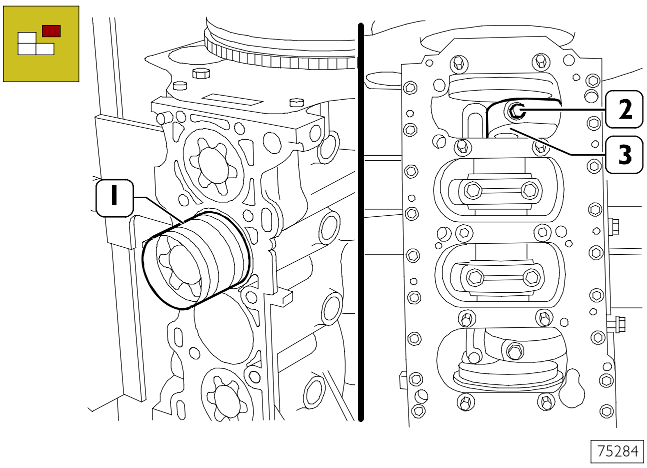
Undo the screws (2) and remove the oil sump (1) with the associated gasket and frame (3).

Figure 86



Take out the screws (2), (3), (4) and (5) and remove the suction strainer (1) together with the pipe (6).

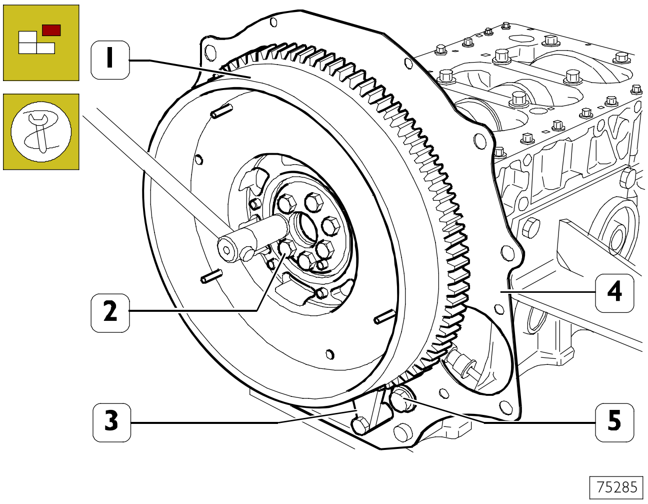
Figure 87



Take out the screws (2) and remove the connecting rod caps (3).
Extract the pistons (1) from the top of the crankcase.

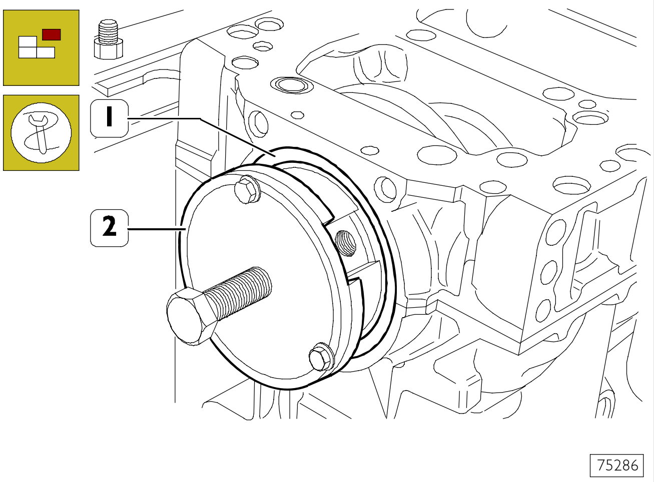
NOTE On the same side of the connecting rod and its associated cap, indicate the number of the cylinder from which the connecting rod has been removed. Keep the bearing shells in their respective housings since, if they are used, they will need to be fitted in the position found during removal.

Figure 88



Block rotation of the flywheel (1) with tool 99360306 (3).
Take out the screws (2) and remove the engine flywheel (1).
Take out the screw (5) and remove the guard (4).

Figure 89



Apply tool 99340058 (2) to the rear O-ring (1) and extract it from the crankcase.

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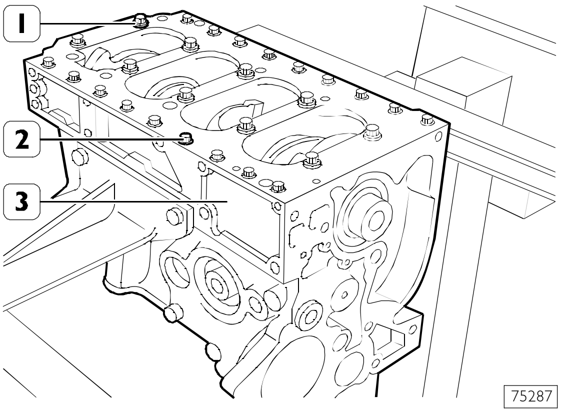
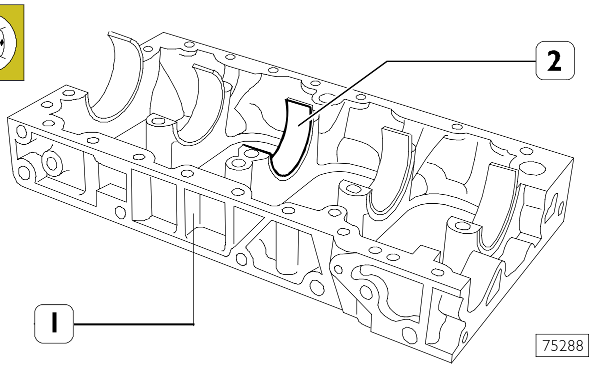
Figure 90



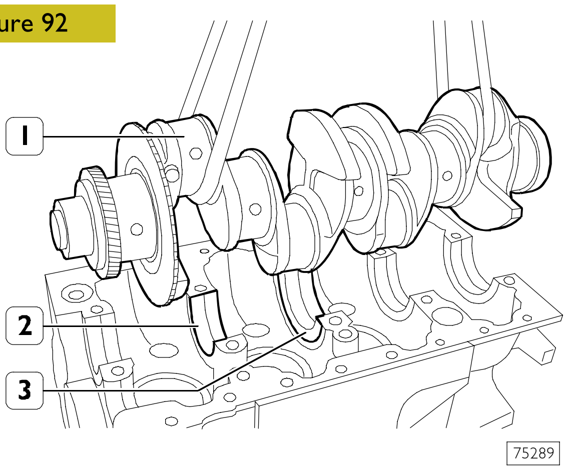
Using an appropriate wrench and a hex-fluted wrench, unscrew the screws (1) and (2) and remove the crankcase base (3).

Figure 91



NOTE Note the assembly position of the bottom main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

Figure 92

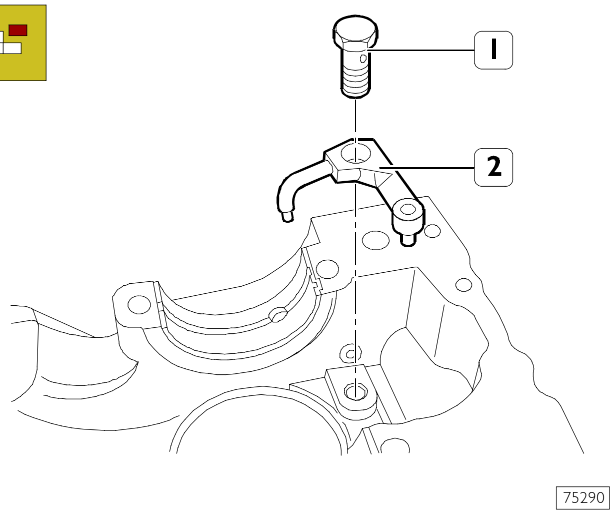


With the aid of a hoist and a rope, remove the crankshaft (1).

NOTE Note the assembly position of the top main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

The central half ring (3) is fitted with thrust half-washers.

Figure 93

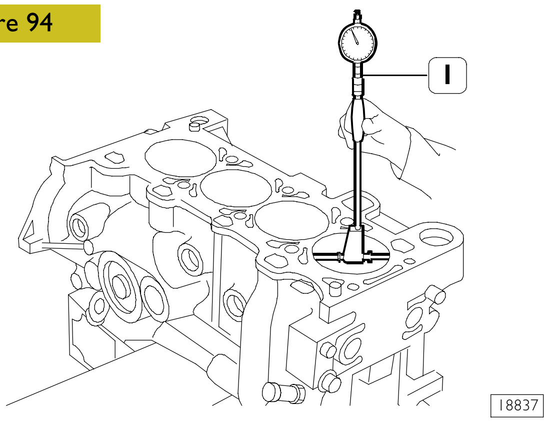


Take out the couplings (1) and remove the oil jets (2).

NOTE On completing engine removal, it is necessary to clean the removed parts thoroughly and check their integrity.
The following pages give the instructions for the main checks and measurements to make in order to determine whether the parts can be reused.

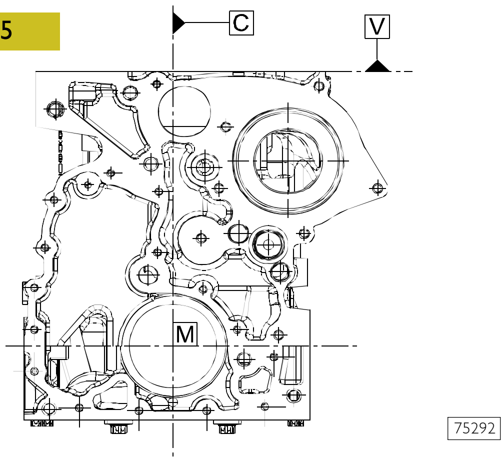
REPAIRS
CYLINDER BLOCK
Checks and measurements

Figure 94



After removing the engine, thoroughly clean the cylinder-crankcase assembly. Use the rings 99365508 to carry the cylinder block.
Carefully check that the crankcase has no cracks in it.
Check the conditions of processing caps. If the caps are rusted or if you have even the slightest doubt about their sealing efficiency, the caps shall be replaced. Apply LOCTITE 270 sealant (IVECO NO. 93162429) to the caps when fitting the latter back into place.. Examine the surfaces of the cylinder liners; they must show no sign of meshing, scoring, ovalization, taper or excessive wear. The inside diameter of the cylinder liners is checked, to ascertain the extent of ovalization, taper and wear, using the bore meter 99395687 (1) fitted with a dial gauge previously reset on the ring gauge of the diameter of the cylinder liner or on a micrometer.

Figure 95



* Surface roughness parameters:

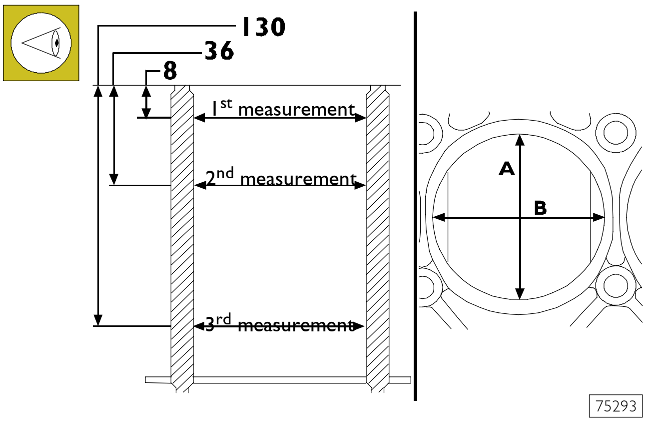
Rt = 4 ÷ 10 µm
Rz = 3 ÷ 8 µm
Ra = 0,25 ÷ 0,6 µm
Wt < 1,5 µm

Permissible surface porosity for machined cylinder (see Figure 97)

ZONE B1 = Area of greatest mechanical stress, segment/liner contact:
No.2 non-continuous porosities are permissible max. 0.5x0.5. C 100%

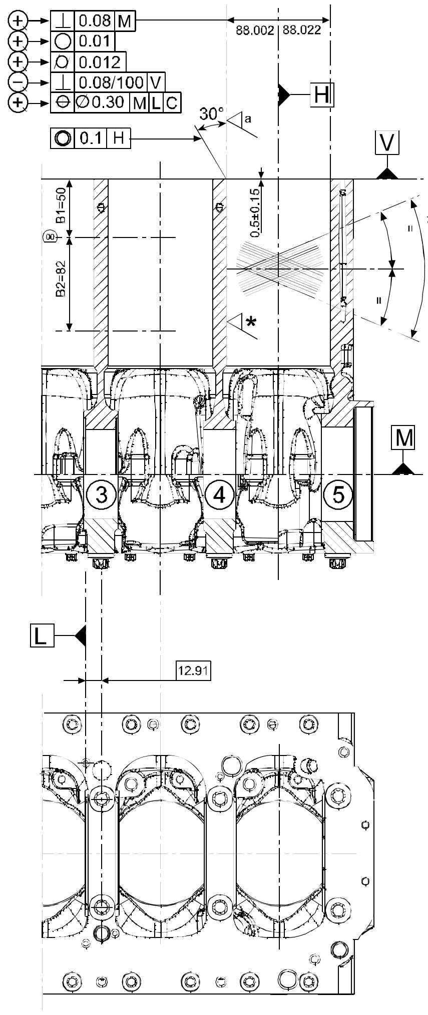
ZONE B2 = Surface involved in segment rubbing:
No.2 non-contiguous porosities are permissible max. 1x0.8. C 100%

Figure 96



The measurements must be made for each single cylinder at three different heights up the liner and on two planes at right angles to each other: one parallel to the longitudinal axis of the engine (B) and the perpendicular (A); the greatest wear is generally found on this last plane with the first measurement.
On finding ovalization, taper or wear, go ahead and bore/grind and finish the face of the cylinder liners. The refacing of the cylinder liners should be done in relation to the diameter of the pistons supplied as spare parts oversized by 0.4 mm of the nominal value and to the prescribed assembly clearance.

Figure 97



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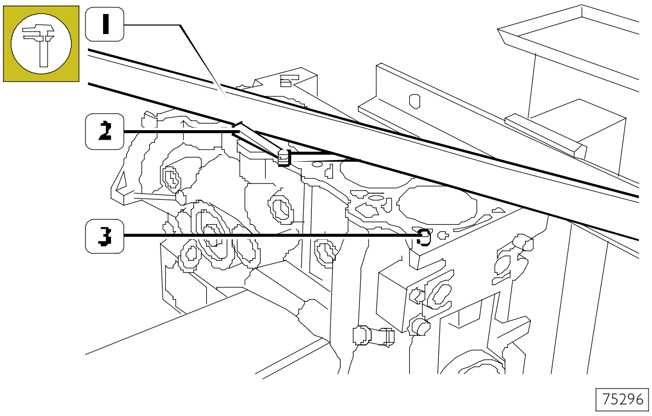
Checking head mating surface on cylinder block

Figure 98

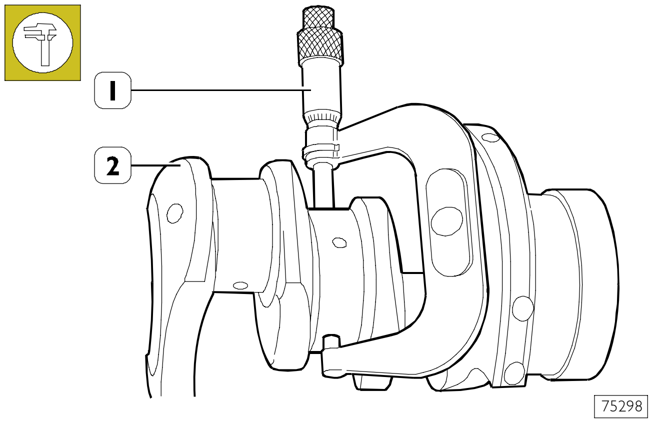


See that the head mating surface, on the cylinder block, has no deformation.
This check can be made, after taking out the grub screws (3), with a surface plate spread with carbon black or with a calibrated rule (1) and a feeler gauge (2). After ascertaining the areas of deformation, level the bearing surface with a grinding machine.

NOTE The crankcase can only be surfaced after making sure that, on completing the work, the piston protrudes from the cylinder liner by no more than the prescribed value.

5408 CRANKSHAFT
540810 Measuring main journals and crank pins

Figure 100



On finding signs of seizure, scoring or excessive ovalization on main journals and crankpins, it is necessary to regrind the pins. Before grinding the pins (2), measure the shaft pins with a micrometer (1) to establish to what diameter it is necessary to decrease the pins.

NOTE It is advisable to enter the measurements in a table. See Figure 99.

Figure 99

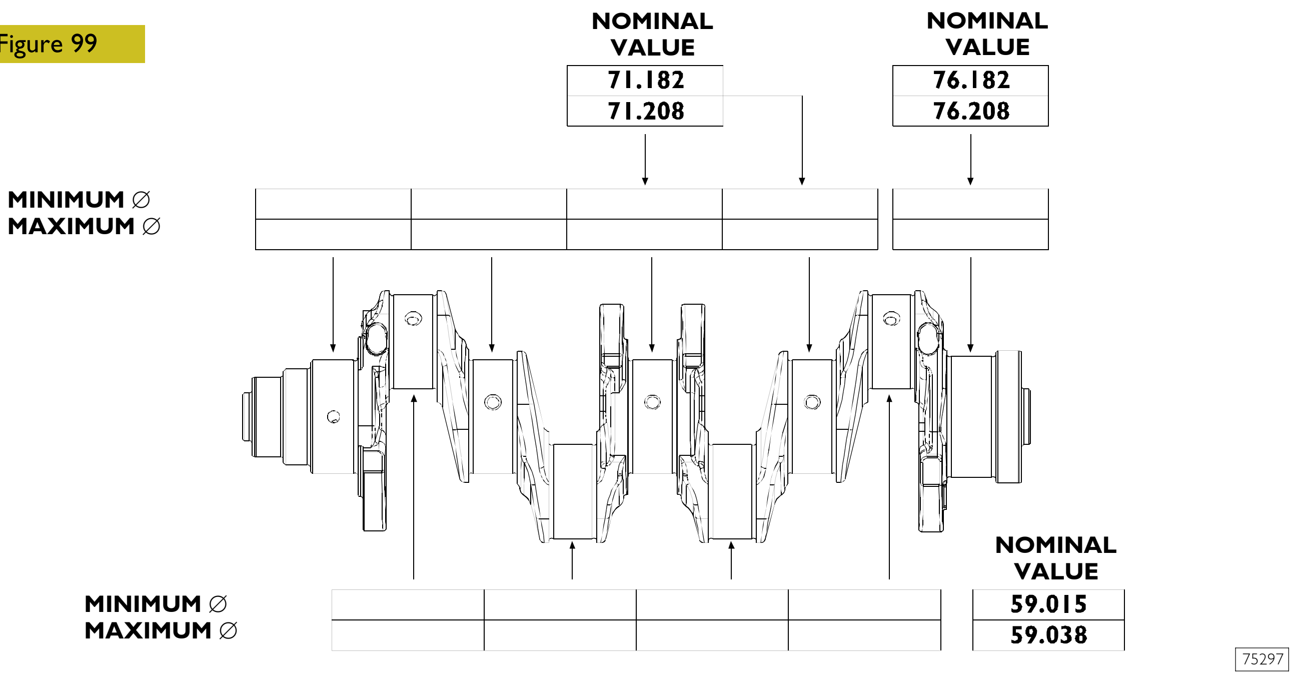


TABLE IN WHICH TO ENTER THE MEASUREMENTS OF THE CRANKSHAFT MAIN JOURNALS AND CRANKPINS

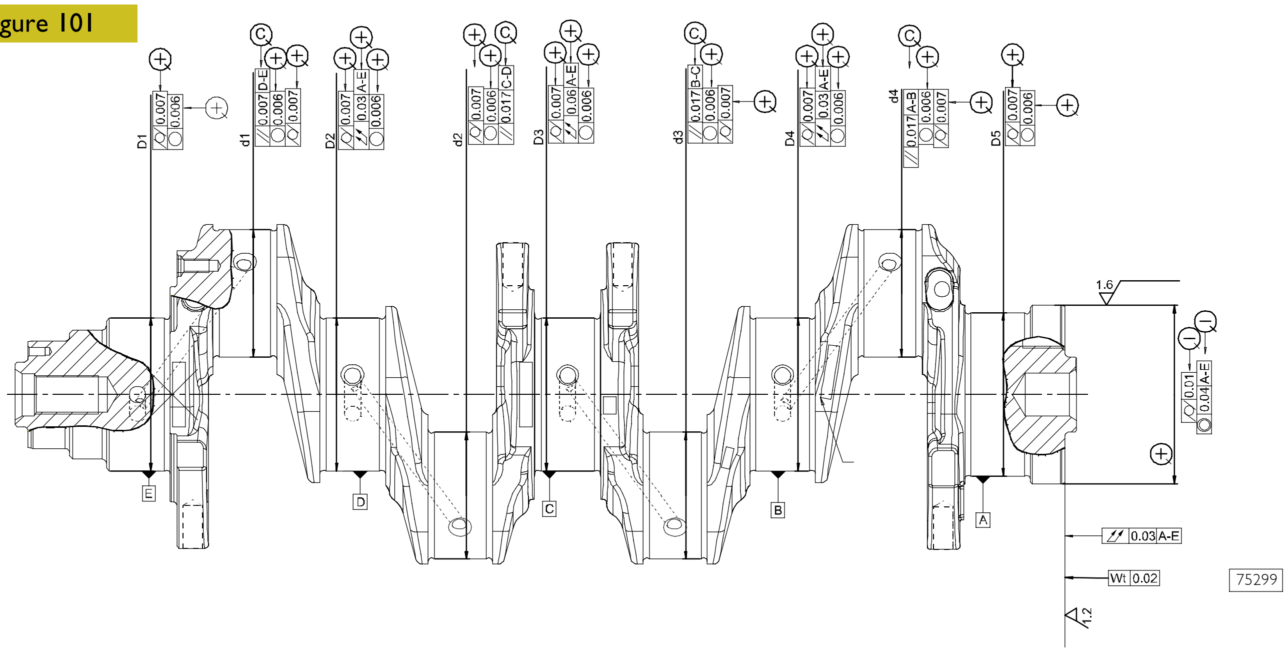
NOTE The main journals and crankpins must always be ground to the same undersize class.
The undersizing performed, on the main journals or crankpins, must be marked by punching on the side of crank arm no. 1.

For undersized crankpins, letter M.
For undersized main journals, letter B.
For undersized crankpins and main journals, letter MB.

Undersize classes are of:
0.254 - 0.508 mm.

Checking crankshaft

Figure 101

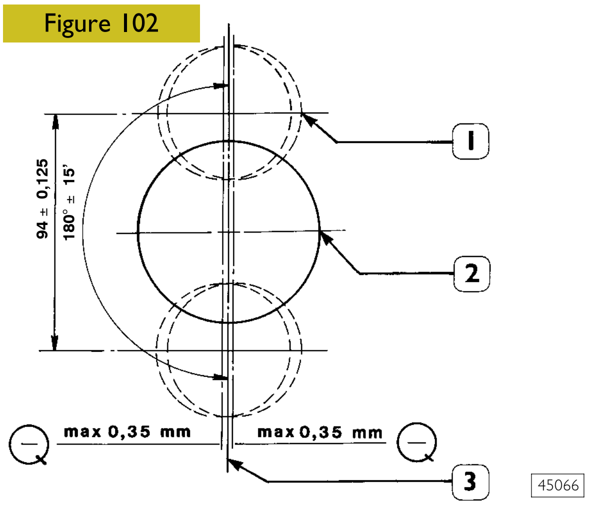


MAIN CRANKSHAFT TOLERANCES

TOLERANCES	TOLERANCE CHARACTERISTIC	SYMBOL
SHAPE	Circularity	○
	Cylindricality	⌭
DIRECTION	Parallelism	//
	Perpendicularity	⊥
OF POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	⌰

CLASS OF IMPORTANCE ASCRIBED TO THE PRODUCT CHARACTERISTICS	SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Figure 102



NOTE The checks on the tolerances indicated in the figures must be made after grinding the crankshaft pins.

SYMMETRY BETWEEN MAIN JOURNALS AND CRANK-PINS
1. Crank pins
2. Main Journals
3. Normal position.
After grinding, keep to the following:

❑ Round off the edges of deburring the holes for lubrication of the main journals and crankpins.

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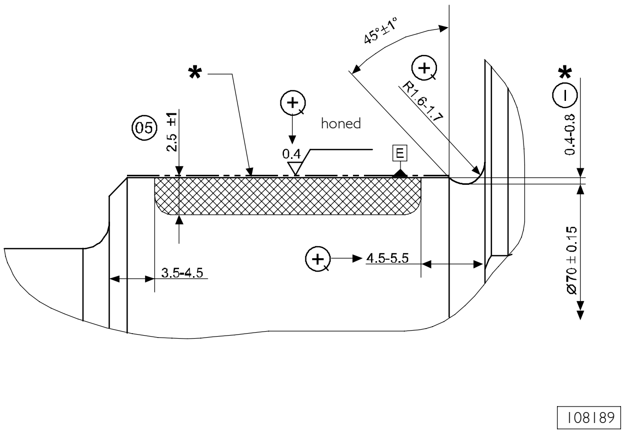
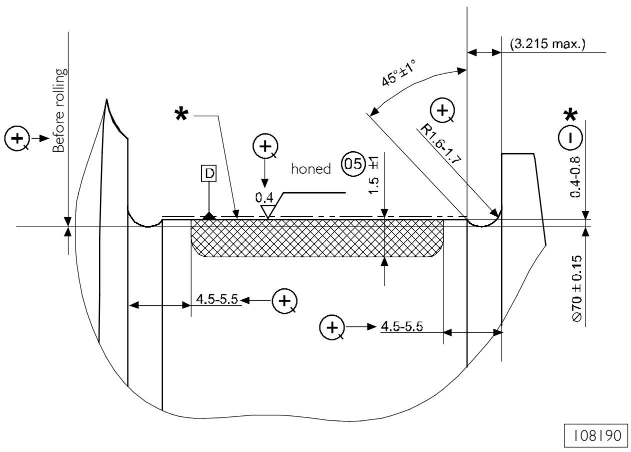
JOURNAL ON TIMING SYSTEM SIDE

Figure 103



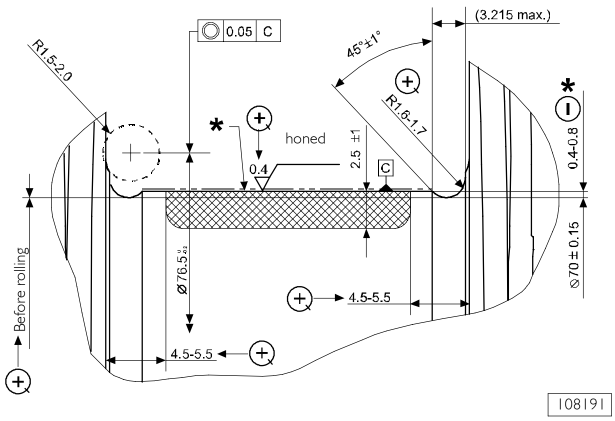
INTERMEDIATE JOURNALS No. 2-4

Figure 104



INTERMEDIATE JOURNAL No. 3

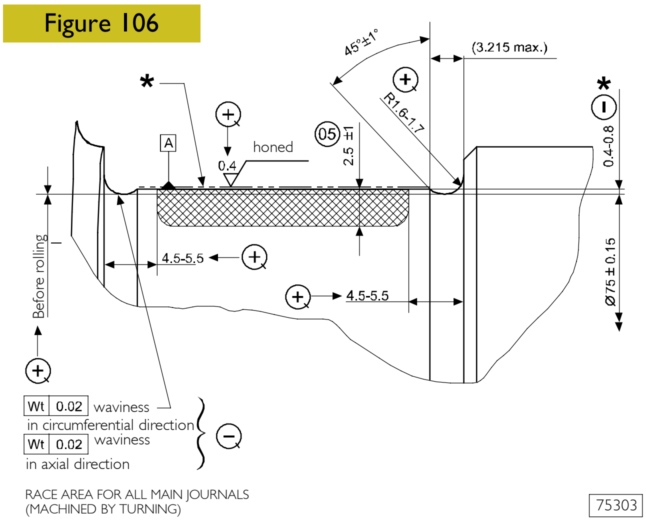
Figure 105



MAIN DATA OF MAIN JOURNALS AND CRANKPINS

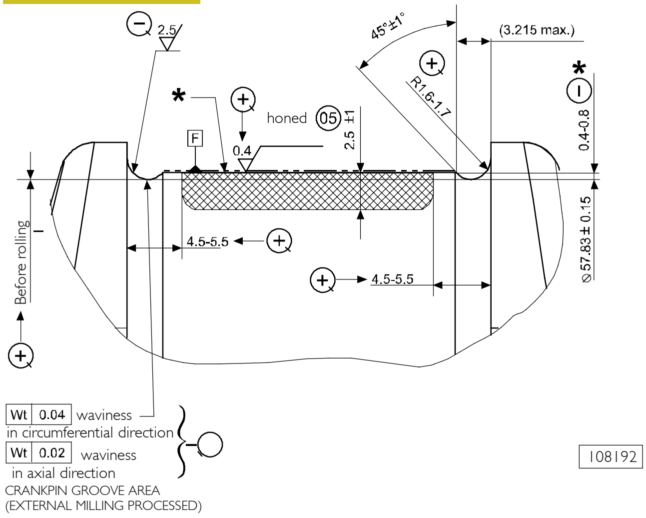
JOURNAL ON FLYWHEEL SIDE

Figure 106



CRANKPINS

Figure 107



* On both races, on all 360°.

NOTE Since, during the 0.254 and 0.508 mm undersizing on the diameter of the crankpins and main journals, the rolled portion of the side races of the pins may get involved, it is necessary to turn the races keeping to the data given in the figure and to do the rolling keeping to the following instructions

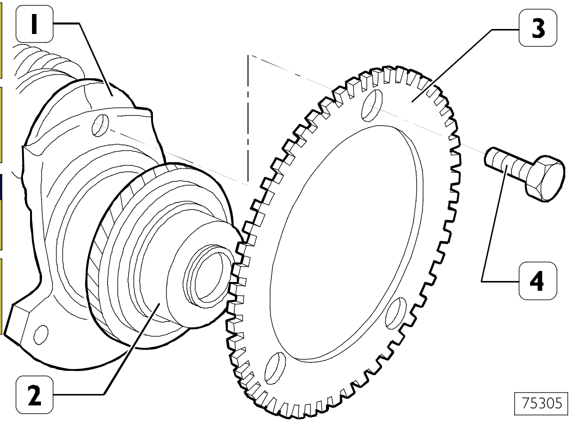
Rolling force:

- ❑ 1^{st} main journal 925 ±25 daN.
- ❑ 2^{nd} – 3^{rd} – 4^{th} – 5^{th} main journal 1850 ±50 daN.
- ❑ crankpin 1850 ±50 daN.

- ❑ Rolling turns: 3 approach, 12 effective, 3 out.
- ❑ Rolling speed: 56 rpm.
- ❑ Decrease in crankpin race depth after rolling: 0.15 – 0.30 mm*.
- ❑ Decrease in main journal race depth after rolling: 0.15 – 0.30 mm*.

* Measured with calibrated rollers Ø 2.5 mm.

Figure 108



Take out the screws (4) and replace the phonic wheel (3). The screws (4) hey must be tightened to a torque of 15 Nm.

Replacing timing control gear

On finding the timing control gear teeth (1) damaged or worn, remove them from the crankshaft (2) using a suitable extractor.

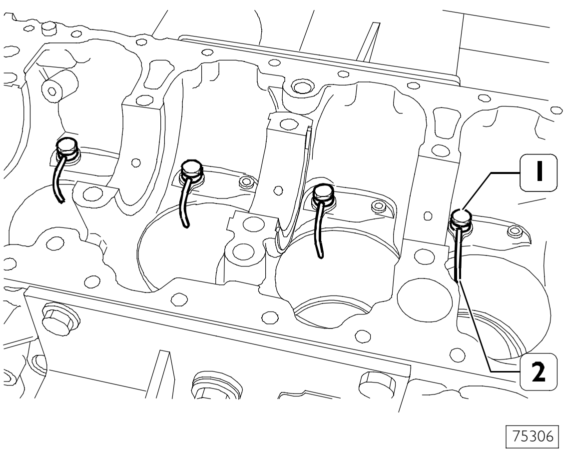
The new gear is fitted onto the crankshaft by heating it to a temperature of 200°C for no longer than 15 minutes.

On completing assembly and after the gear has cooled, it must withstand a torque of 150 Nm without slipping.

ENGINE ASSEMBLY

The following parts must be replaced with new ones at the time of assembly: retaining rings, seals and gaskets, screws whose thread is coated with sealant.

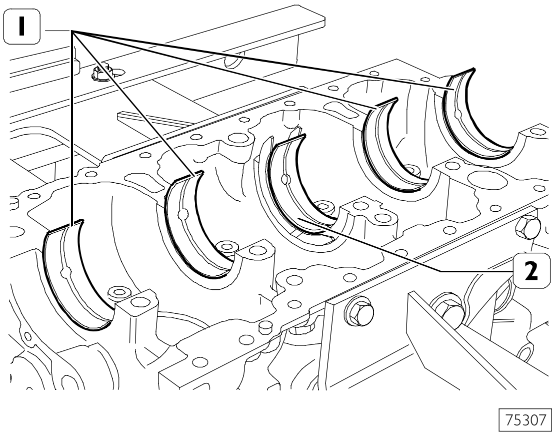
Figure 109



Fit on the oil spray nozzles (2) and tighten the couplings (1) to the prescribed torque.

Assembling main bearings

Figure 110



NOTE Not having found it necessary to replace the main bearings, they need to be fitted back on in the same sequence and position found upon disassembly.

The main bearings (1) are supplied as spare parts undersized on the inside diameter by 0.254 ÷ 0.508 mm.

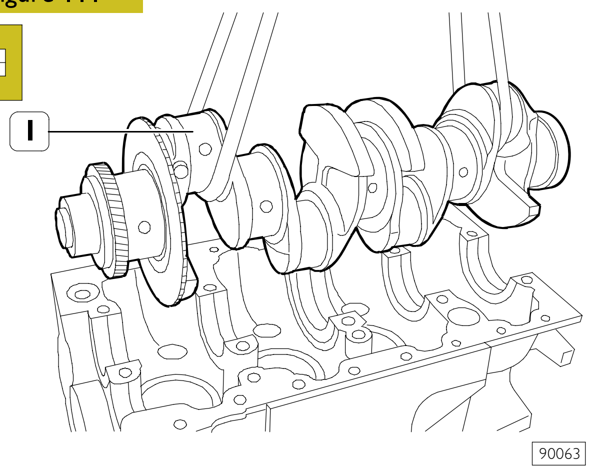
NOTE Do not do any accommodating on the bearings.

Thoroughly clean the top main bearing shells (1) and position them in the crankcase.

NOTE The middle half ring (2) is fitted with thrust washers.

540811 Measuring main journal assembly clearance

Figure 111



Mount the crankshaft (1).
Check the clearance between the crankshaft main journals and their respective bearings by proceeding as follows:

- ❑ Thoroughly clean the pins.
- ❑ Apply a calibrated wire onto the main journals.

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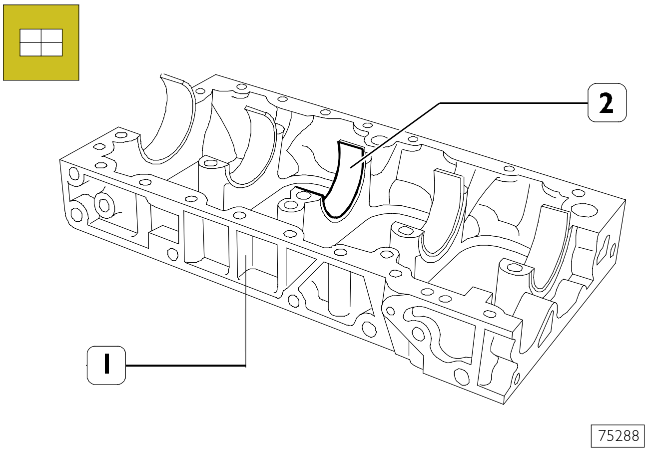
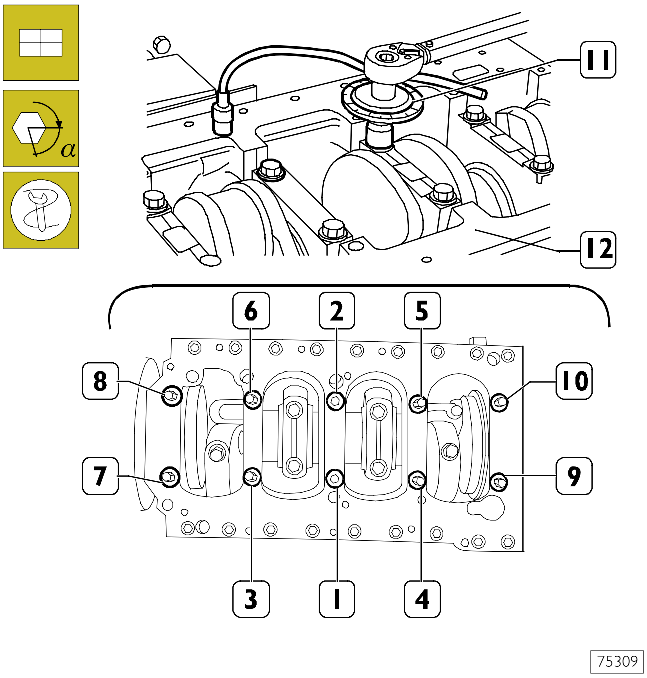
Figure 112



Thoroughly clean the bottom main bearing shells (2) and mount them in the crankcase base (1)

Figure 113



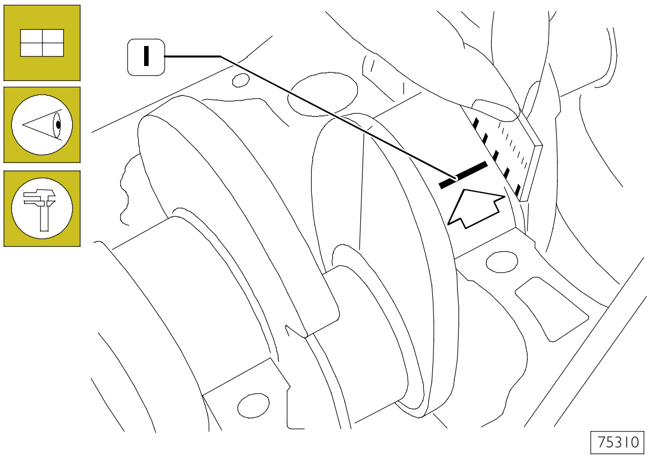
Mount the crankcase base (12).

Tighten the screws in the sequence shown in the figure in three steps:

- Step 1: with a torque wrench, to a torque of 50 Nm.
- Step 2: closing to an angle of 60°.
- Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

Figure 114

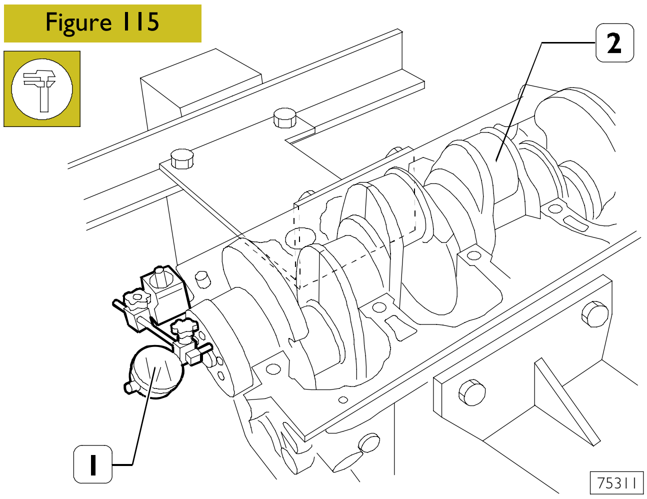


- Remove the bottom crankcase.

The clearance between the main bearings and their associated pins is measured by comparing the length of the calibrated wire (1), at the point of greatest crushing, with the graduated scale on the casing containing the calibrated wire. The numbers on the scale indicate the clearance of the coupling in millimetres, which must be 0.032 ÷ 0.102 mm. If the clearance is not as prescribed, replace the bearings and repeat the check.

Checking crankshaft end float

Figure 115



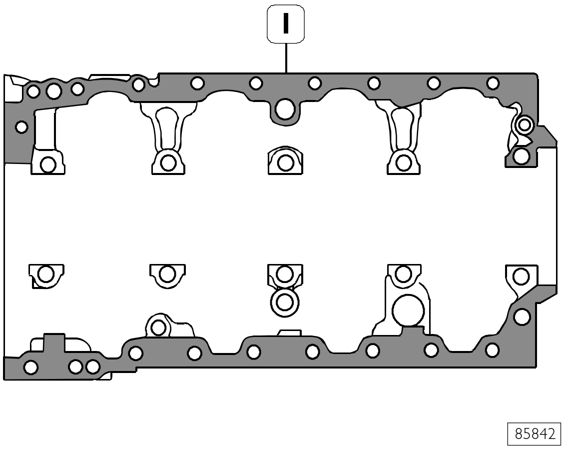
The end float is checked by setting a dial gauge (1) with a magnetic base on the crankshaft (2) as shown in the figure. The normal assembly clearance is 0.060 – 0.310 mm.

If you find the clearance to be greater than as required, replace the rear main bearing shells carrying the thrust bearings and repeat the clearance check between the crankshaft pins and the main bearing shells.

If the end float of the crankshaft does not come within the prescribed values, it is necessary to grind the crankshaft and accordingly change the main bearing shells.

NOTE: The middle main bearing has half thrust washers integrated in it, so it performs the function of a thrust bearing. It is supplied as a spare part only with the normal shoulder thickness.

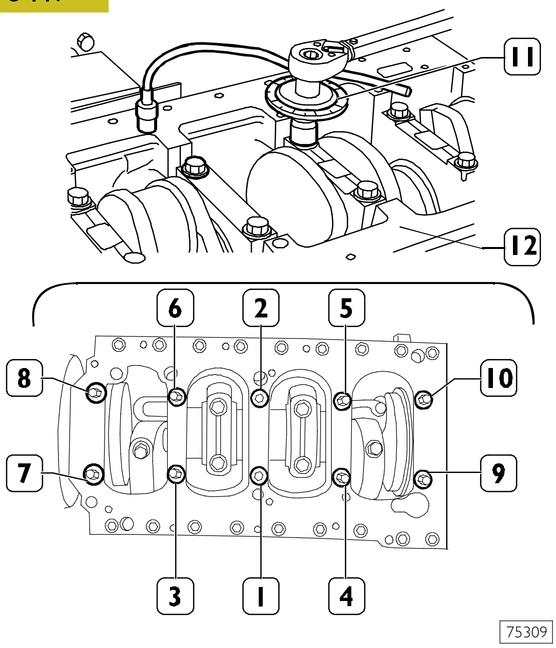
Figure 116



Thoroughly clean the crankcase / crankcase base mating surface.
Apply, on base, sealant LOCTITE 510 IVECO no. 93162432, as indicated in the scheme. The sealant must result to be even, not patchy.

NOTE Mount the crankcase base within 10 minutes of applying the sealant.

Figure 117

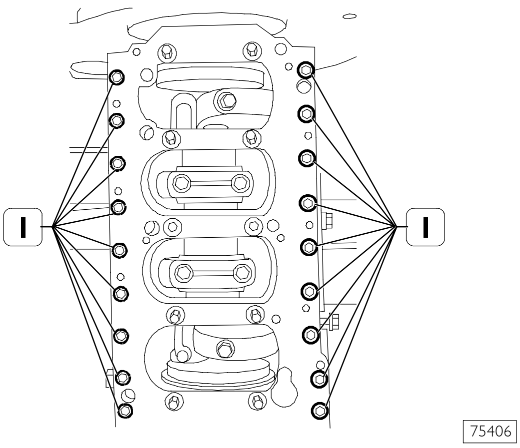


Mount the crankcase base (12) and tighten the fixing screws in three stages, following the sequence shown in the figure:

- ❑ Step 1: with a torque wrench, to a torque of 50 Nm.
- ❑ Step 2: closing to an angle of 60°.
- ❑ Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

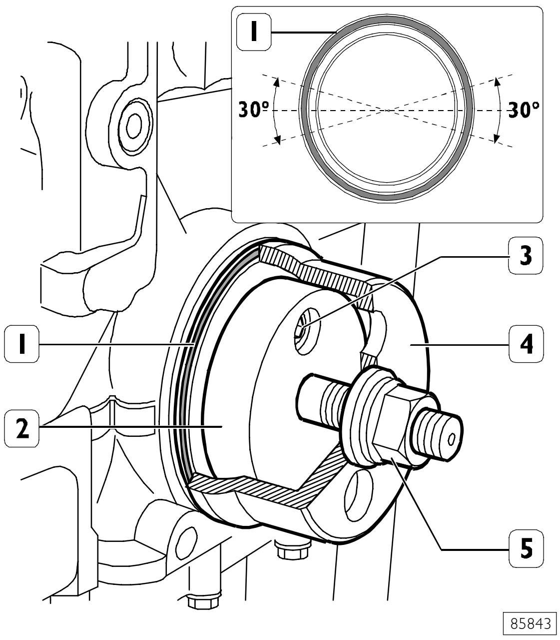
Figure 118



Then tighten the outer screws (1) to a torque of 36 – 30 Nm.

540460 Assembling rear seal

Figure 119



Carefully clean the seal seat. Apply LOCTITE 510 IVECO nr. 2992504 on the seal (1) for 30° in the points shown in the figure.
Lubricate the rear shank of the crankshaft with engine oil.
Fit part (2) of tool 99346255 onto the rear shank of the crankshaft; secure it with the screws (3) and key the fresh seal (1) onto it.
Position part (4) on part (2); screw down the nut (5) to fit the seal (1) fully inside the crankcase.

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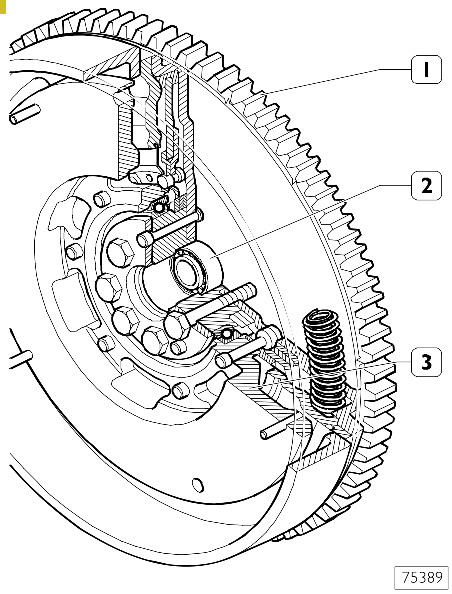
540850 ENGINE FLYWHEEL

Figure 120



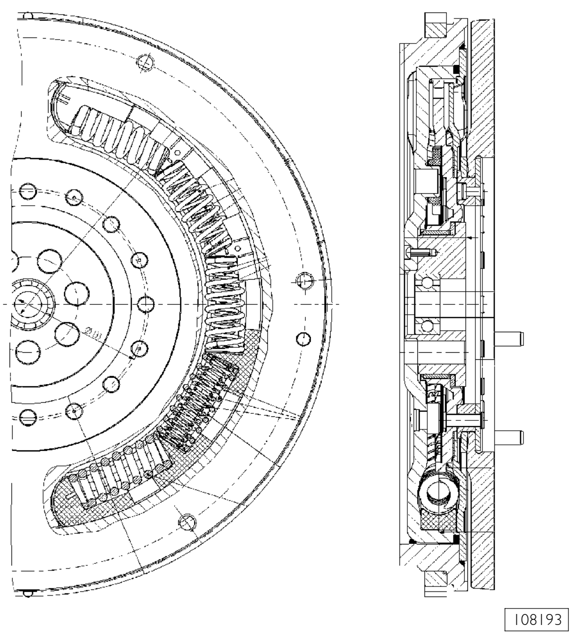
"LUK" ENGINE FLYWHEEL FOR ENGINES FITTED TO THE VEHICLES EQUIPPED WITH MECHANIC TRANSMISSION

Check clutch disk rest surface: if it shows deep scoring, a replacement must be performed.

NOTE The nominal thickness of the engine flywheel is 50 ±0.6 mm.

Check conditions of the teeth of crown wheel (1); where excessive cracking or wear is found, replace engine flywheel.

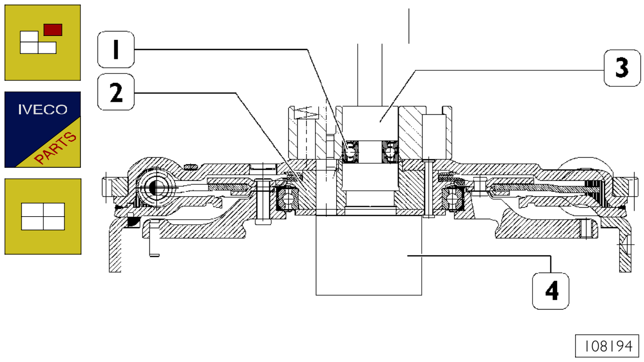
Figure 121



"SACHS" ENGINE FLYWHEEL FOR ENGINES FITTED TO THE VEHICLES EQUIPPED WITH AUTOMATIC TRANSMISSION

540852 Replacing bearing supporting gearbox input shaft

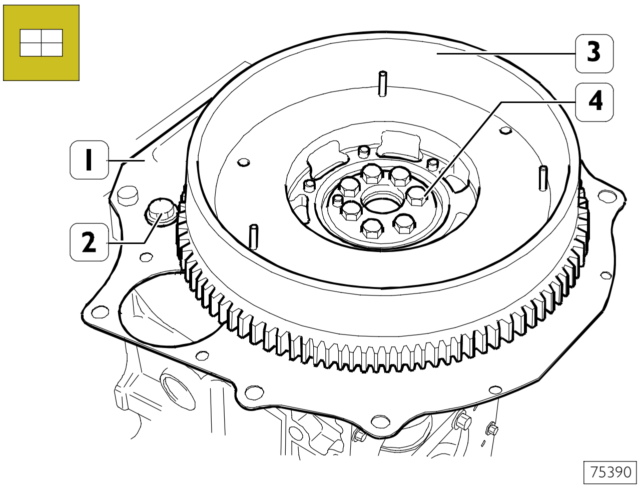
Figure 122



Use a suitable beater to take off engine flywheel bearing (1), taking care that the bearing does not set itself sideways or get stuck, with resulting flywheel housing damage.

To fit back into place, put engine flywheel hub (2) onto a suitable support (4) by using a suitable beater (3) placed on bearing (1) outer race, then fit the bearing into the engine flywheel. This operation shall be carried out by using a hydraulic press.

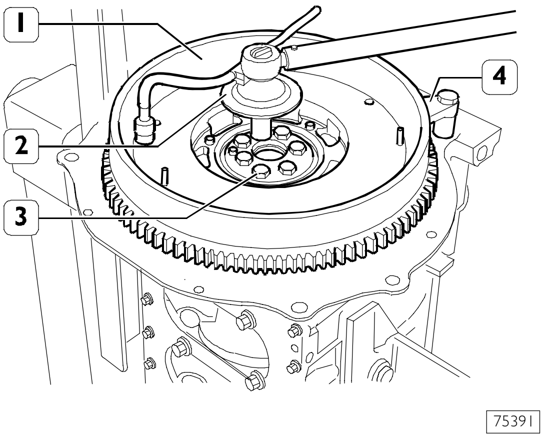
Figure 123



Mount the sheet metal guard (1) and secure it to the crankcase tightening the screw (2) to the prescribed torque.

Mount the engine flywheel (3) and screw down the screws (4).

Figure 124



Fit tool 99360351 (4) onto the crankcase to block rotation of the engine flywheel (1).

Tighten the screws (3) fixing the engine flywheel (1) in two steps:

- ❑ Step 1: with a torque wrench, to a torque of 30 Nm.
- ❑ Step 2: closing to an angle of 90°.

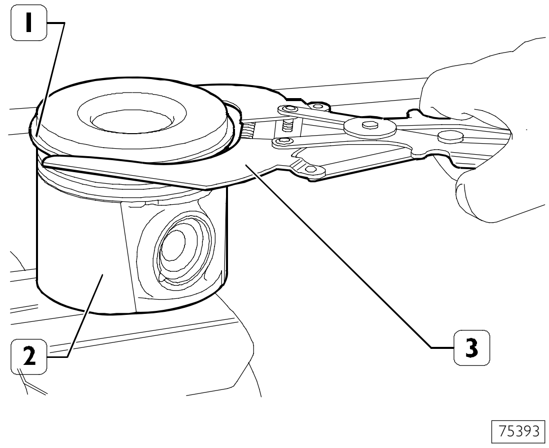
NOTE Use tool 99395216 (2) for the angle closing.

5408 CONNECTING ROD – PISTON ASSEMBLY

Check the pistons. They must show no signs of seizure, scoring, cracking or excessive wear; replace them if they do.

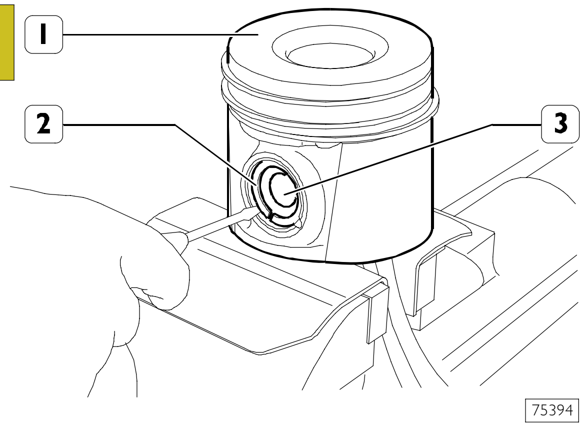
540840 Pistons Disassembly

Figure 125



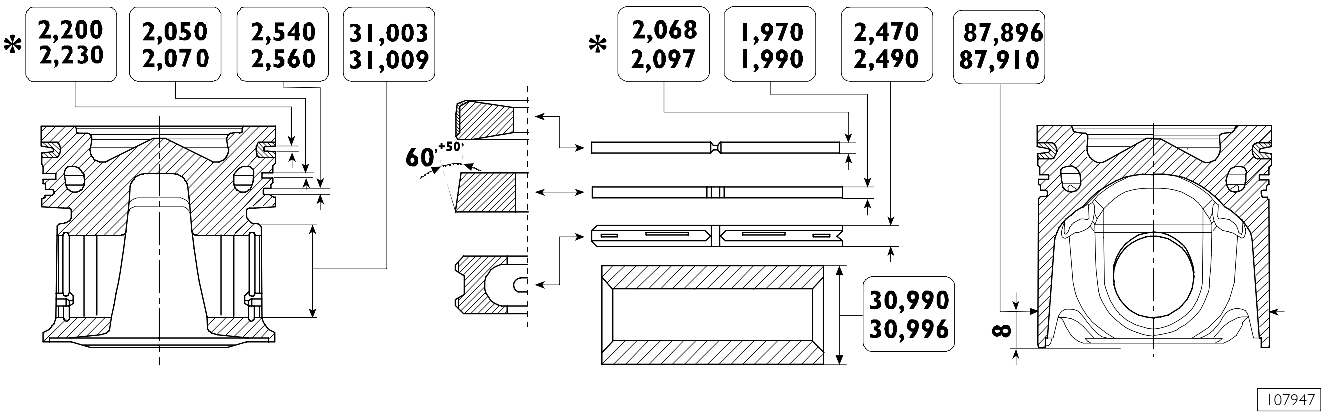
Remove the piston rings (1) from the piston (2) using pliers 99360183 (3).

Figure 126



Take plunger (1) off the connecting rod by removing snap ring (2) and taking pin (3) out.

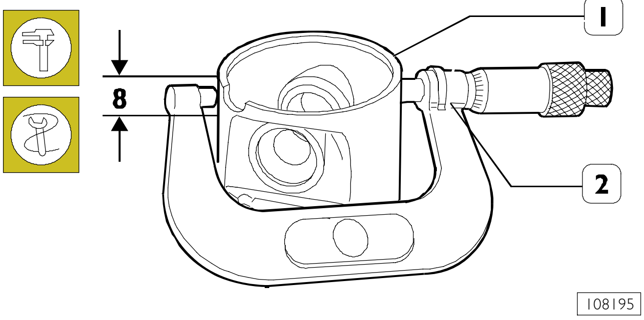
Figure 127



MAIN DATA ON PISTON MAHLE MONDIAL, PINS AND SPRING RINGS
ENGINE F1AE 0481B (116 HP)
* Measured on the diameter of 85 mm.

Measuring piston diameter

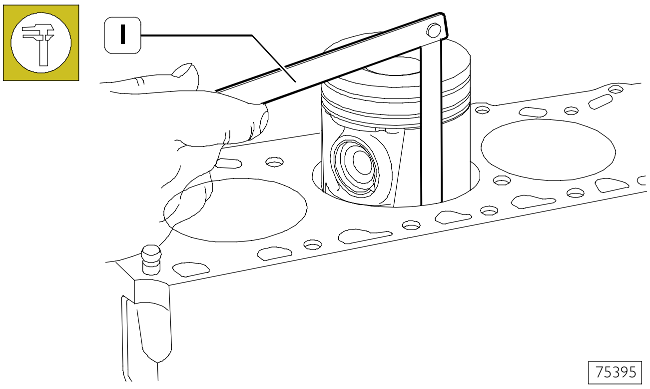
Figure 128



Use a micrometer (2) to measure plunger (1) diameter, in order to determine the assembling play. The diameter shall be measured at such a distance from the plunger base as shown in the figure.

NOTE The pistons are supplied as spare parts with the standard, normal and 0.4mm oversize diameters together with rings, pin and retaining rings.

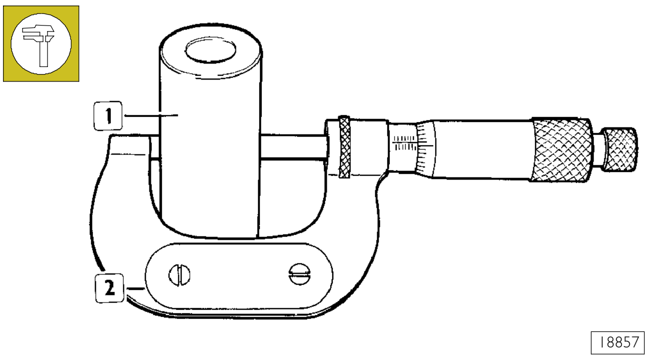
Figure 129



The clearance between the piston and cylinder liner can also be checked using a feeler gauge (1) as illustrated in the figure.

540841 Piston pins

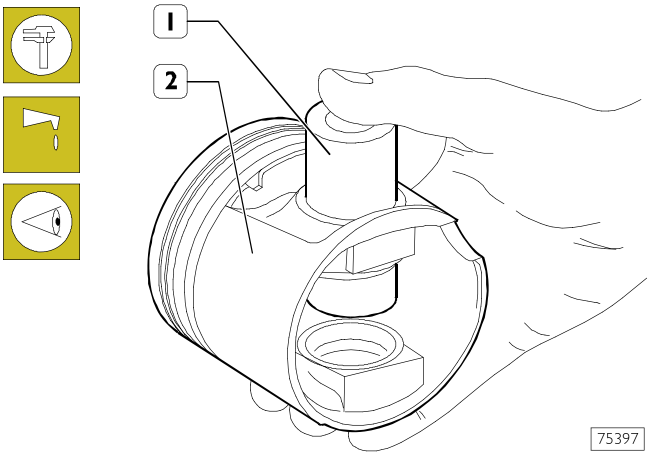
Figure 130



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

Conditions for correct pin-piston coupling

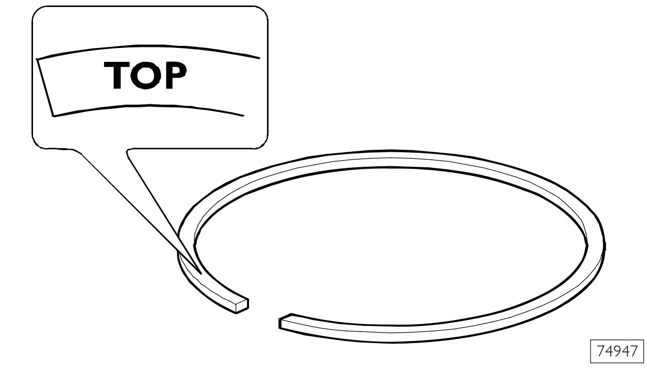
Figure 131



Lubricate the pin (1) and its seat on the hubs of the piston (2) with engine oil. The pin must go into the piston by lightly pressing with the fingers and must not drop out by gravity.

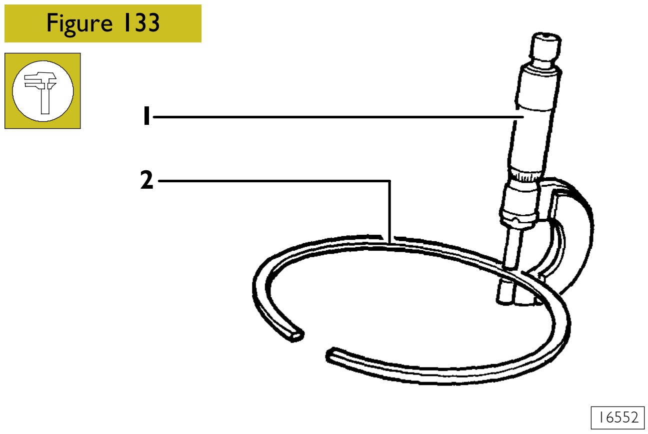
540842 Piston rings

Figure 132



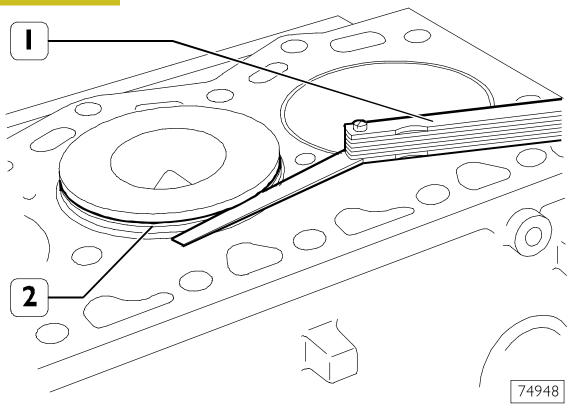
The trapezoidal split rings (1st slot) and the oil scraper rings (2nd slot) have the word TOP etched in them; when fitting them on the piston, the word TOP must be facing upwards.

Figure 133



Check the thickness of the piston rings (2) with a micrometer (1).

Figure 134



Check the clearance between the trapezoidal ring (2) (1st slot) and the associated slot on the piston with a feeler gauge (1), proceeding as follows: insert the piston into the cylinder liner so that the ring (2) comes approximately half way out of it.

Figure 135

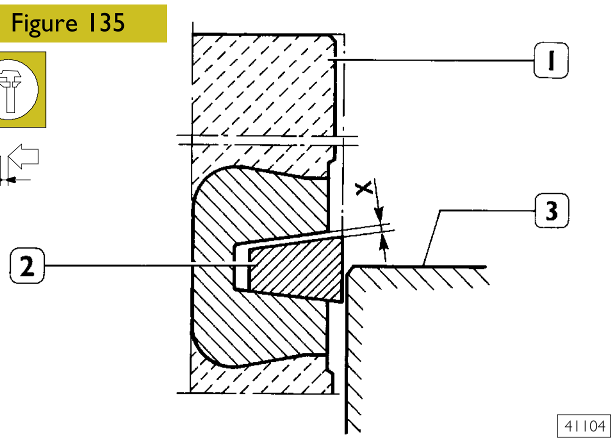
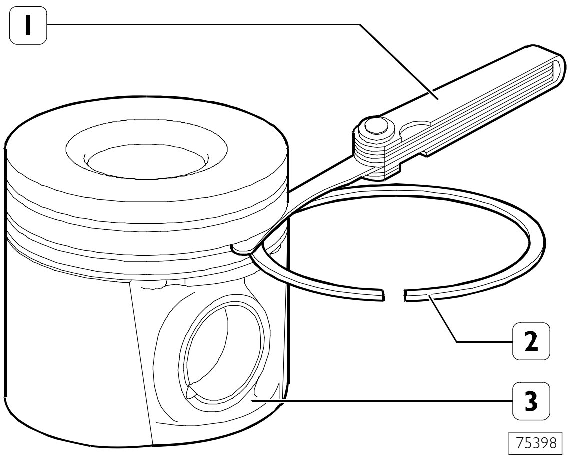


DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING
1. Piston slot – 2. Trapezoidal piston ring – 3. Cylinder liner

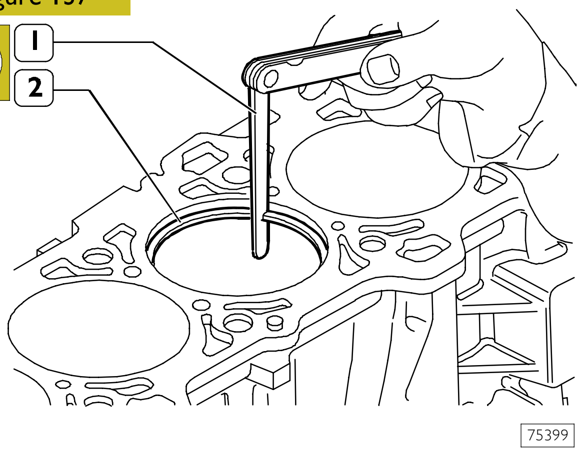
Using a feeler gauge (1, Figure 134), check the clearance (X) between the ring (2) and the slot (1); this clearance must have the prescribed value.

Figure 136



Check the clearance between the piston rings (2) of the 2nd and 3rd slot and the associated seats on the piston (3) with a feeler gauge (1).

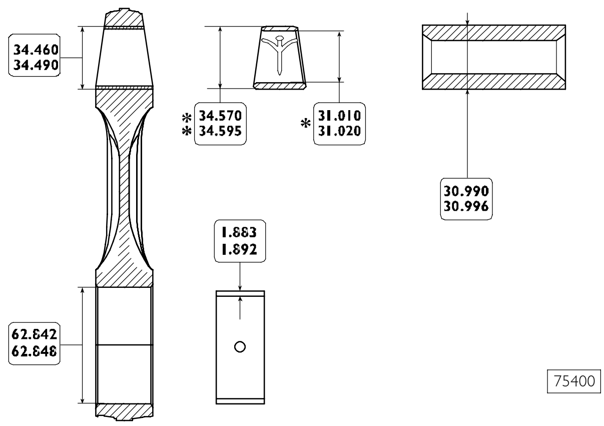
Figure 137



Check the opening between the ends of the piston rings (2) inserted in the cylinder liner using a feeler gauge (1).

540830 Connecting rods

Figure 138



MAIN DATA OF THE CONNECTING ROD, BUSHING, PISTON PIN AND BEARING SHELLS

* Internal diameter to obtain after driving into the small end and grinding with a reamer.
** Dimension cannot be measured in the free state.
*** Thickness of the bearing shell supplied as a spare part.

NOTE Each connecting rod has its cap marked:

- with a letter: O or X indicating the diameter class of the big end mounted in production;
- with a number indicating the weight class of the connecting rod mounted in production.

In addition, it could be stamped with the number of the cylinder in which it is fitted.

In the event of replacement it is therefore necessary to number the new connecting rod with the same number as the one replaced.

The numbering must be done on the opposite side to the bearing shell retaining slots.

The connecting rods are supplied as spare parts with the diameter of the big end 62.842 – 62.848 mm marked with the letter O and the weight class marked with the number 33.

It is not permissible to remove material.

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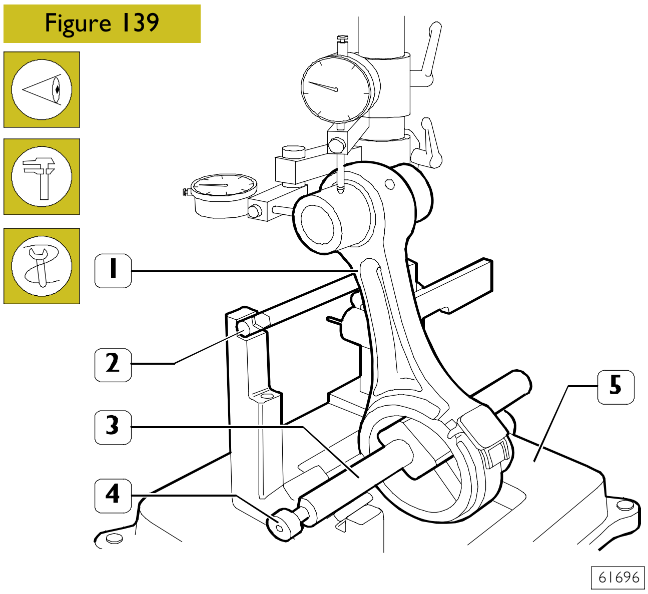
540834 Bushes

Check that the bush in the small end has not come loose and shows no sign of seizure or scoring. If it does, replace the complete connecting rod.

Checking connecting rod

Figure 139

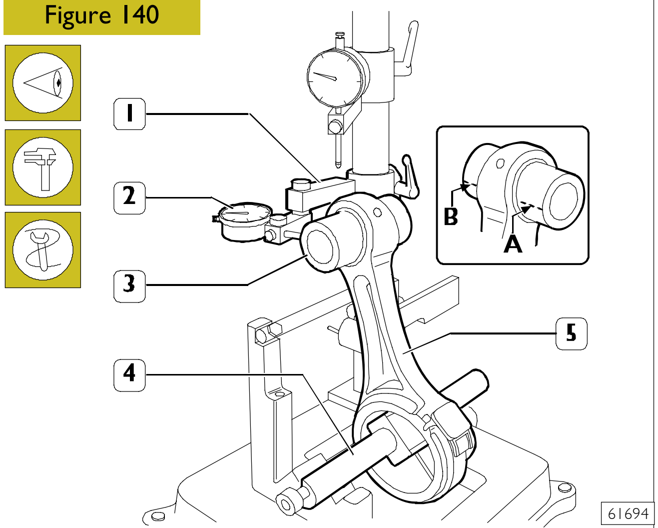


Check the alignment of the axes of the connecting rods (1) with device 99395363 (5), proceeding as follows:

- Fit the connecting rod (1) on the spindle of the tool 99395363 (5) and lock it with the screw (4).
- Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

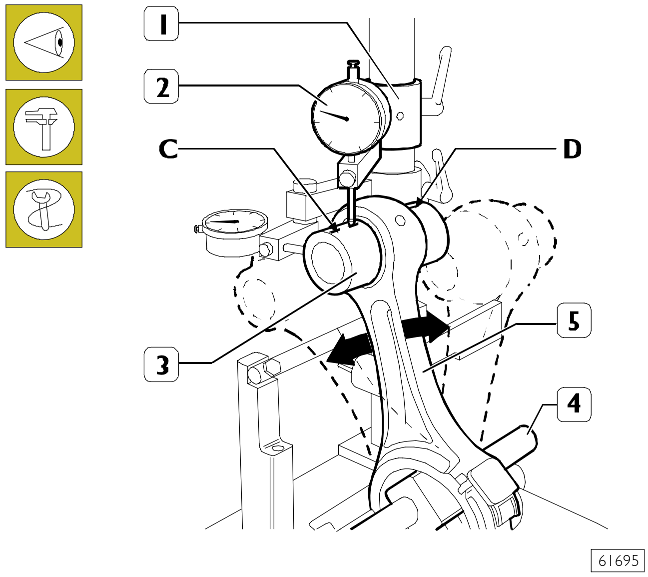
Figure 140



Check the torsion of the connecting rod (5) by comparing two points (**A** and **B**) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point A and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side B of the pin (3): the difference between A and B must be no greater than 0.08 mm.

Checking bending

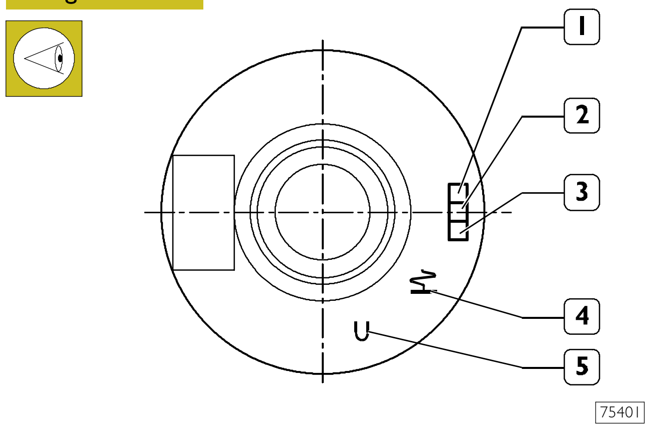
Figure 141



Check the bending of the connecting rod (5) by comparing two points C and D of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point C.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2).
Shift the spindle with the connecting rod (5) and repeat the check on the highest point on the opposite side D of the pin (3). The difference between point C and point D must be no greater than 0.08 mm.

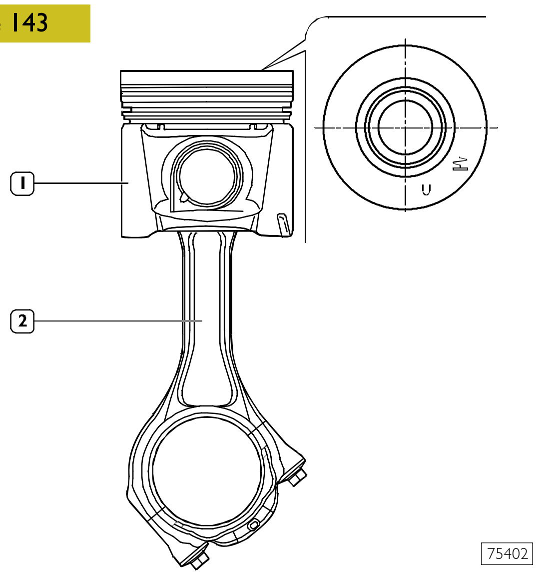
Assembling connecting rod-piston assembly

Figure 142



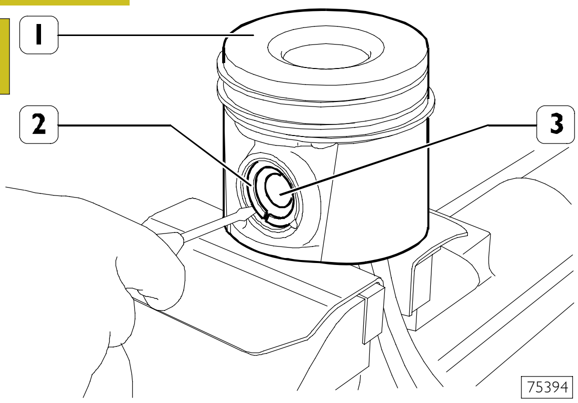
Etched on the top of the piston are: the type of engine (1), class selection (2) and supplier (3) as well as the direction of fitting the piston in the cylinder liner (4). The mark (5) is for passing the 1st slot insert adhesion test.

Figure 143



Connect the piston (1) to the connecting rod (2) together with its cap so that the piston assembly reference, position of the connecting rod and of the cap are observed as shown in the figure.

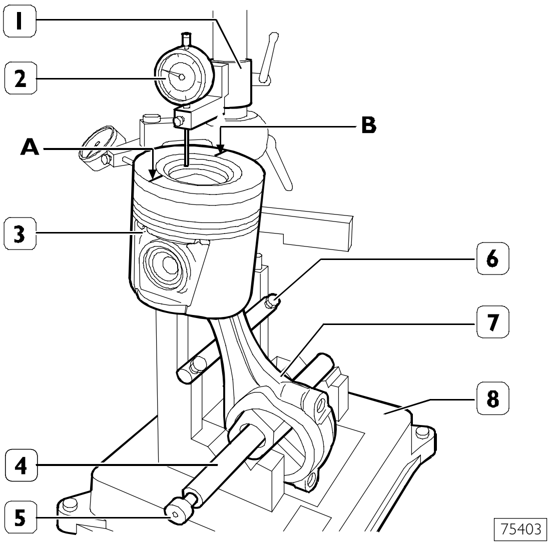
Figure 144



Position the piston (1) on the connecting rod, insert the pin (3) and secure it with the split rings (2).

Checking for connecting rod – piston distortion

Figure 145

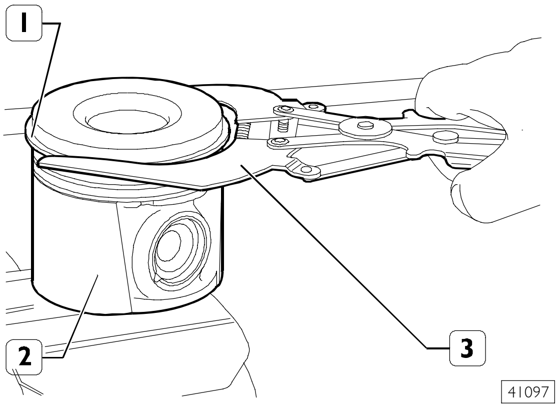


After fitting the connecting rod – piston assembly together, check for distortion with the tool 99395363 (8) as follows:

- ❑ Fit the connecting rod (7) together with the piston (3) on the spindle (4) of tool 99395363 (8) and lock it with the screw (5).
- ❑ Rest the connecting rod (7) on the bar (6).
- ❑ Position the mount (1) of the dial gauge (2) so that this is positioned at point A of the piston with a pre-load of 0.5 mm and zero the dial gauge (2).
- ❑ Shift the spindle (4) so as to position the dial gauge (2) at point B of the piston (3) and check for any deviation.

Fitting piston rings

Figure 146

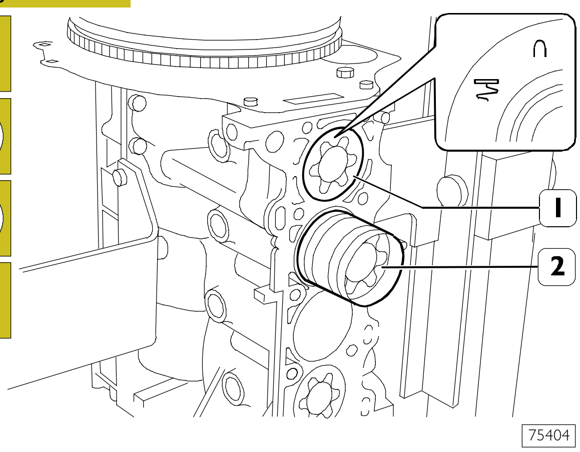


Fit the piston rings (1) on the piston (2) using the pliers 99360183 (3).

NOTE The 1st and 2nd slot rings need to be mounted with the word "TOP" facing upwards.

Assembling connecting rod – piston assemblies in cylinder barrels

Figure 147



Lubricate the pistons well, including the piston rings and the inside of the cylinder liners.

With the aid of the clamp 99360605 (2), fit the connecting rod – piston assembly (1) in the cylinder liners, checking that:

- ❑ The number of each connecting rod corresponds to the cap mating number.

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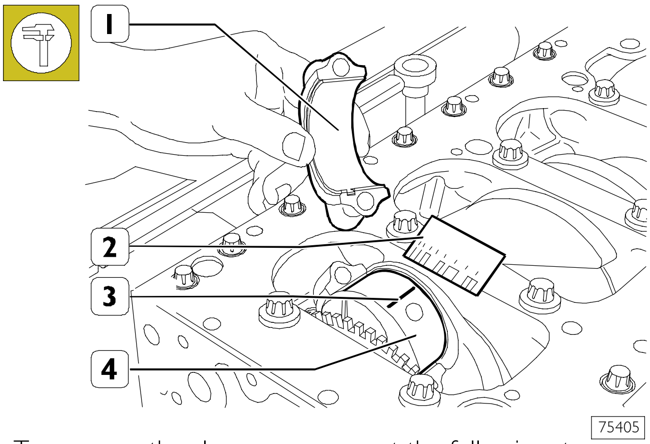
- The openings of the piston rings are staggered 120° apart.
- The pistons are all of the same weight.
- The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil spray nozzles.

NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position found on disassembly.

540831 Measuring crankpin assembly clearance

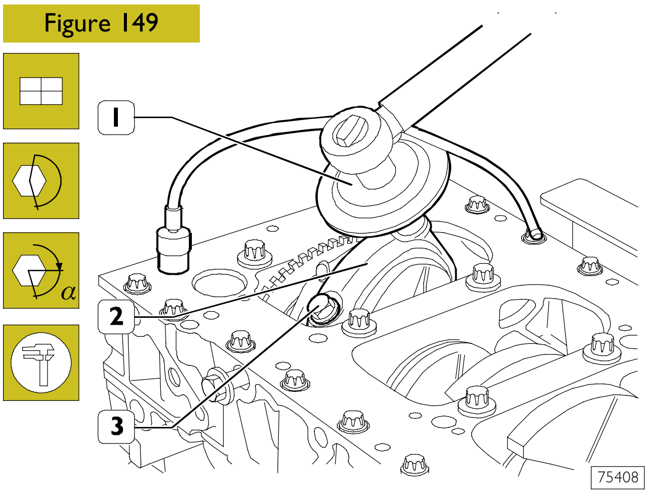
Figure 148



To measure the clearance, carry out the following steps:

- Thoroughly clean parts (1) and (4) and eliminate all traces of oil.
- Place a length of calibrated wire (3) on the crankshaft pins (4).

Figure 149



- Fit the connecting rod caps (2) with the associated bearing shells.
- Tighten the screws (3) in two steps:
  - Step 1: with a torque wrench, to a torque of 50 Nm.
  - Step 2: closing to an angle of 60°.

NOTE Use tool 99395216 (1) for the angle closing.

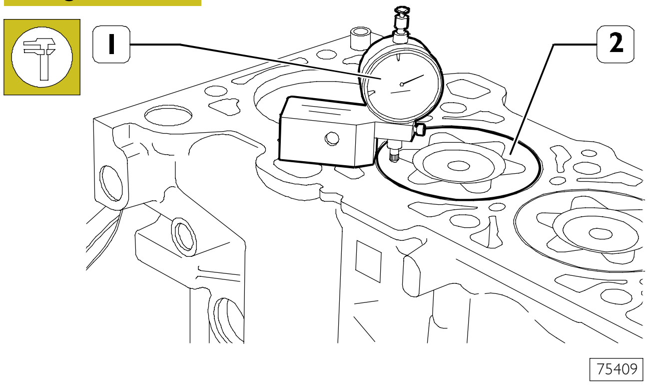
- Remove the cap (2) and determine the existing clearance by comparing the width of the calibrated wire (3, Figure 148) with the graduated scale on the case (2, Figure 148) that contained the calibrated wire. On finding a clearance other than as prescribed, replace the bearing shells and repeat the check. On obtaining the prescribed clearance, lubricate the connecting rod bearing shells and fit them permanently by tightening the connecting rod cap fixing screws as described.

NOTE The connecting rod cap fixing screws must always be replaced for permanent assembly.

Manually check that the connecting rods slide axially on the pins of the crankshaft.

Checking piston protrusion

Figure 150

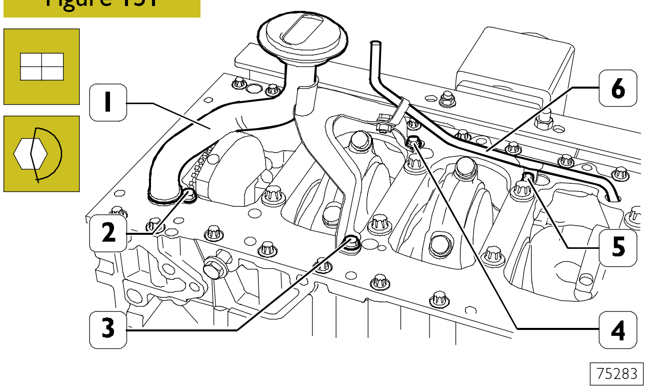


After mounting the connecting rod – piston assemblies, check the protrusion of the pistons (2) at the T.D.C. in relation to the top surface of the crankcase with a dial gauge (1).

NOTE The difference between the minimum and maximum protrusions of the four pistons must be = 0.15 mm.

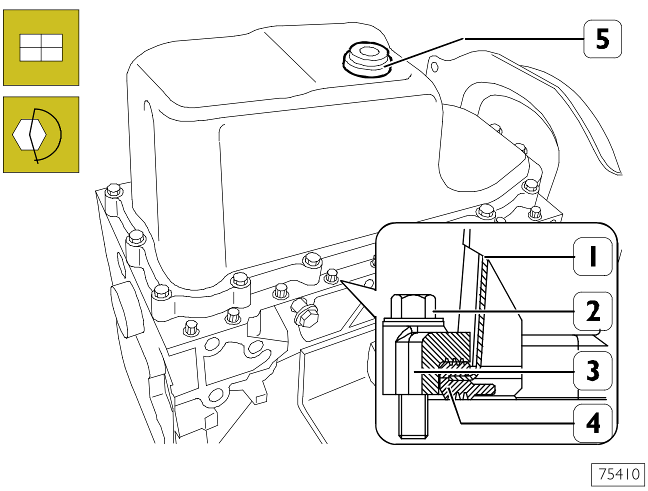
The cylinder head gasket in the set of spare gaskets needed for complete engine overhaul is supplied with a single thickness. Clearly, it is supplied separately too.

Figure 151



Mount the suction strainer (1) together with the pipe (6). Screw down the fixing screws (2-3-4-6) and tighten them to the prescribed torque.

Figure 152

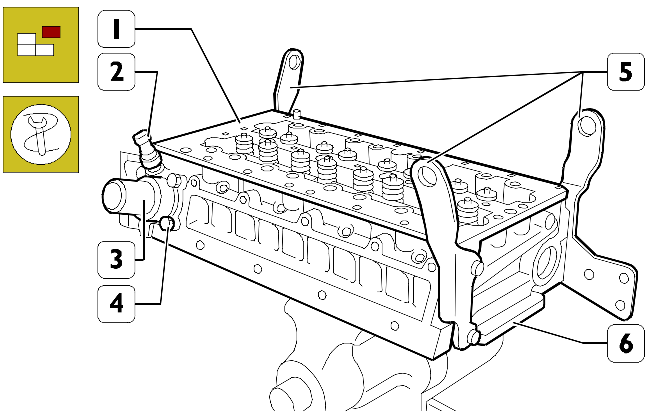


Fit the gasket (4) and the frame (3) onto the oil sump (1). Screw down the fixing screws (2) and tighten them to the prescribed torque.
Screw down the oil drain plug (5) and tighten it to the prescribed torque.

560610 CYLINDER HEADS

Disassembly

Figure 153



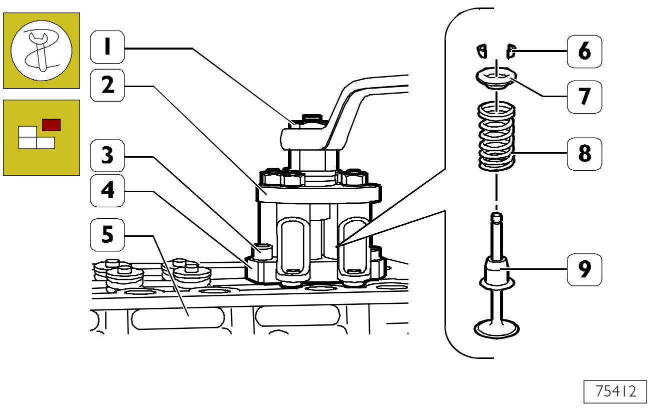
Place the cylinder head (1) on the mounting SP.2271 (6). Remove the brackets (5) for lifting the engine.

In the event that temperature sensor (2) need disassembling, wrench SP 2262 shall be used.

Take out the screws (4) and remove the thermostat casing (3).

541210 Removing valves

Figure 154



Fit part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

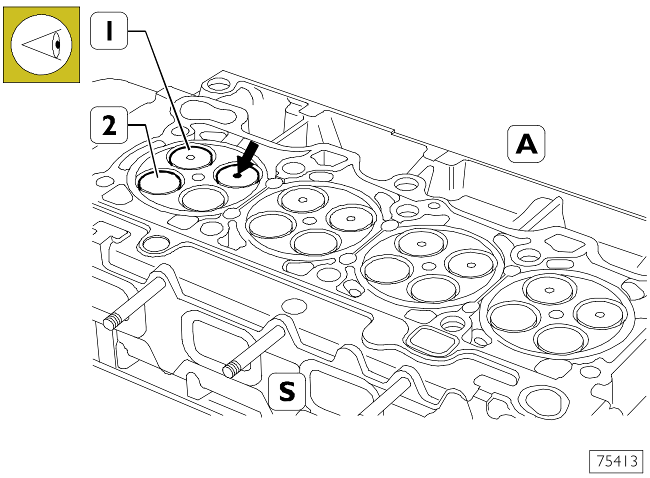
Fit part (2) of tool 99360260 onto part (4), screw down the nut (1) so that on compressing the springs (8) it is possible to remove the cotters (6). Then take out the plates (7) and the springs (8).

Using suitable pliers, remove the oil seal (9).

Repeat these operations on the remaining valves.

Turn the cylinder head over.

Figure 155



The intake (1) and exhaust (2) valves have the same diameter mushroom.

The central cavity (→) of the mushroom of the intake valve (1) is distinguished from that of the exhaust valve (2).

NOTE Before dismounting the valves from cylinder head, number them, to the purpose of being able to remount them in the position that was found on dismounting operation where they should not be replaced.
A = intake side – S = exhaust side

Remove the intake (1) and exhaust (2) valves.

Checking cylinder head seal

Check the hydraulic seal using a suitable tool.
Pump in water heated to approx. 90°C at a pressure of 2 ÷ 3 bars.

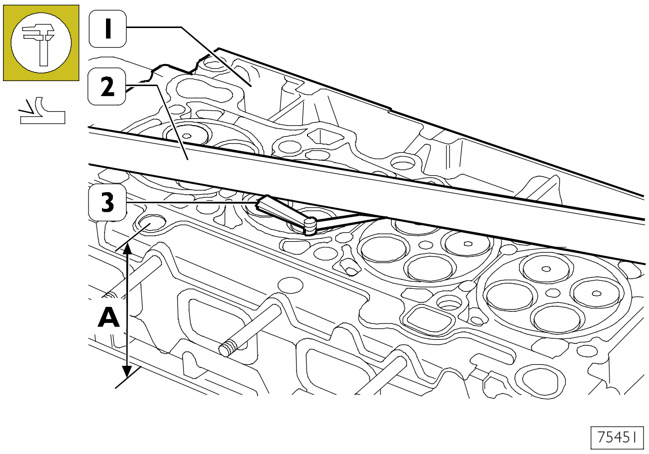
Replace the cup plugs if they are found to leak at oil, using a suitable drift for their removal – assembly.

NOTE Before mounting the plugs, apply LOCTITE 270 water-reacting sealant on their sealing surfaces.

If there is any leakage from the cylinder head, it must be replaced.

Checking cylinder head mating surface

Figure 156



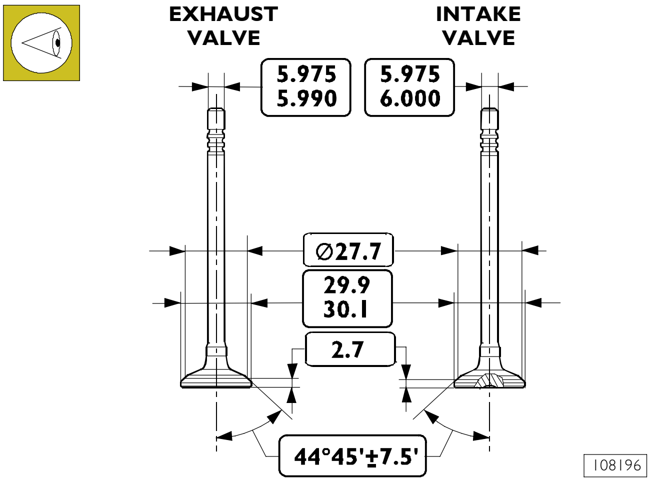
The mating surface of the head (1) with the cylinder block is checked using a rule (2) and a feeler gauge (3).
The deformation found on the entire length of the cylinder head must be no greater than 0.20 mm.
For greater values, regrind the cylinder head according to the values and instructions given in the following figure.

The nominal thickness A of the cylinder head is 112 ±0.1 mm; the maximum permissible removal of metal must not exceed a thickness of 0.2 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to make the prescribed valve recessing.

540662 VALVES

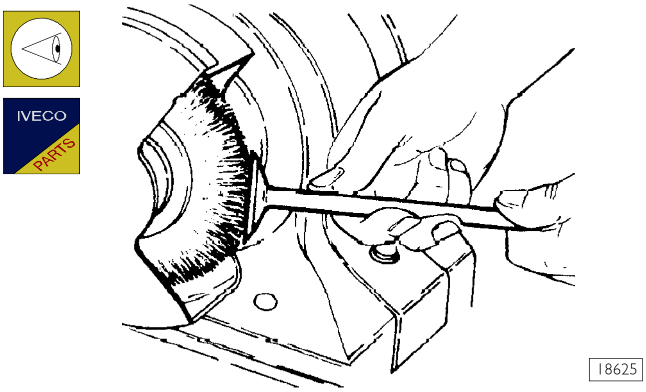
Figure 157



MAIN DATA OF INTAKE AND EXHAUST VALVES

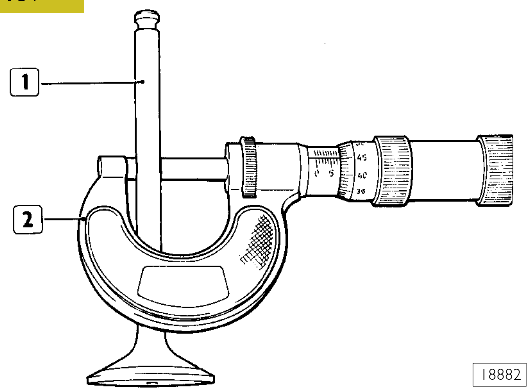
Removing deposits, refacing and checking valves

Figure 158



Remove the carbon deposits on the valves with a wire brush.
Check that the valves show no signs of seizure, cracking or burning.

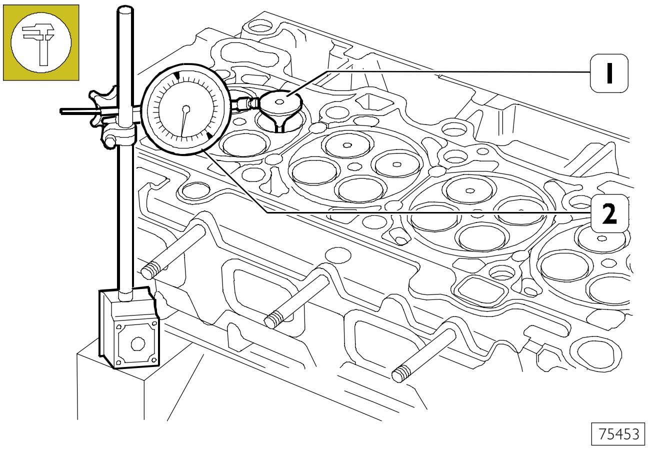
Figure 159



Use micrometer (2) to measure valve (1) stem: it shall correspond to the value shown in figure 135. Use grinding machine 99305018 to grind, if necessary, the valve seats (remove as less material as possible).

Checking clearance between valve stem and valve guide and centring valves

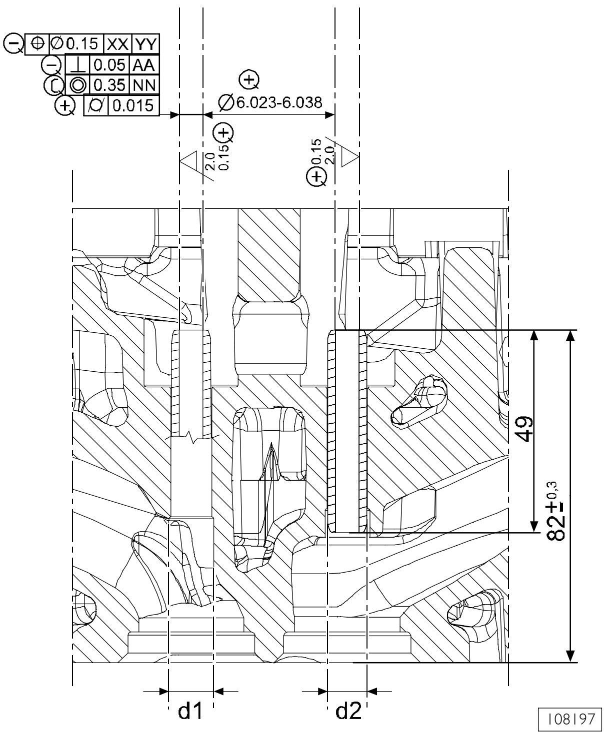
Figure 160



The checks are made using a dial gauge (2) with a magnetic base, positioned as illustrated. The assembly clearance is 0.033 – 0.063 mm.
Making the valve (1) turn, check that the centring error is no greater than 0.03 mm.

540667 VALVE GUIDE
Replacing valve guide

Figure 161

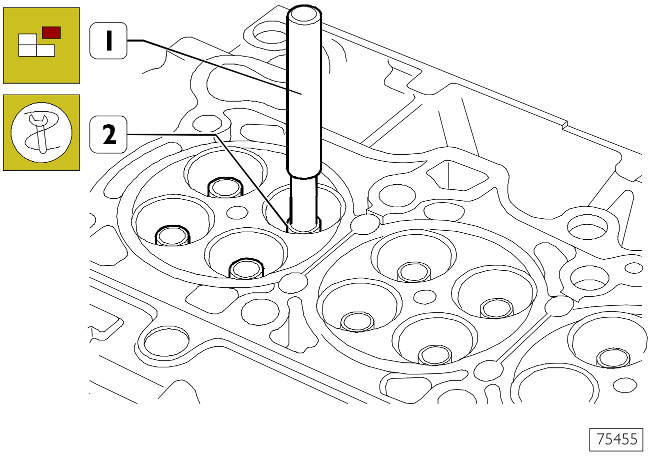


MAIN DATA OF VALVE GUIDES – SEATS

Valve guide seat inside Ø	9.980 ÷ 10.000 mm
Valve guide outside Ø	10.028 ÷ 10.039 mm

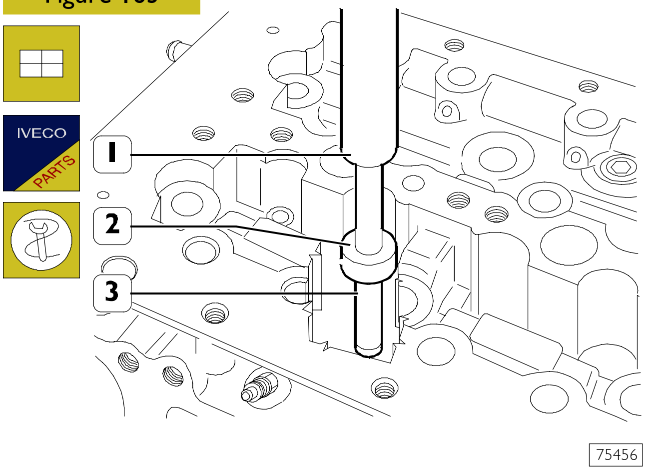
* Measurement to be made after driving in the valve guides.

Figure 162



Remove the valve guides (2) with the drift SP.2312 (1).

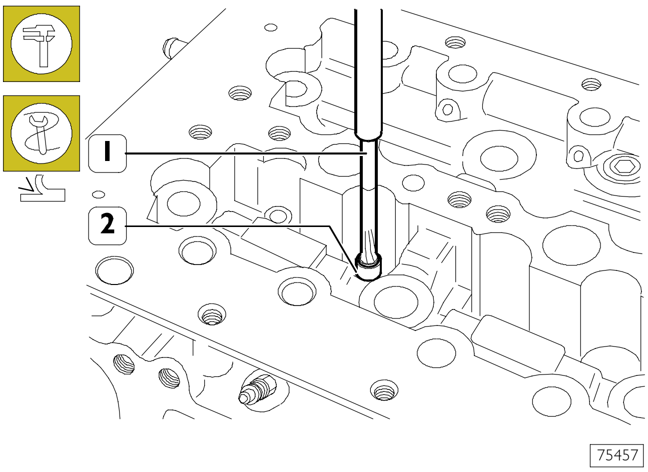
Figure 163



Heat the cylinder head to 80 – 100°C and, using the drift SP.2312 (1) provided with part SP.2311 (2), mount the new valve guides (3) previously chilled in liquid nitrogen.
Where above indicated tools are not available, mount valve guides positioning them in cylinder head according to dimension indicated in Figure 139.

Boring valve guides

Figure 164



After driving in the valve guides (2), regrind them with the smoother SP.2310 (1).

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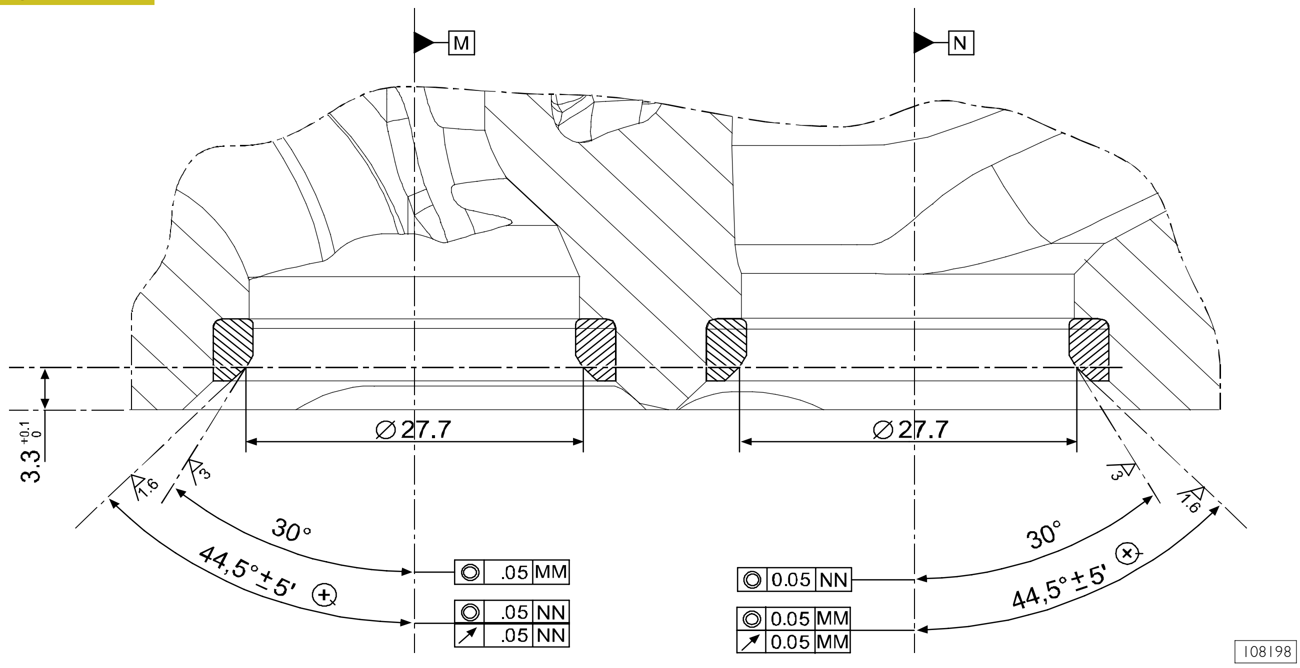
540661 VALVE SEATS
Recutting and replacing valve seats

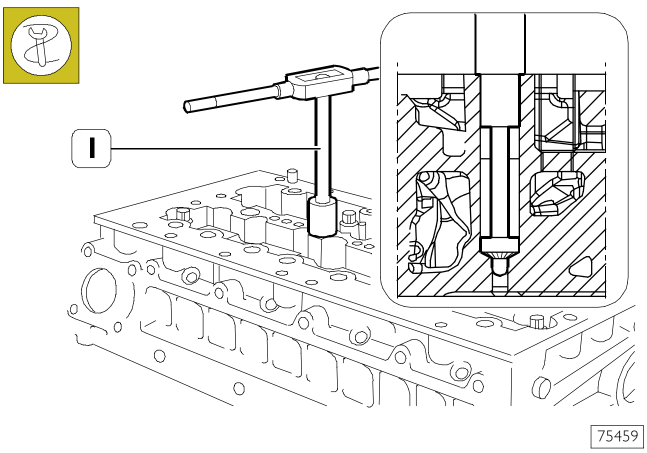
Figure 165



Check the valve seats. On finding any slight scoring or burns, regrind them with an appropriate tool according to the angles given in Figure 165.
Having to replace them, with the same tool and taking care not to affect the cylinder head, remove as much material from the valve seats as possible until, with a punch, it is possible to extract them from the cylinder head.

Heat the cylinder head to 80 ÷ 100°C and, using a suitable drift, fit in it the new valve seats, previously chilled in liquid nitrogen.
Using a specific tool, regrind the valve seats according to the angles given in Figure 165.

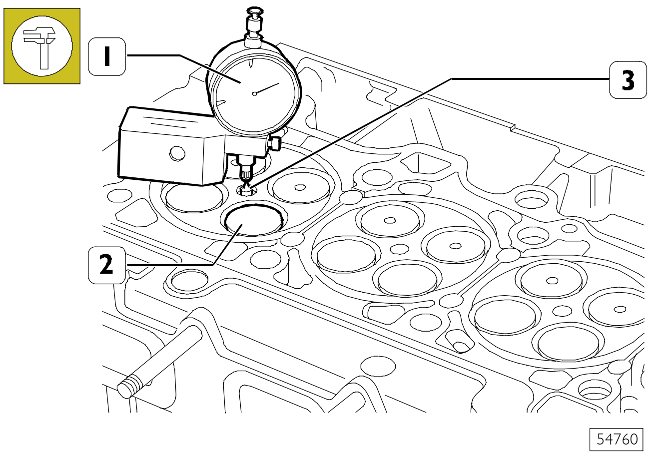
Figure 166



Using the milling cutter 99394038 (1), clean the injector seat of any deposits.

Mount the valves, block the seat of the electro-injectors and glow plugs; using a suitable tool, check the seal of the valves/seats.

Figure 167

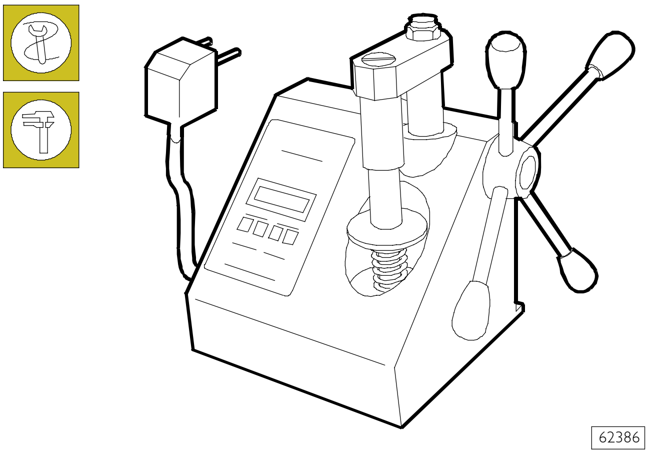


Using a dial gauge (1), check that, from the plane of the cylinder head, the valve recessing (2) and the protrusion of the injector (3) and of the glow plug have the prescribed value:

- Valve recessing: 0.5 ÷ 0.8 mm.
- Injector protrusion: 2.77 ÷ 3.23 mm.
- Glow plug protrusion: 3.78 mm.

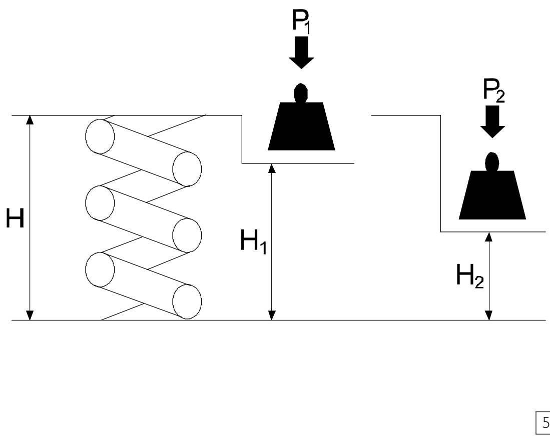
540665 VALVE SPRINGS

Figure 168



Before assembly, check the flexibility of the valve springs with the tool 99305047. Compare the load and elastic deformation data with those of the new springs given in the following figures.

Figure 169

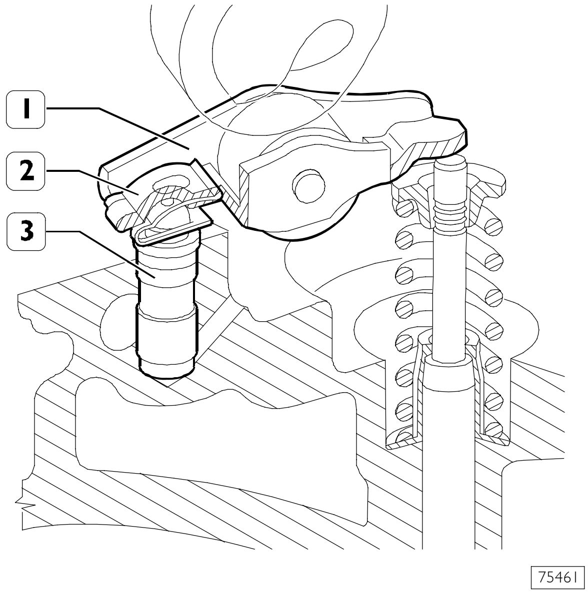


MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Height	Under a load of
mm	kg
H 54	Free
H1 45	P 243 ±12
H2 35	P1 533 ±24

ROCKER ARMS – TAPPETS

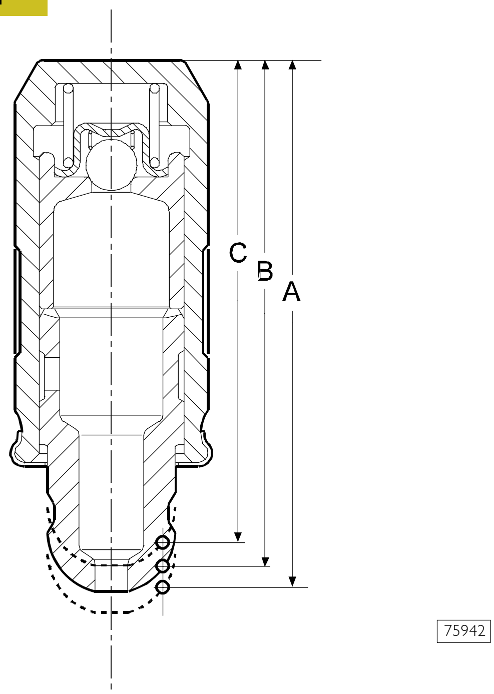
Figure 170



COMPLETE ROCKER ARM ASSEMBLY

The rocker arm assembly is composed of the rocker arm (1), hydraulic tappet (3), made integral with each other by the clip (2).

Figure 171



CROSS-SECTION OF THE HYDRAULIC TAPPET

A = 32.44 ±0.3, end of stroke
B = 31.30, working position
C = 29.75 ±0.25, start of stroke

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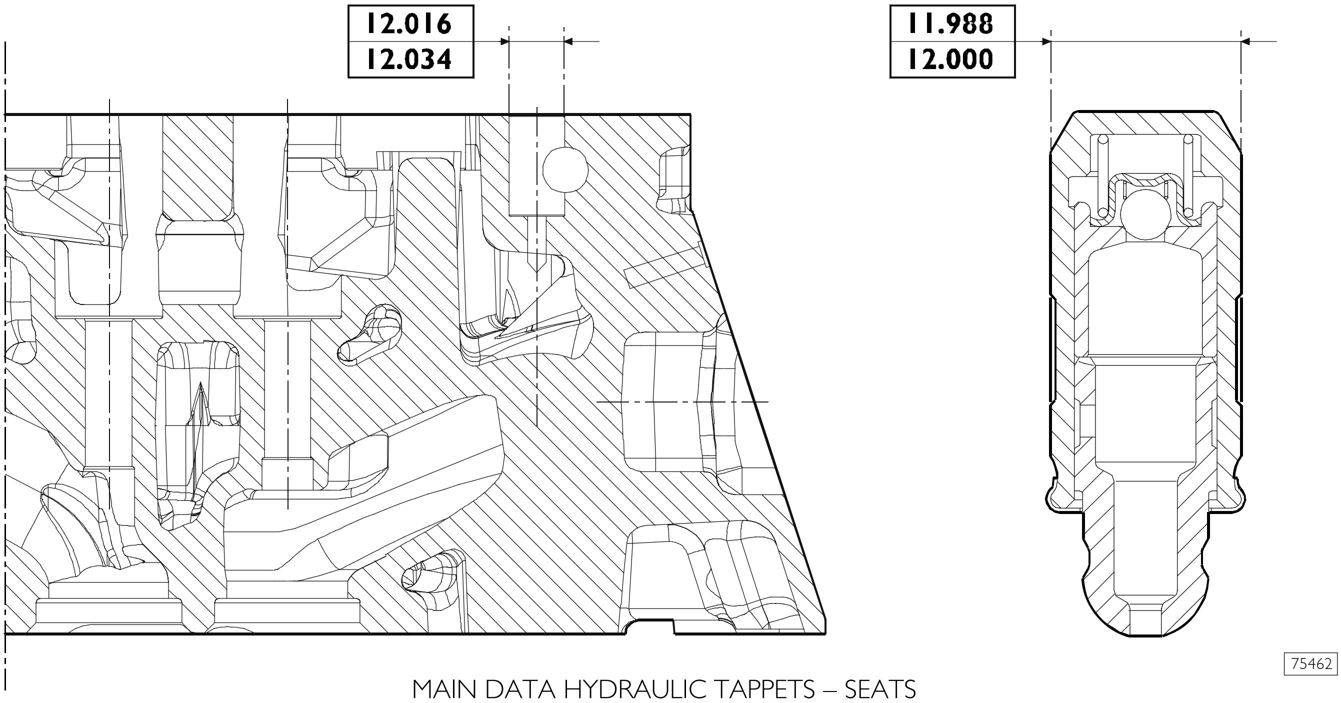
Figure 172



MAIN DATA HYDRAULIC TAPPETS – SEATS

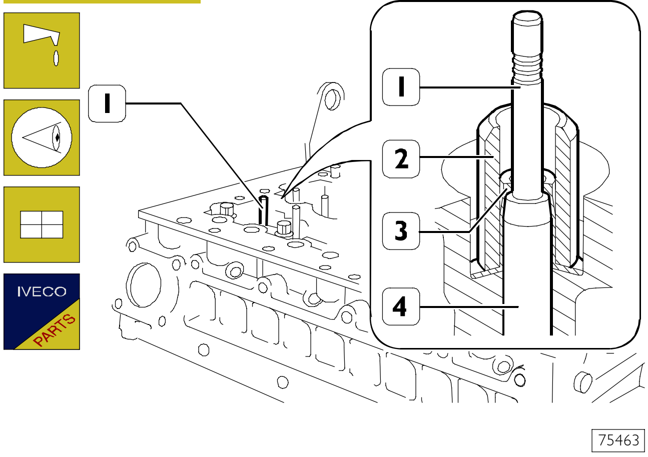
Checks

The sliding surface of the tappets must have no scoring/dents; replace them if they do.

Using a micrometer, measure the diameter of the tappets and, using a bore meter, measure the diameter of the seats in the cylinder head; the difference in the measurements will give the assembly clearance.

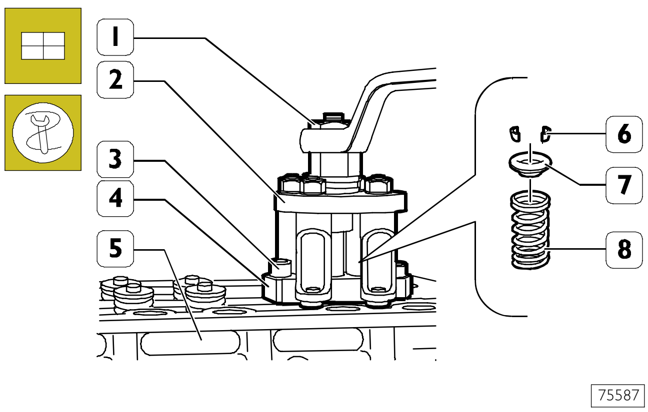
ASSEMBLING CYLINDER HEADS

Figure 173



Lubricate the stem of the valves (1) and insert them into the associated valve guides (4) according to the position marked during removal. Using tool SP.2264 (2), mount the oil seals (3) on the valve guides (4).

Figure 174



Position the springs (8) and plates (7) on the cylinder head (5).

Fit the part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

Fit the part (2) of tool 99360260 onto part (4), screw down the nut (1) so that by compressing the springs (8) it is possible to insert the retaining cotters (6); then unscrew the nut (1) checking that the cotters (6) have settled in correctly.

Repeat these operations on the remaining valves.

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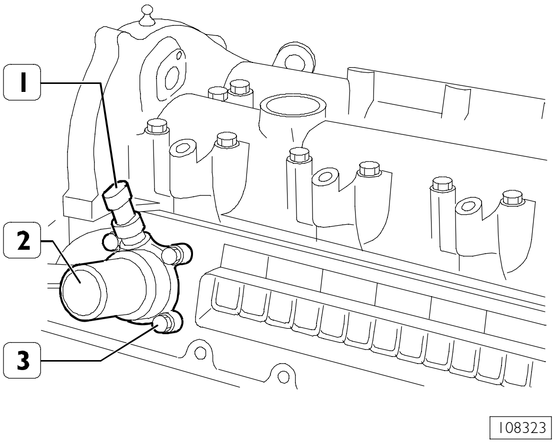
Figure 175



Fit the thermostat casing (2) with a new seal and tighten the fixing screws (3) to the prescribed torque.

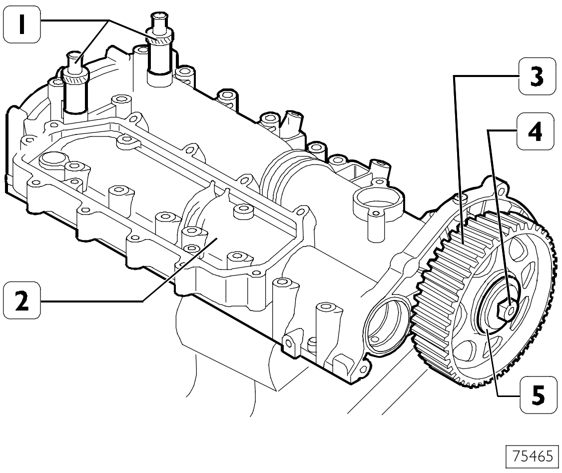
Fit temperature sensor (1) into place and tighten it to the prescribed torque.

Mount the temperature sensors (1 and 2) and, using the wrench SP.2263 (3), tighten them to the prescribed torque.

540650 Overhead

Overhead removal

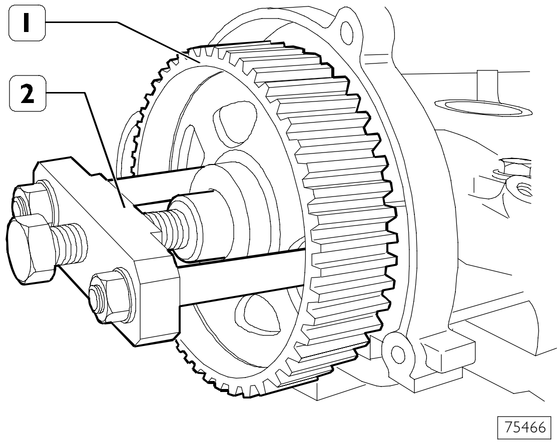
Figure 176



Position the overhead (2) together with the pins 99360614 (1) on the mounting SP. 2271.
Stop rotation the toothed pulley.

Take out the screw (4) with the washer (5) beneath fastening the toothed pulley (3).

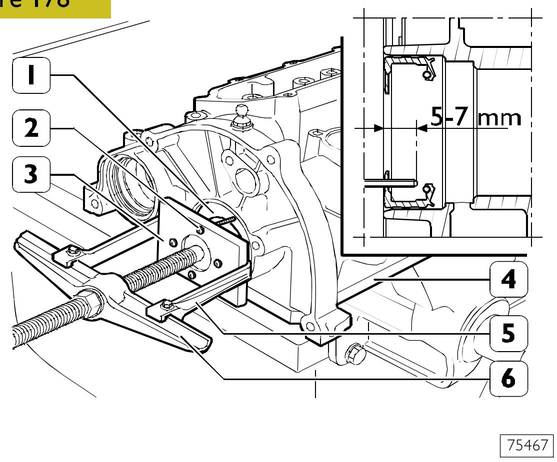
Figure 177



Only engines with intake distributing shaft con tapered shank.

Using the extractor 99340028 (2) extract the toothed pulley (1) driving the camshaft.

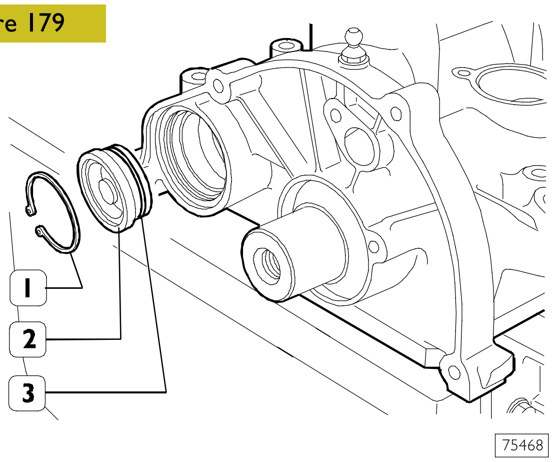
Figure 178



Using four self-tapping screws (2), apply the tool SP. 2325 (3) to the seal (1) and with the extractor (5 and 6) remove the seal (1) from the overhead (4).

NOTE The screws (2) must be screwed down so they get positioned at the dimension shown in the figure.

Figure 179



Remove the circlip (1) and take off the cover (2) together with the seal (3).

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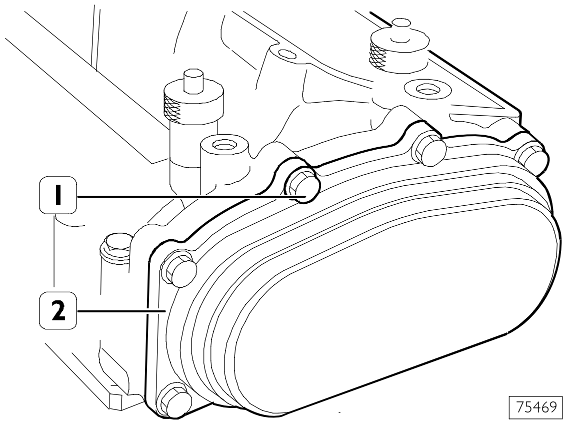
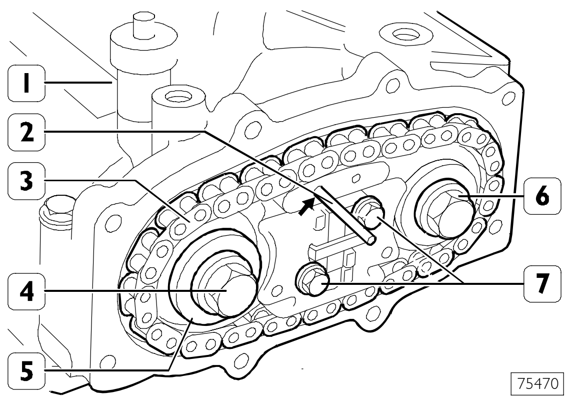
Figure 180



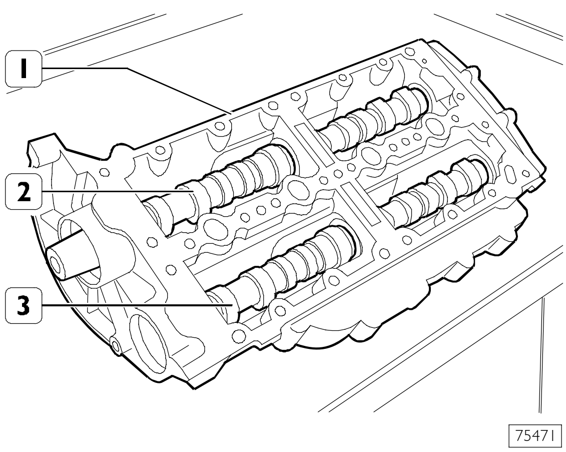
Take out the screws (1) and remove the rear cover (2) together with its gasket.

Figure 181



Insert a suitable pin (2) in the hole (⇒) of the chain drive (3).
Take out the screws (4) and (6) with their washers (5) for fixing gears to the camshafts.
Take out the screws (7) and remove the chain drive (3) from the overhead (1).

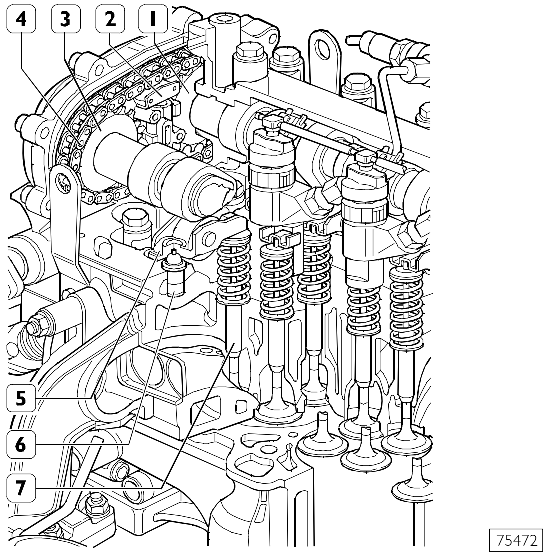
Figure 182



Turn over the overhead (1) and, taking care not to damage the seats, extract the camshafts (2) and (3) from it.

5412 TIMING SYSTEM

Figure 183

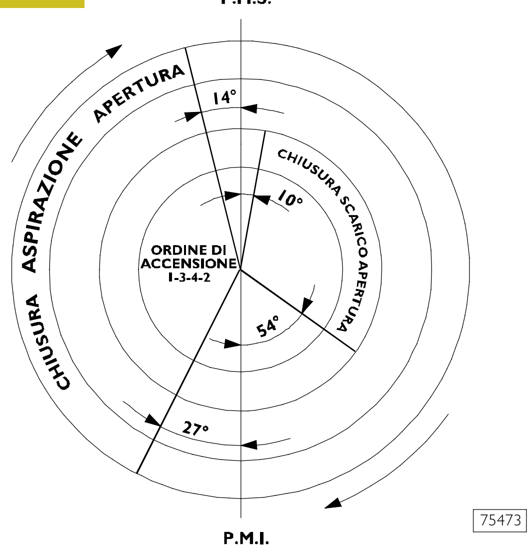


1. Camshaft on intake side – 2. Hydraulic tightener – 3. Camshaft on exhaust side – 4. MORSE chain – 5. Rocker arms – 6. Hydraulic reacting tappet – 7. Valve assembly.

Description

The timing system is the type with a twin camshaft in the head and four valves per cylinder with hydraulic tappets.
Motion is transmitted by the crankshaft, via a toothed belt, to the gear keyed onto the intake valve drive shaft. The drive transmission of the exhaust valve drive shaft takes place via a MORSE-type chain kept under tension by a hydraulic tightener.
The toothed belt, moreover, drives the water pump and the high-pressure pump CP3 and is kept at the right tension by an automatic tightener roller.
The four valves move by the action of the “free” rocker arms (with no supporting shaft).
The rocker arms, one per valve, are always in contact with the corresponding cam and are kept in this position by a hydraulic reacting tappet, thereby eliminating the need for periodical adjustment.

Figure 184



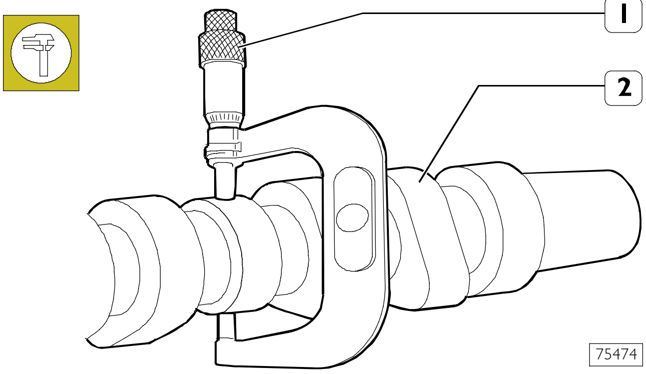
TIMING SYSTEM DIAGRAM

541210 Camshaft

Checks

The surfaces of the shaft supporting pins and of the cams must be finely honed; if there is any sign of meshing or scoring, replace the shaft.

Figure 185



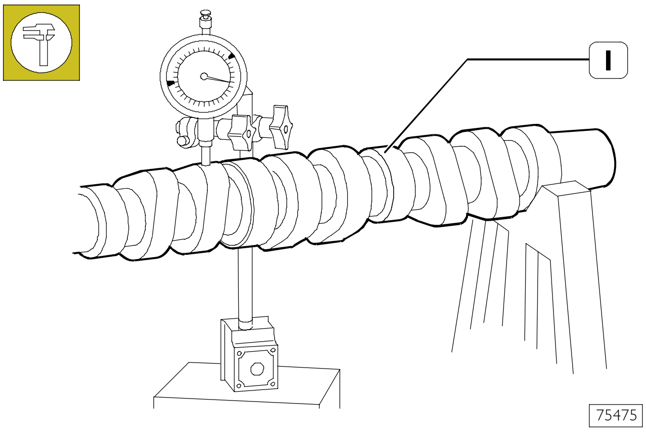
Using a micrometer (1), measure the diameter of the pins (2) of the camshaft and, using a bore meter, measure the diameter of the supporting seats in the overhead.

The difference between these two measurements gives the existing clearance.

The nominal assembly clearance is 0.037 ÷ 0.088 mm.

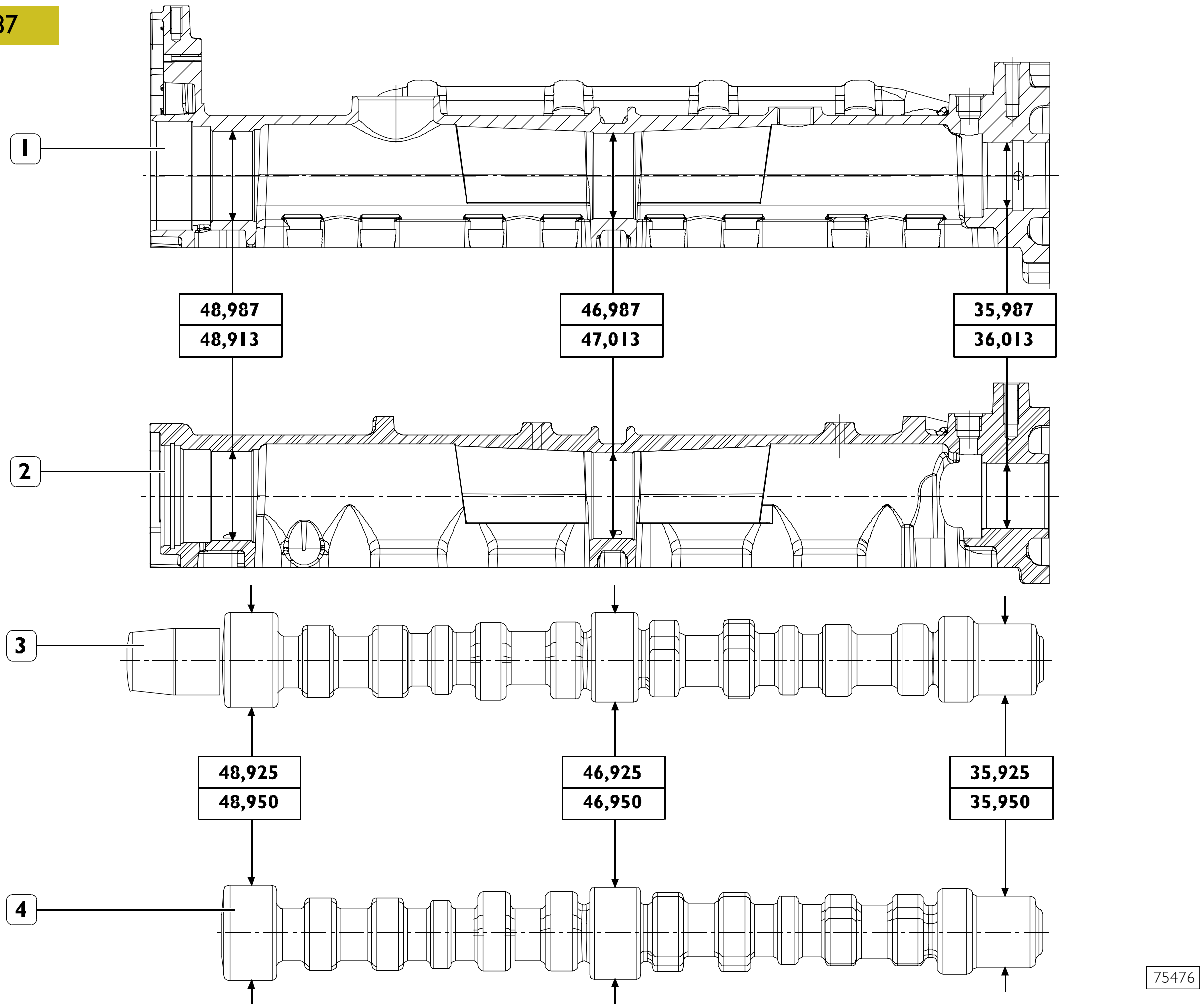
541211 Checking cam lift and pin alignment

Figure 186



Set the shaft (1) on tailstocks and, using a dial gauge on the middle mounting, check that the alignment error is no greater than 0.04 mm; replace the shaft if it is. In addition, check the cam lift: it must be as prescribed; replace the shaft if it is any different.

Figure 187



MAIN SPECIFICATIONS, FULL-SECTION DISTRIBUTING SHAFT SEATS AND PINS

1. Intake valve camshaft seats – 2. Exhaust valve camshaft seats – 3. Intake valve camshaft – 4. Exhaust valve camshaft.

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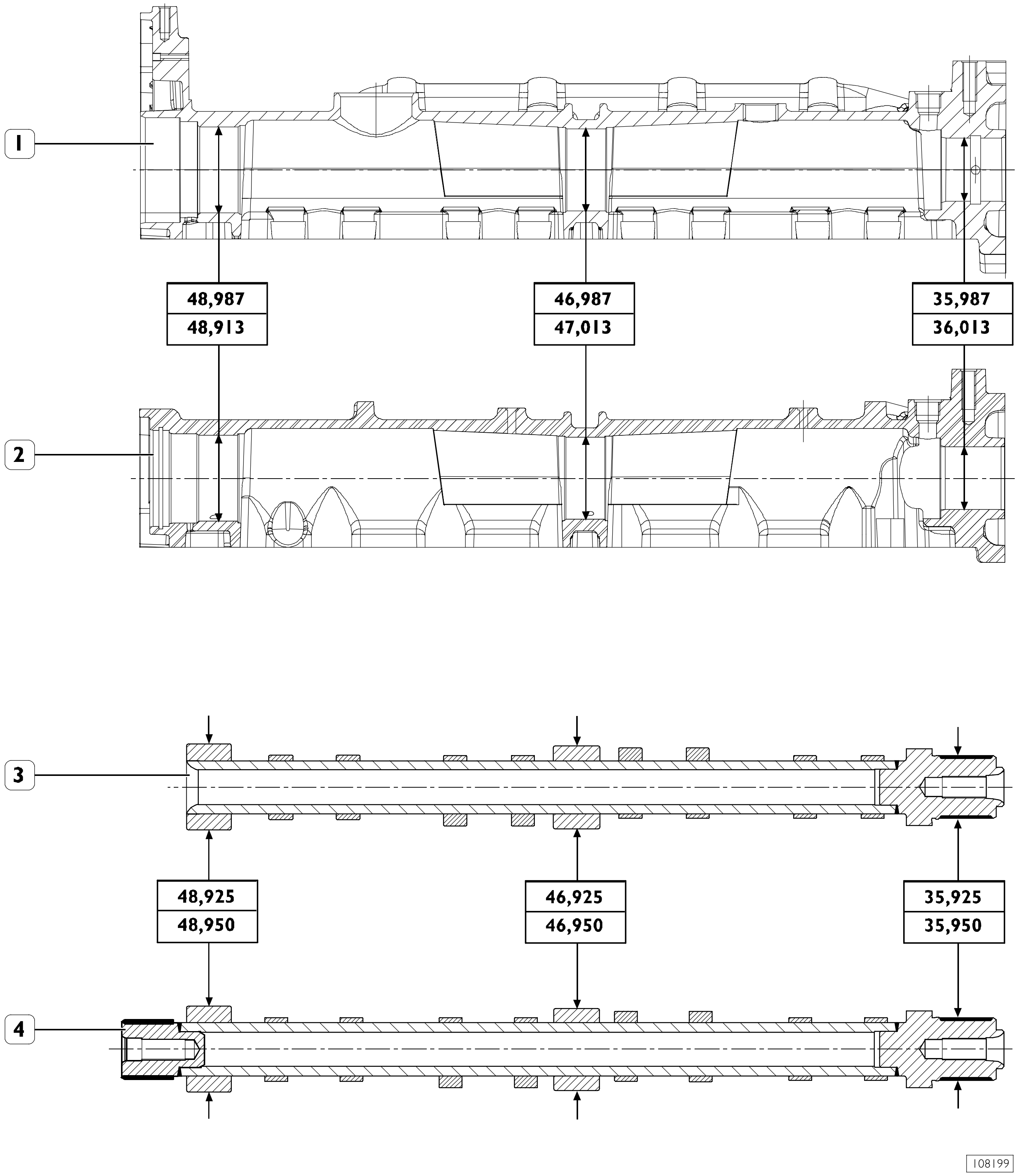
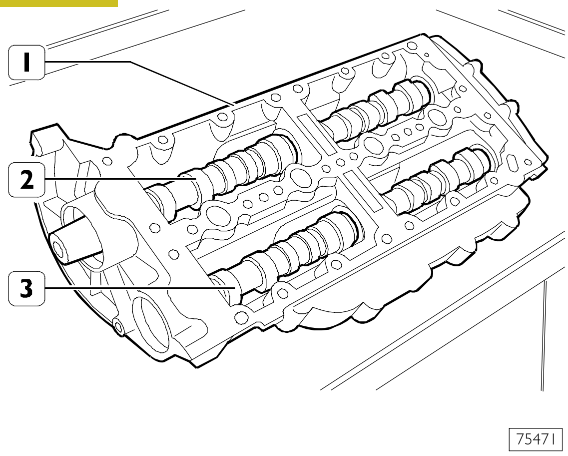
Figure 188



MAIN SPECIFICATIONS, HOLLOW-SECTION DISTRIBUTING SHAFT SEATS AND PINS
1. Intake valve camshaft seats – 2. Exhaust valve camshaft seats – 3. Exhaust valve camshaft – 4. Intake valve camshaft.

Assembling overhead

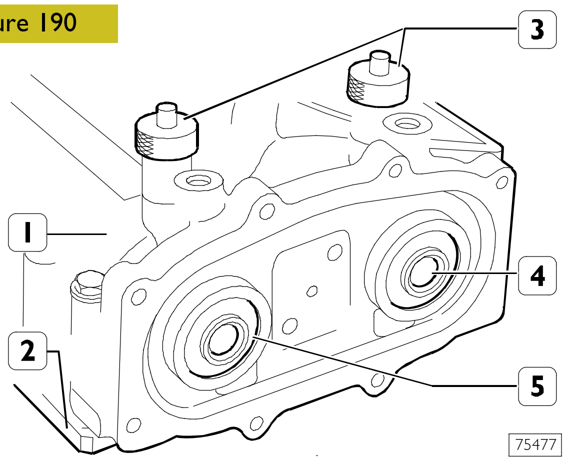
Figure 189



Lubricate the supporting pins of the shafts (2 and 3) and fit them in the overhead (1).

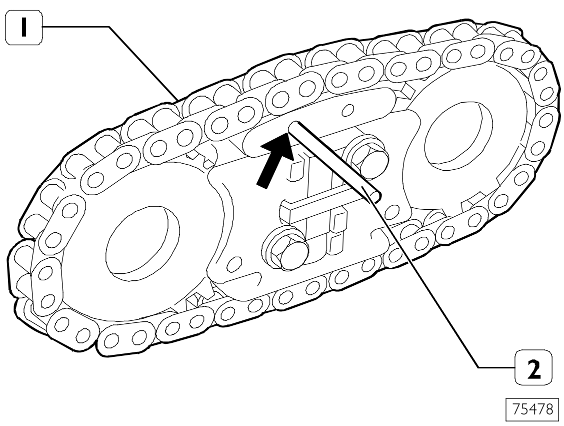
NOTE In this operation, take care not to damage the overhead supporting seats.

Figure 190



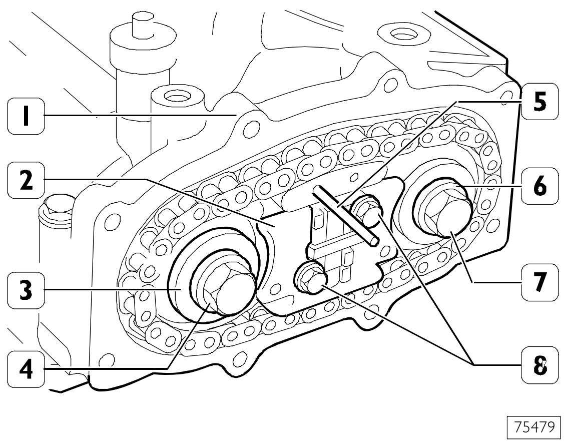
Position the overhead (1) and secure it on the mounting SP.2271 (2).
Position the camshafts (4 and 5) so as to be able to insert the pins 99360614 (3) into their radial holes through the threaded holes of the overhead.

Figure 191



Compress the tightener so as to be able to insert a suitable pin (2) into the hole (→) of the chain drive (1).

Figure 192



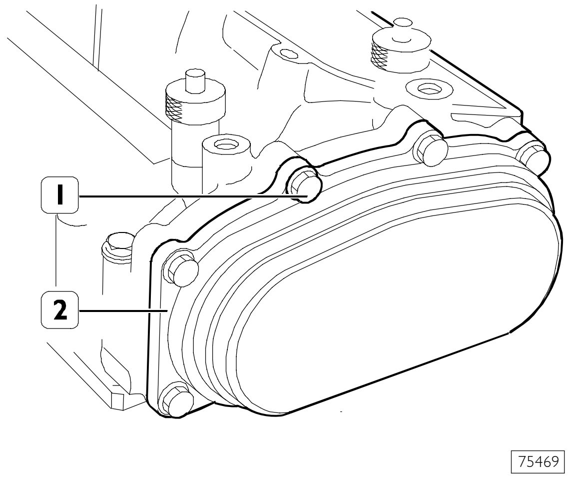
Fit the chain drive (2) on the camshafts and secure it to the overhead (1) tightening the screws (8) to the prescribed torque.

Screw down the screws (4) and (7) with the washers (5) and (6) and tighten them as follows:

- ❑ Tighten the screw (7) to a torque of 50 Nm.
- ❑ Close further with an angle of 60°.
- ❑ Take out the pin (5).
- ❑ Tighten the screw (4) to a torque of 50 Nm.
- ❑ Close further with an angle of 60°.

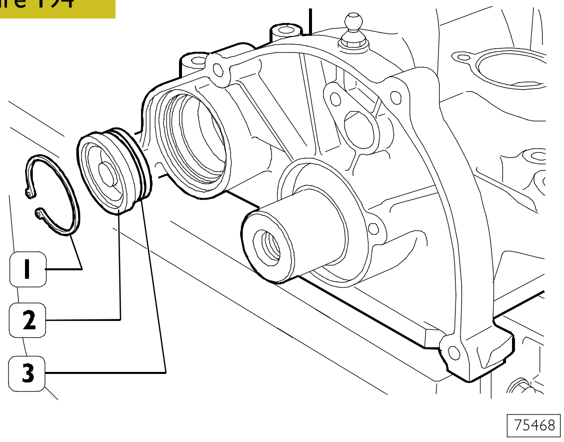
NOTE Use the goniometer 99395216 for the angle closing.

Figure 193



Fit on the rear cover (2) with a new gasket and tighten the fixing screws (1) to the prescribed torque.

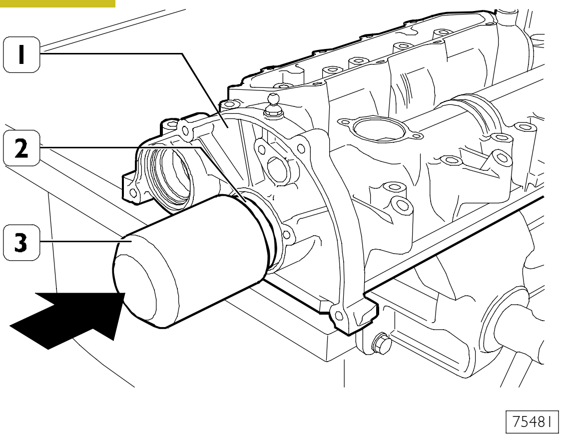
Figure 194



Fit a new seal (3) on the cover (2) and fit this in the overhead.

Fit on the seal (1).

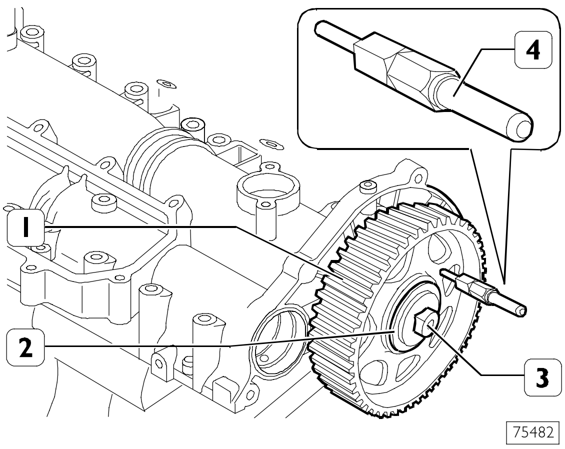
Figure 195



Lubricate the shank of the camshaft.

Using the keying device 99374458 (3), fit the seal (2) in the overhead (1).

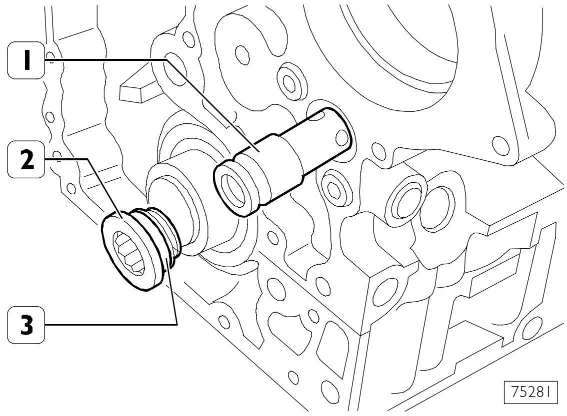
Figure 196



Fit the toothed pulley (1) Only for the intake shaft with full-section front tapered shank, so as to align the pulley hole with the overhead hole and fit tool 99360608 (4) into the holes themselves. Screw down the screw (3) together with the washer (2) without tightening fully.

NOTE The toothed pulley (1, Figure 196) for the intake shaft with full-section tapered shank is not locked on the shaft since it must be able to turn when fitting and tensioning the timing belt. For the same reason, keep the tools 99360608 (4, Figure 196) and 99360614 (3, Figure 190) fitted.

Figure 197

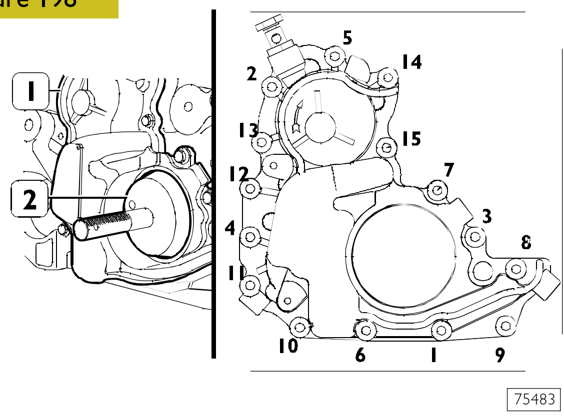


Fit the oil pressure control valve (1) in the crankcase.

Fit on the plug (2) with the seal (3) and tighten it to the prescribed torque.

540442 Assembling front seal ring

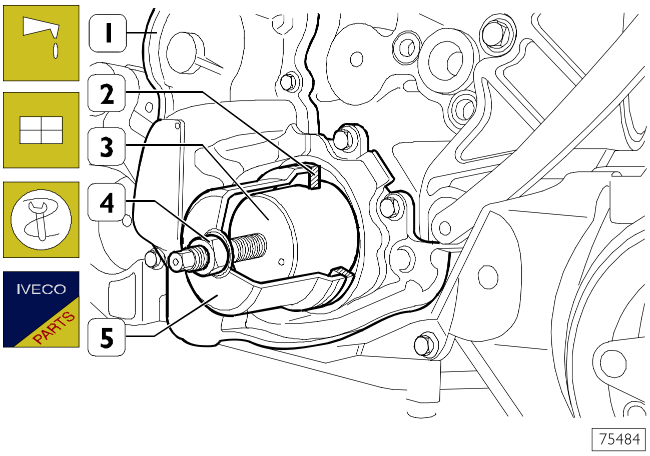
Figure 198



Fit the centring tool 99396037 (2) onto the shank of the crankshaft.
Mount the oil vacuum pump assembly (1) with a new gasket and tighten the screws (1-15) according to the following procedures:

- ❑ Tighten the screws from no. 1 to no. 6 to a torque of 5 ±1 Nm while checking that the tool 99360037 (2) turns freely.
- ❑ Tighten the screws from no. 7 to no. 15 to a torque of 10 ±1 Nm.
- ❑ Tighten the screws from no. 1 to no. 6 to a torque of 10 ±1 Nm.
- ❑ After checking that tool 99360037 (2) turns freely, remove it.

Figure 199



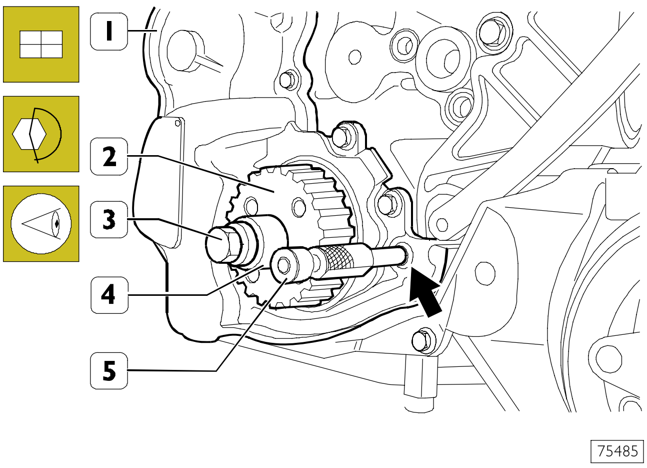
Lubricate the shank of the crankshaft.

Screw down part (3) of tool 99346254 in the crankshaft and place the seal (2) on the part (3).

Key part (5) of tool 99346254 onto part (3), screw down the nut (4) until the seal (2) gets into position in the seat of the oil vacuum pump assembly (1).

Take out the tool 99346254 (3, 4 and 5).

Figure 200

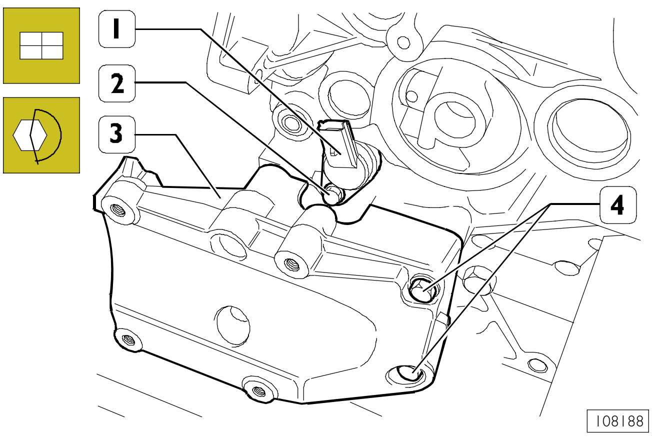


Turn the crankshaft so as to be able to insert tool 99360615 (5) into the hole in the crank of the crankshaft, through the hole in the oil vacuum pump assembly (1), to block crankshaft rotation.

Mount the gear (2), screw down the screw (3) together with the spacer (4) and tighten it to the prescribed torque.

NOTE Do not remove the tool 99360615 (5) as it will be needed for fitting the timing drive belt.

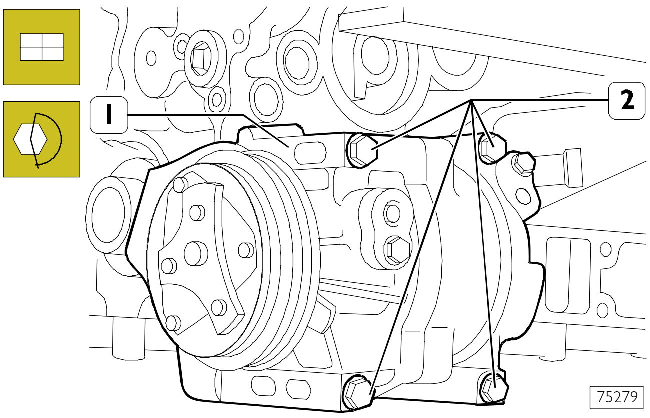
Figure 201



Mount the speed sensor (1) with a fresh gasket and tighten the fixing screw (2) to the prescribed torque (if applicable).

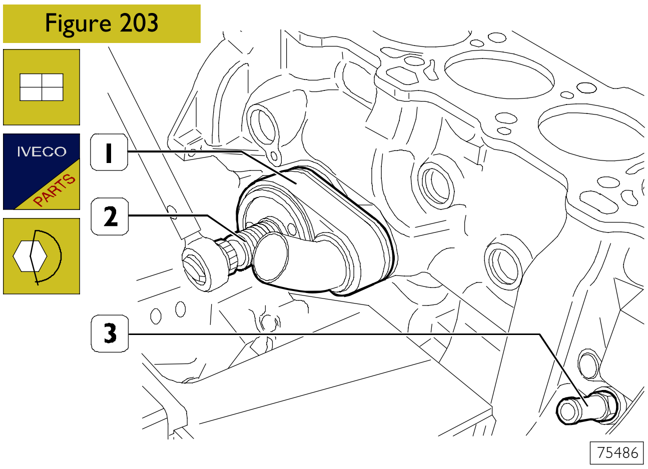
Fit on the compressor mounting (3) and tighten the fixing screws (4) to the prescribed torque.

Figure 202



Mount the air-conditioner compressor (1) (if applicable) and tighten its fixing (2) screws to the prescribed torque.

Figure 203



Mount the oil pressure transmitter (3) with a fresh gasket.

Mount the heat exchanger (1) with a fresh seal and tighten the coupling (2) to the prescribed torque.

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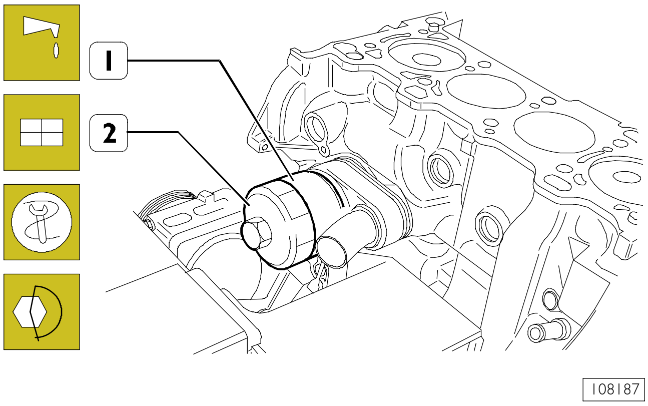
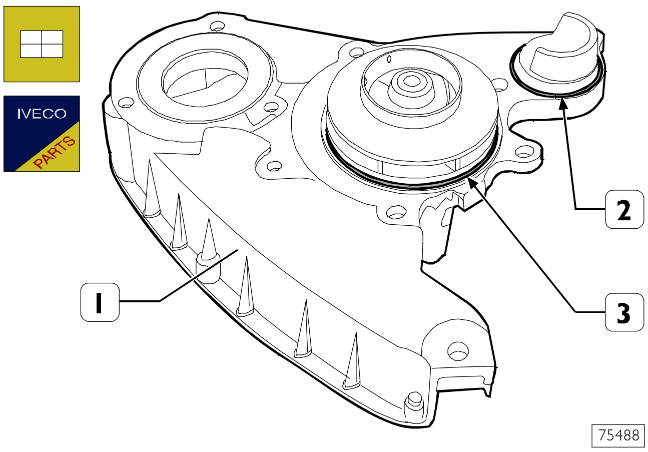
Figure 204



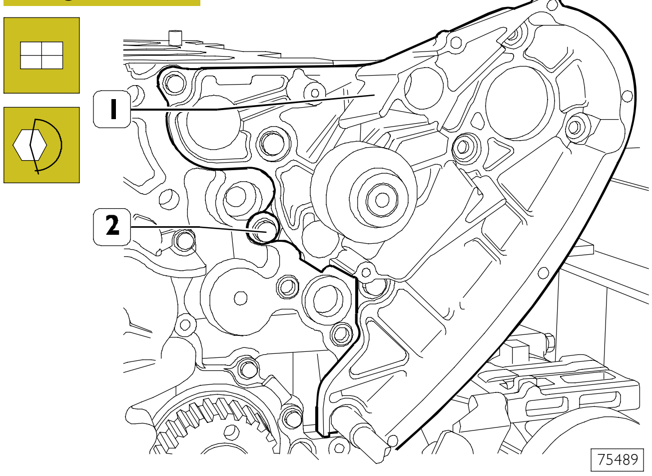
Lubricate the seal of the oil filter (1) with engine oil.
Using tool 99360076 (2), tighten the oil filter to the prescribed torque.

Figure 205



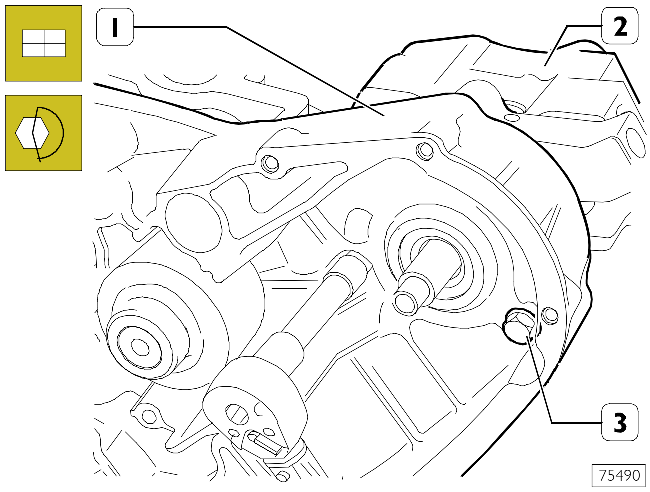
Thoroughly clean the mating surface (à) of the water pump (1) and position fresh seals (2 and 3) on it.

Figure 206



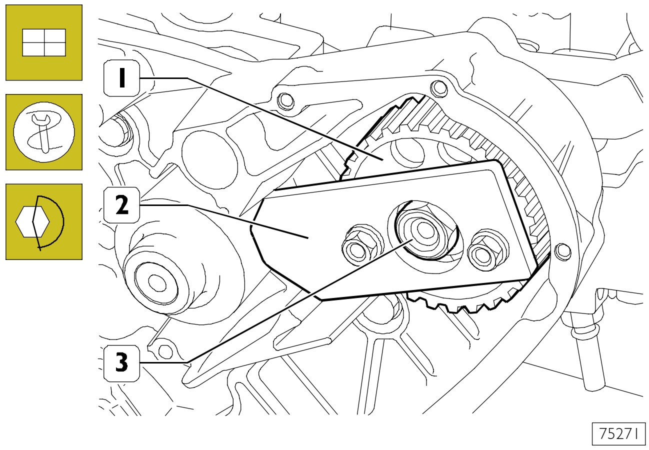
Mount the water pump (1) and tighten the fixing screws (2) to the prescribed torque.

Figure 207



Fit the high-pressure pump (2) onto the flange of the water pump (1) and tighten the fixing screws (3) to the prescribed torque.

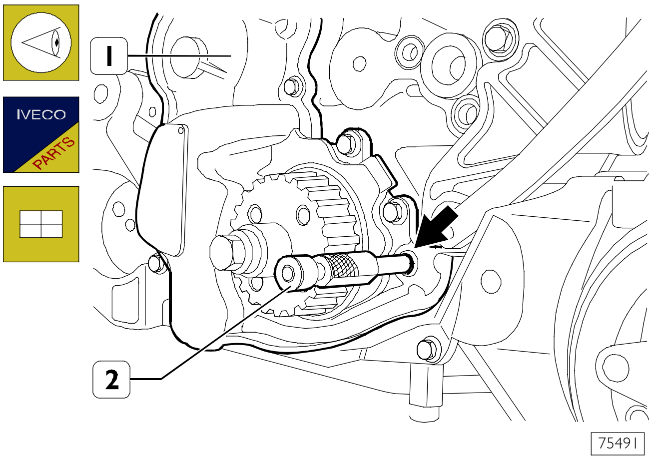
Figure 208



Fit the driving gear (1) onto the shaft of the high-pressure pump and block rotation of this shaft by applying tool SP.2263 (2) as illustrated in the figure. Tighten the nut (3) to the prescribed torque and remove the tool (2).

Refitting cylinder head

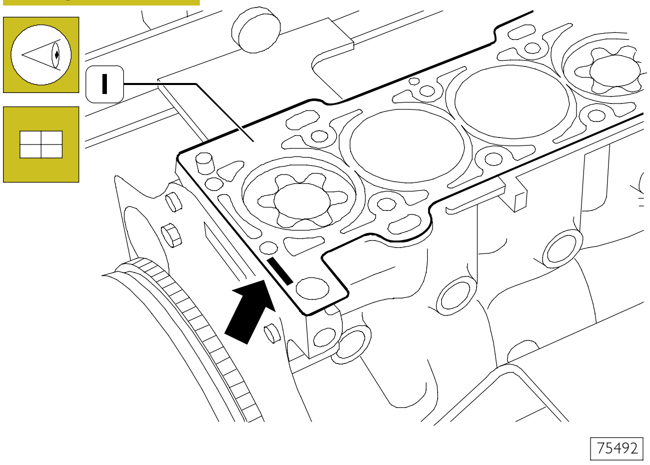
Figure 209



Check that tool 99360619 (2) inserted in the hole (→) of the oil vacuum pump assembly (1) blocks crankshaft rotation.

This condition is necessary for setting up the timing system and to prevent the valves interfering with the pistons.

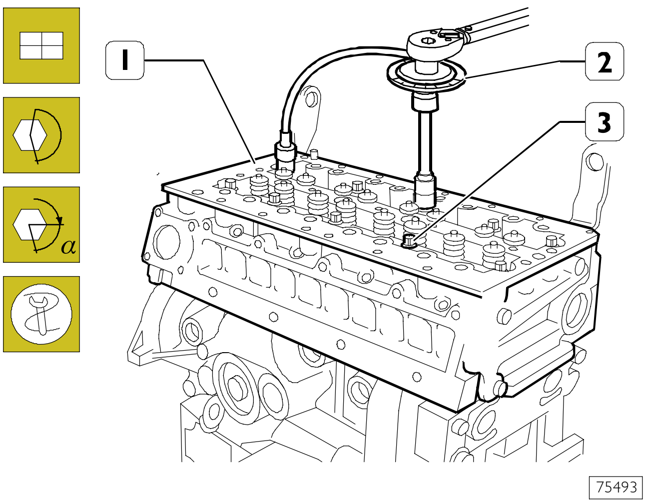
Figure 210



Check that the mating surfaces of the cylinder head and crankcase are clean.
Keep the cylinder head gasket clean.
Position the cylinder head gasket (1) of the thickness determined under the heading "checking piston protrusion" with the lettering "TOP" facing the cylinder head.

NOTE It is essential to keep the gasket sealed in its package until just before assembly.

Figure 211



Mount the cylinder head (1).

Screw down the fixing screws (3) and tighten them, in three successive stages, following the order and methods shown in the following figure.

NOTE The angle closure is done with tool 99395216 (2).

Figure 212

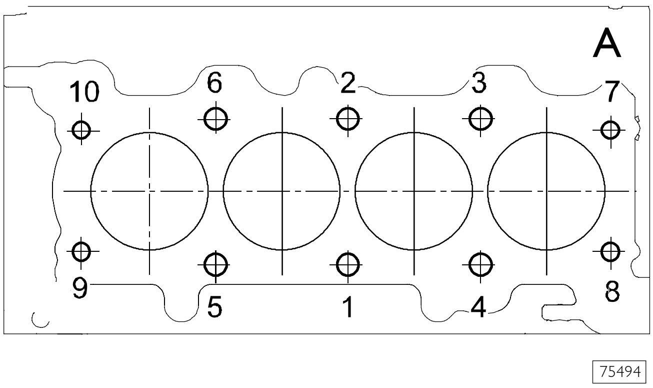


Diagram of the tightening sequence for the cylinder head fixing screws:

- ❑ 1st phase: pre-tightening with torque wrench
  - screws 1-2-3-4-5-6 to a torque of 100 ±5 Nm;
  - screws 7-8-9-10 to a torque of 50 ±2.5 Nm.
- ❑ 2nd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.
- ❑ 3rd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.

A = flywheel side.

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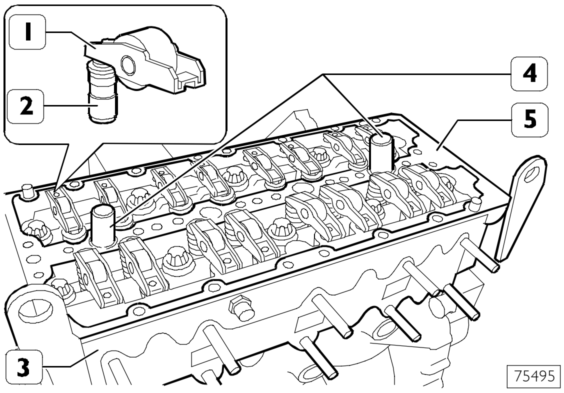
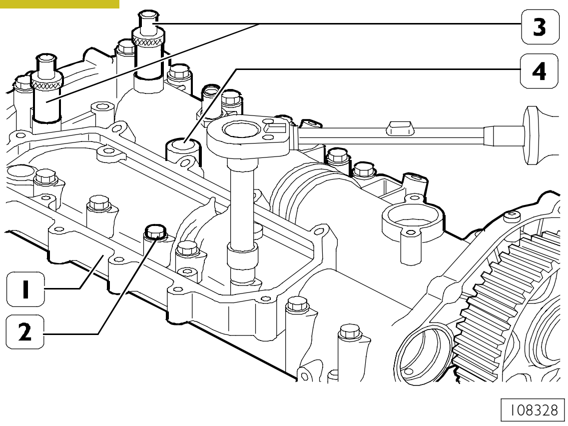
Figure 213



Thoroughly clean the hydraulic tappets (2), lubricate them and fit them in the cylinder head (3), positioning the rocker arms (1) on the valves correctly.
Fit on the gasket (5).
Insert the two tools SP. 2264 (4) into the electro-injector seats for subsequent centring of the overhead on the cylinder head.

Figure 214

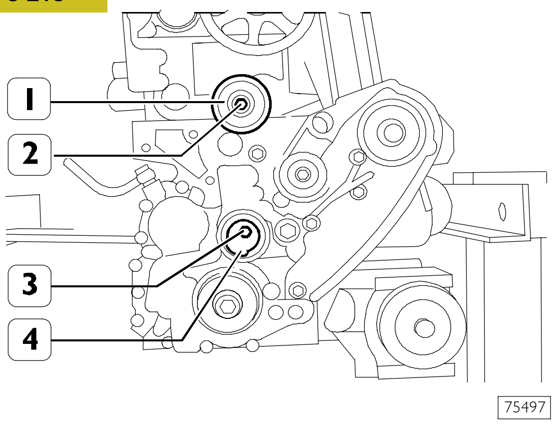


Mount the overhead (1) together with the tools 99360614 (3) for the timing and tighten the fixing screws (2) to the prescribed torque.

Take out the tools SP. 2264 (4).

Camshaft drive

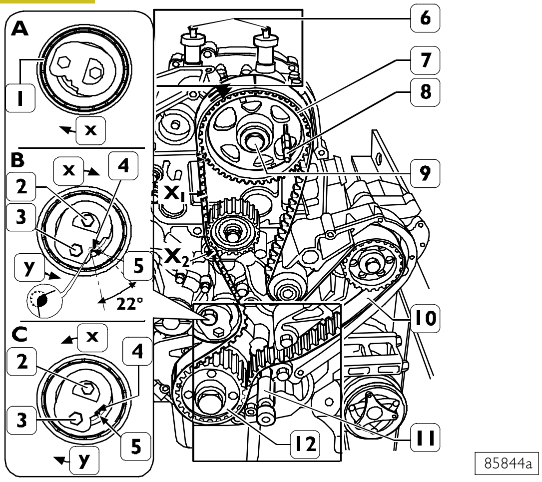
Figure 215



Mount the fixed tightener (1) and tighten the fixing screw (2) to the prescribed torque.

Mount the automatic tightener (4) without fully tightening the fixing screw (3), max. closing torque 5 Nm.

Figure 216



X = Direction of movement of the tightener –
Y = Direction of rotation of the key.

Turn the automatic tightener (1) clockwise, positioning it as shown in frame A.
Turn the timing belt (10) as shown in the figure observing the precautions below.

NOTE If the engine has run for a period equivalent to ≥ 25,000 km, the toothed belt must be replaced with a fresh one, no matter what its state of wear.

Do not bend the timing belt. Arrows indicating the direction of assembly of the timing belt on the engine are shown on the back of the belt. The arrows must correspond to the direction of rotation of the belt and the notches must coincide with those on the pulley (7) and the gear (12).

NOTE Only for the intake valve distributing shaft with full-section tapered shank.
If required to fit the timing belt (10) on the pulley (7), remove tool 99360608 (8) and turn the pulley (7) clockwise by no more than half a pulley tooth.

On completing assembly, adjust the toothed pulley (7) to put the section X of the belt under tension and tighten the screw (9) to a torque of 90 Nm
Keeping the screw (2) stationary and using a suitable wrench on the hexagon of the plate (3) of the tightener, turn it anticlockwise to cover the reference hole (5) located on the fixed portion of the tightener (see frame B).
In the above conditions, tighten the fixing screw (2) to a torque of 36 ± 4 Nm.
Tighten screw (9) to the torque values below:

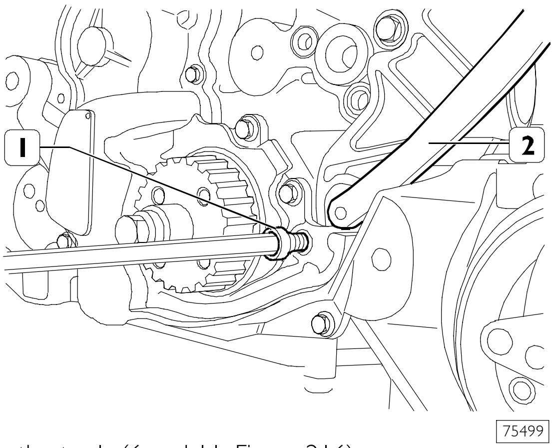
- screw (9) securing pulley (7) to the distributing shaft with full-section tapered shank: 90 Nm;
- screw (9) securing pulley (7) to the distributing shaft with hollow-section cylindrical shank: 130 Nm.

Remove the tools 99360614 (6) and 99360615 (11) for the timing.
Turn the engine in its direction of rotation by 8 turns to be able to put the tools (6) and (11) back in to do the timing.
In these conditions, the notches of the timing belt (10) must coincide with those of the pulley (7) and the gear (12).

NOTE Do not turn the engine in the opposite direction; if, on turning the engine, you pass the point for inserting the tools (6) and (11), turn the engine clockwise by another two turns.

See frame C: Figure 216, holding the tightener plate (3) stationary with the wrench inserted in its hexagon, loosen the fixing screw (2). Keeping the fixing screw (2) stationary, turn the plate (3) clockwise until its reference mark (4) coincides with the reference hole (5) of the fixed portion of the tightener. In the above conditions, tighten the screw (2) to a torque of 36 ±4 Nm.
Rotate the engine by two turns in its direction of rotation until the point of tool 99360615 (1) engagement into the drive shaft is reached. When this point is exceeded, the drive shaft shall be rotated by two more turns. Verify, under the above conditions, that reference hole (5) is found within index (4) as represented in box **C**; otherwise, the aforesaid operations shall be repeated.
After assembly, the belt (10) tension measured using tool 99395849 must be as follows in the following points: X_1 = 212 ± 12 Hz -X_1 = 178 ± 10 Hz.

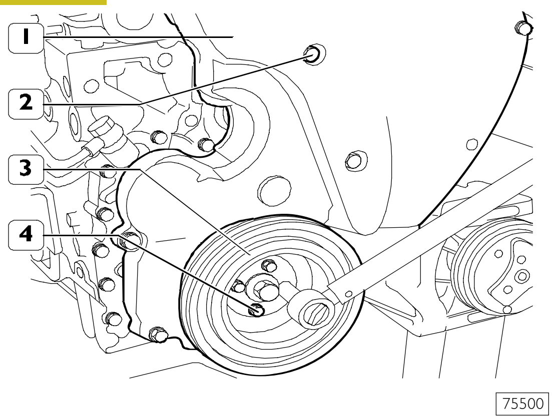
Figure 217



Remove the tools (6 and 11, Figure 216).

Screw the plug (1) into the oil-vacuum pump mounting (2) and the plugs on the holes of the overhead.

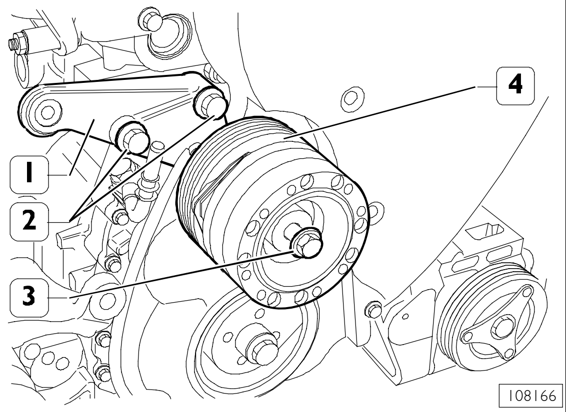
Figure 218



Mount the timing cover (1) and tighten the screws (2) to the prescribed torque.

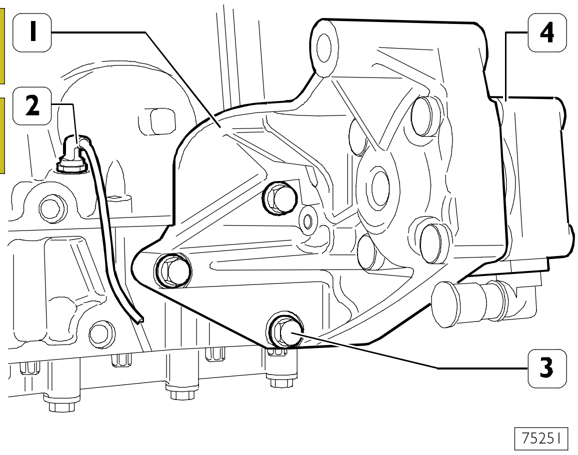
Mount the damper pulley (3) and tighten the screws (4) to the prescribed torque.

Figure 219



Fit on the mounting (1) together with the electromagnetic coupling (4) and tighten the fixing screws (2 and 3) to the prescribed torque.

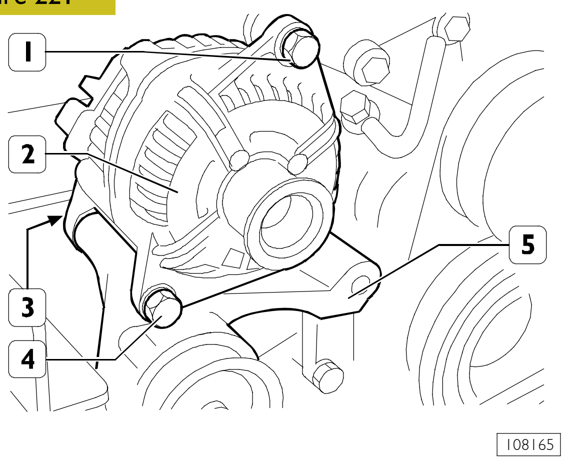
Figure 220



Mount the oil level sensor (1).

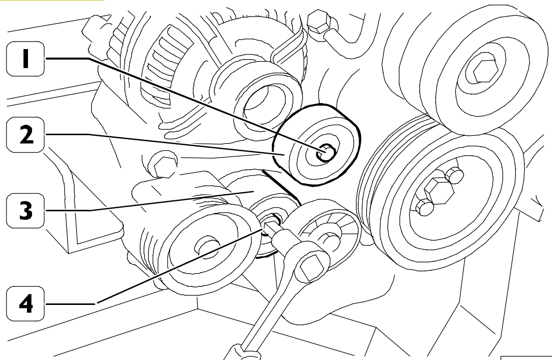
Fit on the power steering (2) pump mounting (4) and tighten the fixing screws (3) to the prescribed torque.

Figure 221



Position the alternator (2) on the mounting (5) and secure it with the bottom screws (3 and 4) and the bolt.

Figure 222

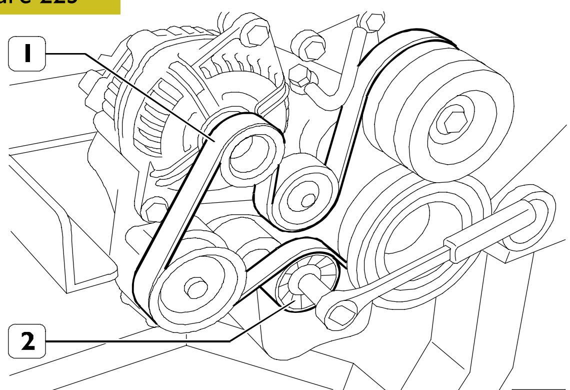


75501

Mount the fixed tightener (2) and tighten the fixing screw (1).

Mount the automatic tightener (3) and tighten the screw (4) to the prescribed torque.

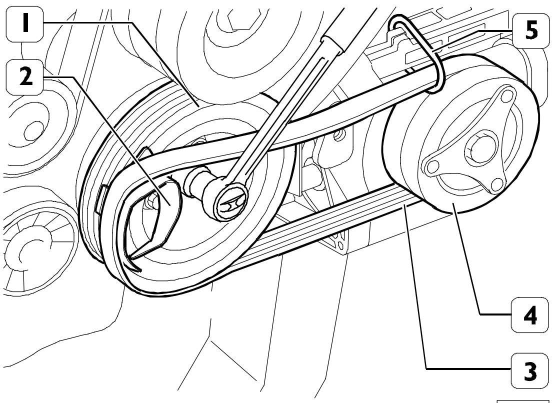
Figure 223



75248

Using a wrench on the automatic tightener (2), mount the drive belt (1), taking care to position its ribs correctly in the respective races of the pulleys.

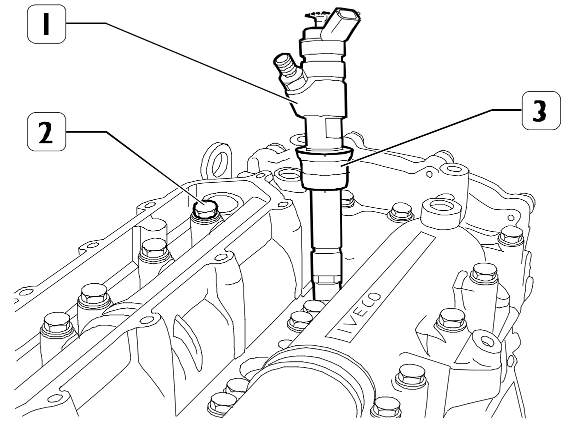
Figure 224



90155

Fit the flexible belt (3) equipped with tool 99360191 (2) on the pulley (4) and apply the tool on the pulley (1).
Fit the drive ring (5) on the flexible belt (3) and fasten the ring on the compressor support.
Turn the drive shaft clockwise until the belt fits perfectly on the pulley (1).

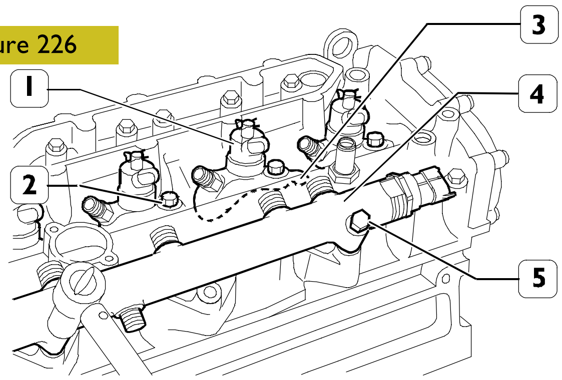
Figure 225



75503

Fit a new seal (3) on the electro-injector (1) and mount this in the overhead (2).

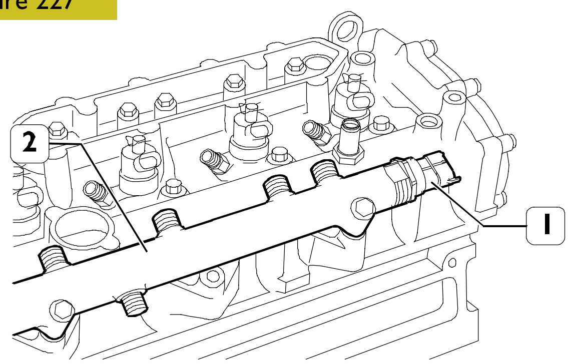
Figure 226



108326

Mount the brackets (3) fastening the electro-injectors (1) and screw down the screws (2) without locking them.
Mount the hydraulic accumulator (4) and tighten the fixing screws to the prescribed torque.

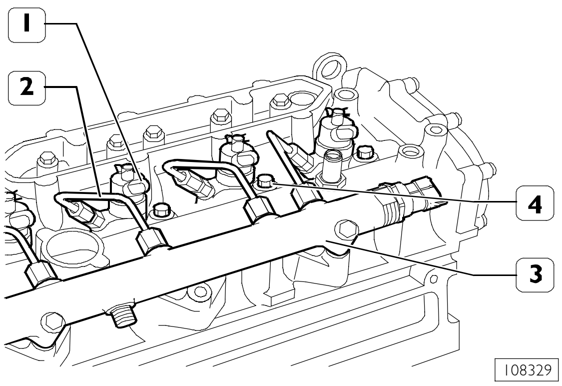
Figure 227



108327

Screw down pressure sensor (2) onto hydraulic accumulator (1) and tighten it to 70 + 5 Nm.

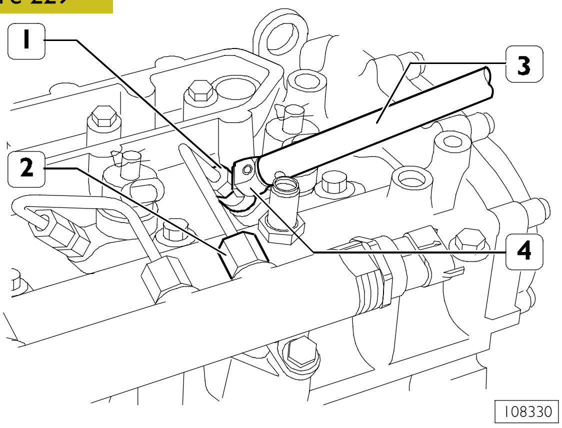
Figure 228



Connect the fuel pipes (2) to the electro-injectors (1) and to the hydraulic accumulator (3).
Tighten the screws (4) fixing the electro-injector brackets to the prescribed torque.

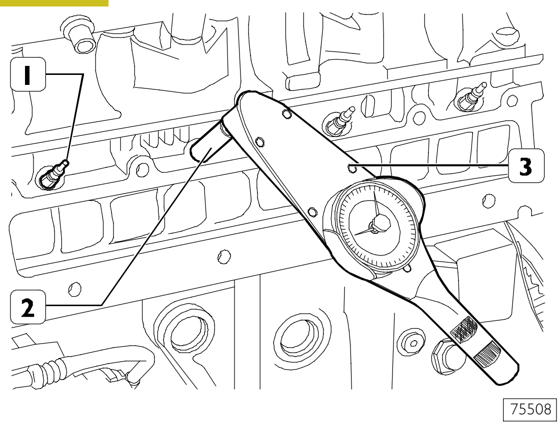
NOTE Whenever they get removed, the fuel pipes must be replaced with new ones.

Figure 229



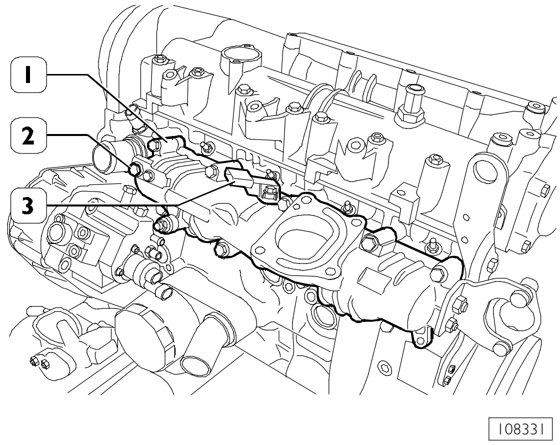
Using the wrench (4) of the 99317915 series and the torque wrench 99389829 (3), tighten the fuel pipe fittings (1) and (2) to the prescribed torque.

Figure 230



Mount the glow plugs (1) and, using the box-type wrench SP. 2275 (2) and torque wrench 99389819 (3), tighten them to a torque of 8 ÷ 10 Nm.

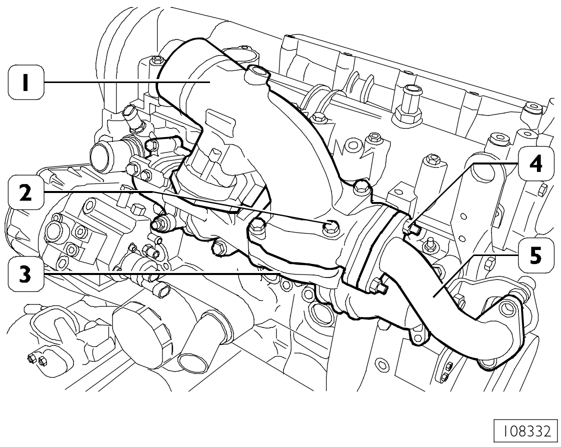
Figure 231



Mount the intake manifold (1) with a new gasket and, using a torque wrench, tighten the fixing screws (2) to the prescribed torque.

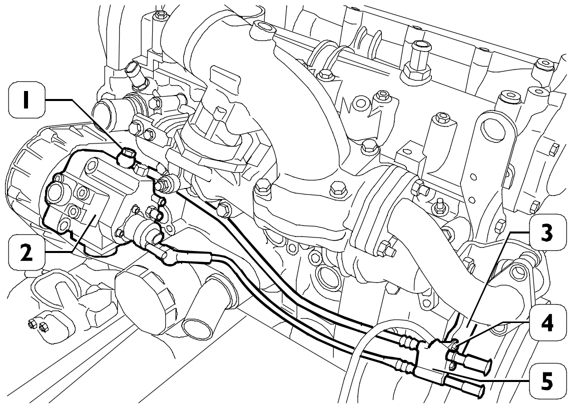
Fit air pressure/temperature sensor (3) into place, then tighten the fastening screw to the prescribed torque.

Figure 232



Fit throttle valve assembly (1), together with a new gasket, onto inlet manifold (3).
Screw down screws (2), then tighten them to the prescribed torque.
Fit pipe (5), together with a new gasket, onto throttle valve assembly (1).
Screw down fastening nuts (4) by a few turns, so that pipe (5) can still be moved.

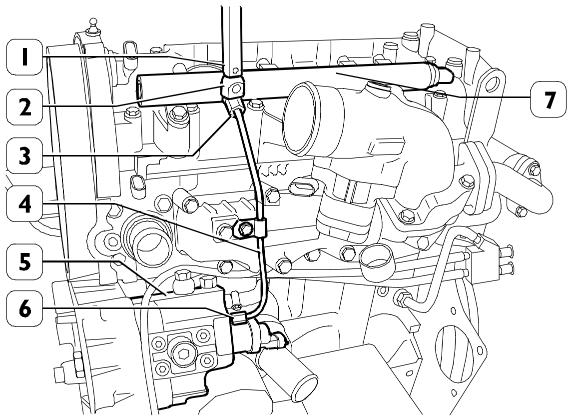
Figure 233



108176

Connect, with coupling (1) equipped with new gaskets, pipe (5) to high-pressure pump (2).
Fit low-pressure pipe (5) onto bracket (3), then tighten screw (4) to the prescribed torque.

Figure 234

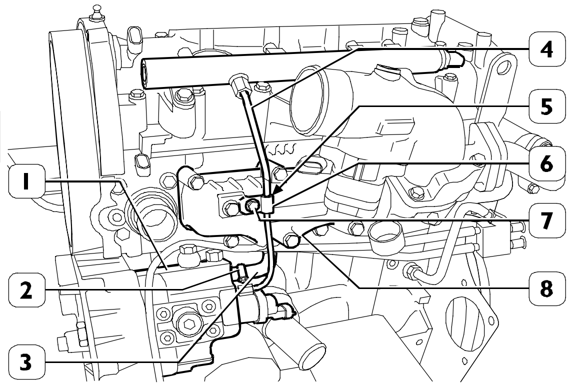


108333

Connect the fuel pipe (4) to the hydraulic accumulator (7) and to the high-pressure pump (5).
With wrench (2) of series 99317915 and dynamometric wrench 99389829 (1), tighten pipe fittings (3 and 6) at prescribed torque.

NOTE Whenever they get removed, the fuel pipes (4) must be replaced with new ones.

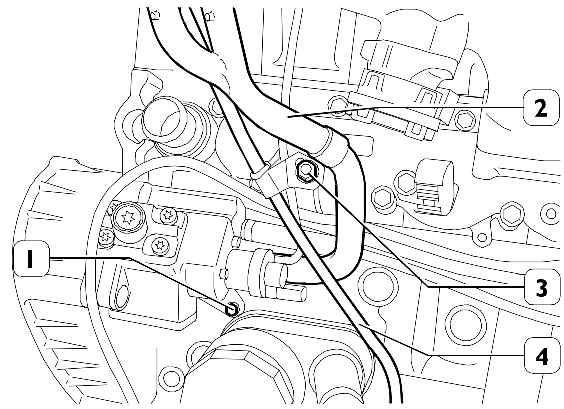
Figure 235



108334

Connect fuel pipe (3) to high-pressure pump (1) pipe union.
Secure the pipe by means of clamp (2).
Fit a new rubber top (5) onto pipe (4), then secure the latter to inlet manifold (8) by means of bracket (6) and tighten screw (7) to the prescribed torque.

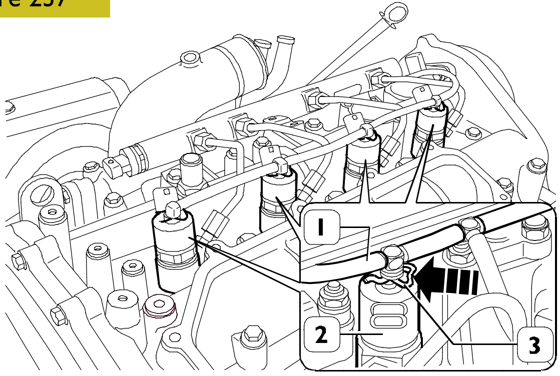
Figure 236



108173

Fit coolant pipe (2) into the engine base.
Screw down screw (1), then tighten it to the prescribed torque.
Fit oil dipstick pipe (4), together with a new seal ring, into the engine base.
Screw down pipe (2 and 4) fastening nut (3) to the inlet manifold, then tighten it to the prescribed torque.

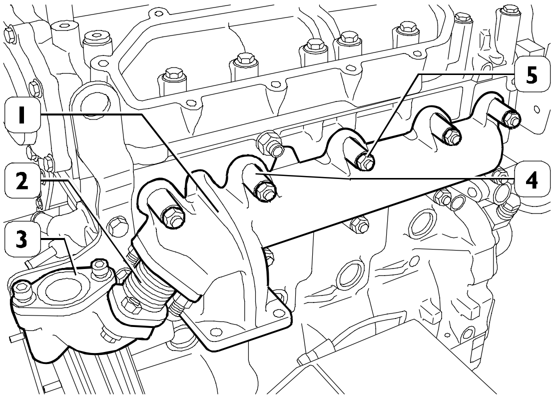
Figure 237



108189

Press the clips (3) in the direction shown by the arrow and connect the fuel recovery pipe fittings (1) to the electro-injectors (2).

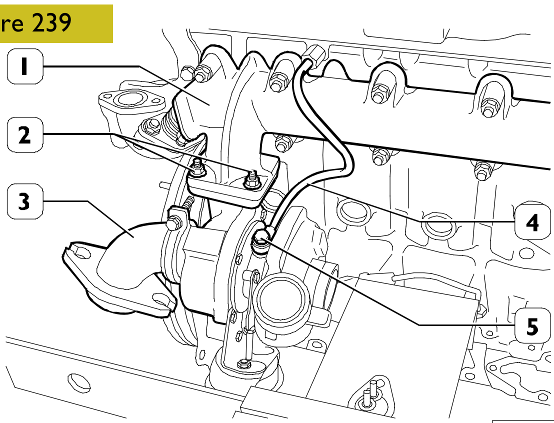
Figure 238



108184

Connect exhaust manifold (1), together with a new gasket and complete with elbow (3) and pipe (2), to the cylinder head again. Fit spacers (4) into place, screw down nuts (5), then tighten them to the prescribed torque.

Figure 239



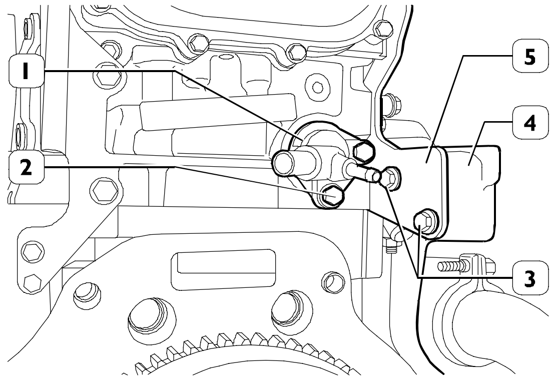
108183

Connect turboblower (5), together with a new gasket, to exhaust manifold (1) again. Screw down nuts (2) then tighten them to the prescribed torque.

NOTE Before fitting the turbocharger on the engine, it is necessary to fill the central body with engine lubricating oil.

Connect oil pipe (4) to turboblower (5) and to the coupling on the cylinder head, and tighten the fasteners to the prescribed torque.

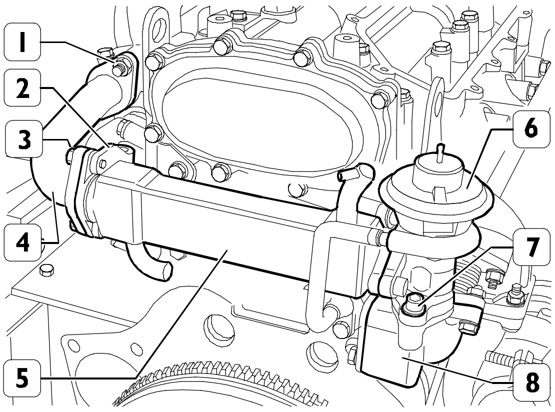
Figure 240



108182

Fit pipe union (1), together with a new seal ring, into place, then screw down screw (2) then tighten it to the prescribed torque.
Screw down screws (3) securing elbow (4) to bracket (5), then tighten them to the prescribed torque.

Figure 241

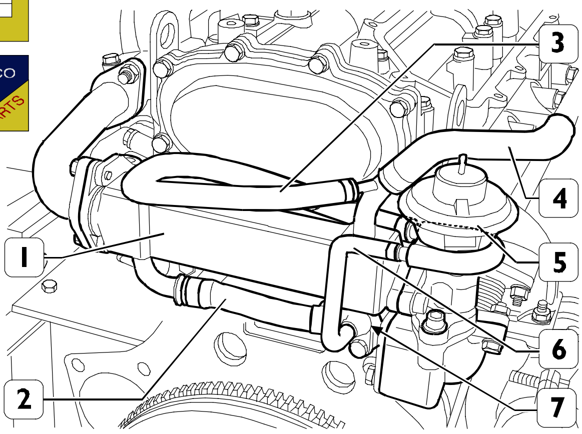


108335

Fit heat exchanger (5), together with EGR valve (6), back into place, by proceeding as follows:

- position (by placing a new gasket in between) heat exchanger (5) onto pipe (4), then screw down screws (3) securing to bracket (2) by a few turns;
- position a new gasket onto elbow (8), then screw down screws (7) securing EGR valve (6) to elbow (8);
- tighten nuts (4) and screws (3 and 7) to the prescribed torque.

Figure 242

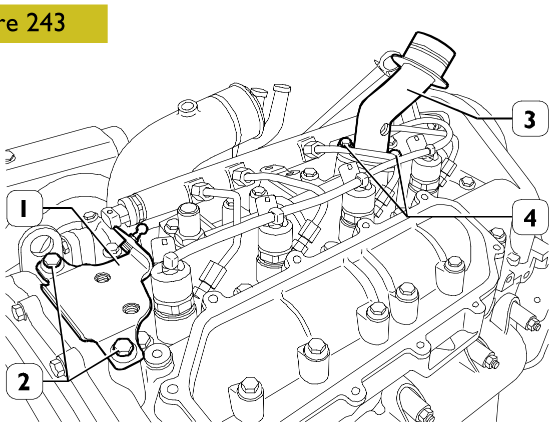


108336

Connect the coolant pipes (by securing them with the new clamps):

- (3), to heat exchanger (1) pipe union and EGR valve (5);
- (2), to heat exchanger (1) and pipe union (7);
- (6), to pipe union (7) and EGR valve (5);
- (4), to heat exchanger (1) pipe union.

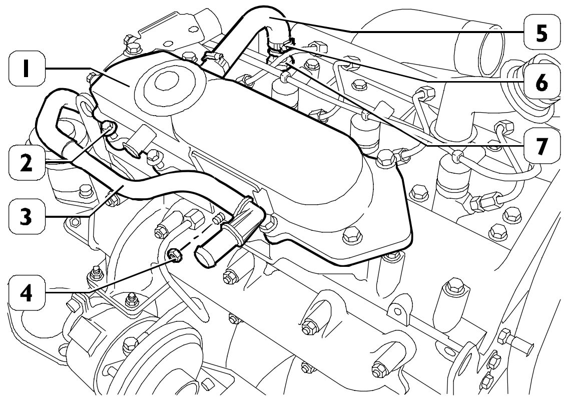
Figure 243



108168

Fit oil filling pipe union (3), together with a new seal ring, screw down screws (4), then tighten them to the prescribed torque.
Fit bracket (1) into place, screw down screws (2), then tighten them to the prescribed torque.

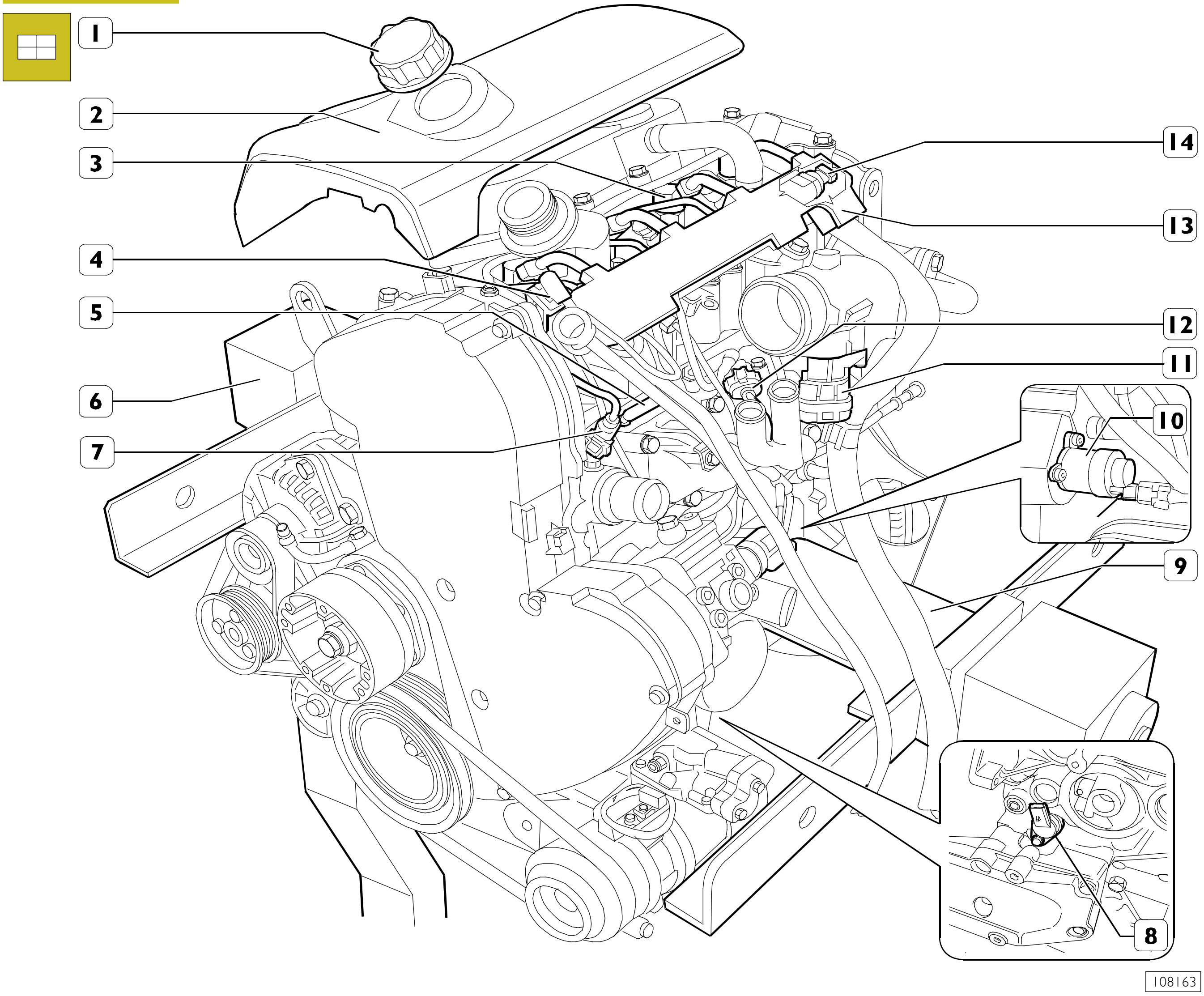
Figure 244



108167

Fit coalescence filter (1) into place, screw down screws (2), then tighten them to the prescribed torque.
Connect pipe (3) to coalescence filter (1), screw down nut (4), then tighten it to the prescribed torque.
Connect pipe (5) to pipe union (7), then secure it with a new clamp (6).

Figure 245

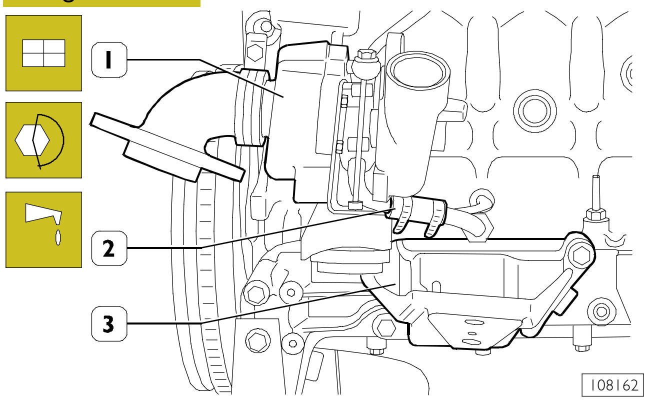


Fit the following items (if any) into place:

- ❑ cooling fan to electromagnetic joint;
- ❑ engine cable with ducts (13) available by disconnecting it from:
- ❑ electric injectors (3);
- ❑ preheating plugs (5);
- ❑ hydraulic accumulator pressure sensor (14);
- ❑ throttle valve actuator (11);
- ❑ inlet manifold air pressure/temperature sensor (12);
- ❑ high-pressure pump pressure regulator (10);
- ❑ phase sensor (4);
- ❑ thermostat coolant temperature sensor (9);
- ❑ throttle valve actuator (11);
- ❑ rpm sensor (8);
- ❑ high pressure pump pressure regulator (10);
- ❑ temperature sensor (7);
- ❑ deadening hood (2) if included;
- ❑ plug (1);
- ❑ the engine with lubricating oil of the prescribed grade and amount.

Fit the swing bar to the engine lifting hooks, then secure the swing bar to the hoist and take the engine off rotary stand (6). Take off brackets 99361038 (9).

Figure 246



Complete engine assembly.
Fit on the left and right engine mountings (3) and tighten the fixing screws to the prescribed torque.
Connect the oil pipe (2) to the turbocharger (1) and to the crankcase and tighten the fixing screws and the coupling of the oil pipe (2) to the prescribed torque.

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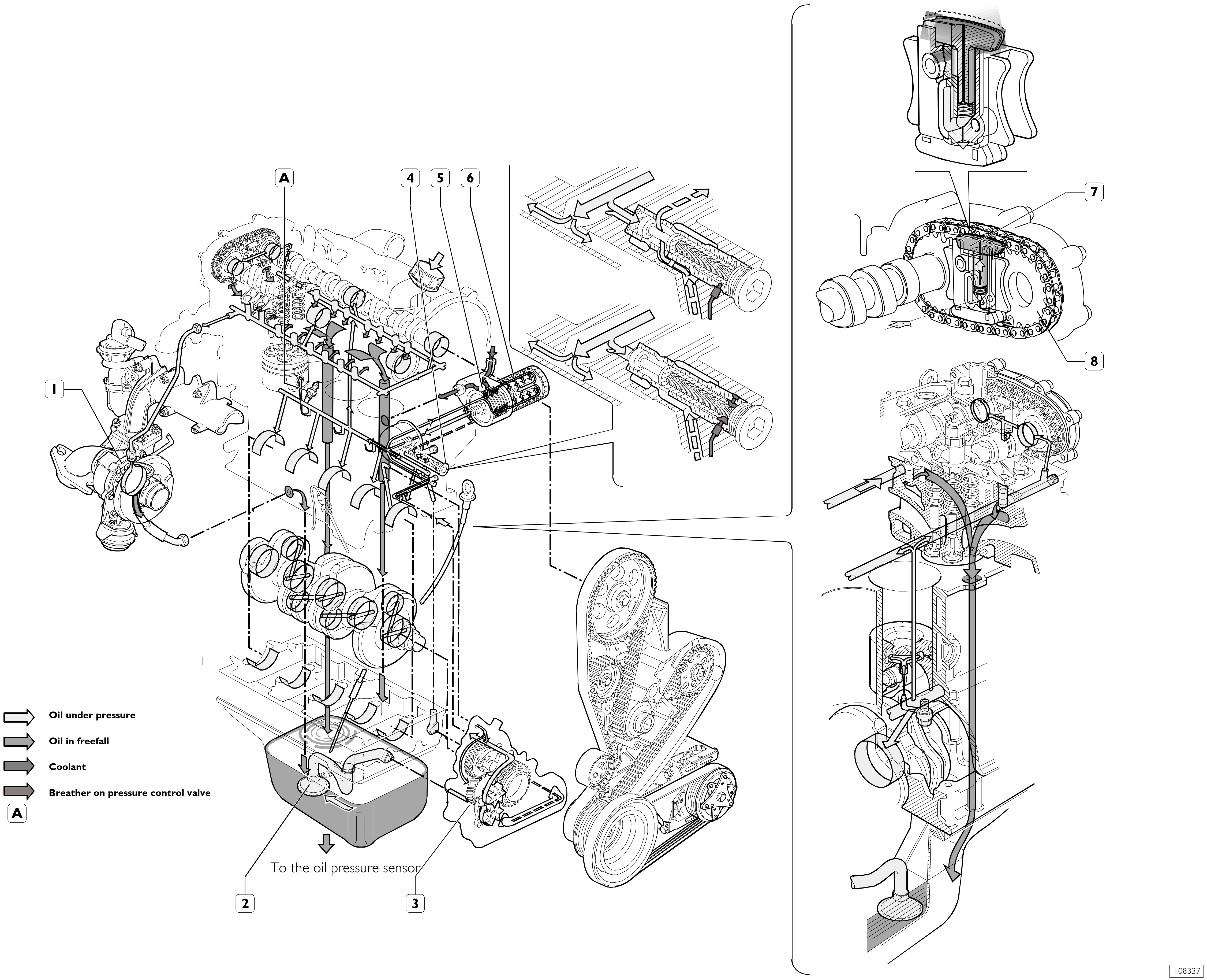
5450 LUBRICATION

General

The engine is lubricated by forced circulation performed by the following parts:

- An oil gear pump is incorporated in an assembly that also includes the vacuum pump (GPOD).
- A pressure control valve incorporated in the crankcase.
- A Modine-type heat exchanger with built-in safety valve.
- A double filtration oil filter with built-in safety valve.
  Operation (see Figure 247).
  Engine oil is drawn up from the sump by the oil pump (3) via the suction strainer (2) and delivered under pressure to the heat exchanger (5) where it is cooled.
  The oil continues through the oil filter (6) and goes to lubricate the relevant parts through ducts or pipes.
  At the end of the lubrication cycle, the oil returns to the sump by gravity. The oil filter can be excluded by the safety valve built into it if it gets clogged. The heat exchanger is also excluded by a safety valve if it gets clogged.
  In addition, the lubrication oil supplies the hydraulic automatic tightener (7) of the camshaft drive (8).

Figure 247



OIL VACUUM PUMP ASSEMBLY (GPOD)

Figure 248

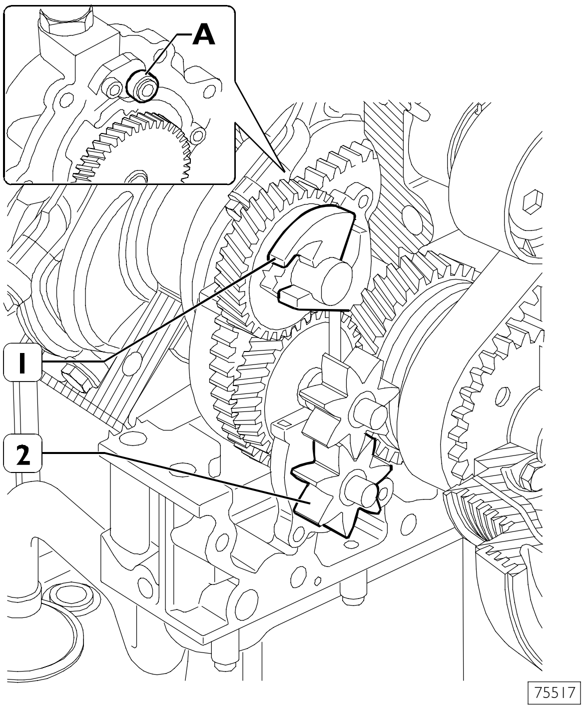


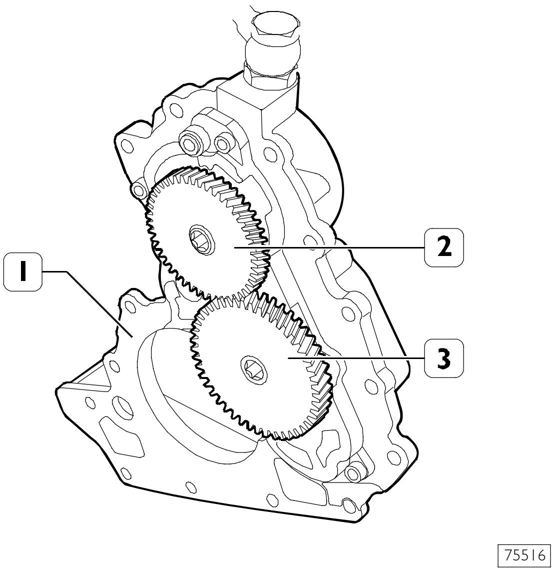
DIAGRAM OF GPOD ASSEMBLY ON ENGINE

1. Vacuum pump – 2. Oil pump – 3. Crankshaft – A. Vacuum pump oil supply hole.

Clearance between the crankshaft gear teeth and the oil pump drive gear 0.003 ÷ 0.2 mm.
The assembly must not be overhauled; in the event of defective operation, it must be replaced.

503010 Oil pump

Figure 249



The oil pump (3) is a gear pump driven directly by the crankshaft.

Characteristic data

transmission ratio	1.15	
displacement	16.2	cm^3
pumping diameter	49.5	mm
number of teeth	7	
height	11	
oil pump minimum speed	862	rpm
oil pump max. speed	4485	rpm
oil pump over-revs	5247	rpm
oil pump forced over-revs	6279	rpm
speed	2500	rpm
torque	2.1	Nm
power draw (calc.)	550	W

Oil temperature: 100°C – closed recirculation – max. outlet pressure 5 bars	
engine speed rpm (oil pump speed – rpm)	capacity (l/min)
750 (862)	12
3900 (4485)	68

Vacuum pump

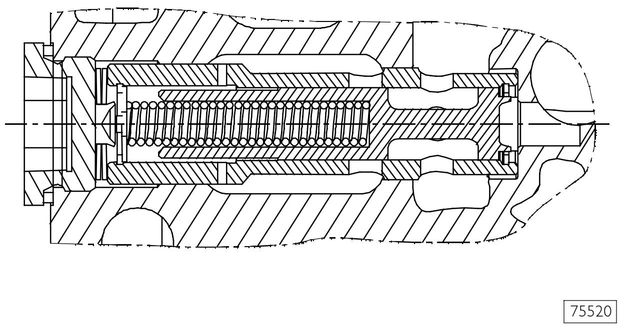
The vacuum pump (2, SENZA CODICE), with radial blades, is also incorporated in the GPOD (1, Figure 249). It is driven directly by the oil pump.

transmission ratio	3.25	
displacement	86	cm^3
volume to drain	4.5	litres
volume to drain with EGR	9	litres
chamber diameter	65	mm
rotor diameter	50	mm
cam	7.5	mm
number of blades	3	
height	34	mm
vacuum pump minimum speed	994	rpm
vacuum pump max. speed	5168	rpm
vacuum pump over-revs	6046	rpm
vacuum pump forced over-revs	7235	rpm
theoretical flow rate at minimum (air)	85.5	l/min
actual flow rate at minimum (air) – at atmospheric pressure	46	l/min
Theoretical speed at max. speed – (air)	444.4	l/min
Actual flow rate at max. speed – (air) at atmospheric pressure	60	l/min
measured power draw (maximum)		
speed	2500	rpm
torque	2.1	Nm
power draw (calc.)	550	W

Oil temperature: 100°C – engine speed 750 rpm (pump speed 994 rpm)			
tank (litres)	vacuum (bar)	0.5	0.8
4.5	time (sec)	4.5	12.5
5.6		6.0	16.5
9		9.0	24.0

543475 Oil pressure control valve

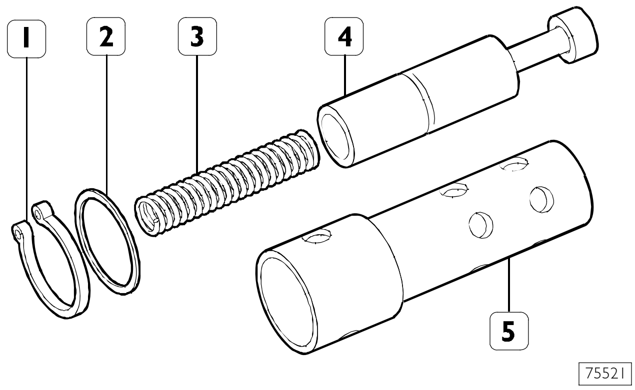
Figure 250



CROSS-SECTION OF OIL PRESSURE CONTROL VALVE MOUNTED IN CRANKCASE

Valve removed from crankcase L = 51.75 mm.
Valve fitted in crankcase L = 50.75 mm.
Start of opening 4 bar L = 49.5
maximum opening 4.6 bar L = 44.

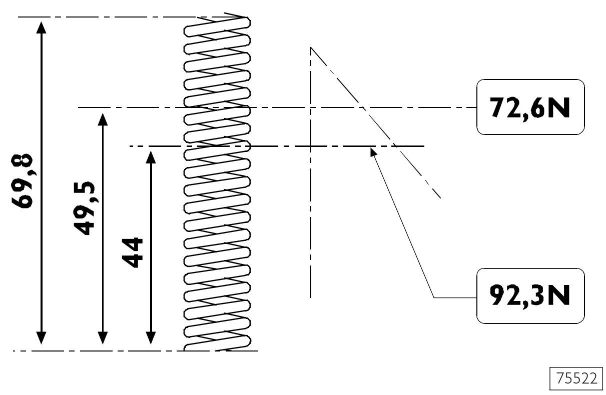
Figure 251



PARTS COMPRISING THE OIL PRESSURE CONTROL VALVE

1. Split ring – 2. Washer – 3. Spring – 4. Valve – 5. Valve casing.

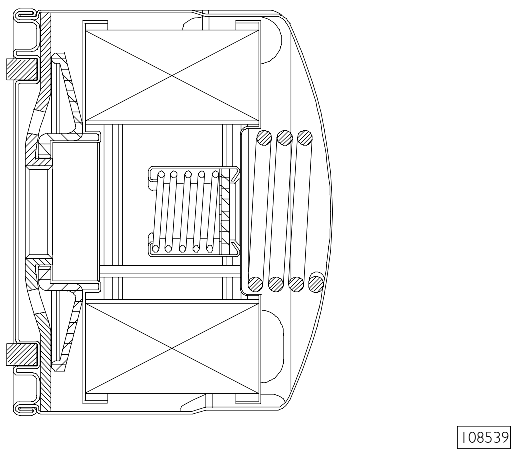
Figure 252



MAIN DATA OF THE OIL PRESSURE CONTROL VALVE SPRING

543070 Oil filter

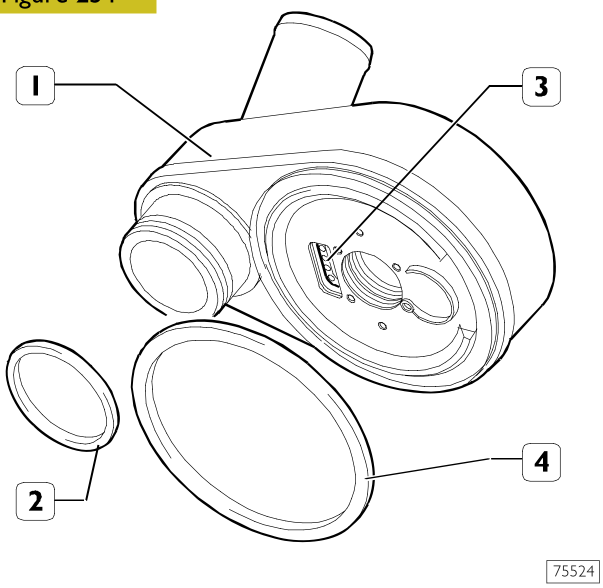
Figure 253



Oil filter with single filtration with built-in by-pass valve – opening pressure 2.5 ± 0.3 bar.

543110 Modine heat exchanger

Figure 254



Thoroughly clean the heat exchanger (1).
Always change the seals (2 and 4).
Built-in safety valve (3).

Opening pressure	0.82 - 1.03 bar

No. of heat exchanger elements:
- 6 (96/116 HP engine)
- 8 (136 HP engine).

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540480 Oil vapour recirculation system

Description

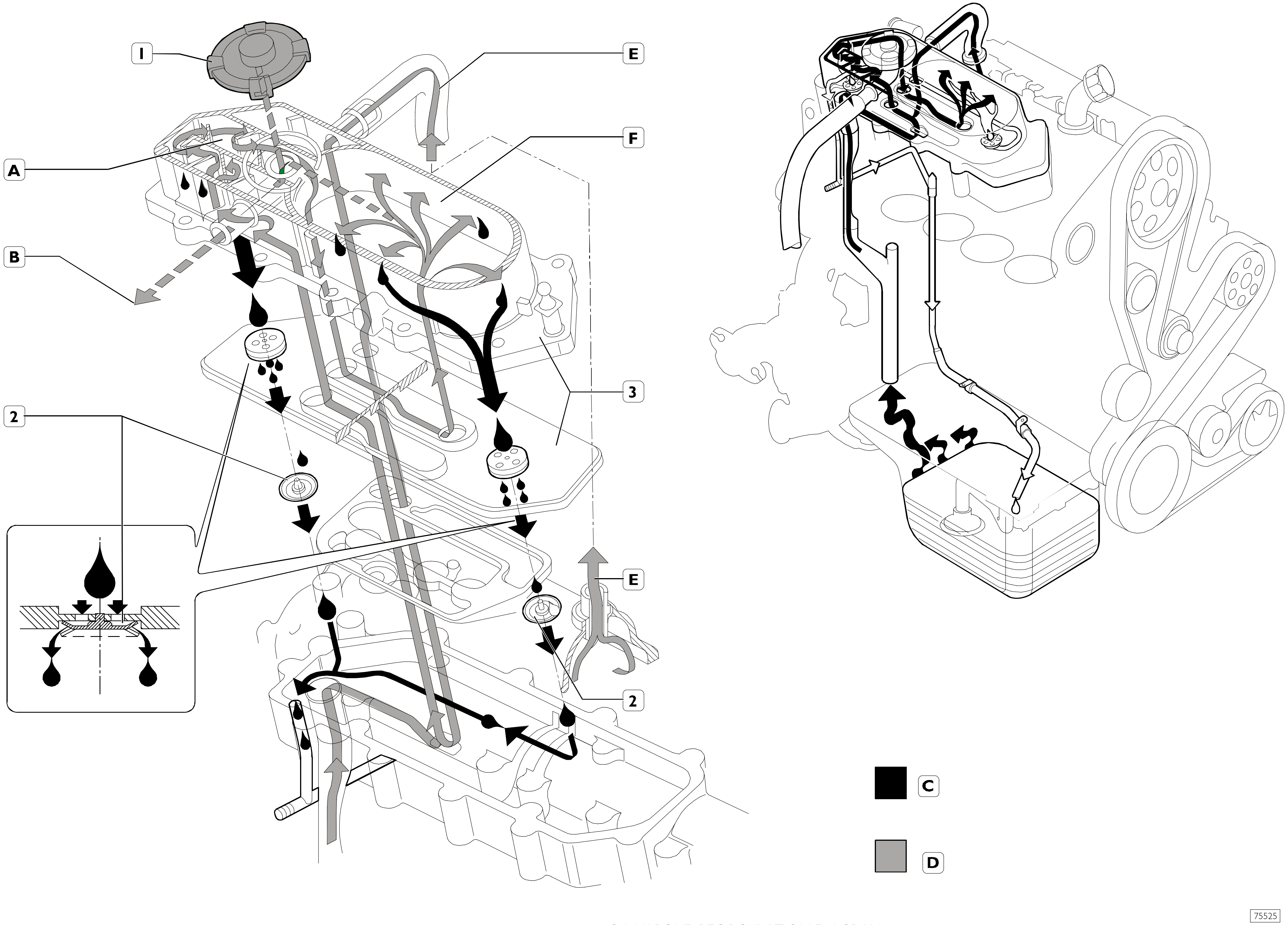
The oil vapours formed in the sump while the engine is running, passing through the overhead cover, are channelled into the separator / condenser filter known as the blow-by. The filter is structured in two sections:

- The first one with a labyrinth, where most of the vapours are condensed and return to the sump through an umbrella outlet valve.
- The second one includes a coalescence filter that condenses the remaining vapours that return to the sump through another umbrella valve.

The portion of vapour that has not condensed is sent, via a MANN-HUMMEL valve, to the intake duct and burnt during normal engine operation.

NOTE The blow-by filter cannot be taken apart and must therefore be replaced entirely.

Figure 255



OIL VAPOUR RECIRCULATION DIAGRAM

1. MANN-HUMMEL valve – 2. Umbrella valves – 3. Blow-by filter – A. Labyrinth – B. Intake oil vapour recovery flow – C. Oil return flow into sump – D. Flow of oil vapours from the sump – E. Flow of oil vapours from the overhead – F. Coalescence filter.

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5432 COOLING

Description

The engine cooling system is the type with forced circulation in a closed circuit. It comprises the following parts:

- An expansion tank whose plug has two valves incorporated in it: an outlet and an inlet, which govern the pressure of the system.
- A coolant level sensor at the base of the expansion tank.
- Only 136 HP, pressure switch (3), of normally closed type (calibrated at 0.4 bar, absolute pressure 1.4 bar), located on expansion tank and connected to EDC central unit, protects engine against overheating caused by cooling system failure. Where coolant temperature exceeds 100 °C and contemporarily the pressure inside expansion tank and it becomes lower than 0.4 bar, EDC central unit reduces engine performance by changing fuel flow rate (De-rating) until engine goes off.
- An engine cooling module to dissipate the heat taken from the engine by the coolant with a heat exchanger for the intercooler.
- A heat exchanger to cool the lubricating oil.
- A heat exchanger to cool the exhaust gases (engines with EGR).
- A centrifugal water pump incorporated in the crankcase.
- An electric fan comprising an electromagnetic coupling on whose shaft a hub turns idle that is fitted with an axially mobile metal plate on which is mounted the impeller.
- A 3-way thermostat governing the circulation of the coolant.

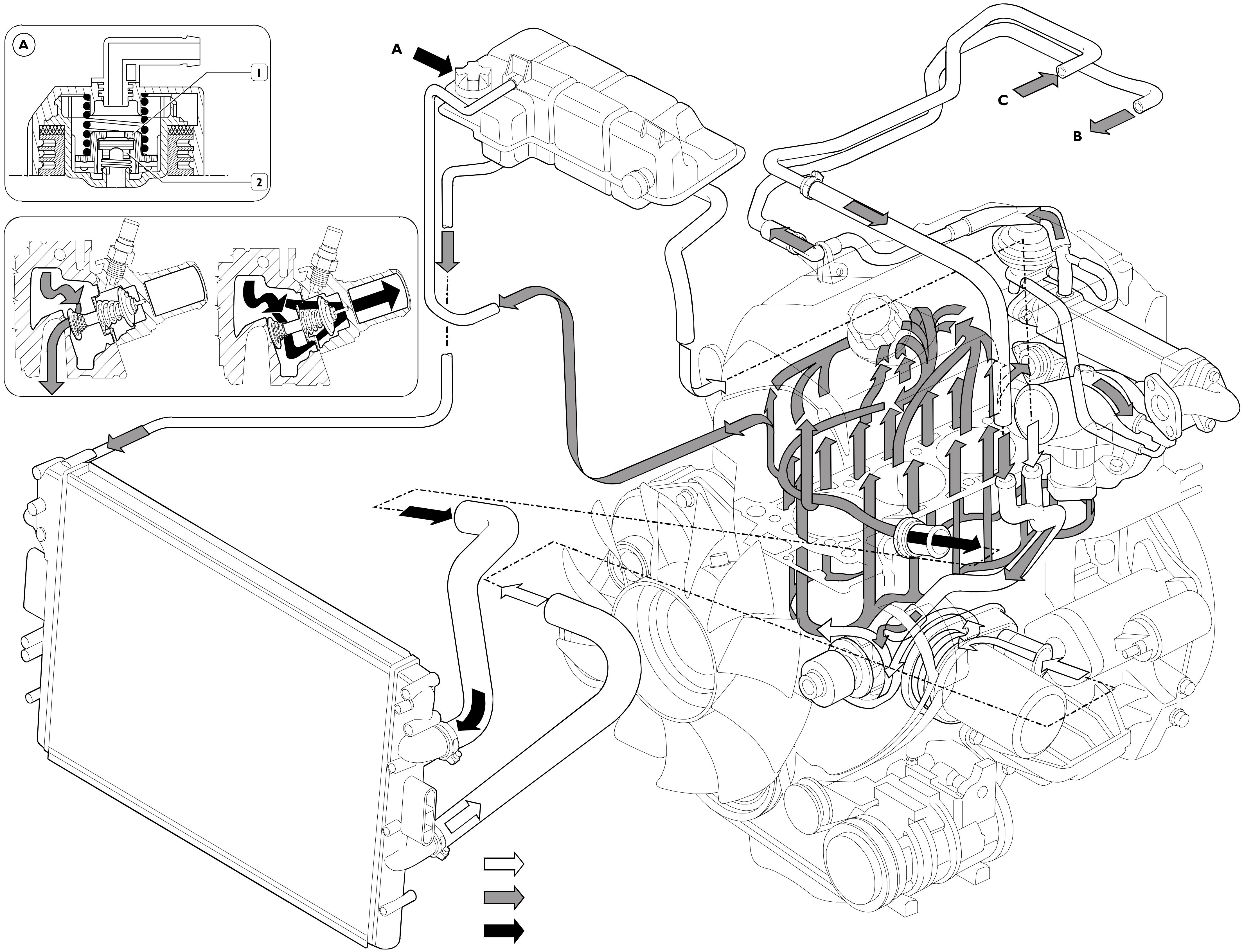
Operation

The water pump driven by a poly-V belt by the crankshaft sends coolant into the crankcase and with a greater head into the cylinder head.
When the coolant temperature reaches and exceeds the working temperature, it causes the thermostat to open and the fluid is channelled from here to the radiator and cooled by the fan.
The pressure in the system due to the change in temperature is governed by the outlet (2) and inlet (1) valves incorporated in the expansion tank filler plug (detail A).
The outlet valve (2) has a twofold function:

- to keep the system slightly pressurized so as to raise the boiling point of the coolant;
- to discharge into the atmosphere the excess pressure produced in case of high coolant temperatures.

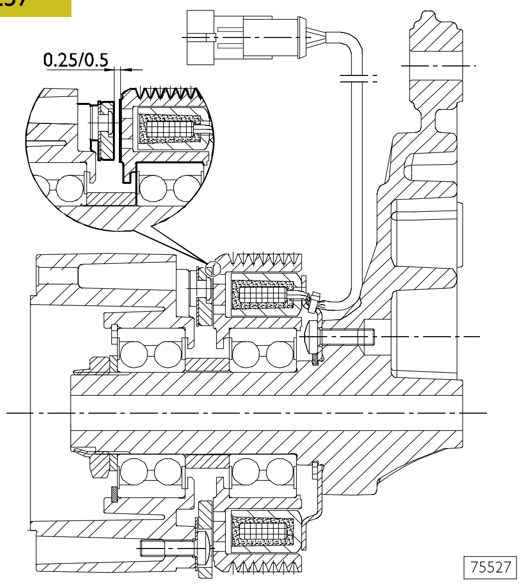
The function of the inlet valve (1) is to permit transferring the coolant from the expansion tank to the radiator when a lower pressure is created in the system due to the reduction in volume of the coolant as a result of its temperature lowering.
Outlet valve opening 1 ± 0.1 kg/cm^2.
Inlet valve opening 0.005 – 0.02 kg/cm^2.

Figure 256



543212 Electromagnetic pulley

Figure 257



CROSS-SECTION OF THE ELECTROMAGNETIC JOINT

Characteristics

Transmissible torque at 20°C with clutch run in	45 Nm
Voltage	12 Volts
Power input	26 W

The electric fan control relay is activated or deactivated according to the temperatures of: the engine coolant, the fuel supercharging air and the pressure of the air conditioner fluid (if present).

Coolant temperature

(if the sensor is not defective)

For 96/116 HP engines:

- it activates at > 96°C and deactivates at < 84°C.

For 136 HP engines:

- it activates at > 102°C and deactivates at < 90°C.

Turbocharging air temperature

It activates at > 75°C and deactivates at < 65°C.

Fuel temperatures

(if the coolant temperature sensor is acknowledged to be defective by the EDC control unit)

It activates at > 20°C and deactivates at < 10°C.

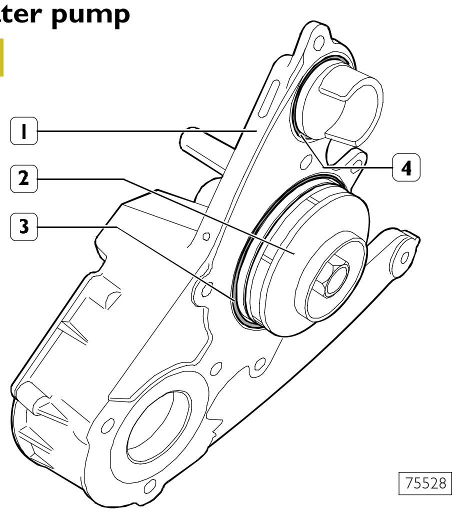
With climate control system

With pressure in the system

it turns on	18.5 ± 0.98 bar
it turns off	14.58 ± 0.98 bar

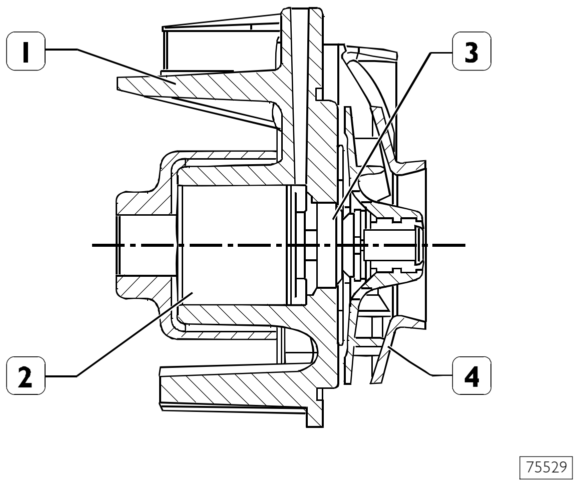
543210 Water pump

Figure 258



The water pump (3) cannot be overhauled. In case of coolant leaking from the seal or damage, it must be replaced. The water pump casing (1) is also used as a mounting for the high-pressure pump. The seals (3 and 4) must always be replaced.

Figure 259

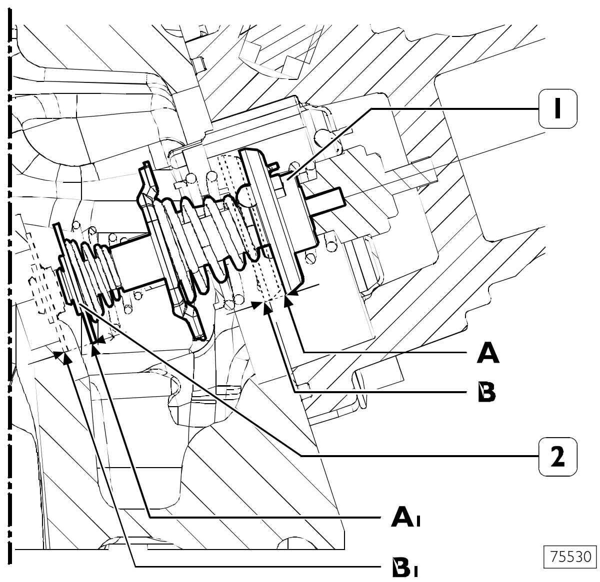


LONGITUDINAL CROSS-SECTION OF THE WATER PUMP

1. Pump casing – 2. Pump drive shaft together with bearing – 3. Seal – 4. Impeller.

543250 Thermostat

Figure 260



The by-pass thermostat (1) needs no adjustment.

If there is any doubt about its operation, replace it.

The thermostat casing is fitted with the thermometric switch/transmitter and water temperature sensor.

A. – A1 Start of stroke at 78°C ±2°C.

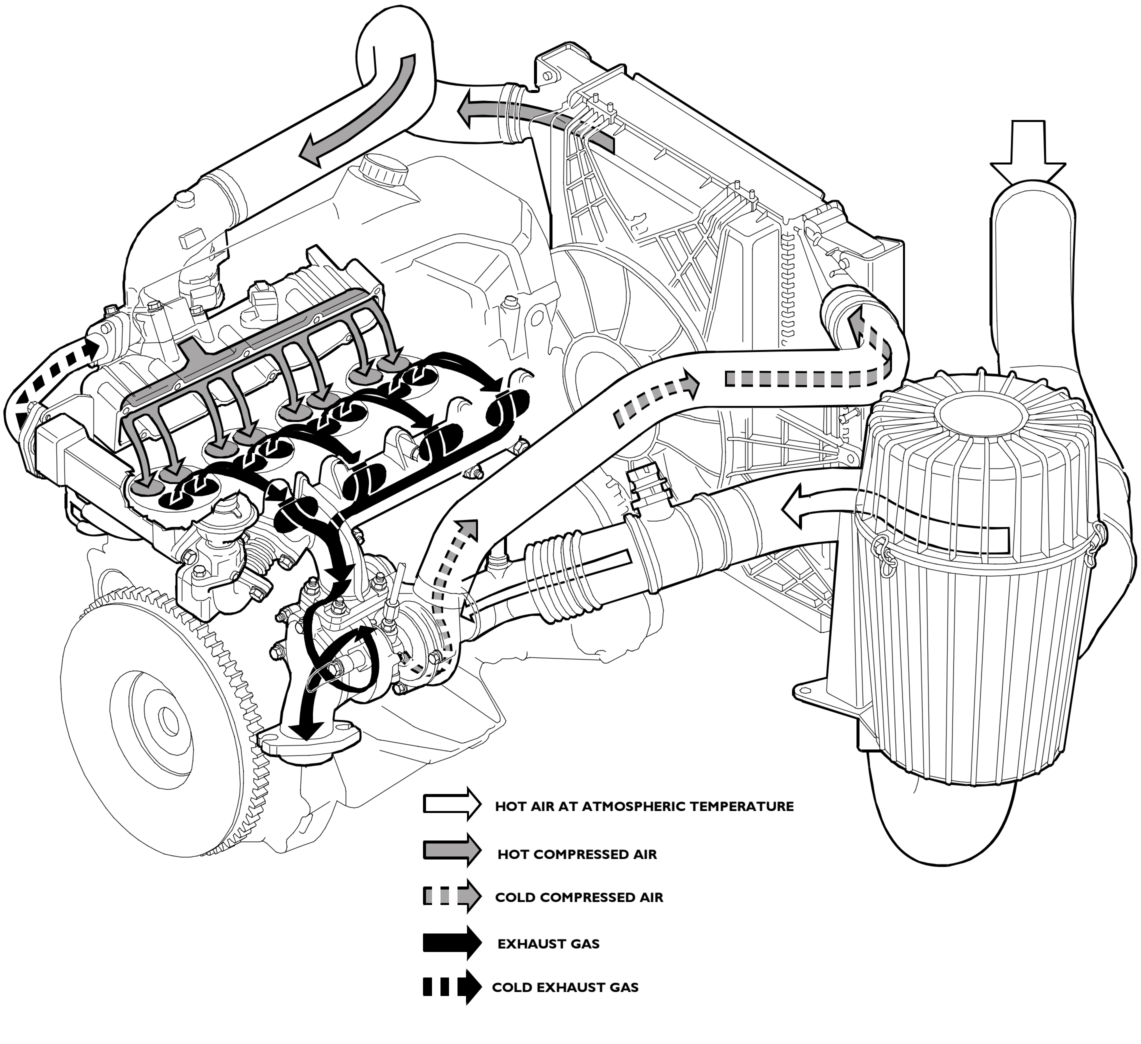
B. Valve (1) stroke at 94°C = 7 mm.

B1 Valve (2) stroke 94°C, 6.4 mm

The stroke of 7 mm less than 60''.

TURBOCHARGING

Figure 261



TURBOCHARGING DIAGRAM

Description

The turbocharging system comprises an air filter, turbocharger and intercooler.
The air filter is the dry type comprising a filtering cartridge to be periodically replaced.

The function of the turbocharger is to use the energy of the engine's exhaust gas to send pressurized air to the cylinders.
The intercooler comprises a radiator included in the engine coolant radiator and its function is to lower the temperature of the air leaving the turbocharger to send it to the cylinders.

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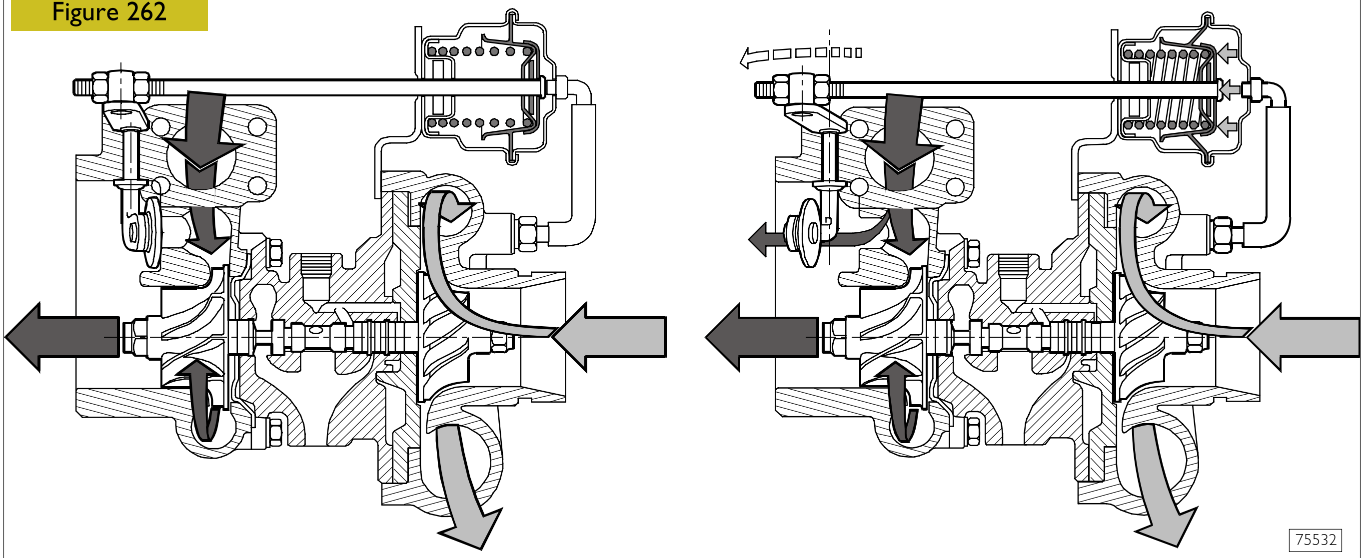
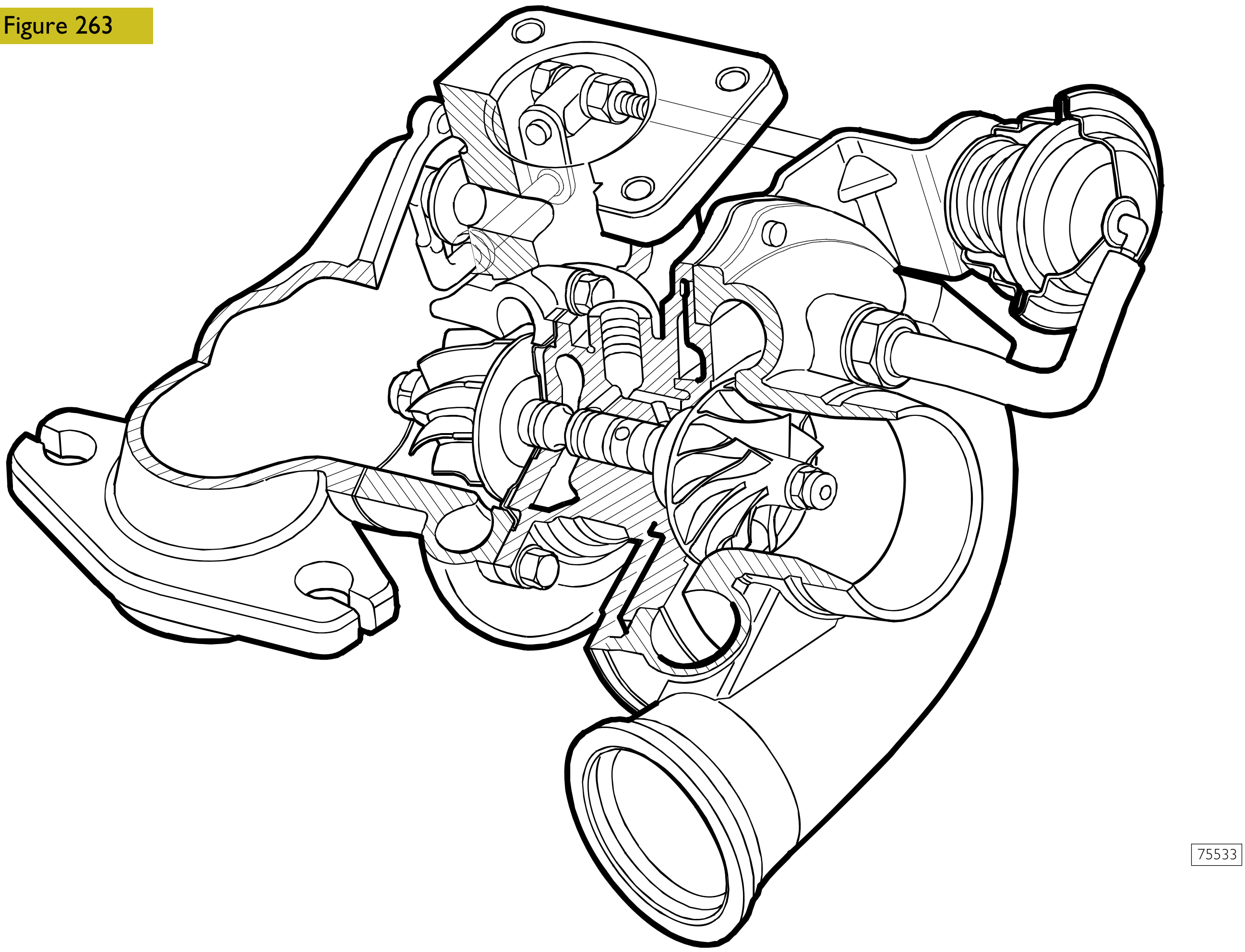
542410 Turbocharger (KKK K03-2074-CCB 5.88 type)

Figure 262



A. THROTTLE VALVE SHUT B. THROTTLE VALVE OPEN

Figure 263



It is basically composed of:

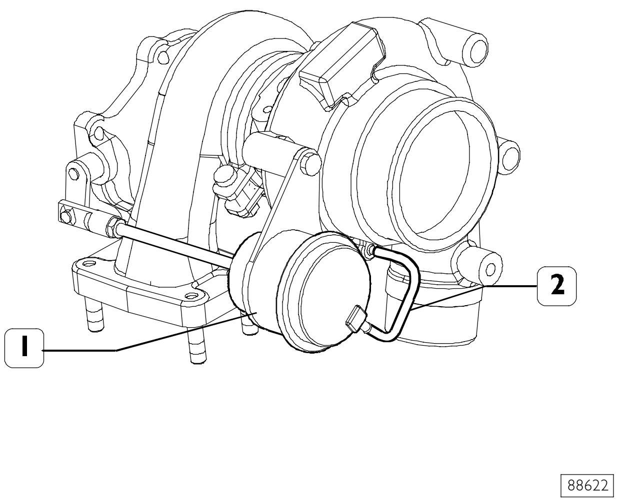
- a central casing housing a shaft supported by bushings at whose opposite ends are fitted the turbine wheel and the compressor rotor;
- a turbine casing and a compressor casing mounted on the end of the central body;
- an overpressure relief valve fitted on the turbine casing. Its function is to choke the exhaust gas outlet (detail B), sending a portion of the exhaust gas straight into the exhaust pipe when the turbocharging pressure downstream from the turbocharger reaches the setting.

REPAIRS

NOTE On finding irregular engine operation due to the turbocharging system, it is first expedient to perform the checks on the turbocharger, check the efficiency of the seals and the fixing of the couplings, additionally checking there is no clogging in the intake sleeves, air filter or radiators. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not burst or clogged, in which case replace them or eliminate the trouble.

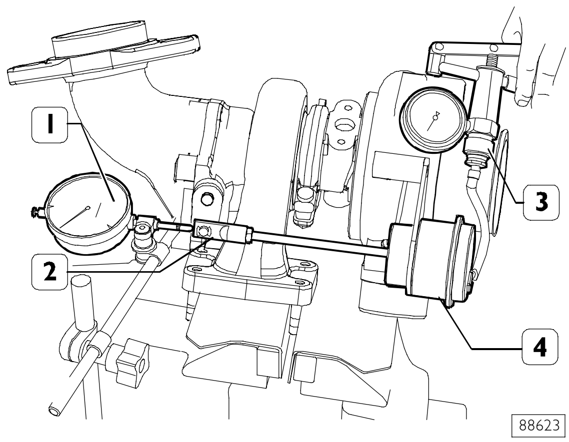
542418 Pressure relief valve
Checking pressure relief valve

Figure 264



Cover the air, exhaust gas and lubricating oil inlets and outlets. Thoroughly clean the outside of the turbocharger using anticorrosive and antioxidant fluid. Disconnect the pipe (2) from the union of the pressure relief valve (1) and fit on it the pipe of the device 99367121 (3, Figure 265).

Figure 265



Rest the tip of the dial gauge (1) with a magnetic base on the end of the tie rod (2) and zero it. Using the device 99367121 (3), introduce compressed air into the valve casing (4) at the prescribed pressure and make sure this value stays constant throughout the check; replace the valve if it doesn't. In the above conditions, the tie rod must have made the prescribed travel.

NOTE Before fitting the turbocharger on the engine, it is necessary to fill the central body with engine lubricating oil.

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542410 GARRET GT 17 variable geometry turbosupercharger (engine F1A E0481 H - 136 HP)

General

The variable geometry turbosupercharger consists of the following:

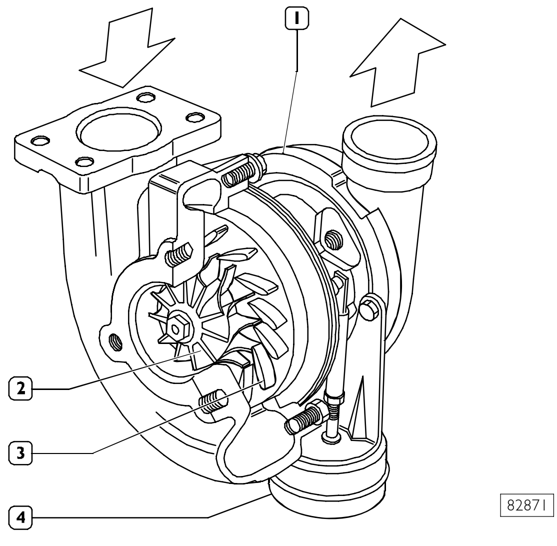
- centrifugal supercharger (1);
- turbine (2);
- set of mobile blades (3);
- mobile blade control pneumatic actuator (4), vacuum controlled by proportional solenoid valve controlled by EDC 16 ECU.

Variable geometry enables:

- to increase the speed of the exhaust gases running into the turbine at low engine rpm;
- to decrease the speed of the exhaust gases running into the turbine at high engine rpm.

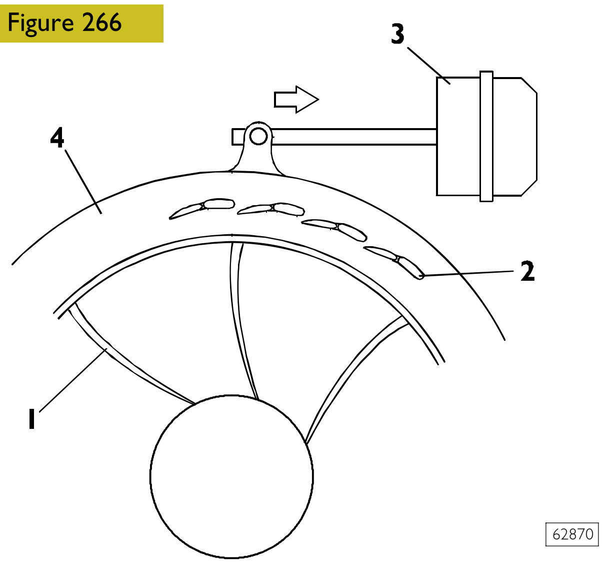
To obtain the max. engine volumetric efficiency also at low rpm (with on-load engine).

Figure 267



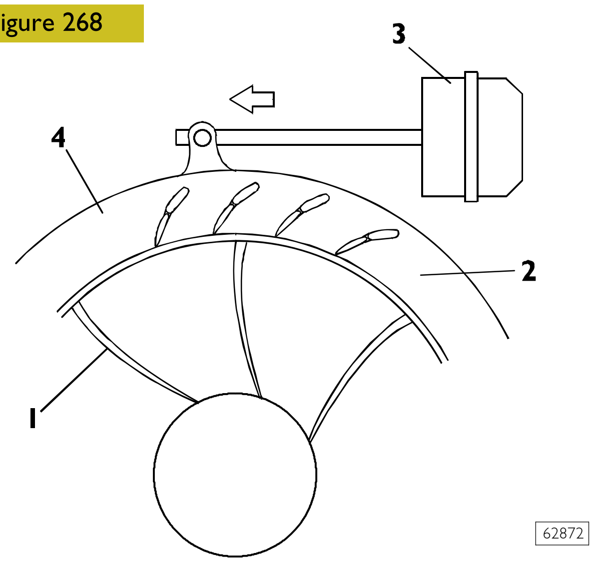
Operation at low engine rpm

Figure 266



Operation at high engine rpm

Figure 268



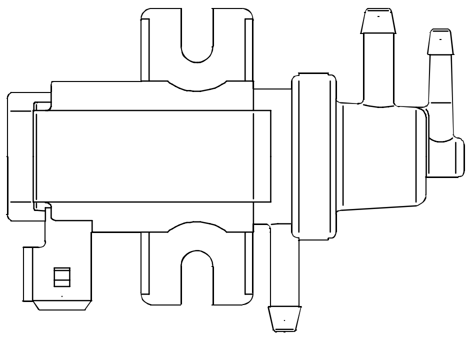
1. TURBINE - 2. MOBILE BLADES - 3. PNEUMATIC ACTUATOR - 4. REVOLVING RING

When engine is running at low speed, the exhaust gases show weak kinetic energy; under these conditions a traditional turbine shall rotate slowly, thus providing a limited booster pressure.
In the variable geometry turbine (1), the mobile blades (2) are set to max. closed position and the small through-sections between the blades increase the inlet gas speed. Higher inlet speeds involve higher tip speeds of the turbine and therefore of the turbosupercharger.
Engine speed increase results in a gradual increase of exhaust gas kinetic energy, and also in turbine (1) speed and booster pressure increase.

The ECU, through the actuator control solenoid valve, modulates the vacuum acting on the diaphragm, so actuator (3) controls through the tie rod, the gradual opening of the mobile blades (2) until reaching the max. open position.
Blade through-sections results larger thus producing a speed decrease in exhaust gas flow through the turbine (1) with speeds equal to or lower than those of the low rpm condition.
Turbine (1) speed is therefore adjusted to a proper value enabling suitable engine operation at high speeds.

Proportional solenoid valve controlling turbocharger actuator

Figure 269

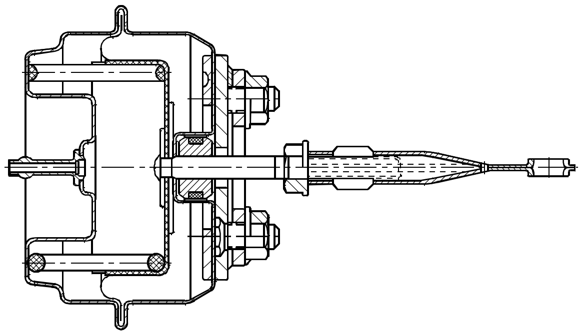


The solenoid valve modulates the low pressure controlling the turbocharger actuator, taken from the air circuit of the servo brake, according to the information exchanged between the electronic control unit and the sensors: engine speed, throttle pedal position and pressure/temperature fitted on the intake manifold.

As a result, the actuator varies the opening of the blades of the turbocharger that adjust the flow of exhaust gases.

Actuator

Figure 271

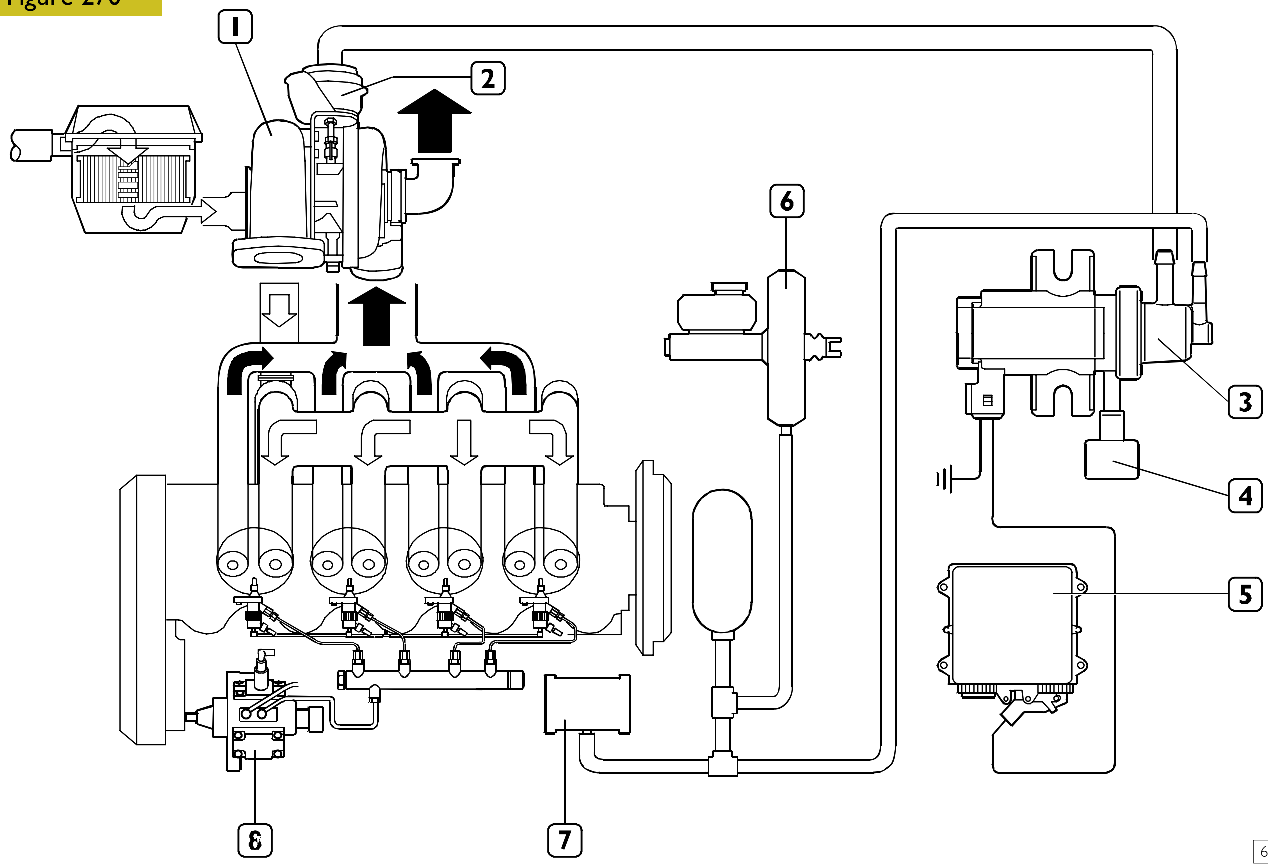


SECTION ON THE ACTUATOR

The actuator diaphragm, connected to the control rod, is governed by the low pressure on the top of the actuator.

The low pressure modulated by the proportional solenoid valve varies the movement of the diaphragm and, as a result, of the rod governing the turbine's mobile blades.

Figure 270



TURBOCHARGING FUNCTIONAL DIAGRAM

1. Variable geometry turbocharger - 2. Pneumatic actuator - 3. Proportional solenoid valve - 4. Air filter - 5. EDC 16 control unit - 6. Servo brake - 7. Vacuum device - 8. High-pressure pump.

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REPAIRS

542451 Checking and adjusting the actuator

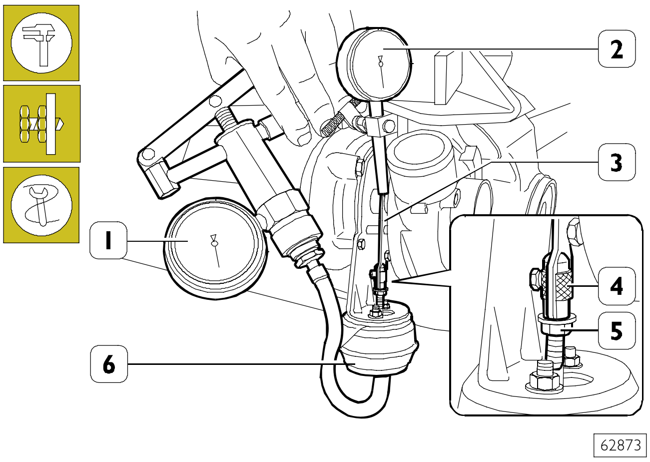
NOTE NOT ALLOWED ARE:

- **any replacement or regulation of the actuator, since the calibration of such component is made in an optimal way for each turbocharger and is guaranteed for the turbocharger;**
- **any operation on nut (5) and ring nut (4), since such operation does not change engine supply characteristics but may impair engine reliability and duration.**

Ring nut (4) is sealed with antitempering yellow paint.

In case of engines under guarantee, each above specified intervention and/or alteration to paint applied on ring nut (4) causes the lapse of the guarantee.

Figure 272



Cover air, exhaust gas and lubricant inlets and outlets.

Clean the turbosupercharger outside accurately using anticorrosive and antioxidant fluid and check the actuator (6).

Clamp the turbosupercharger in a vice.

Apply vacuometer 99367121 (1) pipe to actuator (6) hose.

Apply the magnetic base gauge (2) to exhaust gas inlet flange in the turbine.

Set gauge (2) feeler pin on tie rod (3) end and set gauge (2) to zero.

Operate the vacuum pump and check whether the tie rod (3) stroke values correspond to the vacuum values shown in the following table:

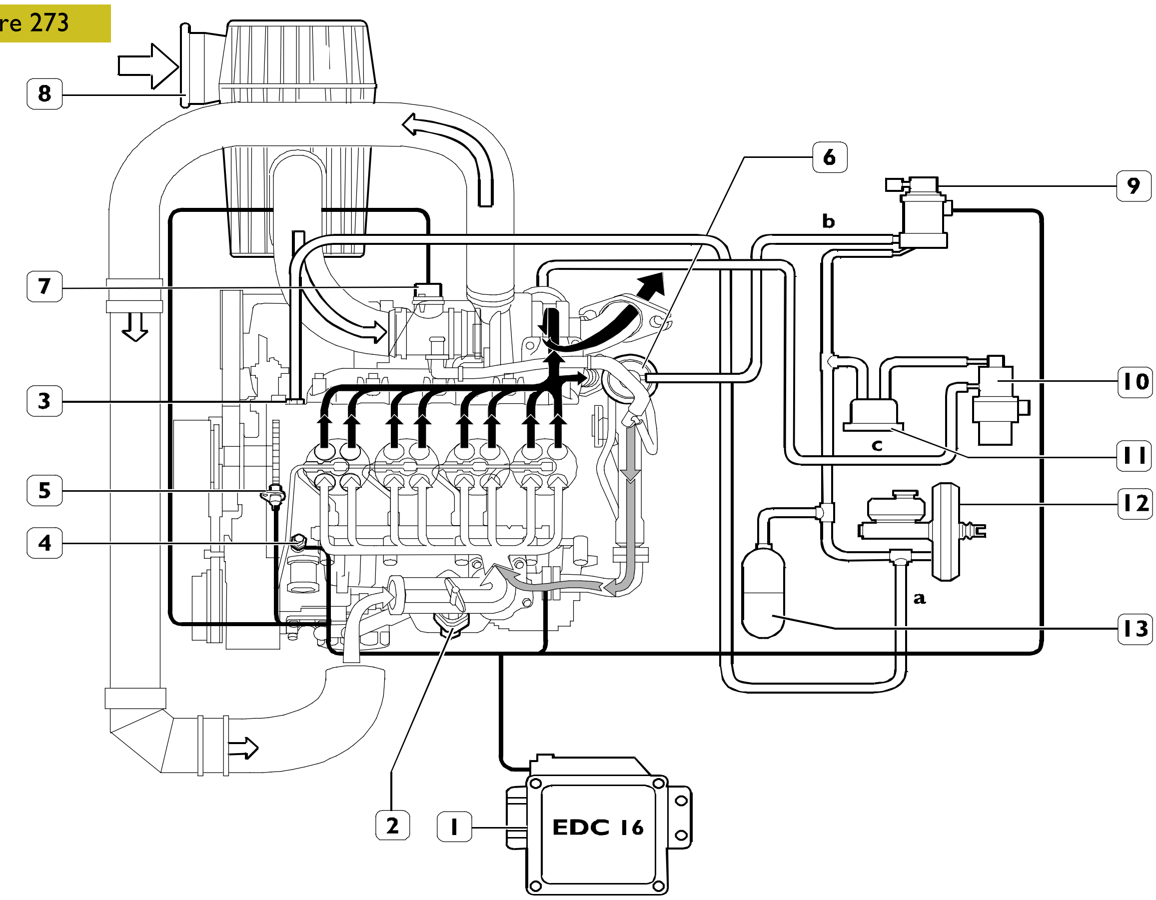
- vacuum 0 mm Hg	Fully open valve
- vacuum 0.2 bar	Valve stroke 2 ÷ 4 mm
- vacuum 0.64 bar	Valve stroke 10.5 ÷ 12.5 mm

Where a different value is found, replace turbocharger.

NOTE During the check the vacuum value shall not fall, otherwise the actuator shall be replaced.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM (Exhaust gas recirculation)

Figure 273



a. Brake booster vacuum circuit - b. EGR modulated vacuum circuit. - c. VGT actuator modulated negative pressure circuit 1. Electronic central unit - 2. Throttle valve assembly - 3. Negative pressure take-off - 4 Water temperature sensor - 5. Engine rpm sensor - 6. E.G.R. pneumatic valve - 7. Flow meter - 8. Intake air filter - 9. EGR modulating solenoid valve - 10. VGT actuator modulating solenoid valve (if present) - 11. Negative pressure additional tank (only vehicles with 136 HP engine) - 12. Negative pressure power-assisted brake- 13. Negative pressure tank.

EGR system operation

The E.D.C. electronic control unit E.D.C. processes the information from the atmospheric pressure sensor, water temperature sensor, engine revs sensor and accelerator pedal potentiometer. It drives, according to ways and procedures properly programmed within its own memory, both the modulating solenoid valve and the throttle valve by means of a PWM signal.
The modulating solenoid valve will, every time is it driver by the E.D.C. control unit 16, communicate the servo brake vacuum circuit with the E.G.R. one. A vacuum value will be obtained within the EGR circuit, depending on the control signal.
Such vacuum will act on the E.G.R. pneumatic valve membrane, by withdrawing and lifting the shutter that normally obstructs the passage of the exhaust gas towards the intake.
Thus, the exhaust gas, passing through the heat exchanger where it is cooled, will be conveyed into the throttle valve assembly chamber where it will be mixed with the air from the intercooler and made to flow out into the inlet manifold.
If the vehicle is equipped with the D.P.F. catalyst, the EDC control unit 16 will simultaneously adapt the flow rate of fuel to be injected into the cylinders, depending on the amount of circulated exhaust gas.

During the engine operating phases not requiring gas circulation (e.g. particulate filter regeneration, start-up, engine cold, idle running, load demands, vehicle running at high altitudes), the control unit control signal to the modulating solenoid valve will be cancelled. The solenoid valve will close the connection between the servo brake vacuum circuit and the E.G.R. one, and will simultaneously resume the atmospheric pressure within the E.G.R. circuit.

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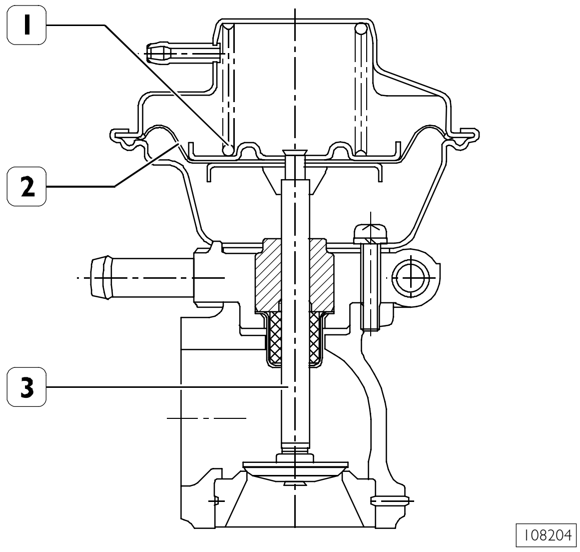
Main system components

540744 E.G.R. valve

Figure 274

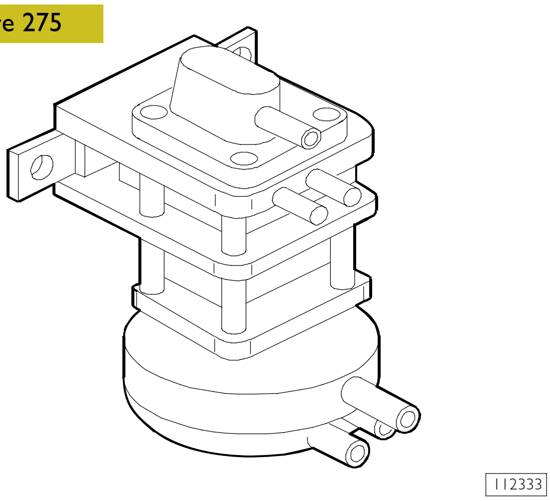


E.G.R. valve is mounted on heat exchanger end.
To ensure higher efficiency and longer durability to the valve, the valve is cooled by engine coolant from heat exchanger.

Recirculated gas quantity regulation is through a mushroom valve, pneumatically driven under under-pressure; the under-pressure, through calibrated section fitting, is taken from the tube connecting the vacuum unit to power-assisted brake.
Driving under-pressure modulated by the solenoid valve and overcoming the force exerted by counteracting spring (1), will lift membrane (2), connected to cut-off unit (3), which moves upwards and enables the recirculation of burnt out gasses towards inlet manifold.

540746 Modulator solenoid valve

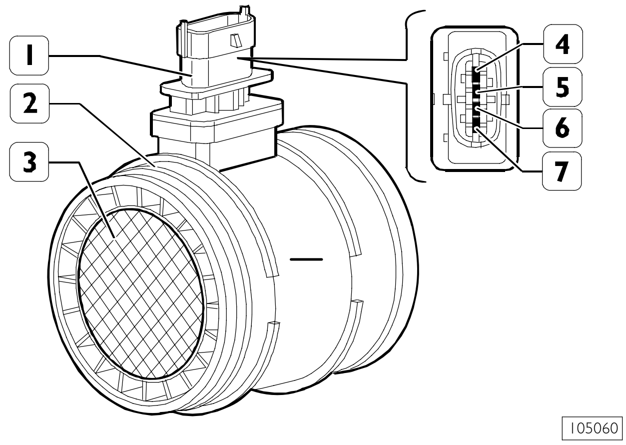
Figure 275



Modulator solenoid valve is an integrating part in E.G.R. system and power-assisted brake under-pressure tubes.
It is a proportional solenoid valve modulating E.G.R. valve driving under-pressure depending on PWM signal generated by EDC 16 central unit.

772652 Air flow rate meter (flow meter)

Figure 276



1. Connector - 2. Flow meter body - 3. Recirculated oil vapours air inlet grid - 4. Power supply - 5. Earth - 6. Inlet air temperature sensor - 7. Flow rate output signal.

The flow meter is a heated film type flow meter and is placed between turbocharger and intercooler.
Inside the flow meter, sucked in air temperature sensor is built in.

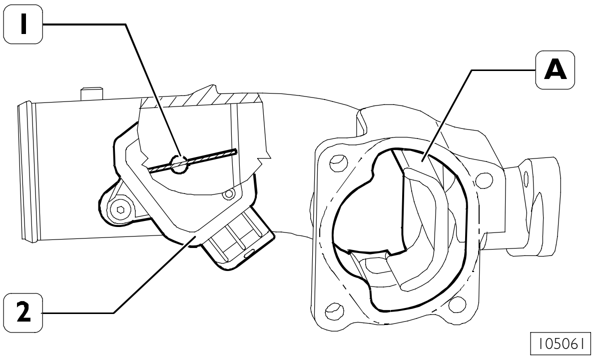
NOTE The air flow meter body bears an arrow which indicates the air flow and, therefore, the correct assembling of the meter on the vehicle.

Operation

Operation principle is based on a heated membrane put in between a measurement channel through which inlet air entering the engine is flowing.
The heated film membrane is kept at constant temperature (about 120 °C, higher than incoming air temperature) by heating resistance.
The air mass which runs through measurement channel tends to take out heat from the membrane; therefore, to keep the membrane at constant temperature, the current must run through the resistance.
Absorbed current is proportional to air mass flowing to engine; the current is measured by a Wheatstone bridge and signal obtained is sent to the electronic central unit.
If the vehicle is equipped with the DPF catalyst, the control unit program will feature a function capable of correcting the flow rate meter deviation in time. During vehicle deceleration with pedal released (overrun), the central unit performs some checks determining a number of flow rate meter reading rectification factors (self-adapting process). Therefore, replacing flow rate meter involves the self-rectifying process.
Where the central unit is replaced, flow rate meter rectification coefficients (ZFC) stored in old central unit have to be copied down and entered into new central unit. Where it is not possible, they must be reset and self-learning process must be started.

540760 Throttle valve assembly

Figure 277



1. Throttle valve - 2. Electrical actuator
A. Air / exhaust gas mixing chamber

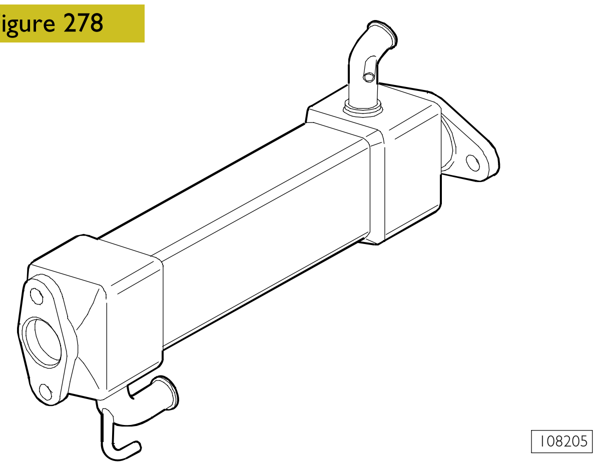
Throttle valve (normally open) assembly, mounted on inlet manifold, has the task to regulate the flow rate of air, incoming from the intercooler, to be mixed to exhaust gasses recirculated by E.G.R. valve according to programmed percentage.
Throttle valve is driven by an electrical actuator driven by a PWM signal from EDC 16 central unit.

In case of throttle valve lock, the central unit reduces engine performance to prevent the engine from being damaged.

When the engine is switched off, the throttle valve will close in order to reduce engine noise during this phase.

540730 Heat exchanger

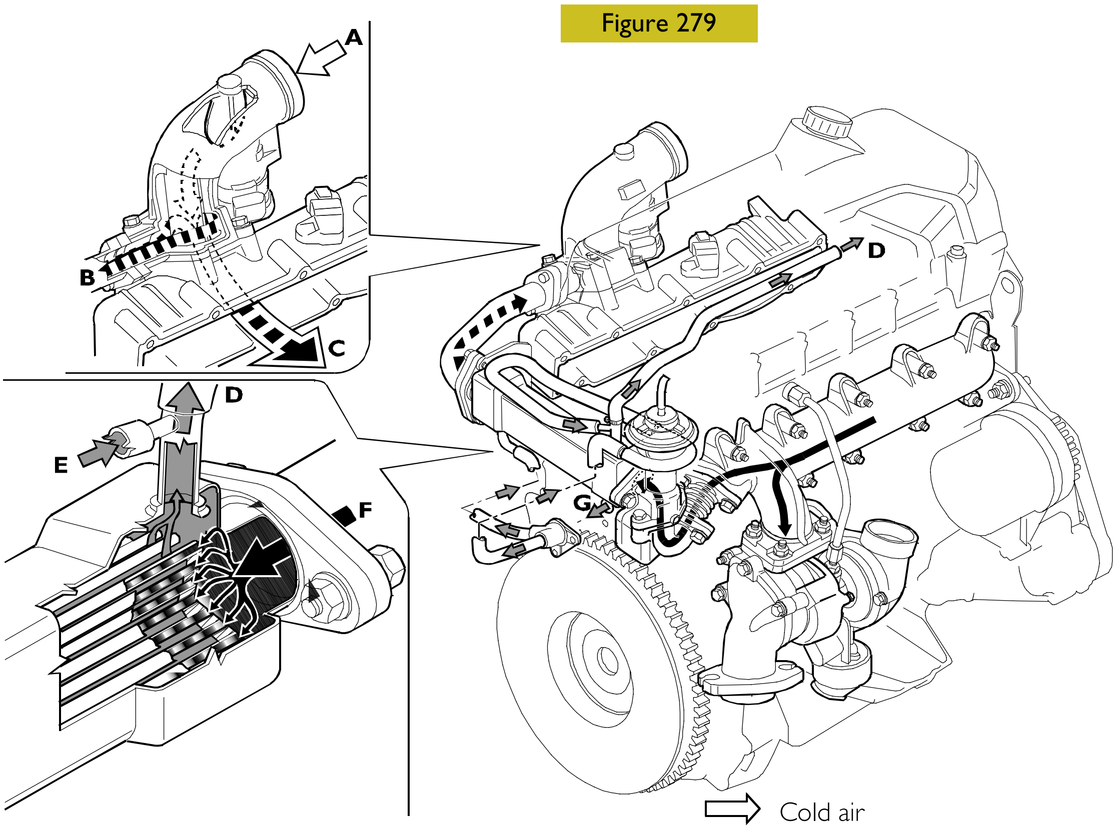
Figure 278



Heat exchanger, mounted between turbocharger and throttle valve assembly, has the task to lower exhaust gas temperature in order to reduce gas volume.

It consists of a body that incorporates a number of corrugated pipes. The circulated exhaust gas flowing through the pipes are cooled by the engine coolant flowing inside the body

Figure 279



Air from intercooler
Cooled exhaust gasses
Engine coolant
Hot exhaust gasses

Cold air
Hot exhaust gasses
Engine coolant
Cooled exhaust gasses
Exhaust gas - air mixture

EXHAUST GAS COOLING SCHEME
A. Air from intercooler - B. Cooled exhaust gasses - C. Intake exhaust gas mixture - D. Coolant to heater - E. Coolant - F. E.G.R. valve exhaust gasses - G. Coolant incoming from cylinder head -

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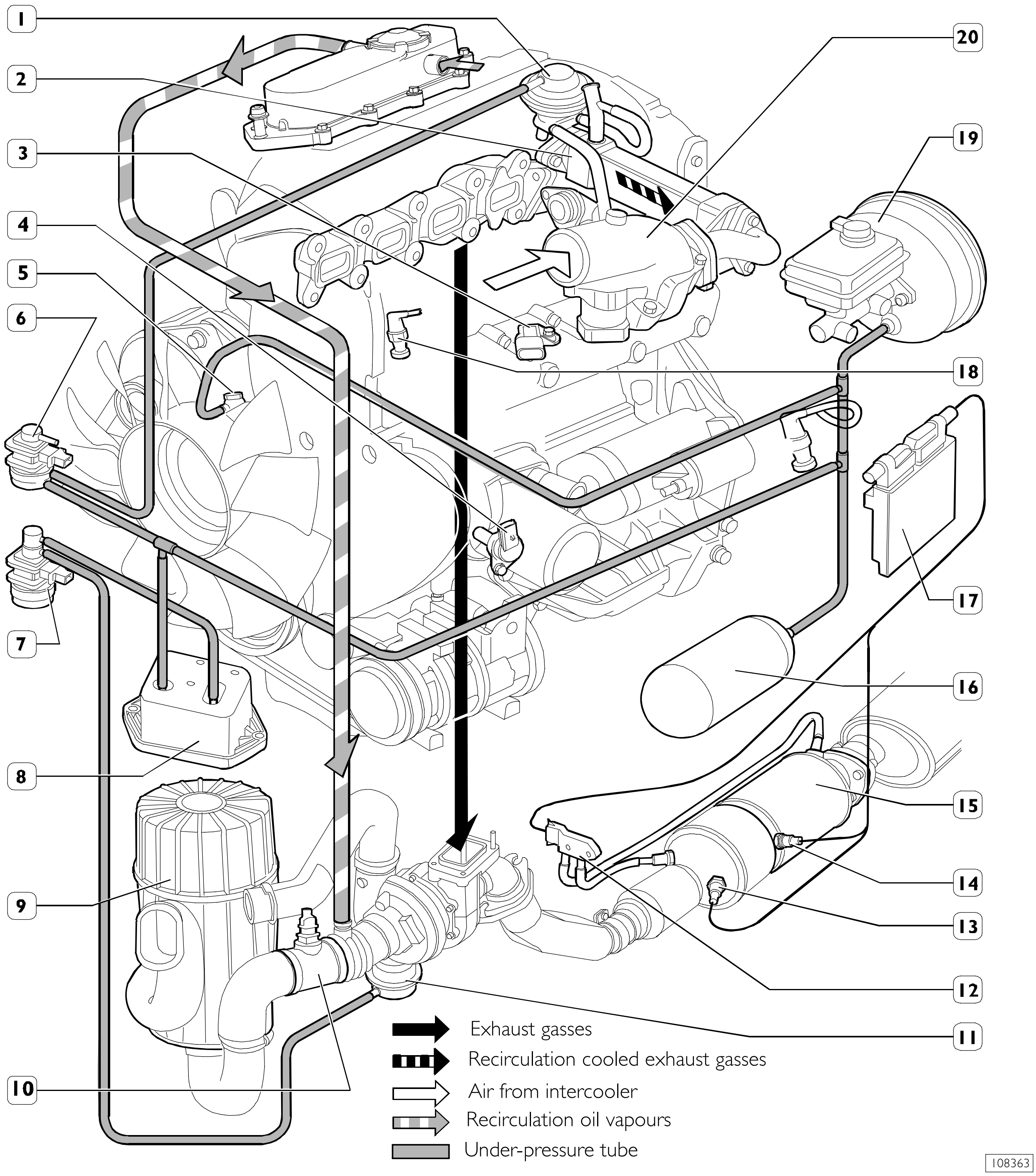
EXHAUST POLLUTANT REDUCTION SYSTEM WITH DPF CATALYST (ON REQUEST)

Figure 280



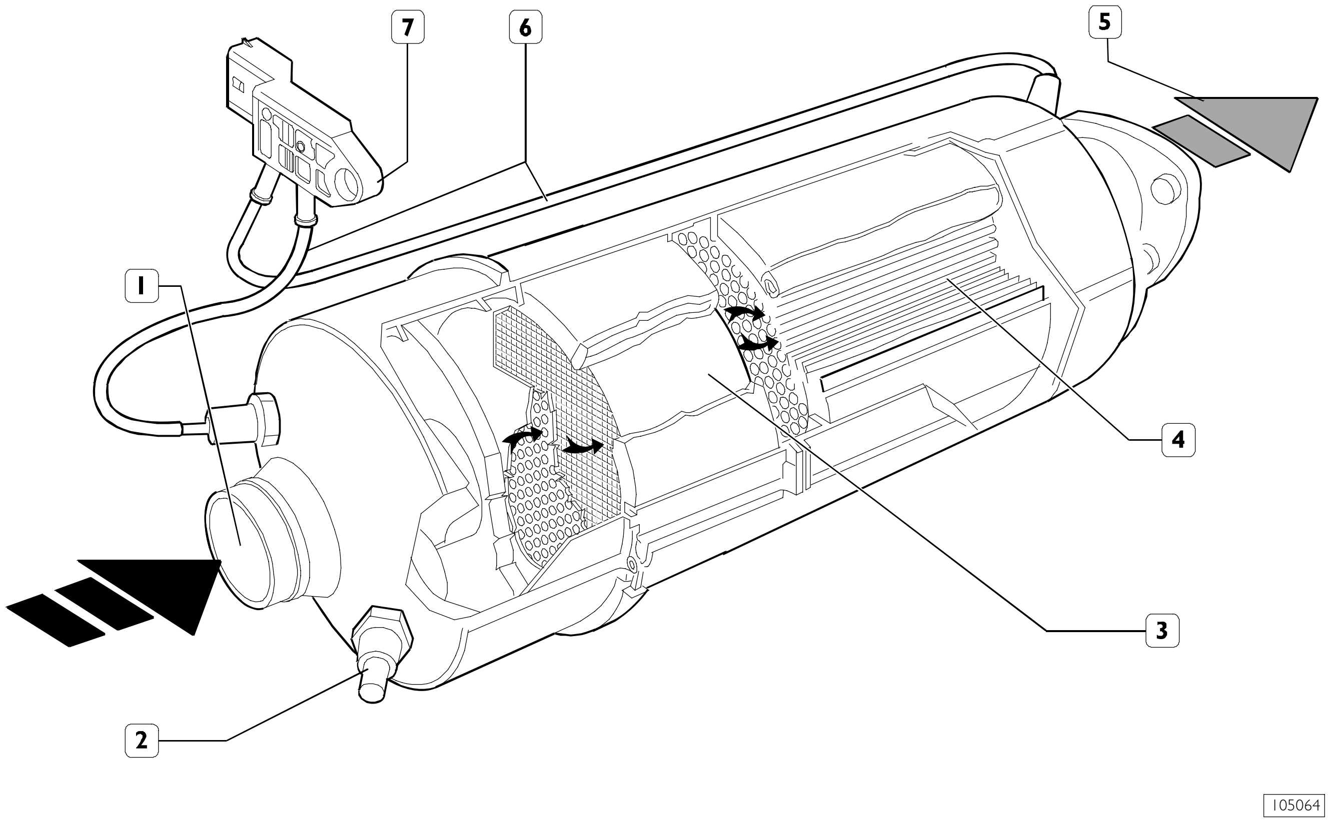
1. E.G.R. valve - 2. E.G.R. heat exchanger - 3. Air pressure/temperature sensor - 4. Engine revs sensor - 5. Vacuum pump coupling - 6. Modulating solenoid valve - 7. VGT actuator modulating solenoid valve (136 HP engine) - 8. Auxiliary vacuum tank for vehicles equipped with 136 HP engine - 9. Air filter - 10. Air flow meter) - 11. VGT actuator - 12. Differential pressure sensor (delta p) - 13. Incoming exhaust gas temperature sensor - 14. Outgoing exhaust gas temperature sensor - 15. DPF catalytic silencer - 16. Vacuum tank - 17. EDC control unit 16 - 18. Engine coolant temperature sensor - 19. Servo brake - 20. Throttle valve assembly.

General

To keep the exhaust emission levels of pollutants such as nitric oxides (NOx), hydrocarbons (HC) and particulate (PM) within the limits established by the Euro 4 standard, the engine is equipped with an EGR system combined, on request, to the DPF catalytic silencer for post-treatment of the aforesaid polluting substances.

507130 D.P.F. (Diesel Particulate Filter) CATALYST

Figure 281



D.P.F. CATALYST VIEW

1. Exhaust gas inlet- 2. Exhaust gas temperature sensor connection - 3. Catalyst module - 4. Particulate filter - 5. Exhaust gas outlet - 6. Pipes connecting pressure sensor to catalyst - 7. Differential pressure (Δp) sensor

Description

D.P.F. catalyst is made up of an oxidiser catalyst and a particulate filter.

Oxidiser catalyst (3) is an exhaust gas post-treatment device. Active substances, contained in the catalyst, oxidise, at 250 °C÷450 °C temperature, carbon oxide (CO) and hydrocarbons (HC), turning them into carbon dioxide (CO_2) and steam (H_2O).

Catalyst module is made up of a ceramic structure impregnated with platinum, as platinum is a catalysing substance in oxidation reactions. Exhaust gasses heat the catalyst, so triggering the conversion of pollutants into inert compounds.

Particulate filter (4), connected to the catalyst, has a double task: retaining particulate particles (PM) depositing between the pores of the ceramic structure of which the filter is made up and working as a particulate particles combustion chamber when the filter is being clogged.

If filter interior is kept at a temperature higher than 530 °C and oxygen percentage is higher than 8% (oxygen being produced by the decomposition of nitrogen oxide NO_2), then some combustion reactions, boosted by the catalyst put before the filter, burn particulate particles (regeneration), so keeping the filter clean.

Conversely, if its temperature is lower, the filter will get clogged, with bad effects on the back pressure to the exhaust gas generated.

In this case, to regenerate the filter, temperature of exhaust gasses is artificially raised (up to 630 °C) by fuel post-injection.

A differential pressure sensor (7), connected to D.P.F. catalyst, as it detects a pressure difference between inlet and outlet, sends a (feed-back) signal to the central unit to warn about particulate filter possible clogging.

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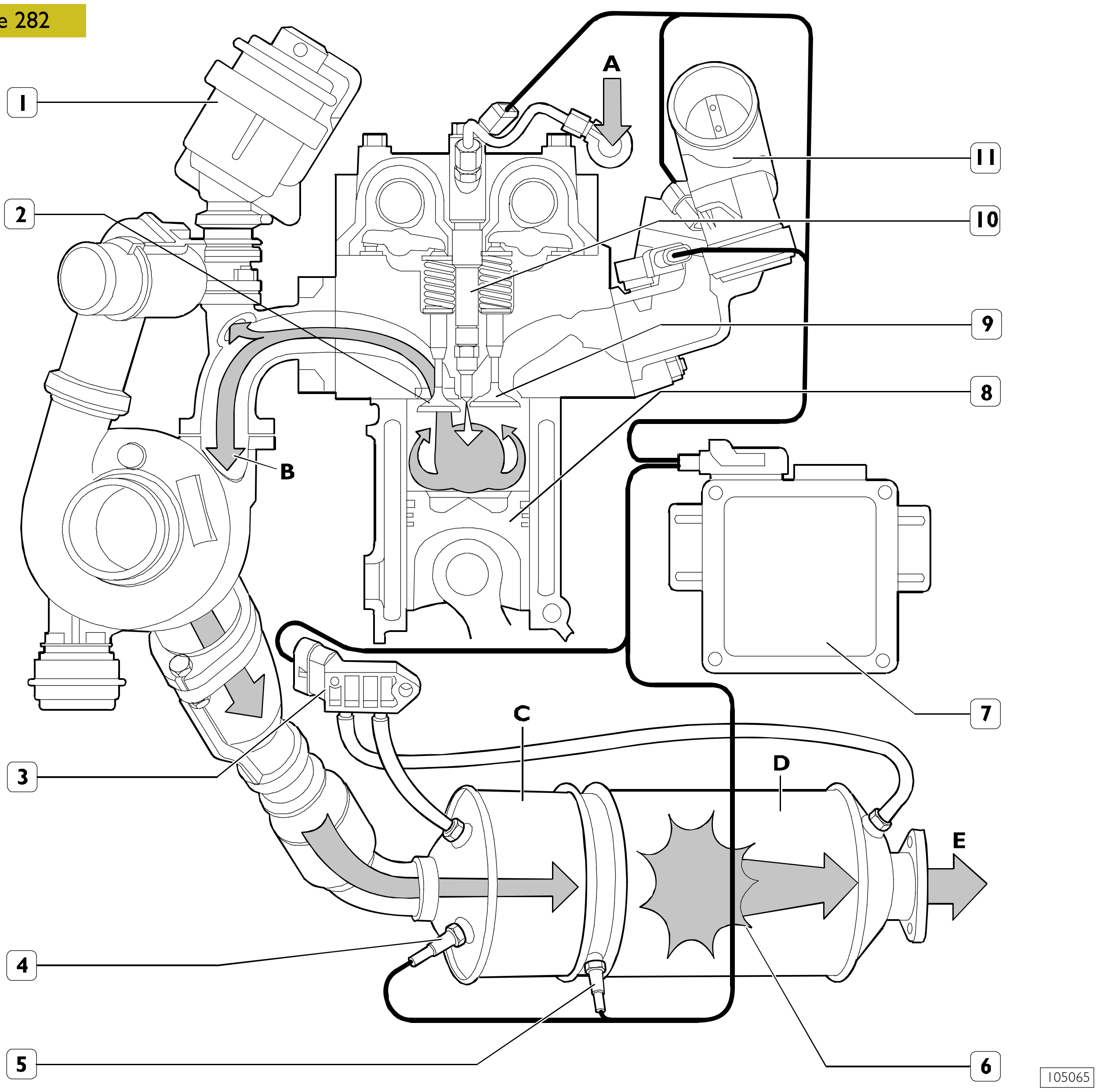
PARTICULATE FILTER REGENERATION SYSTEM

Figure 282



1. E.G.R. valve - 2. Exhaust valve - 3. Differential pressure sensor - 4. Inlet exhaust gas temperature sensor - 5. Outlet exhaust gas temperature sensor - 6. D.P.F. catalysed silencer - 7. E.D.C. 16 central unit - 8. Piston - 9. Inlet valve - 10. Electrical injector - 11. Throttle valve
A. Post-injection - B. Exhaust gasses heated by post-injection - C. Catalyst - D. Particulate filter - E. Purified exhaust gasses

Operation

Particulate filter regeneration is managed by engine E.D.C. 16 central unit. The central unit, based on the temperature of exhaust gasses detected by sensors (5 and 4) and particulate filter clogging grade detected by differential pressure sensor (3), when exhaust valve (2) is closing at about 1°÷3° from T.D.C., causes electrical injectors (8) to inject small quantities of fuel into the cylinders. The combustion of this fuel increases the temperature of flowing gasses.

At the same time, the central unit shuts out:

- ❑ Throttle valve (11), to prevent, at opening start, air from entering through inlet valve (9), as air would cool exhaust gasses;
- ❑ E.G.R. valve (1), to prevent recirculated oil vapours and gasses produced by post-injection from being sucked into the cylinders.

Exhaust gasses, so heated enter into the silencer, where, passing through the catalyst, the pollutants they are composed of (nitrogen oxides) are reduced or transformed into inert substances (carbon dioxide - steam), then pass into particulate filter where the regeneration process takes place: exhaust gas high temperature causes the combustion of particulate particles accumulated in the filter.

Particulate filter regeneration is realised when following conditions are present:

- catalyst inlet exhaust gas temperature >230 °C with the help from post-injection;
- exhaust gas temperature in particulate filter >530 °C with presence of free oxygen having a percentage >8%;
- minimum time of permanence in above conditions >10'.

Forced regeneration

In many cases of doubts about particulate filter cleanness actual conditions and/or of impossibility to regenerate it owing to very particular engine/vehicle running conditions (persistent idling, very slow speeds and very frequent stops), a safety forced regeneration has to be performed.

Independently of all parameters activating the regeneration, the engine is taken to run without load to a point where exhaust gasses have a temperature (>230 °C) such as to activate the reaction in the Oxicat in presence of post-injection.

The only limit to this operation is the presence in the filter of a particulate quantity that is in excess, being anyhow calculated by the central unit and set as a condition to regeneration startup.

Refilling engine oil

During vehicle use, the central unit counts post-injected fuel quantity in order to activate and maintain particulate filter regeneration.

A small quantity of this fuel, which is injected into the cylinders after combustion has already taken place and remains partially unburnt, leaks out through pistons spring rings into oil sump, accumulating to lubrication oil. Although a part of it, evaporating, will be burnt in the engine through recirculation system, its remaining part can degrade oil characteristics, impairing its functionality.

Quantity of accumulated fuel may increase in case of catalyst or engine inefficiency, and vehicle use in conditions of low temperature and/or small amounts of miles covered.

The central unit counts the amounts of post-injections and consequently determines the quantity of fuel accumulated in engine oil, and warns about refilling needed.

If, after refilling engine oil, the function is not reset, the central unit will keep on counting fuel accumulation increase even with new oil, with consequent engine oil refilling warning.

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FUEL SUPPLY

HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM (MS 6.3 - EDC 16)

General

Common Rail MS6.3 is a high-pressure electronic injection system for fast diesel engines with direct injection.
Its main features comprise:

- high injection pressures available (1600 bar);
- these pressures can be modulated between 250 bar up to the maximum operating pressure of 1600 bar, irrespective of the speed of rotation and engine load;
- capacity to operate at very high speeds (up to 6000 rpm);
- injection control precision (injection duration and advance);
- lower consumption;
- lower emissions.

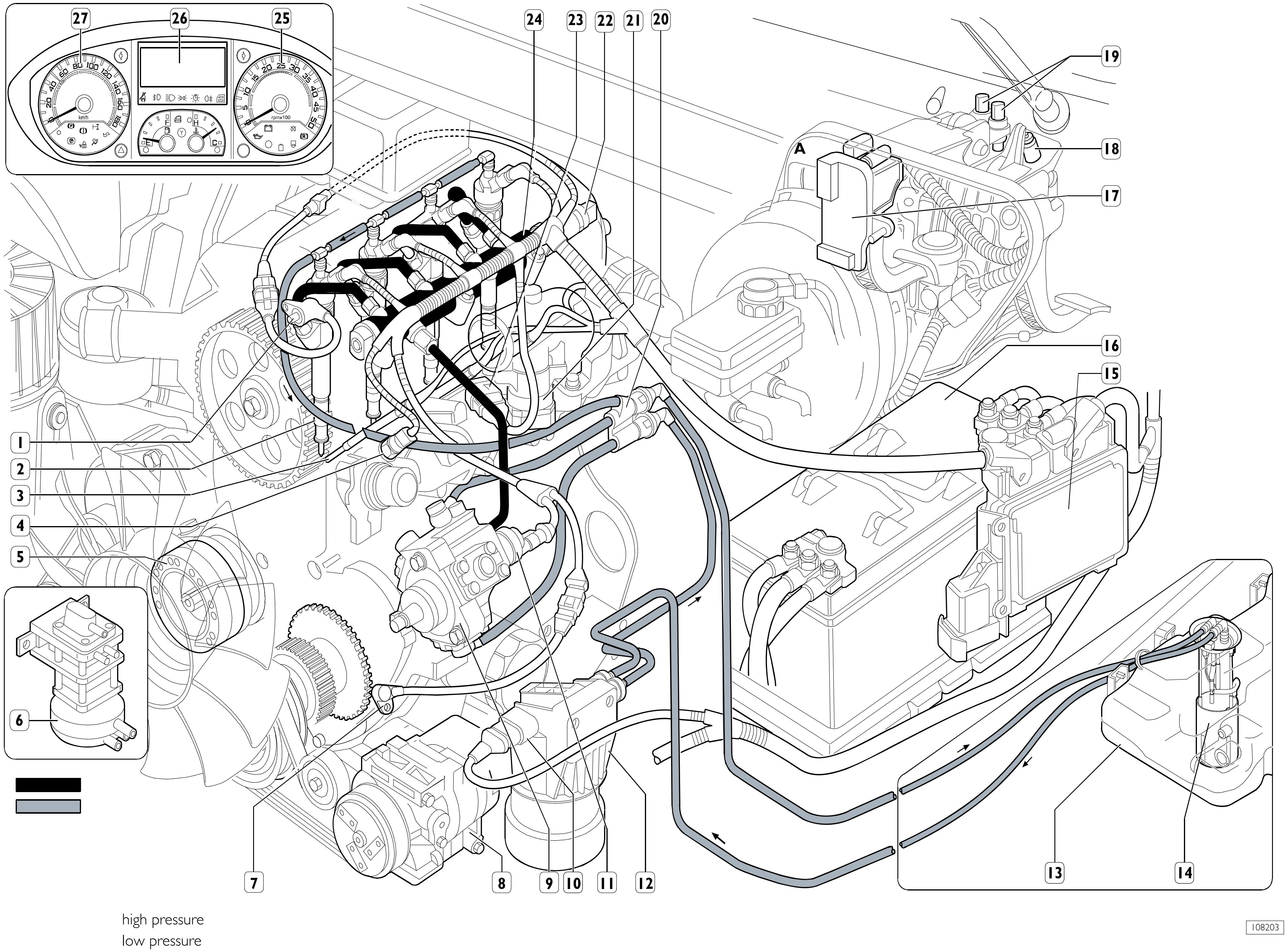
The main functions of the system are basically as follows:

- checking fuel temperature;
- checking engine coolant temperature;
- checking amount of fuel injected;
- checking idling speed;
- cutting off fuel in release phase;
- checking cylinder balancing when idling;
- checking anti-sawing;
- checking smokiness at exhaust on acceleration;
- checking exhaust gas recirculation (E.G.R.);
- checking top speed limit;
- checking glow plugs;
- checking activation of air-conditioning system (if any);
- checking auxiliary fuel pump;
- checking position of cylinders;
- checking main and pilot injection advance;
- checking closed cycle of injection pressure;
- checking turbocharging pressure;
- self-diagnosis;
- connection with immobilizer unit;
- checking maximum torque limitation.

The system makes pre-injection (pilot injection) possible before the TDC with the advantage of decreasing the derivative of the pressure in the combustion chamber, lowering the noise level of combustion, which is typical of direct injection engines.
The control unit checks the amount of fuel injected, adjusting the line pressure and injection times.
The information the control unit processes to regulate the amount of fuel to be injected comprises:

- engine speed;
- coolant temperature;
- turbocharging pressure;
- air temperature;
- intake air quantity;
- battery voltage;
- diesel pressure;
- position of throttle pedal.

Figure 283



HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM COMPONENTS LAYOUT

1. Timing phase sensor - 2. Electric injectors - 3. Preheating plug - 4. Coolant temperature sensor - 5. Electromagnetic fan - 6. E.G.R. valve modulator - 7. Engine revs sensor - 8. Compressor (if any) - 9. High-pressure pump - 10. Connector for fuel temperature sensor, heater and fuel filter clogging sensor (on request) - 11. Pressure regulator - 12. Fuel filter - 13. Fuel tank - 14. Fuel gauge with built-in electric fuel pump - 15. Control unit with atmospheric pressure sensor - 16. Battery - 17. Accelerator pedal sensor - 18. Clutch pedal sensors - 19. Brake pedal sensors - 20. Low-pressure fuel pipes - 21. Throttle valve assembly - 22. Hydraulic accumulator (rail) air pressure/temperature sensor - 23. Air pressure/temperature sensor - 24. Hydraulic accumulator - 25. Engine revs counter - 26. Display - 27. Tachograph.

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SYSTEM OPERATION
Self-diagnosis – BLINK CODE

The control unit self-diagnosis system checks the signals from the sensors, comparing them with the admitted limits (see relative heading):

Immobilizer recognition

When the control unit receives the signal of the key on "MAR" it communicates with the immobilizer control unit to enable starting.

Checking fuel temperature

With the fuel temperature greater than 75°C, detected by the sensor on the fuel filter, the control unit operates the pressure regulator to decrease the line pressure (injection times are not changed). If the temperature exceeds 90°C, the power is reduced to 60%.

Checking engine coolant temperature

The control unit, depending on the temperature:

- of the engine coolant, turbocharging air and fuel, operates the electromagnetic fan (Baruffaldi) and switches on the coolant temperature warning light.

Checking quantity of fuel injected

According to the signals from the sensors and the mapped values, the control unit:

- operates the pressure regulator;
- varies the "pilot" injection time to 2200 rpm;
- varies the "main" injection time.

Checking idling adjustment

The control unit processes the signals from the various sensors and regulates the amount of fuel injected:

- it operates the pressure regulator;
- it varies the injection times of the electro-injectors.

Within certain thresholds the speed takes account of the battery voltage.

Fuel cut-off in release phase

In the phase of releasing the throttle pedal the control unit actuates the following logic elements:

- it cuts off supply to the electro-injectors;
- it partially reactivates supply to the electro-injectors before reaching idling speed;
- it operates the fuel pressure regulator.

Checking cylinder balancing on idling

According to the signals received from the sensors, the control unit controls the regularity of the torque at idling speed:

- it varies the amount of fuel injected into the single electro-injectors (injection time).

Checking regular engine rotation (anti-sawing)

It ensures regular engine rotation at a constant rate while increasing revs.
The control unit processes the signals received from the sensors and determines the amount of fuel to be injected via:

- the pressure regulator;
- the electro-injector opening time.

Checking smokiness at exhaust on acceleration

With heavy acceleration, on the basis of the signals received from the air introduction meter and engine speed sensor, the control unit determines the optimum amount of fuel to inject:

- it operates the pressure regulator;
- it varies the electro-injector injection time.

Checking exhaust gas recirculation (E.G.R.)

Depending on the engine load and the signal from the accelerator pedal sensor, the control unit limits the amount of air taken in, actuating partial suction of the exhaust gases.

Checking top speed limit

Depending on the number of revs, the control unit actuates two action strategies:

- at 4250 rpm it cuts off the fuel, decreasing the electro-injector opening time;
- over 5000 rpm it deactivates the electro-injectors.

Checking regular rotation on acceleration

Regular progression is assured in all conditions by the control of the pressure regulator and the electro-injector opening time.

Checking glow plug control unit

The injection control unit, in the phase of:

- starting
- after-starting

times operation of the glow plugs according to the engine temperature.

Checking activation of air-conditioning system

The control unit operates the air-conditioning compressor:

- switching it on/off when the relative switch is pressed;
- momentarily turning it off (approximately 6 sec.) if the engine coolant reaches the set temperature.

Checking fuel pump

Irrespective of the speed, the control unit:

- supplies the auxiliary fuel pump with the key on MAR;
- cuts off auxiliary pump supply if the engine is not started up within a few seconds.

Checking diesel warming

It times operation of diesel warming in relation to ambient temperature.

Checking cylinder position

During each turn of the engine, the control unit recognizes which cylinder is in the power stroke and operates the injection sequence for the appropriate cylinder.

Checking pilot and main injection timing

According to the signals from the various sensors, including the absolute pressure sensor built into the control unit, the control unit determines the optimum point of injection according to internal mapping.

Checking injection pressure closed cycle

Depending on the engine load, determined by processing the signals from the various sensors, the control unit operates the regulator to obtain optimum line pressure.

Fuel supply

The fuel supply is calculated in relation to:

- accelerator pedal position
- engine speed
- quantity of air introduced.

The outcome may be corrected in relation to:

- the water temperature.

Or to avoid:

- noise
- smoke
- overloading
- overheating
- turbine over-revving.

The delivery can be modified in the case of:

- action of external devices (ABS), ABD, EDB
- serious trouble decreasing the load or stopping the engine.

After determining the mass of air introduced by measuring its volume and temperature, the control unit calculates the corresponding mass of fuel to inject into the relevant cylinder (mg per delivery) also taking into account the temperature of the diesel.
The mass of fuel calculated in this way is first converted into volume (mm^3 per delivery) and then into degrees of throw, or duration of injection.

Correcting flow rate according to water temperature

A cold engine meets with greater resistance during operation: friction is high, the oil is still very viscous, and the various clearances are not yet optimized.
In addition, the injected fuel tends to condense on the metal surfaces that are still cold.
The fuel supply for a cold engine is therefore greater than for a warm one.

Correcting flow rate to avoid noise, smoke or overloading

The behaviour that could lead to this kind of trouble is well known.

The designer has therefore included special instructions in the control unit to avoid it.

De-rating

In the event of the engine overheating, injection is modified, decreasing the delivery to a varying degree, in proportion to the temperature reached by the coolant.

Injection timing electronic test

The advance (start of delivery, expressed in degrees) may be different from one injection to the next, also differentiated from one cylinder to another. It is calculated, similarly to the delivery, in relation to the engine load (accelerator position, engine speed and air introduced).
The advance is appropriately corrected:

- in phases of acceleration;
- according to the water temperature.

And also to obtain:

- lower emissions, noise and overloading;
- better vehicle acceleration.

An extremely high advance is set on starting, depending on the water temperature.
Feedback from the start of delivery is supplied by the change in impedance of the injector solenoid valve.

Speed governor

The electronic speed governor has both features of governors:

- idling and top speed
- all speeds

It is stable in ranges where conventional, mechanical governors are imprecise.

Engine starting

During the first few turns of the engine, the timing and cylinder no. 1 recognition signals (flywheel sensor and camshaft sensor) are synchronized.
The accelerator pedal signal is ignored on starting. Starting delivery is set only according to water temperature, by a special map.
When the control unit detects such speed and acceleration of the flywheel as to be able to consider the engine started up and no longer driven by the starter motor, it re-enables the accelerator pedal.

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Cold starting

If even just one of the three temperature sensors (water, air or diesel) records a temperature lower than 10°C, pre-post heating is activated.
When the key makes contact the pre-heating indicator light comes on and stays on for a length of time that varies in relation to the temperature (while the glow plugs in the cylinder head heat the air), then flashes. It is now possible to start up the engine.
When the motor is running this indicator light goes out, while the glow plugs continue to be powered for a certain length of time (variable) for post-heating.
If, with the indicator light flashing, the engine is not started up within 20-25 seconds (inattention time), the operation is cancelled so as not to run down the batteries pointlessly.
The pre-heating curve is also variable in relation to the battery voltage.

Warm starting

If the reference temperatures all exceed 10°C, when the key makes contact the indicator light comes on for approximately 2 sec., for a short test, and then goes out. It is now possible to start up the engine.

Run up

When the key makes contact, the control unit transfers the information stored in memory when the engine was last stopped into the main memory (see After Run) and makes a diagnosis of the system.

After run

Whenever the engine is switched off with the key, the control unit stays powered for a few seconds by the main relay.
This makes it possible for the microprocessor to transfer some data from the main memory (volatile) to a non-volatile memory, which can be erased and written over (EEPROM), so as to make it available at the next start up (see Run Up).

These data basically consist of:

- various settings (engine idling adjustment, etc.);
- settings of some components;
- fault memory.

The process lasts a few seconds, typically from 2 to 7 (depending on the amount of data to save), after which the ECU sends a command to the main relay and makes it disconnect from the battery.

NOTE It is extremely important for this procedure not to be broken off, for example by switching off the engine with the battery cut-out, or by disconnecting the battery cut-out before 10 seconds have passed since switching off the engine.
If this happens, the functioning of the system is ensured, but repeated interruptions may damage the control unit.

Cut-off

This function cuts off fuel delivery when the vehicle is decelerating (accelerator pedal released).

Cylinder balancing

Individual cylinder balancing contributes to increasing comfort and handling.
This function permits individual, customized control over the delivery of fuel and the start of delivery for each cylinder, even differently from one cylinder to another, to compensate for the hydraulic tolerances of the injector.

The differences in flow (delivery specifications) between the various injectors cannot be evaluated directly by the control unit. This information is supplied by Modus reading the bar code of each injector at the time of assembly.

Synchronization search

If there is no signal from the camshaft sensor, the control unit is anyhow able to recognize the cylinders into which the fuel is to be injected.
If this occurs when the engine is already running, the combustion sequence has already been acquired, so the control unit continues with the sequence on which it has already been synchronized.
If this occurs when the machine is at a standstill, the control unit energizes a single solenoid valve. Within at most 2 turns of the crankshaft, injection will take place in that cylinder, so the control unit just needs to get synchronized on the firing sequence and to start up the engine.

OPERATION

In this injection system, the pressure regulator, located upstream from the high-pressure pump, governs the flow of fuel needed in the low-pressure system. Afterwards, the high-pressure pump correctly supplies the hydraulic accumulator.

This solution, pressurizing solely the necessary fuel, improves the energy efficiency and limits heating the fuel in the system. The relief valve fitted on the high-pressure pump has the function of keeping the pressure, at the pressure regulator inlet, constant at 5 bars; irrespective of the efficiency of the fuel filter and of the system upstream. The action of the relief valve causes an increase in the flow of fuel in the high-pressure pump cooling circuit.

The high-pressure pump continually keeps the fuel at the working pressure, irrespective of the timing and the cylinder that is to receive the injection and accumulates it in a duct common to all the electro-injectors.

At the electro-injector inlet, there is therefore always fuel at the injection pressure calculated by the electronic control unit.

When the solenoid valve of an electro-injector is energized by the electronic control unit, fuel taken straight from the hydraulic accumulator gets injected into the relevant cylinder.

The hydraulic system is made out of a low-pressure fuel recirculation circuit and a high-pressure circuit.

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

- ;pipe connecting the high-pressure pump outlet to the hydraulic accumulator (rail);
- hydraulic accumulator (rail);
- pipes feeding the electric injectors from the hydraulic accumulator.

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

- fuel intake pipe from the tank to the filter;
- pipe assembly made up of the following:
  - feed pipe from the fuel filter to the high-pressure pump;
  - fuel return pipe from the high-pressure pump to the tank;
  - fuel exhaust pipe from the injectors to the fuel return pipe to the tank.

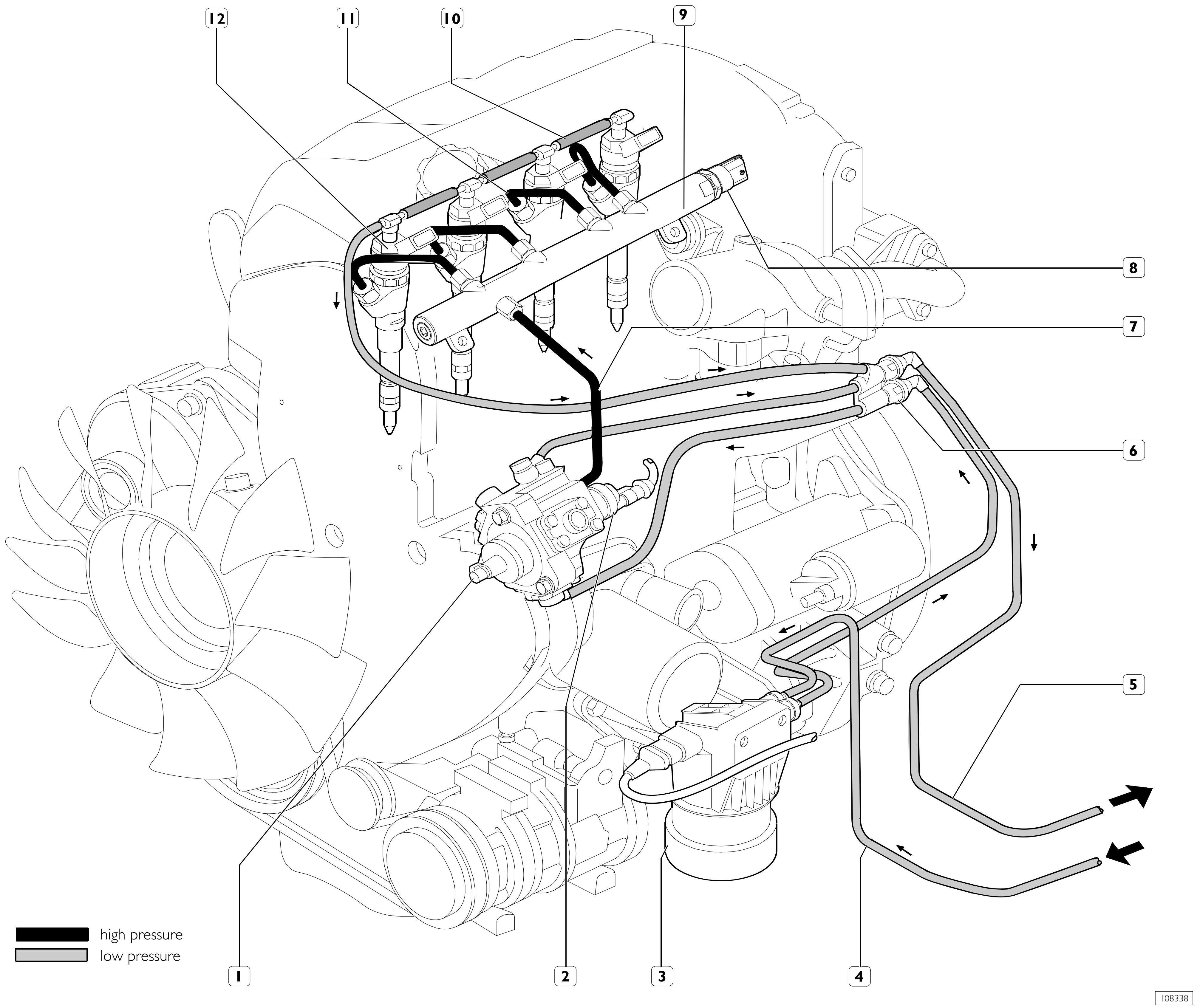
According to the high performance of this hydraulic system, for reasons of safety it is necessary to:

- avoid connecting high-pressure pipe fittings with approximate tightening;
- avoid disconnecting the high-pressure pipes with the engine running (NEVER try bleeding, which is both pointless and dangerous).

The integrity of the low-pressure circuit is also essential for the system to work properly; it is therefore necessary to avoid all manipulation and modifications and act only in the event of leakage.

NOTE The pipes connected to the fuel filter support to the low-pressure pipe assembly are of the quick-connect type.
Before fitting them, make sure the couplings and the associated fittings on the mounting are clean.

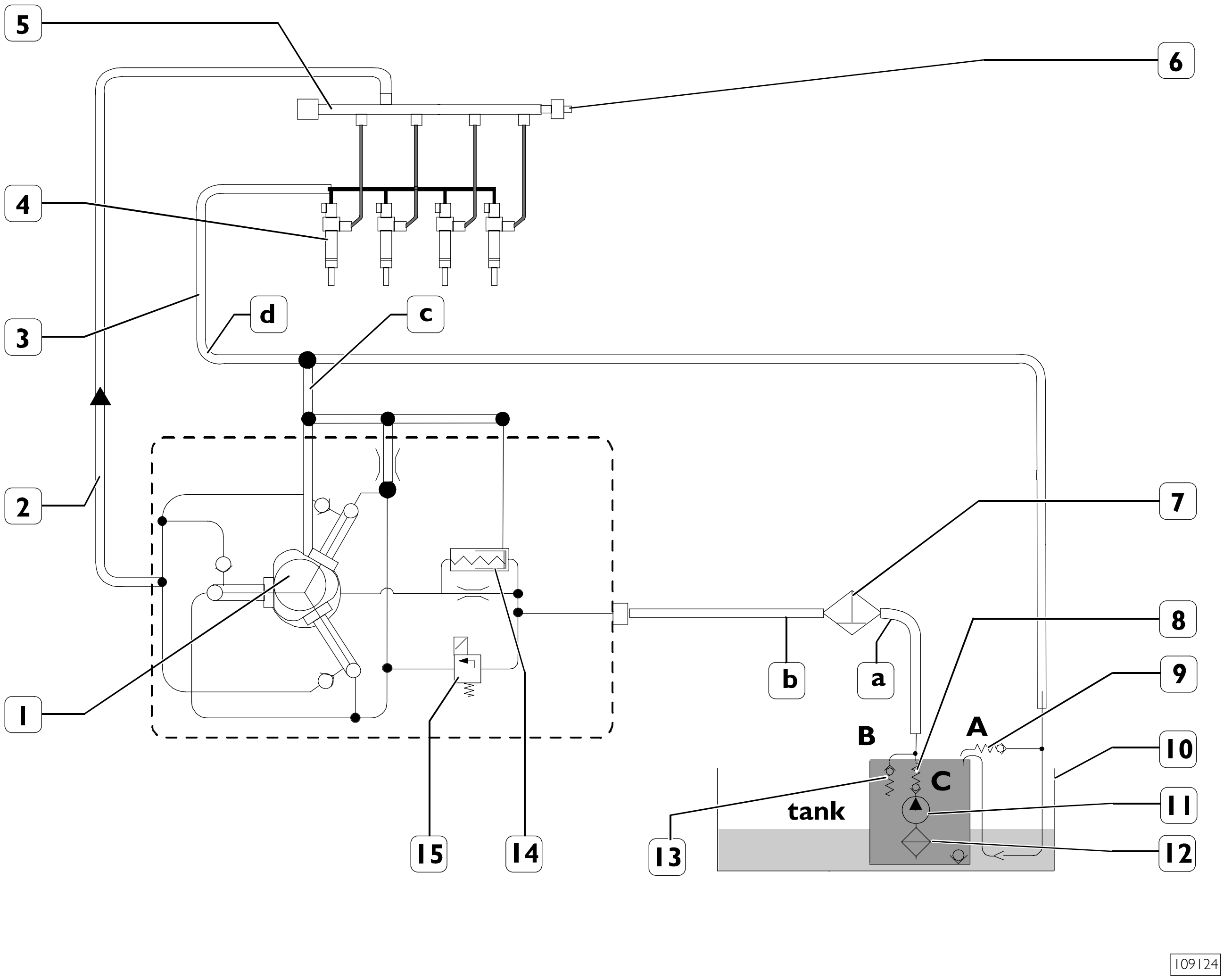
Figure 284



FUEL RECIRCULATION AND SUPPLY SYSTEM DIAGRAM

1. CP1 H high-pressure pump - 2. Pressure regulator - 3. Heated fuel filter with water separator - 4. Fuel delivery pipe to the filter - 5. Fuel return pipe to the tank - 6. Low-pressure pipe assembly - 7. High-pressure delivery pipe to the hydraulic accumulator - 8. Pressure sensor - 9. Hydraulic accumulator - 10. Return pipe from the electric injectors to the low-pressure pipe assembly - 11. High-pressure pipe between the hydraulic accumulator and the electric injectors - 12. Electric injectors.

Figure 285



FUNCTIONAL DIAGRAM OF HYDRAULIC SYSTEM

1. High-pressure pump - 2. High-pressure delivery pipe - 3. Electric injector return pipe - 4. Electric injectors - 5. Common rail - 6. Fuel pressure sensor - 7. Filter with water separator - 8. Fuel electric pump non-return valve - 9. Injector return line pressure-relief valve - 10. Tank - 11. Fuel electric pump - 12. Fuel electric pump intake filter - 13. Fuel electric pump overpressure valve - 14. Pressure-relief valve - 15. Proportional pressure-relief valve.

Relative pressures within the circuit:

a. 4.15 bar < p < 5.35 bar
b. 3.5 bar < p < 5.0 bar
c. p < 0.8 bar
d. 0.3 bar < p < 0.8 bar

HYDRAULIC SYSTEM

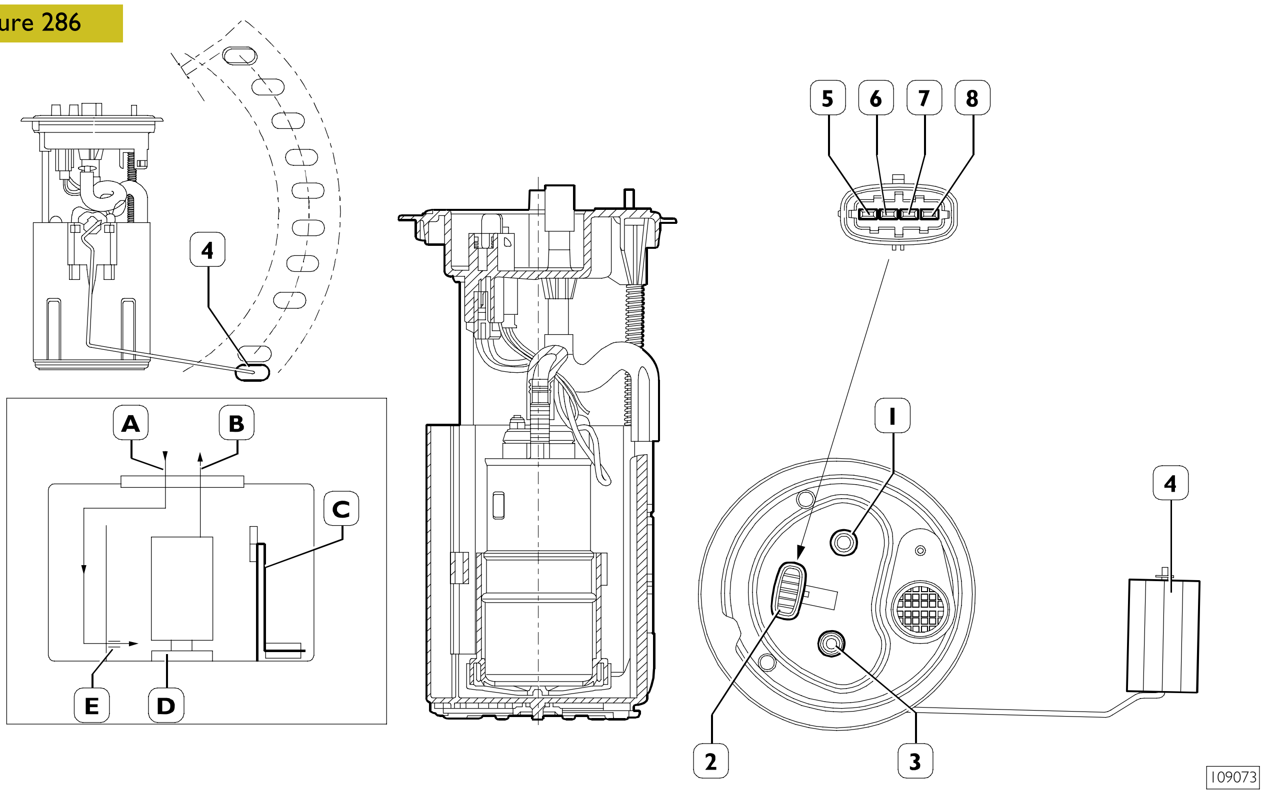
The hydraulic system is composed of:

- tank
- electronic fuel pump;
- fuel filter;
- high-pressure feed pump;
- pressure regulator;
- manifold (rail);
- electric injectors;
- low-pressure feed pipe assembly;
- high-pressure pipes.

773010 Fuel pump

The fuel electric pump is of the volumetric, low-pressure type. It is built into the fuel level indicator located in the fuel tank

Figure 286



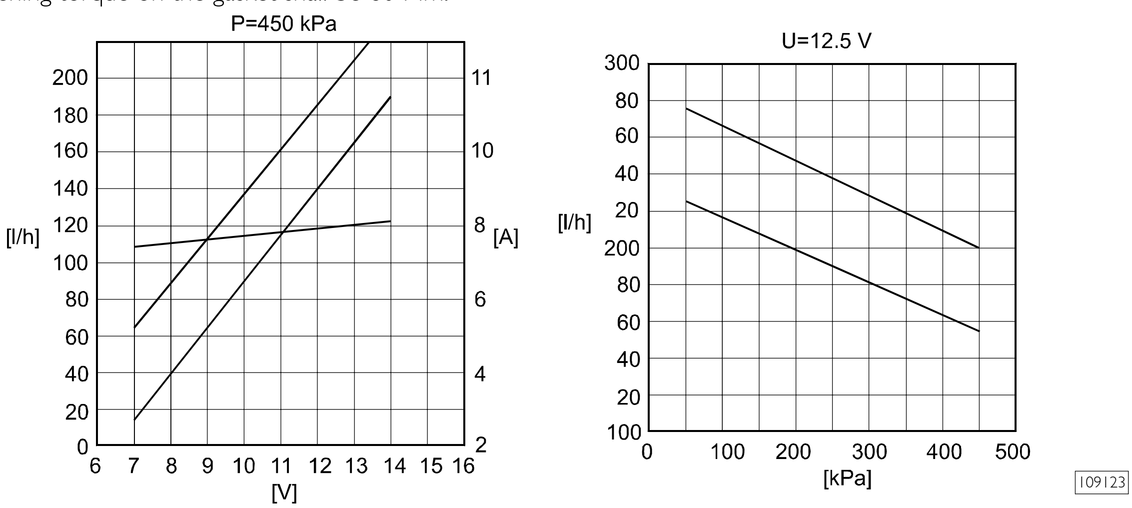
FUEL ELECTRIC PUMP ASSEMBLY SECTION

1. Return - 2. Connector - 3. Delivery - 4. Float - 5. Level sensor (+) - 6. Level sensor (-) - 7. Pump (-) - 8. Pump (+) - A. Return line - B. Delivery line - C. Level sensor - D. Prefilter - E. Jet pump.

Electric connector (2), located in the upper portion of the assembly, features the pins both for the electric pump and the level sensor.

During the installation, the assembly shall not be stressed with axial loads of more than 67 N and torque of more than 3 Nm. The maximum fastening torque on the gasket shall be 60 Nm.

Figure 287



CHARACTERISTIC CURVES

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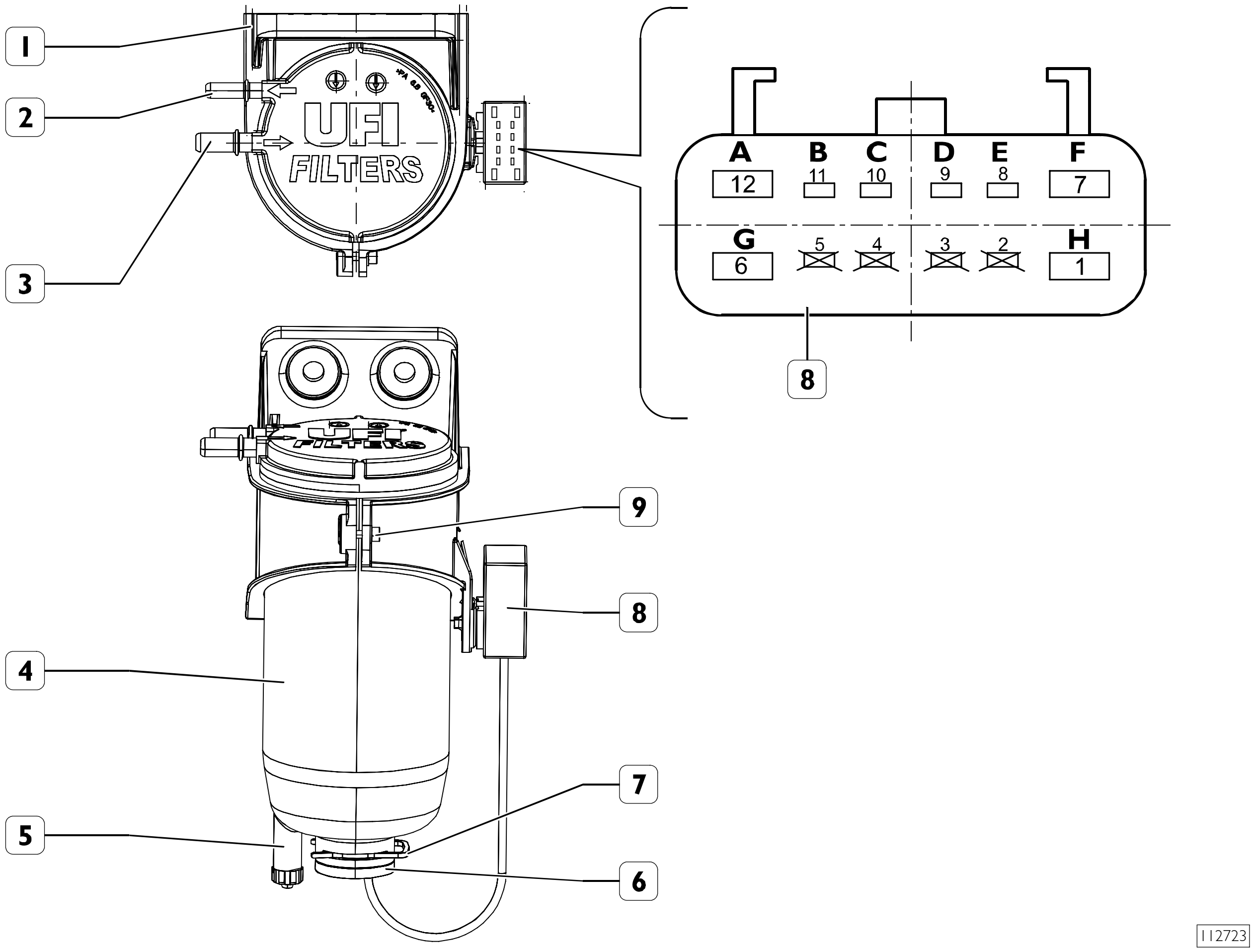
542011 Fuel filter "UFIfilters"

Figure 288



1. Fuel filter support- 2. Diesel oil outlet - 3. Diesel oil inlet - 4. Diesel oil filter - 5. Drain screw - 6. Electronic unit - 7. Fastener - 8. 12-way connector - 9. Screw securing Diesel oil filter: H-G-B, water present sensor; - H-C, clogging sensor (if foreseen); - D-E, NTC temperature sensor; - F-A, heater.

Fuel filter (4) is made up of a filtering cartridge with water separator, inside which electronic unit (6) is housed.
Water accumulation capacity is equal to 140 cm^3.
Electronic unit (6) includes water present sensor, (optional) filter clogging sensor and temperature sensor.

Water present sensor

Water present sensor detects water present in the filter starting from 110 cm^3 volume present. Water present sensor provides values of:

- low voltage in presence of water;
- high voltage in absence of water.

Characteristics

12V nominal voltage (8V minimum -16V maximum

Absorbed current:

- lower than 15 mA in rest conditions;
- lower than 150 mA in alarm conditions (including load).

Voltage on load:

- in rest conditions: higher than 11.8 V;
- in alarm conditions: lower than 3.9 V.

At key-on operation, the sensor makes a self-test issuing 2.5 second duration sound signal.

Normally open contact type.

Operation differential pressure delta p: 0.8 $^{+0,05}_{-0,5}$ bar

NTC temperature sensor

30 °C =	26.114 ohm ± 9.7%
0°C =	5.896 ohm ± 7.3%
+25 °C =	2.057 ohm ± 5.6%
+60 °C =	596 ohm ± 3.8%
+100 °C =	186 ohm ± .2.0%
+110 °C =	144 ohm ± 2.4%

Temperature range: -40°C to +130°C

Heater

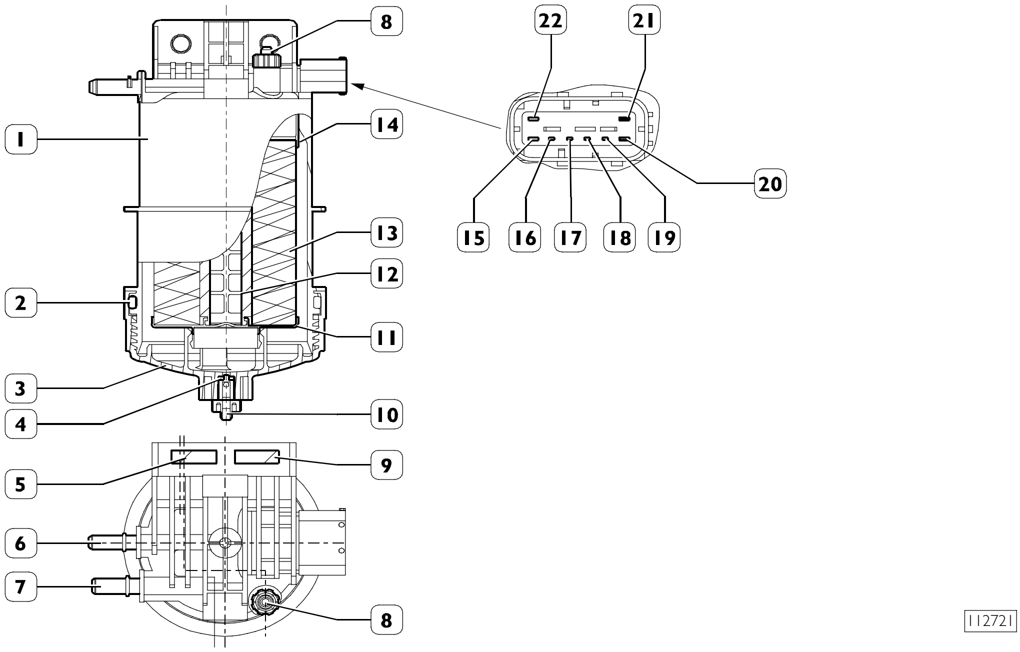
Nominal voltage	12 V
Maximum allowed voltage	30 V
Nominal power	250 W

Tightening torques

9.	Screw securing filter	1.5 + 0.5 Nm
4.	Water draining or air bleeding screw	1.5 + 0.5 Nm

542011 Fuel filter "Filtrauto"

Figure 289



1. Body - 2. Gasket - 3. Cover bottom - 4. Drain screw gasket - 5. Customer reference - 6. Diesel oil outlet - 7. Diesel oil inlet - 8. Air drain screw - 9. Supplier code - 10. Air bleeding or water draining screw - 11. Lower bottom - 12. Inner pipe - 13. Filtering paper - 14. Upper bottom - 15. Heating earth - 16. NTC1 - 17. NTC2 - 18. Clogging sensor (if foreseen) - 19. Water sensor - 20. Heating - 21. Feed - 22. GND

The fuel filter consists of an internal filtering-paper cartridge (13) and is equipped with a water separator.
The maximum water storage capacity of the filter is 150 cm^3.
The water sensor detects the presence of water in the filter starting from an existing volume of 70 cm^3.
This sensor is located in the lower part of the filter.
The temperature, water and clogging (if any) sensors are interfaced with the electronic circuit (11) located inside in the upper portion of the assembly.
When the diesel fuel temperature is lower than a limit value, the electric resistor will come into operation by properly heating the diesel fuel before the latter is conveyed to the high-pressure pump.

Clogging sensor (if any) features:
- differential working pressure: 0.7 to 0.85 bar

Tightening torques

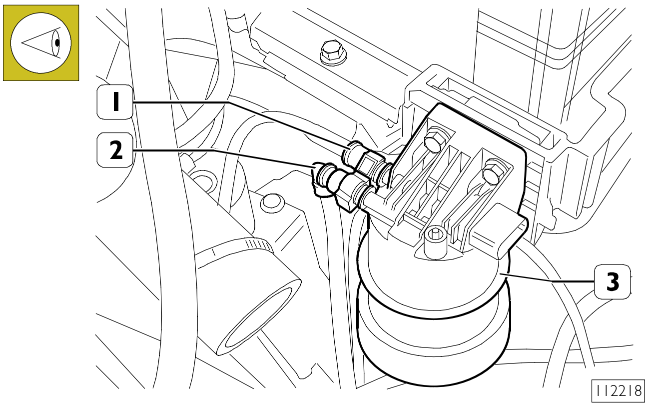
5. Cover	35±5 Nm
12. Air/water drain screw	1±0.2 Nm

NTC and heating features

- rated voltage	13.5 V
- max. permitted voltage	30 V
- rated output	250 W at 185 l/h, T = - 10°C
- temperature range	-30 to 120°C

Fuel pipes

Figure 290



1. High-pressure pump supply pipe quick-coupling fitting – 2. Supply pipe quick-coupling fitting – 3. – Fuel filter mounting.

NOTE Due to the very high pressure existing within this hydraulic system, the following precautions shall be taken for safety reasons:

- avoid connecting the high-pressure pipe fittings by means of makeshift fasteners: tighten them to the specified torque;
- avoid disconnecting the high-pressure pipes when the engine is running (DO NOT make any attempt at draining: this is absolutely useless and dangerous

To ensure correct operation of the system, it is essential that the low-pressure circuit is intact. Therefore, any modification or attempt at tampering shall be avoided, and corrective actions shall be taken immediately in case of leaks.

In the event that fuel pipes (1-2-3) are disconnected from support (1), make sure, when reattaching the pipes, that their respective fittings are fully clean.

Such precautions shall be taken to avoid detective sealing, with resulting fuel leaks.

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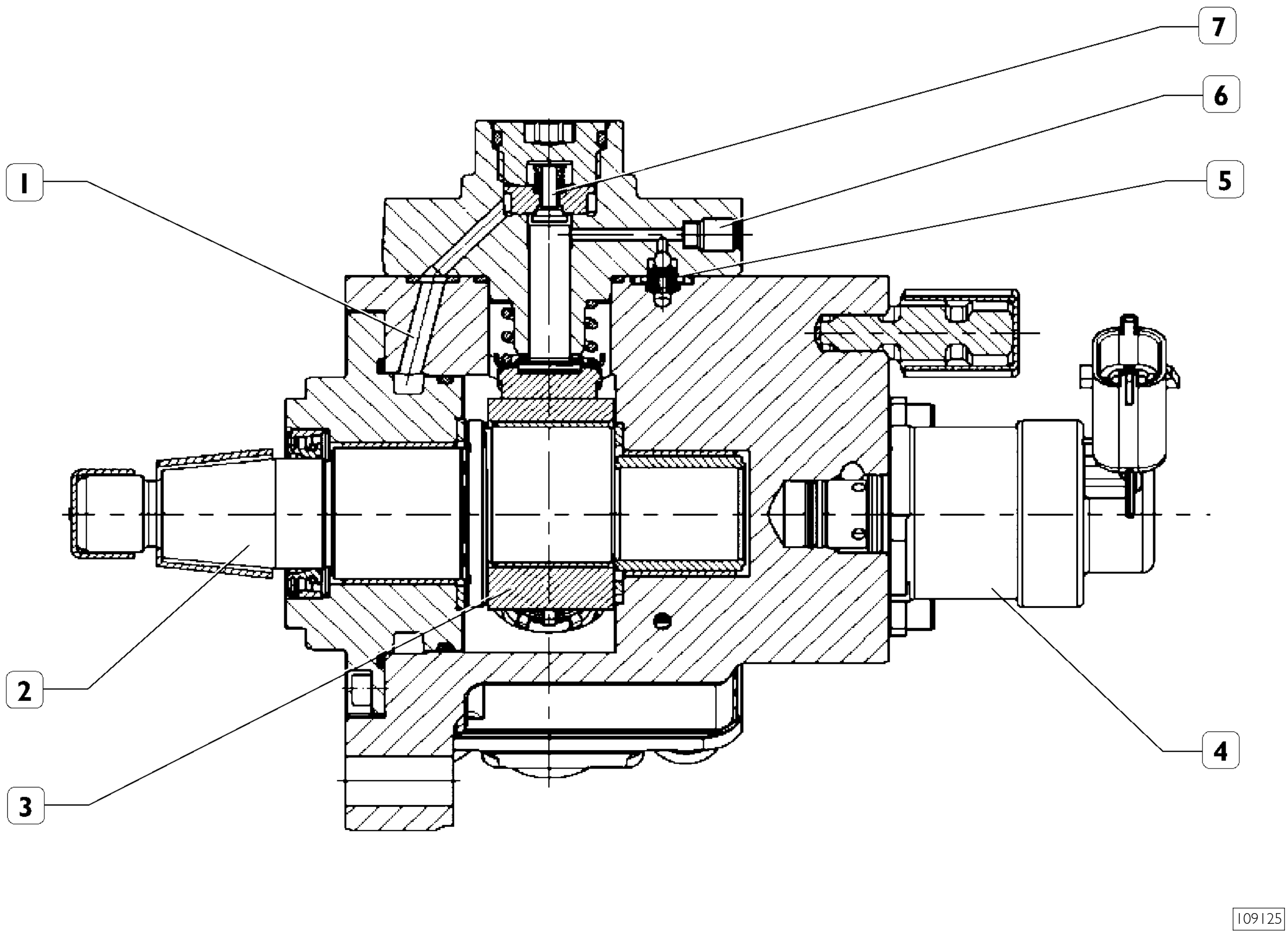
775010 High-pressure pump CPH1

Figure 291



1. Low-pressure feed line - 2. Shaft with cam - 3. 3-lobe element - 4. Pressure regulator - 5. High-pressure line non-return valve - 6. Delivery line - 7. Low/high-pressure line non-return valve.

Pump with 3 radial pumping elements controlled via a gear by the timing belt; it needs no timing.
The pump is lubricated and cooled by the fuel.

NOTE The high-pressure pump cannot be overhauled; therefore, the fastening screws shall not be removed or tampered with. The only operation that can be carried out is the replacement of the drive gear and pressure regulator.

771034 Pressure control valve

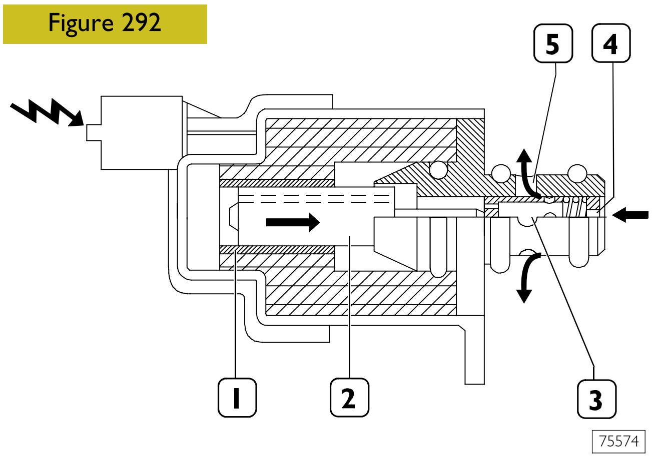
The fuel pressure regulator is mounted on the low-pressure circuit of the CP3 pump. The pressure regulator modulates the amount of fuel sent to the high-pressure circuit according to the commands received directly from the engine control unit. The pressure regulator is mainly composed of the following components:

- connector
- casing
- solenoid
- pre-load spring
- shutter cylinder.

When there is no signal, the pressure regulator is normally open, therefore with the pump providing maximum delivery. The engine control unit, via the PWM (Pulse Width Modulation) signal, modulates the change in fuel flow rate in the high-pressure circuit by partially closing or opening the sections of passage of the fuel in the low-pressure circuit.

Operation

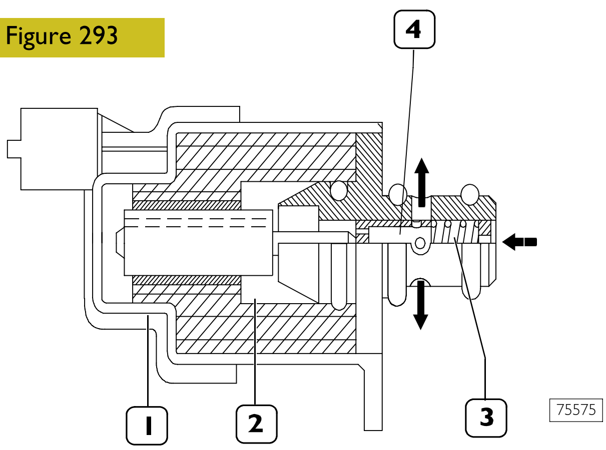
Figure 292



1. Solenoid – 2. Magnetic core – 3. Shutter cylinder – 4. Fuel inlet – 5. Fuel outlet.

When the engine control unit governs the pressure regulator (via PWM signal), the solenoid (1) is energized that, in its turn, generates the movement of the magnetic core (2). The shift of the core causes the shutter cylinder (3) to move axially, choking the flow of fuel.

Figure 293

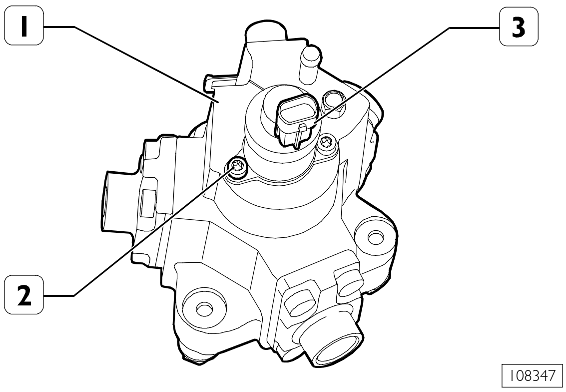


1. Solenoid – 2. Magnetic core – 3. Pre-load spring – 4. Shutter cylinder.

When the solenoid (1) is not energized, the magnetic core is pushed into the rest position by the pre-load spring (3). In this condition, the shutter cylinder (4) is in such a position as to offer the fuel the greatest section of passage.

Replacing pressure regulator

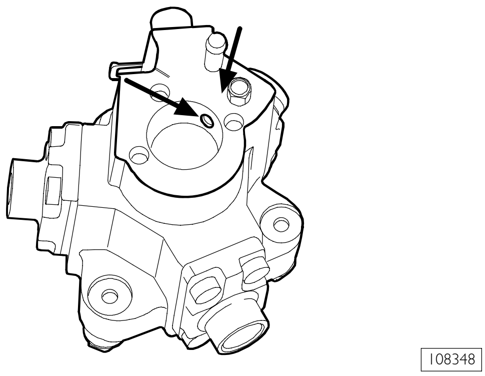
Figure 294



Accurately clean high pressure pump.

Take off screws (2) and unthread pressure regulator (3) from high pressure pump.

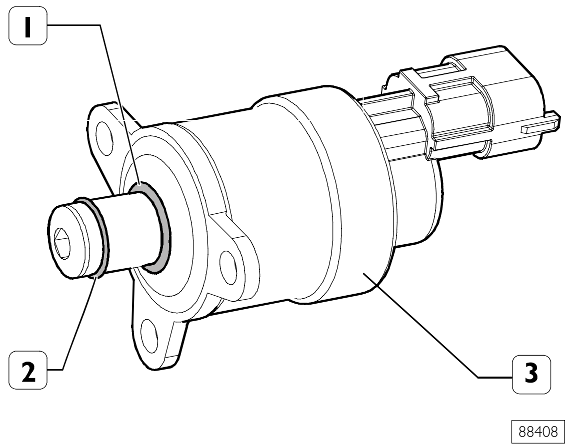
Figure 295



Accurately clean the seat (→) of pressure regulator and the connection surface (→) of the regulator.

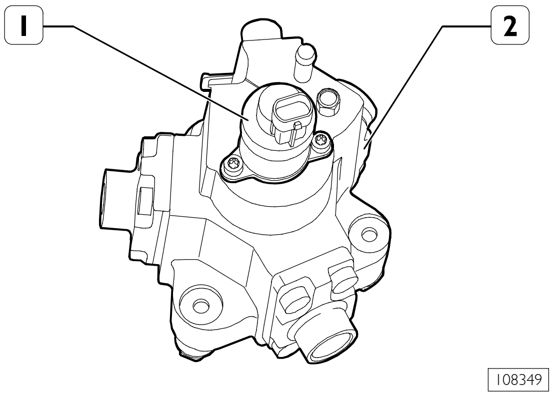
NOTE For cleaning, do not use a tool which could damage the surfaces and pay attention that impurities are not introduced into channels.

Figure 296



Mount new seal rings (1 and 2) on pressure regulator (3) and lubricate the rings with vaseline.

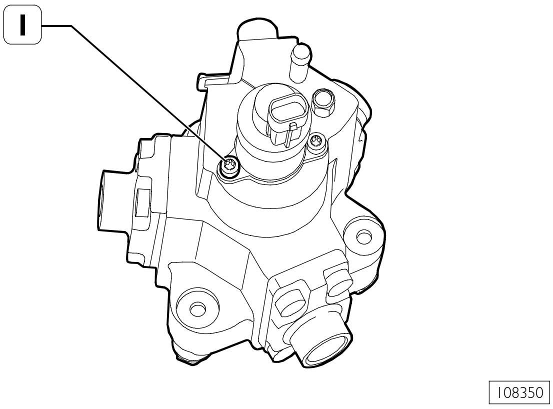
Figure 297



Mount pressure regulator (1) on high pressure pump (2).

NOTE Mounting operation must be performed keeping the regulator perpendicular to connection plane without angling it, in order not to damage seal rings (1-2, Figure 296).

Figure 298

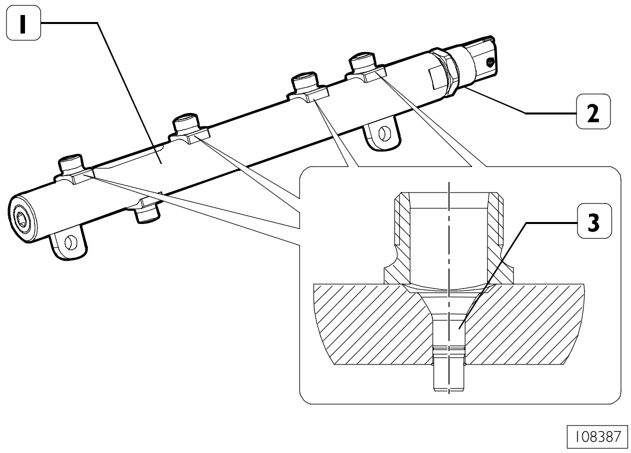


Screw up screws (1) and tighten them at 6 ÷ 7 Nm (0.6 ÷ 0.7 kgm) torque.

NOTE Where pressure regulator is replaced on the engine mounted on the vehicle, it is needed, after replacement, to check that there are no fuel leaks after an engine working period.

774510 Hydraulic accumulator (rail)

Figure 299



The hydraulic accumulator is mounted on aspiration side cylinder head.
Its task is to damp pressure oscillations caused:

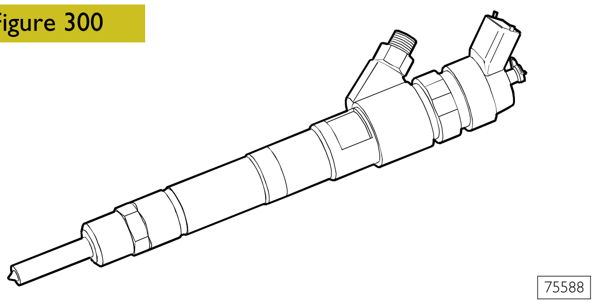
- the operation of the high-pressure pump;
- the opening of the electro-injectors.

Fuel pressure sensor (2) is fitted on hydraulic accumulator (1).

Small valves (throttle valves) or control bushes (3), with ∅ = 0.85 mm, have been fitted to the fuel delivery couplings, which control the fuel pressure waves generated by the high-pressure pump. Their function is to protect the electric injectors by reducing their wear in time.
Fuel pressure sensor (2) may affect the accuracy of the injector minimum flow rate correction, since the minimum flow rate depends both on the injection time and the actual pressure of the hydraulic accumulator.
In case of replacement, the EDC control unit 16 correction coefficients (ZFC) shall be set to zero.
The correction coefficients can be set to zero by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the sensor replacement procedure, in accordance with the instructions given by the diagnosis instruments.

775010 ELECTRO-INJECTORS

Figure 300

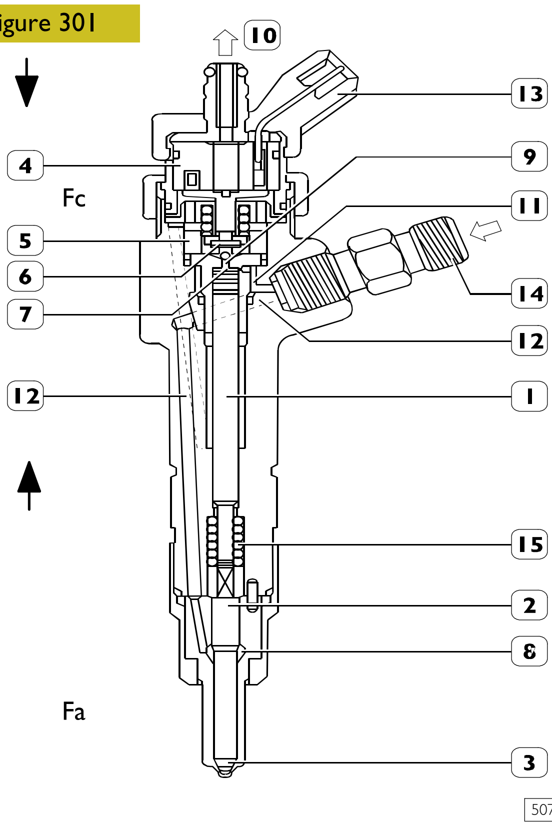


The electro-injectors have high-pressure supply (up to 1600 bar) and recirculation at atmospheric pressure, necessary for the diesel used to operate the pilot valve.
The temperature of the diesel put back into circulation by the electro-injector can get very high (approximately 120°C).
The head of the electro-injector has a fitting for the electrical connector.
They are mounted on the cylinder head and operated by the injection control unit.

The electro-injector can be divided into two parts (see Figure 301):

- actuator/jet composed of pressure rod (1), pin (2) and nozzle (3);
- control solenoid valve composed of coil (4) and pilot valve (5).

Figure 301



1 Pressure rod – 2 Pin – 3 Nozzle – 4 Coil – 5 Pilot valve – 6 Ball shutter – 7 Control area – 8. Pressure chamber – 9 Control volume – 10 Low-pressure fuel return – 11 Control pipe – 12 Supply pipe – 13 Electrical connection – 14 High-pressure fuel inlet fitting – 15 Spring.

Operation

Electro-injector operation can be broken down into three phases:

- "rest position"

Coil (4) is de-energised, and shutter (6) is in closing position and prevents fuel from being introduced into the cylinder, Fc > Fa (Fc: caused by fuel pressure acting on control area (7) of rod (1); Fa: caused by line pressure acting on pressure chamber (8).

- "start of injection"

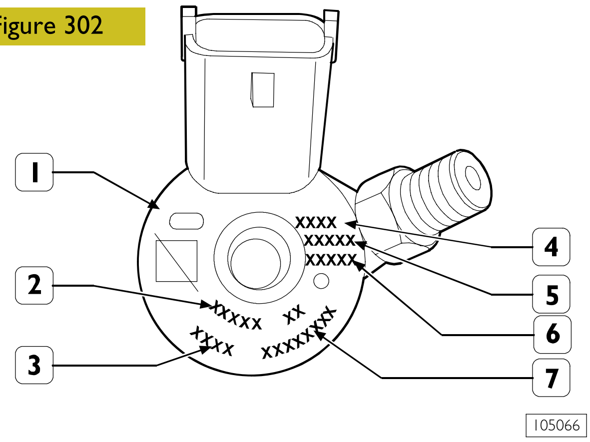
The coil (4) is energized and causes the shutter (6) to rise.
The fuel of the control volume (9) flows off towards the return manifold (10) causing a drop in pressure in the control area (7).
At the same time, line pressure through feed duct (12) applies a force Fa > Fc in pressure chamber (8) lifting peg (2), with fuel being consequently introduced into cylinders.

- "end of injection"

The coil (4) is de-energized and makes the shutter (6) return to its closed position. This recreates such a balance in the forces as to make the pin (2) return to its closed position and consequently end injection.

755010 Replacing an electrical injector

Figure 302



1. IMA Matrix code- 2. Bosch spare part no.-
3. IMA code in clear - 4. Iveco spare part no. - 5. Code -
6. Series no. - 7. Production date

Electrical injectors are not assigned any more to classes Min (01) - Med (02) - Max (03); therefore, flow rate deviations from design values are detected, during final check step, by the manufacturer on each single injector and printed with I.M.A. (Injector Menge Abgleichung) [Injector Quantity Offset] code on injector magnet.
At engine production plant, I.M.A. code is read on line from an automatic reading station, converted into bar code, printed on engine identification label and applied on the engine itself.
At vehicles production plant, at line end, E.D.C. 16 central unit is programmed automatically reading the engine identification label.

Figure 303

numero	codice OCR iniettore	numero	codice OCR iniettore	numero	codice OCR iniettore
0	0	A	A	P	P
1	1	B	B	Q	Q
2	2	C	C	R	R
3	3	D	D	S	S
4	4	E	E	T	T
5	5	F	F	U	U
6	6	G	G	V	V
7	7	H	H	W	W
8	8	I	I	Y	Y
9	9	J	J	Z	Z
		K	K		
		L	L		
		M	M		
		N	N		
		O	O		

105067

Conversion table of OCR characters into ARIAL characters

At assistance, code written in clear has to be used (3, Figure 31) for central unit replacement and reprogramming procedures.
In the table there is shown the conversion of OCR characters into Arial characters.

When electrical injectors mounted on the vehicle must be replaced, meet following warnings:

- where electrical injectors are dismounted and do not need to be replaced, their mounting position has to be noted down in order to remount them later in the same position; this is done to avoid to reprogram the central unit;
- after replacing one or more injectors, the central unit has to be reprogrammed;
- before mounting a new electrical injector, note down IMA code printed on the injector, because the code is difficult to read after the injector has been mounted;
- where the central unit is replaced, reprogram the new central unit with the IMA codes of the electrical injectors mounted on the engine and copy down the rectification coefficients (ZFC) of replaced central unit; where it is not possible, they must be reset and self-learning process must be started up again.

During engine running, EDC 16 central unit performs some checks on electrical injectors minimum flow rate.

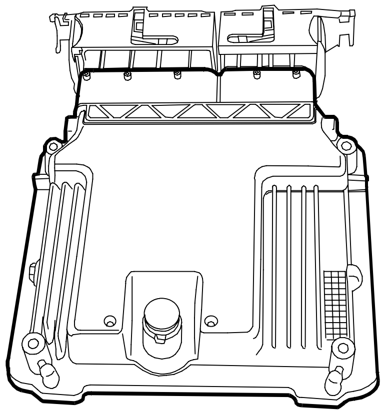
In certain conditions (overrun: vehicle deceleration with pedal released) an increasing (very small) fuel quantity starting from zero is injected and its effect on engine rotation smoothness is observed.
Injection start threshold is detected and stored by the central unit.
This self-learning process is carried out on each single cylinder.
Therefore, replacing an electrical injector involves the need of reprogramming the central unit by entering the IMA codes of new electrical injectors and resetting the rectification factors (ZFC) of the cylinder considered.
Replacing all electrical injectors extends the need of resetting to all the rectification coefficients (ZFC) of each single electrical injector.

The correction coefficients (ZCF) can be set to zero by means of the IVECO: MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the sensor replacement procedure indicated by the diagnosis instrument itself.

ELECTRIC/ELECTRONIC COMPONENTS

766161 Electronic control unit EDC 16

Figure 304



85711

The control unit is a "flash EPROM" and so it can be reprogrammed from outside without changing the hardware.
It processes the signals from the sensors by applying software algorithms and controls the actuators (especially the electro-injectors and pressure regulator).
The control unit records, in the memory non-labile area, the information on the engine parameters originally set or acquired during engine operation.
The injection control unit has the absolute pressure sensor built in to further improve the control of the injection system.
The control unit is mounted on the left-hand side of the engine bay and is connected to the vehicle's wiring harness by two connectors:

– 60-pin connector **A** for the components on the engine
– 94-pin connector **K** for the components on the vehicle

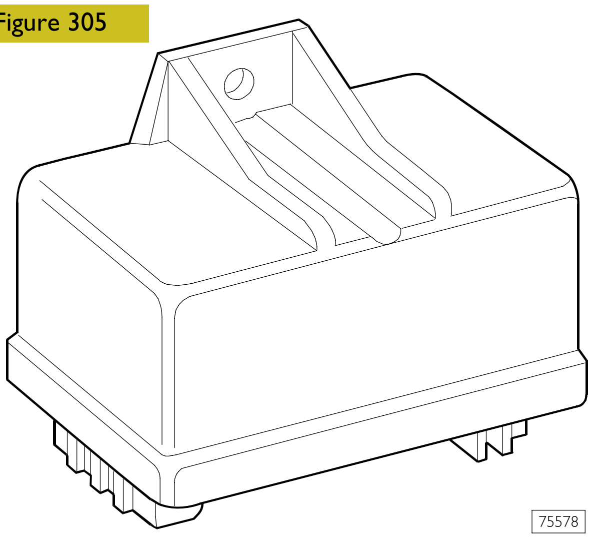
In addition to handling the operation of the system described under the relevant heading, the electronic control unit is interfaced with the other electronic systems on the vehicles such as ABS – EBD cruise control, speed limiting device, immobilizer (IVECO CODE), EGR and glow plugs.
On the vehicles equipped with D.P.F. catalyst, the control unit also controls the catalyst regeneration system. In this case, after any of the operations below is carried out:

- replacing one or several injectors;
- replace all injectors;
- replace flow rate meter (flow meter);
- rreplacing the hydraulic accumulator (common rail) pressure sensor;
- replace E.D.C. 16 central unit;
- refill engine oil;
- replace D.P.F. catalyst;
- replace filter differential pressure (Δp) sensor;
- replace components relevant to emissions;
- necessarily perform a forced regeneration;

the following operations shall be carried out by using the IVECO diagnosis instrument:: MODUS - E.A.SY. - IT 2000; then the procedure to replace affected component has to be carried out, following below indications provided by diagnosis tools:

761917 Glow plug electronic control unit

Figure 305



The engine control unit, in the phase of:

- starting
- after-starting

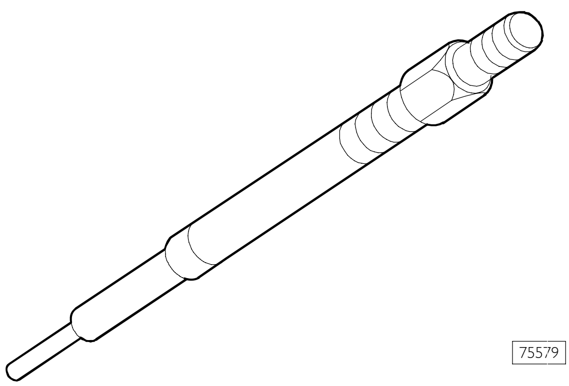
times the operation of the glow plug control unit according to the engine temperature.

Glow plugs drive is through glow plugs pre-heating central unit depending on engine temperature under close control of engine control central unit.

The pre-heating control unit contains an "intelligent" contactor that sends feedback to the control unit that is thus informed about any fault with the pre-heating control unit or shorting to earth of the glow plugs.

761915 Glow plugs

Figure 306



CONTROL VALUES

With a constant supply voltage of 11 V:

- max. current drawn	18 A
- in 5 sec.	11 ±1.5 A
- in 30 sec.	6 ±0.9 A
- temperature after 7 sec.	850°C
- tightening torque	8-10 Nm

SENSORS

764266 Engine speed sensor

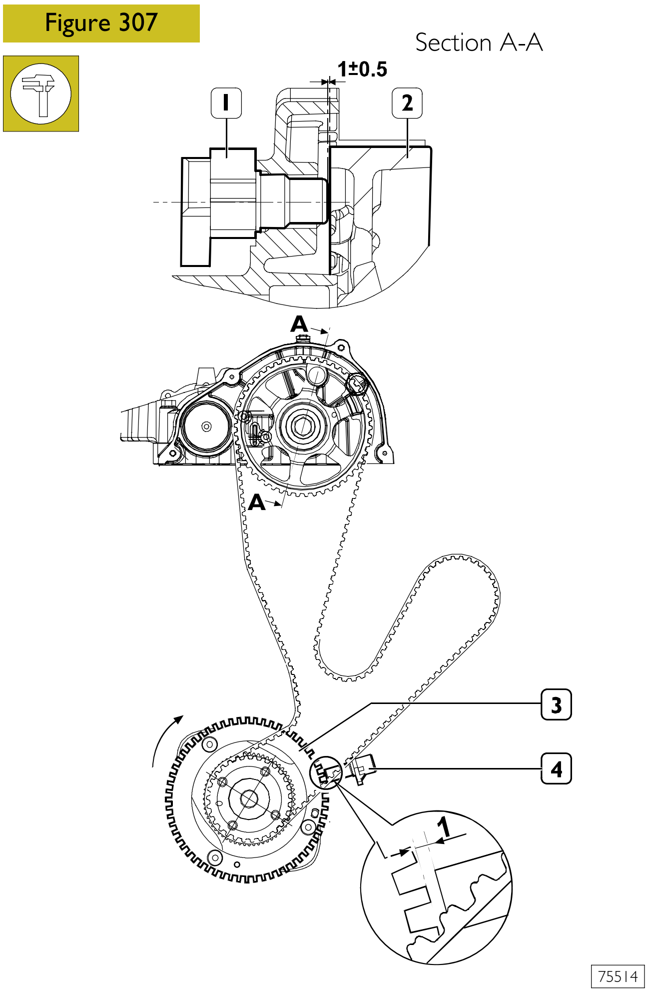
It is an inductive type sensor and is positioned on the phonic wheel mounted on engine shaft front end.
It generates signals obtained from magnetic flux lines which close through phonic wheel teeth. Teeth number: 58.

The electronic control unit uses this signal to measure the speed of rotation of the engine, its angular position and to operate the electronic rev counter.
If this signal fails the rev counter will not work.

764264 Camshaft timing sensor

It is a Hall effect type sensor positioned on camshaft pulley.
It generates signals obtained from lines of magnetic flux that close through a notch in the pulley.
The signal generated by this sensor is used by the electronic control unit as a redundant signal to measure the different engine speeds.

Figure 307



SENSOR ASSEMBLING DIAGRAM

The sensor gap is:

- ❑ 1 ±0.5 mm, between the camshaft pulley (2) and timing sensor (1).
- ❑ 1 mm, between the phonic wheel (4) and speed sensor (3).

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772655 Air temperature and pressure sensor

Positioned on the intake manifold, it measures the pressure of the turbocharging air introduced into the intake manifold.
This value, together with that of the air temperature sensor, makes it possible for the electronic control unit to calculate the exact quantity of air introduced into the cylinders so as to operate the injectors adjusting the fuel delivery, limiting harmful emissions, improving consumption and performance.
The sensor contains an electronic temperature correction circuit to optimize the pressure measurement in relation to the temperature of the intake air.

772656 Fuel temperature sensor

Integrated in the fuel filter, it measures the fuel temperature and transmits it to the electronic control unit.
When the fuel temperature is too high (ambient temperature condition, engine at full load and tank in reserve), correct lubrication of the high-pressure pump is no longer assured. On the basis of the values received, the control unit determines the density and volume of the fuel, correcting the delivery limiting engine performance.

774511 Fuel pressure sensor

This is mounted in the middle of the hydraulic accumulator (rail) and it has the task of providing feedback for the injection control unit to:

- adjust injection pressure
- adjust the duration of injection.

NOTE In case of replacement, the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, by performing the replacement procedure indicated by the diagnosis instrument itself.

766161 Atmospheric pressure sensor

This is integrated in the electronic control unit. It provides a criterion of correction for the measurement of the air flow rate and to calculate the reference air flow rate to check the EGR.

764254 Engine coolant temperature sensor

This provides the control unit with an index of the thermal status of the engine in order to determine corrections for the fuel delivery, injection pressure, EGR injection advance when starting cold (if mounted) and warm-up.

505910 Throttle pedal position sensor

The accelerator pedal position sensor provides the control unit with a voltage value in proportion to the angle of operation of the pedal determining fuel delivery.

772641 Clutch pedal position sensor

Mounted on the pedal board, it provides the control unit with a positive signal when the clutch is engaged (pedal released). Every time the clutch is disengaged to change gear, the control unit fails to receive this signal and deactivates the Cruise Control function.

772642 Brake pedal position sensor

There are two of these sensors mounted on the pedal board. With the brake pedal released, they provide the control unit with a positive signal that is used to detect brake operation so as to deactivate the Cruise Control function and stop delivery of fuel.
In addition, a sensor switches on the brake lights.

764261 Vehicle speed sensor

This sensor, mounted on the gearbox by the drive output shaft, transmits the vehicle speed signal, through the electronic tachograph, to the control unit.

540743 Differential pressure sensor - delta p (Dp)

This sensor detects the difference between the pressure (Dp) of the incoming exhaust gas and the pressure of the gas flowing out of the D.P.F. catalyst.
The measured value indicates the extent of particulate (PM) particle accumulation or clogging in the D.P.F. filter.
This value will, through a proper signal (feed-back), be processed by the EDC control unit 16, which will cause post-injection so as to increase the exhaust gas temperature (630°-650°C) and also cause the particulate particles accumulated in the D.P.F. filter to be burned.

NOTE In case of replacement, the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, by performing the replacement procedure indicated by the diagnosis instrument itself.

Exhaust gas temperature sensor

The D.P.F. catalyst includes two temperature sensors located at the D.P.F. catalyst inlet and outlet, respectively.
The temperature values are processed by the control unit to determine post-combustion, in order to increase the exhaust gas temperature needed to burn the particulate particles.

ACTUATORS

The injection system comprises three classes of actuators interlocked with the electronic control unit:

- ❑ electro-injectors (see relevant heading);
- ❑ regulators (see relevant headings) requiring PWM control (Pulse Width Modulation):
  - for pressure
  - EGR (see respective chapter)
  - turbocharger with variable geometry (if mounted);
- ❑ actuators with continuous ON/OFF signal to:
  - engage electromagnetic coupling for radiator cooling fan;
  - turn on/off air-conditioner compressor (if mounted);
  - Cruise Control;
  - starter heater control;
  - fuel filter heating;
  - electric supply pump.

NOTE All the power controls are made with relays located in the cab.

PWM (Pulse Width Modulation) controls

A PWM control has an active and an inactive state that alternate within a constant set length of time. During the active state the actuator control circuit is closed, which is thus powered with the control voltage; whereas, during the inactive state the circuit is open.
The duration of the two states may be varied with the condition that the sum of the two times is equal to the length of the modulation delivery.
The duration of the active state determines the duty-cycle, which is normally expressed as a percentage of the total time. Therefore, if the duration of the two active and passive states are the same, the duty-cycle is equal to 50%.
For reasons of diagnostics, the duty-cycle is limited between 1% and 99%; the control resolution is equal to 0.005% (1/20000 of the time).
The time length has been chosen taking account of the dynamic actuator response specifications.
Too low a carrier frequency could cause oscillations in the actuator, while too high a frequency would decrease control resolution.
The E.G.R. and variable geometry turbocharger (if mounted) are controlled through a vacuum modulating valve.

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F1C engine

Page

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MAIN OPERATIONS ON ENGINE MOUNTED ON VEHICLE

Keep to the following instructions before doing any work on the engine involving components of the fuel supply system.

- Before doing any work on the engine, perform the engine/vehicle fault diagnosis with specific IVECO diagnosis equipment and print out the results.
- Replacement of the MS6.3 or EDC 16control unit must be authorized by the **Help Desk.** Replacing operation requires reprogramming as described in specific section.
- Following components in feed system cannot be overhauled but have to be replaced: pressure relief valve, if present, fuel pressure sensor, hydraulic accumulator, complete CP3 high pressure feed pump, pressure control valve, electric injectors.
- All the parts of the Common Rail system are packaged by the supplier in sheets of oiled paper and are stored in cardboard boxes. They must therefore be protected against moisture and unpacked just prior to assembly.
- The greatest care must be taken over the cleanliness of parts, making sure that when handling or assembling (starting with straightforward filter and pre-filter replacement) no dirt of foreign bodies can get inside. For this reason, the plugs protecting the hydraulic parts and sensors must be removed just prior to positioning in their seats.
- Take care over the direction of assembly for all electrical connections.
- All threaded connections must be tightened to the prescribed torque.
- All the quick-coupling connectors (on the engine they are found on the high-pressure pump and on the diesel drain manifold) must be fully inserted. To drive them out, press on the tabs at the base of the connectors.

Electro-injector

None of the couplings/unions/nuts on the injector body may be handled. It is neither necessary nor permitted to dismantle the nozzle body or the electromagnet.
If working on the high-pressure pipe, the hexagon on the injector side must be kept stationary with a wrench.
Before working on pipes, make sure the injector is stationary in its seat on the cylinder head.
When assembling/disassembling the injector drain, the retaining spring must not be removed from its seat in the injector: pushing the spring towards the engine and applying a vertical force on the connector frees the recirculation. When assembling, rest the recirculation connector in its seat and apply a vertical force while keeping the retaining spring pressed in the direction of the engine. Fitting in has to be easy.
Replacing one or more electrical injectors requires central unit programming as described in specific section.

CP3 High-pressure pump

If working on the high-pressure pipe, the hexagon on the pump side must be kept stationary with a wrench.
Before working on the high-pressure pipe, make sure the pump is secured in its seat.

High-pressure pipes

Each high-pressure pipe must be replaced after disassembly operations.
The couplings must be tightened or loosened with the injectors, hydraulic accumulator (rail) and high-pressure pump well secured and taking care to keep the hexagon on the component side stationary, space permitting.

Hydraulic accumulator (rail) and accessories

The pressure sensor can be assembled five consecutive times; after that, it must be replaced. They must be lubricated with a thin layer of oil before being mounted.. Replacing the sensor requires central unit programming as described in specific section.

Service procedures to be performed after replacing high-pressure feeding system and/or exhaust gas post-treatment system components

For engine correct operation, E.D.C. 16 central unit stores, into memory non volatile area, information relating to engine parameters originally set or acquired during operation.

Consequently, whenever a component of high pressure feed system and/or of the post-treating system for below listed exhaust gasses, the central unit has to be reprogrammed by IVECO diagnosis tool: MODUS - E.A.SY. - IT 2000; then the procedure to replace affected component has to be carried out, following below indications provided by diagnosis tools:

- replace injector;
- replace all injectors;
- replace flow rate meter (flow meter);
- replace hydraulic accumulator (common rail);
- replace E.D.C. 16 central unit;
- refill engine oil;
- replace D.P.F. catalyst;
- replace filter differential pressure (Δp) sensor;
- replace components relevant to emissions;
- necessarily perform a forced regeneration;
- replace central unit.

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540110 POWER UNIT REMOVAL/REFITTING

Removal

Place the vehicle on the pit or auto lift.
Lift the engine hood (26), undo the fastening screws (27) and then remove the hood; remove supporting rod (28).
Disconnect negative cable (4) and positive cable (11) from battery (10), then remove the latter from the engine compartment.
Disconnect electric connections (5, 7, 8 and 9) and engine cable (6) from the EDC control unit, then release the engine cable from the straps securing the same to the cab.
Unhook cable (1) from the hood opening control devices.
Disconnect front headlamp electric connections (12).
Remove screws (19), then take off cover (18).
Remove fastening screws (32), then take off headlamp inserts (13).

NOTE Do not change the assembly position of headlamp insert (13) threaded bush (14, detail D).

Remove the screws and/or fastening nuts, then remove crosspiece (33).
Remove the screws and/or fastening nuts, then remove bumper (17).
Remove expansion tank (3) cap (2).
Act as follows, from under the vehicle (see figure 4):

- ❑ undo fastening screws (12 and 13), then remove lower side guards (14);
- ❑ undo fastening screws (16), then remove lower central guard (26).

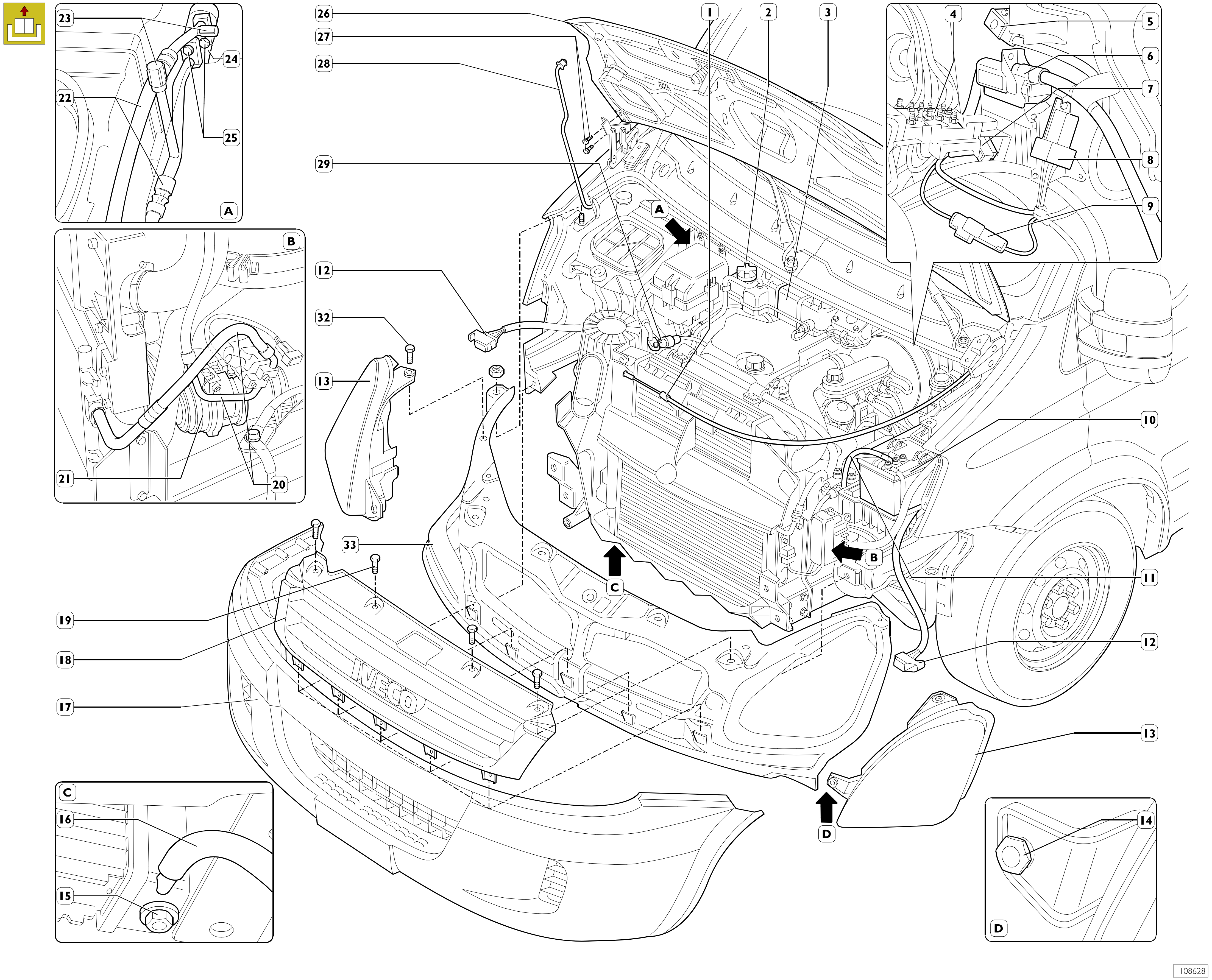
Apply a tube (16) to radiator pipe union (detail C), then unscrew cap (15) and drain the coolant into a suitable container.

NOTE If the vehicle is equipped with a cab air-conditioning unit, proceed as follows:

- ❑ fit the unit 99309146 pipes to connections (23), then blow the gas off the air-conditioning unit as described in the respective charter of the "Bodywork and chassis" section;
- ❑ disconnect electric connection (29) from the drying filter pressure switch;
- ❑ disconnect pipes (20) from air-conditioner compressor (21);
- ❑ remove nuts (25), then disconnect pipes (22) from expansion valve connection (24).

NOTE Seal the air-conditioning unit pipes and their respective mounts, to prevent moisture and impurities from penetrating into the system.

Figure 1



Remove nuts (4), then place remote-control switch/fuse holder (3) aside.
Disconnect pipe (18) from the heat exchanger and the turboblower.
Disconnect pipe (34) from the heat exchanger and the throttle valve assembly.

NOTE Properly obstruct the turboblower air outlet to avoid casual penetration of foreign bodies into the turboblower and, therefore, damage to the latter.

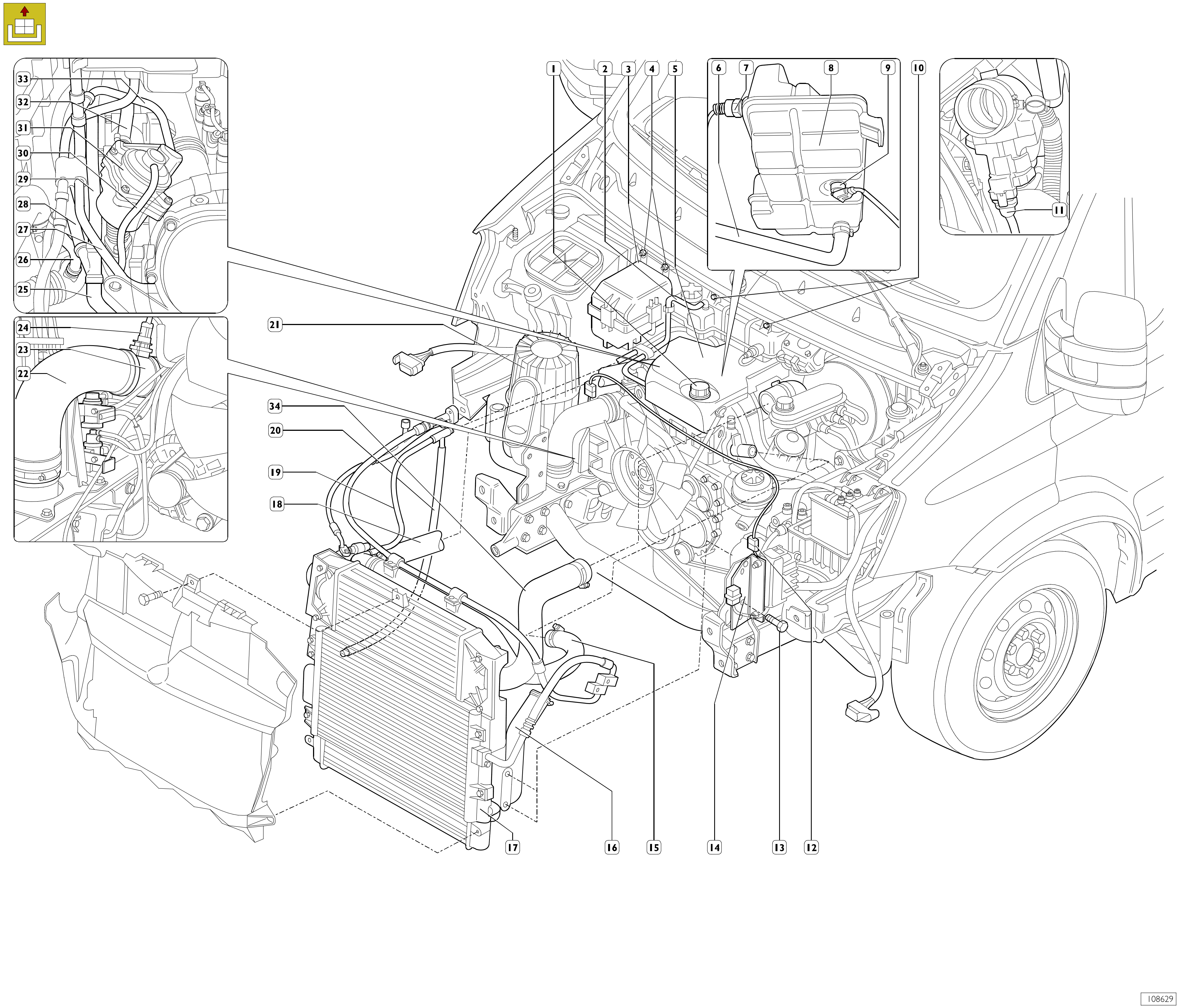
Disconnect or remove the coolant pipes:

- (15), from the thermostat;
- (16), from the engine oil heat exchanger;
- (19), from pipe (18);
- (20), from radiator (17).

Remove screws (13) securing radiator (17) to the supports.
Disconnect electric connection (12).
Release remote-control switch supporting bracket (14) from the left side.
Remove radiator/heat exchanger assembly (17) together with the condenser-drying filter and pipes (if any).
Remove oil filling cap (1) and remove sound-proofing cover (5).
Loosen the straps, then disconnect coolant vent pipes (2) from expansion tank (8).
Disconnect tank (8) pressure sensor (7) electric connection.
Remove tank (8) fastening nuts (10), then remove the tank from the wall.
Disconnect electric connection (9) of the level sensor placed under tank (8).
Loosen the straps, then disconnect coolant pipe (6) located below tank (8).
Disconnect electric connection (11) from the throttle valve assembly actuator.
Disconnect expansion tank (8) pipe (28) and cab heater pipe (29) from water pump pipe (25).
Loosen the straps, then disconnect coolant vent pipes (33) from EGR valve (31) and (27) from the cylinder head.
Loosen the strap, then disconnect coolant pipe (32) and vacuum pipe (30) from EGR valve (31).
Loosen the strap, then disconnect pipe (26) from air pipe (22).
Disconnect electric connection (24) from air flow meter (23).
Loosen the straps, then disconnect air pipe (22) complete with air flow meter (23) from the turboblower and air filter (21).

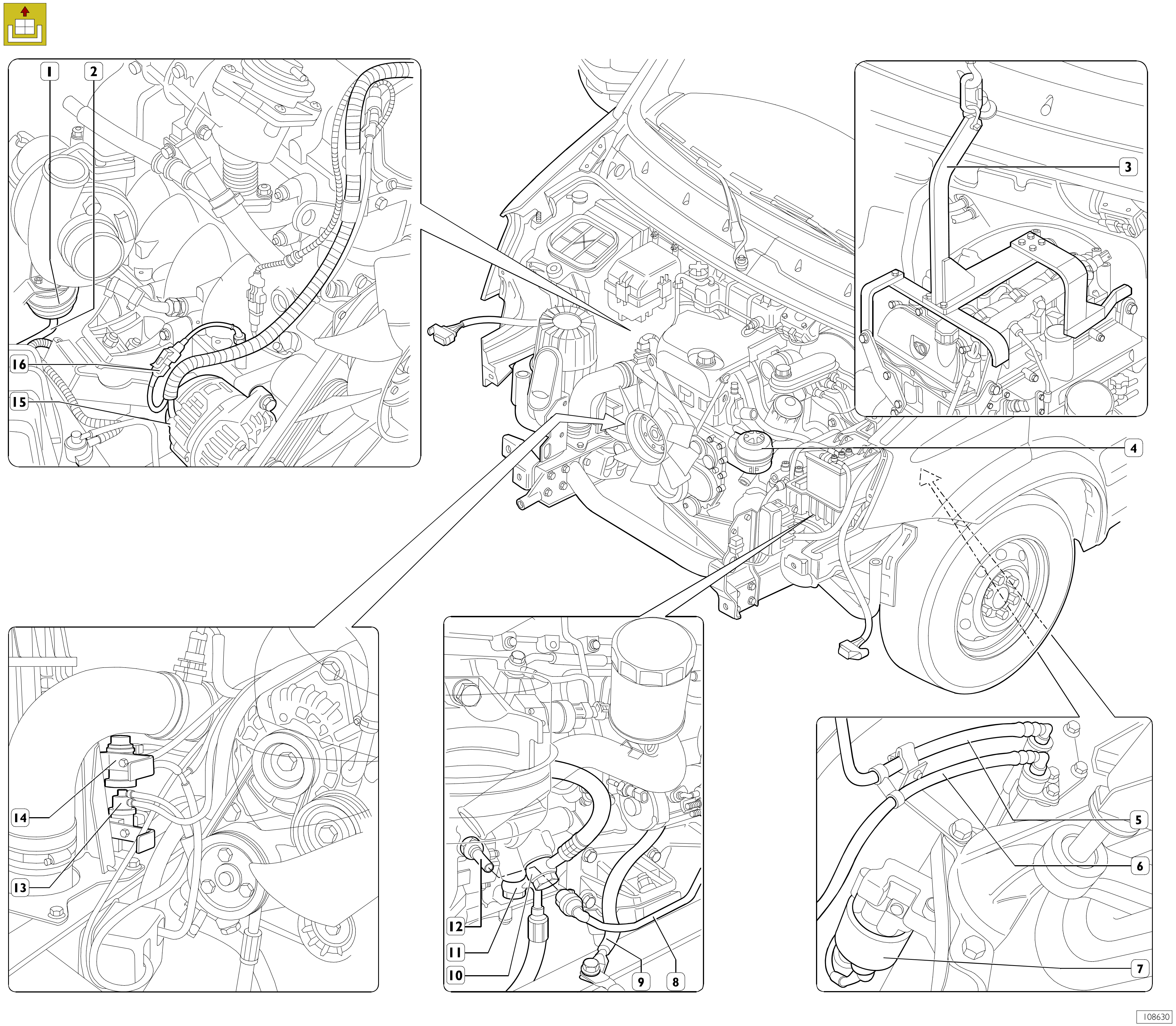
NOTE Properly obstruct the turboblower air outlet to avoid casual penetration of foreign bodies into the turboblower and, therefore, damage to the latter.

Figure 2



Disconnect vacuum pipe (2) from variable geometry turboblower actuator (1) (if any).
Cut the straps securing the cables to the engine, then disconnect the electric connections from the VGT solenoid valve (13, if any), alternator (15), oil level sensor (16).
Remove the screw and take ground cable (9) off.
Remove the nuts, then take cables off starting motor (7).
Disconnect servo brake vacuum pipe (8) from pipe union (12).
Disconnect delivery pipe (5) and return pipe (6) from the low-pressure fuel pipes.
Place a container under the power steering pump to recover the system oil, then detach oil return and delivery pipes (11 and 10).
Loosen the fastening strap, then remove power steering tank (4) from the support.
Apply tool 99360543 (3) onto the engine brackets to take the engine off its compartment and secure it to the hoist.

Figure 3



Act from under the vehicle to disconnect jointed heads (17) from:
- lever shift control cables (16);
- selection cable (max. pull-out load: 250 N - max. pull-in load: 60 N);
- engagement cable (max. pull-out load: 100 N - max. pull-in load: 80 N).

Use a suitable screwdriver to open out flexible cable fins (18) so that the pawls are disengaged from the support.
Undo fastening screws (22), move clutch control cylinder (23) together with its bracket and properly secure it to the chassis.
Remove the sealing from ring (1), then unscrew the same and disconnect the speed indicator control cable.
Disconnect electric connection (4) or (28 - for vehicles equipped with automatic transmission) from the reversing light switch.

NOTE Vehicles equipped with automatic transmission: disconnect gearbox-chassis cable connector (27) from control unit.

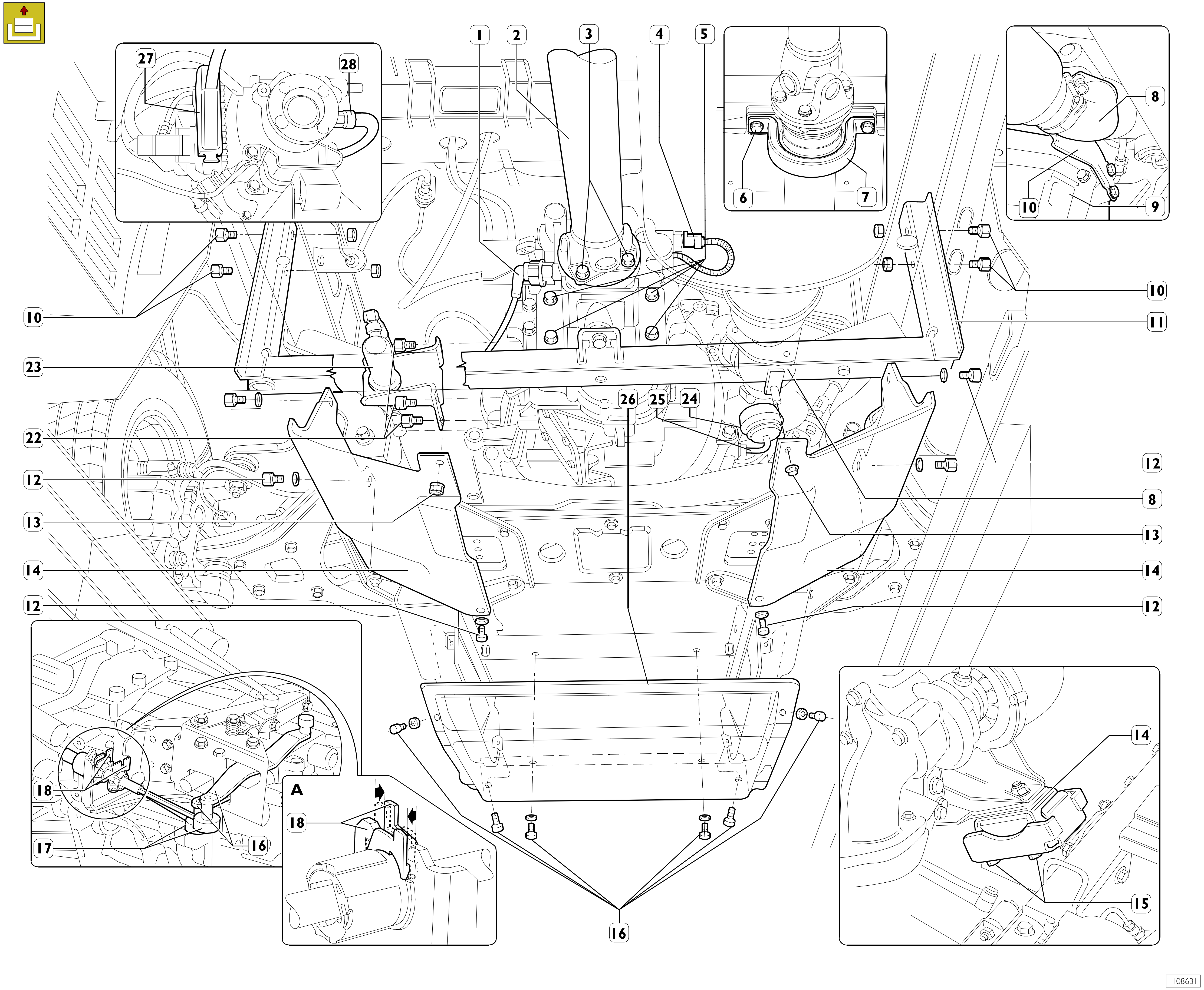
Disconnect exhaust pipe (8) from the turboblower outlet pipe.
Vehicles equipped with D.P.F. catalyst: remove the fastening screws, then take exhaust pipe (8) supporting bracket (10) off gearbox unit (9).
Disconnect vacuum pipe (25) from VGT actuator (24 - only 176 HP engines).
Put a supporting jack under the gearbox unit.
Remove the bracket supporting the gearbox to the rear crosspiece by acting on the four screws (5).
Undo fastening screws (10), then remove gearbox unit supporting crosspiece (11) complete with its gearbox/supporting bracket.
Remove nuts (15) securing elastic supports (14) to the chassis.
Remove bolts (3) securing propeller shaft (2) to the gearbox unit; if necessary, remove screws (6) securing elastic support (7) to the chassis and properly secure propeller shaft to the chassis.
Remove the jack from under the gearbox.
Lift the power unit and remove it from the engine compartment.

NOTE The power unit shall be removed from the engine compartment with the greatest care, so as not avoid damaging the parts left on the vehicle, especially the steering box oil pipes.

When removing the gearbox unit from the engine, remove the fastening screws and detach the starting motor.
Remove the fastening screws and take the gearbox unit off the engine.

NOTE As regards the vehicles equipped with automatic transmission, carefully carry out the operations described in the charter of the "Gearbox unit" section.

Figure 4



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Refitting

To refit the engine assembly, carry out the operations described for removal in reverse order, following these instructions:

- Before refitting the gearbox to the engine, it is necessary to remove the pressure plate bearing from the diaphragm spring by opening out the retaining circlip.
  Fit the pressure plate bearing on the sleeve of the drive input shaft cover, connecting it to the clutch release lever. Spread the gearbox input shaft with Molikote molybdenum disulphide grease.
  As regards the 6 S 400 O.D. gearbox units, proceed as follows.
  Engage a gear to let the main shaft turn, rotating the propeller shaft connecting flange. Push the gearbox fully in so that the pressure plate bearing couples with the diaphragm spring correctly.
  As regards the 6 S 400 O.D. gearbox units, follow the procedures described in the specific chapter.
- Pay special attention to the operations needed to install the engine assembly in the engine bay.
- Check the conditions of the coolant pipes or sleeves and of the air ducts. Replace them if they show any sign of deterioration.
- Check the flexible mountings of the assemblies: engine and gearbox. Replace them if they show any sign of deterioration.
- Check that the exhaust pipe members have not deteriorated and are not about to deteriorate. If this is so, replace them along with the flexible parts for securing them.
- Tighten the screws or nuts to the required torque.
- Meticulously check the state of the vacuum pipe. It must show no sign of cracking, cutting, scoring or of being crushed. Replace it if there is any doubt at all about its soundness. When mounting it, make sure the pipe does not come into contact with sharp metal parts or corners or with any particularly hot parts. In addition, after assembly, the pipe must have no bends or constrictions, its radius of curvature should be broad and it must be secured to the vacuum pump fitting with a suitable clamp.
- Make sure that fuel pipes rapid engagement fittings are accurately clean, and result to have been fully inserted and not going to be disconnected after their being connected to relating engagement unions.
- Fill the cooling system with coolant.
- Fill the hydraulic power steering circuit and bleed the air as described under the relevant heading.
- Check the level of oil in the engine and gearbox.
- Recharge the air-conditioning system (if any), as described in the relevant chapter in the "Bodywork and chassis" section.
- Check, if necessary, the headlamp orientation.

NOTE When positioning the engine in the engine bay, take special care not to damage the top pipe of the power steering and the soundproof-heatproof cladding of the engine bay.
Once positioned, meticulously check that the top pipe of the power steering is sound.
Before using it again, check that the power steering oil and coolant contain no impurities. If they do, filter with suitable mesh filters. For any topping up, refer to the REPLENISHING FLUIDS table in the "GENERAL" section.

Checks and tests

Start up the engine, leave it running just a little faster than idling speed and wait for the coolant temperature to reach the value for opening the thermostat, then check that:

- No water leaks from the connecting sleeves of the engine cooling and cab heating circuit pipes; tighten the collars if necessary.
- No oil leaks from between the cover and cylinder head, oil sump and crankcase, oil filter and its seat, heat exchanger and crankcase or from between the various pipes of the lubricating circuit.
- No fuel leaks from injection pump and injector lines. Tighten fittings if necessary.
- Check the indicator and warning lights on the instrument panel and the devices disconnected on removing the engine all work properly.

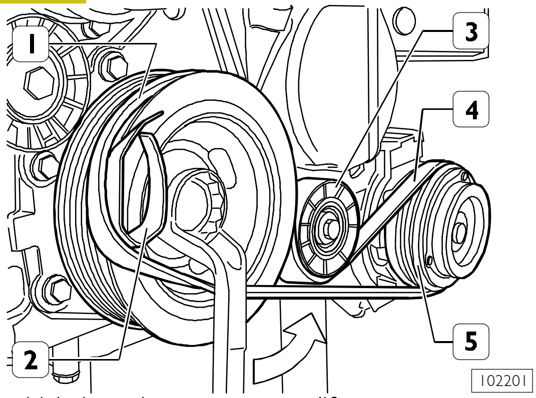
501430 Power steering system air bleed

Check the level of oil in the tank and top it up if necessary.
Lift the vehicle at the front, start up the engine and let it idle for some time.
Check there is no oil leakage from the hydraulic circuit and check the level in the tank.
Slowly turn the steering wheel in both directions of steering so that the air in the hydraulic system comes out.
Check the level of oil in the tank again and top up if necessary.

543910 REPLACING AIR-CONDITIONING COMPRESSOR DRIVE BELT

Disassembly

Figure 5



Place the vehicle in a pit or on an auto lift.
Remove, from under the vehicle, the central sound-proofing guard. Remove elastic belt (4) from pulleys (1 and 5).

Assembly

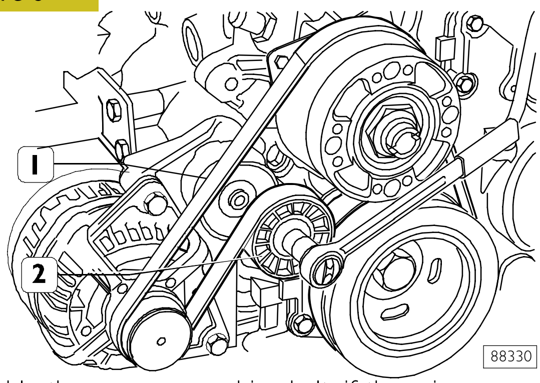
Apply wedge 99360161 (2) with elastic belt (4) to pulley (1), then place the elastic belt onto roller (3) and pulley (5), taking care to place the pulley ribs in the corresponding races of pulleys (1 and 5).

Rotate the drive shaft counterclockwise (→) until belt (4) is correctly coupled with pulley (1).

543910 POWER STEERING PUMP-ALTERNATOR BELT REPLACEMENT

Disassembly

Figure 6



Disassemble the compressor drive belt, if there is one, as described under the relevant heading.
Slacken off the tension of the belt (1) using a specific wrench on the automatic tightener (2) and remove the belt.

Assembly

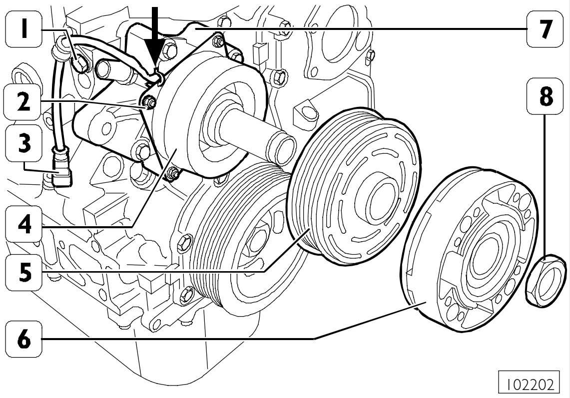
Mount the drive belt (1) taking care to position its ribs correctly in the respective races of the pulleys. Release the automatic tightener (2). Turn the crankshaft by one turn to settle the belt.

Mount the compressor drive belt, if there is one, and adjust the tension as described under the relevant heading.
Fit the middle soundproofing guard back on.

543210 REPLACING THE WATER PUMP

Removal

Figure 7



Drain the cooling fluid, and then remove both the front cross-member and the radiator, as described in the "Power unit detachment/re-attachment" chapter.
Take the fan off the electro-magnetic joint.
Remove electric connection (3) from the engine cable.
Stop rotation of electro-magnetic joint (6), then remove nut (8).

NOTE Unscrew nut (8) in a clockwise direction, since the nut thread goes leftwards.

Take off hub (6) and pulley (5).
Cut the strap (→), remove electric cable (3) retaining strap fastening screw (1), remove nuts (2), then take electro-magnet (4) off water pump (7).
Remove the fastening screws, and then take off water pump (7).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. In particular, tighten the screws and nuts to the specified torque values.

After re-attachment has been completed, fill the engine cooling system, start the engine and check for cooling fluid leaks.

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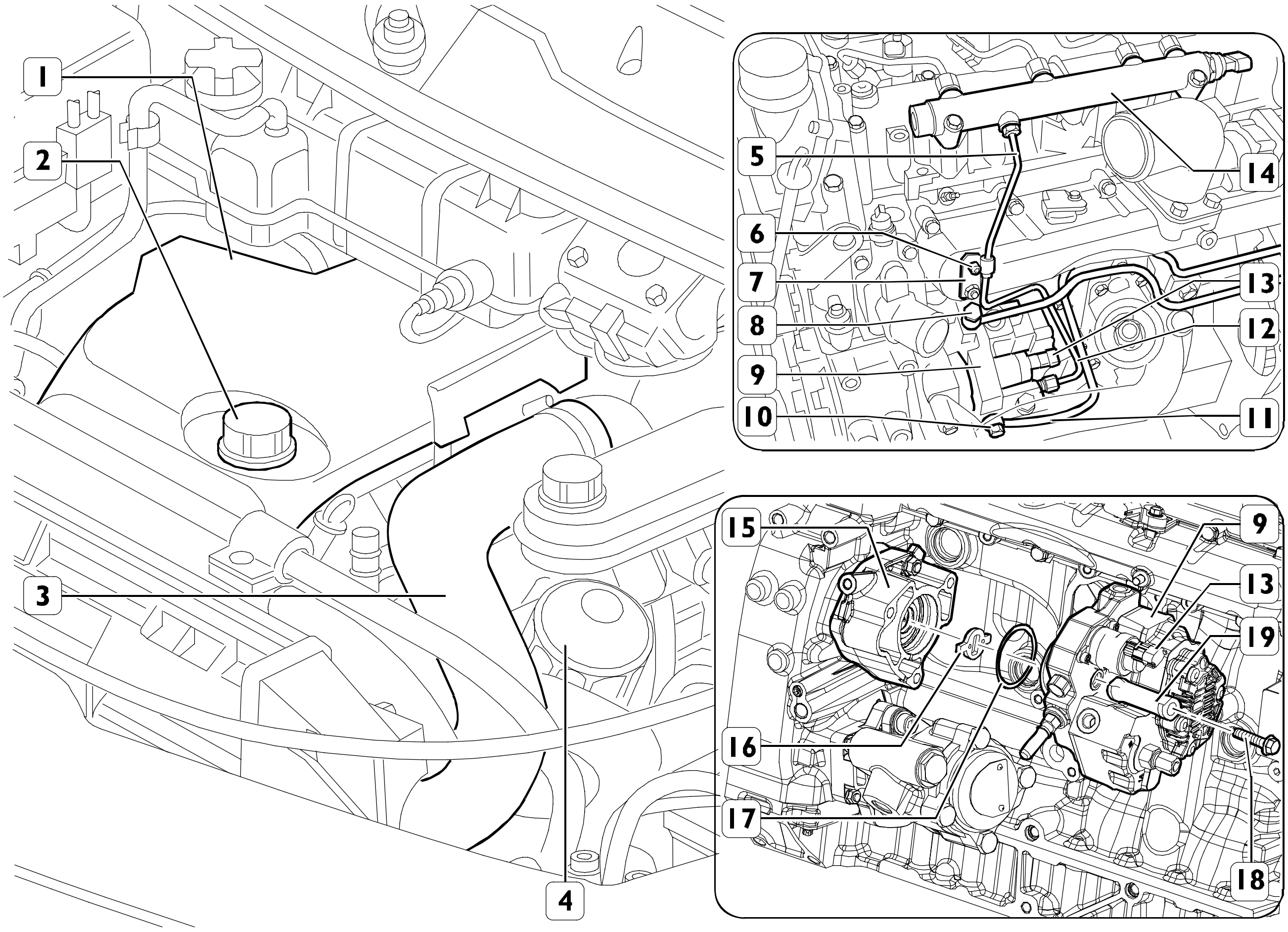
771010 REPLACING THE HIGH-PRESSURE PUMP

Removal

Figure 8



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Remove cap (2), then take cover (1) off the cylinder head. Loosen the straps, then disconnect air pipe (3) from the inlet manifold and the heat exchanger.
Use tool 99360076 to take oil filter (4) off the heat exchanger.
Remove the electric connection from pressure regulator (13).
Remove connections (8 and 10), then disconnect low-pressure pipes (11) from high-pressure pump (9).
Remove pipe (5) retaining bracket (7) fastening screw (6), then disconnect the retaining bracket from hydraulic accumulator (14) and high-pressure pump (9).
Remove screws (18) and spacers (19), then remove high-pressure pump (9) from support (15). Remove joint (16).

Refitting

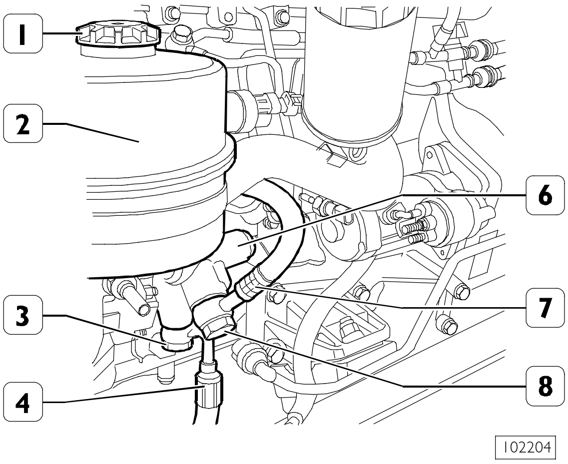
Re-attachment is carried out by reversing the order of detachment operations. In particular, comply with the following instructions:

- replace the seal rings, gaskets, high-pressure pipe and oil filter with new parts;
- lubricate, prior to assembling, seal ring (17) with engine oil;
- tighten the screws, nuts, fittings and oil filter to the specified torque value;
- check the engine oil level; top up, if necessary.

501450 REPLACING THE POWER STEERING PUMP

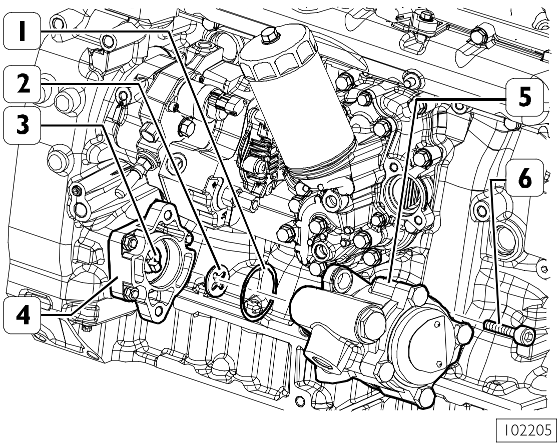
Removal

Figure 9



Remove oil filling plug (1) from oil tank (2).
Remove, from under the engine compartment, the central sound-proofing guard.
Place a container under power steering pump (6) to recover the oil from the system, and then remove fittings (3 and 8) and disconnect oil pipes (4 and 7) from power steering pump (6).

Figure 10



Remove screws (6) and take power steering pump (5) off support (4). Remove joint (2) from drive arbor (3).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. In particular, take care of the following:

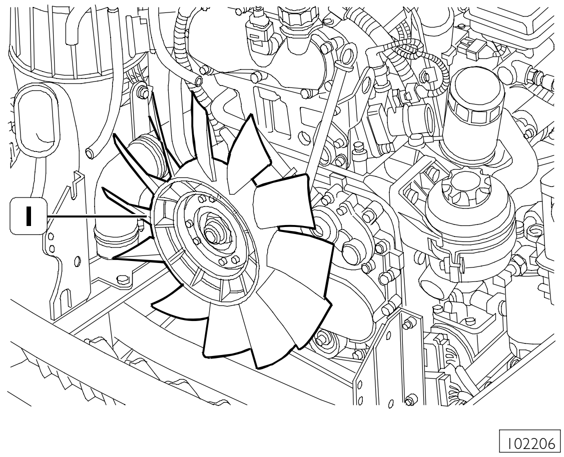
- ❑ replace seal ring (1) with a new part, and lubricate the same with engine oil prior to assembling;
- ❑ replace the oil pipe gaskets (as above);
- ❑ tighten the nuts, screws and fittings to the specified torque values.

After re-attachment has been completed, fill the hydraulic power steering circuit and bleed the air as described under the relevant heading.

540440 REPLACING THE DRIVE SHAFT SEAL RING AND THE FRONT COVER GASKET

Removal

Figure 11

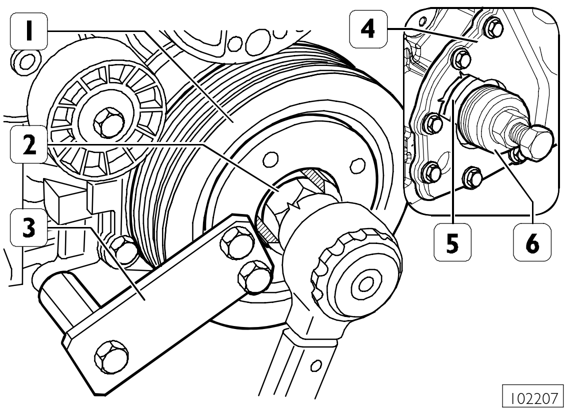


Proceed as follows, by operating as described in the "Power unit detachment/re-attachment" chapter:

- ❑ drain the engine cooling fluid;
- ❑ remove the front cross-member;
- ❑ remove the radiator.

Remove fan (1) from the electro-magnetic joint.
Take off the air-conditioning compressor drive belt (if any) as well as the water pump-alternator drive belt, as described in the relevant chapters.

Figure 12



Use tool 99360190 (3) to stop drive shaft rotation, then remove screw (2) and take off damper pulley (1).

Apply tool 99340059 (6) as shown in the figure to remove seal ring (5) from cover (4).

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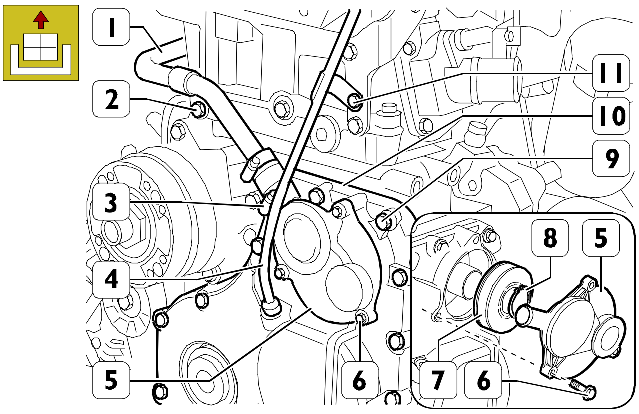
Figure 13



102209

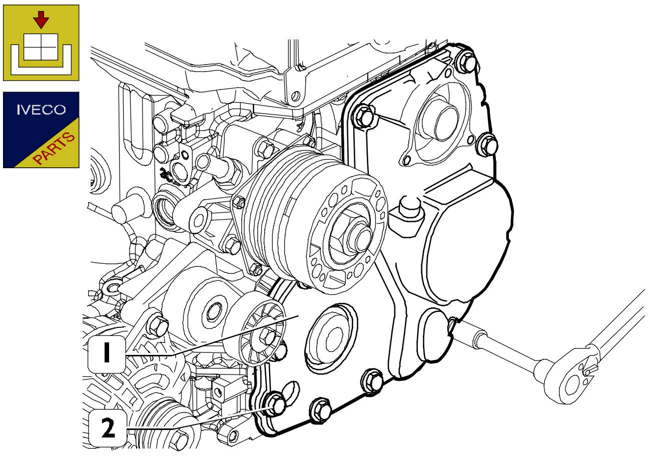
Remove screw (11), and then take off dipstick pipe (4). Loosen strap (3), remove screw (2), then take pipe (1) off cover (5).
Remove screws (6), and then take off cover (5). Remove snap ring (8). Take out centrifugal filter (7).

NOTE Both centrifugal filter (7) and cover seal ring (5) must be replaced every time they are dismounted.

Remove screws (9), and then take off front cover (10).

Refitting

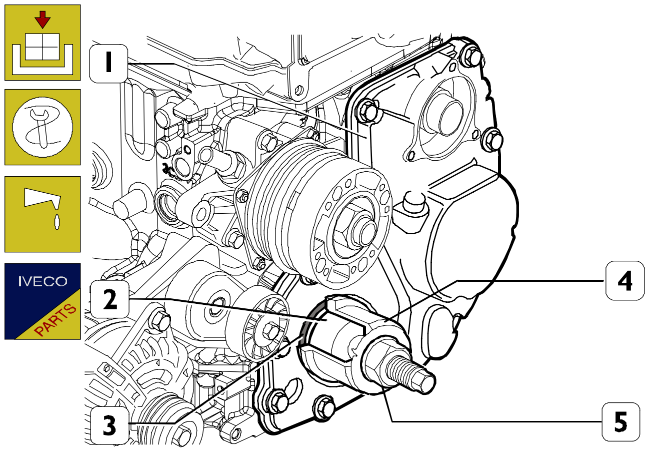
Figure 14



102214

Mount cover (1) with a new gasket. Screw down screws (2) without tightening them up.

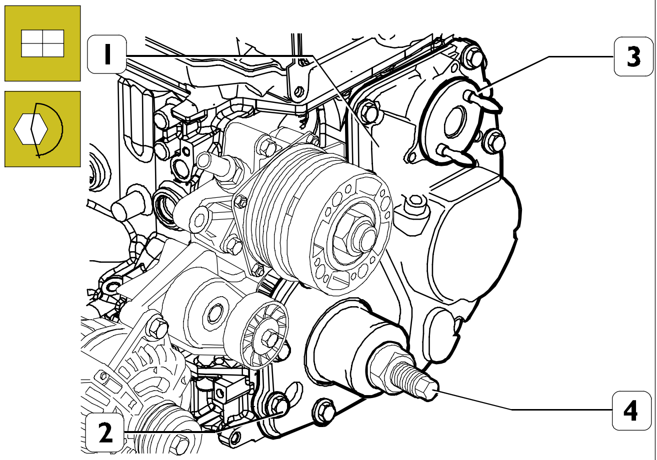
Figure 15



102215

Thoroughly clean cover (1) seal ring seat.
Screw down part (2) of tool 99346258 into the drive shaft shank.
Lubricate the drive shaft shank and the outside of part (2), then couple the new seal ring (3) with part (2).
Place part (4) onto part (2), screw down nut (5) until seal ring (3) is fully assembled to cover (1).

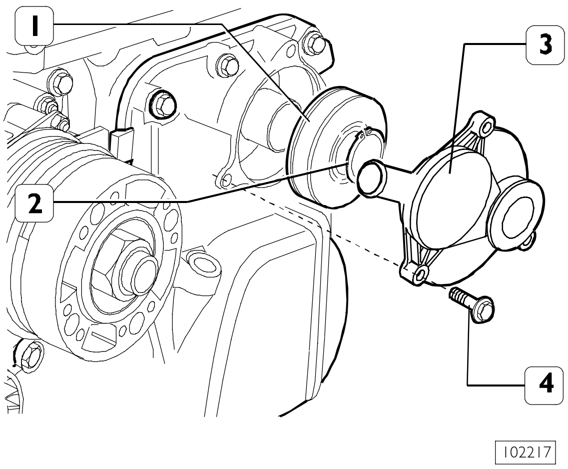
Figure 16



102216

Fit cover (1) centring tool 99396030 (3) into the centrifugal filter seat, then tighten screws (2) to the specified torque.
Remove tools 99346258 (4) and 99396039 (3).

Figure 17



Fit a new centrifugal filter (1).
Fit a new snap ring (2).
Fit cover (3), and then tighten screws (4) to the specified torque.

NOTE Both centrifugal filter (1) and cover (3) seal ring must be replaced every time they are dismounted.

Re-attachment is carried out by reversing the order of detachment operations. In particular, tighten the screws and nuts to the specified torque values.

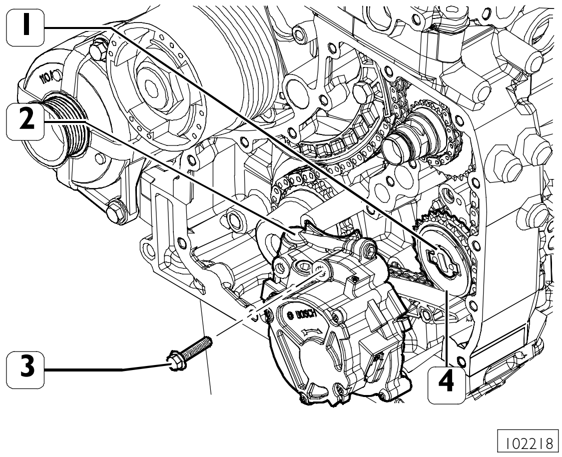
After re-attachment has been completed, fill the engine cooling system, check the engine oil level (top up, if necessary), start the engine and check for cooling fluid leaks.

503010 REPLACING THE VACUUM PUMP OIL PUMP ASSEMBLY (GPOD)

Removal

Remove the front cover, as described in the "Replacing the drive shaft seal ring and the front cover gasket" chapter.

Figure 18



Remove screws (3), and then take off vacuum pump oil pump assembly (2).

Remove connecting joint (1) from gear (4).

Refitting

Position connecting joint (1) into gear (4).

Fit vacuum pump oil pump assembly (2) by placing a new gasket in between.

Tighten screws (3) to the specified torque.

Re-attachment is carried out by reversing the order of detachment operations. In particular, tighten the screws and nuts to the specified torque values.

After re-attachment has been completed, fill the engine cooling system, start the engine and check for cooling fluid leaks.

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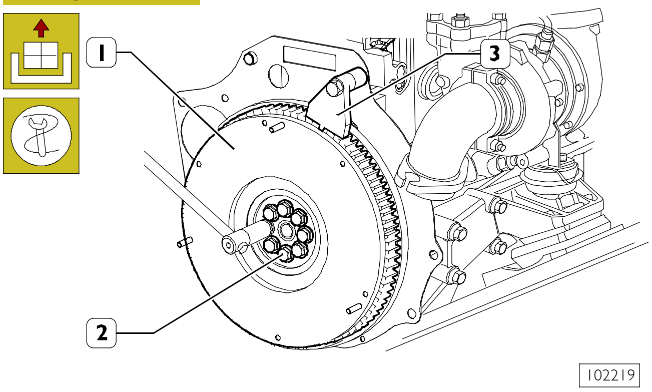
540640 REPLACING THE DRIVE SHAFT REAR SEAL RING

Removal

This operation involves:

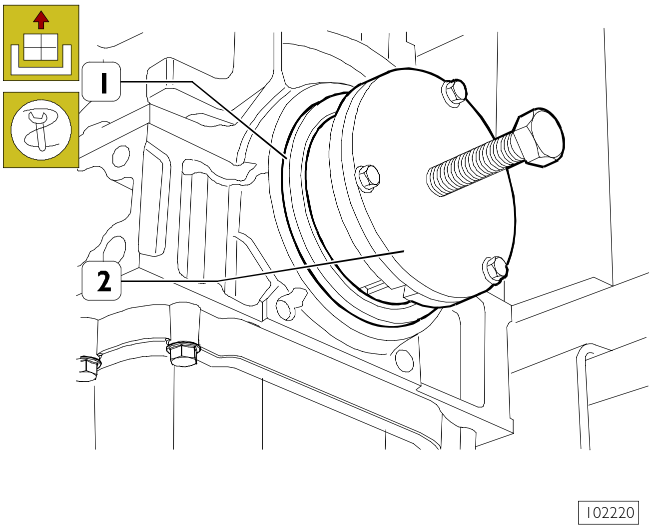
- ❑ detaching/re-attaching the drive shafts (see relevant section 505620);
- ❑ detaching/re-attaching the gear shift (see relevant section 530210;
- ❑ detaching/re-attaching the clutch (see relevant section 505210).

Figure 19



Stop flywheel (1) rotation by means of tool 99360306 (4).
Remove screws (2), and then take off engine flywheel (1).

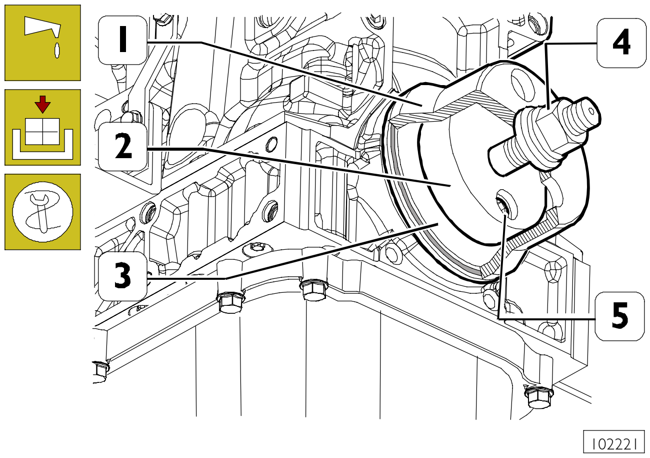
Figure 20



Apply tool 99340060 (2) to rear seal ring (1), then take the latter out of the engine base.

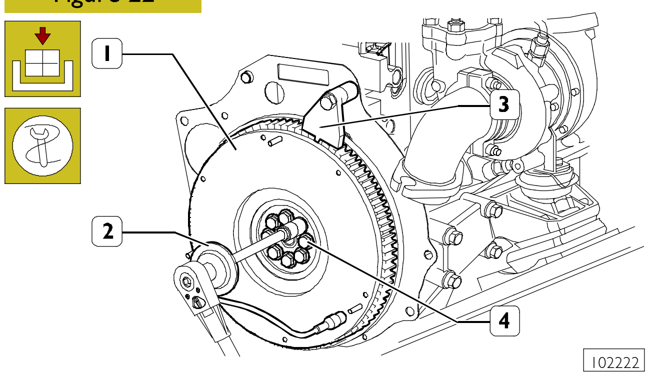
Refitting

Figure 21



Thoroughly clean the seal ring seat.
Lubricate the drive shaft rear shank with engine oil.
Apply part (2) of tool 99346259 to the drive shaft rear shank, then secure it with screws (5) and couple the new seal ring (3) with the same.
Place part (1) onto part (2), screw down nut (4) until seal ring (3) is fully assembled to the base.

Figure 22



Fit engine flywheel (1), then tighten screws (4).
Apply tool 99360351 (3) to the base in order to stop engine flywheel (1) rotation.
Tighten engine flywheel (1) fastening screws (4) in two separate steps:

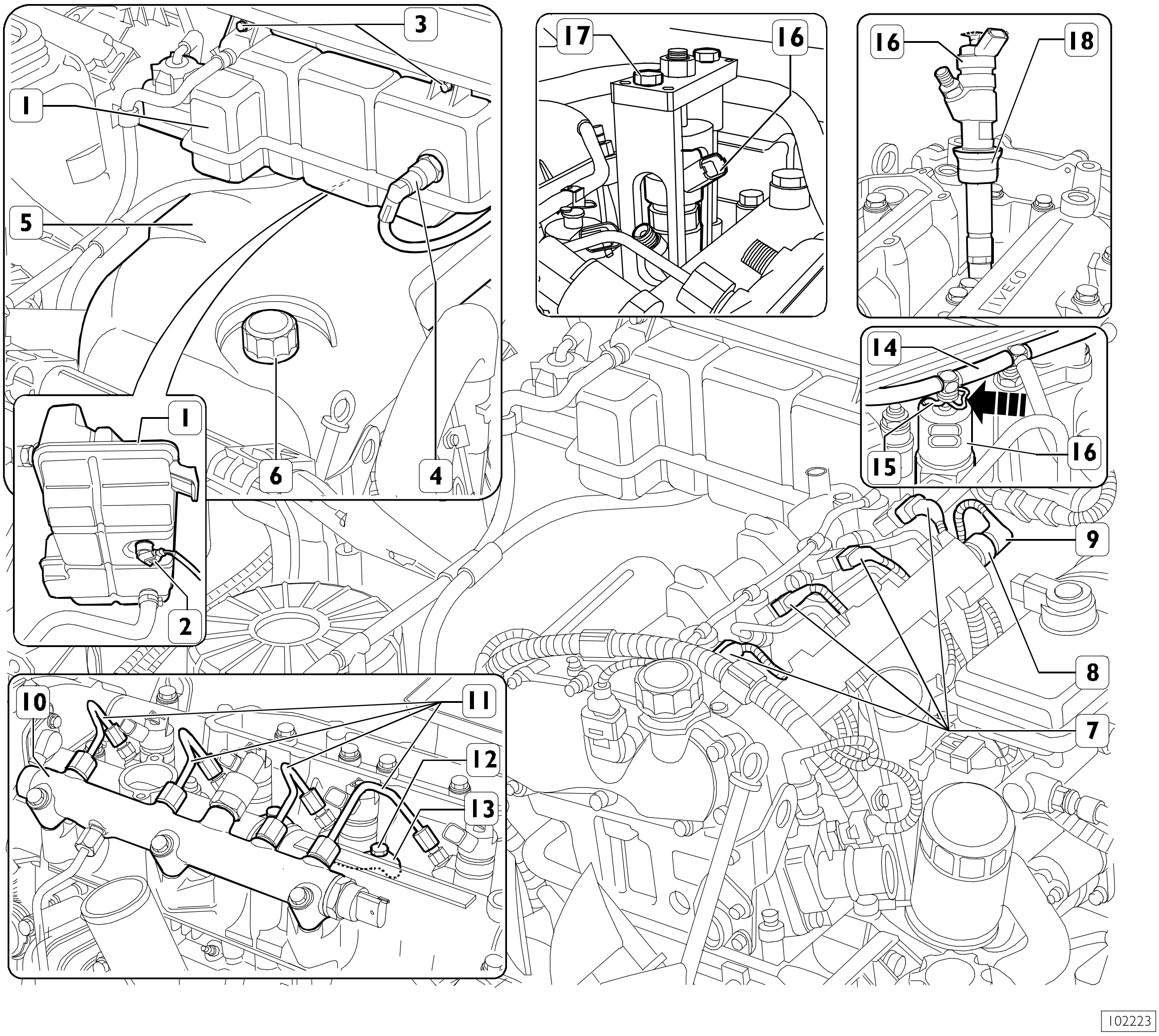
- ❑ step 1: tighten to 30 Nm by means of a torque wrench;
- ❑ step 2: tighten to 90° angle lock.

NOTE Angle lock is performed by means of tool 99395216 (2).

Disassemble tool 99360351 (3).Then fit the clutch, gear shift and drive shaft back into position, as described in the relevant sections.

775010 REPLACING ELECTRO-INJECTORS

Figure 23



Removal

Disconnect the following electric connections: (4), from the pressure sensor, and (2), from the level sensors, both of them located on expansion tank (1).
Remove nuts (3) securing expansion tank (1) to the wall, then put the expansion tank aside.
Remove plug (6), and then take off sound-proofing cover (5).
Disconnect electric connections (7) from electric injectors (16) and (9) from fuel pressure sensor (8).
Press clips (15) in the direction shown by the arrow, then disconnect fuel recovery pipe (14) fittings from electric injectors (16).
Disconnect fuel pipes (11) from electric injectors (16) and hydraulic accumulator (10).
Remove screws (12) and brackets (13) securing electric injectors (16) to the cylinder head.
Use tool 99342153 (17) to take electric injectors (16) off the overhead.

Refitting

Thoroughly clean the electric injector seat, taking care not to introduce foreign bodies into the cylinder liners.
Fit a new gasket (18) onto electric injector (16), and then fit the latter into the overhead.

Re-attachment is carried out by reversing the order of detachment operations. In particular, comply with the following instructions:

- fuel pipes must be replaced with new parts every time they are disassembled;
- tighten the nuts, screws and fittings to the specified torque values;
- to tighten the fuel pipe fittings, use a wrench of the 99317915 series as well as torque wrench 99389829.

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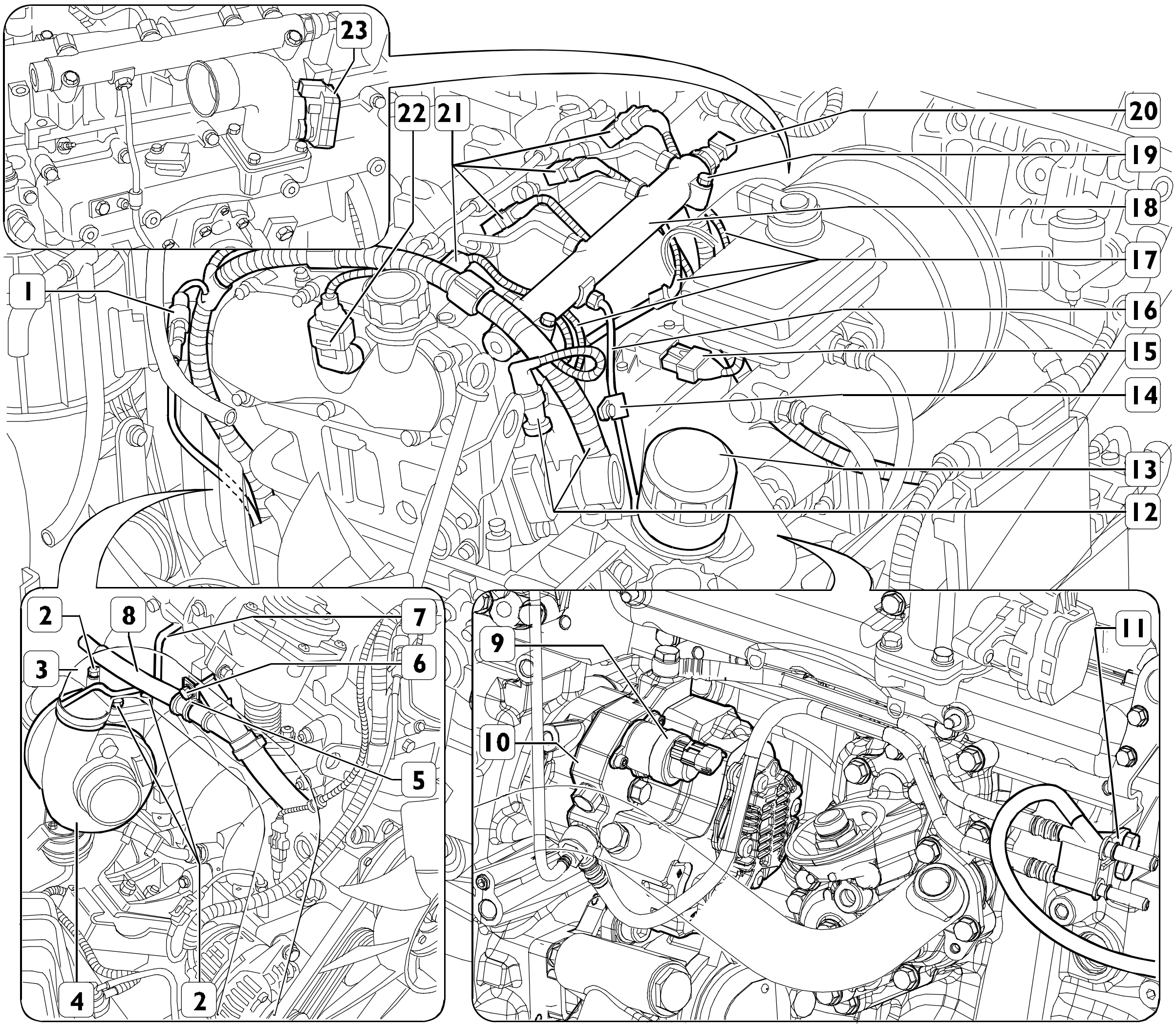
540610 REMOVAL/REFITTING THE CYLINDER HEAD

Figure 24



Removal

Proceed as follows, by operating as described in the "Power unit detachment/re-attachment" chapter:

- drain the cooling fluid;
- remove the front cross-member;
- remove the expansion tank.

Cut the straps securing the cables to the engine, then disconnect the electric connections below:

- (12) thermostat;
- (17) preheating plugs;
- (20) pressure sensor;
- (21) electric injectors;
- (1) electromagnetic joint;
- (22) phase sensor;
- (9) pressure regulator;
- (15) air temperature sensor;
- (23) throttle valve assembly actuator.

Remove the electric injectors as described in the respective charter. Remove screw (14), then take fuel pipe (16) off high-pressure pump (10) and hydraulic accumulator (18).
Remove the fastening screws, then take off hydraulic accumulator (18).
Use tool 99360076 to remove oil filter (3) from the heat exchanger.

Remove bracket (11) securing the low-pressure pipe assembly to the inlet manifold.
Remove screw (6), then take coolant pipe (8) fastening strap (5) off the cylinder head.
Remove air conveyor (3) from the overhead, from turboblower (4).
Disconnect oil pipe (7) from the connection on the cylinder head.
Remove nuts (2), then remove turboblower (4) from exhaust manifold.

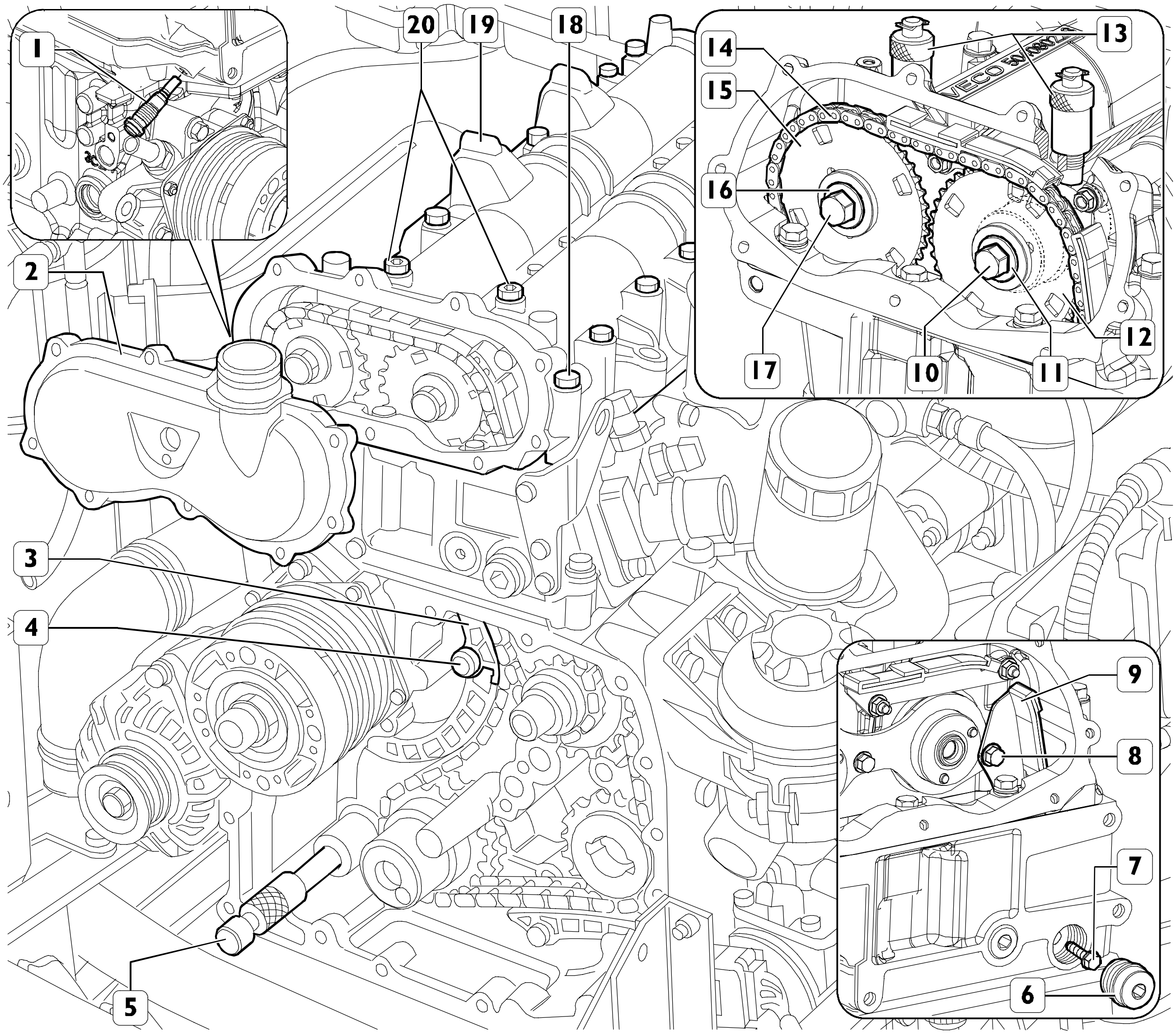
NOTE Properly plug the turbocharger air outlet/inlet, to prevent foreign bodies from penetrating accidentally into the turbocharger (and, therefore, damaging the same).

Remove the fan from the electro-magnetic joint.

Take off the air-conditioning compressor drive belt (if any) as well as the water pump-alternator drive belt, as described in the relevant chapters.

Remove the front cover, as described in the "Replacing the seal ring and the front cover gasket" chapter".

Figure 25



Remove the screws, and then take upper cover (2) off overhead (19).
Remove plugs (20) from overhead (19).

Rotate the drive shaft clockwise, so that pins 99360614 (13) can be inserted, through the holes of plugs (20), into the corresponding holes of the drive shafts, and pin 99360615 (5) can be inserted into the drive shaft through the base unit hole.

Remove upper chain stretcher (1).
Remove pin (4), then take off upper shoe (3).
Remove both screw (17) and washer (16), and then disassemble gear (15).
Remove both screw (10) and washer (11), then disassemble gear (12) and chain (14).
Remove both plug (6) and screws (7 and 8), then disassemble fixed upper shoe (9).

Remove screws (18), then take off overhead (19) complete with pins 99360614 (13).

NOTE Pins 99360614, applied in order to avoid modifying timing after the toothed chain has been disassembled, must be removed from the overhead only when the latter has been disassembled.

Remove the overhead gasket.
Remove the tappets and put them apart carefully.
Remove the pre-heating spark plugs by means of tool 99355041.
Remove the cylinder head fastening screws, and then take the head off the base unit.
Remove the cylinder head gasket.

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Refitting

Unless otherwise specified, re-attachment is carried out by reversing the order of detachment operations. In particular, comply with the following instructions:
Verify the conditions listed below, which refer to the tools used for valve timing:
- tool 99360614 (6, SENZA CODICE) must be inserted into the overhead;
- tool 99360615 (11, SENZA CODICE) must be inserted into the base unit.

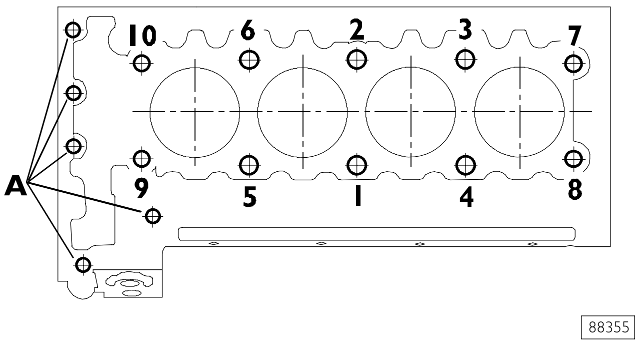
Verify that the junction planes of the cylinder head and the base unit are clean.
Do not soil the cylinder head gasket.
Place the cylinder head gasket with the “TOP” writing facing the head itself.

NOTE The gasket must strictly be kept sealed in its own package and be unwrapped soon before being fitted.

Fit the cylinder head, insert the screws and tighten up in three subsequent steps, by following the sequence and indications shown in the next figure.

NOTE Angle lock is carried out by means of tool 99395216.

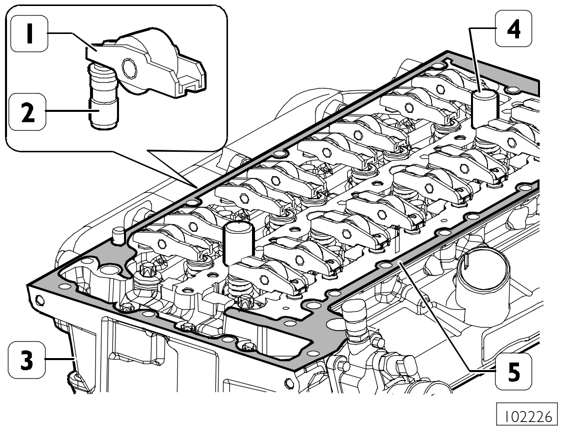
Figure 26



Cylinder head fastening screw tightening sequence:

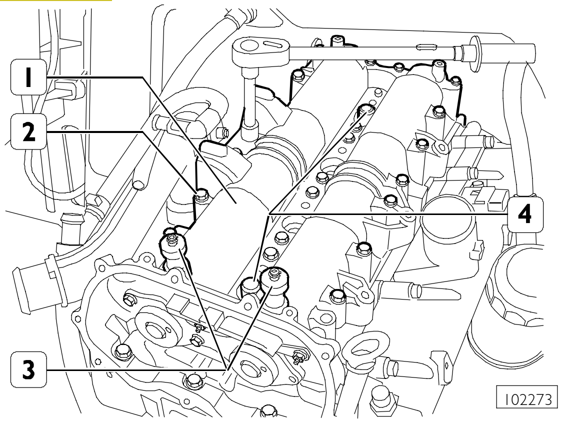
- ❑ step 1: preliminary tightening by means of a torque wrench:
  - tighten screws 1-2-3-4-5-6 to 130 Nm;
  - tighten screws 7-8-9-10 to 65 Nm.
- ❑ step 2: angle locking:
  - tighten screws 1-2-3-4-5-6 to 90°;
  - tighten screws 7-8-9-10 to 90°.
- ❑ step 3: angle locking:
  - tighten screws 1-2-3-4-5-6 to 90°;
  - tighten screws 7-8-9-10 to 60°.
- ❑ Tighten screws A to 25 Nm.

Figure 27



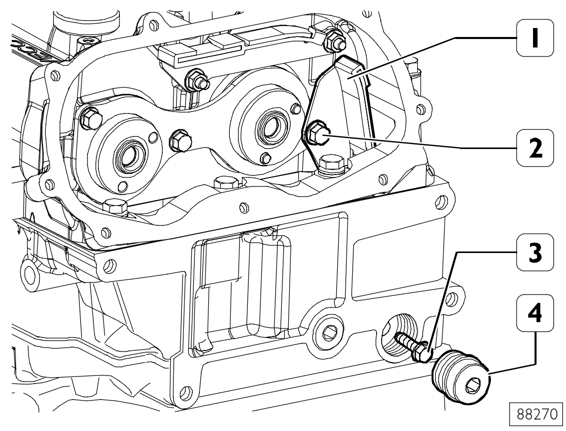
Thoroughly clean hydraulic tappets (2), then lubricate and fit them to cylinder head (3), by correctly positioning rocker arms (1) on the valves.
Fit gasket (5).
Insert the two tools Sp. 2264 (4) into the electric injector seats for subsequent overhead centring on the cylinder head.

Figure 28



Fit overhead (1) complete with tools 99360614 (3) for valve timing, then tighten fastening screws (2) to the specified torque.
Remove tools Sp. 2264 (4).

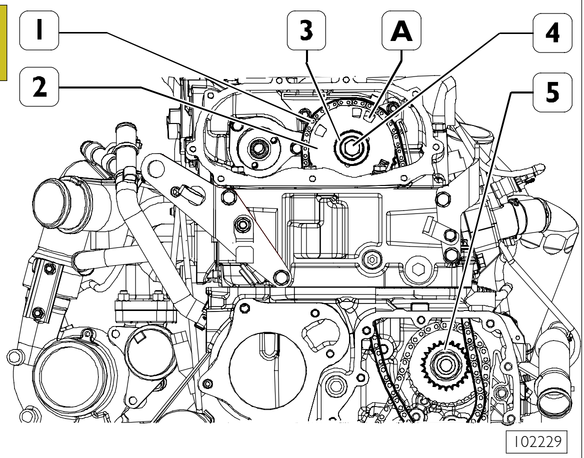
Figure 29



Fit fixed upper shoe (1). Tighten screws (2 and 3) to the specified torque.
Fit plug (4) together with a new basket, then tighten it to the specified torque.

NOTE All the camshaft drive components (fixed and moving pads, timing gears, chain nuts and timing control chains) shall be replaced even though the anomaly affects only one of the above-mentioned items.

Figure 30

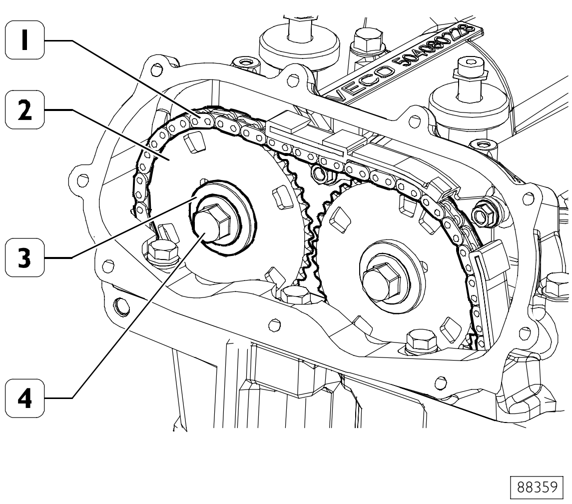


Place chain (1) on gear (5) and on gear (2).
Fit the gear in such a way that when it is inserted onto the dowel bolt of the intake valve distributing shaft, slots A will be positioned as shown in the figure.

NOTE The chain (1) branch included between the two gears must be subjected to tension.

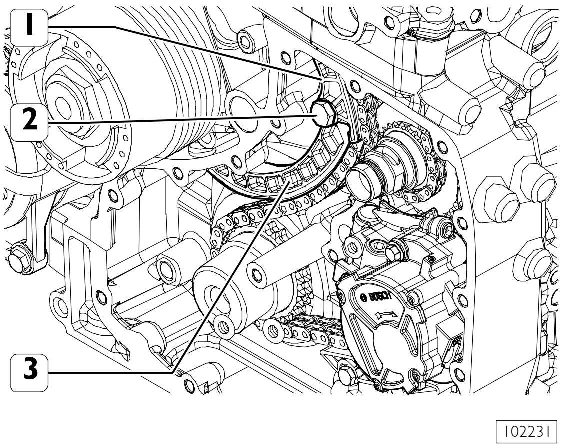
Screw down fastening screw (4) with washer (3) without tightening up.

Figure 31



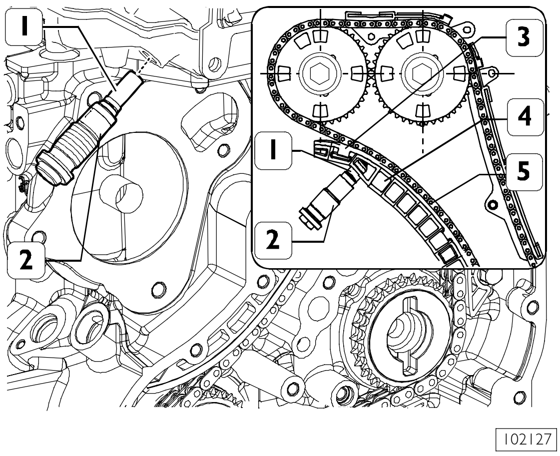
Place chain (1) on gear (2), then fit the latter onto the exhaust valve distributing shaft.
Screw down fastening screw (4) with washer (3) without tightening up.

Figure 32



Check the conditions of moving pads (1 and 3): if they are worn, they shall be replaced together with the other camshaft drive components.
Position moving shoes (1 and 3), then secure them to the base unit with pin (2) by tightening the latter to the specified torque

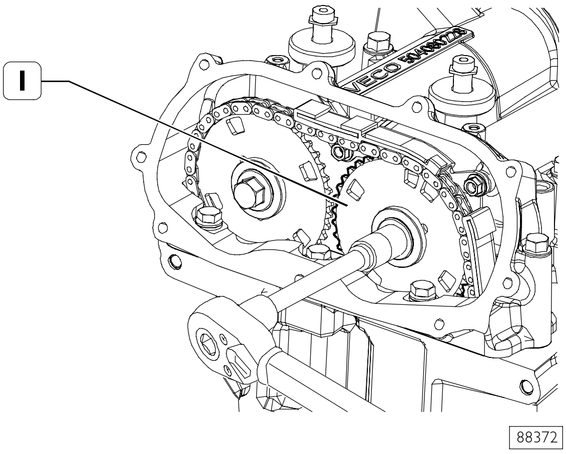
Figure 33



NOTE Chain stretcher (1) cannot be re-used for any reason after it has been disassembled. Moreover, in the event that piston (1) has been unintentionally made to escape from chain stretcher (2), the latter must be replaced.
Chain stretcher reconditioning is not permitted.

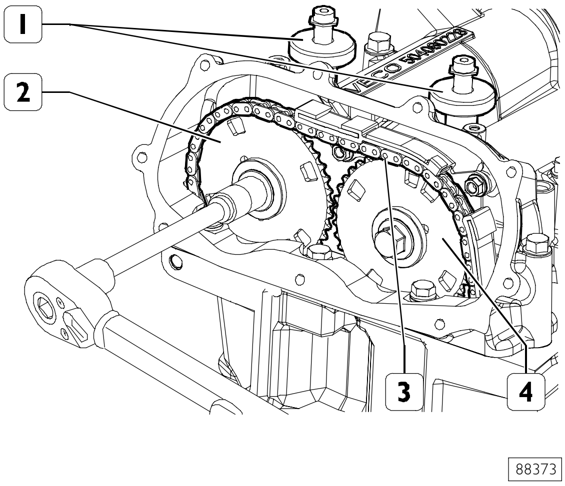
Screw down hydraulic chain stretcher (2), then tighten it to the specified torque.
Insert, through the opening on the overhead, a suitable screwdriver, then press on moving shoe (4) fin (3) until chain stretcher (2) piston (1) is pushed to its end of stroke.
Release moving shoe (4), and make sure that piston (1) causes, by escaping from its seat, chain (5) to be subjected to tension.

Figure 34



Tighten the screw securing gear (1) to the intake valve distributing shaft to the specified torque.

Figure 35



Make sure that chain (3) is subjected to tension in the length included between gear (2) and gear (4).
Tighten the screw securing gear (2) to the exhaust valve distributing shaft to the specified torque.
Remove tools 99360614 (1) and 99360615 (5, Figure 25).

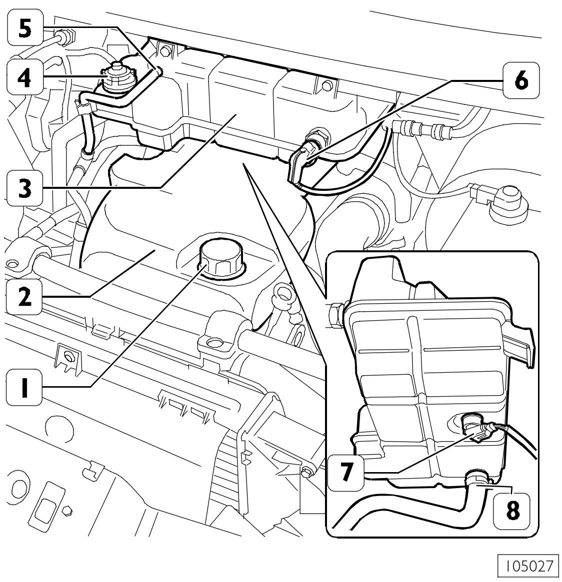
Re-attachment is carried out by reversing the order of detachment operations. In particular, comply with the following instructions:

- replace the seal rings, gaskets, safety snap rings and high-pressure pipes with new parts;
- lubricate the seal rings with engine oil prior to assembling;
- tighten the screws, nuts and pipe fittings to the specified torque values;
- check the engine oil level; top up, if necessary;
- fill the engine cooling system, start the engine, and check for cooling fluid leaks.

540730 EGR HEAT EXCHANGER REMOVAL - REFITTING

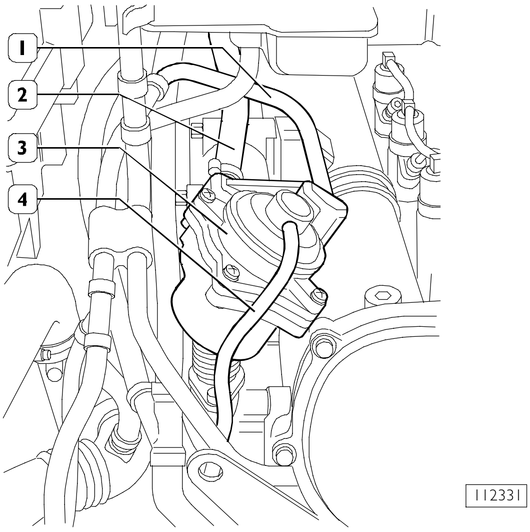
Removal

Figure 36



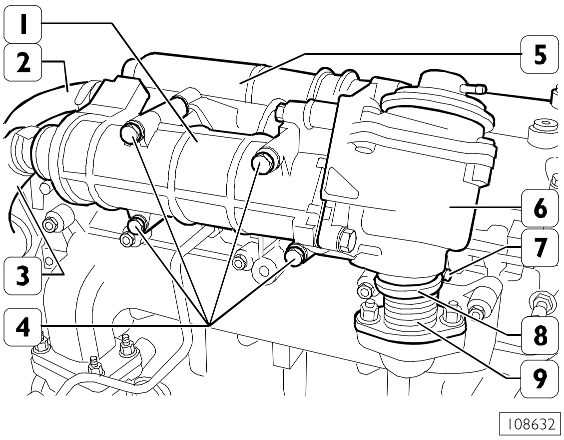
Remove plug (4) from expansion tank (3).
Arrange special container under the radiator, remove plug located on radiator right side and drain engine coolant.
Remove oil filling plug (1) and take off sound deadening cover (2).
Disconnect electrical connection (6) from pressure switch.
Loosen clamps and disconnect coolant vent tube (5).
Remove securing screws and disconnect tank (3) from wall.
Disconnect electrical connection (7) from the level sensor placed under tank (3).
Loosen clamps and disconnect coolant tube (8) placed under tank (3).

Figure 37



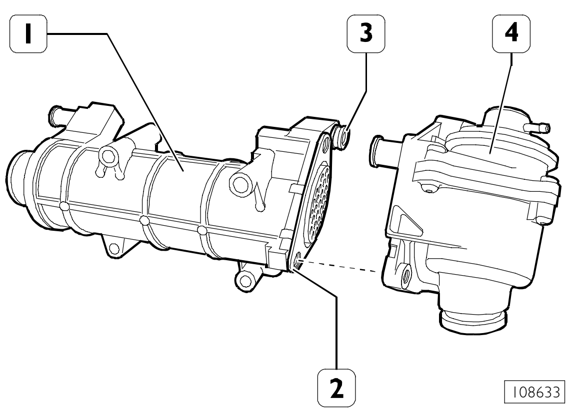
Loosen the straps, then disconnect coolant pipes (1 and 2) and vacuum pipe (4) from EGR valve (3).

Figure 38



Loosen the straps, then disconnect coolant pipes (2 and 3) from EGR valve (6). Loosen screw (7) of strap (8) joining EGR valve (6) to pipe (9). Remove screws (4), then take heat exchanger (1), complete with EGR valve (6), off the overhead.

Figure 39



Place the heat exchanger/valve assembly onto a work bench, then remove EGR valve (4) fastening screws and take EGR valve (4) off heat exchanger (1).

Refitting

IVECO PARTS

For refitting, reverse the operations described for removal observing following warnings:

- ❑ replace gaskets (2 and 3) and the straps with new parts.
- ❑ tighten the screws to the specified torque value.
- ❑ fill expansion tank with coolant.

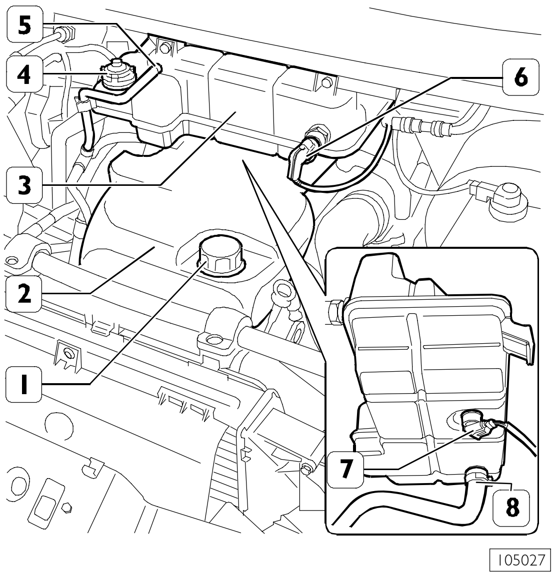
Checks and tests

Start up the engine, let it run at rpm's just a little over idling and wait for coolant temperature to reach the value for opening the temperature switch, then check for no water leaks existing from cooling circuits tubes.

540730 EGR HEAT EXCHANGER REMOVAL - REFITTING

Removal

Figure 40



Remove plug (4) from expansion tank (3).
Arrange special container under the radiator, remove plug located on radiator right side and drain engine coolant.
Remove oil filling plug (1) and take off sound deadening cover (2).
Disconnect electrical connection (6) from pressure switch.
Loosen clamps and disconnect coolant vent tube (5).
Remove securing screws and disconnect tank (3) from wall.
Disconnect electrical connection (7) from the level sensor placed under tank (3).
Loosen clamps and disconnect coolant tube (8) placed under tank (3).

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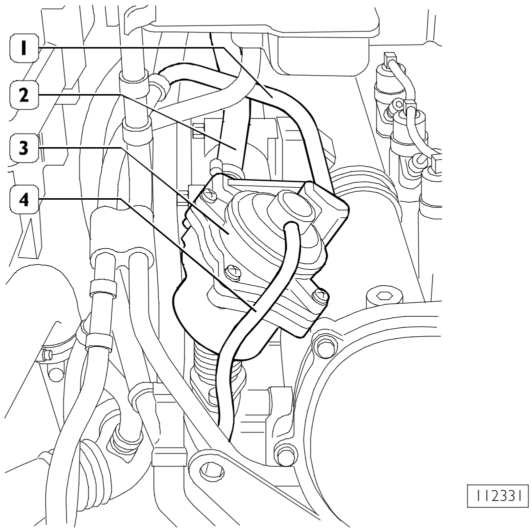
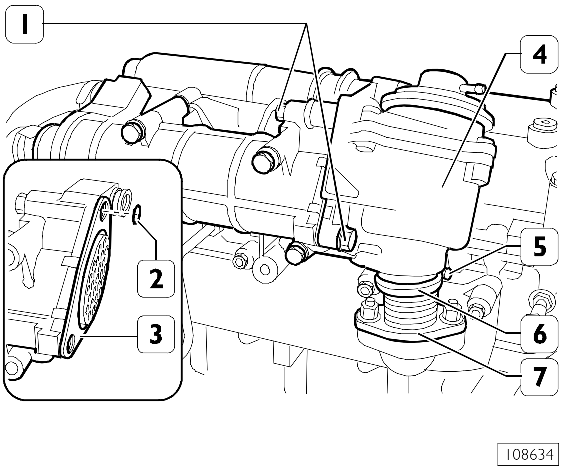
Figure 41



Loosen the straps, then disconnect coolant pipes (1 and 2) and vacuum pipe (4) from EGR valve (3).

Figure 42



Loosen screw (5) of strap (6) joining EGR valve (4) to pipe (7).
Remove screws (1), then take EGR valve (4) off the heat exchanger.

Refitting

For refitting, reverse the operations described for removal observing following warnings:

- replace gaskets (2 and 3) and the straps with new parts.
- tighten the screws to the specified torque value.
- fill expansion tank with coolant.

Checks and tests

Start up the engine, let it run at rpm's just a little over idling and wait for coolant temperature to reach the value for opening the temperature switch, then check for no water leaks existing from cooling circuits tubes.

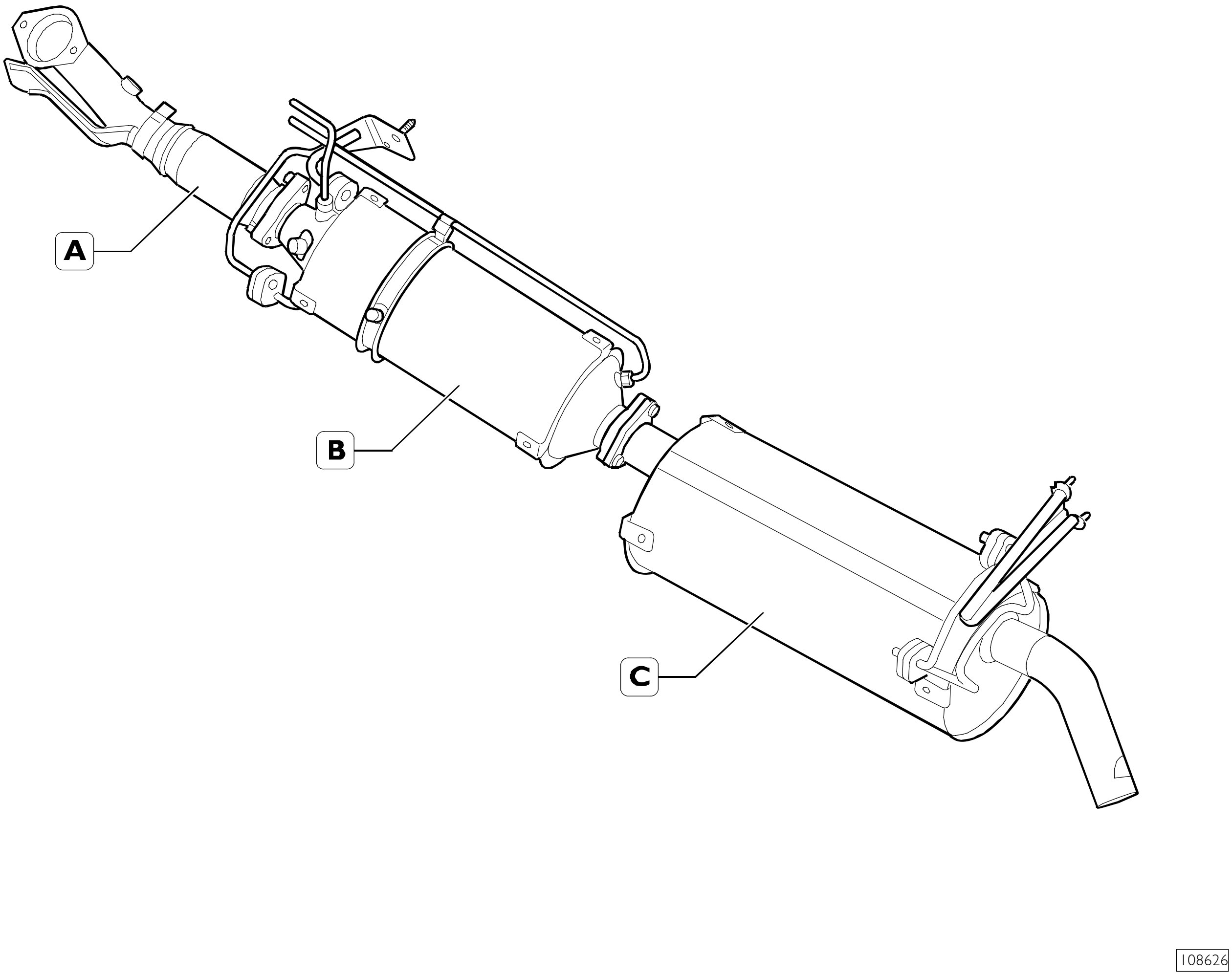
BURNT GAS EXHAUST SYSTEM

The exhaust system is made up of three components:

A. system length with hose;
B. catalyst with particulate filter (DPF);
C. silencer.

The exhaust system is manufactured by Arvin Meritor (ArM).

Figure 43



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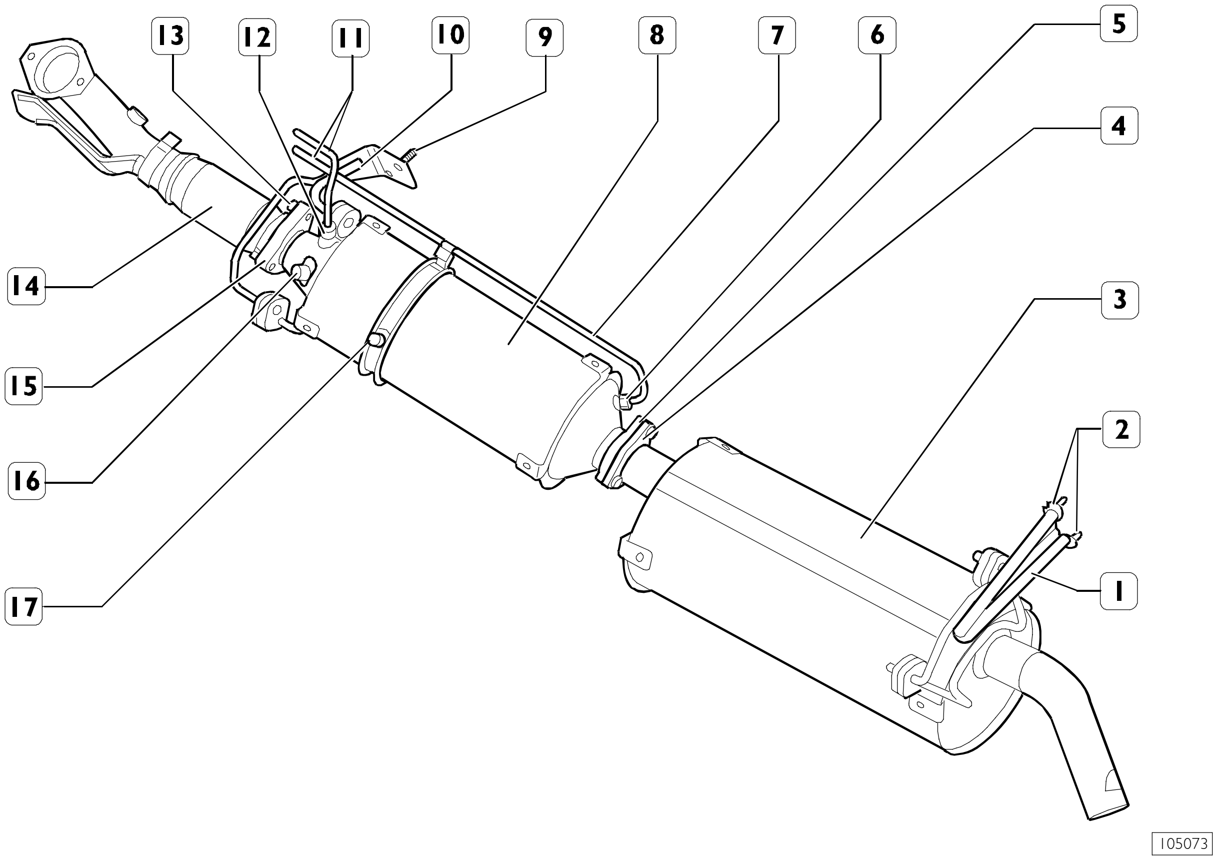
REMOVAL/REFITTING OF EXHAUST PIPE ASSEMBLY COMPONENTS (SYSTEMS EQUIPPED WITH D.P.F. CATALYST)

Figure 44



Exhaust silencer removal

Place the vehicle on a pit or auto lift.
Carry out the following operations by acting from under the vehicle:

- ❑ unscrew nuts (2) securing silencer (3) supporting bracket (1) to the vehicle chassis;
- ❑ unscrew and remove fastening screws (4) of flanges (5) connecting exhaust silencer (3) and D.P.F. particulate filter (8);
- ❑ remove exhaust silencer (3).

D.P.F. catalyst removal

- ❑ unscrew and remove the exhaust gas temperature sensors at the catalyst inlet 16) and outlet (17);
- ❑ unscrew to disconnect couplings (6 and 12) securing rigid pipes (7 and 11) running to the pressure sensor to D.P.F. catalyst (8);
- ❑ properly secure D.P.F. catalyst (8) to the vehicle chassis;
- ❑ unscrew nuts (9) securing D.P.F. catalyst (8) filter supporting bracket (10) to the vehicle chassis;
- ❑ unscrew and remove fastening screws (13) of flanges (15) connecting D.P.F. catalyst (8) filter to the exhaust gas outlet pipe from turbine (14);
- ❑ remove D.P.F. catalyst (8) filter.

Refitting

Refitting is carried out by reversing the order of the detachment operations. Moreover, the following instructions shall be observed:

- ❑ check the conditions of the elastic dowels, taking care to replace the defective ones (if any);
- ❑ replace the gaskets with new parts;
- ❑ tighten the nuts and screws to the specified torque.

After the operation has been completed, and in the event that either the D.P.F. catalyst or the differential sensor (delta-p) needs replacing, follow the instructions given in the respective chapters.

507130 Replacing D.P.F. catalyst

Replacing D.P.F. catalyst needs that all the counters of below indicated parameters are reset in the central unit, as:

- particulate quantity in new filter is zero, so, if particulate quantity is not reset, filter regeneration will start even if it is not necessary;
- quantity of accumulated ashes is zero, so, if ashes counter is not reset, regeneration frequency will be greater than needed, consequently increasing fuel consumption, and particulate filter thermal fatigue; and, in extreme cases, there will be an unnecessary request to refill engine oil;
- post-injected fuel quantity is zero, so, if post-injected fuel counter is not reset, there may be an early request to refill engine oil.

NOTE Where both DPF catalyst is replaced and engine oil is refilled, resetting post-injected fuel counter is not necessary.

- regeneration status: regeneration unnecessary, in progress, interrupted, resumed;
- miles covered and times from last complete regeneration;
- differential pressure (delta-p) sensor drift self-rectification;
- oxidiser catalyst drift; consequently, if catalyst ageing function is not reset, quantities of unnecessary post-injections might be present.

The meters used to evaluate the above-mentioned parameters can be reset by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the differential sensor replacement procedure, in accordance with the instructions given by the diagnosis instruments.

540743 Replacing differential sensor (delta-p)

Pressure difference between gas pressure at catalyst module inlet and gas pressure at ceramic walls filter outlet is converted into a voltage signal (Vout) by pressure sensor.

During engine running, E.D.C. 16 central unit performs checks on differential pressure sensor drift and calculates engine compensation and running values, and corrects them. Consequently, after replacing the sensor, it is necessary to reset rectification coefficients.

The meters used to evaluate the above-mentioned parameters can be reset by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the differential sensor replacement procedure, in accordance with the instructions given by the diagnosis instruments.

ENGINE VIEWS

Figure 45

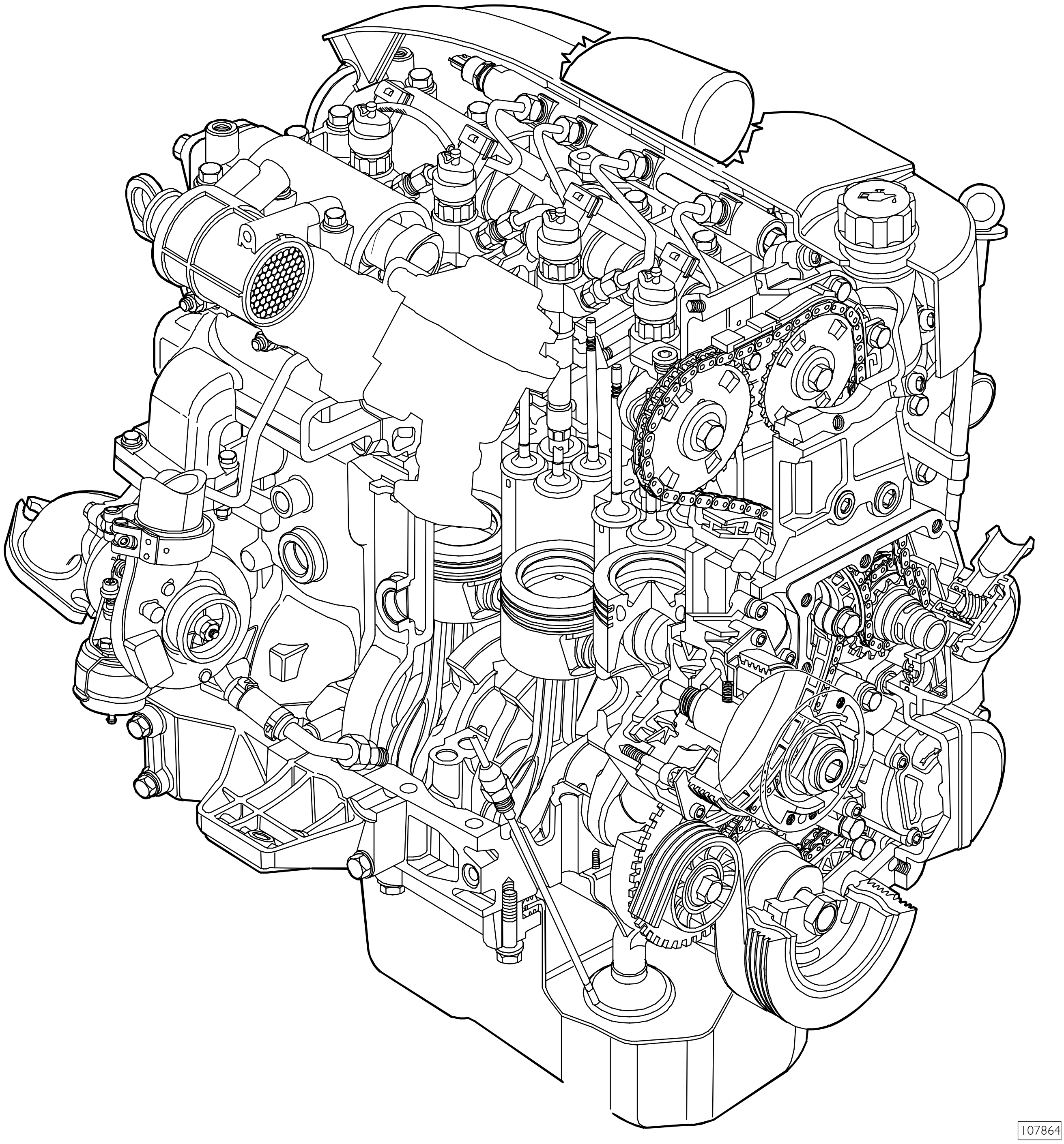
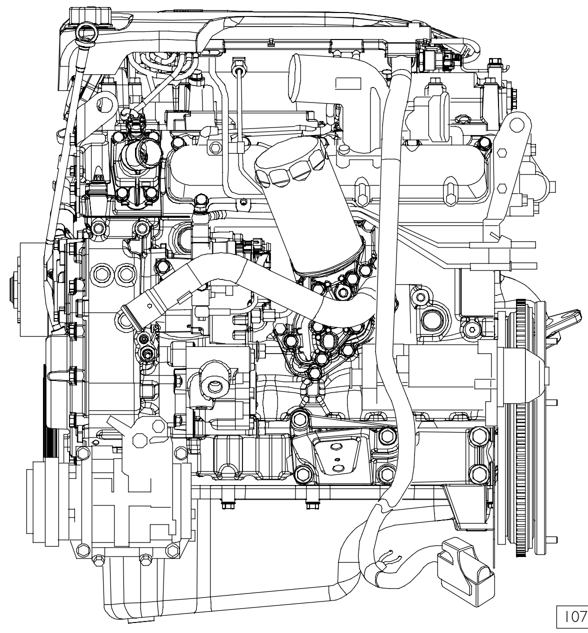


Figure 46



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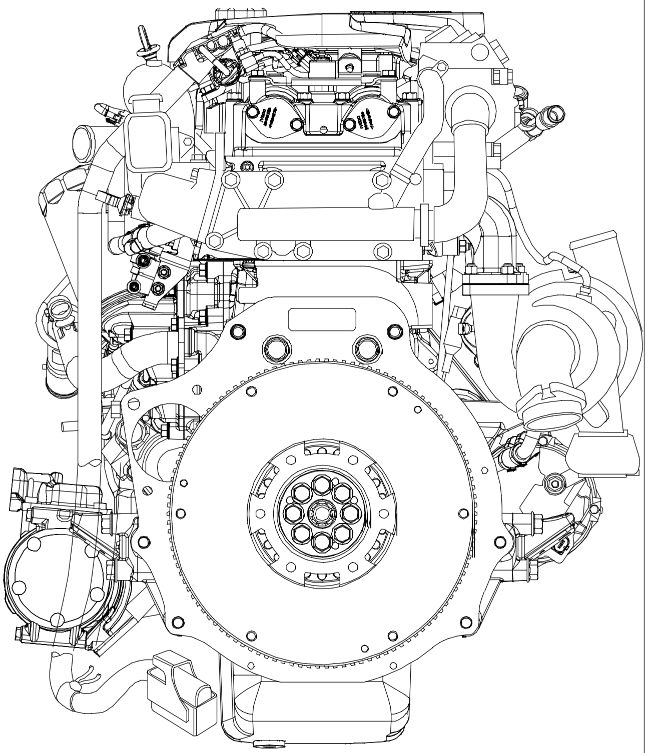
LEFT-HAND SIDE VIEW

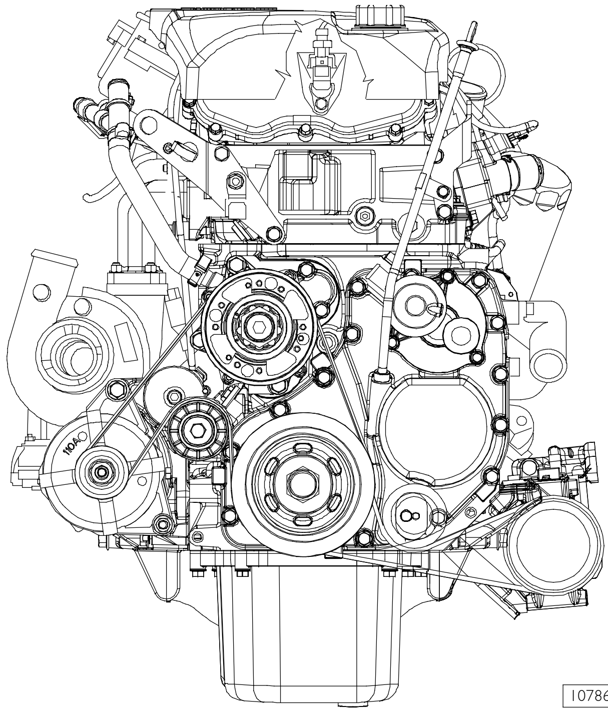
Figure 47



107866

REAR VIEW

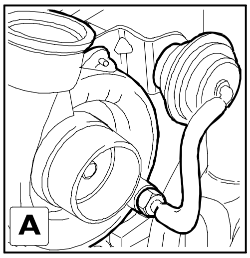
Figure 48

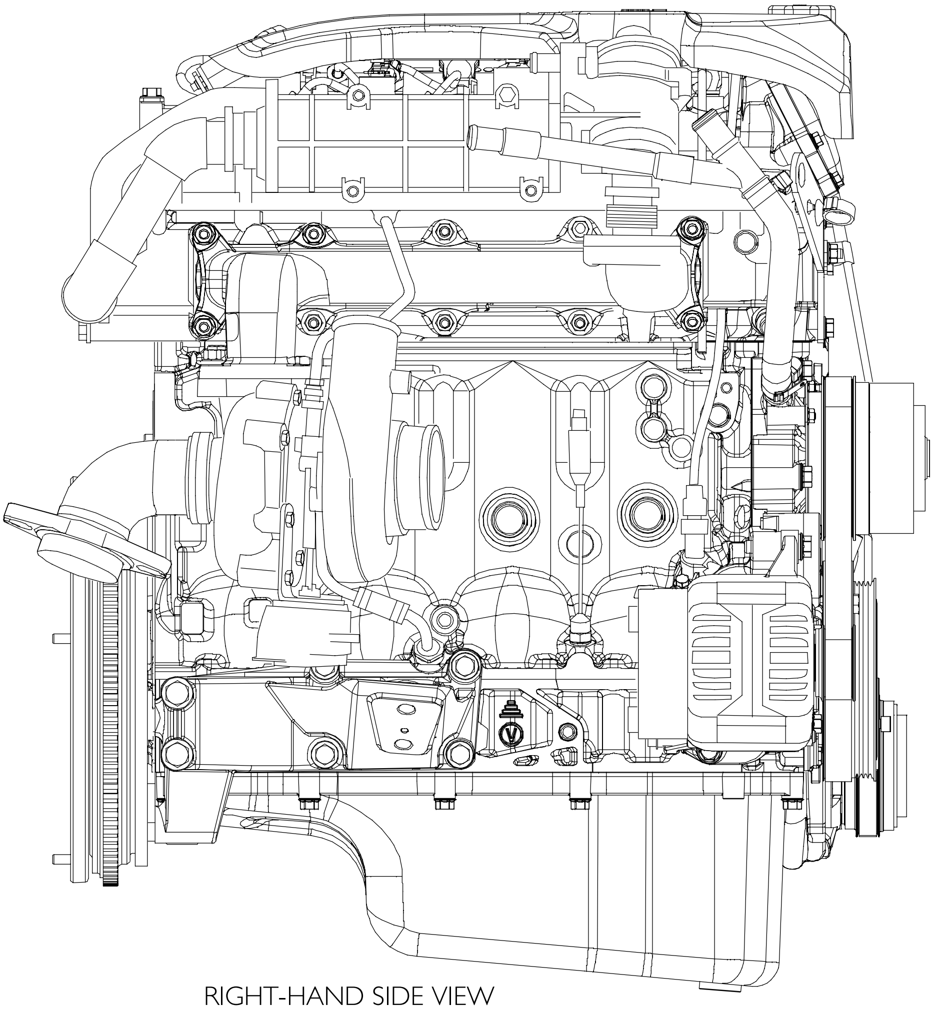


107867

FRONT VIEW

Figure 49

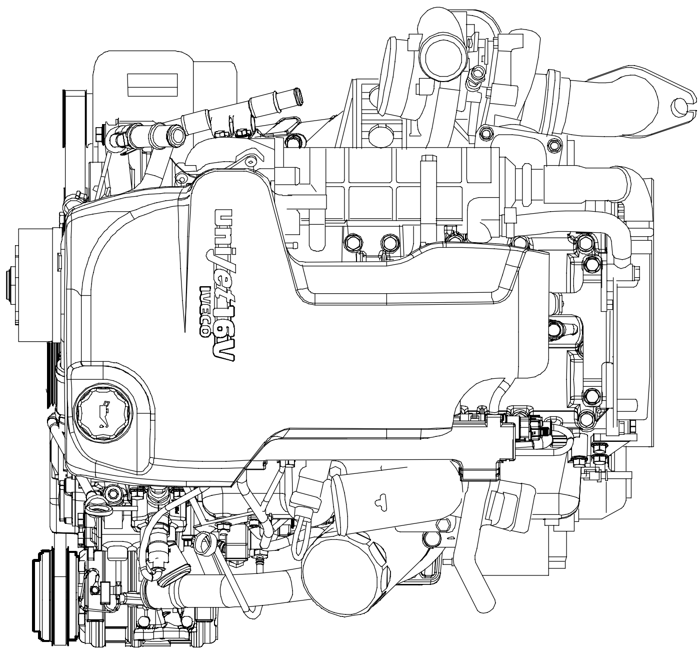




RIGHT-HAND SIDE VIEW

A. Turbocharger with pressure relief valve (Waste-Gate, ENGINE 136 HP)

Figure 50



TOP VIEW

EMISSIONS

Engines for LD (Light Duty) vehicles

Gas emissions

Engines comply with Euro4 Gas Emission Regulation (measurement at engine bench according to cycle ECE15+EUDC), with following limits set by Regulation 98/69 - 1999/102/CEI - level B:

- CO (carbon oxide) 0.74 g/kWh
- NOx (nitrogen oxide) 0.39 g/kWh
- HC (unburnt hydrocarbons) + NOx (nitrogen oxide) 0.46 g/kWh
- Particulate 0.06 g/kWh

Test fuel: CEC RTF 73 - T90 S = 0.05 %.

Grade of smoke

Engines comply with grade of smoke limits requested by regulations to have following grade of smoke values at outlet:

- maximum power (Bosch BSU opacimeter grades) 1.5
- maximum torque (Bosch BSU opacimeter grades) 1.5

Sound emissions

Maximum average acoustic level, Lpa, of standard configuration engines measured according to ISO Std 3745 (microphones at one metre distance from engine surfaces):

- at idling .... (800 rpm) .... 72 dB A
- at maximum torque .... 84 dB A
- at maximum power (3800 rpm) .... 93 dB A.

Engines for HD (Heavy Duty) vehicles

Gas emissions

Engines comply with Euro4 Gas Emission Regulation (measurement at engine bench according to cycles ETC and ESC/ELR, with following limits set by Regulation 98/69 - 1999/102/CEI - level B:

Cycle ESC + ELR:

- CO (carbon oxide) .... 1.5 g/kWh
- NOx (nitrogen oxide) .... 3.5 g/kWh
- HC (unburnt hydrocarbons) .... 0.46 g/kWh
- Particulate .... 0.02 g/kWh

Cycle ETC:

- CO (carbon oxide) .... 1.5 g/kWh
- NOx (nitrogen oxide) .... 3.5 g/kWh
- HC (unburnt hydrocarbons) .... -- g/kWh
- Particulate .... 0.03 g/kWh

Test fuel: CEC RTF 73 - T90 S = 0.05 %.

Grade of smoke

Engines comply with grade of smoke limits requested by regulations to have following grade of smoke values at outlet:

- maximum power (Bosch BSU opacimeter grades) 1.5
- maximum torque (Bosch BSU opacimeter grades) 1.5

Sound emissions

Maximum average acoustic level, Lpa, of standard configuration engines measured according to ISO Std 3745 (microphones at one metre distance from engine surfaces):

- at idling .... (800 rpm) .... 72 dB A
- at maximum torque .... 84 dB A
- at maximum power . (3800 rpm) .... 93 dB A.

ENGINE IDENTIFICATION CODE

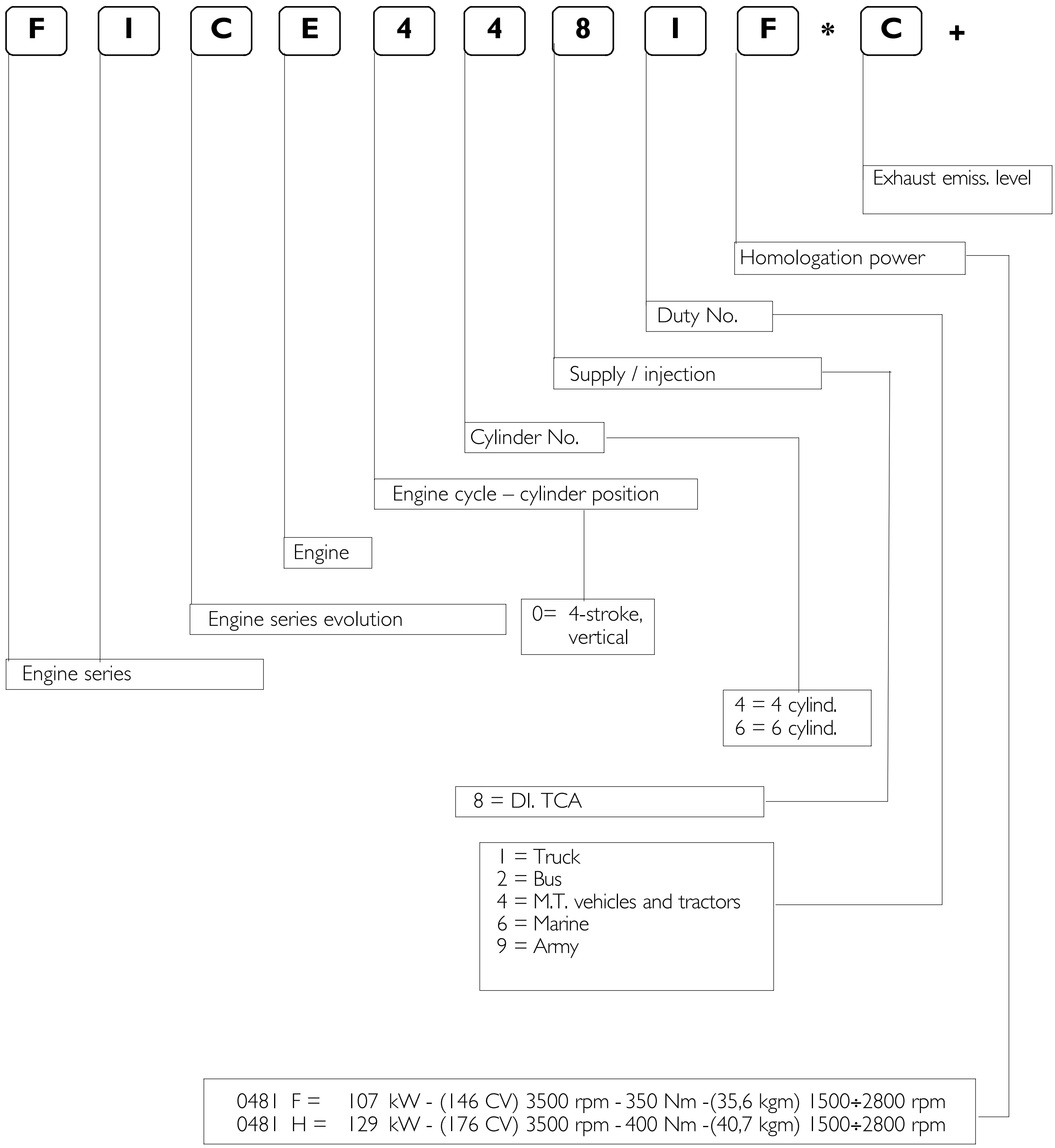
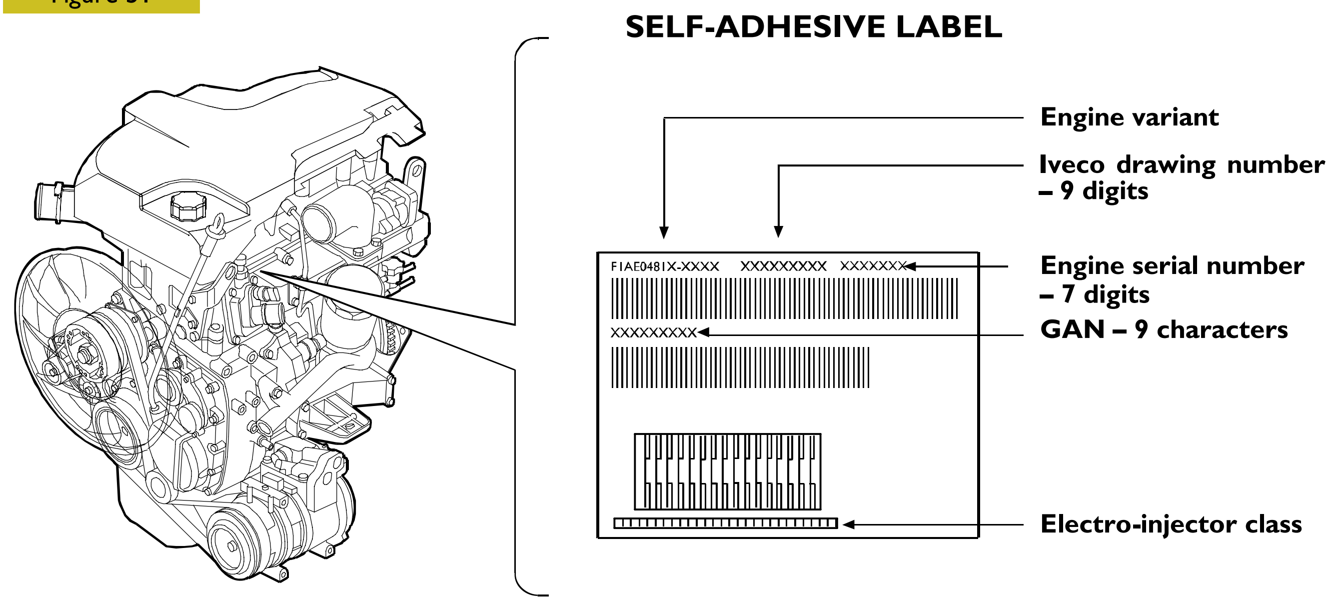
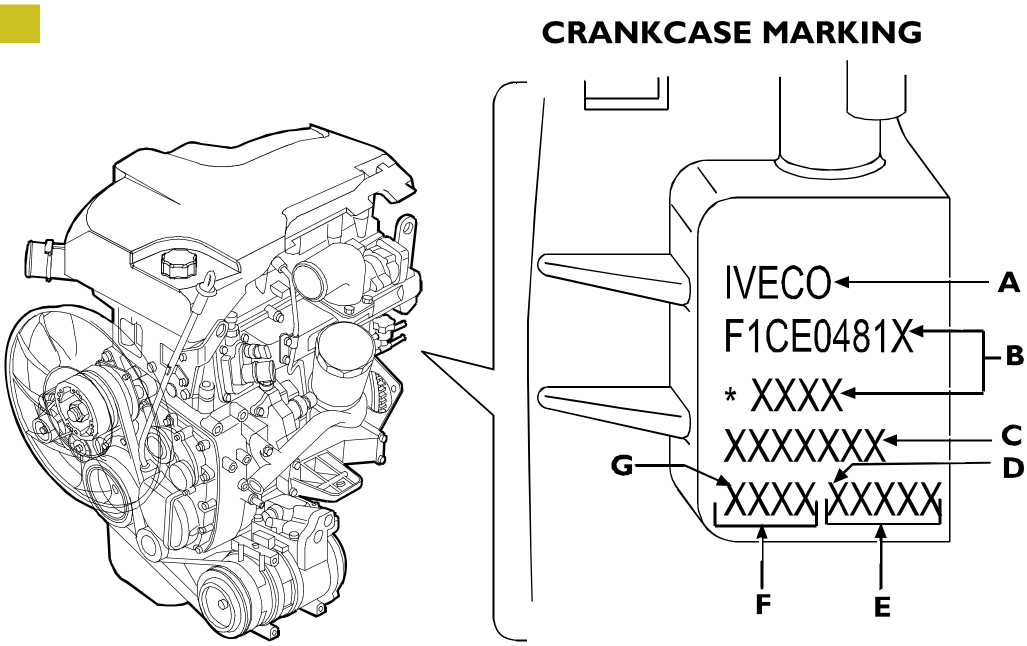


Figure 51



107870

Figure 52



107871

	EXAMPLE
A = IVECO trademark	IVECO
B = IVECO name of engine variant **	F1CE0481F/H * A001
C = Engine serial number	1359862
D = 1st digit, main journal no. 1 (engine front)	
E = Main bearing selection diameters	12345
F = Barrel selection diameters	1234
G = 1st digit, cylinder no. 1 (engine front)	

(**) Data obtainable from "XZ" engine ordering number information

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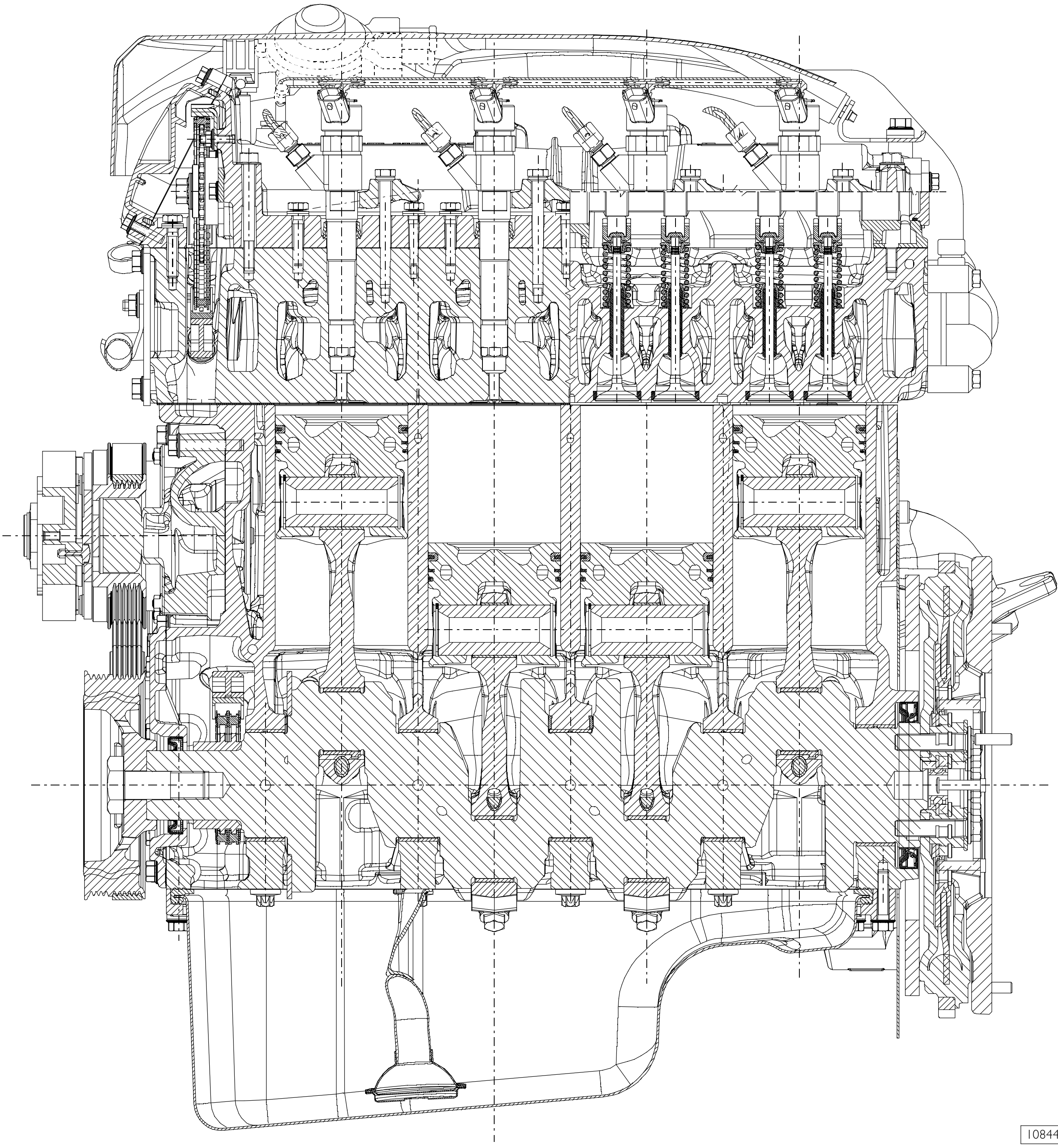
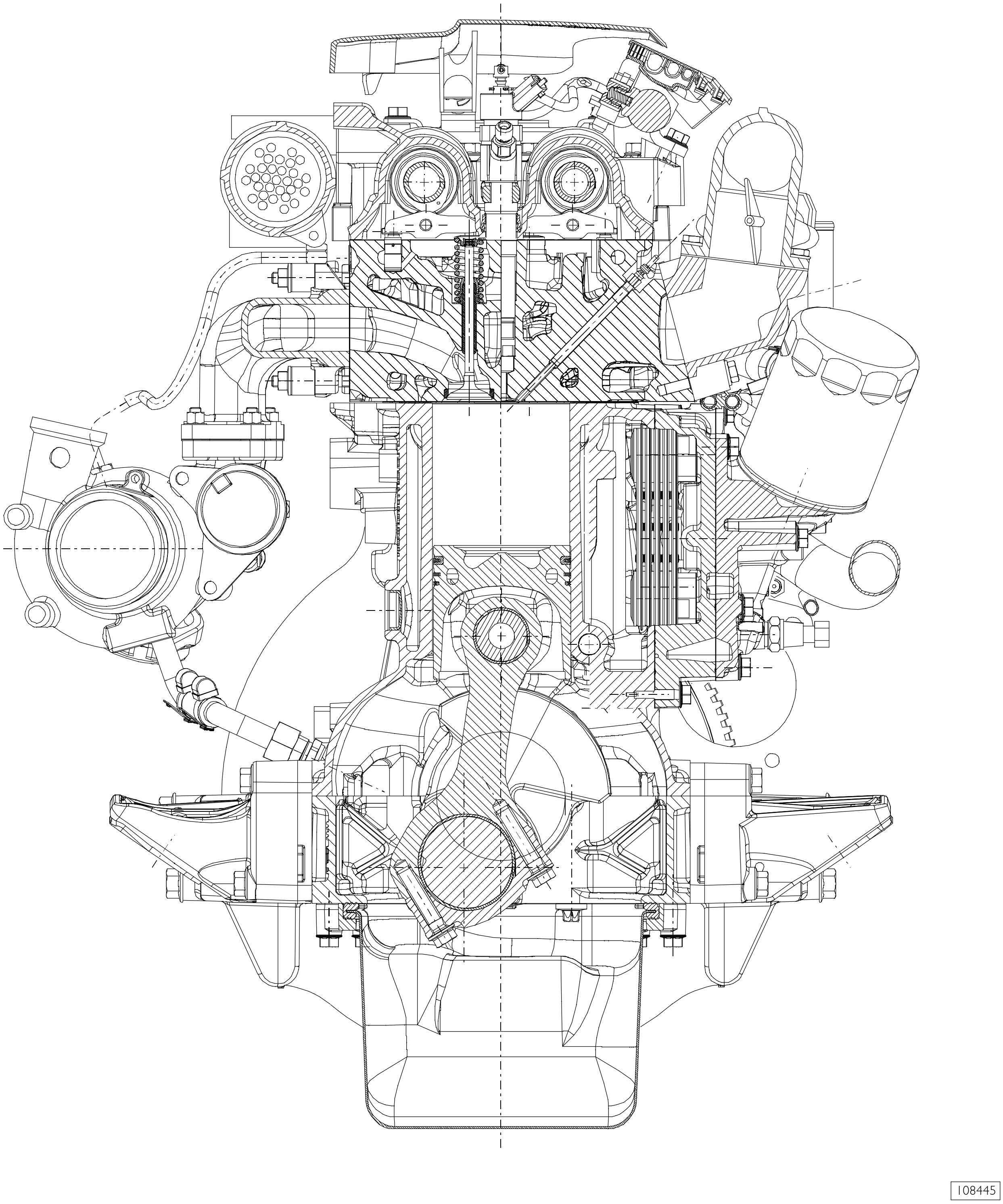
Figure 53



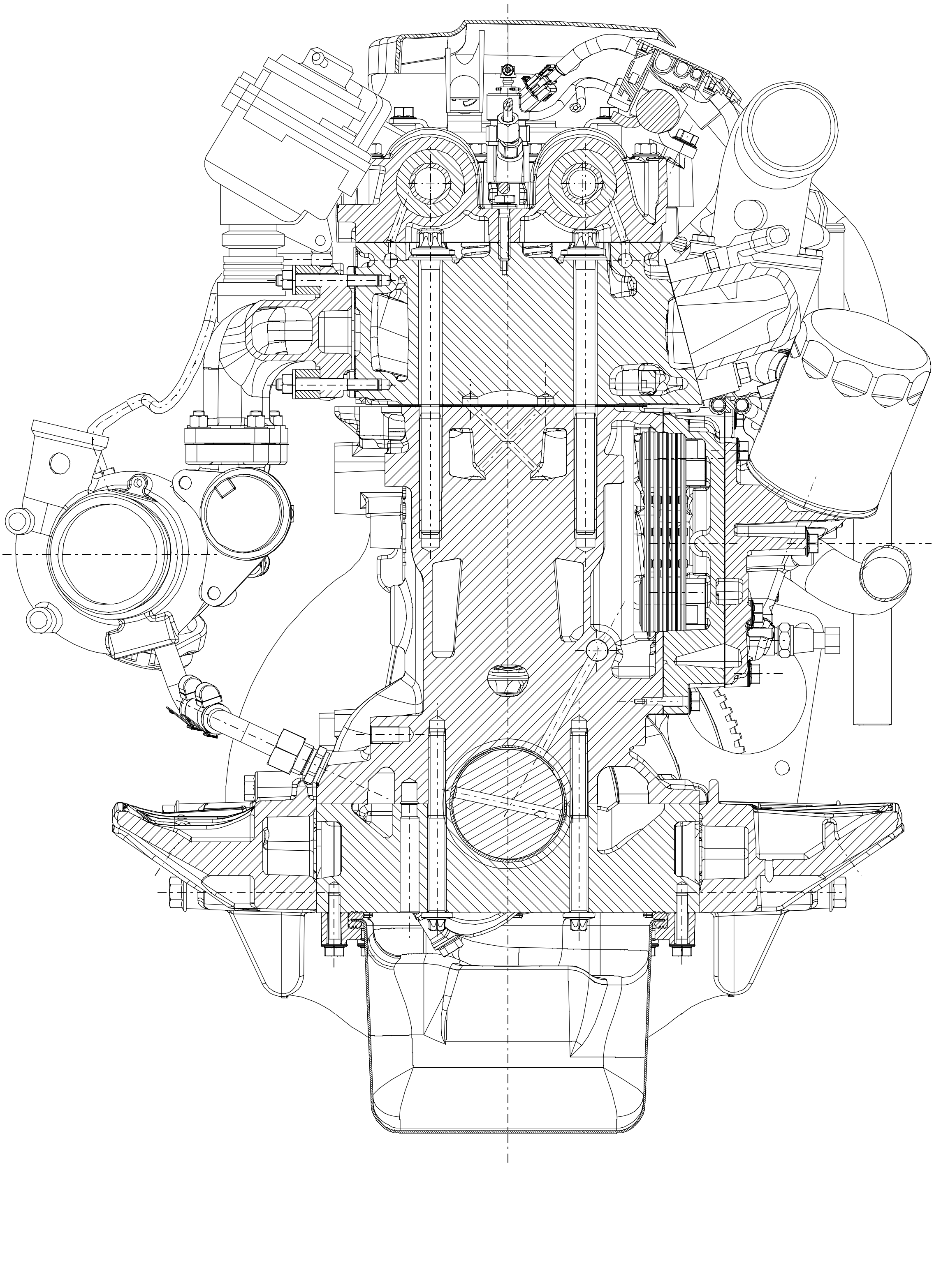
LONGITUDINAL SECTION

Figure 54



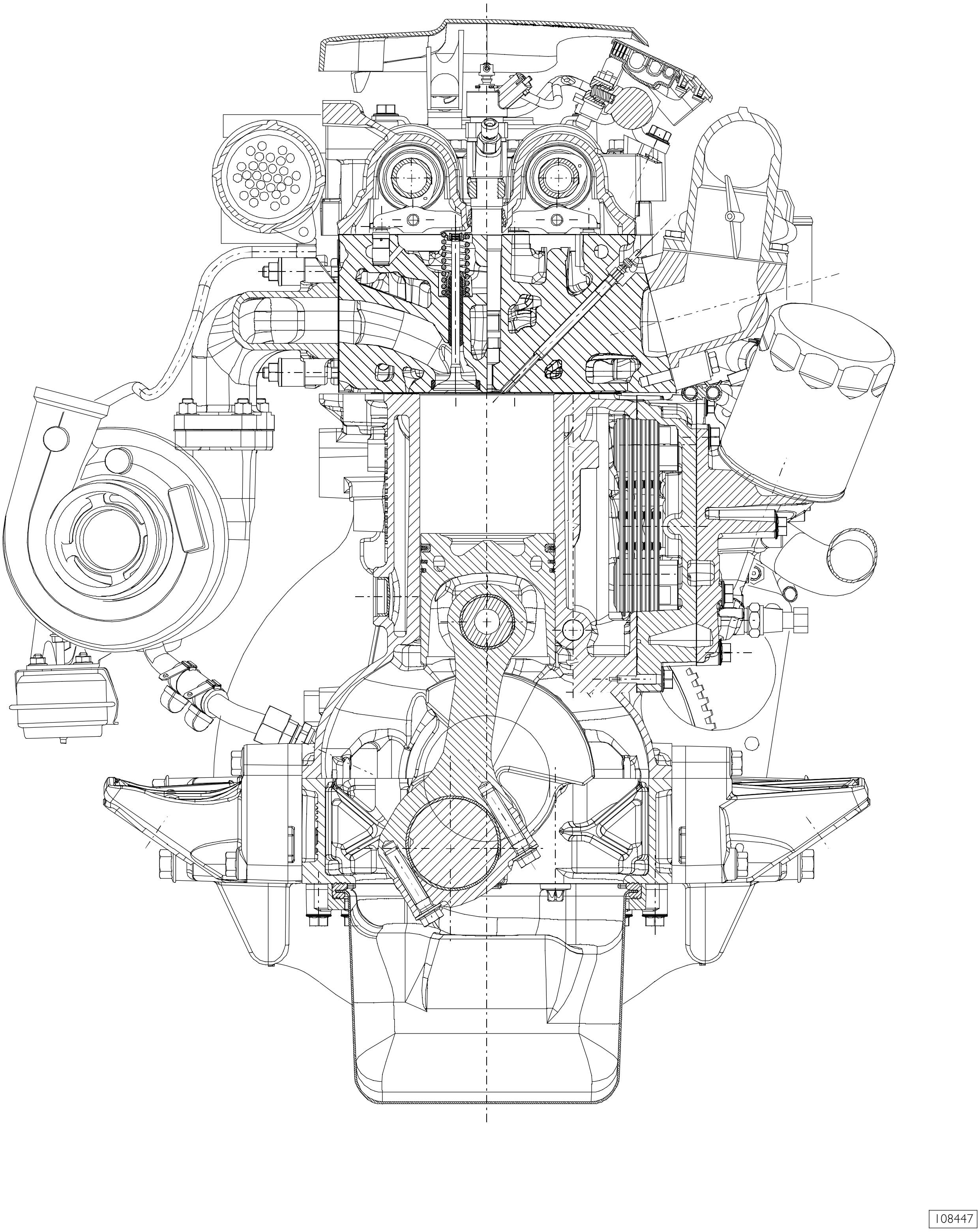
F1C ENGINE CYLINDER AXIS CROSS SECTION (146 HP)

Figure 55



F1C ENGINE SUPPORT AXIS CROSS SECTION (146 HP)

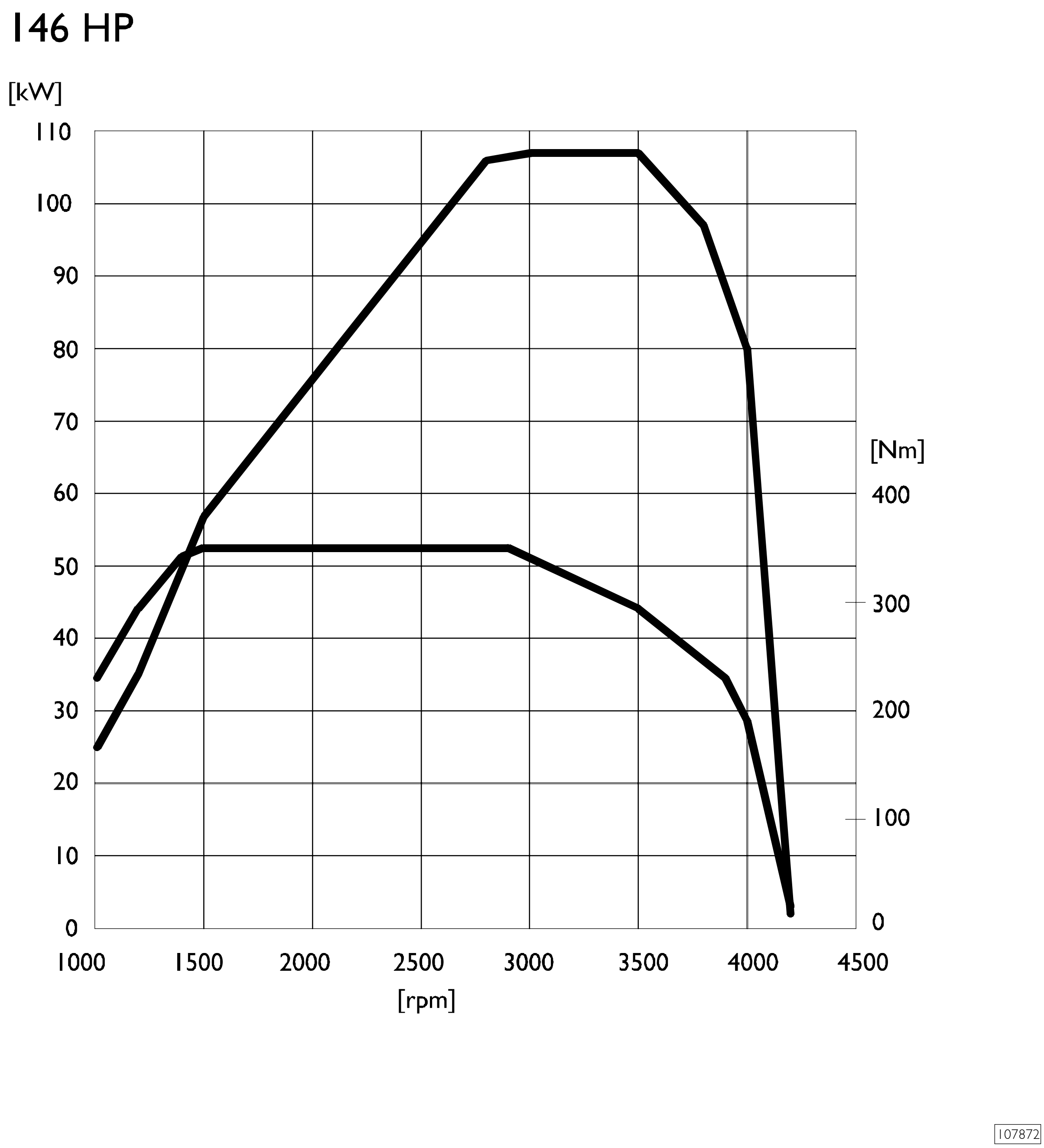
Figure 56



F1C ENGINE CROSS SECTION (176 HP)

CHARACTERISTIC CURVES

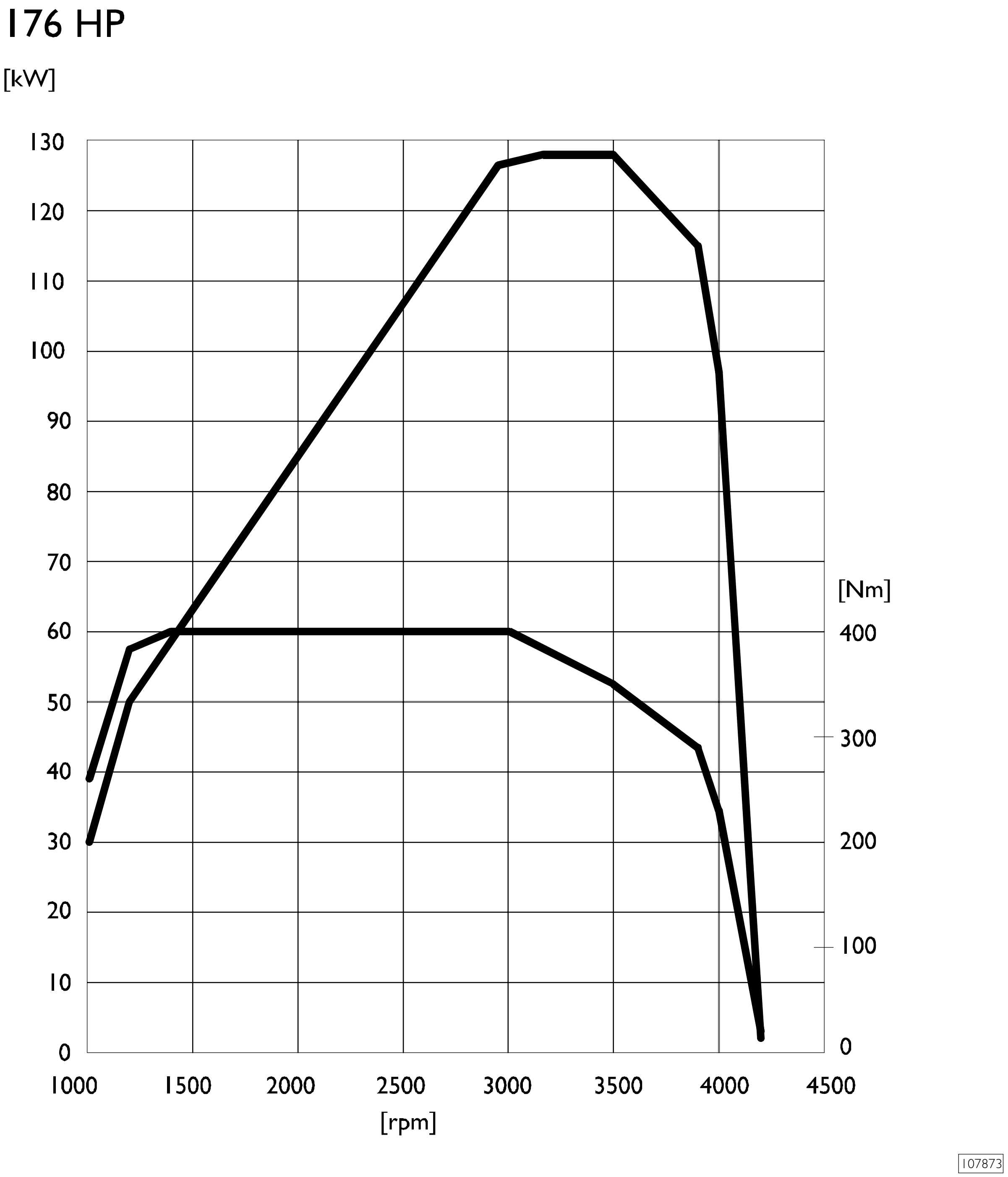
Figure 57



CHARACTERISTIC CURVES OF ENGINE F1C (146 HP)

Max OUTPUT 107 kW	**146 HP**	**at 3500 rpm**
Max TORQUE 350 Nm	**35,6 kgm**	**at 1500 ÷ 2800 rpm**

Figure 58



CHARACTERISTIC CURVES OF ENGINE F1C (176 HP)

Max OUTPUT 122 kW	**176 HP**	**at 3500 rpm**
Max TORQUE 400 Nm	**40,7 kgm**	**at 1250 ÷ 3000 rpm**

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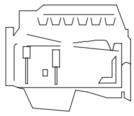
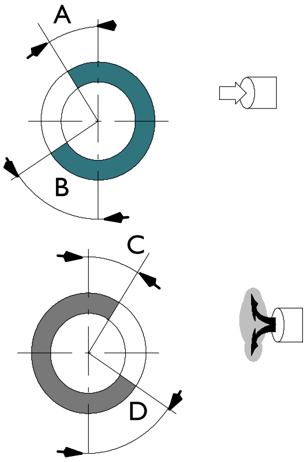
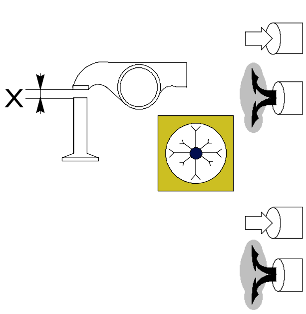
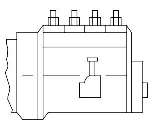
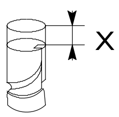
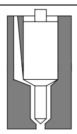
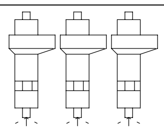
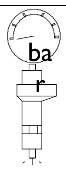
GENERAL SPECIFICATIONS

Type		F1CE0481 F	F1CE0481 H
Cycle		Diesel 4 strokes	
Feeding		Turbocharged with intercooler	
Injection		Direct	
N. of cylinders		4 on-line	
Diameter	mm	95,8	
Stroke	mm	104	
+ + +.. = Total displacement	cm^3	2998	
Max. power	KW (HP) rpm	107 (146) 3500	122 (176) 3500
Max. power Max. power	KW (HP) KW (HP) rpm	350 350 (35,6) 1500 ÷ 2800	250 400 (40,7) 1500 ÷ 2800
Engine idling speed, no load	rpm	800 ± 25	
Maximum engine speed, no load	rpm	4200 ± 50	
Pressure at T.D.C.	*bar	20 ÷ 26	
Minimum permissible pressure at T.D.C.	*bar	16	

(*) The pressure value is recorded by turning the engine over with the electric starter motor, with oil temperature at 40°- 50°C and the injection pump in the stop condition.

	Type	F1CE0481 F	F1CE0481 H
	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	 24° 26° 70° 24°	
	For timing check mm X mm Running mm X mm	- - - -	
	FEED	High pressure electronic fuel feed system BOSCH EDC16 Composed of CP3.2 high-pressure pump, electro-injectors, hydraulic accumulator (rail), EDC control unit, pressure and temperature sensors	
	Pump arrangement With piston n. 1 at T.D.C. Start of delivery mm	- -	
	Injector nozzle type	BOSCH CR1 2-2	
	Injection order	1- 3 - 4 - 2	
	Release pressure bar	1600	

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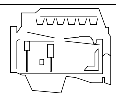
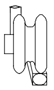
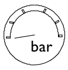
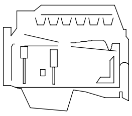
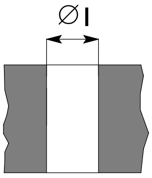
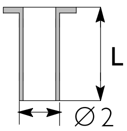
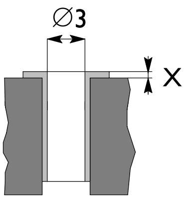
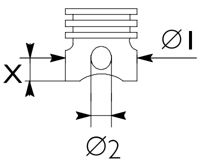
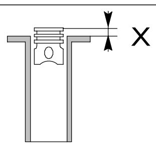
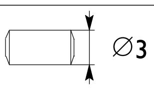
		F1CE0481 F	F1CE0481 H
	Type	**F1CE0481 F**	**F1CE0481 H**
	SUPERCHARGING	With intercooler	
	Turbocharger type	MITSUBISHI TD 04 - HL - 13T-6 with Waste-Gate	GARRETT GT 2260 V variable geometry
Turbocharger shaft radial clearance		0,396 ÷ 0,602	0,086 ÷ 0,117
Turbocharger shaft axial clearance		0,034 ÷ 0,106	0,030 ÷ 0,083
Minimum opening stroke of pressure relief valve	mm	1	-
Maximum opening stroke of pressure relief valve	mm	5	-
Pressure corresponding to the minimum stroke	bar	1,22 ± 0,027	-
Pressure corresponding to the maximum stroke	bar	1,38 ± 0,047	-
Actuator setting: - low pressure 0 . mmHg valve fully open - low pressure 0,2 bar valve stroke - low pressure 0,64 bar valve stroke	 mm mm	 - -	 0,5 ÷ 2,5 9,5 ÷ 11,5
	LUBRICATION	Forced lubrication by means of gear pump, pressure-relief valve and simple-filtering oil filter.	
 	Oil pressure with engine hot (100 ± 5 °C):		
	at idling speed bar	1,0	
	at maximum speed bar	5,0	
	COOLING	by centrifugal pump, thermostat for adjustment, coolant temperature, fan with electromagnetic coupling, radiator, heat exchanger	
	Water pump control:	by belt	
	Thermostat:	N. I.	
	starts to open:	79 °C ± 2 °C	
	fully open:	94° C ± 2 °C	
 Urania Daily Urania Turbo LD 5	OIL REPLENISHMENT		
	Total capacity at 1st filling liters kg	7,6 6,79	
	Quantity at periodical replacements: - engine sump liters kg	6,6 5,81	

ASSEMBLY DATA – CLEARANCES

	Type	F1CE0481 F	F1CE0481 H
CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS			
	Bores for cylinder liners Ø 1	95,802 ÷ 95,822	
	Cylinder liners: outside diameter Ø length L	- - -	
	Cylinder liners - crankcase bores (negative allowance)	-	
	Outside diameter Ø 2	-	
	Cylinder sleeve inside diameter Ø 3	- -	
	Pistons: supplied as spare parts type: measuring dimension X outside diameter Ø 1 pin bore Ø 2	MAHLE 10 95,705 ÷ 95,715 36,003 ÷ 36,009	
	Piston - cylinder sleeve	0,087 ÷ 0,117	
	Piston diameter Ø 1	0,4	
	Pistons protrusion X	0,3 ÷ 0,6	
	Gudgeon pin Ø 3	35,990 ÷ 35,996	
	Gudgeon pin - pin housing	0,07 ÷ 0,019	

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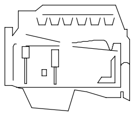
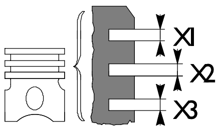
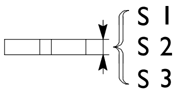
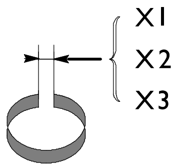
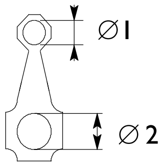
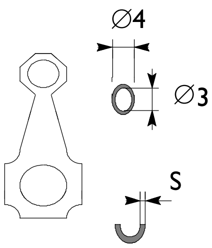
	Type	F1CE0481 F	F1CE0481 H
CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS			
	Piston type X1* Piston ring grooves X2 X3 * measured on ø of 92.8 mm	- 2,200 ÷ 2,230 2,050 ÷ 2,070 2,540 ÷ 2,560	
	Piston rings S 2 S 3 * measured on ø of mm	2,068 ÷ 2,097 1,970 ÷ 1,990 2,470 ÷ 2,490	
	Piston rings - grooves 2 3	0,103 ÷ 0,162 0,060 ÷ 0,100 0,050 ÷ 0,090	
IVECO PARTS	Piston rings	0,4	
	Piston ring end gap in cylinder liners X1 X2 X3	0,20 ÷ 0,35 0,60 ÷ 0,80 0,30 ÷ 0,60	
	Small end bush housing Ø 1 Big end bearing housing Ø 2	39,460 ÷ 39,490 67,833 ÷ 67,848	
	Small end bush diameter outside Ø 4 inside Ø 3 Big end bearing shell supplied as spare parts S outside Ø 4 outside Ø 4	39,570 ÷ 39,595 36,010 ÷ 36,020 1,883 ÷ 1,892 1,885 ÷ 1,891	
	Small end bush - housing	0,08 ÷ 0,135	
	Piston pin - bush	0,014 ÷ 0,030	
IVECO PARTS	Piston rings	0,254 - 0,508	

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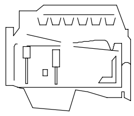
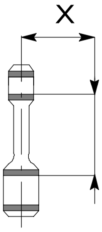
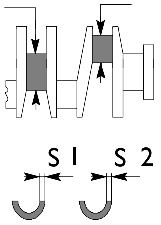
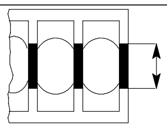
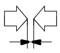
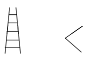
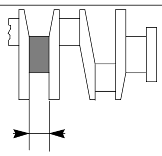
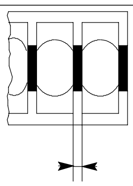
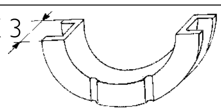
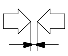
		FICE0481 F	FICE0481 H
	Type	FICE0481 F	FICE0481 H
CYLINDER ASSEMBLY AND CRANK MEMBERS		mm	
	Measurement X Maximum error on alignment of connecting rod axes =	125 0,09	
	Main journals Ø 1 No. 1-2-3-4 No. 5 Crankpins Ø 2 Main bearing shells S1* Big end bearing shells - superior S2* - inferior * supplied as spare parts	76,182 ÷ 76,208 83,182 ÷ 83,208 64,015 ÷ 64,038 2,165 ÷ 2,174 1,883 ÷ 1,892 1,885 ÷ 1,891	
	Main bearing housings Ø 3 No. 1-2-3-4 No. 5	80,588 ÷ 80.614 87,588 ÷ 87,614	
	Bearing shells - main journals	0,032 ÷ 0,102	
	Bearing shells – crankpins	0,035 ÷ 0.083	
IVECO PARTS 	Main bearing shells Big end bearing shells	0,254 - 0,508 0,254 - 0,508	
	Main journal for shoulder X 1	32,500 ÷ 32,550	
	Main bearing housing for shoulder X 2	27,240 ÷ 27,290	
	Half thrust washers X 3	32,310 ÷ 32,460	
	Crankshaft shoulder	0,040 ÷ 0,240	

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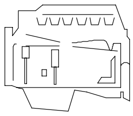
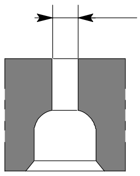
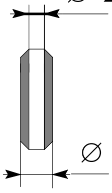
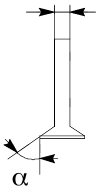
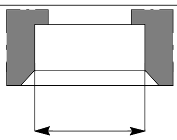
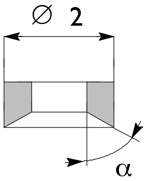
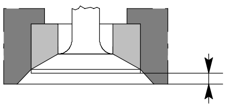
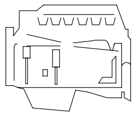
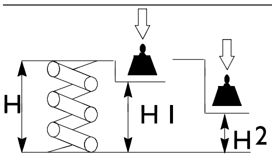
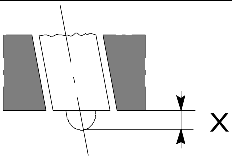
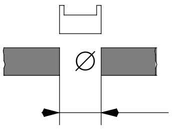
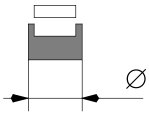
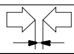
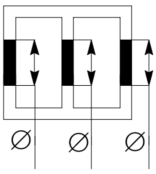
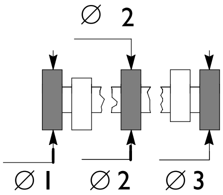
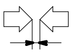
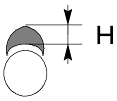
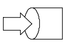
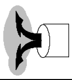
 Type	F1CE0481 F	F1CE0481 H
CYLINDER HEADS - VALVE GEAR		
Ø 1  Valve guide housings in the cylinder heads Ø1	9,980 ÷ 10,000	
Ø 2  Ø 3 Valve guide Ø 2 Ø 3	6,023 ÷ 6,038 10,028 ÷ 10,039	
Valve guides and seats on head (interference)	0,028 ÷ 0,059	
IVECO PARTS Valve guide	0,05 - 0,10 - 0,25	
Ø 4  α Valves: Ø 4 α Ø 4 α	5,985 ÷ 6,000 60° ±7,5' 5,975 ÷ 5,990 60° ±7,5'	
Valve stem and its guide	0,023 ÷ 0,053	
 Ø 1 Seat on head for valve seat: Ø1 Ø1	34,490 ÷ 34,515 34,490 ÷ 34,515	
Ø 2  α Outside diameter of valve seat; angle of valve seat in cylinder head: Ø 2 α Ø 2 α	34,590 ÷ 34,610 59,5° ±5' 34,590 ÷ 34,610 59,5° ±5'	
 X Recessing X X	0,375 ÷ 0,525 0,375 ÷ 0,525	
Between valve seat and head	0,075 - 0,12 0,075 - 0,12	
IVECO PARTS Valve seats	-	

	Type		F1CE0481 F	F1CE0481 H
CYLINDER HEAD – TIMING SYSTEM			mm	
	Valve spring height: free height under a load of: N243 ± 12 N533 ± 24	 H H1 H2	 54 45 35	
	Injector protrusion	X	2,77 ÷ 3,23	
	Seats for tappets on cylinder head	normal ∅	12,016 ÷ 12,034	
	Tappet ∅ normal		11,988 ÷ 12,000	
	Between tappets and seats		0,016 ÷ 0,046	
	Camshaft pin seats in cylinder overhead 1 ⇒ 7	∅ 1 ∅ 2 ∅ 3	48,988 ÷ 49,012 46,988 ÷ 47,012 35,988 ÷ 36,012	
	Camshaft supporting pins:	∅ 1 ∅ 2 ∅ 3	48,925 ÷ 48,950 46,925 ÷ 46,950 35,925 ÷ 35,950	
	Between seats and supporting pins		0,032 ÷ 0,087	
	Useful cam height	 H  H	3,622 4,328	

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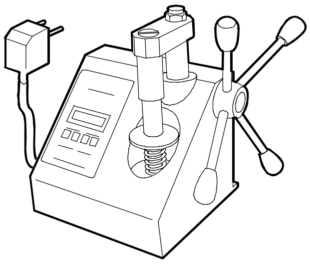
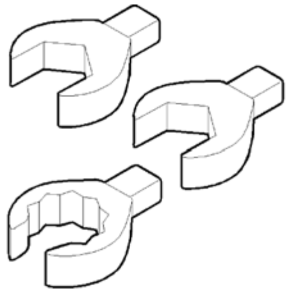
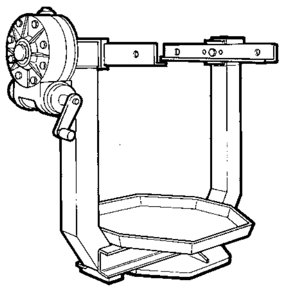
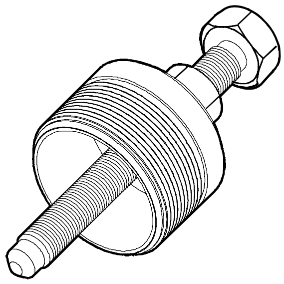
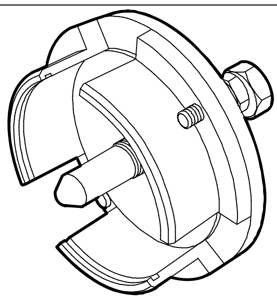
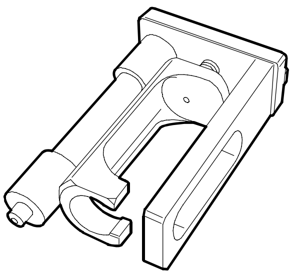
TOOLS

TOOL NO.		DESCRIPTION
99305047		Appliance to check spring loads
99317915		Set of six box-type wrenches (14-17-19 mm)
99322205		Rotary telescopic stand for overhauling assemblies (capacity 700 daN, torque 120 daN/m)
99340059		Extractor for camshaft pulley
99340060		High-pressure pump toothed pulley extractor
99342153		Tool to remove crankshaft front gasket

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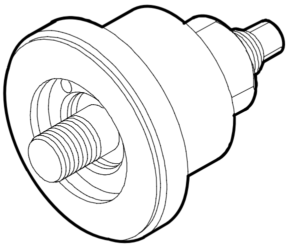
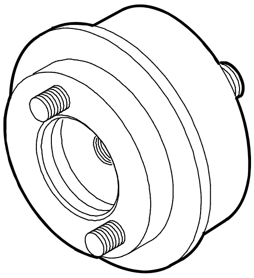
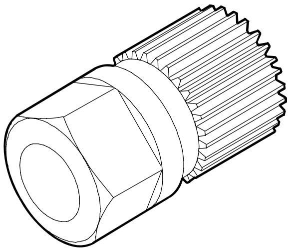
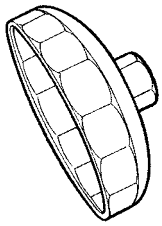
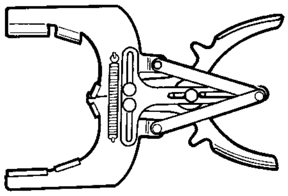
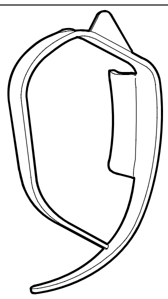
TOOLS

TOOL NO.		DESCRIPTION
99346258		Keying device for mounting crankshaft front gasket
99346259		Keying device for mounting crankshaft rear gasket
99358026		Wrench for alternator pulley (free wheel) removal/refitting
99360076		Tool to remove cartridge filters
99360183		Pliers for mounting rings on engine pistons
99360186		Guide for flexible belt

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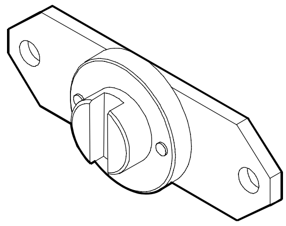
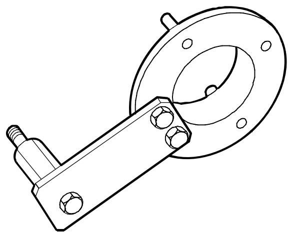
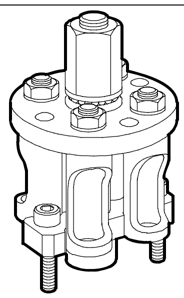
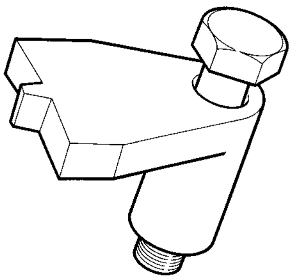
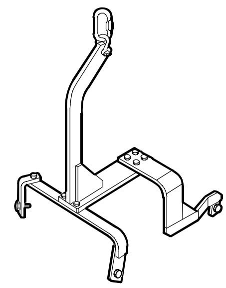
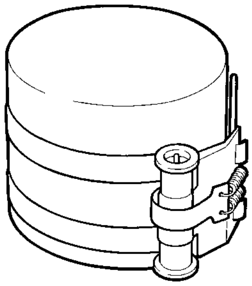
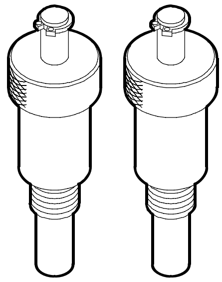
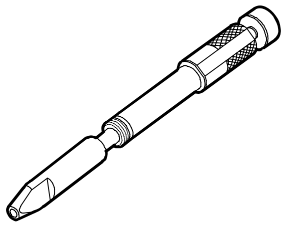
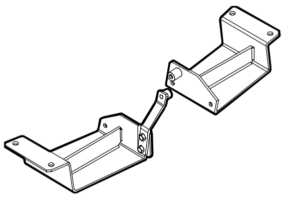
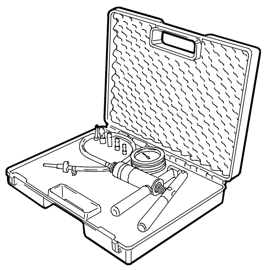
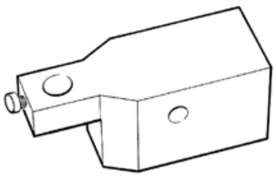
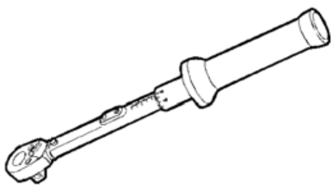
TOOLS

TOOL NO.		DESCRIPTION
99360187		Retaining tool for hydraulic power steering control shaft
99360190		Damper pulley retaining tool
99360260		Tool for removing and refitting engine valves
99360306		Tool to retain engine flywheel
99360543		Swing bar for engine detachment/re-attachment
99360605		Band to insert standard and oversized pistons into the cylinders

TOOLS

TOOL NO.		DESCRIPTION
99360614		Tool (2) for camshaft timing
99360615		Tool for crankshaft timing
99361041		Brackets securing engine to rotary stand 99322205
99367121		Manual pump to measure pressure and vacuum
99370415		Dial-gauge base for various measurements (to be used with 99395603)
99389817		Dynamometric wrench (60 ÷ 320 Nm) with 3/4'' coupling

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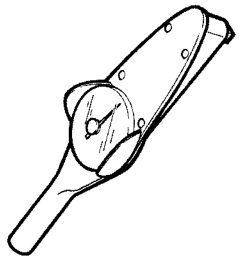
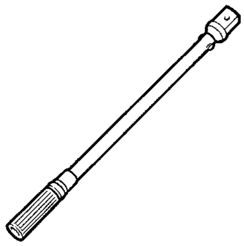
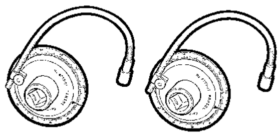
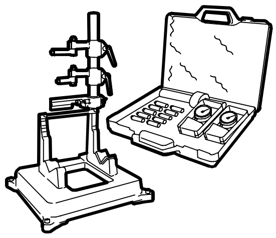
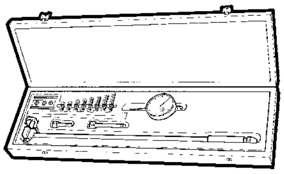
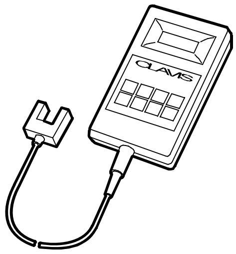
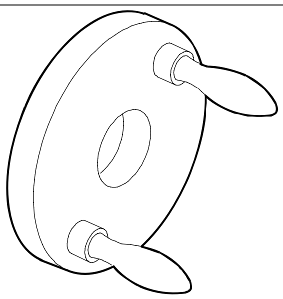
TOOLS

TOOL NO.		DESCRIPTION
99389818		Dynamometric wrench (150-800 Nm) with 3/4" square coupling
99389819		Torque wrench (0-10 Nm) with square 1/4" connection
99389829		9x12 coupling torque wrench (5-60 Nm)
99395216		Pair of meters for angular tightening with square 1/2" and 3/4" connection
99395363		Complete square to check for connecting rod distortion
99395603		Dial gauge (0-5 mm)

TOOLS

TOOL NO.		DESCRIPTION
99395687		Bore meter (50 – 178 mm)
99395849		Belt tension control device (frequency from 10.0 bis 600 Hz)
99396039		Centring ring for timing gear cover

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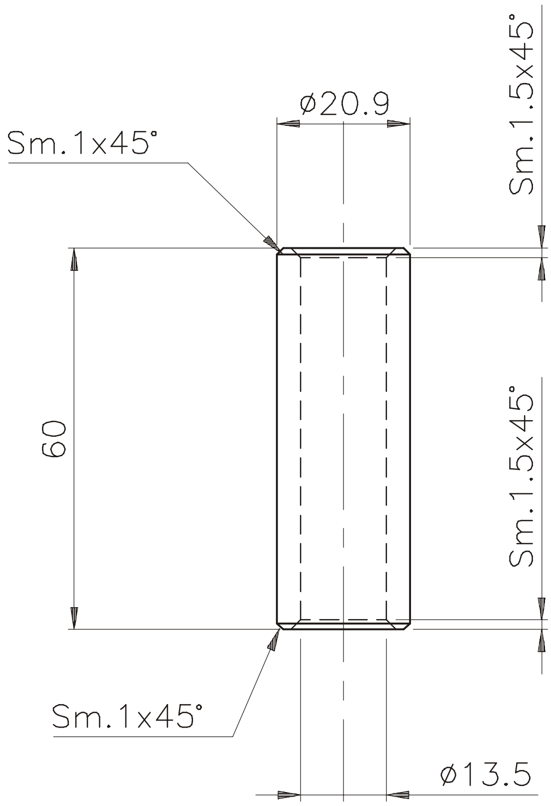
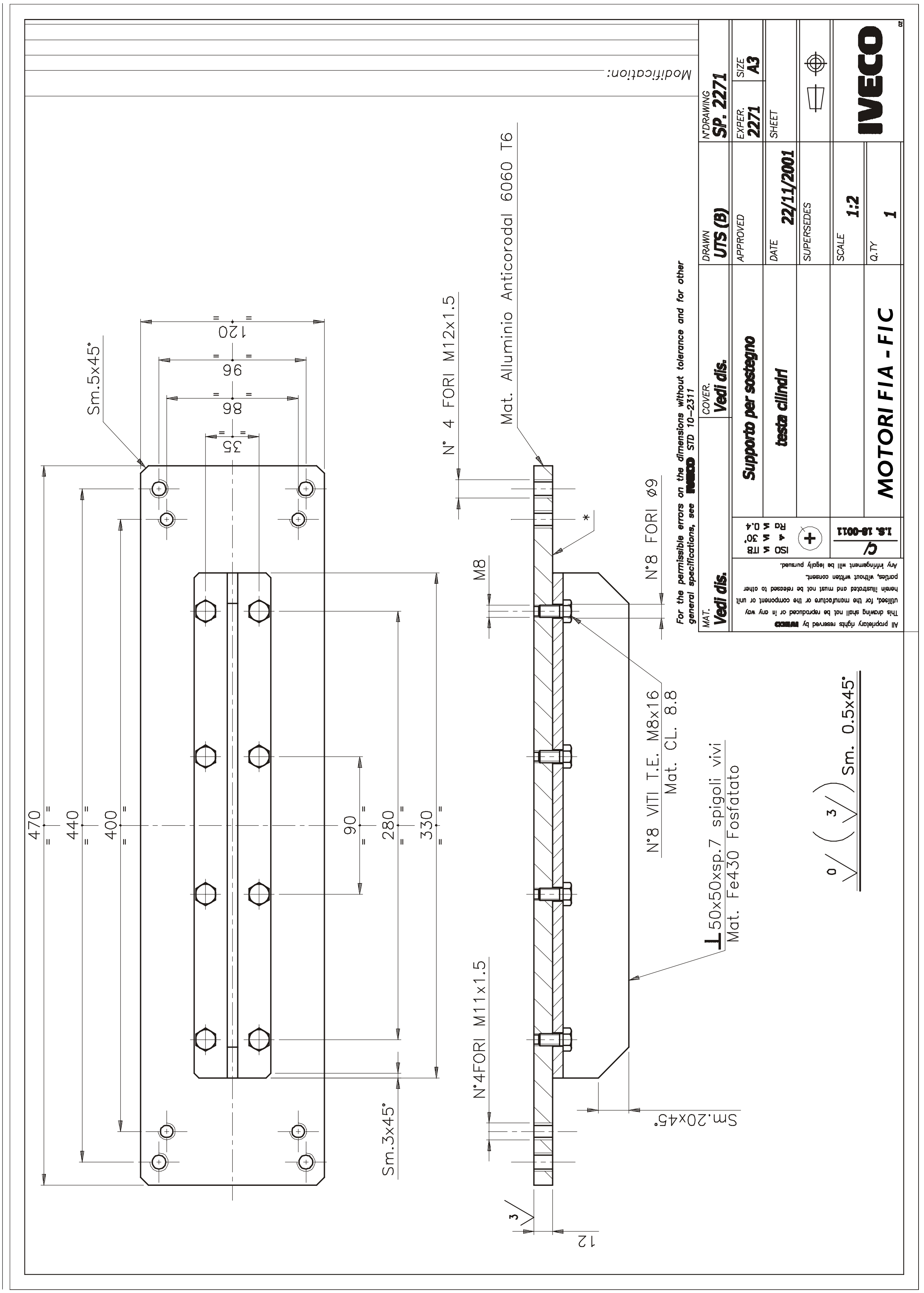
EXPERIMENTAL TOOLS

This section shows the working drawings for the experimental tools (S.P.) used in overhauling the engine described in this section, which may be made by the repair shops.



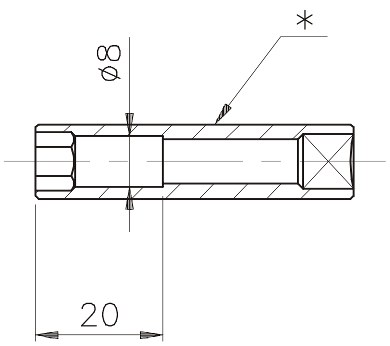
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT. **Pom / Nylon**	COVER. **/**	DRAWN **UTS (B)**	N°DRAWING **SP. 2264**
ISO ≤ IT8 / ∢ ≤ 30' / Ra ≤ 0.4	**Perni di centraggio sovratesta**	APPROVED	EXPER. **2264** / SIZE **A4**
	e per piantaggio guarnizione	DATE **19/06/2001**	SHEET
	guida valvole	SUPERSEDES	
C/ I.S. 18-0011		SCALE **1:1**	IVECO
	MOTORI F1A - F1C	Q.TY **2**	02


Modification:
N°DRAWING SP. 2271
SIZE A3
EXPER. 2271
SHEET
DRAWN UTS (B)
APPROVED
DATE 22/11/2001
SUPERSEDES
SCALE 1:2
Q.TY 1
MAT. Vedi dis.
COVER. Vedi dis.
Supporto per sostegno
testa cilindri
MOTORI F1A - F1C
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
All proprietary rights reserved by IVECO This drawing shall not be reproduced or in any way utilised, for the manufacture of the component or unit herein illustrated and must not be released to other parties, without written consent. Any infringement will be legally pursued.
I.S. 18-0011
IVECO
Mat. Alluminio Anticorodal 6060 T6
N° 4 FORI M12x1.5
N°8 FORI Ø9
M8
N°8 VITI T.E. M8x16
Mat. CL. 8.8
⊥50x50xsp.7 spigoli vivi
Mat. Fe430 Fosfatato
Sm. 0.5x45°
Sm.5x45°
Sm.3x45°
Sm.20x45°
N°4FORI M11x1.5
120
96
86
35
470
440
400
90
280
330
12

VARIA DA ART. COMMERCIALE USAG cod.235EL 1/4" – Ch.8

SOLO PER QUANTO INDICATO

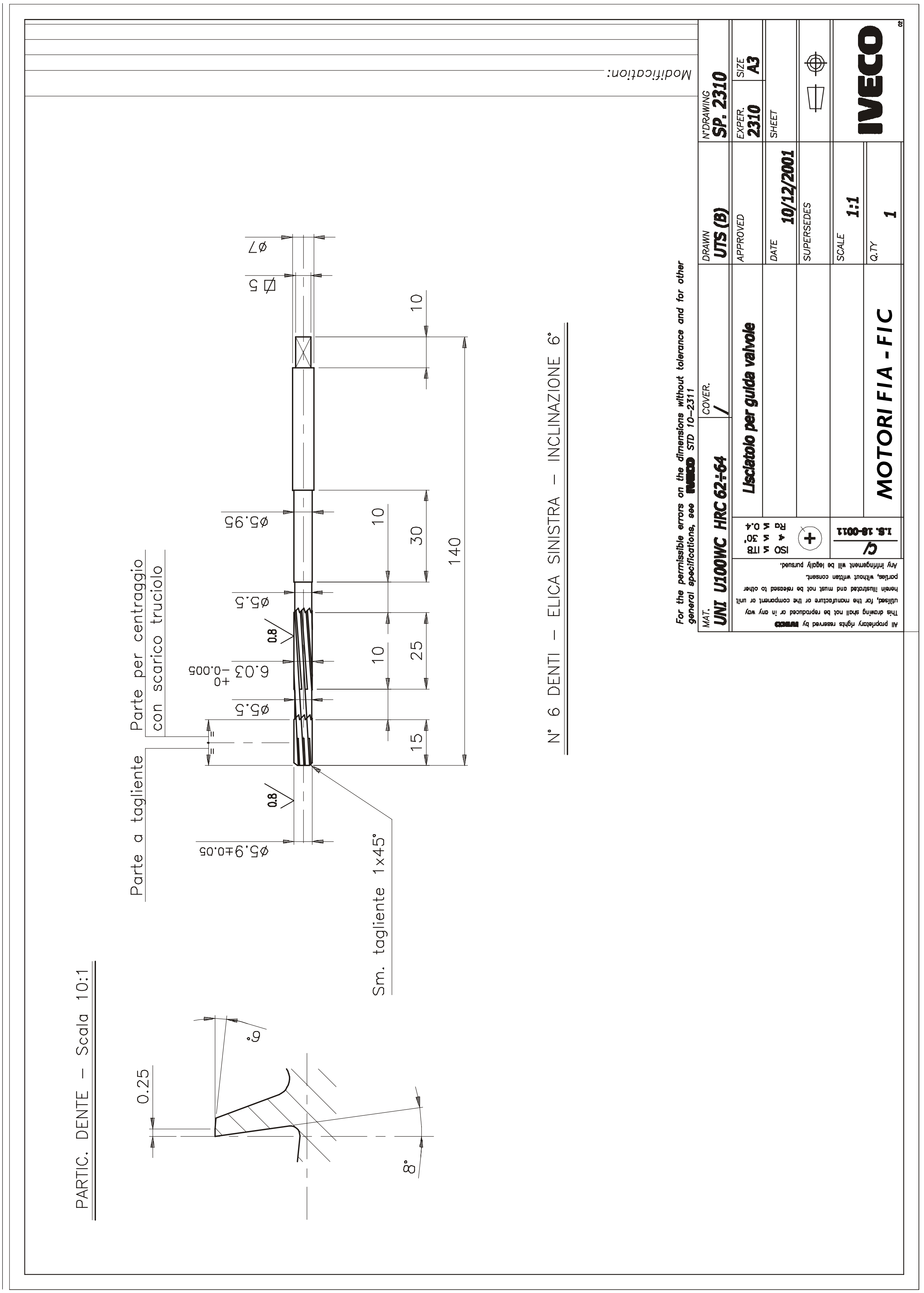


6 Sm. 0.5x45°

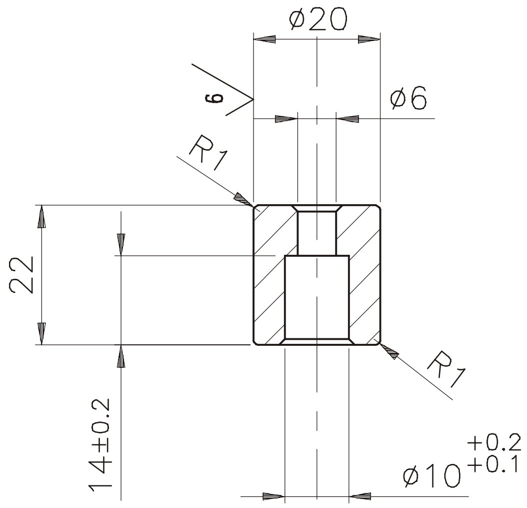
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

Modification:

MAT. /	COVER. /	DRAWN UTS (B)	N°DRAWING SP. 2275
ISO ≤ IT8, ∢ ≤ 30', Ra ≤ 0.4	**Bussola (8 mm) per montaggio/**	APPROVED	EXPER. 2275 / SIZE A4
	smontaggio candelette	DATE 25/07/2001	SHEET
		SUPERSEDES	
C/ I.S. 18-0011		SCALE 1:1	IVECO
	MOTORI F1A - F1C	Q.TY 1	02



Modification:
N°DRAWING SP. 2310
SIZE A3
EXPER. 2310
SHEET
IVECO
DRAWN UTS (B)
APPROVED
DATE 10/12/2001
SUPERSEDES
SCALE 1:1
Q.TY 1
COVER. /
MAT. UNI U100WC HRC 62÷64
Lisciatoio per guida valvole
MOTORI F1A - F1C
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
ISO ≤ IT8 ≤ 30' Ra ≤ 0.4
I.S. 18-0011
All proprietary rights reserved by IVECO. This drawing shall not be reproduced or in any way utilised, for the manufacture of the component or unit herein illustrated and must not be released to other parties, without written consent. Any infringement will be legally pursued.
Ø7
Ø5
Ø5.95
Ø5.5
6.03 +0 −0.005
Ø5.5
Ø5.9±0.05
0.8
0.8
10
10
30
140
10
25
15
Parte per centraggio con scarico truciolo
Parte a tagliente
Sm. tagliente 1x45°
N° 6 DENTI – ELICA SINISTRA – INCLINAZIONE 6°
PARTIC. DENTE – Scala 10:1
0.25
6°
8°



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT. **39NiCrMo3 Bon.**

COVER. **Fosfat.**

DRAWN **UTS (B)**

N°DRAWING **SP. 2311**

ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4

Battitoio per piantaggio

guida valvole

(usare con sp. 2312)

C/

I.S. 18-0011

MOTORI F1A - F1C

APPROVED

DATE **10/12/2001**

SUPERSEDES

SCALE **1:1**

Q.TY **1**

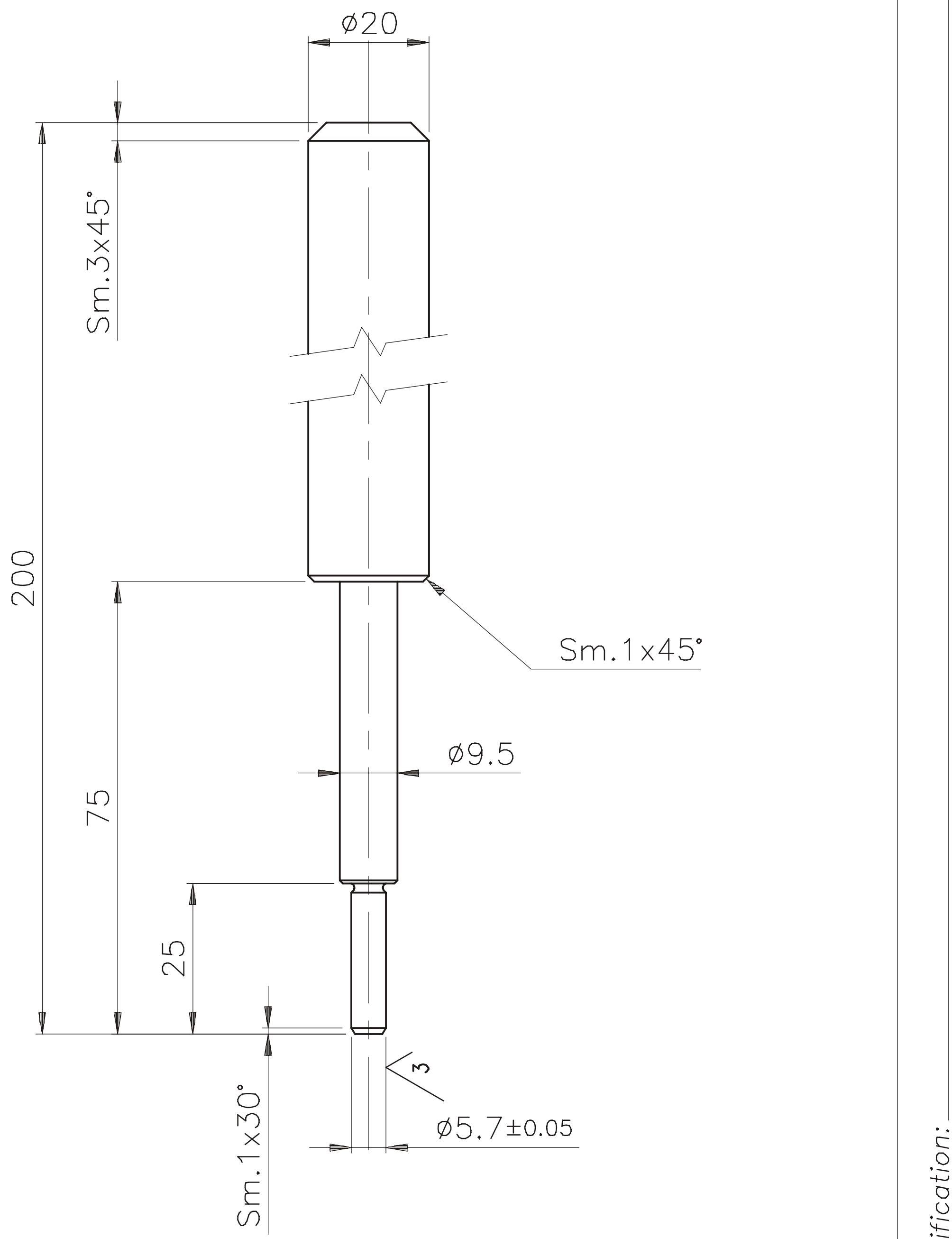
EXPER. **2311**

SIZE **A4**

SHEET

IVECO

02



For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10–2311

MAT. 39NiCrMo3 Bon.	COVER. Fosfat.	DRAWN UTS (B)	N°DRAWING SP. 2312
ISO ≤ IT8 / ∢ ≤ 30' / Ra ≤ 0.4	Battitoio per spiantaggio guida valvole	APPROVED	EXPER. 2312 / SIZE A4
		DATE 10/12/2001	SHEET
		SUPERSEDES	
C/ I.S. 18-0011	MOTORI F1A - F1C	SCALE 1:1	IVECO
		Q.TY 1	02

TIGHTENING TORQUE

PART	TORQUE	
	Nm	kgm
Six-lobe screw (M15x1.5 L 193) for cylinder head internal fastening		
First stage: pre-tightening	130	13
Second stage: angle	90°	
Third stage: angle	90°	
Six-lobe screw (M12x1.5 L 165) for cylinder head side fastening		
First stage: pre-tightening	65	6,5
Second stage: angle	90°	
Third stage: angle	60°	
Six-lobe screw (M8x1.25 L 117/58) for chain compartment side fastening (cylinder head)	25	2,5
R 1/2"bevel threaded cap with socket head	40	4
R 3/8" bevel threaded cap with socket head	29	2,9
R 1/8" bevel threaded cap with socket head	7	0,7
R 1/4" bevel threaded cap with socket head	9	0,9
M26x1.5 threaded screw tap	50	5
Screw with flange M6x1 for camshaft rear cover fastening	10	1
Screw with flange M6x1 for camshaft shoulder plate fastening	10	1
Socket head screw with flange M8x1.25 L 30/40/77/100 for over-head fastening	25	2,5
M14x1.5 L 10 threaded screw tap	25	2,5
Cap bolt socket screw (M6x1x25) for camshaft drive cover fastening	10	1
Flanged nut (M6x1) for camshaft drive cover fastening	10	1
M12x1.5 L 125 inner fastening screw for lower cylinder block		
First stage: pre-tightening	50 ± 5	5 ± 0,5
Second stage: angle	60° ± 2,5°	
Third stage: angle	60° ± 2,5°	
M8x1.25 L 77.5/40 outer fastening screw for lower cylinder block	26	2,6
Socket head screw with flange M11x1.25x49 for connecting rod cap fastening		
Preliminary torque	50	5
Second stage: angle	70°	
Socket head screw with flange M12x1.25x52,5 for engine flywheel fastening		
Preliminary torque	30	3
Second stage: angle	90°	
Six-lobe socket screw (M6x1x15) for securing the phonic wheel to the drive shaft	15	1,5
Connection M10x1 for piston cooling nozzle	25	2,5
Tapered threaded cap with socket head (R 3/8"x10)	40	4
TE flanged screw (M20x1.5x58) for securing the camping pulley to the drive shaft	350	35
Bevel cap R 1/8 x 8	7	0,7
Water draining plug M14x1.5 L10	25	2,5
Pipe union on block for oil return from turbocharger G 3/8" x 12	50	5
Suction rose M6x1 fastening screw	10	1
Socket head nut with flange M8x1.25 for depressor – oil pump unit support fastening	25	2,5
Pin (M12x1.5x35) for oil pump/vacuum pump assembly control	130	13
Male threaded cap (M26x1.5)	40	4
Connection (R 1/4") for oil delivery to the turboblower	40	4
Socket head screw with flange M8x1.5 L35 for oil sump retaining frame fastening	25	2,5
Threaded cap with O-ring (M22x1.5 L10)	50 ±10	5 ±1
Socket head screw with flange M8x1.25 L60 for depressor - oil pump unit fastening	25	2,5
Flanged, hexagon nut (M8x1.25) for power steering pump support fastening	25	2,5

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PART	TORQUE	
	Nm	kgm
TE screw with flange (M10x1.25x60/110)	50	5
TE screw with flange (M8x1.25x16) for blow-by pipe fastening.	28	2,8
Socket head screw with flange M8x1.25 L18 for suction manifold fastening	25	2,5
TE screw with flange (M6x1 L20) for blow-by pipe fastening.	10	1
M14x1.5 L10 cap	25	2,5
Flanged nut M8x1.25 L40 for exhaust manifold fastening	30	3
Flanged nut M8x1.25 for exhaust manifold fastening	25	2,5
Socket cylinder head screw M8x1.25 L65 for Poli-V belt automatic backstand	25	2,5
Flanged screw M10x1.25 L22 for Poli-V belt take-up pulley fastening	40	4
Flanged head M12x1.75 L30 for camshaft gear fastening	110	11
Timing chain tightener fastener M22x1.5x22	50	5
Screw (M10x1.5x12) for timing chain moving pad fastening	40	4
Socket cylinder head screw M8x1.25x30 for fixed skid fastening	25	2.5
Socket cylinder head screw M6x1 L16/20 for skid fastening	10	1
Water temperature/pressure sensor fastener (M12x1.5)	30	3
Socket cylinder head screw M6x1 for water temperature/pressure sensor fastening	10	1
Socket cylinder head screw M6x1 for air temperature/pressure sensor fastening	10	1
Socket cylinder head screw M6x1 for engine rev sensor fastening	10	1
High-pressure injection system		
Flanged nut M8x1.25 for high pressure pump support fastening	25	2,5
Hydraulic accumulator fastening screw M8x1.25 L50	28	2,8
High pressure pump fastening screw M8x1.25 L90	25	2,5
Screw M6x1x16 for fastening of fuel delivery pipe anchoring bracket	10	1
Pipe union for fuel delivery pipes to rail and electric injectors: - M14x1.5 - M12x1.5	 19 ± 2 25 ± 2	 1,9 ± 0,2 2,5 ± 0,2
Socket cylinder head screw M8x1,25 for fastening of electric injector retaining bracket	28	2,8
Flanged nut M8x1,25 for anchoring bracket support fastening	25	2,5
Pin fastener M12x1.25 for high pressure pump	110	11
Flanged nut (M6x1) for low-pressure fuel pipe fastening	10	1
TE flanged screw (M8x1.25) for pipe supporting bracket fastening	25	2,5
Filler neck M12x1.5 for adjustable pipe union	25	2,5
Filler neck M16x1.5 for adjustable pipe union	40	4
Pipe union for revolving multiple-way connection to the high-pressure pump (M12x1.5)	25	2,5
Nut M8x1.25 for turbocharger fastening	25	2,5
TE flanged screw (M8x1.25) for turboblower exhaust gas outlet pipe fastening	25	2,5
Pipe union M14x1.5 or M12x1.5 for oil delivery pipe to turbocharger	35	3,5
Pipe union M22x1.5 for oil return pipe from turbocharger	45	4,5
Flanged screw M6x1 for fastening of oil return pipe from turbocharger	10	1
Pipe union M14x1.5 for fastening of oil delivery pipe to turbocharger	35	3,5
Threaded union R 1/4"	40	4
TE screw with flange (M8x1.25) for air conveyor bracket fastening	28	2,8
TE screw with flange (M8x1.25) for air conveyor fastening	28	2,8
Socket cylinder head screw M6x1 for V-clamp closing ring	8	0,8
TE screw with flange (M6x1x16) for air pipe fastening	10	1
TE screw with flange (M6x1) for oil filling pipe fastening	10	1
Pre-warming plug M8x1	8 ÷ 11	0,8 ÷ 1,1
Oil filter cartridge M22x1.5	25	2,5
TE screw with flange (M8x1.25x20) for water inlet pipe fastening	25	2,5
TE screw (M8x1.25x30) for heat exchanger fastening	25	2,5

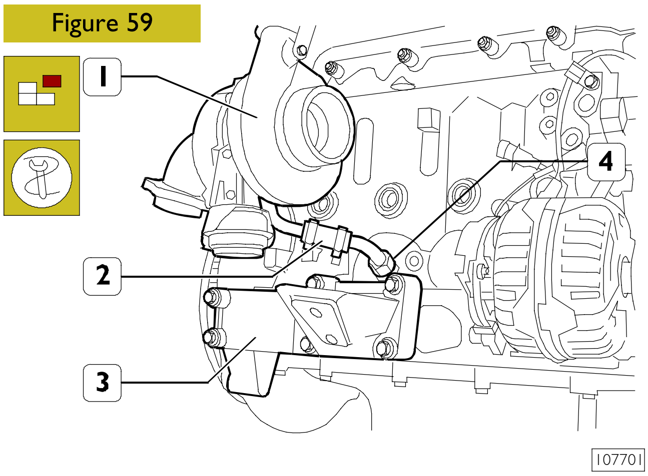
PART	TORQUE	
	Nm	kgm
Pipe union M24x1.5 for oil filter cartridge	80	8
TE flanged screw (M8x1.25x30/40) for heat exchanger inner element fastening	25	2,5
Socket cylinder head screw for water pump fastening: - M10x1.5x55 - M8x1.25x45	 50 25	 5 2,5
Flanged screw M8x1.25 for rear cover fastening to cylinder head	25	2,5
Flanged screw M8x1.25 for coolant delivery pipe fastening	25	2,5
Flanged nut M8x1.25 for coolant delivery pipe support bracket fastening	25	2,5
Pipe union M10x1x10 for vapour vent fastening	12	1,2
Flanged screw M8x1.25 for thermostat fastening	25	2,5
Flanged nut M6x1 for electro-magnetic joint fastening	10	1
Nut (M30x1.5) for electromagnetic joint	150	15
Flanged screw M8x1.25 for air conditioner compressor fastening	25	2,5
Flanged screw M8x1.25 L20/130 for air conditioner compressor support fastening	25	2,5
Socket cylinder head screw M8x1.25 for fastening of air conditioner compressor control belt idler	25	2,5
Socket cylinder head screw M10x1.5 for alternator fastening	50	5
Flanged screw M10x1,25x110 for hydraulic power steering pump fastening	40	4
Flanged screw M12x1,25 securing the power steering pump	50	5
Flanged screw M8x1,25 securing the power steering tank support	25	2,5
Flanged screws M10x1.25 for power take off cover fastening	50	5
Depressor pipe union M14x1.5	35	3.5
Oil level sensor M12x1.25	25	2,5
Thermometric transmitter/switch M16x1.5 (conical)	25	2,5
Oil pressure switch M14x1.5	25	2,5
Power unit suspension		
Screw (M8x16) securing the elastic dowel to the gearbox cross-member	23,5±2,5	2,3±0,2
Nut (M12) securing the gearbox cross-member to the chassis	92±9	9,2±0,9
Nut (M12) securing the engine supports to the elastic dowels	49±4	4,9±0,4
Nut (M12) securing the gearbox bracket onto the rear cross-member elastic dowel	49±4	4,9±0,4
Locknut (M10) with flange, securing the engine supports to the chassis	52,5±5,5	5,2±0,5
Screw (M10x30) securing the gearbox support to the gearshift	46,5±4,5	4,6±0,4

* On the threading apply LOCTITE 577

OVERHAULING ENGINE F1C

540110 DISASSEMBLING THE ENGINE AT THE BENCH

Figure 59



To fit the engine base with the brackets securing the rotor to the overhaul bench, disassemble the left and right engine mounts (3), then disconnect oil pipe (2) from turboblower (1) and engine base connection (4).

NOTE Block the turbocharger air/exhaust gas inlets and outlets to prevent foreign bodies getting inside.

Fit the brackets 99361041 (11) to the crankcase and use these to secure the engine to the rotary stand 99322205 (12). Drain the oil from the engine by removing the plug from the oil sump.

If fitted, remove the fan (1) from the electro-magnetic joint (2).

Remove the items below, if they have not yet been removed prior to detachment:

- ❑ upper sound-proofing cover;
- ❑ engine cable complete with raceway (6), by disconnecting the electric connections of the same from:
  - electric injectors (1);
  - preheating plugs (3);
  - hydraulic accumulator pressure sensor (5);
  - throttle valve actuator (7);
  - inlet manifold air pressure/temperature sensor (8);
  - revs sensor (4);
  - high-pressure pump pressure regulator (10);
  - phase sensor (2);
  - thermostat coolant temperature sensor (9).

Figure 60

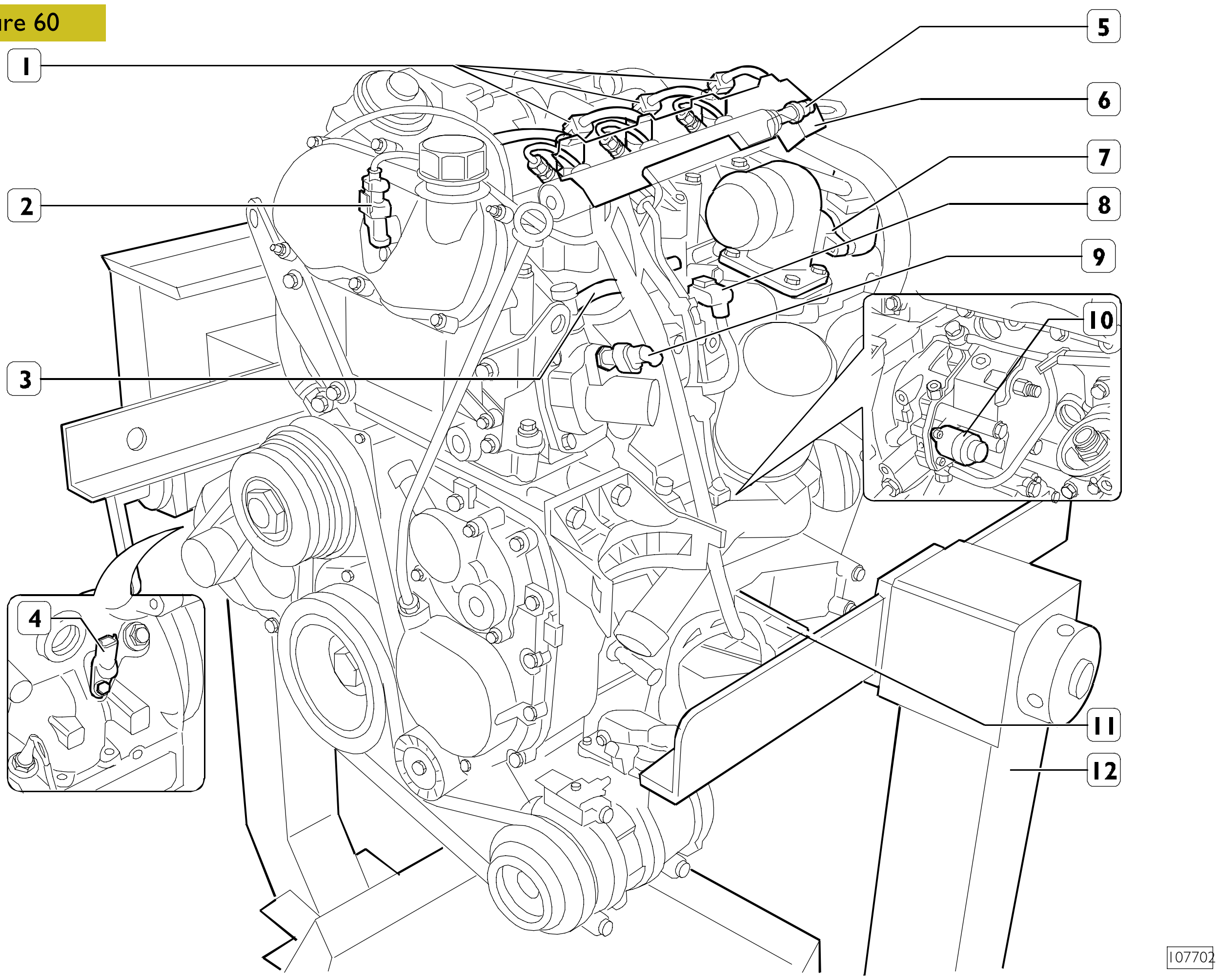
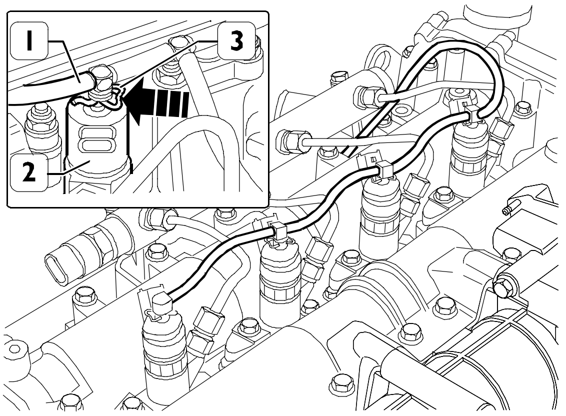


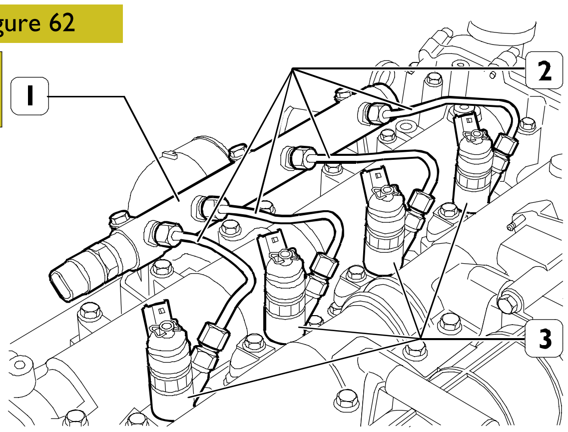
Figure 61



107703

Press the springs (3) in the direction shown by the arrow and disconnect the fittings of the pipe (1) recovering fuel from the electro-injectors (2).

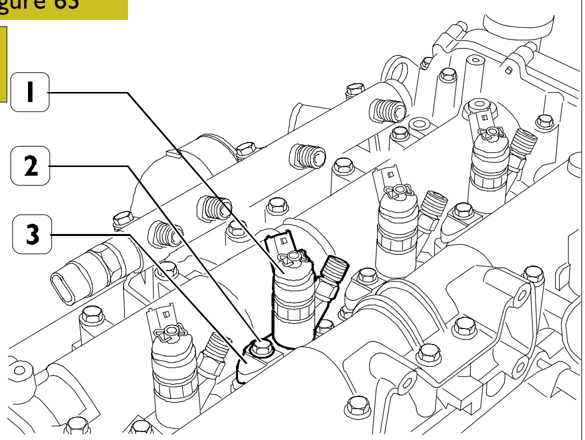
Figure 62



107704

Disconnect the fuel pipes (2) from the electro-injectors (3) and from the hydraulic accumulator (1) (rail).

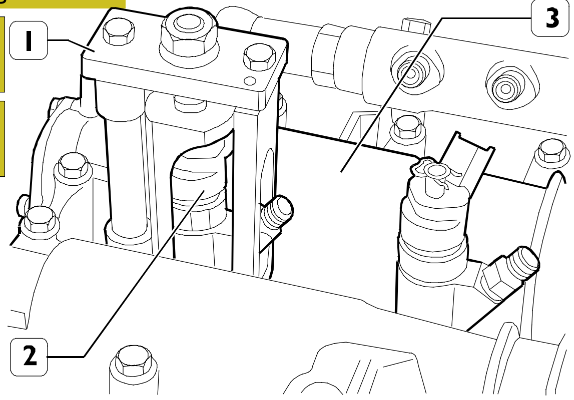
Figure 63



107705

Take out the screws (2) and the brackets (3) fixing the electro-injectors (1) to the cylinder overhead.

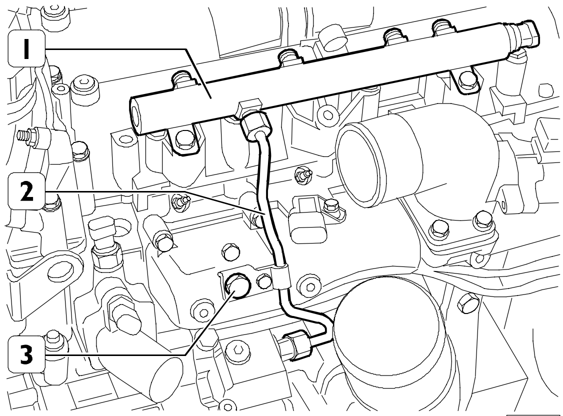
Figure 64



88244

Using tool 99342153 (1) extract the electro-injectors (2) from the overhead (3).

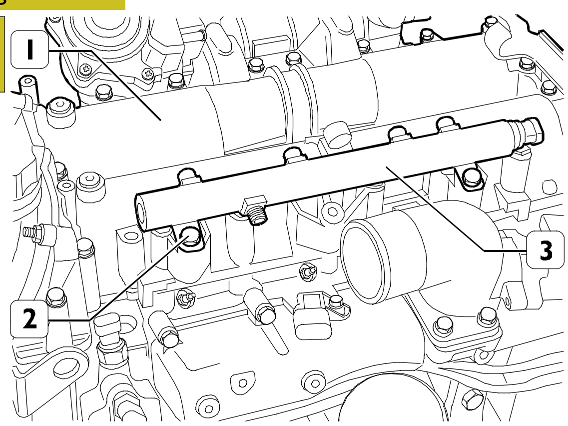
Figure 65



107706

Remove the fastening screw (3) of the pipe retaining bracket (2). Disconnect the pipe (2) from the hydraulic accumulator (1) and the high pressure pump (4).

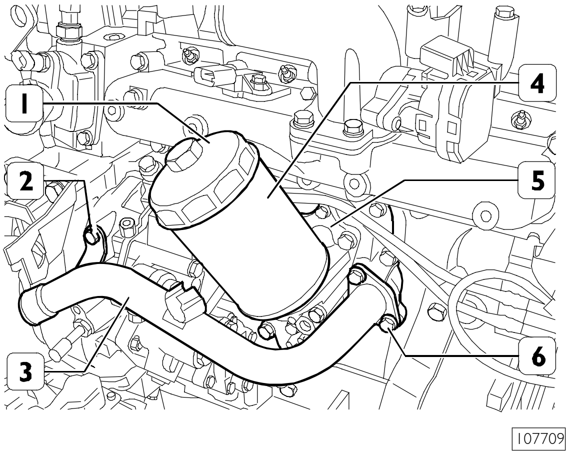
Figure 66



107708

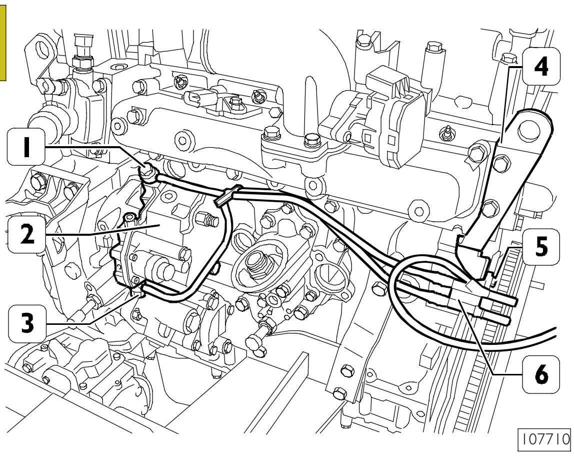
Remove the screws (1) and the hydraulic accumulator (2) from the overhead device (3).

Figure 67



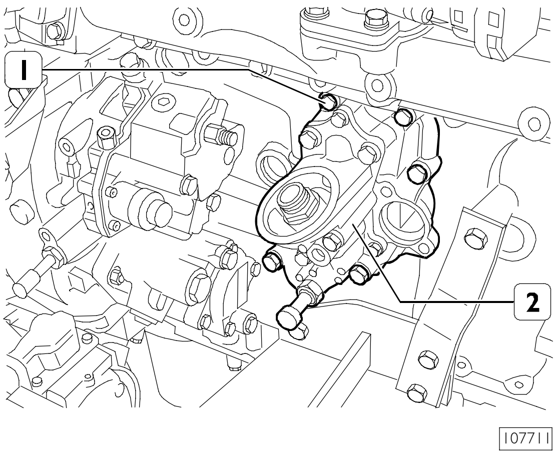
Use tool 99360076 (1) to take oil filter (4) off heat exchanger (5).
Remove screws (2) and (6), then disconnect pipe (3) from heat exchanger (5).

Figure 68



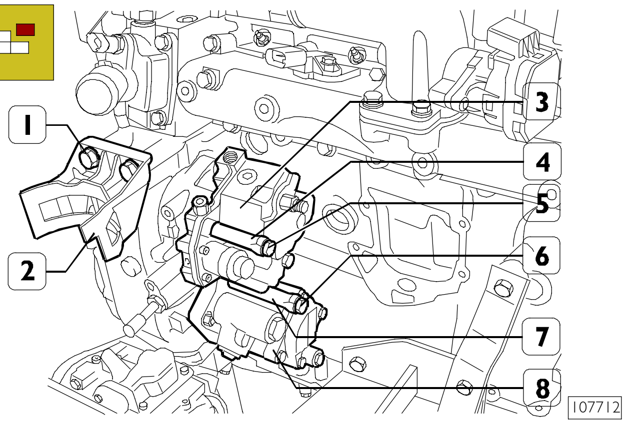
Remove the screw (6) and the low pressure pipes (5) from the bracket (4).
Slacken the pipe unions (1 and 3) and remove the low pressure pipes (5) from the high pressure pump (2).

Figure 69



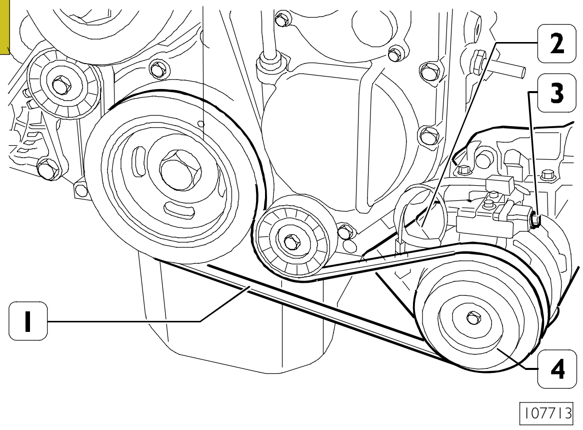
Remove screws (1), then take heat exchanger (2), with its respective gasket, off the engine base.

Figure 70



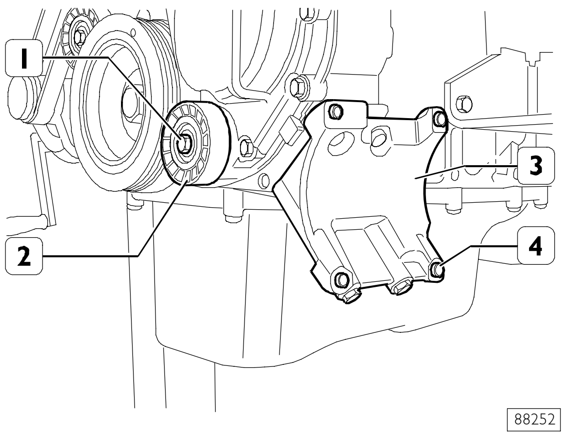
Remove screws (5) with spacers (4), then take off high-pressure pump (3).
Remove screws (6) with spacers (7), then take off power steering pump (8).
Remove screws (1), then take off power steering tank support (2).

Figure 71



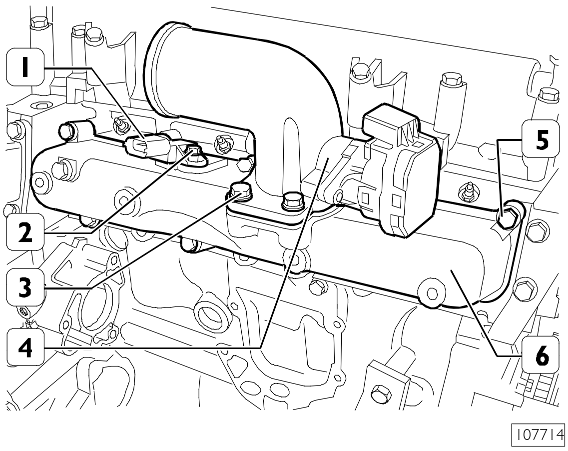
Cut elastic belt (1), if any, due to its being unable to be reused.
Remove screws (3), then remove air-conditioner compressor (4) from support (2).

Figure 72



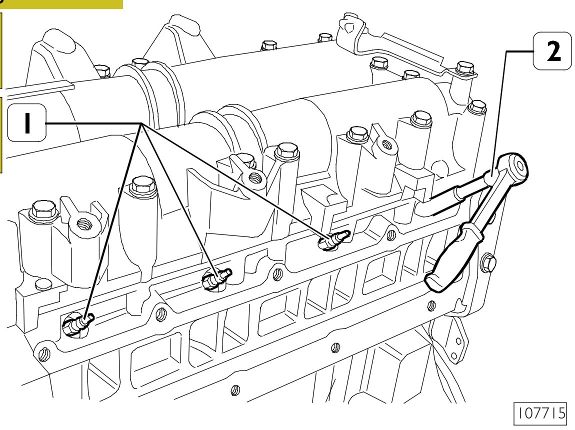
Remove the screws (4) and take off the support (3).
Remove the screw (1) and the fixed backstand (2).

Figure 73



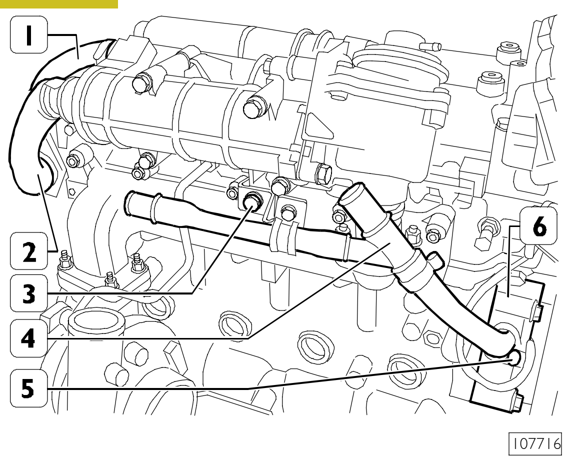
Remove screws (3), then remove throttle valve assembly (4).
Remove the screw (2) and take off the air temperature and pressure sensor (1).
Remove the screws (5) and take off the suction manifold (6) with the relevant gasket.

Figure 74



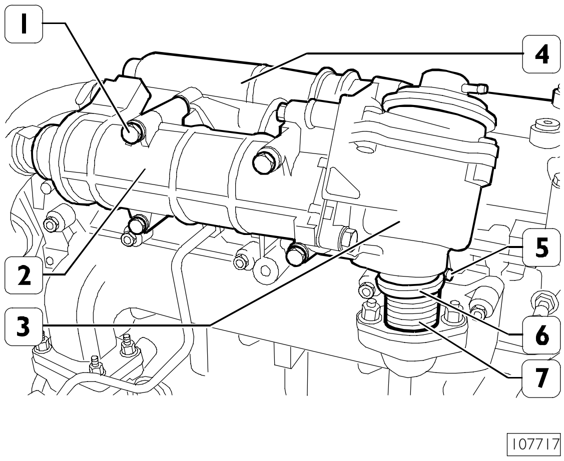
Using wrench SP.2275 (3), remove the glow plugs (4).

Figure 75



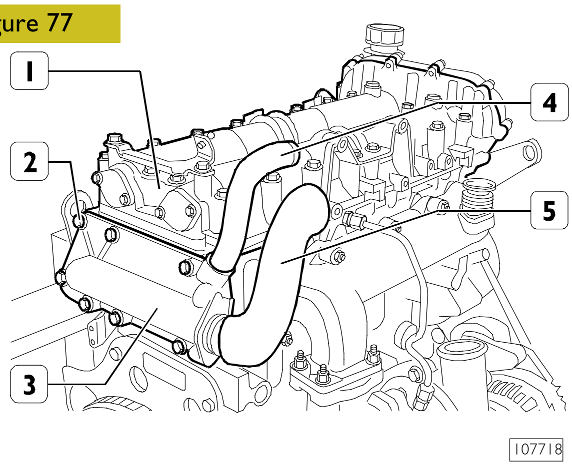
Remove the retaining straps, then remove coolant pipes (1 and 2).
Remove screw (3) and strap (5), then disconnect coolant pipe (4) from water pump (6).

Figure 76



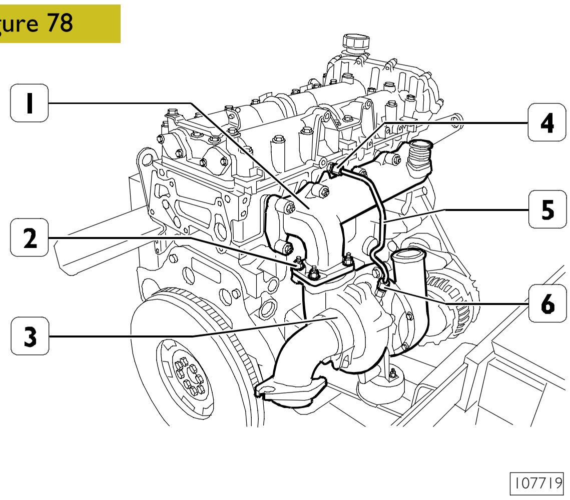
Loosen screw (5), then remove strap (6).
Remove screws (1), then take heat exchanger (2), together with EGR valve (3), off overhead (4) and connecting pipe (7).

Figure 77



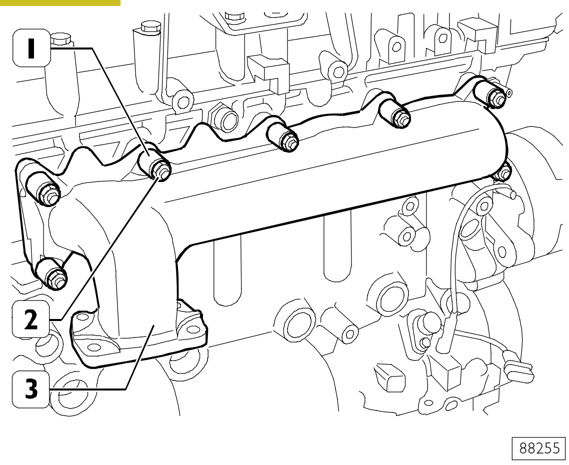
Remove screws (2), then take cover (3), together with pipes (4 and 5), off cylinder head (1).

Figure 78



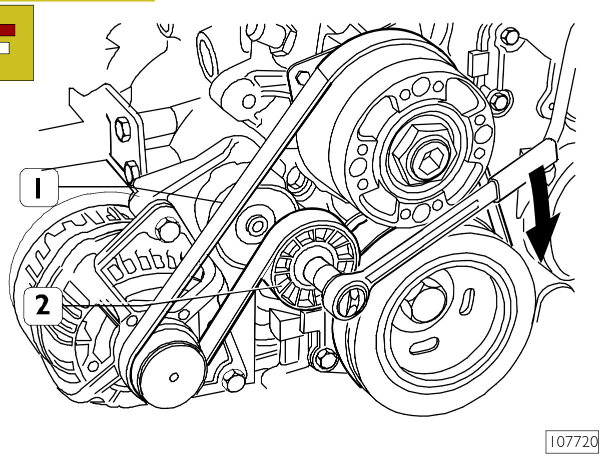
Unscrew connections (2, 4 and 6), then disconnect oil pipe (5).
Remove nuts (2), then take turboblower (3), together with its respective gasket, off exhaust manifold (1).

Figure 79



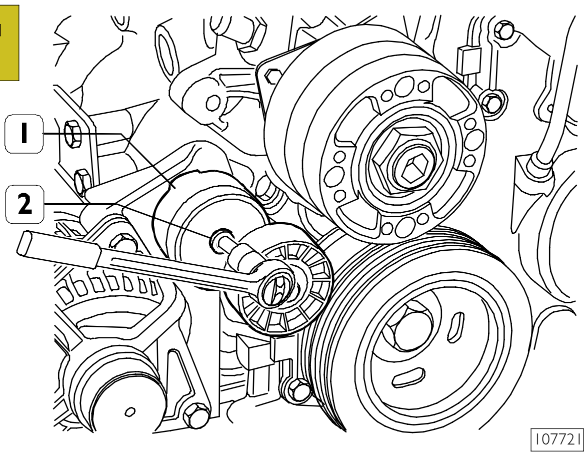
Remove the nuts (2), the spacers (1) and take off the exhaust manifold (3) with the relevant gasket from the cylinder head.

Figure 80



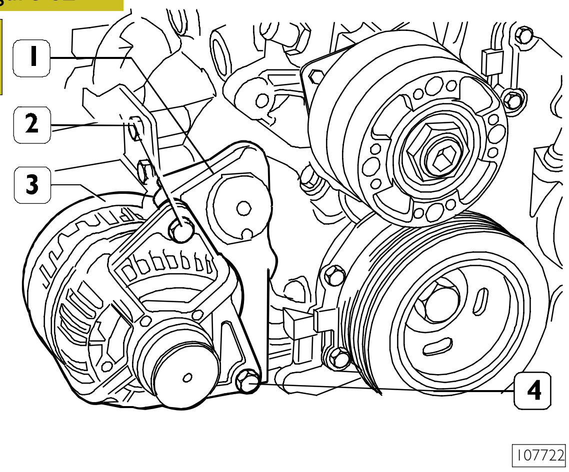
Using the specific wrench on the automatic tightener (2), slacken the tension of the belt (1) and remove it.

Figure 81



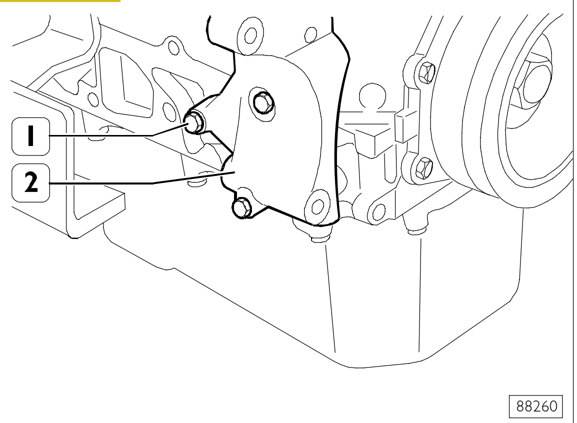
Take out the screw (2) and remove the automatic tightener (1).

Figure 82



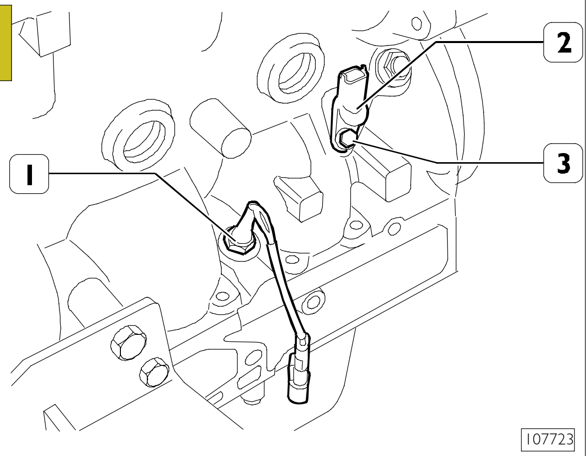
Remove the screw (2), the bolt (4) and pull the alternator (3) out of the support (1).

Figure 83



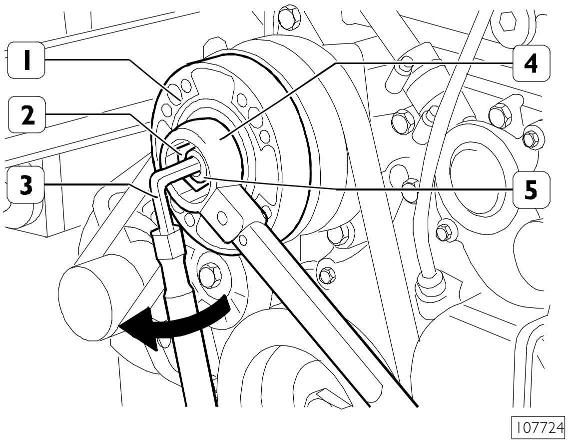
Remove the screws (1) and take off the support (2) from the cylinder block.

Figure 84



Use the suitable wrench to remove the oil level sensor (1). Remove the fastening screw and the rev sensor (2).

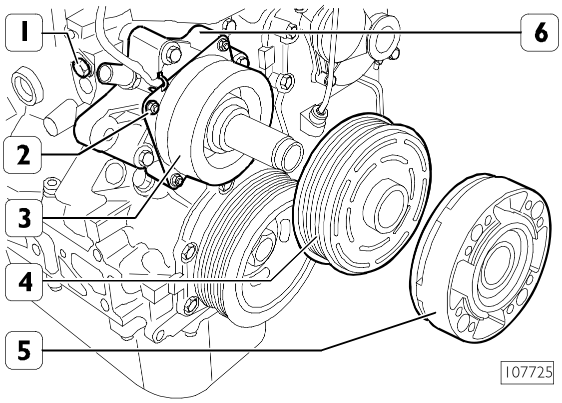
Figure 85



Secure water pump shaft (5) by means of an Allen wrench (3) and a special lever. Use a suitable wrench (4) to remove nut (2) securing hub (1) to shaft (5).

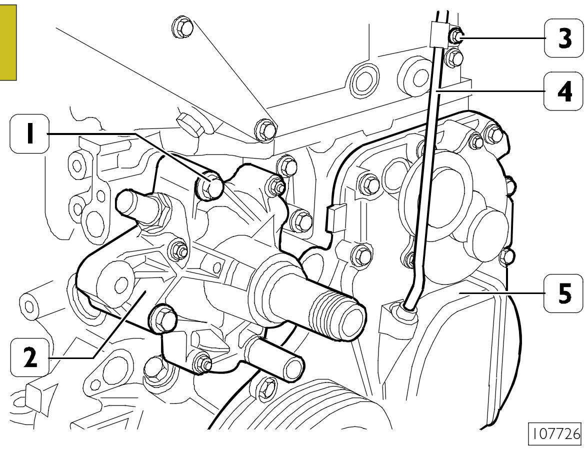
NOTE Slacken the nut (2) anticlockwise because its threading is left-handed.

Figure 86



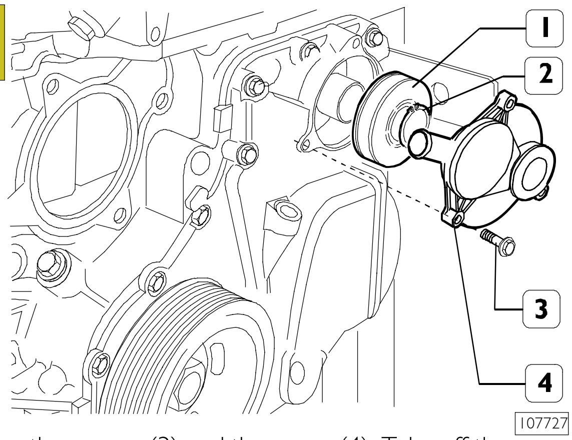
Disassemble hub (5) and pulley (4).
Disconnect electric cable (1) from the retaining clip, then remove nuts (2) and take electromagnet (3) off water pump (6).

Figure 87



Remove screws (1), then take water pump (2) off.
Remove screw (3), then take oil dipstick pipe (4) out of front cover (5).

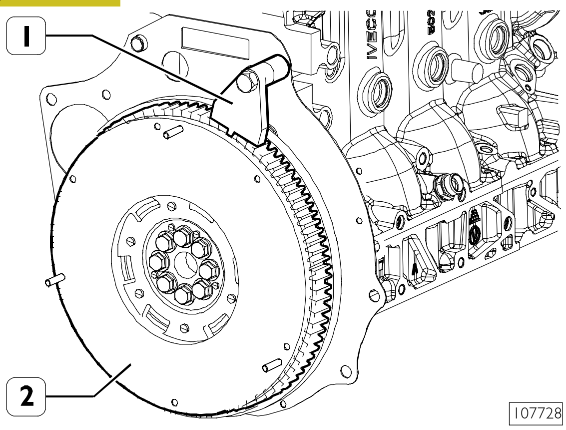
Figure 88



Remove the screws (3) and the cover (4). Take off the snap ring (2). Pull out the centrifugal filter (1).

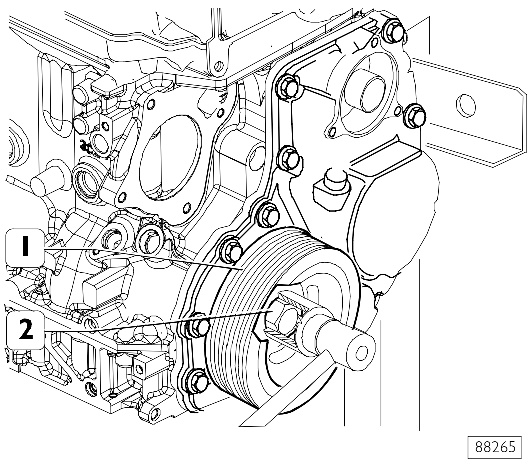
NOTE The centrifugal filter (1) and the seal ring of the cover (4) must be changed at every removal.

Figure 89



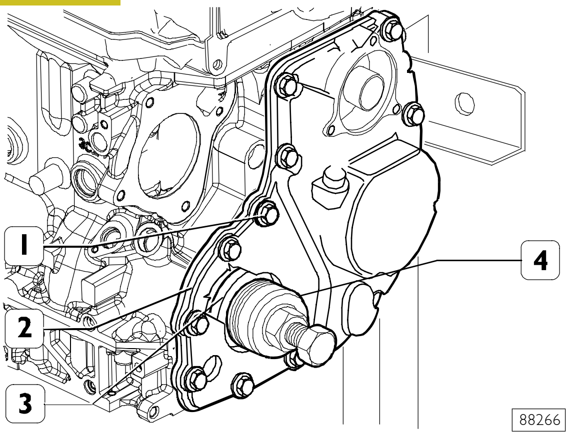
Stop the rotation of the engine flywheel (2) by means of tool 99360306 (1).

Figure 90



Remove the screw (2) and the damper pulley (1).

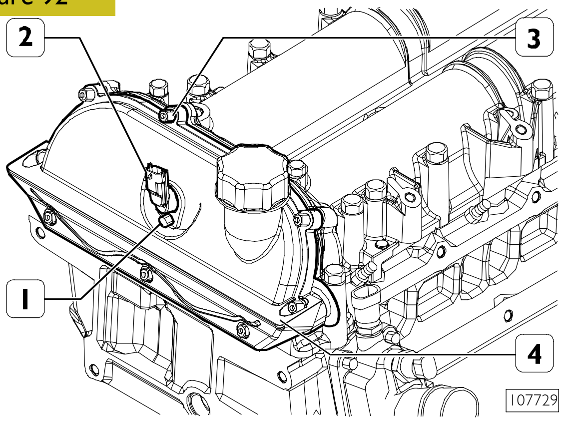
Figure 91



Remove the screws (1) and the distribution cover (2).

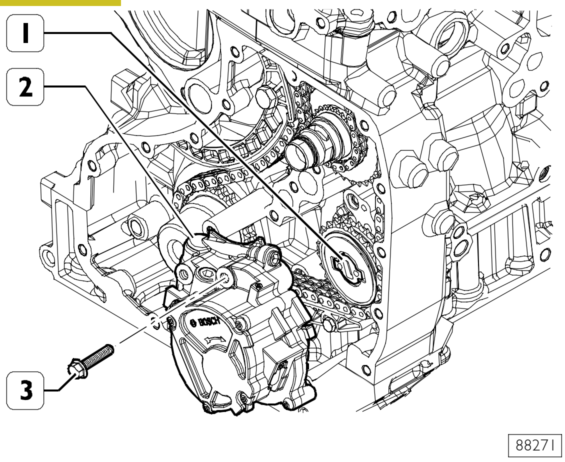
NOTE Tool 99340059 (4) is used to remove the seal ring (3) from the cover (2) when the engine is installed on the vehicle.

Figure 92



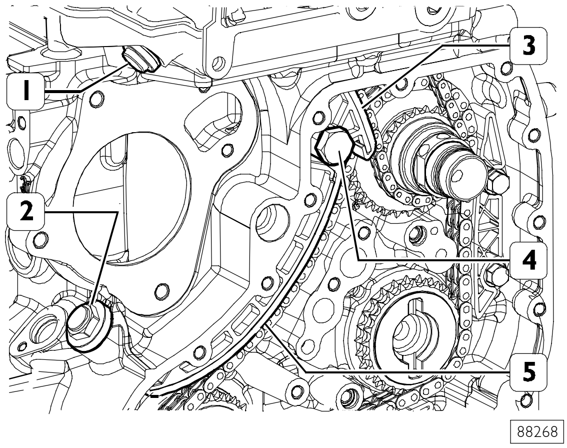
Remove the nut (1) and the phase sensor (2).
Remove the nuts (3) and the cover (4).

Figure 93



Remove the screws (3) and disassemble the depressor/oil pump unit (2).
Remove the connection key (1).

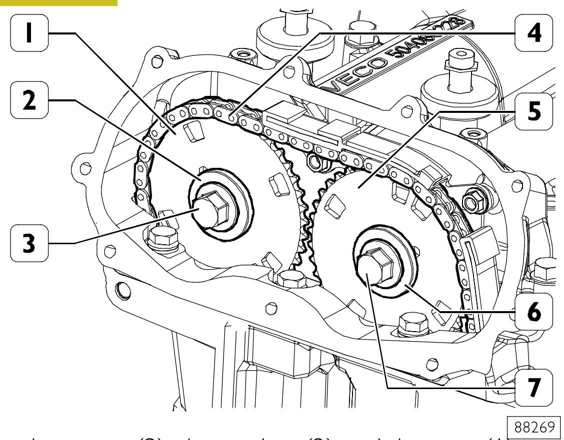
Figure 94



Remove the hydraulic chain tightener: top (1) and lower (2). Remove the pin (4) and disassemble the mobile skid: lower (5) and top (3).

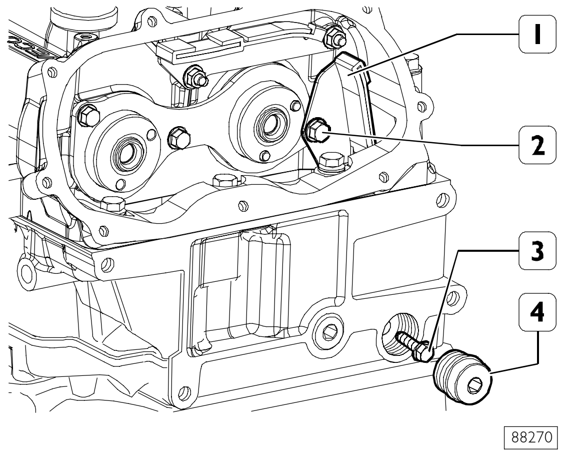
NOTE Upper hydraulic chain stretcher (1) is equipped with an anti-return device that makes it necessary to replace the chain stretcher every time it is disassembled.

Figure 95



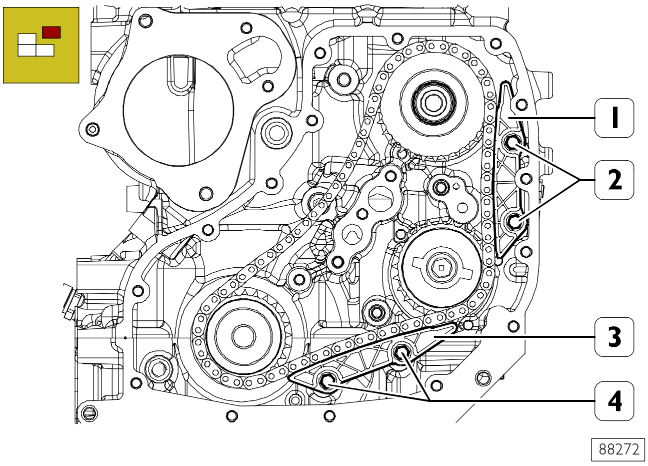
Remove the screw (3), the washer (2) and the gear (1). Remove the screw (7), the washer (6), the gear (5) and the chain (4).

Figure 96



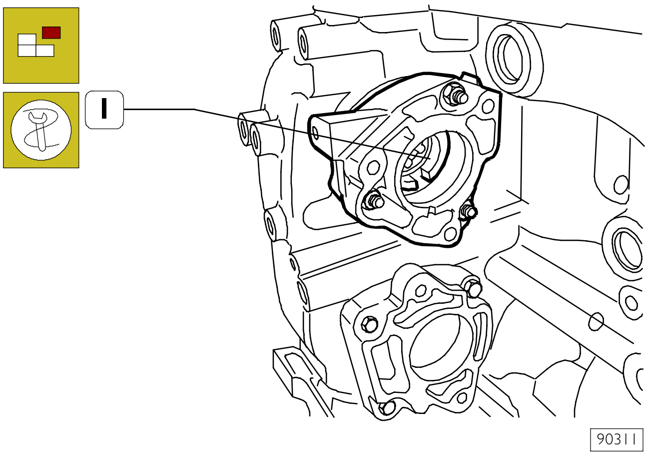
Remove the cap (4), the screws (2 and 3) and the top fixed skid (1).

Figure 97



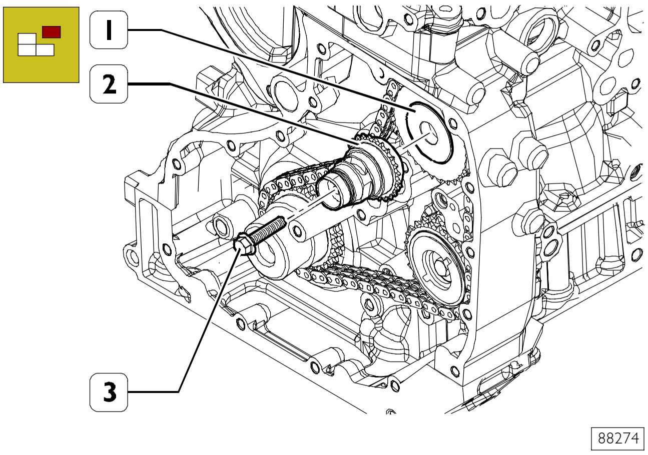
Remove the screws (2) and the side fixed skid (1).
Remove the screws (4) and the lower fixed skid (3).

Figure 98



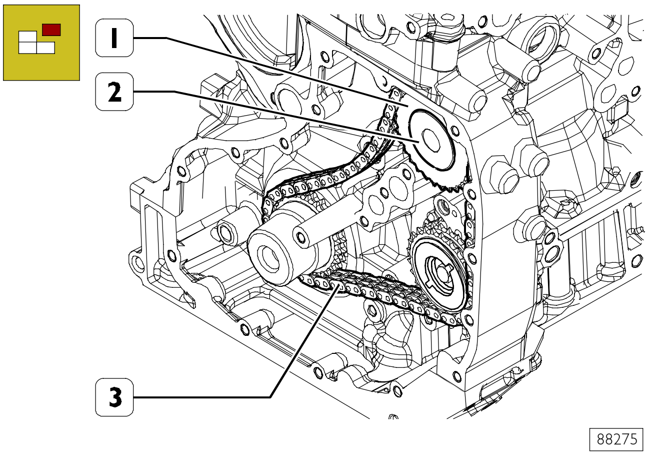
Stop the rotation of the high pressure pump control shaft (1) by inserting the suitable wrench inside it.

Figure 99



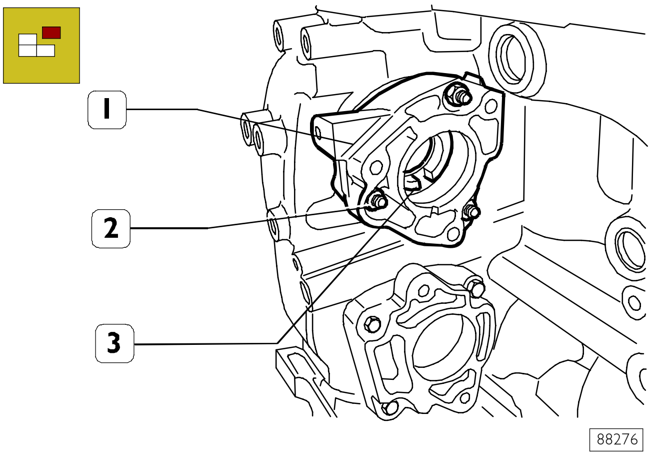
Remove the screw (3) and the stem with the drive gear (2) from the high pressure pump control shaft (1).

Figure 100



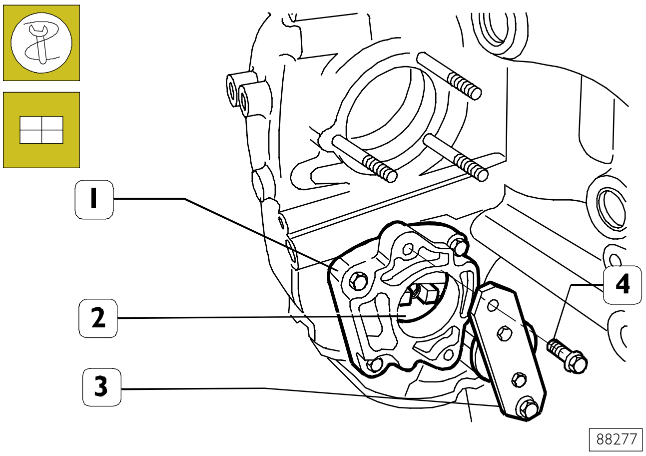
Remove the gear (1) and the chain (3) from the high pressure pump control shaft (2).

Figure 101



Remove the high pressure pump control shaft (3).
Remove the nuts (2) and the support (1).

Figure 102



Stop the rotation of the hydraulic power steering pump control shaft (2) by inserting tool 99360187 (3) in the shaft and fastening the tool on the support (1) by means of the screws (4).

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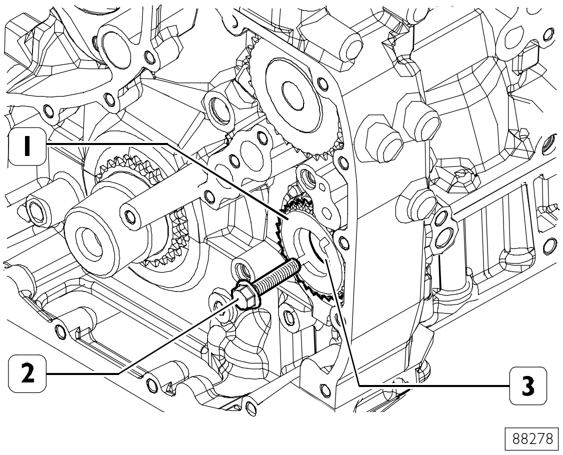
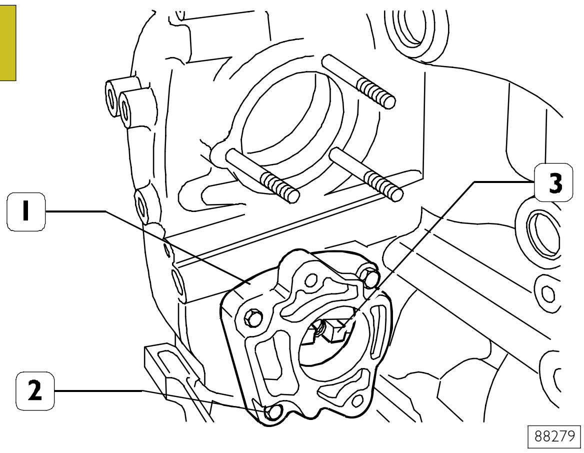
Figure 103



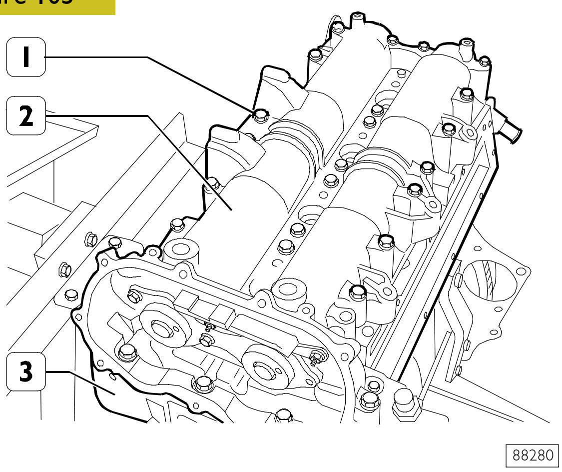
Remove the screw (2) and the gear (1) from the hydraulic power steering control shaft (3).

Figure 104



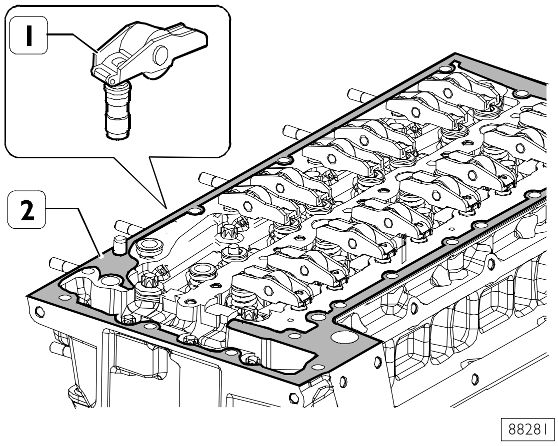
Remove the hydraulic power steering control shaft (3). Remove the nuts (2) and the support (1).

Figure 105



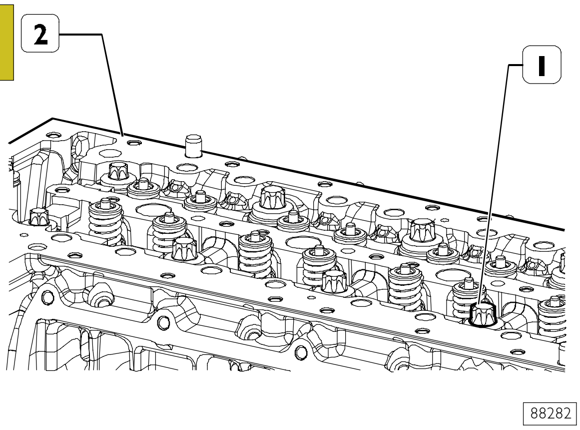
Remove the screws (1) and take off the over-head (2) from the cylinder head (3).

Figure 106



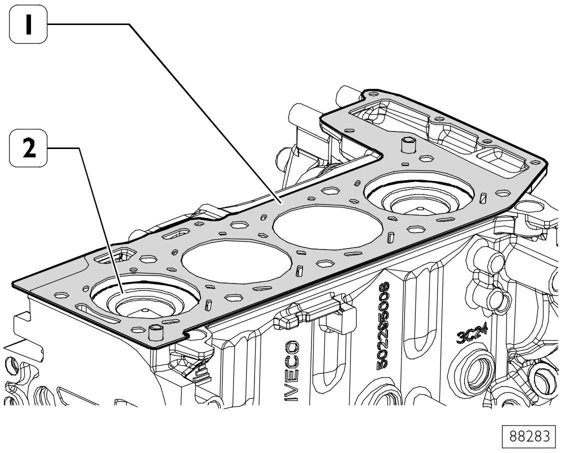
Remove the hydraulic tappets (1) with the rocker arms. Remove the gasket (2).

Figure 107



Take out the screws (1) and remove the cylinder head (2).

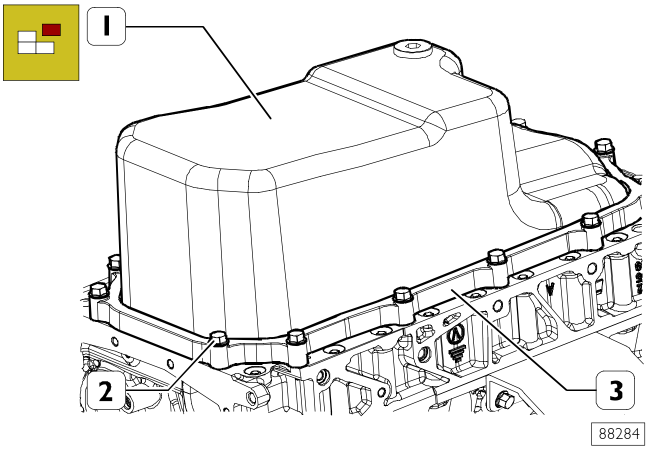
Figure 108



Remove the cylinder head gasket (1).

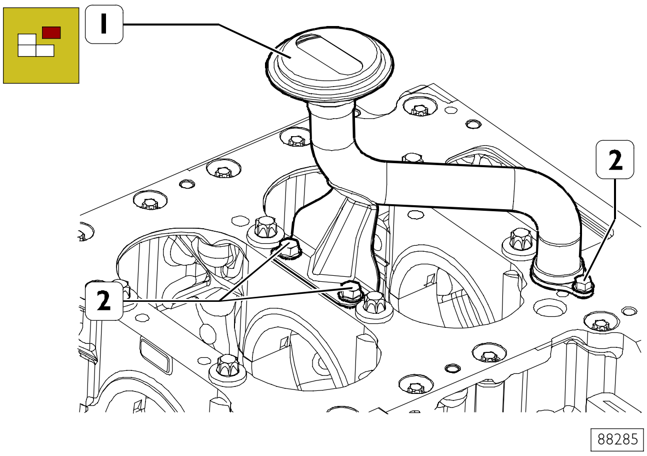
NOTE Check the protrusion of the pistons (2) as described under the relevant heading to check the possibility of facing the crankcase if it has deformed.

Figure 109



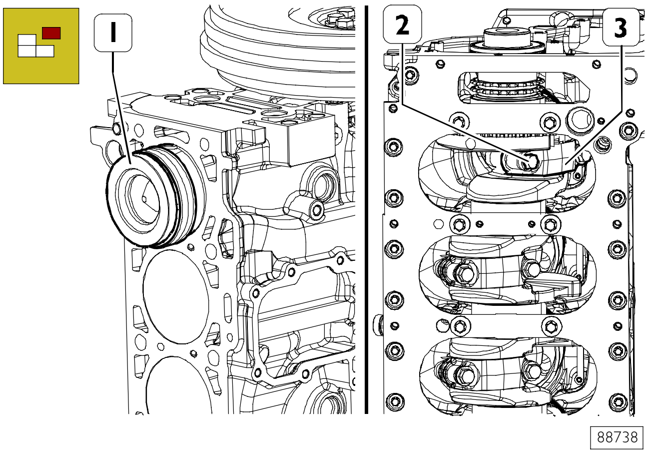
Remove the screws (2) and take off the oil sump (1) with its gasket and frame (3).

Figure 110



Remove the screws (2) and the suction rose (1).

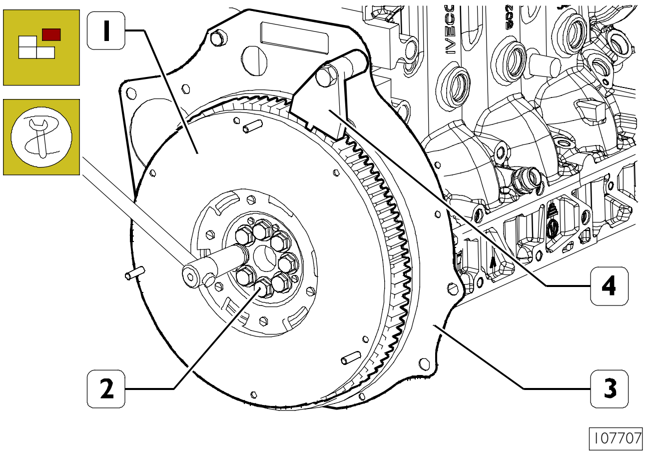
Figure 111



Take out the screws (2) and remove the connecting rod caps (3).
Extract the pistons (1) from the top of the crankcase.

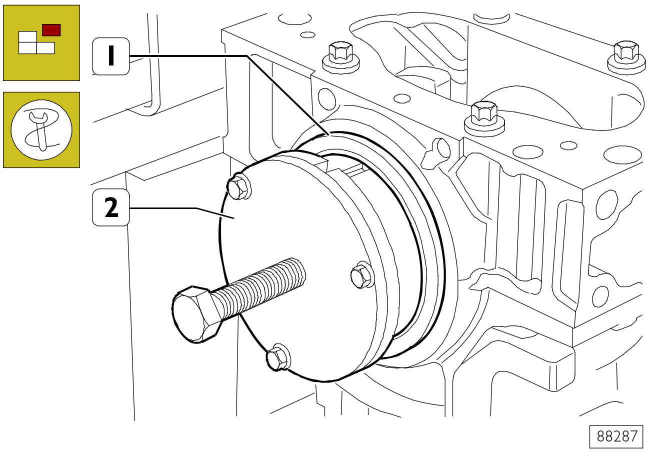
NOTE On the same side of the connecting rod and its associated cap, indicate the number of the cylinder from which the connecting rod has been removed. Keep the bearing shells in their respective housings since, if they are used, they will need to be fitted in the position found during removal.

Figure 112



Block rotation of the flywheel (1) with tool 99360306 (4).
Take out the screws (2) and remove the engine flywheel (1).
Take out the guard (3).

Figure 113



Apply tool 99340060 (2) to the rear O-ring (1) and extract it from the crankcase.

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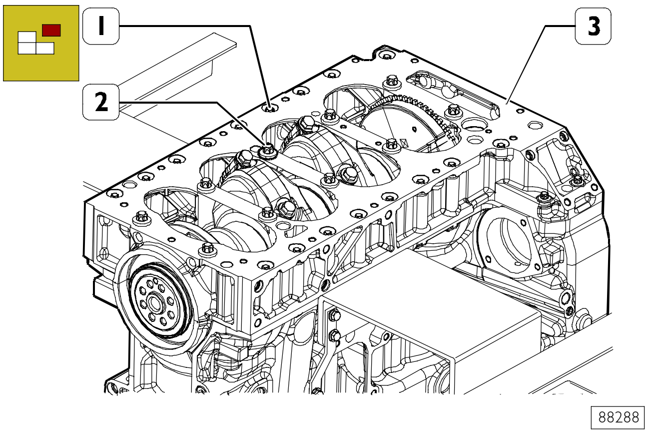
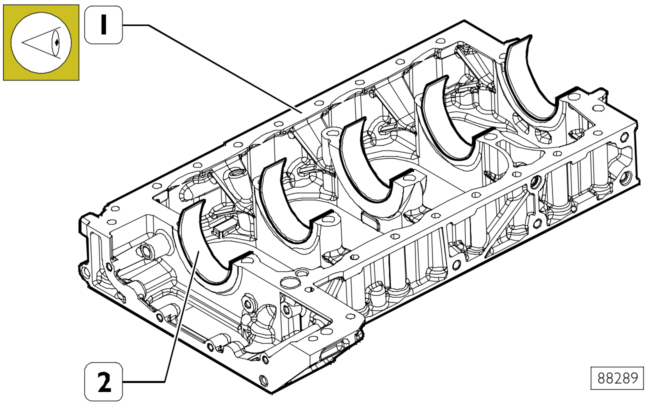
Figure 114



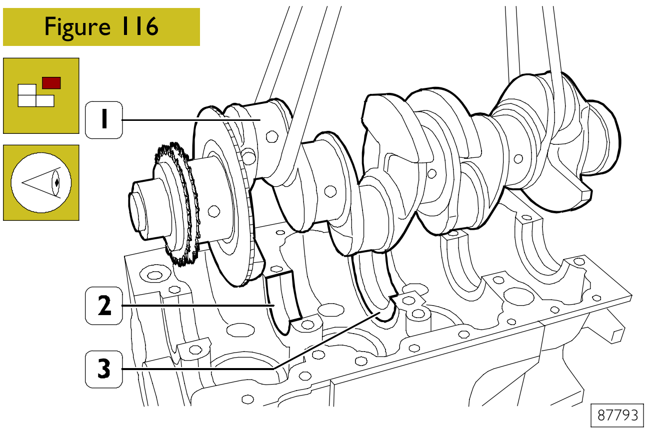
Remove the screws (2) and take off the oil sump (1) with its gasket and frame (3).

Figure 115



NOTE Note the assembly position of the top main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

Figure 116

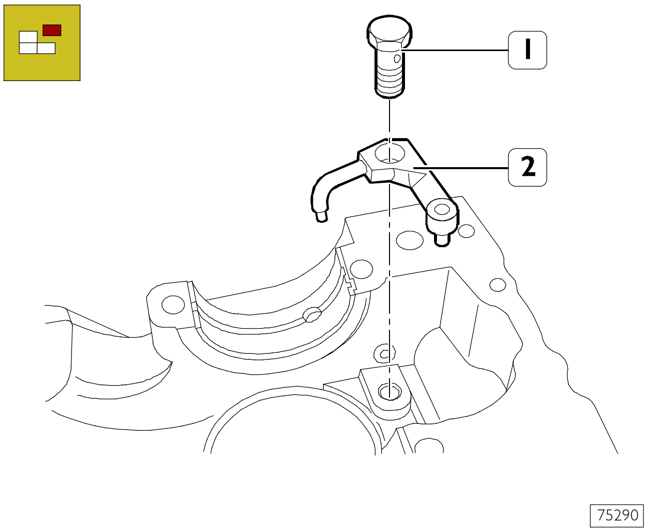


With the aid of a hoist and a rope, remove the crankshaft (1).

NOTE Note the assembly position of the top main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

The central half-bearing (3) is fitted with shoulder half-rings.

Figure 117



Take out the couplings (1) and remove the oil jets (2).

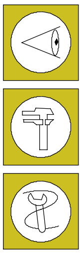
NOTE On completing engine removal, it is necessary to clean the removed parts thoroughly and check their integrity.
The following pages give the instructions for the main checks and measurements to make in order to determine whether the parts can be reused.

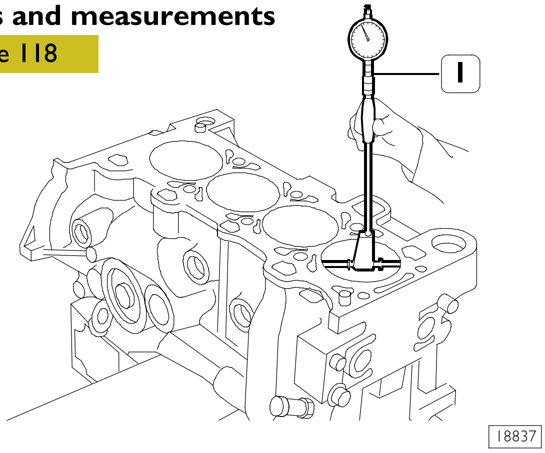
REPAIRS

CYLINDER BLOCK

Checks and measurements

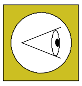
Figure 118

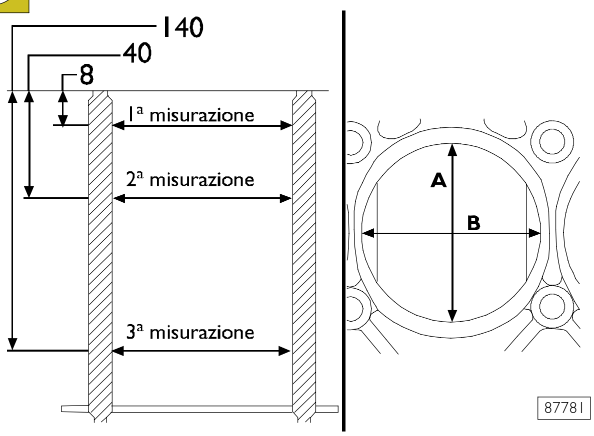




Once the engine removal is complete, carefully clean the cylinder block. For the cylinder block transportation use the suitable rings.
Carefully check that the crankcase has no cracks in it.
Check the state of the plugs. If they are rusty or there is any doubt about their seal, replace them. When fitting the caps into place, apply Loctite 270 sealant (IVECO NO. 93162429) to the same. Examine the surfaces of the cylinder liners; they must show no sign of meshing, scoring, ovalization, taper or excessive wear. The inside diameter of the cylinder liners is checked, to ascertain the extent of ovalization, taper and wear, using the bore meter 99395687 (1) fitted with a dial gauge previously reset on the ring gauge of the diameter of the cylinder liner or on a micrometer.

Figure 119





The measurements must be made for each single cylinder at three different heights up the liner and on two planes at right angles to each other: one parallel to the longitudinal axis of the engine (B) and the perpendicular (A); the greatest wear is generally found on this last plane with the first measurement.
On finding ovalization, taper or wear, go ahead and bore/grind and finish the face of the cylinder liners. The refacing of the cylinder liners should be done in relation to the diameter of the pistons supplied as spare parts oversized by 0.4 mm of the nominal value and to the prescribed assembly clearance.

Figure 120

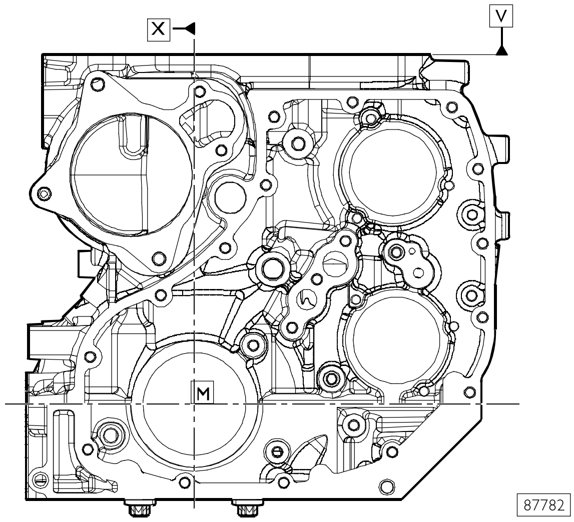
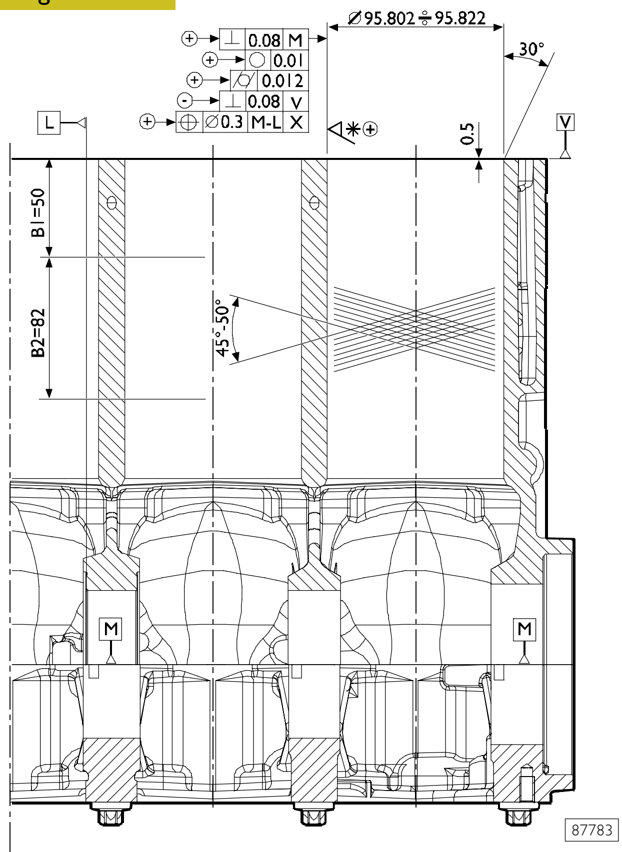


Figure 121

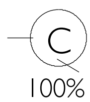


* Surface roughness parameters:

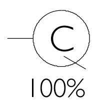
R1 = 4 ÷ 10 µm
Rz = 3 ÷ 8 µm
Ra = 0,3 ÷ 0,6 µm
W1 < 2 µm

Permissible surface porosity for machined cylinder (see Figure 121)

ZONE B1 = Area of greatest mechanical stress, segment/liner contact: No.2 non-continuous porosities are permissible max. 0.5x0.5.



ZONE B2 = Surface involved in segment rubbing: No.2 non-contiguous porosities are permissible max. 1x0.8.



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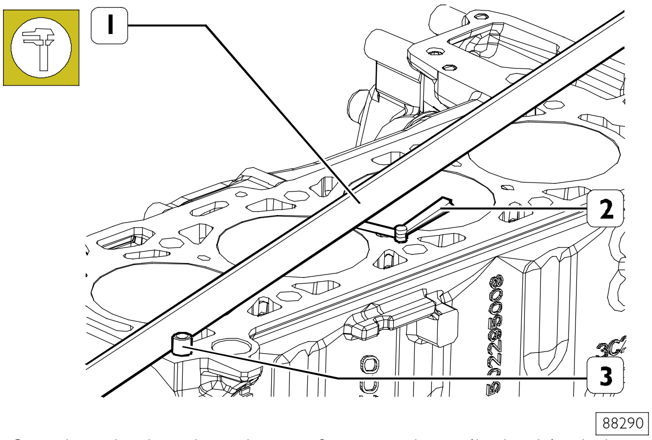
Checking head mating surface on cylinder block

Figure 122

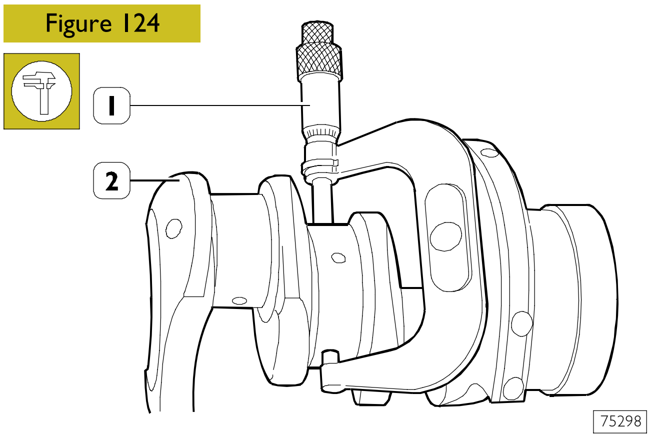


See that the head mating surface, on the cylinder block, has no deformation.
This check can be made, after taking out the grub screws (3), with a surface plate spread with carbon black or with a calibrated rule (1) and a feeler gauge (2). After ascertaining the areas of deformation, level the bearing surface with a grinding machine.

NOTE The crankcase can only be surfaced after making sure that, on completing the work, the piston protrudes from the cylinder liner by no more than the prescribed value.

5408 CRANKSHAFT
540810 Measuring main journals and crank pins

Figure 124



On finding signs of seizure, scoring or excessive ovalization on main journals and crankpins, it is necessary to regrind the pins. Before grinding the pins (2), measure the shaft pins with a micrometer (1) to establish to what diameter it is necessary to decrease the pins.

NOTE It is advisable to enter the measurements in a table. See Figure 123.

Figure 123

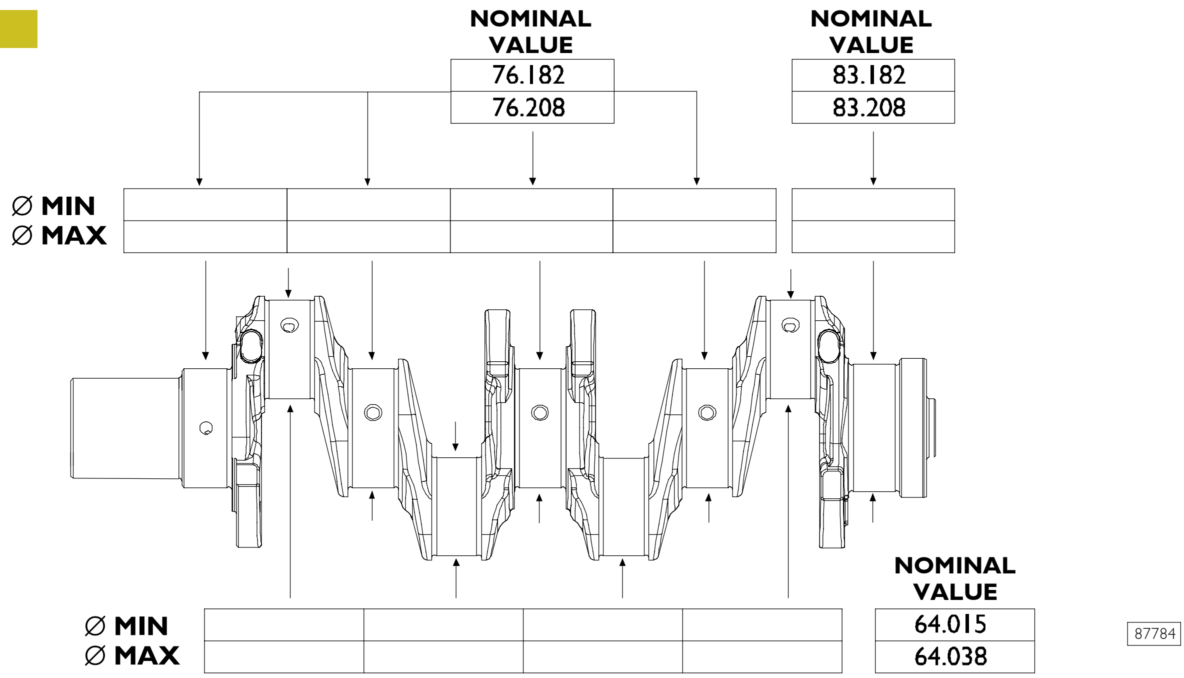


TABLE IN WHICH TO ENTER THE MEASUREMENTS OF THE CRANKSHAFT MAIN JOURNALS AND CRANKPINS

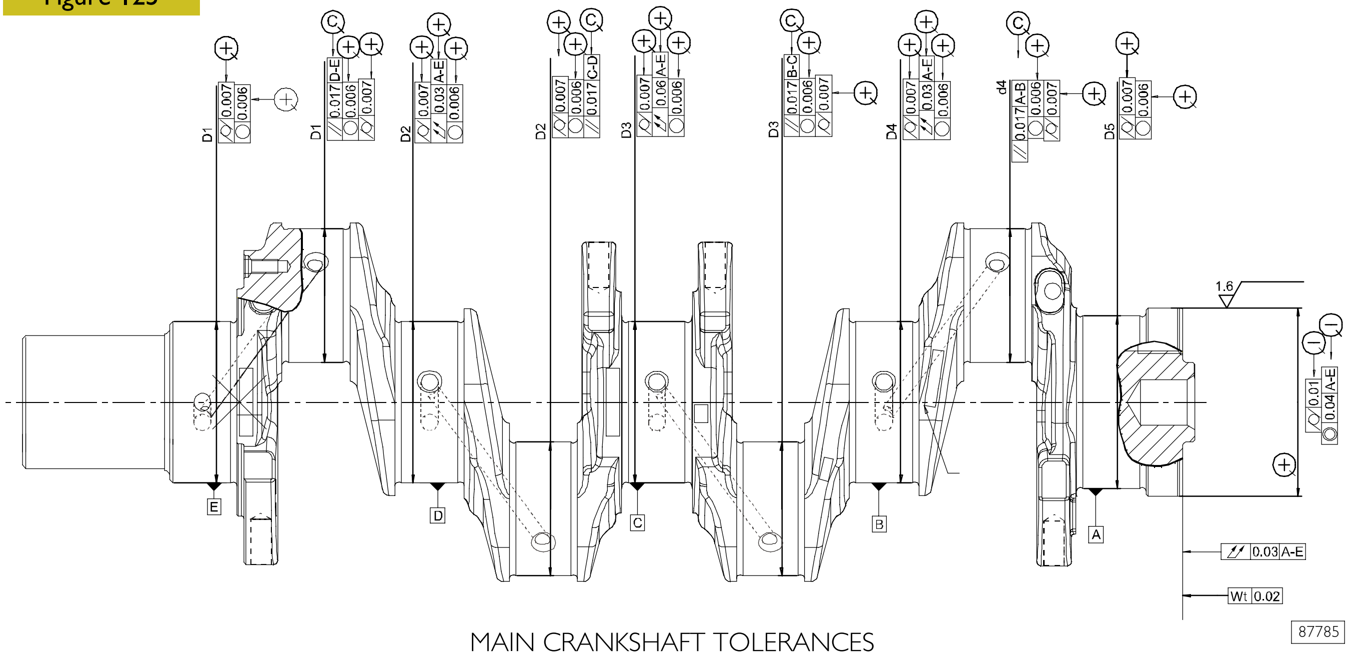
NOTE The main journals and crankpins must always be ground to the same undersize class.
The undersizing performed, on the main journals or crankpins, must be marked by punching on the side of crank arm no. 1.

For undersized crankpins, letter M.
For undersized main journals, letter B.
For undersized crankpins and main journals, letter MB.

The undersize classes are:
0.254 – 0.508 mm.

Checking crankshaft

Figure 125

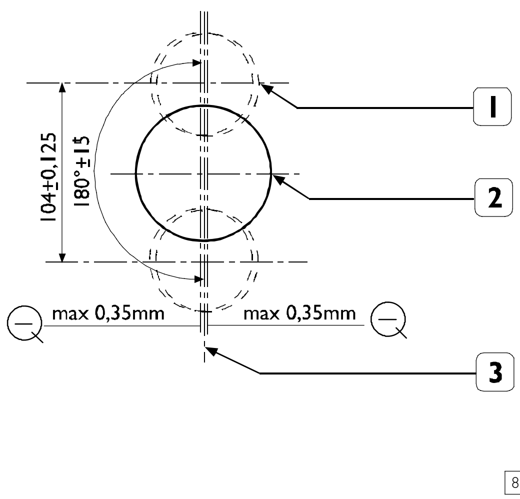


MAIN CRANKSHAFT TOLERANCES

TOLERANCES	TOLERANCE CHARACTERISTIC	GRAPHIC SYMBOL
SHAPE	Circularity	○
	Cylindricality	⌭
ORIENTATION	Parallelism	//
	Perpendicularity	⊥
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	↗↗

CLASS OF IMPORTANCE ATTRIBUTED TO PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Figure 126



NOTE The checks on the tolerances indicated in the figures must be made after grinding the crankshaft pins.

SYMMETRY BETWEEN MAIN JOURNALS AND CRANKPINS
1. Crankpins
2. Main journals
3. Normal position

After grinding, keep to the following:

❑ Round off the edges of deburring the holes for lubrication of the main journals and crankpins.

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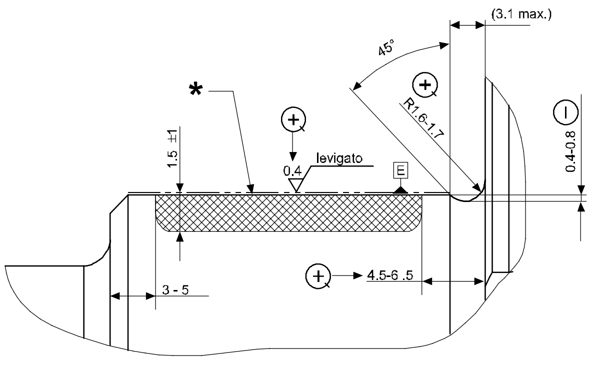
JOURNAL ON TIMING SYSTEM SIDE

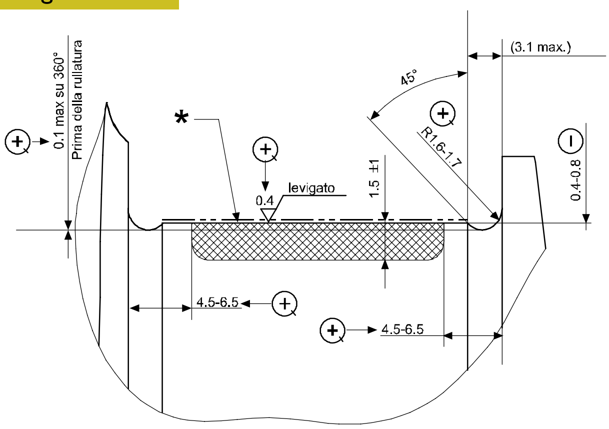
Figure 127



87787

INTERMEDIATE JOURNALS NO. 2-4

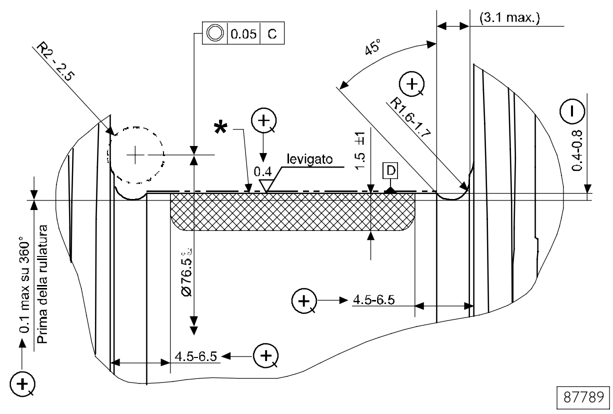
Figure 128



87788

INTERMEDIATE JOURNAL NO. 3

Figure 129

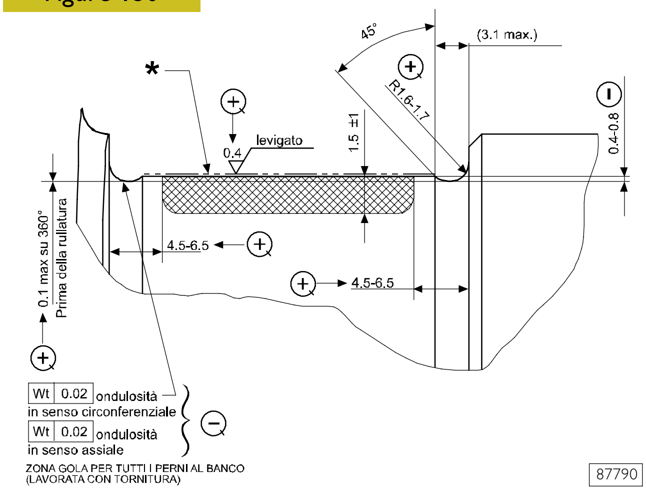


87789

MAIN DATA OF MAIN JOURNALS AND CRANKPINS

JOURNAL ON FLYWHEEL SIDE

Figure 130



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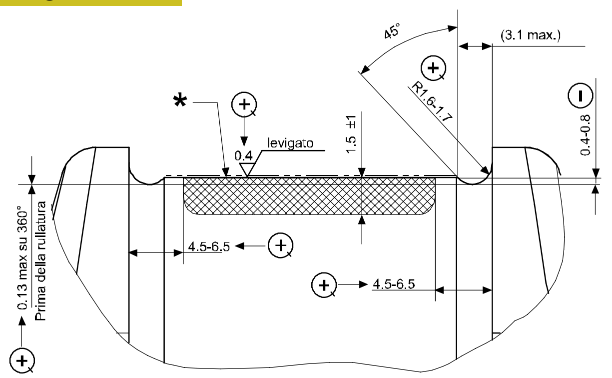
CRANKPINS

Figure 131



87791

* As far as both values are concerned, for the whole 360°.

NOTE Since, during the 0.254 and 0.508 mm undersizing on the diameter of the crankpins and main journals, the rolled portion of the side races of the pins may get involved, it is necessary to turn the races keeping to the data given in the figure and to do the rolling keeping to the following instructions.

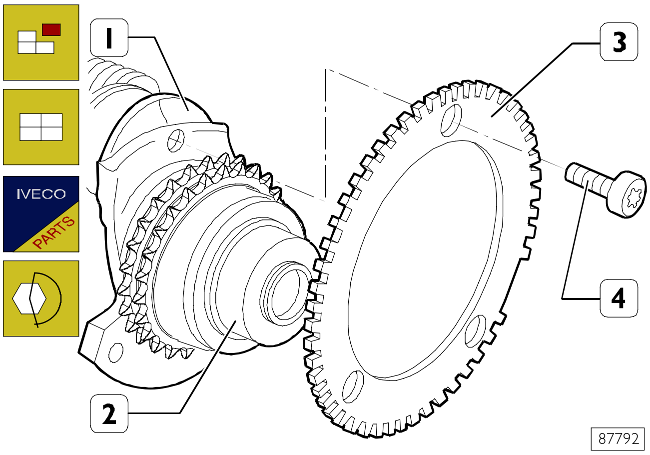
Rolling force:

- ❑ 1st main journal 925 ±25 daN.
- ❑ 2nd – 3rd – 4th – 5th main journal 1850 ±50 daN.
- ❑ crankpin 1850 ±50 daN.

- ❑ Rolling turns: 3 approach, 12 effective, 3 out.
- ❑ Rolling speed: 56 rpm.
- ❑ Reduction of the connecting rod pin slot diameter after rolling: 0.15 ÷ 0.30 mm*.
- ❑ Reduction of the journal slots after rolling: 0.15 ÷ 0.30 mm.

* Measured with calibrated rollers ∅ 2.5 mm.

Figure 132



Take out the screws (4) and replace the phonic wheel (3). Screws (4) shall be tightened to 10 + 1 Nm.

Replacing timing control gear

On finding the timing control gear teeth (1) damaged or worn, remove them from the crankshaft (2) using a suitable extractor.

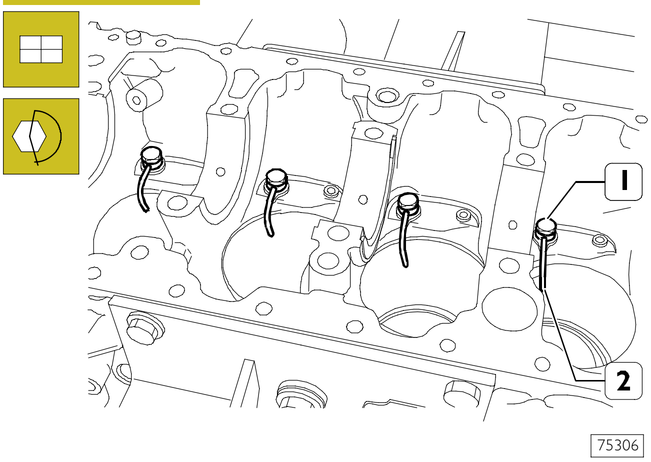
The new gear is fitted onto the crankshaft by heating it to a temperature of 180°C for no longer than 15 minutes.

On completing assembly and after the gear has cooled, it must withstand a torque of 150 Nm without slipping.

ENGINE ASSEMBLY

The following parts must be replaced with new ones at the time of assembly: retaining rings, seals and gaskets, screws whose thread is coated with sealant.

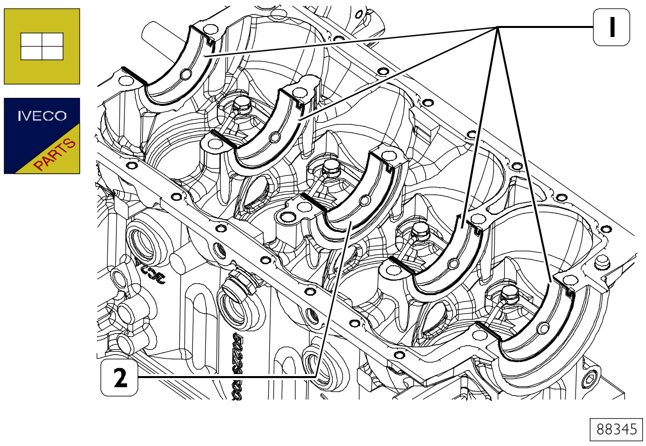
Figure 133



Fit on the oil spray nozzles (2) and tighten the couplings (1) to the prescribed torque.

Assembling main bearings

Figure 134



NOTE Not having found it necessary to replace the main bearings, they need to be fitted back on in the same sequence and position found upon disassembly.

The main bearings (1) are supplied as spare parts undersized on the inside diameter by 0.254 ÷ 0.508 mm.

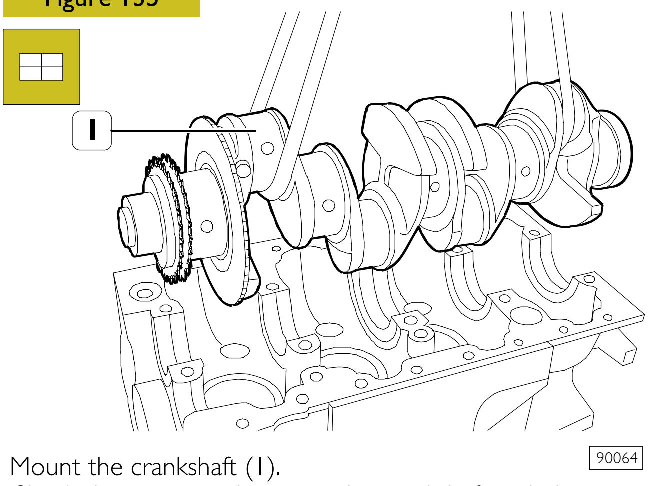
NOTE Do not do any accommodating on the bearings.

Thoroughly clean the top main bearing shells (1) and position them in the crankcase.

NOTE The middle half ring (2) is fitted with thrust washers.

540811 Measuring main journal assembly clearance

Figure 135



Mount the crankshaft (1).
Check the clearance between the crankshaft main journals and their respective bearings by proceeding as follows:

- Thoroughly clean the pins.
- Apply a calibrated wire onto the main journals.

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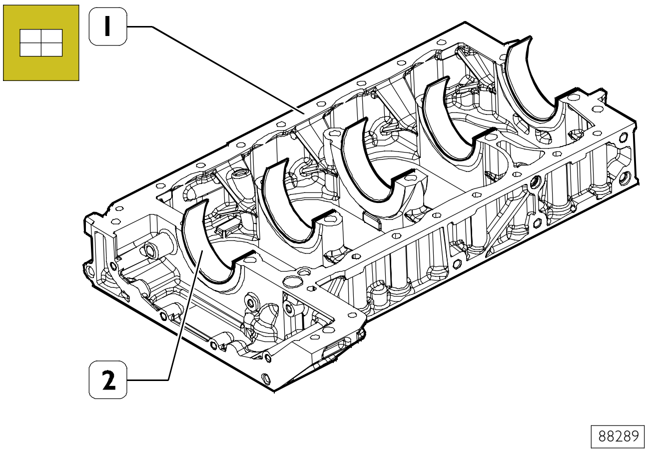
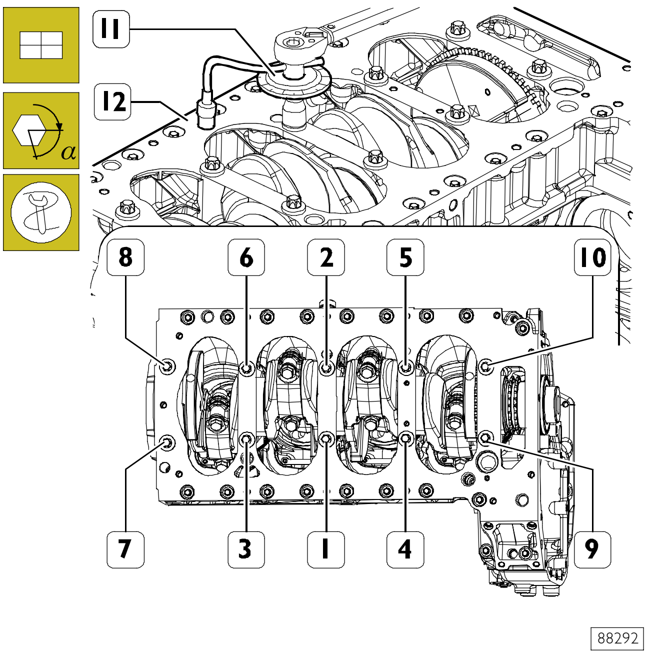
Figure 136



Thoroughly clean the bottom main bearing shells (2) and mount them in the crankcase base (1).

Figure 137



Mount the crankcase base (12).

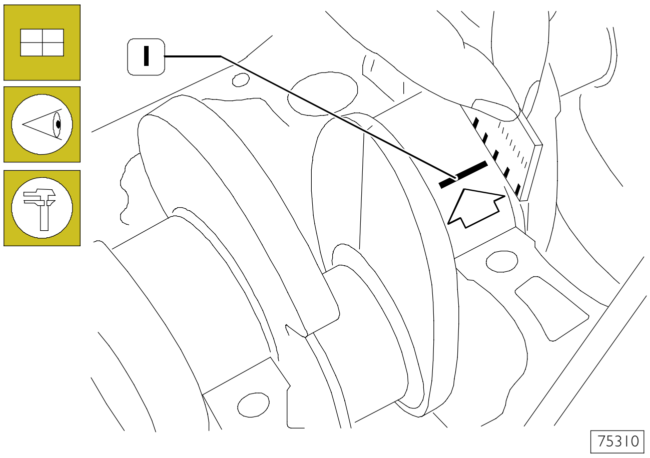
Tighten the screws in the sequence shown in the figure in three steps:

- Step 1: with a torque wrench, to a torque of 50 Nm.
- Step 2: closing to an angle of 60°.
- Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

Then tighten the outer screws to torque 26 Nm.

Figure 138

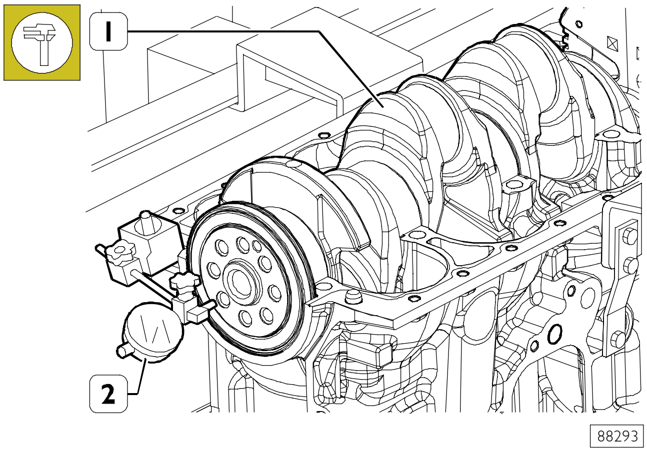


- Remove the bottom crankcase.

The clearance between the main bearings and their associated pins is measured by comparing the length of the calibrated wire (1), at the point of greatest crushing, with the graduated scale on the casing containing the calibrated wire. The numbers on the scale indicate the clearance of the coupling in millimetres, which must be 0.032 ÷ 0.102 mm. If the clearance is not as prescribed, replace the bearings and repeat the check.

Checking crankshaft end float

Figure 139

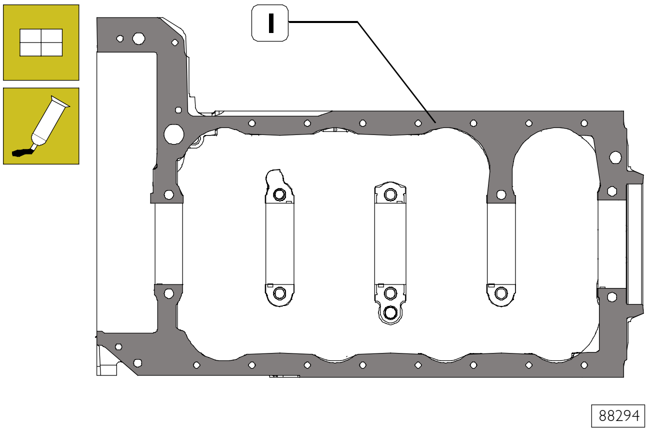


The end float is checked by setting a dial gauge (2) with a magnetic base on the crankshaft (1) as shown in the figure. The normal assembly clearance is 0.060 – 0.310 mm.

If you find the clearance to be greater than as required, replace the rear main bearing shells carrying the thrust bearings and repeat the clearance check between the crankshaft pins and the main bearing shells. If the end float of the crankshaft does not come within the prescribed values, it is necessary to grind the crankshaft and accordingly change the main bearing shells.

NOTE The middle main bearing has half thrust washers integrated in it, so it performs the function of a thrust bearing. It is supplied as a spare part only with the normal shoulder thickness.

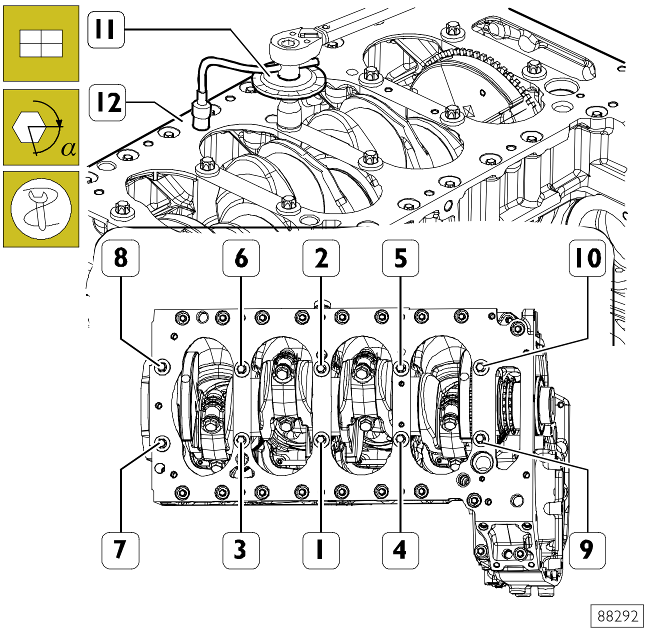
Figure 140



Thoroughly clean the crankcase / crankcase base mating surface.
Apply, on base, sealant LOCTITE 510 IVECO no. 93162432, as indicated in the scheme. The sealant must result to be even, not patchy.

NOTE Mount the crankcase base within 10 minutes of applying the sealant.

Figure 141

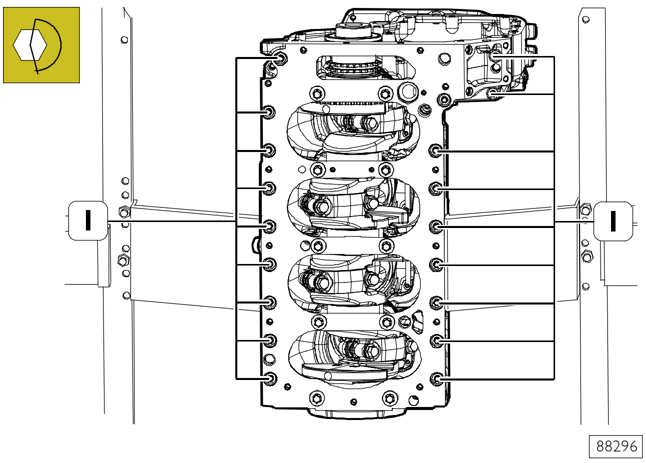


Mount the crankcase base (12) and tighten the fixing screws in three stages, following the sequence shown in the figure:

- ❑ Step 1: with a torque wrench, to a torque of 50 Nm.
- ❑ Step 2: closing to an angle of 60°.
- ❑ Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

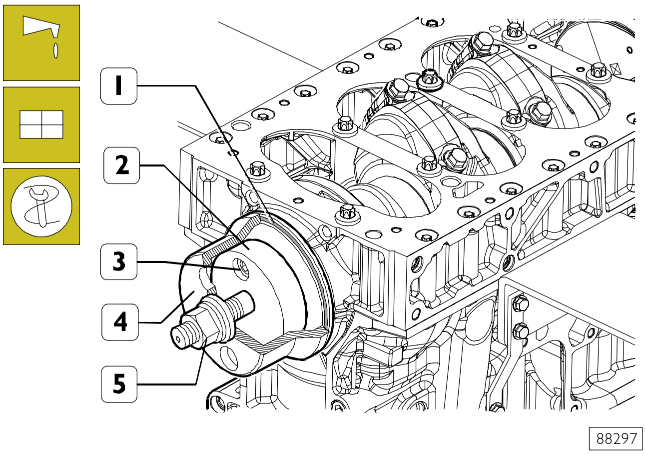
Figure 142



Then tighten the outer screws (1) to a torque of 26 – 30 Nm.

540460 Assembling rear seal

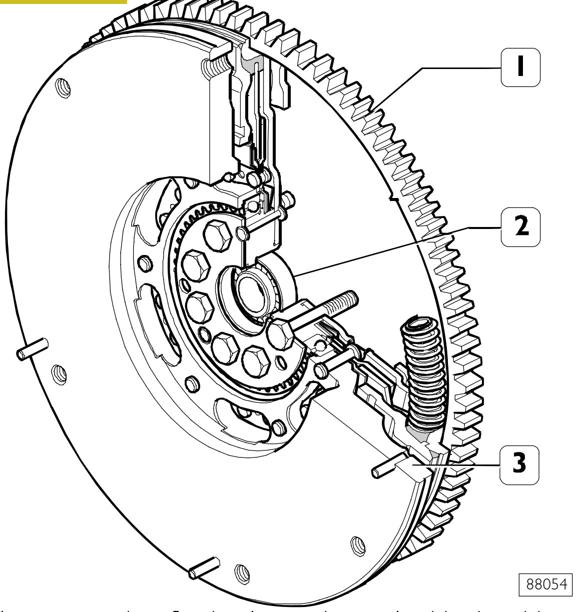
Figure 143



Carefully clean the seal seat.
Lubricate the rear shank of the crankshaft with engine oil.
Fit part (2) of tool 99346259 onto the rear shank of the crankshaft; secure it with the screws (3) and key the fresh seal (1) onto it.
Position part (4) on part (2); screw down the nut (5) to fit the seal (1) fully inside the crankcase.

540850 ENGINE FLYWHEEL

Figure 144



Double-mass engine flywheel, one integral with the drive shaft and one with the input shaft of the gearbox and in between a torsion elastic dampening system.
The advantages of this type of flywheel compared to the normal one are:

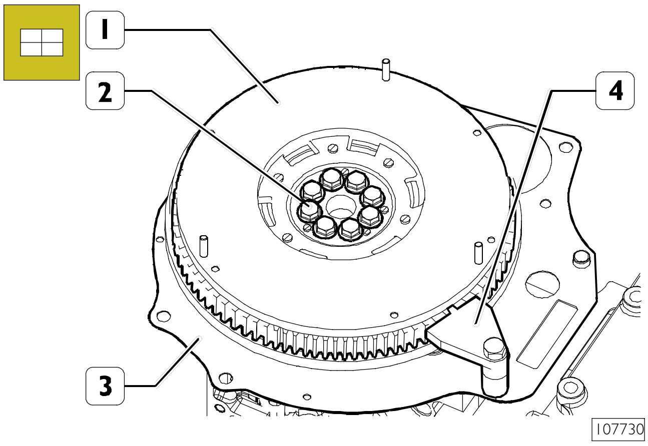
- ❑ Dampening of engine irregularities transmitted to the gearbox and resulting drive noise reduction;
- ❑ Noise reduction in the cabin as a result of the overall noise reduction.

Check the clutch disc mating surface, if there are too many scratches, change the engine flywheel (3).
Check conditions of the teeth of crown wheel (1); where excessive cracking or wear is found, replace engine flywheel.

540852 Replacing bearing supporting gear-box input shaft

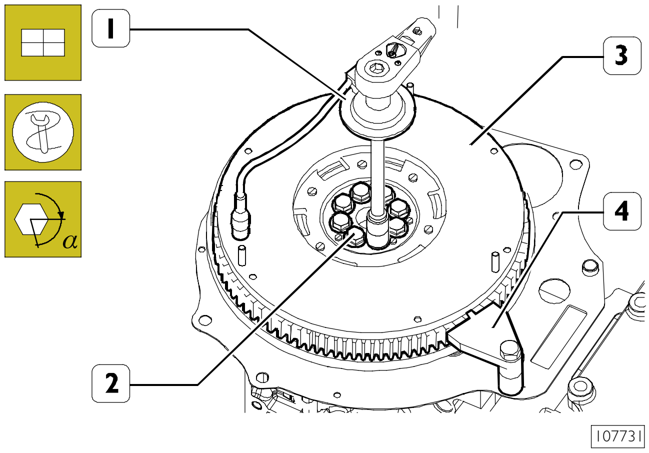
The bearing (2) supporting the gearbox input shaft is removed and fitted using a general-purpose drift.

Figure 145



Position the metal sheet guard (3) on the cylinder block.
Mount the engine flywheel (1) and screw down the screws (2).
Fit tool 99360351 (4) onto the crankcase to block rotation of the engine flywheel (1).

Figure 146



Tighten the screws (2) fixing the engine flywheel (3) in two steps:

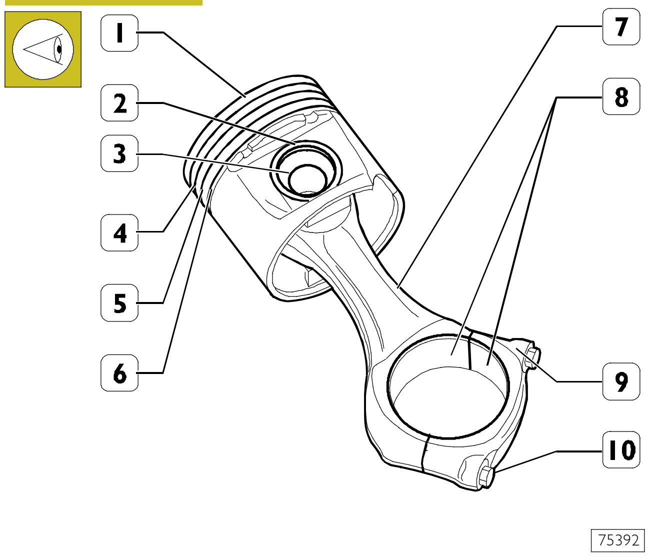
- ❑ Step 1: with a torque wrench, to a torque of 30 Nm.
- ❑ Step 2: closing to an angle of 90°.

NOTE Use tool 99395216 (1) for the angle closing.

Take off tool 99360351 (4).

5408 CONNECTING ROD – PISTON ASSEMBLY

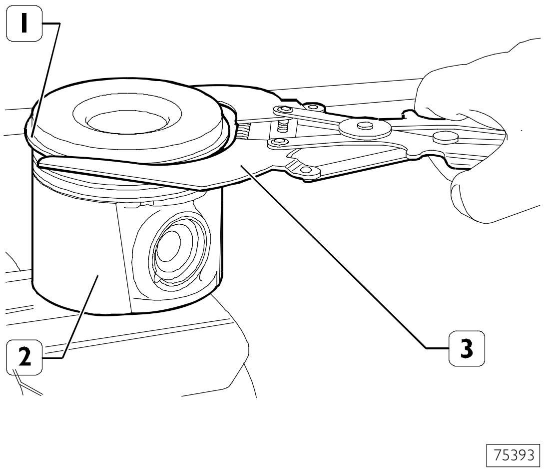
Figure 147



PISTON – CONNECTING ROD ASSEMBLY
1. Piston – 2. Piston ring – 3. Pin – 4. Trapezoidal ring – 5. Oil scraper ring – 6. Slotted oil scraper ring with spiral spring – 7. Connecting rod body – 8. Bearing shells – 9. Connecting rod cap – 10. Cap fixing screws.

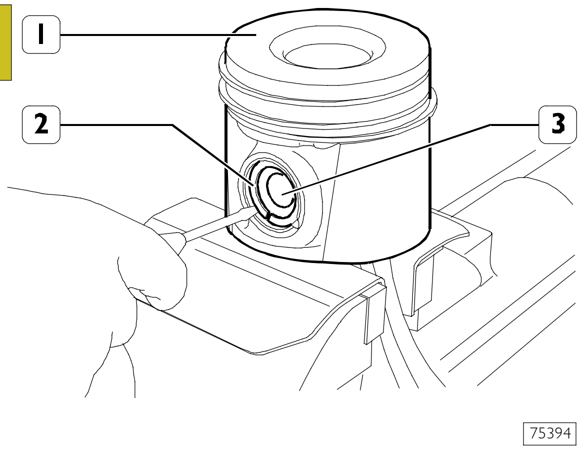
Check the pistons. They must show no signs of seizure, scoring, cracking or excessive wear; replace them if they do.

Figure 148



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

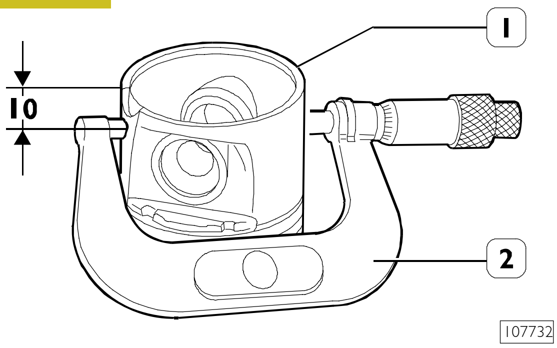
Figure 149



Remove the piston (1) from the connecting rod, taking out the piston ring (2) and extracting the pin (3).

540840 Piston
Measuring piston diameter

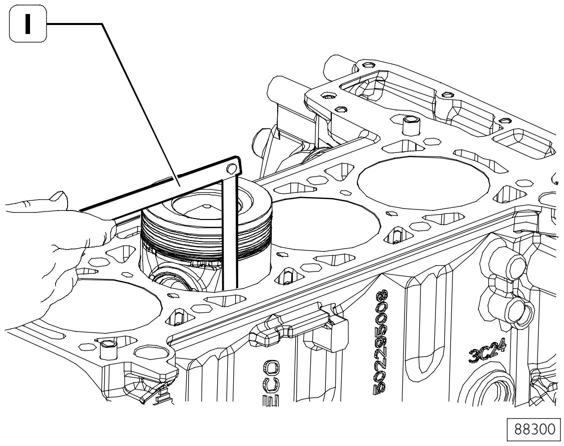
Figure 151



Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance. The diameter has to be measured at the value shown.

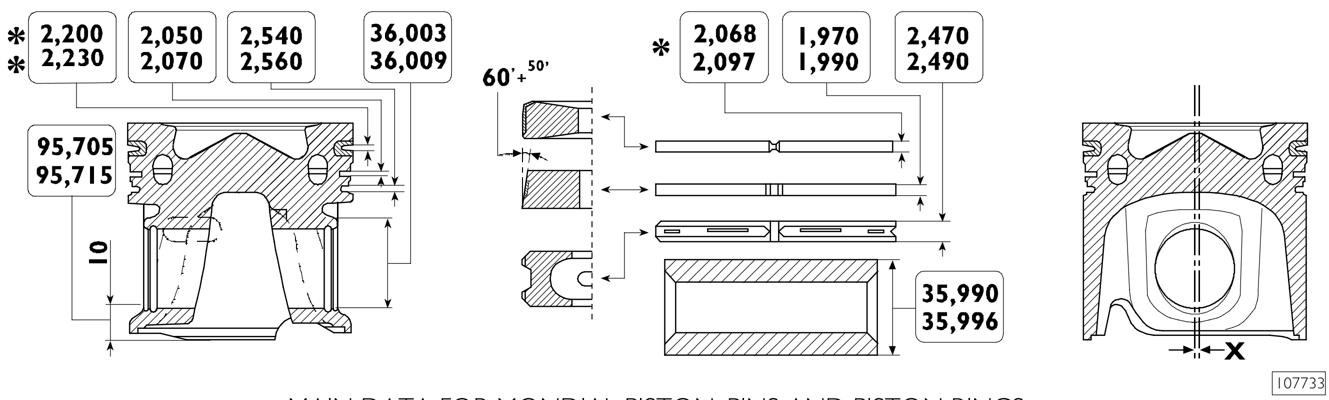
NOTE The pistons are supplied as spare parts with the standard, normal and 0.4mm oversize diameters together with rings, pin and retaining rings.

Figure 152



The clearance between the piston and cylinder liner can also be checked using a feeler gauge (1) as illustrated in the figure.

Figure 150

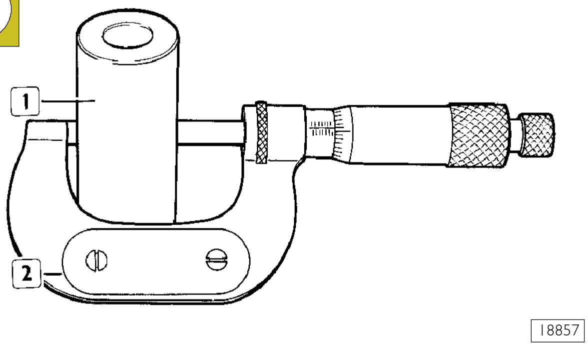


MAIN DATA FOR MONDIAL PISTON, PINS AND PISTON RINGS

* The value is measured at 1.5 mm from the outer diameter
** The value of the diameter measured is 91.4 mm
X = 0.5

540841 Piston pin

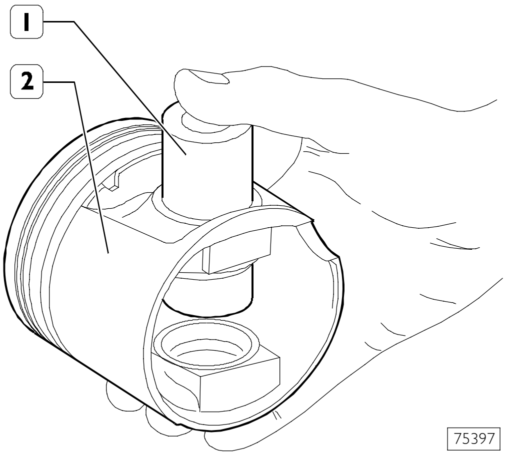
Figure 153



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

Conditions for correct pin-piston coupling

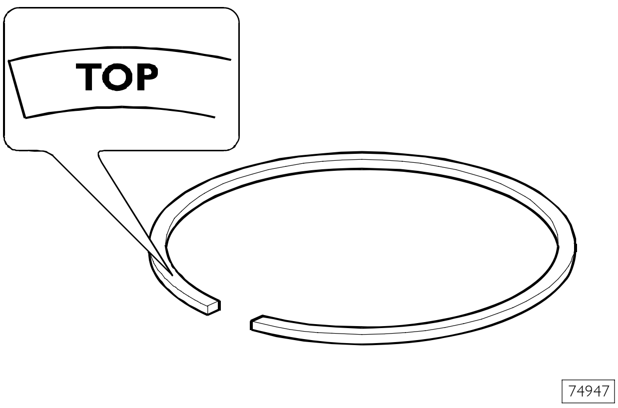
Figure 154



Lubricate the pin (1) and its seat on the hubs of the piston (2) with engine oil. The pin must go into the piston by lightly pressing with the fingers and must not drop out by gravity.

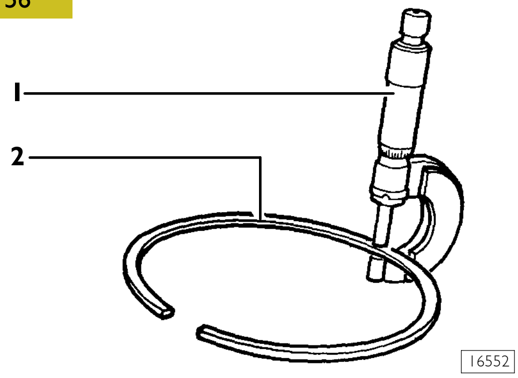
540842 Piston rings

Figure 155



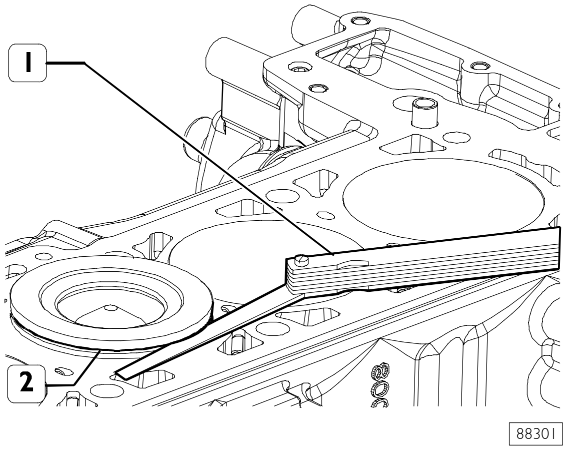
The trapezoidal split rings (1st slot) and the oil scraper rings (2nd slot) have the word TOP etched in them; when fitting them on the piston, the word TOP must be facing upwards.

Figure 156



Check the thickness of the piston rings (2) with a micrometer (1).

Figure 157



Check the clearance between the trapezoidal ring (2) (1st slot) and the associated slot on the piston with a feeler gauge (1), proceeding as follows: insert the piston into the cylinder liner so that the ring (2) comes approximately half way out of it.

Figure 158

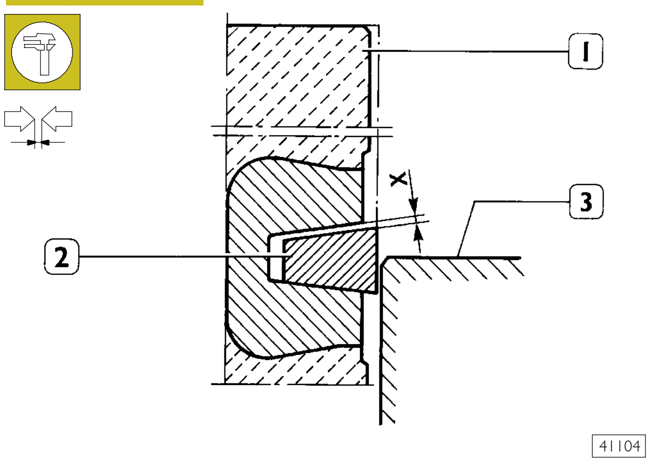
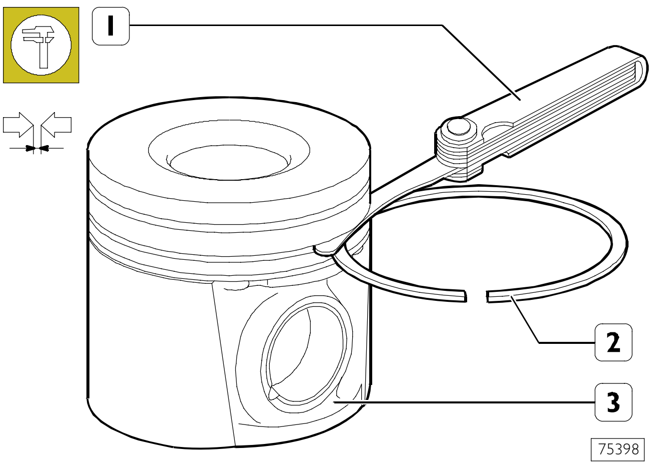


DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING
1. Piston slot – 2. Trapezoidal piston ring – 3. Cylinder liner

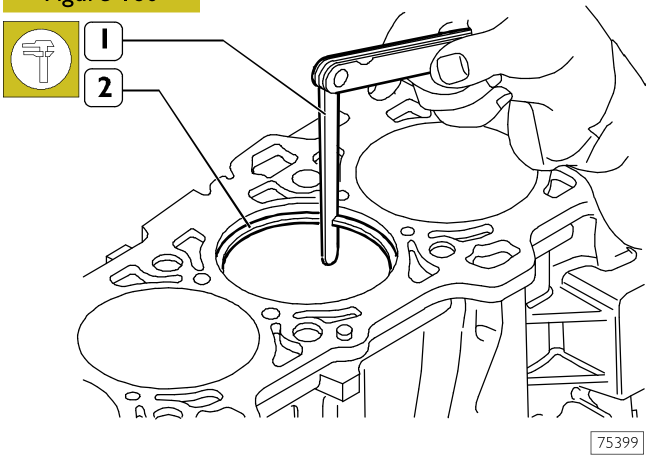
Using a feeler gauge (1, SENZA CODICE), check the clearance (X) between the ring (2) and the slot (1); this clearance must have the prescribed value.

Figure 159



Check the clearance between the piston rings (2) of the 2nd and 3rd slot and the associated seats on the piston (3) with a feeler gauge (1).

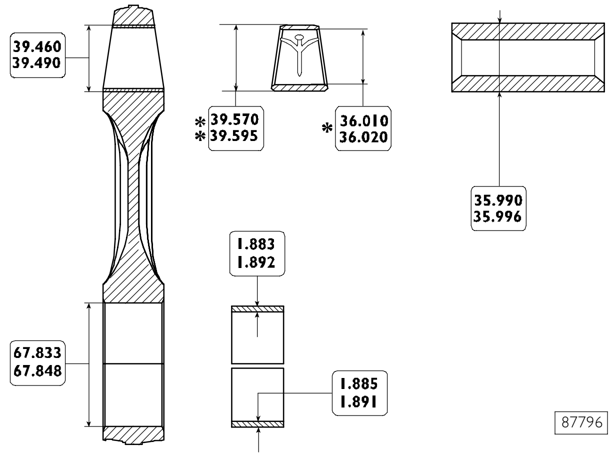
Figure 160



Check the opening between the ends of the piston rings (2) inserted in the cylinder liner using a feeler gauge (1).

540830 Connecting rods

Figure 161



MAIN DATA OF THE CONNECTING ROD, BUSHING, PISTON PIN AND BEARING SHELLS

* Internal diameter to obtain after driving into the small end and grinding with a reamer.

** Dimension cannot be measured in the free state.

*** Thickness of the bearing shell supplied as a spare part.

NOTE Each connecting rod has its cap marked:

- with a letter: O or X indicating the diameter class of the big end mounted in production;
- with a number indicating the weight class of the connecting rod mounted in production.

In addition, it could be stamped with the number of the cylinder in which it is fitted.

In the event of replacement it is therefore necessary to number the new connecting rod with the same number as the one replaced.

The numbering must be done on the opposite side to the bearing shell retaining slots.

The connecting rods are supplied as spare parts with the diameter of the big end 67.833 – 67.848 mm marked with the letter O and the weight class marked with the number 33.

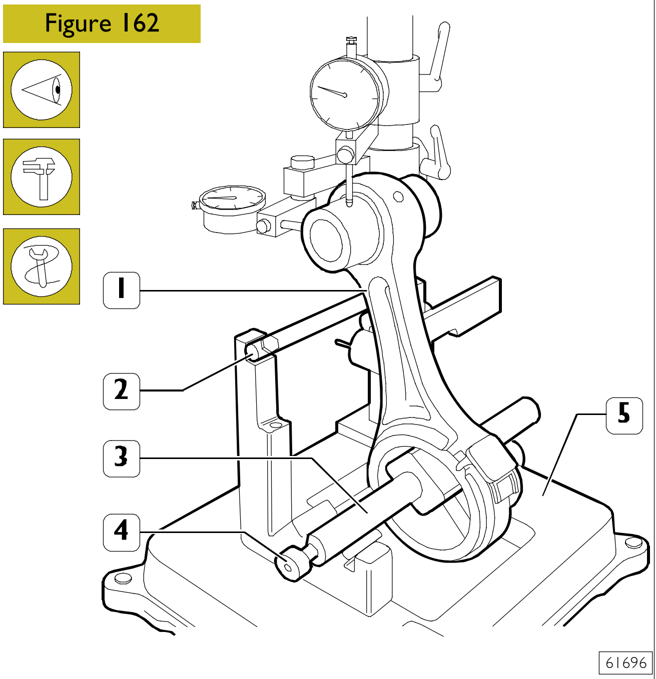
It is not permissible to remove material.

540834 Bushing

Check that the bush in the small end has not come loose and shows no sign of seizure or scoring. If it does, replace the complete connecting rod.

Checking connecting rods

Figure 162

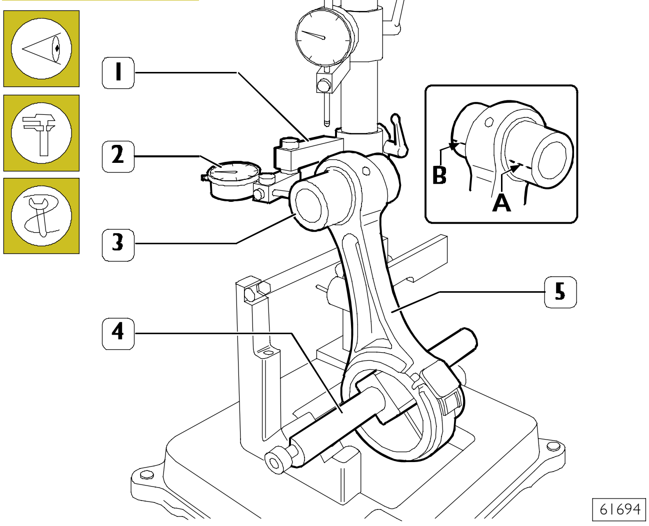


Check the alignment of the axes of the connecting rods (1) with device 99395363 (5), proceeding as follows:

- Fit the connecting rod (1) on the spindle of the tool 99395363 (5) and lock it with the screw (4).
- Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

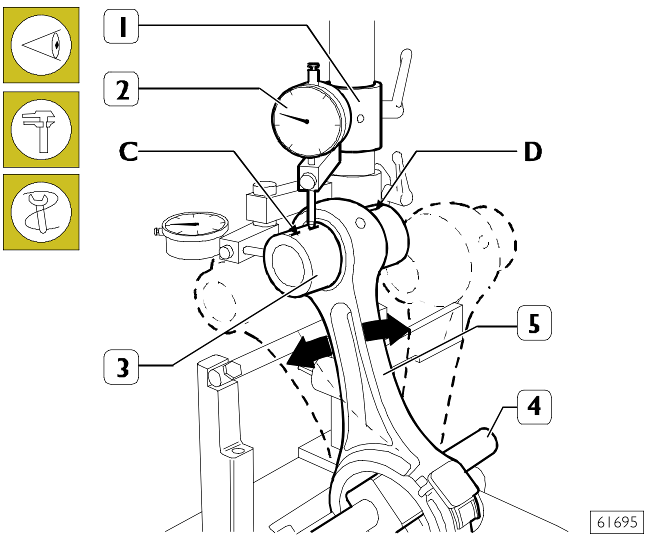
Figure 163



Check the torsion of the connecting rod (5) by comparing two points (**A** and **B**) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point A and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side B of the pin (3): the difference between A and B must be no greater than 0.08 mm.

Checking bending

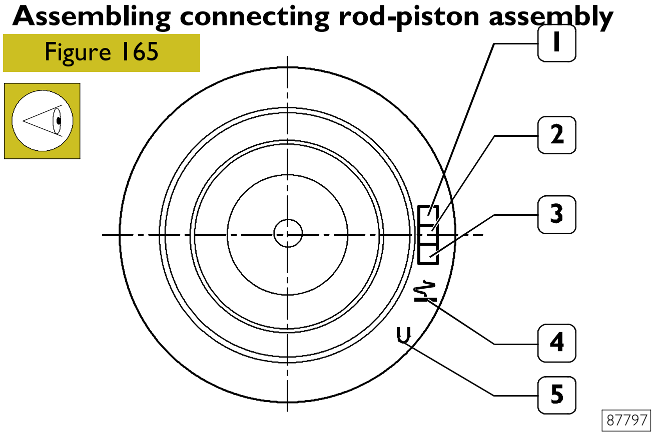
Figure 164



Check the bending of the connecting rod (5) by comparing two points C and D of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point C.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2).
Shift the spindle with the connecting rod (5) and repeat the check on the highest point on the opposite side D of the pin (3). The difference between point C and point D must be no greater than 0.08 mm.

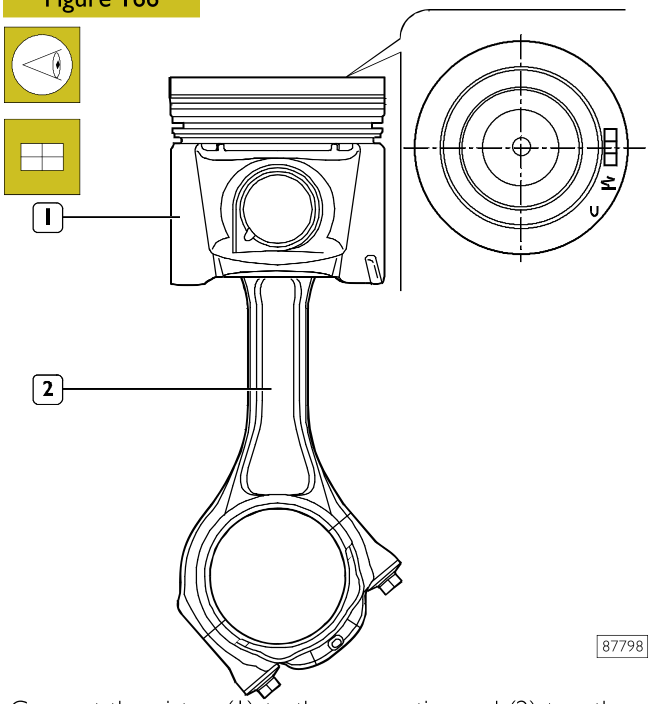
Assembling connecting rod-piston assembly

Figure 165



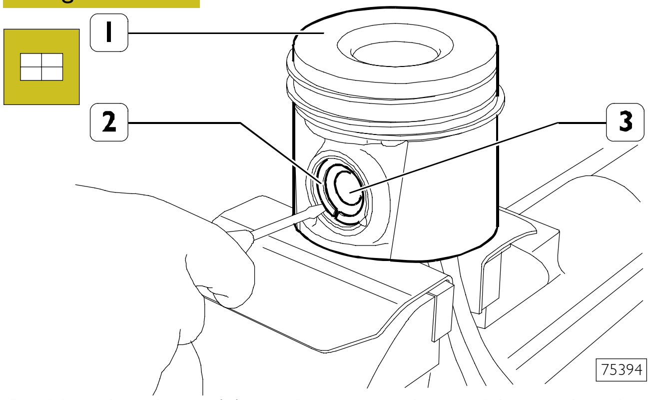
Etched on the top of the piston are: the type of engine (1), class selection (2) and supplier (3) as well as the direction of fitting the piston in the cylinder liner (4). The mark (5) is for passing the 1st slot insert adhesion test.

Figure 166



Connect the piston (1) to the connecting rod (2) together with its cap so that the piston assembly reference, position of the connecting rod and of the cap are observed as shown in the figure.

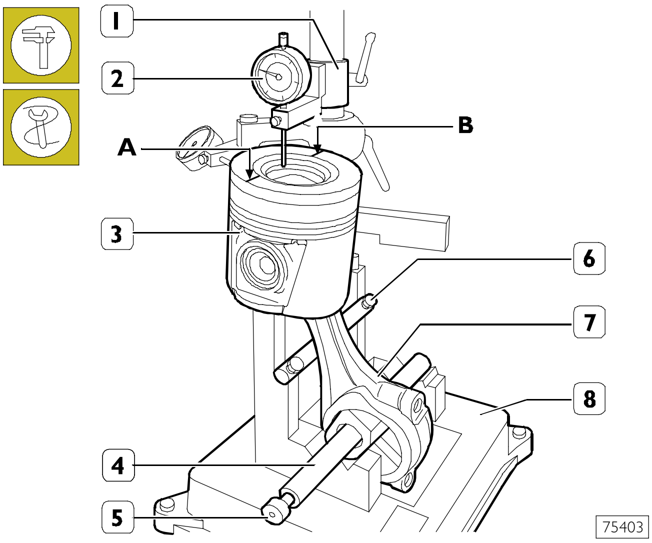
Figure 167



Position the piston (1) on the connecting rod, insert the pin (3) and secure it with the split rings (2).

Checking for connecting rod – piston distortion

Figure 168

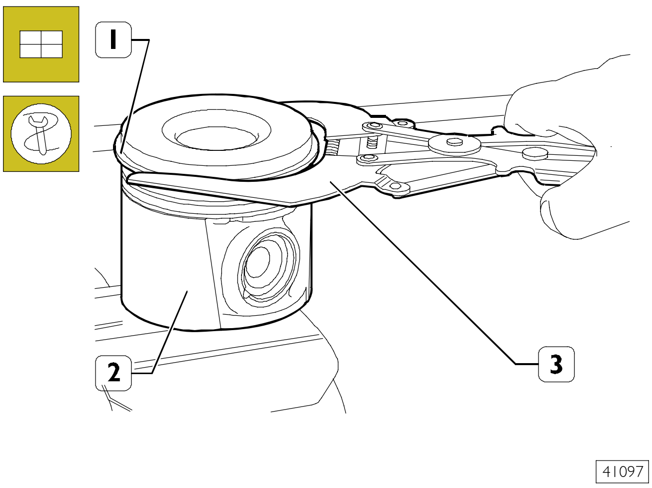


After fitting the connecting rod – piston assembly together, check for distortion with the tool 99395363 (8) as follows:

- Fit the connecting rod (7) together with the piston (3) on the spindle (4) of tool 99395363 (8) and lock it with the screw (5).
- Rest the connecting rod (7) on the bar (6).
- Position the mount (1) of the dial gauge (2) so that this is positioned at point A of the piston with a pre-load of 0.5 mm and zero the dial gauge (2).
- Shift the spindle (4) so as to position the dial gauge (2) at point B of the piston (3) and check for any deviation.

Assembly piston rings

Figure 169

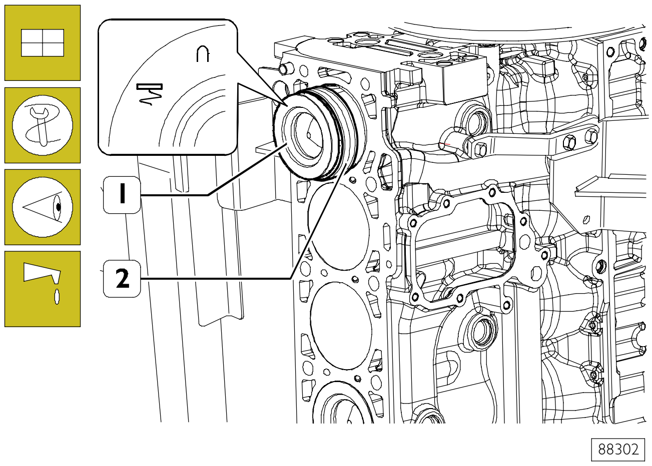


Fit the piston rings (1) on the piston (2) using the pliers 99360183 (3).

NOTE The 1st and 2nd slot rings need to be mounted with the word "TOP" facing upwards.

Assembly connection rod-piston assembly in the cylinder liner

Figure 170



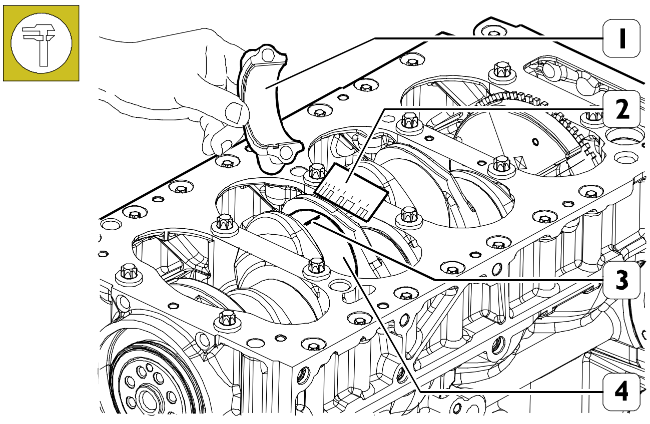
Lubricate the pistons well, including the piston rings and the inside of the cylinder liners.
With the aid of the clamp 99360605 (2), fit the connecting rod – piston assembly (1) in the cylinder liners, checking that:

- The number of each connecting rod corresponds to the cap mating number.
- The openings of the piston rings are staggered 120° apart.
- The pistons are all of the same weight.
- The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil spray nozzles.

NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position found on disassembly.

540831 Measuring crankpin assembly clearance

Figure 171



To measure the clearance, carry out the following steps:

- Thoroughly clean parts (1) and (4) and eliminate all traces of oil.
- Place a length of calibrated wire (3) on the crankshaft pins (4).

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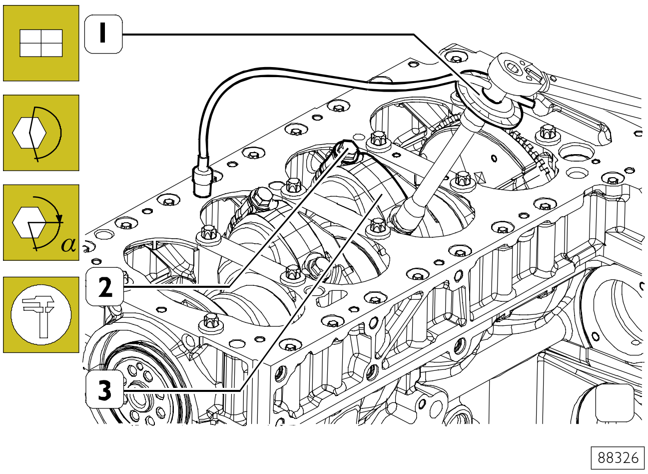
Figure 172



- ❑ Fit the connecting rod caps (3) with the associated bearing shells.
- ❑ Tighten the screws (2) in two steps:
  - Step 1: with a torque wrench, to a torque of 50 Nm.
  - Step 2: closing to an angle of 70°.

NOTE Use tool 99395216 (1) for the angle closing.

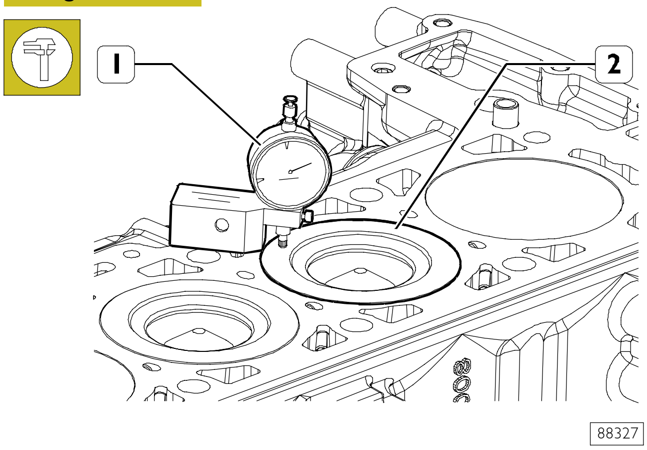
- ❑ Remove the cap (3) and determine the existing clearance by comparing the width of the calibrated wire (3, Figure 171) with the graduated scale on the case (2, Figure 171) that contained the calibrated wire. On finding a clearance other than as prescribed, replace the bearing shells and repeat the check.
  On obtaining the prescribed clearance, lubricate the connecting rod bearing shells and fit them permanently by tightening the connecting rod cap fixing screws as described.

NOTE The connecting rod cap fixing screws must always be replaced for permanent assembly.

Manually check that the connecting rods slide axially on the pins of the crankshaft.

Checking piston protrusion

Figure 173

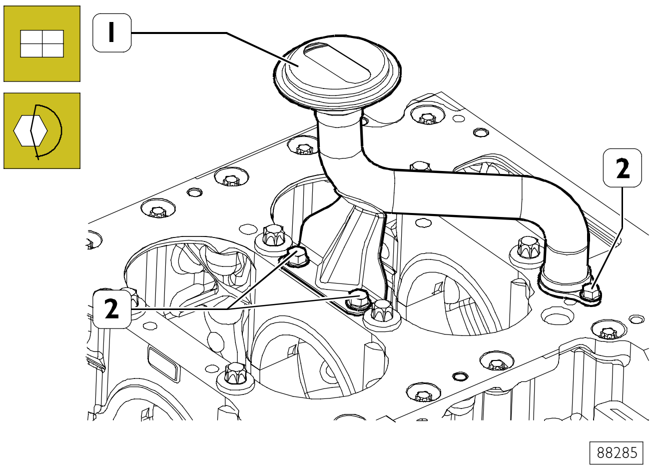


At the end of the connecting rod-piston assembly refitting, check the piston protrusion (2) at the T.D.C. compared to the top level of the cylinder block by means of a dial gauge (1) and relevant base 99370415.

NOTE The difference between the minimum and maximum protrusions of the four pistons must be = 0.15 mm.

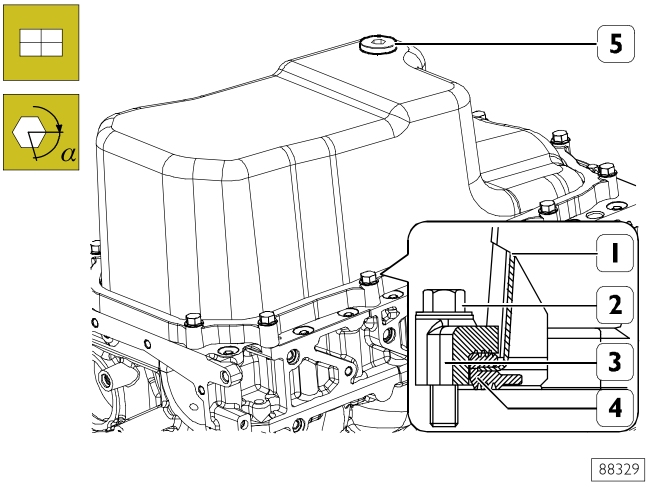
The cylinder head gasket in the set of spare gaskets needed for complete engine overhaul is supplied with a single thickness. Clearly, it is supplied separately too.

Figure 174



Mount the suction strainer (1) together with the pipe. Screw down the fixing screws (2) and tighten them to the prescribed torque.

Figure 175

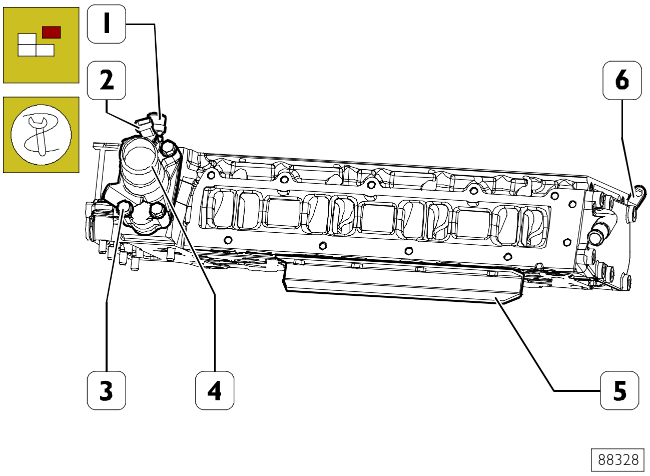


Fit the gasket (4) and the frame (3) onto the oil sump (1).
Screw down the fixing screws (2) and tighten them to the prescribed torque.
Screw down the oil drain plug (5) and tighten it to the prescribed torque.

560610 CYLINDER HEADS

Disassembly

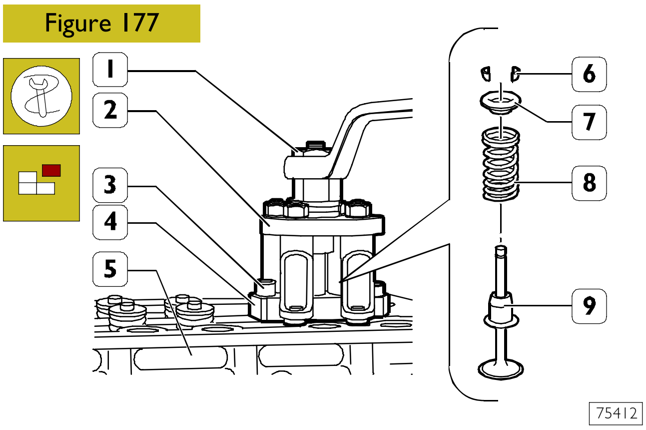
Figure 176



Apply the support SP. 2271 (5) on the cylinder head and tighten the support in a vice.
Remove the brackets (6) for lifting the engine.
Remove the sensors (1 and 2), if needed.
Take out the screws (3) and remove the thermostat casing (4).

541210 Disassembly the camshaft

Figure 177



Fit part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

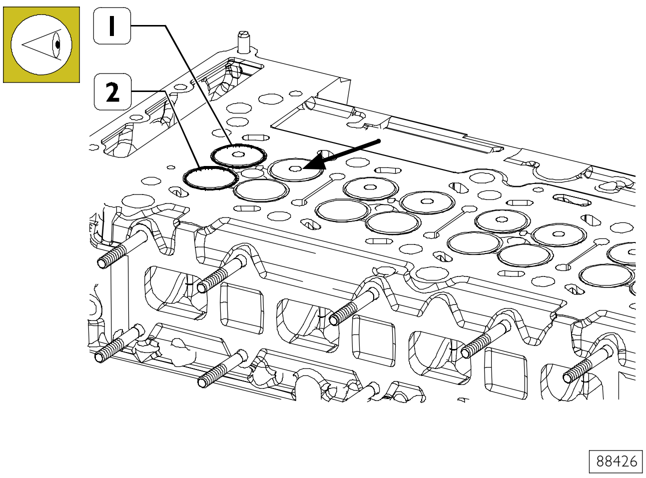
Fit part (2) of tool 99360260 onto part (4), screw down the nut (1) so that on compressing the springs (8) it is possible to remove the cotters (6). Then take out the plates (7) and the springs (8).

Using suitable pliers, remove the oil seal (9).

Repeat these operations on the remaining valves.

Turn the cylinder head over.

Figure 178



The intake (1) and exhaust (2) valves have the same diameter mushroom.

The central cavity (→) of the mushroom of the intake valve (1) is distinguished from that of the exhaust valve (2).

NOTE Before removing the valves from the cylinder heads, number the valves in order to refit them correctly if they are not changed.

A = intake side – S = exhaust side

Remove the intake (1) and exhaust (2) valves.

Checking cylinder head seal

Check the hydraulic seal using a suitable tool.
Pump in water heated to approx. 90°C at a pressure of 2 ÷ 3 bars.

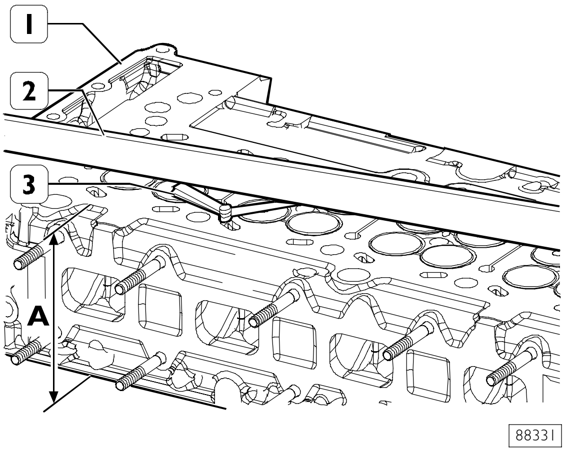
Replace the cup plugs if they are found to leak at oil, using a suitable drift for their removal – assembly.

NOTE Prior to fitting the caps into place, apply Loctite 270 water-reactive sealant (IVECO NO. 93162429) to the cap sealing surface.

If there is any leakage from the cylinder head, it must be replaced.

Checking cylinder head mating surface

Figure 179



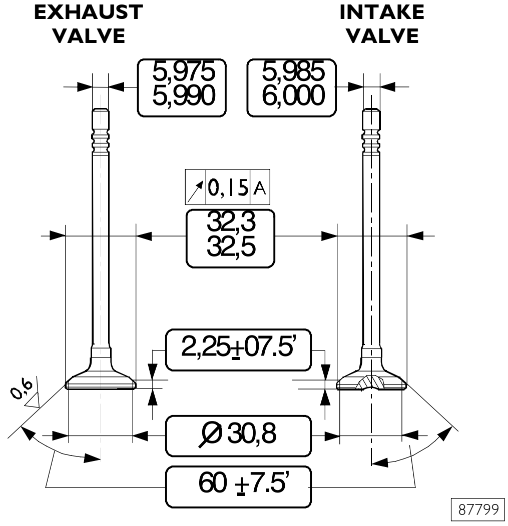
The mating surface of the head (1) with the cylinder block is checked using a rule (2) and a feeler gauge (3).
The deformation found on the entire length of the cylinder head must be no greater than 0.20 mm.
For greater values, regrind the cylinder head according to the values and instructions given in the following figure.

The nominal thickness A of the cylinder head is 112 ±0.1 mm; the maximum permissible removal of metal must not exceed a thickness of 0.2 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to make the prescribed valve recessing.

540662 VALVES

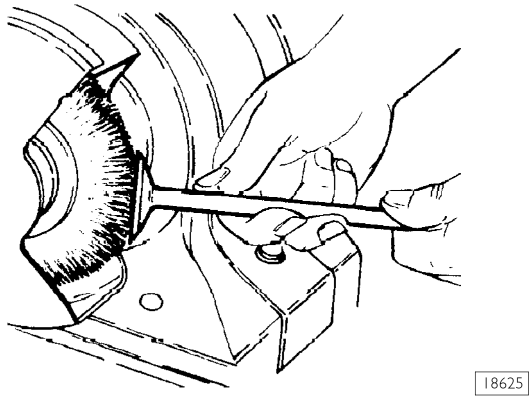
Figure 180



MAIN DATA OF INTAKE AND EXHAUST VALVES

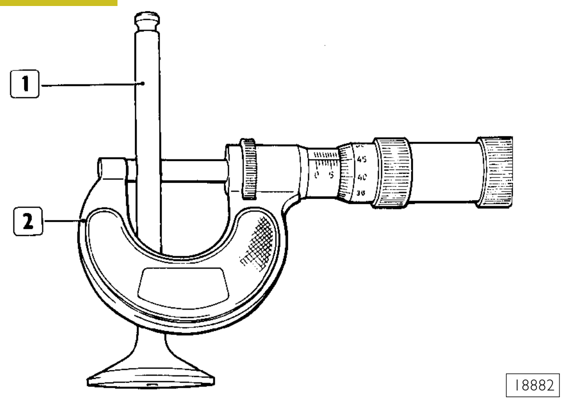
Removing deposits, refacing and checking valves

Figure 181



Remove the carbon deposits on the valves with a wire brush.
Check that the valves show no signs of seizure, cracking or burning.

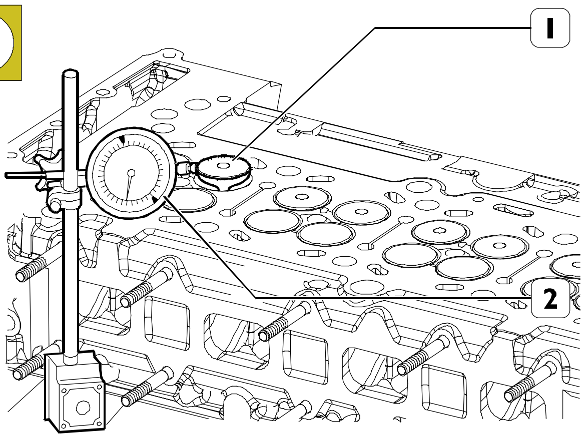
Figure 182



Use a micrometer (2) to measure the valve stem (1): it must have the value shown in Figure 132. If necessary, grind the valve seats by means of the grinding machine 99305018, and remove as little material as possible.

Checking clearance between valve stem and valve guide and centring valves

Figure 183



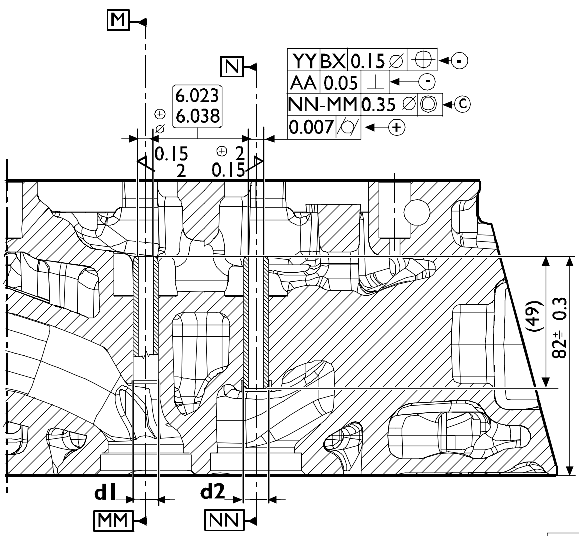
88332

The checks are made using a dial gauge (2) with a magnetic base, positioned as illustrated. The assembly clearance is 0.033 – 0.063 mm.

Making the valve (1) turn, check that the centring error is no greater than 0.03 mm.

540667 VALVE GUIDE
Replacing valve guide

Figure 184



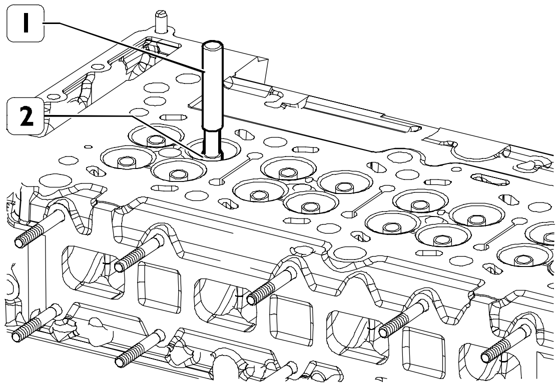
87800

MAIN DATA OF VALVE GUIDES – SEATS

Valve guide seat inside Ø	9.980 ÷ 10.000 mm
Valve guide outside Ø	10.028 ÷ 10.039 mm

* Measurement to be made after driving in the valve guides.

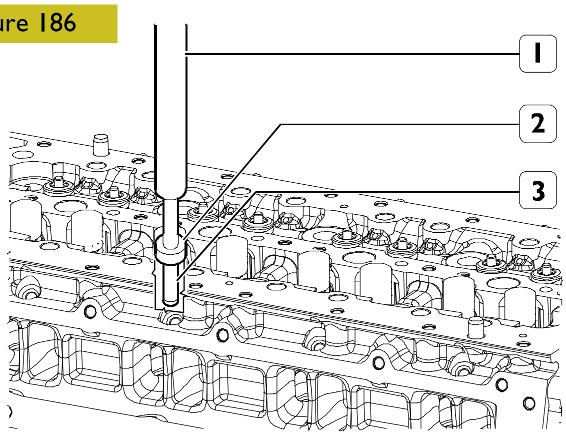
Figure 185



88333

Remove the valve guides (2) with the drift SP.2312 (1).

Figure 186



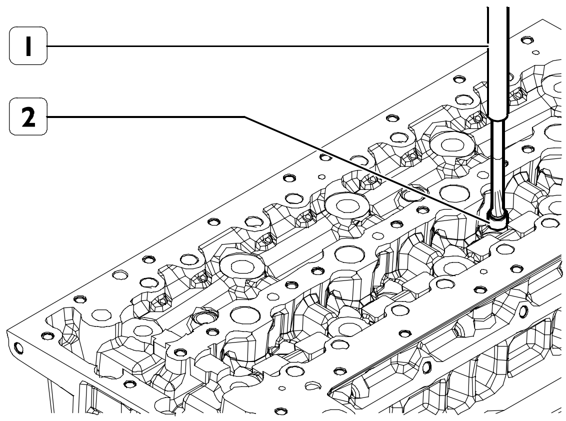
88334

Warm up the cylinder head to 80° ÷ 100°C and, by means of beater SP.2312 (1) fitted with element SP.2311 (2), fit the new valve guides (3) previously lubricated with engine oil. Driving force 10 ÷ 25 KN.

If the above mentioned tools are not available, fit the valve guides by positioning them in the cylinder head according to the value shown in SENZA CODICE.

Boring valve guides

Figure 187



88335

After driving in the valve guides (2), regrind them with the smoother SP.2310 (1).

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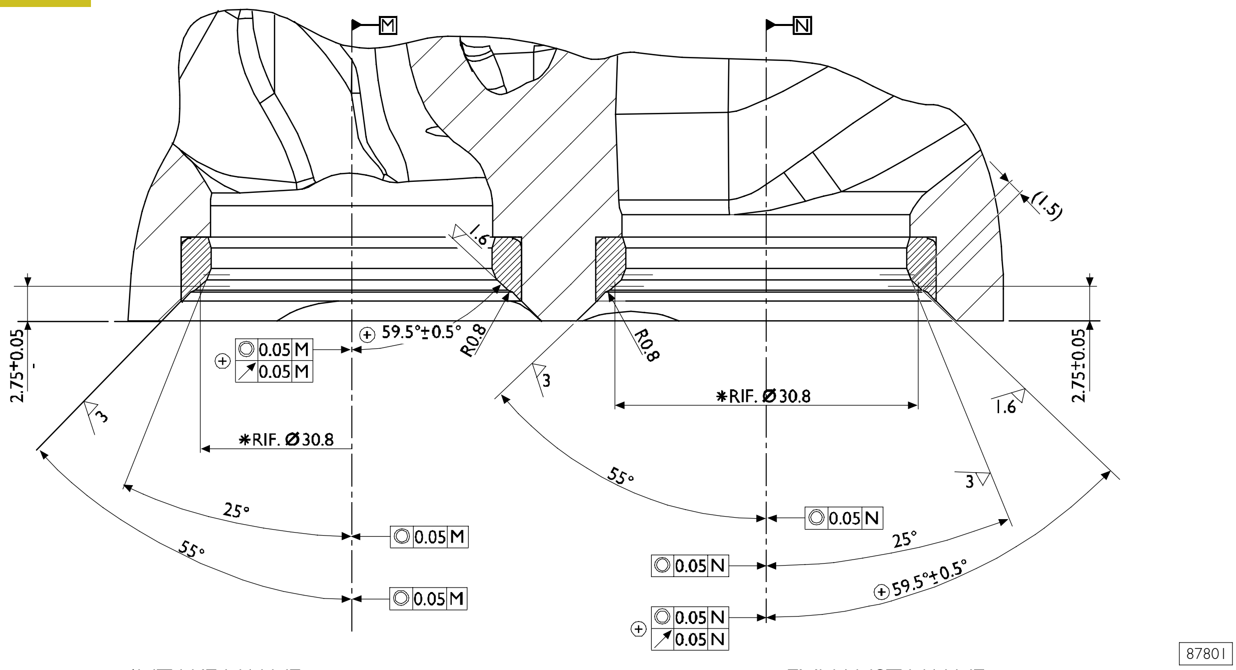
540661 VALVE SEATS

Recutting and replacing valve seats

Figure 188



INTAKE VALVE EXHAUST VALVE

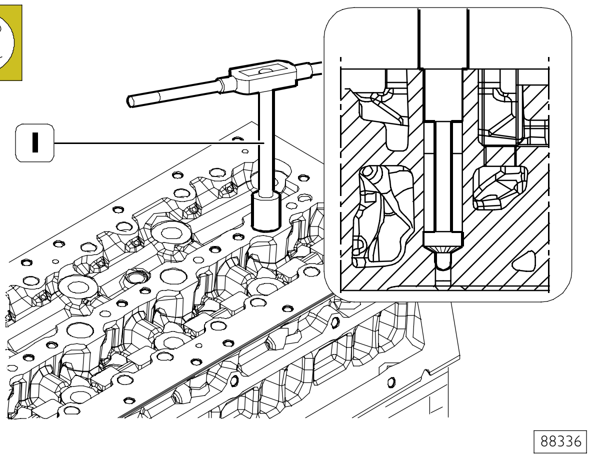
Check the valve seats. On finding any slight scoring or burns, regrind them with an appropriate tool according to the angles given in Figure 188.

Having to replace them, with the same tool and taking care not to affect the cylinder head, remove as much material from the valve seats as possible until, with a punch, it is possible to extract them from the cylinder head.

Heat the cylinder head to 80 ÷ 100°C and, using a suitable drift, fit in it the new valve seats, previously chilled in liquid nitrogen.

Using a specific tool, regrind the valve seats according to the angles given in Figure 188.

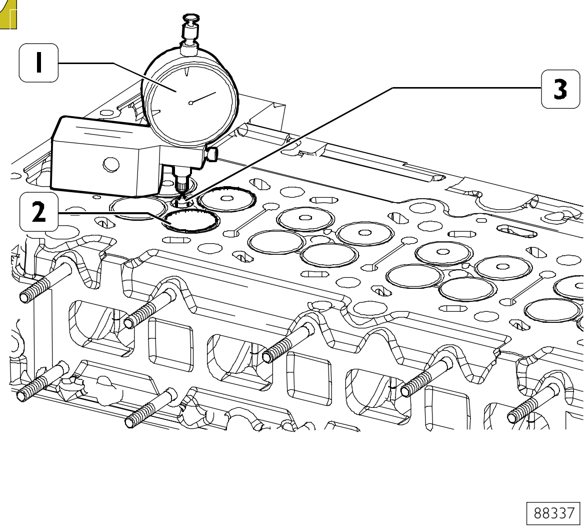
Figure 189



Using the milling cutter 99394038 (1), clean the injector seat of any deposits.

Mount the valves, block the seat of the electro-injectors and glow plugs; using a suitable tool, check the seal of the valves/seats.

Figure 190

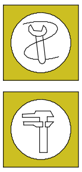


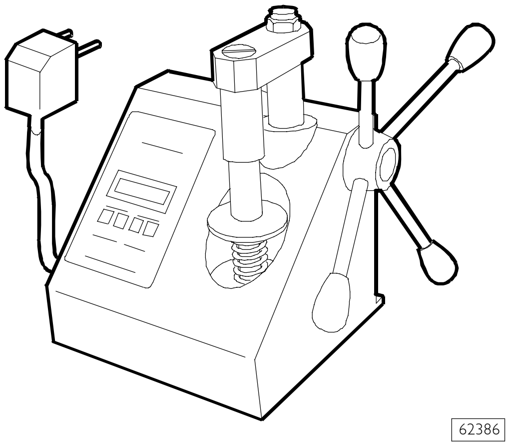
Using a dial gauge (1), check that, from the plane of the cylinder head, the valve recessing (2) and the protrusion of the injector (3) and of the glow plug have the prescribed value:

- Valve recessing: 0.375 ÷ 0.525 mm.
- Injector protrusion: 2.77 ÷ 3.23 mm.
- Glow plug protrusion: 3.78 mm.

540665 VALVE SPRINGS

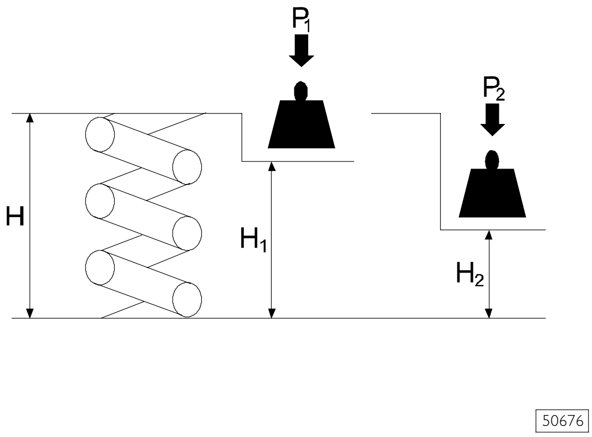
Figure 191





Before assembly, check the flexibility of the valve springs with the tool 99305047. Compare the load and elastic deformation data with those of the new springs given in the following figures.

Figure 192

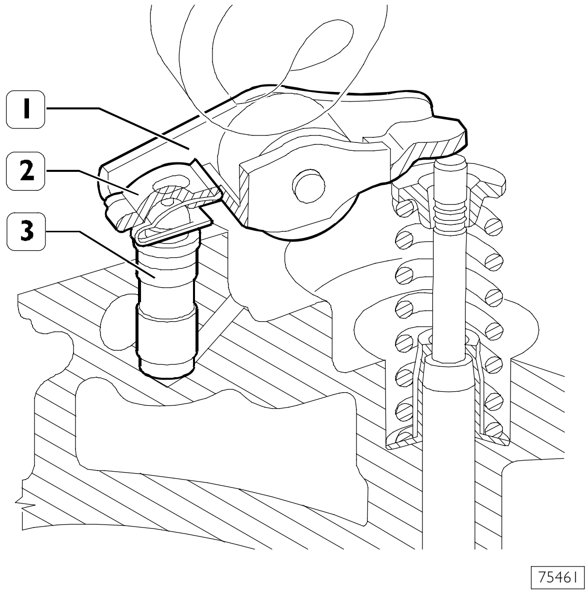


MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Height	Under a load of
mm	kg
H 54	Free
H1 45	P 243 ±12
H2 35	P1 533 ±24

ROCKER ARMS – TAPPETS

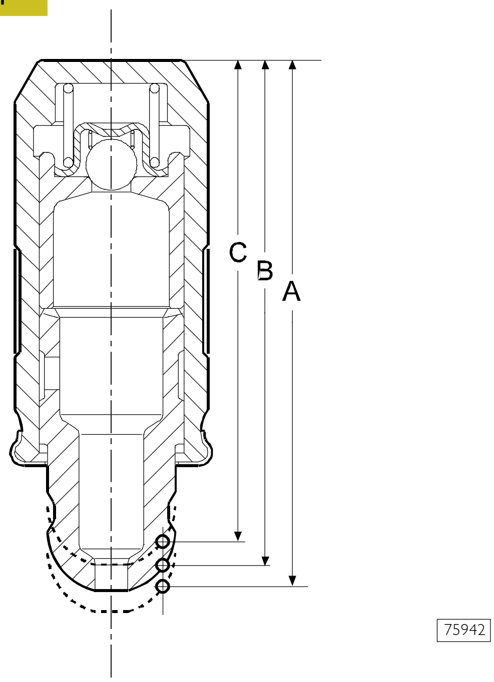
Figure 193



COMPLETE ROCKER ARM ASSEMBLY

The rocker arm assembly is composed of the rocker arm (1), hydraulic tappet (3), made integral with each other by the clip (2).

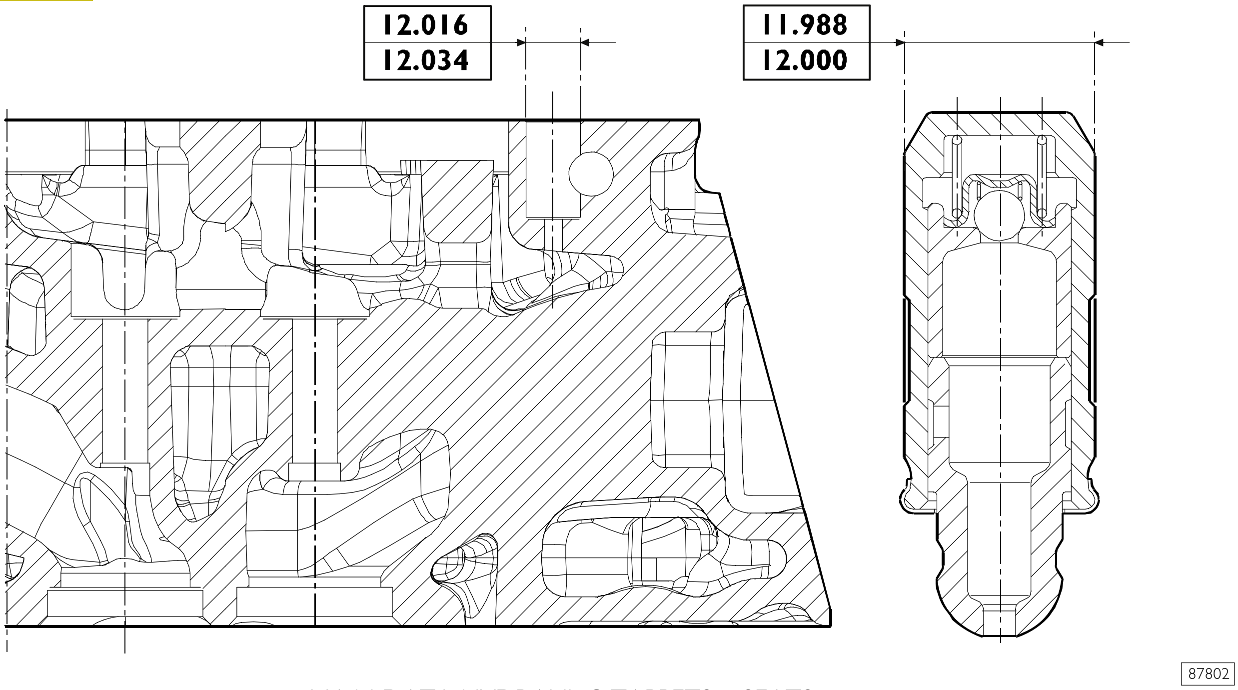
Figure 194



CROSS-SECTION OF THE HYDRAULIC TAPPET

A = 32.44 ±0.3, end of stroke
B = 31.30, working position
C = 29.75 ±0.25, start of stroke

Figure 195



MAIN DATA HYDRAULIC TAPPETS – SEATS

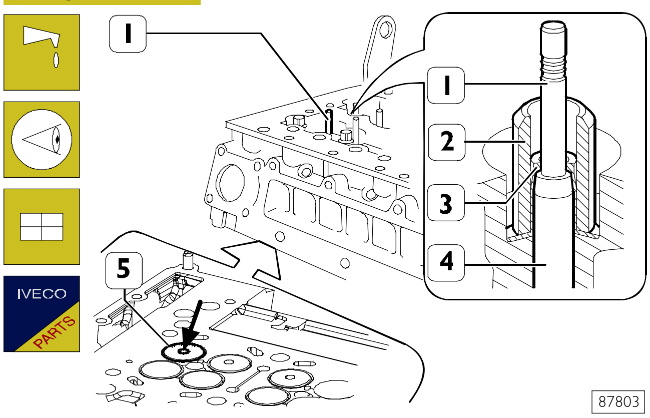
Checks

The sliding surface of the tappets must have no scoring/dents; replace them if they do.

Using a micrometer, measure the diameter of the tappets and, using a bore meter, measure the diameter of the seats in the cylinder head; the difference in the measurements will give the assembly clearance.

ASSEMBLING CYLINDER HEADS

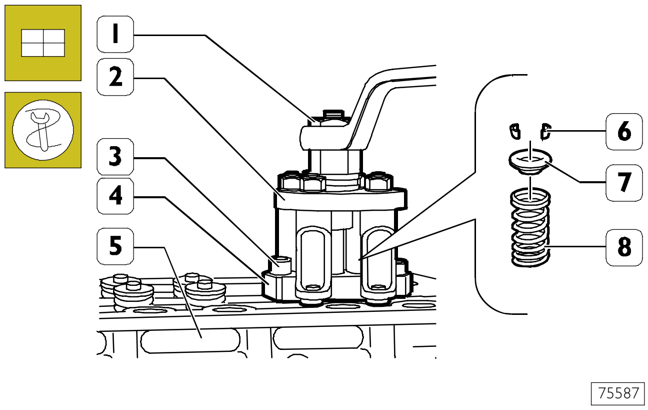
Figure 196



Lubricate the stem of the valves (1) and insert them into the associated valve guides (4) according to the position marked during removal. Using tool SP.2264 (2), mount the oil seals (3) on the valve guides (4).

NOTE The suction valves (5) are different from the exhaust ones for a slot (→) in the centre of the valve head.

Figure 197



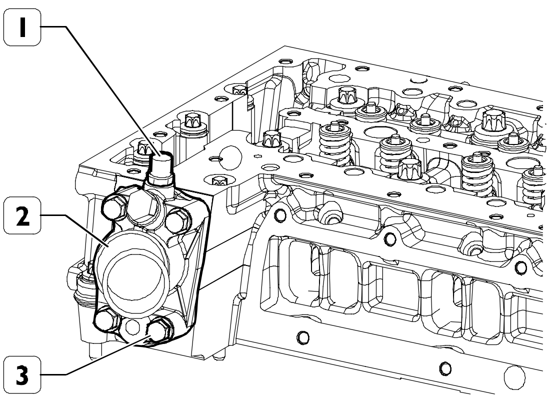
Position the springs (8) and plates (7) on the cylinder head (5).

Fit the part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

Fit the part (2) of tool 99360260 onto part (4), screw down the nut (1) so that by compressing the springs (8) it is possible to insert the retaining cotters (6); then unscrew the nut (1) checking that the cotters (6) have settled in correctly.

Repeat these operations on the remaining valves.

Figure 198



108441

Fit the thermostat casing (2) with a new seal and tighten the fixing screws (3) to the prescribed torque.

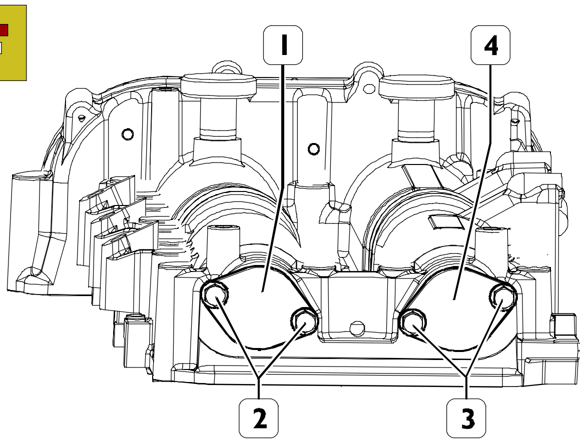
Fit the temperature sensors (1) and tighten them to the prescribed torque.

Fit the brackets for lifting the engine and tighten the fixing screws to the prescribed torque.

540650 Overhead

Overhead removal

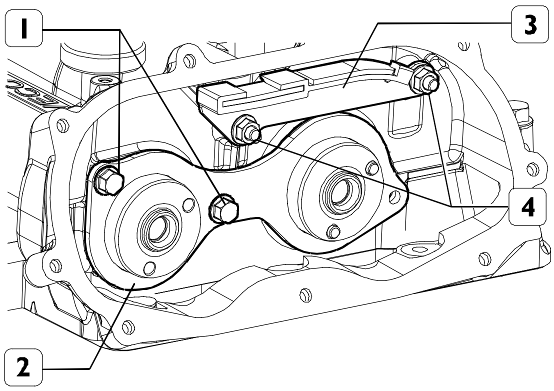
Figure 199



88339

Remove the screws (2 and 3) and the covers (1 and 4) together with the over-head seal rings.

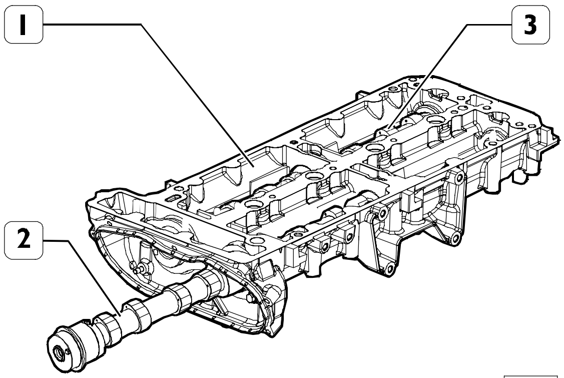
Figure 200



88340

Remove the nuts (4) and the top skid (3).
Remove the screws (1) and the shoulder plate (2).

Figure 201

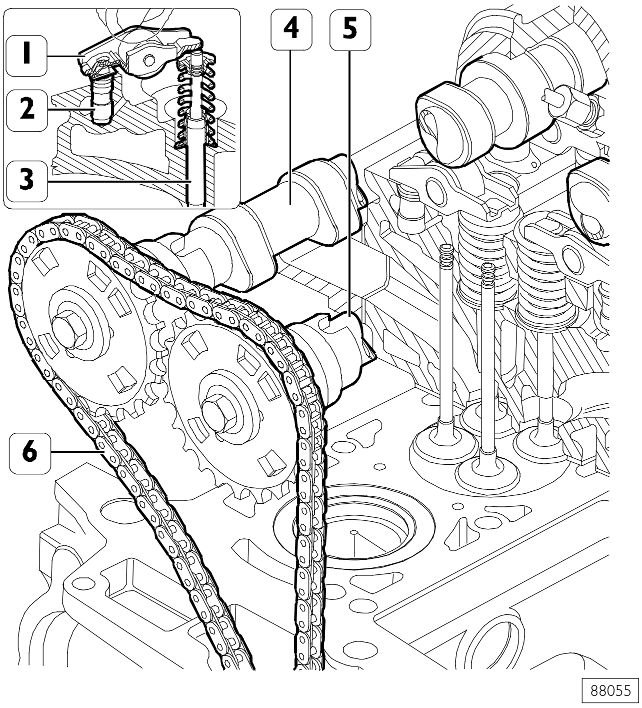


88341

Tilt the over-head (1) and take care not to damage the seats, then take off the camshafts (2 and 3) from the overhead.

5412 TIMING SYSTEM

Figure 202



1. Rocker arm - 2. Reaction hydraulic tappet - 3. Valve assembly - 4. Camshaft on exhaust side - 5. Camshaft on suction side - 6. Camshaft control chain.

Description

The timing system is the type with a twin camshaft in the head and four valves per cylinder with hydraulic tappets.

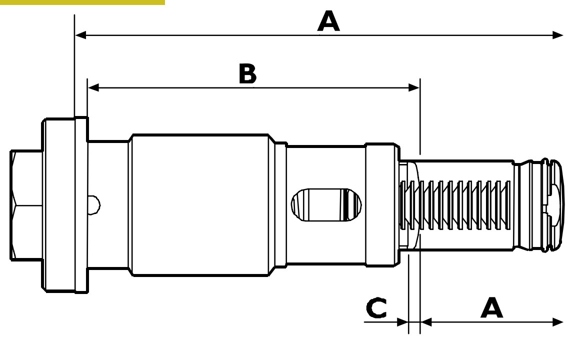
The control is transmitted by two chains:

- a double chain by 3/8" is set in motion by the driving shaft and sets the control shafts in motion: oil pump/depressor – high pressure pump;
- a single chain is set in motion by the high pressure control shaft gear and sets the camshafts in motion.

The camshaft gears are mutually interchangeable and are fitted with slots to make it possible for the phase sensor to detect the phase.

The rocker arms, one for the valve, are kept in contact with the corresponding cam by an hydraulic tappet, thus eliminating the need for regular adjustments.

Figure 203

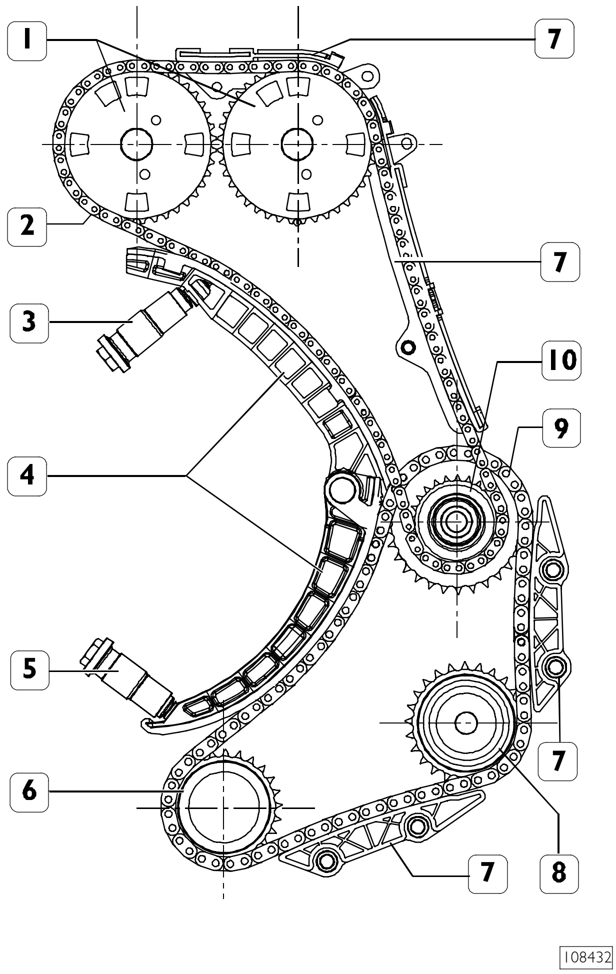


HYDRAULIC BELT STRETCHER WITH ANTI-RETURN DEVICE

A = Max. range: 76.9 ± 0.4 mm
B = Piston engaged: 53.6 mm
C = Min. travel for piston disengagement: 2.3 mm
D = Working travel: 24.5 mm

NOTE Both chains shall be replaced, even though the anomaly affects only one chain: in this case, gears (8-10), pads (7) and belt stretchers (3 and 5) shall also be replaced (see figure 204).
Hydraulic belt stretcher (5) with anti-return device shall be replaced every time it is disassembled. In fact the belt stretcher cannot be assembled back into place after the piston has come off the hydraulic belt stretcher housing.

Figure 204



TIMING SYSTEM AND AUXILIARY SYSTEM DIAGRAM

1. Camshaft control gear - 2. Single chain - 3. Hydraulic chain stretcher with anti-return device - 4. Chain - 5. Hydraulic belt stretcher - 6. Drive gear on driving shaft - 7. Fixed skid - 8. Oil pump/depressor control shaft gear – Hydraulic power steering pump - 9. Double chain - 10. High pressure pump control shaft gear.

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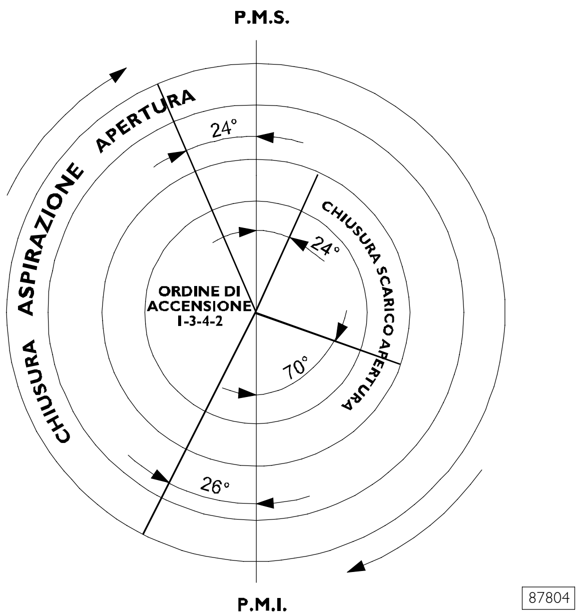
Figure 205



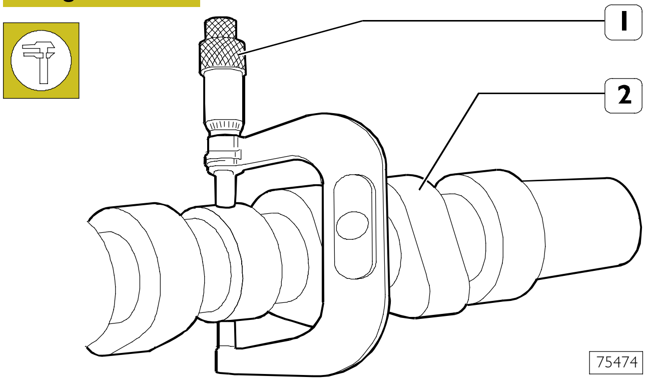
TIMING SYSTEM DIAGRAM

541210 Camshaft

Checks

The surfaces of the shaft supporting pins and of the cams must be finely honed; if there is any sign of meshing or scoring, replace the shaft.

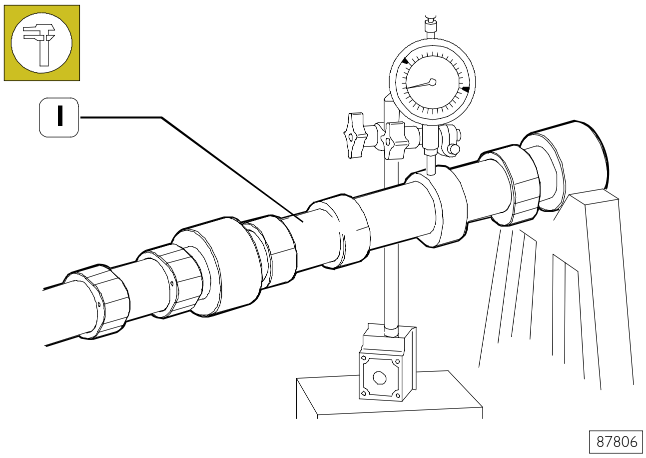
Figure 206



Using a micrometer (1), measure the diameter of the pins (2) of the camshaft and, using a bore meter, measure the diameter of the supporting seats in the overhead.
The difference between these two measurements gives the existing clearance.
The nominal assembly clearance is 0.037 ÷ 0.088 mm.

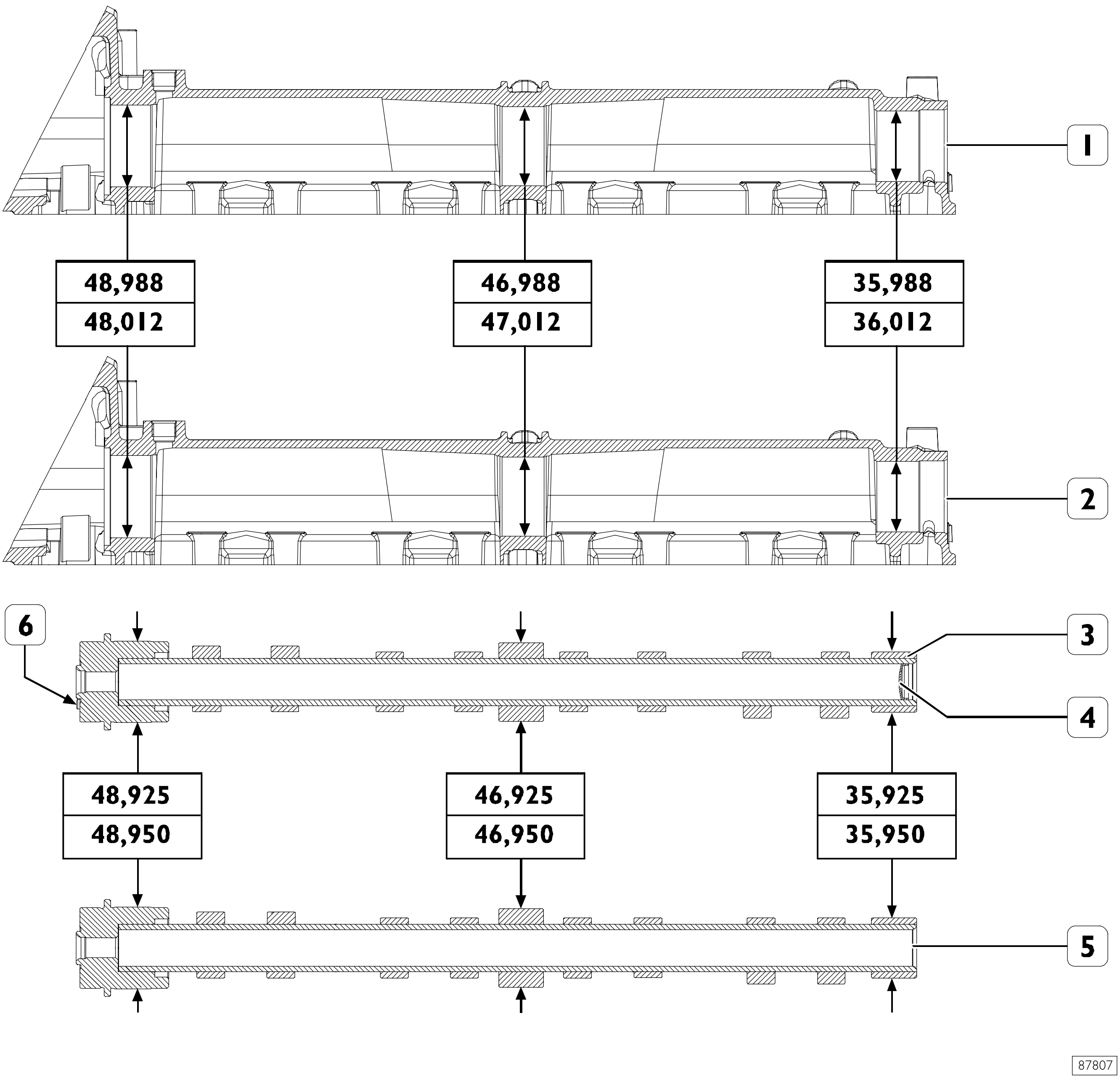
541211 Checking cam lift and pin alignment

Figure 207



Place the shaft (1) on the parallels and use a centesimal dial gauge fitted on the central support to check that the alignment error does not exceed 0.04 mm; otherwise, change the shaft. Check also the cam lift: it must correspond to the prescribed value; if different values are detected, change the shaft.

Figure 208



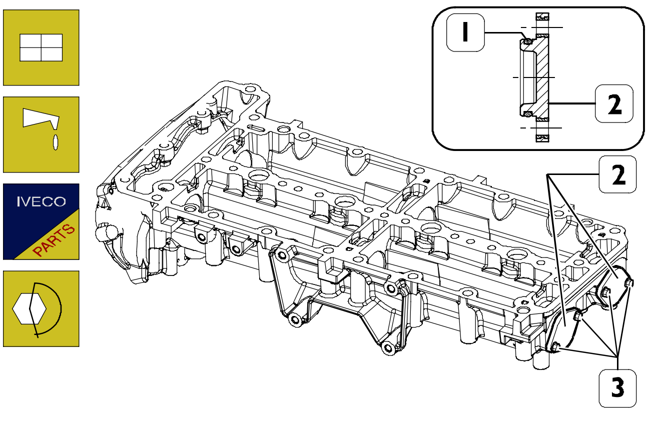
MAIN DATA, CAMSHAFT PINS AND SEATS

1. Intake valve camshaft seats – 2. Exhaust valve camshaft seats – 3. Intake valve camshaft – 4. Exhaust valve camshaft.

NOTE The camshaft (3) of the suction valves can be recognised through the spring cup (4) and the dowel (6).

Assembling overhead

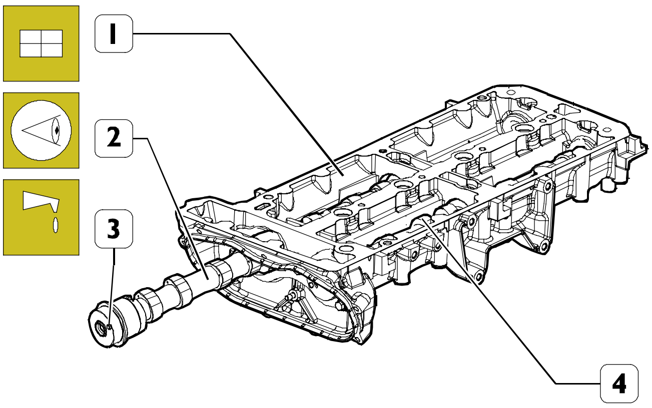
Figure 209



88343

Lubricate the new seal rings (1) with engine oil and fit them on the covers (2).
Fit the covers (2) on the overhead, drive in the fastening screws (3) and tighten them to the prescribed torque.

Figure 210

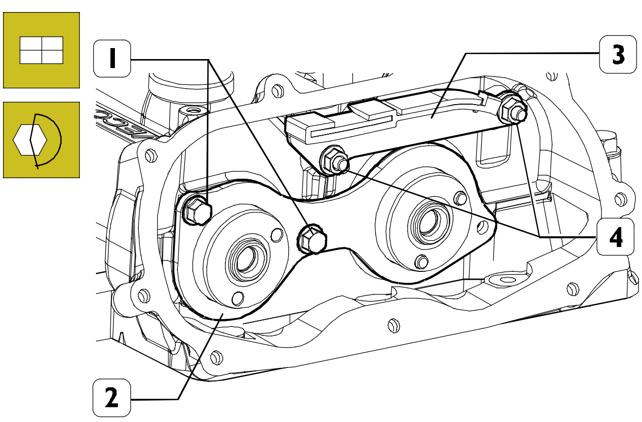


88344

Lubricate the support pins of the suction camshafts (2) and exhaust camshafts (4) and fit them on the overhead (1).

NOTE During this operation do not exchange the assembly position of the shafts.
The suction camshaft can be recognised (2) through the dowel (3) on the front side and the retainer on the rear side.
In addition, take care not to damage the support seats of the over-head shafts.

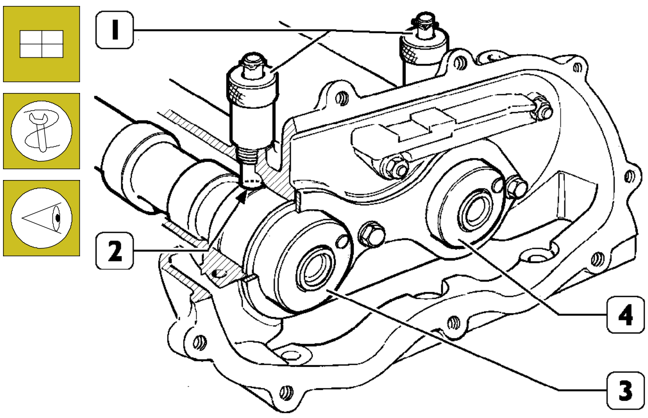
Figure 211



88340

Fit the top skid (3) and drive in the nuts (4), then tighten them to the prescribed torque.
Fit the shoulder plate (2) and drive in the screws (1), then tighten them to the prescribed torque.

Figure 212

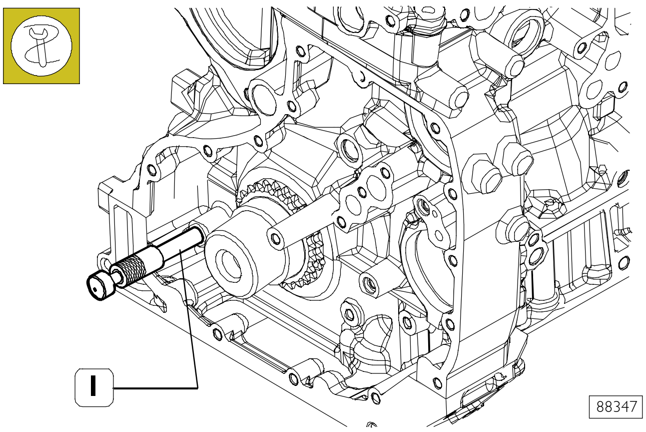


88346

Position the camshafts (3 and 4) so that the pins 99360614 (1) can be inserted in the camshaft slots (2) through the over-head threaded holes.

AUXILIARY ORGAN CONTROLS

Figure 213



88347

Rotate the driving shaft so that the tool 99360615 (1) can be inserted in the shaft crank hole through the cylinder block hole, in order to stop the engine in the timing system setting condition.

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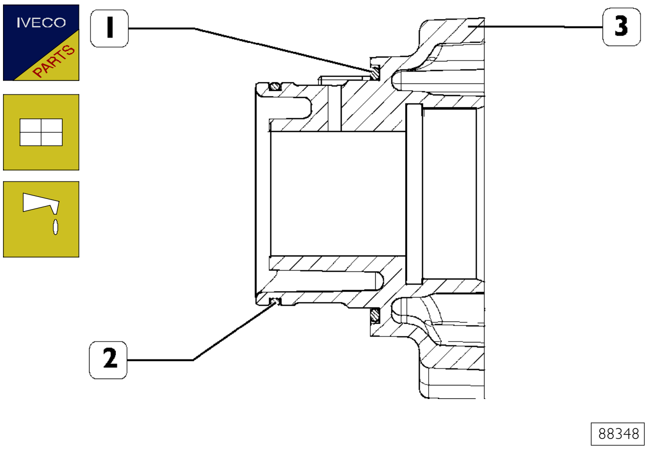
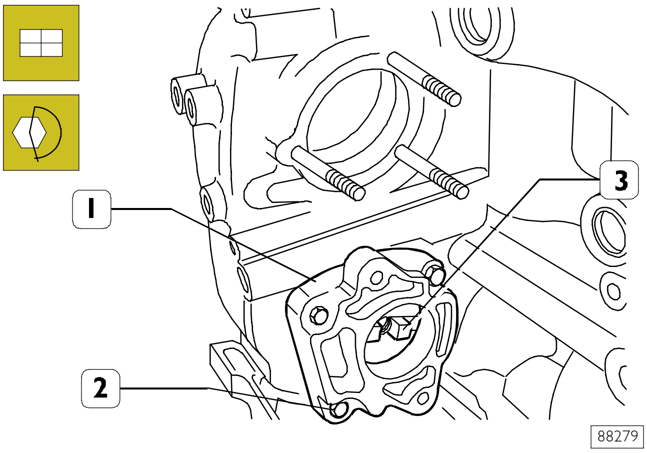
Figure 214



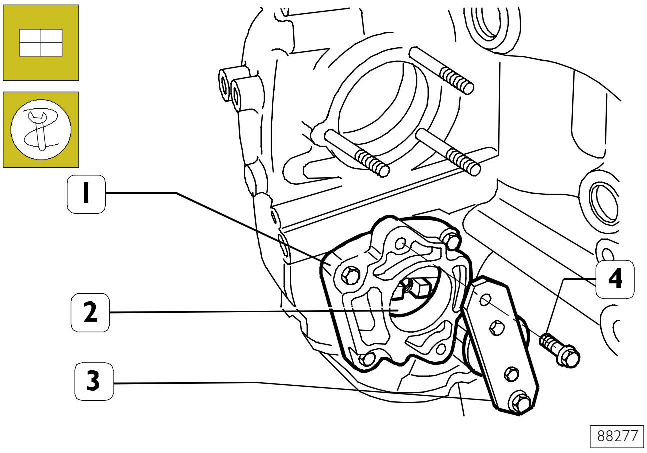
Lubricate the seal rings (1 and 2) with engine oil and fit them on the support (3).

Figure 215



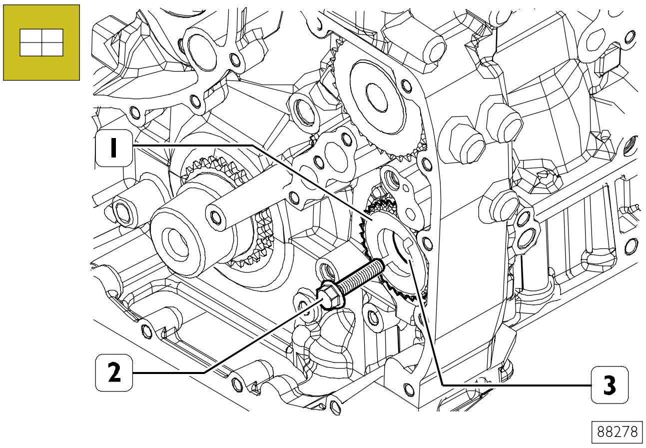
Fit the support (1) and drive in the nuts (2), then tighten them to the prescribed torque.
Fit the stem (3).

Figure 216



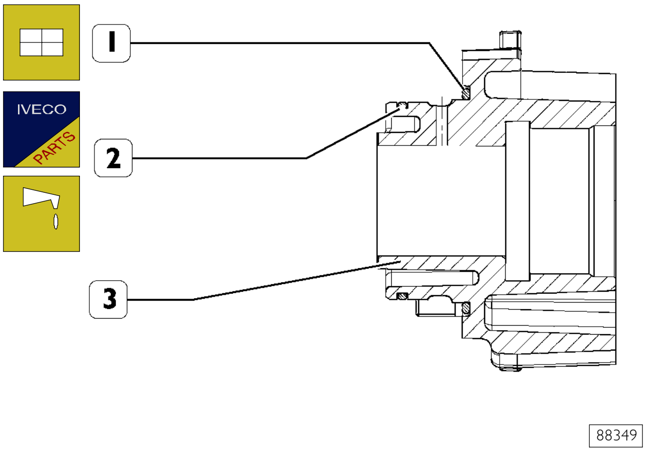
Stop the stem rotation (2) of the hydraulic power steering pump by inserting in the latter the tool (3) and fastening the tool on the support (1) by means of the screws (4).

Figure 217



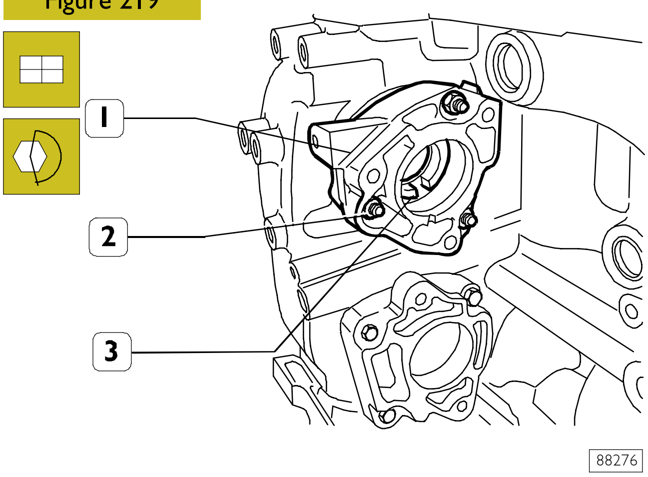
Fit the gear (1) on the stem (3) of the hydraulic power steering pump.
Drive in the screw (2) without locking it.

Figure 218



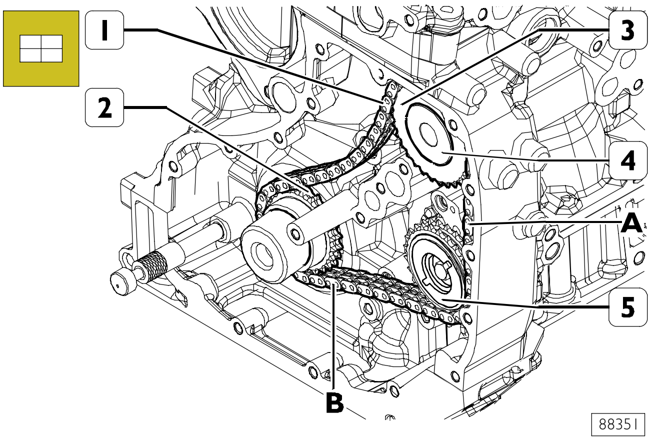
Lubricate the new seal rings (1 and 2) with engine oil and fit them on the support (3).

Figure 219



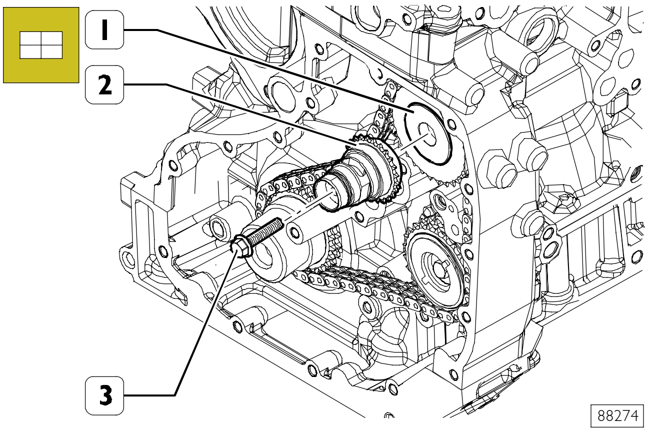
Fit the support (1), drive in the nuts (2) and tighten them to the prescribed torque.
Fit the control stem (3) of the high pressure pump.

Figure 220



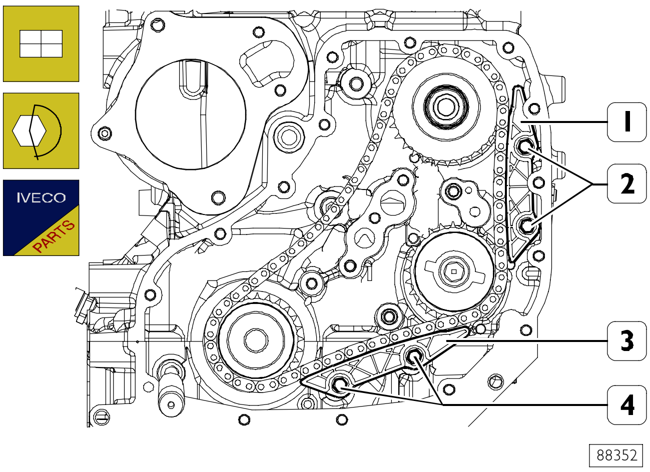
Position the chain (1) on the gears (2, 3 and 5) and fit the gear (3) on the stem (4) so that the chain (1) in tracts A and B is tensioned.

Figure 221



Fit the stem with the drive gear (2) on the high pressure pump control stem (1).
Drive in the fastening screw (3).

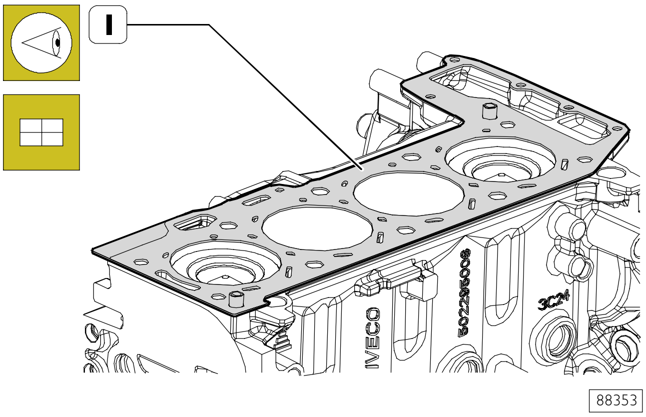
Figure 222



Check the conditions of the fixed skids (1 and 3) and change them if worn out.
Fit the skid (1) and drive in the fastening screws (2), then tighten them to the prescribed torque.
Fit the skid (3) and drive in the fastening screws (4), then tighten them to the prescribed torque.

Cynder head refitting

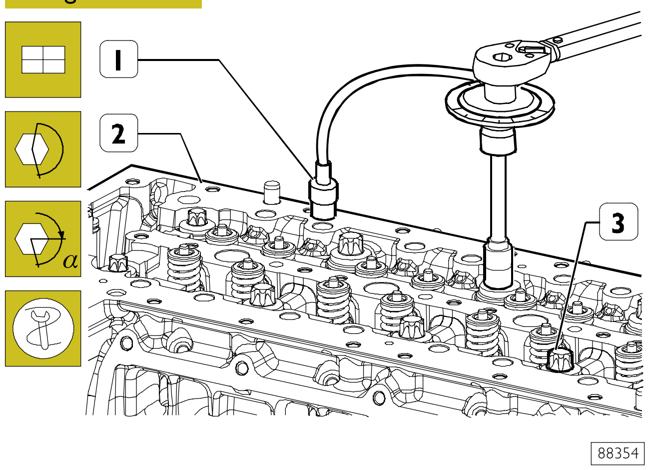
Figure 223



Check that the mating surfaces of the cylinder head and crankcase are clean.
Keep the cylinder head gasket clean.
Place the gasket (1) of the cylinder head with the thickness given in section "Check piston protrusion", with the "TOP" sign facing the head.

NOTE It is essential to keep the gasket sealed in its package until just before assembly.

Figure 224



Mount the cylinder head (2).

Screw down the fixing screws (3) and tighten them, in three successive stages, following the order and methods shown in the following figure.

NOTE The angle closure is done with tool 99395216 (1).

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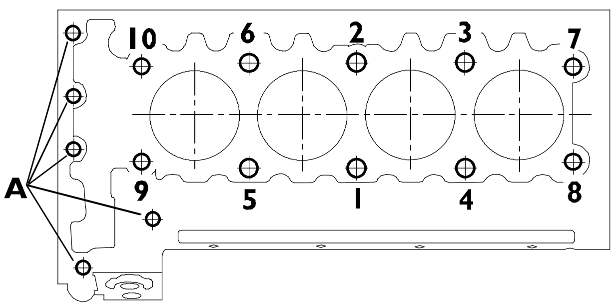
Figure 225

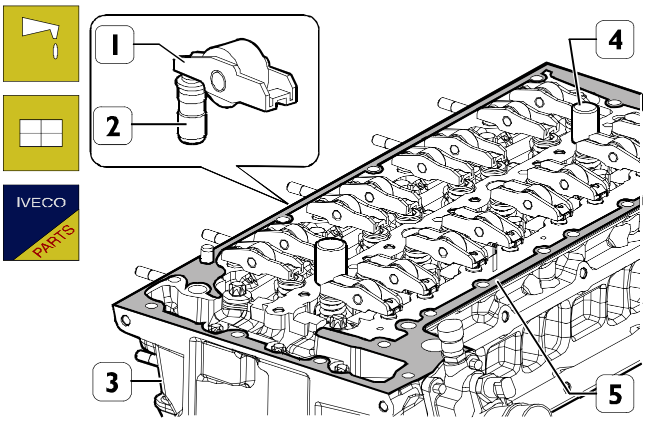


88355

Diagram of the tightening sequence for the cylinder head fixing screws:

- ❑ 1st phase: pre-tightening with torque wrench
  - screws 1-2-3-4-5-6 to a torque of 130 Nm;
  - screws 7-8-9-10 to a torque of 65 Nm.
- ❑ 2nd phase: angle closing
  - screws 1-2-3-4-5-6 90°;
  - screws 7-8-9-10 90°.
- ❑ 3rd phase: angle closing
  - screws 1-2-3-4-5-6 90°;
  - screws 7-8-9-10 60°.
- ❑ Screws A, to a torque of 25 Nm

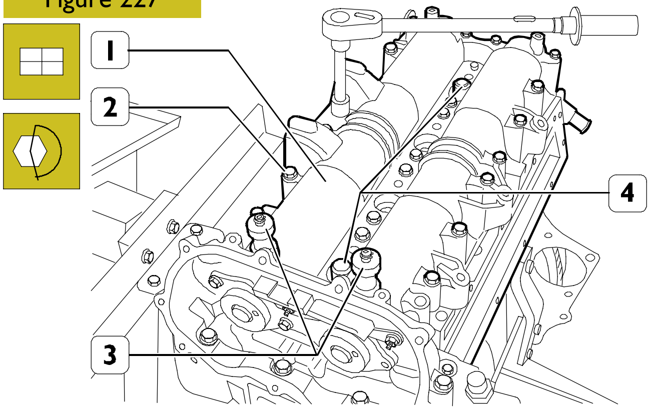
Figure 226



88356

Thoroughly clean the hydraulic tappets (2), lubricate them and fit them in the cylinder head (3), positioning the rocker arms (1) on the valves correctly.
Fit on the gasket (5).
Insert the two tools SP. 2264 (4) into the electro-injector seats for subsequent centring of the overhead on the cylinder head.

Figure 227

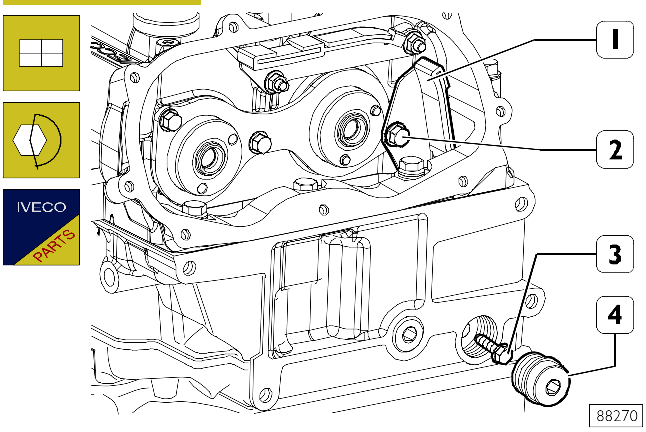


88357

Mount the overhead (1) together with the tools 99360614 (3) for the timing and tighten the fixing screws (2) to the prescribed torque.
Take out the tools SP. 2264 (4).

TIMING SYSTEM CONTROL

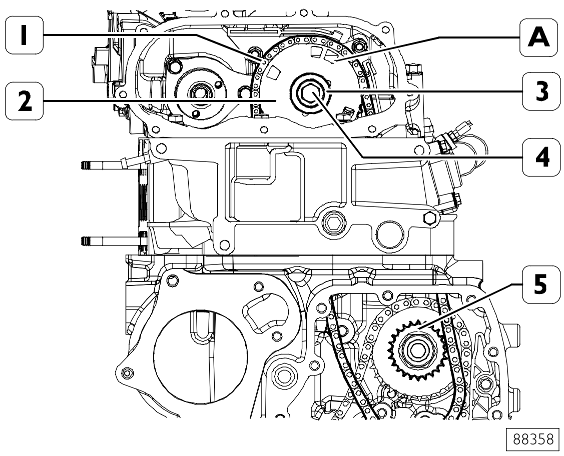
Figure 228



88270

Fit the top fixed skid (1). Drive in the screws (2 and 3) and tighten them to the prescribed torque.
Fit the rubber cap (4) of the new gasket and tighten it to the prescribed torque.

Figure 229

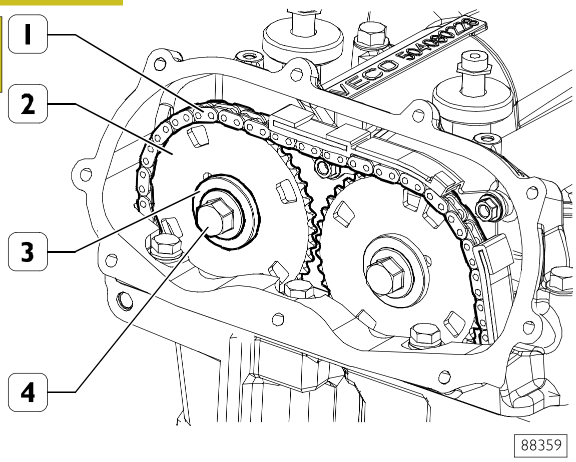


Position the chain (1) on the gear (5) and gear (2).
Mount the gear in such a way that fitting on aspiration valve timing system shaft dowel makes slots A to result to be positioned as in figure.

NOTE The chain arm (1) between the two gears must be tensioned.

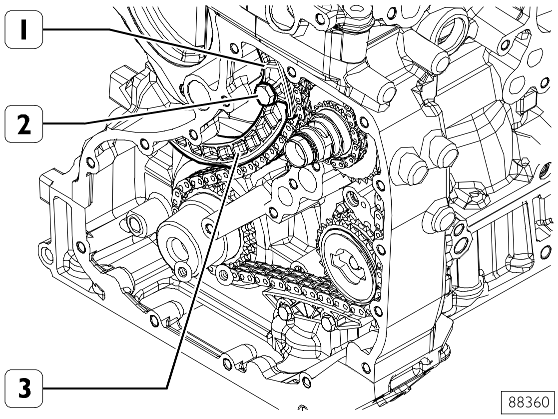
Drive in the fastening screw (4) with the washer (3) without tightening it completely.

Figure 230



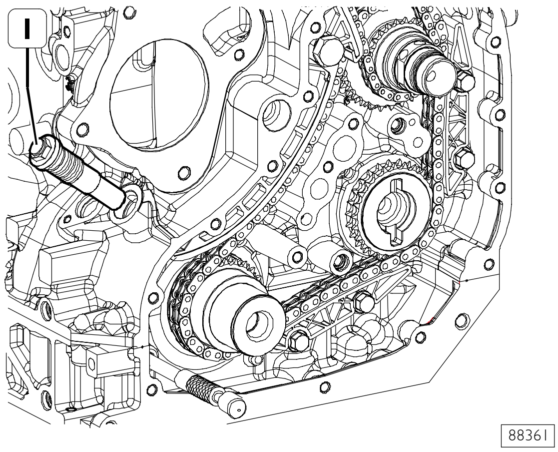
Position the chain (1) on the gear (2) and fit the latter on the camshaft of the exhaust valves.
Drive in the fastening screw (4) with the washer (3) without tightening it completely.

Figure 231



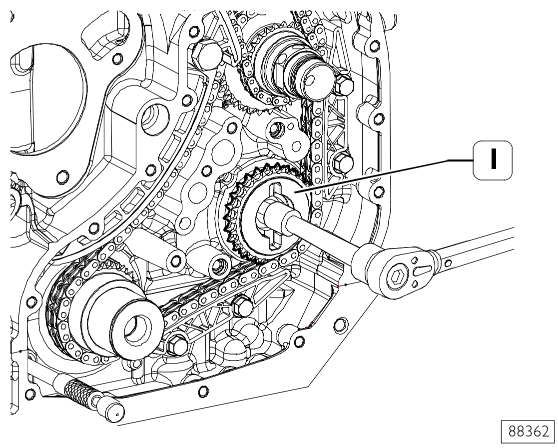
Check the conditions of the mobile skids (1 and 3), if worn out change them.
Position the mobile skids (1 and 3) and clamp them on the cylinder block by the pin (2) and tighten it to the prescribed torque.

Figure 232



Drive in the chain hydraulic tightener (1) and lock it to the prescribed torque.

Figure 233



Tighten the fastening screw of the gear (1) on the hydraulic power steering control stem to the prescribed torque.

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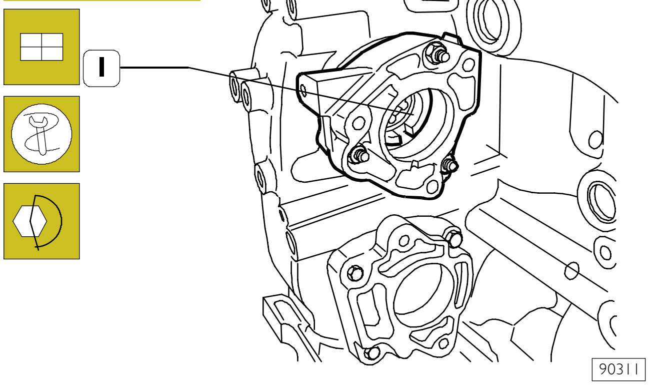
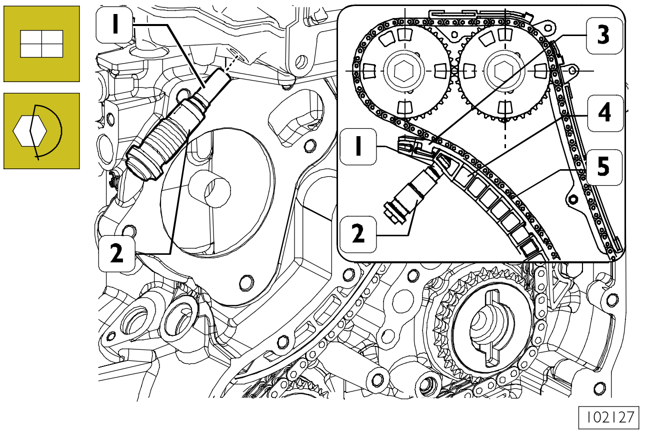
Figure 234



Stop the rotation of the high pressure pump control shaft (1) by inserting the suitable wrench inside it.

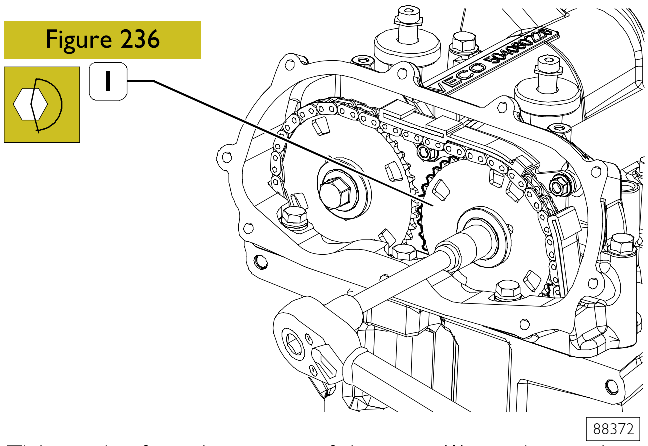
Figure 235



NOTE Chain stretcher (1) cannot be re-used for any reason after it has been disassembled. Moreover, in the event that piston (1) has been unintentionally made to escape from chain stretcher (2), the latter must be replaced. Chain stretcher reconditioning is not permitted.

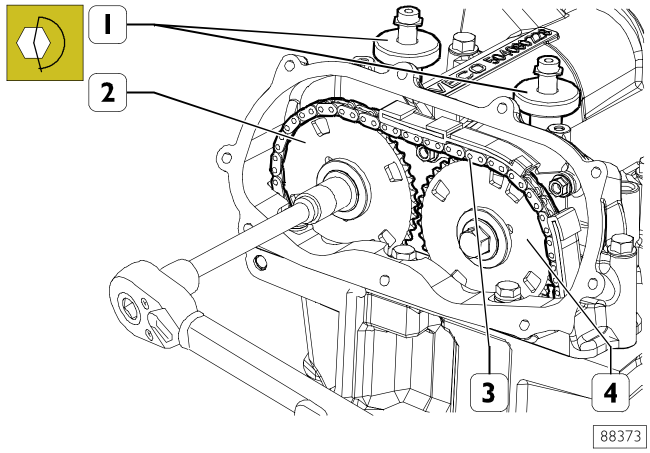
Screw down hydraulic chain stretcher (2), then tighten it to the specified torque.
Insert, through the opening on the overhead, a suitable screwdriver, then press on moving shoe (4) fin (3) until chain stretcher (2) piston (1) is pushed to its end of stroke.
Release moving shoe (4), and make sure that piston (1) causes, by escaping from its seat, chain (5) to be subjected to tension.

Figure 236



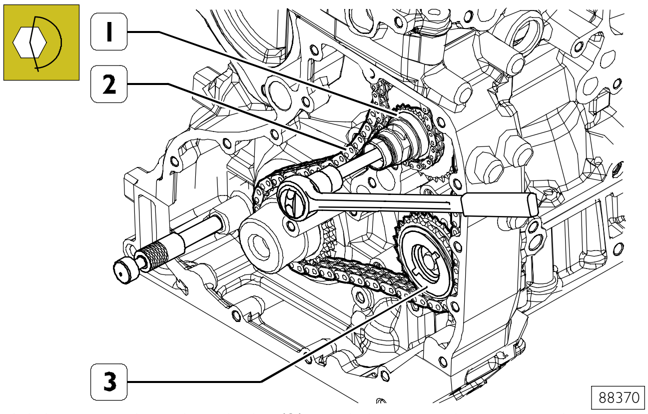
Tighten the fastening screw of the gear (1) on the suction valve camshaft to the prescribed torque.

Figure 237



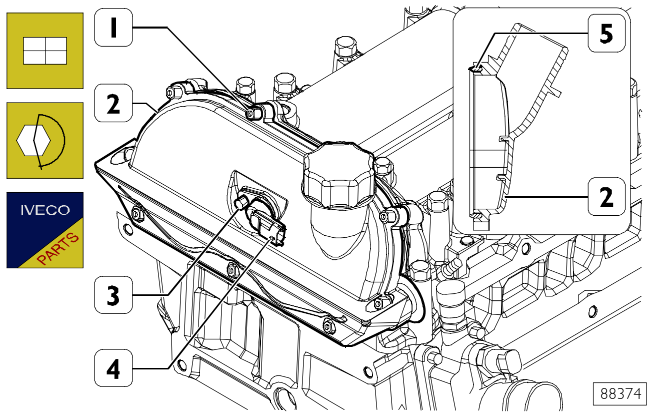
Make sure that the chain (3) in the tract between the gear (2) and gear (4) is tensioned.
Tighten the fastening screw of the gear (2) on the exhaust valve camshaft to the prescribed torque.
Remove tools 99360614 (1).

Figure 238



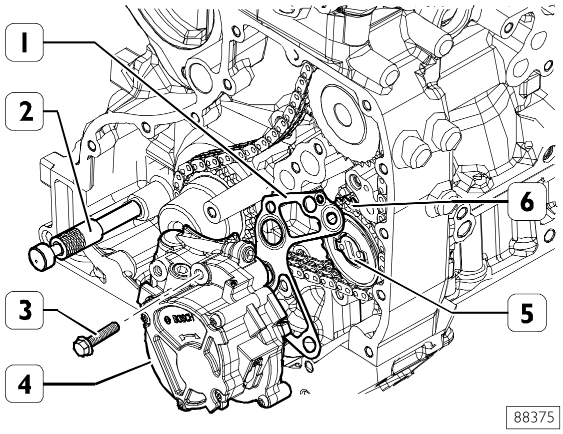
Make sure that the chain (2) and the tract between the gear (1) and gear (3) is tensioned.
Tighten the fastening screw of the stem with the drive gear (1) on the high pressure pump control stem to the prescribed torque.

Figure 239



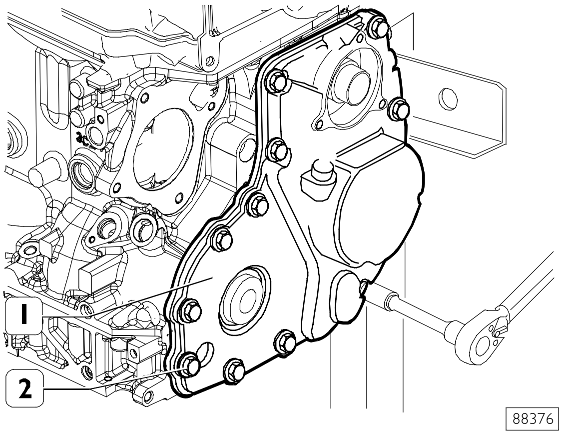
Fit a new gasket (5) in the cover (2).
Fit the cover (2), drive in the screws (1) and tighten them to the prescribed torque.
Fit the phase sensor (4).
Drive in the fastening nut (3) and tighten it to the prescribed torque.

Figure 240



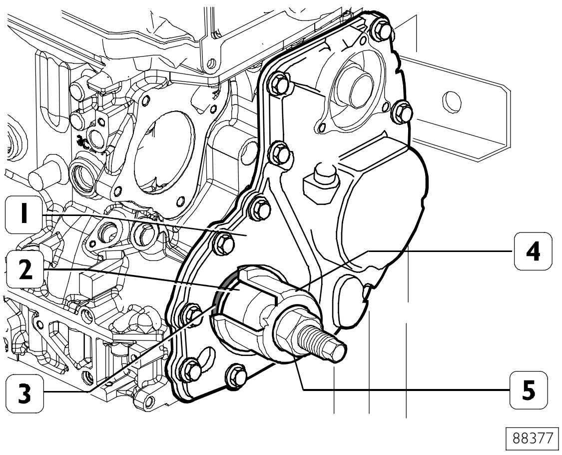
Position the joint (5) in the gear (6).
Fit the oil pump/depressor unit (4) by inserting a new gasket (1).
Drive in the screws (2) and tighten them to the prescribed torque.
Remove tool 99360615 (2).

Figure 241



Fit the cover (1) with a new gasket. Drive in the screws (2) without tightening them completely.

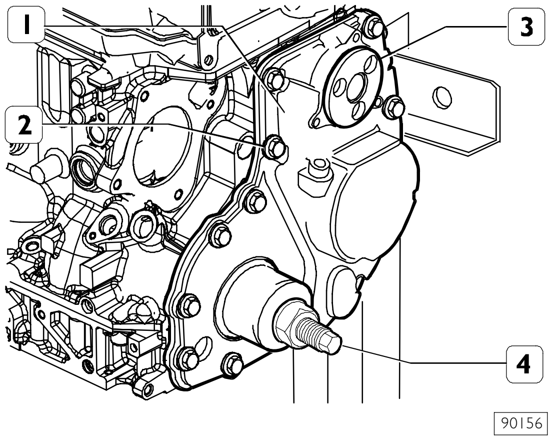
Figure 242



Clean accurately the seat of the cover seal ring (1).
Drive in the element (2) of tool 99346258 in the driving shaft tang.

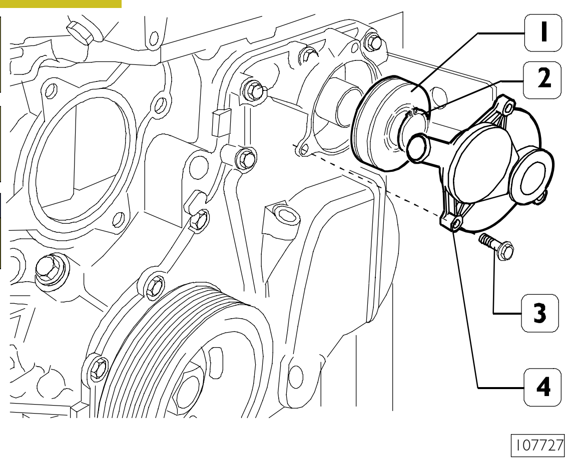
Lubricate the tang of the driving shaft and the element outside (2) and fit flush the new seal ring on this element (3). Position the element (4) on element (2), lock the nut (5) until fitting the seal ring (3) completely in the cover (1).

Figure 243



Mount tool 99396030 (3), for centering cover (1), into centrifugal filter seat and tighten screws (2) at prescribed torque. Remove: 99346258 (4) and 99396039 (3) tools.

Figure 244



Fit a new centrifugal filter (1).
Fit a new snap ring (2).
Fit the cover (3), drive in the screws (4) and tighten them to the prescribed torque.

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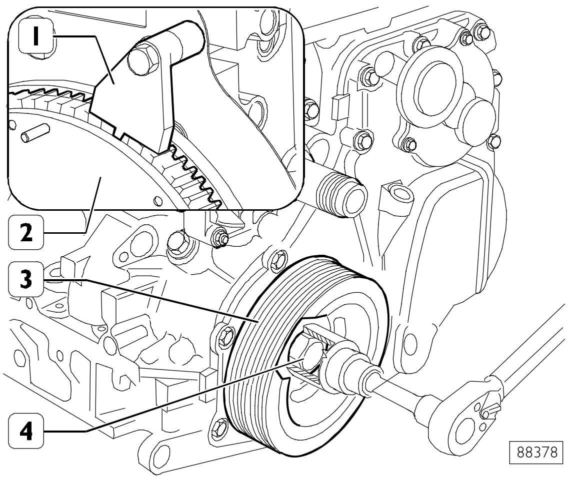
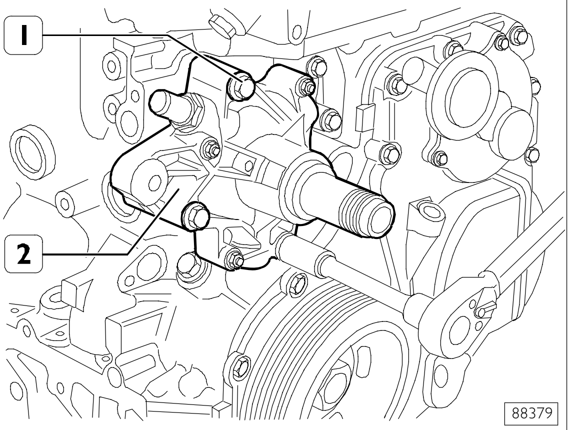
Figure 245



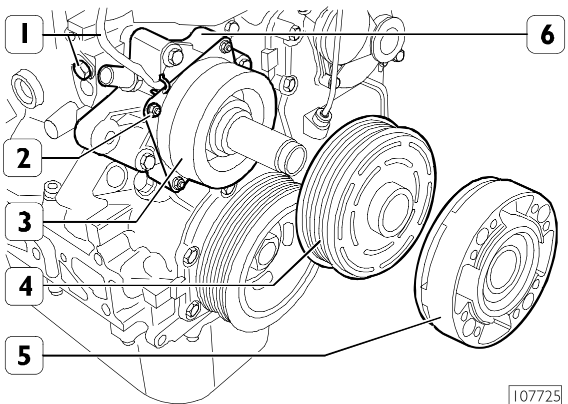
Stop the rotation of the engine flywheel (2) by means of tool 99360306 (1).
Fit the damper pulley (3). Drive in the screw (4) and tighten it to the prescribed torque.

Figure 246



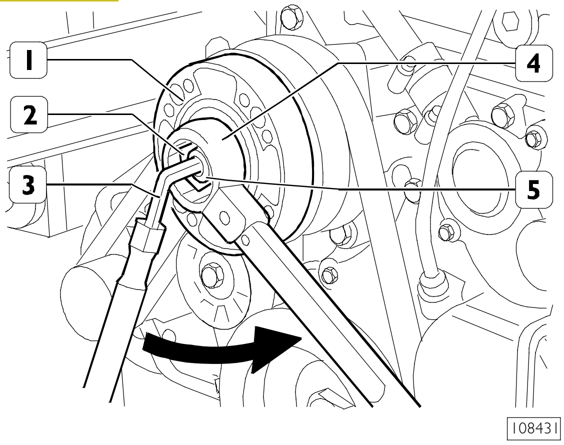
Fit the water pump (2) with a new gasket.
Drive in the screws (1) and tighten them to the prescribed torque.

Figure 247



Fit the electric magnet (3) of the cooling fan joint on the water pump (6).
Drive in the nuts (2) and tighten them to the prescribed torque.
Secure the electric cable to retaining clip (1).
Fit the pulley (4) and the hub (5).

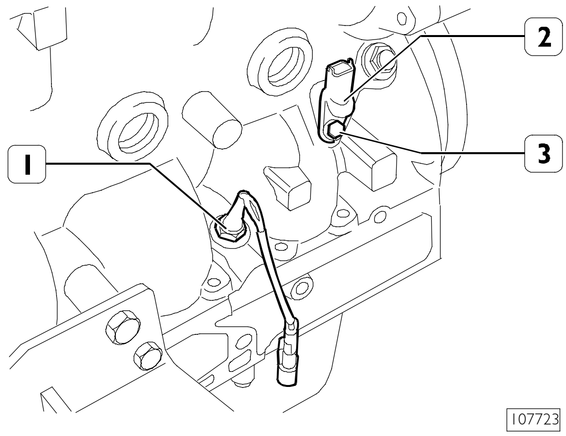
Figure 248



Stop the rotation of water pump shaft (5) by means of an Allen wrench (3) and a special lever. Screw down hub (1) fastening nut (2). Use a suitable wrench (4) to tighten nut (2) to the specified torque.

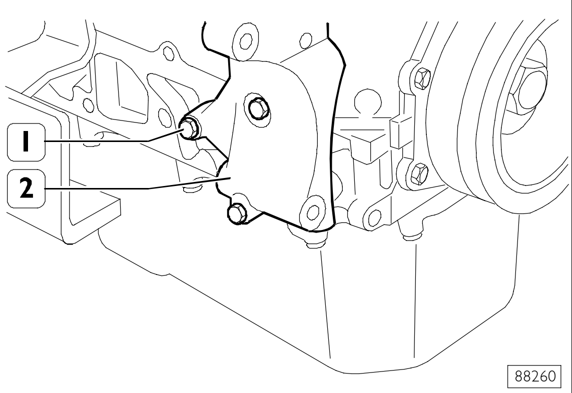
NOTE The nut (2) must be driven in anticlockwise (→) because its threading is left-handed.

Figure 249



Drive in the oil level sensor (1) and tighten it to the prescribed torque.
Fit the rev sensor (2), drive in the fastening screw (3) and tighten it to the prescribed torque.

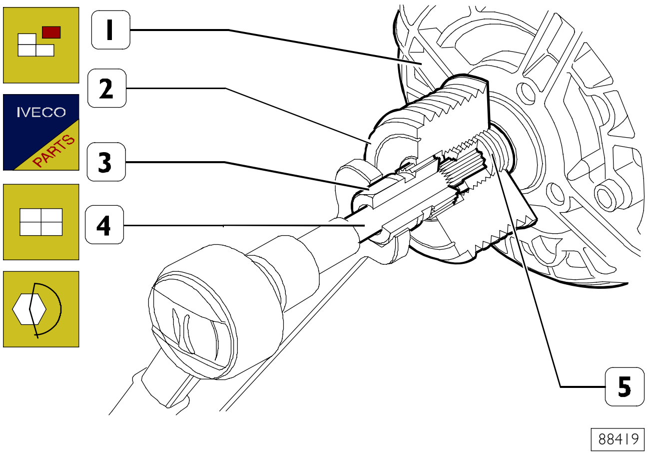
Figure 250



Fit the support (2), drive in the screws (1) and tighten them to the prescribed torque.

544017 Replacement of alternator free wheel

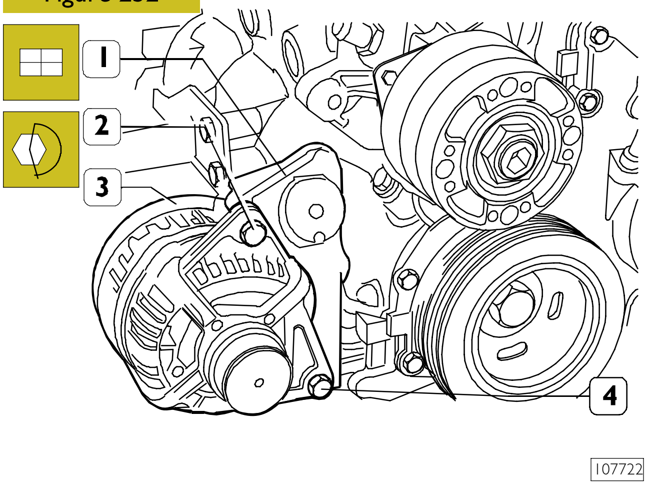
Figure 251



The free wheel (2) function is to prevent that the engine idling oscillations bounce back though the control belt on the alternator (1).
If it is necessary to change the free wheel (2), operate as follows.

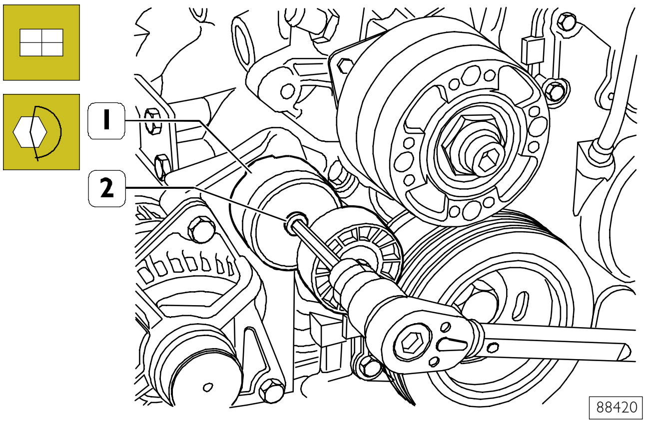
Remove the protection cap from the free wheel (2).
Apply tool 99358026 (3 and 4) as illustrated in the figure.
Stop the rotation of the free wheel (2) with the element (3) and slacken the stem (5) of the alternator (1) with the element (4).
Fit the new free wheel (2) by reversing the removal operations. The free wheel (2) must be clamped on the stem (5) by applying a max torque of 85 Nm.

Figure 252



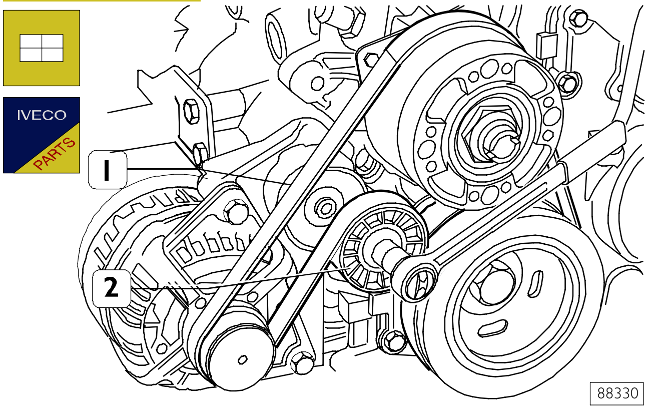
Fit the alternator (3) on the support (1), lock it with the bolt (4) and the screw (2) and tighten them to the prescribed torque.

Figure 253



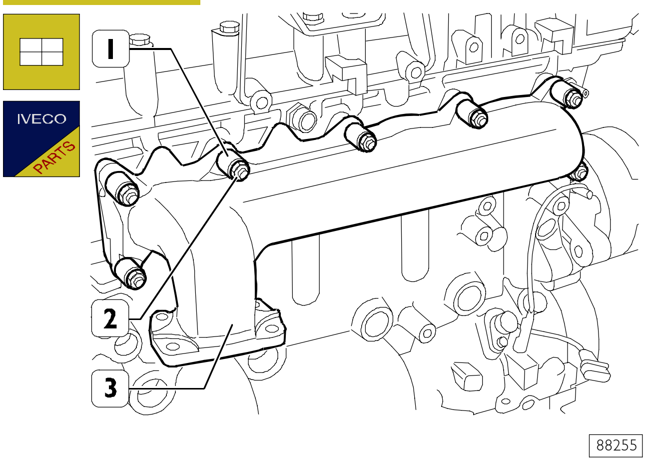
Fit the automatic backstand (1), drive in the screw (2) and tighten it to the prescribed torque.

Figure 254



Operate the automatic backstand (2) with the suitable wrench, fit the belt (1) and make sure the ribs are positioned correctly in the respective pulley races.

Figure 255



Fit the exhaust manifold (3) with a new gasket.
Fit the spacers (1), drive in the nuts (2) and tighten them to the prescribed torque.

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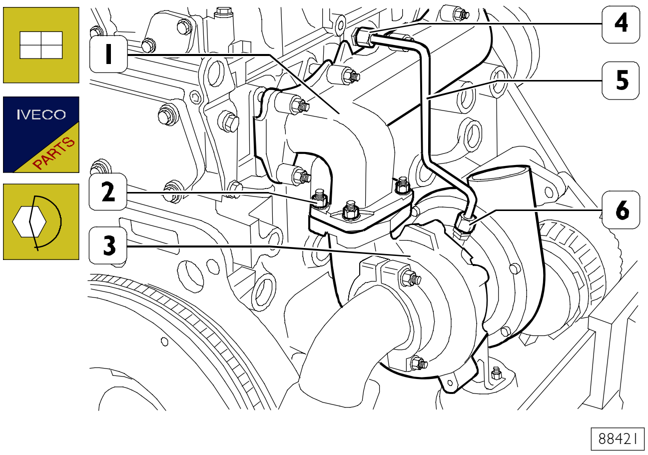
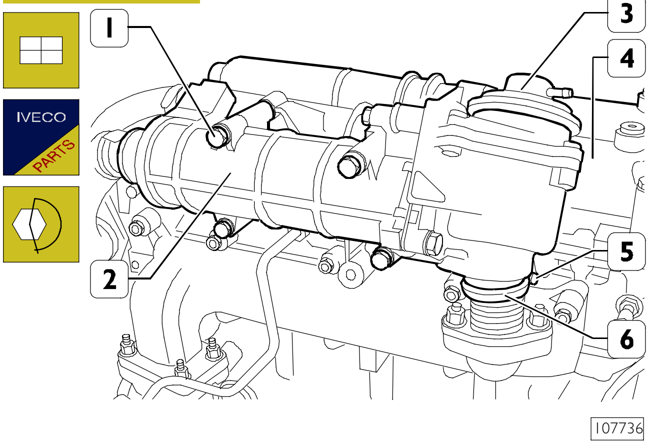
Figure 256



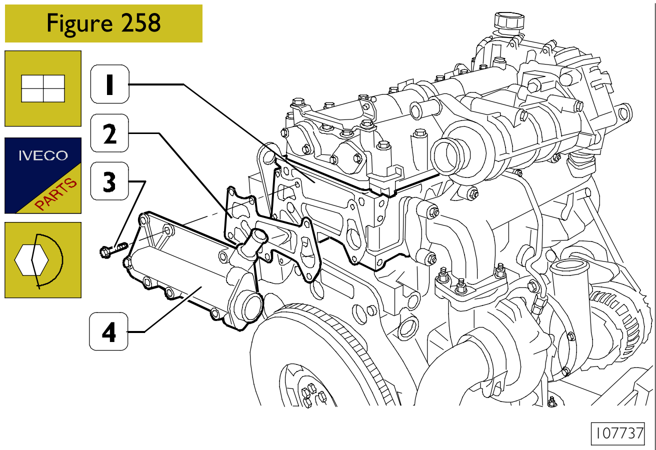
Fit the turbocharger (3) with the relevant gasket on the exhaust manifold (1). Drive in the nuts (2) and tighten them to the prescribed torque.
Connect the oil pipe (5) to the turbocharger (3) and the cylinder head, and tighten the pipe unions (4 and 6) to the prescribed torque.

Figure 257



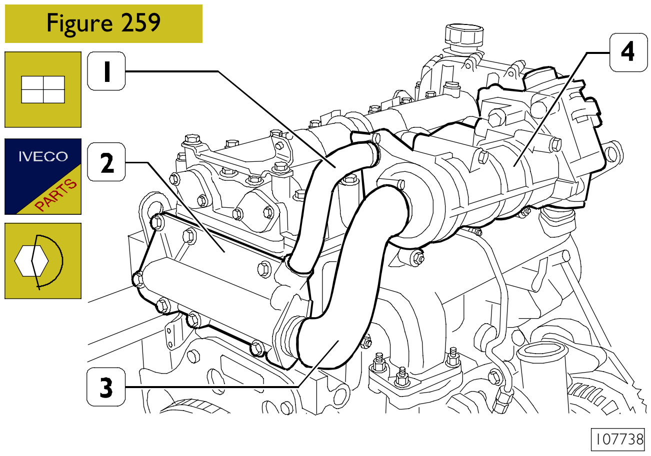
Fit heat exchanger (2), together with EGR valve (3), back to the overhead, then tighten fastening screws (1) to the specified torque. Connect EGR valve (3) to pipe (6) with a new collar (4), then tighten fastening screw (5) to the specified torque.

Figure 258



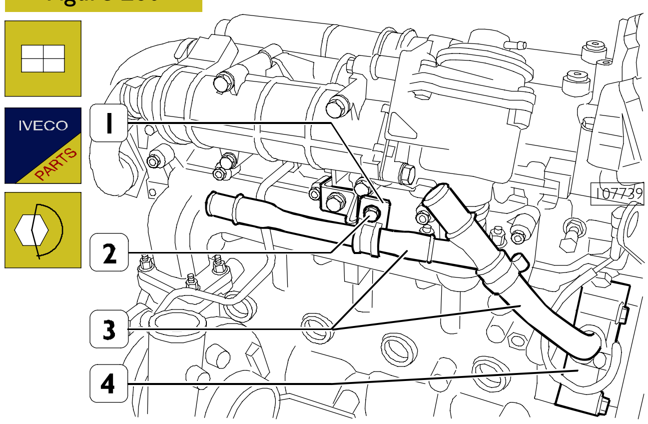
Fit rear cover (4) with a new gasket (2) back to cylinder head (1).
Screw down fastening screws (3) and tighten them to the specified torque.

Figure 259



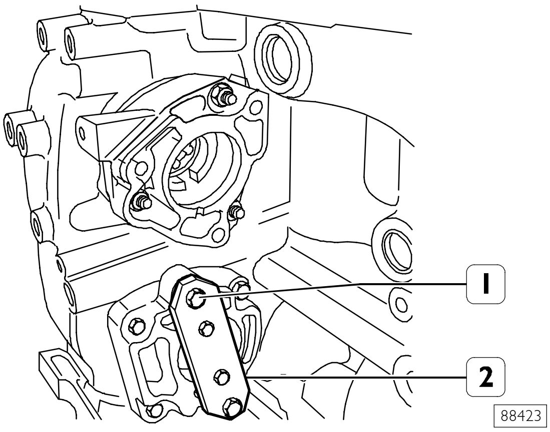
Fit coolant pipes (1 and 3) to rear cover (2) and heat exchanger (4), and secure them with new clamps and collars.

Figure 260



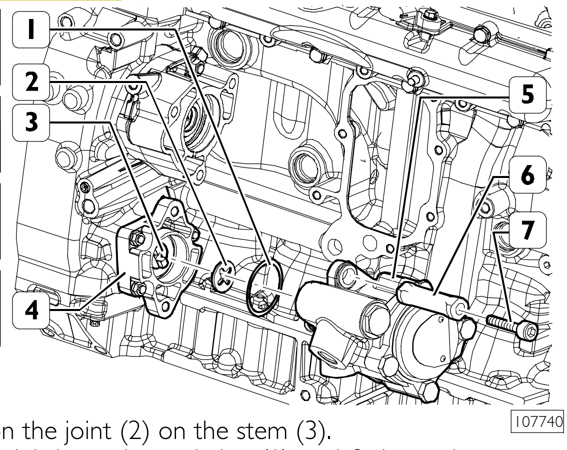
Connect pipe assembly (3) to water pump (4), then secure the latter to supporting bracket (1) with screw (2), by tightening the latter to the specified torque.

Figure 261



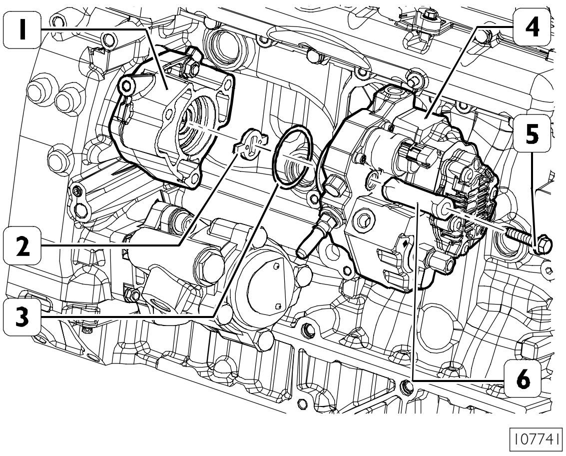
Remove the fastening screws (1) and remove tool 99360187 (2).

Figure 262



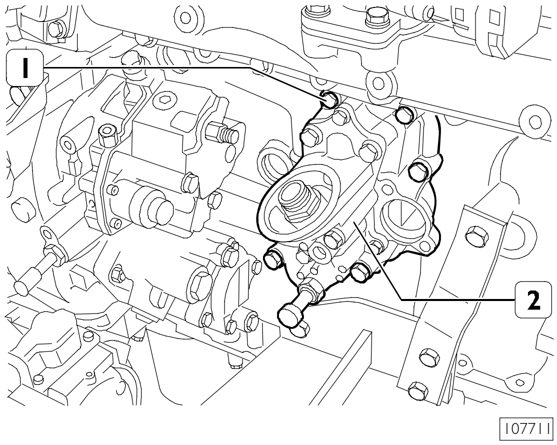
Position the joint (2) on the stem (3).
Slightly lubricate the seal ring (1) and fit it on the power steering pump (5).
Fit the power steering pump on the support (4).
Screw down fastening screws (7) complete with spacers (6) and tighten them to the specified torque.

Figure 263



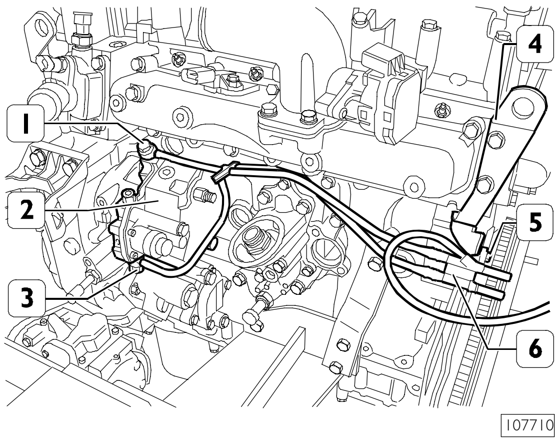
Lubricate a new seal ring (3) and fit it on the high pressure pump (4).
Position the joint (2) on the high pressure pump stem (4).
Fit the high pressure pump (4) on the support (1), drive in the screws (5) complete with spacers (6) and tighten them to the prescribed torque.

Figure 264



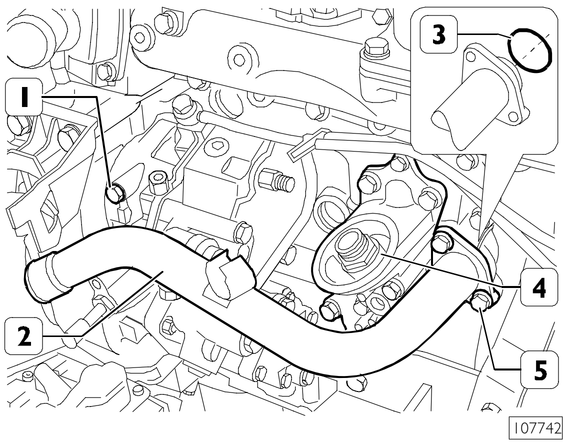
Fit heat exchanger (2), complete with a new gasket, onto the engine base.
Drive in the screws (1) and tighten them to the prescribed torque.

Figure 265



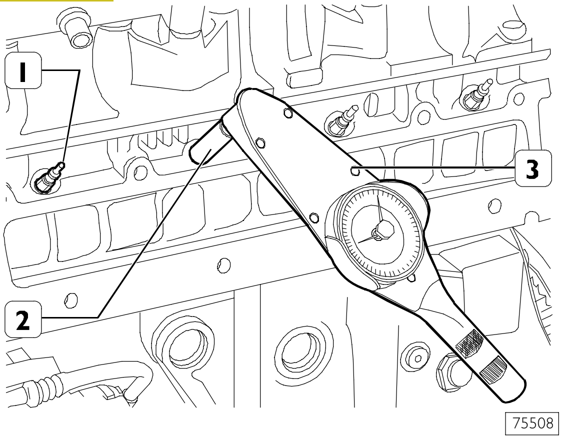
Connect the low pressure pipes (5) with the new gaskets to the high pressure pump (2) and tighten the pipe unions (1 and 3) to the prescribed torque.
Drive in the fastening screw (6) of the pipe (5) on the bracket (4) and tighten it to the prescribed torque.

Figure 266



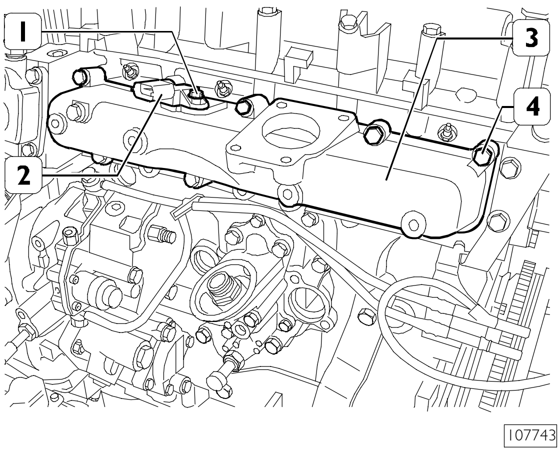
Lubricate a new seal ring (3), then fit it onto the pipe.
Fit pipe (2) onto heat exchanger (4).
Screw down screws (1 and 5), then tighten them to the specified torque.

Figure 267



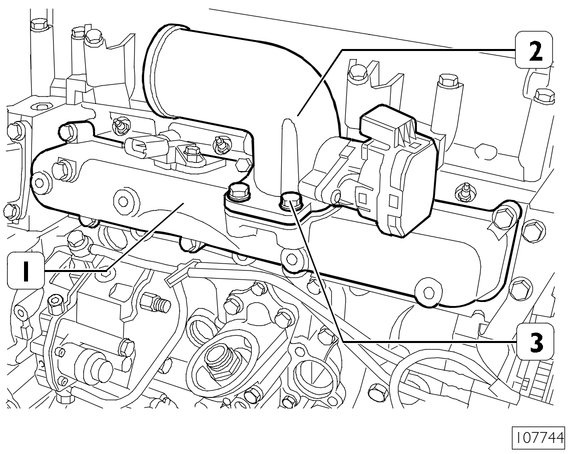
Mount the glow plugs (1) and, using the box-type wrench SP. 2275 (2) and torque wrench 99389819 (3), tighten them to a torque of 8 ÷ 10 Nm.

Figure 268



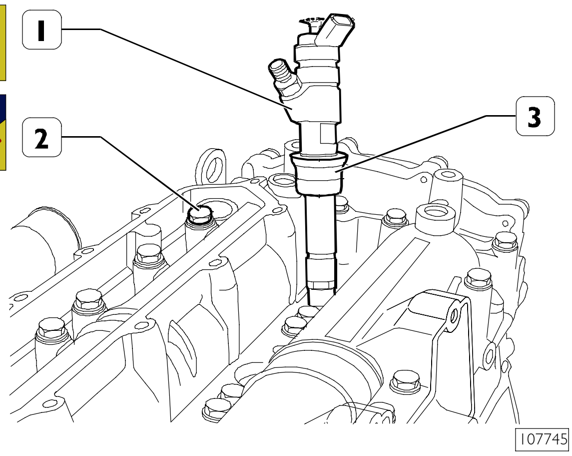
Fit the suction manifold (1) with a new gasket.
Drive in the screws (2) and tighten them to the prescribed torque. Fit the air temperature and pressure sensor (3).
Drive in the screw (4) and tighten it to the prescribed torque.

Figure 269



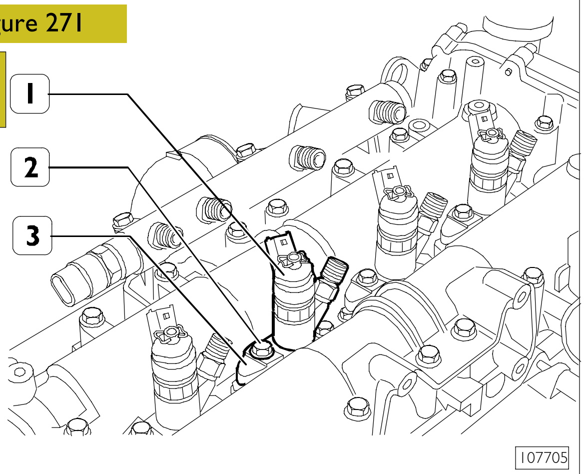
Fit throttle valve assembly (2), together with a new gasket, onto inlet manifold (1).
Screw down fastening screws (3), then tighten them to the specified torque.

Figure 270



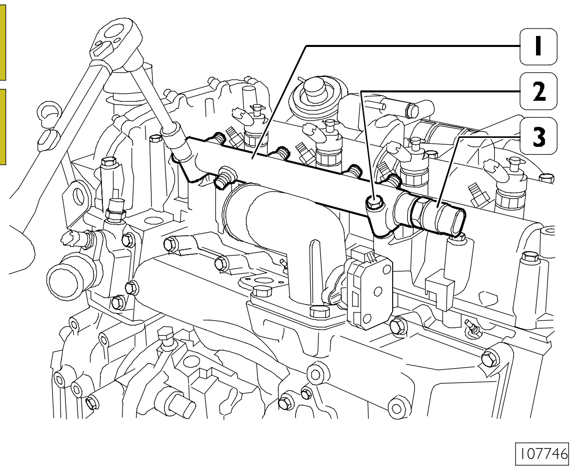
Fit a new seal (3) on the electro-injector (1) and mount this in the overhead (2).

Figure 271



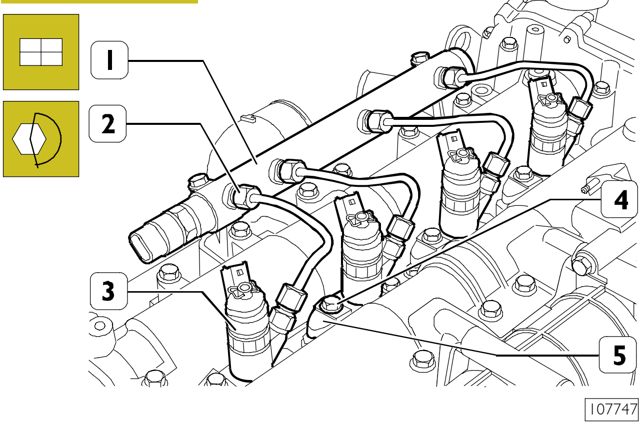
Mount the brackets (3) fastening the electro-injectors (1) and screw down the screws (2) without locking them.

Figure 272



Mount the hydraulic accumulator (1) and tighten the fixing screws (2) to the prescribed torque.
Fit the pressure sensor (3) on the hydraulic accumulator (1) and tighten it to the prescribed torque.

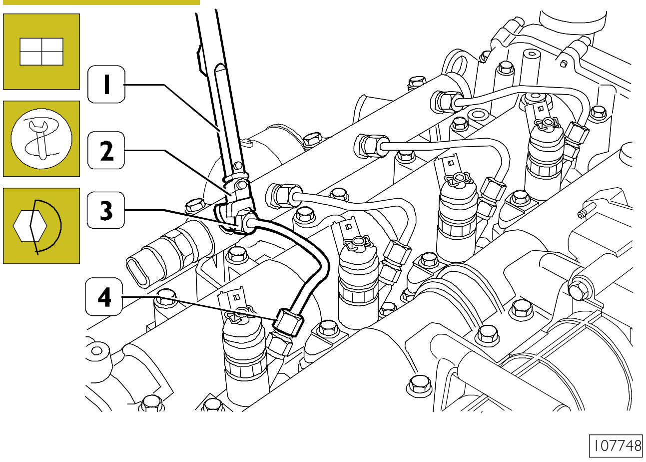
Figure 273



Connect the fuel pipes (2) to the electro-injectors (3) and to the hydraulic accumulator (1).
Tighten the screws (4) fixing the electro-injector brackets (5) to the prescribed torque.

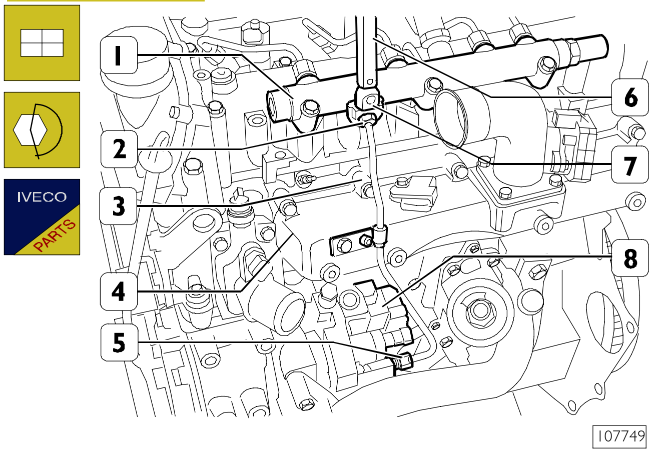
NOTE Whenever they get removed, the fuel pipes must be replaced with new ones.

Figure 274



Using the wrench (2) of the 99317915 series and the torque wrench 99389829 (1), tighten the fuel pipe fittings (3) and (4) to the prescribed torque.

Figure 275

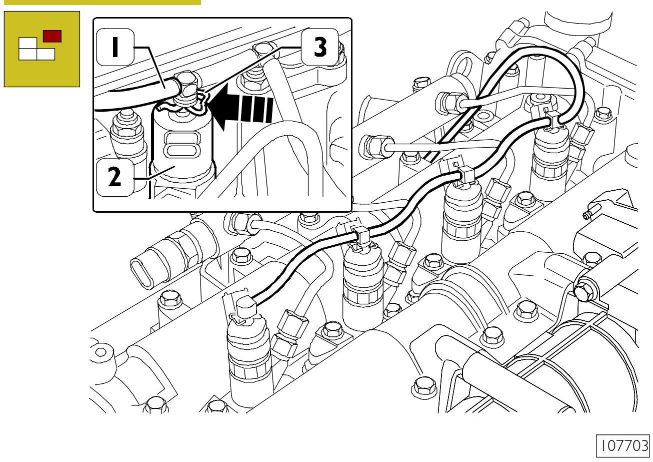


Connect the fuel pipe (3) to the hydraulic accumulator (1) and to the high-pressure pump (8).
Tighten the couplings (2 and 5) using a wrench (7) in the 99317915 series and the torque wrench 99389829 (6).

NOTE Whenever they get removed, the fuel pipes (3) must be replaced with new ones.

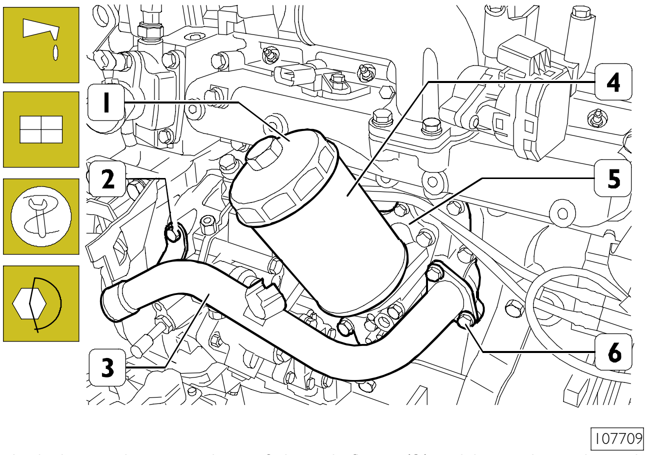
Fasten the pipe (3) on the support bracket with the bolt (4) tightened to the prescribed torque.

Figure 276



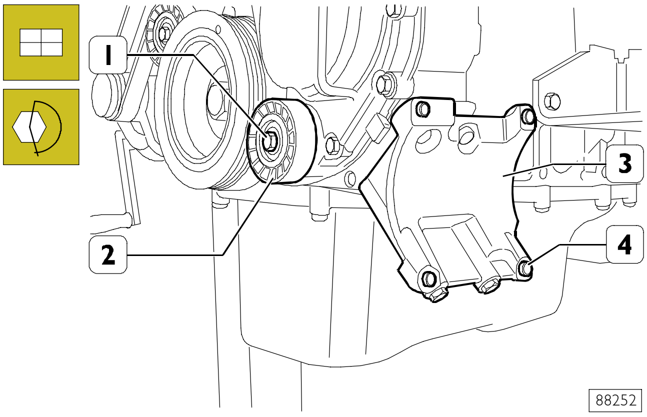
Press clamps (3) in the direction shown by the arrow, then disconnect the connections of fuel recovery pipe (1) to electric injectors (2).

Figure 277



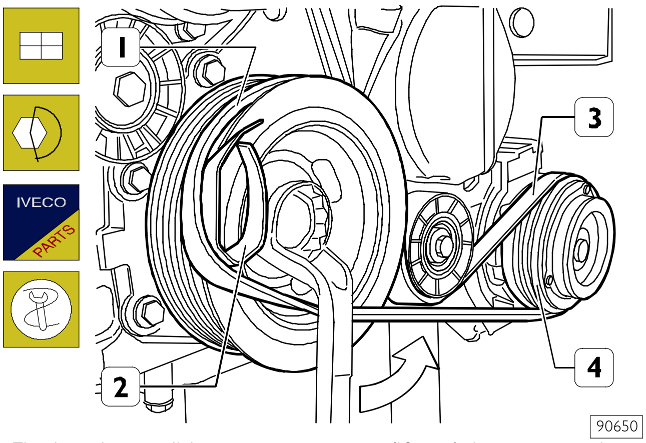
Lubricate the seal ring of the oil filter (2) with engine oil and fasten it on the heat exchanger (3). Use tool 99360076 (1) to tighten the oil filter to the prescribed torque.

Figure 278



If present, fit the support (3), drive in the screws (4) and tighten them to the prescribed torque.
Fit the fixed backstand (2), drive in the screw (1) and tighten it to the prescribed torque.

Figure 279



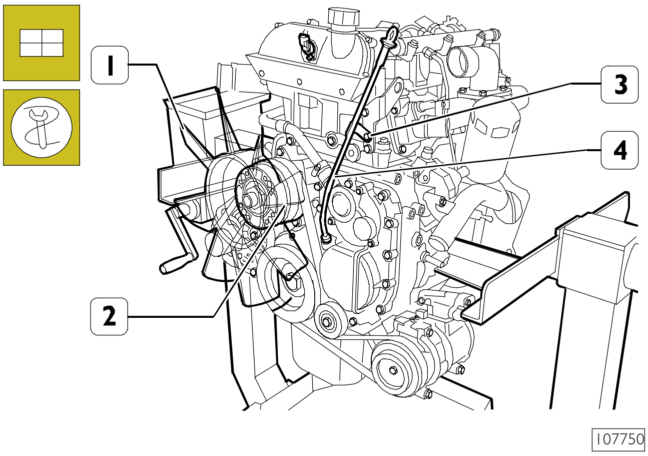
Fit the air-conditioner compressor (if any) into place, then tighten the fastening screws to the specified torque and fit elastic belt (4) into place, as described below.

NOTE To fit the air-conditioner compressor elastic drive belt into place, tool 99360191 (2) must be used. Any other tool or method may cause dangerous tension to the elastic belt.

Fit the flexible belt (3) equipped with tool 99360191 (2) on the pulley (4) and apply the tool on the pulley (1).
Turn the drive shaft counterclockwise (⇒) until the belt fits perfectly on the pulley (1).

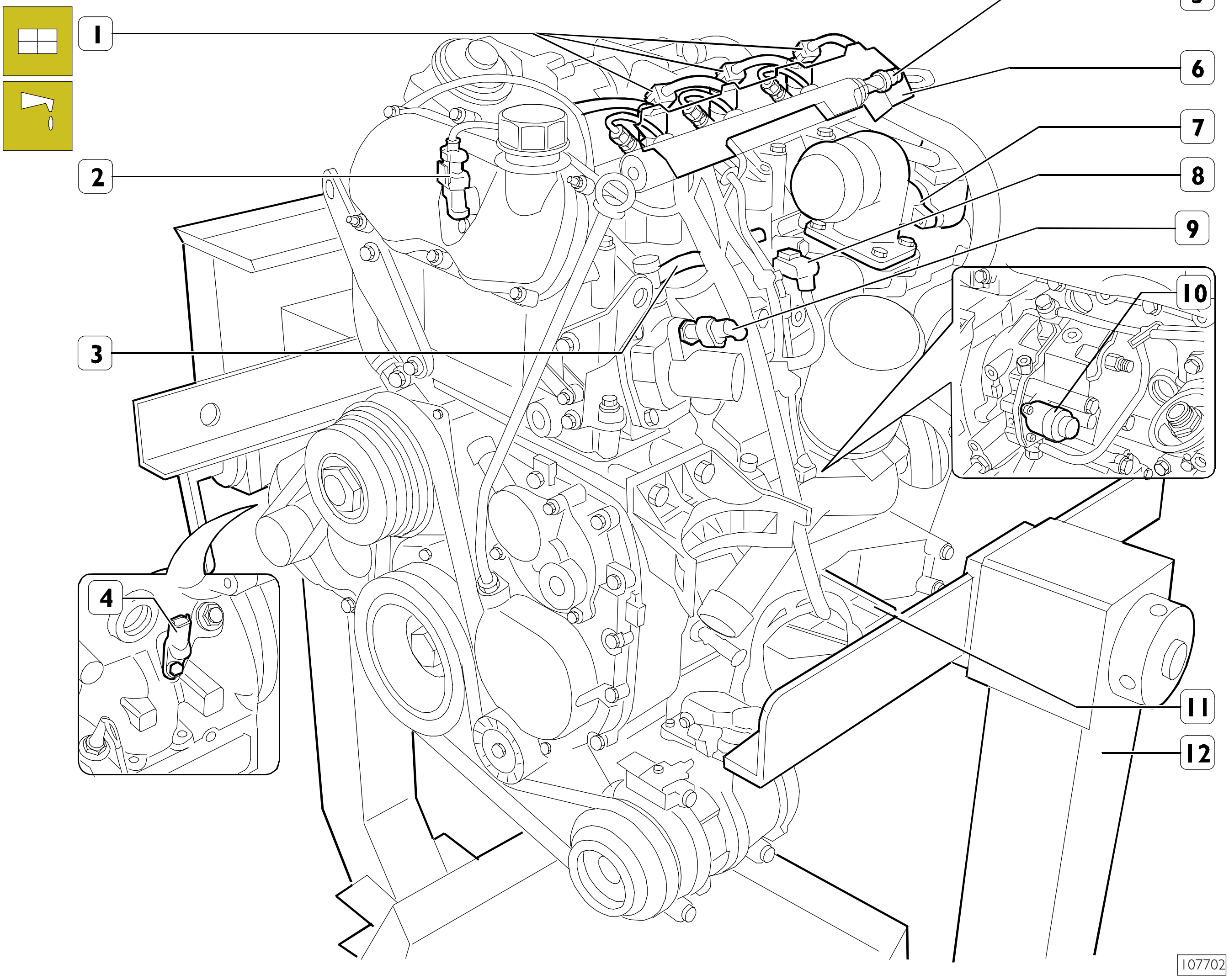
NOTE The elastic belt shall be replaced with a new one every time it is disassembled.

Figure 280



Fit the pipe (4) of the oil level dip rod and fasten the support bracket on the cylinder head by tightening the screw (3) to the prescribed torque.
Fit cooling fan (1), if any, back to electromagnetic joint (2).

Figure 281

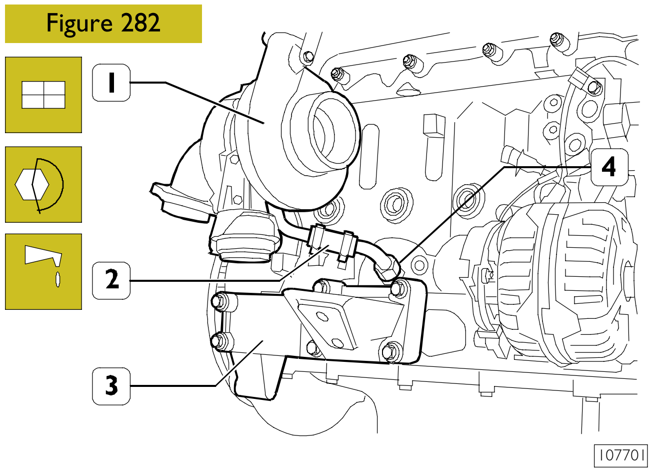


Fit the items below, if any, into place:

- engine cable, by connecting the electric connections of the same to:
  - electric injectors (1);
  - preheating plugs (3);
  - hydraulic accumulator pressure sensor (5);
  - throttle valve actuator (7);
  - inlet manifold air pressure/temperature sensor (8);
  - high-pressure pump pressure regulator (10);
  - phase sensor (2);
  - thermostat coolant temperature sensor (9).
- channelling duct (6);
- upper sound-proofing cover (if any);
- fill the engine with lubricating oil of the prescribed grade and amount.

Fit the swing bar to the engine lifting hooks, then secure the swing bar to the hoist and take the engine off rotary stand (12). Take off brackets 99361041 (11).

Figure 282



Complete engine assembly.
Fit on the left and right engine mountings (3) and tighten the fixing screws to the prescribed torque.
Connect the oil pipe (2) to the turbocharger (1) and to the crankcase and tighten the fixing screws and the coupling of the oil pipe (2) to the prescribed torque.

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5450 LUBRICATION

General

The engine is lubricated by forced circulation performed by the following parts:

- a gear oil pump with built-in depressor (GPOD);
- a pressure relief valve integrated in the oil pump;
- a heat exchanger made up of five elements;
- A double filtration oil filter with built-in safety valve.

Operation (see Figure 283)

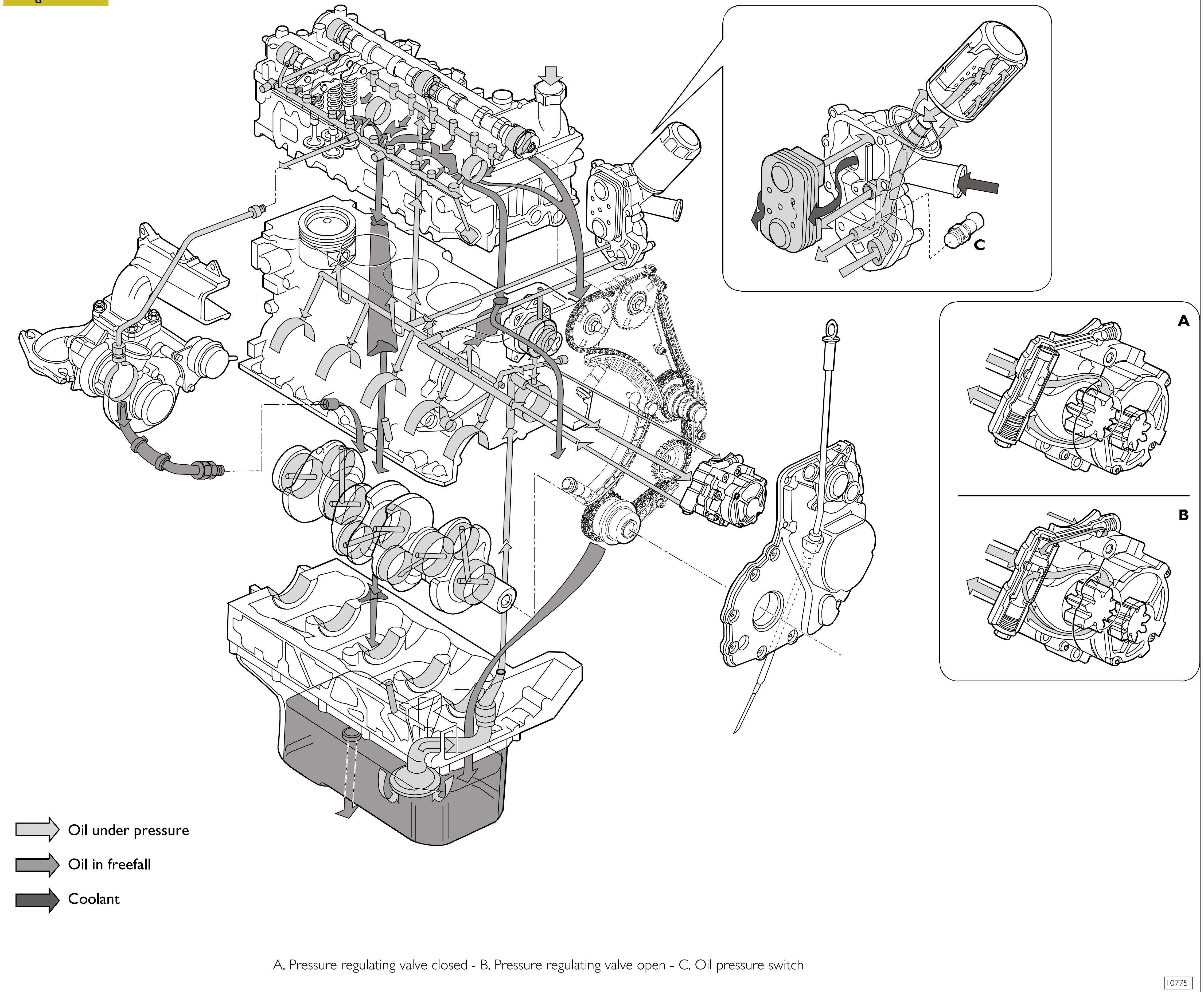
Engine oil is drawn up from the sump by the oil pump via the suction strainer and delivered under pressure to the heat exchanger where it is cooled.

The oil continues through the oil filter and goes to lubricate the relevant parts through ducts or pipes.

At the end of the lubrication cycle, the oil returns to the sump by gravity. The oil filter can be excluded by the safety valve built into it if it gets clogged.

In addition, the lubricating oil feeds the chain hydraulic tightening devices for the control of the auxiliary elements and the timing system and the hydraulic tappet.

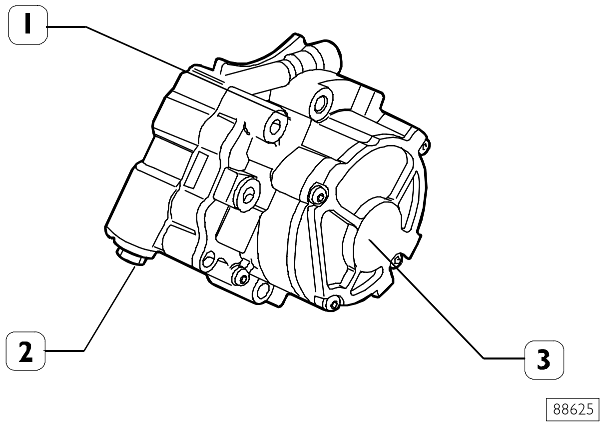
Figure 283



A. Pressure regulating valve closed - B. Pressure regulating valve open - C. Oil pressure switch

OIL PUMP/DEPRESSOR UNIT

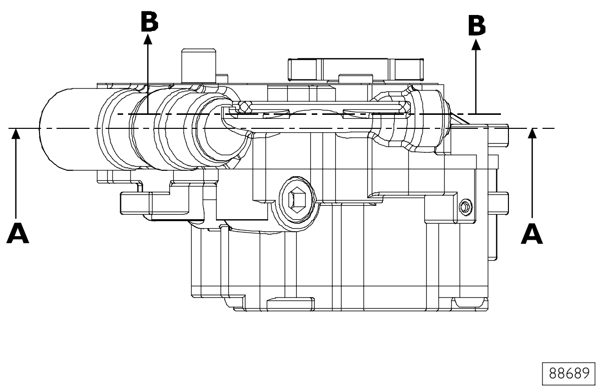
Figure 284



1. Oil pump - 2. Oil pressure adjusting valve - 3. Depressor.

NOTE Should the unit be faulty, not due to the oil pressure adjusting valve, change the whole unit.

Figure 285



SECTIONS OF OIL PUMP/DEPRESSOR UNIT

1. Oil input pipe from cylinder block - 2. Oil suction pipe - 3. Oil pressure adjusting valve - 4. Oil delivery pipe - 5. Depressor air suction pipe - 6. Depressor oil suction pipe.

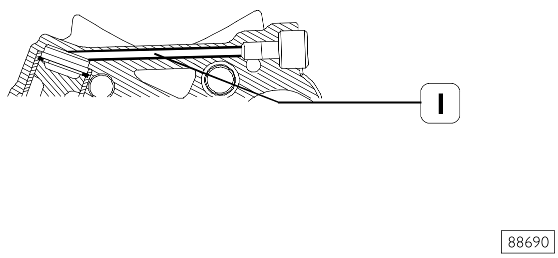
503010 Oil pump

Characteristic data

transmission ratio	1	
displacement	23.52	cm^3
pumping diameter	49.5	mm
number of teeth	7	
height	16	mm
oil pump minimum speed	780	rpm
oil pump max. speed	3500	rpm
oil pump over-revs	4200	rpm
oil pump forced over-revs	4900	rpm
speed	3500	rpm
torque	-	Nm
power draw (calc.)	-	W

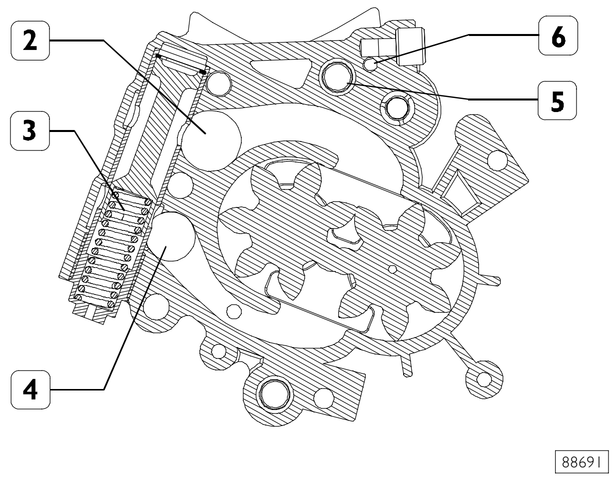
Oil temperature: 100°C – closed recirculation – max. outlet pressure 5 bars	
engine speed rpm (oil pump speed – rpm)	capacity (l/min)
780 (862)	
3500 (4485)	-

Figure 286



SECTION B-B

Figure 287



SECTION A-A

Vacuum pump

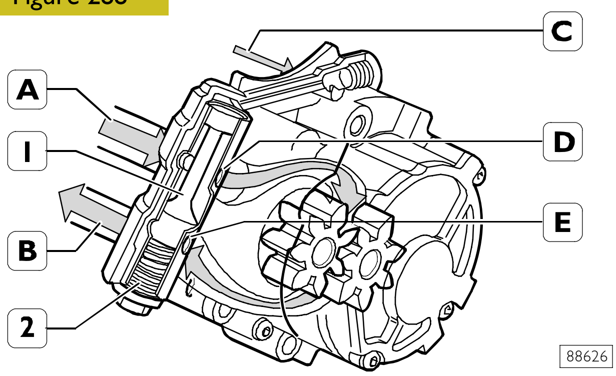
The vacuum pump (2, Figure 284), with radial blades, is also incorporated in the GPOD (1, Figure 285). It is driven directly by the oil pump.

transmission ratio	1	
displacement	150	cm^3
volume to drain	4.5	litres
chamber diameter	65	mm
rotor diameter	45.5	mm
cam	7.5	mm
number of blades	3	
height	34	mm
vacuum pump minimum speed	780	rpm
vacuum pump max. speed	3500	rpm
vacuum pump over-revs	4200	rpm
vacuum pump forced over-revs	4900	rpm
theoretical flow rate at minimum (air)	-	l/min
actual flow rate at minimum (air) – at atmospheric pressure	-	l/min
Theoretical speed at max. speed – (air)	-	l/min
Actual flow rate at max. speed – (air) at atmospheric pressure	-	l/min
measured power draw (maximum)		
speed	3500	rpm
torque	-	Nm
power draw (calc.)	-	W

Oil temperature: 100°C – engine speed 780 rpm (pump speed 994 rpm)			
tank (litres)	vacuum (bar)	0,5	0,8
4,5		4,5	12,5
9		9,5	26,0

543475 Oil pressure adjusting valve

Figure 288



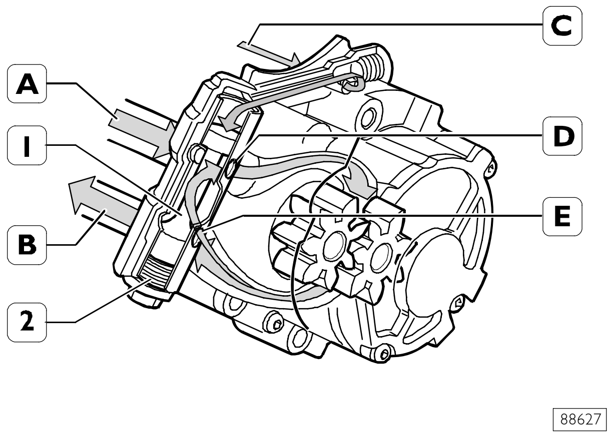
1. Valve - 2. Spring - A. Oil inlet duct from the sump - B. Oil supply duct to the crankcase - C. Oil return duct from the crankcase - D. Oil drainage port

Pressure at opening start: 4.4 bar

Description of oil pressure adjusting valve closed

If in pipe **C** the oil pressure is below 4.4 bar, the valve (1) closes the holes **D** - **E**.

Figure 289

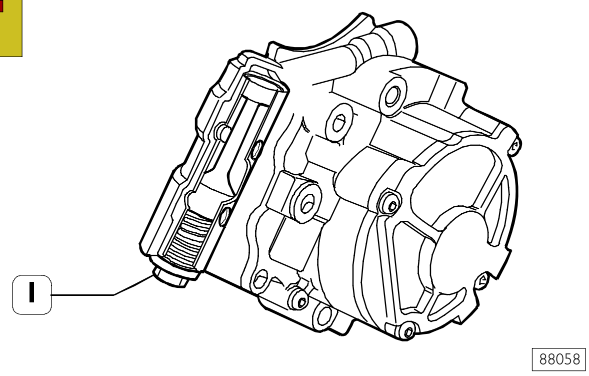


Oil pressure adjusting valve open

If in pipe **C** the oil pressure is equal or above 4.4 bar, the valve (1), as a result of the pressure itself, wins through the spring reaction (2) and goes down, thus opening communication between the delivery pipe **A** and the suction pipe **B**, through draining holes **D**-**E**, and therefore the pressure drops.
When the pressure falls below 4.4 bar, the spring (2) takes the valve (1) to the initial position of closed valve.

Disassembly

Figure 290



Use the suitable wrench to remove the oil pressure adjusting valve (1) from the oil pump.

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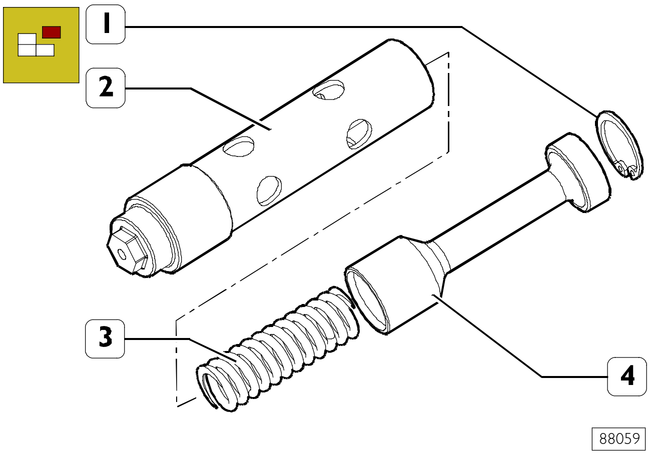
Figure 291

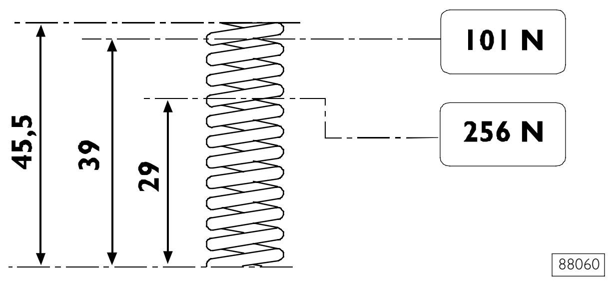


PARTS COMPRISING THE OIL PRESSURE CONTROL VALVE

1. Split ring – 2. Valve – 3. Spring – 4. Valve casing.

Use the suitable pliers to remove the snap ring (1), take off the valve (4) and the spring (3) from the valve body (2).

Figure 292



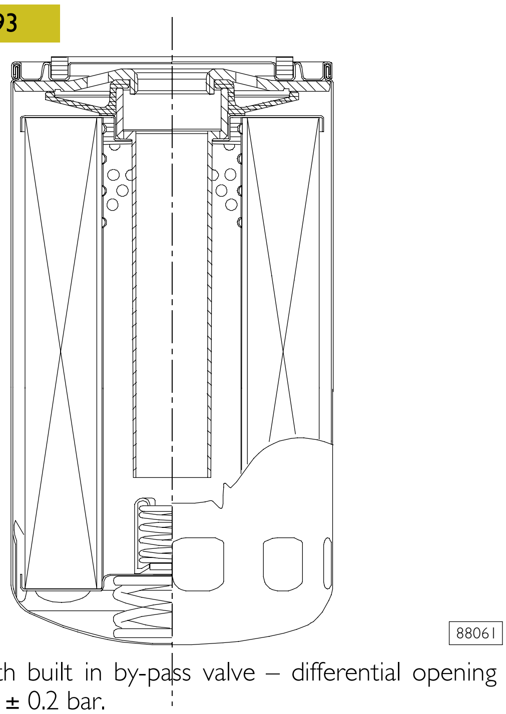
MAIN DATA OF THE OIL PRESSURE CONTROL VALVE SPRING

Assembly

For refitting, reverse the removal operations.

543070 Oil filter

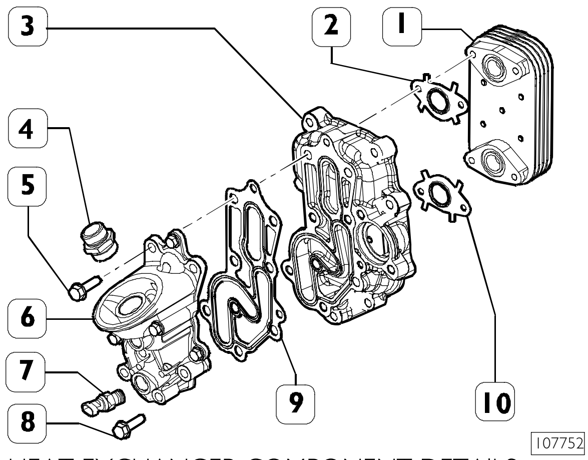
Figure 293



Oil filter with built in by-pass valve – differential opening pressure 2.5 ± 0.2 bar.

543110 Heat exchanger

Figure 294



HEAT EXCHANGER COMPONENT DETAILS

1. Heat exchanger made up of five elements - 2. Gasket - 3. Box - 4. Pipe union - 5. Screw - 6. Oil filter support - 7. Oil pressure switch - 8. Screw - 9. Heat exchanger box - 10. Gasket.

Disassembly

Remove the screws (5) and take off the heat exchanger (1) from the box (3) with the gasket (8).
Remove the screws (7) and take off the oil filter support (6) from the box (3).

Assembly

For refitting, reverse the removal operations and observe the following warnings.
Clean accurately the heat exchanger (1).
Always change the gaskets (2, 9 and 8). Apply LOCTITE 577 on the threading of the pipe union (4) (if removed), drive it in the support (1) and tighten it to the prescribed torque.
Tighten the screws to the prescribed torque.

Figure 295

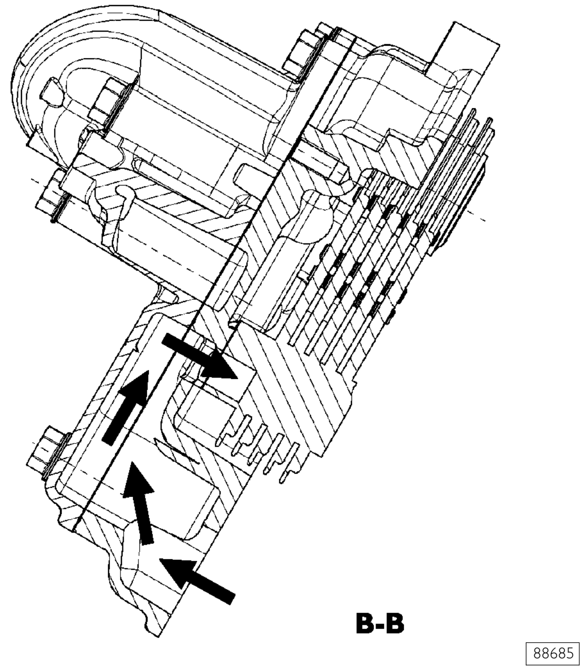


Figure 296

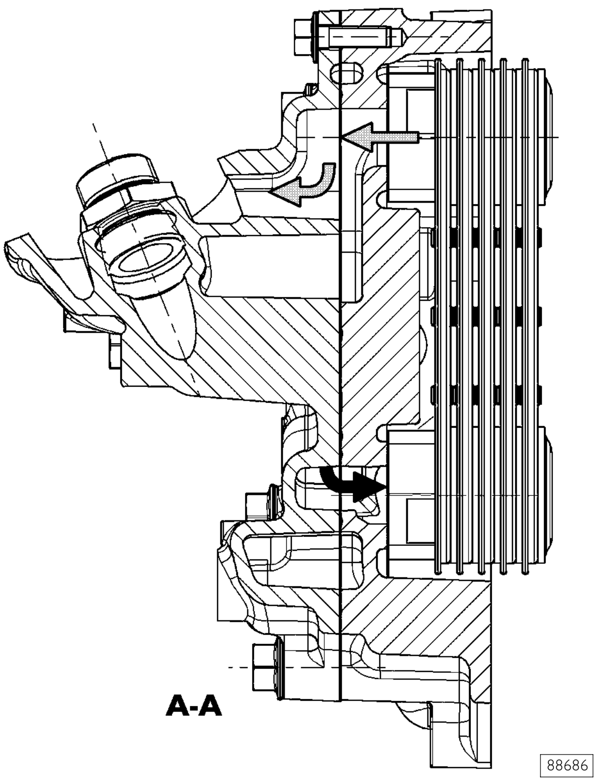


Figure 297

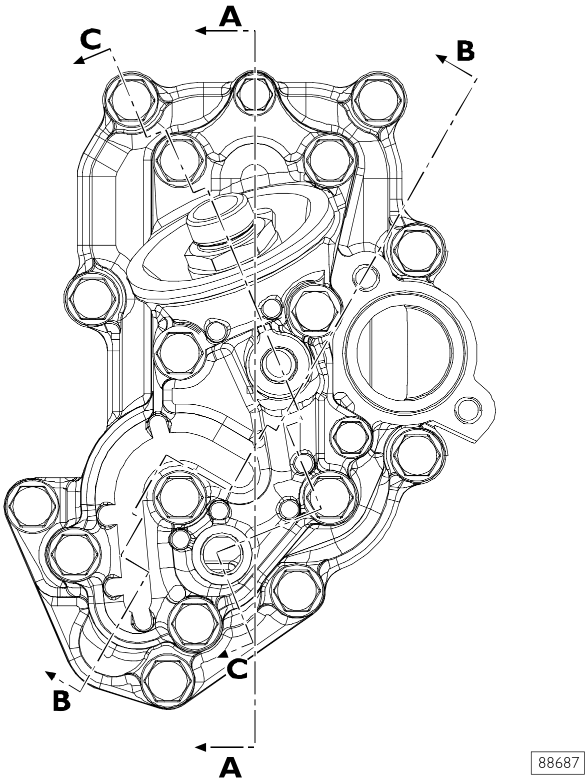
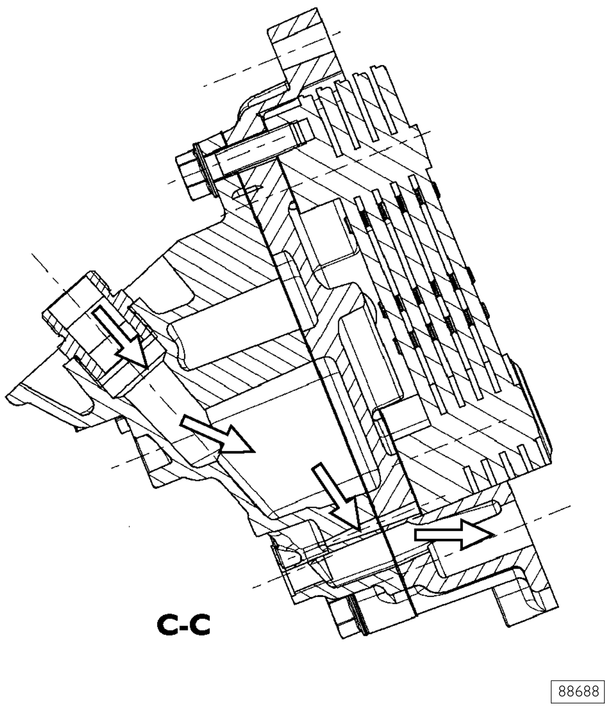


Figure 298



HEAT EXCHANGER SECTIONS

Oil flow from heat exchanger to oil filter

Oil flow from oil filter to cylinder block

Oil flow from cylinder block to heat exchanger

540480 Oil vapour recirculation (Blow-by)

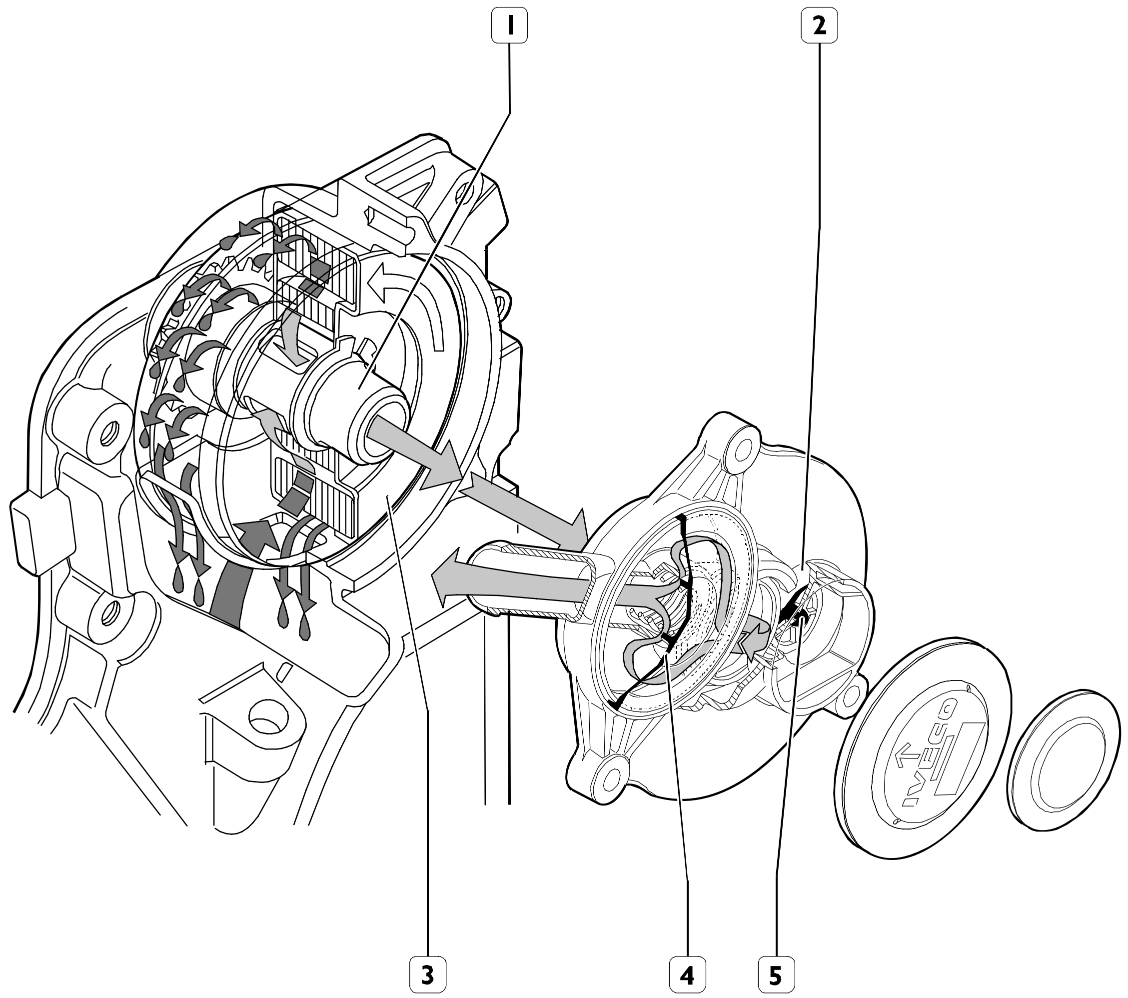
Part of the gas produced by the combustion during the engine operation blows by the piston snap ring ports, in the oil sump, and mixes with the oil vapours present in the oil sump. This mixture, conveyed from the chain compartment to the top, is partially separated from the oil by means of a device situated on the top side of the distribution cover and is introduced in the air suction system. This device consists mainly of a rotating filter (3), fit flush on the stem (1), a high pressure/shaft control and a cover (2) where the valves (4 and 5), usually closed, are fitted. The diaphragm valve (4) regulates the partially purified mixture and keeps the pressure inside the chain compartment around a value of ~ 10 ÷ 15 mbar.

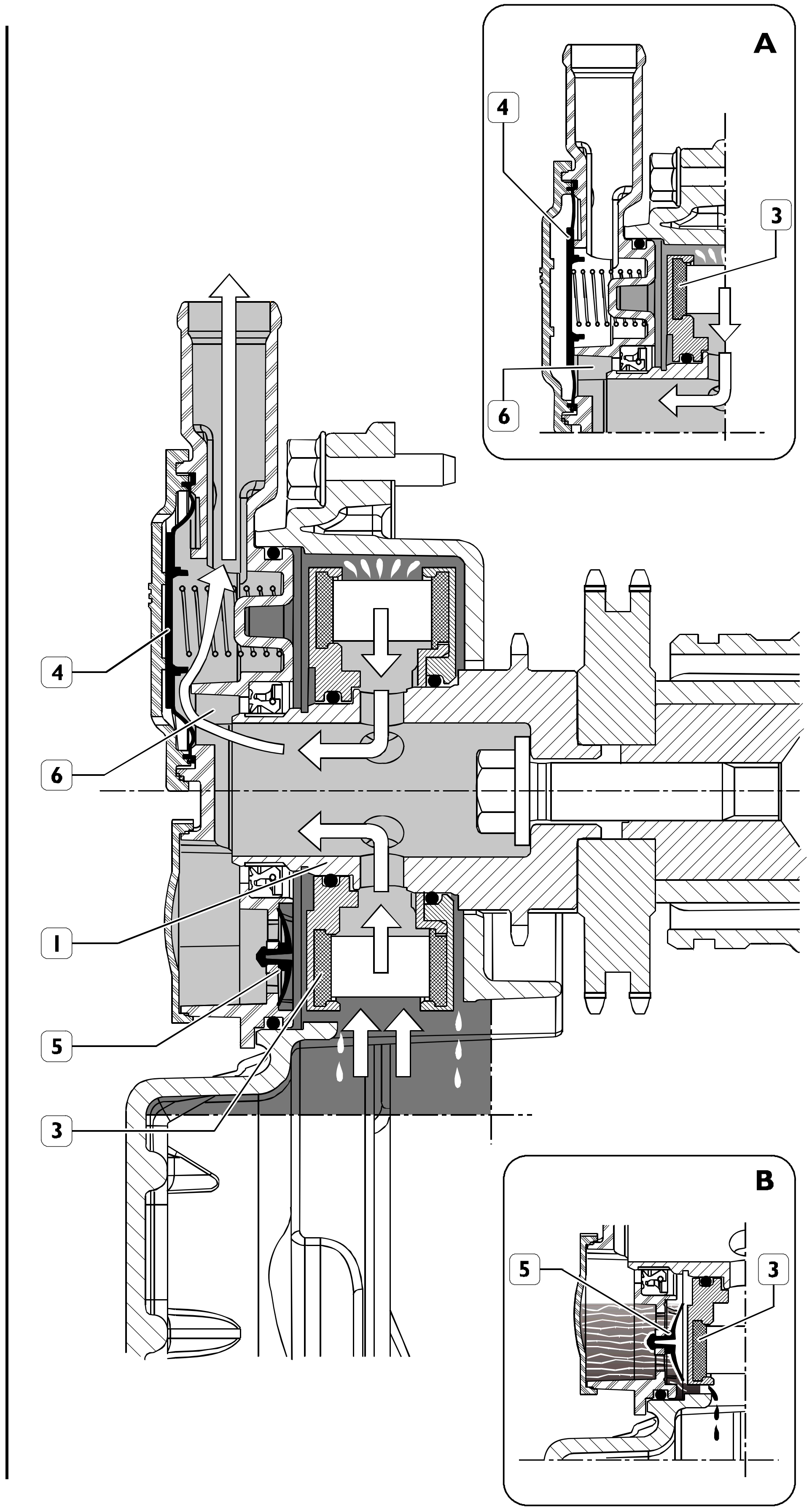
The umbrella valve (5) discharges some of the oil still present in the mixture coming from the filter (3) in the chain compartment and the oil condenses in the chamber (6).

Operation

The mixture which passes through the rotating filter (3) is partially purified from the oil particles, as a result of centrifugation, and so these particles condense on the cover walls to return to the lubrication circuit. The resulting purified mixture is let in through the stem holes (1) and the diaphragm valve consensus (4) inside the air vent upstream of the turbocharger. The opening/closing of the valve (4) depends mainly in the ratio between the pressure operating the diaphragm (4) and the depression below it. The oil still present in the mixture coming from the rotating filter (3) and which condenses in the chamber (6) is drained into the chain compartment through the umbrella valve (5), when the pressure that keeps it closed drops as a result of the engine stop.

Figure 299





Gas with oil level above 10 g/h

Gas with oil level ~ 0,2 g/h

Condensed oil returning to the oil sump

88062

5432 COOLING

Description

The engine cooling system is the type with forced circulation in a closed circuit. It comprises the following parts:

- An expansion tank whose plug has two valves incorporated in it: an outlet and an inlet, which govern the pressure of the system.
- A coolant level sensor at the base of the expansion tank.
- A pressure switch (3), of normally closed type (calibrated at 0.4 bar, absolute pressure 1.4 bar), located on expansion tank and connected to EDC central unit, protects engine against overheating caused by cooling system failure. Where coolant temperature exceeds a certain threshold and pressure inside expansion tank is lower than 0.4 bar, EDC central unit reduces engine performance by changing fuel flow rate (De-rating) until engine goes off.
- An engine cooling module to dissipate the heat taken from the engine by the coolant with a heat exchanger for the intercooler.
- A heat exchanger to cool the lubricating oil.
- A centrifugal water pump incorporated in the crankcase.
- An electric fan comprising an electromagnetic coupling on whose shaft a hub turns idle that is fitted with an axially mobile metal plate on which is mounted the impeller.
- A 3-way thermostat governing the circulation of the coolant.

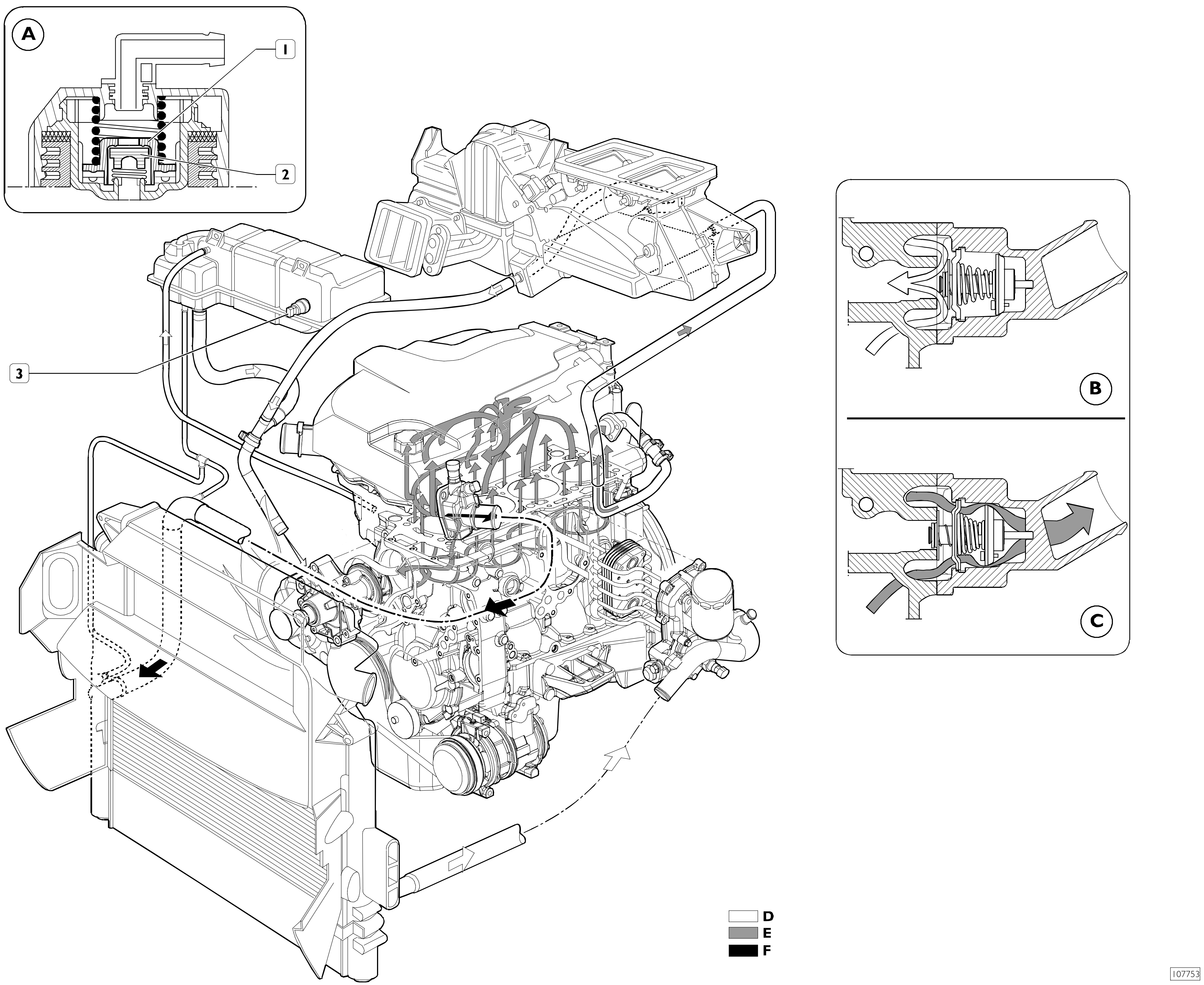
Operation

The water pump driven by a poly-V belt by the crankshaft sends coolant into the crankcase and with a greater head into the cylinder head.
When the coolant temperature reaches and exceeds the working temperature, it causes the thermostat to open and the fluid is channelled from here to the radiator and cooled by the fan.
The pressure in the system due to the change in temperature is governed by the outlet (2) and inlet (1) valves incorporated in the expansion tank filler plug (detail A).
The outlet valve (2) has a twofold function:

- to keep the system slightly pressurized so as to raise the boiling point of the coolant;
- to discharge into the atmosphere the excess pressure produced in case of high coolant temperatures.

The function of the inlet valve (1) is to permit transferring the coolant from the expansion tank to the radiator when a lower pressure is created in the system due to the reduction in volume of the coolant as a result of its temperature lowering.
Outlet valve opening 1 ± 0.1 kg/cm^2.
Inlet valve opening 0.005 – 0.02 kg/cm^2.

Figure 300



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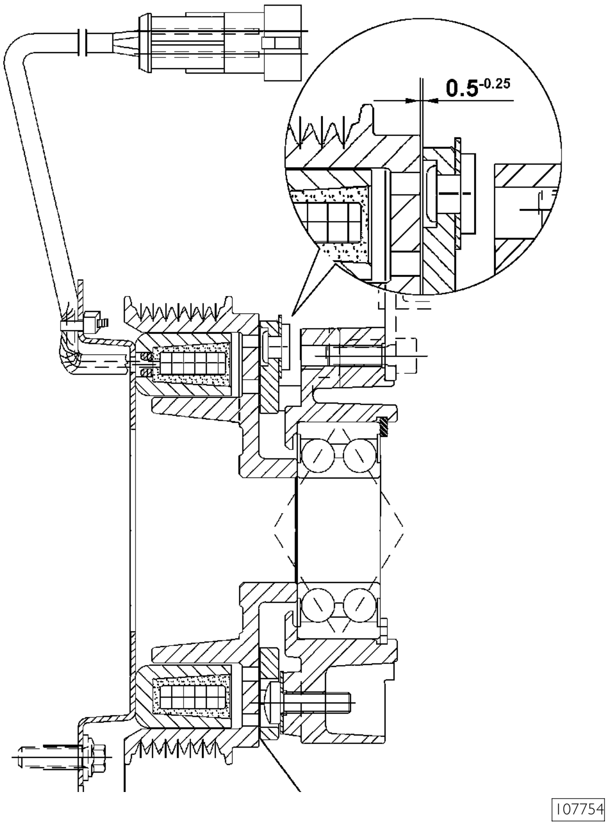
543212 Electromagnetic pulley

Figure 301



CROSS-SECTION OF THE ELECTROMAGNETIC JOINT

Characteristics

Transmissible torque at 20°C with clutch run in	85 Nm
Voltage	12 Volts
Power input at 20°C	48 W

The electric fan control relay is activated or deactivated according to the temperatures of: the engine coolant, the fuel supercharging air and the pressure of the air conditioner fluid (if present).

Turbocharging air temperature
It activates at > 75°C and deactivates at < 65°C.
Coolant temperature (if the sensor is not defective)
It activates at > 96°C and deactivates at < 84°C.

Fuel temperatures
(if the coolant temperature sensor is acknowledged to be defective by the EDC control unit)
It activates at > 20°C and deactivates at < 10°C.

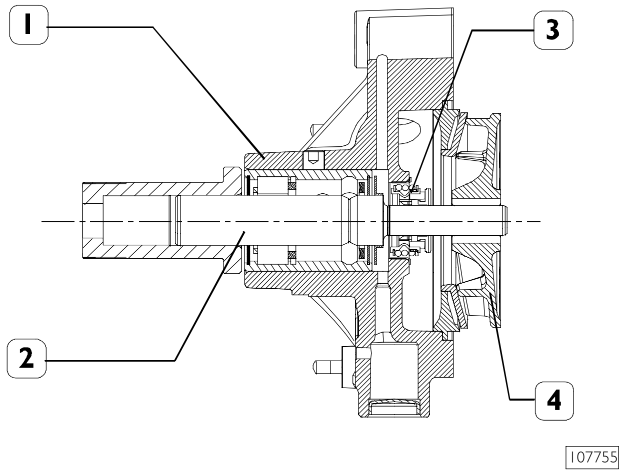
With climate control system
With pressure in the system

it turns on	18.5 ± 0.98 bar
it turns off	14.58 ± 0.98 bar

543210 Water pump

The water pump cannot be overhauled. In case of coolant leaking from the seal or damage, it must be replaced.

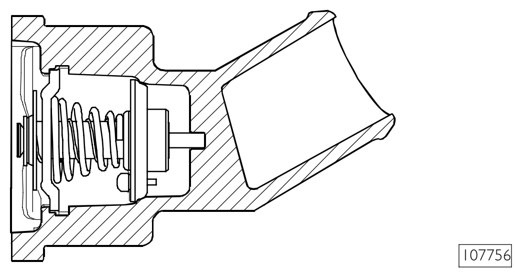
Figure 302



LONGITUDINAL CROSS-SECTION OF THE WATER PUMP
1. Pump casing – 2. Pump drive shaft together with bearing – 3. Seal – 4. Impeller.

543250 Thermostat

Figure 303

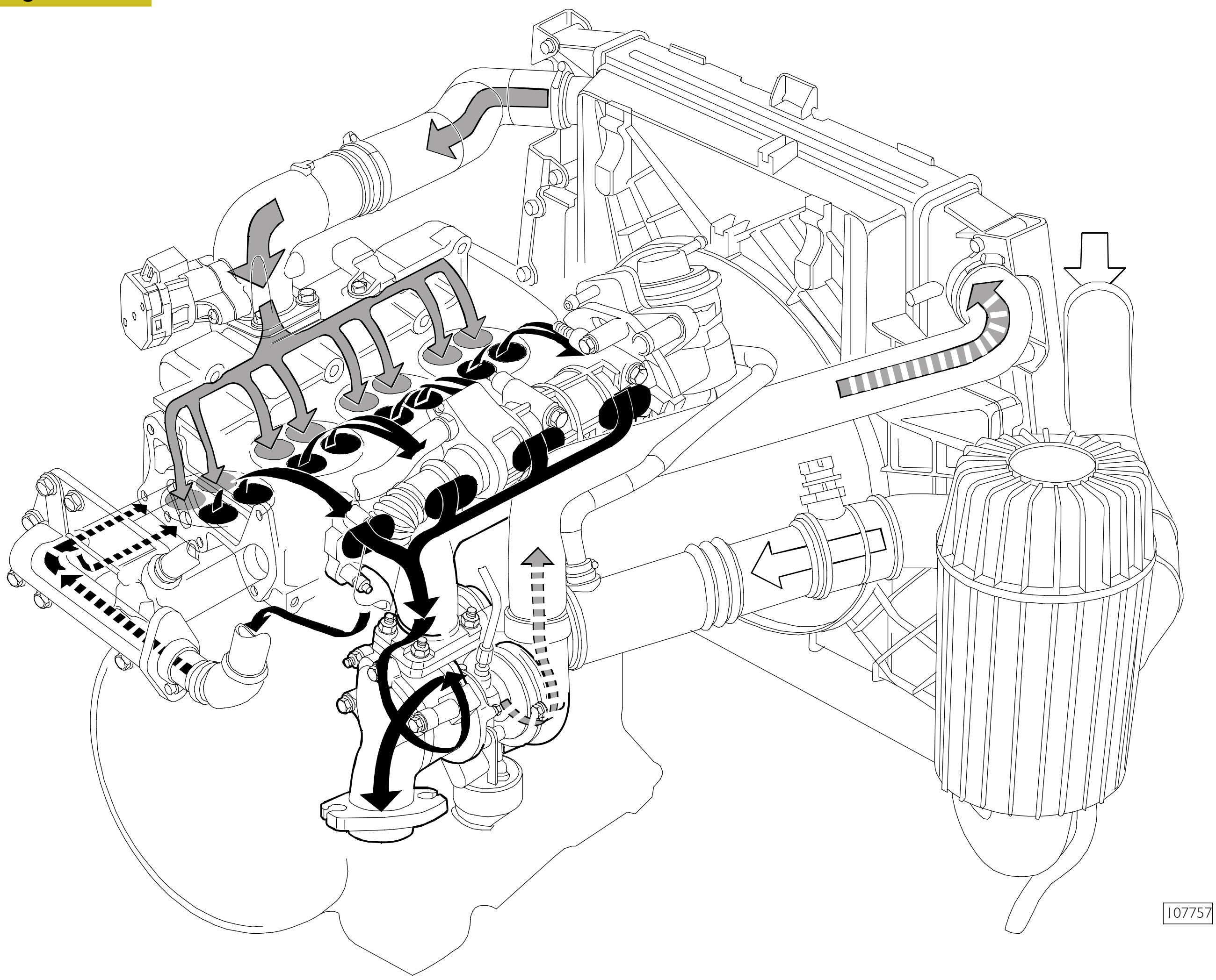


The by-pass thermostat (1) needs no adjustment.
If there is any doubt about its operation, replace it.
The thermostat casing is fitted with the thermometric switch/transmitter and water temperature sensor.

Valve travel at 79 + 2 5C = 0.1 mm
Valve travel at 94 + 2 5C, min. 7 mm

TURBOCHARGING

Figure 304



HOT AIR AT ATMOSPHERIC TEMPERATURE
HOT COMPRESSED AIR
COLD COMPRESSED AIR
EXHAUST GAS
COLD EXHAUST GAS

TURBOCHARGING DIAGRAM

Description

The turbocharging system comprises an air filter, turbocharger and intercooler.
The air filter is the dry type comprising a filtering cartridge to be periodically replaced.

The function of the turbocharger is to use the energy of the engine's exhaust gas to send pressurized air to the cylinders.
The intercooler comprises a radiator included in the engine coolant radiator and its function is to lower the temperature of the air leaving the turbocharger to send it to the cylinders.

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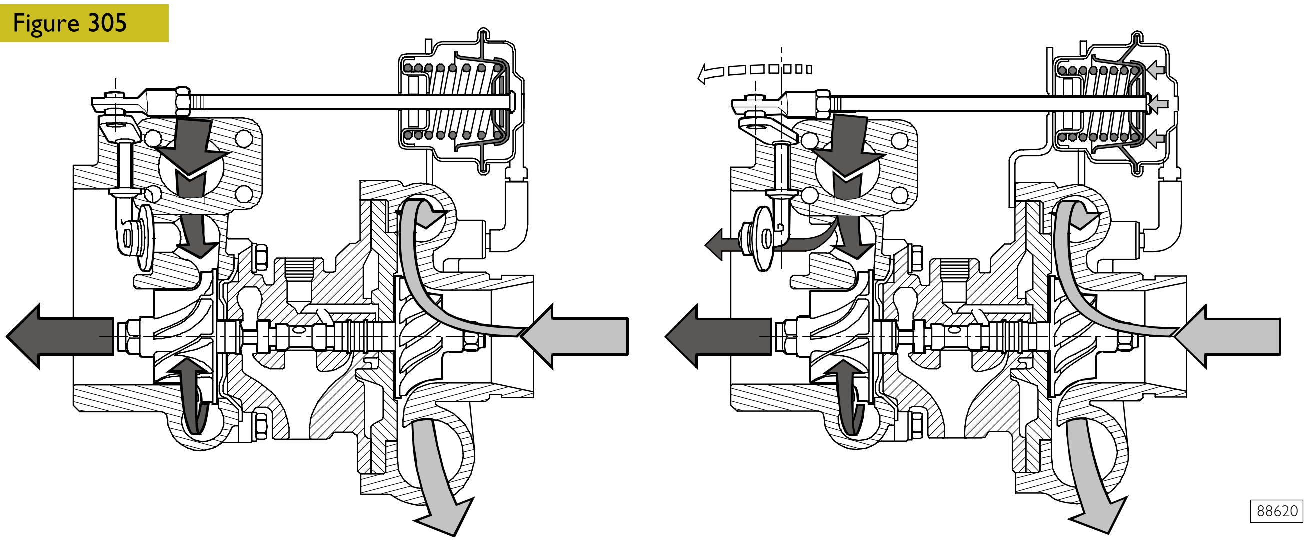
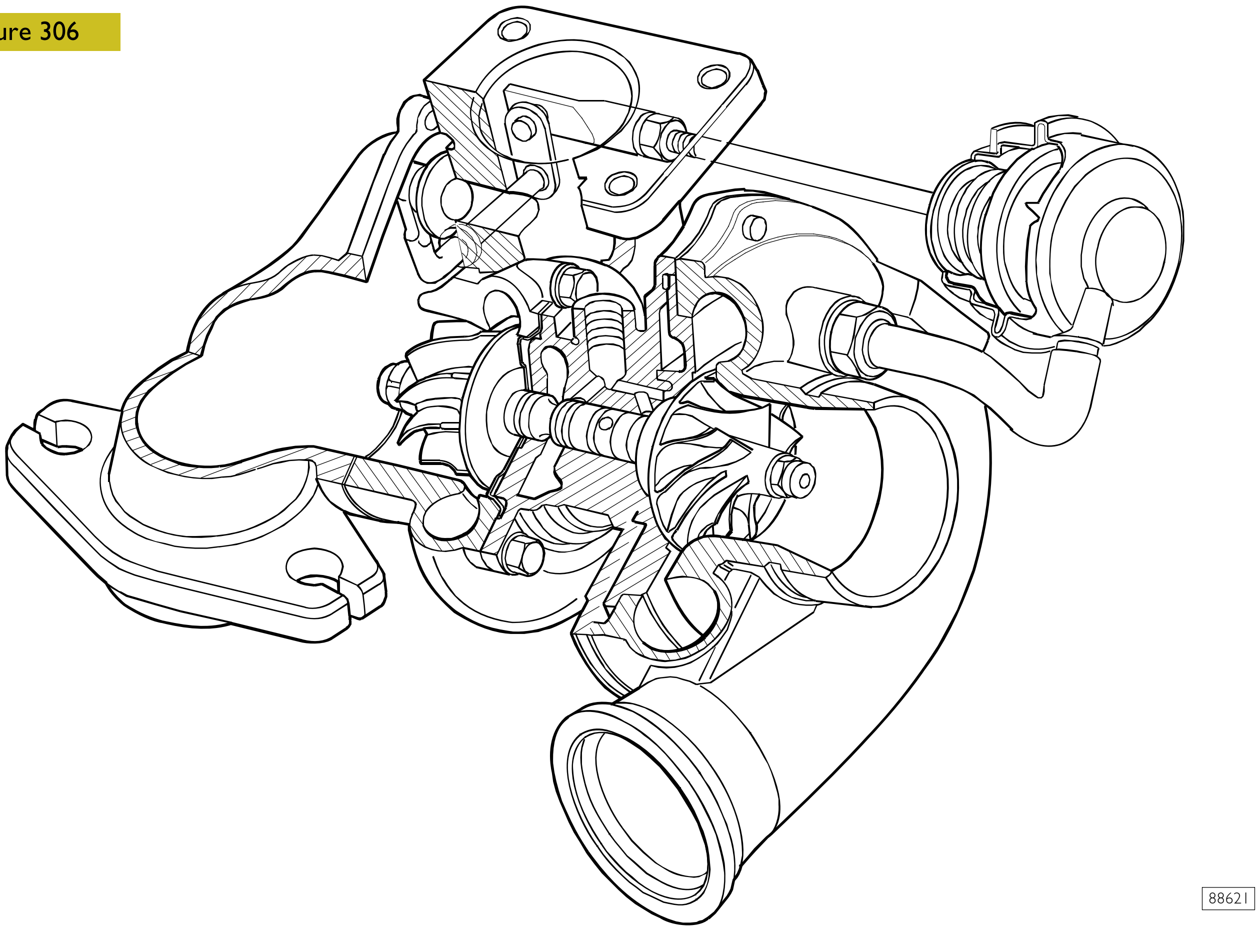
542410 Turbocharger type MITSUBISHI TD 4 HL-13T - 6

Figure 305



A. THROTTLE VALVE SHUT B. THROTTLE VALVE OPEN

Figure 306



The turbocharger installed on the engine F1C AE0481 F (146 CV) is fitted with pressure relief valve (waste-gate).
It is basically composed of:

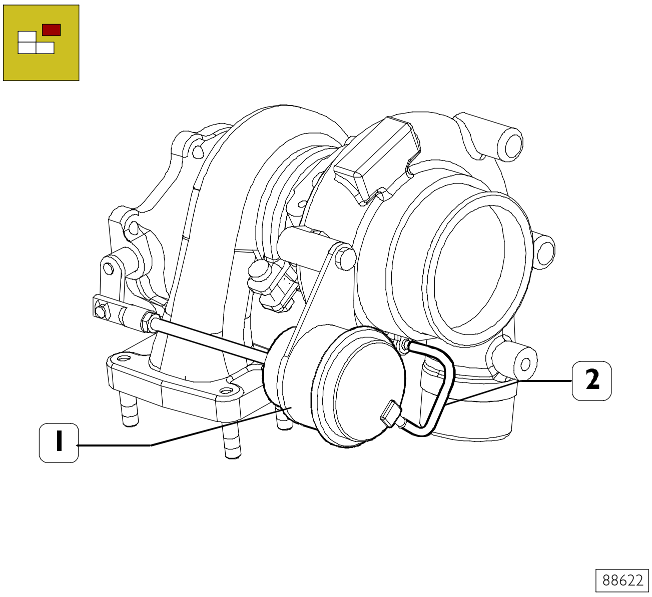
- ❑ a central casing housing a shaft supported by bushings at whose opposite ends are fitted the turbine wheel and the compressor rotor;
- ❑ a turbine casing and a compressor casing mounted on the end of the central body;
- ❑ a pressure relief valve applied on the turbine body. Its function is to choke the output of the exhaust gases (detail B) and send part of them directly into the exhaust pipe, when the supercharging pressure downstream of the turbocharger is above the rated valued;

REPAIRS

NOTE On finding irregular engine operation due to the turbocharging system, it is first expedient to perform the checks on the turbocharger, check the efficiency of the seals and the fixing of the couplings, additionally checking there is no clogging in the intake sleeves, air filter or radiators. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not burst or clogged, in which case replace them or eliminate the trouble.

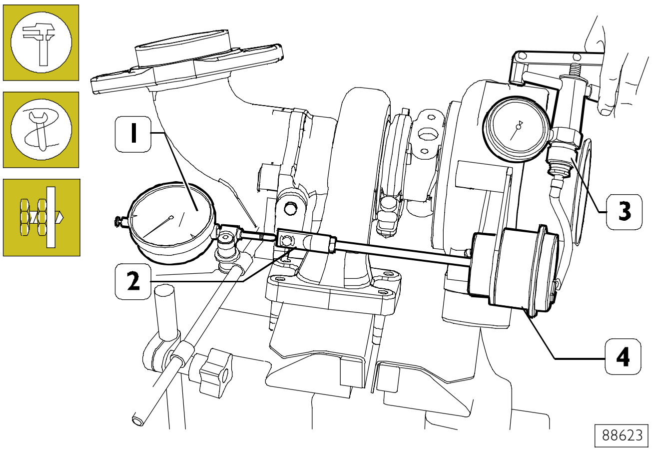
542418 Pressure relief valve
Pressure-relief valve check

Figure 307



Cover the air, exhaust gas and lubricating oil inlets and outlets. Thoroughly clean the outside of the turbocharger using anticorrosive and antioxidant fluid. Disconnect the pipe (2) from the union of the pressure relief valve (1) and fit on it the pipe of the device 99367121 (3, SENZA CODICE).

Figure 308



Rest the tip of the dial gauge (1) with a magnetic base on the end of the tie rod (2) and zero it. Using the device 99367121 (3), introduce compressed air into the valve casing (4) at the prescribed pressure and make sure this value stays constant throughout the check; replace the valve if it doesn't. In the above conditions, the tie rod must have made the prescribed travel.

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542410 GARRET GT 2260 V variable geometry turbosupercharger

General

The variable geometry turbosupercharger consists of the following:

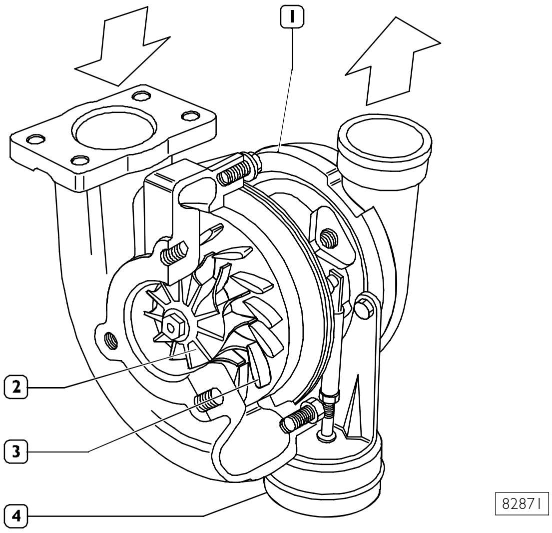
- centrifugal supercharger (1);
- turbine (2);
- set of mobile blades (3);
- mobile blade control pneumatic actuator (4), vacuum controlled by proportional solenoid valve controlled by EDC 16 ECU.

Variable geometry enables:

- to increase the speed of the exhaust gases running into the turbine at low engine rpm;
- to decrease the speed of the exhaust gases running into the turbine at high engine rpm.

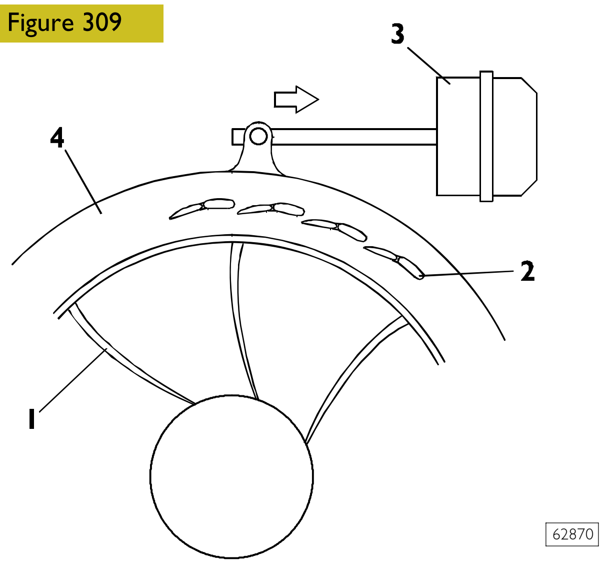
To obtain the max. engine volumetric efficiency also at low rpm (with on-load engine).

Figure 310



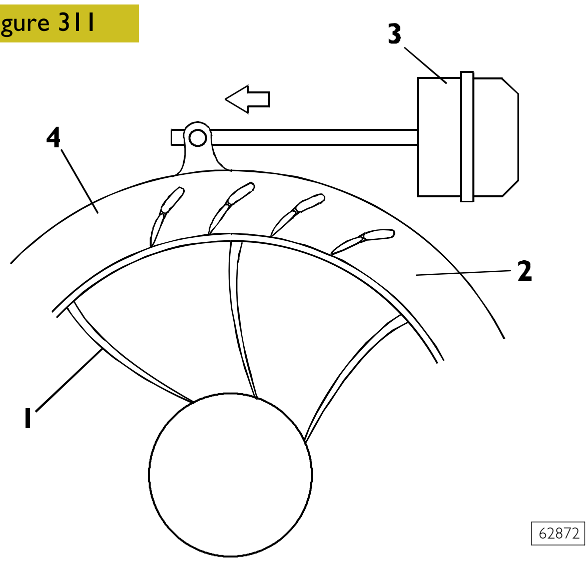
Operation at low engine rpm

Figure 309



Operation at high engine rpm

Figure 311



1. TURBINE - 2. MOBILE BLADES - 3. PNEUMATIC ACTUATOR - 4. REVOLVING RING

When engine is running at low speed, the exhaust gases show weak kinetic energy; under these conditions a traditional turbine shall rotate slowly, thus providing a limited booster pressure.

In the variable geometry turbine (1), the mobile blades (2) are set to max. closed position and the small through-sections between the blades increase the inlet gas speed. Higher inlet speeds involve higher tip speeds of the turbine and therefore of the turbosupercharger.

Engine speed increase results in a gradual increase of exhaust gas kinetic energy, and also in turbine (1) speed and booster pressure increase.

The ECU, through the actuator control solenoid valve, modulates the vacuum acting on the diaphragm, so actuator (3) controls through the tie rod, the gradual opening of the mobile blades (2) until reaching the max. open position.

Blade through-sections results larger thus producing a speed decrease in exhaust gas flow through the turbine (1) with speeds equal to or lower than those of the low rpm condition.

Turbine (1) speed is therefore adjusted to a proper value enabling suitable engine operation at high speeds.

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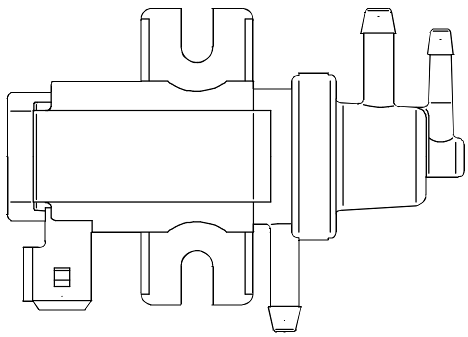
Proportional solenoid valve controlling turbocharger actuator

Figure 312

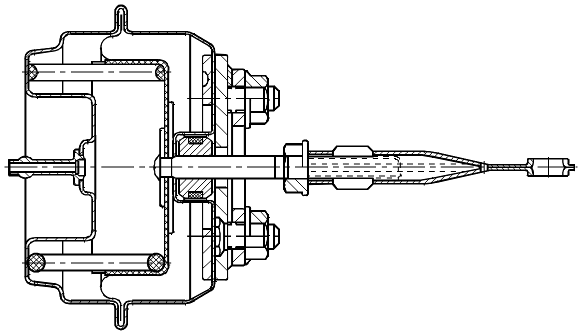


The solenoid valve modulates the low pressure controlling the turbocharger actuator, taken from the air circuit of the servo brake, according to the information exchanged between the electronic control unit and the sensors: engine speed, throttle pedal position and pressure/temperature fitted on the intake manifold.

As a result, the actuator varies the opening of the blades of the turbocharger that adjust the flow of exhaust gases.

Actuator

Figure 314

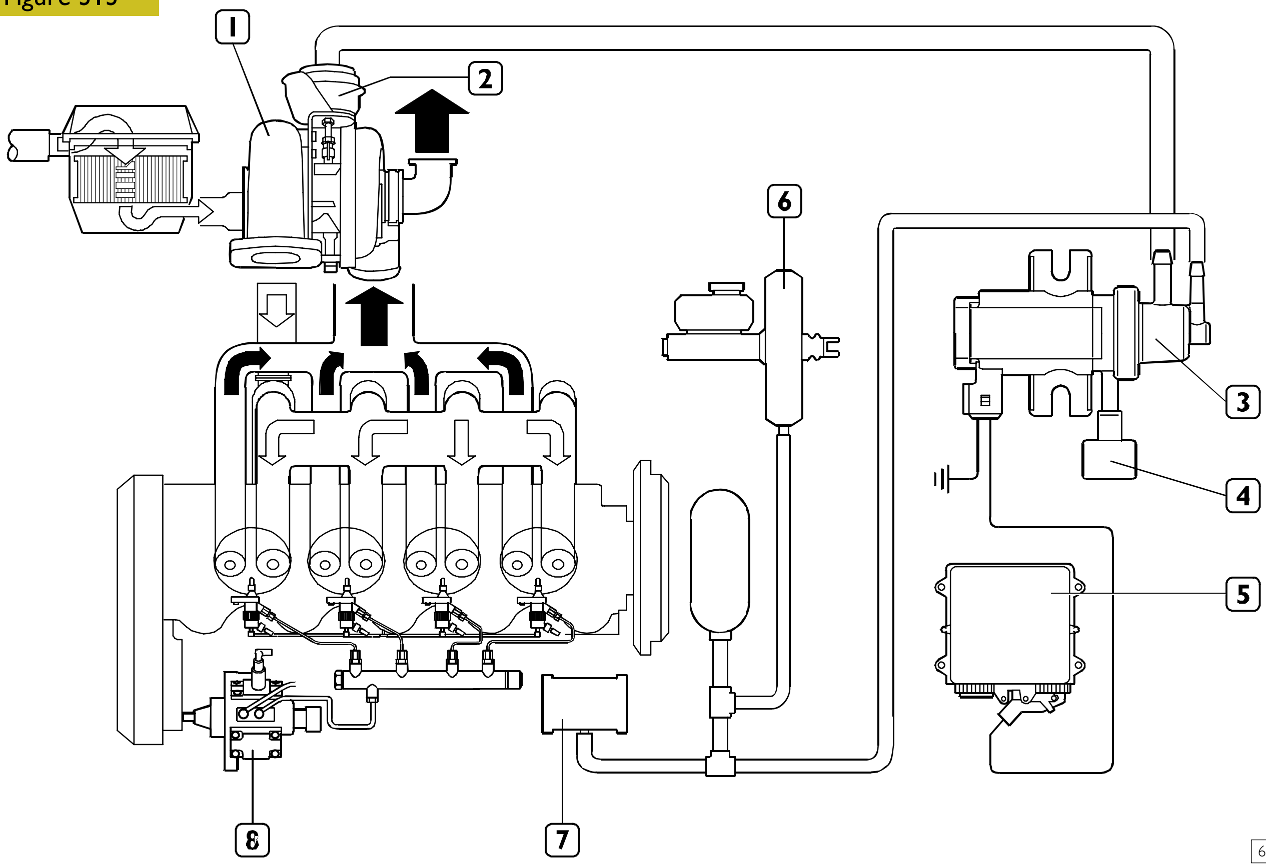


SECTION ON THE ACTUATOR

The actuator diaphragm, connected to the control rod, is governed by the low pressure on the top of the actuator.

The low pressure modulated by the proportional solenoid valve varies the movement of the diaphragm and, as a result, of the rod governing the turbine's mobile blades.

Figure 313



TURBOCHARGING FUNCTIONAL DIAGRAM

1. Variable geometry turbocharger - 2. Pneumatic actuator - 3. Proportional solenoid valve - 4. Air filter - 5. EDC 16 control unit - 6. Servo brake - 7. Vacuum device - 8. High-pressure pump.

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REPAIRS

542451 Checking and adjusting the actuator

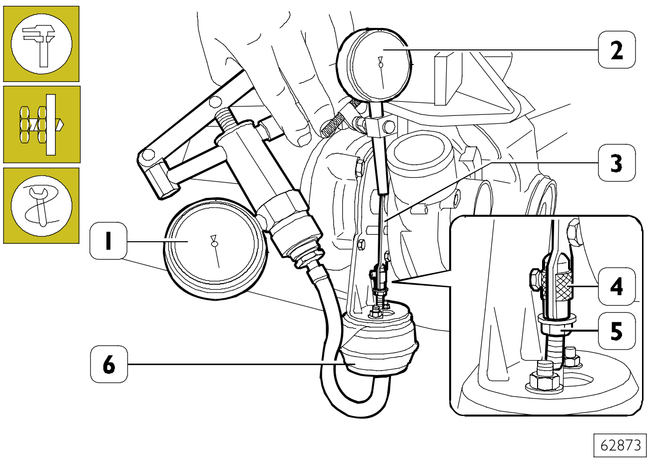
NOTE NOT ALLOWED ARE:

- **any replacement or regulation of the actuator, since the calibration of such component is made in an optimal way for each turbocharger and is guaranteed for the turbocharger;**
- **any operation on nut (5) and ring nut (4), since such operation does not change engine supply characteristics but may impair engine reliability and duration.**

Ring nut (4) is sealed with antitempering yellow paint.

In case of engines under guarantee, each above specified intervention and/or alteration to paint applied on ring nut (4) causes the lapse of the guarantee.

Figure 315



Cover air, exhaust gas and lubricant inlets and outlets.

Clean the turbosupercharger outside accurately using anticorrosive and antioxidant fluid and check the actuator (6).

Clamp the turbosupercharger in a vice.

Apply vacuometer 99367121 (1) pipe to actuator (6) hose.

Apply the magnetic base gauge (2) to exhaust gas inlet flange in the turbine.

Set gauge (2) feeler pin on tie rod (3) end and set gauge (2) to zero.

Operate the vacuum pump and check whether the tie rod (3) stroke values correspond to the vacuum values shown in the following table:

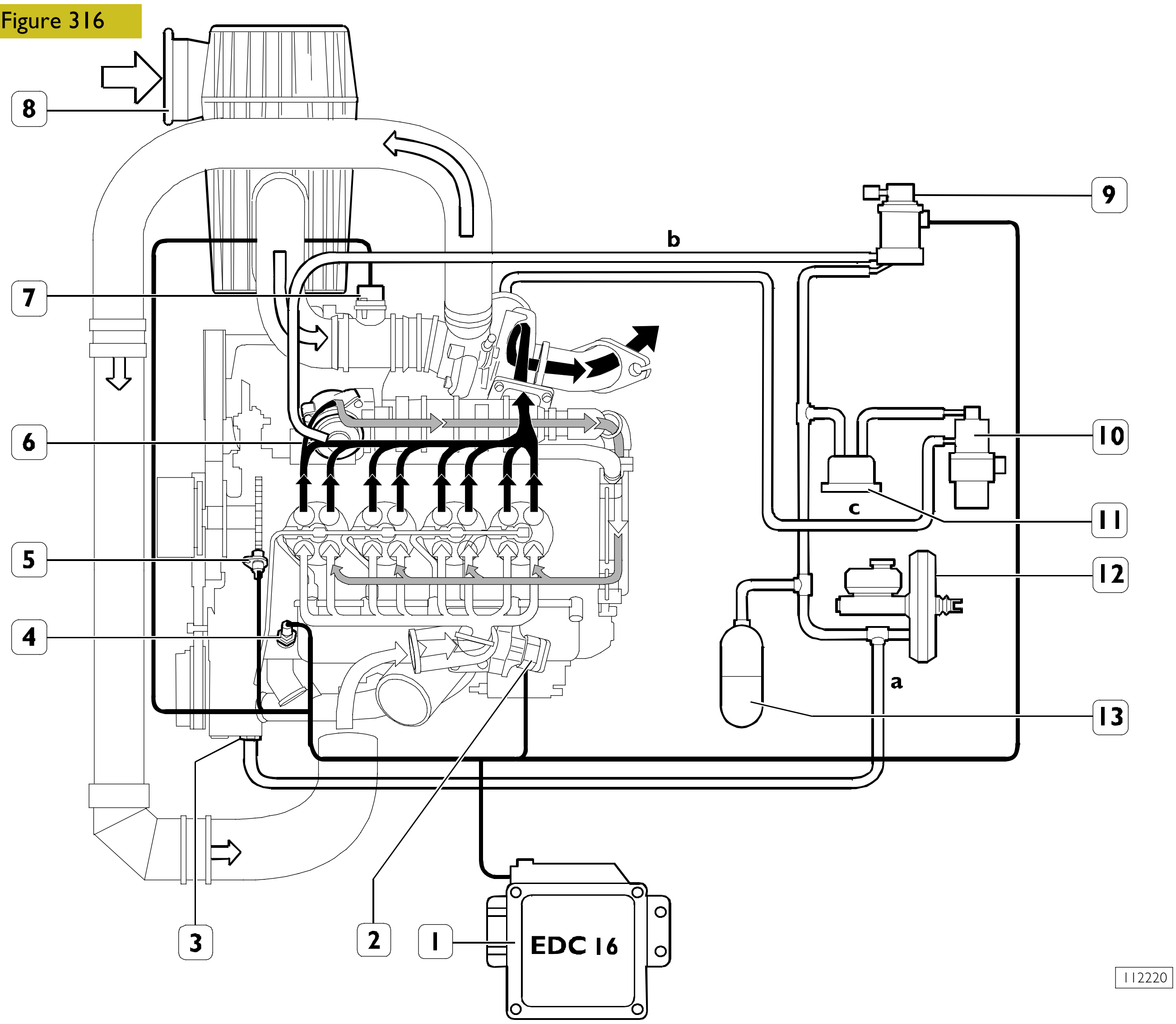
- vacuum 0 mm Hg	Fully open valve
- vacuum 0,2 bar	Valve stroke 0,5 ÷ 2,5 mm
- vacuum 0,64 bar	Valve stroke 9,5 ÷ 11,5 mm

Where a different value is found, replace turbocharger.

NOTE During the check the vacuum value shall not fall, otherwise the actuator shall be replaced.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Figure 316



a. Servo brake vacuum circuit - b. E.G.R. modulated vacuum circuit -
c. V.G.T. modulated vacuum circuit

1. Electronic control unit - 2. Throttle valve assembly - 3. Vacuum connector - 4. Water temperature sensor - 5. Engine revs sensor - 6. E.G.R. pneumatic valve - 7. Air flow meter - 8. Inlet air filter - 9. EGR modulating solenoid valve - 10. VGT actuator modulating solenoid valve (if any) - 11. Auxiliary vacuum tank (vehicles equipped with 176 HP engines) - 12. Vacuum servo brake - 13. Vacuum tank

Operating

The E.D.C. electronic control unit E.D.C. processes the information from the atmospheric pressure sensor, water temperature sensor, engine revs sensor and accelerator pedal potentiometer. It drives, according to ways and procedures properly programmed within its own memory, both the modulating solenoid valve and the throttle valve by means of a PWM signal.

The modulating solenoid valve will, every time is it driver by the E.D.C. control unit 16, communicate the servo brake vacuum circuit with the E.G.R. one. A vacuum value will be obtained within the EGR circuit, depending on the control signal.

Such vacuum will act on the E.G.R. pneumatic valve membrane, by withdrawing and lifting the shutter that normally obstructs the passage of the exhaust gas towards the intake.

Thus, the exhaust gas, passing through the heat exchanger where it is cooled, will be conveyed into the throttle valve assembly chamber where it will be mixed with the air from the intercooler and made to flow out into the inlet manifold.

If the vehicle is equipped with the D.P.F. catalyst, the EDC control unit 16 will simultaneously adapt the flow rate of fuel to be injected into the cylinders, depending on the amount of circulated exhaust gas.

During the engine operating phases not requiring gas circulation (e.g. particulate filter regeneration, start-up, engine cold, idle running, load demands, vehicle running at high altitudes), the control unit control signal to the modulating solenoid valve will be cancelled. The solenoid valve will close the connection between the servo brake vacuum circuit and the E.G.R. one, and will simultaneously resume the atmospheric pressure within the E.G.R. circuit.

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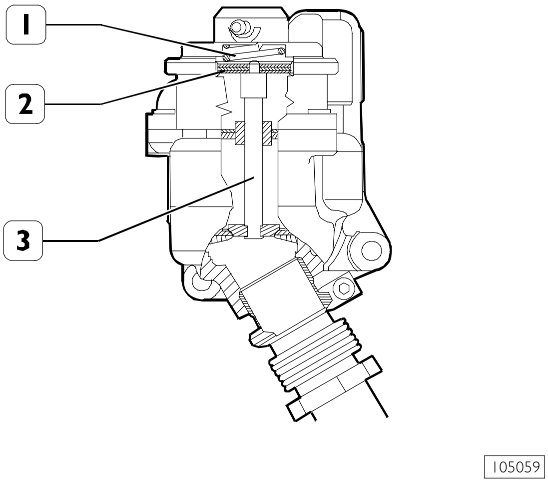
Main system components

540744 E.G.R. valve

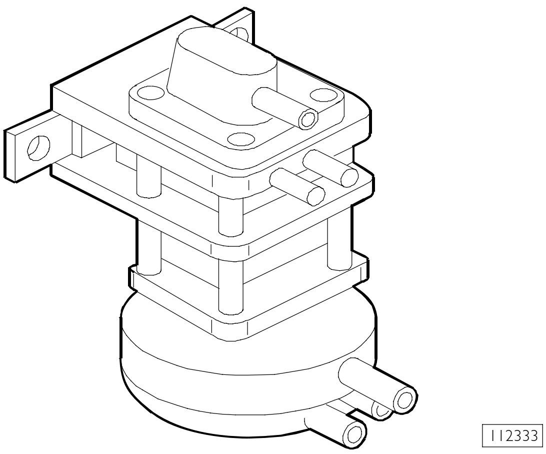
Figure 317



The E.G.R. valve is fitted to the heat exchanger end.
To ensure optimum valve efficiency and service life, the valve is cooled by the engine coolant flowing out of the heat exchanger.
The amount of circulating gas is controlled by means of a mushroom valve pneumatically controlled through the vacuum drawn, by means of a calibrated-section connector, from the pipe connecting the vacuum pump with the servo brake.
The control vacuum modulated by the solenoid valve will overcome the force generated by counter spring (1) and will lift membrane (2) connected with shutter (3) which will move upwards and allow burnt gas to circulate towards the inlet manifold.

540746 Modulator solenoid valve

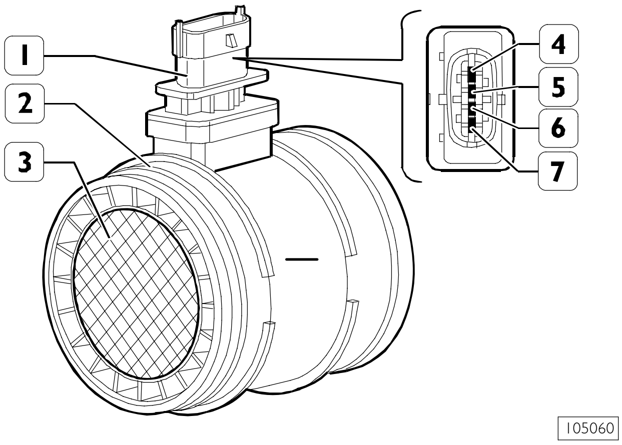
Figure 318



The modulating solenoid valve is an integral part to the vacuum pipes for the E.G.R. system and the servo brake.
A proportional solenoid valve modulates the E.G.R. valve control vacuum depending on the PWM signal generated by EDC control unit 16.

772652 Air flow rate meter (flow meter)

Figure 319



1. Connector - 2. Flow meter body - 3. Recirculated oil vapours air inlet grid - 4. Power supply - 5. Earth - 6. Inlet air temperature sensor - 7. Flow rate output signal.

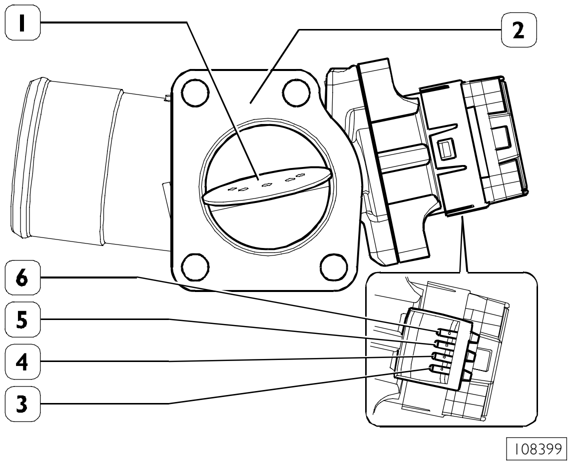
The air flow meter is of the hot-film type and is placed between the turboblower and the intercooler.
The air flow meter incorporates the sucked air temperature sensor.

NOTE The air flow meter body bears an arrow which indicates the air flow and, therefore, the correct assembling of the meter on the vehicle.

Operating
The operating principle is based on a heated membrane put in a measuring channel through which the intake air directed to the engine flows.
The hot-film membrane is kept at a steady temperature (approximately 1205C higher than the incoming air temperature) by the heating resistor.
The air mass flowing through the measuring channel tends to take heat away from the membrane; therefore, the current shall go through the resistor in order for the membrane to be kept at a steady temperature.
The absorbed current is proportional to the air mass flowing to the engine. It can be measured by means of a Wheatstone bridge, and the signal obtained will be sent to the electronic control unit.
If the vehicle is equipped with a D.P.F. catalyst, the control unit program will feature a function capable of correcting the flow rate meter deviation in time. The control unit will, during vehicle deceleration with the pedal released (overrun), carry out a few checks, thus determining correction factors for the flow rate meter readings (self-adapting process). The replacement of the flow rate meter will therefore involve a self-correction process.
If the control unit is replaced, the flow rate meter correction coefficients (ZFC) stored in the old control unit shall be copied and entered into the new control unit. If this is not possible, they shall be reset, and the self-learning process shall be initiated.

540760 Throttle valve assembly

Figure 320



1. Throttle valve - 2. Electric actuator - 3. Throttle position signal - 4. Ground - 5. Voltage - 6. PWM signal

The throttle valve (N.O.) assembly, fitted on the inlet manifold, controls the amount of air from the intercooler, to be mixed with the exhaust gas made to circulate by the E.G.R. valve, according to a programmed percentage.

The circulated exhaust gas will be mixed with the air from the intercooler within a duct obtained in the cylinder head.

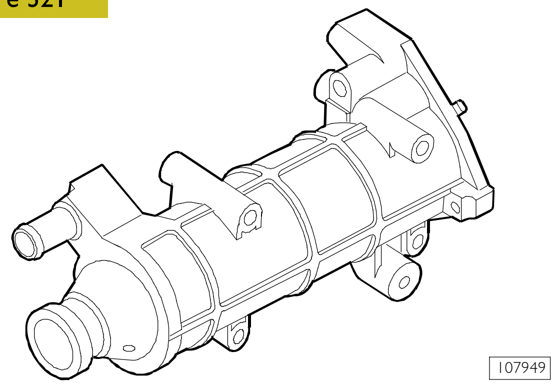
The throttle valve is operated by an electric actuator controlled by a PWM signal from EDC control unit 16.

In the event that the throttle valve gets stuck, the control unit will reduce the engine performance to avoid possible damage to the engine itself.

When the engine is switched off, the throttle valve will closet o reduce the engine noise during this phase.

540730 Heat exchanger

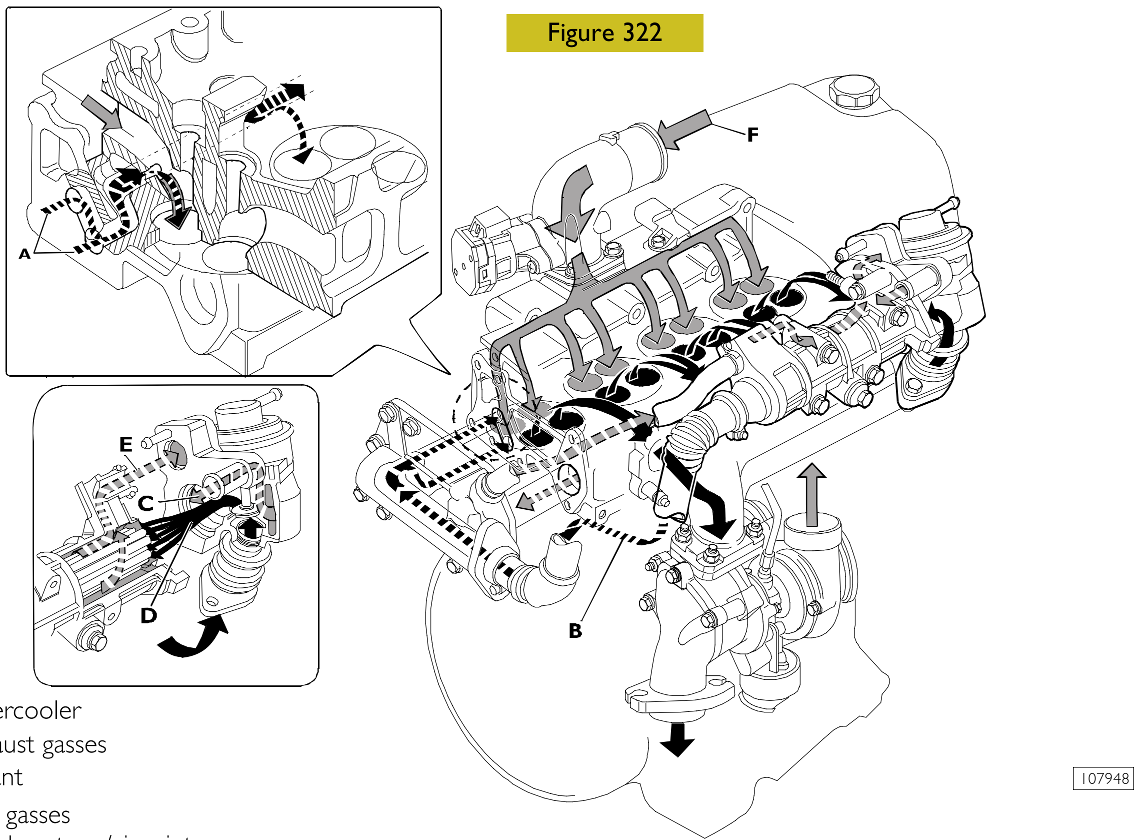
Figure 321



The heat exchanger fitted between the turboblower and the throttle valve assembly is used to lower the exhaust gas temperature in order to accordingly reduce the volume of the same.

It consists of a body that incorporates a number of corrugated pipes. The circulated exhaust gas flowing through the pipes are cooled by the engine coolant flowing inside the body.

Figure 322



Air from intercooler
Cooled exhaust gasses
Engine coolant
Hot exhaust gasses
Circulated exhaust gas/air mixture

EXHAUST GAS COOLING SCHEME

A. Intake exhaust gasses - B. Cooled exhaust gasses - C. Coolant to heater - D. E.G.R. valve exhaust gasses - E. Coolant incoming from cylinder head - F. Air from intercooler

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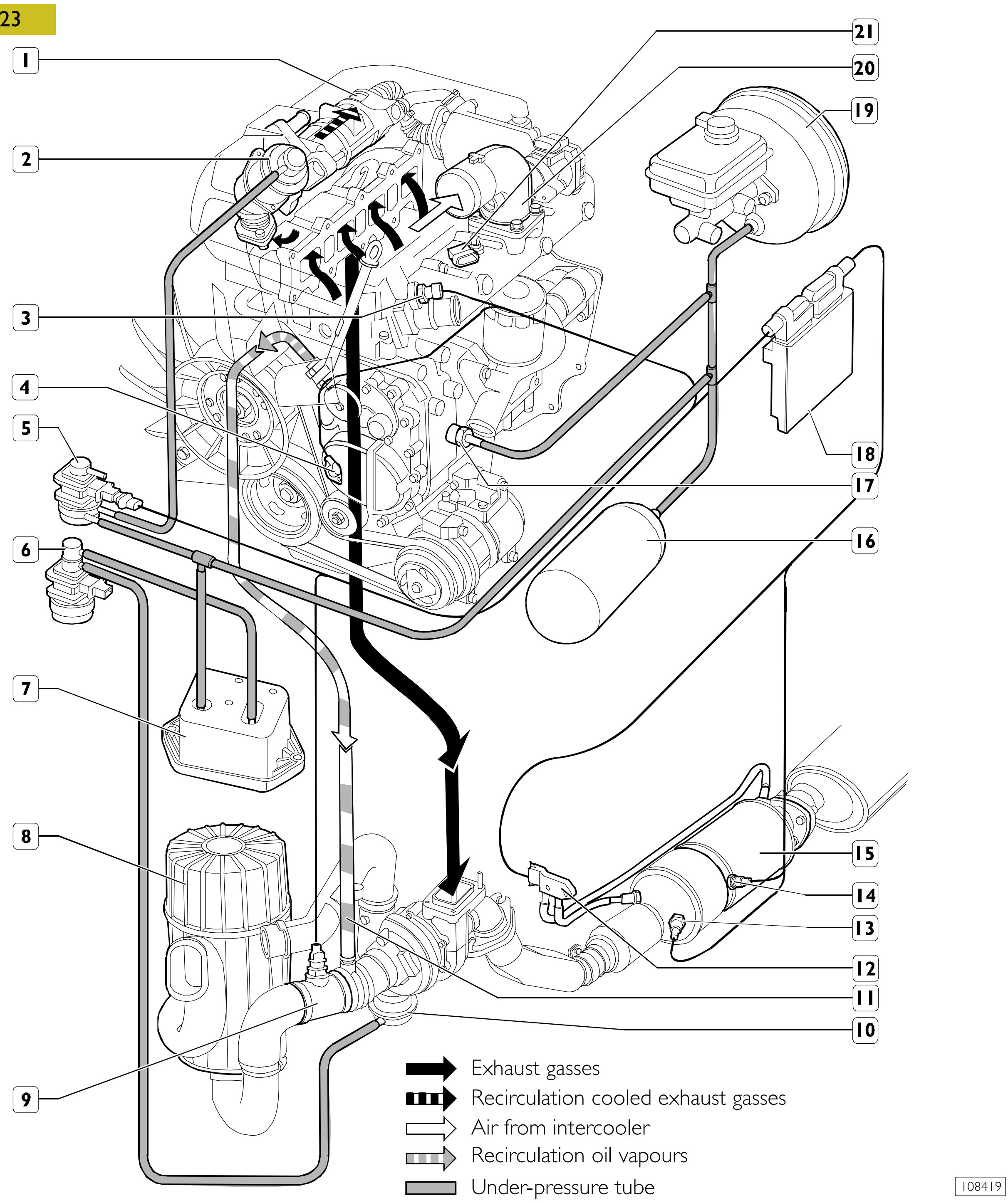
EXHAUST SYSTEM REMOVAL-REFITTING

Figure 323



1. E.G.R. heat exchanger - 2. E.G.R. valve - 3. Engine coolant temperature sensor - 4. Engine revs sensor - 5. E.G.R. modulating solenoid valve - 6. V.G.I. modulating solenoid valve - 7. Vacuum tank (only vehicles equipped with 176 HP engines) - 8. Air filter - 9. Air flow rate meter (air flow meter) - 10. VGT actuator (176 HP engine) - 11. Oil vapour circulating pipe - 12. Differential pressure sensor (delta p) - 13. Incoming exhaust gas temperature sensor - 14. Outgoing exhaust gas temperature sensor - 15. DPF catalytic silencer - 16. Vacuum tank - 17. Vacuum pump connector - 18. EDC control unit 16 - 19. Servo brake - 20. Throttle valve assembly - 21. Air pressure/temperature sensor.

General

To keep the exhaust emission levels of pollutants such as nitric oxides (NOx), hydrocarbons (HC) and particulate (PM) within the limits established by the Euro 4 standard, the engine is equipped with an EGR system combined, where applicable, to the DPF catalytic silencer for post-treatment of the aforesaid polluting substances.

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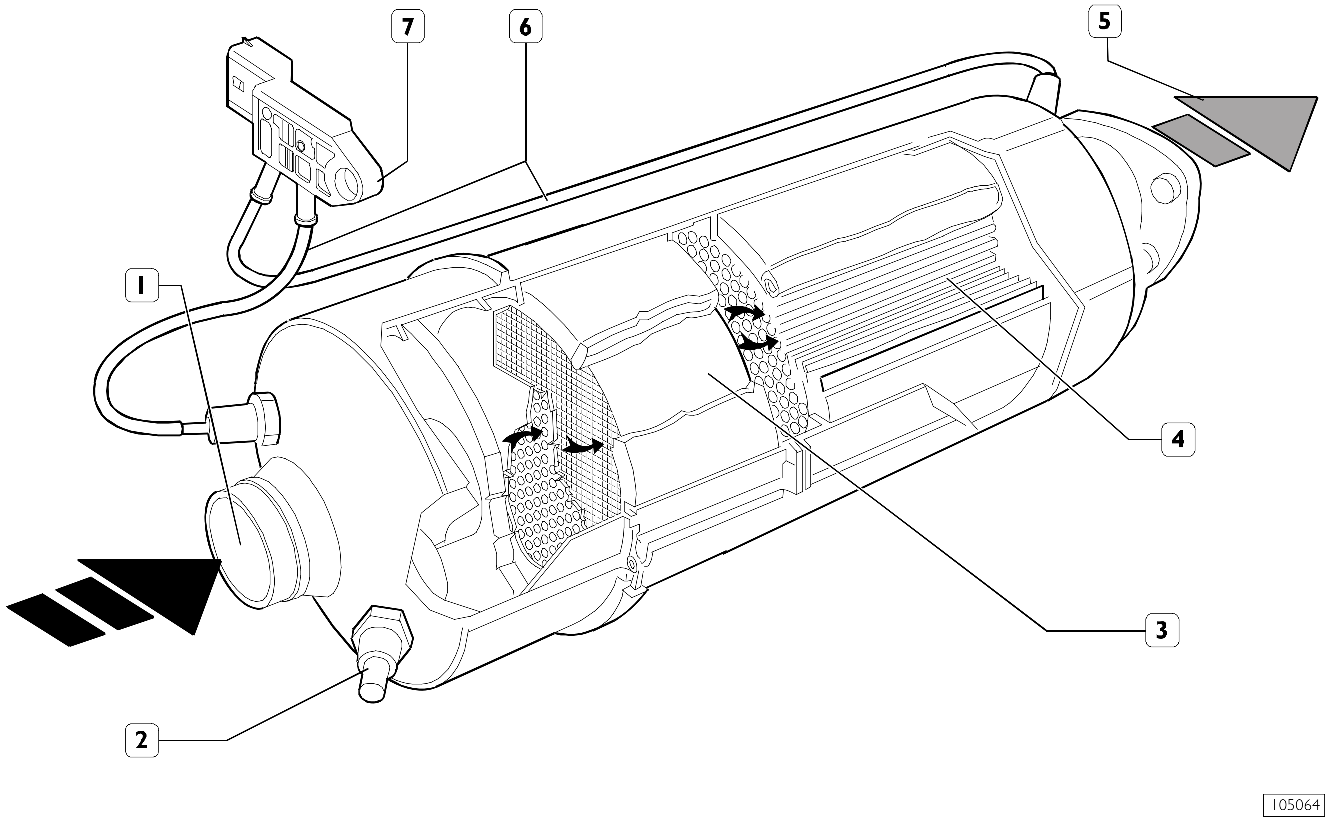
507130 D.P.F. (Diesel Particulate Filter) CATALYST

Figure 324



D.P.F. CATALYST VIEW
1. Exhaust gas inlet- 2. Exhaust gas temperature sensor connection - 3. Catalyst module - 4. Particulate filter - 5. Exhaust gas outlet - 6. Pipes connecting pressure sensor to catalyst - 7. Differential pressure (Δp) sensor

Description

D.P.F. catalyst is made up of an oxidiser catalyst and a particulate filter.
Oxidiser catalyst (3) is an exhaust gas post-treatment device. Active substances, contained in the catalyst, oxidise, at 250 °C÷450 °C temperature, carbon oxide (CO) and hydrocarbons (HC), turning them into carbon dioxide (CO_2) and steam (H_2O).

Catalyst module is made up of a ceramic structure impregnated with platinum, as platinum is a catalysing substance in oxidation reactions. Exhaust gasses heat the catalyst, so triggering the conversion of pollutants into inert compounds.

Particulate filter (4), connected to the catalyst, has a double task: retaining particulate particles (PM) depositing between the pores of the ceramic structure of which the filter is made up and working as a particulate particles combustion chamber when the filter is being clogged.

If filter interior is kept at a temperature higher than 530 °C and oxygen percentage is higher than 8% (oxygen being produced by the decomposition of nitrogen oxide NO_2), then some combustion reactions, boosted by the catalyst put before the filter, burn particulate particles (regeneration), so keeping the filter clean.

On the contrary, if its temperature is lower, the filter is clogged, with negative effects, on counterpressure, on exhaust gasses generated by the filter.

In this case, to regenerate the filter, temperature of exhaust gasses is artificially raised (up to 630 °C) by fuel post-injection.

A differential pressure sensor (7), connected to D.P.F. catalyst, as it detects a pressure difference between inlet and outlet, sends a (feed-back) signal to the central unit to warn about particulate filter possible clogging.

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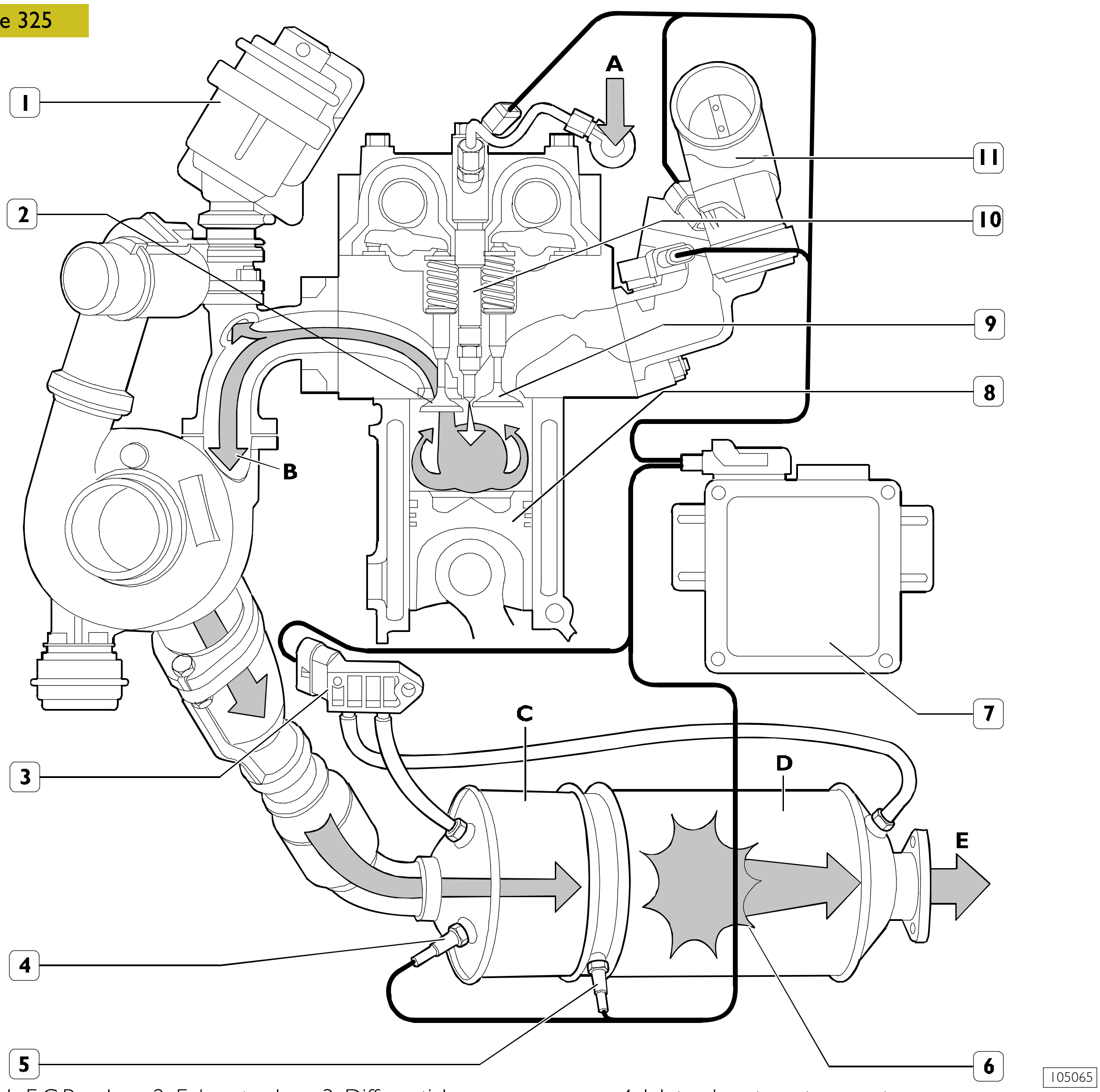
SYSTEM TO REDUCE POLLUTANTS AT EXHAUST

Figure 325



1. E.G.R. valve - 2. Exhaust valve - 3. Differential pressure sensor - 4. Inlet exhaust gas temperature sensor - 5. Outlet exhaust gas temperature sensor - 6. D.P.F. catalysed silencer - 7. E.D.C. 16 central unit - 8. Piston - 9. Inlet valve - 10. Electrical injector - 11. Throttle valve
A. Post-injection - B. Exhaust gasses heated by post-injection - C. Catalyst - D. Particulate filter - E. Purified exhaust gasses

Operation

Particulate filter regeneration is managed by engine E.D.C. 16 central unit. The central unit, based on the temperature of exhaust gasses detected by sensors (3 and 4) and particulate filter clogging grade detected by differential pressure sensor (3), when exhaust valve (2) is closing at about 1°÷3° from T.D.C., causes electrical injectors (8) to inject small quantities of fuel into the cylinders. The combustion of this fuel increases the temperature of flowing gasses.

At the same time, the central unit shuts out:

- ❑ Throttle valve (11), to prevent, at opening start, air from entering through inlet valve (9), as air would cool exhaust gasses;
- ❑ E.G.R. valve (1), to prevent recirculated oil vapours and gasses produced by post-injection from being sucked into the cylinders.

Exhaust gasses, so heated enter into the silencer, where, passing through the catalyst, the pollutants they are composed of (nitrogen oxides) are reduced or transformed into inert substances (carbon dioxide - steam), then pass into particulate filter where the regeneration process takes place: exhaust gas high temperature causes the combustion of particulate particles accumulated in the filter.

Particulate filter regeneration is realised when following conditions are present:

- catalyst inlet exhaust gas temperature >230 °C with the help from post-injection;
- exhaust gas temperature in particulate filter >530 °C with presence of free oxygen having a percentage >8%;
- minimum time of permanence in above conditions >10'.

Forced regeneration

In order that a regeneration can take place, following conditions are necessary:

- exhaust gas temperature >530 °C at particulate filter inlet and free oxygen present (>8%);
- oxicat inlet gas temperature >230 °C with the help from post-injection;
- minimum time of permanence in such conditions approximately >10 minutes.

In many cases of doubts about particulate filter cleanness actual conditions and/or of impossibility to regenerate it owing to very particular engine/vehicle running conditions (persistent idling, very slow speeds and very frequent stops), a safety forced regeneration has to be performed.

Independently of all parameters activating the regeneration, the engine is taken to run without load to a point where exhaust gasses have a temperature (>230 °C) such as to activate the reaction in the Oxicat in presence of post-injection.

The only limit to this operation is the presence in the filter of a particulate quantity that is in excess, being anyhow calculated by the central unit and set as a condition to regeneration startup.

Refilling engine oil

During vehicle use, the central unit counts post-injected fuel quantity in order to activate and maintain particulate filter regeneration.

A small quantity of this fuel, which is injected into the cylinders after combustion has already taken place and remains partially unburnt, leaks out through pistons spring rings into oil sump, accumulating to lubrication oil. Although a part of it, evaporating, will be burnt in the engine through recirculation system, its remaining part can degrade oil characteristics, impairing its functionality.

Quantity of accumulated fuel may increase in case of catalyst or engine inefficiency, and vehicle use in conditions of low temperature and/or small amounts of miles covered.

The central unit counts the amounts of post-injections and consequently determines the quantity of fuel accumulated in engine oil, and warns about refilling needed.

If, after refilling engine oil, the function is not reset, the central unit will keep on counting fuel accumulation increase even with new oil, with consequent engine oil refilling warning.

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FUEL SUPPLY

HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM (EDC 16)

General

The main characteristics of the high pressure electronic injection system are:

- high injection pressures available (1600 bar);
- these pressures can be modulated between 150 bar up to the maximum operating pressure of 1600 bar, irrespective of the speed of rotation and engine load;
- capacity to operate at very high speeds (up to 6000 rpm);
- injection control precision (injection duration and advance);
- lower consumption;
- lower emissions.

The main functions of the system are basically as follows:

- checking fuel temperature;
- checking engine coolant temperature;
- checking amount of fuel injected;
- checking idling speed;
- cutting off fuel in release phase;
- checking cylinder balancing when idling;
- checking anti-sawing;
- checking smokiness at exhaust on acceleration;
- checking exhaust gas recirculation (E.G.R. if present);
- checking top speed limit;
- checking glow plugs;
- checking activation of air-conditioning system (if any);
- checking auxiliary fuel pump;
- checking position of cylinders;
- checking main and pilot injection advance;
- checking closed cycle of injection pressure;
- checking turbocharging pressure;
- self-diagnosis;
- connection with immobilizer unit;
- checking maximum torque limitation.

The system makes pre-injection (pilot injection) possible before the TDC with the advantage of decreasing the derivative of the pressure in the combustion chamber, lowering the noise level of combustion, which is typical of direct injection engines.
The control unit checks the amount of fuel injected, adjusting the line pressure and injection times.

The information the control unit processes to regulate the amount of fuel to be injected comprises:

- engine speed;
- coolant temperature;
- turbocharging pressure;
- air temperature;
- intake air quantity;
- battery voltage;
- diesel pressure;
- position of throttle pedal.

Figure 326

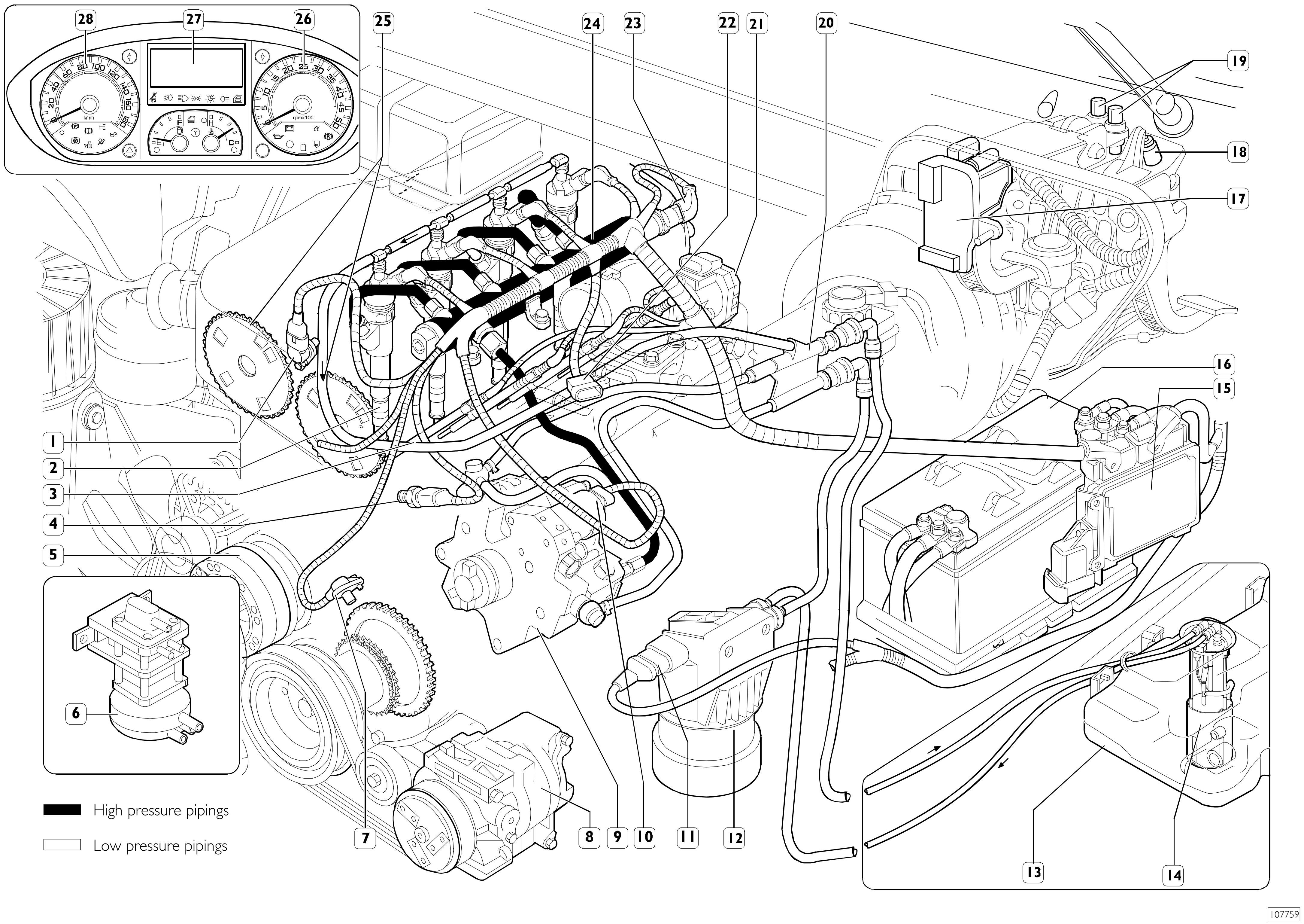

DIAGRAM ILLUSTRATING THE POSITION OF THE ELECTRONIC, HIGH-PRESSURE INJECTION SYSTEM COMPONENTS

1. Phase sensor - 2. Electric injectors - 3. Preheating plug - 4. EDC coolant temperature sensor - 5. Electromagnetic fan - 6. V.G.T. and E.G.R. valve modulator (if any) - 7. Engine revs sensor - 8. Compressor (if any) - 9. High-pressure pump - 10. Pressure regulator - 11. Connector for heater, fuel temperature sensor and fuel filter clogging sensor - 12. Fuel filter - 13. Fuel tank - 14. Fuel gauge with electric fuel pump - 15. Control unit with atmospheric pressure sensor - 16. Battery - 17. Accelerator pedal sensor - 18. Clutch pedal sensors - 19. Brake pedal sensors - 20. Low-pressure fuel pipe assembly - 21. Throttle valve assembly actuator - 22. Air pressure/temperature sensor - 23. Hydraulic accumulator fuel pressure sensor (rail) - 24. Hydraulic accumulator (rail) - 25. Slotted gear for phase detection from sensor (1) - 26. Engine revs counter - 27. Display - 28. Tachograph

SYSTEM OPERATION

Self-diagnosis – BLINK CODE

The control unit self-diagnosis system checks the signals from the sensors, comparing them with the admitted limits (see relative heading):

Immobilizer recognition

When the control unit receives the signal of the key on "MAR" it communicates with the immobilizer control unit to enable starting.

Checking fuel temperature

With the fuel temperature greater than 75°C, detected by the sensor on the fuel filter, the control unit operates the pressure regulator to decrease the line pressure (injection times are not changed). If the temperature exceeds 90°C, the power is reduced to 60%.

Checking engine coolant temperature

The control unit, depending on the temperature:

- of the engine coolant, turbocharging air and fuel, operates the electromagnetic fan (Baruffaldi) and switches on the coolant temperature warning light.

Checking quantity of fuel injected

According to the signals from the sensors and the mapped values, the control unit:

- operates the pressure regulator;
- varies the "pilot" injection time to 2200 rpm;
- varies the "main" injection time.

Checking idling adjustment

The control unit processes the signals from the various sensors and regulates the amount of fuel injected:

- it operates the pressure regulator;
- it varies the injection times of the electro-injectors.

Within certain thresholds the speed takes account of the battery voltage.

Fuel cut-off in release phase

In the phase of releasing the throttle pedal the control unit actuates the following logic elements:

- it cuts off supply to the electro-injectors;
- it partially reactivates supply to the electro-injectors before reaching idling speed;
- it operates the fuel pressure regulator.

Checking cylinder balancing on idling

According to the signals received from the sensors, the control unit controls the regularity of the torque at idling speed:

- it varies the amount of fuel injected into the single electro-injectors (injection time).

Checking regular engine rotation (anti-sawing)

It ensures regular engine rotation at a constant rate while increasing revs.
The control unit processes the signals received from the sensors and determines the amount of fuel to be injected via:

- the pressure regulator;
- the electro-injector opening time.

Checking smokiness at exhaust on acceleration

With heavy acceleration, on the basis of the signals received from the air introduction meter and engine speed sensor, the control unit determines the optimum amount of fuel to inject:

- it operates the pressure regulator;
- it varies the electro-injector injection time.

Checking exhaust gas recirculation (E.G.R.)

Depending on the engine load and the signal from the accelerator pedal sensor, the control unit limits the amount of air taken in, actuating partial suction of the exhaust gases.

Checking top speed limit

Depending on the number of revs, the control unit actuates two action strategies:

- at 4250 rpm it cuts off the fuel, decreasing the electro-injector opening time;
- over 5000 rpm it deactivates the electro-injectors.

Checking regular rotation on acceleration

Regular progression is assured in all conditions by the control of the pressure regulator and the electro-injector opening time.

Checking glow plug control unit

The injection control unit, in the phase of:

- starting
- after-starting

times operation of the glow plugs according to the engine temperature.

Checking activation of air-conditioning system

The control unit operates the air-conditioning compressor:

- switching it on/off when the relative switch is pressed;
- momentarily turning it off (approximately 6 sec.) if the engine coolant reaches the set temperature.

Checking fuel pump

Irrespective of the speed, the control unit:

- supplies the auxiliary fuel pump with the key on MAR;
- cuts off auxiliary pump supply if the engine is not started up within a few seconds.

Checking diesel warming

It times operation of diesel warming in relation to ambient temperature.

Checking cylinder position

During each turn of the engine, the control unit recognizes which cylinder is in the power stroke and operates the injection sequence for the appropriate cylinder.

Checking pilot and main injection timing

According to the signals from the various sensors, including the absolute pressure sensor built into the control unit, the control unit determines the optimum point of injection according to internal mapping.

Checking injection pressure closed cycle

Depending on the engine load, determined by processing the signals from the various sensors, the control unit operates the regulator to obtain optimum line pressure.

Fuel supply

The fuel supply is calculated in relation to:

- accelerator pedal position
- engine speed
- quantity of air introduced.

The outcome may be corrected in relation to:

- the water temperature.

Or to avoid:

- noise
- smoke
- overloading
- overheating
- turbine over-revving.

The delivery can be modified in the case of:

- action of external devices (ABS), ABD, EDB
- serious trouble decreasing the load or stopping the engine.

After determining the mass of air introduced by measuring its volume and temperature, the control unit calculates the corresponding mass of fuel to inject into the relevant cylinder (mg per delivery) also taking into account the temperature of the diesel.
The mass of fuel calculated in this way is first converted into volume (mm^3 per delivery) and then into degrees of throw, or duration of injection.

Correcting flow rate according to water temperature

A cold engine meets with greater resistance during operation: friction is high, the oil is still very viscous, and the various clearances are not yet optimized.
In addition, the injected fuel tends to condense on the metal surfaces that are still cold.
The fuel supply for a cold engine is therefore greater than for a warm one.

Correcting flow rate to avoid noise, smoke or overloading

The behaviour that could lead to this kind of trouble is well known.

The designer has therefore included special instructions in the control unit to avoid it.

De-rating

In the event of the engine overheating, injection is modified, decreasing the delivery to a varying degree, in proportion to the temperature reached by the coolant.

Injection timing electronic test

The advance (start of delivery, expressed in degrees) may be different from one injection to the next, also differentiated from one cylinder to another. It is calculated, similarly to the delivery, in relation to the engine load (accelerator position, engine speed and air introduced).
The advance is appropriately corrected:

- in phases of acceleration;
- according to the water temperature.

And also to obtain:

- lower emissions, noise and overloading;
- better vehicle acceleration.

An extremely high advance is set on starting, depending on the water temperature.
Feedback from the start of delivery is supplied by the change in impedance of the injector solenoid valve.

Speed governor

The electronic speed governor has both features of governors:

- idling and top speed
- all speeds

It is stable in ranges where conventional, mechanical governors are imprecise.

Engine starting

During the first few turns of the engine, the timing and cylinder no. 1 recognition signals (flywheel sensor and camshaft sensor) are synchronized.
The accelerator pedal signal is ignored on starting. Starting delivery is set only according to water temperature, by a special map.
When the control unit detects such speed and acceleration of the flywheel as to be able to consider the engine started up and no longer driven by the starter motor, it re-enables the accelerator pedal.

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Cold starting

If even just one of the three temperature sensors (water, air or diesel) records a temperature lower than 10°C, pre-post heating is activated.
When the key makes contact the pre-heating indicator light comes on and stays on for a length of time that varies in relation to the temperature (while the glow plugs in the cylinder head heat the air), then flashes. It is now possible to start up the engine.
When the motor is running this indicator light goes out, while the glow plugs continue to be powered for a certain length of time (variable) for post-heating.
If, with the indicator light flashing, the engine is not started up within 20-25 seconds (inattention time), the operation is cancelled so as not to run down the batteries pointlessly.
The pre-heating curve is also variable in relation to the battery voltage.

Warm starting

If the reference temperatures all exceed 10°C, when the key makes contact the indicator light comes on for approximately 2 sec., for a short test, and then goes out. It is now possible to start up the engine.

Run up

When the key makes contact, the control unit transfers the information stored in memory when the engine was last stopped into the main memory (see After Run) and makes a diagnosis of the system.

After run

Whenever the engine is switched off with the key, the control unit stays powered for a few seconds by the main relay.
This makes it possible for the microprocessor to transfer some data from the main memory (volatile) to a non-volatile memory, which can be erased and written over (EEPROM), so as to make it available at the next start up (see Run Up).

These data basically consist of:

- various settings (engine idling adjustment, etc.);
- settings of some components;
- fault memory.

The process lasts a few seconds, typically from 2 to 7 (depending on the amount of data to save), after which the ECU sends a command to the main relay and makes it disconnect from the battery.

NOTE It is extremely important for this procedure not to be broken off, for example by switching off the engine with the battery cut-out, or by disconnecting the battery cut-out before 10 seconds have passed since switching off the engine.
If this happens, the functioning of the system is ensured, but repeated interruptions may damage the control unit.

Cut-off

This function cuts off fuel delivery when the vehicle is decelerating (accelerator pedal released).

Cylinder balancing

Individual cylinder balancing contributes to increasing comfort and handling.
This function permits individual, customized control over the delivery of fuel and the start of delivery for each cylinder, even differently from one cylinder to another, to compensate for the hydraulic tolerances of the injector.

The differences in flow (delivery specifications) between the various injectors cannot be evaluated directly by the control unit. This information is supplied by Modus reading the bar code of each injector at the time of assembly.

Synchronization search

If there is no signal from the camshaft sensor, the control unit is anyhow able to recognize the cylinders into which the fuel is to be injected.
If this occurs when the engine is already running, the combustion sequence has already been acquired, so the control unit continues with the sequence on which it has already been synchronized.
If this occurs when the machine is at a standstill, the control unit energizes a single solenoid valve. Within at most 2 turns of the crankshaft, injection will take place in that cylinder, so the control unit just needs to get synchronized on the firing sequence and to start up the engine.

OPERATION

In this injection system, the pressure regulator, located upstream from the high-pressure pump, governs the flow of fuel needed in the low-pressure system. Afterwards, the high-pressure pump correctly supplies the hydraulic accumulator.

This solution, pressurizing solely the necessary fuel, improves the energy efficiency and limits heating the fuel in the system. The relief valve fitted on the high-pressure pump has the function of keeping the pressure, at the pressure regulator inlet, constant at 5 bars; irrespective of the efficiency of the fuel filter and of the system upstream. The action of the relief valve causes an increase in the flow of fuel in the high-pressure pump cooling circuit.

The high-pressure pump continually keeps the fuel at the working pressure, irrespective of the timing and the cylinder that is to receive the injection and accumulates it in a duct common to all the electro-injectors.

At the electro-injector inlet, there is therefore always fuel at the injection pressure calculated by the electronic control unit.

When the solenoid valve of an electro-injector is energized by the electronic control unit, fuel taken straight from the hydraulic accumulator gets injected into the relevant cylinder.

The hydraulic system is made out of a low-pressure fuel recirculation circuit and a high-pressure circuit.

The high-pressure circuit is made up of the following pipes:
- pipe connecting the high-pressure pump outlet to the hydraulic accumulator (rail);
- hydraulic accumulator (rail);
- pipes feeding the electric injectors from the hydraulic accumulator.

The low-pressure circuit is made up of the following pipes:
- fuel intake pipe from the tank to the filter;
- pipe assembly made up of the following:
- feed pipe from the fuel filter to the high-pressure pump;
- fuel return pipe from the high-pressure pump to the tank;
- fuel exhaust pipe from the injectors to the fuel return pipe to the tank.

According to the high performance of this hydraulic system, for reasons of safety it is necessary to:
- avoid connecting high-pressure pipe fittings with approximate tightening;
- avoid disconnecting the high-pressure pipes with the engine running (NEVER try bleeding, which is both pointless and dangerous).

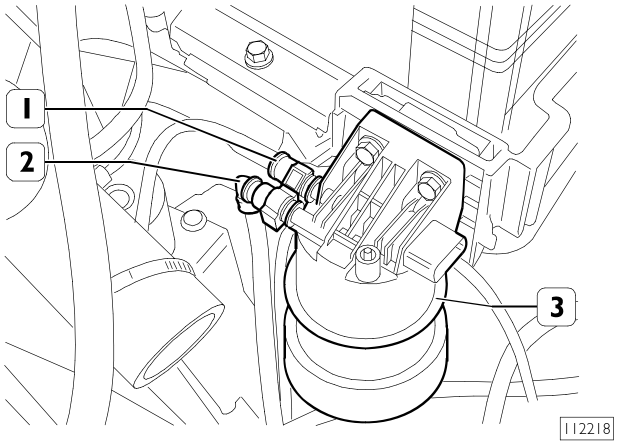
The integrity of the low-pressure circuit is also essential for the system to work properly; it is therefore necessary to avoid all manipulation and modifications and act only in the event of leakage.

HYDRAULIC SYSTEM

The hydraulic system is composed of:
- tank
- fuel pre-filter
- electric supply pump
- fuel filter
- high pressure supply pump with supply pump built inpressure regulator
- manifold (rail)
- electro-injectors
- supply pipes and fuel recirculation

Fuel pipes

Figure 327



1. Quick-connect coupling for high-pressure pump feed pipe - 2. Quick-connect coupling for feed pipe - 3. Fuel filter support

NOTE Due to the very high pressure existing within this hydraulic system, the following precautions shall be taken for safety reasons:

- ❑ avoid connecting the high-pressure pipe fittings by means of makeshift fasteners: tighten them to the specified torque;
- ❑ avoid disconnecting the high-pressure pipes when the engine is running (DO NOT make any attempt at draining: this is absolutely useless and dangerous!).

To ensure correct operation of the system, it is essential that the low-pressure circuit is intact. Therefore, any modification or attempt at tampering shall be avoided, and corrective actions shall be taken immediately in case of leaks.
In the event that fuel pipes (1 and 2) are disconnected from support (3), make sure, when reattaching the pipes, that their respective fittings are fully clean.
Such precautions shall be taken to avoid detective sealing, with resulting fuel leaks.

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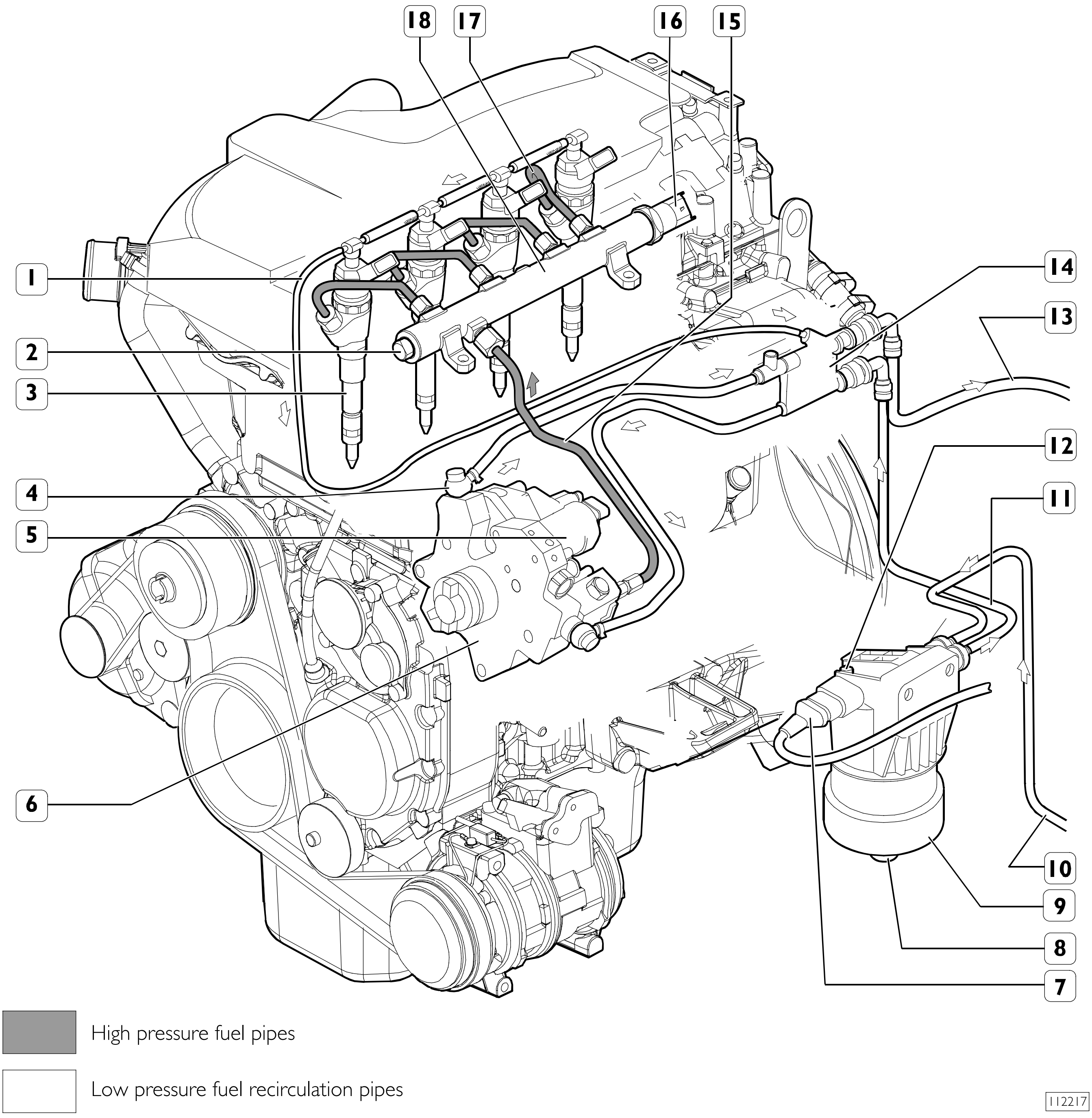
FEED SYSTEM AND FUEL RECIRCULATION

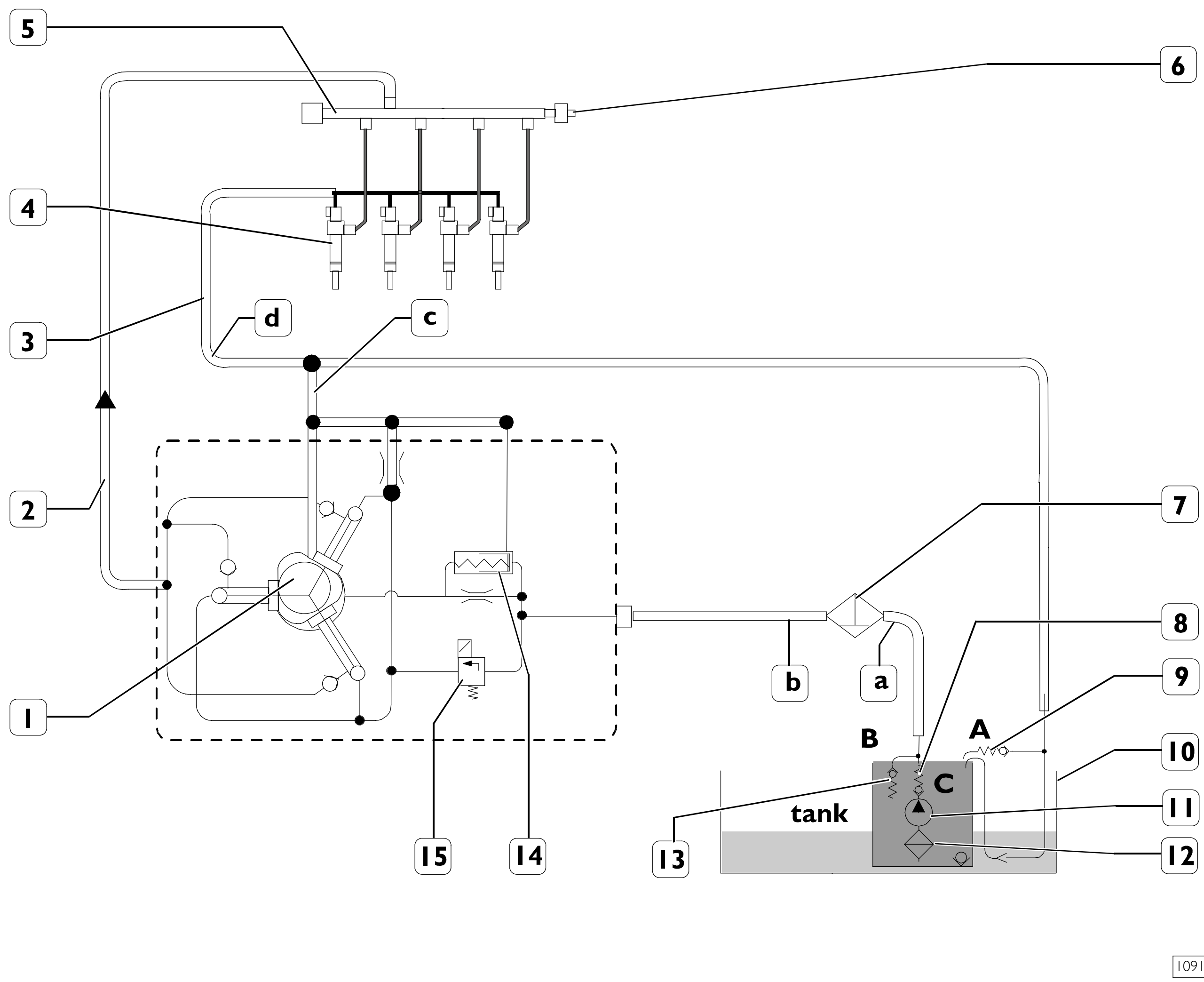
Figure 328



FUEL FEED AND CIRCULATION SYSTEM

1. Injector fuel exhaust pipe - 2. Cap - 3. Electric injector - 4. Coupling - 5. Pressure regulator - 6. CP3.2 high-pressure pump with built-in feed pump - 7. Connector for heater connection, temperature sensor, clogging sensor (optional item) and water sensor - 8 Water drain screw - 9. Fuel filter - 10. Fuel return pipe from the tank - 11. Fuel delivery pipe to the high-pressure pump - 12. Air drain screw - 13. Fuel return pipe to the tank - 14. Pressurized fuel pipe assembly - 15. High-pressure fuel delivery pipe to the hydraulic accumulator (rail) - 16. Pressure sensor - 17. High-pressure fuel delivery pipe to the electric injectors - 18. Hydraulic accumulator (rail)

Figure 329



FUNCTIONAL DIAGRAM OF HYDRAULIC SYSTEM

1. High-pressure pump - 2. High-pressure delivery pipe - 3. Electric injector return pipe - 4. Electric injectors - 5. Common rail - 6. Fuel pressure sensor - 7. Filter with water separator - 8. Fuel electric pump non-return valve - 9. Injector return line pressure-relief valve - 10. Tank - 11. Fuel electric pump - 12. Fuel electric pump intake filter - 13. Fuel electric pump overpressure valve - 14. Pressure-relief valve - 15. Proportional pressure-relief valve

Relative pressures within the circuit:

a. 4,15 bar $< p <$ 5,35 bar
b. 3,5 bar $< p <$ 5,0 bar
c. $p <$ 0,8 bar
d. 0,3 bar $< p <$ 0,8 bar

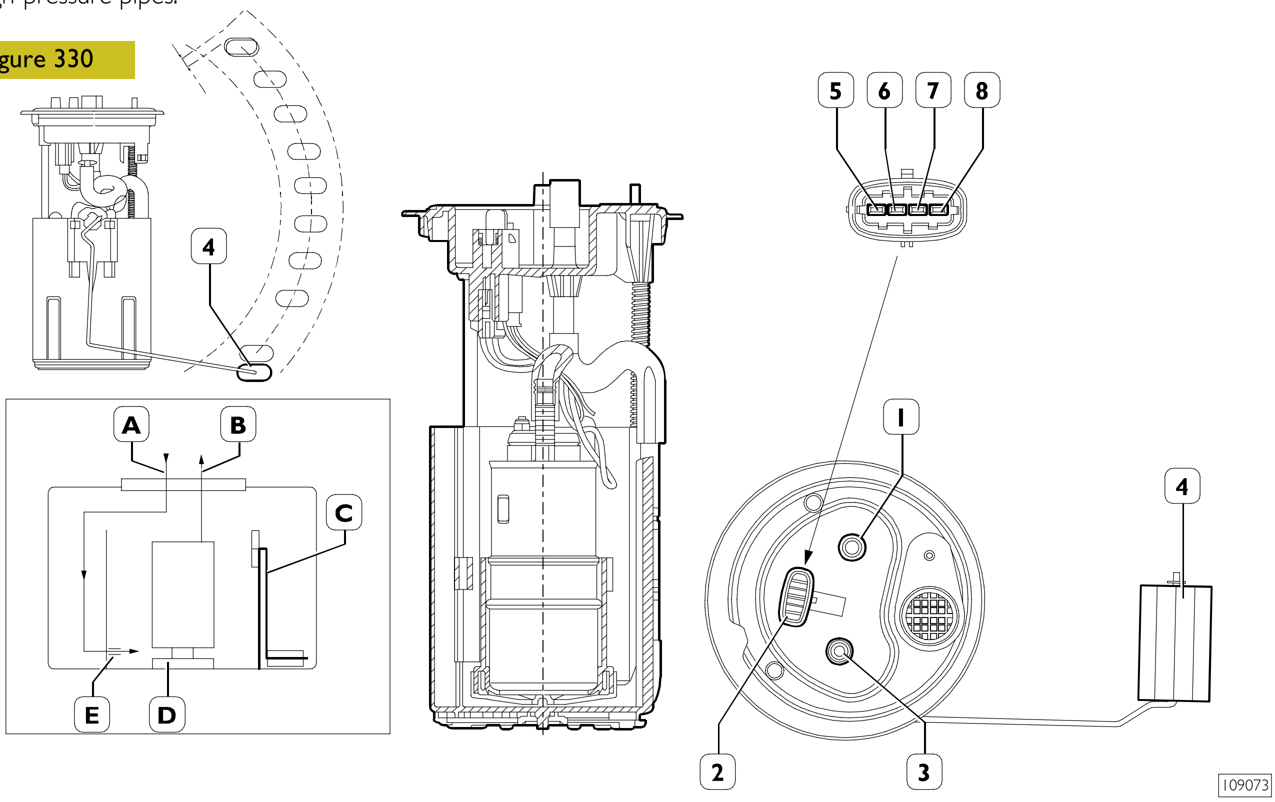
HYDRAULIC SYSTEM

The hydraulic system is made up of the following items:
- tank;
- electronic fuel pump;
- fuel filter;
- high-pressure feed pump;
- pressure regulator;
- manifold (rail);
- electric injectors;
- low-pressure feed pipe assembly;
- high-pressure pipes.

773010 Fuel pump

The fuel electric pump is of the volumetric, low-pressure type. It is built into the fuel level indicator located in the fuel tank.

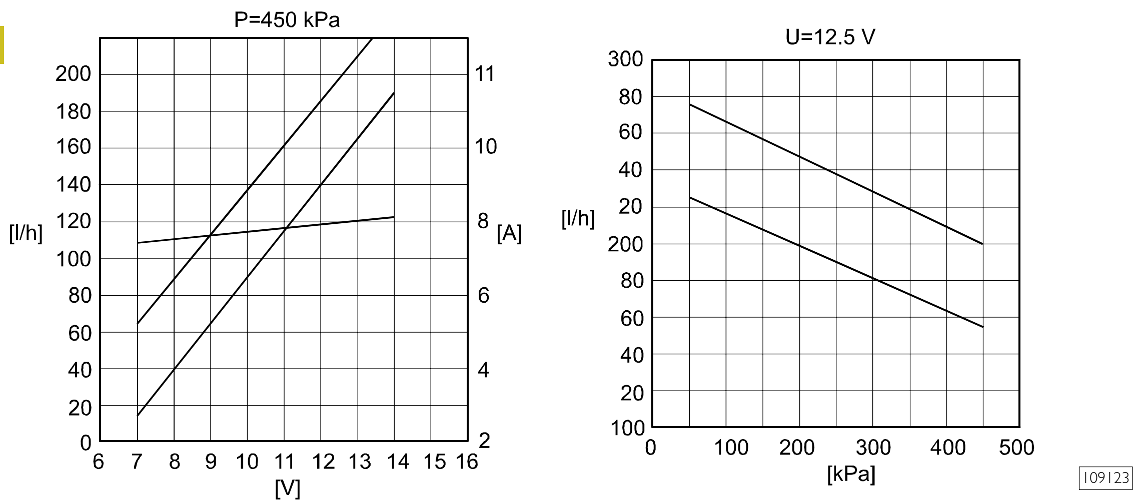
Figure 330



FUEL ELECTRIC PUMP ASSEMBLY SECTION
1. Return - 2. Connector - 3. Delivery - 4. Float - 5. Level sensor (+) - 6. Level sensor (-) - 7. Pump (-) - 8. Pump (+) - A. Return line - B. Delivery line - C. Level sensor - D. Prefilter - E. Jet pump

Electric connector (2), located in the upper portion of the assembly, features the pins both for the electric pump and the level sensor. During the installation, the assembly shall not be stressed with axial loads of more than 67 N and torque of more than 3 Nm. The maximum fastening torque on the gasket shall be 60 Nm.

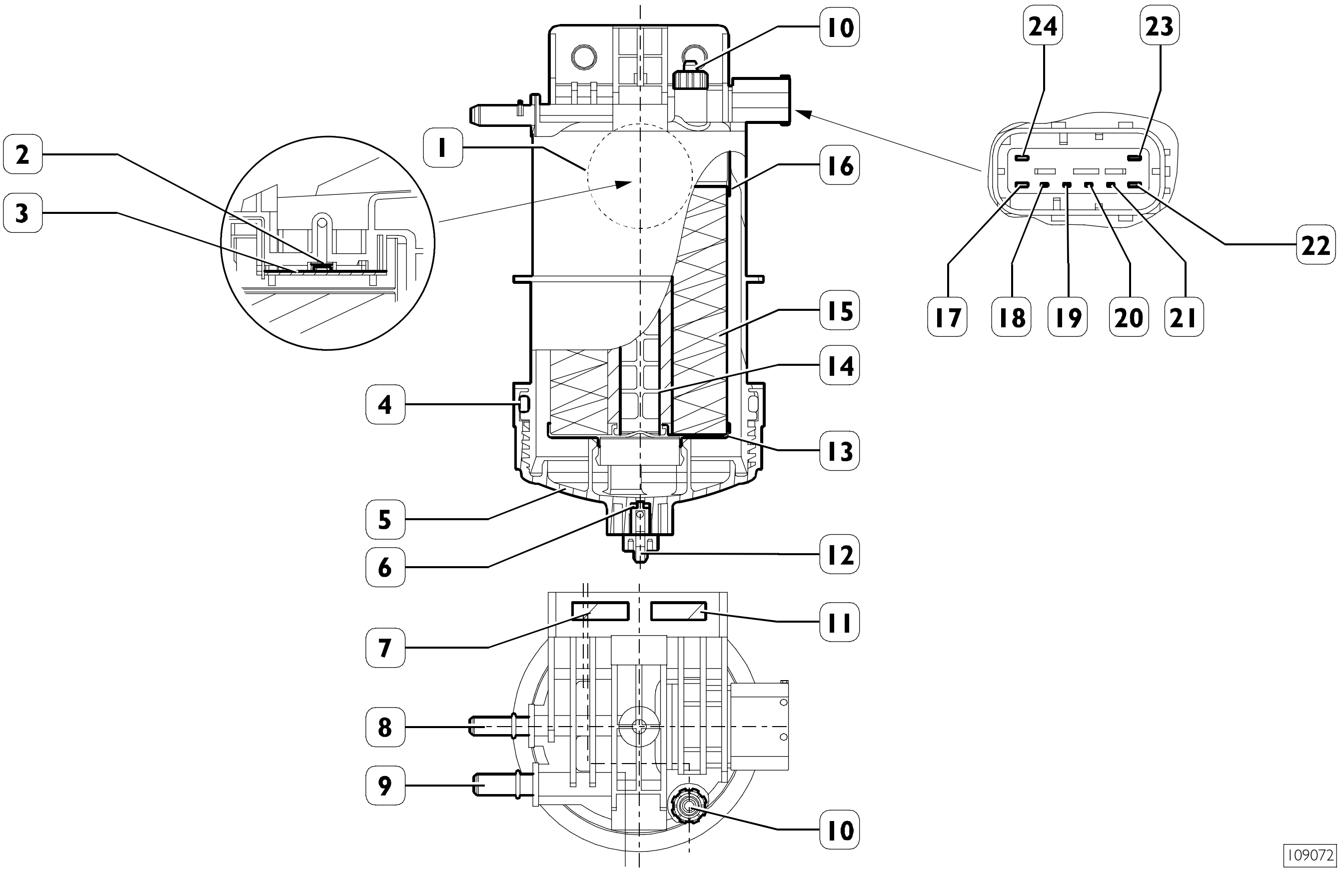
Figure 331



CHARACTERISTIC CURVES

542011 "Filtrauto" fuel filter

Figure 332



1. Body - 2. Gasket - 3. Cover bottom - 4. Drain screw gasket - 5. Customer reference - 6. Diesel oil outlet - 7. Diesel oil inlet - 8. Air drain screw - 9. Supplier code - 10. Air bleeding or water draining screw - 11. Lower bottom - 12. Inner pipe - 13. Filtering paper - 14. Upper bottom - 15. Heating earth - 16. NTC1 - 17. NTC2 - 18. Clogging sensor (if foreseen) - 19. Water sensor - 20. Heating - 21. Feed - 22. GND

The fuel filter consists of an internal filtering-paper cartridge (15) and is equipped with a water separator.
The maximum water storage capacity of the filter is 150 cm3.
The water sensor detects the presence of water in the filter starting from an existing volume of 70 cm3.
This sensor is located in the lower part of the filter.
The temperature, water and clogging (if any) sensors are interfaced with the electronic circuit (13) located inside in the upper portion of the assembly.
When the diesel fuel temperature is lower than a limit value, the electric resistor will come into operation by properly heating the diesel fuel before the latter is conveyed to the high-pressure pump.

Clogging sensor (if any) features

- differential working pressure:	0.7 ÷ 0.85 bar

Tightening torque

5. Cover	35±5 Nm
12. Air/water drain screw	1±0.2 Nm

NTC and heating features

- rated voltage	13.5 V
- max. permitted voltage	30 V
- rated output	250 W at 185 l/h, T = -10°C
- temperature range	-30÷120°C

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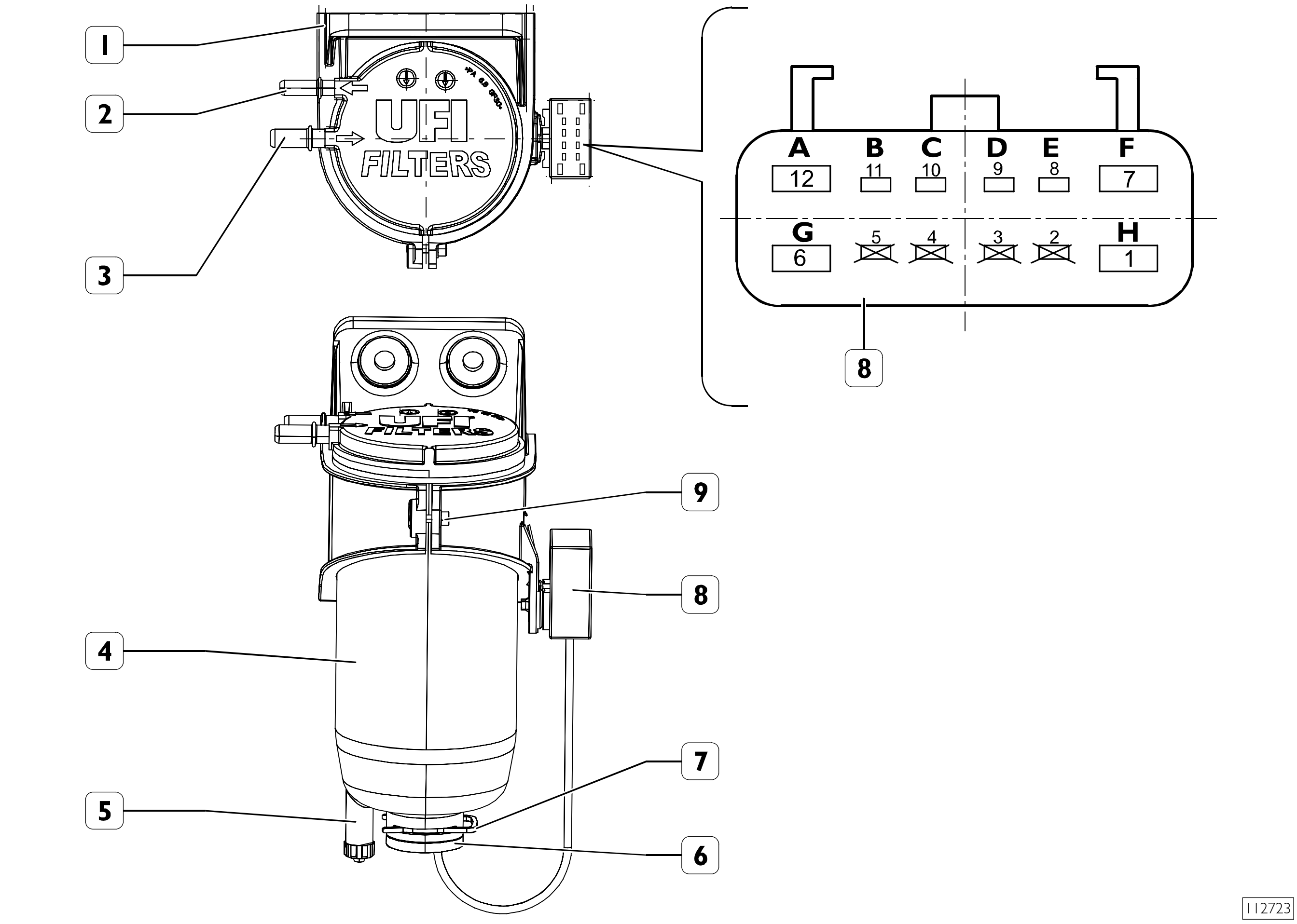
542011 ”UFIfilters” fuel filter

Figure 333



1. Fuel filter support- 2. Diesel oil outlet - 3. Diesel oil inlet - 4. Diesel oil filter - 5. Drain screw - 6. Electronic unit - 7. Fastener - 8. 12-way connector - 9. Screw securing Diesel oil filter: H-G-B, water present sensor; - H-C, clogging sensor (if foreseen); - D-E, NTC temperature sensor; - F-A, heater.

Fuel filter (4) is made up of a filtering cartridge with water separator, inside which electronic unit (6) is housed.
Water accumulation capacity is equal to 140 cm3.
Electronic unit (6) includes water present sensor, (optional) filter clogging sensor and temperature sensor.

Water present sensor
Water present sensor detects water present in the filter starting from 110 cm□ volume present. Water present sensor provides values of:
- low voltage in presence of water;
- high voltage in absence of water.

Characteristics
12V nominal voltage (8V minimum -16V maximum)
Absorbed current:
- lower than 15 mA in rest conditions;
- lower than 150 mA in alarm conditions (including load).

Voltage on load:
- in rest conditions: higher than 11.8 V;
- in alarm conditions: lower than 3.9 V.
At key-on operation, the sensor makes a self-test issuing 2.5 second duration sound signal.

(Optional) filter clogging sensor
Normally open contact type.
Operation differential pressure delta p: 0.8 bar

NTC temperature sensor
-30 °C = 26.114 ohm ± 9,7%
0 °C = 5.896 ohm ± 7,3%
+25 °C = 2.057 ohm ± 5,6%
+60 °C = 596 ohm ± 3,8%
+100 °C = 186 ohm ± 2,0%
+110 °C = 144 ohm ± 2,4%
Temperature range: -40°C to +130°C

+0,05
-0,5

Heater

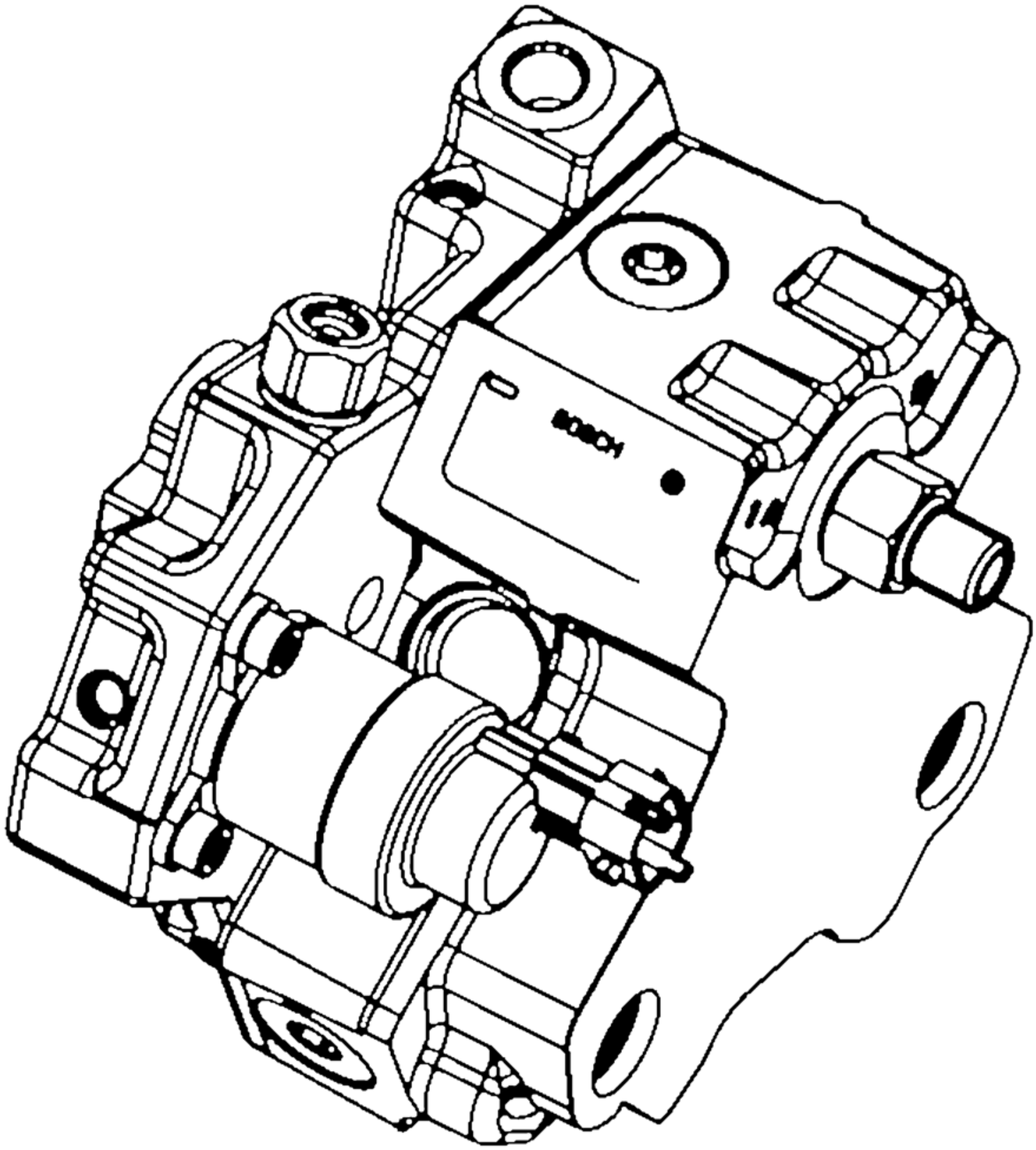
Nominal voltage	12 V
Maximum allowed voltage	30 V
Nominal power	250 W

Tightening torques

9. Screw securing filter	1.5 + 0.5 Nm
4. Water draining or air bleeding screw	1.5 + 0.5 Nm

775010 CP3.2 high-pressure pump

Figure 334



109126

Pump with three radial plungers, controlled by the timing belt gear. It does not require timing.
The pump is lubricated and cooled by the fuel itself.
It differs from the CP3.2 high-pressure pump (Euro 3 version) is that it does not feature the mechanic feed pump.

NOTE The high-pressure pump/feed pump assembly cannot be overhauled; therefore, the fastening screws shall not be removed or tampered with. The only operation that can be carried out is the replacement of the pressure regulator drive gear.

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771034 Pressure regulator

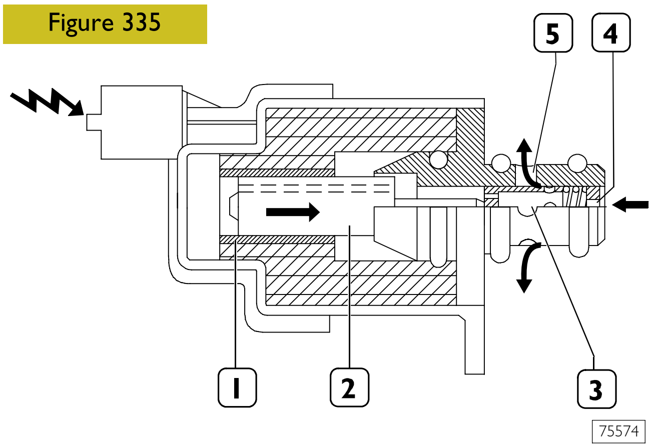
The fuel pressure regulator is mounted on the low-pressure circuit of the CP3 pump. The pressure regulator modulates the amount of fuel sent to the high-pressure circuit according to the commands received directly from the engine control unit. The pressure regulator is mainly composed of the following components:

- connector
- casing
- solenoid
- pre-load spring
- shutter cylinder.

When there is no signal, the pressure regulator is normally open, therefore with the pump providing maximum delivery. The engine control unit, via the PWM (Pulse Width Modulation) signal, modulates the change in fuel flow rate in the high-pressure circuit by partially closing or opening the sections of passage of the fuel in the low-pressure circuit.

Operation

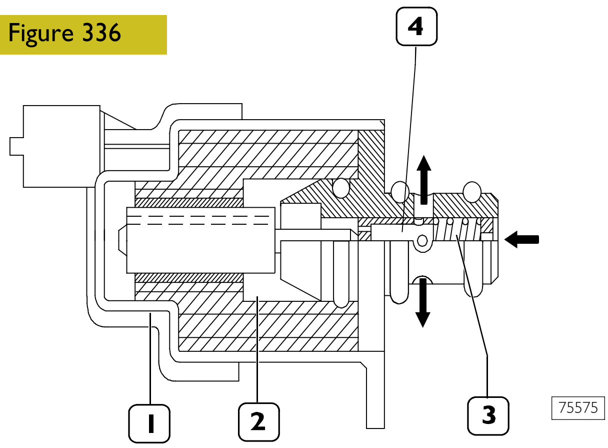
Figure 335



1. Solenoid – 2. Magnetic core – 3. Shutter cylinder – 4. Fuel inlet – 5. Fuel outlet.

When the engine control unit governs the pressure regulator (via PWM signal), the solenoid (1) is energized that, in its turn, generates the movement of the magnetic core (2). The shift of the core causes the shutter cylinder (3) to move axially, choking the flow of fuel.

Figure 336

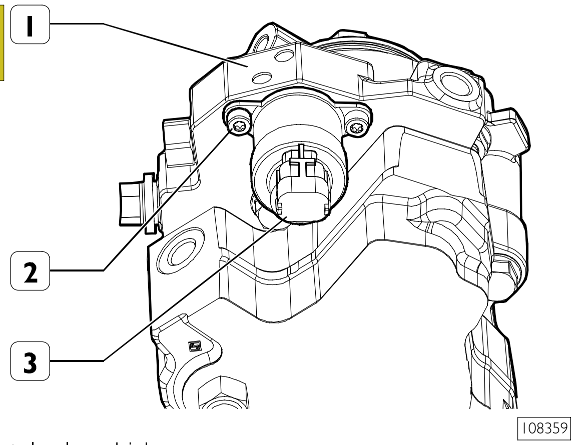


1. Solenoid – 2. Magnetic core – 3. Pre-load spring – 4. Shutter cylinder.

When the solenoid (1) is not energized, the magnetic core is pushed into the rest position by the pre-load spring (3). In this condition, the shutter cylinder (4) is in such a position as to offer the fuel the greatest section of passage.

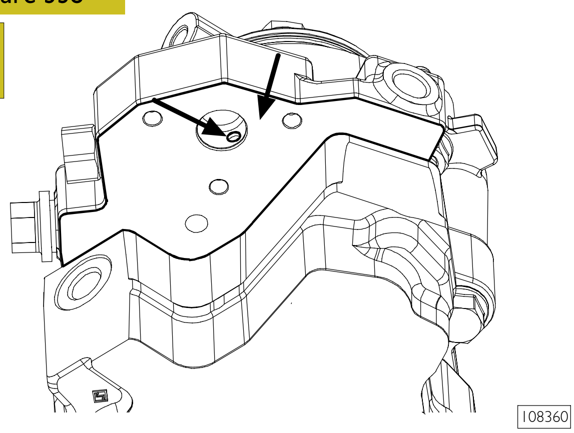
Replacing pressure regulator

Figure 337



Accurately clean high pressure pump.
Take off screws (2) and unthread pressure regulator (3) from high pressure pump.

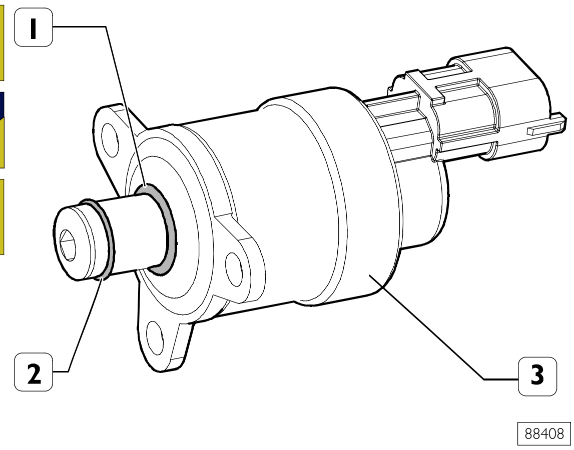
Figure 338



Accurately clean the seat (→) of pressure regulator and the connection surface (→) of the regulator.

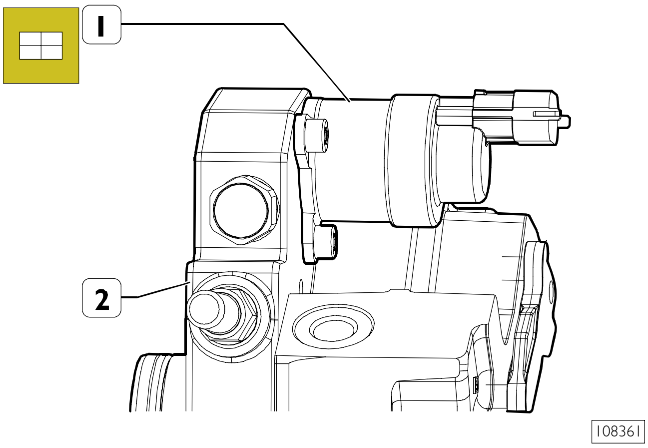
NOTE For cleaning, do not use a tool which could damage the surfaces and pay attention that impurities are not introduced into channels.

Figure 339



Mount new seal rings (1 and 2) on pressure regulator (3) and lubricate the rings with vaseline.

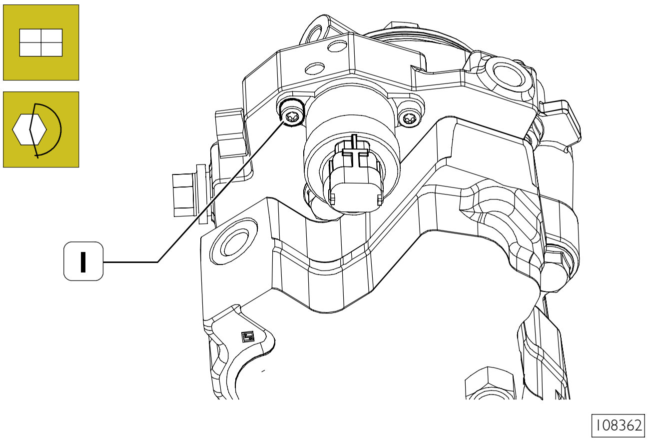
Figure 340



Mount pressure regulator (1) on high pressure pump (2).

NOTE Mounting operation must be performed keeping the regulator perpendicular to connection plane without angling it, in order not to damage seal rings (1-2, Figure 339).

Figure 341

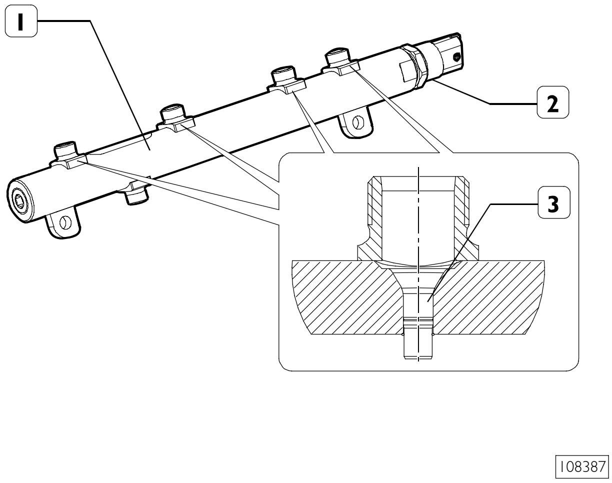


Screw up screws (1) and tighten them at 6 ÷ 7 Nm (0.6 ÷ 0.7 kgm) torque.

NOTE Where pressure regulator is replaced on the engine mounted on the vehicle, it is needed, after replacement, to check that there are no fuel leaks after an engine working period.

774510 Hydraulic accumulator (rail)

Figure 342



The hydraulic accumulator is fitted on the cylinder head on the suction side.

With its volume of approximately 23 cm^3 it dampens the pressure ripples of the fuel due to:

- the operation of the high-pressure pump;
- the opening of the electro-injectors.

On the hydraulic accumulator (1) there is the fuel pressure sensor (2).
Fuel pressure sensor (2) is fitted on hydraulic accumulator (1).
Small valves (throttle valves) or control bushes (3), with "j" = 0.85 mm, have been fitted to the fuel delivery couplings, which control the fuel pressure waves generated by the high-pressure pump. Their function is to protect the electric injectors by reducing their wear in time.
Fuel pressure sensor (2) may affect the accuracy of the injector minimum flow rate correction, since the minimum flow rate depends both on the injection time and the actual pressure of the hydraulic accumulator.
In case of replacement, the EDC control unit 16 correction coefficients (ZFC) shall be set to zero.
The correction coefficients (ZCF) can be corrected by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the sensor replacement procedure, in accordance with the instructions given by the diagnosis instruments.

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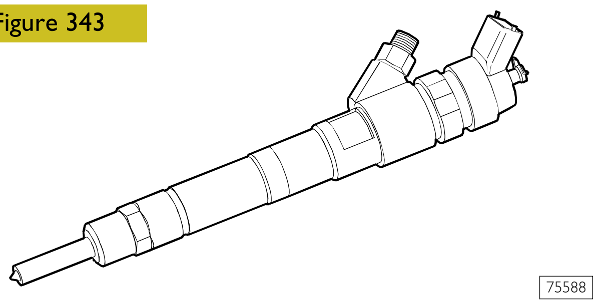
775010 ELECTRO-INJECTORS

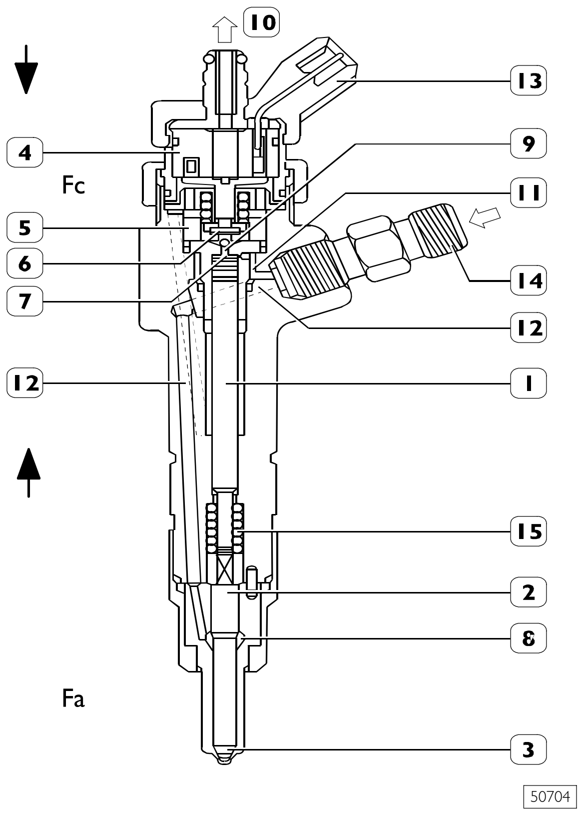
Figure 343



The electro-injectors have high-pressure supply (up to 1600 bar) and recirculation at atmospheric pressure, necessary for the diesel used to operate the pilot valve.
The temperature of the diesel put back into circulation by the electro-injector can get very high (approximately 120°C).
The head of the electro-injector has a fitting for the electrical connector.
They are mounted on the cylinder head and operated by the injection control unit.
The electric injector can be subdivided into two parts (see SENZA CODICE):

The electro-injector can be divided into two parts:
- actuator/jet composed of pressure rod (1), pin (2) and nozzle (3);
- control solenoid valve composed of coil (4) and pilot valve (5).

Figure 344



1 Pressure rod – 2 Pin – 3 Nozzle – 4 Coil – 5 Pilot valve – 6 Ball shutter – 7 Control area – 8. Pressure chamber - 9 Control volume – 10 Low-pressure fuel return – 11 Control pipe – 12. Feeding pipe - 13 Electrical connection – 14 High-pressure fuel inlet fitting – 15 Spring.

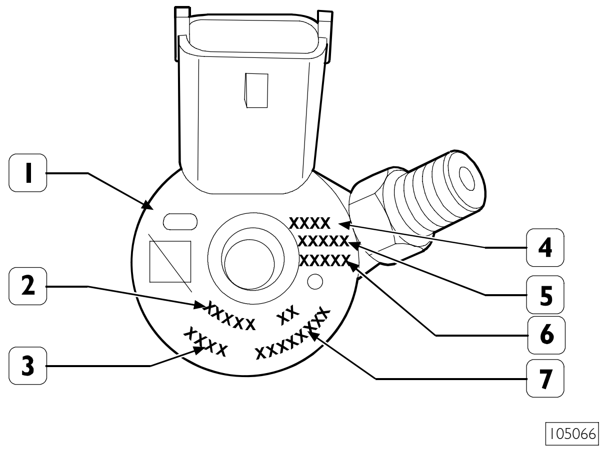
Operation

Electro-injector operation can be broken down into three phases:

- "rest position"
  The coil (4) is de-energised and the shutter (6) is in closed position and does not allow the fuel to get in the cylinder, Fc > Fa (Fc: due to the fuel pressure operating the rod (1) control area (7). Fa: due to the line pressure operating in the pressure chamber (8).
- "start of injection"
  The coil (4) is energized and causes the shutter (6) to rise. The fuel of the control volume (9) flows off towards the return manifold (10) causing a drop in pressure in the control area (7).
  At the same time, the line pressure through the fuel pipe (12) exerts in the pressure chamber (8) a force equal to Fa > Fc and thus makes the pin (2) lift and so the fuel gets in the cylinders.
- "end of injection"
  The coil (4) is de-energized and makes the shutter (6) return to its closed position. This recreates such a balance in the forces as to make the pin (2) return to its closed position and consequently end injection.

755010 Replacing an electrical injector

Figure 345



1. IMA Matrix code- 2. Bosch spare part no.-
3. IMA code in clear - 4. Iveco spare part no. - 5. Code -
6. Series no. - 7. Production date

Electrical injectors are not assigned any more to classes Min (01) - Med (02) - Max (03); therefore, flow rate deviations from design values are detected, during final check step, by the manufacturer on each single injector and printed with I.M.A. (Injector Menge Abgleichung) [Injector Quantity Offset] code on injector magnet.
At engine production plant, I.M.A. code is read on line from an automatic reading station, converted into bar code, printed on engine identification label and applied on the engine itself.
At vehicles production plant, at line end, E.D.C. 16 central unit is programmed automatically reading the engine identification label.

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Figure 346

numero	codice OCR iniettore
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

numero	codice OCR iniettore
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
I	I
J	J
K	K
L	L
M	M
N	N
O	O

numero	codice OCR iniettore
P	P
Q	Q
R	R
S	S
T	T
U	U
V	V
W	W
Y	Y
Z	Z

105067

Conversion table of OCR characters into ARIEL characters

At assistance, code written in clear has to be used (3, Figure 31) for central unit replacement and reprogramming procedures.
In the table there is shown the conversion of OCR characters into Ariel characters.

When electrical injectors mounted on the vehicle must be replaced, meet following warnings:

- ❑ where electrical injectors are dismounted and do not need to be replaced, their mounting position has to be noted down in order to remount them later in the same position; this is done to avoid to reprogram the central unit;
- ❑ after replacing one or more injectors, the central unit has to be reprogrammed;
- ❑ before mounting a new electrical injector, note down IMA code printed on the injector, because the code is difficult to read after the injector has been mounted;
- ❑ where the central unit is replaced, reprogram the new central unit with the IMA codes of the electrical injectors mounted on the engine and copy down the rectification coefficients (ZFC) of replaced central unit; where it is not possible, they must be reset and self-learning process must be started up again.

During engine running, EDC 16 central unit performs some checks on electrical injectors minimum flow rate.

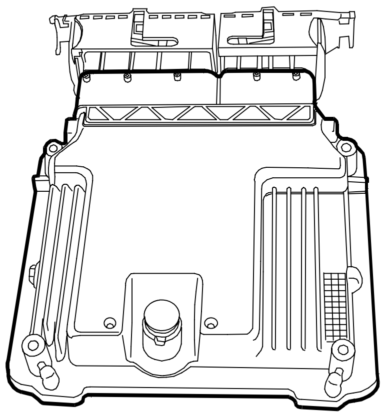
In certain conditions (overrun: vehicle deceleration with pedal released) an increasing (very small) fuel quantity starting from zero is injected and its effect on engine rotation smoothness is observed.
Injection start threshold is detected and stored by the central unit.
This self-learning process is carried out on each single cylinder.
Therefore, replacing an electrical injector involves the need of reprogramming the central unit by entering the IMA codes of new electrical injectors and resetting the rectification factors (ZFC) of the cylinder considered.
Replacing all electrical injectors extends the need of resetting to all the rectification coefficients (ZFC) of each single electrical injector.

The correction coefficients (ZFC) can be set to zero by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instruments, by programming the control unit again and performing the replacement procedure indicated by the instrument itself.

ELECTRIC/ELECTRONIC COMPONENTS

766161 Electronic control unit EDC 16

Figure 347



85711

The control unit is of the "flash EPROM" type, i.e. it can be reprogrammed from the outside without acting on its hardware.
The control unit processes the signals from the sensors by applying software algorithms, and also controls the actuators (in particular, the electric injectors and the pressure regulator).
The control unit records, in the memory non-labile area, the information on the engine parameters originally set or acquired during engine operation.
The injection control unit incorporates the absolute pressure sensor, in order to further improve the injection system control.
The control unit is fitted to the left side of the engine compartment and is connected to the vehicle wiring by means of two connectors:

- 60-pole connector "A" for the components available on the engine;
- 94-pole connector "K" for the components on the vehicle.

In addition to controlling the system functions described in the respective charter, the electronic control unit is interfaced with the other electronic systems found on the vehicle, such as ABS - EBD, cruise control, speed limiter, immobilizer (IVECO CODE), EGR, preheating plugs.
On the vehicles equipped with D.P.F. catalyst, the control unit also controls the catalyst regeneration system. In this case, after any of the operations below is carried out:

- replacing one or several injectors,
- replacing all the injectors,
- replacing the air flow meter,
- replacing the hydraulic accumulator pressure sensor (common rail),
- replacing the EDC control unit 16;
- changing the engine oil,
- replacing the D.P.F. catalyst,
- replacing the filter differential pressure (Dp) sensor,
- replacing any significant component as regards emission levels,
- performing forced regeneration,

the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, and the replacement procedure for the concerned component shall be performed, in accordance with the indications of the diagnosis instruments.

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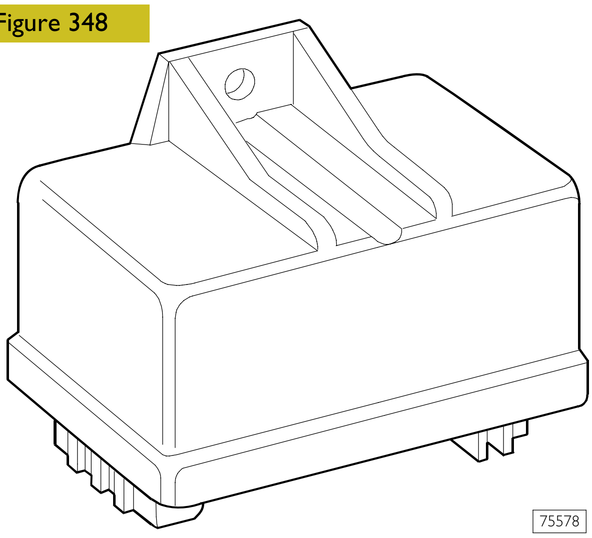
761917 Glow plug electronic control unit

Figure 348

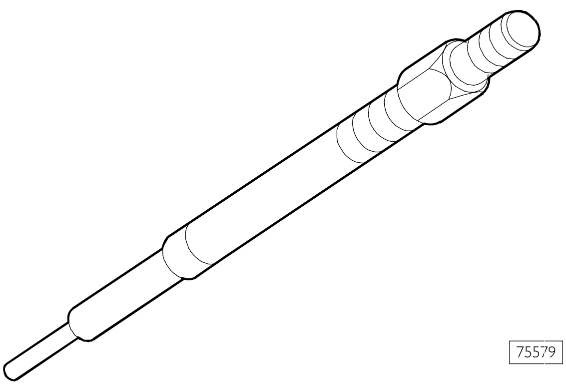


During the phases below:
- starting phase,
- post-starting phase,

the engine management control unit will time the plug preheating control unit operation depending on the engine temperature.
The plugs will be triggered through the plug preheating control unit, depending on the engine temperature, under direct control of the engine management control unit.
The preheating control unit incorporates a "smart" remote-control switch that sends a return response ("feed-back") to the management control unit: the latter will therefore be informed about the preheating control unit failure (if any) or the plug short-circuit to the ground.

761915 Glow plugs

Figure 349



CONTROL VALUES

With a constant supply voltage of 11 V:

- max. current drawn	18 A
- min 5 sec.	11 ±1.5 A
- in 30 sec.	6 ±0.9 A
- temperature after 7 sec.	850°C
- tightening torque	8-10 Nm

SENSORS

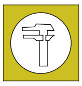
764266 Engine speed sensor

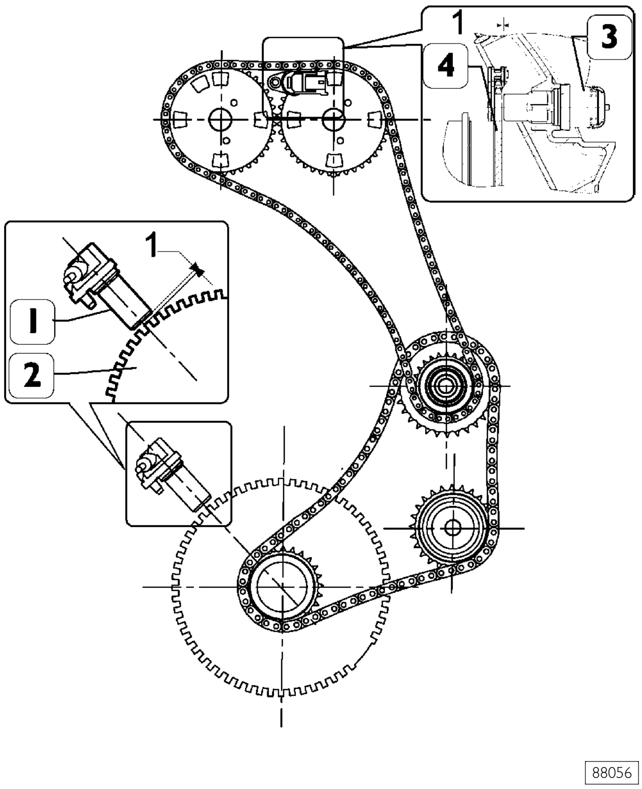
It is an inductive sensor and is positioned on the phonic wheel fitted on the front end of the drive shaft
It generates the signals resulting from the magnetic flow lines which close through the teeth of the phonic wheel.
Tooth number 58.
The electronic control unit uses this signal to measure the speed of rotation of the engine, its angular position and to operate the electronic rev counter.
If this signal fails the rev counter will not work.

764264 Camshaft timing sensor

It is an inductive sensor and is positioned on the camshaft gear of the suction valves.
It generates the signals resulting from the magnetic flow lines which close through a slot on the gear itself.
The signal generated by this sensor is used by the electronic control unit as a redundant signal to measure the different engine speeds.

Figure 350





SENSOR ASSEMBLING DIAGRAM

The sensor gap shall be as follows:

- ❑ 1 + 0.5 mm, between distributing shaft pulley (4) and phase sensor (1);
- ❑ 1 mm, between phonic wheel (2) and revs sensor (1).

772655 Air temperature and pressure sensor

Positioned on the intake manifold, it measures the pressure of the turbocharging air introduced into the intake manifold.
This value, together with that of the air temperature sensor, makes it possible for the electronic control unit to calculate the exact quantity of air introduced into the cylinders so as to operate the injectors adjusting the fuel delivery, limiting harmful emissions, improving consumption and performance.
The sensor contains an electronic temperature correction circuit to optimize the pressure measurement in relation to the temperature of the intake air.

772656 Fuel temperature sensor

Integrated in the fuel filter, it measures the fuel temperature and transmits it to the electronic control unit.
When the fuel temperature is too high (ambient temperature condition, engine at full load and tank in reserve), correct lubrication of the high-pressure pump is no longer assured. On the basis of the values received, the control unit determines the density and volume of the fuel, correcting the delivery limiting engine performance.

774511 Fuel pressure sensor

It is fitted on the hydraulic accumulator end (rail) and its function is to transmit a "feed-back" signal to the injection control unit for:

- adjust injection pressure
- adjust the duration of injection.

NOTE In case of replacement, the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, by performing the replacement procedure indicated by the diagnosis instrument itself.

766161 Atmospheric pressure sensor

This is integrated in the electronic control unit. It provides a criterion of correction for the measurement of the air flow rate and to calculate the reference air flow rate to check the EGR.

764254 Engine coolant temperature sensor

This provides the control unit with an index of the thermal status of the engine in order to determine corrections for the fuel delivery, injection pressure, EGR injection advance when starting cold (if mounted) and warm-up.

505910 Throttle pedal position sensor

The accelerator pedal position sensor provides the control unit with a voltage value in proportion to the angle of operation of the pedal determining fuel delivery.

772641 Clutch pedal position sensor

Mounted on the pedal board, it provides the control unit with a positive signal when the clutch is engaged (pedal released). Every time the clutch is disengaged to change gear, the control unit fails to receive this signal and deactivates the Cruise Control function.

772642 Brake pedal position sensor

There are two of these sensors mounted on the pedal board. With the brake pedal released, they provide the control unit with a positive signal that is used to detect brake operation so as to deactivate the Cruise Control function and stop delivery of fuel.
In addition, a sensor switches on the brake lights.

764261 Vehicle speed sensor

This sensor, mounted on the gearbox by the drive output shaft, transmits the vehicle speed signal, through the electronic tachograph, to the control unit.

540743 Differential pressure sensor - delta p (Dp)

This sensor detects the difference between the pressure (Dp) of the incoming exhaust gas and the pressure of the gas flowing out of the D.P.F. catalyst.
The measured value indicates the extent of particulate (PM) particle accumulation or clogging in the D.P.F. filter.
This value will, through a proper signal (feed-back), be processed by the EDC control unit 16, which will cause post-injection so as to increase the exhaust gas temperature (630°-650°C) and also cause the particulate particles accumulated in the D.P.F. filter to be burned.

NOTE In case of replacement, the control unit shall be programmed again by means of the IVECO MODUS - E.A.SY. - IT 2000 diagnosis instrument, by performing the replacement procedure indicated by the diagnosis instrument itself.

Exhaust gas temperature sensor

The D.P.F. catalyst includes two temperature sensors located at the D.P.F. catalyst inlet and outlet, respectively.
The temperature values are processed by the control unit to determine post-combustion, in order to increase the exhaust gas temperature needed to burn the particulate particles.

ACTUATORS

The injection system comprises three classes of actuators interlocked with the electronic control unit:

- ❑ electro-injectors (see relevant heading);
- ❑ regulators (see relevant headings) requiring PWM control (Pulse Width Modulation):
  - for pressure
  - EGR (if mounted)
  - turbocharger with variable geometry (if mounted);
- ❑ actuators with continuous ON/OFF signal to:
  - engage electromagnetic coupling for radiator cooling fan;
  - turn on/off air-conditioner compressor (if mounted);
  - Cruise Control;
  - starter heater control;
  - fuel filter heating;
  - electric supply pump.

NOTE All the power controls are made with relays located in the cab.

PWM (Pulse Width Modulation) controls

A PWM control has an active and an inactive state that alternate within a constant set length of time. During the active state the actuator control circuit is closed, which is thus powered with the control voltage; whereas, during the inactive state the circuit is open.
The duration of the two states may be varied with the condition that the sum of the two times is equal to the length of the modulation delivery.
The duration of the active state determines the duty-cycle, which is normally expressed as a percentage of the total time.
Therefore, if the duration of the two active and passive states are the same, the duty-cycle is equal to 50%.
For reasons of diagnostics, the duty-cycle is limited between 1% and 99%; the control resolution is equal to 0.005% (1/20000 of the time).
The time length has been chosen taking account of the dynamic actuator response specifications.
Too low a carrier frequency could cause oscillations in the actuator, while too high a frequency would decrease control resolution.
The control of the E.G.R. (if fitted) and the turbocharger with variable geometry (if fitted) occurs through the idle modulating valve.

SECTION 3

5052 Clutch

DESCRIPTION

The clutch unit consists of the following:

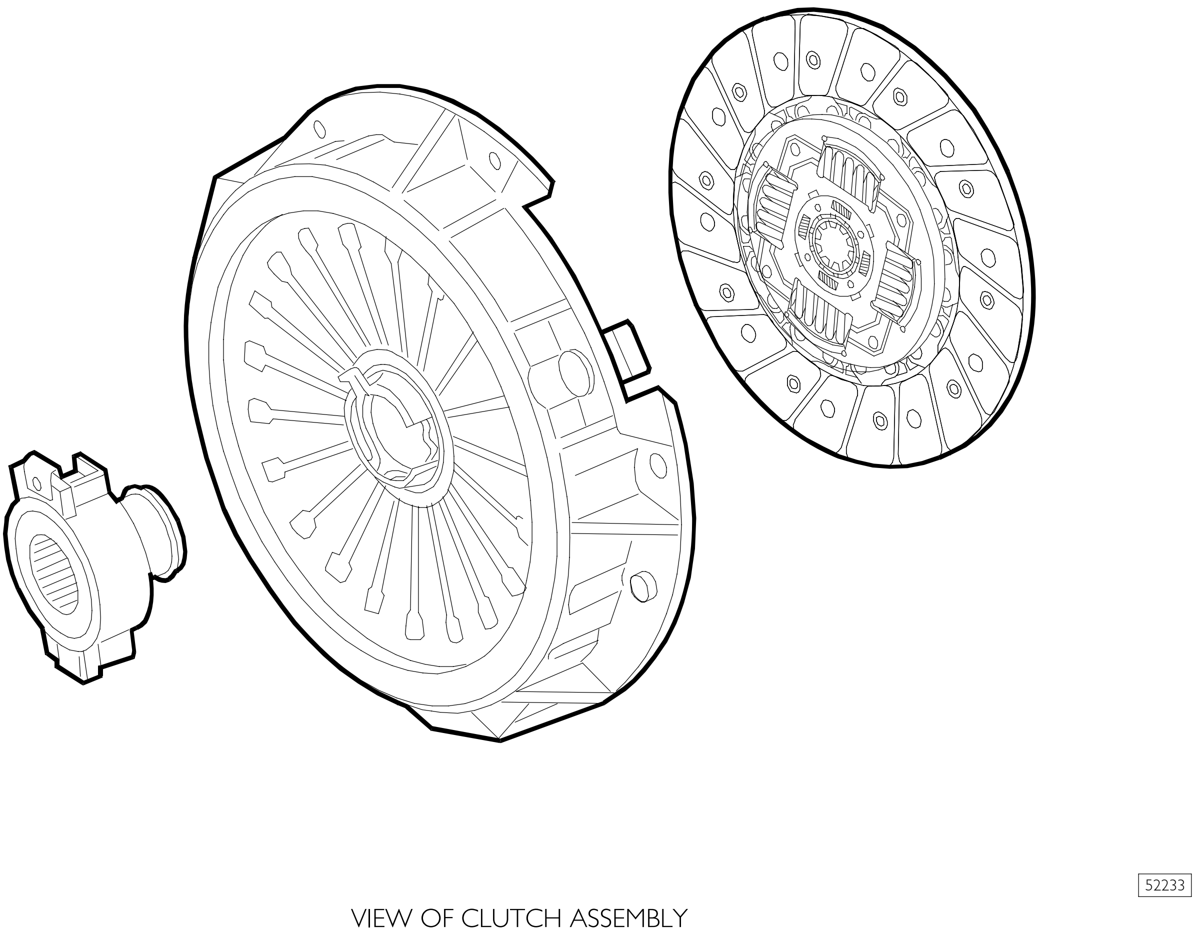
- ❑ a driven disk - lined on both sides with friction seals and fitted with a hub at the centre. Additionally, a hub spring is provided to make it more elastic and soft;
- ❑ a thrust pad - fixed to the cover or body of the friction clutch mechanism by means of plates that allow for axial movement when the diaphragm spring is driven by the collar bearing;
- ❑ a diaphragm spring made from a certain number of blades arranged in a dial form;
- ❑ a collar bearing mounted on the diaphragm spring and locked to the same by means of the split ring. With this solution it is no longer necessary to adjust the clearance between the collar bearing and diaphragm spring since both the components are in contact. Moreover, the clutch is released by traction of the collar bearing.

The introduction of a diaphragm spring (or Belville washer) as an elastic driving brings about important advantages, such as:

- ❑ smaller axial size and reduced sensibility of the centrifugal force, due to the absence of the release lever;
- ❑ greater constructive accuracy due to the reduced number of components;
- ❑ improved cooling capacity due to the reduced contact surfaces between diaphragm and disk driver;
- ❑ less unbalance;
- ❑ easy maintenance thanks to:
  1. no regulation required for clearance;
  2. no further need to level-off the thrust pad.

Finally, it must be noted how the non-linear characteristics of the diaphragm spring offer a reduced variation of the release force as the control pedal gradually completes its travel and, with a load on the disk driver not less than the rated value even with worn seals.

Figure 1



VIEW OF CLUTCH ASSEMBLY

DIAGNOSTICS

Main operating faults of the clutch are:

1. - Noise when the clutch pedal is pressed;
2. - Noise when the pedal is released;
3. - Clutch jerks;
4. - The clutch does not release;
5. - The clutch slips;
6. - Abnormal wear of driven disk seals.

1 NOISE WHEN CLUTCH PEDAL IS PRESSED

Collar bearing excessively worn, damaged or not properly lubricated.	YES →	Replace the collar bearing.
NO ↓		
Excessive play between the clutch engagement grooves on the shaft and the relevant seat on the hub of the driven disk.	YES →	Replace the shaft and, if necessary, the driven disk also.

2 NOISE WHEN THE PEDAL IS RELEASED

Driven disk springs are broken or weakened.	YES →	Replace the driven disk.
NO ↓		
Clutch engagement shaft worn.	YES →	Replace the shaft and, if necessary, the driven disk also.
NO ↓		
Collar bearing has excessive play in the joint.	YES →	Replace the collar bearing.

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3 CLUTCH JERKS

Oil or grease on the engine flywheel, or on the seals of the driven disk. — YES → Replace the oil or grease, clean the flywheel, and replace the driven disk.

NO

Thrust pad deformed. — YES → Replace the clutch.

NO

Friction seals worn due to off centring of the driven disk. — YES → Replace the driven disk.

NO

Clutch diaphragm spring weak or broken. — YES → Replace the driven disk.

NO

Driven disk springs broken or yielded. — YES → Replace the driven disk.

4 THE CLUTCH DOES NOT RELEASE

Oil or grease on the seals of the driven disk. — YES → Remove the oil or grease; clean the flywheel and replace the driven disk.

NO

Grooves on the clutch engagement shaft are worn and impede the movement of the driven disk. — YES → Replace the shaft and, if necessary, the driven disk.

(Continue)

Clutch pedal height not adjusted (only mechanical control).	YES →	The driver must stop this habit and use the clutch pedal only when necessary. Adjust the height of the clutch pedal.
↓ NO		
Clutch release hydraulic control not efficient.	YES →	Replace the hydraulic control.

5 THE CLUTCH SLIPS

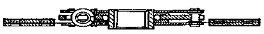
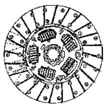
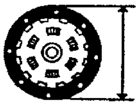
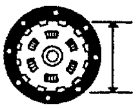
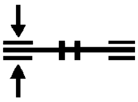
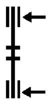
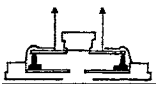
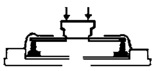
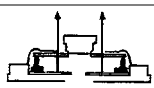
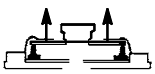
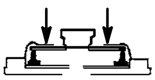
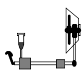
Driven disk seals worn or burnt.	YES →	Replace the driven disk.
↓ NO		
Clutch diaphragm springs weak or broken.	YES →	Replace the clutch.
↓ NO		
Oil or grease on the seals of the driven disk.	YES →	Remove the oil or grease, and replace the driven disk.

6 ABNORMAL WEAR OF DRIVEN DISK SEALS

The driver keeps the clutch pedal pressed while driving.	YES →	The driver must stop this habit and use the clutch pedal only when necessary.
↓ NO		
Clutch diaphragm spring blades weakened or broken.	YES →	Replace the clutch.

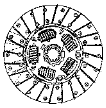
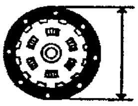
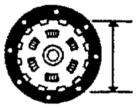
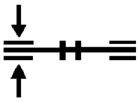
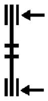
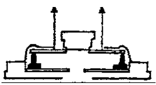
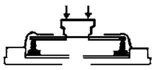
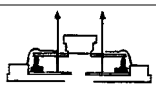
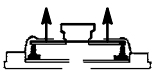
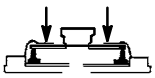
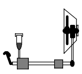
CHARACTERISTICS AND DATA

Models 29 L 10 - 29 L 12 - 35 S 10 - 35 S 12 - 35 C 10 - 35 C 12 - 40 C 10 - 40 C 12 (except for the vehicles equipped with 6 S 400 A O.D. gearbox unit)

9 " 1/4 CLUTCH			BORG & BECK
	Type		Dry single disk
	Clutch mechanism		"Pull" with diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		with single elastic coupling
	External ∅ seal	mm	$235\ ^{0}_{-1}$
	Internal ∅ seal	mm	$160\ ^{+1,5}$
	Disk thickness (new)	mm	7,7 ± 0,3
	Under load	N	6850
Minimum thickness due to wear		mm	1,25
	Max. off centring driven disk	mm	~ 0,2
	Minimum load on thrust plate	N	6850
	Max. release load at 9 mm. release height	N	1400
	Maximum rise thrust pad at 9 mm. release height	mm	1,6
	Disengagement stroke	mm	9^{+1}
	Max. depression stroke	mm	9,5
	Disengagement control		hydraulic
	Lubricant		-

NOTE Values refer to new clutch

Models 29 L 10 - 29 L 12 - 35 S 10 - 35 S 12 - 35 C 10 - 35 C 12 - 40 C 10 - 40 C 12 (only vehicles equipped with 6 S 400 A O.D. gearbox unit)

10 " 1/2 CLUTCH			SACHS
	Type		Dry single disk
	Clutch mechanism		Pull-type, with automatic wear recovery diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		with double elastic coupling springs
	External Ø seal	mm	$266^{\ 0}_{-1}$
	Internal Ø seal	mm	$180^{+1,5}$
	Disk thickness (new)	mm	7,6 ± 0,3
	Under load	N	9000
Minimum thickness due to wear		mm	1,25
	Max. off centring driven disk	mm	~ 0,4
	Minimum load on thrust plate	N	7900
	Max. release load at 9 mm. release height	N	9100
	Maximum rise thrust pad at 9 mm. release height	mm	1,1
	Disengagement stroke	mm	12^{+1}
	Max. consumption travel at the thrust block	mm	4
	Disengagement control		Electric actuator controlled by the gearbox control unit
	Lubricant		-

NOTE Values refer to new clutch

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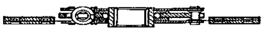
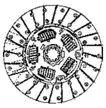
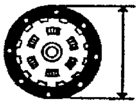
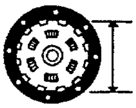
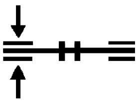
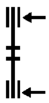
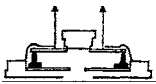
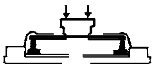
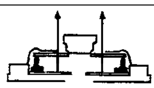
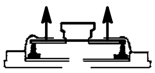
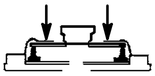
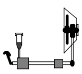
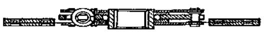
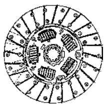
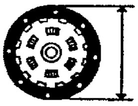
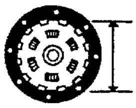
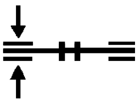
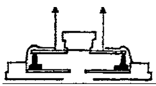
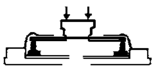
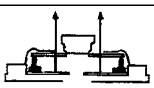
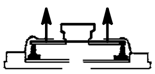
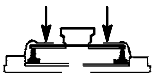
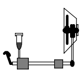
Models 29 L 14 - 35 S 14 - 35 C 14 - 40 C 14
(except for the vehicles equipped with 6 S 400 A O.D. gearbox unit)

10 " $^{1}/_{2}$ CLUTCH			VALEO
	Type		Dry single disk
	Clutch mechanism		"Pull" with diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		With double hub springs
	External ∅ seal	mm	$267^{\ 0}_{-1}$
	Internal ∅ seal	mm	$171^{+1}_{-0,5}$
	Disk thickness (new) Under load	mm N	8,5 ± 0,3 8000
Minimum thickness due to wear		mm	1,25
	Max. off centring driven disk	mm	~ 0,2
	Minimum load on thrust plate	N	6500
	Max. release load at 9 mm. release height	N	1600
	Maximum rise thrust pad at 9 mm. release height	mm	1,4
	Disengagement stroke	mm	9^{+1}
	Max. depression stroke	mm	10,7
	Hydraulic control		hydraulic
	Lubricant		-

NOTE Values refer to new clutch

Models 35 C 15 - 40 C 15 - 45 C 15 - 50 C 15 - 60 C 15 - 65 C 15
(except for the vehicles equipped with 6 S 400 A O.D. gearbox unit)

11" CLUTCH			VALEO
	Type		Dry single disk
	Clutch mechanism		"Pull" with diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		With double hub springs
	External ∅ seal	mm	$280^{\,0}_{-0.4}$
	Internal ∅ seal	mm	$170^{\,0}_{-0.4}$
	Disk thickness (new)	mm	8,5 ± 0,3
	Under load	N	8000
Minimum thickness due to wear		mm	1,5
	Max. off centring driven disk	mm	~ 0,2
	Minimum load on thrust plate	N	7000
	Max. release load at 9 mm. release height	N	1850
	Maximum rise thrust pad at 9 mm. release height	mm	1,5
	Disengagement stroke	mm	$9^{0}_{-0.4}$
	Max. depression stroke	mm	13,6
	Disengagement control		hydraulic
	Lubricant		-

NOTE Values refer to new clutch

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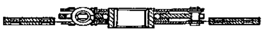
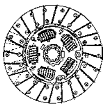
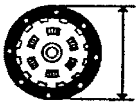
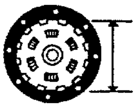
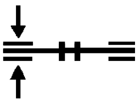
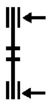
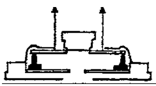
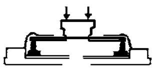
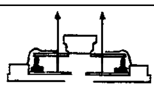
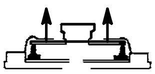
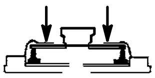
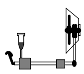
Models 35 S 18 - 35 C 18 - 40 C 18 - 45 C 18 - 50 C 18 - 60 C 18 - 65 C 18
(except for the vehicles equipped with 6 S 400 A O.D. gearbox unit)

11" CLUTCH			VALEO
	Type		Dry single disk
	Clutch mechanism		"Pull" with diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		With double hub springs
	External ∅ seal	mm	280 $^{0}_{-0.4}$
	Internal ∅ seal	mm	170 $^{0}_{-0.4}$
	Disk thickness (new)	mm	8,5 ± 0,3
	Under load	N	8000
Minimum thickness due to wear		mm	1,5
	Max. off centring driven disk	mm	~ 0,2
	Minimum load on thrust plate	N	7500
	Max. release load at 9 mm. release height	N	1850
	Maximum rise thrust pad at 9 mm. release height	mm	1,4
	Disengagement stroke	mm	9 $^{0}_{-0.4}$
	Max. depression stroke	mm	13,6
	Disengagement control		hydraulic
	Lubricant		-

NOTE Values refer to new clutch

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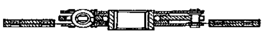
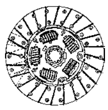
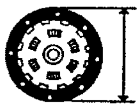
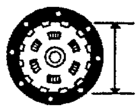
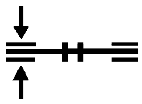
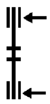
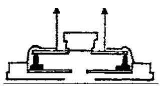
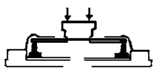
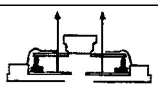
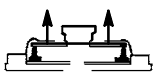
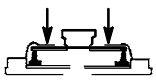
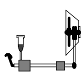
Models 35 S 18 - 35 C 15/18 - 40 C 15/18 - 45 C 15/18 - 50 C 15/18 - 60 C 15/18 - 65 C 15/18 (only vehicles equipped with 6 S 400 A O.D. gearbox unit)

11" CLUTCH			SACHS
	Type		Dry single disk
	Clutch mechanism		"Pull" with diaphragm spring
	Driven disk		With friction seals
	Driven disk hub		With double hub springs
	External ∅ seal	mm	$280^{\ 0}_{-0.4}$
	Internal ∅ seal	mm	$175^{\ 0}_{-0.4}$
	Disk thickness (new)	mm	8,4 ± 0,3
	Under load	N	9100
Minimum thickness due to wear		mm	1,5
	Max. off centring driven disk	mm	~ 0,2
	Minimum load on thrust plate	N	7900
	Max. release load at 9 mm. release height	N	1100
	Maximum rise thrust pad at 9 mm. release height	mm	1,1
	Disengagement stroke	mm	$12^{\ 0}_{-0.4}$
	Max. consumption travel at the thrust block	mm	4
	Disengagement control		Electric actuator controlled by the gearbox control unit
	Lubricant		-

NOTE Values refer to new clutch

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TIGHTENING TORQUES

PART	TORQUE	
	Nm	kgm
Screw securing clutch to engine flywheel	46,5	4,7
Screw securing operator cylinder mounting to gearbox	10 ± 1	1 ± 0,1
Screw secuing pedal board mounting	-	-
Screw to secure clutch disengagement lever support to gearbox front cover	23,5 ± 2,5	2,3 ± 0,2

TOOLS

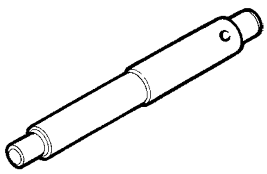
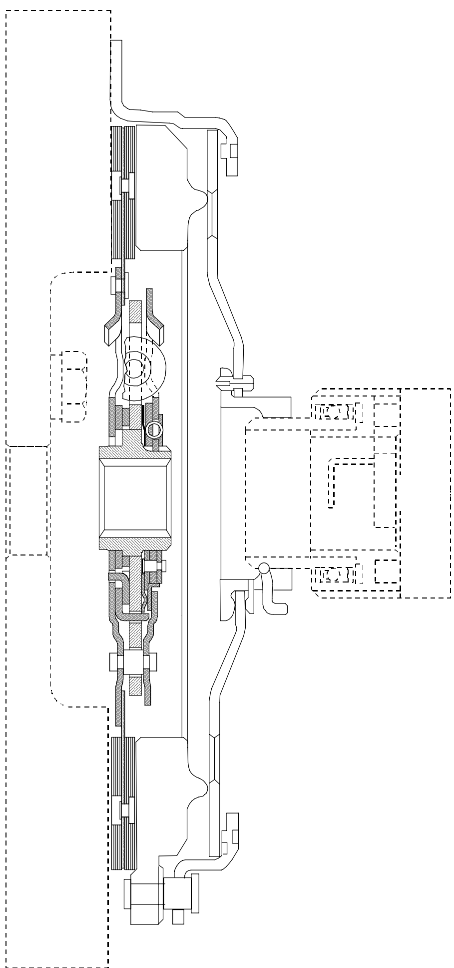
TOOL NO.	DESCRIPTION
99370205 	Guide pin for centring clutch driven disk

Figure 2



52230

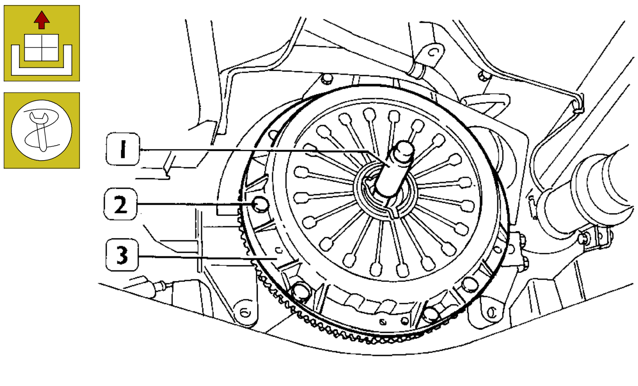
505210 CLUTCH REMOVAL AND REFITTING

Removal

The operation consists of:

- ❑ removal-refitting of transmission shafts (see section 505620)
- ❑ removal-refitting of gear box (see section 530210).

Figure 3

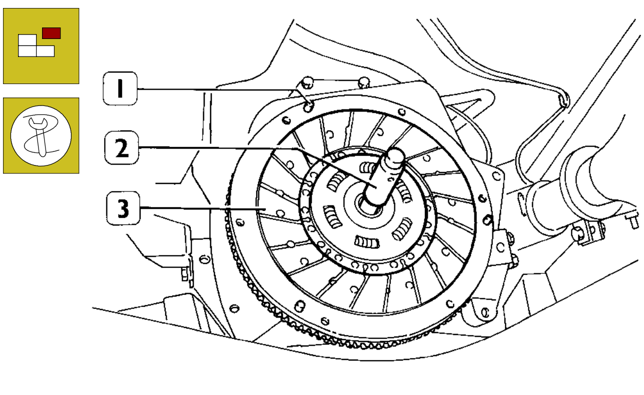


44570

Insert the centering pin 99370205 (1) in the gear infeed shaft support bearing, to facilitate clutch removal operations.

Remove the fixing screws (2) and remove the thrust pad (3) from the engine flywheel.

Figure 4



44571

Remove the clutch disk (3) by extracting the centring pin 99370205 (2).

Disk plate centering pin (1) located on the engine flywheel.

CHECKS

The checks to be made are as follows:

- ❑ the mating surface, on the engine flywheel, of the driven disk must not be excessively worn or scored.
- ❑ the teeth of the toothed crown must not be worn or broken.

If this is not the case, disassemble the engine flywheel (operation 540850) as described in the relevant paragraph at section 2.

Proceed on the engine flywheel as described in relevant paragraph (operation 540853) at 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 as described in the relevant paragraph. Remove the rear cover complete with sealing rings and replace the same as described at section 2.

Check that the support bearing or bushing of the take up shaft on the gears fitted to the drive shaft are not worn or broken and, if necessary, replace them as described in the relevant paragraph (540852).

Check the condition of the thrust pad; the driven disk support surface must not be scored or excessively worn or should there be signs of overheating; the diaphragm spring must be in perfect condition.

Check the condition of the driven disk:

- ❑ the friction seals must not be excessively worn or present signs of overheating, or traces of oil or grease;
- ❑ there should be very little backlash between the hub and gear take up shaft;
- ❑ the hub rings must not be loose or broken.

When any defects are found, replace the part in question.

The complete clutch is supplied with a spare kit.

The following are supplied singularly:

- ❑ the driven disk and collar bearing.

In this case it will necessary to assemble the new parts of the driven disk spring that is to be reused.

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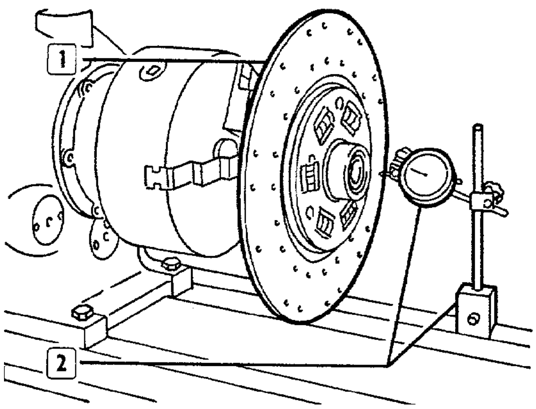
Figure 5

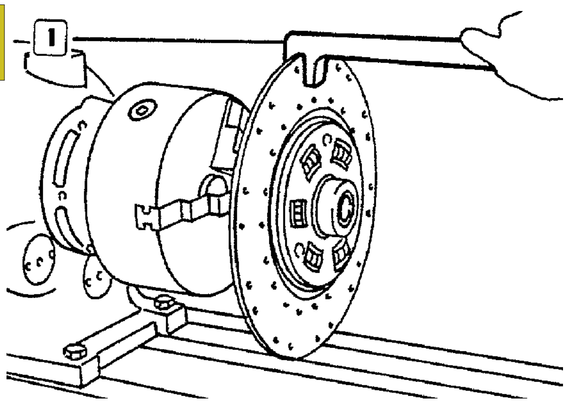


Before fitting a new driven disk check that it is centred as follows:

Position the driven disk (1) on a lathe and, with the use of a magnetic base dial gauge (2), check that the surface of the disk is not out of line at any point.

Maximum tolerance allowed for the driven disk is 0.20 mm.

Figure 6



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

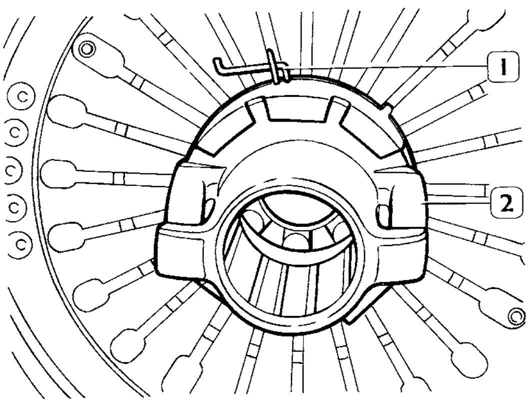
Refitting

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

- ❑ carefully clean the faying surface of the flywheel disk using methylated spirits or petrol; if any slight scratches are noted remove with an abrasive cloth;
- ❑ position the driven disk (3, SENZA CODICE), using the guide pin (2, SENZA CODICE) to obtain perfect centring and to avoid straining the hub when the gears are reconnected;
- ❑ position the thrust pad by aligning the holes with the centring grub screws (1, SENZA CODICE) on the engine flywheel;
- ❑ assemble and lock the thrust pad fixing screws to the correct torque;
- ❑ remove the guide pin;
- ❑ reconnect the gears after spreading the grooved shaft with molybdenum disulphide Molikote as described in Section 4;
- ❑ adjust the clutch travel as described in the relevant paragraph (operation ..).

505254 THRUST BEARING REMOVAL AND REFITTING

Figure 7



The operation consists of:

- ❑ removal-refitting of transmission shafts (see section 505620);
- ❑ removal-refitting of gear box (see section 530210).

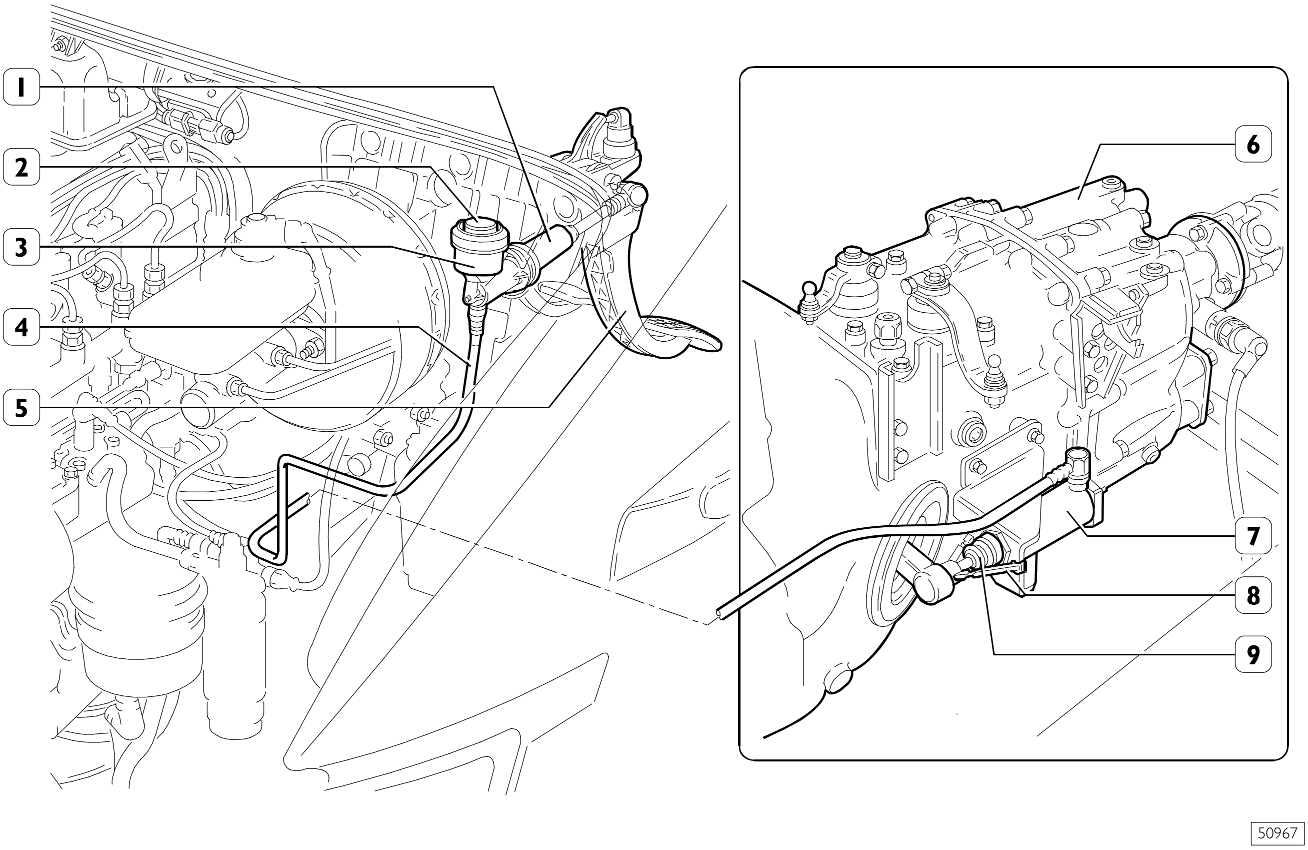
By using the appropriate pliers open the split pin (1) and extract the collar bearing (2) from the thrust pad (3).

To assemble, carry out the disassembly operations in reverse.

NOTE The new part must be of the same supply as the driven disk that is to be reused.

505260 HYDRAULIC CLUTCH DRIVE

Figure 8



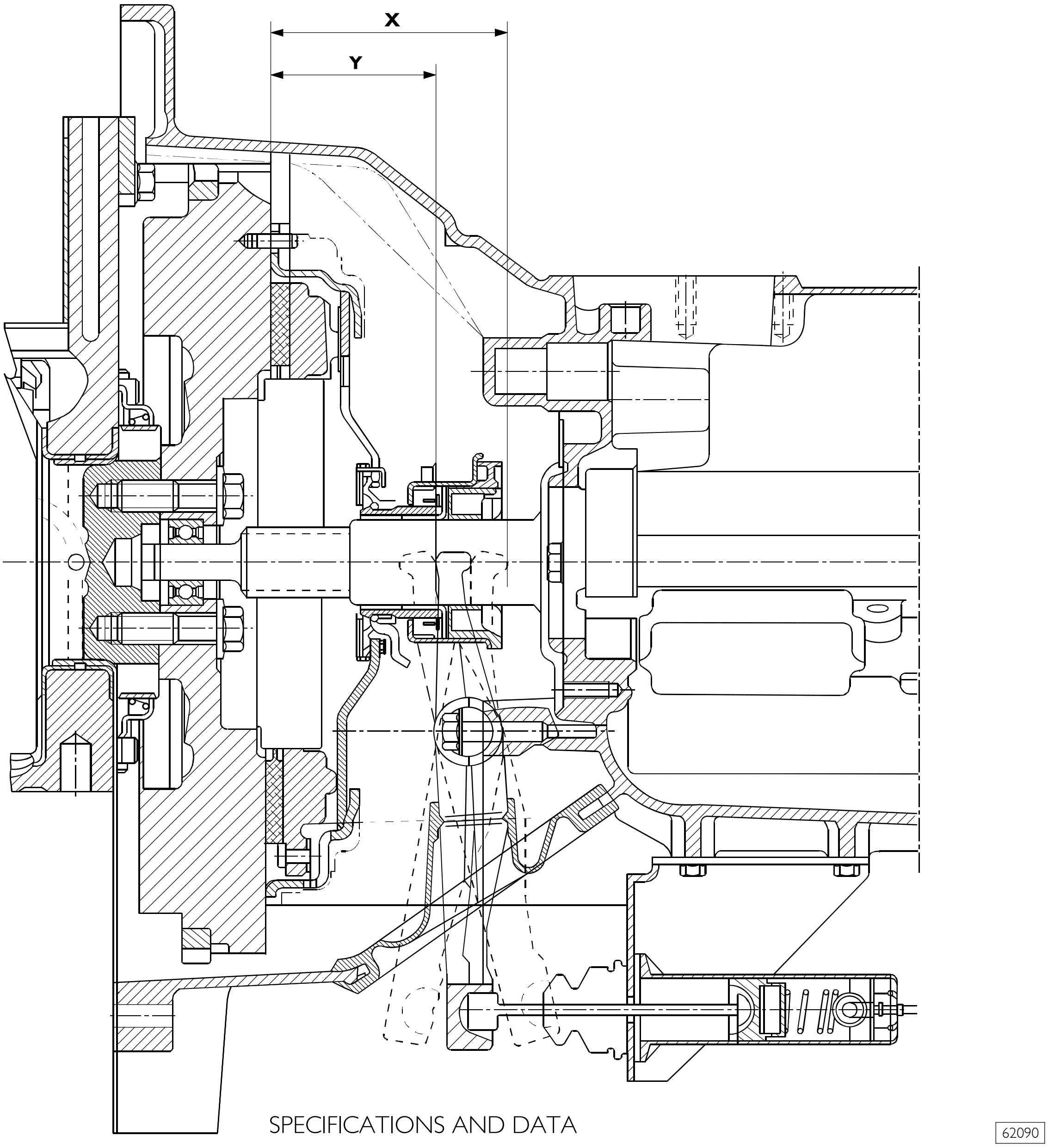
The hydraulic clutch drive is composed of:

- a master cylinder (1) mounted on the pedal board and connected to the clutch pedal (5), with an integrated oil tank (3).
- an operating cylinder (7) fixed to the gearbox (6).
- an oil pipe (4).

NOTE The components of the hydraulic drive must never be dismantled or separated from each other in any way.
The cover (2) of the oil tank (3) must not be removed.

This assembly requires no maintenance and the hydraulic circuit must not be vented.
In the event of defectiveness, the entire assembly needs to be replaced as it is supplied as a spare part, proceeding as described under the relevant heading.
The clip (8) holding the push rod (9) on the assembly supplied as a spare part must not be removed or cut.

Figure 9



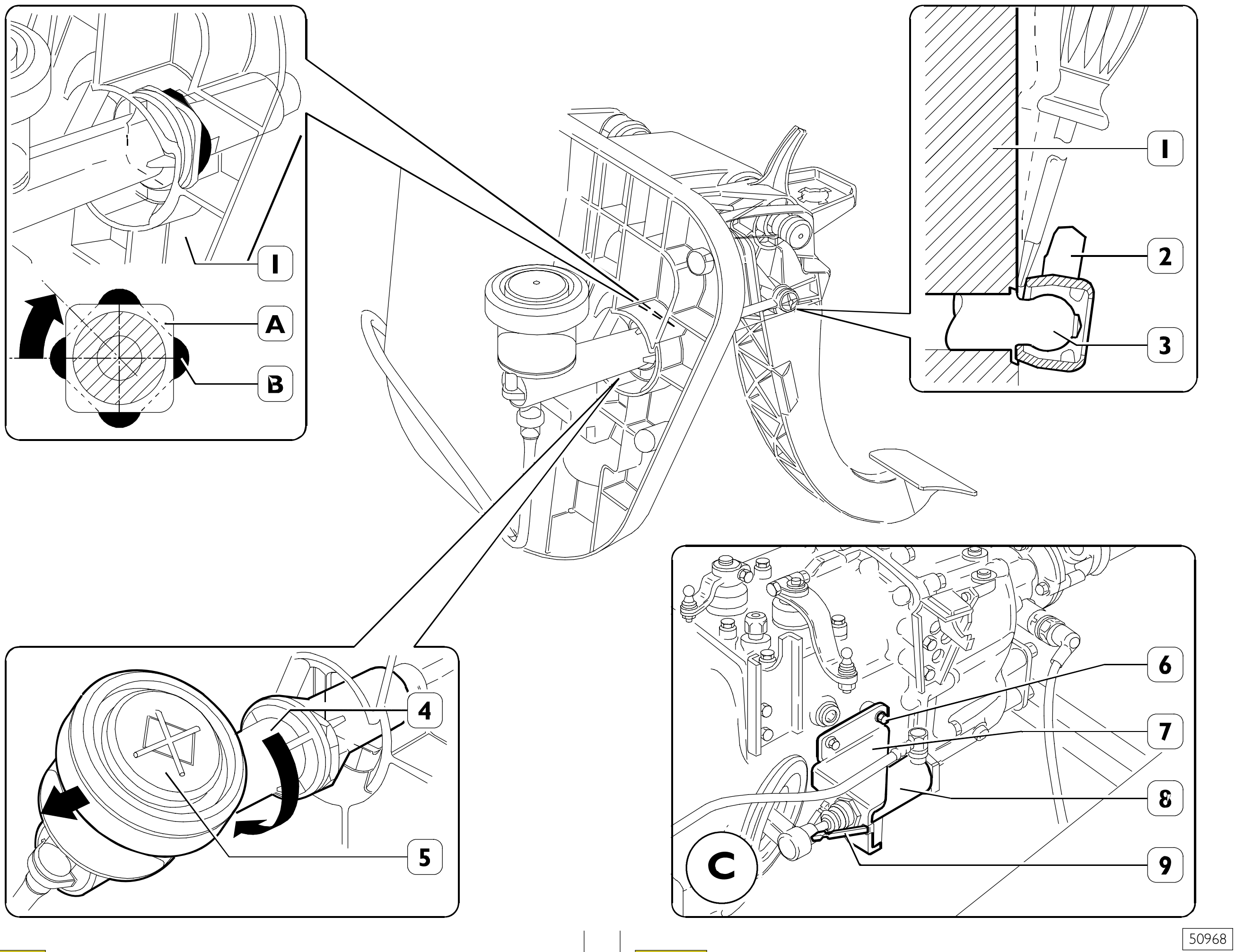
SPECIFICATIONS AND DATA

Main cylinder diameter	18 mm
Main cylinder section	254,47 mm^2
Operating cylinder diameter	22 mm
Operating cylinder section	346,36 mm^2
Clutch pedal ratio	5,85
Hydraulic ratio	1,36
Clutch disengagement lever ratio	1,67
Overall reduction ratio	13,28
Max disengagement stroke X	▲(94) ●(99) ■(98.7) mm
Max wear stroke Y	▲(67,5) ●(70.8) ■(69,1) mm

▲ 9 " 1/4 CLUTCH
● 10 " 1/2 CLUTCH
■ 11" CLUTCH

HYDRAULIC CLUTCH DRIVE REMOVAL - REFITTING

Figure 10



Removal

Position the vehicle over the pit or on the lift.
From inside the cab, using a screwdriver, unhook the swivel head (2) of the master cylinder push rod from the clutch pedal link pin (3).

NOTE Do not act on the pin (3) to prevent it coming out of the pedal board (1).

Working from the engine bay, turn the master cylinder (4) to the right (approx. 1/8 of a turn) to align the square of the hole (A) in the pedal board (1) with the square (B) of the master cylinder body and extract it from the pedal board (1).

Working under the vehicle, disengage the operating cylinder (8 detail C) by unscrewing the screws (6 detail C) securing the cylinder mounting (7 detail C) from the gearbox.

Remove the hydraulic clutch drive assembly from the vehicle.

Refitting

For refitting, carry out the operations for removal in reverse order, taking the following precautions:

- Do not press the clutch pedal until refitting is complete.
- During assembly, handle parts carefully.
- Lubricate the contact surfaces of the clutch disengagement lever with the clutch pedal link pin.
- Lubricate the contact surface of the master cylinder swivel head with the clutch pedal link pin.
- After refitting the operating cylinder mounting to the gearbox, check that the cylinder push rod is aligned with the clutch disengagement lever seat.
- If replacing with a new hydraulic drive assembly, after refitting, press firmly on the clutch pedal so as to break or free the clamp holding the push rod (9).
- Lift the clutch pedal by hand with a force of no greater than 5 daN to its limit and hold it in this position for at least five seconds so that the oil from the tank will supply the master cylinder. Repeat this operation if necessary.

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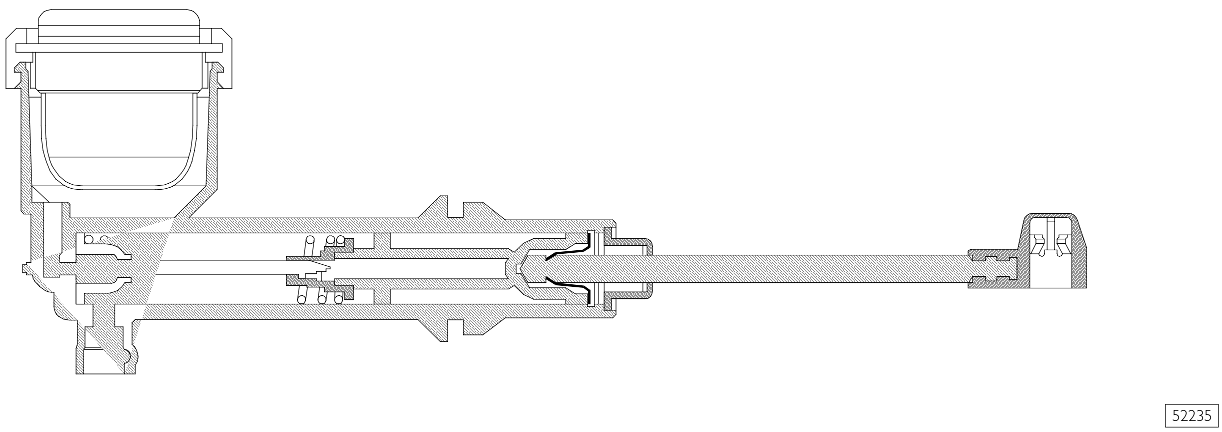
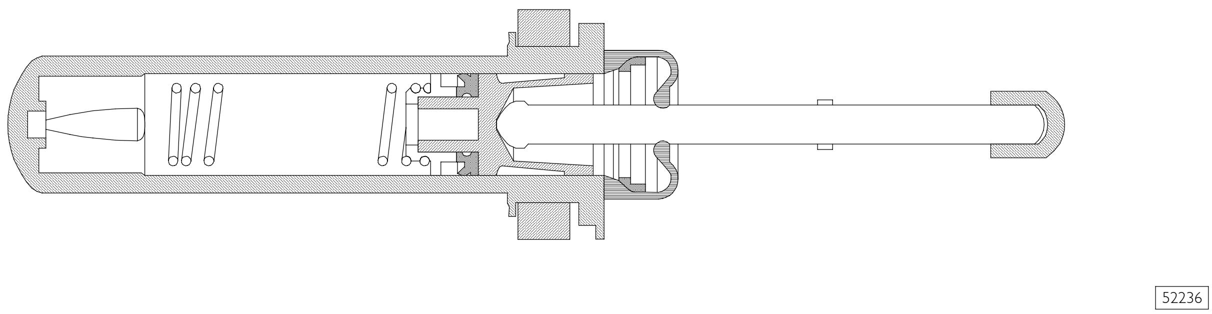
Figure 11



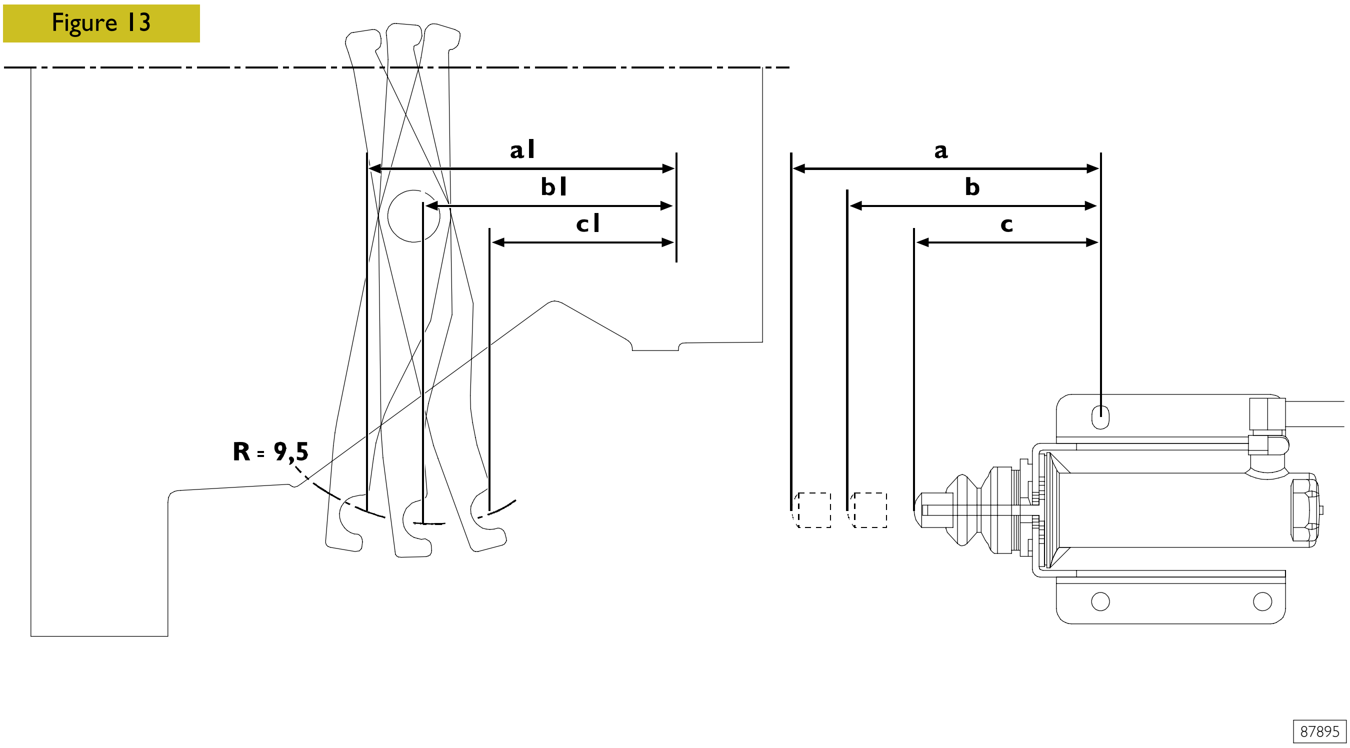
MASTER CYLINDER

Figure 12



OPERATING CYLINDER

Figure 13



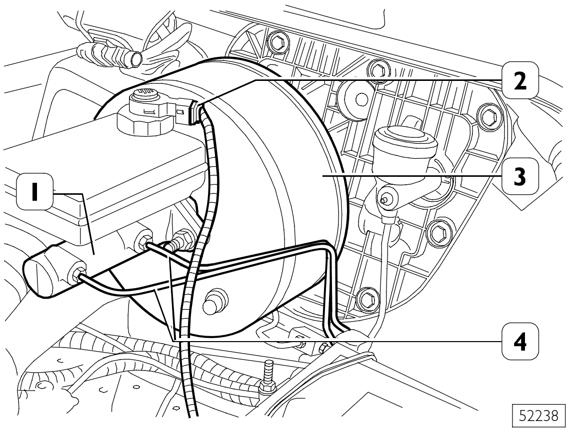
The operating cylinder makes up for the wear of the driven disc marking an increase in load on the pedal during disengagement when the wear on the driven disc gets to be 90%.

Maximum disengagement position when new	a = 121.8 mm.	a1 = 112.8 mm.
Engagement position when new	b = 99.3 5.8 mm.	b1 = 89.8 mm
Minimum position with worn disc	c = 73.3 mm.	c1 = 63.8 mm

502601 PEDAL BOARD REMOVAL - REFITTING

Removal

Figure 14

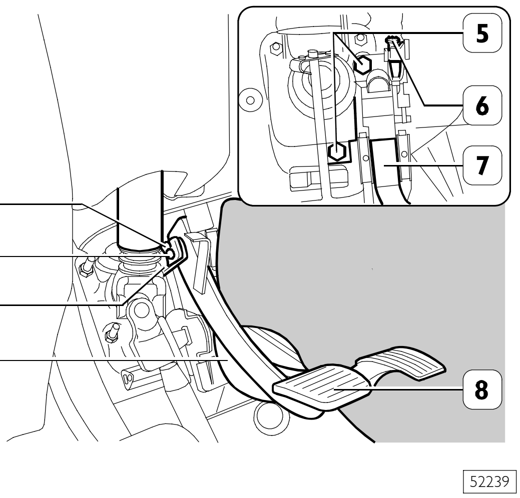


Set a proper container under the brake pipes (4) and remove them from the brake pump (1) of the vacuum brake (3).

When draining the brake oil, take care it does not come into contact with anyone, clothes, or painted parts.

Disconnect the electrical connection (2) from the brake liquid tank plug.

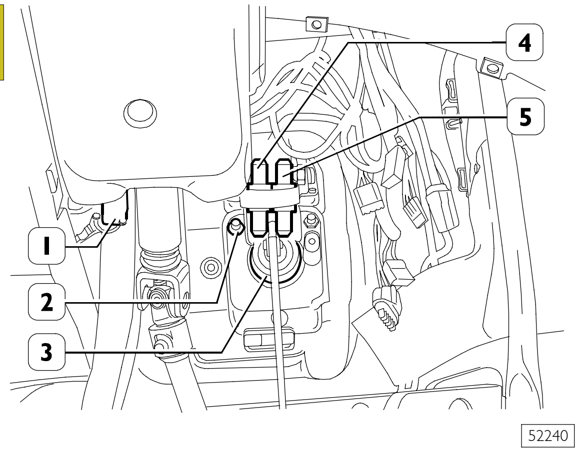
Figure 15



From inside the cab:

Remove the side guard (7), disconnect the electrical connection (6) from the accelerator pedal (4). Take out the screws (5) and remove the accelerator pedal (4) from the pedal board.

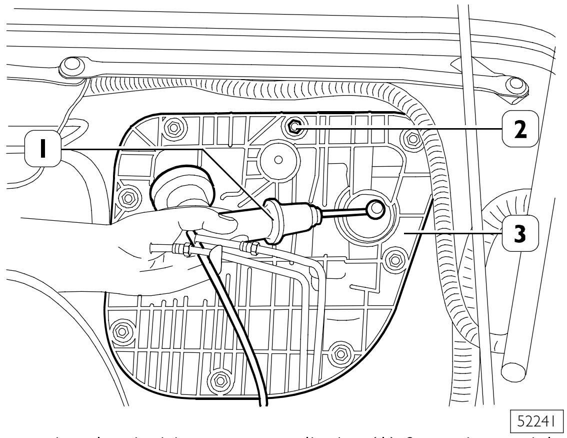
Figure 16



Remove the four nuts (2) fixing the servo brake (3) and take this out of the engine bay.

Disconnect the electrical connection (1) from the sensor on the clutch pedal and the electrical connection (4) from the sensor on the brake pedal. Disconnect the electrical connection (5) from the switch on the brake pedal.

Figure 17



Disconnect the clutch drive master cylinder (1) from the pedal board as described under the relevant heading and set it aside appropriately in the engine bay, taking care not to damage or bend the oil pipe.

Take out the nuts (2) and remove the pedal board (3).

Refitting

For refitting, carry out the operations described for removal in reverse order, taking the following precautions:

- tighten the nuts/screws to the required tightening torque under the relevant heading;
- refit the clutch drive cylinder as described under the relevant heading;
- fill the brake liquid tank with the required quantity and grade and bleed the air (operation 784010) as described under the relevant heading;
- after making the electrical connections, check the efficiency of the connected components.

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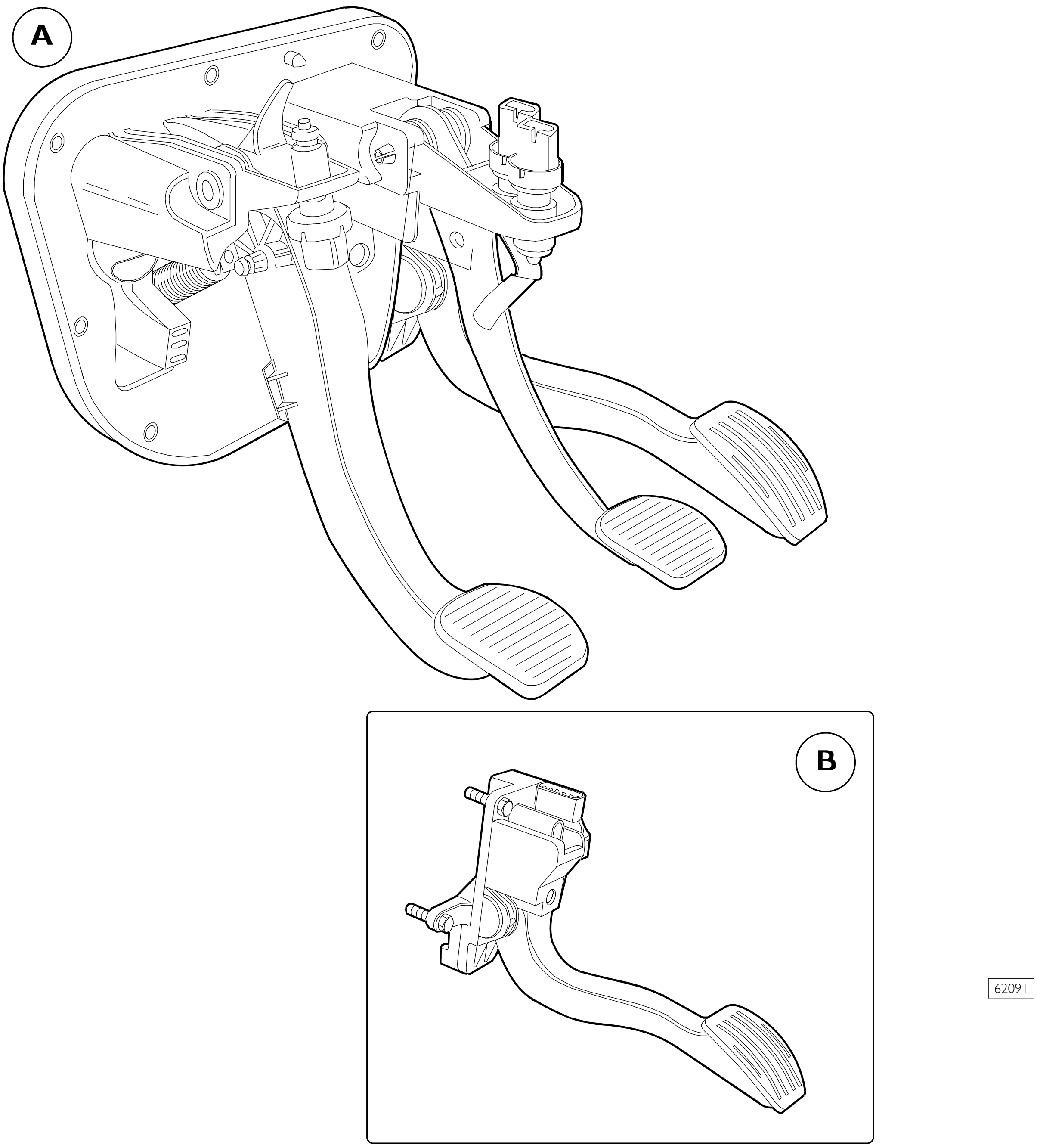
PEDAL BOARD

Figure 18



A. Pedal board with mechanical accelerator pedal
B. Electronic accelerator pedal

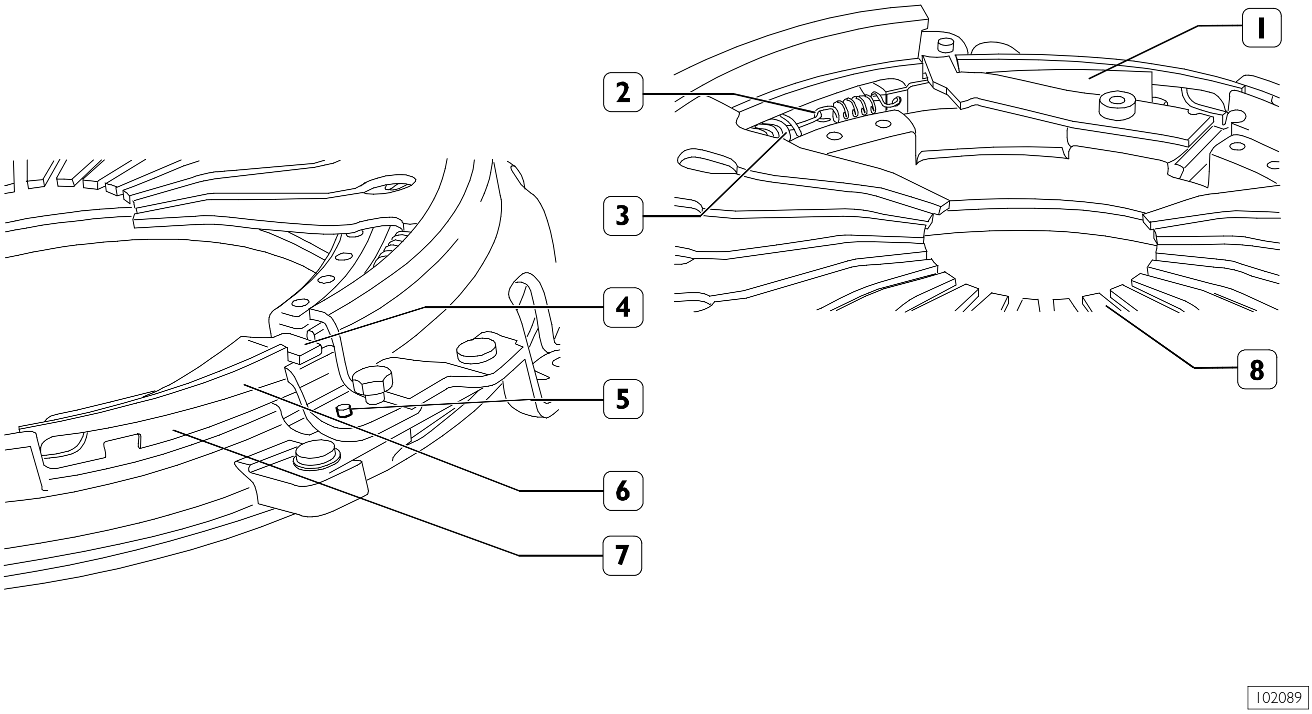
NOTE The only repair operations to be performed on the pedal-assy are the following:

- accelerator pedal replacement;
- sensor replacement.

In any other case, replace the pedal using the above-mentioned components if they are serviceable.

CLUTCH WITH AUTOMATIC WEAR RECOVERY - COMBINED WITH 6 AS'300 VD GEARBOX

Figure 19



1. Sliding wedge - 2. Wedge (1) actuating spring - 3. Wear recovery ring (6 & 7) actuating spring - 4. Wear indicator - 5. Retainer - 6. Wear recovery upper sliding ring - 7. Wear recovery lower ring - 8. Diaphragm spring

Description

The automatic wear recovery device is placed between the diaphragm spring and the thrust plate of the pressure plate assembly. It is essentially made up of wedge-shaped rings which recover, under sliding conditions, the clutch disc wear real-time, while keeping both the diaphragm spring characteristics and the force required to actuate the spring unchanged.

Operation

Automatic wear recovery takes place in two separate phases:

- ❑ Phase 1: every time the clutch is closed (engaged) and the clutch disc wear – as detected by retainer (3) – is such that the pressure plate is made to travel an extra stroke, spring (4) will disengage wedge (1), which will be pulled by spring (2) and will stop again against spring (4) and retainer (5) after travelling a stroke equal to the disc wear.
- ❑ Phase 2: when the clutch is opened (disengaged), diaphragm spring (8) will release wear recovery rings (6 & 7); as a result, spring (3) will, by causing lower ring (6) to slide over upper ring (7) due to the inclined planes of the same, lift the latter by an amount equal to the clutch disc wear.

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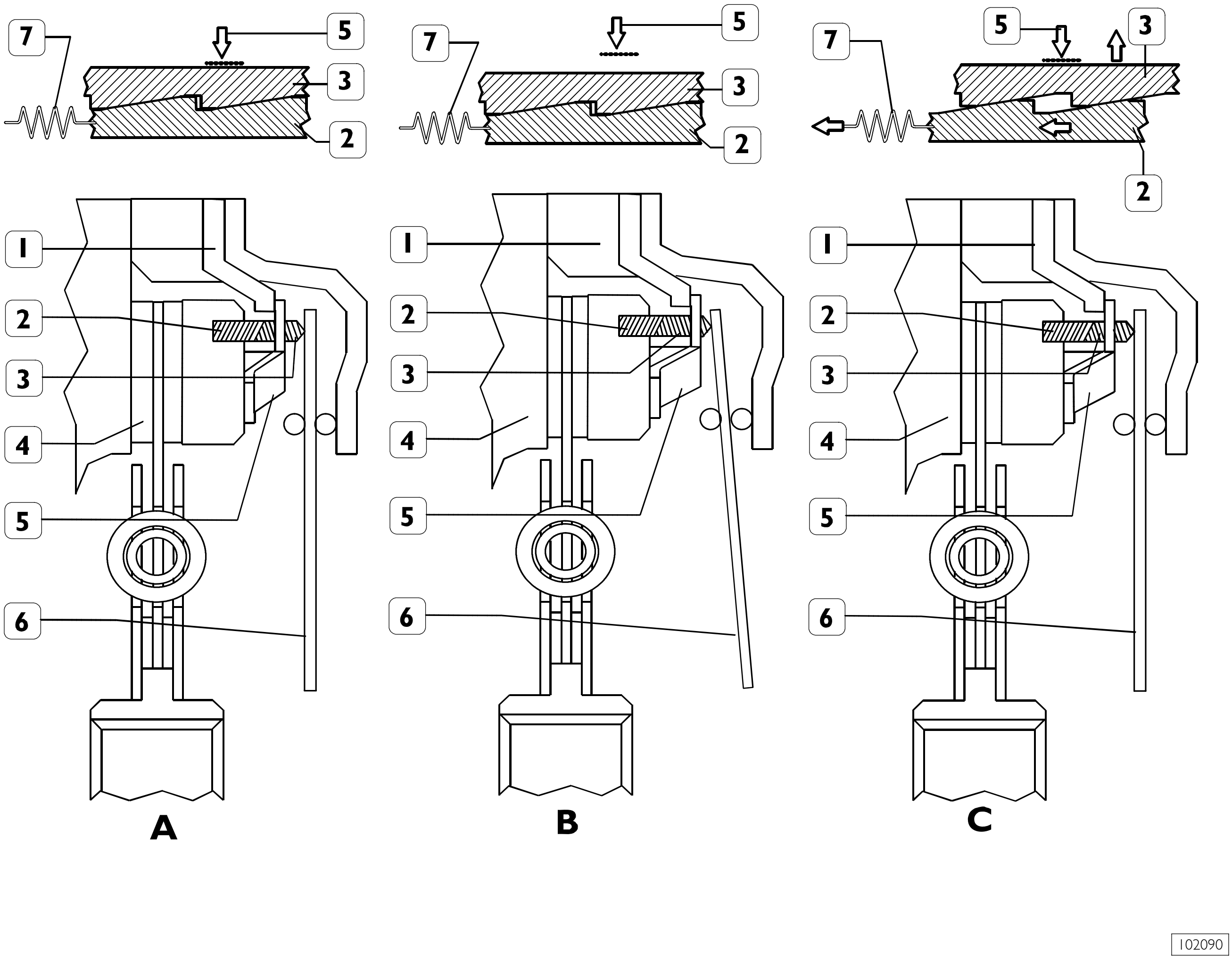
Figure 20



CLUTCH DISC AUTOMATIC WEAR RECOVERY DIAGRAM

A. Position of the diaphragm spring with a new clutch disc - B. Position of the diaphragm spring with a worn clutch disc prior to operation of the automatic wear recovery device - C. Position of the diaphragm spring with a worn clutch disc after operation of the automatic wear recovery device

1. Retainer - 2. Lower ring - 3. Upper ring - 4. Clutch disc - 5. Retainer (1) spring - 6. Diaphragm spring - 7. Wear recovery ring actuating spring

← = ring (2) sliding

↑ = ring (3) lifting

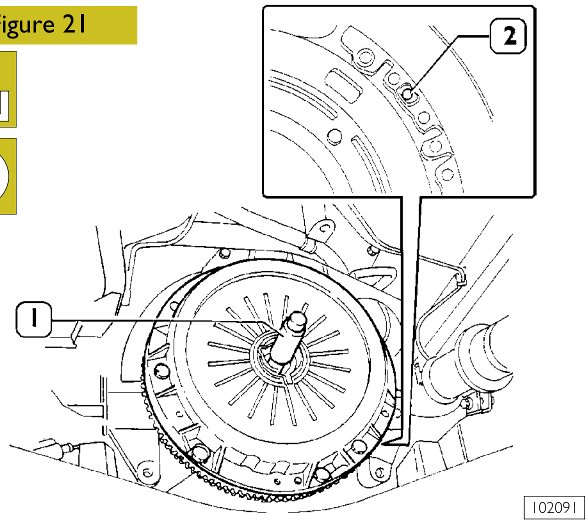
505210 REMOVAL AND REFITTING OF CLUTCH WITH DEVICE RECOVERY COMBINED

Removal

The operation consists of:

- removal-refitting of transmission shafts (see section 505620)
- removal-refitting of gear box (see section 530210).

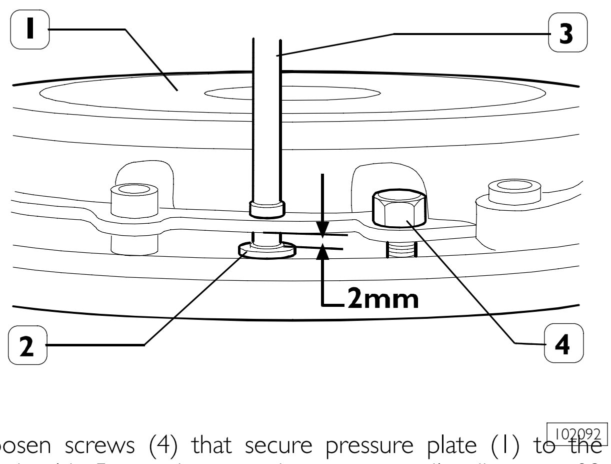
Figure 21



Insert clutch centring pin 99370205 (1) in the shaft support bearing.

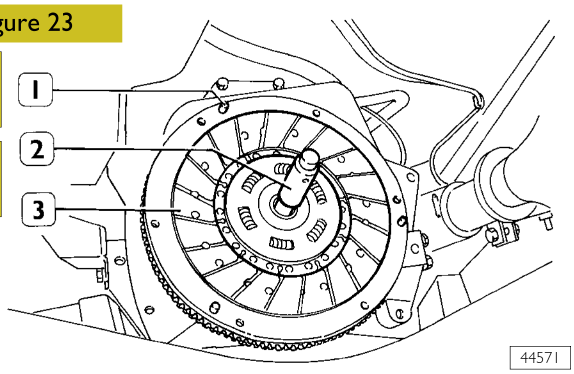
Locate the position of retainer (2): it is positioned between the engine flywheel plug for clutch assembly centering and a hole for the screw used to fasten the same. It sticks out the clutch assembly by approximately 3 mm.

Figure 22



Loosen screws (4) that secure pressure plate (1) to the flywheel in 5 steps in crossed sequence until a distance of 2 mm is obtained between retainer (2) and the clutch. Also make sure that retainer (2) is released from pressure plate (1); otherwise, use a suitable beater (3) to hit the top of retainer (2).
Then remove screws (4) and take the pressure plate off the engine flywheel.

Figure 23



Remove the clutch disk (3) by extracting the centring pin 99370205 (2).

CHECKS

The checks to be made are as follows:

- the faying surface, on the engine flywheel, of the driven disk must not be excessively worn or scored.
- the teeth of the toothed crown must not be worn or broken.

If this is not the case, disassemble the engine flywheel (operation 540850) as described in the relevant paragraph at section 2.

Proceed on the engine flywheel as described in relevant paragraph (operation 540853) at 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 as described in the relevant paragraph.

Replace the seal ring as described in section 2.

Check that the support bearing or bushing of the take up shaft on the gears fitted to the drive shaft are not worn or broken and, if necessary, replace them as described in the relevant paragraph (540852).

Check the condition of the thrust pad; the driven disk support surface must not be scored or excessively worn or should there be signs of overheating; the diaphragm spring must be in perfect condition.

Check the condition of the driven disk:

- the friction seals must not be excessively worn or present signs of overheating, or traces of oil or grease;
- there should be very little backlash between the hub and gear take up shaft;
- the hub rings must not be loose or broken.

Should any anomaly be found, the full clutch shall be replaced. Inspect the conditions of the clutch-release bearing and the release lever, should any anomaly be found, the concerned part shall be replaced.

NOTE In the event that the clutch release lever is replaced, calibration shall be carried out after re-attaching the gearbox, as described in the relevant charter of the "Gearbox" section.

Refitting

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

- ❑ carefully clean the faying surface of the flywheel disk using methylated spirits or petrol; if any slight scratches are noted remove with an abrasive cloth;
- ❑ position the driven disk (3, SENZA CODICE), using the guide pin to obtain perfect centring and to avoid straining the hub when the gears are reconnected;
- ❑ position the thrust pad by aligning the holes with the grub screws (1, SENZA CODICE) on the engine flywheel;
- ❑ screw down the pressure plate fastening screws in four subsequent steps and in crossed sequence, then tighten them to the specified torque

SECTION 4

5302 Transmission

Page

DIAGNOSTICS

Main transmission operation faults:

1 - Noisy transmission

2 - Noisy transmission only in reverse speed

3 - Gear spontaneous disengagement

4 - Difficult speed engagement or selection

5 - Leakages of lubricant.

1 NOISY TRANSMISSION

Insufficient lubricating oil level.	YES →	Add **TUTELA TRUCK GEARLITE** oil up to proper level.
NO ↓		
Screws which fasten the transmission to the chassis are loose.	YES →	Tighten loose screws properly.
NO ↓		
Excessive backlash between gears.	YES →	Overhaul transmission and replace worn gears.
NO ↓		
Gears, bearings, synchronizer rings and sliding sleeves worn. Springs broken.	YES →	Replace worn or damaged components.

2 NOISY TRANSMISSION ONLY IN REVERSE SPEED

Reverse speed or connected gears damaged.	YES →	Overhaul transmission.

3	**GEAR SPONTANEOUS DISENGAGEMENT**

Cause		Remedy
Speed engagement/selection rod release ball spring yielded or broken.	YES →	Remove the cap and replace the spring.
NO ↓		
Sliding sleeves positioning springs yielded or broken.	YES →	Remove the transmission and replace the springs.

4	**DIFFICULT SPEED ENGAGEMENT OR SELECTION**

Cause		Remedy
Incorrect clutch disengagement.	YES →	Check the command or replace clutch.
NO ↓		
Wrong quality of oil in the box. Insufficient oil level.	YES →	Drain the oil and refill with **TUTELA TRUCK GEARLITE** oil up to proper level.
NO ↓		
Movement of sliding sleeves hindered. Forks, sliding sleeves, synchronizer rings worn.	YES →	Disassemble the gearbox and look for the cause and carry out repairs if necessary.
NO ↓		
Wrong assembly of levers on selection and/or gear engagement levers.	YES →	Check and/or mount the levers as described under the relevant heading.

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5	LEAKAGES OF LUBRICANT

Cause		Remedy
Oil level too high.	YES →	Restore proper level
NO ↓		
Breather clogged	YES →	Clean breather
NO ↓		
Input and/or output shaft retaining rings worn.	YES →	Replace retaining rings.
NO ↓		
Loose screws and/or nuts which fasten: covers, support, boxes	YES →	Remove the component; clean coupling surfaces. Spread on them some LOCTITE 5206 sealing, re-fit and tighten screws and/or nuts to the prescribed torque.

TRANSMISSION REMOVAL - REFITTING

Removal

Here we describe the removal-refitting operations for the 5 S 300 transmission that, unless specified otherwise, also hold for the 6 S 400 O.D. transmission.
Position the vehicle over the pit or on a lift or on special stands.
Act from inside the engine compartment to remove the screws securing the starting motor to the gearbox case front cover (the upper screw also secures the fuel pipe supporting bracket).
Remove the starter motor and put it appropriately aside in the engine bay.
Act from under the vehicle to:

- remove screws (11) and take sound-proofing guards (12) off;
- disconnect exhaust pipe (13) from the turboblower pipe.

On 6 S 400 O:D. gearbox units: remove screws (17) securing exhaust pipe supporting bracket (16) to the gearbox unit.
Remove the sealing from ring (25), then unscrew the same and disconnect the speed indicator control cable.
Disconnect reversing light electric connection (22) (on 6 S 400 O.D. gearbox units, the reversing light switch is located on the left side of the gearbox unit).
Remove bolts (23) securing propeller shaft (24) to the gearbox unit; if necessary, remove screws (19) securing elastic support (18) to the chassis, and properly secure the propeller shaft to the chassis.
Disconnect the jointed heads:

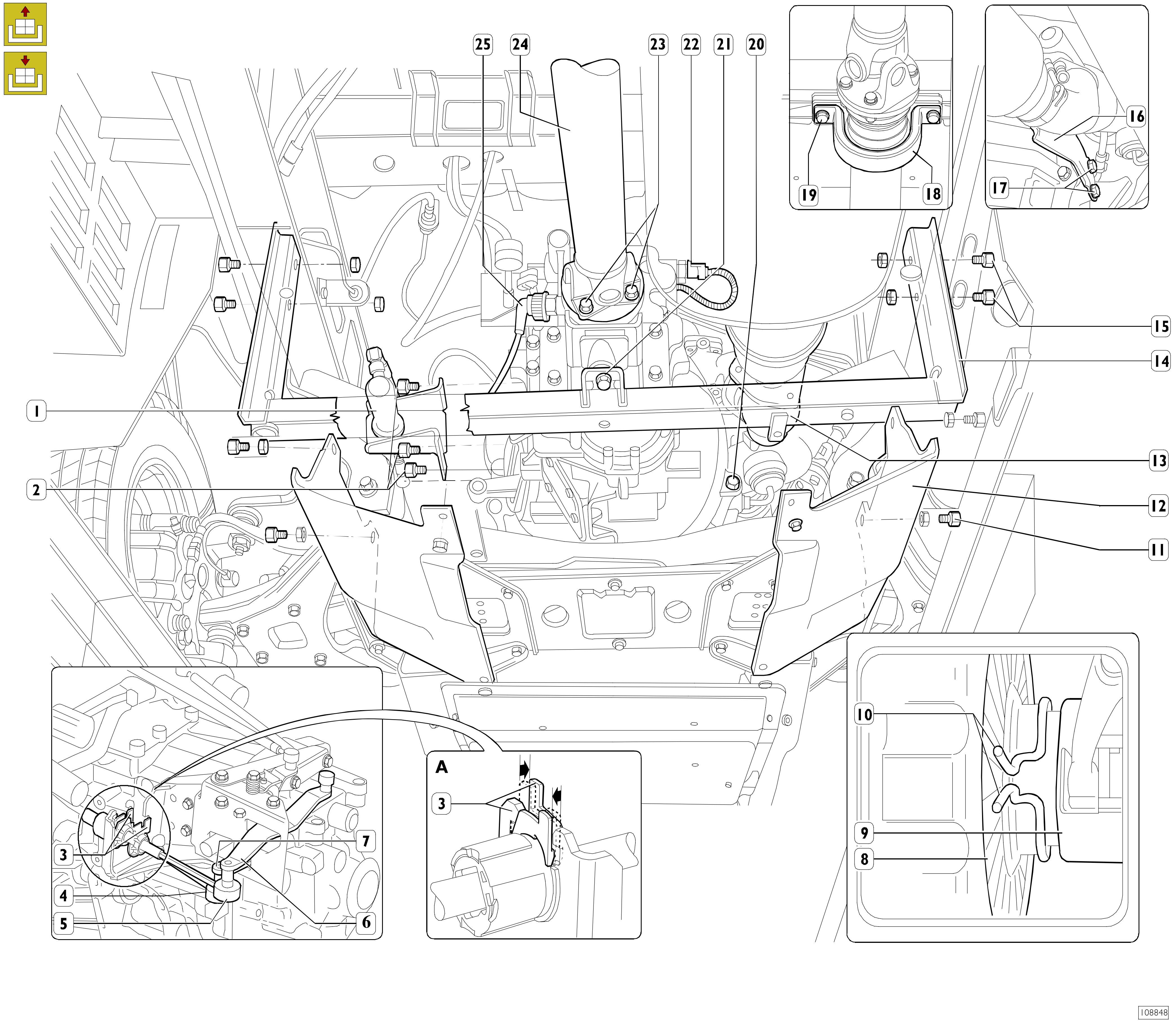
- of the selection cable: 4 (max. pull-out load: 250 N - max. pull-in load: 60 N);
- of the engagement cable: 5 (max. pull-out load: 100 N - max. pull-in load: 80 N, from lever 6 and 7). Use a suitable screwdriver to open out flexible cable fins (3) so that the pawls are disengaged from the support (see detail A).

Undo fastening screws (2), move clutch control cylinder (1) together with its bracket and properly secure it to the chassis.
Use a hydraulic jack to place bracket 99370629 under the gearbox unit, then lay the chain onto the gearbox unit and fit a link of the chain into the bracket slot. Screw down the nut so as to firmly secure the gearbox unit to the bracket through the chain. Remove screws (20) securing the gearbox case to the engine base.
Undo fastening screws (15) and elastic dowel fastening screw (21), then remove gearbox supporting crosspiece (14) together with its dowel.
Move the gearbox back until the gearbox input shaft has come off the clutch disc hub. Then lower the hydraulic jack while simultaneously verifying that the gearbox unit does not, during the downward movement, hit or get stuck into a component.

Refitting

Gearbox unit reattachment is not particularly difficult and is carried out by properly reversing the order of the detachment operations. However, the following instructions shall be followed when coupling the clutch with the gearbox.
Use suitable pliers to open safety snap ring (10) and take pressure plate bearing (9) out of clutch diaphragm spring (8). Fit the bearing onto the motion input shaft cover quill, by connecting the same to the clutch disengagement lever.
Apply Molikote molybdenum disulfide grease to the gearbox input shaft.
Engage a gear to allow the output shaft to rotate by turning the propeller shaft mount flange. Push the gear shift fully down so that pressure plate bearing (9) is properly engaged into the diaphragm spring.
When connecting the propeller shaft, use new nuts for the fastening screws of the respective flanges. All the bolts and nuts shall be tightened to the prescribed torque values indicates in the relevant tables.
Prior to assembling, lubricate the flexible cable (Bowden) jointed head connection points with MOLIKOTE 33 LIGHT or MOLIKOTE G72 grease.
After the gearbox unit has been reattached, check for correct connection of electric cables.
Verify that the gears are engaged correctly; otherwise, proceed as described in the "Gear control check and adjustment" chapter.

Figure 1



Gear control check and adjustment

Verify that the cable length as measured at the points shown in the figures corresponds with the values shown in the following table:

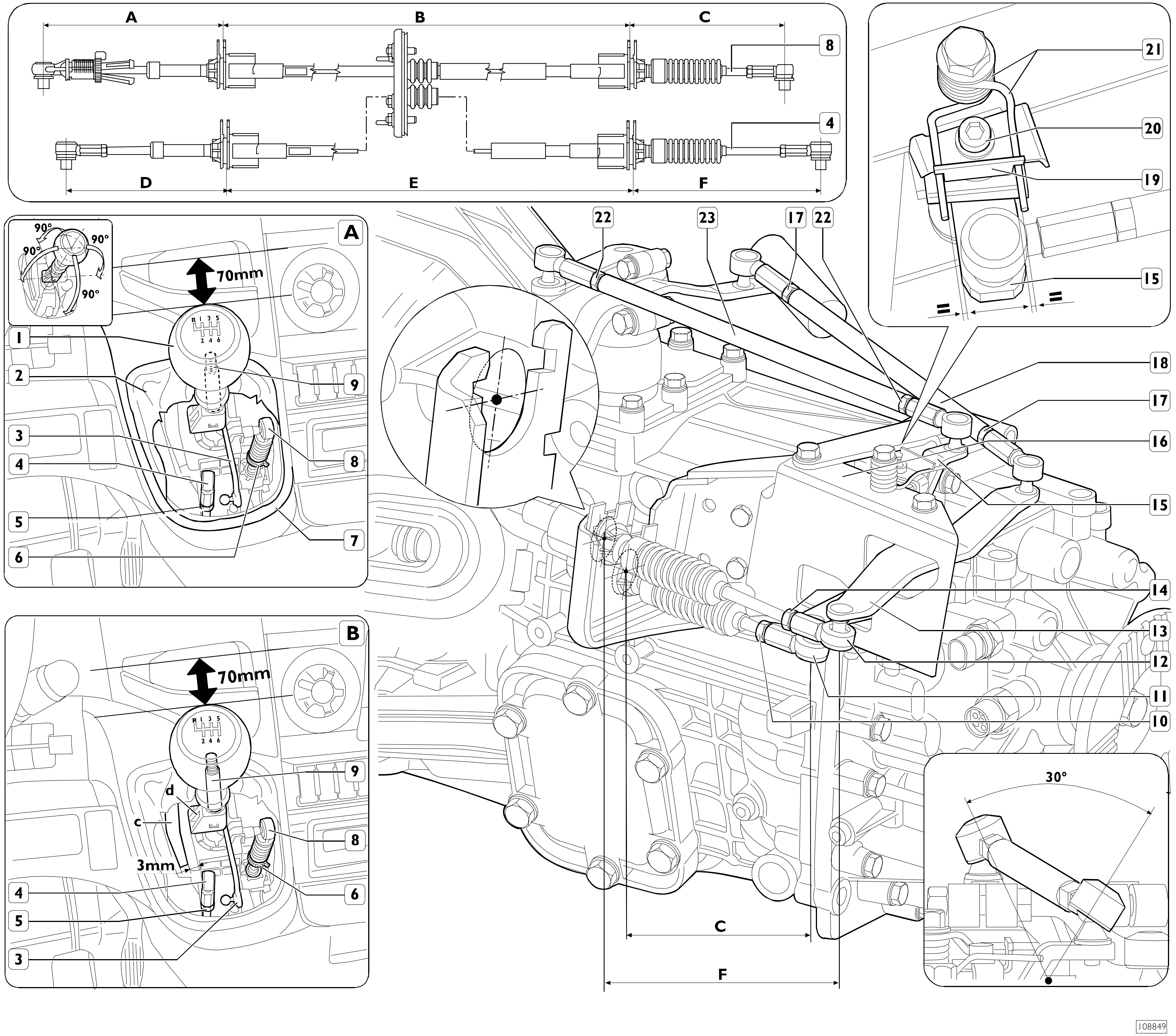
Selection cable (8)	Left-hand drive	Right-hand drive
A	156	156
B	783 ± 2	894 ± 2
C	146 ± 1	146 1
Selection cable (4)		
D	150	150
E	790 ± 2	859 ± 2
F	180 ± 1	180 ± 1

Check, with the gears idling, the distance "C" as measured between the outer side of support (16) and the centre of jointed head (11) of the selection cable. This distance shall be 146 + 1 mm; otherwise, proceed as follows:

- disconnect jointed head (11) from lever (15) (pull-out load: 250 N), loosen nut (10) and properly rotate jointed head (11) until distance "**C**" is obtained, then tighten the nut (10) to the prescribed torque;
- loosen nuts (22) and rotate tie-rod (23) until the same aforesaid distance "C" is obtained between the ball pin (11) centre and the outer side of support (16), then tighten nuts (21) to the prescribed torque so that the vertical axes of the jointed heads are aligned with a maximum deviation of 30°;
- lubricate the jointed head (11) inside with MOLIKOTO 33 LIGHT or MOLIKOTO G 72 grease, then connect the head to lever (15) ball pin (pull-in load: 60 N).
  Check, with the gears idling, the distance **F** measured between the outer side of support (16) and the centre of jointed head (12) of engagement cable (4). This distance shall be 180 + 1 mm; otherwise, proceed as follows:
- disconnect jointed head (12) from lever (13) (pull-out load: 100 N), loosen nut (14) and properly rotate jointed head (12) until distance "**F**" is obtained, then tighten the nut to the prescribed torque;
- loosen nuts (17) and rotate tie-rod (18) until the same aforesaid distance "**F**" is obtained between the ball pin (12) centre and the outer side of support (16), then tighten nuts (17) to the prescribed torque so that the vertical axes of the jointed heads are aligned with a maximum deviation of 30°;
- lubricate jointed head (12) inside with MOLIKOTO 33 LIGHT or MOLIKOTO G 72 grease, then connect the head to lever (13) ball pin (pull-in load: 80 N).

Verify that spring (21) ends come into contact with selection lever (15) or are at least 1 mm within the same. Otherwise, loosen screw (20) so that the spring is correctly positioned, due to plate (19) being released.

Figure 2



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Act from inside the cab (see figure 2) to take off knob (1) and protection boot (2), then screw down knob (1) again and proceed as follows.

5-speed gearbox unit (detail A, figure 2)

Selection cable adjustment (8):

- ❑ put the gear shift lever in neutral;
- ❑ open the adjusting device, by lifting the lock ring (6) selection cable (8);
- ❑ position gear lever (9) in such a way that it is perpendicular to support (7) plane;
- ❑ under the above conditions, release lock ring (6).

Engagement cable adjustment (4).

Engage the 5th speed, then move the lever forwards: under such condition, verify that the distance between knob (1) and the dashboard is ~ 70 mm. Otherwise, proceed as follows:

- ❑ disconnect jointed head (4) from lever (3) (pull-out load: 100 N);
- ❑ loosen nut (5);
- ❑ properly rotate jointed head (4) until, at the aforesaid distance of 70 mm, jointed head (4) is aligned with the connecting ball pin;
- ❑ lubricate the jointed head inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the head to lever (3) ball pin (pull-in load: 60 N);
- ❑ tighten nut (5) to the prescribed torque so that the axis of jointed head (4) is aligned with the axis of lever (3) ball pin.

Adjustment check

Verify that all the gears are correctly engaged. In particular, the 1st and 2nd gears shall be engaged without control lever (9) coming into contact with the safety barrier. Otherwise, repeat selection cable (8) adjustment procedure, by positioning lever (9) slightly inclined to the left instead of perpendicular.
Verify that, after engaging the 5th gear, the distance between knob (1) and the dashboard is close to the prescribed distance of 70 mm.

6-speed gearbox unit (detail B, figure 2)

Selection cable adjustment (8):

- ❑ engage the 2nd gear;
- ❑ move control lever (9) fully to the left, then verify that the distance between restraint quill (**d**) and reverse gear safety barrier (**C**) is 2 P 3 mm. Otherwise, place a spacer of 2 P 3 mm in between the above parts, open the adjusting device by lifting lock ring (6), bring lever (9) into contact with the spacer, and release lock ring (6).

Engagement cable adjustment (4):

Engage the 5th speed, then move the lever (9) forwards: under such condition, verify that the distance between knob (1) and the dashboard is ~ 70 mm. Otherwise, proceed as follows:

- ❑ disconnect jointed head (4) from lever (3) (pull-out load: 100 N);
- ❑ loosen nut (5);
- ❑ properly rotate jointed head (4) until, at the aforesaid distance of 70 mm, jointed head (4) is aligned with the connecting ball pin;
- ❑ lubricate jointed head (4) inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the head to lever (3) ball pin (pull-in load: 60 N);
- ❑ tighten nut (5) to the prescribed torque so that the axis of jointed head (4) is aligned with the axis of lever (3) ball pin.

Adjustment check

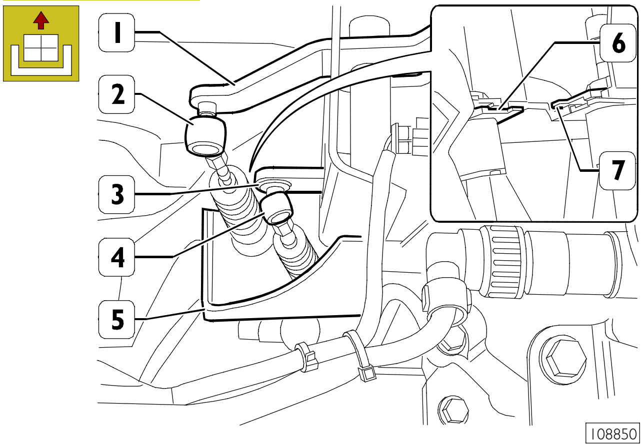
Verify that all the gears can be engaged with no crawling. In particular:

- ❑ verify that the 1st and 2nd gears can be engaged without problems (by pressing the clutch pedal, if possible), also by trying to engage them while keeping lever (9) slightly moved away from safety barrier (**C**) or by lifting quill (6) while going slightly further. If the gears can be engaged more easily after the above procedure is performed, you will have to act on the selection cable adjustment:
  - if gear engagement proves to be better when moving over barrier (**C**), adjust the cable by allowing for a greater distance between lever (9) and barrier (**C**);
  - if, on the contrary, gear engagement proves to be better when moving away from barrier (**C**), adjust the cable by allowing for a smaller distance between lever (9) and barrier (**C**);
- ❑ verify that, when the 5th gear is engaged, the distance from the dashboard is not too far from the prescribed dimension (70 mm).

GEAR CONTROL

Flexible cable replacement
Removal

Figure 3



Place the vehicle on a pit or auto lift.
Act from under the vehicle to disconnect the jointed heads of:

- selection cable (2, max. pull-out load: 250 N - max. pull-in load: 60 N) from lever (1);
- engagement cable (4, max. pull-out load: 100 N - max. pull-in load: 80 N) from lever (1).

Act from the upper part of the gearbox unit and use a suitable screwdriver to open out flexible cable fins (6 and 7) so that the pawls are disengaged from bracket (5).

Proceed as follows, by acting from inside the cab (see figure 4):

- unscrew and remove knob (1);
- remove protection boot (2);
- remove the fastening screws, then take covering (3) off;
- remove glove compartment (4);
- remove the fastening screws, then take lower central covering (5) off.

Figure 4

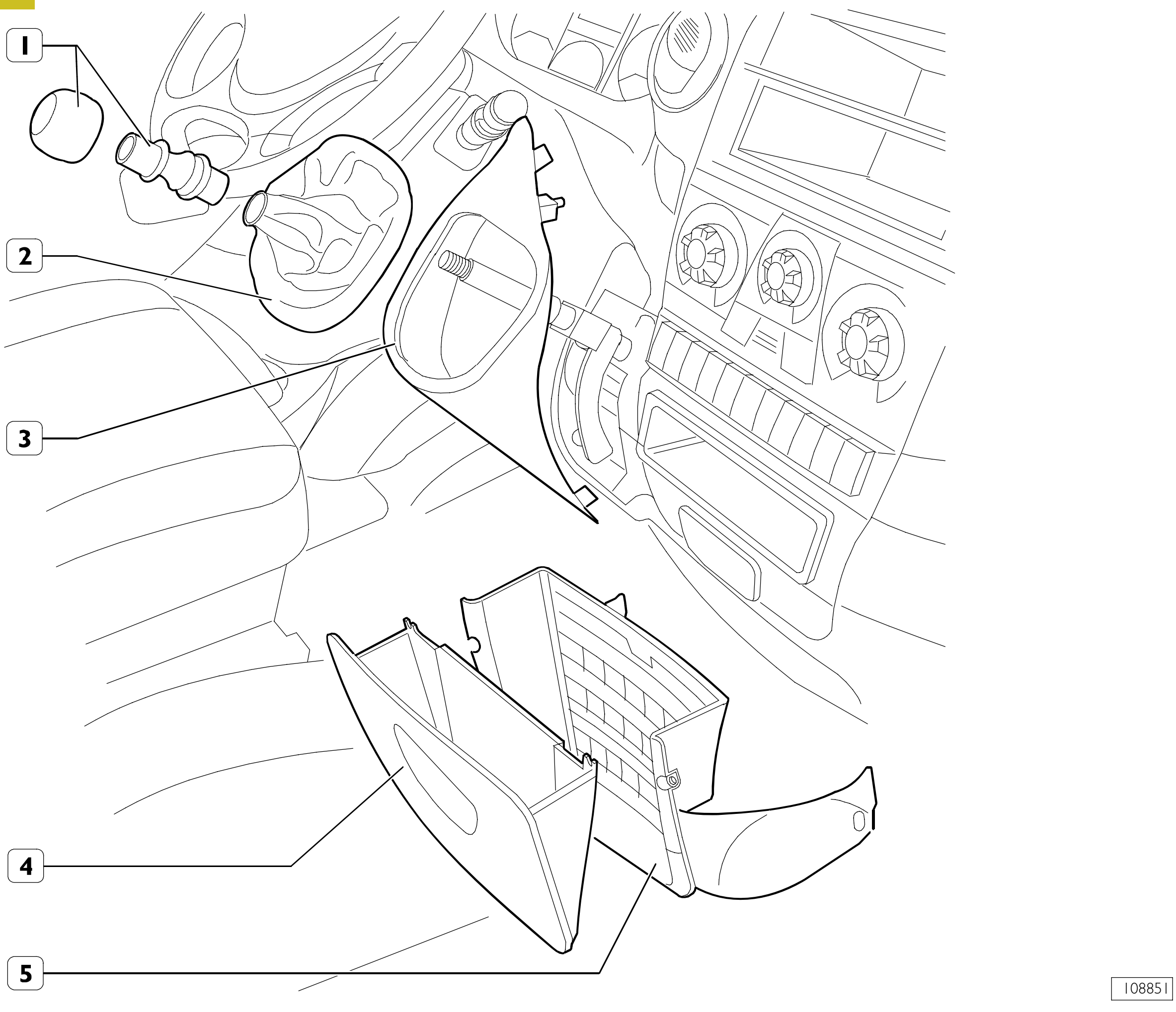
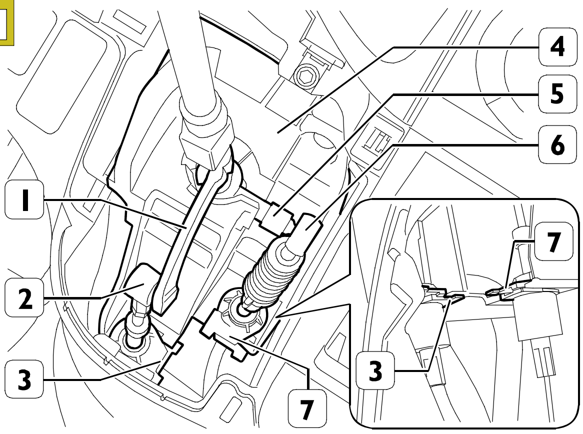


Figure 5



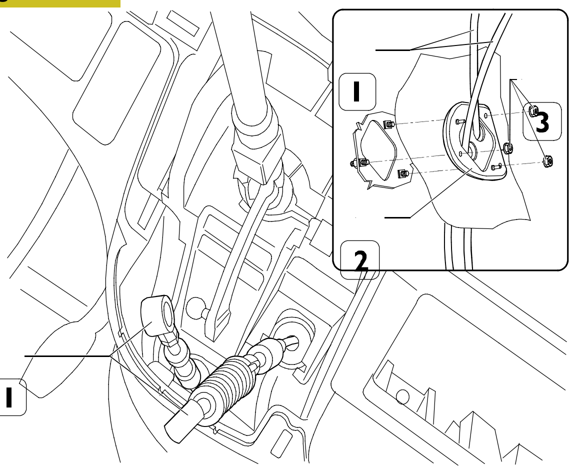
108852

Disconnect the jointed heads of:

- selection cable (2, max. pull-out load: 250 N - max. pull-in load: 60 N);
- engagement cable (6, max. pull-out load: 100 N - max. pull-in load: 80 N) from levers (1 and 5).

Use a suitable screwdriver to open out flexible cable fins (3 and 7) so that the pawls are disengaged from support (4).

Figure 6



108853

Remove nuts (3) securing flange (2) to the cab floor, then take flexible cable assembly (1) out.

Refitting

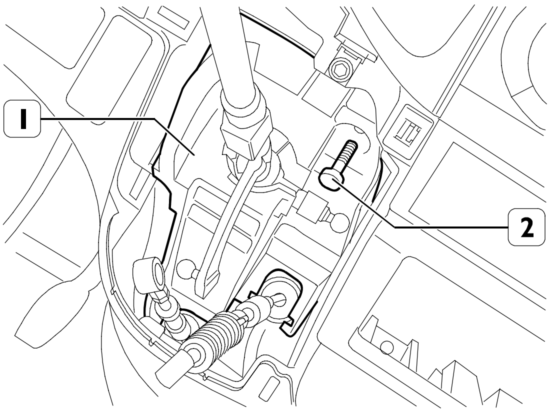
Reattachment is carried out by reversing the order of the detachment operations. Moreover, the following instructions shall be observed:

- ❑ prior to assembling, lubricate the flexible cable (Bowden) jointed head connection points with MOLIKOTE 33 LIGHT or MOLIKOTE G72 grease;
- ❑ tighten the nuts and screws to the prescribed torque;
- ❑ adjust the gear control, as described in the respective chapter.

GEAR SHIFT LEVER SUPPORT

Removal

Figure 7



108854

Proceed as described in figures 5 and 6, by acting from inside the cab.

Remove fastening screws (2), then take gear shift lever support (1) off the cab.

Refitting

- ❑ prior to assembling, lubricate the flexible cable (Bowden) jointed head connection points with MOLIKOTE 33 LIGHT or MOLIKOTE G72 grease;
- ❑ tighten the nuts and screws to the prescribed torque;
- ❑ adjust the gear control, as described in the respective chapter.

5 S 300 Transmissions

GENERAL

The 5 S 300 transmission is mechanical with synchronized engagement of forward gears.

It is composed of a light alloy box (which also serves as a clutch cover), a rear cover (where the speed engagement controls and gearing are housed) and a control box.

There is an opening on the side of the transmission to apply a power take-off.

Drive transmission is accomplished by a set of helical-toothed constant mesh gears, for both forward and reverse gears.

The splined or machined gears are on four shafts: input, main, transmission and reverse gear.

The gears splined on the main and reverse gear shafts idle on straight roller bearings.

The input and main shafts are supported, in the transmission, by watertight, non-adjustable ball bearings.

The transmission shaft is supported, in the transmission, by tapered roller bearings that can be adjusted axially by means of ring shims.

Gear engagement synchronization is accomplished by means of free ring synchronizing devices with a single cone for 5th - 4th - 3rd gears -R.G. and dual cone for 1st - 2nd gears.

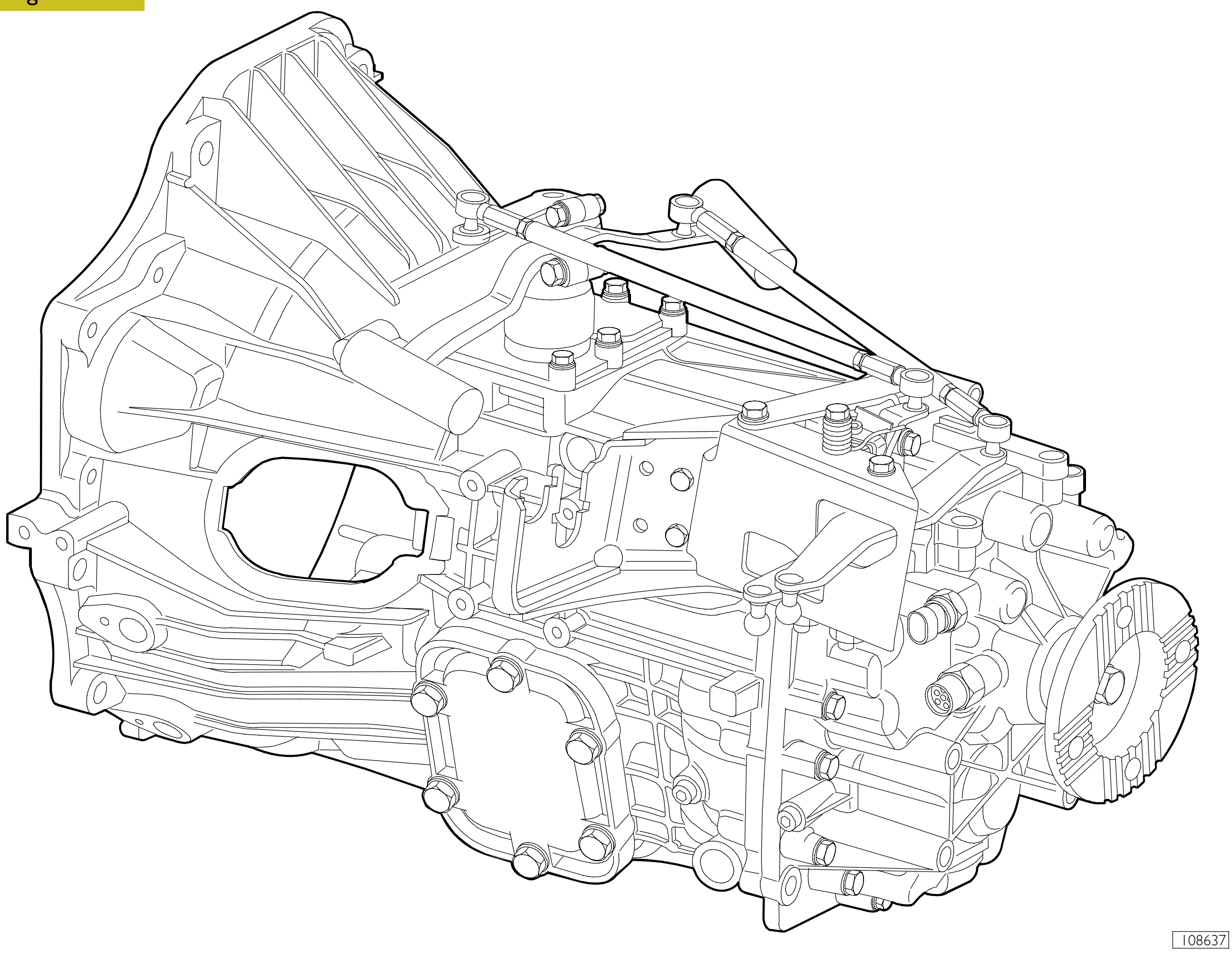
Control inside the transmission is accomplished with four rods:

- a main rod to select and engage gears;
- three rods equipped with forks for engaging gears.

The external control is achieved by means of two levers: (selection and engagement levers). The levers are actuated by tie-rods through a transfer case, connected to the gear shift lever located in the cab, by an assembly made up of two flexible cables (BOWDEN cables).

The external engagement lever features two opposed weights, used to dampen the flexible control cable (BOWDEN) engagement thrust and, as a result, its noise.

Figure 1



GEAR SELECTION AND ENGAGEMENT CONTROL

The combined action of the selection (2) and engagement (1) levers bring about the rotation and/or axial shift of the rod (4) in two successive stages, engaging the desired gear by means of one of the rods (9, 8 or 7).

First Stage

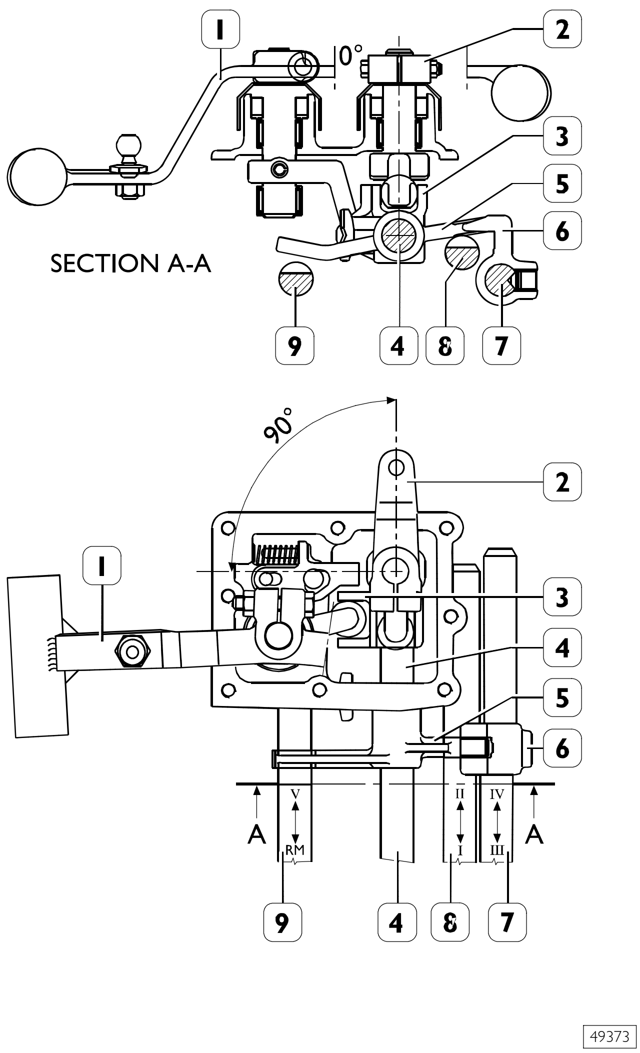
Depending on the angular position of the selection lever (2), the driver (3) (integral with it) turns the selector (5) with the rod (4) (connected together), setting the selector on the rod of the chosen gear.

Second Stage

Depending on the movement given to the engagement lever (1), the driver (3) (integral with it) shifts the selector (5) (already prepared) axially with the rod (4) and consequently also the engagement rod of the chosen gear.

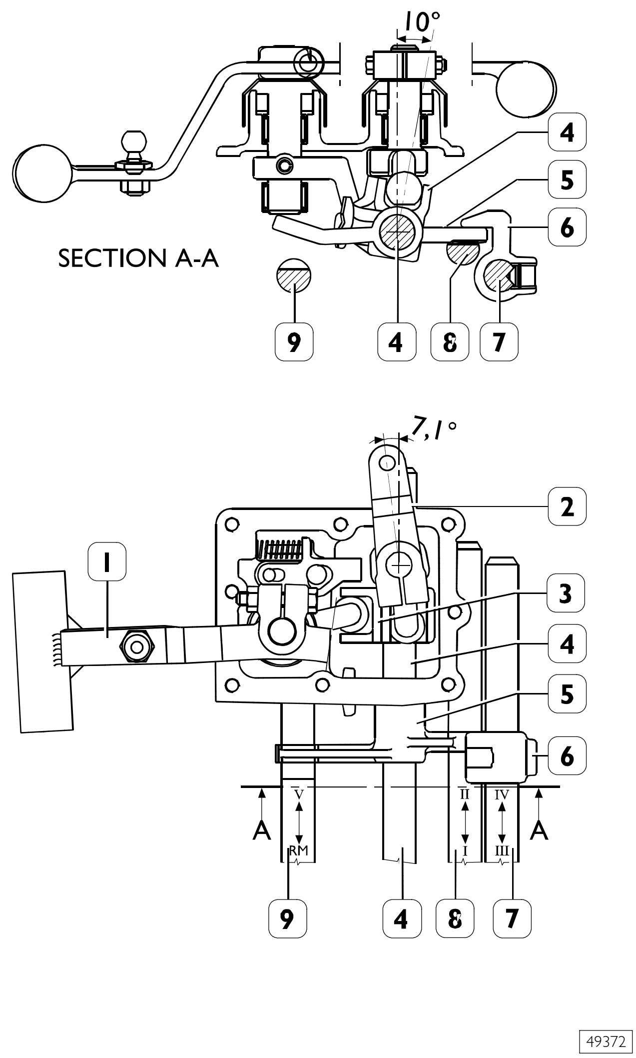
Position of transmission in neutral and/or ready to select 3rd/4th gear

Figure 2



Ready for 1st/2nd gear

Figure 3



1. Gear engagement lever - 2. Gear selection lever - 3. Driver - 4. Gear selection/engagement control rod - 5. Selector - 6. Driver - 7. Rod for 3rd/4th gear engagement fork - 8. Rod for 1st/2nd gear engagement fork - 9. Rod for 5th/reverse gear engagement fork.

The position of the transmission in neutral coincides with being ready to select 3rd/4th gear.

In this case the vertical axis of the selection lever (2) is exactly 90° from the horizontal control axis, corresponding to no change in the angle of the rod (4).

This arrangement is accomplished by shifting the selection lever (2) anticlockwise by 7.1° to the control axis, which corresponds to a clockwise change in the angle of the rod (4) of 10°.

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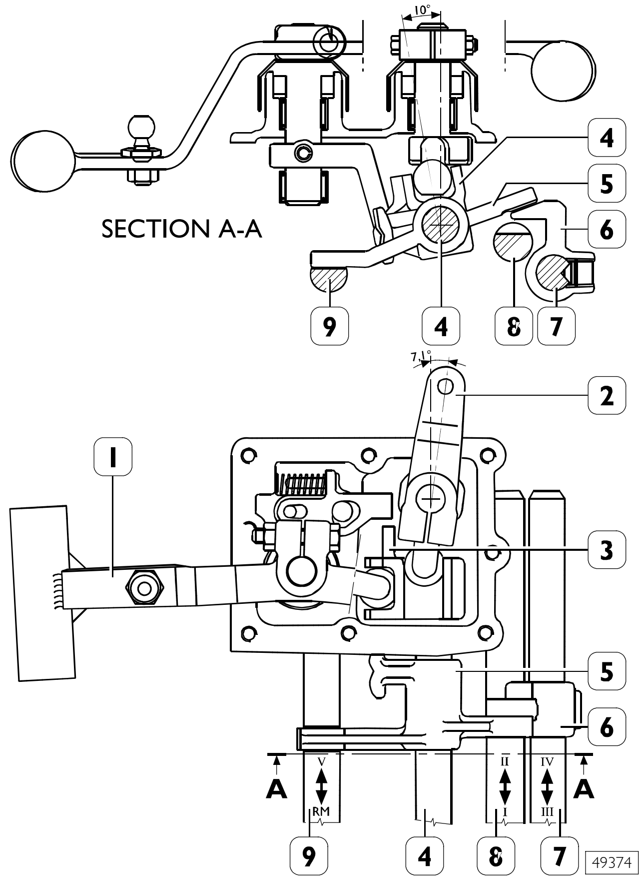
Ready to select 5th/reverse gear

Figure 4



1. Gear engagement lever - 2. Gear selection lever - 3. Driver - 4. Gear selection/engagement control rod - 5. Selector - 6. Driver - 7. Rod for 3rd/4th gear engagement fork - 8. Rod for 1st/2nd gear engagement fork - 9. Rod for 5th/reverse gear engagement fork.

Above presetting is implemented by moving selector (2) clockwise by 7.1° with respect to control vertical axis, that corresponds to 10° anticlockwise angular displacement of rod (4).

SAFETY DEVICES

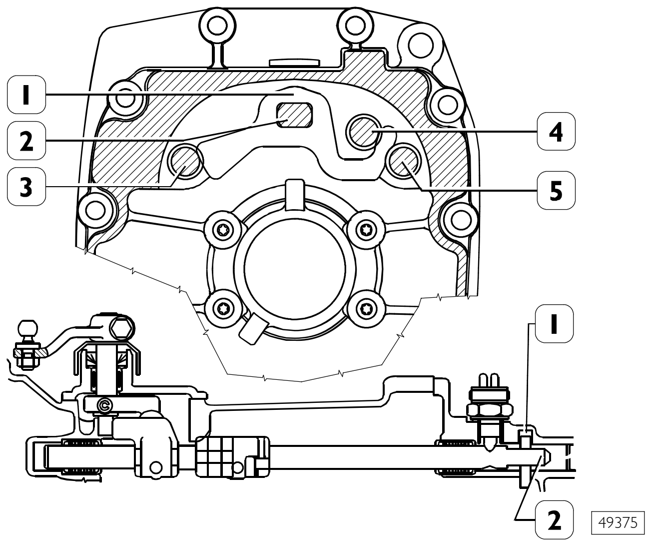
The transmission is equipped with two mechanical safety devices:

Engagement locking device to prevent more than one gear getting engaged at the same time.

Reverse gear anti-engagement device when passing from 5th to 4th gear.

Engagement locking device

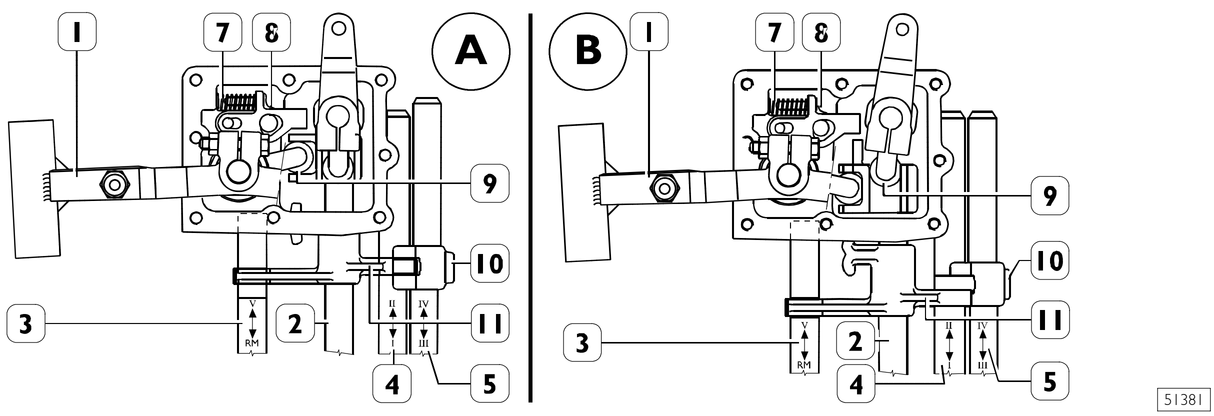
Figure 5



This device is composed of a plate (1), housed in the rear cover, operated by the gear selection/engagement control rod (2). When selecting/engaging a gear, the rod (2) simultaneously turns the plate (1) in which it is inserted. In this way, the plate (1) will free itself from the slot of the rod involved in engaging the gear and will lock the other two rods by inserting itself into their slots.

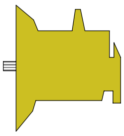
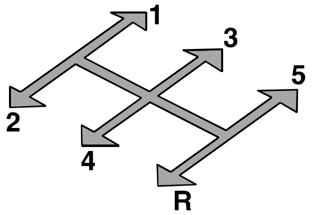
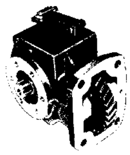
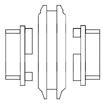
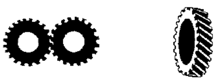
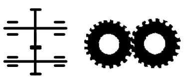
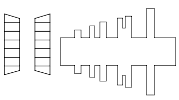
Reverse gear anti-engagement device

Figure 6



This device is composed of a plate (8) and a spring (7) housed in the transmission. When passing from the 4th gear position (Figure A) to the 5th gear position (Figure B), the driver (9), moving in the direction of the arrow, disengages the plate (8), which under the action of the spring (7) moves onto the driver (9) preventing reverse gear from getting engaged in the opposite manoeuvre.

SPECIFICATIONS AND DATA

	TRANSMISSION		5 S 300
	Type		Mechanical
	Input torque	Nm	300
	Weight	kg	44.6
	Speeds		5 forward speeds 1 reverse speed
	Speed control		Mechanical
	Power take-off		Optional
	Speed engagement: Forward speeds ❑ 5th / 4th / 3nd ❑ 2nd / 1st Reverse speed Speed retention mechanism		 Single-cone synchronizer Dual-cone synchronizer Rapid shift Sliding sleeves retained by pawls and springs.
	Gears		Helical-toothed constant mesh gears
	Gear ratio First Second Third Fourth Fifth Reverse		 5.00 2.62 1.54 1.00 0.78 4.58
	Shaft bearings: Main shaft Straight roller bearing		 watertight ball bearing tapered roller

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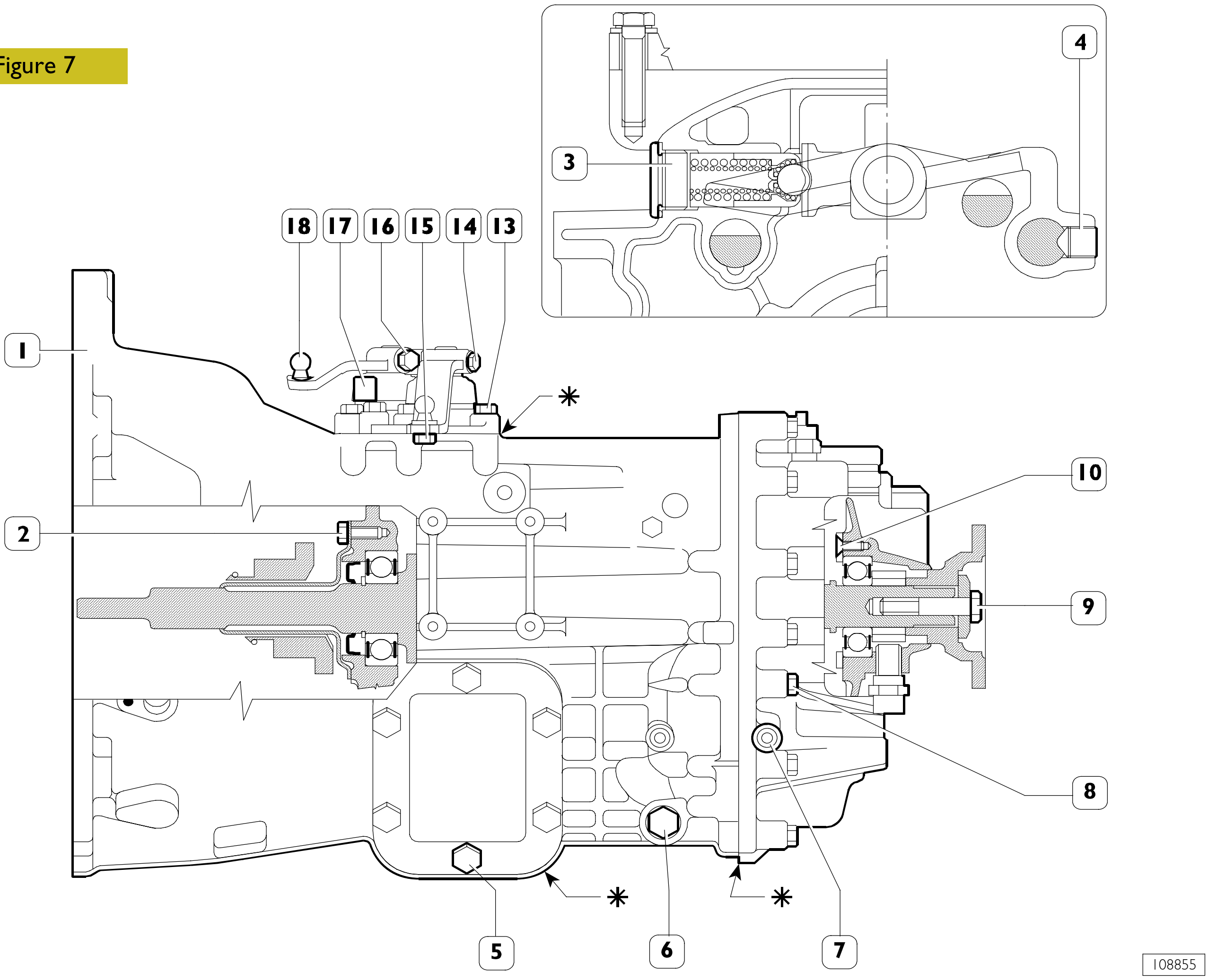
	TRANSMISSION	5 S 300
	Transmission shaft bearing end play:	0 ÷ 0.05 mm
	Transmission shaft bearing end play adjustment	by shims
	Shim thickness for transmission shaft bearing end play adjustment	2.00 - 2.30 - 2.45 mm with 0.05 mm progressive sequence
	Main shaft **Assembly temperatures:** sliding sleeve hubs 2nd and 3rd speed gear bushings and spacer 5th speed gear spacer	 150 °C 170 °C ÷ 160 °C 90 °C
	Secondary shaft **Assembly temperatures:** bearings 5th speed gear 5th speed gear driving load 5th speed gear removing load	 80 °C (max 120 °C) 140 °C ÷ 170 °C 31 KN 50 KN
	Input shaft **Assembly temperatures:** front bearing*	 80 °C (max 120 °C)
	Gear axial backlash: 1st - 3rd - 4th - R - 5th speed 2nd speed	 0.15 ÷ 0.3 mm 0.25 ÷ 0.4 mm
	3rd and 4th speed sliding sleeve hub retaining circlip axial backlash	0 ÷ 0.05 mm
	3rd and 4th speed sliding sleeve hub retaining circlip thickness	2 - 2.85 mm with progression of 0.05 mm
	Transmission shaft rear bearing retaining ring end float	0 ÷ 0.05 mm
	Transmission shaft rear bearing retaining ring thickness	2.05 ÷ 2.45 mm with progression of 0.05 mm
	LOCTITE sealant	242 510 5206
	Type of oil: Quantity	**TUTELA TRUCK GEARLITE** 2 litres 1.8 kg

* = Do not use hot air equipment to heat bearing.

TIGHTENING TORQUES

Gearbox unit

Figure 7



	DESCRIPTION	TORQUE	
		Nm	kgm
1	Clutch housing, screw to fasten clutch housing to chassis	80	8
2	Screw to fasten clutch housing to box	23 ± 15%	2.3 ± 15%
3	Constant mesh shaft cover fastening screw	23 ± 15%	2.3 ± 15%
4	Spring retaining plug	32 ± 10%	3.2 ± 10%
5	Grub screw securing gear selection sector to rod	60 ± 15%	6 ± 15%
6**	Screw securing p.t.o. side cover	46 ± 15%	4.6 ± 15%
7	Plug	28 ÷ 30 ± 15%	2.8 ÷ 3 ± 15%
8	Screw securing reverse gear shaft	22 ± 15%	2.2 ± 15%
9	Screw securing rear cover	23 ± 15%	2.3 ± 15%
10	Screw locking sleeve for transmission coupling on main shaft	120 ± 15%	12 ± 15%
11●	Screw securing ball bearing retaining ring	9.5 ± 15%	0.9 ± 15%
12	Screw securing control cable bracket	23 ± 15%	2.3 ± 15%
13	Screw securing gear control mounting	23 ± 15%	2.3 ± 15%
14	Nut for screw securing lever to control rod	34 ± 15%	3.4 ± 15%
15	Nut securing articulation pin to control lever	23 ± 15%	2.3 ± 15%
16	Nut for screw securing lever to control rod	34 ± 15%	3.4 ± 15%
17	Oil vapour breather	10 ± 15%	1± 15%
18	Nut to secure articulation pin to control lever	23 ± 15%	2.3 ± 15%

* Spread LOCTITE 5206 sealant on the contact surfaces

● Spread LOCTITE 242 on the thread

** Spread LOCTITE 510 on the thread

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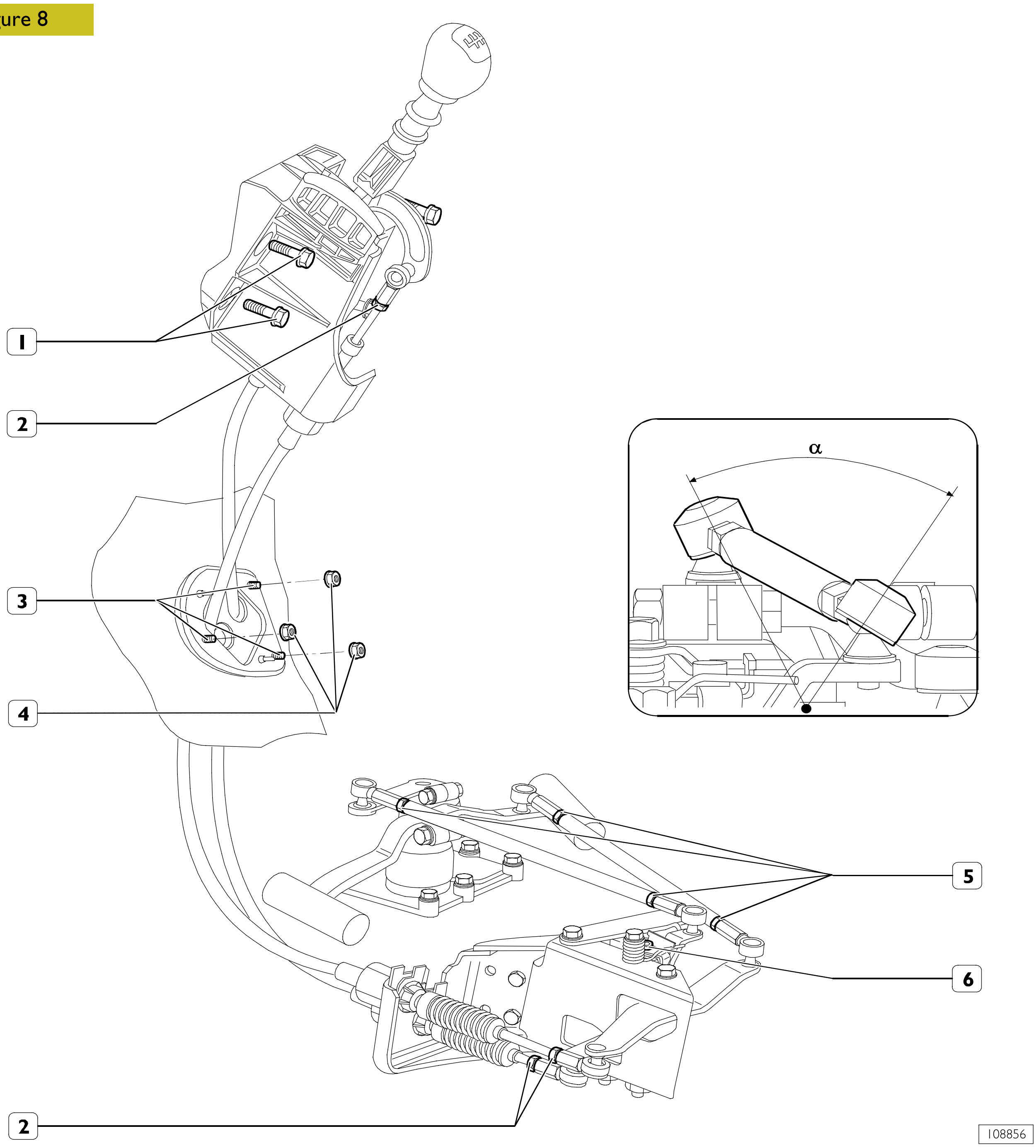
TIGHTENING TORQUES

Gearbox control

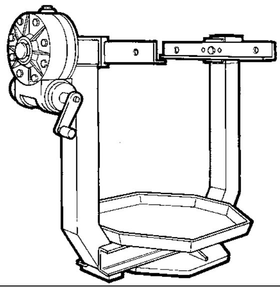
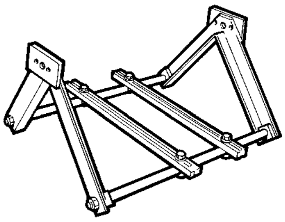
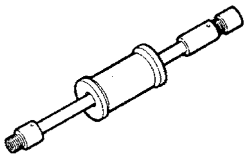
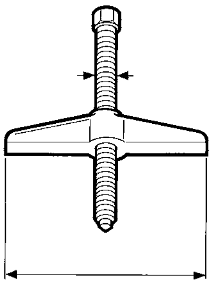
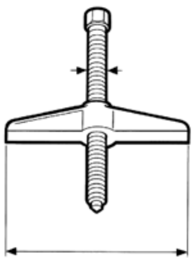
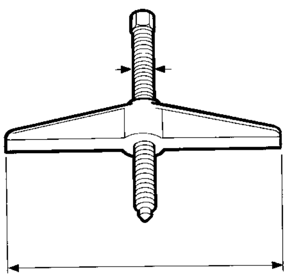
Figure 8



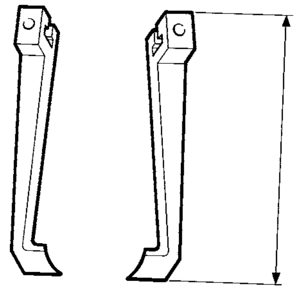
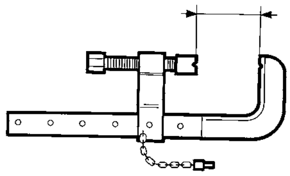
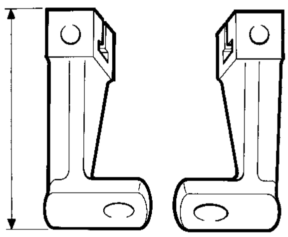
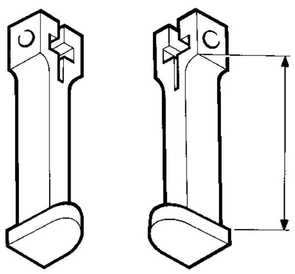
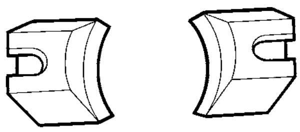
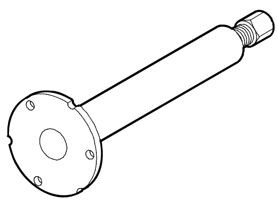
	DESCRIPTION	TORQUE	
		Nm	kgm
1	M8 screw for gearbox control support fastening	14 ± 17	1.4 ± 1.7
2	Nut securing the jointed heads to the cable	4 ± 4.8	0.4 ± 0.48
3	M8 screw securing the transfer case to the gearbox	21 ± 25	2.1 ± 2.5
4	M8 self-locking nut securing the flange to the cab	3.5	0.35
5	Nut securing the jointed head to the tie-rod	4 ± 4.5	0.4 ± 0.5
6	Plate fastening screw	7.8 ± 9.25	0.78 ± 0.95

After tightening nuts (4), the jointed head hole axis shall be aligned with the axis of the ball pin to which it is connected. After tightening nuts (5), the vertical axes of tie-rod (5) jointed heads shall be aligned, with a maximum deviation of less than $\alpha < 30^\circ$ (lower).

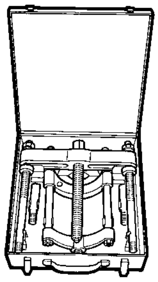
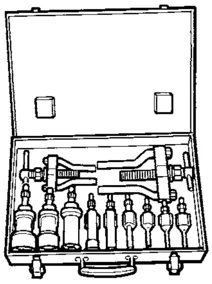
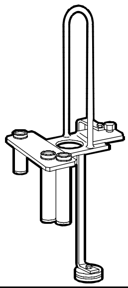
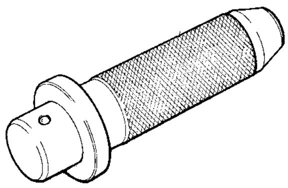
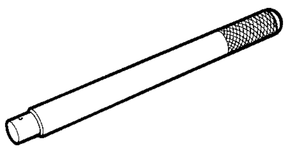
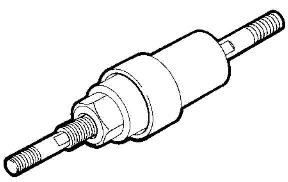
TOOLS

TOOL NO.		DESCRIPTION
99322205		Assemblies overhaul revolving stand
99322225		Unit support (to use with stand 99322205)
99340205		Percussion extractor
99341002		Single-acting scaffold
99341003		Single-acting scaffold
99341004		Single-acting scaffold

TOOLS

TOOL NO.		DESCRIPTION
99341012		Pair of brackets
99341015		Press
99341017		Couple of brackets whit hole
99341019		Pair of tie rods with grips
99341025		Grips
99345003		Extractor for gearbox front half-casing

TOOLS

TOOL NO.		DESCRIPTION
99348001		Extractor with locking device
99348004		Universal male extractor from 5 to 70 mm
99360521		Tool to extract and insert main shaft, transmission shaft and rod - fork assembly
99370006		Handle for interchangeable drivers
99370007		Handle for interchangeable drivers
99370234		Tool for fitting main shaft in rear bearing and fitting output flange on main shaft

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TOOL

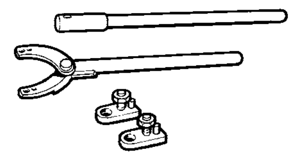
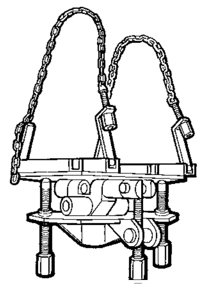
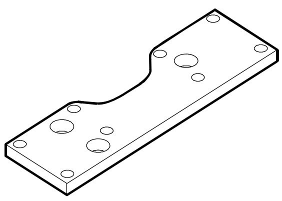
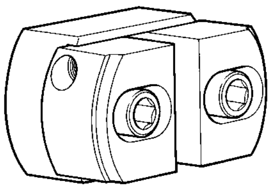
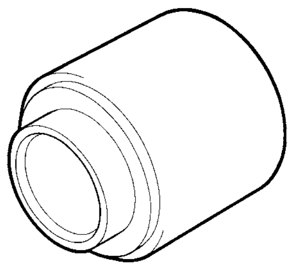
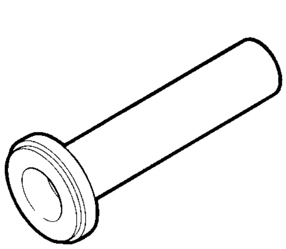
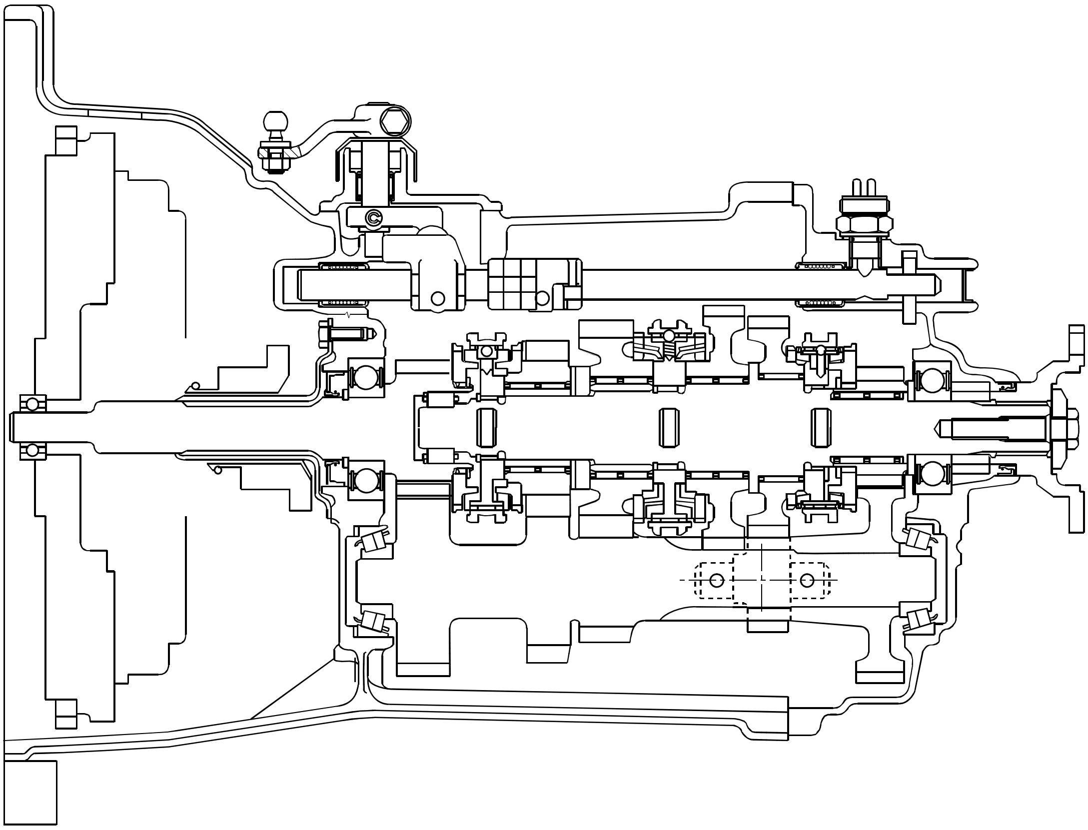
TOOL NO.		DESCRIPTION
99370317		Reaction lever with extension for holding flange
99370629		Transmission support during removal from and refitting to vehicle
99371057		Bracket for supporting gearbox during overhaul (use with 99322205-99322225)
99374091		Punch for fitting bearing external races (dia. 55 ÷ 69 mm) (use with 99370007)
99374452		Keying device to fit gasket on transmission rear cover (use with 99370006)
99374453		Keying device to fit gasket on transmission

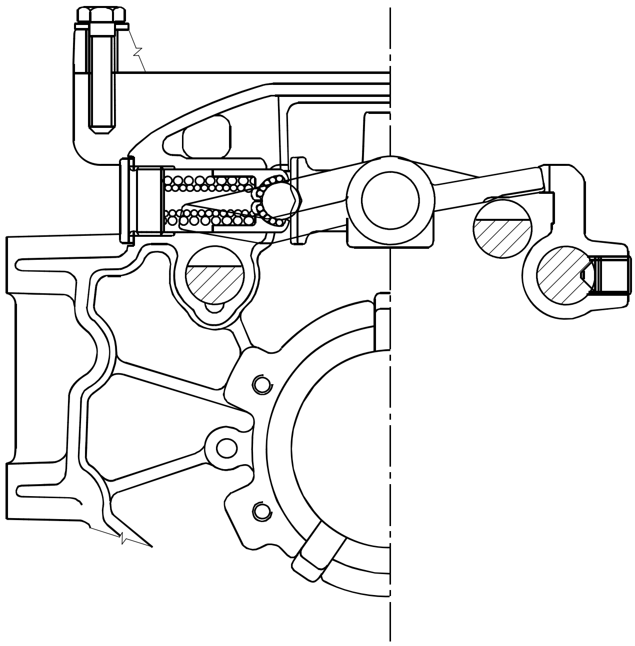
Figure 9



75420

LONGITUDINAL SECTION

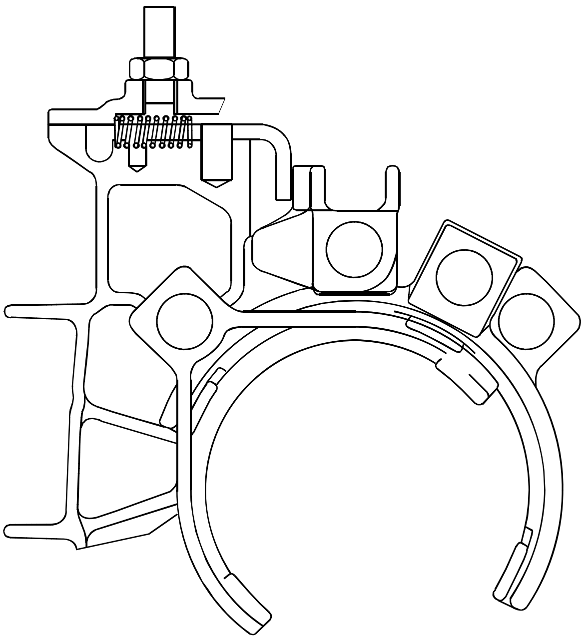
Figure 10



47371

TRANSVERSE SECTION ON THE GEAR SELECTION/ENGAGEMENT ROD POSITIONING PUSH ROD

Figure 11



47369

TRANSVERSE SECTION ON THE REVERSE GEAR ANTI-ENGAGEMENT DEVICE

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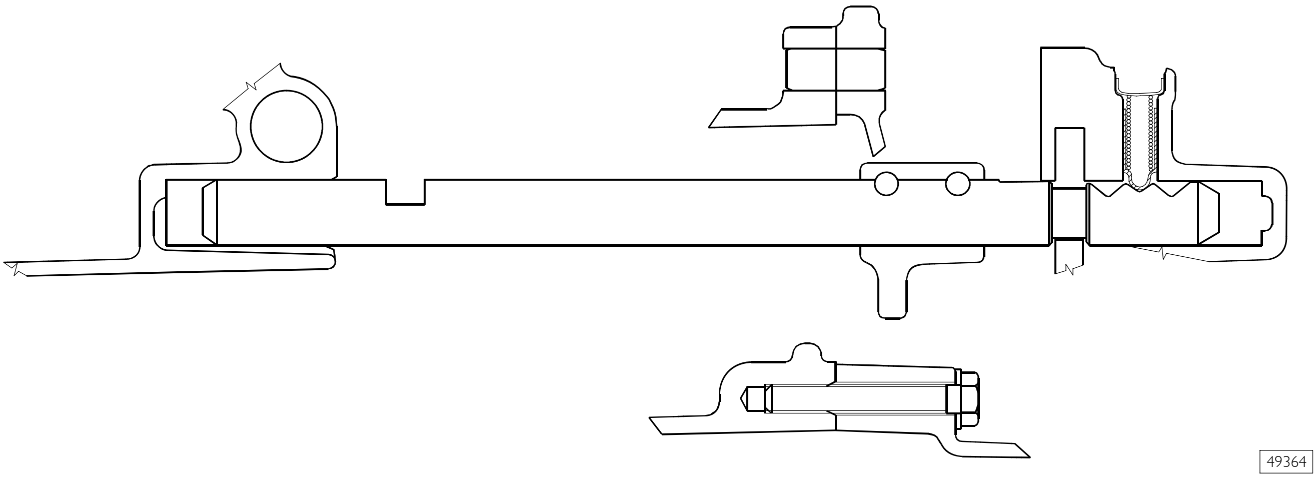
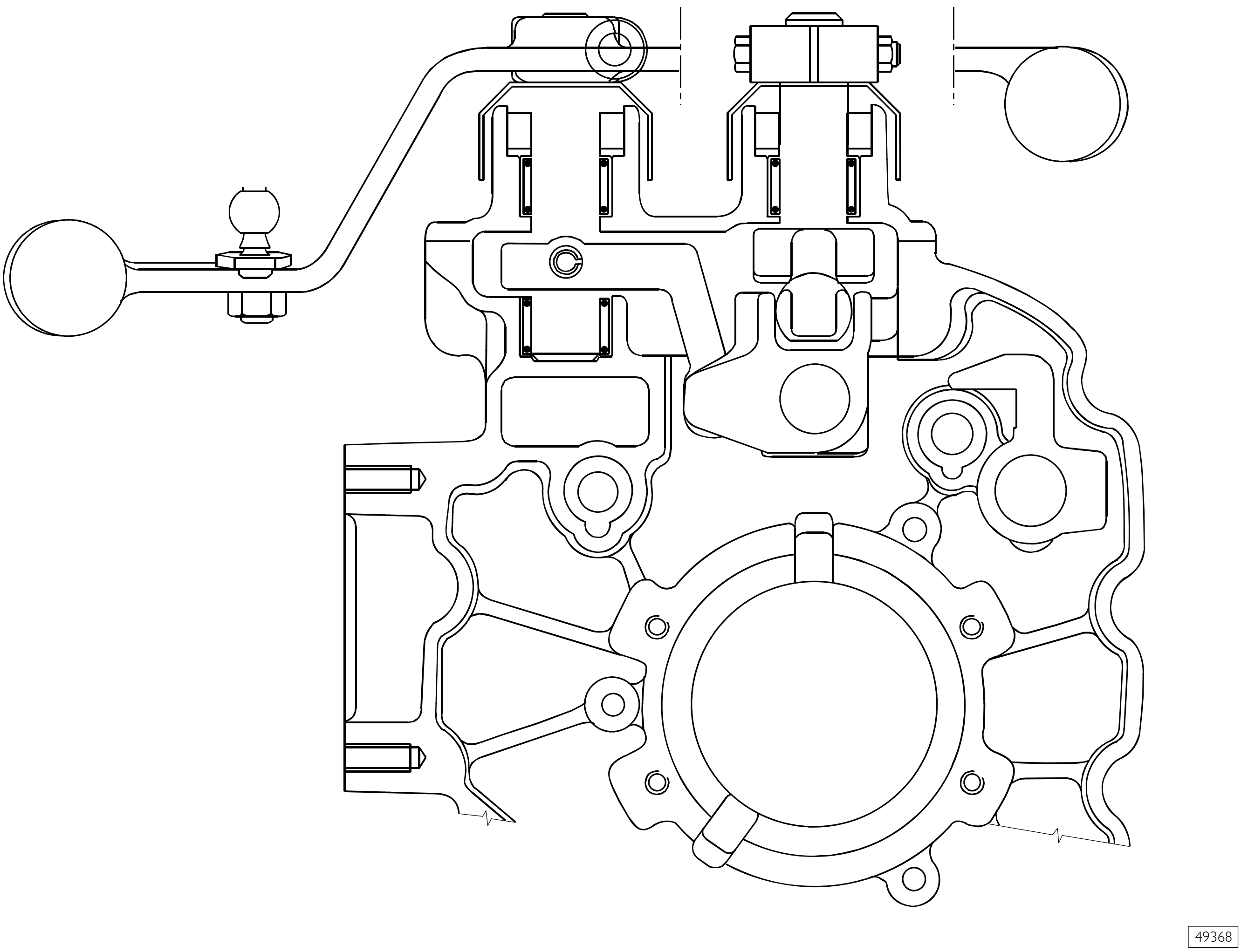
Figure 12



SECTION ON GEAR ENGAGEMENT ROD POSITIONING PAWLS

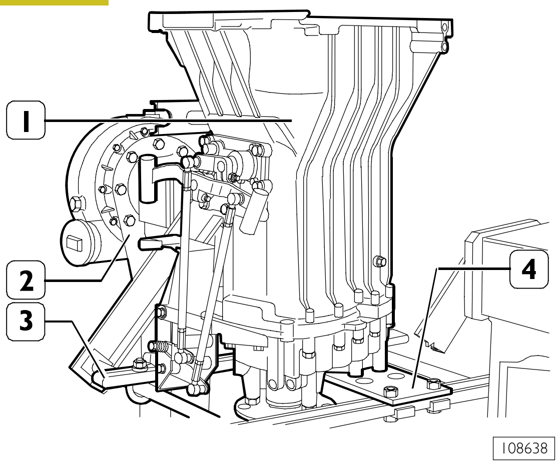
Figure 13



TRANSVERSE SECTION ON INTERNAL CONTROL BOX

530210 OVERHAULING THE TRANSMISSION

Figure 14



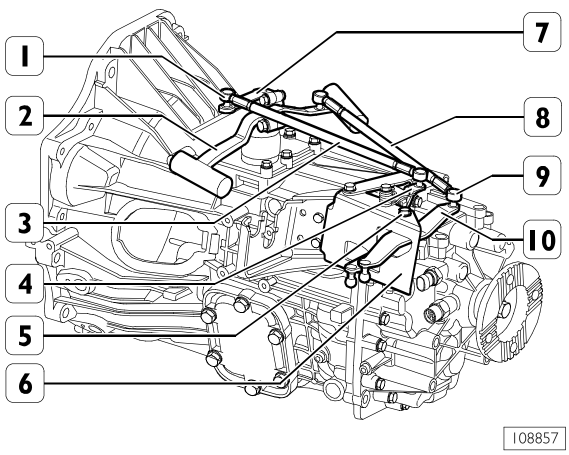
Remove the plug and drain off the lubricating oil.

The used oil must be disposed of according to the law in force.

Fit the gearbox (1) with the bracket 99371057 (4) and secure this to the brackets 99322225 (3) on the rotary stand 99322205 (2).

530220 Gear control box Disassembly

Figure 15

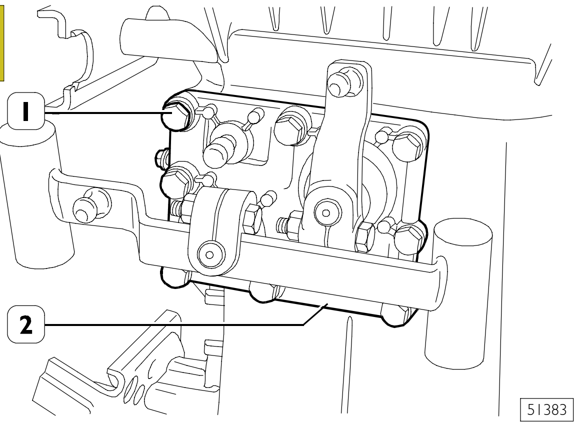


Take tie-rod (3) off by disconnecting jointed heads (1) from levers (4 and 7).
Take tie-rod (8) off by disconnecting jointed heads (9) from levers (10 and 2).

NOTE Tie-rods (3 and 8) are interchangeable.

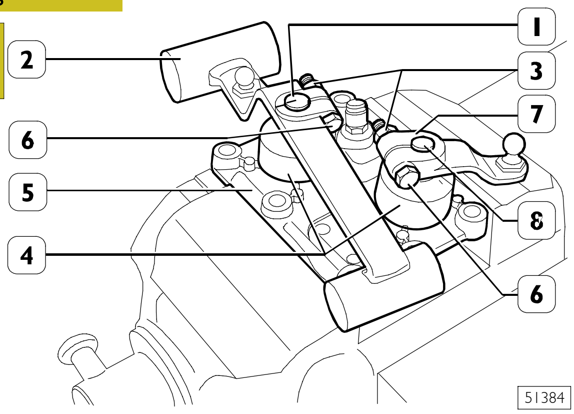
Remove screws (5), then take transfer case (6) off the gearbox unit.

Figure 16



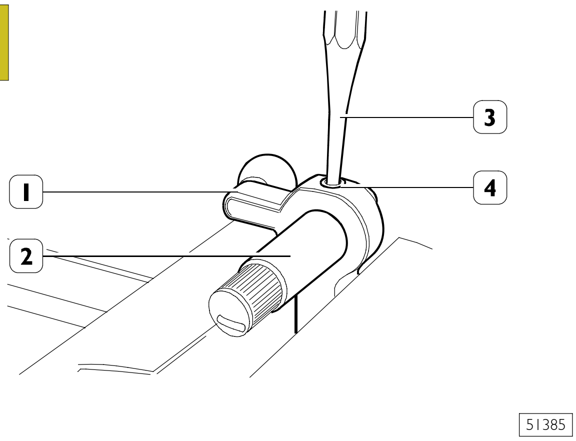
Take out the fixing screws (1) and remove the gear control box (2).

Figure 17



Loosen the nuts (3) for the retaining screws (6).
Extract the levers (2 and 7) from the shafts (1 and 8) and extract these from the box (5). Take off the caps (4).

Figure 18



With a punch (3), remove the spring pin (4) and extract the shaft (2) from the internal lever (1).
Repeat these steps for the other shaft.

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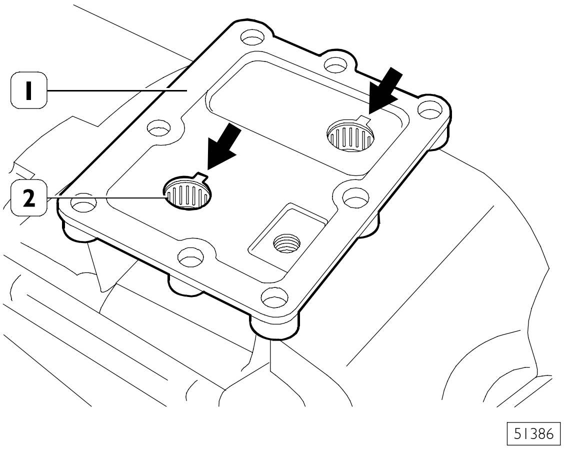
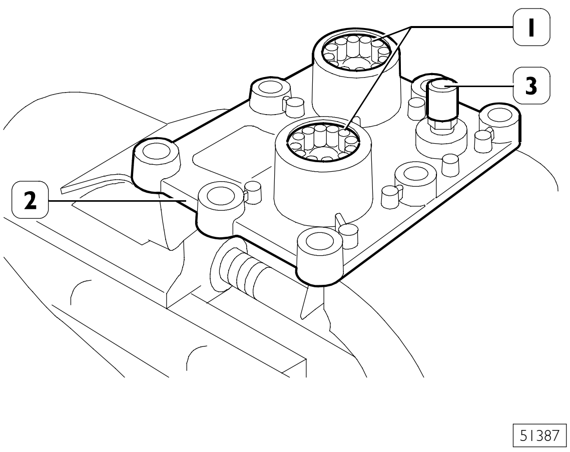
Figure 19



Use a punch on the point shown by the arrow and eject the O-rings and roller bushes (2) from the box (1).

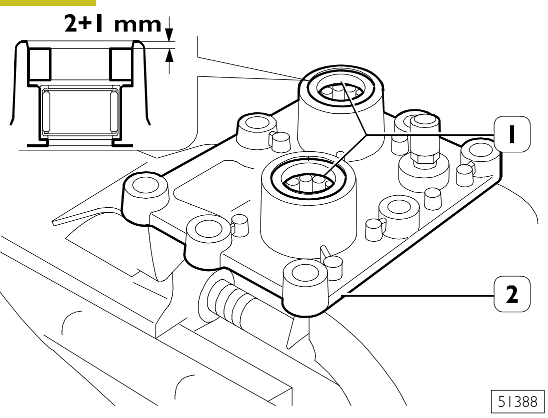
Assembly

Figure 20



Thoroughly clean the oil vapour vent (3).
With a suitable punch, mount the roller bearings (1) in the box (2).

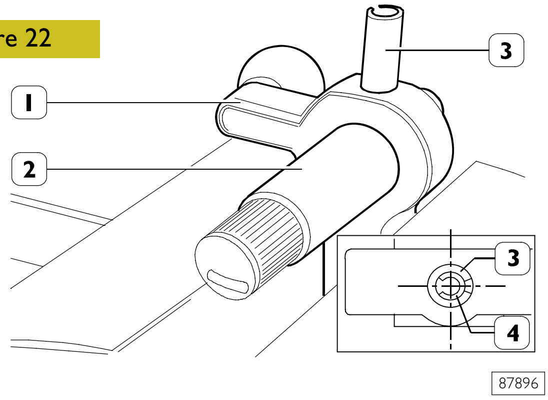
Figure 21



Using a suitable punch, mount the O-rings (1) in the box (2), positioning them at the height shown.

Pack the gap between the O-ring and roller bearing with grease.

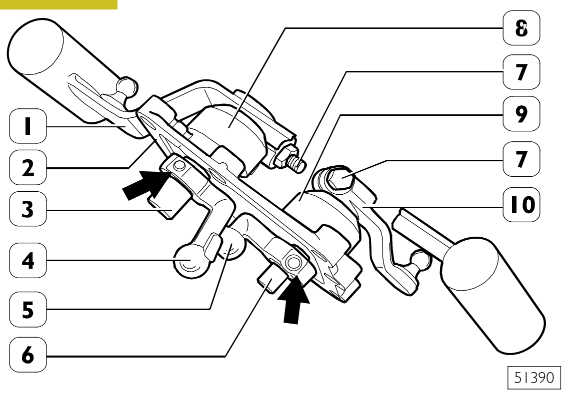
Figure 22



Mount the selection and engagement levers (1) on their respective shafts (2) and fasten them with the spring pins (3).

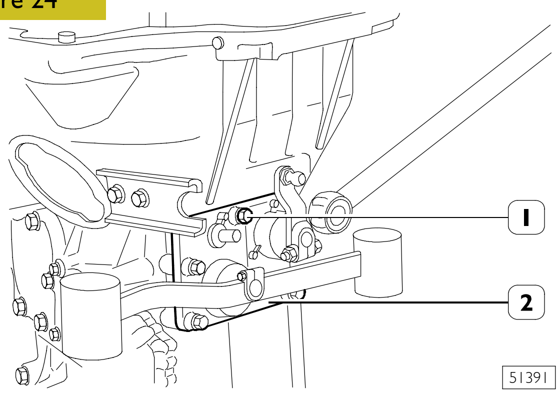
NOTE The spring pin (3) must be positioned with the cut horizontal. Fit spring peg (4), with cutting edge positioned at 180° from spring peg (3) cutting edge, in spring peg (3) engagement lever.

Figure 23



Lubricate the roller bearings (1, Figure 19) with TUTELA MR3 grease and mount the shafts (3 and 6) complete with the internal levers (4 and 5) in the box (2). Mount the caps (8 and 9) and levers (1 and 10) on the shafts (3 and 6) tightening the nuts for the fixing screw (7).

Figure 24

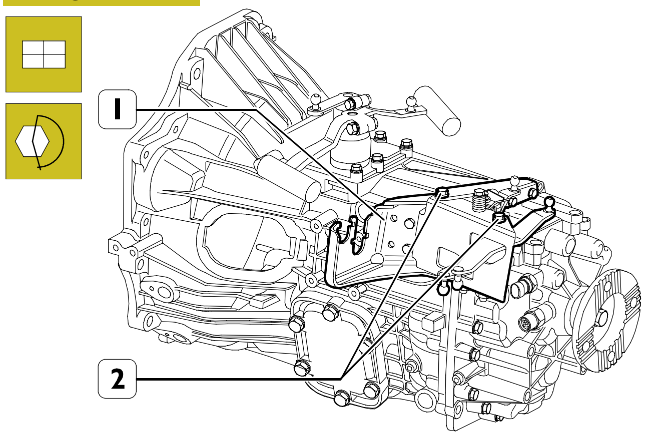


Thoroughly clean the mating surfaces of the gear control box (2) and apply LOCTITE 5206 sealant on them.

Fit the box (2) on the transmission, taking care that the levers and shafts are positioned correctly in their respective seats.

Tighten the screws (1) to the required torque.

Figure 25

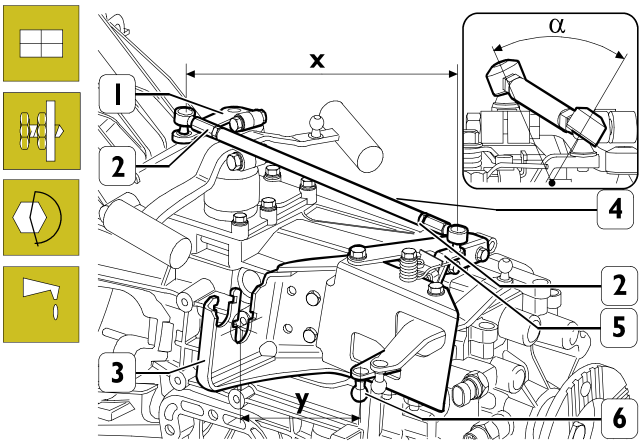


108858

Fit transfer case (1) into place, by tightening fastening screws (2) to the prescribed torque.

Selection and adjustment tie-rod assembling

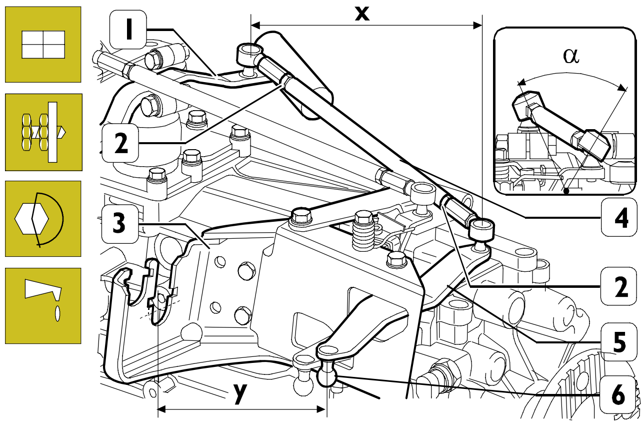
Figure 26



108859

Verify that the tie-rod (4) length "X", as measured between the jointed head centres is not greater than 342 mm.
Lubricate the jointed head inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the jointed heads to levers (1 and 5).
Measure the distance "y" between transfer case (3) outer surface and ball pin (6) centre: it shall be "y" = 146 ± 1 mm. Otherwise, loosen nuts (2) and properly rotate tie-rod (4) until the prescribed distance is obtained. Then tighten nuts (2) to the prescribed torque, so that the vertical axes of the jointed heads are aligned, with a maximum deviation of less than 30° (lower).

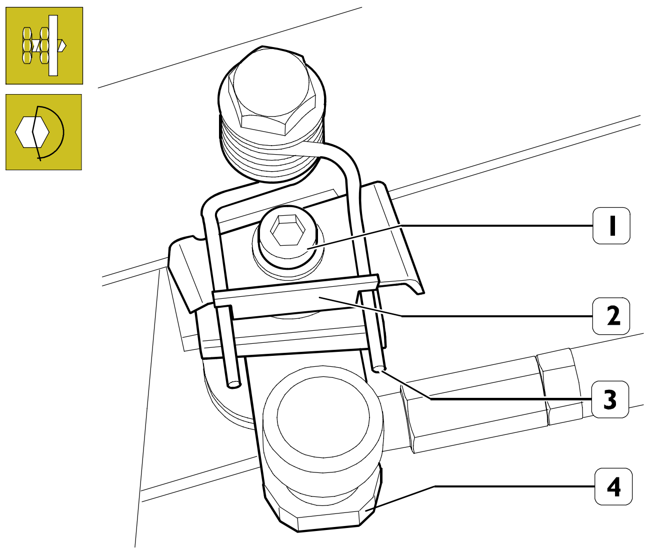
Figure 27



108860

Verify that the tie-rod (4) length "X", as measured between the jointed head centres is not greater than 342 mm.
Lubricate the jointed head inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the jointed heads to levers (1 and 5).
Measure the distance "y" between transfer case (3) outer surface and ball pin (6) centre: it shall be "y" = 180 ± 1 mm. Otherwise, loosen nuts (2) and properly rotate tie-rod (4) until the prescribed distance is obtained. Then tighten nuts (2) to the prescribed torque, so that the vertical axes of the jointed heads are aligned, with a maximum deviation of less than 30° (lower).

Figure 28



108861

Verify that spring (3) ends come into contact with selection lever (4) or are at least 1 mm within the same. Otherwise, loosen screw (1) so that spring (3) is correctly positioned, due to plate (2) being released.

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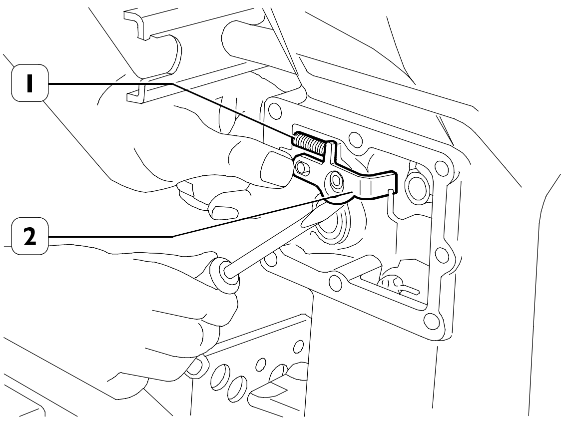
Disassembling the transmission

Figure 29

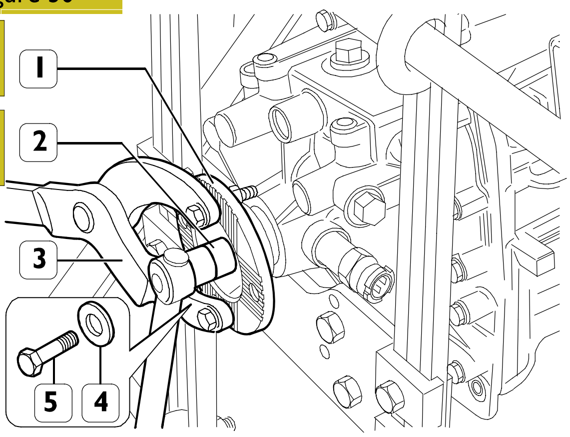


51393

Dismantle the gear control box as described under the relevant heading.

Remove the reverse gear stop plate (2) and the spring (1).

Figure 30

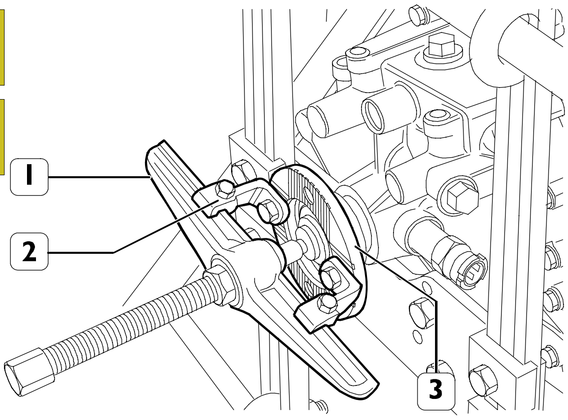


74955

Block rotation of the sleeve (1) by applying the lever 99370317 (3). With the bushing (2) remove the screw (5) with the washer beneath (4).

Take out the lever 99370317 (3).

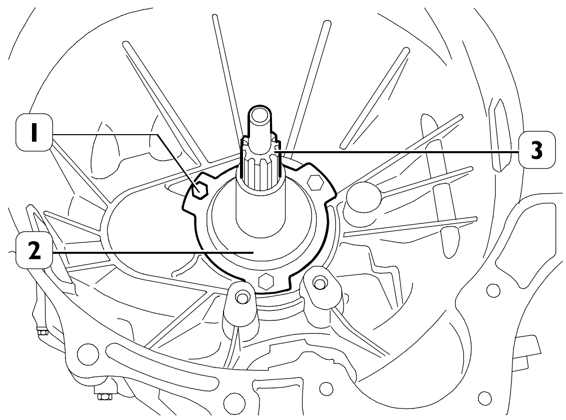
Figure 31



74956

Apply the bridge 99341003 (1) and clamps 99341017 (2) onto the sleeve (3).
Extract the sleeve (3) from the main shaft.

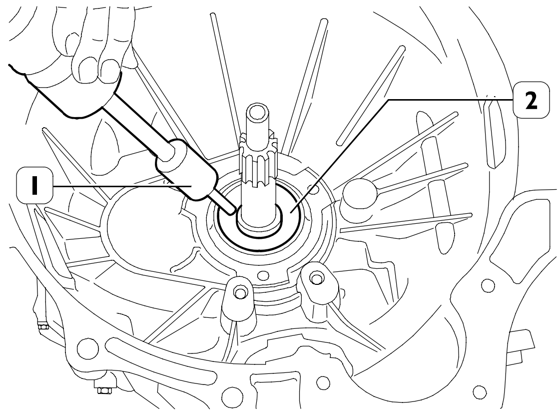
Figure 32



51396

Remove the screws (1) and take off the cover (2) protecting the input shaft (3).

Figure 33

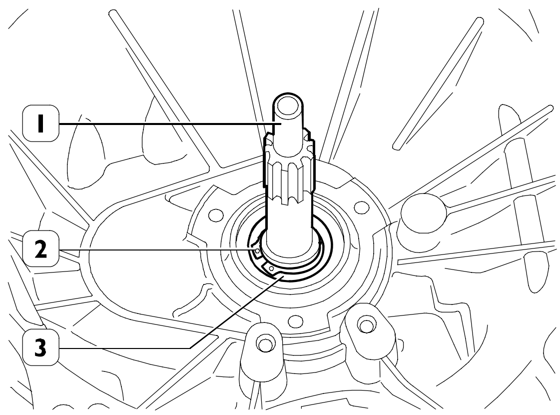


51397

Drill the O-ring (2).

Using a suitable hook and extractor (1), remove the O-ring (2) from the transmission.

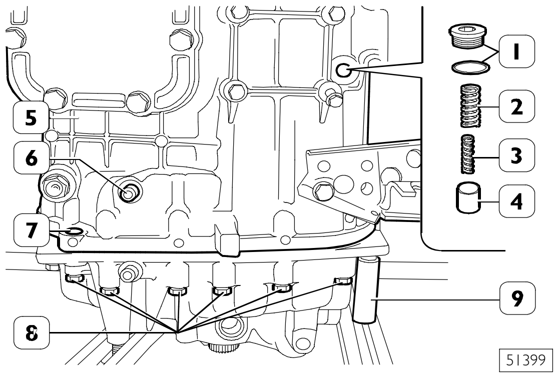
Figure 34



51398

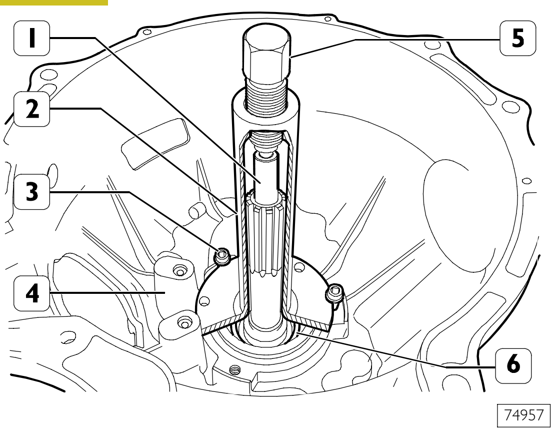
Remove the circlip (2) retaining the front bearing (3) from the input shaft (1).

Figure 35



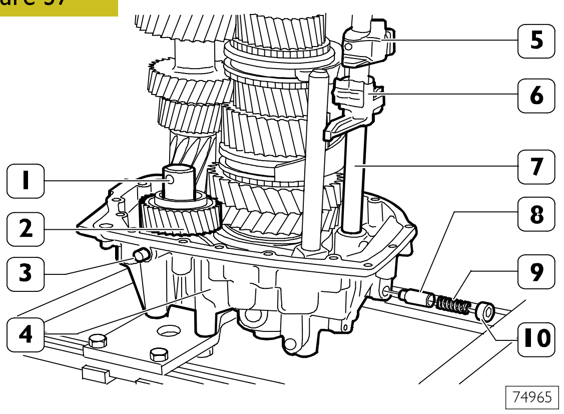
Take out the plug with the washer (1), extract the springs (2 and 3) and the push rod (4). Remove the screw (6) securing the reverse gear shaft to the transmission (5). Push the two centring pins (7) downwards to free them from the transmission (5). Remove the screws (8) securing the rear cover (9) to the transmission (5).

Figure 36



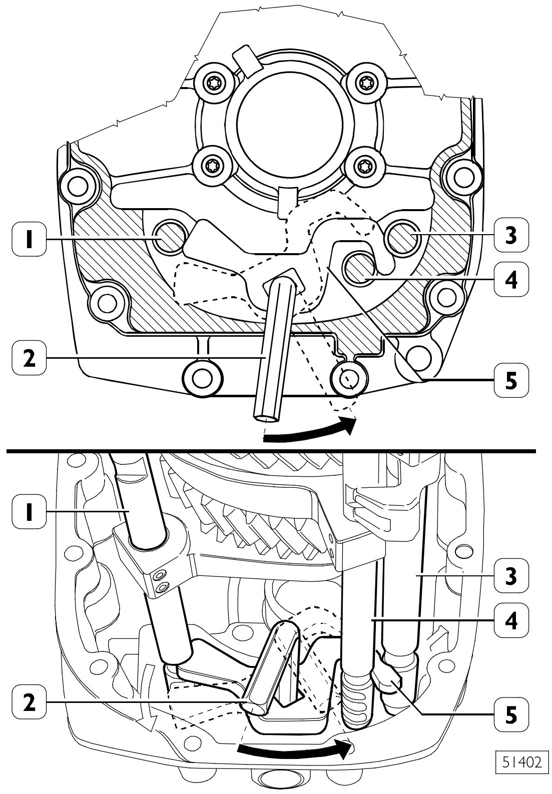
Fit the drive input shaft (1) with tool 99345003 (2) and secure this to the gearbox (4) with screws (3). Screw down the screw (5) of the tool (2) to extract the gearbox from the bearing (6).

Figure 37



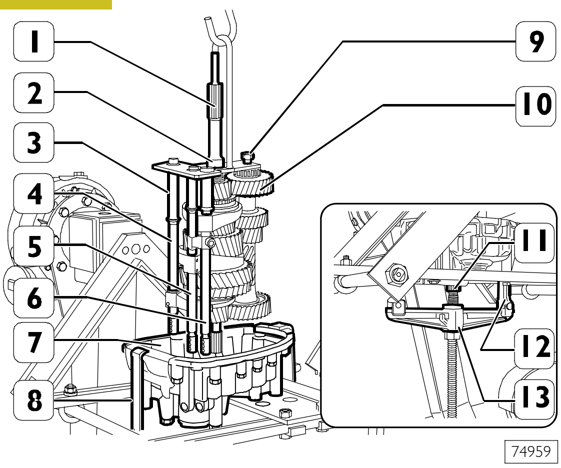
Take out the screw (3) and extract the shaft (1) from the rear cover (4). Remove the reverse gear (2). Drill the cups (10) screw a special screw into them; with the aid of the screw, extract the cups (10) from the rear cover (4). Remove the springs (9) and the pawls (8). Extract the rod (7) together with the selector (5) and driver (6).

Figure 38



Insert an Allen wrench (2) into the engagement locking plate (5). Turn the Allen wrench (2) to position the engagement locking plate (5) outside the slots (⇒) in the engagement rods (1, 3 and 4).

Figure 39



Mount the tool 99360521 (3) onto the rods (4, 5 and 6), on the input shaft (1) and on the transmission shaft (10). Secure the tool 99360521 (3) on the input shaft (1) with the retaining ring (2) and with the screw (9) to the transmission shaft (10). Hook the tool 99360521 (3) onto the lift. Apply the extractor composed of the bridge 99341004 (13) and ties 99341012 (12) onto the rear cover (7). Use the screw of the bridge (13) and work on the lift to extract the main shaft (11) from the rear bearing. Set this assembly on the workbench. Remove the tool 99360521 (3) and separate the transmission shaft (10), input shaft with relative synchronizing ring and the rods (4, 5 and 6) from the main shaft.

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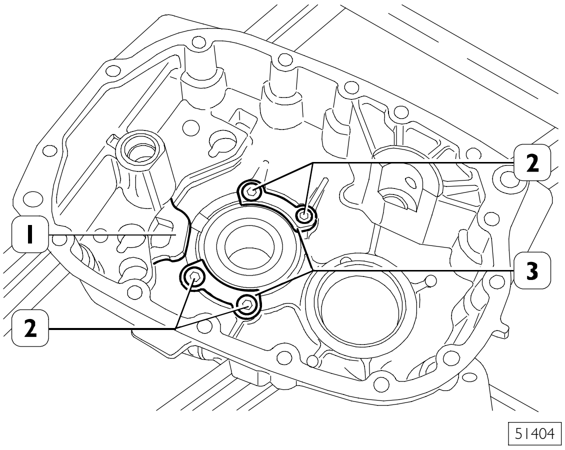
Disassembling the rear cover bearings

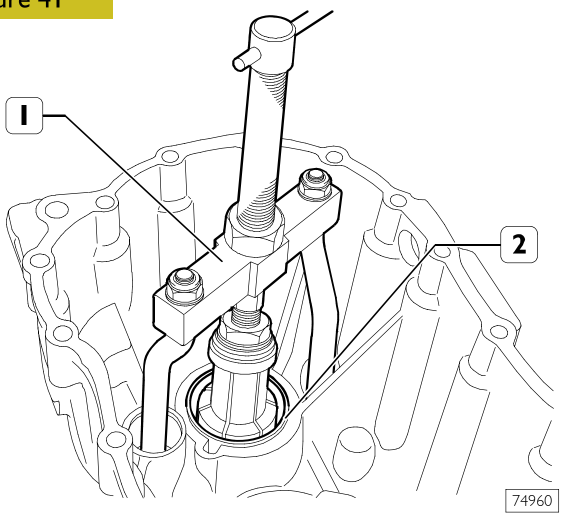
Figure 40



Remove the screws (2) securing the plates (3).

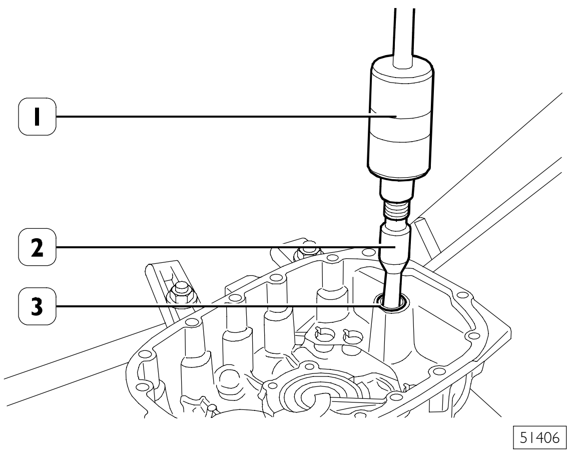
Take out the plates (3) and the engagement locking plate (1).

Figure 41



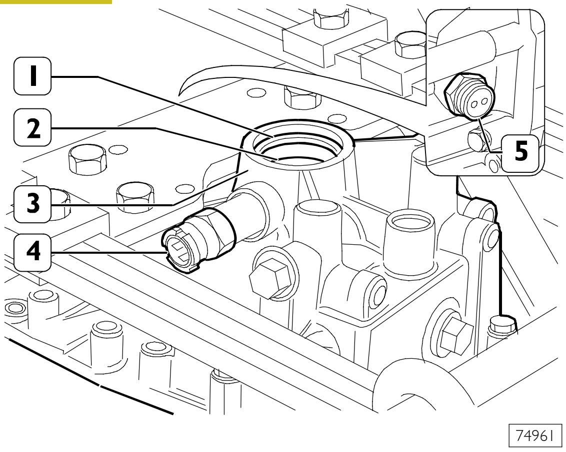
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 42



Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

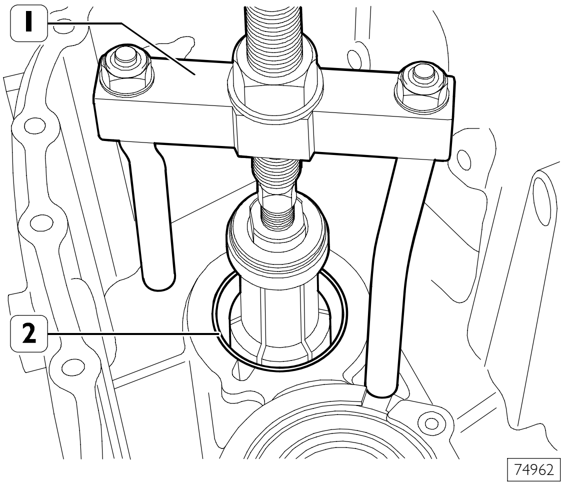
Figure 43



Turn over the rear cover (3). Take out the O-ring (1) and the "phonic wheel" (2). Using a suitable punch, remove the ball bearing (4, Figure 36). Remove the tachograph sensor (5) and the reversing light switch (4).

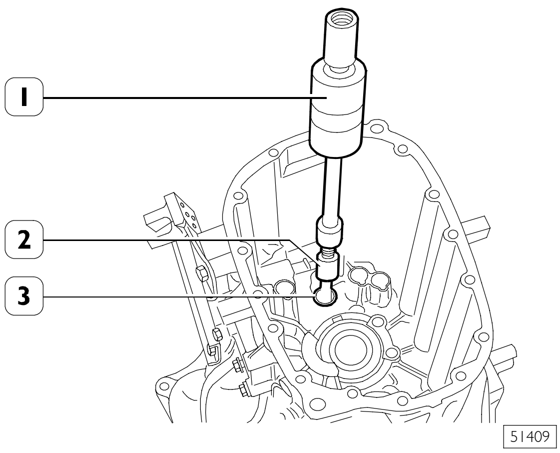
Disassembling the transmission bearings

Figure 44



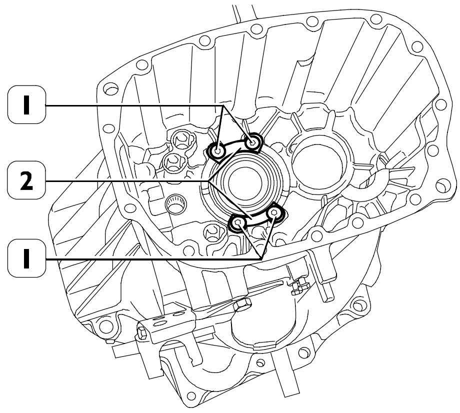
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 45



Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

Figure 46

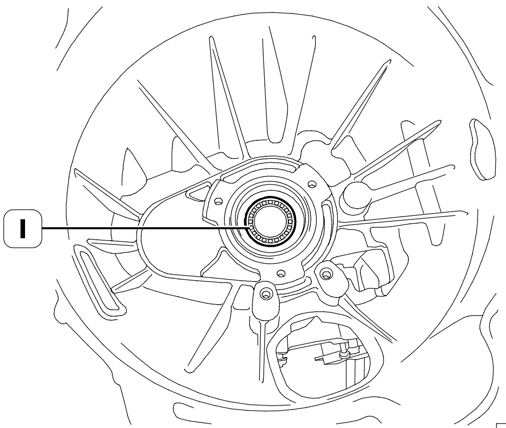


51410

Remove the screws (1) securing the plates (2).

Take out the plates (2).

Figure 47

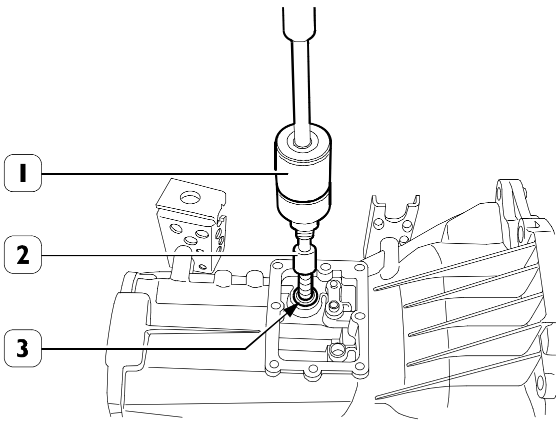


51411

Turn over the transmission.

Using a suitable punch, remove the ball bearing (1).

Figure 48



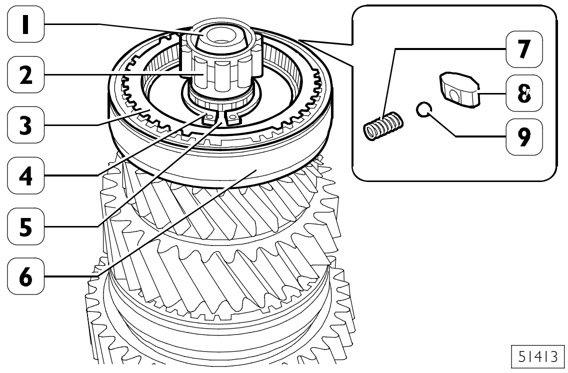
51412

Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the roller bearing (3).

Disassembling the main shaft

NOTE Mark the assembly position of each synchronizing device on the respective gears.

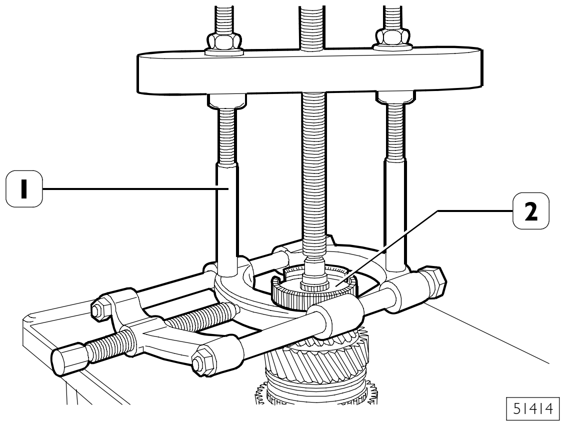
Figure 49



51413

Clamp the main shaft (1) in a vice. Remove the roller bearing (2) and the synchronizer ring (3). Remove the sliding sleeve (6) for engaging 3rd-4th gear from the hub (5) and, taking care as the plugs (8) come out with their relative balls (9) and springs (7), recover them.

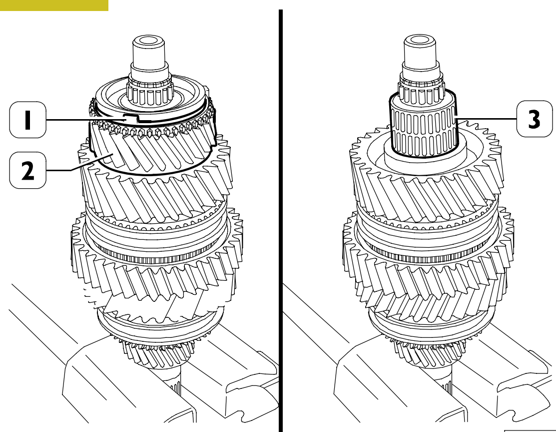
Figure 50



51414

Remove the retaining ring (4, Figure 44). Extract the hub (2) with the extractor 99348001 (1).

Figure 51



51415

Remove the synchronizer ring (1), 3rd gear (2) and roller bearing (3).

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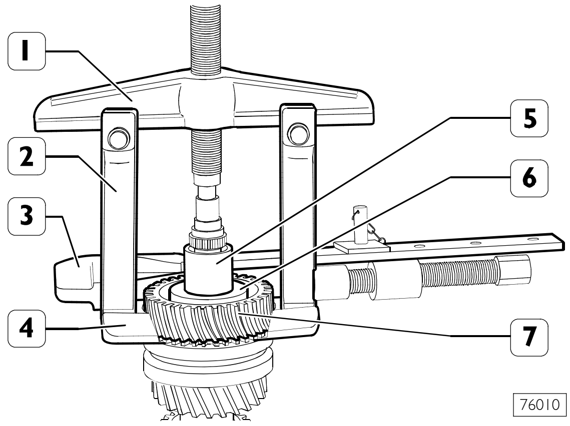
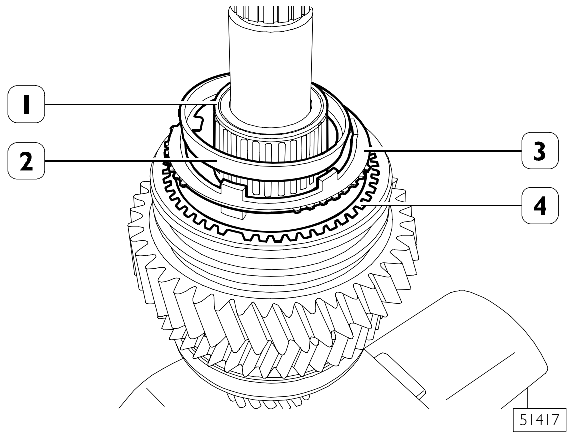
Figure 52



Using bridge 99341003 (1), screw stays 99341019 (2), grips 99341025 (4) and clamp 99341015 (3), take out the 2nd gear (7), spacer (6) and bushing (5).

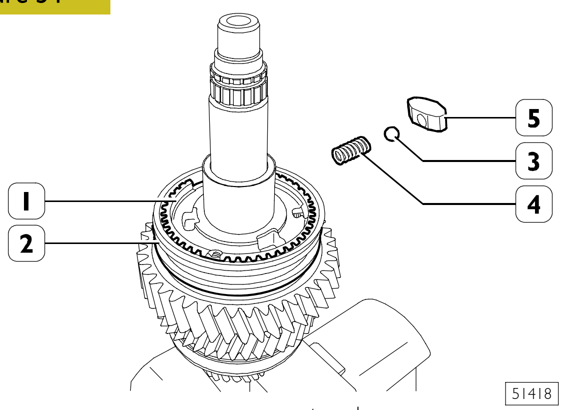
NOTE Force of extraction of the bushing (4) 40 kN.

Figure 53



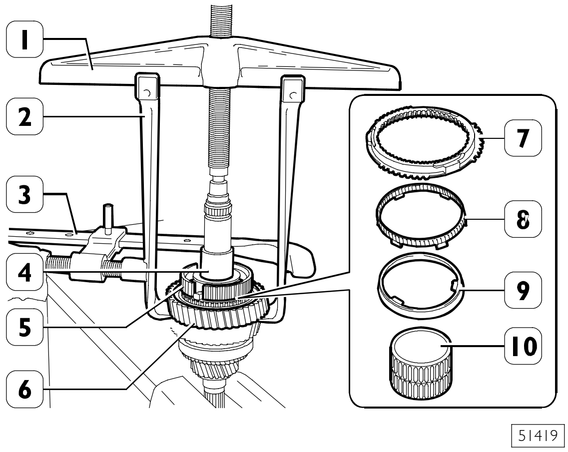
Take out the synchronizer ring (4), middle ring (3), ring (2) and roller bearing (1).

Figure 54



Remove the sleeve (2) for engaging 1st-2nd gear from the hub (1) and, taking care as the plugs (5) come out with their relative balls (3) and springs (4), recover them.

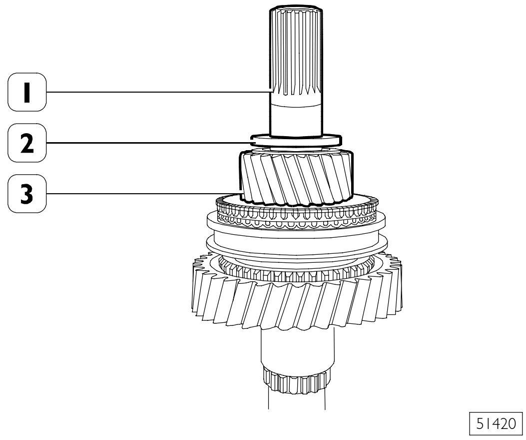
Figure 55



Using the bridge 99341003 (1), ties 99341012 (2) and clamp 99341015 (3), extract the 1st gear (6), with the synchronizer ring (7), middle ring (8) and ring (9), hub (5) and bushing (4). Remove the roller bearing (10).

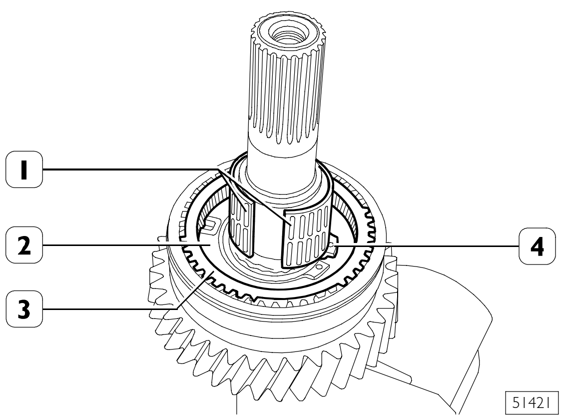
NOTE Force of extraction of the bushing (4) 40 kN.

Figure 56



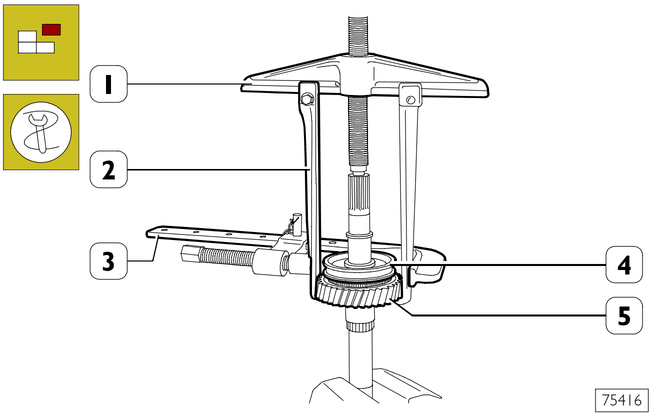
Turn over the main shaft (1). Take out the spacer ring (2) and remove the 5th gear (3).

Figure 57



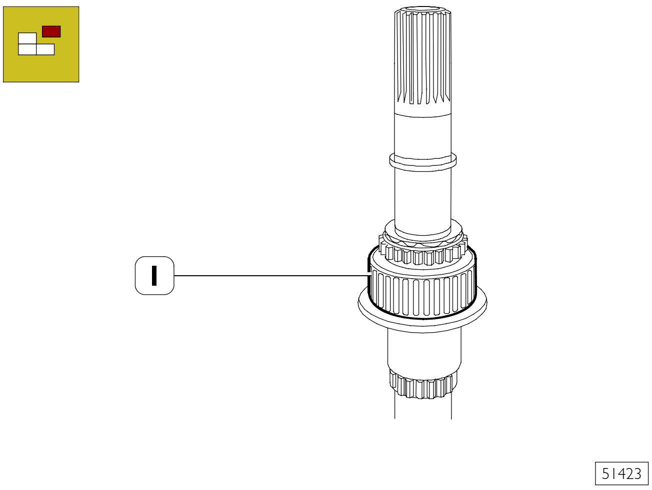
Remove the half roller bearings (1), the synchronizer ring (3) and the retaining ring (4) holding the hub (2).

Figure 58



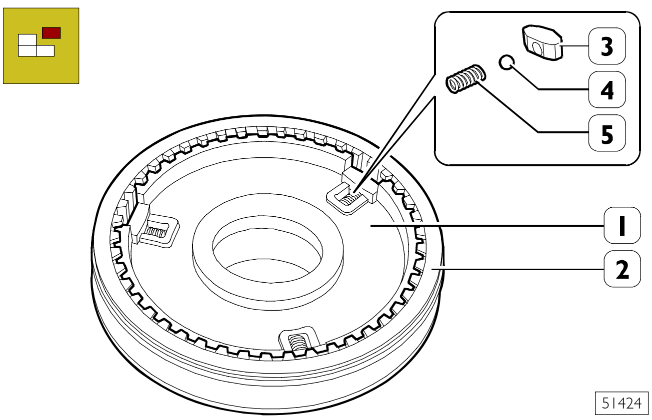
Using the bridge 99341003 (1), ties 99341012 (2) and clamp 99341015 (3), extract the reverse gear (5) and the synchronizer assembly (4).

Figure 59



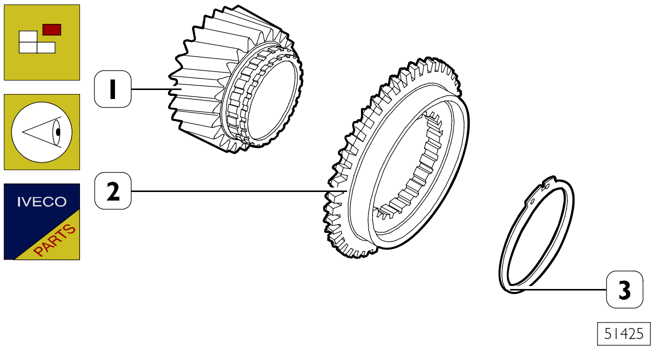
Remove the roller bearing (1).

Figure 60



Remove the sliding sleeve (2) for engaging reverse - 5th gear from the hub (1), taking care as the plugs (3) come out with their relative balls (4) and springs (5), recover them.

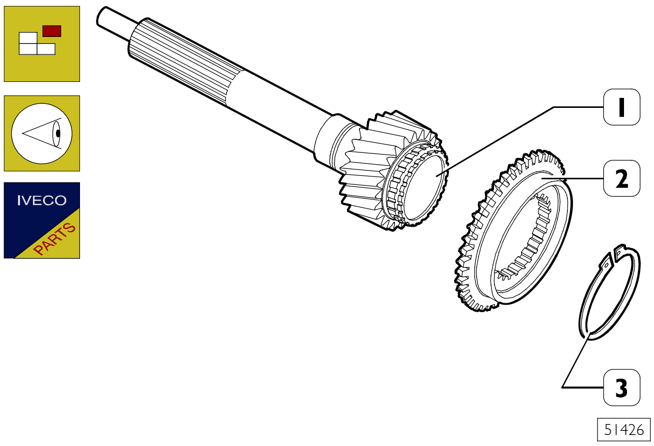
Figure 61



If the cog-wheel (2) of the 5th gear (1) shows any sign of damage, take out the retaining ring (3), replace the cog-wheel (2) and refit the retaining ring (3).

Drive input shaft

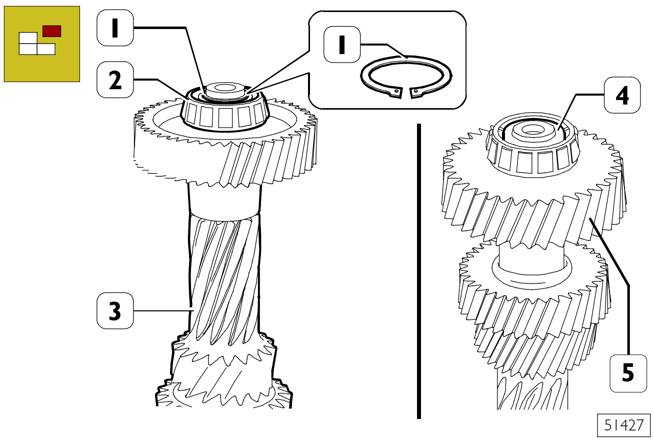
Figure 62



If the cog-wheel (2) of the input shaft gear (1) shows any sign of damage, take out the retaining ring (3), replace the cog-wheel (2) and refit the retaining ring (3).

Disassembling the transmission shaft

Figure 63



Take out the retaining ring (1) and extract the internal ring (2) of the rear bearing. Turn over the shaft (3) and extract the internal ring (4) of the front bearing.
Shaft (3) gear (5) removal, if required, shall be performed by hydraulic press; 50 kN removing load.

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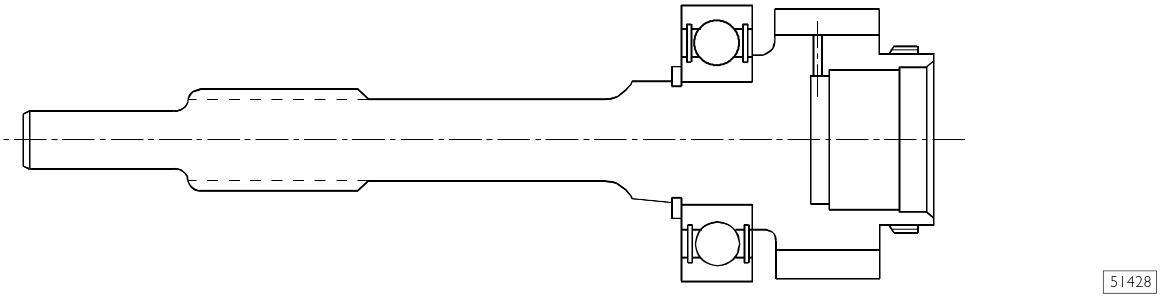
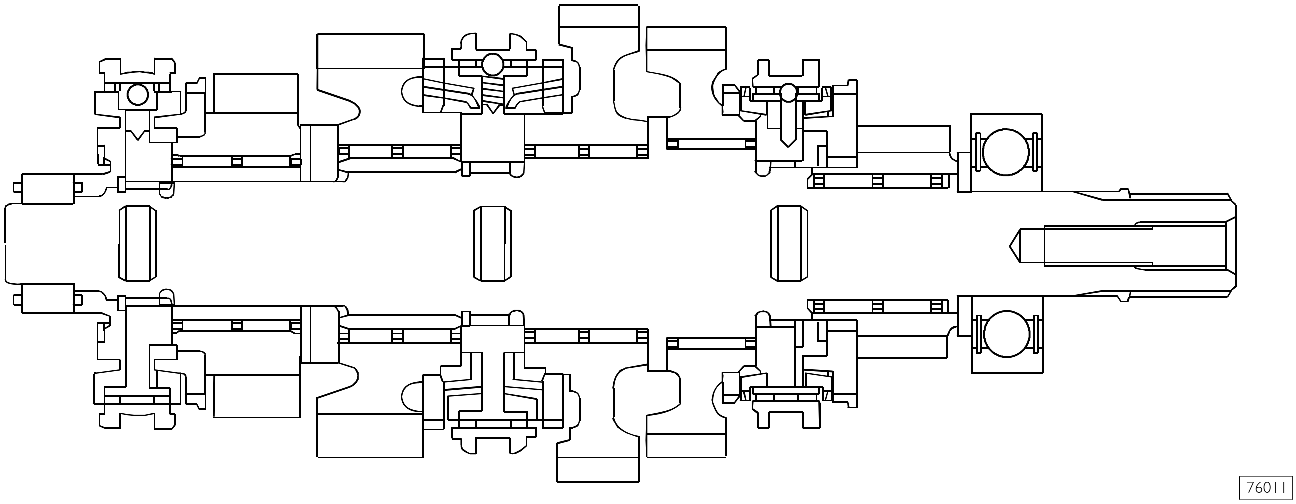
Figure 64



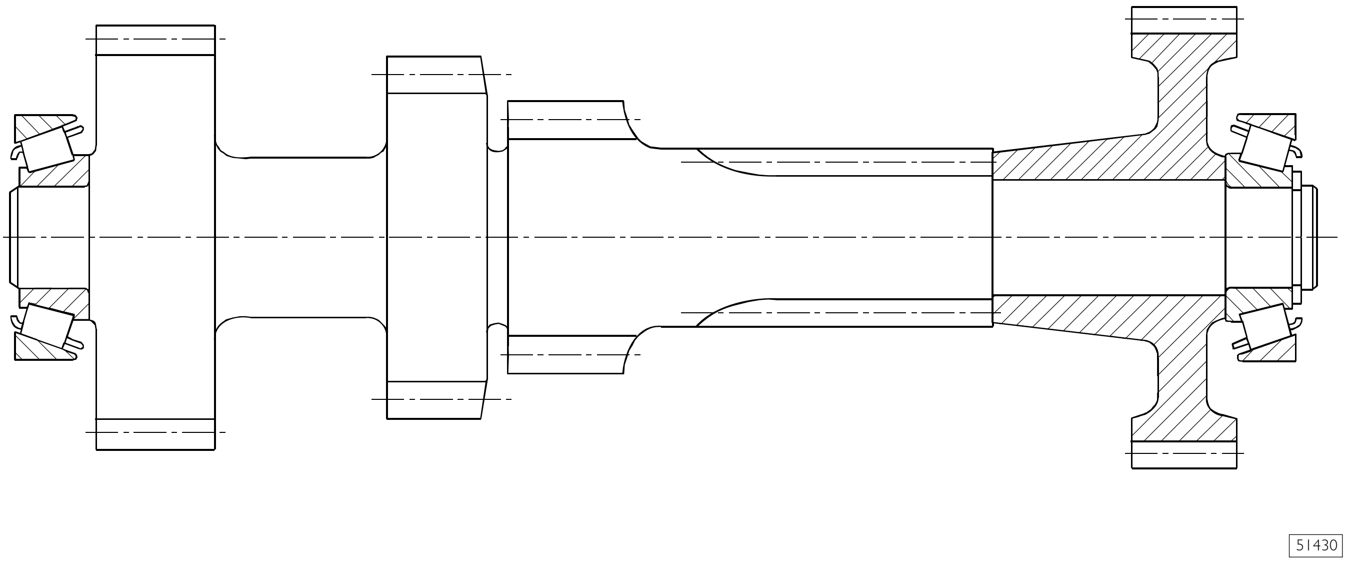
INPUT SHAFT ASSEMBLY DRAWING

Figure 65



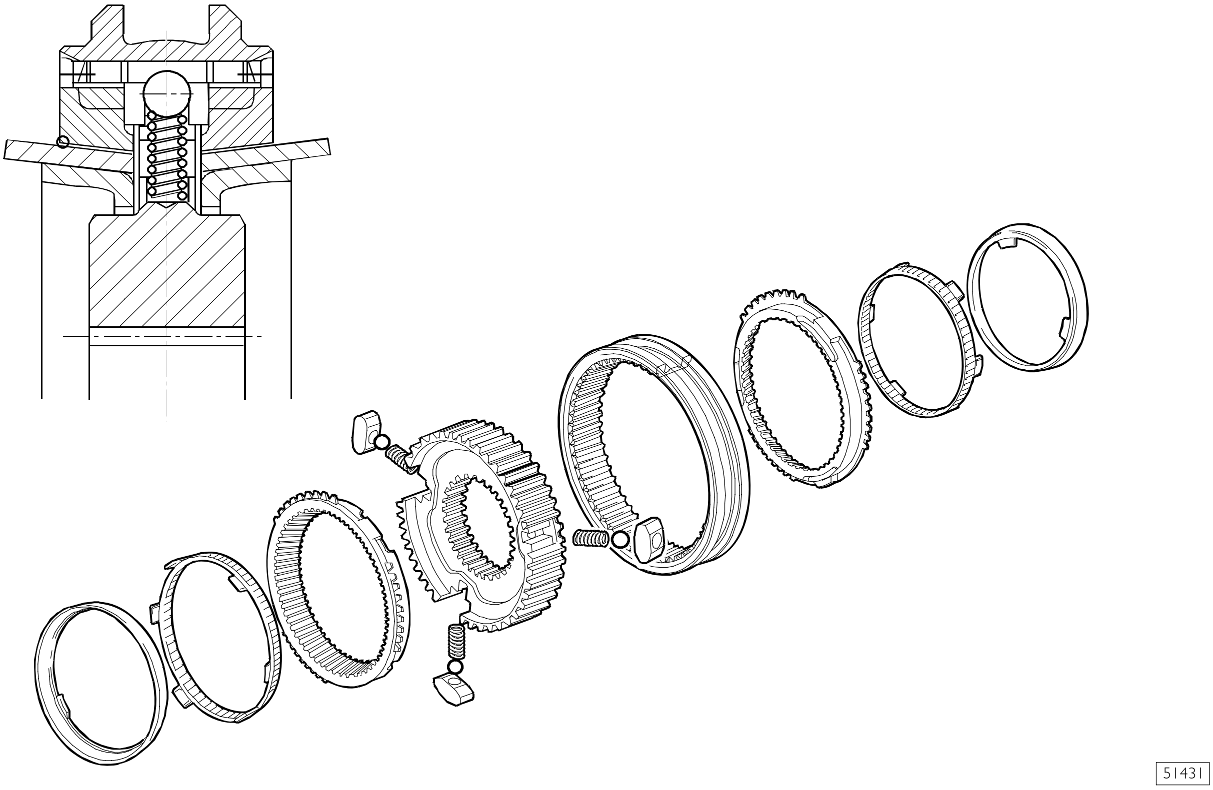
MAIN SHAFT ASSEMBLY DRAWING

Figure 66



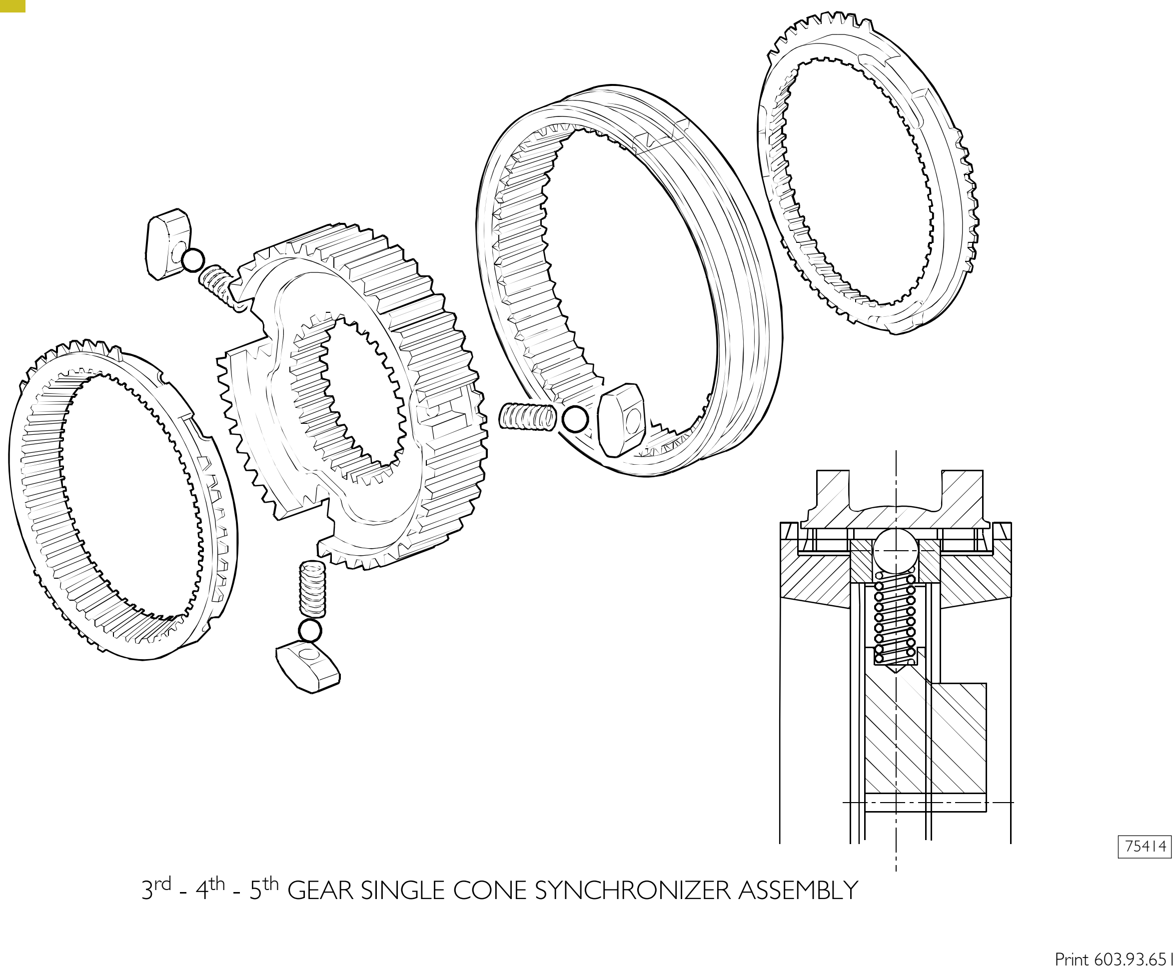
TRANSMISSION SHAFT ASSEMBLY DRAWING

Figure 67



1st-2nd GEAR DUAL CONE SYNCHRONIZER ASSEMBLY

Figure 68



3rd - 4th - 5th GEAR SINGLE CONE SYNCHRONIZER ASSEMBLY

CHECKS

Transmission

The transmission and relative covers must show no sign of cracking.
The mating surfaces of the covers and transmission must not be damaged or deformed. Remove any remains of sealant from them.

The seats of the bearings, reverse gear shaft and gear control rods must be neither damaged nor too worn.

Hubs - sliding sleeves - forks

The grooves on the hubs and relative sliding sleeves must not be damaged. The sliding sleeve must run freely on the hub. The plugs and balls for positioning the sliding sleeve must be neither damaged nor worn. The toothing of the sliding sleeves must not be damaged. The forks must be sound with an end float, in the radial groove of the sleeve, no greater than 1 mm.

Bearings

The roller bearings must be in perfect condition with no signs of wear or overheating. They must only be removed if they are to be replaced.

Shafts - gears

The seats on the shafts, for bearings, must be neither damaged nor worn. The toothing of the gears must be neither damaged nor worn.

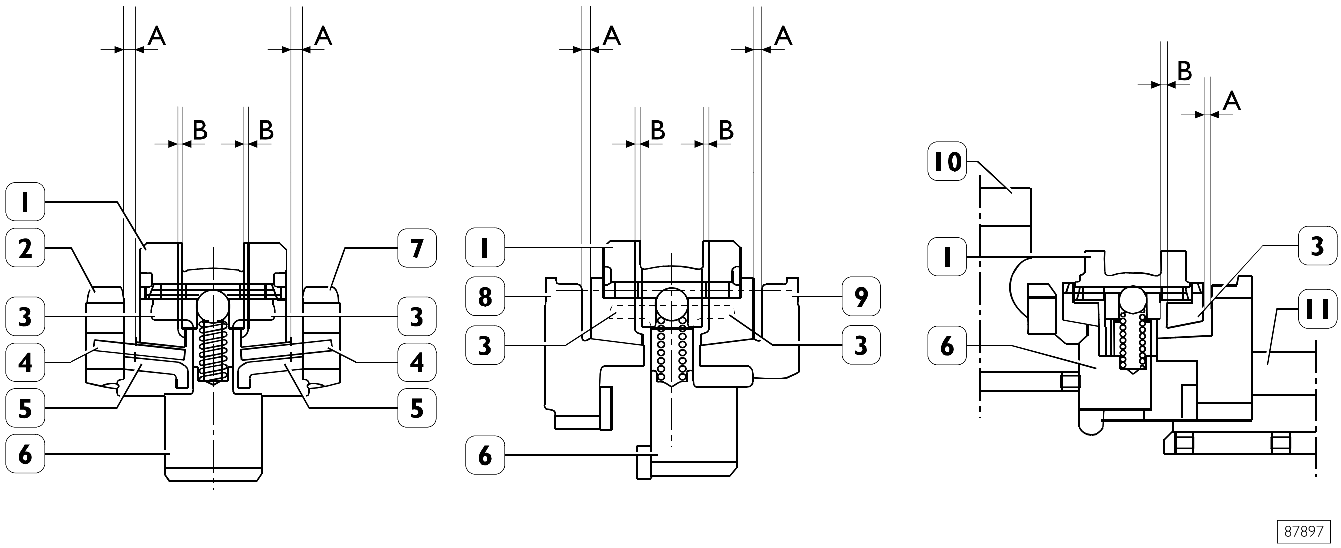
Synchronizing devices

Check the wear on the synchronizer rings (3, Figure 70) proceeding as follows:

- ❑ position the synchronizer ring (3) on the respective cog-wheel (2, 7, 8, 9 and 11, Figure 70);
- ❑ turn the synchronizer ring so as to ensure correct coupling on the tapered surface of the cog-wheel of the gear.
- ❑ With a feeler gauge, check the distance **A** on two diametrically opposite points.
  If the average measured value **A** is less than 0.5 mm, replace the synchronizer ring.

NOTE After this check, the synchronizer rings must be marked on their respective gears to avoid swapping their positions over when assembling.

Figure 69



1st - 2nd GEAR SYNCHRONIZERS

A. Synchronization reserve
1st-2nd gear 1.4 $^{+0,25}_{-0.35}$ mm
B. 1st-2nd gear release clearance 0.9 $^{+0,6}_{-0.35}$ mm

3rd - 4th GEAR SYNCHRONIZERS

A. Synchronization reserve
3rd - 4th gear 1.15 + 0.2 mm
B. 3rd - 4th gear release clearance 1.40 + 0.65 mm

5th GEAR SYNCHRONIZER

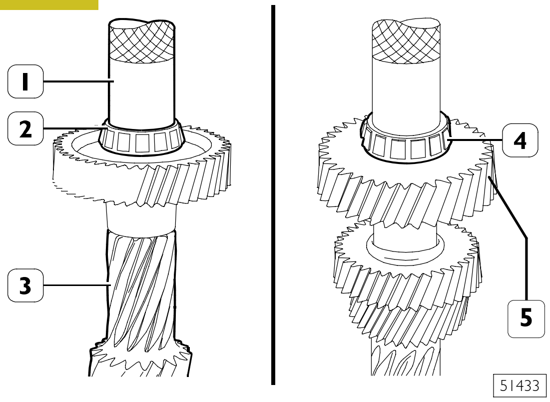
A. Synchronization reserve
5th gear 1.15 + 0.2 mm
B. 5th gear release clearance 1.10 + 0.4 mm

Force of sliding of sliding sleeves 80 ÷ 95 Nm.
Maximum admitted wear on the synchronizers, distance **A** - 0,5 mm

1. Sliding sleeve - 2. 1st gear cog-wheel - 3. Synchronizer ring - 4. Middle ring - 5. Ring - 6. Hub - 7. 2nd gear cog-wheel - 8. 3rd gear cog-wheel - 9. 4th gear cog-wheel - 10. Reverse gear - 11. 5th gear cog-wheel

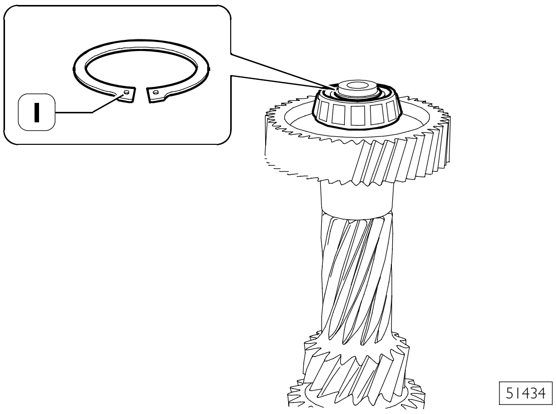
Mounting the transmission shaft

Figure 70



Gear (5) fitting on shaft (3), if required, shall be performed by hydraulic press after heating the gear to 140°C ÷ 170°C; 31 kN driving load.
Heat the internal rings (2 and 4) of the tapered roller bearings to a temperature of approx. ~ 80°C and, with a suitable punch (1), mount them on the transmission shaft (3).

Figure 71

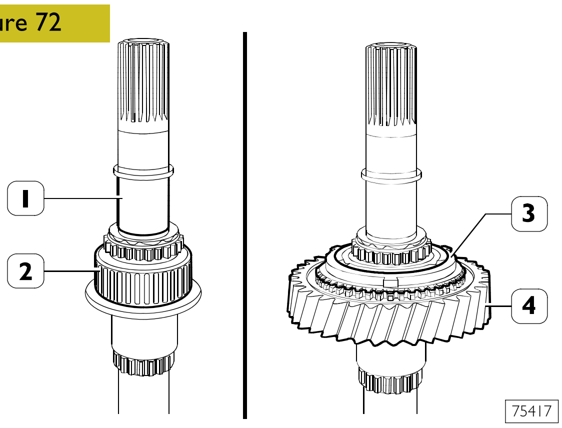


Mount the retaining ring (1) whose thickness gives an end float when in its seat of 0 ÷ 0.05 mm.

Mounting the main shaft

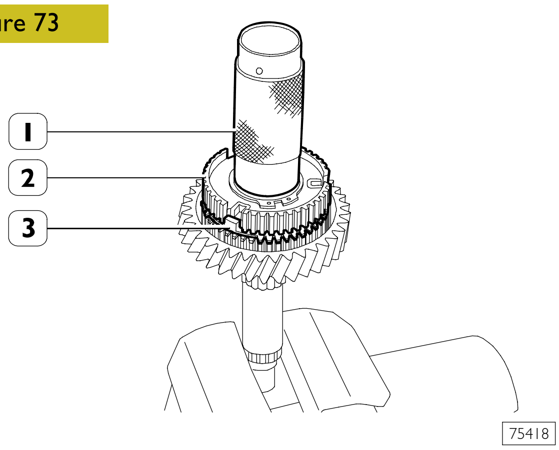
NOTE Mount the synchronizer rings on their respective gears according to the marks made during disassembly or when checking in the case of replacement.

Figure 72



Tighten the main shaft (1) in a vice and mount on it: the roller cage (2), reverse gear (4) and synchronizer ring (3).

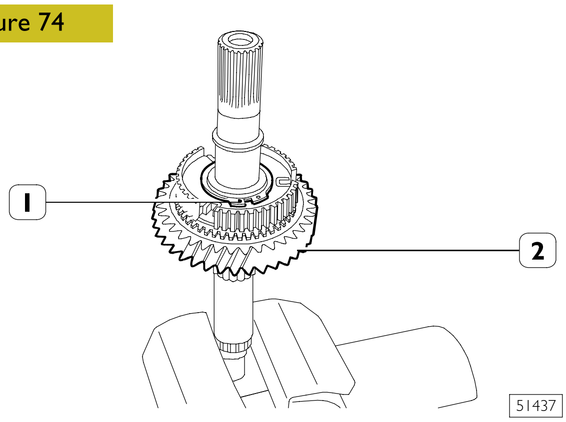
Figure 73



Heat the hub (2) for the 5th - reverse gear engagement sliding sleeve to a temperature no higher than 150°C and mount it on the main shaft with a suitable punch (1).

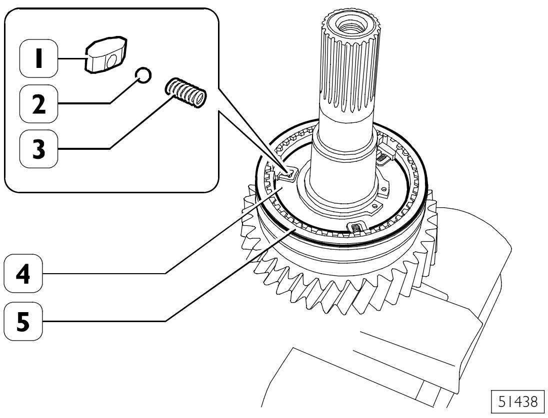
NOTE When fitting, make sure that the projecting parts (3) of the synchronizer ring get positioned in the hub (2) correctly.

Figure 74



Mount the retaining ring (1) whose thickness makes for null clearance in its seat.
Check the end float of the reverse gear (2). It should be 0.15 ÷ 0.3 mm.

Figure 75



Mount the sliding sleeve (5) on the hub (4) facing as shown in the figure.
Put the springs (3), plugs (1) and balls (2) into the seats of the hub (4), settling them under the sliding sleeve.

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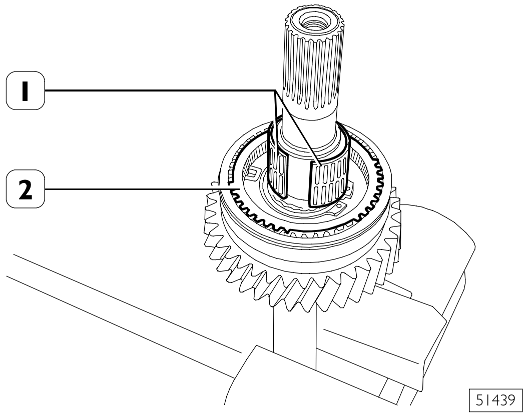
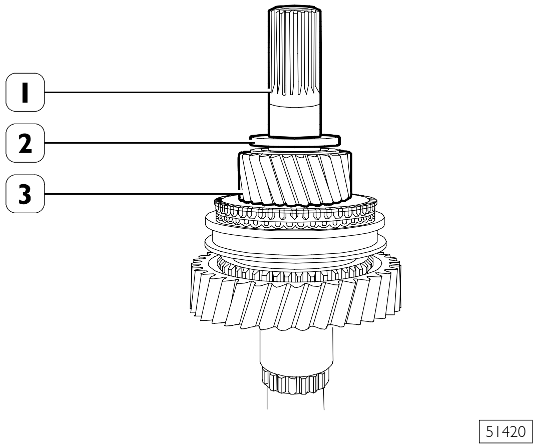
Figure 76



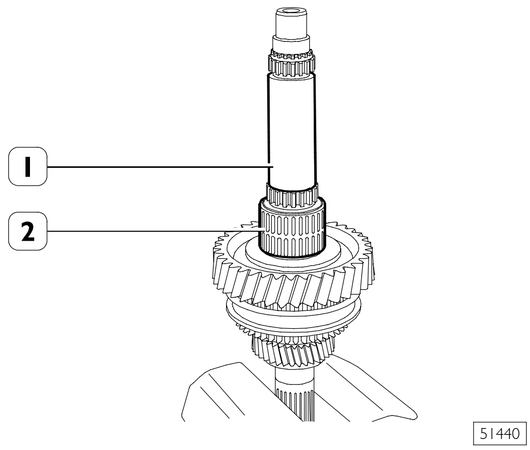
Positioning the synchronizer ring (2) and the half roller bearings (1).

Figure 77



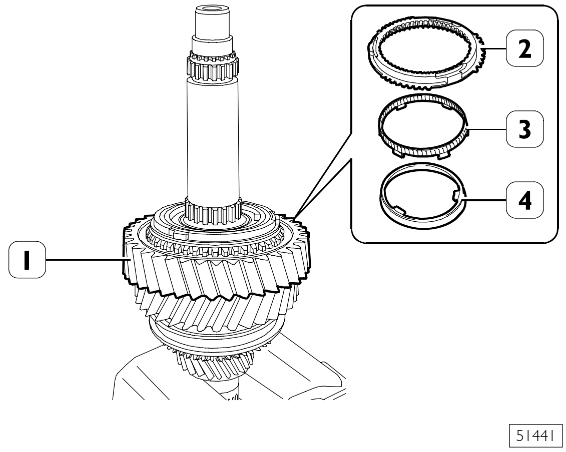
Install the 5th speed gear (3).
Heat spacer ring (2) to 90°C and install it.
Upset the main shaft (1).

Figure 78



Position the roller bearing (2) on the main shaft (1).

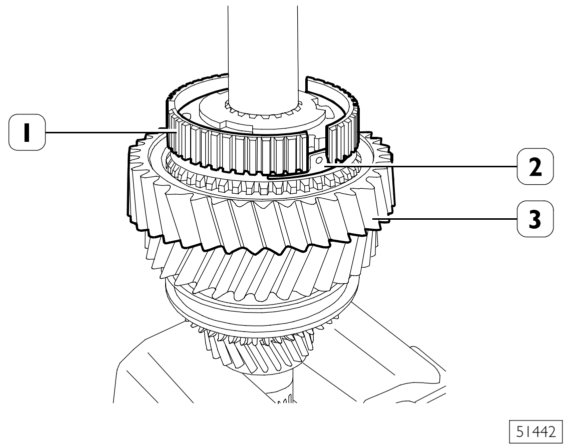
Figure 79



Mount the 1st gear (1).
Lubricate the ring (4), middle ring (3), synchronizer ring (2) with TUTELA MR3 grease and mount them on the gear (1).

NOTE Make sure the tongues of the rings (2 and 3) are positioned correctly in their respective seats.

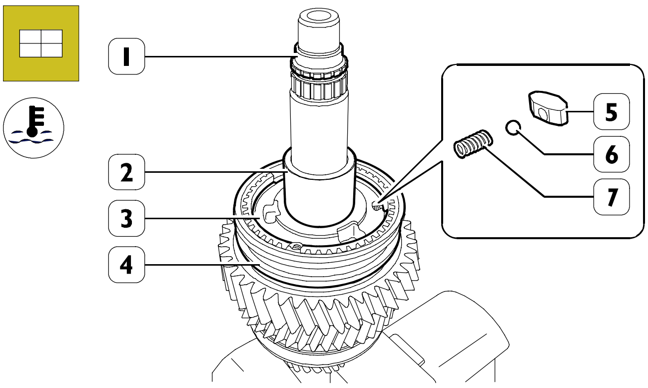
Figure 80



Heat the hub (1) for the 1st - 2nd gear sliding sleeve to a temperature no higher than 150°C and mount it on the main shaft with a suitable punch.

NOTE When assembling, make sure the tongues of the rings (3 and 4, Figure 79) and the projections of the synchronizer ring (2) are positioned correctly in the hub (1). Check that the end float of the 1st gear (3) is 0.15 ÷ 0.30 mm.

Figure 81



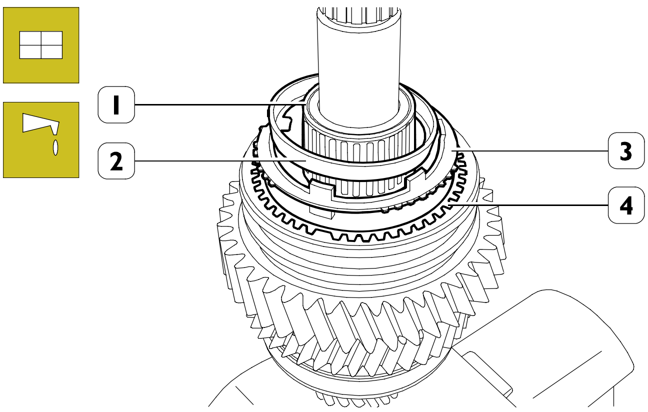
51443

Heat the bushing (2) to a temperature no higher than 170°C and mount it on the main shaft (1).

Mount the sliding sleeve (4) on the hub (3).

Put (3) the springs (7), plugs (5) and balls (6) into the seats in the hub, settling them under the sliding sleeve (4).

Figure 82



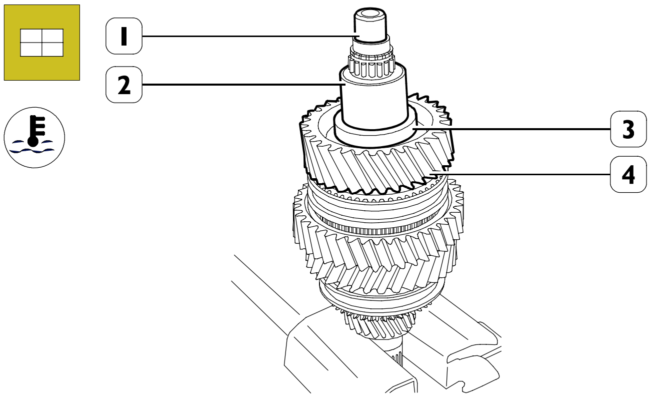
51417

Lubricate the synchronizer ring (4), middle ring (3) and the ring (2) with TUTELA MR3 grease.

NOTE Make sure the tongues of the rings (2 - 3) and the projections of the synchronizer ring (4) are positioned correctly in their respective seats.

Mount the roller bearing (1).

Figure 83



51445

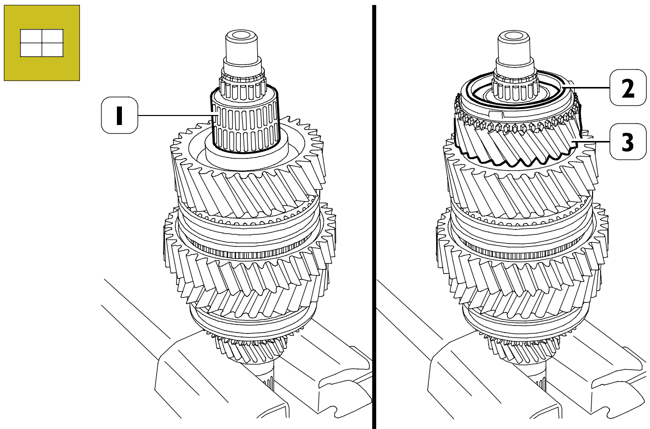
Mount the 2^{nd} gear (4).

Heat the spacer (3) to a temperature no higher than 170°C and mount it on the main shaft (1).

Check the end float of the 2nd gear (4). It should be 0.15 ÷ 0.30 mm.

Heat the bushing (2) to a temperature no higher than 170°C and mount it on the main shaft (1).

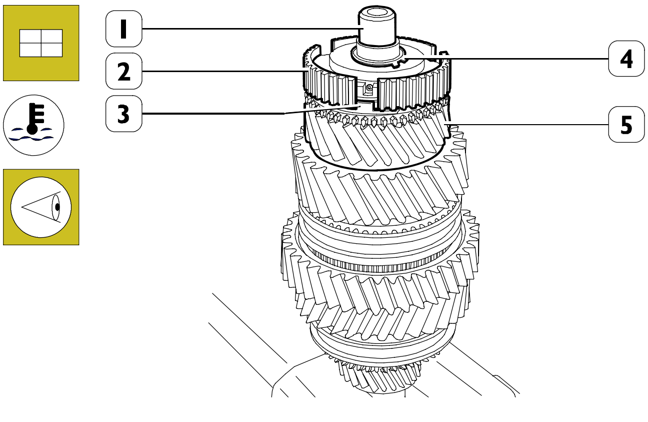
Figure 84



51446

Mount the roller bearing (1) and the 3^{rd} gear (3). Position the synchronizer ring (2) on the 3^{rd} gear (3).

Figure 85

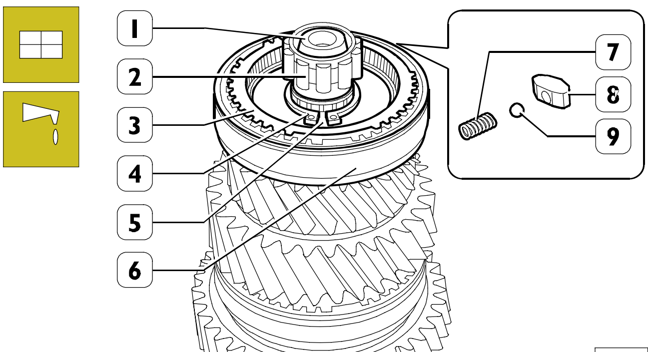


Heat the hub (2) to a temperature no higher than 150°C and mount it on the main shaft (1) checking that the projections (3) of the synchronizer ring are positioned in the compartments of the hub (2).

Mount the retainer ring (4) whose thickness determines an end float in its seat of 0 ÷ 0.05 mm.

Check the end float of the 3rd gear (5). It should be 0.15 ÷ 0.30 mm.

Figure 86



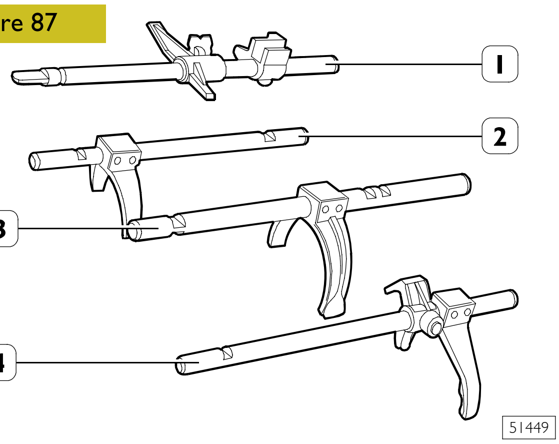
Mount the sliding sleeve (6) on the hub (5). Put the springs (7), plugs (8) and balls (9) into the seats in the hub (5), settling them under the sliding sleeve (6).

Grease the roller bearing (2) and fit it on the main shaft (1).

Position the synchronizer bearing (3) on the hub (5).

Rods - forks - selector - driver
Disassembly - assembly

Figure 87



To replace the forks of the selector and driver from their respective control rods it is sufficient to remove the retaining spring pins with a suitable punch.

For assembly, carry out these steps in reverse order, replacing the spring pins.

NOTE Spring pegs must be positioned with the cutting edge placed level.

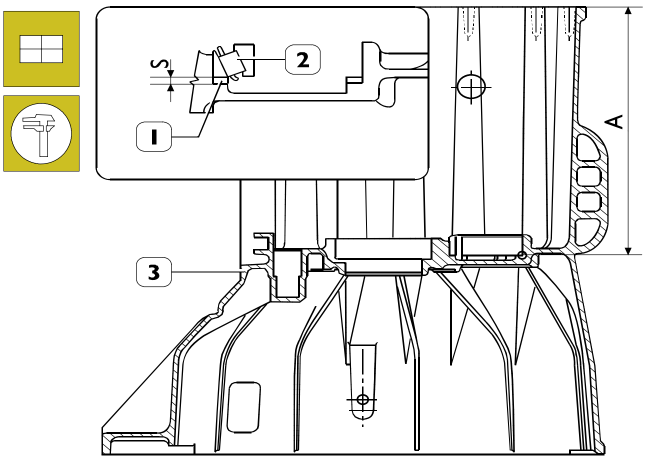
Mounting the transmission

NOTE During assembly, the gaskets, retaining rings, O-rings, spring pins, safety plates and springs must always be replaced with new parts.

The nuts and screws must be tightened to the required torque unless specified otherwise, with the thread dry and greased.

Adjusting the transmission shaft bearing end float

Figure 88



Determine the thickness **S** of the ring (1) for adjusting the transmission shaft bearing (2) end float, proceeding as follows:

- ❑ measure the distance **A** between the end of the transmission (3) and the seat of the ring of the front bearing (2);

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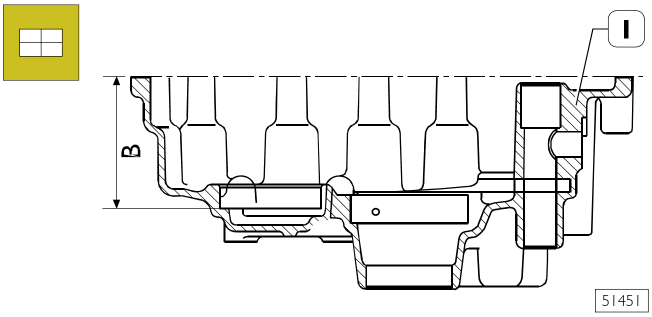
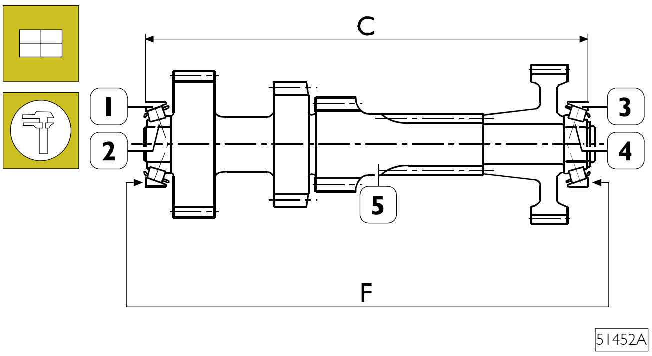
Figure 89



- measure the distance **B** between the end of the rear cover (1) and the seat of the ring of the rear bearing;

Figure 90



- mount the internal rings (2 - 4) of the tapered roller bearings on the transmission shaft (5);
- position the external rings (1 - 3) on the internal ones (2 - 4);
- apply a load **F** of 100 ÷120 N on the external rings (1 - 3).
- In these conditions, measure the distance **C** between the ends of the rings (1 - 3).
- The thickness **S** of the bearing end float adjustment ring is given by:

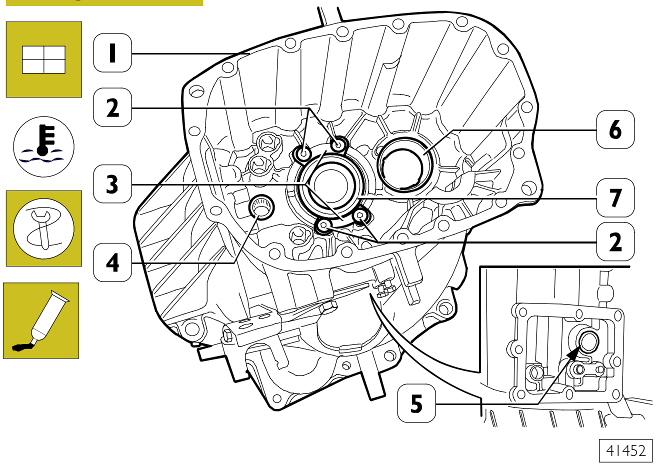
$$S = A + B - C - 0,10$$

Where:

A - B - C are the measured values

0.10 = constant value, including the deformation of the external rings (1 - 3) after driving them into their seats and the end float of the bearings of 0.05 mm.

Figure 91



Position the adjustment ring (1, Figure 88) of the thickness determined with the above measurement in the transmission (1).

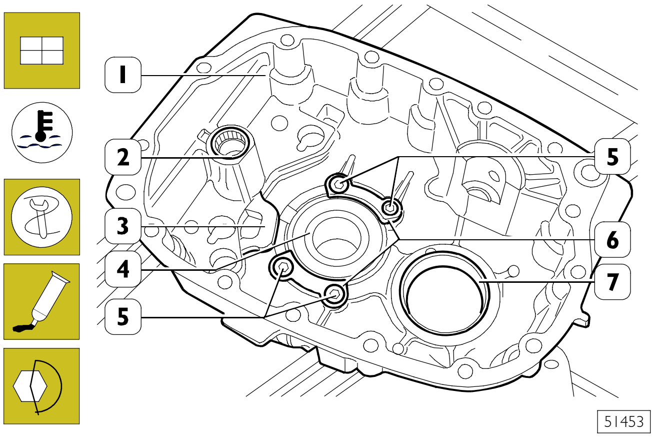
Heat the bearing seats of the box (1) to a temperature of approx. 80°C and mount:

- the external ring (6) of the front tapered roller bearing with punch 99374091 and grip 99370007;
- the ball bearing (7) with a general punch;
- the bushing with ball bearing (4) and the roller bearing (5) with a general punch.

Position the retaining plates (3) and secure them to the box, tightening the screws (2) to the required torque.

NOTE Apply LOCTITE 242 onto the thread of the screws (2, Figure 91 and 5, Figure 92).

Figure 92



Heat the bearing seats of the box (1) to a temperature of approx. 80°C and mount:

- the external ring (7) of the tapered roller bearing with punch 99374091 and grip 99370007;
- the ball bearing (4) and the bushing with ball bearings (2) with a general punch.

Position the retaining plates (6) and the engagement locking plate (3) in their seats.

Secure these to the box, tightening the screws (5) to the required torque.

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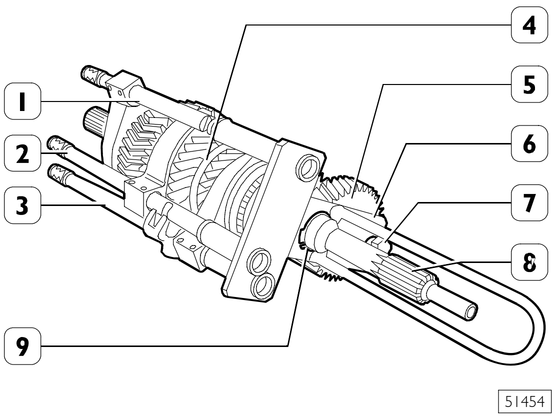
Figure 93



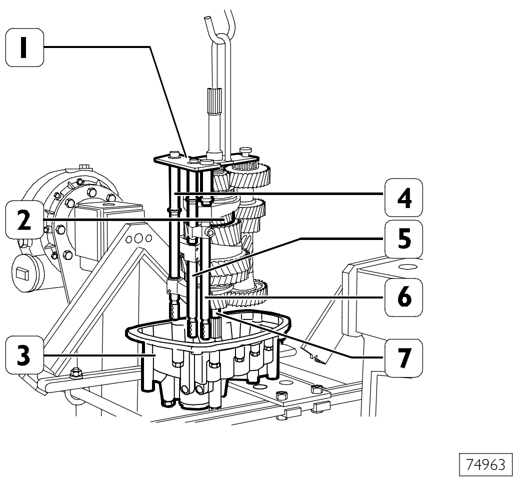
Clamp the main shaft in a vice.

Mount the input shaft (8) on the main shaft (4) and couple this with the transmission shaft (5).

Fit tool 99360521 (6) on shafts (8 and 5) and tie it to input shaft (8) by circlip (9) and to secondary shaft (5) by screw (7).

Set forks and rods thereof (1 - 2 - 3) on sliding sleeves and tie by tool 99360521 sleeves (6).

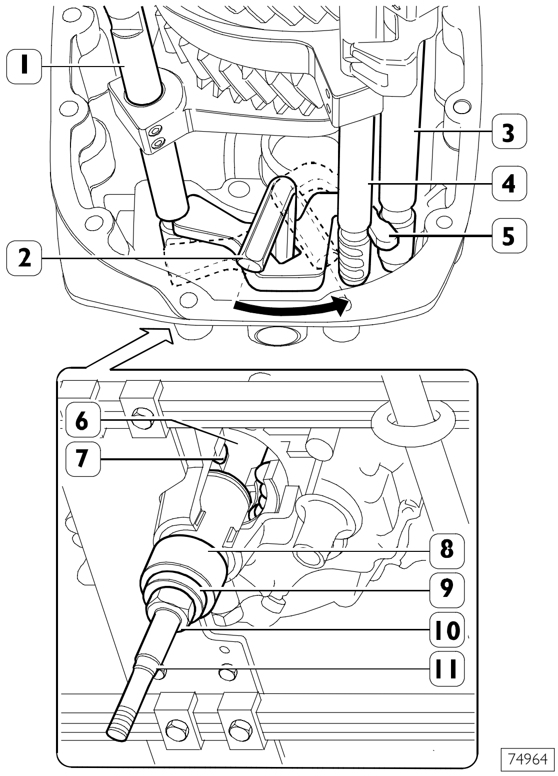
Figure 94



Hook the hoist onto tool 99360521 (1). Lift the assembly (2) as put together beforehand and mount it in the rear cover (3).

During this operation, check that the output shaft (7) goes into the supporting ball bearing and the control rods (4 - 5 - 6) go into their respective seats.

Figure 95



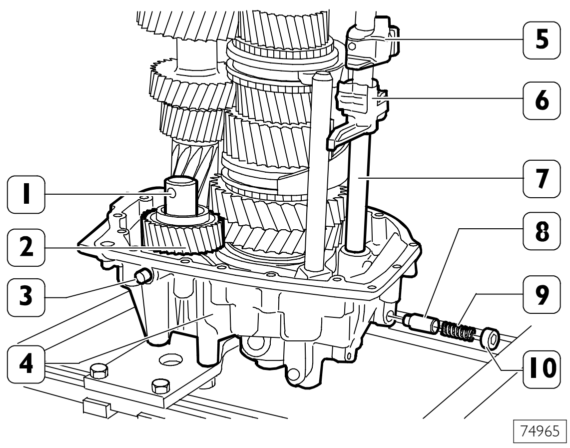
Set properly clutch locking plate (5) by setscrew wrench (2) to avoid control rods (1 - 3 - 4) interference with plate during next operation.

Screw the pin (11) of tool 99370234 into the hole in the output shaft (6). Mount the bushing (8) and spacer (9) on the tool 99370234.

Screw on the nut (10) and at the same time lower the hoist so the output shaft (6) is positioned on the ball bearing (7).

Remove the tool 99360521 and the parts (8 - 9 - 10 - 11) of the tool 99370234.

Figure 96



Mount the rod (7) complete with selector (5) and driver (6).

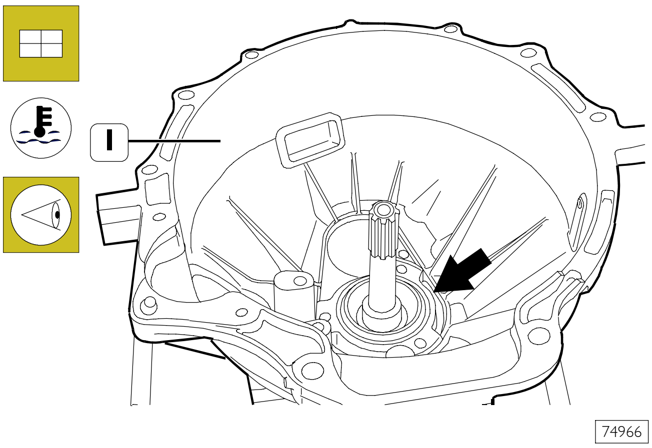
Put the pawls (8) and springs (9) into the rear cover (4).

Mount the cups (10).

Mount the reverse gear idler (2) with the shaft (1) and secure the shaft to the rear cover (4) tightening the screw (3) to the required torque.

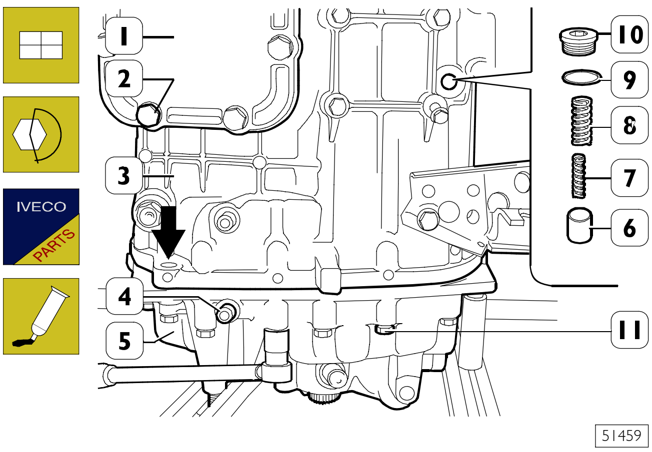
Apply LOCTITE 5206 sealant to the mating surfaces of the transmission.

Figure 97



Warm up the roller bearing inner ring (→) at 80°C and fit the gearbox (1) on the rear cover and check that the shafts and the control rods fit correctly in the respective seats.

Figure 98



Insert the centring pins (⇒) in the rear cover (5).

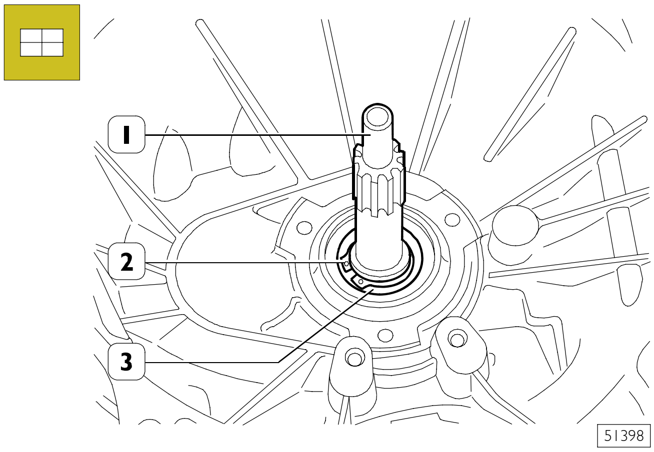
Screw on the screws (11) fixing the rear cover (5) to the transmission (3) and tighten them to the required torque.

Tighten the screw (4) fixing the reverse gear idler shaft to the transmission (3) to the required torque.

Insert the push rod (6) and springs (7 - 8) and tighten the plug (10) with a new gasket (9) to the required torque.

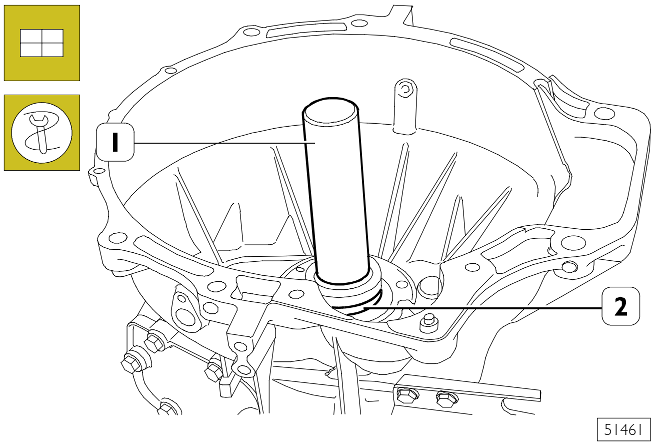
If the side cover (1) has been removed, apply LOCTITE 5206 sealant on the mating surface and tighten the screws (2) to the required tightening torque.

Figure 99



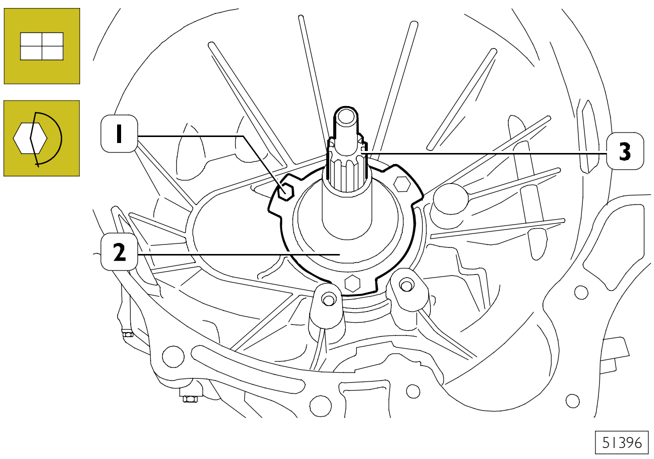
Mount the front bearing (3) retaining ring (2) on the input shaft (1).

Figure 100



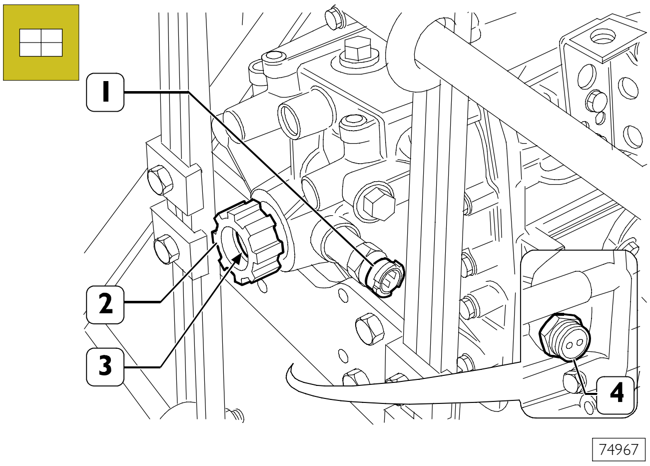
Mount the O-ring (2) with the key 99374453 (1).

Figure 101



Mount input shaft (3) protection cover (2) and tighten screws (1) to the required torque.

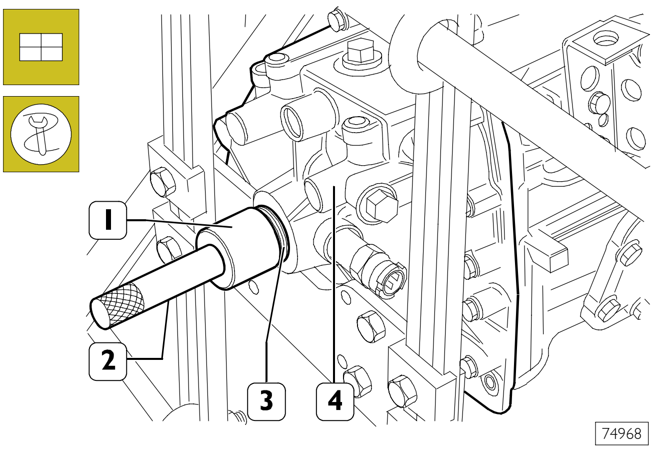
Figure 102



Mount the phonic wheel (2) onto the main shaft (3).

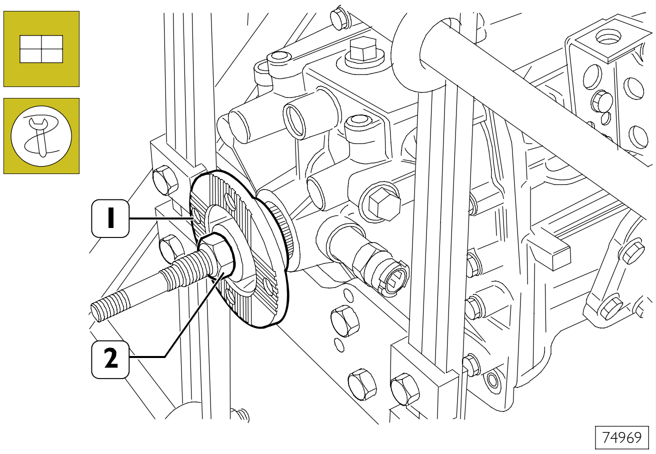
Mount the reversing light switch (4) and the tachograph sensor (1).

Figure 103



Mount the O-ring (3) in the rear cover (4) with the key 99374452 (1) and the grip 99370007 (2).

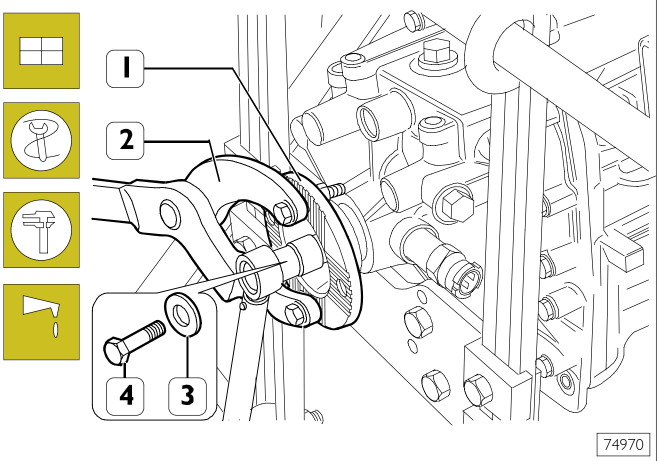
Figure 104



Mount the output flange (1) on the main shaft with the tool 99370234 (2).

Remove the tool 99370234 (2).

Figure 105



Mount the washer (3) and screw on the screw (4).

Lock the rotation of the flange (1) with the lever 99370317 (2) and tighten the screw (4) to the required torque.

Mount the control box as described under the relevant heading.

Fill the transmission with lubricating oil in the required quantity and grade.

6 S 400 O.D. Transmission

GENERAL

The 6 S 400 O.D. transmission is mechanical with synchronized engagement of forward gears.

It is composed of a light alloy box (which also serves as a clutch cover), a rear cover (where the speed engagement controls and gearing are housed) and a control box.

There is an opening on the side of the transmission to apply a power take-off.

Drive transmission is accomplished by a set of helical-toothed constant mesh gears, for both forward and reverse gears.

The splined or machined gears are on four shafts: input, main, transmission and reverse gear.

The input and main shafts are supported, in the transmission, by watertight, non-adjustable ball bearings.

The transmission shaft is supported, in the transmission, by roller bearings that can be adjusted axially by means of ring shims.

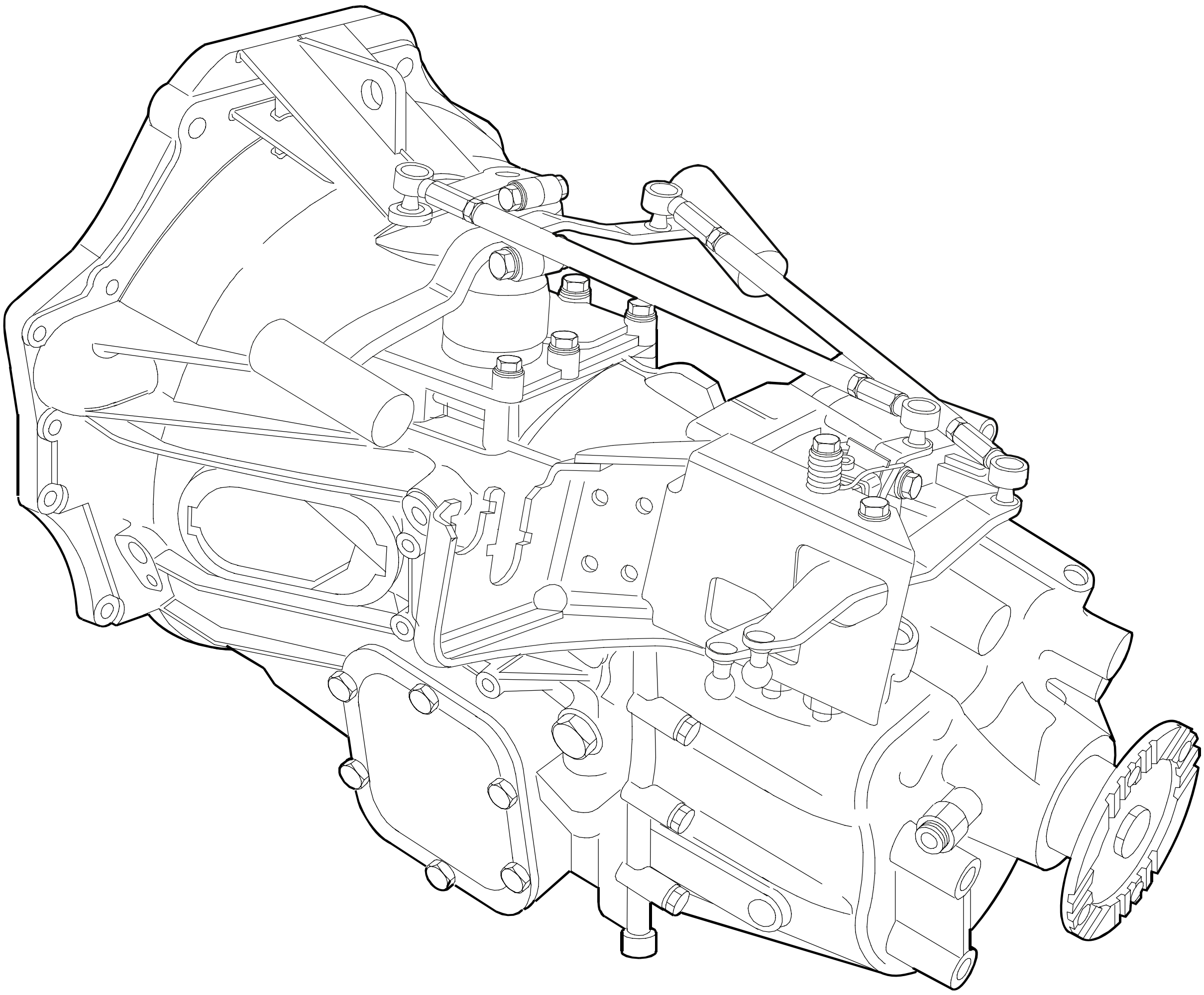
6^{th}, 5^{th}, 4^{th}, 3^{rd} and reverse gears (new version transmissions) are synchronised by means of single taper free synchroniser rings; double taper wheels are used for 1^{st} and 2^{nd} gear.

Control inside the transmission is accomplished with five rods: a main rod to select and engage gears; four rods equipped with forks for engaging gears.

The external control is achieved by means of two levers: (selection and engagement levers). The levers are actuated by tie-rods through a transfer case, connected to the gear shift lever located in the cab, by an assembly made up of two flexible cables (BOWDEN cables).

The external engagement lever features two opposed weights, used to dampen the flexible control cable (BOWDEN) engagement thrust and, as a result, its noise.

Figure 1

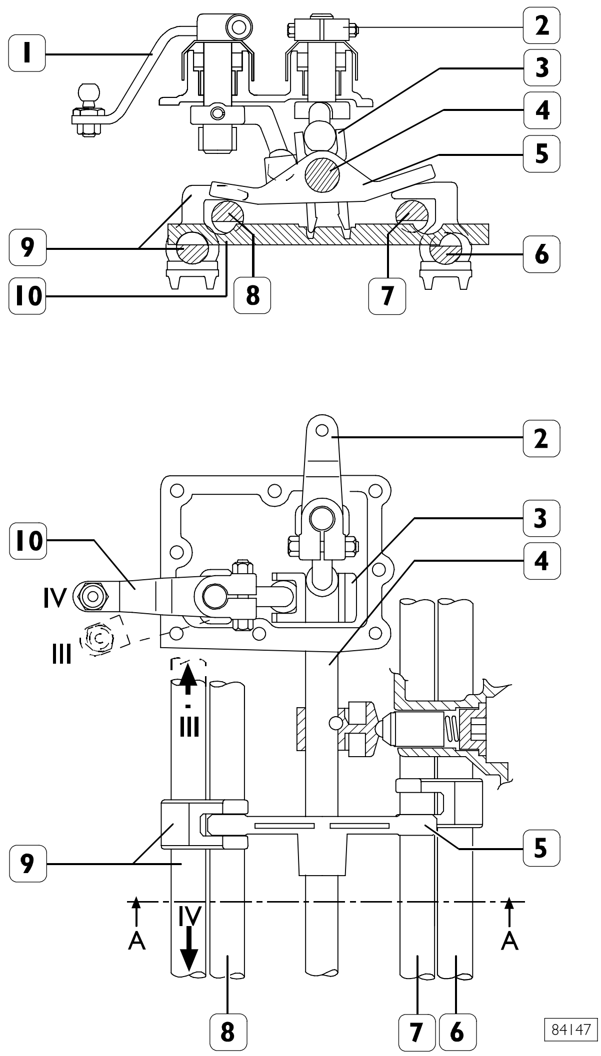


GEAR SELECTION AND ENGAGEMENT

The combined action of the selector lever (2) and the engagement lever (1) cause the rotation and axial movement of the rod (4) in two subsequent steps to engage the required gear by means of the rods (8-7-6 and 9).

Neutral arrangement and/or $3^{rd}/4^{th}$ gear selection and engagement arrangement

Figure 2



$3^{rd}/4^{th}$ gear selection

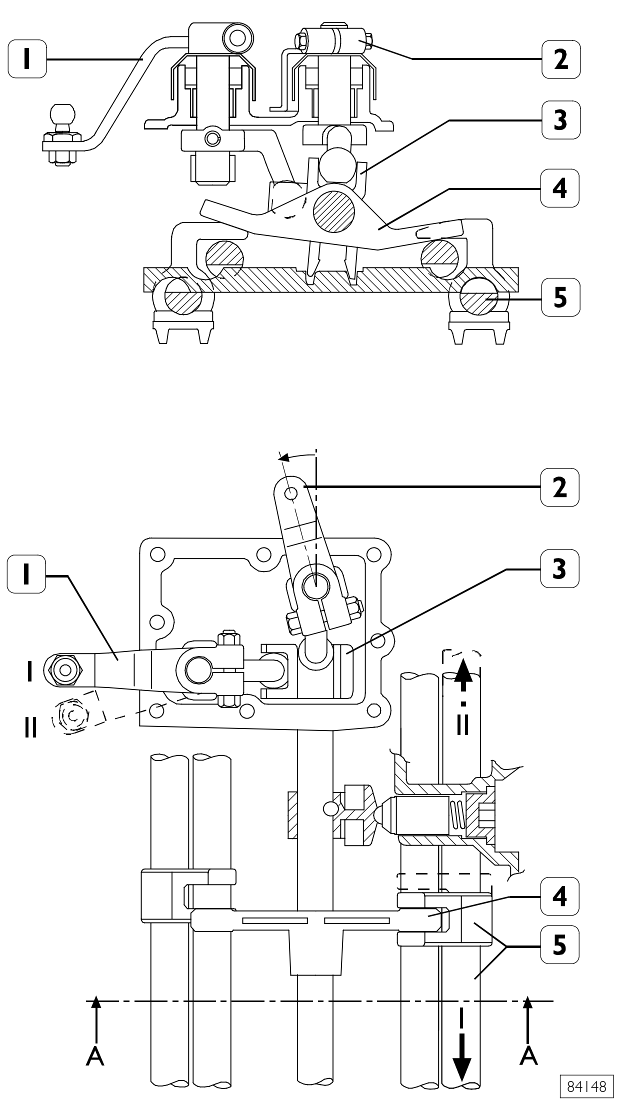
According to the angular position of the selector lever (2), the slider (3) turns with the rod (4) (which is integral) and the selector (5) arranges the slider on the $3^{rd}/4^{th}$ gear rod (9). At the same time, the slider (3) moves the rod (10) to prevent the simultaneous engagement of two gears, to keep the 3^{rd} and 4^{th} gear engagement rod (9) free and to prevent movement of the other rods by engaging the grooves in the rods.

$3^{rd}/4^{th}$ gear engagement

According to the movement of the engagement lever (1), the slider (3) axial moves the rod (4) (which is integral), the selector (5) (previously arranged) and consequently the chosen 3^{rd} and 4^{th} gear engagement rod (9).
Neutral position coincides with the $3^{rd}/4^{th}$ gear selection arrangement.
In this case, the vertical axis of the selector lever (2) is exactly at 90° with respect to the horizontal axis of the control corresponding to no angular variation of the rod (4).

$1^{st}/3^{rd}$ gear selection election and engagement arrangement

Figure 3



This arrangement is obtained by moving the selector lever (2) anticlockwise. In this way, the selector (4) is inserted in the $1^{st}/2^{nd}$ gear engagement rod (5).
By moving the lever (1), the slider (3) will axially move the $1^{st}/2^{nd}$ gear engagement rod (5).

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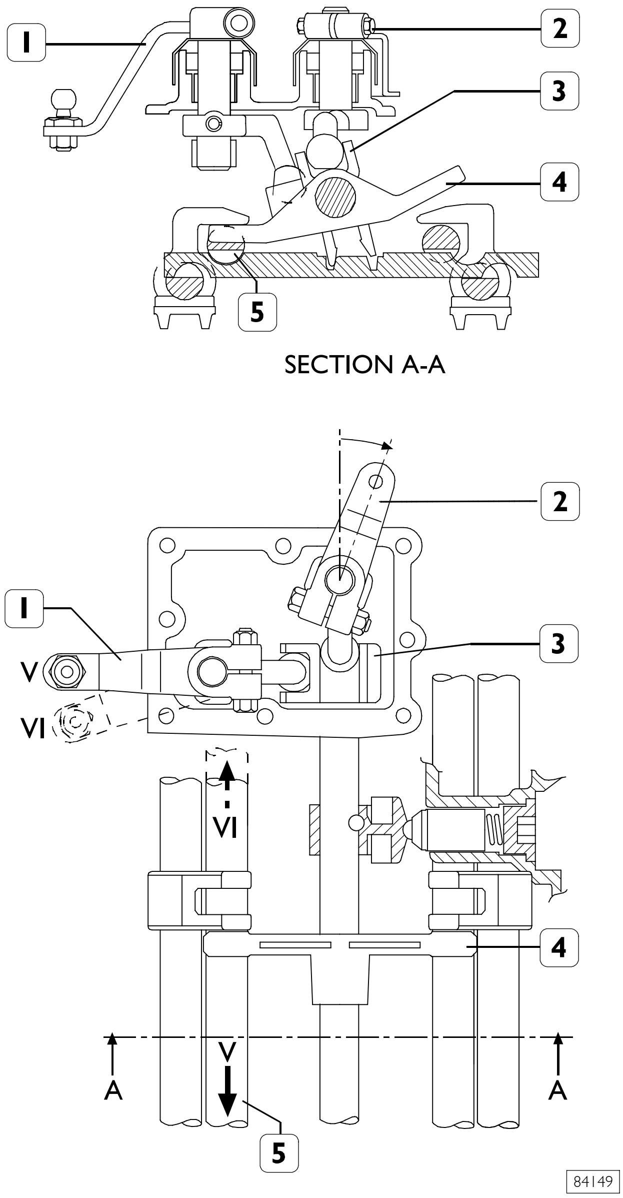
$5^{th}/6^{th}$ gear selection and engagement arrangement

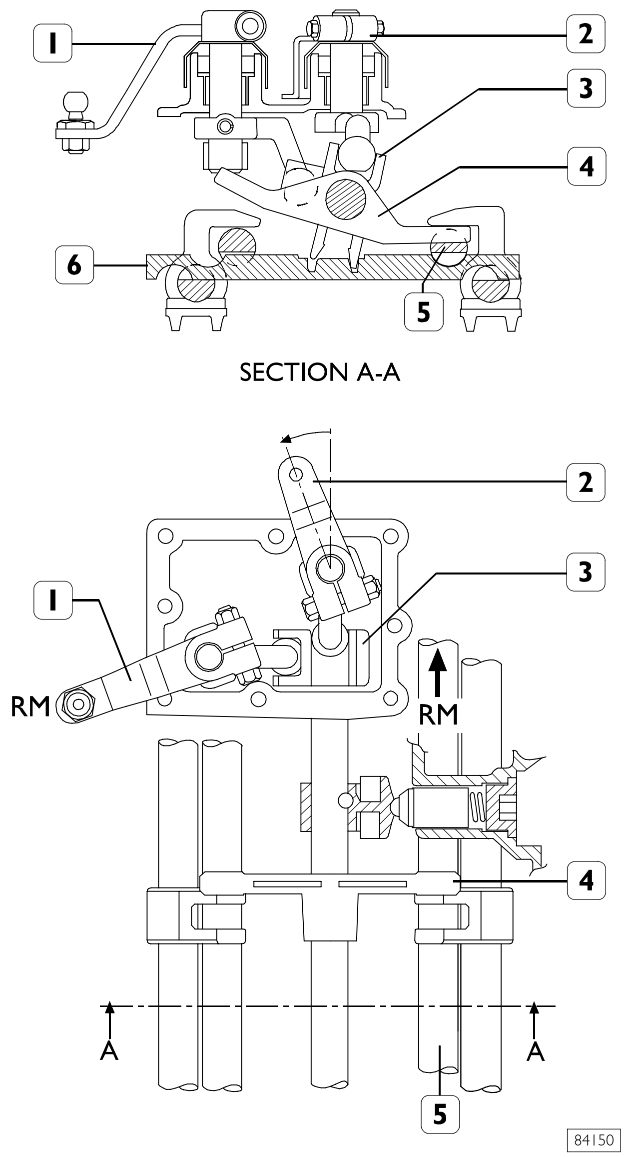
Figure 4



This arrangement is obtained by moving the selector lever (2) clockwise. In this way, the selector (4) is inserted in the $5^{th}/6^{th}$ gear engagement rod (5).
By moving the lever (1), the slider (3) will axially move the $5^{th}/6^{th}$ gear engagement rod.

Reverse gear selection and engagement arrangement

Figure 5



This arrangement is obtained by moving the selector lever (2) anticlockwise. In this way, the selector (4) is inserted in the reverse gear engagement rod (5).
By moving the lever (1), the slider (3) will axially move the reverse gear engagement rod (5).

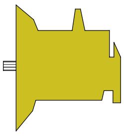
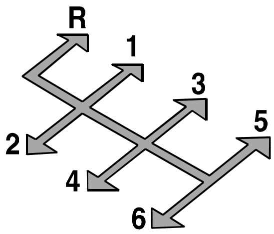
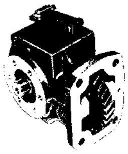
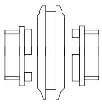
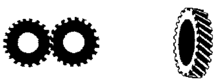
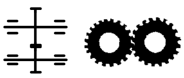
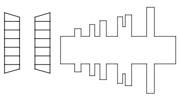
Safety device

The transmission is equipped with a device which prevents the simultaneous engagement of two gears.

It consists of a suitably shaped rod (6) fitted transversally in the transmission box.

The slider (3), moves the rod (6) under the action of the lever (2). This keeps the selected gear engagement rod free and prevents movement of the other gears by engaging their respective grooves.

SPECIFICATIONS AND DATA

	TRANSMISSION	6 S 400 O.D.
	Type	Mechanical
	Input torque	400 Nm
	Weight	63 kg
	Speeds	6 forward speeds 1 reverse speed
	Speed control	Mechanical
	Power take-off	Optional
	Speed engagement: Forward speeds ❑ 5th/6th - 3rd/4th ❑ 1st/2nd Reverse speed Speed retention mechanism	 Single-cone synchronizer Dual-cone synchronizer clip-on, in new version transmission with single taper synchroniser ring Sliding sleeves retained by pawls and springs.
	Gears	Helical-toothed constant mesh gears
	Gear ratio First Second Third Fourth Fifth Fifth Reverse	 5.375 3.154 2.041 1.365 1 0.791 4.838
	Shaft bearings: Main shaft Straight roller bearing	 watertight ball bearing tapered roller

O.D.. = Over Drive

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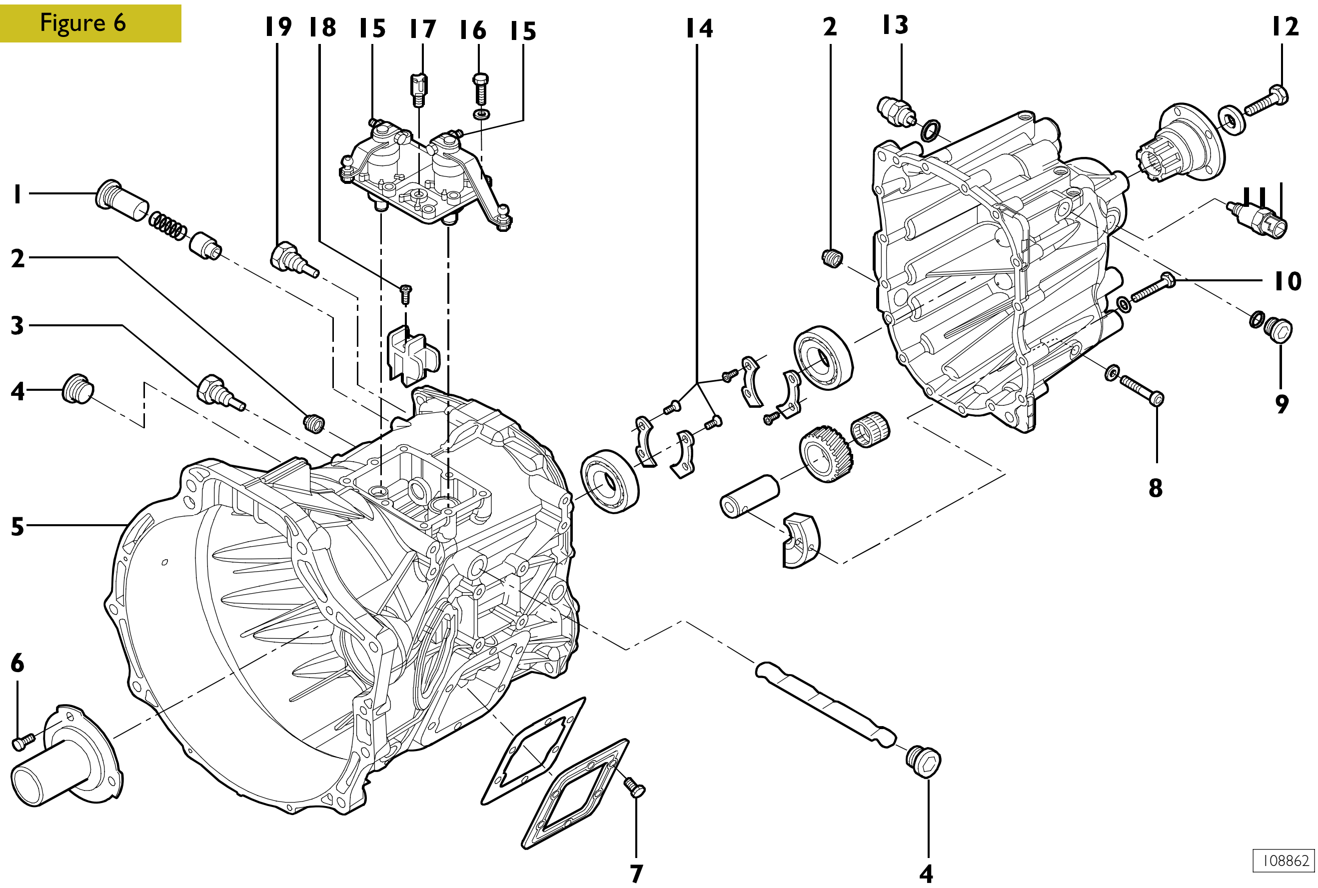
SPECIFICATIONS AND DATA

	Transmission shaft bearing end play	0 ÷ - 0.05 mm
	Transmission shaft bearing end play adjustment	by shims
	Shim thickness for transmission shaft bearing end play adjustment	-
	Main shaft Temperature for fitting: ❑ hubs for sliding sleeves ❑ 1st-R gear bushes and gear ❑ front bearing*	 80° ÷ 110°C 110° ÷ 150°C 90° ÷ 110°C
	Transmission shaft Temperature for fitting: ❑ bearings ❑ 5th-4th gears	 80°C (max 120°C) 170° ÷ 160°C
	Gear end float: 1st - 3rd - 4th - R - 5th gear 2nd gear	 0.15 ÷ 0.40 mm 0.25 ÷ 0.5 mm
	5th - 4th gear sliding sleeve hub retaining ring end float	0 ÷ - 0.15 mm
	5th - 4th gear sliding sleeve hub retaining ring thickness	-
	Retaining ring end float: ❑ transmission shaft front bearing ❑ main shaft roller bearing	 0 ÷ - 0.1 mm 0 ÷ - 0.1 mm
	Transmission shaft rear bearing retaining ring thickness	-
	Sealant	LOCTITE 510 LOCTITE 242 LOCTITE 5206
	Type of oil: Quantity	**TUTELA TRUCK GEARLITE** 2.2 litres

* = Do not use hot air equipment to heat bearing.

TIGHTENING TORQUES

Figure 6



	DESCRIPTION	TORQUE	
		Nm	kgm
1	Plug retaining spring and reverse gear hardening push rod	32 ± 10%	3.2 ± 10%
2	M22x1.5 plug	50	5
3●	3rd and 4th gear fork articulation pins	45●	4.5
4	Plugs for rod preventing gear engagement	32	3.2
5	Clutch housing, screw to fasten clutch housing to crankcase	80	8
6	Constant mesh shaft cover fastening screw	23 ± 15%	2.3 ± 15%
7■	Screw securing p.t.o. side cover	46 ± 15%	4.6 ± 15%
8	Screw securing reverse gear shaft	23 ± 15%	2.3 ± 15%
9	Side plug on rear cover	35	3.5
10	Screw securing rear cover	23 ± 15%	2.3 ± 15%
11	Speedometer transmitter fixing	50	5
12	Screw locking sleeve for transmission coupling on main shaft	235	23.5
13	Fixing switches and reversing lights	40	4
14●	Screw securing ball bearing retaining ring	9.5 ± 15%	0.9 ± 15%
15	Nut for screw securing lever to control rod	34 ± 15%	3.4 ± 15%
16	Screw securing gear control mounting	23 ± 15%	2.3 ± 15%
17	Oil vapour breather	10 ± 15%	1 ± 15%
18●	Screw securing driver to main rod	9.5●	0.9
19●	5th and 6th gear fork articulation pins	45	4.5

✱ Spread LOCTITE 5206 sealant on the contact surfaces
● Spread LOCTITE 242 on the thread
■ Spread LOCTITE 510 on the thread

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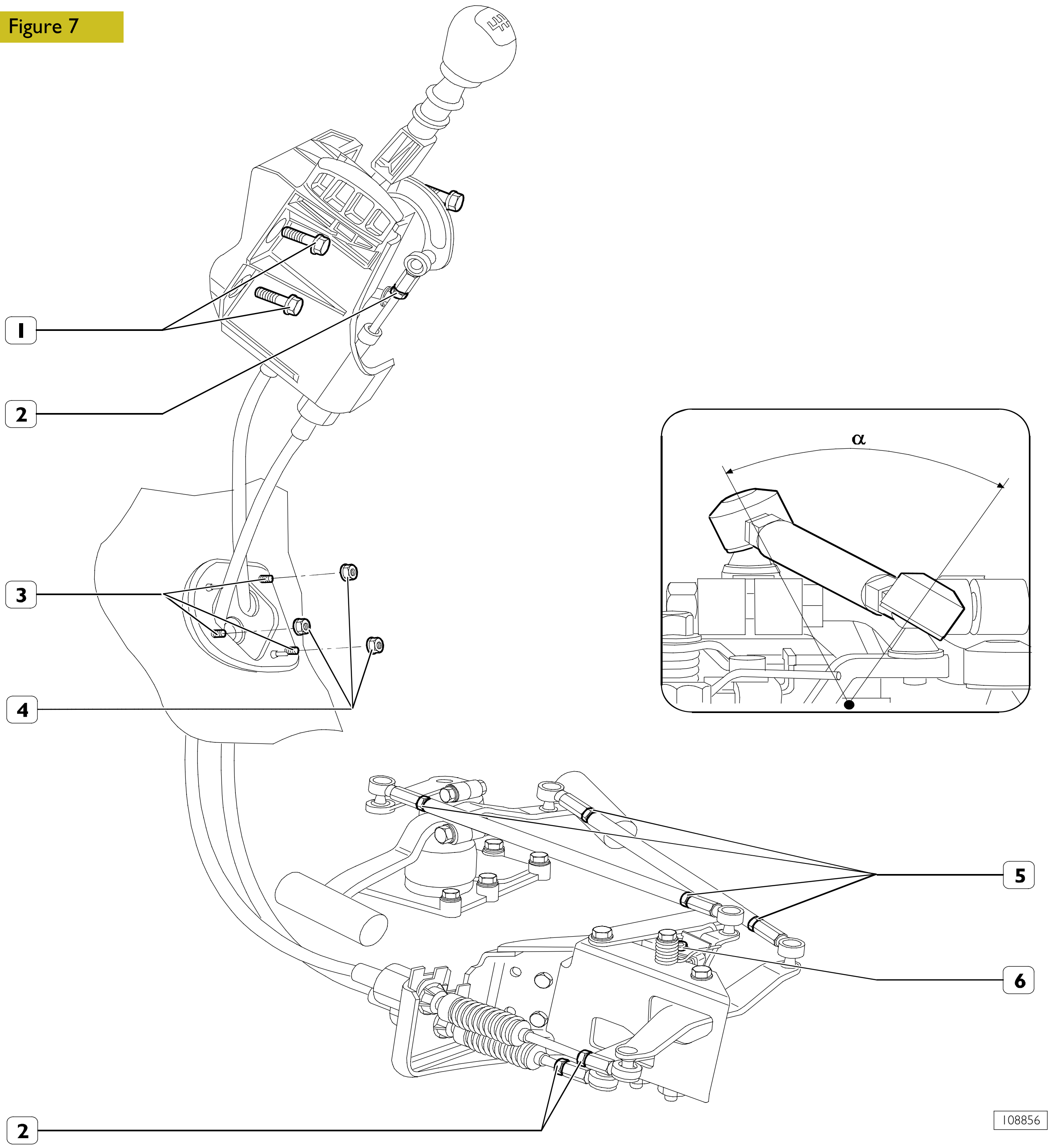
TIGHTENING TORQUES

Gearbox control

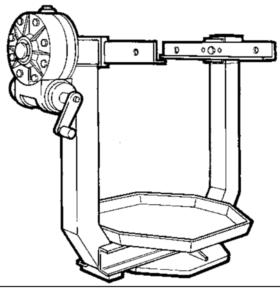
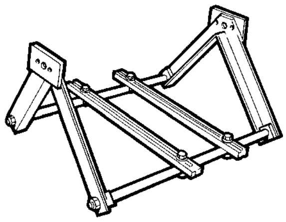
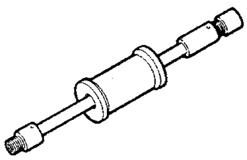
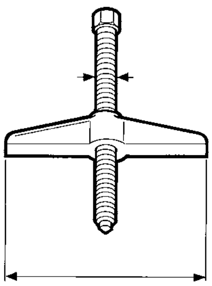
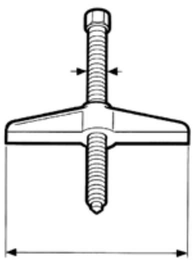
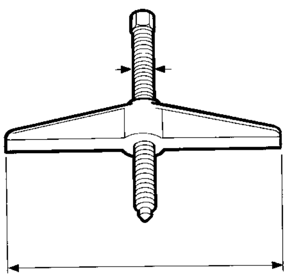
Figure 7



	DESCRIPTION	TORQUE Nm	kgm
1	M8 screw for gearbox control support fastening	14 ± 17	1,4 ± 1,7
2	Nut securing the jointed heads to the cable	4 ± 4,8	0,4 ± 0,48
3	M8 screw securing the transfer case to the gearbox	21 ± 25	2,1 ± 2,5
4	M8 self-locking nut securing the flange to the cab	3,5	0,35
5	Nut securing the jointed head to the tie-rod	4 ± 4,5	0,4 ± 0,5
6	Plate fastening screw	2,3 ± 15%	0,78 ± 0,95

After tightening nuts (4), the jointed head hole axis shall be aligned with the axis of the ball pin to which it is connected. After tightening nuts (5), the vertical axes of tie-rod (5) jointed heads shall be aligned, with a maximum deviation of less than α 30° (lower).

TOOL

TOOL NO.		DESCRIPTION
99322205		Assemblies overhaul revolving stand
99322225		Unit support (to use with stand 99322205)
99340205		Percussion extractor
99341002		Single-acting scaffold
99341003		Single-acting bridge
99341004		Pair of brackets

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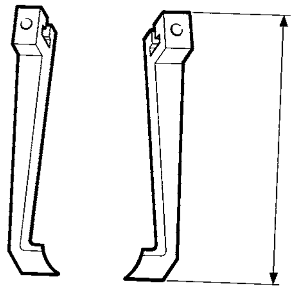
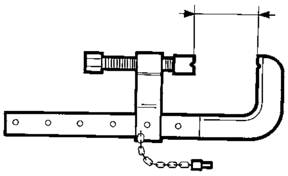
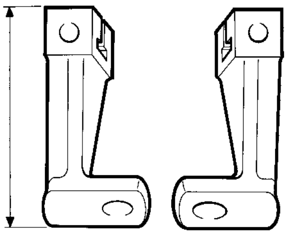
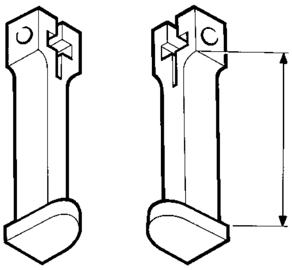
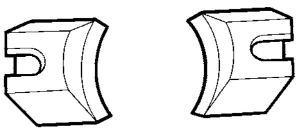
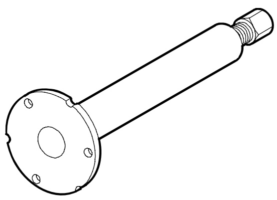
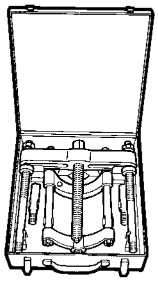
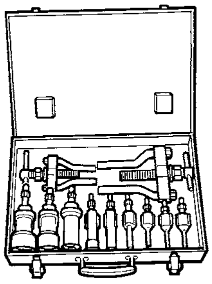
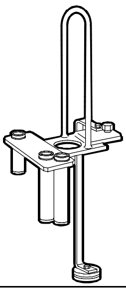
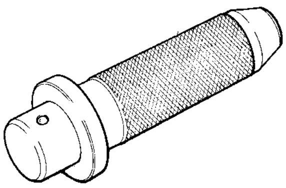
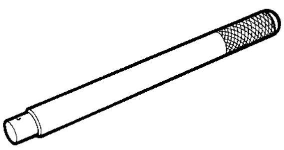
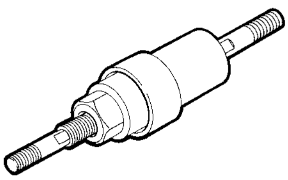
TOOL

TOOL NO.		DESCRIPTION
99341012		Pair of brackets
99341015		Constrictor
99341017		Pair of brackets with hole
99341019		Pair of tie rods with grips
99341025		Grips
99345003		Extractor for gearbox front half-casing

TOOL

TOOL NO.		DESCRIPTION
99348001		Extractor with locking device
99348004		Universal male extractor from 5 to 70 mm
99360522		Tool to extract and insert main shaft, transmission shaft and rod - fork assembly
99370006		Handle for interchangeable drivers
99370007		Handle for interchangeable drivers
99370234		Tool for fitting rear bearing and sleeve on main shaft

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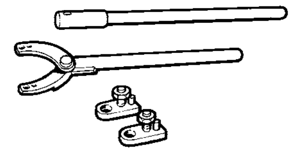
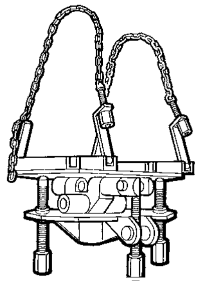
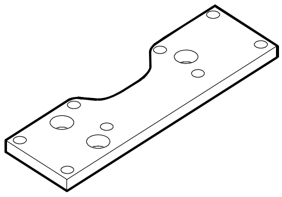
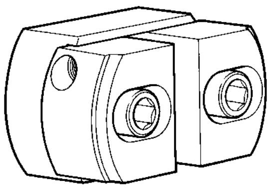
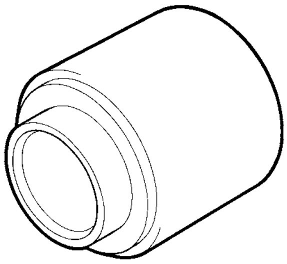
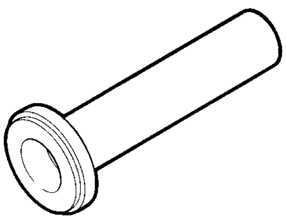
TOOL

TOOL NO.		DESCRIPTION
99370317		Reaction lever with extension for holding flange
99370629		Transmission support during removal from and refitting to vehicle
99371057		Bracket for supporting gearbox during overhaul (use with 99322205-99322225)
99374091		Punch for fitting bearing external races (dia. 55 ÷ 69 mm use with 99370007)
99374452		Keying device to fit gasket on transmission rear cover (use with 99370006)
99374453		Keying device to fit gasket on transmission

LONGITUDINAL SECTION

Figure 8

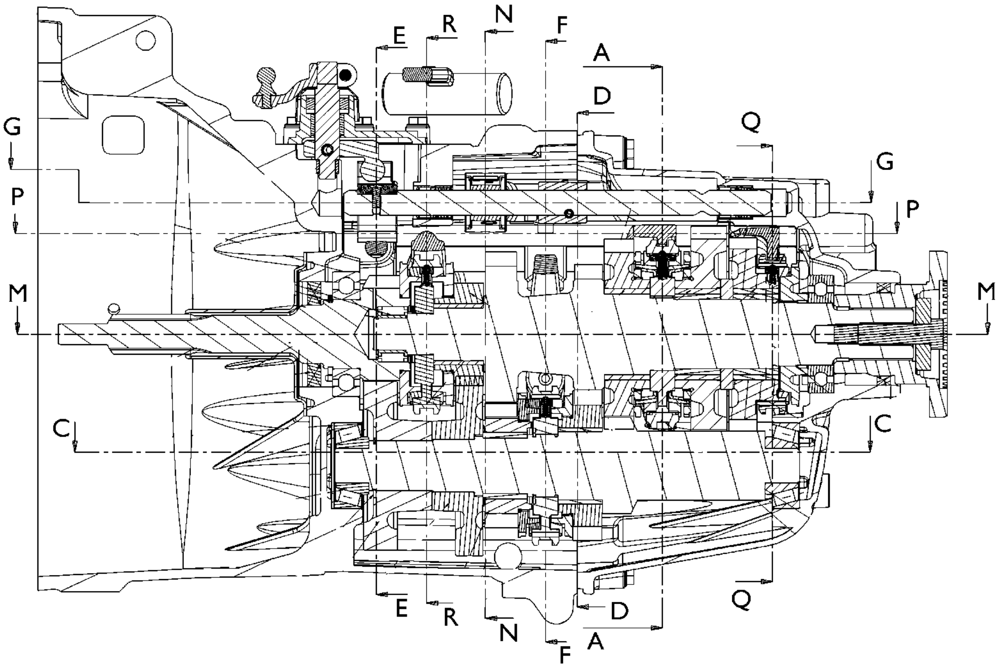
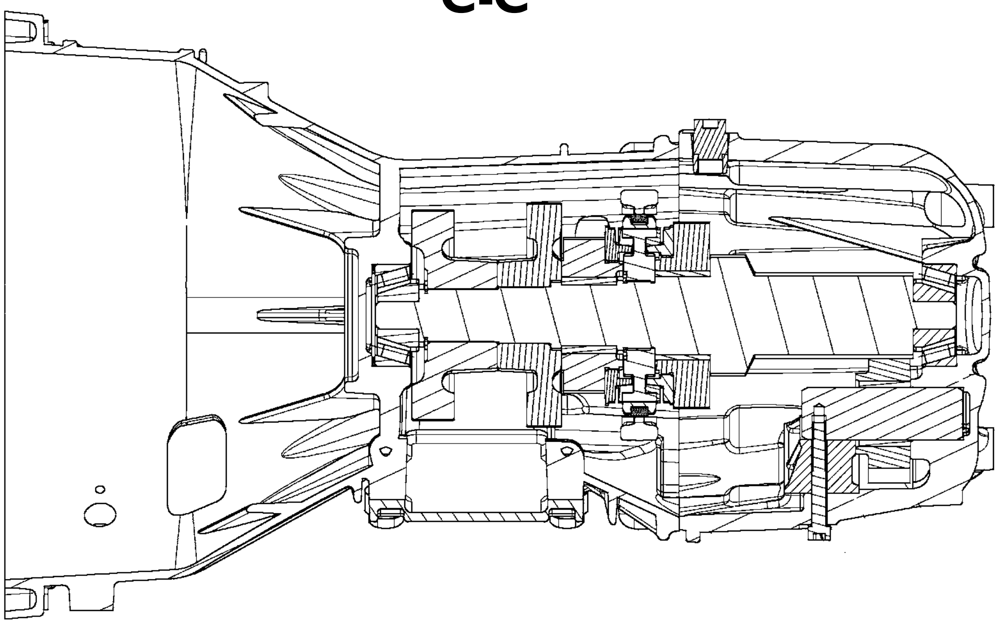
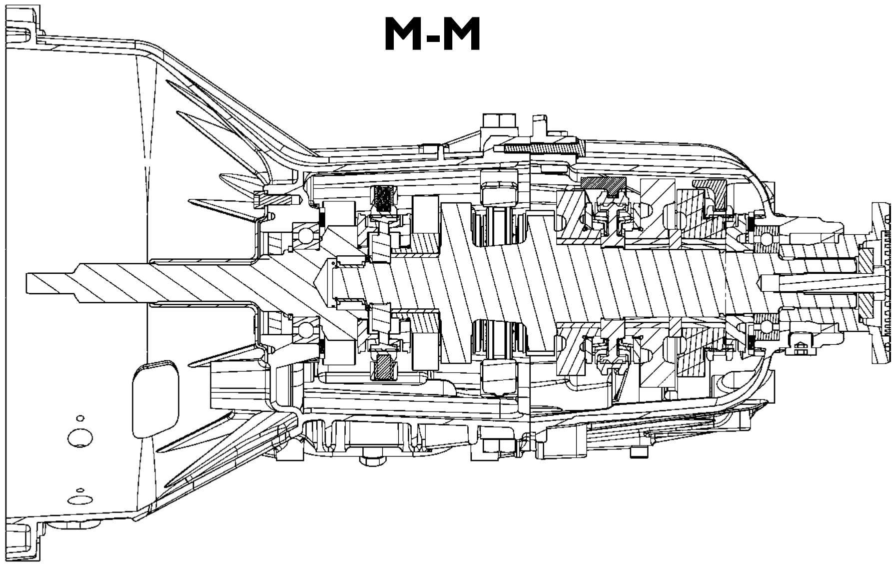


Figure 9



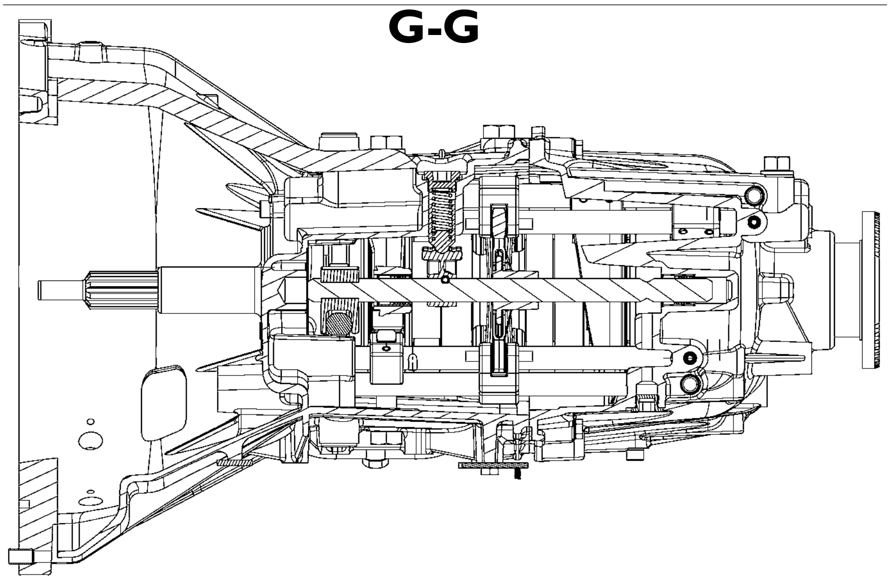
LONGITUDINAL SECTION

Figure 10



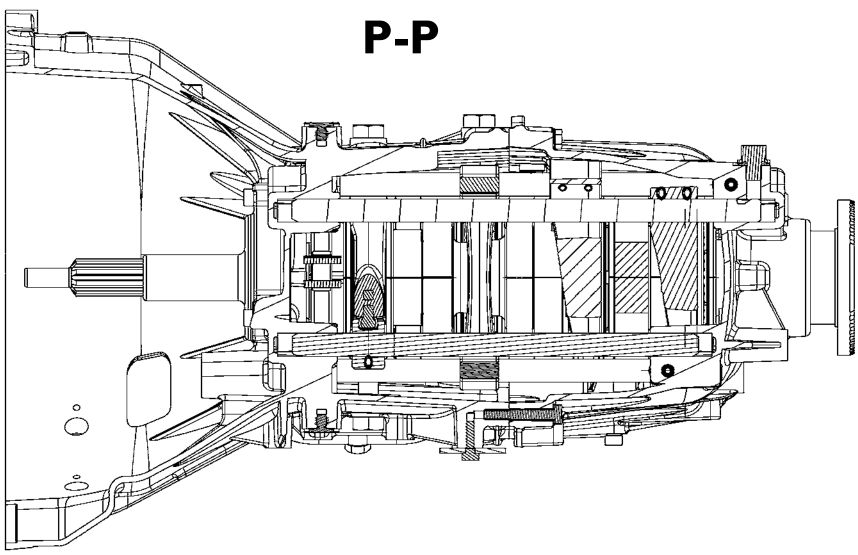
87900

Figure 11



87901

Figure 12



87902

TRANSMISSION TRANSVERSAL CROSS-SECTIONS

Figure 13

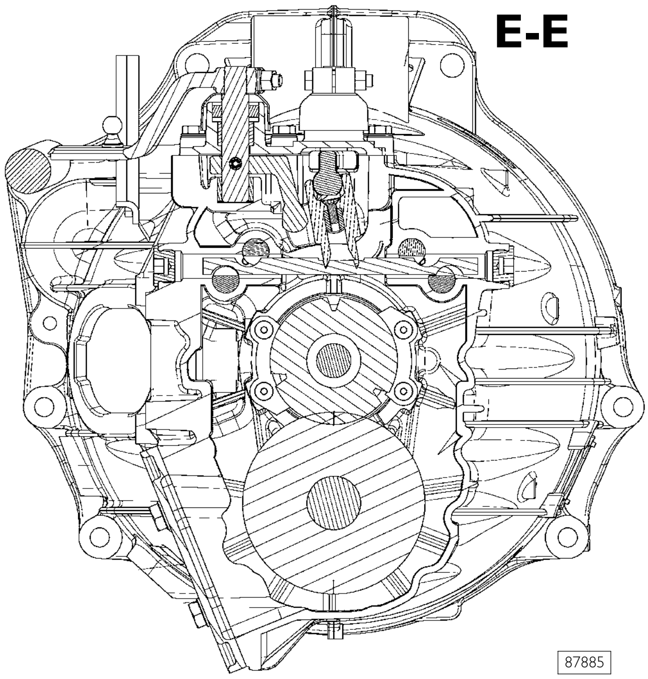


Figure 15

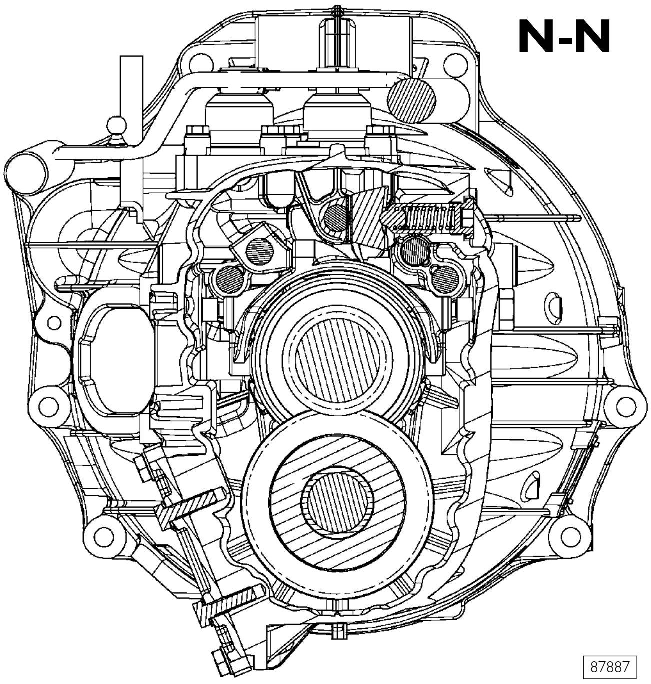


Figure 14

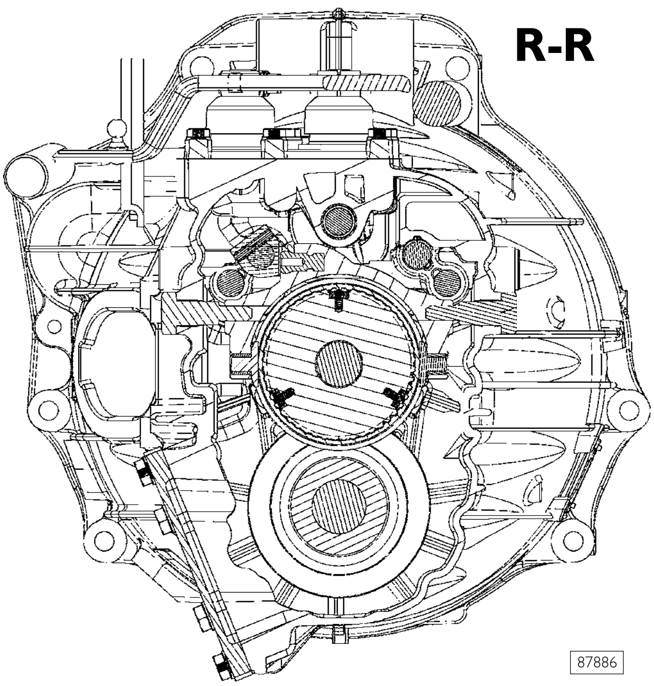
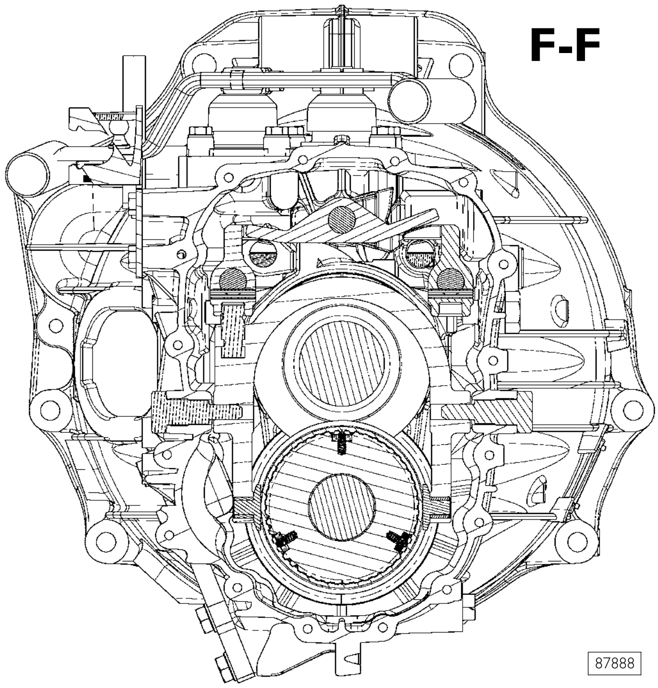


Figure 16



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TRANSMISSION TRANSVERSAL CROSS-SECTIONS

Figure 17

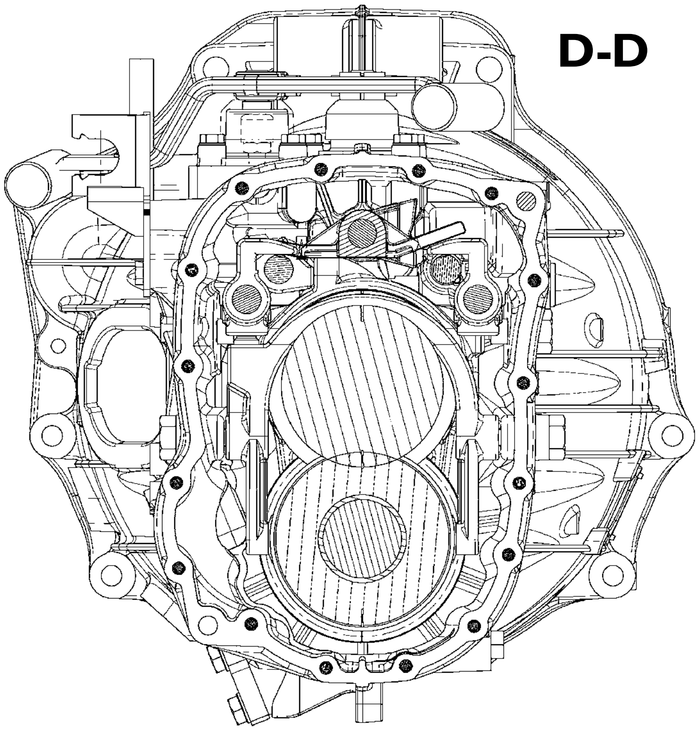


Figure 18

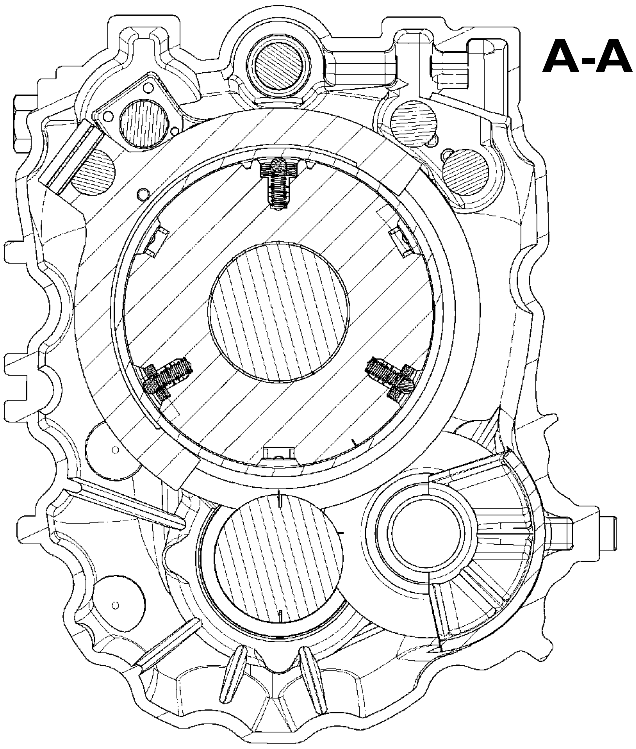
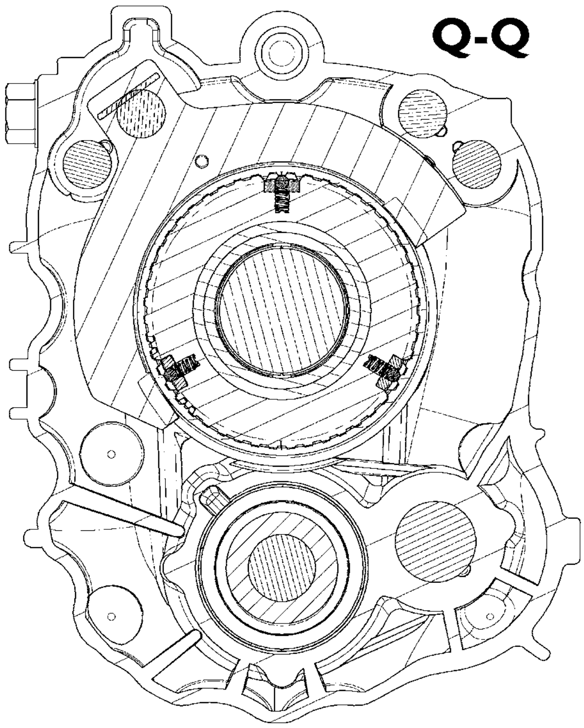
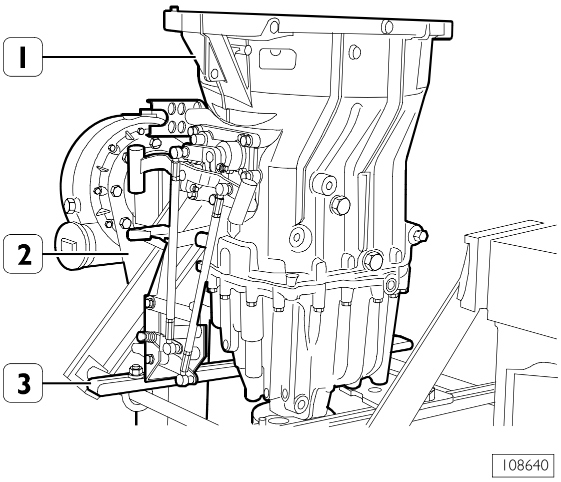


Figure 19



530210 OVERHAULING THE TRANSMISSION

Figure 20

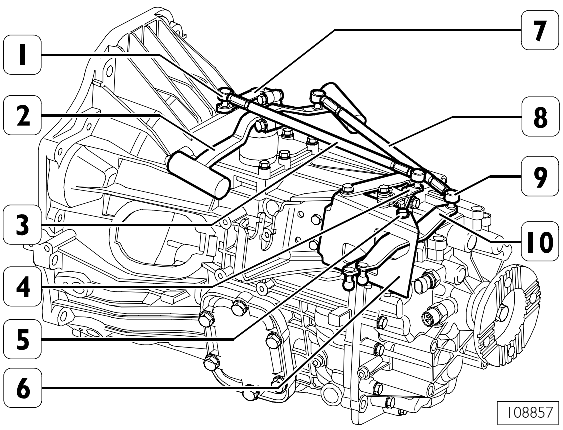


Remove the rev sensor (4).
Fit the gearbox (1) with the bracket 99371057 (6) and secure this to the brackets 99322225 (3) on the rotary stand 99322205 (2).
Remove the plug (5) and drain off the lubricating oil.

The used oil must be disposed of according to the law in force.

530220 Gear control box
Disassembly

Figure 21

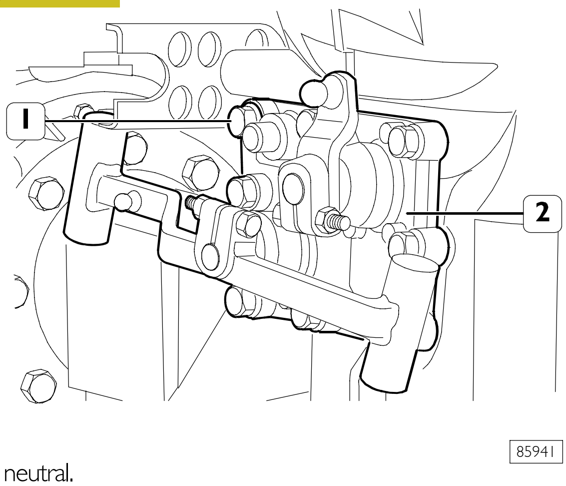


Take tie-rod (3) off by disconnecting jointed heads (1) from levers (4 and 7).
Take tie-rod (8) off by disconnecting jointed heads (9) from levers (10 and 7).

NOTE Tie-rods (3 and 8) are interchangeable.

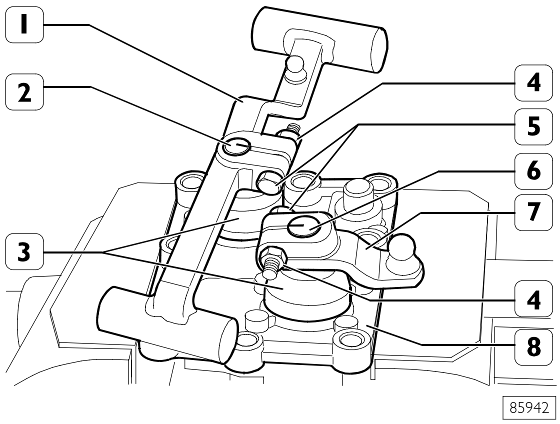
Remove screws (5), then take transfer case (6) off the gearbox unit.

Figure 22



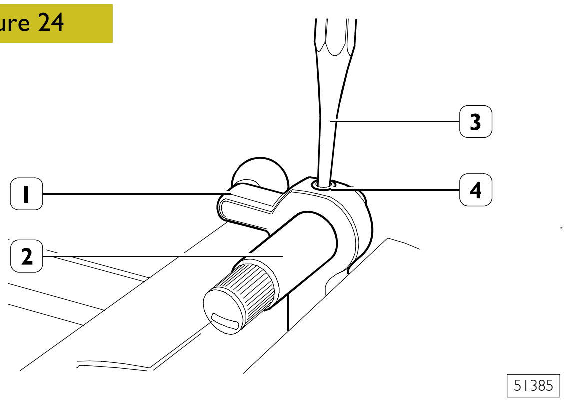
Shift to neutral.
Take out the fixing screws (1) and remove the gear control box (2).

Figure 23



Loosen the nuts (4) for the retaining screws (5).
Extract the levers (1 and 7) from the shafts (2 and 6) and extract these from the box (8). Take off the caps (4).

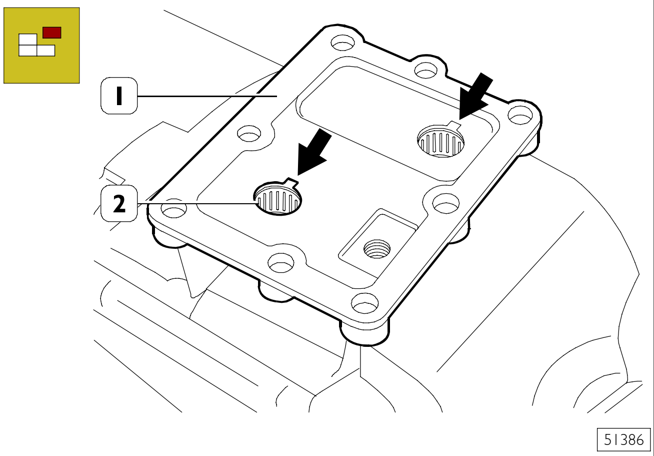
Figure 24



With a punch (3), remove the spring pin (4) and extract the shaft (2) from the internal lever (1).
Repeat these steps for the other shaft.

NOTE The coupling lever is bound to the stem by two snap pins.

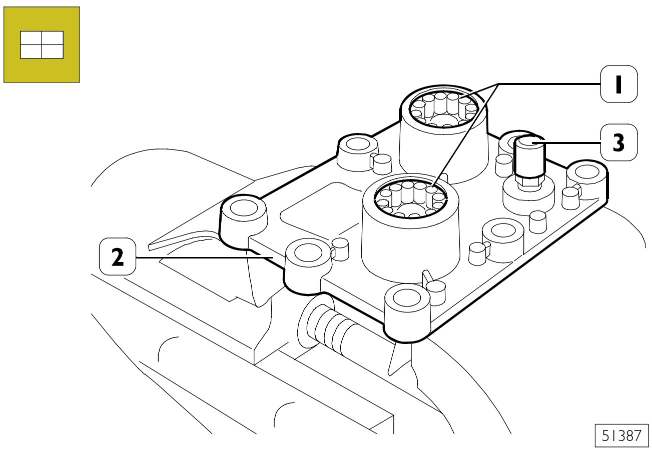
Figure 25



Use a punch on the point shown by the arrow and eject the O-rings and roller bushes (2) from the box (1).

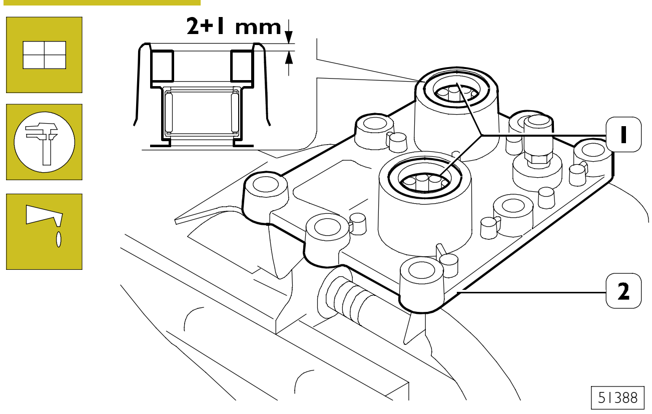
Assembly

Figure 26



Thoroughly clean the oil vapour vent (3).
With a suitable punch, mount the roller bearings (1) in the box (2).

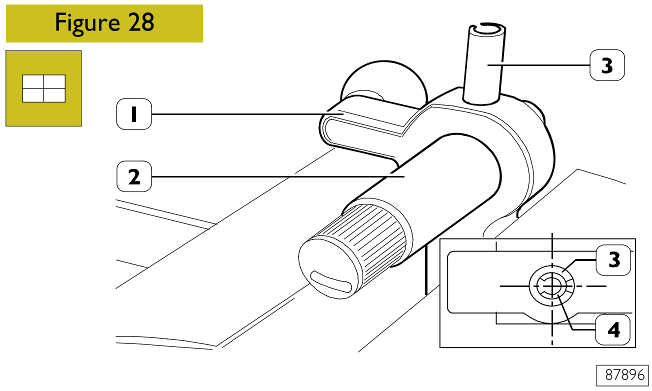
Figure 27



Using a suitable punch, mount the O-rings (1) in the box (2), positioning them at the height shown.

Pack the gap between the O-ring and roller bearing with grease.

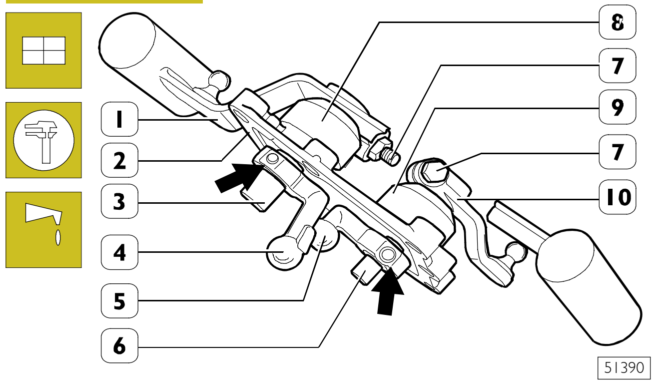
Figure 28



Mount the selection and engagement levers (1) on their respective shafts (2) and fasten them with the spring pins (3).

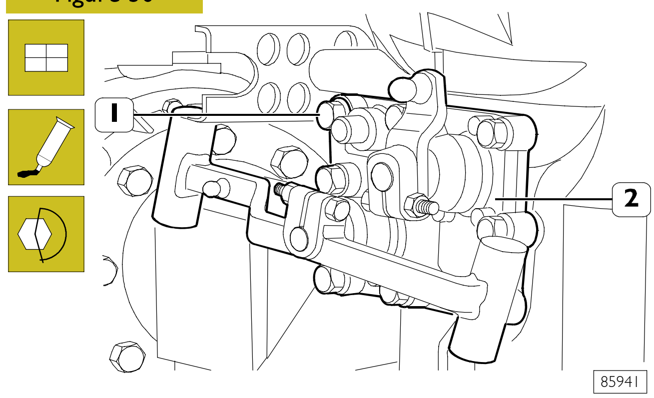
NOTE The spring pin (3) must be positioned with the cut horizontal. Fit spring peg (4), with cutting edge positioned at 180° from spring peg (3) cutting edge, in spring peg (3) engagement lever.

Figure 29



Lubricate the roller bearings (1, Figure 27) with TUTELA MR3 grease and mount the shafts (3 and 6) complete with the internal levers (4 and 5) in the box (2). Mount the caps (8 and 9) and levers (1 and 10) on the shafts (3 and 6) and tightening the nuts for the fixing screw (7).

Figure 30

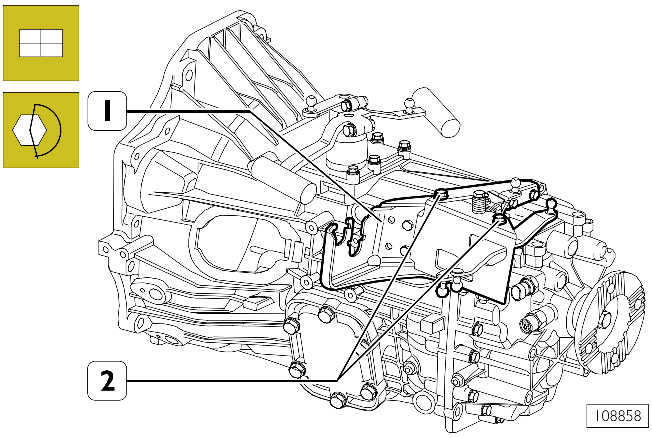


Thoroughly clean the mating surfaces of the gear control box (2) and apply LOCTITE 5706 sealant on them.

Fit the box (2) on the transmission, taking care that the levers and shafts are positioned correctly in their respective seats.

Tighten the screws (1) to the required torque.

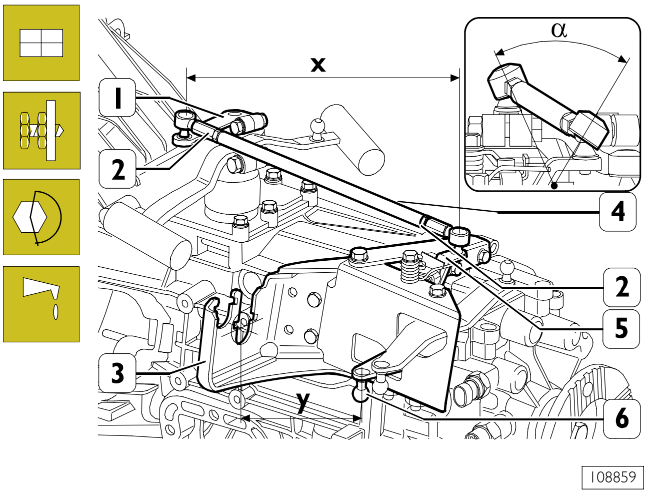
Figure 31



Fit transfer case (1) into place, by tightening fastening screws (2) to the prescribed torque.

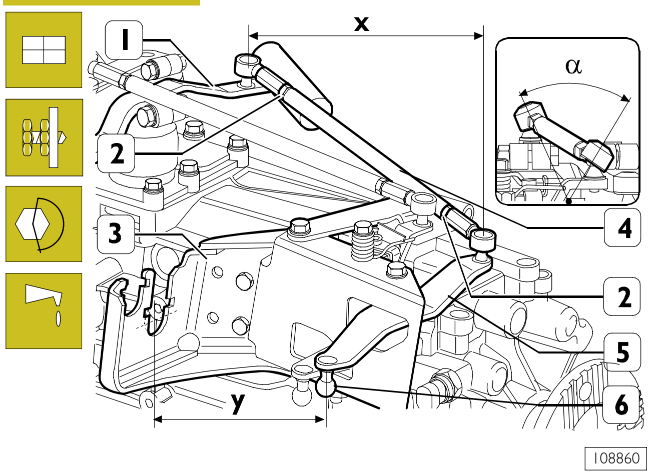
Selection and adjustment tie-rod assembling

Figure 32



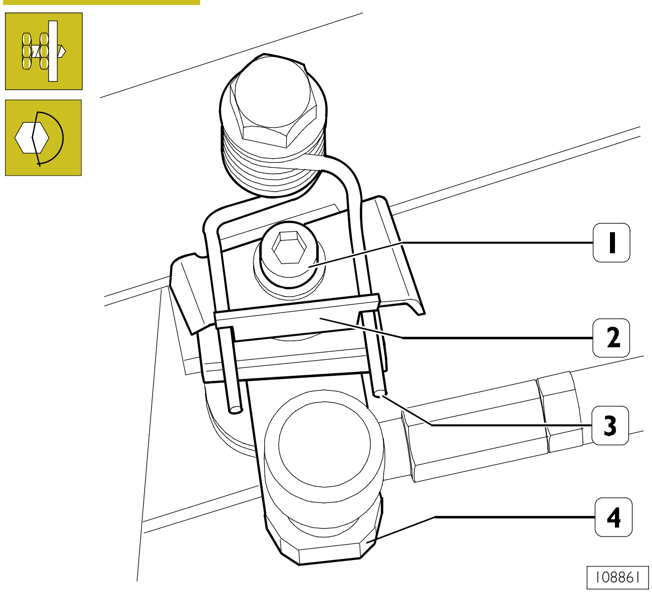
Verify that the tie-rod (4) length "X", as measured between the jointed head centres is not greater than 342 mm.
Lubricate the jointed head inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the jointed heads to levers (1 and 5).
Measure the distance "y" between transfer case (3) outer surface and ball pin (6) centre: it shall be "y" = 146 ± 1 mm. Otherwise, loosen nuts (2) and properly rotate tie-rod (4) until the prescribed distance is obtained. Then tighten nuts (2) to the prescribed torque, so that the vertical axes of the jointed heads are aligned, with a maximum deviation of less than α < 30° (lower).

Figure 33



Verify that the tie-rod (4) length "X", as measured between the jointed head centres is not greater than 342 mm.
Lubricate the jointed head inside with MOLIKOTE 33 LIGHT or MOLIKOTE G 72 grease, then connect the jointed heads to levers (1 and 5).
Measure the distance "y" between transfer case (3) outer surface and ball pin (6) centre: it shall be "y" = 146 ± 1 mm. Otherwise, loosen nuts (2) and properly rotate tie-rod (4) until the prescribed distance is obtained. Then tighten nuts (2) to the prescribed torque, so that the vertical axes of the jointed heads are aligned, with a maximum deviation of less than < 30° (lower).

Figure 34



Verify that spring (3) ends come into contact with selection lever (4) or are at least 1 mm within the same. Otherwise, loosen screw (1) so that spring (3) is correctly positioned, due to plate (2) being released.

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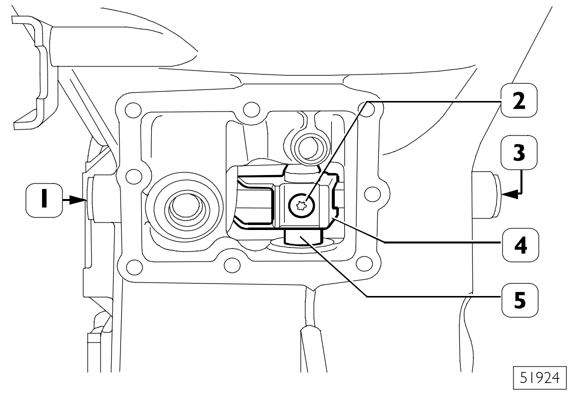
Disassembling the transmission

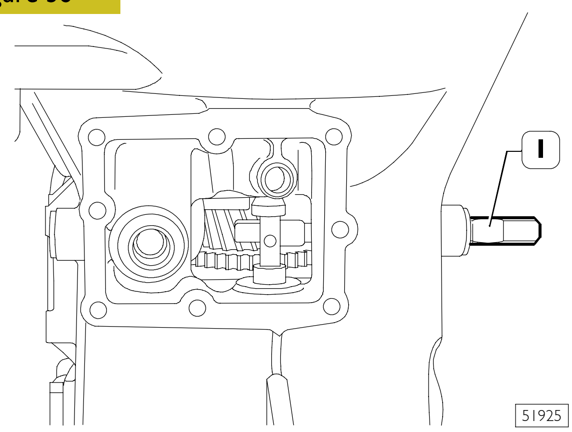
Figure 35



Shift to neutral.
Dismantle the gear control box as described under the relevant heading.
Remove the two side plugs (1 - 3). Remove the screw (2) and take off the rod (5) dragging device (4).

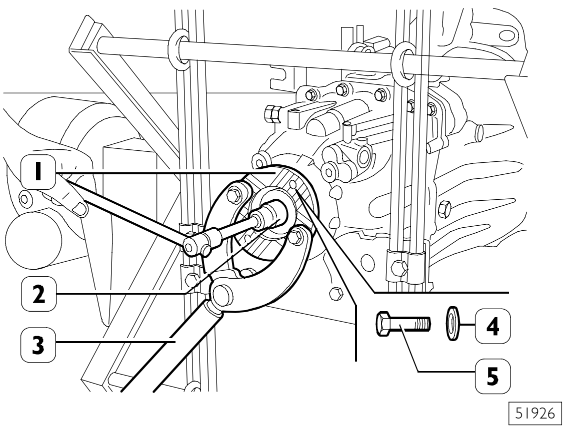
NOTE The screw threading (2) is treated with LOCTITE 242.

Figure 36



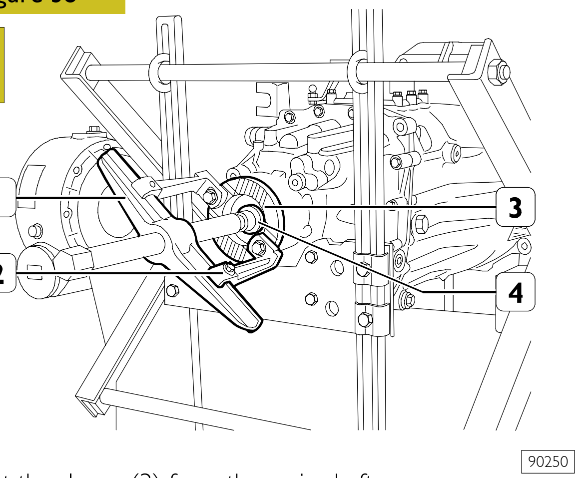
Mark the assembly position of the rod (1) preventing engagement of more than one gear at the same time and remove it from the transmission.

Figure 37



Block rotation of the sleeve (1) by applying the lever 99370317 (3). With the bushing (2) remove the screw (5) with the washer beneath (4).
Take out the lever 99370317 (3).

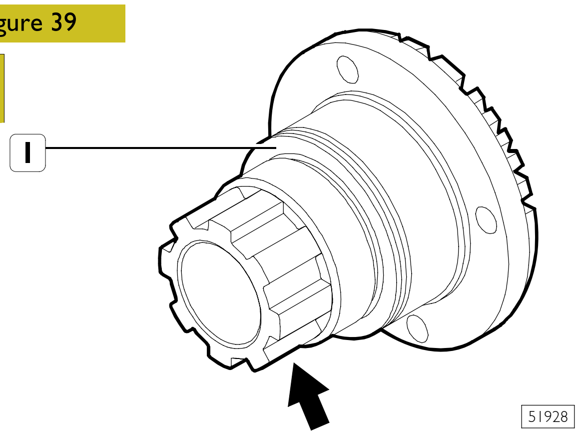
Figure 38



Extract the sleeve (3) from the main shaft.

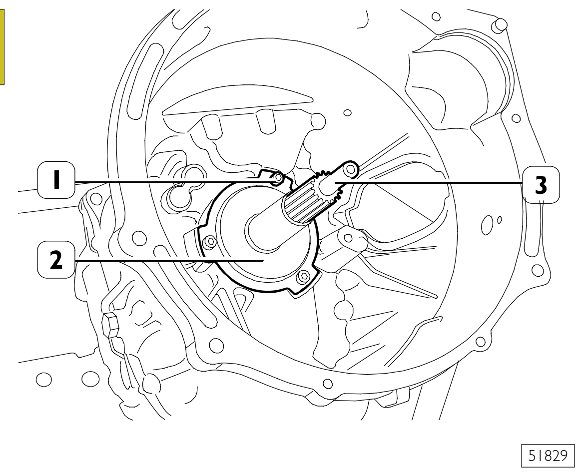
NOTE If difficult, remove the sleeve (3) with extractor made up of link 99341003 (1) and grips 99341017 (2) and block (4).

Figure 39



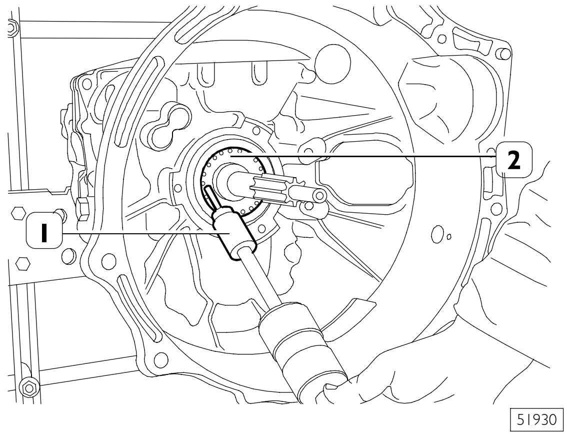
NOTE When putting away the sleeve (1) take care not to damage the phonic wheel (→) obtained by machining.

Figure 40



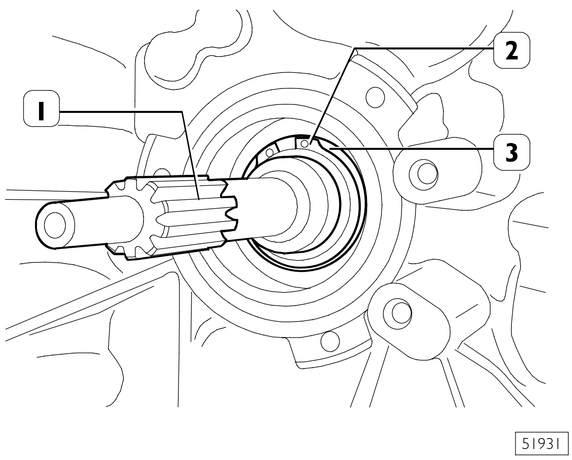
Remove the screws (1) and take off the cover (2) protecting the input shaft (3).

Figure 41



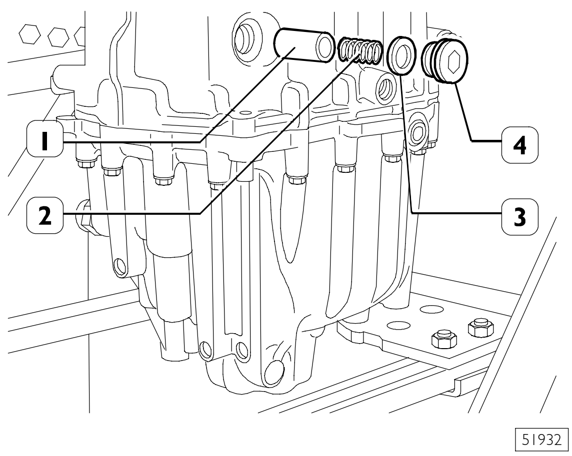
Perforate the o-ring (2) with a suitable hook and ram extractor 99340205 (1) and remove the o-ring from the transmission box.

Figure 42



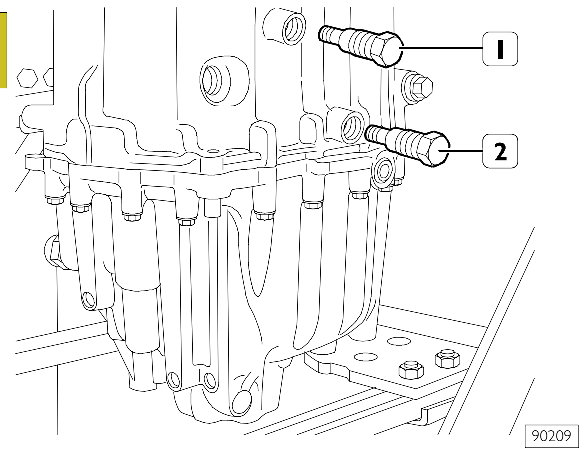
Remove the circlip (2) retaining the front bearing (3) from the input shaft (1).

Figure 43



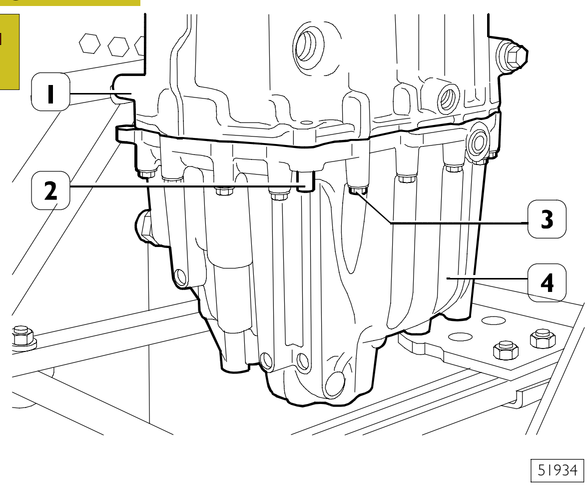
Take out the plug (4) with the washer (3), and extract the spring (2) and the push rod (1).

Figure 44



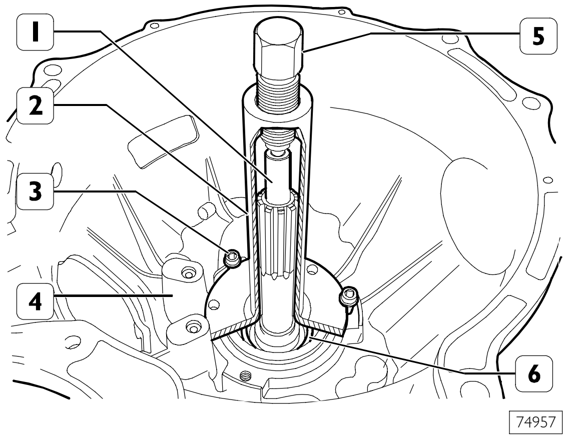
Remove the two fork knuckle pins (1) which control the 3rd – 4th speed and the two fork knuckle pins (2) which control the 5th – 6th speed.

Figure 45



Push the two locating pins (2) downwards until taking them out of the rear cover (4).
Remove the screws (3) securing the rear cover (4) to the transmission (1).

Figure 46



Fit the drive input shaft (1) with tool 99345003 (2) and secure this onto the gearbox (4), with the screws (3); screw down the screw (5) of tool (2) to extract the gearbox from the bearing (6).

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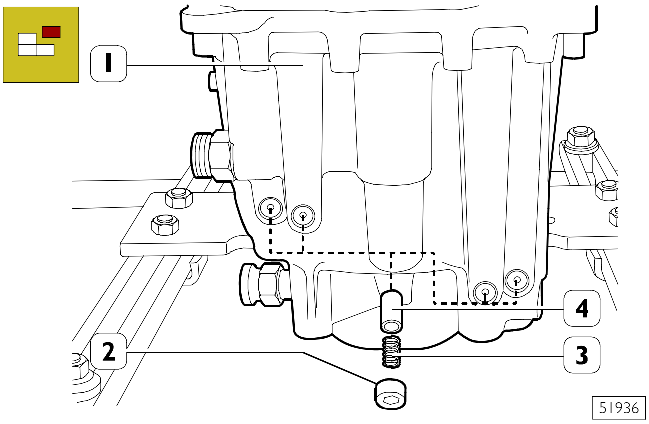
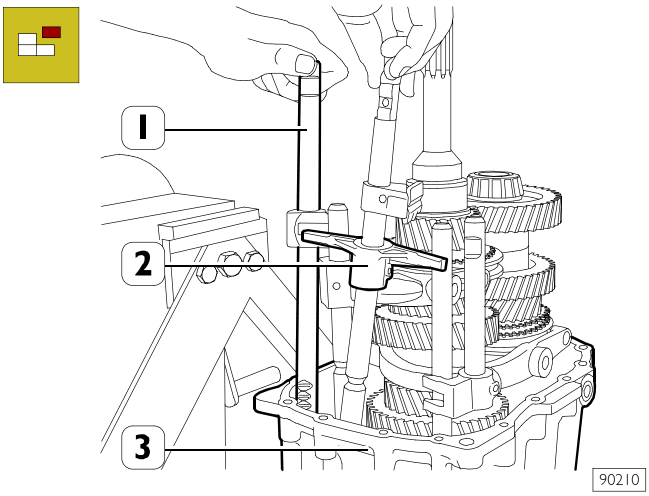
Figure 47



Drill the cups (2), screw a special screw into them.

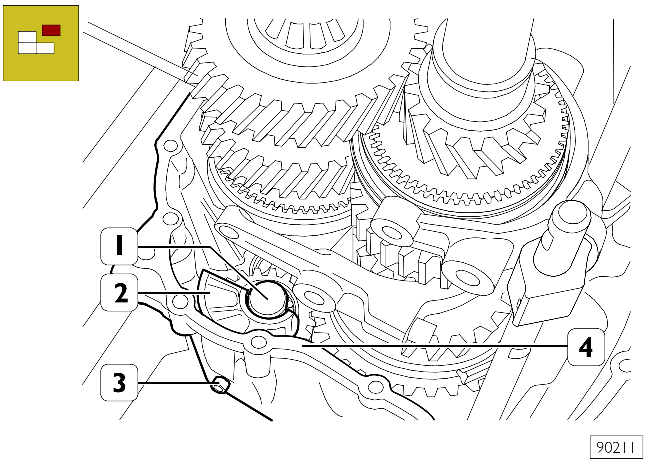
Using the screw, extract the cups (2) from the rear cover (1). Remove the springs (3) and pawls (4).

Figure 48



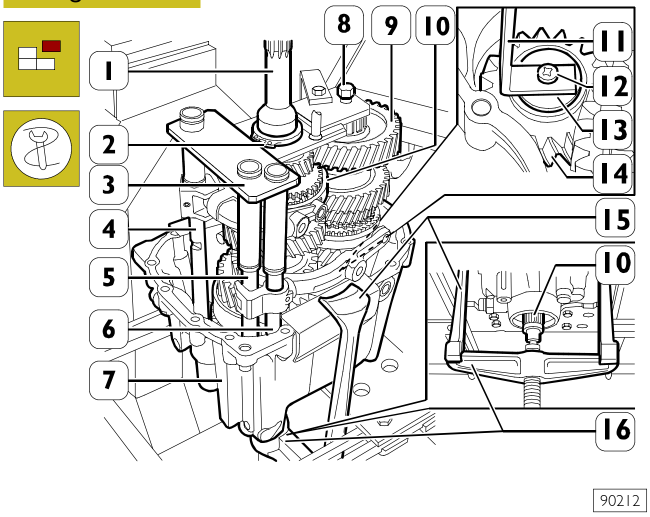
Remove the rod (1) controlling the 3rd/4th gear and the main rod (2) from the rear cover (3).

Figure 49



Take out the screw (3) and remove the reverse gear shaft (1) with the mounting (2) from the rear cover (4).

Figure 50



Mount the tool 99360522 (3) onto the rods (4, 5 and 6), on the input shaft (1) and on the transmission shaft (9).

Secure the tool 99360522 (3) on the input shaft (1) with the retaining ring (2) and with the screw (8) to the transmission shaft (9).

Insert the part (13) of the bracket (11) into the reverse gear (14) and tighten the screw (12).

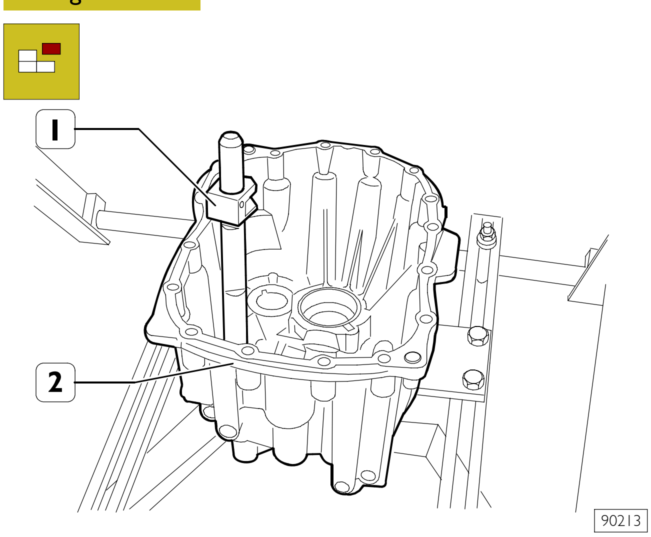
Hook the tool 99360522 (3) onto the lift.

Apply the extractor composed of the bridge 99341004 (16) and ties 99341012 (15) onto the rear cover (7).

NOTE In order not to damage the rear cover (7), place special protections between it and the ties (15).

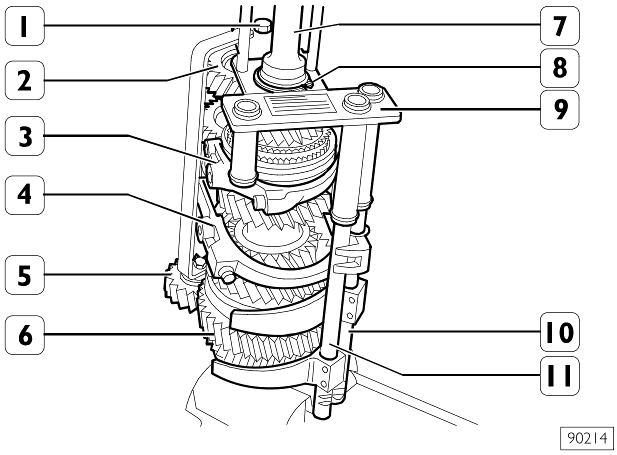
Using the extractor screw and the lift on the main shaft (10), remove the main shaft (10) from the rear ball bearing and extract the shaft-rod assembly from the rear cover (7).

Figure 51



Remove the rod (1) from the rear cover (2).

Figure 52



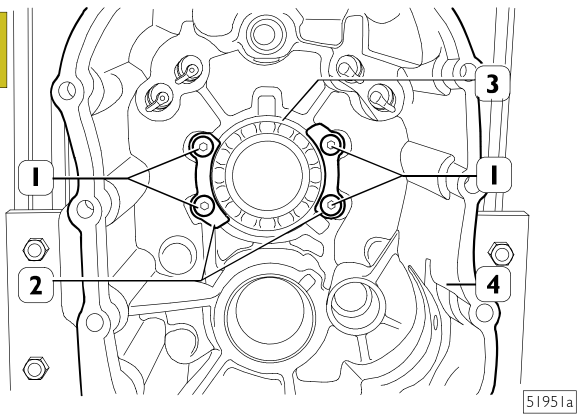
Clamp the primary shaft (6) in a vice.
Remove the rods (10 and 11) with the relevant forks. Remove the forks (3 and 4) and the small blocks.

Support the secondary shaft (2), slacken the screw (1) and remove the secondary shaft (2).

Remove the RM gear (4).
Remove the snap ring (8) and the tool 9936522 (9).
Remove the input shaft (7).

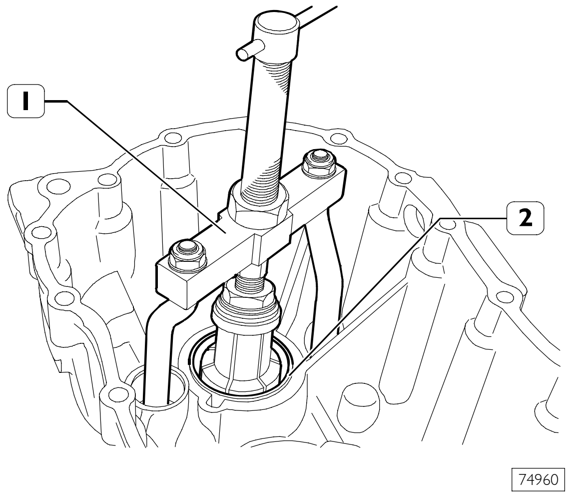
Disassembling the rear cover bearings

Figure 53



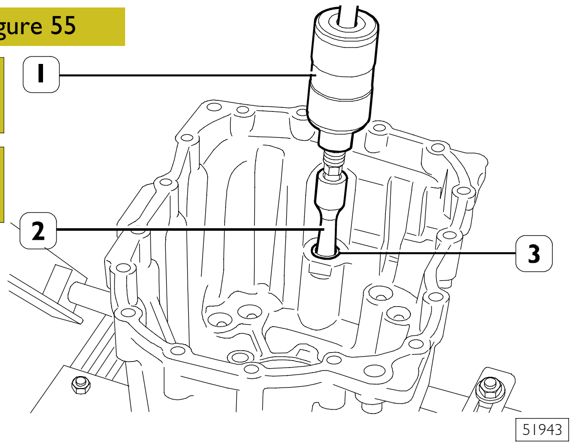
Remove the screws (1) securing the plates (2).
Take out the plates (2).
Turn over the rear cover (4) and remove the bearing (3).

Figure 54



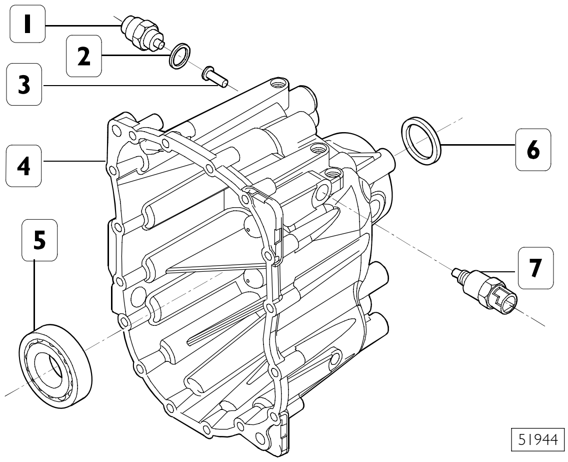
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 55



Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

Figure 56



Turn over the rear cover (4).

Take out the O-ring (6).

Using a suitable punch, remove the ball bearing (5). Remove the tachograph sensor (7) and the reversing light switch (1) with the washer (2) and extract the push rod (3).

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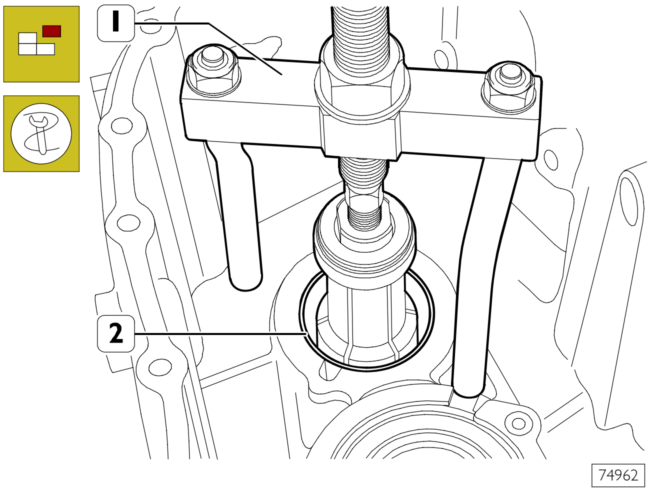
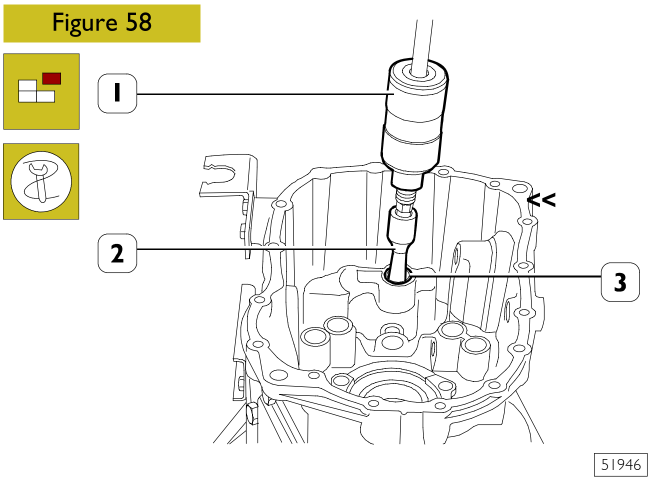
Disassembling the transmission bearings

Figure 57



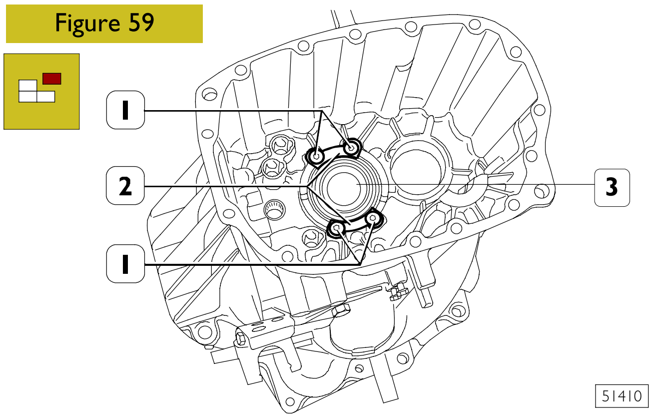
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 58



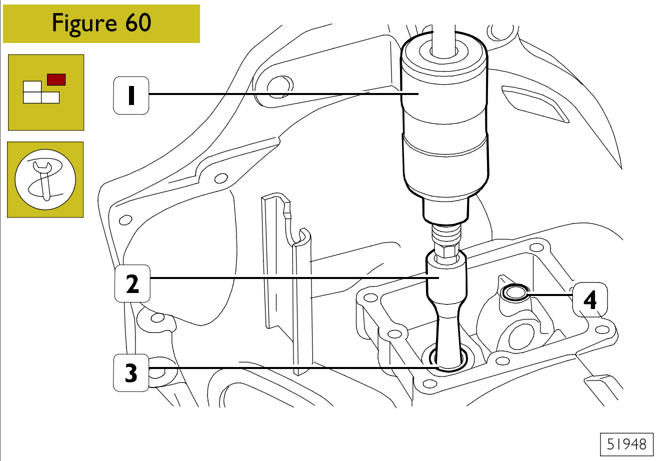
Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

Figure 59



Remove the screws (1) securing the plates (2).
Take out the plates (2).
Turn over the transmission. Using a suitable punch, remove the ball bearing (3).

Figure 60

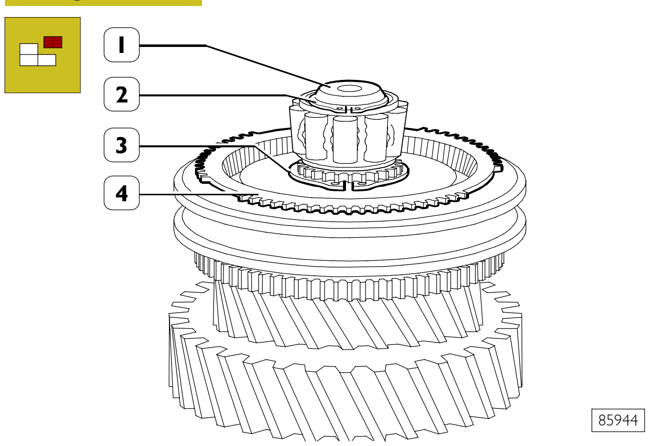


Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the roller bearing (4-3).

Disassembling the main shaft

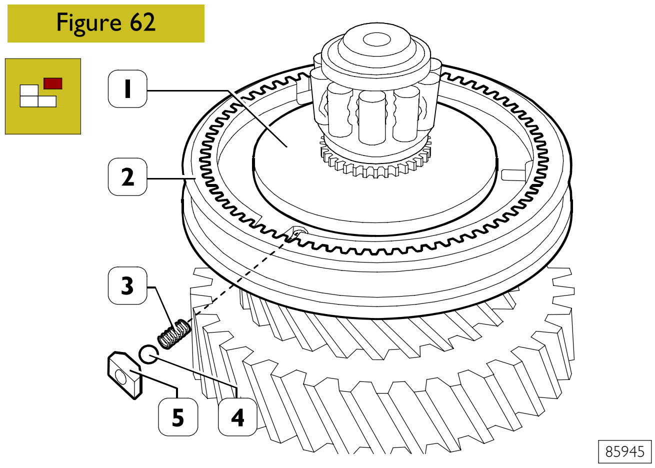
NOTE Mark the assembly position of each synchronizing device on the respective gear.

Figure 61



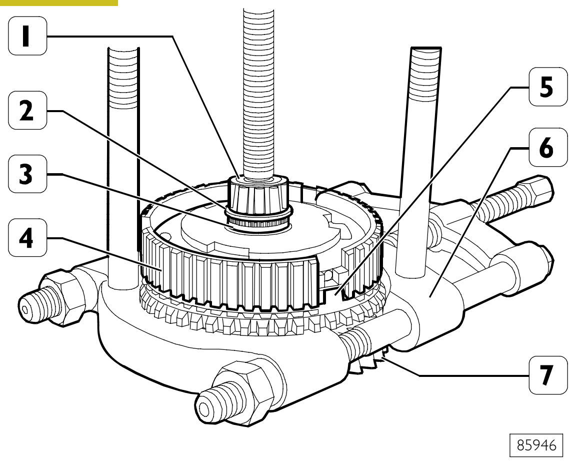
Tighten the primary shaft (1) in a vice. Remove the synchroniser ring (4) and the circlip (2). Remove the circlip (3) from its housing.

Figure 62



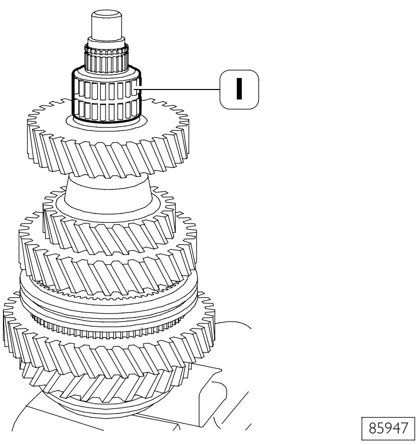
Remove the sliding sleeve (2) for engaging 5th - 6th gear from the hub (1) and, taking care as the plugs (5) come out with the balls (4) and springs (3), recover them.

Figure 63



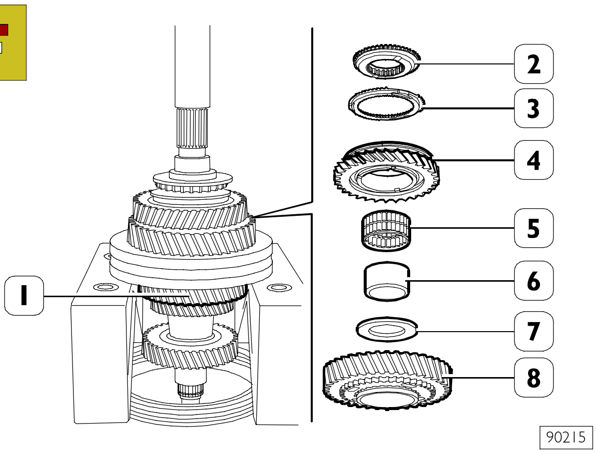
Use extractor 99348001 (6) as shown in the figure to extract the primary shaft (1), the 5th gear (7), the synchroniser ring (5), the hub (4), the circlip (3) and the roller bearing (2).

Figure 64



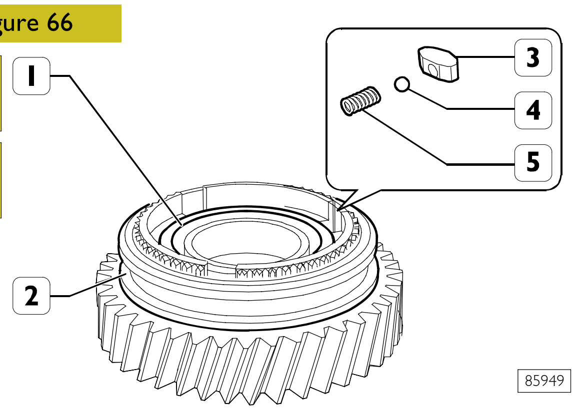
Remove the roller half cages (1).

Figure 65



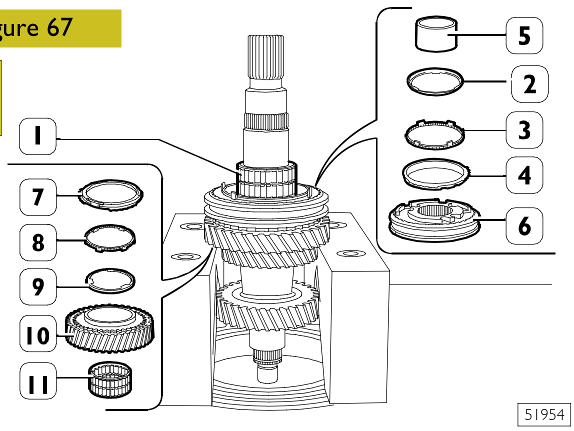
Use the hydraulic vice to remove from the primary shaft (1): the 1st speed gear (8), the spacer (7), the bush (6), the roller cage (5), the R.M. gear (4) together with the coupling elements, the synchronising ring (3) and the serrated ring (2).

Figure 66



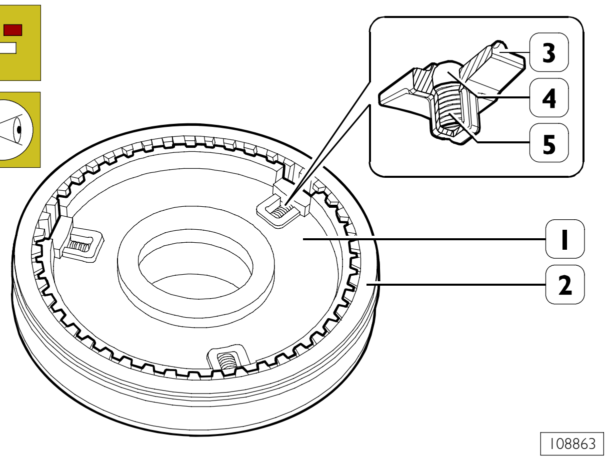
Remove the reverse gear engagement sliding sleeve (2) from the reverse gear (1). Retrieve hub (1) and pads (3) with respective balls (4) and springs (5).

Figure 67



Take out the synchronizer ring (4), middle ring (3), ring (2) and roller bearing (1).
Using a hydraulic press, remove the 2nd gear (10), ring (9), middle ring (8), synchronizer ring (7), synchronizer assembly (6) and the bushing (5). Take out the roller bearing (11).

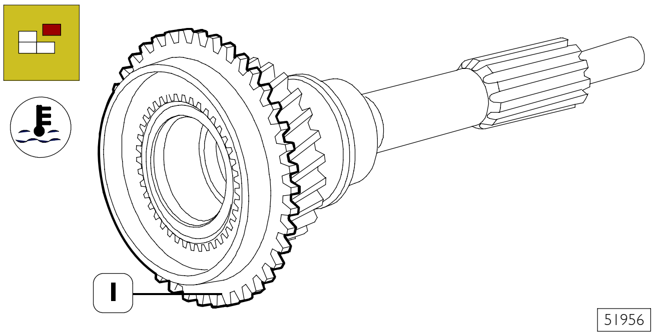
Figure 68



Take 1st/2nd gear engagement sliding sleeve (2) and dowels (3), together with balls (4) and springs (5), off hub (1).

Disassembling the drive input shaft

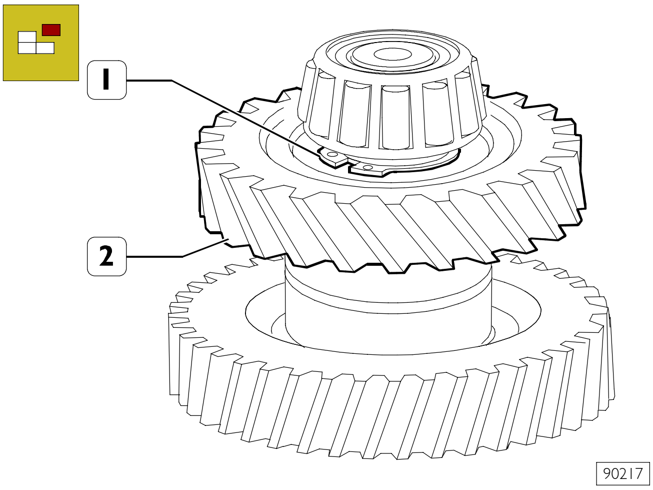
Figure 69



To replace the cog-wheel (1), use the same general tools for disassembly as for assembly, heat it to a temperature of 80°C.

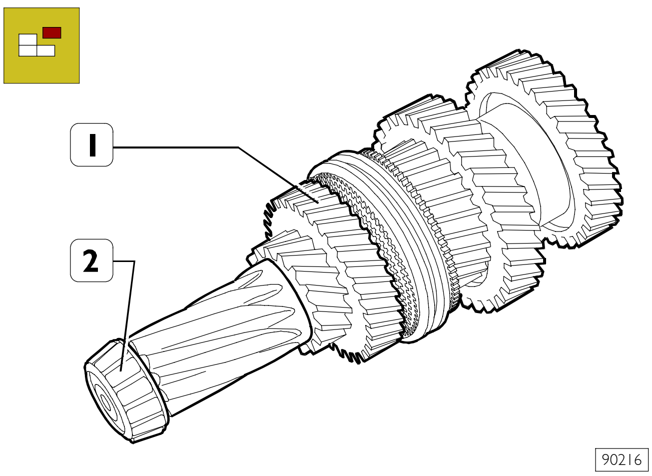
Disassembling the transmission shaft

Figure 70



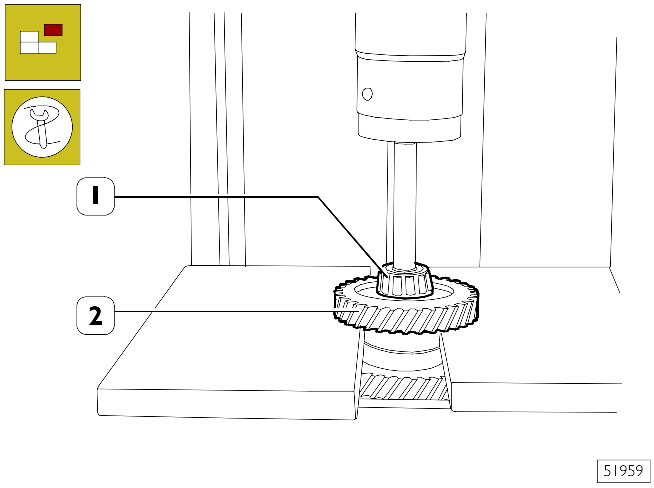
Take out the retaining ring (1) holding the 5th gear (2).

Figure 71



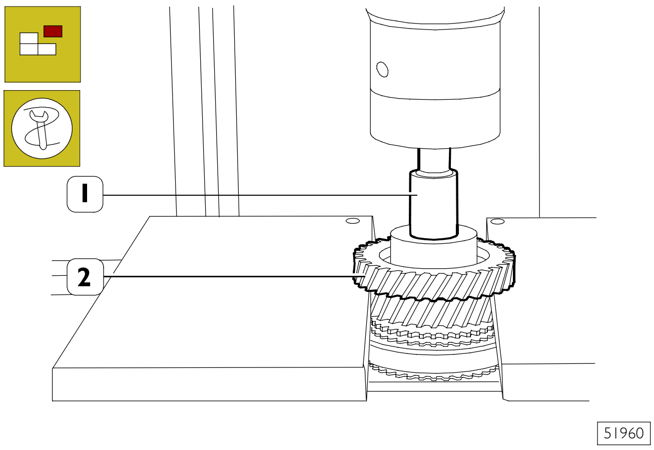
Using general tools, extract the internal ring (2) of the rear tapered roller bearing from the transmission shaft (1).

Figure 72



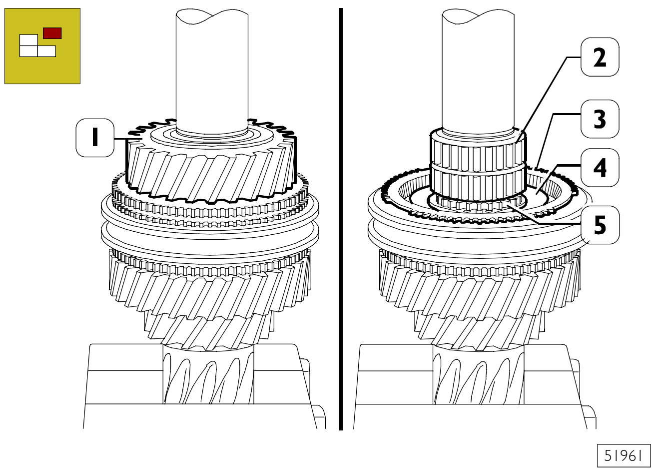
Using a hydraulic press, extract the 6th gear (2) and the internal ring (1) of the tapered roller bearing from the transmission shaft.

Figure 73



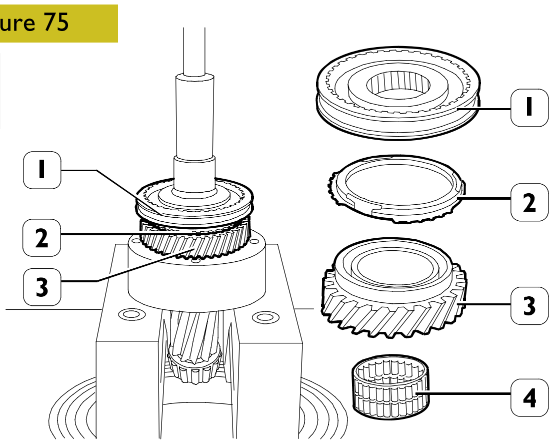
Using a hydraulic press, remove the 5th gear (2) from the transmission shaft (1).

Figure 74



Remove the 3rd gear (1) and the roller bearing (2). Remove the synchronizer ring (3). Remove the retaining ring (5) securing the hub (4).

Figure 75



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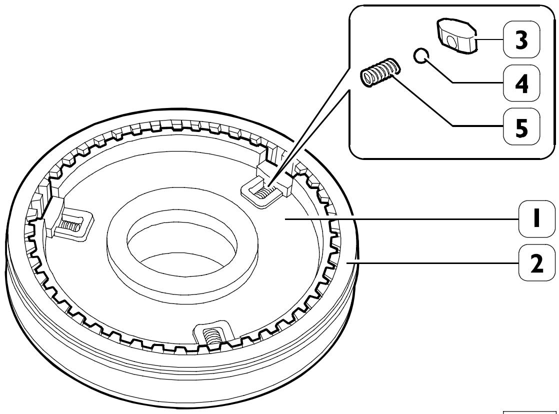
Using a hydraulic press, remove the 4th gear (3), the synchronizer ring (2) and the synchronizer assembly (1).

Remove the half roller bearings (4).

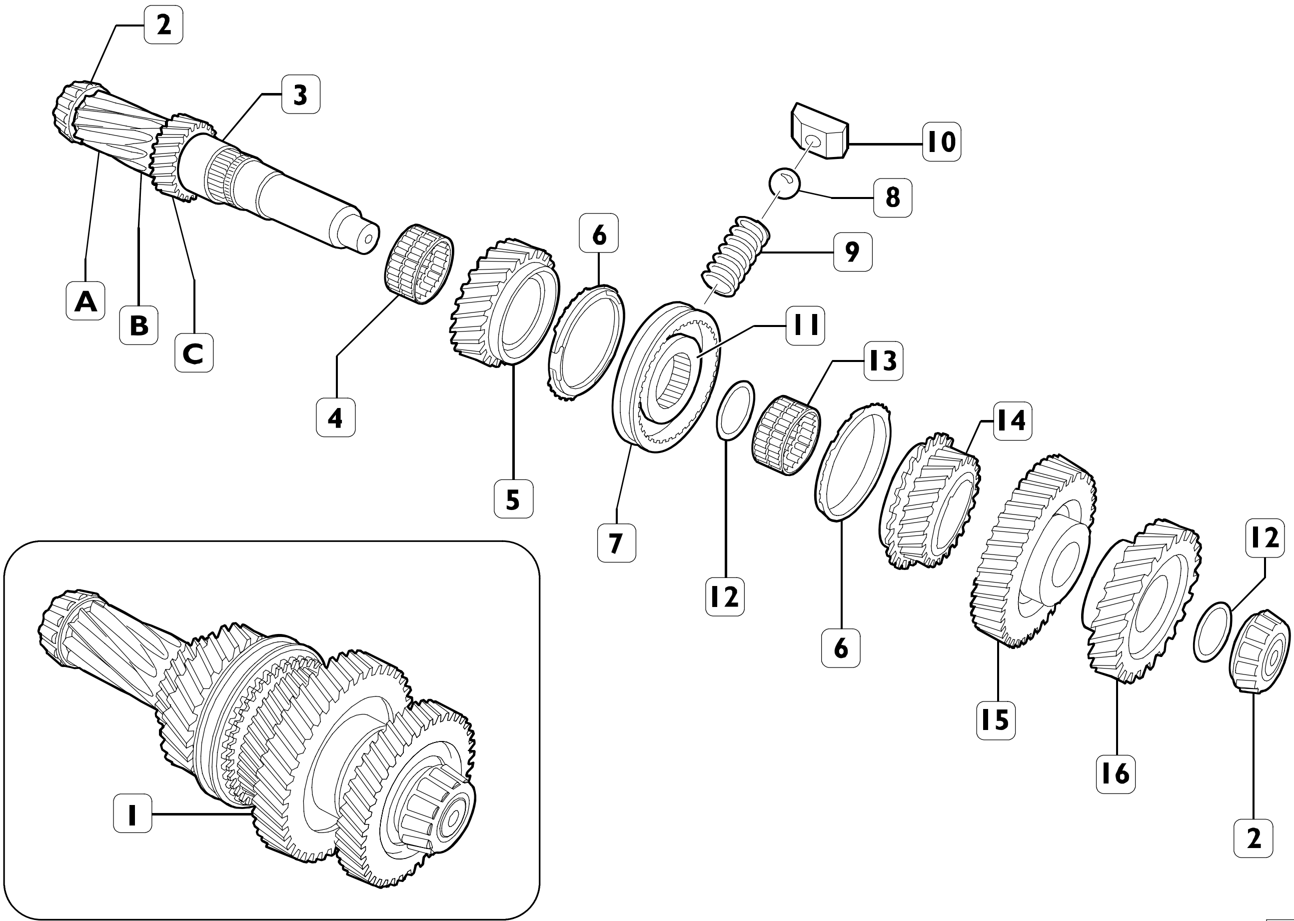
Figure 76



51424

Remove the sleeve (2) for engaging the 3rd-4th gear from the hub (1) and, taking care over the plugs (3) coming out with their relative balls (4) and springs (5), recover them.

Figure 77



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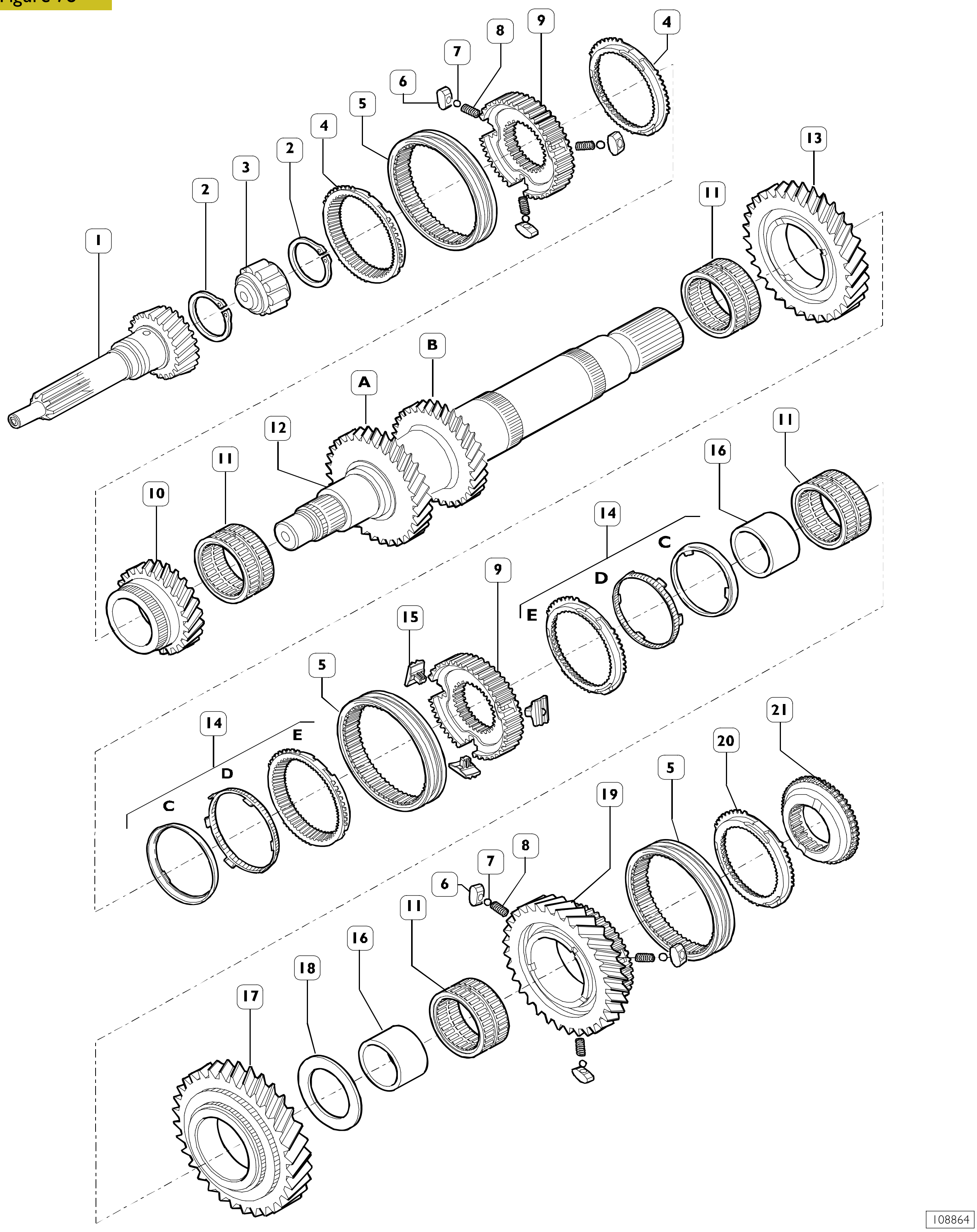
TRANSMISSION SHAFT ASSEMBLY DRAWING

1. Transmission shaft assembly - 2. Tapered roller bearing - 3. Transmission shaft with reverse gear toothing (A), 1st gear (B), 2nd gear (C) - 4. Tapered bearing - 5. 4th gear - 6. Synchronizer ring - 7. Sliding sleeve - 8. Ball - 9. Spring - 10. Plug - 11. Hub - 12. Retaining ring - 13. Half roller bearings - 14. 3rd gear - 15. 6th gear - 16. 5th gear.

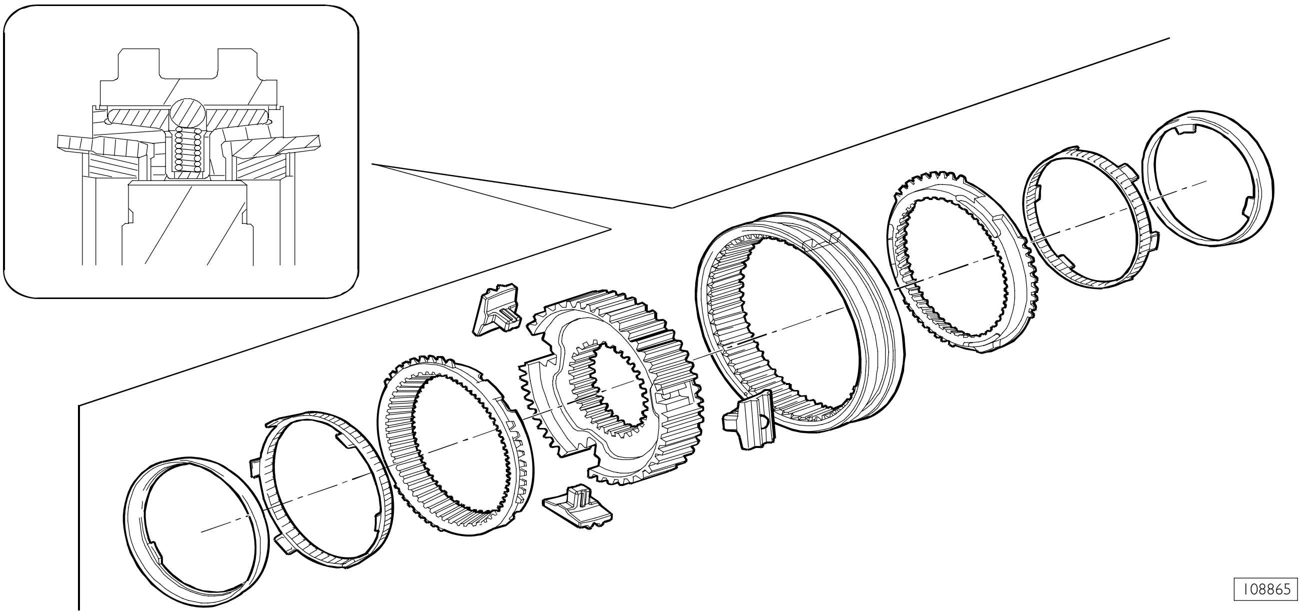
Figure 78



PRIMARY SHAFT AND INPUT SHAFT ASSEMBLY

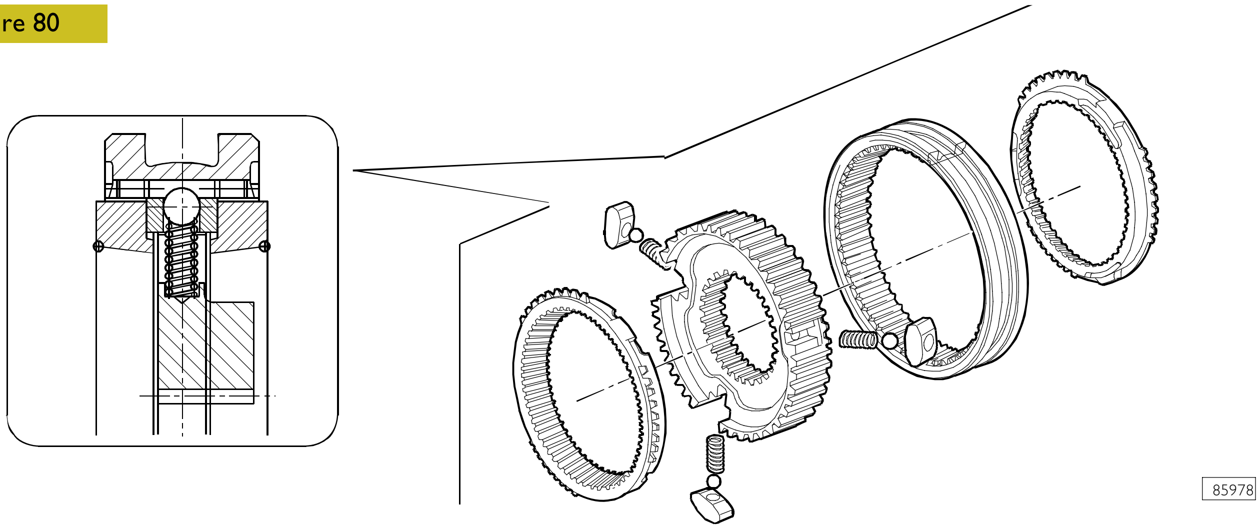
1. Input shaft with 5^{th} speed gear. - 2. Retaining ring - 3. Roller bearing - 4. Single cone synchronizer ring - 5. Sliding sleeve - 6. Plug - 7. Ball - 8. Spring - 9. Hub - 10. 6th gear - 11. Main shaft with 3rd gear toothing (A), 4th gear toothing (B) - 12. Roller bearing - 13. 2nd gear - 14. Dual-cone synchronizing unit for 1st/2nd speed - 15. Dowels with built-in ball springs for 1st/2nd speed hub - 16. Bushing - 17. 1st gear - 18. Spacer ring - 19. Reverse gear - 20. Synchroniser ring - 21. Gear.

Figure 79



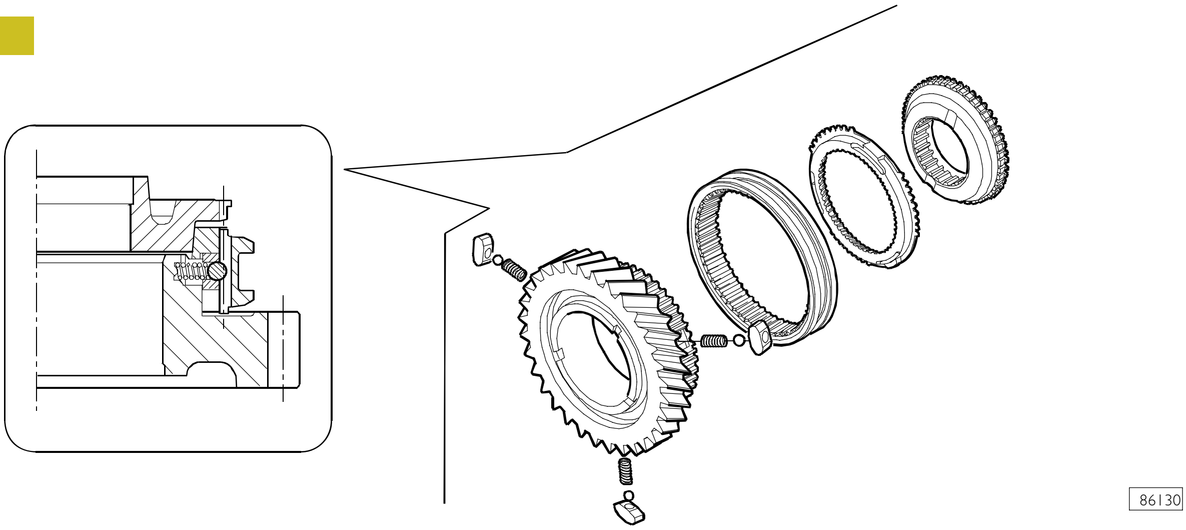
1ST-2ND GEAR DUAL CONE SYNCHRONIZER ASSEMBLY

Figure 80



3RD - 4TH - 5TH - 6TH GEAR SINGLE CONE SYNCHRONIZER ASSEMBLY

Figure 81



SINGLE CONE SYNCHRONIZER ASSEMBLY REVERSE GEAR

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CHECKS

Transmission

The transmission and relative covers must show no sign of cracking.
The mating surfaces of the covers and transmission must not be damaged or deformed. Remove any remains of sealant from them.

The seats of the bearings, reverse gear shaft and gear control rods must be neither damaged nor too worn.

Hubs - sliding sleeves - forks

The grooves on the hubs and relative sliding sleeves must not be damaged. The sliding sleeve must run freely on the hub. The plugs and balls for positioning the sliding sleeve must be neither damaged nor worn. The toothing of the sliding sleeves must not be damaged. The forks must be sound with an end float, in the radial groove of the sleeve, no greater than 1 mm.

Bearings

The roller bearings must be in perfect condition with no signs of wear or overheating. They must only be removed if they are to be replaced.

Shafts - gears

The seats on the shafts, for bearings, must be neither damaged nor worn. The toothing of the gears must be neither damaged nor worn.

Synchronizing devices

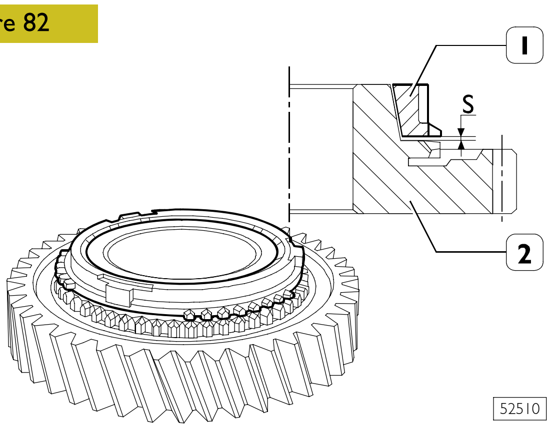
Check the wear on the synchronizer rings, proceeding as follows:

After this check, the synchronizer rings must be marked on their respective gears to avoid swapping their positions over when assembling.

❑ See that the friction surface is not undulated.

BK-type single cone synchronizers for 3rd/4th/5th/6th gears

Figure 82



Arrange the synchroniser ring (1) on the respective gear or reverse taper ring (2).

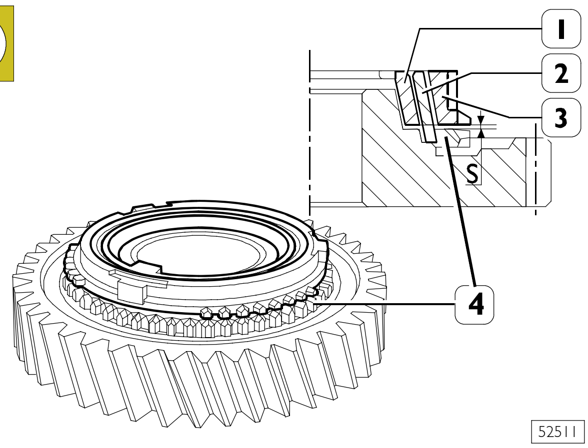
With a feeler gauge, check the distance **S** on two diametrically opposite points.

If the measured value **S** is less than 0.8 mm, replace the synchronizer ring.

Turn the synchronizer ring (1) so as to ensure correct coupling on the cog-wheel.

D-type dual cone synchronizers for 1st/2nd gears

Figure 83



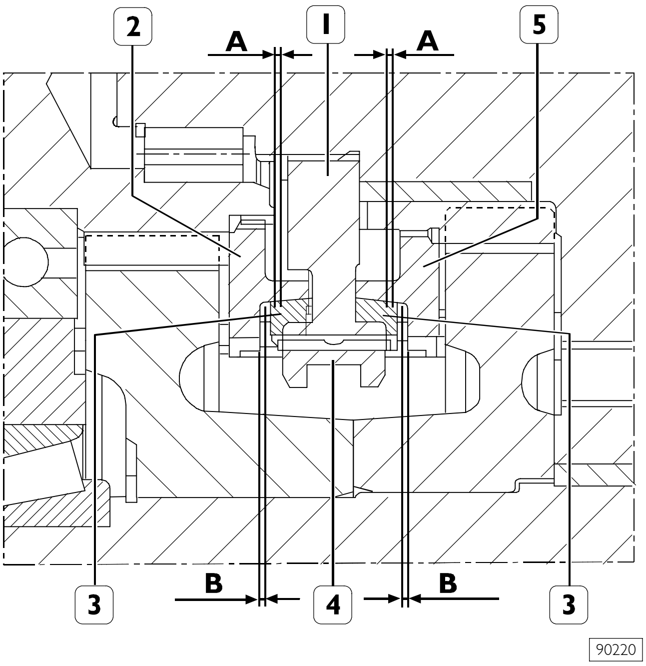
Position the internal ring (3), middle ring (2) and the synchronizer ring (1) on the tapered cog-wheel (4) of the gear.

Turn the synchronizer ring (1) so as to ensure correct coupling between the parts.

Applying a uniform force of 50 N on the synchronizer ring (1), measure the distance **S** on two diametrically opposite points with a feeler gauge.

If the average measured value **S** is less than 1.5 mm, replace all the rings.

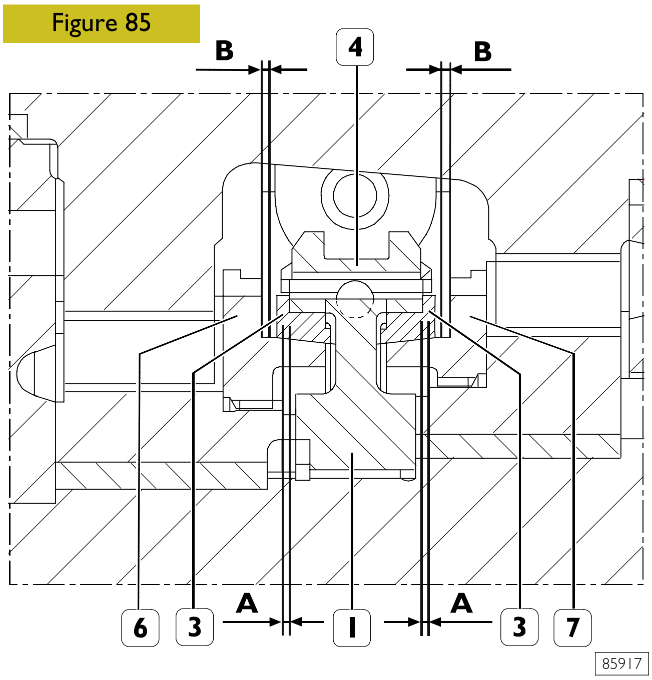
Figure 84



5TH - 6TH GEAR SYNCHRONISERS

A. synchronization reserve 6th-5th gear: 1÷1,4 mm
B. 5th-6th release clearance: 0,3÷0,7 mm

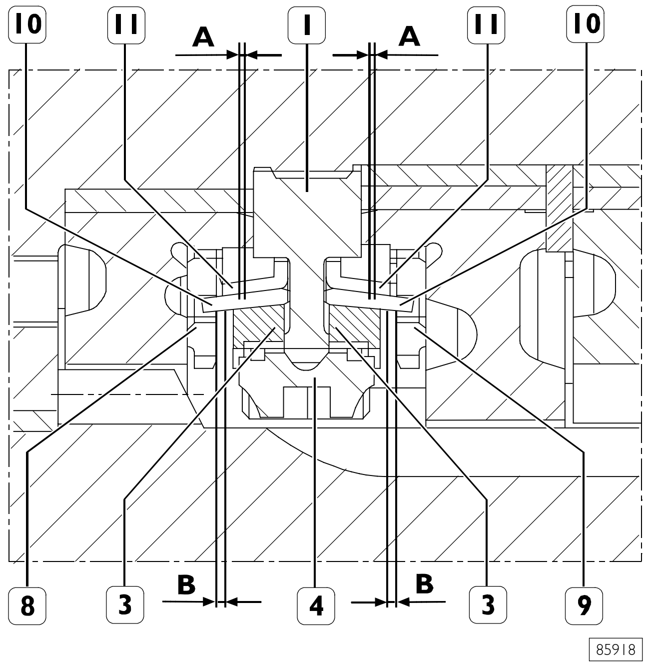
Figure 85



3TH/4TH GEAR SYNCHRONISERS

A. synchronization reserve 1st-2nd gear: 1÷1,4 mm
B. 1st-2nd release clearance: 0,3÷0,7 mm

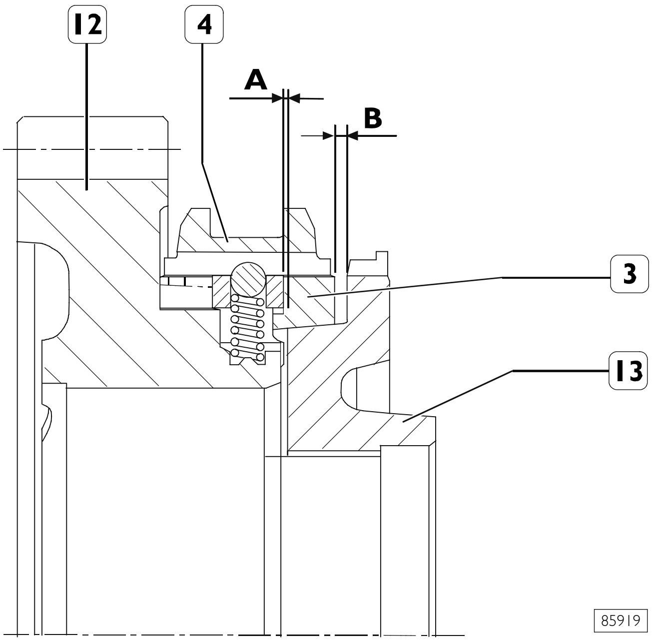
Figure 86



2ND-1ST GEAR SYNCHRONISERS

A. synchronization reserve 2nd-1st gear: 1,6÷2,0 mm
B. 1st-2nd release clearance: 0,9÷1,5 mm

Figure 87



REVERSE GEAR SYNCHRONISER

A. Synchronization reserve: 0.9÷1,4 mm
B. release clearance: 0,35÷0,85 mm

1. Hub - 2. 5th gear - 3. Synchronizer ring - 4. Sliding sleeve - 5. 6th gear cog-wheel - 6. 3rd gear cog-wheel - 7. 4th gear cog-wheel - 8. 2nd gear cog-wheel - 9. 1st gear cog-wheel - 10. Middle ring - 11. Ring - 12. Reverse gear - 13. Reverse gear ring

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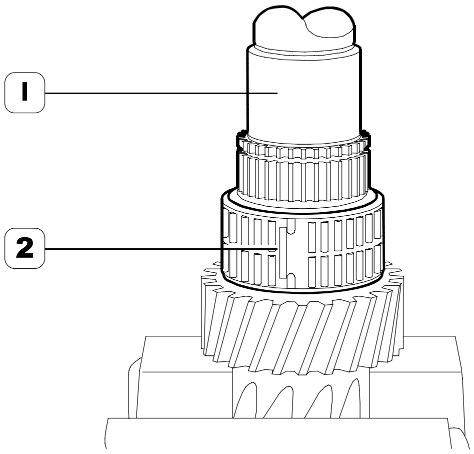
Mounting the transmission shaft

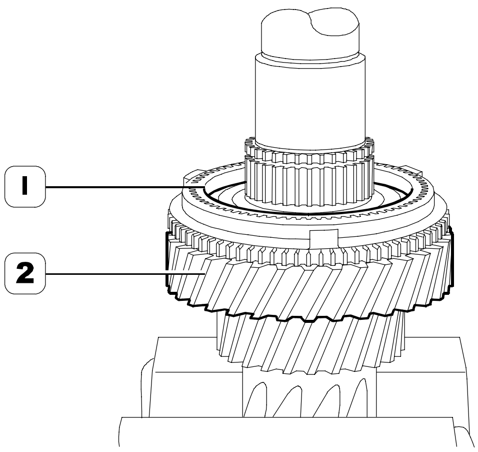
Figure 88



51966

Clamp the transmission shaft (1) in a vice and position the half roller bearings (2) on it.

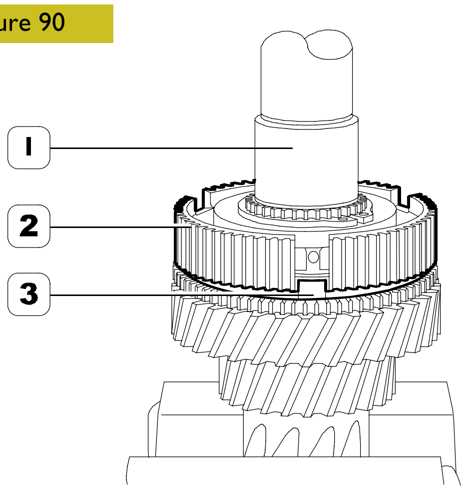
Figure 89



51967

Mount the 4th gear (2) and position the synchronizer ring (1) on this.

Figure 90



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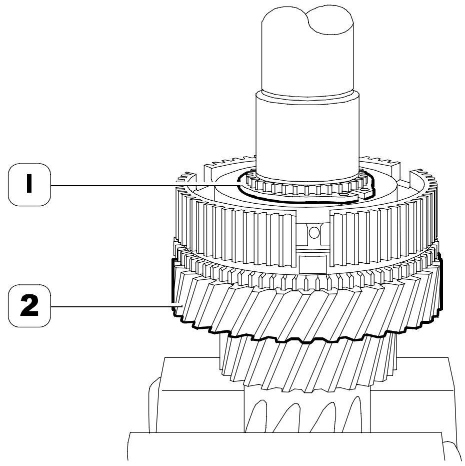
Heat the hub (2) to a temperature of 110° ÷ 150°C and mount it on the transmission shaft (1), taking care that the protrusions (3) of the synchronizer ring are positioned correctly in their seats in the hub (2).

Figure 91

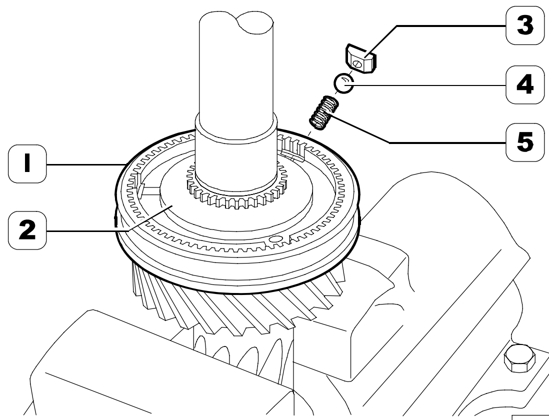


51969

Mount the retaining ring (1) whose thickness produces null end float in its seat.

Check the end float of the 4th gear (2). It should be 0.15 ÷ 0.40 mm.

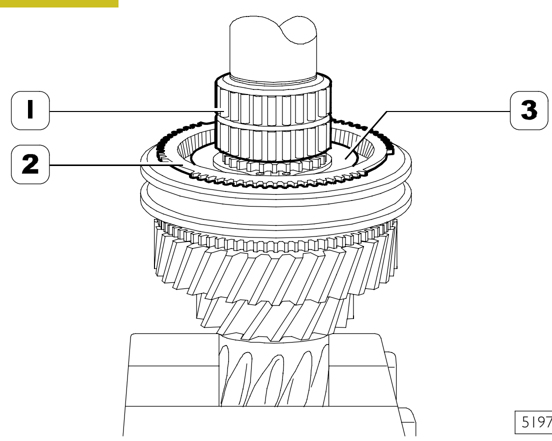
Figure 92



51970

Mount the sliding sleeve (1) on the hub (2). Put the springs (5), plugs (3) and balls (4) into the seats in the hub (2), settling them under the sliding sleeve (1).

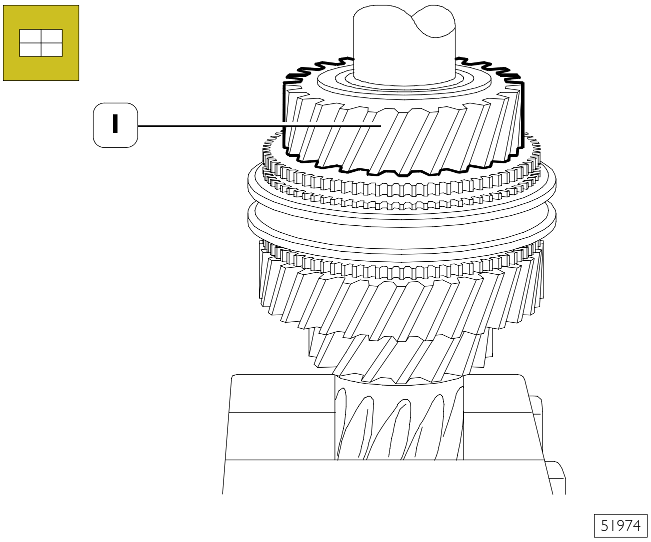
Figure 93



51971

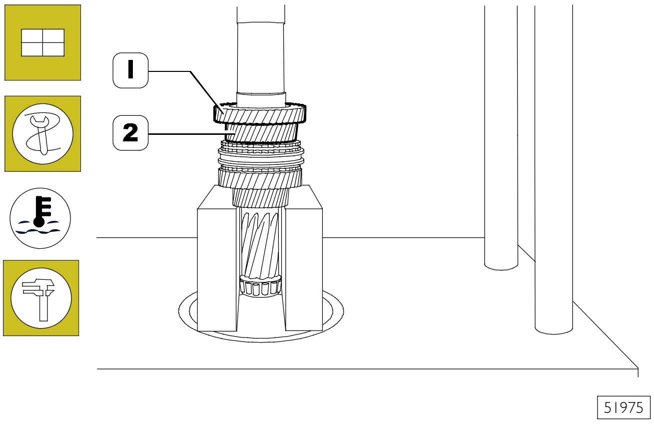
Position the synchronizer ring (2) on the hub (3) so that its protrusions enter the seats in the hub (3). Mount the roller bearing (1).

Figure 94



Mount the 3rd gear (1).

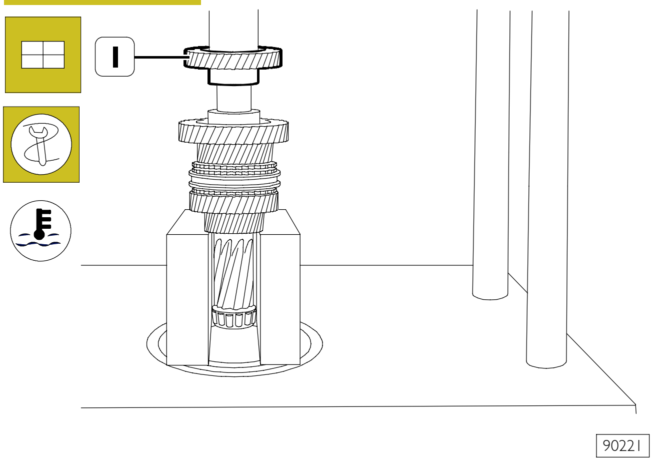
Figure 95



With a hydraulic press, mount the 6th gear (1) pre-heated to approx. 170°C.

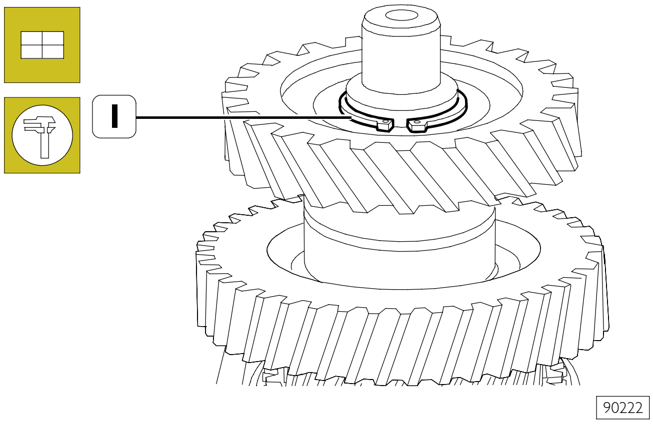
Check the end float of the 3rd gear (2). It should be 0.15 ÷ 0.40 mm.

Figure 96



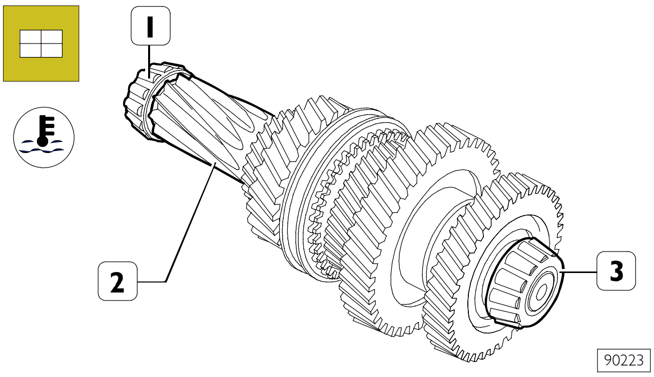
With a hydraulic press, mount the 5th gear (1) pre-heated to approx. 170°C.

Figure 97



Mount the retaining ring (1) whose thickness produces null end float in its seat.

Figure 98

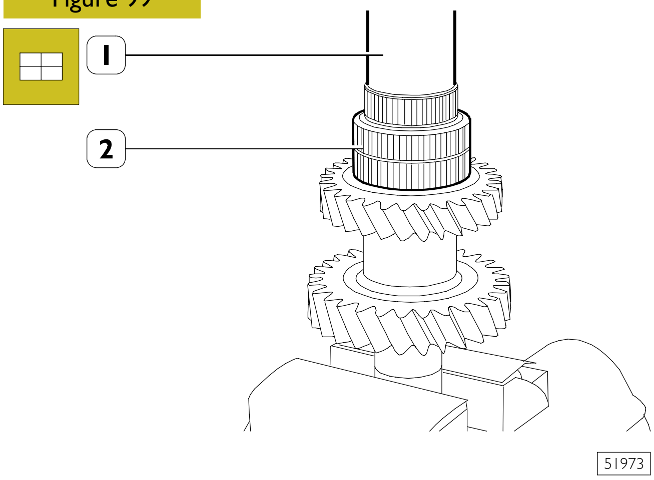


Heat the internal rings (1-3) of the tapered roller bearings to a temperature of approx. 80°C and, with a suitable punch (1), mount them on the transmission shaft (2).

Mounting the main shaft

NOTE Mount the synchronizer rings on their respective gears according to the marks made during disassembly or when checking in the case of replacement.

Figure 99



Tighten the main shaft (1) and position the roller bearing (2) on it.

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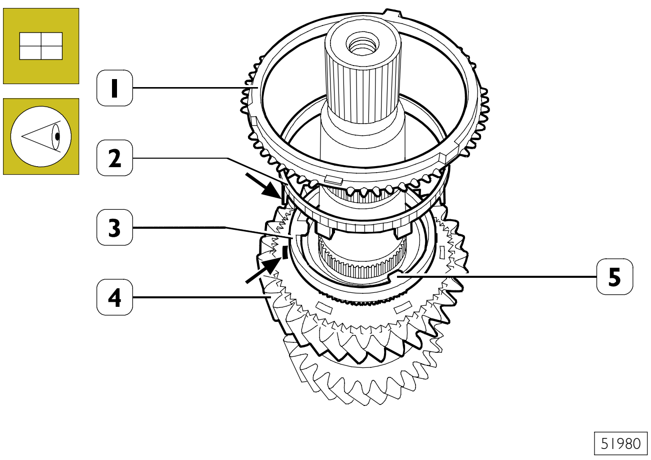
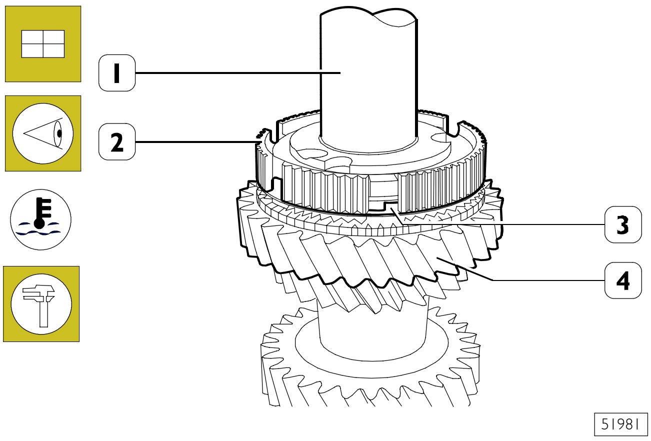
Figure 100



Mount the 2nd gear (4) and position the ring (3), middle ring (2) and synchronizer ring (1) on it, taking care that the tongues (→) of the middle ring (2) enter the slots (→) in the gear (4).

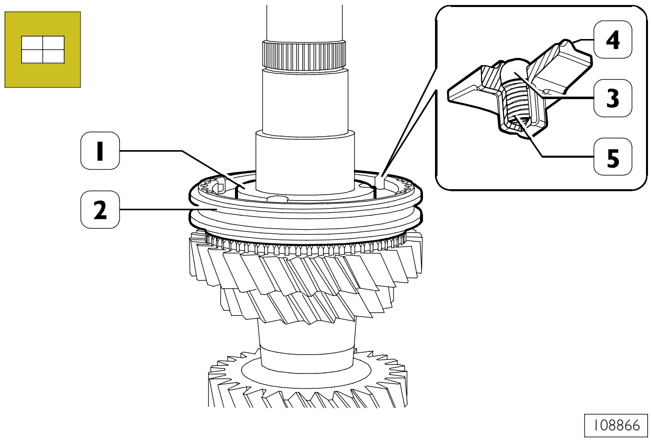
Figure 101



Heat the hub (2) to a temperature of 80° ÷ 110°C and mount it on the main shaft (1), taking care that the projections (3) of the synchronizer ring and the tongues (→) of the ring (3, Figure 100) are positioned correctly in the seats in the hub (2).

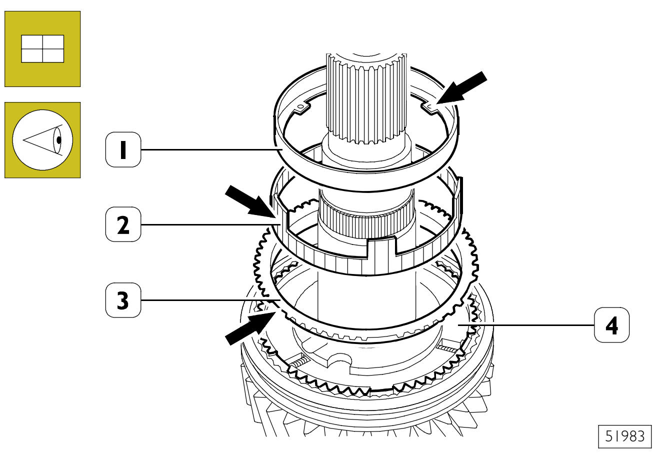
Check the end float of the gear (4). It should be 0.25 ÷ 0.5 mm.

Figure 102



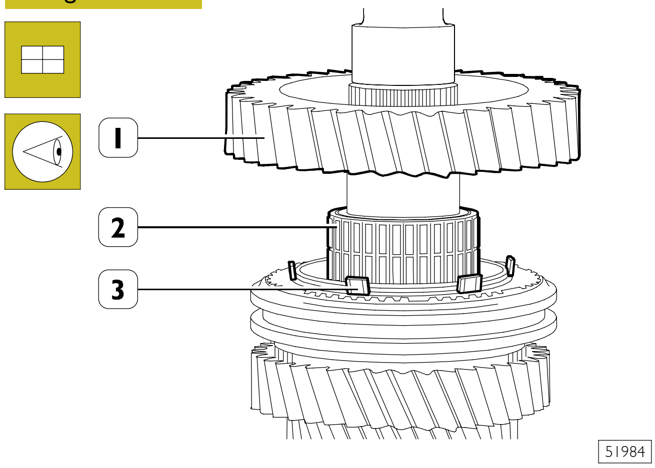
Fit sliding sleeve (2) onto hub (1). Fit dowels (4) with built-in springs (5) and balls (3) into hub (1) housings.

Figure 103



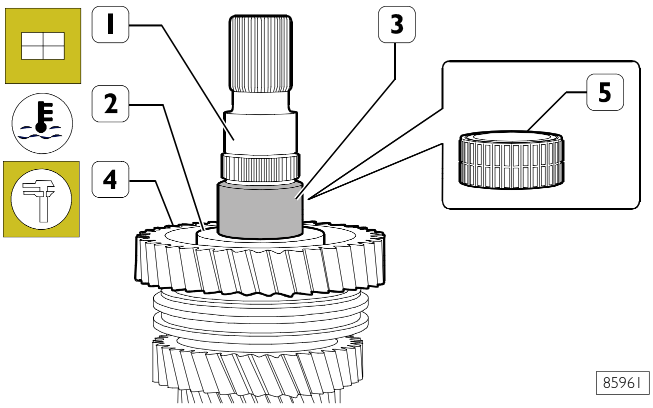
Position the synchronizer ring (3), middle ring (2) and ring (1) on the hub (4), taking care that the tongues (→) of the ring (1) and the projections (→) of the ring (3) enter the seats in the hub (4).

Figure 104



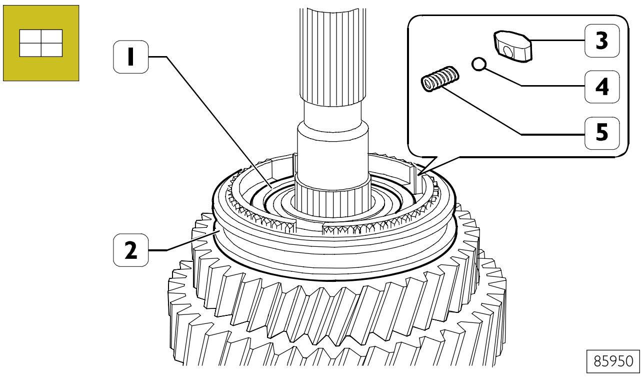
Position the roller bearing (2). Mount the 1st gear (1) taking care that the tongues (3) of the middle ring enter the slots in the gear (1).

Figure 105



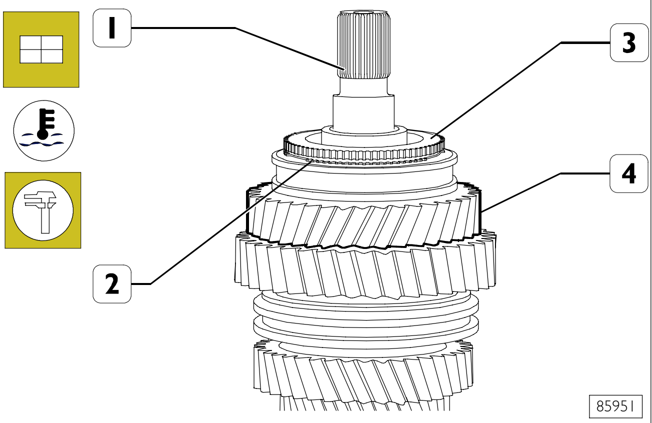
Heat the spacer ring (2) to a temperature of approx. ~80° ÷ 110°C and mount it on the main shaft (1). Check the end float of the gear (4); this should be 0.15 ÷0.3 mm.
Heat the bushing (3) to a temperature of approx. 80° ÷ 110°C and mount it on the main shaft (1).
Mount the roller bearing (5).

Figure 106



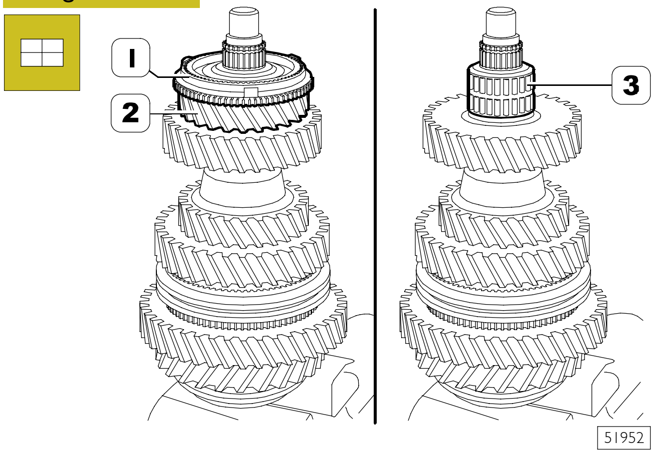
Fit reverse gear (1).
Fit sliding sleeve (2) on reverse gear hub (1).
Insert the springs (5), the pads (3) and the balls (4) in the hub seats (1) and arrange them with respect to the sliding sleeve (2).

Figure 107



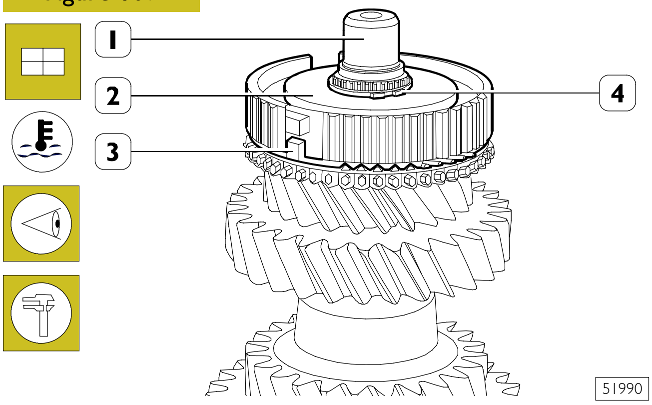
Fit the synchroniser ring (2).
Heat the gear ring (3) to 110° ÷ 150° and fit on primary shaft (1).
Check reverse gear play (4) which must be 0.15 ÷ 0.4 mm.

Figure 108



Turn the main shaft over and position the half roller bearings (3) on it.
Mount the 6th gear (2) and position the synchronizer ring (1) on it.

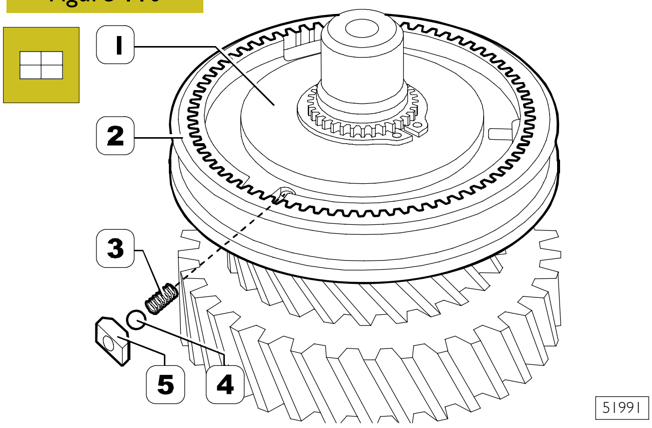
Figure 109



Heat the hub (2) to a temperature of approx. ~ 80° ÷ 110°C and mount it on the main shaft (1) taking care that the projections (3) of the synchronizer ring are positioned in the seats in the hub (2).

Mount the retaining ring (4) whose thickness produces null end float in its seat.

Figure 110



Mount the sliding sleeve (2).

Put the springs (3), plugs (5) and balls (4) into the seats in the hub (1) and position them under the sliding sleeve (2).

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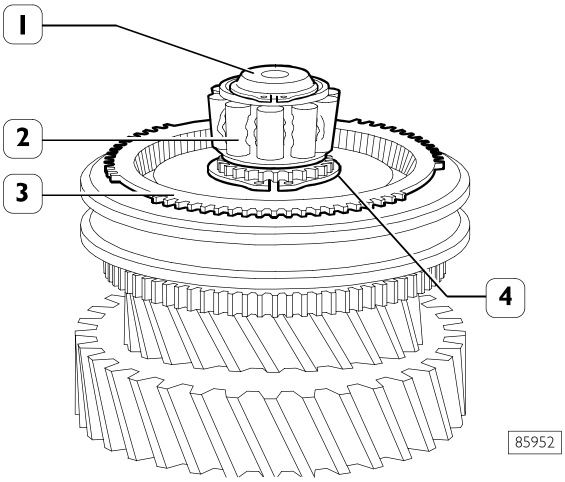
Figure 111

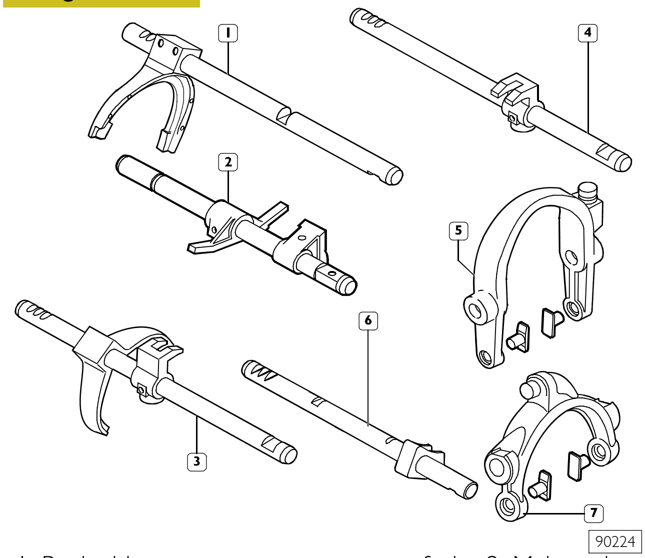


Heat the bearing (2) to 80÷110°C and fit on primary shaft (1). Fit the circlip (4) and synchroniser ring (3).

Rods - forks - selector - driver

Disassembly - assembly

Figure 112



1. Rod with reverse gear engagement fork - 2. Main rod - 3. Rod with 1st-2nd gear engagement fork. - 4. Fork control rod (5).- 5. 3rd-4th gear engagement fork - 6. Fork control rod (7) - 7. 5th-6th gear engagement fork

Check the state of the plugs (2) of the 3rd-4th-5th-6th gear engagement fork and replace them if they are worn.
To replace the forks of the selector and driver from their respective control rods it is sufficient to remove the retaining spring pins with a suitable punch.
For assembly, carry out these steps in reverse order, replacing the spring pins.

NOTE Spring pegs must be positioned with the cutting edge placed level.

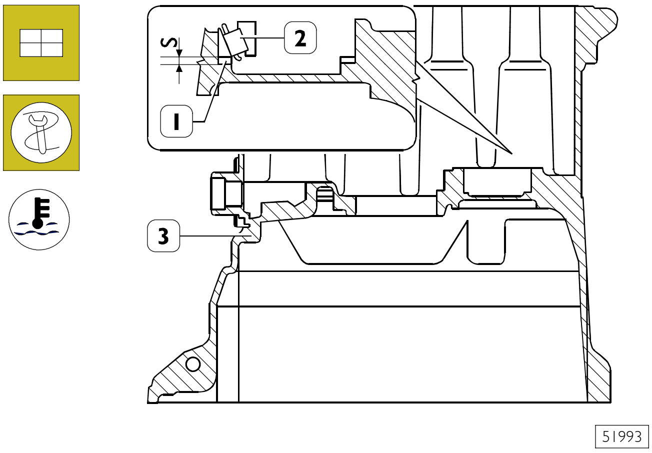
Mounting the transmission

NOTE During assembly, the gaskets, retaining rings, O-rings, spring pins, safety plates and springs must always be replaced with new parts.
The nuts and screws must be tightened to the required torque unless specified otherwise, with the thread dry and degreased.

Adjusting the transmission shaft bearing end float

NOTE The transmission shaft bearing end float is only adjusted if the bearings, transmission shaft gears, transmission shaft, transmission or rear cover have been replaced or if too much clearance has been found.

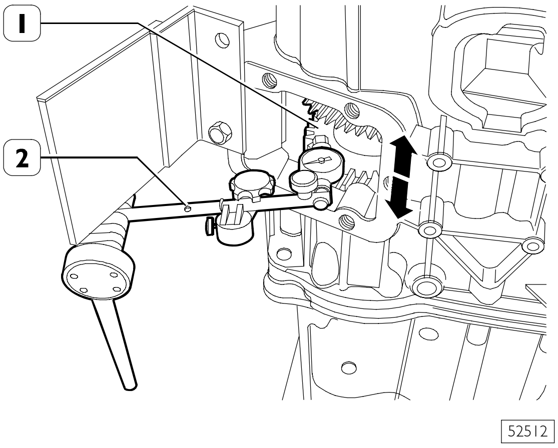
Figure 113



Determine the thickness **S** of the ring (1) for adjusting the transmission shaft bearing end float, proceeding as follows:

- ❑ position the thinner adjustment ring (1) 1.65 mm thick in the seat in the transmission (3);
- ❑ heat the seat of the bearing (2) to approx. 60°C. Mount the external ring of the bearing (2) with the punch 99374091 and grip 99370007, see Figure 115;
- ❑ mount the transmission shaft complete with the internal rings of the tapered roller bearings;
- ❑ mount the external ring of the rear bearing in the rear cover in a similar manner to the front one (see Figure 115);
- ❑ mount the rear cover on the transmission;
- ❑ screw on the 8 fixing screws so that between one screw and another there is a hole for a free screw and tighten them to the required torque;
- ❑ turn the transmission shaft to settle the bearings;

Figure 114



❑ using a comparator (2) zeroed on the 5th gear toothing of the transmission shaft (1) measure its end float **A** through the opening for the power take-off connection and note it down.

The thickness **S** is given by:
S = A + B + C

Where:

A = measured end float, e.g. 0.18 mm;

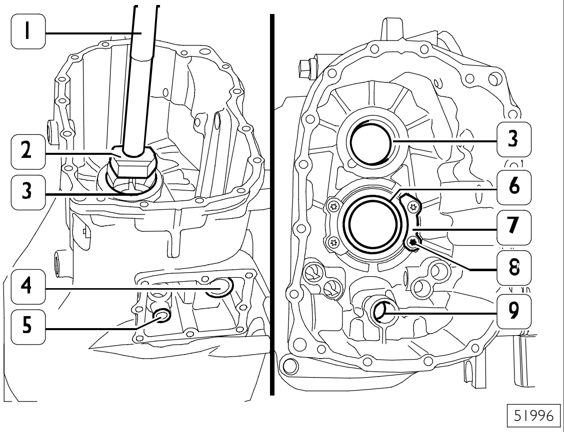
B = average bearing pre-load, e.g. 0.02 mm;

C = adjustment value used for the measurement 1.65 mm;

S = 0,18 + 0,02 + 1,65 = 1,85

Then mount the rear cover, transmission shaft and external ring of the front bearing.

Figure 115



Position the adjustment ring (1, Figure 119) of the thickness determined with the above measurement. Heat the bearing seats of the box to a temperature of approx. 80°C and mount:

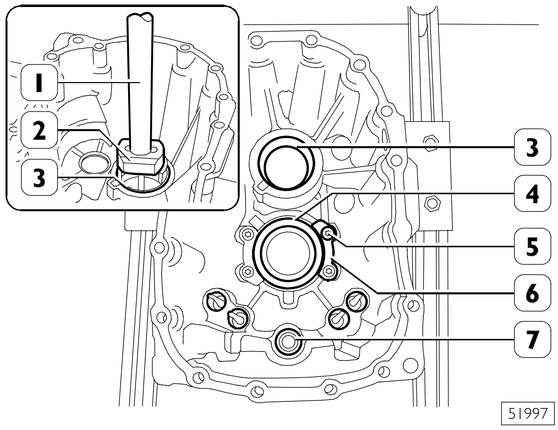
❑ the external ring (3) of the front tapered roller bearing with punch 99374091 (2) and grip 99370007 (1);

❑ the ball bearing (6) with a general punch;

❑ the bushing with ball bearing (9) and the roller bearings (4-5) with a general punch.

Position the retaining plates (7) and secure them to the box, tightening the screws (8) to the required torque.

Figure 116



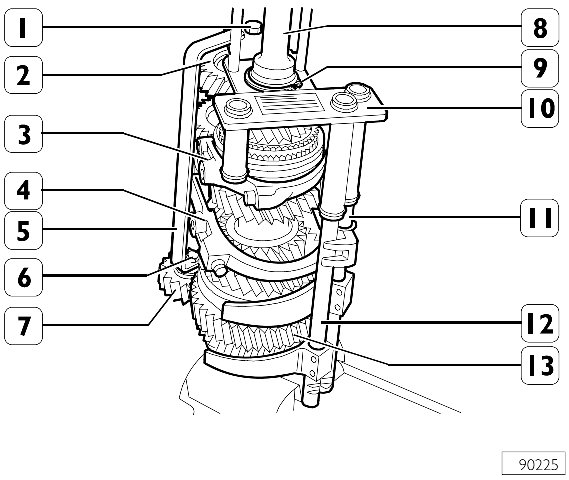
Heat the bearing seats of the rear cover (1) to a temperature of approx. ∼ 80°C and mount:

❑ the external ring (3) of the tapered roller bearing with punch 99374091 (2) and grip 99370007 (1);

❑ the ball bearing (4) and the bushing with ball bearings (7) with a general punch.

Position the retaining plates (6). Secure these to the rear cover, tightening the screws (5) to the required torque.

Figure 117



Clamp the primary shaft (13) in a vice, fit on it the synchronising ring and the input shaft (8).
Fit tool 99360522 (10) on the input transmission shaft (8) and fasten with the circlip (9).
Couple the secondary shaft (2) to the primary shaft (13) and fasten by tightening the screw (1) on the tool (10).
Fit the clutch forks: 3rd – 4th speed (4) and 5th – 6th speed (3) on the relevant sliding sleeves.
Couple the rods (11 and 13), fit the relevant forks on the sliding sleeves and clamp the rods with the sleeves of tool 99360522 (10).
Couple the reverse gear (7) with the shafts (2 and 13) and fasten it to them with the part of the bracket (5) tighten the screw (6).

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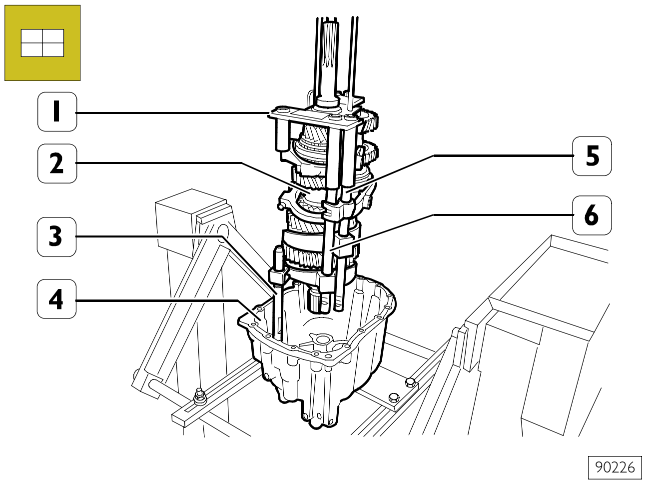
Figure 118

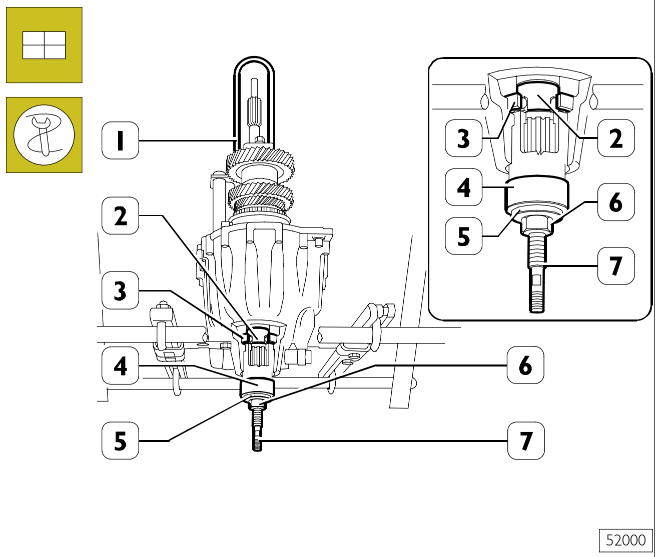


Fit the rod (3) in the rear cover (4).

Hook hoist to tool 99360522 (1), lift the unit (2) as previously mounted, and partially insert it into the rear cover (4).

During this operation, check that the output shaft goes into the supporting ball bearing and the control rods (5 -6) go into their respective seats.

Figure 119

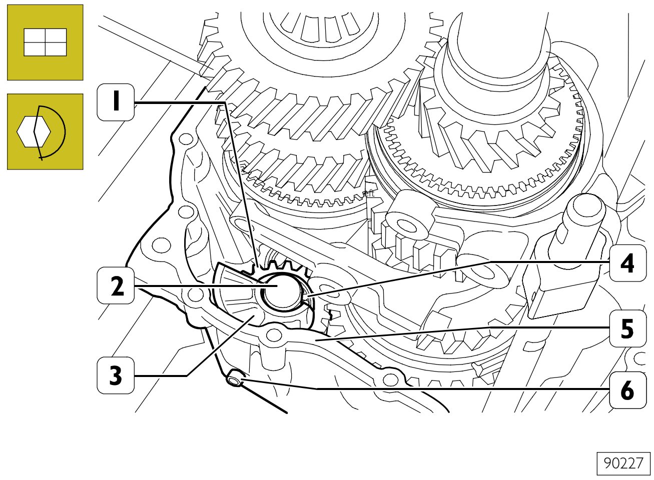


Screw tool 99370234 pin (7) into output shaft hole (2) and fit bushing (4) and spacer (5) on tool.

Screw on the nut (6) and at the same time lower the hoist so the output shaft (2) is positioned on the rear ball bearing (3).

Remove tools 99360522 (1) and 99370234 (4-5-6-7).

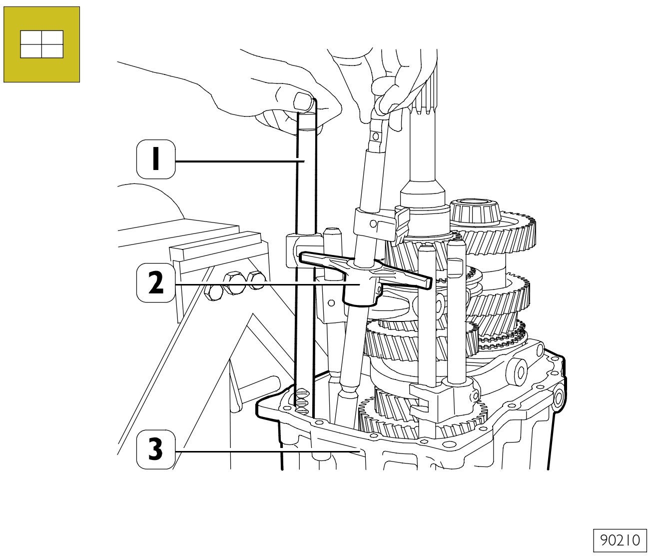
Figure 120



Place the roller bearings (2) in the reverse gear (1).

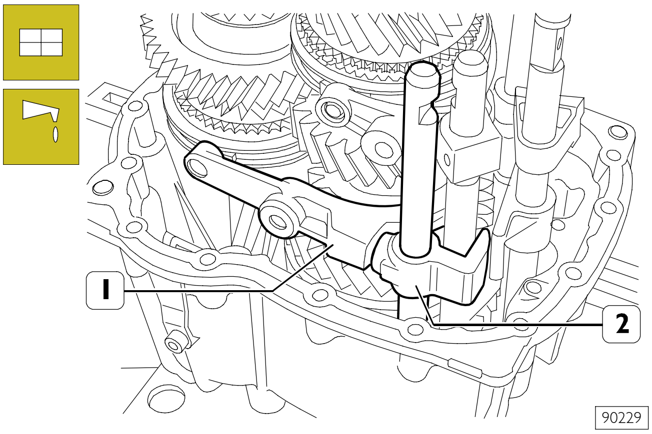
Fit the stem (2) and the support (3) so that the respective holes for the fastening screw are aligned with the relevant hole on the rear cover (5).
Drive in the fastening screw (6) of the stem (3) and the support (4) on the rear cover (5) and tighten it to the prescribed torque.

Figure 121



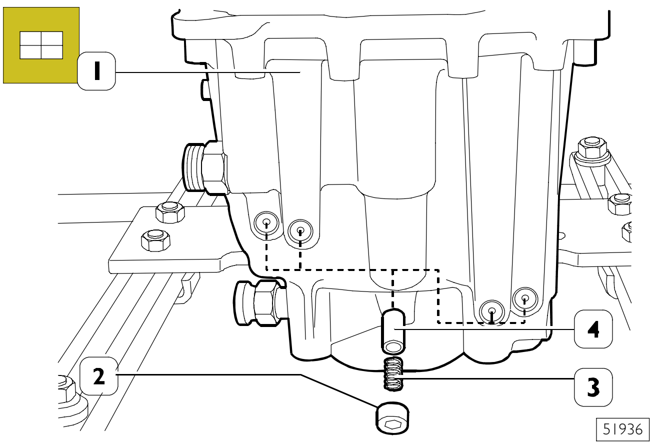
Fit the control rod (1) of the 3rd – 4th speed and the main rod (2) in the rear cover (3).

Figure 122



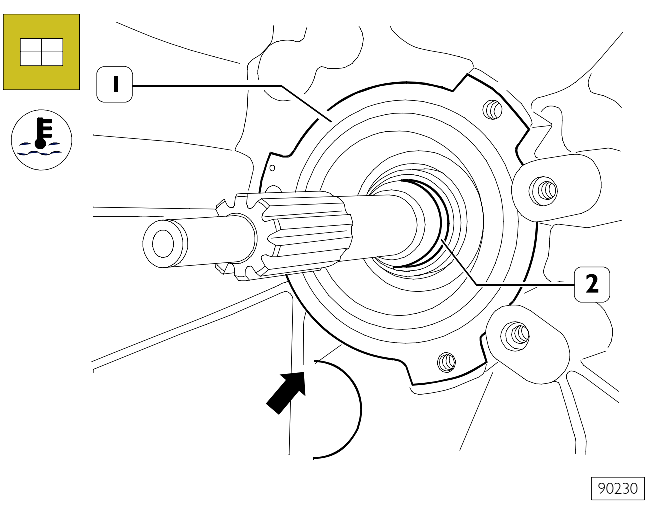
Apply some grease on the pin of the dragging device (2) and fit the clutch fork (1) for the 3rd – 4th speed on this device.

Figure 123



Put the pawls (4) and springs (3) in the rear cover (1) and drive in the retaining cups (2) with a suitable punch.
Apply LOCTITE 5206 on gearbox attachment.

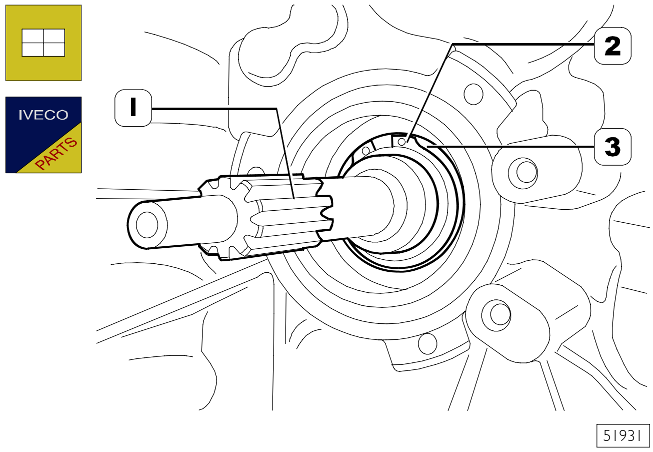
Figure 124



Warm up the front bearing inner ring (2) at 90÷110°C and fit the gearbox (1) on the rear cover.

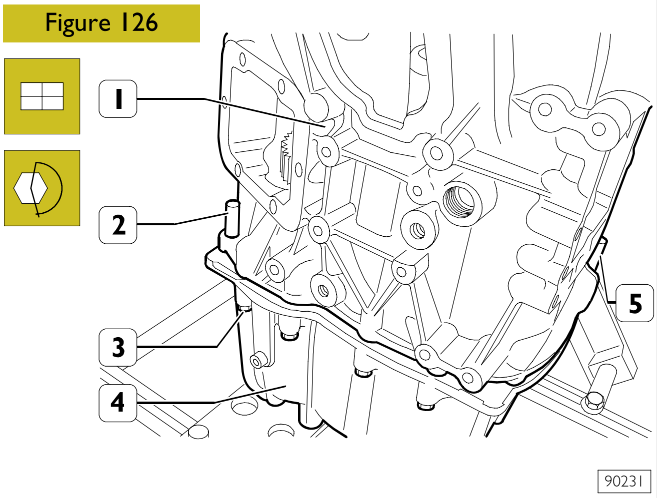
NOTE When fitting the gearbox, check that the shafts and the control rods fit correctly in the respective seat and that the fork (1, Figure 117) does not disconnect from the clutch rod (2, Figure 122) for the 3rd – 4th speed.

Figure 125



Fit a new retaining ring (2) securing the front bearing (3) onto the input shaft (1).

Figure 126

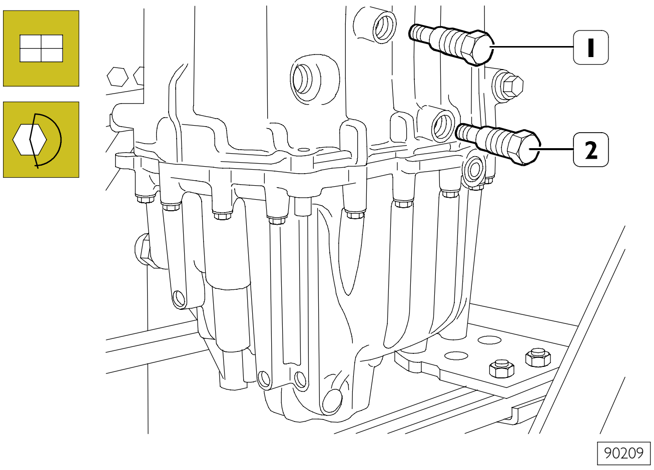


Screw on the screws (2) securing the rear cover (3) to the transmission (1) without fully tightening them.

Mount the centring pins (4) in the rear cover (3) and in the transmission (1).

Tighten the screws (2) to the required torque.

Figure 127



NOTE Make sure that the clutch control rods are all in neutral position.

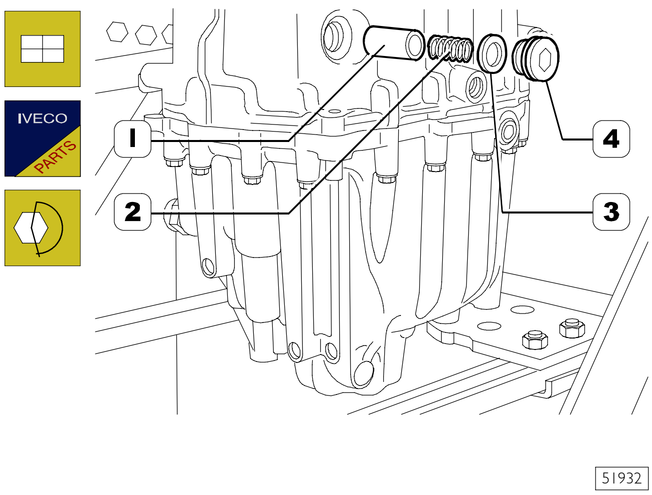
Apply LOCTITE 242 to the thread of the pins (1).

Screw the pins (1) into the box, checking that their ends go into the hole of the 3rd/4th gear engagement fork link (1, Figure 122) and then tighten them to the required torque.

Drive in the pins (2) and check that their ends fit in the knuckle hole of the clutch fork for the 5th – 6th speed and tighten it to the prescribed torque.

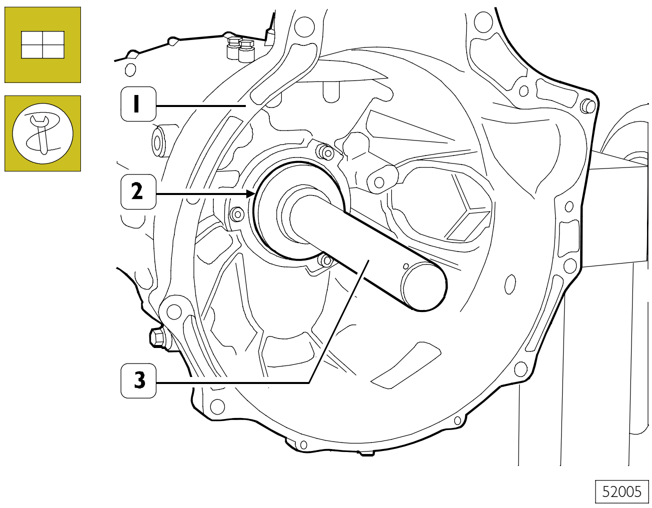
NOTE If during these assembly operations the fork (1, Figure 122.) comes free of the control rod, it will not be possible to mount the pins (1) until they have been reconnected.

Figure 128



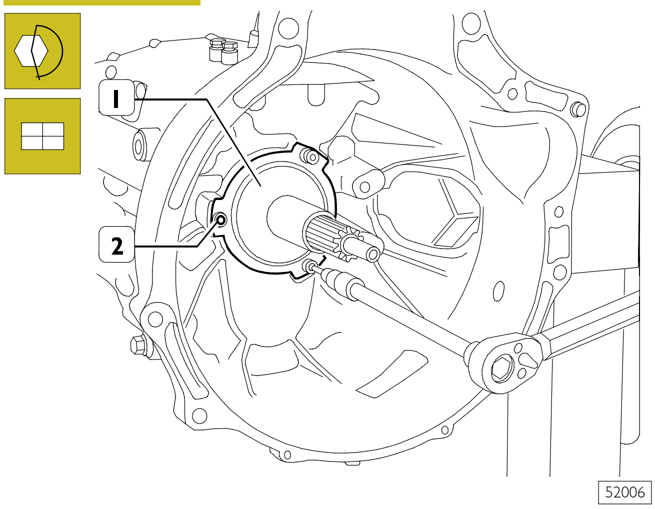
Mount the push rod (1) and the spring (2). Screw on the plug (4) with a new washer (3), tightening it to the required torque.

Figure 129



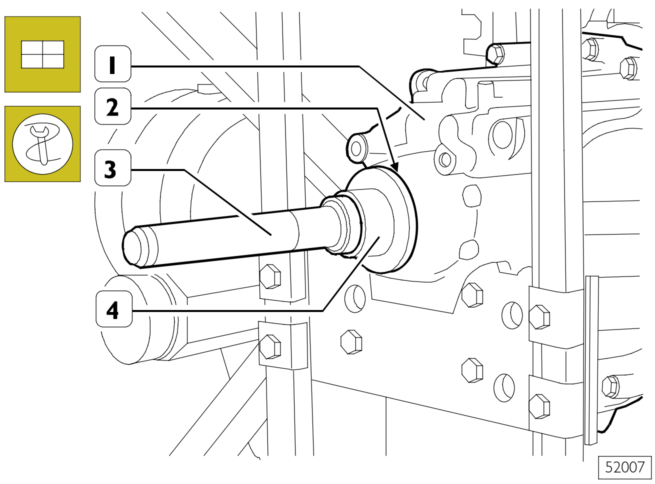
Using the key 9937455 (3), mount the O-ring (2) in the transmission (1).

Figure 130



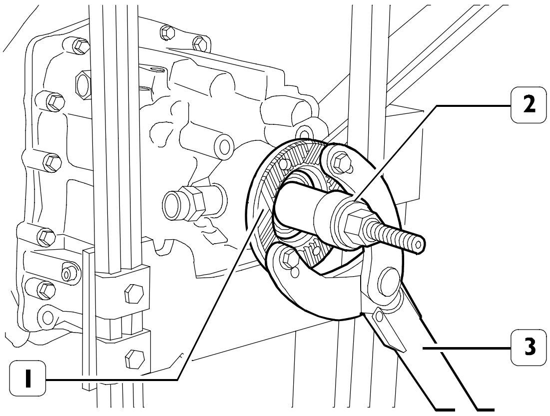
Mount the cover (1) protecting the input shaft and tighten the screws (2) to the required torque.

Figure 131



Mount the O-ring (2) in the rear cover (1) with the key 99374454 (4) and the grip 9937006 (3).

Figure 132



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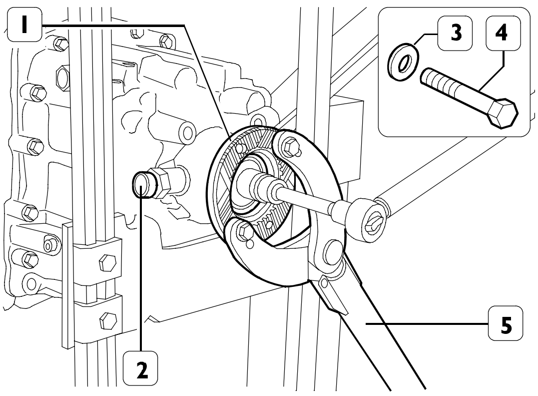
Fit the transmission shaft coupling (1) onto the output shaft.

If there is any interference, use the tool 99370234 (2) for assembly with the lever 99370317 (3) to lock the coupling.

Figure 133



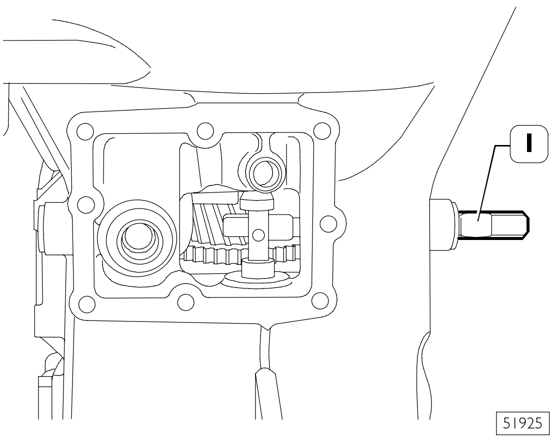
52009

Mount the washer (3) and screw on the screw (4).

Lock the rotation of the flange (1) with the lever 99370317 (5) and tighten the screw (4) to the required torque.

Mount the tachograph sensor (2) and the reversing light switch.

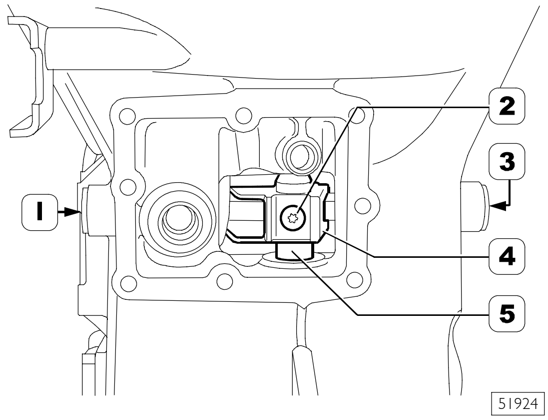
Figure 134



51925

Mount the rod (1) preventing engagement of more than one gear at the same time, in the position marked during disassembly.

Figure 135



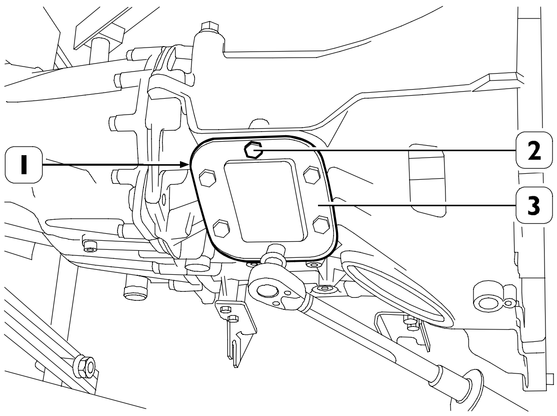
51924

Apply sealant to the thread of the plugs (1 - 3), screw them into the box, tightening them to the required torque.

Position the driver (4) on the rod (5).

Secure it with the screw (2) after applying LOCTITE 242 onto its thread.

Figure 136



52118

Fit a new gasket (1) onto the transmission.

Apply LOCTITE 510 on the screw threading (2).

Mount the side cover (3) and tighten the fixing screws (2) to the required torque.

Mount the control box as described under the relevant heading.

Mount the oil drainage plug, tightening it to the required torque.

Fill the transmission with lubricating oil in the required quantity and grade.

Mount the oil filler and level indicator cap, tightening it to the required torque.

6 S 400 A O.D. Transmission

GENERAL

Gearboxes 6 S 400 A O.D are made up of an electronic/mechanical system controlling and managing the gearbox in the different conditions of vehicle use.

This is the automatic version of the 6 S 400 gearbox unit.

Driver's intervention is just limited to using the gear selection/engagement control lever and the accelerator pedal, so making clutch control pedal application not necessary any more.

The system is equipped with:

- ❑ Safety device preventing vehicle engine start up under determined situations (gearbox central unit managing the ignition).
- ❑ Sound and visual signalling device drawing driver's attention on system operation or faults.
- ❑ Diagnosis device.
- ❑ Provided display unit acquainting about:
  Selected A/M mode;
  Gear;
  Faults status.

The system interfaces to EDC system and ABS8/ESP8 device via CAN line.

On the rear cover there is the speed selection and engagement control support.

On a side of the main casing there is a slot where it is possible to apply a power take-off.

Motion transmission is carried out by a set of helical-toothed constant mesh gears both for forward speeds and for reverse speed.

Splined or machined gears are placed on four shafts: input, main, transmission and reverse shaft.

Gears splined on main and on reverse shaft, idle on straight roller bearings.

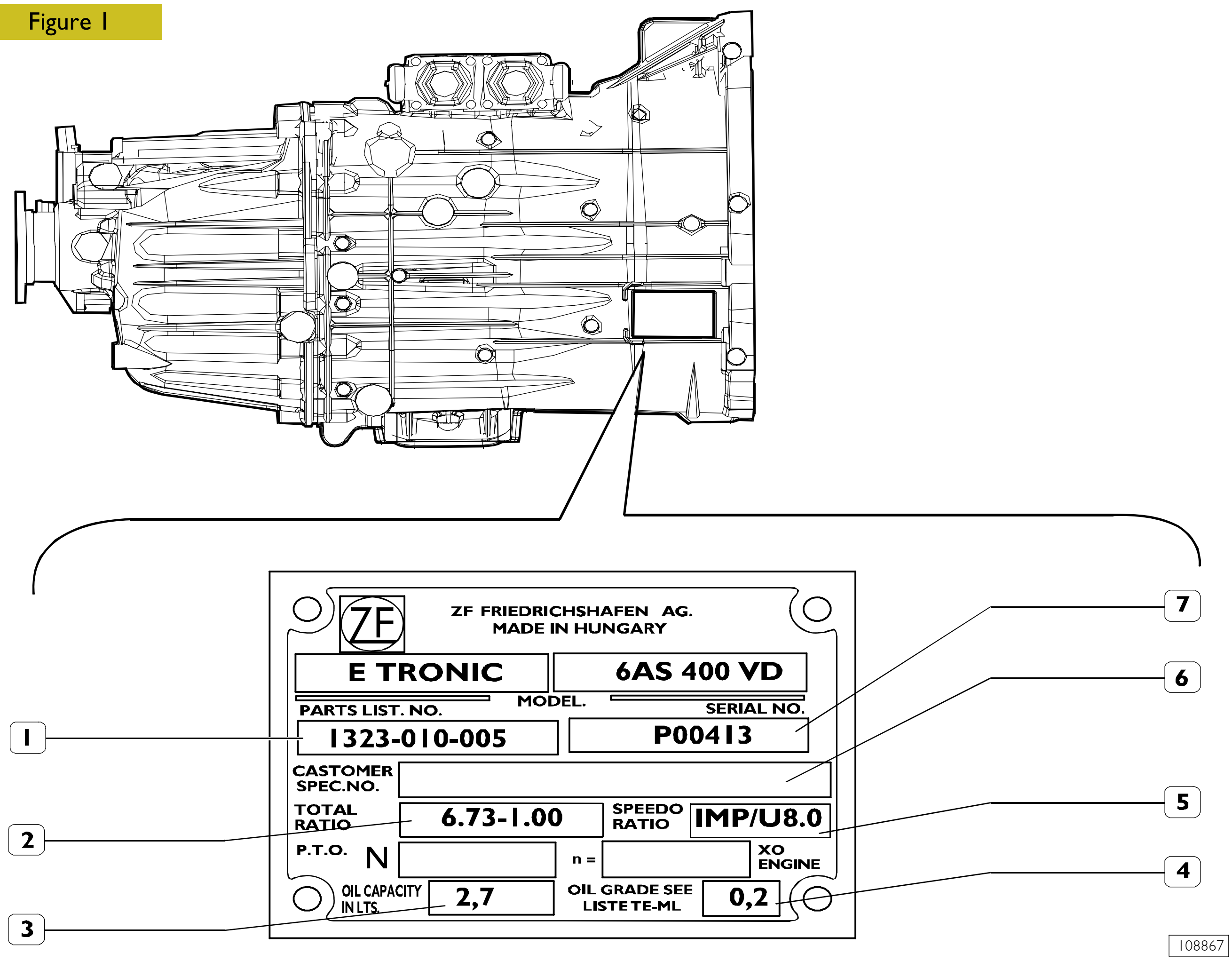
Input and main shaft are supported, in the gearbox, by four-contact ball bearings.

Transmission shaft is supported, in the gearbox, by roller bearings which can be adjusted, axially, by means of ring shims.

The synchronization of the speed engagement is carried out by means of free synchronizer rings having the same dimension for: first, fourth, and fifth speed and a greater dimension for second and third speed.

Speed engagement sliding sleeve control forks, are controlled by one shaft only, the same which supports them.

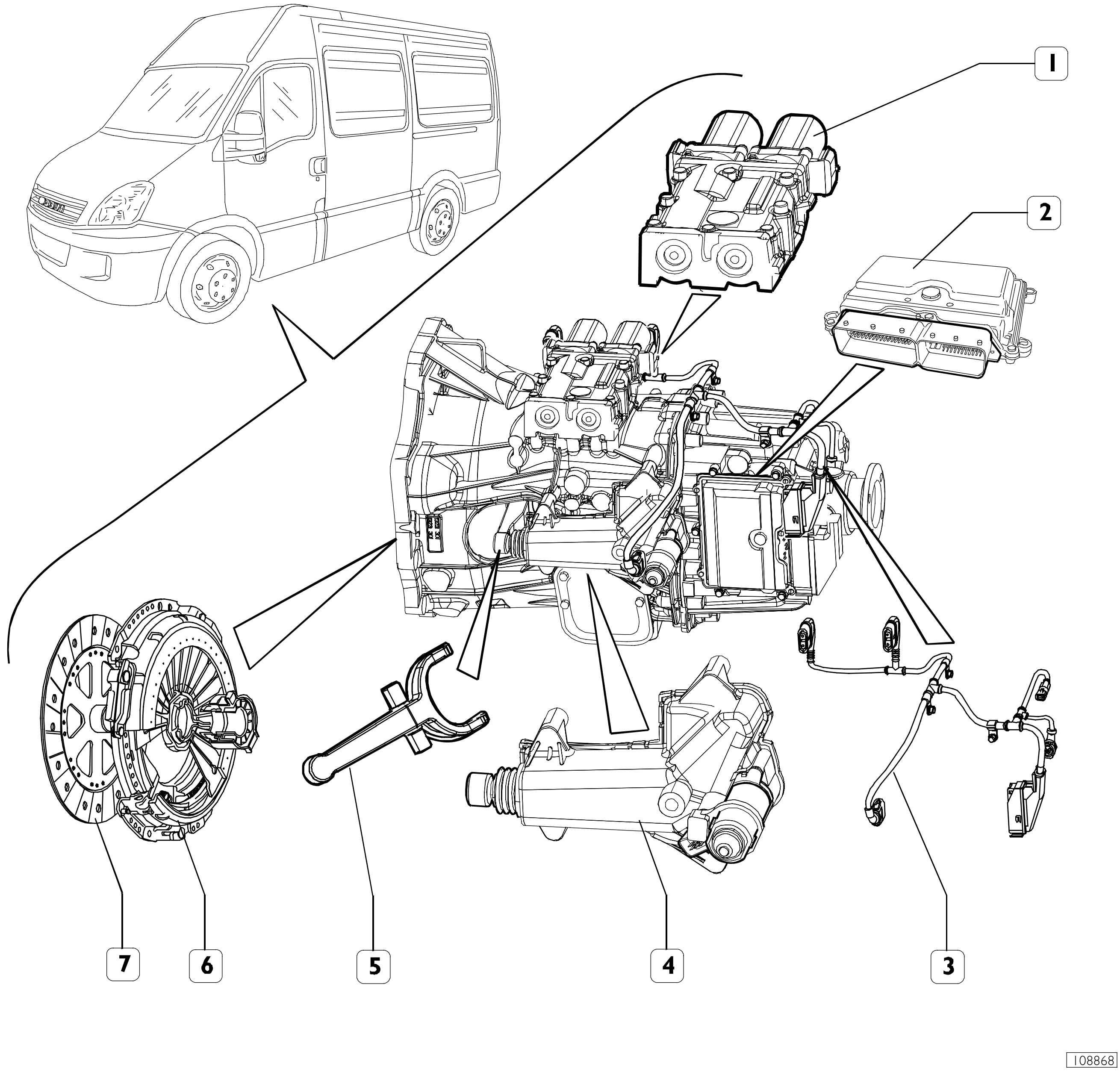
Figure 1



1. Production series number - 2. 1st / 6th gears ratio - 3. Dry oil quantity - 4. Oil rules - 5. Tachograph report - 6. IVECO number - 7. ZF series number.

MAIN COMPONENTS LOCATION

Figure 2



1. Gears actuator - 2. Electronic central unit - 3. Gearbox cable - 4. Clutch actuator - 5. Fork - 6. Flywheel - 7. Clutch disk

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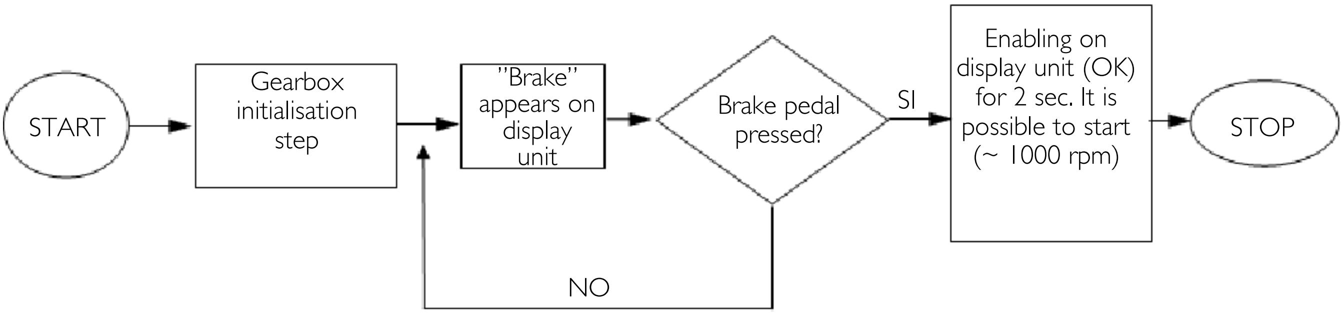
MAIN SYSTEM FUNCTIONS
Startup/start procedure



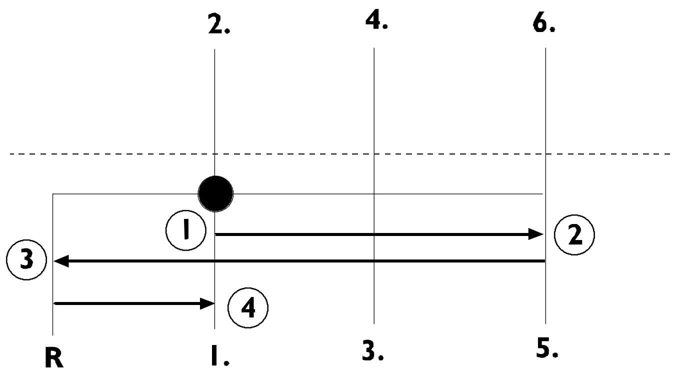
NOTE In order to have correct signalling on the display unit, "keying off" and then "keying on" must be carried out within a time not shorter than 4 seconds, as in the other electronic systems aboard the vehicle. If, after writing "BRAKE" has appeared, the brake is not pressed, the clutch remains shut.

NOTE (FOR MARKET AUSTRALIA ONLY)

The system only enables engine start up with the gearbox in neutral position. If, during engine startup, the gearbox is in 1st or reverse gear position, then the system disables the engine from being started up but warns by an "N" blinking on the display unit that the gearbox has to be put into neutral position in order that start up is enabled.

Check procedures

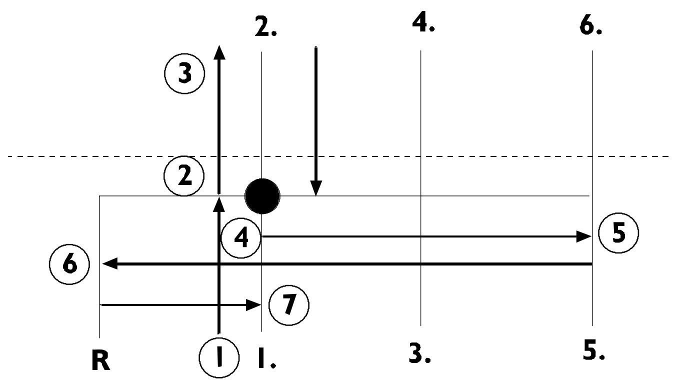
Figure 3



107203

On starting up again the engine after switching off with the gearbox in neutral position, the system carries out above indicated check procedure.

Figure 4



107203

On starting up again the engine after switching off with the gearbox in 1st gear position, the system carries out above indicated check procedure.

Limp Home

Limp Home function allows to remove the vehicle when system faults are so serious that they cannot be automatically managed by the system.

Information loss in gearbox central unit allows to drive in manual mode. Gears allowed depend on fault type:

1. **driving with gears from first to fourth plus reverse gear:** e.g. when B7 speed signal is lost;
2. **driving with first, second and reverse gears:** when accelerator pedal failure is present;
3. **driving with first and second gears:** when gear selector failure is present;
4. **driving with first gear only:** when a failure is present either in selection actuator electrical motor or in the actuator with a gear entered;
5. **locked clutch:** e.g. when clutch actuator is faulty; in this case, the system remains in its current condition.

Buzzer

The buzzer is activated in following situations:

- ❑ To warn about faults such as clutch slipping. Through a calculation algorithm, threshold temperature overflow is signalled by an intermitting Beep sound.
- ❑ To show reverse gear being entered (intermitting Beep sound) or warn about driver's door being opened with a gear entered and engine on (intermitting Beep sound).
- ❑ To warn about parking brake not operated with the engine off (KEY ON) and the gearbox in neutral position. It warns about the danger that the vehicle might skid (intermitting Beep sound).

Start up with tow

- ❑ Select 1st gear (clutch is open)
- ❑ start towing the vehicle
- ❑ once a speed of 12 km/h has been reached, the clutch shuts engaging the gear and starting up the engine.

NOTE if you are towed, use neutral gear position before using accelerator pedal. On the contrary, if you are skidding on sloping down, drive normally.

NOTE Starting up with reverse gear is not suggested.

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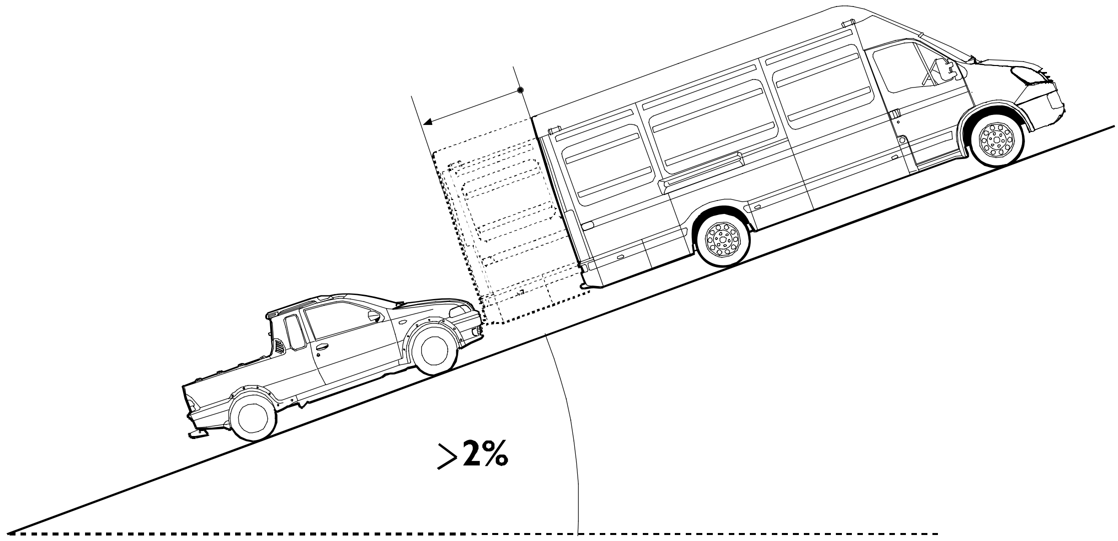
HILL HOLDER (FUNCTION ONLY AVAILABLE TO VEHICLES WITH ESP8 BRAKING SYSTEM)

Functional features

Figure 5



- It prevents the vehicle from moving either uphill with 1st gear or downhill with reverse gear after releasing brake pedal.
- It keeps that brakes pressure which was applied by driver's foot.
- Brakes pressure is kept up to 2 s. This time is sufficient to driver to displace his/her foot from brake pedal to accelerator pedal in order to perform start operation in an easier way.
- 2-second safety concept is applied in order to prevent driver from going out of the vehicle as if it was parked.
- If the vehicle is skidding with its wheels locked, the brakes are released in order to maintain its stability.

Activation:

- Stopped uphill/downhill (>2% slope)
- Press brake pedal
- 1st gear (uphill) reverse gear (downhill)

Deactivation:

- Start
- shifting from 1st to reverse gear (uphill) or from reverse gear to neutral (downhill)
- clutch shutting
- 2 sec. after releasing brake pedal
- with hand brake engaged (signal from ESP 8 central unit).

SYSTEM STRUCTURE
System central unit

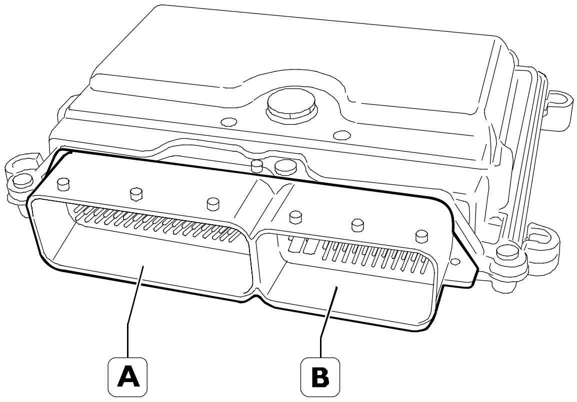
The electronic central unit receives signals from sensors/switches; on these signals, it bases management and control of the system in the different operation conditions of the gearbox.

It is interfaced with other electronic systems on board, such as EDC and ABS, through CAN communication lines.

A - Gearbox side connector

B - Vehicle side connector

Figure 6



From the connection to EDC 16 system, gearbox central unit is able to detect accelerator pedal position and engine rpm's.

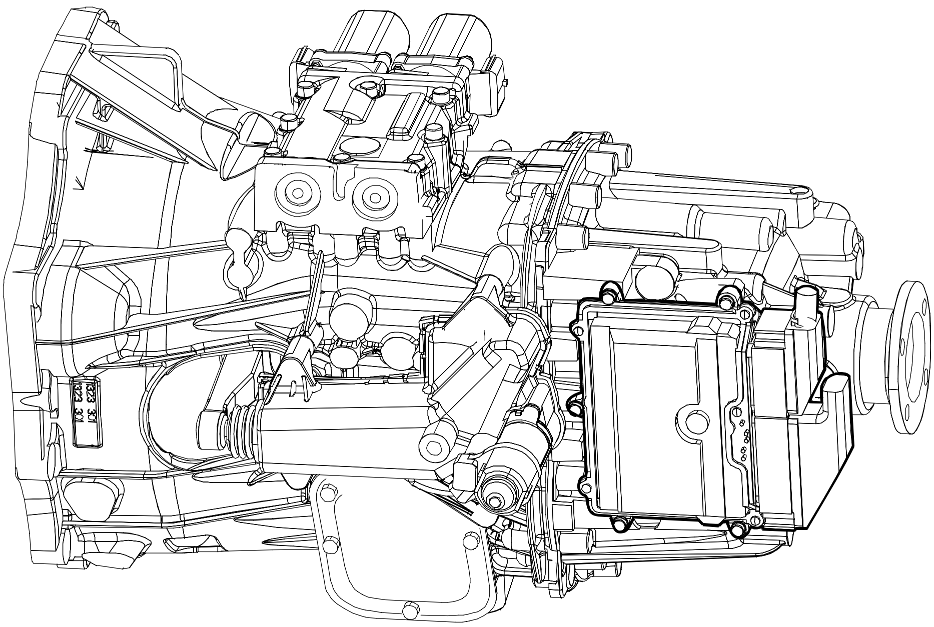
Connection with ABS8/ESP8 central unit is used to prevent gear shift "UP" on bending and manages the drive in low adhesion conditions in case of drive in mode "A" (automatic mode).

New ABS system manages "intelligent" warning lamps integrated into board panel. Their going on shows a failure in braking system.

NOTE Signal "Brake", at start up, is directly coming from EDC central unit.

Reverse gear signal is direct.

Figure 7



Central unit location

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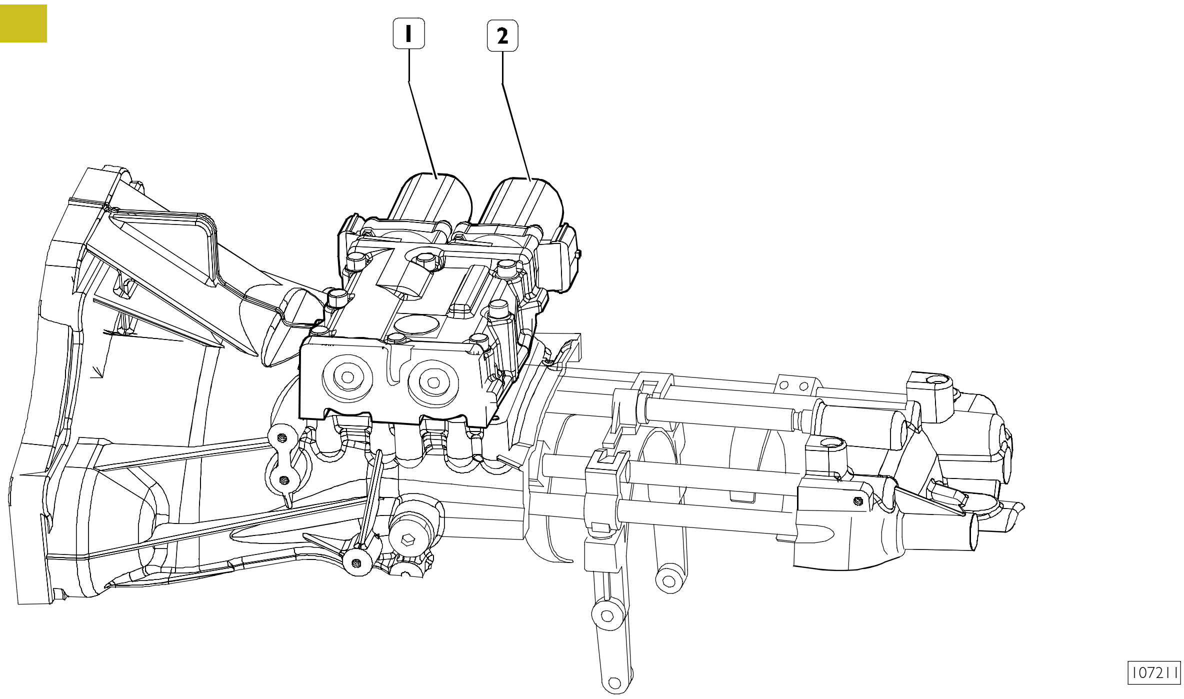
Gears actuator

Figure 8



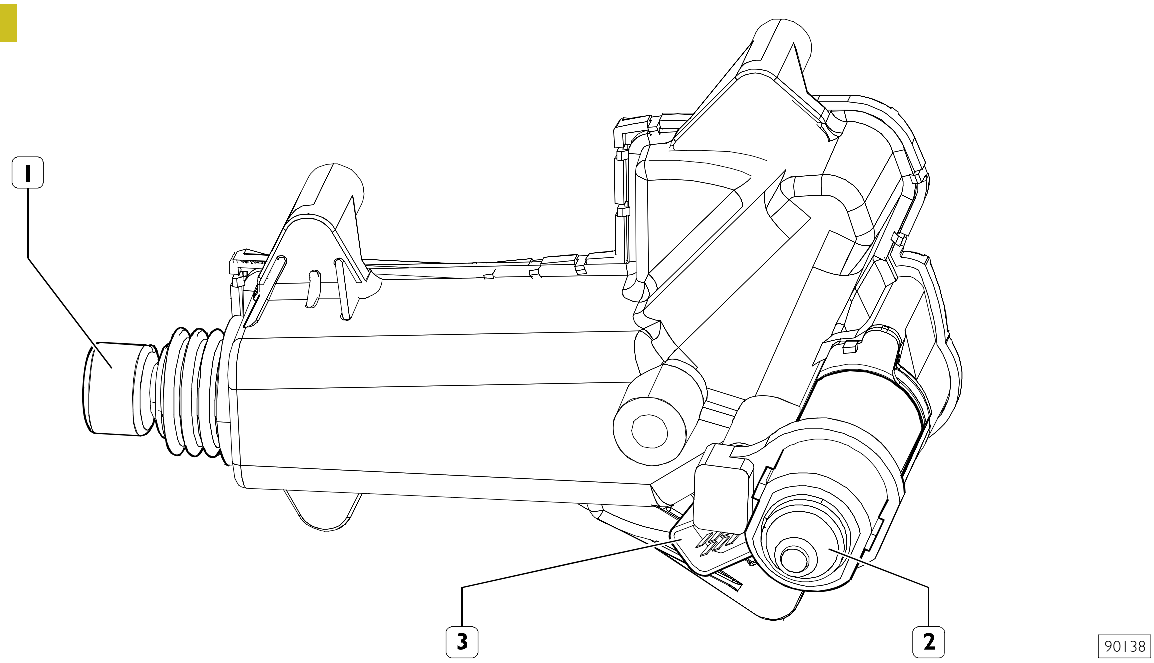
Gear engagement electrical motor - 2. Gear selection electrical motor

Gears actuator has the task of continuously exchanging gears selection and engagement information with electronic central unit.

It is made up of two electrical motors, drive cylinders, and their sensors.

Clutch actuator

Figure 9



1. Actuator cylinder - 2. Electrical motor - 3. Vehicle electrical wiring harness junction block

It is made up of:

- ❑ One cylinder operating on clutch engaging/disengaging lever.
- ❑ One position sensor detecting clutch lever travel and acquainting the electronic central unit of actuator cylinder position and clutch disk wear.

Accelerator pedal

To detect engine idling position and enable clutch entering at vehicle start, N.O. switch is used with pedal released; the switch is integrated in position sensor.

This signal comes to EDC central unit and is sent to gearbox central unit through VDB (Vehicle Data Base) CAN line.

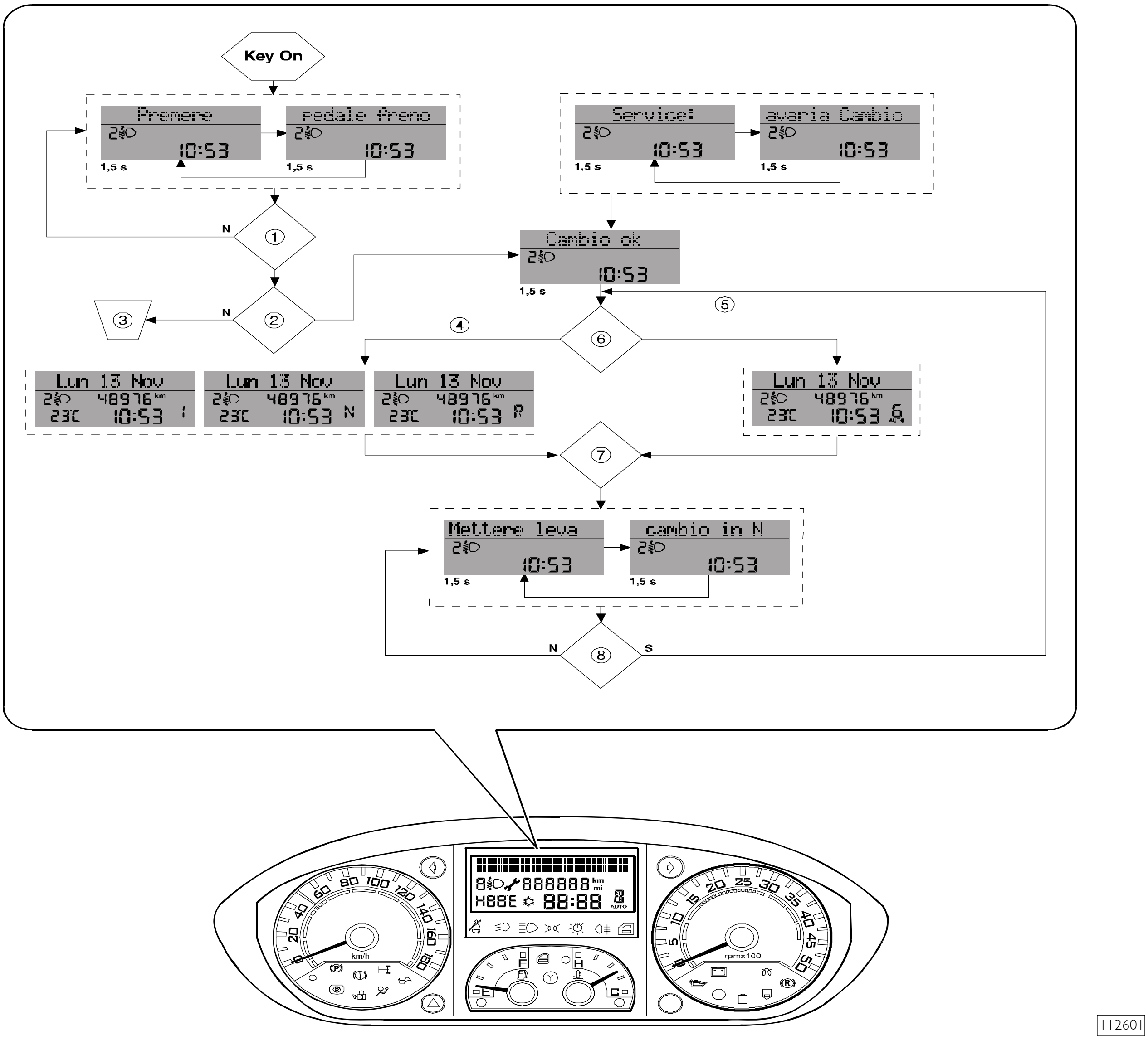
During ride, "kick down" function can be activated in automatic mode.

In conditions where the pedal is 98% pressed, e.g. on overtaking, the system automatically shifts down by one gear, so allowing to best exploit the drive torque.

In practice, if accelerator pedal is fully pressed, a drive with an engine rotation speed with higher gear shift is chosen.

Display unit

Figure 10

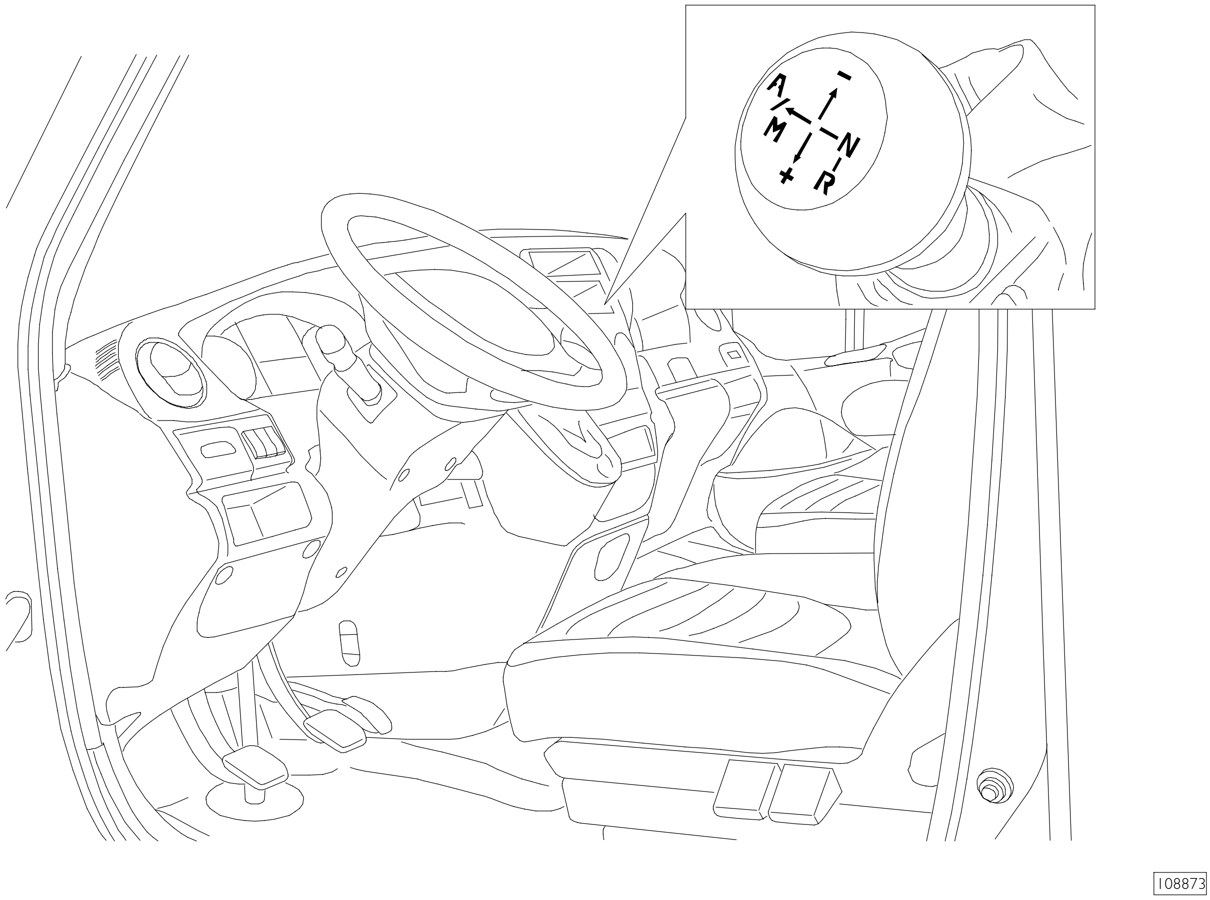


The display unit, positioned on instrument panel allows to display all information needed for system correct use, e.g.:

- Mode: manual or automated, and, in both cases, gear ratio entered;
- Reverse/neutral (R/N) position;
- Faults signalling:
  - SERVICE: gearbox failure
  - SERVICE: serious gearbox failure (associated to acoustic warning signal)
  - SERVICE: excessive clutch temperature (associated to acoustic warning signal)
  - Gearbox failure in "SERVICE" mode (this message is displayed only at the Dealership Centres)
- Failure code at page 50 can only be displayed through diagnosis tool.
- Vehicle status: gear entered.

Gear selector

Figure 11



- Capability to switch from automated to manual mode selection and from manual to automated mode selection by operating the lever leftwards. In this way, entered gear / rpm is not lost on shifting.
- Capability to skip gears: by repeatedly operating the lever, a gear which is correct and suitable to the speed is entered (3-4 gears can be skipped, too).
- Central "N" - Neutral - position and "R" - reverse positions are stable.
- The gearbox shows that gear with which you stopped. Should the gear be entered, the system opens the clutch in order to enable engine start up.
- The system optimises the performances by identifying a drive style depending on how accelerator pedal is operated. If accelerator pedal is fully pressed, a drive with an engine rotation speed with higher gear shift (~ 3900 rpm) is chosen.
- Complete signalling on the display unit showing:
  mode (manual or automated)
  reverse/neutral position
  failure/misuse with sound warning (e.g. clutch overheating).
- On bending, shifting "UP" is inhibited. This function persists for some metres after the exit from the bend.

Gear shitting

- It is either in manual mode by operating on gears lever or in automated mode. Gear shifting is without releasing the accelerator pedal. The system opens the clutch, enters the gear and shuts the clutch.
- Clutch pedal is not present.

Vehicle parking

On vehicle putting off operation, the system automatically opens the clutch, then shuts it back, without the need of positioning the lever to neutral position. In these conditions, the clutch is shut and parking with the gear entered is enabled.

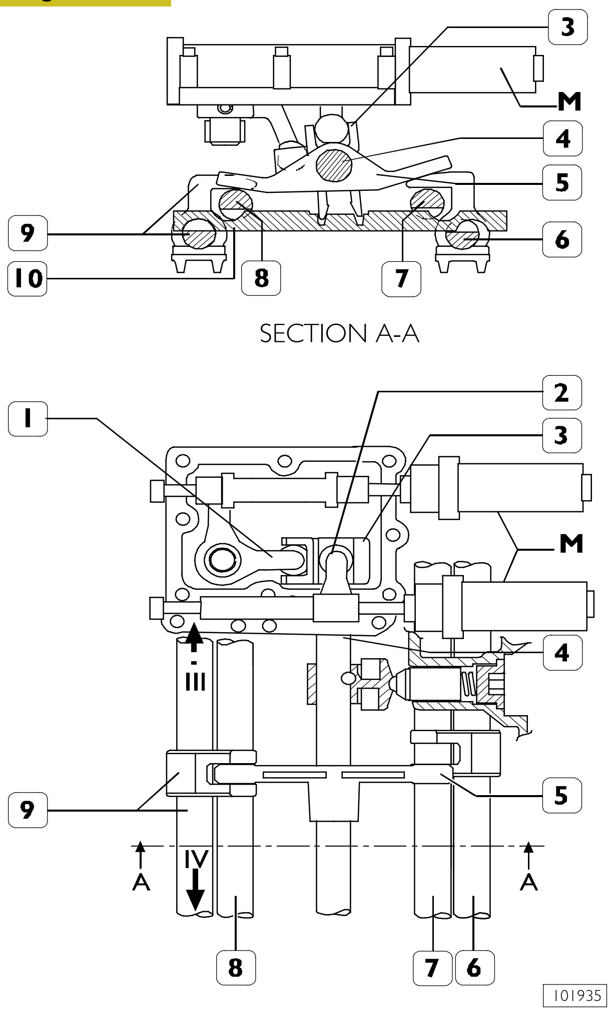
GEAR SELECTION AND ENGAGEMENT

The combined action of the selector lever (2) and the engagement lever (1) cause the rotation and axial movement of the rod (4) in two subsequent steps to engage the required gear by means of the rods (8-7-6 and 9).

The motion of speed selection/engagement levers occurs through the action of two electric motors (M) managed directly by the gearbox electronic control unit.

Neutral arrangement and/or 3rd/4th gear selection and engagement arrangement

Figure 12



3rd/4th gear selection

According to the angular position of the selector lever (2), the slider (3) turns with the rod (4) (which is integral) and the selector (5) arranges the slider on the 3rd/4th gear rod (9). At the same time, the slider (3) moves the rod (10) to prevent the simultaneous engagement of two gears, to keep the 3rd and 4th gear engagement rod (9) free and to prevent movement of the other rods by engaging the grooves in the rods.

3rd/4th gear engagement

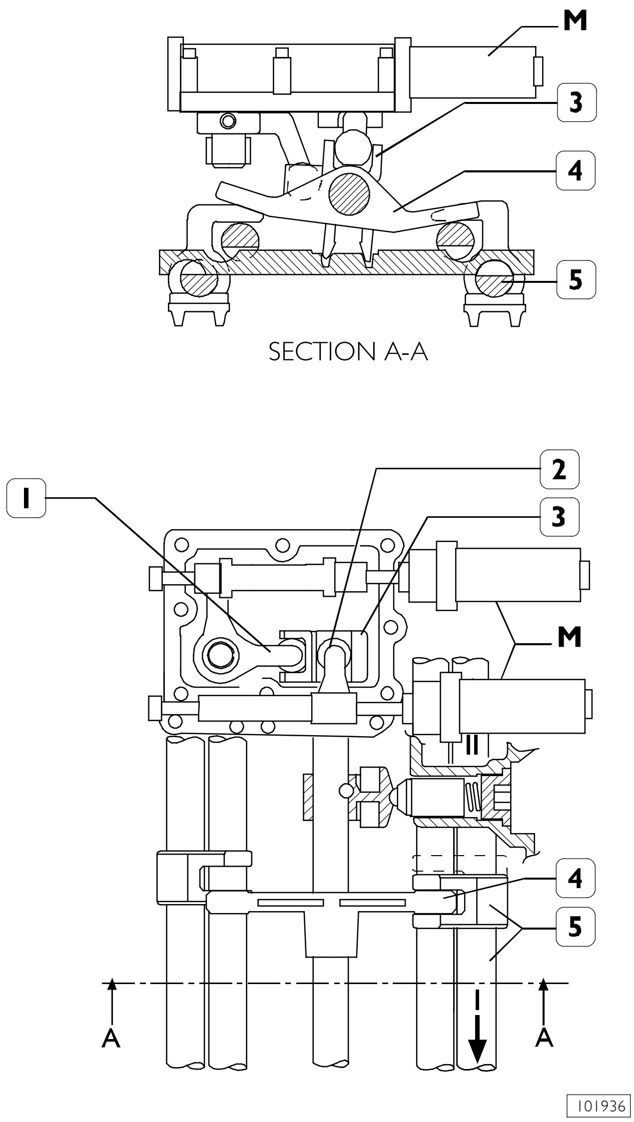
According to the movement of the engagement lever (1), the slider (3) axial moves the rod (4) (which is integral), the selector (5) (previously arranged) and consequently the chosen 3rd and 4th gear engagement rod (9).

Neutral position coincides with the 3rd/4th gear selection arrangement.

In this case, the vertical axis of the selector lever (2) is exactly at 90° with respect to the horizontal axis of the control corresponding to no angular variation of the rod (4).

1st/3rd gear selection election and engagement arrangement

Figure 13



This arrangement is obtained by moving the selector lever (2) anticlockwise. In this way, the selector (4) is inserted in the 1st/2nd gear engagement rod (5).

By moving the lever (1), the slider (3) will axially move the 1st/2nd gear engagement rod (5).

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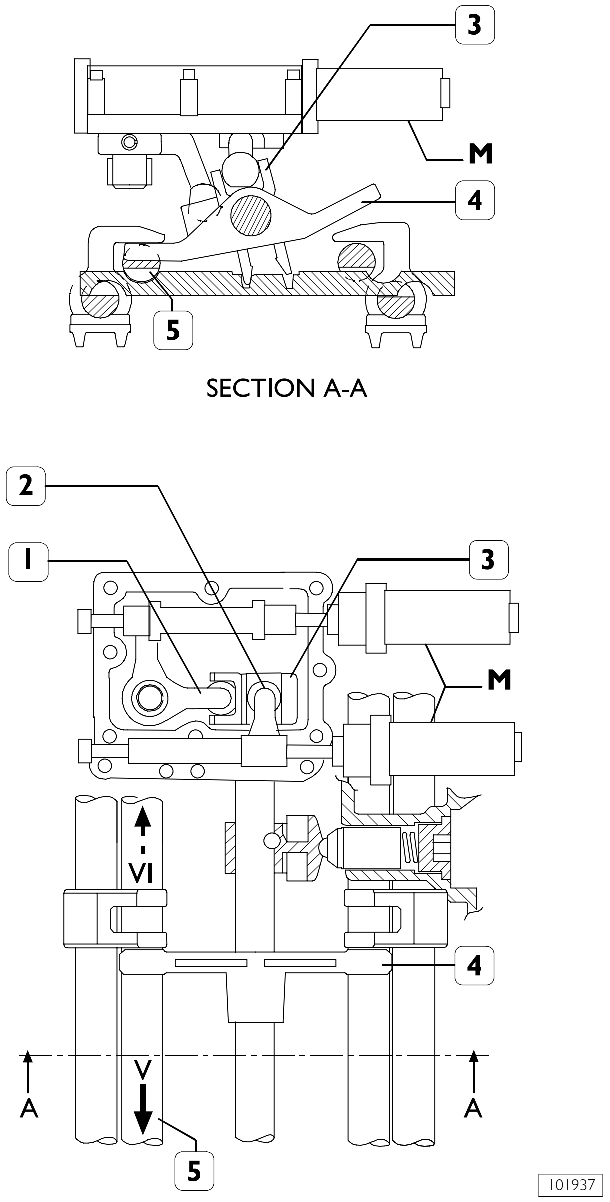
5th/6th gear selection and engagement arrangement

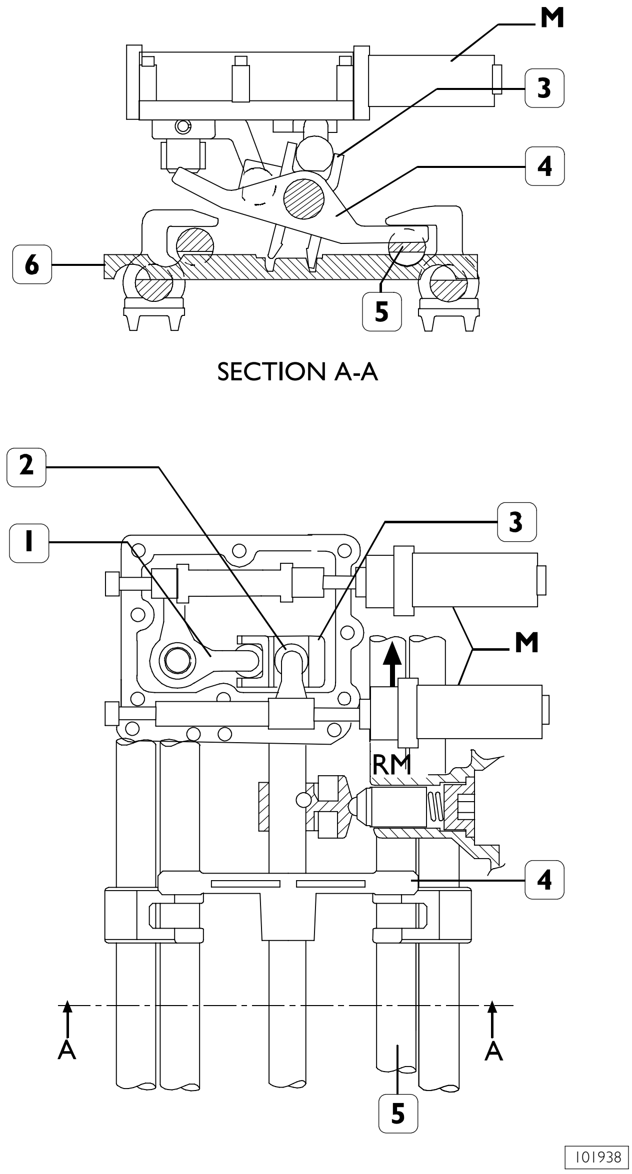
Figure 14



This arrangement is obtained by moving the selector lever (2) clockwise. In this way, the selector (4) is inserted in the 5th/6th gear engagement rod (5).
By moving the lever (1), the slider (3) will axially move the 5th/6th gear engagement rod.

Reverse gear selection and engagement arrangement

Figure 15



This arrangement is obtained by moving the selector lever (2) anticlockwise. In this way, the selector (4) is inserted in the reverse gear engagement rod (5).
By moving the lever (1), the slider (3) will axially move the reverse gear engagement rod (5).

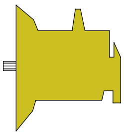
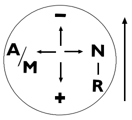
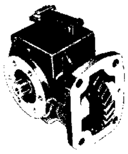
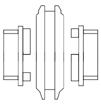
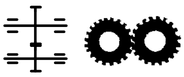
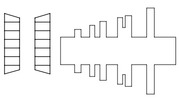
Safety device

The transmission is equipped with a device which prevents the simultaneous engagement of two gears.

It consists of a suitably shaped rod (6) fitted transversally in the transmission box.

The slider (3), moves the rod (6) under the action of the lever (2). This keeps the selected gear engagement rod free and prevents movement of the other gears by engaging their respective grooves.

SPECIFICATIONS AND DATA

	TRANSMISSION	6 S 400 A O.D.
	Type	Mechanical
	Input torque	400 Nm
	Weight	72 kg
	Speeds	6 forward speeds 1 reverse speed
	Speed control	Electronic
	Power take-off	Optional (HYDROCAR type only)
	Speed engagement: Forward speeds ❑ 5th/6th - 3rd/4th ❑ 1st/2nd Reverse speed Speed retention mechanism	 Single-cone synchronizer Dual-cone synchronizer Quick-connect (non-synchronized) type Sliding sleeves retained by pawls and springs.
	Gears	Helical-toothed constant mesh gears
	Gear ratio First Second Third Fourth Fifth Fifth Reverse	 6.727 3.947 2.555 1.776 1.289 1.000 6.055
	Shaft bearings: Main shaft Transmission shaft	 watertight ball bearing tapered roller

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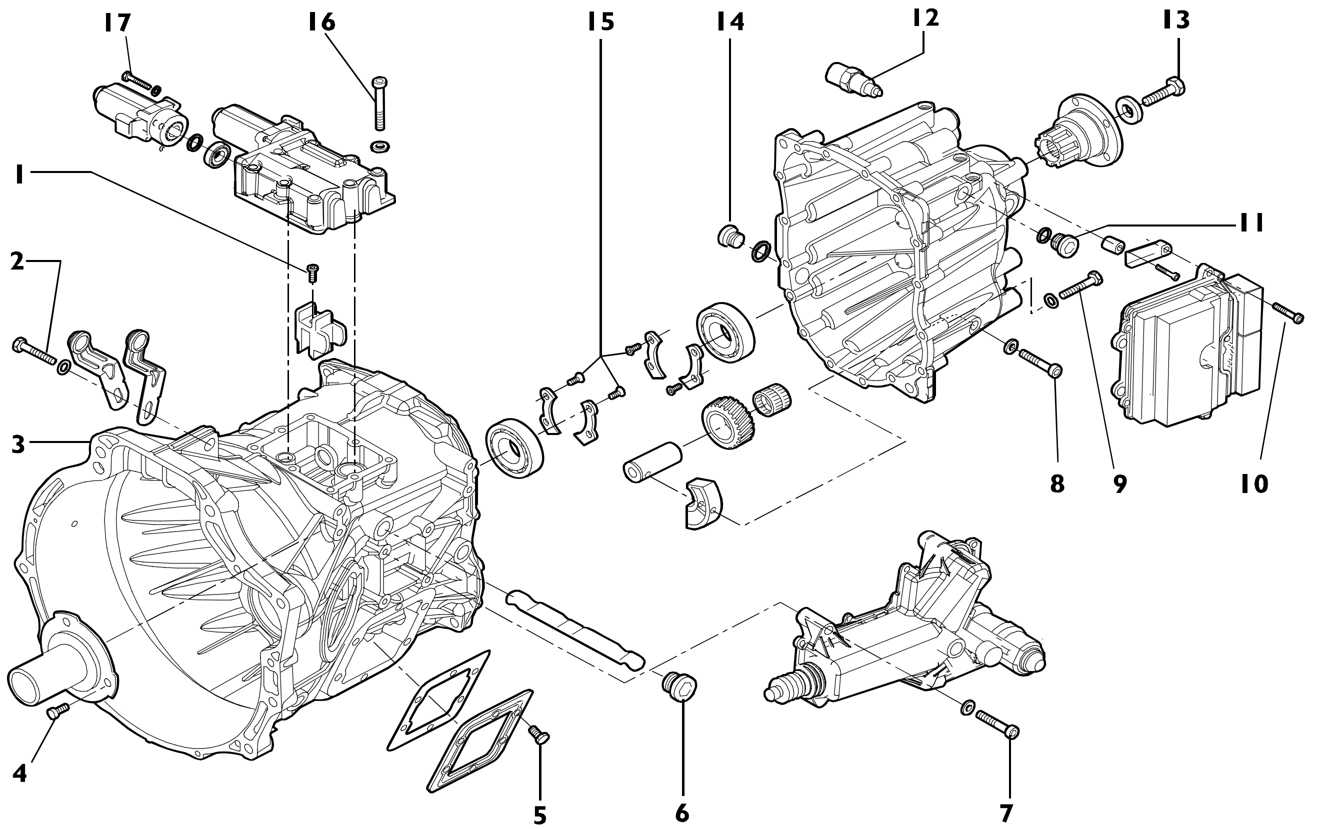
SPECIFICATIONS AND DATA

Transmission shaft bearing end play	0 ÷ - 0.05 mm
Transmission shaft bearing end play adjustment	by shims
Shim thickness for transmission shaft bearing end play adjustment	-
Main shaft Temperature for fitting: ❑ hubs for sliding sleeves ❑ 1st-R gear bushes and spacer ring ❑ front bearing*	 80° ÷ 110°C 80° ÷ 110°C 90° ÷ 110°C
Transmission shaft Temperature for fitting: ❑ bearings ❑ 5th-4th gears	 80°C (max 120°C) 170°÷160°C
Gear end float: 1st - 3rd - 4th - R - 5th gear 2nd gear	 0.15 ÷ 0.40 mm 0.25 ÷ 0.5 mm
5th - 4th gear sliding sleeve hub retaining ring end float	0 ÷ 0.15 mm
5th - 4th gear sliding sleeve hub retaining ring thickness	-
Retaining ring end float: ❑ transmission shaft front bearing ❑ main shaft roller bearing	 0 ÷ 0.1 mm 0 ÷ 0.1 mm
Transmission shaft rear bearing retaining ring thickness	-
Sealant	LOCTITE 510 LOCTITE 242 LOCTITE 5206
Type of oil: Quantity	**TUTELA TRUCK GEARLITE** 2.7 litres 2.43 kg

* = Do not use hot air equipment to heat bearing.

TIGHTENING TORQUES

Figure 16



	DESCRIPTION	TORQUE	
		Nm	kgm
1●	Screw securing driver to main rod	9.5	0.9
2	Gearbox actuator support fastening screw	23	2.3
3	Clutch housing, screw to fasten clutch housing to crankcase	80	8
4	Constant mesh shaft cover fastening screw	23 ± 15%	2.3 ± 15%
5■	Screw securing p.t.o. side cover	46 ± 15%	4.6 ± 15%
6	Plugs for rod preventing gear engagement	32	3.2
7	Clutch actuator fastening screws	23	2.3
8	Screw securing reverse gear shaft	23 ± 15%	2.3 ± 15%
9*	Screw securing rear cover	23 ± 15%	2.3 ± 15%
10	Electronic control unit fastening screws	9.5	0.9
11	Side plug on rear cover	35	3.5
12	Speedometer transmitter fixing	50	5
13	Screw locking sleeve for transmission coupling on main shaft	235	23.5
14	Cap	32	3.2
15●	Screw securing ball bearing retaining ring	9.5 ± 15%	0,. ± 15%
16	Gearbox actuator fastening screws	23	3.2
17	Electric motor fastening screws	-	-

* Spread LOCTITE 5206 sealant on the contact surfaces
● Spread LOCTITE 242 on the thread
■ Spread LOCTITE 510 on the thread

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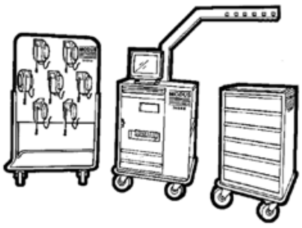
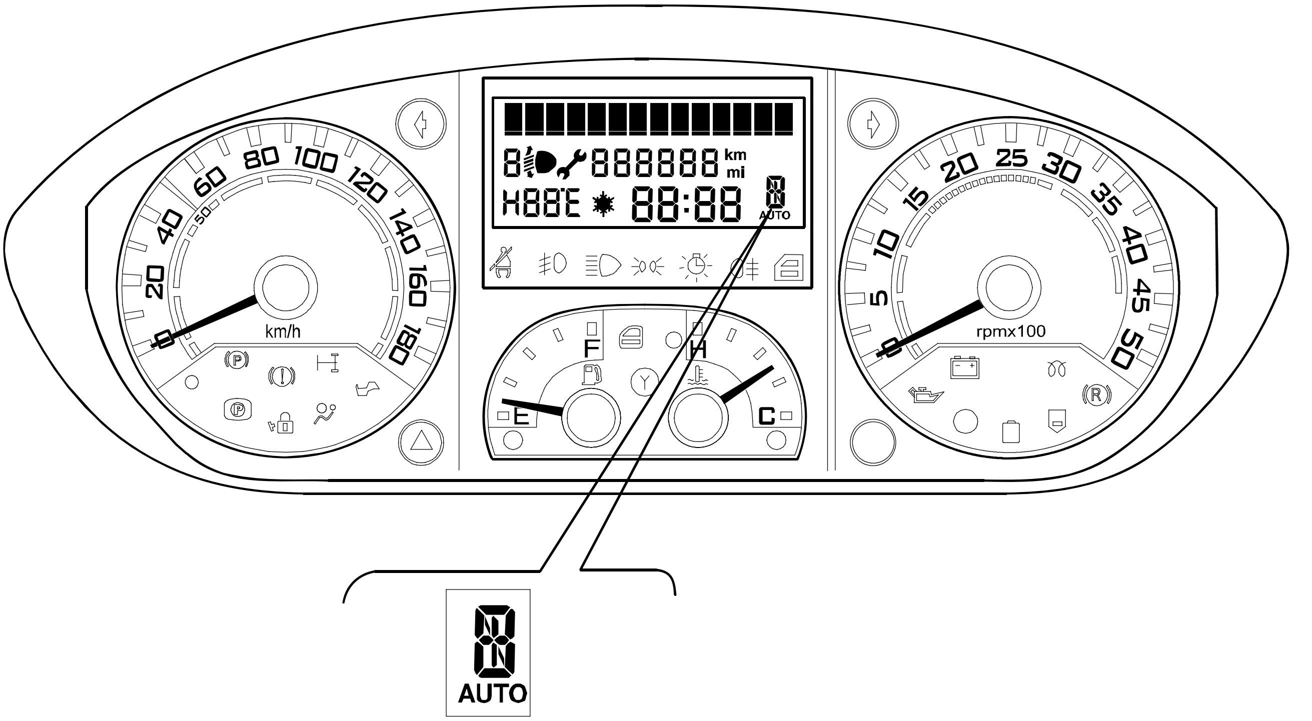
TOOLS

TOOL NO.		DESCRIPTION
99327010		E.A.SY.
99327001		Modus station

DIAGNOSIS
Diagnosis instruments
DISPLAY

Figure 17



System fault displayed with symbols indicated in figure.

MODUS

Computer-assisted diagnosis station intended for diagnosis of electronically-controlled braking systems, pneumatic suspensions, engines and systems.

This station is equipped with auxiliary functions such as electronic control unit programming, spare part catalogue referencing, time-charts, etc.

IT 2000

IT 2000 is a diagnosis instrument for all Electronic Systems fitted to IVECOvehicles. It allows you to promptly operate on a vehicle by recognizing the latter by means of the chassis number.

It stores the results of the diagnostic work carried out.

It can also be used as a laptop PC and is set for remote diagnosis.

Using MODUS as a mother station allows you to update and configure IT 2000.

E.A.SY.

The E.A.SY. system allows you to easily diagnose and program the various electronic controls unit fitted to the vehicle. It is made up of an ECI module for communication with the electronic control units and a Panasonic PC.

The ECI module allows you, by taking advantage of the Panasonic PC, to easily carry out work on the road; in particular, diagnostic work can be assisted by a specialized remote centre, thanks to the wireless technology incorporated into the Panasonic PC (e.g. GPRS).

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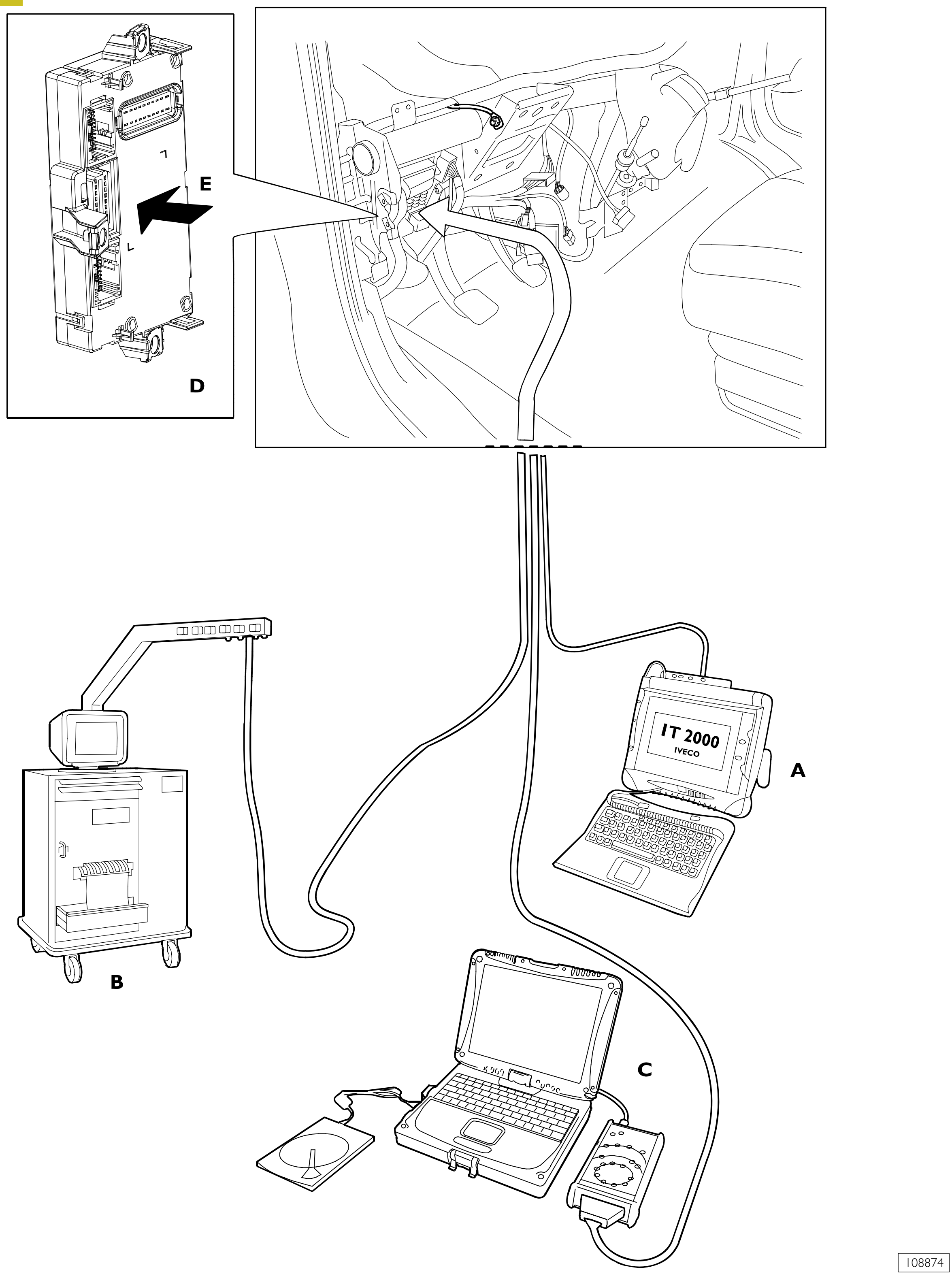
MODUS - IT 2000 - E.A.SY. CONNECTION

The 38-pole connection makes it possible to perform the following operations:

- ❑ Gearbox control unit data reading
- ❑ Error (if any) detection and clearing
- ❑ Clutch engagement/release control
- ❑ Control unit configuring

Figure 18



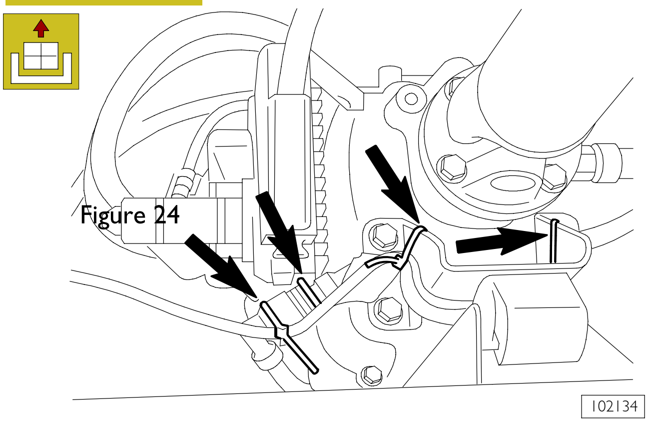
A. IT 2000 - B. E.A.SY. - C. MODUS - D. Body computer - E. Diagnosis socket.

530210 GEARBOX REMOVAL/REFITTING

Removal

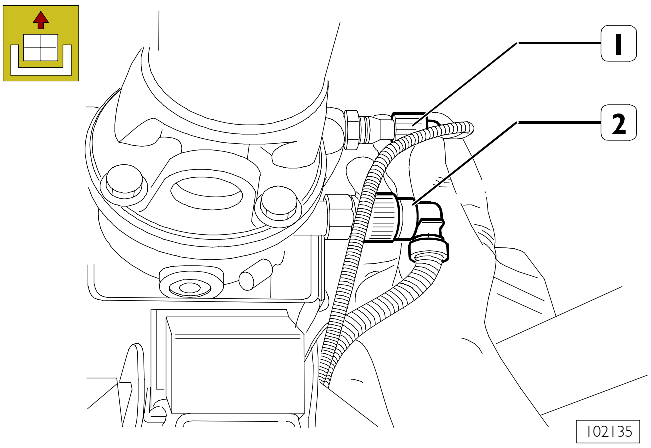
Disconnect the battery cable in engine opening.
Place the vehicle in a pit, or on an auto lift or special supporting stands.

Figure 19



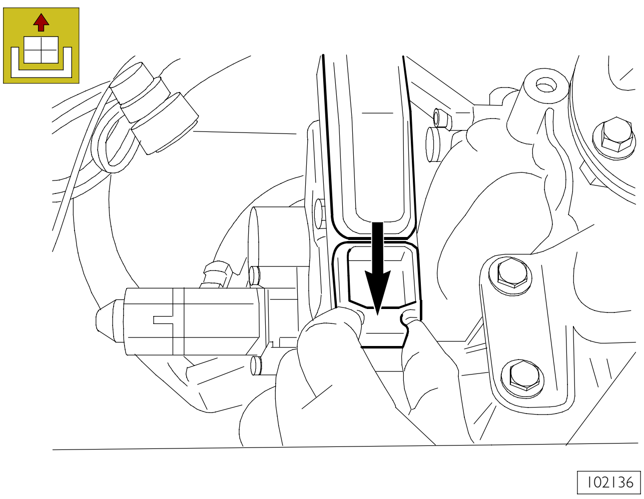
Remove the straps (shown by arrows) that secure the electric cable to the gearbox.

Figure 20



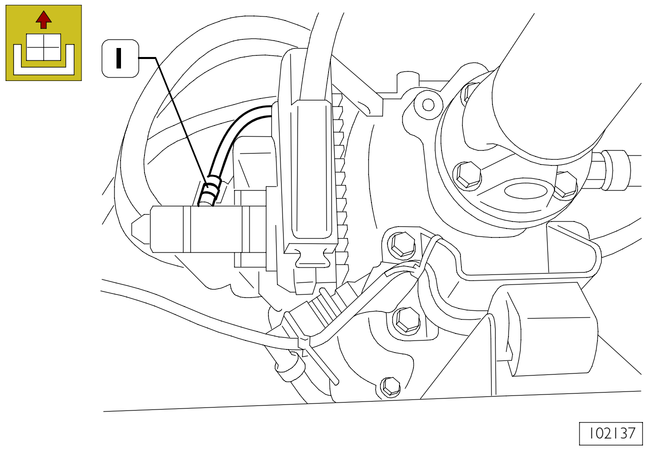
Remove reverse gear light connectors (1) and revs number sensor (2).
Remove the power take-off electric connections (if any) from the other side of the gearbox.

Figure 21



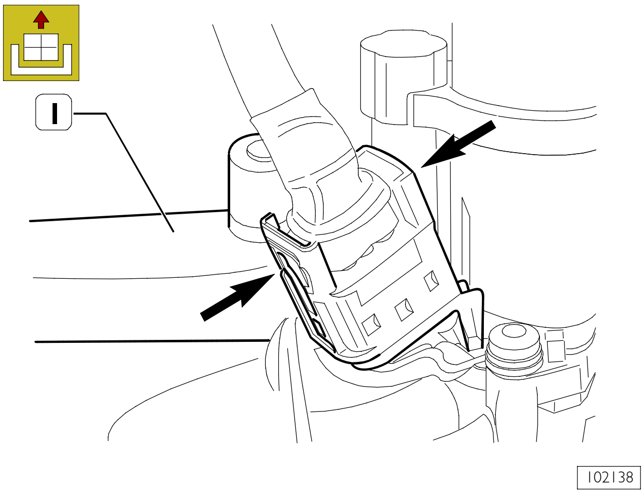
Push the safety retainer downwards, then remove the connector form the control unit (see arrow).

Figure 22



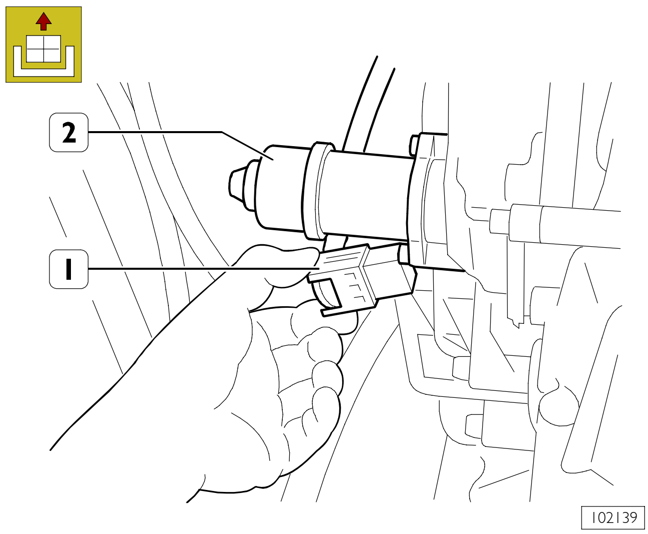
Remove electric cable fastening strap (1) on the clutch actuator side.

Figure 23



Press clutch actuator connector pull-back spring (1), as shown by the arrow

Figure 24



Remove connector (1) from clutch actuator (2).

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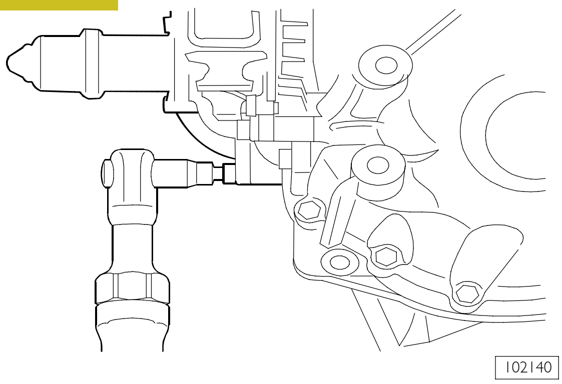
Figure 25

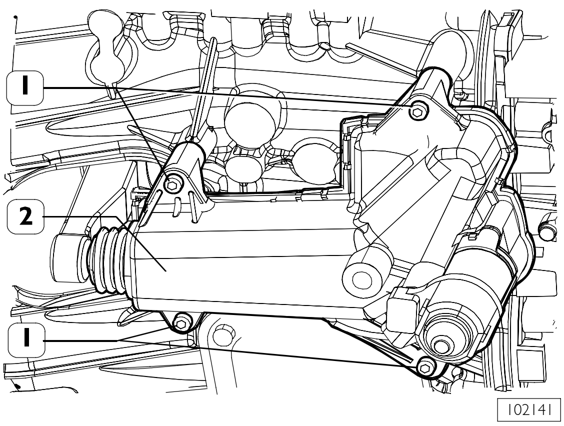


Prior to removing the actuator, verify that the clutch is closed. This can be done either by means of the diagnosis instrument or by visually inspecting the position of the fork which must be perpendicular to the gearbox axis.

In the event that the clutch has been left open, due to a mechanic or electric fault, the fork will be loaded by the actuator internal spring

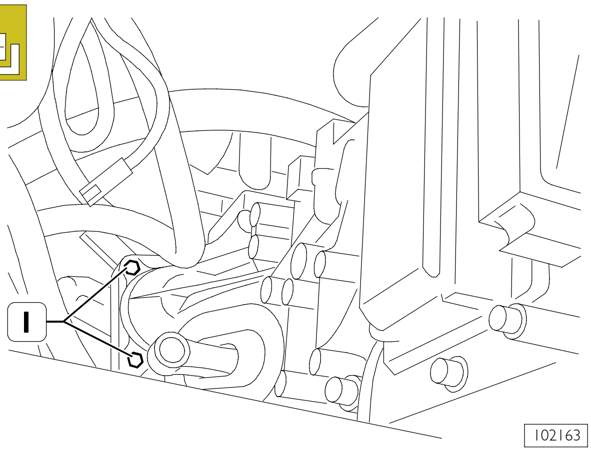
Therefore, avoid touching the engaging tip straight with your hands.

Figure 26



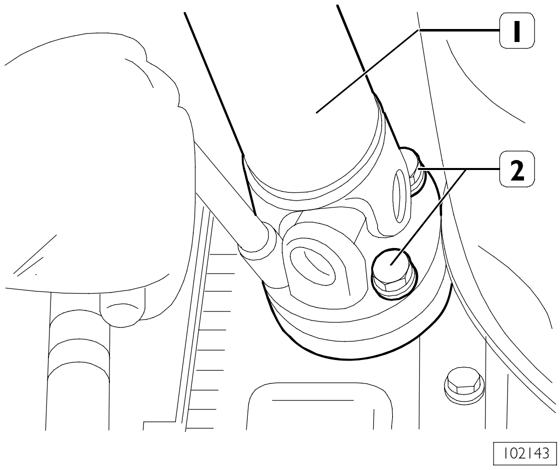
Remove the four clutch actuator fastening screws (1).
Take off actuator (2).

Figure 27



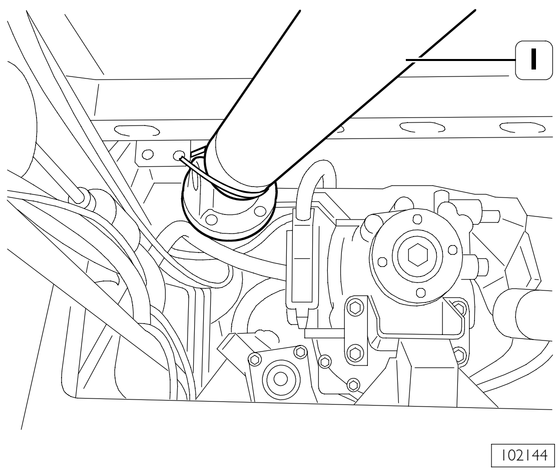
Remove screws (1) securing the starting motor to the gearbox case front cover. Then, place it carefully in the engine compartment.

Figure 28



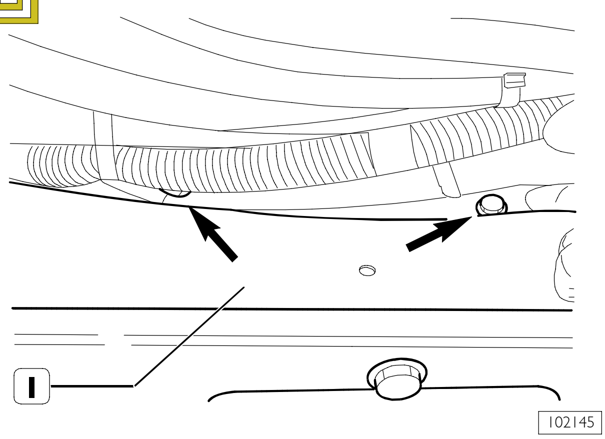
Unscrew the four screws (2) securing drive shaft (1) to the gearbox.

Figure 29



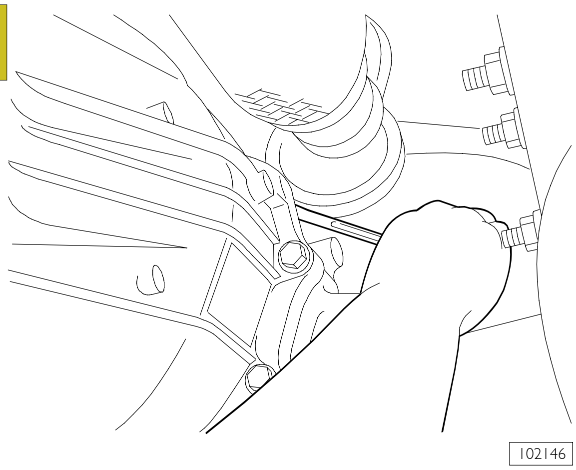
Properly secure drive shaft (1) to the chassis.

Figure 30



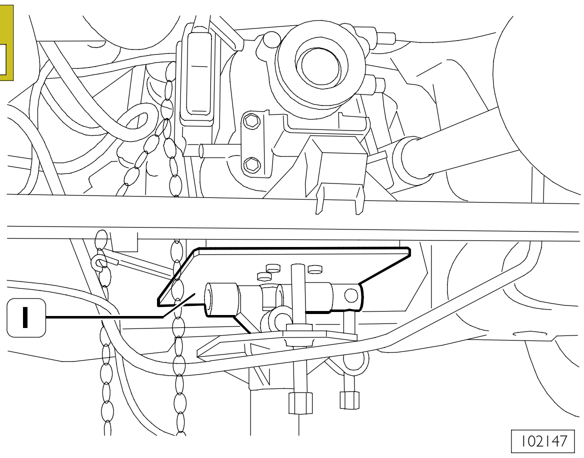
Remove the two hexagonal screws (1), then take off the engine lower cover (opposite the axle).

Figure 31



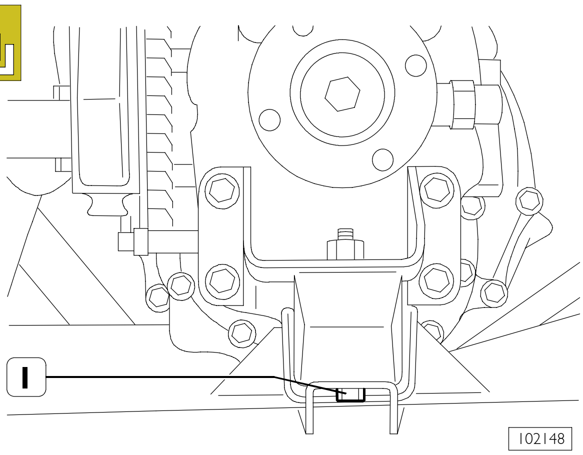
Before mounting bracket 99372069, remove a number of screws securing gearbox to block.

Figure 32



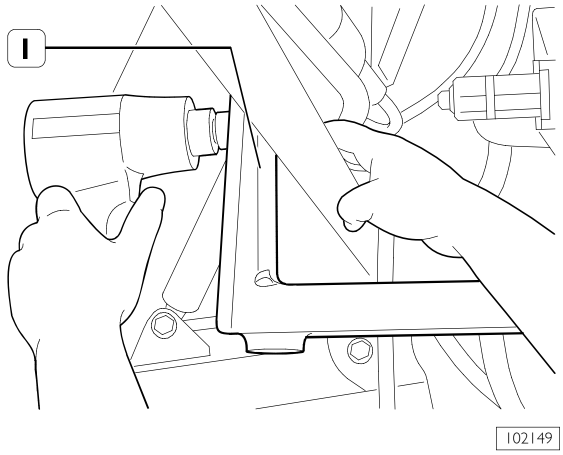
Use a hydraulic jack to position bracket 99370629 (1) under the gearbox; then, put the chain onto the gearbox and place a ring of the same into the bracket slotted hole.
Screw down the nut so as to tightly secure, through the chain, the gearbox to the bracket.

Figure 33



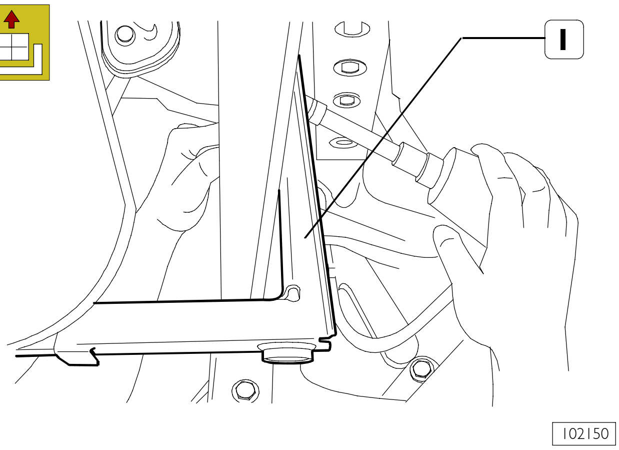
Remove screw (1) centrally securing the rear crossbar to the gearbox.

Figure 34



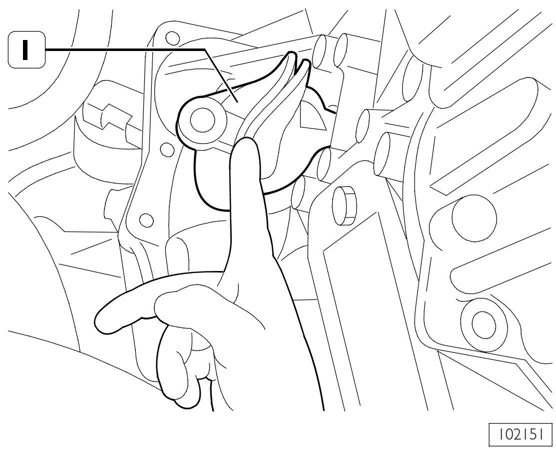
Remove the crossbar fastening screws (1) on the left side.

Figure 35



Remove the crossbar fastening screws (1) on the right side, then remove the crossbar, taking care not to drop it on the floor.

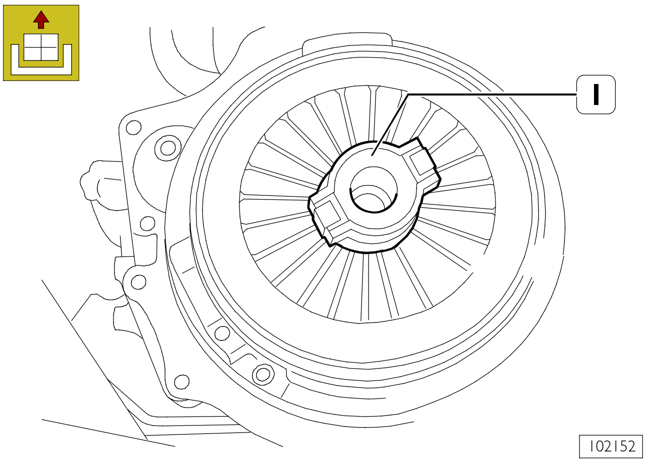
Figure 36



Remove boot (1) from its housing.
This operation is necessary to make the fork travel the full disengagement stroke when detaching the gearbox
Remove the remaining screws securing the gearbox to the clutch bell.

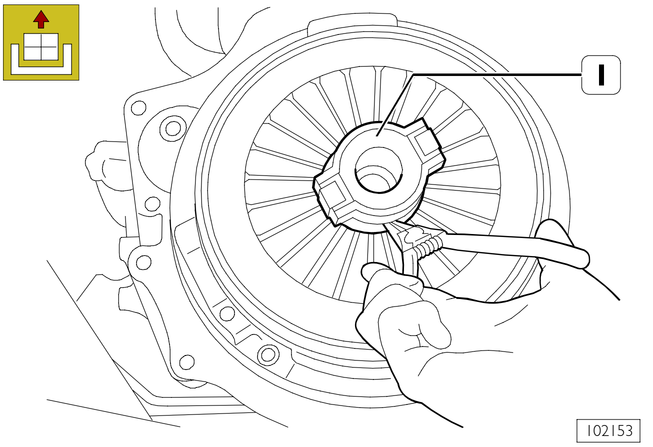
Move the gearbox backwards until the motion input shaft has come out of the clutch disc hub. Fully take out the gearbox, taking care not to hit it or get it caught in some component.

Figure 37



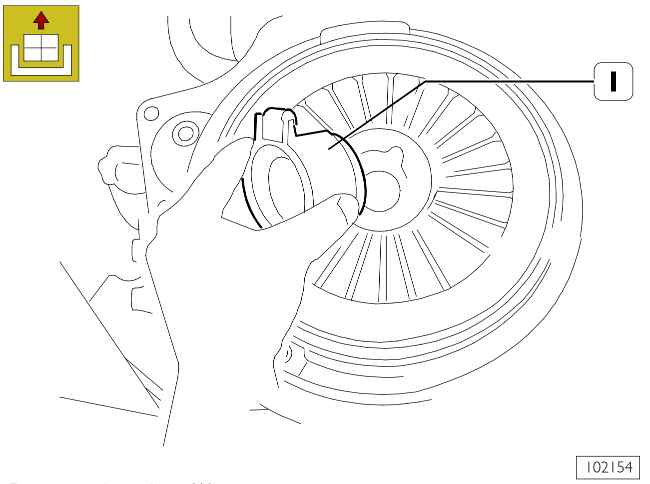
After the detachment operation has been completed, pressure plate bearing (1) shall remain fitted into the clutch (as shown in the figure).

Figure 38



Use pliers to act on the retaining ring to disassemble bearing (1).

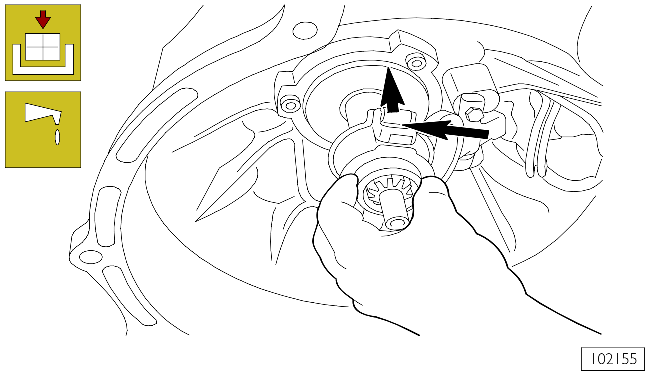
Figure 39



Remove bearing (1).

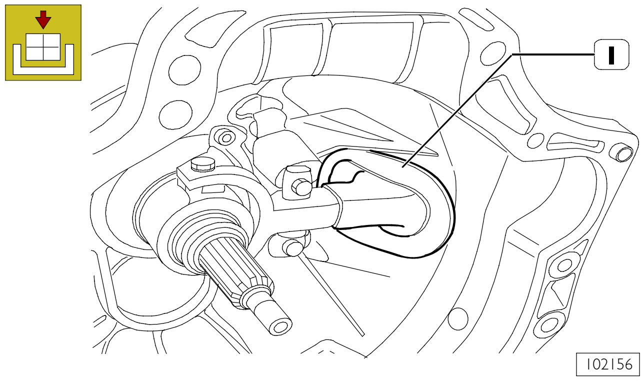
Refitting

Figure 40



Press the pressure plate bearing onto the shaft and the fork against the bearing, as shown in the figure. Apply grease MRM2 to the fork at the bearing pressure point.

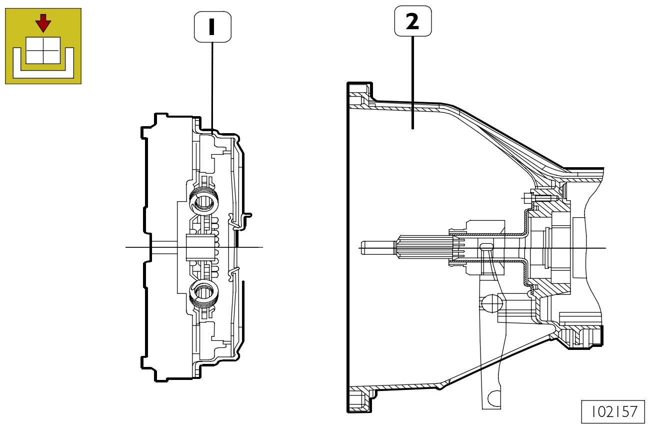
Figure 41



Put rubber boot (1) into its housing.

NOTE Gearbox is provided by spares in second gear in order to enable primary shaft rotation through transmission shaft connection flange rotation.

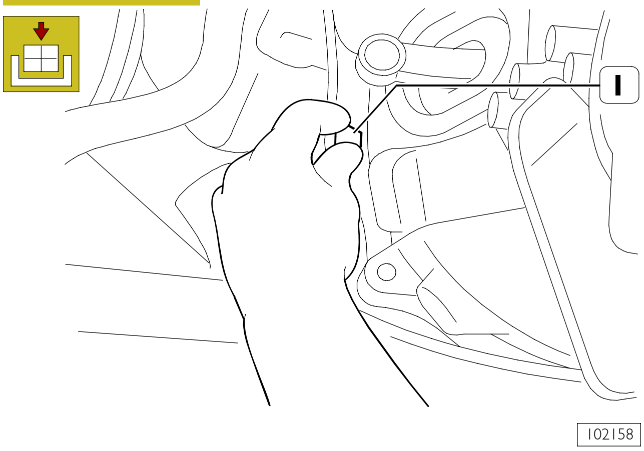
Figure 42



Couple gearbox (2) with clutch (1).

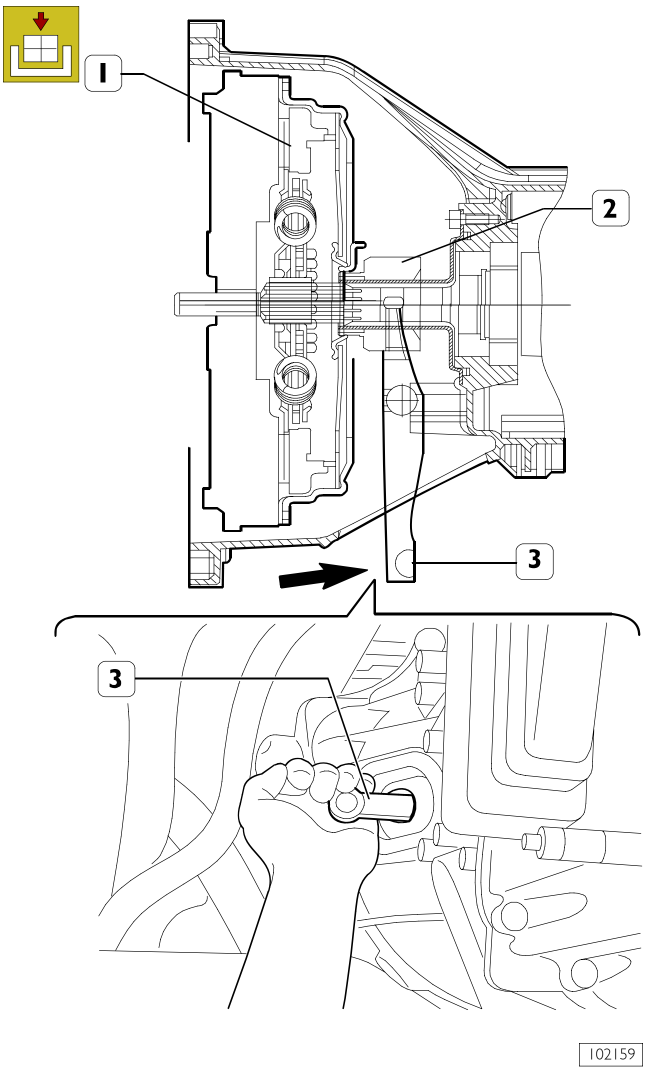
NOTE In order to facilitate coupling, two guiding pins, fitted onto two of the holes used to secure the gearbox to the base unit, can be used.

Figure 43



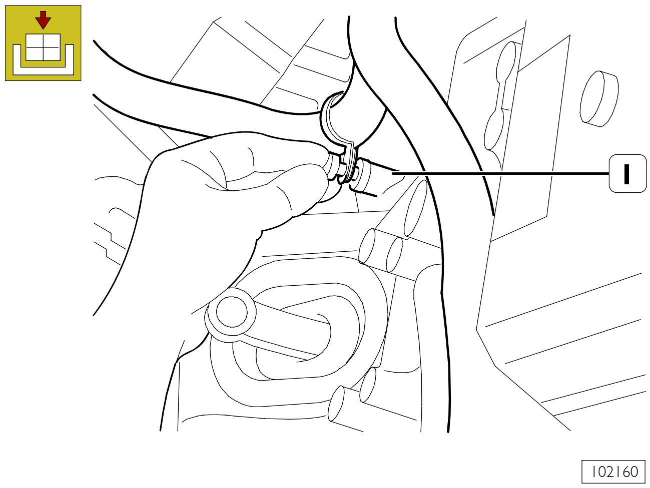
Manually screw down screws (1) securing the gearbox case to the base unit prior to tightening them to torque.

Figure 44



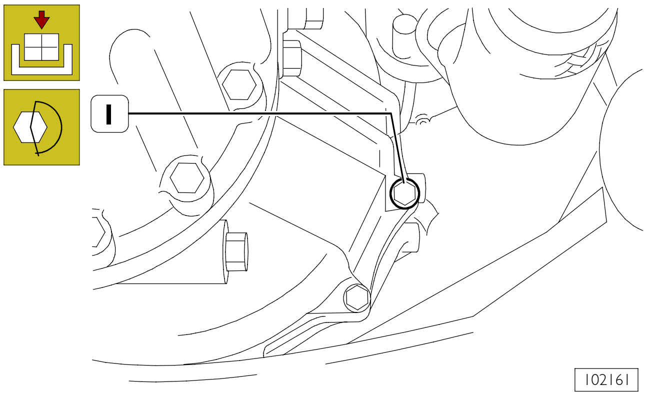
NOTE Pull the fork (3) towards the control unit, so that pressure plate bearing (2) is correctly engaged into diaphragm spring (1).

Figure 45



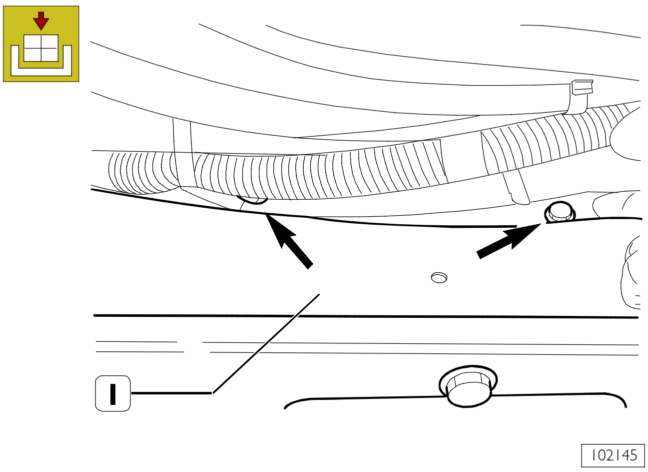
Secure the cable to the gearbox by means of the special fasteners (1).

Figure 46



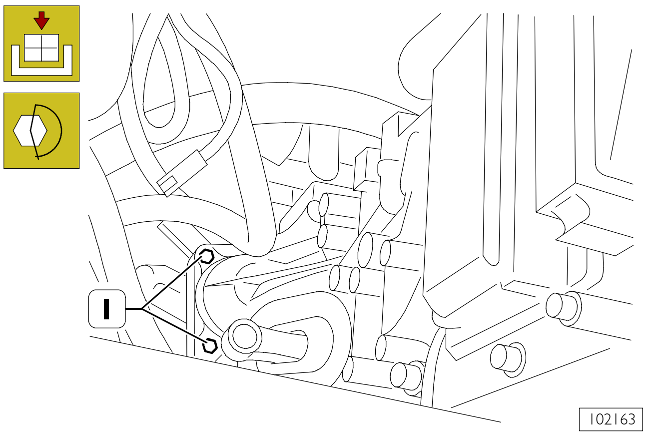
Screw down gearbox fastening screws (1) by tightening them to torque.

Figure 47



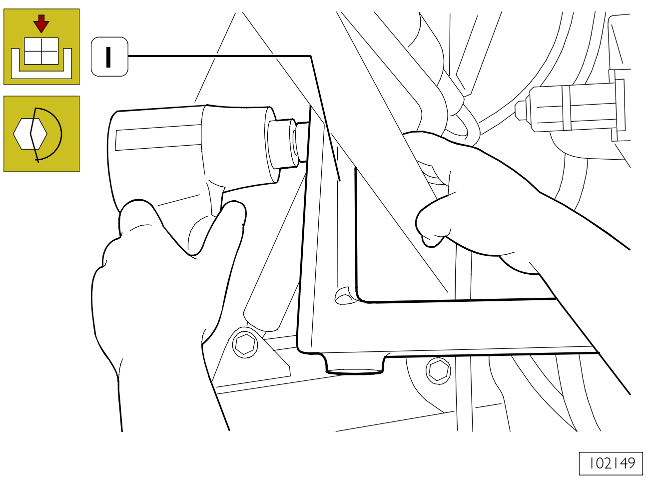
Screw down screws (1), then fit the engine lower cover.

Figure 48



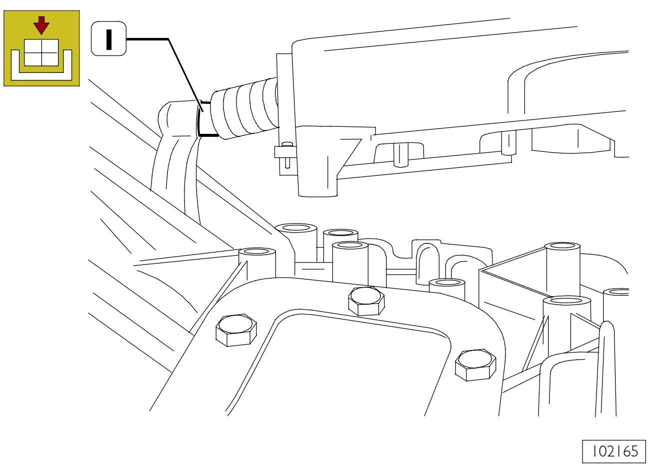
Re-attach the starting motor to the gearbox case front cover by tightening the screws (1) to the specified torque.

Figure 49



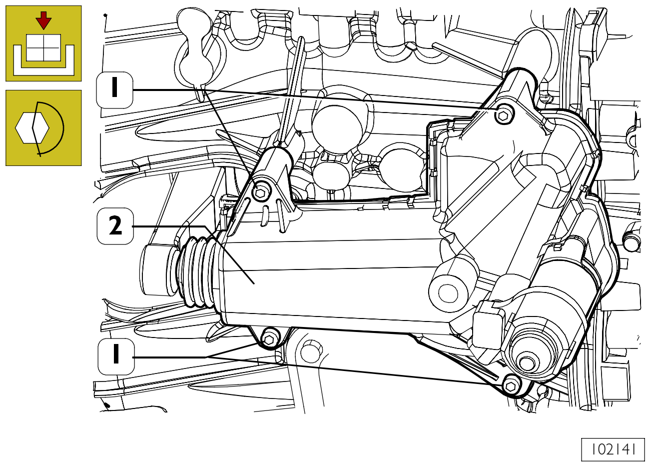
Secure crossbar (1) to the gearbox and to the chassis by tightening the screws to the specified torque.

Figure 50



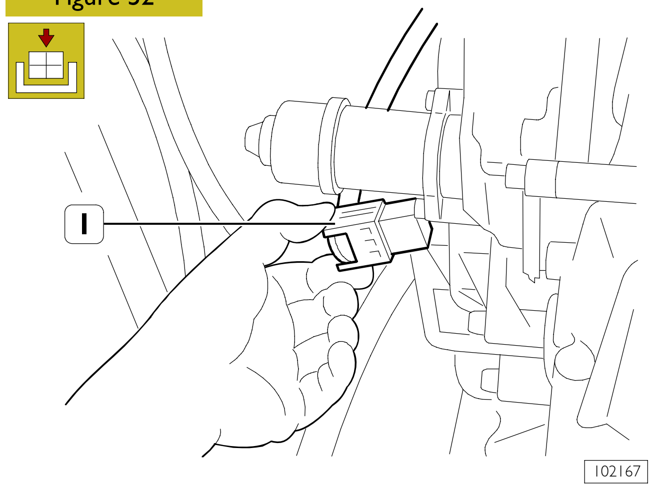
Fit the clutch actuator (1) engaging tip into the special fork slot, taking care not to touch it straight with your hands.

Figure 51



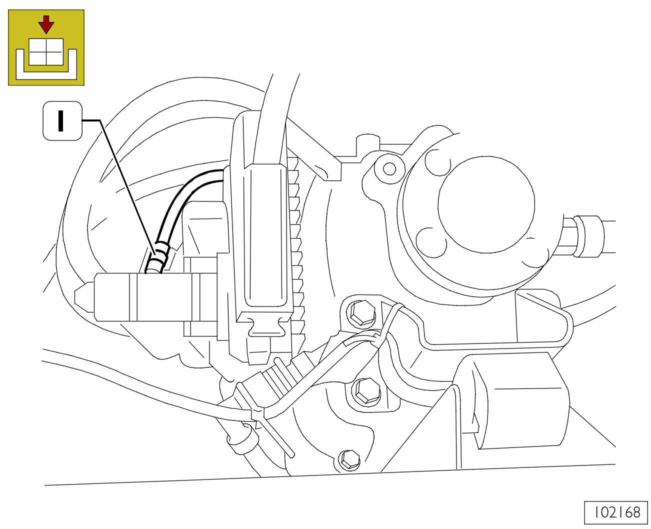
Secure clutch actuator (1) to the gearbox by means of the four screws (2), then tighten to the specified torque.

Figure 52



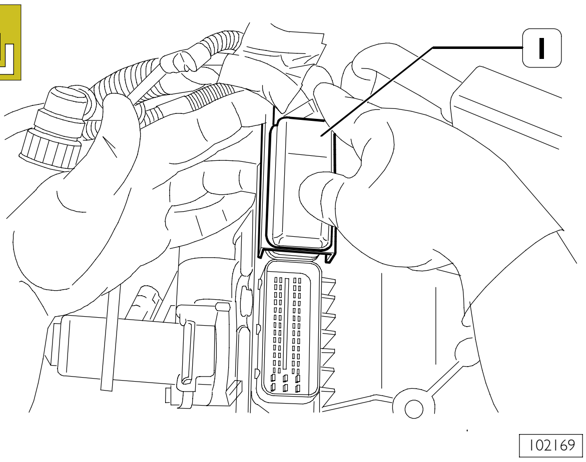
Connect connector (1) to the clutch actuator.

Figure 53



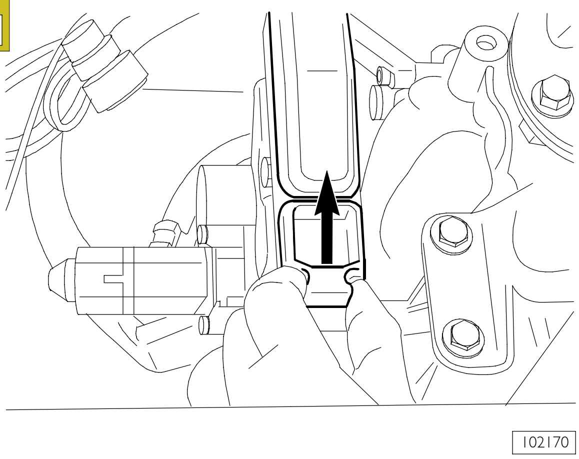
Secure the gearbox cable by means of strap (1).

Figure 54



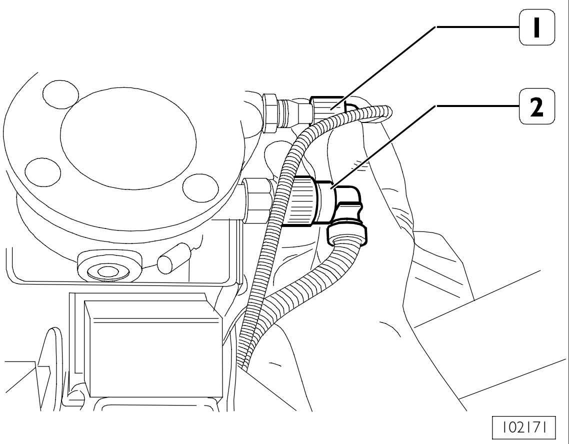
Connect connectors (1) to the control unit.

Figure 55



Properly secure the connector until the pull-back spring clicks into position (see arrow).

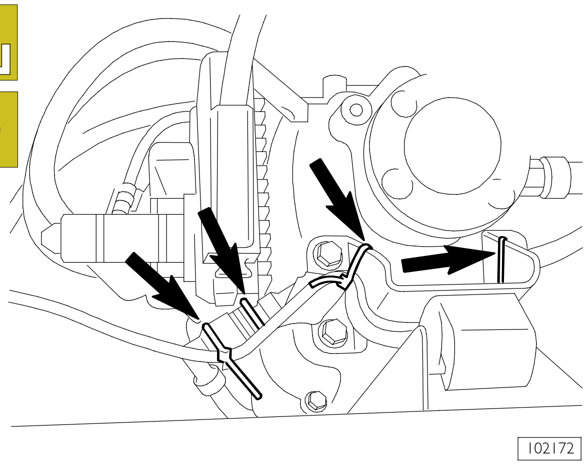
Figure 56



Connect the reverse light (1) and revs number sensor (2) connectors.

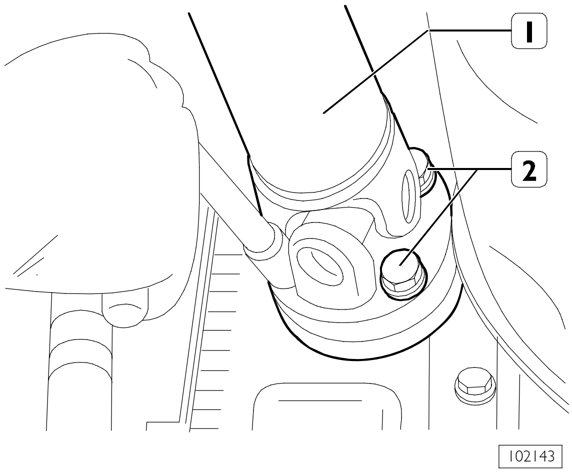
Connect the electrical connections of the power take-off, if present, from the other side of gearbox.

Figure 57



Secure the wiring to the gearbox, as shown by the arrows in the figure.

Figure 58



Secure drive shaft (1) to the gearbox by tightening fastening screws (2) to torque.

After the gearbox has been re-attached completely, check for correct connection of electric cables.

NOTE After re-attachment has been completed, perform the specific calibration procedure by means of the diagnosis instrument described on page 122/30.

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GEARBOX UNIT OVERHAULING

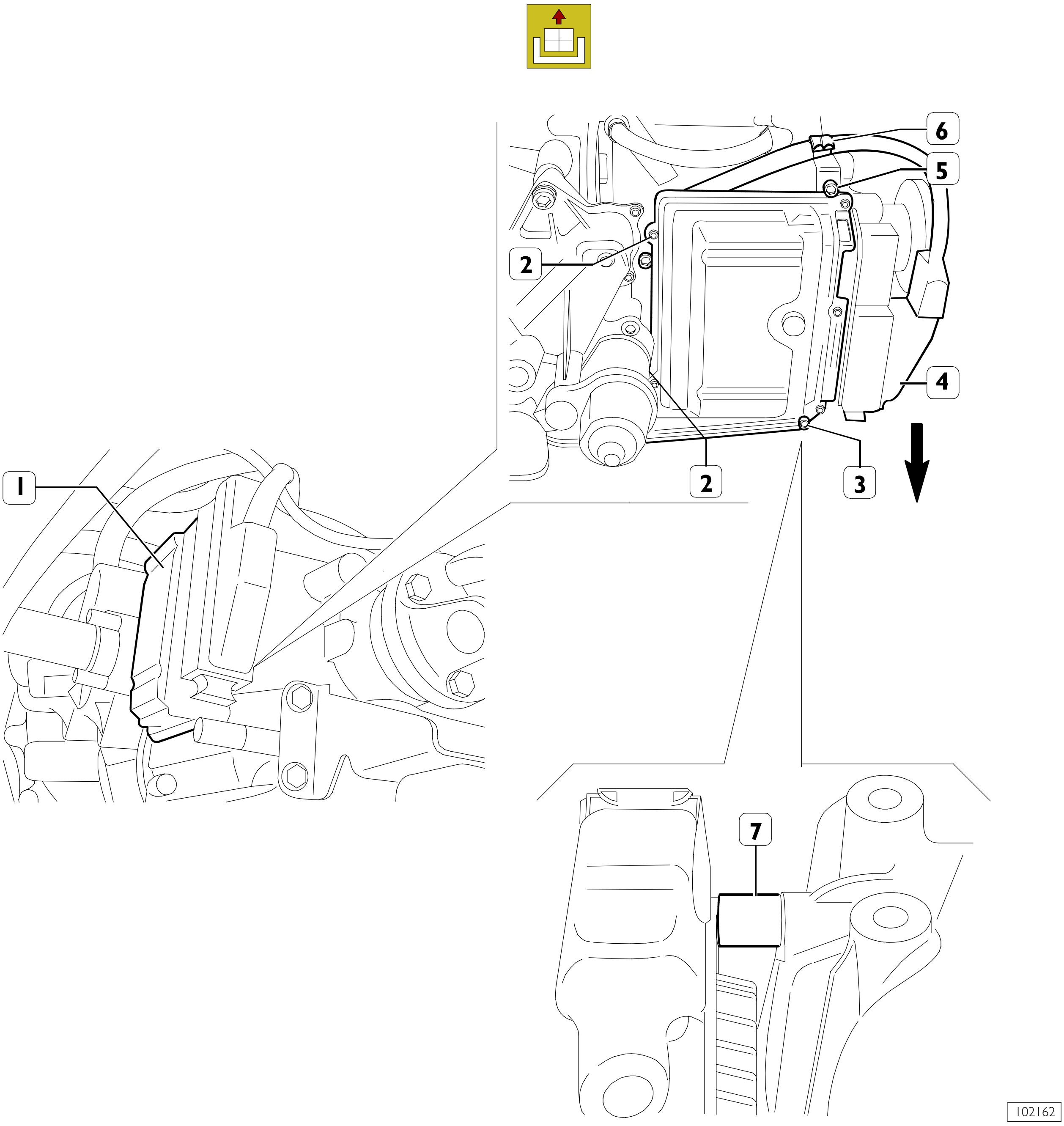
NOTE As far as gearbox unit overhauling is concerned, follow the instructions and illustrations relative to the 6 S 400 O.D. gearbox unit.
Below are the descriptions and illustrations relative to the replacement of the gearbox unit electric/electronic components supplied with spare parts.

66136114 CONTROL UNIT

Removal

Place the vehicle in a pit or on an auto lift.
Disconnect the battery cable in the engine compartment.

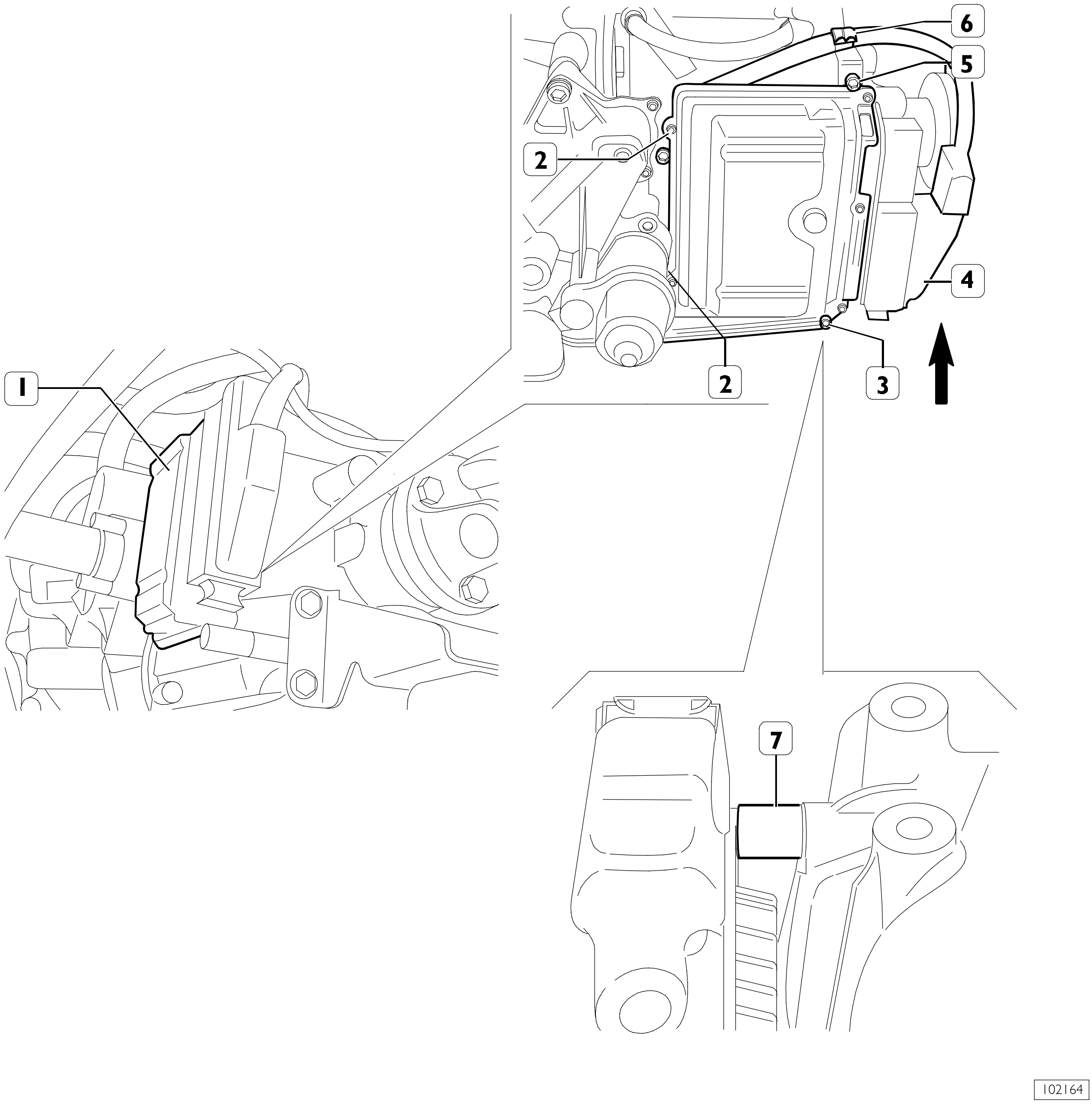
Figure 59



Remove connector (4) from control unit (1) by pulling the safety retainer downwards, as shown by the arrow.
Remove strap (6). Unscrew screws (2, 3).
Remove screw (5) while holding the control unit and taking care to recover spacer (7) placed behind screw (3). Take off control unit (1).

Refitting

Figure 60



Screw down screw (5), yet without tightening it to torque.

Fit spacer (7), between the control unit and the gearbox, behind screw (3), then screw down the latter.

Screw down screws (2).

Screw down all screws (2, 3 & 5) to the specified torque.

Insert control unit connector (4) by securing it with the safety hook, as shown by the arrow.

Connect the battery cable.

NOTE After re-attachment has been completed, perform the specific calibration procedure by means of the diagnosis instrument described on page 122/30.

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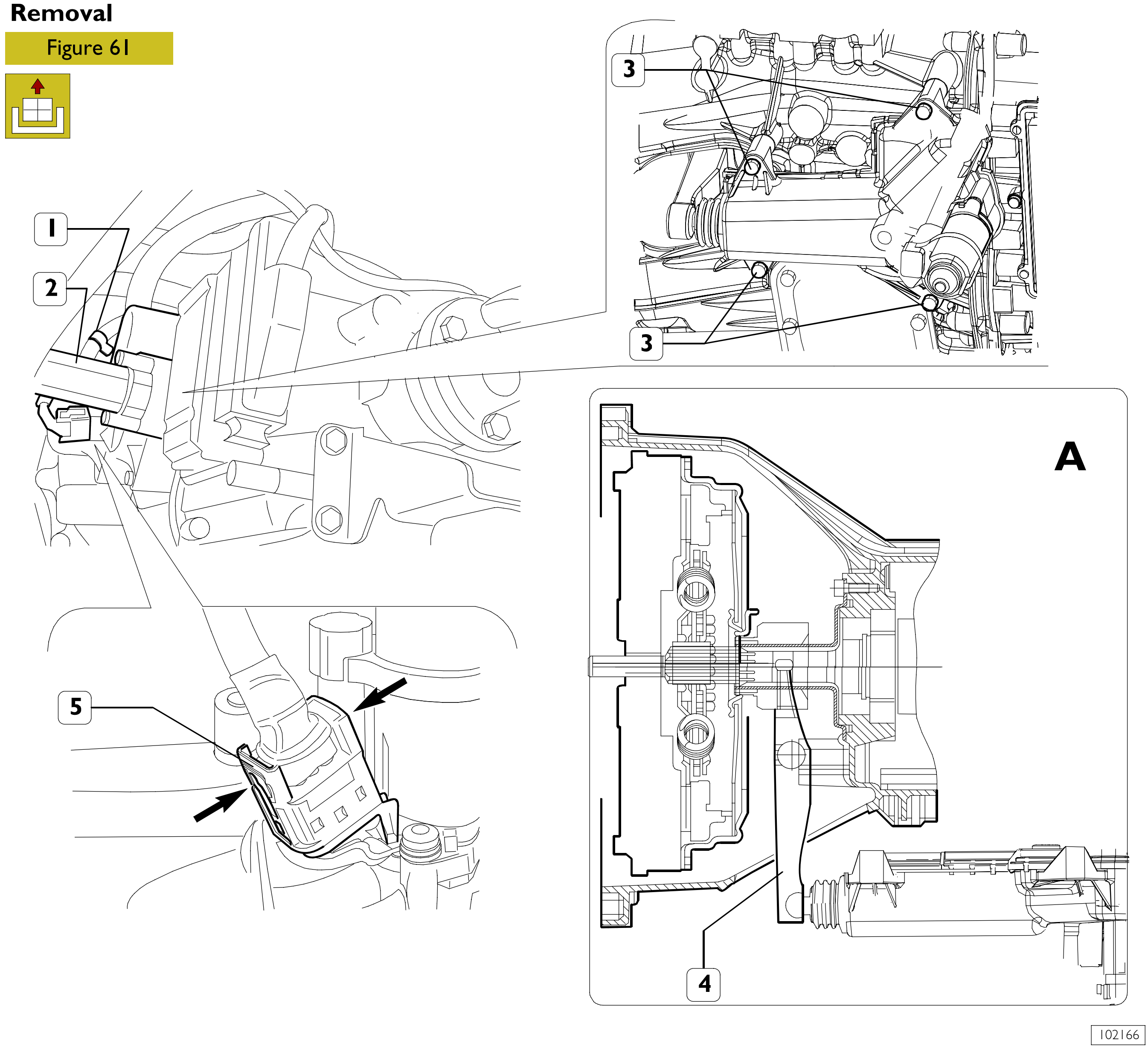
505279104 CLUTCH ACTUATOR

Removal

Figure 61



Place the vehicle in a pit, or on an auto lift or special supporting stands.

Disconnect the battery cable in the engine compartment.

Remove strap (1).

Take off connector (5) by pressing onto the fastening springs, as shown by the arrows.

Prior to removing the clutch actuator, make sure that the clutch is closed.
Engaging lever (4) must be in the position shown in box A (perpendicular to the gearbox axle).
If the lever is not found in that position, the clutch will be open.
This condition can be inspected both visually and by getting connected to the vehicle by means of the diagnosis instrument and subsequently reading the data memory. In the event that the clutch is open, it is required that the action of the lever is forced back, since the lever is loaded by the clutch diaphragm spring. Properly lock the motion of lever (4), and avoid, during the subsequent actuator releasing phase, getting your hands near the engaging tip area.

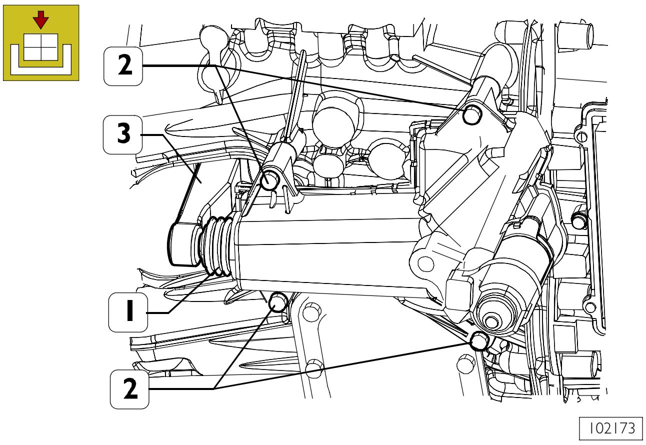
Remove the four fastening screws (3).

Take off clutch actuator (2).

In the event that the actuator has been taken off with the clutch open, release lever (4), previously engaged, with the utmost care.
Avoid touching the lever straight with your hands, owing to the lever being loaded.

Refitting

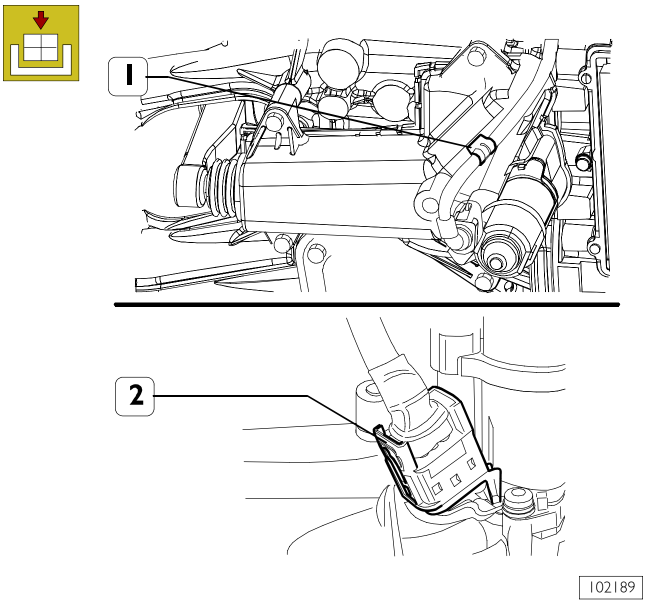
Figure 62



Position clutch actuator tip (1) into fork aperture (3).

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

Figure 63



Fit connector (2) by pressing it until it gets engaged.

Secure the cable by means of strap (1).

Connect the battery cable.

NOTE After re-attachment has been completed, perform the specific calibration procedure by means of the diagnosis instrument described on page 125.

530520100 GEARBOX ACTUATOR

Removal

Place the vehicle in a pit, or on an auto lift or special supporting stands.

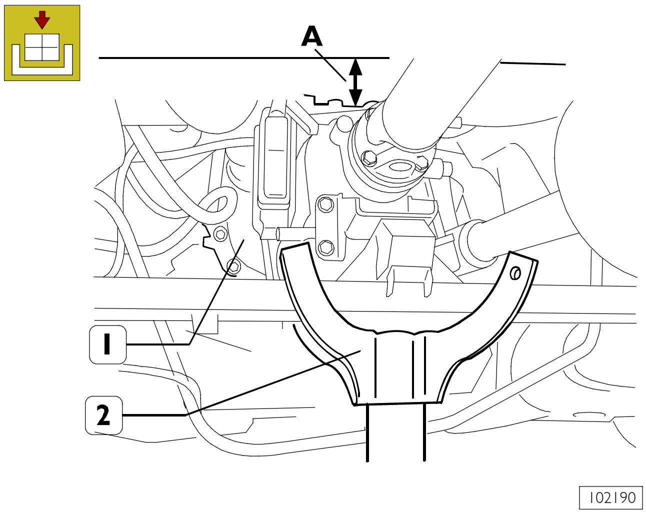
Disconnect the battery cable in the engine compartment.

Take off the clutch actuator, as described on page 119.

NOTE The actuator, positioned in the upper part of the gearbox, cannot be accessed, owing to the very narrow space between the cabin floor and the actuator itself.

Proceed as it follows:

Figure 64



Place a pit lift (2) under gearbox (1). Unscrew the gearbox crossbar fastening screws. Lower the lift so as to obtain a distance "A" of 12-13 cm between the actuator and the cabin floor.

NOTE This operation must be carried out with the greatest care, avoiding hitting the front part of the power unit.

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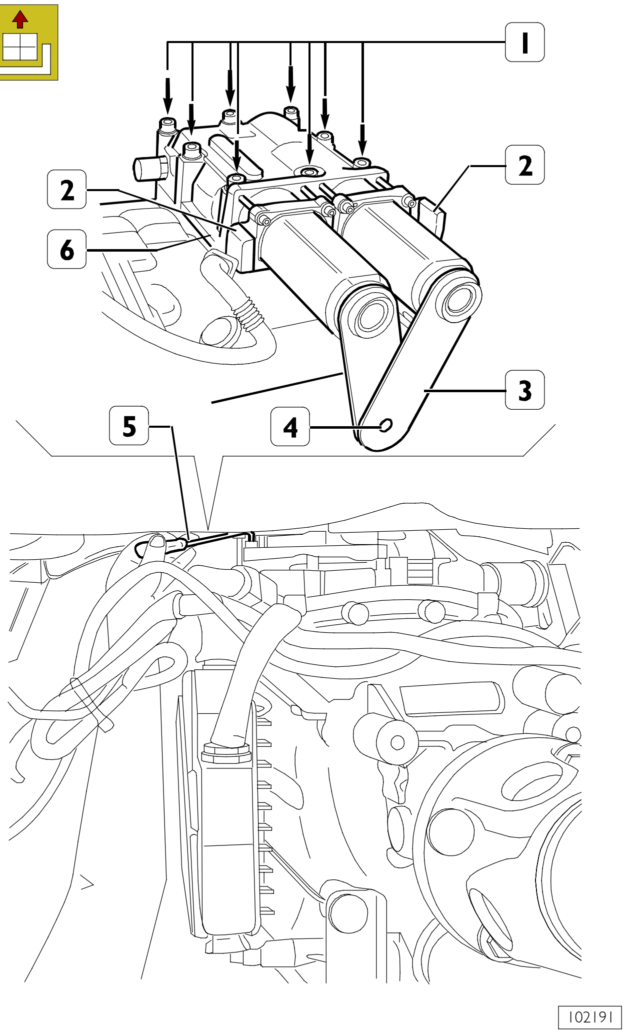
Figure 65



Take electric connectors (2) off the actuator.

Unscrew electric motor support fastening screw (4). Take off supports (3).

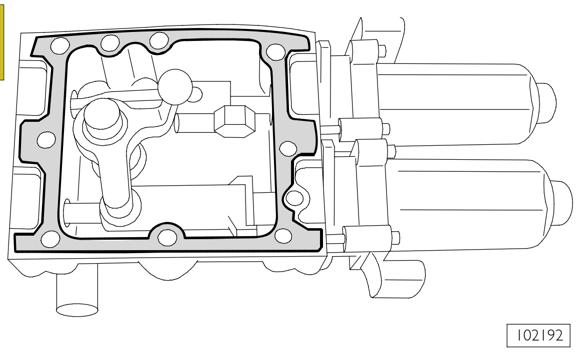
Use a suitable tool (5) to remove the eight fastening screws (1), then take off gearbox actuator (6).

NOTE Clean the supporting surface of the actuator on the gearbox case.

Refitting

Re-attachment is carried out by reversing the order of detachment operations. Also follow the advice below:

Figure 66



- ❑ Apply an even coat of LOCTITE 574 sealant on the gearbox actuator supporting surface.
- ❑ Position the actuator into its seat with the greatest care.
- ❑ Tighten the nuts or screws to the specified torque.

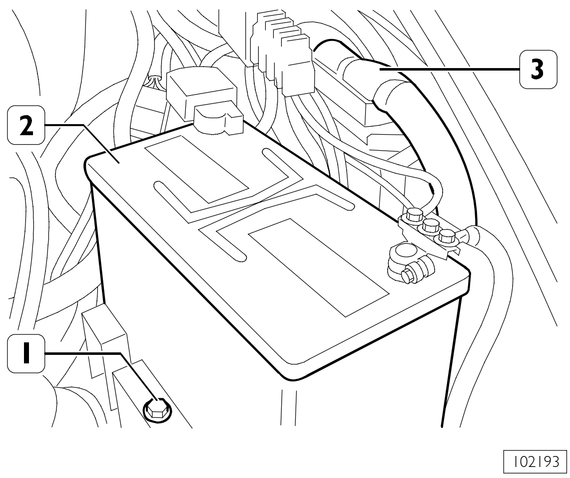
NOTE After re-attachment has been completed, perform the specific calibration procedure by means of the diagnosis instrument described on page 125.

769152104 CHASSIS WIRING GEARBOX

Removal

Place the vehicle in a pit, or on an auto lift or special supporting stands.

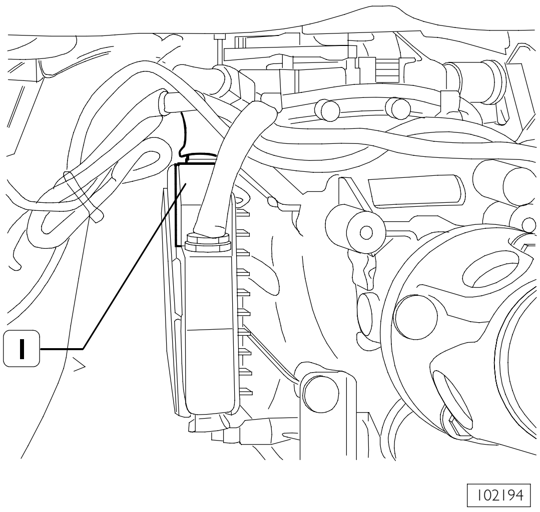
Figure 67



Open the engine hood.

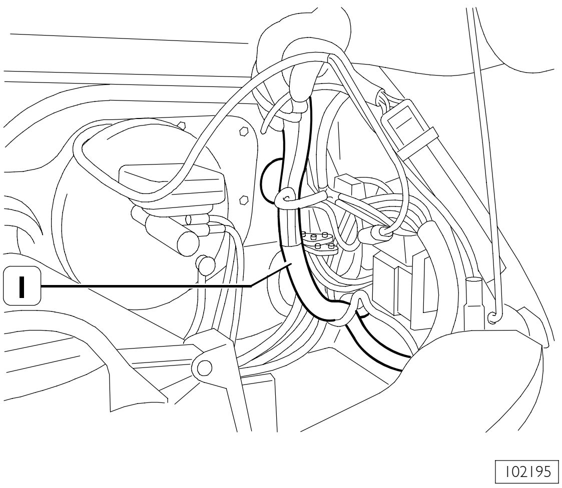
Unscrew screw (1), disconnect the battery cables and take off battery (2). Take connector (3) off EDC central unit.

Figure 68



Disconnect wiring (1) from the gearbox control unit, taking care that it is not hit or does not get caught.

Figure 69



Take full wiring (1) off the vehicle.

Refitting

Re-attachment is carried out by reversing the order of detachment operations. Also tighten the nuts or screws to the specified torque.

NOTE After the re-attachment operation has been completed, verify, by getting connected to the vehicle by means of the diagnosis instrument, that no error is found in the gearbox control unit fault memory.

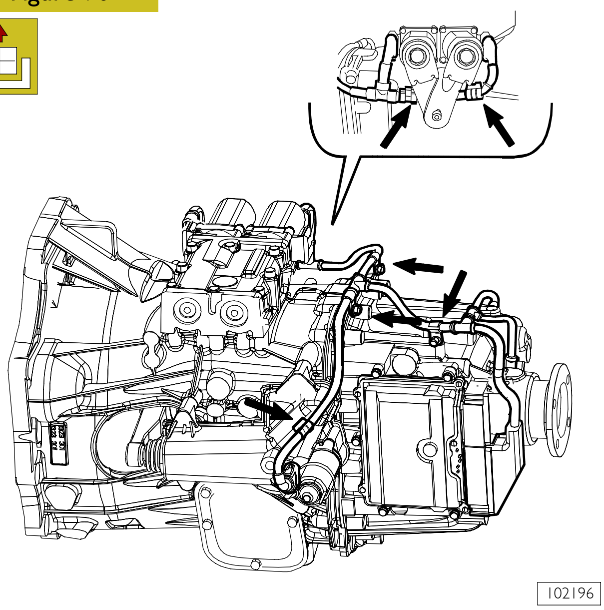
769152104 GEARBOX WIRING - GEARBOX

Removal

Place the vehicle in a pit, or on an auto lift or special supporting stands.

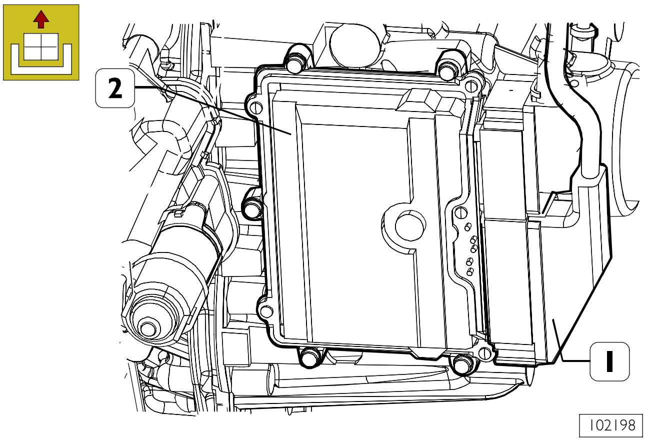
Disconnect the battery cable in the engine compartment.

Figure 70



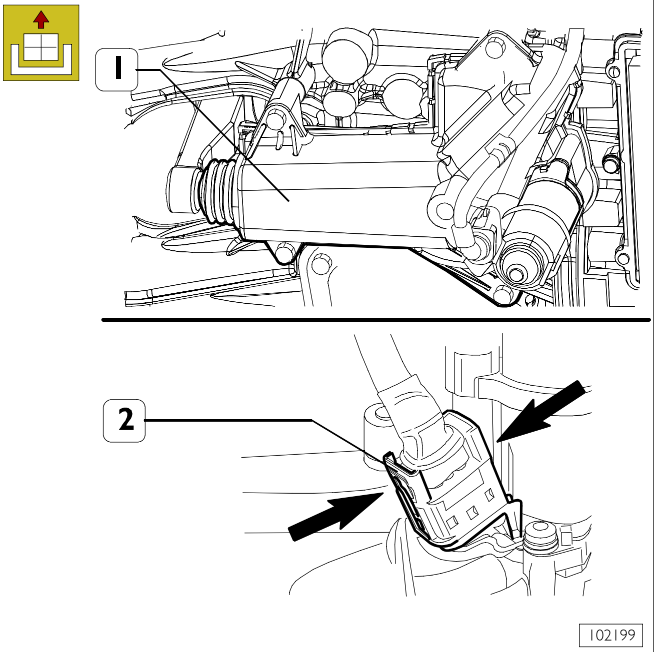
Remove the straps (shown by arrows) that secure the cable to the gearbox.

Figure 71



Remove connector (1) from control unit (2), by releasing the pull-back spring downwards, as shown by the arrow.

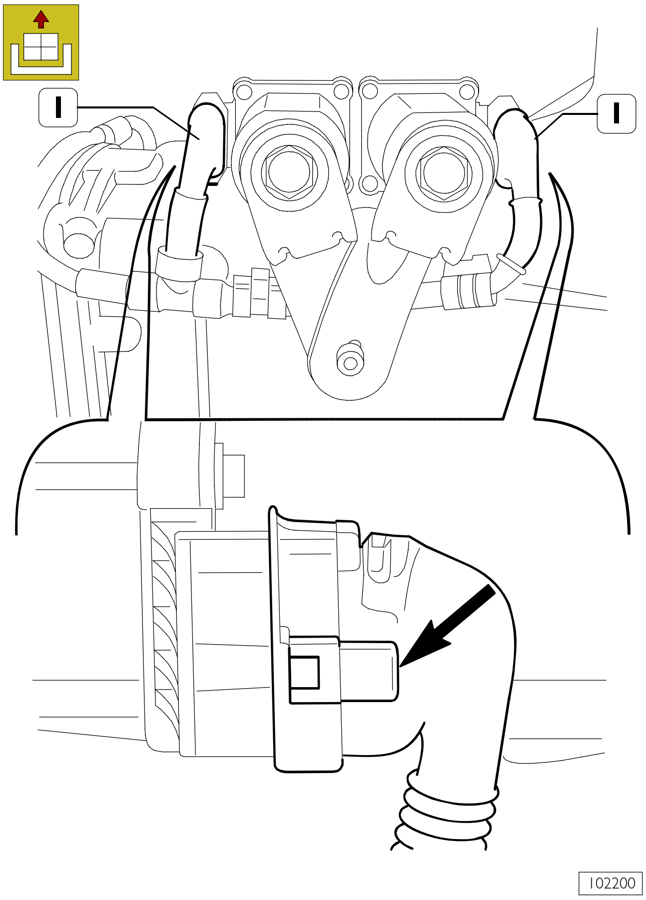
Figure 72



Press connector springs (2) inwards (see arrows).

Remove the connector from clutch actuator (1).

Figure 73



Remove the connectors (1) from the gearbox actuator electric motors by pressing the fastening springs, as shown by the arrows.

Refitting

Re-attachment is carried out by reversing the order of detachment operations. Also follow the advice below:

- Lay the wiring onto the gearbox by fitting the same with brackets at the specified points, then place it on the engine, taking care that it does not get pinched.
- Check for correct insertion of connectors, which can be felt when the locking bracket has been closet.

NOTE After the re-attachment operation has been completed, verify, by getting connected to the vehicle by means of the diagnosis instrument, that no error is found in the gearbox control unit fault memory.

CALIBRATION

Some modifications or repairs that affect the ESV1 system components, automatic transmission, require a calibration procedure. The repairs that require this operation are detailed as follows:

- Replacing the gearbox kit + control unit
- Replacing the control unit only
- Replacing the clutch actuator
- Replacing the gearbox actuator
- Replacing an electric motor of the gearbox actuator
- Replacing the engaging fork

NOTE Replacing the gearbox wiring requires no calibration procedure.

Calibration in case of replacement of the gearbox kit + control unit

The control unit must be programmed (no error in the memory) by providing the same with the vehicle data, e.g. axle ratio, rolling radius, strength curve, etc.

Get connected to the vehicle by means of the diagnosis instrument, with the vehicle stationary, engine OFF and gearshift lever in neutral.

Carry out the operations indicated by the instrument: key ON (engine ON), then the dedicated calibration procedure will be started → " *Adaptation of touch Point.*

Message "service" will appear on the display; the system in automatic mode will carry out the following operations:

- ❑ opening the clutch;
- ❑ engaging the 5th or 6th speed;
- ❑ he clutch closes three times searching for the point of initial slip (the vehicle will pick up three times);
- ❑ putting the lever in neutral;
- ❑ closing the clutch.

The procedure is interrupted when the engine is switched off.

NOTE Wait 10 seconds prior to the next KEY ON.

When the procedure has been completed, check the control unit memory and verify that no error is found.

Calibration in case of replacement of the control unit

The control unit must be programmed by providing the same with the vehicle data, e.g. axle ratio, rolling radius, strength curve, etc.

Get connected to the vehicle by means of the diagnosis instrument, with the vehicle stationary, engine OFF and gearshift lever in neutral.

Carry out the operations indicated by the instrument: key ON (engine OFF), then the dedicated calibration procedures will be started → *Measurement of Maximum Clutch Travel*
Transmission Self Adaptation

Message "service" will appear on the display; the system in automatic mode will carry out the aforesaid procedures. Upon completion of this step, the engine will be started and the → *Adaptation of touch Point* calibration procedure will be started.

Message "service" will appear on the display; the system in automatic mode will carry out the following operations:

- ❑ opening the clutch;
- ❑ engaging the 5th or 6th speed;
- ❑ he clutch closes three times searching for the point of initial slip (the vehicle will pick up three times);
- ❑ putting the lever in neutral;
- ❑ closing the clutch.

The procedure is interrupted when the engine is switched off.

NOTE Wait 10 seconds prior to the next KEY ON.

When the procedure has been completed, check the control unit memory and verify that no error is found.

Calibration in case of replacement of the clutch actuator

Clear the control unit error memory.

Get connected to the vehicle by means of the diagnosis instrument, with the vehicle stationary, engine OFF and gearshift lever in neutral.

Carry out the operations indicated by the instrument: key ON (engine OFF), then the dedicated calibration procedure will be started → *Measurement of Maximum Clutch Travel.*

Message "service" will appear on the display; the system in automatic mode will carry out the necessary operations. The procedure will be interrupted when the engine is switched off.

NOTE Wait 10 seconds prior to the next KEY ON.

When the procedure has been completed, check the control unit memory and verify that no error is found.

Calibration in case of replacement of the gearbox actuator or an electric motor of the gearbox actuator

Clear the control unit error memory.

Get connected to the vehicle by means of the diagnosis instrument, with the vehicle stationary, engine OFF and gearshift lever in neutral.

Carry out the operations indicated by the instrument: key ON (engine OFF), then the dedicated calibration procedure will be started → *Transmission Self Adaptation.*

Message "service" will appear on the display; the system in automatic mode will carry out the necessary operations. The procedure will be interrupted when the engine is switched off.

NOTE Wait 10 seconds prior to the next KEY ON.

When the procedure has been completed, check the control unit memory and verify that no error is found.

Calibration in case of replacement of the clutch engaging/release fork

Clear the control unit error memory.

Get connected to the vehicle by means of the diagnosis instrument, with the vehicle stationary, engine OFF and gearshift lever in neutral.

Carry out the operations indicated by the instrument: key ON (engine ON), then the dedicated calibration procedure will be started → *Adaptation of Touch Point.*

Message "service" will appear on the display; the system in automatic mode will carry out the following operations:

- ❑ opening the clutch;
- ❑ engaging the 5th or 6th speed;
- ❑ the clutch closes three times searching for the point of initial slip (the vehicle will pick up three times);
- ❑ putting the lever in neutral;
- ❑ closing the clutch.

The procedure is interrupted when the engine is switched off.

NOTE Wait 10 seconds prior to the next KEY ON.

When the procedure has been completed, check the control unit memory and verify that no error is found.

Power take off

SPECIFICATIONS AND DATA

TYPE	Hidrocar 20Z1	Hidrocar 20 Z2
Application	**5 S 300**	**6 S 400 A O.D.**
Gear ratio I, PTO(*) output revs., normal PTO(*) input revs.	1	0.910
PTO(*) output rated torque at 1500 rpm (Nm)	120	180
Expected duration at rated torque and at 1500 rpm hours	500	
Rotation direction (with respect to engine)	Opposite	
Control	Electric	
Assembly side (with respect to running direction)	Left side	
Torque obtainable from gearbox (Nm)	175	303
Oil capacity (litres)	~ 0.6 ÷ 0.4	

(*) = Power Take Off

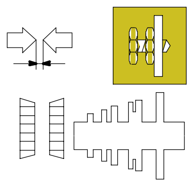
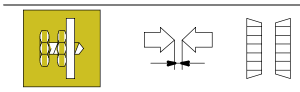
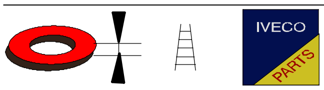
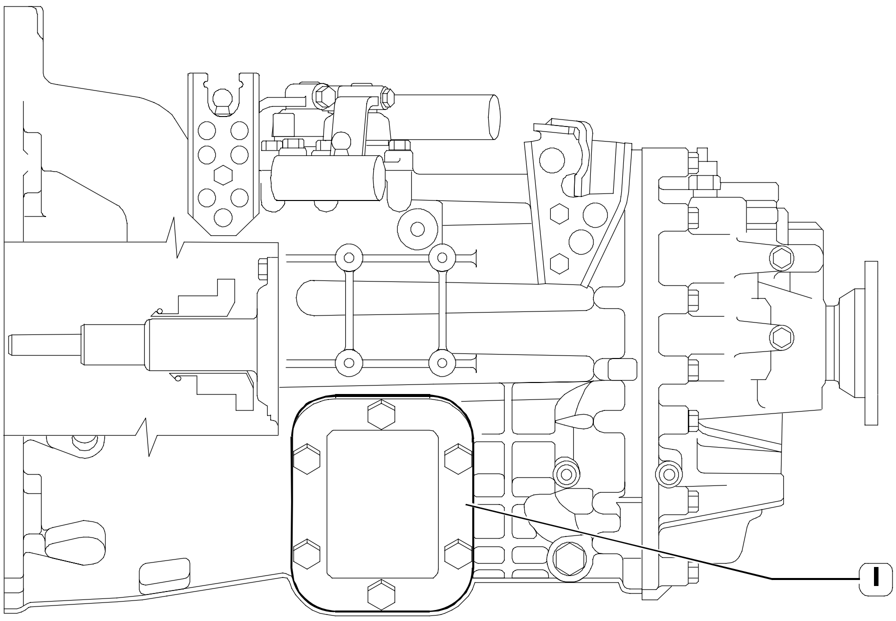
	Drive gear taper roller bearing axial backlash	0 - 0.1 mm
	Drive gear taper roller bearing axial backlash adjustment	by shims
	Drive gear taper roller bearing axial backlash adjusting ring thickness	0.1 - 0.2 - 0.3 - 0.5 mm

Figure 1



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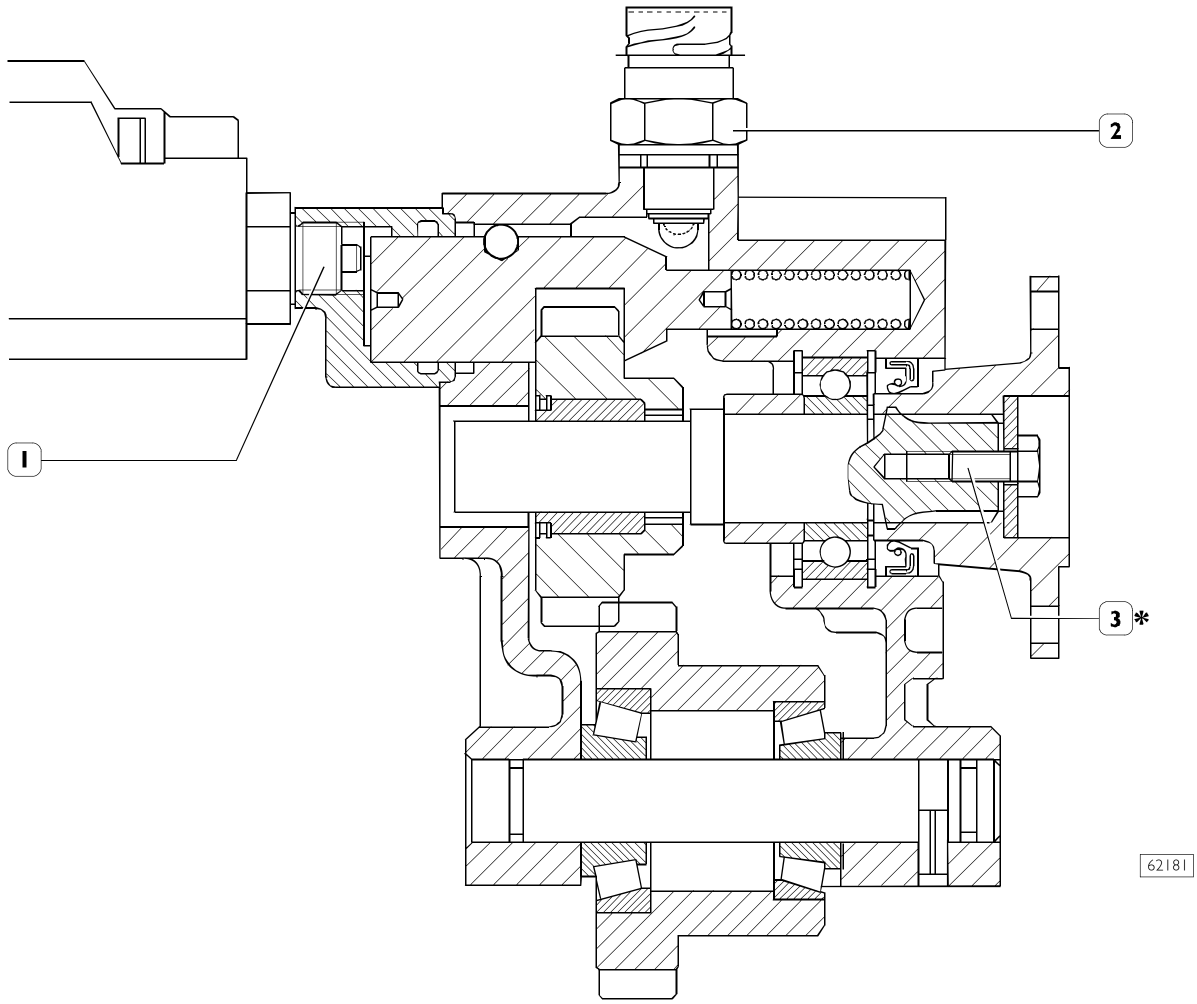
Power take offs are applied to secondary shaft on gearbox left side instead of cover (1).

NOTE Fill and check gearbox oil level.

TIGHTENING TORQUES

Figure 2



	DESCRIPTION	TORQUE Nm	TORQUE kgm
1	M16x1.5 actuator fixing tang	50	5
2	Switch fixing	50	5
3*	Flange fixing screw	25	2,5
	M10 nuts for fixing PTO to gearbox	35 ÷ 39	3.5 ÷ 3.9

* Smear screw thread with LOCTITE 242

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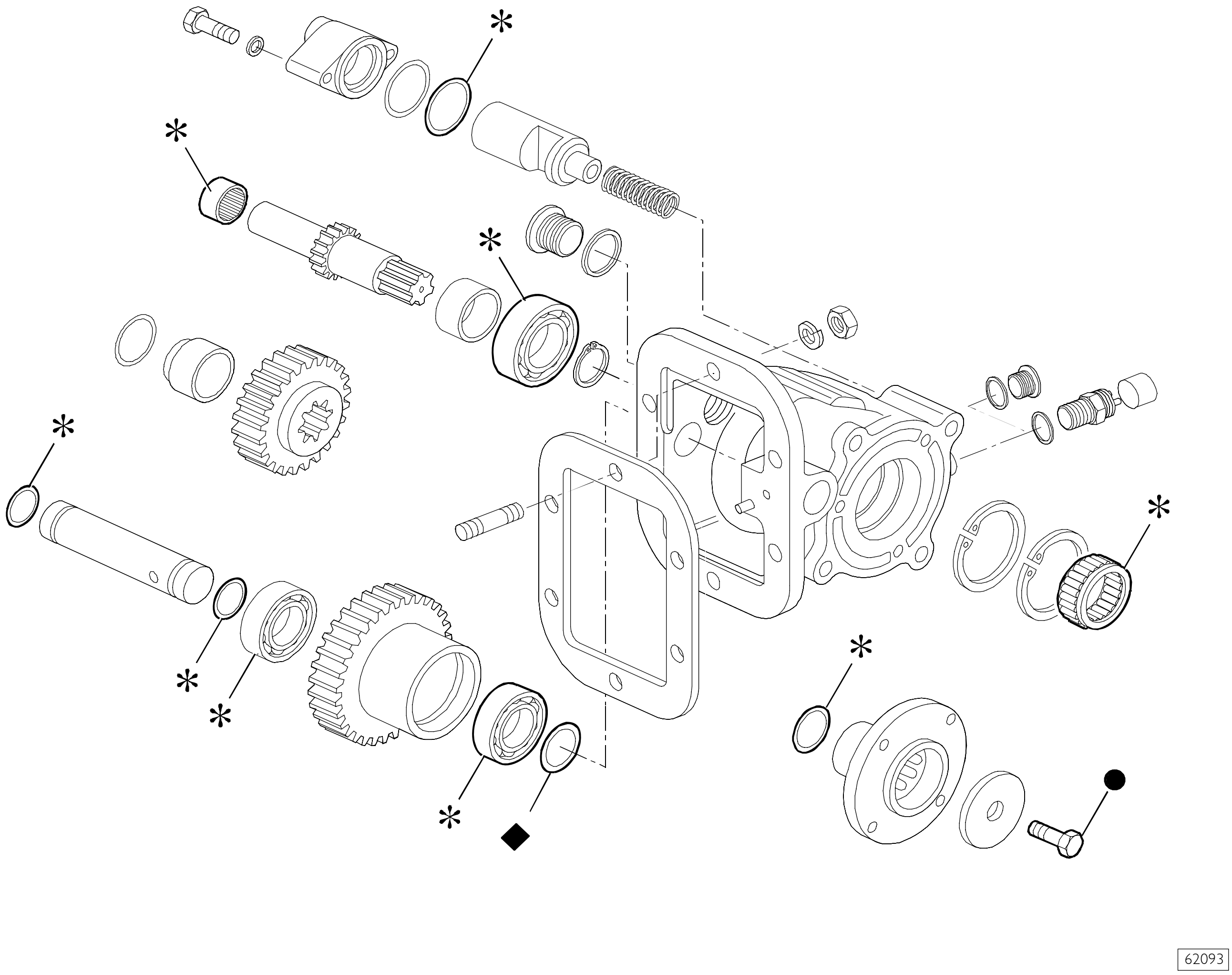
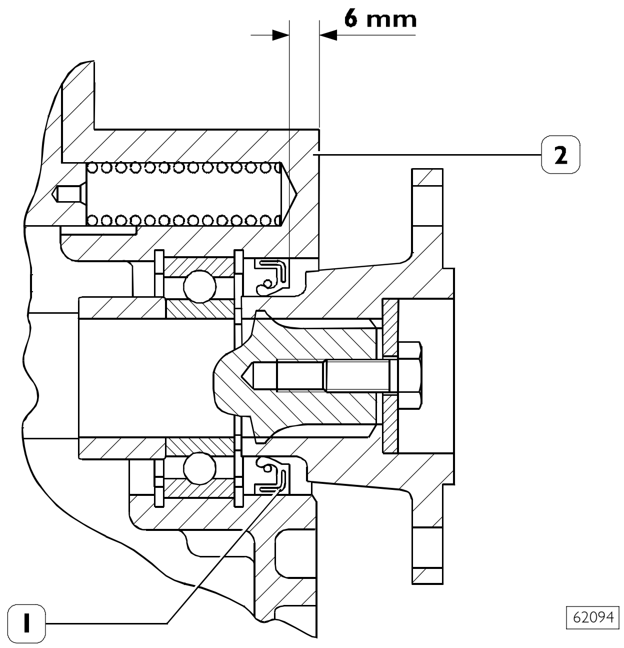
Figure 3



POWER TAKE OFF COMPONENTS

Figure 4



ASSEMBLY STANDARDS

Parts (*): sealing rings and bearings shall be smeared with grease POLIMER 400.

Adjusting ring (♦) thickness shall guarantee taper roller bearing axial backlash equal to 0 ÷ 0.1 mm.

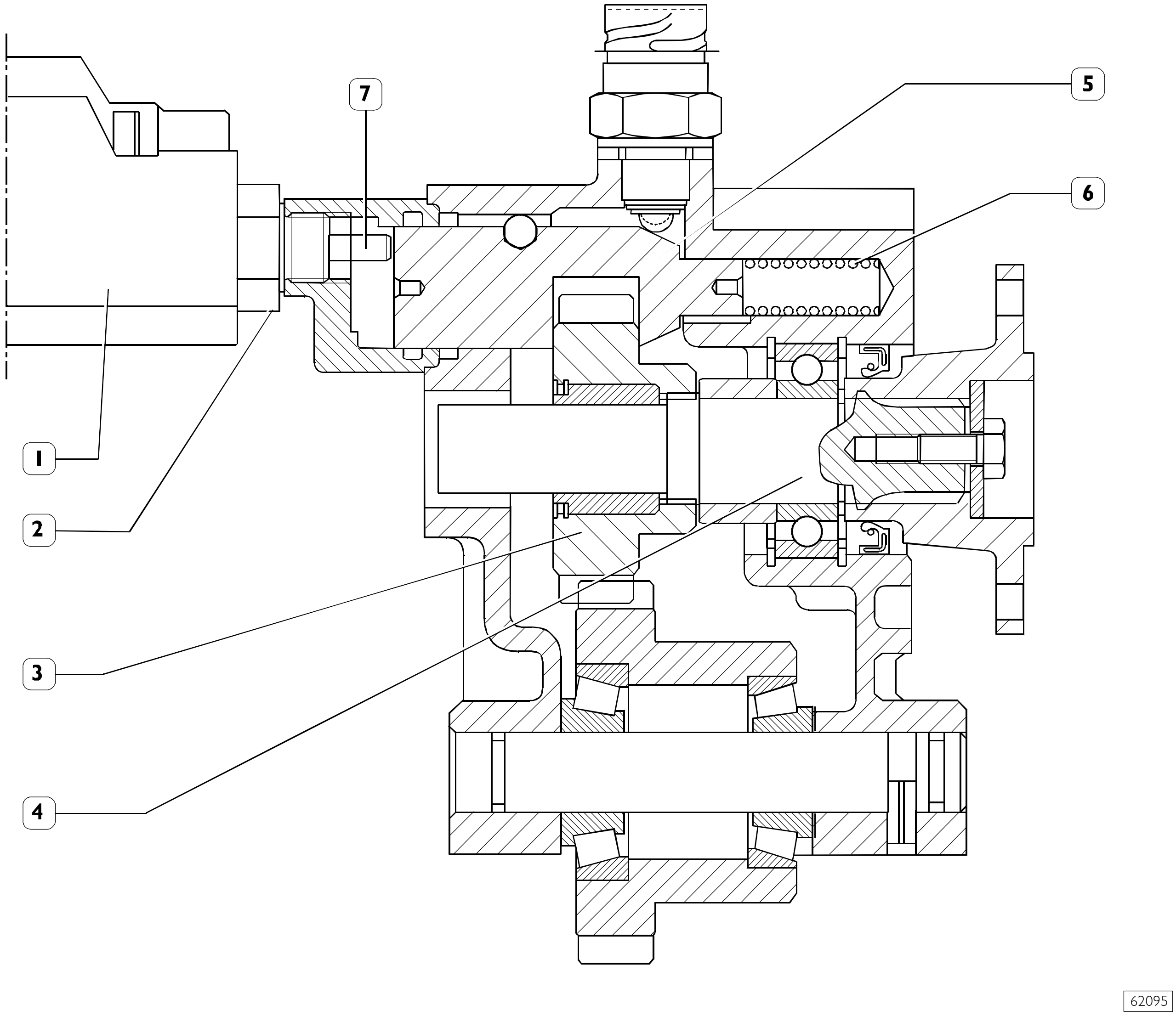
Screw thread (•) shall be smeared with Loctite 242.

Sealing ring (1) shall be fitted with 6 mm sinking from power take off housing (2) surface.

POWER TAKE OFF ELECTRIC ACTUATOR

Description

Figure 5



The linear actuator (1) provides motion to control rod (5) controlling power takeoff connection and disconnection.

It is fixed to power takeoff through the bottom side (2), screwing it on the power takeoff box.

Control rod motion is generated by a system composed of electric motor and worm screw (7) which, being blocked in rotation, linearly moves along two directions enabling to connect and disconnect the PTO.

Axial power load is controlled by a spring, set inside actuator (1), providing approx. 350 N force on power takeoff control rod (5).

Operation

POWER TAKEOFF CONNECTION

PTO connection (Figure 5) is divided into two different phases:

The first phase consists in moving forward worm screw (7), rod (5) and sleeve (3), which, coming into contact with shaft toothing (4), creates axial backstop of the rod and worm screw in an intermediate position as to the whole stroke.

The axial backstop of worm screw (7) preloads the spring inside the actuator and switches the electric motor off; the pretensioned spring exerts energises control rod (5) and keeps the axial load even after electric motor switching off.

The second phase consists in stroke continuation if sleeve (3) toothing sustains a relative rotation as to the shaft (4) toothing and therefore stops the axial backstop previously set by the two toothing contrast.

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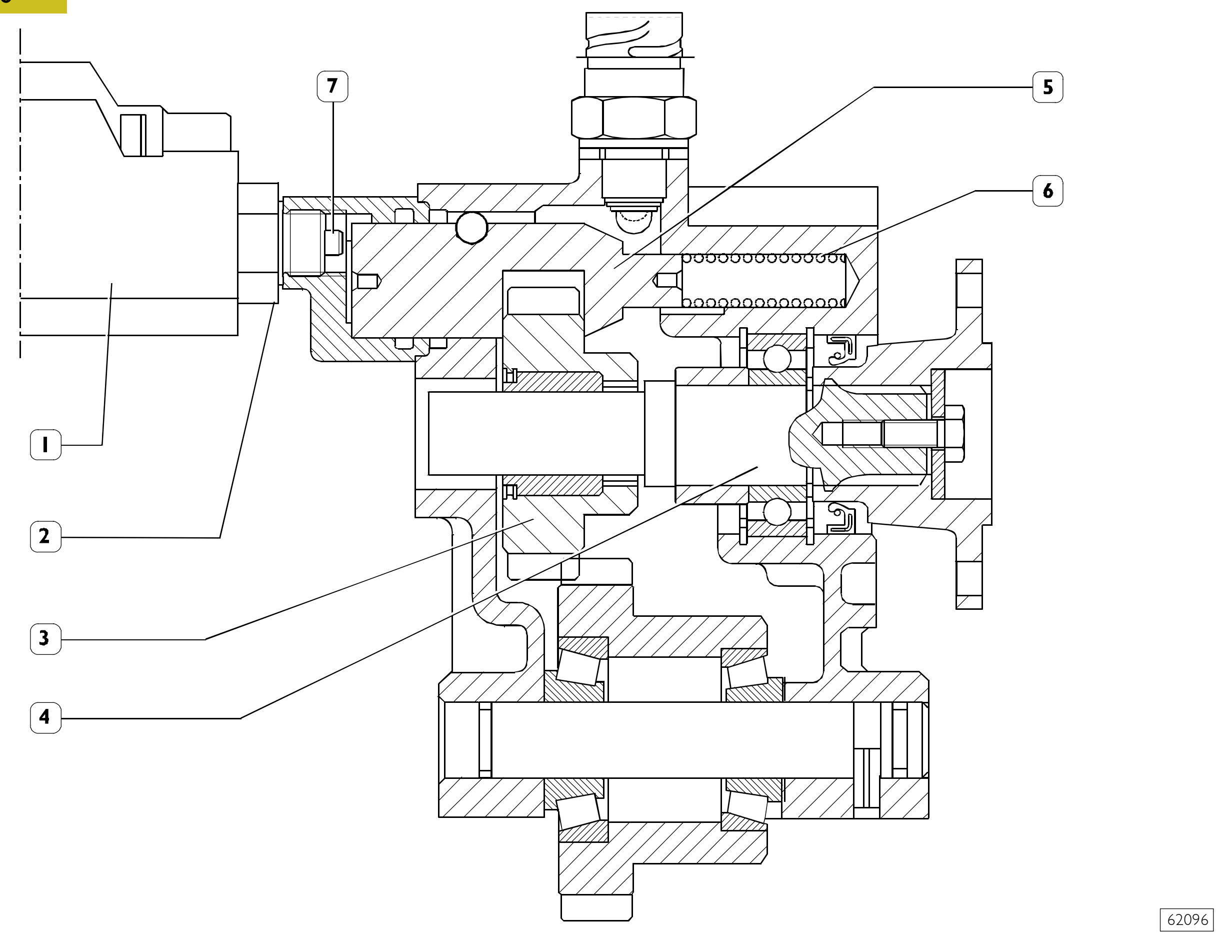
Figure 6



In this case, the spring inside the actuator, previously preloaded, provides a first motion to the elements (7, 5 and 3) and causes the electric motor, previously stopped, starting.

Subsequently, the stroke starts again until it meets a new obstacle, represented by rod (5) limit stop on the power takeoff box.

At this point, another axial backstop condition is created and the above-mentioned operation is repeated: rod (5) tension and electric motor switching off.

As long as the PTO engagement toothings stay on contact with each other, the electric motor is switched off because the pressure on the toothings (3 and 4) is kept by the spring, inside the actuator.

The axial load on the engagement toothings is calibrated (about 350 N) and gradually applied because the action spring (inside the actuator) carries out a determined stroke before being completely loaded. Toothing mouths (3 and 4) shall therefore be protected against violent impacts assuring, as to traditional mechanical or pneumatic system, less engagement element wear and consequently, an higher number of turns to be implemented before component deterioration.

The functionality is more serviceable since the engagement is softer and more silent as to the traditional systems.

Worm screw (7) limit stop is determined by axial load and distance covered by control rod (5).

It is therefore possible to install on PTO having different stroke values without modifying or adding compensation elements.

POWER TAKEOFF DISCONNECTION

The PTO disconnection phase (Figure 6) is divided into two motions:

The first motion consists in the worm screw return (7) through the reversal carried out on the electric motor.

The second motion consists in the control rod retrocession (5) through spring (6) and consequent shaft (4) sleeve (3) disengagement.

NOTE The retrocession motion of the worm screw (7) do not depend on the movement carried out by the control rod (5); this guarantees, if the sleeve (3) cannot be disengaged, the immediate backing of the worm screw (7) without causing overloads to the electric motor.

The PTO will be disconnected when the backstop condition is over.

This event can occur if during the disengagement request the shaft (4) is still in rotation or pretensioned by a residual torque.

SECTION 5

5056 Propeller shafts

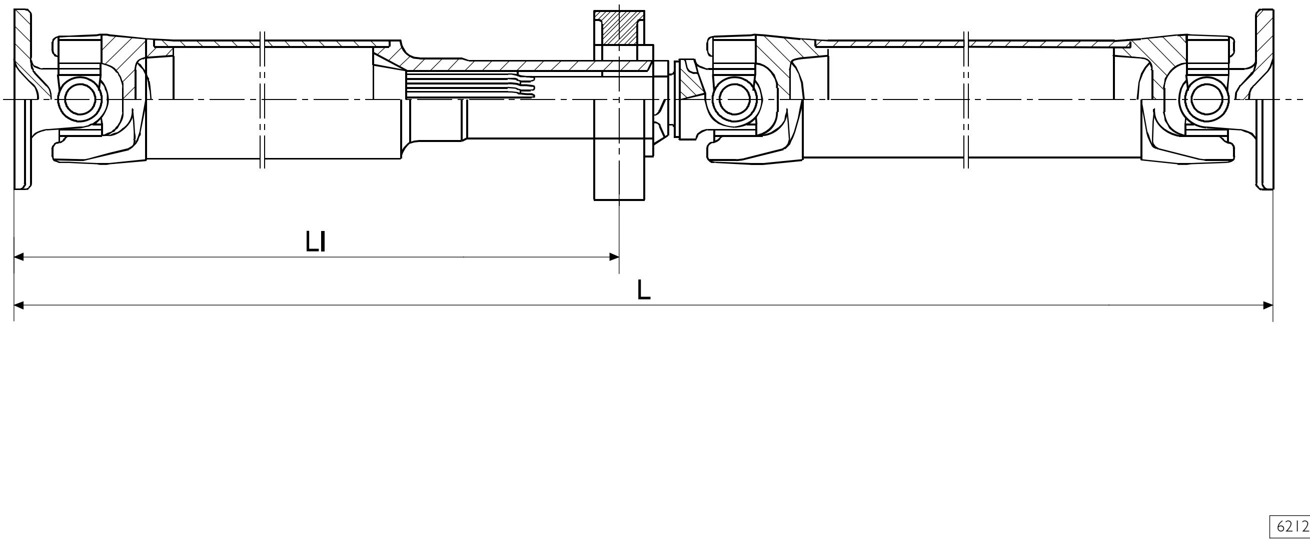
Page

CHARACTERISTICS AND DATA

Name	mm
Complete spider assembly (radial) in the fork housings	0,03
Transmission shaft max. off-centring	
❑ measured at centre	0,4
❑ measured at extremities	0,25
❑ measured on tang	0,15
Max. working angle	20°

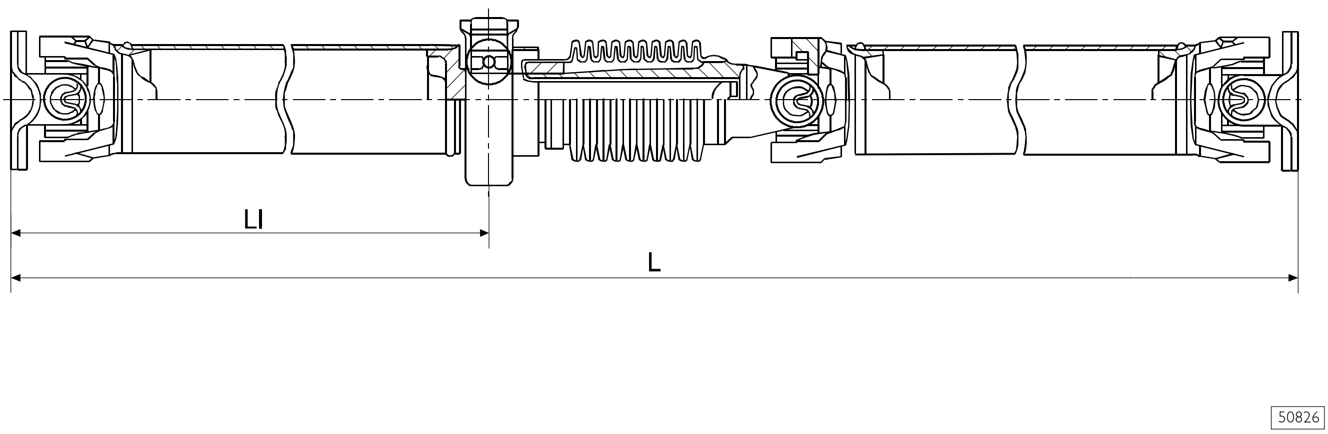
4x2 Vehicles

Figure 1



GKN-TYPE ARTICULATED PROPELLER SHAFT

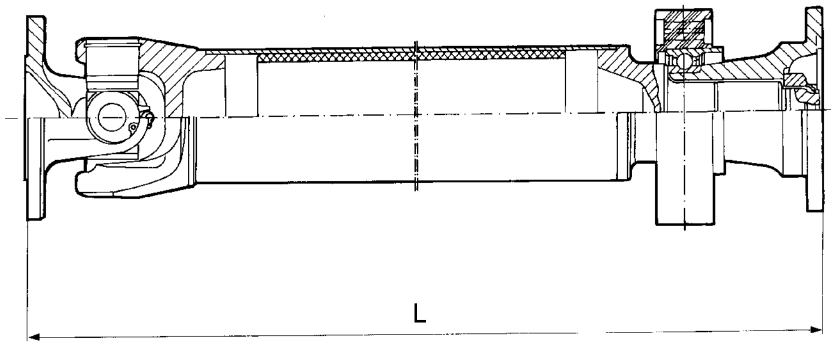
Figure 2



DANA-TYPE ARTICULATED PROPELLER SHAFT

4x2 Vehicles

Figure 3



GKN-TYPE CONNECTING SHAFT

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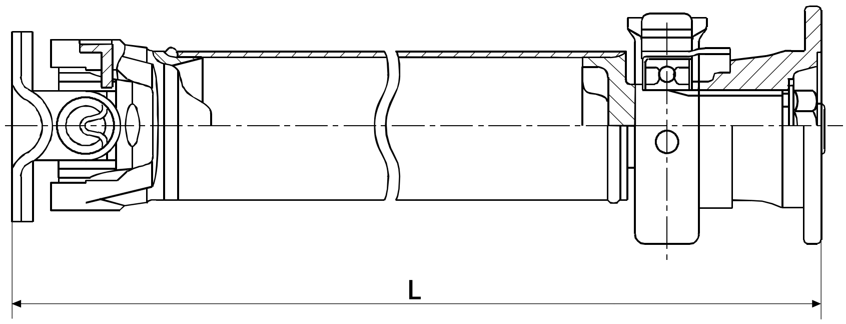
Figure 4



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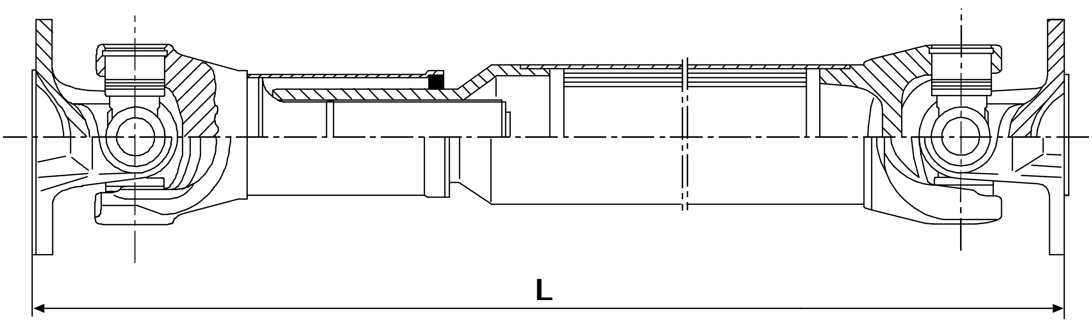
DANA-TYPE CONNECTING SHAFT

Figure 5



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GKN-TYPE CONNECTING SHAFT

MODEL	VERSION	PITCH (mm)	Propeller shaft length (mm) SENZA CODICE-2		
			L_1	L	
				GKN supply	DANA supply
29L-35S 10/12 29L-35S 14	VAN CHASSI CAB	3000	813	2120 ÷ 2210	2120 ÷ 2205 2130 ÷ 2215*
	VAN	3450	1134	2565 ÷ 2655	-
			1135	-	2580 ÷ 2665
35S 10/12/15/18	VAN	3000	763	2075 ÷ 2165	2075 ÷ 2160 2085 ÷ 2170*
	CHASSI CAB	3450	1085	2520 ÷ 2610	2520 ÷ 2605
35C - 40C 10/12 35C 14	VAN CHASSI CAB	3000	652	2080 ÷ 2170	2080 ÷ 2165 2090 ÷ 2175*
35C 10/12/18	VAN	3000	602	2035 ÷ 2125	2035 ÷ 2120
35C - 40C 10/12/15/18	CHASSI CAB				

(*) Power trains extended by 10 mm.

MODEL	VERSION	PITCH (mm)	Propeller shaft length (mm)			
			Front shaft SENZA CODICE-4	Rear shaft SENZA CODICE-2		
			L	L_1	L	
					GKN supply	DANA supply
29L.10/12/14 35S 10/12/14	VAN	3300	891	343	1540 ÷ 1630	1540 ÷ 1625
	CHASSI CAB	3750	891	666	1980 ÷ 2070	1980 ÷ 2065 1990 ÷ 2075*
	VAN	3950	891	866	2180 ÷ 2270	2180 ÷ 2265 2190 ÷ 2275*
35S 10/12/14 /15/18	VAN	3300	841	343	1540 ÷ 1630	1540 ÷ 1625
	CHASSI CAB	3750	841	666	1980 ÷ 2070	1980 ÷ 2065 1990 ÷ 2075*
	VAN	3950	841	866	2180 ÷ 2270	2180 ÷ 2265 2190 ÷ 2275*
35C - 40C 10/12 35C 14	VAN	3300	730	608	1650 ÷ 1740	1650 ÷ 1735 1660 ÷ 1745*
	CHASSI CAB	3450	730	607	1815 ÷ 1905	1815 ÷ 1900
	CHASSI CAB	3750	730	652	2090 ÷ 2180	2090 ÷ 2175 2110 ÷ 2195*
	VAN	3950	730	986	2315 ÷ 2405	2315 ÷ 2400
	CHASSI CAB	4100	730	1024	2450 ÷ 2540	2450 ÷ 2530 2460 ÷ 2540*
35C - 50C 15 45C - 50C 10/12 14/15/18	CHASSI CAB	3450	680	607	1800 ÷ 1905	1815 ÷ 1900
	CHASSI CAB	3750	680	652	2090 ÷ 2180	2090 ÷ 2175 2110 ÷ 2195*
	VAN	3950	680	986	2295 ÷ 2385	2315 ÷ 2400

(*) Power trains extended by 10 mm.

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MODEL	VERSION	PITCH (mm)	Propeller shaft length in mm.			
			Front shaft SENZA CODICE-4 (*)	Rear shaft SENZA CODICE-2 - (*) 5		
			L	L_1	L	
					GKN supply	DANA supply
35C - 40C 10/12/14/15/18	VAN	4100	680	1024	2450 ÷ 2540	2460 ÷ 2545
	CHASSI CAB	3300	680	607	1650 ÷ 1740	1650 ÷ 1735 1660 ÷ 1745*
45C - 50C 15/18	VAN	3300	(*) 680		(*) 690 ÷ 790	
35C - 50C 45C - 50C 10/12/15/18	VAN	3950	680	986	2295 ÷ 2405	2315 ÷ 2400

MODEL	VERSION	PITCH (mm)	Propeller shaft length in mm.					
			Front shaft SENZA CODIC -4	Central shaft SENZA CODICE-4-(•) 5		Rear shaft SENZA CODICE-2-(•) 5		
				L		L_1	L	
			L	GKN supply	DANA supply		GKN supply	DANA supply
45 - 50C 15/18	CHASSIS COWL	3750	(•) 680	(•) 755 ÷ 855	(•) 755 ÷ 855	-	(•) 1080 ÷ 2180	(•) 1080 ÷ 1190
	CHASSI CAB	4350	680	746		722	1950 ÷ 2040	1965 ÷ 2050
	CHASSIS COWL (•)			(•) 755 ÷ 855	(•) 755 ÷ 865	(•)440	(•) 1630 ÷ 1720	(•) 1630 ÷ 1715
	CHASSI CAB	4750	680	730		1056	2380 ÷ 2470	2380 ÷ 2465
	CHASSIS COWL (•)			(•) 755 ÷ 855	(•) 755 ÷ 865	(•)781	(•) 2100 ÷ 2190	(•) 2100 ÷ 2185
	VAN	3950	(*) 680	(•) 1120 ÷ 1220		-	(•) 900 ÷ 1000	-

(•) Vehicles with Telma retarder

(*) Power trains extended by 10 mm.

MODEL	VERSION	PITCH (mm)	Propeller shaft length in mm.			
			Front shaft SENZA CODICE-4	Rear shaft SENZA CODICE-2		
			L	L_1	L	
					GKN supply	DANA supply
60C - 65C 15/18	VAN	3300	670	614	1630 ÷ 1720	1630 ÷ 1715
	CHASSI CAB	3450	670	626	1780 ÷ 1870	1790 ÷ 1875
	CHASSI CAB	3750	670	660	2075 ÷ 2165	2085 ÷ 2170
	VAN	3950	670	995	2280 ÷ 2370	2280 ÷ 2365

MODEL	VERSION	PITCH (mm)	Propeller shaft length in mm.				
			Front shaft SENZA CODIC -4	Central shaft SENZA CODICE-4	Rear shaft		
					L_1	L	
			L	L		GKN supply	DANA supply
60C - 65C 15/18	CHASSI CAB	4350	670	801	724	1885 ÷ 1975	1885 ÷ 1970
	CHASSI CAB	4750	670	730	1065	2350 ÷ 2440	2350 ÷ 2435

MODEL	VERSION	PITCH (mm)	Propeller shaft length in mm.					
			Front shaft SENZA CODIC -4	Central shaft SENZA CODICE		Rear shaft Figure 5.1.2		
				L		L_1	L	
			L	GKN supply	DANA supply		GKN supply	DANA supply
60C - 65C 15/18	CHASSIS COWL	3750	670	(•) 970 ÷ 1070	-	-	(•) 825 ÷ 925	-
	CHASSIS COWL	4350	670	(•) 970 ÷ 1070	-	-	(•) 1395 ÷ 1495	-
	CHASSIS COWL	4750	670	(•) 1080 ÷ 1180	-	408	-	(•) 1705 ÷ 1790

(•) Vehicles with Telma retarder

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DIAGNOSTICS

The main operating faults of the propeller shaft are as follows:

1. Noise and vibrations

1	NOISE AND VIBRATIONS

Fault		Remedy
Deformation of shaft.	YES →	Replace shaft.
NO ↓		
Shaft unbalanced.	YES →	Check balancing of shaft and determine the points where to weld the counterweights.
NO ↓		
Excessive play between the splined profiles.	YES →	Replace the shaft.
NO ↓		
Nuts and bolts fastening shaft to either transmission or rear axle sleeves loose.	YES →	After a careful check, tighten up the loose screws and nuts, and eventually replace any damaged ones.
NO ↓		
Universal joints seized-up or excessively worn.	YES →	Overhaul or replace the universal joints.
NO ↓		
Insufficient lubrication of the parts.	YES →	Lubricate the parts at the appropriate nipples.
NO ↓		
Elastic support fixing screws loose.	YES →	Tighten the screws to the required driving torque.

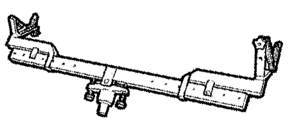
(Continues)

Elastic dowel of central support in bad condition.	– YES →	Replace the support.
NO ↓		
Central elastic support bearing in bad condition or excessive play.	– YES →	Replace the support.
NO ↓		
Flange fixing screws or ring nuts on propeller shaft tang loose.	– YES →	Tighten the screws or the ring nuts to required driving torque.

TIGHTENING TORQUES

PART		TORQUE	
		Nm	kgm
Ring nut for fixing to connecting shaft		250 ± 25	25,4 ± 2,5
Nut for screw for fixing flanges to propeller shaft	M10 × 1,5	63,5 ± 6,5	6,5 ± 0,6
	M12 × 1,25	116,5 ± 11,5	11,8 ± 1,2
Nut, linkage shaft to chassis side member fixing screw		62,5 ± 6,5	6,3 ± 0,6

TOOLS

TOOL NO.		DESCRIPTION
99370618		Support for removal-refitting propeller shaft

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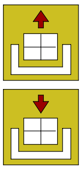
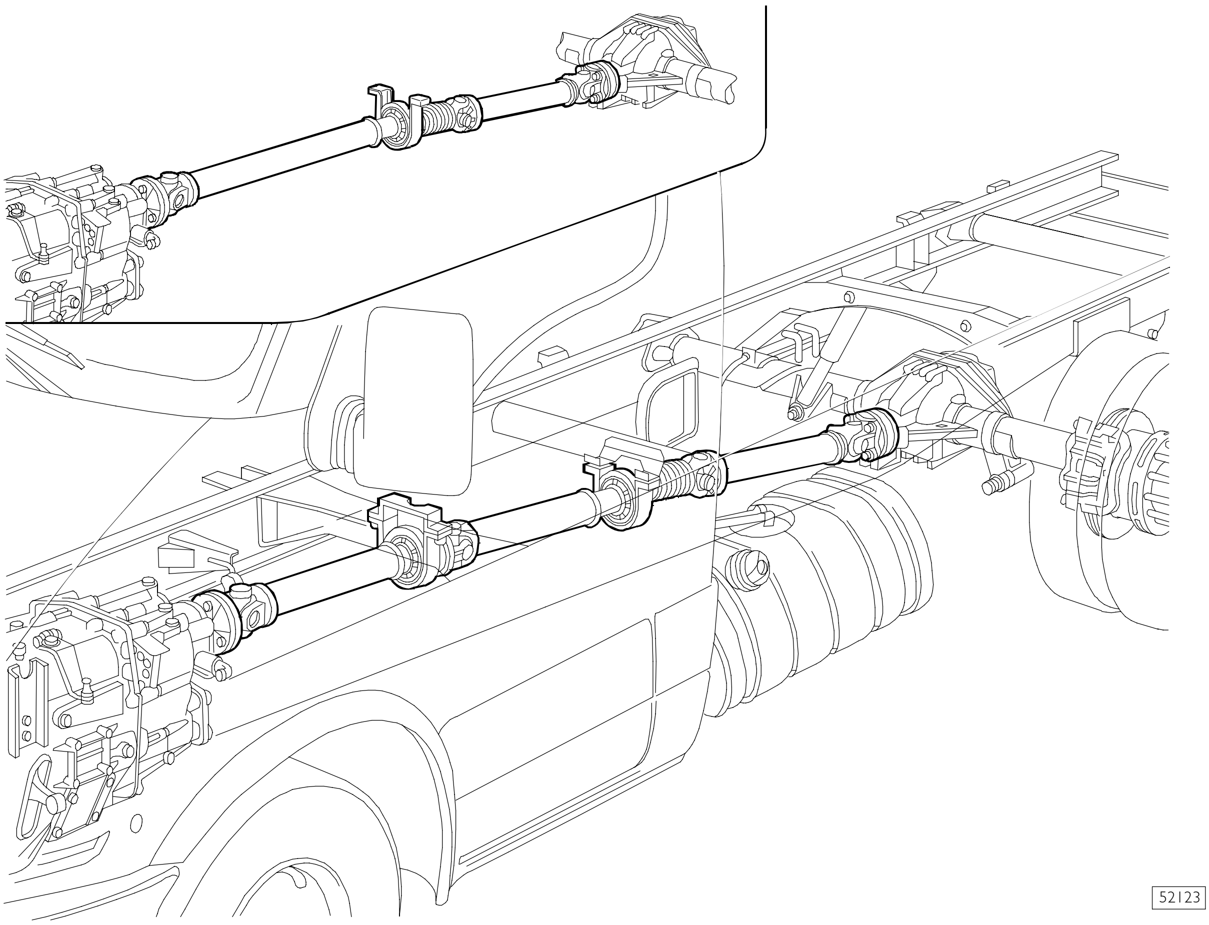
505620 PROPELLER SHAFT REMOVAL AND REFITTING

Figure 6





52123

Removal

NOTE When overhauling the propeller shaft, always begin by removing the rear shaft.

Arrange the support 99370618 on the hydraulic jack and apply the support to the propeller shaft.
Remove the fixing bolts from the flange and remove the shaft; for the intermediate and front axles, also remove the chassis shaft support.

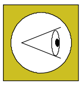
Refitting

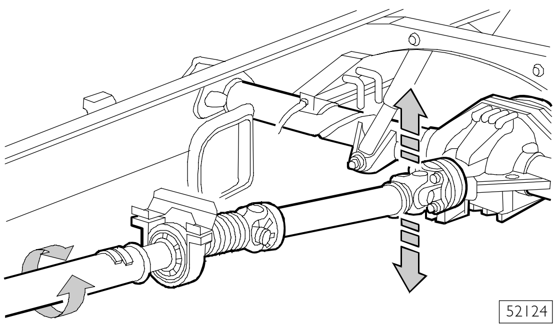
Repeat the same operations for removal in the opposite order and observe the following:

- ❑ Make sure that the arrows shown on the moving part and on the shaft are aligned.
- ❑ Make sure that the holes of the front flange are aligned with those of the rear flange;
- ❑ the nuts for the flange coupling screws must be replaced and never reused;
- ❑ the flange coupling screws must be inserted into the holes of the flange from the side of the universal joint;
- ❑ the nuts and screws must be tightened to the required driving torque;
- ❑ the flange of the moving part of the propeller shaft must be connected to the output shaft flange.

CHECKING PROPELLER SHAFTS ON VEHICLE

Figure 7





52124

The plates welded to the propeller shafts are counterweights. If the plates are missing the shaft must be re-balanced.
By operating on the propeller shaft and at the same time, in the opposite direction, on the sliding sleeve, check that there is not too much slack between the splines.
By operating on the sleeve forks. check that the spiders are not worn; if they are, replace them.

SECTION 6

5250 Rear axles

DIAGNOSTICS

The main rear axle operating faults are as follows:

1. - Wheel hubs noise;
2. - Rear axles noise;
3. - Noise at release;
4. - Noise during acceleration;
5. - Cornering noise.

1 WHEEL HUBS NOISE

Insufficient lubrication.

YES → Check that there are no leaks from gaskets or the rear axle casing and top up oil to correct level.

NO ↓

Wheel hub bearings inefficient.

YES → Remove the hub and replace inefficient parts.

NO ↓

Wheel hub bearings out of adjustment.

YES → Adjust bearings.

2 REAR AXLES NOISE

Lubricating oil level low.

YES → Check that there are no leaks from gaskets or the rear axle casing and top up oil to correct level.

NO ↓

Drive shaft splines to fit the differential crown wheels damaged.

YES → Overhaul the rear axle and replace worn or damaged parts.

NO ↓

Wheel hub bearings inefficient.

YES → Adjust the bearings clearance.

Cause		Remedy
Bad adjustment or wear on differential gears or bearings.	YES	Locate the trouble and overhaul the unit.

3 NOISE AT RELEASE

Cause		Remedy
Improper fitting clearance between pinion and ring bevel gear.	YES	Remove the gear housing inspection cover and adjust clearance between pinion and ring bevel gear.

4 NOISE DURING ACCELERATION

Cause		Remedy
Insufficient lubrication.	YES	Check that there are no leaks from gaskets or the rear axle casing and top up oil to 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

Cause		Remedy
Improper clearance between planetary gears and crown wheels.	YES	Overhaul or replace the unit.

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Rear axle NDA RS

DESCRIPTION

The rear axle is the load-bearing type with a single reduction using a hypoid crown wheel and pinion.

The axle housing is made of pressed sheet steel with hot pressed arms.

The bevel pinion is supported by two pre-lapped tapered roller bearings to hold the bearing pre-load better.

The bearings are factory lubricated by the manufacturer with rustproof protective oil.

The rolling torque of the bearings of the bevel pinion is adjusted by changing the thickness of the adjustment ring between the two tapered roller bearings.

In addition, it is possible to adjust the position of the bevel pinion with respect to the ring bevel gear by changing the thickness of the ring between the axle housing and the bevel pinion rear bearing external ring.

The gear housing is supported by two tapered roller bearings, also pre-lapped and lubricated with rustproof protective oil.

The adjustment of bearing rolling torque is through adjusting rings put in between box and stop rings.

The clearance between pinion and crown wheel is adjusted by changing the thickness and/or position of the adjustment rings, though the total thickness must be the same as that of the adjustment rings removed.

Differential wheelwork assembly is made up of two planetary and two crown wheel gears.

The drive shafts are supported inside the arms of the axle housing by UNIT BEARINGS lubricated for life, which require no adjustment.

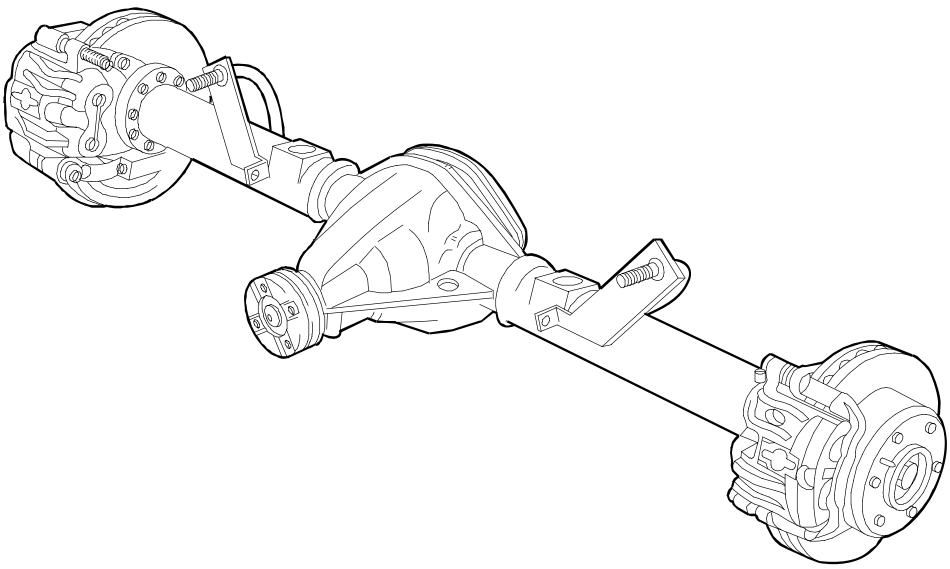
The brakes are disc brakes with floating brake calipers.

The disc brakes are splined onto the end of the drive shafts and secured with pins that also serve as centring for the wheel rims.

The brake calipers are secured with flanges welded onto the end of the arms of the axle housing.

The brake calipers are equipped with the parking brake device.

Figure 1



107834

SPECIFICATIONS AND DATA

Type of rear axle: Simple reduction type	NDA RS
DIFFERENTIAL UNIT Reduction bevel gear pair ratio (No. of teeth: pinion/crown)	1/3,154 (13/41) - 1/3,416 (12/41) - 1/3,727 (11/41) - 1/3,916 (12/47) - 1/4,182 (11/46) - 1/4,444 (9/40) - 1/4,889(9/44) - 1/5,111 (9/46)
Bevel pinion bearings	2 with taper rollers
Bevel pinion bearings rolling torque (bearings lubricated and without gasket) Nm New bearings kgm	2.3 ÷ 3.3 0.23 ÷ 0.33
Adjustment of pre-load of bevel pinion bearings	By means of adjustment rings
Bevel pinion bearings pre-load adjustment rings	0.545 ÷ 1.070 mm with progression of 0.025 mm.
Temperature at assembly of inner bearing ring on bevel pinion	-
Position of bevel pinion with respect to differential casing	By means of adjustment spacers
Thickness of adjustment rings placed between bevel pinion and differential casing	3.585 ÷ 4.235 mm with progression of 0.025 mm.
Bearings for gear housing	2 with taper rollers
Differential casing bearings rolling torque (bearings lubricated and without gasket) ❑ 15/44 - 13/41- 12/41 - 12/43 - 12/47 - 10/41: Nm kgm ❑ 11/49 - 9/40 - 9/44 - 8/41 - 8/45: Nm kgm	 2.7 ÷ 3.9 0.27 ÷ 0.39 2.6 ÷ 3.7 0.26 ÷ 0.37
Adjustment of differential casing bearings rolling torque	By means of adjustment rings
Thickness of adjustment rings of differential casing bearings rolling torque	1 ÷ 1,95 mm with progression of 0.05 mm.

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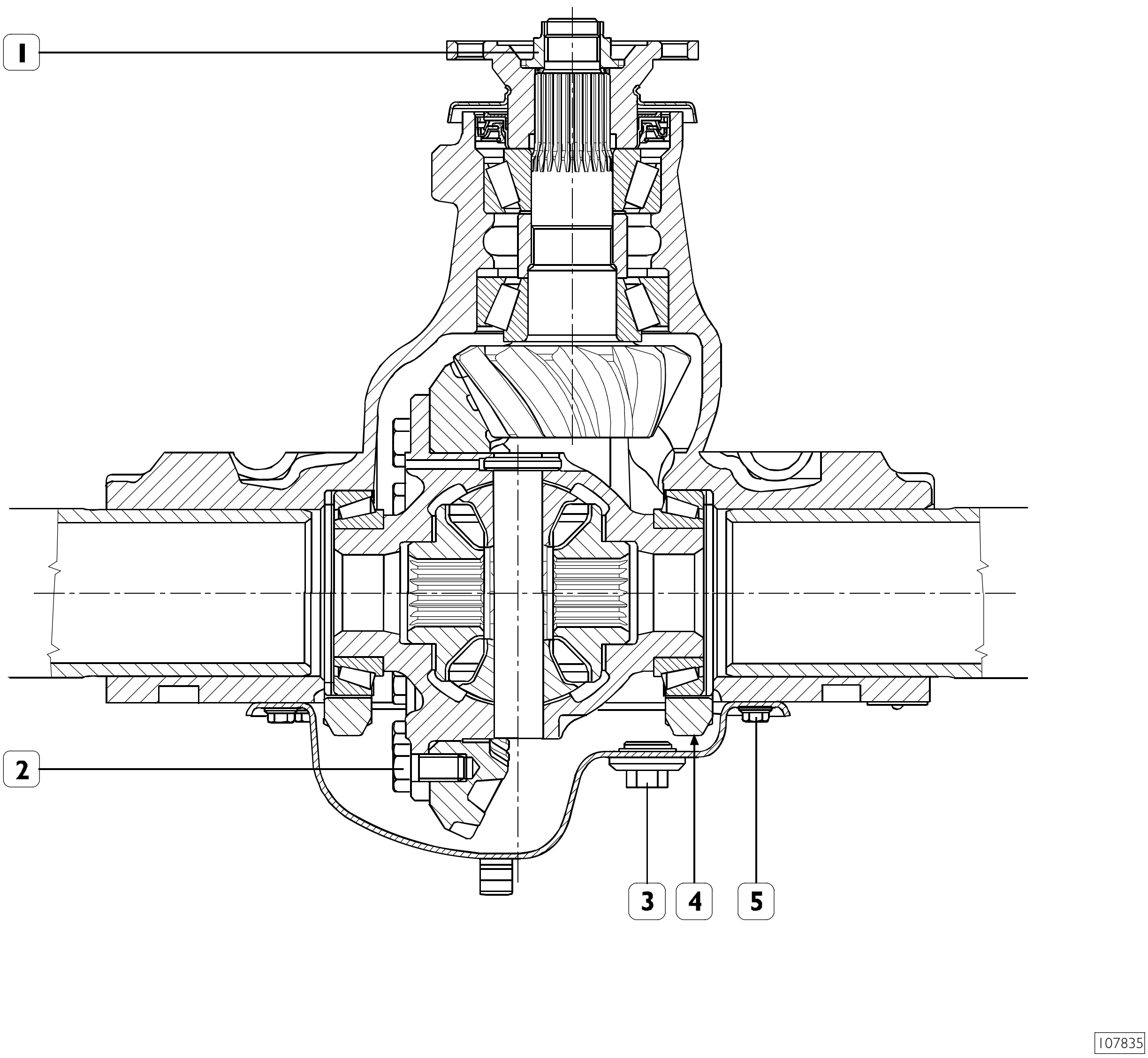
Type of rear axle: Simple reduction type	NDA RS
Clearance between pinion and ring bevel gear with reduction ratios ❑ 1/3.916 - 1/4.182 - 1/4.444 - 1/5.111: ❑ 1/3.154 - 1/3.416 - 1/3.727 - 1/4.889:	 0.13 ÷ 0.18 mm 0.15 ÷ 0.20 mm
Adjustment of clearance between pinion and ring bevel gear	By means of adjustment rings
Clearance between planetary and crown wheels	0.05 ÷ 0.15 mm
WHEEL HUBS	
Wheel hub bearings	UNIT-BEARING
Wheel hub bearings end play	-
Wheel hub bearings rolling torque Nm kgm	 - -
Adjustment of wheel hub bearings end play	Not adjustable Tighten fixing ring nut to torque
Rear axle oil Quantity Litres	**TUTELA W90/M-DA (SAE 80 W 90)** 1,35
Dry rear axle weight : ❑ With ABS kg ❑ Without ABS kg ❑ Max capacity (GAW) kg	 112.1 110.6 2240

TIGHTENING TORQUES

Figure 2



NDA RS REAR AXLE DIFFERENTIAL SECTION

PART		TORQUE Nm	TORQUE Kgm
1	Bevel pinion retaining nut	400 ÷ 500	40 ÷ 50
2	Screw securing half-housing and ring bevel gear	89 ÷ 108	8.9 ÷ 10.8
3**	Oil filler plug	49 ÷ 62	4.9 ÷ 6.2
4	Screw securing caps to differential housing	100 ÷ 120	10 ÷ 12
5	Screw securing gearing inspection cover to the axle housing	80 ÷ 95	8 ÷ 9.5
***	Oil drainage plug	49 ÷ 62	4.9 ÷ 6.2

* = Apply LOCTITE 5910 on the housing

** = Apply LOCTITE 577 on the plug thread

*** = Apply LOCTITE 573 on both sides of the gasket

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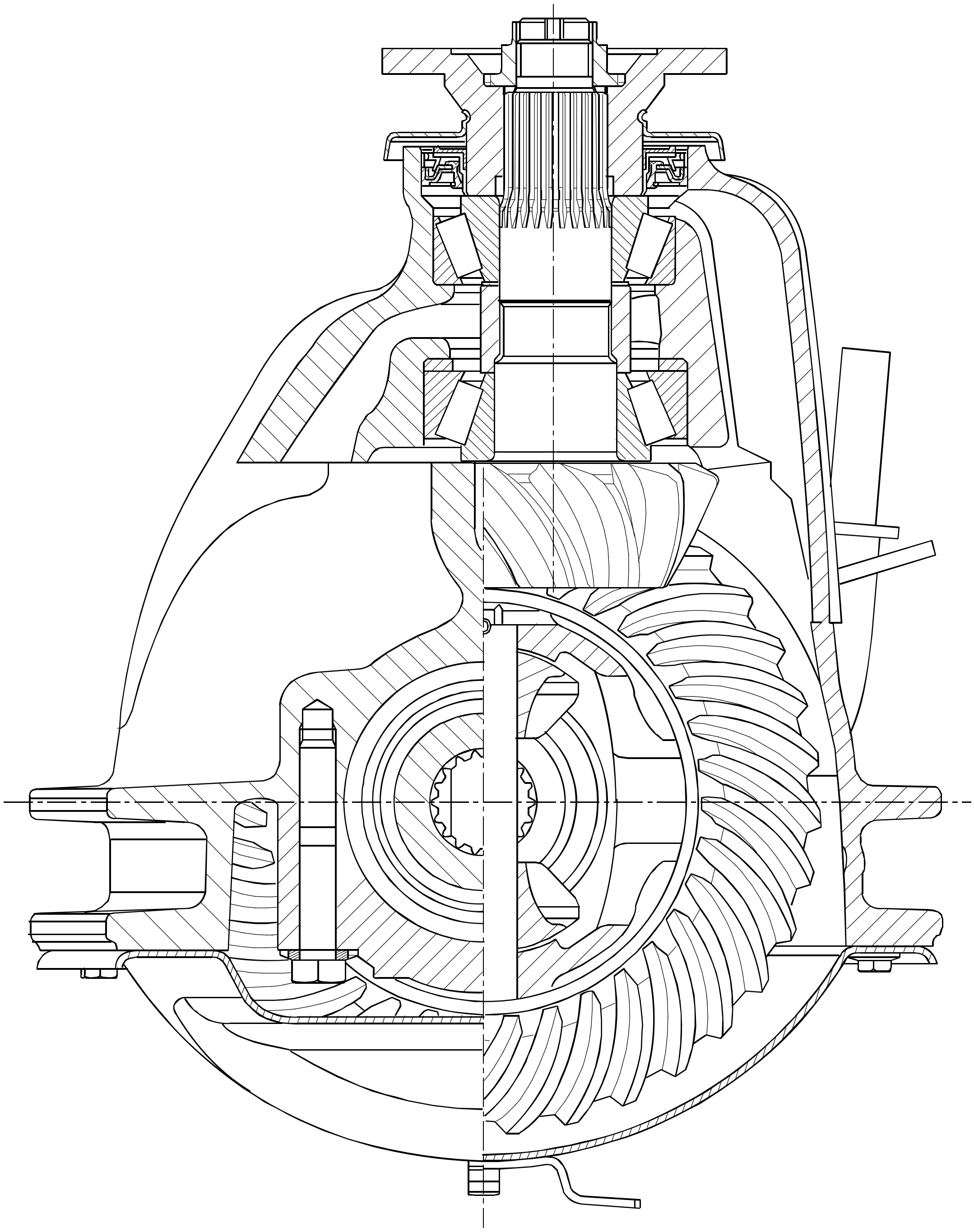
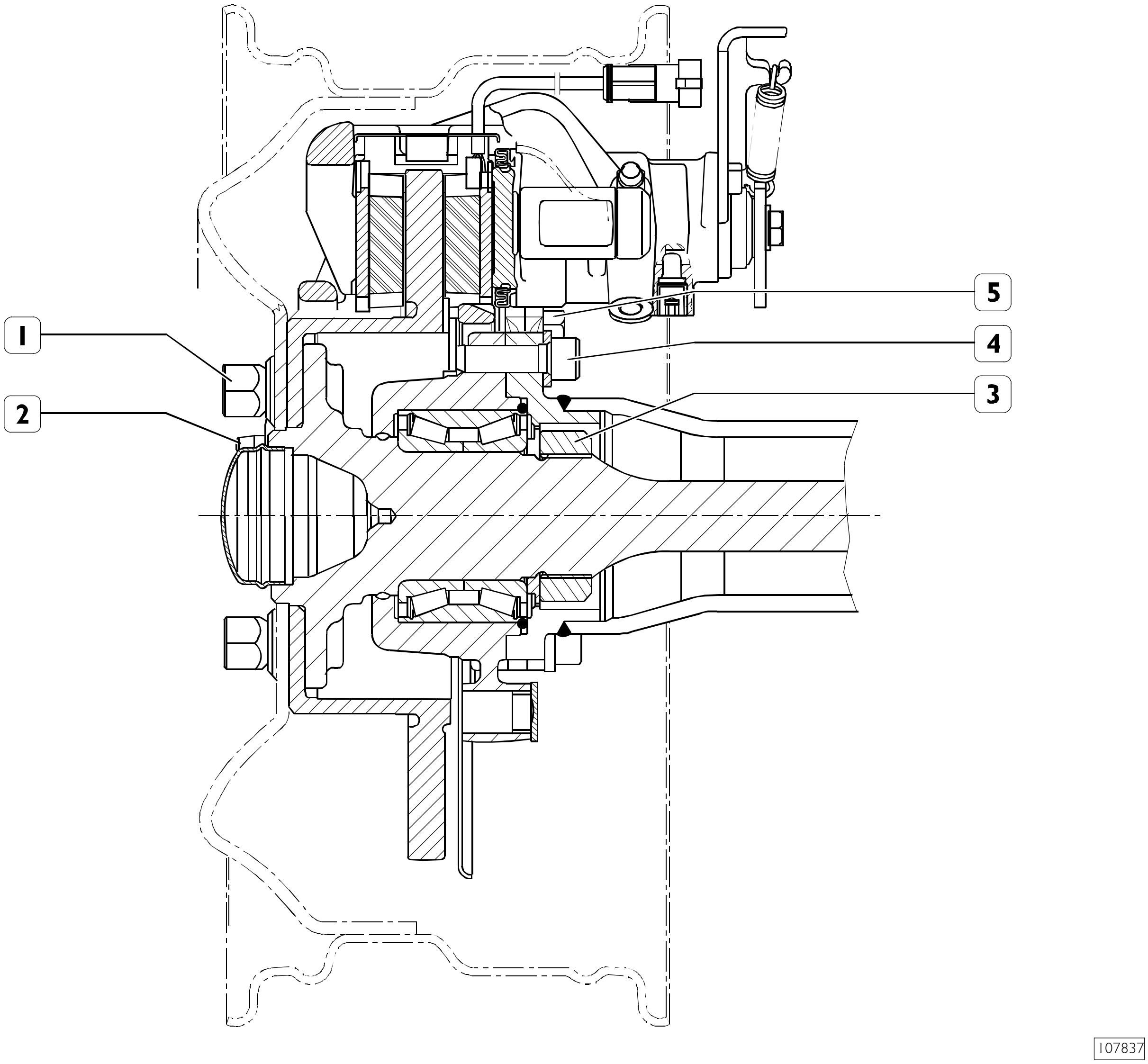
Figure 3



107836

NDA RS REAR AXLE DIFFERENTIAL SECTION

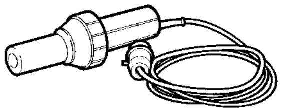
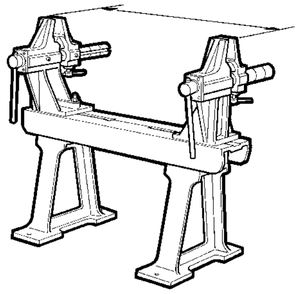
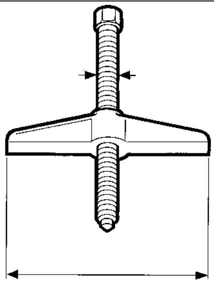
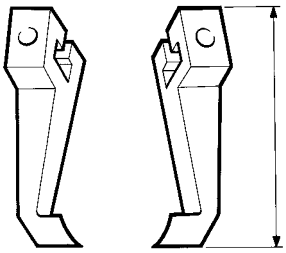
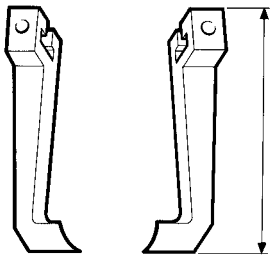
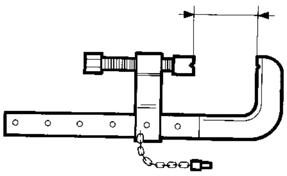
Figure 4



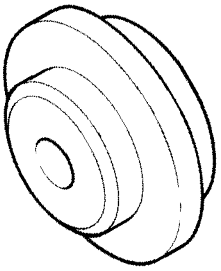
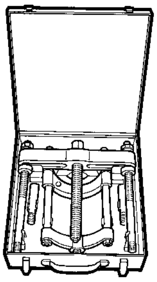
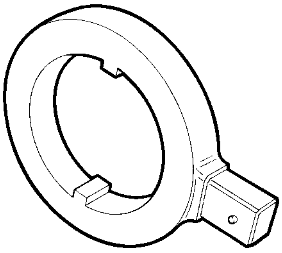
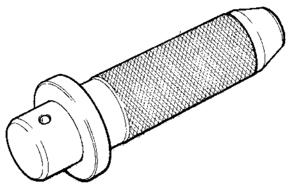
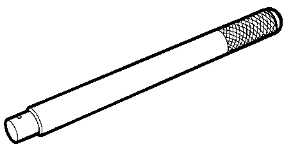
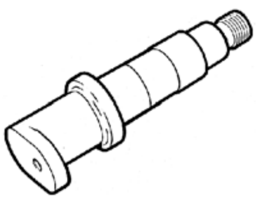
NDA RS REAR AXLE WHEEL HUB SECTION

PART		TORQUE	
		Nm	Kgm
1	Wheel securing screw	160	16,3
2	M8x1.25 brake disk securing screw	13 ÷ 21	1,3 ÷ 2,1
3	M52x3 half shaft bearing securing ring nut	559 ÷ 677	57,0 ÷ 69,0
4	M12 rear axle arm - bearing support securing screw	125 ÷ 135	12,7 ÷ 13,8
5	M14x1.5 brake caliper securing screw	176 ÷ 217	17,9 ÷ 22,1
-	M6 metal sheet guard securing screws	10 ÷ 16	1,0 ÷ 1,6

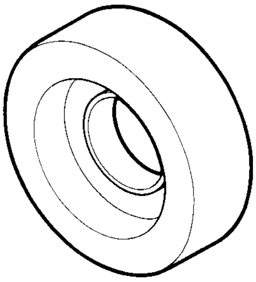
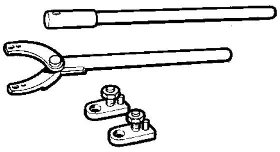
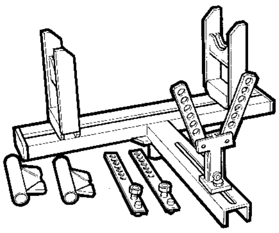
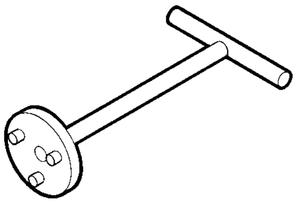
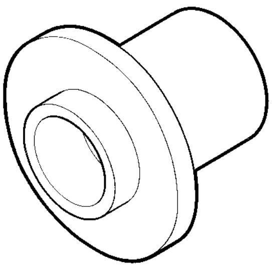
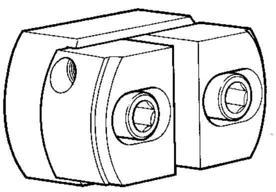
TOOLS

TOOL NO.		DESCRIPTION
99305121		Hot air drier
99322215		Front and rear axle overhaul stand
99341003		Single-acting rear axle
99341009		Pair of brackets
99341011		Pair of brackets
99341015		Clamp

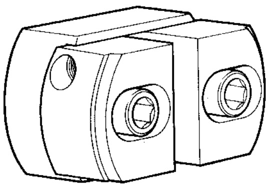
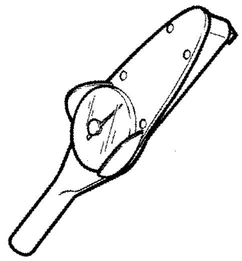
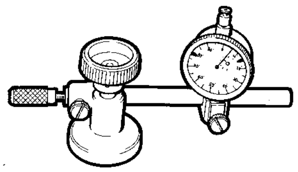
TOOLS

TOOL NO.		DESCRIPTION
99345057		Extractor reaction block
99348001		Extractor with locking device
99355184		Shaft bearing ring nut wrench
99370006		Handle, interchangeable drift
99370007		Grip for interchangeable punches
99370239		Tool to determine thickness of adjustment of bevel pinion (use with 99395728)

TOOLS

TOOL NO.		DESCRIPTION
99370241		Tool for fitting drive shaft bearing
99370317		Reaction lever with extension for flange retaining
99370617		Universal mounting to support axles during removal and refitting
99372236		Tool to move brake caliper piston back
99374022		Key to fit differential bevel pinion gasket (use with 99370007)
99374091		Punch to fit external races of bearings (diameter 55 ÷ 69 mm use with 99370007)

TOOLS

TOOL NO.		DESCRIPTION
99374092		Punch to fit external races of bearings (diameter 69 ÷ 91 mm use with 99370007)
99389819		Dynamometric wrench (0 ÷ 10 Nm) with 1/4" square connection
99395728		Dial gauge with mounting to be used with the tools to determine the thickness of adjustment of the bevel pinion

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525010 REAR AXLE NDA - RS REMOVAL - REFITTING

Removal

Position the vehicle on level ground and stop front wheels.
Loosen rear wheels securing screws.
Lift the vehicle from its rear side and position it on support stands.
Position hydraulic truck under rear wheels. Remove wheels securing screws and take them off the vehicle.
Unscrew nut (2) adjusting hand brake linkage. Release the cables from the chassis by uncoupling check springs (1).
Unscrew screws (7) securing transmission shaft (8).
Disconnect electrical cables (15) of the sensors of brake pad wear and phonic wheel rpm's (6).
Unscrew nuts (12) securing shock absorbers (11).
Take hydraulic pipes (16) of brake system off the fitting on the chassis. Such pipes will be removed together with real axle in the end step of the disconnection from the vehicle.

> ⚠ In disconnecting the hydraulic pipes of brake circuit and vapours breather, pay attention to any oil losses. Prearrange suitable collectors in such a way that brake liquid is not spread out into environment. Avoid contact of liquid with skin and eyes. In case of contact, wash abundantly with water.

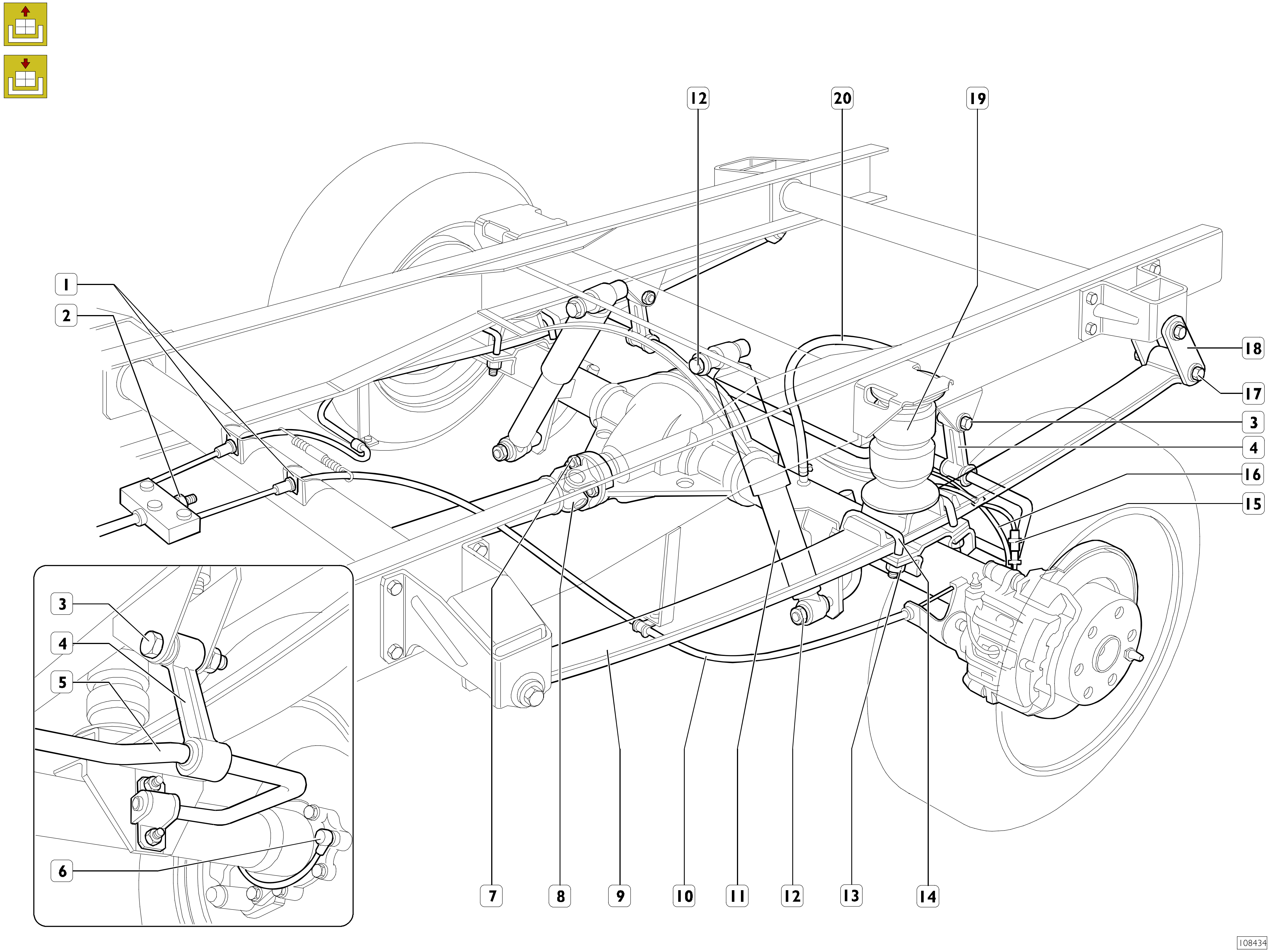
Unscrew screws (3) securing rods (4) supporting stabilising bar (5).
Disconnect rear axle oil vapours breather pipe (20).
Properly position a hydraulic jack provided with support 99370617 under rear axle.
Unscrew nut (17) securing leaf spring (9) to rod (18).
Unscrew nuts (13) of brackets (14) securing rear axle to leaf springs (9).
Lower hydraulic jack and take out rear axle.

Refitting

For refitting, carry out the operations described for removal in reverse order, taking the following precautions:

- ❑ Check the thread of the brackets joining the leaf springs to the axle. If there are any irregularities, rectify the thread (operation 500412) or replace the brackets.
- ❑ Bleed the air from the brake hydraulic system as described under the relevant heading (operation 784010).
- ❑ Adjust the handbrake control ties as described under the relevant heading (operation 502710).
- ❑ Lock the nuts or screws to the required tightening torque.
- ❑ The self-locking nuts must not be reused.
- ❑ The lubricating oil in the axle housing should be at the right level.
- ❑ Check the state of the flexible pads (19) and replace them if they have deteriorated (operation 500417).

Figure 5

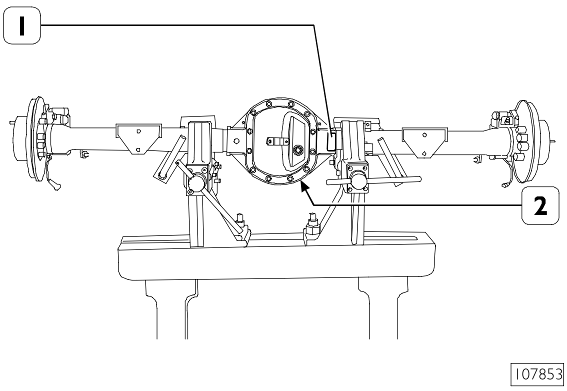


525010 OVERHAULING THE REAR AXLE ASSEMBLY

The drive shafts, brake disc and calipers, air breather and differential can all be removed and refitted even with the unit mounted on the vehicle.

Before positioning the rear axle assembly on the stand for overhauling, drain off the oil by unscrewing the side plug of the axle housing.

Figure 6

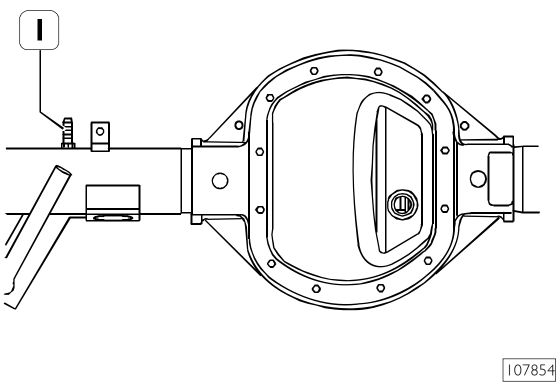


Set the entire rear axle assembly on stand 99322215.

The identification data of the rear axle unit are given on the plate (1) fixed near to the leaf spring attachment support.

525013 Air breather disassembly - assembly

Figure 7

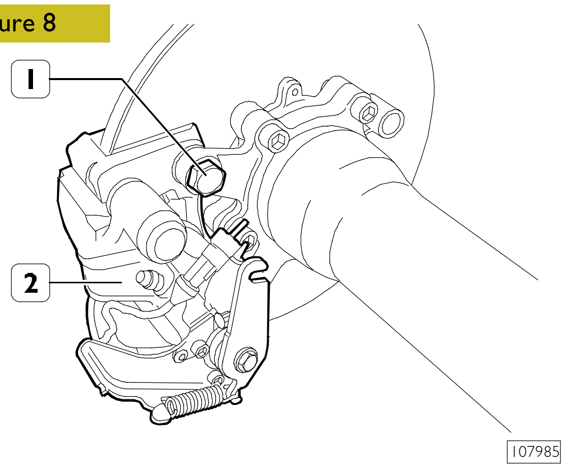


Check that the air breather (1) is not clogged; otherwise, disassemble and clean it thoroughly before refitting.

525030 Wheel hub overhaul

Disassembly

Figure 8



Take out the screws (1) and remove the brake caliper (2) with its brake linings from the mounting.

The caliper must not be violently knocked or dropped.

Prevent the rubber caps coming into contact with sharp metal tools.

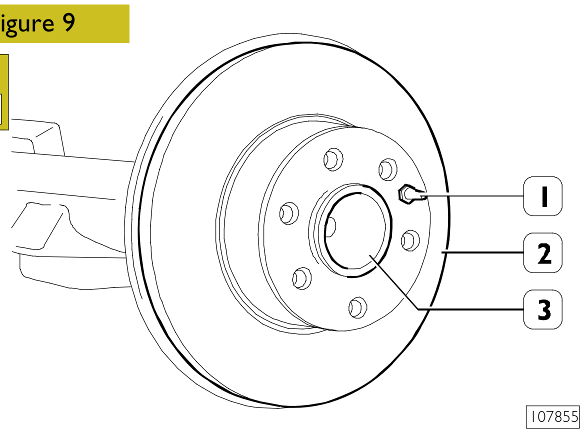
Do not dirty or wet the rubber caps with mineral grease or oil.

Do not dirty the pads with liquids or grease.

Do not operate the parking brake lever before mounting on the disc: this makes the piston come out, decreasing the gap between the two brake linings and jeopardizing wearability on the disc.

Should this be done unexpectedly, it is necessary to take down the brake linings and move the piston back with tool 99372236, taking the precautions given in the BRAKES section.

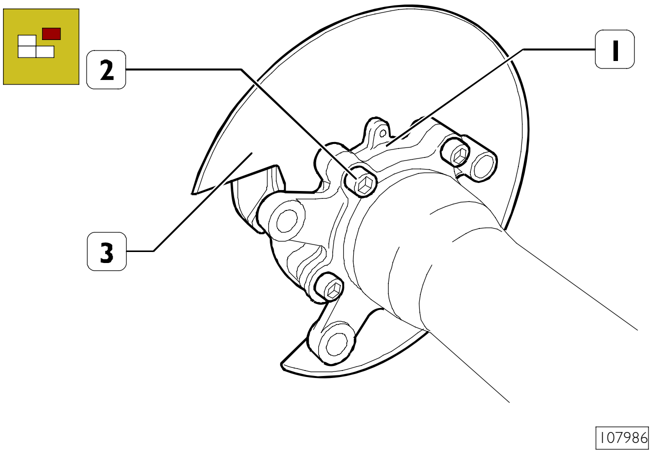
Figure 9



Remove pin (1) centering/securing brake disk (2) to half shaft (3). Take off brake disk (2).

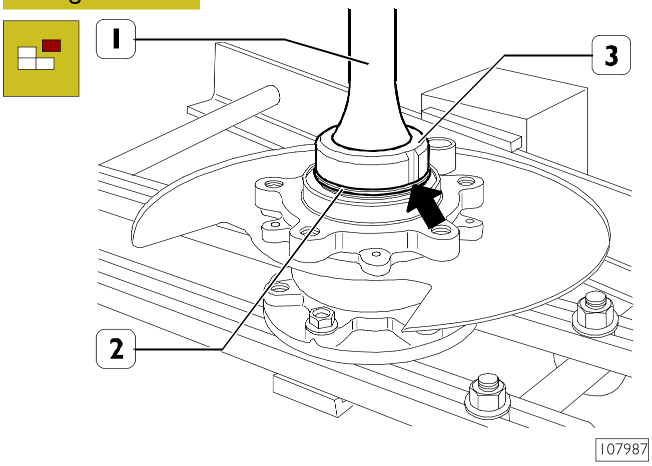
NOTE Check brake disk as described in Brakes section. On putting away the brake disk, do not damage phonic wheel toothing.

Figure 10



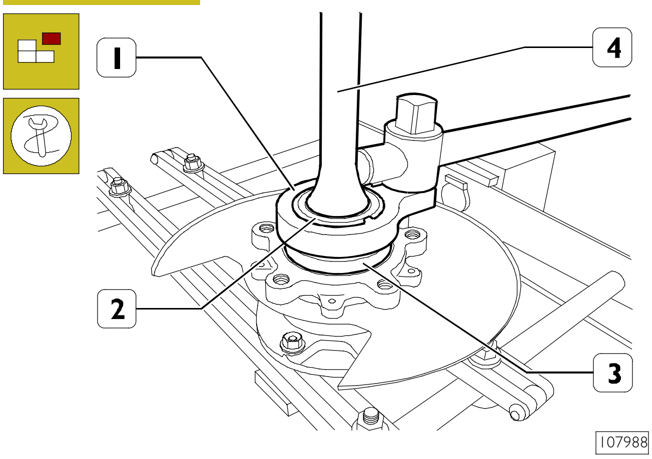
Unscrew securing screws (2) and take out half shaft comprehensive of unit-bearing support (1), bearing, ring nut and metal sheet guard (3).

Figure 11



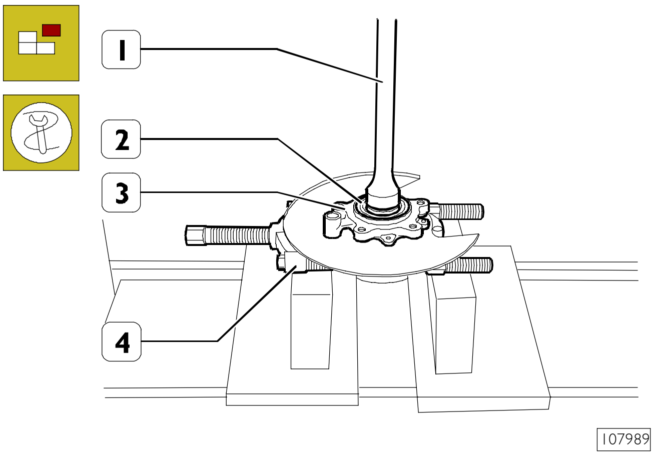
Tighten half shaft (1) in a vice.
Remove denting (→) of ring (2) engaging in ring nut (3).

Figure 12



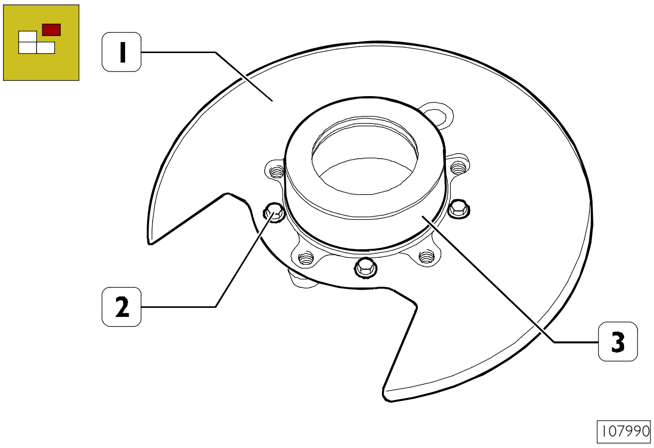
Using wrench 99355184 (1), unscrew ring nut (2) checking bearing (3) to half shaft (4).

Figure 13



Properly arrange half shaft (1) on hydraulic press and take out bearing (2) together with support (3). Using extractor 99348001 (4).

Figure 14



Unscrew screws (2) securing metal sheet guard (1) to support (3). Pull guard apart from support.

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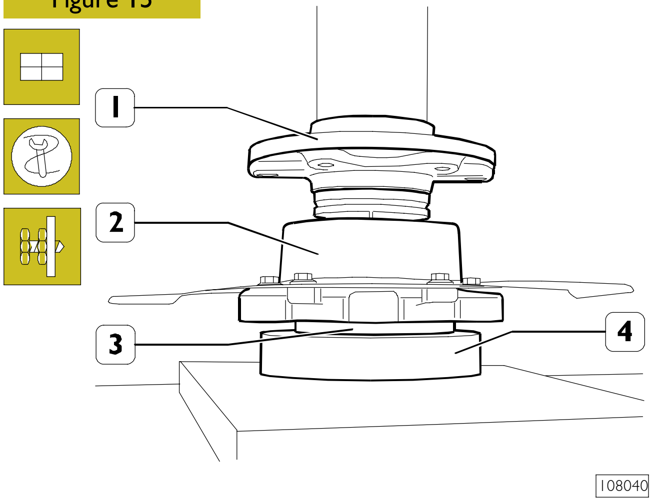
Assembly

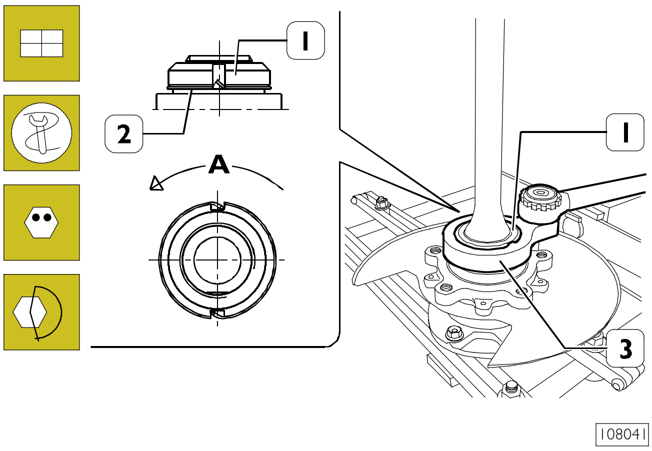
Figure 15



Arrange tool 99370241 (4) on the press and position bearing (3) and support (2) comprehensive of metal sheet guard on the tool.
Put in half shaft (1) and, by the press (driving load 3300÷18000 N), put it into up to ledge.

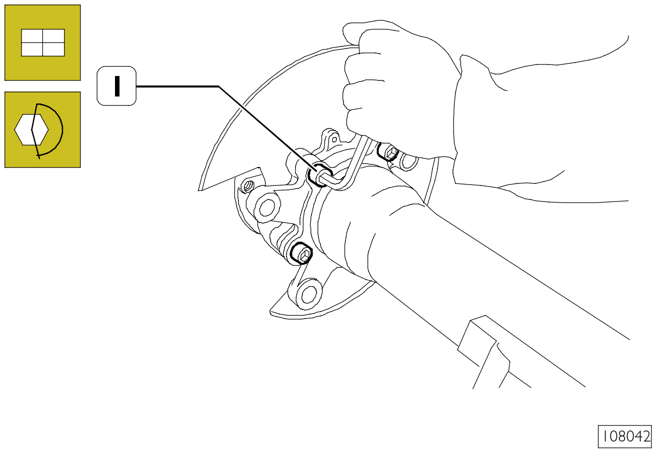
NOTE The bearing (3) must not be heated.

Figure 16



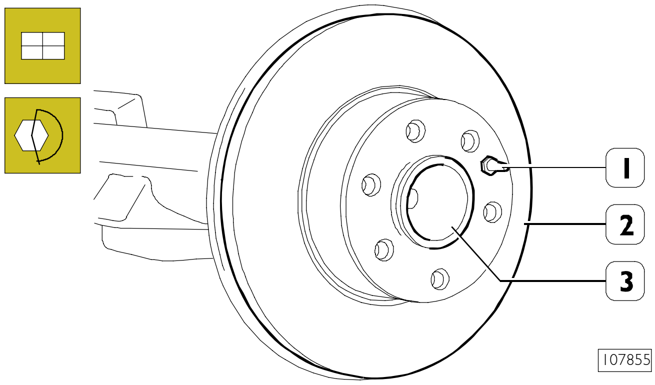
Mount the assembly on a vice.
Thread washer (2) and ring nut (1).
Using wrench 99355184 (3), tighten ring nut (1) at prescribed torque.
Dent washer (2) on milled portion of ring nut (1) as indicated in figure.

Figure 17



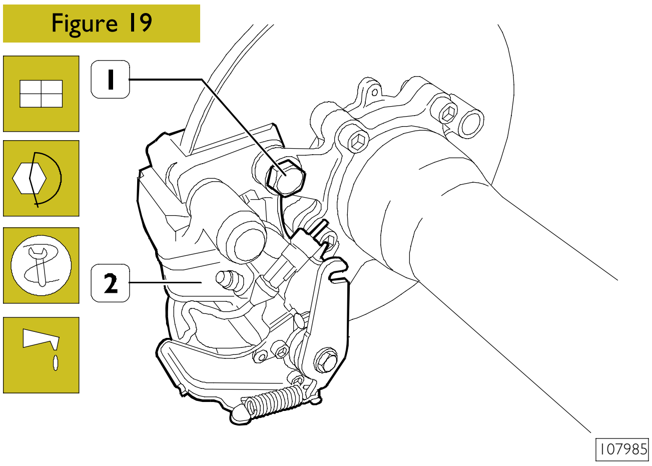
Put assembled half shaft into rear axle box. Tighten screws (1), securing half shaft to rear axle arm, at prescribed torque.

Figure 18



Mount brake disk (2) on half shaft (3) and tighten securing pin (1) at prescribed torque.

Figure 19



NOTE The brake lining with the wear indicator must be mounted on the piston side of the brake caliper.

Rest the brake caliper (2) with the brake linings on the mounting.

NOTE Should brake calliper piston be moved backward, use tool 99372236 and follow the recommendations set out in the BRAKES section.

Tighten the screws (1) securing the caliper (2) to the required torque.

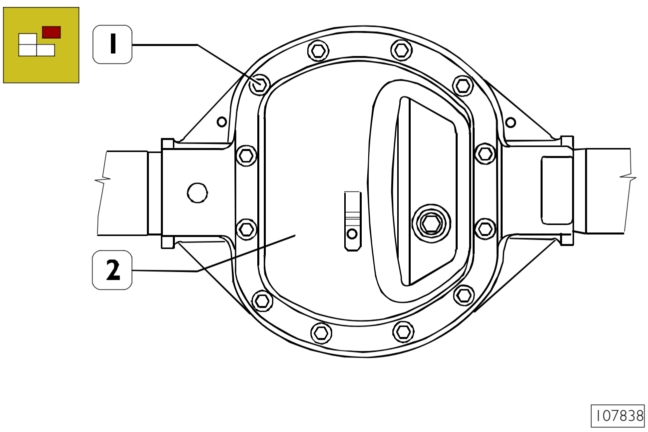
After assembly, fill the axle housing with TUTELA W90/M - DA oil in the required quantity and grade.

526210 REPAIRING THE DIFFERENTIAL

Disassembling the differential unit

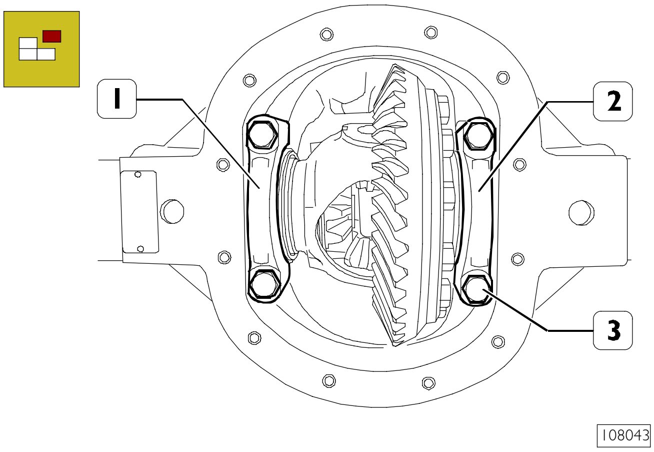
NOTE Before repairing the differential it is necessary to drain off the oil and dismantle the drive shafts, as described under the heading of overhauling the wheel hub (operation 525030).

Figure 20



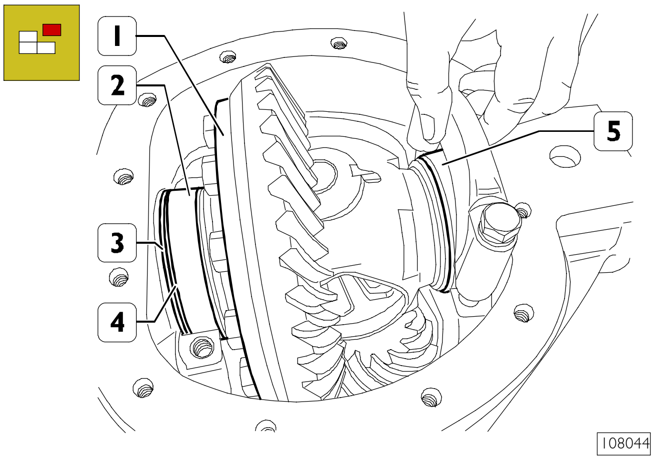
Unscrew screws (1) complete with safety washers and take off wheelwork inspection cover (2).

Figure 21



Mark the position of the caps (1 and 2), take out the screws (3) and remove them.

Figure 22



Take differential box (1), comprehensive of ring gear, wheelwork, bearings (2-5), adjusting shims (4) and rib rings (3), out of rear axle box.

NOTE Write down the positions of adjusting shims, rib rings and bearing outer rings in order to be able to arrange them according to original configuration on mounting step.

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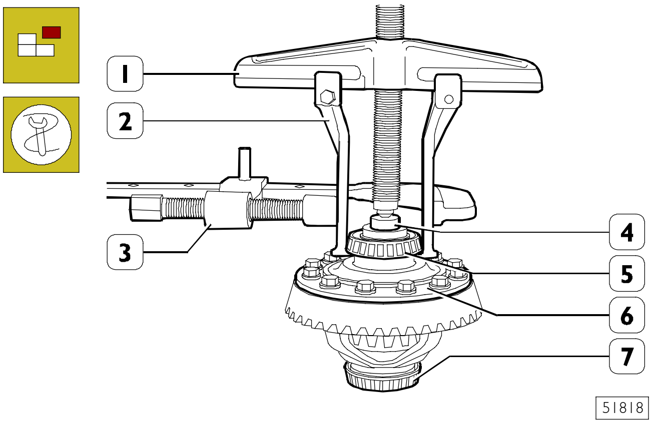
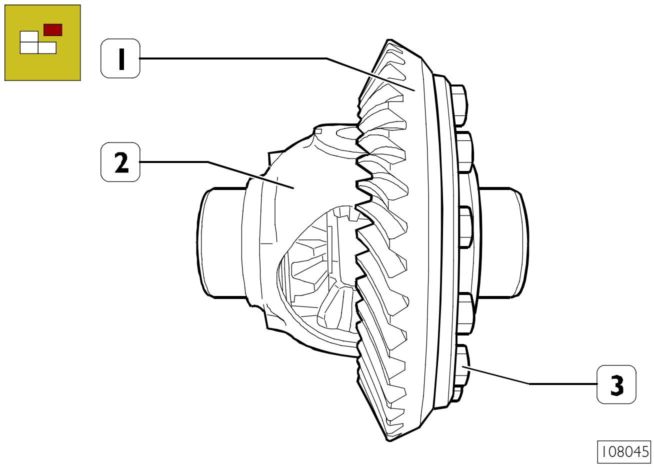
Gear housing removal

Figure 23



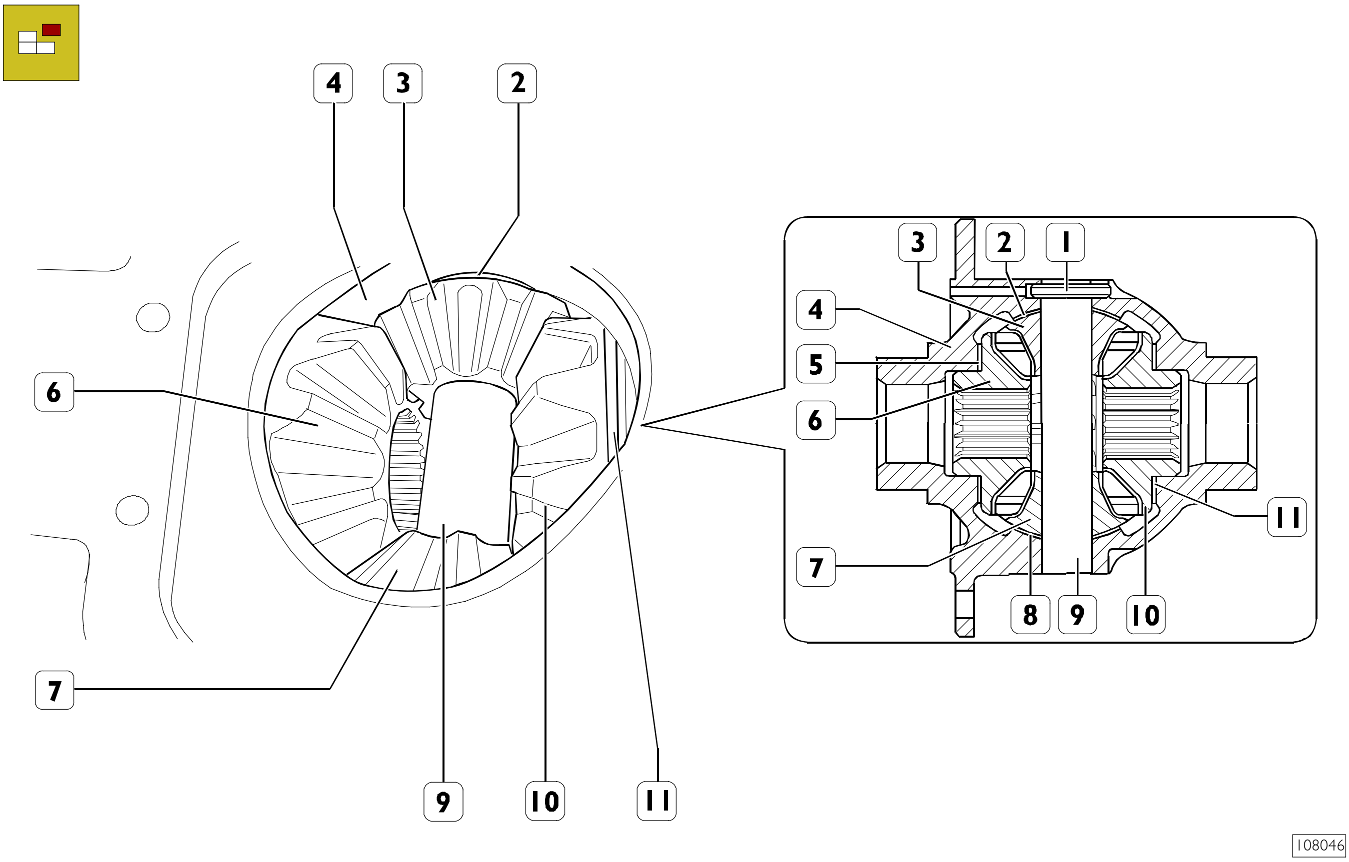
Use tool 99341003 (1), brackets 99341009 (2), clamp 99341015 (3) and reaction block 99345057 (4) to remove taper roller bearing inner rings (5 - 7) from gear housing (6).

Figure 24



Unscrew screws (3) and remove bevel wheel (1) from differential box (2).

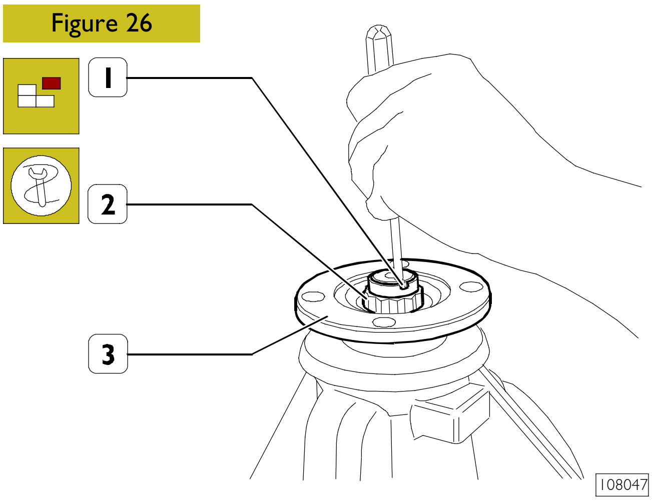
Figure 25



Using a proper beater, remove spring peg (1) and unthread planetary gear holder pin (9).
Rotate crown wheels (6 and 10) in such a way as to have planetary gears (3 and 7) matching the slits on differential box (4).
Remove planetary gears (3 and 7) and relating thrust blocks (2 and 8) from differential box (4).
Remove crown wheels (6 and 10) and relating rib thrust blocks (5 and 11).

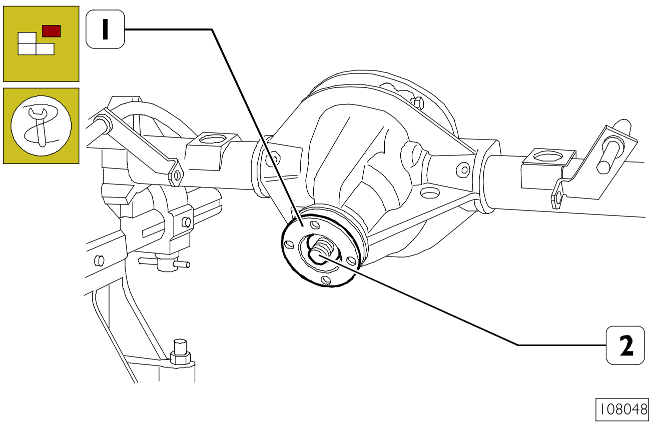
Dismounting bevel pinion

Figure 26



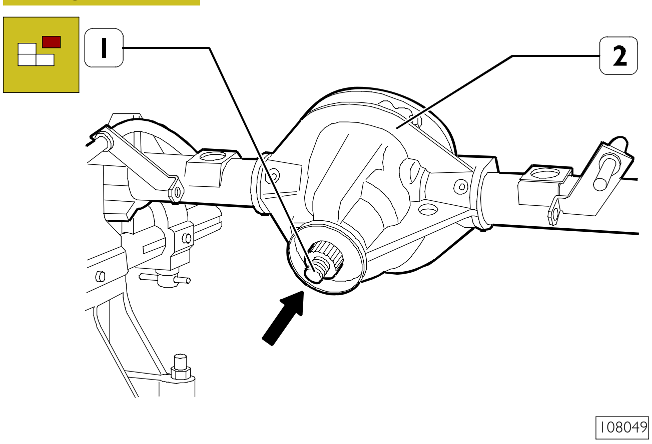
Lift denting (1) checking nut (2).
Using tool 99370317, stop the rotation of flange (3).
Unscrew and remove nut (2).

Figure 27



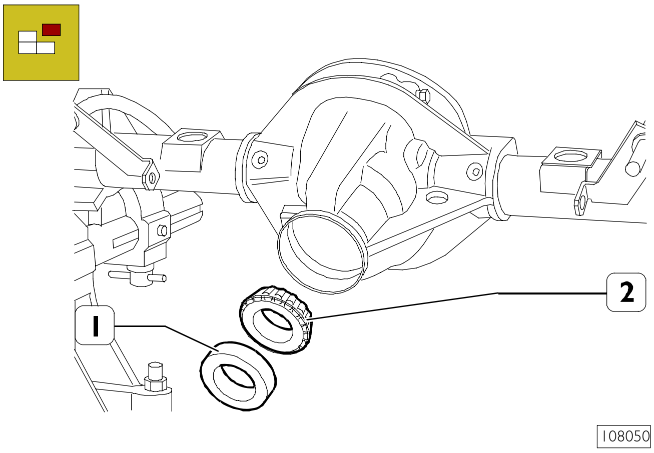
Take flange (1) out of bevel pinion (2).
Should flange (2) be too difficult to remove, single-acting rear axle 99341003 coupled to bracket pair 99341009 can be used as an extracting assembly.

Figure 28



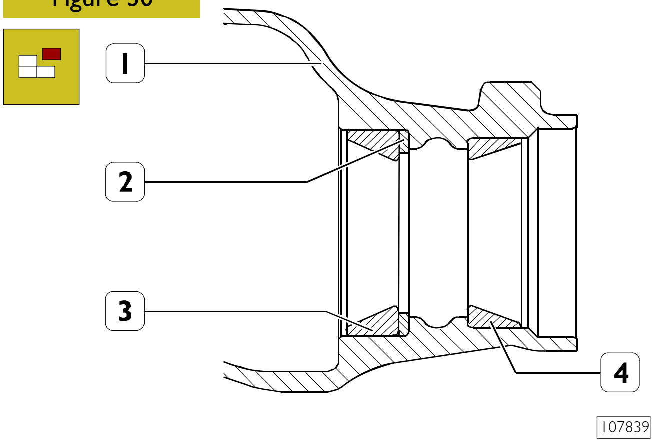
Using a proper beater, beat according to direction indicated by the arrow until bevel pinion (1) complete with rear bearing, fixed spacer and adjusting nut is ejected from rear axle box (2).

Figure 29



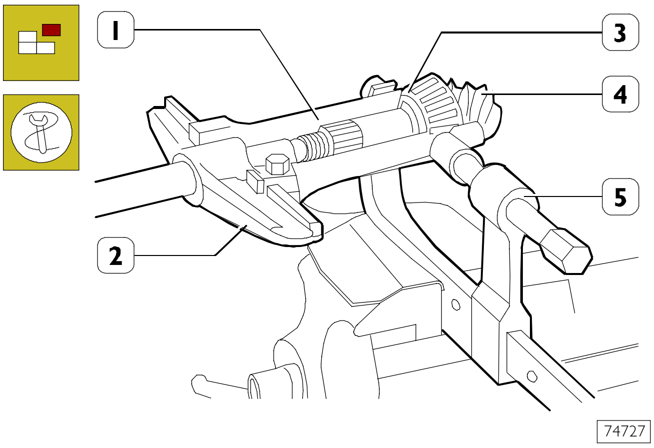
Remove the seal (1) and the internal ring (2) of the front bearing.

Figure 30



Use a punch to remove the external rings (3 - 4) of the tapered roller bearings from the axle housing (1) and take out the adjustment shim (2).

Figure 31



With axle 99341003 (2), brackets 99341011 (1), press 99341015 (5) extract the internal ring (3) on the bevel pinion (4).

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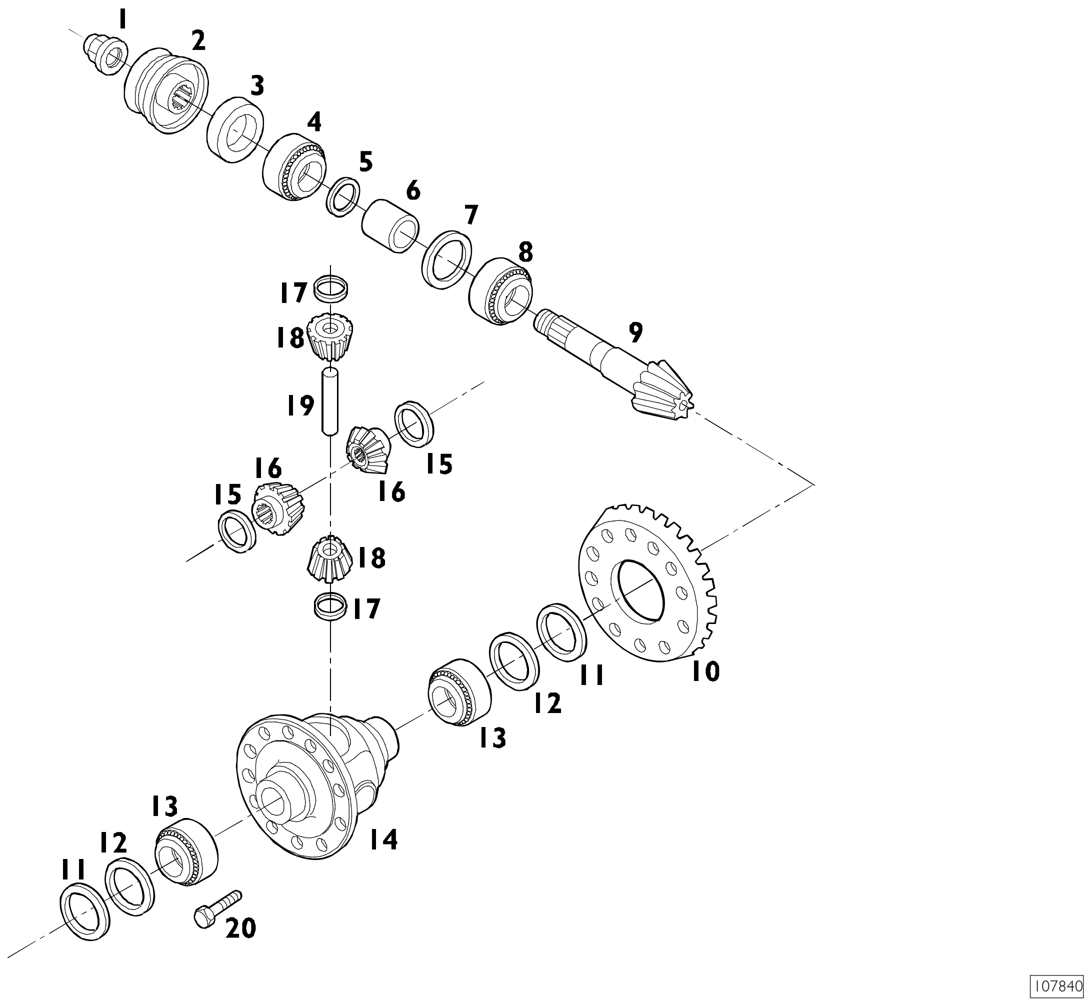
Figure 32



DIFFERENTIAL UNIT COMPONENTS
1. Nut - 2. Transmission connection flange - 3. Gasket - 4. Front bearing - 5. Bearing adjusting shim - 6. Spacer - 7. Ledge ring - 8. Rear bearing - 9. Bevel pinion - 10. Ring bevel gear - 11. Rib ring -12. Adjusting ring - 13. Taper roller bearing - 14. Differential box - 15. Crown wheel rib thrust block - 16. Crown wheel - 17. Planetary gear rib thrust block - 18. Planetary gear - 19. Pin - 20. Screw securing ring gear / differential box

Checking the parts comprising the differential

Carefully clean the single components of the differential locking.
Lubricate the bearings and rotate the roller cage freely; rotation must be even and without signs of stiffness. Check the support surfaces of the ring bevel gear and the striking surface of the half-casing so that the ring bevel gear fits perfectly. Deformations of such parts, could determine vibration of the ring bevel gear fastening screws, thus compromising the perfect operation of the unit.

NOTE Carefully clean all the threads in order to obtain exact adjustments and accurate tightening torque.

Check for grooved section for keying the flange on the pinion not being excessively worn out. Otherwise, replace the pinion.

NOTE If it is necessary to replace the ring bevel gear or pinion, replace both parts since they are supplied in pairs.

Check planetary gears with relating rib thrust blocks, pin and crown wheels with rib thrust blocks.

Replace all the sealing elements, the bevel pinion retaining nut and the gear housing bearing adjustment ring nut with new parts.

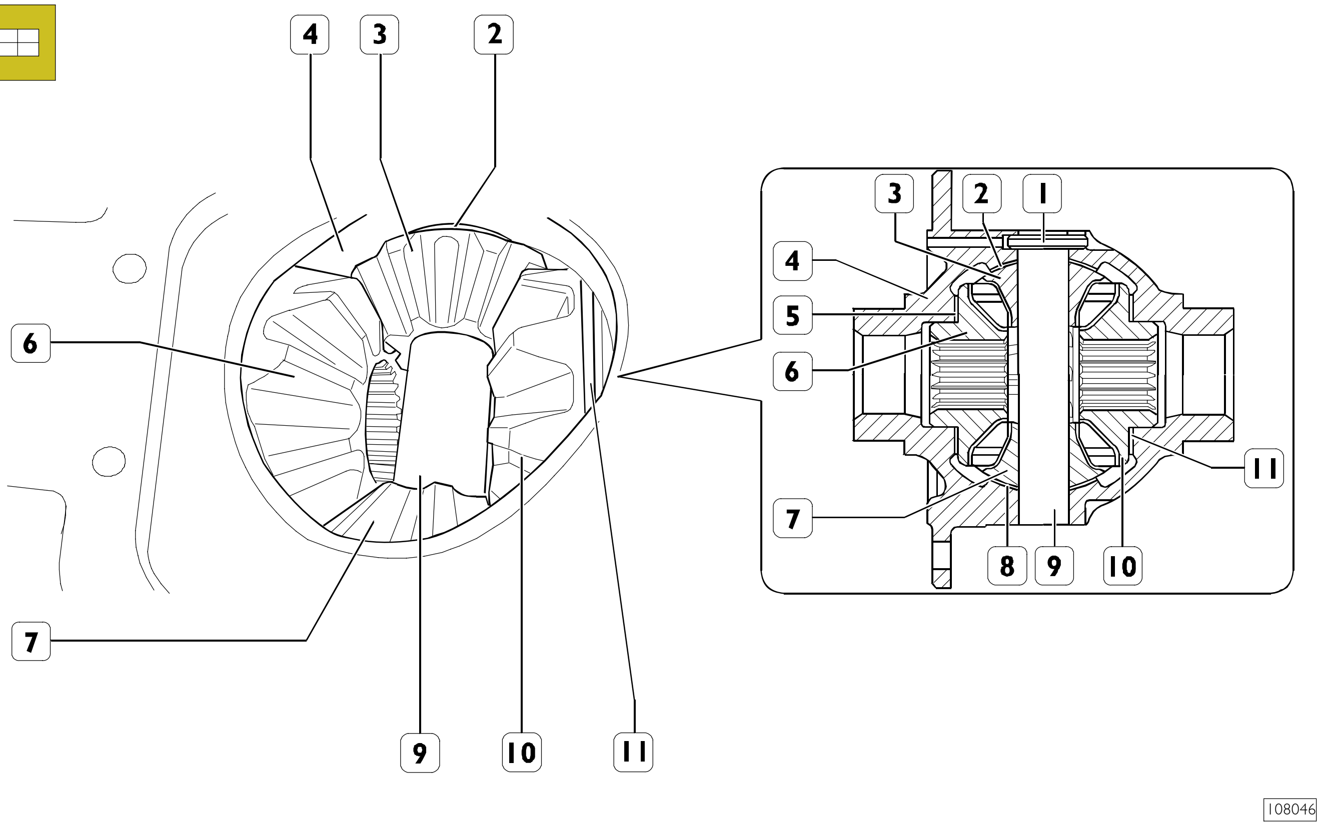
NOTE The tapered roller bearings are supplied as spare parts, lubricated with rustproof oil.

They must not be washed or heated for assembly.

The differential housing support bearings must both be from the same supplier.

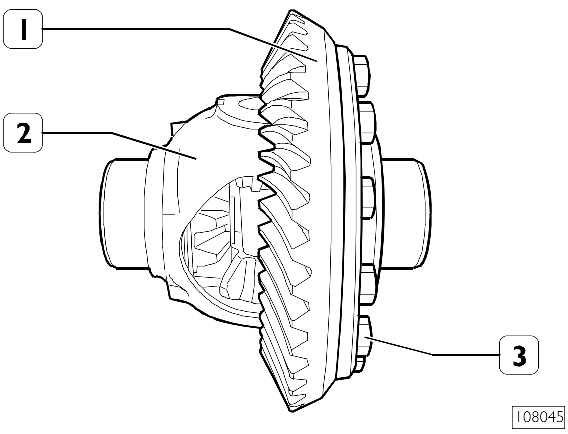
Assembly of gear housing

Figure 33



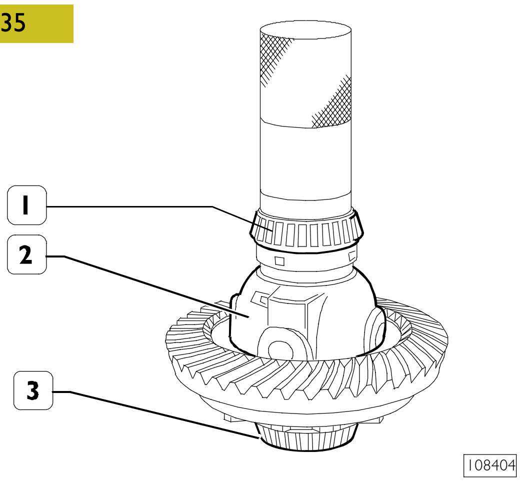
Put crown wheels (6) and (10), complete with rib rings (5) and (11), into seats inside differential box (4).
Through the slits on box (4), position planetary gears (3) and (7), complete with rib thrust blocks (2) and (8), in order them to contact crown wheels (6) and (10).
Rotate crown wheels in such a way that the holes of planetary gears are aligned to guide holes for pin (9) that are present on the box of differential (4).
Thread pin (9) aligning the hole for spring peg (1) to the hole that is present on the box of differential (4).
Using a proper beater, put spring peg (1) into its seat.

Figure 34



Tighten screws (3), for matching between bevel wheel (1) and the box of differential (2), at prescribed torque.

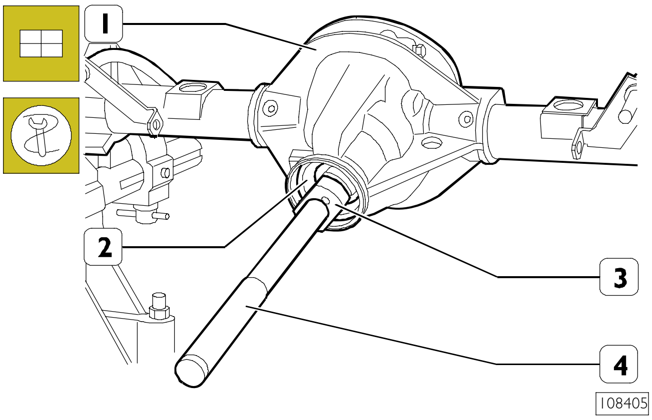
Figure 35



Using a proper beater, mount inner ring (1) on wheelwork box (2).
Repeat operation for outer ring (3).

Assembling the bevel pinion assembly

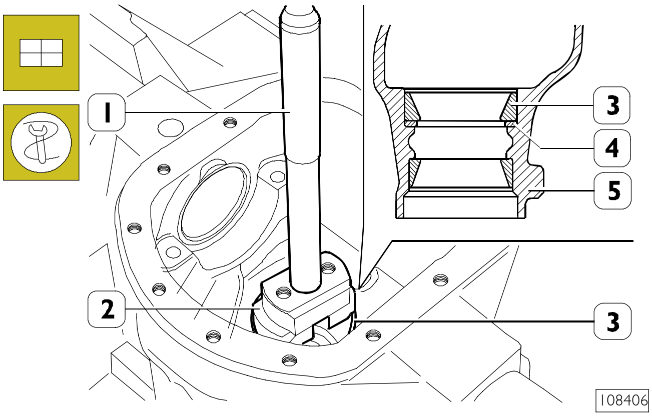
Figure 36



Using the punch 99374091 (3) and grip 99370006 (4), mount the external ring (2) of the tapered roller bearing in the axle housing (1).

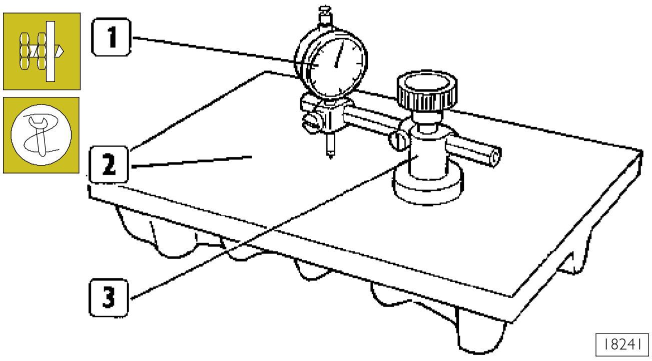
NOTE New bearings are lubricated with rustproof oil and must therefore not be washed or heated for assembly.

Figure 37



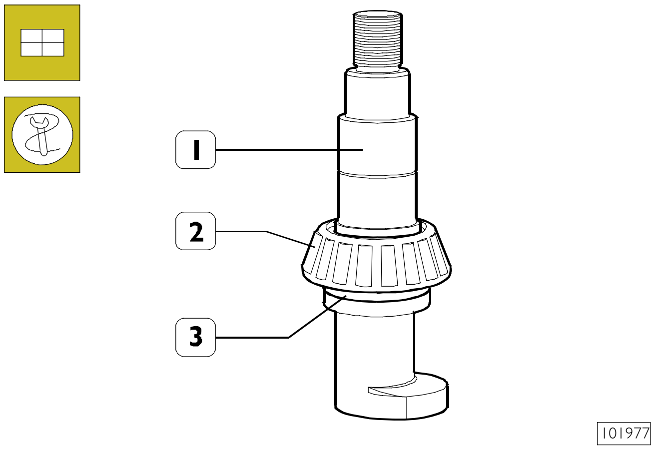
Set adjusting ring (4), removed at disassembling, into rear axle casing (5).
Using the punch 99374092 (2) and grip 99370007 (1), mount the external ring (3) of the tapered roller bearing.

Figure 38



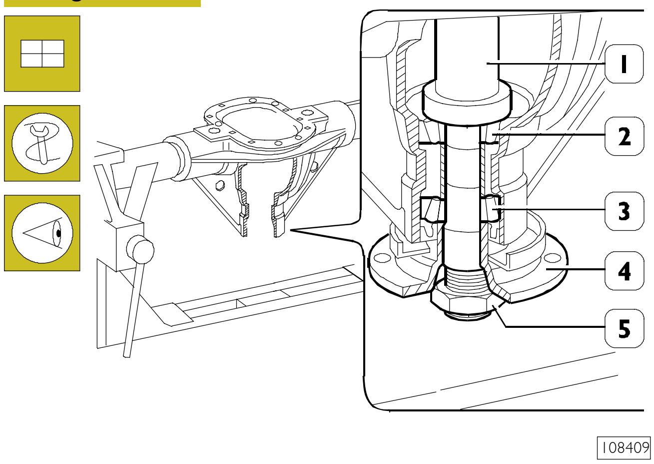
On a surface plate (2), zero a dial gauge (1) set on the mounting 99395728 (3) and pre-load it slightly.

Figure 39



Mount provided washer (3) and inner ring (2) of taper roller bearing on dummy pinion 99370239 (1).

Figure 40

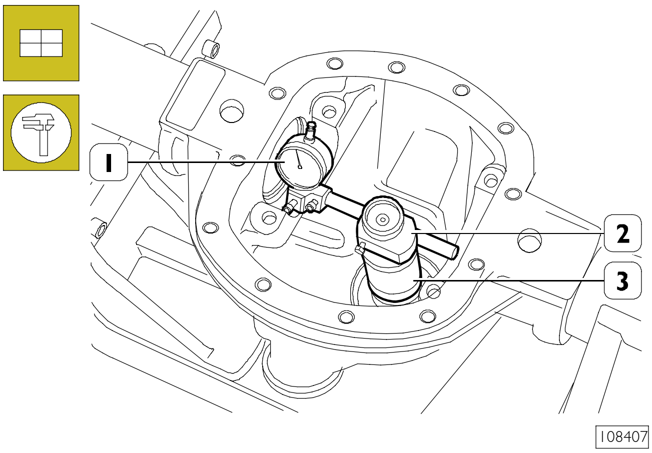


Position dummy pinion 99370239 (1), assembled as in Figure 39, on the outer ring of taper roller bearing (2).

On the opposite side, fit the taper bearing internal ring (3) on the dummy pinion (1) and the transmission shaft flange (4) .

Screw nut (5) until dummy pinion is freely rotating without axial clearance.

Figure 41



Fit the mounting 99395728 (2) with the dial gauge (1) on the dummy pinion 99370239 (3).

Orientate the, previously zeroed, dial gauge so as to position the rod on the lowest portion of the seat of the bearing supporting the gear housing and note the difference **A1**.

Repeat the same operation on the seat of the other bearing and note the difference **A2**.

Thickness **S** to be added to adjusting ring thickness (4, Figure 43) used for measuring, for pinion positioning is obtained by the following formula:

$$\mathbf{S} = \frac{A1 + A2}{2} - (\pm B)$$

A1 indicates the value measured on the right-hand seat.

A2 indicates the value measured on the left-hand seat.

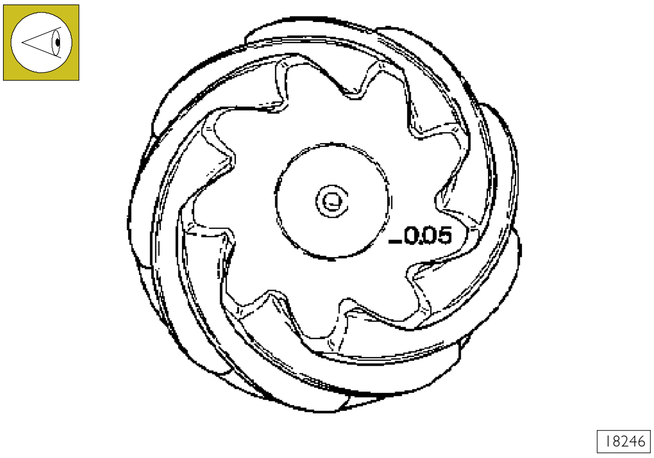
B indicates the value marked on the bevel pinion (see Figure 42).

For example:

$$\mathbf{S} = \frac{1,05 + 1,10}{2} - (-0,05) = \frac{2,15}{2} + 0,05 = \mathbf{1,125}$$

The result of the formula must be added algebraically to the value of the adjusting ring used to make the measurements.
Example:
if the value of the adjusting ring used is 3.00 mm, replace with one measuring 4.125 mm (3.00 + 1.125).

Figure 42

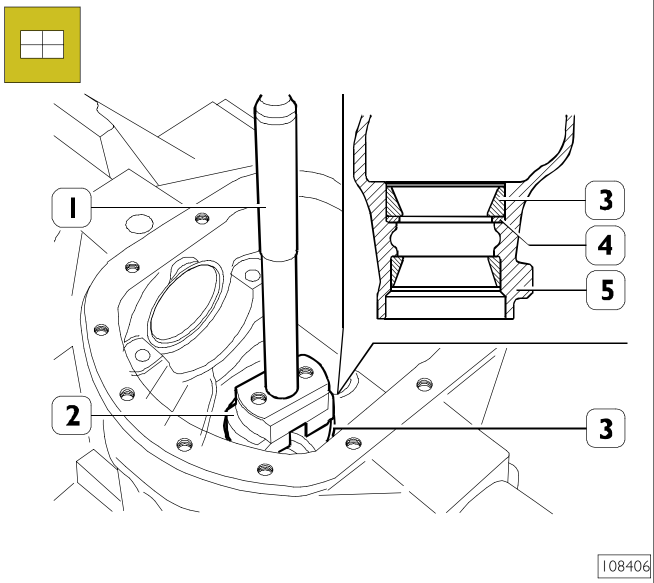


NOTE If the value marked on the pinion is preceded by a positive sign (+), it must be subtracted from the value of the sum divided by two for both seats, whereas it has to be added if it is preceded by a negative sign (-).

Unscrew check nut and transmission connection flange. Unthread flange and bearing from dummy pinion.

Remove the dummy pinion with the mounting 99395728, dial gauge and rear bearing from the axle housing.

Figure 43

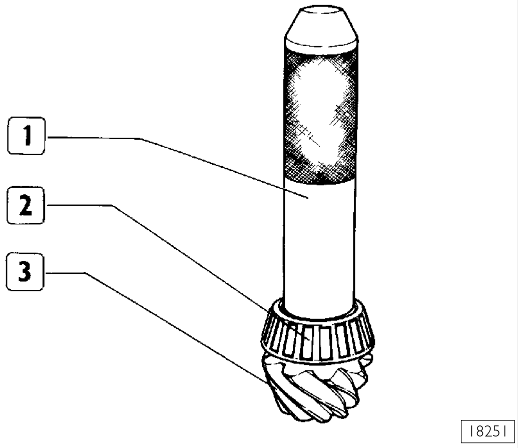


If required, replace adjusting ring (4) with a new one having the calculated thickness, after removing bearing outer ring (3) from rear axle casing (5) by beater.

Then fit the new adjusting ring (4) into rear axle casing (5).

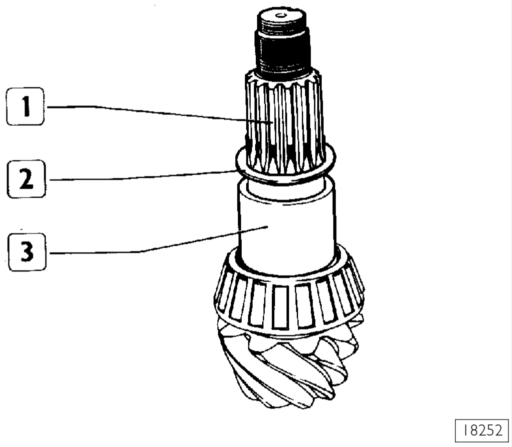
Using the punch 99374092 (2) and grip 99370007 (1), mount the external ring (3) of the tapered roller bearing.

Figure 44



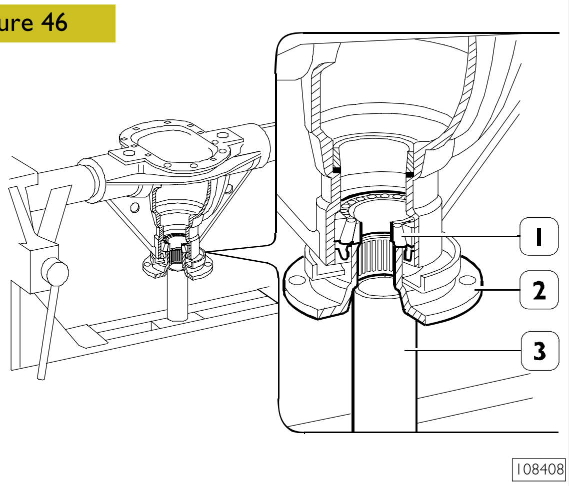
Using a suitable punch (1) and a hydraulic, press mount the internal ring (2) of the tapered roller bearing on the bevel pinion (3).

Figure 45



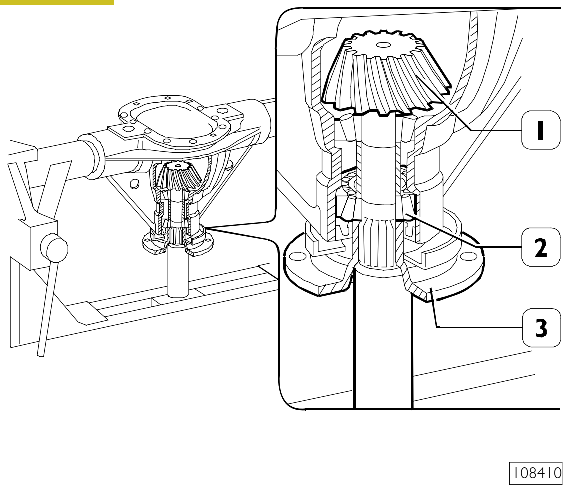
Position fixed spacer (3) and adjusting ring (2) on bevel pinion (1).

Figure 46



Position the axle casing as indicated in the figure.
Fit the taper bearing internal ring (1) and the transmission shaft flange (2).
Position a suitable pipe (3) on the stand so that the flange (2) and the taper bearing internal ring (1) are correctly supported.

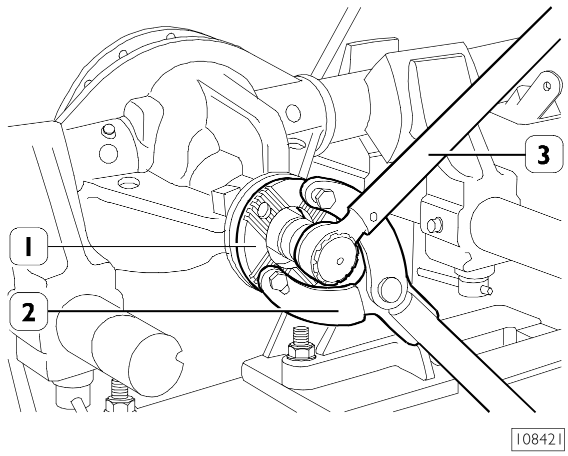
Figure 47



Mount the bevel pinion (1) in the axle housing so as to enter the internal ring (2) of the tapered roller bearing.

Beat on the top of pinion (1) until nut securing flange (3) can be mounted.

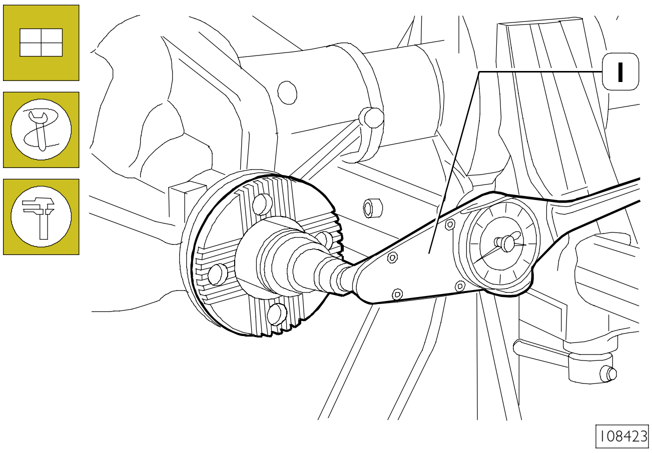
Figure 48



Use tool 99370317 (2) to prevent the flange (1) from rotating.

Tighten the bevel pinion retainer nut to the required torque with a torque wrench (3).

Figure 49



Using torque meter 99389819 (1), detect bevel pinion rolling torque.

NOTE Rolling torque must be detected at 25 °C ambient temperature having the pinion rotating at 50 rpm speed, after the pinion has run 10 revolutions.

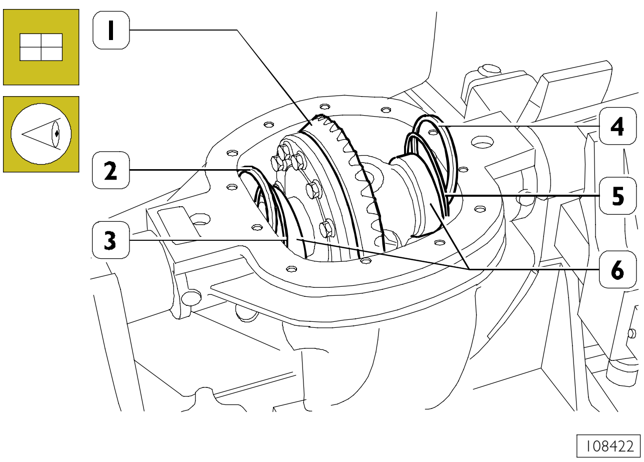
If the reading differs from the prescribed value, disassemble the pinion (1, Figure 47), replace the adjuster ring (2, Figure 45) with a ring of the correct thickness.

Refit the pinion and repeat the rolling torque check.

Assembly of differential unit

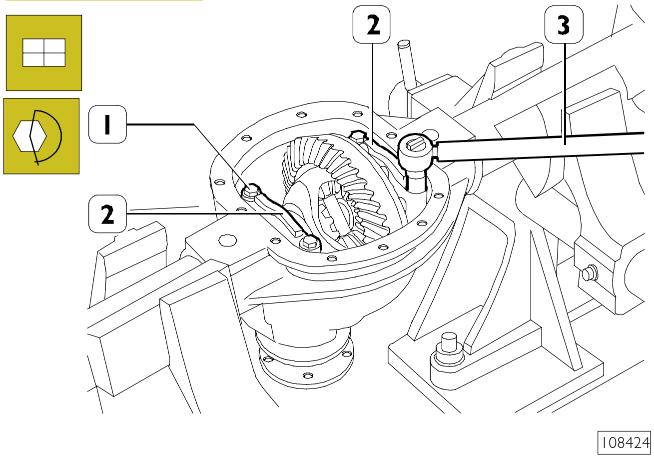
NOTE When fitting the differential unit, carefully comply with the tightening torque values specified, and make use of a torque wrench.

Figure 50



Fit the differential (1) unit and support (6) bearings in the axle casing.
Mount spacers and adjusting rings in same quantity, thickness and position as detecting on dismounting, according to following sequence: stop ring (2), adjusting rings (3 and 5) and stop ring (4).

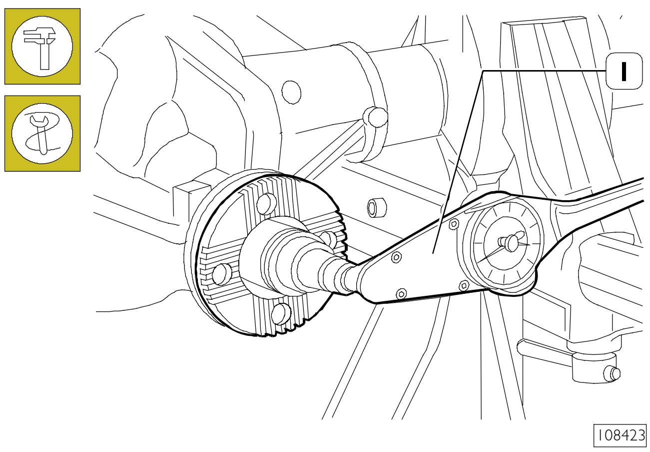
Figure 51



NOTE Position the caps (2) making the marks made during disassembly coincide.

Screw on the screws (1) and tighten them to the required torque with the dynamometric wrench (3).

Figure 52



Check total rolling torque using torque meter 99389819 (1).

NOTE The rolling torque must be measured at an ambient temperature of 25°C, making the pinion turn at a speed of 50 rpm after it has made 10 turns.

If the value of the measurement is not as required, replace the adjustment rings (3 and 5, Figure 50) with another one of a suitable thickness.

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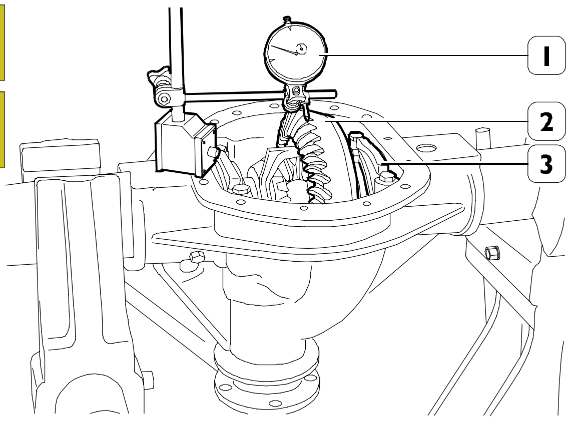
Figure 53



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Position the dial gauge 99395728 (1) with a magnetic base and measure the clearance between the pinion and crown wheel on four opposite teeth of the crown wheel (2).

The average of the measurements must equal the required value.

If a different clearance is found, remove the caps (3) again and swap over the assembly position of the adjustment rings (1 and 3, Figure 50).

Should this not be sufficient, replace adjusting rings by other rings having different thickness, on condition that total thickness must be equal to the total thickness of the adjusting rings that were dismounted.

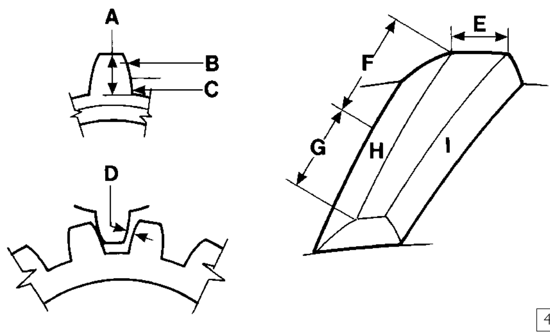
This is so as not to change the total rolling torque.

Using a brush, apply a thin layer of Prussian blue on ring gear teeth.

Turn the pinion and measure the impression of the contact of the pinion toothing on the crown wheel toothing.

Here we illustrate the possible contacts with the corrections to obtain precise coupling of the crown wheel and pinion.

Figure 54

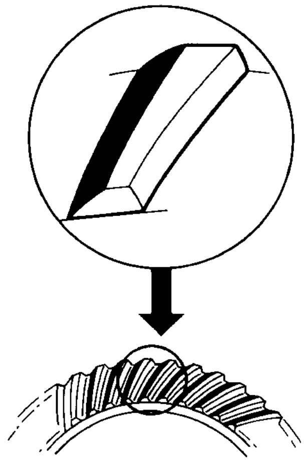


44603

A = Coupling depth
B = Crest
C = Side
D = Play

E = Greater base
F = Heel
G = Top land
H = Contact surface
I = Lateral surface

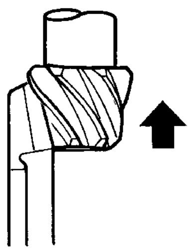
Figure 55

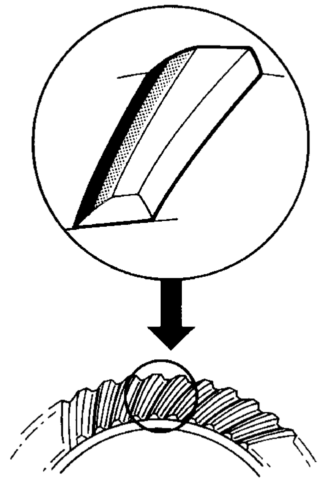


Correct contact.

44604

Figure 56

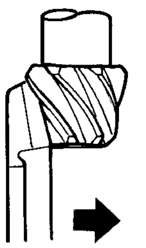


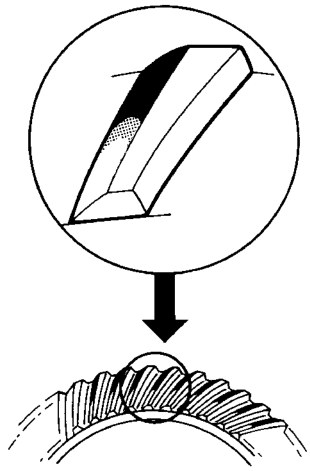


Excessive contact on tooth bottom or flank.
Move pinion away from ring gear, then move ring gear close to pinion in order to adjust clearance.

44605

Figure 57

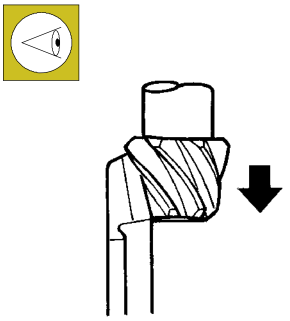


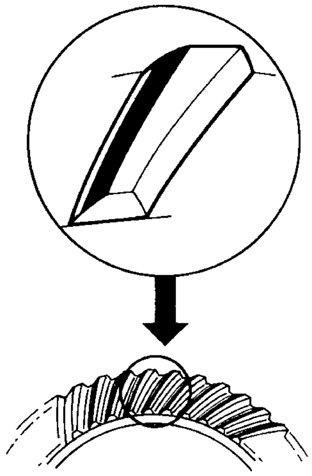


Excessive contact on heel of tooth.
Move the ring bevel gear towards the pinion and then move the pinion away from the ring bevel gear to adjust clearance.

44606

Figure 58



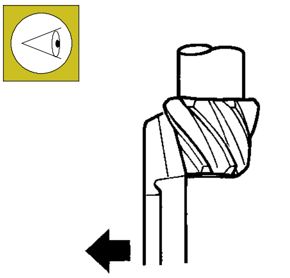


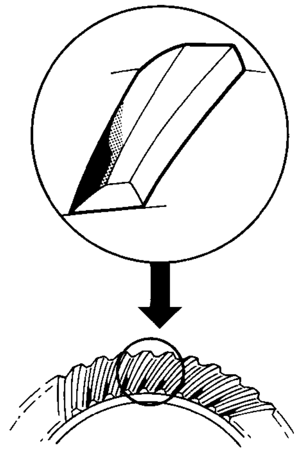
Excessive contact in the upper part or crest of the tooth

Move pinion close to ring gear, then move ring gear away from pinion in order to adjust clearance.

44607

Figure 59



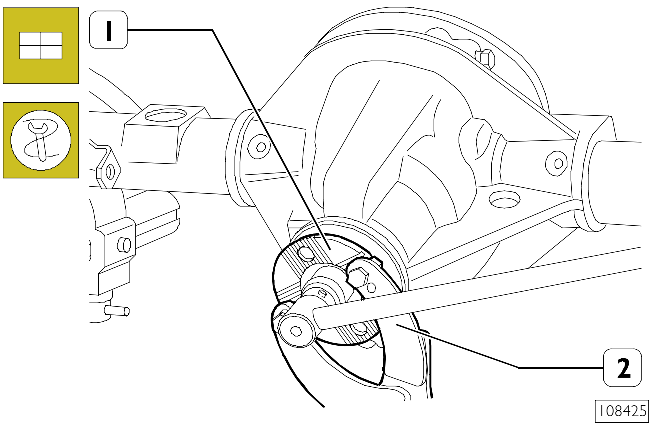


Excessive contact on the top land of the tooth

Move the ring bevel gear away from the pinion them move the pinion towards the ring bevel gear to adjust clearance.

44608

Figure 60



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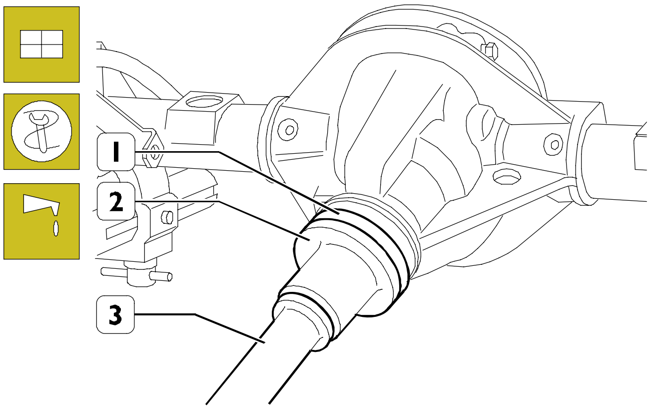
After prescribed coupling clearance has been completed, stop the rotation of flange (1) using tool 99370317 (2).

Unscrew the retaining nut and extract the flange (1) from the bevel pinion.

Figure 61



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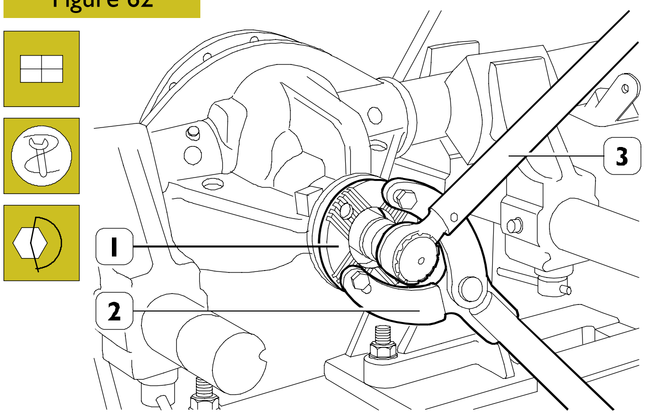
Lubricate the internal lip of the seal (1).

With the key 99374022 (2) and grip 99370007 (3), mount the seal in the axle housing.

Figure 62

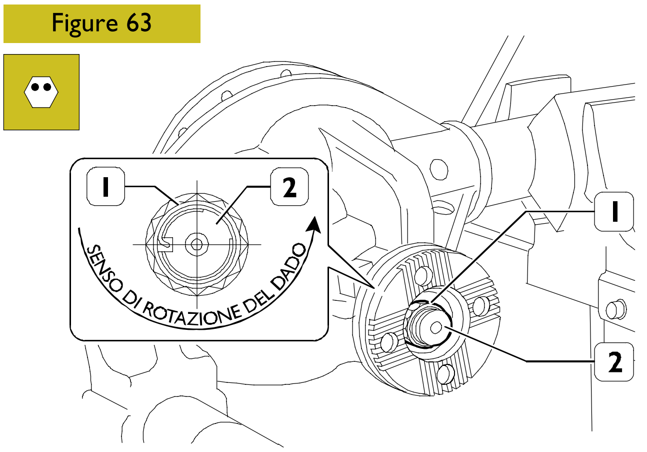


108421

Mount flange (1). Stop the rotation of flange (1) using tool 99370317 (2).

Using torque wrench (3), tighten nut checking bevel pinion at prescribed torque.

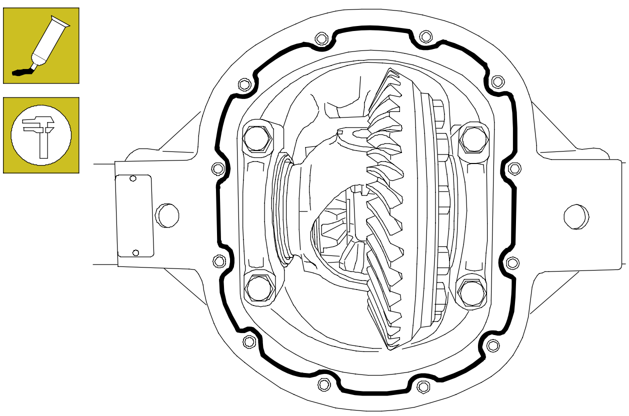
Figure 63



108428

Deform the collar of the nut (1) as shown in the figure at the milling of the bevel pinion (2).

Figure 64



108429

Thoroughly clean the flange of the axle housing.

Apply LOCTITE 5910 sealant on the flange of the axle housing to form a bead of approx. 5 mm diameter.

It must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint.

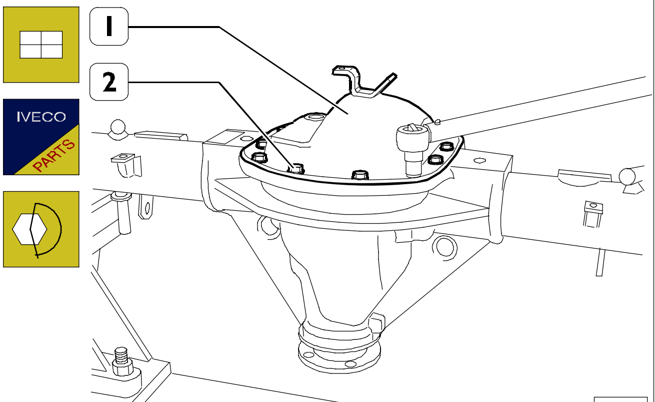
Too much sealant would tend to come out on both sides of the joint.

After applying the sealant, the joints need to be assembled immediately (10 - 20 minutes).

To seal at a later date, there is product 21623 capable of softening or liquefying the above-mentioned sealant.

It is essential to clean the surface to be sealed in order to achieve good future sealing.

Figure 65

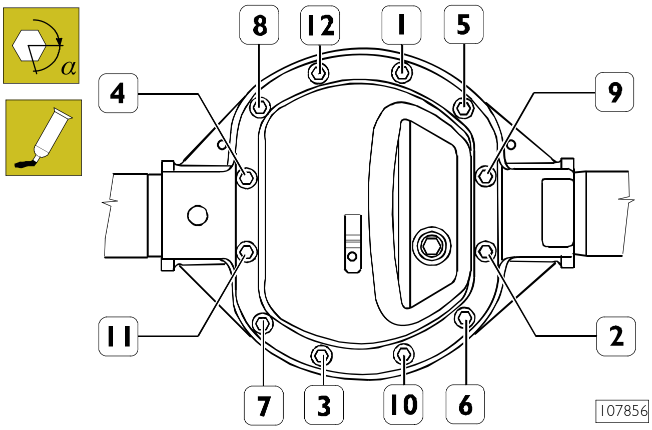


108430

Mount the cover (1) and screw on the screws (2).

- ❑ Flanged screws (for solution without gasket).
- ❑ Screws with washer (for solution with gasket).

Figure 66



According to sequence indicated in figure, tighten the screws at prescribed torque.

Complete mounting operation observing the following:

- ❑ Mount the drive shafts as described under the heading: "525030 overhauling hubs".
- ❑ Apply LOCTITE 577 thread-locking oil on the oil drain plug thread, screw it into the axle housing, tightening it to the required torque.
- ❑ Add lubricating oil in the required quantity and grade through the hole.
- ❑ Apply LOCTITE 577 thread-locking oil on the inspection plug thread, screw it into the axle housing, tightening it to the required torque.
- ❑ Take the assembly off the stand.

NOTE The assembly should be put back on its mounting to prevent the dust guards and/or brake discs from getting damaged.

Rear axles NDA RG

DESCRIPTION

The rear axle is the load-bearing type with a single reduction using a hypoid crown wheel and pinion.

The axle housing is made of pressed sheet steel with hot pressed arms.

The bevel pinion is supported by two pre-lapped tapered roller bearings to hold the bearing pre-load better.

The rolling torque of the bearings of the bevel pinion is adjusted by changing the thickness of the adjustment ring between the two tapered roller bearings.

In addition, it is possible to adjust the position of the bevel pinion with respect to the ring bevel gear by changing the thickness of the ring between the axle housing and the bevel pinion rear bearing external ring.

The gear housing is supported by two tapered roller bearings.

The rolling torque of the bearings is adjusted with adjustment rings between the spacer rings and the external rings of the bearings.

The clearance between pinion and crown wheel is adjusted by changing the thickness and/or position of the adjustment rings, though the total thickness must be the same as that of the adjustment rings removed.

The gearing of the differential is composed of two planetary gears and two crown wheels.

The wheel hubs are keyed, with UNIT BEARINGS lubricated for life, onto the arms of the axle housing.

The bearings UNIT BEARINGS need no adjustment.

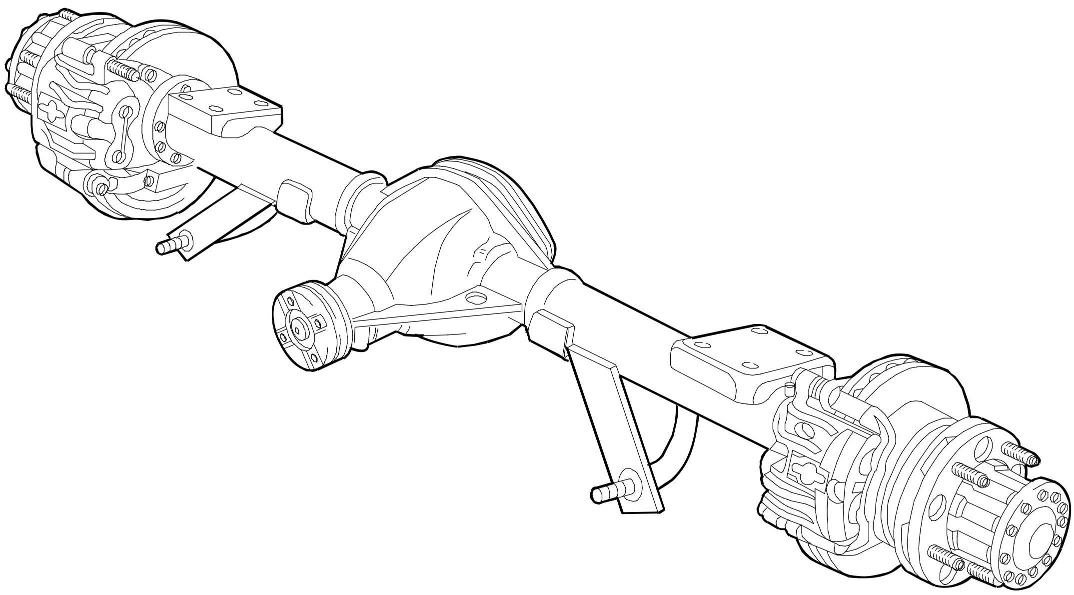
The brakes are disc brakes with floating brake calipers.

The disc brakes are keyed onto the wheel hubs.

The brake calipers are secured with flanges fixed onto the arms of the axle housing.

Brake caliper is equipped with parking brake device.

Figure 1



107857

SPECIFICATIONS AND DATA

Type of rear axle: Simple reduction type with mechanical control differential locking	NDA RG
DIFFERENTIAL UNIT Reduction bevel gear pair ratio (No. of teeth: pinion/crown)	1/4.182 (11/46) - 1/4.444 (9/40) - 1/4.889 (9/44)- 1/3.416 (12/41) - 1/3.916 (12/47) - 1/3.154 (13/41) - 1/3.615 (13/47) - 1/3.308 (13/43) - 1/3.727 (11/41)
Bevel pinion bearings	2 with taper rollers
Bevel pinion bearings rolling torque (without seal ring) Nm kgm	2.3 ÷ 3.3 0.23 ÷ 0.33
Adjustment of pre-load of bevel pinion bearings	By means of adjustment rings
Bevel pinion bearings pre-load adjustment rings	0.545 ÷ 1.070 mm with progression of 0.025 mm.
Temperature at assembly of inner bearing ring on bevel pinion	-
Position of bevel pinion with respect to differential casing	By means of adjustment spacers
Thickness of adjustment rings placed between bevel pinion and differential casing	3.585 ÷ 4.235 mm with progression of 0.025 mm.
Bearings for gear housing	2 with taper rollers
Differential casing bearings rolling torque Nm kgm	2.7 ÷ 3.9 0.27 ÷ 0.39
Adjustment of differential casing bearings rolling torque	By means of adjustment rings
Thickness of adjustment rings of differential casing bearings rolling torque	1.00 ÷ 1.95 mm with progression of 0.05 mm.
Clearance between pinion and ring bevel gear ❑ 1/3,615 - 1/3,727 - 1/3,916 - 1/4,182 - 1/4,444: ❑ 1/3,154 - 1/3,308 - 1/3,417 - 1/4,889:	 0.13 ÷ 0.18 0.15 ÷ 0.20

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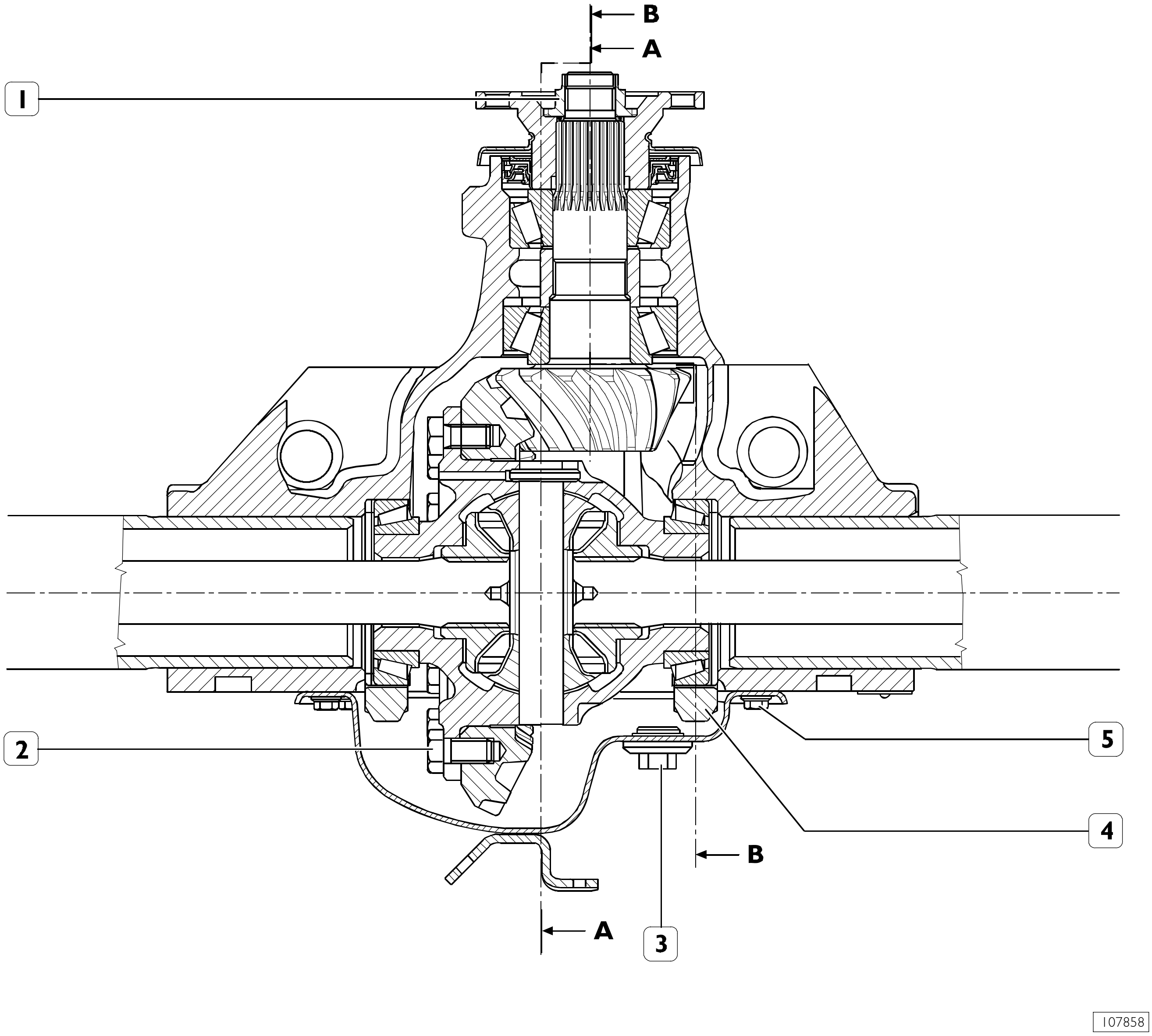
Type of rear axle: Simple reduction type	**NDA RG**
Adjustment of clearance between pinion and ring bevel gear	By means of adjustment rings
Clearance between planetary and crown wheels	0.05 ÷ 0.15 mm
WHEEL HUBS	
Wheel hub bearings	UNIT-BEARING
Wheel hub bearings end play	-
Wheel hub bearings rolling torque Nm kgm	 - -
Adjustment of wheel hub bearings end play	By means of nut Torquing the securing nut
Rear axle oil Quantity Litres	**TUTELA W90/M-DA (SAE 80 W 90)** 1.35
Max capacity (GAW) kg	2240

TIGHTENING TORQUES

Figure 2



NDA RG REAR AXLE DIFFERENTIAL SECTION

PART		TORQUE	
		Nm	Kgm
1	M26x1.5 bevel pinion securing nut	400 ÷ 500	40.8 ÷ 51.0
2	M12x1.5 ring bevel gear wheelwork box securing screw	89 ÷ 108	9.0 ÷ 11.0
3	M22x1.5 oil filling plug**	49 ÷ 62	5.0 ÷ 6.32
4	Screw securing caps to differential box	100 ÷ 120	10.2 ÷ 12.2
5	M8x1.25 rear axle box rear cover securing screw	80 ÷ 95	8.2 ÷ 9.7
-	M22x1.5 oil draining magnetic plug**	49 ÷ 62	5.0 ÷ 6.3

* Apply Loctite 5910 on the housing

** Apply Loctite 577 on the plug thread

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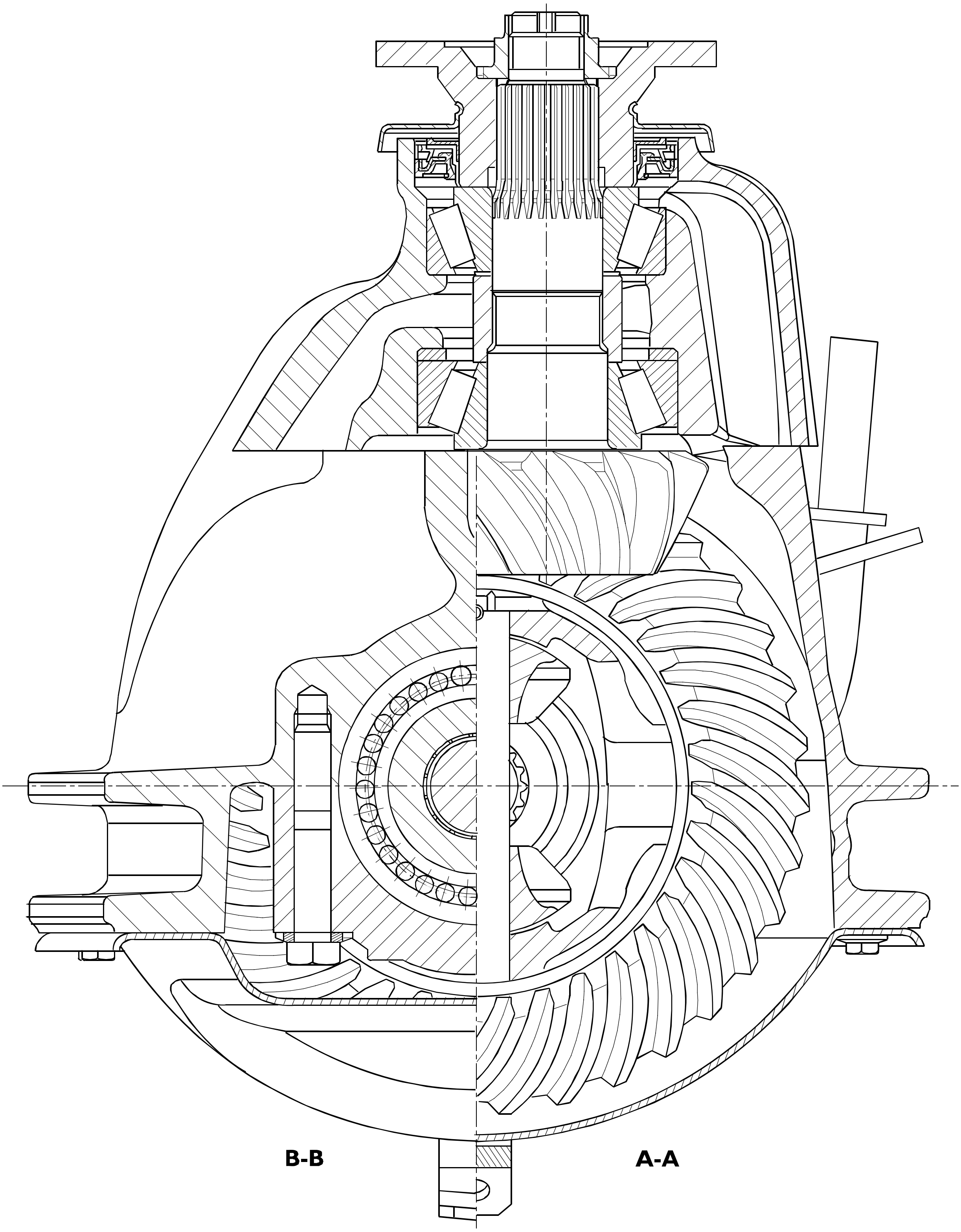
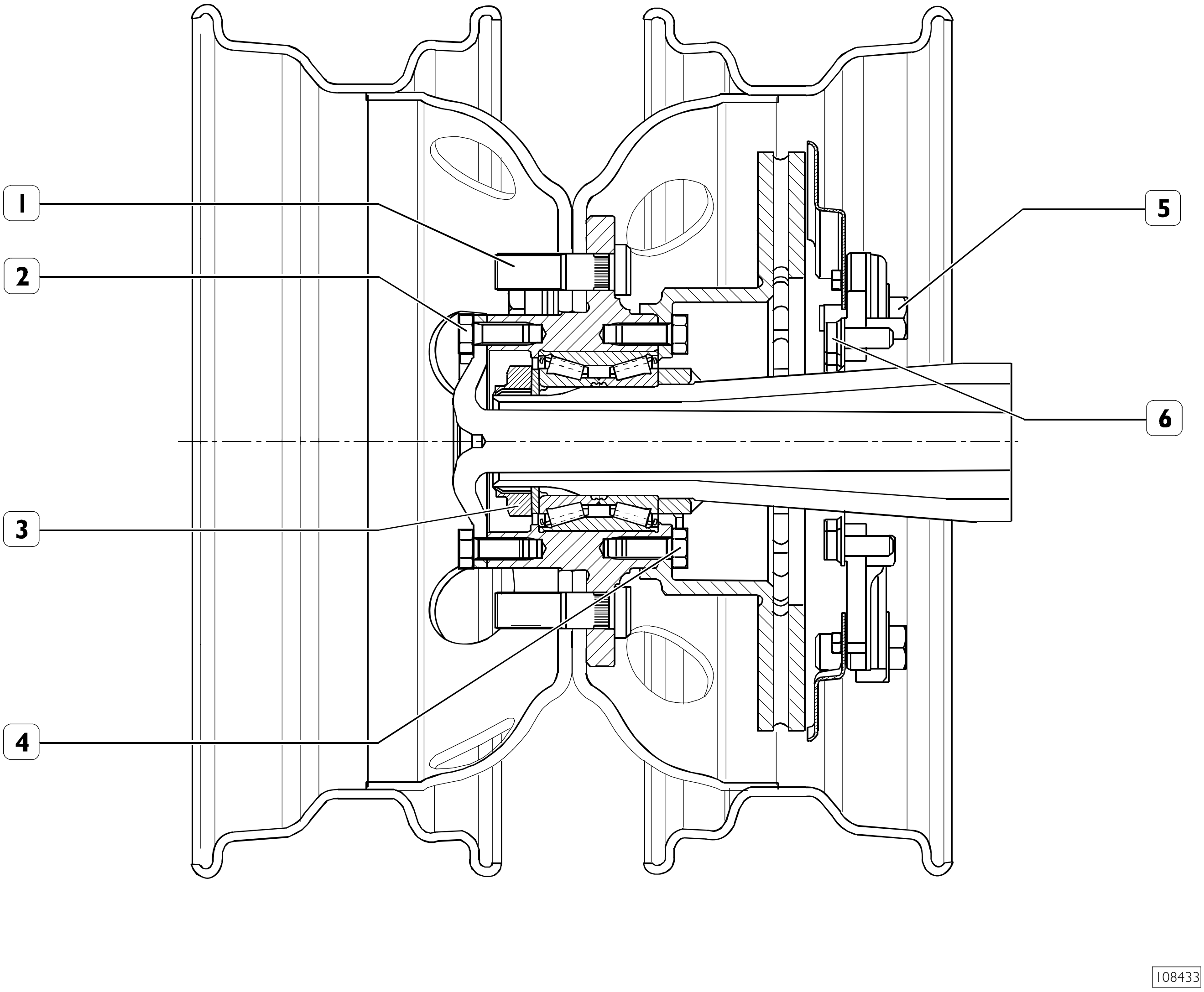
Figure 3



NDA RG REAR AXLE DIFFERENTIAL SECTION

Figure 4



NDA RG REAR AXLE WHEEL HUB SECTION

PART		TORQUE	
		Nm	kgm
1	Wheel securing screw	-	
2	M10x1.25 screw securing half shaft to wheel hub	63 ÷ 76	6.4 ÷ 7.7
3	M52x1.5 ring nut checking wheel hub bearing	545 ÷ 565	55.5 ÷ 57.6
4	M10x1.25 screw securing brake disk to wheel hub	69 ÷ 76	7.0 ÷ 7.7
5	M14x1.5 screw securing shoes support to caliper support	177 ÷ 217	18.0 ÷ 22.1
6	M10x1.5 screw securing brake caliper support to rear axle arm	85 ÷ 97	8.7 ÷ 9.8

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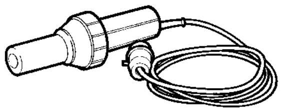
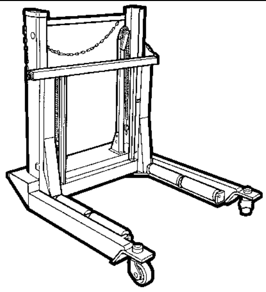
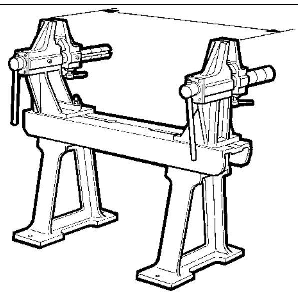
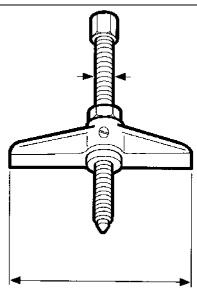
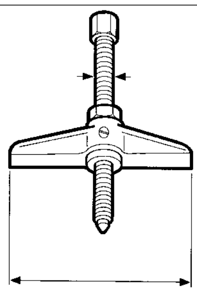
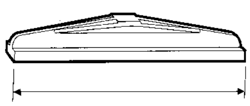
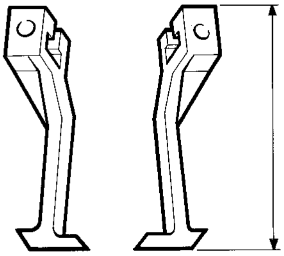
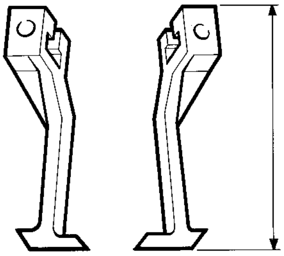
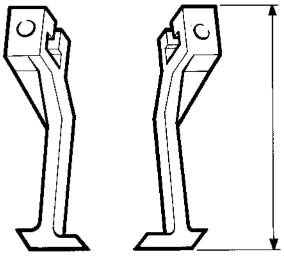
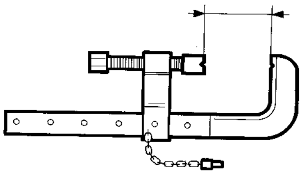
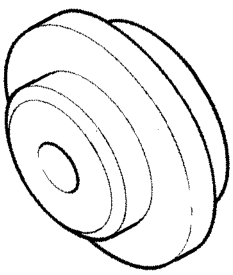
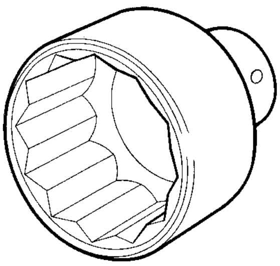
TOOLS

TOOL NO.		DESCRIPTION
99305121		Hot air drier
99321024		Hydraulic trolley for removing and refitting wheels
99322215		Driving and steering axle overhaul stand
99341001		Double effect bridge
99341003		Single-acting rear axle
99341005		Reaction bridge

TOOLS

TOOL NO.		DESCRIPTION
99341009		Pair of retainers
99341010		Pair of retainers
99341011		Pair of retainers
99341015		Clamp
99345057		Extractor reaction block
99355087		65 mm. diam. box wrench for disassembly - assembly wheel hub locking ring

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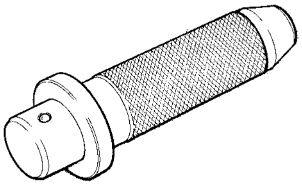
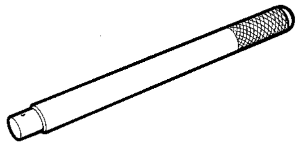
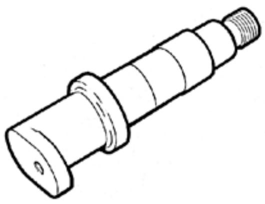
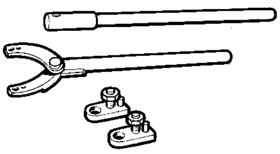
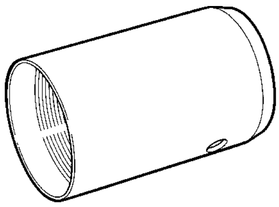
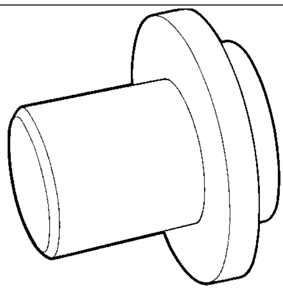
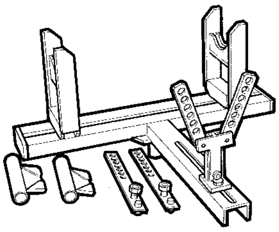
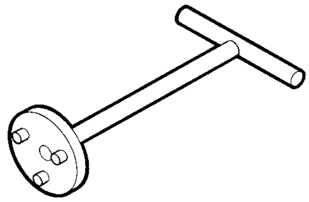
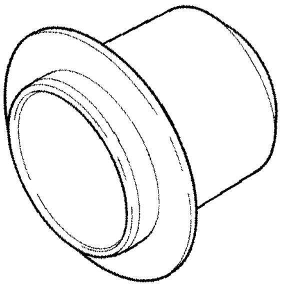
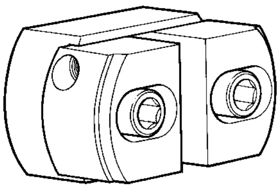
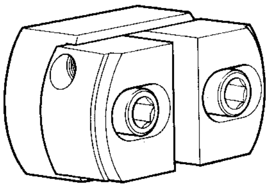
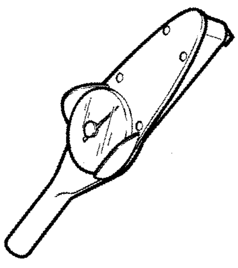
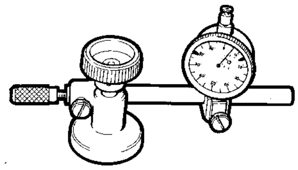
TOOLS

TOOL NO.		DESCRIPTION
99370006		Handle, interchangeable drift
99370007		Grip for interchangeable punches
99370239		Tool for measuring thickness of bevel pinion adjustment rings (to be used with 99395728)
99370317		Lever and relevant extension bar to retain flanges
99370497		Tool for assembly of wheel hub
99370498		Tool for assembly of wheel hub bearing and phonic wheel

TOOLS

TOOL NO.		DESCRIPTION
99370617		Axle universal support during removal/installation
99372236		Tool to move brake caliper piston back
99374022		Keying tool for assembly of differential bevel pinion gasket (to be used with 99370006)
99374091		Punch to fit external races of bearings (diameter 55 ÷ 69 mm use with 99370007)
99374092		Punch to fit external races of bearings (diameter 69 ÷ 91 mm use with 99370007)
99389819		Torque wrench (0 to 10 mm) with 1/4" square attachment

TOOLS

TOOL NO.		DESCRIPTION
99395728		Dial gauge with support to be used with the tools to determine the adjustment thickness of the bevel pinion

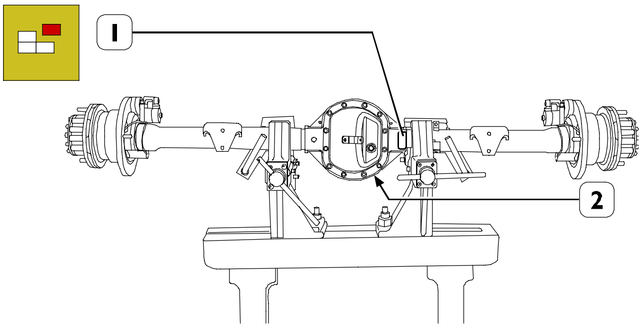
525010 OVERHAULING THE REAR AXLE ASSEMBLYOVERHAULING THE REAR AXLE ASSEMBLY

NOTE For differential assembly repair operations, refer to what described in chapter " NDA-RS rear axle" on pages 22 to 34.

NOTE The drive shafts, brake disc and calipers, air breather and differential can all be removed and refitted even with the unit mounted on the vehicle.

Before positioning the rear axle assembly on the stand for overhauling, drain oil by loosening rear axle casing plug.

Figure 5

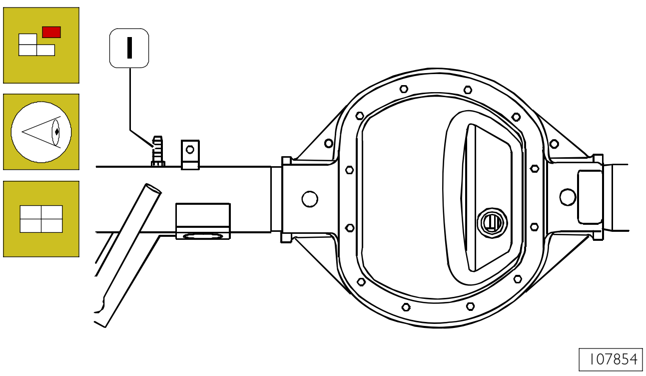


Set the entire rear axle assembly on stand 99322215.

NOTE The identification data of the rear axle unit are given on the plate (1) fixed near to the leaf spring attachment support.

525013 Air breather disassembly - assembly

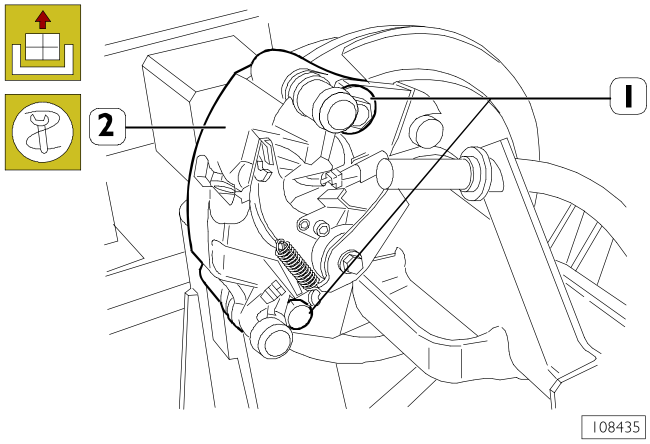
Figure 6



Take out the screws (1) and remove the brake caliper with its brake linings from the mounting.

525030 Wheel hub overhaul

Figure 7



Take out the screws (1) and remove the brake caliper (2) with its brake linings from the mounting.

The caliper must not be violently knocked or dropped.

Prevent the rubber caps coming into contact with sharp metal tools.

Do not dirty or wet the rubber caps with mineral grease or oil.

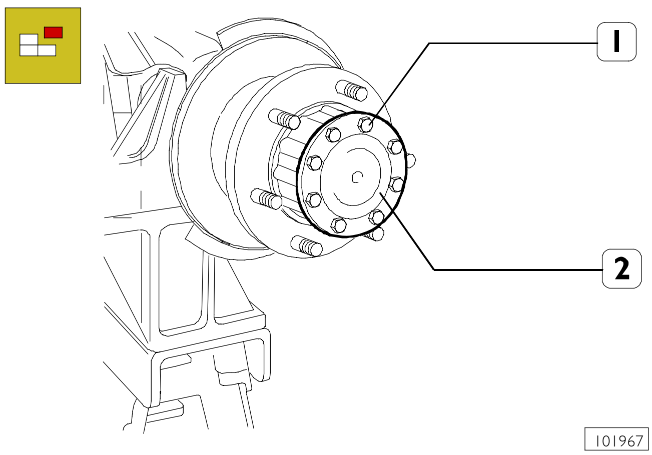
Do not dirty the pads with liquids or grease.

Do not operate the parking brake lever before mounting on the disc.

This makes the piston come out, decreasing the gap between the two brake linings and jeopardizing wearability on the disc.

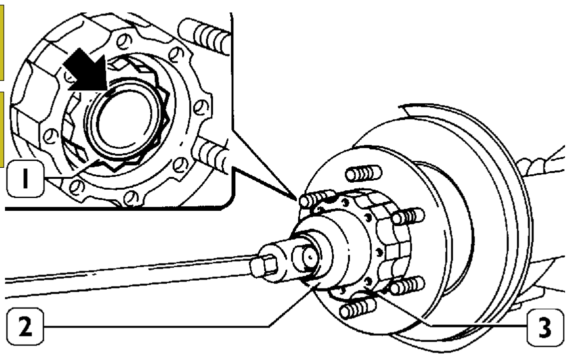
Should this be done unexpectedly, it is necessary to take down the brake linings and move the piston back with tool 99372236, taking the precautions given in the BRAKES section.

Figure 8



Take out the screws (1) and remove the drive shaft (2).

Figure 9



44613

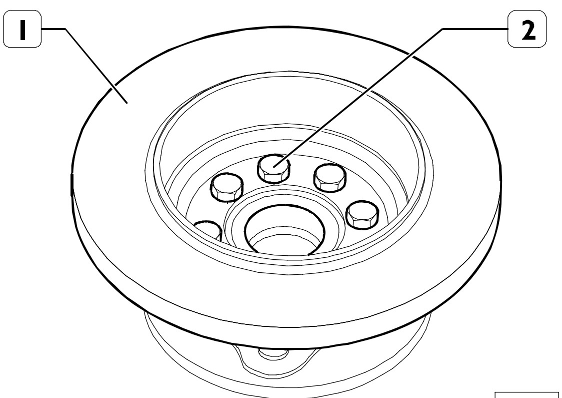
Lift up the notch (⇒) of the ring nut (1). Using the wrench 99355087 (2) remove the ring nut (1), take out the washer and extract the wheel hubs (3).

NOTE In resting the hubs on the bench, pay attention that phonic wheel is not being damaged.

525031 Replacing the wheel hub bearing

Disassembly

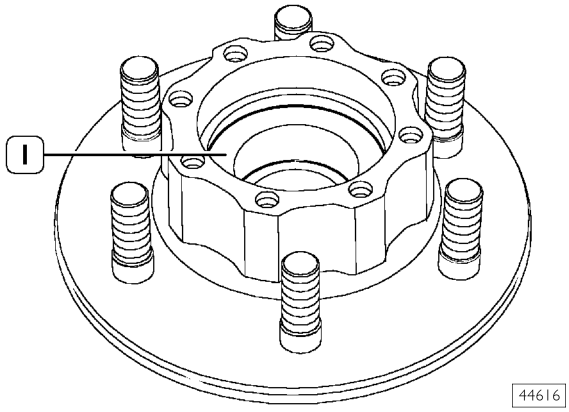
Figure 10



101969

Remove bearing protection ring.
Take out the screws (2) and remove the brake disc (1) from the wheel hub. Check the brake disc as described under the Brakes heading.

Figure 11



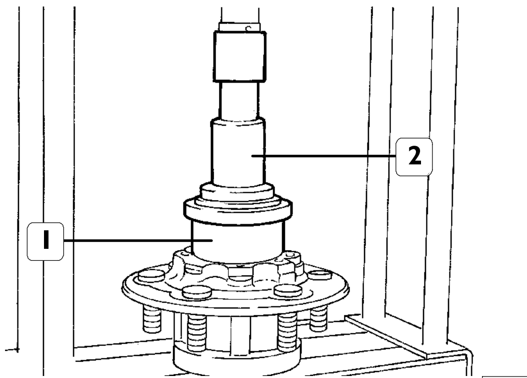
44616

The bearing (1) is removed from the wheel hub with the aid of an ordinary punch.

Assembly

NOTE Bearing (1) driving load is 2100 ÷ 5000 kg.

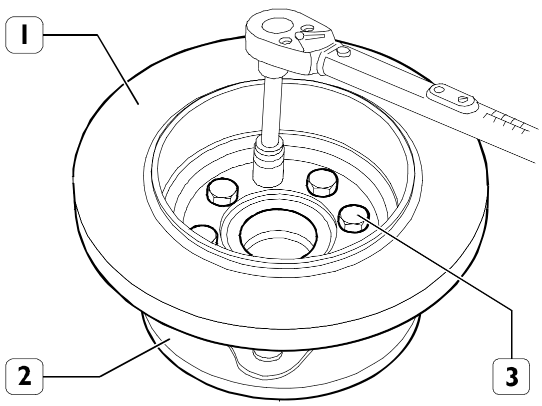
Figure 12



45164

The new bearing should be mounted in the wheel hub with a press and tool 99370498.

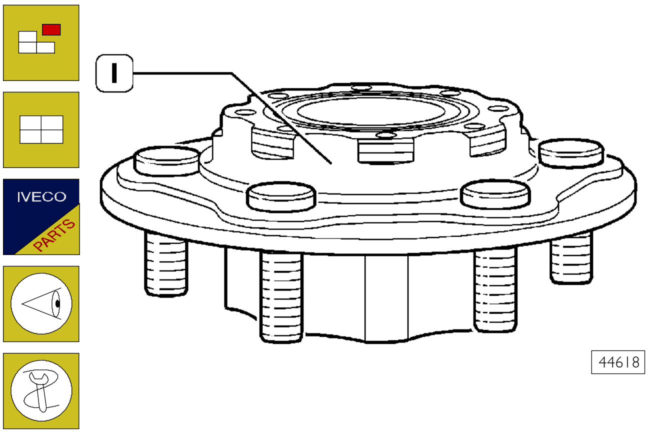
Figure 13



101970

Mount the brake disc (1) on the wheel hub (2) and tighten the fixing screws (3) to the required torque.

Figure 14

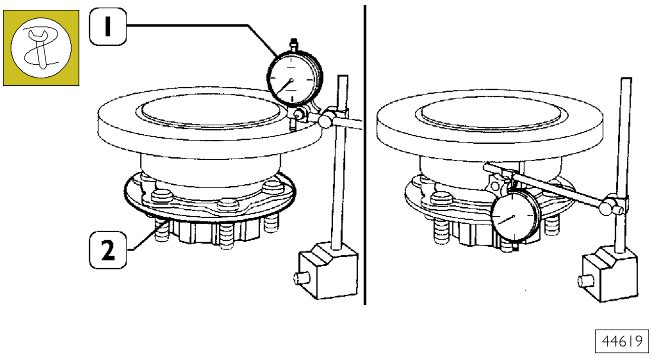


If it is necessary to replace the pins of the wheel hub (1), before mounting the new ones, check that the mating surface of the pin head is free from burrs, dross and blisters.

The pins should be driven in by applying a load on their head no greater than 2000 kg.

After driving them home, check that the pins are perfectly in touch with the hub: maximum orthogonal tolerance 0.2 mm.

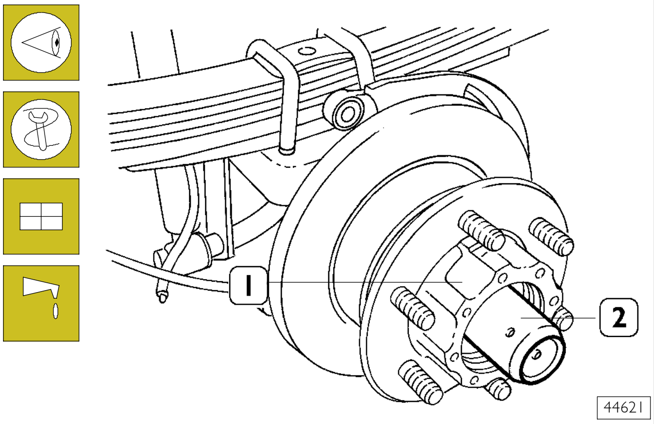
Figure 15



Stand the bearing of the wheel hub (2) on a special mounting that permits rotation. With a magnetic dial gauge (1) check the off-centring of the brake disc on both sides.

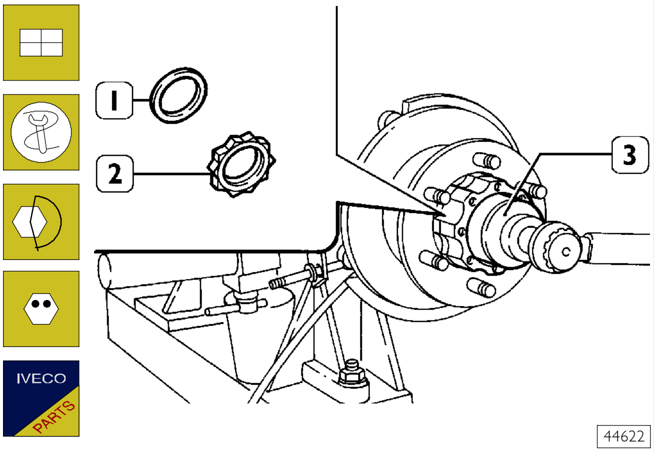
Centering error must not exceed 0.1 mm.

Figure 16



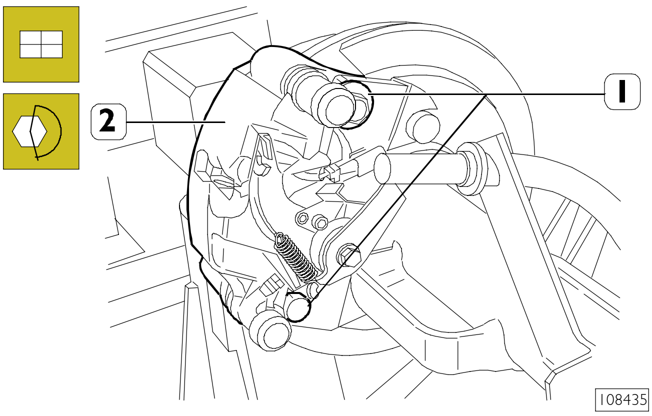
Mount the inserter 99370497 (2) on the sleeve.
Lubricate the sleeve with TUTELA W90/M-DA oil and key the wheel hub (1).

Figure 17



Mount new washer (1), ring nut (2) and, using wrench 99355087 (3), tighten ring nut (2) at prescribed torque.
Notch the fixing ring nut (2) on the milling of the axle housing arm.

Figure 18



Mount brake caliper support on rear axle arm observing prescribed tightening torques.

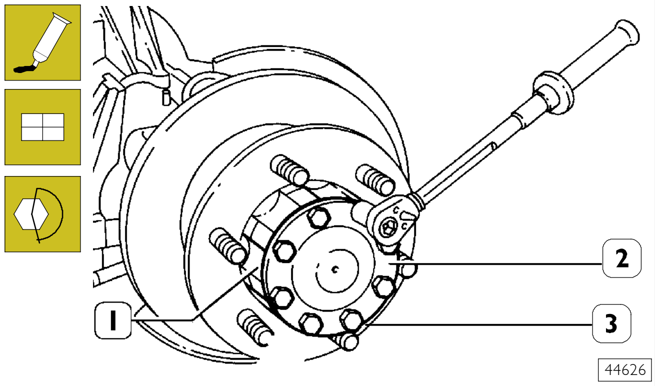
Thread braking gaskets.

Apply brake caliper (2) to the support and tighten securing screws (1) at prescribed torque using a torque wrench.

Where brake caliper plunger must be withdrawn, observe what indicated in section Brakes.

NOTE On each brake caliper remounting operation, replace screws (1): these screws cannot be reused once they have been unscrewed.

Figure 19



Apply IVECO 1905685 sealant on the contact surfaces of the drive shaft (2) with the wheel hub (1).
Mount the drive shaft (2) in the sleeve.
Tighten the screws (3) securing the drive shaft (2) to the hub (1) to the required torque.
After the assembling operation has been completed, fill the rear axle case with TUTELA W90/M - DA oil to the prescribed amount and grade.

Rear axles 450511

DESCRIPTION

The rear axle is the load-bearing type with a single reduction using a hypoid crown wheel and pinion.

The axle housing is made of pressed sheet steel with hot pressed arms.

The bevel pinion is supported by two pre-lapped tapered roller bearings to hold the bearing pre-load better.

The rolling torque of the bearings of the bevel pinion is adjusted by changing the thickness of the adjustment ring between the two tapered roller bearings.

In addition, it is possible to adjust the position of the bevel pinion with respect to the ring bevel gear by changing the thickness of the ring between the axle housing and the bevel pinion rear bearing external ring.

The gear housing is supported by two tapered roller bearings.

The rolling torque of the bearings is adjusted with adjustment rings between the spacer rings and the external rings of the bearings.

The clearance between pinion and crown wheel is adjusted by changing the thickness and/or position of the adjustment rings, though the total thickness must be the same as that of the adjustment rings removed.

The gear housing is composed of two half-housings.

It may be of two different sizes depending on the ratio of the crown wheel and pinion.

The gearing of the differential is composed of four planetary gears and two crown wheels.

The wheel hubs are keyed, with UNIT BEARINGS lubricated for life, onto the arms of the axle housing.

The bearings need no adjustment.

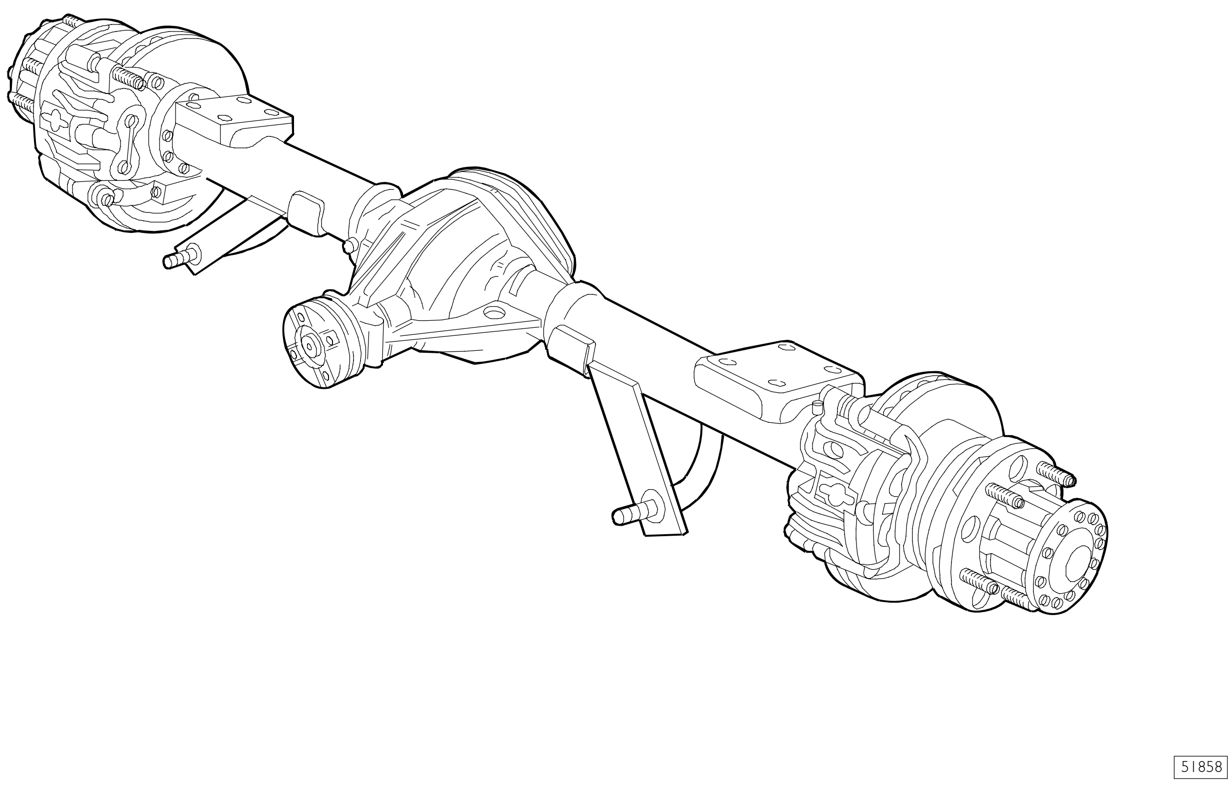
The brakes are disc brakes with floating brake calipers.

The disc brakes are keyed onto the wheel hubs.

The brake calipers are secured with flanges fixed onto the arms of the axle housing.

The parking brake is the drum type, built into the brake disc.

Figure 1



SPECIFICATIONS AND DATA

Type of rear axle: Simple reduction type	**450511**
Electric control mechanical differential locking	on request
DIFFERENTIAL UNIT Reduction bevel gear pair ratio (No. of teeth: pinion/crown)	13/41(1/3.15) - 13/43(1/3.31) - 13/47(1/3.62) - 12/47(1/3.92) - 11/46(1/4.18) - 9/40(1/4.40) 9/44(1/4.89) - 9/46(1/5.11) - 9/47(1/5.22) - 8/45(1/5.63) - 7/41(1/5.86) 13/47(1/3.62) - 12/47(1/3.92) - 11/46(1/4.18) - 9/40(1/4.40) - 8/45(1/5.63) - 9/47(1/5.22)
Bevel pinion bearings	2 with taper rollers
Bevel pinion bearings rolling torque (lubricated bearings and gaskets) Nm New bearings kgm	1.2 ÷ 2.4 0.12 ÷ 0.24
Adjustment of pre-load of bevel pinion bearings	By means of adjustment rings
Bevel pinion bearing preload adjusting ring thickness	1 ÷ 1.975 mm with progression of 0.025 mm.
Temperature of assembly of inner bearing ring on bevel pinion	80 °C ÷ 90 °C
Position of bevel pinion with respect to differential casing	By means of adjustment rings
Thickness of adjusting ring placed between bevel pinion bearing and differential carrier.	1 ÷ 1.975 mm with progression of 0.025 mm.
Bearings for gear housing	2 with taper rollers
Differential casing bearings rolling torque Nm kgm	2 ÷ 2.8 0.20 ÷ 0.28
Adjustment of differential casing bearings rolling torque	By means of adjustment rings
Differential carrier bearing rolling torque adjusting ring thickness	1 ÷ 1.95 mm with progression of 0.05 mm.
Clearance between pinion and ring bevel gear	0.15 ÷ 0.20 mm
Adjustment of clearance between pinion and ring bevel gear	By means of adjustment rings
Clearance between planetary and crown wheels	0.12 ÷ 0.18 mm

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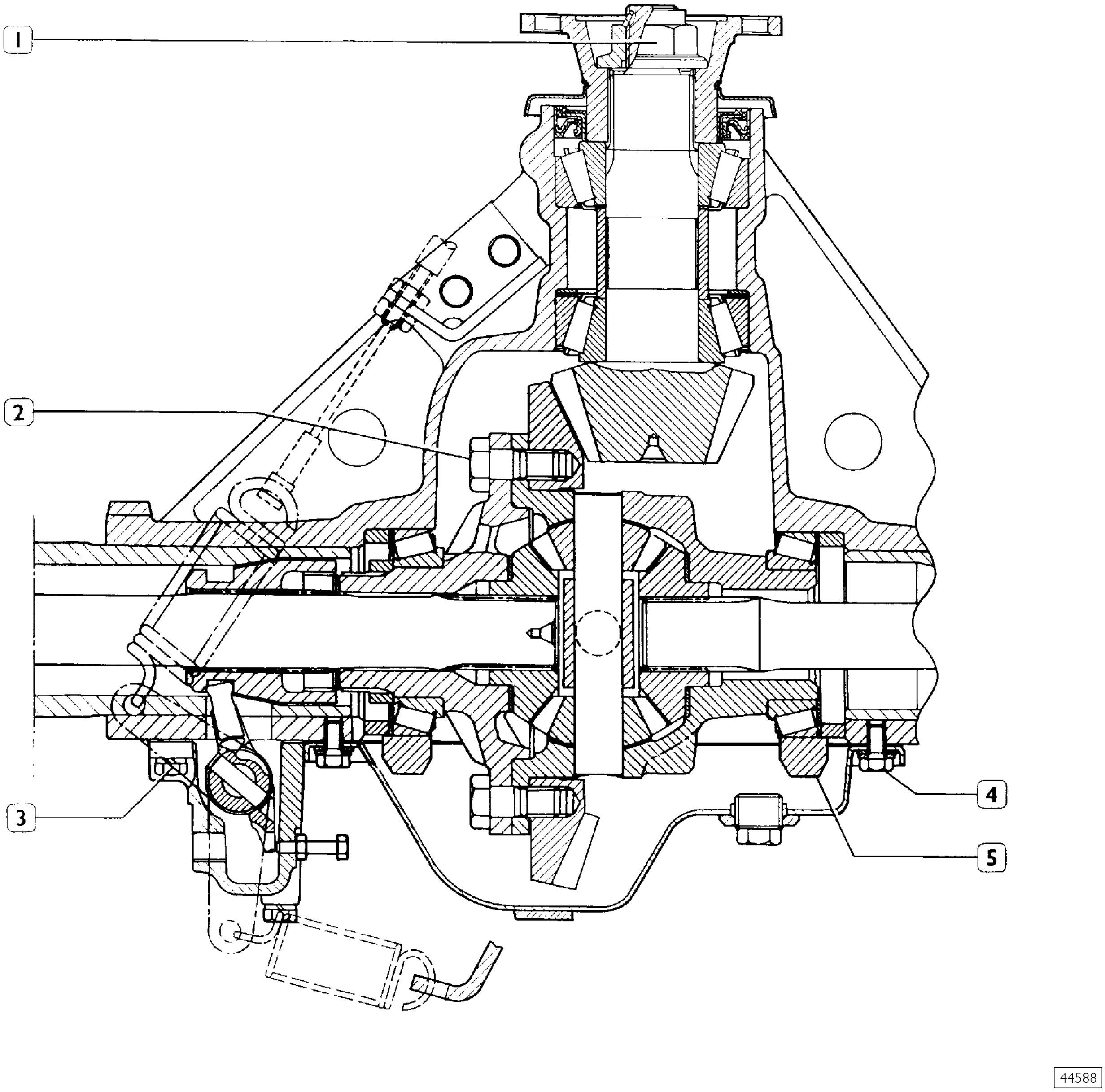
Type of rear axle: Simple reduction type	**450511**
WHEEL HUBS	
Wheel hub bearings	Unit-Bearing
Wheel hub bearings end play	-
Wheel hub bearings rolling torque Nm kgm	 - -
Adjustment of wheel hub bearings end play	Non-adjustable Tightening to fixing ring nut torque
Rear axle oil Quantity Litres	**TUTELA W140/M-DA (SAE 85 W 140)** 1.9
Dry rear axle weight : ❑ With ABS kg ❑ Without ABS kg ❑ Max capacity (GRW) kg	 154,6 153 3700

TIGHTENING TORQUES

Figure 2



REAR AXLE DIFFERENTIAL SECTION WITH DIFFERENTIAL LOCKING

PART		TORQUE	
		Nm	kgm
1	M26x1.5 bevel pinion securing nut.	400 ÷ 500	40 ÷ 50
2	Screw securing half-housing and ring bevel gear M14 x 1.5	200 ÷ 210	20 ÷ 21
3	Screw securing mounting for differential locking to the axle housing or securing cover for differential locking mounting seat cover	21 ÷ 25	2.1 ÷ 2.5
4	Screw securing gearing inspection cover to the axle housing	21 ÷ 26	2.1 ÷ 2.6
5	Screw securing caps to axle housing	96 ÷ 117	9.6 ÷ 11.7

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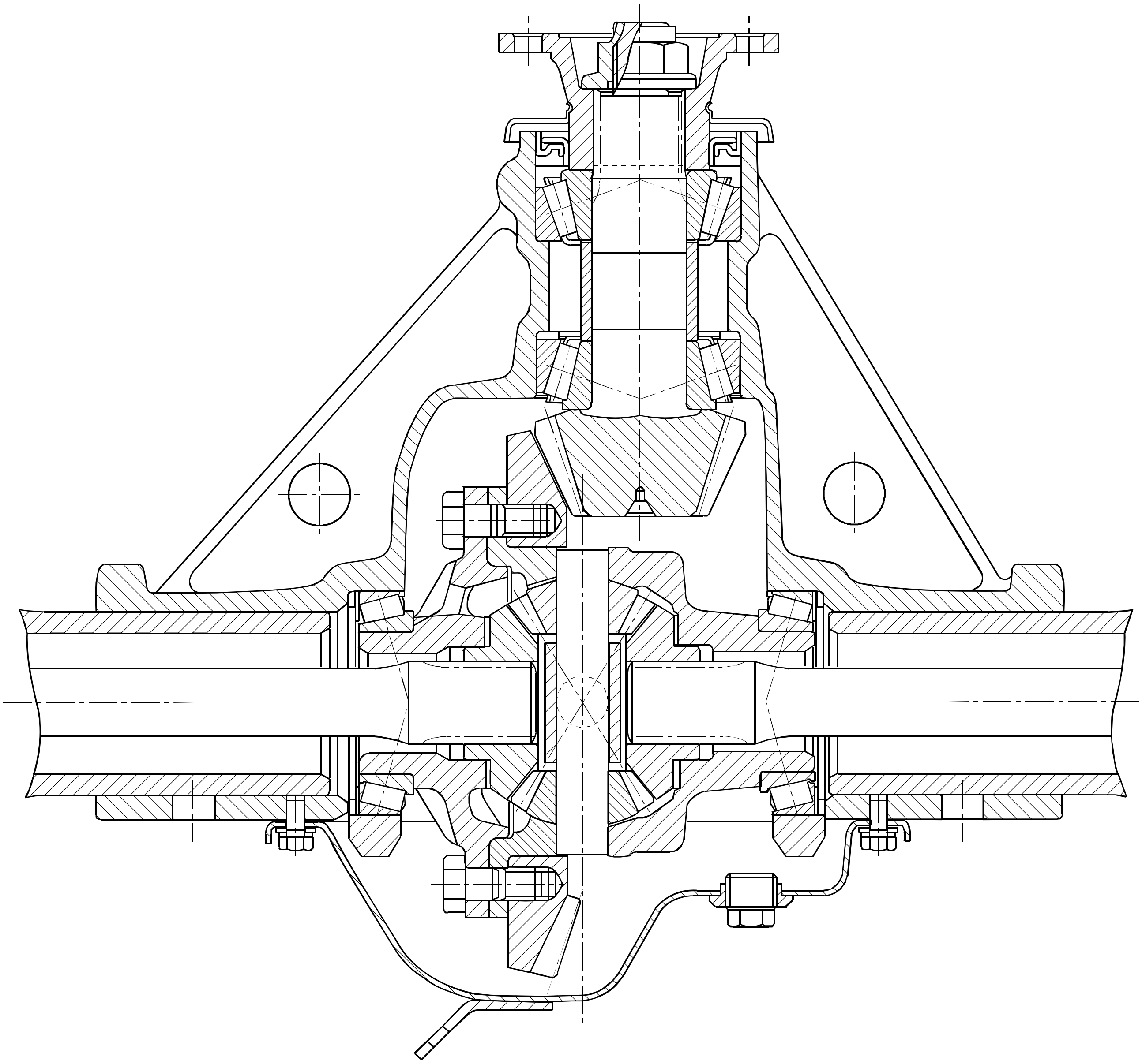
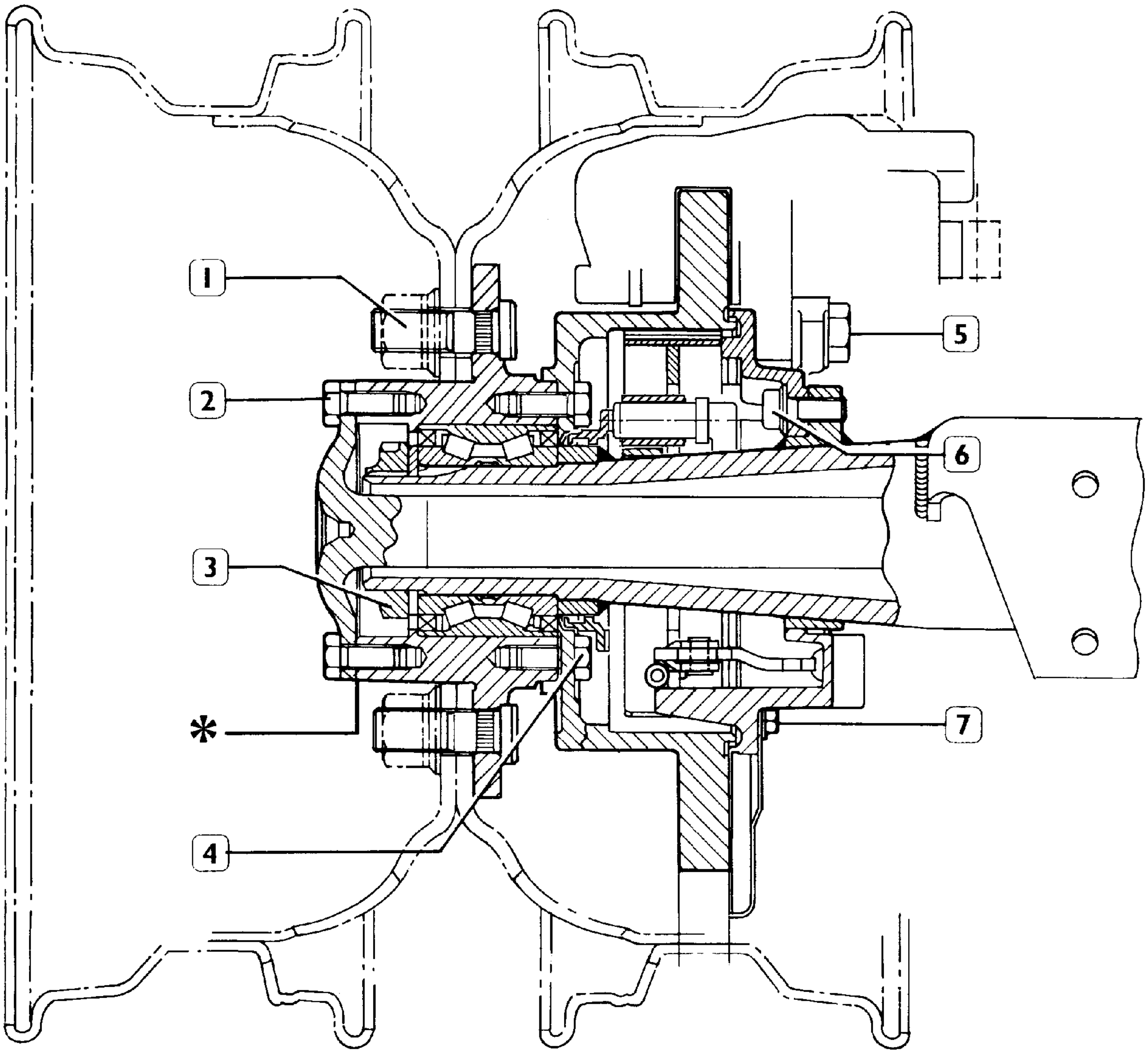
Figure 3



450511 REAR AXLE DIFFERENTIAL SECTION

Figure 4



WHEEL HUB SECTION

PART		TORQUE	
		Nm	kgm
1	Wheel retaining nut M18	290 ÷ 349	29 ÷ 34.9
2	Screw securing drive shaft to the wheel hub M10x1.25	63 ÷ 76	6.3 ÷ 7.6
3	Ring nut retaining wheel hub bearing M52x1.5	545 ÷ 565	54.5 ÷ 56.5
4	Screw securing brake disc to wheel hub M10x1.25	69 ÷ 76	6.9 ÷ 7.6
5	Screw securing caliper mounting to shoe mounting M14x1.5	180 ÷ 220	18 ÷ 22
6	Screw securing shoe mounting to axle housing M10x1.5	85 ÷ 97	8.5 ÷ 9.7
7	Screw securing guard	8	0.8
**	Screw securing sensor mounting	5 ÷ 7	0.5 ÷ 0.7

* Spread the surface of the drive shaft - wheel hub union with B-type sealant.
** When assembling the screws securing the timing sensor mounting, apply a few drops of LOCTITE 243 thread-lock onto the thread of the corresponding holes of the bracket welded onto the axle arm.

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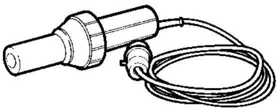
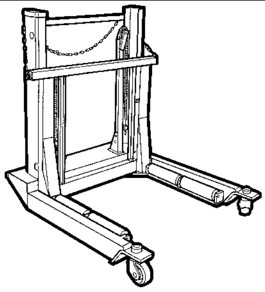
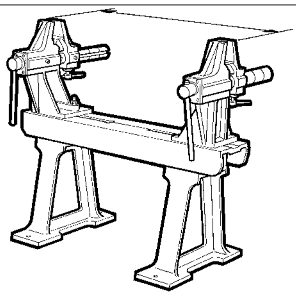
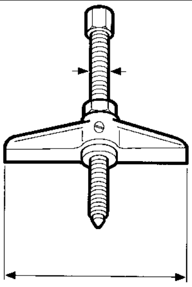
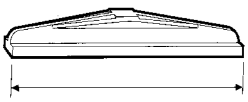
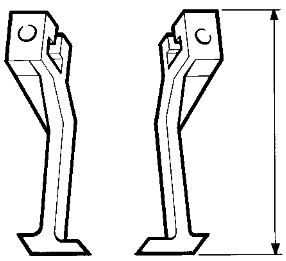
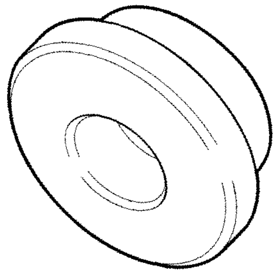
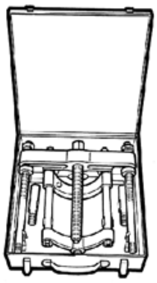
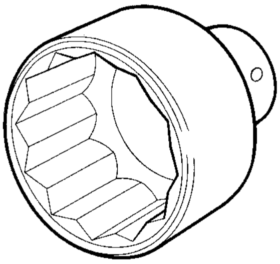
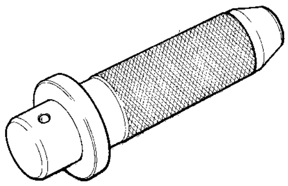
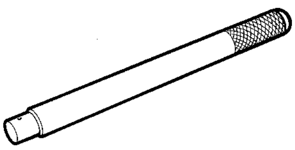
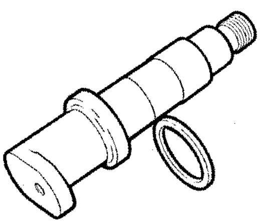
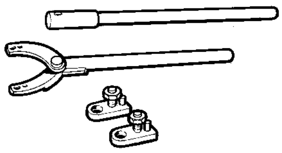
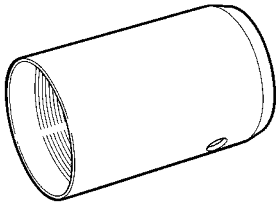
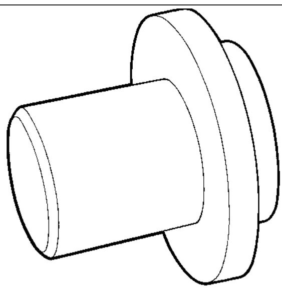
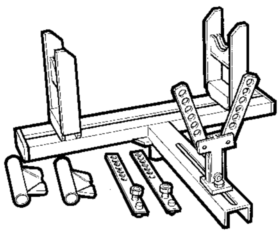
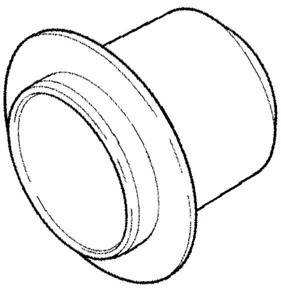
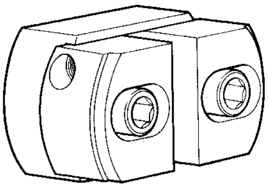
TOOLS

TOOL NO.		DESCRIPTION
99305121		Hot air drier
99321024		Hydraulic trolley for removing and refitting wheels
99322215		Driving and steering axle overhaul stand
99341001		Double effect bridge
99341005		Reaction bridge
99341010		Pair of retainers

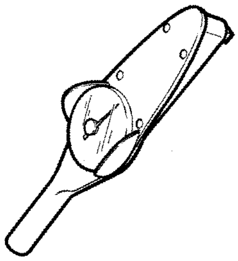
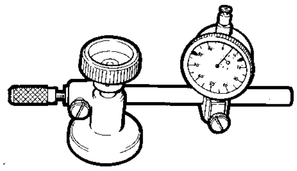
TOOLS

TOOL NO.		DESCRIPTION
99345056		Counter block for pullers
99348001		Extractor with locking device
99355087		65 mm. diam. box wrench for disassembly - assembly wheel hub locking ring
99370006		Handle, interchangeable drift
99370007		Handle, interchangeable drift
99370309		Tool for measuring thickness of bevel pinion adjustment rings (to be used with 99395728)

TOOLS

TOOL NO.		DESCRIPTION
99370317		Lever and relevant extension bar to retain flanges
99370497		Tool for assembly of wheel hub
99370498		Tool for assembly of wheel hub bearing and phonic wheel
99370617		Axle universal support during removal/installation
99374022		Keying tool for assembly of differential bevel pinion gasket (to be used with 99370006)
99374092		Punch to fit external races of bearings (diameter 69 ÷ 91 mm use with 99370007)

TOOLS

TOOL NO.		DESCRIPTION
99389819		Torque wrench (0 to 10 mm) with 1/4" square attachment
99395728		Dial gauge with support to be used with the tools to determine the adjustment thickness of the bevel pinion

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REAR AXLE REMOVAL - REFITTING

Removal

Position the vehicle on level ground and lock the front wheels.

Loosen the nuts securing the rear wheels.

Lift the vehicle at the back and set it on stands.

Put the hydraulic trolley 99321024 under the rear wheels. Take out the nuts securing the wheels.

Unscrew the handbrake adjustment nut (4). Free the cables from the vehicle crosspiece, unhooking the retaining clamps (3).

Unscrew the screws (6) securing the propeller shaft.

Disconnect the electric cables for indicating brake lining wear (2) and (13), for the ABS speed sensors, if present.

Disconnect the braking corrector adjustment tie (14) from the axle housing.

Unscrew the nuts (5) securing the shock absorbers.

Disconnect the oil pipe (1) from the fitting secured to the axle housing.

Unscrew the screws (9) securing the stabilizer bar (10) to the axle.

Disconnect the pipe (16) from the axle housing oil vapour vent.

For axles with differential locking only

Release spring (17) and unthread flexible tie rod (18) from bracket (19).

Disconnect the electric cable of the differential locking indicator transmitter (15).

For all vehicles

Position a hydraulic jack equipped with the mounting 99370617 under the axle.

Unscrew the nuts (7) of the brackets (8) securing the axle to the leaf spring (11).

Lower the hydraulic jack and extract the axle.

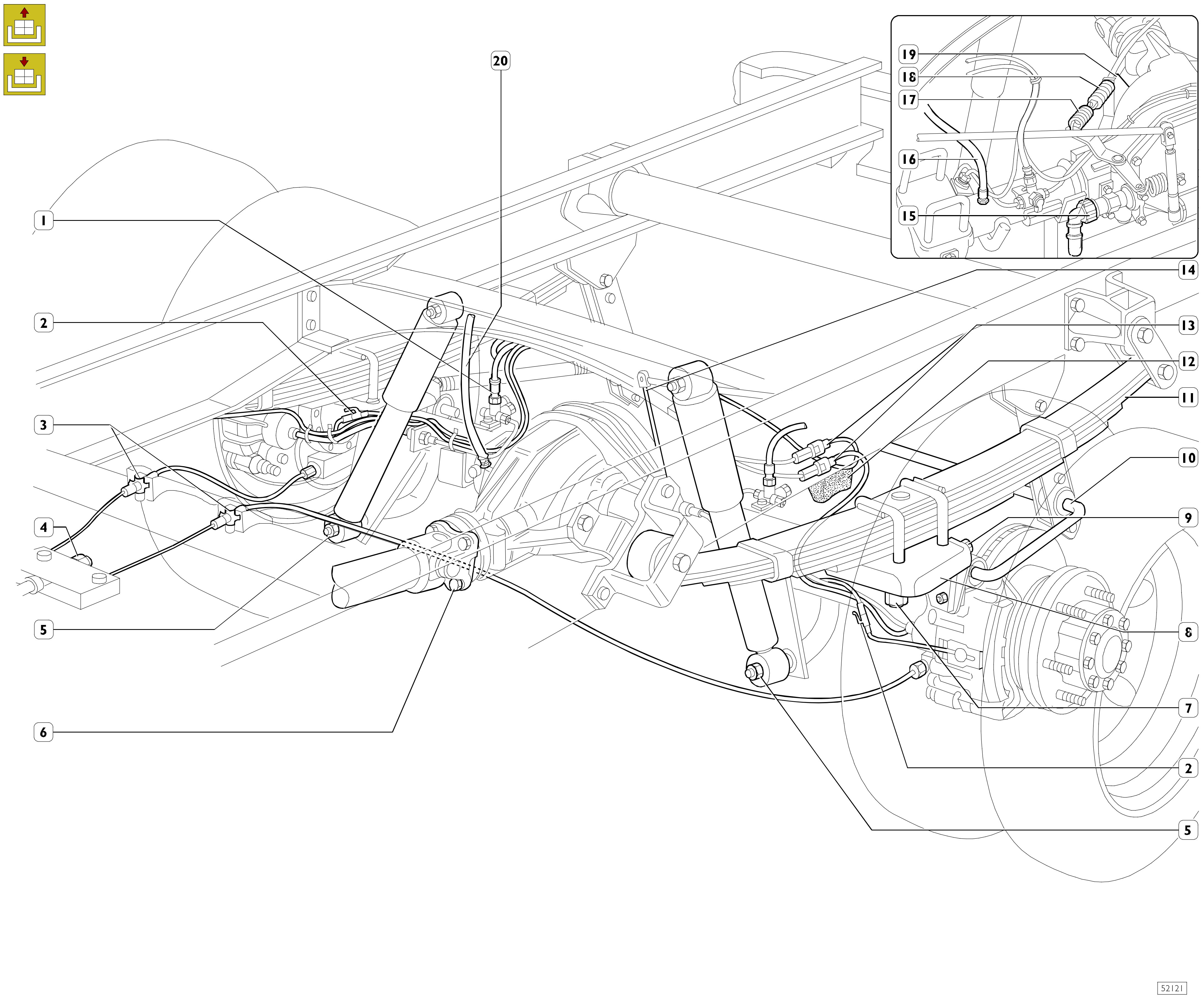
Refitting

For refitting, carry out the operations described for removal in reverse order, observing the required tightening torques for the screws and/or nuts.

At procedure completion:

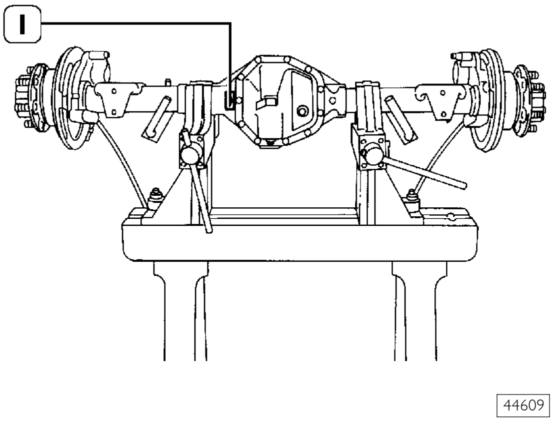
- ❑ Check the thread of the brackets joining the leaf springs to the axle. If there are any irregularities, rectify the thread (operation 500412) or replace the brackets.
- ❑ Bleed the air from the brake hydraulic system as described under the relevant heading (operation 784010).
- ❑ Adjust the handbrake control ties as described under the relevant heading (operation 502710).
- ❑ Lock the nuts or screws to the required tightening torque.
- ❑ Check for self-locking nuts having been replaced;
- ❑ Check the state of the flexible pads (12) and replace them if they have deteriorated (operation 500417).
- ❑ Check for rear axle box lubrication oil correct level.

Figure 5



525010 OVERHAULING THE REAR AXLE ASSEMBLY

Figure 6

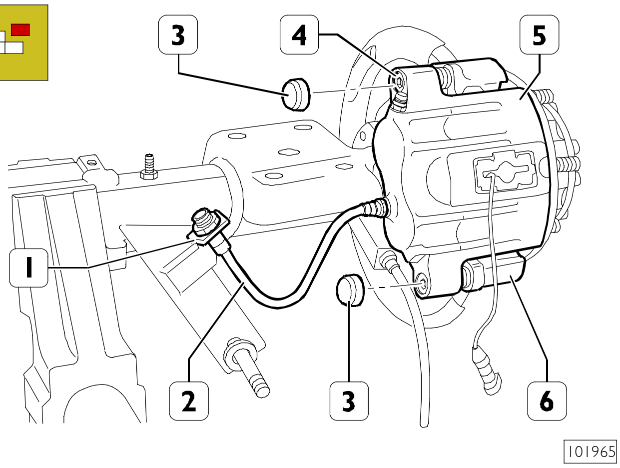


Set the entire rear axle assembly on stand 99322215.

The identification data of the rear axle unit are given on the plate (1) fixed near to the leaf spring attachment support.

525030 Wheel hub overhaul

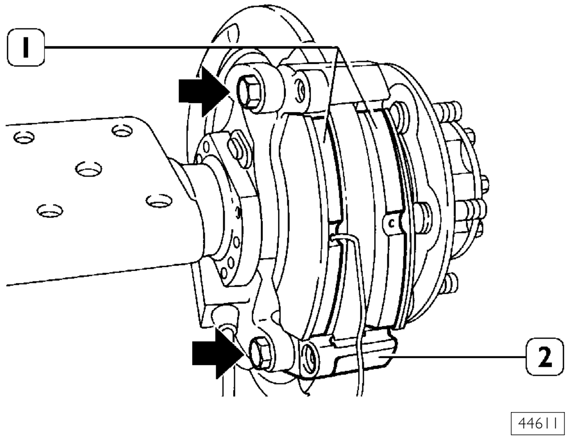
Figure 7



Disconnect the pipe (2) from the support bracket (1). Remove caps (3), take off screws (4), then remove brake caliper (5) from support (6).

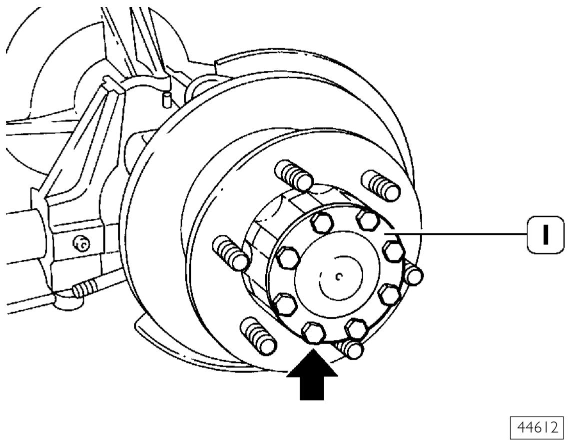
NOTE The thread of the screws securing the brake caliper is treated with adhesive. Therefore, they must not be reused, but replaced with new ones every time they are removed.

Figure 8



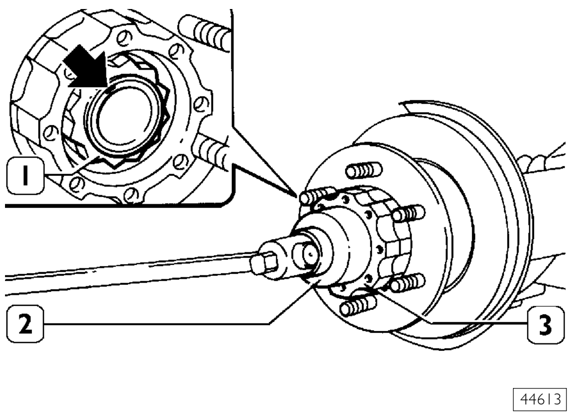
Unthread braking pads (1). Take off screws (→) and detach support (2).

Figure 9



Take out the screws (⇒) and remove the drive shaft (1).

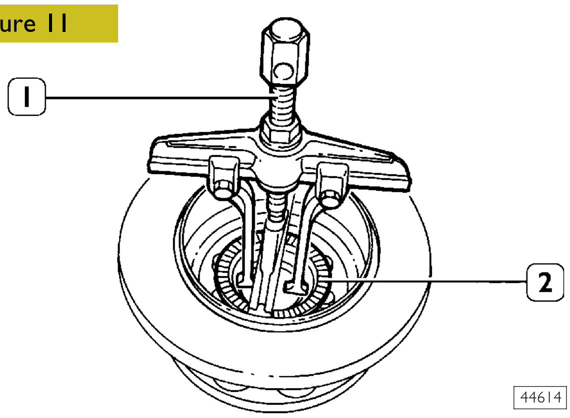
Figure 10



Lift up the notch (⇒) of the ring nut (1). Using the wrench 99355087 (2) remove the ring nut (1), take out the washer and extract the wheel hubs (3).

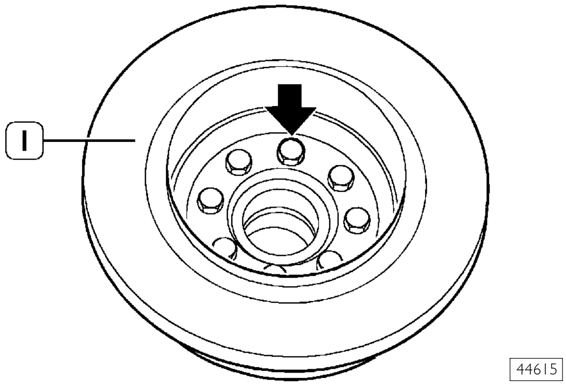
525031 Replacing the wheel hub bearing

Figure 11



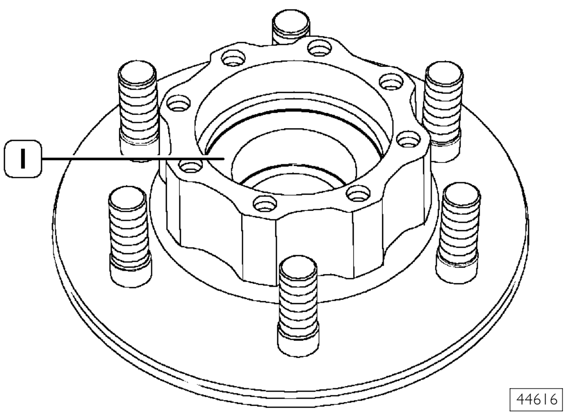
If the hub is fitted with a phonic wheel (2), take it out with the extractor (1) 99341001 as shown in the figure. Otherwise, take out the bearing guard ring.

Figure 12



Take out the screws (⇒) and remove the brake disc (1) from the wheel hub. Check the brake disc as described under the Brakes heading.

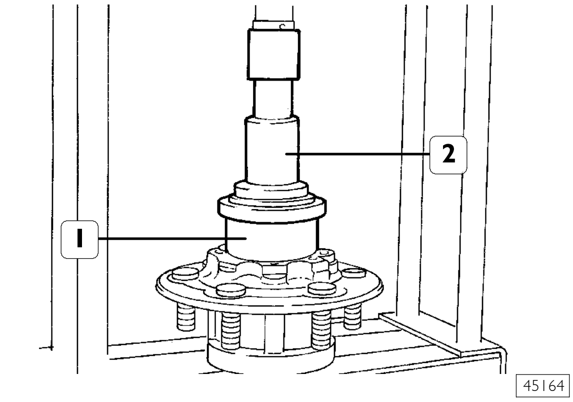
Figure 13



The bearing (1) is removed from the wheel hub with the aid of an ordinary punch.

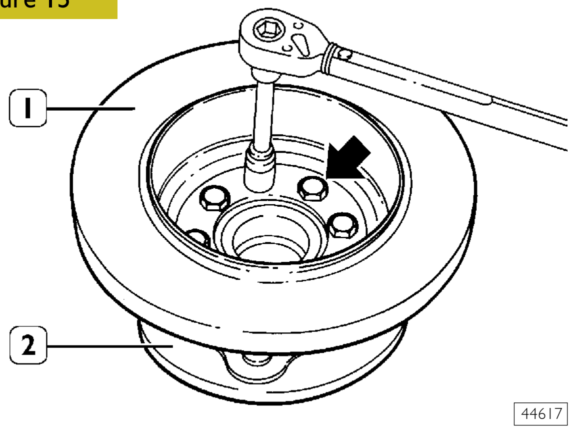
NOTE Bearing (1) driving load is 2100 ÷ 5000 kg.

Figure 14



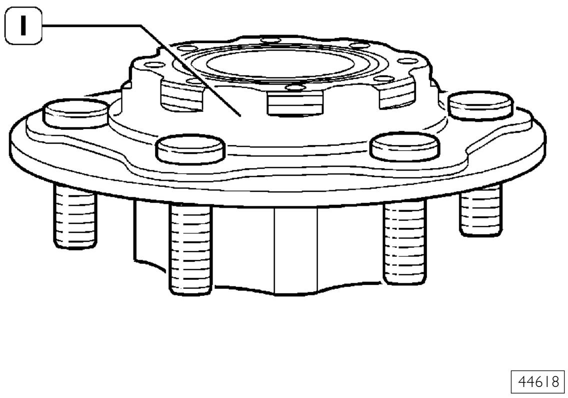
The new bearing should be mounted in the wheel hub with a press and tool 99370498.

Figure 15



Mount the brake disc (1) on the wheel hub (2) and tighten the fixing screws (⇒) to the required torque.

Figure 16



If it is necessary to replace the pins of the wheel hub (1), before mounting the new ones, check that the mating surface of the pin head is free from burrs, dross and blisters.

The pins should be driven in by applying a load on their head no greater than 2000 kg.

After driving them home, check that the pins are perfectly in touch with the hub: maximum orthogonal tolerance 0.2 mm.

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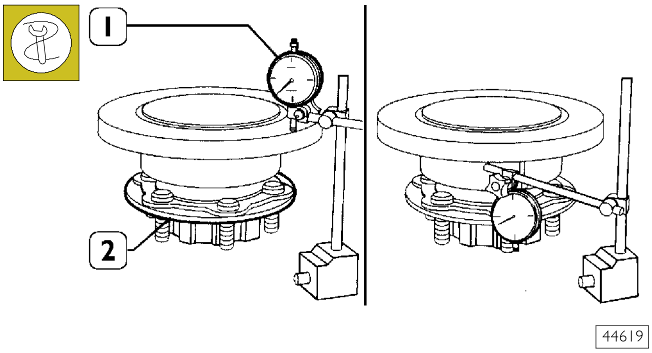
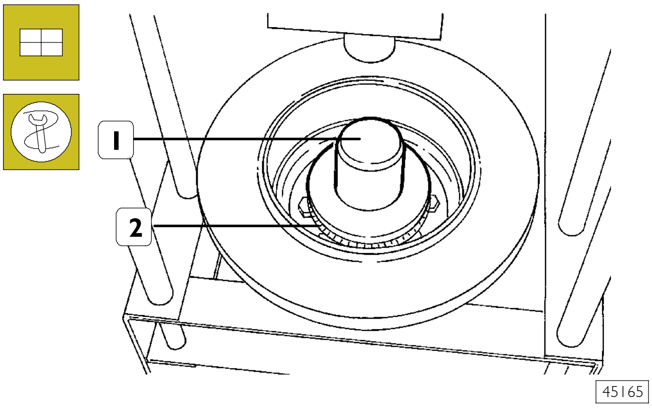
Figure 17



Stand the bearing of the wheel hub (2) on a special mounting that permits rotation. With a magnetic dial gauge (1) check the off-centring of the brake disc on both sides.

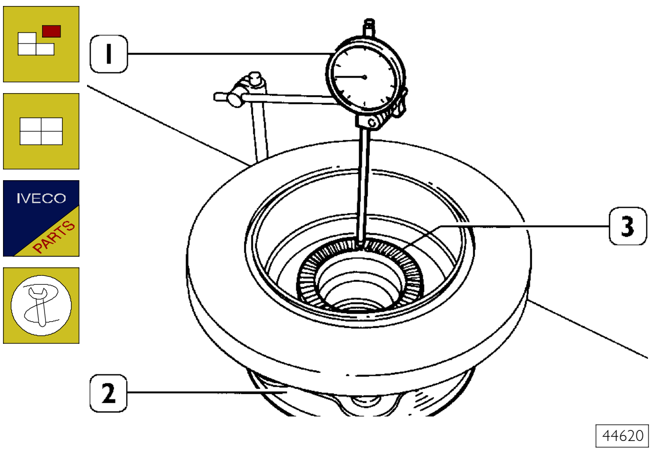
Off-centring must not exceed 0.1 mm.

Figure 18



The phonic wheel (2) should be mounted in the hub with the punch 99370498 (1), checking after assembly that the "phonic" wheel rests perfectly in its seat in the hub.

Figure 19

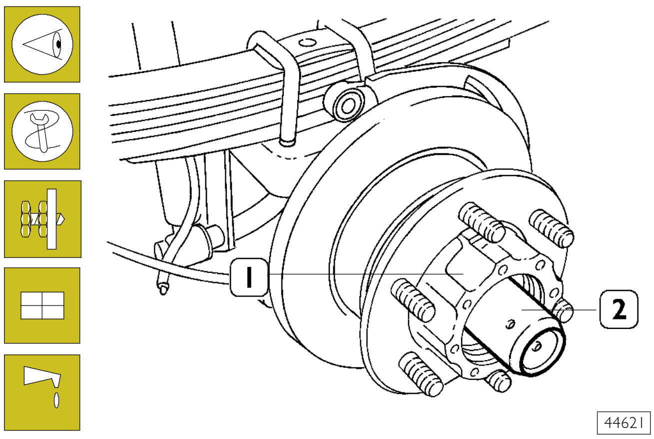


Check the orthogonality of the phonic wheel (2), proceeding as follows:

Position the feeler of the magnetic dial gauge (1) on the phonic wheel.

Making the wheel hub (3) turn, check that the maximum error of orthogonality of the phonic wheel (2) is no greater than 0.1 mm.

Figure 20

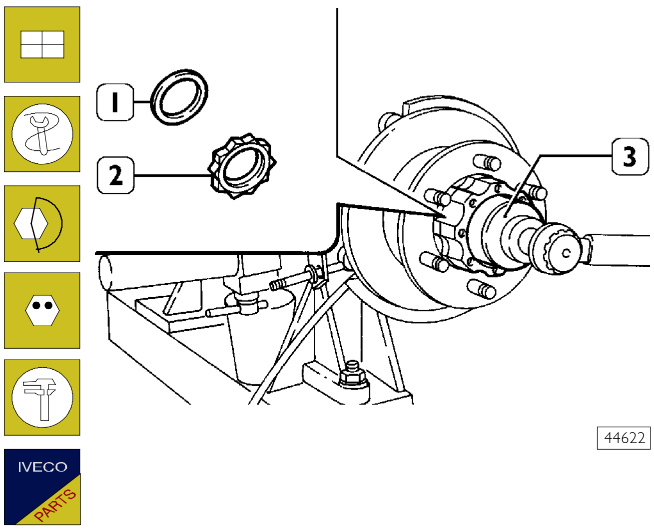


NOTE Check and, if necessary, adjust the clearance between the parking brake drum and shoes as described in the Brakes section.

Mount the inserter 99370497 (2) on the sleeve.

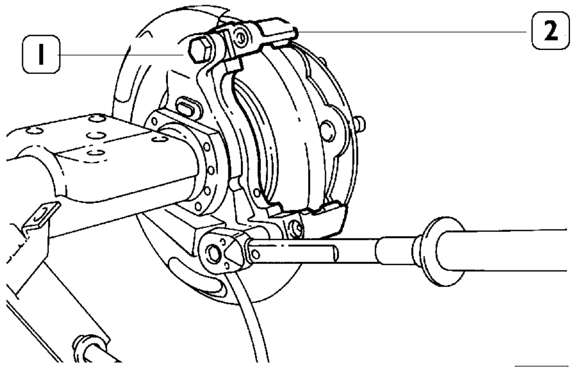
Lubricate the sleeve with TUTELA W140/M-DA oil and key the wheel hub (1).

Figure 21



Mount the washer (1) and a new ring nut (2). Using the wrench 99355087 (3), tighten the ring nut (2) to the required torque.
Notch the fixing ring nut (2) on the milling of the axle housing arm.

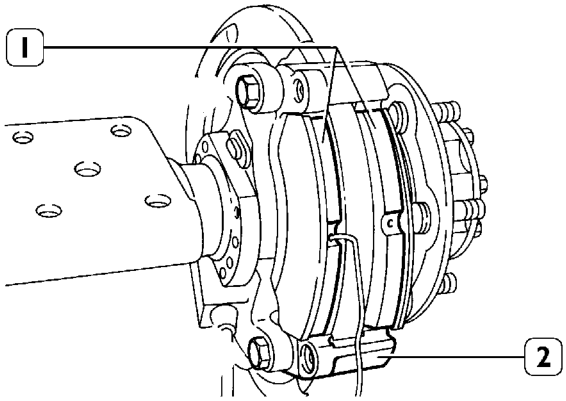
Figure 22



44623

Mount the support (2) and tighten the fixing screws (1) to the required torque.

Figure 23

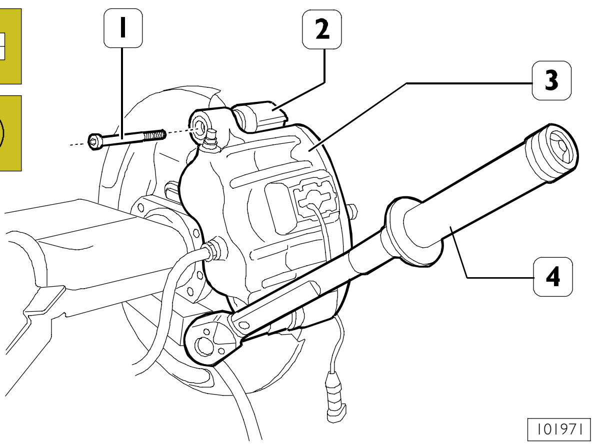


44611

Mount braking pads (1).

> ⚠ Braking pad with wear signalling unit must be mounted at brake caliper plunger side.

Figure 24



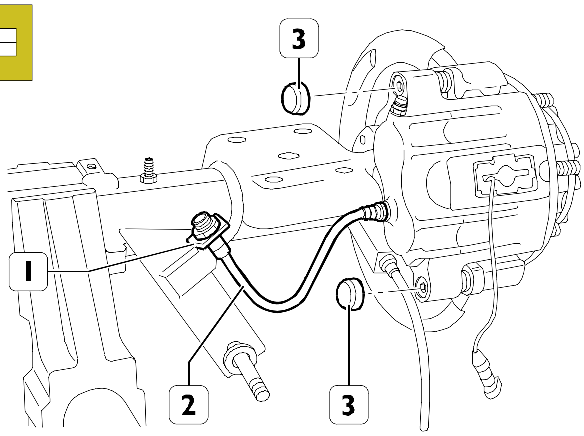
101971

Fit brake caliper (3) to support (2), then use torque wrench (4) to tighten fastening screws (1) to a torque of 32 to 36 Nm.

Having to move the brake caliper piston back, keep to the instructions given in the BRAKES section.

> ⚠ Mount only new screws (1, Figure 24).
>
> Every time they are removed, they must be replaced.

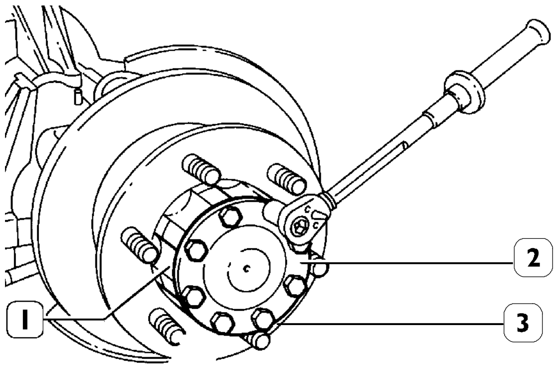
Figure 25



101962

Fit new protection caps (3).
Connect the pipe (2) to the support bracket (1).

Figure 26



44626

Apply IVECO 1905685 sealant on the contact surfaces of the drive shaft (2) with the wheel hub (1).

Mount the drive shaft (2) in the sleeve.

Tighten the screws (3) securing the drive shaft (2) to the hub (1) to the required torque.

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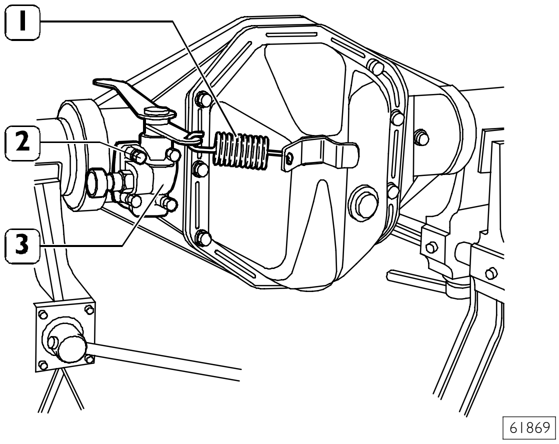
526210 DIFFERENTIAL REPAIR OPERATIONS

526260 Disassembly of differential locking

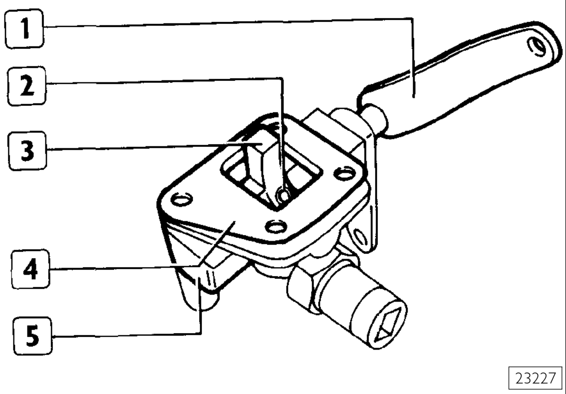
Figure 27



Remove the spring (1).
Unscrew and remove the 4 screws (2) including washers and then disconnect the differential locking device (3).
If required, remove the unit as described in the following paragraphs.

Differential locking removal

Figure 28



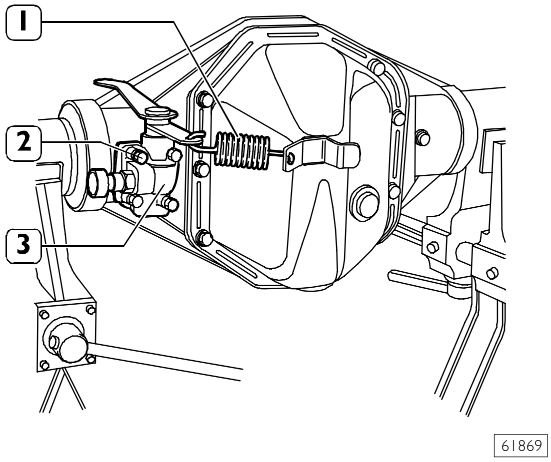
Remove gasket (4).
By means of a normal beater knock out the elastic pin (2), remove the lever (1) complete with ring and washer.
Finally, remove the control lever (3) from the support (5).

Assembling the differential locking device

Assemble the differential locking device by following the removal operations in the reverse order.
Re-attach the differential locking device to the rear axle casing as follows:

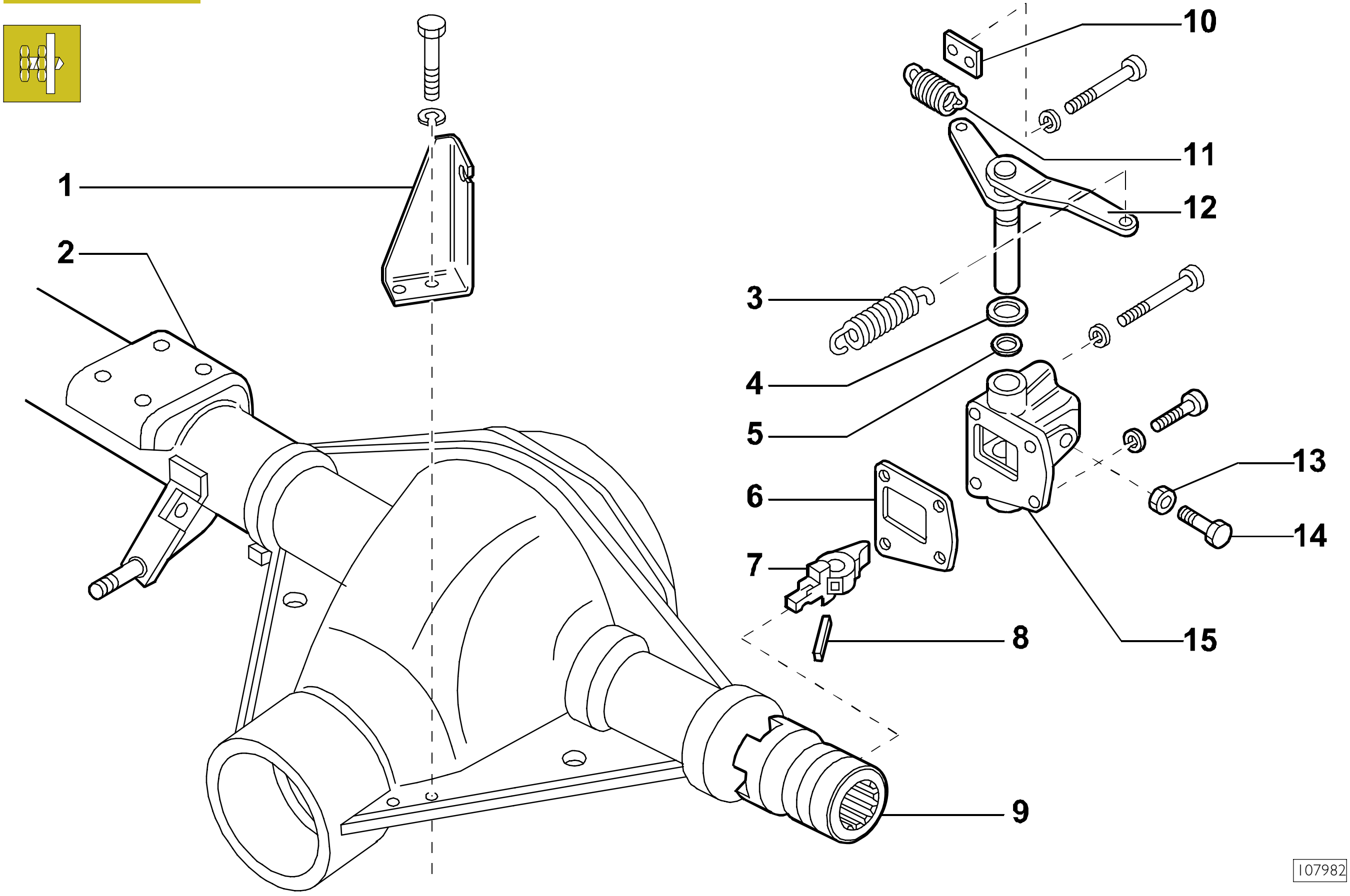
Differential locking refitting

Figure 29



Mount a new O-ring on the differential locking attachment plane.
Position the previously assembled support (3) so as to insert the control lever in the spline on the sliding sleeve.
Insert the 4 screws (2) complete with washers and spring washers and tighten the screws to the driving torque of 23 Nm (2.35 kgm).
Assemble the spring (1).
Adjust the differential locking device by following the procedures below.

Figure 30



DIFFERENTIAL LOCKING DEVICE COMPONENTS
1. Flexible tie rod bracket (Bowden) - 2. Rear axle casing - 3. Spring - 4. Gasket - 5. Sealing ring - 6. Gasket - 7. Sleeve control lever (9) - 8. Elastic pin to fix lever (7) to lever (12) - 9. Differential locking sliding sleeve - 10. Spring coupling plate (11) - 11. Lever return spring (12) - 12. Transmission lever - 13. Adjusting screw nut - 14. Adjusting screw - 15. Differential locking device body.

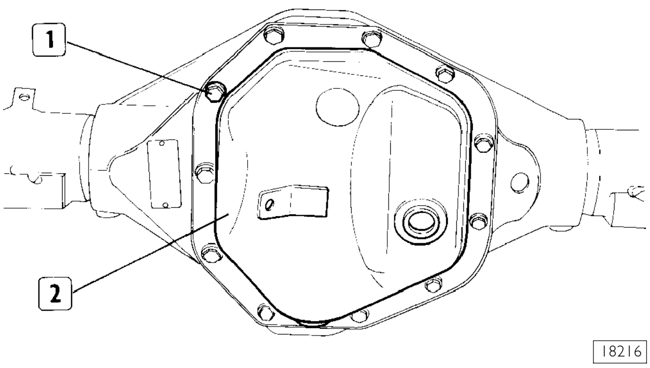
Adjusting the differential locking device

Engage the sliding sleeve (9). Once this has been done, loosen the nut (13), move the adjustment screw (14) so that it is contact with the control lever (7). After this, unscrew the adjustment screw by 9.5 turns (corresponding to 9.5 mm. travel of the screw) and lock it with the fastening nut (13).

Disassembling the differential unit

NOTE Before carrying out repair operations on the differential unit you must drain off the oil and disassemble the drive shafts. For the rear axle, you must disassemble the differential locking as described in the relevant paragraphs.

Figure 31



Unscrew the screws (1) complete with tab washers and spring washers and remove the gear housing inspection cover (2) complete with gasket.

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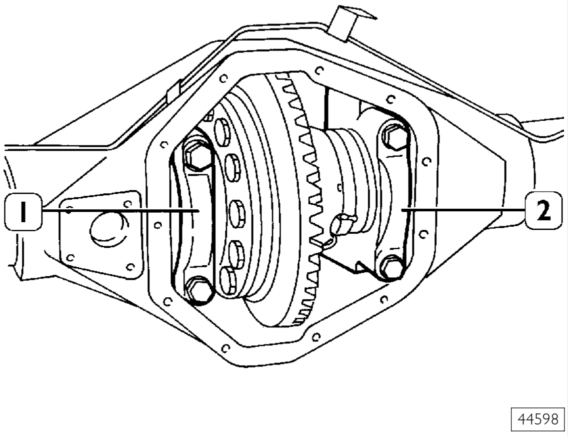
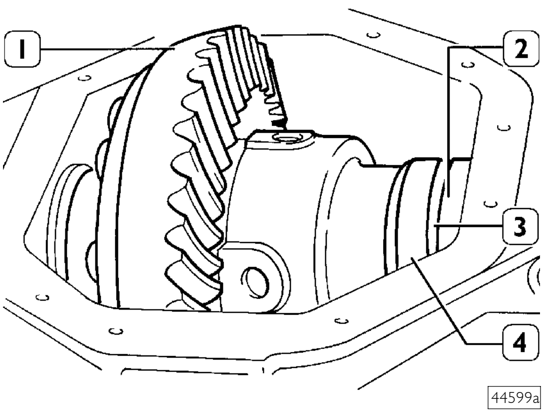
Figure 32



Mark the position of the caps (1 and 2) and remove them.

Figure 33



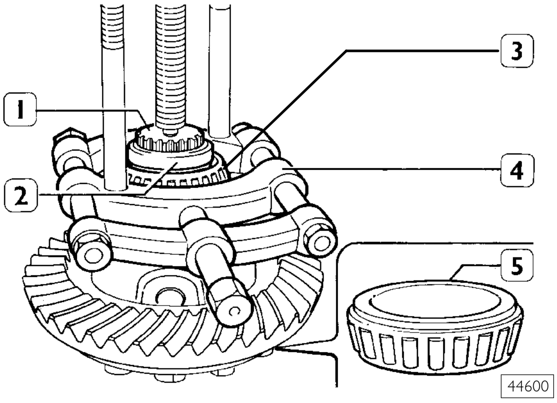
Take out the gear housing (1).

Note the assembly position of the adjustment rings (3) and take them out of the housing together with the spacer rings (2).

NOTE In the case of reuse, do not swap over the assembly positions of the external rings (4) of the tapered roller bearings.

Disassembly of gear housing

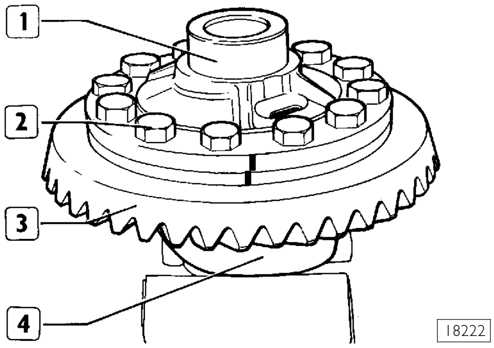
Figure 34



Extract the support bearing inner rings (3 and 5) and shoulder ring (2) from the gear housing and, by means of the puller tool 99348001 (4), extract the counter block (1).

NOTE The thrust ring (2) is only present with rear axles fitted with differential locking.

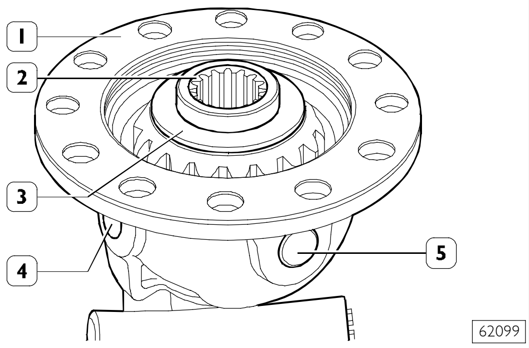
Figure 35



NOTE Mark the cover (1) and the gear housing (4).

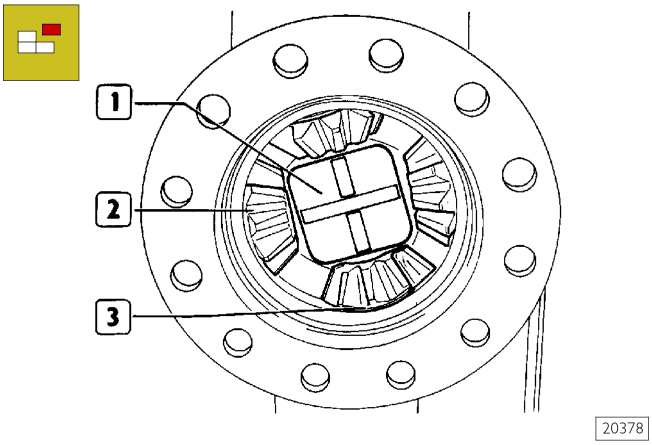
Unscrew the screws (2), remove the ring bevel gear (3) and the gear housing (4) cover (1).

Figure 36



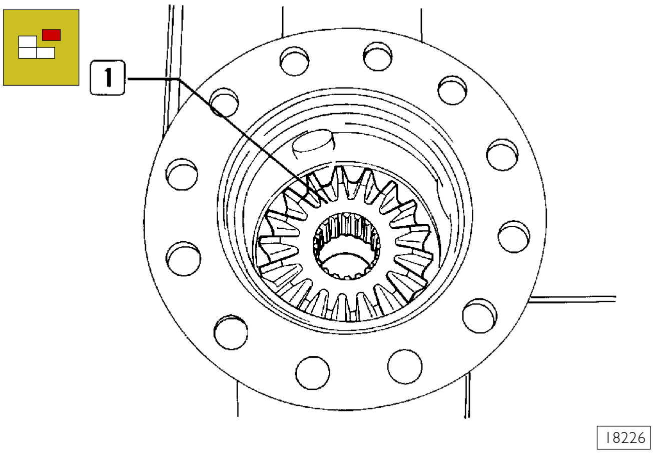
Remove the crown wheel (2) on the cover side with its thrust washer (3) from the gear housing (1).
Using a generic beater to remove the long pin (4) and the two short pins (5) from the gearing case (1).

Figure 37



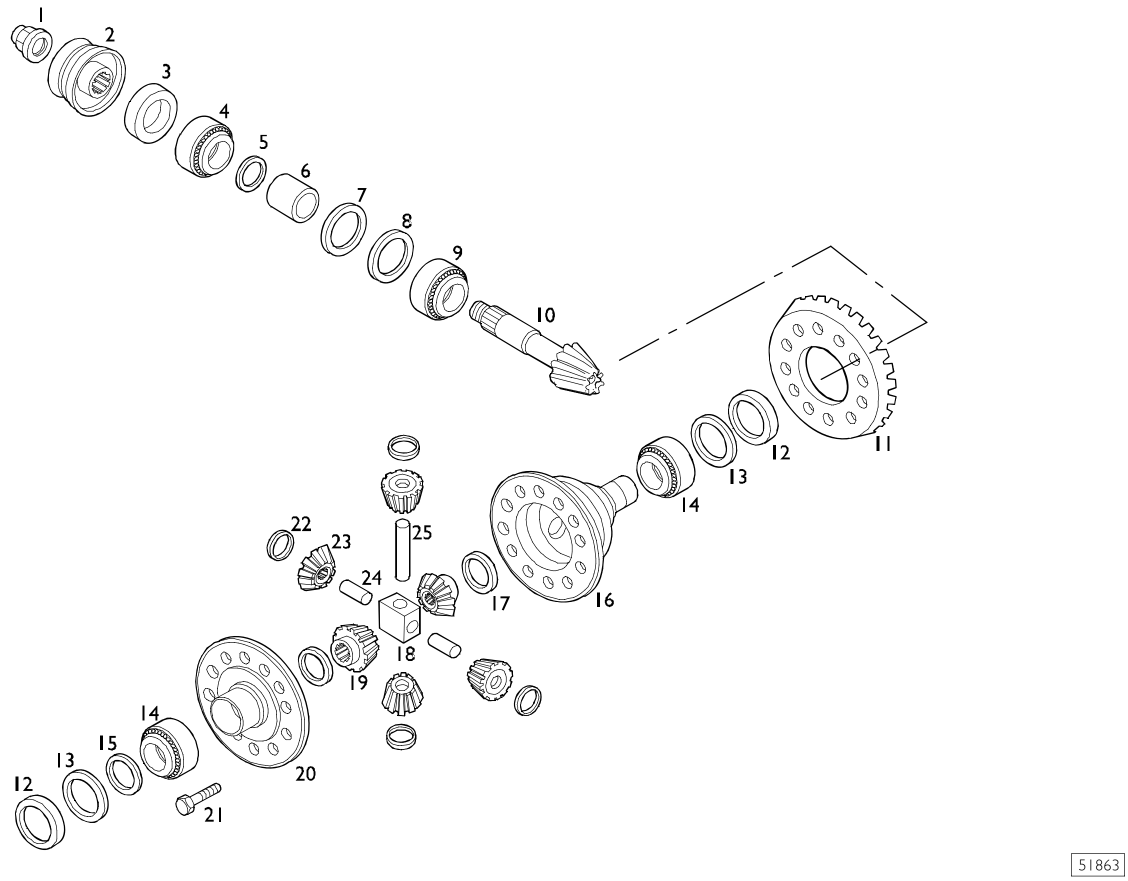
Remove the spider (1) and the four planetary gears (2) with their shoulder washers (3) from the gear housing.

Figure 38



Remove the crown wheel (1) on the gear housing side with the thrust washers.

Figure 39



PARTS COMPRISING THE DIFFERENTIAL UNIT

1. Nut - 2. Transmission connection coupling - 3. Seal - 4. Front bearing - 5. Pinion shim ring - 6. Fixed spacer - 7. Spacer ring - 8. Adjustment ring - 9. Rear bearing - 10. Bevel pinion - 11. Ring bevel gear - 12. Fixed ring - 13. Adjustment ring - 14. Bearing - 15. Thrust ring (axle with differential locking) - 16. Gear housing - 17. Crown wheel thrust washer - 18. Spider - 19. Crown wheel - 20. Gear housing cover - 21. Screw - 22. Planetary gear thrust washer - 23. Planetary gear - 24. Short pin - 25. Long pin.

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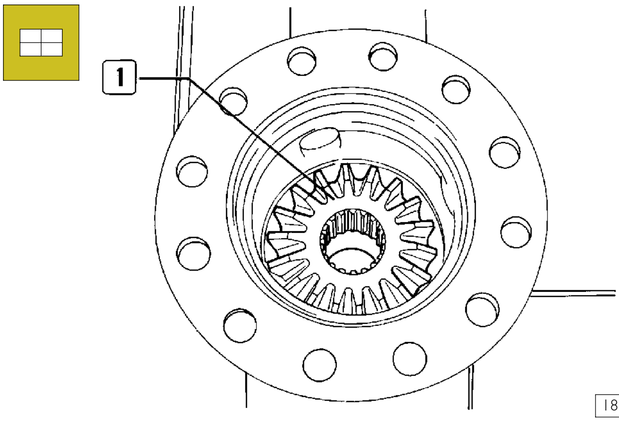
Assembly of gear housing

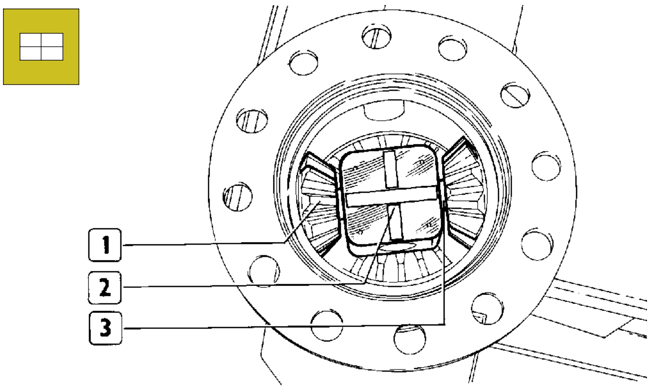
Figure 40



18226

Position the crown wheel (1), gear housing side, complete with thrust washer, into its own housing.

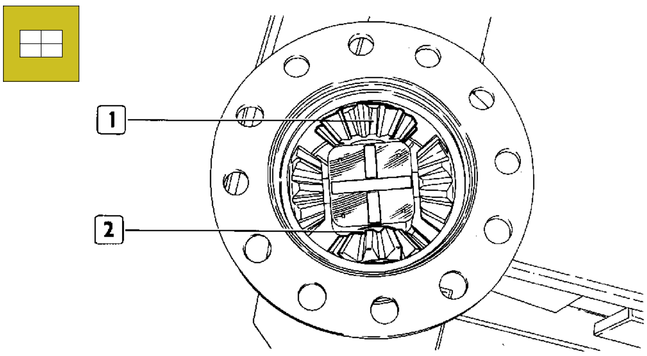
Figure 41



20379

Position the two planetary gears (1) complete with thrust washers, spider (2) and then insert the long pin (3).

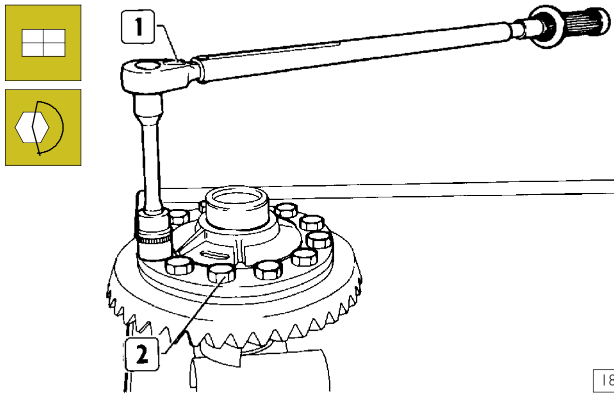
Figure 42



20380

Position the other two planetary gears (1) complete with thrust washers and then insert the two short pins (2).
Rotate the planetary gears-crown wheel unit and check that it is free without stiffness.
Assemble the other crown wheel complete with thrust washer.

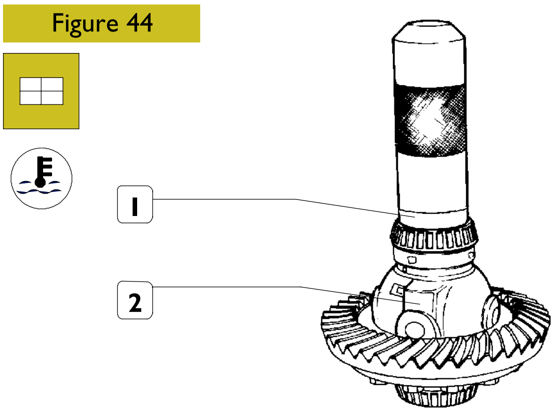
Figure 43



18237

Assemble the cover and make the marks made during disassembly coincide. Assemble the ring bevel gear and fasten this to the half-casing by means of the fixing screws.
By means of a torque wrench (1) tighten the fixing screws (2) to the required tightening torque.

Figure 44

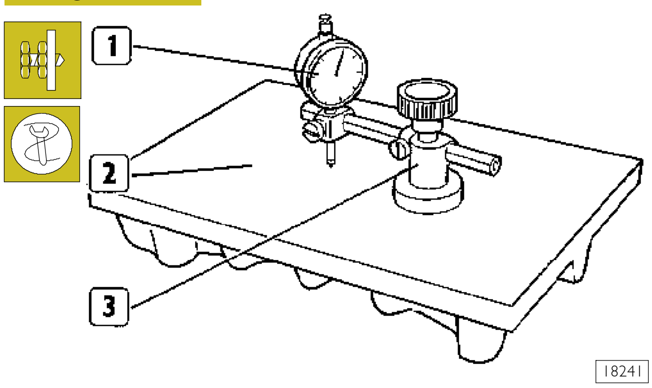


18240

Only for axles with differential lock.
Using tool 99305121, heat thrust ring (1) to a temperature of 120°C ÷ 150°C for 15' and fit on the gear casing (2) from the side with the differential lock.

Assembling bevel pinion unit

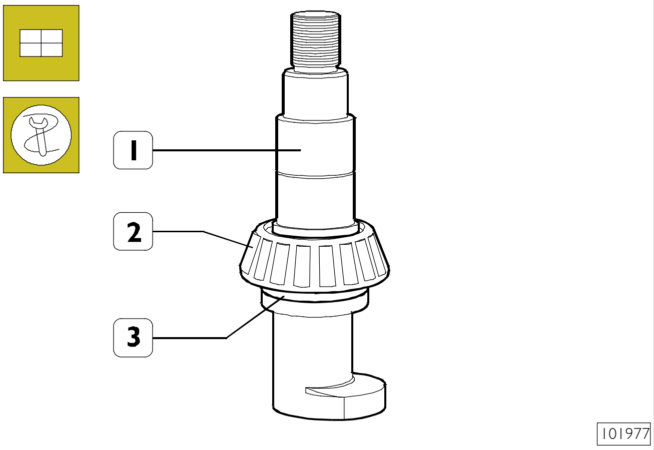
Figure 45



18241

On a surface plate (2) zero the dial gauge (1) placed on the support 99395728 (3) and lightly pre-load it.

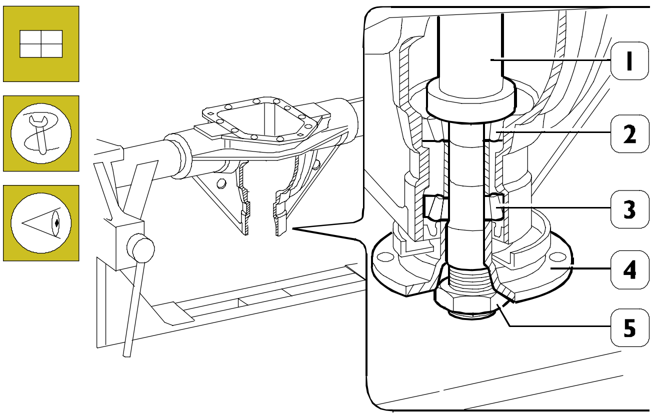
Figure 46



101977

Fit tapered-roller bearing internal ring (2) onto false pinion 99370309 (1) with the washer supplied (3).

Figure 47



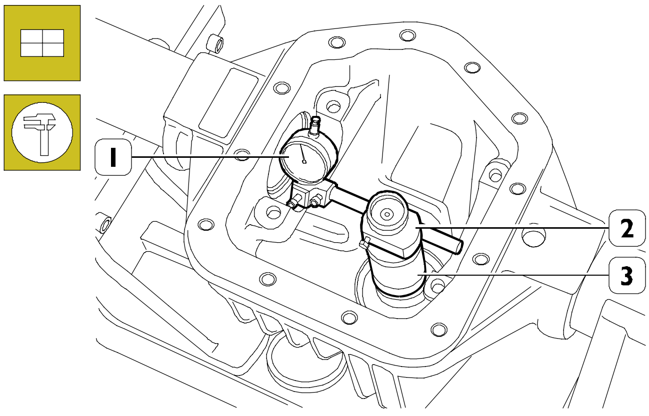
51839

Position the dummy pinion 99370309 (1), assembled as shown in Figure 46, on the external ring (2) of the tapered roller bearing.

On the opposite side, fit the taper bearing internal ring (3) on the dummy pinion (1) and the transmission shaft flange (4) .

Screw on the nut (5) so that the dummy pinion turns freely with no end float.

Figure 48



51840

Fit the mounting 99395728 (2) with the dial gauge (1) on the dummy pinion 99370309 (3).

Orientate the, previously zeroed, dial gauge so as to position the rod on the lowest portion of the seat of the bearing supporting the gear housing and note the difference **A1**.

Repeat the same operation on the seat of the other bearing and note the difference **A2**.

Thickness **S** to be added to adjusting ring thickness (4, Figure 50) used for measuring, for pinion positioning is obtained by the following formula:

$$\mathbf{S} = \frac{A1 + A2}{2} - (\pm\ B)$$

A1 indicates the value measured on the right-hand seat.

A2 indicates the value measured on the left-hand seat.

B indicates the value marked on the bevel pinion (see Figure 49).

For example:

$$\mathbf{S} = \frac{1,05 + 1,10}{2} - (-\ 0,05) = \frac{2,15}{2} + 0,05 = \mathbf{1,125}$$

The result of the formula must be added algebraically to the value of the adjusting ring used to make the measurements.
Example:
if the value of the adjusting ring used is 3.00 mm, replace with one measuring 4.125 mm (3.00 + 1.125).

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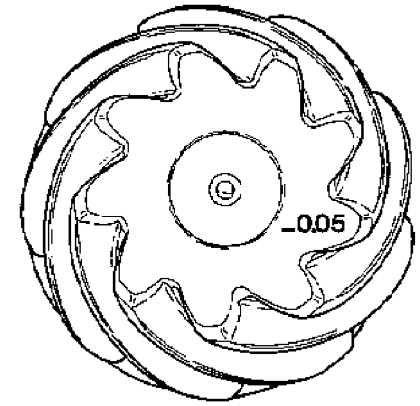
Figure 49

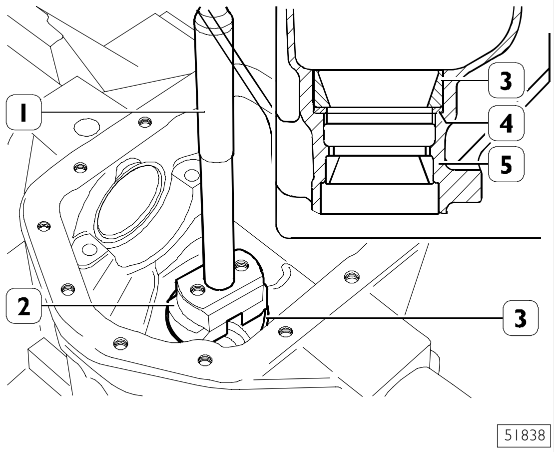


NOTE If the value marked on the pinion is preceded by a positive sign (+), it must be subtracted from the value of the sum divided by two for both seats, whereas it has to be added if it is preceded by a negative sign (-).

Unscrew the retaining nut, the transmission connection flange and remove it and the bearing from the dummy pinion.

Remove the dummy pinion with the mounting 99395728, dial gauge and rear bearing from the axle housing.

Figure 50

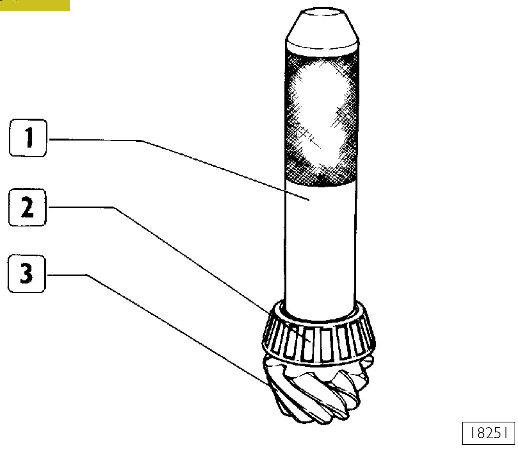


If required, replace adjusting ring (4) with a new one having the calculated thickness, after removing bearing outer ring (3) from rear axle casing (5) by beater.

Then fit the new adjusting ring (4) into rear axle casing (5).

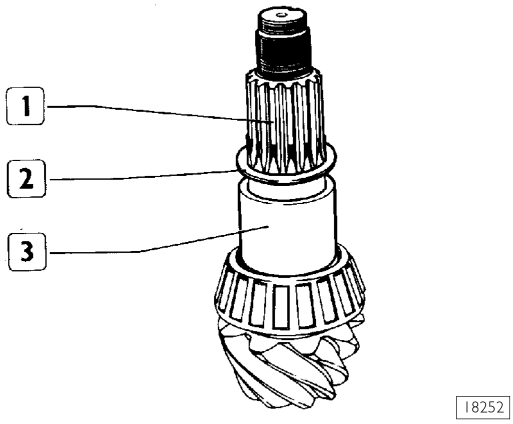
Using the punch 99374092 (2) and grip 99370007 (1), mount the external ring (3) of the tapered roller bearing.

Figure 51



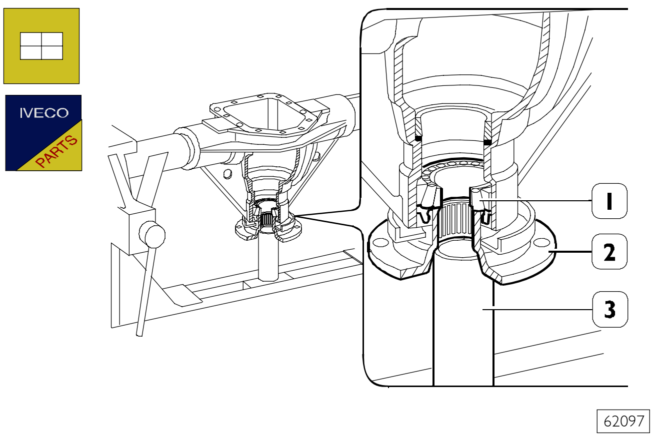
Using a suitable punch (1) and a hydraulic press, mount the internal ring (2) of the tapered roller bearing on the bevel pinion (3).

Figure 52



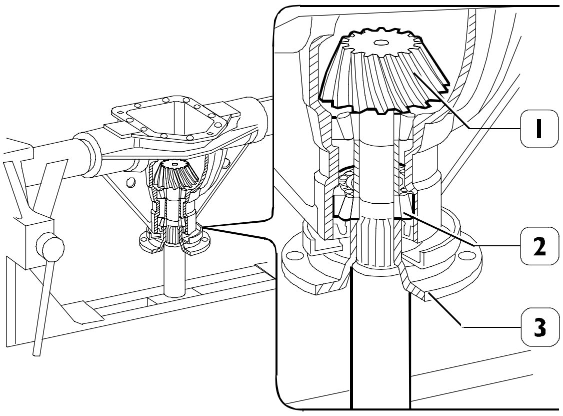
Position the fixed spacer (3) and the adjustment ring (2), used previously to obtain the required rolling torque, on the bevel pinion (1).

Figure 53



Position the axle casing as indicated in the figure.
Fit the taper bearing internal ring (1) and the transmission shaft flange (2).
Position a suitable pipe (3) on the stand so that the flange (2) and the taper bearing internal ring (1) are correctly supported.

Figure 54

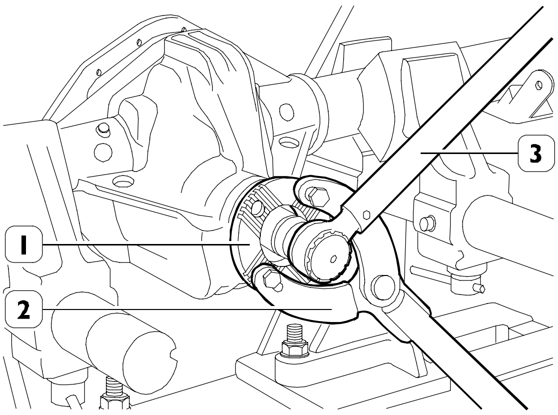


51845

Mount the bevel pinion (1) in the axle housing so as to enter the internal ring (2) of the tapered roller bearing.

Tap on the end of the pinion (1) so that the transmission shaft flange retaining nut (3) can be fitted.

Figure 55

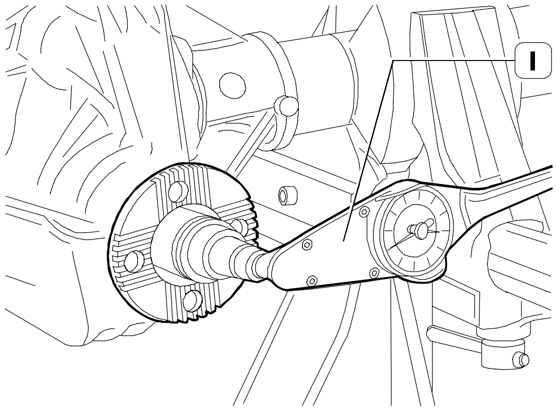


51846

Use tool 99370317 (2) to prevent the flange (1) from rotating.

Tighten the bevel pinion retainer nut to the required torque with a torque wrench (3).

Figure 56



74728

Using torque meter 99389819 (1), detect bevel pinion rolling torque.

NOTE The rolling torque must be measured at an ambient temperature of 25°C, making the pinion turn at a speed of 50 rpm after it has made 10 turns.

If the reading differs from the prescribed value, disassemble the pinion (1, Figure 54), replace the adjuster ring (2, Figure 52) with a ring of the correct thickness.

Refit the pinion and repeat the rolling torque check.

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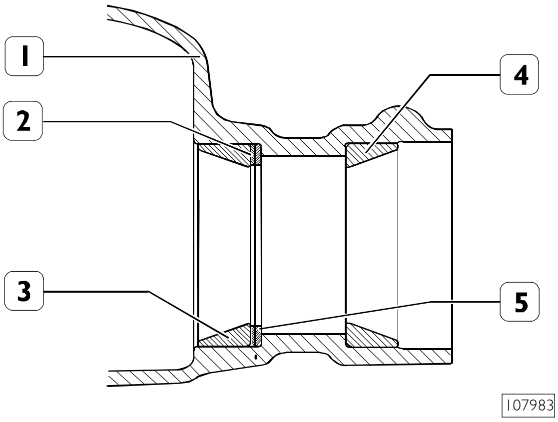
Differential unit refitting

Figure 57



Using a suitable punch, with a grip, drive the external ring (4) for the front bearing into the axle housing (1).

Position stop ring (5) with 2 mm thickness and drive outer ring (3) of rear bearing using a proper beater.

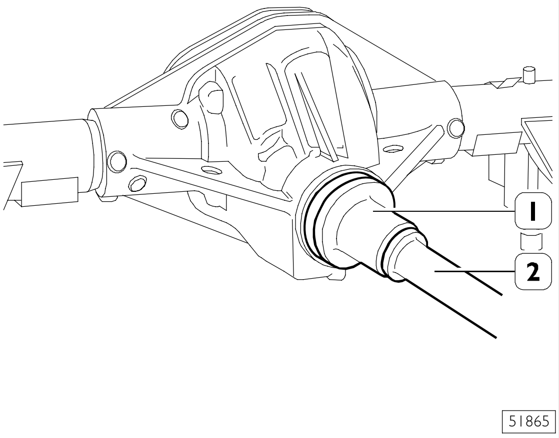
Determine bevel pinion position adjusting shim as described above.

Remove the external ring (3) of the tapered roller bearing.

Position adjusting ring (2) having the calculated thickness, on stop ring (5).

Refit the external ring (3) of the tapered roller bearing.

Figure 58



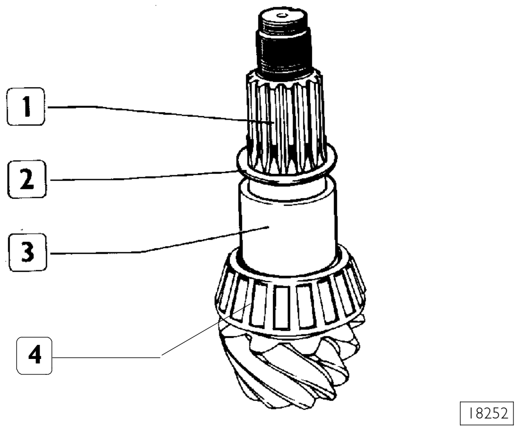
Lubricate the internal ring of the front bearing and position it in the housing.

Using the key 99374022 (1) and grip 99370006 (2), mount the pre-lubricated seal.

Determine bevel pinion rolling torque adjusting ring as described above.

NOTE The rolling torque of the bevel pinion must be measured with lubricated bearings and seals.

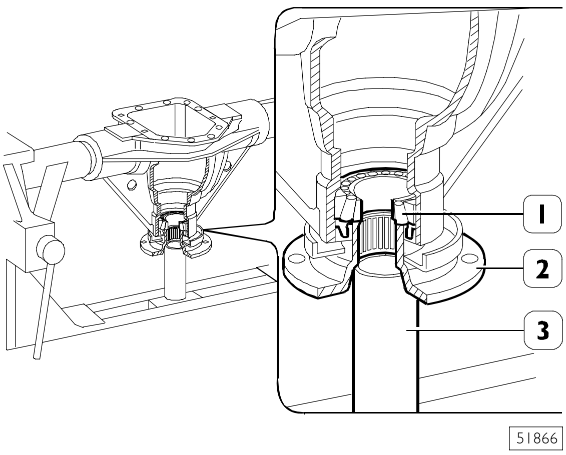
Figure 59



Heat the internal ring (4) of the tapered roller bearing to 80°C ÷ 90°C for approximately 15 min. and drive it, with a suitable punch, onto the bevel pinion (1).

Position the spacer ring (3) and adjustment ring (2), calculated beforehand to obtain the required rolling torque, on the bevel pinion (1).

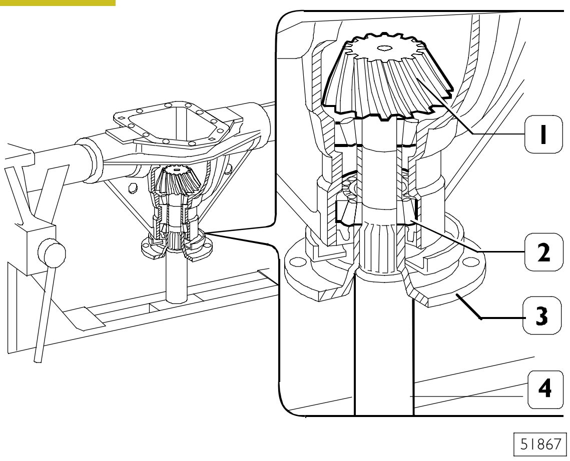
Figure 60



Position the axle housing as shown in the figure.

On the stand, set a pipe (3) of such diameter and length as to provide a solid supporting surface for the flange (2) and the internal ring (1) of the front bearing above, already mounted in the axle housing.

Figure 61



Insert the bevel pinion (1), assembled as shown in the figure, in the internal ring of the front bearing (2) and in the flange (3).

NOTE Strike the top of the bevel pinion until it is possible to fit the nut (1, Figure 62) securing the flange (3).

Take out the support pipe (4).

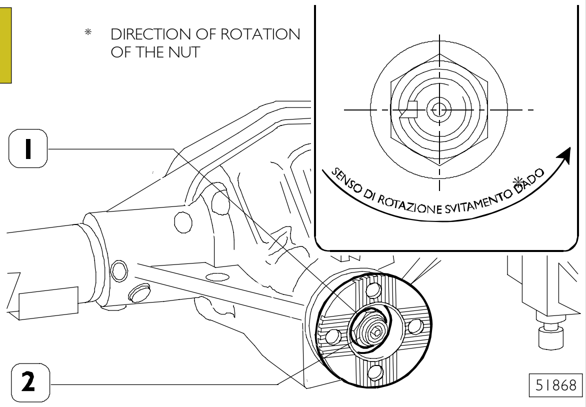
Complete assembling the pinion by fully tightening the nut.

Block rotation of the transmission flange with the retainer tool 99370317.

Using a suitable Allen wrench and the torque wrench, tighten the bevel pinion retainer nut (1, Figure 62) to the required torque.

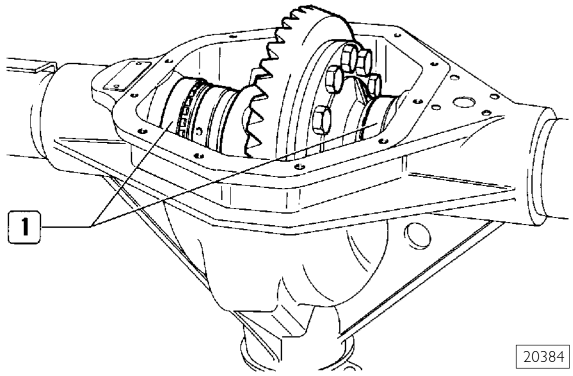
To be on the safe side, check the rolling torque of the bevel pinion with the dynamometer 99389819.

Figure 62



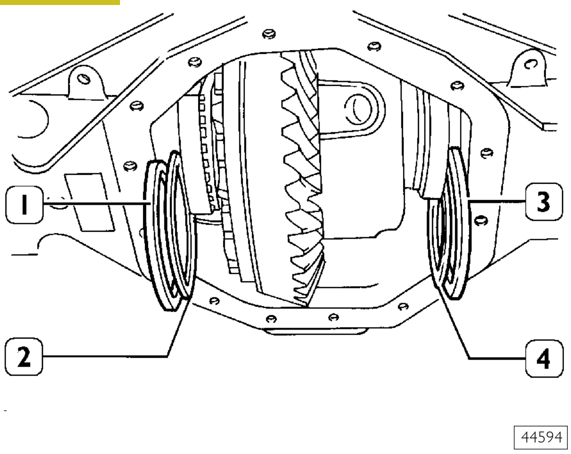
Make a cut in the collar of the nut (1) by the milling of the bevel pinion (2) as shown in the figure.

Figure 63



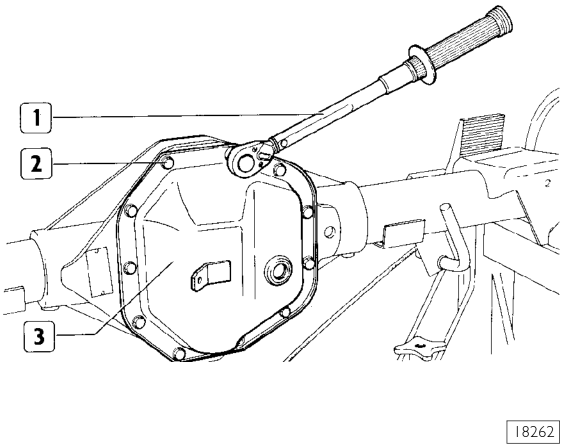
Position the sliding sleeve in the rear axle housing for differential locking (if present). Mount the external rings (1) for the gear housing support bearings and then position the previously mounted gear housing in the rear axle housing.

Figure 64



Mount the spacers and adjustment rings in the same number, thickness and position found during disassembly, in the following order: spacer (1), adjustment ring (2), adjustment ring (3) and spacer (4).

Figure 65



Complete mounting operation by checking total rolling torque and the clearance of ring gear and pinion coupling as described for NDA rear axles.

Position a new seal ring over the gear housing inspection attachment surface.

Mount the cover (3), insert the fixing screws (2) complete with tab washers and spring washers.

Tighten the screws (2) with the torque wrench (1) to the required tightening torque.

NOTE Do not tighten the screws to a torque greater than the value indicated since this would impair the sealing effect of the gasket placed between the coupling plane and the gear housing inspection cover.

Mount the differential locking device (if present) and adjust it as described under the relevant heading.

Mount the drive shafts as described under heading: “525030 Overhauling the Hubs”.

Screw on the oil drainage plug and tighten it to the required torque.

Add lubricating oil in the required quantity and grade through the hole.

Screw on the oil filler plug and tighten it to the required torque.

Take the assembly off the stand.

NOTE The assembly should be put back on its mounting to prevent the dust guards and/or brake discs from getting damaged.

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Rear axle 450517/2

DESCRIPTION

The rear axle is the load-bearing type with a single reduction using a hypoid crown wheel and pinion.

The axle housing is made of pressed sheet steel with hot pressed arms.

The central portion, seat of the differential unit, is equipped with cooling fins.

The bevel pinion is supported by two pre-lapped tapered roller bearings to hold the bearing pre-load better.

The rolling torque of the bearings of the bevel pinion is adjusted by changing the thickness of the adjustment ring between the two tapered roller bearings.

In addition, it is possible to adjust the position of the bevel pinion with respect to the ring bevel gear by changing the thickness of the ring between the axle housing and the bevel pinion rear bearing external ring.

The gear housing is supported by two tapered roller bearings.

The rolling torque of the bearings is adjusted with adjustment rings between the spacer rings and the external rings of the bearings.

The clearance between pinion and crown wheel is adjusted by changing the thickness and/or position of the adjustment rings, though the total thickness must be the same as that of the adjustment rings removed.

The gear housing is composed of two half-housings.

It may be of two different sizes depending on the ratio of the crown wheel and pinion.

The gearing of the differential is composed of four planetary gears and two crown wheels.

Wheel hubs are supported by two "SET RIGHT" type bearings set on the sleeve.

The bearings need no adjustment.

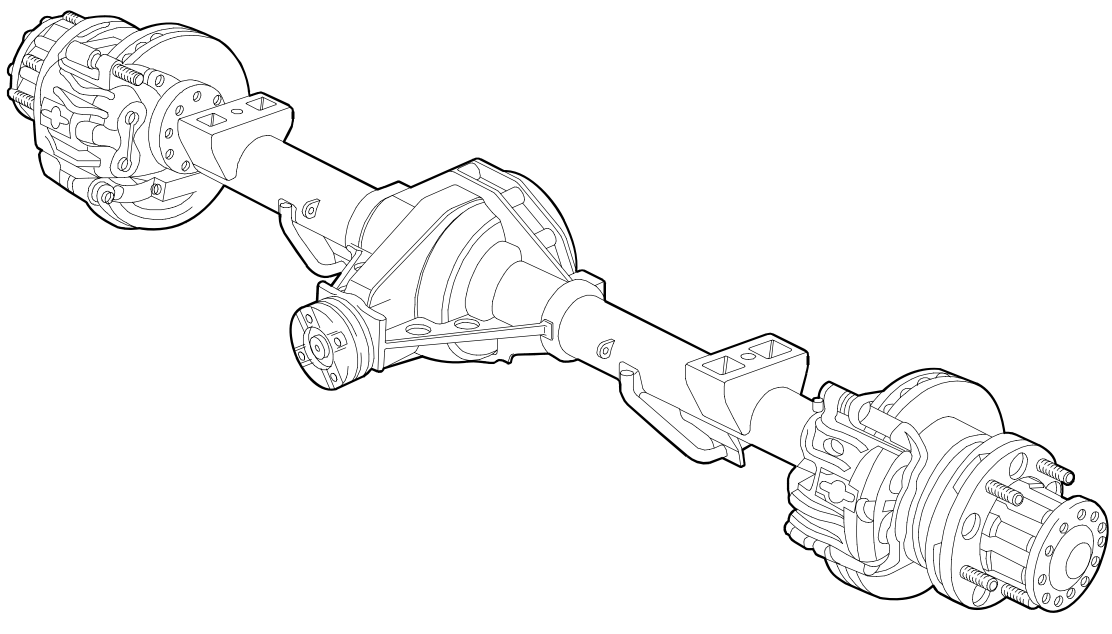
The brakes are disc brakes with floating brake calipers.

The disc brakes are keyed onto the wheel hubs.

Perrot type brake callipers are supported by flanges welded to rear axle casing arms.

The parking brake is the drum type, built into the brake disc.

Figure 1



62983

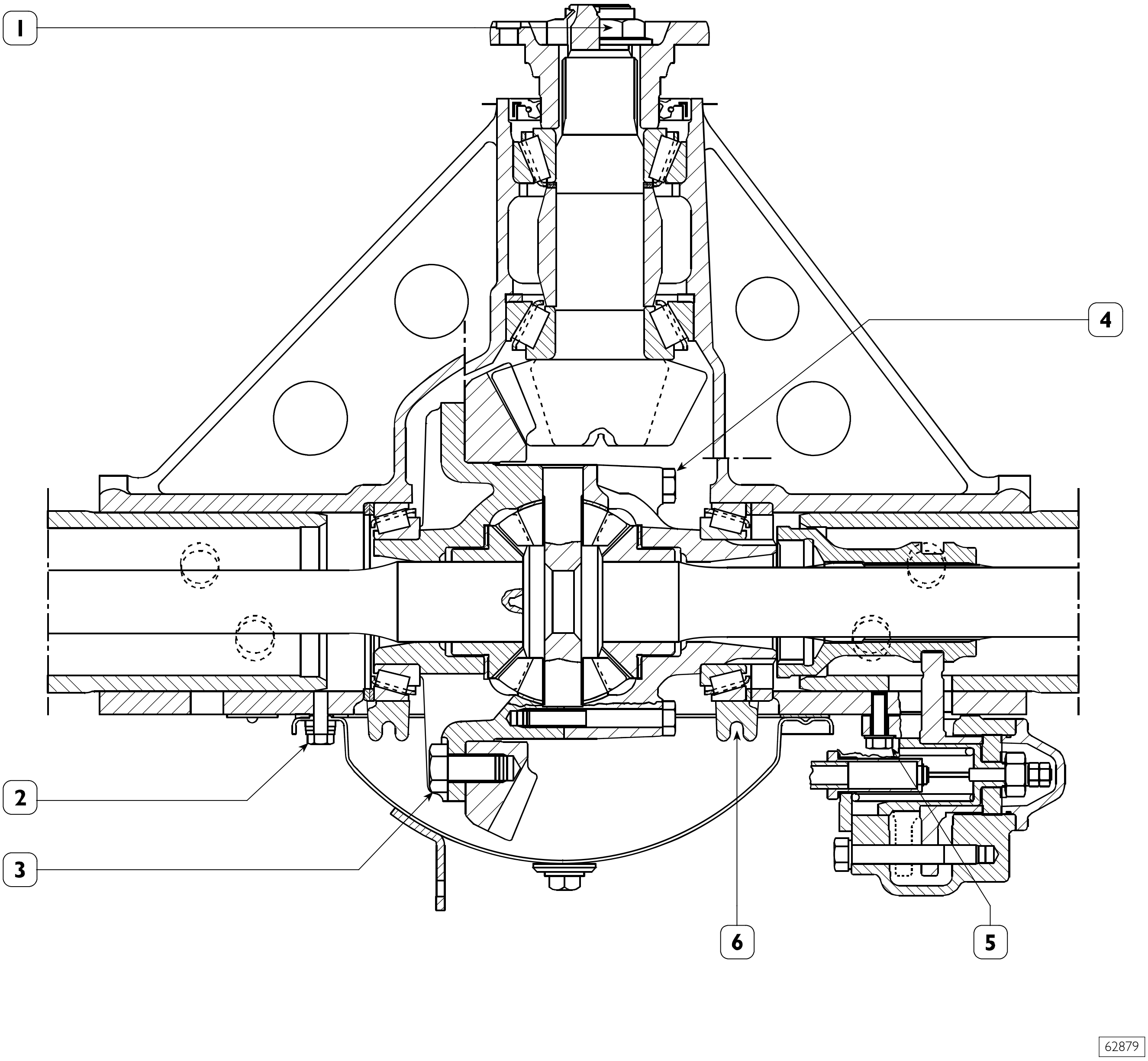
CHARACTERISTICS AND DATA

Type of rear axle: Bearing with single reduction and mechanical control differential locking	**450517/2**
DIFFERENTIAL UNIT Reduction bevel gear pair ratio (tooth no.: pinion/crown wheel), on request	1/3,91 (11/43) - 1/4,30 (10/43) - 1/4,56 (9/41) - 1/5,13 (8/41)
Bevel pinion bearings	2 with taper rollers
Bevel pinion bearing rolling torque (lubricated gaskets and bearings) Nm New bearings kgm	2 ÷ 3 0.20 ÷ 0.30
Bevel pinion bearing preload adjustment	through adjustment rings
Bevel pinion bearing preload adjustment ring thickness	1 - 2 mm with 0.025 mm progression
Temperature for fitting inner bearing ring on bevel pinion	80 °C ÷ 90 °C
Bevel pinion position with reference to differential casing	By means of shims
Thickness of adjustment rings between bevel pinion and differential casing	3.45 ÷ 4.35 mm with 0.025 mm progression
Bearings for gearing case	2 taper rollers
Differential case bearing rolling torque Nm kgm	2.6 ÷ 3.9 0.26 ÷ 0.39
Adjustment of differential case bearing rolling torque	Through adjustment rings
Thickness of adjustment rings for differential case bearing rolling torque	2.65 ÷ 3.20 mm with 0.05 mm progression
Backlash between pinion and crown wheel	0.15 ÷ 0.20 mm
Adjustment of backlash between pinion and crown wheel	Through adjustment rings

Type of rear axle:	**450517/2**
WHEEL HUBS	
Wheel hub bearings	Two "SET-RIGHT" type taper rollers
Hub bearing end play	0.16 max.
Wheel hub bearing rolling torque Nm kgm	0 ÷ 4 0 ÷ 0.4
Adjustment of wheel hub bearings end play	Fastening nut tightening to torque
Rear axle oil	**Tutela W140/M-DA** (SAE 85 W140)
Amount Litres	3
kg	2.7
Max. capacity GAW kg	5000

TIGHTENING TORQUES

Figure 2



450517/2 (R0537) REAR AXLE DIFFERENTIAL SECTION

PART		TORQUE Nm	TORQUE kgm
1	Bevel pinion retaining nut	533 ÷ 589	53.3 ÷ 58.9
2	Screw fastening gearing inspection cover to rear axle casing*	26 ÷ 21	2.6 ÷ 2.1
3	Screw fastening crown gear to 12RDAC5 half casing*	309,5 ÷ 342,5	30.9 ÷ 34.2
	Screw fastening crown gear to 10RDAC5 half casing	266 ÷ 294	26.6 ÷ 29.4
4	Screw fastening half casings	61 ÷ 74	6.1 ÷ 7.4
5	Screw fastening differential locking device or cover	23	2,3
6	Screw fastening caps to rear axle casing	102 ÷ 113	10.2 ÷ 11.3

* Before tightening the screws, smear their threaded holes with IVECO sealant 1905683.

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Figure 3

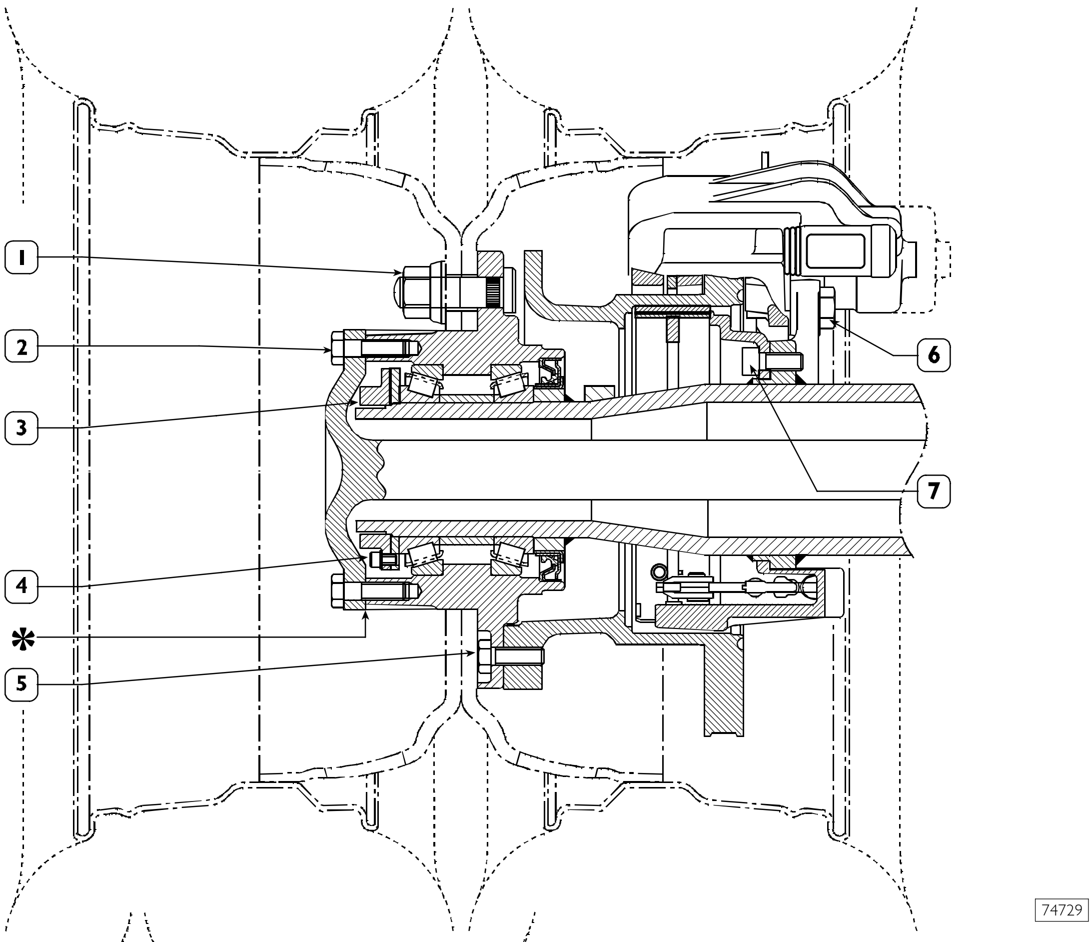
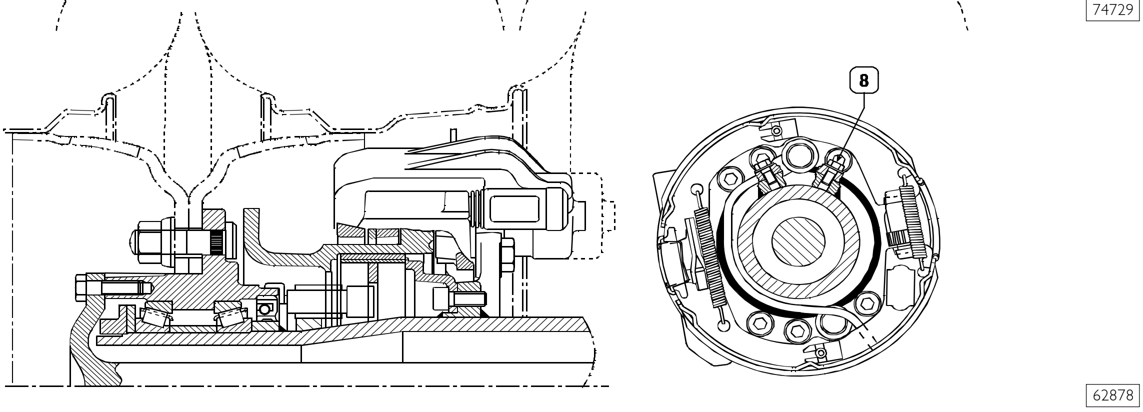


Figure 4

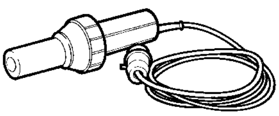
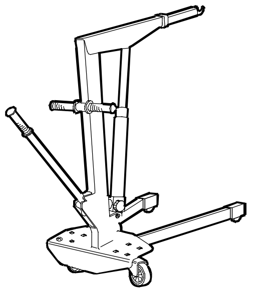
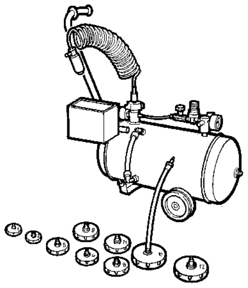
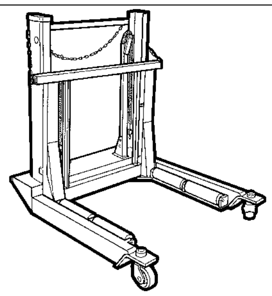
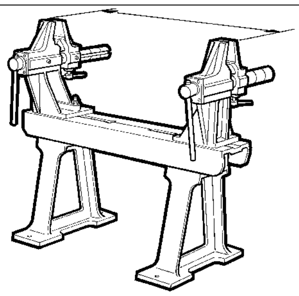
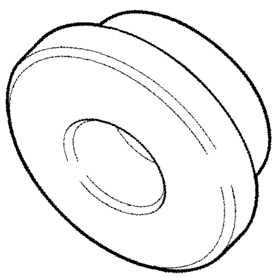


ABS VERSION

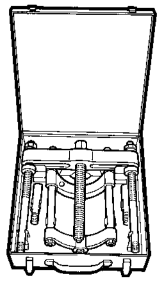
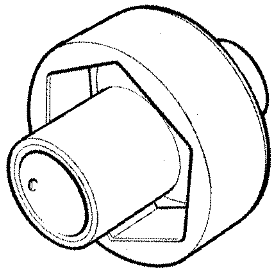
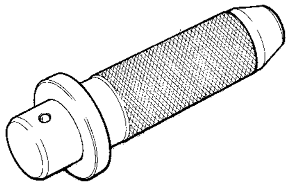
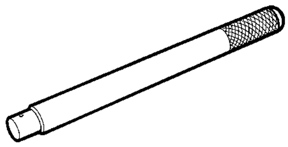
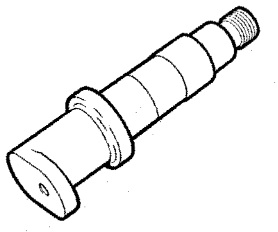
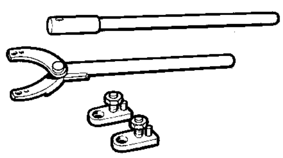
PART		TORQUE Nm	kgm
1	Wheel fastening nut	238.8 ÷ 342.6	23.8 ÷ 34.2
2**	Screw fastening axle shaft to wheel hub	56 ÷ 69	5.6 ÷ 6.9
3	Wheel hub bearing retaining ring nut	441 ÷ 540	44.1 ÷ 54
4	Safety screw	9.5 ÷ 11.5	0.9 ÷ 1.1
5	Screw fastening brake disc to wheel hub	54 ÷ 59	5.4 ÷ 5.9
6	Screw fastening brake calliper to rear axle	176 ÷ 194	17.9 ÷ 19.7
7	Screw fastening brake shoe support to rear axle casing	68 ÷ 75	6.9 ÷ 7.6
8***	Rpm sensor support fastening screw	5 ÷ 7	0.5 ÷ 0.7

* Apply IVECO 1905685 sealant on half shaft - wheel hub joint surface
** Apply IVECO 1905683 sealant on the threading of plugging screws
*** Apply LOCTITE 243 on the threading of holes

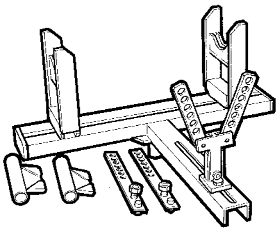
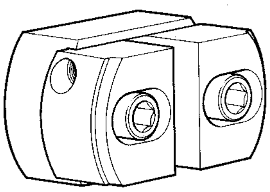
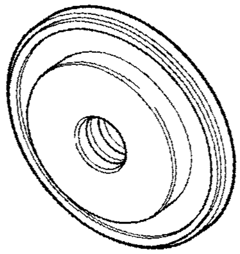
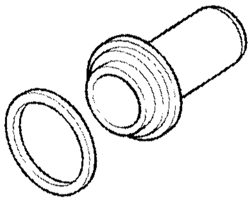
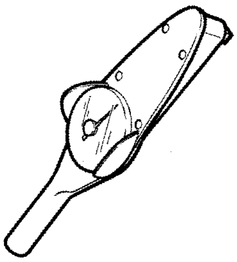
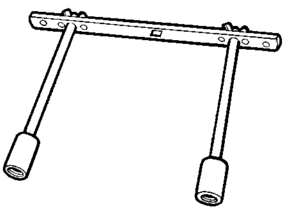
TOOLS

TOOL NO.		DESCRIPTION
99305121		Hot air operated equipment
99306004		300 kg hydraulic crane
99306010		Equipment for bleeding air from brake and clutch system
99321024		Hydraulic truck for removing - refitting wheels
99322215		Stand to overhaul axles
99345056		Counter block for pullers

TOOLS

TOOL NO.		DESCRIPTION
99348001		Puller with locking device
99357080		Wrench (91.5 mm) for wheel hub bearing adjustment nut
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370296		Tool to find bevel pinion shims (to be used with 99395728)
99370317		Counter lever and relevant extension to retain flanges

TOOLS

TOOL NO.		DESCRIPTION
99370617		Universal support to hold axles during removal/refitting
99374093		Beater to fit in place bearing outer races (91-134) (to be used with 99370007)
99374132		Element to fit in place wheel hub internal gasket (to be used with 99370006)
99374201		Element to fit in place differential bevel pinion gasket
99389819		Dynamometric wrench (0-10 Nm) connection 1/4"
99395026		Tool to check hub rolling torque (to be used with dynamometric wrench)

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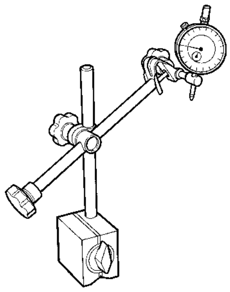
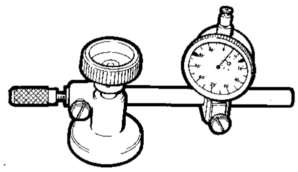
TOOLS

TOOL NO.		DESCRIPTION
99395684		Dial gauge with magnetic base
99395728		Dial gauge with support to be used with the tools for finding proper bevel pinion shims

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REAR AXLE REMOVAL - REFITTING

Removal

Position the vehicle on level ground and lock the front wheels.

Loosen rear wheel fastening nuts.

Lift the rear part of the vehicle and position it on proper stands.

Fit hydraulic truck 99321024 under the rear wheels, remove wheel fastening nuts and then remove wheels.

Loosen handbrake lever adjustment nut (4). Release cables (2) from vehicle cross member by releasing the retaining clips (5), and from the side member brackets by loosening clamp fastening screws (3).

Loosen propeller shaft fastening screws (6).

Release cables from clamps and disconnect the brake lining (1) and (7) wear indication electrical cables of ABS sensors, if any.

Loosen shock absorber (14) fastening nuts (16).

Loosen the screws (17) fastening the stabilizer bar (10) to the rear axle.

Disconnect brake oil pipes from connection (13) and secure them to the chassis to prevent oil draining from system.

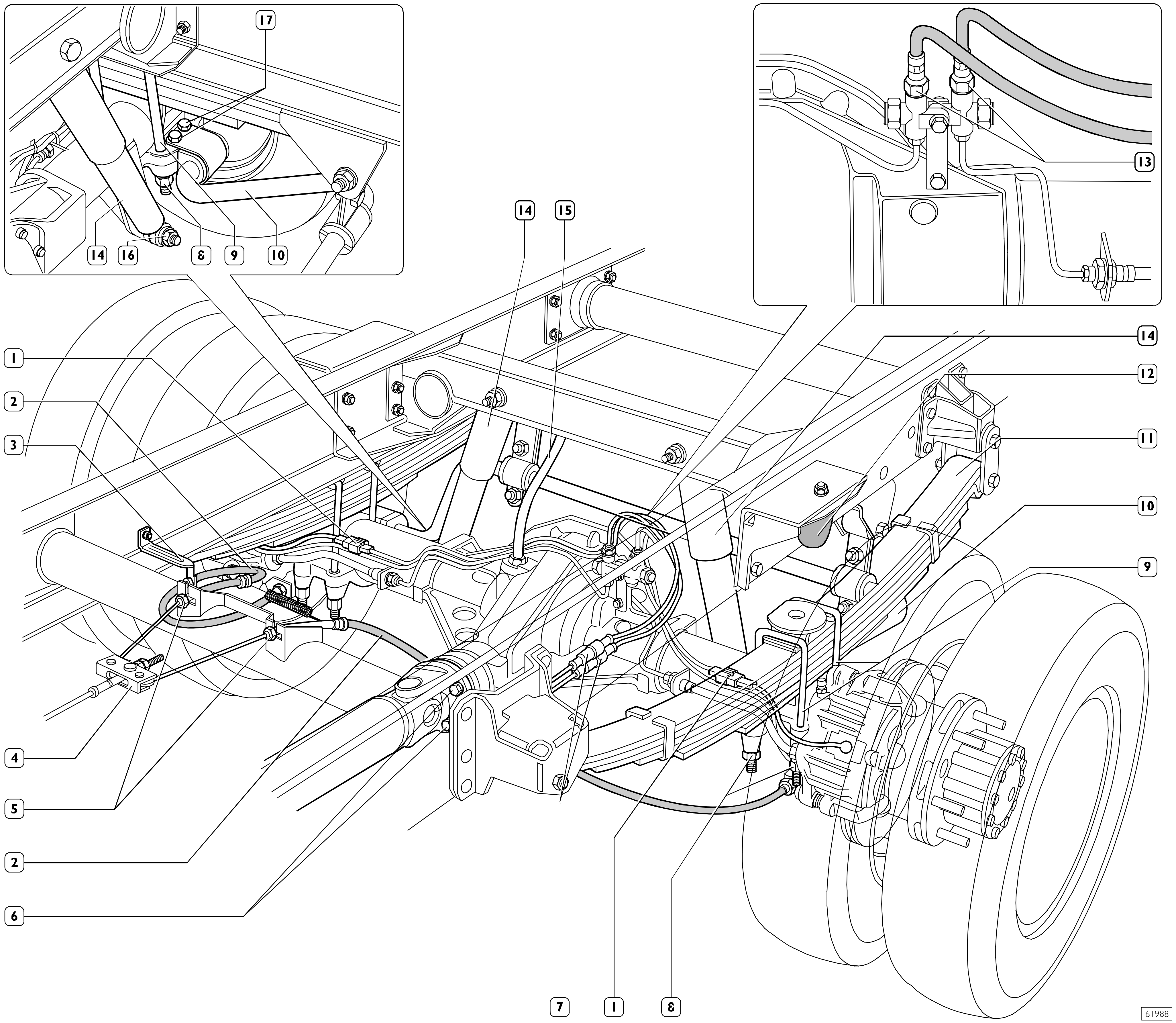
Disconnect pipe (15) from rear axle casing oil vapour bleed.

Position the hydraulic jack fitted with support 99370617 under the rear axle.

Loosen the nuts (8) of the brackets (9) fastening the rear axle to the leaf spring (10).

Lower the hydraulic jack and remove the rear axle.

Figure 5



Refitting

For refitting, carry out the operations described for removal in reverse order, observing the required tightening torques for the screws and/or nuts.

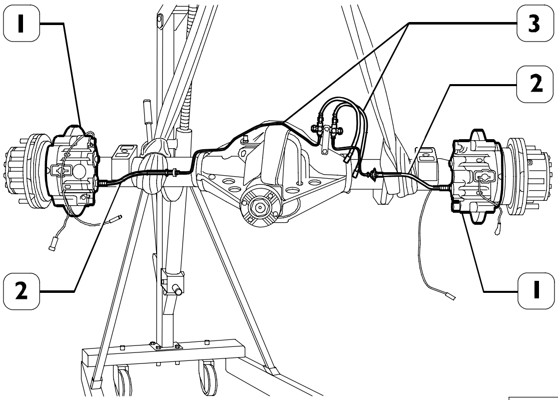
Afterwards, check that:

- ❑ Check the thread of the brackets joining the leaf springs to the axle. If there are any irregularities, rectify the thread (operation 500412) or replace the brackets.
- ❑ Bleed the air from the brake hydraulic system as described under the relevant heading (operation 784010).
- ❑ Adjust the handbrake control ties as described under the relevant heading (operation 502710).
- ❑ Lock the nuts or screws to the required tightening torque.
- ❑ The self-locking nuts must not be reused.
- ❑ Check the state of the flexible pads (12) and replace them if they have deteriorated (operation 500417).
- ❑ The lubricating oil in the axle housing should be at the right level.

525010 OVERHAUL OF REAR AXLE

The drive shafts, brake disc and calipers, air breather and differential can all be removed and refitted even with the unit mounted on the vehicle.

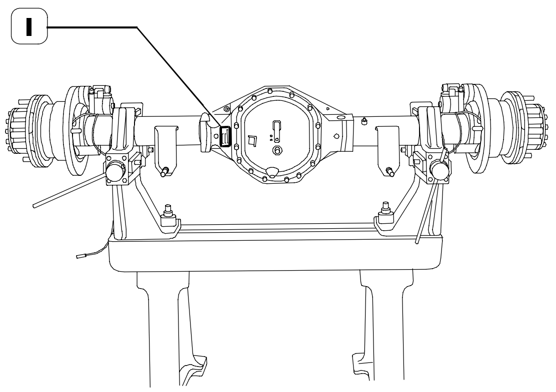
Figure 6



62880

Before positioning the rear axle assembly on the stand for overhauling, drain oil by loosening rear axle casing plug. Disconnect brake fluid pipes (2) from brake callipers (1) and from rear axle casing and pipes (3) from rear axle casing.

Figure 7



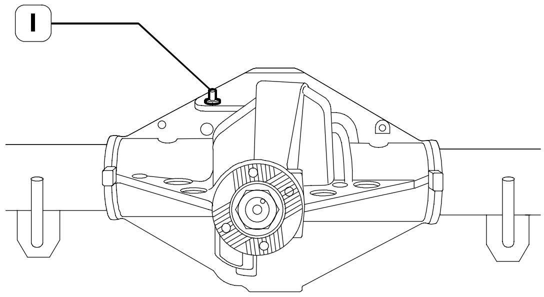
62881

Set the entire rear axle assembly on stand 99322215.

NOTE The identification data of the rear axle unit are given on the plate (1) fixed near to the leaf spring attachment support.

525013 Air breather disassembly - assembly

Figure 8

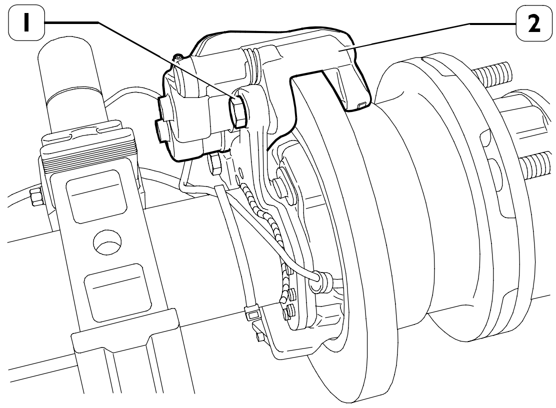


62882

Take out the screws (1) and remove the brake caliper with its brake linings from the mounting.

525030 Overhaul of wheel hubs Disassembly

Figure 9



62883

Take out the screws (1) and remove the brake caliper (2) with its brake linings from the mounting.

The caliper must not be violently knocked or dropped.

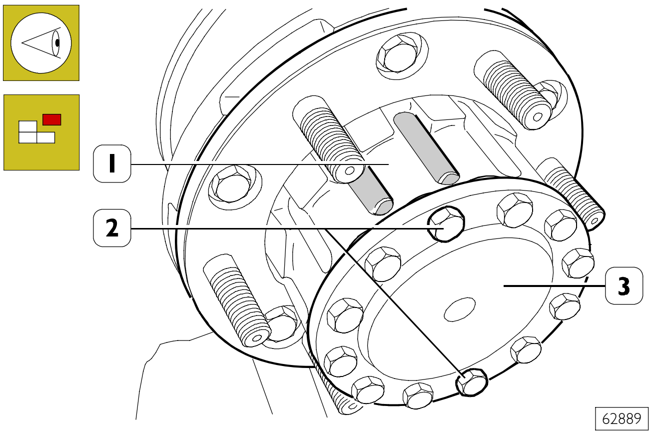
Prevent the rubber caps coming into contact with sharp metal tools.

Do not dirty or wet the rubber caps with mineral grease or oil.

Do not dirty the pads with liquids or grease.

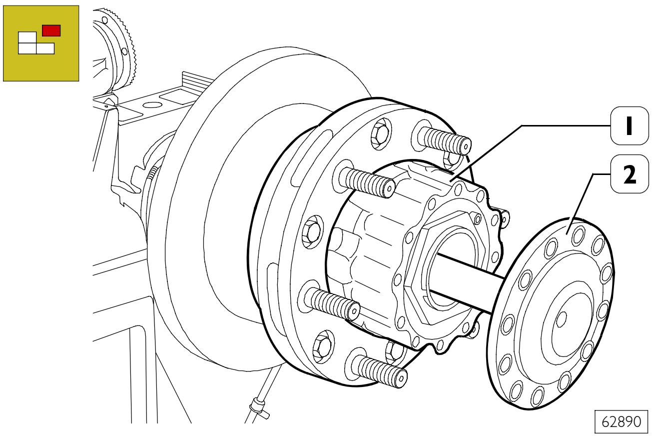
Check proper brake calliper and brake lining conditions as described in "Brake" section.

Figure 10



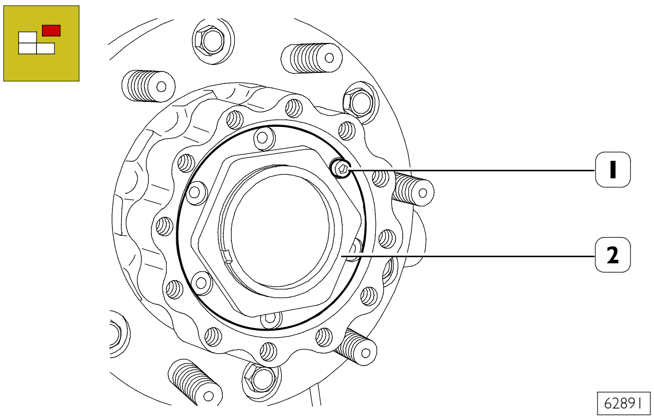
Rotate the wheel hub (1) to set downward one of the two screws (2) located between hub reliefs; remove the screws and drain oil completely from wheel side. Remove the other screws fastening the axle shaft (3) to the wheel hub (1).

Figure 11



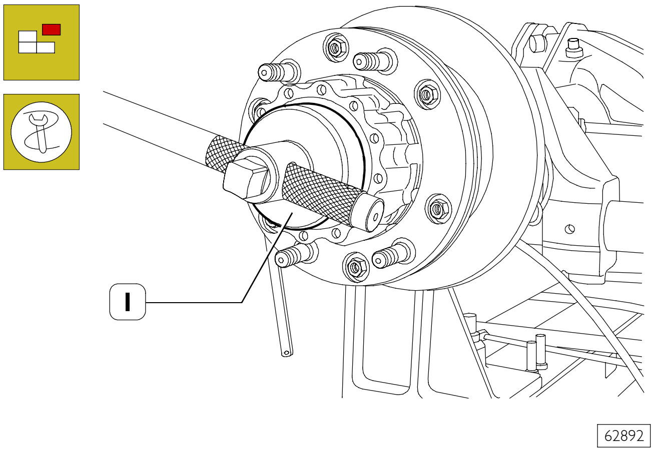
Remove the axle shaft (2) from the wheel hub (1).

Figure 12



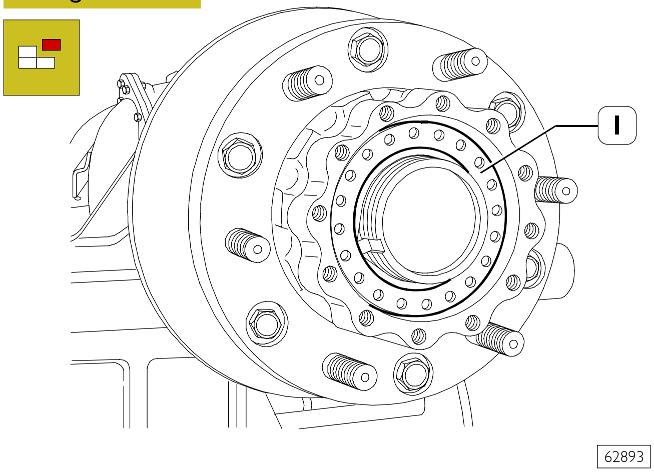
Remove ring nut (1) safety screw (2).

Figure 13



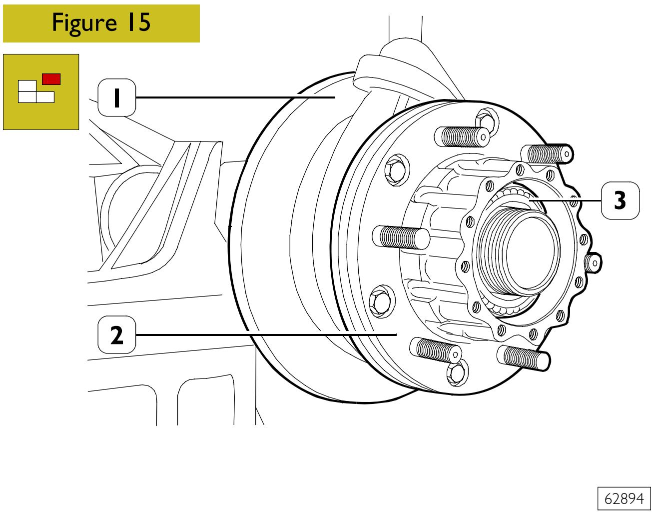
Loosen bearing retaining ring nut (2, Figure 12) using wrench 99357080 (1).

Figure 14



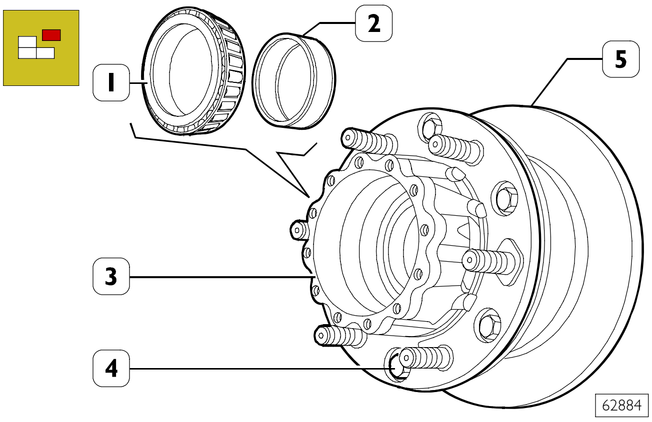
Remove the safety washer (1).

Figure 15



Sling brake disk (1) with rope and hoist, take off wheel hub (2) complete with brake disk (1), front (3) and rear bearings, seal ring and spacer.

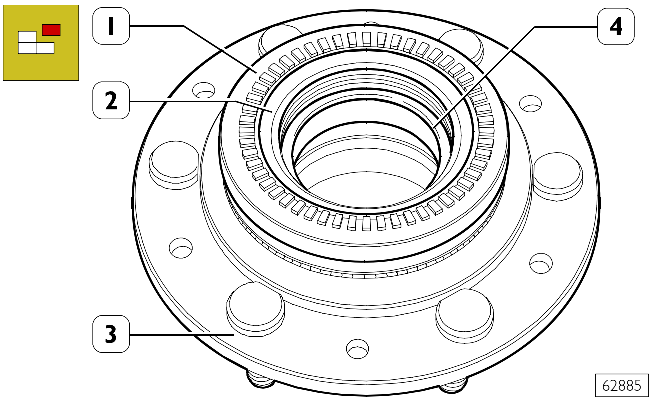
Figure 16



Remove front bearing (1) inner ring and spacer (2).
Remove screws (4) and disconnect the brake disc (5) from the wheel hub (3).

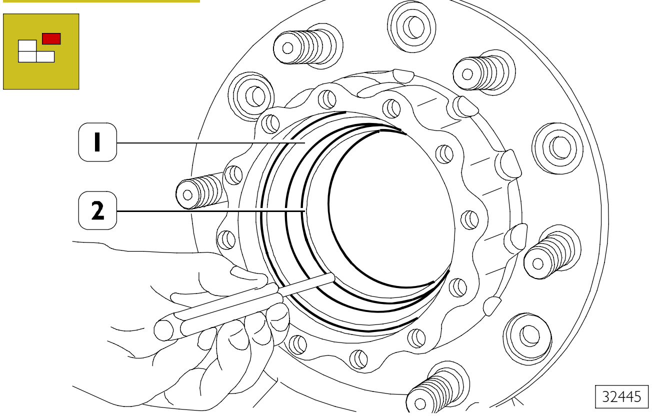
NOTE Check the brake disc as described in the "Brake" section.

Figure 17



Remove phonic wheel (1), if any, using suitable equipment.
Remove sealing ring (2) and the rear bearing inner ring (4) set below from the wheel hub (3).

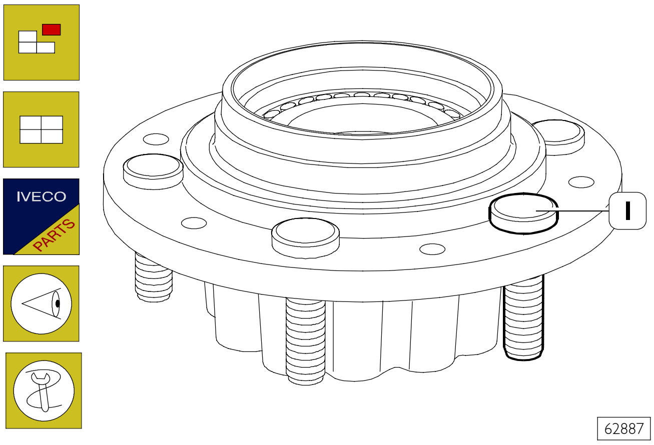
Figure 18



Use a suitable punch to remove the rear taper roller bearing outer ring (1). Repeat this operation to remove the front taper roller bearing outer ring.

Stud replacement

Figure 19

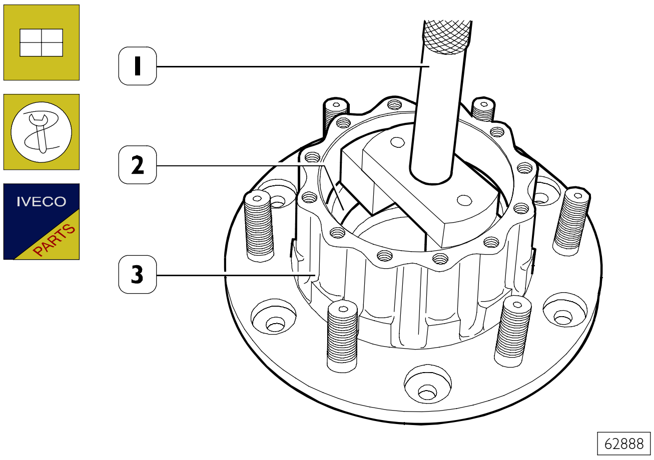


Where the studs of wheel hub (1) must be replaced, before mounting the new studs, make sure that studs head rest plane is free from slag, burr and blisters.

The pins should be driven in by applying a load on their head no greater than 2000 kg.

After driving them home, check that the pins are perfectly in touch with the hub: maximum orthogonal tolerance 0.2 mm.

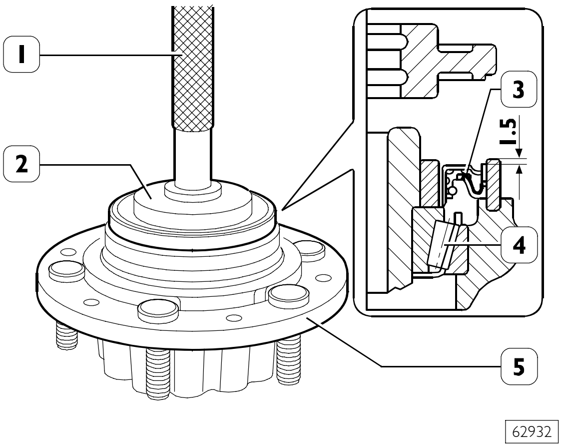
Figure 20



Use handle 99370007 (1) and beater 99374093 (2) to fit taper roller bearing outer rings into the wheel hub.

NOTE This operation shall be performed using a press until positioning the rings at 5 mm from their abutting end, their fitting shall be then completed by hand.

Figure 21



Lubricate rear taper roller bearing inner ring (4) with SAE W 140 M-DA oil and fit it to wheel hub (5).
Use tool 99374132 (2) provided with proper handle 99370006 (1) to fit sealing ring (3).

NOTE Use tool 99374132 (2) side to position the sealing ring (3) at 1.5 mm from wheel hub side surface.

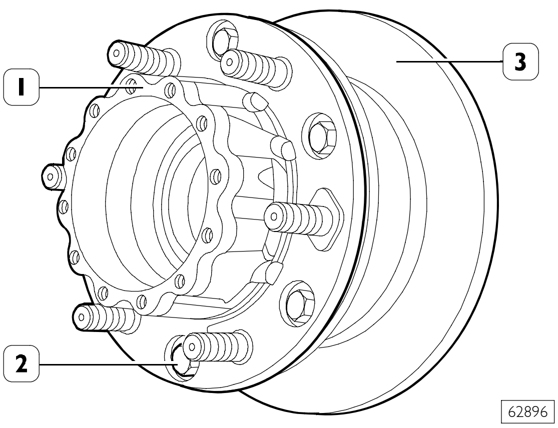
Fit the phonic wheel, if any, on the wheel hub.

NOTE Phonic wheel fitting shall be performed after heating it at 150°C.

When fitting is over, check whether the phonic wheel is resting perfectly on the hub seat.

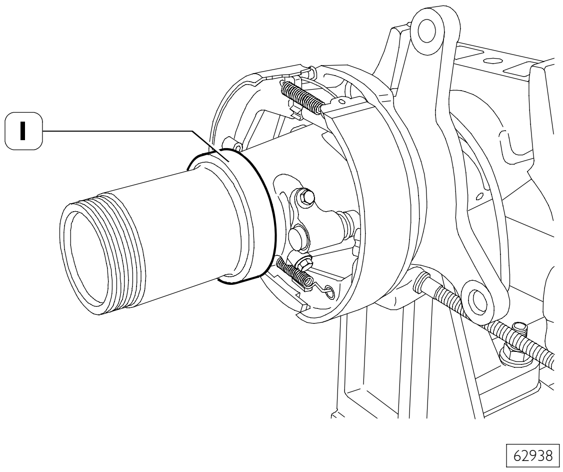
Check whether phonic wheel squareness and oscillation is lower than 0.2 mm.

Figure 22



Fit the brake disc (3) on the wheel hub (1) and tighten the fastening screws (2) to the specified torque.

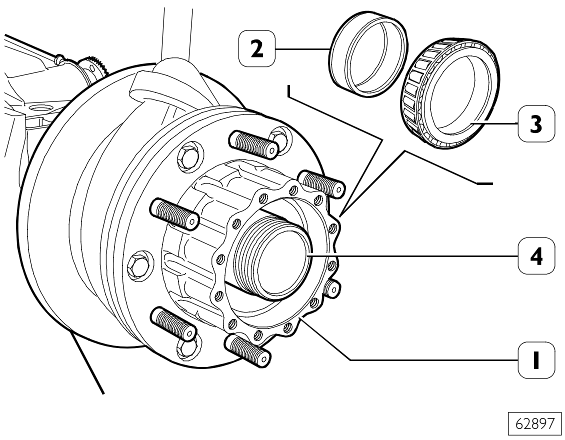
Figure 23



NOTE Check and, if necessary, adjust the clearance between the parking brake drum and shoes as described in the Brakes section.

Lubricate the sleeve and the sealing ring supporting ring (1) with TUTELA W140/M-DA (SAE 85W140) oil.

Figure 24



Use suitable rope and hoist to fit wheel hub (1) on sleeve (4). Lubricate spacer (2) and outer bearing inner ring (3) with Tutela W140/M-DA and fit them on sleeve (4).

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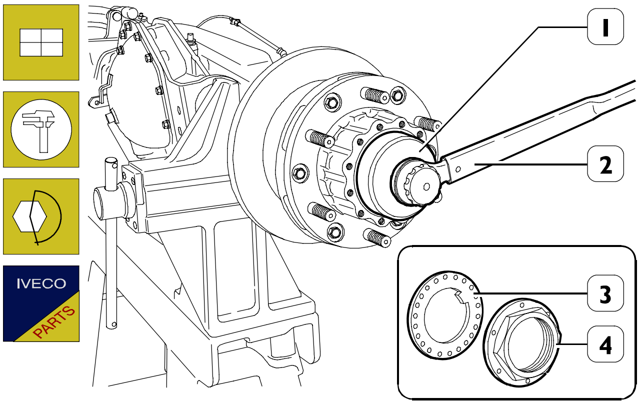
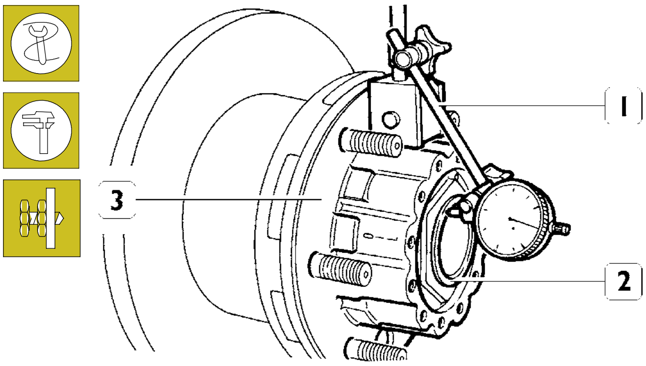
Figure 25



62898

Fit the safety washer (3) so that the clip is guided properly into rear axle casing sleeve groove.
Tighten ring nut (4) with wrench 99357080 (1) and dynamometric wrench (2), tighten the new ring nut (4) to the specified torque.

Figure 26

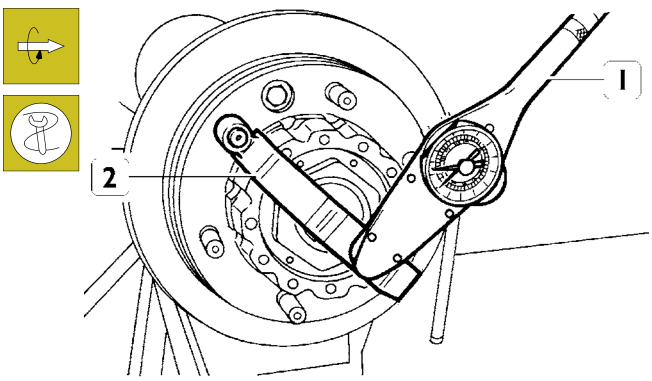


62899

Position the dial gauge 99395684 (1) with a magnetic base on the wheel hub (3) and rest the rod on the sleeve (2).

Check whether wheel hub end play is falling between 0 and 0.16 mm.

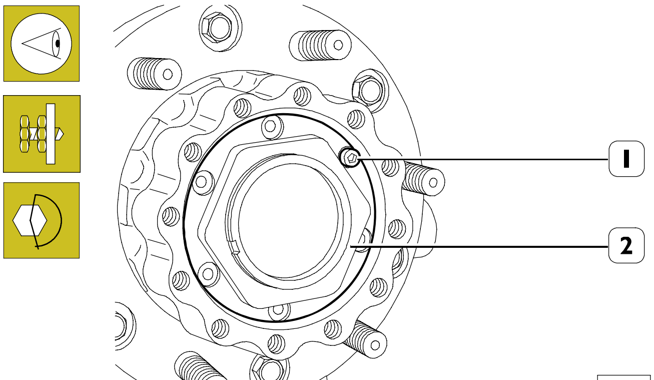
Figure 27



62900

Use tool 99395026 (2) and the dynamometric wrench 99389819 (1) to check whether the wheel hub rolling torque is falling between 0 and 4 Nm (0 - 0.4 kgm).

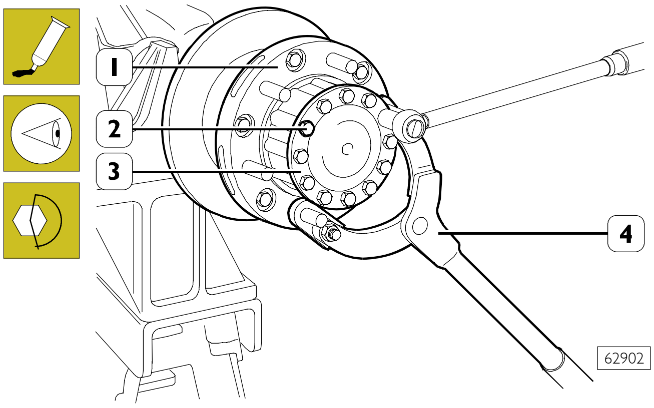
Figure 28



62891

After checking the end play and the rolling torque, check whether one of the adjustment nut (1) holes is coinciding with one of the safety washer holes otherwise loosen the adjustment nut (1) until it is possible to fit the fastening screw (2). Tighten the fastening screw (2) and the adjustment nut to the specified torque.

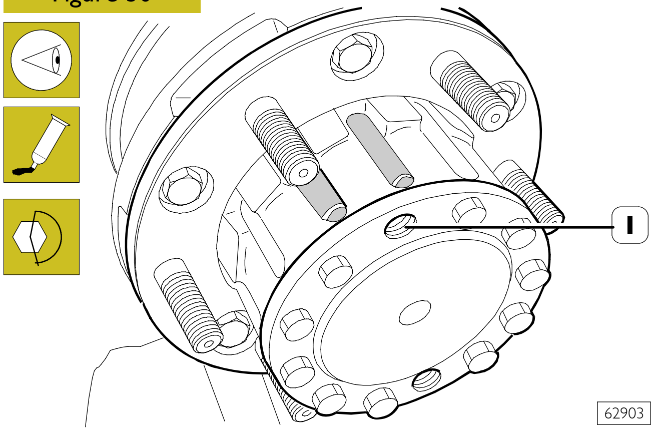
Figure 29



62902

Smear the contact surface between axle shaft (3) and wheel hub (1) with IVECO sealing compound 1905685.
Fit axle shaft (3), tighten the fastening screws (2), excluding those set between the two wheel hub marks (see Figure 30) with tool 99370317 (4) lock wheel hub (1) rotation.

Figure 30

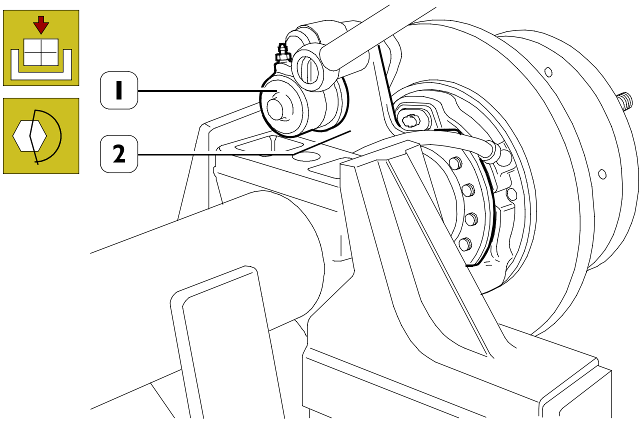


62903

Set horizontally to ground the two holes (1) located between the wheel hub marks and pour through 0.2 l of W140 M-DA oil on each wheel side.

Smear the threaded section of the screws acting as plug with IVECO sealant 1905683 and tighten to the specified torque.

Figure 31

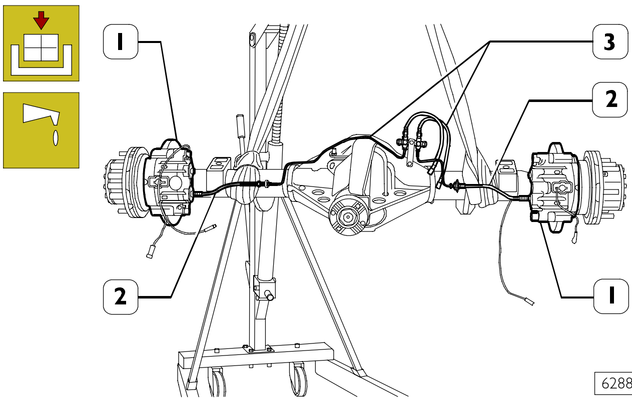


62904

Position brake calliper (1) including the brake lining on the supporting flange (2).
Tighten the fastening screws to the specified torque.

NOTE The brake lining with the wear sensor shall be fitted on brake calliper piston side.
Comply with BRAKE section requirements to move back the brake calliper piston.

Figure 32



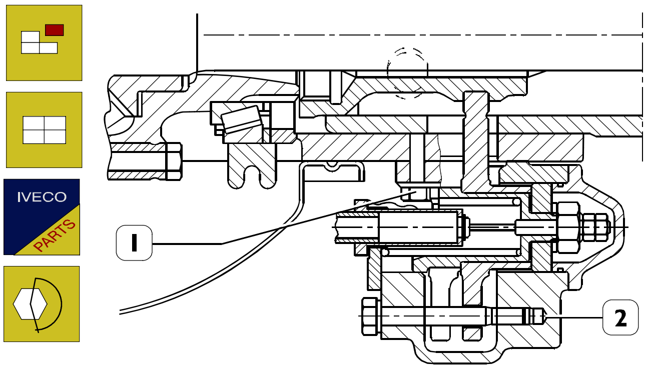
62880

Remove the rear axle assembly from the overhaul stand. Refit brake fluid pipes (2 and 3) to rear axle casing and brake callipers (1).
Fill rear axle casing with oil in the specified amount and quality.

526210 DIFFERENTIAL REPAIR OPERATIONS

526260 Differential locking

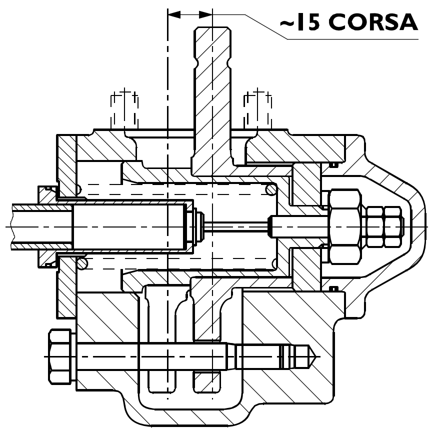
Figure 33



62906

Remove the 4 screws (1) including washers and disconnect the differential locking device (2).
When refitting, replace the gasket located between differential locking device and rear axle casing.
Tighten screws (1) to the specified torque.

Figure 34



62907

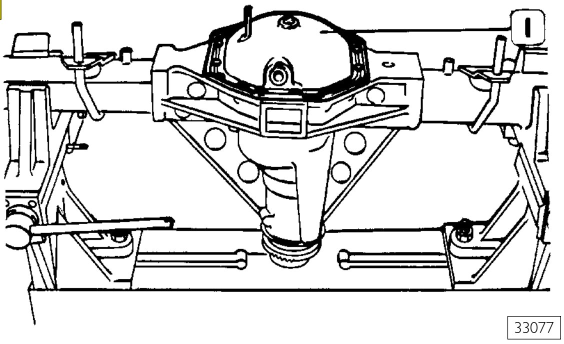
DIFFERENTIAL LOCKING DEVICE SECTION

Differential locking device engagement/disengagement lever stroke shall be equal to 5 mm.

Differential unit removal

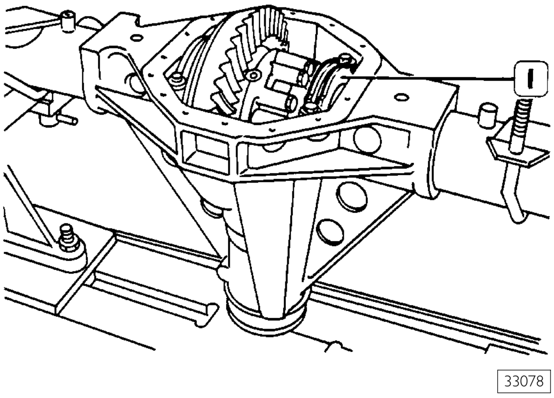
NOTE Before performing differential repair, drain oil and remove axle shafts as described previously.

Figure 35



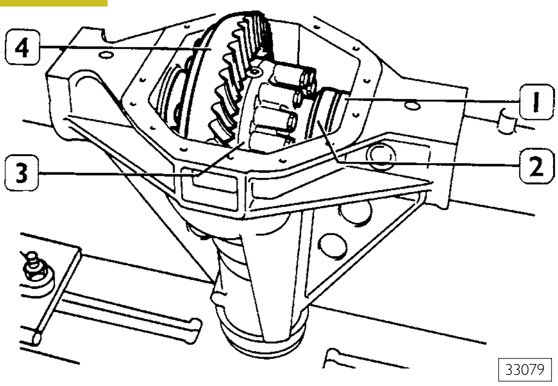
Remove gearing (1) inspection cover including the gasket.

Figure 36



Remove caps (1) after marking them.

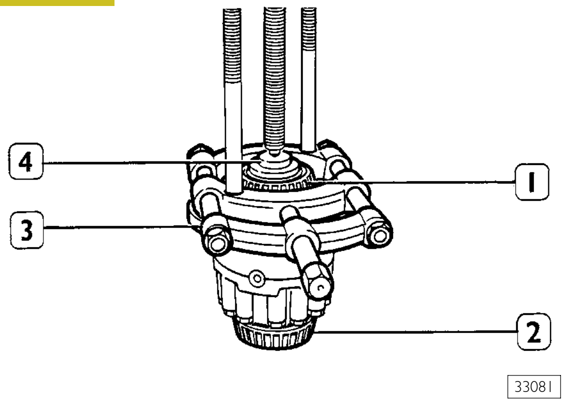
Figure 37



Remove the spacer (1) and remove the gearing case (3) including the crown wheel (4) and the outer rings (2) for supporting bearings. Remove the other spacer and the adjustment rings. Do not reverse the outer races of the gearing case supporting bearings.

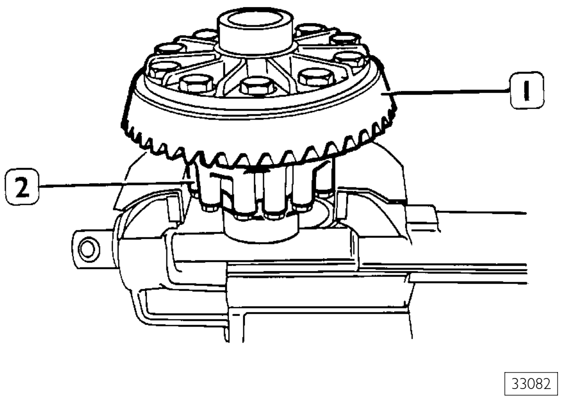
Gearing case removal

Figure 38



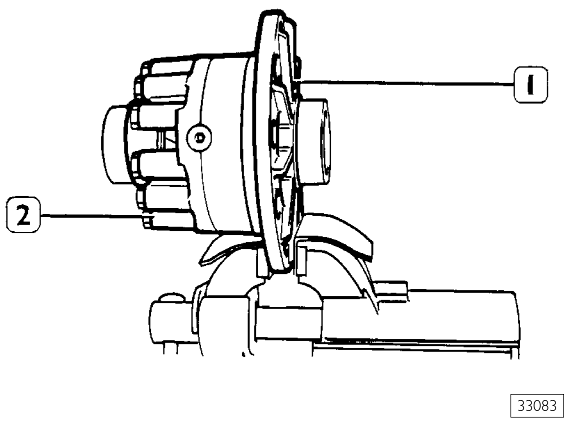
Remove gearing case supporting bearings (1 and 2) using puller 99348001 (3) and counter block 99345056 (4).

Figure 39



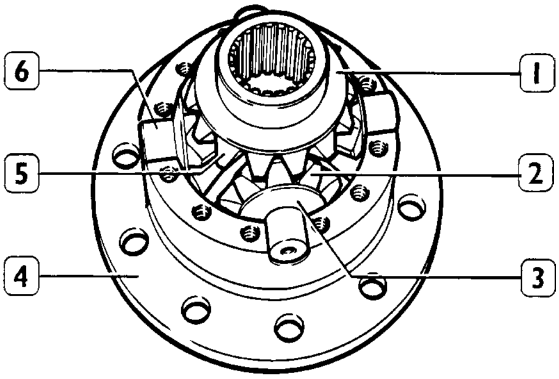
Clamp the gearing case (2) in a vice and remove the ring bevel gear (1) from the gearing case (2).

Figure 40



Mark gearing half-boxes (1 and 2), loosen the fastening screws, position the gearing case on a bench and remove the two half-boxes.

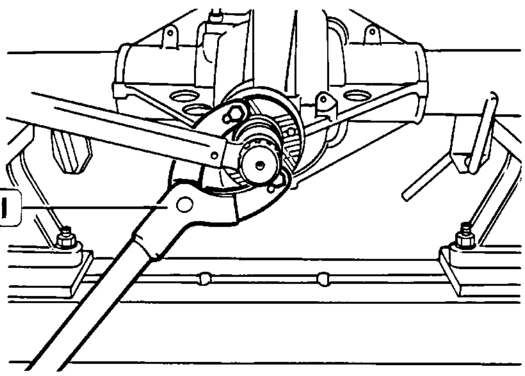
Figure 41



33084

Remove sun gears (5) and planetary gears (2) including the spider (6) from the gearing half-box (4). Recover the shoulder washers (1 and 3).

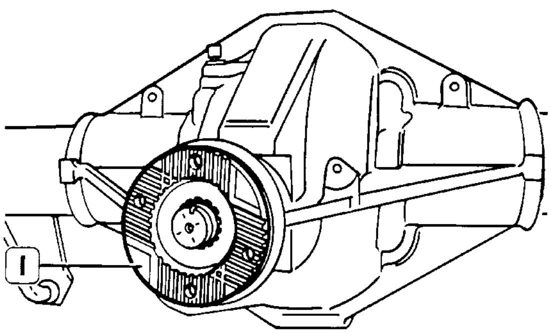
Figure 42



33086

Remove bevel pinion retaining nut safety crimp and loosen the nut using the counter lever 99370317 (1).

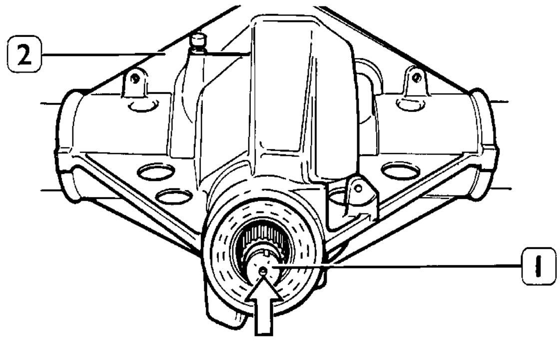
Figure 43



33087

Remove transmission connection flange (1).

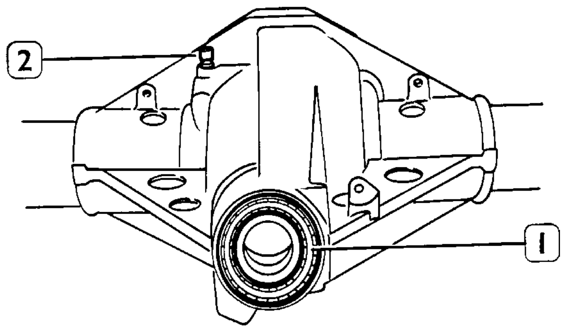
Figure 44



33088

Use a bronze beater in arrow direction to remove the bevel pinion (1) including the rear bearing, the fixed spacer and the adjustment rings from the rear axle casing (2).

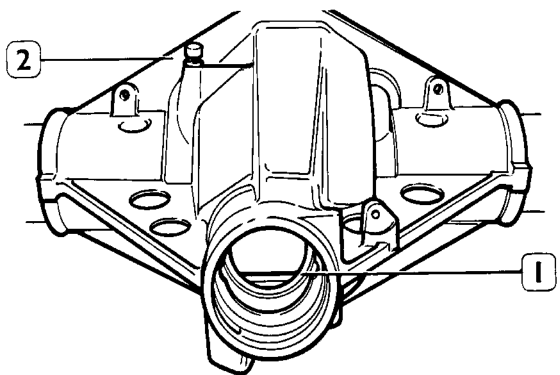
Figure 45



33089

Remove the sealing ring (1) and the front taper roller bearing from the rear axle casing (2). Use a bronze beater to remove the front taper roller bearing outer ring.

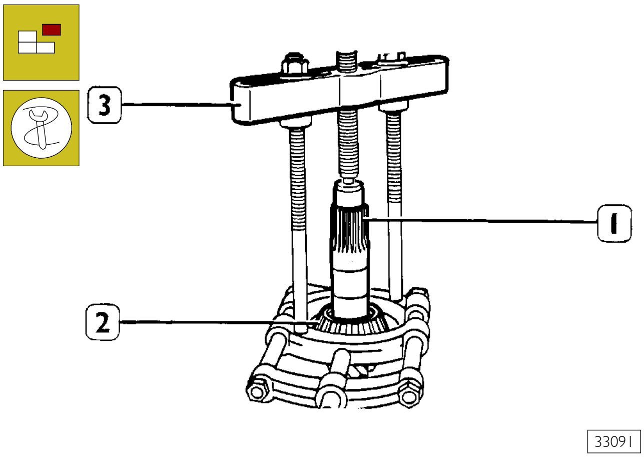
Figure 46



33090

Use a bronze beater to remove the rear taper roller bearing outer ring (1) from the rear axle casing (2).

Figure 47



Use puller 99348001 (3) to remove the rear taper roller bearing (2) from the bevel pinion (1).

Differential components check

Carefully clean each differential component.
Lubricate the bearings and rotate the roller cage freely. The rotation must be even and without sign of stiffness. Check the ring bevel gear contact surfaces and the half-box striker plate to ensure that the crown wheel adheres perfectly. Deformations on these surfaces cause the crown wheel fastening screws to vibrate, thus jeopardizing the correct operation of the unit.

NOTE Carefully clean all threads in order to obtain exact adjustments and accurate tightening torque.

Check that the splined section for flange-pinion connection is not badly worn, otherwise replace the pinion.

NOTE When replacing the crown wheel or pinion it is necessary to replace both parts since they are supplied in pairs.

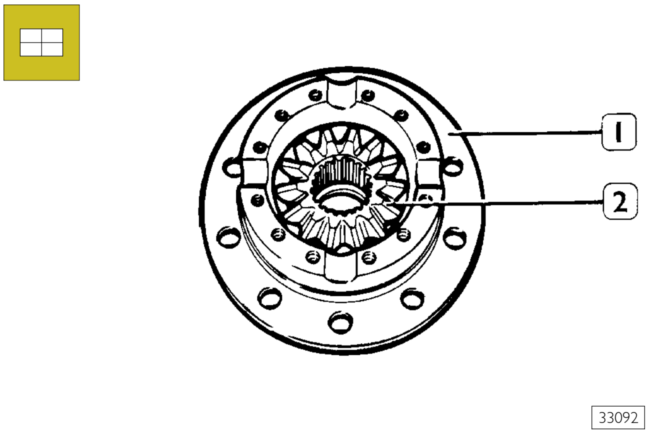
Check the planetary gears and the relevant shoulder washers, the spider and the crown wheels with the relevant shoulder washers.
Replace all sealing elements, the bevel pinion retaining nut and gearing case bearing adjustment nut with new parts.

Rear axle casing check

Check whether rear axle casing is not deformed.

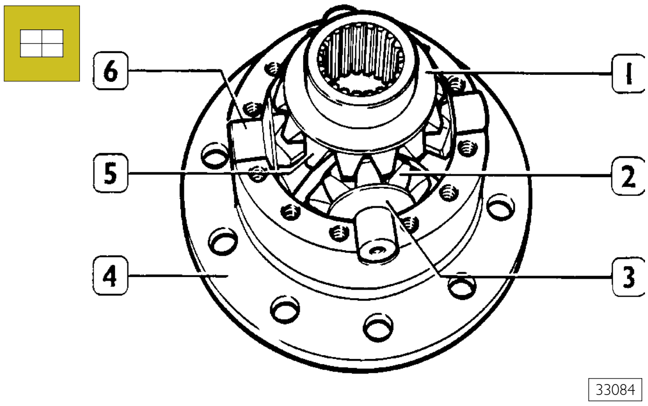
Gearing case refitting

Figure 48



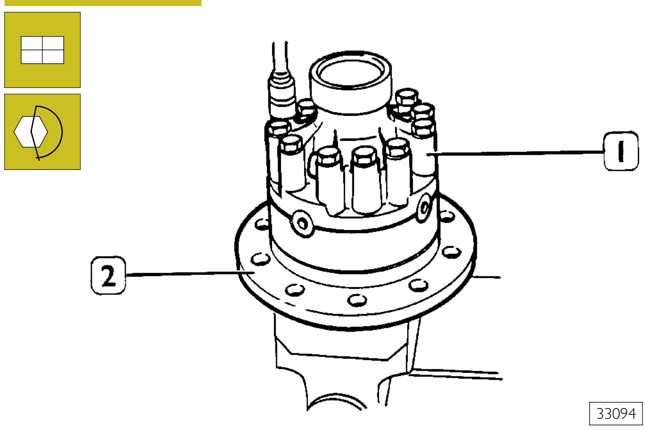
Fit in place the sun gear (2) with the shoulder washer set below in gearing half-box (1).

Figure 49



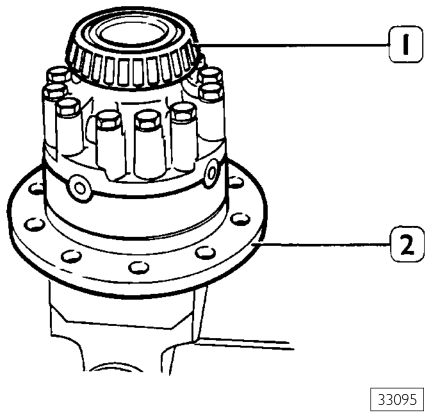
Fit in place the planetary gears (2) with shoulder washers (3), the spider (6) and the sun gear (5) with shoulder washer (1) in the gearing half-box (4).

Figure 50



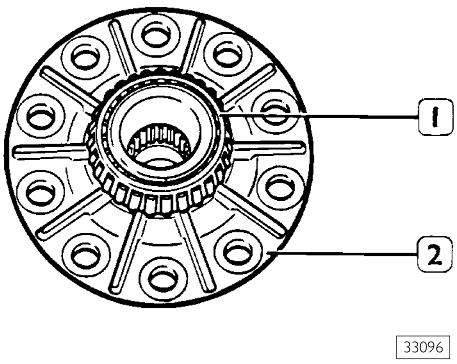
Fit between them the half-boxes (1 and 2) and tighten the fastening screws to the specified torque.

Figure 51



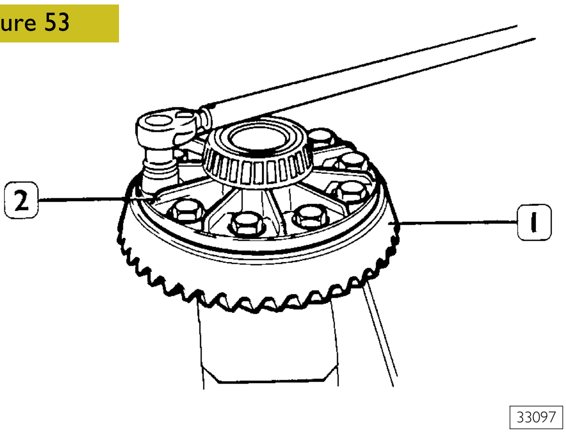
Heat in air-circulation furnace at 100°C for approx. 15' the taper roller supporting bearing (1) on toothing side and fit it down onto the gearing case (2) completely.

Figure 52



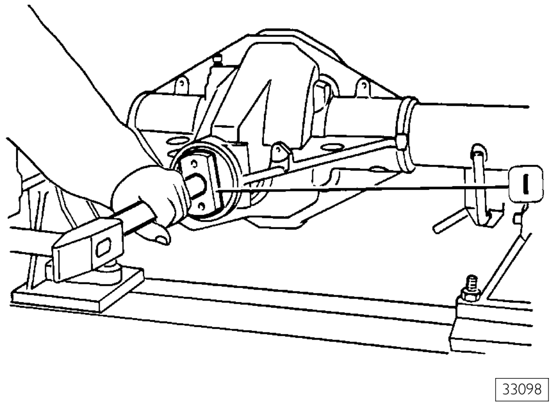
Heat in air-circulation furnace at 100°C for approx. 15' the taper roller supporting bearing (1) on toothing opposite side and fit it down onto the gearing case (2) completely.

Figure 53



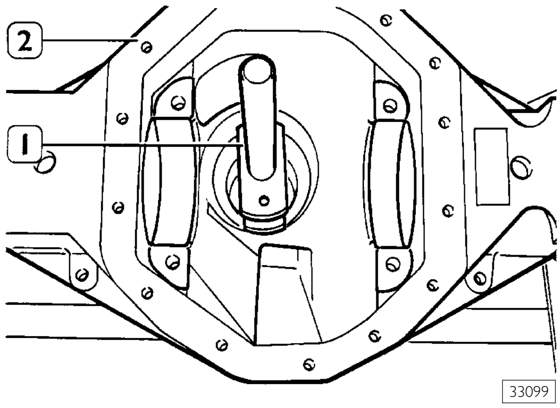
Pour few drops of LOCTITE 270 into crown wheel (1) holes, fit the crown wheel (1) on the gearing case (2) and tighten the fastening screws to the specified torque.

Figure 54



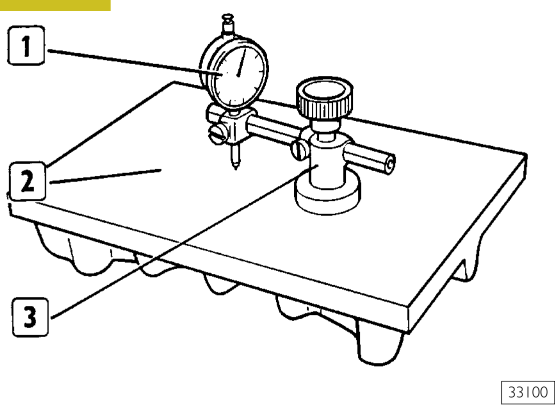
Mount the outer ring of front taper roller bearing into rear axle box using beater 99374093 (1).

Figure 55



Use beater 99374093 (1) to fit in place rear taper roller bearing outer ring on rear axle casing (2) without adjustment ring.

Figure 56



On surface plate (2), set to zero dial gauge 99395728 (1) on support (3) and slightly preload it.

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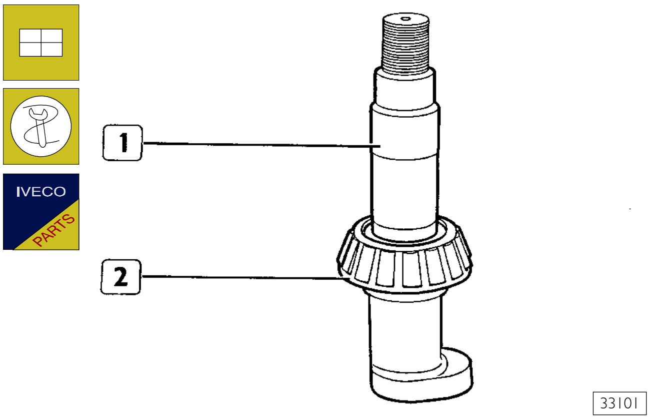
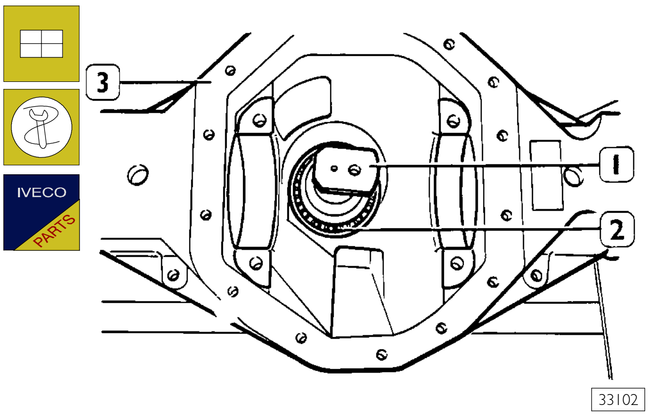
Figure 57



Fit the rear bearing (2) on the false pinion 99370296 (1).

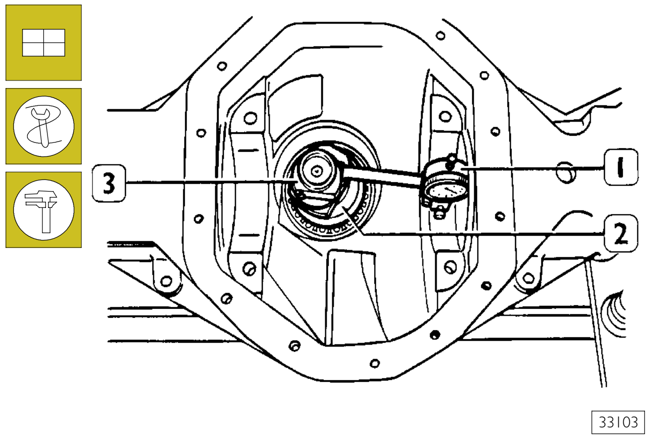
Figure 58



Position the false pinion 99370296 (1) including the rear bearing (2) into its seat on rear axle casing (3).

Fit the front bearing, the transmission connecting flange and the bevel pinion retaining nut and tighten so as to remove end play and to enable false pinion rotation.

Figure 59



Set dial gauge 99395728 (1) including support (3) on false pinion 99370296 (2).
Direct suitably the dial gauge previously set to zero (see Figure 56) to position the rod to the bottom of the gearing case supporting bearing housing.

Repeat this operation for the other bearing and take note of both found values.

Pinion adjustment ring thickness is obtained through the following formula:

$$S = \frac{A_1 + A_2}{2} - (\pm B)$$

"S" = thickness of the adjustment rings to be positioned between bevel pinion rear bearing outer ring and rear axle casing.
"A1" = value found on right housing
"A2" = value found on left housing
"B" = reference value marked on bevel pinion (see Figure 60)

Example:

$$S = \frac{3{,}90 + 4{,}10}{2} - (\pm 0{,}05)$$

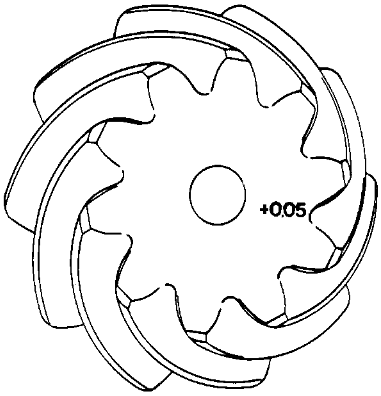
$$S = \frac{8{,}00}{2} - 0{,}05$$

$$S = 4{,}00 - 0{,}05$$

$$S = 3{,}95$$

Adjustment ring thickness shall therefore be: 3.95 mm.

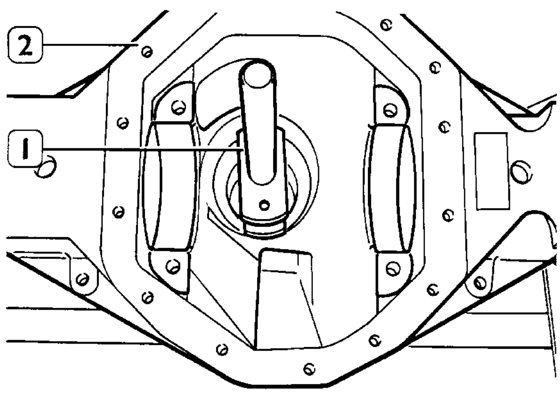
Figure 60



33104

NOTE If the value marked on the pinion is preceded by positive sign (+), it shall be subtracted from the value obtained by the sum divided by two of the housings, whereas it shall be added if preceded by negative sign (-).

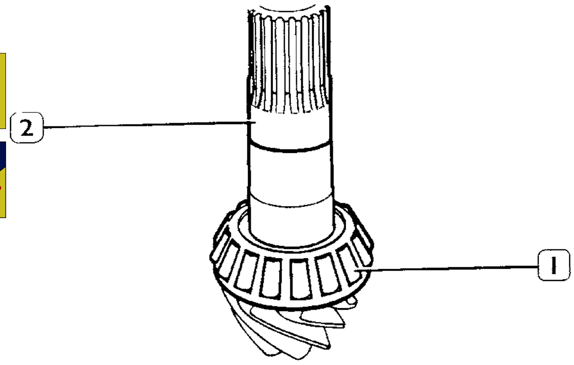
Figure 61



33099

Choose an adjustment ring having the same thickness obtained by using the formula shown in SENZA CODICE and fit it into the rear axle casing after removing rear taper roller bearing outer ring previously mounted.
Use beater 99374093 (1) to fit definitely the rear taper roller bearing outer ring into rear axle casing (2).

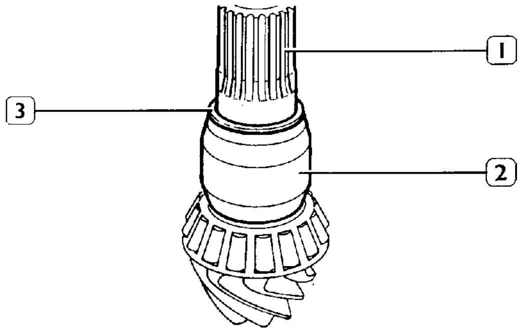
Figure 62



32481

Heat the rear bearing (1) to 100°C for approx. 15' into an air-circulation furnace and then fit it down onto the bevel pinion (2).

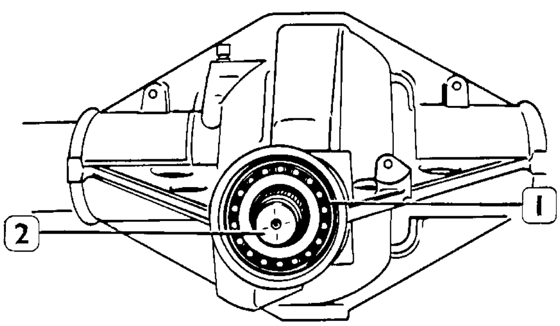
Figure 63



32482

Position the fixed spacer (2) and the adjustment ring (3), previously used to obtain the specified rolling torque, on the bevel pinion (1).

Figure 64



33111

Position the complete bevel pinion into the rear axle casing.
Heat the front bearing (1) to 100°C for approx. 15' into an air-circulation furnace and then fit it down onto the bevel pinion (2).

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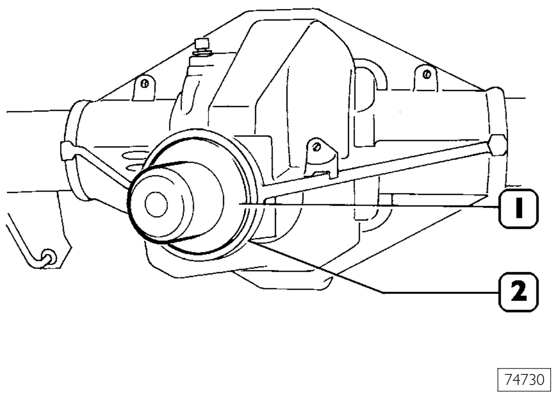
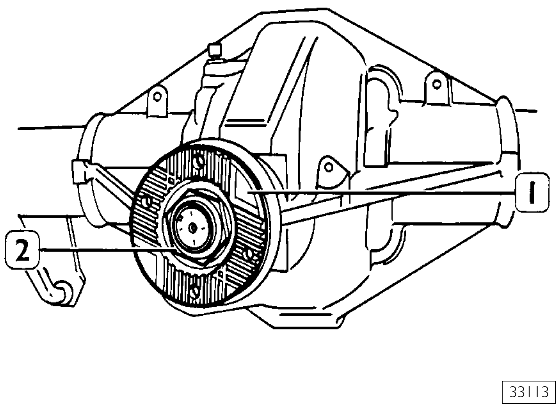
Figure 65



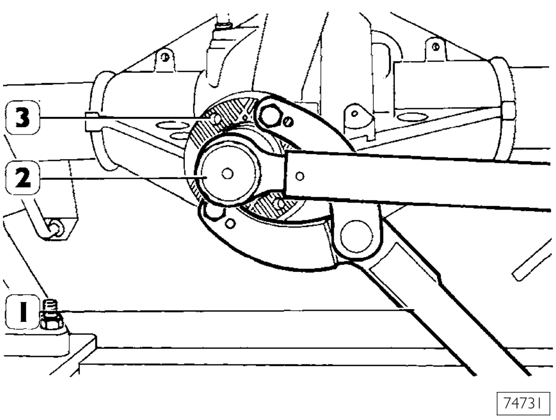
Fit the seal ring (2) in the axle casing with tool 99374201 (1).

Figure 66



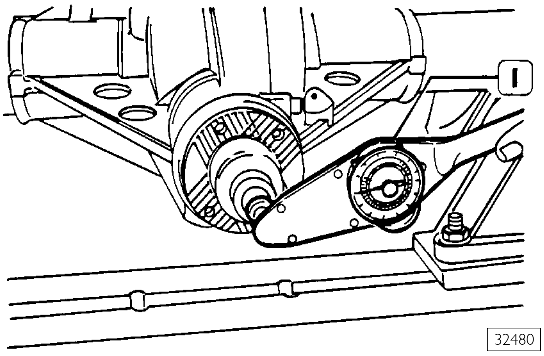
Fit the transmission connecting flange (1) and the bevel pinion retaining nut (2).

Figure 67



Assemble the flange (3) and prevent rotation with tool 99370317 (1).
Using the torque wrench (2), tighten the bevel pinion flange (3) retaining nut to the correct torque value.

Figure 68



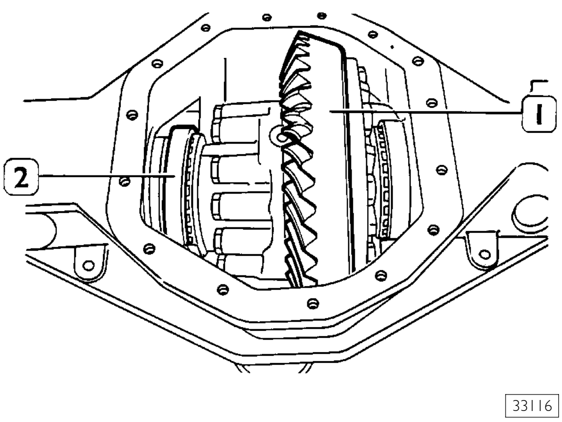
Using the torque wrench 99389819 (1), measure the rolling torque of the bevel pinion.

NOTE The rolling torque must be measured at an ambient temperature of 25°C, making the pinion turn at a speed of 50 rpm after it has made 10 turns.

If the value is incorrect disassemble the pinion (2, Figure 64), and replace the adjuster ring (3, Figure 63) with a suitable ring. Refit the pinion and repeat the rolling torque check.

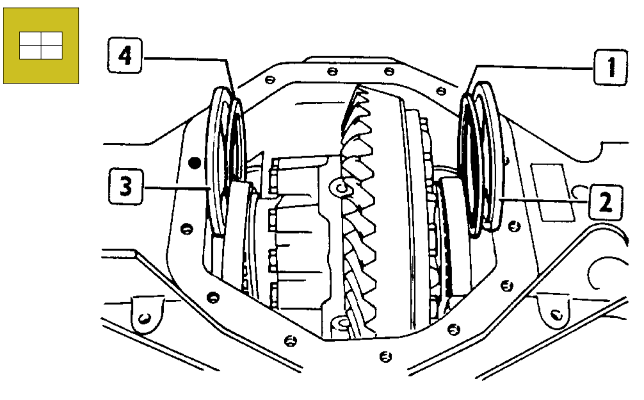
Differential unit refitting

Figure 69



Fit gearing case supporting bearing outer rings (2) and then position the gearing case (1), previously fitted, in the rear axle casing.

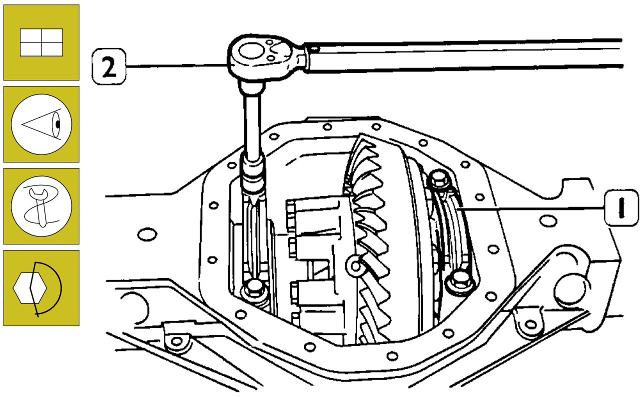
Figure 70



33117

Insert the spacer (2), adjuster ring (1), adjuster ring (4) and then spacer (3).

Figure 71

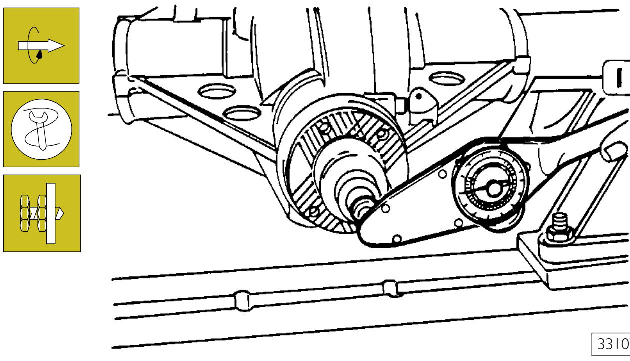


33119

Refit caps (1) taking into account the marks made at removal. Use dynamometric wrench 99389827 (2) to tighten the fastening screws to the specified torque.
Set gearing case supporting bearings and check total rolling torque.

NOTE The rolling torque must be measured at an ambient temperature of 25°C, making the pinion turn at a speed of 50 rpm after it has made 10 turns.

Figure 72



33107

Use dynamometric wrench 99389819 (1) to check total rolling torque:

$$Ct = Cp + \left(\frac{Cd}{R} \times 0.99\right)$$

Ct = total rolling torque
Cp = bevel pinion bearing rolling torque
Cd = 2 ÷ 2.8 Nm (0.2 ÷ 0.29 kgm)
R = Rear axle reduction ratio

Example:

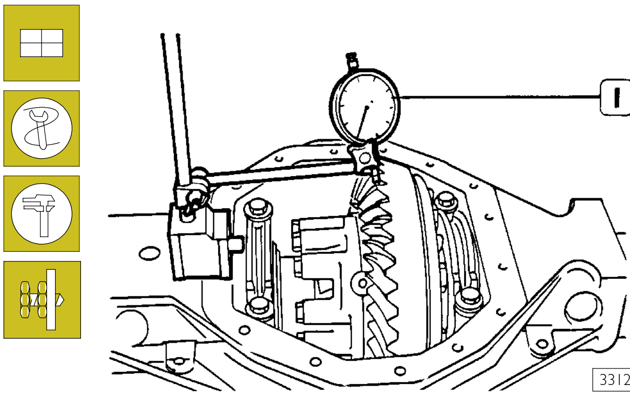
$$Ct = 2.5 + \left(\frac{2,8}{3,91} \times 0.99\right)$$

$$Ct = 2.5 + 0.71$$

$$Ct = 3.21 \text{ Nm } (0.33 \text{ kgm})$$

If the value is incorrect, replace the adjuster rings (1 and 4, Figure 70) with rings of the correct thickness.

Figure 73



33121

Position magnetic dial gauge 99395684 (1) and check the clearance between the pinion and crown on four equidistant teeth on the crown. The average of the measurements must equal the required value. If a different clearance is found, remove the caps (3) again and swap over the assembly position of the adjustment rings (1 and 4, Figure 70).
If this is not sufficient, replace the adjustment rings with ones of a different thickness, but the total thickness must still be the same as that of the adjustment rings removed.
This is so as not to change the total rolling torque.
Apply a thin layer of Prussian blue on ring gear teeth by brush.
Turn the pinion and measure the impression of the contact of the pinion toothing on the crown wheel toothing.
Here we illustrate the possible contacts with the corrections to obtain precise coupling of the crown wheel and pinion.

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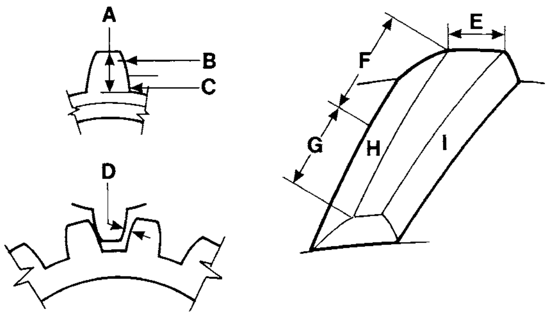
Figure 74

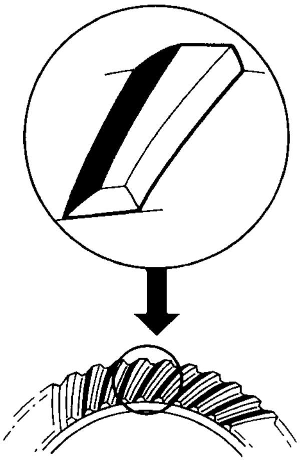


44603

A = Coupling depth
B = Crest
C = Side
D = Play

E = Greater base
F = Heel
G = Top land
H = Contact surface
I = Lateral surface

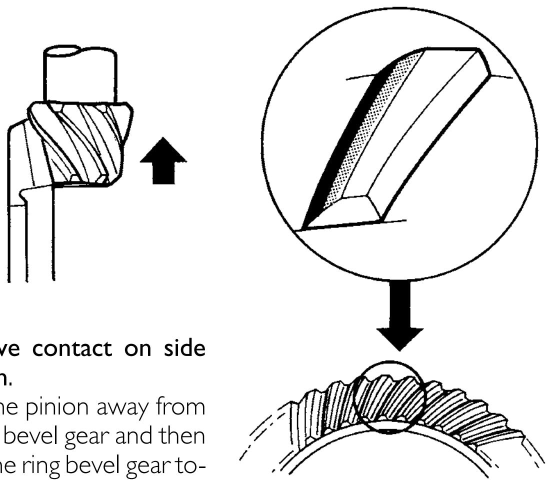
Figure 75



Correct contact.

44604

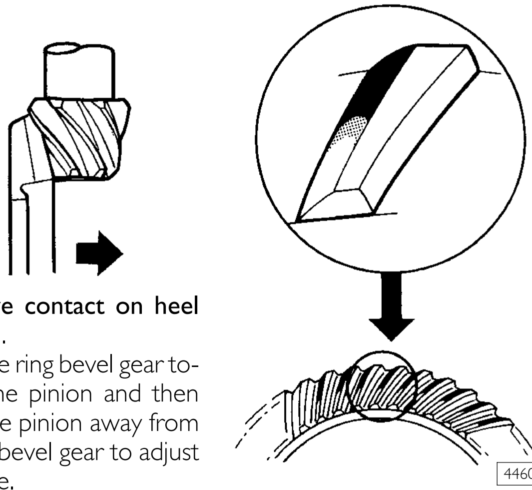
Figure 76



Excessive contact on side of tooth.
Move the pinion away from the ring bevel gear and then move the ring bevel gear towards the pinion to adjust clearance.

44605

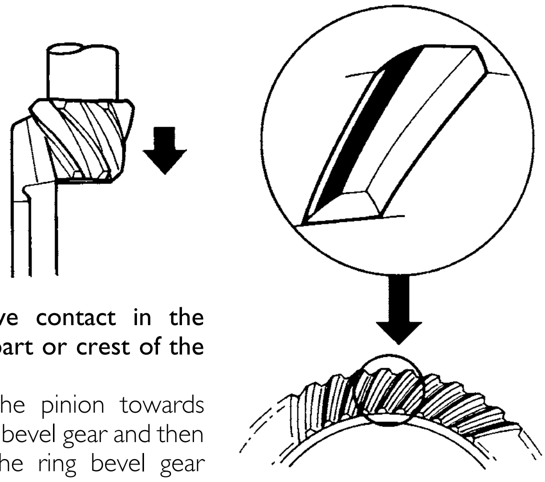
Figure 77



Excessive contact on heel of tooth.
Move the ring bevel gear towards the pinion and then move the pinion away from the ring bevel gear to adjust clearance.

44606

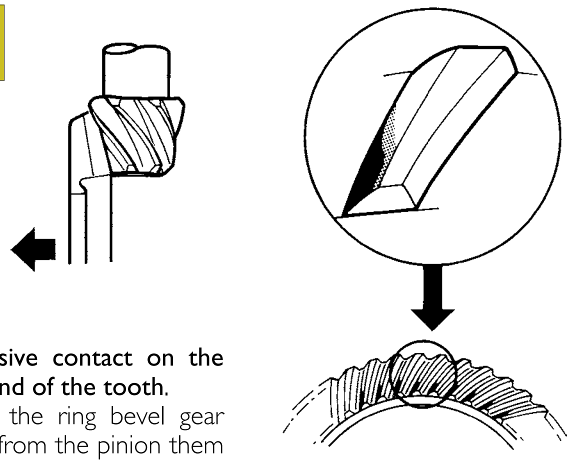
Figure 78



Excessive contact in the upper part or crest of the tooth.
Move the pinion towards the ring bevel gear and then move the ring bevel gear away from the pinion to adjust clearance.

44607

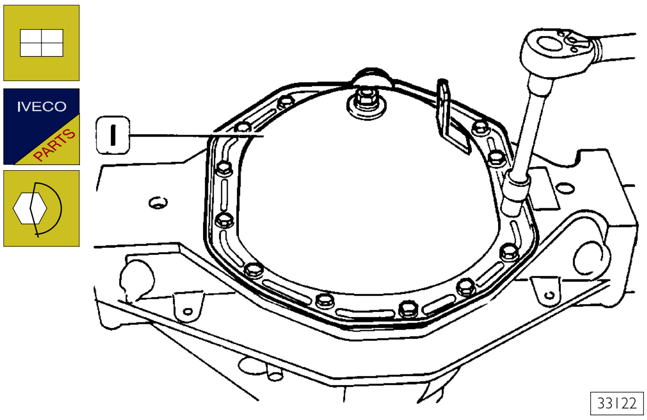
Figure 79



Excessive contact on the top land of the tooth.
Move the ring bevel gear away from the pinion them move the pinion towards the ring bevel gear to adjust clearance.

44608

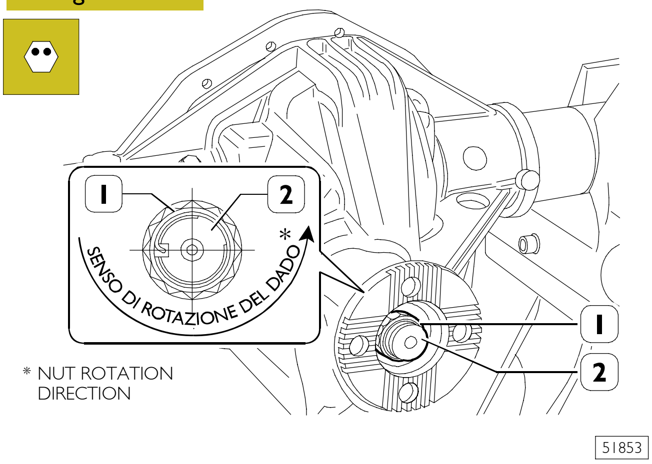
Figure 80



Fit a new sealing gasket on gearing inspection cover connection surface. Apply Loctite 270 on the thread of the holes for screws to secure cover (1). Fit cover (1) and use dynamometric wrench to tighten the fastening screws to the specified torque.

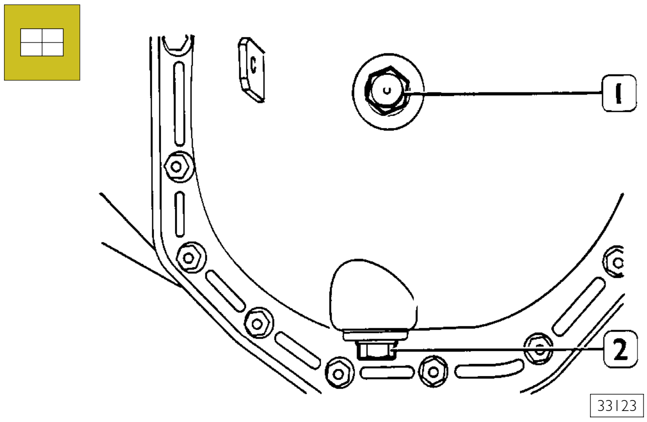
NOTE Do not tighten screws at higher torque value since this shall jeopardize the effect of the sealing gasket located between the connection surface and the gearing inspection cover.

Figure 81



Crimp nut (1) collar on bevel pinion (2) milling as shown in the figure.

Figure 82



Fit oil drain plug (2). Pour 3 litres of W140/M-DA oil through the proper hole and fit inspection and filling plug (1).

SECTION 7

5206 Axles

Page

This section contains:

DIAGNOSTICS

Front axle main working faults:

1 - Stiff steering;
2 - Wobble;
3 - Noise.

1	STIFF STEERING

Front wheels not aligned.	YES →	Align front wheels.
NO ↓		
Irregular wheel toe-in.	YES →	Adjust front wheel toe-in.
NO ↓		
Irregular tyre pressure.	YES →	Inflate tyres to prescribed pressure.
NO ↓		
Elements involved in the stub axle rotation on the pin inefficient.	YES →	Check and replace the elements deteriorated.

2 WOBBLE

Irregular wheel camber.	YES →	Check the tie rod assembly, adjust or repair the deformed parts.
NO ↓		
Front wheels not aligned.	YES →	Align front wheels.
NO ↓		
Irregular wheel toe-in.	YES →	Correctly adjust toe-in.
NO ↓		
Steering gear tie rod king-pins inefficient.	YES →	Replace defective parts.
NO ↓		
Irregular play of wheel hub bearings.	YES →	Replace the wheel hubs.
NO ↓		
Eccentric wheels: eccentric, deformed rim tyre assembled on wrong rim.	YES →	Replace the wrong rim. Deflate and centre the tyre on the rim.
NO ↓		
Unbalanced wheels.	YES →	Balance the wheels.

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3	**NOISE**

Wheel hub bearings worn.	YES →	Replace worn bearings and adjust end play.
NO ↓		
Stabiliser bar elastic inserts worn or relevant fixing brackets loosen.	YES →	Replace elastic inserts, tighten fixing nuts.
NO ↓		
Play between torsion bar-suspension arm splines.	YES →	Replace worn parts and adjust torsion bar pre-loading.
NO ↓		
Suspension arm bushes and/or articulation pins worn.	YES →	Replace worn parts.

Axle 5817

DESCRIPTION

The front axle 5817 is composed of a load-bearing cross member on which are mounted the suspensions and power steering.

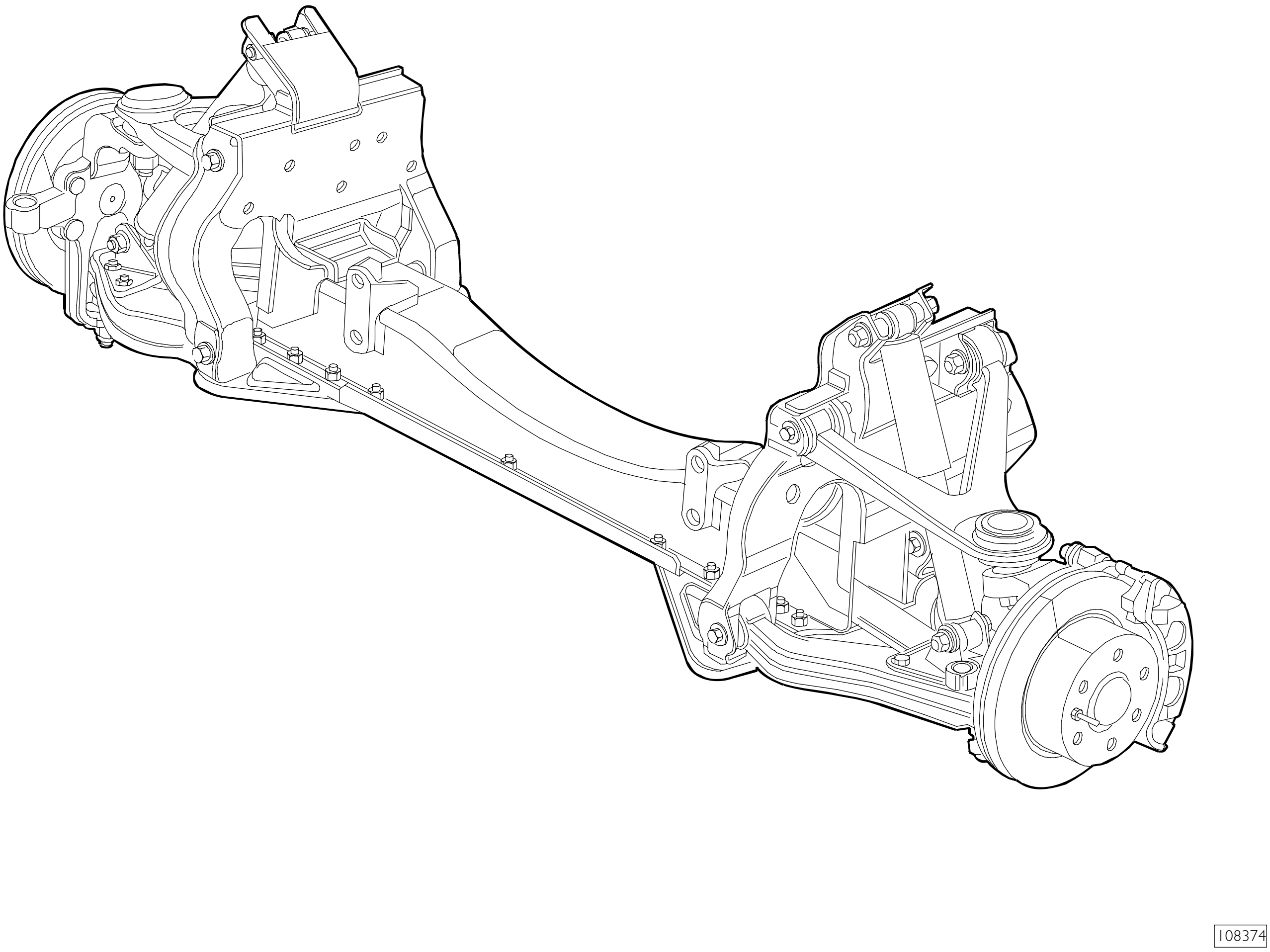
The stub axles turn, by means of swivel heads, on the ends of the suspensions.

The steering levers are cast on the king-pin of the stub axles to which are secured the brake calipers.

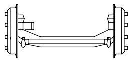
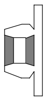
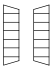
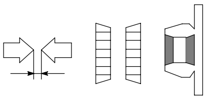
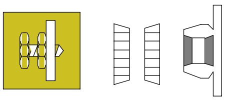
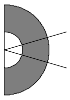
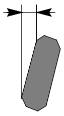
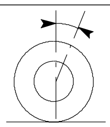
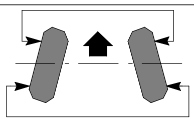
The wheel hubs are supported on the pins of the stub axles by UNIT - BEARINGS that need neither lubrication nor adjustment.

The wheel rims are secured onto the wheel hubs by five screws.

Figure 1



SPECIFICATIONS AND DATA

	Axle type	5817
	**WHEEL HUBS**	
	Wheel hubs bearings	UNIT BEARING
	Hub bearings end play	-
	Wheel hub bearings play adjustment	Not Adjustable Fixing nut torque tightening
	**WHEEL GEOMETRY**	
	Wheel camber angle (vehicle at static load)	0° ± 20'
	Wheel caster angle (vehicle at static load)	3° ± 20'
	Wheel toe-in (vehicle at static load)	2 ± 1 mm

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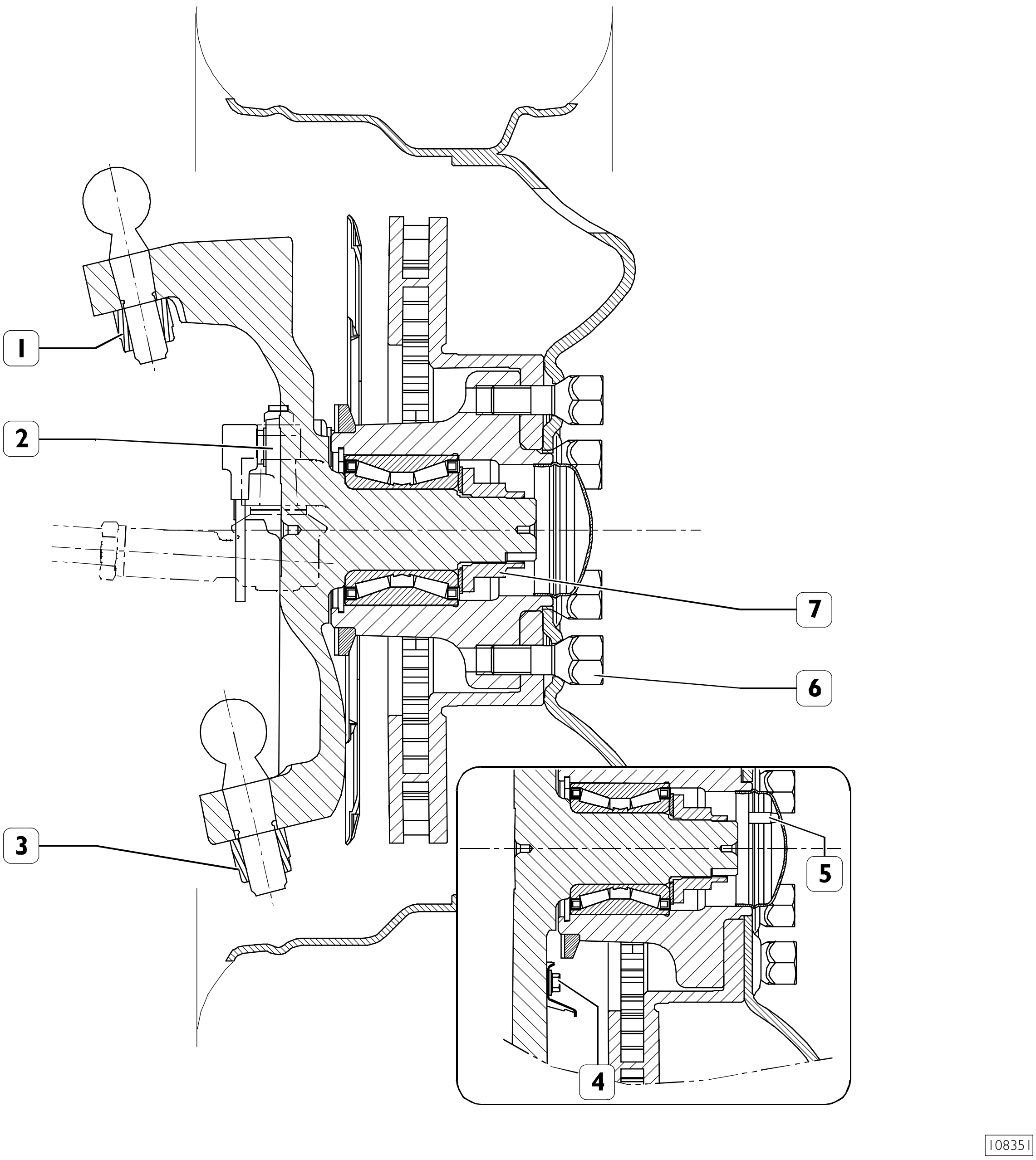
TIGHTENING TORQUES

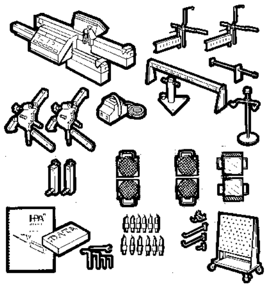
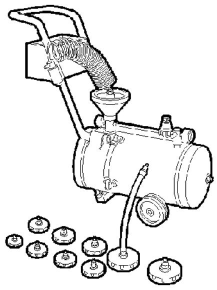
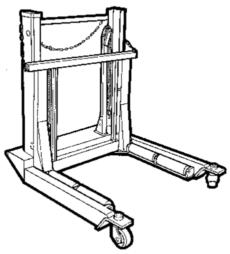
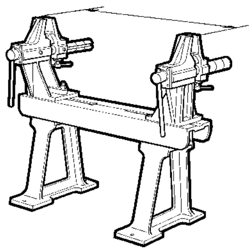
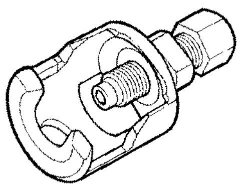
Figure 2



AXLE 5817

PART		TORQUE	
		Nm	*kgm*
	Screw securing caliper mounting to stub axle	176 ÷ 217	18 ÷ 22
1	Nut securing the upper swinging arm jointed head to the stub axle	125 ÷ 140	12.5 ÷ 14
2	Nut securing the steering rod jointed head to the lever	68 ÷ 83	6.8 ÷ 8.3
3	Nut securing the lower swinging arm jointed head to the stub axle	160 ÷ 180	16 ÷ 18
4	Screw securing stub axle guard	6 ÷ 7.5	0.6 ÷ 0.7
5	Screw securing brake disc to wheel hub	19.5 ÷ 24.9	2 ÷ 2,5
6	Screw securing wheel	180 ÷ 200	18 ÷ 20
7	Nut securing wheel hub	320 ÷ 420	32 ÷ 42

TOOLS

TOOL NO.		DESCRIPTION
99305354		Portable optical reading tool for checking wheel trim
99306010		Apparatus to purge air from brakes and clutch
99321024		Hydraulic trolley for removing/refitting wheels
99322215		Guide to wheel hub assembly
99347074		Puller for steering tie rod king-pins

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REMOVING AND REFITTING AXLE 5817

Removal

Set the vehicle on solid, level ground.

Lock the rear wheels with scotches, remove the wheel rim guards and loosen the screws or nuts fixing the wheel.

Lift the front of the vehicle and rest the chassis frame on supports.

Take out the screws or nuts fixing the wheel and remove them with tool 99321024.

From underneath the vehicle:

- ❑ remove the central guard (15) under the engine by taking out the screws securing it to the side guards and to the front cross member of the chassis frame;
- ❑ remove the engine side guards (6) and (19) by taking out the screws securing them to the chassis frame;
- ❑ remove the gearbox side guards (5) and (20) by taking out the screws securing them to the chassis frame and the nuts securing them to the cross member under the gearbox (23);
- ❑ disconnect the brake fluid pipe (21) from the retaining blocks on the axle (22);
- ❑ drain off the power-steering fluid and disconnect the pipes (11) and (12) in correspondence with the fittings on the hydraulic power steering (13);
- ❑ disconnect the power steering column in correspondence with the coupling (14).

If it is decided to leave the brake callipers on the axle, proceed to:

- ❑ disconnect the electrical connection (1) signalling brake lining wear and the ABS sensor (4) if there is one;
- ❑ disconnect the brake fluid pipes in correspondence with the fittings (7) and (18) after draining the system.

If it is decided to leave the brake callipers on the vehicle, proceed to:

- ❑ disconnect the brake fluid pipes from the axle (22) in correspondence with the brackets (8, 10, 16, 17);
- ❑ then disconnect the brake callipers (3) from their respective stub axles by taking out the screws (2) and supporting the callipers to prevent any strain on the pipes.

To complete removing the axle:

- ❑ unscrew five of the six fixing screws (9) on both sides of the chassis frame;
- ❑ put a hydraulic lift under the axle and take out the last two screws;
- ❑ lower the hydraulic jack and extract the axle.

Refitting

Reverse the steps described for removal tightening the screws or nuts to the prescribed torque.

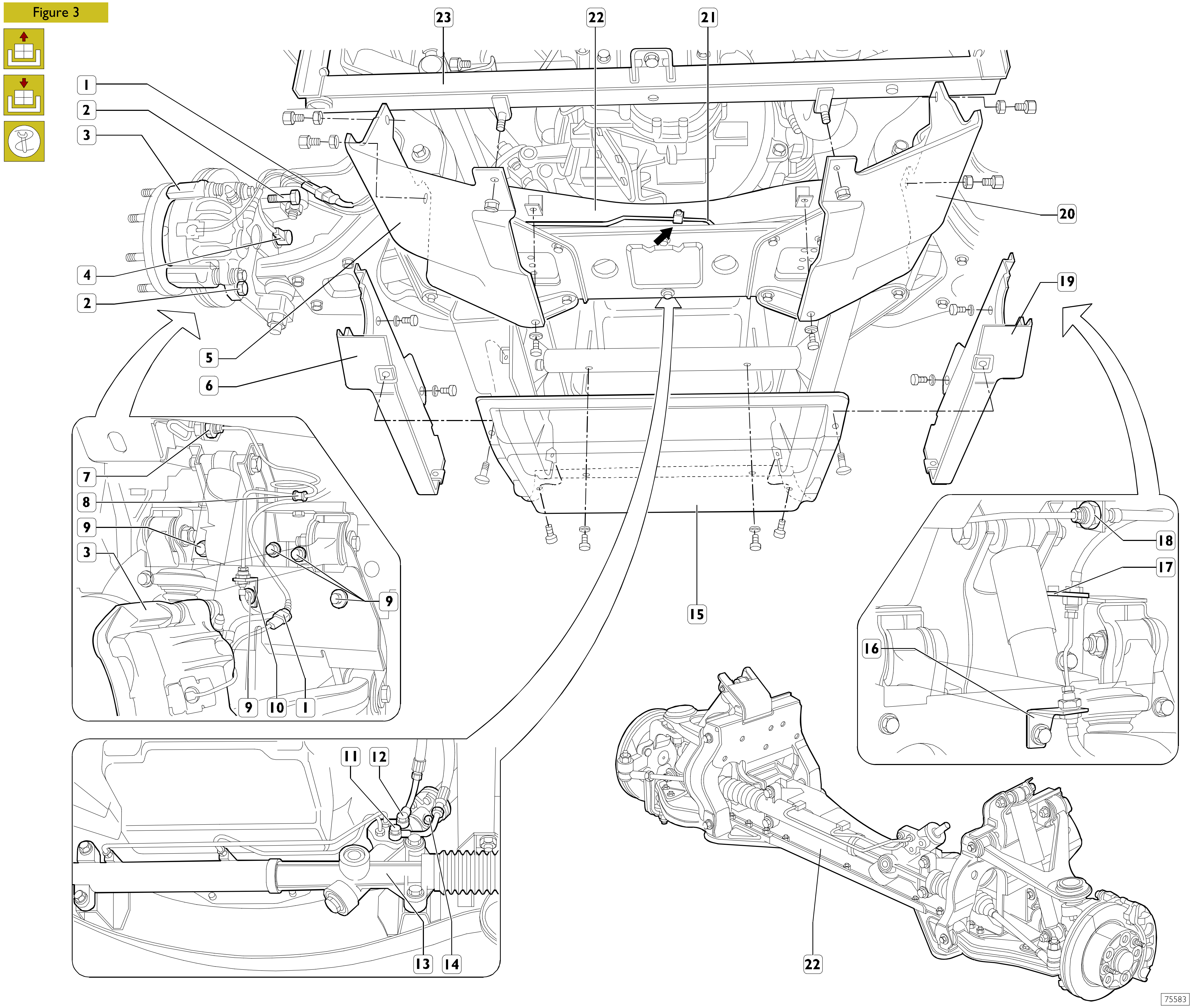
Adjust the load of the torsion bar as illustrated under the specific heading.

Top up the power-steering fluid.

If the brake callipers have been left on the axle, restore the brake fluid level and bleed off any air.

Check and adjust the front wheel geometry.

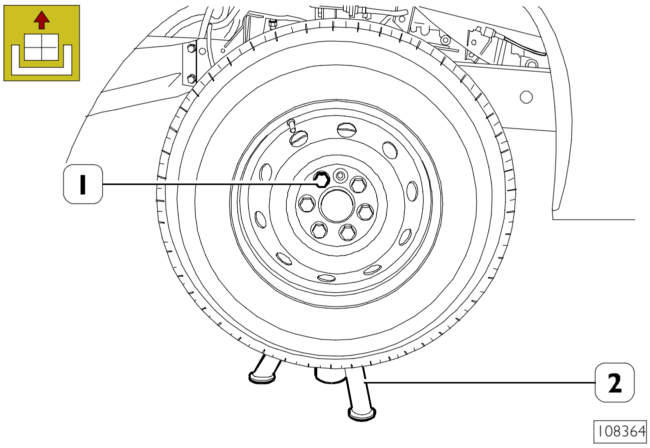
Figure 3



REPAIRS

520610 OVERHAULING AXLE 5817

Figure 4



Free the screws (1) securing the wheel rim.

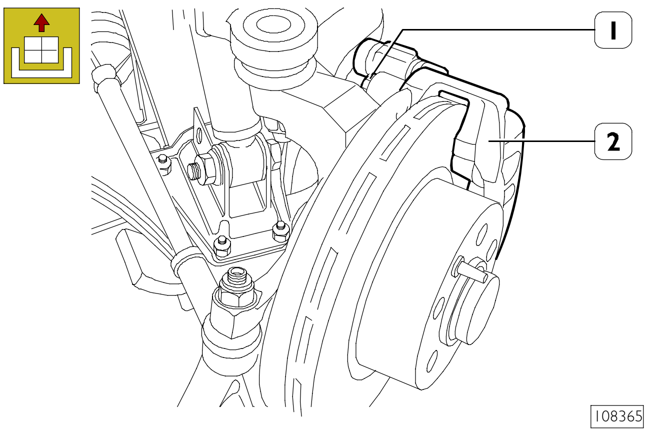
Lift the vehicle and put the stands (2) under the structural members in a forward position.

Undo screws (1), remove screw guard (1) and remove the entire wheel.

520620 Wheel hub removal and refitting

Removal

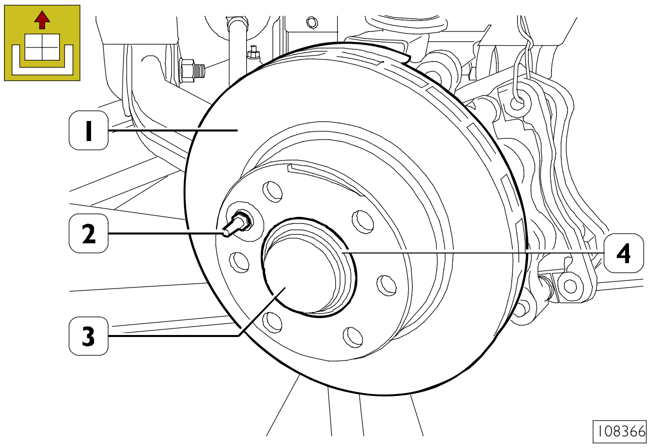
Figure 5



Remove the braking gaskets as described in the "Brake" section, or remove screws (1) and take the support together with brake caliper (2) off the stub axle.

Support the brake caliper suitably to prevent strain on the oil pipe.

Figure 6

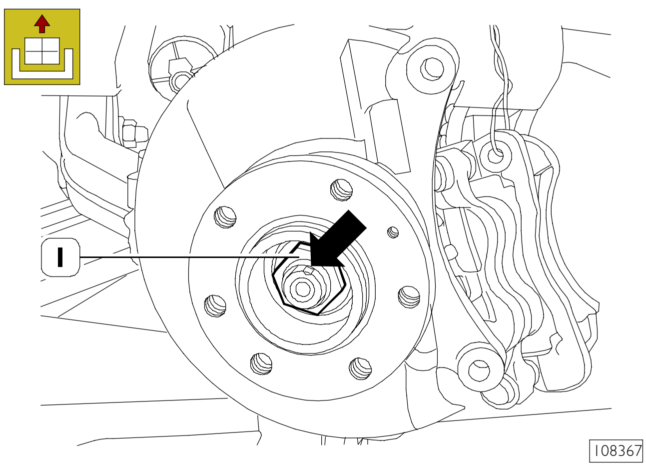


Remove centring pin (2), then take brake disc (1) off wheel hub (4).

Remove the cup (3) from the wheel hub (4).

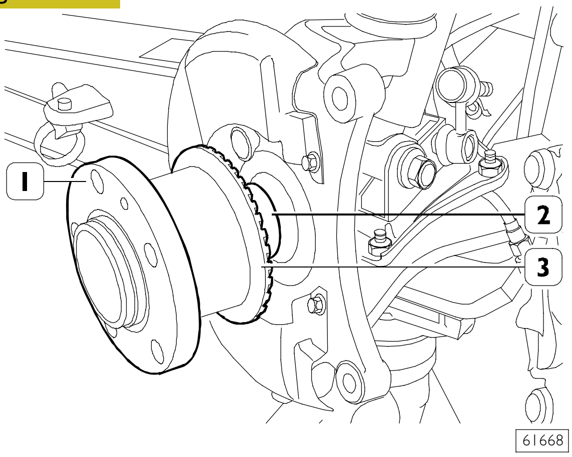
NOTE Check the conditions of the brake disc and the braking gaskets, as described in the "BRAKING SYSTEM" section.

Figure 7



Lift the deformation (⇒) of the nut (1) and unscrew this with a suitable wrench.

Figure 8



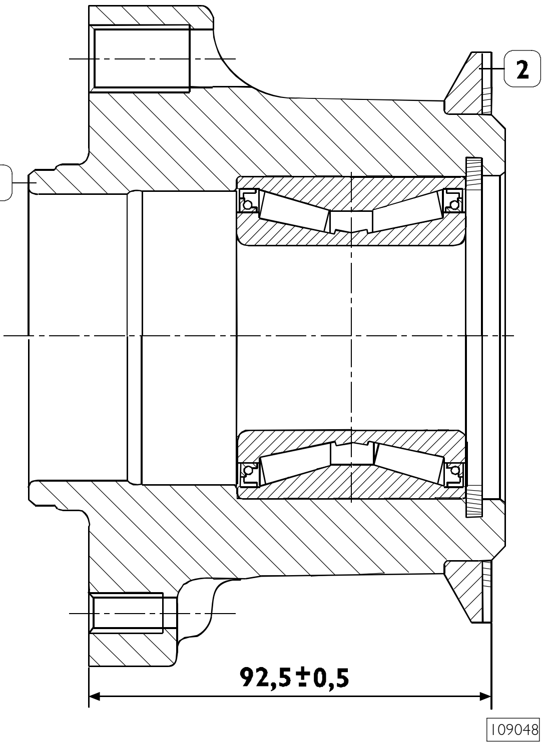
Extract the wheel hub (1) from the pin of the stub axle (2).

NOTE If any trouble is found with the wheel hub or bearing, the assembly needs to be replaced since the parts are not supplied as single spares.

When repairing the wheel hub (1), take care not to damage the phonic wheel (3).

526712 Replacing phonic wheel

Figure 9



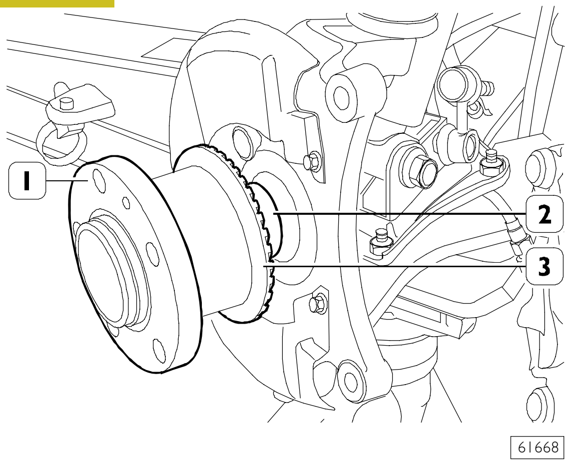
Phonic wheel (2) can be taken off wheel hub (1) by using generic tools. Pull-in load: 500 ÷ 900 kg.

On completing assembly, make sure the phonic wheel sits in its seat in the hub properly.

Check that the orthogonality and oscillation of the phonic wheel is no greater than 0.1 mm.

Refitting

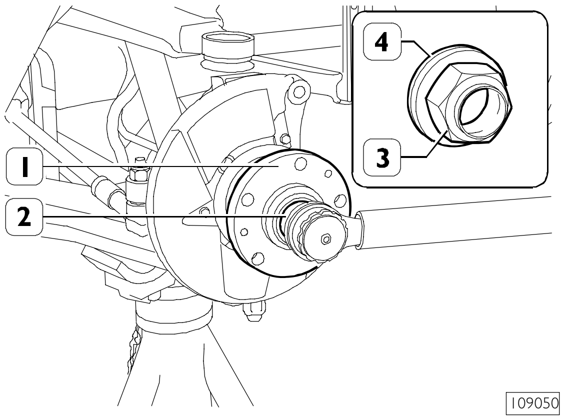
Figure 10



Lubricate the surface of the stub axle pin (2) with TUTELA MR3 grease and key the wheel hub (1).

NOTE The wheel hub must be keyed without forcing.. If there are difficulties, do not assemble since the bearing may be damaged.
Extract the wheel hub, check the cause of the difficulties and eliminate them.

Figure 11



After hub (1) is force-fitted, screw down nut (3).

Tighten the nut (3) to the required torque with the Allen wrench (2).

NOTE Nut (3) is equipped with a fixed washer (4).

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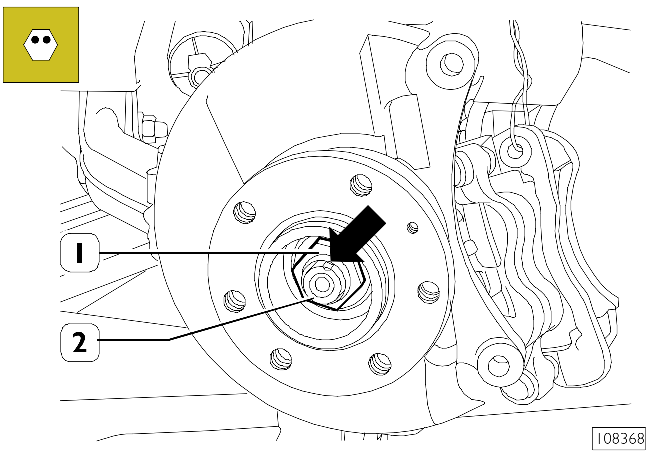
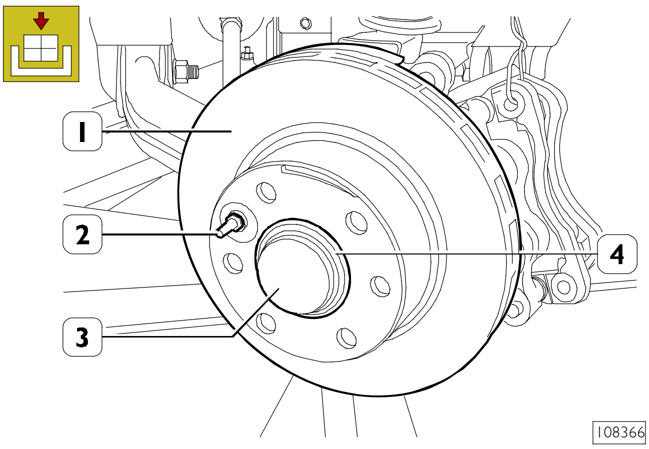
Figure 12



Deform the collar of the nut (1) by the milling (⇒) of the pin (2).

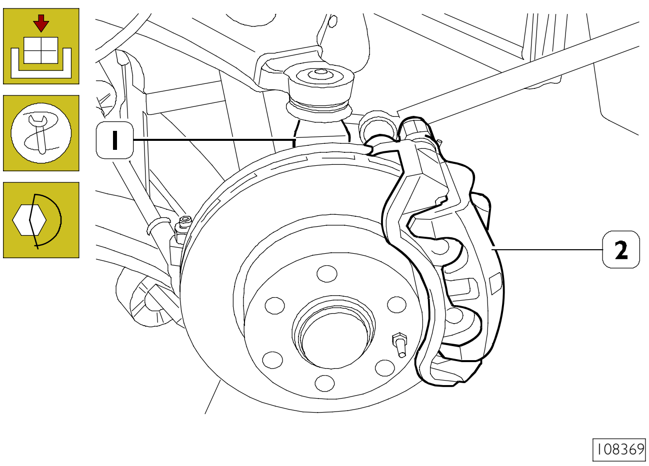
Figure 13



Mount the cup (3) in the wheel hub (4).

Mount the brake disc (1) and secure it to the wheel hub (4) with the two centring pins (2).

Figure 14



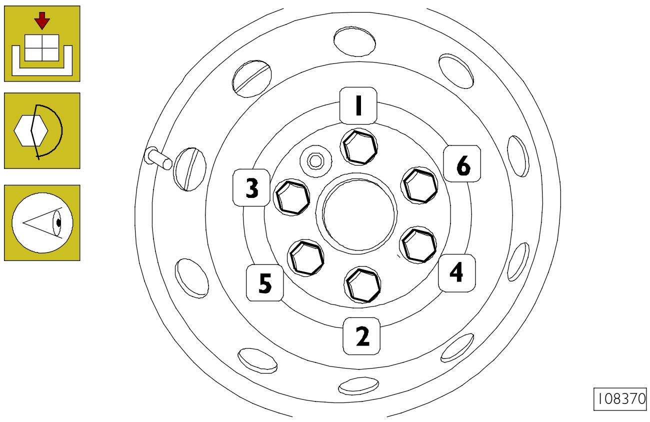
Rest the brake caliper (2) with the brake linings on the stub axle (1).

NOTE The brake lining with its wear indicator must be mounted from the piston side of the brake caliper.

If it is necessary to move the brake caliper piston back, use tool 99372236, taking the precautions given in the BRAKES section.

Tighten brake calliper (2) fixing screws to the prescribed torque.

Figure 15



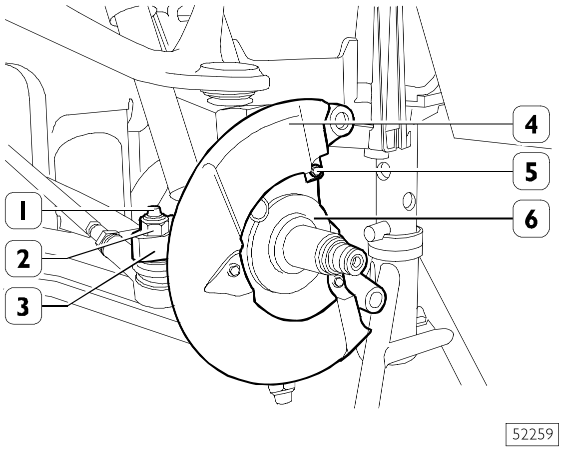
Fit the wheel onto the brake disc, then place the screw guard into position. Tighten the wheel fastening screws to the specified torque, in accordance with the diagram illustrated in the figure.

522820 STUB AXLE REMOVAL-REFITTING

Removal

Remove the wheel hubs as described under the relevant heading (operation 520620).

Figure 16

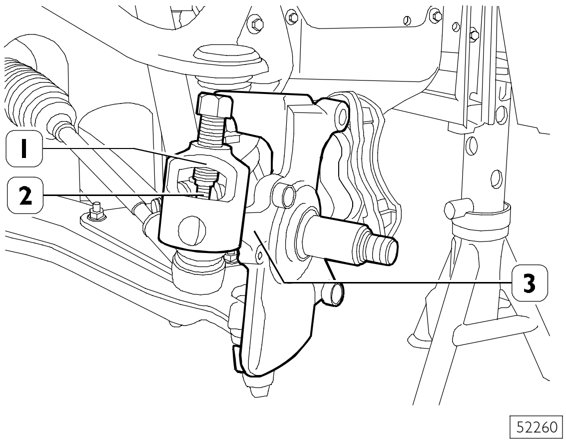


Remove screws (5) and remove protection (4) from stub axle (6).

Remove nut (2) fixing kingpin (1) to lever (3).

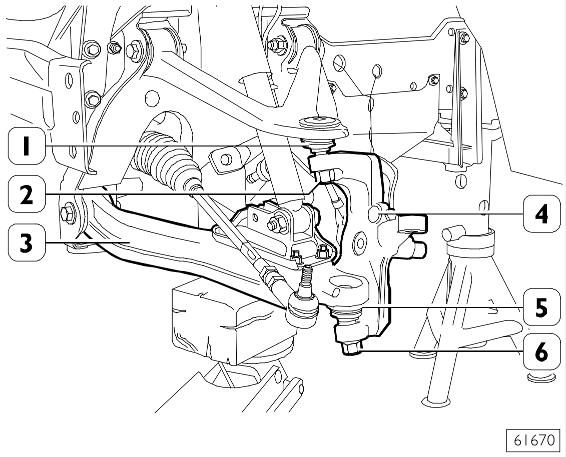
NOTE Fit the proper setscrew wrench into kingpin (1) to stop its rotation, if required.

Figure 17



Using the extractor 99347074 (1), remove the pin (2) of the swivel head from the steering lever of the stub axle (3).

Figure 18

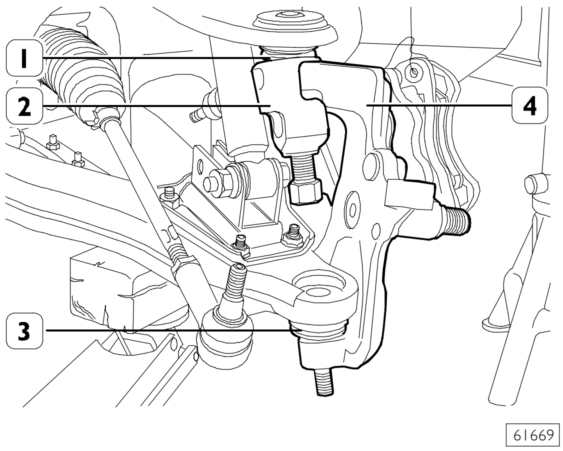


With the hydraulic jack under the bottom suspension arm (3) oppose the action of the transverse leaf spring.

Remove the nuts (2 - 6) securing the swivel head pin (1 - 5) to the stub axle (4).

NOTE To block rotation of the swivel head pins (1 - 5), insert a suitable Allen wrench into the hexagon sunk into them.

Figure 19



Using the extractor 99347074 (2), remove the link pins (1 - 3) of the stub axle (4) and put this aside.

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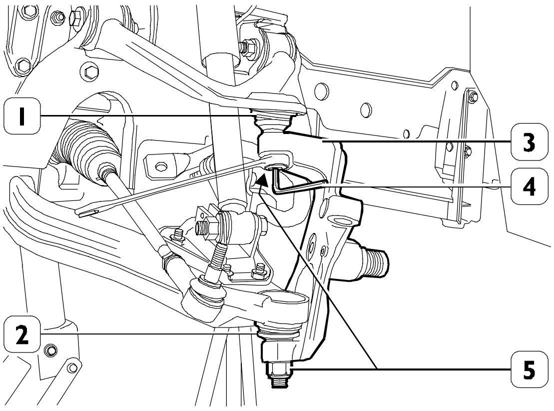
Refitting

Figure 20



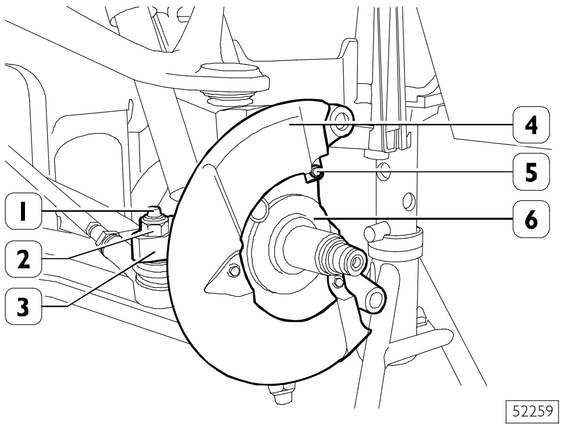
61671

Insert the pins of the swivel heads (1 - 2) of the top and bottom suspension arms into the seats of the stub axle (3). Then screw on the self-locking nuts (5) and lock them at the required torque.

NOTE Once removed, self-locking nuts (5) must not be reused.

To block rotation of the swivel head pins (1 - 2), insert a suitable Allen wrench (4) into the hexagon sunk into them.

Figure 21



52259

Connect the pin of the swivel head (1) of the power steering tie to the lever (3) of the stub axle (6) and tighten the fixing nut (2) to the required torque.

NOTE Once removed, self-locking nuts (2) must not be reused.

To block rotation of the swivel head pin (1), insert a suitable Allen wrench into the hexagon sunk into them.

Mount the guard (4) on the stub axle and secure it, tightening the screws (5) to the required torque.

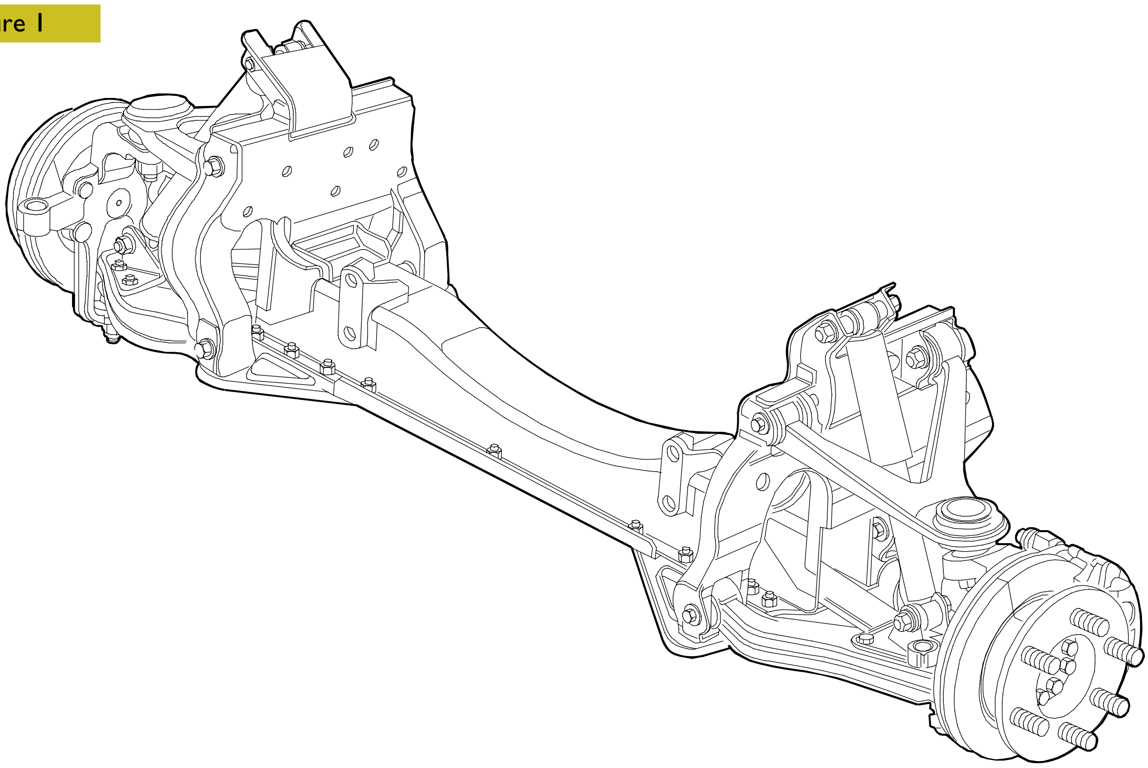
Refit the wheel hub as described in the relevant chapter (operation 520620).

Axle 5818

DESCRIPTION

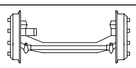
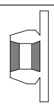
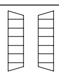
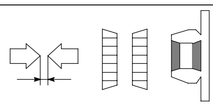
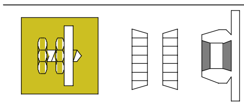
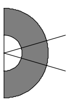
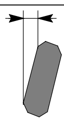
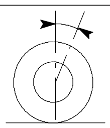
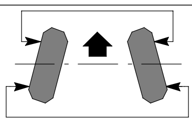
Axle 5818 differs from axle 5817 for wheel hub, brake disc and wheel rim fixing to brake disc that is implemented by nut studs without stabiliser bar.

Figure 1



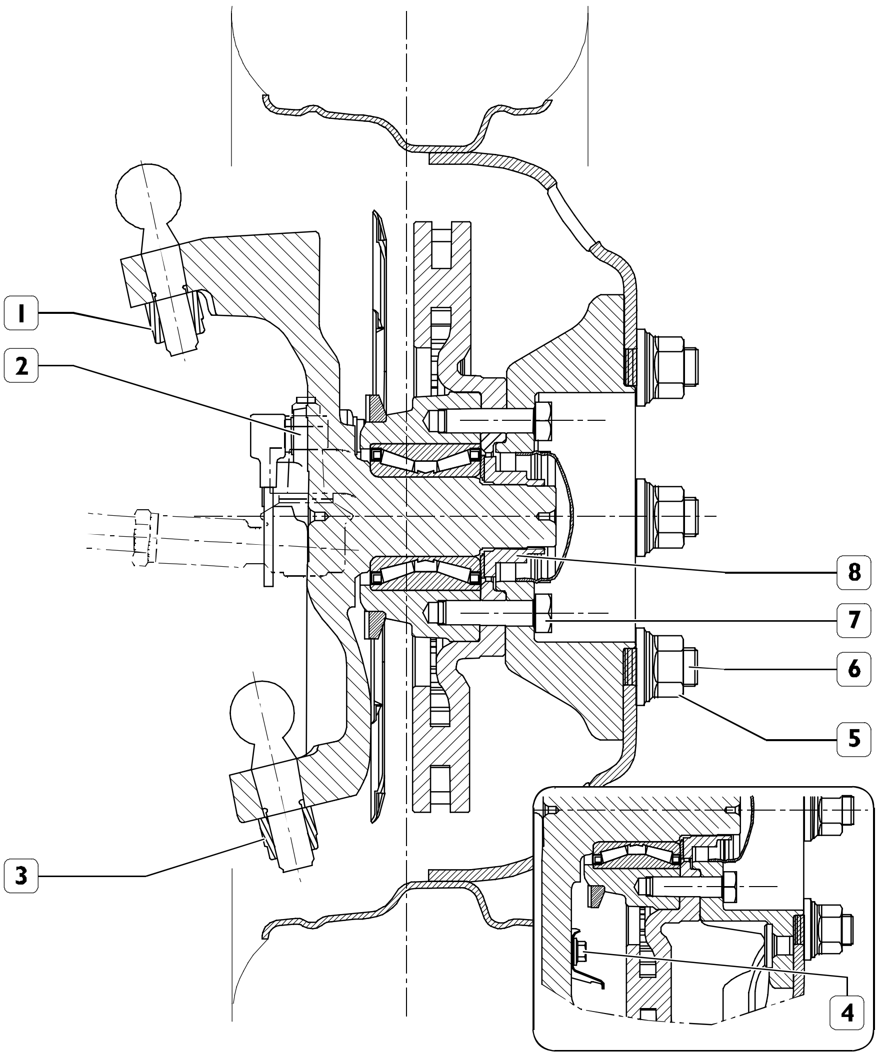
108375

SPECIFICATION AND DATA

	Axle type	5818
	**WHEEL HUBS**	
	Wheel hubs bearings	UNIT BEARING
	Hub bearings end play	-
	Wheel hub bearings play adjustment	Not Adjustable Fixing nut torque tightening
	**WHEEL GEOMETRY**	
	Wheel camber angle (vehicle at static load)	0° ± 20'
	Wheel caster angle (vehicle at static load)	3° ± 20'
	Wheel toe-in (vehicle at static load)	2 ± 1 mm

TIGHTENING TORQUES

Figure 2



108352

AXLE 5818

PART		TORQUE	
		Nm	kgm
	Screw securing caliper mounting to stub axle	176 ÷ 217	18 ÷ 22
1	Nut securing the upper swinging arm jointed head to the stub axle	125 ÷ 140	12.5 ÷ 14
2	Nut securing the steering rod jointed head to the lever	68 ÷ 83	6.8 ÷ 8.3
3	Nut securing the lower swinging arm jointed head to the stub axle	160 ÷ 180	16 ÷ 18
4	Screw securing guard to stub axle	6 ÷ 7.5	0.6 ÷ 0.7
5	Nut securing wheel	180 ÷ 200	18 ÷ 20
7	Screw securing the brake disc and flange to the wheel hub.	98.1 ÷ 107.9	9.8 ÷ 10.7
8	Nut securing wheel hub	320 ÷ 420	32 ÷ 43

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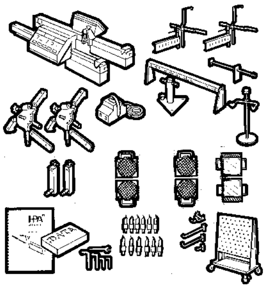
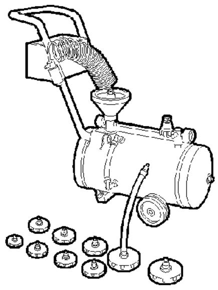
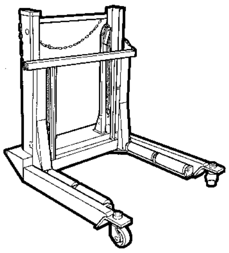
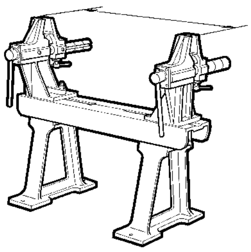
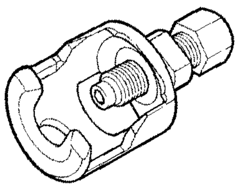
TOOLS

TOOL NO.		DESCRIPTION
99305354		Portable optical reading tool for checking wheel trim
99306010		Apparatus to purge air from brakes and clutch
99321024		Hydraulic trolley for removing/refitting wheels
99322215		Guide to wheel hub assembly
99347074		Puller for steering tie rod king-pins

520610 OVERHAULING AXLE 5818

The overhauling operation different from the ones concerning the axle 5817 are described below.

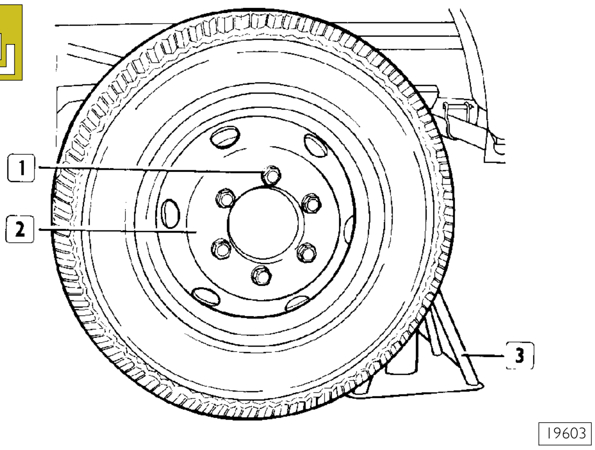
To remove and refit axle 5818, proceed in a similar manner as for axle 5817.

Adjustment values, tightening torque values and equipment are those specified in this chapter.

520620 Wheel hub removal and refitting

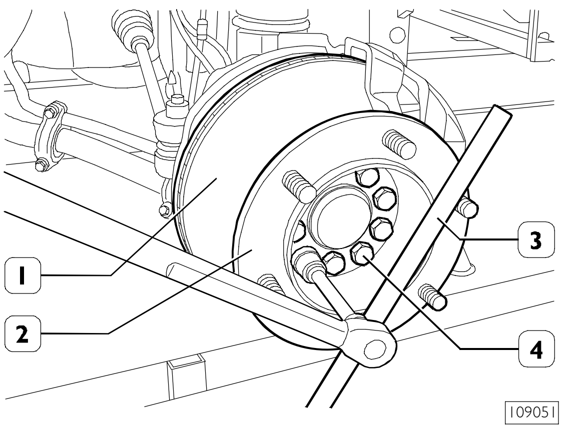
Removal

Figure 3



Free the screws (1) securing the wheel rim.
Lift the vehicle and put the stands (3) under the structural members in a forward position.
Unscrew the nuts (1), take off the protection (2) and remove the entire wheel.
Remove the braking gaskets as described in the "Brake" section, or remove the mounting with the brake caliper as described for axle 5817.

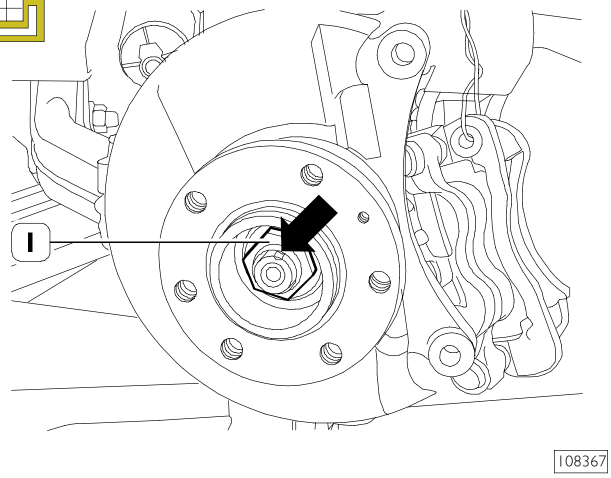
Figure 4



Stop flange (2) rotation by means of a proper lever (3), then remove screws (4) and take flange (3) and brake disc (1) off the wheel hub.

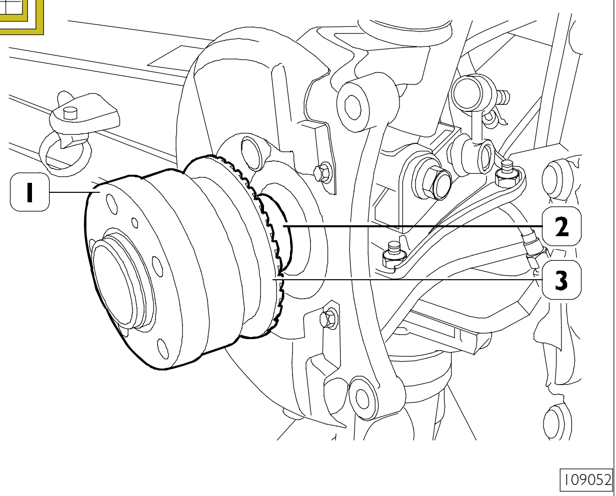
NOTE Check the conditions of the brake disc and the braking gaskets, as described in the "BRAKING SYSTEM" section.

Figure 5



Lift the deformation (⇒) of the nut (1) and unscrew this with a suitable wrench.

Figure 6



Extract the wheel hub (1) from the pin of the stub axle (2).

NOTE If any trouble is found with the wheel hub or bearing, the assembly needs to be replaced since the parts are not supplied as single spares.

When putting aside the wheel hub, take care not to damage the phonic wheel.

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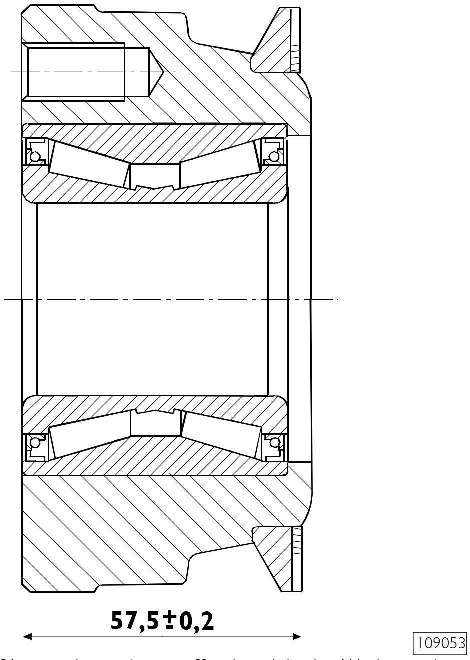
526712 Replacing phonic wheel

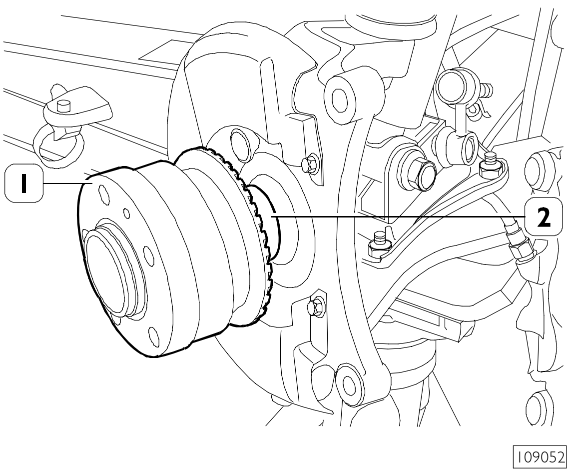
Figure 7



Phonic wheel (2) can be taken off wheel hub (1) by using generic tools. Pull-in load: 500 ÷ 900 kg.
The phonic wheel should be mounted on the wheel hub after heating it to a temperature of 150°C.
On completing assembly, make sure the "phonic" wheel sits in its seat in the hub properly and is positioned at the distance shown in the figure.
Check the oscillation of the phonic wheel (2). Tolerance must be no greater than 0.1 mm.

Refitting

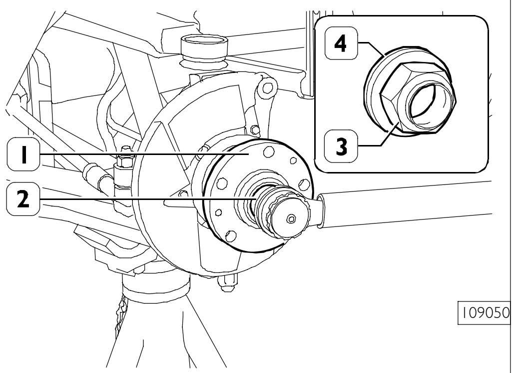
Figure 8



Lubricate the surface of the stub axle pin (2) with TUTELA MR3 grease and key the wheel hub (1).

NOTE The wheel hub must be keyed without forcing.. If there are difficulties, do not assemble since the bearing may be damaged.
Extract the wheel hub, check the cause of the difficulties and eliminate them.

Figure 9

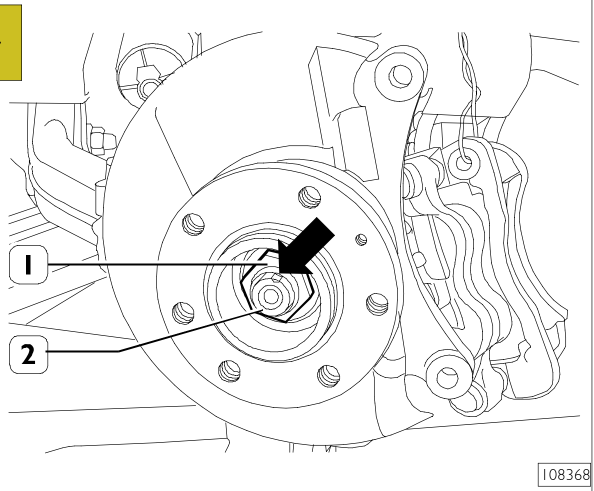


After hub (1) is force-fitted, screw down nut (3).

Tighten the nut (3) to the required torque with the Allen wrench (2).

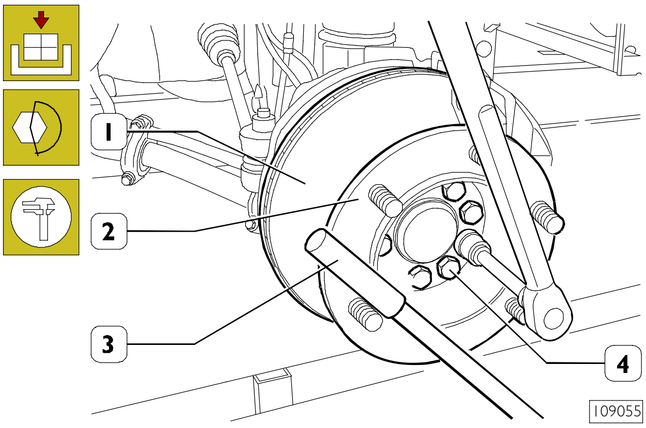
NOTE Nut (3) is equipped with a fixed washer (4).

Figure 10



Deform the collar of the nut (1) by the milling (⇒) of the pin (2).

Figure 11

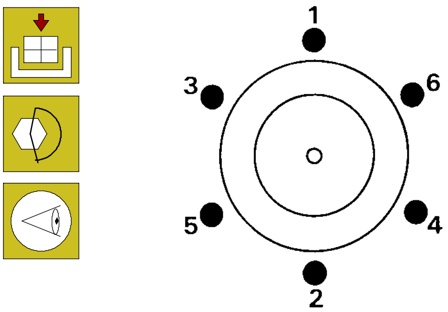


Fit brake disc (1) and flange (2) onto the wheel hub. Stop flange (2) rotation by means of a proper lever (3), then tighten fastening screws (4) to the specified torque.

Using a magnetic dial gauge, check the eccentricity of the brake disc: it must not exceed 0.125 mm.

Fit the support, together with the brake caliper and braking gaskets, into place back to the stub axle, by tightening the fastening screws to the specified torque.

Figure 12



Assemble:

- the wheel on the brake drum;
- the nut protection and screw the fixing nuts.

Tighten the nuts fixing the wheel to the prescribed torque according to the diagram shown in figure.

522820 STUB AXLE REMOVAL AND RE-FITTING

Perform stub axle removal and refitting as described for axle 5817, without considering the points concerning the stabiliser bar since the latter is lacking on axle 5818.

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Axle 5819

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DESCRIPTION

The front axle 5819 has independent wheels.

It is basically composed of:

- stub axles;
- wheel hubs;
- suspension arms.

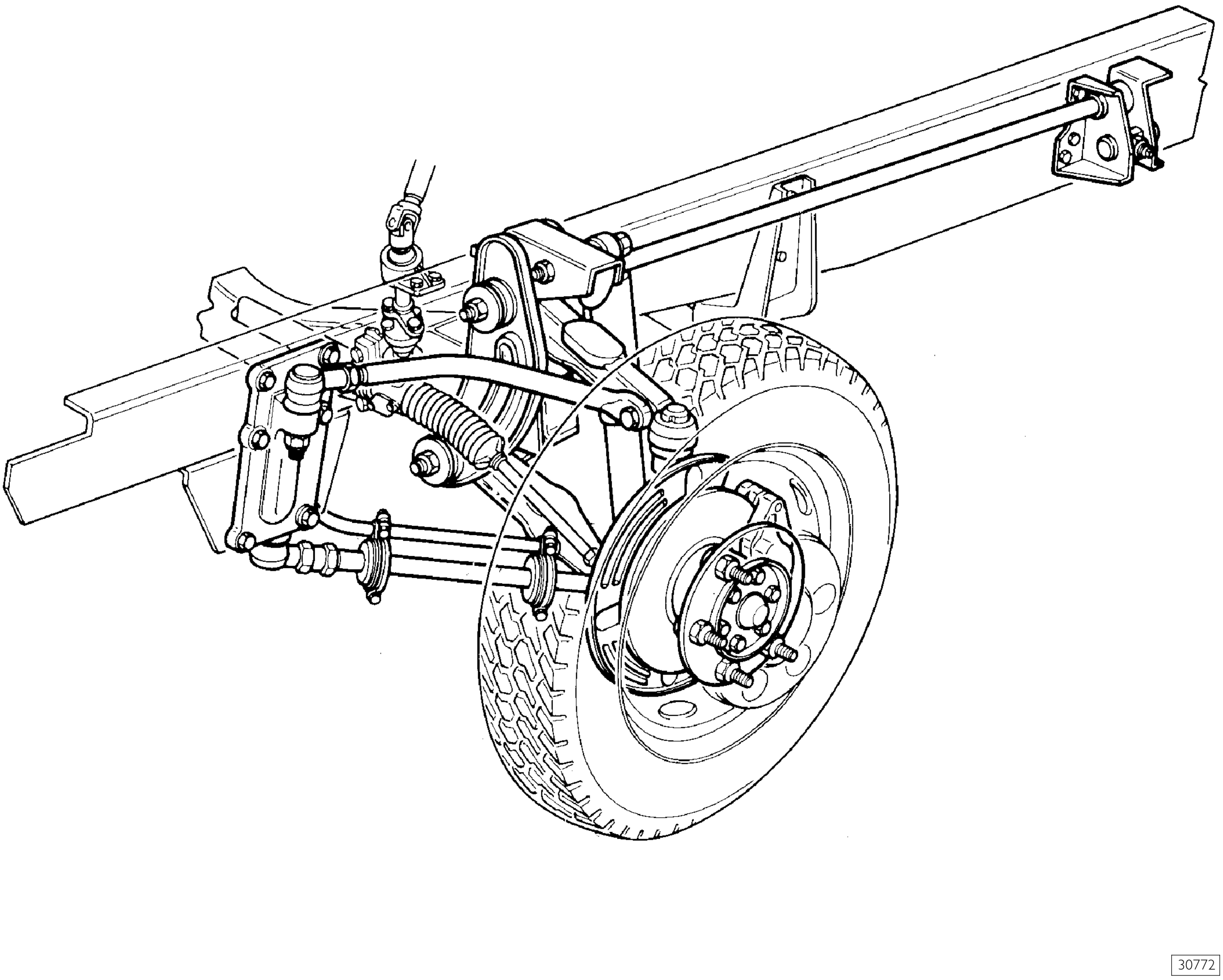
The stub axles are also the end elements of the suspension.

They are connected to the top and bottom suspension arms by swivel heads that allow turning the stub axle.

The brake calipers and steering levers are secured on the king-pin of the stub axles.

The hubs are supported on the stub axle pins by Unit-Bearings, which need no adjustment or lubrication.

Figure 1



SPECIFICATION AND DATA

Axle type	5819
WHEEL HUBS	
Wheel hubs bearings	UNIT BEARING
Hub bearings end play	-
Wheel hub bearings play adjustment	Not Adjustable Fixing nut torque tightening
WHEEL GEOMETRY	
Wheel camber angle (vehicle at static load)	0° 30' ± 20'
Wheel caster angle (vehicle at static load)	1° 35' ± 20'
Wheel toe-in (vehicle at static load)	2.5 ± 1

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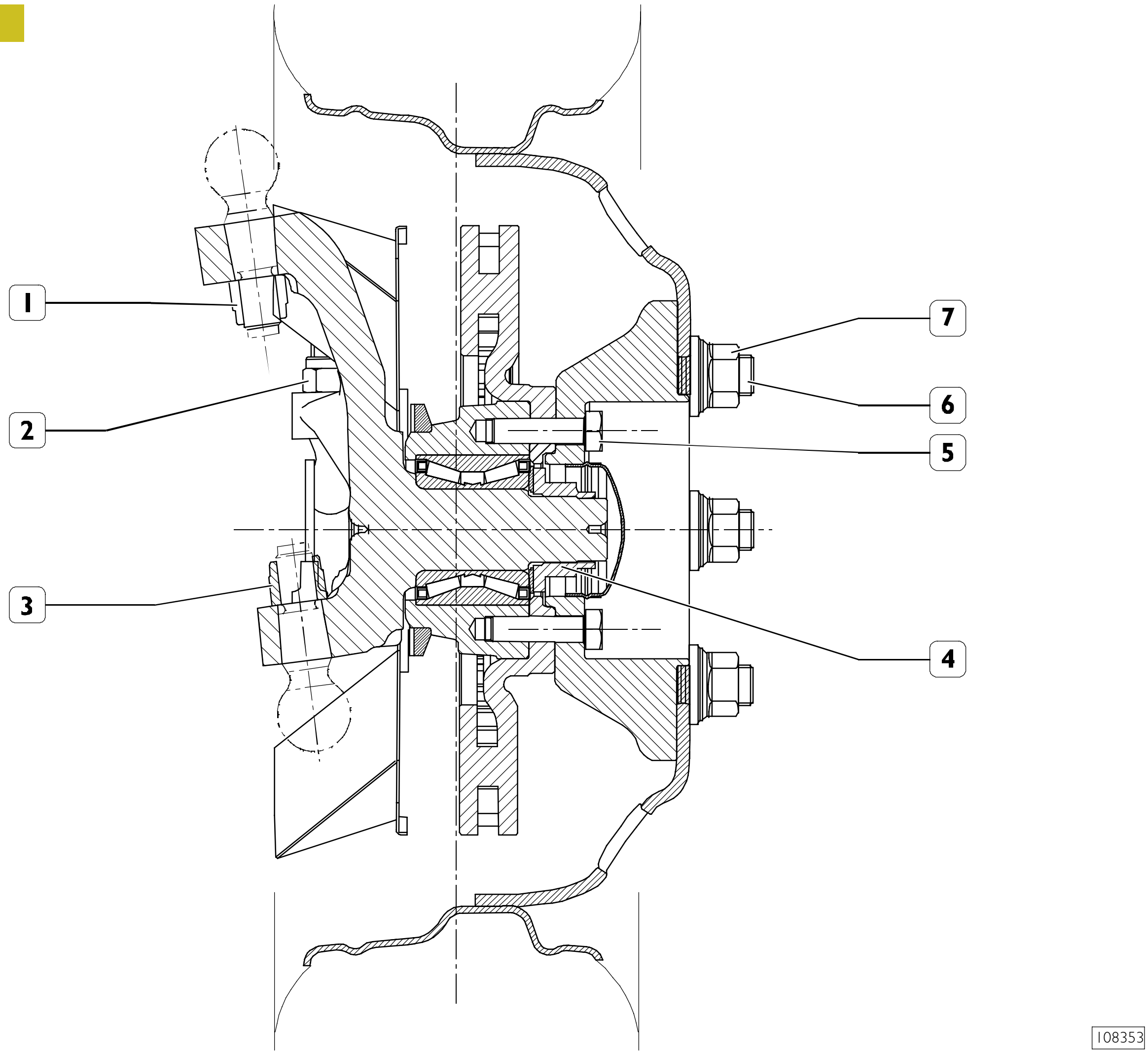
TIGHTENING TORQUES

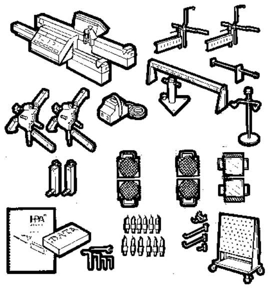
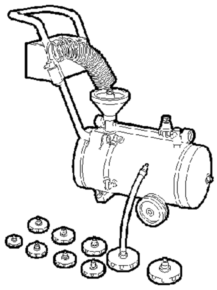
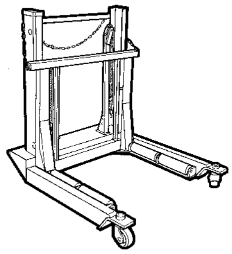
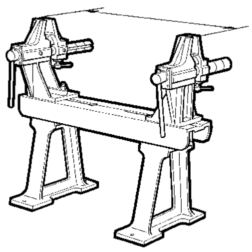
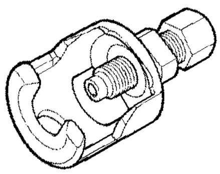
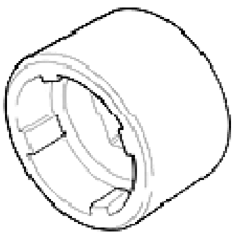
Figure 2



AXLE 5819

PART		TORQUE Nm	TORQUE kgm
	Screw securing caliper mounting to stub axle	176 ÷ 217	18 ÷ 22
1	Nut securing the upper swinging arm jointed head to the stub axle	157 ÷ 177	15.7 ÷ 17.7
2	Nut securing the steering rod jointed head to the lever	68 ÷ 83	6.8 ÷ 8.3
3	Nut securing the lower swinging arm jointed head to the stub axle	157 ÷ 177	15.7 ÷ 17.7
4	Nut securing wheel hub	320 ÷ 420	32 ÷ 42
5	Screw securing plate and brake disc to wheel hub	98 ÷ 108	9.8 ÷ 10.8
7	Nut securing wheel	180 ÷ 200	18 ÷ 20
	Screw securing guards to stub axle	7 ÷ 10	0.7 ÷ 1

TOOLS

TOOL NO.		DESCRIPTION
99305354		Portable optical reading tool for checking wheel trim
99306010		Apparatus to purge air from brakes and clutch
99321024		Hydraulic trolley for removing/refitting wheels
99322215		Driving and steering axle overhaul stand
99347074		Tool for extracting steering tie rod king-pins
99357144		Wrench for spindle pin ring nut

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REPAIR OPERATIONS

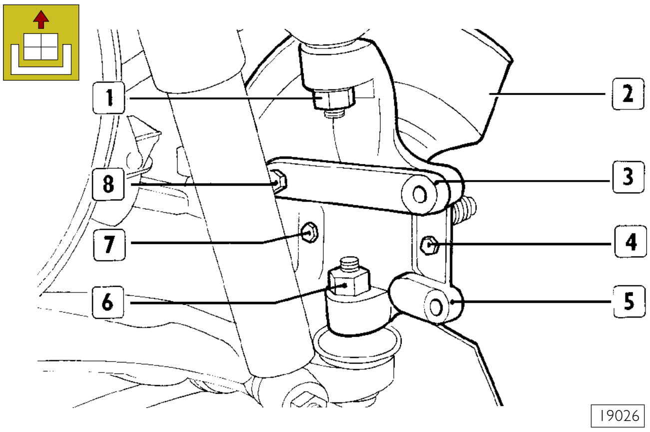
520610 AXLE 5819 OVERHAUL

The following paragraphs describe the overhaul operations that differ from axle 5818 operations.
To remove and refit axle 5819, proceed in a similar manner as for axle 5823.
Adjustment values, tightening torque values and equipment are those specified in this chapter.

520611 Stub axle removal and refitting

Removal

Figure 3



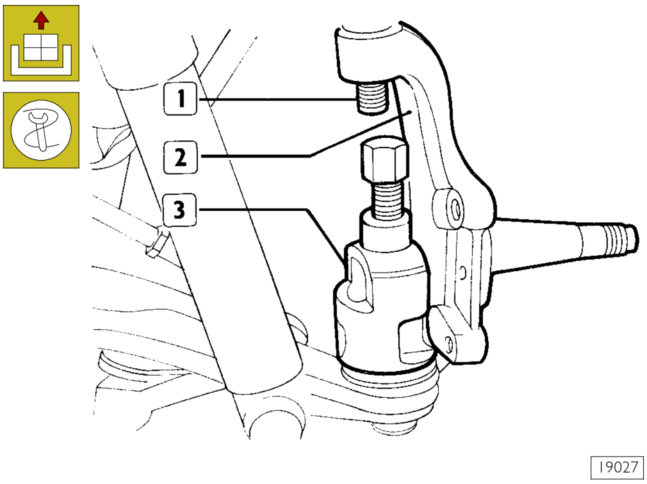
Remove wheel hub as described in the relevant chapter (operation 520620) concerning axle 5817.

Remove from stub axle (5):

- ❑ dust cover (2) by loosening screw (7);
- ❑ steering lever (3) by loosening screw (8);

Loosen kingpin (1 and 6) fixing nuts from stub axle (5).

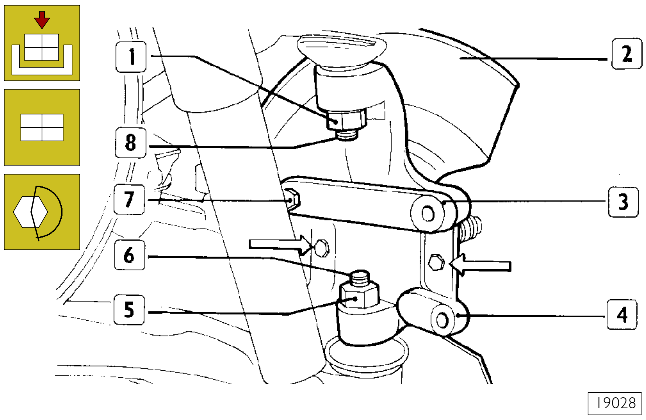
Figure 4



Use tool 99347074 (3) to remove kingpin (1) from stub axle (2) then remove the latter.

Refitting

Figure 5



Set upper and lower lever kingpins (6 and 8) into stub axle seat (4) then tighten self-locking nuts (1 and 5) to the prescribed torque.

Refit steering lever (3) on stub axle by tightening the relevant fixing screw and nut (7) to the prescribed torque.

Refit dust cover (2) to stub axle by means of the proper screws indicated with arrows.

NOTE Self-locking nuts (1 and 5) cannot be reused after removing.

Refit wheel hub as described in the relevant chapter (operation 520620) concerning axle 5818.

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5206 Axle 5823

DESCRIPTION

The front axle 5823 has independent wheels.

It is basically composed of:

- stub axles;
- wheel hubs;
- suspension arms.

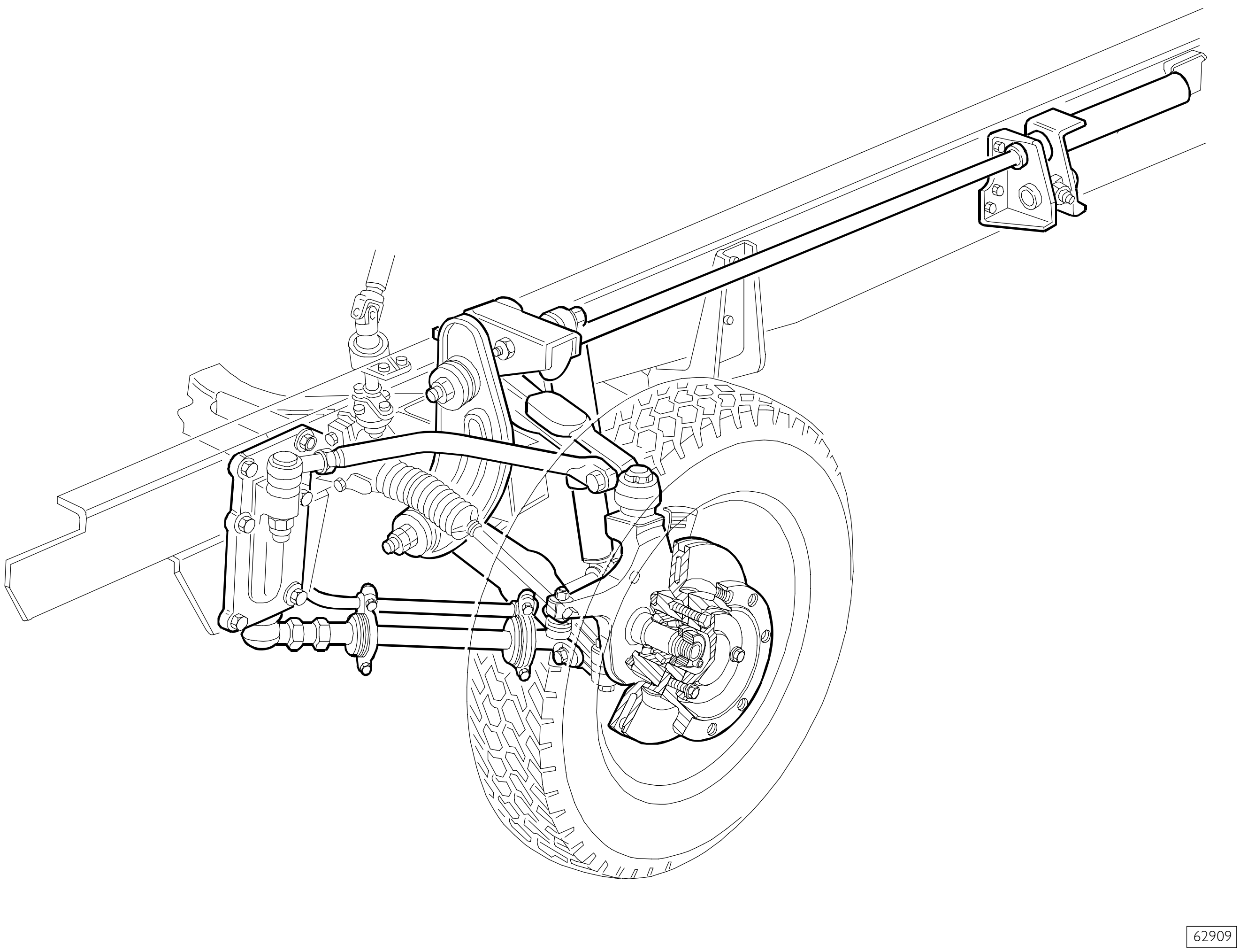
The stub axles are also the end elements of the suspension.

They are connected to the top and bottom suspension arms by swivel heads that allow turning the stub axle.

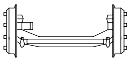
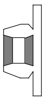
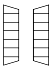
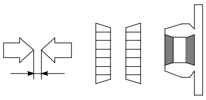
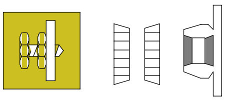
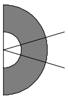
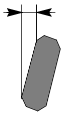
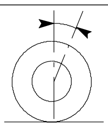
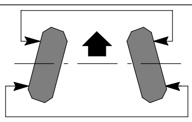
The brake calipers and steering levers are secured on the king-pin of the stub axles.

The hubs are supported on the stub axle pins by Unit-Bearings, which need no adjustment or lubrication.

Figure 1



SPECIFICATION AND DATA

	Axle type	5823
	**WHEEL HUBS**	
	Wheel hubs bearings	UNIT BEARING
	Hub bearings end play	0.11 ÷ 0.14
	Wheel hub bearings play adjustment	Not Adjustable Fixing nut torque tightening
	**WHEEL GEOMETRY**	
	Wheel camber angle (vehicle at static load)	1° ± 20'
	Wheel caster angle (vehicle at static load)	2° 30' ± 20'
	Wheel toe-in (vehicle at static load)	2.5 ± 1 mm

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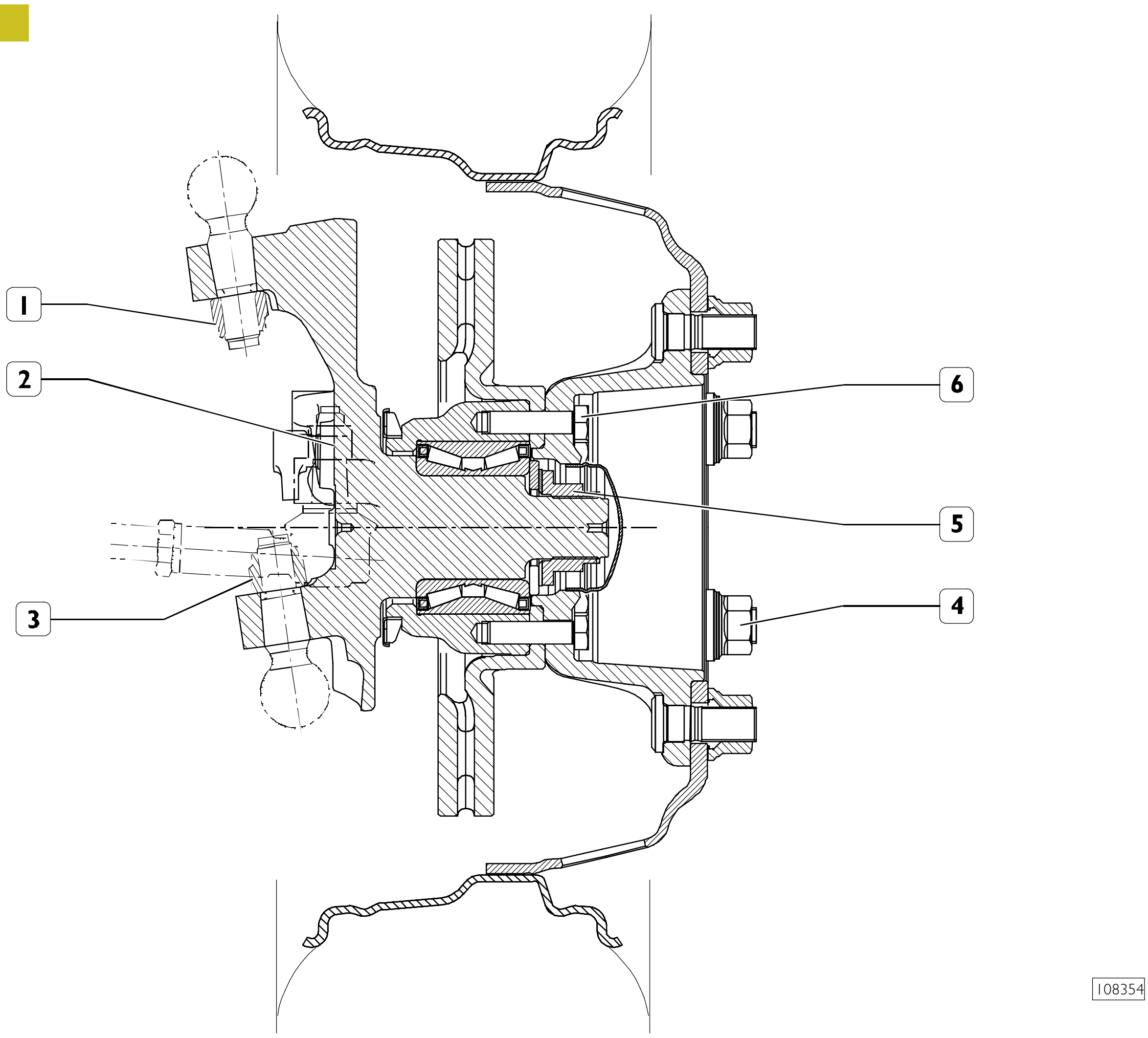
TIGHTENING TORQUES

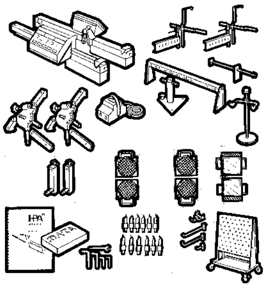
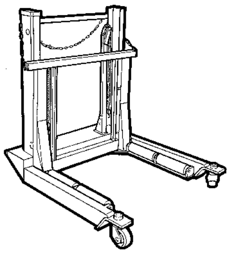
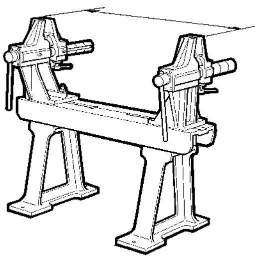
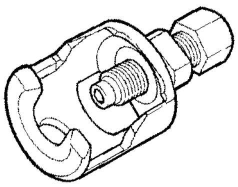
Figure 2



AXLE 5823

COMPONENT		TORQUE	
		Nm	kgm
1	Nut securing the upper swinging arm jointed head to the stub axle	125 ÷ 140	12.5 ÷ 14
2	Nut securing the steering rod jointed head to the lever	68 ÷ 83	6.8 ÷ 8.3
3	Nut securing the lower swinging arm jointed head to the stub axle	160 ÷ 180	16 ÷ 18
5	Nut securing wheel hub - torque - angle	 50 ÷ 60 30.1° ÷ 34.1°	 5 ÷ 6
6	Screw securing the brake disc and flange to the wheel hub. - torque - angle	 43 ÷ 53 28.4° ÷ 30.4°	 4.3 ÷ 5.3
4	Nut securing wheel	284.5÷ 343.3	28.4 ÷ 34.3
	Screw securing caliper to stub axle	7 ÷ 10	0.7 ÷ 1
	Screw securing caliper mounting to stub axle	110 ÷ 140	11.2 ÷ 14.3

TOOLS

TOOL No.		DESCRIPTION
99305354		Portable optical reading tool for checking wheel trim
99321024		Hydraulic truck for removing - refitting operations
99322215		Stand to overhaul axles
99347074		Tool to remove drag link joints and wishbones

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REMOVING AND REFITTING AXLE 5823

Removal

Set the vehicle on solid, level ground.

Lock the rear wheels with scotches, remove the wheel rim guards and loosen the screws or nuts fixing the wheel.

Lift the front of the vehicle and rest the chassis frame on supports.

Take out the screws or nuts fixing the wheel and remove them with tool 99321024.

Remove the front right and left mudguard (1).

Remove the right and left mudguards under the bumpers (17).

To help remove the front suspension mounting (2), free the top screw stay (14) in correspondence with the screw (15) fixing to the suspension arm (13).

Remove the front suspension mounting (2) by taking out the chassis frame fasteners (16).

Fit the top screw stay (14) back onto the suspension arm (13).

The same steps must be performed on both left and right.

Adjust the load on the right and left torsion bars (9).

Undo the nut (11) and unscrew the threaded pin (12) until the torsion bar (9) is entirely "discharged".

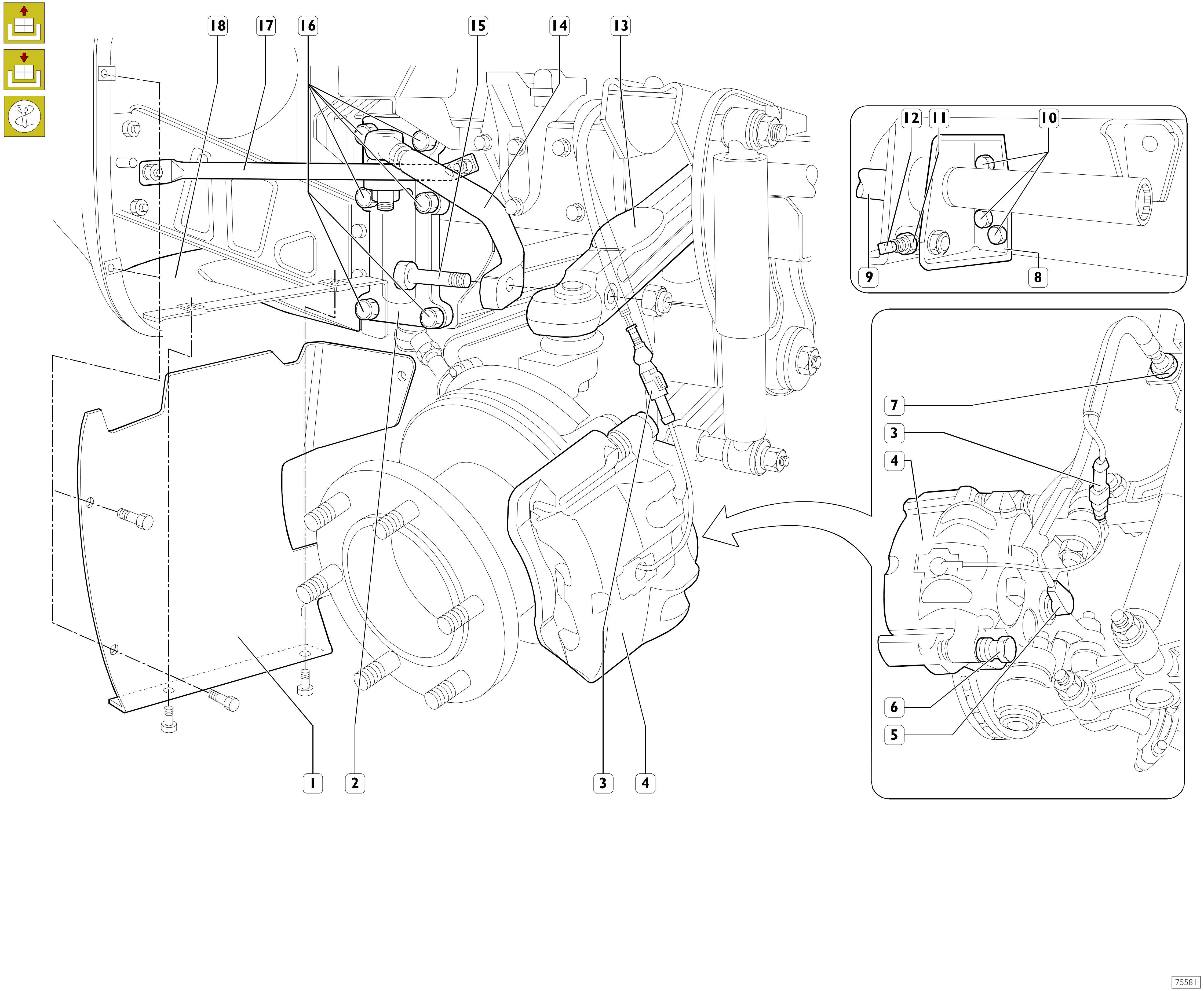
Remove the fasteners (10) fixing the mounting (8) to the chassis frame.

Extract the mounting (8) from the torsion bar (9).

If it is decided to leave the brake callipers on the axle, proceed to:

- ❑ disconnect the electrical connection (3) signalling brake lining wear and the ABS sensor (5) if there is one;
- ❑ disconnect the brake fluid pipes in correspondence with the fittings (7) after draining the system;
- ❑ if it is decided to leave the brake callipers on the vehicle, proceed to:
- ❑ disconnect the brake callipers (4) from their respective stub axles by taking out the screws (6) and supporting the callipers to prevent any strain on the pipes.

Figure 3



From underneath the vehicle:

- ❑ remove the central guard (7) under the engine by taking out the screws securing it to the side guards (8) and to the front cross member of the chassis frame;
- ❑ remove the right and left side guards (8) of the engine by taking out the screws securing them to the chassis frame;
- ❑ remove the right and left side guards (9) of the gearbox by taking out the screws securing them to the axle (11) and to the cross member (12) under the gearbox;
- ❑ disconnect the brake fluid pipe (10) from the retaining blocks on the axle;
- ❑ drain off the power-steering fluid and disconnect the pipes (4) and (5);
- ❑ disconnect the power steering column (3) in correspondence with the coupling (6);
- ❑ place the removal bracket on the hydraulic jack and put it all under the axle;
- ❑ undo the chassis frame bottom fixing screws (2) and the top fixing nuts (1);
- ❑ lower the hydraulic jack and extract the axle (11).

Refitting

Reverse the steps described for removal tightening the screws or nuts to the prescribed torque.

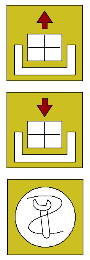
Adjust the load of the torsion bar as illustrated under the specific heading.

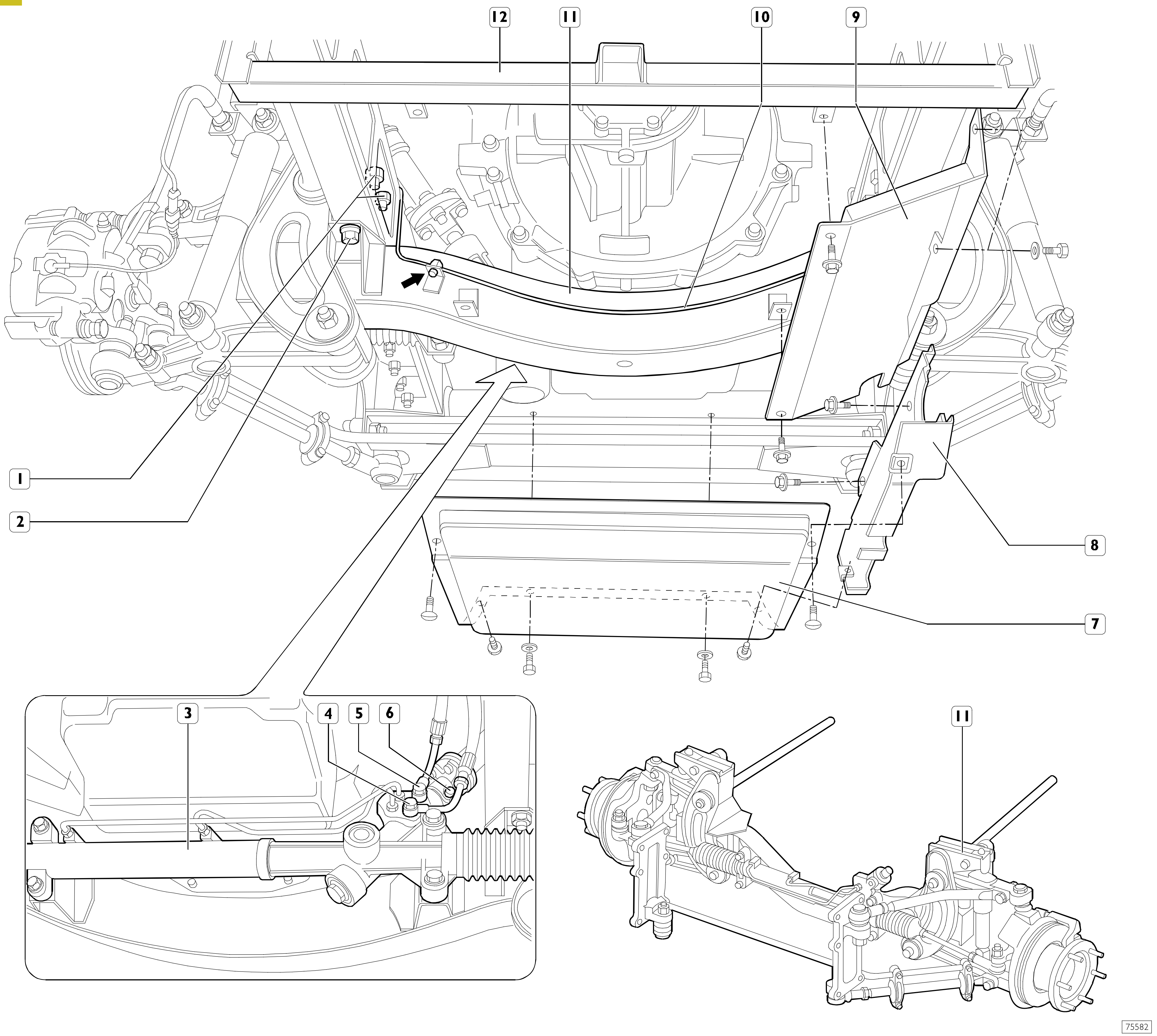
Top up the power-steering fluid.

If the brake callipers have been left on the axle, restore the brake fluid level and bleed off any air.

Check and adjust the front wheel geometry.

Figure 4





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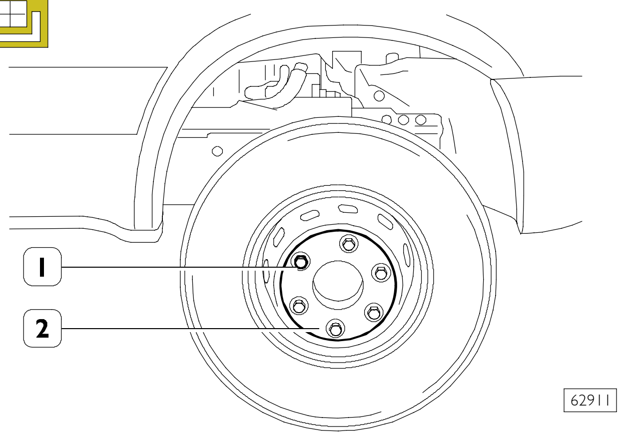
520610 AXLE 5823 OVERHAUL

Overhaul operations described in this sections are those differing from axle 5819.

Figure 5



Loosen wheel rim fastening nuts (1).

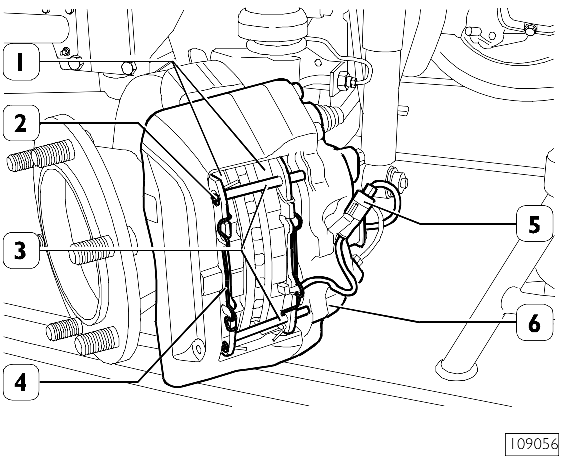
Lift the vehicle and set the supporting stands under the side members in forward position.

Loosen nuts (1), remove protection (2) and remove the entire wheel.

520620 Wheel hub removal and refitting

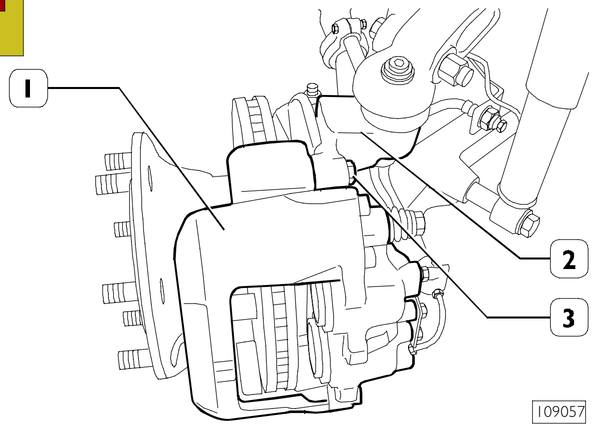
Removal

Figure 6



Remove safety springs (2) from pins (3).
Take pins (3) out of brake caliper (6), then recover braking gasket (1) retaining clips (4).
Disconnect gasket wear indicator electric connection (5).
Take braking gaskets (1) out of brake caliper (6).

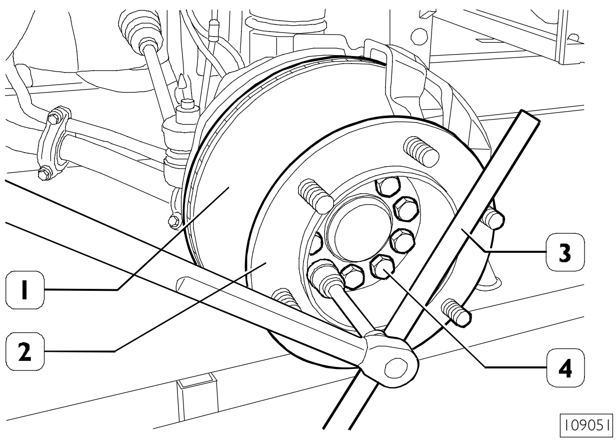
Figure 7



Remove screws (3), then take the support, together with brake caliper (1), off stub axle (2).

NOTE Suitably support the brake calliper (1) to prevent oil pipe tensioning.

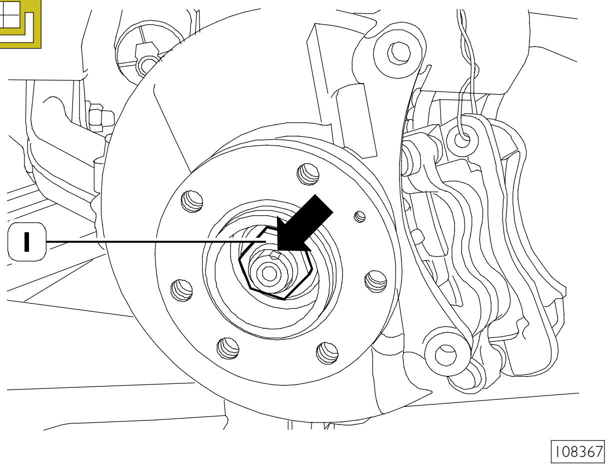
Figure 8



Stop flange (2) rotation by means of a proper lever (3), then remove screws (4) and take flange (3) and brake disc (1) off the wheel hub.

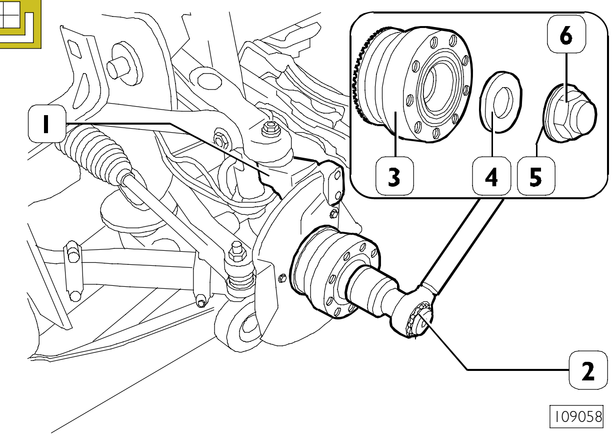
NOTE Check brake disc and lining conditions as described in the BRAKE SYSTEM section.

Figure 9



Lift nut (1) countersink (⇒).

Figure 10



Use a box wrench (2) to remove nut (5) securing wheel hub (3) to stub axle (1) pin.
Take wheel hub (3) and washer (4) out of stub axle (1) pin.

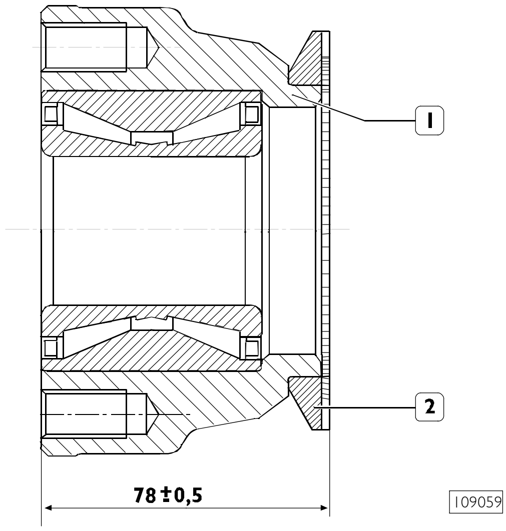
NOTE Nut (6) is equipped with a fixed washer (5).

NOTE If any trouble is found with the wheel hub or bearing, the assembly needs to be replaced since the parts are not supplied as single spares.

When repairing the wheel hub, take care not to damage the phonic wheel.

526712 Replacing phonic wheel

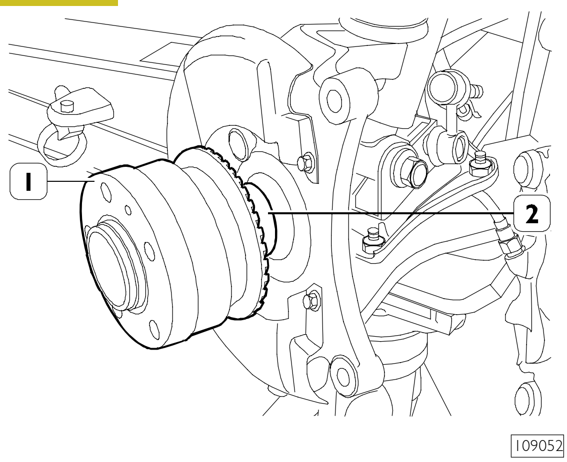
Figure 11



The possible extraction of the phonic wheel (2) can be taken off wheel hub (1) by using generic tools. Pull-in load: 500 ÷ 900 kg.
When the assembly is ended, make sure that the "phonic" wheel perfectly rests on the hub housing and that is positioned at the dimension shown in figure.
Check that the orthogonality and oscillation of the phonic (2) wheel is no greater than 0.1 mm.

Refitting

Figure 12



Lubricate the surface of the stub axle pin (2) with TUTELA MR3 grease and key the wheel hub (1).

NOTE The wheel hub must be keyed without forcing.. If there are difficulties, do not assemble since the bearing may be damaged.
Extract the wheel hub, check the cause of the difficulties and eliminate them.

See Figure 10.
Fit washer (4) into place, then screw down nut (6).

NOTE Nut (6) is equipped with a fixed washer (5).

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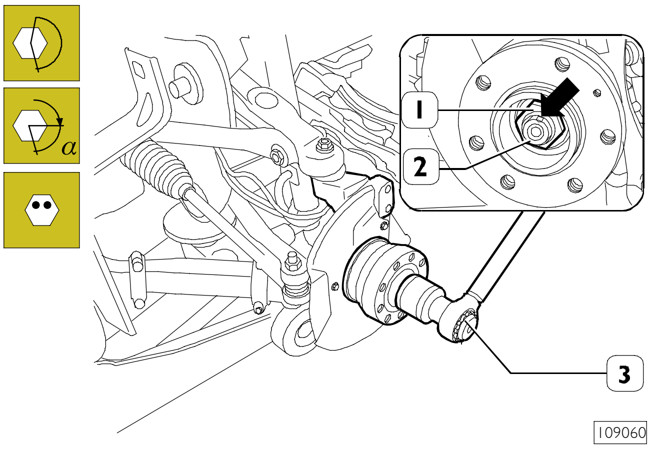
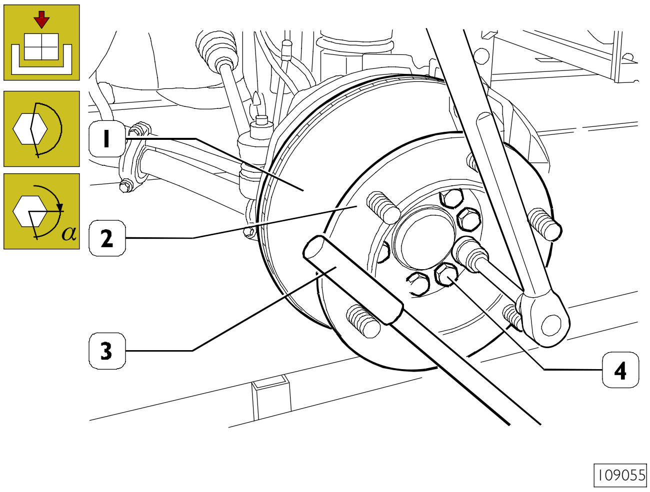
Figure 13



Use a torque wrench and a box wrench (3) to tighten nut (1) in two separate phases:
phase 1: torque tightening to 50 ÷ 60 Nm (5 ÷ 6 kgm)
phase 2: angle tightening (30.1° ÷ 34.1°).

Countersink nut (1) collar at pin (2) milled portion (⇒).

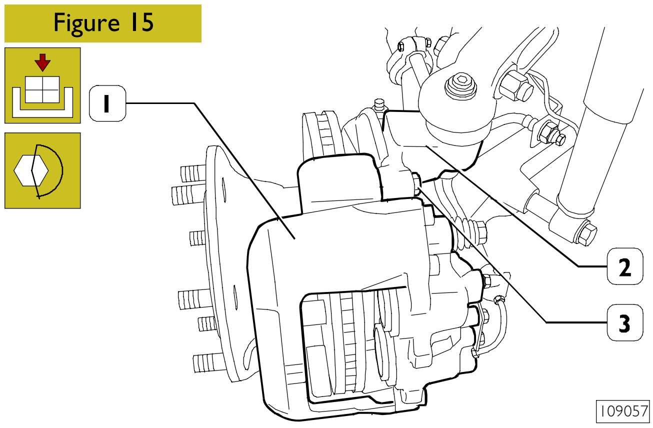
Figure 14



Fit brake disc (1) and flange (2) onto the wheel hub.
Screw down screws (4).

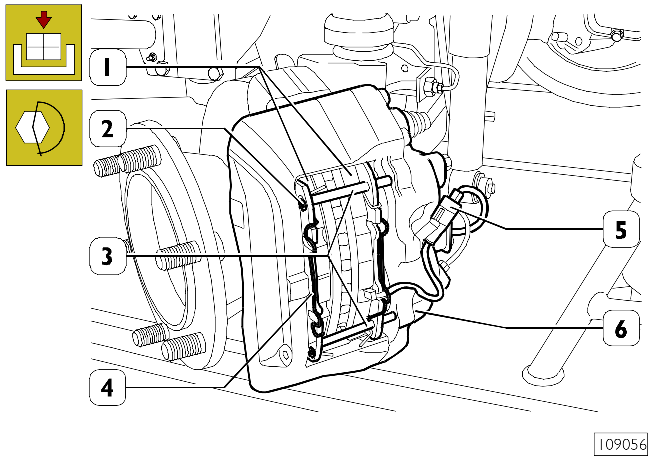
Stop flange (2) rotation. Tighten screws (4) in two separate phases:
phase 1: torque tightening to 43 ÷ 53 Nm (4.3 ÷ 5.3 kgm)
phase 1: angle tightening (28.4° ÷ 30.4°).

Figure 15



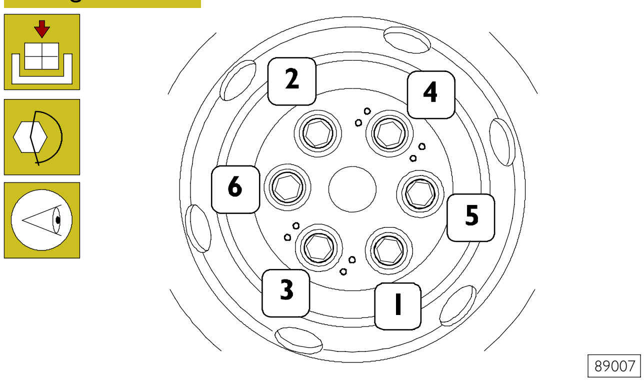
Place brake caliper (1) onto stub axle (2).
Screw down screws (3) and tighten them to the specified torque.

Figure 16



Fit braking gaskets (1) into place. Position springs (4), then fit pins (3) into brake caliper (6).
Fit safety springs (2) into pins (3).
Connect braking gaskets wear indicator electric connection (5).

Figure 17



Fit the wheel onto the flange, then position the nut protection. Tighten the wheel fastening nuts to the specified torque, in accordance with the diagram illustrated in the figure.

Wheel geometry

DESCRIPTION

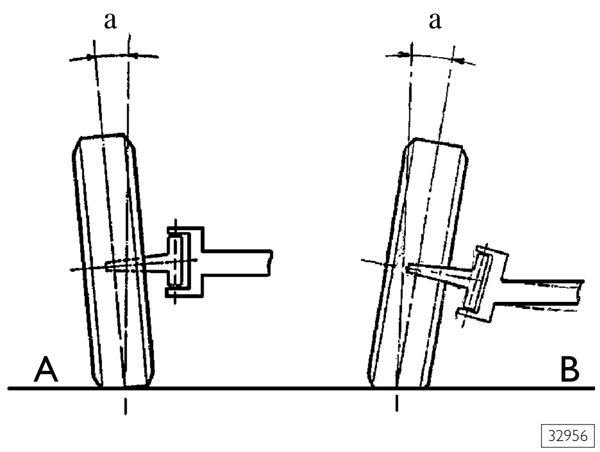
In order to have a good vehicle ground holding, a low consumption of tyre and to enable the driving wheels to return to straight running after steering, the front wheels are adjusted at defined assembly angles:

- ❑ wheel camber angle;
- ❑ king-pin camber angle;
- ❑ caster angle;
- ❑ wheel toe-in.

These angles, accurately calculated, enable the correct balancing of the forces created when the vehicle is moving, in the different load conditions, tending to change the position of the wheels on the ground.

Wheel camber angle

Figure 1

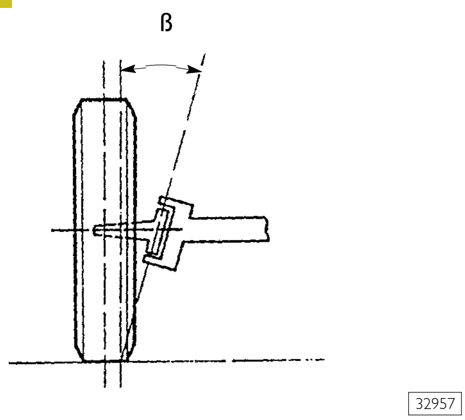


The camber angle (α) is the angle formed by the axis passing through the wheel centre line and the vertical to the ground, looking at the vehicle from the front.

The camber angle is positive (A) when the upper part of the wheel tends toward the outside; it is negative (B) when the wheel upper part tend toward the inside.

Camber angle

Figure 2



The king-pin camber angle (β) is the angle formed by the axis passing through the king-pin and the vertical to the ground, looking at the vehicle from the front.

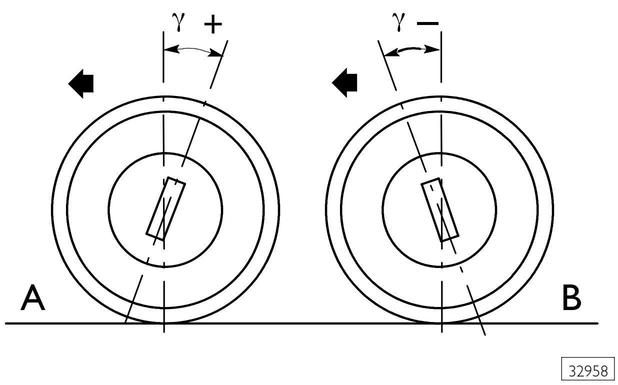
When the projection of the king-pin axis is near to the contact point of the wheel with the ground (opposite tendency to the wheel camber) the angle is positive, it is difficult to say that it is impossible to have the king-pin camber angle negative.

The wheel camber angle (α) and the king-pin camber angle (β) enable wheel axis and the king-pin axis to come nearer as much as possible to the contact centre of the tyre on the ground.

In this way, reduced tyre wear and lower steering torque are obtained.

Caster angle

Figure 3



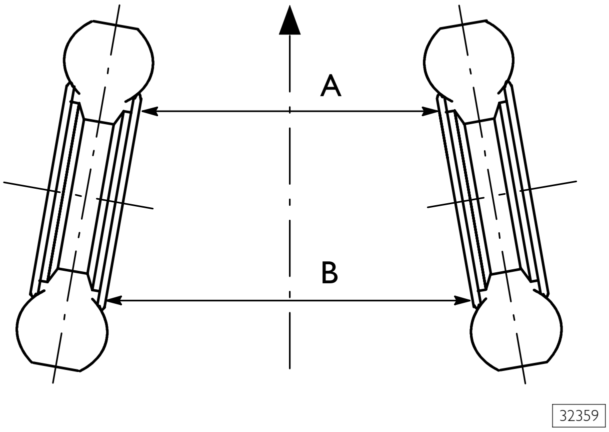
The caster angle (γ) is the angle formed by the king-pin axis with the vertical to the ground, looking at the vehicle from one side.

If the projection formed by the king-pin axis falls in front of the wheel contact point with the ground, in the direction of travel of the vehicle, the caster angle is by convention positive (A); it is negative (B) if it falls behind the wheel contact point with the ground; it is equal to zero if it is perfectly vertical to the contact point.

This angle makes it possible to keep the front wheels straight when the vehicle is running straight and allows the wheels to return spontaneously to running straight from the position taken in the bend, as soon as the steering wheel is released by the driver.

Wheel toe-in

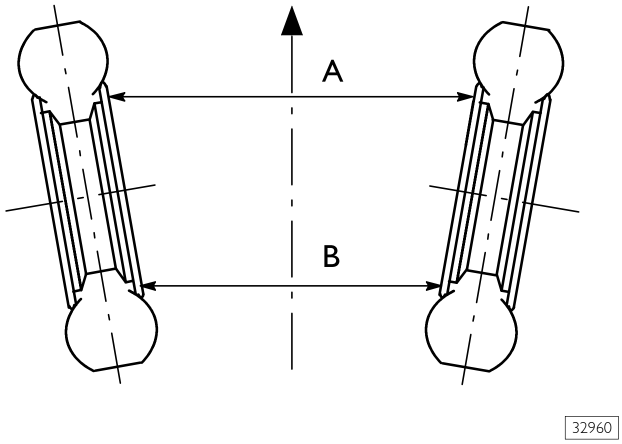
Figure 4



The wheel toe-in results from the difference between the distances A and B (value expressed in mm) measured on the horizontal axis of the rims, looking at the vehicle from the top. In this way a light drive and a low tyre consumption is obtained.

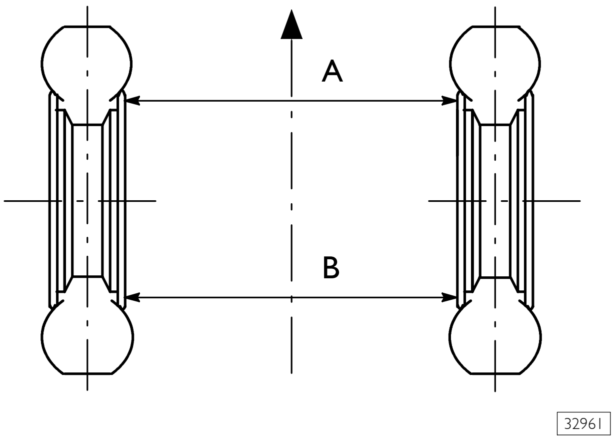
The toe-in is positive if B is higher than A.

Figure 5



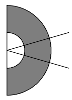
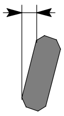
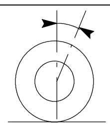
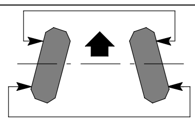
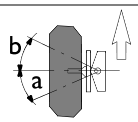
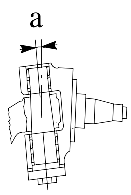
The toe-in is negative if B is lower than A.

Figure 6



The toe-in is equal to zero if B is equal to A.

WHEEL GEOMETRY
SPECIFICATIONS AND DATA

		MODELS			
		29L - 35S	35 (1)	35 (2).40 - 45. - 50.	60C - 65C
	**WHEEL GEOMETRY**	-	-	-	-
	Wheel camber angle (vehicle at static load) (± 20')	0° ± 20'		0° 30' ± 20'	1° ± 20'
	Wheel caster angle (vehicle at static load)	3° ± 20'		1° 35' ± 20'	2° 30' ± 20'
	Wheel toe-in (vehicle at static load) mm	2 ± 1		2.5 ± 1	
	Steering angle: Internal a External b	 47° 30' ± 30' 39° ± 30'		 43° 36° 30'	 37° 7' 45° 6'
	Stub axle king-pin camber α	13.38°		7°	

(1) Front suspension with transverse leaf spring

(2) Front suspension with torsion bar

TIGHTENING TORQUES

PART	TORQUE	
	Nm	kgm
Nut fixing king-pin to the side tie rod of the steering box	15 ÷ 20	1.5 ÷ 2

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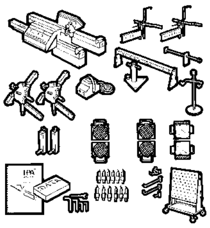
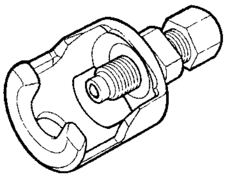
TOOLS

TOOL NO.		DESCRIPTION
99305354		Tool for checking wheel geometry
99347074		Puller for king-pins

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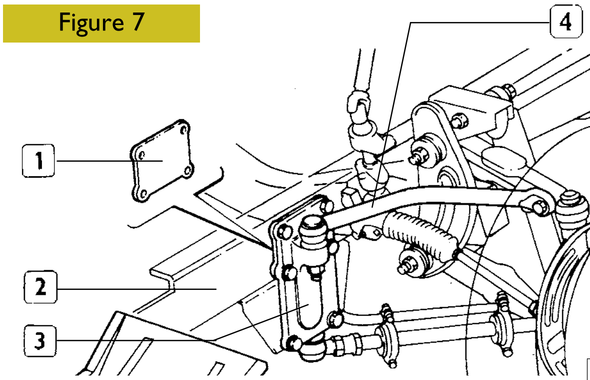
CHECKING CHARACTERISTIC ANGLES

Before proceeding with the checks, it is necessary to perform a preliminary inspection at some of the vehicle members, which can affect the geometry: if malfunctions are found, it is necessary to eliminate them in order to avoid wrong detection.

The check to be performed are the following:

- ❑ tyre pressure;
- ❑ wheel hub bearing play
- ❑ play between steering tie rod pins and stub axle levers;
- ❑ shock absorber efficiency;
- ❑ unallowed deformation of the wheel rims.

Figure 7



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- ❑ Ensure the presence of spacers (1) between side members (2) and tie rod (4) attachment mountings (3) (with the exception of vehicles equipped with 5 mm thick side members). If not, proceed as described on page 60.

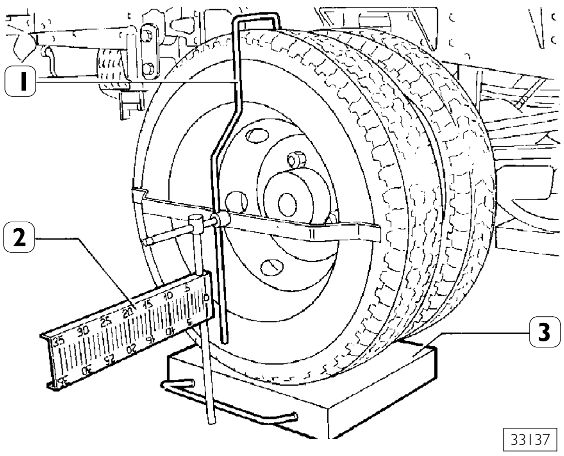
NOTE The checks and possible operations on the wheel geometry must be carried out with the vehicle at static load. Make sure, periodically, that the optical unit are perfectly calibrated.

For modification of the characteristic angles of the wheels, in vehicles with ESP, follow the calibrating procedure of the steering angle sensor assembled in the flywheel as described on page 63 of the Brake Section.

Perform the geometry check using the tool 99305354.

Positioning jaws and projectors

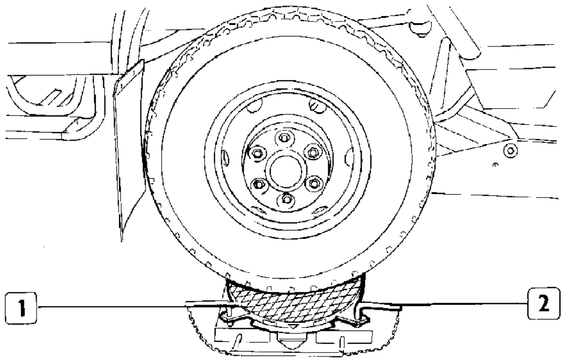
Figure 8



33137

Place the vehicle with the wheel in straight running position on a level surface. Lift the rear of the vehicle and position the board (3). Lower the vehicle, brake the rear wheels and apply the hook (1) with the slide rule (2).

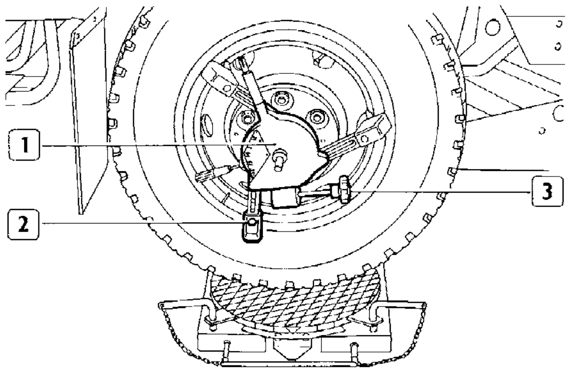
Figure 9



23311

Lift the vehicle front part and position the floating wheels (1) locking them with the locks (2).

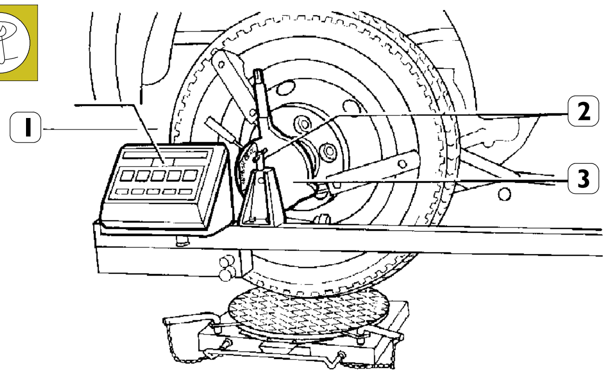
Figure 10



25114

Position the clutch jaw (1) fitted with fixing pins (2). Operating the handgrip (3), lock the jaw on the wheel, making sure that it is perfectly secured.

Figure 11



32818

Assemble the detecting unit (1) on the jaws (3) and constrain it with the screw (2). Repeat the operation on the other wheel.

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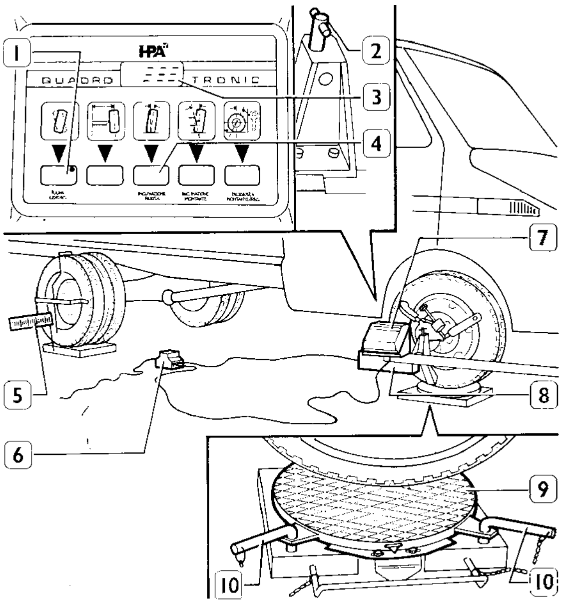
Electronic balancing of rim eccentricity

Figure 12



32819

Connect the detectors plugs (7) to the transformer (6) and switch on the switch (8); loosen the locking screw (2) of the detector and lift the detector lens guard (7).

Make sure that the laser beam does not hit the eyes of people, it will severely damage their sight.

Press the push-button "out of centre" (1) for at least two seconds, the display (3) shows nine lines.

Manually rotate the wheel slowly in the running direction and project the light signal on the slide rule scale (5).

Stop the wheel when the signal read on the slide rule (5) has reached the maximum value and note down the value (e.g. 12).

Rotate the wheel again until the minimum value is reached and note it down (e.g. 8).

Calculate the mean value of the amplitude: 12 + 8 = 20 : 2 = 10 and position the wheel on the mean value calculated marking its position.

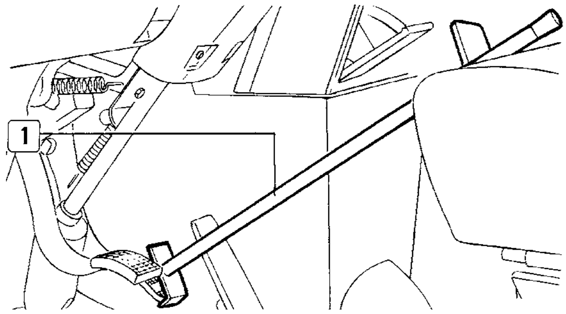
Press the push-button "out of centre " again (1) until the LED (4) of the wheel camber is lighted and on the display (3) a fictitious value is shown.

Repeat the operations on the other wheel.

Lower the vehicle so that the wheels, in the position previously marked, completely rest at the centre of the floating discs (9).

Loosen the floating discs (9) from their bases extracting the pins (10).

Figure 13



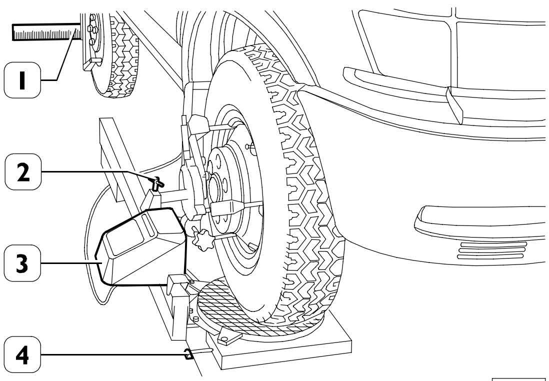
25120

Press the brake pedal locking it with the suitable tool (1) positioned against the seat.

NOTE The wheels must be braked during the whole measuring cycle.

Wheel alignment

Figure 14



52269

Using the level (4) arrange horizontally the detectors (3) and fix them to their position with the screw (2).

Move the slide rules (1) until they are centred by the light signal transmitted by the detector (3) and note down the values.

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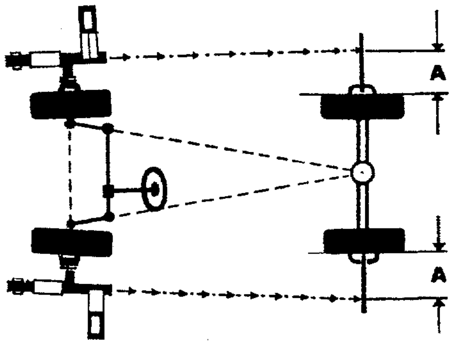
Figure 15



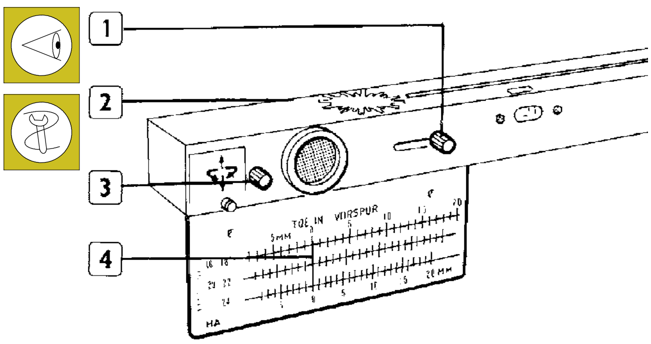
13952

If the values are different, steer the wheels until the light signal indexes are set to two values equal (A) and exactly the mean value of the two previous readings.

In this way a perfect wheel alignment is obtained.

Checking toe-in

Figure 16

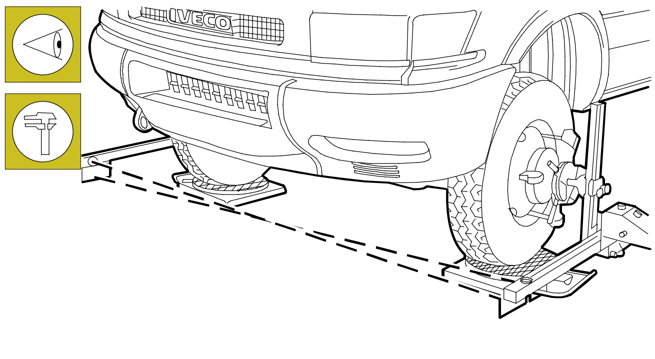


25122

Keeping the detectors in horizontal position and the wheels perfectly aligned, move the lens guard (2) using the lever (1)

Operate the lever (3) and direct the light signal index on the slide rule scale (4) corresponding to the rim diameter.

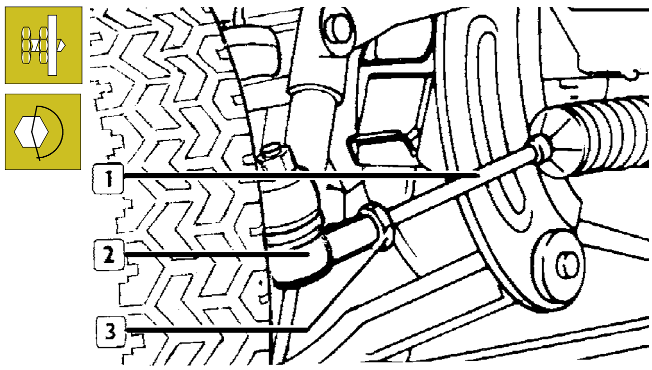
Figure 17



52270

Repeat the same operations on the opposite detector and read the toe-in value on the scales (in millimetres): the result of the algebraic sum of the two values must be the prescribed value.

Figure 18



32295

The positive or negative toe-in adjustment is carried out as follows:

Loosen the nuts (3) on the joint heads (2, right and left).

Turn tie rods (1) up to obtain the toe-in of each wheel equal to half of the prescribed value.

Then tighten the nuts (3) to the prescribed torque.

Front wheel deviation test (vehicle wheelbase check)

The front wheel deviation test and toe-in reading are carried out at the same time.
The partial toe-in values, to be detected on the proper straightedges divided into millimetres, must have the same value and their sum must correspond to the whole toe-in value.
If between the readings there is a difference (e.g.: -2 and + 3), it means that there is a deviation between the two wheels: a wheel onward as to the other wheel, equal to 5 lines of the toe-in scale.
The number of lines is calculated by the algebraic sum [+3-2(-1)=5] or counting the lines included between the two values.

Each line corresponds to a deviation of 2 mm, so the deviation between the two wheels is equal to 10 mm (5 x2).

For vehicles with torsion bar suspension:

After determining which is the defective wheel, check its conditions and the exact assembly dimension of the upper and lower tie rods of the wheel suspension.

If the tie rods have been subject to deformations, replace them; if the assembly dimension is wrong, screw or unscrew the tie rod on the king-pin so that the vehicle wheel base is adjusted and the wheel are on the same axis.

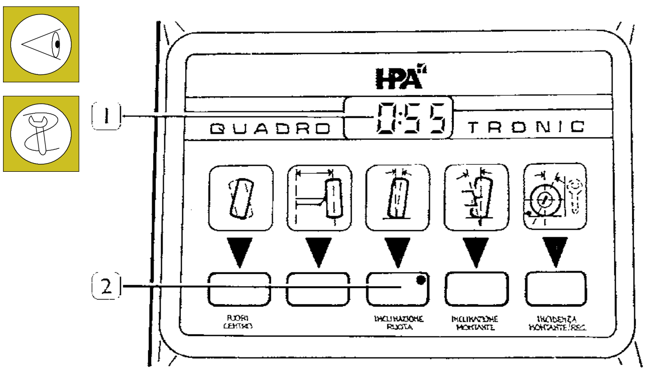
NOTE In order not to change wheel caster angle, a lengthening or shortening of the lower tie rod must correspond to a lengthening or shortening of the upper tie rod.

For vehicles with transverse leaf spring suspension:

The deviation error may be due to deformation of the frame or of the assemblies connected to the wheels.

Checking camber

Figure 19

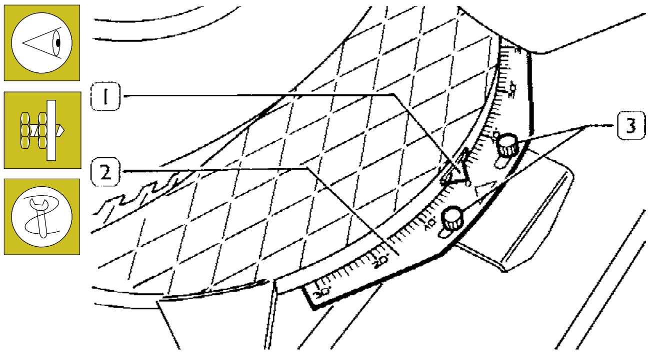


32821

When the front wheels are aligned to the rear ones and the detectors are on an horizontal plane, press the key wheel camber (2) the LED lights up and the display (1) shows the camber angle value.

Checking king-pin angle and caster angle

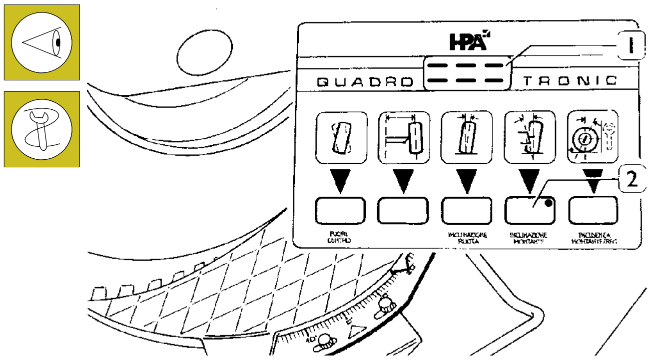
Figure 20



32823

When the front wheels are aligned to the rear ones, loosen the knurled knobs (3) and zero the graduated sector (2) on the index (1) of the floating disc.

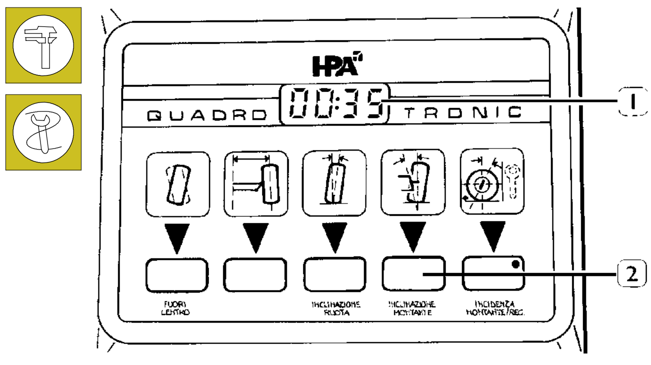
Figure 21



32824

Steer the wheel 20° toward the inside; press twice the king-pin camber push-button (2), the LED lights up and the display (1) shows 9 horizontal lines.

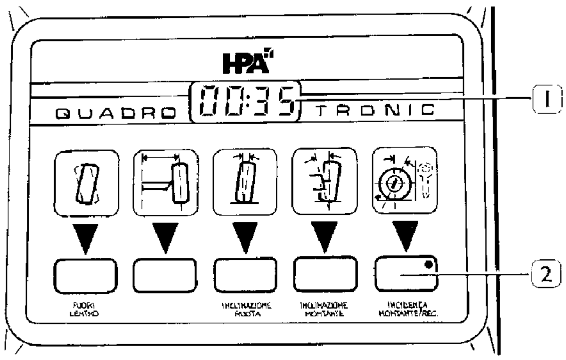
Figure 22



32825

Steer the wheels 20° toward the outside, press the king-pin camber push-button (2) and the display (1) shows the king-pin camber angle.

Figure 23



32826

Without moving the wheel, press the caster angle push-button (2), the LED lights up and the display (1) shows the caster angle value.

Repeat these operations on the other wheel.

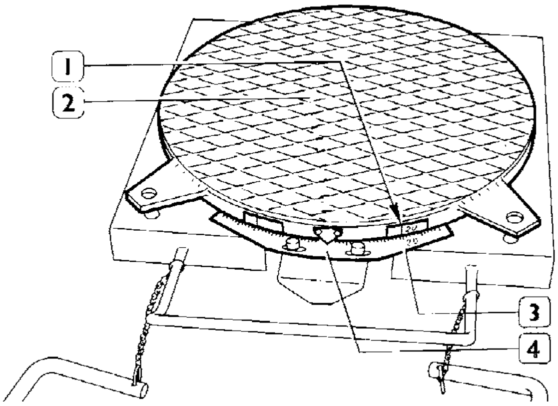
NOTE The king-pin camber angle and the wheel caster angle are stored, after detection, by the instrument and can be recalled when necessary pressing the push-button relevant to the concerned angle.

For regulating the caster angle proceed as follows:

- ❑ set wheels in a straight running condition;
- ❑ press the kingping angle button until its relevant LED starts blinking;
- ❑ screw and unscrew, as required, lower tie rod joint head, considering that the joint head can't carry out more than one turn.

Checking steering angles

Figure 24



33134

This check is carried out during the king-pin camber check of during the caster angle check, making the following operations:

- ❑ if the prescribed steering angles exceed 30°, the mark 20°(1) on the floating disc (2) and the mark 30° (3) on the graduated selector (4) mast be considered as initial reference values.
- ❑ Steer the wheels until the floating disc index of the wheel inside the bend in correspondence with the prescribed steering angle.

NOTE For steering angles higher than 30°, it is necessary to consider as reference index the mark 20° (1).

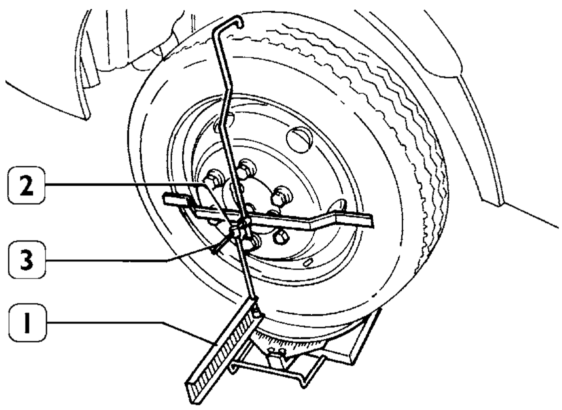
- ❑ under the above conditions, check on the other wheel that the steering angle value is as expected;
- ❑ reverse steering and check again.

If different values are found, possible causes can be:

- ❑ wrong centering of the steering box;
- ❑ deformations caused by impacts;
- ❑ deviation error between axles (front and rear axles) higher than 20 mm.

Checking rear axle alignment

Figure 25

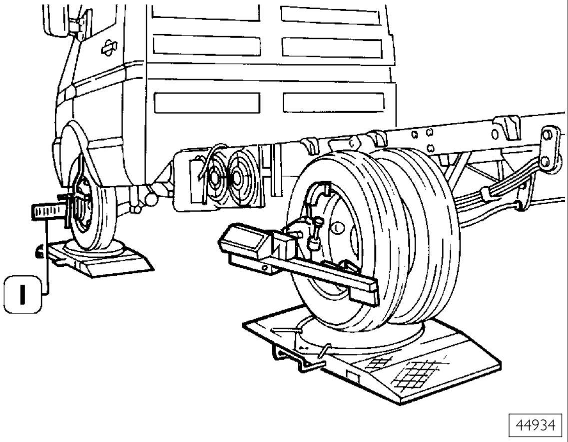


44933

Apply the slide rule (1) to the front wheels checking that the cursor (2) is exactly in the middle of the two ring splines of the shaft (3)

Apply the detectors to the rear wheels and proceed as already described for the front axle wheels.

Figure 26



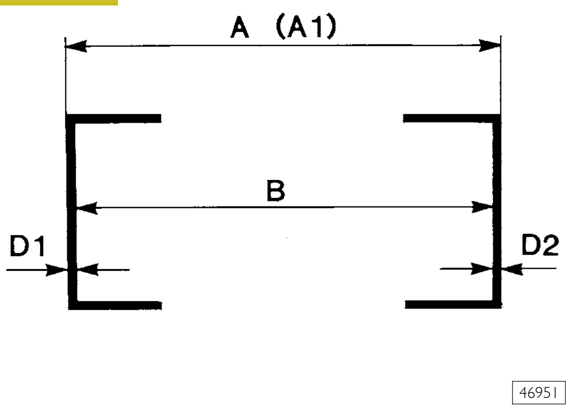
Project the light signal on the slide rule (1) and mark the value shown.

Repeat the measure on the other wheel and check that the value is equal to the noted down value, otherwise carefully check the vehicle rear axle assembly

If no malfunctions are detected, check that the frame is not deformed, sticking to the procedures described in the section "Body and frame".

Calculating thickness of spacers to be fitted between tie rod mountings and chassis side members (with the exception of vehicles equipped with 5-mm thick chassis or with transverse leaf-spring suspension)

Figure 27



Introduction

The external width of the chassis with reference to tie rod mountings attachment point can vary from vehicle to vehicle depending on chassis assembling tolerances and side member thickness.
Therefore, width **A** (864 mm) is considered as an acceptable reference value on which to base correct wheel geometry.
The above value results from the sum of chassis internal width **B** (854 ± 2 mm) plus thickness D_1 - D_2 of a 4 mm thick chassis.

Proceed as follows.

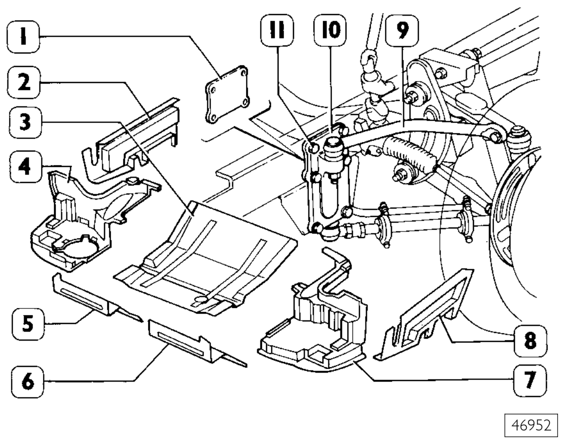
Measure external chassis width A_1 at the axle.

If chassis width is not 864 mm (reference value **A**), subtract your reading (for example, A_1 = 859 mm) from the reference value: 864 - 859 = 5 mm.

Divide this figure by 2 (5 : 2 = 2.5 mm).
2.5 mm is therefore the thickness of the compensating spacers that should be fitted to each side member.

Spacers are supplied as spare parts in the following thicknesses: 1 - 1.5 - 2 mm.

Figure 28



Proceed as follows to install compensating spacers (1).

Dismantle:

- ❑ Rh and lh front engine guard (5 and 6).
- ❑ Engine oil sump guard (3).
- ❑ Rh and lh wheel guard (4 and 7).
- ❑ Rh and lh side engine guard (2 and 8).

Position spacers (1) of the thickness calculated before, fit mounting (10), screw in screws (11) and lock them to a torque of 14.25 kgm (142.5 Nm).

Reassemble all previously dismantled guards.

When assembly is completed, check and adjust wheel geometry as required following directions provided in the relevant chapters.

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SECTION 8

Suspensions

Page

Front and rear mechanical suspensions

Page

DIAGNOSTICS

Main possible suspension defects

1 - noisy suspension;
2 - the vehicle tends to drift to one side;
3 - excessive suspension flexibility;
4 - excessive suspension stiffness.

1	NOISY SUSPENSION

Fault (NO ↓ to next)	YES →
Insufficient lubrication.	Lubricate carefully.
Shock absorbers noisy or inefficient.	Check and if necessary replace shock absorbers.
Wheel bearings worn and with excessive backlash.	Replace bearings or adjust backlash.
Wishbone spring bushes worn.	Detach wishbones and replace bushes.
Wishbone articulated heads worn.	Replace wishbone articulated heads.
Tie-rod articulated heads worn (vehicles with torsion bar suspension).	Replace tie-rod articulated heads.

(Continues)

Steering knuckle nuts or fastening ring nuts loose (vehicles with torsion bar suspension).	YES →	Check and tighten nuts and fastening ring nuts to driving torque.
↓ NO		
Stabilizer bar spring bushes worn.	YES →	Replace spring bushes.
↓ NO		
Stabilizer bar fastening screw nuts loose.	YES →	Check and tighten to torque.
↓ NO		
Suspension fastening nuts and screws loose.	YES →	Check and tighten suspension fastening nuts and screws to torque.
↓ NO		
Torsion bar toothing worn.	YES →	Detach torsion bars and replace them and adjust pre-loading.
↓ NO		
Toothing of torsion bar rear supports or of wishbones worn.	YES →	Replace rear support or upper wishbones and adjust torsion bar pre-loadings.
↓ NO		
Leaf spring supports loose.	YES →	Check the supports and replace chassis fastening screws or rivets if they are loose.
↓ NO		
Leaf spring pack loose for central fastening pin failure.	YES →	Overhaul leaf springs and replace central pin and its self-locking nut.

(Continues)

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Leaf spring pack loose for spring fixing brackets fastening rivets failure.	YES →	Check leaf spring fixing brackets and replace fastening rivets.

2 THE VEHICLE TENDS TO DRIFT TO ONE SIDE

Tyre pressure low or incorrect.	YES →	Check and accurately inflate tyres to the prescribed pressure.
NO ↓		
Incorrect front wheel geometry.	YES →	Check and correct wheel geometry.
NO ↓		
Too much front wheel bearing play.	YES →	Replace the wheel hubs.
NO ↓		
Inefficient hydraulic shock absorbers.	YES →	Remove shock absorbers and replace them.
NO ↓		
Torsion bar broken.	YES →	Replace torsion bar and adjust pre-loading.
NO ↓		
Incorrect torsion bar pre-loading adjustment.	YES →	Check and adjust torsion pre-loading.
NO ↓		
Leaf spring broken.	YES →	Overhaul the leaf spring and replace if necessary.

(Continues)

Incorrect vehicle loading.	YES →	Check the load and arrange it evenly over the loading area.

3 EXCESSIVE SUSPENSION FLEXIBILITY

Torsion bars yielded.	YES →	Replace torsion bars and adjust pre-loading.
NO ↓		
Incorrect torsion bar pre-loading adjustment.	YES →	Check and adjust torsion bar pre-loading.
NO ↓		
Shock absorbers inefficient.	YES →	Check and replace the shock absorbers if necessary.
NO ↓		
Leaf spring central pin broken.	YES →	Replace the component.
NO ↓		
Leaf spring leaves yielded or broken.	YES →	Overhaul the spring and replace the unusable components or, if necessary, the entire spring.

4 EXCESSIVE SUSPENSION STIFFNESS

Incorrect torsion bar pre-loading adjustment.	YES →	Check and adjust torsion bar pre-loading.

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Front mechanical suspensions

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MECHANICAL FRONT SUSPENSIONS

DESCRIPTION

The front suspension has independent wheels of the type:

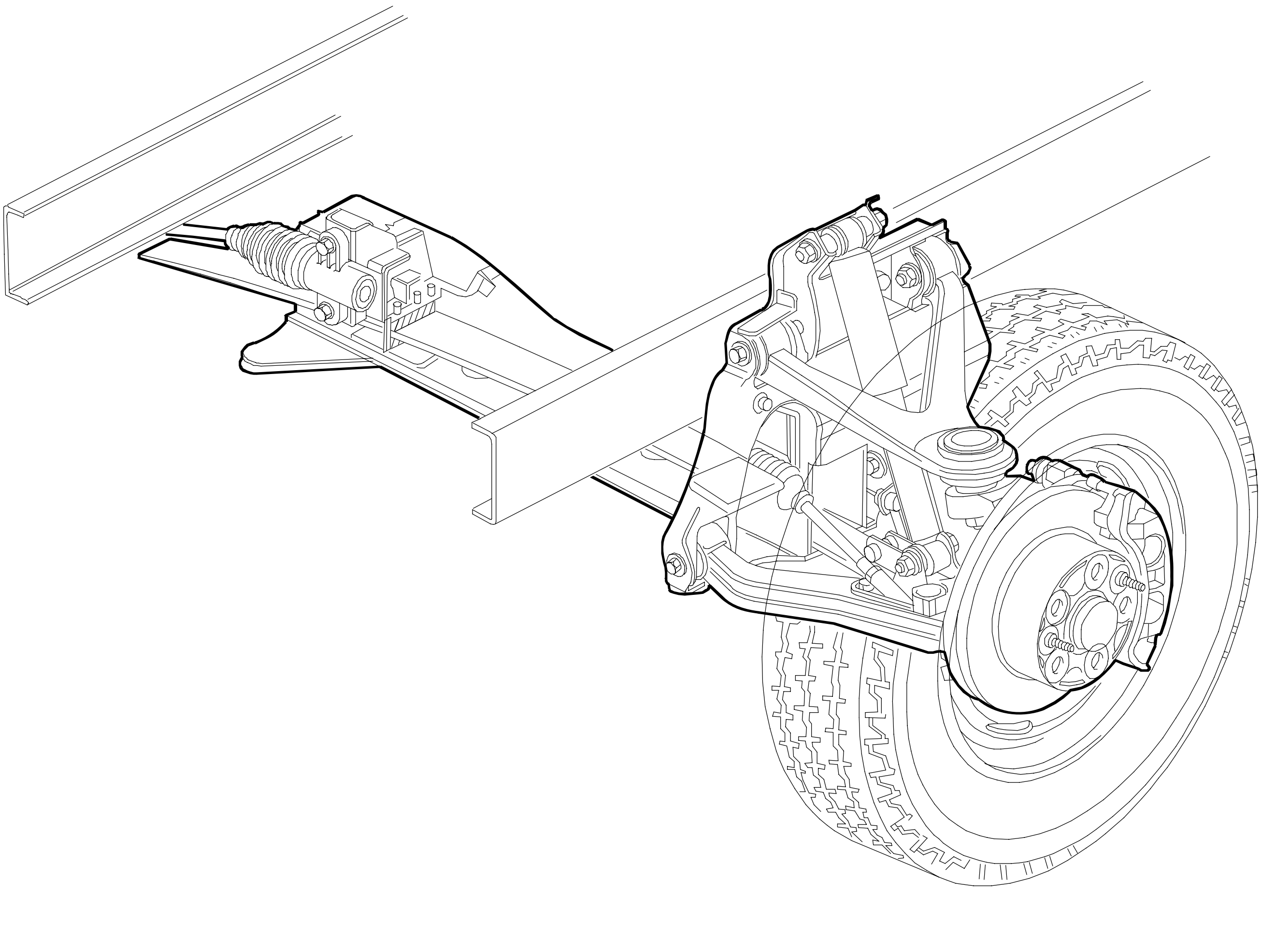
- with an articulated quadrilateral with a transverse leaf spring for axles 5817 and 5818;
- with longitudinal torsion bars for axle 5819 and 5823.

ARTICULATED QUADRILATERAL SUSPENSION WITH TRANSVERSE LEAF SPRING (vehicles 29l - 35s - 35c)

The suspension comprises:

- two top triangular suspension arms, composed of a sheet-metal shell, connected by elastic bushings to the crosspiece by pins articulated to the stub axle;
- two bottom triangular suspension arms, composed of two sheet-metal half-shells welded together, connected by elastic bushings with metal reinforcement to the crosspiece and pins articulated to the stub axle.
  The bottom suspension arms have reaction points for the leaf spring and the bottom mountings of the shock absorbers;
- a single-blade leaf spring, made of composite material for axles 5817 mounted on vehicles 29 L and 35 S, steel for axles 5818 mounted on vehicles 35 C; the spring is kept inside the crosspiece by two top reaction plugs fitted on the ends of the spring housed in the seats in the bottom suspension arms.
  The steel leaf spring, due to the resistance it provides for the rolling movements of the vehicle, makes mounting the front stabilizer bar superfluous;
- two double-acting hydraulic shock absorbers with integrated limit stops.

Figure 1

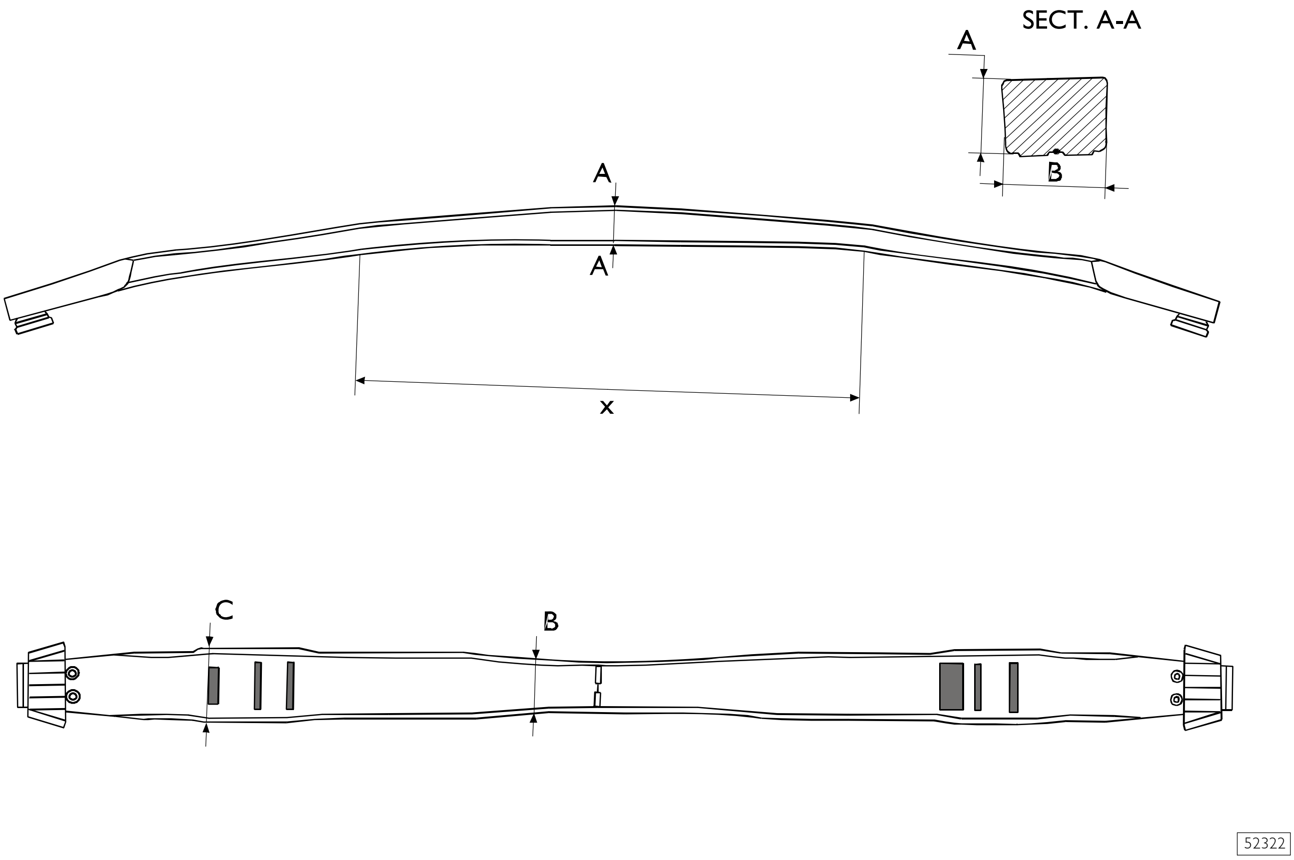


62102

SPECIFICATIONS AND DATA
Front leaf spring

Models: 29 L - 35 S			
Transverse			N° 1
Spring length	(mm)		1313.2
Sheet thickness measured at	(mm)	A	39.92 ± 0.50
Sheet width measured at	(mm)	B	56.0 ± 0.5
		C	81.0 ± 0.5

Figure 2



COMPOSITE LEAF SPRING

NEW LEAF SPRING CHECK DATA			
		29 L	35 S
STATIC LOAD	(N)	19865	21040
SAG WITH STATIC LOAD	(mm)	71.7	68.4
DYNAMIC LOAD	(N)	34270	37005
SAG WITH DYNAMIC LOAD	(mm)	123.7	120.4
FLEXIBILITY ± 5%1	(mm/kN)	277	307.0
DISTANCE BETWEEN SUPPORT PLUGS	(mm)	540	600

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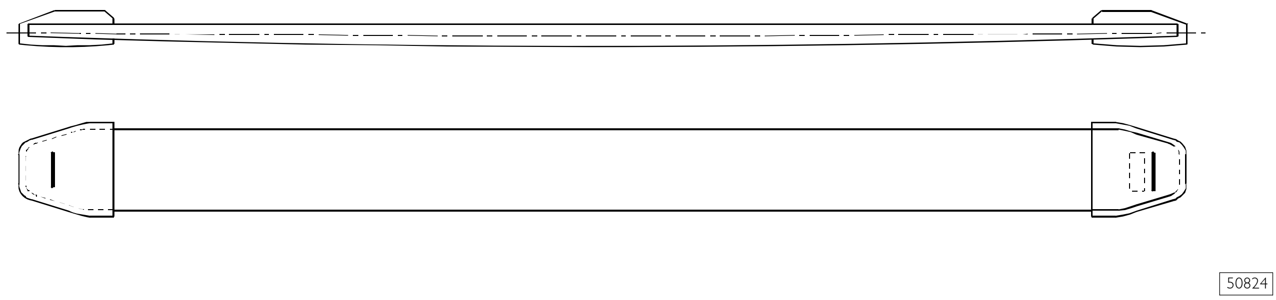
Front leaf spring

Models: 35 C		
Transverse		N° 1
Spring length	(mm)	1365 ± 3
Sheet thickness	(mm)	20 ± 0.2
Sheet width	(mm)	80 ± 0.5

Figure 3



STEEL LEAF SPRING

NEW LEAF SPRING CHECK DATA					
POSITION	LOAD		CAMBER (mm)	FLEXIBILITY	
	daN	kg		mm/100 daN	mm/100 kg
STATIC LOAD	845.1	861.5	70.25	8.31	8.15
DYNAMIC LOAD	1453.3	1481.4	120.8		

Front shock absorbers

Models:	29 L - 35 S - 35 C			
			**Mannesmann - Sachs**	**Arvin Meritor**
	Distance between centre of eyes:			
	Open	(mm)	405 ± 3	
	Closed	(mm)	320 ± 3	
	Stroke	(mm)	85	

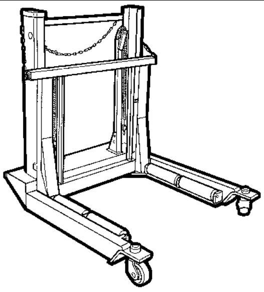
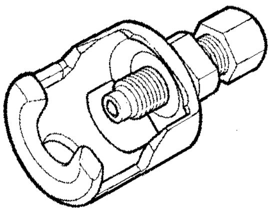
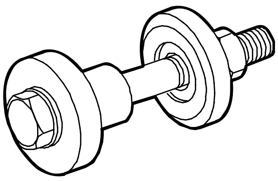
Front stabilizer bar

Models:	**35C - 40C - 45C - 60C* - 65C***	60C - 65C dual cab
Stabilizer bar diameter	24	22

* except for dual cab

NOTE The torsion bar is not provided for the COMBI version.

TOOLS

TOOL NO.		DESCRIPTION
99321024		Hydraulic trolley for wheel removal and refitting
99347074		Extractor to take out link pins
99374179		Tool for disassembling and reassembling suspension arm flexible bushings

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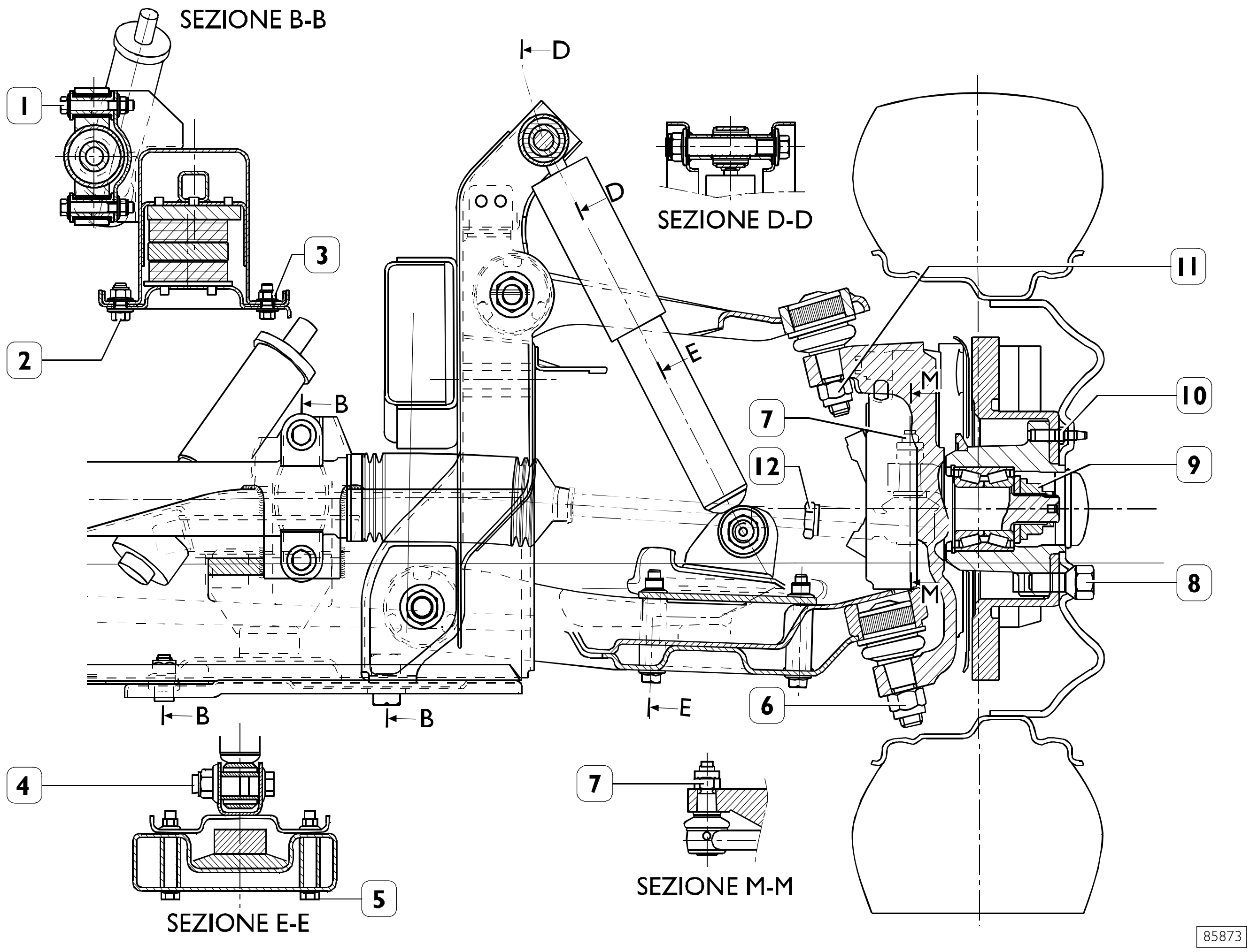
TIGHTENING TORQUES
Vehicles 29 L - 35 S

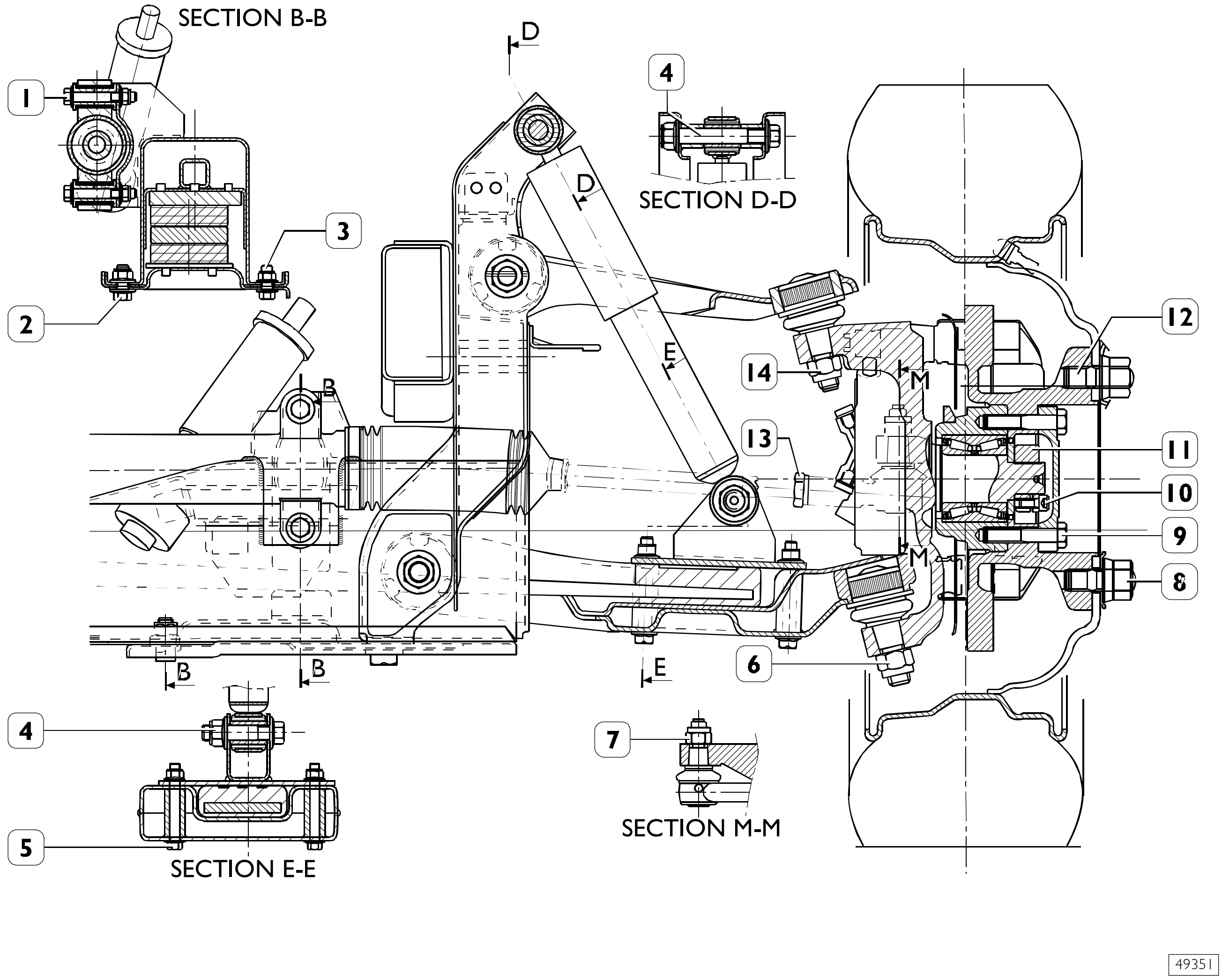
Figure 4



COMPONENT		TORQUE	
		Nm	kgm
1	Screw for nut securing steering gear housing	50 ÷ 61	5 ÷ 6.1
2	M12 screw for nut securing leaf spring mounting to the cross member	100 ÷ 124	10 ÷ 12.4
3	M10 screw for nut securing leaf spring mounting to the cross member	39 ÷ 48	3.9 ÷ 4.8
4	Nut for screw securing shock absorber top and bottom	124 ÷ 152	12.4 ÷ 15.2
5	Screw for nut securing shock absorber mounting to bottom suspension arm	39 ÷ 48	3.9 ÷ 4.8
6	Nut securing bottom suspension arm ball joint to the stub axle	160 ÷ 180	16 ÷ 18
7	Nut securing steering gear housing tie rod ball joint to the stub axle	68 ÷ 83	6.8 ÷ 8.3
8	Screw securing wheel	180 ÷ 200	18 ÷ 20
9	Nut securing hub to stub axle	256 ÷ 314	25.6 ÷ 31.4
10	Screw securing brake disc to wheel hub	19.5 ÷ 24	1.9 ÷ 2.4
11	Nut securing top suspension arm ball joint to the stub axle	125 ÷ 140	12.5 ÷ 14
12	Nut securing ball joint to the steering gear housing tie rod	70 ÷ 100	7 ÷ 10

TIGHTENING TORQUES
Vehicles 35 C

Figure 5



COMPONENT		TORQUE	
		Nm	kgm
1	Screw for nut securing steering gear housing	50 ÷ 61	5 ÷ 6.1
2	M12 screw for nut securing leaf spring mounting to the cross member	100 ÷ 124	10 ÷ 12.4
3	M10 screw for nut securing leaf spring mounting to the cross member	39 ÷ 48	3.9 ÷ 4.8
4	Nut for screw securing shock absorber top and bottom	124 ÷ 152	12.4 ÷ 15.2
5	Screw for nut securing shock absorber mounting to bottom suspension arm	39 ÷ 48	3.9 ÷ 4.8
6	Nut securing bottom suspension arm ball joint to the stub axle	160 ÷ 180	16 ÷ 18
7	Nut securing steering gear housing tie rod ball joint to the stub axle	68 ÷ 83	6.8 ÷ 8.3
8	Nut securing wheel	180 ÷ 200	18 ÷ 20
9	Screw securing cover and brake disc to wheel hub	98.1 ÷ 107.9	9.8 ÷ 10.7
10	Screw retaining ring nut securing hub to stub axle	20 ÷ 24	2 ÷ 2.4
11	Ghiera fissaggio mozzo al fuso snodo	257 ÷ 314	25.7 ÷ 31.4
12	Stud to brake disc (apply LOCTITE 242 or 270 sealant to the thread)	85 ÷ 104	8.5 ÷ 10.4
13	Nut securing ball joint to the steering gear housing tie rod	70 ÷ 100	7 ÷ 10
14	Nut securing top suspension arm ball joint to the stub axle	125 ÷ 140	12.5 ÷ 14

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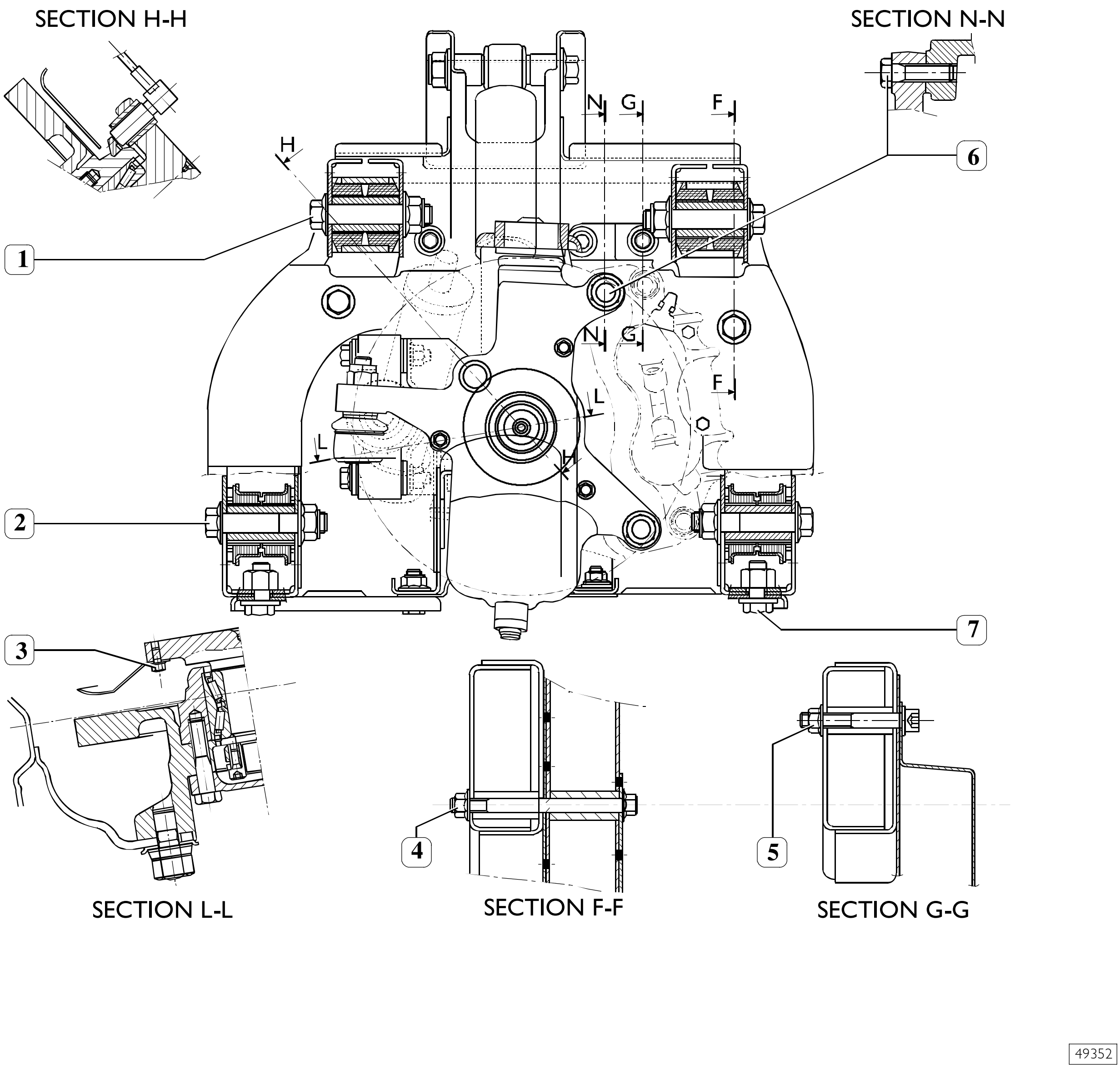
TIGHTENING TORQUES
Vehicles 29 L - 35 S - 35C

Figure 6

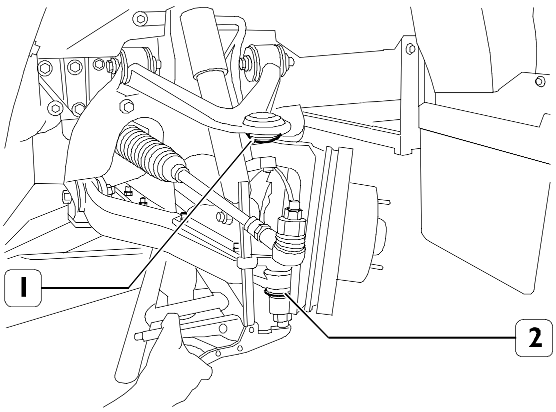


COMPONENT		TORQUE	
		Nm	kgm
1 - 2	Screw for nut securing suspension arm to the top cross member and bottom to the cross member	170 ÷ 280	17 ÷ 28
3	Screw securing disc guard to the axle stub	6 ÷ 7.5	0.6 ÷ 0.7
4	Nut for screw securing cross member to chassis frame	83 ÷ 101	8.3 ÷ 10.1
5	Nut for screw securing cross member to chassis frame	83 ÷ 101	8.4 ÷ 10.1
6	Screw securing caliper mounting to the axle stub	170 ÷ 196	17.0 ÷ 19.6
7	M14 screw securing covers to the cross member	151 ÷ 184	15.1 ÷ 18.4

REPAIRS

Check the clearance of upper swinging arm articulated head

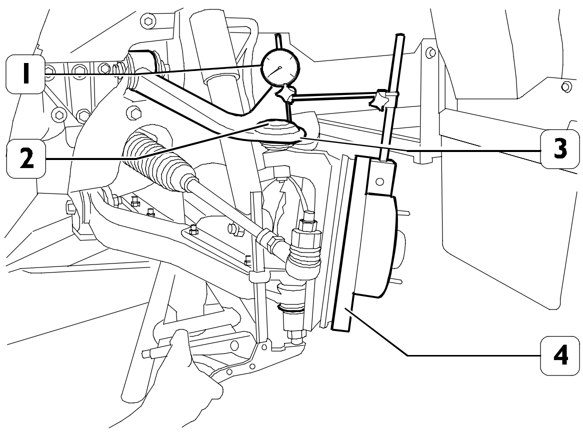
Figure 7



88671

Adjust vehicle on flat ground and lock rear wheels.
Unloosen rear wheels securing nuts.
By a hydraulic jack, lift the vehicle on front side and rest it on two supporting stands.
Unscrew wheels securing nuts and detach wheels again by hydraulic truck 99321024.
Check that protection cowlings (1 and 2) of articulated heads are not damaged.

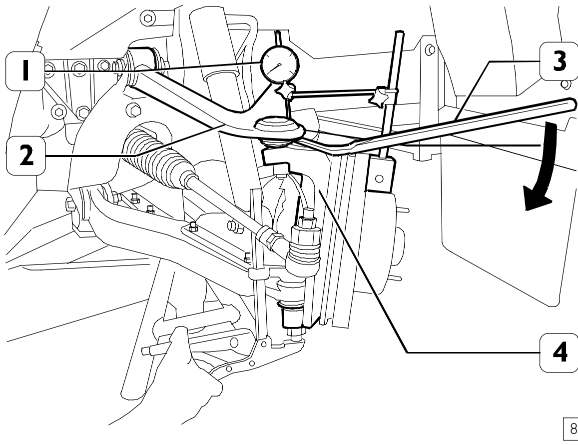
Figure 8



88672

Apply the magnetic base of comparator 99395684 (1) to brake disk (4) and position comparator tracer point on the top of the articulated head (2) of upper swinging arm (3). Pre-load comparator by approximately 4 mm.

Figure 9

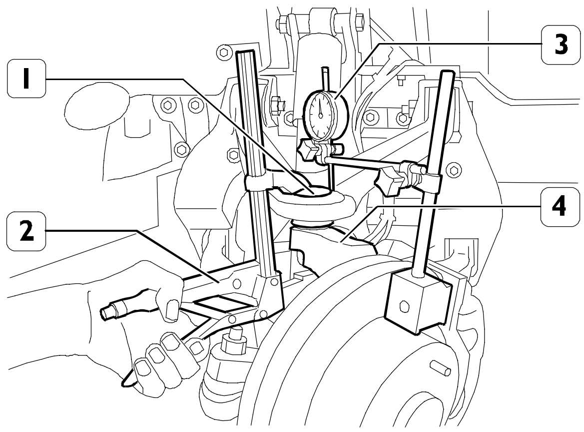


88673

By suitable lever (3) resting on articulated spindle (4), lift swinging arm (2) as much as possible and reset comparator (1).

NOTE In operation, take care not to damage the protection cowling of articulated head .

Figure 10



88674

By suitable pliers (2) applied on articulated head (1) and on articulated spindle (4), apply strong pressure on head and spindle and check comparator (3) hand displacement corresponding to articulated head clearance.
If detected value is between 1.5 and 2.0 mm, the swinging arm needs to be replaced, as described in relating chapter.

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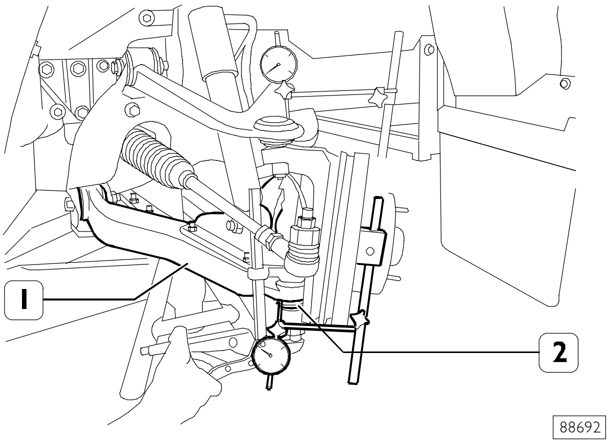
Check the clearance of lower swinging arm articulated head

Figure 11



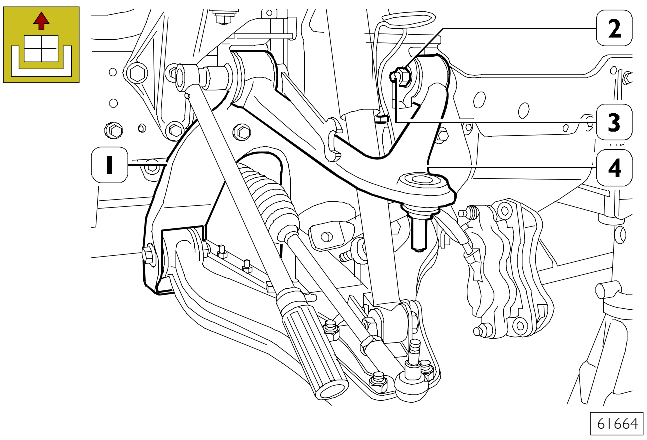
The check of the clearance of the articulated head (2) of lower swinging arm (1) is similar to the one of upper swinging arm.
If detected value is between 1.5 and 2.0 mm, the swinging arm needs to be replaced, as described in relating chapter.

500760 OVERHAULING THE SUSPENSION

Suspension arms

Removal

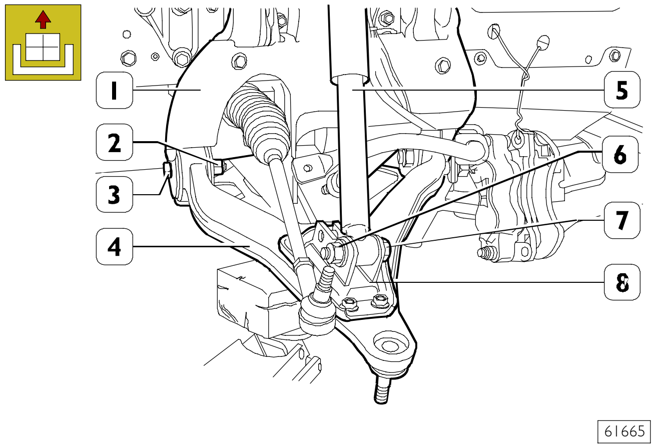
Figure 12



Remove the stub axle as described under the relevant heading (operation 520611 including removal of the wheel hubs operation 520620).

Take out the nuts (2), extract the screws (3) and remove the top suspension arm (4) from the mountings of the cross member (1).

Figure 13

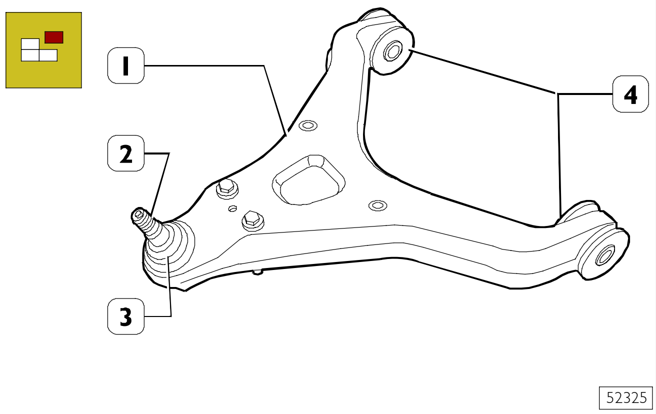


Take out the nut (6) and remove the shock absorber (5) from the mounting (8) of the bottom suspension arm, extracting the screw (7).
Take out the nuts (2), extract the screws (3) and remove the bottom suspension arm (4) from the mountings of the cross member (1).

Replacing suspension arm bushings

Disassembly

Figure 14



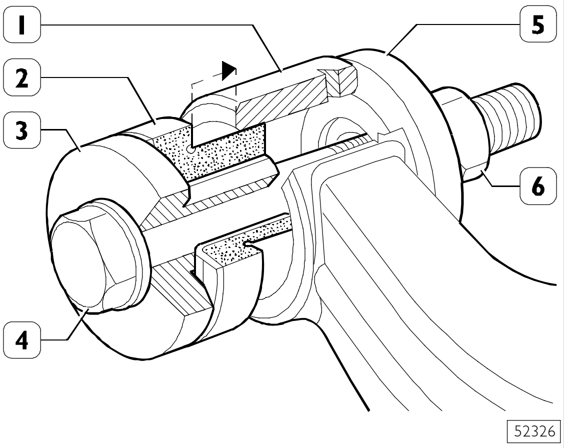
NOTE If there is damage to the caps (3) protecting the link pins (2) or if these have too much play, replace the suspension arm (1).

Using general tools, extract the flexible bushings (4) from the suspension arms (1).

Assembly

NOTE The flexible bushings of the bottom suspension arms are equipped with metal reinforcement.

Figure 15



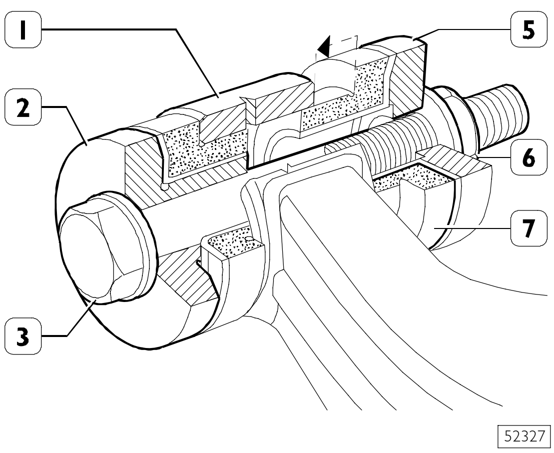
Insert the bushing (2) into the suspension arm (1).

Apply the parts (3 - 4 - 5 - 6) of the tool 99374179, as shown in the figure.

Screw on the nut (6) to make the bushing (2) flush with the suspension arm (1).

Remove the parts of tool 99374179.

Figure 16



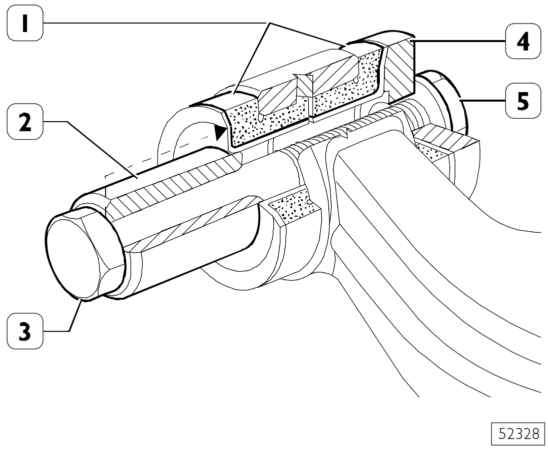
Insert the bushing (7) into the suspension arm (1).

Apply the parts (2 - 3 - 5 - 6) of the tool 99374179, as shown in the figure.

Screw on the nut (6) to make the bushing (7) flush with the suspension arm (1).

Remove the parts of tool 99374179.

Figure 17



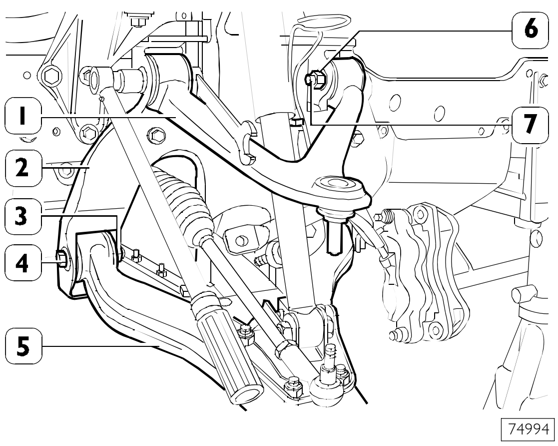
Insert the spacer (2) into the bushing (1).

Apply the parts (3 - 4 - 5) of the tool 99374179, as shown in the figure.

Screw on the nut (5) to fully insert the spacer (2) into the flexible bushings (1).

Refitting

Figure 18



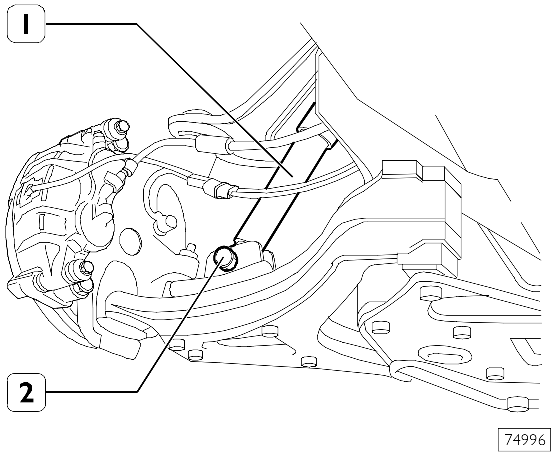
To refit the bottom (5) and top (1) suspension arms to the crosspiece (2), reverse the steps described for removal tightening the nuts (6 - 3) for the fixing screws (4 - 7) to the prescribed torque.

NOTE Self-locking nuts, once removed, must be replaced with new ones.

500910 FRONT SHOCK ABSORBERS

Removal

Figure 19



FRONT SHOCK ABSORBER
VEHICLES 29 L - 35S

Set the vehicle on level ground. Lock the rear wheels with a scotch, remove the wheel rim guards and loosen the screws or nuts fixing the wheel.
Lift the front of the vehicle and rest the chassis frame on supports.
Take out the screws or nuts fixing the wheel and remove them with tool 99321024.
Unscrew the top and bottom bolts (2) and remove the shock absorbers (1) from the vehicle.

Check that the bushings and/or elastic elements are not worn or deteriorated; if they are, replace the relevant part.

Check the efficiency of the shock absorbers with a suitable instrument.

Refitting

For refitting, carry out the removal operations in reverse order and keep to the required tightening torques.

LEAF SPRING
Removal

Set the vehicle on level ground.

Lock the rear wheels with chocks. Take off the wheel rim guards and loosen the screws or nuts securing the wheel.

Lift the front of the vehicle and rest the chassis frame on stands.

Take out the screws or nuts securing the wheel with tool 99321024.

On the right-hand side:

- ❑ using a hydraulic jack, slightly lift the stub axle so as to limit the load of the leaf spring;
- ❑ disconnect the electrical connection (1) for indicating brake lining wear;
- ❑ disconnect the ABS speed sensor (4) (if there is one);
- ❑ take out the screws (2) securing the brake caliper to the axle stub and remove it. Remove the brake linings from the brake caliper (3) and support this adequately to prevent strain on the brake pipes;

NOTE Check the state of the brake linings and brake disc as described in the BRAKES section.

- ❑ take out the nut locking the link pin of the tie rod (20) and, with tool 99347074 (19), remove the link pin (20) of the steering tie rod from the stub axle;
- ❑ take out the nut (21) and, with tool 99347074 (19), remove the link pin (22) of the top suspension arm from the stub axle;
- ❑ take out the nuts (16) and screws (18) securing the shock absorber mounting (15) to the bottom suspension arm;
- ❑ lower the hydraulic jack;

Repeat the similar operations on the left-hand side;

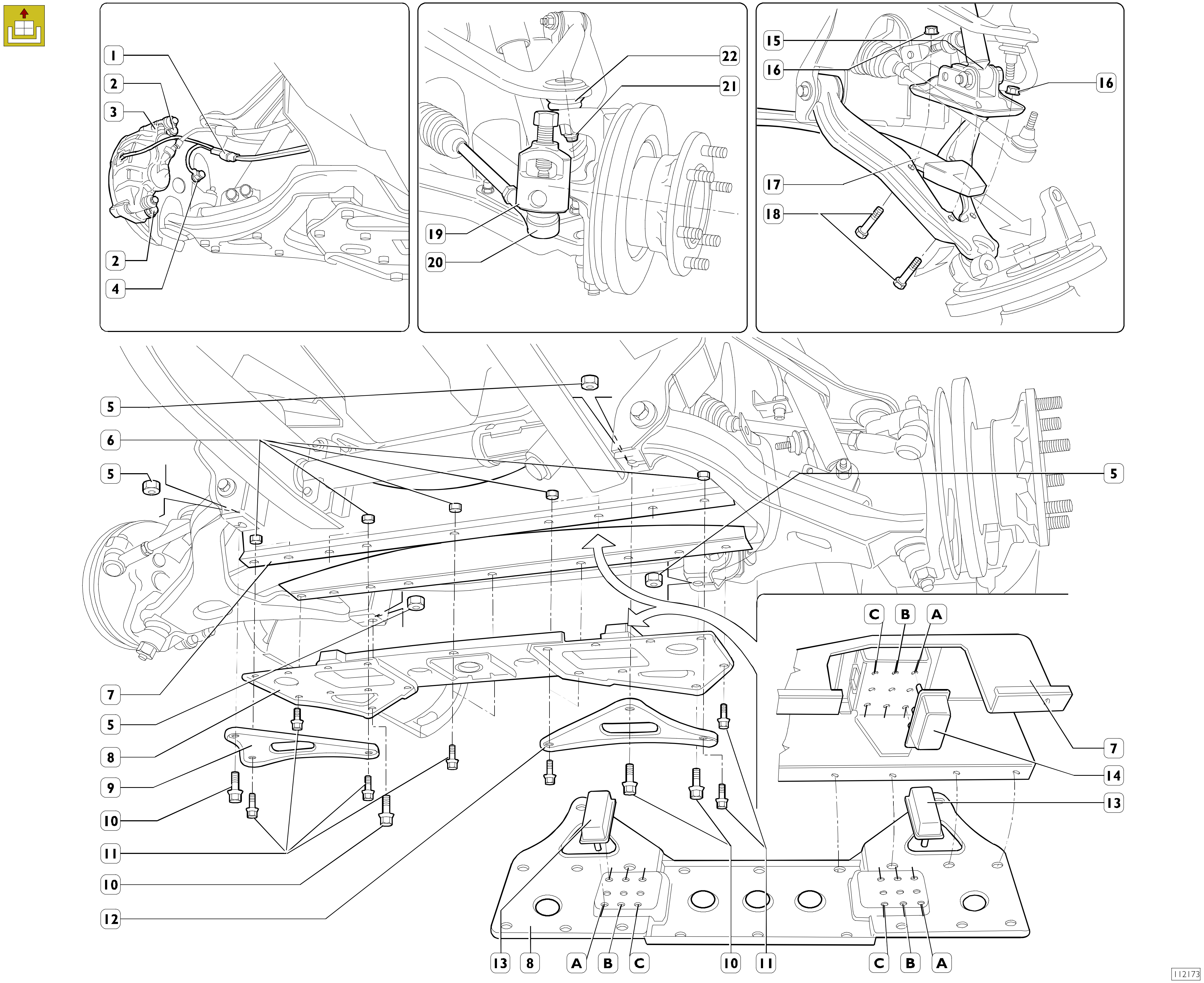
- ❑ take out the nuts (6 and 5) and screws (10 and 11) and remove the covers (8, 9 and 12) from the cross member (7).

NOTE Note the assembly position of the bottom flexible plugs (13) on the cover (8).

Remove the leaf spring (17).

NOTE Note the assembly position of the top flexible plugs (14) in the cross member (7).

Figure 20



Refitting

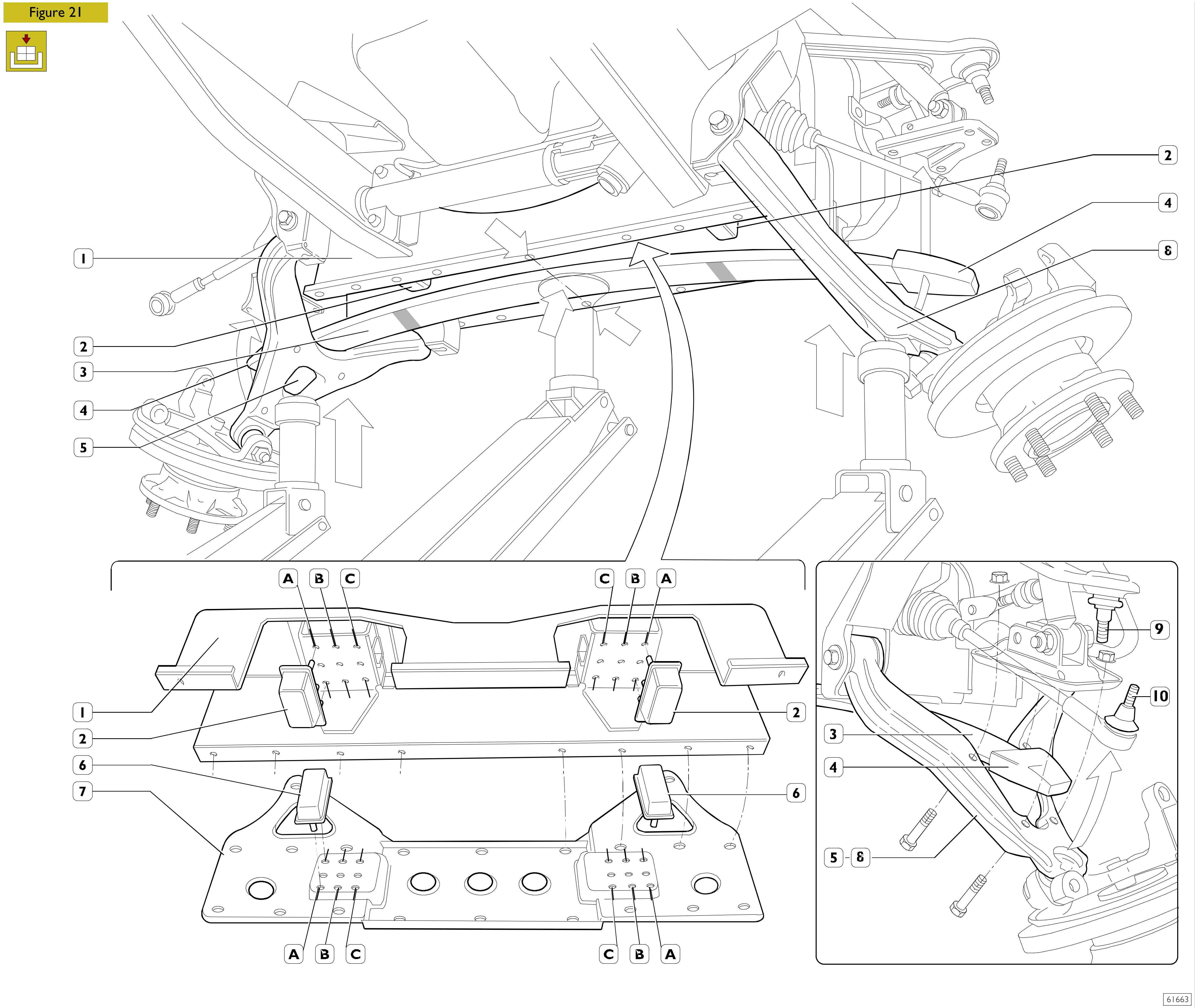
Carry out the operations described for removal in reverse order, but you must take the following precautions:

- fit the top flexible plugs (2) in the cross member (1) at the position found during disassembly;
- fit the flexible plugs (4) onto the ends of the new leaf spring (3);
- fit the leaf spring (3) into the cross member and support it with a hydraulic lift;
- with two lifts arranged under the stub axles, lift them together, checking that the flexible plugs (4) of the leaf spring (3) get correctly positioned in the honeycomb of the bottom suspension arms (5 and 8) and the centre line (⇒) of the leaf spring is aligned with the central holes (⇒) della traversa (1), of the cross member (1), max. error ±2 mm;
- then complete refitting by tightening the screws or nuts to the required torque;
- position the bottom flexible plugs (6) on the cover (7) at the position found during disassembly;
- mount the cover (7) and tighten the screws and nuts to the required torque.

NOTE The nylon self-locking nuts must be replaced with new ones every time they are taken down.

NOTE To block rotation of the pins of the swivel heads (9 - 10), insert a suitable Allen wrench into the hexagon sunk in it.

Figure 21



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TORSION BAR SUSPENSION
(Axle 5819 - vehicles 35C - 40C - 45C - 50C)

Description

The torsion bar suspension is composed of:
- two bottom suspension arms.
- two top suspension arms;
- two longitudinal torsion bars;
- two hydraulic shock absorbers;
- two bottom reaction tie rods;
- two top reaction tie rods;
- a stabilizer bar;
- two rubber pads.

The longitudinal torsion bars are anchored at the front to the top suspension arms and at the rear to a mounting secured to the chassis frame.

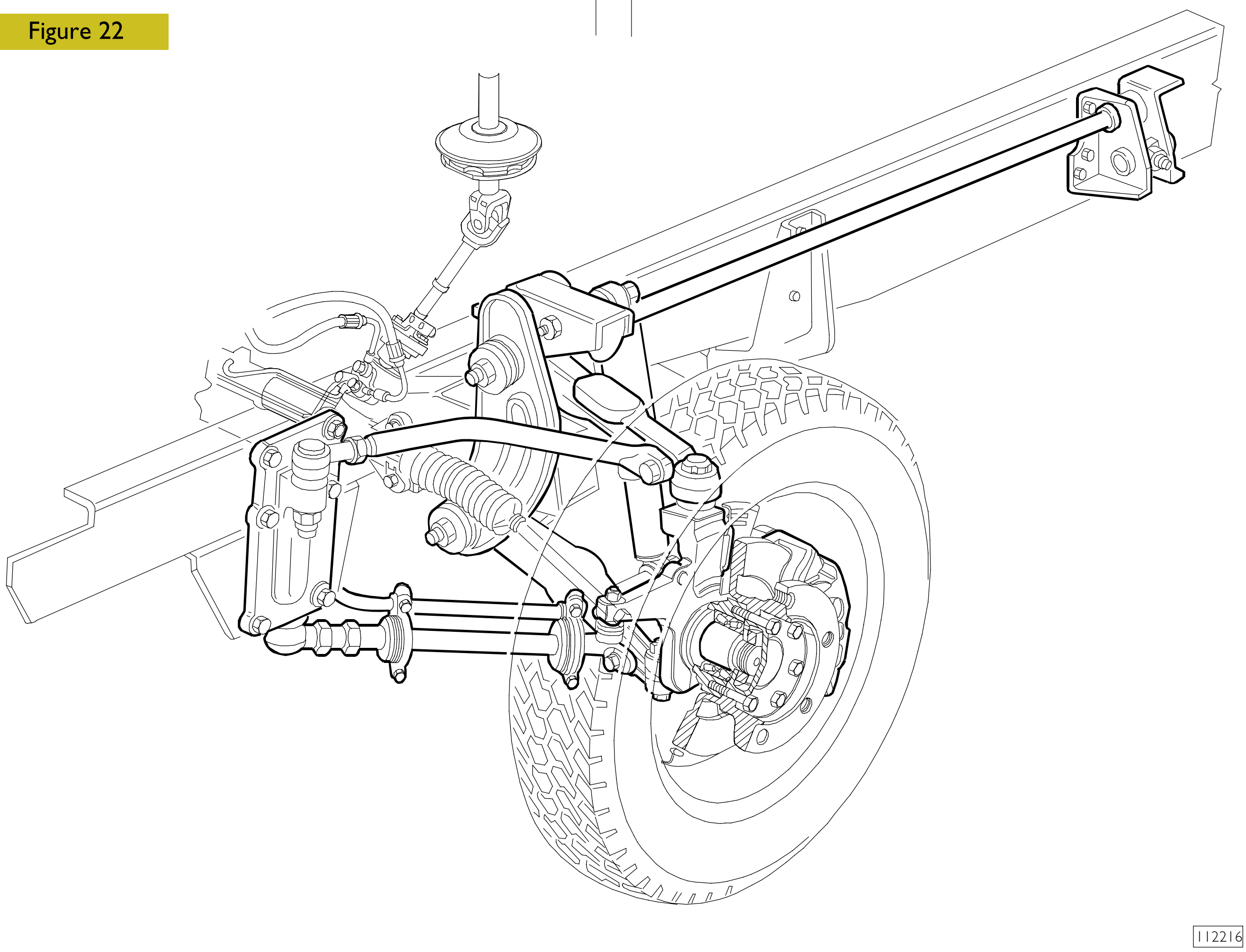
The hydraulic shock absorbers are the double-acting telescopic type.

The side tie rods are mounted at the front to the chassis frame mounting by means of adjustable link pins, and at the rear to the transverse levers.

The purpose of the stabilizer bar, mounted on the bottom reaction screw stays, is to maintain the parallelism between the axis of the wheels and the chassis frame, cancelling any load unbalance on the wheels mounted on the same axle.

The purpose of the rubber pads fixed on the top mounting of the shock absorbers is to limit the upward movement of the suspension.

Figure 22

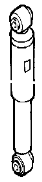


ASSEMBLY DRAWING OF FRONT TORSION BAR SUSPENSION

SPECIFICATIONS AND DATA

Torsion bar suspension with independent wheels, stabilizer bar and hydraulic shock absorbers		**Models**			
		35 C	**40 C**	**45 C**	**50 C**
Torsion bar diameter	mm	29			
Top tie rod adjustment distance		378 ± 0.15 mm 220.4 ± 0.15 mm			
Bottom tie rod adjustment distance		364.5 ± 0.15 mm 300.4 ± 0.15 mm			

Front shock absorbers

Models:	**35 C - 40 C - 45 C - 50 C**			
			**Mannesmann - Sachs**	**Arvin Meritor**
	Distance between centre of eyes:			
	Open	mm	430 ± 3	444 ± 3 mm
	Closed	mm	280 ± 3	286 ± 3 mm
	Stroke	mm	150	158 mm

Stabilizer bar diameter

Models:		**35 C - 40 C - 45 C - 50 C**
Stabilizer bar diameter	mm	20

NOTE The torsion bar is not provided for the COMBI version.

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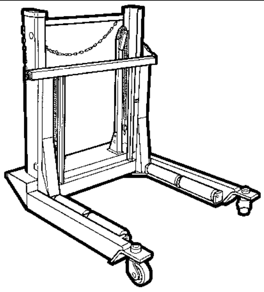
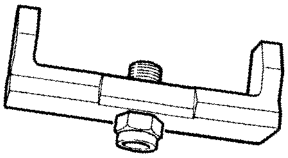
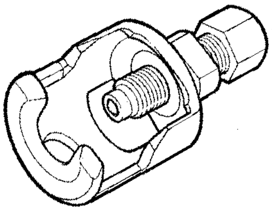
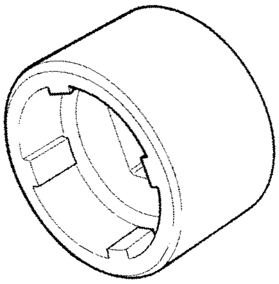
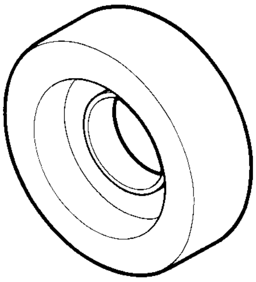
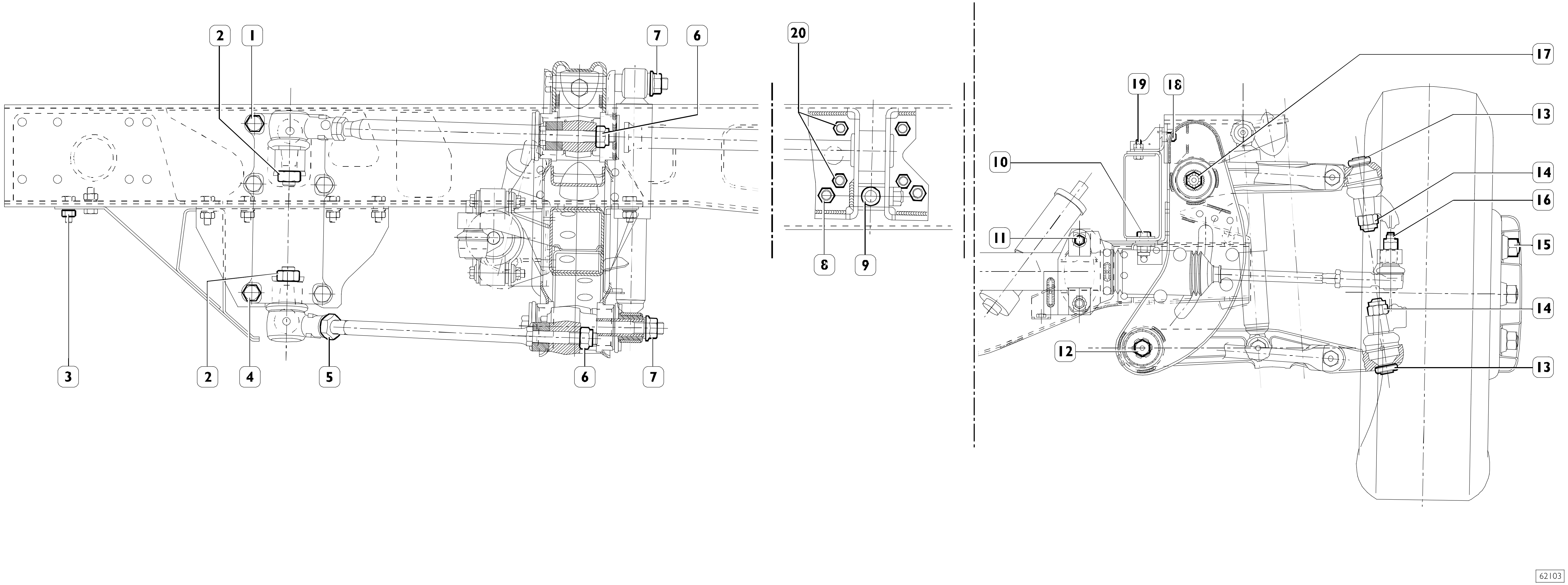
TOOLS

TOOL NO.		DESCRIPTION
99321024		Hydraulic trolley for wheel removal - refitting
99347060		Extractor to take out tie rod link pins
99347074		Extractor to take out steering tie rod link pins and suspension arms
99357144		Wrench for ring nut securing link pins
99374241		Tool for disassembling and reassembling front suspension flexible bushings

TIGHTENING TORQUES
Vehicles 35 C - 40 C - 45 C - 50 C

Figure 23



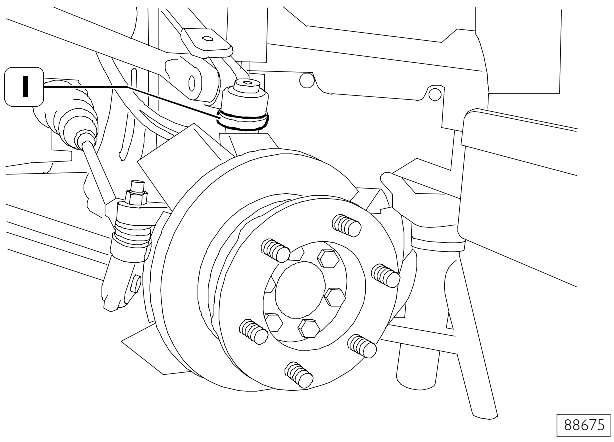
	DESCRIPTION	TORQUE Nm	TORQUE kgm
1	Nut, reaction rod mounting upper fastening to chassis fixing screw	126 ÷ 154	12.8 ÷ 15.7
2	Nut, reaction rod ball joint to mounting	98 ÷ 137	10 ÷ 14
3	Nut, reaction rod and knckle joint stiffener to chassis fixing screw	33 ÷ 49	3.4 ÷ 5.0
4	Nut for screw fixing cross member to reaction rod support	126 ÷ 154	12.8 ÷ 15.7
5	Nut, ball joint to upper tie rod	98 ÷ 137	10 ÷ 14
6	Nut, upper tie rod to upper arm fastening screw	150 ÷ 183	15.3 ÷ 18.7
7	Nut, shock absorber upper and lower fastening screw	116 ÷ 142	11.8 ÷ 14.5
8	Nut, lower bracket fastening screw suspension adjustment unit	151 ÷ 184	15.4 ÷ 18.8
9	Nut, torsion bar adjusting lever pin	254 ÷ 311	25.9 ÷ 31.7
10	Nut, cross member to chassis side member lower wing fixing screw	72 ÷ 88	7.3 ÷ 9
11	Nut for steering box fixing screw	50 ÷ 61	5 ÷ 6.1
12	Nut, lower arms to cross member anchoring screw	206 ÷ 252	21.0 ÷ 25.7

	DESCRIPTION	TORQUE Nm	TORQUE kgm
13	Ring nut, ball joint to upper/lower arms	83 ÷ 152	8.5 ÷ 15.5
14	Nut, ball joint to steering knuckle	157 ÷ 177	16 ÷ 18
15	Nut, fixing will	180 ÷ 200	18 ÷ 20
16	Nut fixing steering box rod ball joint to stub axle lever	68 ÷ 83	6.8 ÷ 8.3
17	Hexagonal-head slotted nut, torsion bar to supension arm	84 ÷ 103	8.5 ÷ 10.5
18	Nut, cross member upper fastening to bracket on chassis side member upper wing fixing screw	47 ÷ 58	4.8 ÷ 5.9
19	Nut, cross member upper anchoring bracket to chassis side member upper wing fixing screw	18 ÷ 22	1.8 ÷ 2.2
20	Nut, upper and intermediate bracket fastening screw (suspension adjustment unit)	94 ÷ 115	9.6 ÷ 11.7
-	Screw for nut fixing front tubular cross member to side members	42 ÷ 51	4.2 ÷ 5.2
-	Nut, stabilizer bar clamps fixing screw	18 ÷ 22	1.8 ÷ 2.2
-	Rubber plug nut	68 ÷ 83	6.9 ÷ 8.5

REPAIRS

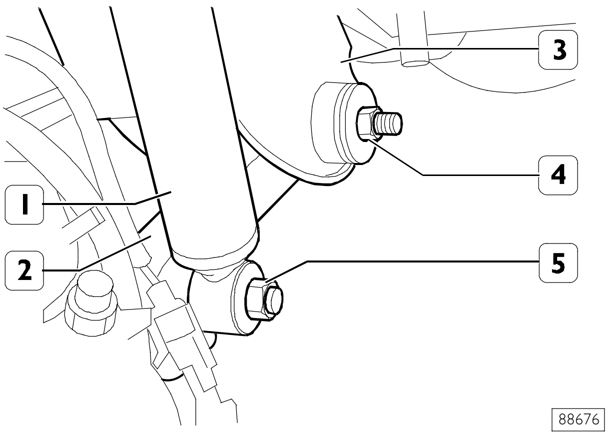
Check the clearance of upper swinging arm articulated head

Figure 24



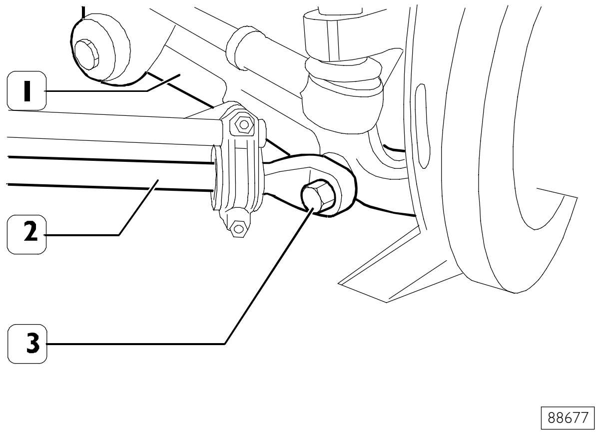
Adjust vehicle on flat ground and lock rear wheels.
Unloosen rear wheels securing nuts.
By a hydraulic jack, lift the vehicle on front side and rest it on two supporting stands.
Unscrew wheels securing nuts and detach wheels again by hydraulic truck 99321024.
Check that protection cowlings (1) of articulated heads are not damaged.

Figure 25



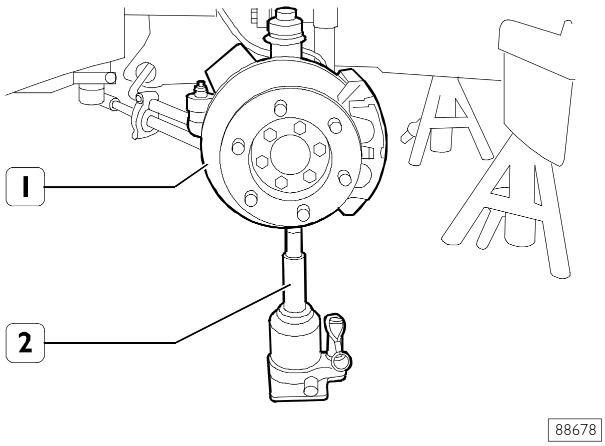
Remove nut (5) and dismount shock absorber (1) from lower swinging arm (2).
Unloosen nut (4) for the screw to secure lower swinging arm (2) to cross member (3).

Figure 26



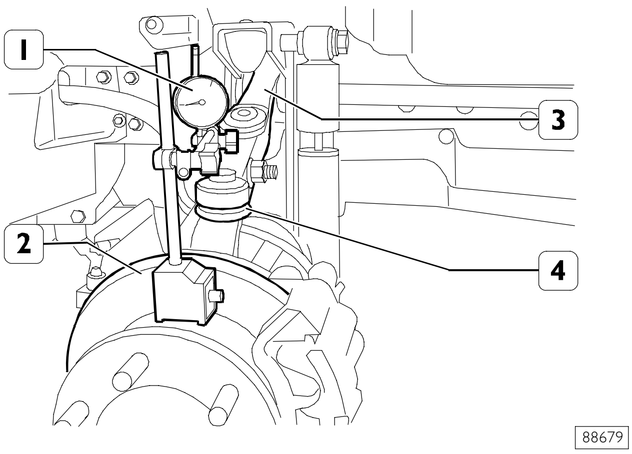
Remove screw (3) and detach tie rod (2) from lower swinging arm (1).

Figure 27



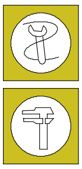
By suitable jack (2), positioned under wheel hub (1), load suspension.

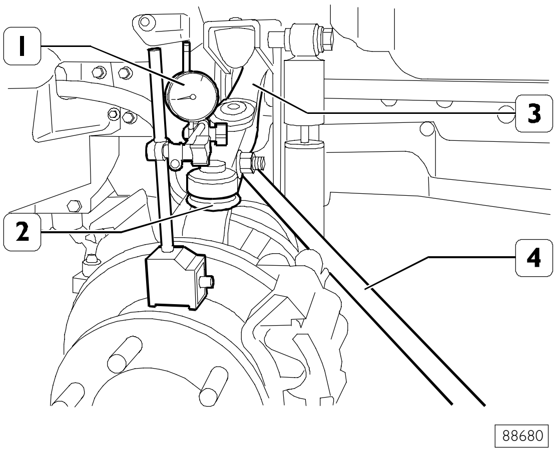
Figure 28



Apply the magnetic base of comparator 99395684 (1) to brake disk (2) and position comparator tracer point on the top of the articulated head (4) of upper swinging arm (3).

Figure 29

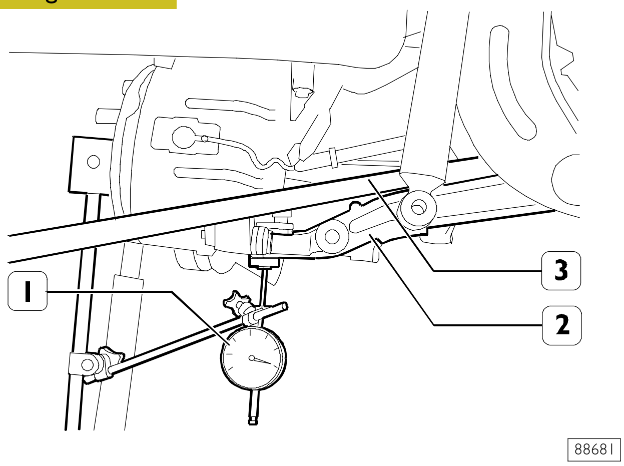




Pre-load comparator (1) by approximately 4 mm and reset it by suitable lever (4), lift upper swinging arm (3) as much as possible and detect the displacement of comparator (1) hand corresponding to the clearance of articulated head (2). If detected value is between 1.5 and 2.0 mm, the articulated head (2) needs to be replaced, as described in relating chapter.

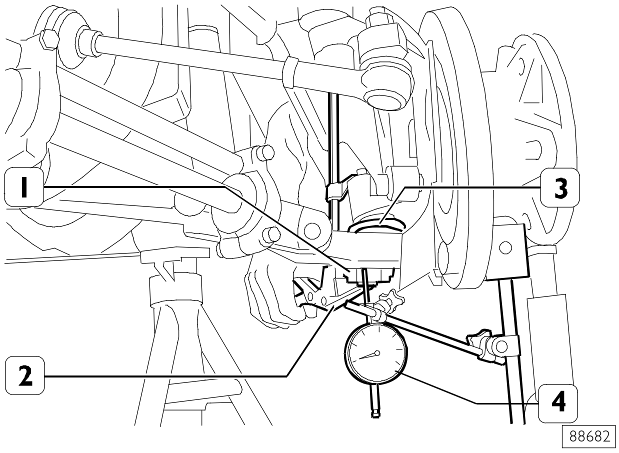
Check the clearance of lower swinging arm articulated head

Figure 30



Position comparator (1) tracer point with magnetic base 99395684 on the top of the articulated head of lower swinging arm (2).
By suitable lever, lower swinging arm (2) and reset comparator (1).

Figure 31



By suitable pliers (2) applied on articulated head (3) and on lower swinging arm (1), apply strong pressure on head and arm and write down comparator (4) hand displacement corresponding to articulated head clearance.
If detected value is between 1.5 and 2.0 mm, the swinging arm needs to be replaced, as described in relating chapter.
Remount dismounted parts in order to make checks.

NOTE See Figure 26: the nut for screw (3) to secure tie rod (2) to lower swinging arm (1) and see Figure 25: the nut (4) for the screw to secure lower swinging arm (2) to cross member (3): they must be tightened at prescribed torque with the vehicle lowered and vehicle empty weight weighing down on suspension.

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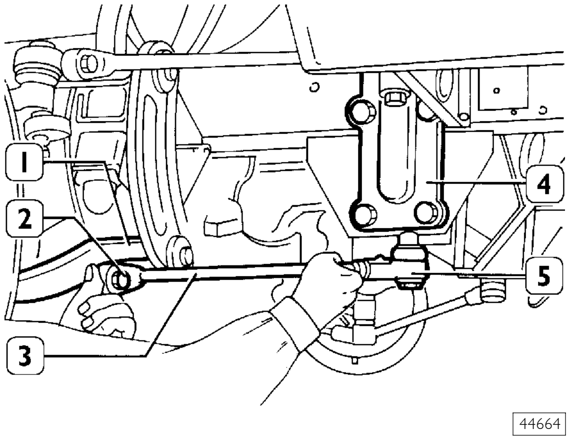
500760 OVERHAULING THE SUSPENSION

TIE RODS

Removal

Figure 32

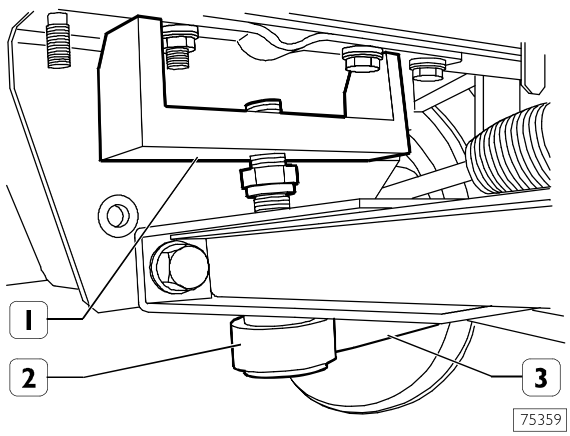


Remove the stabilizer bar as described under the relevant heading (operation 528030).

Take out the nut for the screw (2) securing the tie rod (3) to the bottom suspension arm (1) and remove the screw (2) from this.

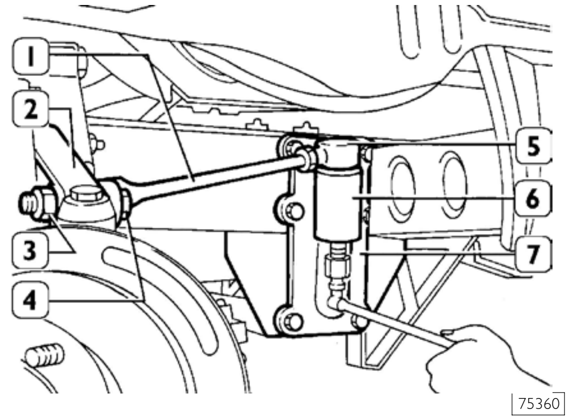
Take out the nut securing the link pin (5) to the mounting (4). Using the extractor 99347060, remove the swivel head (5) from the mounting (4).

Figure 33



Using the extractor 99347060 (1), detach the stub axle (2) from the mounting (4) Figure 22.
Remove the screw stay (3) from the vehicle.

Figure 34

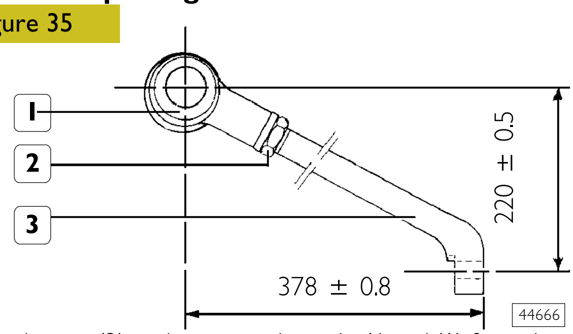


Take out the nut (3) for the screw (4) securing the tie rod (1) to the top suspension arm (2) and remove the screw (4) from this. Take out the nut securing the link pin (5) to the mounting (7). Using the extractor 99347074 (6), remove the swivel head (5) from the mounting (7). Remove the screw stay (1) from the vehicle.

NOTE If removing the mounting (7), so as not to change the wheel geometry, not the number and thickness of the spacers (if there are any) under the mounting to mount them in the same way when refitting the mounting (7).

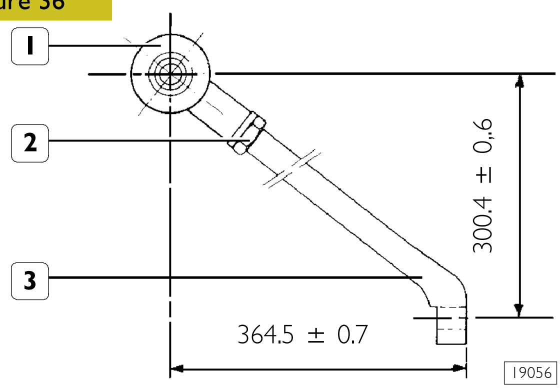
500764 Replacing swivel heads

Figure 35



Loosen the nut (2) and unscrew the swivel head (1) from the top tie rod (3).
Screw the new swivel head (1) onto the tie rod (3) positioning it at the values shown in the figure.

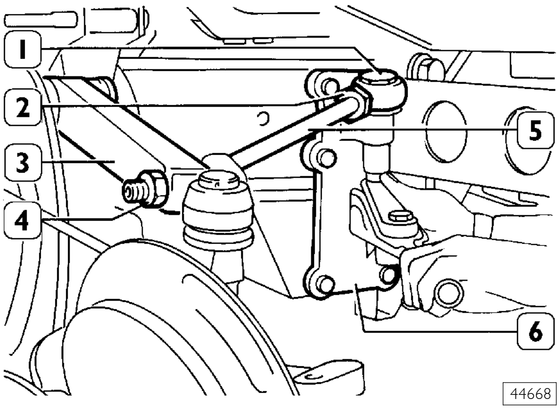
Figure 36



Loosen the nut (2) and unscrew the swivel head (1) from the bottom tie rod (3).
Screw the new swivel head (1) onto the tie rod (3) positioning it at the values shown in the figure.
Tighten the nut (2) to the prescribed torque.

Refitting

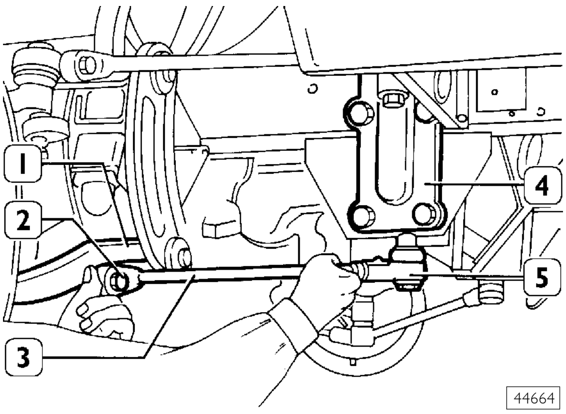
Figure 37



Refit the top tie rod (5) to the top suspension arm (3) and to the mounting (6).
Tighten the nut securing the link pin (1) to the required torque.

NOTE The nut (4) for the screw securing the tie rod (5) to the lever (3) must be tightened when the load of the empty vehicle weighs on the suspension.

Figure 38



Refit the bottom tie rod (3) to the bottom suspension arm (1) and to the mounting (4).
Tighten the nut securing the link pin (5) to the required torque.

NOTE The nut (2) for the screw securing the tie rod (3) to the bottom lever must be tightened when the load of the empty vehicle weighs on the suspension.

Re-fit the stabilizer bar.

NOTE At the end of the re-fitting check the wheels geometry as described in the relevant paragraph.

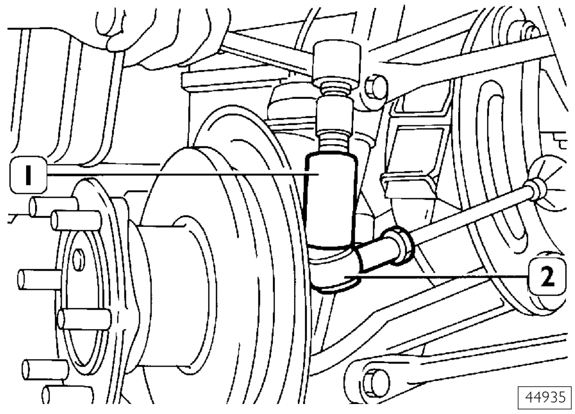
Then tighten the nuts, which fasten the articulated head to the relevant tie-rods, to the prescribed torque.

500666 TORSION BARS

Removal

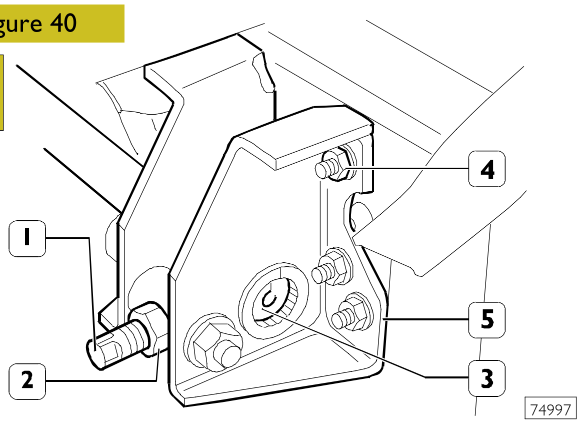
Remove the lower and upper tie-rods as described in the relevant paragraph (operation 500761) and go on as follows:

Figure 39



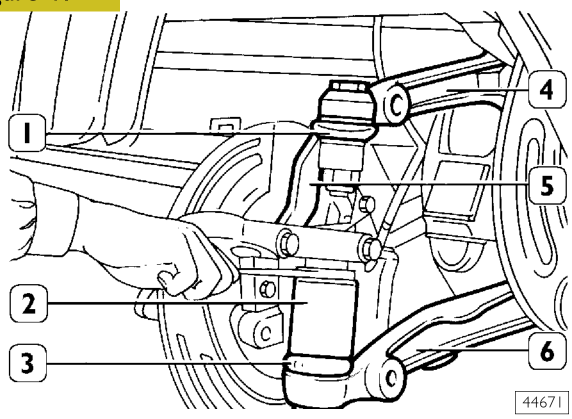
Remove the nut which fastens the articulated head (2) of the gearbox tie-rod to the steering knuckle; with the puller No. 99347074 (1) remove the articulated head (2).

Figure 40



Loosen the nut (2) and unscrew the threaded pin (1) until the torsion bar (3) is fully "unloaded".
Take out the nuts (4) for the screws securing the mounting (5) to the chassis frame.
Remove the mounting (5) from the torsion bar (3).

Figure 41



Remove the nuts securing the link pins (1) from the top (4) and bottom (6) suspension arms to the stub axle (5).
Support in an appropriate way the steering knuckle (5) together with brake caliper and wheel hub and with the tool No. 99347074 (2) remove the steering knuckle (5) from the levers (4 and 6).
Place the steering knuckle (5) on a support without straining the brake fluid hose and the electrical wires.

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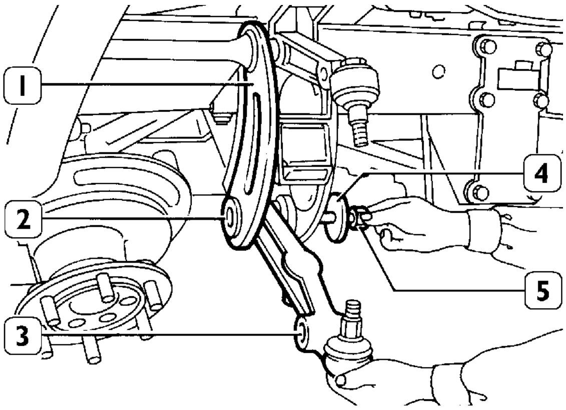
Figure 42

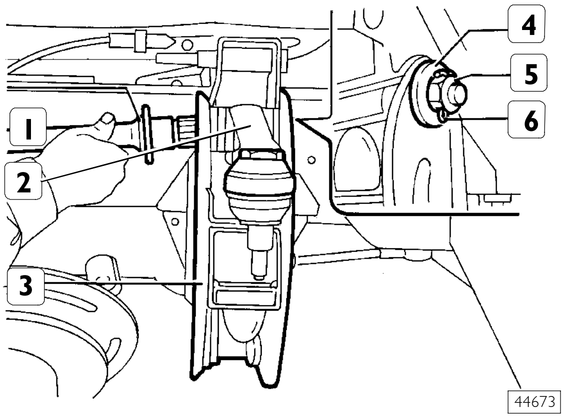


44672

Take out the nut (5), remove the screw (4) and recover the two washers.

Disconnect the bottom suspension arm (3) from the cross member (1) extracting the bushing (2).

Figure 43



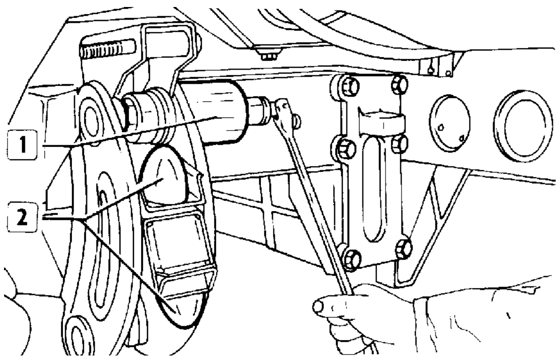
44673

Remove the split pin (6), the nut (5) and the washer (4).

Disconnect the top suspension arm (2) from the cross member (3) extracting the torsion bar (1).

Replacing silentbloc and limit stops

Figure 44

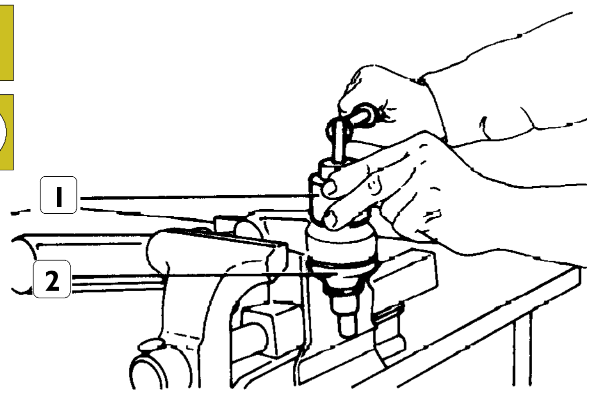


19045

Silentbloc is replaced using tool 99374241 (1); the limit stops (2) are replaced with general tools.

Replacing link pins

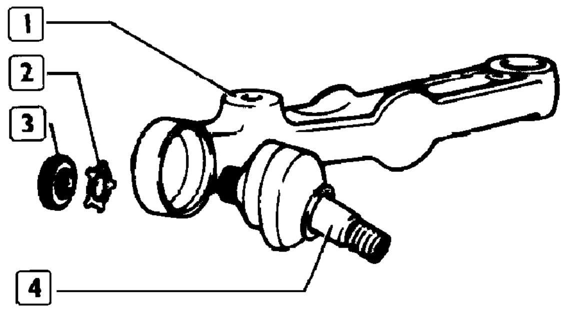
Figure 45



19602

Using tool 99357151 (1) loosen the ring nut and extract the link pin (2) from the suspension arm.

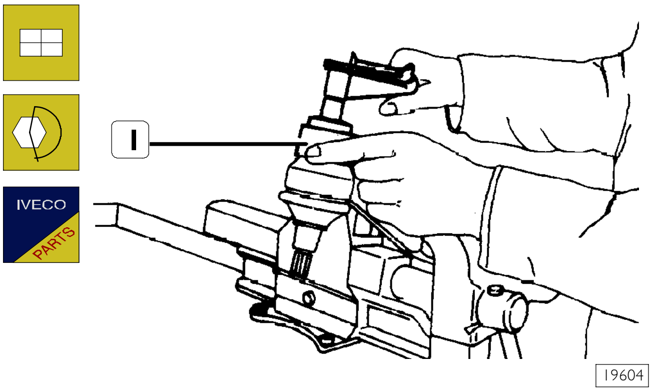
Figure 46



19603

Fit the new knuckle pin (3) on upper and lower swinging arm (1).
Loosen ring (2).

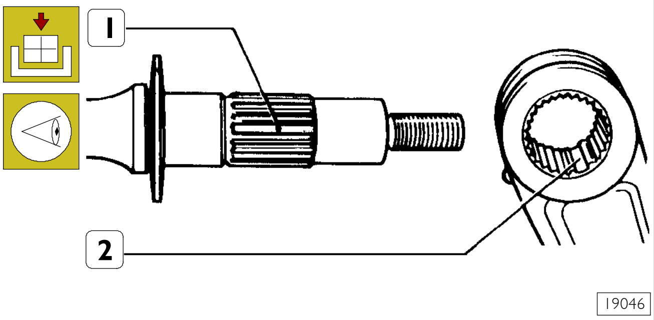
Figure 47



With the tool No. 99357151 (1) fasten the ring nut (3, Figure 46) to the prescribed torque.

Refitting

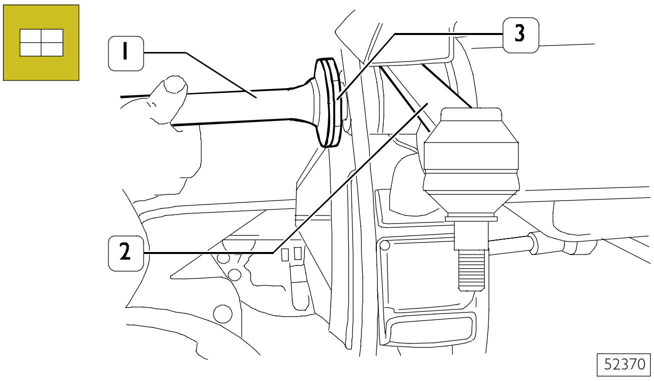
Figure 48



NOTE The letters AD - AS, printed in the back of torsion bars, indicate respectively the right bar and the left one.

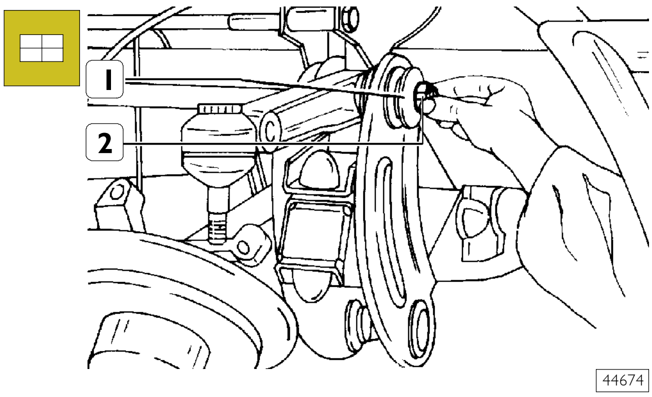
Moreover the splined part has a double tooth (1) which, at the reassembly, must correspond to the double spline (2) of the upper lever.

Figure 49



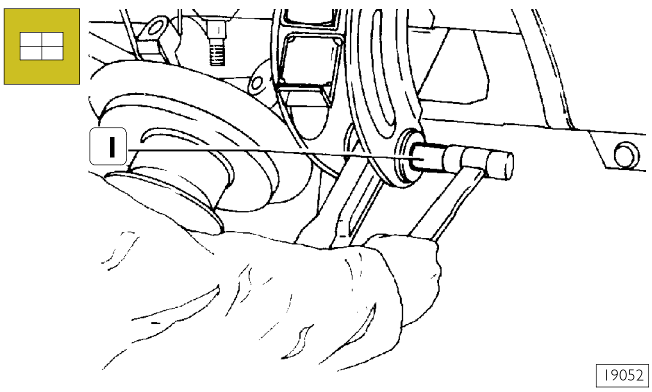
Position the top suspension arm (2) in the cross member. Then insert the torsion bar (1), with the washer (3), in the cross member and in the suspension arm.

Figure 50



Place the washer (1) and screw the nut (2) without tightening it.

Figure 51



Position the bottom suspension arm in the cross member and insert the bushing (1).

Insert the screw with its washers and screw the nut without tightening it.

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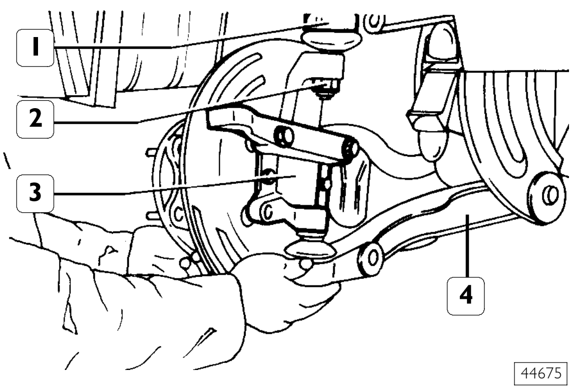
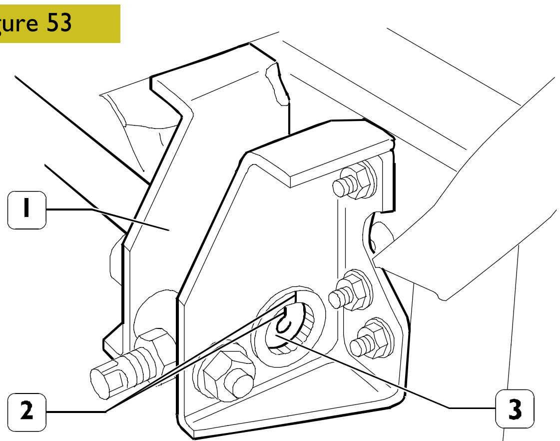
Figure 52



44675

Connect the stub axle (3) to the link pins of the top (1) and bottom (4) suspension arms. Tighten the fixing nuts (2) to the required torque.

Figure 53



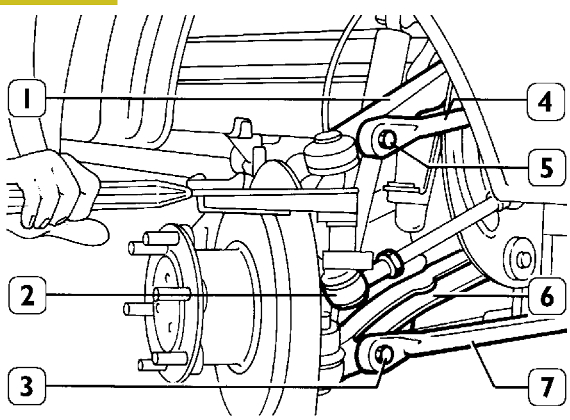
74998

Lubricate the grooved portion of the torsion bar (3).

Assemble the torsion bar (3) and the support (1) so that the splines (2) of the toothed bush and of the torsion bar coincide.

Fix the support (1) to the chassis tightening the fastening screw nuts to the prescribed torque.

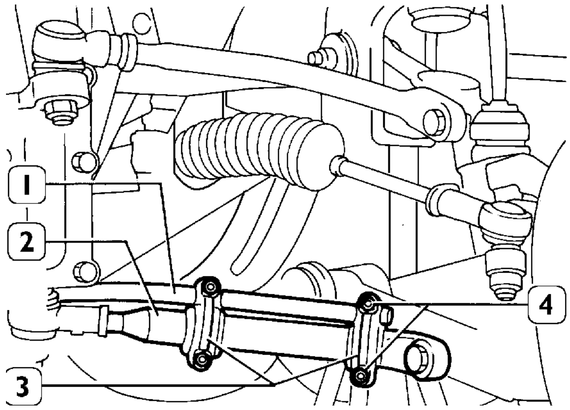
Figure 54



44676

Refit the tie rods (4 and 7) to the suspension arms (1 and 6) without tightening the nuts for the screws (3 and 5) to their torque; connect the link pin (2) of the steering gear housing tie rod to the lever of the stub axle and tighten the nut to the required torque.

Figure 55

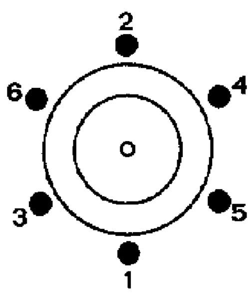


44697

Fit the stabilizer bar (1) back onto the bottom screw stays (2) with the clamps (3), taking care that the screws (4) go into the slots in the stabilizer bar.

Complete fitting the suspension back on by mounting the shock absorber.

Figure 56



7768

Refit the wheels, mount the nut guard and screw on the fixing nuts; lower the vehicle, removing the stands..

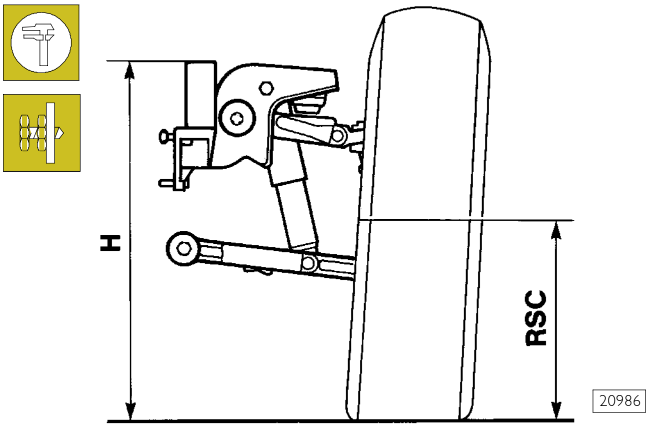
Following the order shown in the figure, tighten the fixing nuts to the required torque.

Then tighten the torsion bar fixing nuts to the required torque and mount the safety split pins on them.

Tighten the nuts for the screws securing the top and bottom tie rods to their respective levers to the required torque.

Adjusting torsion bar pre-load

Figure 57



TORSION BAR PRE-LOADING CONTROL DIAGRAM
H = mm, distance from ground of the side frame upper thread, measured as near as possible the suspension connecting area

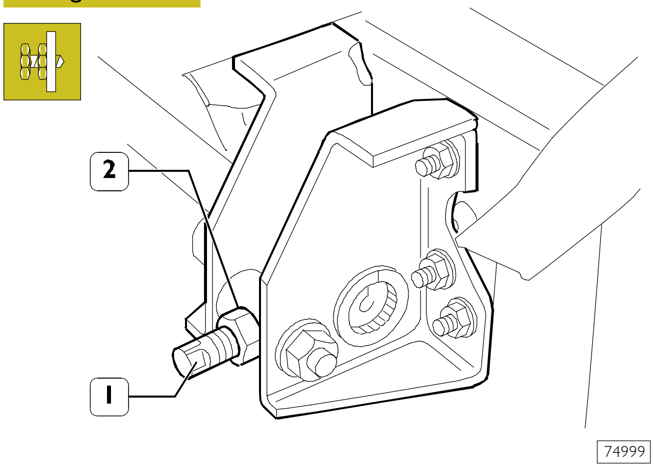
RSC = mm, loaded wheel radius

Ensure that the wheel pressure complies with the prescribed one and check, with the suitable gauge, that the thread depth of tyres is more or less the same on both wheels.

Measure on both sides of the vehicle, the distance from ground (H) of the side frame upper thread, measured as near as possible the suspension connecting area.

The height H must correspond to the value given in the table below.

Figure 58



If the value is different, act on the adjusting screw (1) as much as you need it, but remember that, before acting on the screw, it is necessary, to lift the vehicle with the hydraulic jack, so that the wheels are lifted from the ground. This is necessary if you do not want to damage the screw.

Once the vehicle has reached the right position, lock the screw with the lock nut (2).

HEIGHT OFF GROUND (H in millimetres) OF THE TOP EDGE OF THE CHASSIS FRAME IN RELATION TO THE WEIGHT FOR MODELS 35C/40C/45C/50C WITH TORSION BAR DIAMETER 29 mm.

Weight on the front wheels (Kg)	Tyres	
	195/75 R 16	**6. 50 R 16**
1200	610	629
1220	608	627
1240	606	625
1260	604	623
1280	603	622
1300	601	620
1320	599	618
1340	597	616
1360	596	615
1380	594	613
1400	592	611
1450	588	607
1500	584	602
1550	579	598
1600	575	593
1650	571	589
1700	566	585
1750	562	580
1800	558	576
1850	553	571
1900	549	567

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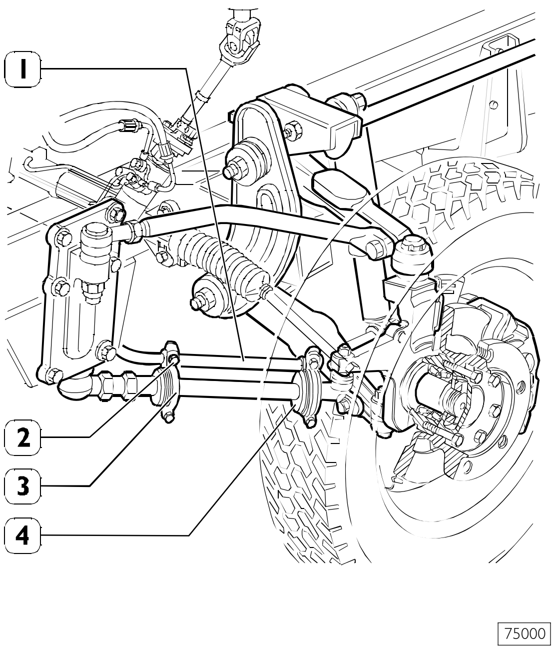
528030 STABILIZER BAR

Removal

Figure 59



FRONT STABILISER BAR
Vehicles 35C - 40C - 45C - 50C

Unscrew the screws (2) fixing the half-brackets (3) and remove the stabilizer bar (1) from the vehicle, recovering the rubber plugs (4).

Check that the bushings and/or elastic elements are not worn or deteriorated; if they are, replace the relevant part.

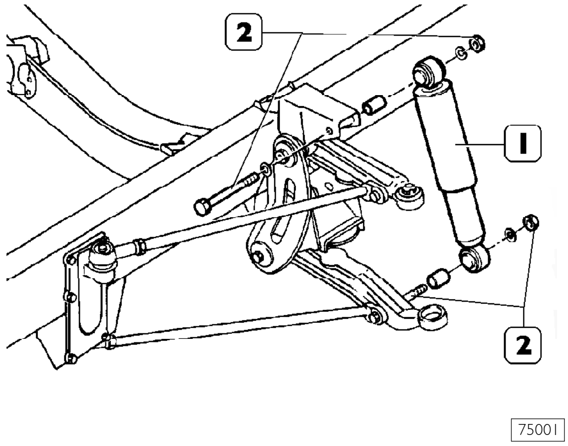
Refitting

To fit it back on, perform the steps carried out for removal in reverse order, keeping to the prescribed tightening torques.

500910 FRONT SHOCK ABSORBERS

Removal

Figure 60



FRONT SHOCK ABSORBER
Vehicles 35C - 40C - 45C - 50C

Set the vehicle on level ground.
Lock the rear wheels with scotches, remove the wheel rim guards and loosen the screws or nuts fixing the wheel.
Lift the front of the vehicle and rest the chassis frame on supports.
Take out the screws or nuts fixing the wheel and remove them with tool 99321024.
Unscrew the top and bottom bolts (2), then remove the shock absorbers (1) from the vehicle.

Check that the bushings and/or elastic elements are not worn or deteriorated; if they are, replace the relevant part.

Using a suitable instrument, check the efficiency of the shock absorbers.

Refitting

To fit it back on, perform the steps carried out for removal in reverse order, keeping to the prescribed tightening torques.

TORSION BAR SUSPENSION

(Axle 5823 - vehicles 60C - 65C)

Description

The torsion bar suspension is composed of:

- two bottom suspension arms;
- two top suspension arms;
- two longitudinal torsion bars;
- two hydraulic shock absorbers;
- two bottom reaction tie rods;
- two top reaction tie rods;
- a stabilizer bar;
- two rubber pads.

The longitudinal torsion bars are anchored at the front to the top suspension arms and at the rear to a mounting secured to the chassis frame.

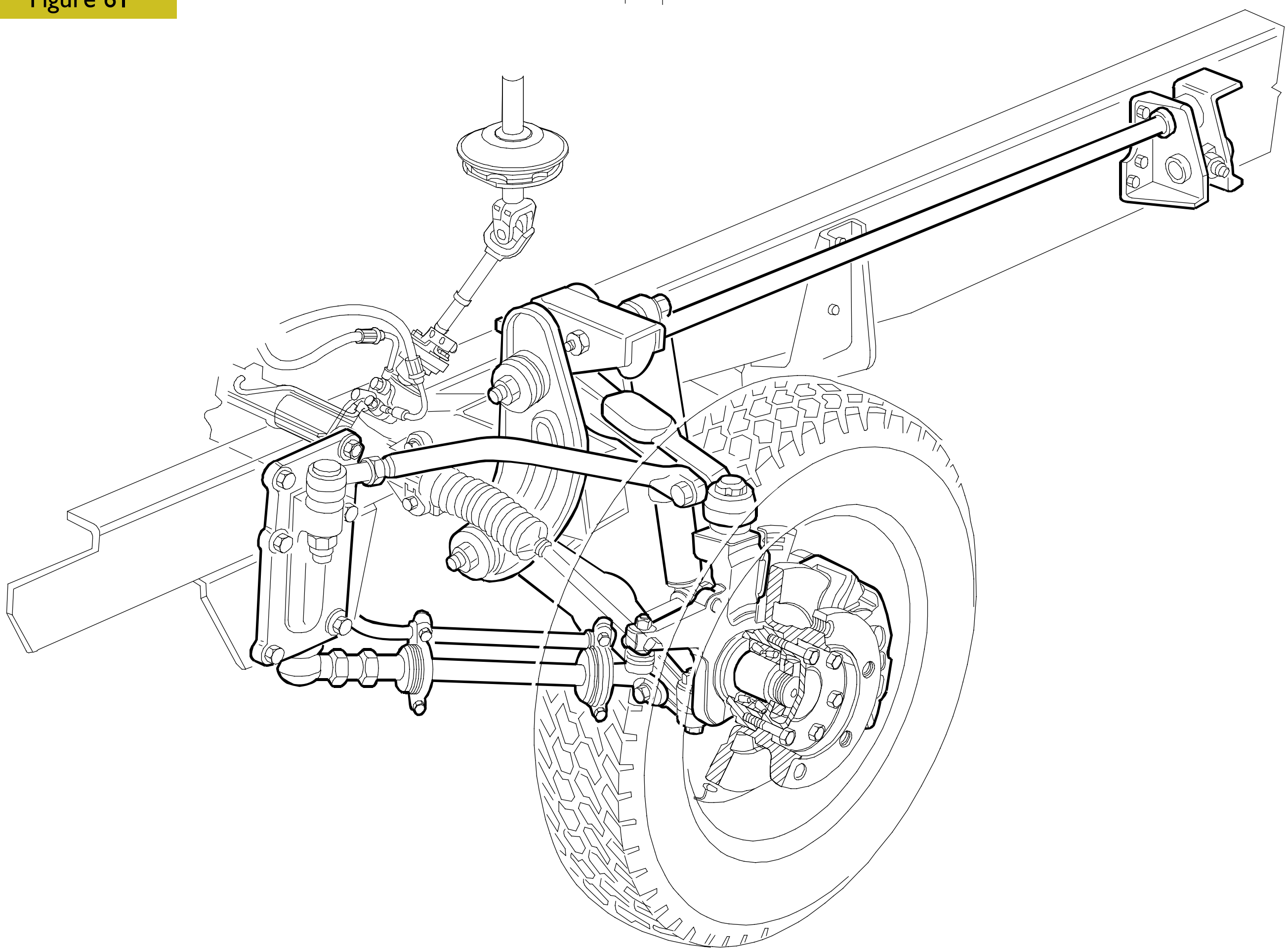
The hydraulic shock absorbers are the double-acting telescopic type.

The side tie rods are mounted at the front to the chassis frame mounting by means of adjustable link pins, and at the rear to the transverse levers.

The purpose of the stabilizer bar, mounted on the bottom reaction screw stays, is to maintain the parallelism between the axis of the wheels and the chassis frame, cancelling any load unbalance on the wheels mounted on the same axle.

The purpose of the rubber pads fixed on the top mounting of the shock absorbers is to limit the upward movement of the suspension.

Figure 61

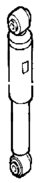


ASSEMBLY DRAWING OF FRONT TORSION BAR SUSPENSION

SPECIFICATIONS AND DATA

Torsion bar suspension with independent wheels, stabilizer bar and hydraulic shock absorbers	**Models**
	60 C - 65 C
Torsion bar diameter mm	33
Top tie rod adjustment distance	378 ± 0.8 mm 220 ± 0.5 mm
Bottom tie rod adjustment distance	369 ± 0.5 mm 300.4 ± 0.5 mm
Lower linkage adjustment (for recently manufactured vehicles)	363.5 ± 0.5 mm 299 ± $^{+0.3}_{0}$ mm
	377 ± 0.15 mm 219 ± 0.15 mm

Front shock absorbers

Models:	**60 C - 65 C**		
		**Mannesmann - Sachs**	**ARVIN**
	Distance between centre of eyes:		
	Open mm	430 ± 3	400 ± 3
	Closed mm	280 ± 3	280 ± 3
	Stroke mm	150	120

Stabilizer bar

Models:	**60 C - 65 C**					
	Twin cab	Truck Chassis Cabs	Cut Away	Vans	Chassis Cowls	Semi-Glazed
Stabilizer bar diameter mm	**20**			**22**		

NOTE The torsion bar is not provided for the Combi version.

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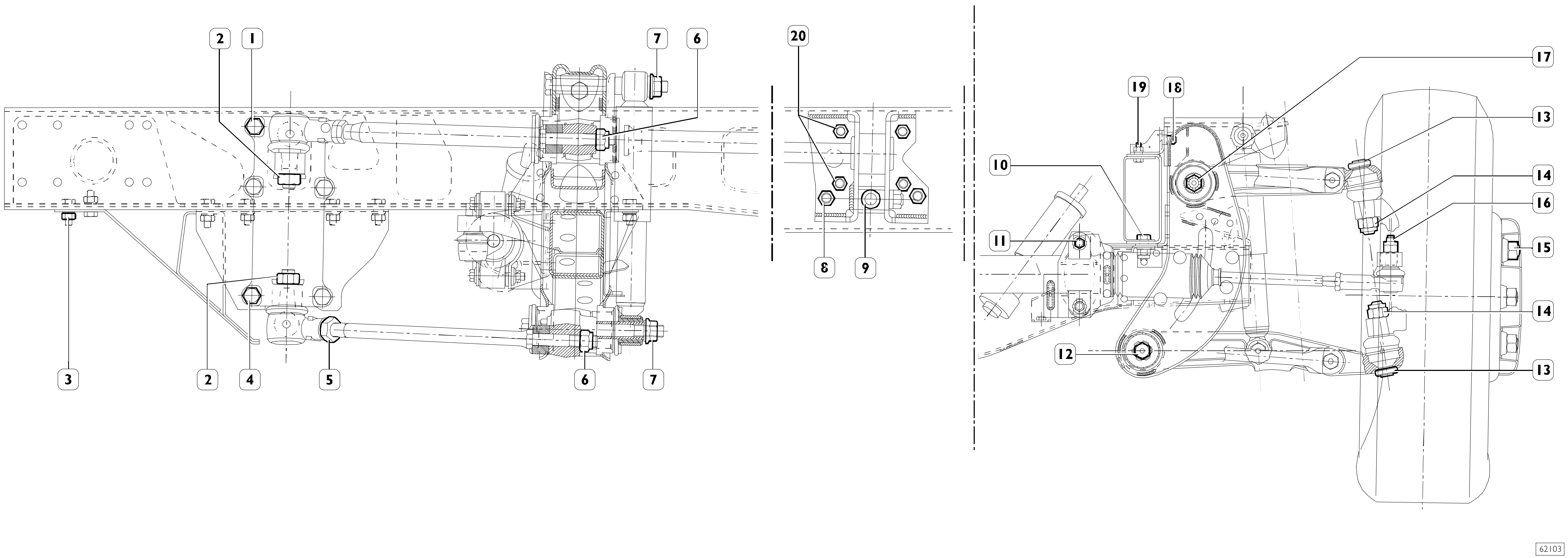
TIGHTENING TORQUES

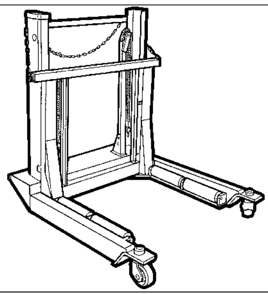
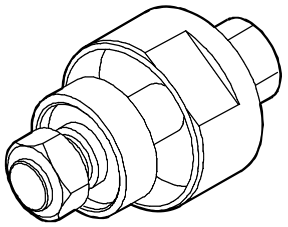
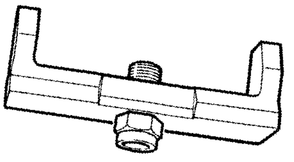
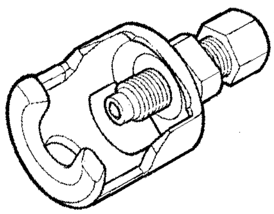
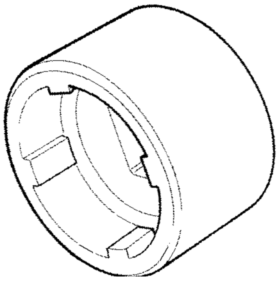
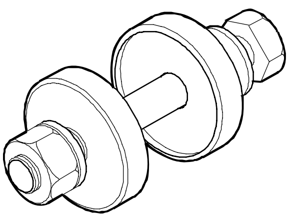
Figure 62



	DESCRIPTION	TORQUE Nm	kgm
1	Nut, reaction rod mounting upper fastening to chassis fixing screw	140	14
2	Nut, reaction rod ball joint to mounting	98 ÷ 137	10 ÷ 14
3	Nut, reaction rod and knckle joint stiffener to chassis fixing screw	41	4.1
4	Nut for screw fixing cross member to reaction rod support	140	14
5	Nut, ball joint to upper tie rod	98 ÷ 137	10 ÷ 14
6	Nut, upper tie rod to upper arm fastening screw	150 ÷ 183	15.3 ÷ 18.7
7	Nut, shock absorber upper and lower fastening screw	116 ÷ 142	11.8 ÷ 14.5
8	Nut, lower bracket fastening screw suspension adjustment unit	151 ÷ 184	15.4 ÷ 18.8
9	Nut, torsion bar adjusting lever pin	197 ÷ 241	20 ÷ 24
10	Nut, cross member to chassis side member lower wing fixing screw	80	8
11	Nut for steering box fixing screw	50 ÷ 61	5.1 ÷ 6.2
12	Nut, lower arms to cross member anchoring screw	206 ÷ 252	21.0 ÷ 25.7

	DESCRIPTION	TORQUE Nm	kgm
13	Ring nut, ball joint to upper/lower arms	83 ÷ 152	8.5 ÷ 15.5
14	Nut, ball joint to steering knuckle	157 ÷ 177	16 ÷ 18
15	Nut, fixing will	284.5 ÷ 343.3	28.4 ÷ 34.3
16	Nut fixing steering box rod ball joint to stub axle lever	83 ÷ 68	8.4 ÷ 6.9
17	Hexagonal-head slotted nut, torsion bar to supension arm	84 ÷ 103	8.6÷10.5
18	Nut, cross member upper fastening to bracket on chassis side member upper wing fixing screw	52.5	5.2
19	Nut, cross member upper anchoring bracket to chassis side member upper wing fixing screw	20	2
20	Nut, upper and intermediate bracket fastening screw (suspension adjustment unit)	104	10.4
-	Screw for nut fixing front tubular cross member to side members	42 ÷ 51	4.2 ÷ 5.2
-	Nut, stabilizer bar clamps fixing screw	24.5	2.4
-	Rubber plug nut	68 ÷ 83	6.9 ÷ 8.5

TOOLS

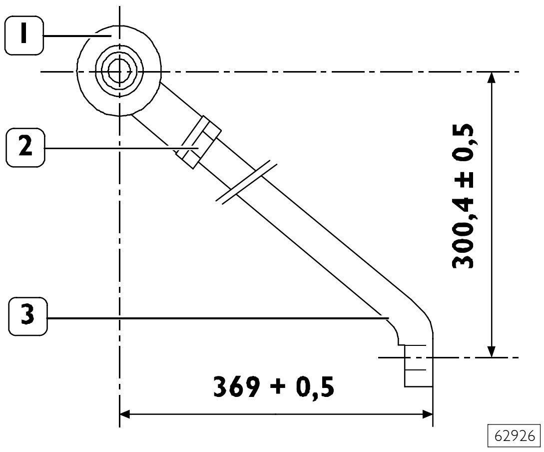
TOOL No.		DESCRIPTION
99321024		Hydraulic trolley for wheel removal and refitting
99347027		Tool for removing front suspension rubber bushes
99347060		Extractor to take out link pins
99347074		Extractor to take out link pins and suspension arms
99357144		Tool for link pins fixing screw
99374166		Tool for refitting front suspension rubber bushes

REPAIR OPERATIONS
500760 SUSPENSION OVERHAUL

NOTE It differs from suspension overhaul with torsion bars for vehicles: 35C, 40C, 45C, 50C for the following points.

500764 Lower tie rod articulated heads replacement

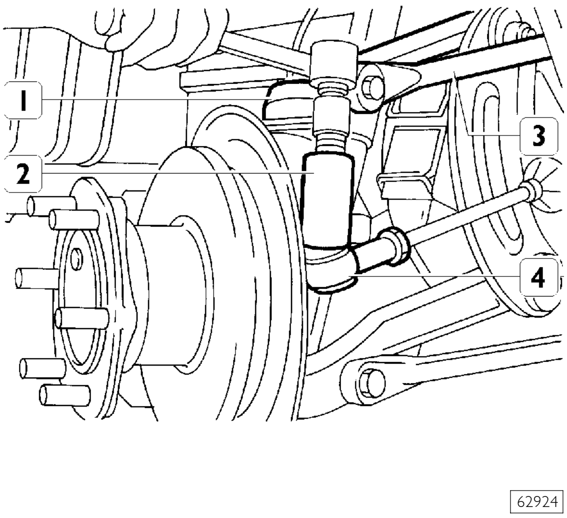
Figure 63



Loosen the nut (2) and unscrew the articulated head (1) from the upper tie rod (3).
Screw the new articulated head (1) on the tie rod (3). Position it according to the values show in the above figure.

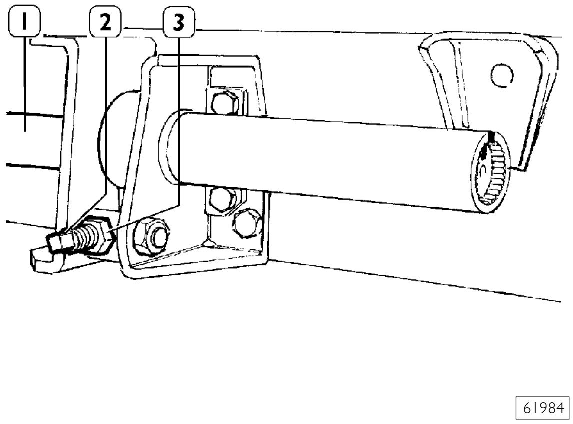
500666 TORSION BARS
Removal

Figure 64



Remove the nut fastening the steering box tie rod kingpin (4) from stub axle lever; use puller 99347074 (2) to remove the kingpin (4).
Remove suspension lever (1) upper tie rod (3).

Figure 65

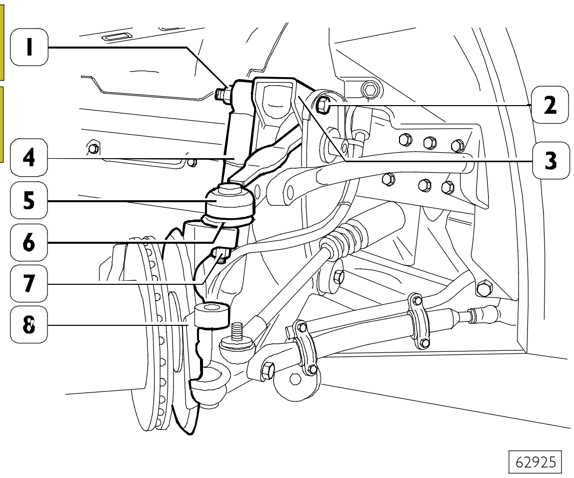


Loosen the nut (3) and loosen the threaded pin (2) until the torsion bar (1) is completely ''released''.

NOTE Take note of the number of pin (2) threads above nut (3); these data shall provide the starting point to adjust the torsion bar after assembling..

NOTE For left torsion bar disconnect the fuel tank.

Figure 66



Remove the nut (2), withdraw the screw (3) and disconnect the shock absorber (4) from the upper support (1).

Remove the nut (7) fastening the articulated head (6) from the upper lever (5) to stub axle (8).

Suitably support the stub axle (8) including the brake calliper and the wheel hub and using tool 99347074 remove the lever (5) from the stub axle (8).

Rest the stub axle (8) on a proper stand to prevent brake fluid pipes and electric cables tensioning.

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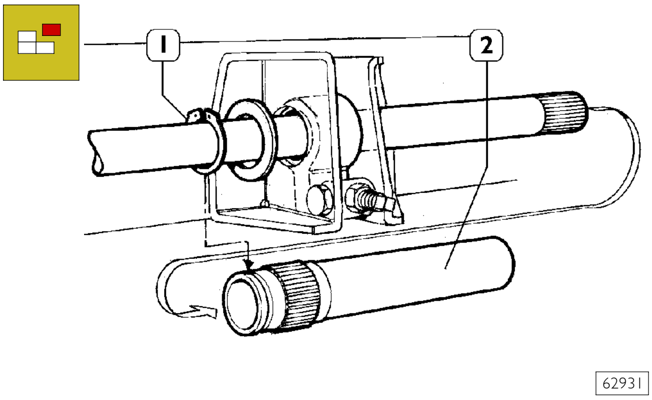
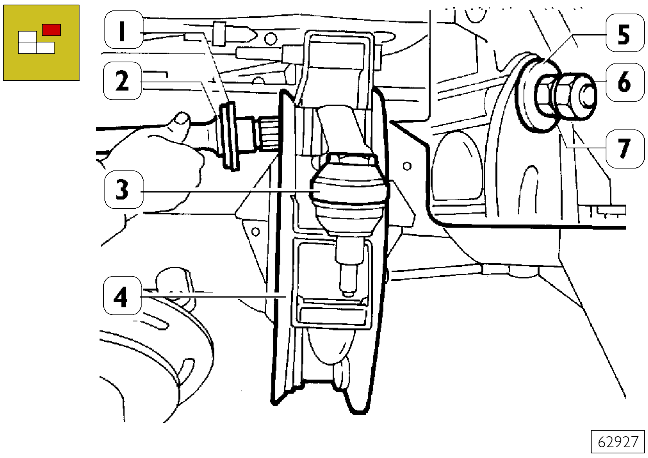
Figure 67



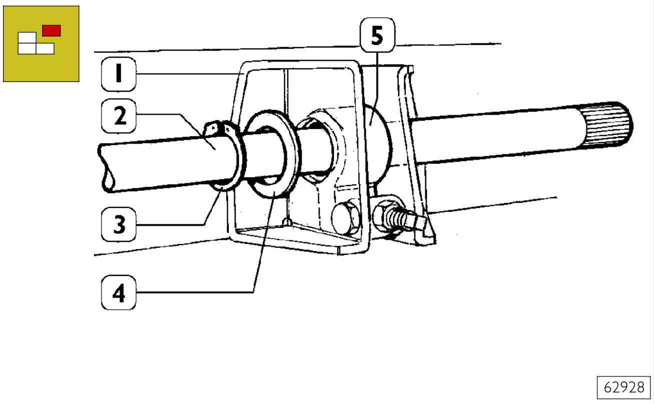
Remove the circlip (1) from the sleeve (2) and remove it.

Figure 68



Remove the lock nut (6), the nut (7) and withdraw the washer (5).
Remove the torsion bar (2) with the washer (1) from the upper lever (3) and remove it from the bracket (4).

Figure 69

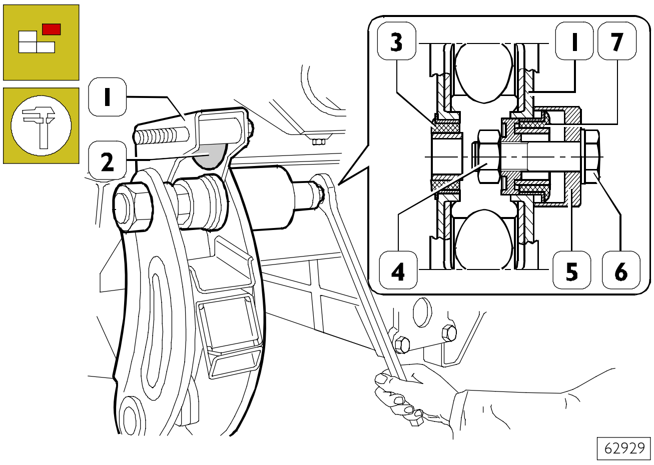


Remove the torsion bar (2) including the circlip (3) and the washer (4) from the adjustment lever (5) and remove it from the bracket (1).

Rubber bush replacement

Removal

Figure 70



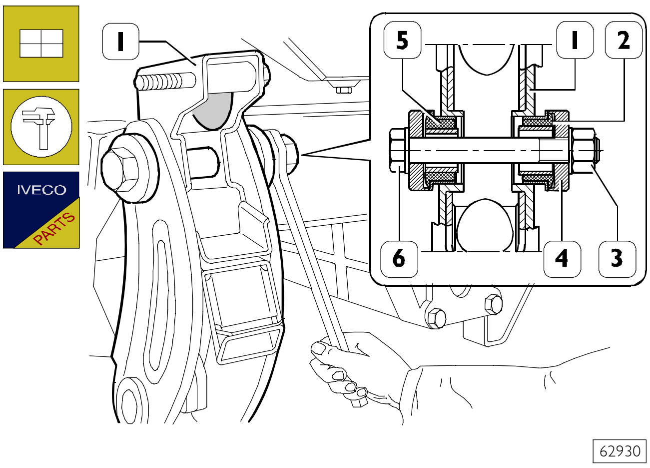
Apply tool 99347027 (5) as shown in the figure.

Hold the screw (6), tighten the nut (4) and remove the rubber bushes (3 and 7) from the cross member (1).

NOTE The rubber stop plug (2) is pressure-fitted to cross member (1) and no tool is required for its replacement.

Refitting

Figure 71

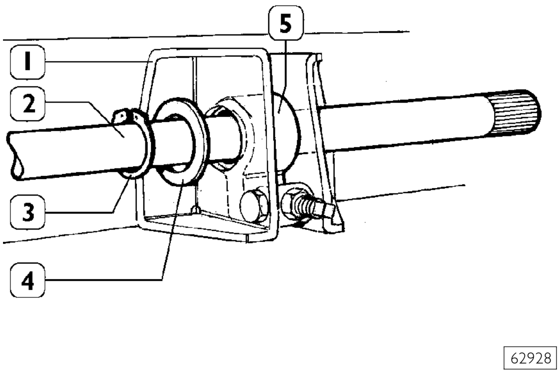


Position rubber bushes (2-5) in cross member (1).

Apply tool 99374166 (4) to bushes (2-5) as shown in the figure.

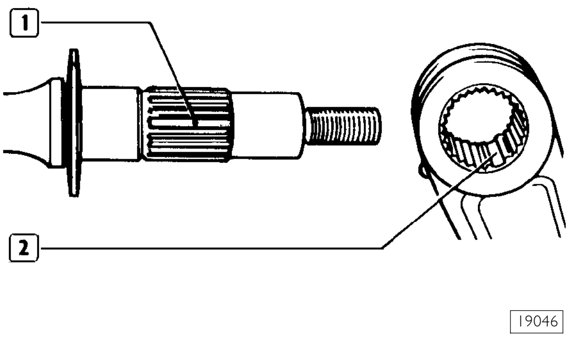
Hold the screw (6) and tighten the nut (3) until fitting in place the rubber bushes (2-5).

Figure 72



Set the adjustment lever (5) in the bracket (1) and insert the torsion bar (2) including the washer (4) and the circlip (3).

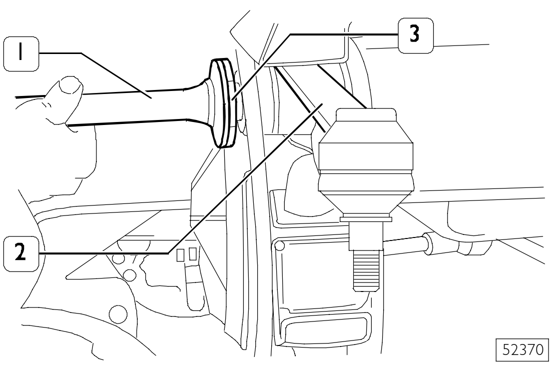
Figure 73



NOTE The rear part of the torsion bars is marked with AD-AS to identify respectively the right bar and the left bar.

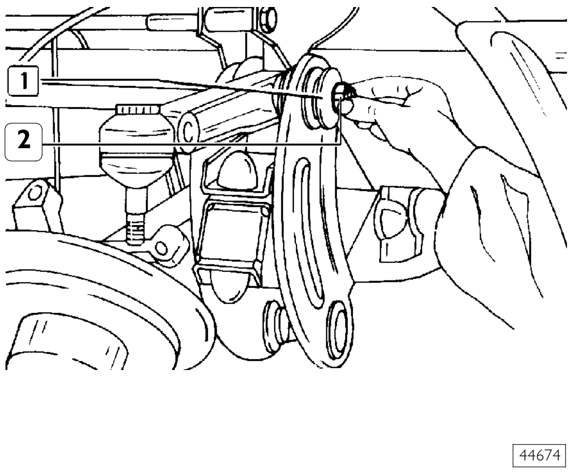
The splined part is provided with a double tooth (1), that shall coincide at refitting with the double space (2) of the upper lever.

Figure 74



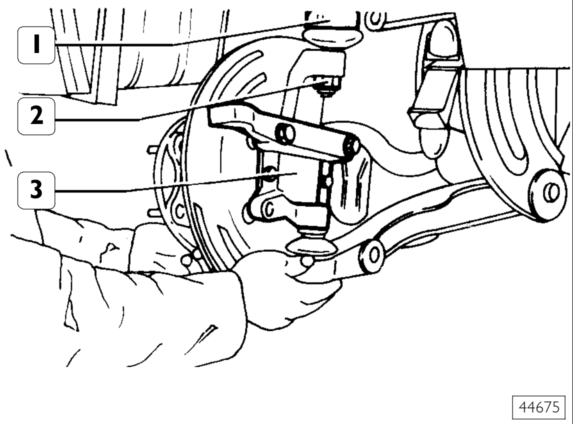
Set the upper lever (2) in the cross member, then insert the torsion bar (1), including the washer (3), into cross member and lever, making the double tooth coinciding with the double space of the lever.

Figure 75



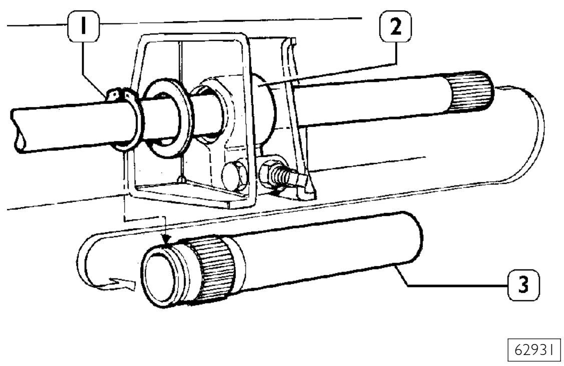
Set the washer (1) and screw the nut (2) without locking it.

Figure 76



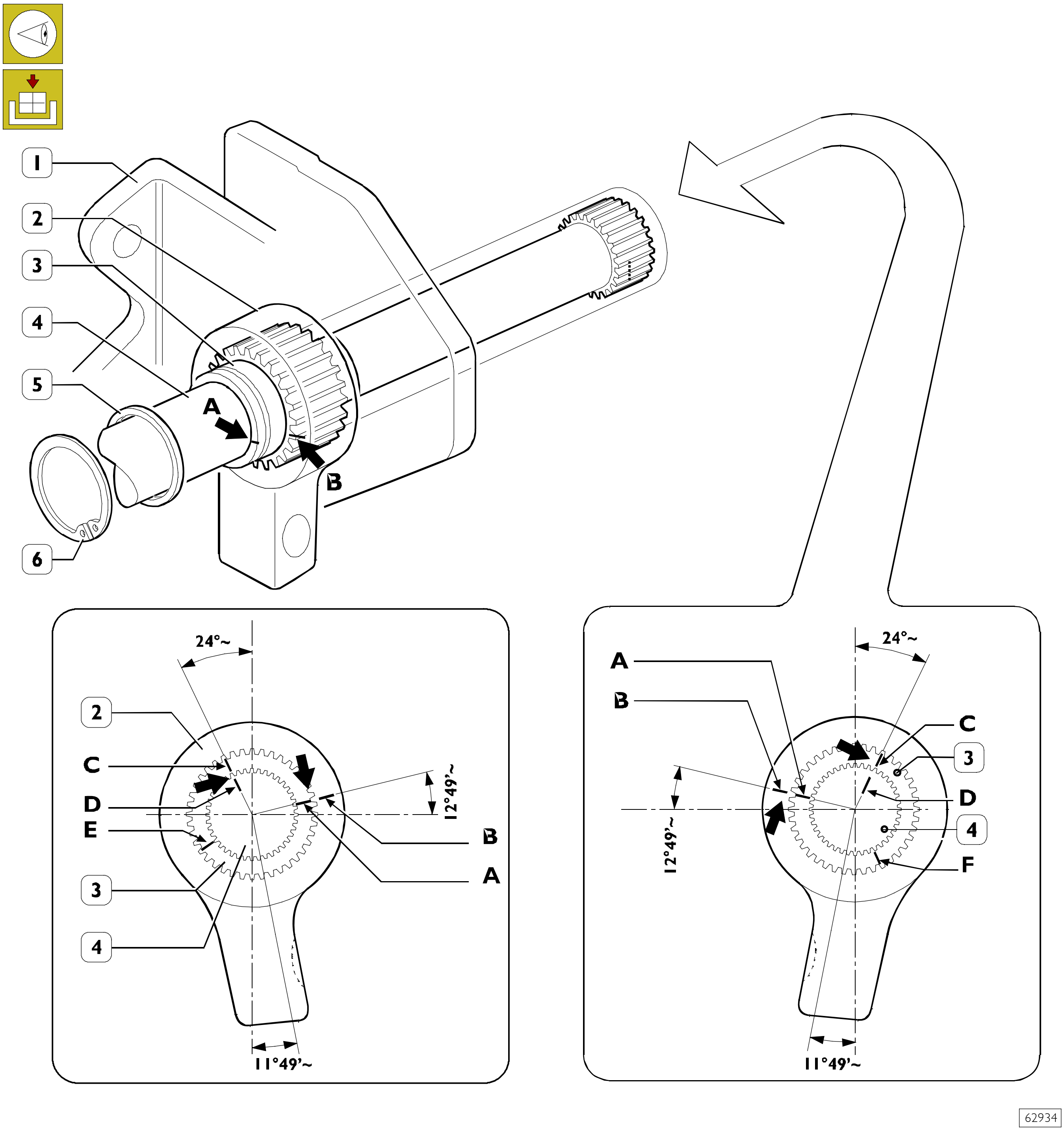
Connect the stub axle (3) to the upper lever (1) ball joint; tighten the fastening nut (2) to the specified torque.

Figure 77



Fit the sleeve (3) on the torsion bar (1) and in the adjustment lever (2) so that the marks on these components coincide as shown in the following figure.

Figure 78



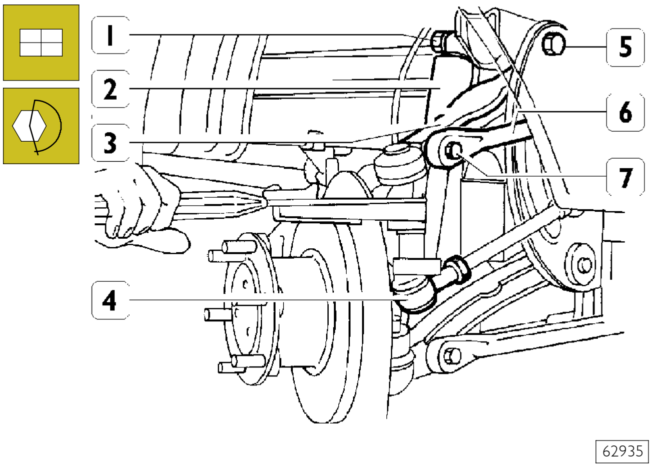
AD. Right torsion bar

AS. Left torsion bar

1. Bracket - 2. Adjustment lever - 3. Sleeve - 4. Torsion bar - 5. Washer - 6. Circlip - A. Front reference mark on sleeve (3) - B. Front reference mark on adjustment lever (2) - C. Rear reference mark on sleeve (3) - D. Reference mark on torsion bar (4) - E. Reference mark on left torsion bar - F. Reference mark on right torsion bar.

After refitting torsion bar (4)/ sleeve (3)/ adjustment lever (2), secure the sleeve (3) to the bracket with the circlip (6). Refit the fuel tank (if removed).

Figure 79



Refit the tie rod (6) to the lever (3) without tightening to torque the nut for screw (7); connect the articulated head (4) of the steering box tie rod to the stub axle lever and tighten the nut to the specified torque.

Connect the shock absorber with the screw (5) and the nut (1) and tighten the latter to the specified torque.

Refit wheels, fit nut protection and tighten the fastening nuts; remove stands and lower the vehicle.

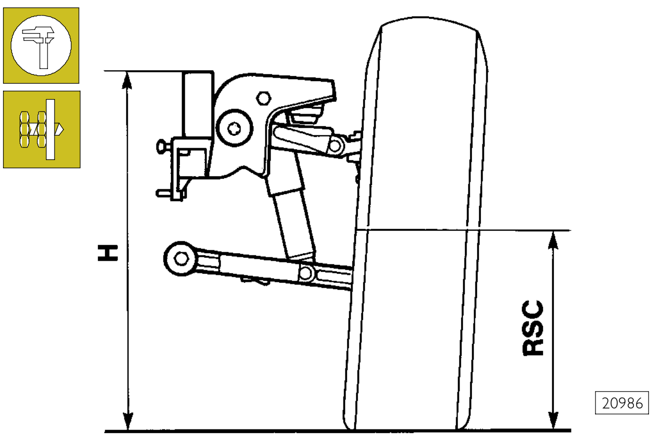
Then tighten to the specified torque the following components:

- ❑ wheel fastening nuts;
- ❑ nut and lock nut fastening the torsion bars to the relevant levers;
- ❑ nuts for screws fastening the upper tie rods to the relevant levers.

Adjust torsion bar preload as described in the following paragraph.

Torsion bar preload adjustment

Figure 80



TORSION BAR PRELOAD CHECK DIAGRAM

H = mm, height from ground of side member upper edge measured as close as possible to suspension connection area

RSC (Loaded radius):

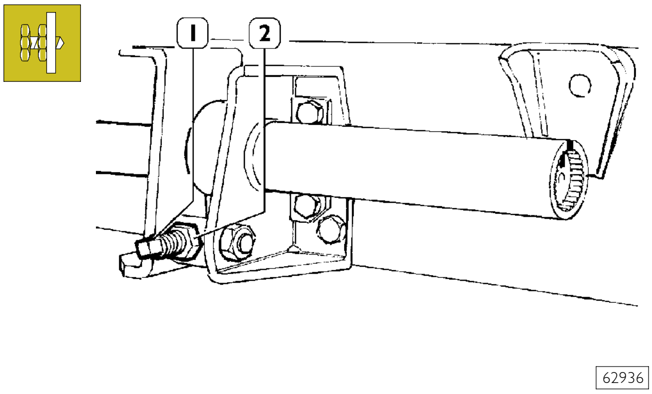
- with 225/75R16 tyres, 345 mm with 2500 kg load
- with 7.00R16 tyres, 364 mm with 2000 kg load

Check whether tyre pressure is the specified one and then using the proper gauge, check whether tyre tread depth is almost the same on both wheels.

Measure on both vehicle sides the height (H) from ground of side member upper edge - measured as close as possible to suspension connection area

Height (H) shall correspond to the value specified in the following table.

Figure 81



If a different value is found, operate on the adjustment screw (1) as required, taking into account that before performing this operation the vehicle shall always be lifted from ground with hydraulic jack to prevent screw damaging.

Once proper vehicle setup is obtained, lock the screw with the lock nut (2).

Load on front wheels (Kg)	Tyres	
	225/75 R 16	7.00 R 16
1400	672	691
1500	665.6	684.6
1700	652.6	671.6
1800	646	665
1900	639.4	658.4
2100	626.1	645.1
2300	612.8	631.8
2400	606.1	625.1
2500	599.5	618.5

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Rear mechanical suspensions

DESCRIPTION

The rear suspension is composed of:

- two leaf springs which, according to the vehicle, can be of a semi-elliptic type with double flexibility or of a parabolic type with simple flexibility.;
- two stop bumpers;
- two hydraulic double acting shock absorbers;
- stabilizer bar.

The semi-elliptic leaf spring is very stiff because all leaves forming the leaf spring have the same thickness from one end to the other.

Moreover, leaves are placed one against the other and this causes a great internal friction which limits the movements of the leaf spring.

The parabolic leaf spring is formed by leaves which have a greater thickness in the middle than at the two ends.

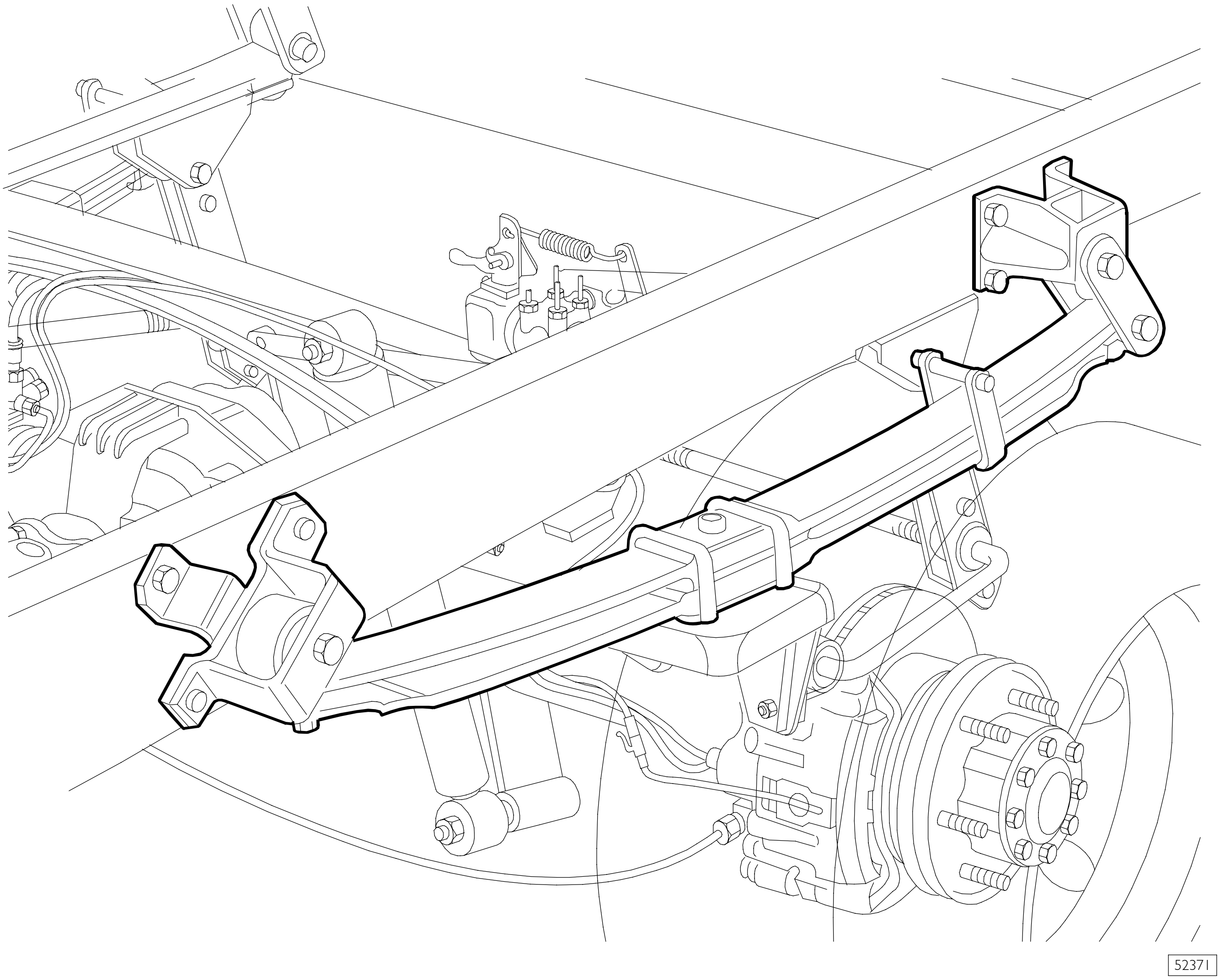
Leaves are spaced by means of shims and this reduces much of the internal friction.

The low internal friction and the particular form of the leaves make the parabolic leaf spring more "soft", this makes driving easier.

Hydraulic double-acting telescopic shock absorbers, hinder the wheel movement both upwards and downwards, allowing a great driving stability.

The stabilizer bar must keep the geometry between the wheel axle and the chassis and arrange the load evenly over the wheels on the same axle.

Figure 82

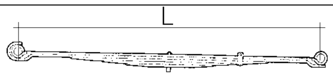
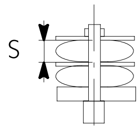
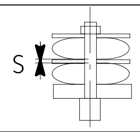
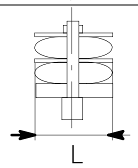
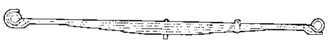
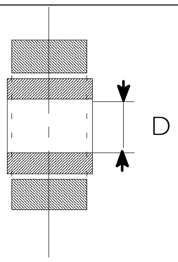
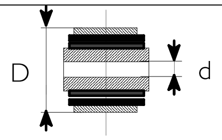


REAR SUSPENSION

CHARACTERISTICS AND DATA

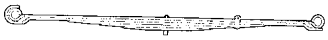
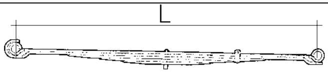
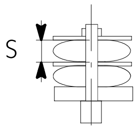
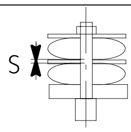
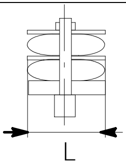
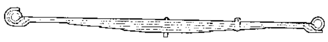
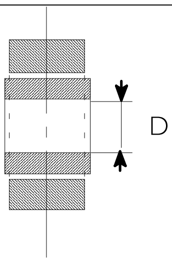
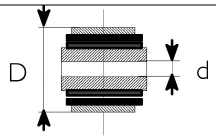
Rear leaf spring

Vehicles: 29 L - 35 S

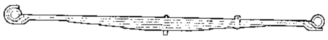
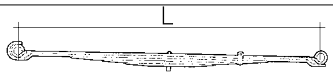
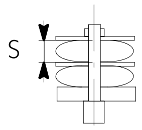
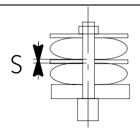
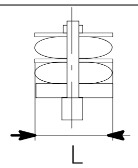
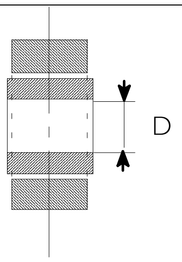
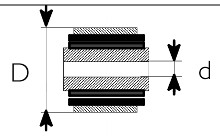
		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1500 ± 3
	Leaf thickness (measured at centre)	24 (22)*
	Gap between leaves	-
	Leaf width	80 ± 0.5
	CONTROL DATA WITH NEW SPRING: Spring flexibility with static load	8.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

(*) Alternatively

Rear leaf spring
Vehicles: 35 C - Camper version

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at centre)	-
	Gap between leaves	15
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Spring flexibility with static load	6.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

Rear leaf spring
Vehicles: 35 C

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at centre)	19
	Gap between leaves	3 (1 x 3 + 1 x 25)*
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Spring flexibility with static load	10.5 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

(*) For versions with maximum front load = 1900 kg

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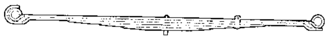
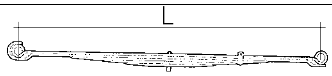
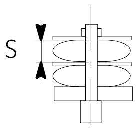
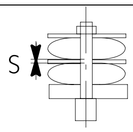
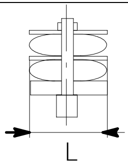
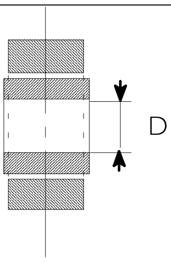
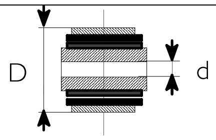
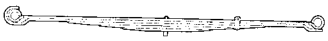
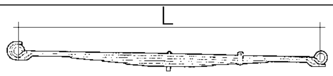
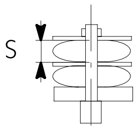
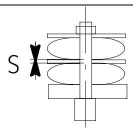
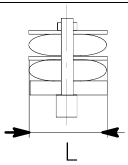
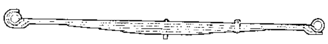
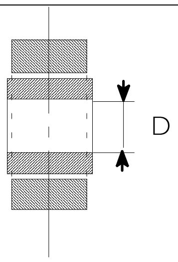
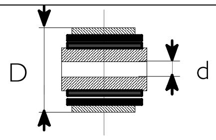
Rear leaf spring
Vehicles: 40 C chassis cowls

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at centre)	22
	Gap between leaves	3
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load	7.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

Rear leaf spring

Vehicles: 40 C

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at the centre) thickness of the auxiliary leaf (measured at the centre)	18 18
	Gap between leaves	3
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load	7.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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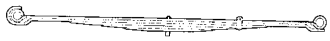
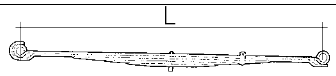
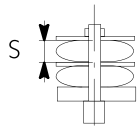
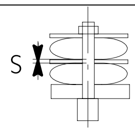
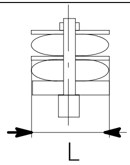
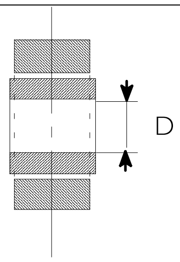
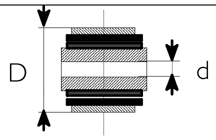
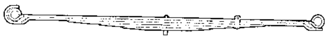
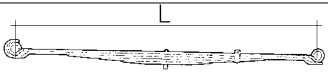
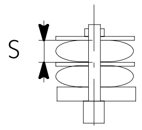
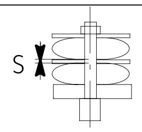
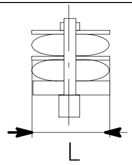
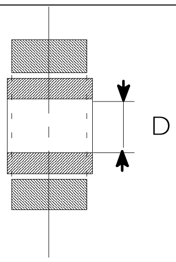
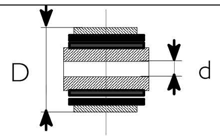
Rear leaf spring
Vehicles: 45 C

		mm
	Parabolic springs	Nº 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at centre)	22 (23)*
	Gap between leaves	3
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Spring flexibility with static load	6.9 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

(*) Alternatively

Rear leaf spring
Vehicles: 50 C

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at centre)	19
	Gap between leaves	3
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring deflection with static load Auxiliary spring deflection with static load Main spring flexibility with static load	5.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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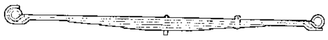
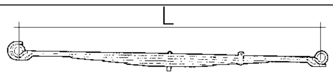
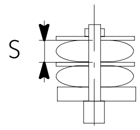
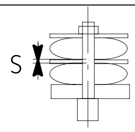
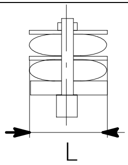
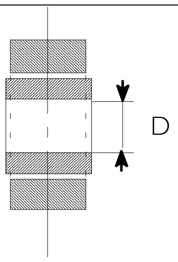
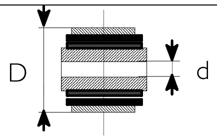
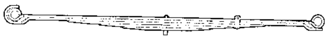
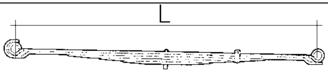
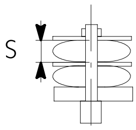
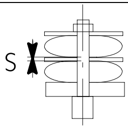
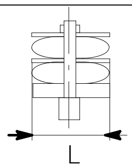
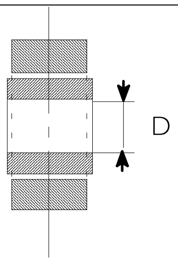
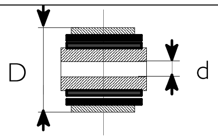
Rear leaf spring
Vehicles: 60 C - 65 C

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Thickness of the main leaves (measured at the centre) thickness of the auxiliary leaf (measured at the centre)	18 (19)* 28
	Gap between leaves	3
	Leaf width	70 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring deflection with static load Flexibility with static load after aux. spring action	 9.3 mm/kN 3.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	$40^{+0.5}_{-0.2}$
	D = bush outer diameter d = bush inner diameter	$40^{+0.02}_{-0.07}$ $16.5^{+0.2}_{-0}$

(*) Alternatively

Rear leaf spring
Vehicles: 35 C

		mm
	Semi-elliptical springs	N° 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), main leaf (1st - 4th) auxiliary leaf (1st - 2nd)	9 15
	Gap between leaves	--
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	20.2 mm/kN 10.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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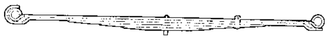
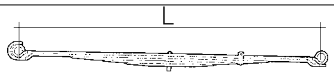
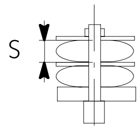
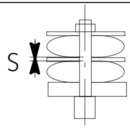
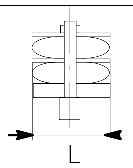
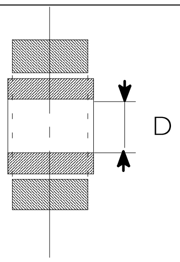
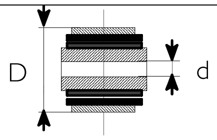
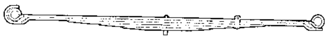
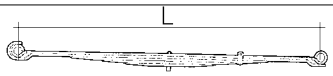
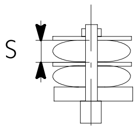
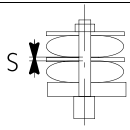
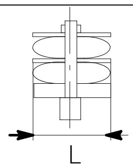
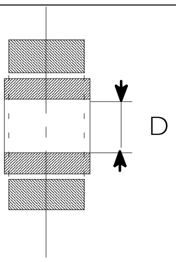
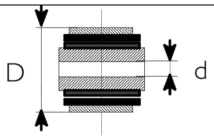
Rear leaf spring
Vehicles: 35 C - 40 C

		mm
	Semi-elliptical springs	N° 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), main leaf (1st - 4th) auxiliary leaf (1st - 3rd)	 9 15
	Gap between leaves	--
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 19.7 mm/kN 6.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

Rear leaf spring

Vehicles: 45 C - 50 C (semi-elliptical with leaf spring)

		mm
	Semi-elliptical springs	Nº 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), master leaf (1st - 7th) additional leaf (1st - 6th)	 9 8
	Gap between leaves	7
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 15 mm/kN 3.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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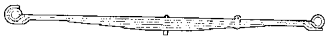
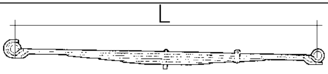
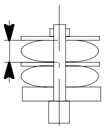
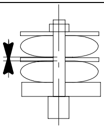
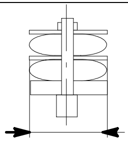
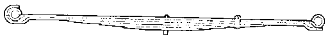
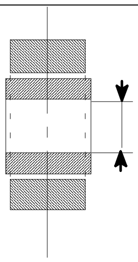
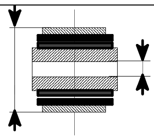
Rear leaf spring
Vehicles: 45 C

		mm
	Semi-elliptical springs	N° 2
L 	Spring length (measured at centre of eyes)	1415 ± 4
S 	Leaf thickness (measured at the centre), master leaf (1st - 4th) additional leaf (5th - 7th)	 9 15
S 	Gap between leaves	-
 L	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 19.7 mm/kN 5.8 mm/kN
 D	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
D  d	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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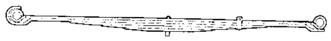
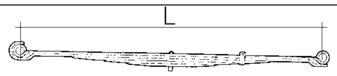
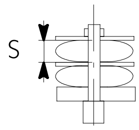
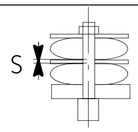
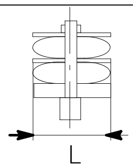
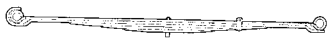
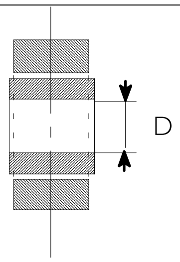
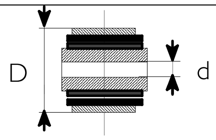
Rear leaf spring
Vehicles: 45 C - 50 C (semi-elliptical with leaf spring)

		mm
	Semi-elliptical springs	N° 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), master leaf (1st - 7th) additional leaf (1st - 6th)	 9 8
	Gap between leaves	10
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 14.5 mm/kN 3.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

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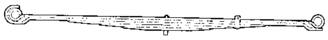
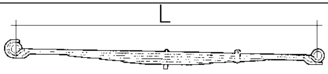
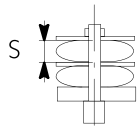
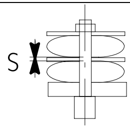
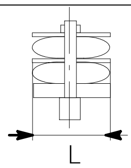
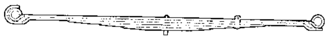
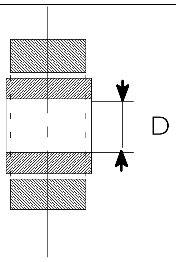
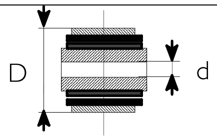
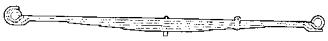
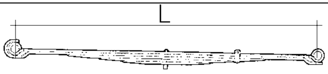
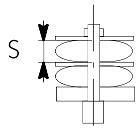
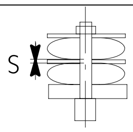
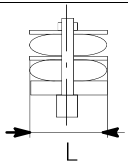
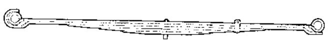
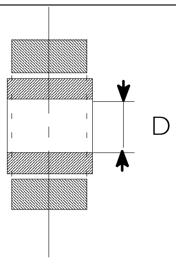
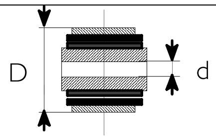
Rear leaf spring
Vehicles: 50 C

		mm
	Semi-elliptical springs	Nº 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), master leaf (1st - 4th) additional leaf (1st - 3th)	 9 16
	Gap between leaves	10
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 19.7 mm/kN 4.9 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

Rear leaf spring
Vehicles: 50 C

		mm
	Parabolic springs	N° 2
	Spring length (measured at eye centres)	1415 ± 3
	Leaf thickness (measured at the centre) master leaf	22 (24)*
	Gap between leaves	3 (10)*
	Leaf width	60 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load	5.6 mm/kN
	Main leaf eye inner diameter (Bush seat)	40 ± 0.5
	D = bush outer diameter d = bush inner diameter	$40^{+0}_{-0.1}$ $16.5^{+0.2}_{-0}$

(*) Alternatively

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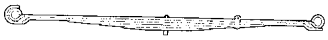
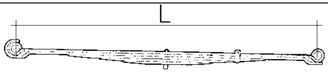
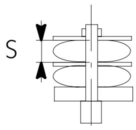
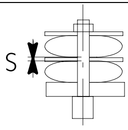
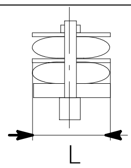
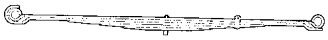
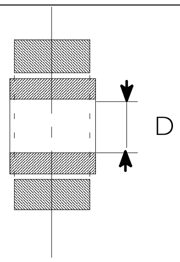
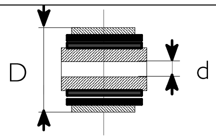
Rear leaf spring
Vehicles: 60 C - 65 C

		mm
	Semi-elliptical springs	N° 2
	Spring length (measured at centre of eyes)	1415 ± 4
	Leaf thickness (measured at the centre), master leaf (1st - 4th) additional leaf (1st - 2nd)	11 22
	Gap between leaves	--
	Leaf width	70 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	9.3 mm/kN 3.1 mm/kN
	Main leaf eye inner diameter (Bush seat)	$40^{+0.5}_{-0.2}$
	D = bush outer diameter d = bush inner diameter	$40^{+0.02}_{-0.07}$ $16.5^{+0.2}_{-0}$

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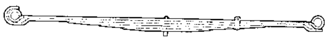
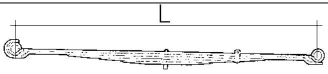
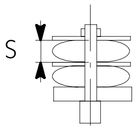
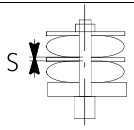
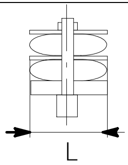
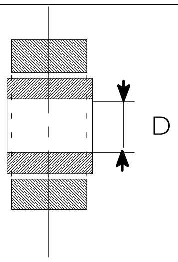
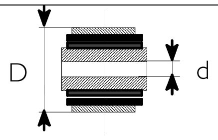
Rear leaf spring
Vehicles: 60 C - 65 C (semi-elliptical with leaf spring)

		mm
	Semi-elliptical springs	Nº 2
	Spring length (measured at centre of eyes)	1415
	Leaf thickness (measured at the centre), master leaf (1st - 10th) auxiliary leaf thickness (1st - 10th)	9 7
	Gap between leaves	9
	Leaf width	70 ± 0.5
	CONTROL DATA WITH NEW SPRING: Main spring flexibility with static load Flexibility with static load after aux. spring action	 8.5 mm/kN 2.4 mm/kN
	Main leaf eye inner diameter (Bush seat)	$40^{+0.5}_{-0.2}$
	D = bush outer diameter d = bush inner diameter	$40^{+0.02}_{-0.07}$ $16.5^{+0.2}_{-0}$

(*) Alternatively

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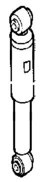
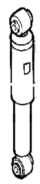
Rear shock absorbers

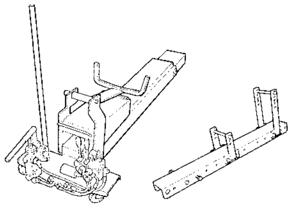
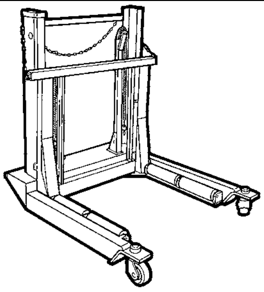
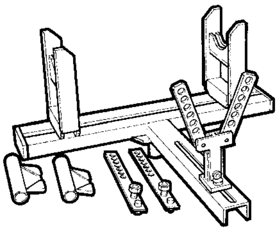
Models:	29 L - 35 S		
		**Arvin Meritor**	**Sachs**
	Distance between centre of eyes:		
	Open	505 ± 3 mm	507 ± 3 mm
	Closed	318 ± 3 mm	317 ± 3 mm
	Stroke	187 mm	180 mm
Models:	**35 C - 40 C - 45 C - 50 C**		
		**Arvin Meritor**	**Sachs**
	Distance between centre of eyes:		
	Open	571 ± 3 mm	565 ± 3 mm
	Closed	350 ± 3 mm	345 ± 3 mm
	Stroke	221 mm	220 mm
Models:	**60 C - 65 C**		
		**Arvin Meritor**	**Sachs**
	Distance between centre of eyes:		
	Open	564 ± 3 mm	565 ± 3 mm
	Closed	347 ± 3 mm	345 ± 3 mm
	Stroke	217 mm	220 mm

Rear stabilizer bar

Models:	29 L - 35 S	35 C - 40 C *	45 C - 50 C * Vans	45 C - 50 C * Truck Chassis Cabs	60 C - 65 C *
Stabilizer bar diameter (mm)		**20**	**20**	**22**	**28**

* The torsion bar is not provided for the COMBI version.

TOOLS

TOOL NO.		DESCRIPTION
99306064		Hydraulic trolley to support leaf spring during removal and refitting
99321024		Hydraulic trolley for wheel removal and refitting
99370617		Bracket for removal - refitting and/or support of rear axle

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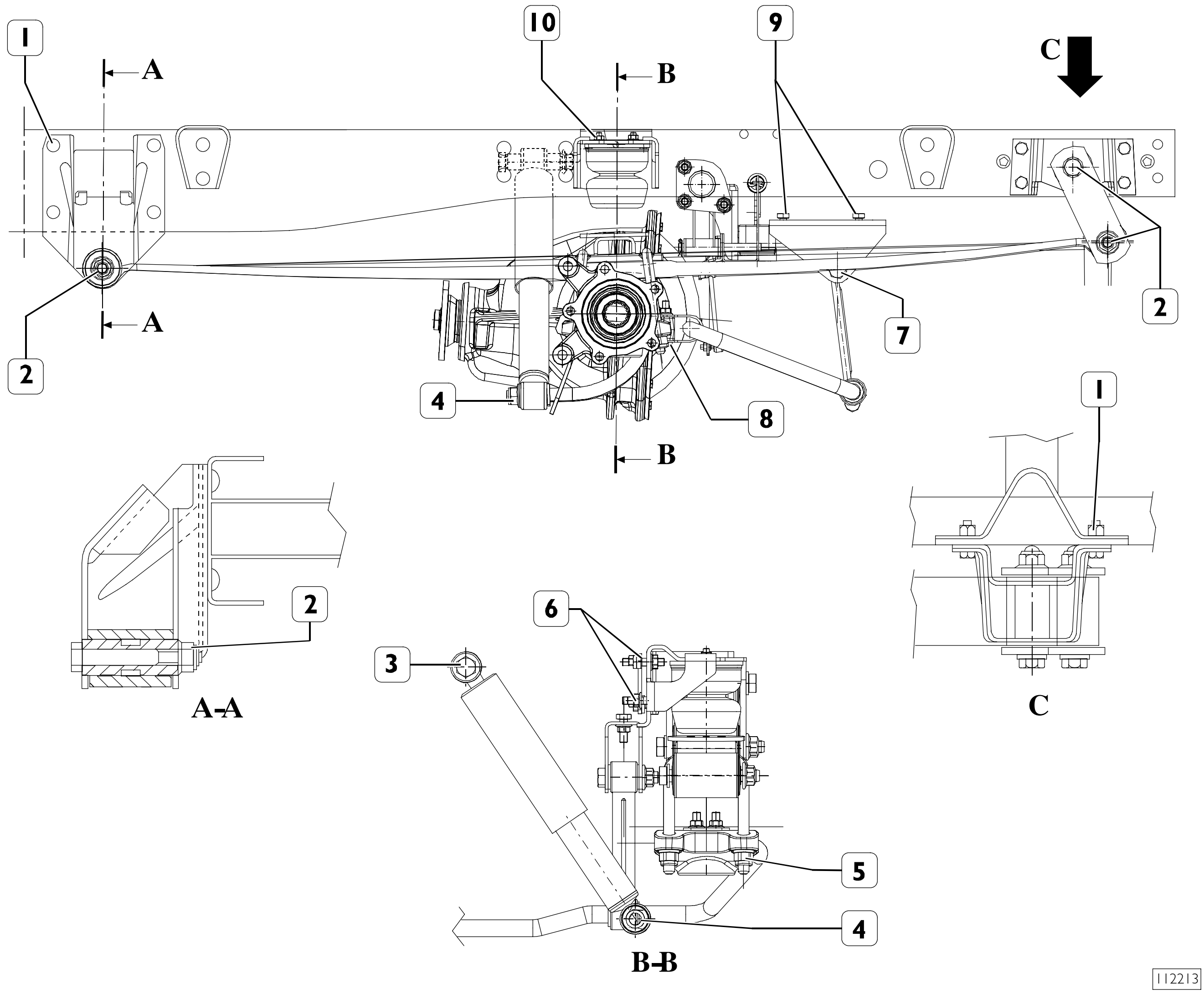
TIGHTENING TORQUES
Vehicles 29 L - 35 S

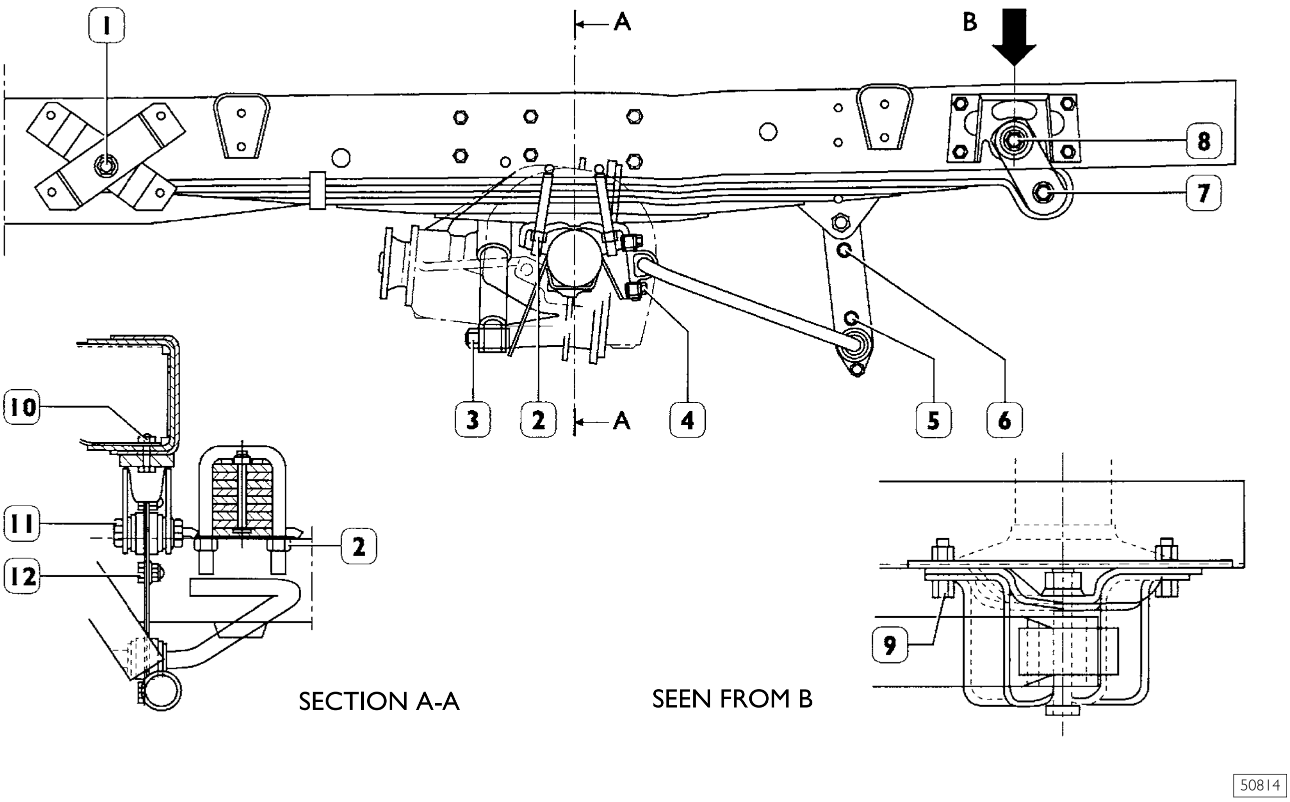
Figure 83



COMPONENT		TORQUE	
		Nm	kgm
1	M10 nuts for screws securing leaf spring rear support to chassis	47 ÷ 58	4,7 ÷ 5,8
2	Securing leaf spring and shackle:		
	- M16 screw	160 ÷ 196	16,0 ÷ 19,6
	- M16 nut	146 ÷ 178	14,6 ÷ 17,8
3	M16 nut securing shock absorber to chassis	124 ÷ 152	12,4 ÷ 15,2
4	M16 nut securing shock absorber to rear axle	124 ÷ 152	12,4 ÷ 15,2
5	M14 nuts for U bolts securing leaf spring to rear axle	118 ÷ 144	11,8 ÷ 14,4
6	M10 nut securing spring buffer support bracket	47 ÷ 58	4,7 ÷ 5,8
7	Securing articulated connecting rod to upper bracket:		
	- M16x2 screw	137 ÷ 167	13,7 ÷ 16,7
	- M16x2 nut	124 ÷ 152	12,4 ÷ 15,2
8	M10x1.5 nut securing bracket for stabiliser bar to rear axle	32 ÷ 39	3,2 ÷ 3,9
9	M10 nut securing bracket for stabiliser bar support shackle	32 ÷ 39	3,2 ÷ 3,9
10	M8 nut securing spring buffer to bracket	16 ÷ 24	1,6 ÷ 2,4

TIGHTENING TORQUES
Vehicles 35 C - 40 C - 45 C- 50 C

Figure 84



COMPONENT		TORQUE Nm	TORQUE kgm
1	M16 nut for screw securing front leaf spring	139 ÷ 170	13.9 ÷ 17
2	Nuts for stands securing leaf spring to the rear axle { M 14 / M16	74.5 ÷ 91.2 113 ÷ 170	7.4 ÷ 9.1 11.3 ÷ 17
3	M16 nut for screw securing top and bottom shock absorber	124 ÷ 152	12.4 ÷ 15.2
4	M10 nut for screw securing stabilizer bar support cap	26.4 ÷ 35.3	2.6 ÷ 3.5
5	M10 nut for screw joining stabilizer bar anchoring connecting rods	26.4 ÷ 35.3	2.6 ÷ 3.5
6	M16 screw for nut securing connecting rod to mounting	179.4 ÷ 220.6	17.9 ÷ 22
7	M16 screw for nut securing rear leaf spring	139 ÷ 170	13.9 ÷ 17
8	M16 screw for nut securing shackle to rear mounting	139 ÷ 170	13.9 ÷ 17
9	M10 screw for nut securing connecting rod mounting to the chassis frame	43 ÷ 53	4.3 ÷ 5.3
10	M8 screw for nut securing buffer to the chassis frame	26.4 ÷ 35.3	2.6 ÷ 3.5

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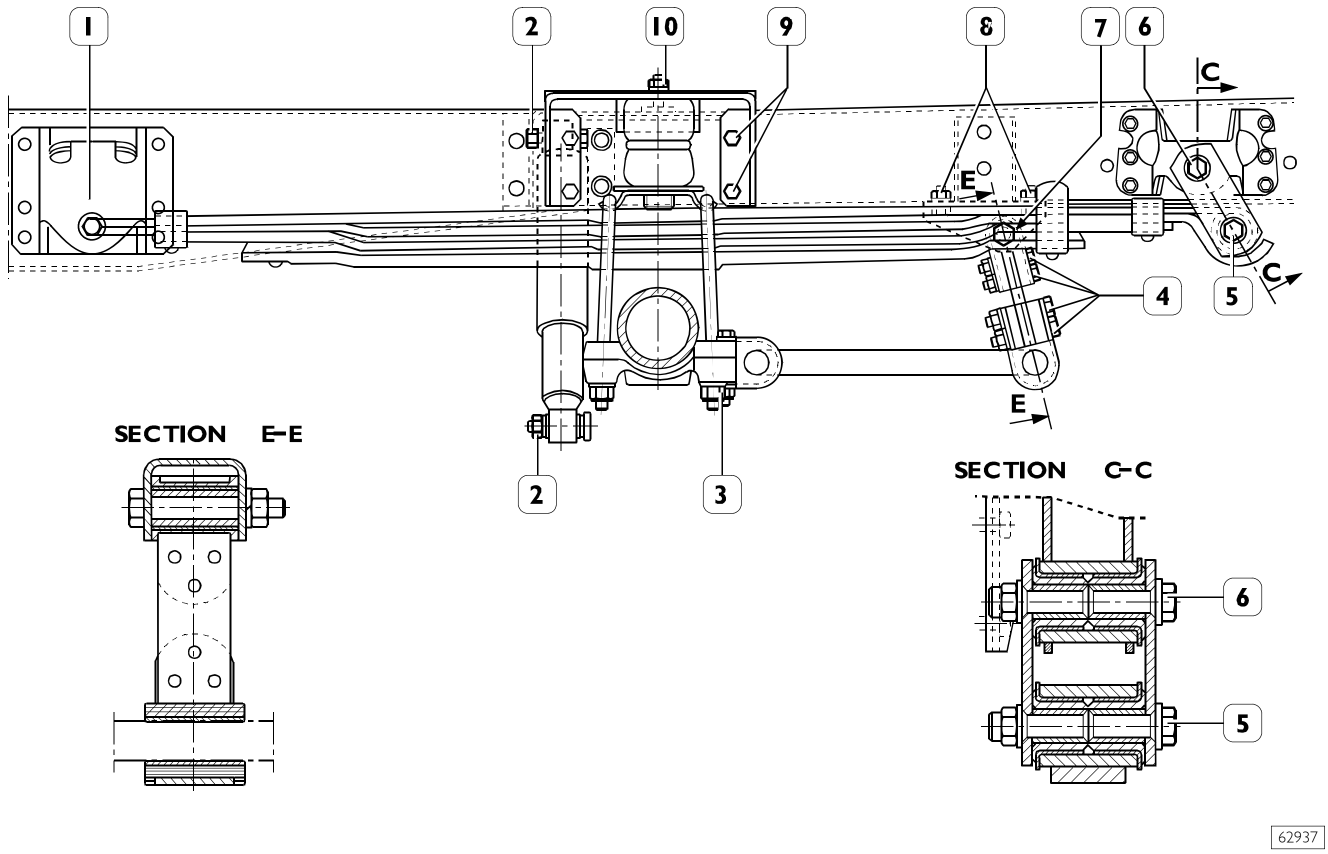
TIGHTENING TORQUES
Vehicles 60C - 65C

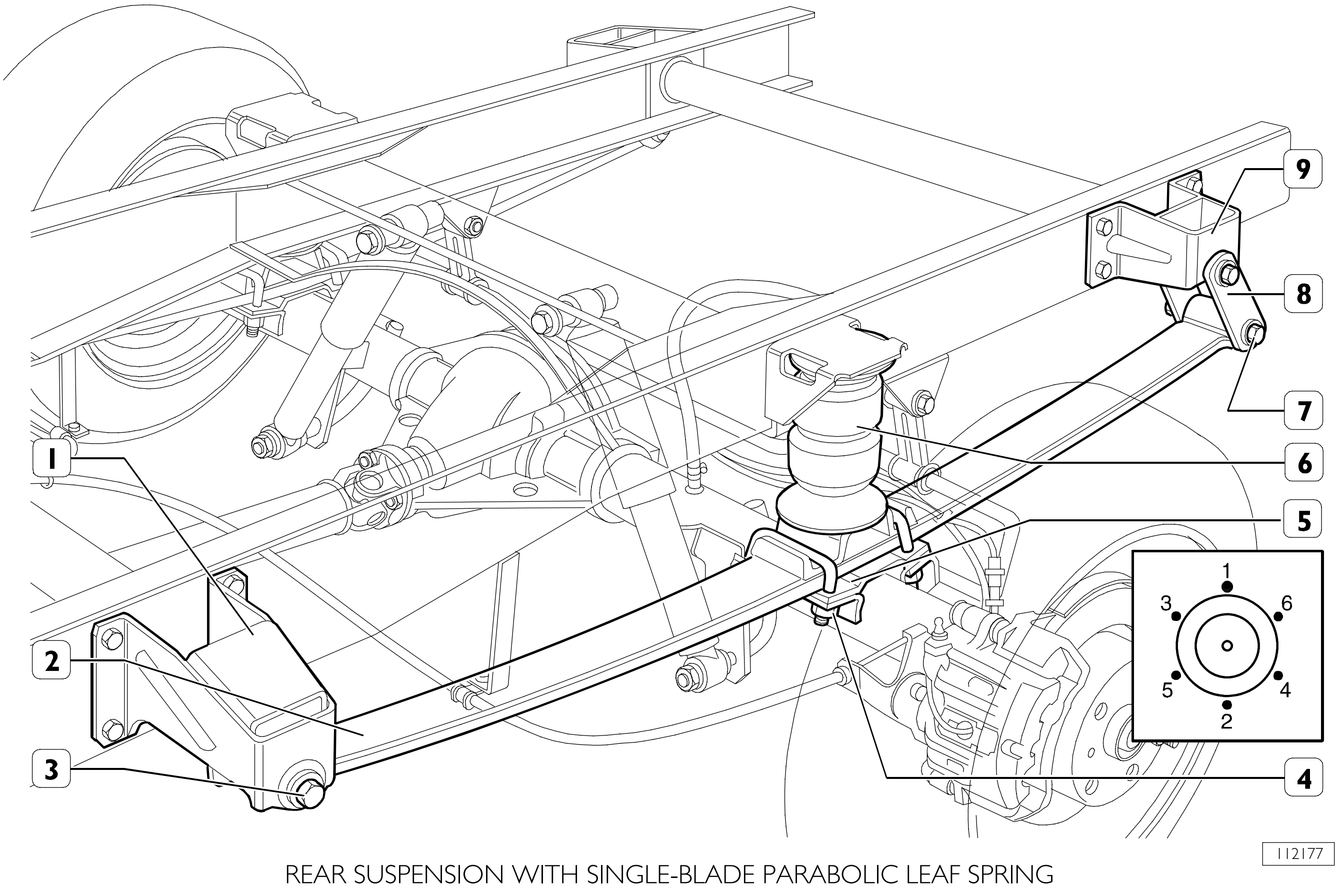
Figure 85



COMPONENT		TORQUE	
		Nm	kgm
1	Screw for front leaf spring fastening nut	186 ÷ 152	18.6 ÷ 15.2
2	M16 nut for upper and lower shock absorber fastening screw	92 ÷ 74	9.2 ÷ 7.4
3	Nut for stands fastening leaf spring to rear axle	150 ÷ 190	15.3 ÷ 19.3
4	Nut for screw fastening brackets and spacers to stabilizer bar supporting rod		
5	Screw for rear leaf spring fastening nut	186 ÷ 152	18.6 ÷ 15.2
6	Screw for nut fastening connecting rods to support	186 ÷ 152	18.6 ÷ 15.2
7	Nut for screw fastening stabilizer bar spacer and rod to support	109.9 ÷ 137.7	11.2 ÷ 14
8	M10 screw for nut fastening support to chassis	26.4 ÷ 32.3	2.7 ÷ 3.3
9	Screw for nut fastening cross member to chassis	71.7 ÷ 87.7	7.3 ÷ 8.9
10	Nut fastening bumper to chassis	49 ÷ 40	4.9 ÷ 4

REAR LEAF SPRING
Vehicles: 29 L - 35 S

Figure 86



REAR SUSPENSION WITH SINGLE-BLADE PARABOLIC LEAF SPRING

Removal

Set the vehicle on level ground. Lock the front wheels with chocks. Loosen the screws securing the rear wheels.

Put the bracket 99370617 on a hydraulic lift, position it under the rear axle and lift the vehicle.
Rest the chassis frame on stands, keeping the bracket in contact with the rear axle.

Take out the nuts securing the wheels with tool 99321024.

Take out the nuts (4) and remove the brackets (5) joining the leaf springs (2) to the rear axle.

Position the trolley 99306064 under the leaf spring (2) and fasten this to the trolley support with the brackets.

Take out the nuts and remove the screw (3) securing the leaf spring (2) to the front mounting (1).

Take out the nut and remove the screw (7) securing the leaf spring (2) to the shackle (8) of the rear mounting (9).

Lower the trolley 99306064 and extract the leaf spring.

Refitting

To re-fit, carry out the removal operations in reverse, taking the following precautions.

Check the threads of brackets which fasten the leaf springs to the axle; if they are damaged, re-machine the threads (operation 500412) or replace the brackets.
Check the conditions of bumpers (6), if they are damaged, replace them (operation 500417).

Tighten the nuts to the prescribed driving torque. Following the order shown in the figure.

After replacing the leaf springs and the hydraulic shock absorbers, it is necessary to check the efficiency of the braking control and, if necessary, carry out its adjustment (operation 796910. See Braking System Section).

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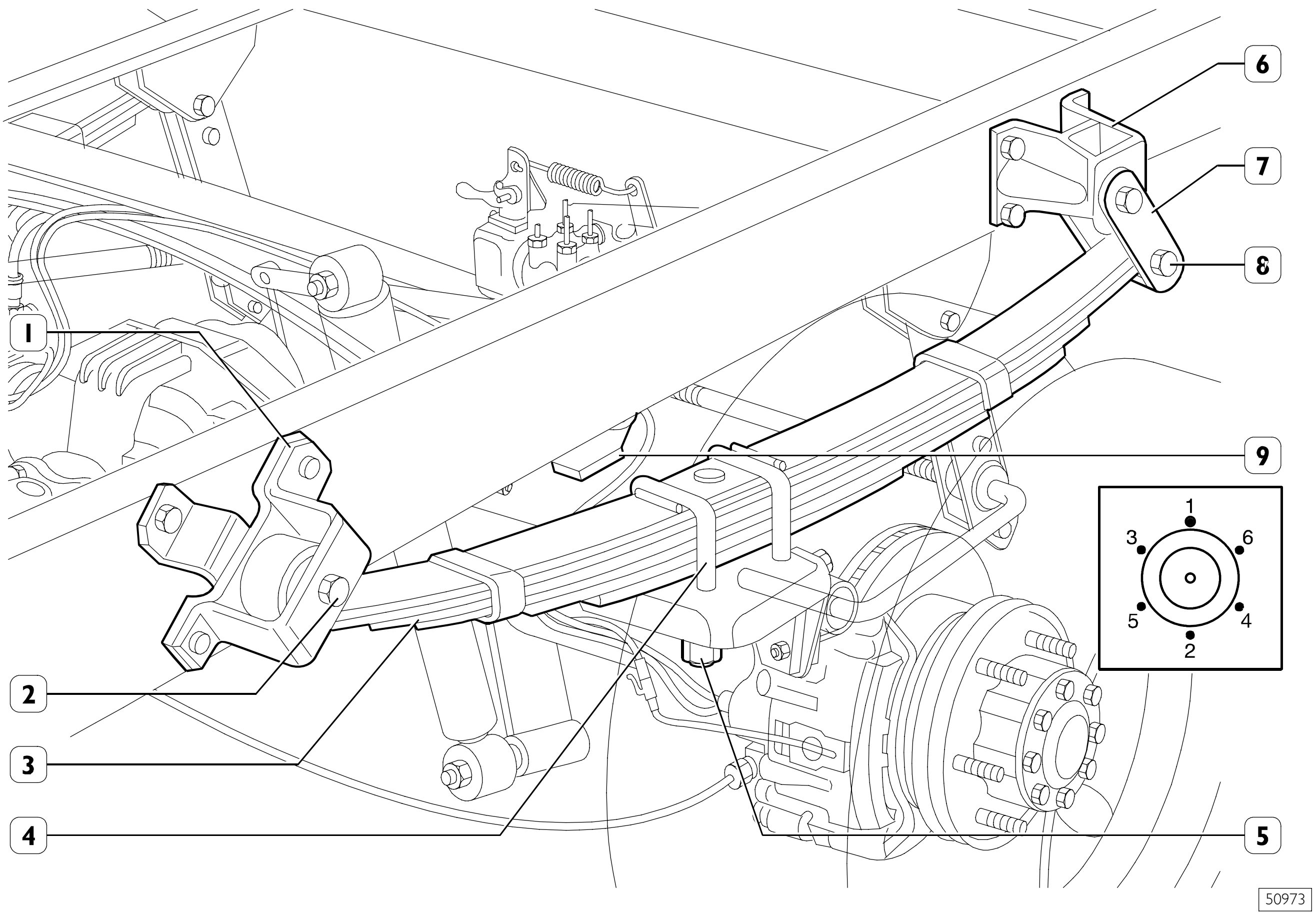
Vehicles: 35 C - 40 C - 45 C - 50 C - 60 C - 65 C

Figure 87



REAR SUSPENSION WITH SEMI-ELLIPTICAL LEAF SPRING

Removal

Set the vehicle on level ground. Lock the front wheels with chocks. Loosen the screws securing the rear wheels.

Put the bracket 99370617 on a hydraulic lift, position it under the rear axle and lift the vehicle rest the chassis frame on stands, keeping the bracket in contact with the rear axle.

Take out the nuts securing the wheels with tool 99321024.

Take out the nuts (5) and remove the brackets (4) joining the leaf springs (3) to the rear axle.

Position the trolley 99306064 under the leaf spring and fasten this to the trolley support with the brackets.

Take out the nut and remove the screw (2) securing the leaf spring (3) to the front mounting (1).

Take out the nut and remove the screw (8) securing the leaf spring (3) to the shackle (7) of the rear mounting (6).

Operating the hydraulic lift, lower the rear axle to be able to remove the centring setscrew of the leaf spring from it and extract the leaf spring.

When lowering the rear axle, make sure the brake system pipes are not put under strain.

Refitting

To re-fit, carry out the removal operations in reverse, taking the following precautions.

Check the threads of brackets which fasten the leaf springs to the axle; if they are damaged, re-machine the threads (operation 500412) or replace the brackets.

Check the conditions of bumpers (9), if they are damaged, replace them.

Tighten the nuts to the prescribed driving torque. Following the order shown in the figure.

After replacing the leaf springs and the hydraulic shock absorbers, it is necessary to check the efficiency of the braking control and, if necessary, carry out its adjustment (operation 796910. See Braking System Section).

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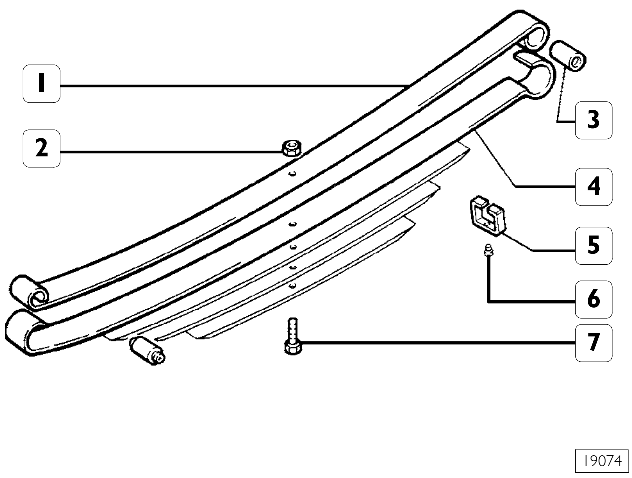
REPAIRS

Disassembling the leaf spring

NOTE Leaf springs must be disassembled only Figure 88 if it is necessary to replace the main leaf (1) or the first leaf (4), in this case go on as follows.

In case other leaves are broken or yielded, replace the whole leaf spring.

Figure 88



Place the leaf spring in the vice of the suitable bench, clamping it near the central pin; remove the relevant nut and extract the central coupling pin.

Unscrew the fastening nut (2) of the central pin (7) and extract the pin. Open the pack side clips (5), lifting the two ends that are bent on the main leaf. Open the vice and disassemble the leaf spring.

! Side clips (5) fastened with a rivet (6) to the leaf, can be re-used, provided that they do not show signs of breakage when they are re-bent to hold the pack. In this case, it is necessary to replace them with new ones to be fixed to the leaf with new rivets.

Checks

Carefully clean, with diesel oil or solvent, all components; ensure that the bushes are firmly driven in the spring eyes and shackles.

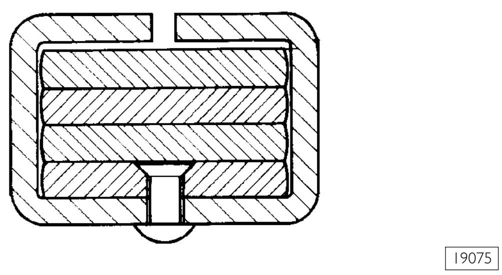
Check that the internal surface is not ovalized and that the pins are not worn or strained, in case they are, replace them.

Assembling the leaf spring

Ensure that the leaf contact surfaces are perfectly smooth and clean.
Before re-assembling the leaves, grease contact surfaces with a little of CA IG Grease.
Re-assemble the pack as follows (see Figure 88):

- ❑ place the main leaf (1) with the end eyes in the end pin of the 1st leaf (4);
- ❑ place the other leaves, included the one with the clip (5), near the former ones, rest them on one side and align them in the bench vice;
- ❑ insert through the central hole of the leaves, the central pin (7), then lock the pack in the vice;
- ❑ insert the nut (2) on the central pin (7) and lock;

Figure 89



- ❑ close the two side retaining clamps (5) by folding the ends back as shown in the figure.

500454 Replacing the bushings

The leaf spring bushings (3) are replaced with the hydraulic press and a suitable punch.

500940 REAR SHOCK ABSORBERS

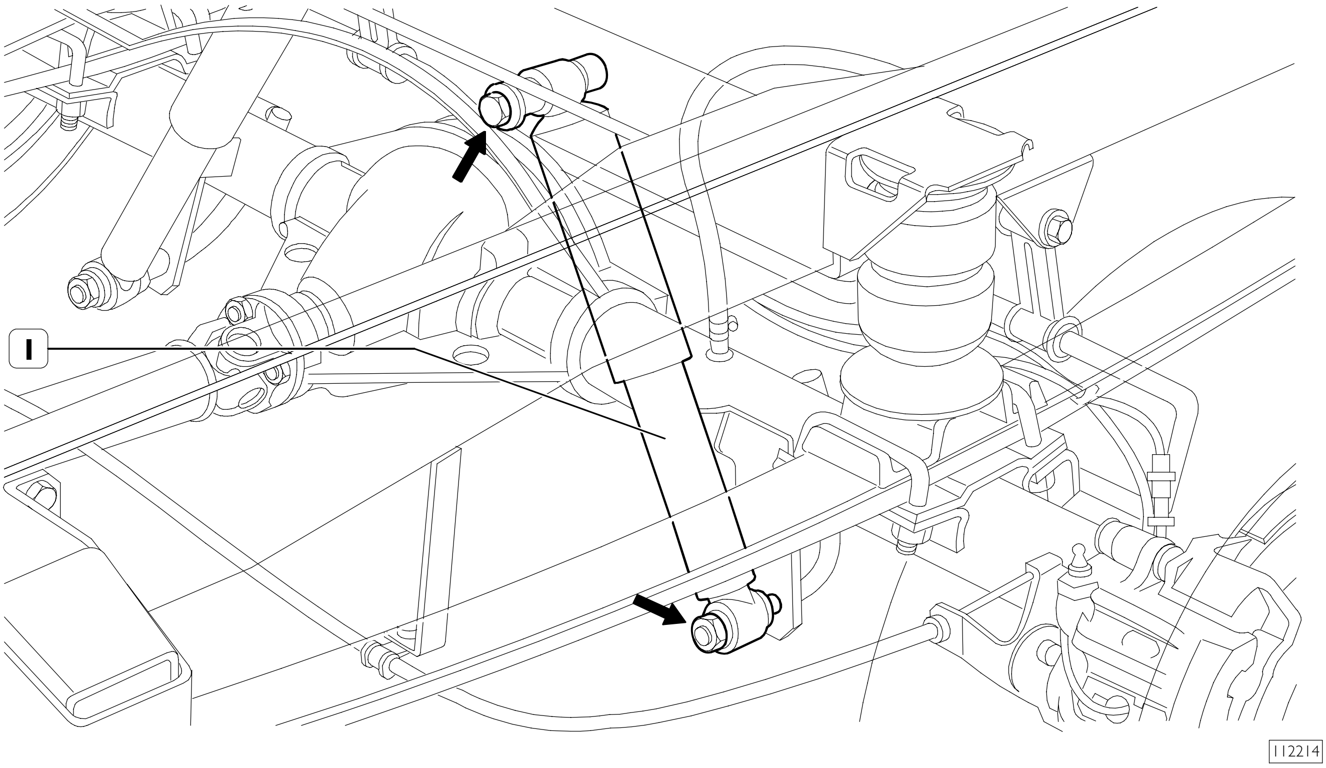
Removal

Remove the shock absorber (1) extracting the upper and lower fastening nuts or bolts (⇐) of the shock absorber.

Refitting

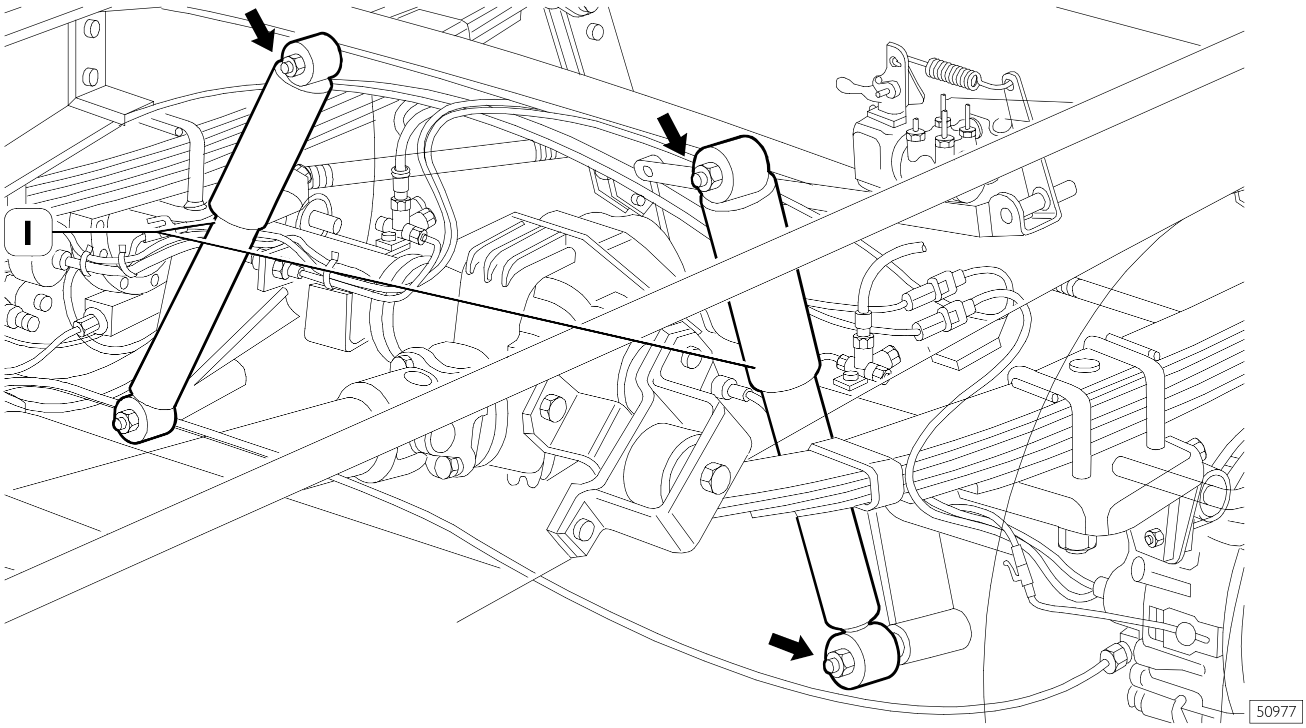
To re-fit shock absorbers carry out the removal operations in reverse and comply with the prescribed torques.

Figure 90



REAR AXLE SHOCK ABSORBERS VEHICLES 29 L - 35 S

Figure 91



REAR AXLE SHOCK ABSORBERS VEHICLES 35 C - 65 C

528960 STABILIZER BAR

Removal

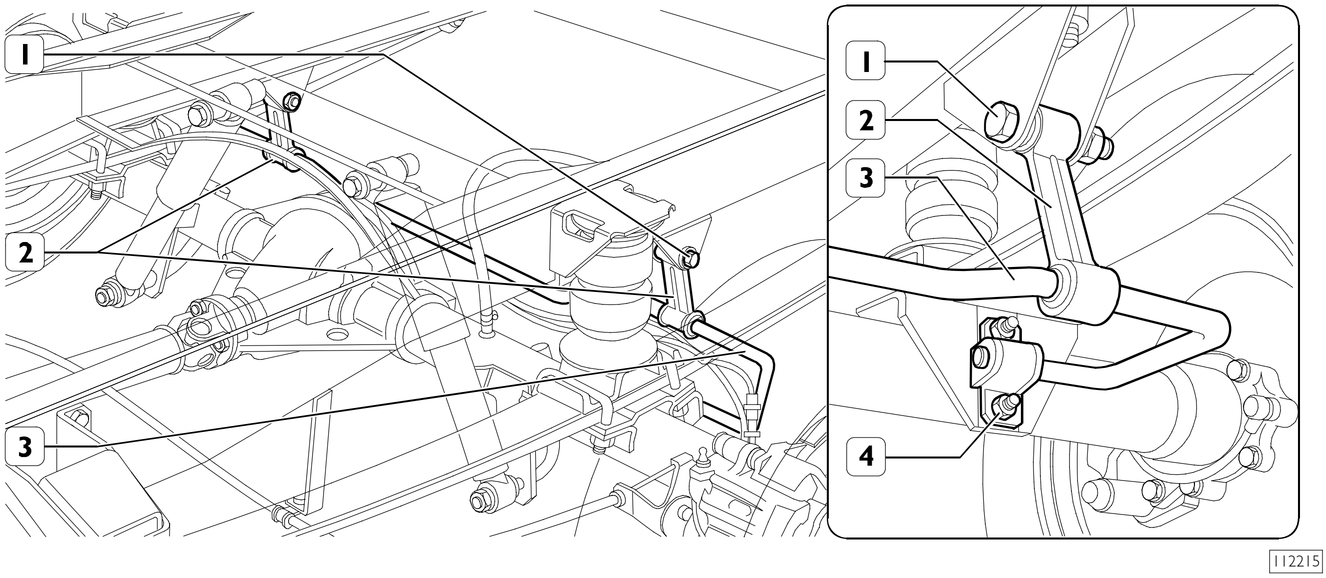
Remove stabilizer bar (3) from its attachment points by removing nuts (4) and screws (1) together with the fastening nuts, then release the bar from articulated rod (2).

NOTE Check that the bushings and/or flexible parts are not worn or deteriorated, if they are, replace them.

Refitting

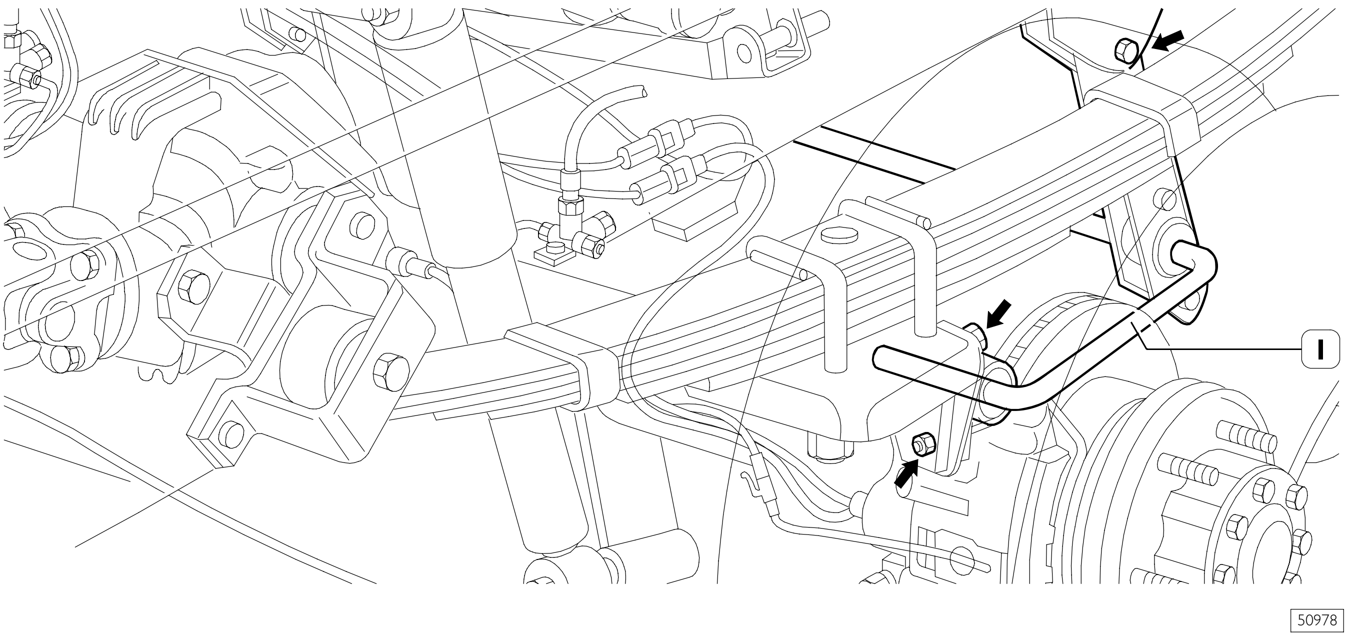
For refitting, carry out the removal operations in reverse and comply with the prescribed torques.

Figure 92



REAR STABILIZER BAR VEHICLES 29 L - 35 S

Figure 93



REAR STABILIZER BAR VEHICLES 35 C - 65 C

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Rear air suspensions

DIAGNOSTIC

Pneumatic suspension main failures:

1 - Poor or irregular pneumatic system supply;

2 - Vehicle irregular conditions.

1 POOR OR IRREGULAR PNEUMATIC SYSTEM SUPPLY

Pneumatic system pipe leaks or breakage.	YES →	Tighten or replace loosen or damaged connections. Replace broken or damaged pipes.
NO ↓		
Electrocompressor malfunctioning.	YES →	Overhaul or replace.

2 VEHICLE IRREGULAR CONDITIONS

Pneumatic system pipe leaks or breakage.	YES →	Tighten or replace loosen or damaged connections. Replace broken or damaged pipes.
NO ↓		
Faulty pneumatic and/or electric connections.	YES →	Find and reset faulty connections.
NO ↓		
Level sensor malfunctioning.	YES →	Adjust levers and replace level sensor if required.
NO ↓		
ECU malfunctioning.	YES →	Replace ECU.

GENERAL

These pneumatic suspensions show high flexibility and significant vibration damping. Their main characteristic is that the distance between chassis and road level, irrespectively of vehicle load, remains constant due to the effect of the automatic adjustment of the system.

Electronic-control pneumatic suspensions are activated automatically when starting the vehicle.

Electronic-control pneumatic suspensions enable, through the proper push buttons located in the cab, to change manually the distance between chassis and road level and therefore the height of the vehicle load bed.

The following two types of pneumatic suspensions are currently adopted:

- WABCO pneumatic suspensions for 29L - 35S vehicles
- Streparava pneumatic suspensions for 35C - 40C - 45C - 50C - 60C - 65C vehicles.

PNEUMATIC SUSPENSIONS - WABCO TYPE (for 29L - 35S vehicles)

WABCO system in addition to known advantages offered by pneumatic suspension, enables the following:

- significant air consumption reduction;
- ready response to the different adjustment processes;
- friendly systems;
- high safety performance;
- complete system diagnostic.

The WABCO system controls automatically the rated level of vehicle pneumatic suspensions.

The above mentioned operations are bound to preset operating conditions and to the relevant system safety requirements.

The ECU controls automatically the chassis level (distance from road level), through the real values provided by sensors and compares these values to the rated ones stored in its memory.

If the driving position is changed, the electronic control unit governs the electro-pneumatic assemblies, by means of which the actual level is corrected in relation to the nominal level set or saved by the driver.

Figure 94

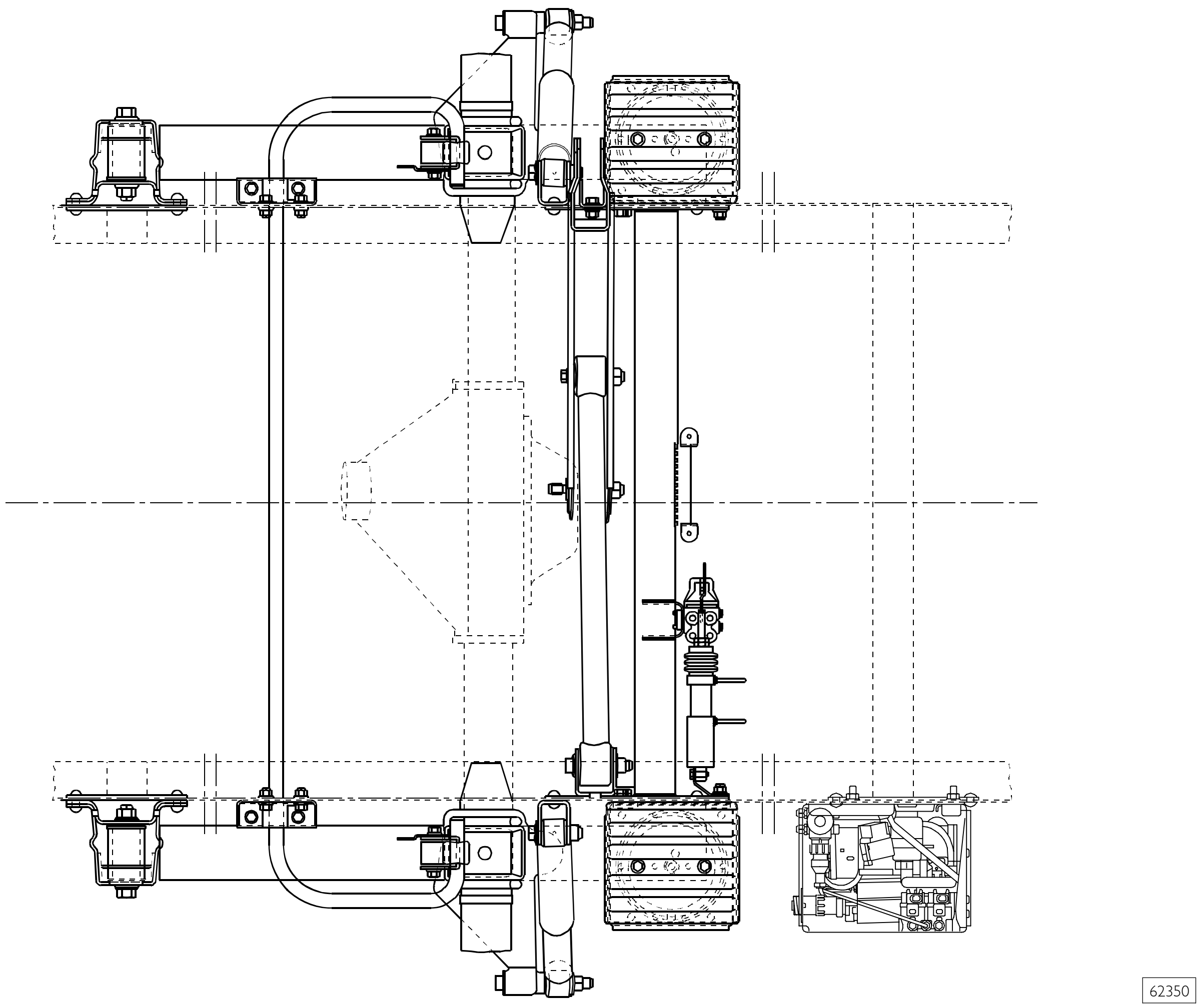
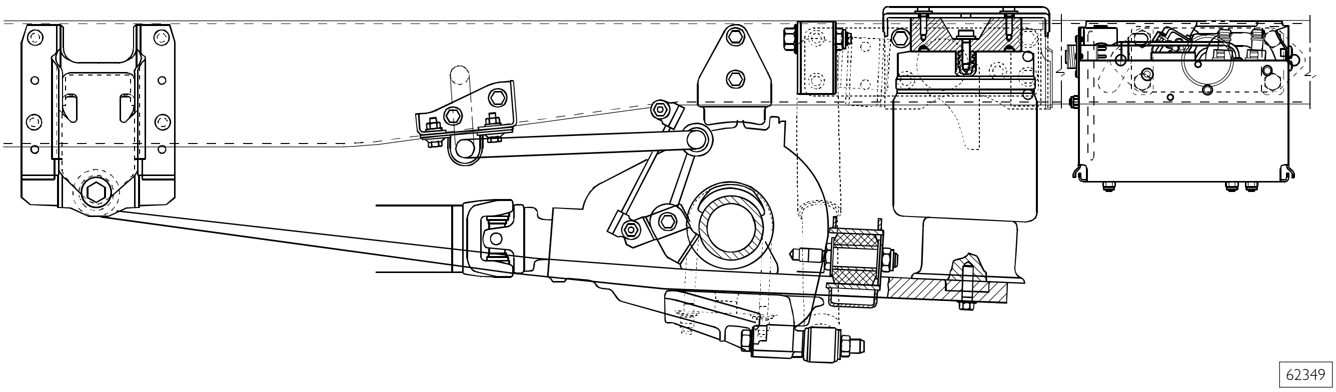


Figure 95

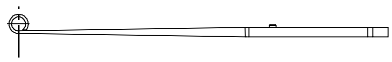
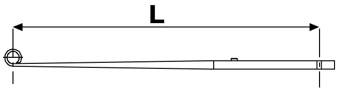
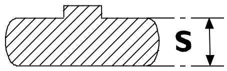
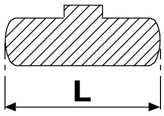
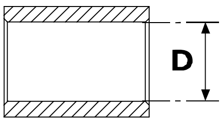
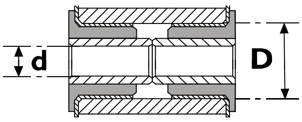


SPECIFICATIONS AND DATA

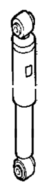
Air system components

COMPONENT	
Pneumatic supply unit	
❑ Type: WABCO 415 403 402 0	
Operating temperature Max. operating pressure Rated voltage Pressure control	- 30°C to 65°C 12.7 bar 12V DC 14 to 17.1 bar
Level sensors	
❑ Type: WABCO 441 050 012 0	
ECU	
❑ Type: WABCO 446 055 450 0	
Rated voltage	12V
Double circuit load sensing valve (vehicles without ABS)	
❑ Type : BOSCH NM/FV/98-347 (ref. 796803)	
Ratio	0.15
Pneumatic actuator	
❑ Type : ELLENA EE6492	
Operating temperature Operating pressure	- 20°C to 80°C max 8 bar
Air tank (litres)	31
Rear air spring (Mod. 29 L - 35 S)	
Max. diameter Min. length Max. length	171 mm 350 mm 150 mm

Rear leaf spring

		mm
		N° 2
	Spring length (measured between eye centre and air spring connection)	1073 ± 6
	Leaf thickness (measured at the securing point to rear axle)	24 ± 0.3
	Leaf width	80 ± 0.5
	Bush seat inner diameter	$40^{-0,05}_{-0,2}$
	D = bush outer diameter d = bush inner diameter	$40.2^{0}_{-0.15}$ $16.5^{+0.2}_{-0}$

Rear shock absorbers

			Mannesmann Sachs	ARVIN MERITOR	
	Length between eye centres:				
	Open	mm	460 ± 3	460 ± 3	480 ± 3
	Closed	mm	315 ± 3	315 ± 3	315 ± 3
	Stroke	mm	145	145	165

Stabilizer bar

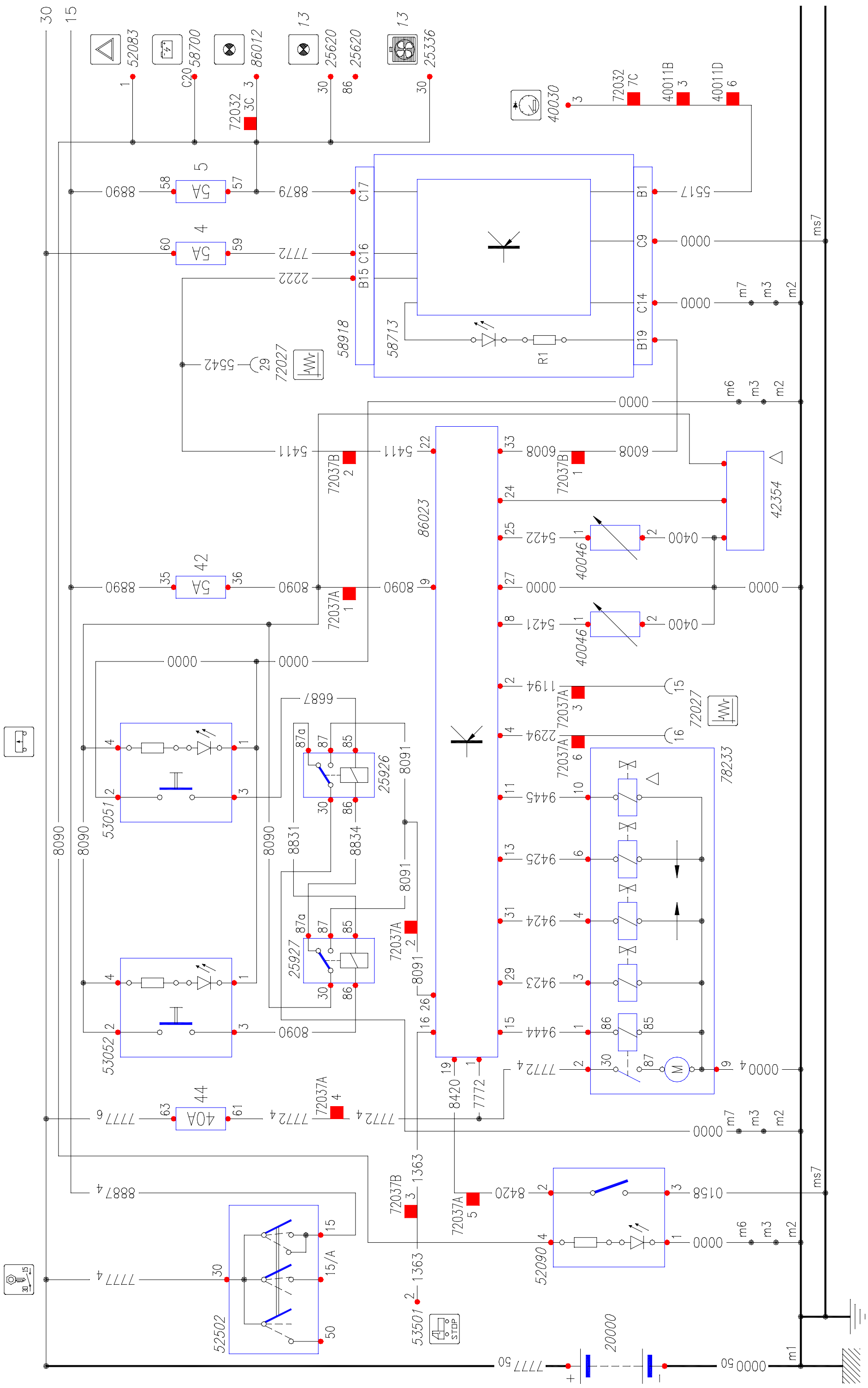
Models:	29 L - 35 S
Stabilizer bar diameter (mm)	20

Levelling and height values

Suspension condition	Distance between upper chassis edge and road level (mm)	Max. distance (mm)
Max. height	620	+ 40
Self-levelling	580	-
Min. height	520	- 60

ELECTRIC SYSTEM WABCO (ECAS)

Figure 96



61099

Legend

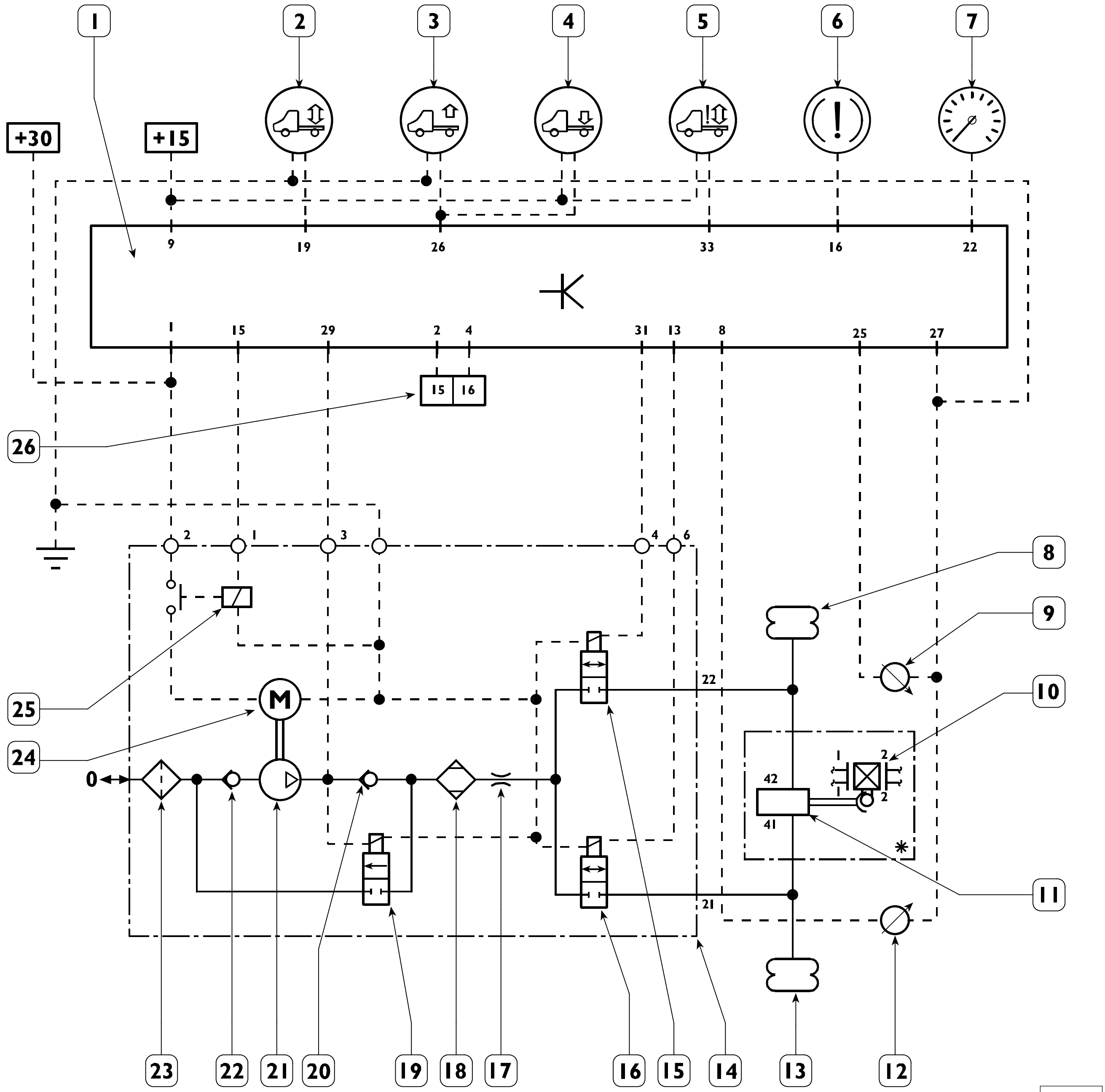
20000	Battery
25926	Relay for enabling suspension lifting and stopping the lowering function
25927	Relay for enabling suspension lowering and stopping the lifting function
42354	Pneumatic suspension system failure switch
52090	Suspension levelling switch
52502	Key switch
53051	Suspension lifting control switch
53052	Suspension lowering control switch
58713	Failure warning led
58918	Board with 32 optical indications plus instruments
78233	Vehicle lifting solenoid valve unit
86023	Vehicle lifting/lowering control unit

PNEUMATIC SYSTEM WABCO (ECAS)

Electronic-control

Vehicles: 29 L - 35 S

Figure 97



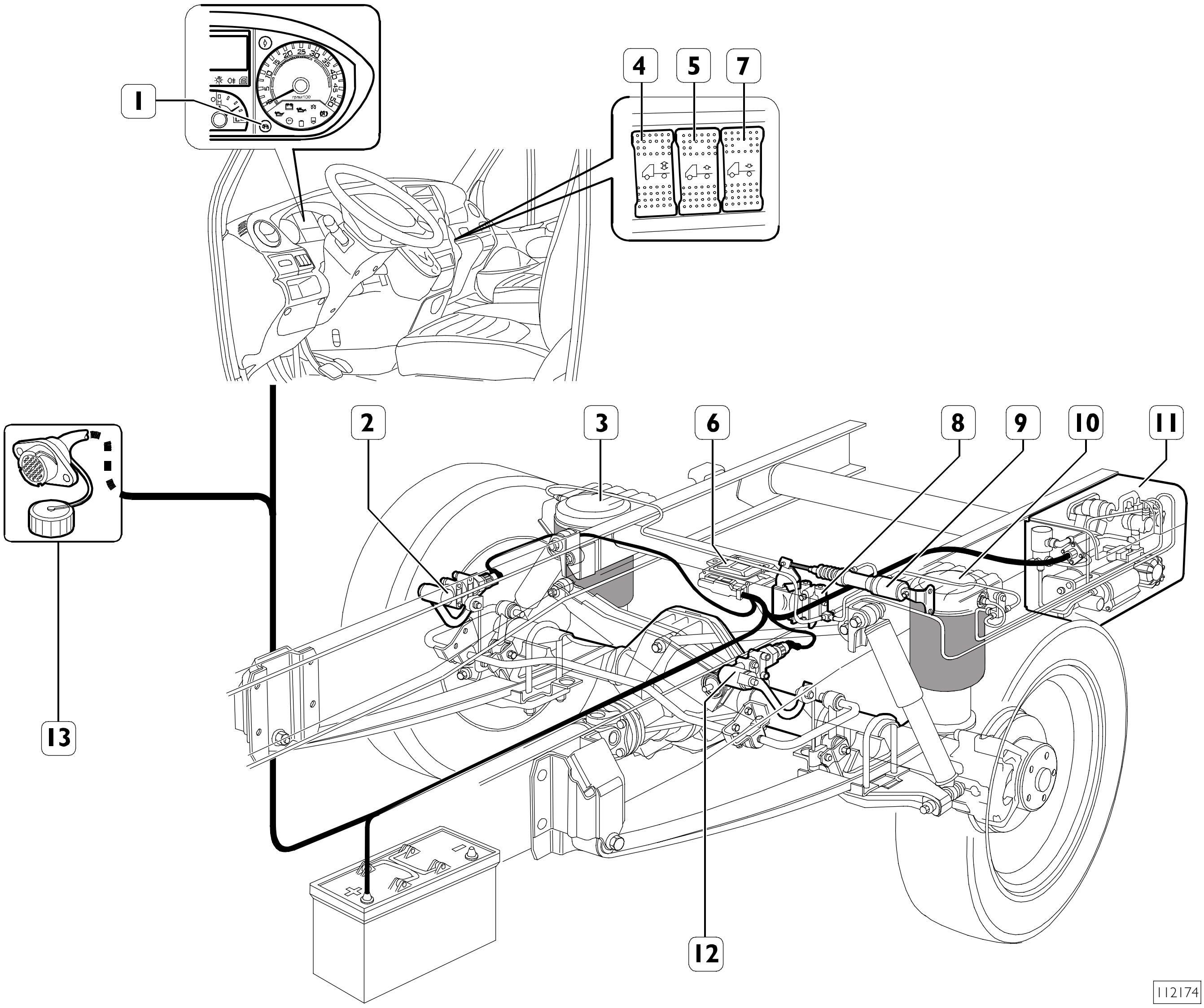
Legend

1 - ECU (ECAS).
2 - Manual chassis levelling control switch.
3 - Chassis lifting control switch.
4 - Chassis lowering control switch.
5 - Warning light ECAS.
6 - Stop light switch.
7 - Speedometer - tachograph.
8 - Right air spring.
9 - Right level sensor.
10 - Hydraulic load sensing valve*.
11 - Load sensing valve control pneumatic cylinder*.
12 - Left level sensor.
13 - Left air spring.
14 - Electrocompressor and distribution valve unit.
15 - Right chassis control solenoid valve.
16 - Left chassis control solenoid valve.
17 - Choke valve.
18 - Drier filter
19 - Air spring discharge solenoid valve.
20 - One-way valve.
21 - Compressor.
22 - One-way valve
23 - Intake filter.
24 - Compressor motor
25 - Motor control relay
26 - Diagnosis socket
* For vehicles without ABS only.

PNEUMATIC SYSTEM ON VEHICLE

Vehicles without ABS

Figure 98

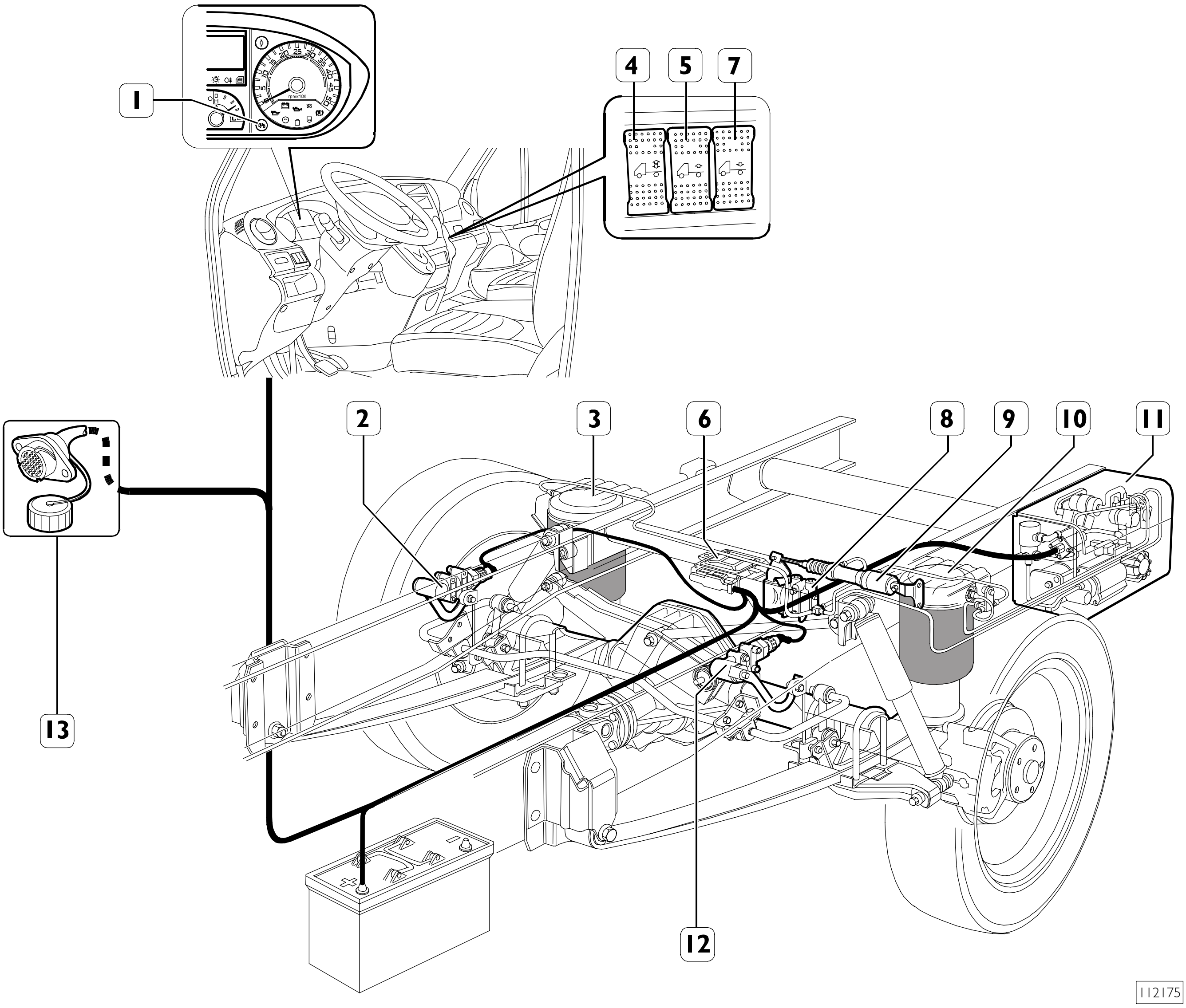


Legend

1 - Warning light
2 - Right level sensor
3 - Right air spring
4 - Chassis lowering control button
5 - Manual chassis levelling control button
6 - Electronic control unit
7 - Chassis lifting control button
8 - Hydraulic brake corrector
9 - Corrector control pneumatic cylinder
10 - Left air spring
11 - Pneumatic feeding unit
12 - Left level sensor
13 - Central diagnosis connector

Vehicles with ABS

Figure 99

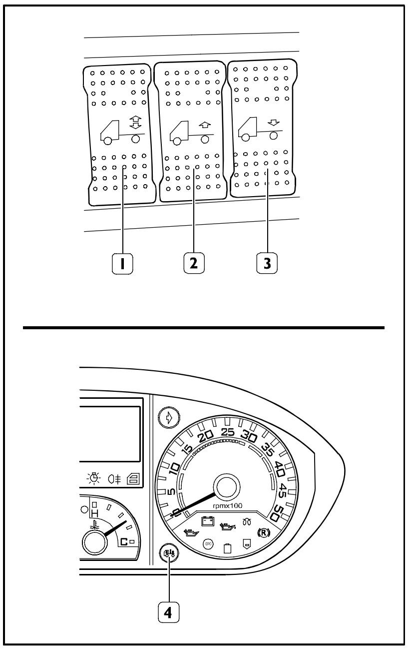


Legend

1 - Warning light
2 - Right level sensor
3 - Right air spring
4 - Chassis lowering control button
5 - Manual chassis levelling control button
6 - Electronic control unit
7 - Chassis lifting control button
8 - Left air spring
9 - Pneumatic feeding unit
10 - Left level sensor
11 - Central diagnosis connector

CHASSIS SELF-LEVELLING, LIFTING AND LOWERING

Figure 100



112176

Operation

The system consists of the following:

- ❑ Pneumatic supply unit (electrocompressor, solenoid valve unit);
- ❑ One ECU;
- ❑ Two level sensors;
- ❑ Two air springs;
- ❑ Three levelling push buttons (1, 2, 3);
- ❑ One warning light (4).

Level sensors send to ECU the signals corresponding to chassis-road distance. The ECU processes these signals, generates accordingly activation signals and sends them to the electrocompressor.

Turn the ignition key to "MAR" and depress push buttons (1, 2, 3) for lifting, lowering or activating the self-levelling function of the chassis.

This system enables vehicle running up to 20 km/h under whatever height and level condition. When this speed is exceeded, chassis automatic levelling is activated.

Variation operations are indicated by warning light (4) blinking.

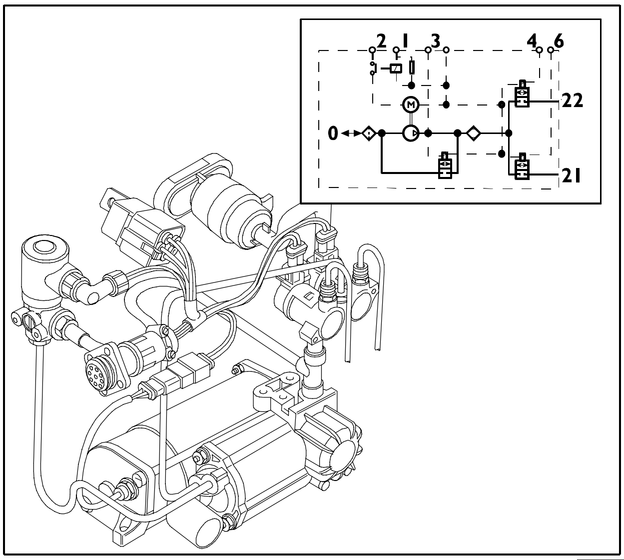
MAIN SYSTEM COMPONENTS

790560 PNEUMATIC SUPPLY UNIT

Specifications and data

Type	Wabco
Lubrication	Dry operation
Max. operating pressure	12.7 bar
Operating temperature	-30 C° to 65° C
Rated voltage	12V DC

Figure 101

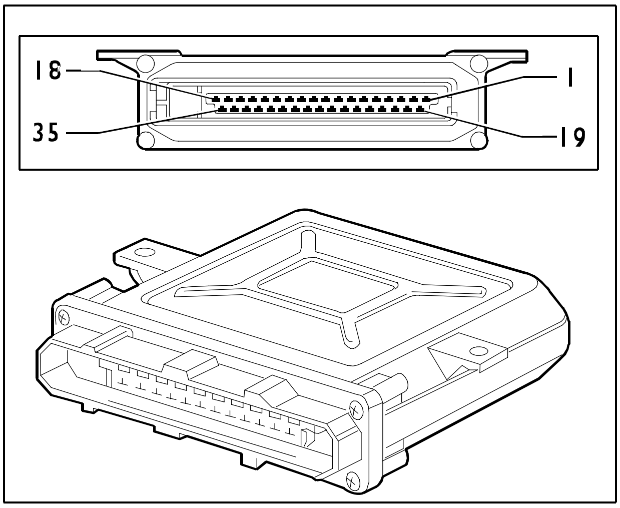


62356

This unit produces the compressed air required to supply the pneumatic system and enables to bleed air from the pneumatic system to lower the load bed.

766175 ELECTRONIC CONTROL UNIT

Figure 102



62357

The ECU is the mastermind of the system.

It controls every logic function of suspensions under both static and dynamic stage.

ECU receives signals from the control switches set in the cab and lifts and lowers the load bed accordingly. It also receives signals from the level sensors and controls the electrocompressor and the air spring to keep the vehicle in the self-levelling condition.

ECU indicates any system failure through the dedicated warning light set on the instrument panel.

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ECU programming/setting

WABCO ECU is not requiring programming since it is supplied already programmed.

Setting can be performed by MODUS, E.A.SY. and IT2000 diagnostic systems and shall be performed when replacing the following:

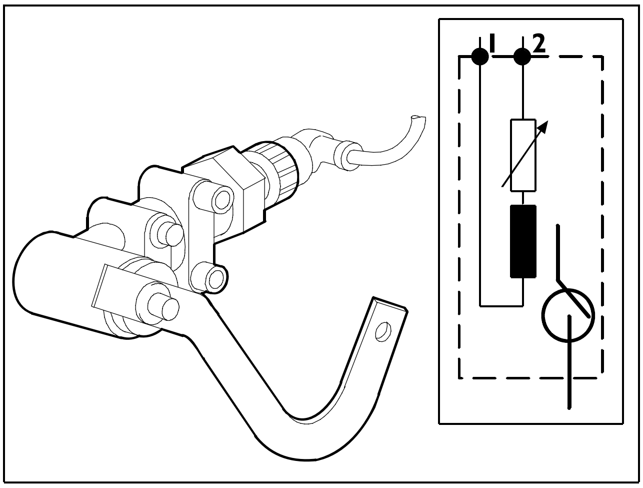
- ECU;
- level sensor;
- level sensor levers.

Connect the diagnostic tool to the 38-pin socket and proceed as follows to obtain correct setting:

- check and adjust to 110 mm the level sensor lever length, if required;
- lift the chassis by depressing the proper video push button (max. lifting);
- Insert the special spacers provided (99346151) between the chassis and the rear axle measuring 65 mm;
- lower the chassis completely by depressing the proper video push button (max.lowering);
- set ECU by depressing the proper video push button.

768822 LEVEL SENSOR

Figure 103



62358

Level sensors inform constantly the ECU on distance changes between chassis and road level.

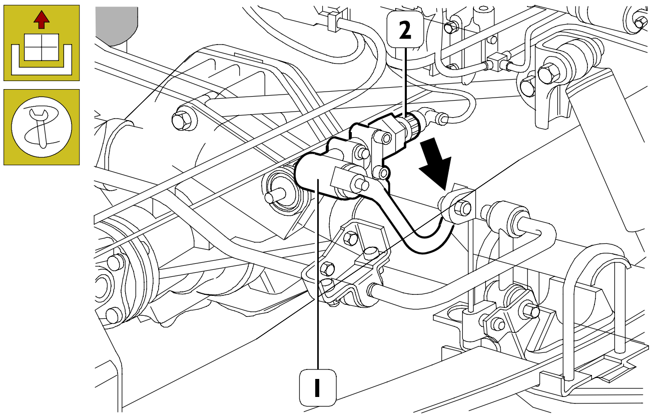
Level sensors consists of a coil secured to the chassis and a small piston.

When chassis height changes, a cam and a lever linked to the axle make the piston move inside the coil, thus modifying its inductance.

These changes will be used by the ECU in the different stages of the system.

Level sensor replacement
Removal

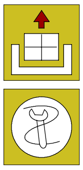
Figure 104



62460

Disconnect the electrical connection (2), loosen the screw (⇒) and disconnect the levers. Loosen the fastening screws and remove the level sensor (1).

Refitting

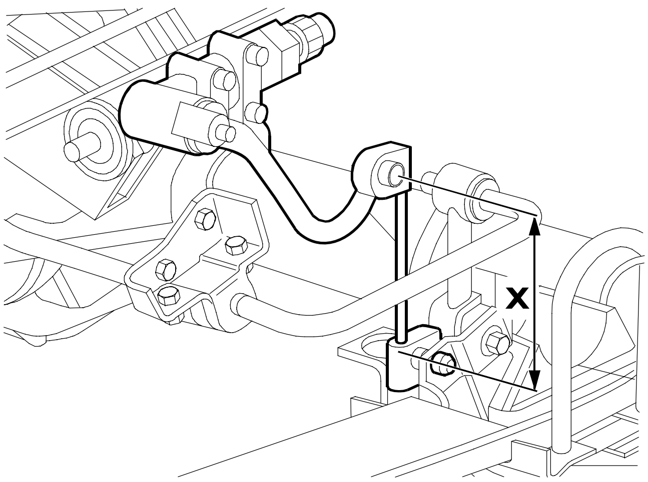


Reverse removal operations to perform refitting.

Perform level sensor and ECU setting as shown in the relevant paragraphs "ECU programming/setting" and "Level sensor adjustment".

Level sensor adjustment

Figure 105



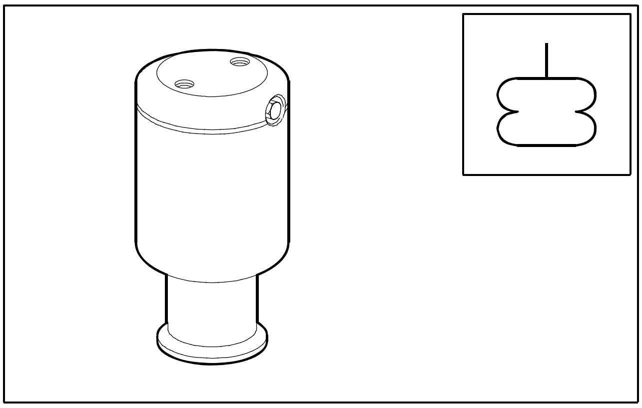
62584

Operate on adjustment screws and set relay lever X value to 110 mm.

Perform ECU setting as shown in the relevant paragraphs "ECU programming/setting".

500731 AIR SPRING

Figure 106

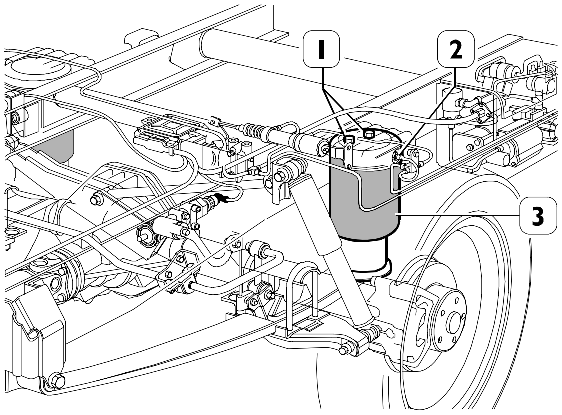


62359

Air spring is an elastic element dedicated to contain pressure air and to change its extension irrespectively of the applied load.

Air spring replacement
Removal

Figure 107



62360

Position the vehicle on level ground.

Lift the rear part of the vehicle and rest the chassis on the proper stands.

Use the hydraulic jack to support the rear axle.

Bleed the system and disconnect the air spring (3) supply pipe (2).

Loosen upper (1) and lower fastening nuts.

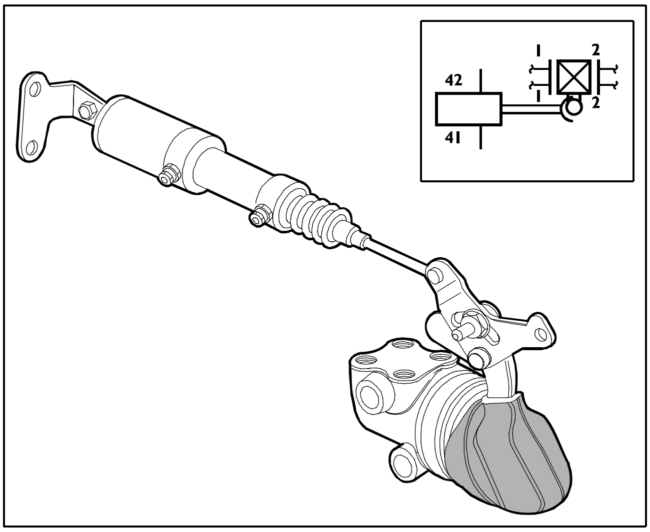
Lower the rear axle and remove the air spring (3).

Refitting

Reverse removal operations to perform refitting.

784310 LOAD SENSING VALVE

Figure 108



62361

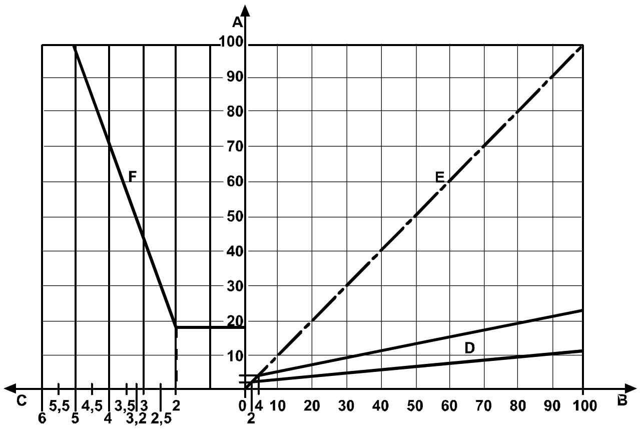
Vehicles not fitted with ABS/EBS/ABD systems have been provided with the following components to obtain brakeforce distribution:

- double circuit load sensing valve;
- load sensing valve pneumatic actuator.

The load sensing valve controls automatically the braking torque produced by brakes on the rear axle, according to the load applied on the rear axle, measured and transferred to the load sensing valve of the pneumatic actuator.

The following diagram shows the brakeforce distribution ratio corresponding to 0.15 as a function of pneumatic pressure change inside air springs.

Figure 109



62362

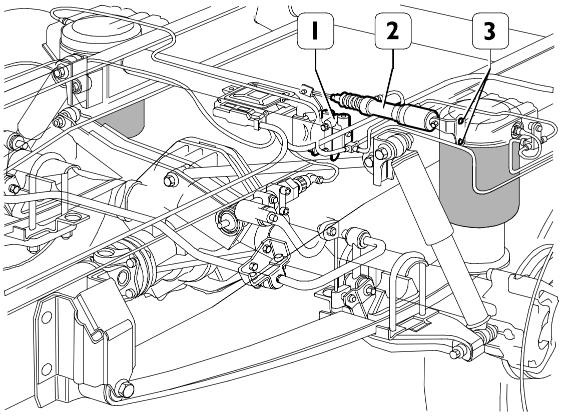
Legend

A	Hydraulic output pressure in bar;
B	Hydraulic control pressure in bar;
C	Pneumatic control pressure in bar;
D	Characteristic curves, 0.15 ratio (without load);
E	1:1 ratio (with load);
F	Pneumatic pressure/load characteristic curves.

Load sensing valve replacement

Removal

Figure 110



Bleed the system, loosen the screws (3) and disconnect the pneumatic actuator (2).
Loosen the fastening screws of the load sensing valve (1) and remove it including the pneumatic actuator (2).

Refitting

Reverse removal operations to perform refitting.

Perform load sensing valve adjustment as shown in the relevant paragraphs "Load sensing valve adjustment on vehicle".

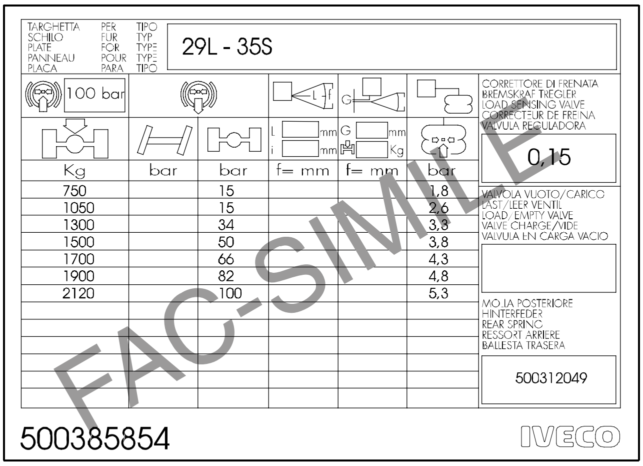
Load sensing valve adjustment on vehicle

This device shall be checked and adjusted, if required, at regular intervals by checking the values indicated on the plate (Figure 111) located on the internal part of the engine hood.

Should the plate or the relevant technical data be missing, ask the manufacturer for a duplicate specifying the following:

- ❑ Vehicle type and wheelbase
- ❑ Rear axle weight
- ❑ Load sensing valve No.

Figure 111



TARGHETTA PER TIPO / SCHILD FUR TYP / PLATE FOR TYPE / PANNEAU POUR TYPE / PLACA PARA TIPO: 29L - 35S

100 bar

Kg	bar	bar	f= mm	f= mm	bar
750		15			1,8
1050		15			2,6
1300		34			3,3
1500		50			3,8
1700		66			4,3
1900		82			4,8
2120		100			5,3

CORRETTORE DI FRENATA / BREMSKRAF TREGLER / LOAD SENSING VALVE / CORRECTEUR DE FREINA / VALVULA REGULADORA: 0,15

VALVOLA VUOTO/CARICO / LAST/LEER VENTIL / LOAD/EMPTY VALVE / VALVE CHARGE/VIDE / VALVULA EN CARGA VACIO

MOLLA POSTERIORE / HINTERFEDER / REAR SPRING / RESSORT ARRIERE / BALLESTA TRASERA: 500312049

500385854 IVECO

FAC-SIMILE

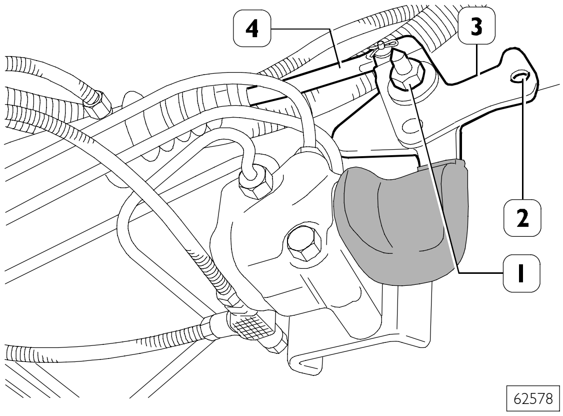
62577

LOAD SENSING VALVE PLATE

Perform required operations in the following sequence:

- ❑ position the vehicle with the rear wheels set on the brake test bed 99336914;
- ❑ connect gauges 99372269 or Modus to pressure control intakes set upstream and downstream connector;
- ❑ should gauges not be fitted with valves for automatic bleeding, bleed air by loosening the suitable ring nuts

Figure 112



- ❑ Loosen nut (1);
- ❑ apply 5 kg to plate (3) in point (2);
- ❑ start engine;
- ❑ disconnect the pneumatic actuator (4);
- ❑ with engine running at idle, depress the brake pedal gradually until obtaining 100 bar pressure read on the gauge set upstream connector. This value shall be constant and shall be read on vehicle with load and without load;
- ❑ simulate the fully laden condition by lifting completely the relay lever (3) and the unloaded condition by lowering the lever completely;
- ❑ read output pressure value under both vehicle conditions (laden and unloaded); obtained values shall comply with those indicated on the plate, otherwise replace the load sensing valve;
- ❑ operate the relay lever (3) to check whether the load sensing valve piston is sliding smoothly into its seat, otherwise replace the load sensing valve;
- ❑ reconnect the pneumatic actuator (4);
- ❑ load the vehicle to obtain 1500 kg weight on the rear axle evenly distributed on the right and left side of the vehicle with ± 5 kg tolerance;
- ❑ with engine running at idle and 100 bar pressure read on the gauge set upstream the connector, check whether the output pressure value read on the gauge set downstream the connector is corresponding to the values indicated on the plate, otherwise replace the load sensing valve;
- ❑ stop the vehicle, tighten nut (1) to the specified torque and remove applied loads.

Perform this check with gradually increasing pressure.

To check the load sensing valve, every braking system component shall be in perfect operating conditions. When replacing the leaf spring for special set-up, a new plate is required with properly corrected values.

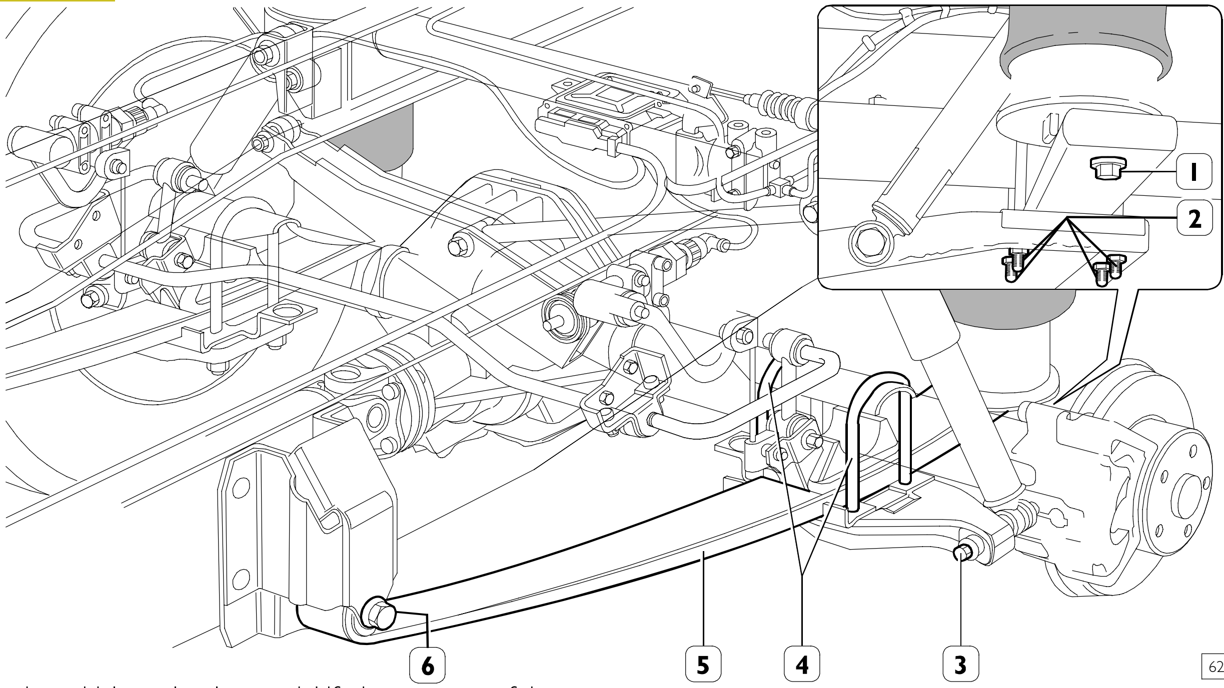
- ❑ when tests are over, check brake performance.

500730 REAR SUSPENSION OVERHAUL

500450 LEAF SPRING

Removal

Figure 113



Position the vehicle on level ground. Lift the rear part of the vehicle and rest the chassis on the proper stands. Use the hydraulic jack to support the rear axle.
Bleed the system, remove the wheel, loosen the air spring lower fastening screw (1). Loosen shock absorber lower fastening nut (3) and disconnect it.
Loosen nuts (2) and remove the U bolts (4) and the elements securing the leaf spring to the rear axle.
Loosen and remove the pin (6) and remove the leaf spring (5).

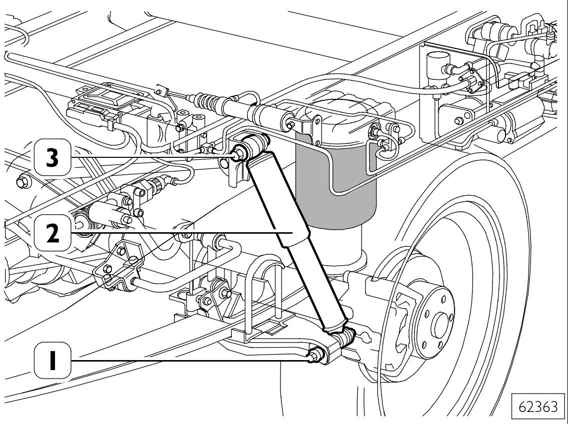
Refitting

Reverse removal operations to perform refitting.

500940 REAR SHOCK ABSORBERS

Removal

Figure 114



Lift the rear part of the vehicle and use the jack to support the rear axle. Loosen the upper (3) and the lower (1) fastening nuts and remove the shock absorber (2).

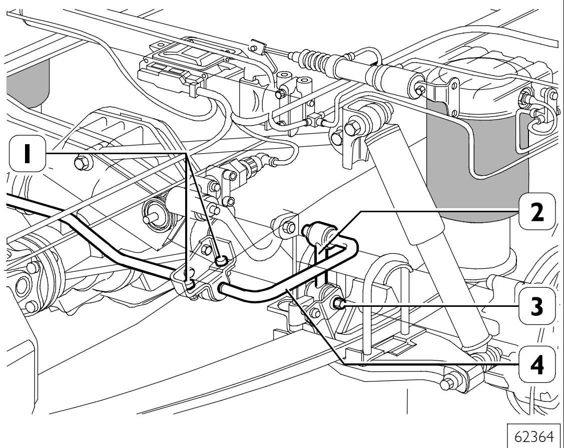
Refitting

Reverse removal operations to perform refitting.

528960 REAR STABILIZER BAR

Removal

Figure 115



Operate on both vehicle sides.
Loosen the screws (1) and the nut (3). Remove the stabilizer bar (4) including the joints (2).

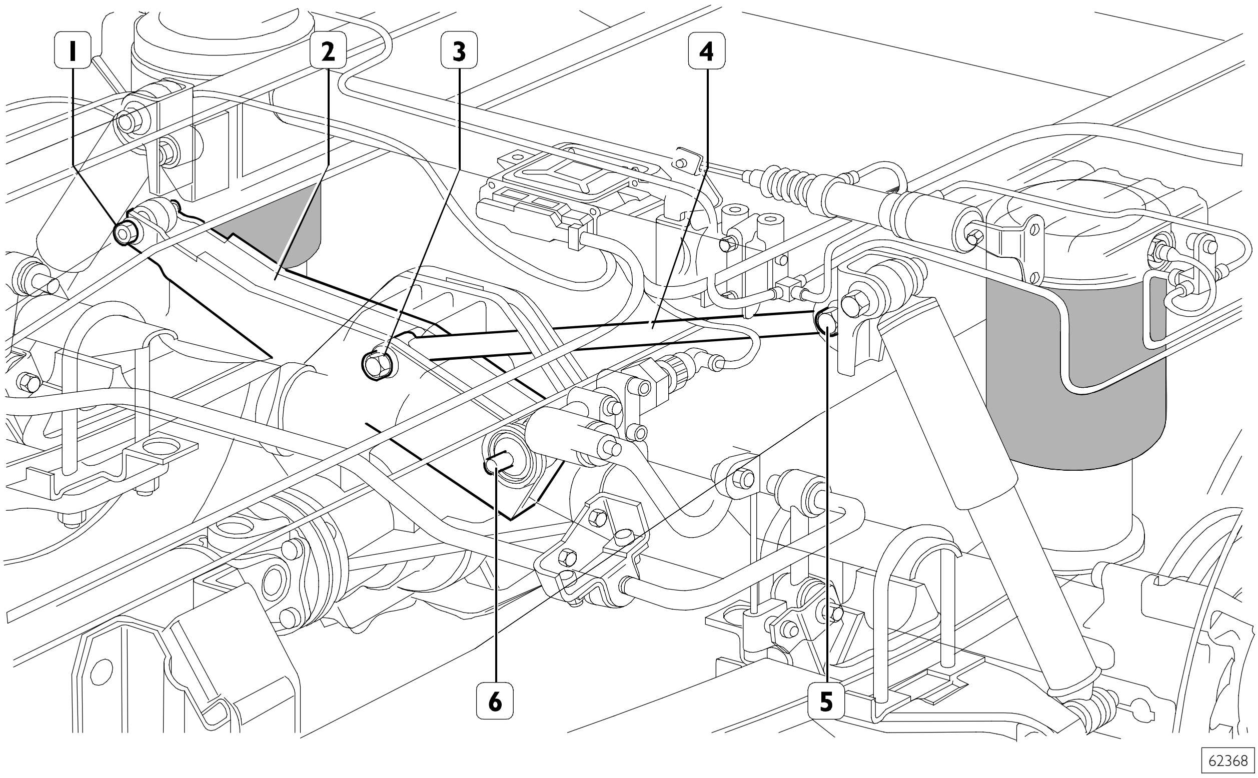
Refitting

Reverse removal operations to perform refitting.

PANHARD REACTION BAR

Removal

Figure 116



Loosen the "Panhard" reaction bar (4) fastening screws (3 and 5) and remove it.

Loosen the relay rod (2) fastening screws (1 and 6) and remove it.

Refitting

Reverse removal operations to perform refitting.

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SECTION 9

5025 Wheel and tyres

DESCRIPTION

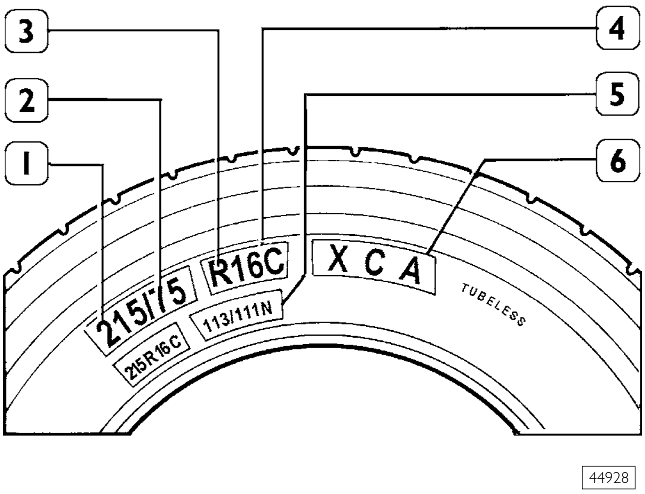
The wheel rim represents the rigid structure of the wheel and is identified by the following dimensions:

- ❑ diameter of the rim, measured at the base of the circumferential groove (i.e., on the surface on which the air chamber rests);
- ❑ width of the circumferential groove in the wheel rim (i.e., the distance between the surfaces on which the cover rests).

The tyre has the following functions:

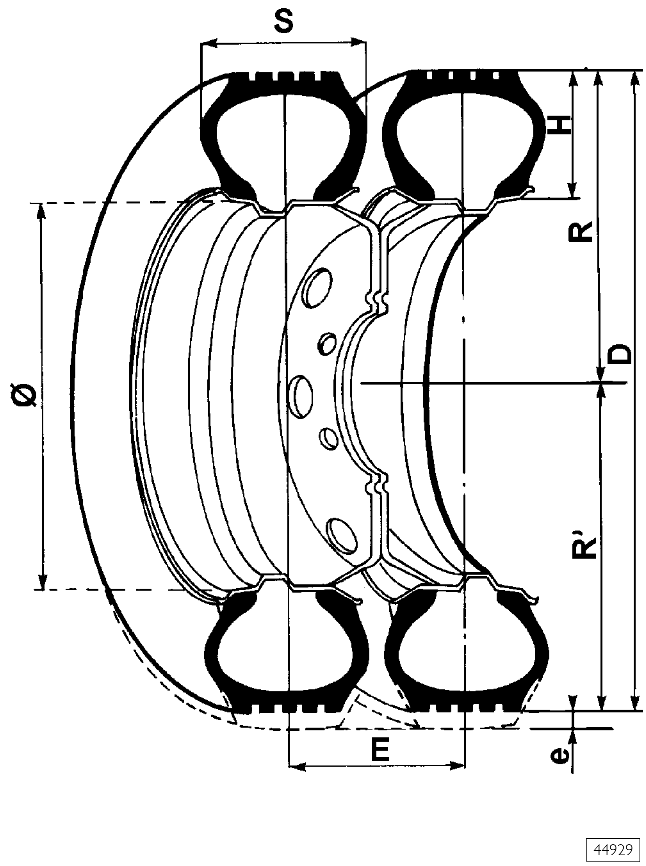
- ❑ to absorb the greater part of the jolts caused by roughness of the road surface by utilising the elasticity of air;
- ❑ to generate on the ground the motive force supplied by the engine necessary for the vehicle to move;
- ❑ to ensure the maximum grip and stability of contact between the tyre and the road, with satisfactory tyre 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.

Figure 1



1. Tyre section rated width (mm)
2. Tyre height-width ratio percentage e.g., H/S = 0,75
3. Tyre structure (R = Radial)
4. Wheel rim diameter in inches
5. Load and speed index symbols
   113: tyre load index on simple axis: 1150 kg
   111: tyre load index on paired axis: 1090kg
   Speed category (N= 140 km/h)
6. Manufacturer's trade name:
   XC A tubeless (IL): tyres without inner tube.

Figure 2



S = Tyre section rated width (mm)
H = Tyre height
D = Max. utilisation diameter (Rx2)
R = Radius under load (static)
Ø = Fitting diameter
E = Min. distance between centres in case of paired tyres
e = Tyre deflection
CdR = Rolling circumference

Tyre pressure

Tyre type			Inflation pressure		
			3,5 bar	4 bar	4,75 bar
195/65 R16 TL102/104R TL102/104Q	simple	weight on front axle in kg	1410	1569	1800
	twin	weight on front axle in kg	2663	2963	3400
195/75 R16 TL105/107R TL105/107Q	simple	weight on front axle in kg	1527	1700	1950
	twin	weight on front axle in kg	2898	3225	3700
205/65 R16 TL105/107T	simple	weight on front axle in kg	1527	1700	1950
	twin	weight on front axle in kg	2898	3225	3700
215/65 R16 TL107/109R	simple	weight on front axle in kg	1613	1795	2060
	twin	weight on front axle in kg	3055	3399	3900
225/65 R16 TL110/112R	simple	weight on front axle in kg	1754	1952	2240
	twin	weight on front axle in kg	3321	3695	4240

Tyre type			Inflation pressure		
			4 bar	4,5 bar	5,25 bar
225/75 R16 TL116/118Q TL116/118R	simple	weight on front axle in kg	2124	2334	2640
	twin	weight on front axle in kg	4022	4420	5000

NOTE The pressures indicated refer to cold tyres and an outside temperature of 20°C.

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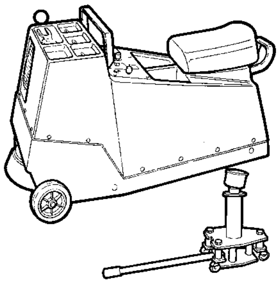
TOOLS

TOOL NO.		DESCRIPTION
99305037		Electronic equipment for front wheel balancing on the vehicle

FAULT DIAGNOSIS

Main tyre malfunctions:

1 - Excessive wear.
2 - Irregular wear.
3 - Vehicle pulls to one side.

1	**EXCESSIVE WEAR**

Cause		Remedy
Excessive speed on particularly uneven ground	YES →	Reduce speed
NO ↓		
Sudden variations in speed, violent or harsh braking	YES →	Avoid all unnecessary acceleration or braking
NO ↓		
Excessive speed with tyre pressures too low	YES →	Check tyre pressures cold
NO ↓		
Tyres pressures too high	YES →	Reduce pressures
NO ↓		
Truck overloaded	YES →	Consult data on loads permitted

2 IRREGULAR WEAR

Difference in tyre pressures between one pair of wheels and the other	YES	Check pressure
NO		
Tyre pressures too low; wear more accentuated on the outsides of the tread than in the middle	YES	Increase tyre pressure
NO		
Tyre pressure too high, with excessive wear in the middle of the tread	YES	Reduce pressure
NO		
Insufficient toe-in of front wheels; substantial wear on the inside surfaces of the tread	YES	Check and adjust toe-in
NO		
Front wheel geometry incorrect	YES	Restore normal wheel geometry
NO		
Distortion of wheel rims causing imbalance	YES	If possible, repair the rims or replace; then balance the wheels
NO		
Tyres incorrectly fitted to rims	YES	Fit the tyre correctly and balance the wheel

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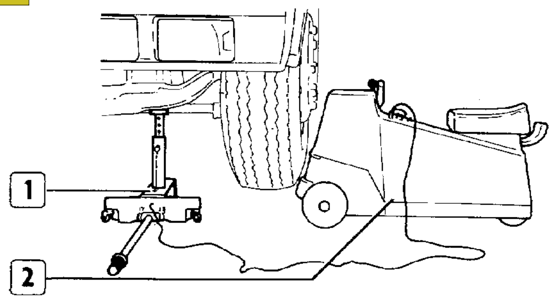
Rear axle out of parallel due to breakage of the leaf spring centre pin, or springs of different lengths, or bent springs	YES →	Overhaul the suspension
NO ↓		
Excessive toe-in of front wheels; excessive wear of the outside surfaces of the tread	YES →	Check and adjust toe-in

3 VEHICLE PULLS TO ONE SIDE

Front wheels out of balance	YES →	Balance the wheels
NO ↓		
Front tyres at different pressures	YES →	Check pressures ensuring that both are at the correct value
NO ↓		
Excessive difference in wear between a pair of tyres	YES →	Replace excessively worn tyre

502511 STATIC WHEEL BALANCING

Figure 3

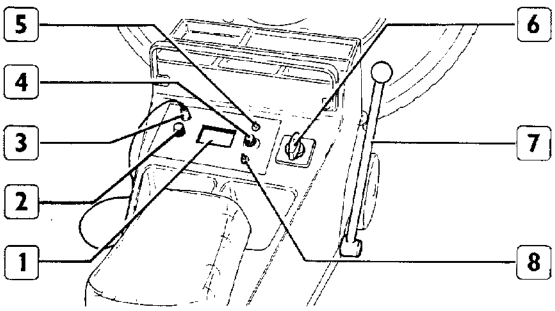


The front wheels can be balanced on the vehicle using the electronic unit 99305037; this has the advantage of balancing the wheel together with the other rotating masses.

The operation must be carried out as follows:

- ❑ Raise the front of the vehicle and make sure that the wheels are free to rotate
- ❑ 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 4



16997

- ❑ 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.

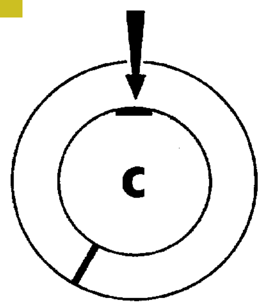
While the wheel is being spun, it will be found that the stroboscopic effect on the wheel will make the reference mark appear stationary; the pointer of the instrument (1), moving from the value zero, reaches a maximum value on the scale and then returns to zero.

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 5



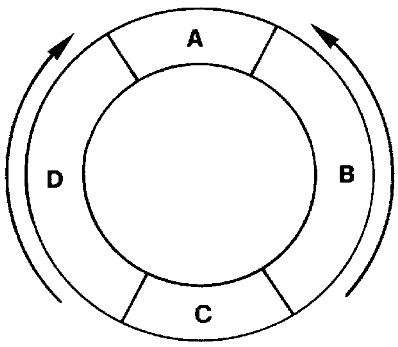
16998

Fit the balance weight calculated in this way as shown in the figure.

If during the test, the pointer of the instrument (1, Fig. 4) remains in the green area of the box, the wheel is balanced.

NOTE If the weight required to balance the wheel is more than 60 ÷ 80 grams, 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.

Figure 6



23885

To correct the residual imbalance, repeat the operations already carried out as above; depending on the new reading of the instrument (1, Fig. 4), refer to the diagram in the figure and proceed as follows to adjust:

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- 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. 4).
- 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 Fig. 6.

502510 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.

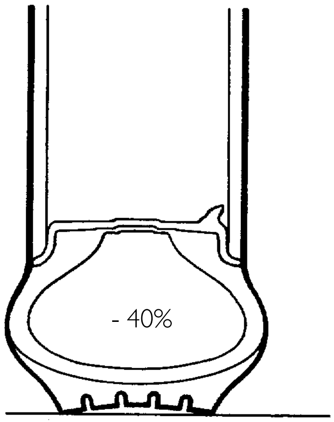
Tyre abnormal wear can occur in different areas of tread.

HOW TYRE BEHAVIOUR DEPENDS ON PRESSURE

Schematic views to demonstrate how tyre behaviour and performance depend on pressure.

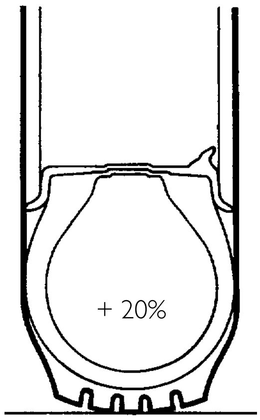
NOTE The value shown inside each tyre indicates the level of pressure of the tyre, while the efficiency relates to the life of the tyre.

Figure 7



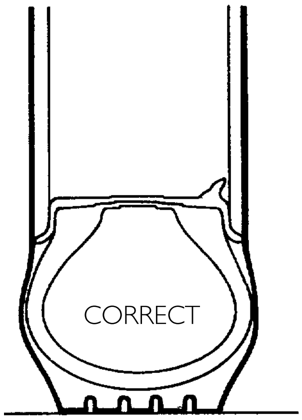
EFFICIENCY 40%

Figure 8



EFFICIENCY 90%

Figure 9



EFFICIENCY 100%

SECTION 10

5014 Steering gear

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STEERING GEAR

General

Generally, the steering gear members consist of: a full steering gear control, a steering box, the linkage joining the driving wheels and, for the hydraulic-type steering box of: an hydraulic pump, an oil tank and oil piping.
In vehicle system 35C-65C with F1C engine, there is installed a pipe coil (A) to cool oil.
The rotary movement given to the steering wheel by the driver is transmitted to the steering box by three shafts joined one another by universal joints.
The universal joints allow the transmission of the rotary movement on different planes.
The upper shaft, on which the steering wheel is keyed, is housed and supported in the upper support by elastic bushes.
In addition, the indicator automatic switch-off and the antitheft steering lock are keyed to the support.
The steering box is of the type: pinion - rack rod with hydraulic power.

It has two functions:

❑ angle driving between spin axis of the steering control and the wheels' steering axis.

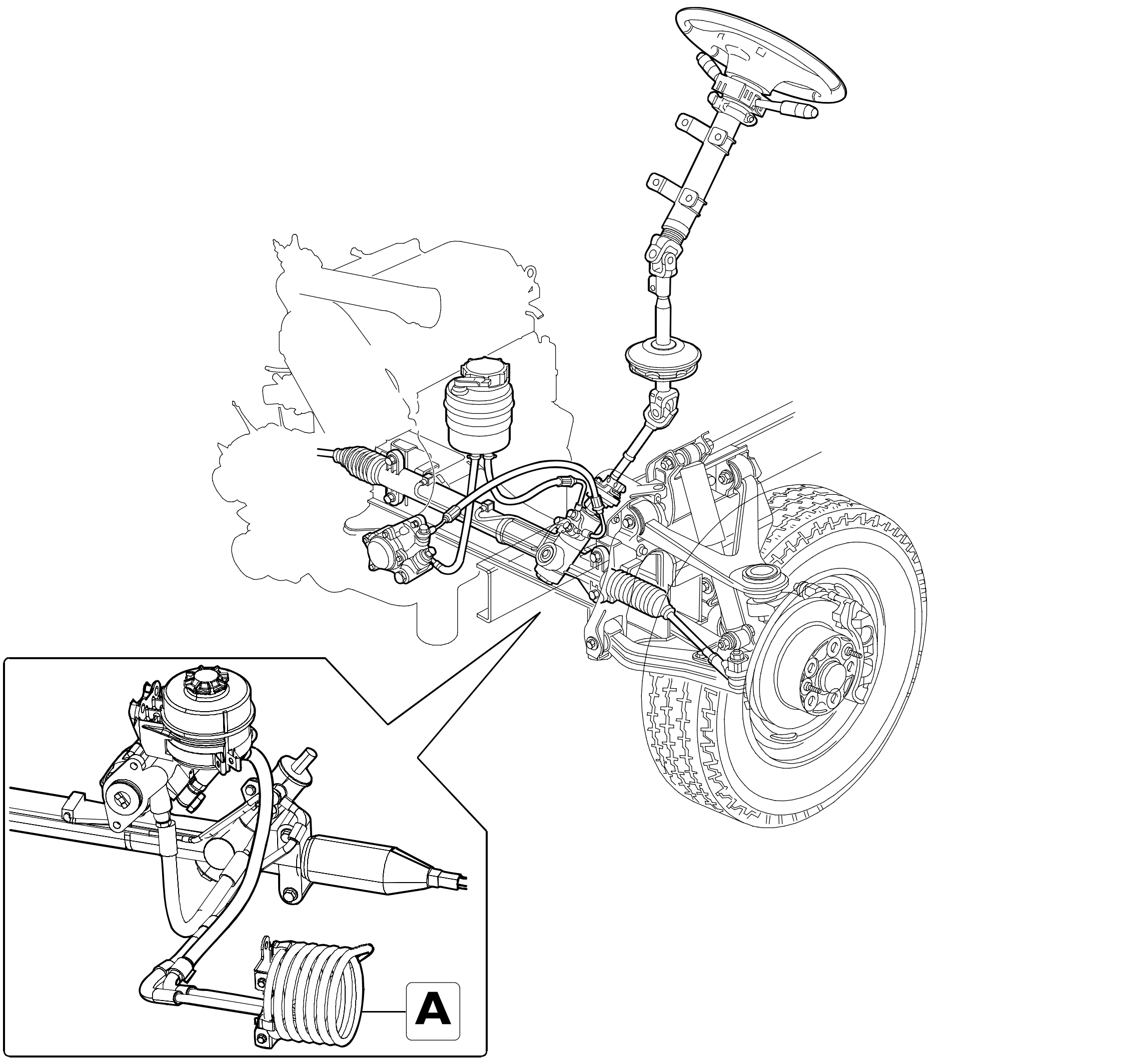
❑ gear down through the coupling ratio the resistant moment opposing the wheels under the steering effect.

The value of this ratio and the wheel geometry characteristics (toe-in - camber - caster), determine the stress and the type of steering, more or less direct; this increases or decreases the driver sensitivity of the vehicle attitude on road; besides, it determines the steering caster action degree, that is, the spontaneous return to straight normal running when the steering wheel is released after steering.

The tie rods joining the steering levers mounted on stub axles using knuckle heads are joined by ball joints at the end of the rack rod. Operating the tie rod the wheel camber is adjusted.

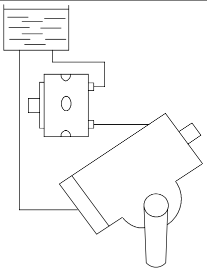
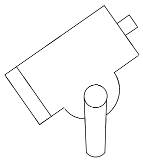
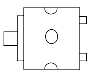
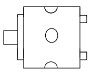
The hydraulic pump is of the blade type:
- on F1A engines, it is flanged to the alternator support;
- on F1C engines, it is flanged on the left side of the engine base.
The pump incorporates the overpressure control valve.

Figure 1



STEERING GEAR DIAGRAM

POWER STEERING SPECIFICATIONS AND DATA
Steering gear

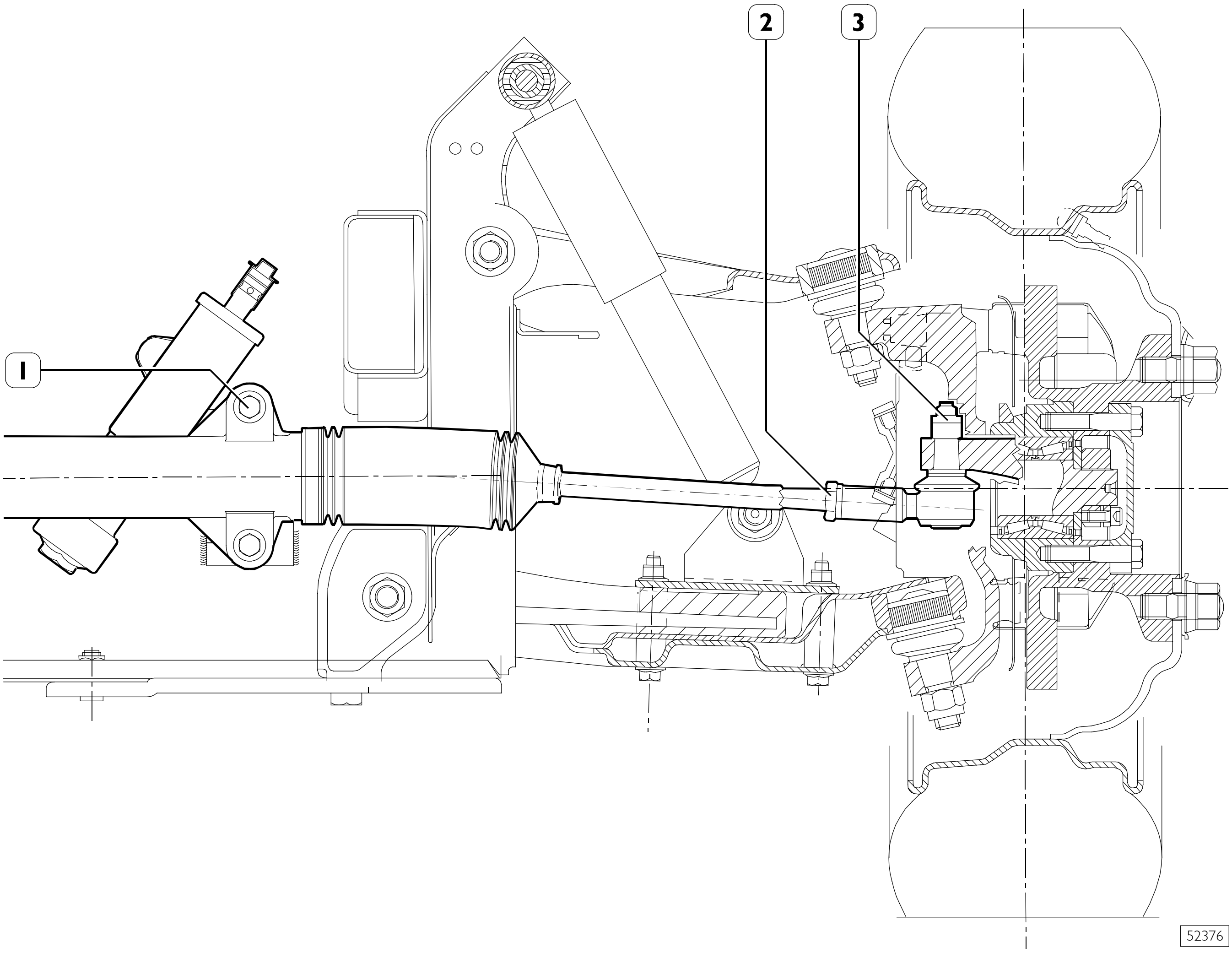
	Steering gear		Hydraulic	
	Hydraulic power steering		Pinion and rack type	
	Type		ZF*	TRW
	Operating pressure X		100 bar	
	Maximum delivery volume		-	
	No. of steering wheel turns		3,8	
	Rack travel in both steering directions:		180 ± 1,5 mm	
Lube oil	Type		TEXAND F020	SHELL-ALVANIA LS00
	pinion side	kg	-	0,060
	pipe end side	kg	-	0,030
	Power steering pump		blade type with pressure relief valve incorporated	
	Motor		FIA	FIC
	Type		ZF 7612 955117	ZF 7682 955133
	Minimum RGM	rpm	500	750
	Maximum RGM	rpm	8500	3500
	Maximum pressure	bar	100 + 10	115+10
	Minimum delivery	dm^3/min	-	-
	Adjusted delivery	dm^3/min	9 ± 0,75	9 ± 0,8

Turning circle (theoretical value) [m]

Wheelbase [mm]	MODELS			
	29 L - 35 S	35 C (1)	35 C (2) - 40 C - 45 C - 50 C	60 C - 65 C
Tyres	205 - 225/70 R 15	195/65 R 16	195/75 R 16	225/75 R 16
3000	10,37	10,34	11,04	-
3300	11,25	11,22	11,98	11,79
3450	11,69	11,66	12,46	12,25
3750	12,57	12,54	13,40	13,17
3950	13,15	13,12	14,03	13,78
4100	-	13,56	14,50 (3)	14,24
4350	-	-	15,29 (4)	15,01
4750	-	-	16,55 (4)	16,24

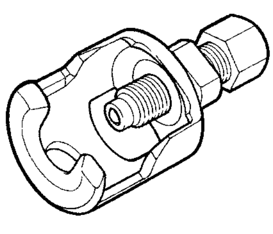
(1) Front suspension with trasverse leaf spring.
(2) Front suspension with torsion bar.
(3) Models 35C-40C only
(4) Models 45C-50C only

TIGHTENING TORQUES



	DESCRIPTION	TORQUE	
		Nm	kgm
1	Screw, steering box fastening nut	50 ÷ 61	5 ÷ 6,1
2	Nut securing the jointed head to the steering box rod	70 ÷ 100	7 ÷ 10
3	Nut, ball joint to steering arm	68 ÷ 83	6,8 ÷ 8,3

SPECIFIC TOOLS

TOOL NO.		DESCRIPTION
99347074		Knuckle pivot extractor

DIAGNOSTICS

Main hydraulic power steering operating faults:

1 - Steering stiff when turning right and left;
2 - Steering stiff only when turning left or right;
3 - Steering stiff when the wheel is turned quickly;
4 - When steering, heavy jolts are felt at the wheel;
5 - Torsional vibration of the steering wheel;
6 - Excessive play at the steering wheel;
7 - Loss of oil;
8 - Insufficient pressure in the circuit;
9 - The vehicle tends to move sidewards;
10 - Hydraulic power steering pilot light always lighted.

1 STEERING STIFF WHEN TURNING RIGHT AND LEFT

Insufficient oil in system — YES → Open tank and check oil level. With engine running, top up oil to upper mark on dipstick and bleed system.

NO ↓

Air in hydraulic circuit — YES → Check suction tube and pump shaft seal for leaks. Bleed system and top up the oil

NO ↓

Pump regulating valve jammed or blocked — YES → Replace the power steering pump

NO ↓

Insufficient oil pump delivery — YES → Overhaul or replace pump.

NO ↓

Universal joint not serviceable — YES → Make joint free to slide by moving it to and fro several times so that it tilts under its own weight

NO ↓

Internal power steering failure — YES → Replace the power steering unit

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2	**STEERING STIFF ONLY WHEN TURNING LEFT OR RIGHT**

Incorrect position of hydraulic centre (when wheel is released, the steering returns to one end of travel by itself): (ZF steering case only).	YES →	Replace the power steering unit

3	**STEERING STIFF WHEN THE WHEEL IS TURNED QUICKLY**

Regulating valve in pump blocked	YES →	Replace the power steering pump
NO ↓		
Insufficient pump delivery (gears worn)	YES →	Replace the hydraulic pump
NO ↓		
Air in steering system	YES →	Check suction tube and pump shaft seal for leaks. Bleed system and top up the oil

4	**WHEN STEERING, HEAVY JOLTS ARE FELT AT THE WHEEL**

Play in universal joint	YES →	Fit a new seal
NO ↓		
Internal failure of hydraulic power steering	YES →	Replace the power steering unit
NO ↓		
Insufficient oil in system	YES →	Top up oil and bleed system

(Continue)

Front wheel geometry incorrect	YES →	Check and adjust according to specifications in the section "Axles"
NO ↓		
Wheels out of balance	YES →	Balance in accordance with instructions given in the section "Wheels and tyres"
NO ↓		
Steering rod joints loose on the levers	YES →	Replace any worn parts
NO ↓		
Irregular pump operation	YES →	Replace pump
NO ↓		
Leakage of oil from hydraulic power steering circuit couplings	YES →	Check coupling seals for serviceability, replacing any which are worn

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 ↓		
Wrong wheel toe-in	YES →	Adjust in accordance with characteristic data for described in the section "Axles"
NO ↓		
Air in hydraulic system	YES →	Check suction tube and pump shaft seal for leaks. Bleed system and top up the fluid.

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6	EXCESSIVE PLAY AT THE STEERING WHEEL

Cause		Remedy
Play in ball joints and/or elastic supports loosen	YES →	Secure the supports Replace the ball joints
NO ↓		
Play in universal joint	YES →	Replace universal joint
NO ↓		
Internal failure of hydraulic power steering	YES →	Replace the power steering unit

7	LOSS OF OIL

Cause		Remedy
Tank cover not secured	YES →	Secure cover
NO ↓		
Seal gaskets worn	YES →	Replace worn seal gaskets, top up oil and bleed

In any case it is necessary to determine the place and the reason why there is oil leakage, eliminate the cause, top up oil in the tank with the engine started up to the upper mark of the dipstick.

8	INSUFFICIENT PRESSURE IN THE CIRCUIT

Cause		Remedy
Hydraulic pump not operating correctly	YES →	Replace the power steering pump

(Continue)

Oil leaking from couplings in power steering circuit	YES →	Check coupling seals for serviceability, replacing any which are worn
↓ NO		
Insufficient oil level in the tank	YES →	Top up level and bleed circuit

9	**THE VEHICLE TENDS TO MOVE SIDEWARDS** →	Replace the power steering unit

10	**HYDRAULIC POWER STEERING PILOT LIGHT ALWAYS LIGHTED**

Hydraulic power steering oil level low	YES →	Top up oil
↓ NO		
Oil pressure sender malfunction	YES →	Check the windings and in case replace oil pressure sender.

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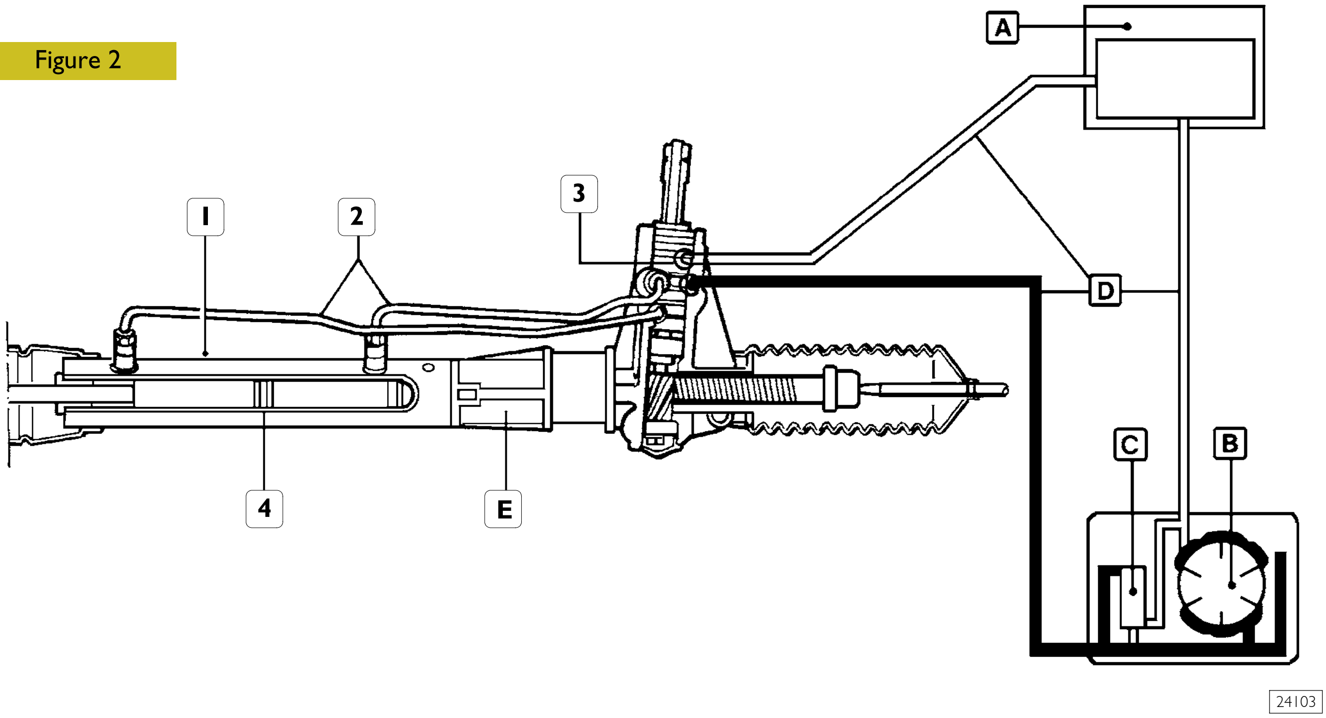
POWER STEERING
Description

Figure 2



HYDRAULIC POWER STEERING SYSTEM DIAGRAM

HIGH PRESSURE   LOW PRESSURE

The power steering system consists of:
- a tank (A);
- a blade pump (B) with delivery regulating valves (C);
- a series of connecting pipings (D);
- an hydraulic power steering (E).

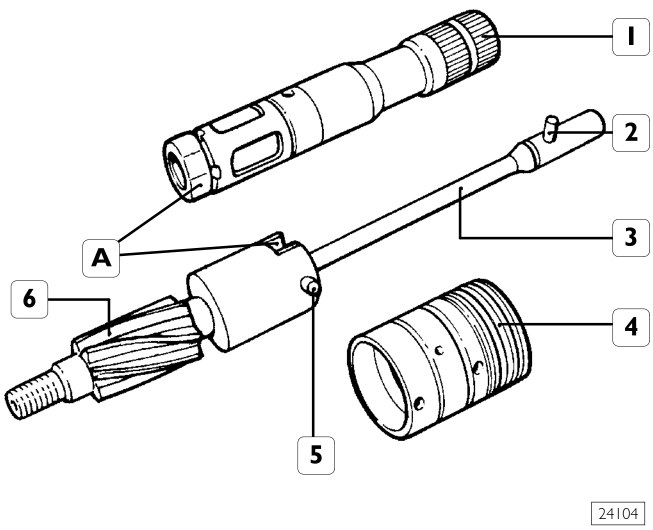
The oil tank, in the engine compartment, feeds the blade pump. This pump is able to provide a feeding pressure ranging from a minimum of approx. 4 bar to a maximum of approx. 80+10. The oil come to the steering box, which is similar to a mechanical steering as for general building features, from the pump.
In fact, its operation is mechanical for pinion to rack coupling, The rack rod is joined to the wheels with two side tie rods.
The system is self-bleeding; bleeding is performed by completely steering to the right or to the left with the engine started and the vehicle stopped.
The oil level check must be performed with the engine started.

NOTE The description below concerns the TRW hydraulic power steering and due to their similarity, it also applies to the ZF hydraulic power steering.

The hydraulic part of the steering box consist of:
- a distributor (3);
- an hydraulic cylinder (1);
- a double-acting piston (4) integral with the rack rod.

The hydraulic connection between distributor and hydraulic cylinder is achieved using two stiff pipes (2). The distributor (3) is integral with the hydraulic power steering pinion.

Figure 3

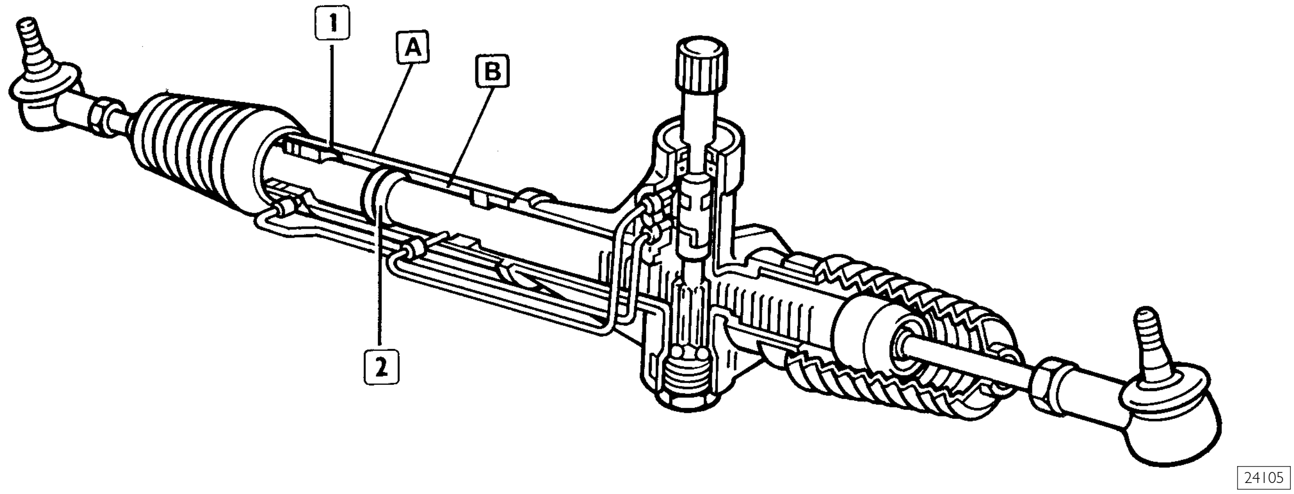


The distributor consists of:
- a drive shaft (1) (joined to the steering column);
- a distributing valve (4);
- a wrench bar (3);
- a pinion (6).

The drive shaft is elastically joined by the wrench bar to the pinion by means of the pin (2). The distributing valve, trigged on the drive shaft is integral with the pinion by means of a pin (5); it has holes and splines in order to receive and distribute the oil flow to the hydraulic cylinder. Besides, a stiff joint (A) ensures the mechanical working of the hydraulic power steering in case of failure of the hydraulic system, through a bayonet joint.

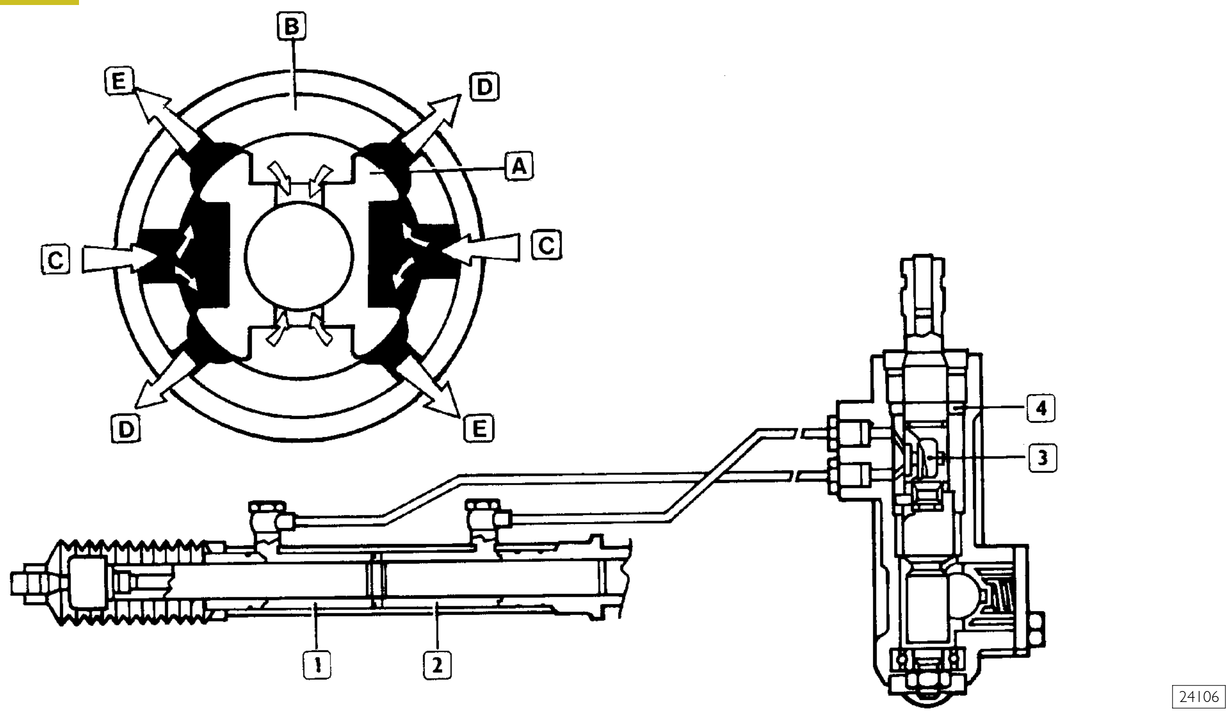
POWER STEERING TYPE TRW
Operation

Figure 4



The hydraulic cylinder (1) is integral part of the hydraulic power steering, The double-acting piston (2) (integral with the rack rod) slides in the hydraulic cylinder and divides it into two separate chambers A and B.
The power steering is obtained by sending oil under pressure into one of the hydraulic cylinder chambers and discharging it into the other one. The power generated by the oil pressure on the side surface of the piston causes the movement of the piston and, as a result, of the rack. The feeding of one of the two hydraulic cylinder chambers occurs when the torque applied to the steering wheel causes the wrench of the bar; in this condition, the port of the drive shaft and the relevant ports of the distributing valve are joined depending on the rotary direction of the steering wheel. If the amount of torque applied to the steering wheel does not cause the wrench of the bar (low wheel resistance), the power steering does not intervene and the steering operates as a mechanical one.

Figure 5

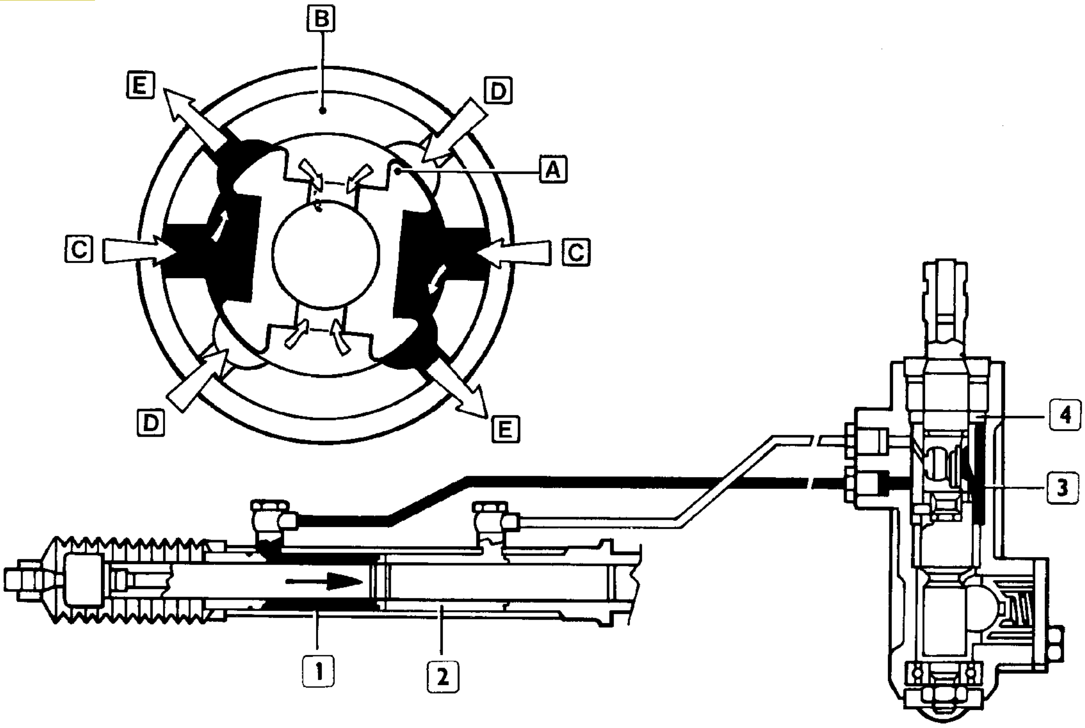


HYDRAULIC POWER STEERING OPERATION DIAGRAM: NEUTRAL POSITION

HIGH PRESSURE LOW PRESSURE

The oil coming from the pump through the joint (3) goes into the distributing valve, circulates in it and returns in the tank through the joint (4), simultaneously passing through the chambers (2) and (1).
The drive shaft (A), since it is not subject to wrench, is centred with respect to the distributing valve (B) and drives the oil coming from the pump directly into the tank through the ports (C). The chokes caused by the shaft (A) position with respect to the distributing valve (B) cause a pressure of ~ 3.5 bar in the right and left chamber through the ports (D) and (E).

Figure 6



HYDRAULIC POWER STEERING OPERATION DIAGRAM: RIGHT STEERING

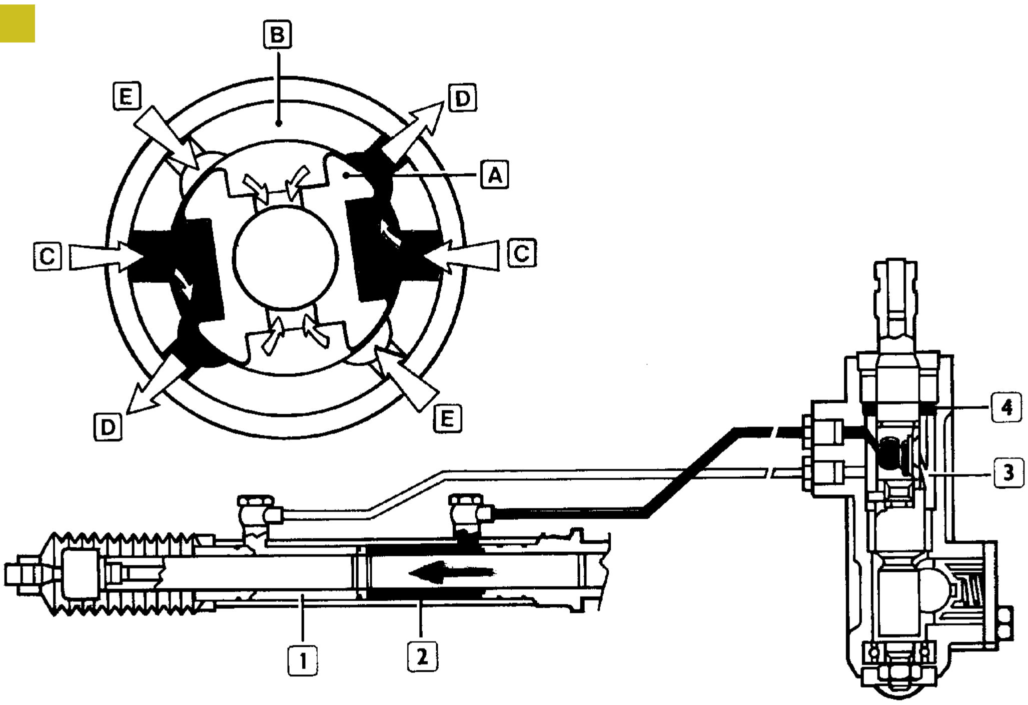
HIGH PRESSURE LOW PRESSURE

The oil coming from the pump through the joint (3) goes into the distributing valve and it is sent to the hydraulic cylinder chamber (1) causing the movement of the piston.

This movement pushes the oil contained into the chamber (2), through the joint (4), into the tank, passing again in the distributing valve. The movement of the piston in the direction of the arrow shows a right steering.

The drive shaft (A), rotating clockwise with respect to the distributing valve (B), drives the oil under pressure coming from the pump through the ports (C), to the left chamber along the ports (E) and joins the discharge and the right chamber circuit by means of the ports (D).

Figure 7



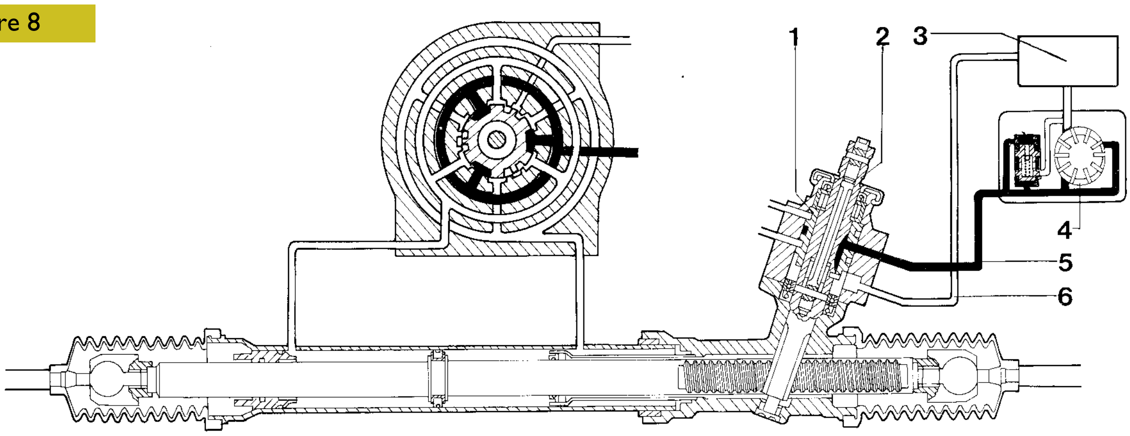
HYDRAULIC POWER STEERING OPERATION DIAGRAM: LEFT STEERING

HIGH PRESSURE LOW PRESSURE

The oil coming from the pump through the joint (3) goes into the distributing valve and it is sent to the hydraulic cylinder chamber (2) causing the movement of the piston. This movement pushes the oil contained into the chamber (1), through the joint (4), into the tank passing again in the distributing valve.
The movement of the piston in the direction of the arrow shows a left steering.
The drive shaft (A), rotating clockwise with respect to the distributing valve (B), drives the oil under pressure coming from the pump through the ports (C), to the left chamber along the ports (D) and joins the discharge and the right chamber circuit by means of the ports (E).

POWER STEERING TYPE ZF
Operation

Figure 8

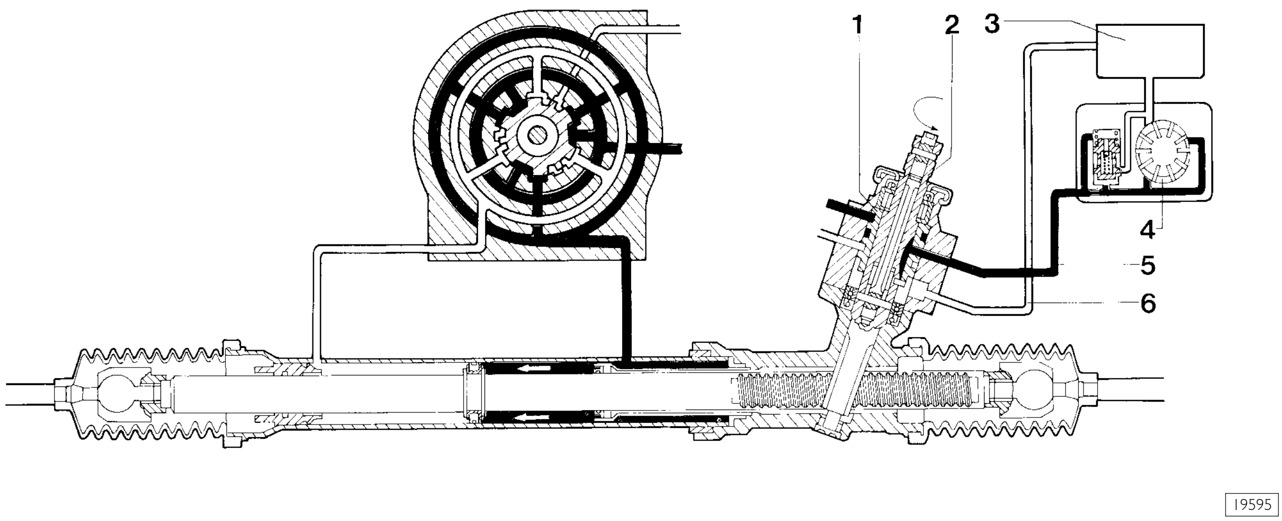


HYDRAULIC POWER STEERING OPERATION DIAGRAM: NEUTRAL POSITION

HIGH PRESSURE LOW PRESSURE

With the steering wheel positioned to straight running, the bush (2) is arranged so that the passage of both feeding and discharge oil of the operating cylinder is closed.
The oil pressures in the right and left chamber of the operating cylinder are balanced.
The oil under pressure coming from the power steering pump (4) through the piping (5) feeds the distributor (1) central grove, flows in the bush (2) splines, goes out from it and, through the piping (6) returns in the tank (3).
The neutral position of the hydraulic power steering is obtained and, therefore, the vehicle straight ride.

Figure 9

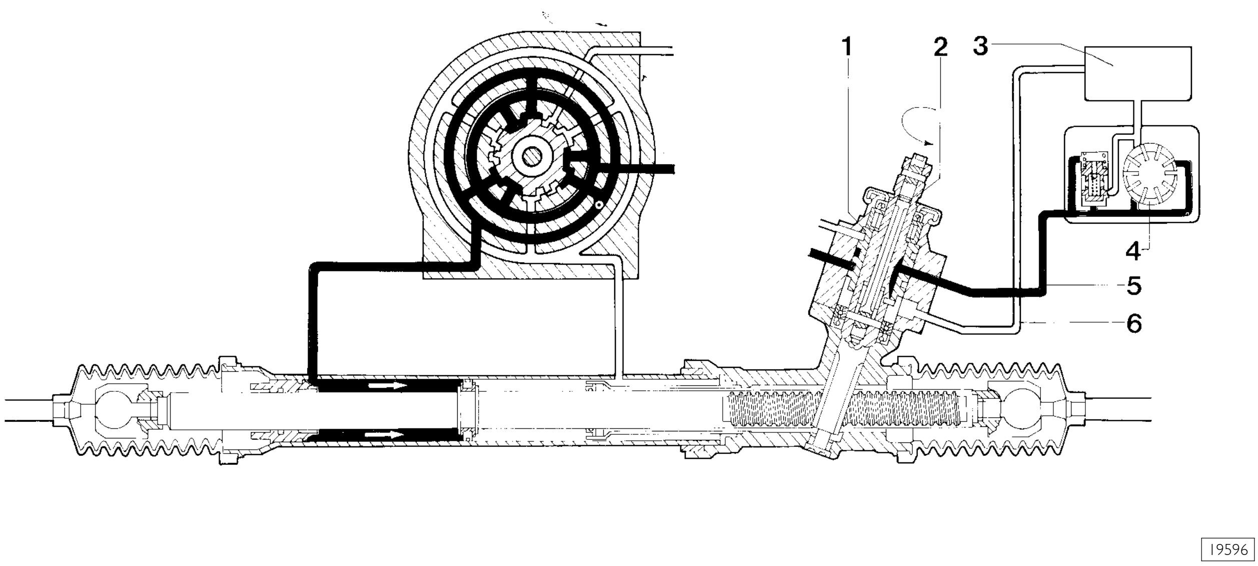


HYDRAULIC POWER STEERING OPERATION DIAGRAM: RIGHT STEERING

HIGH PRESSURE LOW PRESSURE

The oil under pressure coming from the power steering (4) pump, through the piping (5), feeds the distributor (1) passing in the central groove.
The rotation of the steering wheel causes a semi-rotation of the bush (2), this one is positioned so that the oil flows in its three splines and is sent to: the distributor upper groove, in case of right steering (figure 10), or in the distributor lower groove, in case of left steering (figure 11). The latter sends it to the relevant feeding piping (depending on the steering direction) of the operating cylinder chambers. Meanwhile, the oil contained in the chamber opposite to the fed one returns in the distributor. From the latter one, it flows in the discharge grooves of the bush (2) then, through the piping (6), returns in the tank (3).
In this way the hydraulic interlocking is obtained.

Figure 10



HYDRAULIC POWER STEERING OPERATION DIAGRAM: LEFT STEERING

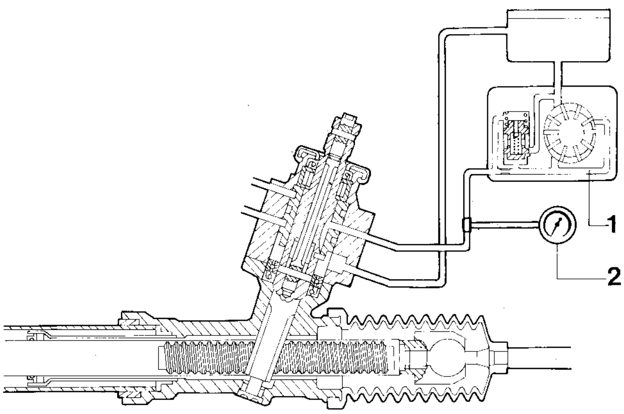
HIGH PRESSURE LOW PRESSURE

NOTE The only possible interventions on the power steering and mechanical steering systems are: replacement of ball joints, replacement of protective rubber boots, linkages and rubber bushings. Follow the instructions provided in the specific paragraphs. Replace the power steering system if problems referred to this system only are found.

CHECKS AND OPERATIONS ON THE VEHICLE

Checking maximum pressure

Figure 11



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Join a pressure gauge (2) on the oil delivery piping on the power steering pump (1). Rotate the steering wheel up to the limit stop, speed up the engine and read on the pressure gauge the maximum pressure value, which mast be of 80 bar.

Checking hydraulic steering centre (for ”ZF” power steering only)

Lift the front of the vehicle and put the wheels in the straight ride position.

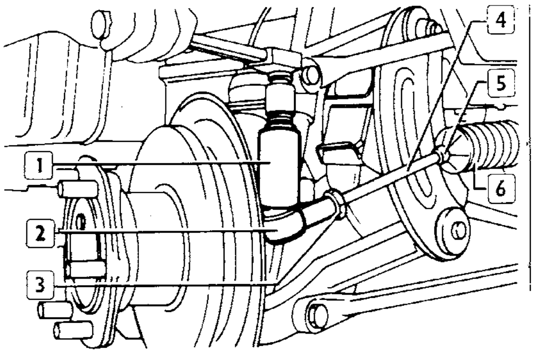
Start the engine and fully speed up; if the steering gear put itself in steering position, the hydraulic steering centre is wrong and the hydraulic power steering must be changed.

501430 Bleeding the air from the hydraulic system

Check the oil level in the tank, if necessary top up.
Lift the front part of the vehicle, start the engine and make it idle for a certain period.
Check that there is no oil leakage from the hydraulic circuit and check the tank level.
Slowly rotate the steering wheel in the two steering directions so that the air contained in the hydraulic system goes out.
Check again the oil level in the tank and, in case top up.

520636 SWIVEL HEADS
501438 PROTECTION CASINGS

Figure 12



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Check that the protection casings of the knuckle heads are in perfect condition and that their pivots do not present play, otherwise replace them as described below.
Loosen the nut (3) securing the knuckle head (2) to the tie rod (4).
Remove the nut fixing the knuckle head to the steering gear lever and using the extractor (1) 99347074 remove the knuckle head.
Unscrew knuckle head from the tie rod of the steering box noting down the number of turns needed to disassemble. Remove the fixing brackets (5) and extract the protection casing (6).
In order to re-fit the assembly, perform the above operation in reversed order, sticking to the following instructions:

- carefully clean the steering gear tie rod knuckle;
- lubricate the protective boot seats on the power steering box to facilitate assembly;
- screw up the knuckle head with the same number of turns used to disassemble it;
- fit a new o-ring on the power steering box;
- tighten the nuts of the prescribed torque;
- Adjust toe-in as shown in the respective section.

501410 STEERING GEAR CONTROL

Vehicles equipped with an Air-Bag

Before doing any work on steering gear control components:

- steering wheel;
- steering control lever system;
- steering gear shaft

Strictly observe the safety standards described in the following paragraphs for Air-Bag system components.

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SAFETY STANDARDS TO BE OBSERVED DURING REPAIR OR MAINTENANCE OPERATIONS ON VEHICLES EQUIPPED WITH AIR-BAG SYSTEM PROVIDED BY SUPPLIER

⚠ The following Standards shall be strictly observed when performing any type of repair or maintenance operations on vehicles equipped with Air-Bag safety system.

Preliminary Standards

⚠ Air-Bag modules shall be handled with the utmost care. Use, transport and storage of these components are governed by the handling procedures described in the following paragraphs.

Before starting any bodywork repair operation, welding or whatever work requiring to remove the Air-Bags or the control unit, proceed as follows:

- set ignition key to "STOP" and take it out;
- always disconnect the battery, i.e.: disconnect the two terminals from the relevant pole and insulate them properly by tape;
- wait for at least 10 minutes before proceeding;
- disconnect control unit connector.

Store modules with the cover set upwards, inside a metallic key-locked cabinet that must be used just with this purpose and that must not contain other type of materials, especially if flammables.

Adopted connectors wired to Air-Bag modules are provided with short-circuit clip. It is impossible to activate units accidentally until Air-Bag modules are connected to a power source with suitable properties.

A system component not activated in case of collision is to be considered still "live" (active).

Live components that shall be removed from vehicles (due to defects, warranty expiry or other reasons) shall be returned to the suitable Centre using the following procedure.

⚠ Component removal and refitting shall be performed EXCLUSIVELY by skilled and authorised personnel. Failure to comply with the following procedure can result in unintentional activation of the system, severe injury or repairs not required. IT IS ABSOLUTELY FORBIDDEN TO DISASSEMBLE Air-Bag MODULE COMPONENTS.

System components are designed to operate just on vehicles of the specified make and type. Air-Bags must therefore not be adapted, reused or installed on other vehicles.
Mount and use them only on the vehicles for which they have been designed and produced.

⚠ Any reuse, adaptation or installation on a different type of vehicle can result in sever injury or death for passengers in case of collision.

Repairs and inspections required after an accident

⚠ Any safety system component damaged after an accident must be replaced.
Do not attempt to repair the control unit, the coil cable or the Air-Bag modules.

Accidents with or without Air-Bag module activation

Certain system components must be inspected after any crash, whether the Air-Bag deployed or not. These components are the following:

- steering column;
- steering column support;
- electronic control unit anchoring area and modules;
- coil cable;
- dashboard (in the area of the passenger Air-Bag).

If any faulty condition is found, replace the faulty component.

Accidents with Air-Bag module activation

In case of front impact with total system activation, the following components must be replaced:

- Air-Bag modules;
- pretensioners;
- electronic control unit;
- coil cable.

Inspect cables and connectors to find any burning, external insulation melting or damages due to excessive heat.

If any faulty condition is found on coil cable, electronic control unit anchoring area and modules, replace the faulty component.

Painting

Since modules and pretensioners are designed to withstand the temperatures developed during standard baking operation on bodywork, no special safety requirement shall be observed during painting or baking.
Do not use open flames when working near the modules.
Electronic control units (including the Air-Bag one) shall always be removed when temperature in certain rooms is equal to or exceeds 85°C.

Risks for health

Precautions to be observed when handling live Air-Bag are the following:

- wear protective polyethylene gloves and goggles;
- wash hands and any exposed body part with water and soap after handling live modules.

Overexposure effects

Since system is completely sealed there is no potential danger of exposure to propelling gas.
Propelling gas mixture is at solid state, it is therefore impossible to inhale gas even in case of gas generator cartridge breakage.
There is no risk for health in case of gas leakage.
Avoid in any case contact with the skin and do not swallow the propelling gas.
In case of:

- contact with the skin: rinse immediately with water and soap;
- contact with eyes: rinse immediately with fresh water for 15 minutes at least;
- inhalation: bring immediately the injured person to open air;
- swallow: make the injured person vomit if conscious.

Always call the doctor in any of the above cases.

Safety Standards to observe when handling Air-Bag modules

Driver and passenger Air-Bags usually activate in case of collision through the action of the electronic activation control. Gas (mainly nitrogen) produced under these conditions are not toxic.
Personnel operating on safety system shall strictly observe the following safety standards.
Personnel operating on these devices shall be suitably trained and must observe the following precautions:

- when removing or replacing activated Air-Bags, wear protective polyethylene gloves and goggles and handle just one module at a time;
- always place the Air-Bag module with the cover and exhaust hole upwards. Never put something on Air-Bag cover;
- once servicing is over rinse hands with water and neutral soap, in case of eyes contact with residual powders rinse immediately with fresh water;
- before starting servicing, disconnect both battery cables (first the negative one), insulate terminals by tape and wait at least 10 minutes before proceeding;
- metal components of the Air-Bag are hot after explosion, avoid to touch these components for at least 20 minutes from module activation;
- do not repair Air-Bags but send faulty modules to supplier. Do not heat the Air-Bag module by welding, percussion, drilling, mechanical machining, etc.;
- never install on vehicle a damaged or fall Air-Bag module;
- it is prohibited to store Air-Bag modules together with flammable material or fuels;
- gas generators must not come into contact with acids, greases or heavy metals since contact can result in formation of poisonous, noxious gas or explosive compounds;
- never use open flames when working near Air-Bag modules or system components.

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Spare parts shall be stored in their original package and temporary storing shall follow the same procedure as for live modules disconnected from vehicle, i.e. storage into dedicated metallic key-locked cabinet (resistant to shocks and provided with grids to enable natural ventilation). Cabinet shall be provided with proper warning plates (RISK OF EXPLOSION - NO OPEN FLAMES - NO OPENING BY UNAUTHORISED PEOPLE).

Air-Bag module scrapping

Air-Bag modules must not be scrapped together with the vehicle, but must be previously removed and activated as described in the following pages.
Air-Bag units must always be activated before scrapping.
An Air-Bag module not exploded during an accident is to be considered still "live".
Live materials MUST NOT BE ACTIVATED but must be sent to a specialised centre (in Italy to GECMA in Chivasso) specifying on the freight note:

- Air-Bag DEVICE CONTAINING PYROTECHNIC CHARGE TO BE DEACTIVATED.

Devices must be sent using their original packages only. Should the original package be not available, a new one shall be requested to SPARE PARTS.
In case of Air-Bag device replacement, the original package shall obviously be kept in good conditions to send the non-activated device.

FOREIGN MARKETS shall observe local current laws and regulations.

Failure to observe these procedures can result in unintentional Air-Bag module activation and severe injury. Live Air-Bag units must NOT be disposed of using the common disposal procedure. Live Air-Bag units contain substances dangerous for health that can cause severe injury if the sealed container is damaged during disposal.

Safety Standards to observe when handling pretensioners

In case of front impact, driver and passenger pretensioners usually activate just a minute before Air-Bag modules
Personnel operating on these devices shall be suitably trained and must observe the following precautions:

- when handling activated pretensioners, i.e. with activated propelling gas, wear protective gloves and goggles;
- once servicing is over rinse hands with water and neutral soap, in case of eyes contact with residual powders rinse immediately with fresh water;
- disconnect both battery cables (first the negative one), insulate terminals by tape and wait at least 10 minutes before proceeding;
- pretensioner produce heat during activation, it is therefore necessary to wait at least 10 minutes before operating;
- protect pretensioners against fall or shock during handling or transport; damaged or fallen pretensioners must not be used and must be returned to supplier communicating the reason for;
- never carry pretensioners by the seat belt;
- pretensioners must be protected against sparks and open flames and must not stay in contact with surfaces with temperatures exceeding 100°C for more than 6 hours;
- propelling gas not burnt is flammable, therefore generator components must never be disassembled, damaged or tampered;
- it is prohibited to store pretensioners together with flammable material or fuels;
- gas generators must not come into contact with acids, greases or heavy metals since contact can result in formation of poisonous, noxious gas or explosive compounds;
- seat belts with pretensioners shall be stored in proper key-locked compartments or cabinets, suitably aerated and away from open flames and heat sources.

After any impact involving pretensioner activation, the seat belt is unserviceable and must be replaced.

Pretensioners scrapping

Non-activated pretensioners (not installed on vehicle) must always be activated before scrapping. Non-activated pretensioners installed on vehicle must not be scrapped together with the vehicle, but must be previously removed.
Pretensioner not activated during an accident is to be considered still "live" and therefore it is necessary to follow the procedure described in this manual.

Operations on system components

Once servicing operations are completed, the system shall be tested by Modus, I.W.T. or equivalent diagnostic equipment.
Air-Bag components are provided at installation with a label with a removable part showing system and components date of installation.
The removable part is detached and data are stored together with the test report provided by Modus, by the workshop that has installed the components.
After 10 years from installation, unless prior replacement, a new Air-Bag system (cable and components) shall be installed. As said above components technical data and the date of installation will be filed.

Removing and scrapping activated Air-Bag module and pretensioner from vehicle

Always wear gloves and goggles when handling activated Air-Bag or pretensioner. Wash hands and exposed skin with water and neutral soap after handling activated Air-Bag or pretensioner. In case of exposure to secondary products, rinse eyes immediately with fresh water. Failure to observe these indications can result in severe injury.
To remove and scrap activated Air-Bag module and pretensioner proceed as follows:

- follow instructions contained in this manual to remove activated Air-Bag module and pretensioner;
- disconnect Air-Bag module and pretensioner mechanical fixings;
- disconnect component connector form Air-Bag wiring;
- put Air-Bag module and pretensioner in the proper sealed nylon bag;
- send to authorised collection/disposal centre;
- dispose of, recycle or scrap deployed Air-Bag module and pretensioner using the suitable procedure.

Propelling gas residues shall be considered with attention. These residues that are mostly concentrated on the generator body or in small amount in the bag can contain copper or chlorides (e.g. potassium chloride). Combustion residues are very alkaline and corrosive.
Always wear skin protections and goggles. Activated Air-Bags must always be stored in dry and well ventilated places.

Removing and scrapping non-activated Air-Bag module from a repairable vehicle

Never cut the cables or tamper the connector between vehicle wiring and Air-Bag module. Connector contains a safety clip.

If connector is cut or removed from Air-Bag unit, the safety clip is disabled and this can result in unintentional activation and severe injury.
Air-Bag systems have a backup power supply located in the control unit. This power supply shall be deactivated by disconnecting the two battery terminals and waiting for at least 10 minutes before starting any operation on whatever Air-Bag component.
Keep the bag and the external bag cover in opposite direction to body when handling a live Air-Bag module. When placing a live Air-Bag on the bench or some surface like that, set the bag and the cover facing upwards and far from people. Never place objects near a live Air-Bag, since in case of module deployment objects will be thrown away like shells.

Always store live Air-Bag modules an pretensioners in fresh, dry, close and safe place. Do not expose to open flames or temperatures exceeding 150°C. Never cut, drill, solder or weld an Air-Bag module or its components. Failure to observe these indications can result in unit damages, fire, unintentional deployment and severe injury.

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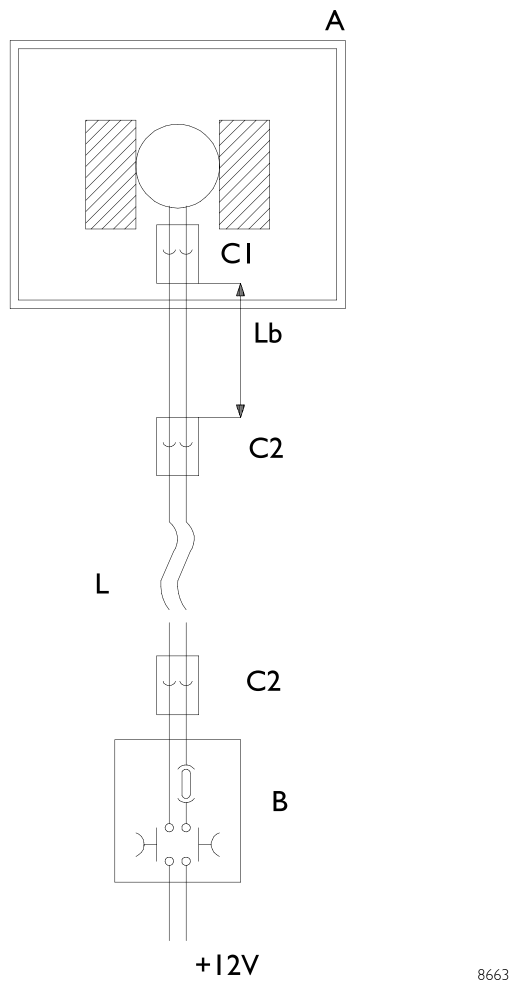
Damaged live Air-Bag modules and pretensioners (e.g. electric connection breakage), shall be store far from corrosive or oxidising substances. Failure to observe these indications can result in fire and/or severe injury.

Air-Bag modules and pretensioners are provided with backup power supply giving the electrical pulse required to bag deployment when the accident damages the battery or the cables before the sensor activates the gas generator.

Figure 13



AIR-BAG MODULE REMOTE ACTIVATION DIAGRAM

C1 = Air-Bag module connector
C2 = remote activation device connector (Air-Bag connector with safety clip, counterparts with male pins on Air-Bag side)
Lb = braid length = approx. 1 m
L = main cable, safety distance 10 m
A fenced area
B Remote activation device

Air-Bag module deployment Remote activation

General instructions:

- activation procedure can be performed in open area, suitably defined and fenced, far from flammable materials, liquids or other substances and far from people. Set the Air-Bag module on a firm surface and lock it;
- clean this area from any material (glass, instruments, parts, etc.) which could become like shells during deployment;
- check whether connector C2 is disconnected from remote activation device (10 m).
- connect electric connector C1, specified by vehicle manufacturer, to remote activation Air-Bag module;
- connect connector C2 to remote activation device;
- connect remote activation device to 12V circuit or equivalent device;
- stand protected;
- wear goggles and protective clothes;
- depress double activation push-button;
- wait for approx. 20 minutes before touching the activated Air-Bag module since it is hot;
- dispose of, recycle or scrap, as required, activated Air-Bag modules as described in the relevant chapters.

Activating Air-Bag modules and electronic pretensioners installed on unrecoverable vehicles

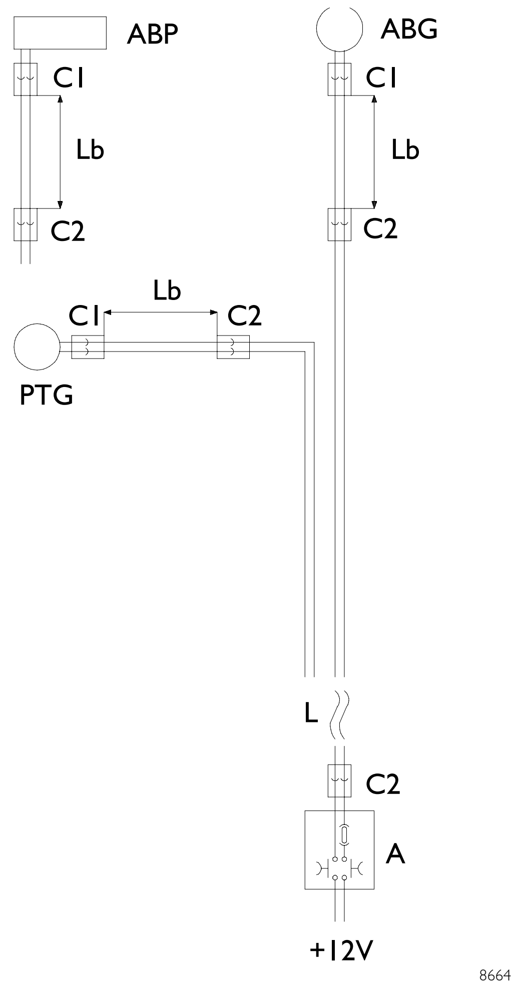
This procedure is to be used when scrapping a vehicle with one or more live Air-Bag modules. This procedure is valid whether Air-Bag system and/or electronic pretensioners are sound or not.
It is recommended to activate pyrotechnic charges on vehicles by directly connecting the electric connector of each module to remote activation device.

Deployment procedure shall be performed outdoor, away from people and in a well defined area. Check for absence of objects and flammable fluids near modules and pretensioners. Do not remain on the vehicle during activation and remember to close the doors. Stand protected (e.g. behind a wall, a vehicle, etc.) against thrown-away objects, if any. Let generators and modules cool down after deployment (20 min. at least before proceeding). Failure to observe these indications can result in severe injury.

General instructions:

- ❑ follow all WARNINGS, PRECAUTIONS and safety instructions reported in this manual;
- ❑ bring the vehicle outside in the provided area;
- ❑ remove from the area around the Air-Bag covering all materials and slugs (glasses, tools, components etc.) and make sure that no inflammable liquids are nearby;
- ❑ disconnect the two battery cables (first the negative cable) and wait for at least 10 minutes before proceeding;
- ❑ use a connecting braid (L= about 1 m) with specific terminal connector for the electric connection with the module to activate;
- ❑ reach the electric module connection (Air-Bag or electronic pretensioner), following the instructions of this manual;
- ❑ disconnect connector C1 of the pretensioner or Air-Bag module;
- ❑ check whether connector C2 is disconnected from remote activation device;
- ❑ connect the electric connector C1 of the pretensioner or Air-Bag module to the connecting braid of the remote activation device;
- ❑ connect connector C2 to remote activation device;
- ❑ place people in a safe place;
- ❑ connect the remote control device to a 12 Volts circuit or equivalent device;
- ❑ press the double activation push-button to activate all pretensioners and Air-Bag modules at the same time;
- ❑ after activating the Air-Bag modules and pretensioners, leave them cooling before touching them (about 20 minutes);
- ❑ after activating the Air-Bag modules and pretensioners, the vehicle can be scrapped - by squashing or crushing - and/or recycled, depending on the cases.

Figure 14



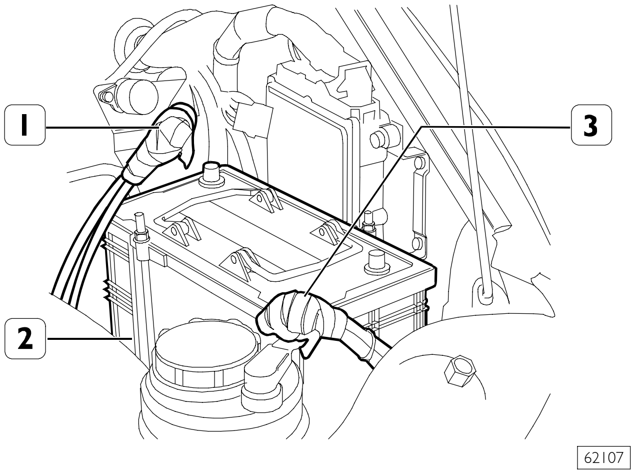
VEHICLE PYROTECHNIC CHARGES ACTIVATION DIAGRAM, SINGLE ACTIVATION

ABG = driver Air-Bag
ABP = passenger Air-Bag
C2 = remote activation device connector
C1 = specific pyrotechnic charge connector
L = main cable, safety distance 10 m
Lb = braid length
PTG = driver pretensioner

A. Remote activation device

541415 Upper steering gear shaft removal

Figure 15

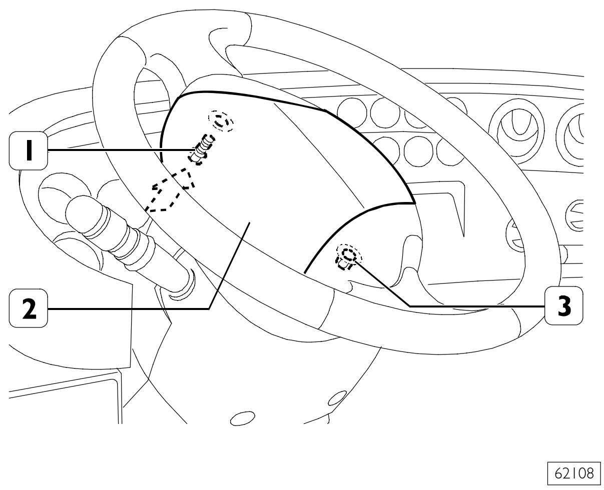


Disconnect the battery (2) cables (1-3) first the negative cable (1) then the positive one (3) and insulate them taping the terminals.

For vehicles equipped with Air-Bag

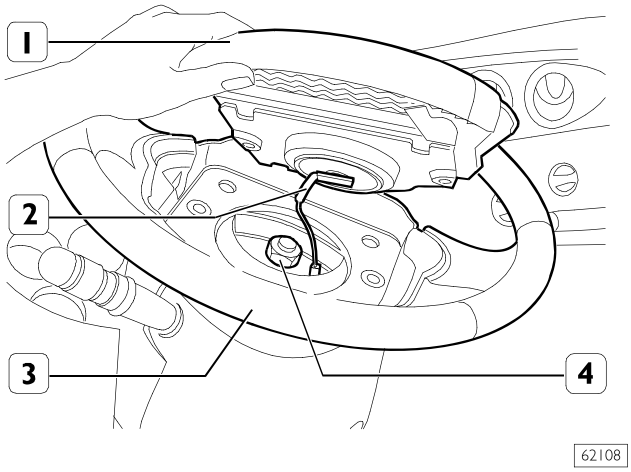
Follow the safety standards given in the relevant chapter and wait for 10 minutes before proceeding.

Figure 16



For vehicles without Air-Bag, remove the pressure-fit cover (2) on the steering wheel.
For vehicles with Air-Bag, turn the steering wheel and position it as shown in the figure, in order to easily reach the screws (1 and 3) and remove them.

Figure 17



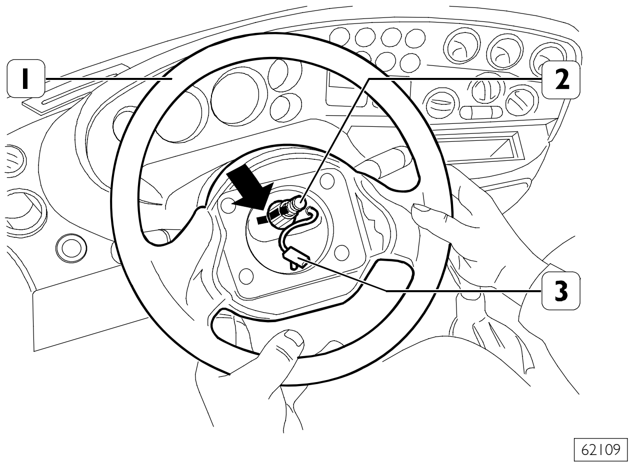
- ❑ Lift the Air-Bag module (1) in order to disconnect connector (2);
- ❑ Remove the Air-Bag module (1) from the steering wheel (3).

> ⚠ After removal, non-activated Air-Bag modules must be stored with plate laying on the surface in a suitable key-locked cabinet.

For all vehicles

Remove fixing nut (4).

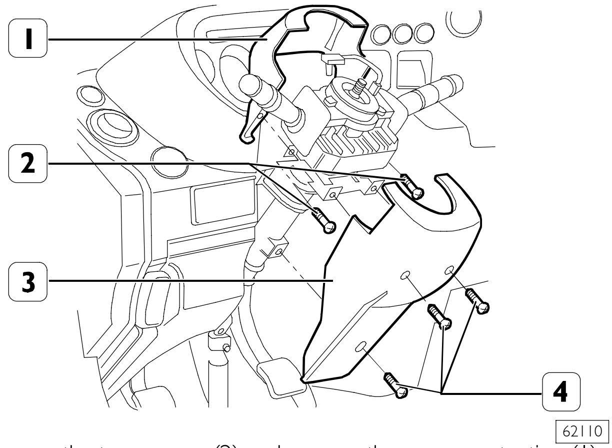
Figure 18



Set front wheels in straight running and mark (→) steering wheel assembly position (1) on upper steering gear shaft (2)
Remove the steering wheel (1) from the shaft (2).
For vehicles with Air-Bag, make sure not to extract or damage coil device cable (3).

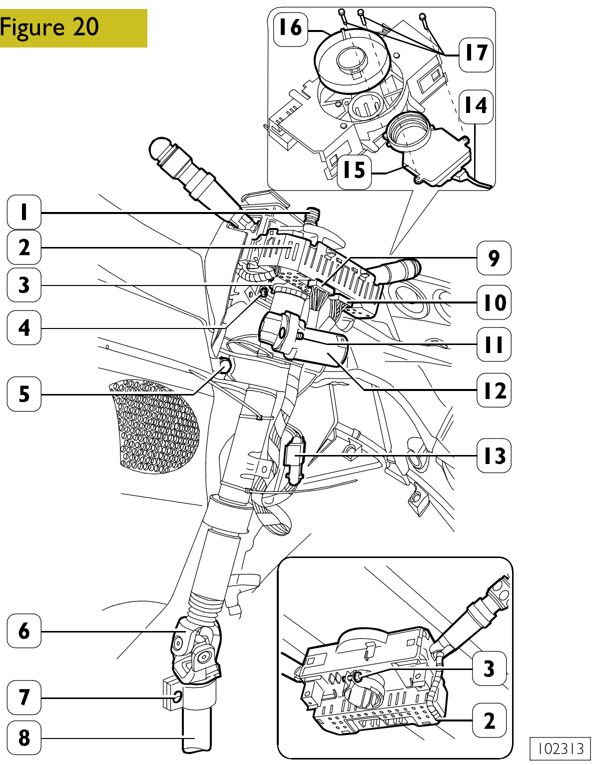
Make sure that steering wheel removal has lifted the top cap of the coil device. If the top cap turns, it will be necessary to block it by bringing it to the outside. If you hear a "click", it means that the cap is blocked. For any removals of the winding device, meticulously observe what specified in "Electric System" section.

Figure 19



Remove the two screws (2) and remove the upper protection (1). Remove the three screws (4) and remove the lower protection (3).

Figure 20



Cut electric cable fixing clamps and disconnect connectors (9-10-13).
On vehicles equipped with ESP, take off connector (14) of steering angle sensor (15) incorporated into the steering column stalk. Loosen screw (3) locking indicator switch retaining clamp to gear shaft (1).
Remove the indicator switch (2) from the gear shaft (1).

To remove steering angle sensor (15), you just need to take off cover (16) and unscrew the three screws (17) that secure it to the steering column stalk. Mark universal joint (6) assembly position on lower shaft (8) and loosen the fixing screw (7).
Remove the screws (4-5) and disconnect the upper steering gear shaft (1) from the lower steering gear shaft (8).
To replace or disassemble switch (12) it is necessary to unscrew screws (11) using a proper punch or drill them in order to eliminate the most of material to remove them. Make sure not to damage switch thread in case of reuse.
At refitting, the new screws (11) must be tightened till the hexagonal head is sheared from its rod.

Refitting

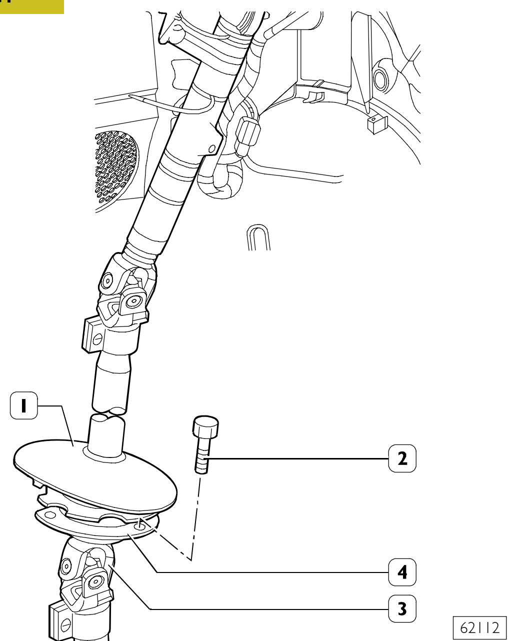
For refitting reverse removal operations and observe the following recommendations:

- ❑ reconnect shafts and refit steering wheel matching the marks made during removal operations;
- ❑ at refitting, the self-braking nuts and the steering wheel fixing nut must always be replaced;
- ❑ tighten nuts and screws to the prescribed torque;
- ❑ after tightening steering wheel fixing nut to upper shaft, it is necessary to crimp the nut;
- ❑ when refitting is completed, carry out operation test on indicator switch and horn.

NOTE On vehicles equipped with ESP, the steering angle sensor is fitted inside the steering column stalk. In this case, you will have to carry out the functional checks as well as the calibration procedure described in the relevant chapter of the "Brakes" section (page 63).

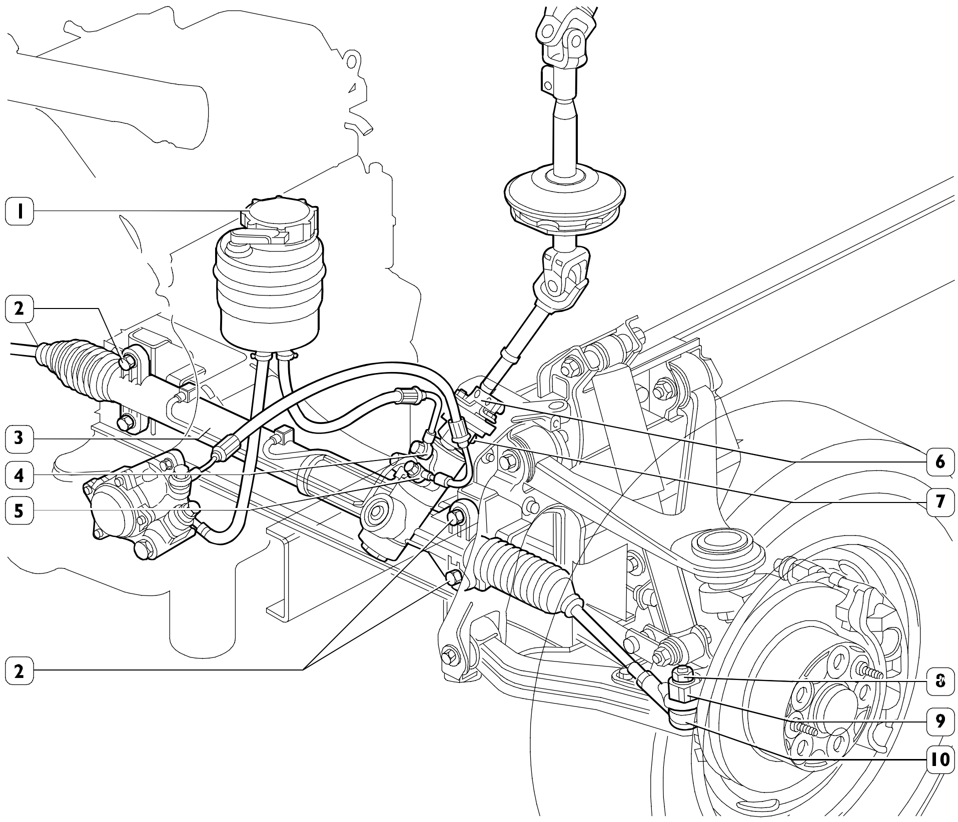
541413 Lower steering gear shaft removal

Figure 21



Remove the upper steering gear shaft as described in the relevant chapter (operation 541415). Lift cover (1) from floor. Unscrew the three fixing screws (2) of lower shaft (3) support (4).

Figure 22



Mark universal joint (6) assembly position on hydraulic power steering (3) shaft.
Loosen screw (7) and remove hydraulic power steering lower shaft.

Refitting

For refitting reverse removal operations, complying with upper steering gear shaft refitting operations.

5014 HYDRAULIC POWER STEERING
541413 Hydraulic power steering removal

Proceed as follows to remove the hydraulic power steering:
Loosen front wheel fixing screws or nuts.
Lift the front part of the vehicle, support it by proper stands and brake rear wheels.
Position tool 99321024 near the wheels, remove wheel fixing screws or nuts. Remove the wheels.
Remove cap (1) from hydraulic power steering oil tank.
Disconnect pipes (4-5) from hydraulic power steering (3) and drain system oil into a suitable container.
Steer wheel hubs in both directions to drain out oil from the system.
Remove nuts (8) fixing kingpins (10) to steering levers (9) and remove the latter using extractor 99347074.
Loosen the screw (7) fixing the universal joint (6) to the hydraulic power steering shaft (3).
Remove the fixing screws (2) and remove the hydraulic power steering (3).

Refitting

For refitting reverse removal operations and observe the following recommendations:

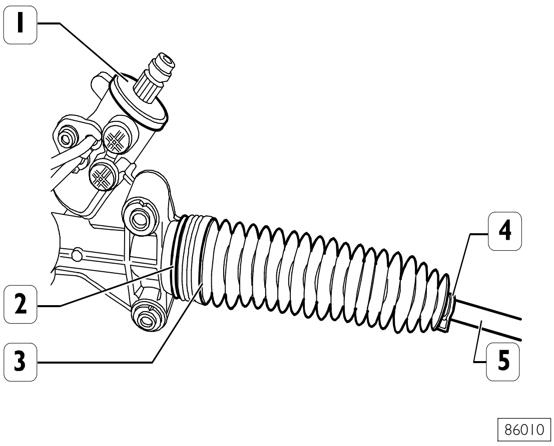
- after refitting the hydraulic power steering to the front cross member or to the driving axle, turn the pinion up to bring the rack to the end of the stroke. Turn again the pinion to the opposite direction for a number of turns equal to half of the turns required to the rack to complete the whole stroke (approx. 2 turns);
- in this position, set steering wheel in straight running condition and connect the elastic joint to hydraulic power steering pinion fork or the universal joint to the hydraulic power steering.
- At refitting, the self-braking nuts must not be reused but replaced with new ones.
- tighten screws and nuts to the prescribed torque;
- fill hydraulic power steering system tank in and carry out the drainage as described in the relevant section;
- check and adjust toe-in as described in the relevant section.

> The only repair operations to carry out on hydraulic power steering and mechanical steering are the following: joint head replacement and rubber boots replacement. In these cases, follow the operations described in the relevant section.
> If defects depending only on the hydraulic power steering are found, replace it.

Steering linkage replacement

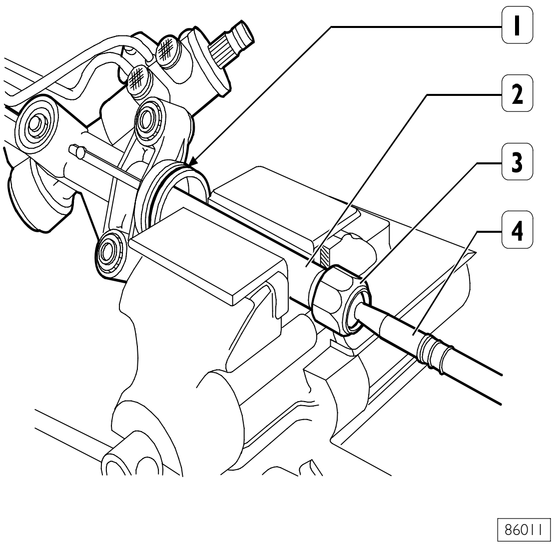
Removal

Figure 23



Use suitable pincers to loosen the retainer clamps (2 and 4), remove the protective boot (3) from the power steering box (1) and move it aside to access the steering linkage connection (5) to the rack rod.

Figure 24

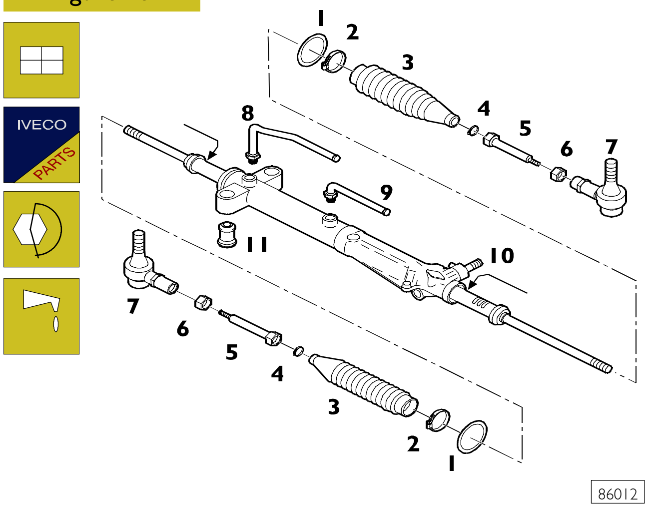


Tighten the rack rod (2) in a vice with lead covered jaws, loosen the joint (3) and remove the steering linkage (4). Remove the o-ring (1). Repeat the operations to remove the opposite steering linkage. Follow the removal/refitting operations described in the respective sections to reuse ball joints.

Do not take the rack rod (2) to end of stroke after removing the linkage (4) to avoid damaging the power steering o-rings.

Refitting

Figure 25



POWER STEERING SYSTEM SPARE PARTS

1. O-ring - 2. Clamp - 3. Protective boot - 4. Clamp - 5. Steering linkage - 6. Nut - 7. Head - 8. Tube - 9. Tube - 10. Power steering unit - 11. Rubber bushing.

Reassemble by reversing the disassembly sequence; observe the following precautions:

- replace o-rings (1) and clamps (2 and 4) with new parts;
- lubricate (→) protective boot (3) seats on power steering unit (10) to facilitate assembly of the boots;
- tighten steering linkage joints (5) at 100 ± 10 Nm (10 ± 1 kgm).

Rubber bushing replacement procedure

Use a suitable ram to remove/refit rubber bushings (11).

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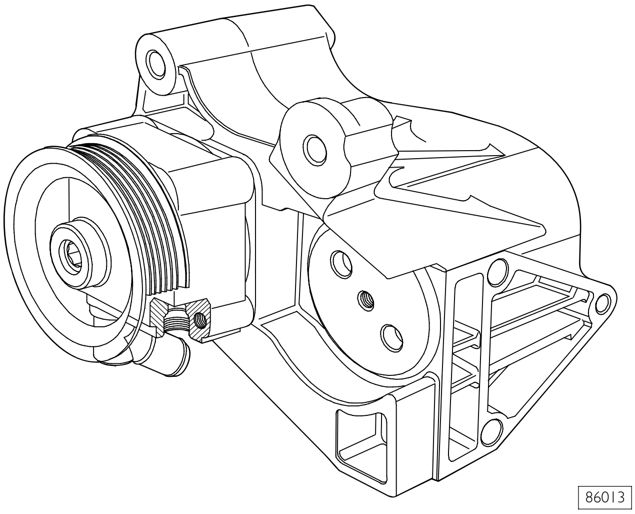
501450 POWER STEERING PUMP

F1A engine power steering pump

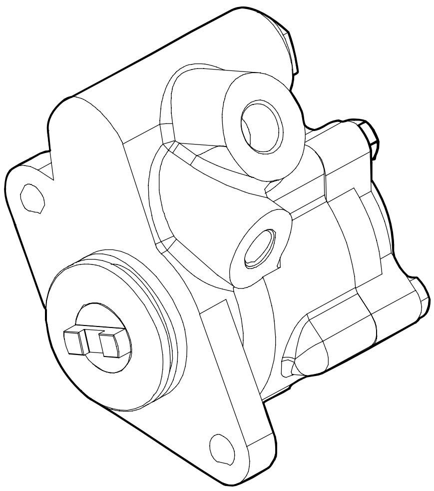
Figure 26



86013

F1C engine power steering pump

Figure 27



89008

Operation of the power steering pumps for FIA/F1C engines is similar to that of 8140 engines.

Power steering pump overhaul procedure

Replace the power steering pump if poor operation is found.

SECTION 11

78 Hydro-pneumatic system

52 Brakes

Page

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GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (MISCELLANEOUS AND GENERATORS)

DESCRIPTION	SYMBOL	
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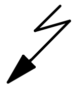
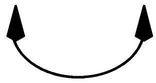
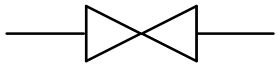
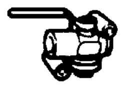
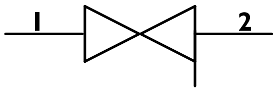
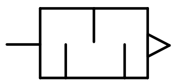
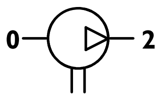
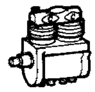
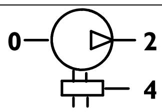
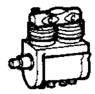
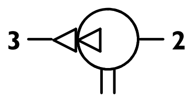
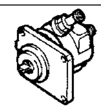
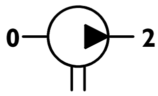
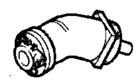
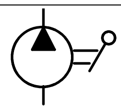
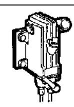
AIR FLOW		
ELECTRICAL LINE		
ABLE TO ROTATE		
CROSSOVER OF CONNECTED LINES		
PRESSURE TEST POINT		
QUICK-RELEASE COUPLING		
COCK		
COCK WITH OUTLET		
SILENCER		
COMPRESSOR		
ENERGY SAVING COMPRESSOR		
VACUUM PUMP		
HYDRAULIC PUMP		
HYDRAULIC HAND PUMP		

32780

GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

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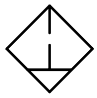
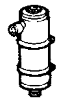
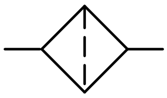
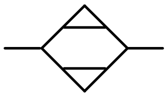
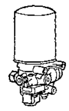
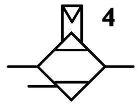
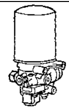
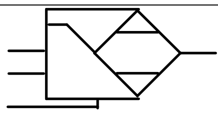
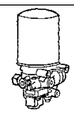
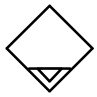
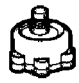
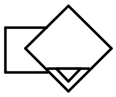
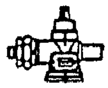
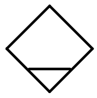
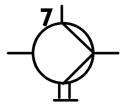
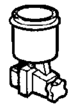
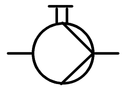
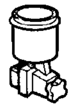
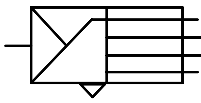
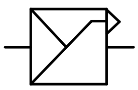
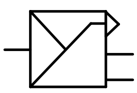
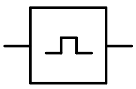
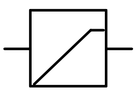
CONDENSATE SEPARATOR		
FILTER		
DEHUMIDIFIER		
DEHUMIDIFIER		
DEHUMIDIFIER WITH BUILT-IN REGULATOR		
AUTOMATIC CONDENSATION DRAIN VALVE		
CONTROLLED CONDENSATION DRAIN VALVE		
HAND CONDENSATE DRAIN VALVE		
CONTROLLED ANTI-ICING UNIT		
AUTOMATIC ANTI-ICING UNIT		
PRESSURE REGULATOR WITH INDEPENDENT CIRCUIT		
PRESSURE CONTROLLER		
PRESSURE CONTROLLER		
PRESSURE CONTROLLER (GOVERNOR)		
PRESSURE LIMITING VALVE		

32782 32783

GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

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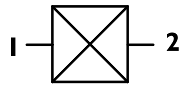
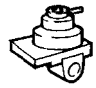
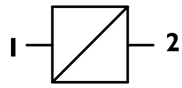
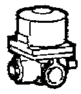
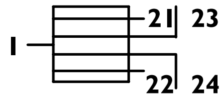
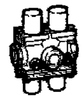
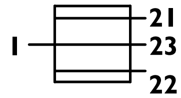
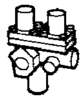
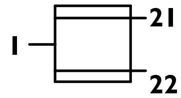
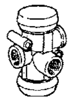
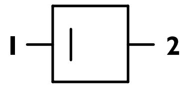
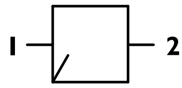
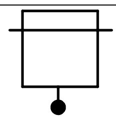
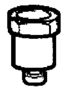
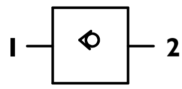
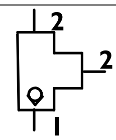
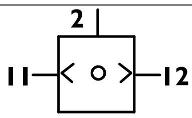
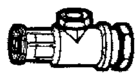
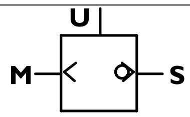
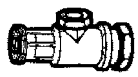
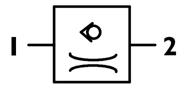
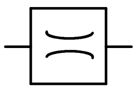
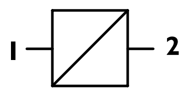
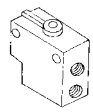
PROPORTIONAL REDUCING VALVE		
MATCHING VALVE		
FOUR CIRCUIT PROTECTION VALVE		
THREE CIRCUIT PROTECTION VALVE		
TWO CIRCUIT PROTECTION VALVE		
NON-RETURN AIR INLET VALVE		
NON-RETURN AIR INLET VALVE		
SAFETY VALVE		
CHECK VALVE		
CHECK VALVE		
DOUBLE SHUT-OFF VALVE		
DIFFERENTIAL DOUBLE SHUT-OFF VALVE		
THROTTLE VALVE WITH QUICK RETURN		
THROTTLE VALVE		
CONTROL VALVE		

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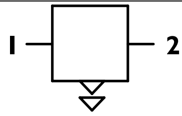
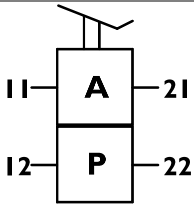
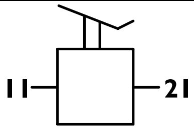
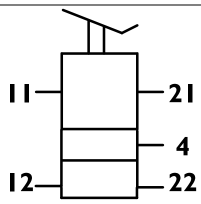
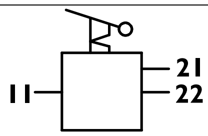
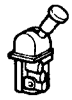
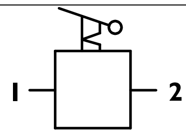
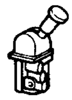
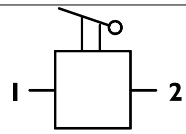
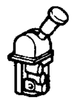
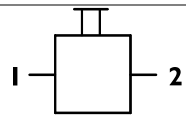
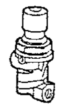
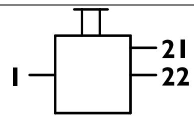
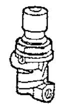
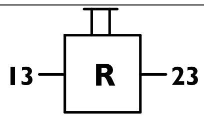
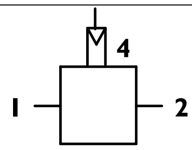
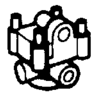
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
DUMP VALVE		
BRAKE CONTROL VALVE		
BRAKE CONTROL VALVE		
BRAKE CONTROL VALVE		
PARKING BRAKE CONTROL VALVE		
PARKING BRAKE CONTROL VALVE		
BRAKE VALVE		
CONTROL VALVE		
CONTROL VALVE		
RETARDER CONTROL VALVE		
SERVO CONTROL VALVE		

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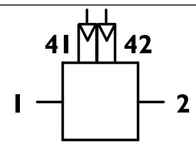
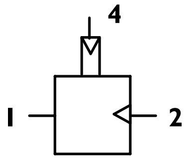
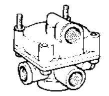
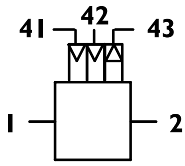
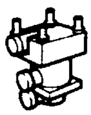
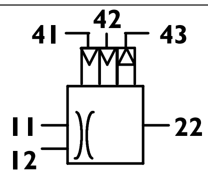
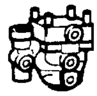
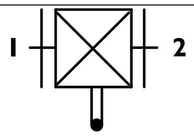
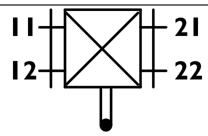
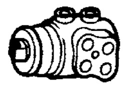
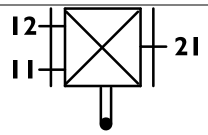
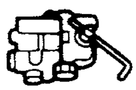
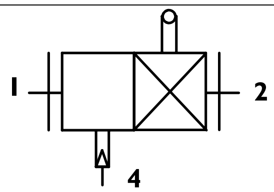
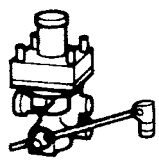
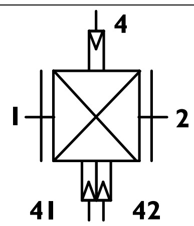
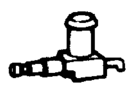
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
SERVO CONTROL VALVE		
SERVO CONTROL VALVE FOR SINGLE LINE		
TRAILER BREAKING TRIPLE CONTROL VALVE		
TRAILER BREAKING TRIPLE CONTROL VALVE WITH BUILT-IN SERVO SWITCHING		
LOAD PROPORTIONING VALVE		
DUAL LOAD PROPORTIONING VALVE		
LOAD PROPORTIONING VALVE WITH BY-PASS		
LOAD PROPORTIONING VALVE WITH BUILT-IN RELAY		
LOAD PROPORTIONING VALVE WITH BUILT-IN RELAY WITH AIR CONTROL		

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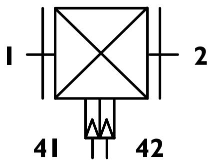
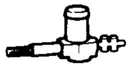
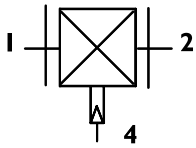
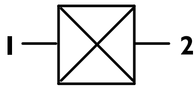
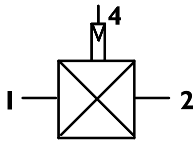
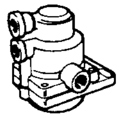
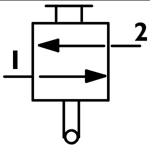
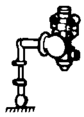
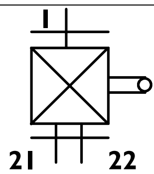
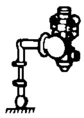
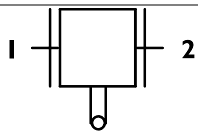
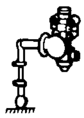
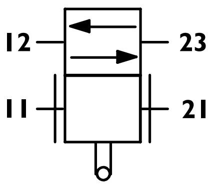
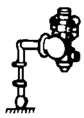
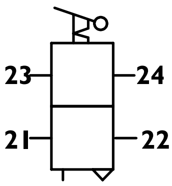
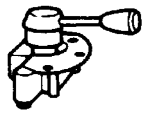
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
LOAD PROPORTIONING VALVE WITH AIR CONTROL		
LOAD PROPORTIONING VALVE WITH AIR CONTROL		
PROPORTIONAL REDUCING VALVE		
SLAVED PROPORTIONAL REDUCING VALVE		
SLAVED LIMITING VALVE		
LEVELLING VALVE		
LEVELLING VALVE		
HAND OPERATED SUSPENSION RAISING CONTROL VALVE		
LEVELLING VALVE WITH BUILT-IN TRAVEL LIMITER		

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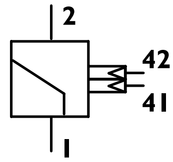
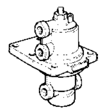
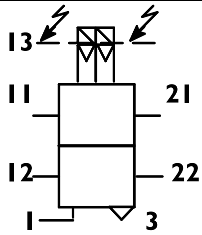
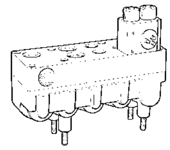
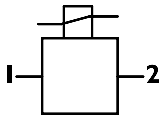
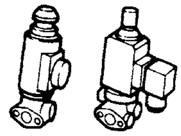
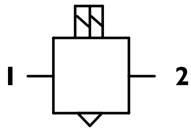
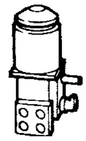
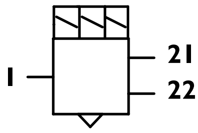
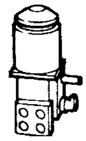
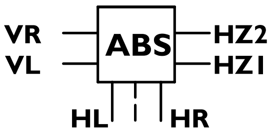
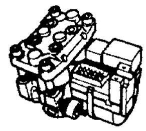
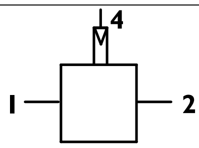
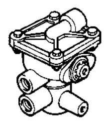
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
PROPORTIONAL CONTROL VALVE		
HAND OPERATED SUSPENSION CONTROL VALVE WITH ELECTRICAL MONITORING		
ELECTROPNEUMATIC VALVE		
ELECTROPNEUMATIC VALVE		
ELECTROPNEUMATIC VALVE		
HYDRAULIC MODULATOR FOR ABS		
AUGMENTER VALVE		

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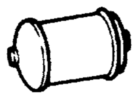
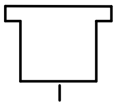
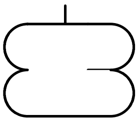
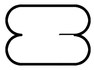
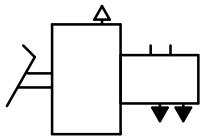
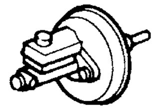
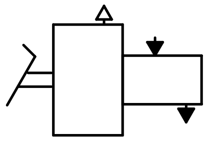
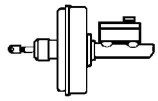
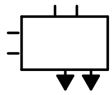
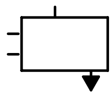
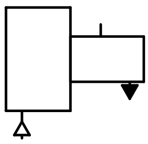
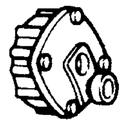
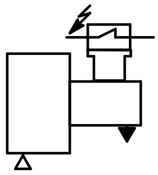
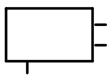
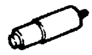
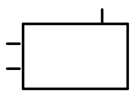
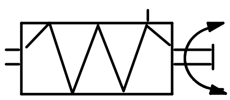
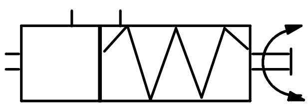
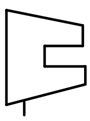
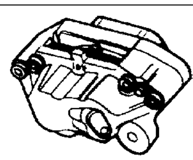
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (TANKS AND ACCUMULATORS)

DESCRIPTION	SYMBOL	
COMPRESSED AIR TANK		
BRAKE FLUID RESERVOIR		
AIR SPRING		

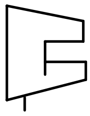
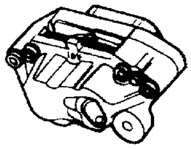
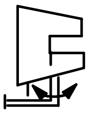
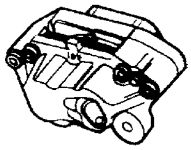
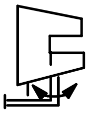
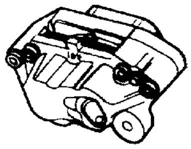
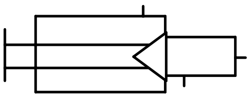
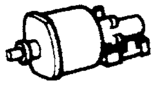
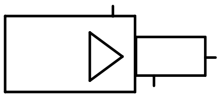
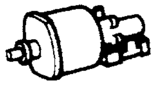
32789

GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CONVERTERS, CYLINDERS AND CALIPERS)

DESCRIPTION	SYMBOL	
VACUUM SERVO BRAKE		
VACUUM SERVO BRAKE		
DUAL CIRCUIT MASTER CYLINDER		
SINGLE CIRCUIT MASTER CYLINDER		
AIR/HYDRAULIC CONVERTER		
AIR/HYDRAULIC CONVERTER		
HYDRAULIC BRAKE CYLINDER		
SLAVE CYLINDER		
BRAKE CYLINDER		
SPRING CYLINDER		
COMBINED BRAKE CYLINDER		
FIXED DISK BRAKE CALIPER		

32790 32791

GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CALIPERS AND CYLINDERS)

DESCRIPTION	SYMBOL	
FLOATING DISK BRAKE CALIPER		
FLOATING DISK BRAKE CALIPER WITH PARKING		
MECHANICAL FLOATING DISK BRAKE CALIPER		
SERVO CLUTCH		
SERVO CLUTCH		

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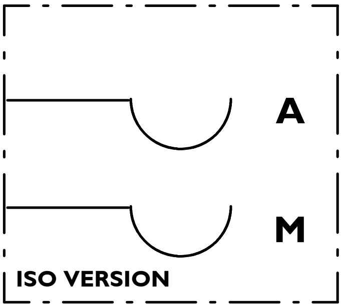
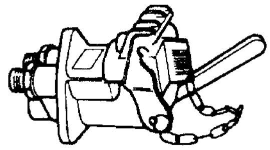
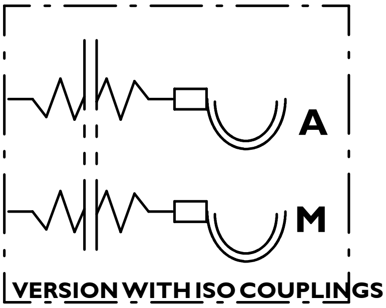
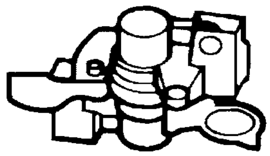
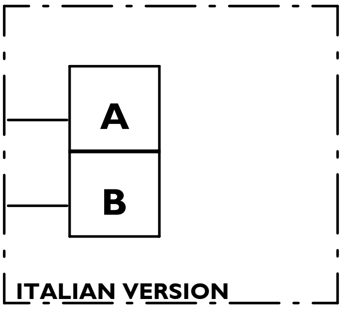
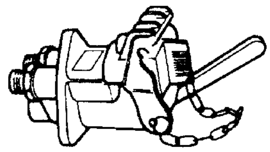
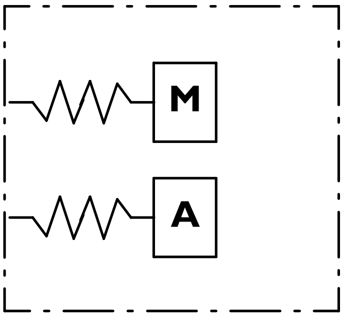
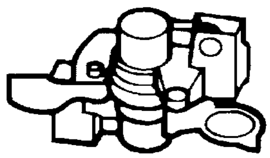
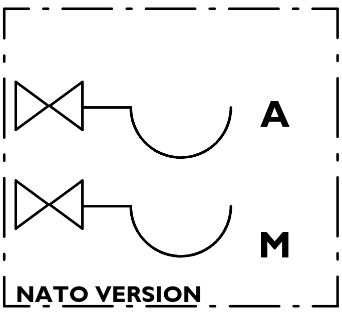
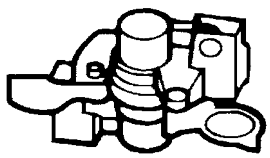
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (SEMI-COUPLINGS AND COUPLING HEADS)

DESCRIPTION	SYMBOL	
"ISO" SEMICOUPLING		
"ISO" SEMICOUPLING		
"CUNA" SEMICOUPLING		
"CUNA" SEMICOUPLING		
"NATO" SEMICOUPLING		

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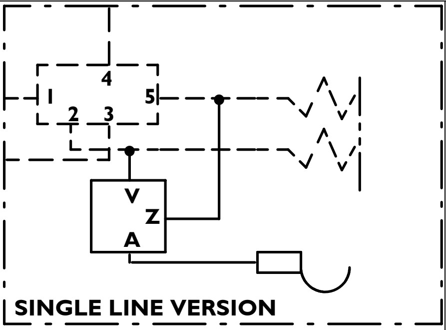
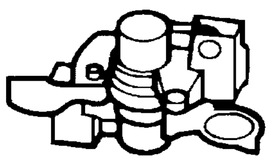
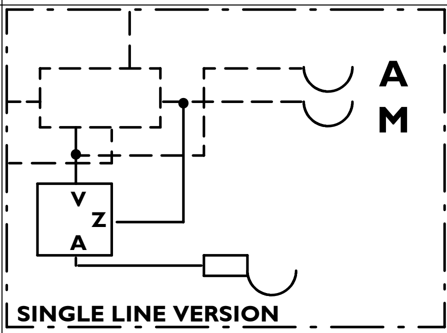
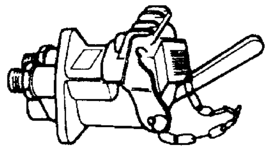
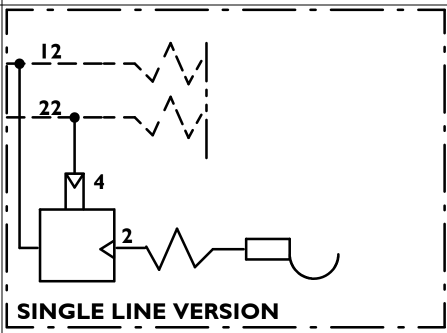
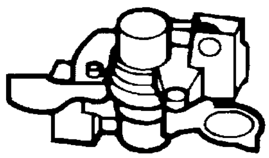
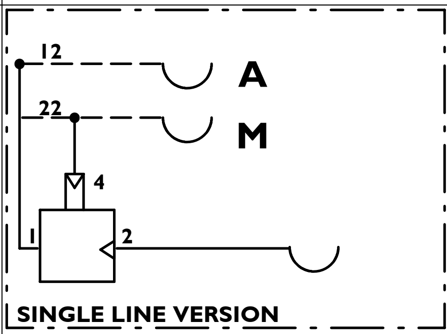
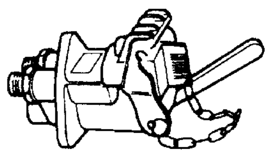
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (SEMI-COUPLINGS AND COUPLING HEADS)

DESCRIPTION	SYMBOL	
SEMI-COUPLING		
SEMI-COUPLING		
SEMI-COUPLING		
SEMI-COUPLING		

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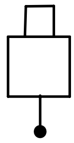
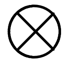
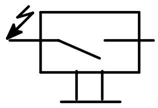
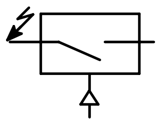
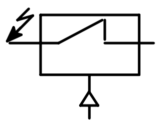
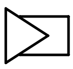
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (INDICATORS AND SWITCHES)

DESCRIPTION	SYMBOL	
PRESSURE GAUGE		
PRESSURE GAUGE		
PRESSURE TRANSMITTER		
LAMP		
MECHANICAL OPERATED SWITCH		
PRESSURE SWITCH		
LOW PRESSURE SWITCH		
AUDIBLE WARNING		
SENSOR		

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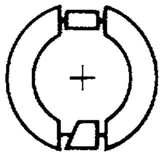
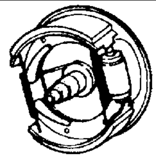
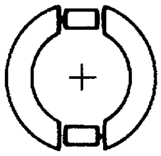
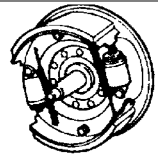
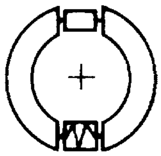
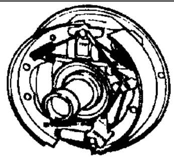
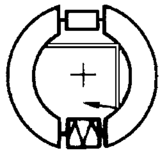
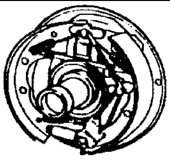
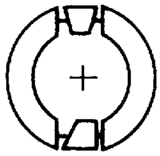
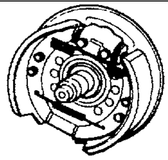
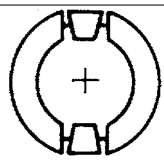
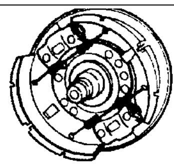
GRAPHIC SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (BRAKES)

DESCRIPTION	SYMBOL	
SINGLE CYLINDER HYDRAULIC BRAKE		
TWIN CYLINDER HYDRAULIC BRAKE		
DUAL SERVO HYDRAULIC BRAKE		
DUAL SERVO HYDRAULIC BRAKE WITH PARKING BRAKE		
SINGLE CAM OPERATED BRAKE		
TWIN DUAL CAM OPERATED BRAKE		

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799512 PIPES AND COUPLINGS

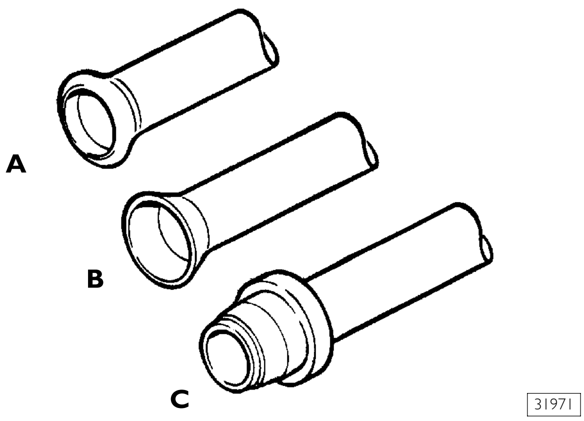
General

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 in metre lengths.
- Rigid metal pipes of the following diameters (Ø 4.75-6.35-8-10-12 mm). Pipes from Ø 4.75 to Ø 10 mm are supplied as spares in straight lengths of 4, 5 and 6 m, while those which are over 10 mm diam. are supplied as spares ready cut, bent and flared.

Re-flanging rigid pipes

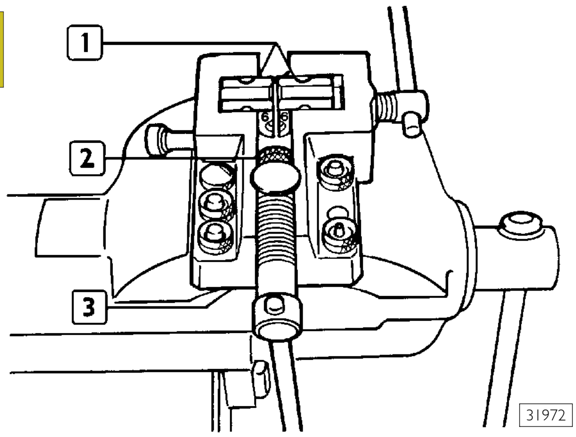
Figure 1



TYPES OF RE-FLANGING OF RIGID PIPES

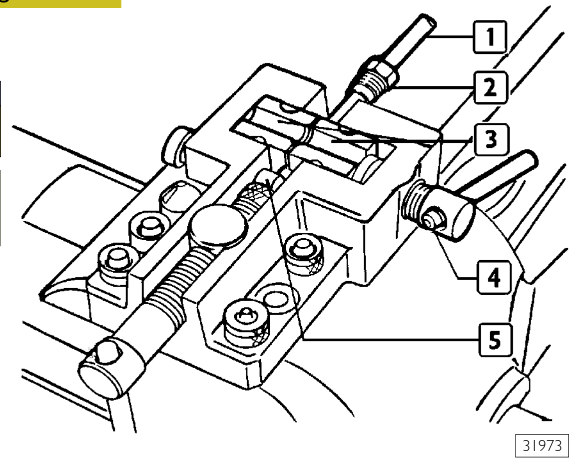
A Type re-flanging

Figure 2



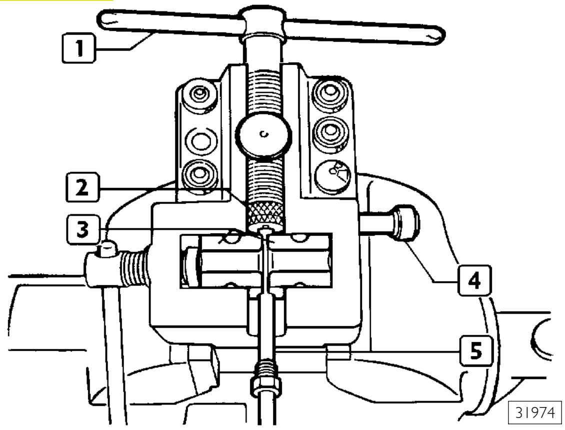
Position of press 99386523 (3) the blocks (1) so that the stamped numbers indicating the diameter of the pipes to be worked are facing towards the due (2). The choice of the matrix die (2) depends on the diameter of the pipe to be re-flanged. Additionally, the diameter of the pipe that can be re-flanged is stamped on the matrix die.

Figure 3



Deburr pipe (1), insert union fitting (2) on this and position it between blocks (3) bearing against pin (5). Lock pipe (1) with screw (4).

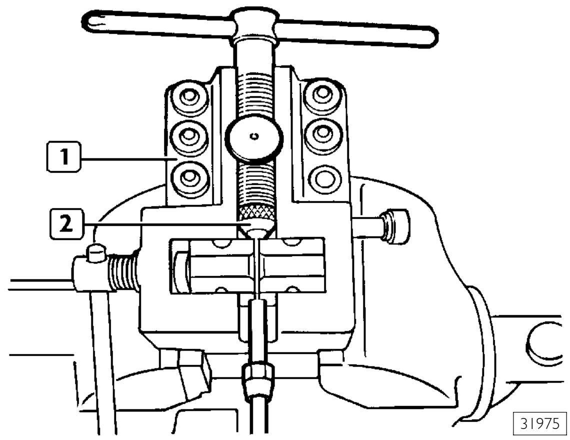
Figure 4



Move pin (4) to neutral position. Tighten screw (1) until matrix die (2) comes up against blocks (3), thus forming the end of the pipe (5).

B Type re-flanging

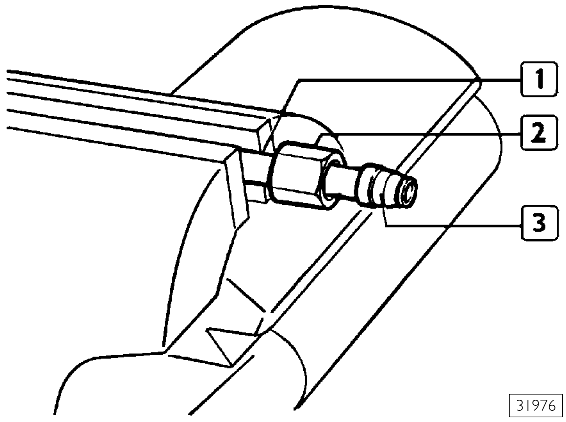
Figure 5



Fix matrix die (2) to press 99386523 (1).
For re-flanging follow the instructions given above for A Type re-flanging.

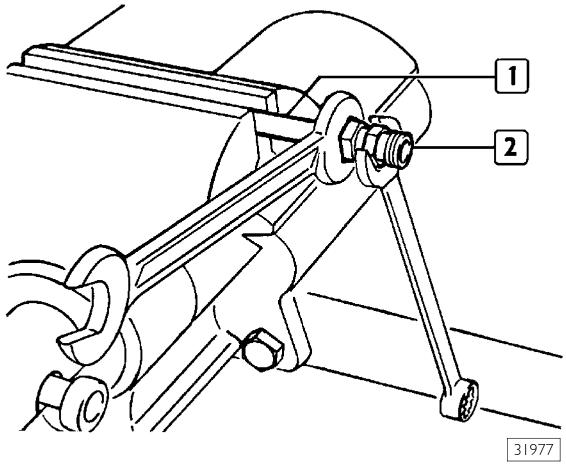
C Type re-flanging

Figure 6



Fit nut (2) and ring (3) over the pipe (1).

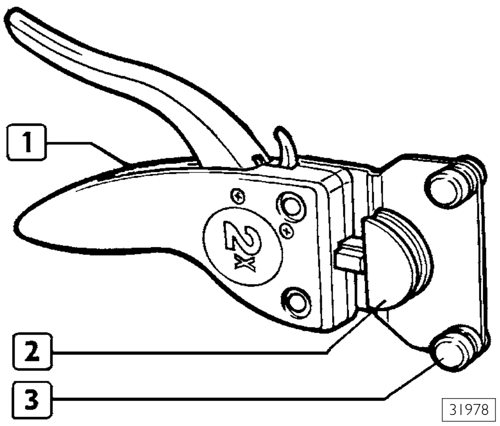
Figure 7



Fit union fitting (2) and tighten so that ring (3, Figure 6) is locked over the pipe (1).

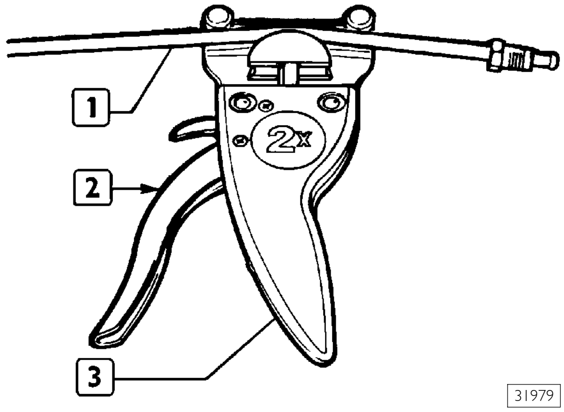
Bending rigid pipes

Figure 8



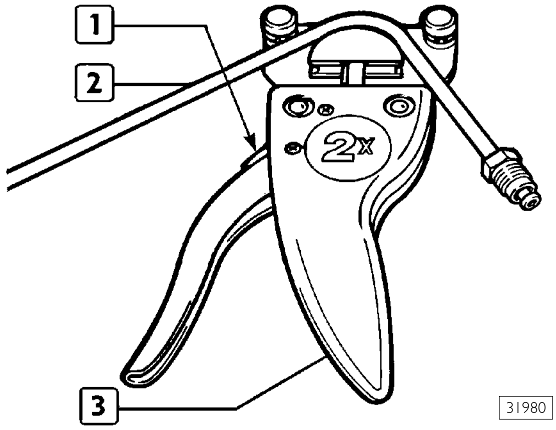
Fit tool (1) 99386523 and select components (2) and (3) according to the diameter of the pipe to be bent.

Figure 9



Position pipe (1) in tool (3) and bend the pipe by acting on lever (2).

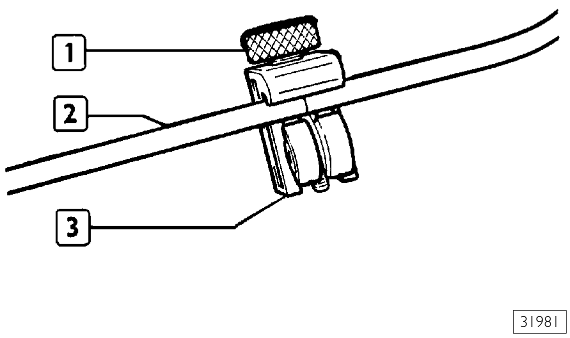
Figure 10



To remove the pipe (2) from the tool (3) use lever (1).

Cutting rigid pipes

Figure 11



Position pipe (2) in tool (3) 99386523 and tighten screw (1). By holding the pipe (2) still, rotate the tool (3) until the pipe has been completely cut.

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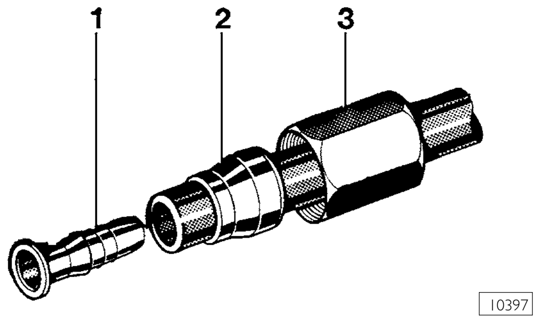
After having cut the pipe, deburr and shape the ends as described previously.

NOTE By turning tool (3) around the pipe (2), screw (1) becomes loose. To completely cut the pipe, you must tighten the screw (1) as soon as it becomes loose.

Replacing flexible hoses with threaded couplings

Carefully follow the instructions below:

Figure 12

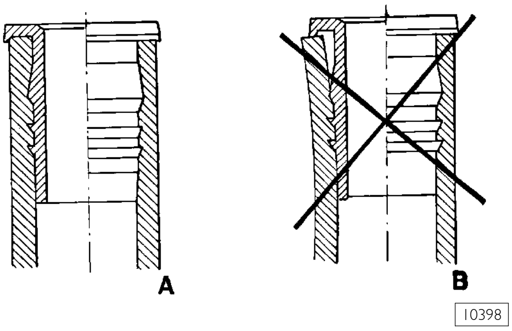


- ❑ Only use type approved hoses;
- ❑ Check the condition of the new hose, that must be free from cracks, cuts or scores;
- ❑ Cut the hose at 90°, with respect the to axis, to the required length by means of pipe-cutter pliers 99387050;

Fit the following in the specified order over the hose:

- ❑ Nut (3), pressure ring (2) (the thickest part should be facing the nut (3) and the reinforcement bush (1);
- ❑ The bush must be in perfect condition (it must be free from deformation or hammer dents);

Figure 13



ASSEMBLY OF REINFORCEMENT BUSH
A = CORRECT ASSEMBLY
B = INCORRECT ASSEMBLY

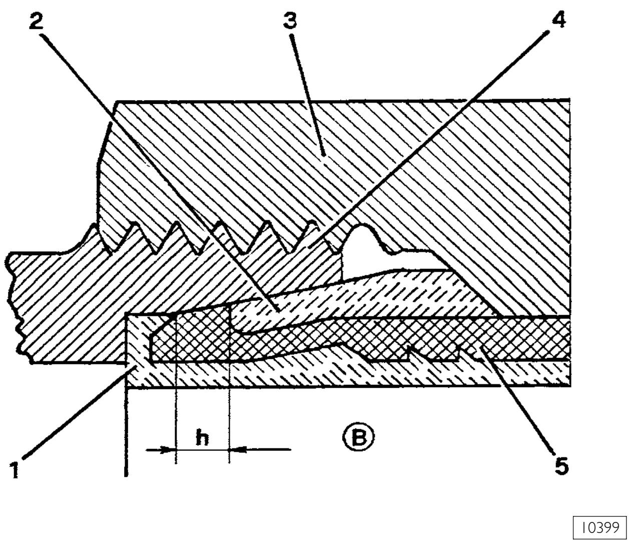
- ❑ Fit the reinforcement bush with tool 99372219 ensuring contact between its flange and end of the hose;
- ❑ Make sure that the end of the hose penetrates into the rake throat of the flange;
- ❑ Re-flange the support ring when fitted on the vehicle or at the test bench on a union fitting.
- ❑ The pressure and the final distance of the pressure ring front edge from the reinforcement bush should be in accordance with those shown in the table below.

NOTE When the hose is incorrectly fitted, do not reuse the hose once the bush and support ring have been removed.

	Hose mm	Distance between bush edge and ring edge mm (*)	Fitting pressure (N/mm²)
Twin-layer	6 x 1	da 1 a 1,5	0,040
	8 x 1	da 2 a 2,5	0,050
Single layer	10 x 1,5	da 2 a 2,5	0,050
	12 x 1,6	da 2 a 2,5	0,060
	16 x 2,34	da 3 a 3,5	0,060

(*) See reference h, Fig. 14

Figure 14



1. Reinforcement bush - 2. Pressure ring - 3. Nut - 4. Union fitting - 5. Hose - h. Distance between bush edge and ring edge (see table)

Introduce the end of the prepared hose into the union fitting until the reinforcement bush flange rests in the appropriate seat:

- ❑ To lock the nut on the union fitting, tighten this up by hand and then by means of a box wrench and dynamometric wrench; this must tightened up to the required driving torque.

When fitting the hose to the vehicle, some important points should be borne in mind:

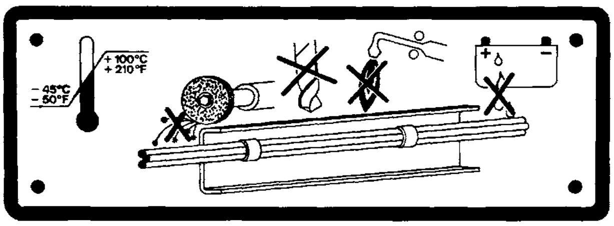
- ❑ Bends must comply with minimum radii, so as to avoid constrictions

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 safe distance of 15mm 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;
- ❑ When the hose has to be attached to existing pipe work, take into account of the additional heat to which it may be subjected (power steering pipe work). 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 15



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 to avoid damage.

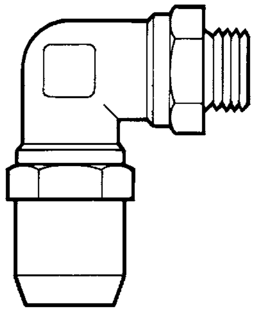
⚠ For greater safety and convenience in working, it is advisable to remove the hoses during these operations.

When fitting is finished, check that all seals (unions, couplings, etc.) are completely free from leaks.

Replacing flexible hoses with quick release couplings

Swivel couplings:

Figure 16

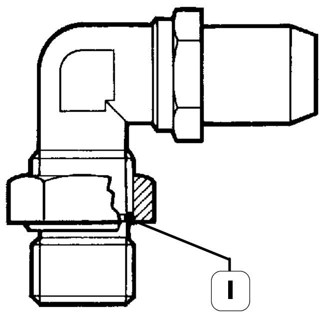


39306

Screw the coupling into the threaded seating provided on the air valve, and tighten it to the driving torque indicated in the table.

Banjo couplings:

Figure 17



39307

- ❑ Check that the seal ring (1) is in its seal;
- ❑ Tighten the coupling until the seal gasket is in contact with the valve;
- ❑ Direct the valve correctly and, by keeping the moveable part still, lock the hexagonal nut to the driving torque indicated in the table.

Swivel and banjo couplings

COUPLING THREAD	DRIVING 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

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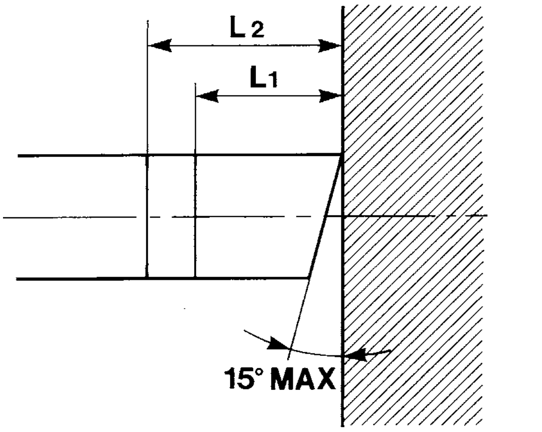
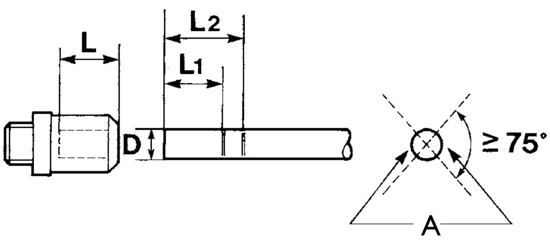
Figure 18



33977

- Only use type approved hoses;
- Check the condition of the new hose, that must be free from 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 19



33976

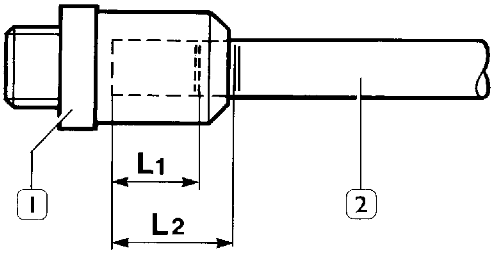
A = Mark to identify end of tube travel

- Use indelible ink to clearly mark two reference notches on both diametrically opposite faces of the pipe at an angle of ≥ 75°, set to distances L_1 and L_2, to ensure correct fitting in place.

NOTE 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 (see Figure 18).

D (mm)	L $^{0}_{+0,5}$ (mm)	L_1 $^{-0,5}_{+1}$ (mm)	L_2 $^{-0,5}_{+1}$ (mm)
6	19,8	17	22
8	20,5	18	23
12	25	22	28
16	27,1	24	30

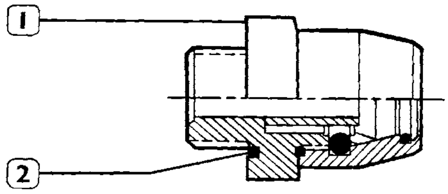
Figure 20



39308

- Insert the hose (2) by hand into the coupling (1), with a force between 30 and 120 N according to the diameter of the hose, so that reference mark L_1 is inside the hose while mark L_2 remains visible.

Figure 21



33978

When removing couplings (1) on pneumatic components, check the condition of the seal ring (2) and, if necessary, replace.

COUPLING THREAD	SEAL RING 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	-

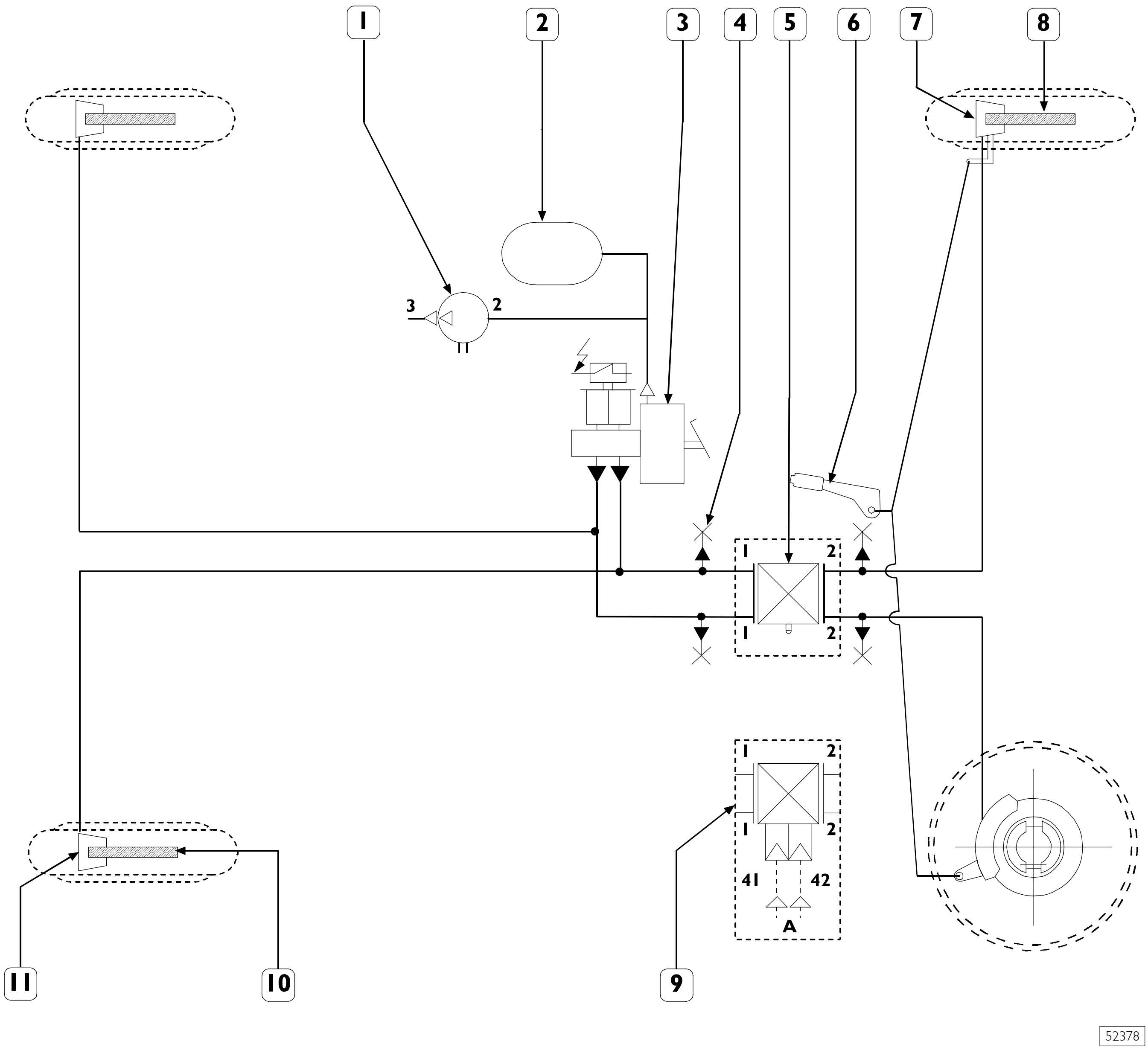
Whenever a hose is removed from a quick release coupling, the coupling itself must be replaced. Spare quick release couplings are supplied complete.

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.

BRAKING SYSTEM

Outline diagram for vehicles 29L - 35S without ABS

Figure 22



1. Pressure reducer - 2. Vacuum tank (2 litres) - 3. Servo brake - 4. Hydraulic pressure test point - 5. Dual mechanical operated load proportioning valve (for vehicles with mechanical suspensions) - 6. Parking brake lever - 7. Rear brake caliper - 8. Rear brake disc - 9. Dual pneumatic operated load proportioning valve (for vehicles with pneumatic suspensions) - 10. Front brake disc - 11. Front brake caliper - A. From pneumatic suspension circuit.

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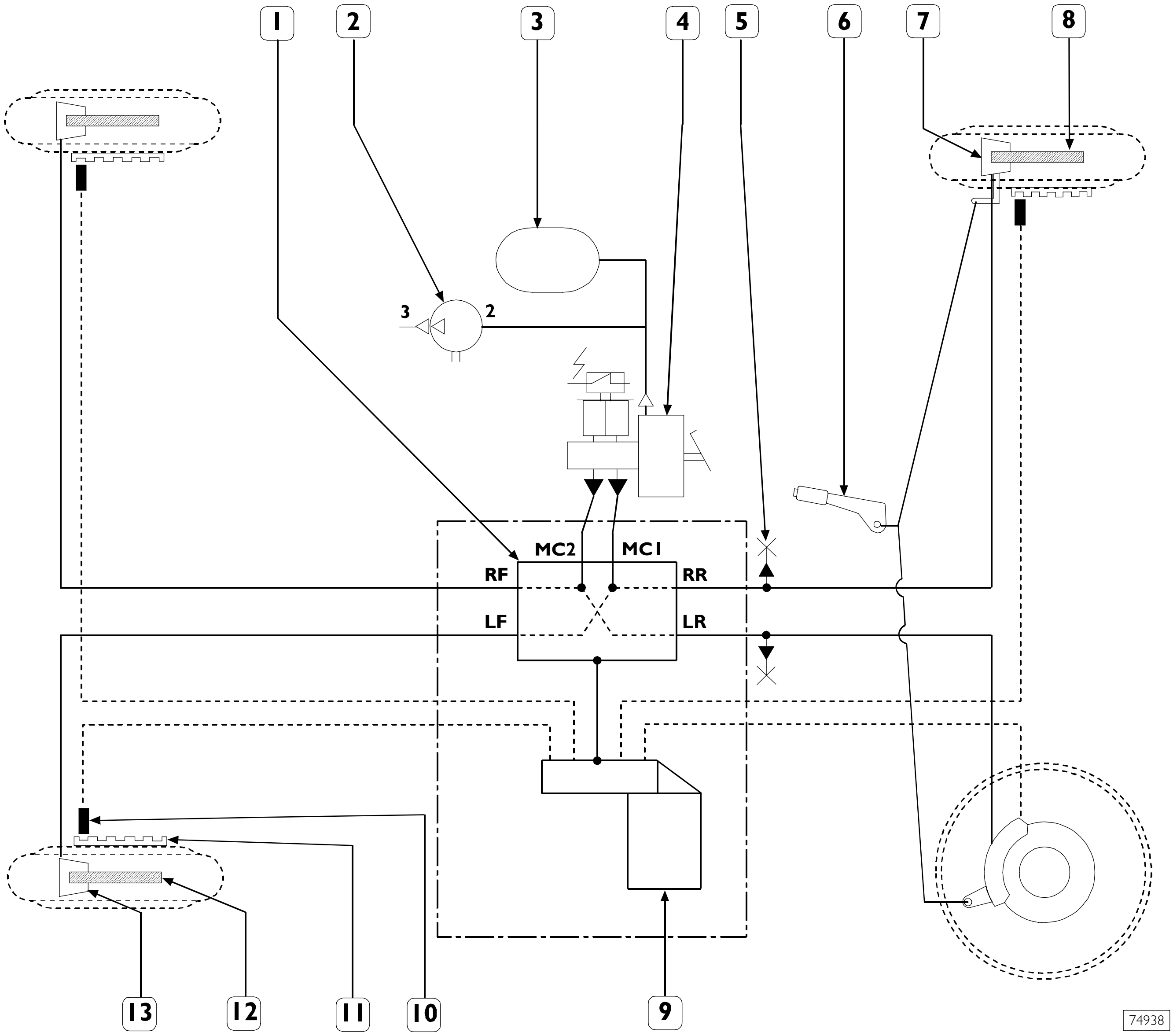
Outline diagram for vehicles 29L - 35S with ABS 8

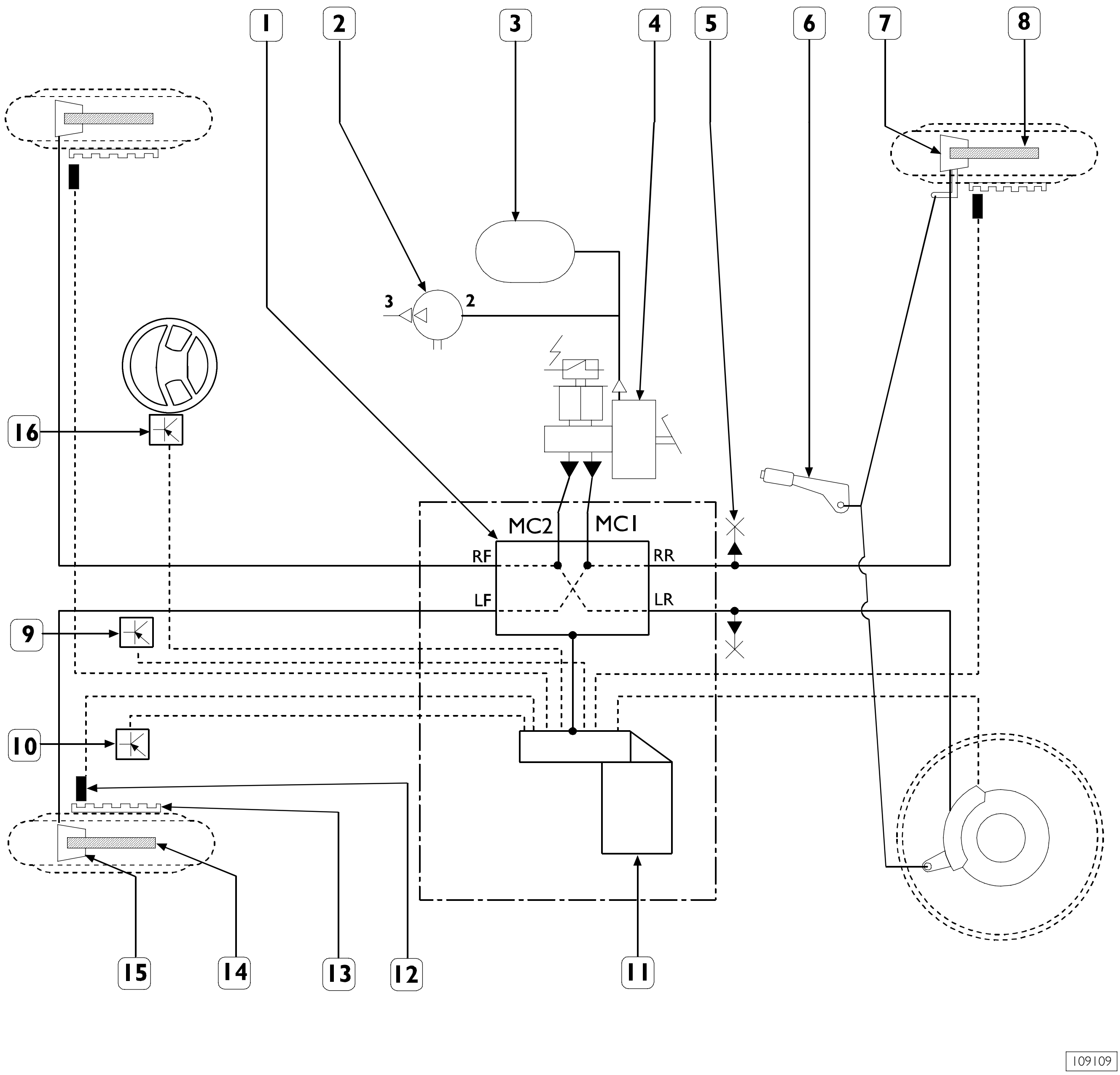
Figure 23



1. Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Rear brake caliper - 8. Rear brake disc - 9. Electronic control unit - 10. Wheel revolutions sensor - 11. Phonic wheel - 12. Front brake disc - 13. Front brake caliper.

Outline diagram for vehicles 29L - 35S with ESP 8

Figure 24



1. Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Rear brake caliper - 8. Rear brake disc - 9. Yaw sensor - 10. Longitudinal acceleration sensor - 11. Electronic control unit -12. Wheel revolutions sensor - 13. Phonic wheel - 14. Front brake disc - 15. Front brake caliper - 16. Steering angle sensor

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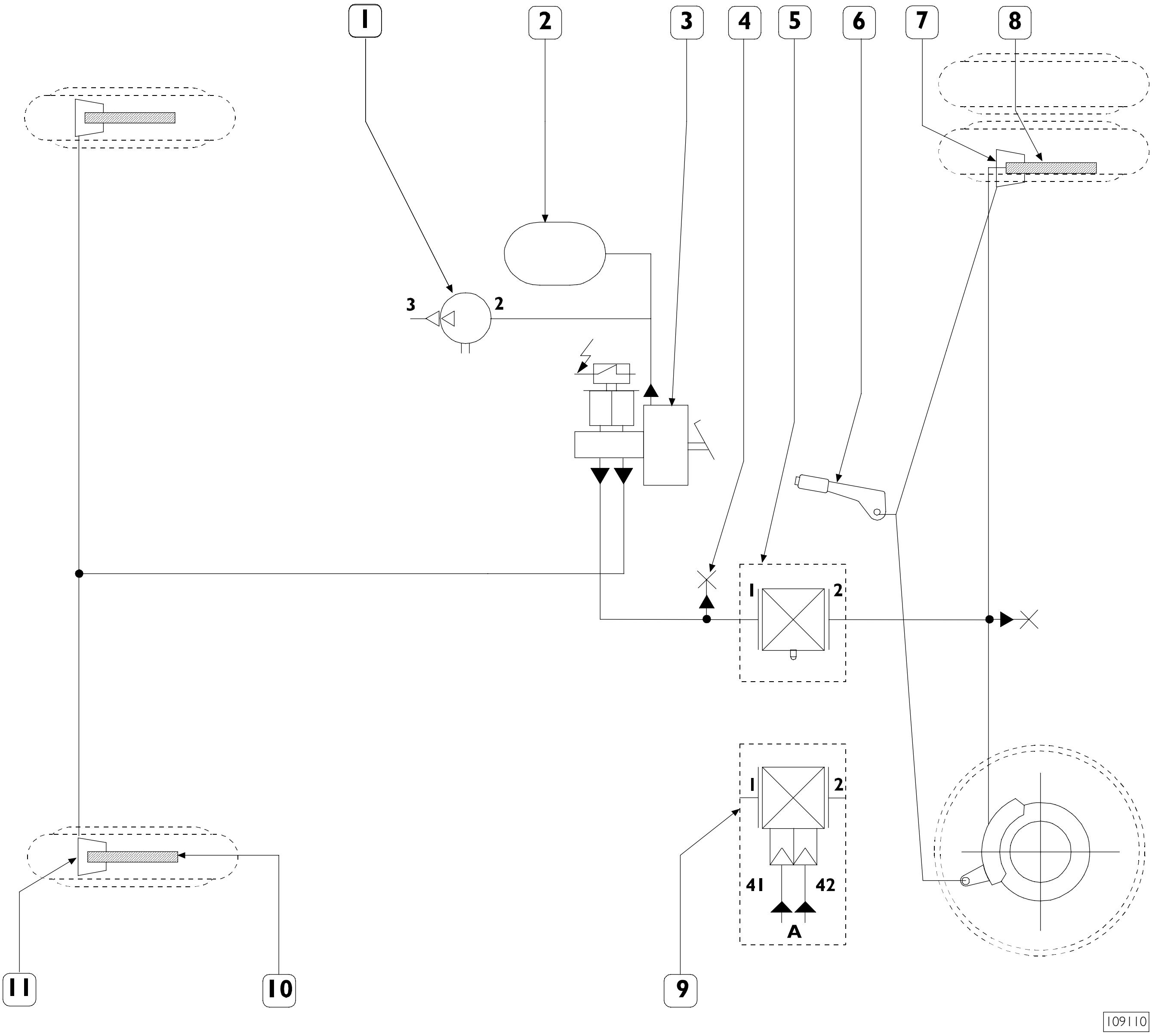
Outline diagram for vehicles 35C - without ABS

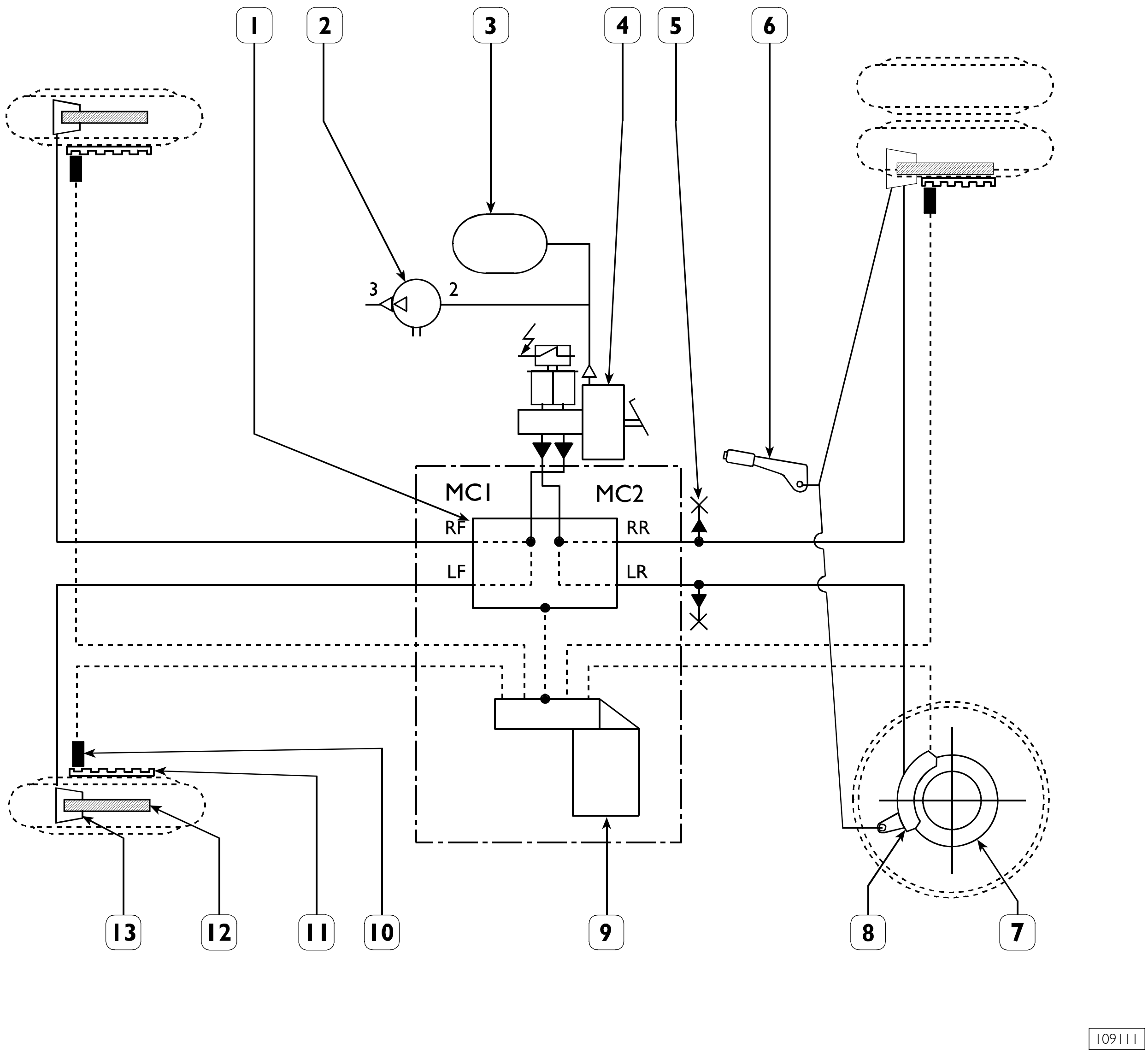
Figure 25



1. Pressure reducer - 2. Vacuum tank (2 litres for 35C, 40C vehicles, 5 litres for 45C / 50C / 60C / 65C vehicles) - 3. Servo brake - 4. Hydraulic pressure test point - 5. Dual mechanical operated load proportioning valve (for vehicles with mechanical suspensions) - 6. Parking brake lever - 7. Rear brake caliper - 8. Rear brake disc - 9. Dual pneumatic operated load proportioning valve (for vehicles with pneumatic suspensions) - 10. Front disc brake - 11. Front brake caliper - A. From the pneumatic suspension circuit.

Outline diagram for vehicles 35C with ABS 8

Figure 26



1 Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Rear brake disc - 8. Rear brake caliper - 9. Electronic control unit - 10. Wheel revolutions sensor - 11. Phonic wheel - 12. Front brake disc - 13. Front brake caliper.

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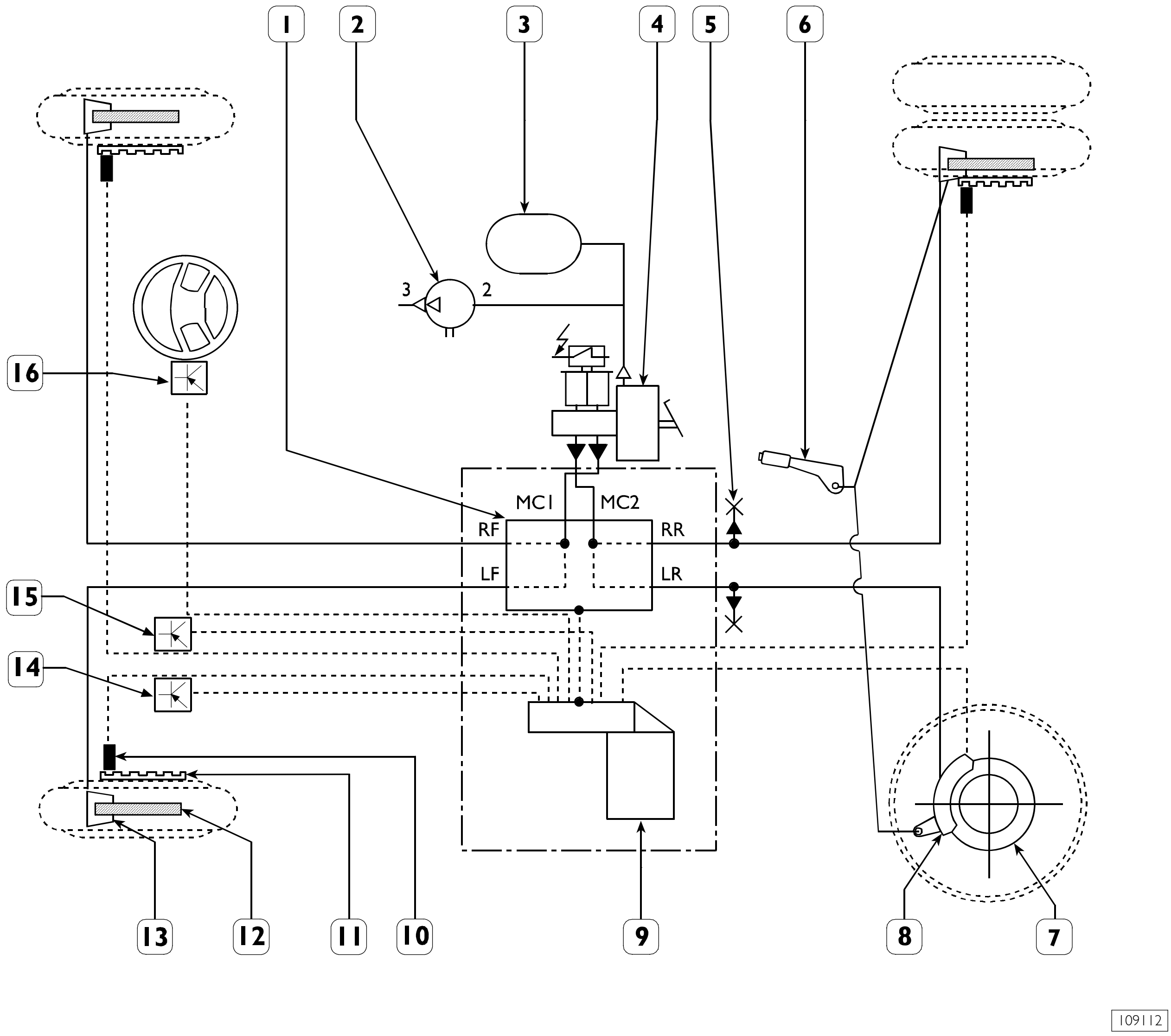
Outline diagram for vehicles 35C with ESP 8

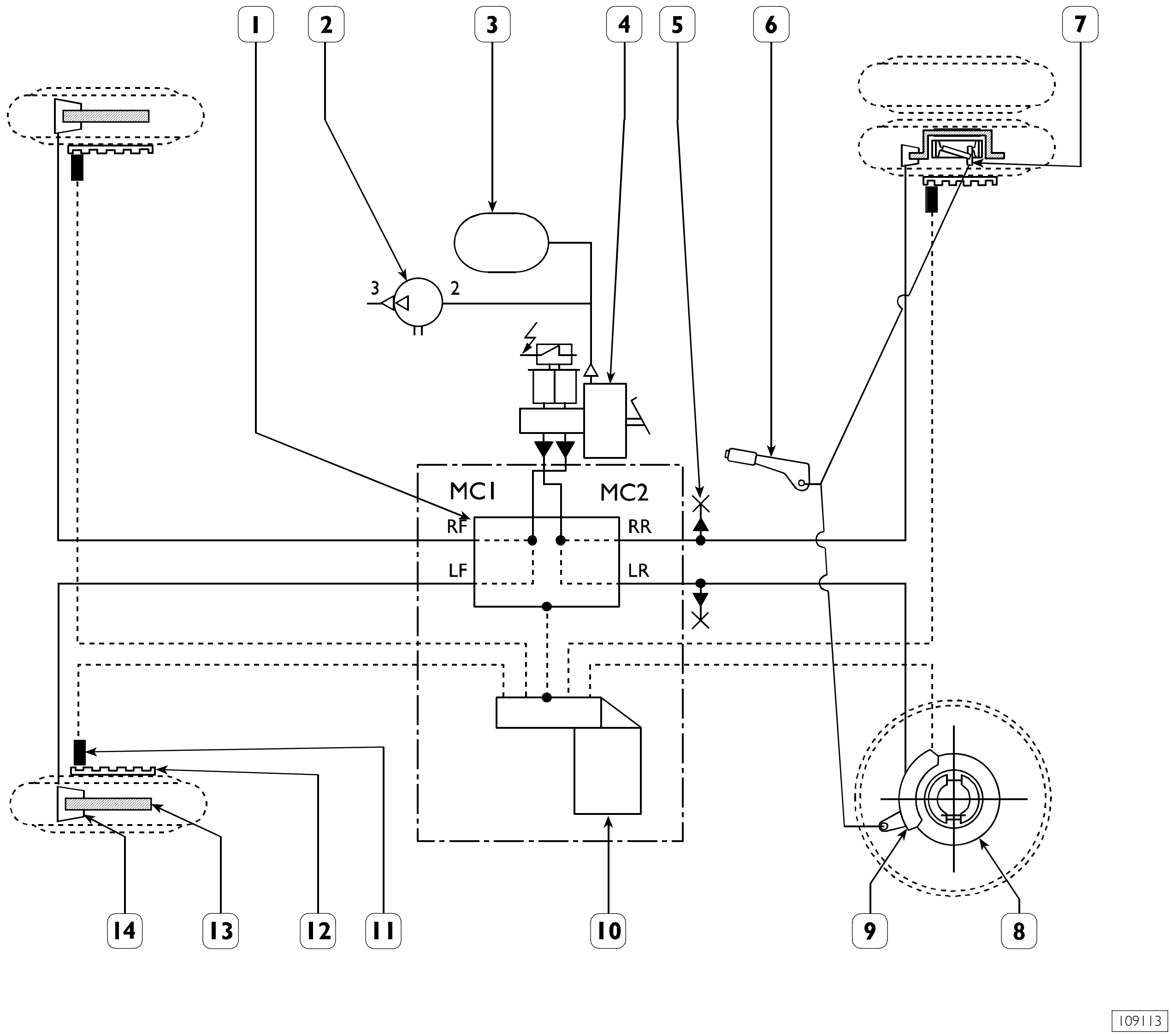
Figure 27



1 Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Rear brake disc - 8. Rear brake caliper - 9. Electronic control unit - 10. Wheel revolutions sensor - 11. Phonic wheel - 12. Front brake disc - 13. Front brake caliper. - 14. Yaw sensor - 15. Longitudinal acceleration sensor - 16. Steering angle sensor

Outline diagram for vehicles 40C - 45C - 50C - 60C - 65C with ABS 8

Figure 28



1 Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Parking drum brake - 8. Rear brake disc - 9. Rear brake caliper - 10. Electronic control unit - 11. Wheel revolutions sensor - 12. Phonic wheel - 13. Front brake disc - 14. Front brake caliper.

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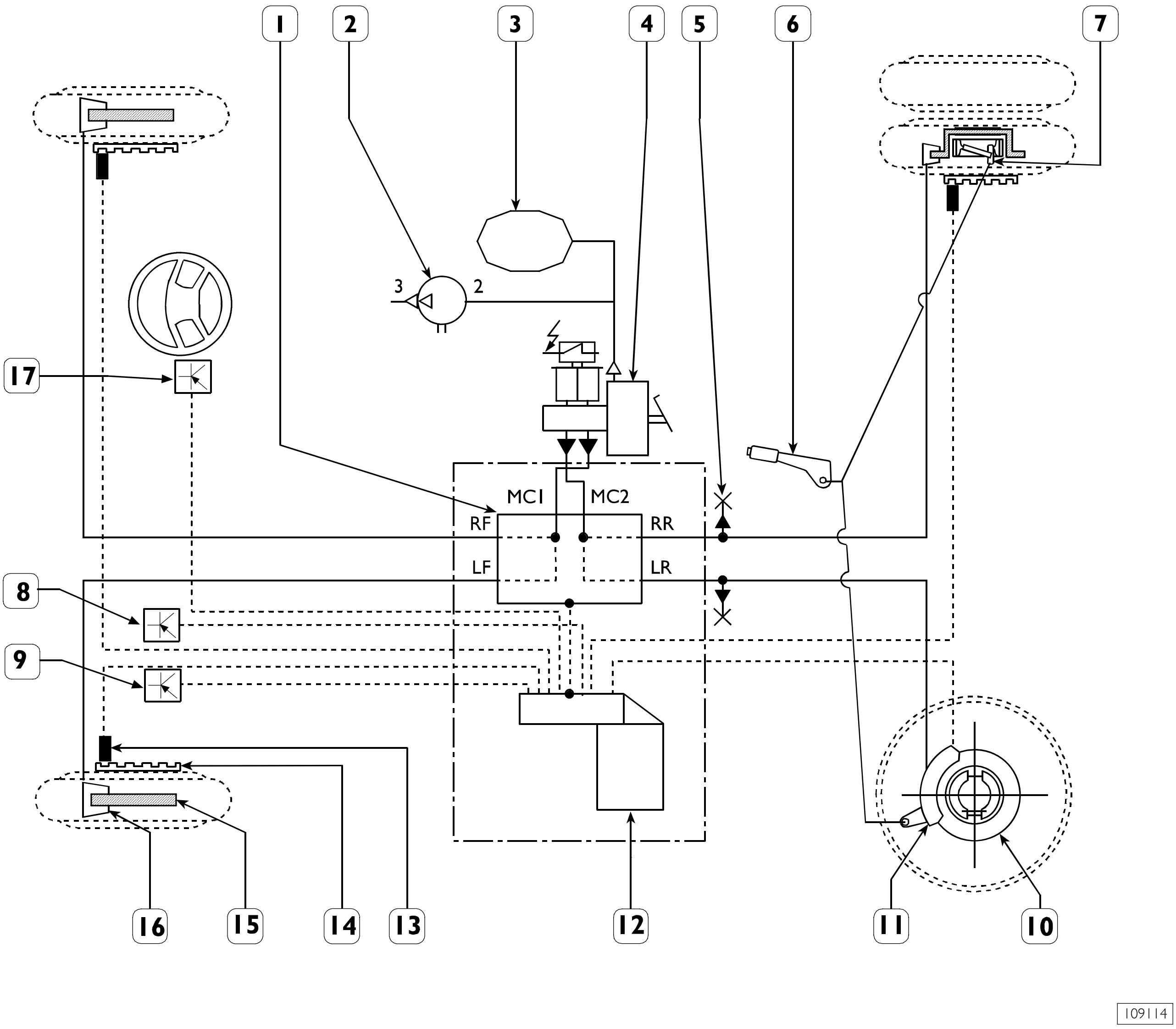
Outline diagram for vehicles 40C-45-50C-60C-65 with ESP 8

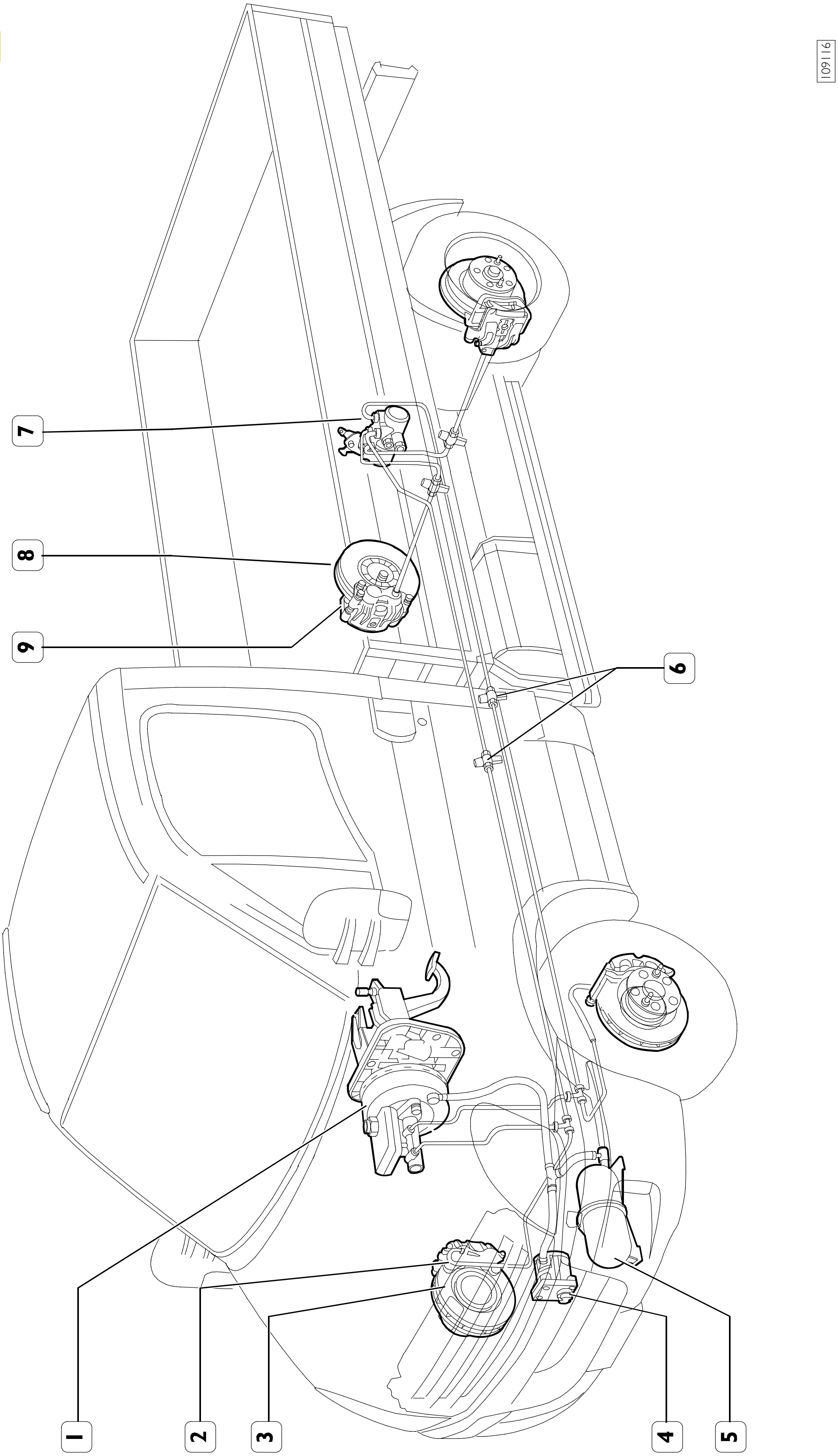
Figure 29



1 Electro-hydraulic modulator - 2. Vacuum pump - 3. Vacuum tank - 4. Servo brake - 5. Hydraulic pressure test point - 6. Parking brake lever - 7. Parking drum brake - 8. Yaw sensor - 9. Longitudinal acceleration sensor - 10. Rear brake disc - 11. Rear brake caliper - 12. Electronic control unit - 13. Wheel revolutions sensor - 14. Phonic wheel - 15. Front brake disc - 16. Front brake caliper. - 17. Steering angle sensor

Braking system main components layout
Vehicles 29L-35S

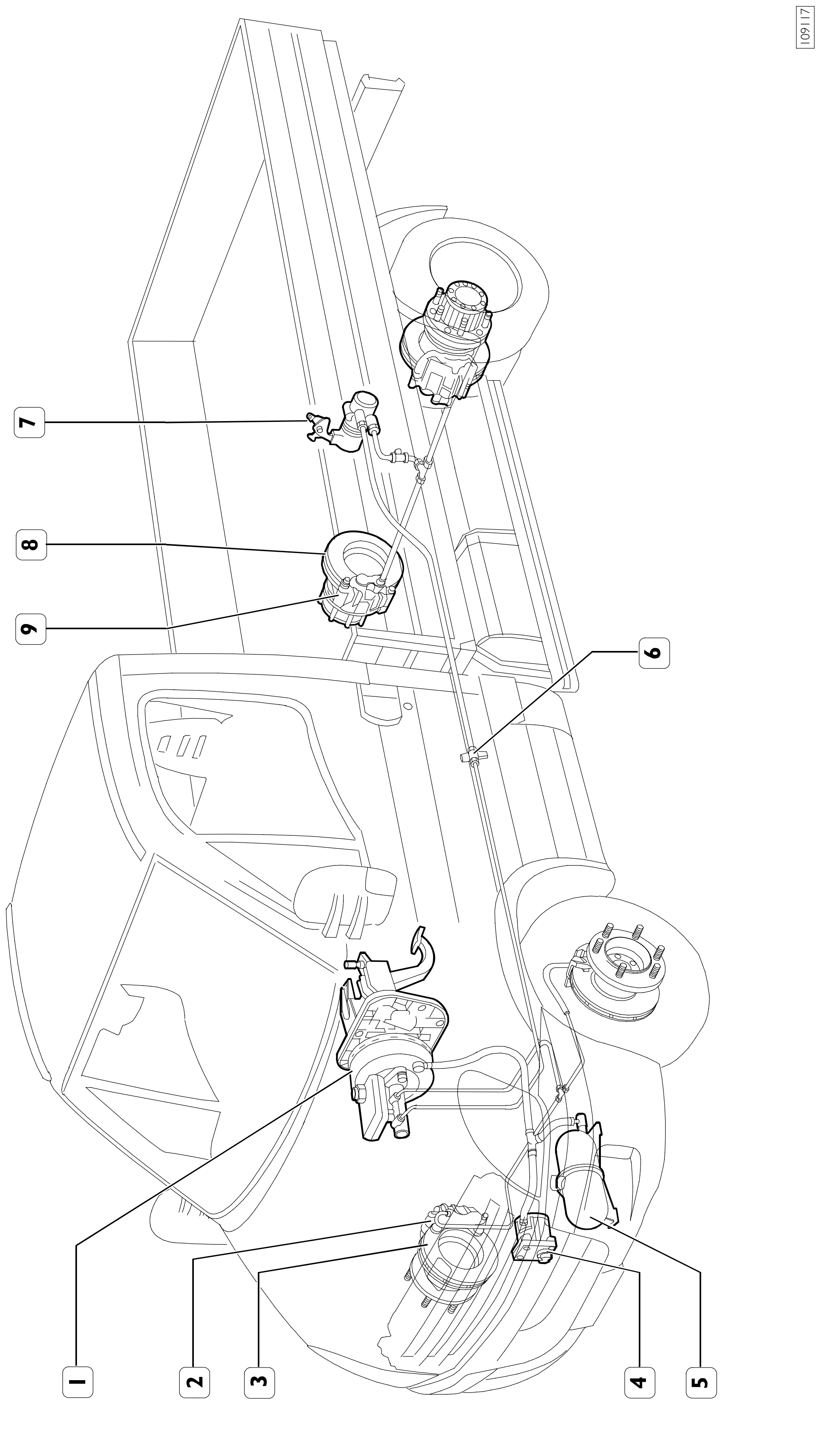
Figure 30



1. Servo brake - 2. Front brake caliper - 3. Front brake disc - 4. Vacuum pump - 5. Vacuum tank - 6. Pressure test points - 7. Brake-force corrector - 8. Rear brake disc - 9. Rear brake caliper.

Vehicles 35C - 40C - 45C - 50C - 60C - 65C

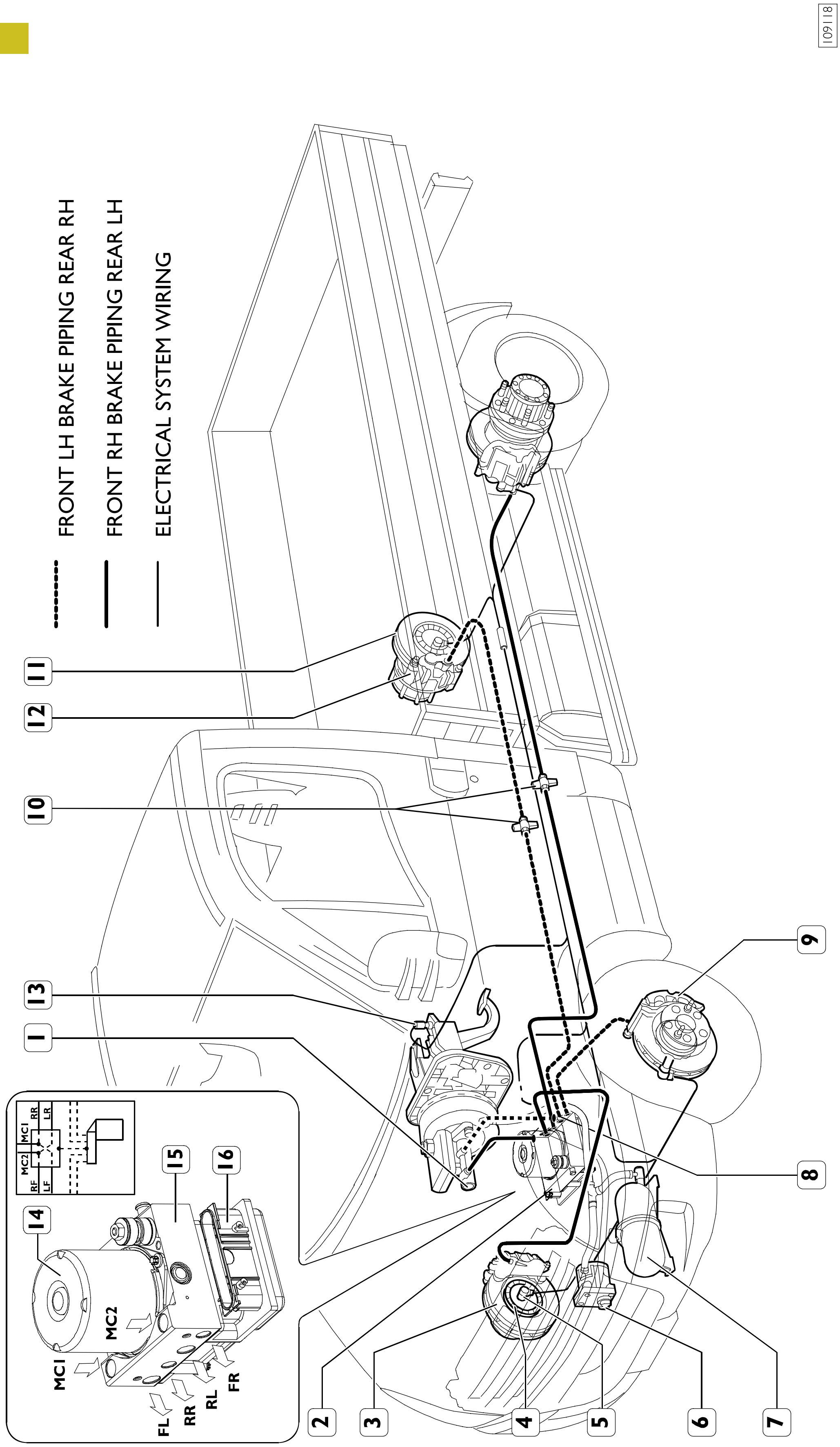
Figure 31



1.Servo brake - 2. Front brake caliper - 3. Front brake disc - 4. Vacuum pump - 5. Vacuum tank - 6. Pressure test point - 7. Proportional load valve - 8. Rear brake disc - 9. Rear brake caliper

Location of the main brake system components on vehicles with ABS Vehicles 29L-35S

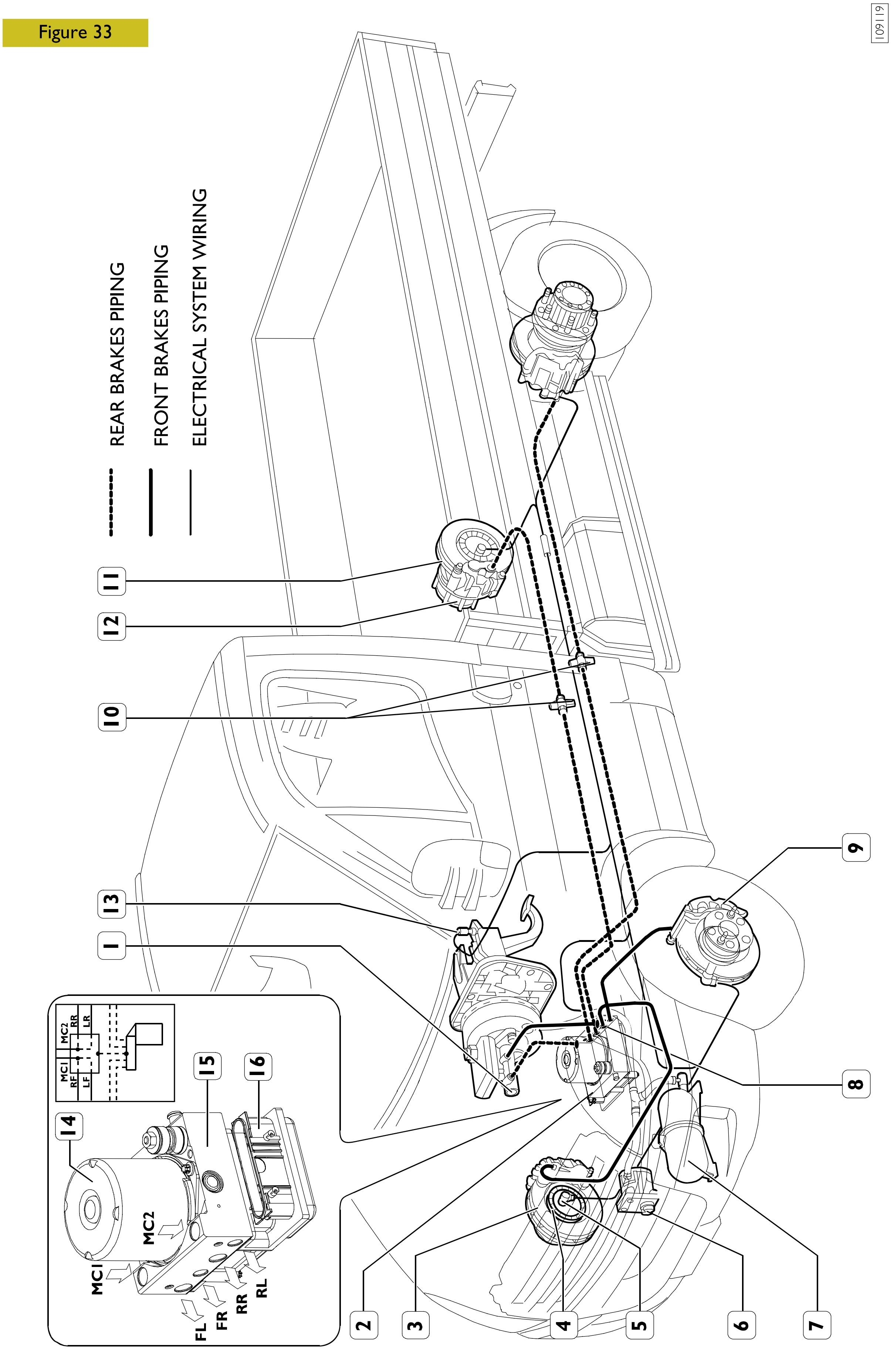
Figure 32



1. Vacuum brake - 2. Electrohydraulic modulator - 3. Front brake disk - 4. Phonic wheel - 5. Wheel revs sensor - 6. Vacuum device - 7. Vacuum chamber - 8. Electronic control unit - 9. Front brake caliper - 10. Hydraulic pressure check sockets - 11. Rear brake disk - 12. Rear brake caliper - 13. Brake lights indicator switch (on vehicles with EDC there are two switches), inform the ABS - EDC control unit that the vehicle is braking - 14. Hydraulic accumulator - 15. Electrohydraulic modulator - 16. Electronic control unit. - A. Fitting the electro-hydraulic modulator/control unit for ABS 8 systems.

Vehicles 35C - 40C - 45C - 50C - 60C - 65C

Figure 33

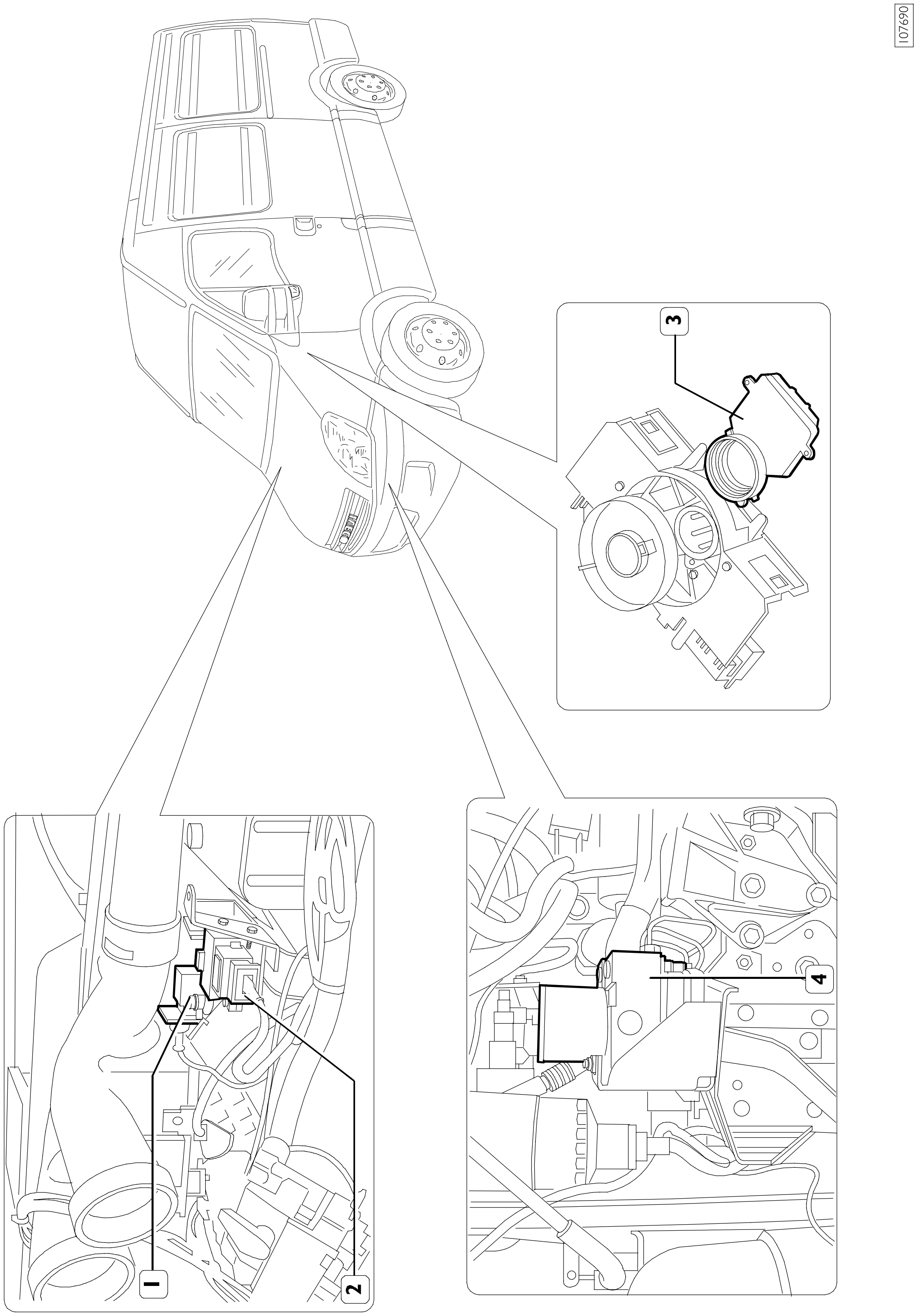


1. Vacuum brake - 2. Electrohydraulic modulator - 3. Front brake disk - 4. Phonic wheel - 5. Wheel revs sensor - 6. Vacuum device - 7. Vacuum chamber - 8. Electronic control unit - 9. Front brake caliper - 10. Hydraulic pressure check sockets - 11. Rear brake disk - 12. Rear brake caliper - 13. Brake lights indicator switch (on vehicles with EDC there are two switches), inform the ABS - EDC control unit that the vehicle is braking - 14. Hydraulic accumulator - 15. Electrohydraulic modulator - 16. Electronic control unit. - A. Fitting the electro-hydraulic modulator/control unit for ABS 8 systems.

Location of the main brake system components on vehicles with ESP

Vehicles < 3,5 ton.

Figure 34



1. Acceleration sensor - 2. Yaw sensor - 3. Steering angle sensor - 4. Electro-hydraulic modulator/control unit

DESCRIPTION

Service brake

The service brake is of the pedal type with two independent hydraulic circuits. Both circuits are served from the vacuum-type servo brake.

The load proportioning valve is inserted in the hydraulic circuit of the rear brakes so as to compensate the braking action of the rear wheels as a function of the load being carried.

By means of a servo brake the pedal acts on the twin section master cylinder that puts the brake liquid under pressure.

Movement of the pistons in the caliper casing, as a consequence of the hydraulic pressure, causes the brake linings to be compressed on both surfaces of the brake disc and therefore brings the vehicle to a standstill.

Emergency brake

Incorporated in the service brake, the twin circuit system allows a single axle to brake even when the other brake is faulty, by acting on the service brake pedal.

Parking brake

Mechanical design consisting of a hand lever and associated linkages and wires that act on the rear wheel bakes.

BRAKES

Front and Rear disc brakes

The ABS phonic wheels are fitted on the wheel hubs.

- Front BREMBO 2x48 (model 29L - 35S);
- Front BREMBO 2x48 (model 35C - 40C - 45C - 50C);
- Front BREMBO 2x60 (model 60C - 65C);
- Rear BREMBO 1x52C (model 29L - 35S);
- Rear BREMBO 1x60C (model 35C);
- Rear BREMBO 2x44 (model 40C - 45C - 50C).
- Rear BREMBO 2x46 (model 60C - 65C).

An electric wire is embedded in the brake linings which is connected to a tell-tale light on the driving panel to indicate the lining wear.

FAULT DIAGNOSIS

SECTION I

Faults affecting the ABS/ESP systems can be found by means of the Modus, E.A.SY. and IT 2000 diagnosis instruments.

These instruments are necessary to perform exhaustive diagnosis and take appropriate measures as regards every single fault.

Each single instrument displays the diagnosis and repair help.

Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

E.A.SY. (Electronic Advance System)

The E.A.SY. system allows you to easily diagnose and program the various electronic control units fitted to the vehicle. It is made up of an ECI module for communication with the electronic control units and a Panasonic PC.

The ECI module allows you, by taking advantage of the Panasonic PC, to easily carry out work on the road; in particular, diagnostic work can be assisted by a specialized remote centre, thanks to the wireless technology incorporated into the Panasonic PC (e.g. GPRS).

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

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SECTION 2

Main operating faults in the brake system:

1 - Rear axle service brake is inefficient or irregular

2 - Front axle service brake is inefficient or irregular

3 - Inefficient or no parking brake

4 - Delayed action of parking brake

5 - Vehicle skids when braking

6 - Rapid brake lining wear

7 - Too long or abnormal travel of brake pedal

8 - Noisy brakes

1 REAR AXLE SERVICE BRAKE IS INEFFICIENT OR IRREGULAR

Leaks or breakage in pneumatic system pipes.	YES →	Tighten or replace damaged fittings. Replace broken or damaged pipes.
NO ↓		
Worn or vitrified brake linings.	YES →	Overhaul or replace the brake linings.
NO ↓		
Automatic clearance device is faulty (caliper 1x52).	YES →	Replace the brake caliper.
NO ↓		
Rear brakes are faulty.	YES →	Overhaul the rear brakes, replacing worn parts.
NO ↓		
Servo brake is faulty.	YES →	Overhaul or replace servo brake
NO ↓		
Load proportioning valve is faulty (vehicles without ABS).	YES →	Adjust and, if necessary, replace the load proportioning valve.

(Continue)

Brake liquid has not been periodically changed.	YES →	Replace brake liquid.
NO ↓		
Presence of air in hydraulic system	YES →	Bleed-off any air from hydraulic system.
NO ↓		
ABS system is faulty.	YES →	Make diagnosis with Modus.

2	**FRONT AXLE SERVICE BRAKE IS INEFFICIENT OR IRREGULAR**

Leaks or breakage in pneumatic system pipes.	YES →	Tighten or replace loose or damaged fittings. Replace broken or damaged pipes.
NO ↓		
Worn or vitrified brake linings.	YES →	Overhaul or replace the brake linings.
NO ↓		
Servo brake is faulty.	YES →	Overhaul or replace servo brake
NO ↓		
Brake caliper is faulty.	YES →	Overhaul and, if necessary, replace brake caliper.

(Continue)

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Front brakes are faulty.	YES →	Overhaul and, if necessary, replace any worn parts.
NO ↓		
Brake liquid has not been periodically changed.	YES →	Replace brake liquid.
NO ↓		
Presence of air in hydraulic system.	YES →	Bleed-off any air from hydraulic plant.
NO ↓		
ABS system is faulty.	YES →	Make diagnosis with Modus.

3 INEFFICIENT OR NO PARKING BRAKE

Tie-rods are faulty.	YES →	Adjust or overhaul tie-rods and replace any worn parts.
NO ↓		
Worn or vitrified brake linings.	YES →	Overhaul or replace the brake linings.
NO ↓		
Rear brakes are faulty.	YES →	Overhaul the brakes and replace any worn parts.

4 DELAYED ACTION OF PARKING BRAKE

Tie-rods are faulty. — YES → Overhaul tie-rods and replace any worn parts.

NO ↓

Shoe return spring is faulty. — YES → Replace shoe return spring.

NO ↓

Rear calipers are faulty (calipers 1x52). — YES → Overhaul calipers and replace any worn parts.

NO ↓

Parking drum brake is faulty (2x44 calipers). — YES → Adjust or overhaul the parking drum brake and replace any worn parts.

5 VEHICLE SKIDS WHEN BRAKING

Leaks or breakage in hydraulic system pipes. — YES → Tighten or replace loose or damaged fittings. Replace broken or damaged pipes.

NO ↓

Load proportioning valve is faulty (vehicles without ABS). — YES → Adjust and, if necessary, replace load proportioning valve.

(Continue)

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Front brakes are faulty.	YES →	Overhaul front brakes.
NO ↓		
Rear brakes are faulty.	YES →	Overhaul rear brakes.
NO ↓		
ABS system is faulty.	YES →	Make diagnosis with Modus.

6 RAPID BRAKE LINING WEAR

Load proportioning valve is faulty (vehicles without ABS).	YES →	Adjust and, if necessary, replace load proportioning valve.
NO ↓		
Brakes are faulty.	YES →	Overhaul brakes.

7	**TOO LONG OR ABNORMAL TRAVEL OF BRAKE PEDAL**

Servo brake is faulty. — YES → Replace servo brake.

NO

Automatic clearance device is faulty (calipers 1x52). — YES → Replace automatic clearance device.

NO

Brake liquid with low boiling point due to:
- ❑ Failure to perform yearly change
- ❑ Presence of water in system
- ❑ Use of wrong liquids.

— YES → Replace brake liquid (use type Tutela DOT SPECIAL).

NO

Presence of air in hydraulic system. — YES → Bleed-off any air from hydraulic system.

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8	**NOISY BRAKES**

Check		Remedy
Worn brake linings.	YES →	Replace brake linings.
NO ↓		
Foreign bodies between discs and brake linings.	YES →	Remove all foreign bodies from between brake linings and discs.
NO ↓		
Disk brakes off-centred.	YES →	Adjust or replace disc brakes.

TIGHTENING TORQUES

COMPONENT	TORQUE	
	Nm	kgm
Screw securing flange and brake disk to wheel hub (Front axle 5818 - 5819)	98.1 ÷ 107.9	9.8 ÷ 1..7
Screw securing flange and brake disk to wheel hub (Front axle 5823) ❑ torque clamping ❑ angle clamping	 43 ÷ 53 28.4° ÷ 30.4°	 4.3 ÷ 5.3
Screw securing brake disc to wheel hub (Front axle 5817)	19.5 ÷ 24	2 ÷ 2.5
Screws to fasten wheel	180 ÷ 200	18 ÷ 20
Screws to fasten brake caliper support to stub axle (Axle 5817 - 5818 - 5819)	176 ÷ 217	18 ÷ 22
Screws to fasten cover to stub axle	7 ÷ 10	0,7 ÷ 1
Wheel hub nut (Front axle 5817 - 5818 - 5819)	320 ÷ 420	32 ÷ 43
Nut securing wheel hub (Front axle 5823) ❑ torque clamping ❑ angle clamping	 50 ÷ 60 30.1° ÷ 34.1°	 5 ÷ 6
Screw securing caliper to caliper mounting (Front axle 5818 - 5819 - 5823)		
Nut securing wheel (Rear axle 450311/1 - 450511)	290 ÷ 349	29 ÷ 34.9
Screw securing brake disk to half shaft (Rear axle NDA R.S.)	13 ÷ 21	1.3 ÷ 2.1
Screw securing drive shaft to wheel hub (Rear axle NDA R.G - 450511)	63 ÷ 76	6.3 ÷ 7.6
Ring nut retaining wheel hub bearing (Rear axle NDA R.S./R.G - 450511)	618 ÷ 667	61.8 ÷ 66.7
Screws securing brake disc to wheel hub (Rear axle NDA R.S./R.G - 450511)	69 ÷ 76	6.9 ÷ 7.6
Screws securing caliper moutning to shoe mounting (Rear axle NDA R.S./R.G - 450511)	177 ÷ 217	18 ÷ 22.1
Nut securing wheel (Rear axle 450517/2)	284.5 ÷ 343.3	28.5 ÷ 34.3
Screw to fasten cover and sheet metal guard to rear axle box (Rear axle NDA R.S.)	81 ÷ 100	8.1 ÷ 10
Screw to fasten cover and sheet metal guard (Rear axle NDA R.S.)	10 ÷ 16	1 ÷ 1.6
Ring nut securing bearing to half shaft (Rear axle NDA R.S.)	559 ÷ 677	57 ÷ 69
Screw securing shoe mounting to rear axle box (Rear axle NDA R.G. - 450511)	85 ÷ 97	8.5 ÷ 9.7
Screws securing sheet metal guard (Rear axle NDA R.G. - 450511)	8	0.8
Screw securing caliper to caliper mounting (Front axle 5817)		
Sensor support retaining screw (Rear axle NDA R.G. - 450511 - 450517/2)	5 ÷ 7	0.5 ÷ 0.7

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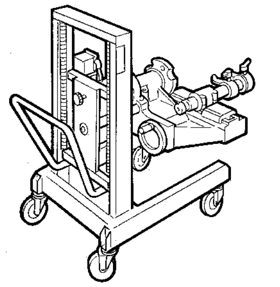
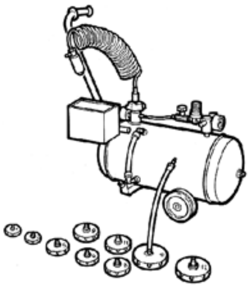
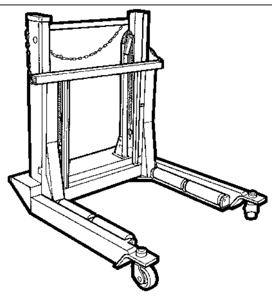
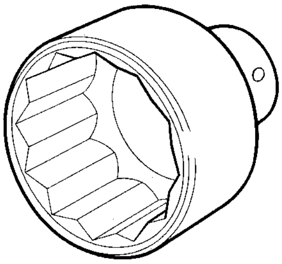
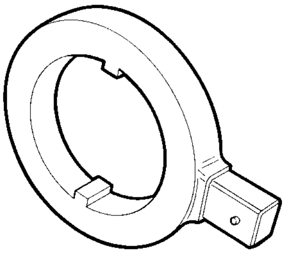
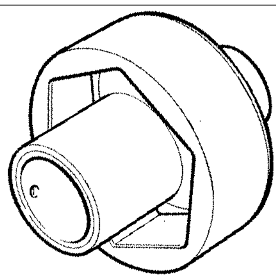
TIGHTENING TORQUES

COMPONENT	TORQUE	
	Nm	kgm
Screw securing flange and brake disk to wheel hub (Front axle 5823)		
❑ torque clamping	43 ÷ 53	4.3 ÷ 5.3
❑ angle clamping	28.4° ÷ 30.4°	
Screws to fasten brake caliper support to stub axle (Axle 5823)	110 ÷ 140	11.2 ÷ 14
Nut securing wheel hub (Front axle 5823)		
❑ torque clamping	50 ÷ 60	4.3 ÷ 5.3
❑ angle clamping	30.1° ÷ 34.1°	
Screw securing drive shaft to wheel hub (Rear axle 450517/2)	56 ÷ 69	5.6 ÷ 6.9
Screw securing brake caliper (Rear axle 450517/2)	150 ÷ 177	15 ÷ 17.7
Ring nut retaining wheel hub bearing (Rear axle 450517/2)	441 ÷ 540	44.1 ÷ 54
Screws securing brake disc to wheel hub (Rear axle 450517/2)	54 ÷ 59	5.4 ÷ 5.9
Screw securing shoe mounting to rear axle box (Rear axle 450517/2)	70	7
Brake shoe/axle casing retaining screw (Rear axle 450517/2)	52 ÷ 57	5.2 ÷ 5.7
Calliper guide bushing socket head screw	28 ÷ 32	2.8 ÷ 3.2

TOOLS

TOOL NO.		DESCRIPTION
99301005		Brake disc assembly
99306010		Appliance to bleed air from brake and clutch systems
99321024		Hydraulic trolley for removing/refitting wheels
99355087		Wrench (65 mm) for wheel hub nut (NDA R.G - 450511)
99355184		Wrench for ring nut retaining drive shaft bearing (rear axle NDA RS)
99357080		Spanner (91.5 mm) for adjusting wheel hub bearings nut (Rear axle 450517/2)

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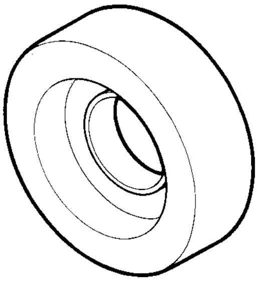
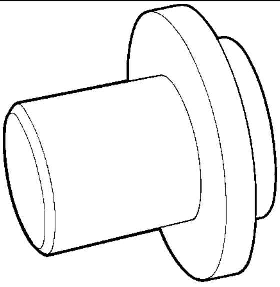
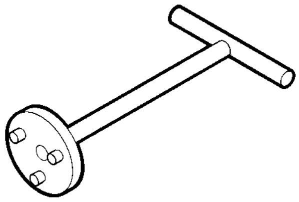
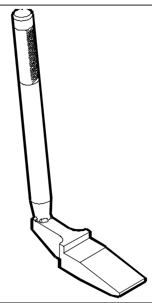
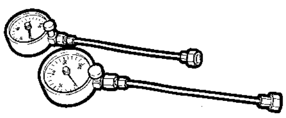
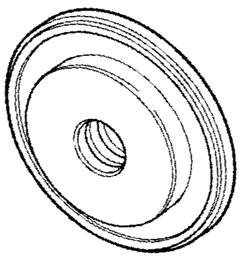
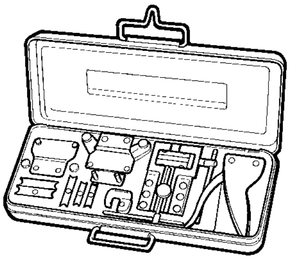
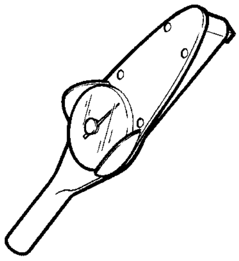
TOOL NO.		DESCRIPTION
99370241		Tool for mounting drive shaft bearing (rear axle NDA RS)
99370498		Tool for driving bearing and phonic wheel onto wheel hub (rear axles NDA R.G. - 450511)
99372236		Tool to retract brake caliper piston (rear axle NDA R.S. - NDA R.G.)
99372249		Parking brake shoes adjusting tool
99372269		Pair of gauges to check pressure and to adjust hydraulic brakeforce distributor
99374132		Tool for fitting wheel hub internal seal (use with 99370006) (Axle 450517/2)

TOOL NO.		DESCRIPTION
99386523		Flanging tool for brake system pipes
99389819		Torque wrench (0 ÷ 10 Nm) with square 1/4" connection.

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SPECIFICATIONS AND DATA - HYDRAULIC SYSTEM

DESIGNATION		
Vacuum pump		
❑ BOSCH ES F009 D00 165 (F1A engines) - BOSCH ES F009 D00 886 (F1C engines)		
Emptying time (4.5 litre tank) at a pressure of:	0.5 bar 0.8 bar	4.5 S 12.5 S
Vacuum servo brake		
❑ Vehicles 29L - 35S - 35C Type 11": BOSCH 0204051186 (tip: 157 mm) (combi vehicles)		
Pneumatic cylinder diameter Hydraulic (or master) cylinder diameter Stroke		288.9 mm 25.4 mm 21 + 21 mm
❑ Vehicles 40C - 45 - 50 Type 10" T: BOSCH 0204021694 (dual) (tip: 157 mm) Pneumatic cylinder diameter Hydraulic (or master) cylinder diameter Stroke		 279.4 mm 28.57 mm 17.5 + 23.5 mm
❑ Vehicles 60C - 65C Type 10" T: BOSCH 31.75 (dual) (tip: 157 mm) Pneumatic cylinder diameter Hydraulic (or master) cylinder diameter Stroke		 267.96 mm 31.75 mm mm
Pneumatic operated load proportioning valve		
❑ BOSCH 796801		
Ratio		0.25
❑ BOSCH 796803		
Ratio		0,15
ABS8 system electro-hydraulic modulator/control unit (*)		
❑ BOSCH 0 265 231 692 (vehicles 29L - 35S) - (PN IVECO spare parts 504182308 - EZ)		
❑ BOSCH 0 265 331 896 (vehicles 5C - 45C - 50C) - (PN IVECO spare parts 504182310 - EZ)		
❑ BOSCH 0 265 231 894 (vehicles 60C - 65C) - (PN IVECO spare parts 504182323 - EZ)		
ABS8/ASR8 system electro-hydraulic modulator/control unit (*)		
❑ BOSCH 0 265 233 360 (vehicles 29L - 35S) - (PN IVECO spare parts 504182312 - EZ)		
❑ BOSCH 0 265 333 028 (vehicles 35C - 45C - 50C) - (PN IVECO spare parts 504182315 - EZ)		
❑ BOSCH 0 265 233 026 (vehicles 60C - 65C) - (PN IVECO spare parts 504182325 - EZ)		
ESP8 system electro-hydraulic modulator/control unit (*)		
❑ BOSCH 0 265 234 525 (vehicles 29L - 35S) - (PN IVECO spare parts 504182317 - EZ)		
❑ BOSCH 0 265 334 528 (vehicles 35C) - (PN IVECO spare parts 504182319 - EZ)		
❑ BOSCH 0 265 234 522 (vehicles 40C - 45C - 50C) - (PN IVECO spare parts 504182321 - EZ)		
❑ BOSCH 0 265 234 524 (vehicles 60C - 65C) - (PN IVECO spare parts 504182327 - EZ)		

* The component shall be supplied filled with brake fluid for storing.

SPECIFICATIONS AND DATA - BRAKES

FRONT AXLE DISC BRAKES		**5817**	**5818**	**5819**	**5823**
Brake caliper cylinders:					
- quantity		2	2		2
- diameter	Ø mm	45	48		52
Brake lining thickness:					
- normal	S mm	12	15		
- min. allowed	S mm	2.9 ÷ 3.4 (*)			
Disc brake diameter	Ø mm	300	$290^{\pm 0,2}$		$301^{\pm 0,2}$ $290^{\pm 0,2}$
Disc brake thickness:					
- normal	S mm	28	$28^{\pm 0,2}$		$30^{\pm 0,2}$
- min. allowed	S_1 mm	8.7	8.7		9.7
	S_2 mm	7.7	7.7		10.5

(*) Remaining thickness of friction material to have the light on (cutting cable)

AXLE WHEEL HUBS

Type of front axle		**5817**	**5818**	**5819**	**5823**
Wheel hub bearings		UNIT-BEARING			
Wheel hub bearings end play	mm	- -			
Wheel hub bearing axial clearance adjustment		Not adjustable Retaining nut torque			

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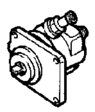
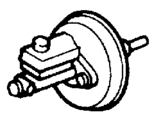
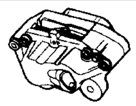
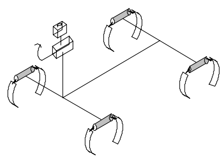
REAR AXLE DISC BRAKES		NDA R.S.	NDA R.G.	450511 450311/1 450310	450517/2
Brake caliper cylinders: - quantity - diameter	Ø	1 52C	1 60C	2 44	2 48
Brake lining thickness: - min. allowed	S mm			15 2.9 ÷ 3.4 (*)	
Disc brake diameter	mm	296 $^{\pm 0,2}$	294 $^{\pm 0,2}$	289 $^{+0,2}_{-0}$	306 $^{\pm 0,2}$
Disc brake thickness: - normal - min. allowed	 S mm S mm	 16 $^{\pm 0,1}$ 13	 24 $^{\pm 0,1}$	 22 $^{\pm 0,1}$ 19	 28 $^{\pm 0,1}$
	S_1 mm	-	7.7	-	9.2
	S_2 mm	-	6.7	-	7.8
Parking drum brake					
Drum diameter: - Nominal	Ø mm	-	-	172 $^{+0,15}_{-0}$ Max 173 mm	190 $^{+0,15}_{-0}$ Max 191
Brake lining thickness: - Nominal - Min. allowed	 S mm S_1 mm	 - -	 - -	 4.25 mm Min. 1.5 mm	 6.2 Min. 3.5
Brake lining diameter: - Nominal	Ø mm	-	-	171.2 ÷ 171.5	189.2 ÷ 189.5
Brake lining width	L mm	-	-	~42	
Clearance between brake linings and drum	G mm			0.2 ÷ 0.5	0.3 ÷ 0.4

(*) Remaining thickness of friction material to have the light on (cutting cable)

AXLE WHEEL HUBS		NDA R.S.	NDA R.G.	450511	450517/2
Wheel hub bearings			UNIT-BEARING		SET-RIGHT
Wheel hub bearings end play		-			0.16
Wheel hub bearings rolling torque	Nm kgm	- -			0 ÷ 4 0 ÷ 0.4
Adjustment of wheel hub bearings end play		By means of nut			
Rear axle oil		TUTELA W90/M-DA (SAE 80 W 90)		TUTELA W140/M-DA (SAE 85 W 140)	
Quantity		1.35		1.90	3

CHECKS

Device	Designation	Checks
	**Pressure Reducer**	Connect a vacuum meter to the intake line. At full operation the pressure reduction must reach the value of 0.80 ÷ 0.85 bar. If this value is not obtained, check if there are any leaks in the pressure piping and servo brake components. Check that the distance between the top of the rotor and cover (with unit fitted) is comprised in the range 0.07 ÷ 0.14mm.
	**Vacuum servo brake**	Check the functionality and that there are no leaks. With the vacuum meter fitted on the piping between the pressure reducer and servo brake with engine at full speed, check that the pressure reduction values are in the range 0.80 ÷ 0.85 bar with the pedal both released and pressed fully down for a period of 1 minute of rotation of the engine.
	Brake liquid compensation tank	Check the level of the brake liquid and eventually top up with Tutela DOT SPECIAL to the specified level. Change the brake liquid once per year.
	**Load proportioning valve**	Check that the values measured with special manometers, via the test points, correspond to those indicated on the self-adhesive plate applied to the inside of the vehicle.
	**Disk brake caliper**	Check the condition of the brake linings; check for scratches on the discs and the efficiency of the pistons.
	**Pipes and fittings**	Ensure that metal pipes are in perfect condition, with no dents or cracks. Also make sure that they are not near sharp edges of the body work or chassis that could damage them. Check that the rubber and cloth flexible hoses are not in contact with oil or mineral grease, or rubber solvents. Press hard on the brake pedal and check that the pipes are not blown, and check that there are no leaks. Check that all brackets fastening the pipes are securely fixed - loose fastenings cause vibrations that could give rise to breakage. Check that 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 breakage due to age and fatigue.

Functional check of vacuum brake system

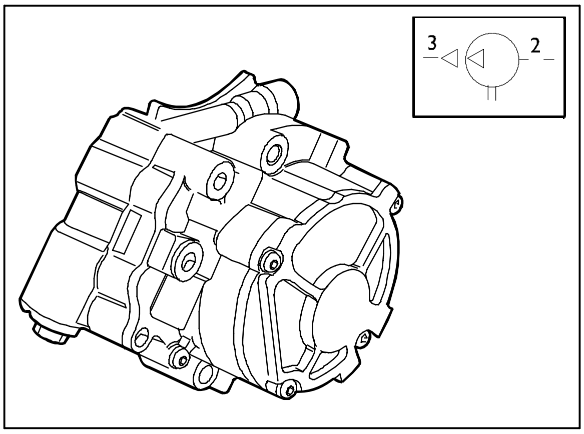
With the engine stopped, press the brake pedal a few times in order to annul the vacuum in the servo brake. Press the pedal once again and keep it pressed, in the brake position, by putting a certain pressure on it. Start the engine and check the pedal stroke:

- if the stroke of the pedal increases, this implies that the servo brake and pipes are satisfactory;
- if the pedal remains still, this implies that the outside has penetrated into the vacuum plant that is not perfectly sealed, or the servo brake is faulty.

BRAKING SYSTEM MAIN COMPONENTS

790530 Vacuum pump

Figure 35



109121

This is the component which generates a reduction in pressure for operation of the servo brake.

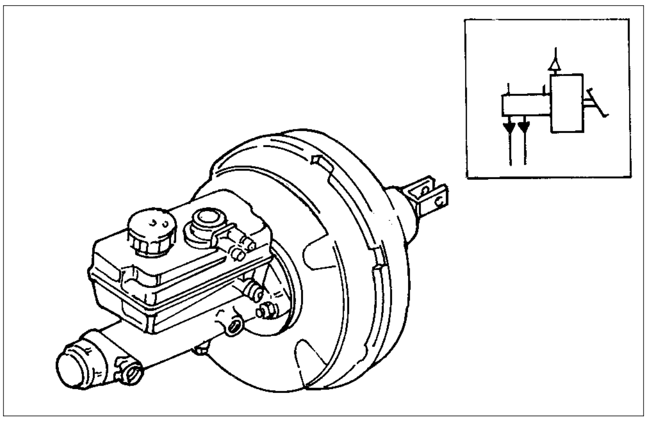
The figure shows the version for vehicles with engine F1C. As regards the vehicles with engine F1A/F1C, the vacuum device is incorporated into the vacuum oil pump unit.

Diagnostics

TROUBLE	POSSIBLE CAUSES	CURE
Oil leakage from cover	Incorrect driving torque between power reducer and engine.	Lock screws to correct driving torque indicated in appropriate table.
	Cover seal surface not completely flat.	Check the seal surfaces, replace any defective parts or place them on a flat surface.
	Broken seal between pump and engine.	Replace seal.
Poor efficiency	Excessive backlash between the blades and sliding surfaces.	Replace blades, or the entire pressure reducer.
	Bad sealing of connecting pipes or uni-directional valve.	Check the seal and eventually replace the connecting pipes or replace the uni-directional valve.
	Insufficient lubrication.	Carefully clean the oil pipes.

794101 Vacuum servo brake

Figure 36



32279

This is a device which increases the force applied by the pedal and consists of two main components:

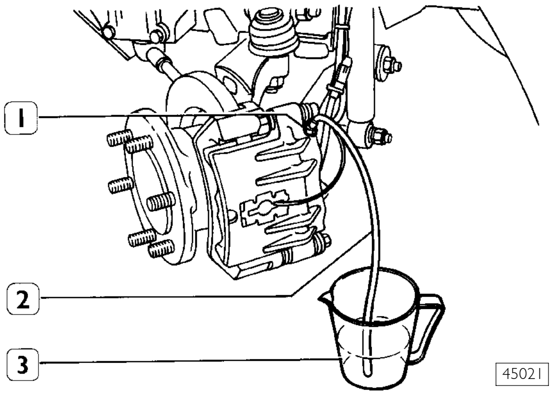
- ❑ a power reducer pneumatic section;
- ❑ an hydraulic section (master cylinder and brake liquid tank).

The servo brake is manufactured in such a way that in case the pneumatic section fails, the brakes can still work. In this case the braking action is obtained by one master cylinder.

784010 Bleeding air from the hydraulic circuit (vehicles not equipped with ABS)

Front brake circuit

Figure 37



One end of a transparent plastic pipe (2) should be fitted to the bleeder screw (1) with the end placed into a container (3) that has been partially filled with brake liquid.

Repeatedly press the brake pedal

By maintaining the brake pedal in the down position unscrew the bleeder screw (1) one full turn.

Tighten the bleeder screw, repeatedly press the brake pedal.

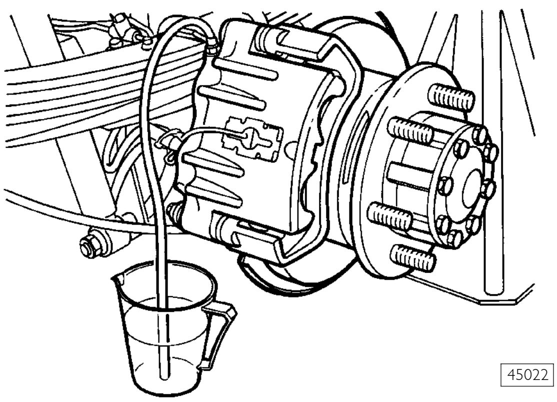
Repeat the above operation until the brake liquid comes out in a uniform manner.

Bleed off the air from the opposite brake assembly. Check that the level of brake liquid in the relevant tank is always sufficient.

This operation will allow the air in the hydraulic circuit liquid piping to be expelled.

Rear brake circuit

Figure 38



Disconnect the load proportioning valve control rod and lock it at the top so as to set the proportioning valve in the fully open position.

Bleed off the air from the hydraulic circuit as described for the front brake circuit.

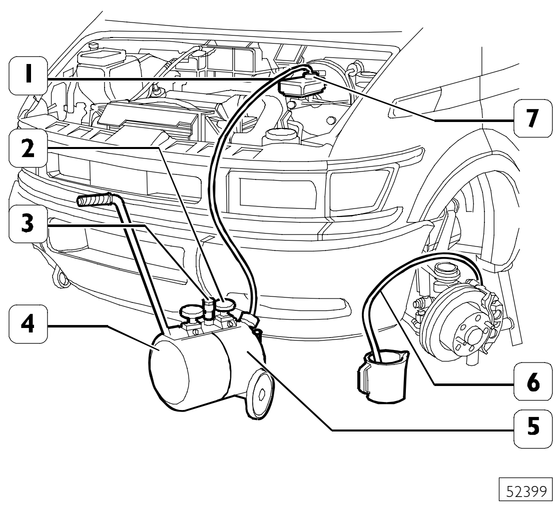
Having terminated this operation connect the load proportioning valve control rod.

> Finish bleeding-off air from the brake circuit, top up to the maximum level with Tutela DOT SPECIAL brake liquid.

784010 Bleeding air from the hydraulic circuit with deaerator device (vehicles not equipped with ABS)

Front brake circuit

Figure 39



As an alternative you can bleed-off air from the brake circuit with the deaerator device 99306010 by following the procedures below:

1. load the air tank (4);
2. fill the tank with brake liquid (5);
3. one end of a transparent plastic pipe (6) should be fitted to the bleeder screw with the end placed into a container that has been partially filled with brake liquid;
4. replace the brake liquid tank cover with one (7) taken from the box supplied with the deaerator;
5. insert the deaerator 99306010 pipe (1) on the cover of the brake liquid tank;
6. unscrew the bleeder screw one full turn, open the cock valve (3) until there is a reading of 1 ÷ 1.2 bar on the manometer (2).

When the brake liquid comes out in a uniform manner from the circuit, close the bleeder screw and discharge air from the aerator tank (4). Repeat this operation for all wheels.

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Air bleeding from the ABS/ESP system hydraulic circuit

The procedure must be performed with the engine stopped and the key turned to running (Key ON).
Get connected to the diagnosis take-off located in the cabin, on the passenger's side, by means of a suitable instrument. Follow the "BLEEDING" procedure described by the instrument.

NOTE Press the brake pedal over and over again during the process.
The correct blow-off sequence for the four wheels is as follows:

- ❑ rear left wheel (RL)
- ❑ front left wheel (FL)
- ❑ front right wheel (FR)
- ❑ rear right wheel (RR)

As regards the systems of the ABS 8/ESP 8 type, no other sequence is permitted. As far as ABS 5.3 systems are concerned, on the contrary, you may act on the single wheels without having to perform the entire procedure.

After every single wheel has been bled, visually inspect the brake fluid level and top up, if necessary. Do not fill with fluid that has already been used.

In the event that either one single phase or the entire blow-off process is repeated, you will have to wait at least 5 minutes in order to let the system solenoid valve cool. Otherwise, the valves themselves may be damaged due to overheating.
Prior to tightening the drain screws, make sure that the corresponding routine has been completed, and the brake fluid flows out smoothly (no air bubbles should appear).

In order to ensure correct bleeding, the vehicle is to be set in a proper way. You will have to clean the drain screws and procure a transparent tube and a container partially filled with brake fluid, to be connected to the screw of the wheel being bled.

ABS 8/ESP 8 system bleeding procedure sequence

Call the "BLEEDING" routine.

→

Open the drain screw of the corresponding wheel.

↓

After rear left wheel bleeding has been completed (as indicated by the diagnosis instrument), tighten the drain screw and then proceed with the front left wheel.

←

Open the front left wheel drain screw.

↓

After front left wheel bleeding has been completed (as signalled by the diagnosis instrument), close the drain screw and proceed with the front right wheel.

→

Open the front right wheel drain screw.

↓

After front right wheel bleeding has been completed (as signalled by the diagnosis instrument), close the drain screw and proceed with the rear right wheel

←

Open the rear right wheel drain screw.

↓

After rear right wheel bleeding has been completed (as signalled by the diagnosis instrument), close the drain screw. The procedure will now be completed.

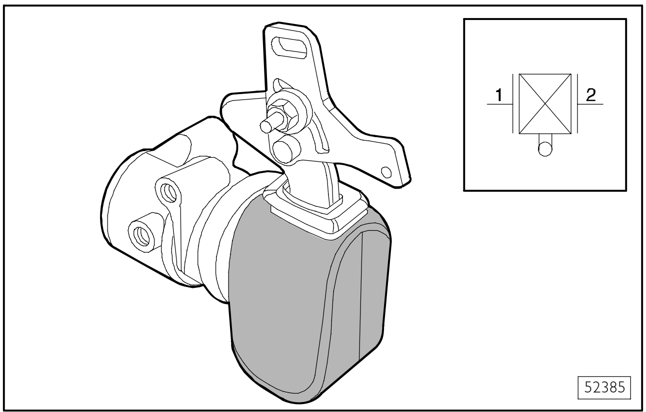
→

In case of failure of one single step or the entire bleeding process, the whole procedure will have to be repeated.

NOTE After air bleeding from the braking circuit has been completed, fill with brake fluid up to the top level (do not fill with oil that has already been used).

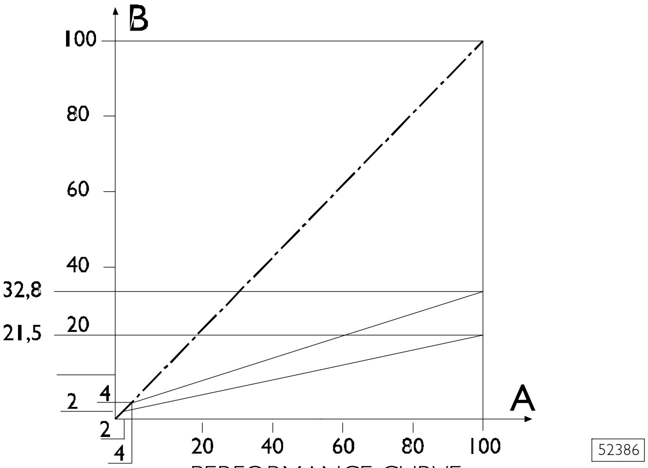
784310 Mechanically controlled load sensing valve (vehicles 35C)

Figure 40



The load proportioning valve automatically adjusts, as a function of the load acting on the rear axle, the braking torque produced by the brakes of the axle itself. This valve has the important job, especially when the vehicle is light without any load, to limit the braking torque that would otherwise block the rear wheels with a consequent skidding and jerking of the vehicle.

Figure 41



PERFORMANCE CURVE

A. Inlet pressure (Bar) - B. Outlet pressure (bar)
Ratio = 0.25

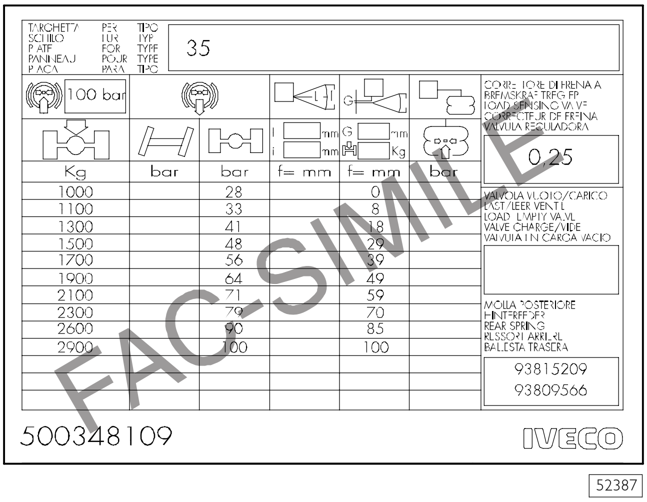
Regulation of load proportioning valve on vehicle

To stop the vehicle from skidding or the wheels from being locked when braking, you must check the device at regular intervals and eventually adjust if necessary. This consists in verifying the values indicated on the plate (SENZA CODICE) applied on the inside of the bonnet.

If there is no plate or if the data is missing, ask the manufacturer for a duplicate by indicating:

- ❑ Vehicle type
- ❑ Number of leaf springs
- ❑ Vehicle pitch
- ❑ Weight of rear axle
- ❑ Number of load proportioning valve

Figure 42


TARGHETTA SCHILD PLATE PANNEAU PLACA — PER FÜR FOR POUR PARA — TIPO TYP TYPE TYPE TIPO: 35

100 bar

Kg	bar	bar	f= mm	f= mm	bar
1000		28		0	
1100		33		8	
1300		41		18	
1500		48		29	
1700		56		39	
1900		64		49	
2100		71		59	
2300		79		70	
2600		90		85	
2900		100		100	

CORRETTORE DI FRENATA / BREMSKRAFTREGLER / LOAD SENSING VALVE / CORRECTEUR DE FREINAGE / VALVULA REGULADORA: 0,25

VALVOLA VUOTO/CARICO / LAST/LEER VENTIL / LOAD EMPTY VALVE / VALVE CHARGE/VIDE / VALVULA EN CARGA VACIO

MOLLA POSTERIORE / HINTERFEDER / REAR SPRING / RESSORT ARRIERE / BALESTA TRASERA: 93815209 93809566

500348109 IVECO

FAC-SIMILE

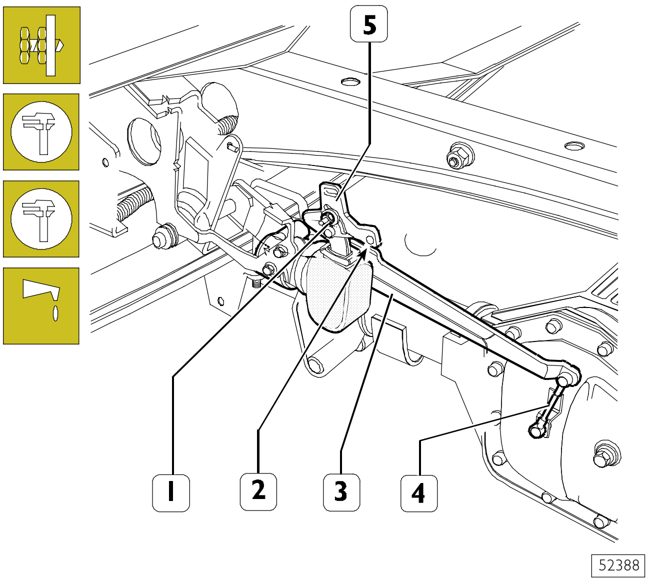
52387

LOAD PROPORTIONING VALVE PLATE

The operations are to be carried out in the following order:

- ❑ set the vehicle with its rear wheel on a weighing machine 99336914 or on the brake test bench;
- ❑ connect the pressure gauges 99372269 or Modus to the pressure test points upstream from the load proportioning valve;
- ❑ if the pressure gauges are not equipped with a valve for automatic bleeding, bleed off the air through the pressure gauges by unscrewing the appropriate ring nuts;
- ❑ load the vehicle so as to have a load (B) on the rear axle divided equally between the right- and left-hand sides of the vehicle with a tolerance of ±5 kg;

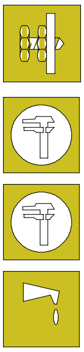
Figure 43

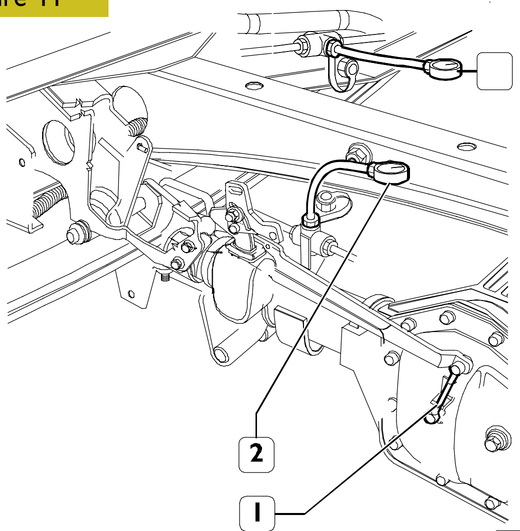


- ❑ loosen the nut (1);
- ❑ connect a weight (A, page 50) to the plate (5) at point (2);
- ❑ tighten the nut (1) at the specified torque and remove the loads (A and B).
- ❑ start up the engine;

- Load the vehicle to obtain the loading sequence shown in the table in fig. 37, equally shared on the rear axle on the left and right sides of the vehicle with a tolerance of ± 5 kg.

Figure 44





52389

- with the engine idling and a pressure of 100 bar, shown on the pressure gauge (3) upstream from the sensing valve, check that the outlet pressure shown on the pressure gauge (2) downstream from the sensing valve corresponds to the values given on the rating plate, otherwise replace the sensing valve;
- Proceed as follows if the pressure read downstream of the corrector do not correspond to the values shown in SENZA CODICE.
- Disconnect the bar (4, SENZA CODICE) from the axle.
- in addition, use the transmission lever (3, SENZA CODICE) to check that the load sensing valve stem runs smoothly in its seat, otherwise replace the sensing valve;
- reconnect the adjustment rod (4, SENZA CODICE) to the rear axle;

Perform the check by gradually increasing the pressure.

To check the load sensing valve, all the components of the braking system must be in full working order. In addition, in the case of replacing the leaf springs for special versions it is necessary to install a new rating plate whose values are correct.

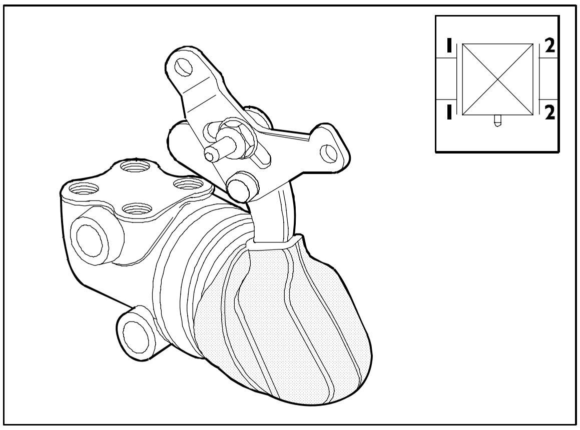
- Once the checks have been completed, verify the operation of the brakes by testing them.

TABLE OF LOADS FOR ADJUSTING THE LOAD SENSING VALVE

Model	Load (A) kg	Load (B) kg
35C	3.5	1500
40C	3	1500
45C	4	1800
50C semi-elliptic and double flex. parabolic leaf springs	9	1800
50C single flex. parabolic leaf springs.	4.5	1800

784310 Dual mechanically controlled load sensing valve (vehicles 29L - 35S)

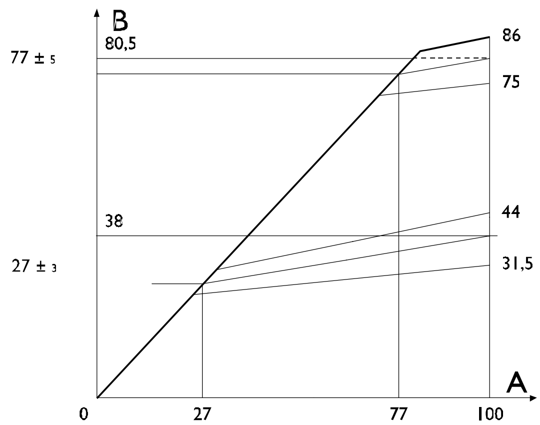
Figure 45



52390

The load sensing valve automatically regulates the braking torque generated by the brakes of the rear axle according to the load weighing on the rear axle.
It has the important function, especially when the vehicle has no load, of limiting the braking torque that would lock the rear wheels causing the vehicle to skid.

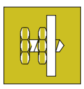
Figure 46



52391

A. Inlet pressure (in bar) - B. Outlet pressure (in bar)
Ratio = 0.15

Adjusting the load sensing valve



This adjustment is similar to that described above, using the following loads.

TABLE OF LOADS FOR ADJUSTING THE LOAD SENSING VALVE

Model	Load (A) kg	Load (B) kg
29L	9	1500
35S	6,5	1500

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STABILITY CONTROL AND ANTI-SKID DEVICES

The devices described below are integrated into three different types of systems:

ABS SYSTEM FUNCTIONS

Antilock braking system (ABS)

This system comprises an electro-hydraulic modulator and an electronic control unit mounted on the modulator, located in the engine bay, four sensors and four phonic wheels that measure the number of turns of the wheels.

The tendency for one or more wheels, whether front or rear, to lock, which is detected by the sensors through the pulses of the phonic wheels, is communicated to the electronic control unit that, by means of the electro-hydraulic modulator, independently or simultaneously regulates the pressure in the hydraulic circuit of the front and rear axles.

Electronic braking distribution device (EBD)

This system acts at a level prior to ABS operation. It ensures a sensitive control over the tendency of the rear wheels to lock with respect to the front ones, when braking, by optimizing the braking force in the different conditions of load, travel and state of use of the vehicle.

This device substitutes the function of the mechanically operated load sensing valve. If this device fails, braking takes place with the same pressure on front and rear brakes.

Electronic Stability Program (ESP) - Option

It monitors the vehicle's behaviour steadily (both on straight stretches and bends, when braking or accelerating).

It also monitors the driver's actions: steering the wheel, pressing the brake pedal, accelerator position, speed.

It is always active in the background, i.e. the ESP system compares the actual vehicle ride with the driver's desired ride 50 times a second. It recognizes dangerous situations before the driver does.

The system considers the different possibilities of coming into operation. It brakes on every single wheel separately.

It operates on the engine control system.

FUNCTIONS INCLUDED IN THE ESP SYSTEM ONLY

Acceleration drive control device (ASR)

This system prevents driving wheel skid through quick action on the engine and brakes. It allows the vehicle to set off safely and fast even on slippery roads or when one driving wheel is skidding. It also reduces the risk of understeering when you accelerate too much when cornering.

Engine braking torque control (MSR)

This system avoids driving wheel drag due to the exhaust brake. It ensures vehicle stability when releasing on slippery roads (e.g. snow, ice), and assists in keeping the path when cornering and shifting down, especially on slippery roads. It requires a slight increase of revs number, through the CAN line.

Hill holder control (HHC)

This function allows the vehicle to be kept automatically locked (braked) until the clutch is closet and the driver subsequently presses the accelerator pedal, thus preventing undesired vehicle motion.

The function is actuated automatically: the braking situation is detected by the sensor inside the modulator. When the brake pedal is released, the vehicle will be kept braked for 2.5 seconds, thus allowing the driver/system to put the gear (and the vehicle to be started). This ensures safe, easy start with any incline, regardless of the weight carried.

Hydraulic Brake Assistant (HBA)

The main feature of the HBA function is to recognize an emergency braking situation followed by "automatic" increase of vehicle deceleration.

Vehicle deceleration is only restricted to actuation of ABS control, thus taking the greatest advantage of the grip between the tyre and the roadbed currently available. Therefore, ordinary drivers can now achieve braking distances which only experienced drivers could achieve in the past.

If the driver reduces the braking intensity, vehicle deceleration is reduced depending on the reduction of the force applied onto the pedal.

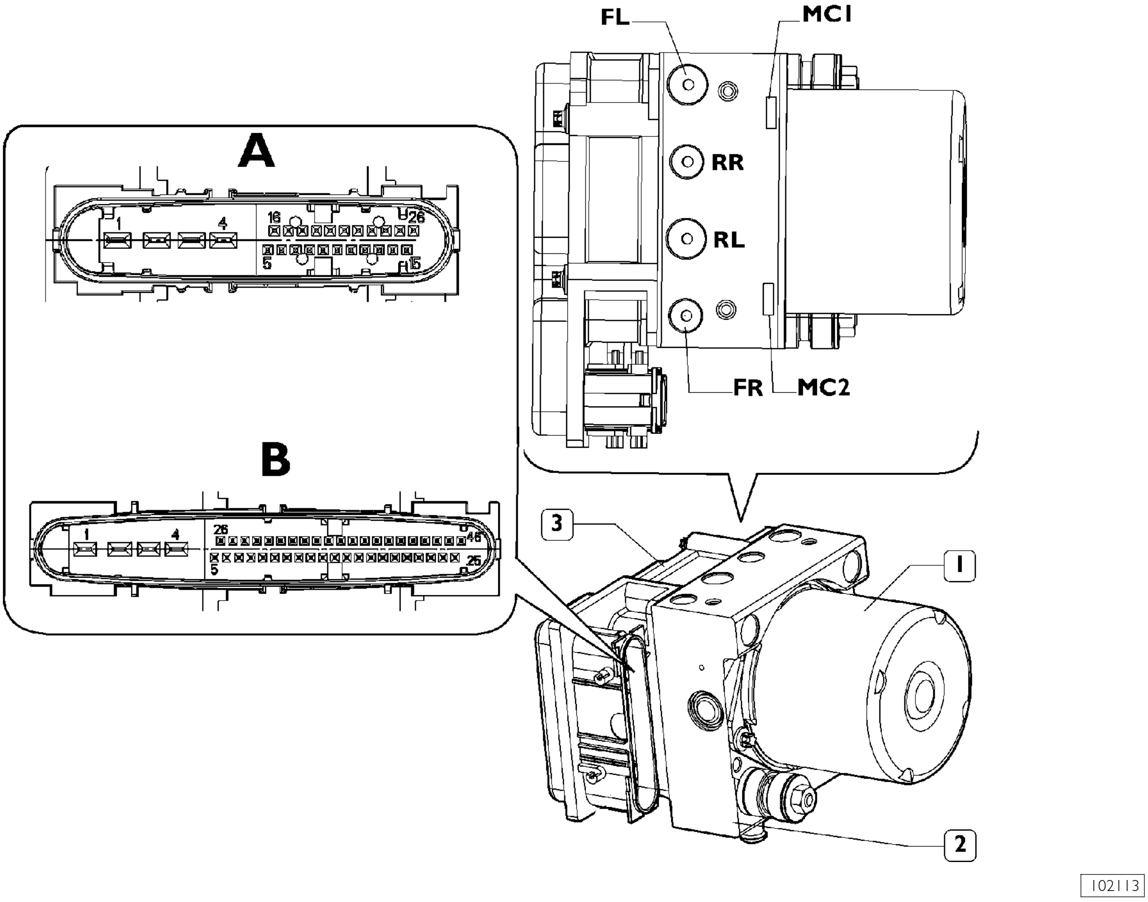
Therefore, the driver can control deceleration accurately after overcoming the emergency situation.

The extent of the braking request from the driver corresponds to the force applied onto the pedal. The force applied onto the pedal is derived from measuring the pressure in the brake pump.

526716 Electro-hydraulic modulator/control unit for 29L - 35S vehicles)

ABS8/ESP8 systems

Figure 47



1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - F/MC1. Front axle power supply - R/MC2. Rear axle power supply - LF (or FL for ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR for ABS8/ESP8 systems). Right front axle output - LR (or RL for ABS8/ESP8 systems) . Left rear axle output

The electronic control unit has the task of controlling the electro-hydraulic modulator solenoid valves according to the signals from the wheel speed sensors.
The electro-hydraulic modulator modulates the pressure of the brake fluid in both front and rear circuits according to the control signals from the control unit.

NOTE The devices comprising the control unit and electro-hydraulic modulator of the various models are not interchangeable.

The parts inside the hydraulic unit are not compatible with mineral oil and unsuitable fluids. In case of contamination by such fluids, the unit shall be replaced and properly disposed of.

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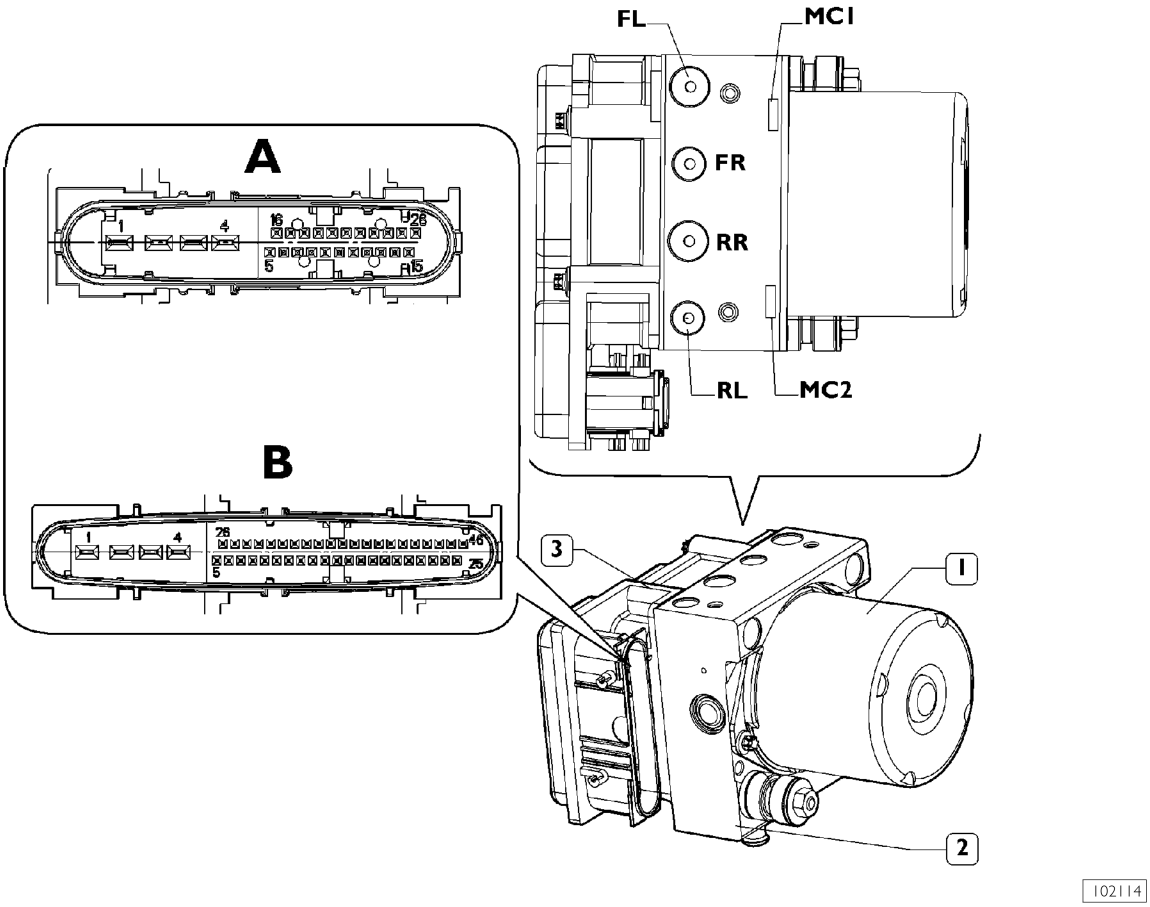
526716 Electro-hydraulic modulator/control unit for 29L - 35S vehicles)

ABS8 systems (vehicles 35C - 65C) / ESP8 (vehicles 35C only)

Figure 48



1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - F/MC1. Front axle power supply - R/MC2. Rear axle power supply - LF (or FL for ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR for ABS8/ESP8 systems). Right front axle output - LR (or RL for ABS8/ESP8 systems) . Left rear axle output

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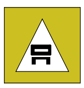
The electro-hydraulic modulator modulates the pressure of the brake fluid in both front and rear circuits according to the control signals from the control unit.

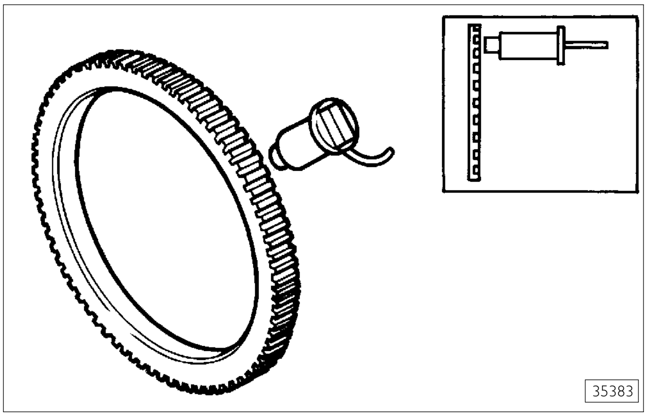
NOTE The devices comprising the control unit and electro-hydraulic modulator of the various models are not interchangeable.



The parts inside the hydraulic unit are not compatible with mineral oil and unsuitable fluids. In case of contamination by such fluids, the unit shall be replaced and properly disposed of.

526713 Rev sensor
526712 Phonic wheels

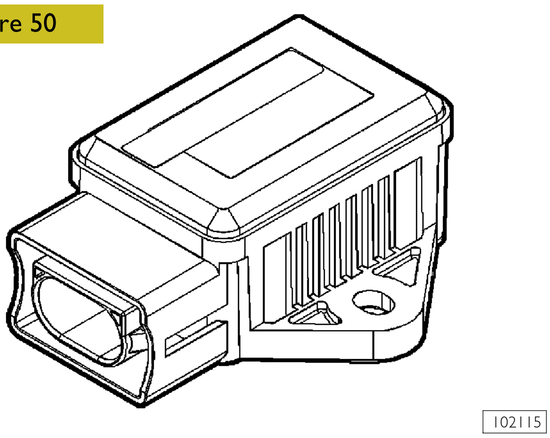
Figure 49



The system for measuring the speed of rotation of the wheels is composed of the wheel speed sensor and the phonic wheel. The phonic wheel is housed or incorporated in the brake disc of the wheel and turns at the same speed as the wheel. By induction in the sensors it generates alternating voltages whose frequency is in proportion to the speed of rotation of the respective wheel. These voltage signals are transmitted to the control unit for processing.

ESP SYSTEM SENSORS
Yaw sensor with built-in side acceleration sensor

Figure 50



It measures the motion of the vehicle around its own vertical axis (yaw) as well as the vehicle's side acceleration.

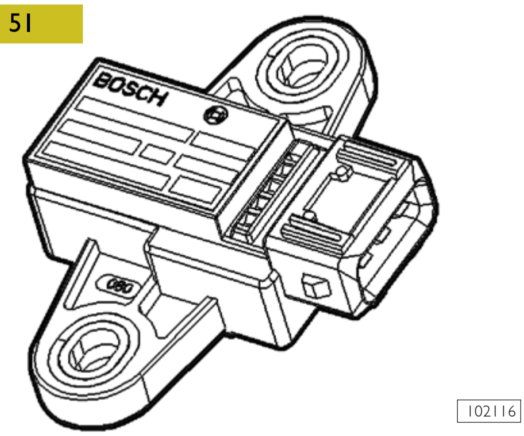
These signals continuously inform the control unit about the vehicle's behaviour.

The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Longitudinal acceleration sensor

Figure 51



It measures the vehicle's acceleration and deceleration changes.

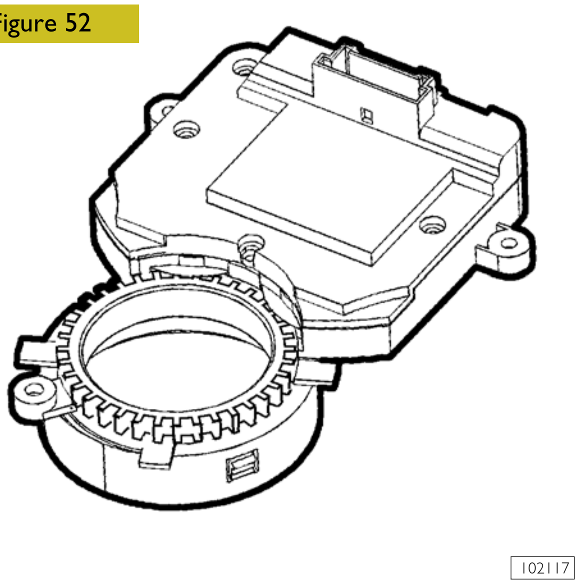
These signals continuously inform the control unit about the vehicle's behaviour.

The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Steering angle sensor

Figure 52



It measures the steering angle required by the driver.

The comparison between this signal and those from all the other sensors allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

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5274 BRAKE REPAIR OPERATIONS

Front brakes

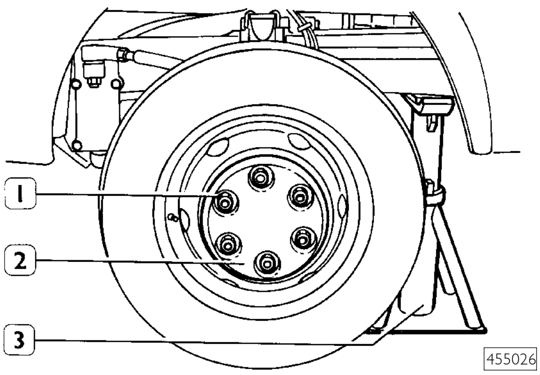
The following operations have been carried out on vehicles with 2x48 Brembo front calipers.

527417 Replacing brake linings

The braking system effects safety. All repairs and servicing operations must be exclusively carried out by skilled, qualified personnel.

The oil inlet hose to the calliper must not be disconnected during the operations that follow.

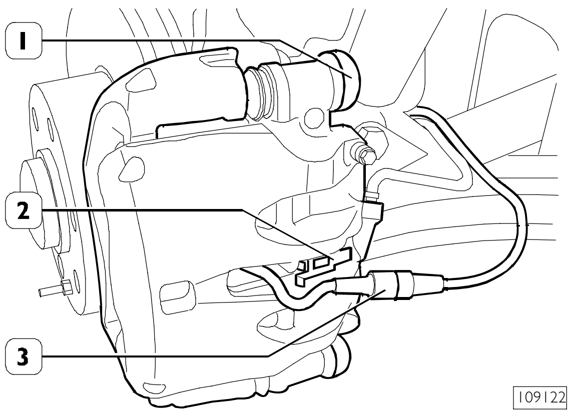
Figure 53



Set the vehicle on level ground and lock the rear wheels. Loosen the nuts (1) securing the front wheels. Lift the front of the vehicle with a hydraulic lift and rest it on two stands (3).

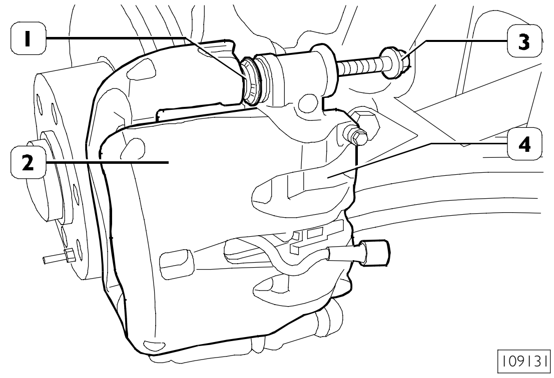
For 2x48 brake calipers

Figure 54



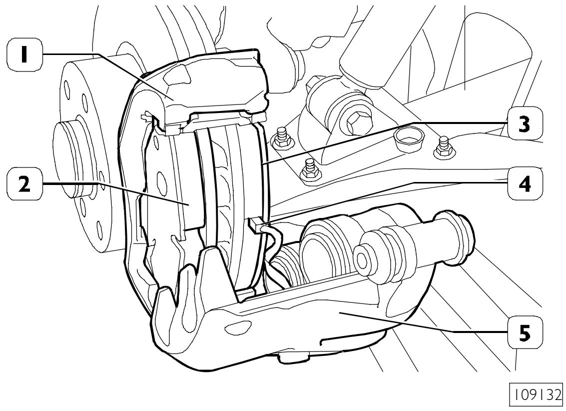
Disconnect electrical connection (3) of wear sensor from chassis cable and release the cable of the electrical connection from securing blade (2).
Remove rubber protection plug (1).

Figure 55



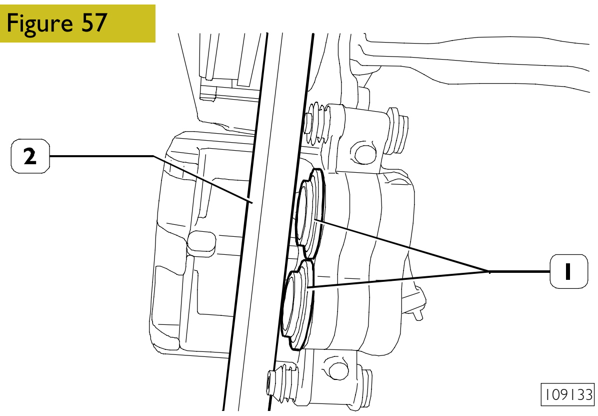
Remove screw (3) securing brake caliper (2) to support (4). Move bush (1) inside brake caliper (2), tilt the brake caliper.

Figure 56



Disconnect cable (4) from braking gasket (3) and unthread the cable from brake caliper (5).
Dismount braking gaskets (2 and 3) from caliper support (1).

Figure 57

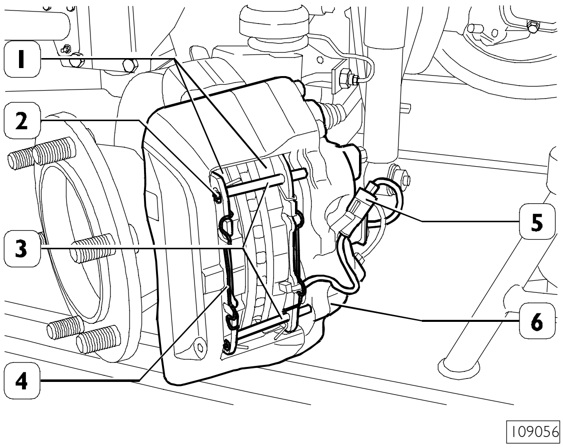


Withdraw pistons (1) by a retractor or other suitable tool (2), paying attention not to damage piston surfaces and protection cowlings.

Retracting the pistons will increase the level of brake fluid in the reservoir. For this reason, check the fluid does not spill out of the reservoir and damage vehicle paintwork during the operation.

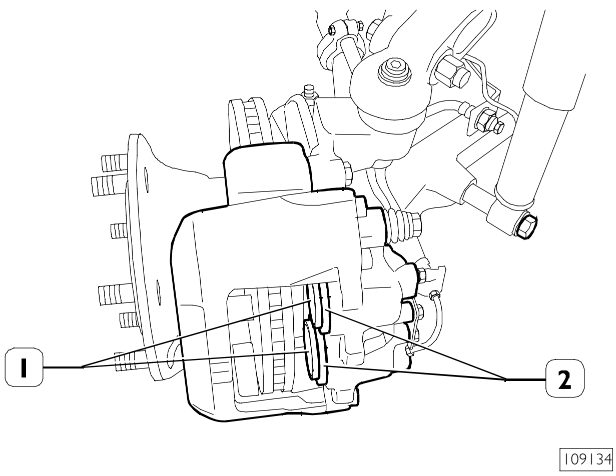
For 2x60 brake calipers

Figure 58



Remove safety springs (2) from pins (3).
Unthread pins (3) from brake caliper (6) and recover springs (4) checking braking gaskets (1).
Disconnect electrical connection (5) for gasket wear signalling unit.
Unthread braking gaskets (1) from brake caliper (6).

Figure 59

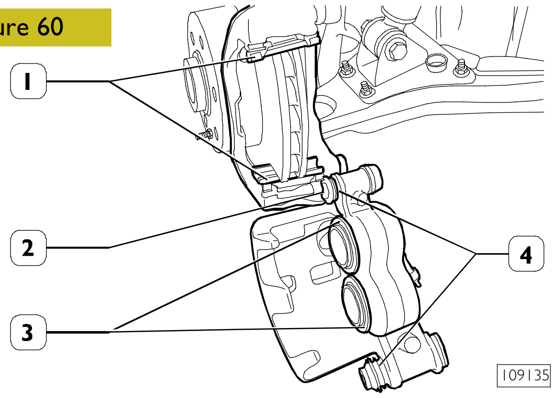


Withdraw pistons (1) by a retractor or other suitable tool (2), paying attention not to damage piston surfaces and protection cowlings.

Retracting the pistons will increase the level of brake fluid in the reservoir. For this reason, check the fluid does not spill out of the reservoir and damage vehicle paintwork during the operation.

Checks

Figure 60



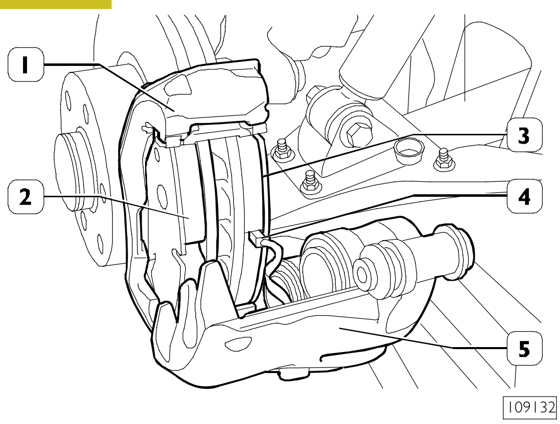
Check the conditions of check springs (1) or (4, Figure 58) of braking gaskets and sliding bushes (2); should they be worn, replace them.
Visually check the conditions of dust cowlings (3 and 4). Should they be deformed or cracked, they must be replaced.
Remove dirt from brake caliper using a metal brush and avoiding to damage the dust cowlings.
Clean pads rest area using suitable materials and products (e.g. a wet cloth); on the contrary, do not use a nitro-perchlorate based diluent, petrol, etc., which might damage the protection cowlings.
Check brake disk surfaces and make sure that the disk is not corroded, scored or grooved.
Slight superficial cracks are acceptable; however, brake disk must be ground as described in relating chapter; on the contrary, if the disk is worn out, it must be replaced.

We suggest that both brake discs be renewed also in case one of them only needs to be replaced.
As regards brake lining pairs, always replace a complete series for each axle.

Always overhaul both brake calipers also in case one of them only seems to be damaged.

For 2x48 calipers

Figure 61



Insert new brake liners (1) in the brake calliper mount and check that they slide in their seats.
Fit cable (4) into brake caliper (1), and connect the cable to braking gasket (3).

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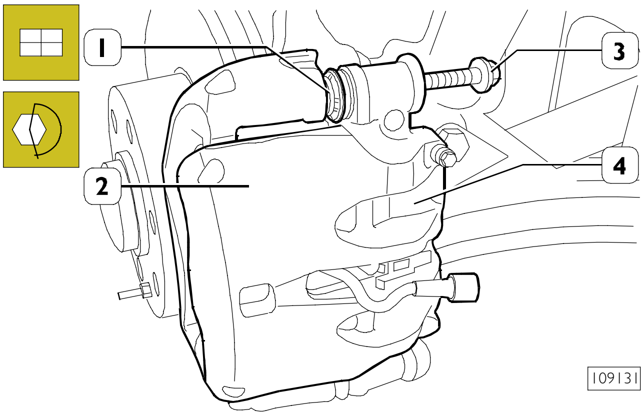
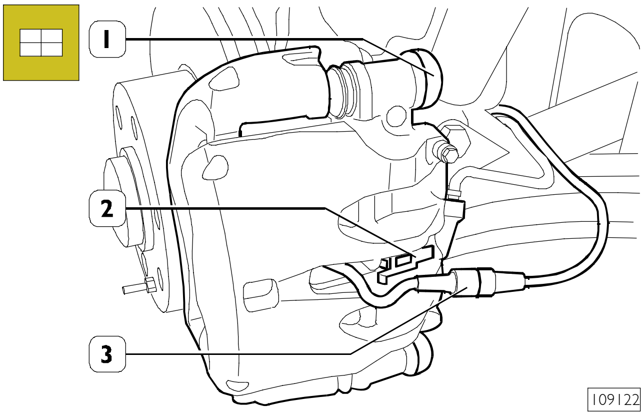
Figure 62



Move bush (1) inside brake caliper (2) and position the caliper on caliper support (4).
Screw screw (3) and tighten it to prescribed torque.

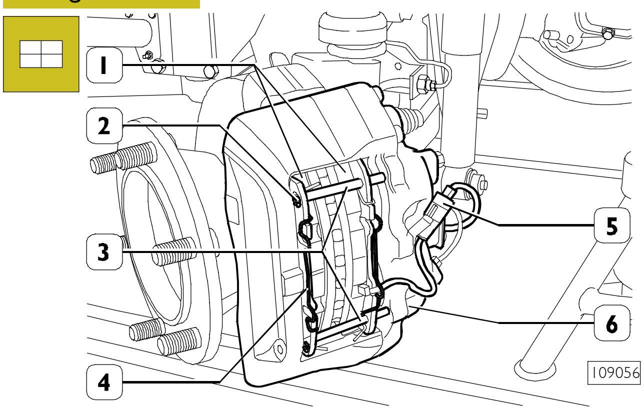
Figure 63



Mount protection plug (1).
Connect cable (3) of wear sensor to support blade (2) and cable connection to chassis cable connection.

For 2x60 calipers

Figure 64



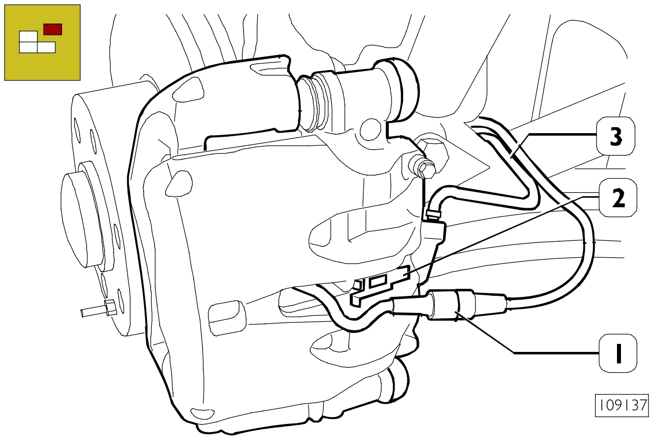
Mount braking gaskets (1).
Position springs (4) and fit pins (3) into brake caliper (6).
Mount safety springs (2) into pins (3).
Connect electrical connection (5) of braking gasket wear signalling unit.

527413 Removal/Re-fitting of brake calipers

Removal 2x48 calipers

For 2x84 brake calipers

Figure 65

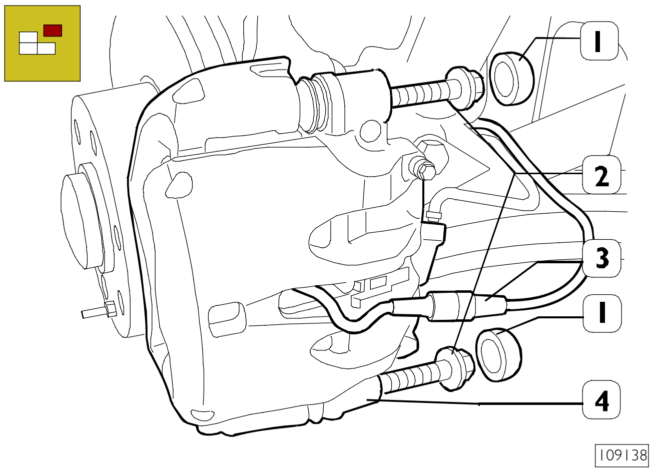


Disconnect electrical connection (1) of wear sensor from chassis cable and release the cable of the electrical connection from support blade (2).
By suitable wrench, disconnect hose (3) of brake liquid from pipe and drain brake liquid into special container.
If necessary, plug the pipe preventing piping complete draining.

NOTE The hose has to be removed at the bench.

Brake liquid is venomous and corrosive: in case of accidental contact, immediately wash with water and neutral soap.

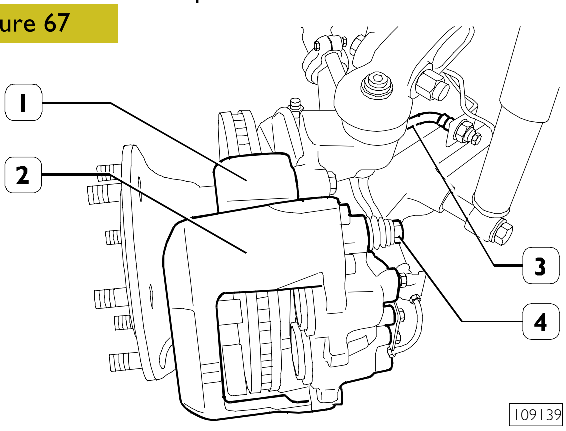
Figure 66



Remove rubber protection plug (1).
Unscrew screws (2), take off brake caliper (4) and disconnect electrical cable (3) of braking gasket wear sensor.
Check braking gaskets conditions. If braking gaskets are found to be worn out, replace them and follow checks as described in relating chapter.

Removal 2x60 brake caliper

Figure 67



Dismount braking gaskets as described in relating chapter.
By suitable wrench, disconnect hose (3) of brake liquid from pipe and drain brake liquid into special container.
If necessary, plug the pipe preventing piping complete draining.

NOTE The hose has to be removed at the bench.

Brake liquid is venomous and corrosive: in case of accidental contact, immediately wash with water and neutral soap.

Remove screws (4) and take brake caliper (2) off caliper support (1).

Refitting

Check the pistons are fully retracted inside the caliper body.

Refit by carrying out the operations described for removal in reverse order, observing the required tightening torques.

Drive slowly without prolonged, sudden brake application during the first period of use of new brake pads because braking efficiency is reduced.

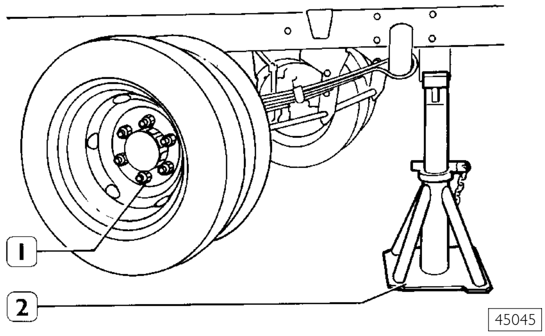
Press the brake pedal repeatedly to restore pressure in the system and correct brake pedal stroke.

527440 REAR BRAKES

The following operations have been carried out on vehicles with 2x48 Brembo rear calipers.
They should be considered similar also for 2x44 - 1x52C - 1x60C Brembo rear calipers unless stated otherwise.

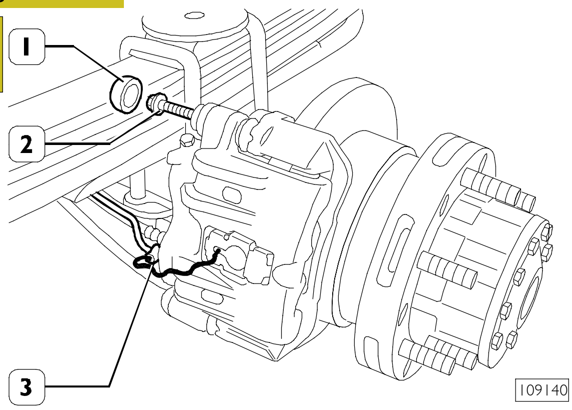
527447 Removal/Refitting of brake calipers

Figure 68



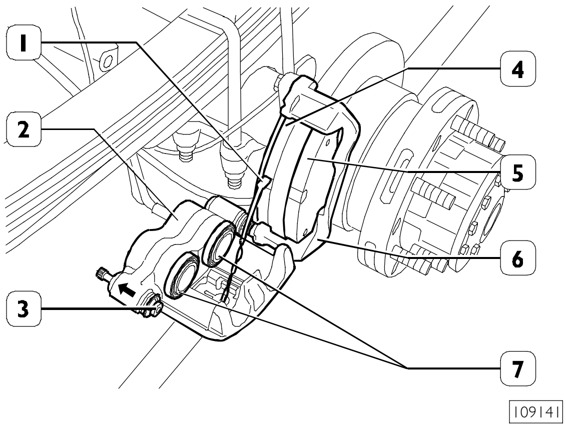
Set the vehicle on level ground, loosen the nuts (1) securing the wheels.
Lift the front of the vehicle with a hydraulic lift and rest it on two stands (2).
Unscrew the nuts (1) and remove the wheels.

Figure 69



Disconnect electrical connection (3) of wear sensor from chassis cable and release the cable of the electrical connection from support blade.
Remove rubber protection plug (1) and unscrew screw (2).

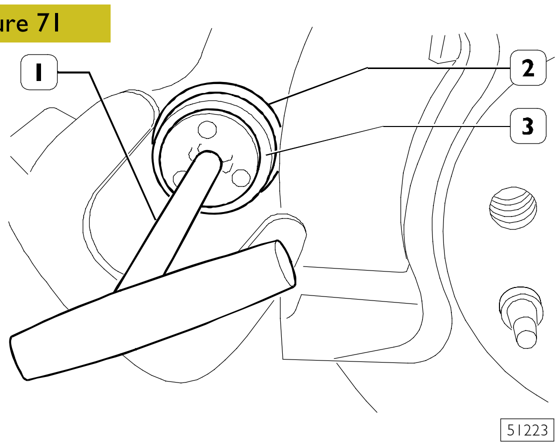
Figure 70



Move (→) bush (3) inside brake caliper (2) and tilt the brake caliper.
Disconnect cable (1) from braking gasket (4) and unthread the cable from brake caliper (2).
Dismount braking gaskets (4 and 5) from caliper support (6).
For 2x44 and 2x48 calipers, withdraw pistons (7) following indications in Figure 57.

For x52 - 1x60 calipers

Figure 71

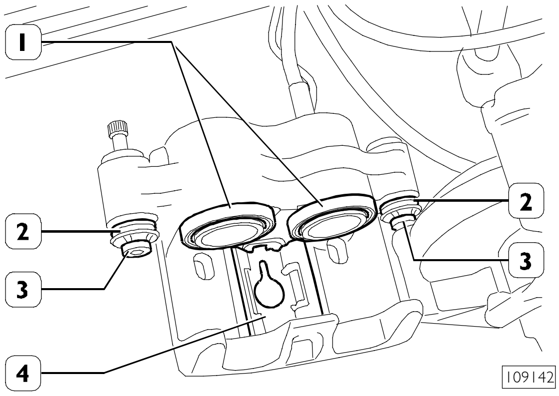


Using tool 99372236 (1) retract the piston (3) by pushing constantly in line with the piston axis with a force of approx. 300 ÷ 400 N while turning the tool clockwise until the piston (3) is fully retracted.

> ! During this operation, take care not to twist the protective cap (2) or let it swell out.
>
> Let the air out of the cap by moving it away from the brake caliper.

Checks

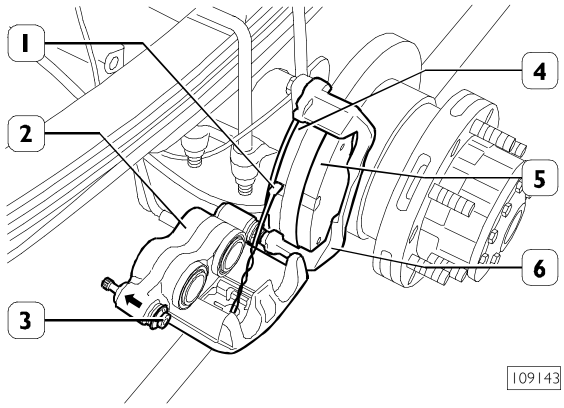
Figure 72



Check the conditions of springs (4) and sliding bushes (2); should they be worn out, replace them.
Visually check the conditions of dust cowlings (1) and (1, Figure 78). Should they be deformed or cracked, they must be replaced. Remove dirt from brake caliper using a metal brush and avoiding to damage the dust cowlings.
Clean pads rest area using suitable materials and products (e.g. a wet cloth); on the contrary, do not use a nitro-perchlorate based diluent, petrol, etc., which might damage the protection cowlings.
Check brake disk surfaces and make sure that the disk is not corroded, scored or grooved.
Slight superficial cracks are acceptable; however, brake disk must be ground as described in relating chapter; on the contrary, if the disk is worn out, it must be replaced.

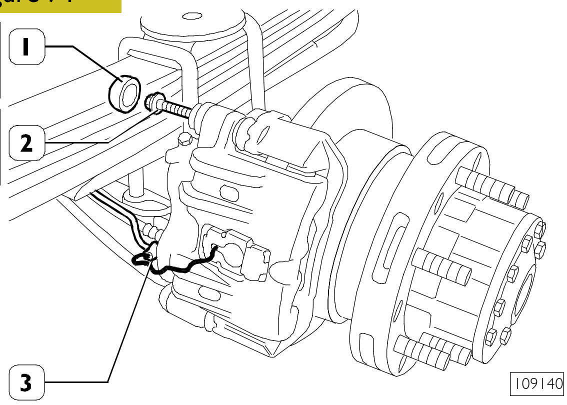
> ! We suggest that both brake discs be renewed also in case one of them only needs to be replaced.
> As regards brake lining pairs, always replace a complete series for each axle.
>
> Always overhaul both brake calipers also in case one of them only seems to be damaged.

Figure 73



Fit new gaskets (4 and 5) into caliper support and check for their freely sliding in their seats.
Fit cable (1) into brake caliper (2) and connected the cable to braking gasket (4).
Move (→) bush (3) inside brake caliper (2) and position it on caliper support (6).

Figure 74



Screw screw (2) and tighten it to prescribed torque.
Mount rubber protection plug (1).
Connect the cable of wear sensor (3) to support blade and cable connection to chassis cable.

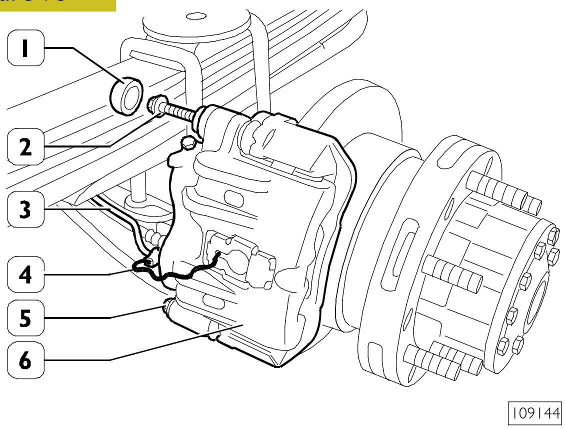
For all brake callipers

> ! Drive slowly without prolonged, sudden brake application during the first period of use of new brake pads because braking efficiency is reduced.

Press the brake pedal repeatedly to restore pressure in the system and correct brake pedal stroke.

527443 Removal/Refitting brake calipers
Removal

Figure 75



Disconnect electrical connection (4) of wear sensor from chassis cable and release the cable of the electrical connection from support blade.
By suitable wrench, disconnect hose (3) of brake liquid from pipe and drain brake liquid into special container.
If necessary, plug the pipe preventing piping complete draining.

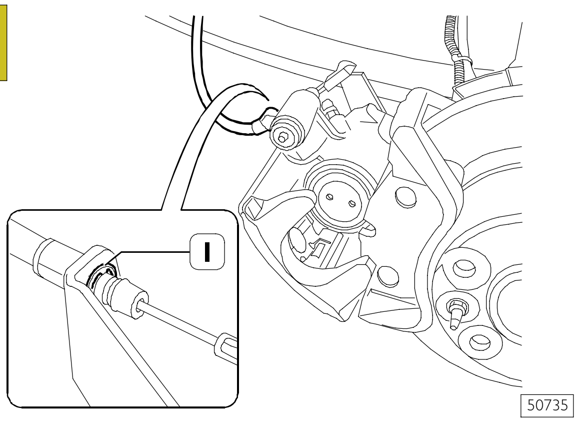
NOTE The hose has to be removed at the bench.

Brake liquid is venomous and corrosive: in case of accidental contact, immediately wash with water and neutral soap.

Remove plug (1), unscrew screws (2) and take brake caliper (5) off support (6).

For 1x52 - 1x60 brake calipers

Figure 76



Remove the retaining clip (1) and unhook the parking brake rope.

Removal

Refit by carrying out the operations described for removal in reverse order, observing the required tightening torques.

Replace the hose if anomalies are found.

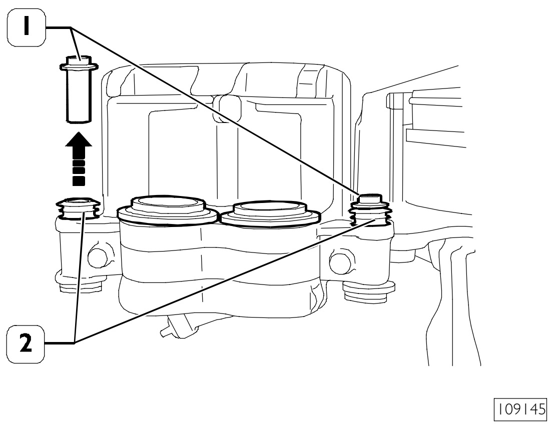
Bleed air from hydraulic system as described in relating chapter.

527413 OVERHAUL OF BRAKE CALIPERS
2x44 - 2x48 - 2x60 Brembo brake calipers

Disassembly

For Brembo 2x44 - 2x48 brake caliper

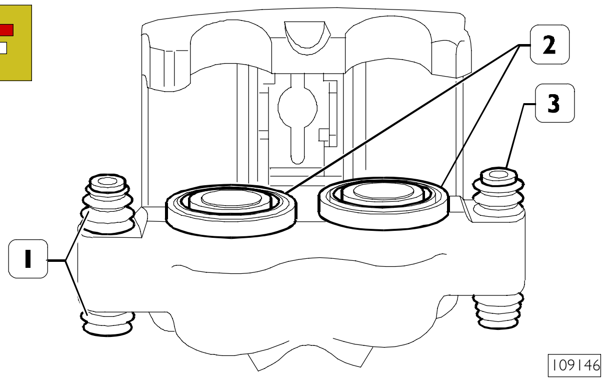
Figure 77



Slide the slippage sleeves (1) and take out the protection casings (2).

For 2x60 brake calipers

Figure 78



Remove the dust covers (1 and 2) and keep the sliding bushes (3).

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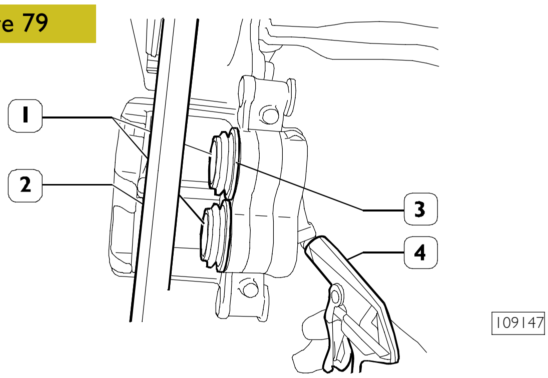
Figure 79

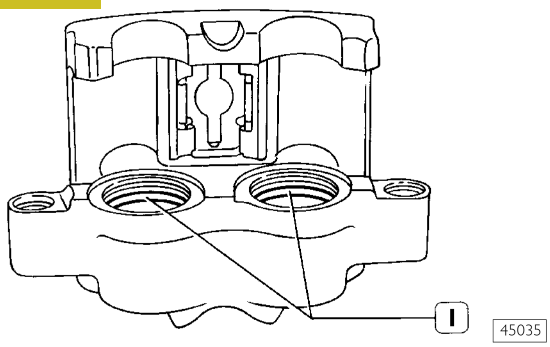


Place the caliper on a work bench. Insert a block of wood (2) so that the pistons can be removed without damaging them, and to make the operations safe for the technician.

By means of a gun (3), introduce air into the brake caliper the pistons (1) are extracted.

Remove the dust boots (3) from the respective seats.

Figure 80



Remove the seal rings (1) from the brake caliper cylinder seats.

Cleaning and checking of main components
For all types of brake calipers

When washing the metal components use hot water with Fiat LCD type detergent.

By means of a metal brush, remove any dirt from the brake caliper, then eliminate any residual dirt with the use of a brush. Carefully clean the seats of the guide pins, sliding bushes, pistons and the pistons themselves.

By means of a suitably sized synthetic brush, remove all traces of grease from the seats of the sliding bushes. Open the bleeder valves, then carefully blow compressed air into the brake caliper casing.

By means of a piece of canvas soaked in methylated spirits or similar, carefully clean the sliding surfaces.

Check the wear on the sliding bushes, pistons and relevant seats on the brake caliper casing. Make sure that the sliding surfaces are neither damaged or worn.

Insert the bushes and pistons into the seats and check that they are free to slide, otherwise restore or replace as necessary.

A regular braking effect depends a great deal on the condition of the sliding surfaces.

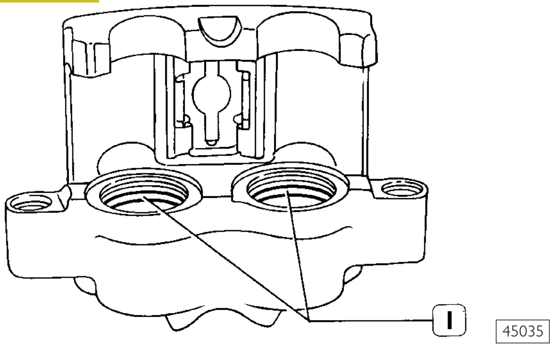
Check wear of brake liners and safety springs. Replace the parts which are either deformed or worn.

It is recommended to replace the piston dust covers and seal rings even if they do not show any signs of deformations or defects.

Assembly

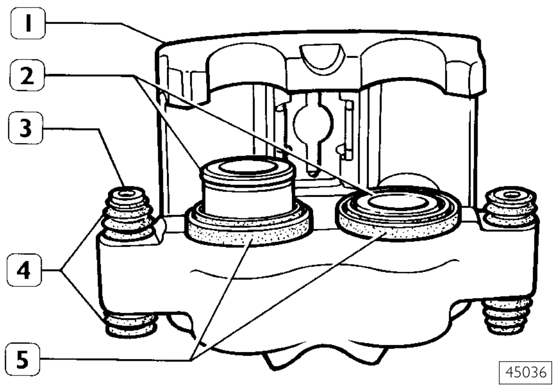
Lubricate the pistons and seal rings with brake liquid Tutela DOT SPECIAL.

Figure 81



Insert the seal rings (1) into the relevant seats of the caliper casing.

Figure 82



Insert the dust boots (4 and 5) in their seat on the brake calliper (1). Fit the cylinders (2) and the sliding bushings (3) or (1, fFigura 77) and make sure they slide freely.

Correct sliding if required by lubricating the bushings with Klueber glk1pf grease.

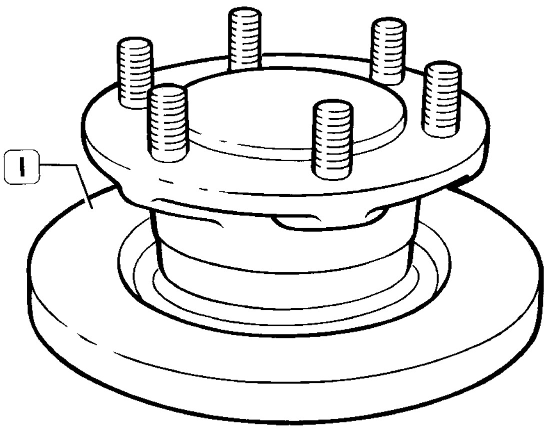
Insert the dust covers into the relevant sears on the pistons (2) and on the sliding bushes (3).

1x52 - 1x60 Brembo brake calipers

The 1x52 callipers (rear, 29 L - 35 S vehicles) are equipped with an automatic brake liner wear tensioner device and the components cannot be removed.
Consequently, replacement/overhauling operations on the piston, dust boot and internal components must only be carried out by specialised personnel.
Only the sliding bushings can be overhauled. The removal/refitting procedure is the same as that described for the other callipers.

527411 OVERHAUL OF BRAKE DISCS

Figure 83



45038

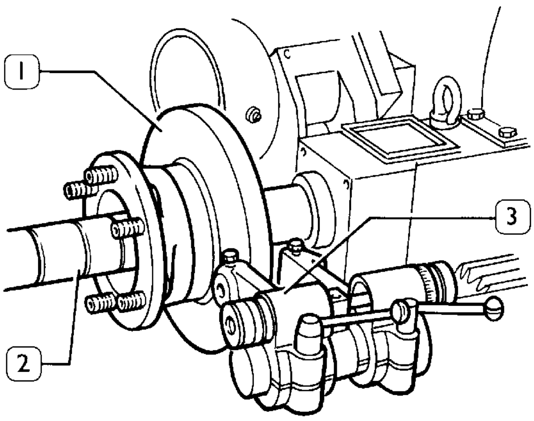
To take down and fit back the brake disk (1) follow the procedures described in the "axles" section.

Check the wear on the surfaces of the drum brakes.

When values different from those indicated in the specifications and data table are found, machine and grind the disk brakes and, if necessary, replace them.

527411 MACHINING AND GRINDING OF DISC BRAKES

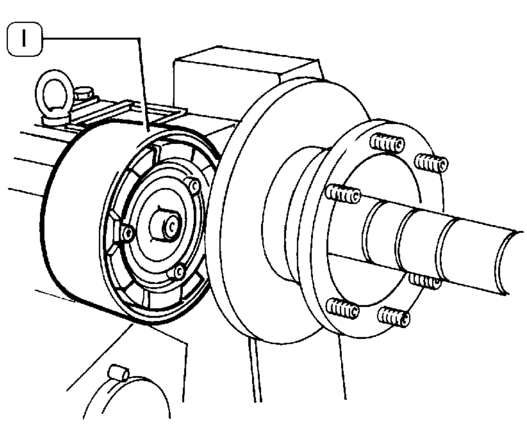
Figure 84



45039

- ❑ Fit the disk brake (1) complete with the wheel-hub to the late arbor 99301005 (2);
- ❑ fit a set of spacers on the shaft to remove unit end play, tighten the lock nut and apply the lathe support;
- ❑ place the tool-holder (3) along the axis of the drum brake (1) then adjust the work depth of the tools;
- ❑ turn down the drum brake (1) by passing over the surface a few times depending on the condition of the surface itself.

Figure 85



45040

By means of the lathe 99301001 (1), machine both working surfaces of the drum brake.

NOTE During this grinding operation, gradually move the sequential wheel towards the working surface in order to completely remove the swarf left over from turning.

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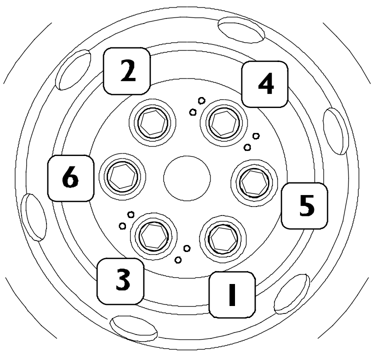
WHEEL NUT TIGHTENING SEQUENCE

Figure 86



52747

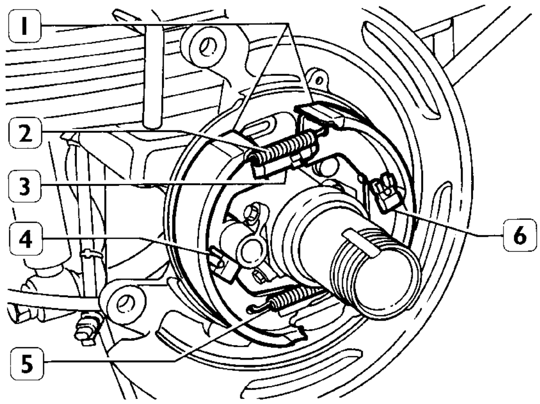
AXLE TIGHTENING ORDER

Tighten the screws at the specified torque in the order shown.

OVERHAULING PARKING BRAKE

Dismantling parking drum brake

Figure 87

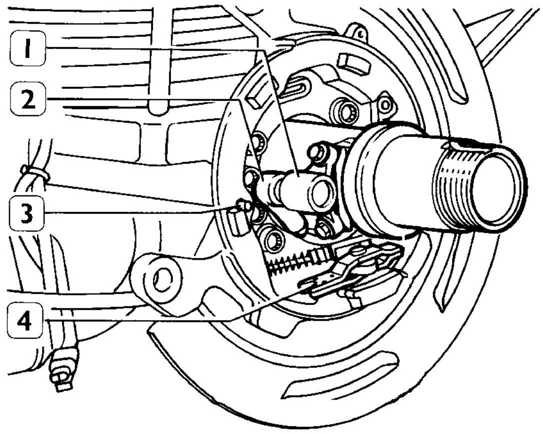


45048

Release shoe (1) return springs (2 and 5). Save the adjusting device (3).

Remove retaining brackets (4 and 6) and detach shoes (1).

Figure 88



45049

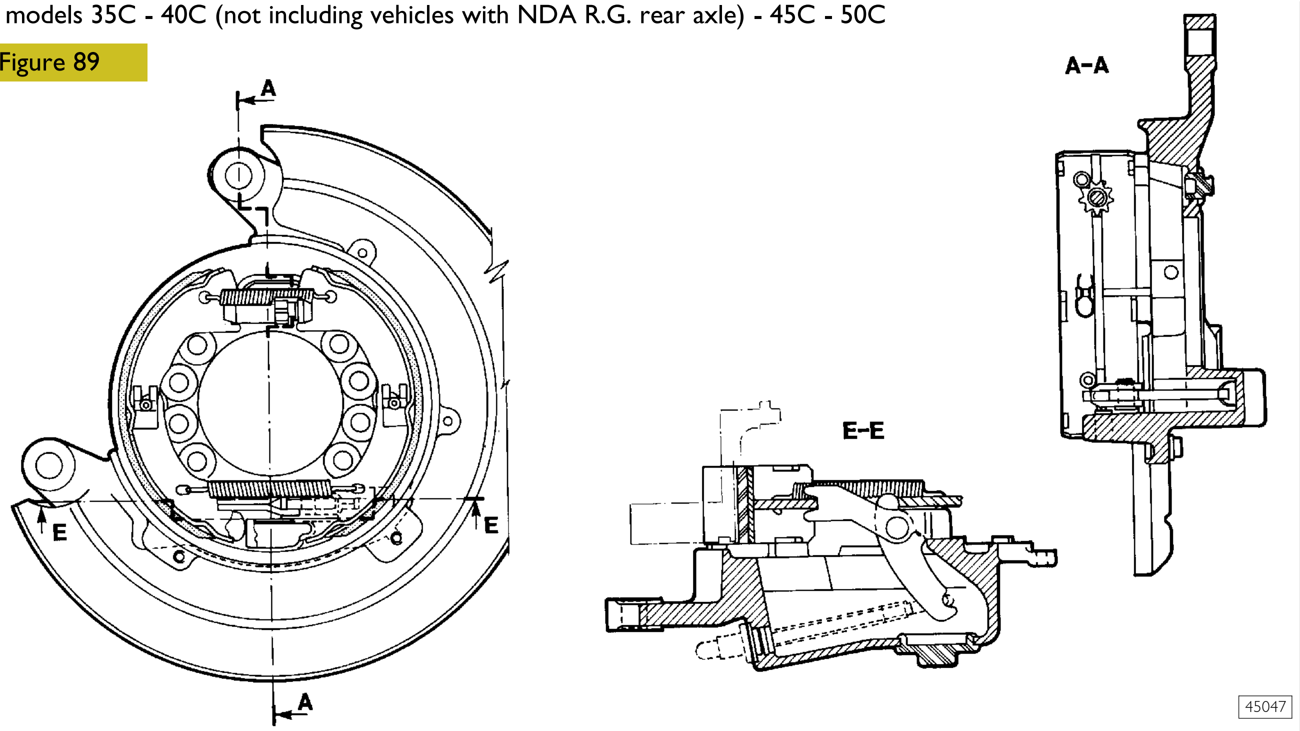
Remove shoe retaining pins (3) and parking brake wire hitching device (4).

NOTE Disjoin support (1) and withdraw sensor (2) to remove ABS sensor (2).

To reassemble the sensor (2), push it as far as it will go inside support (1) and fasten the latter to the rear axle.

For models 35C - 40C (not including vehicles with NDA R.G. rear axle) - 45C - 50C

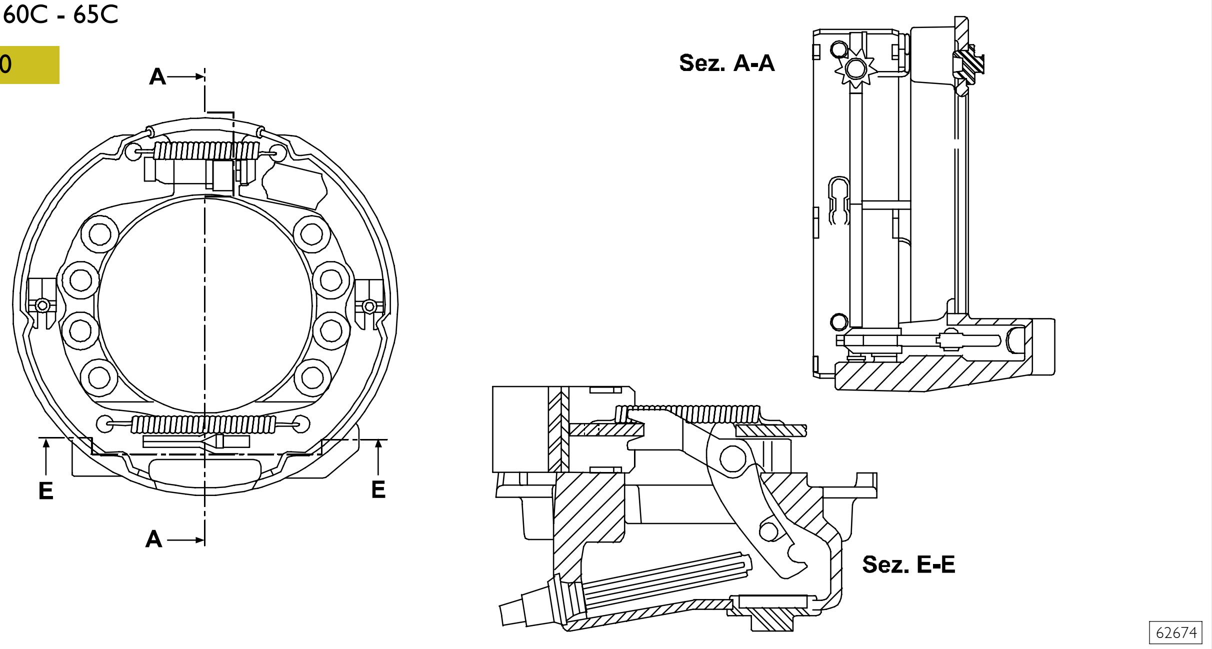
Figure 89



VIEW OF THE PARKING DRUM BRAKE

For models 60C - 65C

Figure 90



VIEW OF THE PARKING DRUM BRAKE

Check inner disc diameter to establish whether it can be reused.

Measure the inner disc diameter with a sliding gauge without moving the arms to an angle.

Measure the drum diameter in several spots to determine ovality and wear. Also examine depth of scoring on the braking surface.

Max permitted ovality and/or eccentricity tolerance is 0.1 mm.

Replace the disc if wear or evident signs of overheating are found (see specifications and data table).

Check brake jaw conditions and replace if anomalies are found.

If the brake lining surface is oily, trace the cause and repair the fault.

The minimum brake seal thickness is 3.5 mm for models 60C - 65C, and 1.5 mm for models 35C - 40C - 45C - 50C.

If this is not so, even if only slightly above or below the specified value, replace them.

Check serviceability of shoe return springs.

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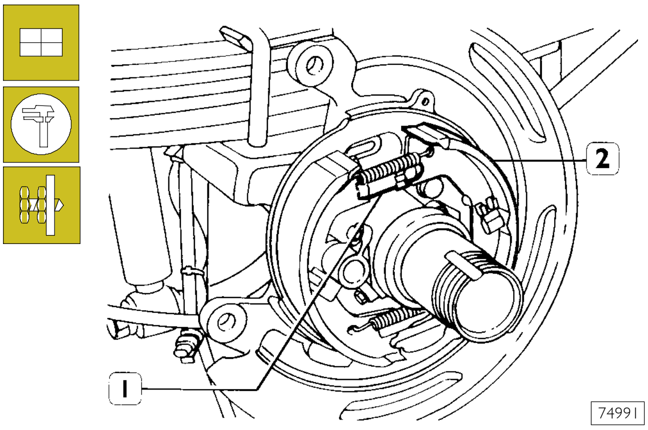
Assembly

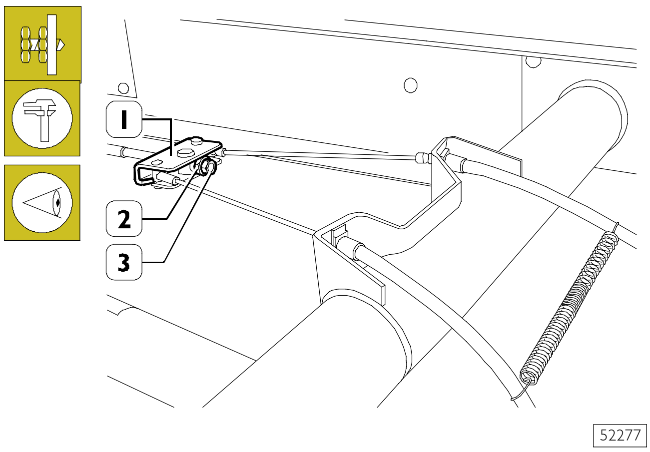
Figure 91



Loosen the tensioner under the chassis in the middle of the vehicle.
Reverse disassembly operations to reassemble.
Using a sliding gauge, measure the diameter of the brake seal (2), check that the values correspond with those indicated on the specifications and data tables, if not, adjust the device (1) until the correct values and data are obtained.

5027 Adjusting parking brake
(vehicles with parking drum brake)

Figure 92



A. Play recovery is not automatic. Minor lever stroke extension (corresponding to approximately 2 notches in addition to the normal lever stroke which is 7 notches) by means of the tensioner (1) as shown below:

- lift the rear of the vehicle, resting the chassis frame on the stands;
- loosen the lock nut (3);
- take the parking brake lever, in the cab, onto its third catch;
- screw down the tightener screw (2) until the rear wheels are hard to turn by hand;
- operate 3-4 times the lever in the cab to set parts, then check whether the stroke is of approx. 6 steps;
- lock the lock nut (3);
- lower the vehicle.

B. For further adjustments, it is necessary to proceed as follows:

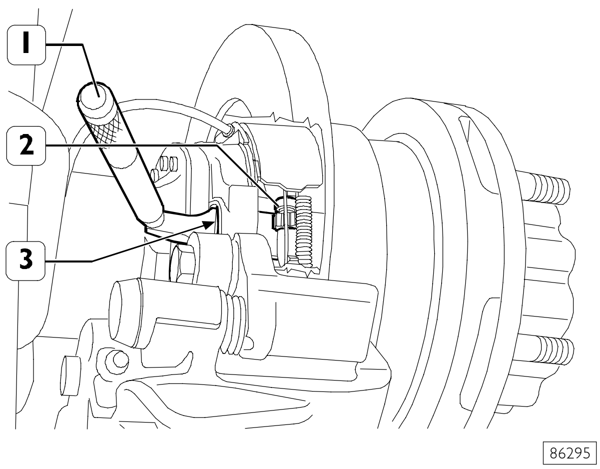
Case 1 – With disk removal

- lift the rear of the vehicle, resting the chassis frame on the stands;
- loosen the screw (2) completely;
- remove the disc as described in the "REAR AXLES" section;
- run the checks described on page 61;
- use the adjustment device (1, SENZA CODICE) to obtain the distances given in the "Specifications and Data" table;
- mount the disc and wheels. Firmly apply the parking brake a few times to settle the sheaths of the ropes;
- take the parking brake lever, in the cab, onto its third catch;
- screw down the tightener until the rear wheels are hard to turn by hand;
- lock the tightener lock nut;
- lower the vehicle.

Case 2 – Without removing disks

- lift the rear part of the vehicle resting the chassis on the supporting stands provided for the purpose and remove wheels;
- loosen the lock nut (3);

Figure 93



- remove the brake upper slot rubber plug (3);
- use tool 99372249 (1) to operate the manual adjuster internal ring nut (2) and widen the shoes until the disk can no longer be turned using just the hands;
- always with tool 99372249 (1), loosen the above mentioned adjusting ring nut (2) by 3 notches and check whether the disk is free to turn;
- refit the rubber plug into the slot;
- refit rear wheels;
- set the lever in the cab to the third position;
- screw the tightener screw (2, Figure 81) until wheels can no longer be turned using just the hands;
- operate 3-4 times the lever in the cab to set parts, then check whether the stroke is of approx. 6 steps;
- lock tightener lock nut;
- lower the vehicle.

NOTE Should new brakes/disks be replaced at the same time, drum brakes are not to be adjusted. Only adjust the main cable tightener since brakes are adjusted yet to the rated installation value.

Vehicles with parking brake on brake disc

Clearance recovery is automatic, but if the ropes are removed or replaced it is necessary to adjust their length in accordance with points A and B.

REPLACING THE ESP COMPONENTS

Some modifications or repairs affecting the ESP system components require a specific calibration procedure.

The repairs that require such procedure are detailed as follows:

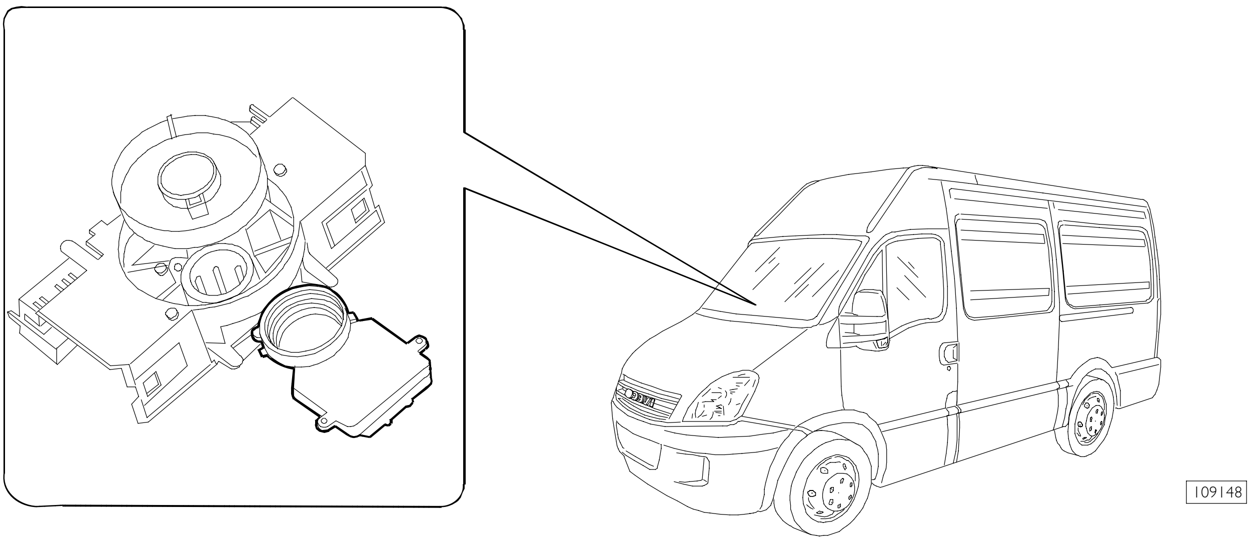
- ❑ replacing the electronic control unit (integrated into the electrohydraulic modulator) of the system's braking apparatus;
- ❑ replacing the steering angle sensor fitted inside the steering wheel;
- ❑ replacing the longitudinal acceleration sensor.

NOTE Replacing the yaw sensor requires no calibration.

STEERING ANGLE SENSOR

Replacing

Figure 94



Below is the description of sensor calibration only. As far as steering angle sensor replacement is concerned, refer to the description on page 24 of the "Steering" section.

Calibration

With both the steering-wheel and the wheels in straight position (after checking toe-in), you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.
Use a diagnosis instrument to clear the errors.
Carry out a road test, to make the control unit verify whether errors are still found. Drive along a straight road at a constant speed. Steer to the right and then to the left several times, after making sure you do not endanger other drivers.

NOTE Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

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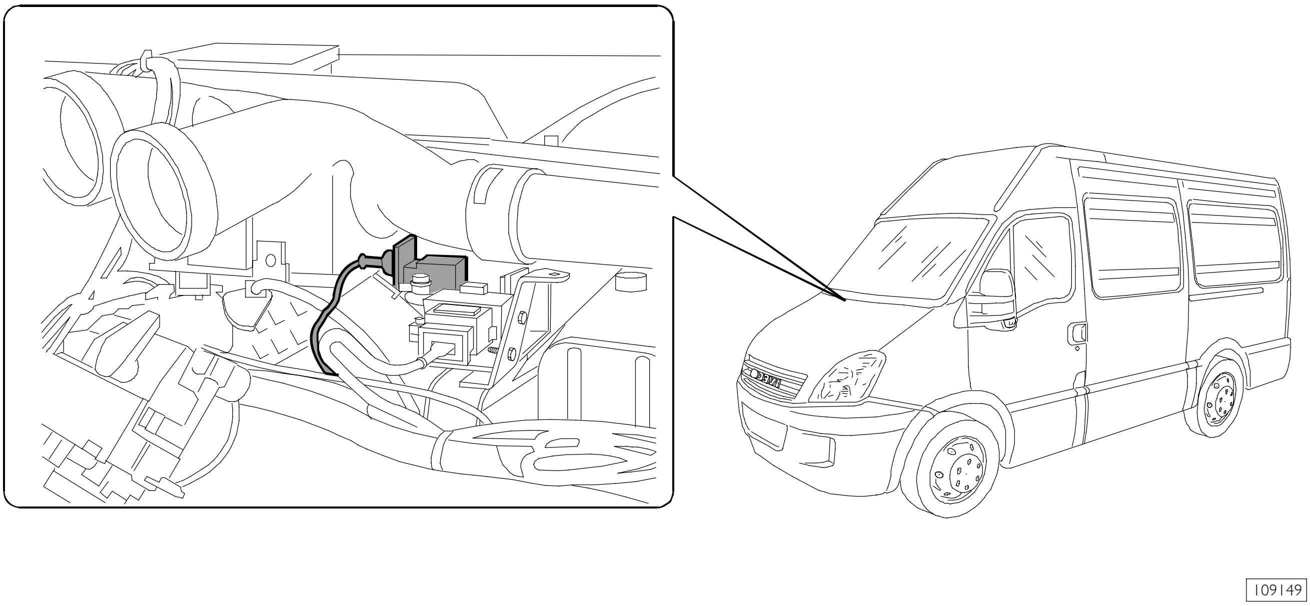
526741104 LONGITUDINAL ACCELERATION SENSOR

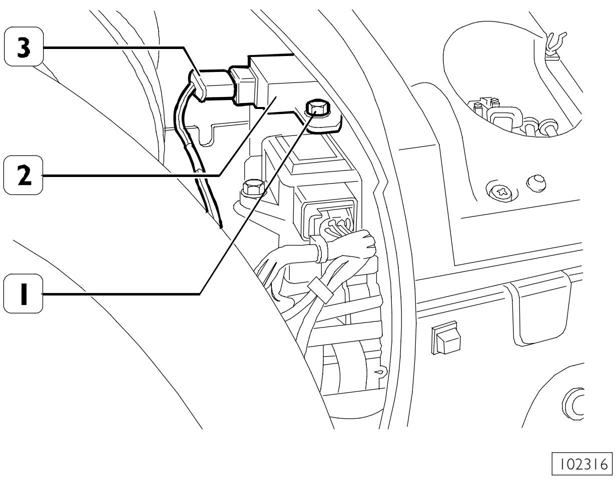
Figure 94



Removal

Disconnect the battery cables in the engine compartment.
Take off the instrument board covering.

Figure 95



Disconnect electric connection (3).
Unscrew the two sensor (2) fastening screws (1).
Remove sensor (2).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. Also follow the advice below:

- never change the sensor position and fastening points. The sensor features an offset position compared with the vehicle centre line, which must not be modified.
- After re-attachment has been completed, follow the calibration procedure described below.

Calibration

Calibration must be carried out with the vehicle on a flat ground.

Assign the sensor "zero" position by means of the diagnosis instrument.

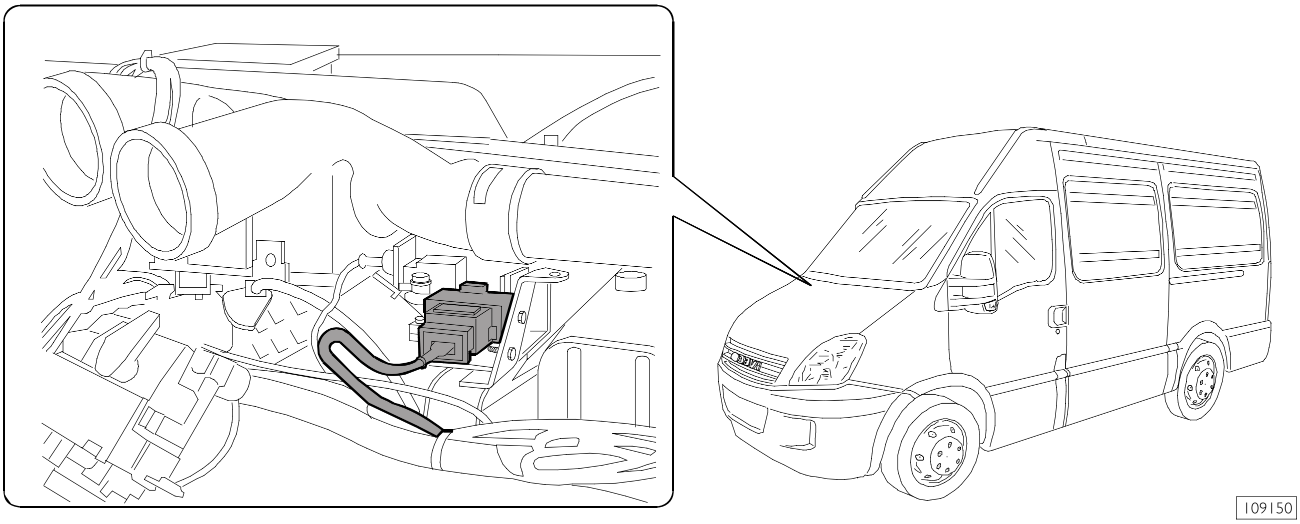
Always clear the errors (if any) found in the control unit memory by means of the diagnosis instrument.

Carry out a functional road test to verify whether errors are still found.
This consists of driving the vehicle to a slight slope and subsequently verifying whether the vehicle is kept braked over 2.5 seconds.

Drive back to the service centre, then use a diagnosis instrument to verify that no anomaly is found any longer.

526742104 YAW SENSOR

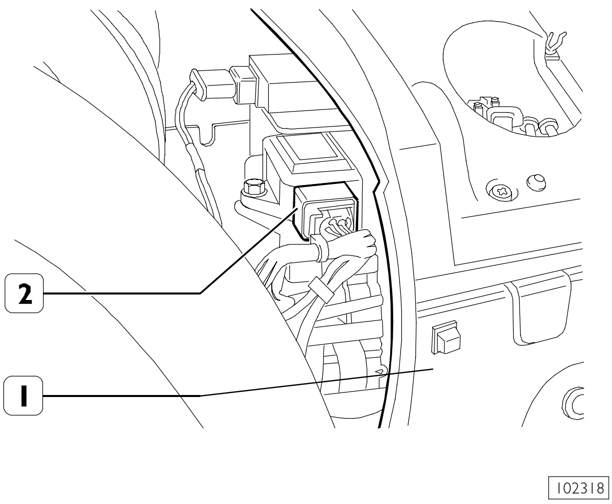
Figure 96



Removal

Disconnect the battery cables in the engine compartment.
Take off the instrument board covering.

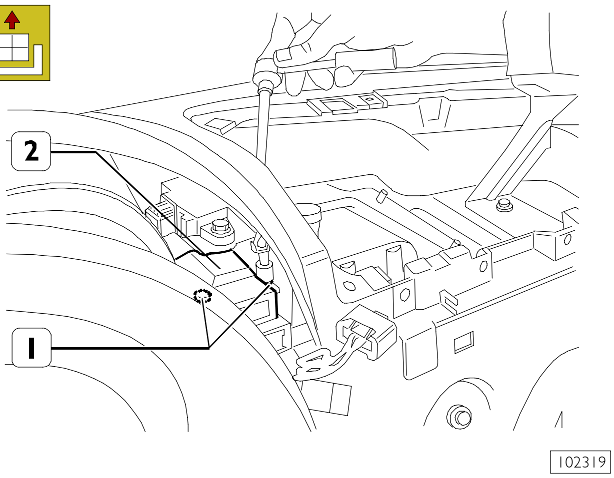
Figure 97



Disconnect electric connection (2).

Take off glove compartment (1) on the passenger's side. If the vehicle is equipped with passenger's airbag, follow the safety rules indicated in the relevant chapter of the "Steering" section.

Figure 98



Unscrew the two sensor (2) fastening screws (1) by using a suitable wrench to remove the side right screw, considering that the latter cannot be accessed easily. Then, remove sensor (2).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. Also follow the advice below:

- never change the sensor position and fastening points. The sensor features an offset position compared with the vehicle centre line, which must not be modified.

Calibration

NOTE Replacing the yaw sensor requires no calibration procedure.

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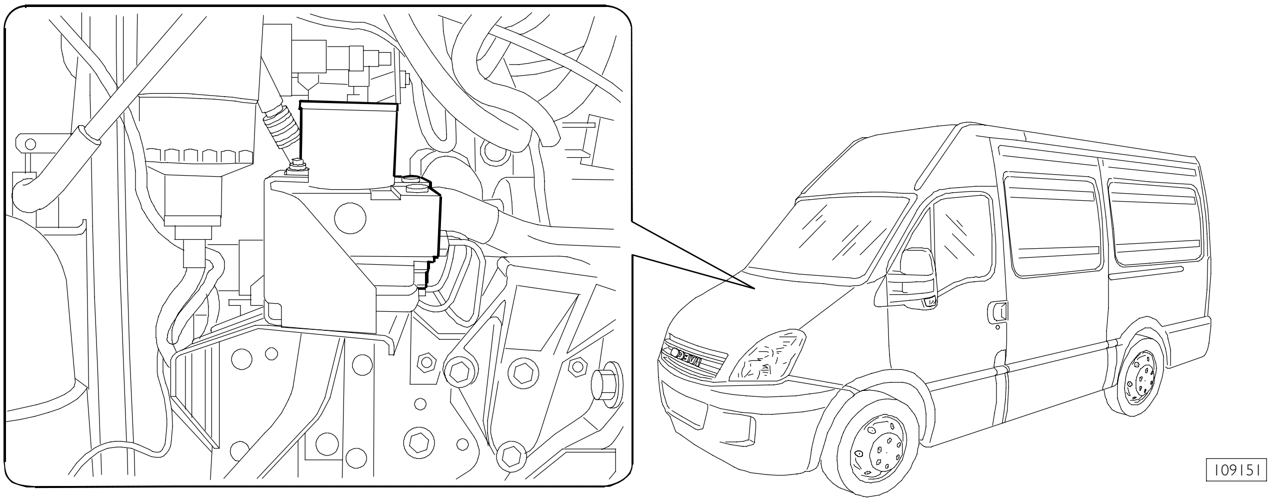
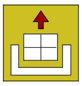
526741104 ELECTROHYDRAULIC MODULATOR/CONTROL UNIT

Figure 99

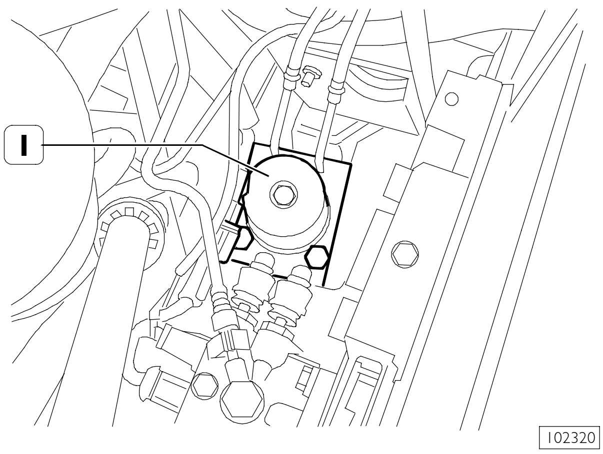


Removal



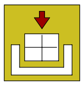
Disconnect the battery cables in the engine compartment.
Take off the hydraulic braking system fluid cap, then remove the filter.
Suck the braking system fluid by means of a syringe.

Figure 100



Disconnect the six oil ducts from modulator (1).
Clear the modulator parts of the oil escaped when disconnecting the ducts.
Disconnect the electric connection.
Loosen the screws securing the modulator to the support bracket.
Remove the modulator/control unit (1).

Refitting



Re-attachment is carried out by reversing the order of detachment operations. Also follow the advice below:

- connect the connector with great attention, taking care to insert it perpendicularly to the seat to avoid damaging the pins;
- after re-attachment has been completed, perform the programming and calibration procedures described below.

Programming

Programming requires entering the following variant codes (by means of the diagnosis instrument): type of drive, engine, MTT, wheelbase, type of front and rear suspensions, height.

Easy compares the type of vehicle (PIC reading) with the control unit code to avoid installation errors (single wheels instead of dual wheels), and downloads the variant codes into the control unit.

Calibration

Replacing the modulator/control unit requires calibration of the longitudinal acceleration sensor (described on page 64). In this case, the steering angle sensor shall not be calibrated since it features its own internal memory.

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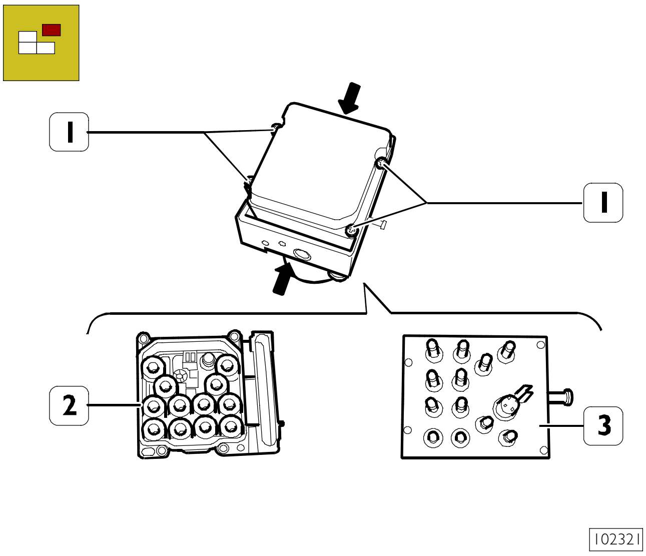
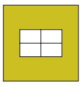
Bench overhauling

Disassembly

Figure 101



Loosen the four screws (1) securing control unit (2) to electrohydraulic modulator (3).
Take control unit (2) out of the modulator.



Assembly

Re-attachment is carried out by reversing the order of detachment operations.

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SECTION 12

5501 Bodywork
5001 Chassis Frame
5532 Cab air-conditioning

NOTE As far as the chassis is concerned, refer to printed document no. 603.93.461

Print 603.93.651

SAFETY STANDARDS TO OBSERVE WHEN WORKING ON VEHICLES EQUIPPED WITH THE AIR-BAG SYSTEM

Before doing any work, you MUST observe the SAFETY rules given in section 10 “Steering system”

CAB AIR-CONDITIONING

General

The purpose of the air-conditioning system is to make the cab comfortable as regards the following parameters:

- temperature and relative humidity of outside air;
- temperature and relative humidity in the cab.

The system subjects the air to thermodynamic transformations that affect its temperature, relative humidity and purity. This is accomplished by:

- **Ventilation**, or introducing air taken from the outside (therefore with the temperature and humidity of the surrounding environment) into the cab.
- **Air-conditioning**, or cooling and de-humidifying the air, with the possibility of heating it afterwards as preferred so as to change the temperature and humidity in the cab.

VENTILATION

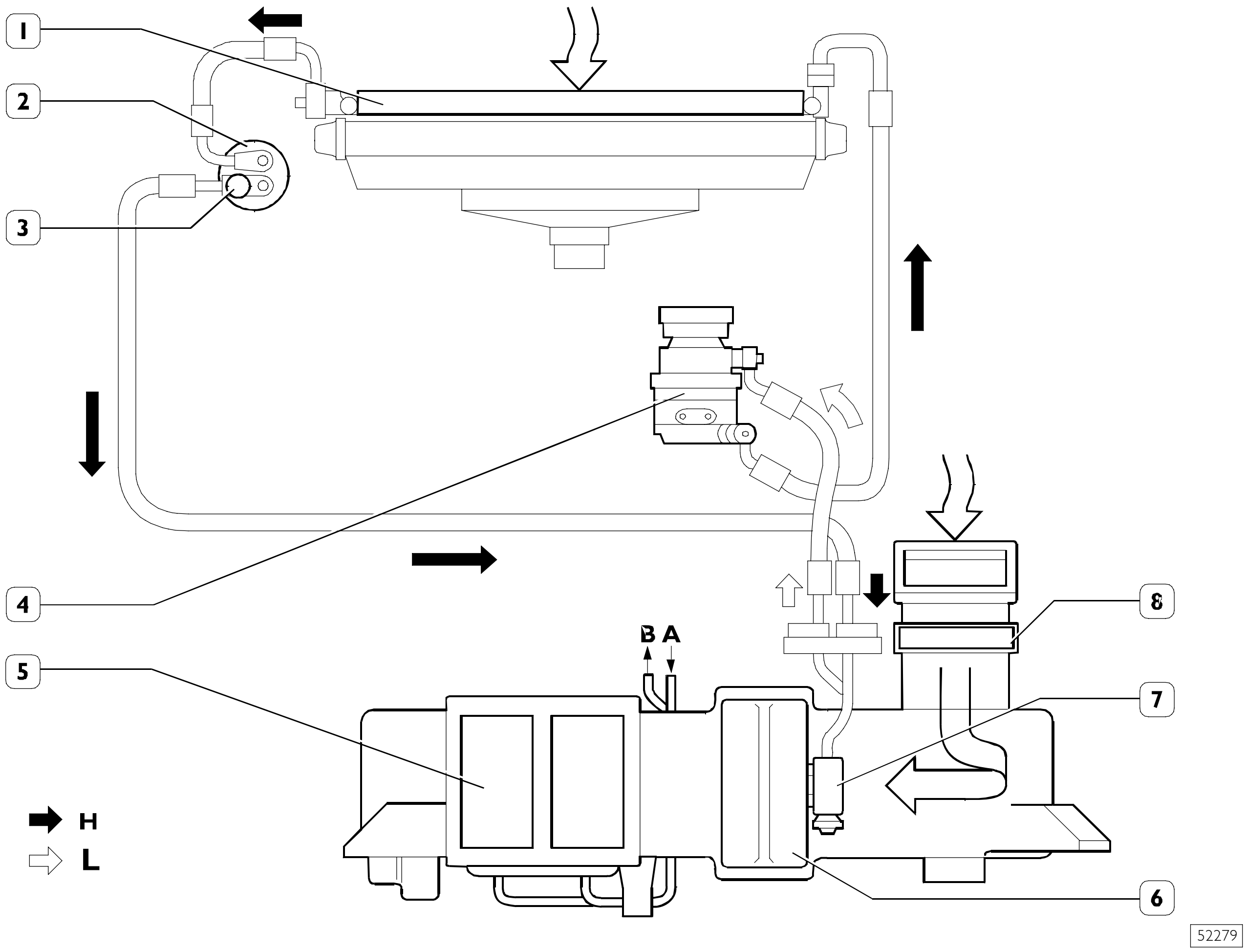
Description

Ventilation is the function of drawing in fresh air from the outside, cleaned of pollen and dust by a special filter, or recycling the air in the cab.

This system is composed of a shell, designed to house the electric fan unit, air ducts, fresh air intake and recycled air intake. The electric fan has several speeds to draw in and circulate large masses of air.

AIR-CONDITIONING SYSTEM MAIN COMPONENTS AND FUNCTIONAL DIAGRAM

Figure 1



A. Refrigerant liquid inlet - B. Refrigerant liquid outlet - H. High-pressure circuit - L. Low-pressure circuit.

1. Condenser - 2. Three-level pressure switch - 3. Drier filter - 4. Compressors - 5. Heater/fan unit - 6. Evaporator - 7. Expansion valve - 8. Pollen filter.

AIR-CONDITIONING AND HEATING

Description

This is accomplished by integrating an air-conditioning and a heating system.

This integration makes it possible to change the temperature and humidity in the cab.

Air-conditioning

Air-conditioning is accomplished by taking advantage of the high capacity of some gases to lower temperature considerably in their phase of expansion, thereby making it possible to absorb heat from the cab.

This condition is obtained by two different levels of pressure (high, when the refrigerant fluid is in its liquid state, and low, when the fluid is in its gaseous state) that are established and maintained during operation of the system.

Heating

Heating is accomplished by a radiator, in the heater unit, in which the engine coolant circulates.

Special doors allow air to pass through the radiator only when the heating function is activated.

The main components of the air-conditioning and heating system comprise:

- compressor (4);
- condenser (1);
- drier filter (2);
- three-level pressure switch (3);
- expansion valve (7);
- evaporator (6);
- heater/fan unit (5);
- pollen filter (8).

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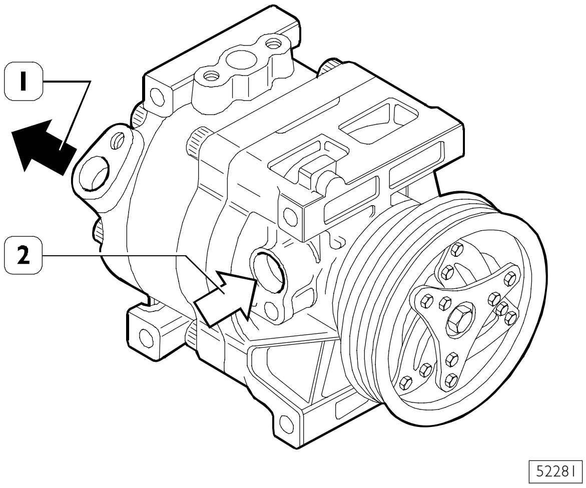
MAIN COMPONENTS

553239 Compressor

Figure 2

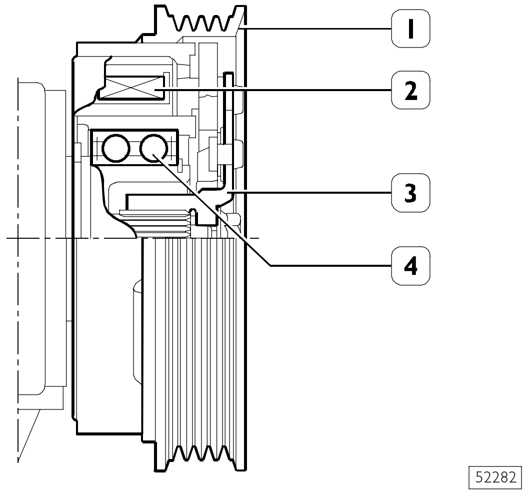


The compressor is located between the evaporator and the condenser. Its function is to:

- draw refrigerant fluid in the form of vapour at low pressure and low temperature from the evaporator through the inlet (2);
- compress the refrigerant fluid drawn up and introduce it at high temperature and high pressure into the condenser through the outlet (1).

The compressor is driven by the electromagnetic friction device mounted on the compressor shaft.

Figure 3



The electromagnetic friction device is composed of an electromagnetic coil (2), a pulley (1) and a front disc (3).

When the system is not running, the pulley (1) turns idle on the bearing (4) since it is driven by the engine via the V-belt.

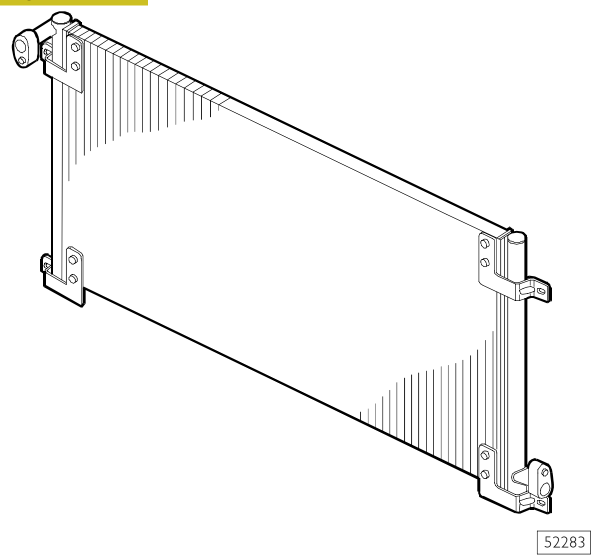
On switching on the air-conditioning system, the electromagnetic coil (2) attracts the front disc (3) on the pulley (1) that comes to be virtually keyed onto the compressor shaft and makes it rotate.

Specifications and data

COMPRESSOR		
Type		SCO 8 C
Displacement	cm^3	80 cm^3
Stroke	mm	33
Rev. No.: Max	RPM	7800
Refrigerant		
Oil type		ND - OIL 8
Refrigerant amount	kg	0.72
Oil amount		80 ± 20 cm^3
Airtightness test		3.14 MPa
Pressure test	High	530 MPa
	Low	250 MPa
ELECTROMAGNETIC FRICTION		
Torque	min	26 Nm
Voltage rating	V	12
Absorbed pressure	W	max 35
Weight	kg	1.5
Belt		4k-type
Pulley actual diameter	mm	105

553232 Condenser

Figure 4



The condenser is a heat exchanger located between the compressor and the drier filter. Its function is to transform the refrigerant fluid from its gaseous state to its liquid state.

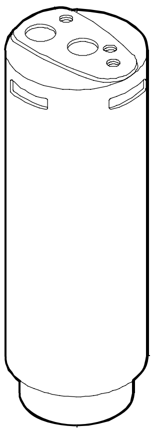
This transformation is made by the refrigerant fluid releasing heat to the outside air. This is why the condenser is installed on the vehicle so as, in the best conditions, to take advantage of the air stream produced by the forward motion of the vehicle.

When the vehicle is stationary or in a traffic jam, the flow of air needed to transform the refrigerant fluid is produced, under the control of the three-level pressure switch, by the fan for cooling the engine coolant.

NOTE The condenser located in vehicles with F1C engine, has the drier filter incorporated.

553234 Drier filter

Figure 5



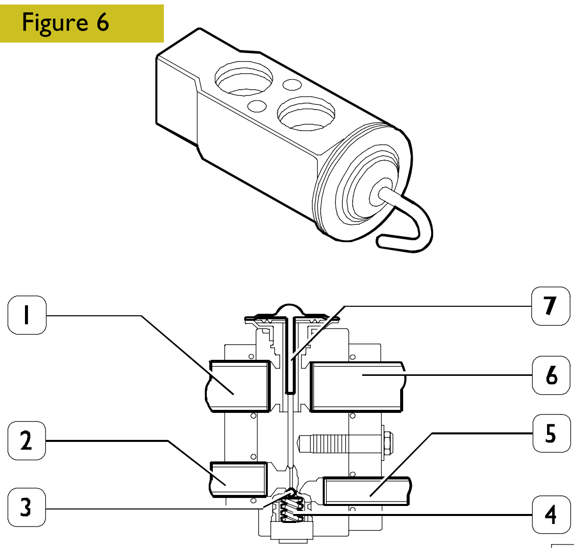
52284

The drying filter is located between the condenser and the expansion valve. On the vehicles equipped with the F1C engine, it is incorporated into the condenser and performs the following function:

- reserve tank for excess refrigerant fluid during variable filling phases;
- filtering element for the solid particles generated by compressor wear;
- eliminating the moisture formed in the system.

553233 Expansion valve

Figure 6



52285

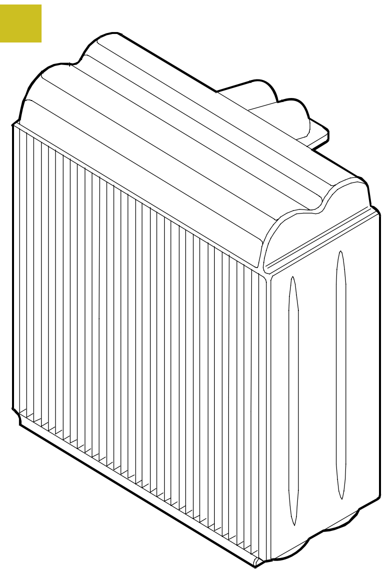
The expansion (block) valve is located between the drier filter and the evaporator.
Its function is to control and proportion the flow of refrigerant fluid to get the highest refrigerating capacity out of the system and to lower the pressure of the refrigerant (at the filter outlet) to a pre-set value so that the fluid, circulating in the evaporator, can be drawn up by the compressor in a completely gaseous form.

This valve has two passages for the refrigerating fluid:

- the bottom one enabling the refrigerant to pass (5) from the drier filter to the evaporator (2). Along this route there is a spring (4) that, appropriately set, makes it possible to obtain such a leap in temperature (overheating) as to make sure that the refrigerant, at the evaporator inlet, is entirely in its gaseous state. In addition, there is also a modulating element, in this case a ball (3) housed in the gauged pipe that controls the flow rate of refrigerant to the evaporator;
- the top one enabling the refrigerant to pass (1) from the evaporator to the compressor (6). Along this route there is a temperature sensor (7) that, depending on the temperature at the evaporator outlet, makes it possible to control the flow rate of refrigerant, by means of the modulating element (3), and control the overheating, by means of the spring (4).

553231 Evaporator

Figure 7



52286

The evaporator is a heat exchanger located between the expansion valve and the compressor.

Its function is to:

- change the state of the refrigerant from a liquid, at the inlet, to a gas, at the outlet;
- absorb the heat in the cab and thereby produce the required refrigerating effect.

To be able to perform these functions, an electric fan draws warm, moist air from the cab and conveys it onto the evaporator.
Since this air is at a higher temperature than the refrigerant, it gives some of its heat to the refrigerant and cools down, while the moisture it contains condenses on the evaporator fins in the form of droplets.
This produces cold, dehumidified air.
This change takes place with considerable heat absorption.
A special channel collects the condensation formed and discharges it outside.
The considerable cooling of the radiating pack is due to the change in state, from liquid to gas, of the refrigerant.

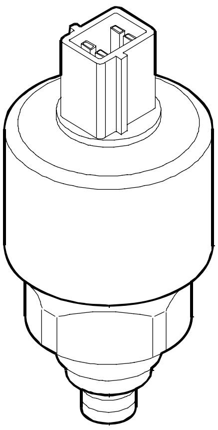
CONTROL AND SAFETY DEVICES

Description

The system is equipped with specific devices that, by checking the pressure and temperature, make it possible to protect the system from possible trouble and provide optimal operation.

553235 Three-level pressure switch

Figure 8



52287

The three-level pressure switch is mounted on the pipe connecting the drier filter to the expansion valves. It has the task of operating the electric fan for the condenser and radiator when the vehicle is stationary or running at low speed, so there is no air stream caused by the forward motion of the vehicle, and it is therefore necessary to activate refrigerant condensation by forced ventilation.

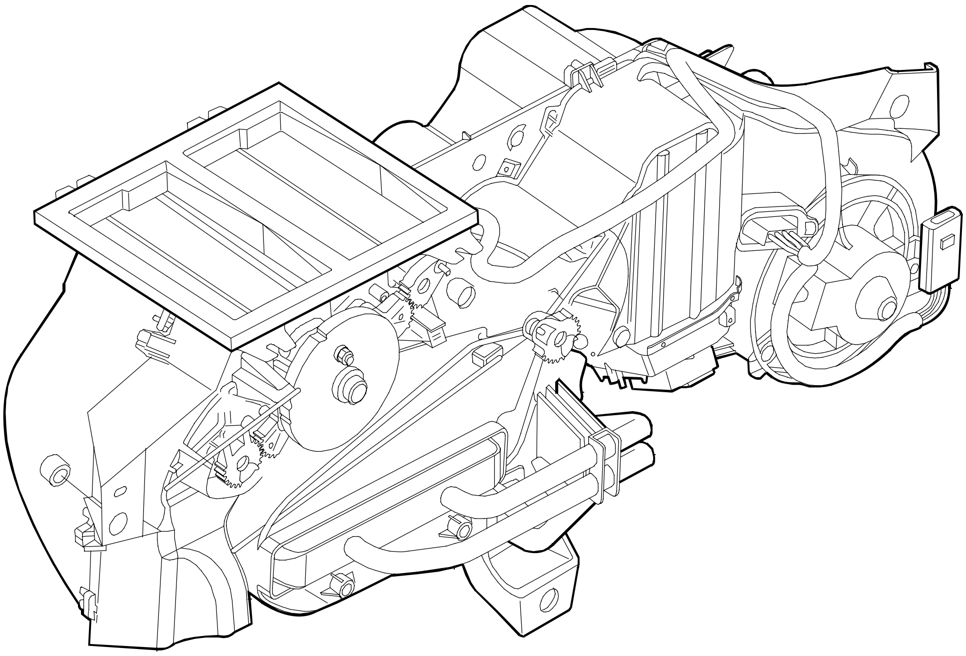
In addition, it has the task of disconnecting the electromagnetic coupling of the compressor pulley when the pressure of the fluid (high pressure side), in spite of the action of the condenser and radiator fan, reaches dangerous limits or when the heating load conditions are not sufficient to make the refrigerant evaporate.

553242 Outside air temperature sensor

It is fitted into the left side rear-view mirror.

553230 AIR-CONDITIONING UNIT ("M. MARELLI" OR "DENSO" TYPE)

Figure 9



General

A special casing, configured so as to permit insulation, houses the radiator-heater, evaporator, fan unit, internal air (recirculation air) and external air (fresh air) intakes, direction flaps, ducts and vents for the flow of treated air.

This unit has to control the following parameters and functions automatically under the control of the control unit: air temperature at vents, fan speed, air distribution, recirculation, and compressor activation.

The system needs to make provision for the possibility of adjusting the following parameters and functions manually: fan speed on 5 positions, air distributor on 4 positions (5 in automatic mode), recirculation, and compressor activation.

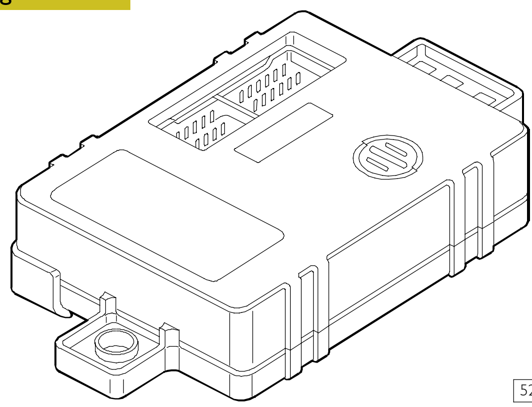
The manual controls have priority over automatic mode and are kept in memory until the user deliberately cancels the command, returning control of the relative function to automatic mode.

If one of the parameters is changed manually, the others remain under automatic control.

The air temperature at the vents is always controlled automatically to produce the temperature shown on the display in the cab (unless the system is not in operation).

553248 Electronic control unit

Figure 10



The automatic air-conditioning/heating system is controlled by an electronic control unit that governs both systems (air-conditioning and heating) and determines the mixture and quantity of air to be introduced into the cab to provide the required conditions.

To obtain the required temperature in the cab, the control unit also takes into account the data from the sensor that measures the outside air temperature.

The control unit therefore governs the following functions:

- switching the air-conditioning system on and off;
- using external or recycled air; the hot/cold air mixture;
- the amount of air to introduce into the cab (with the different fan speeds).

Every time the battery is disconnected, when it is reconnected the control unit automatically zeroes the positions.

553230 "M. MARELLI" TYPE HEATER/ AIR-CONDITIONER UNIT

Components

1. Strip on A.I. flange
2. Treated air sensor
3. Front door hatch
4. Distribution bushing
5. Recirculation door
6. LH air intake box
7. Cond. drain pipe retaining bracket
8. Mixing actuator
9. Rear box
10. Distribution bushing
11. Complete distribution door
12. Strip
13. Strip
14. Radiating mass
15. Wiring harness
16. Tie rod
17. Distribution lever
18. MAX DEF cam
19. Fan potentiometer
20. Mixing potentiometer
21. Control mounting
22. Knob adapter ring
23. Prism
24. Complete microswitch
25. Control pin
26. Knob
27. Cap spring
28. Cap
29. Condensation drain pipe
30. Strip
31. Condensation drain tub
32. Control unit
33. Condensation drain tub strip
34. Front box
35. Self-tapping insert
36. Mixing/foot door lever
37. Bushing
38. Transmission
39. Vent./demist. door lever
40. Water pipe fixing U-bolt
41. Distribution cam
42. Control mounting bracket
43. Anti-frost sensor
44. Wiring retainer clamp
45. Fan strip
46. Electric fan
47. Connection cover
48. Motor mounting
49. Spacer
50. Connector bracket
51. Electronic control
52. Evaporator
53. Distribution bushing
54. Complete distribution door
55. Evaporator strip
56. Pipe
57. OUT O-ring
58. Expansion valve
59. OUT O-ring
60. Fixing screw
61. IN O-ring
62. IN O-ring
63. Pipe passage strip
64. Pipe strips
65. A.I. actuator
66. A.I. door lever
67. RH air intake box
68. Tie rod

Figure 11

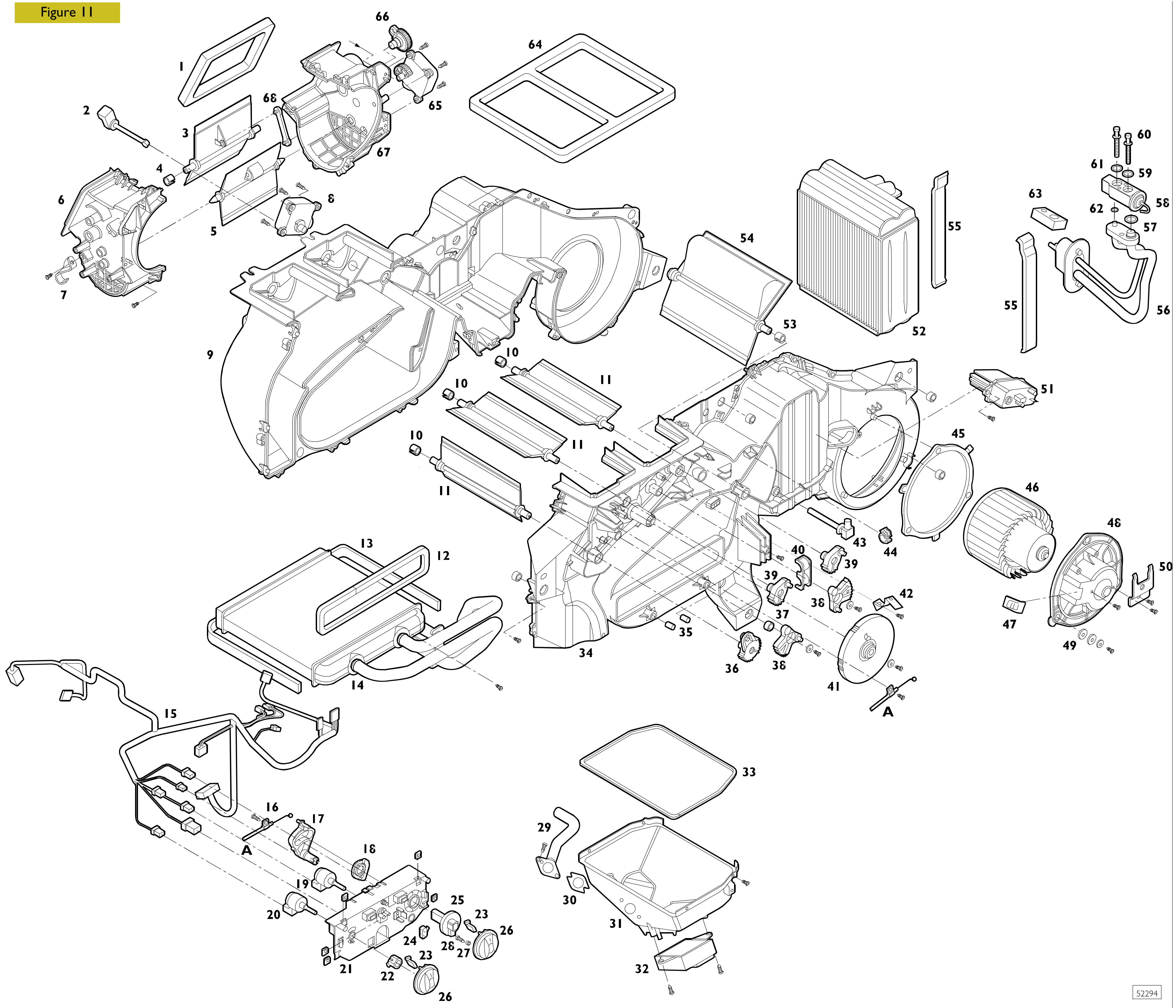
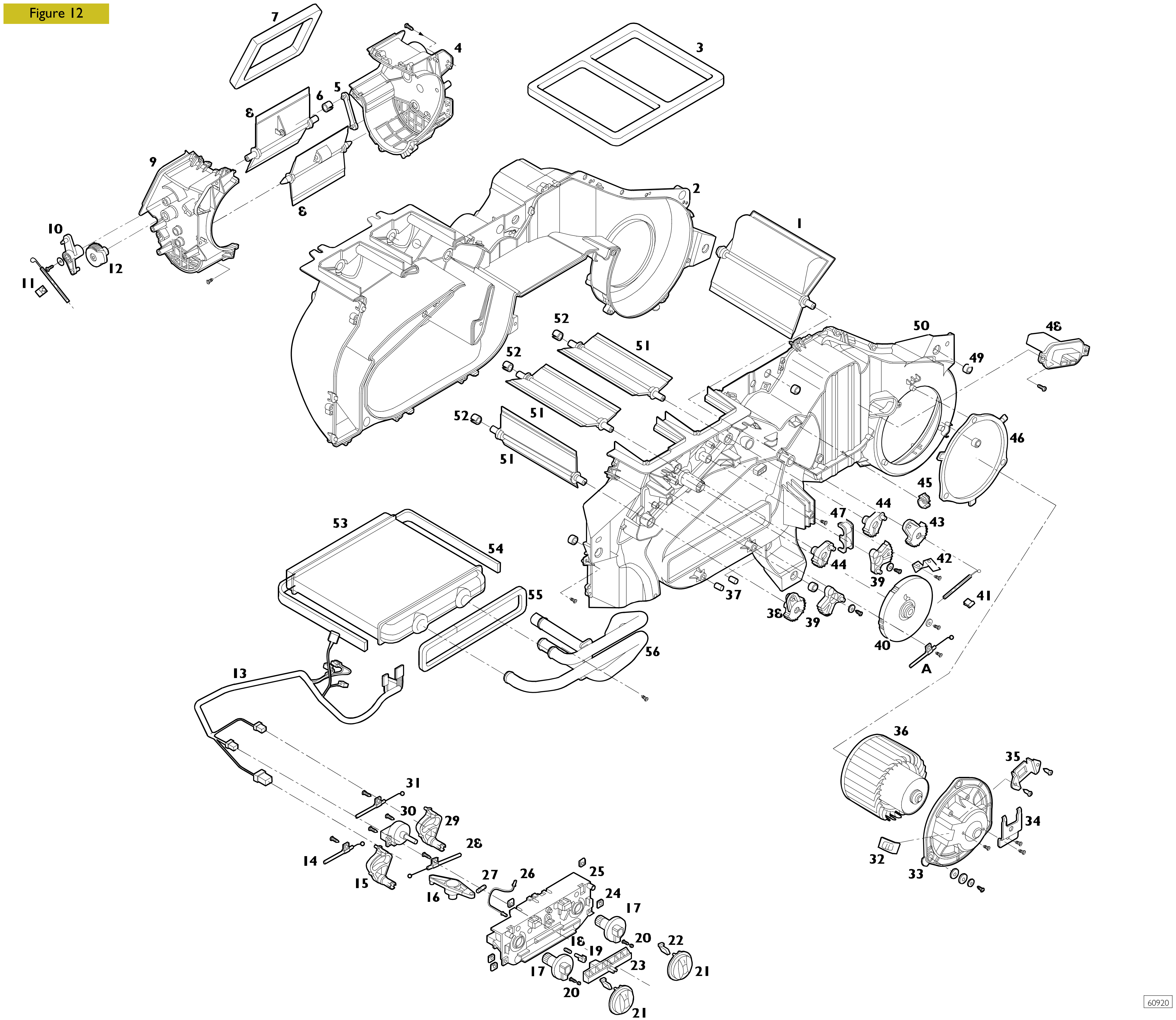


Figure 12



553210 HEATER UNIT

Components

1. Complete distribution door
2. Rear box
3. Pipe strip
4. RH air intake box
5. Tie rod
6. Distribution bushing
7. Strip on A.I. flange
8. Doors
9. LH air intake box
10. Recycle air intake control transmission
11. Bowden clip
12. A.I. door lever
13. Wiring
14. Mixing flexible transmission
15. Mixing control lever
16. Recycle air intake lever
17. Control pin
18. Spring
19. Cap
20. Cap, cap spring
21. Complete distribution - temperature knob
22. Knob prism
23. Recycle air intake cursor
24. Clamp
25. Control mounting
26. Light guide cable
27. Connecting rod
28. I.A.- REC flexible transmission
29. Distribution control lever
30. Switch
31. Distribution flexible transmission
32. Connection cover
33. Motor mounting
34. Connector bracket
35. Frame bracket
36. Electric fan
37. Self-tapping insert
38. Mixing/foot door lever
39. Transmission
40. Distribution cam
41. Mixing bowden clamp
42. Control fixing bracket
43. Mixing/foot door lever
44. Vent/def door lever
45. Wiring retainer clamp
46. Fan strip
47. Water pipe fixing U-bolt
48. 4-speed resistor
49. Bushing
50. Front box
51. Complete distribution door
52. Distribution bushing
53. Radiating mass
54. Side gasket
55. Gasket on tub
56. Water pipe assembly

A. Flexible transmission

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PROCEDURE FOR EMPTYING AND REFILLING THE AIR-CONDITIONING SYSTEMS WITH R134A REFRIGERANT

R134A refrigerant recovery and refilling station (99305146)

This station has been made to be used on all air-conditioning/ heating systems for motor vehicles using R134A gas.

By connecting the station to a refrigerating system the gas it contains can be recovered, cleaned and made ready to be reloaded into the system or be transferred to an external container. In addition, it is possible to see the amount of oil taken from the system, restore it and "empty" the system.

To be operative, the station needs to absorb approximately 3 kg of refrigerant.

For prompt use it is advised to have at least 2 kg of refrigerant in the filler cylinders and to keep the station as level as possible.

NOTE This procedure does not describe the phases of loading and unloading refrigerant to and from external and internal containers or maintenance. Therefore, please refer to the operating and maintenance manual of the appliance.

The station is composed of:

1 control panel;

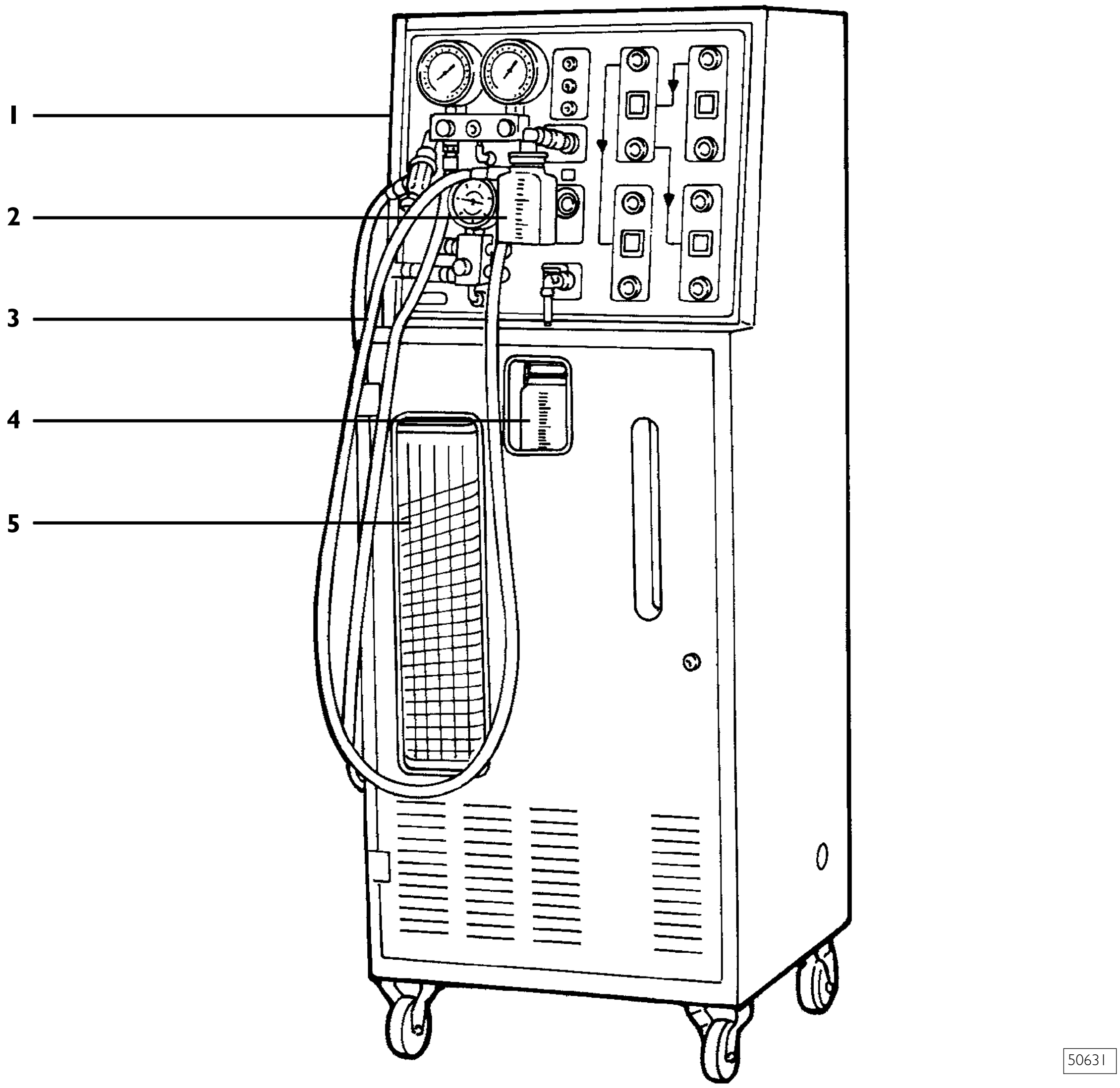
2 container to restore any oil recovered when unloading;

3 flexible hoses;

4 container to collect any oil recovered from the system;

5 filler cylinder with graduated scale revolving.

Figure 13



CONTROL FASCIA

Figure 14

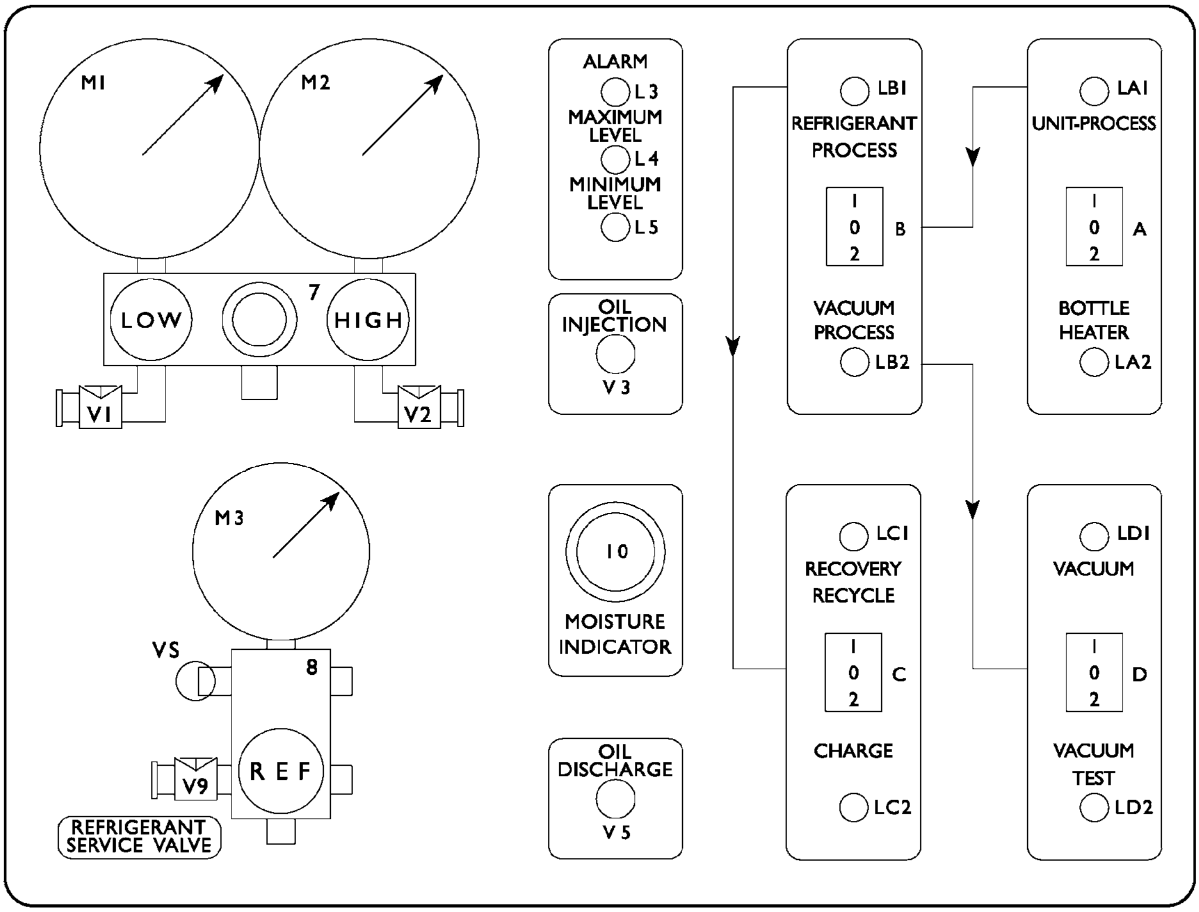


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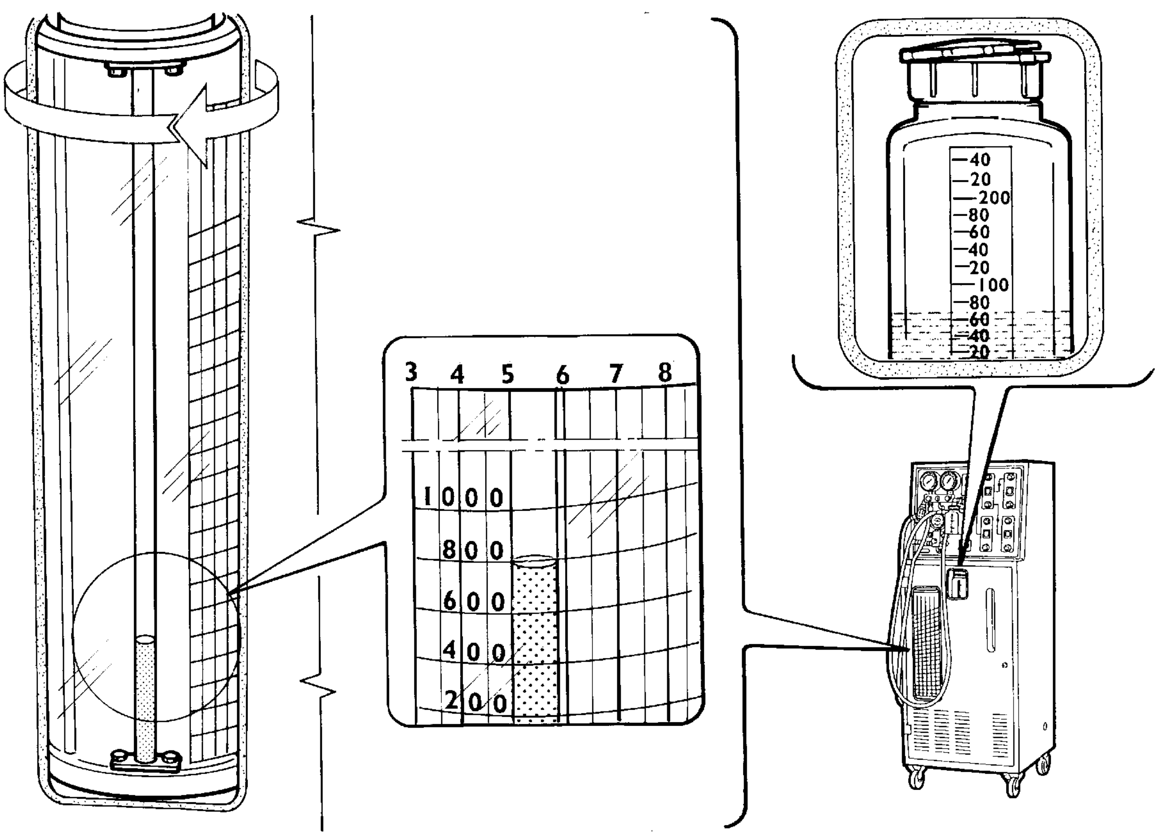
Figure 15



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Control fascia diagram legend

M1	Low pressure gauge
M2	High pressure gauge
M3	Filler cylinder pressure gauge
LOW	Low-pressure valve
HIGH	High-pressure valve
REF	Refrigerant filler and drain valve
V1	Valve on low-pressure pipe
V2	Valve on high-pressure pipe
V3	Oil injection valve for A/C system
V5	Oil drainage valve
V9	A/C system washing refrigerant service valve
10	Moisture indicator
VS	Safety and drainage valve
L3	Alarm warning light
L4	Maximum level warning light
L5	Minimum level warning light
A	Unit process / bottle heater switch
LA1	Unit process indicator light
LA2	Bottle heater indicator light
B	Refrigerant process / vacuum process switch
LB1	Refrigerant process indicator light
LB2	Vacuum process indicator light
C	Recovery recycle cycle / Filling switch
LC1	Recovery recycle cycle indicator light
LC2	Filling indicator light
D	Vacuum / vacuum test switch
LD1	Vacuum indicator light
LD2	Vacuum test indicator light

Filler cylinder legend

1 Pressure values in bar (vertical lines, revolving top cylinder).

2 Weight of load in grams (oblique lines, revolving top cylinder) 50 g division between lines.

3 Tank level viewer (internal cylinder).

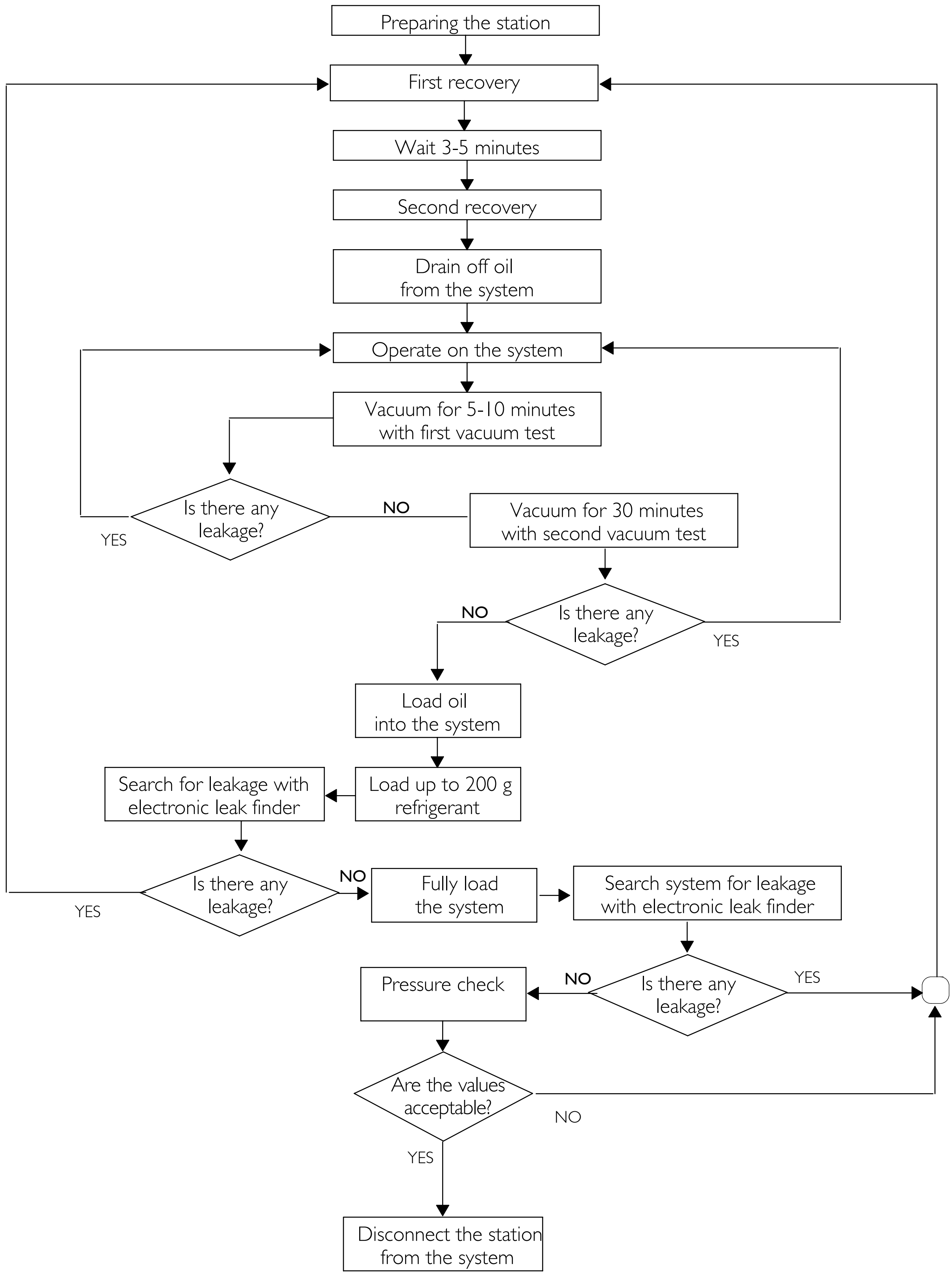
SAFETY STANDARDS


This station is exclusively for professionally trained operators who must be familiar with refrigerating systems, refrigerant gases and the damage pressurized equipment can cause, therefore:

- always wear gloves and goggles when working with refrigerant gases. Contact of refrigerant liquid with the eyes can cause blindness;
- avoid all contact with skin (low boiling point -30°C can cause frostbite);
- never inhale the vapours of refrigerant gases;
- before connecting the station with a system or external container, check that all the valves are closed;
- before disconnecting the station, check that the cycle is over and all the valves are closed. This will prevent dispersing refrigerant gas into the atmosphere;
- never expose the unit or operate it in acidic or wet environments or close to open containers of inflammable substances;
- the unit must operate in places with good ventilation;
- never alter the settings of the safety valves and control systems;
- never use bottles or other storage containers that are not approved and are not fitted with safety valves;
- never load any container over 80% of its maximum capacity;
- never leave the unit powered if it is not to be used immediately. Cut off the mains power supply when it is not planned to use the equipment.

The station is equipped with special fittings to avoid contamination with systems using R12. Do not attempt to adapt this unit for use with R12.

OPERATION FLOW CHART



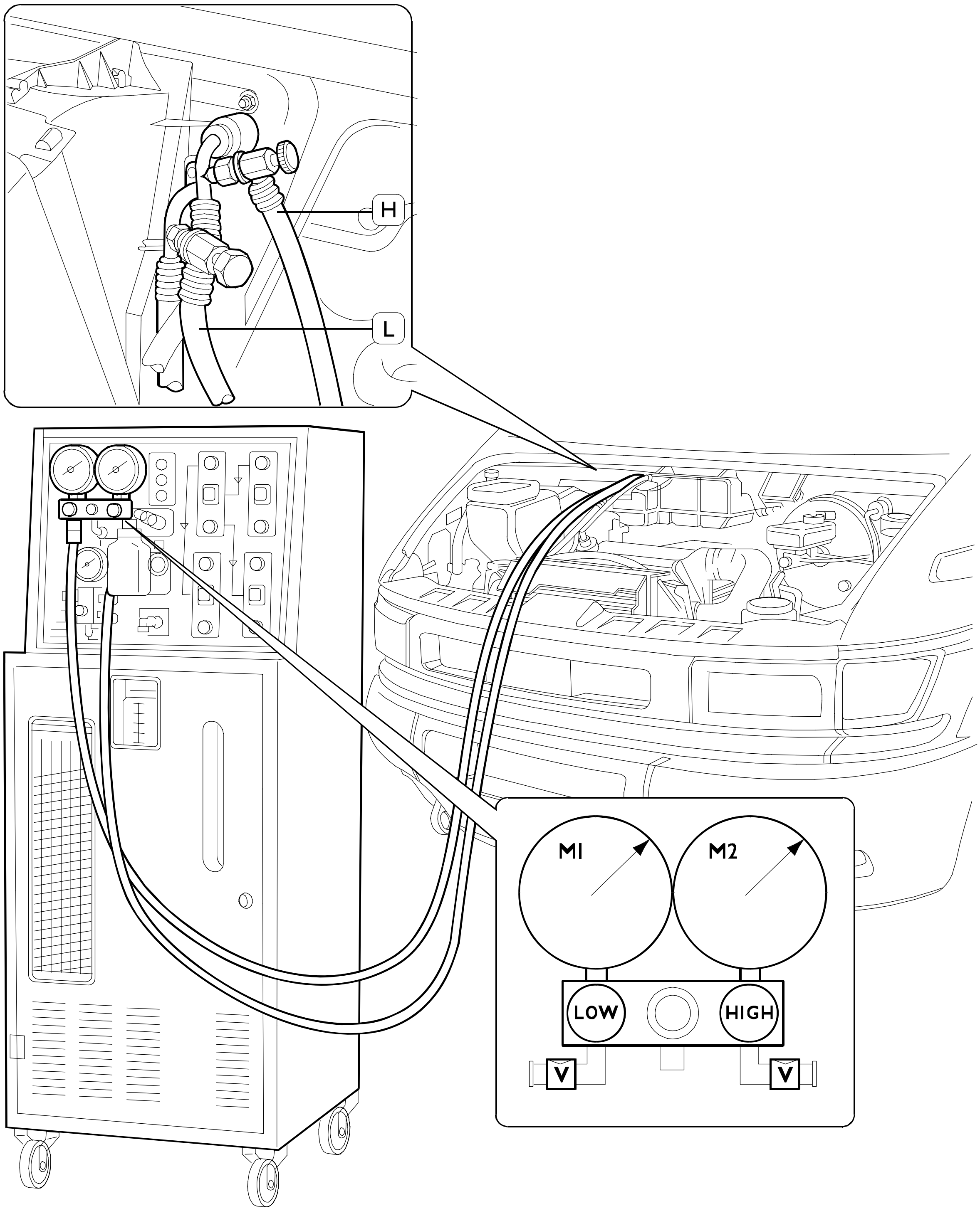
RECOVERING REFRIGERANT FROM THE VEHICLE SYSTEM

Before starting to disconnect the pipes from the air-conditioner, check whether it is possible to do the repairs without discharging the gas.

If this is not possible, the following operations must be carried out:

- Connect the pipe marked **HIGH** under the pressure gauge to the evaporator inlet (the inlet is the one on the pipe with a smaller diameter (H) connecting the drier filter with the evaporator).
- Connect the pipe marked **LOW** under the pressure gauge to the evaporator outlet (the outlet is the one on the pipe with a larger diameter (L) connecting the evaporator with the drier).
- Open the valves **V1** and **V2**.
- Open the **LOW** and **HIGH** cocks.

Figure 16



DEMONSTRATIVE FIGURE

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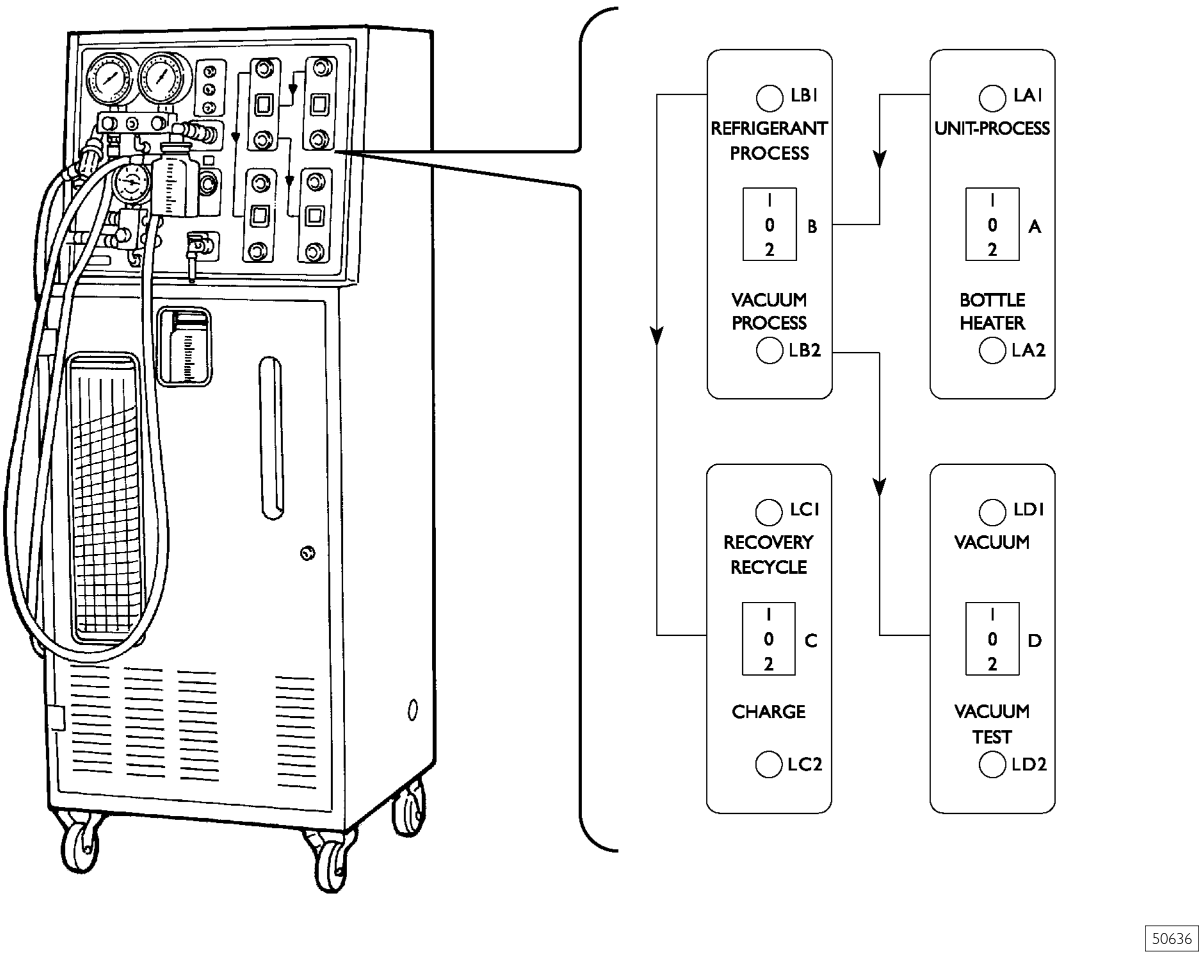
- connect the station to the electricity mains (220 V - 50 Hz);
- press the switch **A** (Process Unit) onto position I
  The respective indicator light **LA1** will come on;
- press the switch **B** (Refrigerant Process) onto position I;
- the respective indicator light **LB1** will come on;
- press the switch **C** (Recovery Recycle) onto position I.
  The recovery and recycling operation will start automatically. The respective indicator light LC1 will come on to signal the operation in progress.
  On completing this operation the unit will automatically stop and the indicator light **LC1** go out. Wait for a few minutes so that any pockets of refrigerant at low pressure remaining in the system can increase their pressure, by absorbing heat, and be able to be recovered. The station will automatically repeat the recovery cycle if the above conditions occur;
- put the switches A, B and C back onto position 0;
- close the **V1**, **V2**, **LOW** and **HIGH** valves.

NOTE If the refrigerant reaches the maximum level (maximum level indicator light L4 on), the recovery cycle must be stopped immediately by pressing switch C onto position 0 and transferring the refrigerant from the filler cylinder to a suitable external bottle.

- Continue the operations following the instructions given on the following pages.

Figure 17



CREATING A VACUUM IN THE SYSTEM

This operation should be carried out if all the repairs have been performed and the system components have been properly refitted. This operation is the phase prior to refilling, therefore proceed as follows:

NOTE Do not run the vacuum cycle when there is even minimal pressure in the station or system.

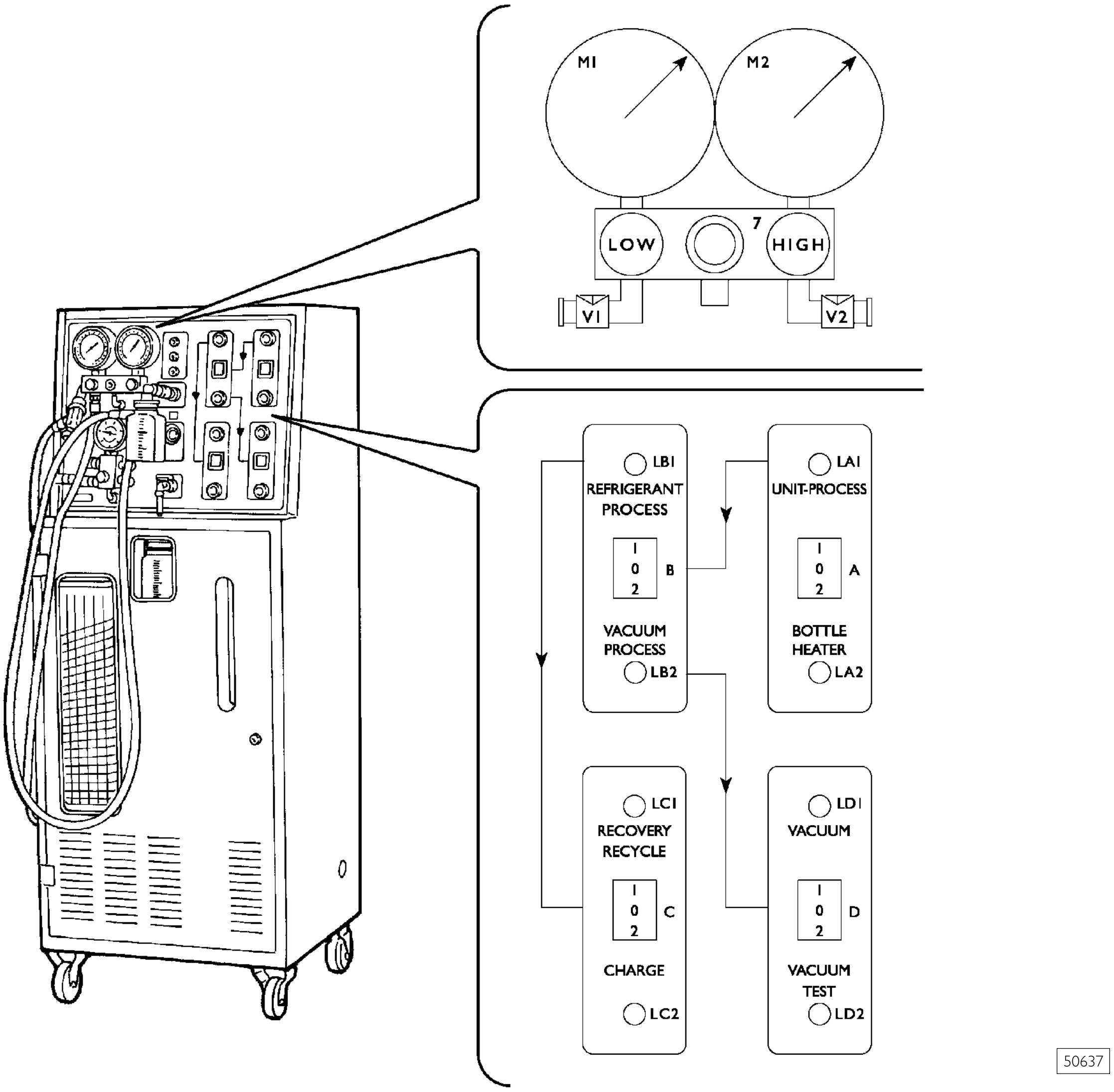
- ❑ Connect the pipes to the specific system connections and open the **V1-V2/LOW** and **HIGH** valves.
- ❑ Press the switch **A** (Process Unit) onto position 1. The respective indicator light **LA1** will come on.
- ❑ Press the switch **B** (Vacuum Process) onto position 2. The respective indicator light **LB2** will come on.
- ❑ Press the switch **D** (Vacuum) onto position 1. The system will automatically start being evacuated and the respective indicator light **LD1** will come on to signal the operation in progress.

After a few minutes of operation (10 at most) if the system has no leaks the indicator light LD2 VACUUM TEST will also come on. From this time on, evacuation should be continued for at least two hours to obtain a good evacuation.

The indicator light LD2 vacuum test fails to come on if there is a leak. Stop evacuation, eliminate the leak and repeat the evacuation procedure.

- ❑ At the end of the time programmed for evacuation, press the switch **D** (vacuum test) onto position 2 and leave the system in this state for 3-5 minutes.
  The indicator light **LD2** VACUUM TEST is on if the system has a good seal. The indicator light **LD2** VACUUM TEST goes out if there is a leak. Eliminate the leak and repeat the evacuation cycle.
- ❑ Put the switches **D** and **B** back onto position 0 and proceed with the following phase.

Figure 18



It is possible that at the end of each recovery cycle the station may have recovered lubrication oil from the compressor, which should be drained off into a specific graduated container (1).

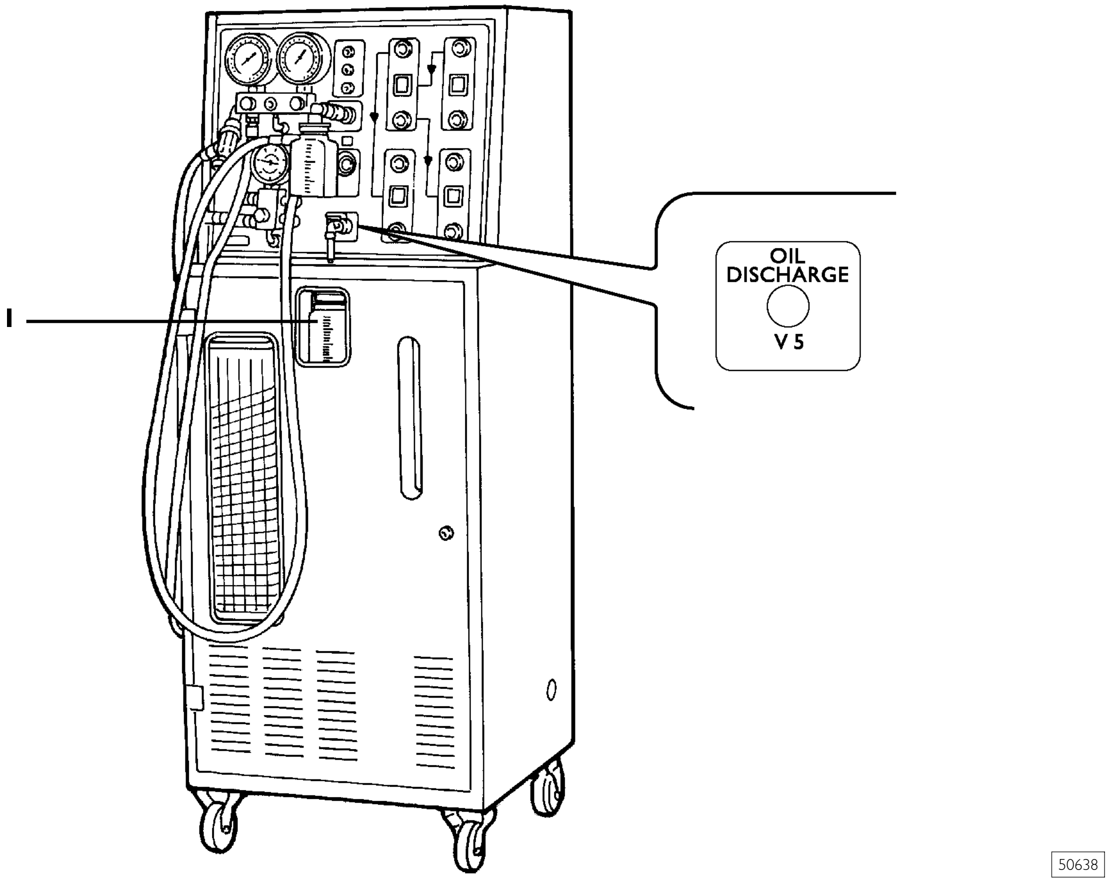
1 Slowly open the valve **V5** (Oil Discharge).

2 When all the oil has been discharged into the container (1) close the valve **V5**.

3 Quantify and **record** the amount of oil discharged.

4 Eliminate the recovered oil correctly.
This oil cannot be reused.
The same amount of new oil as has been removed must be added to the system.

Figure 19



RESTORING OIL IN THE SYSTEM

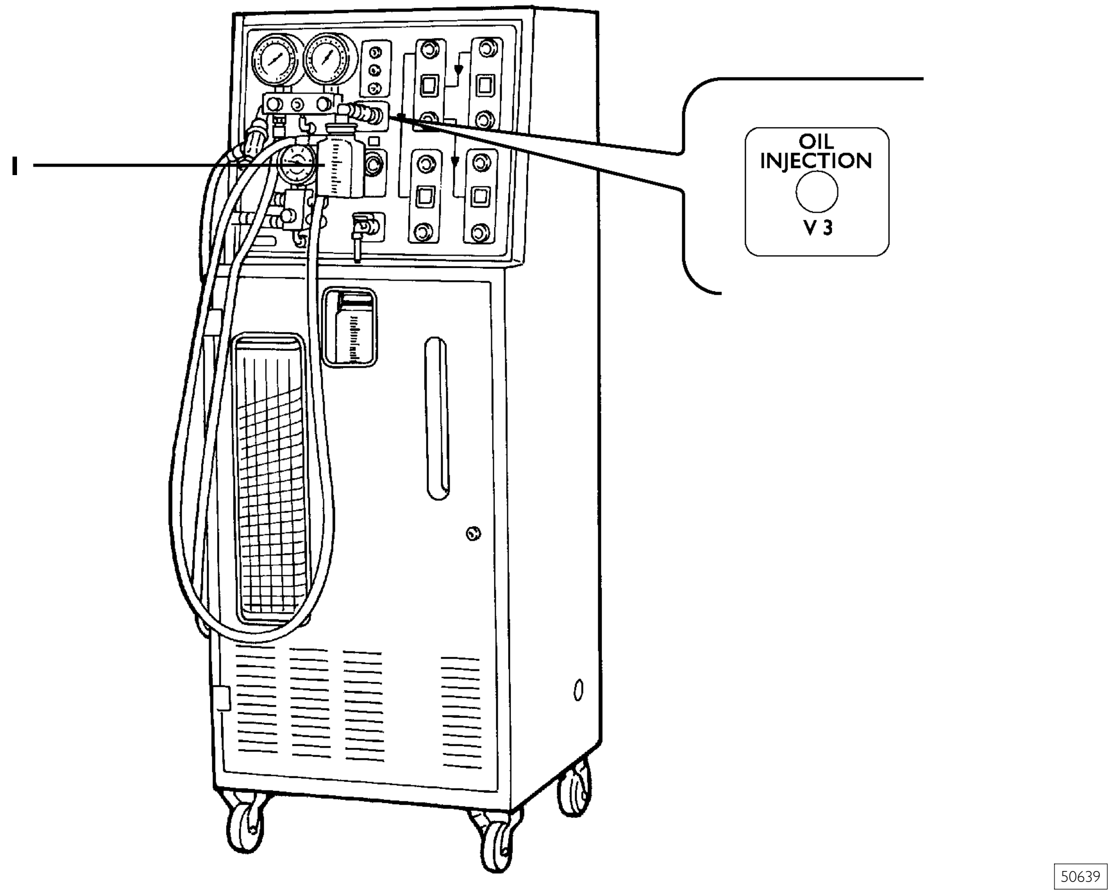
If during the recovery and recycle phase, oil from the system has been removed, it must now be replenished:

- ❑ take the metering device supplied with the right amount of lubricant for the system concerned, or previously measured;
- ❑ connect the metering device (1) to the lubricant injection valve **V3**;
- ❑ open the valve **V3** and then carry out the system vacuum phase for a few moments;
- ❑ open the valve mounted on the metering device container (1). The oil will be drawn into the system;
- ❑ close the valve **V3** and the valve on the metering device container when the required quantity of lubricant has been drawn in;
- ❑ disconnect the metering device (1) from the injection valve **V3** and fit the protective cap back on.

NOTE Keep the oil containers well sealed in order to avoid contamination. In particular, remember that oil is extremely hygroscopic:.

- ❑ never open the oil injection valve **V3** if the system has positive pressure;
- ❑ oil should only be injected with a vacuum in the system;
- ❑ the oil level must never fall under the suction pipe (air would get into the system).

Figure 20



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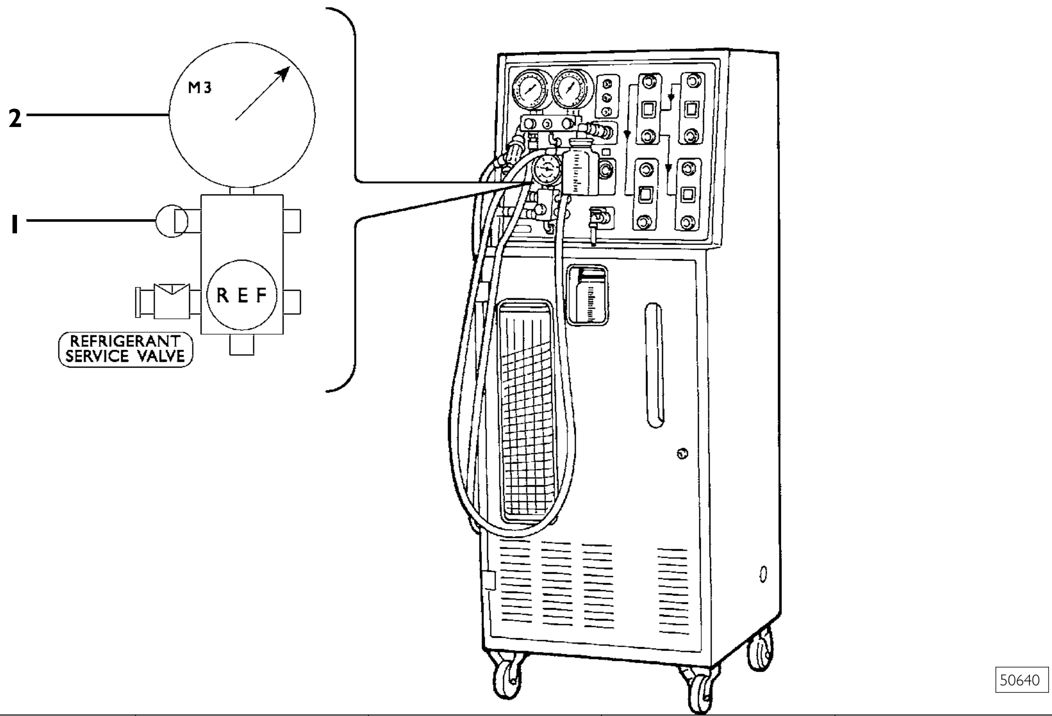
FILLING THE SYSTEM WITH REFRIGERANT

Before refilling, it is wise to be aware of some important rules:

- know the quantity of refrigerant to use (it is normally written on an adhesive plate affixed on the vehicle);
- the filler cylinder is equipped with a minimum level check that prevents introducing incondensable gas into the system.
  This is why the last approx. 600 g of refrigerant it contains cannot be used;
- therefore, before filling, check that the cylinder contains a sufficient quantity for filling (maximum quantity that can be used 3800 g);
- if the pressure inside the filler cylinder indicated on the pressure gauge (2) is greater than as required, which can be seen on the filler cylinder window approx. 10 bar max, discharge the excess pressure through the valve (1) on the pressure gauge assembly to bring it down to the right level, reading the value on the pressure gauge.

NOTE To transfer refrigerant from an external bottle to the filler cylinder and vice versa, refer to the equipment manual.
Considering that the amount of refrigerant depends on its pressure, to know the actual weight it is necessary to turn the outside of the filler cylinder so the line of the diagram matches the level viewer. In this way we can know the exact quantity of refrigerant in the cylinder (starting weight).
When calculating the weight of the refrigerant, in addition to the 600 g that cannot be used, remember to increase the load by approximately 100 g (this is the weight of refrigerant contained in the station-system connecting pipes). The right quantity of refrigerant to introduce into the system will therefore be given by: 600 g + 100 g + (quantity referred to the system capacity).
Always check before filling that the indicator on the "console" shows the refrigerant contains no moisture, in which case the indicator will be bright green. If this is not so, replace the filters in the station as instructed in the equipment manual.

Figure 21



VEHICLE	COMPRESSOR	R134 COULANT QUANTITY PROVIDED FOR IN SYSTEM	COULANT QUANTITY CONTAINED IN THE PIPINGS (150 cm length) THAT ARE USED FOR RECHARGING	COULANT TOTAL QUANTITY TO BE SET ON CHARGING TOOL	OIL QUANTITY TO BE ADDED INTO SYSTEM AT EACH ND 8 TYPE CHARGING
DAILY (8140 engine): WITH CAB, VAN, SPECIAL ITEMS, 6+1	SC 08 OPT 6650	720 g	100 [g] for low pressure pipe, 100 [g] for high pressure pipe	1020 g	30 g
DAILY (8140 engine): WITH CAB, VAN, SPECIAL ITEMS, 6+1	DENSO 10 PA 17 OPT 6652	720 g	100 [g] for low pressure pipe, 100 [g] for high pressure pipe	1020 g	40 g
DAILY (F1A engine): WITH CAB, VAN, SPECIAL ITEMS, 6+1	DENSO 10 PA 17 OPT 6652	720 g	100 [g] for low pressure pipe, 100 [g] for high pressure pipe	1020 g	40 g
DAILY (F1A engine): COMBI	DENSO 10 PA 17 OPT 6652	1200 g	100 [g] for low pressure pipe, 100 [g] for high pressure pipe	1500 g	40 g
DAILY (F1C engine): WITH CAB, VAN, SPECIAL ITEMS, 6+1	DENSO 10 PA 17 OPT 6652	440 g	100 [g] for low pressure pipe, 100 [g] for high pressure pipe	750 g	40 g

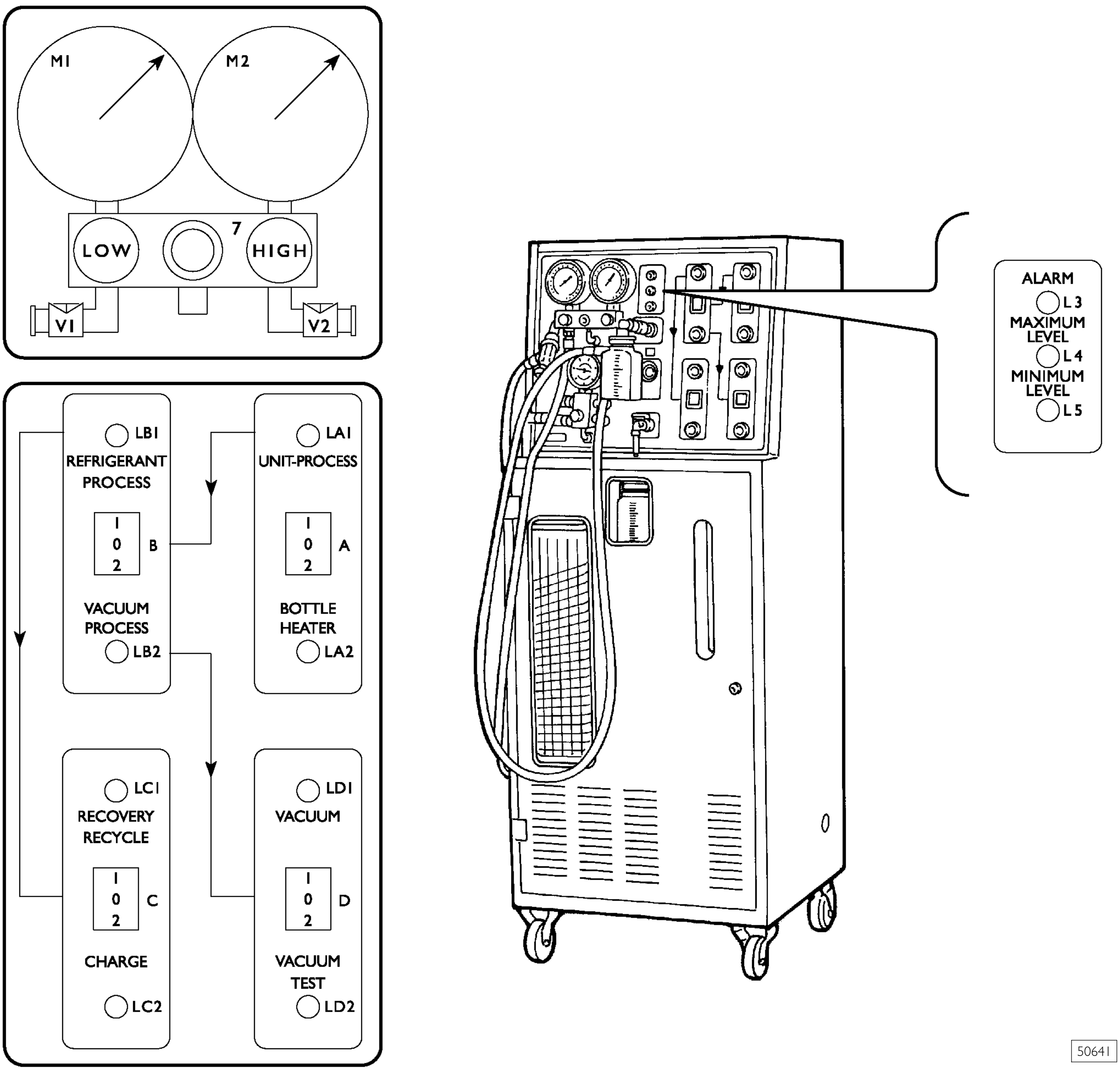
When the cylinder contains the necessary quantity for filling (both pipes must already be connected to the system connectors since the vacuum operation has already been performed), proceed as follows:

- ❑ close the **LOW** valve, keep the **HIGH** and **V1 - V2** valves open;
- ❑ press the switch **B** (Refrigerant process) onto position 1, the indicator light **LB1** will come on;
- ❑ press the switch **C** (Charge) onto position 2, the respective indicator light **LC2** will come on and refrigerant will flow from the station into the system;

NOTE When filling, if the level of refrigerant in the cylinder falls under the required quantity the system will stop and the Minimum Level indicator light (L5) will come on.

- ❑ having loaded 200 ÷ 500 g of refrigerant, depending on the size of the system, stop filling by moving the switch **C** (Charge) onto position 0;
- ❑ check the system is properly sealed with the electronic leak finder;
- ❑ complete filling the system until the **pre-calculated residual weight** in the cylinder is reached; (Residual weight = Total weight - System capacity weight)
- ❑ complete filling, move the switches **C - B** and **A** onto position 0 (A had been moved for the vacuum). Check again there is no leakage;
- ❑ close the **HIGH** valve.

Figure 22



CHECKING THE PRESSURES IN THE SYSTEM

After filling, leave the pipes connected and carry out the following check:

- ❑ close the **HIGH** and **LOW** valves, **V1** and **V2** open;
- ❑ turn on the engine, switch on the air-conditioner and check on the pressure gauges **M1** and **M2** that the pressures correspond, normally: low pressure no less than 1 bar, high pressure 15 ÷ 18 bar, depending on the system specifications.

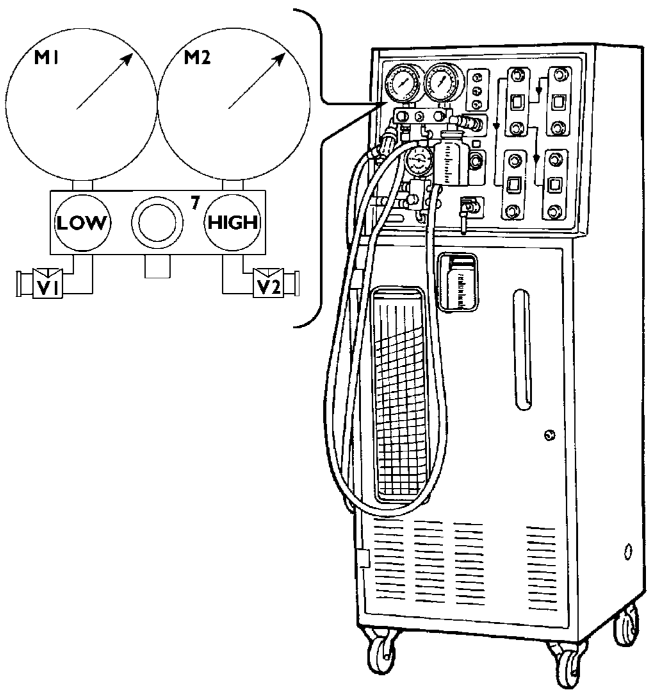
OPERATIONS PRIOR TO DISCONNECTING THE STATION FROM THE SYSTEM

Always observing the above safety rules, carry out the following operations:

- ❑ check that all the valves are closed: **LOW - HIGH**, **V1 - V2**;
- ❑ disconnect the pipes of valves **V1 - V2** and put the caps back onto the system valves;
- ❑ Check the system again with the leak finder.

NOTE Normally, with the air-conditioner switched on, air should come out of the vents at a temperature lower than 5°C and after a period of operation to stabilize the temperature of the ducts.

Figure 23



LEAK FINDER FOR AIR-CONDITIONING SYSTEMS WITH HFC R134A (9905147)

Tool L-780A makes it possible to identify leakage of HFC 134A gas from the system extremely accurately in the order of 3.3 g a year with the switch on maximum sensitivity.

This instrument requires no settings, the operator only needs to select the desired sensitivity.

The instrument warns the operator of any gas leakage with a buzzer and a LED that flashes in proportion to the concentration of gas.

In addition, the LED indicates the battery is flat if it goes out.

Operating temperature is between 0 C and 50°C.

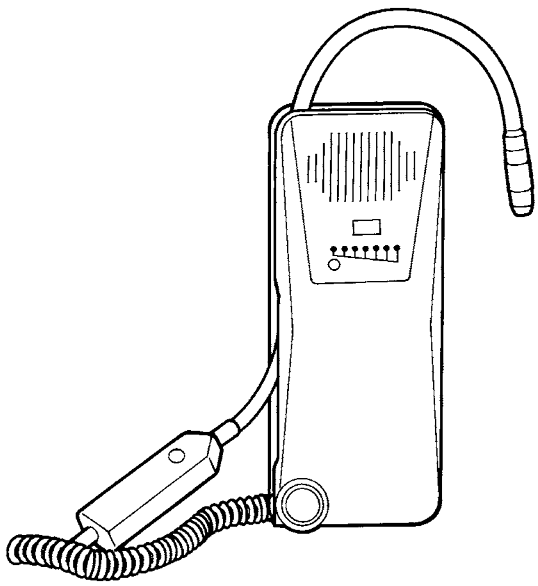
The instrument is equipped with a flexible probe to reach particularly difficult fittings or parts.

The two levels of sensitivity are:

- ❑ low sensitivity = 16.5 g/year;
- ❑ high sensitivity = 3.3 g/year.

NOTE Before checking vehicles, wait for the engine to cool, the hot parts can falsify the test.

Figure 24



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SECTION 13

Scheduled maintenance

Page

MAINTENANCE

Table of maintenance services

The Extra Plan operations (designated with the letters EP) are complementary to standard services (designated with letter M for Maintenance).
They are maintenance operations to be carried out at regular time or mileage intervals and concern optional components that are not present on all models.
Important! The correlation between kilometres and months only applies in cases where the distance travelled by the vehicle corresponds roughly to the specified average annual mileage. This is indicated only in order to suggest a hypothetical maintenance programme,. Note that the time intervals specified for Extra Plan operations (designated by letter T for Time) are to be adhered to regardless of the actual mileage covered.

The kilometre frequency for engine lubrication is in relation to a percentage of sulphur in diesel of under 0.5%.

NOTE: If using diesel with a percentage of sulphur above 0.5%, the oil-change frequency has to be halved.

Use engine oil: **ACEA B5 (Urania Daily)**

To schedule the work, keep to the following chart:

F1A ENGINE VEHICLES

Engine-oil	Engine	Standard Services		Extra plan		Time Operations			
		M1	M2	EP1	EP2	T1	T2	T3	T4
ACEA B5 Urania Daily (1)	Engine F1A	Every 40,000 km or 800 hours	Every 120,000 km or 2,400 hours	Every 240,000 km or 4,800 hours	Every 240,000 km or 4,800 hours	Every year at the start of spring	Every year at the start of winter	Every 2 years	Every 3 years

(1) *IVECO recommend* ***Urania Daily*** *ACEA B5 SAE 5W30 for benefits in terms of "fuel economy". IVECO have already introduced this lubricant with new vehicles*

- Average speed calculated at 50 km/h
- In the case of very low mileage or anyhow under 40,000 km/year, the engine oil and filter must be changed every 12 months.
- In case of urban use of the vehicle requiring repeated regeneration of the particulate filter (on the vehicles equipped with such component), the replacement of the engine oil filter and engine oil might be required in advance of the scheduled time. In this case, the need to carry out this out-of-schedule operation will be signalled by the vehicle computer.
- In case of annual covered distances of less then 40,000 km, the rear axle oil shall be changed at least every two years.
- In case of annual covered distances of less then 40,000 km, the gearbox oil shall be changed at least every three years.

Inspection and/or maintenance interventions (F1A engine vehicles)

Type of intervention		M1 Every 40,000 km or 800 hours	M2 Every 120,000 km or 2,400 hours
LUBRICATION, CHANGING OIL, FILTERS AND CHECKING FLUIDS			
1	Changing engine oil	•	•
1	Changing engine oil filter	•	•
2	Changing fuel filter *	•	•
3	Checking hydraulic brake system fluid level	•	•
5	Changing mechanical gearbox oil		•
CHECKS IN THE ENGINE BAY			
•	Checking state of auxiliary drive belts	•	
•	Changing auxiliary drive belts (1)		•
CHECKS UNDER THE VEHICLE			
7	Checking steering box rack covers	•	•
8	Checking wear of brake discs and shoes	•	•
6	Cleaning rear axle oil breather		•
7	Checking steering column, articulation and linkage		•
9	Checking steering box fixing		•
10	Checking universal joints and propeller shaft fixing		•
CHECKS IN THE CAB			
•	Checking parking brake travel	•	•
EXTERNAL CHECKS			
11	Checking headlight adjustment		•
DIAGNOSTICS			
•	Check-up engine EDC system with MODUS - IT 2000 - E.A.SY.		•
ON-ROAD TESTS			
•	Functional testing on the road	•	•

(1) *Replace every four years. Replace every 60.000 km under harsh conditions of use (dust and/or heat).*

(*) *If the "clogged filter" warning lamp lights up on the instrument panel, the filter must be replaced before the programmed replacement interval*

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Extra plan operations (to be carried out possibly in combination with maintenance service)

EP1 EVERY 80,000 km or 1,600 hours

- ❑ Changing the rear axle oil (1)

EP2 EVERY 240,000 km or, anyhow, every 5 years (or 4,800 hours)

- ❑ Changing the belt driving the alternator (2)
- ❑ Changing the automatic tensioner of the belt driving the alternator
- ❑ Replacing the power steering pump and alternator drive belt automatic stretcher
- ❑ Changing the pre-heating glow plugs

T1 EACH YEAR - especially in early springtime

- ❑ Check state of pollen filters.
  In the case of low mileage, change the filters once a year, early each spring.

T2 EACH YEAR - before the winter season

- ❑ Check coolant density.
- ❑ Check pre-combustion chamber glow plug operation.

T3 EVERY TWO YEARS

- ❑ Change brake fluid and bleed brake fluid system.

T4 EVERY THREE YEARS - even if there is no indication of the air filter clogging

- ❑ Change cartridge and clean air filter container. (1)
- ❑ Change engine coolant (2).

(1) *In case of annual covered distances of less then 40,000 km, the rear axle oil shall be changed at least every two years.*

(2) *Early air cleaner obstruction is generally due to particular environmental conditions. For this reason it may need to be replaced when indicated by the sensor regardless of the replacement interval also if not specifically stated.*

(3) *Paraflu[11] needs to be diluted at 50% with water, while Paraflu FE is already diluted at 50% with water.*

F1C ENGINE VEHICLES

Engine-oil	Engine	Standard Services		Extra plan			Time Operations			
		M1	M2	EP1	EP2	EP3	T1	T2	T3	T4
ACEA B5 Urania Daily (1)	Engine F1A	Every 40,000 km or 800 hours	Every 120,000 km or 2,400 hours	Every 240,000 km or 4,800 hours	Every 240,000 km or 4,800 hours	Every 240,000 km or 4,800 hours	Every year at the start of spring	Every year at the start of winter	Every 2 years	Every 3 years

(1) *IVECO recommend **Urania Daily** ACEA B5 SAE 5W30 for benefits in terms of "fuel economy". IVECO have already introduced this lubricant with new vehicles*

- Average speed calculated at 50 km/h
- In the case of very low mileage or anyhow under 40,000 km/year, the engine oil and filter must be changed every 12 months.
- In case of urban use of the vehicle requiring repeated regeneration of the particulate filter (on the vehicles equipped with such component), the replacement of the engine oil filter and engine oil might be required in advance of the scheduled time. In this case, the need to carry out this out-of-schedule operation will be signalled by the vehicle computer.
- In case of annual covered distances of less then 40,000 km, the rear axle oil shall be changed at least every two years.
- In case of annual covered distances of less then 40,000 km, the gearbox oil shall be changed at least every three years.

Inspection and/or maintenance interventions (F1C engine vehicles)

Type of intervention		M1	M2
		Every 40,000 km or 800 hours	Every 120,000 km or 2,400 hours
LUBRICATION, CHANGING OIL, FILTERS AND CHECKING FLUIDS			
1	Changing engine oil	•	•
1	Changing engine oil filter	•	•
2	Changing fuel filter *	•	•
3	Checking hydraulic brake system fluid level	•	•
5	Changing mechanical gearbox oil		•
CHECKS IN THE ENGINE BAY			
•	Checking state of auxiliary drive belts	•	
•	Changing auxiliary drive belts (1)		•
CHECKS UNDER THE VEHICLE			
7	Checking steering box rack covers	•	•
8	Checking wear of brake discs and shoes	•	•
6	Cleaning rear axle oil breather		•
7	Checking steering column, articulation and linkage		•
9	Checking steering box fixing		•
10	Checking universal joints and propeller shaft fixing		•
CHECKS IN THE CAB			
•	Checking parking brake travel	•	•
EXTERNAL CHECKS			
11	Checking headlight adjustment		•
DIAGNOSTICS			
•	Check-up engine EDC system with MODUS - IT 2000 - E.A.SY.		•
ON-ROAD TESTS			
•	Functional testing on the road	•	•

(1) *Replace every four years. Replace every 60.000 km under harsh conditions of use (dust and/or heat).*

(*) *If the "clogged filter" warning lamp lights up on the instrument panel, the filter must be replaced before the programmed replacement interval*

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Extra plan operations (to be carried out possibly in combination with maintenance service)

EP1 EVERY 80,000 km or, in any case, every two years (or 1,600 hours' operation)

- ❑ Changing the rear axle oil.

EP2 EVERY 240,000 km or, anyhow, every 5 years (or 4,800 hours)

- ❑ Changing the automatic tensioner of the belt driving the alternator.
- ❑ Changing the pre-heating glow plugs.

EP3 EVERY 400,000 km (or 8,000 hours' operation)

- ❑ Replacing the timing chains, chain stretchers, camshaft drive gears, pads.
- ❑ Replacing the exhaust gas catalyst (vehicles equipped with D.P.P. particulate filter).

T1 EACH YEAR - especially in early springtime

- ❑ Check state of pollen filters.
  In the case of low mileage, change the filters once a year, early each spring.

T2 EACH YEAR - before the winter season

- ❑ Check coolant density.
- ❑ Check pre-combustion chamber glow plug operation.

T3 EVERY TWO YEARS

- ❑ Change brake fluid and bleed brake fluid system.

T4 EVERY THREE YEARS - even if there is no indication of the air filter clogging

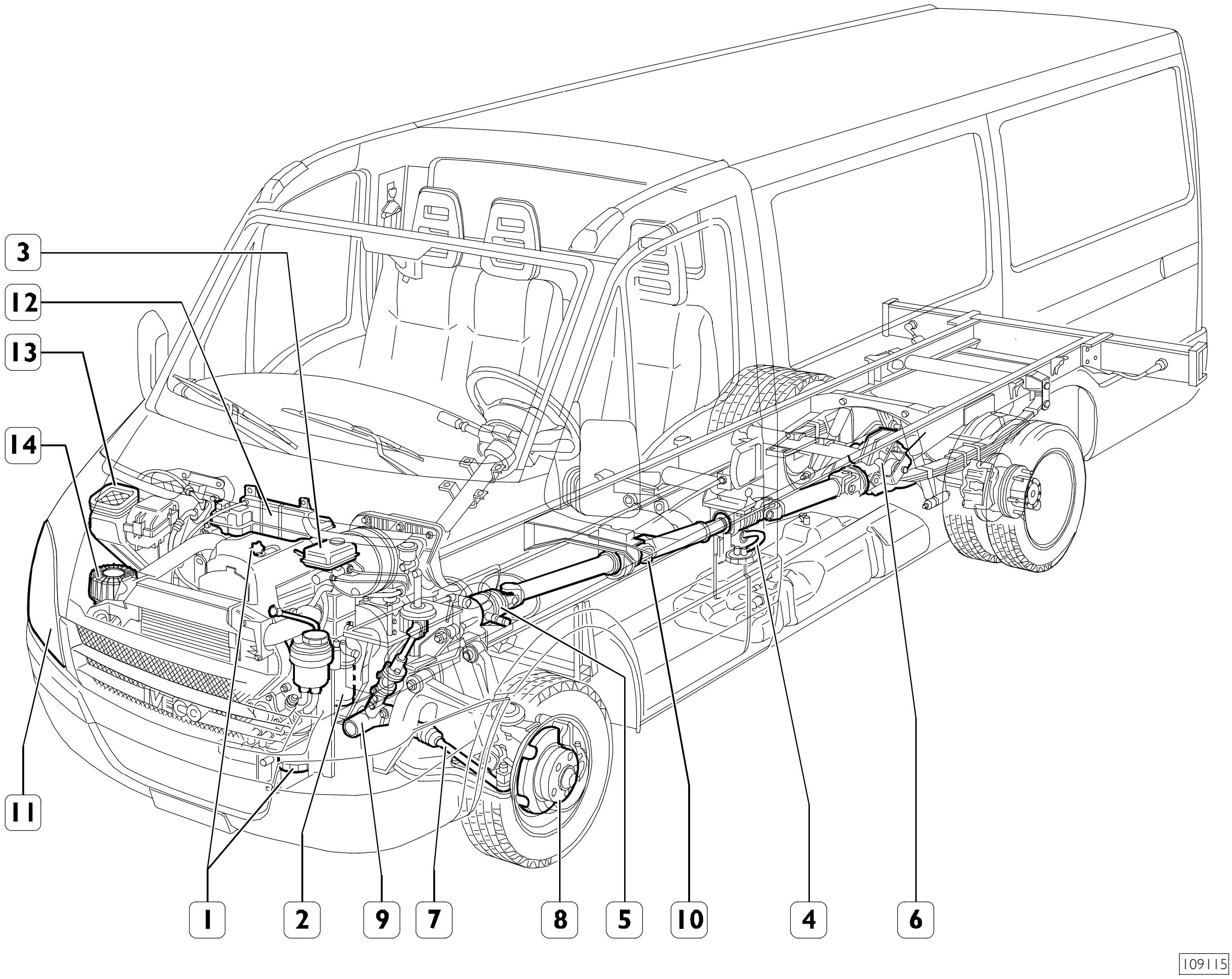
- ❑ Change cartridge and clean air filter container. (1)
- ❑ Change engine coolant (2).

(1) *Early air cleaner obstruction is generally due to particular environmental conditions. For this reason it may need to be replaced when indicated by the sensor regardless of the replacement interval also if not specifically stated.*

(2) *Paraflu[11] needs to be diluted at 50% with water, while Paraflu FE is already diluted at 50% with water.*

DIAGRAM OF CHECK AND/OR MAINTENANCE POINTS

Figure 1

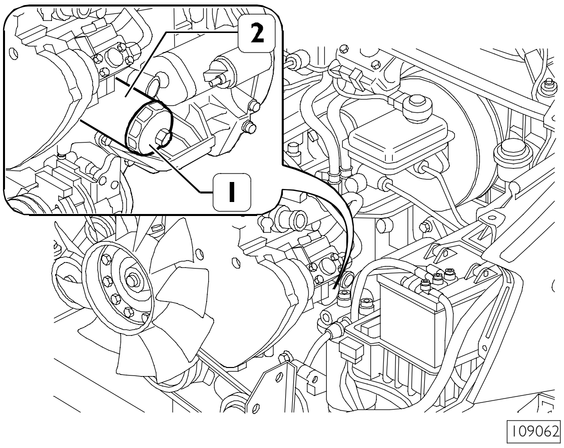


MAINTENANCE OPERATIONS

NOTE After checking or changing parts, test the operation of the vehicle.

M1 SERVICE
1. Changing engine oil
1. Changing engine oil filter

Figure 2



NOTE The figure refers to the F1A engine.

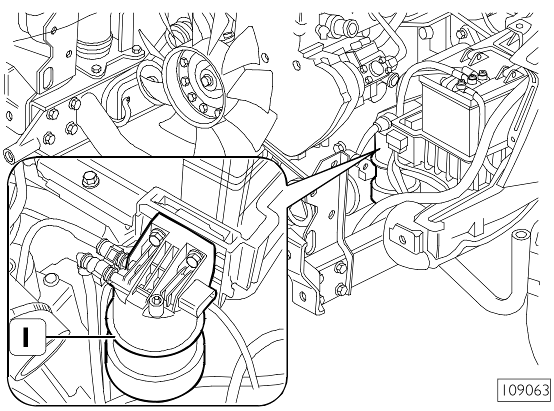
Take out the dipstick (2). From underneath the vehicle, remove the soundproofing guard, and fit it back on after completing the operation. Remove the plug from the oil sump and drain the engine oil off into a special container. With tool 99360076 (1) disassemble oil filter (2).

NOTE Before refitting the new cartridges, moisten the seal with engine oil.

Screw the oil filter (1) on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn (tightening torque 25 Nm). Screw the plug back on under the sump.
Pour oil into the engine through the filling-pipe (1) of the required grade and quantity (see fluids table in the GENERAL section).

2. Replacing Filtrauto type fuel filter

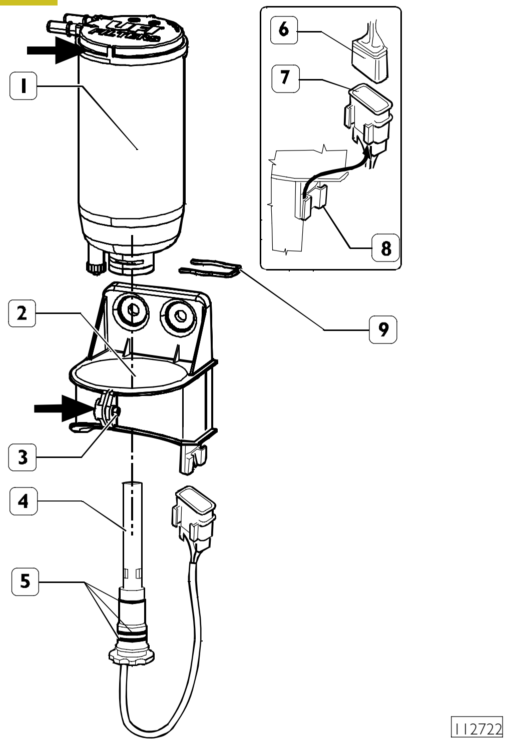
Figure 3



Unscrew fuel filter container (1) and replace the cartridge, then screw container (1) again and tighten it to 35±5 Nm.

2. Replacing UFI Filters type fuel filter

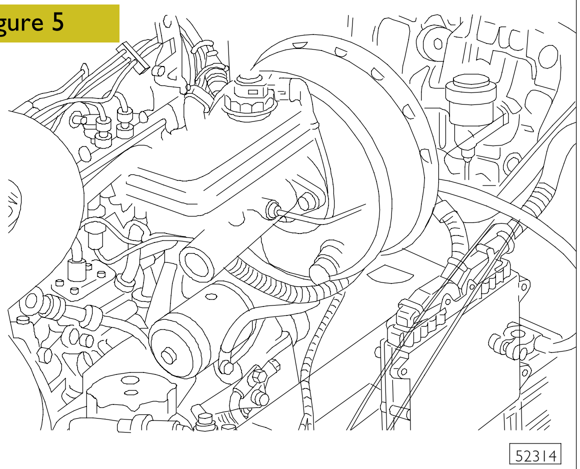
Figure 4



Disconnect chassis cable connection (6) from electronic unit connection (7). Release connection (7) from support bracket (8). Remove fastener (9), unthread electronic unit (4) and put it away accurately in order that it is not damaged or soiled. Loosen screw (3) and unthread fuel filter (1) upwards from support (2). Mount new filter (1) in such a way that mark (→) results to be aligned at the point where the ends of support (2) join each other and tighten screw (3) at prescribed torque. Check the conditions of seal rings (5); if they are detected to be damaged, replace them. Mount electronic unit (4) into fuel filter (1) up to ledge in such a way that fastener (9) is correctly fitted into the ring-shaped grooves of electronic unit (4). Connect connection (7) to bracket (8) and connect connector (6) to connection (7).

3. Checking hydraulic brake system fluid level

Figure 5



Check the level of brake fluid. If it is low, top it up (see fluids table in the GENERAL section).

• Checking state of auxiliary drive belts

Visually check that the belts are not worn or deteriorated, in which case replace them as described in the "ENGINE" section.

7. Checking steering box rack covers

Remove the soundproofing guard from underneath the vehicle.

If the covers are damaged at all, replace them as described in the "STEERING GEAR" section.

8. Checking wear of brake discs and shoes

If the wear is found to be too great, replace the brake discs or shoes as described in the "BRAKES" section.

• Checking parking brake travel

Check that the vehicle stays braked with a lever travel of:

❑ five catches.

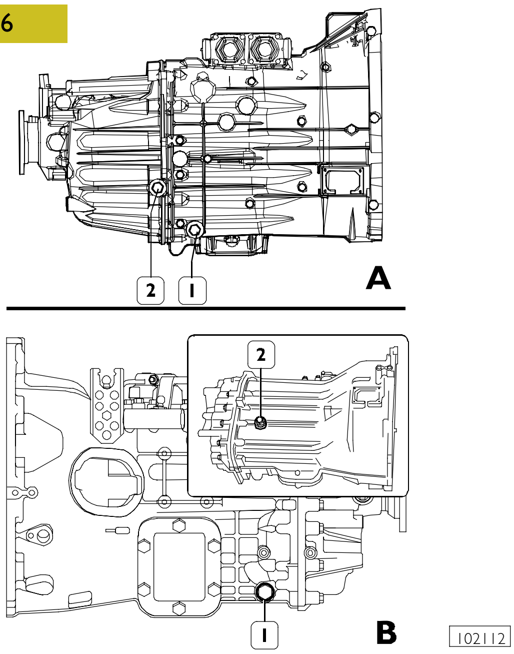
If it does not, adjust it as described in the "BRAKES" section.

M2 SERVICE

NOTE The M2 service comprises some of the operations in the M1 service as well as the following operations.

5. Replacing the mechanic and automatic transmission gearbox oil

Figure 6



A. Automatic transmission - B. Mechanic transmission

The lubrication oil should be drained off when it is warm. Place a special container under the plug (1). Take out the plug and drain off the oil.

Screw the plug back on. Unscrew the filler plug and pour in lubricating oil of the required grade and quantity (see fluids table in the GENERAL section).

Fit the plug (2) back on.

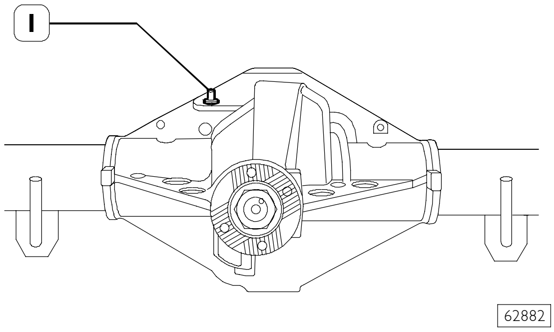
Remove the oil vapour vent and clean it thoroughly.

• Changing auxiliary drive belts

This should be done as described in the "ENGINE" section.

6. Cleaning rear axle oil breather

Figure 7



Take out the screws (1) and remove the brake caliper with its brake linings from the mounting.M

NOTE The oil vent cleaning operations refer to rear axle 450517/2. As far as rear axles 450511 NDA R.S. - NDA R.G. are concerned, refer to Figure 11.

7. Checking steering column, articulation and linkage

Steering linkage

❑ Check that the nuts and screws securing the clamps to the tie rods have not deteriorated and are tightened to the required torque.

❑ The tie rods must not be damaged, likewise the threaded portion must be sound.

Swivel heads

❑ Clean the swivel heads of the tie rods.

❑ This must be done with dry canvas or raw cotton. Use no solvents.

❑ Check that the swivel heads, in their components, have no points of corrosion, with sections affected to a depth greater than 1 mm. In particular, check the sheet metal cover close to the rolled section.

❑ Check the protecting casing: it must be secured to the body and to the pin of the joint with a retaining ring and must not rotate.

❑ The casing must be neither damaged nor deteriorated.

❑ Crush the protective casings by hand and check that lubrication grease comes out.

❑ Check that the nuts and split pins have not deteriorated.

9. Checking steering box fixing

Remove the soundproofing guard from underneath the vehicle.

If there is any damage, refer to the "STEERING GEAR" section.

After making the check, fit the soundproofing guard back on.

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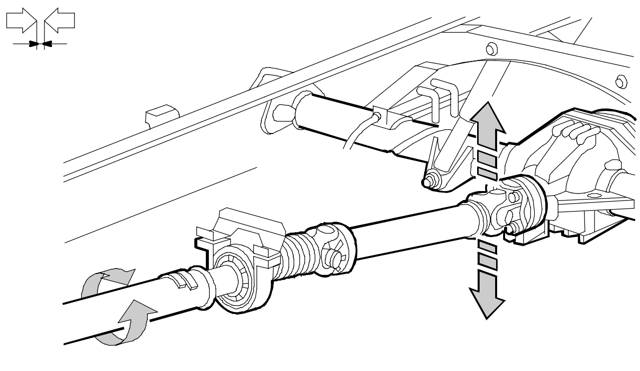
10. Checking universal joints and propeller shaft flange fixing

Figure 8

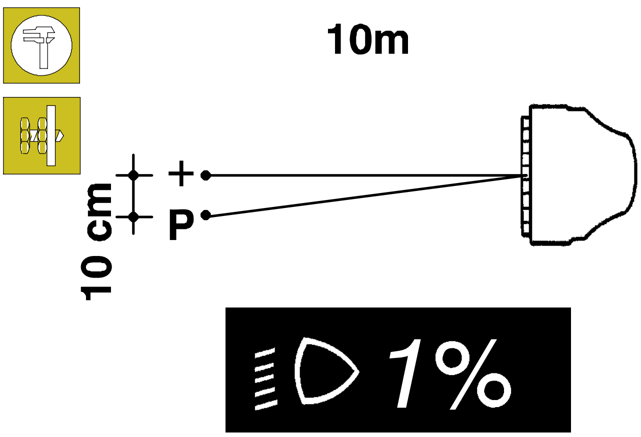


52124

The plates welded onto the propeller shafts are there for balancing.
If there are no plates, it is necessary to balance the shaft again.
Turning the propeller shaft and at the same time the sliding sleeve in the opposite direction, check there is not too much clearance between the splines.
Acting on the forks of the couplings (in the direction of the arrows shown in the figure), check that the spiders are not worn. Replace them if they are.
If there is any damage, refer to the "PROPELLER SHAFTS" section.

11. Headlamp orientation check

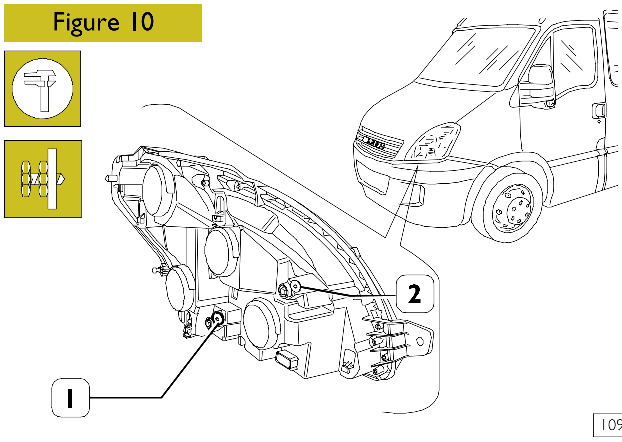
Figure 9



46311

Place the vehicle, unladen and with the tyres inflated to the prescribed pressure, on a flat surface in front of a clear wall at a distance of 10 m.
Draw two crosses (corresponding to the headlamp centres) on the wall.
Set the headlamp control switch to "0", then turn the low-beam headlamps ON. The distance between the crosses and points "P" (corresponding to the headlamp inclination) shall be 10 cm (1% as shown on the tag).

Figure 10



10904

If an orientation error is found, proceed as follows:

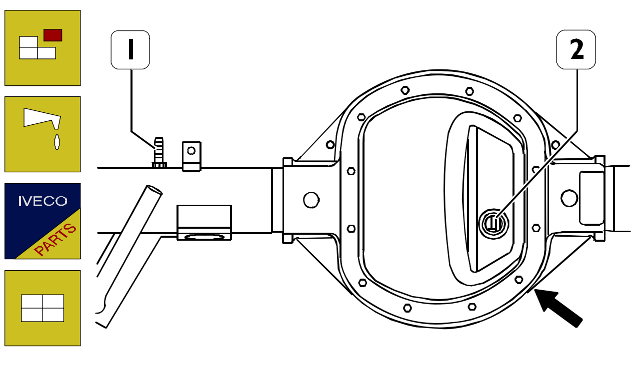
- ❑ open the engine hood;
- ❑ ad just the light beam:
  - horizontally, by acting on screw (2);
  - vertically, by acting on screw (1).

OUT-OF-SCHEDULE MAINTENANCE EP1 service (every 80,000 km or 1,600 hours' operation)

6. Changing rear axle oil

NOTE In case of annual covered distances of less then 40,000 km, the rear axle oil shall be changed at least every two years.

Figure 11

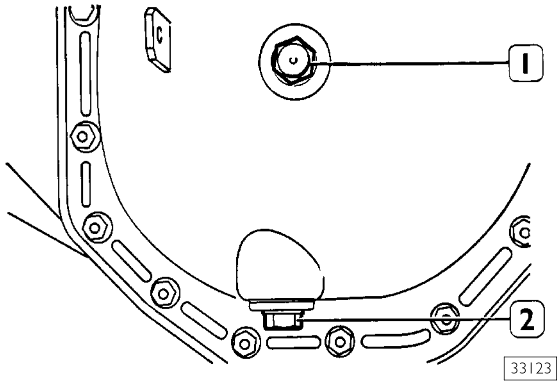


109065

NOTE The oil change shown refers to rear axles NDA R.S. - NDA R.G. - 450511.

The lubricating oil has to be drained off while it is hot.
Place a container under the plug near the arrow; remove the plug and drain off the oil.
Screw the plug back on. Unscrew the plug (2) and pour in the prescribed quantity of lubricating oil (see fluids table under the GENERAL INFORMATION heading).
To get off I leak it some vapors oil (1) and to carefully clean it.

Figure 12



NOTE The oil change described refers to the Rear Axles 450517/2.

The lubrication oil should be drained off when it is warm. Place a special container under the plug (2). Take out the plug and drain off the oil.
Screw the plug (2) back on. Unscrew the plug (1) and pour in lubricating oil of the required grade and quantity (see fluids table in the GENERAL section).
Remove the oil vapour vent and clean it thoroughly.
(Shown in Figure 12).

EP2 service (every 240,000 km or 4,800 hours' operation or, in any case, five years)

1. Replacing the camshaft drive belts (only F1A engines)

The belts shall be replaced as described in the respective "ENGINE" section.

NOTE Under heavy-duty conditions (excessive dust and/or heat), the camshaft drive belt shall be replaced every 120,000 km.

• Replacing the water pump/ alternator drive belt automatic stretcher

The belts shall be replaced as described in the respective "ENGINE" section.

1. Replacing the precombustion chamber engine plugs

The belts shall be replaced as described in the respective "ENGINE" section.

EP3 service (every 400,000 km or 8,000 hours' operation - only F1C engines)

1. Replacing the timing chains, chain stretchers, camshaft drive gears, pads

The belts shall be replaced as described in the respective "ENGINE" section.

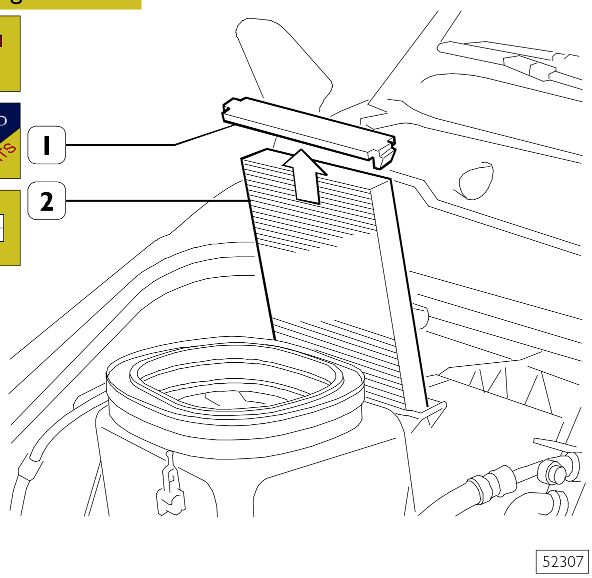
• Replacing the exhaust gas catalyst (vehicles equipped with D.P.F. particulate filter)

The belts shall be replaced as described in the respective "ENGINE" section.

T1 service (annually, at the beginning of spring)

13. Pollen filter check

Figure 13



Act from inside the engine compartment to take out protection cover (1) and remove pollen filter (2).
Check the pollen filter conditions: if the filter is clogged, it shall be replaced (by following the reverse order of the detachment operations).

NOTE Excessive clogging of the pollen filters can cause a reduction in the flow rate of air into the cab and therefore less ventilation. This will be highlighted especially by a significant reduction in the efficiency of the windscreen defrosting function.

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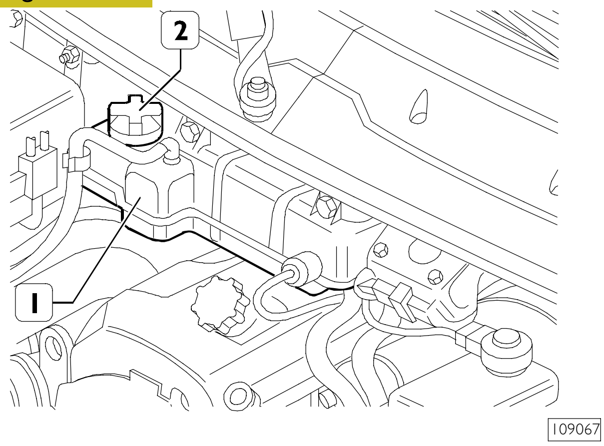
T2 service (annually, prior to the beginning of winter)

12. Checking the antifreeze concentration in the engine coolant

Figure 14



With the engine warm, the cooling system is in overpressure, therefore take care when taking off the cap (2).

Take off the cap (2) and draw off a sample of the coolant from the expansion tank (3) with the densimeter 99395858.

Depending on the temperature of the liquid, check the percentage of antifreeze in the liquid on the scale of the instrument. The percentage has to be higher than 40% and must not exceed 50%.

If necessary, restore the percentage of antifreeze, bearing in mind that the liquid needs to be replaced every 2 years.

NOTE For vehicles fitted with an additional heater, the percentage of antifreeze must never exceed 50%.

- **Replacing the auxiliary heater fuel filter**

T3 service (every two years and, if possible, concurrently with a maintenance service)

3. Changing the draining and braking hydraulic system fluid

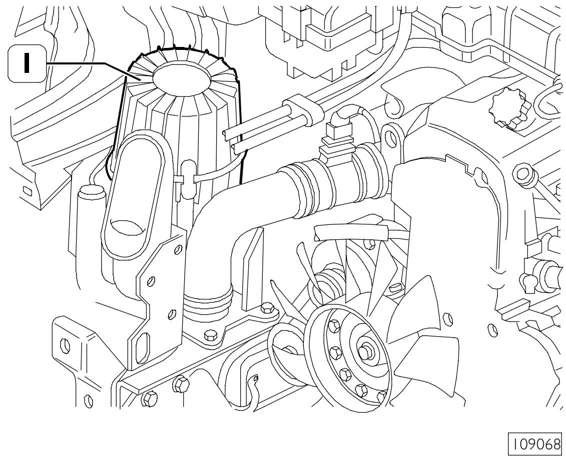
The fluid shall be changed as described in the respective "HYDROPNEUMATIC SYSTEM - BRAKE" section (ad regards the amount of brake fluid, refer to the filling and fuelling table in the "GENERAL REMARKS" charter).

The brake fluid is poisonous and corrosive. In case of accidental contact, wash immediately with water and mild soap.

T4 service (every three years and, if possible, concurrently with a maintenance service)

14. Replacing the air filter cartridge and cleaning the container

Figure 15



Release the retaining clips, then remove upper cover (1) and replace the filtering cartridge.
Thoroughly clean the cartridge housing before fitting the new cartridge into place.

12. Changing the engine coolant

Follow the procedure described in the respective paragraph of the "ENGINE" section (as far as filling is concerned, refer to the table of the "GENERAL REMARKS" charter).

SECTION 14

7600 Electric/Electronic system

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ABBREVIATIONS AND GRAPHIC SYMBOLS


Indicates a general warning

A — Ampere

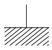
kW — KiloWatt

NB — Note Well

m2 — Identification of an earth point

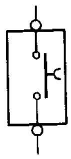
V — Volt

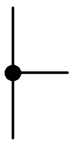
Ω — Ohm

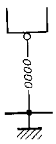

Connection to a power earth point


Connection to a signal earth point

72030_{3C} — Code of connector between cables:
72030 = connector code
3C = cell identification co-ordinates


Base equipment

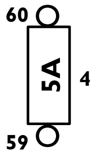

Base electrical connection


Connection to earth by cable

II_6 — Connector between cables:
II = connector number
6 = cell number

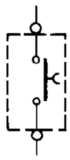
7777 — Cable colour code

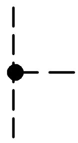

Consult



Reed fuse on control box
4 = fuse number
5A = capacity
59-60 = terminal identification


Electronic component or control unit

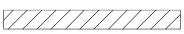

Optional equipment

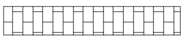

Optional electrical connection in a base circuit chart


Connection to earth through metal agglomerate

Cables symbol


No protection


Protection with continuous PVC tape


Protection with 30 mm spiral PVC tape

The symbol identifies a knot

GENERAL WARNINGS

General conditions for laying electric circuits

- ❑ Engine off
- ❑ Ignition switch off
- ❑ Handbrake engaged
- ❑ Neutral gear
- ❑ Fluids at normal level

Do not ever disconnect the system batteries and do not open the general current switch with the i.c. engine running. Do not start the engine without first connecting the batteries in a permanent manner.

- ❑ Before doing any work on the vehicle chock the wheels appropriately.
- ❑ Do not use quick chargers to start the engine. Starting must only be carried out with separate batteries or with the special trolley.
- ❑ Make sure that the polarity on the battery terminals is correct when starting from an auxiliary trolley.
- ❑ The incorrect polarisation of the power voltage of electronic control units (for example incorrect polarisation of the batteries) may lead to their destruction.
- ❑ When needing to disconnect the battery from the system, firstly always disconnect the battery negative cable that goes to the engine from the negative terminal of the battery itself.
- ❑ Before connecting the battery to the system, make sure that it is well insulated.
- ❑ When seeking faults, insert a wander fuse between the battery negative terminal and the engine earth cable.
- ❑ Before removing any electrical and/or electronic components, disconnect the ground cable from the negative terminal of the battery.
- ❑ Disconnect the battery from the system when charging it with external equipment.
- ❑ Disconnect the external charging equipment from the mains before removing its grippers from the terminals of the battery.
- ❑ Do not insert or remove the connector of electronic control units with the power on.
- ❑ With temperatures above 80 °°C (drying ovens) remove the electronic control units
- ❑ During electric welding work disconnect the connectors of electronic control units.

Key storing procedures are affected by electromagnetic noise (mobile phones, etc.). Therefore, during key storing:

1. Pay attention that there are no noise sources in the cab or near keys.
2. Keys not inserted in panel must be at least at 1 metre distance.

Measurements in electronic control units, plug connections and electric connections to components may be carried out only on appropriate testing lines, with special plugs and sockets. Never use improper means such as metal wires, screwdrivers, clips or the like. In addition to the danger of a short circuit, damage to the plug connectors may also result and this would subsequently cause contact problems.

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Concept of earth and electromagnetic compatibility

The electric system is traditionally a single-pole system. The body, the frame, the metal container of electromechanical components act as equipotential return conductor to the generator, as any point of their metal structure or any negative terminal not isolated is at the same reference potential or EARTH. This is why the earth has been chosen as reference to the whole system, conventionally giving it the value of zero.

Due to obvious reasons of construction, in the negative network of the system there are various earth points located on the vehicle in relation to the location of the components on the frame, engine and body.

On the other hand, ideally, all the equipment should be connected to **only** one earth point in order to provide them, particularly for electronic devices, a clearly defined earth reference.

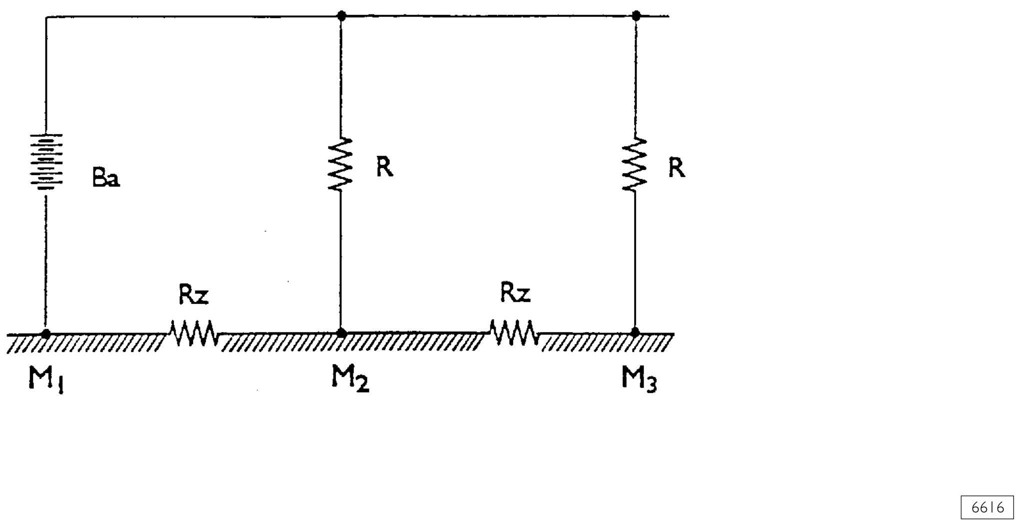
For the above-mentioned reasons it is necessary to distinguish the **supply earth** or system earth, characterised by strong direct current intensity (> 1 A for electromechanical components), from the **analogue earth**, characterised by wave shapes at determinate frequencies and very low current intensity (mA, μA) of electronic systems.

The definition of signal earth or analogue earth depends on the sensitivity of the electronic systems to EMC (electromagnetic compatibility), as parasite signals emitted by the systems on board or outside the vehicle, induce failures and/or deterioration of the systems themselves. The best solution for a signal earth is connection with the battery negative terminal.

In order to minimise both continuous and transient disturbance or interference generated by parasite radiation, **it is of the utmost importance** to always bear in mind that the satisfactory efficiency of the reference plane or system earth depends on the excellent conductivity characteristics (contact resistance tending towards zero) in each of its connection points.

Briefly, we can say that the earth understood as equipotential electrical conductor, i.e. as potential reference for all the electric/electronic components on board, is subdivided into system earth and analogue earth.

Figure 1



EARTH NETWORK
Ba. Battery - R. Loads - Rz. Frame impedance - M_1, M_2, M_3. Earth

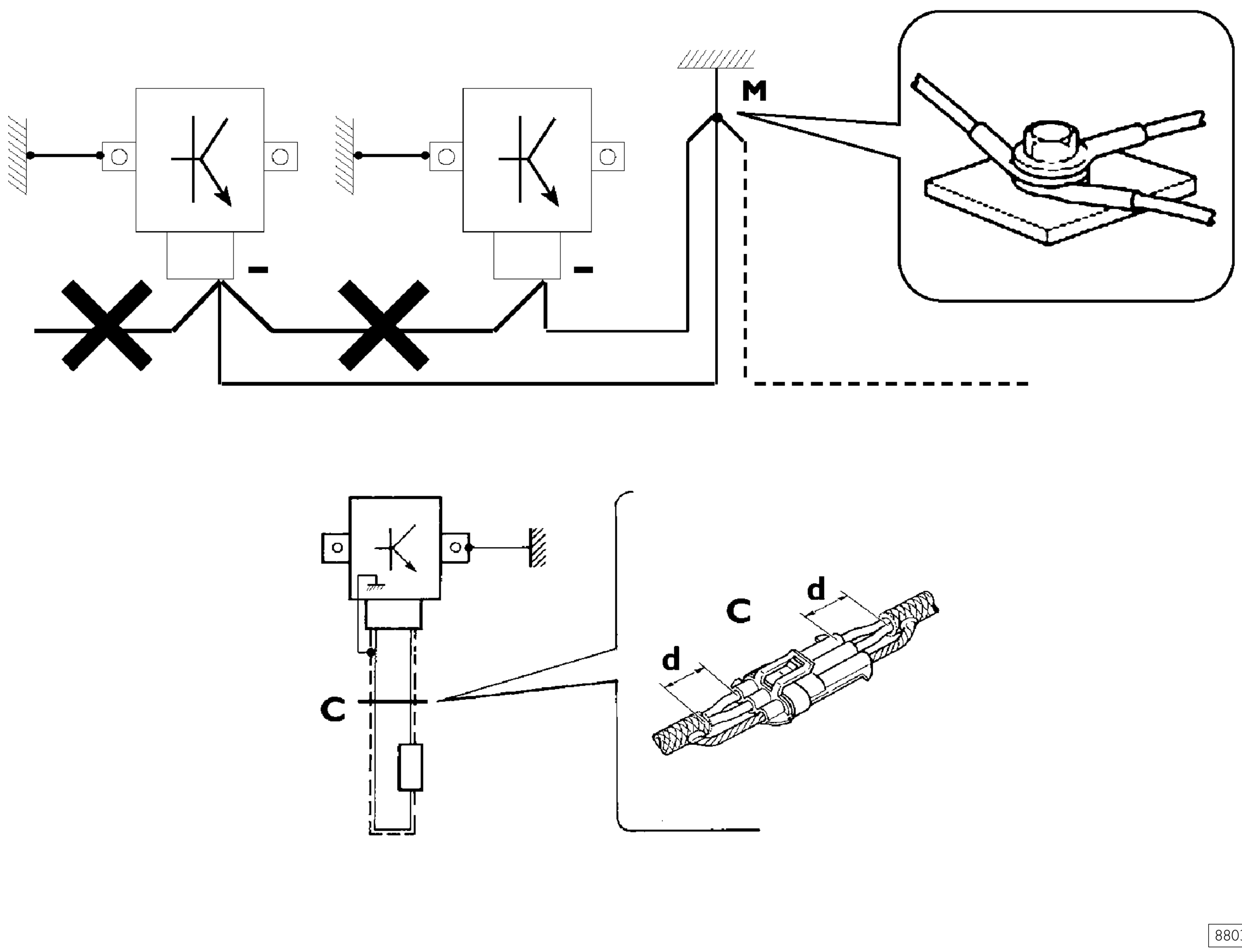
Practical advice

The negative cables connected to an earth point must be as short as possible and connected to one another in a "star" connection, trying to tighten them neatly and adequately.

Additionally, for electronic components the following instructions should absolutely be followed:

- ❑ Electronic control units must be connected to the system earth when they have a metal container.
- ❑ The negative cables of electronic control units must be connected to both a system earth point, for example the dashboard earth (avoiding "serial" or "chain" connections), and to the negative terminal of the battery/ies.
- ❑ Though they are not connected to the system earth/battery negative terminal, analogue earths (sensors) must be perfectly insulated. Therefore, particular care should be given to the parasite resistances of the terminals: oxidation, clinching defects, etc.
- ❑ In the presence of jointing connectors the unscreened section **d**, near them, should be as short as possible.
- ❑ The cables should be laid on parallel with the reference plane, i.e. as near as possible to the frame/body structure.
- ❑ Additional electromechanical systems should be carefully connected to the system earth and must not be set at the side of the cables of electronic components.

Figure 2



SCREENING BY METAL BRAID OF A CABLE TO AN ELECTRONIC COMPONENT
C. Connector - d. Distance → 0

Ultrasonic cable welding

In order to eliminate earth, supply, outer/inner lighting bridges between components, ultrasonic welding points have been used.

These are not easily identifiable as they appear along the cables inside the corrugated tube of the various harnesses and they are isolated from the cables through heat-shrinking sheaths or insulating plastic.

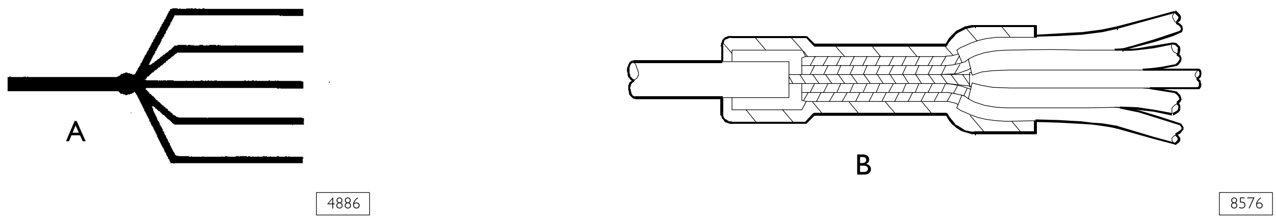
Generally, the cables of the components converge on one side in the different welding points, while on the other only one cable connects them with the earth or supply.

It is also possible to have several welding points connected to one another in which several cables converge on both sides of the welding. In this case, the earth or supply cable will be connected to the last weld of the series.

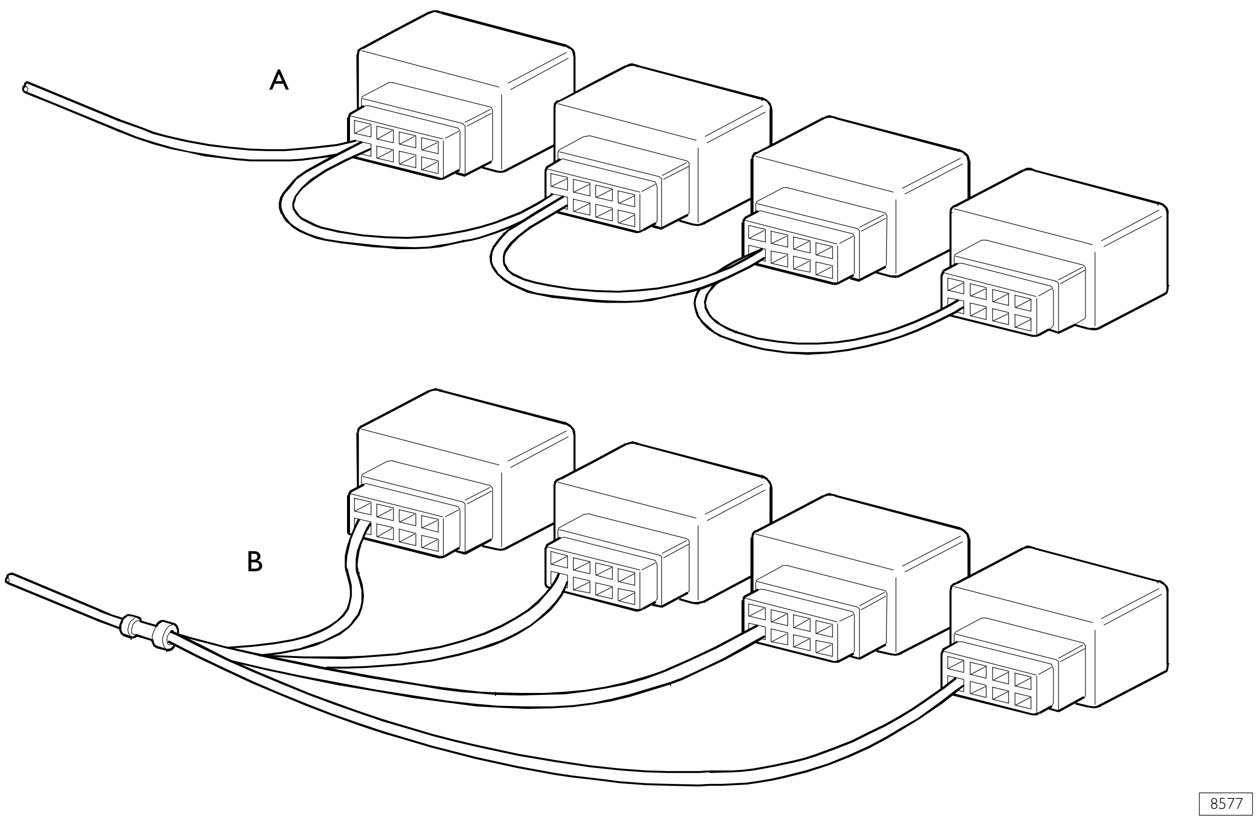
Ultrasonic welding brings considerable advantages, including:

- reduction of electromagnetic interference outside the vehicle
- the almost total reliability of the electric system, due to elimination of the bridges, with lower possibility of faults.

Figure 3



ULTRASONIC WELDING
A. Wiring diagram - B. Technical layout



CONNECTION BETWEEN COMPONENTS
A. Connection through bridges - B. Connection through ultrasonic welding point

TECHNICAL CODES

03000	Self-rectifying alternator with built in voltage regulator
08000	Starter motor
12006	Motor for adjustable mirrors
12010	Motor for locking right door
12011	Motor for locking left door
12012	Compressor for air conditioning system
12025	Power takeoff motor
12026	Motor, winch control
12027	Motor for opening or closing left side door lock
19005	Thermal starter
19010	Heater plug
20000	Starter battery
22001	Horn
22039	Bell for parking lights on signal
25003	Relay for switching on fog lights
25006	Brake lights relay
25014	Relay for enablement of parking lights with engine off
25023	Relay for disconnection of low beam lights with parking lights on
25104	Relay for switching off Retarder with ABS engaged
25209	Relay for switching off services during starting
25222	Relay for allowing connection of thermal starter
25223	Relay for allowing connection of thermal starter fuel tank with atmosphere
25307	Relay for controlling air conditioning compressor
25336	Relay for engine cooling electromagnetic joint
25337	Relay for disconnecting air-conditioning system compressor
25340	Relay, compressor operation, signal to EDC
25620	Relay for fuel filter clogged signal
25704	Relay for switching NC/NO signal for third steering axle
25705	Relay for enabling point switching on
25810	Relay for controlling diesel heating circuit
25811	Ignition timer relay (KSB)
25818	Relay for switching on heated windscreen
25837	Relay for connection of fuel pump
25858	Relay for EDC connection
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
28002	Engine stopping electromagnet
30003	Multifunctional side headlight
30011	Fog light
32002	Front direction indicator
33001	Side direction indicator
33004	Side marker lamp
34000	Multifunctional rear light
34007	Stop light
34009	Rear fog lamp
35000	Number plate light
37001	Front dimensions light
39020	Ashtray light
39022	Courtesy light for cabin interior with adjustable spot light

39025	Lamp for lighting rear hatch
39026	Lamp for lighting side hatch
40011	Electronic tachograph
40030	Sender unit for electronic tachometer
40031	Sender unit for electronic tachograph
40046	Inductive type chassis height sensor (rear axle)
42035	Absolute pressure sensor
42102	Switch signalling handbrake applied
42350	Switch signalling body tilted
42351	Switch signalling air filter blocked
42354	Switch for air suspension system failure
42374	EDC clutch switch
42550	Switch signalling engine oil pressure
42552	Fuel filter clogged indicator switch
42608	Coolant pressure signalling 3-switch assembly
44031	Sender unit, fuel level indicator with w/lamp contact
44033	Insufficient brake fluid level gauge control
44036	Insufficient radiator coolant level gauge control
44037	Insufficient power assisted steering fluid level gauge control
44044	Engine oil low level indicator control
47034	Engine coolant temperature sensor (EGR)
47035	Engine coolant temperature sensor
47104	Switch for engaging engine cooling electromagnet coupling
47106	Switch for engaging diesel fuel heating
47109	Switch for connection of ignition timer (KSB)
47207	Switch/sender unit, engine water temperature indicator
48035	Engine rpm sensor
48042	Engine rpm sensor (on timing gear)
52005	Switch with built in w/l for heated rear view mirrors
52036	Switch with built in w/l for engaging windscreen heater
52082	Switch with built-in w/lamp, fog lights
52083	Switch with built-in w/lamp, hazard lights
52084	Switch with incorporated warning light for switching on rear differential lock
52090	Suspension levelling switch (ECAS)
52091	Switch with incorporated warning light for switching on rearscreen heating
52093	Switch for tail hatch locking safety
52310	Switch for adjustable mirrors
52312	Switch controlling headlamp alignment adjustment
52502	Ignition switch for services with starting
53004	Switch for headlamp washer
53041	Switch for checking EDC system
53051	Suspension lifting switch
53052	Suspension lowering switch
53300	Switch for driver's side electric window
53302	Switch for passenger side electric window
53501	Switch signalling vehicle stopped
53503	Switch signalling reversing lights
53505	Rear differential lock engaged indicator switch
53509	Switch for switching on interior lights
53565	Switch for signalling brake pedal fully pressed
53590	Switch for bonnet open signal

54032	8 function steering column switch unit
58700	Led, battery charging failure
58701	Led, EDC failure
58702	Led, preheating on
58703	Led, ABS failure
58709	Trailer direction indicators ON LED
58710	Water in fuel pre-filter indicator LED
58713	Led, ECAS system failure
58715	Total power take off (PTO) ON indicator LED
58717	Led, Immobilizer on
58718	Brake system failure warning led
58719	Led per segnalazione freno a mano inserito
58720	Led, radiator water level
58722	Led, engine oil pressure (low)
58725	Led, air cleaner restriction
58728	Power steering fluid level w/lamp
58730	Engine oil level w/lamp
58735	Led for indicating rear differential lock on
58918	32-optical indicator panel
61002	3 diode holder container 3A (with + common)
61101	Diesel fuel heater resistor
61102	Rheostat for antipollution device (EGR)
61103	Variable resistance for ignition timer control (KSB)
61106	Windscreen heater resistor
61124	Resistance for rearscreen heating
64000	Electric windscreen washer pump
65000	Windscreen wiper unit
66005	Headlamp washer pump
66010	Headlamp washer timer
68000	Radio equipment
68001	Speaker
68013	Monitor for controlling reverse gear
68014	Camera for controlling reverse gear
72016	13-pole coupling for 12V connection to trailer
72027	38-pole coupling for connection with IVECO
78000	Solenoid valve for connection with atmosphere from fuel tank for thermal starters
78013	Pressure regulator solenoid valve
78015	Solenoid valve to cut out third pumping element
78208	Transmission total power take-off solenoid valve
78209	Solenoid valve for antipollution devices (EGR)
78233	Vehicle raising solenoid valve assembly
78247	Solenoid valve for electronic injection
78248	Solenoid valve for variable geometry turbine order
80000	Motor for right electric window
80001	Motor for left electric window
82000	Windscreen defrosting control unit
82010	Joint between cab-bonnet cable and climate control cable
84020	Outdoor temperature sensor
85000	Cigar lighter
85005	Electrically adjustable heated rear view mirror
85022	Engine cooling electromagnet coupling
85028	Locking device for rear differential

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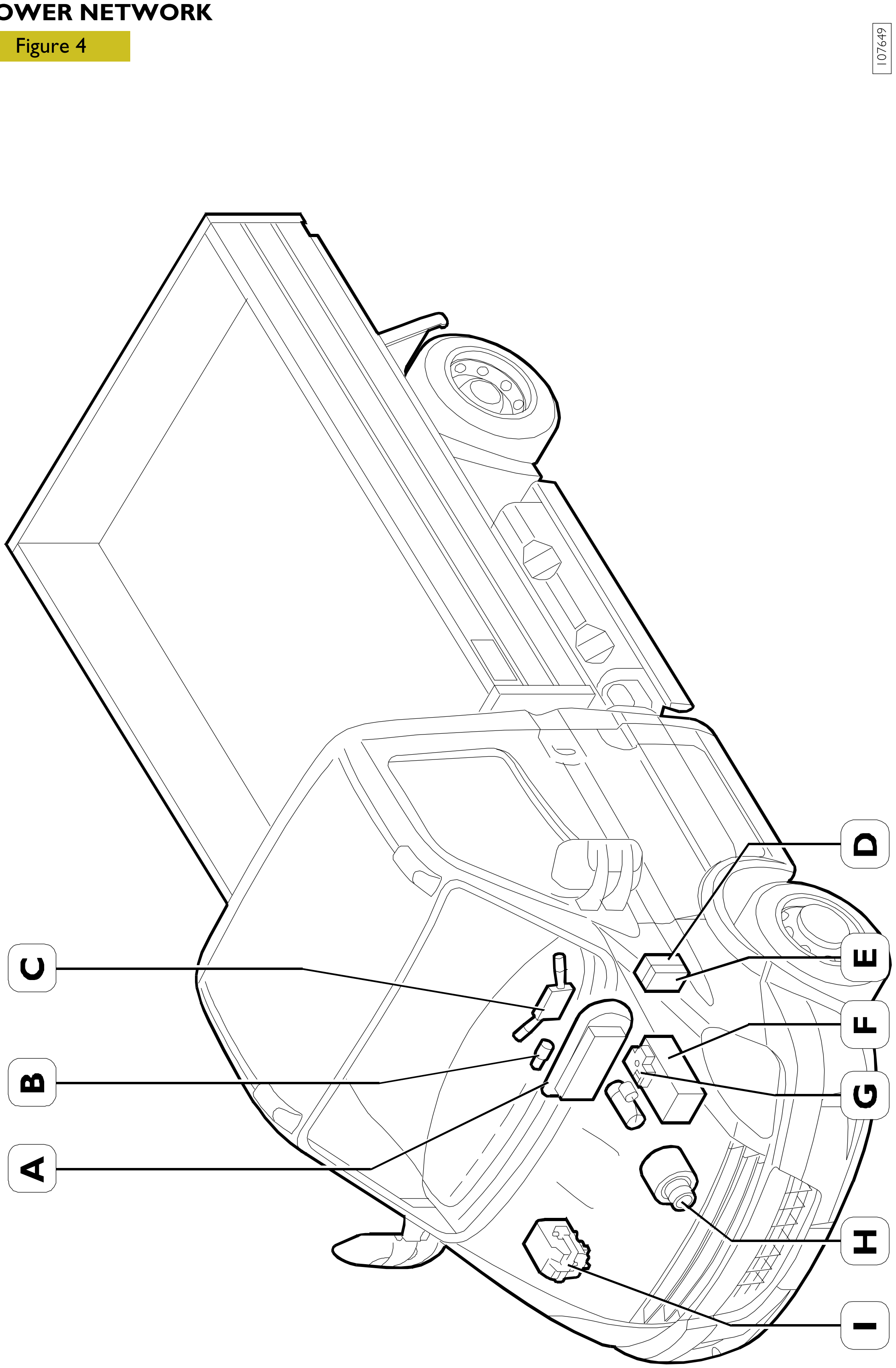
85036	Heated air-suspended seat (driver's side)
85038	Heated air-suspended seat (driver's opposite side)
85130	Immobilizer
85131	Volumetric sensor
85132	Antitheft device self-supplying syren
85150	4-channel methane control unit
85151	EDC injection pump
85152	Accelerator load sensor (EDC)
85156	Turbofan air pressure temperature sensor, (EDC)
85157	Pressure adjustment sensor
86002	Sensors for front brake shoe wear
86003	Sensors for rear brake shoe wear
86011	Electronic control unit, pre/after-heating system
86012	Electronic control unit for signalling water in fuel filter
86013	Sensor, water in fuel filter
86020	Antipollution device control unit (EGR)
86023	Vehicle raising/lowering control unit
86029	Electronic control unit for central door locking
86046	Electronic control unit for trailer lights control
86047	Electronic control unit for switching on total power takeoff
86060	Airbag control unit
86061	Air bag
86062	Pretightener
88000	ABS system electronic control unit
88001	ABS system sensor
86***	Engine oil level control
1-2	Parking sensors (Table no. 5)
3-4	Parking sensors (Table no. 5)
*	Clutch actuator (Table no. 9A)
**	Gears engagement actuator (Table no. 9A)
**	Parking sensors central unit (Table no. 5)
***	Gearbox actuator selector (Table no. 9A)

POWER NETWORK

Figure 4



A. Instrument cluster - B. Key switch - C. Steering column switch unit - D. Interconnection central unit "CPL" - E. Body Computer - F. Battery - G. Positive (+30) distribution central unit "CBA" - H. Alternator - I. (Engine) interconnection central unit "CVM".

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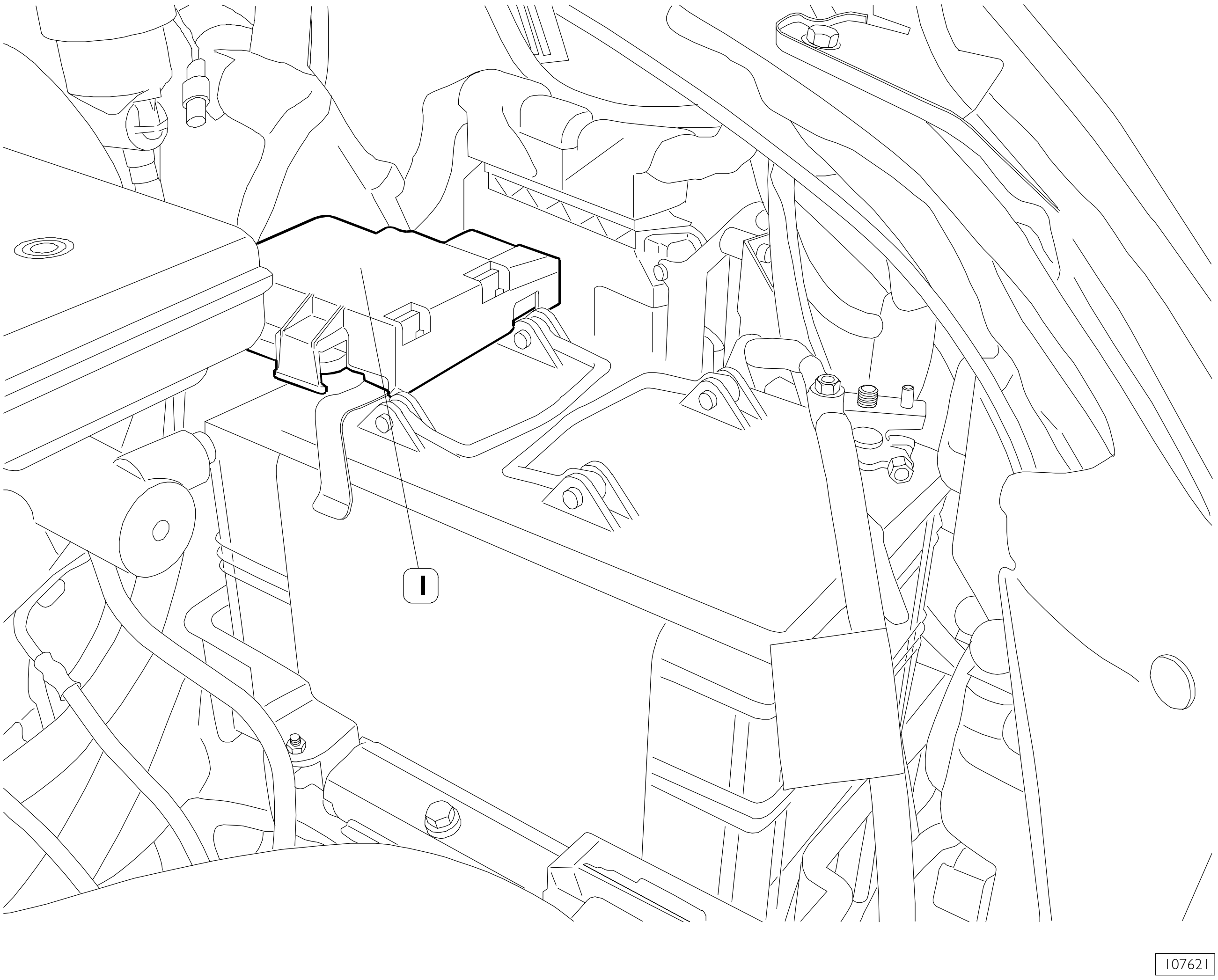
POSITIVE NETWORK (CBA)

Figure 5



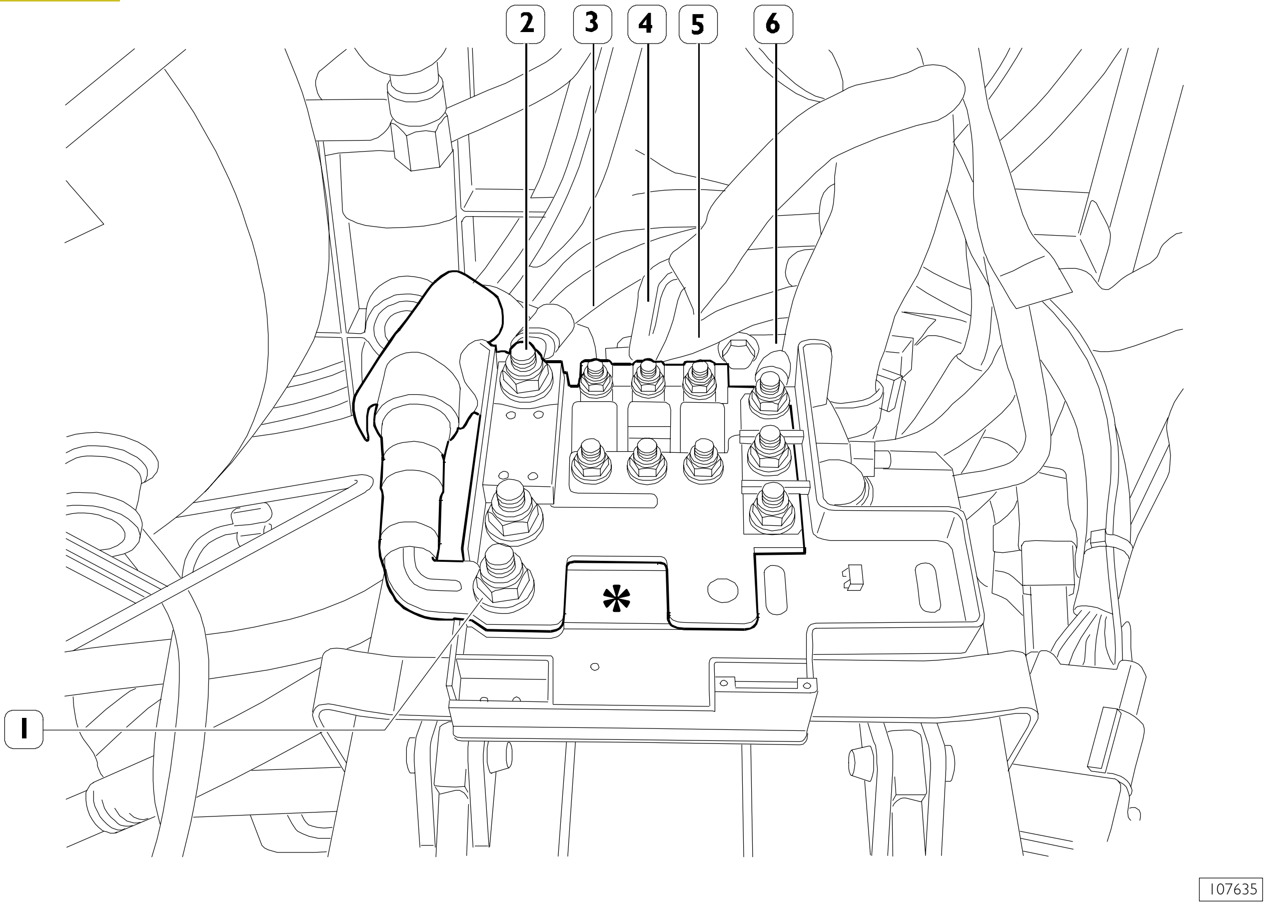
1. Positive connection central unit (CBA)

On battery terminal an interconnection central unit is positioned named "CBA". Its task is to provide + battery (+30) power supply to the different functions of the vehicle.
To this unit there are connected one 6 mm^2 cable, three 10 mm^2 cables, one 35 mm^2 cable, and one 50 mm^2 cable.

There are present five fuses by:

- 150 A
- 70 A
- 70 A
- 50 A
- 500 A

Figure 6

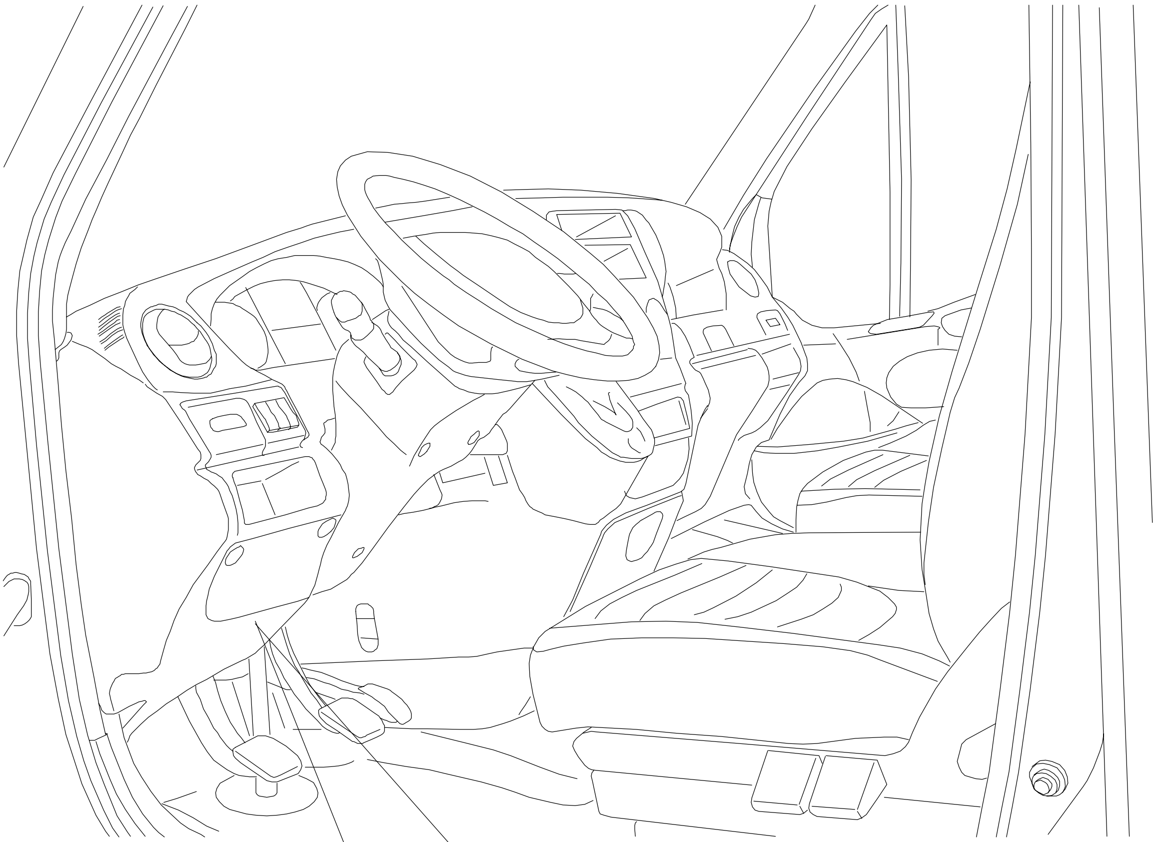


Ref.	Function	Fuse range	Sect.
1	Positive +30 for alternator starter	500	50
2	Positive for engine opening central unit "CVM"	150	35
3	Positive +30 for "CPL"	70	10
4	Positive +30 for "CPL"	70	10
5	Positive +30 for box OPT	50	6
6	Positive +30 for "CPL" - OPT prearrangement	-	10

* On cable no. 1 there is a 500 A fuse (not visible in figure).

INSTRUMENT PANEL INTERCONNECTION CENTRAL UNITS (CPL) “75002”

Figure 7



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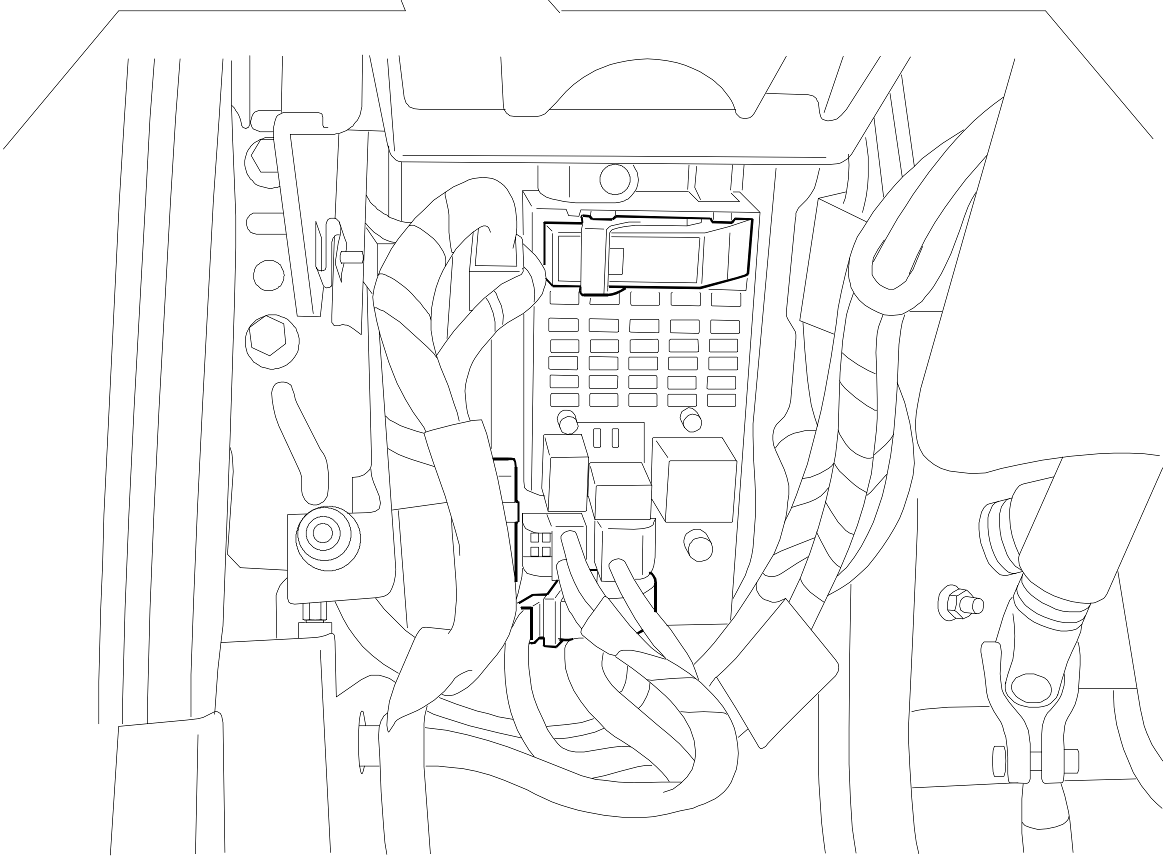
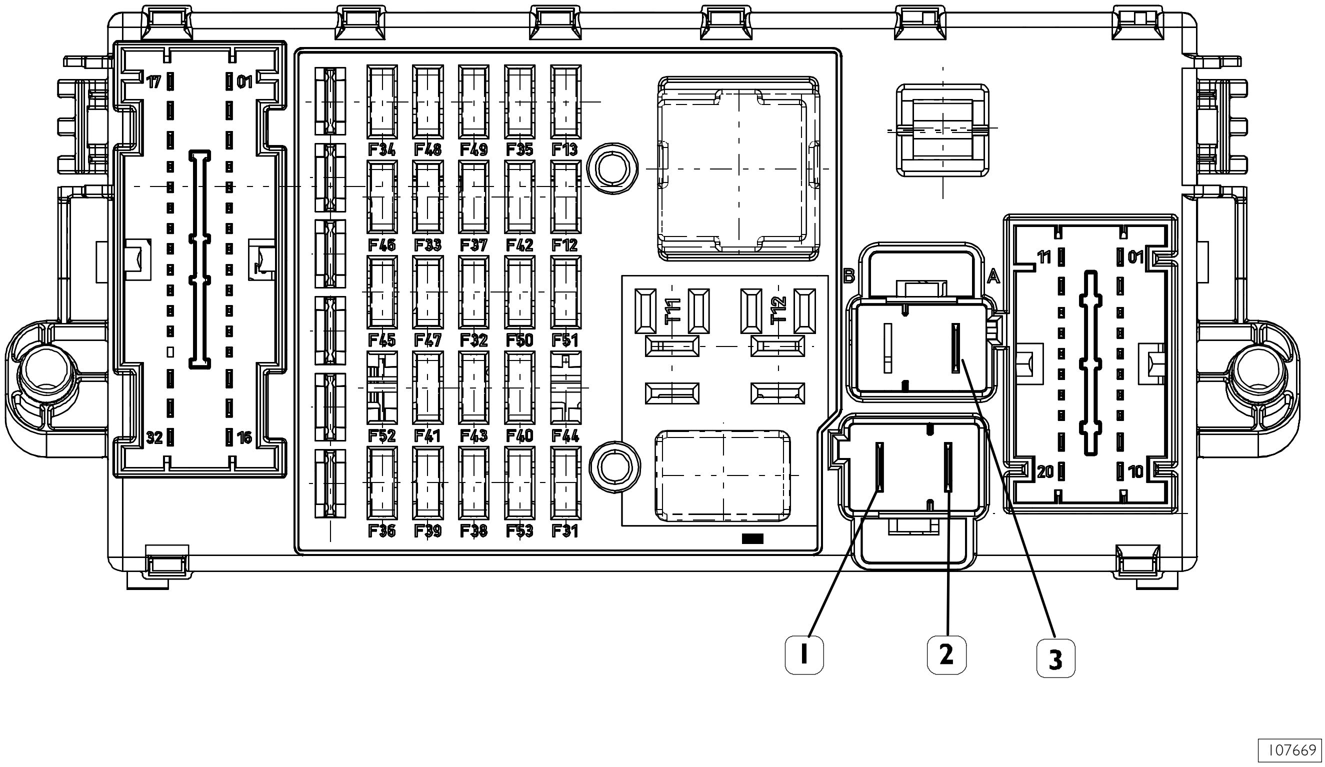


107639

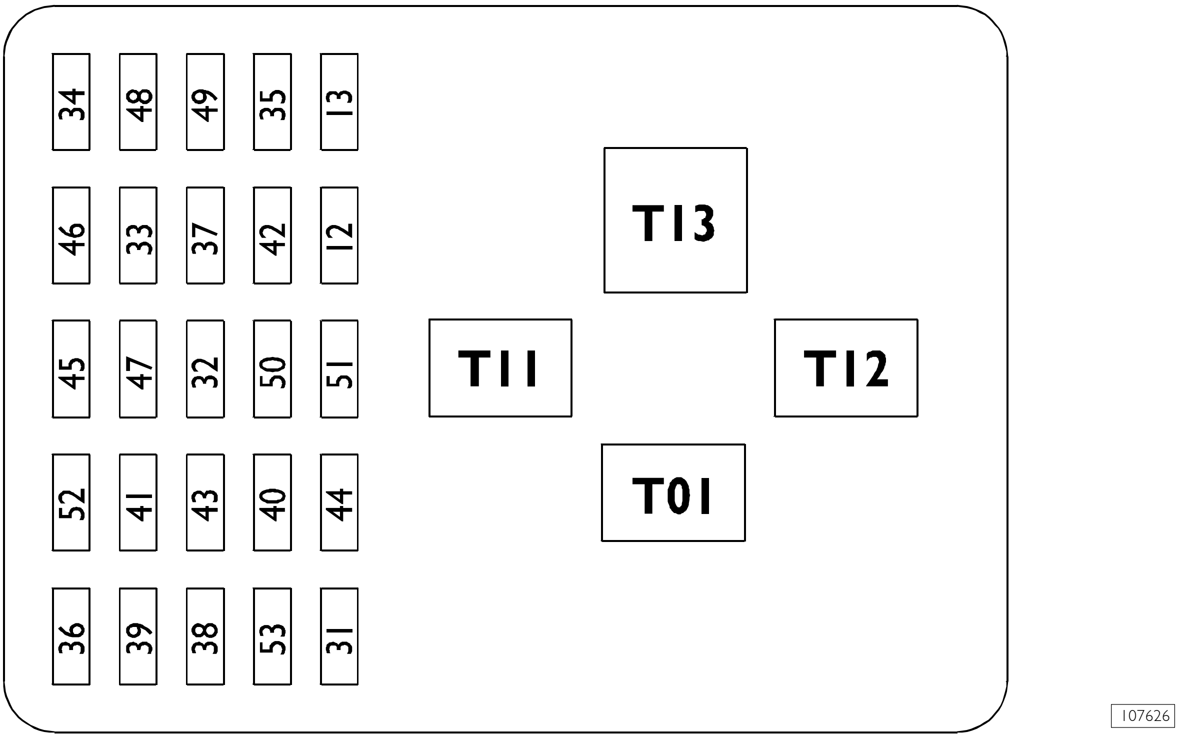
Figure 8



Ref.	Function	Sect.
1	Positive from "CBA" (fuse 70A) - connector B/A	10
2	Positive from "CBA" (fuse 70A) - connector B/B	10
3	Positive from "CBA" - OPT connector D	10

Fuses / remote control switches identification

Figure 9

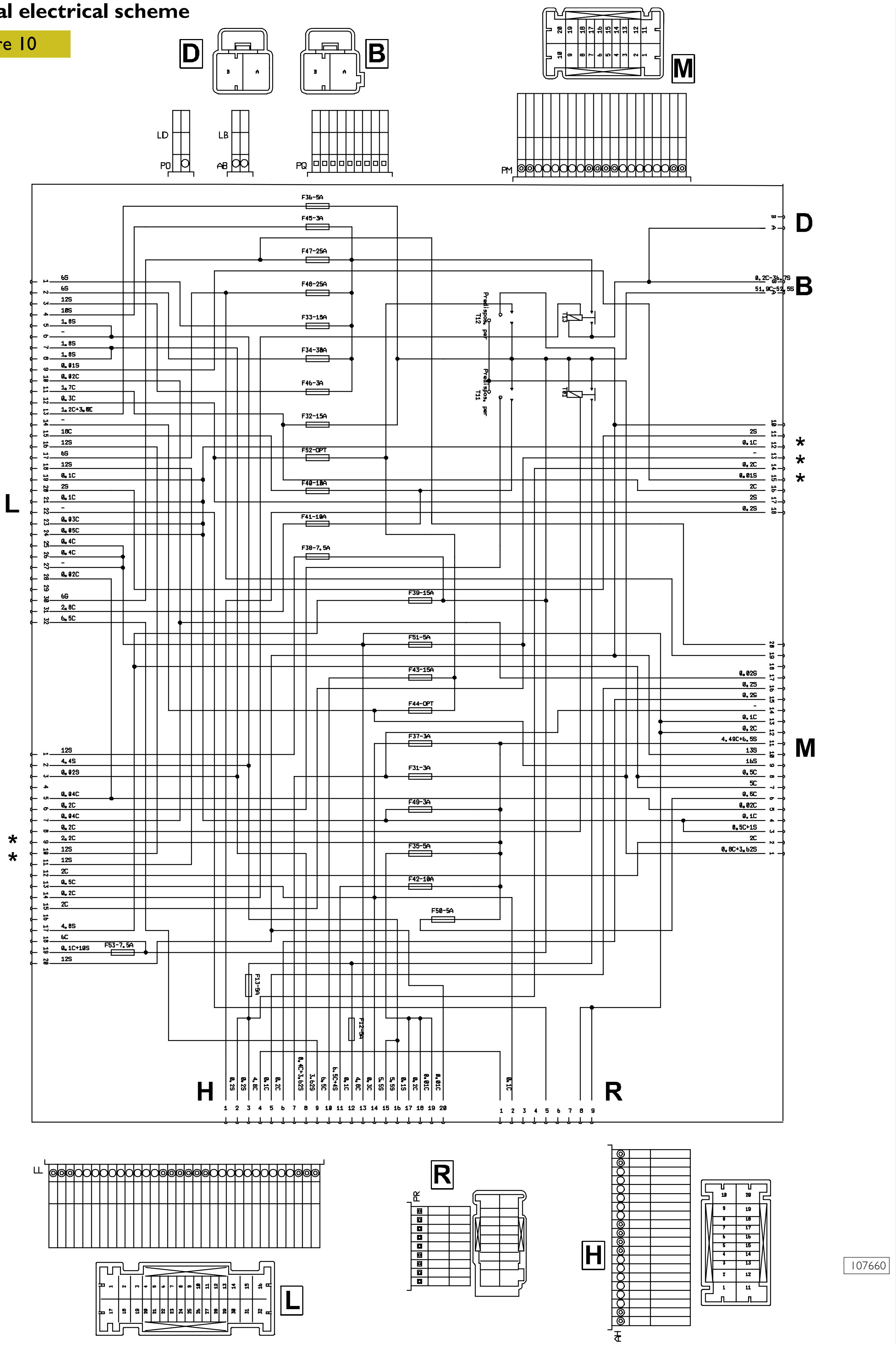


No.	Function	Maximum nominal current
F-12	Right hand dipped headlight	7,5A
F-13	Left hand dipped headlight - headlamp attitude rectifier	7,5A
F-31	Relay T08-T17 in CVM and BC	3A
F-32	Rotating-translating door	15A
F-33	Air heater / Cigarette lighter	15A
F-34	Socket	20A
F-35	ABS8 or ESP8. Telma	10A
F-36	Central locking	20A
F-37	Switches for stop lights and various loads under 15	5A
F-38	BC / Roof lamps internal relays power supply	10A
F-39	Car radio - chrono-tachograph	15A
F-40	Rh heated rear window	10A
F-41	Lh heated rear window	10A
F-42	Reverse lights switch	5A
F-43	Windscreen wiper	20A
F-44	AVAILABLE	-
F-45	AVAILABLE	-
F-46	AVAILABLE	-
F-47	Driver window winder	25A
F-48	Passenger window winder	25A
F-49	ECU for climate control system, car radio, heated seats	15A
F-50	Airbag	5A
F-51	Chrono-tachograph	5A
F-52	AVAILABLE	-
F-53	Instrument cluster, rear fog lights	7,5A

Relay	Function	Maximum nominal current
T-01	Right and left hand dipped headlights	20A
T-11	Heated rear window	20A
T-12	Cigarette lighter / socket / heater or climate control system	20A
T-13	Power release from key	50A

Internal electrical scheme

Figure 10



** Junction between central unit "CPL" and "Body Computer" (internal lamellar junction)

*** Connector "R" unused pins (18 pins)

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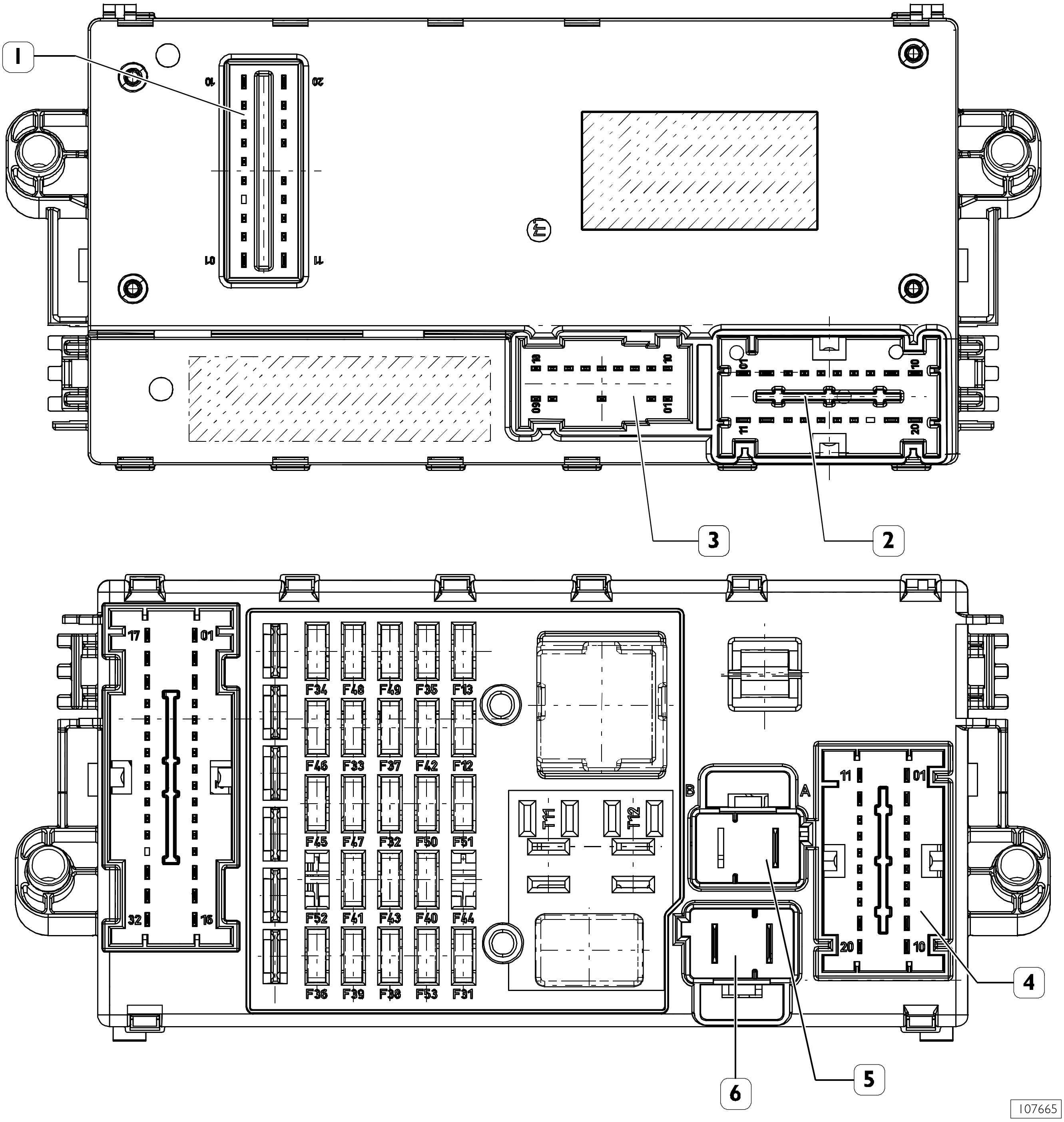
Junction connectors

Figure 11



FRONT VIEW

Ref.	Function
1	Connector (**)
2	Connector "M"
3	Connector "R"
4	Connector "H"
5	Connector "D"
6	Connector "B"
7	Connector "L"

Junction connector "L"

Ref.	Function	Code
1	Positive for cigarette lighter	7721
2	Positive for socket	7721
3	-	-
4	Positive for (rh & lh) door control assembly	8180
5	-	-
6	-	-
7	Positive for reverse headlamp	2226
8	Positive for reverse headlamp	2226
9	-	-
10	B Can line "L" for parking sensors	6111
11	Positive +30	7772
12	-	-
13	Positive for central locking	9076
14	-	-
15	Positive for heated rear window	8021
16	-	-
17	Positive for rh lateral window winder	8863
18	Positive +30 for cab roof lamps	7772
19	Positive +15 for parking sensors	8879
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	-	-
28	B Can line "H" for parking sensors	6110
29	-	-
30	Positive for lh lateral window winder	8863
31	Positive for heated rear window	8021
32	-	-

Junction connector “M”

Ref.	Function	Code
1	Positive +15 with the exclusion of users during start-up step	8849
2	-	-
3	Positive +15 for air-conditioner central unit	8879
4	Positive +15 for radio	8879
5	B Can line "H" for radio	6110
6	Positive +15 for air bag	8879
7	Positive +30 for radio	7772
8	Positive for tachograph	5156
9	-	-
10	Earth	0000
11	-	8887
12	Positive for tachograph	8879
13	-	-
14	Positive +15 for rh & lh window winders	8849
15	-	-
16	-	-
17	B Can line "L" for radio	6111
18	-	-
19	-	-
20	-	-

Junction connector "R"

Ref.	Function	Code
1	-	-
2	Positive +15 to control the exclusion of ASR	8879
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	Headlamp attitude rectifier	9934
15	-	-
16	-	-
17	-	-
18	Headlamp attitude rectifier	9935

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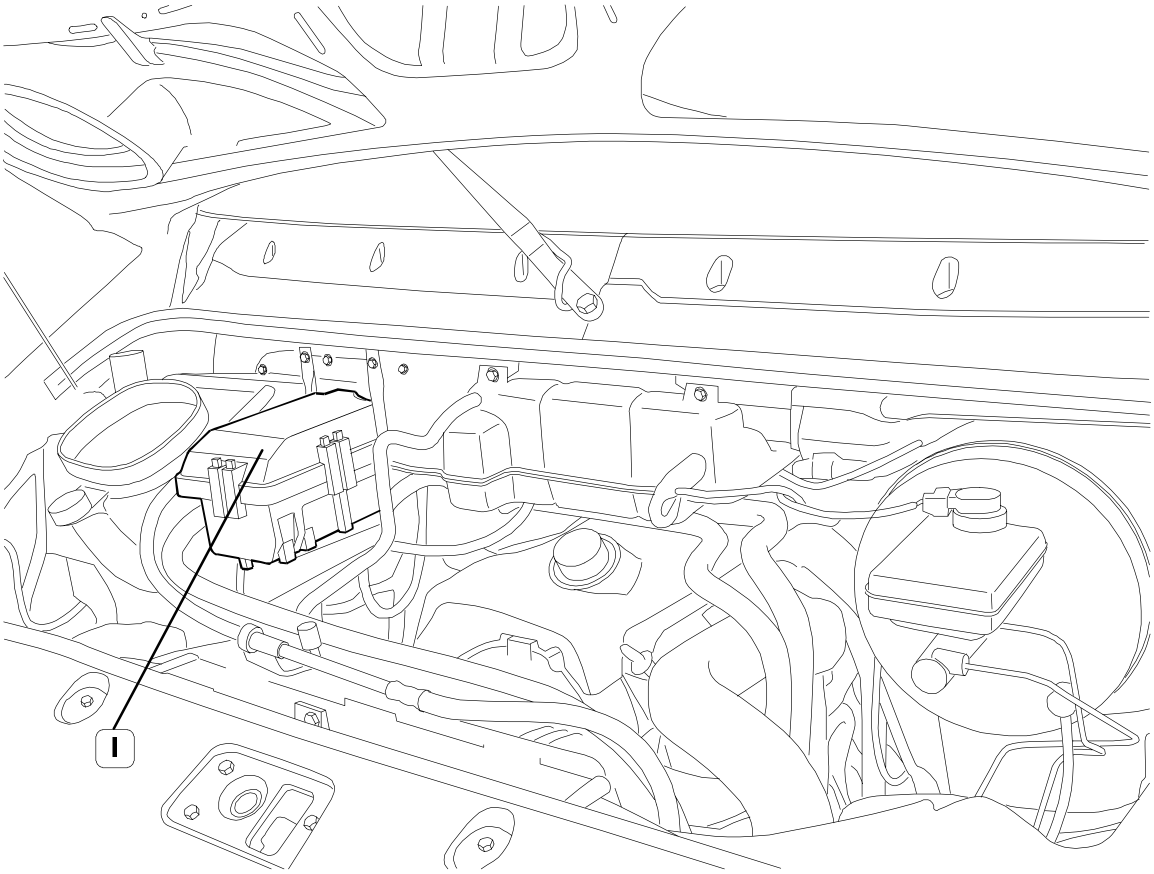
Junction connector "H"

Ref.	Function	Code
1	Positive for headlight attitude electric motor	9935
2	Positive for headlight attitude electric motor	9934
3	Positive for lh dipped headlight	2231
4	-	-
5	-	-
6	-	-
7	Positive +15 with the exclusion of users during start-up step	8849
8	Positive for reverse gear	2226
9	-	-
10	Positive +15 (with exclusion) for windscreen wiper remote control switches	8849
11	Positive for reverse gear on switch	2268
12	Positive for rh dipped headlight	2223
13	-	-
14	Positive +15 to stop warning switch	8879
15	Positive for stop lights control	1176
16	-	-
17	-	-
18	-	-
19	Positive +15 for central unit ESP8	8879
20	-	-

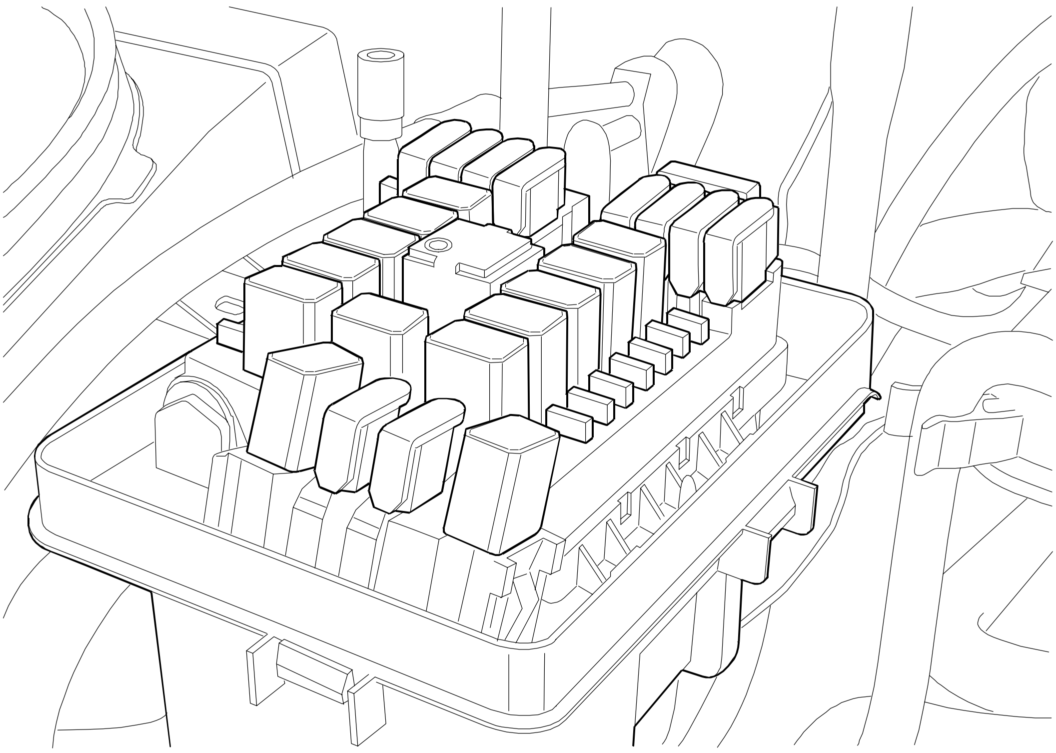
ENGINE OPENING CENTRAL UNIT (CVM) "75001"

Figure 12



1. Interconnection central unit "CVM"

107623



107622

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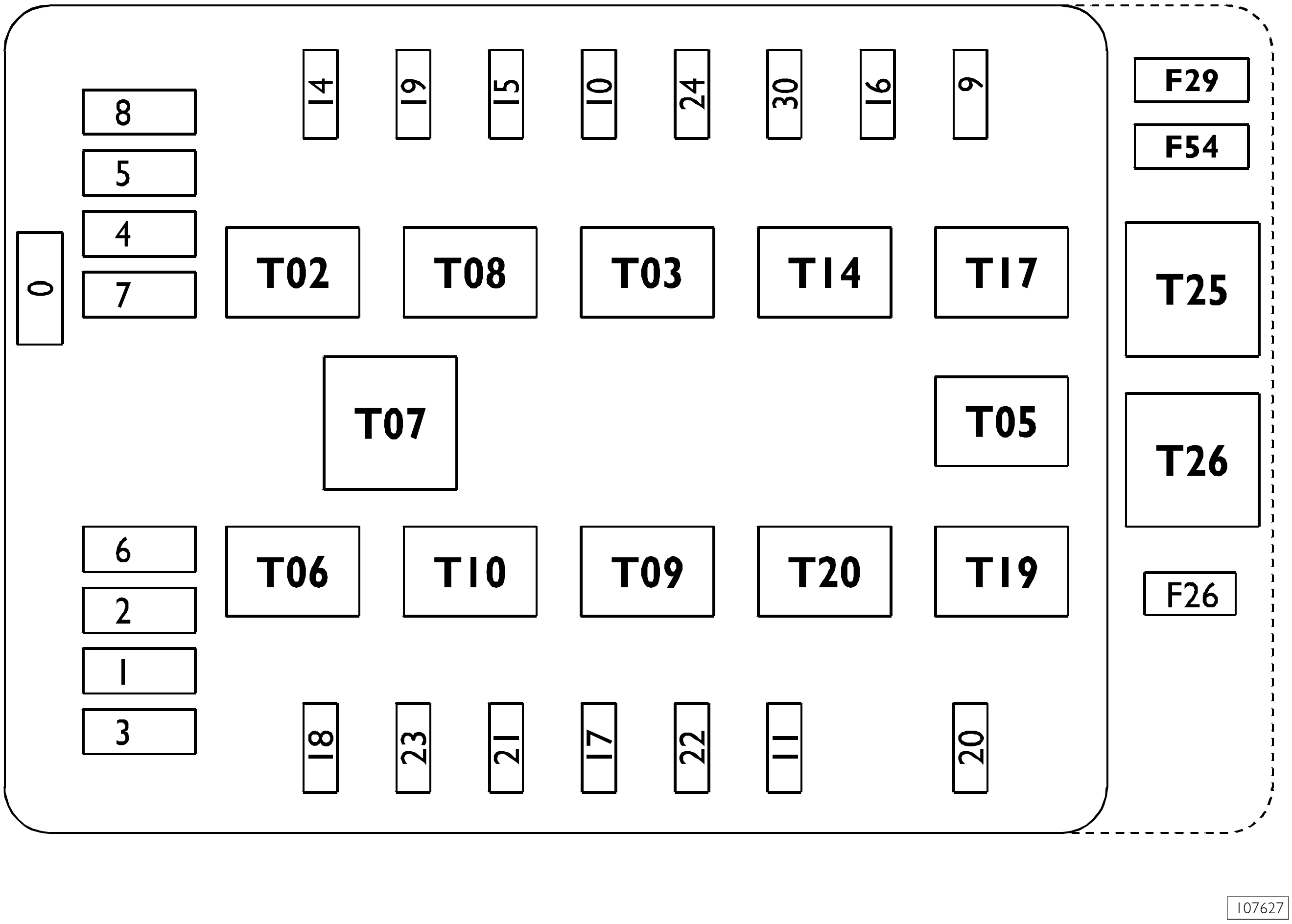
Fuses / remote control switches identification

Figure 13



Ref.	Function	Maximum nominal current
F-0	Ignition glow plugs	60A
F-1	ABS8 or ESP8	40A
F-2	ABS8 or ESP8	30A
F-3	ECU ESV1 (automatic gearbox)	30A
F-4	ECU ESV1 (automatic gearbox)	30A
F-5	Start-up switch	30A
F-6	Heated mirrors and windscreen	20A
F-7	Side marker lamps	20A
F-8	Heater or climate control system fans	30A
F-9	Windscreen washer	20A
F-10	Horn	7,5A
F-11	EDC16 (secondary loads)	10A
F-14	Right hand full beam headlight	7,5A
F-15	Left hand full beam headlight	7,5A
F-16	EDC16, T02, T14, Additional heater	5A
F-17	EDC16 (primary loads)	15A
F-18	ECU ESV1 (automatic gearbox)	10A
F-19	Baruffaldi	5A
F-20	Fuel filter heater	25A
F-21	Fuel pump	15A
F-22	EDC16 (primary loads)	25A
F-23	Additional heater	10A
F-24	ECU ESV1 (automatic gearbox), PTO	15A
F-30	Left and right hand front fog lights	15A
IN CONTAINER, OUT OF CENTRAL UNIT		
F-26	Trailer socket	10A
F-29	Air spring suspensions	40A
F-54	Air spring suspensions	40A

Ref.	Function	Maximum nominal current
T02	Right and left hand full beam headlights	20A
T03	Horn	20A
T05	Baruffaldi power supply	20A
T06	Heater / mirrors / windscreen	20A
T07	Side marker lamps	20A
T08	Heater or climate control system fans	20A
T09	EDC16 (main relay)	20A
T10	Fuel pump	20A
T14	Left and right hand front fog lights	20A
T17	Windscreen washer	20A
T19	Fuel filter heater	20A
T20	Diagnosis MODUS	20A
IN CONTAINER, OUT OF CENTRAL UNIT		
T25	Windscreen wiper on/off	10/20A
T26	Windscreen wiper 1st / 2nd speed	10/20A

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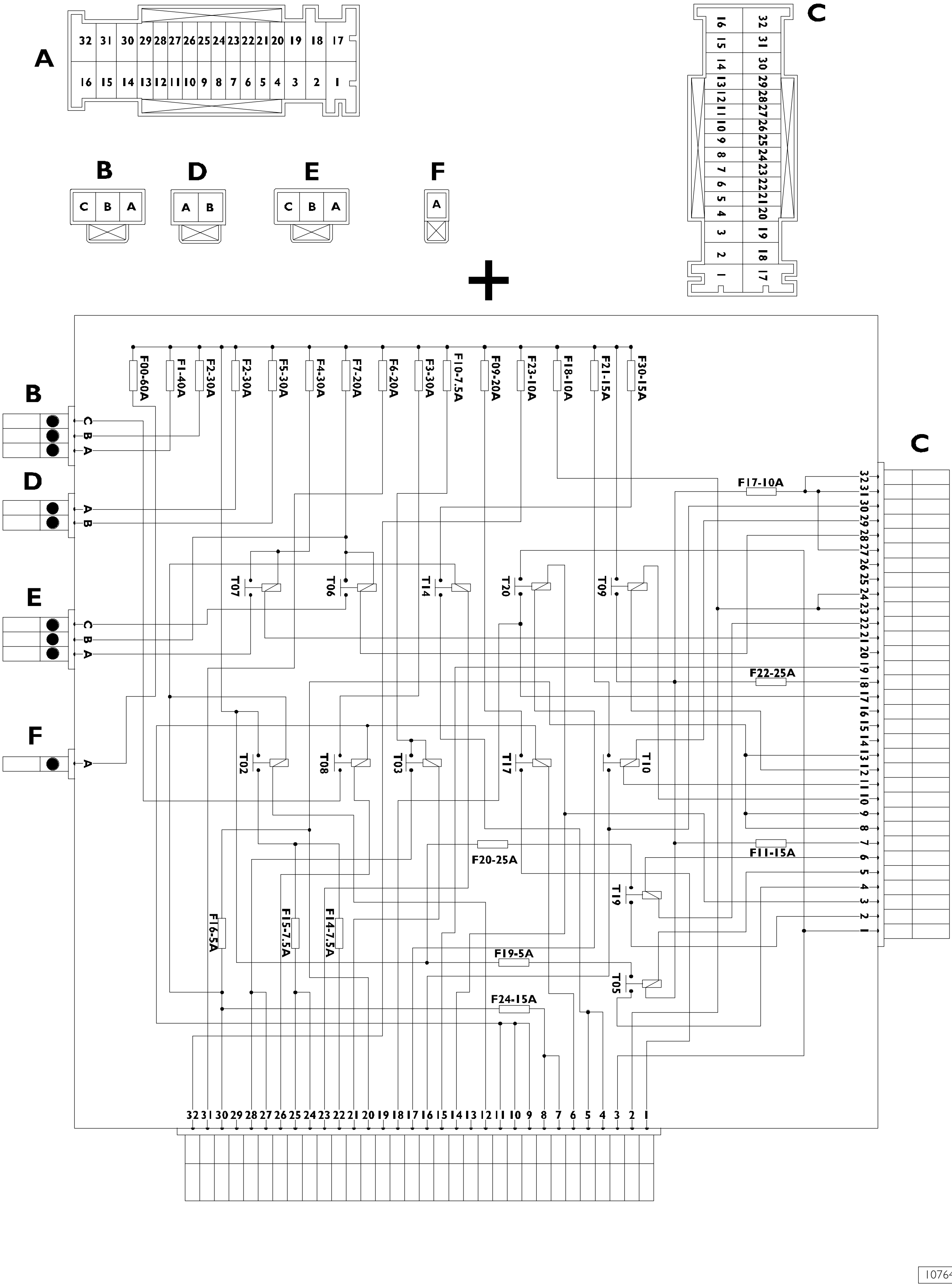
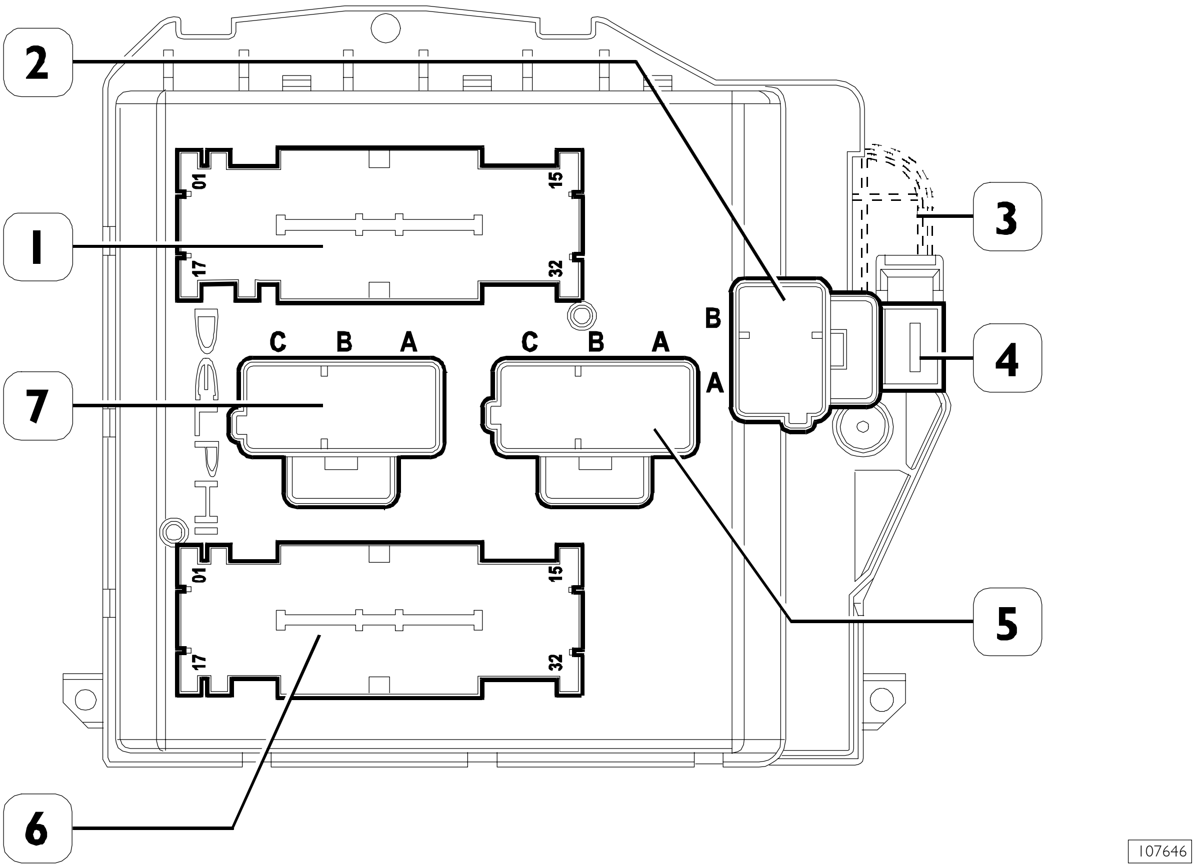
Internal electrical scheme

Figure 14



Junction connectors

Figure 15



REAR VIEW

Ref.	Function
1	Connector "A"
2	Connector "D"
3	Positive "+30" from "CBA"
4	Connector "F"
5	Connector "B"
6	Connector "C"
7	Connector "E"

Junction connectors “A”

Ref.	Function	Code
1	Positive for windscreen washer pump	8886
2	-	-
3	-	-
4	Positive for lh front fog headlamps	2228
5	Positive for rh front fog headlamps	2228
6	Positive from Body Computer	8879
7	Positive for gear selector switch for semi-automatic gearbox	8110
8	Positive +15 for total power take-off	8879
9	-	-
10	-	-
11	Jumper with H7 of 75002	8849
12	Jumper with AV12 of Body Computer	8879
13	-	-
14	Earth	0000
15	-	-
16	-	-
17	Positive for diagnostics connection joint (+)	7797
18	-	-
19	-	-
20	Positive +15	8879
21	Positive for horns	1116
22	Positive for rh full beam headlight	2221
23	Jumper for Body Computer	8879
24	-	-
25	Positive for lh full beam headlight	2219
26	Earth	0000
27	Positive +15 for horns	1116
28	-	-
29	-	-
30	Positive +15	8887
31	Positive +30 for automatic gearbox central unit	7772
32	Positive +30	7772

Junction connectors "C"

Ref.	Function	Code
1	Positive +30 for start-up	7772
2	Positive for diesel oil heating on control	8036
3	-	-
4	Positive for electromagnetic clutch for air conditioning system	9993
5	Earth	0000
6	Positive +30	7772
7	-	-
8	-	-
9	Positive +15	8879
10	Main relay signalling cable for EDC	155
11	Earth	0000
12	(Not protected) direct positive on batteries	7777
13	-	-
14	-	-
15	-	-
16	-	-
17	Positive +15	7772
18	Positive for EDC/MS6 system from main relay	7150
19	-	-
20	-	-
21	Positive +15	8879
22	Water in pre-filter warning lamp	5530
23	Jumper between C23 and C12	7772
24	Positive +30 for automatic gearbox central unit	7772
25	-	-
26	-	-
27	-	-
28	Negative for heated rear view mirrors switch	0000
29	Positive +30	7772
30	Injection pump diesel oil flow actuator for EDC16	9156
31	Positive for EDC16	7150
32	-	-

Junction connectors "B"

Ref.	Function	Code
A	Positive +30 for ABS	7772
B	Positive +30 for ABS	7772
C	Positive +15 for air-conditioner	8849

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Junction connectors "D"

Ref.	Function	Code
A	Positive +30 for key switch	7772
B	Positive +30 for automatic gearbox	7772

Junction connectors "E"

Ref.	Function	Code
A	Positive for chassis cable	3390
B		-
C	Positive +15 for heated rear view mirrors	8830

Junction connectors "F"

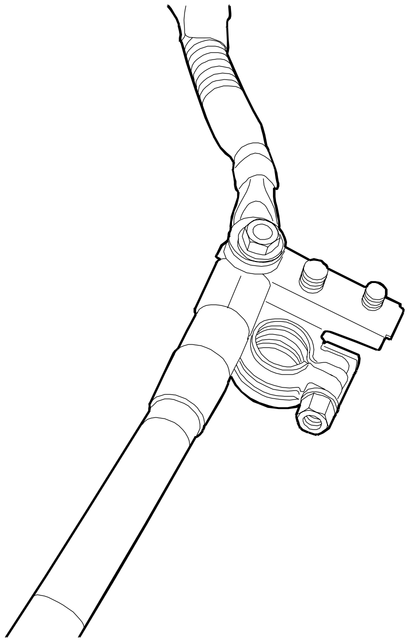
Ref.	Function	Code
A	Positive +30 for pre-heating	7772

NEGATIVE NETWORK

EARTH POINTS

Through a brown 50 mm2 cable, battery negative terminal is connected to earth point (LM2) located at chassis left side on the side member; from this point, a copper braid is connected to engine block, near the starter (*lm1*). At point *lm2* there are connected the earth points relating to chassis cable.

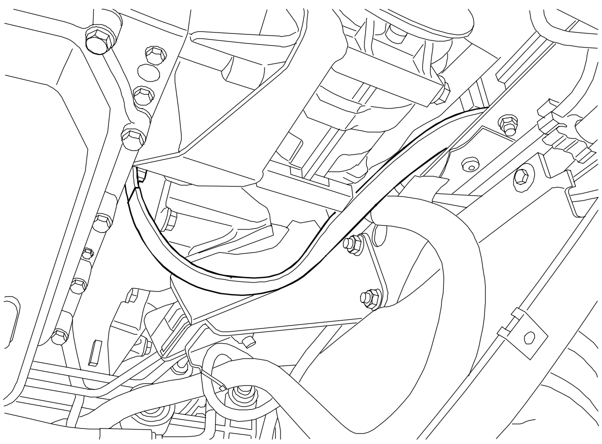
Figure 17



107633

NEGATIVE PIN

Figure 16



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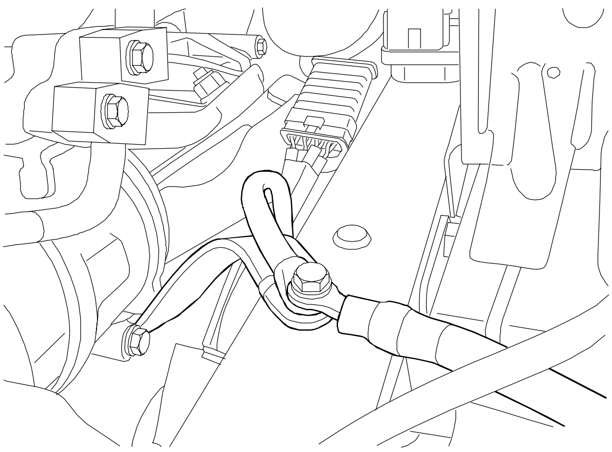
ENGINE BLOCK BRAID (LM1)

Figure 18



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EARTH POINT ON LEFT HAND SIDE MEMBER (LM2)

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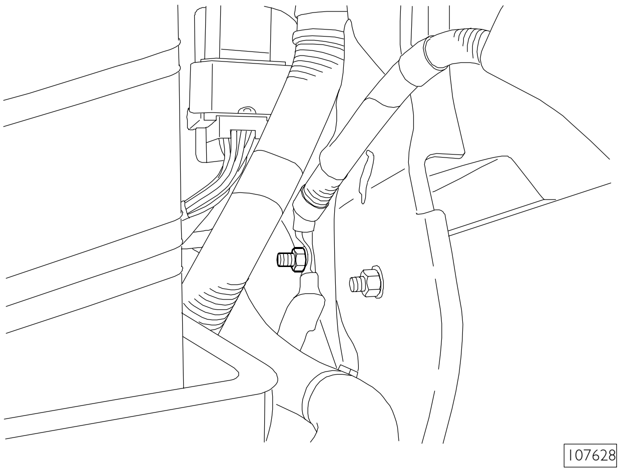
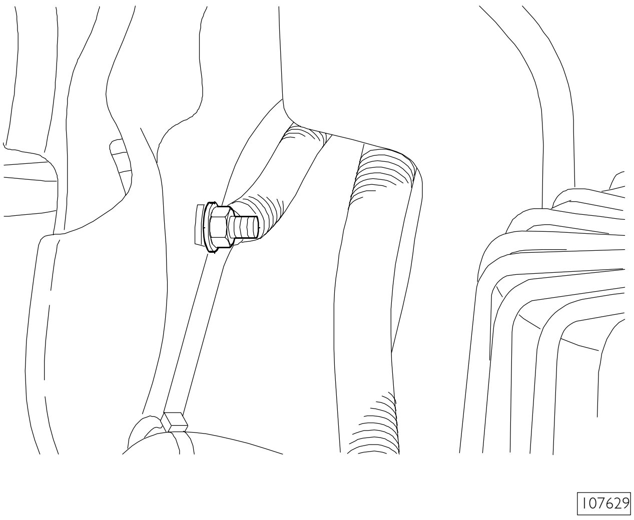
Figure 19



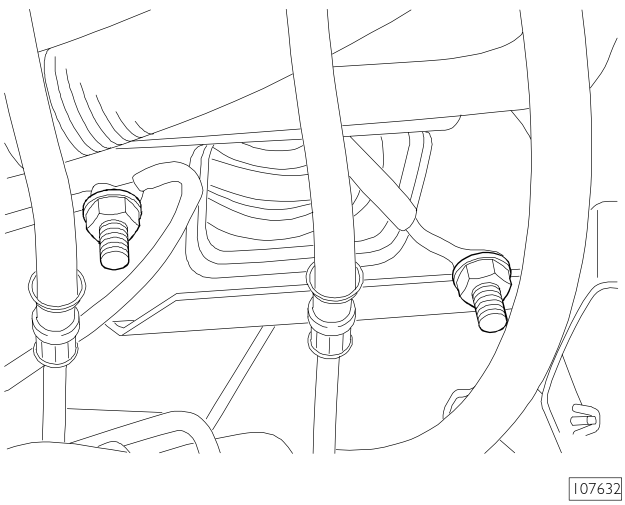
LH BONNET EARTH POINT (LM5)

Figure 20



RH BONNET EARTH POINT (LM4)

Figure 21



EARTH POINTS UNDER POWER-ASSISTED BRAKE (LM3)

In bonnet, in the vicinity of left front blinker there is located earth point ***lm5*** to which connected are:

- ❑ Central unit "CVM"
- ❑ Lh headlamp
- ❑ Pre-heating remote control switch
- ❑ EDC
- ❑ Electromagnetic joint for engine cooling
- ❑ Heated pre-filter
- ❑ Remote control switch to enable air-conditioner compressor to be put on
- ❑ Headlight washer pump
- ❑ Fuel filter clogged switch
- ❑ Switch for engine bonnet opening

In bonnet, in the vicinity of right front blinker there is located earth point *lm4* to which connected are:

- ❑ Rh headlamp
- ❑ Windscreen washer pump
- ❑ Horn
- ❑ Windscreen wiper
- ❑ Compressor connected remote control switch (for EDC)
- ❑ Air-conditioner compressor
- ❑ Heated windscreen
- ❑ Gearbox power take-off in switch
- ❑ Antitheft siren
- ❑ Air filter clogged switch

In the bonnet, under power-assisted brake there are two earth points present:

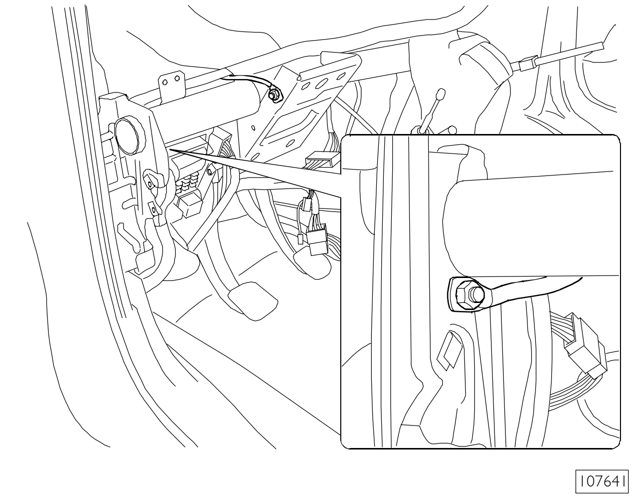
- ❑ ***lm3***: central unit ABS - heated pre-filter central unit
- ❑ ***lm3***/*S*: central unit ABS

Cab interior left side
- ❑ CPL
- ❑ Body Computer
- ❑ Central locking central unit
- ❑ Switch for the exclusion of ASR (symbol)
- ❑ Power central unit
- ❑ Height sensors (ECAS)
- ❑ Steering column switch unit (*lm7/S*)
- ❑ Gear selector for automatic gearbox (*lm7/S*)

Cab interior right side
- ❑ Emergency lights pushbutton
- ❑ Front fog lights (pushbutton)
- ❑ Speed limit setting (pushbutton)
- ❑ Radio
- ❑ Windscreen electric defroster control assembly
- ❑ Air-conditioner central unit
- ❑ Pushbutton for heated rear window
- ❑ Heated mirrors switch
- ❑ Vehicle lifting/lowering pushbuttons (ECAS)
- ❑ Tachograph (*lm6/S)*

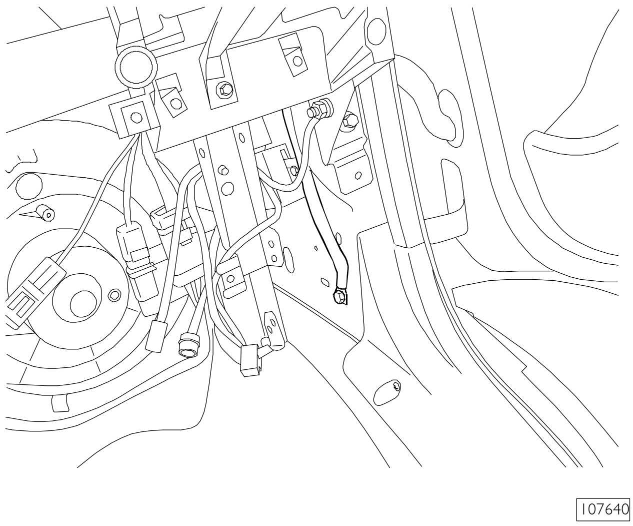
Loading platform central part ***(lm8)***
- ❑ Clearance (rh / lh) front lights
- ❑ AIR BAG (central unit) ***lm8/S***
- ❑ Switch for anti-twisting with gears engaged

Figure 22



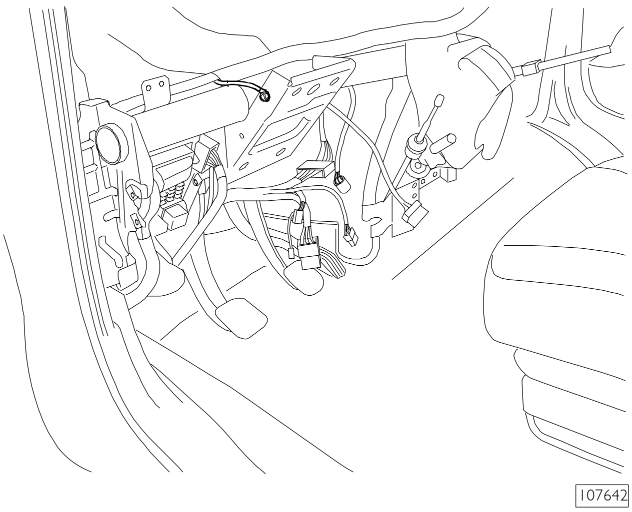
CAB INTERIOR LEFT SIDE (LM7)

Figure 23



CAB INTERIOR RIGHT SIDE (LM6)

Figure 24



CAB INTERIOR LEFT SIDE (LM7/S)

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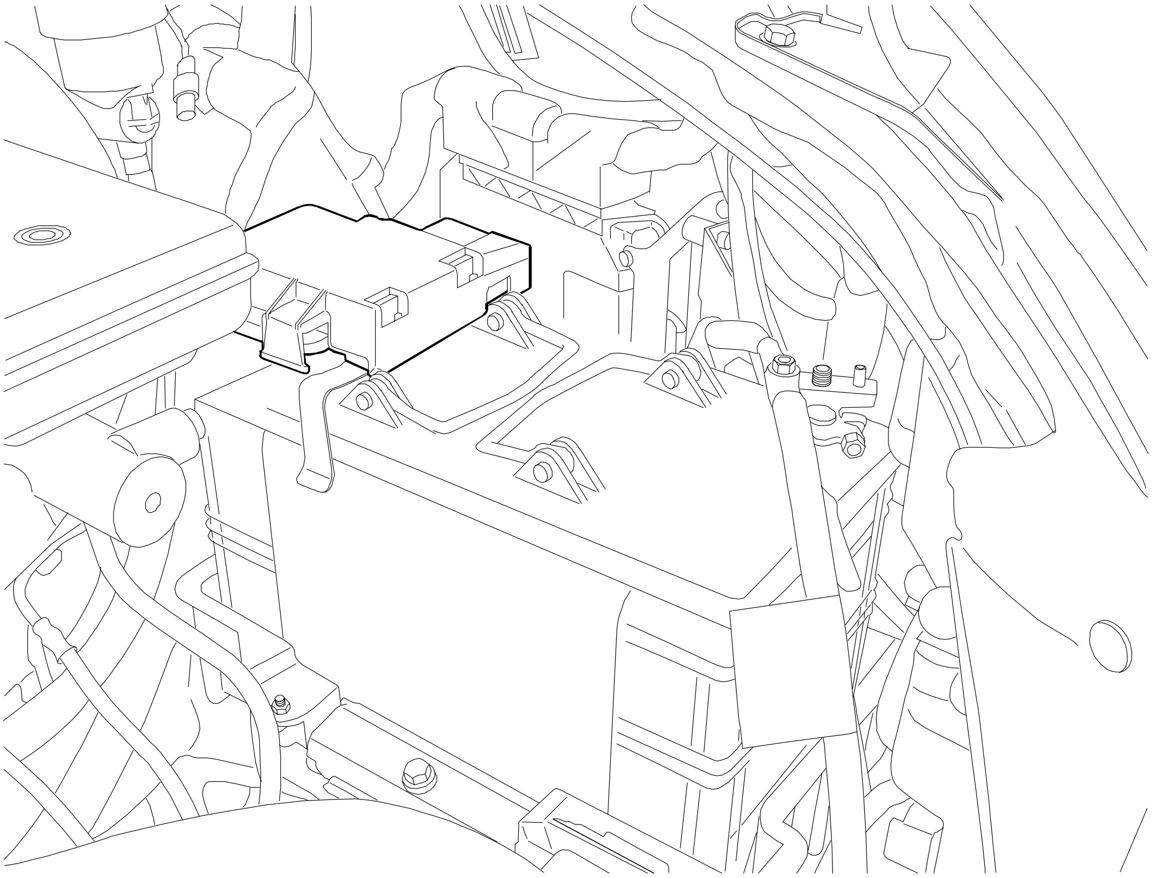
BATTERY (20000)

The battery shown below has a 12Vdc 110Ah 460 A power supply voltage and is installed on the left side of the engine compartment near the EDC control unit.

Requirements

- Case and cover in polypropylethylene plastics PR. 50.100. Matt white case.
- C.S. plugs, blacK. Grids: positive and negative made of Pb Ca.
- Cover integral polypropylene
- Separator: envelope-type polyethylene
- Battery for "tropical duty" marked with red color.
- "Environmental precautions" plate according to Law no. 126 of 10/04/91 "Standards for user information".
- Adhesive label with "Selective disposal" acc. to EEC Directive no. 93/86.

Figure 25



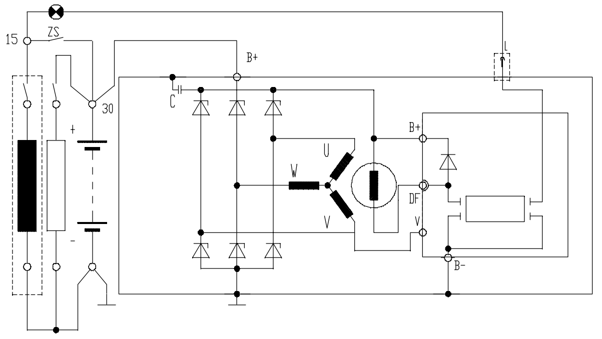
Fast diagnosis

Defect	Possible causes	Remedy
Start defect	1. Low battery	Check battery charge; if regular check recharge circuit
	2. Loose, oxidized or burnt out contacts	Recover
	3. Starter circuit defective	Cf. start section
Low voltage at component leads	1. Battery at half power	Check battery charge; if regular check recharge circuit
	2. Oxidized connections	Sand and replace
Electrolyte level often low	1. Over voltage	Check recharge circuit and/or connection tightness

BOSCH KCBI 14V 110A ALTERNATOR

03000

Figure 26



8649

WIRING DIAGRAM

Specifications for use

Vehicle electric system rated voltage:	12 V

Suitable for coupling with battery of any capacity
It must work with the battery connected.

Connection with inverted polarity is not allowed.

Operating specifications

Rated voltage	14 V
Rated current delivery	110A
Drive side direction of rotation	clockwise
Maximum continuous speed	≤ 12.000 min^{-1}
Storage temperature	-40 °C / +110 °C

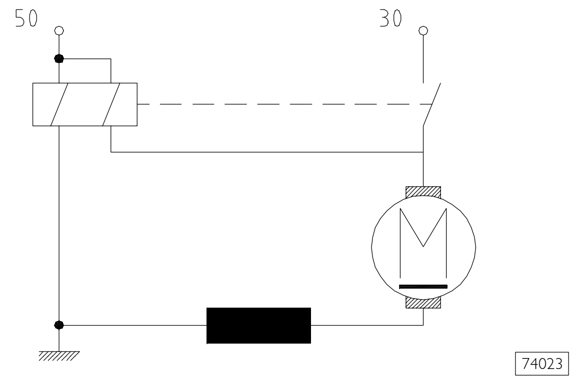
Figure 27

8656

TECHNICAL VIEW

EV 12V - 2.3 KW STARTER MOTOR

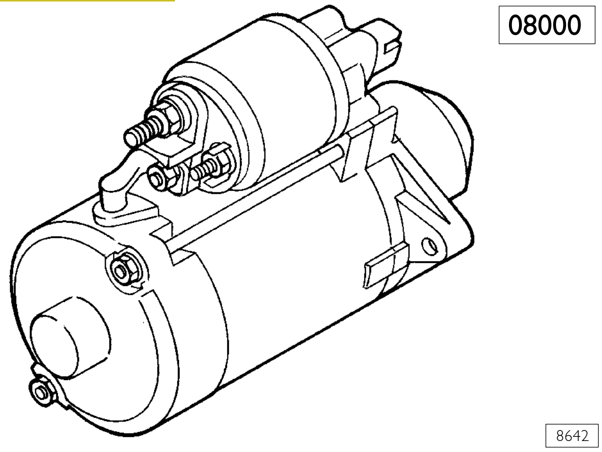
Figure 28



WIRING DIAGRAM

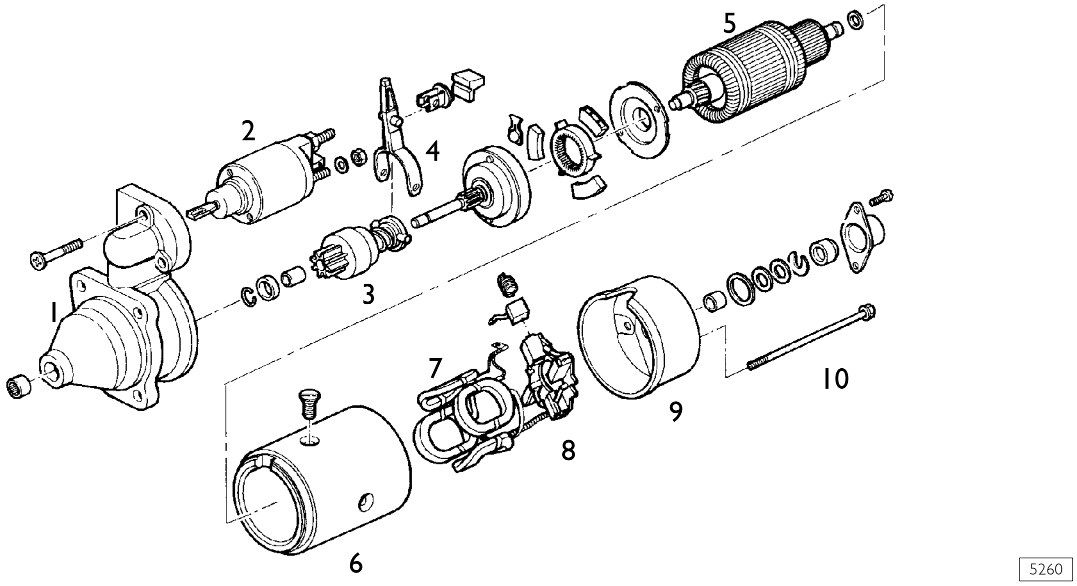
Figure 29

08000



PERSPECTIVE VIEW

Figure 30



PERSPECTIVE BLOWN-UP VIEW
1. Support - 2. Pinion engagement control electromagnet - 3. Pinion - 4. Pinion engament fork - 5. Rotor - 6. Frame - 7. Inductors - 8. Brush holder support - 9. Cover - 10. Screw

Fast diagnosis

Defect	Possible causes	Remedy
Low drawing torque	1. Low battery	Recover
	2. Oxidized or loose circuit connections	Check starter motor and battery connections
	3. Faulty brushes	Check brush slide length and pressure
	4. Field coils short circuited	Replace coils
	5. Rotor cut out or short circuited	Replace rotor
	6. Oval collector	Grind correct or replace
Low drawing torque but engine does not start	1. Defective free wheel or electromagnet	Replace
Pinion disconnected	1. Worn toothed crown	Recover

JUNCTION WELDS

Inside each cable there are ultrasound welds (see start of manual) joining between each other those cable which have similar functions (positive, earth, various junctions, etc.).
In these pages, their location is described divided according to the cable to which the location is belonging to.
This description will be in the future integrated by the drawing of respective cable in order that their location can be identified more easily.

INSTRUMENT PANEL CABLE

Weld	A9	near central instrument panel switches shunt
Weld	A30/A65	near central instrument panel switches shunt
Weld	A43	near instrument panel cable central part
Weld	A49/50	near tachograph
Weld	A51/54	near the shunt towards CPL
Weld	A78	near the shunt for climate control system
Weld	A100	near instrument cluster shunt
Weld	A101/102	near rh speaker shunt

CAB CABLE

Weld	A15	near lh window bag shunt
Weld	A21/a601	near central roof lamp shunt
Weld	A/25	near (lh front) shunt for cable/bonnet junctions
Weld	A26/A18/A700	near lh front shunt for cable / instrument panel junction, Body Computer (LN), CPL (connector "L")
Weld	A/600	near (rh) lateral hatch roof lamp shunt
Weld	A/602	near (lh) driver roof lamp shunt
Weld	A/603	near rh window bag shunt

BONNET CABLE

Weld	A3	near CBA
Weld	A4	near brake oil level sensor cable shunt
Weld	A5/A32/A39/A53	near heated windscreen shunt
Weld	A7/A8/A31/A36/A40	near heated windscreen shunt
Weld	A13/A24/A44/A45/A22	near passage between bonnet and cab (cab side)
Weld	A14/A64	near sensor shunt on DPF
Weld	A17/A20	near passage between bonnet and cab (bonnet side)
Weld	A19	near lh headlight shunt
Weld	A33/A41	near IE cable shunt

Weld	A34/A35	near switching on switch shunt
Weld	A37/A38	near Telma (bonnet side) shunt
Weld	A66	near junction for automatic gearbox (bonnet side)
Weld	A67	near central unit CPL
Weld	A70	near central unit EDC
Weld	A77	near shunt for ECAS, lambda, additional heater (bonnet side)

TRUCK CHASSIS CABLE

Weld	A6	near rear lights shunt
Weld	A10	near fuel level transmitter shunt

VAN CHASSIS CABLE

Weld	A6/A10	near lh clearance lateral headlamp shunt

WIRING HARNESS SECTION

Description

Engine cable
(van-truck) chassis cable
ABS probes cable
cab cable
instrument panel cable
bonnet cable
AIR BAG cable
doors cable

BONNET - INSTRUMENT PANEL - CAB - CHASSIS cables interface to each other through following connectors:

BONNET - INSTRUMENT PANEL cable

Connectors 600-601H 600-601B 600-601D

BONNET - CAB cable

Connectors 600-601G 600-601A

INSTRUMENT PANEL - CAB cable

Connectors 600-601C

BONNET-CHASSIS cable

Connectors C4 C2 C70

All junction connectors are on vehicle left side at interconnection central unit CPL.

The three BONNET - CHASSIS connectors are in engine opening on vehicle left side under front headlamp.

The two AIR-BAG connectors are in cab floor central part. They can be identified by cable yellow colour.

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Figure 31

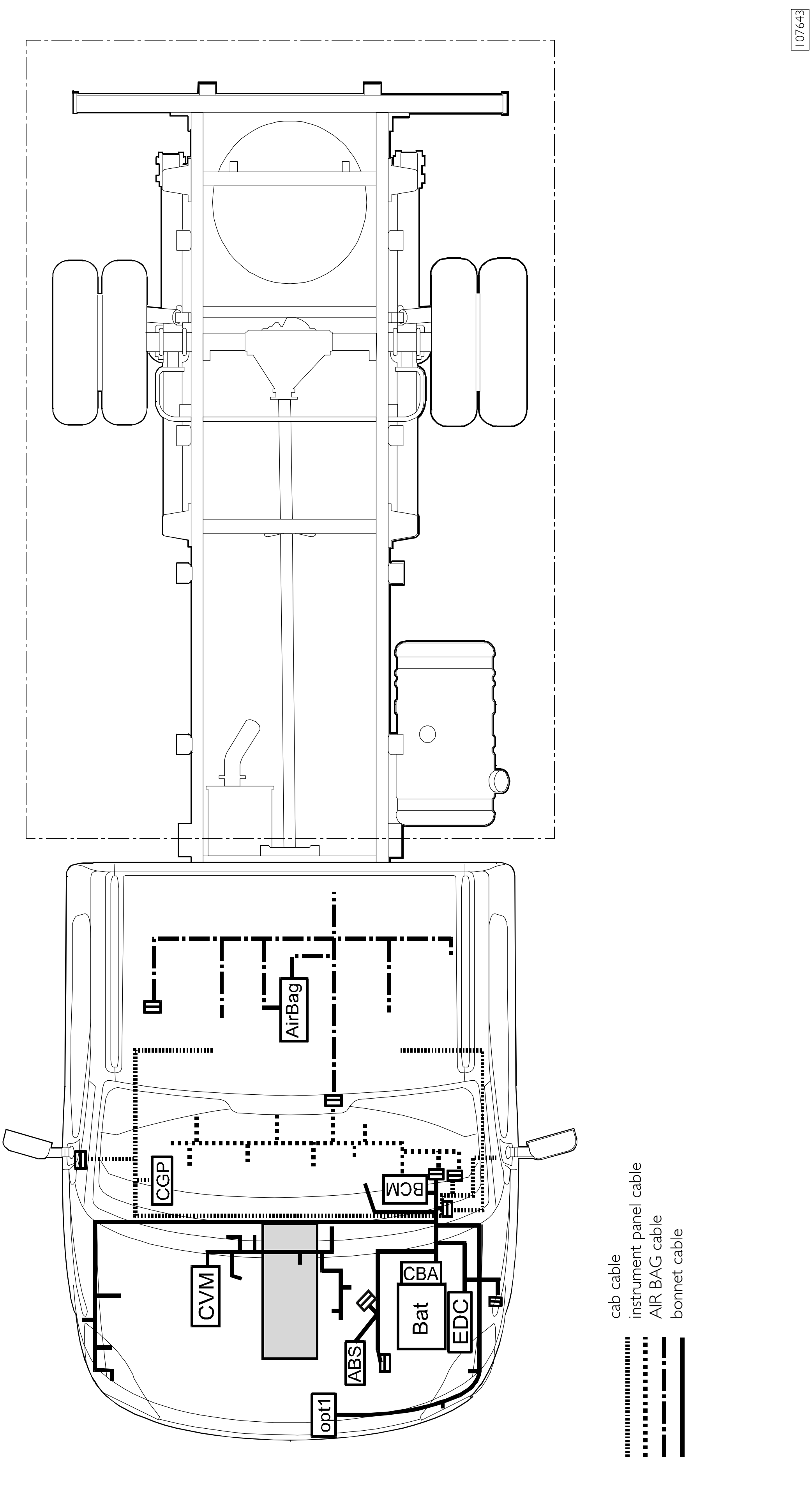
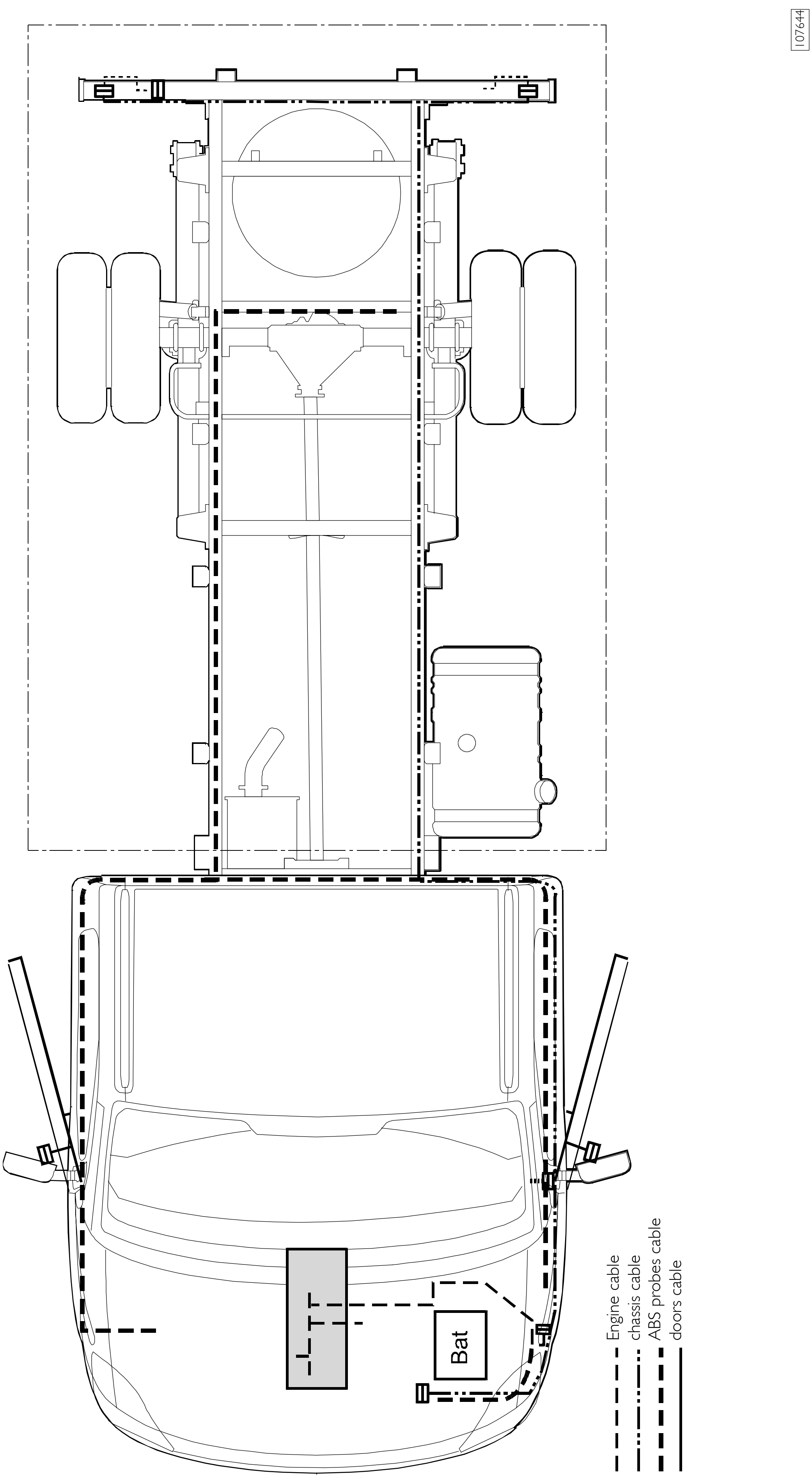

107643
AirBag
CGP
BCM
CVM
CBA
Bat
EDC
ABS
opt1
cab cable
instrument panel cable
AIR BAG cable
bonnet cable

Figure 32



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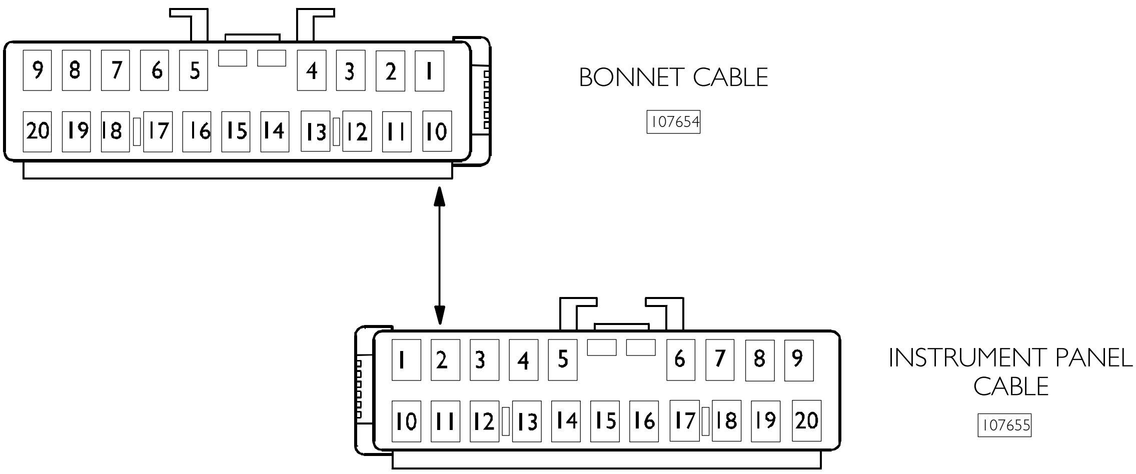
JUNCTION CONNECTORS

Bonnet - instrument panel junction (600/601H)

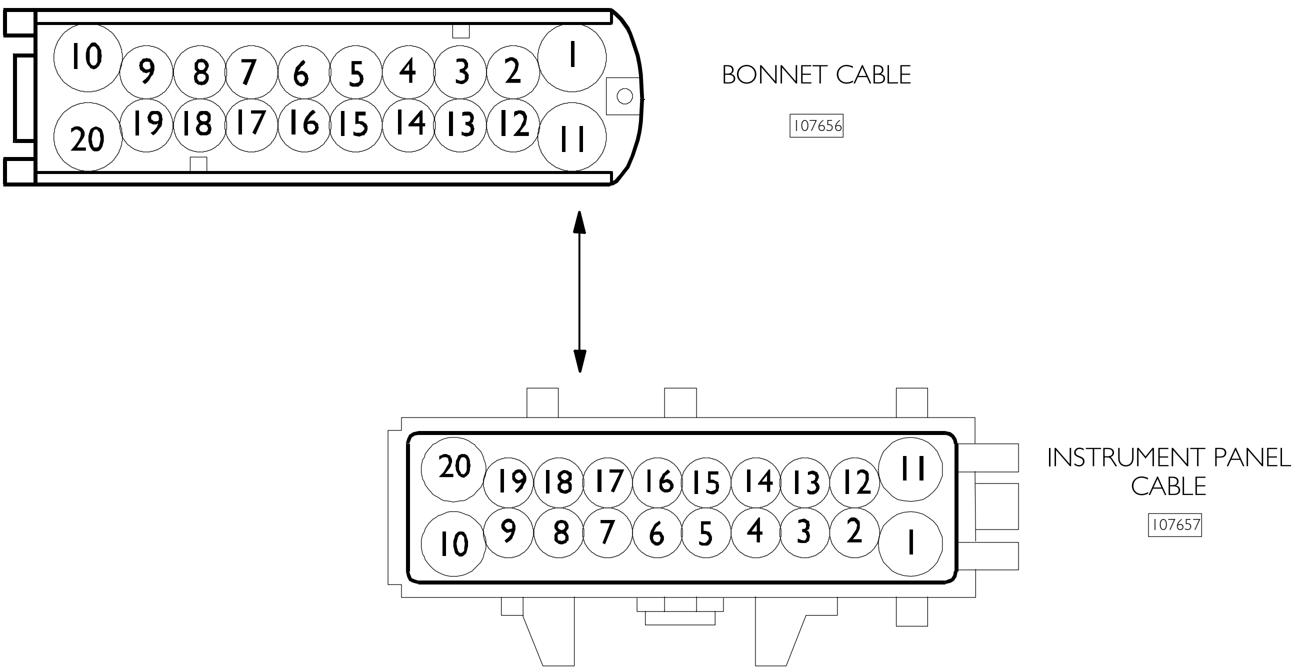
Figure 33



Ref.	Function	Code
1	Positive for power take-off solenoid valve	9131
2	Positive +15	8879
3	Optical indicator to signal that power take-off on gearbox has been connected	6601
4	Positive for "opening" solenoid valve for tilt body	9137
5	Positive for "closing" solenoid valve for tilt body	9138
6	Negative for "opening" solenoid valve for tilt body	9139
7	Positive (+15) to antitheft siren	9140
8	Signal from antitheft central unit to siren	9142
9	Negative for power take-off actuator	9136
10	Positive for power take-off actuator	9135
11	Automatic gearbox central unit pin 3	6141
12	Automatic gearbox central unit pin 5	6143
13	Positive +15	8887
14	Positive for automatic gearbox gear selector	8110
15	Automatic gearbox Gear selector pin 3	White
16	Automatic gearbox Gear selector pin 4	Green
17	Positive for optical indicator for heated rear view mirrors	6652
18	Positive +15	8051
19	Positive +15 for additional heater timer	8879
20	Positive +15 for central unit EDC pin K28	8051

Bonnet - instrument panel junction (600/601B)

Figure 34



Ref.	Function	Code
1	Positive +15 with the exclusion of users during start-up step	8849
2	Earth	0000
3	Earth	0000
4	Control for EDC from speed limiter pushbutton	-
5	Positive for 3-level air-conditioner pressure switch and remote control switch to signal to EDC that compressor has been connected	8163
6	Signal from external temperature sensor for air-conditioner	5532
7	Acceleration sensor earth (ESP8)	0050
8	Acceleration signal (from acceleration sensor) ESP8	9090
9	Positive to acceleration sensor (ESP8)	9091
10	Positive for differential locking system	8066
11	Positive +15	8887
12	Yaw sensor reference signal (ESP8)	9094
13	Yaw sensor test signal (ESP8)	9093
14	Positive +15	8879
15	Yaw sensor signal	9095
16	Lateral acceleration signal	9092
17	Yaw sensor earth	9096
18	-	-
19	Positive for electromagnetic joint for air-conditioner	9993
20	Positive +30	7772

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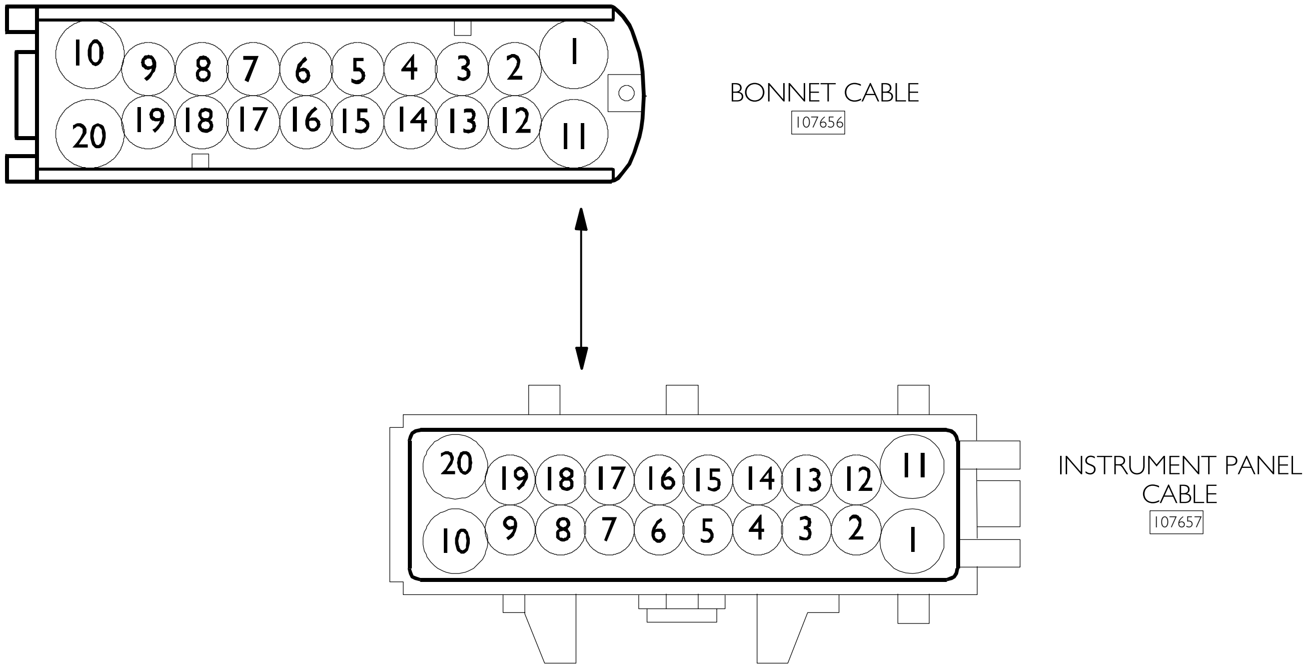
Bonnet - instrument panel junction (600/601D)

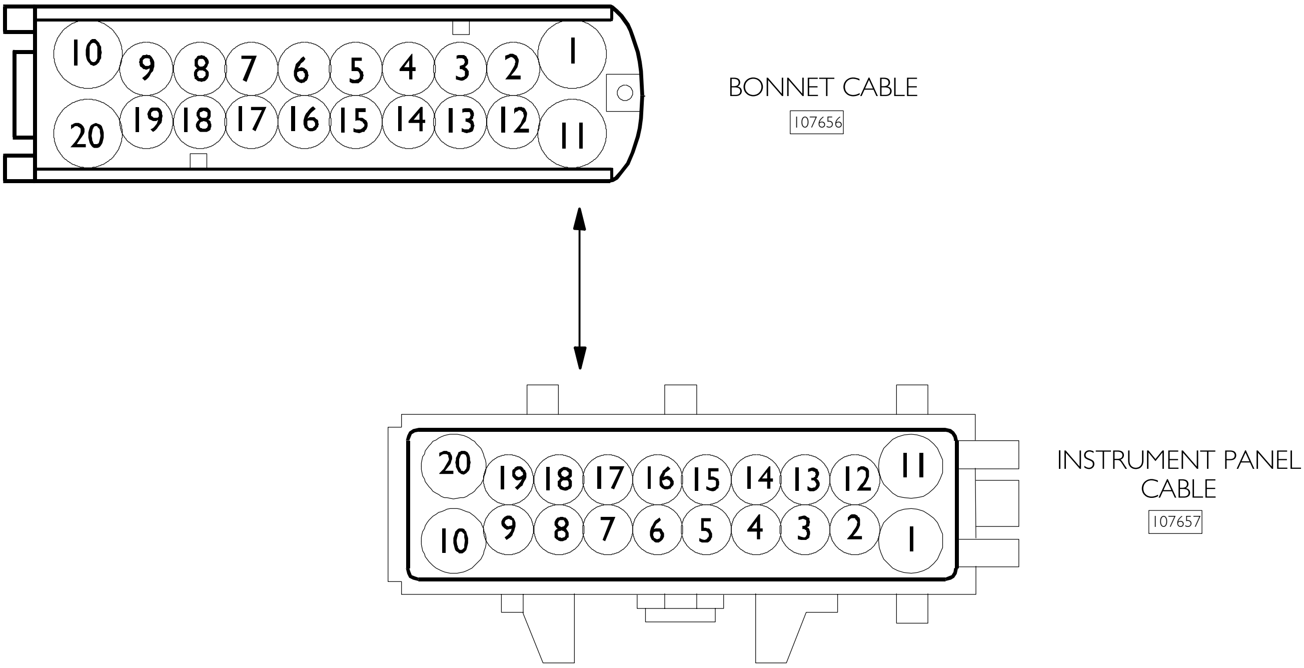
Figure 35



Ref.	Function	Code
1	Positive for diagnosis connector	7797
2	Positive for electronic tachograph transmitter	5514
3	Negative isolated from electronic tachograph transmitter	0058
4	Speed signal from electronic tachograph transmitter	5517
5	Reversed signal from electronic tachograph transmitter	5516
6	Positive for TELMA decelerator: first position	9913
7	Positive for TELMA decelerator: second position	9910
8	Positive for TELMA decelerator: third position	9916
9	Positive for TELMA decelerator: fourth position	9912
10	Positive for TELMA control switch	9911
11	Positive +15	8879
12	Positive for EDC failure warning lamp	5180
13	Negative for optical indicator for differential locking on transfer box (from signalling switch)	6603
14	Positive for horn	1116
15	Earth	0000
16	Air spring suspension control (lifting)	9981
17	Air spring suspension control (lowering)	8091
18	Earth for signal for tachometric sensor	0058
19	Signal from tachometric sensor	5517
20	Positive +30	7772

Bonnet - instrument panel junction (600/601G)

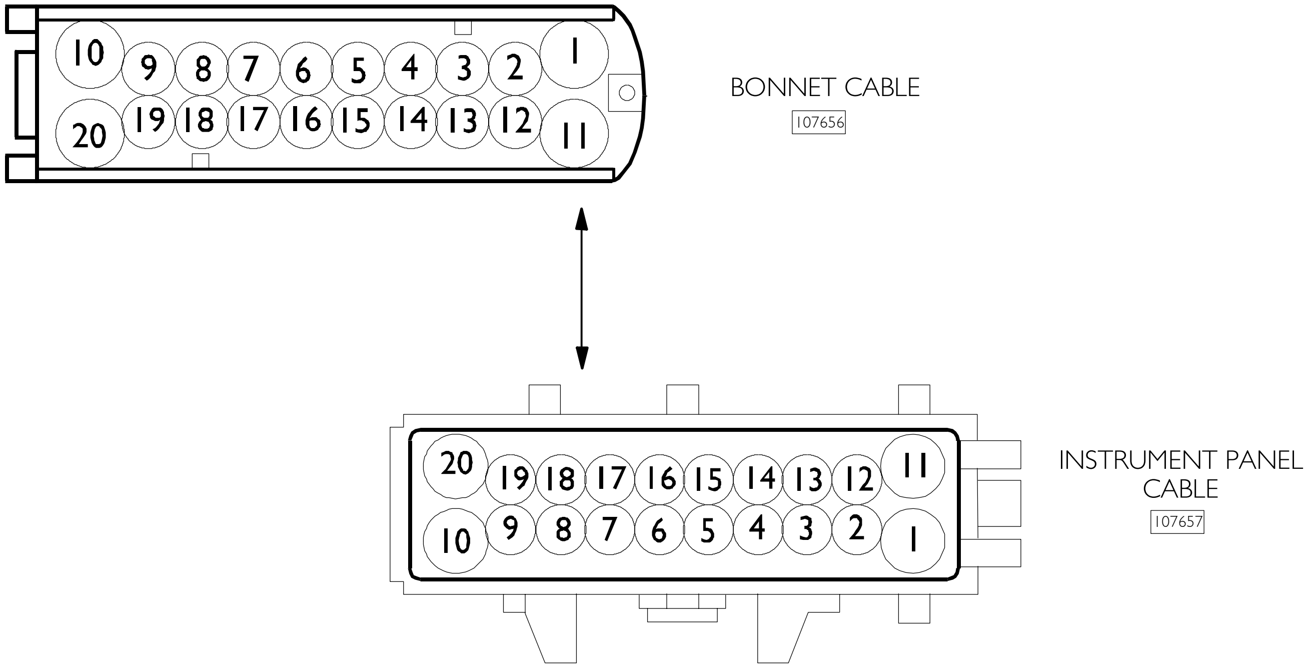
Figure 36



Ref.	Function	Code
1	Negative for rear door actuator	8902
2	Negative for optical indicator for hand brake engaged	6662
3	-	-
4	Negative for fuel level transmitter	0000
5	Signal from fuel level transmitter	5557
6	Positive +30	7772
7	-	-
8	Positive for clearance lights (van)	3325
9	Positive for clearance lights (van)	3324
10	Positive for rear door actuator	8901
11	-	-
12	-	5164
13	Positive for lh front parking light, lh front clearance	3321
14	Positive for rh front parking light, rh front clearance	3320
15	Positive +15	8879
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-

Bonnet - instrument panel junction (600/601A)

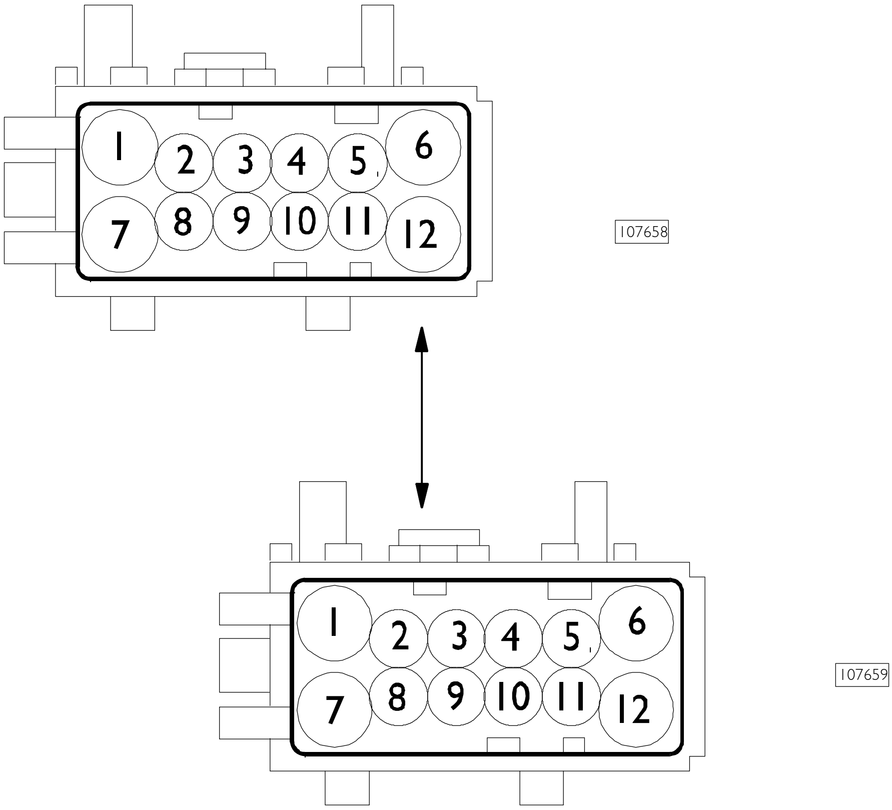
Figure 37



Ref.	Function	Code
1	-	-
2	Positive for reverse headlamp	2226
3	Positive for reverse headlamp	2283
4	Optical indicator TELMA (to Body Computer)	6604
5	Positive for rear fog headlamps	2283
6	Line "K" for air spring suspensions	2294
7	Air spring suspension failure warning lamp (to Body Computer)	6008
8	Positive for plate light	3337
9	Positive for rh blinker	1125
10	Positive for heated rear window	8021
11	Positive for heated rear window	8021
12	Positive for stop rear signalling	1177
13	Positive for heated mirrors	8830
14	Positive for heated mirrors	8830
15	Positive for reverse headlamp	2226
16	Positive for lh rear blinker	1120
17	Positive for rh rear blinker	3322
18	Positive for stop rear signalling	1172
19	Positive for lh rear parking light	3323
20	-	-

Bonnet - instrument panel junction (600/601C)

Figure 38



Ref.	Function	Code
1	Positive +15	8879
2	-	5647
3	To Body Computer (instrument panel - PF - pin 23)	5159
4	External temperature sensor for air-conditioner	5532
5	External temperature sensor for air-conditioner	5532
6	-	-
7	Positive for cigarette lighter	7721
8	Positive +15 with the exclusion of users during start-up step	8849
9	Positive +15 with the exclusion of users during start-up step	8849
10	"B" Can line H (parking sensors)	6111
11	"B" Can line L (parking sensors)	6110
12	Positive for cigarette lighter	7721

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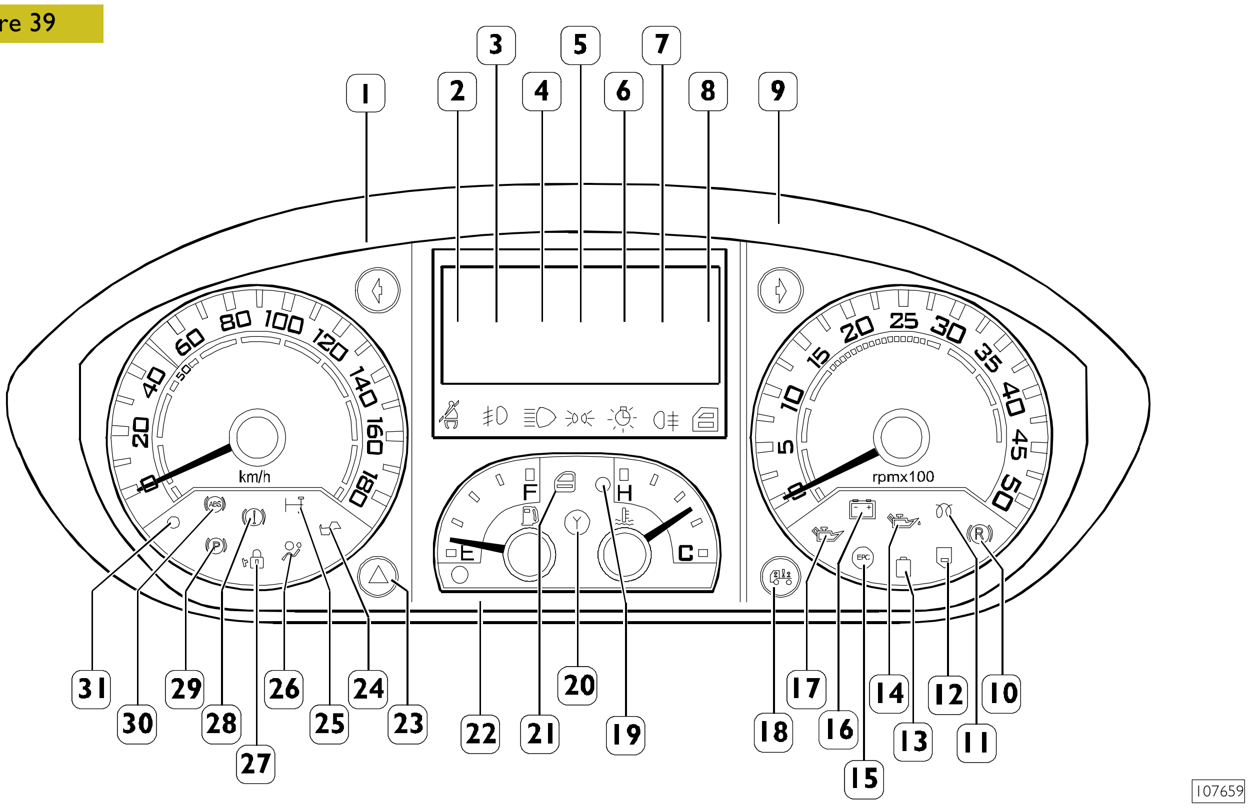
INSTRUMENT CLUSTER (58919)

Figure 39



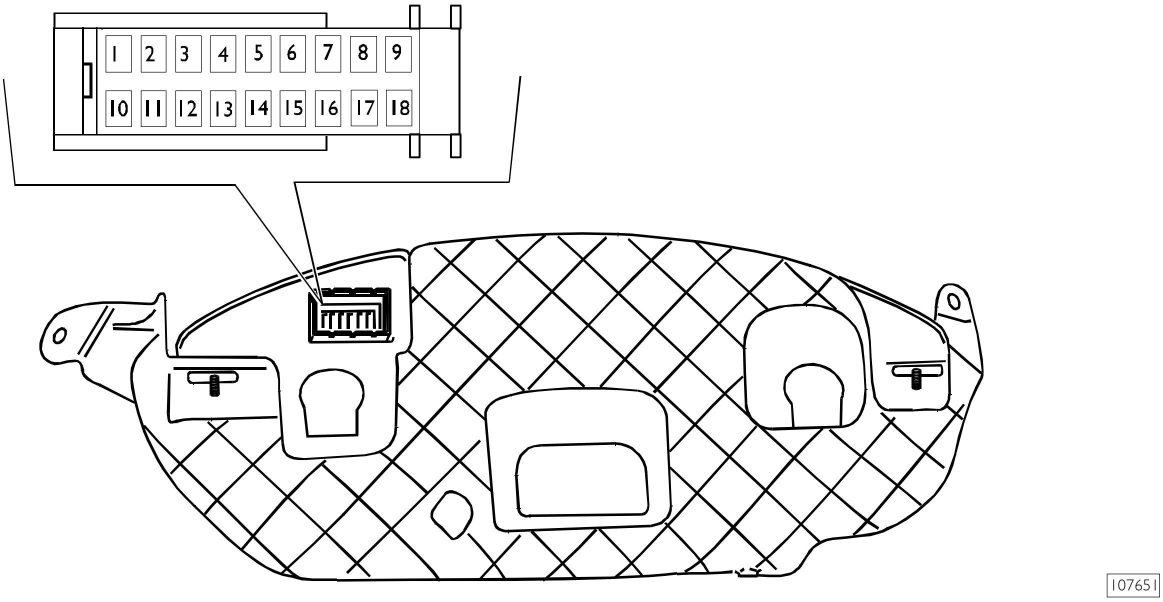
Position	Warning lamps	Colour
1	Lh blinker	green
2	Driver belt unfastened	red
3	Front fog lights	green
4	Full beam headlights	blue
5	Parking lights	green
6	Tractor external light failure	yellow
7	Rear fog lights	yellow
8	Doors open	red
9	Rh blinker	green
10	Decelerator connected	yellow
11	Glow plugs pre-heating	yellow
12	Water present in diesel oil filter	yellow
13	Engine coolant low level	red
14	Engine oil low pressure	red
15	EDC failure	red
16	Battery not being recharged	red

Position	Warning lamps	Colour
17	EOBD	yellow
18	Air spring suspension failure	red
19	Engine coolant high temperature	red
20	Tachograph failure (symbol T)	yellow
21 *	Programmed maintenance	yellow
22	Fuel reserve	yellow
23	Generic failure	yellow
24	Passenger airbag de-activated	yellow
25	Differential locking connected	yellow
26	Air bag failure	red
27	Vehicle protection system failure	yellow
28	Brake failure and EBD failure	red
29	Parking brake	red
30	Failure	yellow
31	Function ESP/ASR	yellow

* "Modal" Version - Outer emergency handle locked by key

Junction connector

Figure 40



REAR VIEW

Ref.	Function	Cable Code
1	Earth	0000
2	Positive +30	7772
3	Positive +15	8879
4	-	-
5	"B" CAN Line L	6111
6	"B CAN Line" H	6110
7	Positive for headlight attitude rectifier (position C)	9935
8	Positive for headlight attitude rectifier	9934
9	Earth (to instrument panel switch assembly)	0000
10	-	-
11	-	-
12	-	-
13	To instrument panel switch assembly	9086
14	To instrument panel switch assembly	9085
15	-	-
16	To instrument panel switch assembly	9087
17	Positive for differential locking optical indicator	6603
18	Positive for EDC failure	5180

Where instrument cluster is replaced, reprogram by diagnosis tools.

A = 1 ÷ 9
B = 10 ÷ 18

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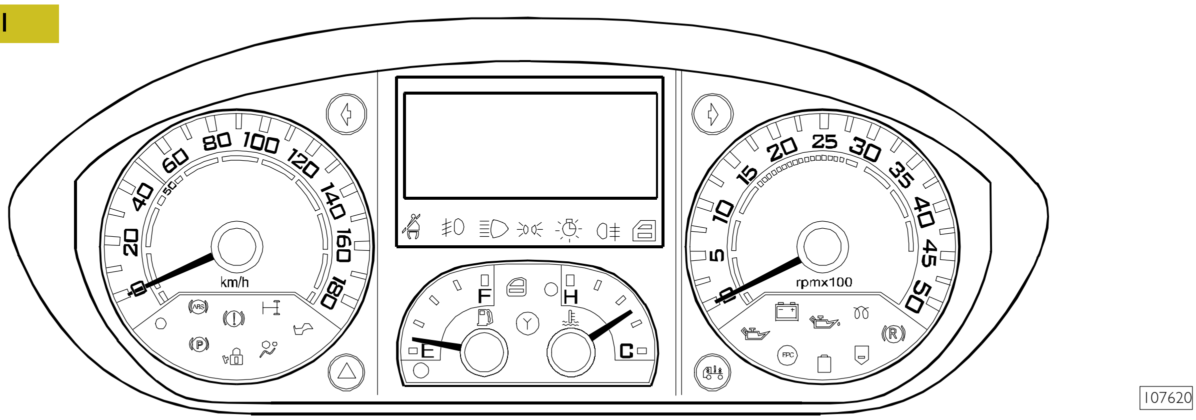
Display screen

Figure 41



Instrument Cluster: Magneti Marelli

Two versions are present of display screen mounted on instrument cluster:

- ❑ Modal version
- ❑ Comfort version

the two versions are different in display size and information displayed.

Modal Version:

this version has a smaller display screen and displays:

- ❑ total/partial KM
- ❑ consumption indication
- ❑ time
- ❑ headlamp attitude rectifier indication.

Comfort Version:

this version has a larger display screen with 14 characters that are used to display trip computer data, menu with relating messages for settings/adjustments, activation/service messages, failure/warning messages. The display also displays:

- ❑ automatic gearbox indication
- ❑ time
- ❑ indication of danger owing to ice
- ❑ adjustable spanner symbol for "service"
- ❑ external temperature
- ❑ headlamp attitude rectifier indication
- ❑ total/partial KM.

Displaying messages on display screen:

Messages on display screen are divided into four different classes:

- ❑ High priority faults (8 display cycles)
- ❑ Low priority faults (4 display cycles)
- ❑ Information messages (4 display cycles)
- ❑ Feedback messages (1 display cycle)
- ❑ Messages driven by central unit (while their cause is persisting)

Longer messages are divided into lines with 14 characters appearing on display screen in order that these messages can be displayed entirely.

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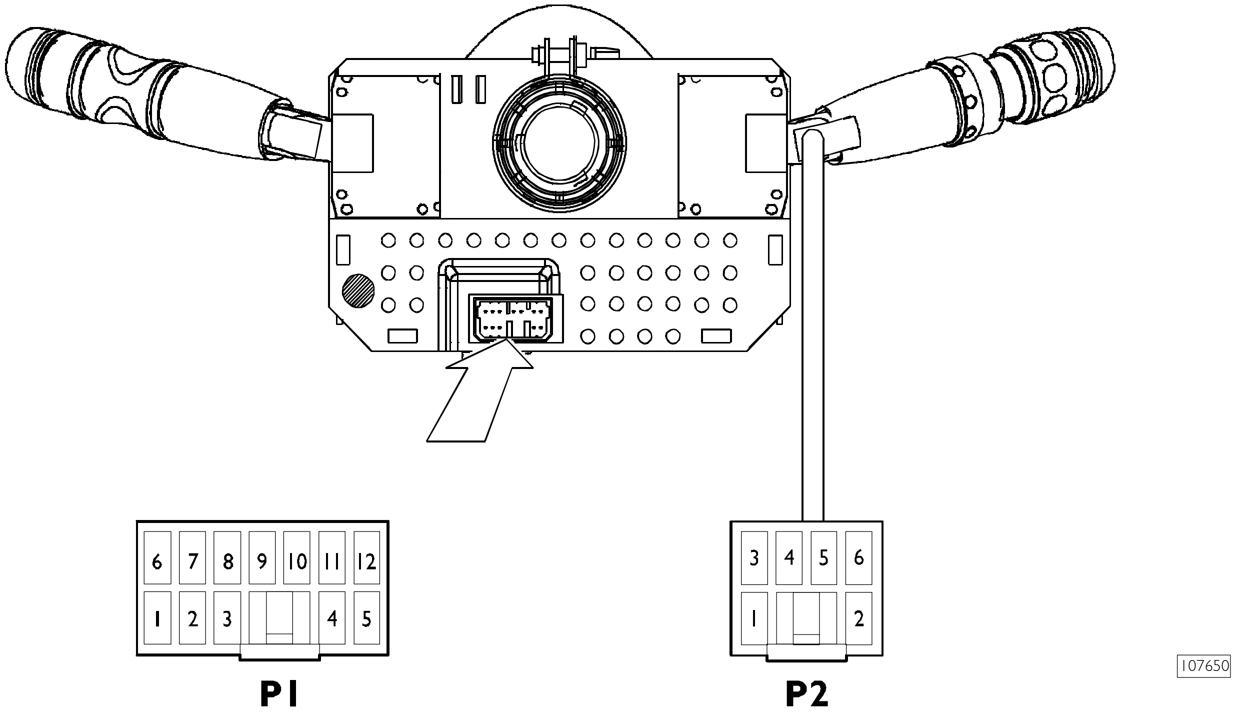
STEERING COLUMN SWITCH UNIT (54030)

Figure 42



Ref.		Function	Cable colour code
	1	Windscreen wiper motor control (to Body Computer)	8880
	2	Windscreen washer pump control (to Body Computer)	8886
	3	Earth	0000
	4	Signal earth (to Body Computer)	0050
	5	Blinker control (to Body Computer)	1111
P1	6	Flashing control (to Body Computer)	8024
(Black)	7	Parking lights control (to Body Computer)	3333
	8	Horns	1116
	9	Front fog lights control (to Body Computer)	2228
	10	-	-
	11	Front fog lights control (to front fog lights on pushbutton)	2228
	12	-	-
	1	Positive for Cruise Control	7155
	2	Positive for Cruise Control	7155
P2	3	Slow down signal (SET-)	8157
(Black)	4	Windscreen wiper reset input	8154
	5	Electric pump for windscreen washer	8155
	6	Supply (+30) for side lights switch	8156

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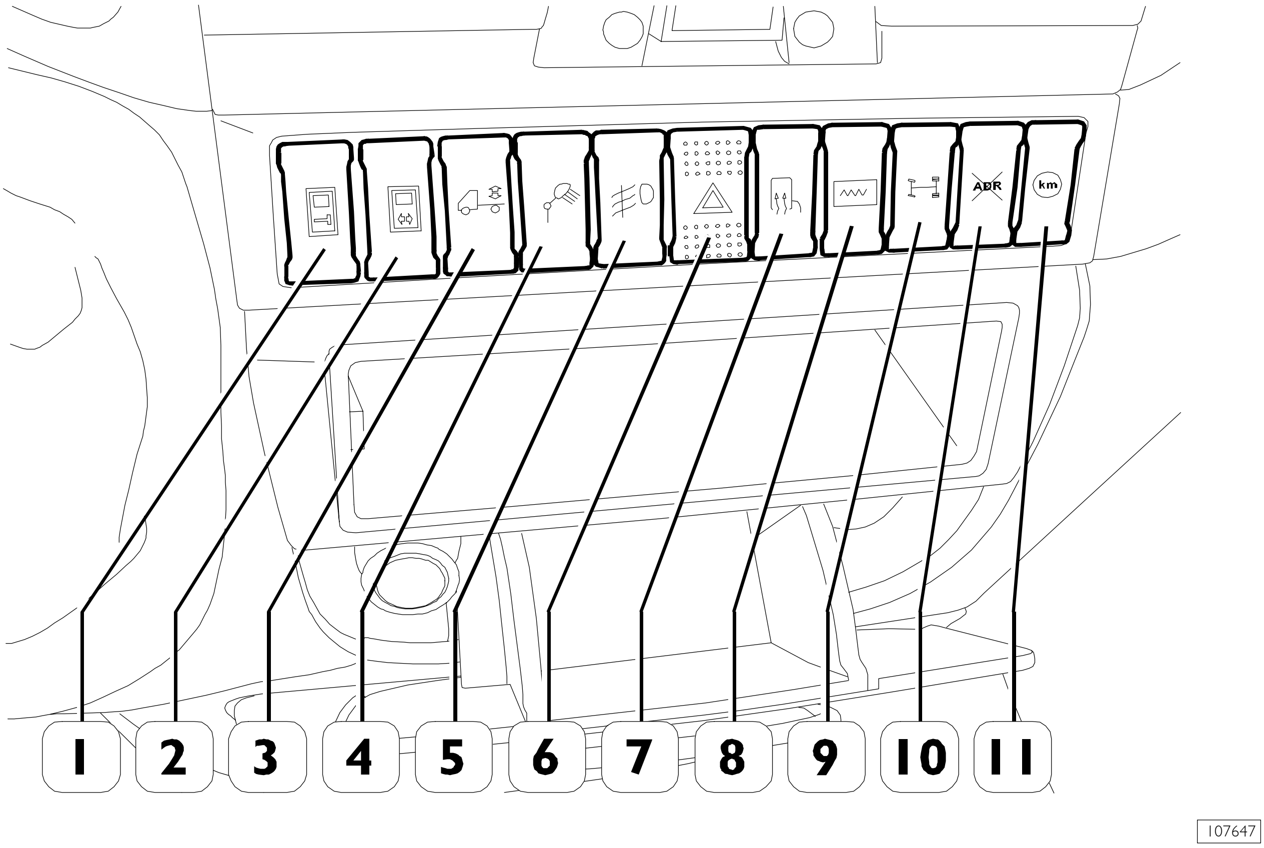
CENTRAL INSTRUMENT PANEL

Figure 43

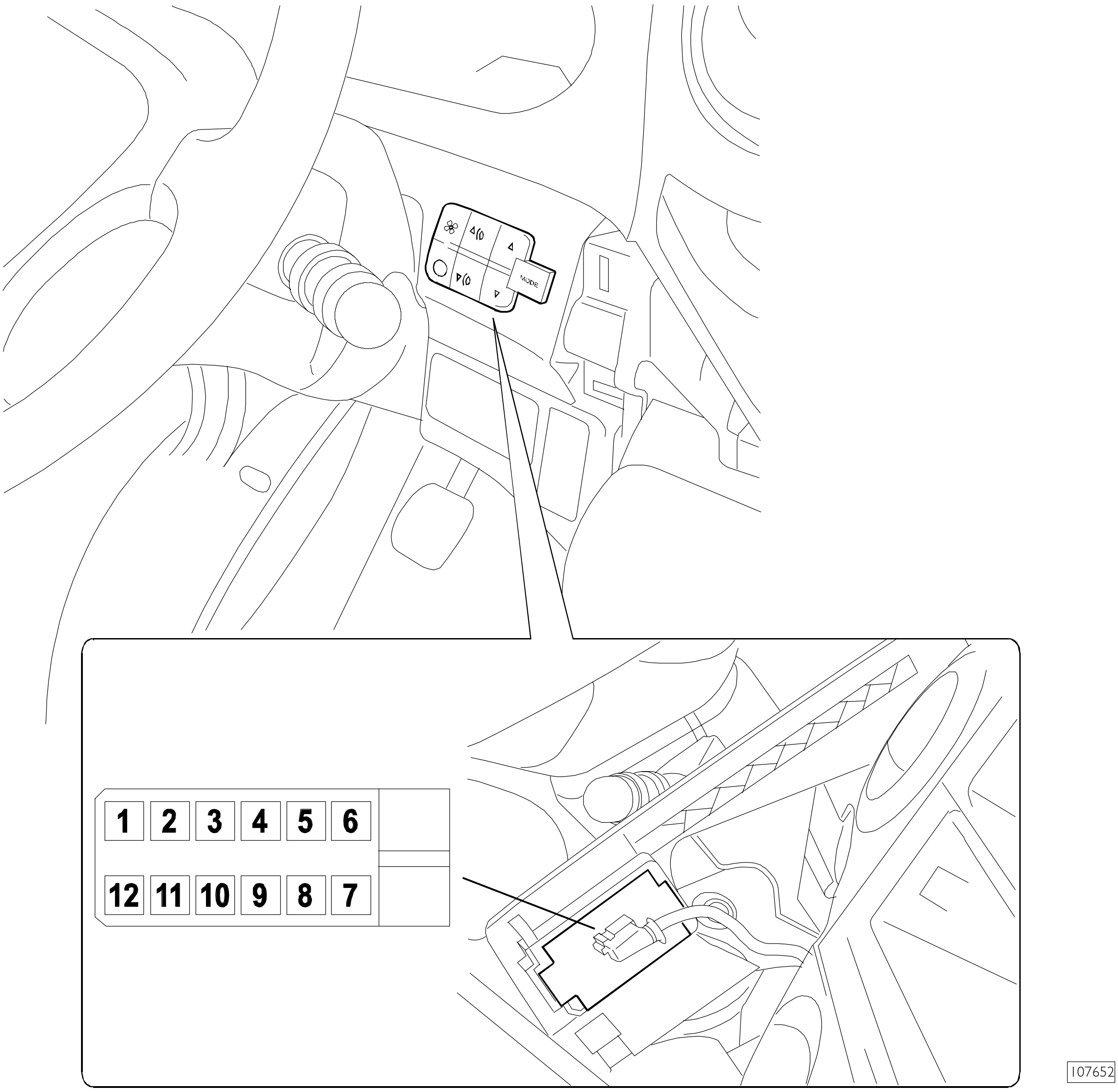


Ref.	Function
1	Hatchback locking
2	Rotating-translating door control
3	Self-levelling air spring suspensions
4	Load area illumination
5	Front fog lights
6	Emergency lights
7	Heated rear view mirrors
8	Heated rear window
9	Rear differential locking
10	Exclusion of ASR
11	Speed limiter in

Pushbutton arrangement may change depending on different preparations.

INSTRUMENT PANEL SWITCH ASSEMBLY (53807)

Figure 44



Ref.	Function	Cable Code
1	Positive +15	3320
2	Earth (to Body Computer)	0000
3	-	-
4	To instrument cluster (headlamp attitude)	9085
5	To instrument cluster (MODE +)	9086
6	To instrument cluster (MODE -)	9087
7	-	-
8	-	-
9	Earth (to instrument cluster (TRIP))	0000
10	Air heater	-
11	-	-
12	-	-

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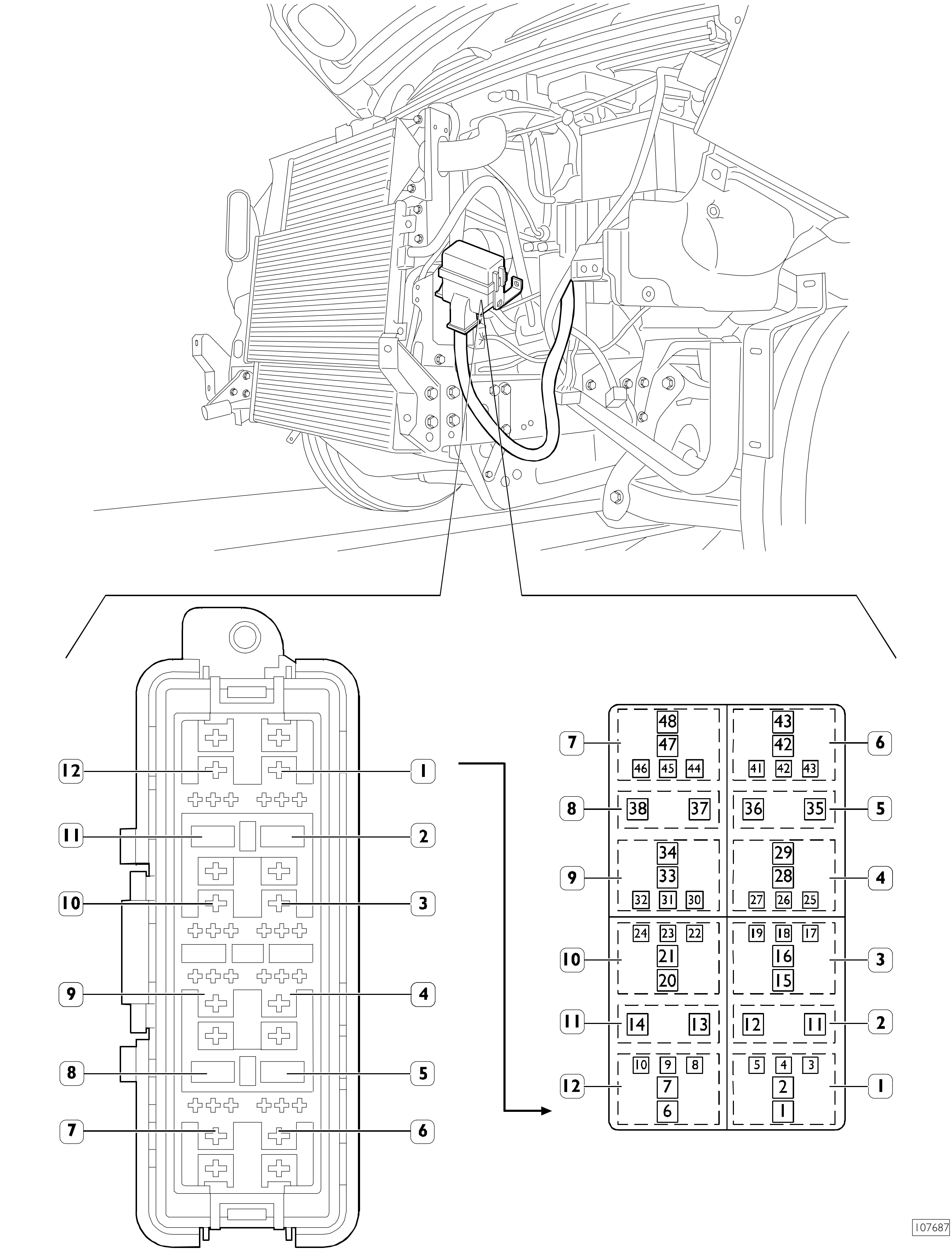
OPTIONAL BOX

Figure 45



CENTRAL UNIT FRONT VIEW

CENTRAL UNIT REAR VIEW

Fuses / remote control switches identification

Ref.	Component identification	Function
1	T4	Remote control switch to release retarder with ABS in
2	F55	30A fuse for additional climate control system
3	T15	Remote control switch (at disposal)
4	T22	Remote control switch to enable compressor switching on
5	F25	10A fuse
6	T18	Remote control switch to set gearbox to neutral position (automatic gearbox)
7	T24	Remote control switch to enable PTO switching on
8	F28	30A fuse for positive for rear differential locking central unit
9	T23	Remote control switch to control air-conditioner compressor
10	T21	Remote control switch to warn that compressor for EDC is on
11	F27	20A fuse for positive for headlight wiper
12	T16	Remote control switch for headlight wipers

* Front view

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OPT central unit Pin-Out

Ref.	Cable Code	Function
1	9911	Positive for decelerator control switch
2	-	-
3	8879	Positive +15
4	9911	Positive for decelerator control switch
5	0000	Negative from central unit ABS
6	7772	Positive +30 for headlamp wipers from CBA
7	7777	Positive for headlamp wiper pump
8	0000	Negative from Body Computer
9	-	-
10	8849	Positive +15
11	7772	Positive +30 for additional climate control system
12	7772	Positive +30 for additional climate control system
13	7772	Positive +30 for headlight wipers
14	7772	Positive +30 for headlight wipers
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	7772	Positive +30 for remote control switch to warn that compressor is on (to EDC)
21	7772	Positive +30 for remote control switch to warn that compressor is on
22	0000	Earth for remote control switch to warn that compressor is on
23	-	-
24	8163	Connection to 3-level pressure switch for air-conditioner
25	0000	Negative from EDC for remote control switch to enable compressor to be put on
26	-	-
27	7772	Positive +30 for remote control switch to enable compressor to be put on
28	0000	Earth for remote control switch to enable compressor to be put on
29	0000	Negative from compressor control remote control switch
30	0000	Negative from remote control switch to enable compressor to be put on (30)
31	-	-
32	0000	Connection to 3-level pressure switch for air-conditioner
33	8883	Positive for air-conditioner compressor control
34	9067	Positive for air-conditioner compressor control remote control switch
35	7772	Positive +30
36	7772	Positive +30
37	8887	Positive +15 for rear differential locking central unit
38	8887	Positive +15 for rear differential locking central unit
39	7772	Positive +30 for remote control switch to put gearbox in neutral position (automatic gearbox)
40	-	-
41	0000	Negative from automatic gearbox central unit
42	8888	Connection to starter
43	8888	Connection to start-up switch
44	7155	Positive for remote control switch to enable PTO to be put on
45	9131	Connection to total power take-off switching on central unit
46	0000	Earth
47	-	-
48	0000	Earth

"CAN LINES" SYSTEM DESCRIPTION

The electrical / electronic system is characterised in the presence of two communication lines which manage vehicle electrical system, directly controlling body functions, access, visibility, board information, comfort, etc.
The structure consists of two CAN communication networks to which all electronic central units present and instrument cluster complete with display screen are connected.
A new central unit is also present: the Body Computer, which manages many functions present and communicates with both CAN lines. For diagnosis, 38-pole connector is not present any more; on the contrary, a 16 pin connector is present named EOBD.
In particular, on CAN line named **Ccan**, connected are central units relating to vehicle systems and information for driver:

- Yaw sensor present with ESP8
- ABS
- Automatic gearbox
- EDC16
- Decelerator
- Digital tachograph
- Body Computer

This communication line is characterised in high speed data transmission relevant to electronic systems connected to it. It is comparable to VDB line present on other vehicles.

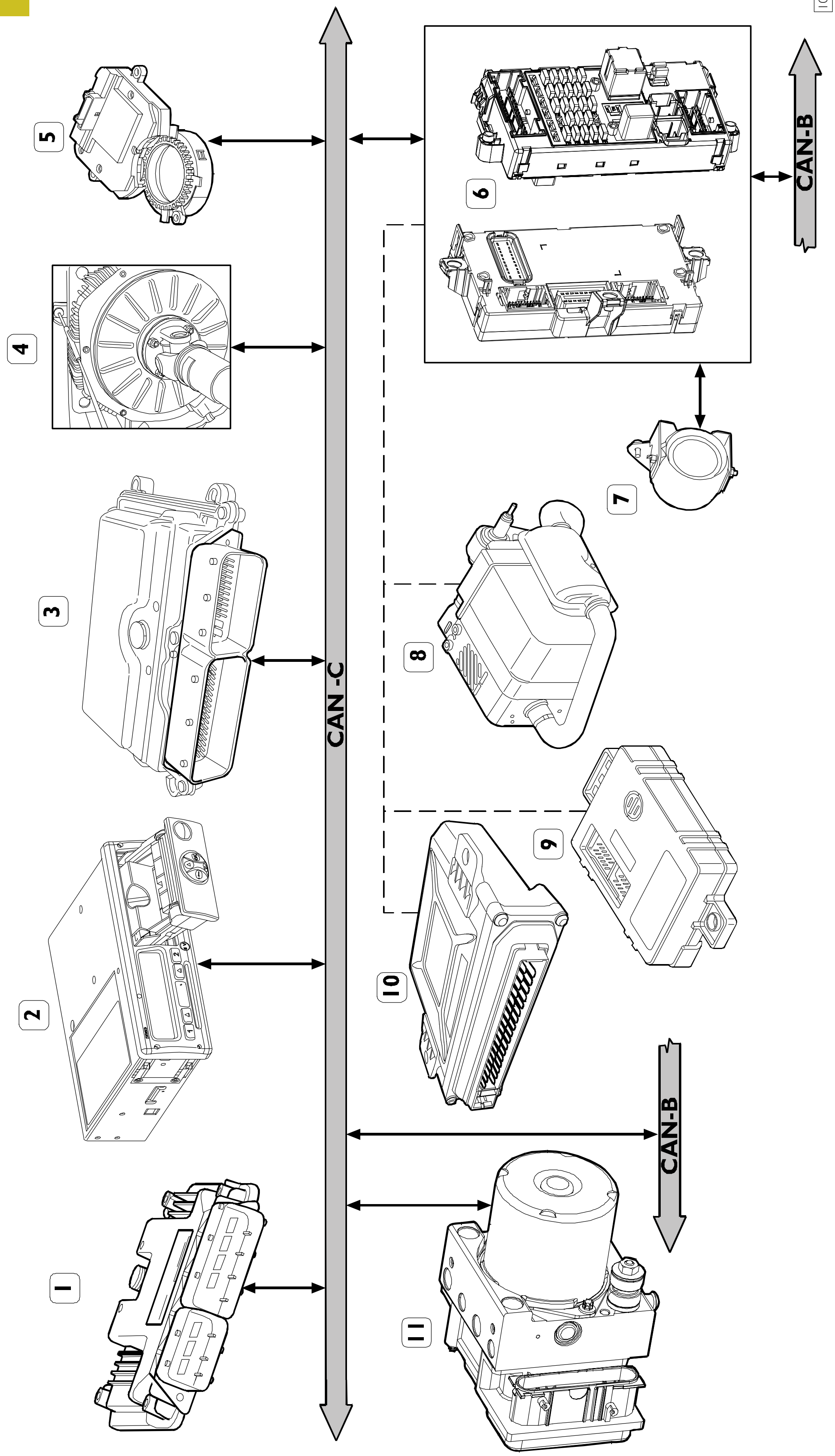
Communication line named **Bcan** enables communication between Body Computer and the various central units employed for the various board services. To this line connected is the instrument cluster, equipped with a display screen.

This communication line enables data transmission at a lower speed than above Ccan line.
Central units connected to this line:

- Body Computer
- Instrument cluster
- Radio and navigator
- Air Bag
- Rotating-translating door

“C” CAN line

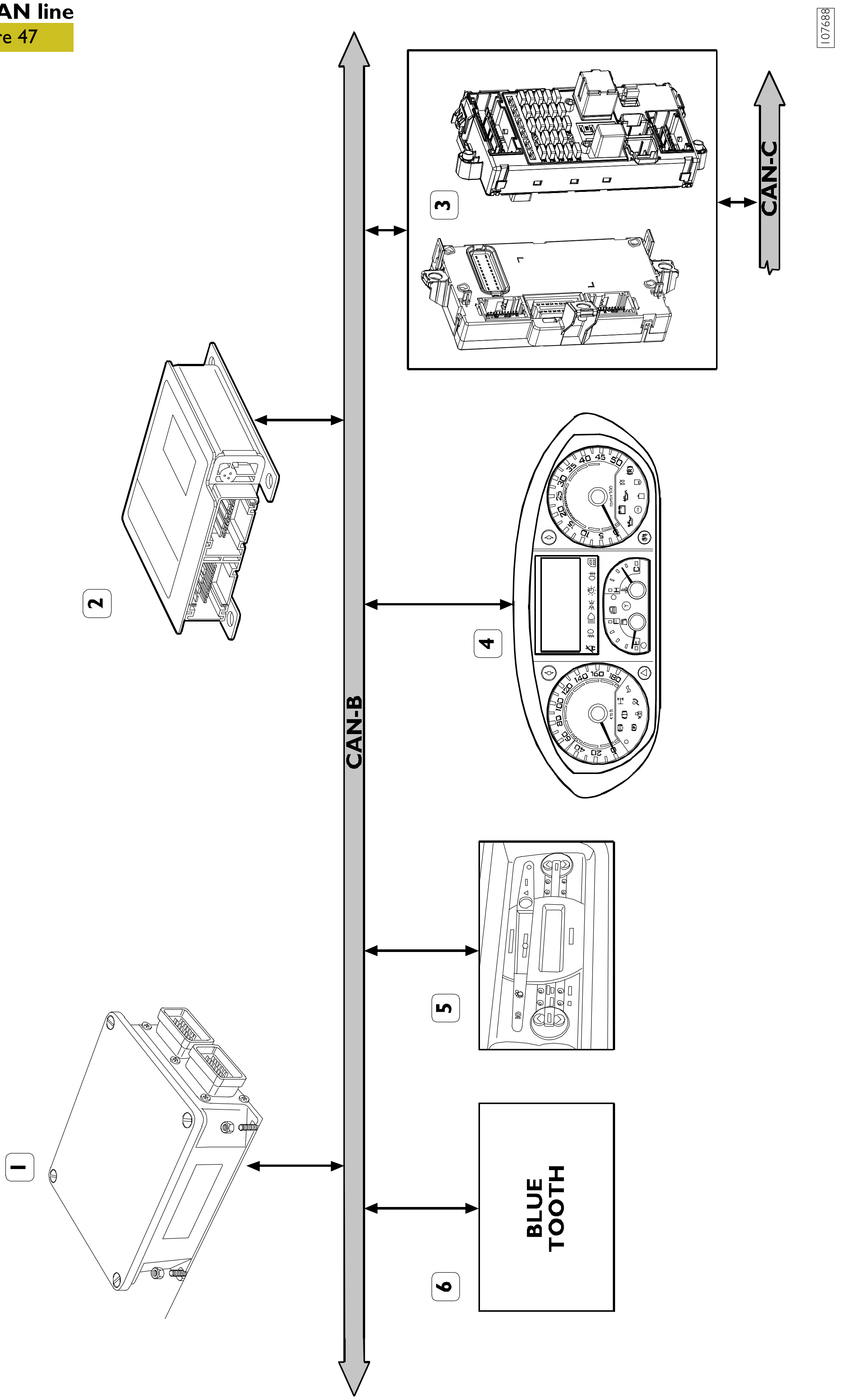
Figure 46



1. Central unit EDC16 - 2. Digital tachograph - 3. Automatic gearbox central unit - 4. Decelerator - 5. Steering angle sensor (ESP8) - 6. Body Computer - 7. Alarm siren - 8. Additional heater - 9. Climate control system central unit - 10. Central unit WABCO - 11. Central unit ABS8/ESP8

"B" CAN line

Figure 47



1. Rotating-translating door central unit (start of 2007) - 2. Air Bag central unit - 3. Body Computer - 4. Instrument cluster - 5. Radio / navigator - 6. Blue Tooth

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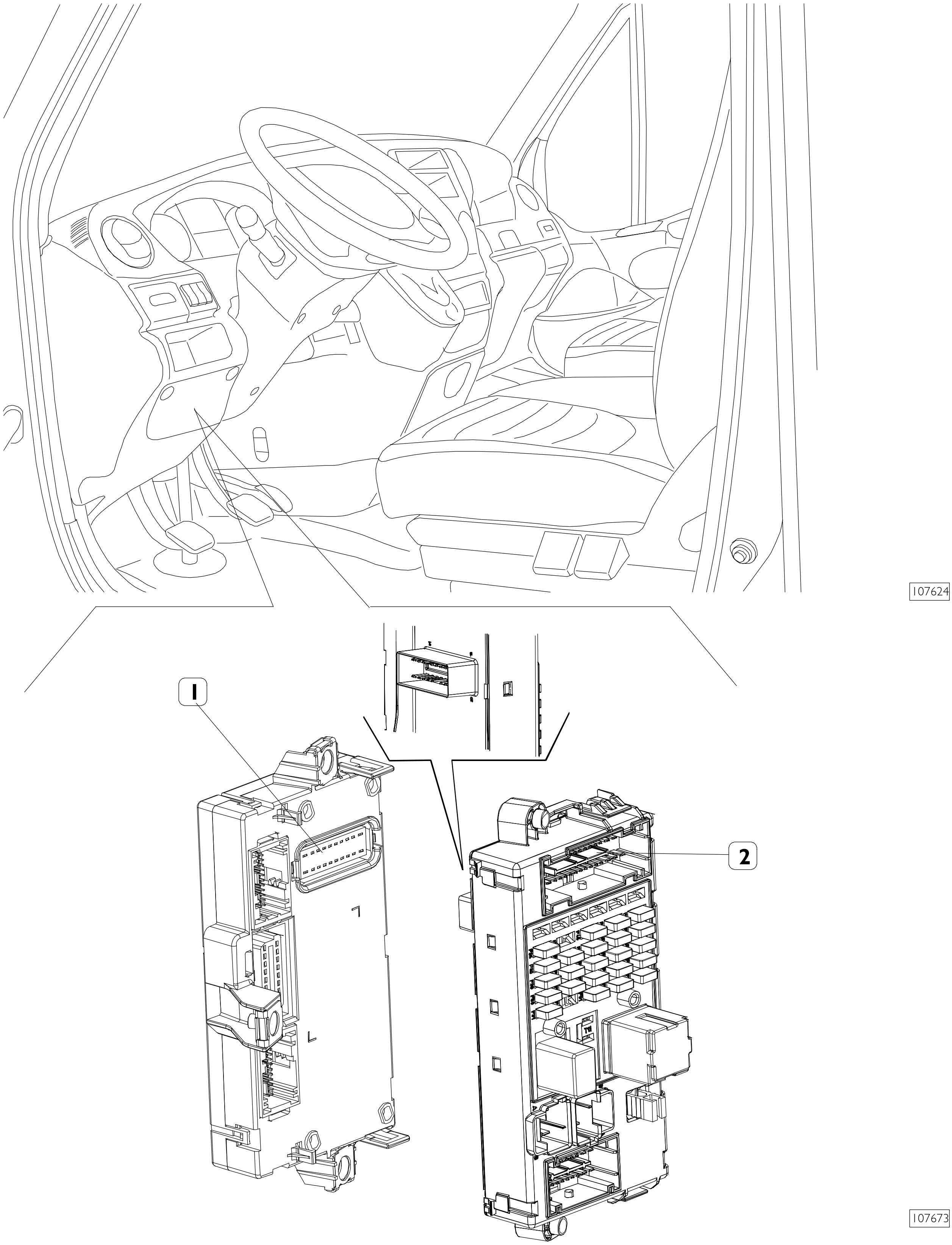
BODY COMPUTER - (86116)

Figure 48



1. Body Computer - 2. Central unit "CPL"

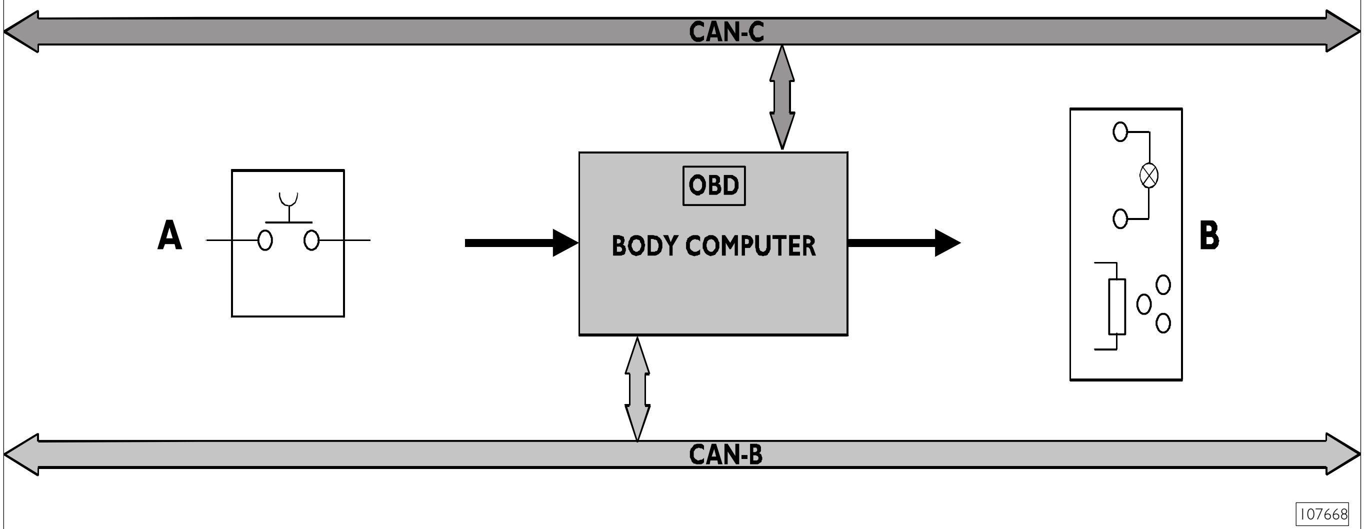
Description

The Body Computer is the central unit of the electrical system of vehicle under examination. Its task is to manage main functions present.
Inside, it integrates "immobilizer" function; therefore, an external central unit is not present any more for this function.
Further, it manages:

- ❑ External and internal illumination
- ❑ Central door locking actuator controls, windscreen washers and wipers, front electric window winders, etc.
- ❑ Acquisition of switches and controls from steering column switch unit, pushbuttons, etc.

Inside, it integrates diagnosis connector EOBD (16 pins) for board diagnostics (previous diagnosis connector is not present any more), it communicates with the two CAN lines present (Bcan, Ccan) and instrument cluster. It is mounted in the cab behind interconnection central unit "CPL" and interfaces with it through a 20 pin lamellar connector located inside the component.

Figure 49



A. Input signals - B. Output signals

It interfaces with vehicle system through three connectors: two connectors are located in front side and one connector is located in rear side accessed by tilting the whole assembly through unscrewing special securing screws.

Front connectors:

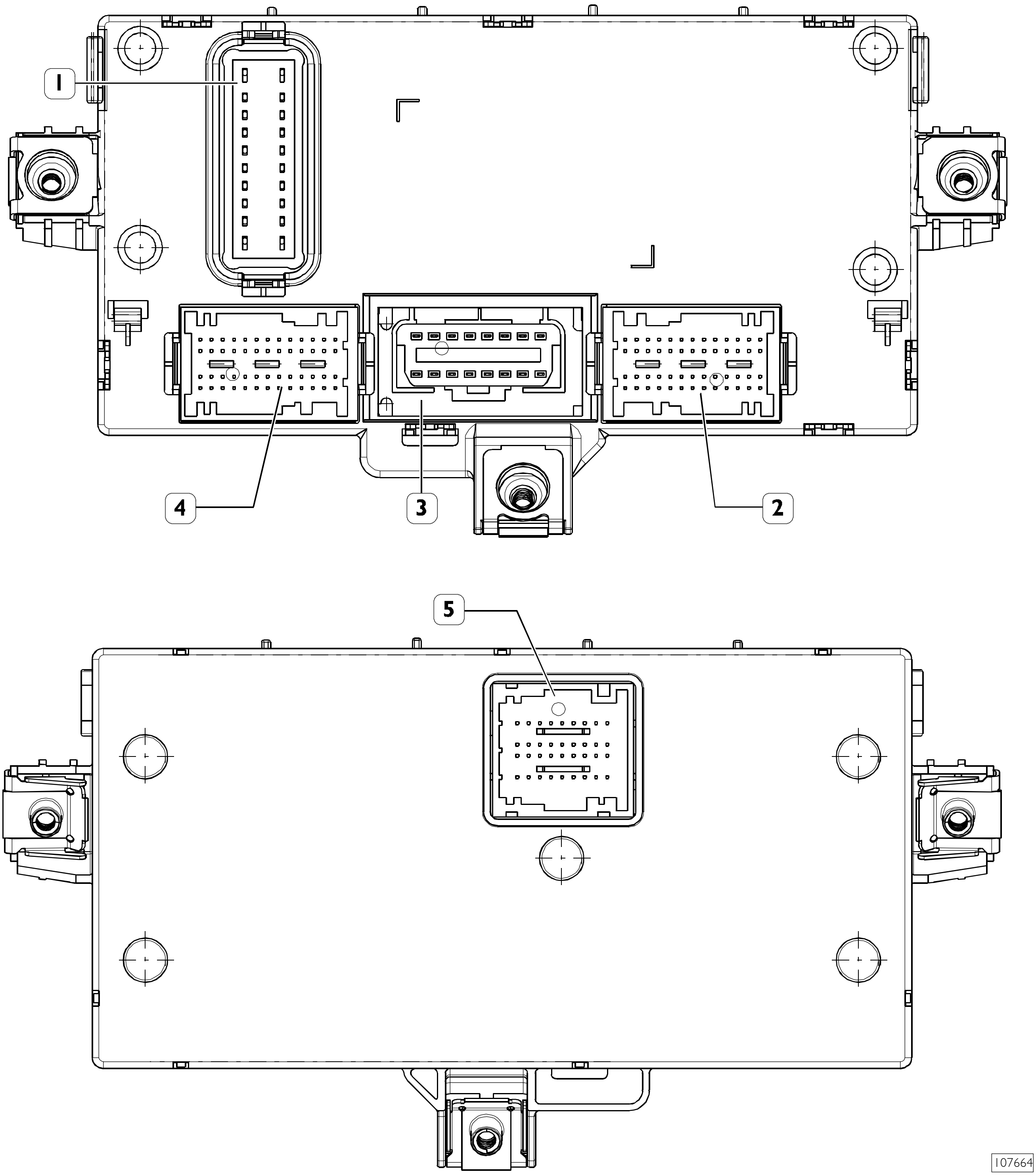
- cab wiring harness (black) connector "LN"
- bonnet wiring harness (blue) connector "AV"
- diagnosis connector EOBD

Rear connector:

- instrument panel wiring harness (blue) connector "PF"

A closing resistance is present on "C" CAN line positioned in the vicinity of steering column switch unit inside instrument panel.

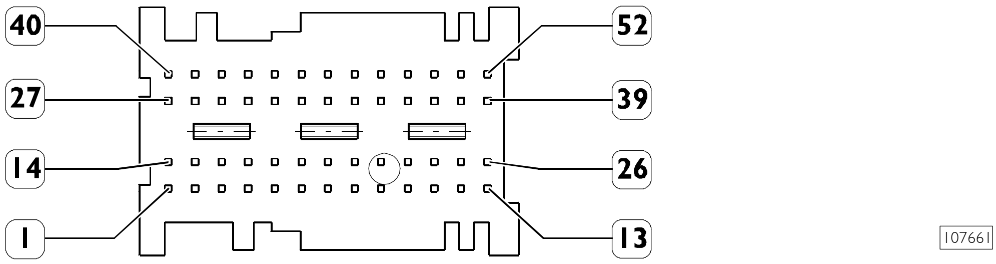
Figure 50



1. Connector "CY" for junction with "CPL" (interior) - 2. Junction connector "AV" (bonnet) - 3. Diagnosis connector "EOBD" - 4. Junction connector "LN" (cab) - 5. Junction connector "PF" (instrument panel)

Black cab junction connector “LN”

Figure 51



Ref.	Function	Cable Code
1	-	-
2	-	-
3	-	-
4	Central locking “H6”	0000
5	Positive for lh lateral blinker	1126
6	Positive for rh rear blinker	1125
7	Fuel level gauge “PIN 4”	5557
8	Positive for lh rear parking light	3323
9	Positive for rh rear parking light	3322
10	-	-
11	Earth for roof lamp switching on	0003
12	Positive for plate light	3337
13	(Driver - passenger) central locking “PIN 1”	8180
14	-	-
15	-	-
16	-	8879
17	-	5164
18	Positive for lh rear blinker	1120
19	Positive for rh blinker	1124
20	Signal for hand brake optical indicator	6662
21	Fuel level gauge “PIN 3”	0000
22	Earth for roof lamp switching on	0003
23	-	-
24	Line “K” for air spring suspension central unit	2294
25	Air spring suspension failure warning lamp	6008
26	Positive for rh rear fog light	2283
27	13-pole socket PIN 9	6120
28	Negative for illumination pushbutton with tools	0000
29	Side hatch roof lamp	4110
30	Cab interior roof lamp	4111
31	Positive for rh stop rear light	1172
32	Positive for rear roof lamp	7772
33	Earth for roof lamp switching on	0003
34	Earth for roof lamp switching on	0003
35	Earth for roof lamp switching on	0003
36	Central locking “C7”	0000

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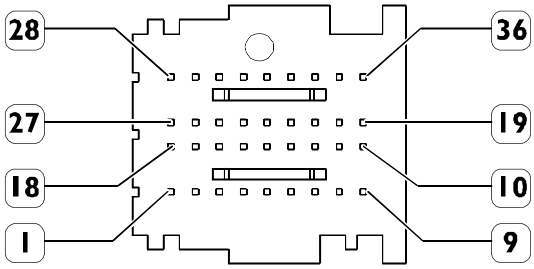
Ref.	Function	Cable Code
37	-	-
38	-	-
39	-	4112
40	Decelerator “TELMA” optical indicator	6604
41	Central locking “C2”	0000
42	Central locking “A2”	0000
43	Positive for lh rear fog light	2283
44	Positive for lh stop rear light	1177
45	-	-
46	-	6606
47	-	-
48	_	6630
49	Roof lamp for side hatch illumination	4113
50	-	-
51	-	-
52	-	-

Blue instrument panel junction connector "PF"

Figure 52



Ref.	Function	Cable Code
1	-	-
2	Parking lights (from steering column switch unit)	3333
3	Positive for instrument cluster	7772
4	Flashing remote control switch control (from steering column switch unit)	8024
5	Instrument cluster "B" CAN line L	6111
6	Instrument cluster "B" CAN line H	6110
7	Positive for blinkers (from steering column switch unit)	1111
8	Earth from instrument panel switches	0000
9	Earth (from steering column switch unit)	0050
10	Earth	0000
11	Positive for diagnosis connector	7797
12	Climate control system central unit line "K"	2296
13	-	-
14	-	-
15	-	-
16	-	-
17	-	0000
18	Positive for the illumination of the symbols of switches	3320
19	Earth	0000
20	Negative for cab roof lamp switch	0000
21	Positive for the illumination of the symbol of heated rear window on	6653
22	-	5647
23	Camera PIN B-1 (visual system for reverse gear)	5+59
24	Air Bag "B" CAN line H	6110
25	Air Bag "B" CAN line L	6111
26	-	-
27	Positive (+15)	8849
28	Positive for windscreen wiper (from steering column switch unit)	8880
29	-	-
30	Positive for windscreen washer pump (from steering column switch unit)	8886
31	Positive for instrument cluster (+15)	8879
32	Negative from heated rear window switching on pushbutton	0000
33	-	-
34	Negative for emergency lights switching on (from pushbutton)	1113
35	Fog front headlamps power supply (from steering column switch unit)	2228
36	Negative for instrument cluster	0000

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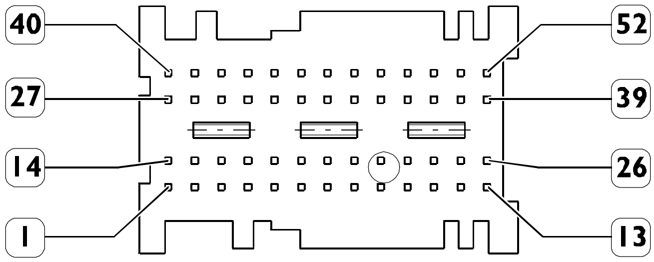
Blue bonnet junction connector "AV"

Figure 53

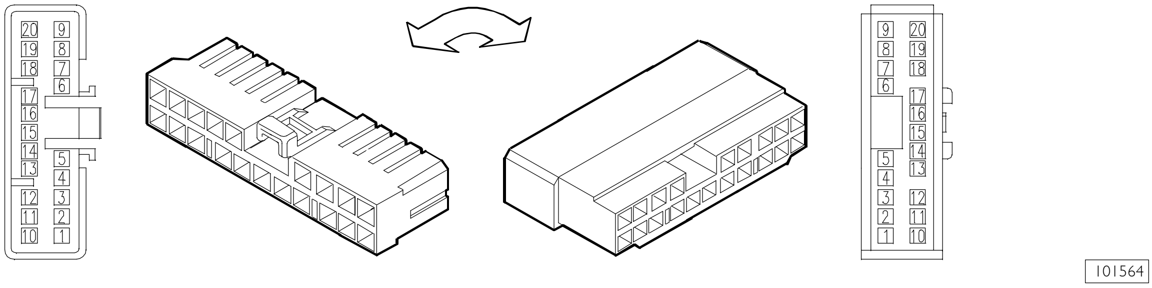


Ref.	Function	Cable Code
1	Negative from fuel filter clogged sensor	5531
2	-	2663
3	Positive for general power-assisted units (+15)	8879
4	-	-
5	For rh front blinker	1129
6	-	-
7	"IMMOBILIZER" antenna PIN 2	8092
8	"IMMOBILIZER" antenna PIN 1	8092
9	Signal from sensor for engine water level gauge	5520
10	Electronic tachometer transmitter "PIN 3"	5517
11	Positive +15	8879
12	Positive +15	8879
13	-	-
14	-	-
15	-	-
16	Positive +15	8879
17	-	-
18	-	-
19	Fixed stop for windscreen wiper "PIN 2A"	8873
20	Negative for remote control switch to switch on headlight wipers	0000
21	Negative for automatic gearbox central unit "PIN 45"	0000
22	Line K for central unit ABS / ASR	2299
23	-	-
24	Negative from brake liquid level sensor	6661
25	Generator charge optical indicator	7778
26	Line "K" for central unit EDC 16	2298
27	Negative for electronic tachometer transmitter "PIN 2"	0058
28	Positive for rh front blinker	1123
29	Control for remote control switch to insert windscreen wiper 1st/2nd speed	8879
30	Central locking antenna "PIN 1"	-
31	-	-
32	Signal from (front / rear) shoes wear sensors	6004
33	Negative from engine bonnet opening switch	5621
34	Signal for antitheft system	9142
35	-	-
36	-	-

Ref.	Function	Cable Code
37	Speed signal (from tachometer) for EDC / automatic gearbox	5517
38	External temperature signal (air-conditioner)	5532
39	Positive for rh front parking light - rh front clearance light	3320
40	Control for remote control switch to switch on windscreen wiper	8879
41	-	-
42	-	-
43	Central locking antenna “PIN 2”	-
44	“C” CAN Line L – Steering angle sensor (PIN 1) - CAN line closing resistance	
45	“C” CAN Line H - Steering angle sensor (PIN 3) - CAN line closing resistance	
46	Positive for antitheft siren (+30)	
47	Line K for additional heater	
48	“C” CAN Line L - ABS / automatic gearbox / EDC16	2950
49	“C” CAN Line H - ABS / automatic gearbox / EDC16	8950
50	-	-
51	-	-
52	Positive for lh front parking light - lh front clearance light	3321

FITTER CONNECTOR (61071)

Figure 54

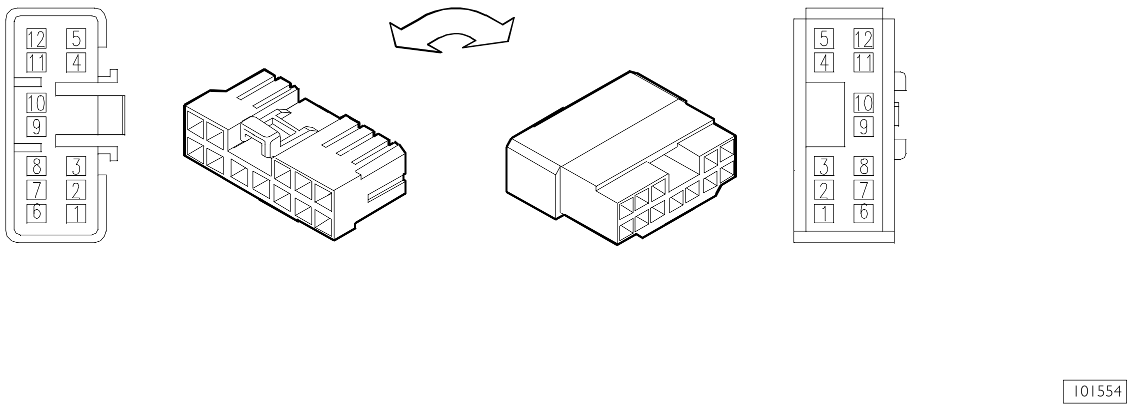


Ref.	Function
1	-
2	-
4	-
5	Hand brake in
6	-
7	Positive K58 (external lights)
8	Alternator charge (alternator signal L)
9	Clutch status (activated / not activated)
10	Reverse gear engaged (positive)
11	-
12	Cruise control (set +)
13	Cruise control (set -)
14	Cruise control (reset)
15	Cruise control (on)
16	-
17	Earth
18	Power take-off 1
19	Power take-off 2
20	Power take-off 3

Positioned in the cab near junction connectors - Air-Bags (at the bottom to the right)

FITTER CONNECTOR (72068)

Figure 55



Ref.	Function
1	Activating secondary speed limiter
2	Activating speed limiter
3	Selecting idling and 2 speeds
4	Vehicle speed signal
5	Positive +15 (key)
6	Power take-off activated
7	Horn activated
8	-
9	-
10	Engine rotation speed
11	-
12	-

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ELECTRONIC INJECTION EDC16
Particular features of engines Euro 4

To observe emission limits Euro 4, engines E4 have following features:

- E.G.R. system present;
- D.P.F. filter (solid particulate trap with constant regeneration) present;
- new digital flow meter HFM6 (positioned after the air filter);
- air pressure sensor present (on the intake manifold after the intercooler);
- fuel electrical pump suitable to pressurise the circuit according to specifications Euro 4;
- vehicle wiring harness for central unit EDC16C39 new electrical scheme;
- throttle valve present driven by EDC central unit (positioned on the intake manifold after the intercooler).

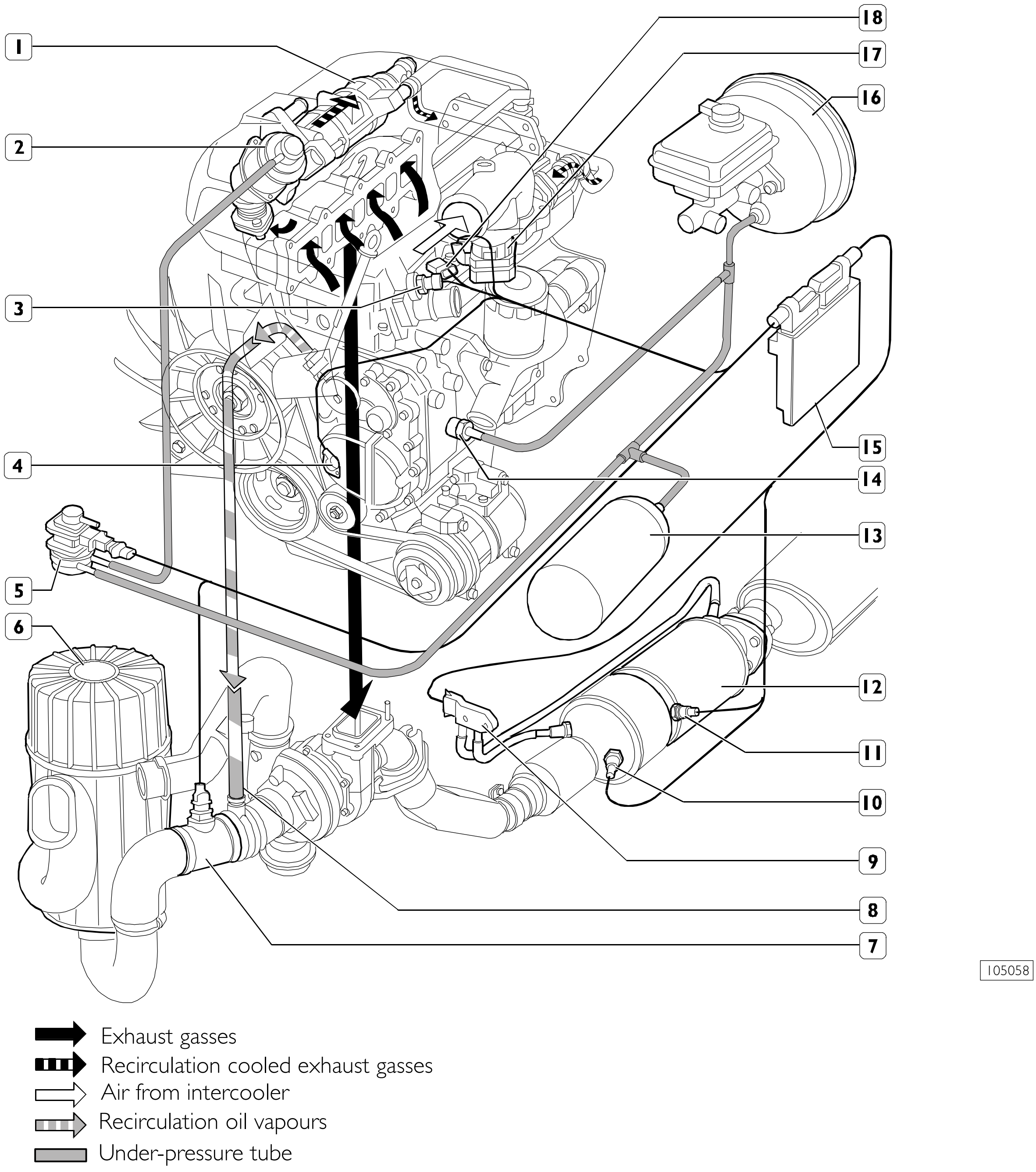
Constant regeneration particulate trap is mounted on engine exhaust. Through data processing (engine rpm's, H2O temperature, oil temperature, lambda probe signal, etc.), the central unit calculates the quantity of particulate accumulated in filter and chooses to increase exhaust gas temperature (through post-injection) in order to burn particulate accumulated inside filter.

Further, vehicles (for compliance with regulations Euro 4) differ from the ones of present production mainly in following components:

- ❑ fitting with catalytic converter DPF (Diesel Particulate Filter) provided with exhaust gas temperature sensors,
- ❑ differential pressure (Delta-p) sensor for detecting DPF catalyst particulate filter clogging,
- ❑ fuel electric pump with different characteristics for boosting fuel system pressurisation,
- ❑ electrical wiring harness.

System to reduce pollutants at exhaust

Figure 56



1. E.G.R. heat exchanger - 2. E.G.R. valve - 3. Engine coolant temperature sensor - 4. Engine rpm sensor - 5. Modulator solenoid valve - 6. Air filter - 7. Air flow rate meter (flow meter) - 8. Oil vapours recirculation tube - 9. Differential pressure (delta p) sensor - 10. Inlet exhaust gas temperature sensor - 11. Outlet exhaust gas temperature sensor - 12. DPF catalysed silencer - 13. Vacuum tank - 14. Vacuum unit fitting - 15. EDC 16 central unit - 16. Power-assisted clutch - 17. Throttle valve assembly - 18. Air pressure sensor.

General

To constrain exhaust emission values of pollutants such as nitrogen oxides (NOx), hydrocarbons (HC) and particulate (PM) within limits requested by Euro 4 regulation, the engine was equipped with an EGR system paired to DPF catalysed silencer for the post-treatment of above substances.

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E.G.R. (Exhaust Gas Recirculation) SYSTEM

Operation

E.D.C. 16 electronic central unit processes information from atmospheric pressure sensor, water temperature sensor, engine rpm sensor, accelerator pedal potentiometer and drives modulator solenoid valve and throttle valve with PWM signals, according to modes properly programmed in its memory.

Modulator solenoid valve, whenever driven by E.D.C. 16 central unit, puts under-pressure power-assisted brake circuit into communication with E.G.R. circuit. In E.G.R. circuit there is set an under-pressure value depending on drive signal.
Such under-pressure acts on pneumatic valve E.G.R. membrane calling and lifting the cut-off unit, which normally shuts out exhaust gas passage towards intake.

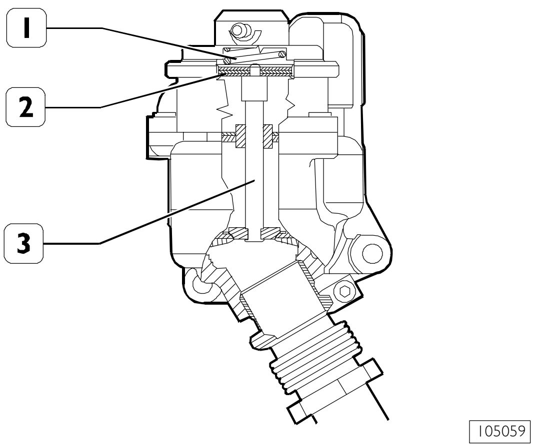
In this way, exhaust gasses, through the heat exchanger, are carried into throttle valve assembly chamber to be mixed to air from intercooler and flowed into intake manifold.

During engine operation steps not requiring gas recirculation (particulate filter regeneration, startup, cold engine, idling rotation speed, load request, high elevation), the central unit control signal to modulator solenoid valve is suppressed. The solenoid valve closes the connection between power-assisted brake under-pressure circuit and E.G.R. circuit, and simultaneously restores atmospheric pressure into E.G.R. circuit.

Main system components

E.G.R. valve

Figure 57



E.G.R. valve is mounted on heat exchanger end.
To ensure higher efficiency and longer durability to the valve, the valve is cooled by engine coolant from heat exchanger.

Recirculated gas quantity regulation is through a mushroom valve, pneumatically driven under under-pressure; the under-pressure, through calibrated section fitting, is taken from the tube connecting the vacuum unit to power-assisted brake.

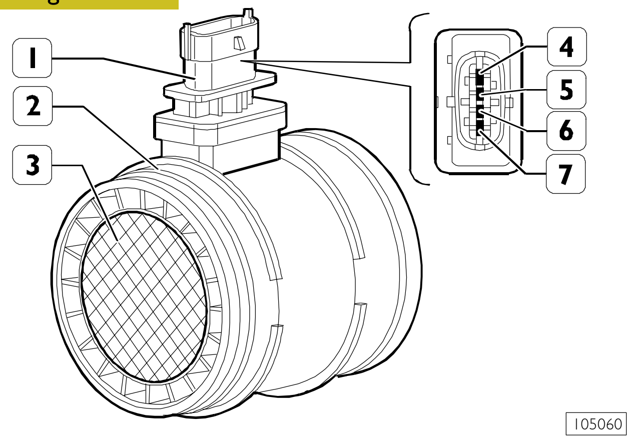
Driving under-pressure modulated by the solenoid valve and overcoming the force exerted by counteracting spring (1), will lift membrane (2), connected to cut-off unit (3), which moves upwards and enables the recirculation of burnt out gasses towards inlet manifold.

540746 Modulator solenoid valve

Modulator solenoid valve is an integrating part in E.G.R. system and power-assisted brake under-pressure tubes.
It is a proportional solenoid valve modulating E.G.R. valve driving under-pressure depending on PWM signal generated by EDC 16 central unit.

85159 Air flow rate meter (flow meter)

Figure 58



1. Connector - 2. Flow meter body - 3. Recirculated oil vapours air inlet grid - 4. Power supply - 5. Earth - 6. Inlet air temperature sensor - 7. Flow rate output signal.

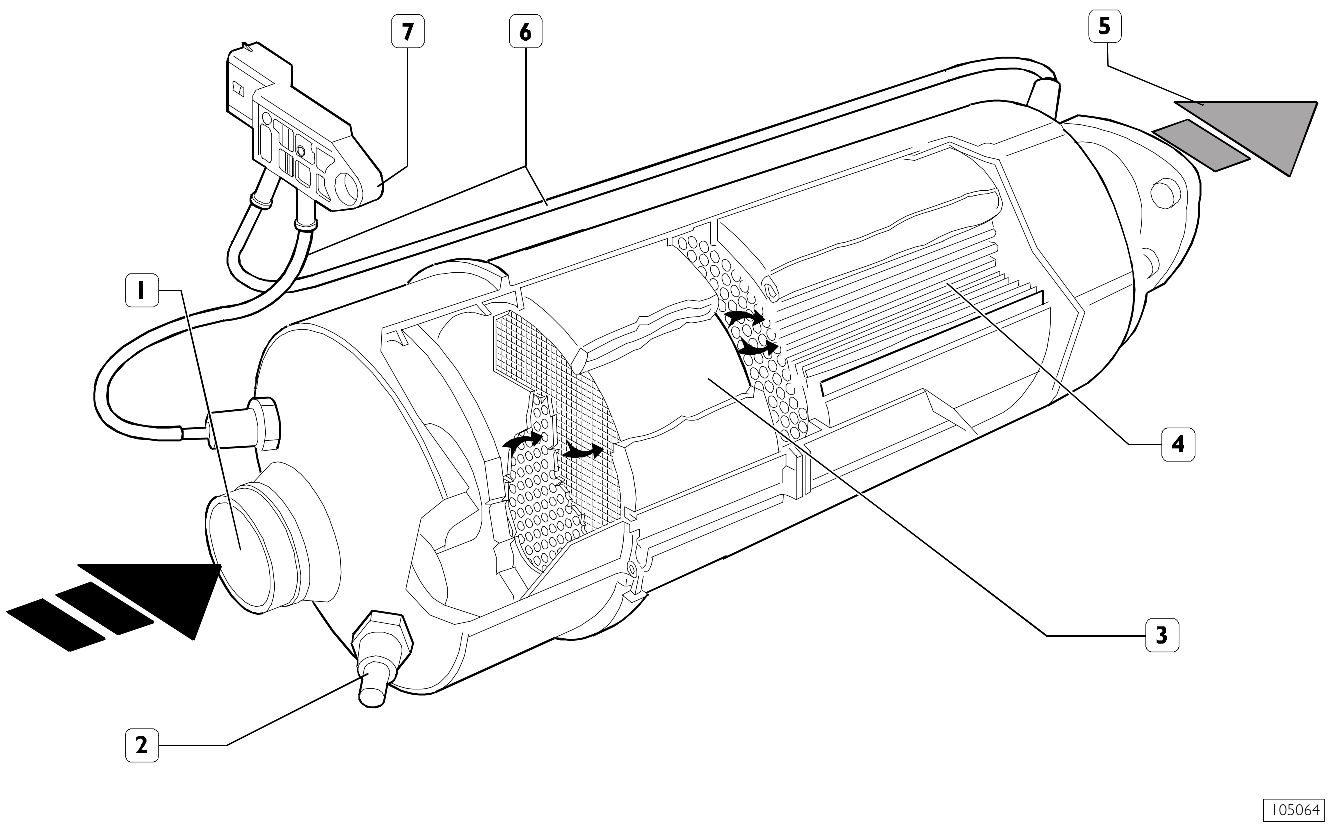
The flow meter is a heated film type flow meter and is placed between turbocharger and intercooler.
Inside the flow meter, sucked in air temperature sensor is built in.

Operation

Operation principle is based on a heated membrane put in between a measurement channel through which inlet air entering the engine is flowing.
The heated film membrane is kept at constant temperature (about 120 °C, higher than incoming air temperature) by heating resistance.
The air mass which runs through measurement channel tends to take out heat from the membrane; therefore, to keep the membrane at constant temperature, the current must run through the resistance.
Absorbed current is proportional to air mass flowing to engine; the current is measured by a Wheatstone bridge and signal obtained is sent to the electronic central unit.

507130 D.P.F. (Diesel Particulate Filter) CATALYST

Figure 59



D.P.F. CATALYST VIEW
1. Exhaust gas inlet- 2. Exhaust gas temperature sensor connection - 3. Catalyst module - 4. Particulate filter - 5. Exhaust gas outlet - 6. Pipes connecting pressure sensor to catalyst - 7. Differential pressure (Δp) sensor

Description

D.P.F. catalyst is made up of an oxidiser catalyst and a particulate filter.
Oxidiser catalyst (3) is an exhaust gas post-treatment device. Active substances, contained in the catalyst, oxidise, at 250 °C÷450 °C temperature, carbon oxide (CO) and hydrocarbons (HC), turning them into carbon dioxide (CO_2) and steam (H_2O).

Catalyst module is made up of a ceramic structure impregnated with platinum, as platinum is a catalysing substance in oxidation reactions. Exhaust gasses heat the catalyst, so triggering the conversion of pollutants into inert compounds.

Particulate filter (4), connected to the catalyst, has a double task: retaining particulate particles (PM) depositing between the pores of the ceramic structure of which the filter is made up and working as a particulate particles combustion chamber when the filter is being clogged.

If filter interior is kept at a temperature higher than 530 °C and oxygen percentage is higher than 8% (oxygen being produced by the decomposition of nitrogen oxide NO_2), then some combustion reactions, boosted by the catalyst put before the filter, burn particulate particles (regeneration), so keeping the filter clean.

On the contrary, if its temperature is lower, the filter is clogged, with negative effects, on counterpressure, on exhaust gasses generated by the filter.

In this case, to regenerate the filter, temperature of exhaust gasses is artificially raised (up to 630 °C) by fuel post-injection.

A differential pressure sensor (7), connected to D.P.F. catalyst, as it detects a pressure difference between inlet and outlet, sends a (feed-back) signal to the central unit to warn about particulate filter possible clogging.

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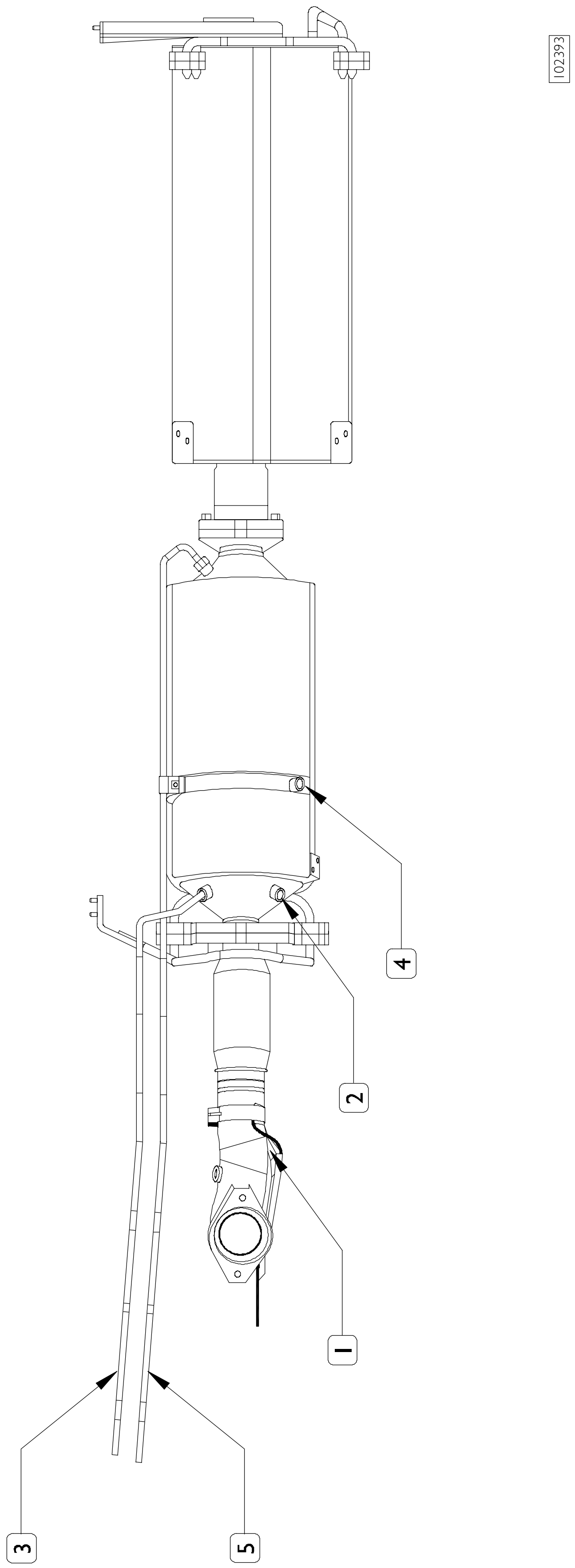
Particulate filter (components location)

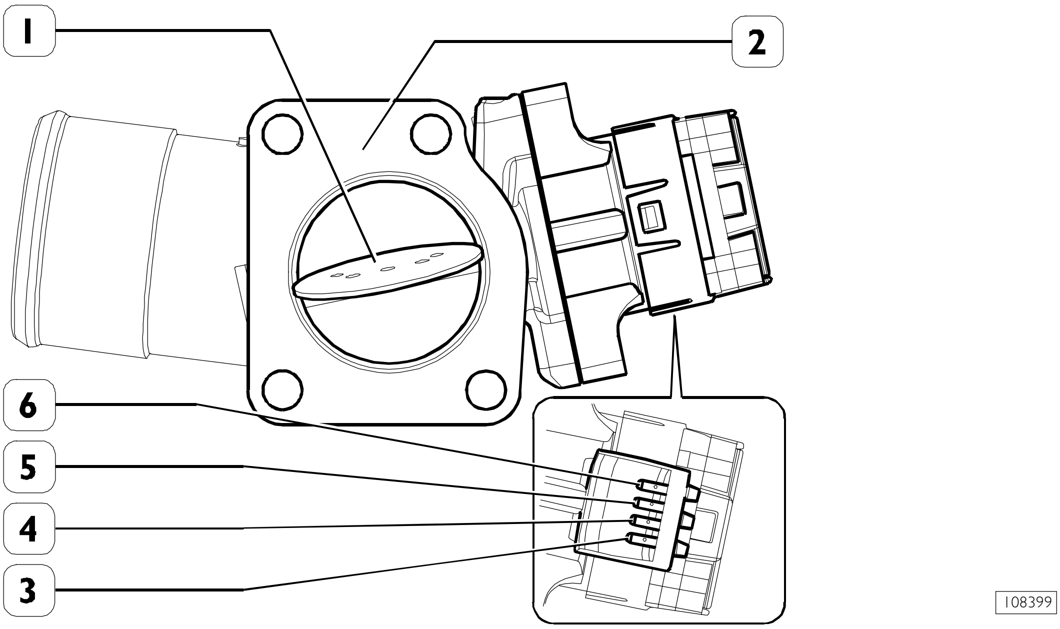
Figure 60



1. Lambda probe - 2. Exhaust gas temperature sensor - 3. TO Pressure sensor (at filter inlet) - 4. Exhaust gas temperature sensor - 5. TO Pressure sensor (at filter outlet)

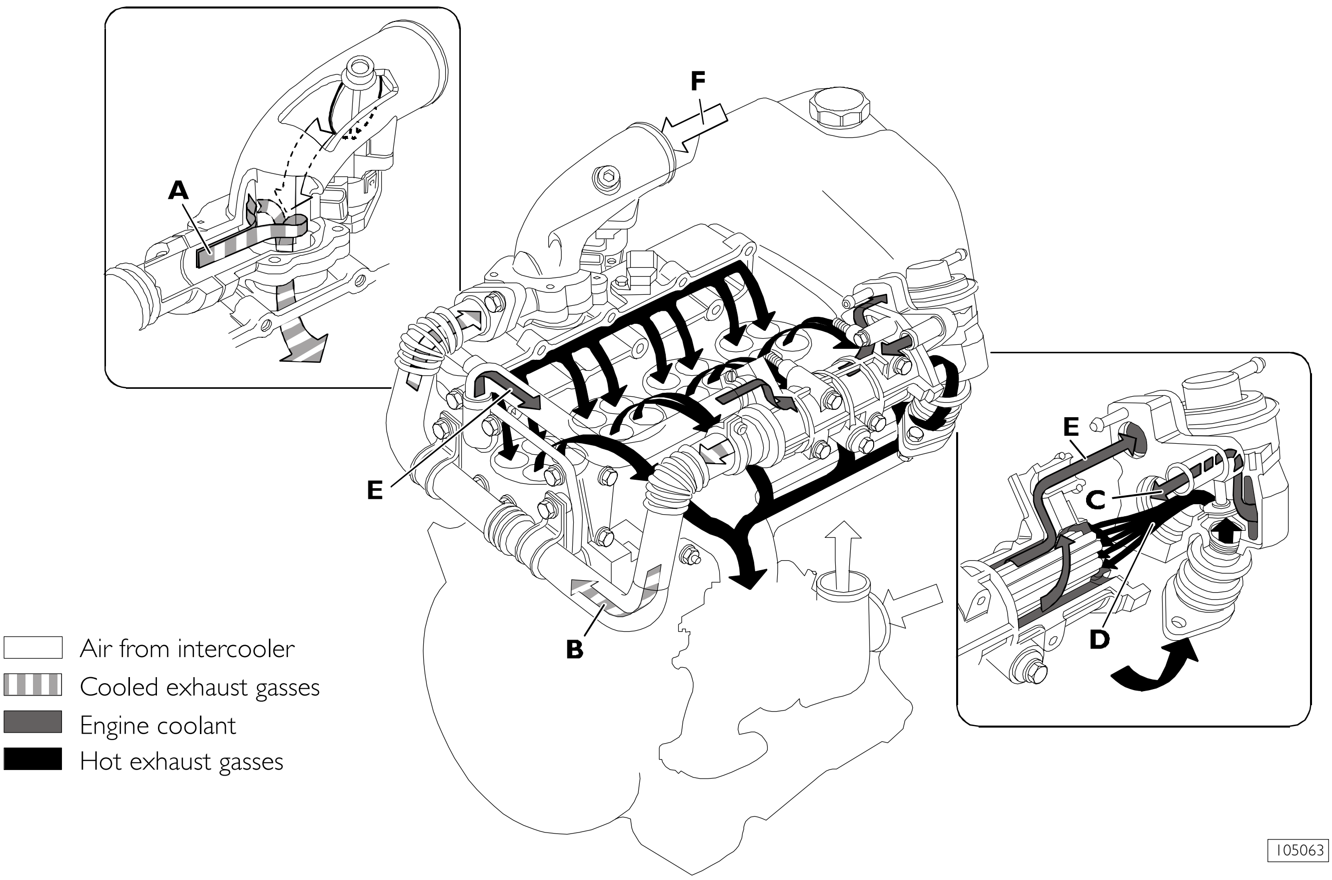
540760 Throttle valve assembly

Figure 61



1. Throttle valve - 2. Electrical actuator - 3. Throttle position signal - 4. Earth - 5. Positive - 6. PWM signal

Figure 62



A. Inlet exhaust gasses - B. Cooled exhaust gasses - C. Coolant to heater - D. Exhaust gasses from E.G.R. valve - E. Coolant coming in from cylinder head - F. Air from intercooler

The assembly of (normally open) throttle valve is mounted on inlet manifold. Its task is to regulate the flow rate of air coming in from the intercooler that is to be mixed with exhaust gasses recirculated by E.G.R. valve according to a programmed percentage.
The throttle valve is driven by an electrical actuator controlled by a PWM signal from central unit EDC 16.

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REPLACING THE COMPONENTS

Replacing particulate filter

Particulate filter, as it is suggested by its name, has the task to filter particulate particles depositing between the pores of the ceramic structure of which the filter is made up.

If the filter is maintained at a temperature over 530 °C and with adequate oxygen content, some reactions, boosted by (Oxicat) catalyst put before the filter, allow particles to burn, so keeping the filter indefinitely clean.

On the contrary, if its temperature is lower, the filter is forced to become clogged, with negative effects, on counterpressure, on exhaust gasses generated by the filter.

To allow to "clean up" the filter at proper time intervals, temperature of exhaust gasses is artificially raised (up to 630 °C) at filter inlet by an hexothermic reaction which takes place in the catalyst put before the filter on exhaust line.

With a lag, after combustion dead point, such as to ensure filter non involvement with combustion, a small fuel quantity is injected which vaporises in combustion chamber and, dragged by exhaust gas draught, is sent to the catalyst. The catalyst (made of noble metals, mainly Platinum) boosts filter combustion through the catalyst itself, easily allowing to reach 630 °C temperature. A regulator of the central unit meters both post-injection and oxygen quantity (closing throttle valve) in order to maintain regeneration optimal temperature.

The reaction can only take place if gas temperature at catalyst inlet is over 230 °C. Proper engine management maps enhance exhaust gas temperature increase when it is necessary to start up a regeneration.

E.G.R. system is of course shut out during regeneration in order to prevent post-injections vapours from being sucked into the cylinder.

During vehicle run, the central unit processes plenty of information on filter status which are relevant to have correct filter operation and reach duration targets.

In particular there are constantly counted and saved, on non volatile memory, following parameters:
- quantity of particulate accumulated in filter (regeneration is triggered if the quantity overflows preset values);
- quantity of ashes accumulated in the filter (not burning, so limiting filter accumulation capacity and consequently the regeneration frequency);
- calculated drift of Oxidant Catalyst efficiency;
- quantity of fuel post-injected to activate and maintain the regeneration, which is important for assessing the danger of presence of fuel in excess in engine oil;
- regeneration status: regeneration unnecessary, in progress, interrupted, resumed;
- miles covered and times from last complete regeneration.

Therefore, replacing particulate filter requires that all the parameter counters are reset, as:
- particulate quantity in filter is zero;
- quantity of accumulated ashes is zero;
- post-injected fuel quantity can be maintained if oil engine is not simultaneously refilled;
- all parameters about regeneration are to be reset, because there is an all new life cycle.
- if ashes counter is not reset, regeneration frequency will be greater than needed, consequently needlessly increasing fuel consumption, and particulate filter thermal fatigue; and, in extreme cases, there will be a groundless request to refill engine oil;
- if Oxicat ageing function is not reset, there is the risk of having unjustified quantities of post-injections;
- if post-injected fuel counter is not reset, there may be an early request to refill engine oil.

Replacing flow meter

In software, a function is present which is capable to rectify flow meter duration drift. In practice, while some manoeuvres (vehicle deceleration with pedal released) are executed, the central unit performs a number of checks and determines some flow meter reading rectification factors. It is a self-adapting process. Therefore, it is clear that replacing the flow meter involves resetting the self-rectifying process.

Where the central unit is replaced, on the contrary, flow meter rectification coefficients are to be copied down from old to new central units; where it is not possible, they are to be reset and self-learning process is started again.

Replacing rail pressure sensor in hydraulic accumulator

Rail pressure sensor can affect injector minimum flow rate correction accuracy, since minimum flow rate depends on both injection times and hydraulic accumulator actual pressure.

Replacing delta-p sensor

During vehicle life time, the central unit makes some checks on filter differential pressure sensor drift, e.g., with engine stopped, pressure value is the same upstream and downstream of filter.

So, some parameters are calculated and engine running values are consequently rectified.

Replacing delta-p sensor involves resetting the rectifications.

Replacing engine oil

During vehicle life time, the central unit counts up the quantity of post-injected fuel in order to activate and maintain regeneration.

A least fraction of this fuel (which is injected at a very long time after combustion, and consequently is not burning, i.e. is not involved in combustion), through engine rings, comes into contact with lubrication oil and dissolves into it. Accumulated post-injection quantity may increase, in case of loss of efficiency in Oxicat, the emissions at low temperature and, of course, impair engine normal running.

The central unit is capable to calculate the limit quantity of fuel dissolved into oil and, consequently, to suggest oil refilling.

It is obvious that, if after engine oil refilling the function is not reset, the central unit will keep on counting the increase of oil fraction in engine oil even with new oil and, sooner or later, groundlessly request to refill engine oil.

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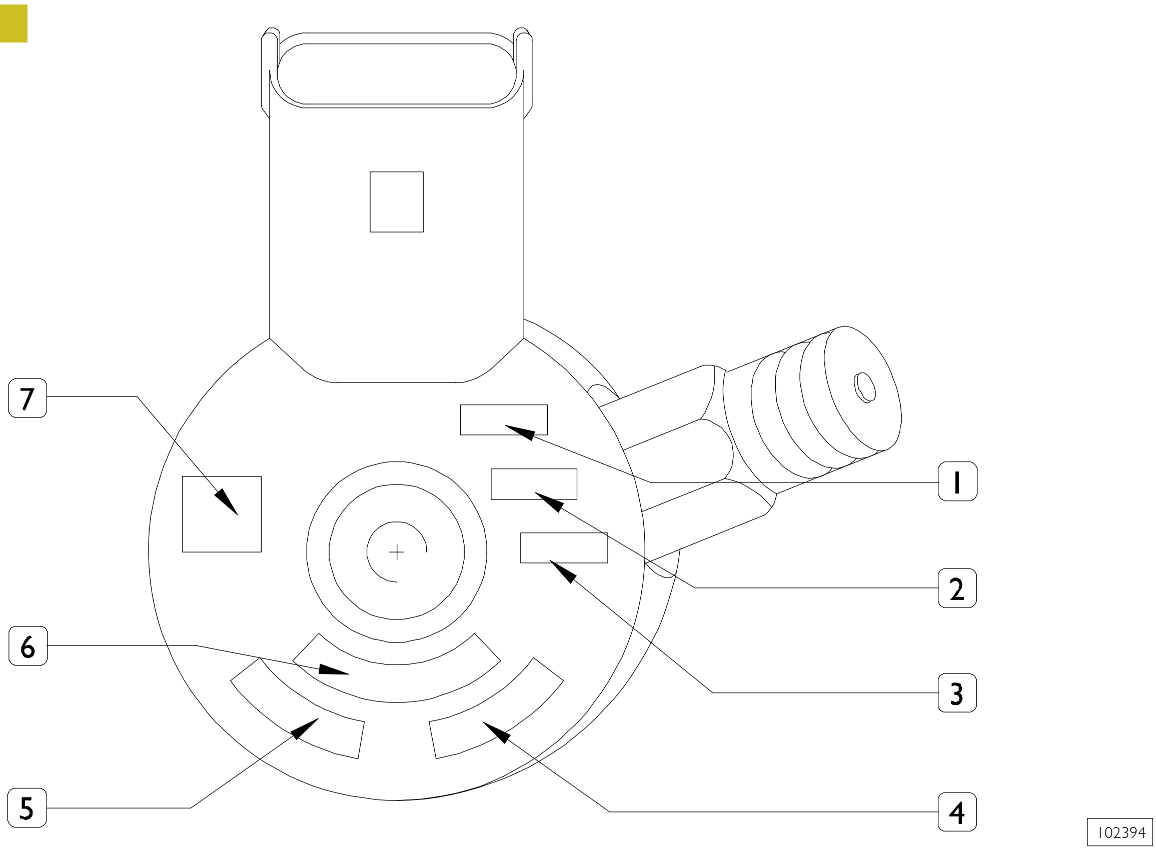
Replacing an injector

Figure 63



1. Production date - 2. Series number - 3. Code - 4. Iveco component number - 5. IMA code - 6. Bosch code - 7. IMA code

On engines Euro 4 there is applied an injection flow rate individual rectification (I.M.A. - Injector Menge Abgleichung) [Injector Quantity Offset].

It means that injectors are not assigned any more to classes (Min – Med – Max, or 01 – 02 – 03), but unavoidable flow rate deviations from average design values are detected, during final check step on Bosch line, on each single injector and stored by printing on injector magnet.

At Sofim Plant, I.M.A. code (7) is read from an on line automatic reading station, converted into bar code and printed on engine identification label applied on the engine itself.

At Vehicle Production Plant, the central unit is programmed at the end of line automatically reading the label.

For interventions off production line (such as Service interventions) I.M.A. code (5) is used.

Therefore, it is necessary to take some precaution measures:

- injector mounting sequence is important and cannot be changed in service operations without reprogramming the central unit;
- it is not possible to replace one or more injectors without reprogramming the central unit;
- where an injector is replaced, it is suggested to note down its code "before" mounting it, since it is problematic to read its value on the vehicle.

It is obvious to conclude that, where the central unit is replaced, the central unit is to be reprogrammed with the I.M.A. codes of the injectors that are mounted on the engine.

During engine running, the central unit makes some checks on injectors minimum flow rate. Under certain specified operation conditions (deceleration with pedal released) an increasing (very small) fuel quantity starting from zero is injected and its effect on engine rotation smoothness is observed. Injection start threshold is then detected and stored into the central unit. The process is a self-learning process, and is carried out on each single cylinder.

Replacing an injector involves the need of resetting the rectification factors on cylinder considered.

Replacing all injectors extends the need of resetting to all the rectification coefficients.

Replacing the central unit requires to store the coefficients on new central unit.

EDC16

Electronic injection control

The system calculates injection on the basis of the processing of the following parameters:

- ❑ Engine rpm
- ❑ Engine coolant fluid temperature
- ❑ Intake air capacity
- ❑ Battery voltage
- ❑ Fuel pressure
- ❑ Accelerator pedal position

Fuel pressure ranges from 400 to 1350 bars (1600 for F1 engines), according to engine rpm and load operating conditions.

The lower pressure is compensated by longer injection times and vice versa, always taking account of the loads required.

Up to 2800 rpm pre-injection is also carried out in order to reduce the typical noise of direct injection.

Pre-injection advance angles, the distance between pre-injection and main injection and advance angles of main injection vary according to the instantaneous engine operating conditions.

System diagnosis is performed by means of diagnostic instruments (no Blink Code is used).

Immobilizer recognition

When the control unit receives the signal of the key on "MAR" it communicates with the immobilizer control unit to enable starting.

Checking fuel temperature

With the fuel temperature greater than 75°C, detected by the sensor on the fuel filter, the control unit operates the pressure regulator to decrease the line pressure (injection times are not changed). If the temperature exceeds 90°C, the power is reduced to 60%.

Checking engine coolant temperature

The control unit, depending on the temperature:

- ❑ of the engine coolant, turbocharging air and fuel, operates the electromagnetic fan (Baruffaldi) and switches on the coolant temperature warning light.

Checking quantity of fuel injected

According to the signals from the sensors and the mapped values, the control unit:

- ❑ operates the pressure regulator;
- ❑ varies the "pilot" injection time to 2200 rpm;
- ❑ varies the "main" injection time.
- ❑ Checking idling adjustment

The control unit processes the signals from the various sensors and regulates the amount of fuel injected:

- ❑ it operates the pressure regulator;
- ❑ it varies the injection times of the electro-injectors.

Within certain thresholds the speed takes account of the battery voltage.

Fuel cut-off in release phase

In the phase of releasing the throttle pedal the control unit actuates the following logic elements:

- ❑ it cuts off supply to the electro-injectors;
- ❑ it partially reactivates supply to the electro-injectors before reaching idling speed;
- ❑ it operates the fuel pressure regulator.

Checking cylinder balancing on idling

According to the signals received from the sensors, the control unit controls the regularity of the torque at idling speed:

- ❑ it varies the amount of fuel injected into the single electro-injectors (injection time).

Checking regular engine rotation (anti-sawing)

It ensures regular engine rotation at a constant rate while increasing revs.
The control unit processes the signals received from the sensors and determines the amount of fuel to be injected via:

- ❑ the pressure regulator;
- ❑ the electro-injector opening time.

Checking smokiness at exhaust on acceleration

With heavy acceleration, on the basis of the signals received from the air introduction meter and engine speed sensor, the control unit determines the optimum amount of fuel to inject:

- ❑ it operates the pressure regulator;
- ❑ it varies the electro-injector injection time.

Checking exhaust gas recirculation

Depending on the engine load and the signal from the accelerator pedal sensor, the control unit limits the amount of air taken in, actuating partial suction of the exhaust gases.

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Checking top speed limit

Depending on the number of revs, the control unit actuates two action strategies:

- at 4250 rpm it cuts off the fuel, decreasing the electro-injector opening time Over 5000 rpm it deactivates the electro-injectors.

Checking regular rotation on acceleration

Regular progression is assured in all conditions by the control of the pressure regulator and the electro-injector opening time.

Preheat plug centre control

During:

- the start step
- the after start step

the injection centre times the heater starter (or preheat plugs for the F1 Engine) according to engine temperature.

Checking activation of air-conditioning system

The control unit operates the air-conditioning compressor:

- switching it on/off when the relative switch is pressed;
- momentarily turning it off (approximately 6 sec.) if the engine coolant reaches the set temperature.

Checking fuel pump

Irrespective of the speed, the control unit:

- supplies the auxiliary fuel pump with the key on MAR;
- cuts off auxiliary pump supply if the engine is not started up within a few seconds.

Checking diesel warming

It times operation of diesel warming in relation to ambient temperature.

Checking cylinder position

During each turn of the engine, the control unit recognizes which cylinder is in the power stroke and operates the injection sequence for the appropriate cylinder.

Checking pilot and main injection timing

According to the signals from the various sensors, including the absolute pressure sensor built into the control unit, the control unit determines the optimum point of injection according to internal mapping.

Checking injection pressure closed cycle

Depending on the engine load, determined by processing the signals from the various sensors, the control unit operates the regulator to obtain optimum line pressure.

Fuel supply

The fuel supply is calculated in relation to:

- accelerator pedal position
- engine speed
- quantity of air introduced.

The outcome may be corrected in relation to:

- the water temperature.

Or to avoid:

- noise
- smoke
- overloading
- overheating
- turbine over-revving.

The delivery can be modified in the case of:

- action of external devices (ABS), ABD, EDB
- serious trouble decreasing the load or stopping the engine.

After determining the mass of air introduced by measuring its volume and temperature, the control unit calculates the corresponding mass of fuel to inject into the relevant cylinder (mg per delivery) also taking into account the temperature of the diesel.
The mass of fuel calculated in this way is first converted into volume (mm^3 per delivery) and then into degrees of throw, or duration of injection.

Correcting flow rate according to water temperature

A cold engine meets with greater resistance during operation: friction is high, the oil is still very viscous, and the various clearances are not yet optimized.
In addition, the injected fuel tends to condense on the metal surfaces that are still cold.
The fuel supply for a cold engine is therefore greater than for a warm one.

Correcting flow rate to avoid noise, smoke or overloading

The behaviour that could lead to this kind of trouble is well known.
The designer has therefore included special instructions in the control unit to avoid it.

De-rating

In the event of the engine overheating, injection is modified, decreasing the delivery to a varying degree, in proportion to the temperature reached by the coolant.

Turbine rpm setting (for the variable geometry turbo-compressor)

By changing its geometry, adjusted turbine speed is monitored by the electronic centre via an electrical signal feeding the compressed air actuator electro valve. Based on signals from the accelerator pedal position and suction manifold air temperature/pressure engine rpm sensors, the electronic centre processes the field-back signal to properly modulate turbine actuator pilot electro valve opening.

Injection timing electronic test

The advance (start of delivery, expressed in degrees) may be different from one injection to the next, also differentiated from one cylinder to another. It is calculated, similarly to the delivery, in relation to the engine load (accelerator position, engine speed and air introduced).
The advance is appropriately corrected:

- in phases of acceleration;
- according to the water temperature.

And also to obtain:

- lower emissions, noise and overloading;
- better vehicle acceleration.

An extremely high advance is set on starting, depending on the water temperature.
Feedback from the start of delivery is supplied by the change in impedance of the injector solenoid valve.

Speed governor

The electronic speed governor has both features of governors:

- idling and top speed
- all speeds

It is stable in ranges where conventional, mechanical governors are imprecise.

Engine starting

During the first few turns of the engine, the timing and cylinder no. 1 recognition signals (flywheel sensor and camshaft sensor) are synchronized.
The accelerator pedal signal is ignored on starting. Starting delivery is set only according to water temperature, by a special map.
When the control unit detects such speed and acceleration of the flywheel as to be able to consider the engine started up and no longer driven by the starter motor, it re-enables the accelerator pedal.

Cold starting

If even just one of the three temperature sensors (water, air or diesel) records a temperature lower than 10°C, pre-post heating is activated.
On inserting the key contact, the pre-heating indicator goes on and remains on for a period varying depending on temperature (air is heated by the pre-heating glow plugs that are located on cylinder head for F1 engines), then it blinks.
Thereafter, the engine can be started up.
When the motor is running this indicator light goes out, while the glow plugs continue to be powered for a certain length of time (variable) for post-heating.
If, with the indicator light flashing, the engine is not started up within 20-25 seconds (inattention time), the operation is cancelled so as not to run down the batteries pointlessly.
The pre-heating curve is also variable in relation to the battery voltage.

Warm starting

If the reference temperatures all exceed 10°C, when the key makes contact the indicator light comes on for approximately 2 sec., for a short test, and then goes out. It is now possible to start up the engine.

Run up

When the key makes contact, the control unit transfers the information stored in memory when the engine was last stopped into the main memory (see After Run) and makes a diagnosis of the system.

After run

Whenever the engine is switched off with the key, the control unit stays powered for a few seconds by the main relay.
This makes it possible for the microprocessor to transfer some data from the main memory (volatile) to a non-volatile memory, which can be erased and written over (EEPROM), so as to make it available at the next start up (see Run Up).

These data basically consist of:

- ❑ various settings (engine idling adjustment, etc.);
- ❑ settings of some components;
- ❑ fault memory.

The process lasts a few seconds, typically from 2 to 7 (depending on the amount of data to save), after which the ECU sends a command to the main relay and makes it disconnect from the battery.

It is extremely important for this procedure not to be broken off, for example by switching off the engine with the battery cut-out, or by disconnecting the battery cut-out before 10 seconds have passed since switching off the engine.
If this happens, the functioning of the system is ensured, but repeated interruptions may damage the control unit.

Cut - off

This function cuts off fuel delivery when the vehicle is decelerating (accelerator pedal released).

Cylider balancing

Individual cylinder balancing contributes to increasing comfort and handling.
This function permits individual, customized control over the delivery of fuel and the start of delivery for each cylinder, even differently from one cylinder to another, to compensate for the hydraulic tolerances of the injector.

The differences in flow (delivery specifications) between the various injectors cannot be evaluated directly by the control unit. This information is supplied by Modus reading the bar code of each injector at the time of assembly.

Synchronisation search

If there is no signal from the camshaft sensor, the control unit is anyhow able to recognize the cylinders into which the fuel is to be injected.
If this occurs when the engine is already running, the combustion sequence has already been acquired, so the control unit continues with the sequence on which it has already been synchronized.
If this occurs when the machine is at a standstill, the control unit energizes a single solenoid valve. Within at most 2 turns of the crankshaft, injection will take place in that cylinder, so the control unit just needs to get synchronized on the firing sequence and to start up the engine.

EDC system components

Ref.	Component code	Description
1	58918	Tachometer on instrument cluster
2	58918	Revolution counter on instrument cluster
3	42374	Clutch pedal switch
4	53565	Brake pedal switches
5	85152	Accelerator pedal position sensor
6	47106	Fuel temperature sensor (on fuel filter)
7	47035	Coolant temperature sensor
8	85156	Air pressure and temperature sensors
9	48042	Timing system shaft sensor
10	85157	Fuel pressure sensor
11	48035	Engine shaft sensor
12	78247	Electrical injectors
13	25231	Glow plugs pre-heating central unit
14	-	Throttle valve assembly
15	19010	Pre-heating glow plug
16	44030	Fuel electric pump (with level gauge)
17	78209	E.G.R. solenoid valve
18	12012	AC compressor
19	85159	Flow meter
20	58701	EDC warning lamp
21	54032	Cruise Control / PTO (optional) control
22	85130	Key for starting up with Immobilizer
23	72027	Diagnosis socket (EOBD) on Body Computer
24	78248	VGT control solenoid valve
25	85022	Fan electromagnetic joint

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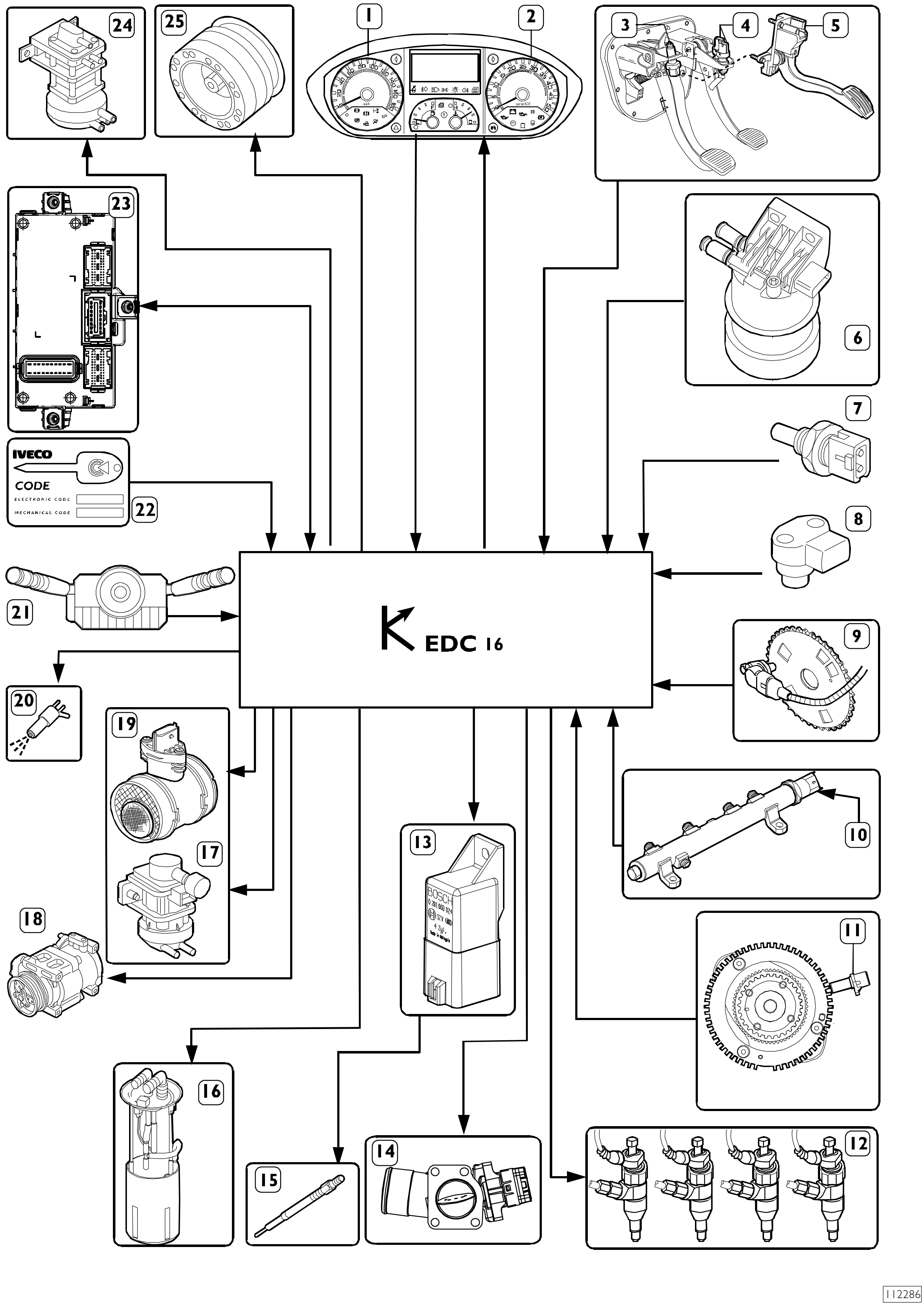
Figure 64



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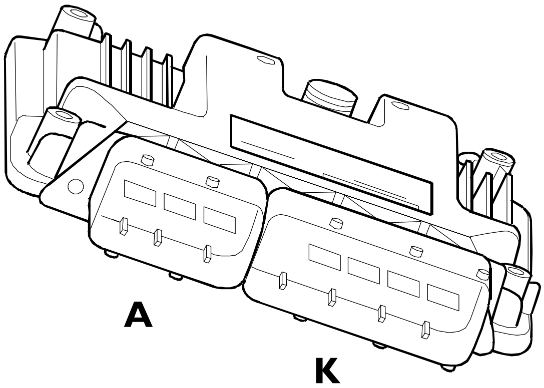
EDC 16
IVECO
CODE
BOSCH
112286

Bosch EDC16 control unit

Figure 65



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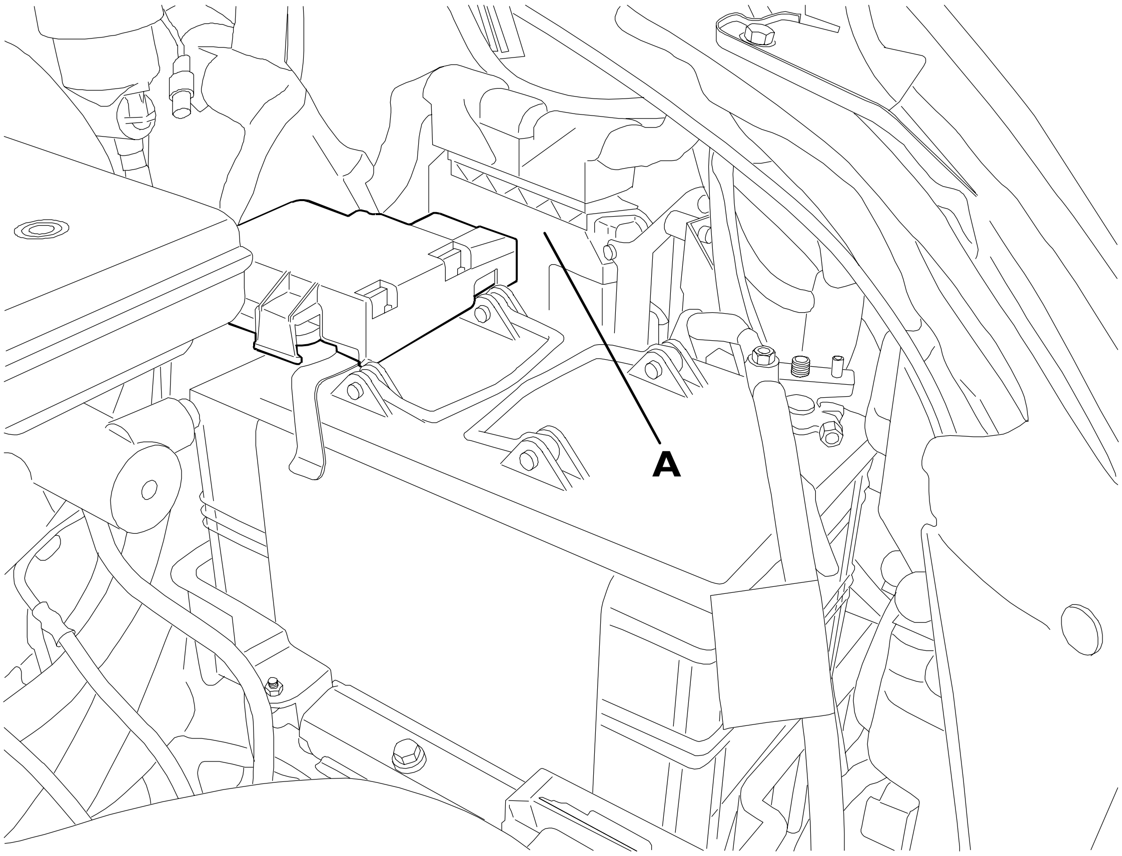
PERSPECTIVE VIEW
A. Engine side injection cable connector - K. Bonnet/cab cable connector

Figure 66



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A. Central unit EDC

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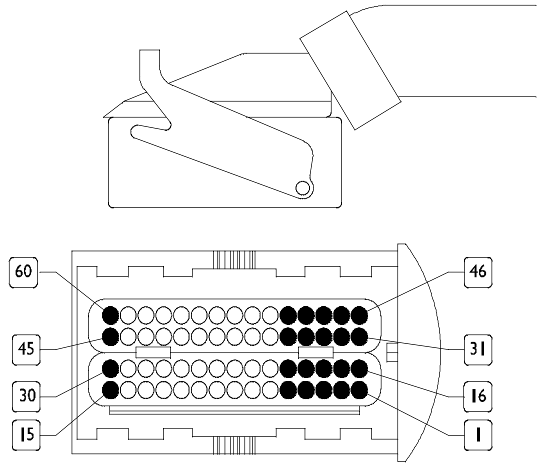
Control unit connection to the injection cable on engine side (housing A)

Figure 67



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Pin	Cable colour code	Function
1	0000	Cylinder injector 3
2	0000	Cylinder injector 2
6	-	Throttle valve actuator
7	-	Drive shaft sensor braided wire
8	0000	Rail pressure sensor negative
11	0174	Distributing shaft sensor negative (phase)
12	red	Drive shaft sensor
13	5153	Boosting air pressure and temperature sensor power supply
15	-	VGT solenoid valve
16	9924	Cylinder injector 1
17	9924	Cylinder injector 4
19	0000	Pressure regulator negative
20	7158	Distributing shaft sensor positive
23	0165	Boosting air pressure and temperature sensor negative
26	-	Throttle valve actuator
27	white	Drive shaft sensor
28	5591	Rail sensor power supply
31	9924	Cylinder injector 2
33	0000	Cylinder injector 4
35	-	Engine oil level signal
37	5151	Air flow meter air temperature signal (available with EGR)
39	-	Engine oil level signal
40	5152	Boosting air pressure sensor signal
41	0150	Water temperature sensor negative
42	8153	Air flow meter signal
43	5591	Rail pressure signal
44	8151	Air flow meter negative (available with EGR)
45	-	Throttle valve actuator
46	9924	Cylinder injector 3
47	0000	Cylinder injector 1
49	9925	Pressure regulator
50	9160	Distributing shaft sensor signal (phase)
51	0150	Fuel temperature sensor negative

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Pin	Cable colour code	Function
52	5592	Fuel temperature sensor signal
53	5151	Boosting air temperature sensor signal
56	-	Throttle valve actuator
58	5154	Water temperature sensor signal
60	8150	EGR solenoid valve
●	Power seats	
○	Signal seats	
-	Pins not highlighted are not used	

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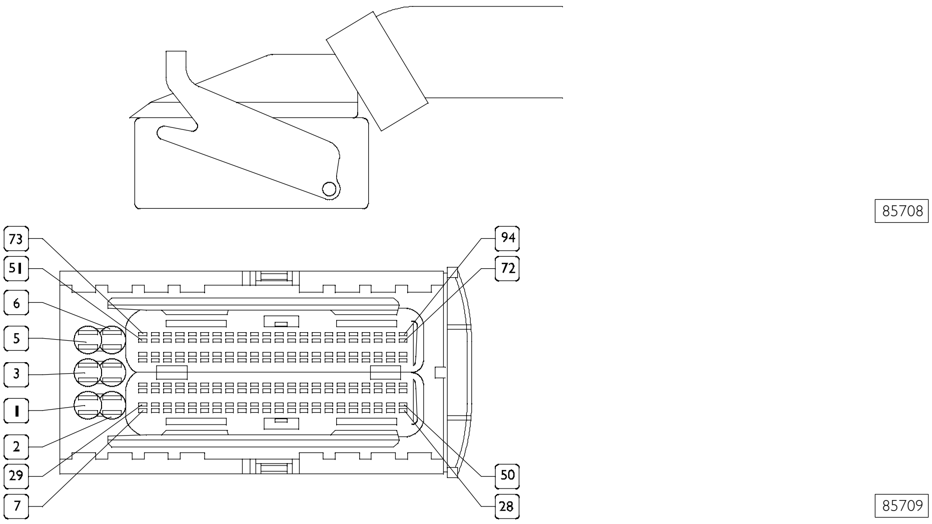
Control unit connection to cab-bonnet cable (housing K)

Figure 68



Pin	Cable colour code	Function
1	-	+30 (main relay)
2	0000	Earth
4	0000	Earth
5	8150	+30 (main relay)
6	0000	Earth
8	0150	Accelerator pedal sensor negative (pin 5)
9	5157	Accelerator pedal sensor signal (pin 4)
10	-	Δp differential sensor
11	-	Exhaust gas temperature sensor 1
12	0000	Coolant pressure switch
13	-	Signal from power takeoff (if any) state selector
15	-	Δp differential sensor
16	-	Negative from power takeoff (if any) state selector
17	-	Signal from brake pedal pressed for stop light ignition
22	-	Δp differential sensor
25	2298	K line
27	5180	Exhaust gas temperature sensor 1
28	8051	+15
30	0157	Accelerator pedal sensor negative (pin 3)
31	5157	Accelerator pedal sensor signal (pin 6)
38	8155	Cruise Control (resume)
42	-	Speed limiter button
45	5157	Accelerator pedal sensor power supply (pin 2)
46	5157	Accelerator pedal sensor power supply (pin 1)
48	5614	Engine speed sensor (revs counter)
49	0000	Exhaust gas temperature sensor 1
50	-	Exhaust gas temperature sensor 1
51	-	Lambda probe
52	1310	To preheating spark plug actuation remote-control switch pin D1

Pin	Cable colour code	Function
54	7772	Positive for air-conditioner compressor switched on
56	8157	Cruise Control (set +)
57	0000	Auxiliary speed limiter (where available)
58	8150	Signal from clutch switch
61	-	CAN L line
62	-	CAN H line
63	8293	Exhaust gas temperature sensor 2
64	8292	Lambda probe
65	8291	Lambda probe
66	8282	Exhaust gas temperature sensor 2
68	8156	Fuel filter heating remote-control switch positive
70	-	Compressor switching on
71	-	EDC warning light negative
72	0155	Main relay (negative)
75	5517	Vehicle speed signal (tachometer)
77	8154	Cruise Control (off)
78	8156	Cruise Control (set -)
79	8167	Coolant pressure switch
80	8158	Brake pedal signal
81	5530	Water in fuel filter
86	8294	Lambda probe
87	8293	Lambda probe
90	-	Positive for engine cooling electromagnetic joint control
91	-	Fuel electric pump remote-control switch negative
92	0000	Pre-heating warning light negative
93	1311	To pre-heating spark plug actuation remote-control switch pin ST
-	Pins not highlighted are not used	

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Accelerator pedal sensor

A new sensor which incorporates two potentiometers (no idling switch is provided) is available on the accelerator pedal. The ratio between the signals from the two potentiometers is 2:1 (one potentiometer exhibits a twofold resistance value compared with the other). Both of these signals (V) are detected by the control unit that processes them according to stored threshold values and manages the injection system as an accelerator pedal position set by the driver. (At the output of these potentiometers, a variable voltage is available which corresponds to the potentiometer resistance value.)

It is connected to the EDC control unit connector K pins 9-30-45-31-8-46. The potentiometers are powered with 5 V voltage supplied by the control unit itself.

Figure 69

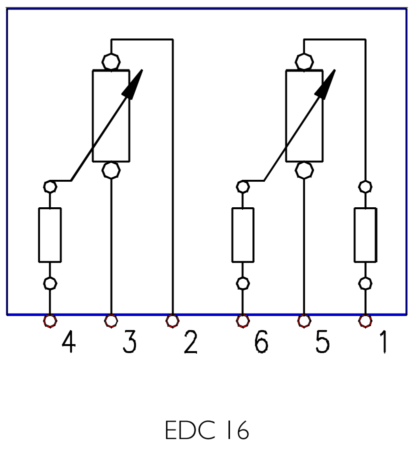
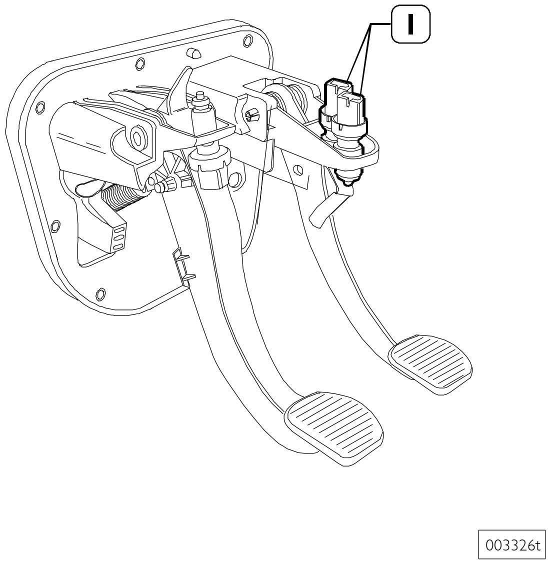
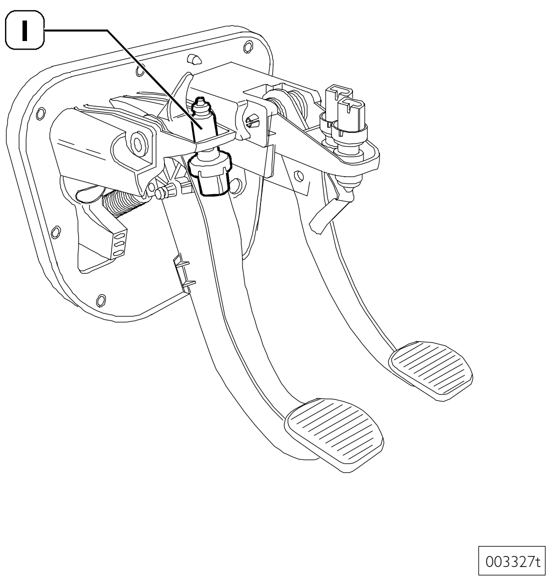


Figure 70



1. Brake pedal switches

Figure 71



1. Clutch pedal switch

Brake pedal switches (53501)

Two switches are present on brake pedal: one is directly connected to pin KB0 of central unit, the other is connected to central unit ESP8 at PIN 30.

Clutch pedal switch (42374)

An N.C. switch connected to electronic centre pin K58 is mounted on the clutch pedal.

The "clutch pedal actuated signal" is used by the centre to identify gear condition selected and gear shifts.

In absence of the pedal pressed switch signal, the centre disenables the Cruise Control function.

Preheat plug electronic centre (F1A/F1C engine)

EDC central unit effects the timing of the functioning of glow plugs pre-heating central unit depending on engine temperature, which, in turn, activates the glow plugs.

The preheat centre contains an "intelligent" remote control switch that sends a feed-back to the control centre for information on any preheat centre defect or plug earth shirt circuit.

Preheat centre pin-out

31 - Mass

86 - Start switch (+15)

ST - EDC electronic centre (pin K93)

DI - EDC electronic centre (pin K52)

30 - Battery positive (+30)

G1 - Preheat plugs

G2 - Preheat plugs

G3 - Preheat plugs

G4 - Preheat plugs

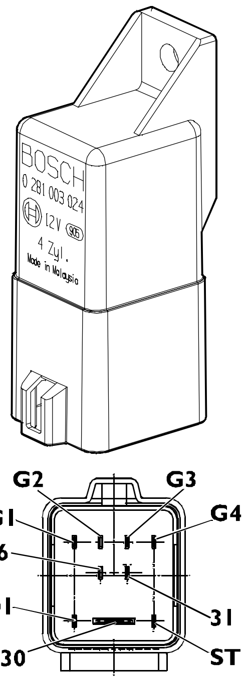
Preheat plugs

CONTROL VALUES

With constant di 11V power supply:

❑ maximum current absorbed	18 A
❑ in 5"	11 ± 1,5 A
❑ in 30"	6 ± 0.9 A
❑ temperature after 7"	850°C
❑ torque	8-10 Nm

Figure 72



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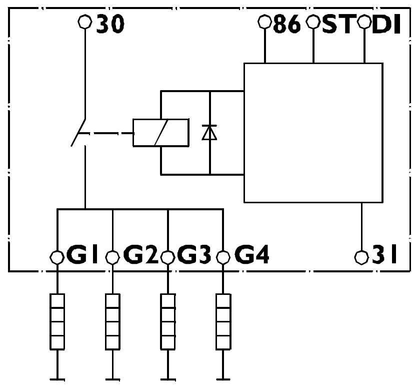
PREHEAT CENTRE

Figure 73



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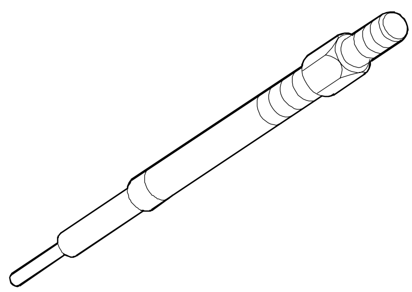
ELECTRICAL DIAGRM

Figure 74



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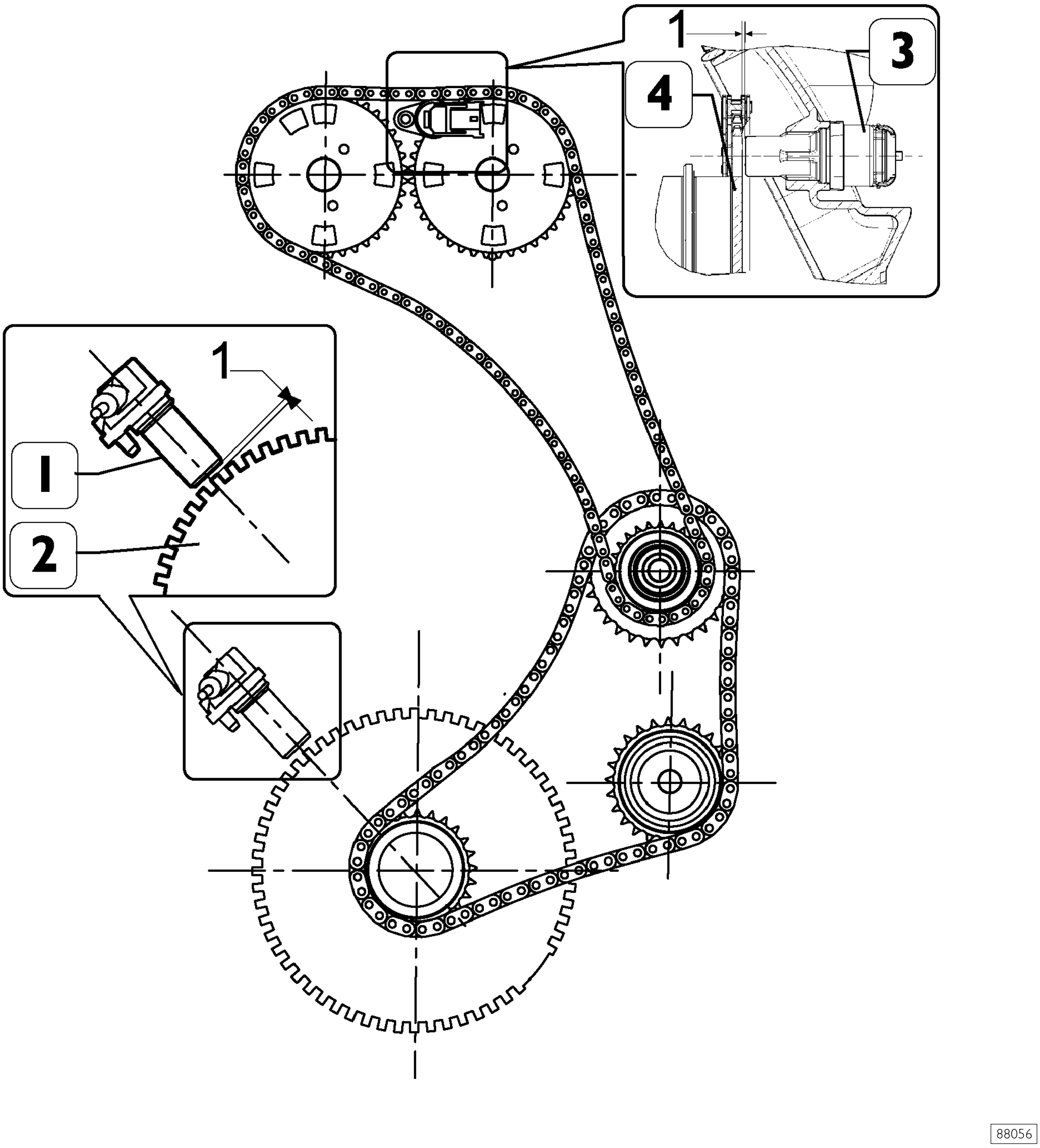
PREHEAT PLUS

R.p.m. / timing sensors (F1C)

Figure 75



1. R.p.m. sensor - 2. Phonic wheel on drive shaft - 3. Timing sensor - 4. Phonic wheel on camshaft

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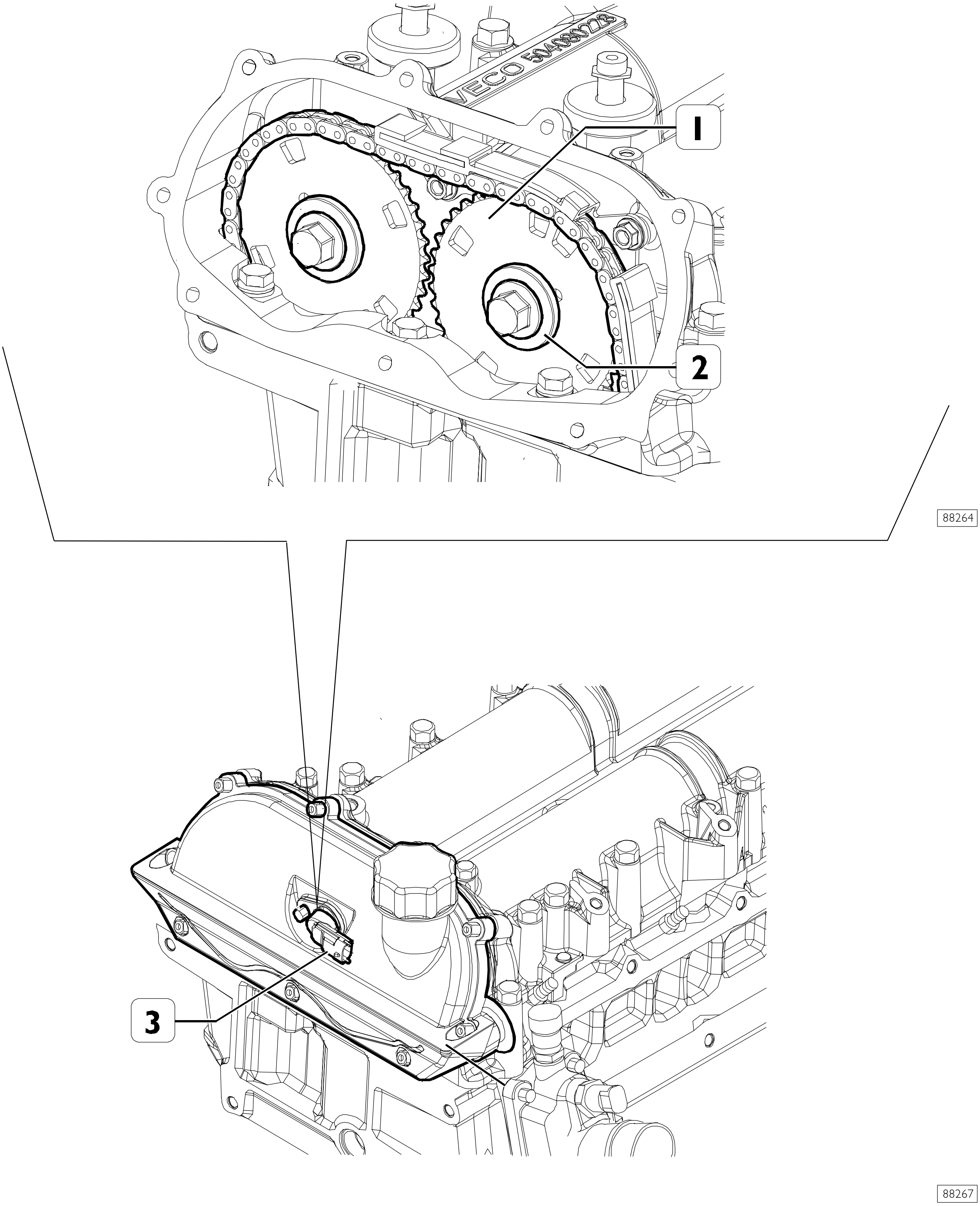
Timing sensor (stroke) (F1C)

Figure 76



1. Phonic wheel on camshaft - 2. Identification slots - 3. Sensor

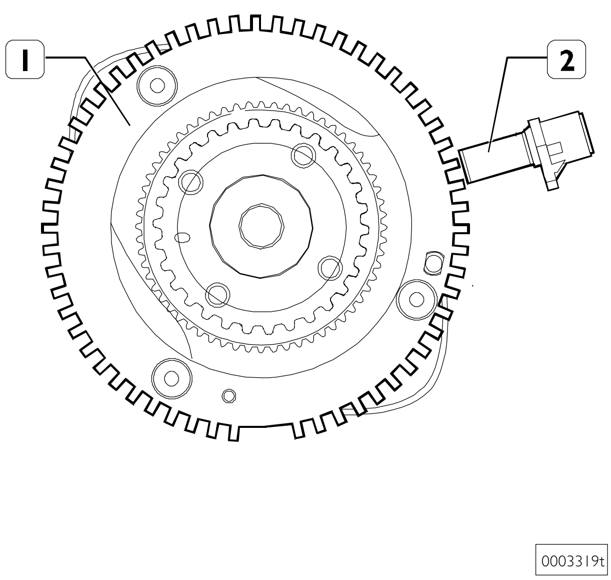
RPM sensor

A phonic wheel is fitted on the drive shaft. As the sensor detects existing teeth passing, it provides the central unit with the signal that is necessary to determine engine r.p.m.'s.

The variation of the signal generated by the lack of some teeth (synchronisation gap) occurring at each drive shaft turn is the reference signal which enables the central unit to detect the lead of the pair of pistons 1-4 with respect to PMS.

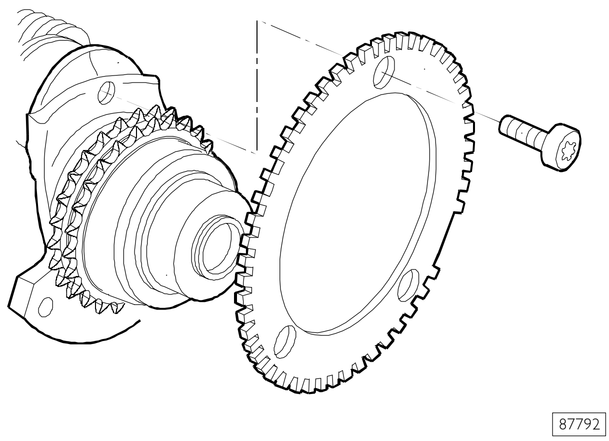
This signal is also used by the control unit to detect the engine rotation speed, the duration of injection and to control the rev counter.

Figure 77



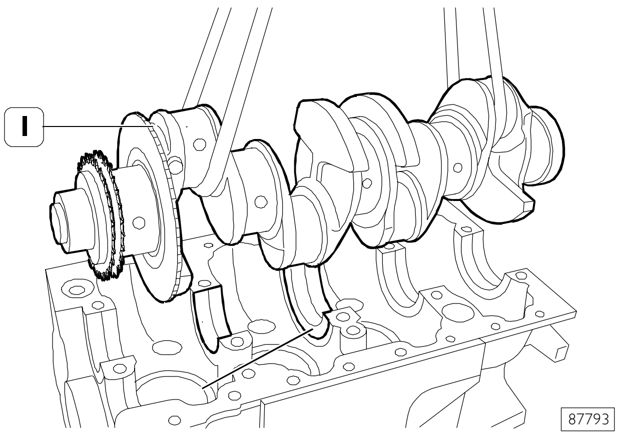
TECHNICAL VIEW OF THE SOUND WHEEL AND SENSOR
1. Sound wheel - 2. Sensor

Figure 78



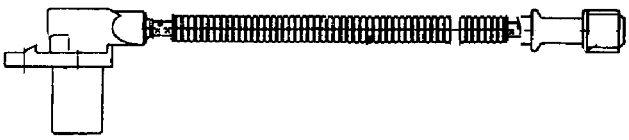
PHONIC WHEEL MOUNTING

Figure 79



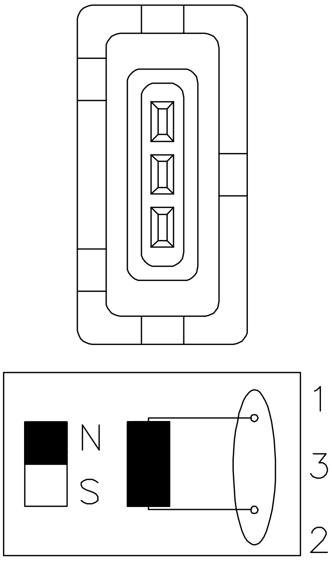
1. Phonic wheel

Figure 80



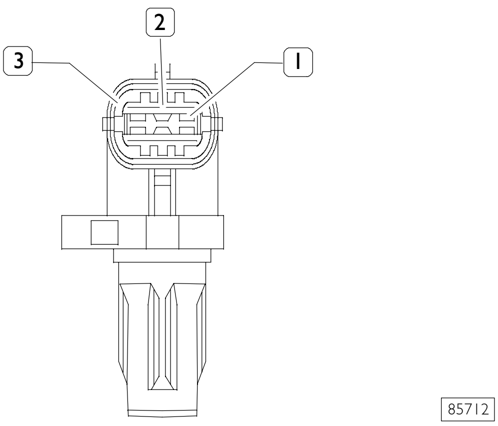
RPM SENSOR AND CONNECTION CABLE

Figure 81



SENSOR CONNECTOR AND WIRING DIRAGRAM

Figure 82



TIMING SENSOR
1. Earth - 2. Signal output - 3. Power supply positive

RPM sensor

These are inductive sensors.

The flywheel sensor (48035) is connected at pins 27 and 12 of connector A of the control unit.

Timing sensor

A semiconductor layer, immersed in a magnetic field and through which current flows, generates a potential difference (called Hall voltage) at its ends.

If current intensity remains constant, the generated voltage depends only on the magnetic field strength: periodical variation of field strength is enough to obtain a modulated electric signal.

The smooth portion of the phonic wheel (distributing shaft pulley) covers, while moving, the sensor, thus blocking the magnetic field with resulting low output signal.

On the contrary, the sensor generates a high signal next to the openings and when a magnetic field is available.

Phase sensor signals are acquired, and the engine position is recognized according to the sequence of the phonic wheel notches.

The mounting function makes it possible to identify signal errors and interferences (if any).

The resulting signal is supplied to the processor that controls the injection system.

The sensor (48042) is connected to the central unit at pins A20/50/11.

Pressure regulator

When the engine control centre pilots the pressure regulator via the PWM signal, solenoid (1) is activated, which in its turn generates movement of magnetic core (2).

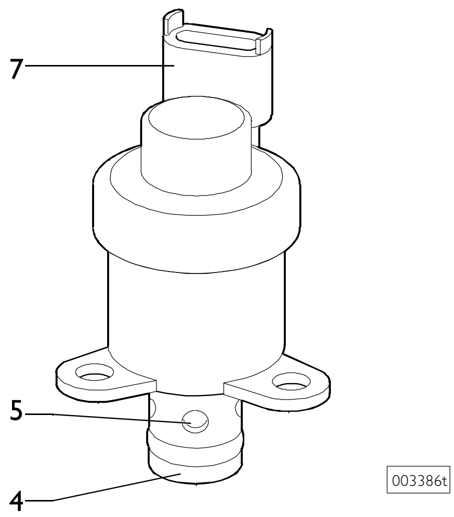
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

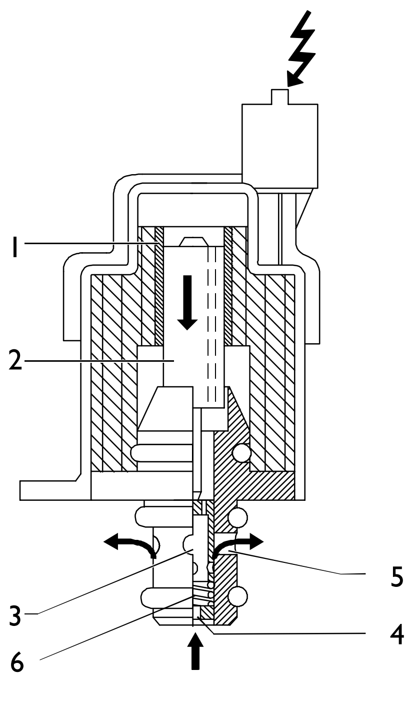
When solenoid (1) is not activated, the magnetic core is moved to its rest position by preload spring (6).

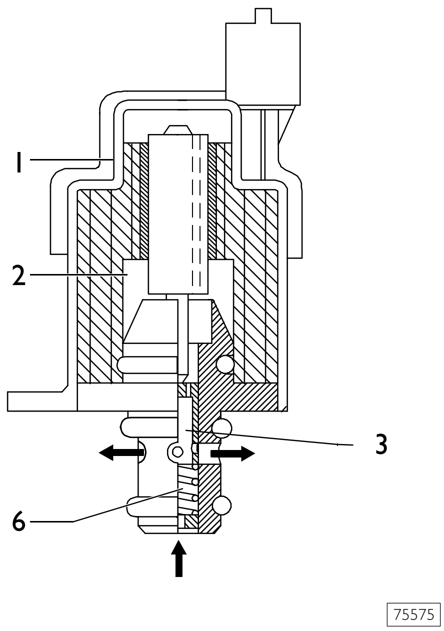
In these conditions, cylinder (3) is in a position to offer maximum fuel passage cross-section.

Control electro valve 78013 is connected to centre connector A pins 19 and 49.

Figure 83







1. Solenoid - 2. Magnetic core - 3. Cylinder - 4. Fuel input - 5. Fuel output - 6. Preloiad spring - 7. Connector

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Rail (pressure accumulator) F1C

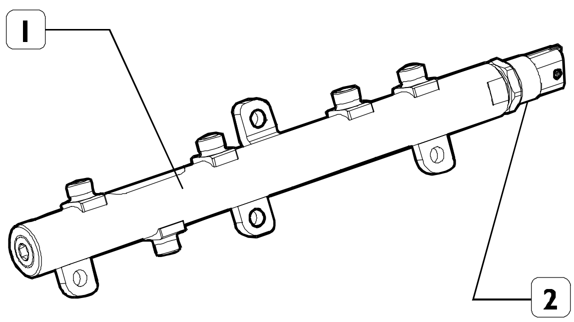
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

By its volume, it damps fuel pressure oscillations owing to:

- high-pressure pump operation
- electro injector opening.

On hydraulic accumulator there is located the fuel pressure sensor.

Figure 84

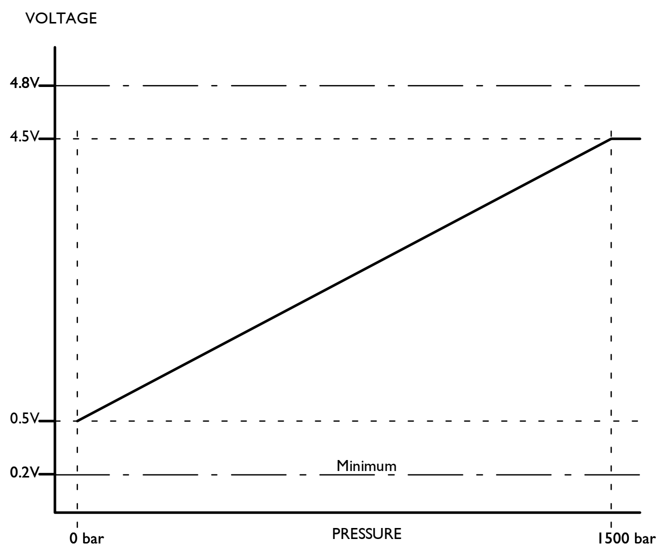


1. Rail - 2. Pressure sensor

Pressure sensor

Fitted to a rail end, it measures fuel pressure present to the purpose of determining existing fuel pressure. Pressure value is used to control pressure and determine injection electric control duration (85157).
It is connected to the central unit at pins A 8/43/28. It is fed at 5 V.

Figure 85



PRESSURE LIMITER OPERATING GRAPH

Air temperature/pressure sensor

This component incorporates a temperature sensor and a pressure sensor (85156).

It is fitted on the engine intake manifold and measures the maximum flow rate of the intake air which is used to accurately calculate the amount of fuel to be injected at each cycle.

It is connected to the central unit on connector "A".

Pin 1 sensor - Pin A23	-	earth -
Pin 2 sensor - Pin A53	-	temperature signal
Pin 3 sensor - Pin A13	-	5V - supply -
Pin 4 sensor - Pin A40	-	0 ÷ 5V pressure signal

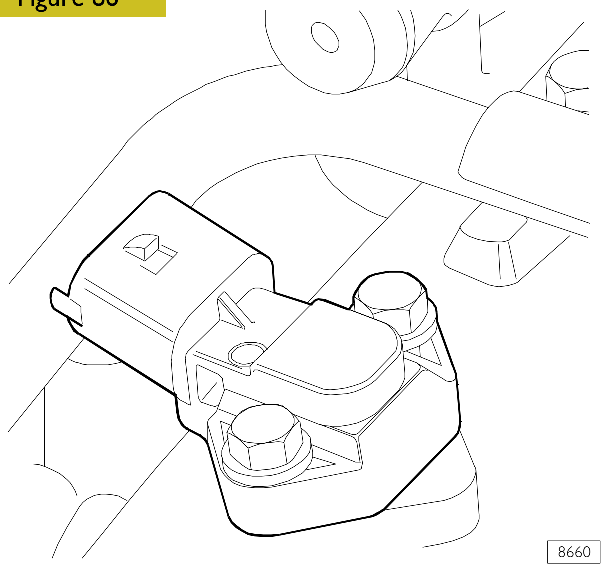
Course of sensor in relation to the temperature

Temperature	Resistance
- 40 °C	48.50 kOhm
- 20 °C	15.67 kOhm
0 °C	5.86 kOhm
20 °C	2.50 kOhm
40 °C	1.17 kOhm
60 °C	0.59 kOhm
80 °C	0.32 kOhm
100 °C	0.18 kOhm
120 °C	0.11 kOhm

Course of sensor in relation to the pressure:

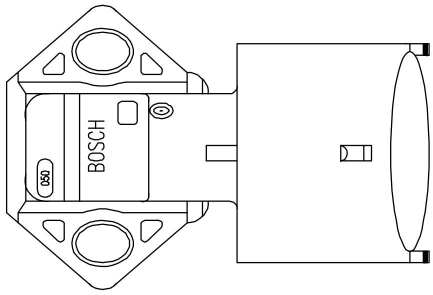
See graph opposite.

Figure 86



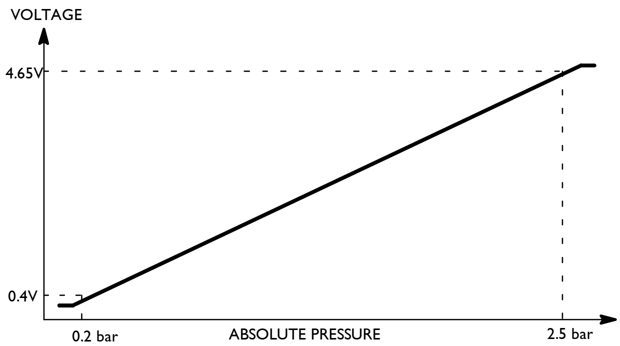
AIR FLOW METER

Figure 87



AIR FLOW METER CONNECTION

Figure 88



AIR FLOW METER OPERATING GRAPH

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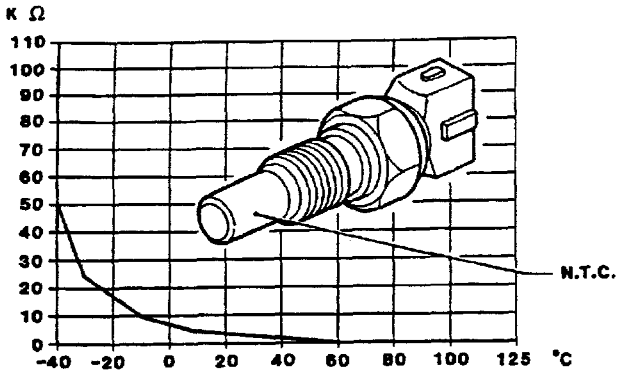
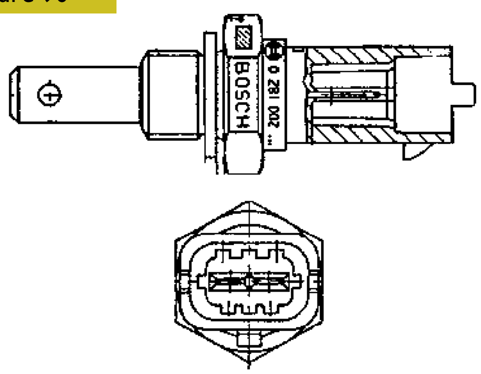
Figure 89



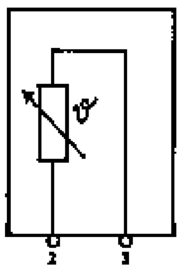
COURSE OF SENSOR RESISTANCE IN RELATION TO TEMPERATURE

Figure 90



TECHNICAL VIEW OF ENGINE COOLANT TEMPERATURE SENSOR

Figure 91



NTC

WIRING DIAGRAM

Atmospheric pressure sensor

This is integrated inside the control unit.

It measures the atmospheric pressure to correct the flow rate in relation to the altitude.

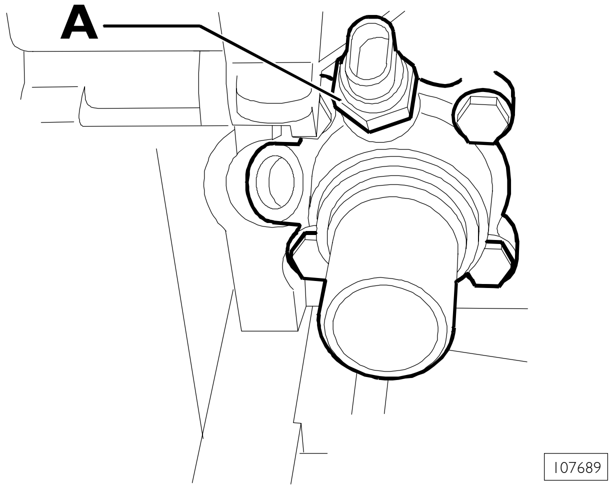
Engine coolant temperature sensor

This is an NTC sensor located on the thermostat box.

It detects the temperature of the coolant fluid to give the control unit information about the engine temperature conditions.

The same signal is used (via CAN lines) to control the instrument cluster where the gauge is present.

Figure 92



A. Temperature sensor

Fuel temperature sensor

This is an NTC sensor located on the fuel filter.

It detects the temperature of the fuel to give the control unit information about the fuel oil temperature conditions.

It is connected to pins 52 and 51 of connector A of the control unit.

Injectors

The solenoid valve controls the lift of the atomiser needle.

On the fuel inlet union a filter protects the injector for impurities. The injector is constructively the same as conventional ones, except that there is no needle return spring.

Access to the injectors is gained by releasing the side soundproof cover from the cylinder head. The fuel recovery pipe has a quick coupling.

The injector comprises two parts:

- actuator - atomiser composed of pressure rod (1), pin (2) and nozzle (3)
- control solenoid valve comprising a coil (4) and drive valve (5).

1st phase: rest position

The coil (4) is not activated and the shutter (6) is in the closed position.

The same fuel pressure acts in both the control area (7) and in the pressure chamber (8), but as the shutter (6) is closed, the needle (2) cannot be raised.

2nd phase: start of injection

The coil (4) is energised and causes the shutter (6) to move upwards.

The fuel of the control volume (9) flows towards the backflow duct (10) causing a drop in the pressure in the control area (7).

At the same time, the pressure of the fuel in the pressure chamber (8) causes the needle (2) to rise, resulting in fuel injection to the cylinder.

3rd phase: end of injection

The coil (4) is not activated and makes the shutter (6) return to the closed position, which re-creates a balance of forces that makes the needle (2) return to the closed position and consequently end injection.

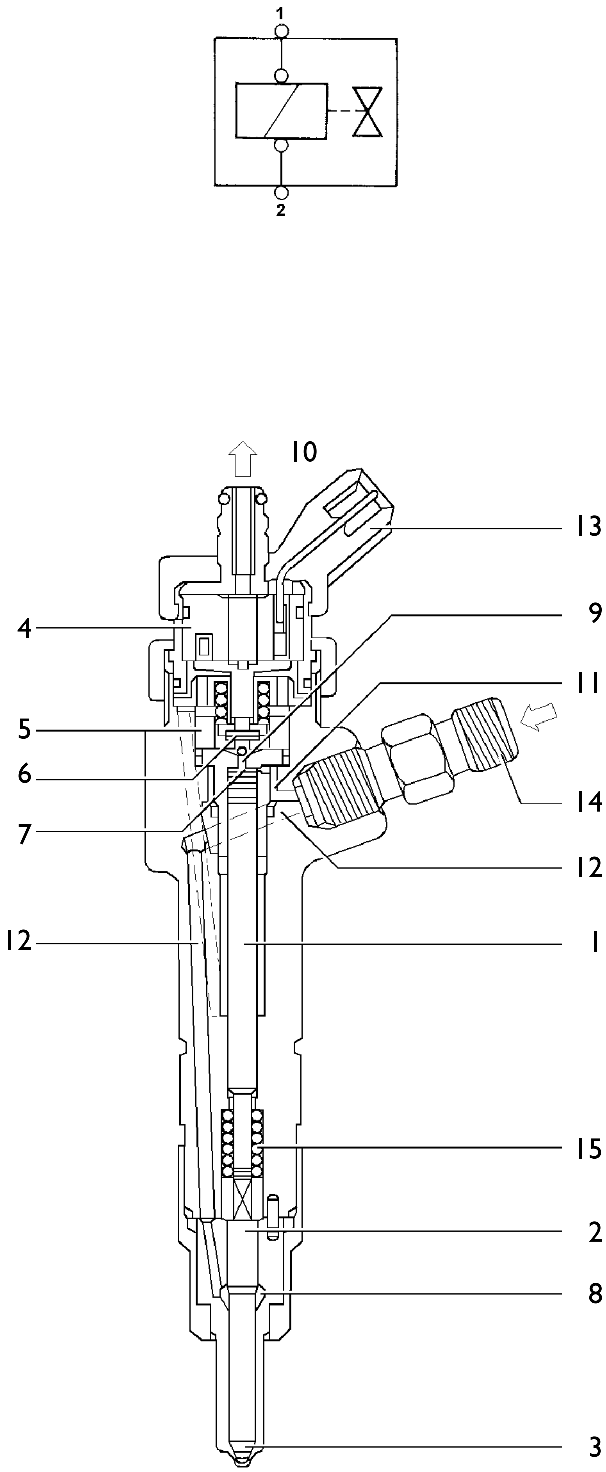
Injectors (78247)

The solenoid valve is of the N.C. type.

The injectors are connected individually to the control unit at the following pins:

- A16 / A47 cylinder 1 injector
- A2 / A31 cylinder 2 injector
- A1 / A46 cylinder 3 injector
- A17 / A33 cylinder 4 injector

Figure 93



INJECTOR WIRING DIAGRAM AND CROSS SECTION
1. Pressure rod - 2. Needle - 3. Nozzle - 4. Coil - 5. Pilot valve - 6. ball shutter - 7. control area - 8. pressure chamber - 9. Control volume - 10. Backflow duct - 11. Control duct - 12. Supply duct - 13. Electrical connection - 14. High pressure fuel inlet - 15. Spring

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Electromagnetic junction fan

The fan is provided with an electromagnetic junction monitored by the electronic centre pin A39 that activated the junction remote control switch, to optimise water cooling.

The electrical fan remote control switch is activated or deactivated by the centre according to the temperature of:

- the coolant
- over supply air
- the fuel

Engine coolant temperature

Activated at over 96 °C and deactivated at under 84 °C

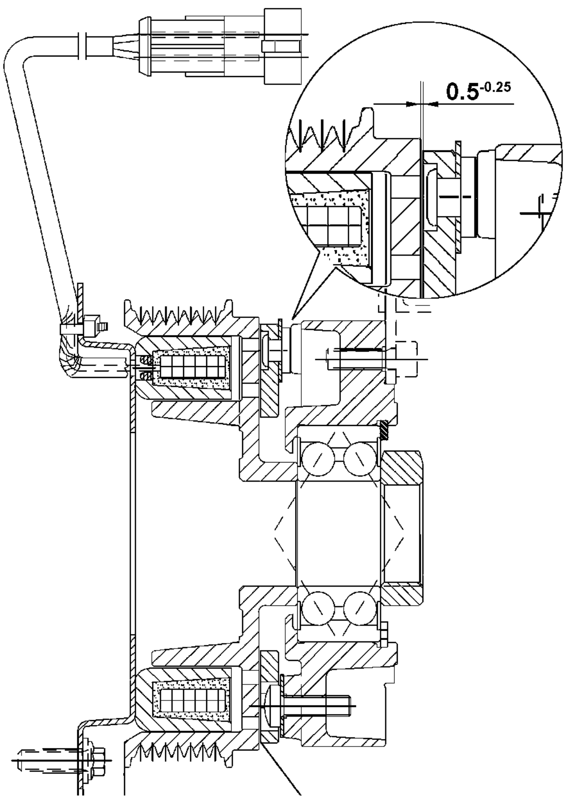
Over supply air temperature

Activated at over 75 °C and deactivated at under 65 °C

Fuel temperature

Activated at over 20 °C and deactivated at under 10 °C

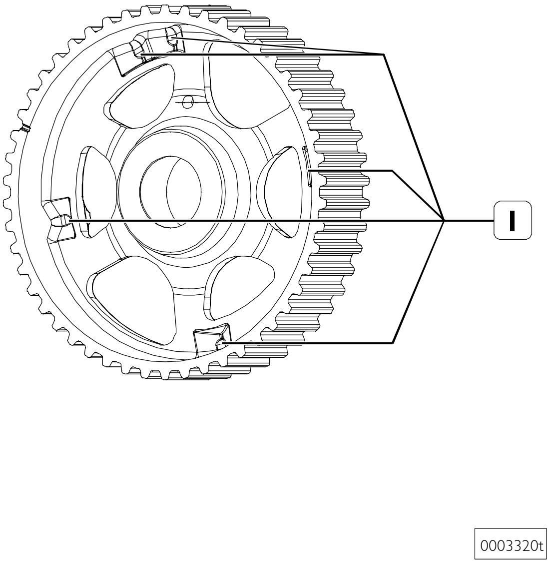
Figure 94



88064

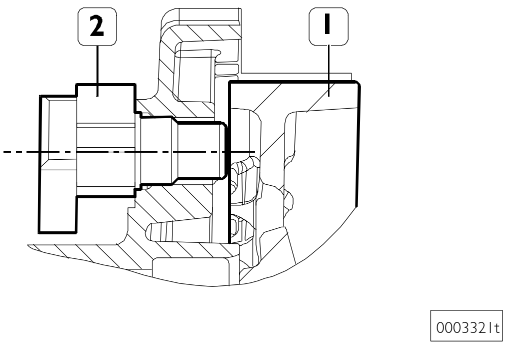
ELECTROMAGNETIC JUNCTION TECHNICAL VIEW
1. Coil - 2. Connector

Figure 95



1. Phase identification holes

Figure 96



1. Distributing shaft pulley - 2. Sensor

Camshaft sensor (F1A) 48042

A semiconductor layer, immersed in a magnetic field and through which current flows, generates a potential difference (called Hall voltage) at its ends.

If current intensity remains constant, the generated voltage depends only on the magnetic field strength: periodical variation of field strength is enough to obtain a modulated electric signal.

The smooth portion of the phonic wheel (distributing shaft pulley) covers, while moving, the sensor, thus blocking the magnetic field with resulting low output signal.

On the contrary, the sensor generates a high signal next to the openings and when a magnetic field is available.

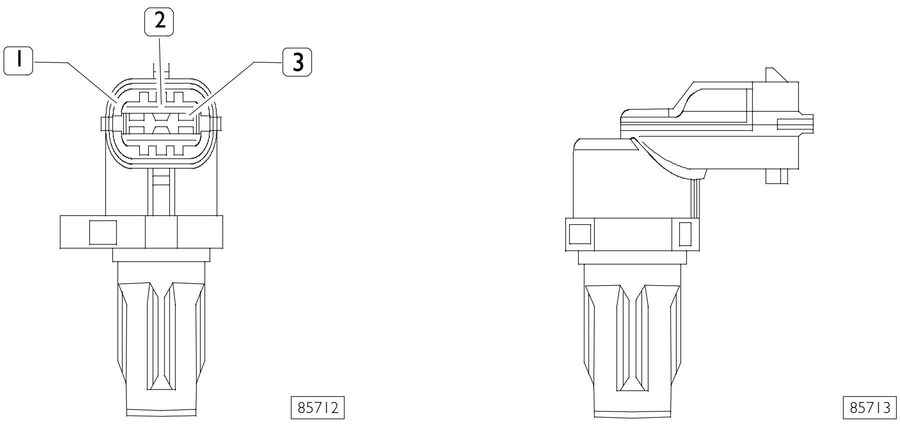
Phase sensor signals are acquired, and the engine position is recognized according to the sequence of the phonic wheel notches.

The mounting function makes it possible to identify signal errors and interferences (if any).

The resulting signal is supplied to the processor that controls the injection system.

It is connected to PINs A20, A50, A11 of central unit EDC16.

Figure 97



PERSPECTIVE VIEW
1. Power supply positive - 2. Signal output - 3. Earth

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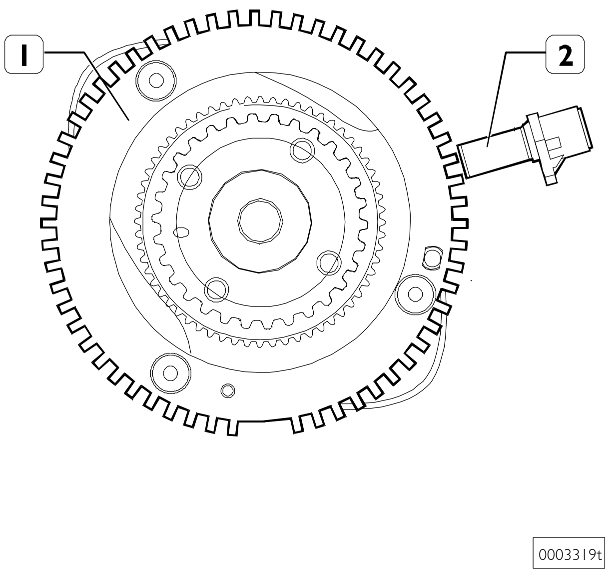
Flywheel and rpm sensor

The F1A engine crankshaft sensor features a slatted sound wheel on the crankshaft front.

This features 58 (60-2) teeth and the sensor detects their passage.

Figure 98



TECHNICAL VIEW OF THE SOUND WHEEL AND SENSOR
1. Sound wheel – 2. Crankshaft sensor

Characteristics of flywheel rpm and timing system sensors

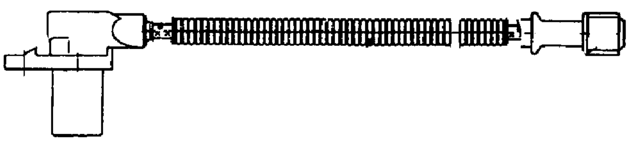
These are inductive sensors.

The flywheel sensor (48035) is connected at pins 27 and 12 of connector A of the control unit.

It is also used to control the electronic rev counter on the instrument cluster.

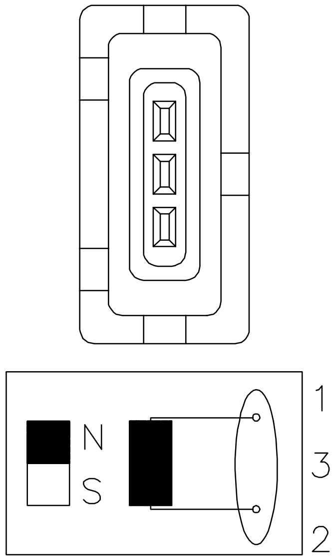
The resistance at 20 °C is approx. ~ 860 Ohm.

Figure 99



SENSOR AND CONNECTION CABLE

Figure 100



SENSOR CONNECTOR AND WIRING DIRAGRAM

Pressure regulator

When the engine control centre pilots the pressure regulator via the PWM signal, solenoid (1) is activated, which in its turn generates movement of magnetic core (2).

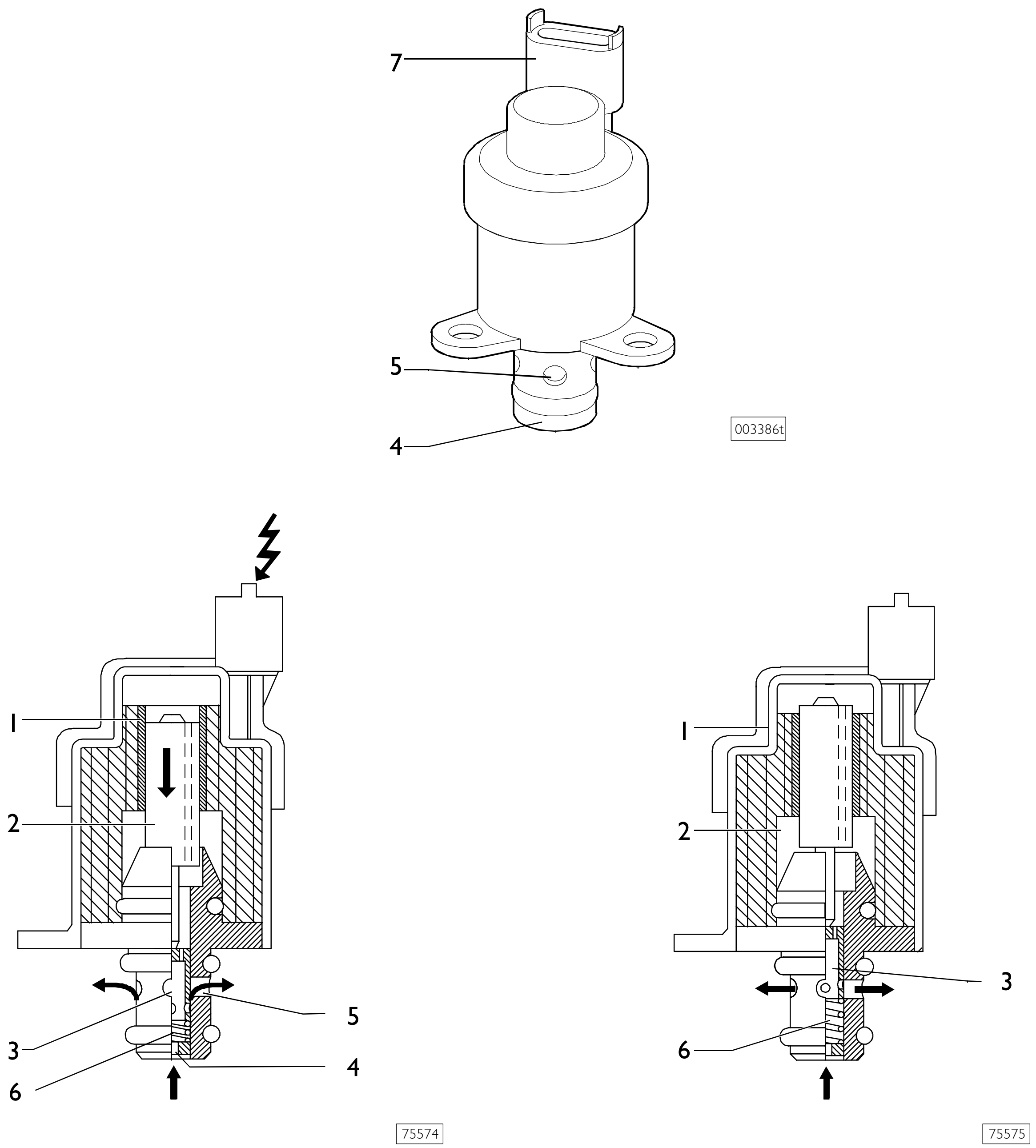
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

When solenoid (1) is not activated, the magnetic core is moved to its rest position by preload spring (6).

In these conditions, cylinder (3) is in a position to offer maximum fuel passage cross-section.

Control electro valve 78013 is connected to centre connector A pins 19 and 49.

Figure 101



1. Solenoid - 2. Magnetic core - 3. Cylinder - 4. Fuel input - 5. Fuel output - 6. Preloaid spring - 7. Connector

Rail (pressure accumulator) F1A

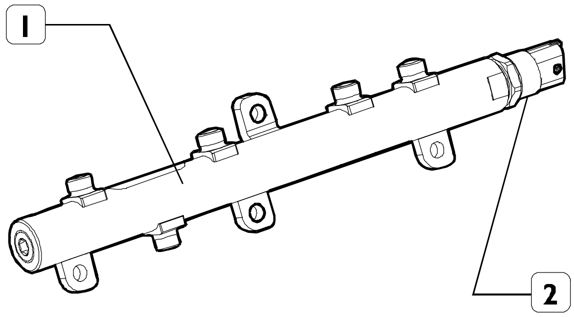
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

By its volume, it damps fuel pressure oscillations owing to:

- high-pressure pump operation
- electro injector opening.

On hydraulic accumulator there is located the fuel pressure sensor.

Figure 102

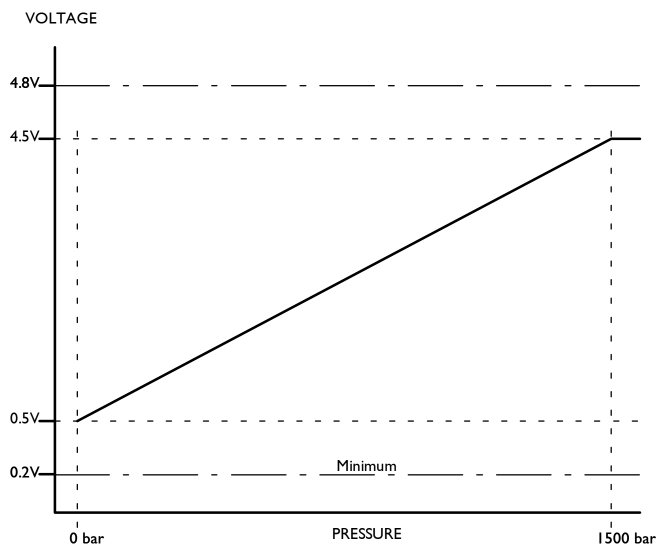


1. Rail - 2. Pressure sensor

Pressure sensor

Fitted to a rail end, it measures fuel pressure present to the purpose of determining existing fuel pressure. Pressure value is used to control pressure and determine injection electric control duration (85157).
It is connected to the central unit at pins A 8/43/28. It is fed at 5 V.

Figure 103



PRESSURE LIMITER OPERATING GRAPH

Injectors

The solenoid valve controls the lift of the atomiser needle.

On the fuel inlet union a filter protects the injector for impurities. The injector is constructively the same as conventional ones, except that there is no needle return spring.

Access to the injectors is gained by releasing the side soundproof cover from the cylinder head. The fuel recovery pipe has a quick coupling.

The injector comprises two parts:

- actuator - atomiser composed of pressure rod (1), pin (2) and nozzle (3)
- control solenoid valve comprising a coil (4) and drive valve (5).

1st phase: rest position

The coil (4) is not activated and the shutter (6) is in the closed position.

The same fuel pressure acts in both the control area (7) and in the pressure chamber (8), but as the shutter (6) is closed, the needle (2) cannot be raised.

2nd phase: start of injection

The coil (4) is energised and causes the shutter (6) to move upwards.

The fuel of the control volume (9) flows towards the backflow duct (10) causing a drop in the pressure in the control area (7).

At the same time, the pressure of the fuel in the pressure chamber (8) causes the needle (2) to rise, resulting in fuel injection to the cylinder.

3rd phase: end of injection

The coil (4) is not activated and makes the shutter (6) return to the closed position, which re-creates a balance of forces that makes the needle (2) return to the closed position and consequently end injection.

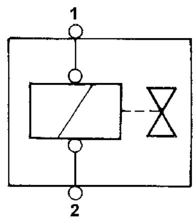
Injectors (78247)

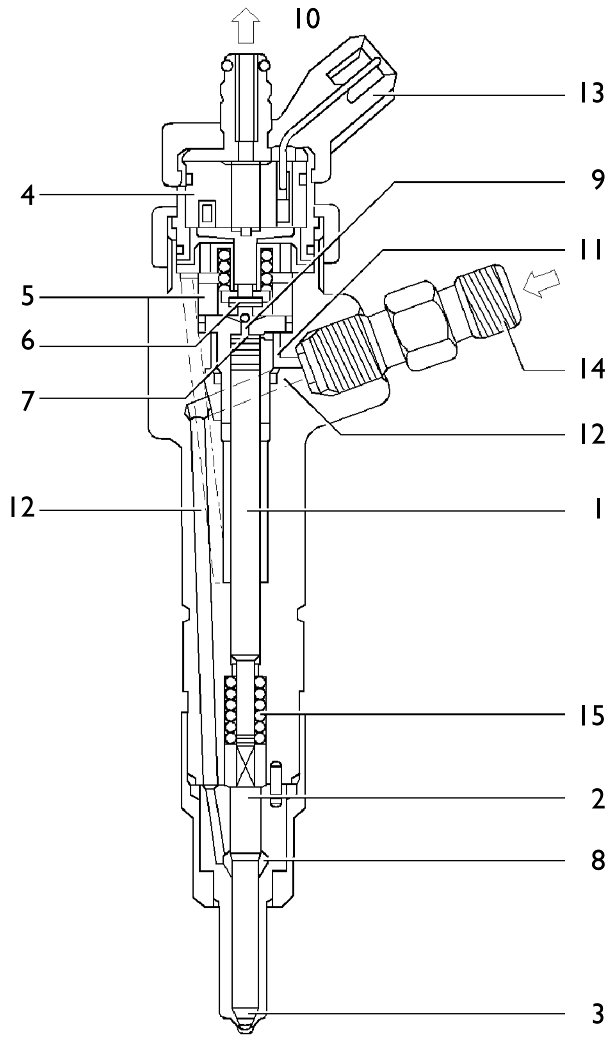
The solenoid valve is of the N.C. type.

The injectors are connected individually to the control unit at the following pins:

- A16 / A47 cylinder 1 injector
- A2 / A31 cylinder 2 injector
- A1 / A46 cylinder 3 injector
- A17 / A33 cylinder 4 injector

Figure 104





INJECTOR WIRING DIAGRAM AND CROSS SECTION
1. Pressure rod - 2. Needle - 3. Nozzle - 4. Coil - 5. Pilot valve - 6. Ball shutter - 7. Control area - 8. Pressure chamber - 9. Control volume - 10. Backflow duct - 11. Control duct - 12. Supply duct - 13. Electrical connection - 14. High pressure fuel inlet - 15. Spring

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Air temperature / pressure meter

This component incorporates a temperature sensor and a pressure sensor.

It is fitted on the engine intake manifold (Figure 107) and measures the maximum flow rate of the intake air which is used to accurately calculate the amount of fuel to be injected at each cycle.

It is connected to the control unit on pins A2 / A3 / A19 / A34.

Pin 1 sensor - Pin A23 ECU	-	earth -
Pin 2 sensor - Pin A53 ECU	-	temperature signal
Pin 3 sensor - Pin A13 ECU	-	5V - supply
Pin 4 sensor - Pin A40 ECU	-	0 ÷ 5V pressure signal -

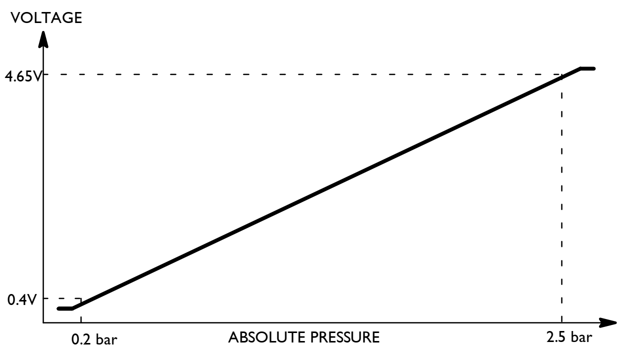
Course of sensor in relation to the temperature:

Temperature	Resistance
- 40 °C	48.50 kOhm
- 20 °C	15.67 kOhm
0 °C	5.86 kOhm
20 °C	2.50 kOhm
40 °C	1.17 kOhm
60 °C	0.59 kOhm
80 °C	0.32 kOhm
100 °C	0.18 kOhm
120 °C	0.11 kOhm

Course of sensor in relation to the pressure:

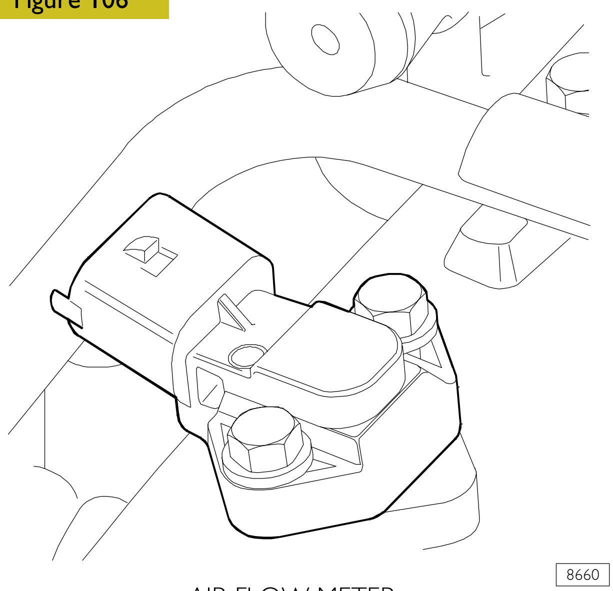
See graph opposite.

Figure 105



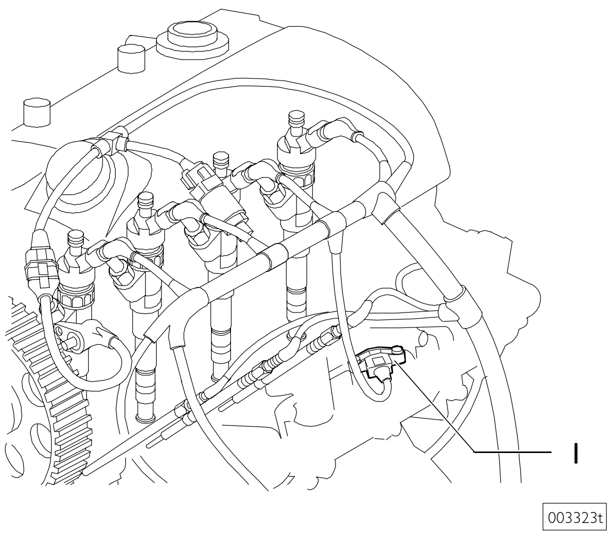
AIR FLOW METER OPERATING GRAPH

Figure 106



AIR FLOW METER

Figure 107



1. Air flow meter location

Electromagnetic junction fan

The fan is provided with an electromagnetic junction monitored by the electronic centre pin A39 that activated the junction remote control switch, to optimise water cooling.

The electrical fan remote control switch is activated or deactivated by the centre according to the temperature of:

- the coolant
- over supply air
- the fuel

Engine coolant temperature

Activated at over 96 °C and deactivated at under 84 °C

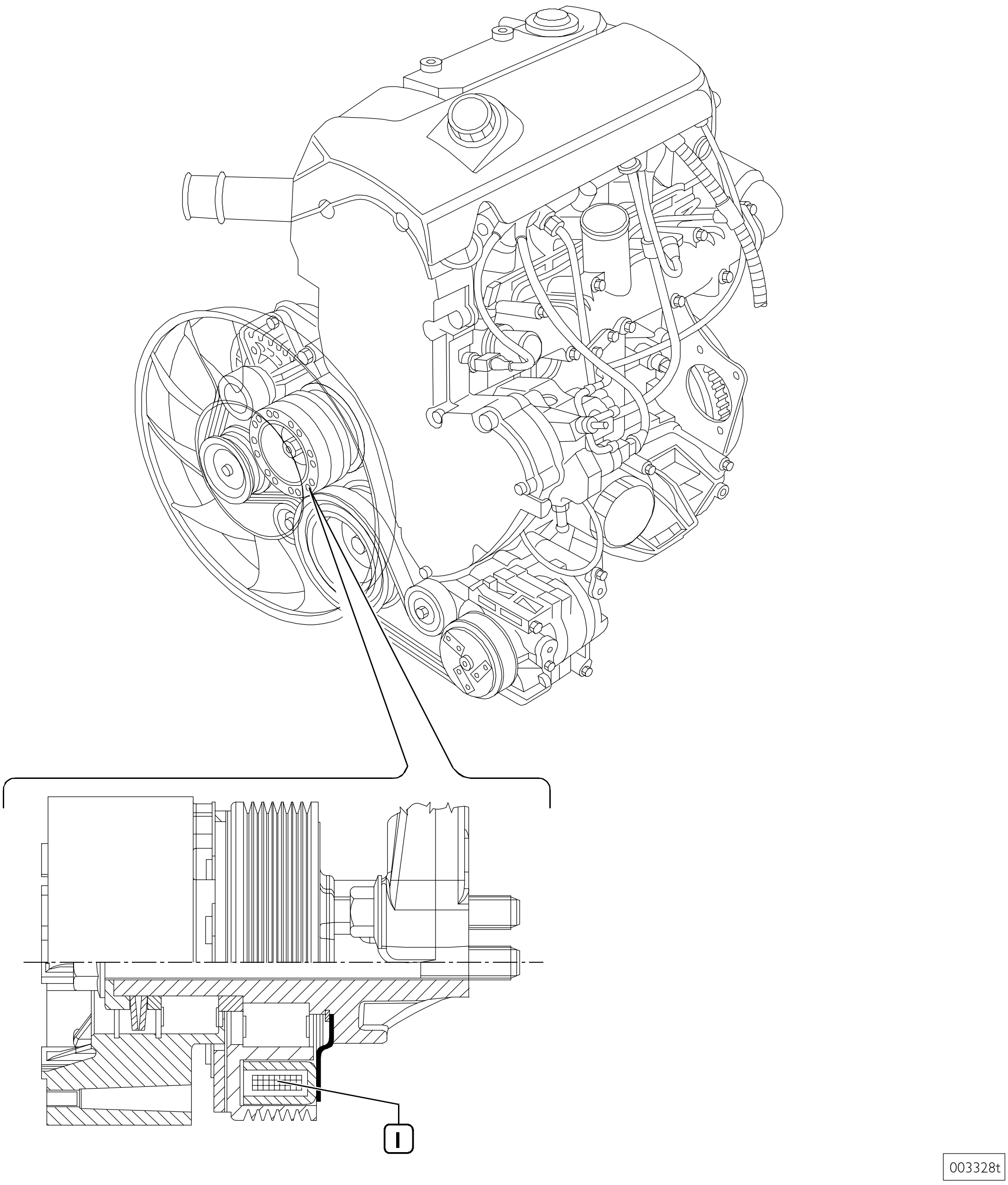
Over supply air temperature

Activated at over 75 °C and deactivated at under 65 °C

Fuel temperature

Activated at over 20 °C and deactivated at under 10 °C

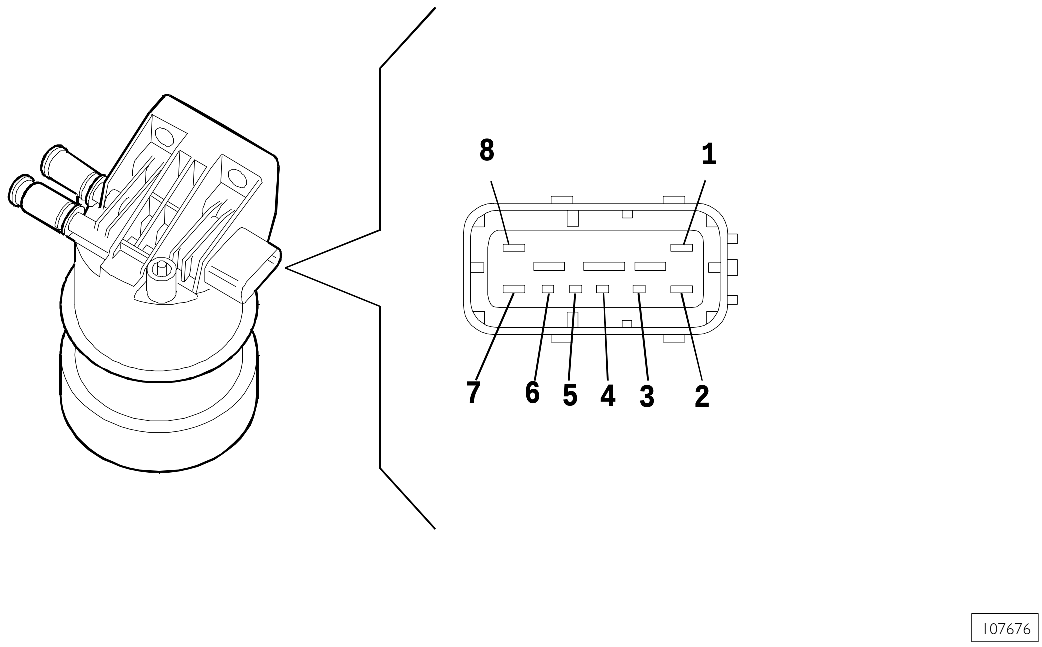
Figure 108



ELECTROMAGNETIC JUNCTION TECHNICAL VIEW0 (F1A)
1. Coil

FUEL FILTER

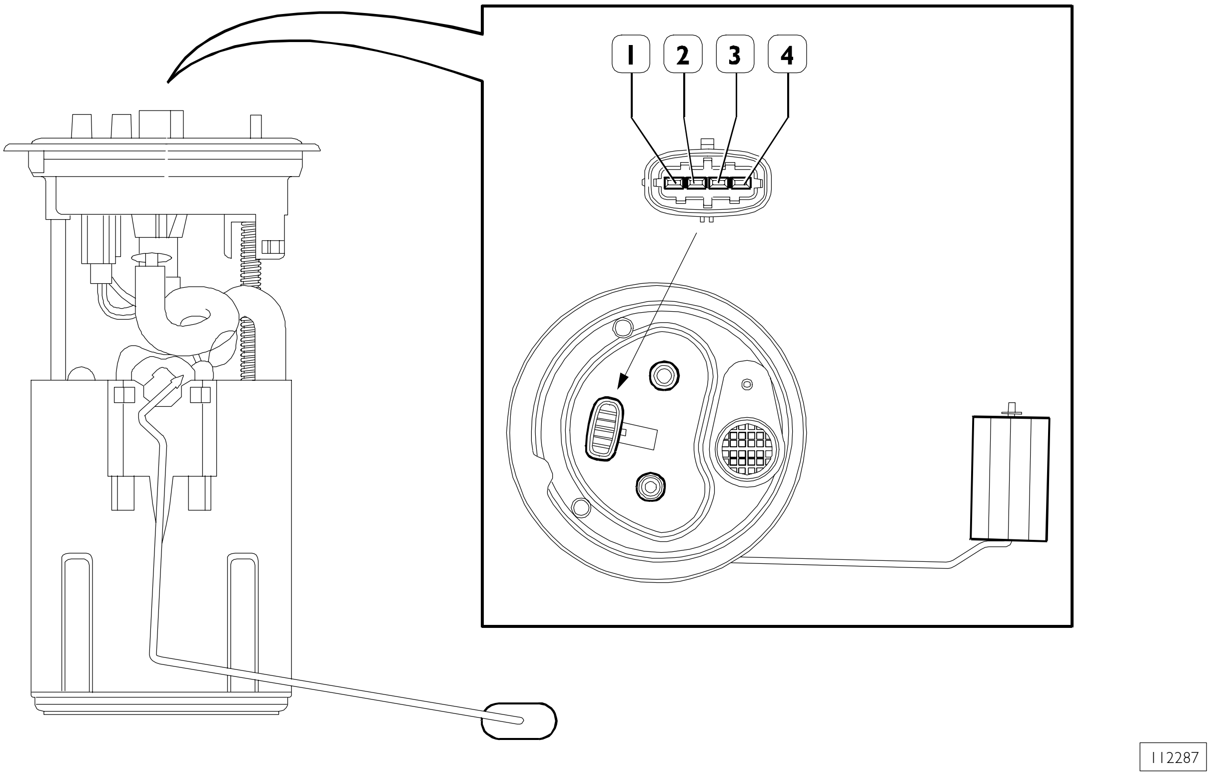
Figure 109



1. Positive for power supply - 2. Heater - 3. Water present sensor - 4. Filter clogged sensor - 5. Fuel temperature sensor - 6. Fuel temperature sensor - 7. Earth for heater - 8. Earth

FUEL PUMP / FUEL LEVEL

Figure 110



1. Level sensor - 2. Level sensor - 3. Negative for fuel pump - 4. Positive for fuel pump

ABS 8/ESP 8

The ABS 8 system integrates the following functions:

- ABS - Antilock Braking System
  It prevents wheels from being locked during braking, thus making it possible to avoid possible obstacles.
  It prevents losing control of the vehicle when braking on a slippery surface (even on one side only → mu-split).
  It also reduces the braking distance compared with the one with the wheels locked.
- EBD - Electronic Brake Force distribution
  It supersedes and optimizes the function of current hydraulic brake correctors, by better controlling the braking force on rear wheels.
  It is implemented by adding a special software to the ABS, and comes into action within a given time interval prior to ABS actuation.
  It makes it possible to control any locking condition affecting the rear wheels compared with the front wheels, by optimizing the braking force under different load, running and vehicle utilization conditions.

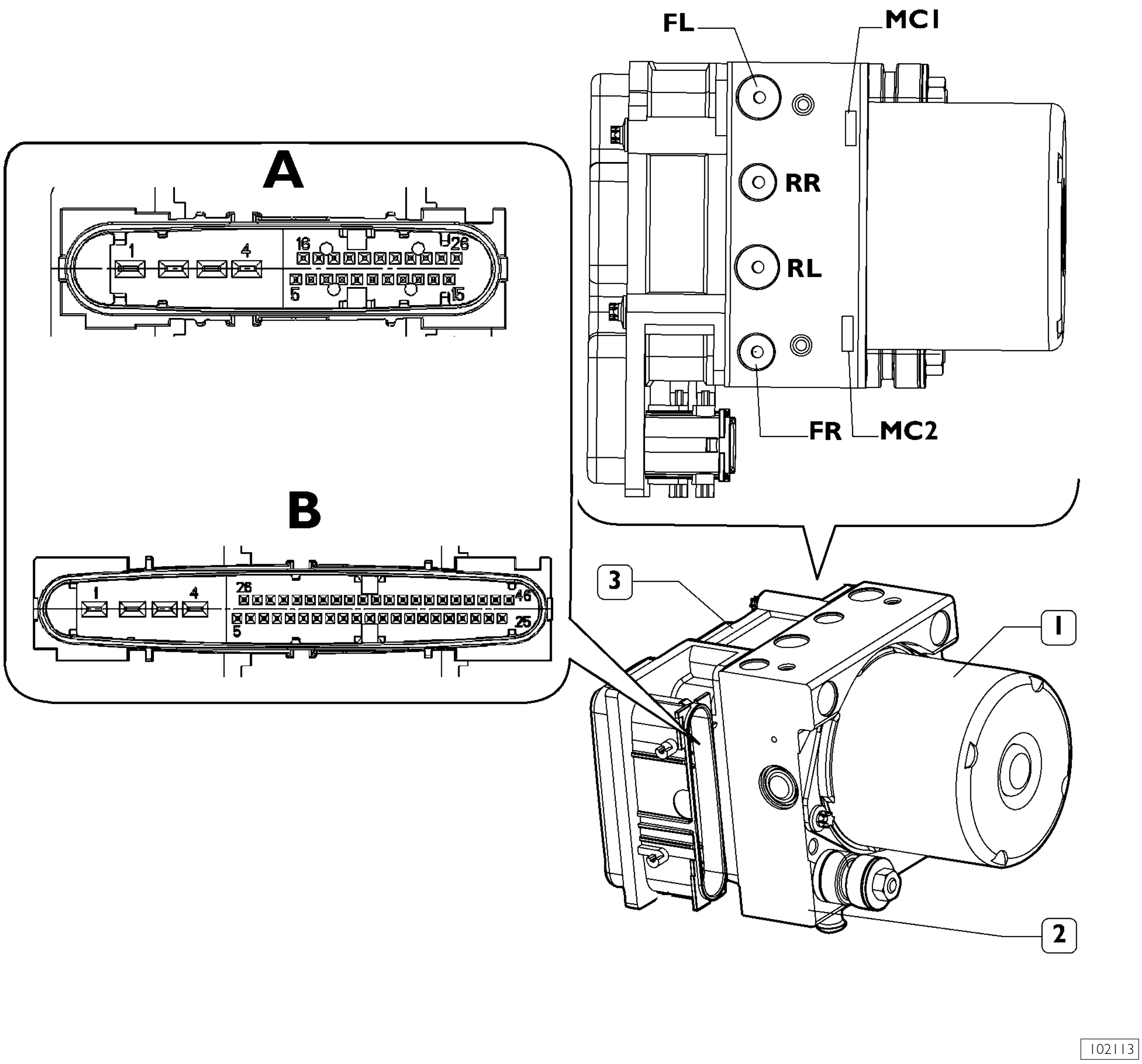
The ESP 8 system, in addition to the EBS 8 system, incorporates the following functions:

- ESP - Electronic Stability Program
  It monitors the vehicle behaviour continuously (both along straight stretches and bends, when braking or accelerating).
  It also monitors the driver's actions: steering the wheel, pressing the brake pedal, accelerator position, and speed.
  It is always active in the background, i.e. the ESP system compares the actual vehicle ride with the driver's desired ride 50 times a second. It recognizes dangerous situations before the driver does.
  The system considers the different possibilities of coming into operation. It brakes on every single wheel separately.
  It operates on the engine control system.
- ASR – Acceleration drive control device
  This system prevents driving wheel skid through quick action on the engine and brakes. It allows the vehicle to set off safely and fast even on slippery roads or when one driving wheel is skidding. It also reduces the risk of understeering when you accelerate too much when cornering.
- MSR – Engine braking torque control
  This system avoids driving wheel drag due to the exhaust brake. It ensures vehicle stability when releasing on slippery roads (e.g. snow, ice), and assists in keeping the path when cornering and shifting down, especially on slippery roads. It requires a slight increase of revs number, through the CAN line.
- HHC – Hill holder control
  This function allows the vehicle to be kept automatically locked (braked) until the clutch is closed and the driver subsequently presses the accelerator pedal, thus preventing undesired vehicle motion.
  The function is actuated automatically: the braking situation is detected by the sensor inside the modulator. When the brake pedal is released, the vehicle will be kept for 2.5 seconds, thus allowing the driver/system to put the gear (and the vehicle to be started). This ensures safe, easy start with any incline, regardless of the weight carried.
- HBA (Hydraulic Brake Assistant) – Hydraulic assistant in emergency braking
  The main feature of the HBA function is to recognize an emergency braking situation followed by "automatic" increase of vehicle deceleration.
  Vehicle deceleration is only restricted to actuation of ABS control, thus taking the greatest advantage of the grip between the tyre and the roadbed currently available. Therefore, ordinary drivers can now achieve braking distances which only experienced drivers could achieve in the past.
  If the driver reduces the braking intensity, vehicle deceleration is reduced depending on the reduction of the force applied onto the pedal.
  Therefore, the driver can control deceleration accurately after overcoming the emergency situation.
  The extent of the braking request from the driver corresponds to the force applied onto the pedal. Such force is derived from measuring the pressure in the brake pump.

Four crossed channel system (x)

Electro-hydraulic modulator/control unit

Figure 111



1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - MC1. LF/RR diagonal power supply (or FL/RR with ABS8/ESP8 systems) - MC2. RF/LR diagonal power supply (or FR/RL with ABS8/ESP8 systems) - LF (or FL with ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR with ABS8/ESP8 systems). Right front axle output - LR (or RL with ABS8/ESP8 systems). Left rear axle output

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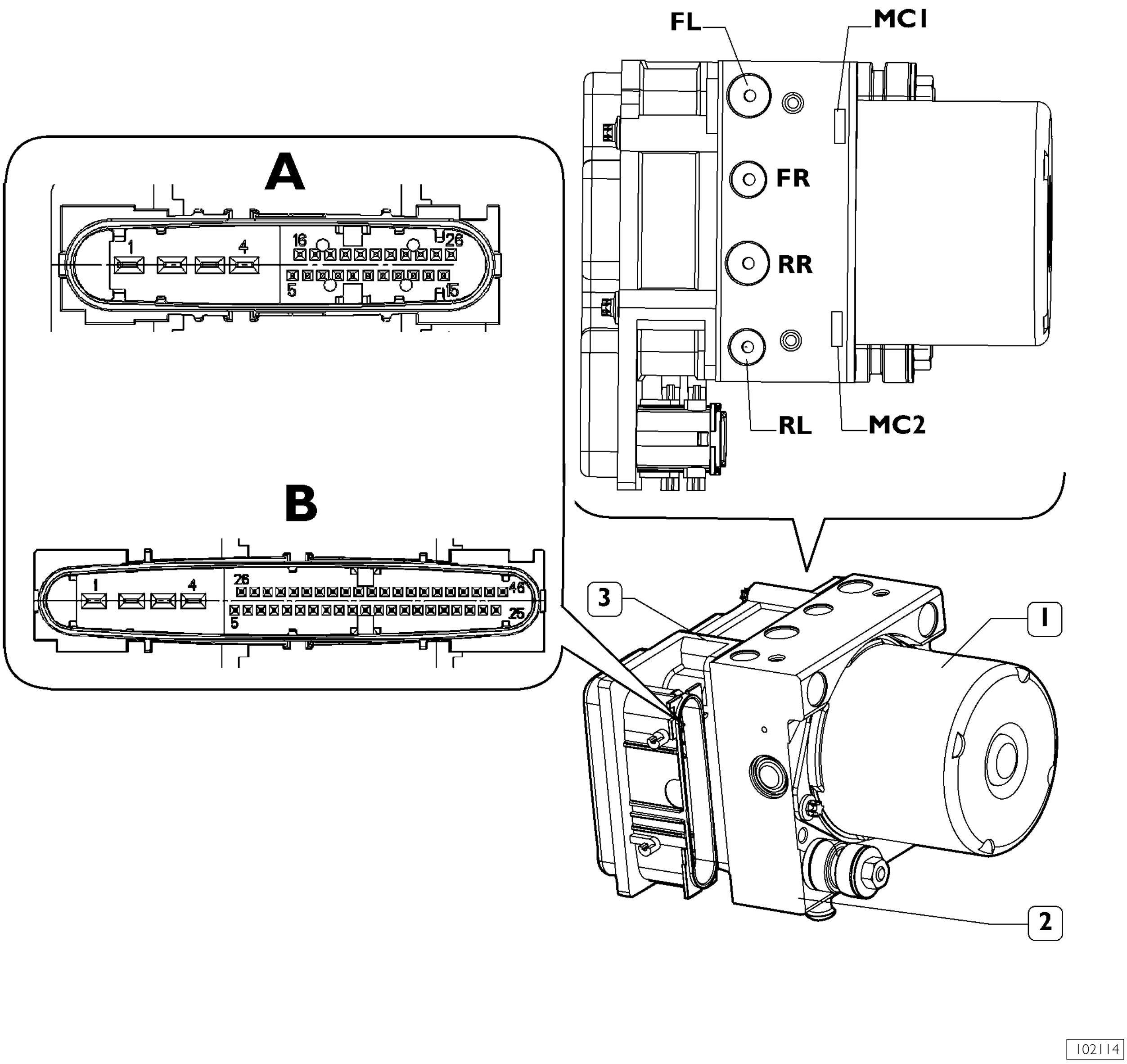
Four parallel channel system (II)

Electro-hydraulic modulator/control unit

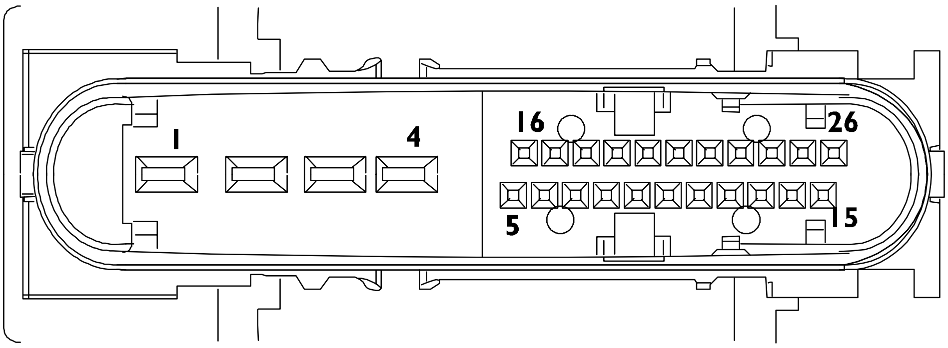
Figure 112



1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - MC1. Front axle power supply - MC2. Rear axle power supply - LF (or FL with ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR with ABS8/ESP8 systems). Right front axle output - LR (or RL with ABS8/ESP8 systems). Left rear axle output

ABS 8 control unit PIN OUT (X - crossed channels, II - parallel channels)

Figure 113



Pin (X)	Pin (II)	Function	Cable
1	1	Earth	0000
2	2	Positive after fuse	7772
3	3	Positive after fuse	7772
4	4	Signal earth	0000
5	5	Front left sensor	5570
6	16	-	-
7	7	Rear left sensor	5572
8	8	Rear right sensor earth	5573
9	9	Front right sensor earth	5571
10	10	Front right sensor	5571
11	11	Diagnosis K line	2299
12	12	-	-
13	13	Decelerator deactivation with ABS system ON	0000
14	14	-	-
15	15	CAN L line	Green
16	6	Front left sensor earth	5570
17	17	Rear left sensor earth	5572
18	18	Positive after fuse (KL 15)	8879
19	19	Rear right sensor	5573
20	20	Stop signalling switch – brake lights	1176
21	21	-	-
22	22	-	-
23	23	-	-
24	24	-	-
25	25	-	-
26	26	CAN H line	White

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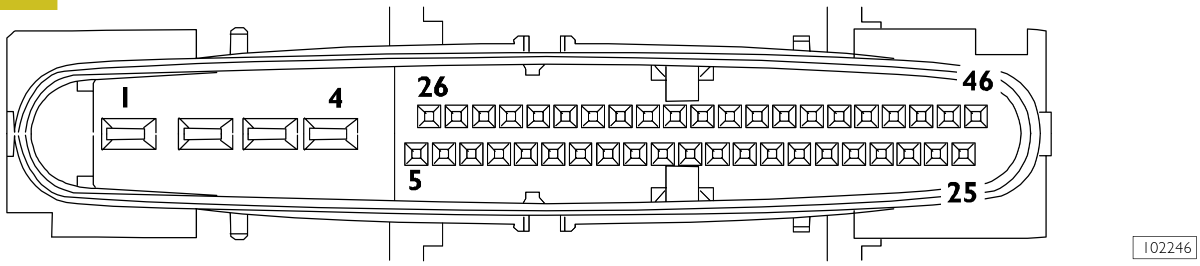
ESP 8 control unit PIN OUT (X - crossed channels, II - parallel channels)

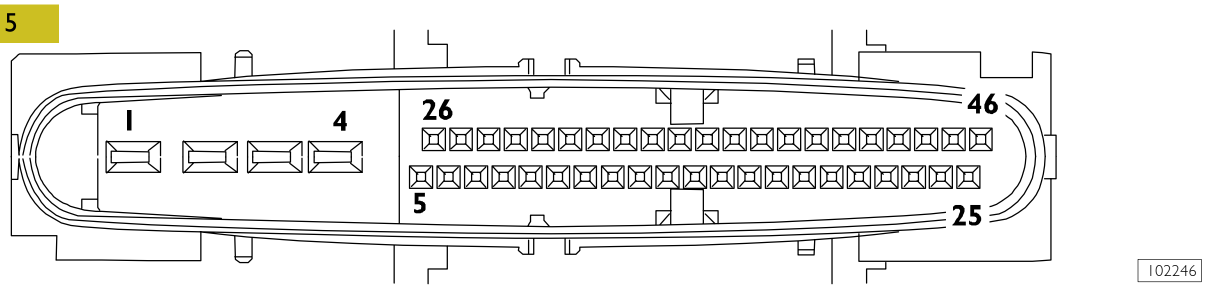
Figure 114



Pin (X)	Pin (II)	Function	Cable
1	1	Earth	0000
2	2	Positive after fuse (pump control motor power supply enable relay)	7772
3	3	Positive after fuse (valve lock power supply enable relay)	7772
4	4	Earth	0000
5	5	Front left sensor	5570
6	26	-	-
7	7	Rear left sensor	5572
8	8	Rear right sensor earth	5573
9	9	Front right sensor earth	5571
10	10	Front right sensor	5571
11	11	Diagnosis K line	2299
12	12	-	-
13	13	-	-
14	14	CAN L line	Green
15	15	Yaw / steering angle sensor earth	9096
16	16	Yaw sensor signal	9095
17	17	Longitudinal acceleration sensor	9090
18	18	Yaw sensor reference signal	9091
19	19	Voltage stabilization signal to the acceleration sensor	9091
20	20	Side acceleration sensor signal	9092
21	21	Side acceleration sensor signal earth	0050
22	22	Decelerator deactivation with ABS system ON	0000
23	23	-	-
24	24	-	1199
25	25	-	-
26	6	Front left sensor earth	5570
27	27	Rear left sensor earth	5572
28	28	Positive after fuse +15	8879
29	29	Rear right sensor	5573
30	30	Stop signalling switch (PIN3)	8158
31	31	Switch for the exclusion of ASR	8921
32	32	-	-
33/34	33/34	-	-
35	35	CAN H line	White
36	36	Hand brake ON signal	6662
37	37	Yaw sensor test signal	9093
38/39/40	38/39/40	-	-
41	41	Stop signalling switch (PIN1)	1176
42	42	-	-
43	43	Reverse gear signal	2226
44/45	44/45	-	-
46	46	Speed limiter or ASR failure warning light	6672

PIN OUT of central unit ASR 8 (4 channels -X)

Figure 115



Pin	Function	Cable
1	Earth	0000
2	Positive after fuse	7772
3	Positive after fuse	7772
4	Signal earth	0000
5	-	-
6	Left rear sensor earth	5571
7	Right rear sensor earth	5572
8	Right rear sensor	5572
9	-	-
10	Front sensor	5570
11	Diagnosis line K	2299
12	-	-
13	De-activating the decelerator with ABS in	0000
14	CAN line L	Green
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	Left rear sensor	5571
28	Positive after fuse for ABS (KL 15)	8847
29	Front sensor earth	5570
30	Stop signalling switch - Stop lights	1173
31	Switch to enable engine brake to be put on (ASR/ESP passive switch)	8800
32/33/34	-	-
35	-	White
36	-	-
37	-	-
38/39/40	-	-
41	-	-
42	-	-
43	-	-
44/45	-	-
46	-	-

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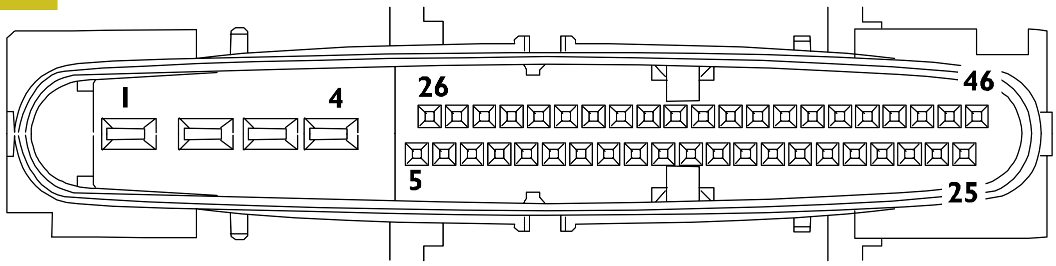
(4 channels -II)

Figure 116



Pin	Function	Cable
1	Earth	0000
2	Positive after fuse	7772
3	Positive after fuse	7772
4	Signal earth	0000
5	Left front sensor	5570
6	Left front sensor earth	5572
7	Left rear sensor	5572
8	Left rear sensor earth	5573
9	Right front sensor earth	5571
10	Right front sensor	5571
11	Diagnosis line K	2299
12	-	-
13	De-activating the decelerator with ABS in	0000
14	CAN line L	Green
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	Left front sensor earth	5570
27	-	5572
28	Positive after fuse (KL 15)	8879
29	Right rear sensor	5573
30	Stop signalling switch - Stop lights	1173
31	Switch for the exclusion of ASR	8921
32/33/34	-	-
35	CAN Line H	White
36	-	-
37	-	-
38/39/40	-	-
41	-	-
42	-	-
43	-	-
44/45	-	-
46	-	-

ESP (Electronic Stability Program) operation

The ESP function controls the vehicle's stability and side dynamics.

The main goals of this function are as follows:

- ❑ to improve stability, especially in understeering and oversteering conditions;
- ❑ to reduce the braking distance in line change conditions and on slippery roads.

The ESP function evaluates the following driver's requests:

- steering-wheel position;
- wheel revs number (speed);
- pressure on the brake pedal or accelerator position.

The ESP control unit microprocessor recognizes the specific manoeuvre and examines the vehicle's behaviour:

- degree of yaw;
- wheel revs number;
- transverse acceleration.

The microprocessor assesses the running behaviour based on the data provided, and the ESP comes into operation by acting on the brakes.

The hydraulic modulator controls brake pressure for every single wheel as quick as possible.

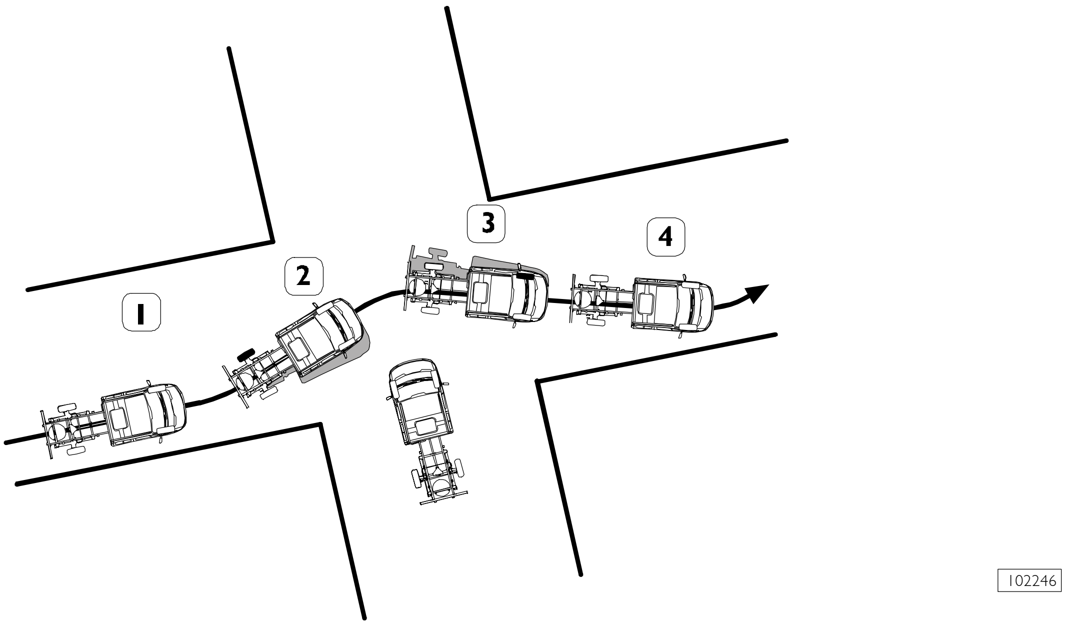
The ESP may, through engine management, reduce the number of revolutions of the engine itself, in order to withstand vehicle deceleration.

The ESP system is always active in the background, i.e. it compares the actual vehicle ride with the driver's desired ride 50 times a second.

Control strategy

Sudden obstacle

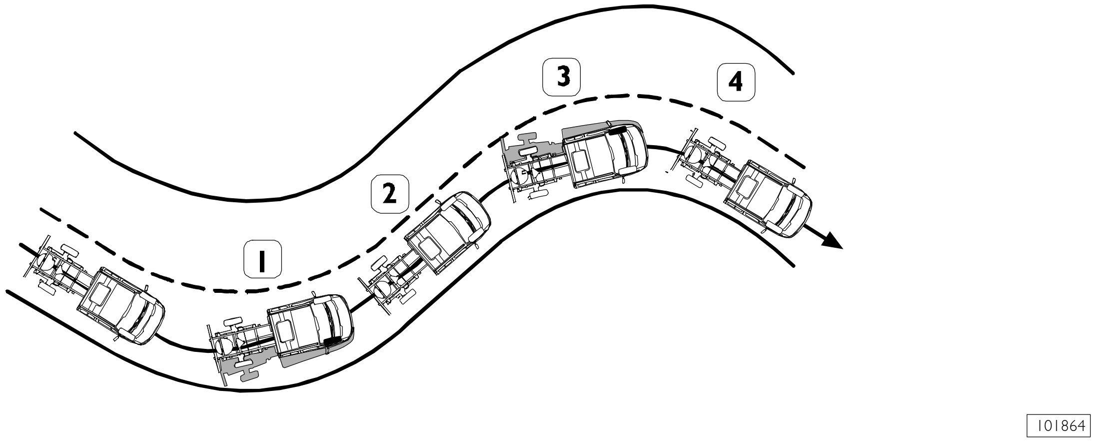
Figure 117



1) Acting on the steering-wheel suddenly: danger of understeering.
2) The ESP brakes the rear left wheel ⇒ the vehicle follows the steering command.
3) The driver countersteers: Danger of <u>oversteering</u> ⇒ The ESP brakes the front left wheel.
4) The vehicle recovers stability.

Sudden steering

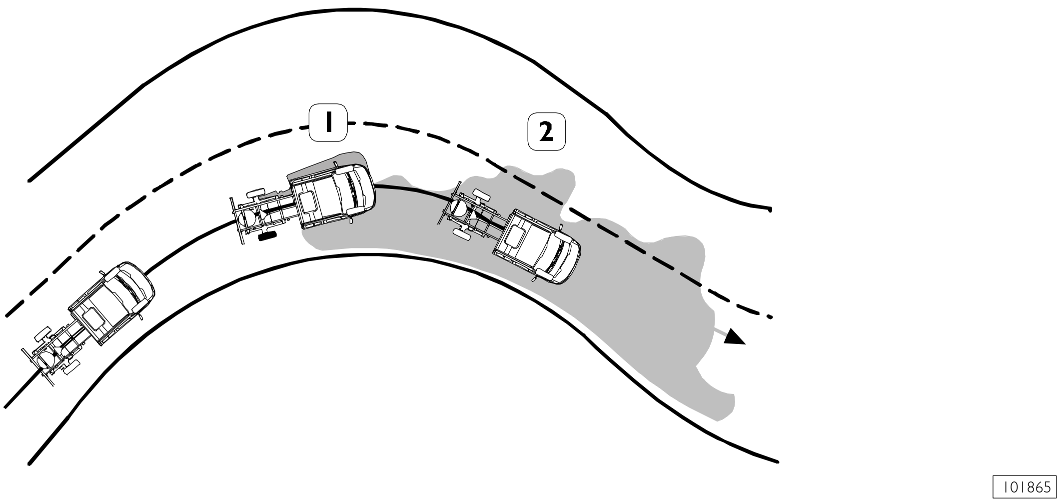
Figure 118



1) The vehicle risks skidding (oversteering): the ESP brakes the front right wheel.
2) The vehicle recovers stability.
3) The vehicle risks skidding (oversteering): the ESP brakes the front left wheel.
4) The vehicle recovers stability.

Vehicle running on a slippery road

Figure 119



1) The vehicle risks skidding (understeering): the ESP brakes the rear right wheel and reduces the engine revs number.
2) The vehicle recovers stability.

ASR deactivation strategies

- Disabling any engine intervention of the ESP and ASR/MSR (torque increase/decrease) over the entire speed range.
- Traction Control actuation enabled up to the speed of 60 k.p.h. (electronic locking of differential, with no reference to the dragged wheels).
- Stability intervention (ESP) enabled over the entire speed range.
- ABS enabled over the entire speed range.
- EBD enabled over the entire speed range.

NOTE ASR deactivation is recommended when driving with the snow-chains mounted, or when the wheels sink into gravel, sand, etc.

Recovery strategy in case of component failure

System failure (warning light ON)	ESP/ASR	ABS	EBD
Broken component			
Steering angle sensor	X		
Yaw sensor	X		
Brake light switch	X	X	
1 or 2 wheel revs sensors	X	X	
3 or 4 wheel revs sensors	X	X	X
Electronic control unit	X	X	X
Solenoid valve hydraulic unit	X	X	X
Pressure sensor, ABS pump motor		X	X

NOTE If the warning lights are OFF, all the systems are working.

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Warning light legend

Warning light ON: ESP/ASR/MSR not working. No action taken by the ESP/ASR on the engine or the brakes.

N.B. Warning light blinking = ESP/ASR coming into operation.

ABS not working

The front axle may get locked sooner than the rear axle. EBD recovery reduces the rear axle pressure.

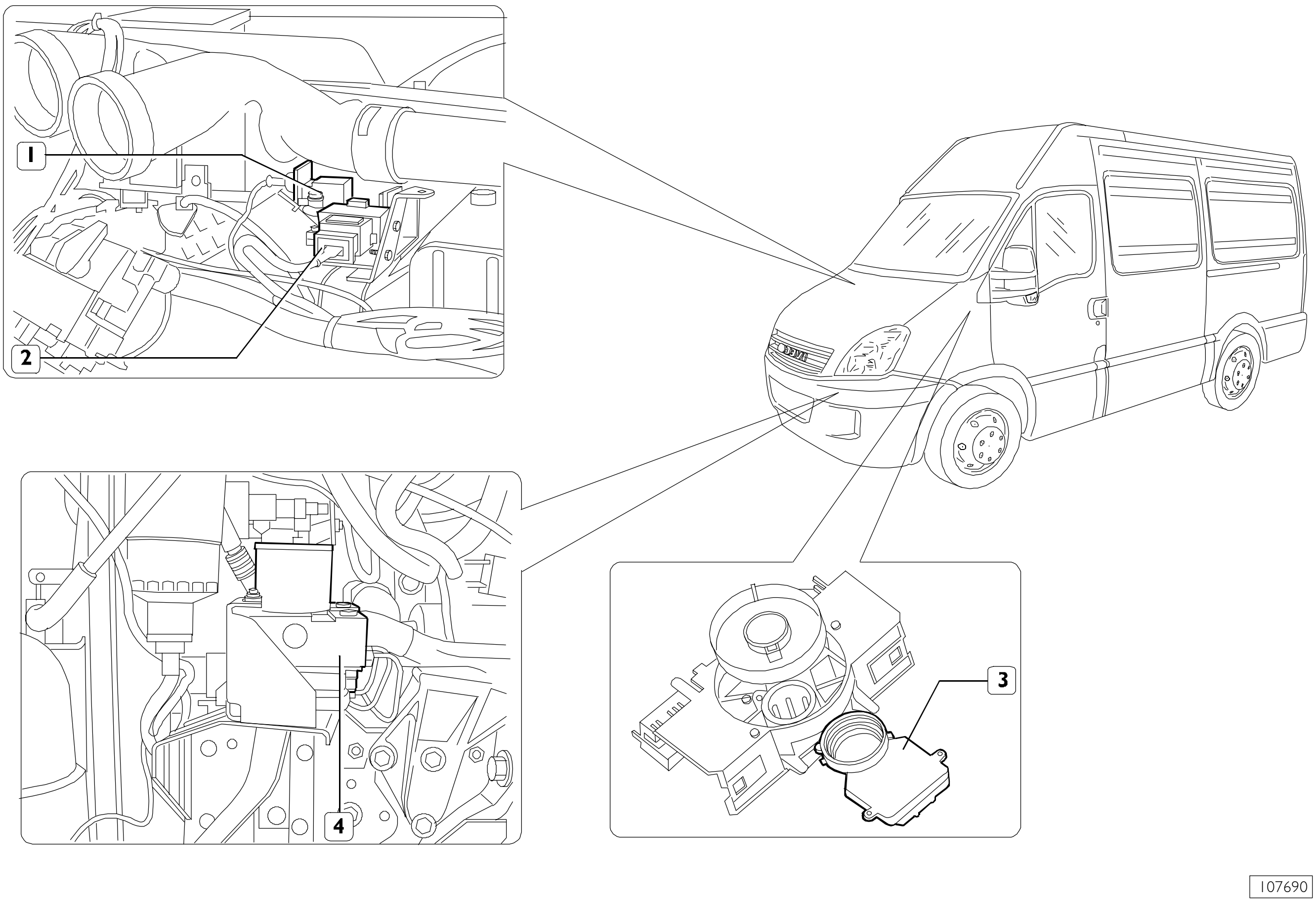
EBD not working

No correction of the rear axle braking pressure: DANGER OF SPINNING THROUGH 180 DEGREES!

The warning light also warns the driver of low brake fluid level, hand brake ON, brake pads worn.

Installing the esp components

Figure 120



1. Acceleration sensor - 2. Yaw sensor - 3. Steering angle sensor - 4. Electro-hydraulic modulator/control unit

NOTE Installation of the electro-hydraulic modulator/control unit is similar in ASB 8 systems, too.

ESP system components and calibration

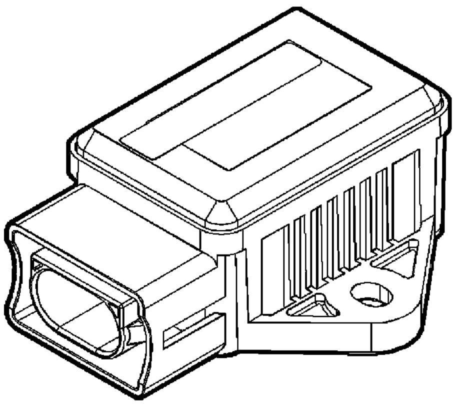
Some modifications or repairs affecting the ESP system components require a calibration procedure.

The repair operations that require the above procedure are detailed as follows:

- Replacing the system's braking apparatus electronic control unit (incorporated into the electro-hydraulic modulator).
- Replacing the steering angle sensor fitted into the steering wheel.
- Replacing the longitudinal acceleration sensor.

Yaw sensor with built-in side acceleration sensor

Figure 121



102115

It measures the motion of the vehicle around its own vertical axis (yaw) as well as the vehicle's side acceleration.

These signals continuously inform the control unit about the vehicle's behaviour.

The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

NOTE Replacing the yaw sensor requires no calibration.

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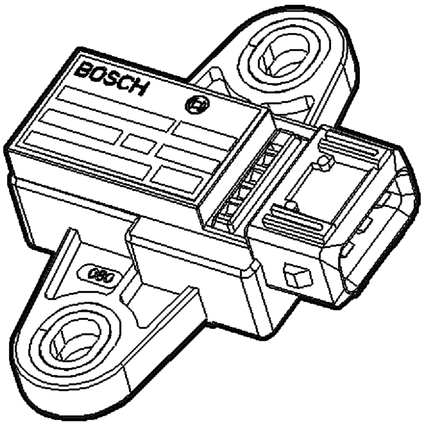
Longitudinal acceleration sensor

Figure 122



It measures the vehicle's acceleration and deceleration changes.

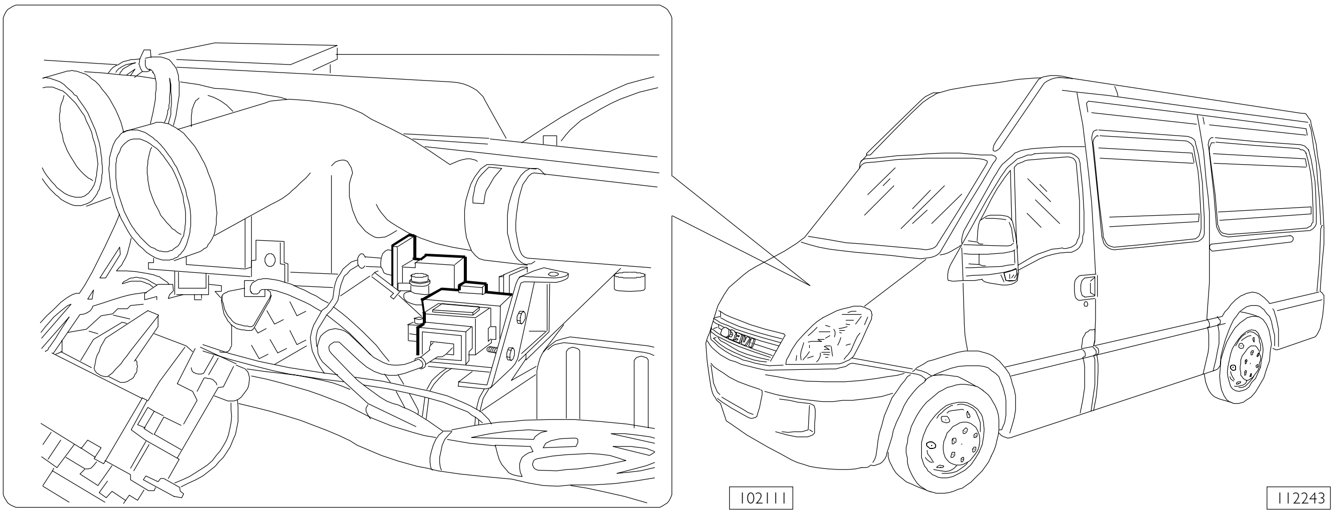
These signals continuously inform the control unit about the vehicle's behaviour.

The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Longitudinal acceleration sensor calibration

Figure 123



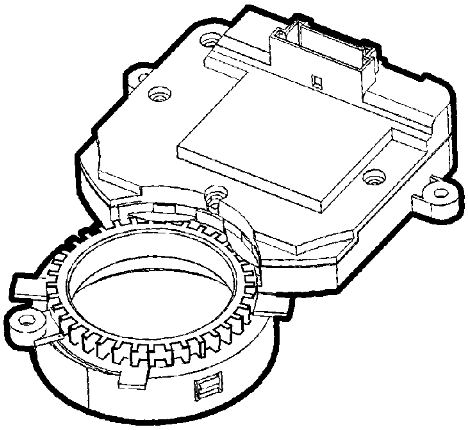
In a horizontal position, you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.

Use a diagnosis instrument to clear the errors.
Carry out a road test, to make the control unit verify whether errors are still found. The vehicle is to be taken to a slight slope and checked if it is kept braked for 2.5 seconds.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

Steering angle sensor

Figure 124



102116

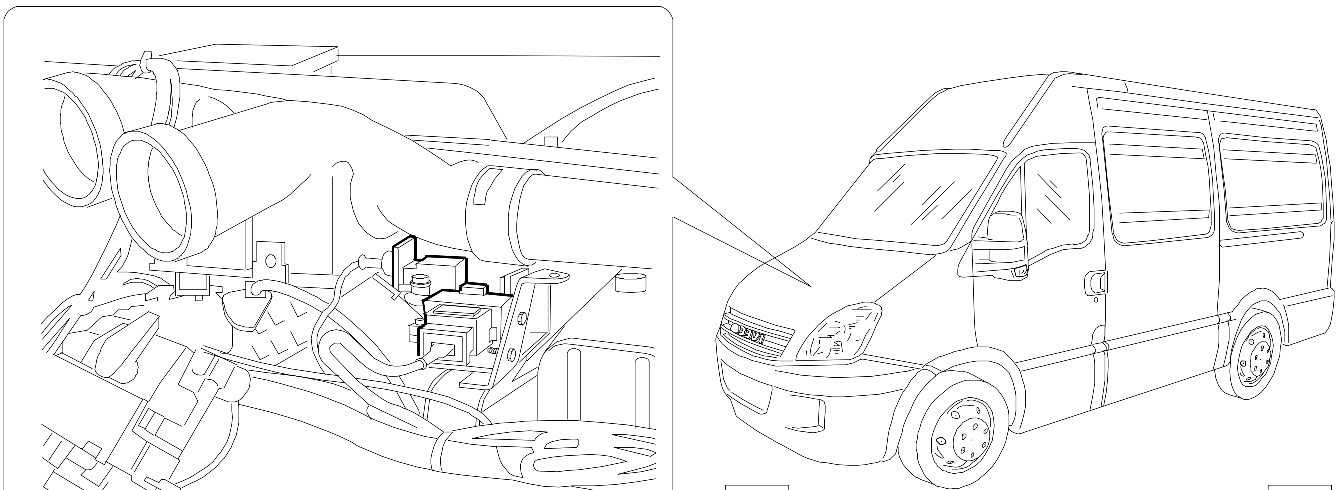
It measures the steering angle required by the driver.

The comparison between this signal and those from all the other sensors allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Steering angle sensor calibration

Figure 125



102110 112243

With both the steering-wheel and the wheels in straight position (after checking toe-in), you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.

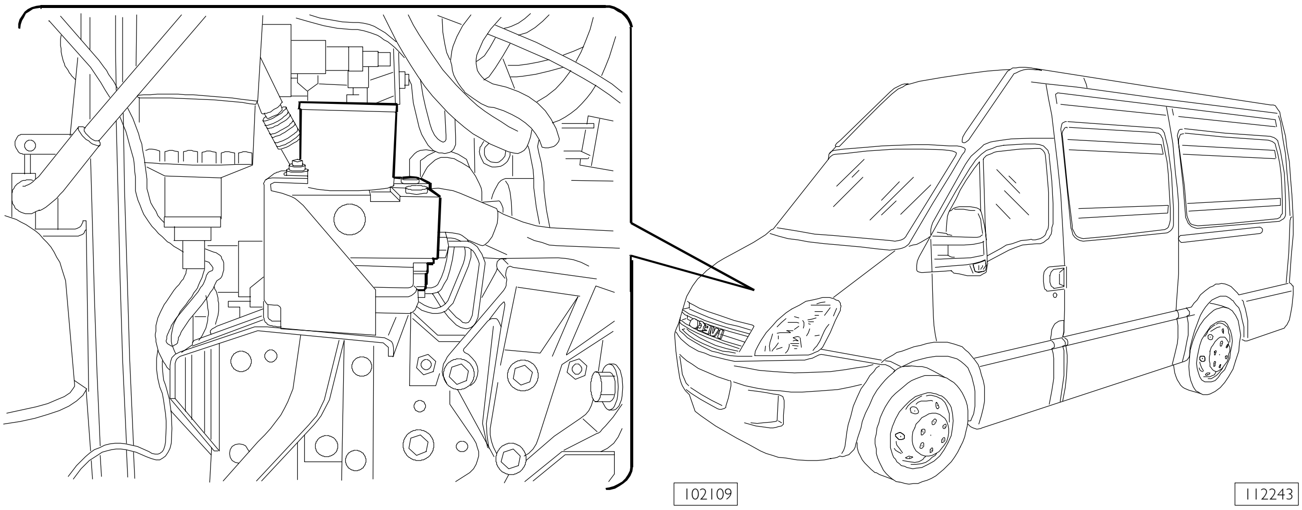
Use a diagnosis instrument to clear the errors.
Carry out a road test, to make the control unit verify whether errors are still found. Drive along a straight road at a speed of approximately 50 k.p.h. Steer to the right and then to the left several times, after making sure you do not endanger other drivers.

NOTE You need not oversteer to cause the ESP warning light to come on.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

ESP control unit programming

Figure 126



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Entering the variant codes: type of drive, engine, MTT, wheelbase, type of front and rear suspensions, height.

Easy compares the type of vehicle (PIC reading) with the control unit code, to avoid installation errors (single wheels instead of dual), and downloads the variant codes into the control unit.

Clear the errors (if any) by means of the diagnosis instrument.

Carry out a road test. Drive along a straight road at a speed of approximately 50 k.p.h. Brake suddenly as if in an emergency, after making sure you do not endanger other drivers: you should feel the system “respond” on the brake pedal. This test makes the control unit verify whether errors are still found.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

Replacing ESP central unit needs the longitudinal acceleration sensor calibration that was already described in previous page.

The steering angle sensor, in this case, is not to be calibrated as it has its own internal memory.

AIR BAG

General

The air bag is a passive safety device comprising one or two cushions which, in the event of a head-on crash, inflate automatically setting themselves between the body of the occupants and the front structures of the cab.

The system is always integrated by seat belts with pretensioner, which are controlled by the air bag control unit, in the event of head-on crashes.

The system does not cut in for front crashes at low speed, side crash, overturning or crashes from behind.

NOTE The air bag is complementary to the use of the seat belts and not in replacement of them.

Inflation of the bags without the restraint of the belts compromises the safety of the driver and passengers.

System components are connected to each other and to the rest of electrical system through a special wiring harness that can be easily identified as it is provided with a yellow sheathe.

SYSTEM OPERATION

Device intervention sequence can be INDICATIVELY REPRESENTED as illustrated in following figure.

For convenience's sake, drive side device only is shown: passenger side air bag operation is quite similar.

Represented diagrams are qualitative and are not concerning subject vehicle.

Diagram A: this diagram represents inflation pressure in cushion versus crash dynamics developing time.

Diagram B: this diagram represents body positions during a front crash with respect to steering wheel and air bag positions. Below is events time sequence from the time of electrical pulse triggering off by electronic central unit.

Time "t1"

Time when inflation system is triggered off. Thereafter, inflation pressure starts rising in the cushion, which is still enclosed inside module cover. The module is made up of a plastic layer located at steering wheel centre. Driver's body is still in almost normal position (Figure B, reference 1).

Time "t2"

Pressure inside still closed module rises until it reaches such a value that the cover is opened, cushion stuck out and inflation started.
Driver's body starts in this time period to move forwards and is placed between normal position taken during drive and the position of the collision against the cushion (Figure B, reference 2).
At the time when the cushion is released from its shell, gas pressure slows rapidly down owing to the high inertia of the cushion. At a certain time, pressure is drawn to take negative values.

Time "t3"

Cushion pressure takes back positive values because from this time the very inflation starts which will lead the cushion to maximum expansion condition.

Time "t4"

Driver's body impact against the cushion takes place (Figure B, reference 3).
Pressure inside the cushion rises because of pressure exerted on it by driver.

Time "t5"

Pressure in the cushion slows rapidly down owing to the presence of an air vent hole and the cushion deflates entirely to the end of allowing driver high mobility (compatible with the rest of the vehicle).

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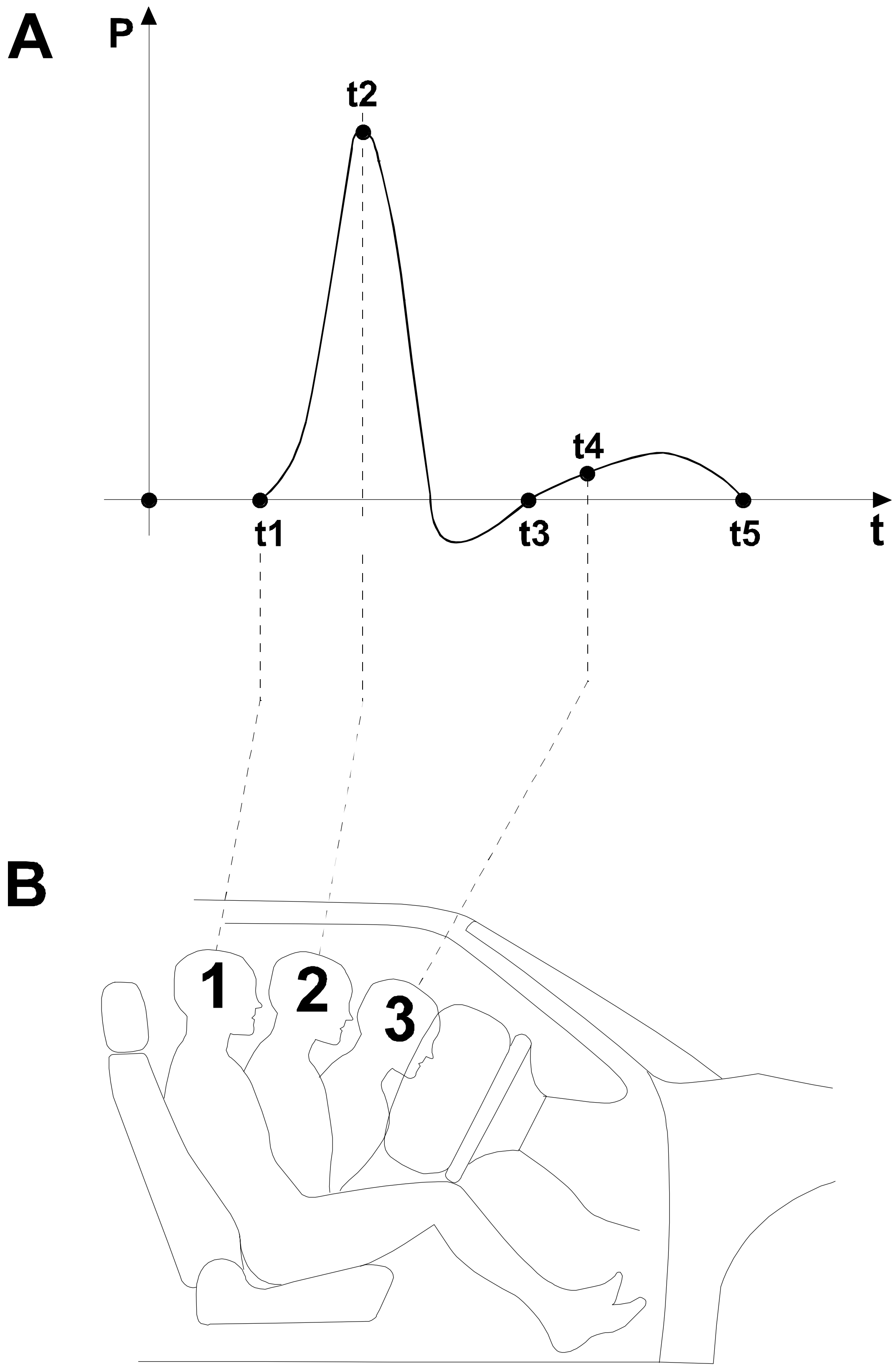
Figure 127



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INTERVENTION LOGICS

The system is capable to cover a deceleration angle, according to vehicle longitudinal axis, of ? 30 degrees and intervenes if a deceleration is reached which matches deceleration present when a front crash occurs at a speed of ~ 24 km/h against a fixed barrier.

NOTE These values are just indicative and depend on various factors, including vehicle weight, etc.

Electronic central unit, if detecting a deceleration exceeding preset calibration curve, triggers off the reaction of a chemical compound through electrical detonators.
Gas inflates the two cushions and activates the pretensioners which enable safety belts rolling up devices rewinding and locking.

Central unit is capable to detect this deceleration by two sensors, one electromechanical sensor and one electronic sensor, that are placed inside it.

The cushions, made of a synthetic fibre, are respectively housed at steering wheel centre and at an opening of the instrument panel in front of passengers.

- At each start-up operation, the central unit puts on the warning lamp and keeps it on for about 4 seconds, making a system self-diagnosis operation.
- After each system activation, the central unit keeps fault warning lamp always on, on instrument cluster and **the whole system** (central unit, belts and relating pretensioners, cushions and wiring harness) **shall necessarily be replaced**.
- <u>The system does **NOT** need either any type of maintenance or any checks.</u>

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Rules of safety to be followed for operations on vehicles fitted with the air bag system supplied to us by the supplier.

⚠ The following rules must absolutely be followed when doing any work concerning vehicles fitted with safety system with air bag.

Preliminary rules

⚠ Remember that air bag modules are devices to be handled with care. Their use, transport and storage are ruled by the following procedures.

Before starting any body repair work, welding, work requiring the removal of air bags or of the control unit, it is necessary to:

- move the ignition key to "STOP" and remove it
- always disconnect the battery, i.e.: disconnect the two terminals from their post and isolate them taping appropriately
- wait for at least 10 minutes before proceeding
- disconnect the control unit connector.

Store the modules with the cover upwards in a key-lockable metal cabinet. The cabinet, to be used for this purpose only, must not be used for storing other types of material, especially if inflammable.

All the connectors used and wired on air bag modules contain a short circuit clip. Up to the moment in which the air bag modules are connected to an appropriate source of energy, there is no possibility of undue activation of the units.

A system component not activated during an accident is to be considered still "active".

Therefore, undeployed components to be removed from vehicles (due to faults, guarantee expiry or other causes) must be returned to the special centre through the procedure described below.

NOTE The assembly or disassembly of components may ONLY be carried out by competent and authorised personnel.
The failure to follow the instructions given below may involve unwanted activation of the system, personal injury or unnecessary system repair. IT IS STRICTLY PROHIBITED TO DISASSEMBLE AIR BAG MODULES STRIPPING THEIR COMPONENTS.

All the system components have been specifically designed to work on vehicles of a specific brand and type. Therefore, air bags cannot be adapted, re-used or installed on other vehicles than the one for which they have been designed and manufactured.

NOTE Any attempt to re-use, adapt or install them on a different type of vehicle may cause serious or lethal harm to the occupants of the vehicle in the event of a crash.

Operations after an accident

NOTE If any component of the safety system is damaged following an accident, it should be replaced.
Do not attempt to repair the control unit, clock spring or air bag modules.

Accidents with or without deployment of the air bag device

Some system components should be inspected whether the system has been activated or not. These components are:

- steering column;
- steering column support;
- electronic control unit and modules retaining area;
- clock spring;
- dashboard (in the passenger's air bag area).

The component must be replaced in the presence of distortion, breakage and flexure.

Accidents with the deployment of the air bag device

If the vehicle has undergone a head-on crash involving the total deployment of the system, the following components must be replaced:

- air bag modules;
- pretensioners;
- electronic control unit;
- clock spring.

The harness and connectors should be inspected for signs of burns, melting of the outer insulation or damage due to excessive heat.

Any signs of damage on the clock spring in the control unit retaining area and on the air bag modules call for the replacement of the damaged components.

Painting work

No particular rules of safety are to be followed for painting work followed by oven drying, as the modules and pretensioners have been designed in such a way that they will not be damaged heating the outer surfaces of the vehicle with normal paint drying systems.

It is prohibited to use naked flames near the modules.

All electronic control units (including the air bag system) should always be removed if their temperature in certain environments may reach or exceed 85 °C.

Health hazards

The precautions to be taken when handling deployed air bags are the following:

- use protective polyethylene gloves and safety goggles;
- after touching triggered air bags, wash your hands and the parts of the body exposed with soap and water.

Effects of over-exposure

There is no potential hazard of exposure to the propellants as the system is completely sealed.

The propellant mixture is in the solid state, therefore inhalation is impossible even in the event of breakage of the gas generator cartridge.

Should any gas come out there is not health hazard.

Avoid any contact with the skin and do not swallow the propellant.

In the event of:

- contact with the skin wash immediately with soap and water;
- contact with the eyes: wash immediately with running water for at least 15 minutes;
- inhalation: take the person outdoors immediately;
- swallowing: induce vomit if the person is conscious.

⚠ Always call a doctor for all the above conditions.

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Rules of safety in handling air bag modules

Under normal conditions the driver's and passenger's air bag are activated by the electronic triggering device during the crash. The gas developed (mainly nitrogen) under these conditions is not harmful.

Personnel carrying out operations on the device fitted on vehicles must absolutely adhere to the rules of safety given below.

Personnel operating on these devices must be suitably trained and follow the precautions given below:

- ❑ In open (exploded) air bag removal and replacement operations handle only one air bag at a time and for removal use polyethylene gloves and protective goggles.
- ❑ Always rest the air bag module with the opening lid and pre-split groove facing upwards. Do not put anything on top of this lid.
- ❑ Afterwards wash your hands carefully with neutral soap and in the event of contact with the eyes of residual powder, rinse immediately with running water.
- ❑ Before starting work on the system, disconnect the two battery cables (firstly the negative one) isolate the terminals with insulating tape and wait at least 10 minutes before proceeding.
- ❑ The metal components of an air bag that has just been deployed are very hot. Avoid touching these components for 20 minutes from the time of air bag deployment.
- ❑ Do not carry out repairs on air bag modules. Send all faulty modules to the supplier. Do not heat the air bag module for example by welding, hammering, drilling, mechanical machining etc.
- ❑ Never install on the vehicle air bags that have been dropped or show signs of any type of damage.
- ❑ It is prohibited to keep air bags together with inflammable material or fuel.
- ❑ The gas generators must not come into contact with acids, greases and heavy metals. Contact with these substances may cause the formation of poisonous, harmful gas or explosive compounds.
- ❑ Never use naked flames near air bag devices and system components.

Any spare parts should be stored in their original packing and temporary storage should follow the same procedure as for an undeployed air bag removed from the vehicle, i.e. a key-lockable metal cabinet must be used, especially for this purpose (metal, shock resistant cabinet with grilles to allow natural ventilation inside). The cabinet must have special warning notices (DANGER EXPLOSIVES - NO NAKED FLAMES - NOT TO BE OPENED BY UNAUTHORISED PERSONS).

Air bag module scrapping

The air bag modules fitted on the vehicle must not be scrapped with the vehicle itself, but removed beforehand and then deployed as described in the following pages.

Air bag units must not be scrapped without firstly deploying them.

If the air bag module has not been activated during a crash, the device is to be considered as still charged.

All unexploded material MUST NOT BE ACTIVATED and should be sent to a specialised centre with the following wording on the delivery note:

- ❑ AIR BAG DEVICE CONTAINING EXPLOSIVE CHARGE TO BE DEACTIVATED

The devices must absolutely be shipped in the same package in which the spares are received and if this is not available it is possible to ask the SPARES division for the package only.

Clearly in the case of replacing air bag devices the original packing should be kept intact for sending the undeployed device.

For FOREIGN MARKETS follow local regulations.

⚠ The failure to follow the procedures listed here may cause undue activation of the air bag units and personal injury. Undeployed air bag units must NOT be disposed of through the usual refuse disposal channels. Undeployed air bag units contain harmful substances for the health and may cause personal injury if the sealed container which contains them is damaged during disposal.

Rules of safety in handling pretensioners

In the event of a head-on crash, the driver's and passenger's pretensioners are activated an instant before the air bag modules.

The personnel that intervenes on the devices must be suitably trained and observe the following precautions:

- ❑ When handling activated pretensioners, i.e. when the propellant has already been triggered, use protective gloves and goggles.
- ❑ At the end of operations wash your hands carefully with neutral soap and in the event of contact of residual powder with the eyes, rinse immediately with running water.
- ❑ Disconnect the two battery cables (firstly the negative one) isolate the terminals with insulating tape and wait at least 10 minutes before proceeding.
- ❑ During activation the pretensioner develops heat; it is therefore necessary to wait at least 10 minutes after deployment, before touching them.
- ❑ During transport or handling, pretensioners should be protected from shocks or falling; pretensioners that have been knocked or dropped must not be used and must be returned to the supplier stating the reason.
- ❑ Pretensioners should not be carried by the belt.
- ❑ Pretensioners must be protected from sparks and naked flames; they should not contact surfaces for over 6 hours with temperatures above 100 °C .
- ❑ The gas generator propellant that is not burnt is inflammable, therefore, the parts of the generator should never be taken to pieces, damaged or tampered with.
- ❑ It is prohibited to store pretensioners with inflammable materials or fuel.
- ❑ The gas generators must not come into contact with acids, greases and heavy metals. Contact with these substances may cause the formation of poisonous, harmful gas or explosive compounds.
- ❑ Belts with pretensioners may only be stored in key-lockable places or cabinets, ventilated and away from naked flames and sources of heat.

After every crash in which the pretensioner has been activated, the belt is unserviceable and must be replaced.

Scrapping pretensioners

Undeployed pretensioners (not fitted on the vehicle) to be scrapped must firstly be deployed; those not activated but fitted on the vehicle must be removed and not scrapped with the vehicle.

If the pretensioner was not activated during a crash, the device is to be considered as still active; proceed as described i this manual.

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Operations on system components

At the end of every operation on the system, it must be checked using Modus, I.W.T. or other diagnostic tools.

During assembly, the air bag components are labelled with a sticker with a removable part stating the date of installation of the system and components. The removable part is detached and the information on it is filed together with the system check report supplied by Modus, by the workshop that installed the components.

After 10 years from installation, unless the components are replaced before that time, a new air bag system (cable and components) should be installed. As mentioned previously, the data concerning the components and the date of system installation are to be filed.

Removing and scrapping an activated air bag module and pretensioner from a vehicle

Always wear gloves and safety goggles for handling an activated air bag or pretensioner. Wash the hands and exposed skin immediately with neutral soap and water after handling the components of an air bag module or pretensioner. In the case of exposure to secondary products, immediately rinse the eyes with running water. The failure to comply with these instructions may result in injury.

To remove and scrap an already activated air bag module and pretensioner:

1. Follow the instructions given in this manual for removing activated air bag module and pretensioners.
2. Disconnect the air bag module and pretensioner mechanical fastenings.
3. Disconnect the component connector from the air bag harness.
4. Place the air bag module and pretensioner in a special sealed polythene bag.
5. Send to the authorised collection/disposal centre.
6. Dispose of, recycle or scrap deployed air bag modules and pretensioners in the appropriate manner.

The residues left by combustion of the propellant require some consideration. They are mostly concentrated in the generator body or in small quantities in the bag. These residues may contain copper or chloride (e.g. potassium chloride). If the propellant is based on sodium azide or potassium nitrate, the combustion residues are highly alkaline and corrosive. **Always wear appropriate protection for the eyes and skin.** Deployed air bags should always be stored in dry, suitably ventilated places.

Removing or scrapping an air bag module that has not been deployed from a reparable vehicle

Do not cut cables or tamper with the connector between the vehicle harness and the air bag module. The connector contains a safety circuit.

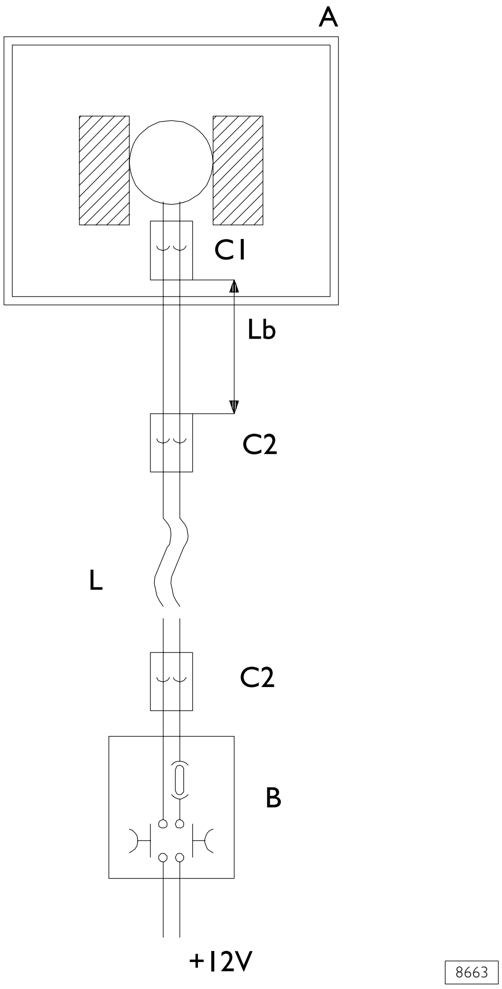
If the connector is cut or removed from the air bag unit, the safety device is disabled and this could cause unforeseen activation with serious consequences for the physical integrity of people.
Air bag systems have a reserve power unit in the control unit. This must be deactivated disconnecting the two battery terminals and waiting for at least 10 minutes before doing any work on any components of the air bag.
When handling an air bag module, always keep the bag and outer cover away from the body. When positioning an active air bag on a bench or other surface, always place the bag and its cover upwards, not on the resting surface and away from people. Never put any object near an active air bag as it would become a bullet in the event of deployment.

Always keep active, undamaged, air bag modules and pretensioners in a cool, dry, locked and safe place. Do not expose to naked flames or temperatures above 150 °C. Do not cut, drill, braze weld an air bag module or its components with electric current. Never expose an air bag module or pretensioner to electric currents. The failure to comply with these instructions may damage the unit, cause fire, cause unforeseen deployment and serious harm to persons.

Active, damaged air bag modules and pretensioners (e.g. breakage of the electrical connection) must be kept away from corrosive or oxidising substances. The failure to comply with these instructions may cause fire, and/or serious harm to persons.

NOTE The air bag modules and pretensioners have an energy reserve. This decive gives the electric pulse needed to deploy the bag if the battery or cables are damaged during the crash before the sensor activates the gas generator.

Figure 128



REMOTE DEPLOYMENT OF AIR BAG MODULES

C1 = air bag module connector
C2 = Connector to remote deployment device (connector for air bag with circuit clip; counterparts with male pins on air bag side)
Lb = bridle length - approx. 1 m
L = general cable, safety distance 10 m

A. Enclosed area
B. Remote deployment device

Deployment of an air bag

Remote activation

General instructions

1. The deployment procedure can be carried out in a suitably identified and enclosed open area away from potentially inflammable materials, fluids or other substances and from persons. Place the air bag module on a firm surface and clamp it closely.
2. Clean the area on which the module is placed from materials and bits (glass, instruments, pieces, etc.) which could be thrown out during deployment.
3. Make sure that connector C2 is disconnected from the remote deployment device (10 m).
4. Connect the electrical connector C1 specified by the vehicle manufacturer to the air bag module
5. Connect connector C2 to the remote deployment device.
6. Connect the remote deployment device to a 12 V circuit or equivalent device.
7. Make sure all persons are under shelter.
8. Wear accident prevention goggles and protective clothing.
9. Press the double deployment button
10. After deploying an air bag module, let it cool before touching it (about 20 min.).
11. Dispose of, recycle or scrap activated air bag modules according to the cases, as described in the corresponding chapters.

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Deployment of air bag modules and electronic pretensioners still on board of irreparable vehicles

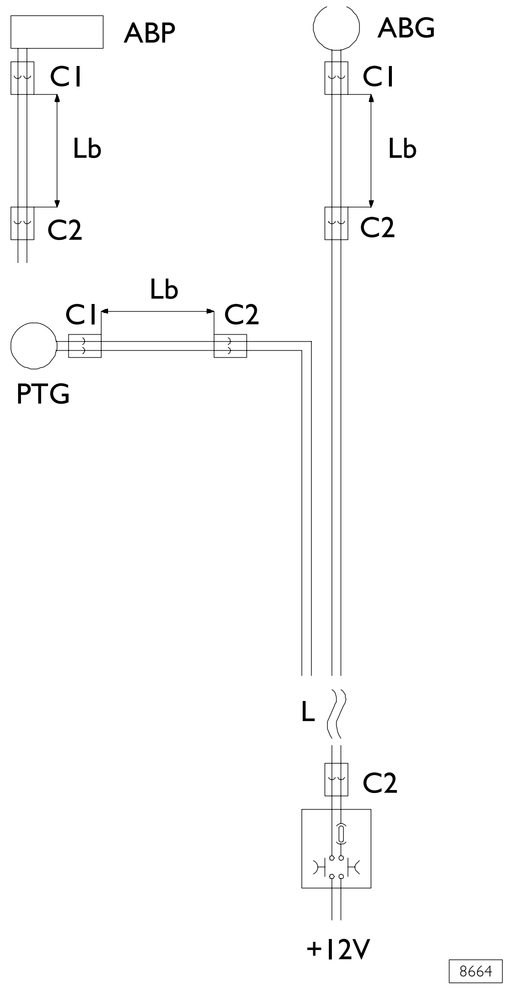
This procedure is followed when the vehicle with one or more active air bags needs to be scrapped. This procedure applies whether the air bag and/or pretensioner system is still intact or not.
It is advisable to deploy the explosive charges on the vehicle directly connecting the electric connector of the single module to the remote deployment system.

The deployment procedure must be carried out away from other persons in a suitably identified area. Check that no type of object has been left near the modules and pretensioners and make sure that there are no inflammable liquids in the vicinity. No-one should remain on board during deployment and remember to close the vehicle doors. Personnel should stay under shelter (e.g. behind a wall, vehicle, etc.) to protect themselves from any objects that may be thrown. Leave the generators and modules to cool after deployment (wait at least 20 min.). The failure to follow these instructions may result in serious physical harm.

General instructions

1. Follow all the WARNINGS, PRECAUTIONS and safety instructions given in this manual.
2. Take the vehicle to the area foreseen.
3. Remove all materials and bits (glass, instruments, pieces, etc.) around the air bag cover and check that there are no inflammable fluids in the immediate vicinity.
4. Disconnect the two battery cables (firstly the negative one) and wait at least 10 minutes before proceeding.
5. Use a connection bridle (L = approx. 1 m) with specific terminal connector for electrical connection with the module to be deployed.
6. Reach the electrical connection of the module in question (air bag or pretensioner) following the instructions given in this manual.
7. Disconnect connector C1 of the air bag module or pretensioner.
8. Check that connector C2 is disconnected from the remote deployment device.
9. Connect electric connector C1 of the air bag module or pretensioner to the connection bridle of the remote deployment device.
10. Connect connector C2 to the remote deployment device.
11. Make people go to a safe place.
12. Connect the remote deployment device to a 12 V circuit or equivalent device.
13. Press the double activation button to deploy all the air bag modules and pretensioners at the same time.
14. After deploying the air bag modules and pretensioners always let them cool before touching them (about 20 min.).
15. Once the modules and pretensioners have been deployed the vehicle can be scrapped - by squashing or crushing - and/or recycled depending on the cases.

Figure 129

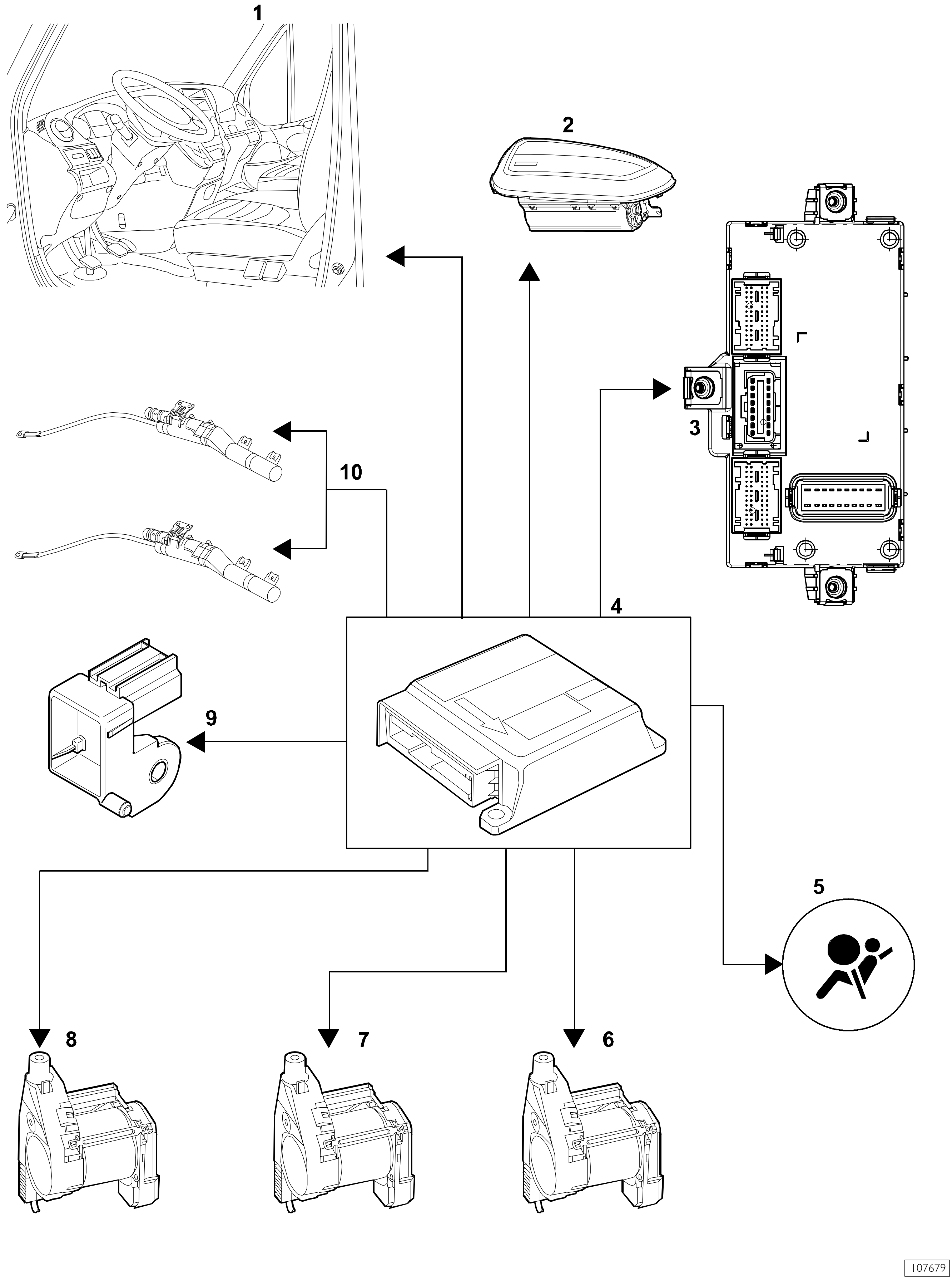


LAYOUT FOR DEPLOYING EXPLOSIVE CHARGES ON THE VEHICLE, SINGLE DEPLOYMENT

ABG	=	driver's air bag
ABP	=	passenger's air bag
C2	=	connector to remote deployment device
C1	=	specific connector to explosive charge
L	=	general cable, safety distance 10 m
Lb	=	bridle length
PTG	=	driver's pretensioner

A. Remote deployment device

Figure 130



Air bag system includes following components:

1. drive side air bag module
2. passenger side air bag module
3. diagnosis connector (EOBD) on Body Computer
4. electronic central unit
5. air bag failure warning lamp on instrument cluster
6. safety belts with passenger side electronic control pretensioner
7. safety belts with drive side electronic control pretensioner
8. safety belts with central electronic control pretensioner
9. lh/rh lateral sensor
10. lh/rh curtain air-bag

DE-ACTIVATING PASSENGER AIR-BAG

Passenger air-bag can be disabled from instrument cluster menu directly by the driver.
Air-bag central unit will send a message through "B" Can line to instrument cluster which activates a yellow warning lamp and a message on display screen (comfort). If passenger air-bag is enabled, the warning lamp will flash on going on and then go off.

Electronic control unit

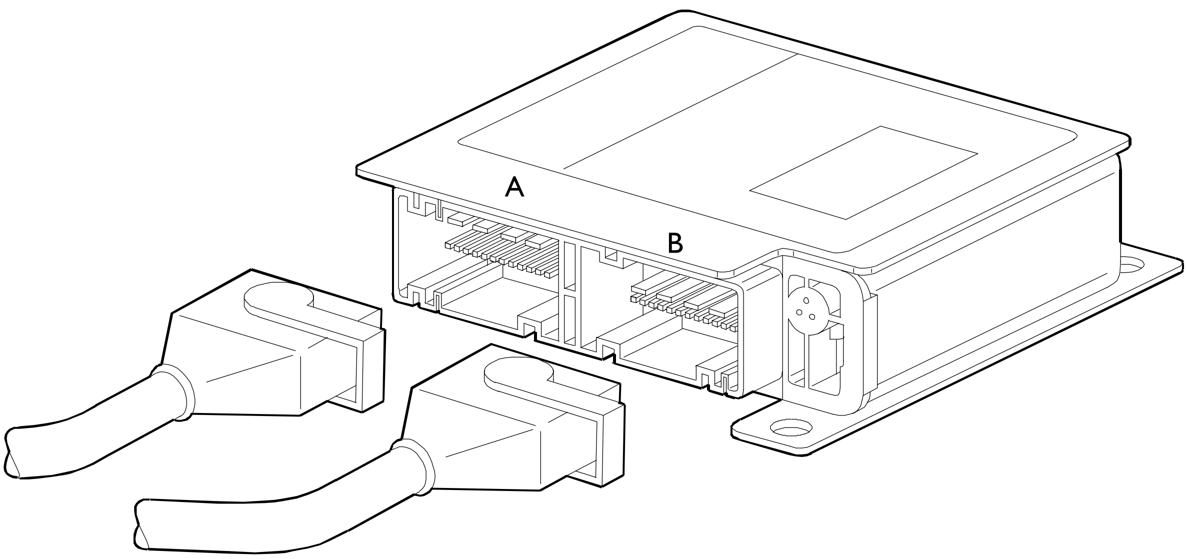
The electronic control unit is located on the floor at the side of the driver's seat between the gearshift lever and the parking brake lever; it is supplied at 12 Volt by a key-operated device, but it is still in a condition to be able to work for about 200 msec after a power cut off.

This is possible due to the presence of a buffer condenser inside which accumulates electric energy for normal operation of the control unit and generate the signal for triggering the explosive capsule.

This way system operation is guaranteed if the crash causes a power system failure (for example damage or breakage of the battery, power cable cut-off etc.).

The control unit must be directed with the arrow printed on the sticker facing the vehicle direction of travel. This is absolutely necessary as it determines the direction in which the deceleration sensor reads the values for defining the crash condition and thus triggering the air bag.

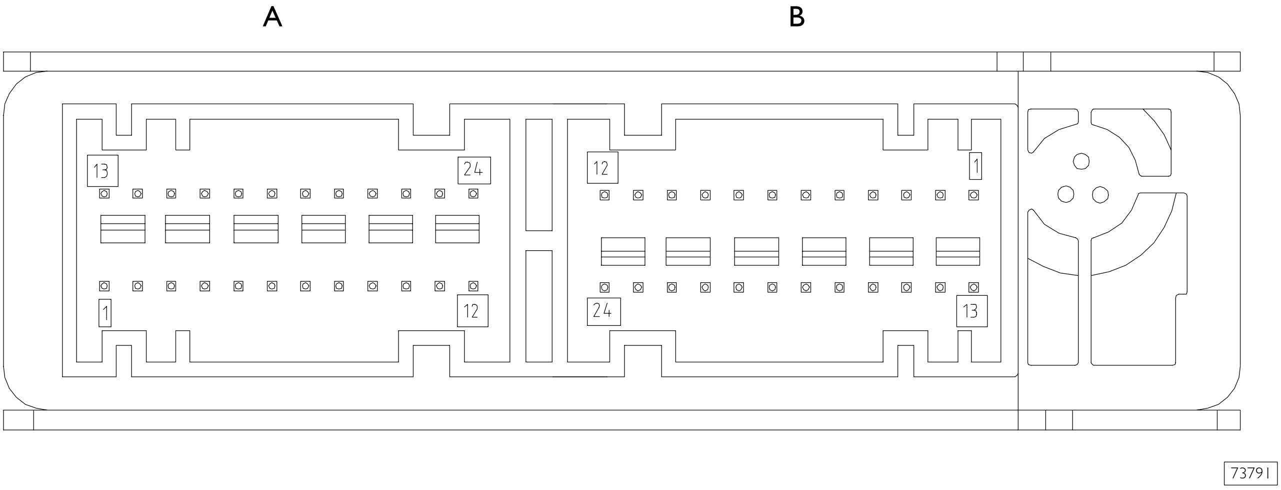
Figure 131



PERSPECTIVE VIEW OF THE ELECTRONIC CONTROL UNIT WITH TWO CONNECTORS
A. Black - B. Brown

Central unit Pin Out

Figure 132



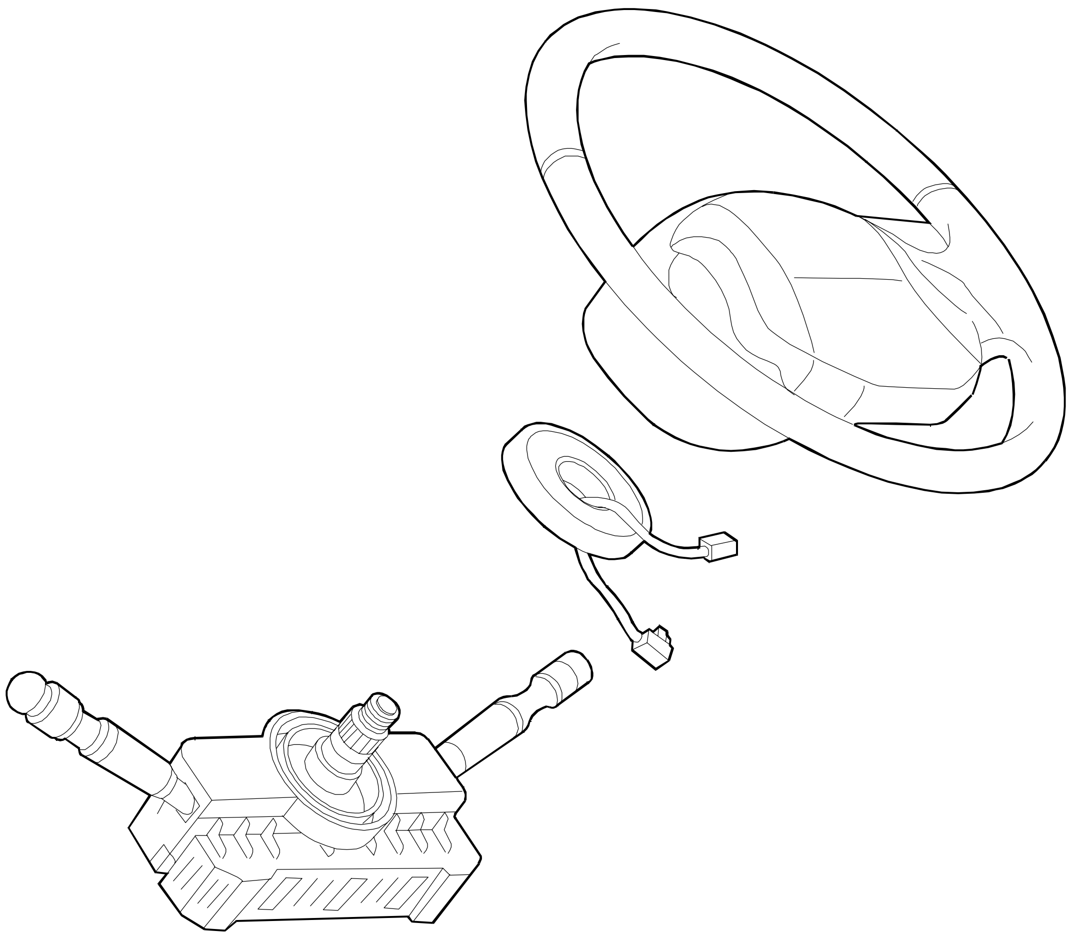
Pin	CONNECTOR B WITH BROWN COLOUR Function	Pin	CONNECTOR A WITH BLACK COLOUR Function
1	"B" Can line L	1	Lh lateral sensor "-"
2	"B" Can line H	2	Lh lateral sensor "+"
3	----	3	Rh lateral sensor "-"
4	----	4	Rh lateral sensor "+"
5	----	5	----
6	----	6	----
7	----	7	----
8	----	8	----
9	----	9	Lh pretensioner "-"
10	----	10	Lh pretensioner "+"
11	----	11	Rh pretensioner "+"
12	Positive for power supply	12	Rh pretensioner "-"
13	----	13	----
14	----	14	----
15	----	15	----
16	Earth	16	----
17	Central pretensioner "+"	17	Lh curtain air-bag "+"
18	Central pretensioner "-"	18	Lh curtain air-bag "-"
19	----	19	Rh curtain air-bag "-"
20	----	20	Rh curtain air-bag "+"
21	Positive for driver air-bag "+"	21	----
22	Negative for driver air-bag "-"	22	----
23	Negative for passenger air-bag "-"	23	----
24	Positive for passenger air-bag "+"	24	----

SPIRAL CONTACT

It is a part which is installed on steering column switch unit and used to enable the connection cables of the cushion on steering wheel to follow steering wheel rotation without risks of breakage.
The device is made up of two caps: lower cap is fixed to steering column switch unit by three screws, while upper cap is made integer to steering wheel through two add-ons inserted on upper side.
Inside the two caps, connection cables are wound up in a spiral shape in order that they are enabled to follow movements.
Spiral contact is also equipped with a device which automatically locks spiral contact rotation when spiral contact is removed from steering wheel; this is done in order to prevent upper cap, that is not constrained any more, from freely rotating, so causing the cables to unexpectedly unwind or wind up and creating consequent risks of cable breakage.
On steering wheel mounting operation, the device is automatically locked.

- Where spiral contact is disconnected/reconnected, it must be made sure that it is remounted on the steering column switch unit in the same position it was removed.
- Where spiral contact is replaced, if it is provided as a spare apart from steering column switch unit, then spiral contact must be installed with wheels perfectly aligned, because this is new device corresponding position.

Figure 133



PRETENSIONERS

Pyrotechnic device that can be electrically activated by a signal from central unit, it is an integrating part of safety belts rolling up device, so that a single component is created which is fixed to vehicle pillar.

In the case of a crash having a certain extent, it intervenes in such a way that it recovers the unavoidable stretch of the belts caused by the action exerted by body weight and it keeps the body adherent to seat back.
At the end of intervention, the belt remains locked, so highlighting that device intervention has occurred.

Operation principle

At the time when a determined deceleration of the vehicle occurs, the electronic sensor, that is placed in control central unit, sends a signal which ignites gas generator pyrotechnic charge (detonator).
Propellant combustion develops a gas the pressure of which generates a force pushing rack piston upwards.
Rack piston upward movement rotates gear wheels, which reverse tape rotation direction, so winding back the tape by a few centimetres.

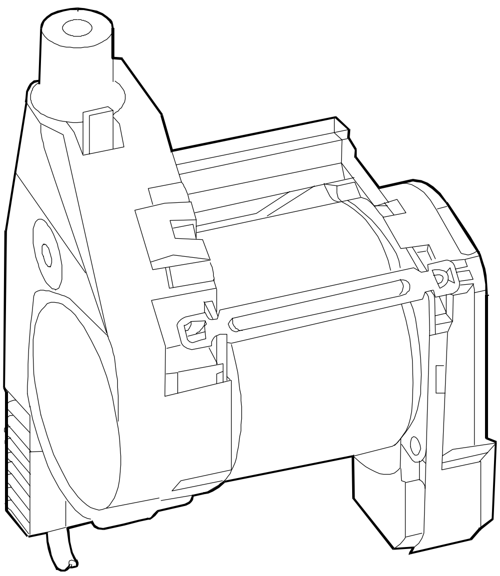
After every crash, the belt becomes unusable: therefore, it must be replaced.

The charge for driver side pretensioner is connected to central unit on pins A9/A10.

The charge for passenger side pretensioner is connected to central unit on pins A11/A12.

The charge for central pretensioner is connected to central unit on pins B17/B18.

Figure 134



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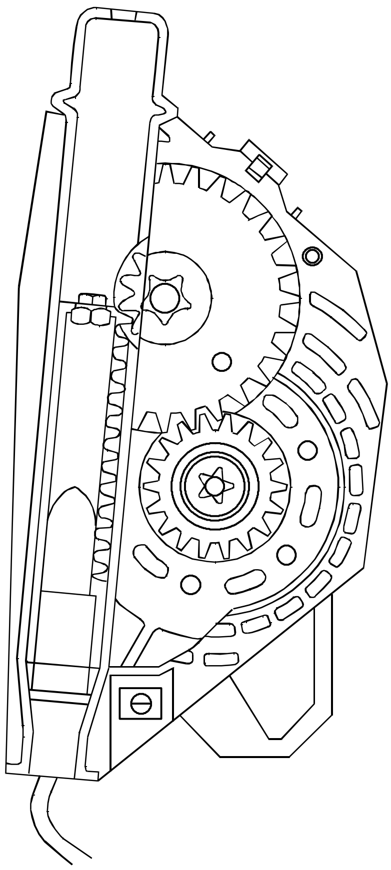

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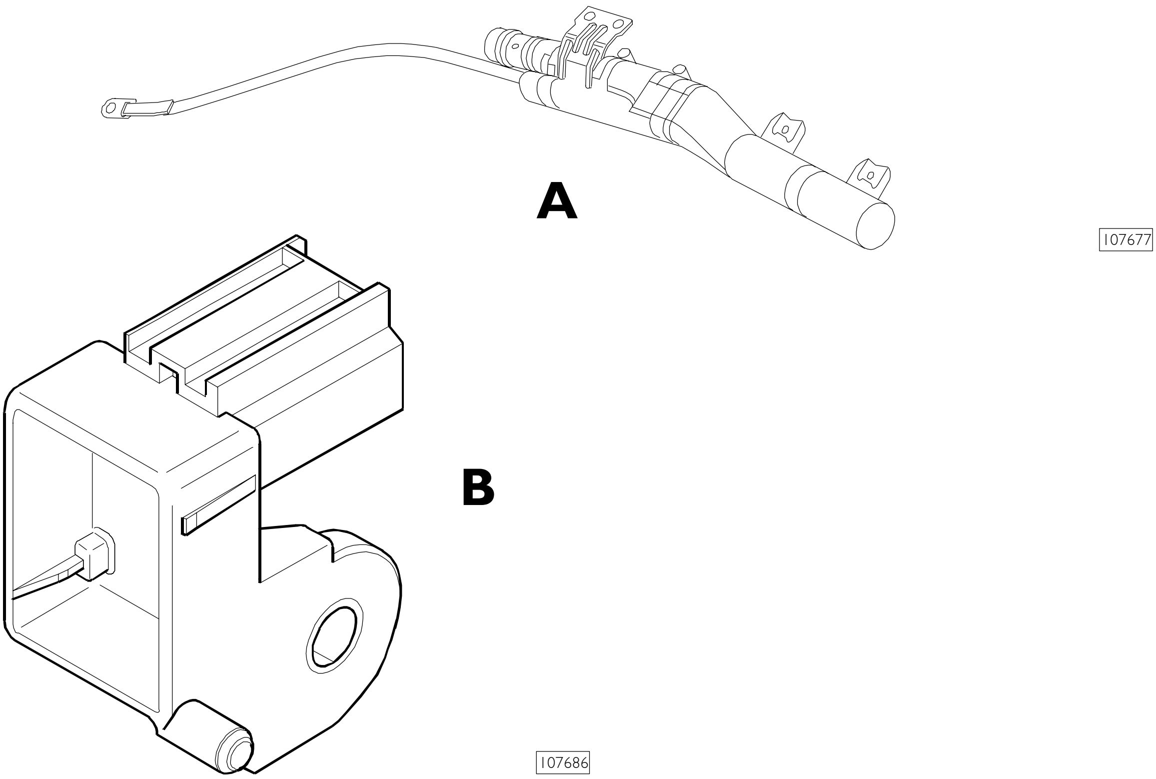
CURTAIN AIR BAG

Figure 135



A. "Curtain" air bag - B. Side crash sensor

On door pillars, two air bags named "curtain" air bags are provided. These devices intervene in case of a side crash. For this purpose, two (lh & rh) sensors are present which detect the occurrence of this event.
For the connections of these components, see central unit pin-out and relating electrical scheme.

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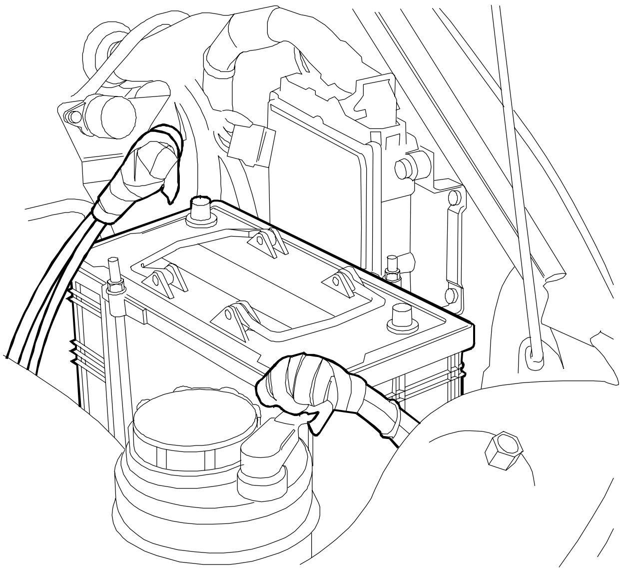
COMPONENT REPLACEMENT INTERVENTIONS

Electronic central unit

To remove the central unit, the following is needed:

- observing safety rules;
- disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins (Figure 136);
- waiting for at least ten minutes before resuming operations;
- removing the protection under which central unit is located;
- operating using a small screwdriver on connector stops locking connector fastening levers and rotating the levers inwards;
- disconnecting the connectors from central unit;
- unscrewing the three screws which fasten central unit to floor (Figure 137).

Figure 136



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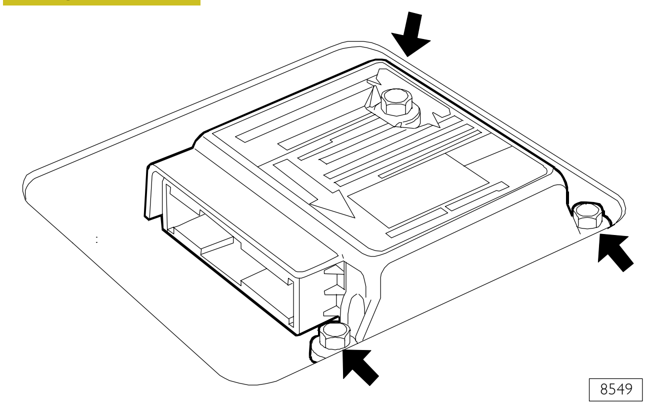
ISOLATING THE BATTERY CABLES

Figure 137



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REMOVING THE CENTRAL UNIT

Drive side air bag module

For removing air bag module, the following is needed:

- observing safety rules;
- disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins;
- waiting for at least ten minutes before resuming operations;
- unscrewing the screws located at steering wheel rear side, and, in order to be able to gain access to each screw, rotating the steering wheel in such a way that you can always operate from steering column upper half-shell side;
- lifting the module by just what needed to be able to disconnect the connector that is placed at the centre of the module;
- removing the module from steering wheel.

Not activated air bag modules, after they have been removed, must be put back into a special locked cabinet with the plate resting on the plane.

Passenger side air bag module

For removing air bag module, the following is needed:

- observing safety rules;
- disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins;
- waiting for at least ten minutes before resuming operations;
- unscrewing the screws fastening instrument panel upper coating (including the screws that are present near central air diffusers);
- removing the coating;
- disconnecting module cable connector from air bag cable;
- unscrewing the four screws, two per side, which fasten module support bracket to body and removing the module.

NOTE Where passenger side cushion is not present as it is optional, on relating connector there is since vehicle production mounted a specific resistance for simulating the charge (R = 2.15 Ohm + 0.35).

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Spiral contact

For removing the spiral contact, the following is needed:

- removing the drive side air bag module;
- aligning the wheels and keeping them in such position throughout the operation;
- unscrewing the nut which fixes the steering wheel to steering column;
- always with the vehicle having the wheels aligned, marking the position between steering wheel hub and steering column;
- taking out the steering wheel paying attention not to unthread spiral contact cable;

⚠ Make sure that steering wheel removal has caused spiral device upper cap lifting. Where upper cap rotates, it has to be locked by taking it outwards; if a click is heard, it will mean that the locking has occurred.

- removing steering column lower half-shell by unscrewing the three fastening screws;
- operating from inside, removing steering column upper half-shell by unscrewing the two fastening screws;
- cutting the clamp fixing spiral device cable to steering column and disconnect spiral device cable connector from air bag cable;
- unscrewing the three screws fastening spiral device to steering column switch unit and removing it.

⚠ Spiral device must be removed without rotating the upper cap, locking spiral device position by either a clamp or some adhesive tape.

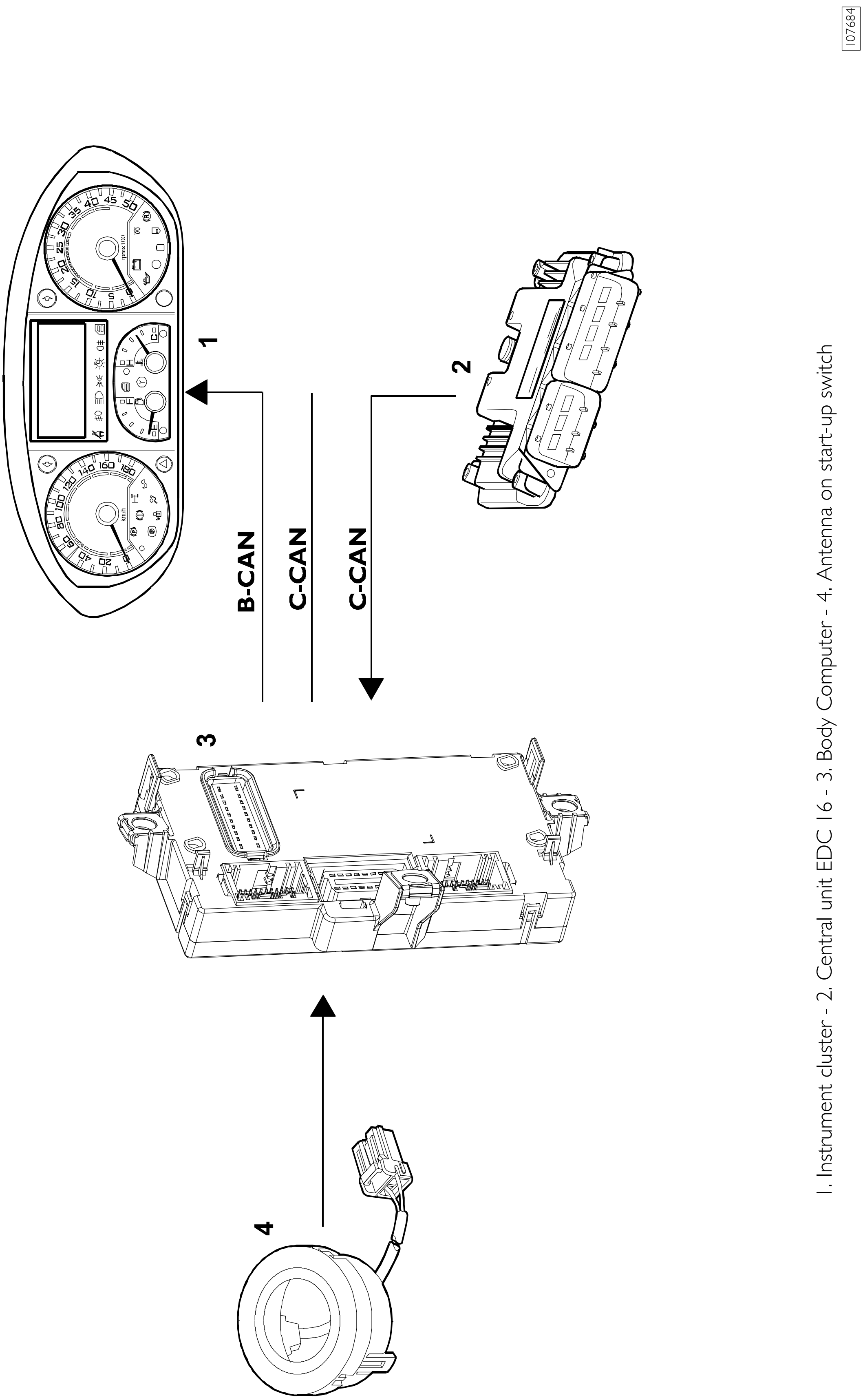
For remounting the spiral device, the following is needed:

- making sure that wheels are aligned;
- if spiral device has not to be replaced, after taking off either adhesive tape or the clamp previously mounted, remounting the spiral device without rotating the upper cap, then screwing the three fastening screws;
- where a new spiral device is mounted, after fixing it to steering column switch unit, tearing off plastic tab locking the upper cap and checking that the upper cap is not rotating;
- connecting air bag cable connector to spiral device cable and fixing spiral device cable to steering column through suitable clamp;
- mounting the two half-shells of steering column fixing them to their support plate through special screws;
- cautiously entering the cable, to be connected to drive side air bag module, into special slit on steering wheel hub;
- mounting the steering wheel making previously marked references match;
- tightening the nut, fixing the steering wheel, at prescribed torque.

NOTE Where steering column switch unit is replaced, it must be replaced by a steering column switch unit comprehensive of spiral device.

IMMOBILIZER

Figure 138



1. Instrument cluster - 2. Central unit EDC 16 - 3. Body Computer - 4. Antenna on start-up switch

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Operation description

Immobilizer present on Daily E4 differs from previous one in some features:

- "Immobilizer" central unit is not present any more, but this function has been integrated inside Body Computer;
- the warning lamp has a different symbol;
- a display screen is present where messages relating to the system are displayed (COMFORT).

Signal received from the "transponder" from the key is sent to connector AV to pins 8 and 7. Body Computer communicates with central unit EDC 16 through "C" Can line and, if the signal is acknowledged, start-up enabling is sent to central unit EDC. By rotating start-up key, engine lock is only de-activated if protection system acknowledges the code that was transmitted by the key.
Body Computer through "B" second Can line communicates with instrument cluster, where Immobilizer warning lamp is present (change of symbol with respect to previous version).

- warning lamp on: key not acknowledged;
- warning lamp off: key acknowledged.

A warning lamp on after approximately two seconds from vehicle start-up not necessarily means system failure but can mean a particularly low charge status in battery.
Where such event occurs, in order to make a system test, vehicle must be stopped and engine put off. Rotate the key again: warning lamp will go on and shall go off after approximately 1 second.
Where warning lamp remains on after this test too, repeat the operation keeping engine stopped up for more than 30 seconds. if the problem persists, comply with provided prescriptions appearing on display screen (if any).

Emergency procedure

It is necessary to enter "PIN code" only operating on accelerator pedal as described below:

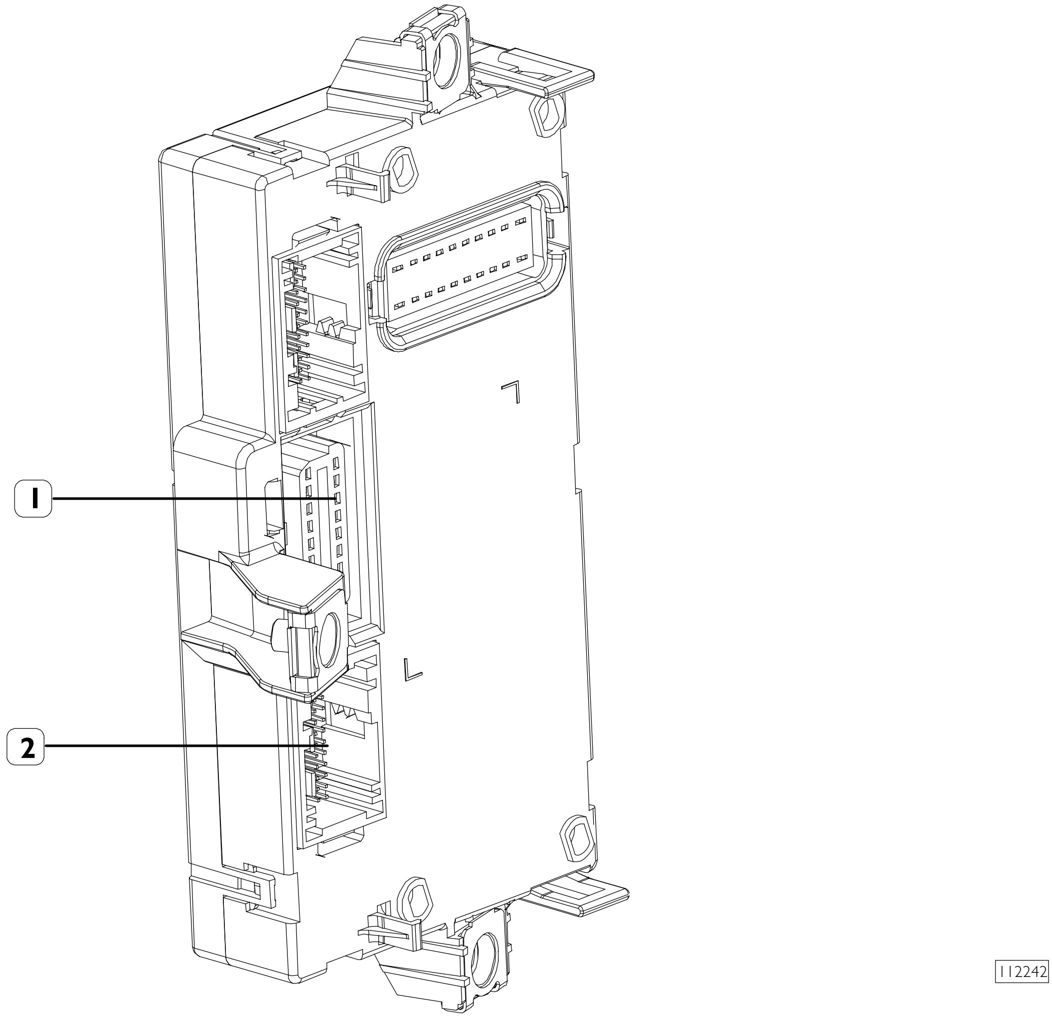
- Insert the key to ride position.
- EDC warning lamp, after ~ 2 seconds, starts flashing rapidly.
- Press accelerator pedal and keep it pressed for ~ 15 seconds.
- EDC warning lamp starts flashing slowly.
- When the number of flashings is matching "PIN code" first figure, fully press down accelerator pedal, then release it again. (While this pressing operation is performed, EDC warning lamp remains off).
- Go on with reading and performing relating pressing operation on accelerator pedal for remaining four "PIN code" figures.
- At the end of the sequence, if entered code results to be correct and no failure is present in the system, EDC warning lamp stops flashing: operation terminated correctly.
- Start up the vehicle.

Keys

- New key memorization procedure (centralized by Iveco)
- New type of key with trasponder (with or without wireless control)
- You can memorize min 1 up to max. 8 keys

Body computer

Figure 139



1. "EDBD" diagnosis connector - 2. "AV" connector

Capable to communicate with central unit "EDC" through "CAN line".

Central unit main tasks are:

acknowledging that the key was entered into the switch and rotated,

activating and reading the secret code issued by "Transponder",

managing code check and processing,

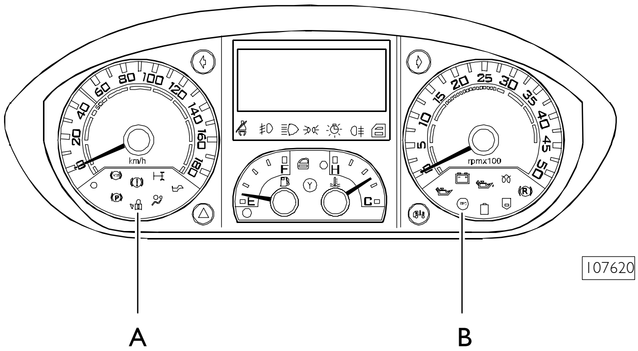
communicating with central unit "EDC",

storing any failures,

making system diagnosis.

AV/7 - AV/8 antenna signal input (Transponder)

Figure 140



A. Immobilizer warning lamp - B. EDC failure warning lamp

Antenna

It is mounted coaxial to key switch and has the task of:

- supplying "Transponder" for sending the secret code;
- receiving the signal from "Transponder" and sending it to central unit.

It is connected to Body Computer to connector AV/7 - AV/8.

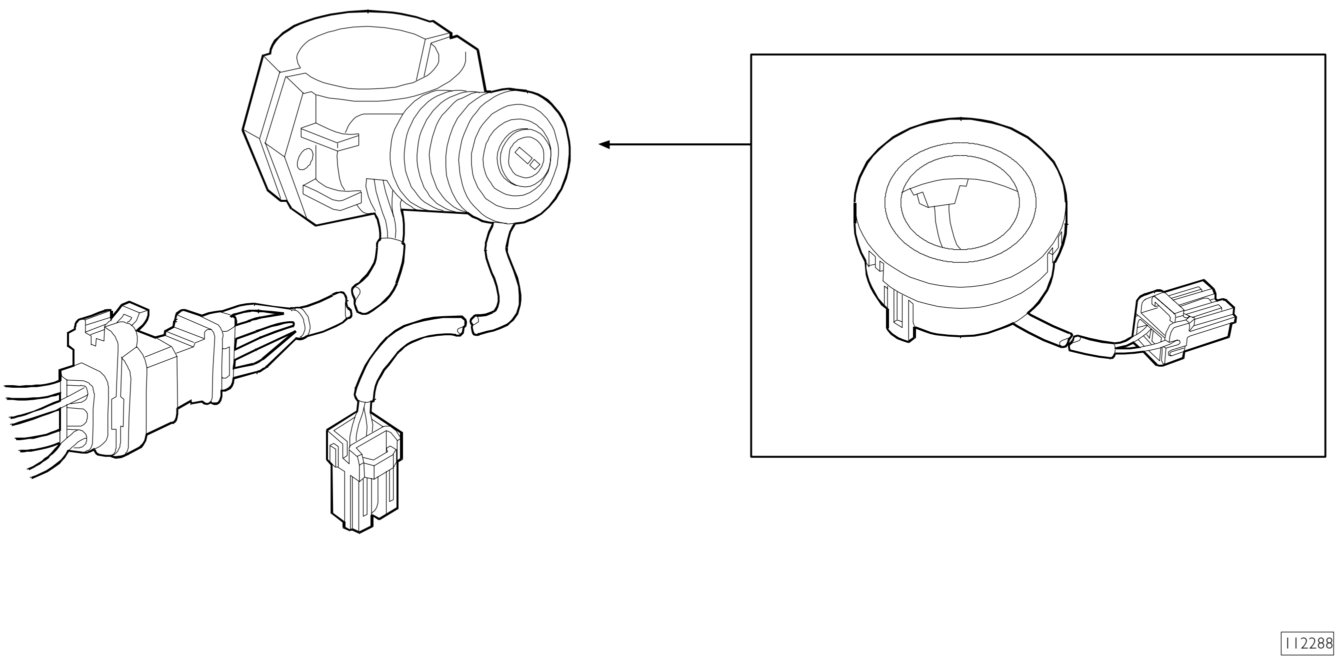
Warning lamp

Placed on instrument cluster, it acquaints the driver of system correct operation or possible failure.

Inserting the key to ride position, central unit makes a system test putting on the warning lamp and keeping it on for a time of about "1 second".

If it goes off after said time, it means that the key was acknowledged and system is working. On the contrary, if it behaves in a different way, it means that key was not acknowledged (star-up not possible).

Figure 141



IMMOBILIZER NEW PROCEDURES

Storing new keys into Body Computer	❑ Send out a fax to Iveco with key VIN and PN. ❑ Keys arrive programmed by Iveco but it is necessary to have them acknowledged through diagnosis tool. Old keys can be stored later
Storing radio commands	Through diagnosis tool
Replacing Body Computer (readable)	Through diagnosis tool: keys need not to be learnt again
Replacing Body Computer (not readable) with remote services	Through remote services: to reset the plan (instrument cluster), Programmed Maintenance keys and/or radio commands need to be learnt again
Replacing Body Computer (not readable) without remote services	❑ BC already programmed by Iveco is sent and it will be necessary to have old keys acknowledged on new Body Computer. ❑ Rewrite maintenance plan. Information stored in old B.C. are lost
Replacing EDC16	No particular procedure: as soon as new EDC is connected, it is automatically configured by Body Computer
Replacing key switch	❑ Order a kit complete with switch and two keys to be programmed at Iveco. ❑ Workshop shall just store the keys into Body Computer by Easy.

Programmed maintenance is a function of display screen in version COMFORT.

6AS 400 A O.D. VD AUTOMATIC TRANSMISSION

Description of operation

The gear engaging system of the 6 AS 300 VD gearbox is a combination of a traditional system of the mechanic type and an electric one.

Below are the main components of the system:

1) electronic control unit;
2) gear selecting/engaging actuator;
3) gear shift lever;
4) clutch actuator;
5) display/buzzer.

In the manual mode, the first gear is used to start the vehicle.

In the automatic mode, you just need to act on the selection lever (A/M): the gear is selected directly by the control unit.

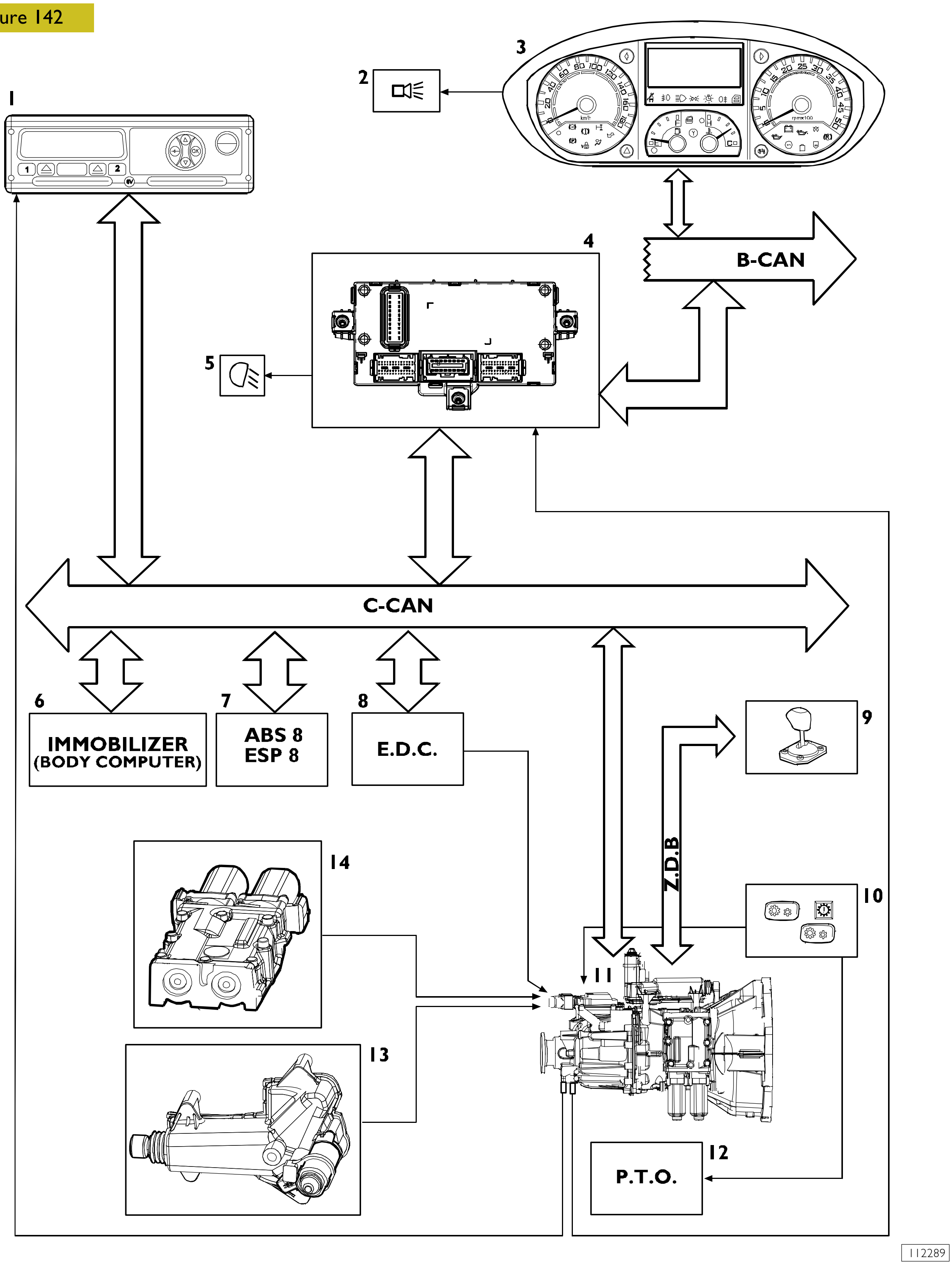
The electronic control unit picks up all the signals required to meet the safety conditions and the parameters programmed in the same. It also drives the electric actuating motor(s) for gear selection/engagement and clutch control.

The information required for driving is in any case made available to the driver by means of the display.

NOTE To ensure correct management of the gearbox and the other auxiliary functions provided for by the system, the control unit is interfaced (CAN line) with the other electric and electronic system fitted to the vehicle.

Electronic management

Figure 142



1. Digital tachograph - 2. Buffer (located inside Instrument Cluster - 3. Instrument Cluster - 4. Body Computer - 5. Switching on reverse lights - 6. IMMOBILIZER central unit - 7. Central unit ABS8/ASP8 - 8. Central unit EDC - 9. Gears lever - 10. Pushbutton board - 11. Central unit gearbox - 12. PTO - 13. Clutch actuator - 14. Gearbox actuator

COMPOSITION OF THE SYSTEM

System control unit

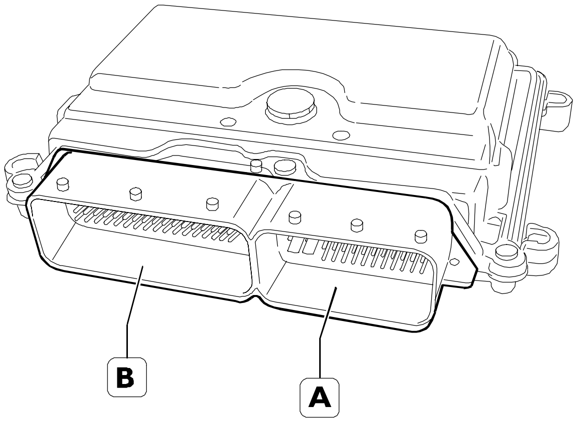
The electronic control unit receives the signals from the sensors/switches: the management and control of the system under the different operating conditions of the gearbox are based on the above signals.

It is interfaced with other electronic systems available on the vehicle, such as EDC and ABS, through CAN communication lines.

A - Connector on the gearbox side

B - Connector on the vehicle side

Figure 143



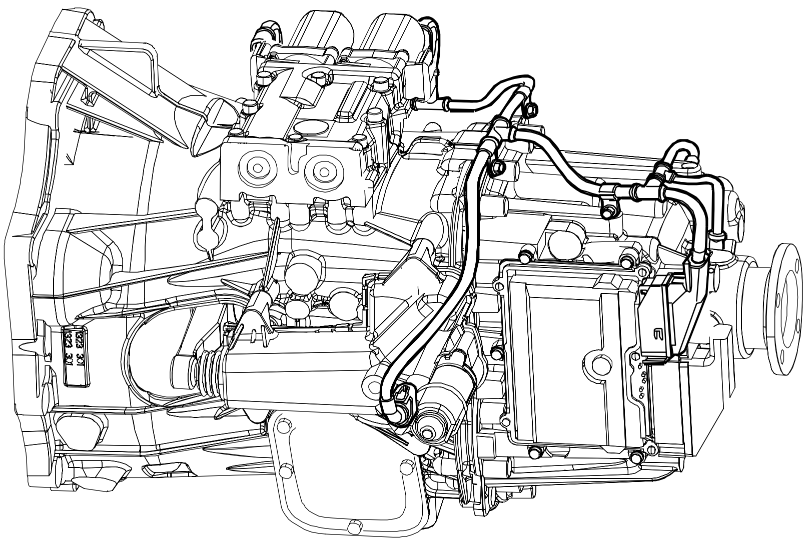
Through the connection with the EDC 16 system, the gearbox control unit is able to detect the position of the accelerator pedal and also the engine revs number.

Connection with the ABS8/ESP8 control unit is used to prevent the "UP" gear shift at bends and also control driving under poor grip conditions in case of mode "A" driving.

The new ABS system controls "smart" warning lights incorporated into the on-board panel. These warning lights come on to indicate braking system failure.

NOTE The "Brake" signal, upon start-up, comes directly from the EDC control unit. The reverse gear signal is direct.

Figure 144



Position of the electronic control unit

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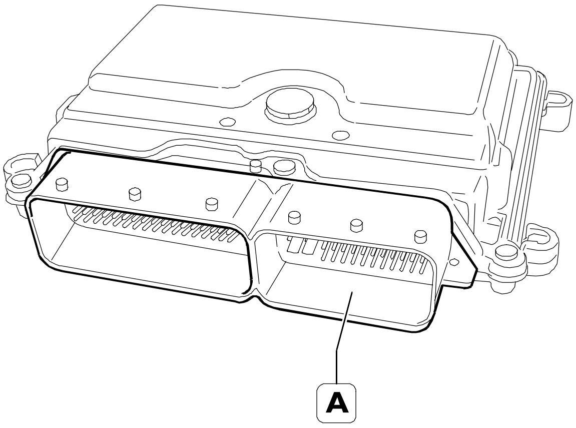
Connector control unit PIN-OUT – gearbox side (A)

Figure 145



Pin	Function
1	Electric motor positive (gearbox actuator selector pin 6)
2	Electric motor negative (gearbox actuator selector pin 1)
3	Electric motor positive (clutch actuator pin 3)
4	Electric motor negative (clutch actuator pin 6)
5	Electric motor positive (gear engaging gearshift actuator pin 6)
6	Electric motor negative (gear engaging gearshift actuator pin 1)
11	Sensor direction signal (clutch actuator pin 4)
12	Sensor speed signal (clutch actuator pin 2)
13	Clutch actuator pin 5 sensor voltage signal (5 V)
15	Sensor direction signal (gear engaging gearshift actuator pin 4)
16	Sensor voltage signal, 12 V (gear engaging gearshift actuator pin 3)
17	Sensor voltage signal, 12 V (gearbox actuator selector pin 3)
18	Sensor direction signal (gearbox actuator selector pin 4)
33	Earth (clutch actuator pin 1)
35	Sensor speed signal (gear engaging gearshift actuator pin 5)
36	Earth (gear engaging gearshift actuator pin 2)
37	Earth (gearbox actuator selector pin 2)
38	Sensor speed signal (gearbox actuator selector pin 5)

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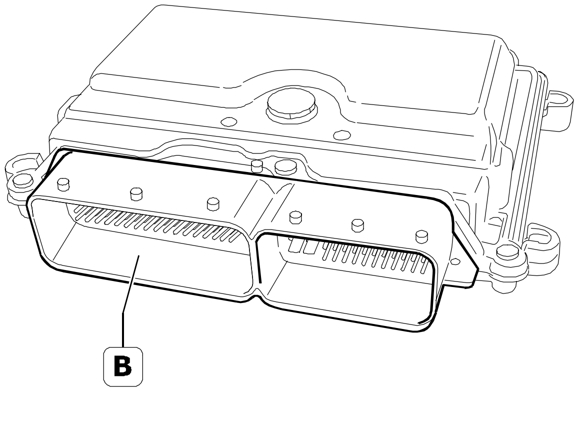
Connector control unit PIN-OUT – vehicle side (B)

Figure 146



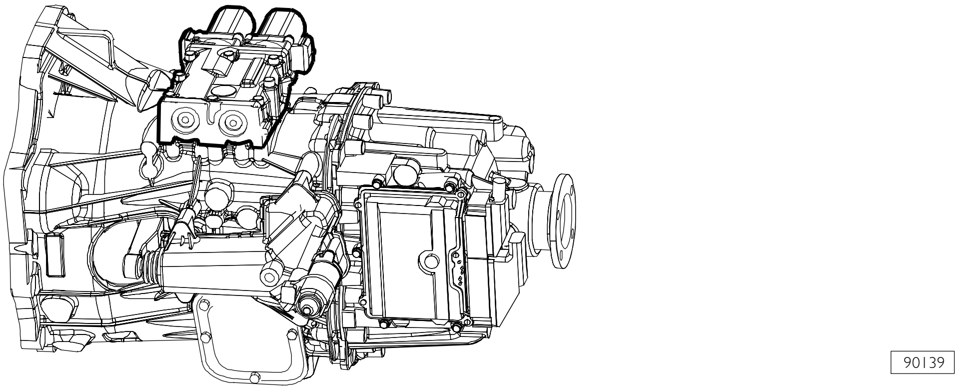
Pin	Function
1	Earth
2	Earth
3	Earth
4	Battery positive
5	Battery positive
6	Battery positive
7	Earth
8	Earth
9	KL 30
14	PTO actuation request signal (option)
17	CAN C "H" line
18	CAN C "EDC" line
28	CAN C "EDC" line
29	CAN "L" line
33	Free
37	Free
38	Free
39	KL 30
40	CAN L --- ZF LINE
41	CAN H --- ZF LINE
43	KL 15
44	Hand brake in signal
45	Signal to Body Computer
46	PTO status signal
47	PTO in signal
49	"Gearbox in neutral position" remote control switch control
51	Speed signal
52	Diagnosis line K (heater, Body Computer)

Gearbox actuator

The function of the gear actuator is to continuously exchange information with the electronic control unit for gear selection and engagement.

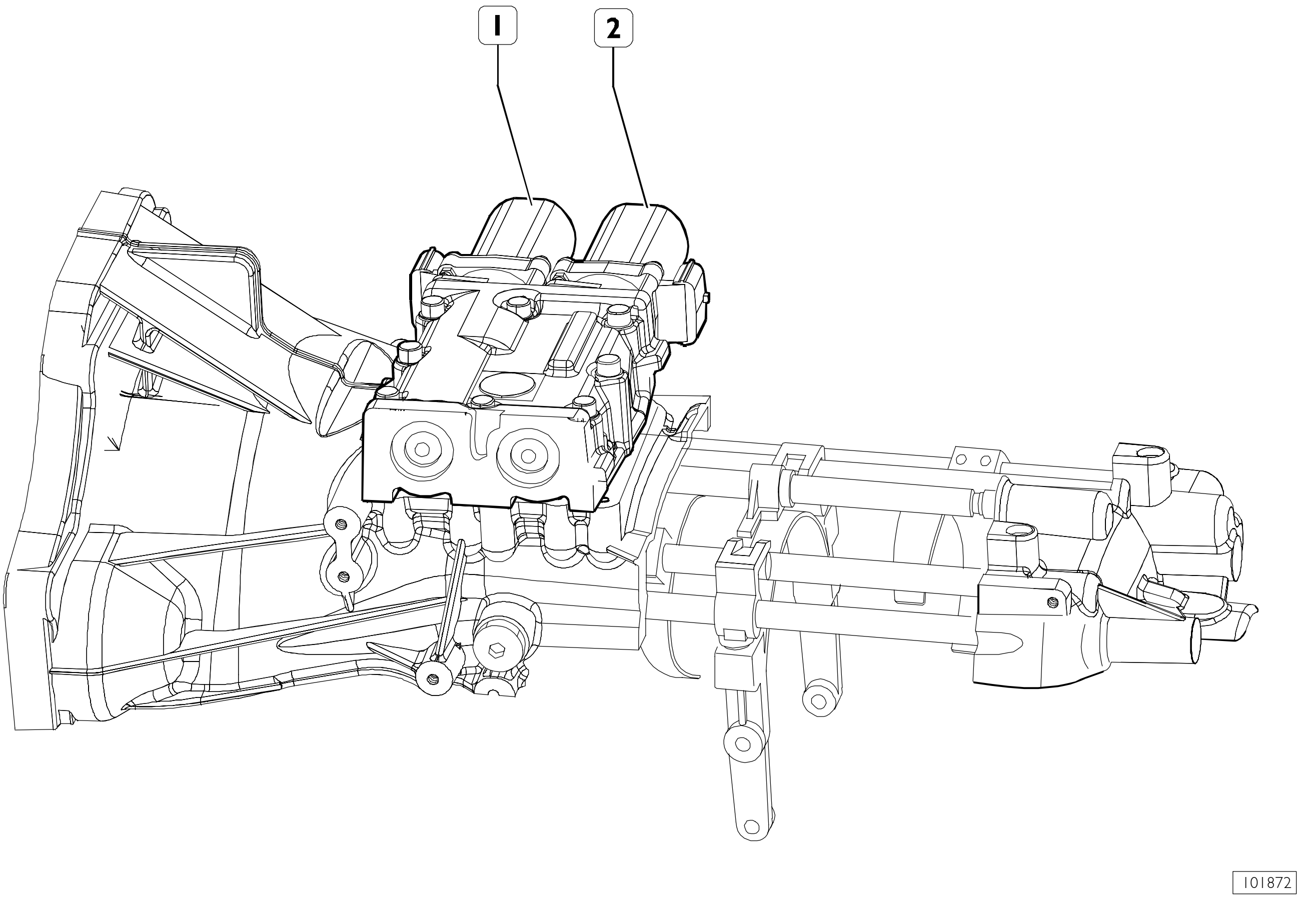
It is made up of two electric motors, control cylinders, and respective sensors.

Figure 147



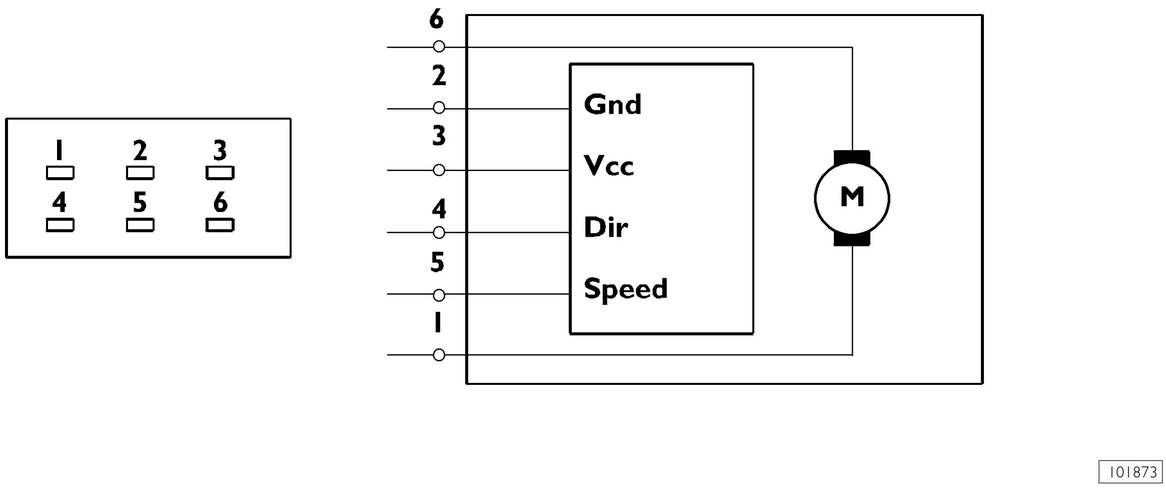
Position of actuator

Figure 148



1. Gear engaging electric motor - 2. Gear selection electric motor

Figure 149



Wiring diagram

Pin	Function
1	Electric motor negative
2	Earth
3	Sensor voltage signal
4	Sensor direction signal
5	Sensor speed signal
6	Electric motor positive

Characteristics of electric motor

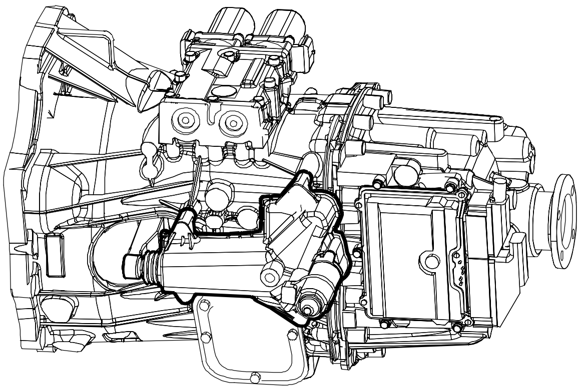
Voltage	12 V
Output	95 W
Torque	0.72 Nm (at 125 °C)
n_{max}	5400 r.p.m.

Clutch actuator

It is made up of the following:

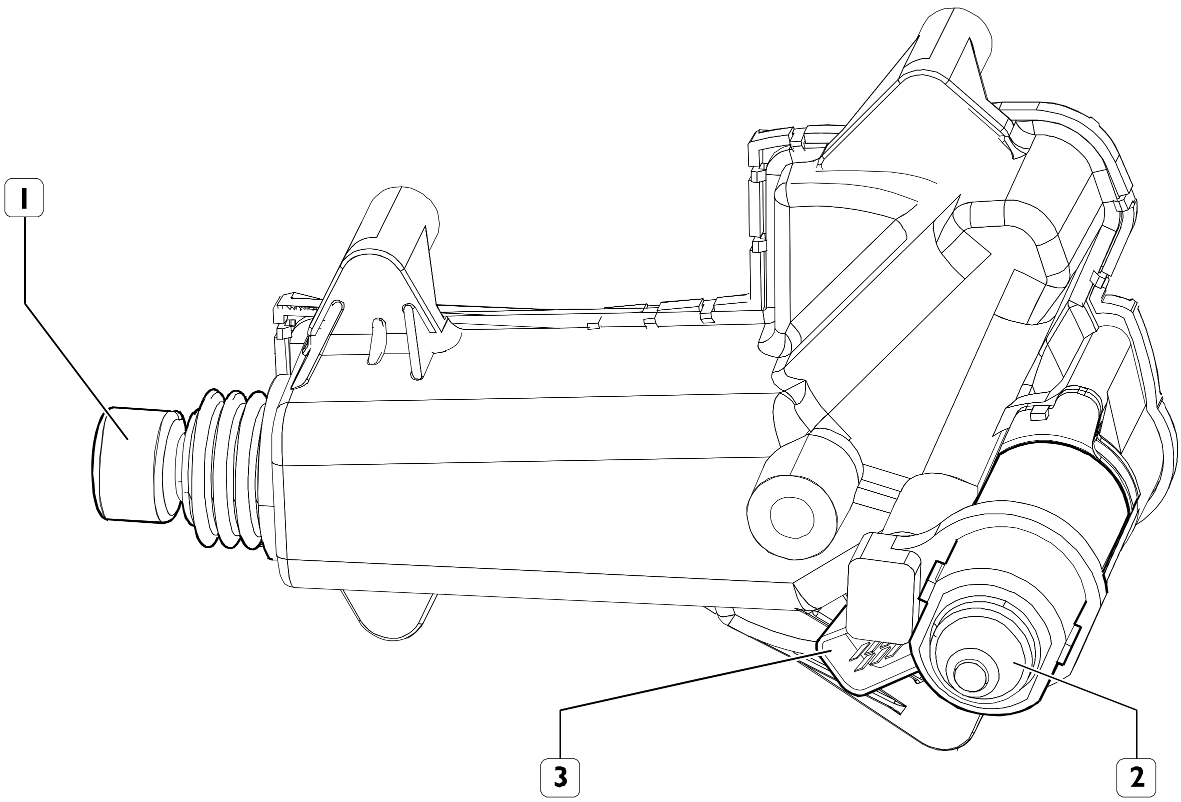
- ❑ a cylinder acting on the clutch engaging/disengaging lever;
- ❑ a position sensor that detects the clutch lever stroke, by informing the electronic control unit of the actuating cylinder position and the clutch plate wear.

Figure 150



90137

Figure 151



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1. Actuating cylinder - 2. Electric motor - 3. Vehicle electric wiring junction block

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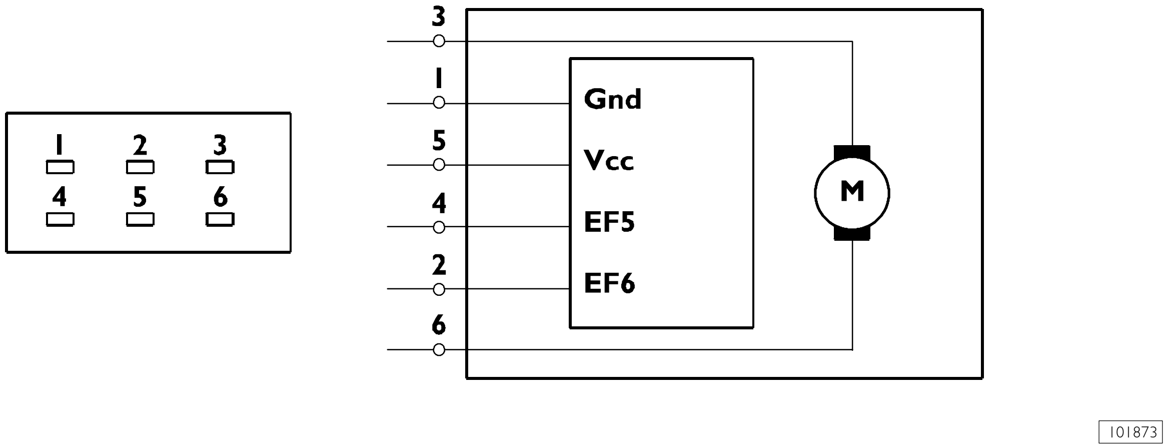
Figure 152



Wiring diagram

Pin	Function
1	Earth
2	Incremental sensor speed signal
3	Electric motor positive
4	Incremental sensor direction signal
5	Sensor voltage signal
6	Electric motor negative

Characteristics of electric motor

Max. torque	0.65 Nm
No-load revs number	5800 r.p.m.
Output	80 W (0.3 Nm - 2,500 r.p.m.)

Accelerator pedal

To detect the engine idling position and allow the clutch to be engaged when the vehicle is about to start, the N.O. switch, incorporated into the position sensor, is used, with the pedal released.

This signal reaches the EDC electronic control unit and is sent, through the CAN VDB (Vehicle Data Base) line, to the gearbox control unit.

The "kick-down" function can be actuated during running, in the automatic mode.

When the pedal is pressed down almost fully (98%), e.g. when overtaking, the system will automatically shift down by one speed, thus making it possible to use the deflecting torque at its best.

In practice, if the accelerator pedal is pressed fully down, the vehicle will ride at a running speed with a higher gear shift.

Figure 153

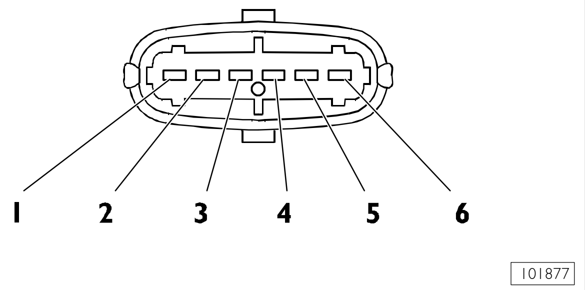


Figure 154

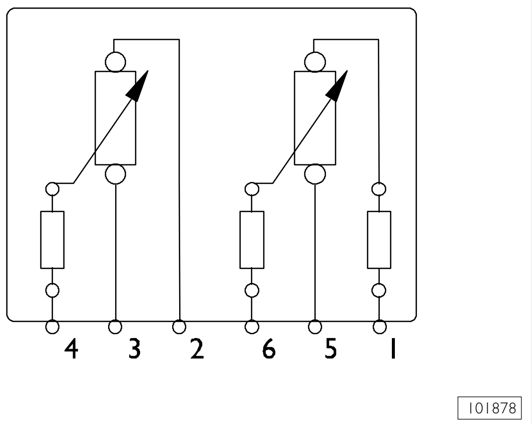
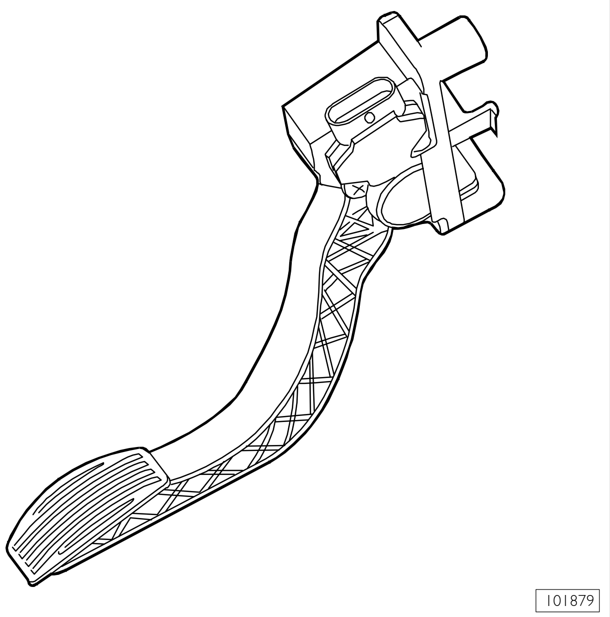


Figure 155



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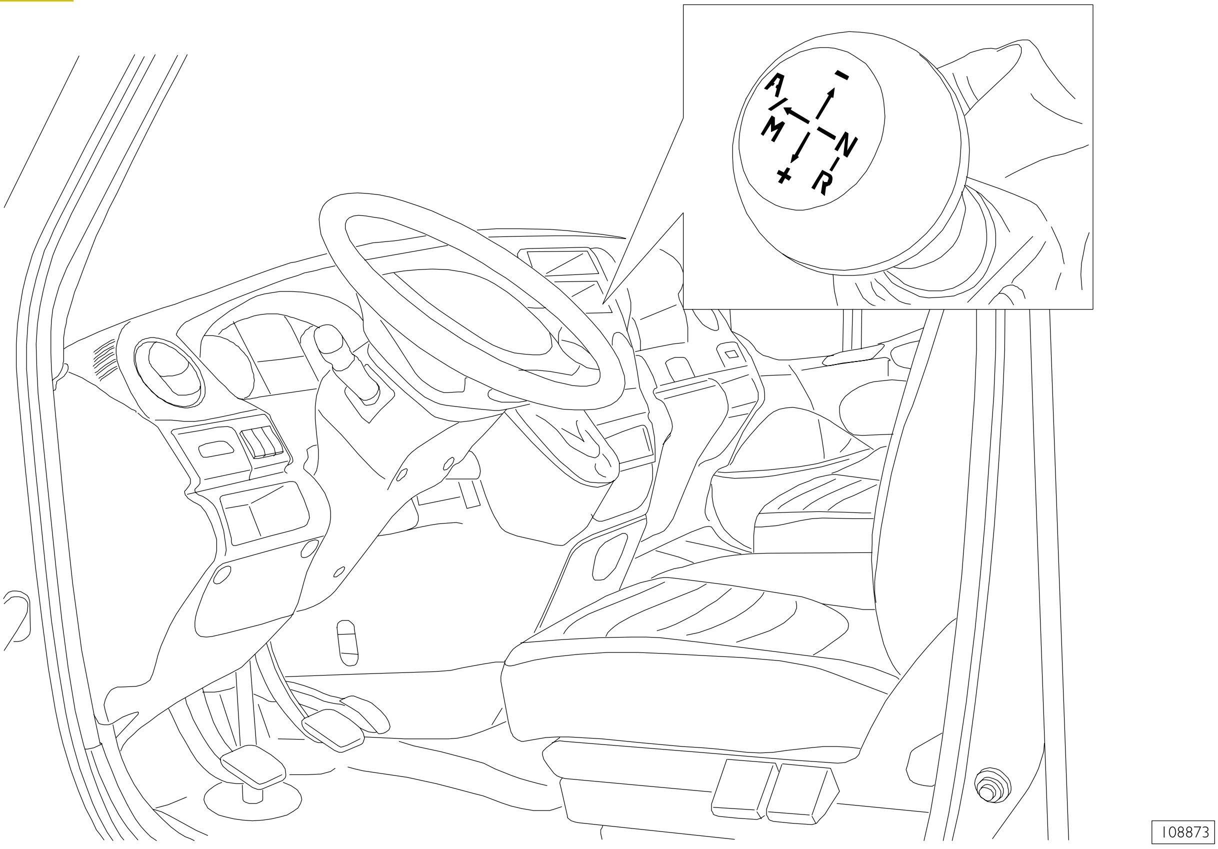
Gear selector

Figure 156



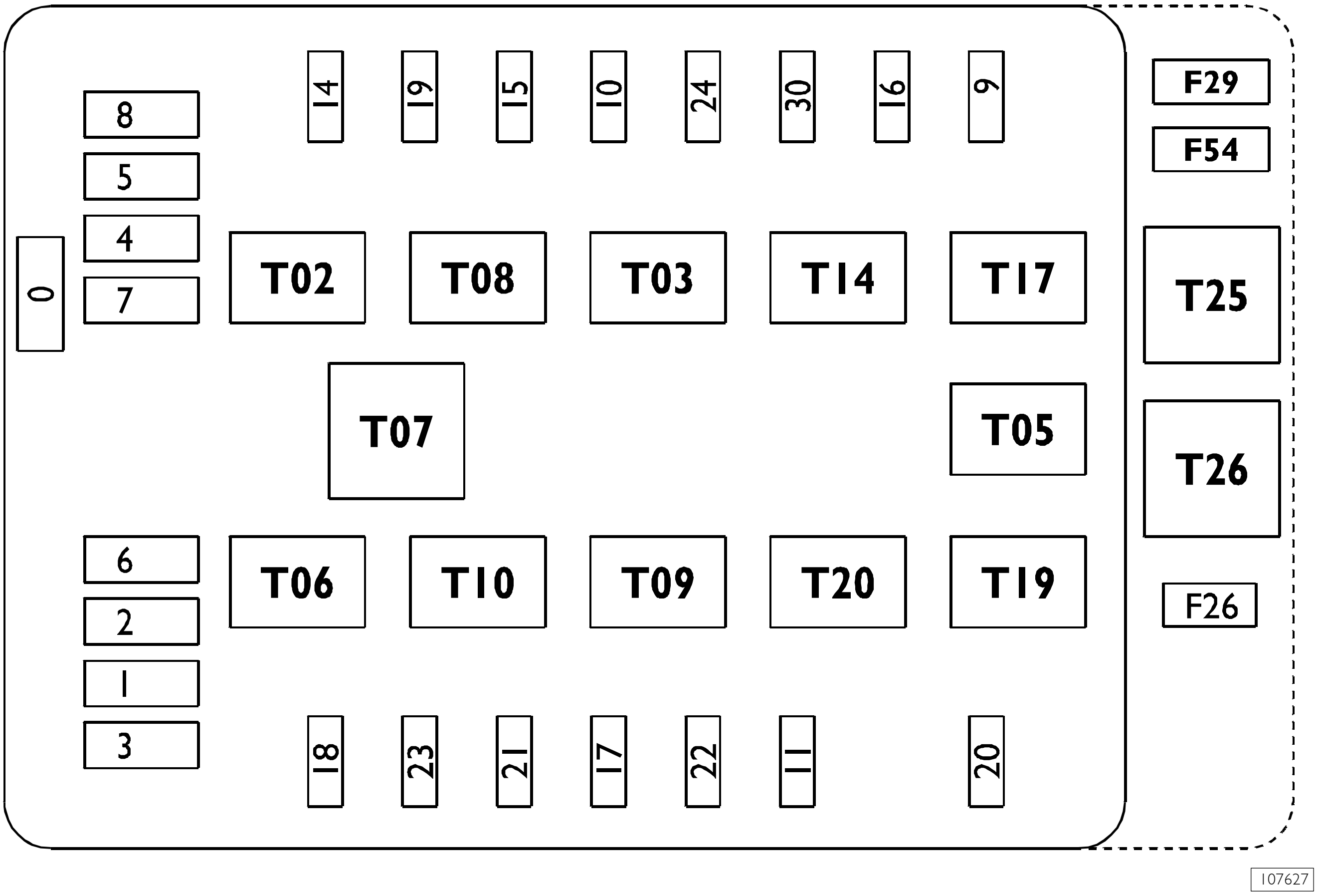
Gear selector is an electronic component placed in the cab at driver side.

It is interfaced with gearbox central unit through CAN communication line in order to signal that the driver is going to select and engage a gear.

PIN	FUNCTION
1	KL 15
2	GROUND
3	CAN L
4	CAN L
5	-
6	-

REMOTE CONTROL SWITCHES / FUSES ASSEMBLY

Figure 157



System power supply is ensured by an assembly of fuses located in engine opening in interconnection central unit at highlighted positions.

F3 – is connected to central unit pin B4

F4 - is connected to central unit pins B5 and B6

F18 - Central unit power supply

F24 – Automated gearbox services

Where one or two of these fuses is burnt, gearbox functionality is not impaired. Failure of fuse F24 only prevents gearbox from operating (clutch movement, gear selection and engagement are inhibited).

Accelerator pedal sensor

Accelerator pedal position is provided to gearbox central unit through proper communication line by electronic central unit EDC, which learns the position thanks to load transmitter directly mounted on accelerator pedal.

Engine rpm sensor

The sensor is mounted at engine flywheel.

Engine rotation speed values are transmitted to electronic central unit EDC, which through proper communication line transfers them to gearbox central unit.

Vehicle speed sensor

The sensor transmits pulses to electronic tachograph / tachometer.

The signal is duplicated by sensors ABS/ESP present on the wheels.

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PTO

There is one pushbutton only, which is used for inserting and disconnecting PTO.

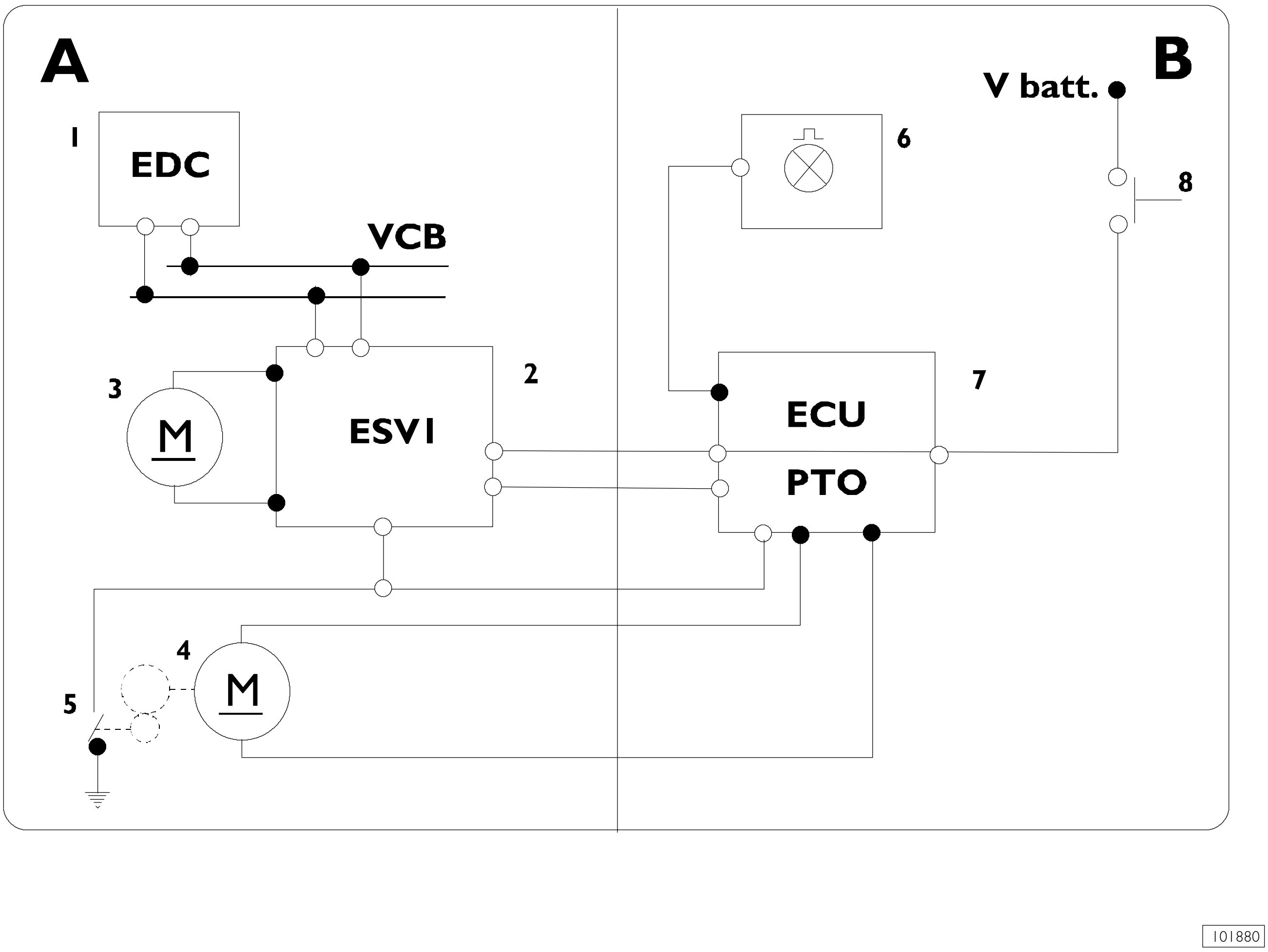
PTO can only be engaged with gearbox in neutral position and engine on.

PTO can be used both in STATIONARY and NON STATIONARY conditions.

In NON STATIONARY conditions valid are following conditions:

- First gear can be put in and vehicle moved.
- Once started, with vehicle moving, gear cannot be shifted any more;
- PTO can be disengaged with gearbox in both gear and neutral position.
- Depending on signal coming in to Pins, self-implementing device acknowledges if it is working with either a mechanical or automated gearbox. If it is working with a mechanical gearbox, signal comes in from clutch pedal.

Figure 158



1. EDC control unit - 2. Gearbox control unit - 3. Clutch actuator electric motor - 4. PTO actuator motor - 5. PTO ON switch - 6. PTO ON warning light - 7. PTO control unit - 8. PTO actuation switch - A. Gearbox side - B. Vehicle side.

PTO engaging procedure

To engage power take-off, following operations must be preformed: Put on engine with gearbox in neutral position.

1) press the PTO button;
2) wait at least 0.5 seconds;
3) release the PTO button.

NOTE
- ❑ The PTO will be actuated only if the PTO button is kept depressed for more than 0.5 seconds.
- ❑ The PTO button will be ignored until the next 5 seconds have elapsed.

PTO disengaging procedure

To disengage the power take-off, the following operations must be carried out:

1) press the PTO button;
2) wait at least 0.5 seconds;
3) release the PTO button.

NOTE
- ❑ The operation will be carried out only if the PTO button is kept depressed for more than 0.5 seconds.
- ❑ The PTO button will be ignored until the next 5 seconds have elapsed. • In the event that the power take-off is not disengaged within 5 seconds, the operator may carry out the operation again, by pressing the button again.

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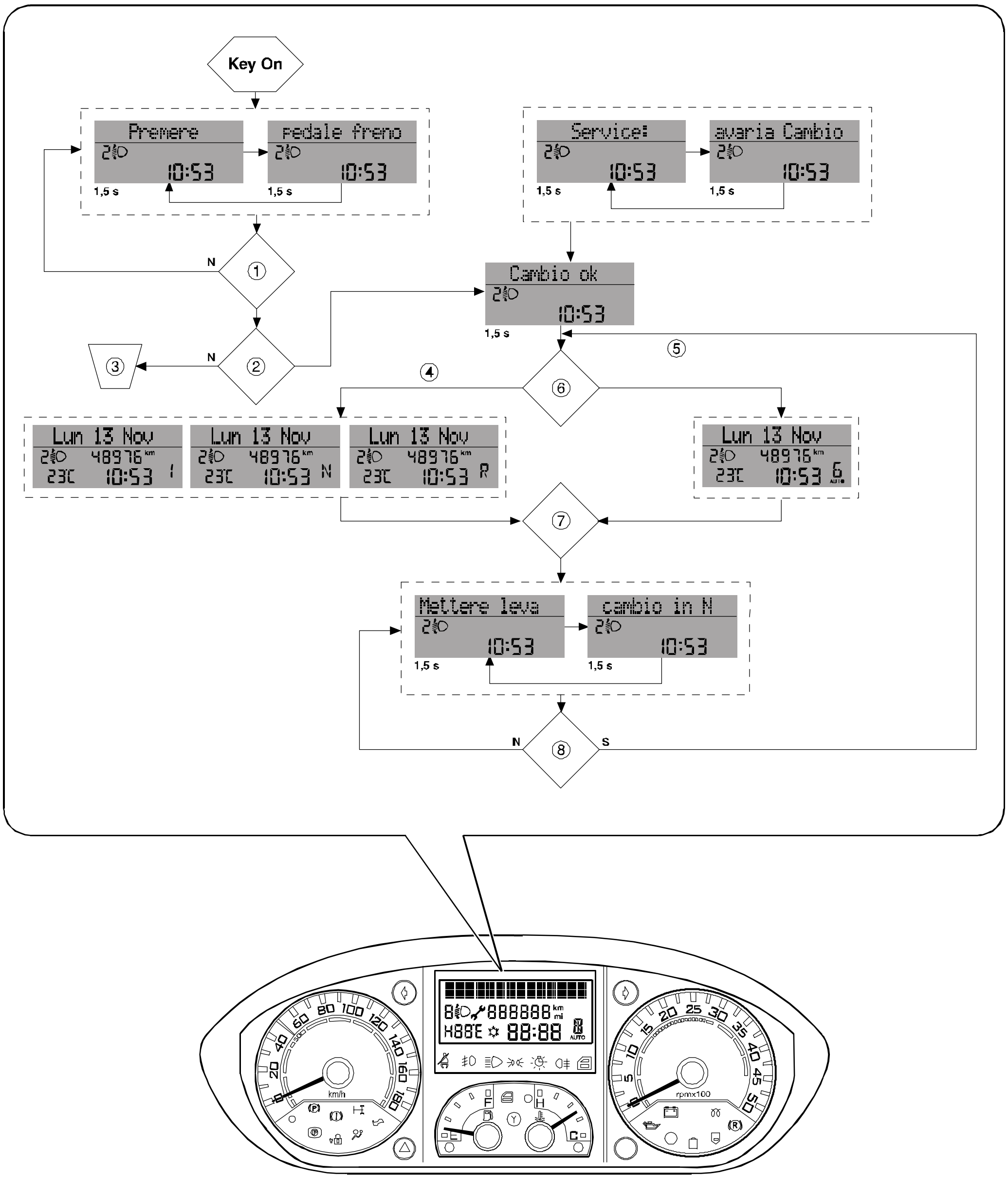
Display screen

Figure 159



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Display screen, positioned on instrument panel, allows to display all information necessary for system correct use, as, for example:

Mode: manual or automated, and, in both cases, gear ratio entered;

Reverse gear / neutral (R/N) position;

Signalling faults:

- ”SERVICE: gearbox failure”
- ”SERVICE: serious gearbox failure” (associated to sound warning)
- ”SERVICE: clutch excessive temperature” (associated to sound warning)
- ”Gearbox failure in SERVICE mode” (message that can only be displayed at Assistance Network)

Alarm is integrated in Body Computer central unit; it is optional.

Where alarm is to be mounted at Assistance, the following is needed:

1. PROGRAMMING THE BODY COMPUTER
2. INSTALLING THE SIREN
3. INSTALLING ENGINE BONNET SWITCH
4. Storing radio commands into Body Computer central unit

Body Computer manages alarm.

Alarm controls vehicle perimetral portion (doors and bonnet switches), and also any battery and siren disconnections. BC directly controls external siren. It also activates inserted alarm LEDs, activates blinkers and transmits all information to Instrument Cluster via B-CAN for managing VPS (Vehicle Protection System) warning lamp on the dashboard.

Body Computer controls and diagnoses alarm siren, receives input from vehicle alarm system and also provides siren condition.

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DIAGNOSIS (CONNECTOR EOBD)

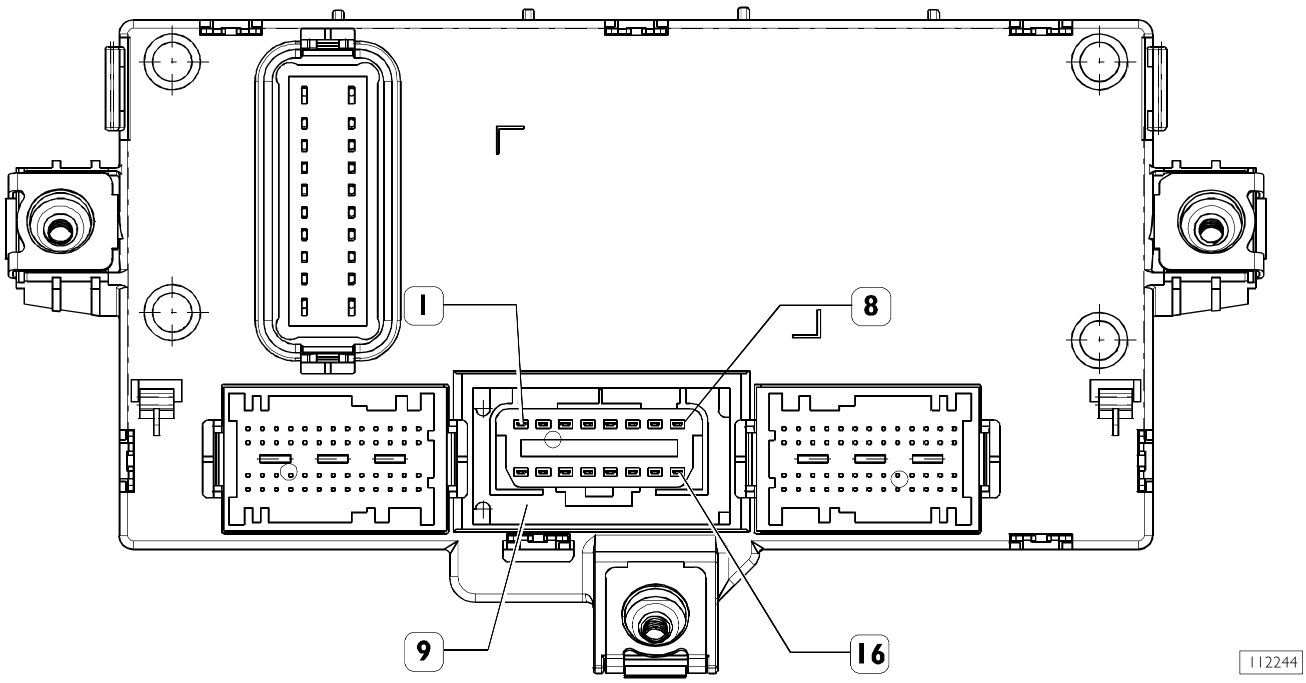
The vehicle that is described in this section has a number of differences with respect to previous version. 30-pole diagnosis connector located on vehicle right side in front of passenger was replaced by a 16-pin connector.

It is placed on vehicle left side near interconnection central unit CPL.

This connector is placed on Body Computer (it is a part of the component). Therefore, connection cables are not present as necessary connections are directly implemented on Body Computer printed circuit.

To be connected to it will be available diagnosis tools.

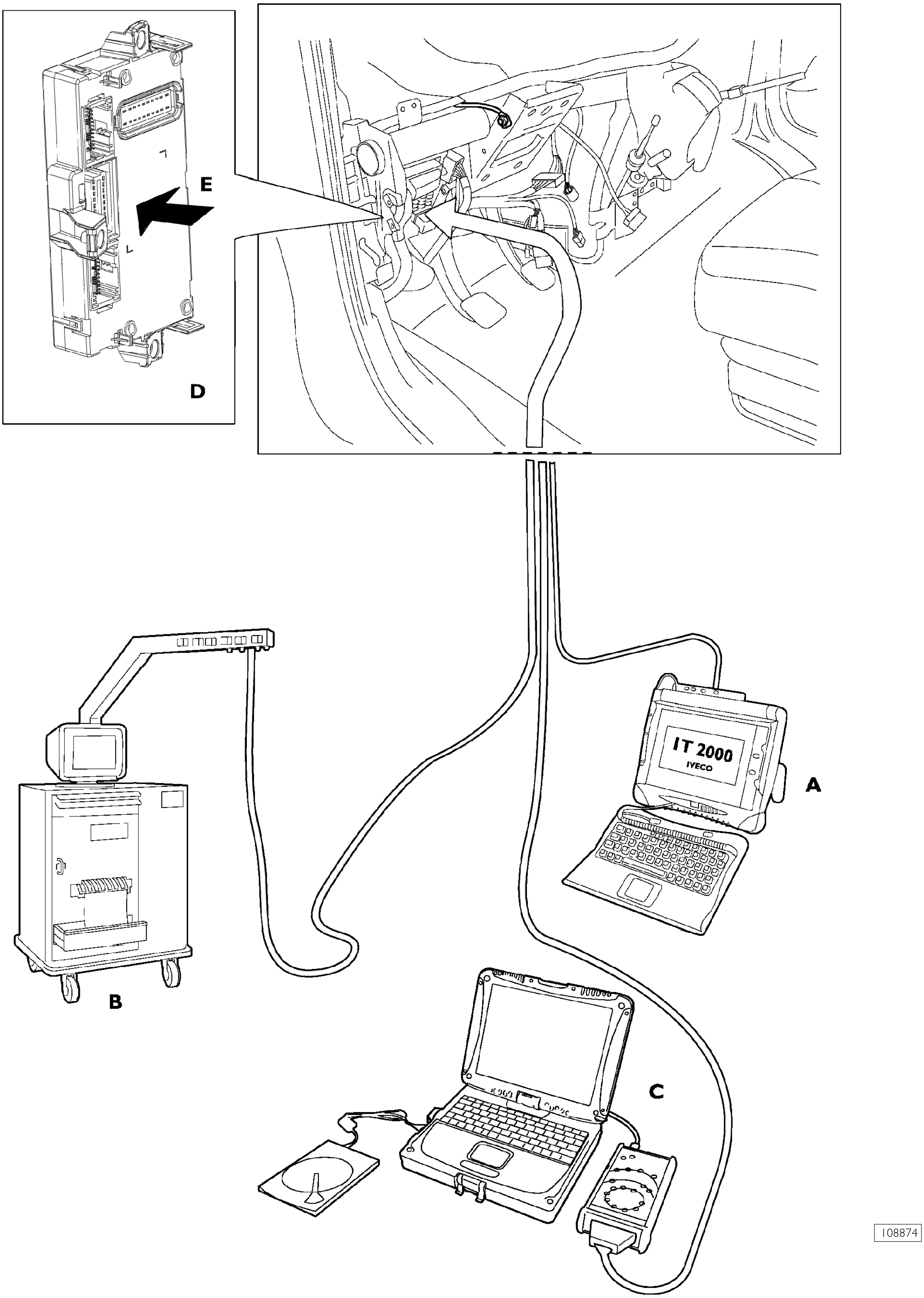
Figure 160



Diagnosis connector "EOBD"

PIN	FUNCTION
1	free
2	free
3	positive +15
4	earth
5	signal earth
6	B Can line "H"
7	line "K" EDC
8	line "K" ABS/ESP, Tachometer
9	free
10	free
11	line "K" for climate control system
12	free
13	line "K" for suspensions, retarder
14	B Can line "L"
15	free
16	positive +30

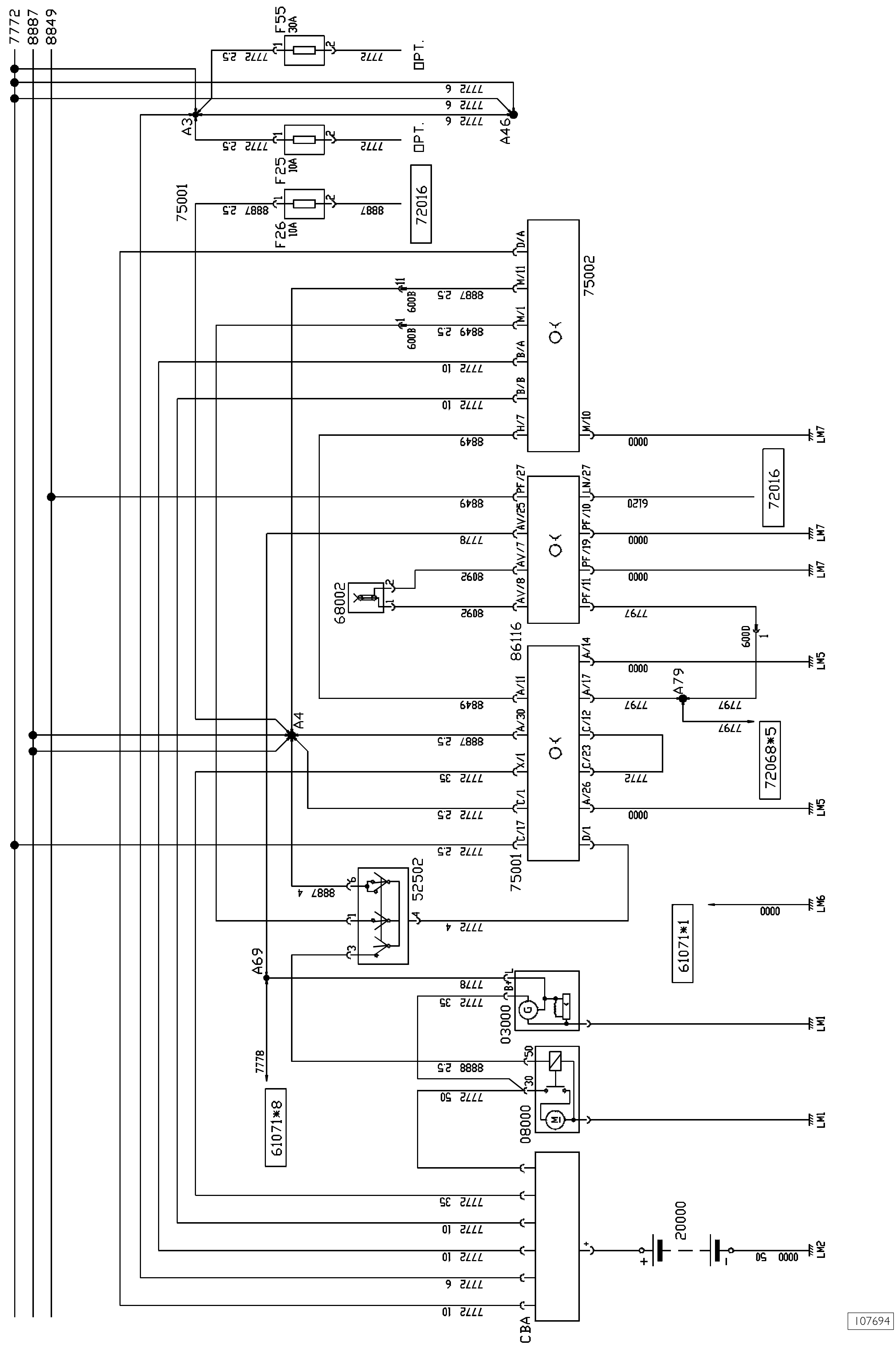
Figure 161



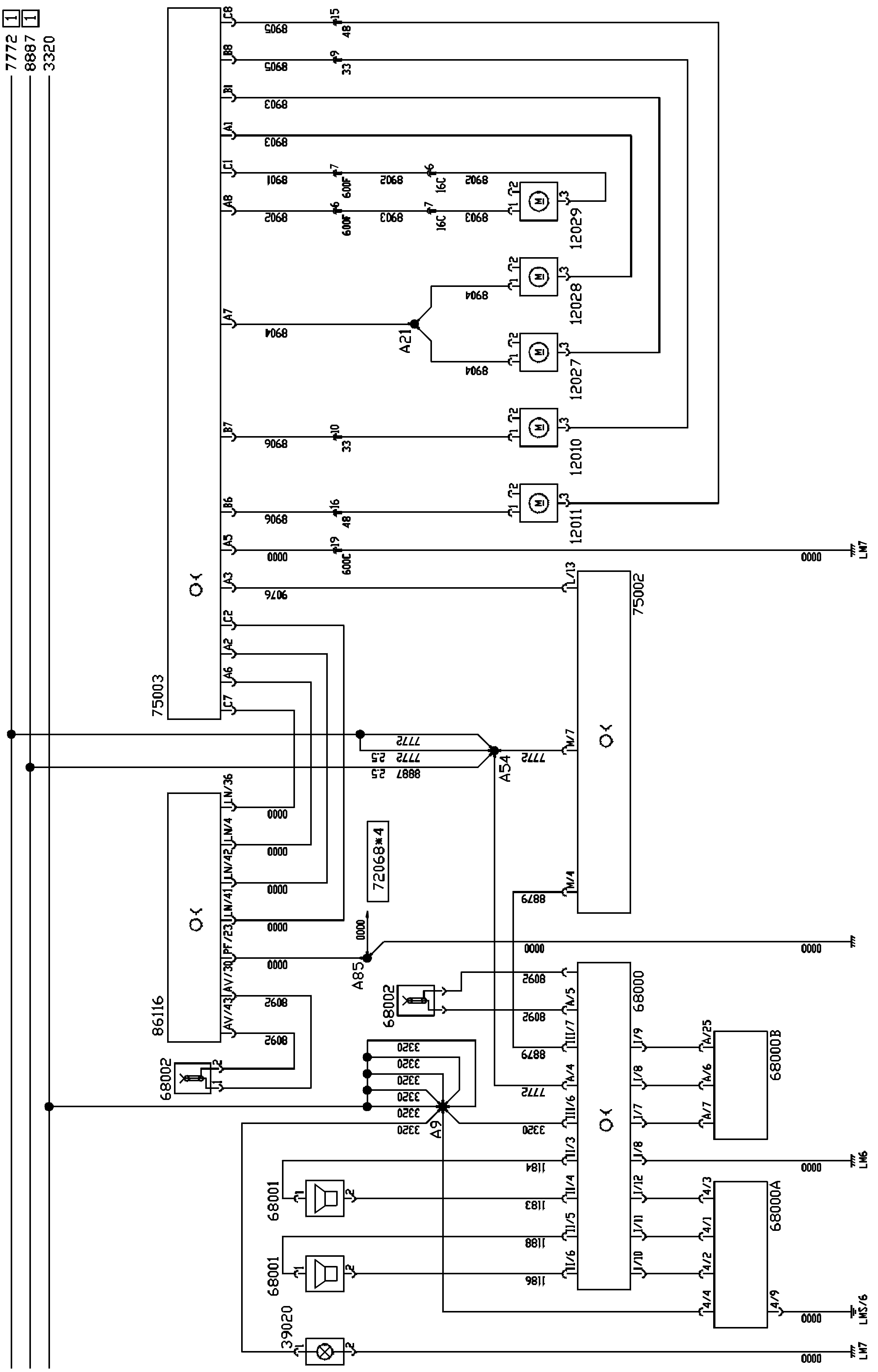
A. IT 2000 - B. Modus - C. EASY - D. Body Computer - E. Diagnosis connector EOBD

Circuit cards

Card 1: Power network



Card 2: Cab interior components



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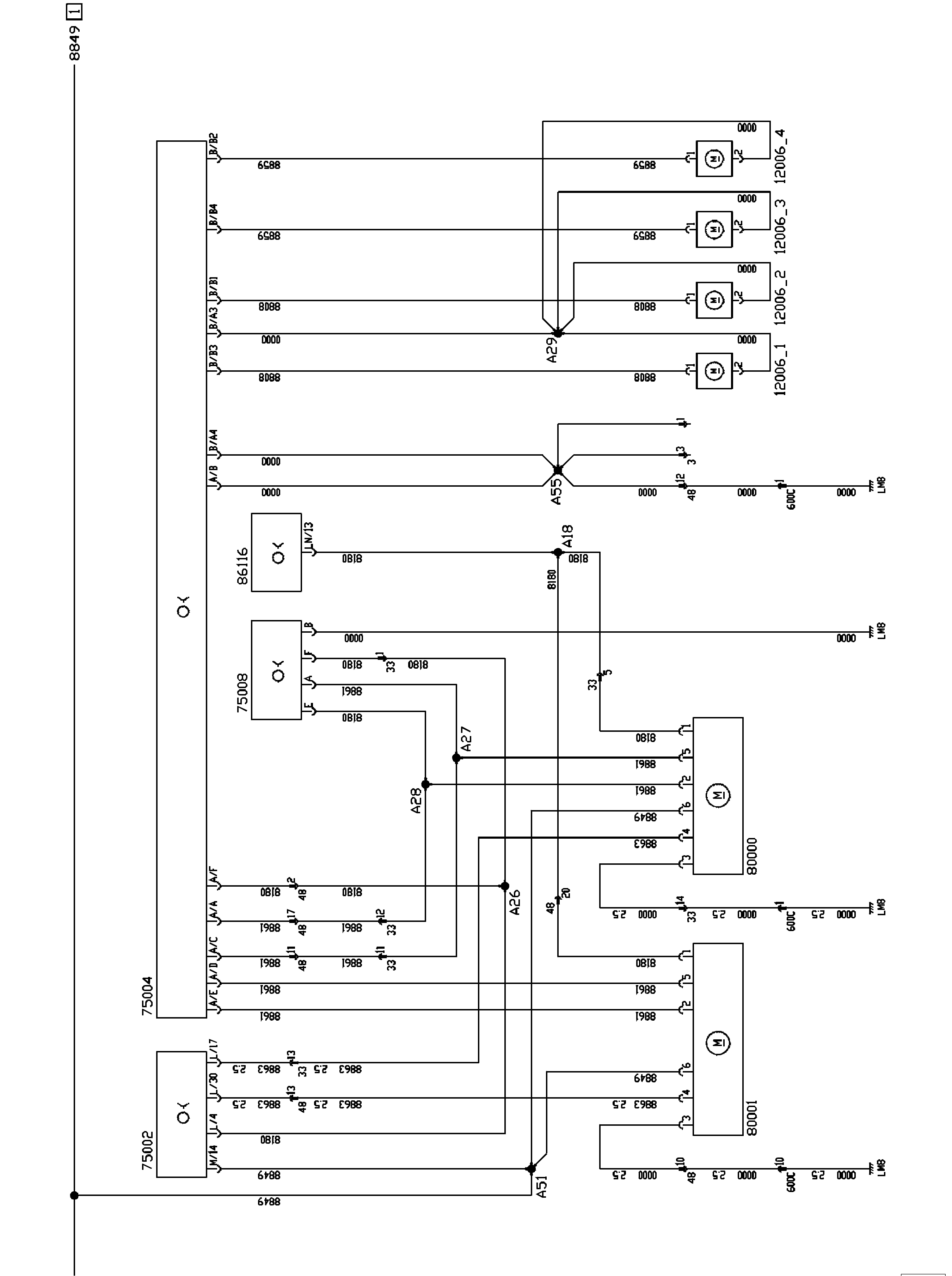
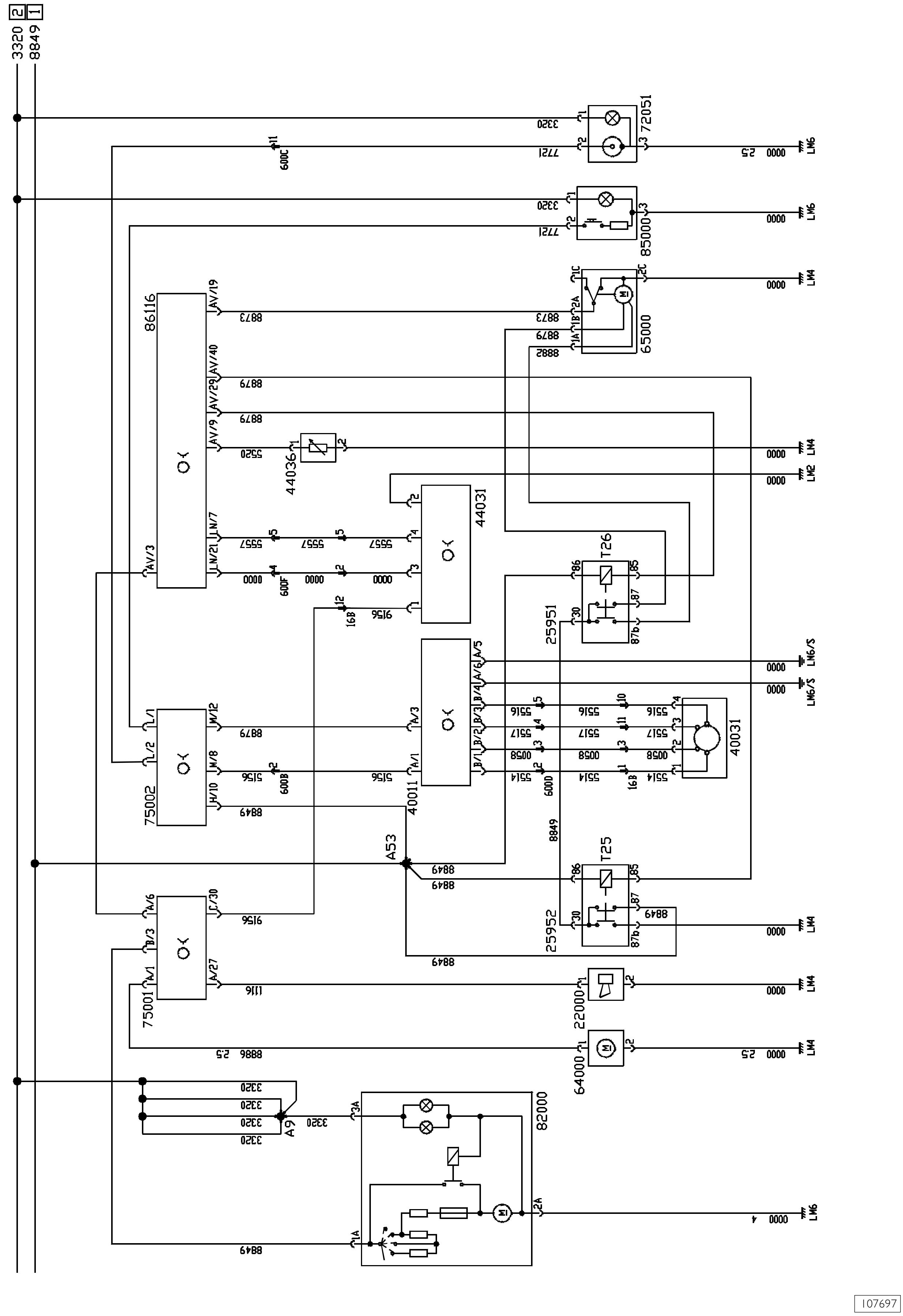
Card 3: Window winders – Electric mirrors

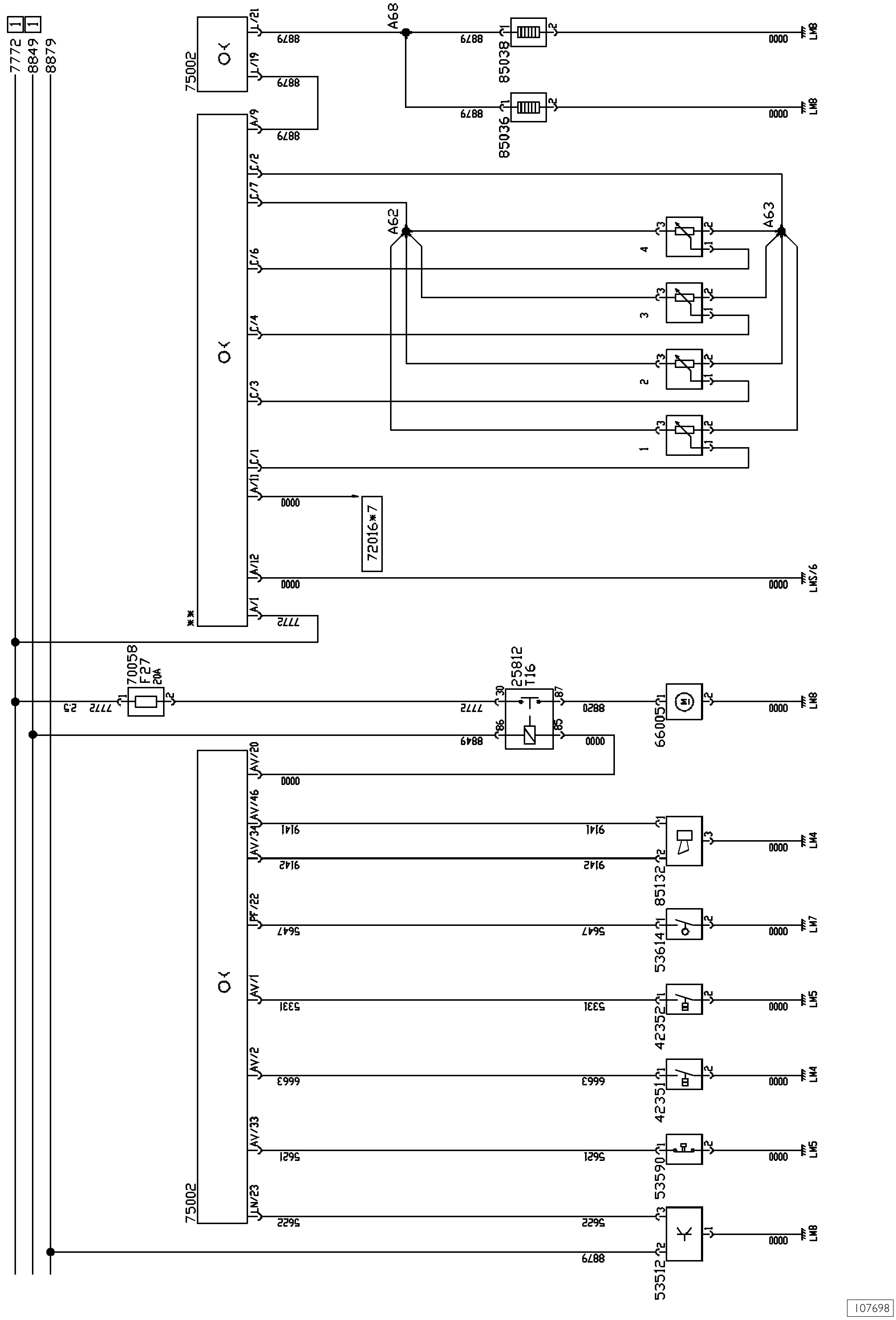


107696

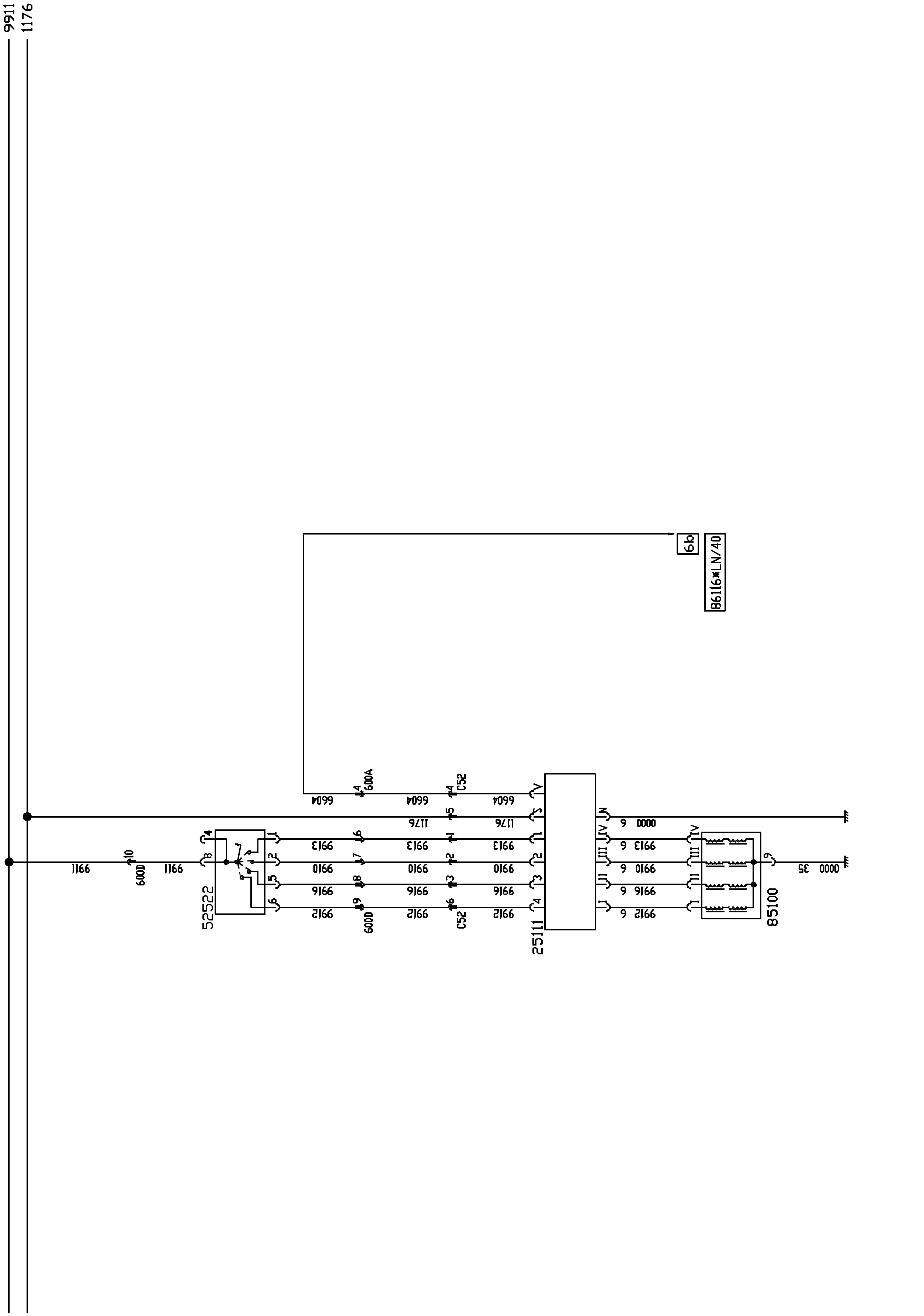
Card 4: Cab interior components



Card 5: Various loads



Card 6A: Telma decelerator



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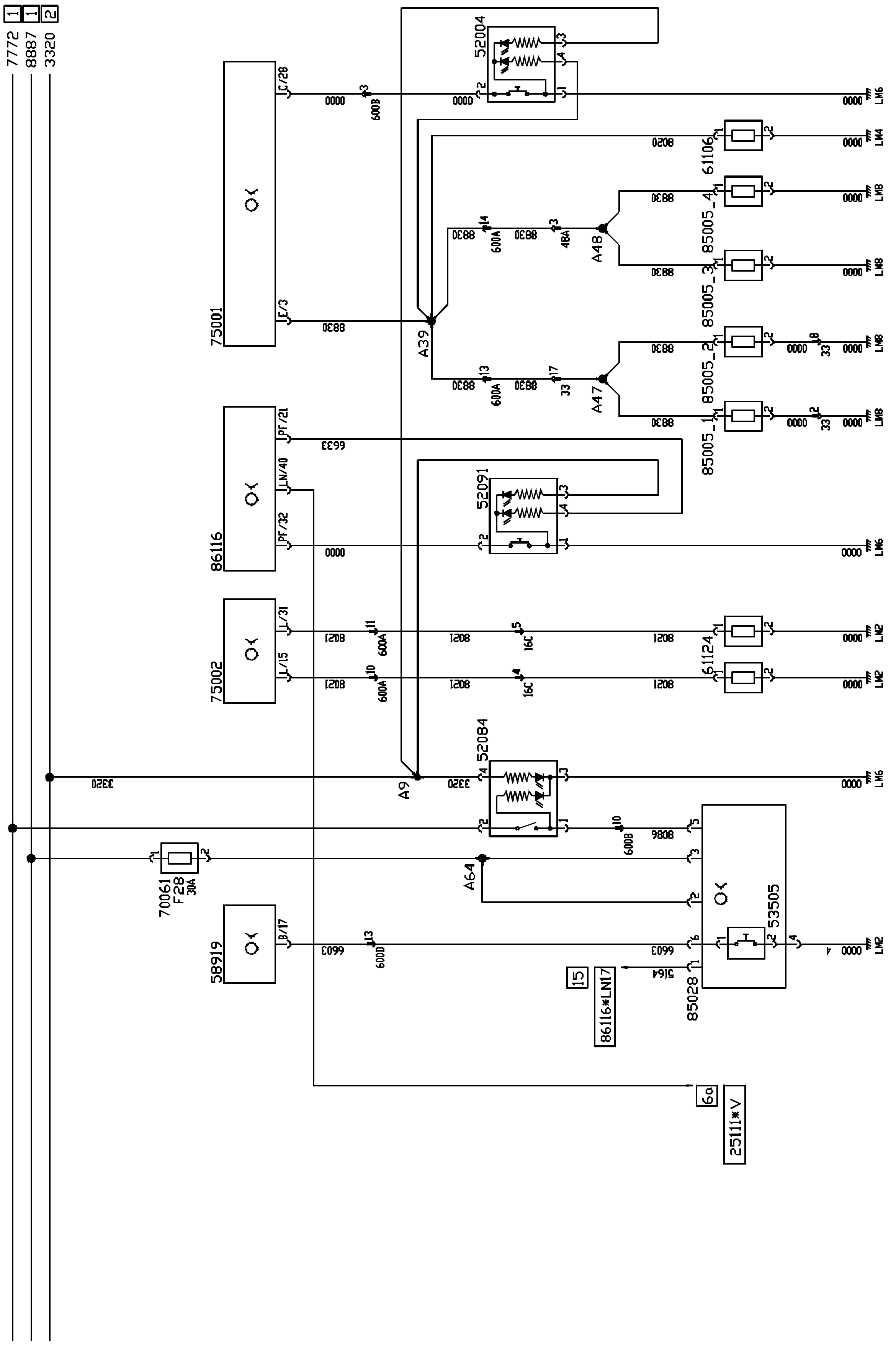
Card 6B: Differential locking - Heated rear window and windscreen



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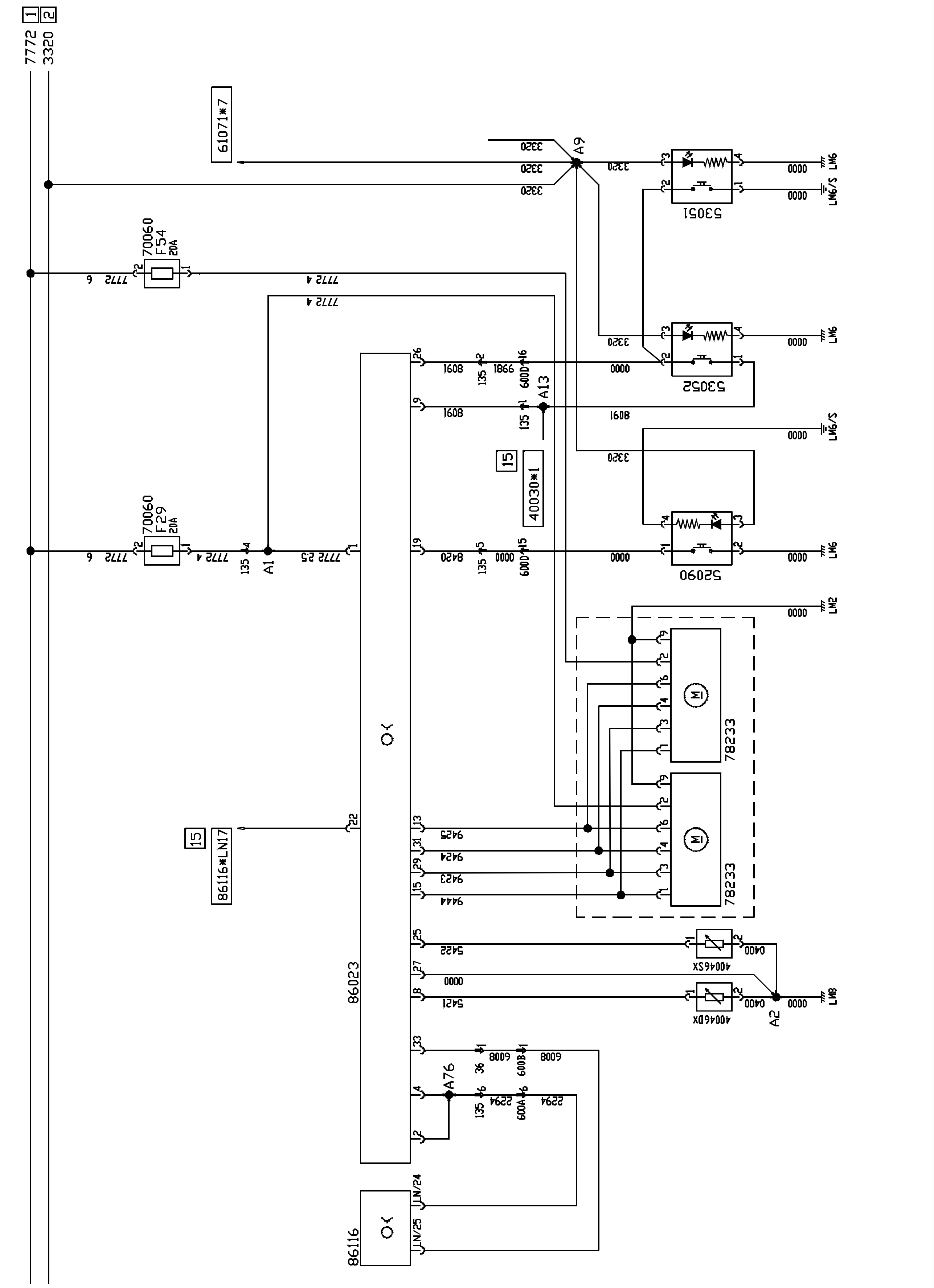
Card 7A: Air spring suspension



112226

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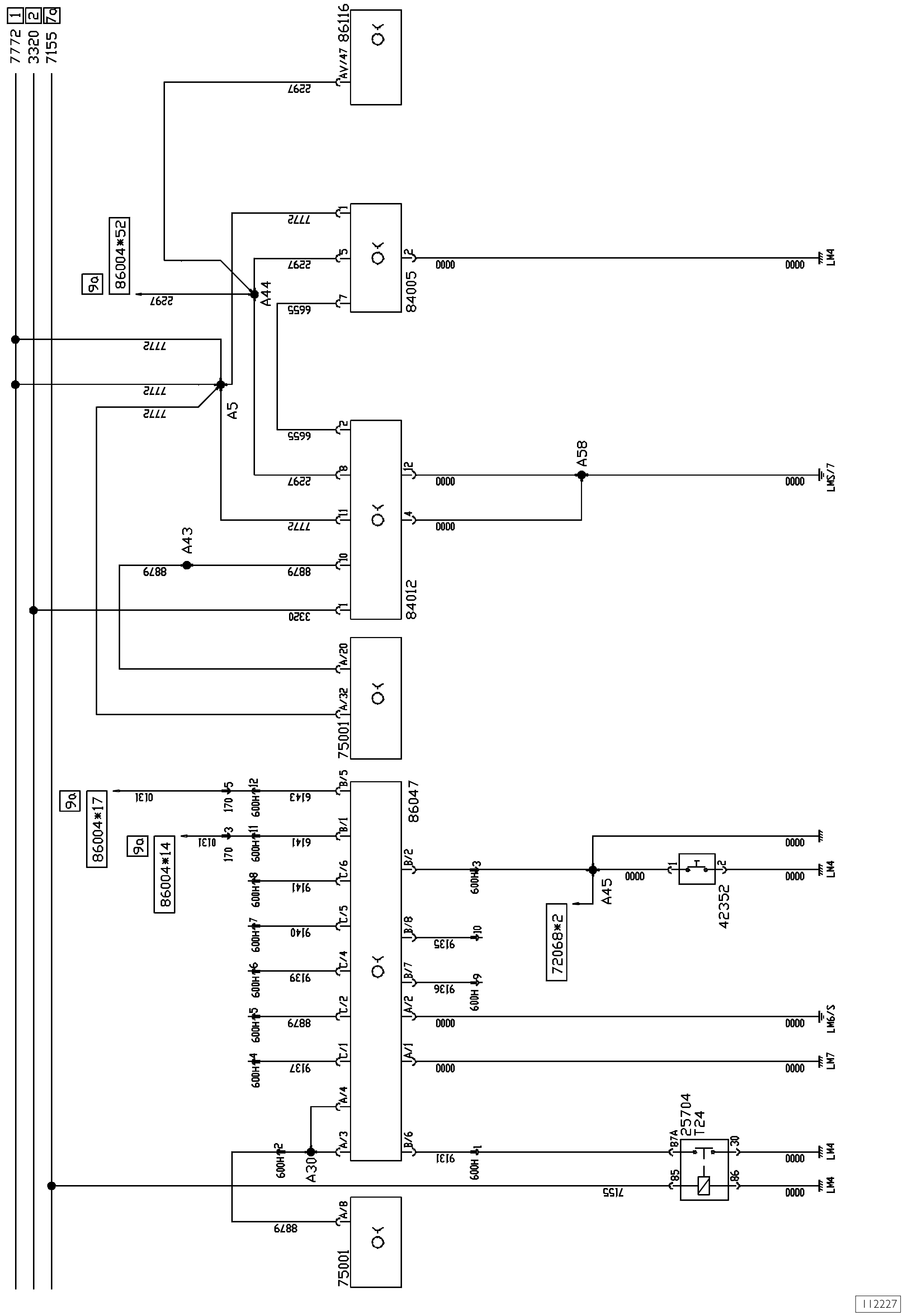
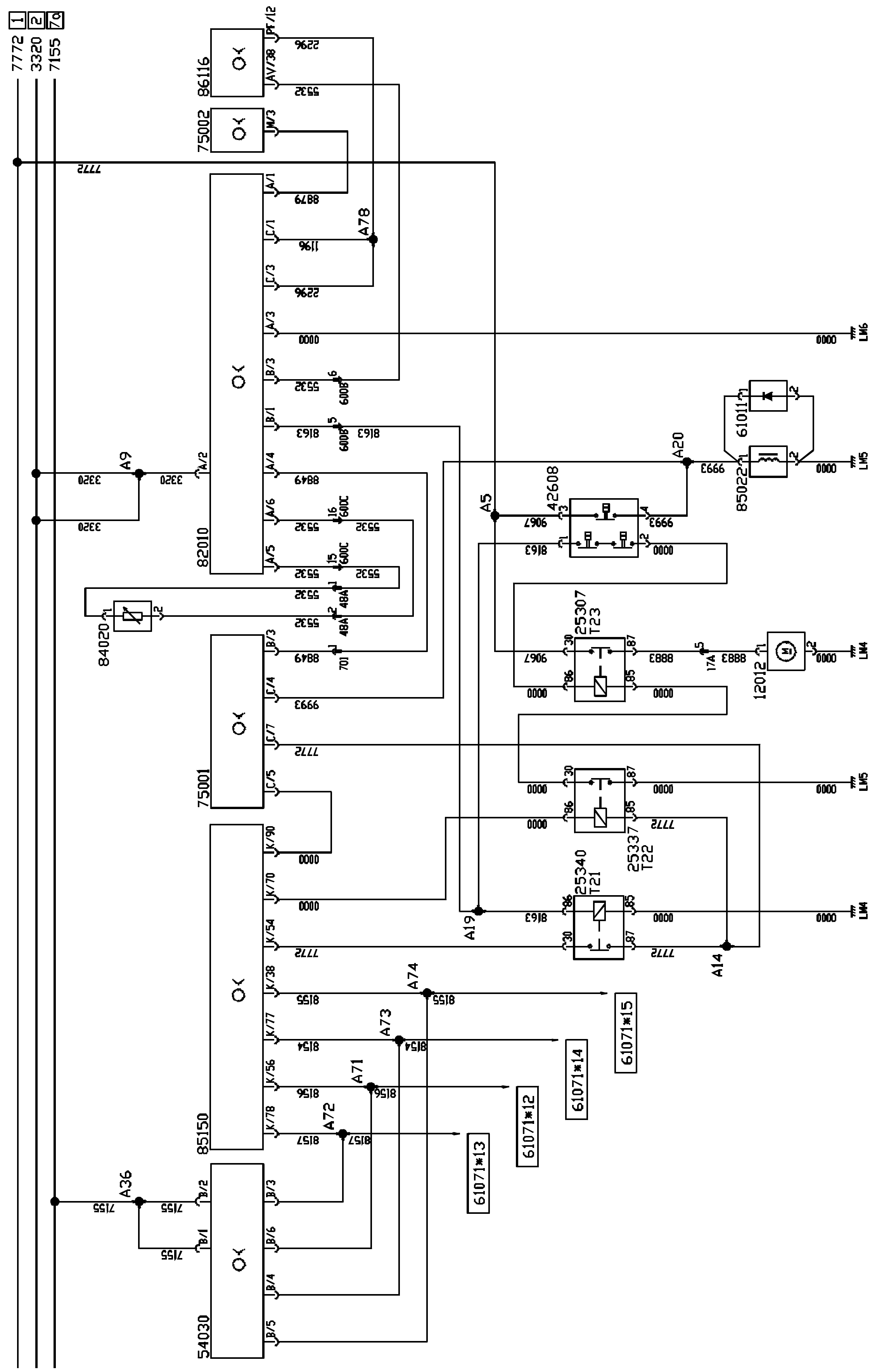
Card 7B: Additional heater - Power take-off

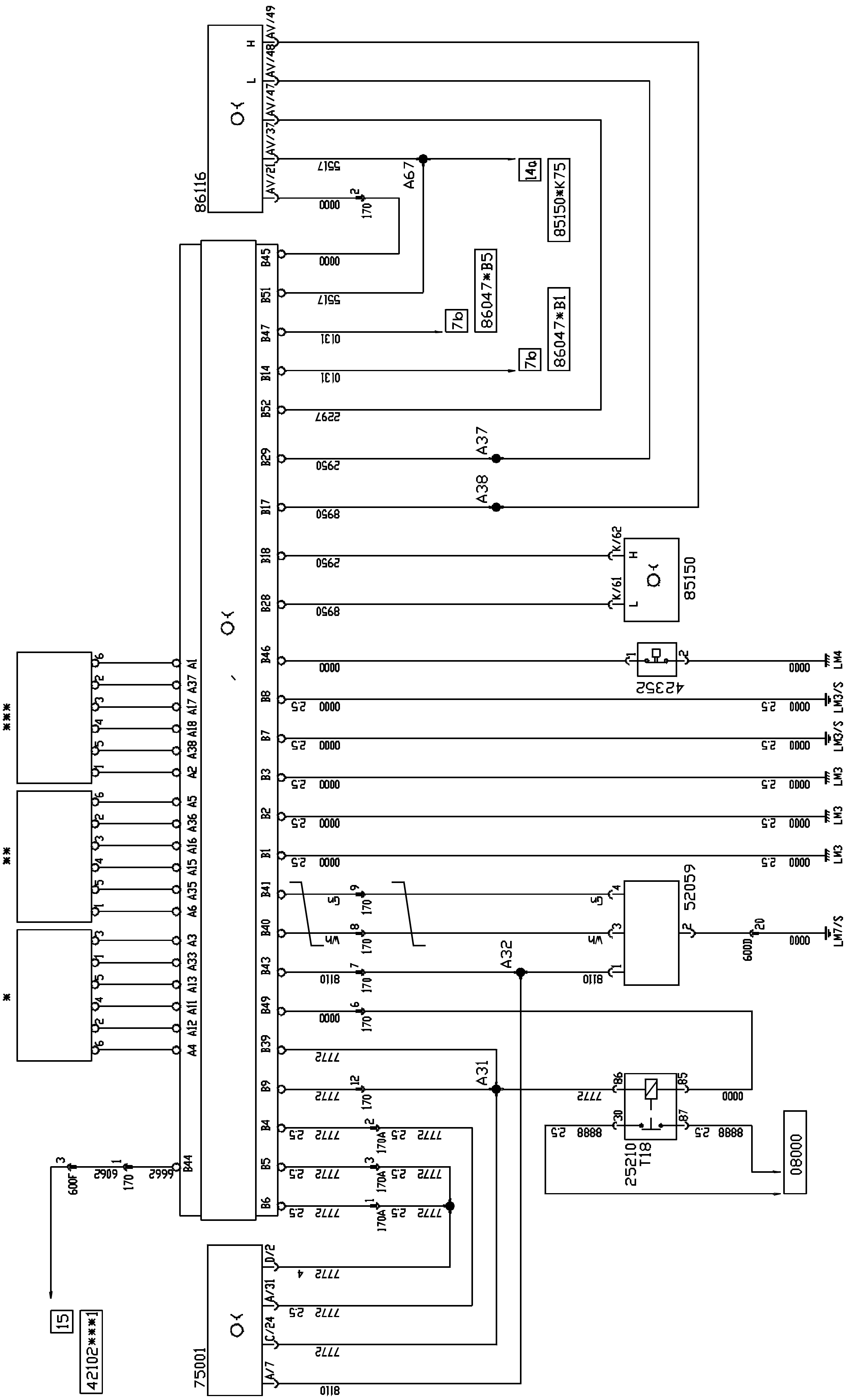


Card 8: Cruise control - Climate control system



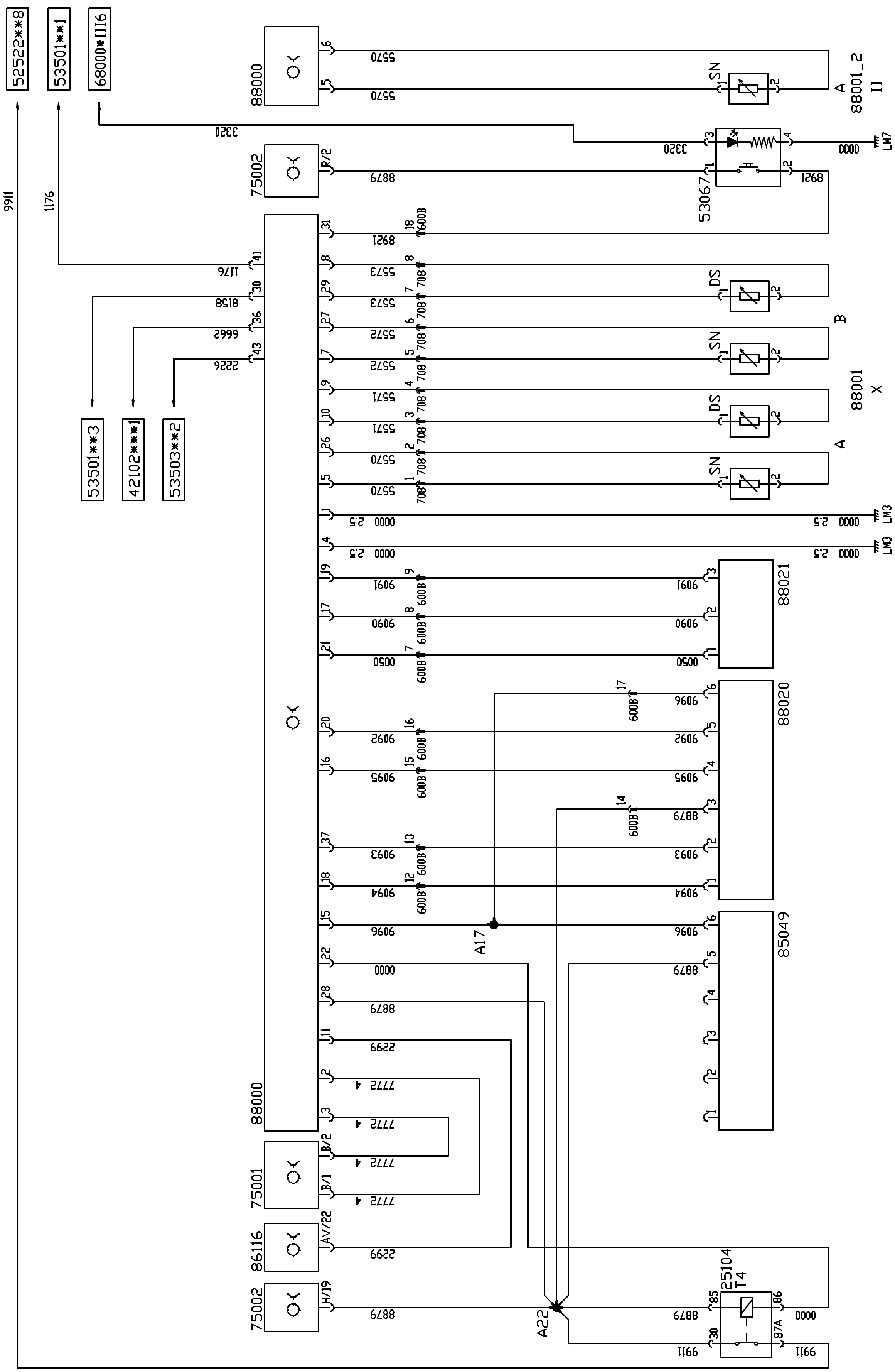
112228

Card 9A: Automatic gearbox



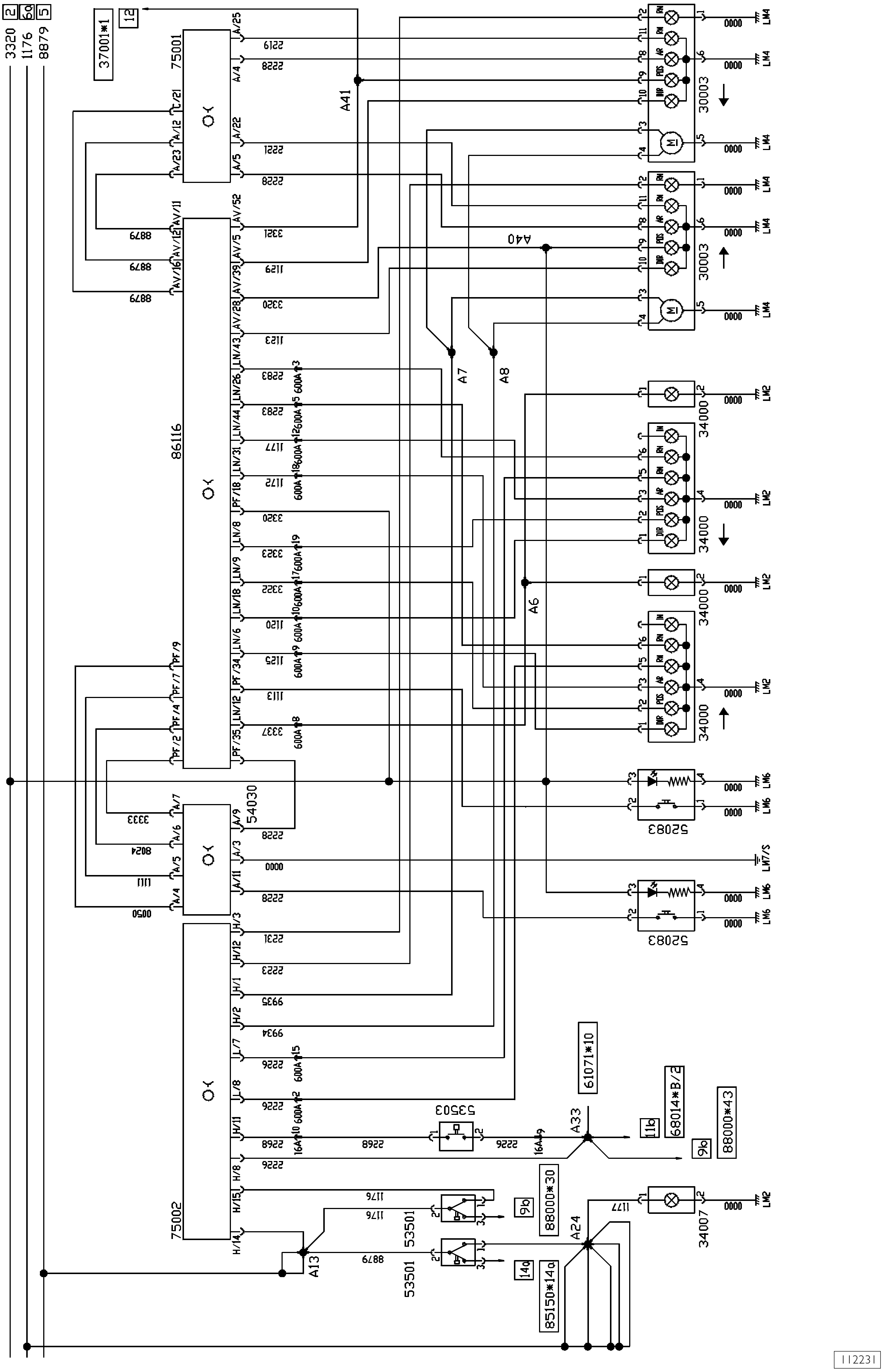
112229

Card 9B: ESP 8

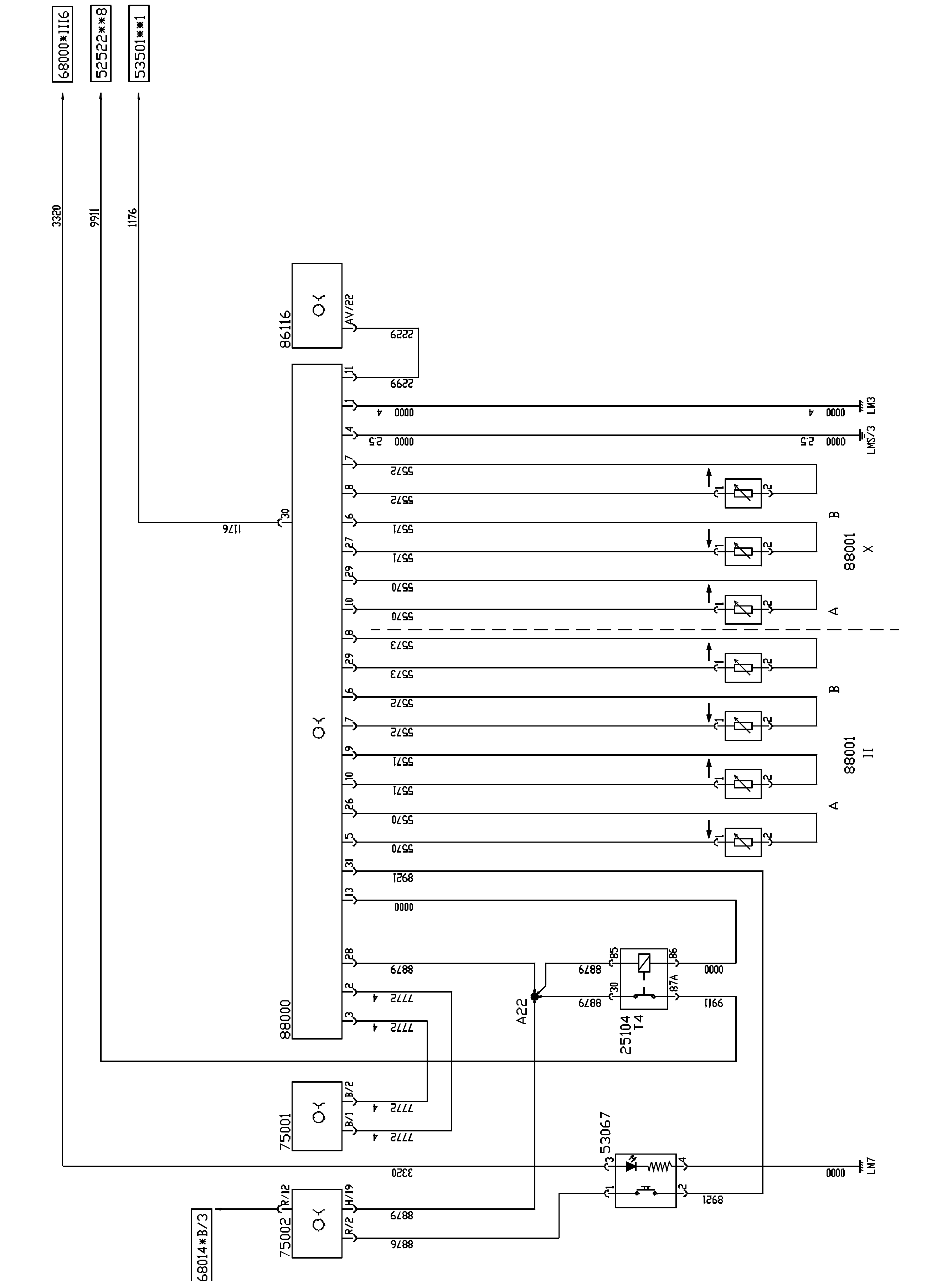


112230

Card 10: External illumination

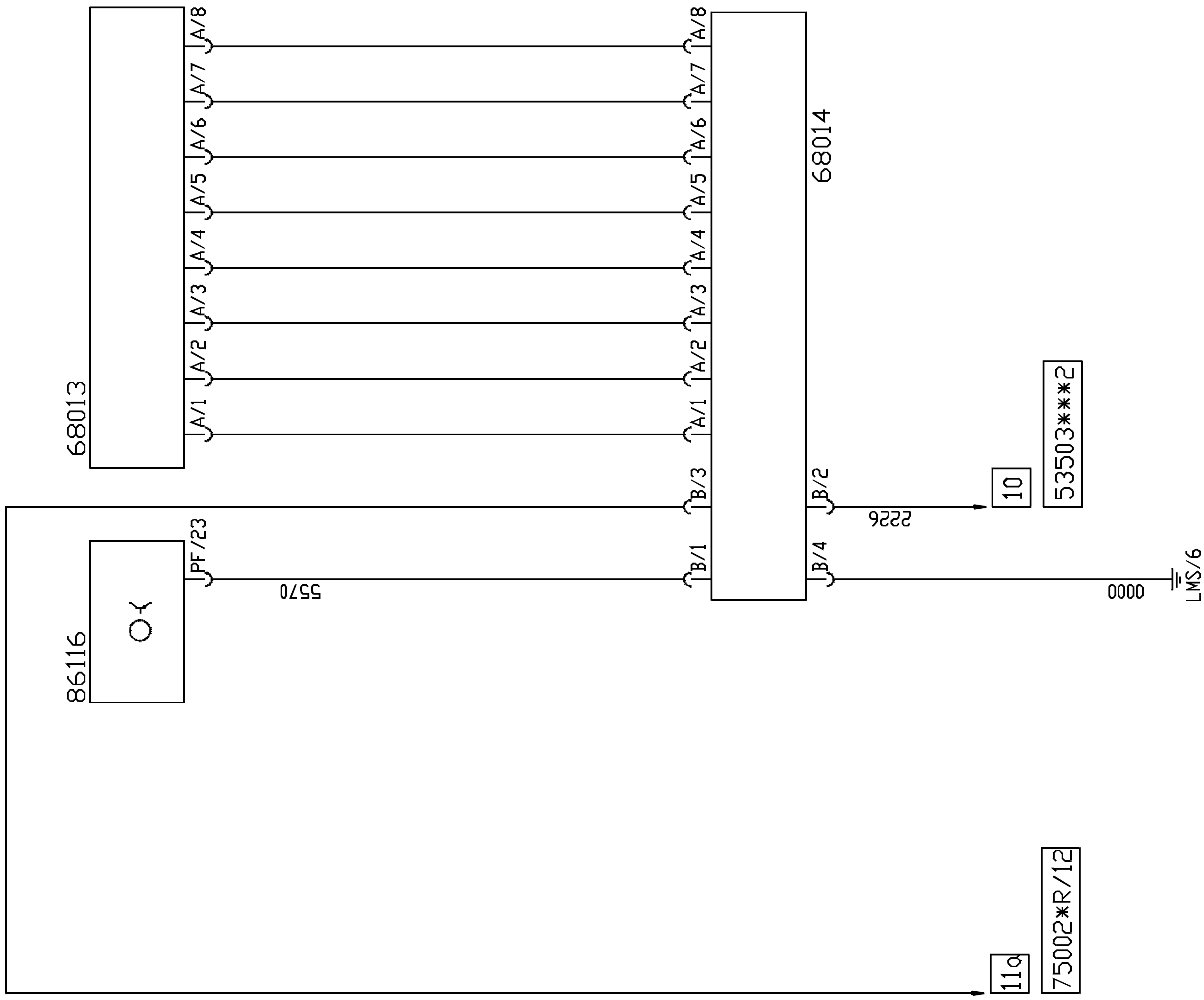


Card 11A: ASR



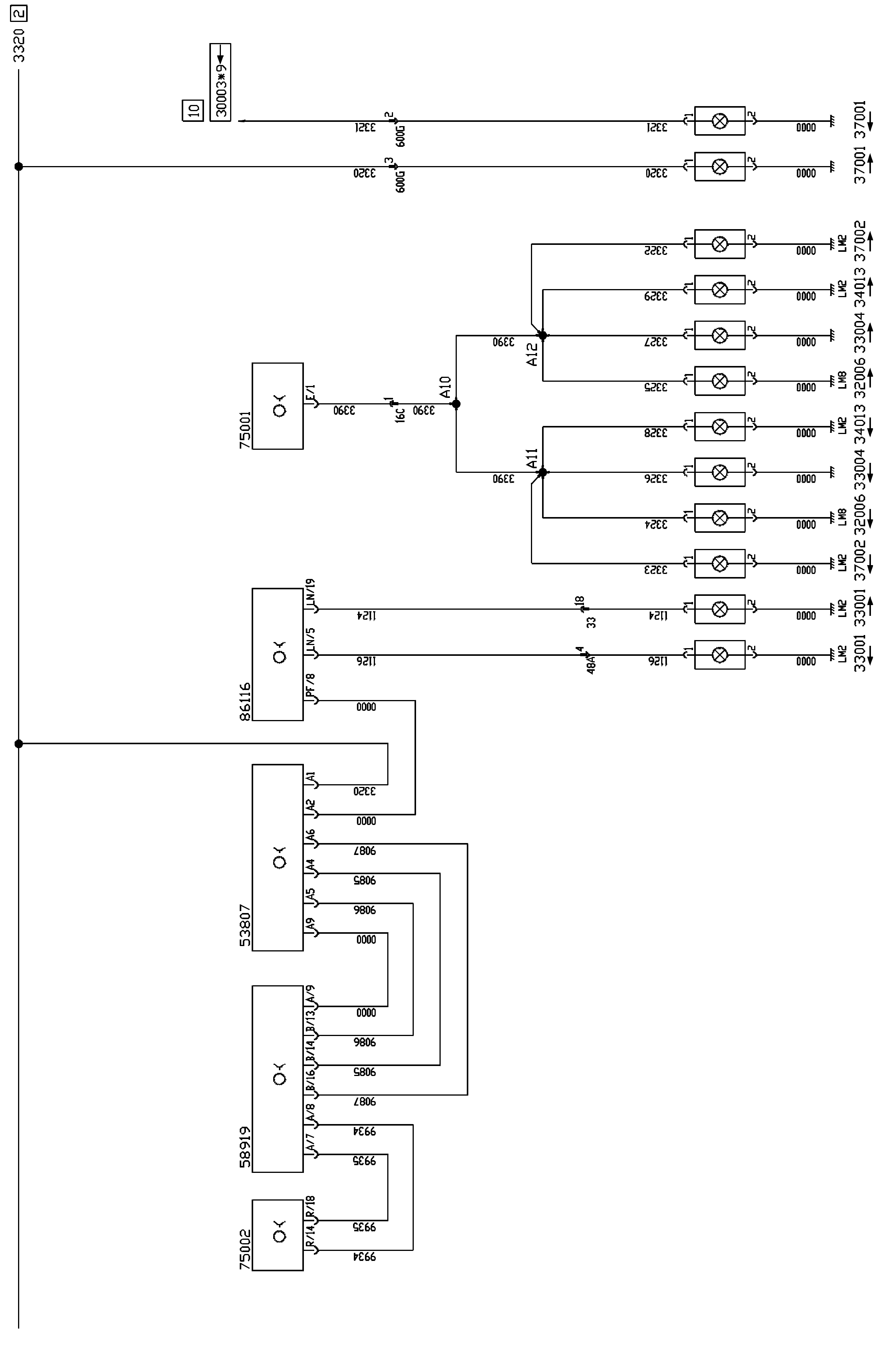
112232

Card 11B: Camera



112233

Card 12: External illumination



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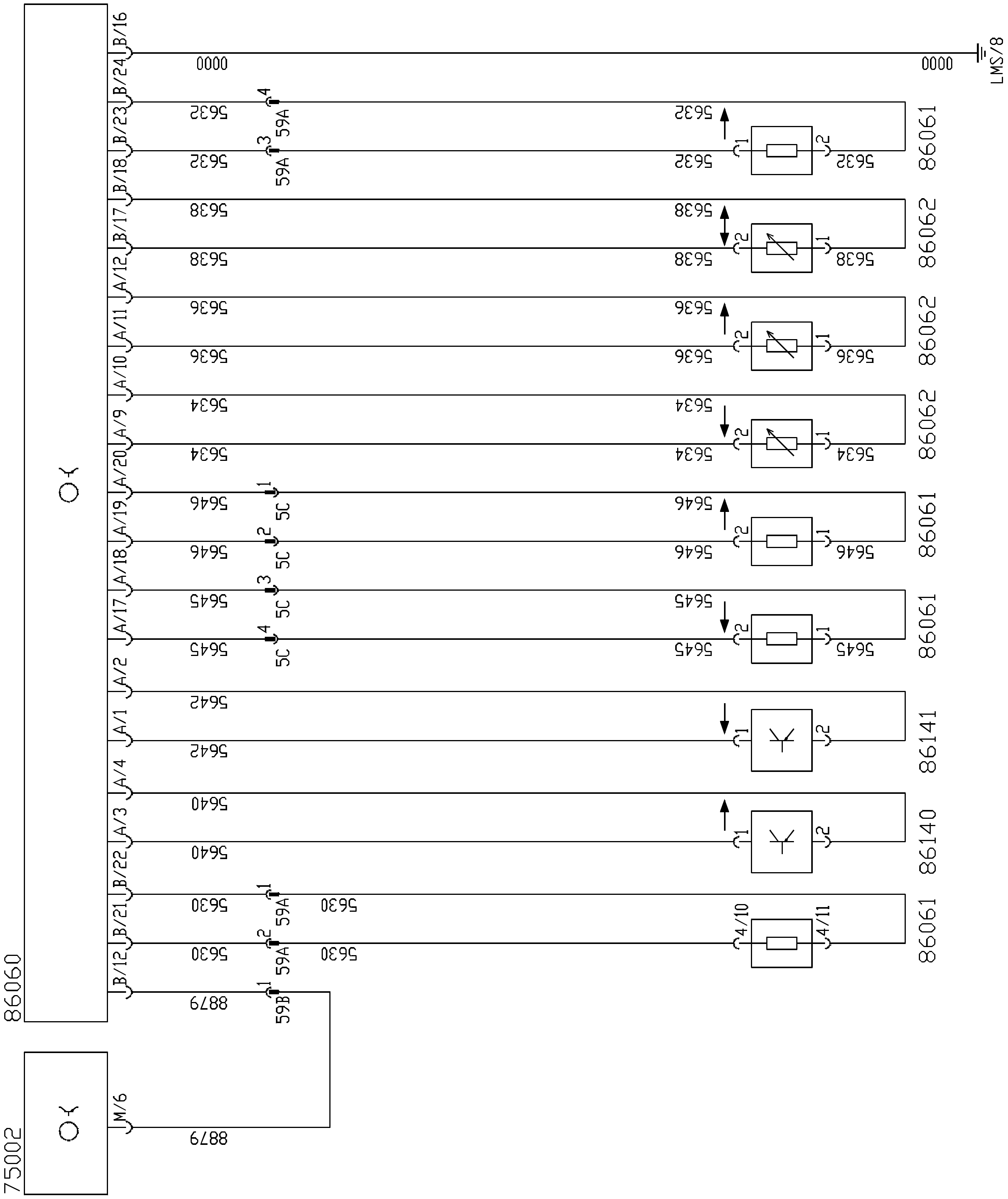
Card 13A: AIR BAG



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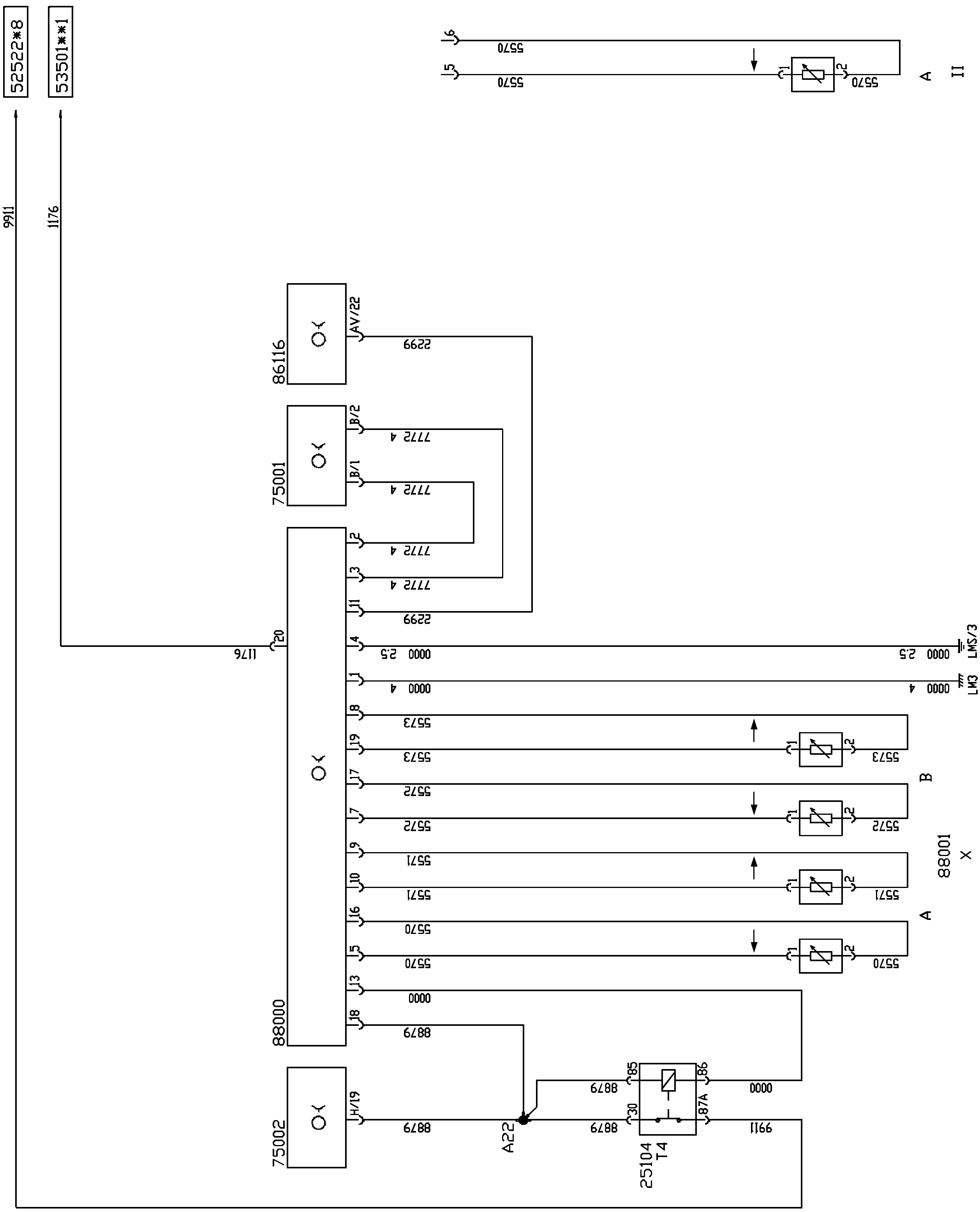
Card 13B: ABS8



112236

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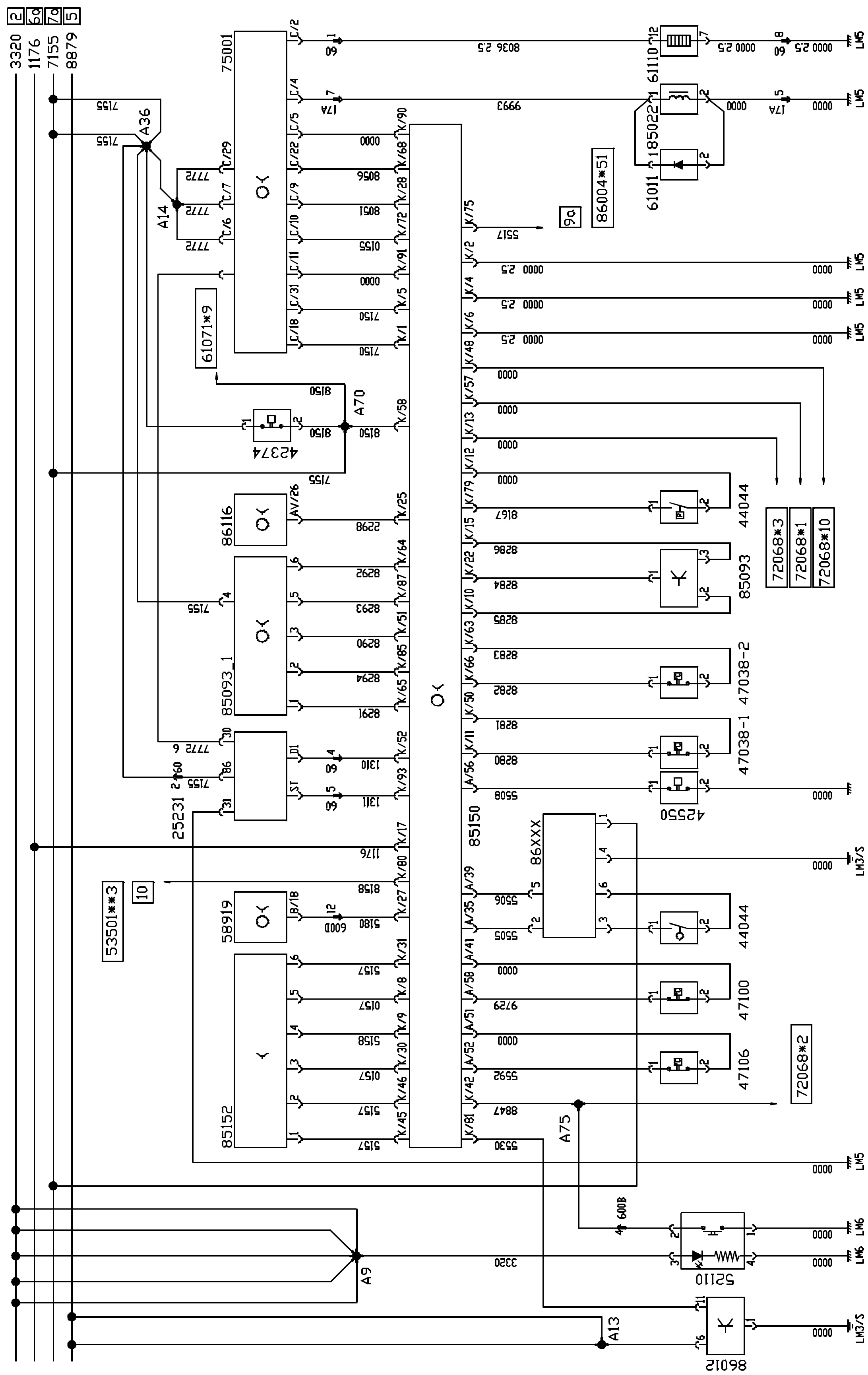
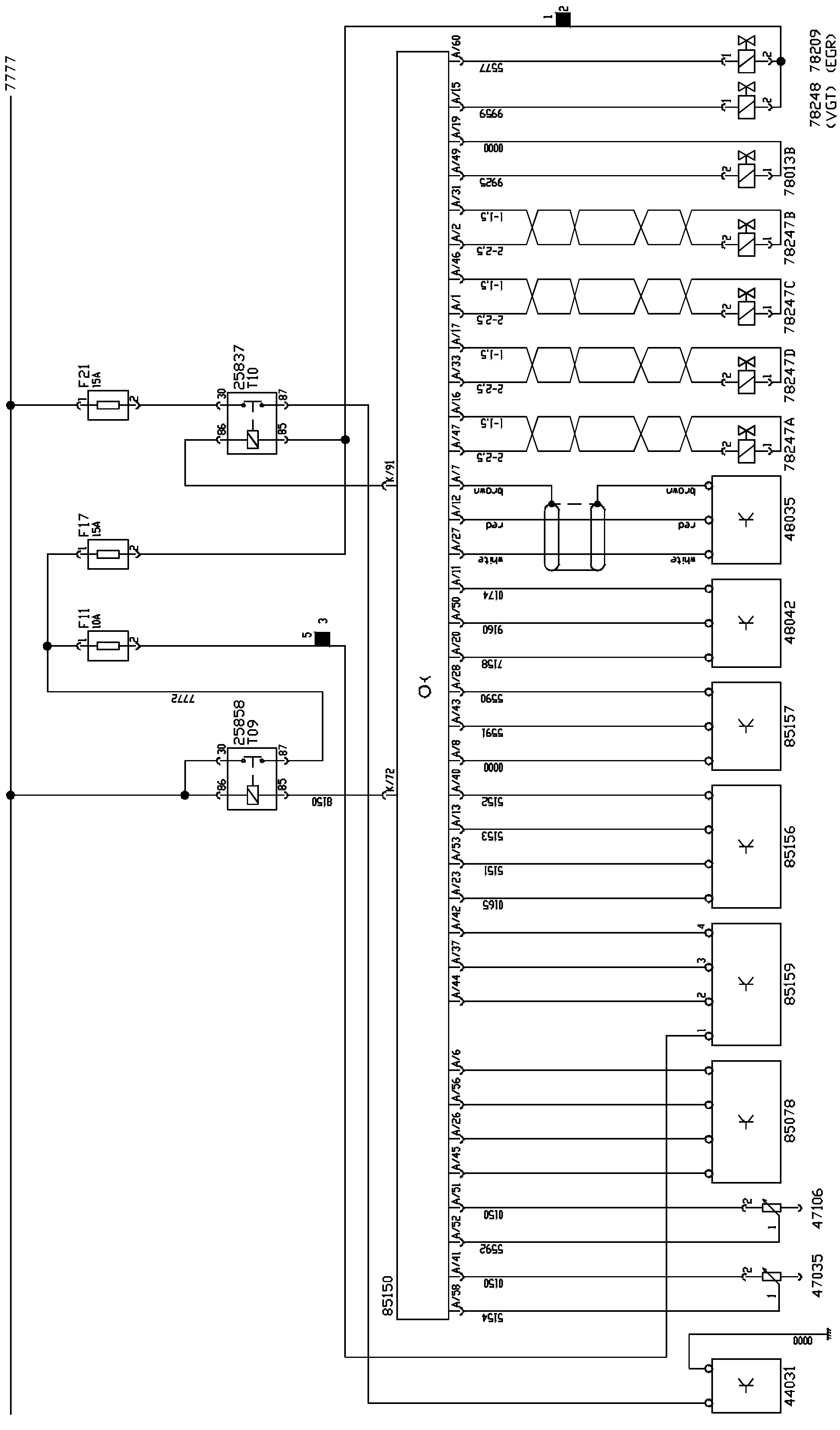
Card 14A: EDC 16



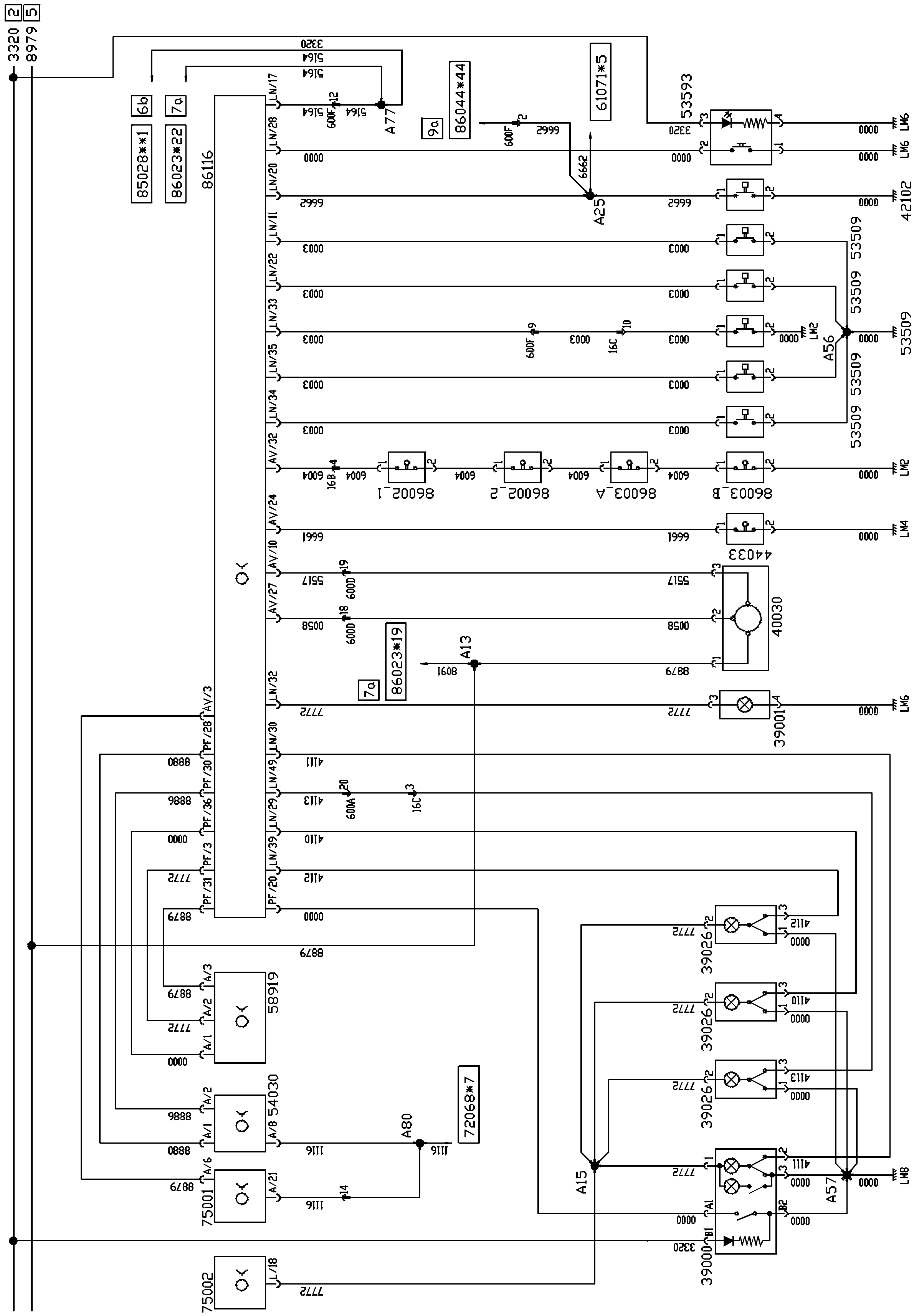
112237

Card 14B: EDC 16



112238

Card 15B: Cab interior components



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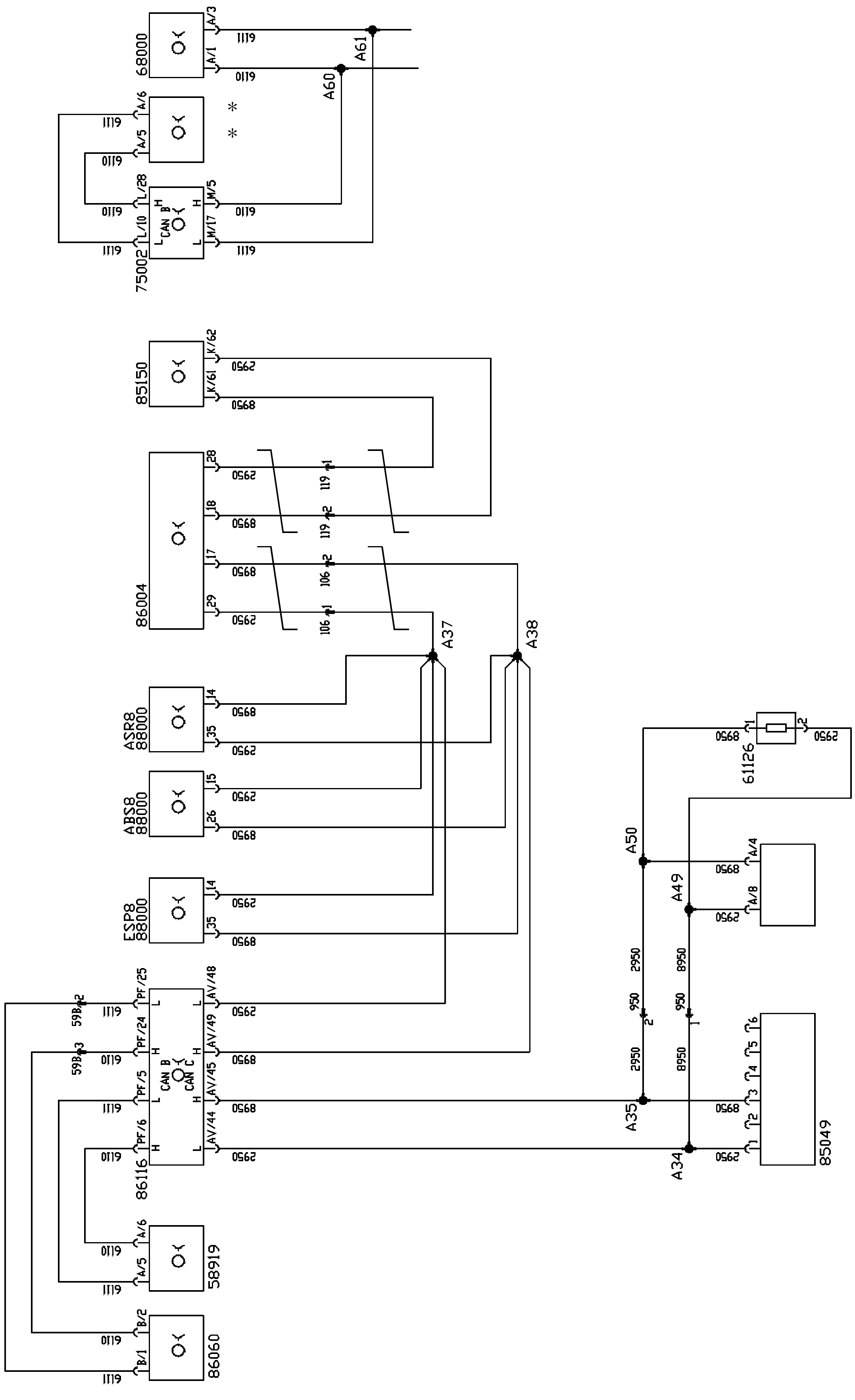
Card 16: “CAN” lines



* Tachograph / **Parking sensors

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