



**TECHNOMATIC EQUIPMENTS**

**SNOW CUTTER/BLOWER**

**TECHNOMATIC F-90**

**WORKSHOP MANUAL FOR BOTH**  
**EQUIPMENT & ENGINE**

**TECHNOMATIC EQUIPMENTS**

**SNOW CUTTER/BLOWER**

**F90**

**WORKSHOP MANUAL FOR EQUIPMENT**

# Technomatic

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## REPAIR MANUAL



## SNOWBLOWER VEHICLE F90

# Summary

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## 1. GENERAL INFORMATION

Dear Valued Customer, we wish to thank you for having chosen and purchased a **TECHNOMATIC SNOW BLOWER Model F90**.

This manual has been prepared for the exclusive use of skilled technicians that shall be working on this vehicle to properly maintain and repair it. It provides the technical characteristics and data of the machine as well as the correct methodology to perform repairs and technical interventions and adjustments on the various components of the vehicle.

The manual illustrates specific details of the various components installed on the vehicle and gives the necessary instructions to correctly execute various operations.

Following the provided indications, and using the prescribed specific tools, shall guarantee that any and all repair/adjustment shall be done correctly and safely as per OEM standards.

Before starting any repair or intervention, we strongly recommend to make sure technicians are equipped with proper personal protection equipment (safety glasses, protection helmet, work gloves, safety shoes, etc...) and to make sure the job is done in a safe work environment. Furthermore, we recommend to verify the efficiency of any lifting and transport equipment that may be used to avoid accidents.

We remain at your full disposal for any possible queries or further needs.

## 2. MANUFACTURER ADDRESS

For any kind of information about the use, maintenance, installation etc. **TECHNOMATIC** is always available to answer the Purchaser's requests.

The Purchaser is requested to ask the questions in a clear way, by referring to this catalogue and always indicating the data reported on the identification plate of the machine.

Any request about service assistance at the customer or clarification regarding the technical aspects of this document should be addressed to:



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### 3. SPARE PARTS ORDER

The vehicle can, over time, present the need for the replacement of the parts subjected to wear. For this purpose, the Purchaser may make the ordination of parts to be replaced. The customer is obliged to buy original spare parts.

It is recommended the intervention of the Technical Assistance Center which is available with qualified personnel, tools and equipment suitable and with original spare parts.

Any request regarding ordering of spare parts of the machine in which this data should always specify the model and serial number of the machine to which the replacement refers as reported on the label machine and must be addressed to:

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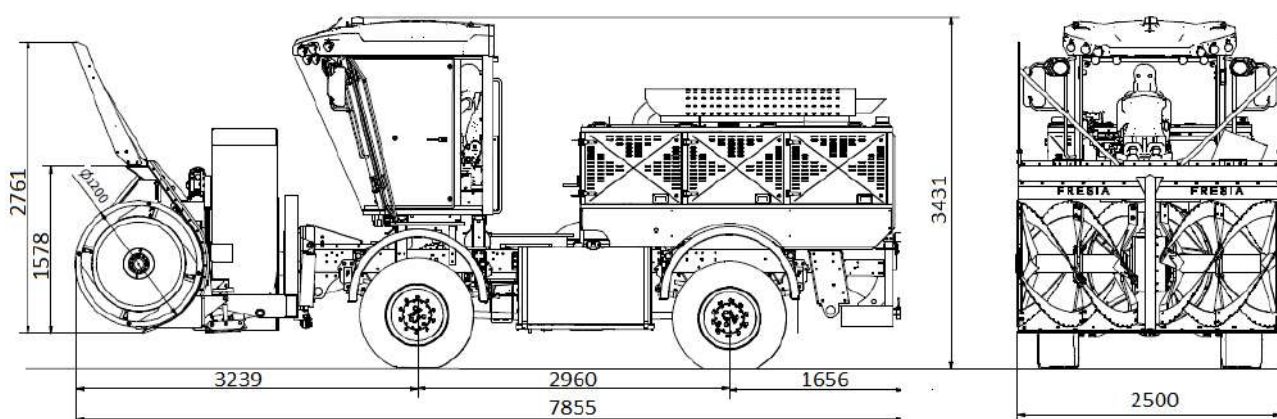
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## 5. VEHICLE DESCRIPTION

*TECHNOMATIC snowblower is a vehicle specifically realized for snow clearance. It is a fusion of an off-road vehicle and an operating machine.*

### Dimensions and performances

Vehicle length	7855 mm
Clearance width	2500 mm
Vehicle height (beacon included)	3431 mm
Wheelbase	2960 mm
Working speed	40 km/h
Clearance capacity >	5000 t/h
Blowerhead diameter 1st stage	1200 mm
Turbine diameter	1200 mm
Weight	12800 kg



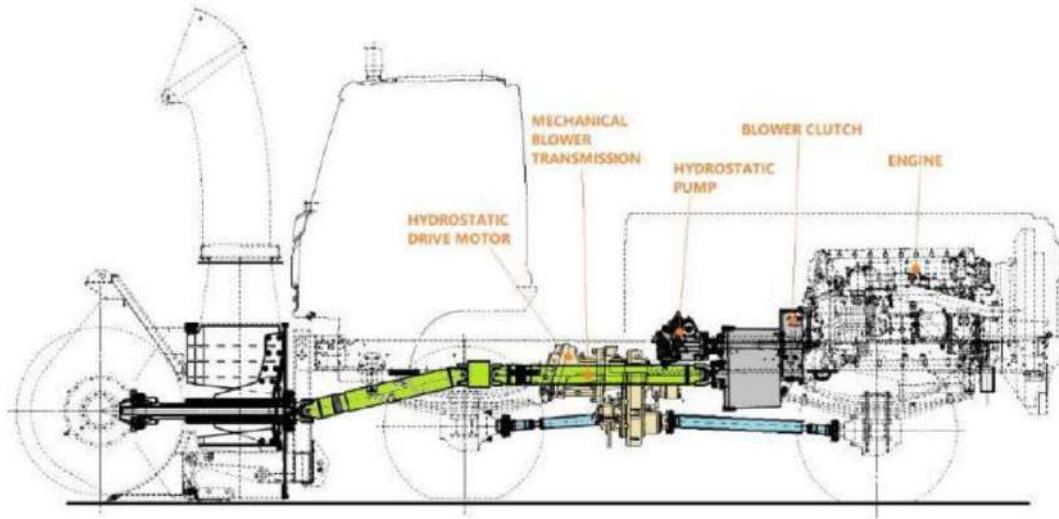
### DC16 076A 425 Kw 1900 rpm IFN

Position	Rear
Model	DC16
Cycle	4 – diesel
Displacement	16,4 dm <sup>3</sup> / 1,001 in <sup>3</sup>
Cylinders	90° - V8
Bore and stroke	130mm x 154 mm
Max. power	425 kW 1900 rpm
Max. torque	2440 Nm a 1500 rpm
Cooling	water
Emission	Bharat stage III

## Main characteristics:

- FRAME with great torsional elasticity, to operate on tracks with cement joints, on paved surfaces and on uneven ground avoiding load concentrations.
- SUSPENSIONS front and rear suspensions with parabolic leaf springs and double-acting hydraulic shock absorbers
- STEERING: Hydraulic power assisted , mechanical steering. Front wheel steering.
- TRANSMISSION:

Traction system made by means of hydrostatic transmission model Sauer Danfoss with displacement pump variable and variable displacement motor. Two speed available: low speed and high speed.



- AXLES: Front steering. Differential locking and planetary reduction in the wheel hubs.
- BRAKES: power-assisted disc brakes on all four wheels with independent pneumatic circuits.  
Negative mechanical parking brake with electric control.
- TYRES: Rim dimension R20. Simple, front and rear tires 365 / 85R20
- BODY: rear equipped with openable doors to facilitate the maintenance operations.
- CASTING CHUTE with deflector to adjust the launch of snow. Extensible.
- ELECTRIC SYSTEM: 24 V - 2 batteries 12V/200 Ah - Alternator 80/110 A.
- LIGHT SYSTEM: Full led
- CAB: modern and metallic structure, 2 seats, high comfort.

- Heatable rearview mirrors. Heating system and control panel.
- Heatable windshield wiper and lateral windows.
- HOOK: Rear towing hook. Front hook for vehicle towing in emergency is supplied.
- BLOWERHEAD: two stages: the first stage is open type with helical cutters, the second with blower fan in communication.

## 6. INSTRUCTIONS FOR MAINTENANCE OPERATORS

The following instructions are provided to skilled technicians on SNOWBLOWER VEHICLE F90 in order to assure a correct procedure for maintenance and repairing operations on the vehicle F90 and its disassembled parts.




### **Before operating, read carefully the safety prescription at the point 7)**

- ✓ before operating, verify the integrity of all the operation tools.
- ✓ where specific tools or instruments are recommended, do not use other kind of common tools instead;
- ✓ before parts and components are revised or repaired, these must be externally accurately washed;
- ✓ tighten screws and nuts at the prescribed tightening values. If not otherwise indicated, threads and screw cuttings must always be cleaned and grease must be removed before tightening;
- ✓ when disassembling parts, all screws, nuts, washers, and rings must be accurately placed in order in boxes;
- ✓ when mounting back component parts, always substitute old gaskets, retaining and lock rings, spring rings, self-locking nuts, spring washers and split pins with new ones;
- ✓ before the mounting operation: paper gaskets must be greased and (retaining) rings with inside spring must be fitted with grease;
- ✓ when filling up or substituting fluids in reservoirs and circuits, use only the products indicated in the Lubrication Chart.

## 7. SAFETY PRESCRIPTIONS

Read and remember all the following safety precautions and warnings before performing any repair or maintenance operation:

- ✓ The operating area must be kept cleaned and tidy as much as possible
- ✓ Before starting any operations, make sure that the whole accident prevention equipment is good condition.
- ✓ Operators should wear cloths and shoes as safety norms recommend and, when necessary, protective glasses, gloves, apron and helmet;
- ✓ The specific and generic tools must be used only for their proper function
- ✓ When the unit to repair is lifted up, make sure that it is safely prompted on supporting blocks/brackets;
- ✓ After moving the vehicle with engine running, change carefully the environment air;
- ✓ All electrical instruments, plugs and cables must follow the safety norms;
- ✓ During the operation remove the spark plugs or the battery to avoid casual engine starting;
- ✓ If the engine has been operating, allow engine and all mechanic parts to cool before operate on them;
- ✓ During operations with running engine, care has to be taken not to touch the flywheel with any hard or metal tool or part. This can be very dangerous for operator.
- ✓ Use only original spare parts and lubricants indicated in the oil table

PPE		USE
<b>Safety shoes</b>		Safety shoes must be insulated, reinforced toe and must be worn to perform work involving parts excited by currents, falling loads and penetration of hazardous liquids. <b>In case of misuse, workers run the risk of crushing feet.</b>
<b>Gloves</b>		Gloves should be worn for all types of work, such as: ⇒ work with excited items ⇒ works with abrasive materials or high temperatures ⇒ work with sharp details <b>Wear gloves is mandatory in case of risk of shearing</b>
<b>Protective helmet</b>		To perform work, which entails risks to the head, particularly during assembly and disassembly, handling of machine components or heavy elements using a crane or other lifting tools. In case of misuse, workers run the risk of head injuries.

## 8. SCREWS TIGHTENING TORQUE

If not otherwise indicated, screws must be tightened according to the torque values of the following table:

How to find out the right tightening value:

- 1) Read class (8-10-12) on screw head
- 2) Measure screw diameter
- 3) Search diameter in the first column
- 4) In the column of screw class, read the torque value corresponding to diameter

Example:



Diameter = 14 mm;

DIAMETER (mm)	THREAD (mm)	COUPLING TORQUE (Kgm)*		
		Class 8	Class 10	Class 12
4	0,70	0,37	0,52	0,62
5	0,80	0,72	1,01	1,22
6	1,00	1,23	1,73	2,08
7	1,00	2,02	2,84	3,40
8	1,00	3,21	4,52	5,43
8	1,25	3,02	4,25	5,10
9	1,25	3,88	5,45	6,55
10	1,00	5,82	8,19	9,82
10	1,50	5,36	7,54	9,05
12	1,50	9,45	13,30	15,90
12	1,75	9,09	12,80	15,30
14	1,50	14,50	20,40	24,40
14	2,00	13,80	19,40	23,30
16	1,50	22,00	30,90	37,10
16	2,00	21,00	29,50	35,40
18	1,50	28,70	40,40	48,40
18	2,50	26,30	37,00	44,40
20	1,50	39,50	55,60	66,70
20	2,50	36,60	51,50	61,80
22	1,50	47,00	66,10	79,30
22	2,50	44,40	62,40	74,90
24	2,00	60,40	84,90	102,00
24	3,00	56,90	80,00	96,00

\*For N/m (x10)

## 9. VEHICLE CLEANING

### **External cleaning**

Once the doors and windows are closed and the engine is off, the vehicle can be washed with water or with a steam jet. If the washing is performed under conditions of extreme cold weather the latches and the hinges of the main gates should be thoroughly dried and when necessary can be used antifreeze.

For painted parts cleaning, it is suggested not to use gasoline.

### **Internal cleaning**

For internal cleaning can be used fresh water with brush and sponge.

Note that all the electrical parts are water repellent but not waterproof. Therefore, the use of water or steam can cause serious damage, short-circuiting or rust.

The performance and the duration of rusted electrical contacts may be compromised.

### **Engine washing**

When washing the engine, the air filter must be protected, to prevent infiltration of water as well as the engine control unit should not be sprayed with water under pressure.

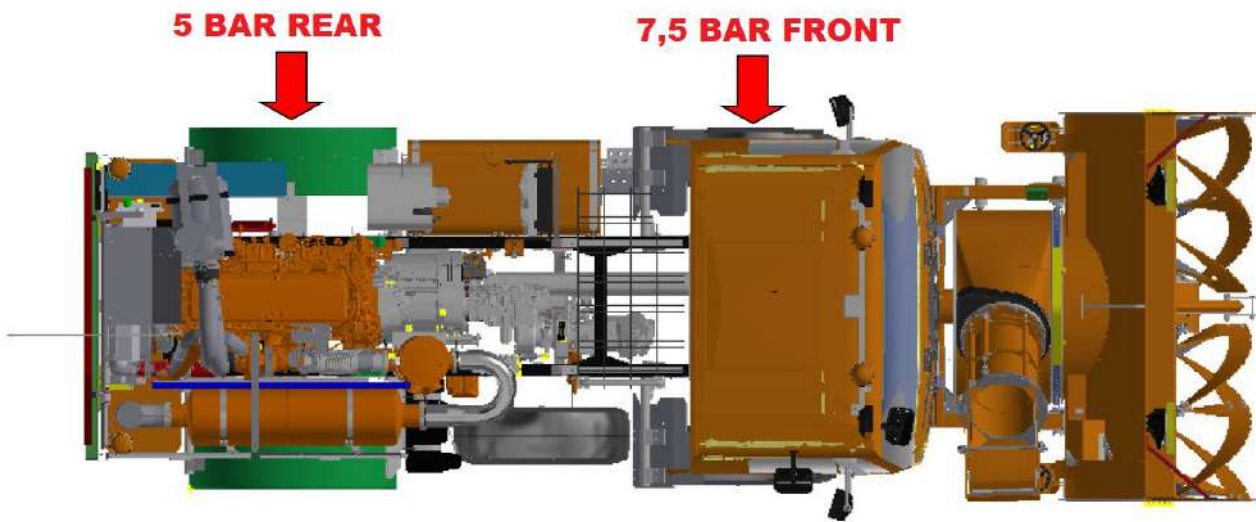
## 10. OIL AND FUEL CHART

COMPONENT	OIL LUBRICANTS/COOLANT	QUANTITY (LITRES)
ENGINE	ENGINE OIL VDS 4.5	48
COOLING LIQUID	VCS-2 READYMIX (OAT BASED) ONLY YELLOW COOLANT	128
HYDRAULIC AND HYDROSTATIC SYSTEM	TUTELA CAR G1/E* (ATF DEXRON III – C4)	70
AXLES	TUTELA W90/M-DA* (SAE80W/90)	7.5+7.5
AXLES PLANETARY GEAR	TUTELA W90/M-DA* (SAE80W/90)	1x4
TRANSFER REDUCER	TUTELA W90/M-DA* (SAE80W/90)	2.5+1.5
TWO SPEED BACK GEAR	TUTELA W90/M-DA* (SAE80W/90)	20
1ST STAGE GEARS	TUTELA W90/M-DA* (SAE80W/90)	10
2ND STAGE GEARS	TUTELA W90/M-DA* (SAE80W/90)	2.5
AUTOMATIC GREASING SYSTEM	GREEN LUBE EP-0	-----
DIESEL WITH ADBLUE	DIESEL SPECIFICATIONS EN590 / CONFORMING TO ISO 22241 STANDARD	500 DIESEL / 68 LITERS

## 11. SEALING PRODUCT

SEAL PRODUCT	APPLICATION
LOCTITE 243 or Arexons 52A43	Medium strength blue thread lock adhesive that seals and secures nuts and bolts to prevent loosening caused by violent shocks and vibrations. Multipurpose threadlocker offering medium bond strength. LOCTITE 243 works on all metals including passive substrates such as stainless steel, aluminum and coated surfaces. It also works in the presence of mild contamination caused by industrial oils: for example, motor oils, anti-corrosion oils and cutting fluids.
LOCTITE SI 5699 or Arexons RS.01	Elastic silicone sealant that cures upon exposure to moisture in the air to form a tough rubber seal. The product is primarily designed for sealing flanges with excellent oil resistance or sealing rigid flanges: for example, on gearboxes and cast metal housings. It is already dry to the touch after 10 minutes. The product is resistant to water and glycol and can be used on machined or die-cast surfaces, on metal or on plastics.

## 12. TYRE PRESSURE



## 13. SUPPLIED TOOLS

- SCREW DRIVERS
- WHEEL WRENCH
- MANEUVERING ROD L
- HYDRAULIC LIFT 10 TON
- FIRE EXTINGUISHER
- FIRST-AID KIT
- SET OF DOUBLR FORK FIXED KEYS
- SET OF BUSEY KEY
- SPANNER
- HAMMER
- 4 LED TORCH VALEX
- GLASS BRAKER HAMMER
- ADJUSTABLE PLIER
- RECHARGEABLE TORCH
- EMERGENCY STOP TRIANGLES
- TOOL BOX
- SPECIAL KEY FOR HUB
- SPECIAL KEY FOR AUGER
- GREASE GUN
- TYRE LEVER
- CUTTING PIIER
- FILTER WRENCH
- SNOW CHAIN SET
- PIPE WRENCH 500 MM WITH EXTENSION PIPE
- FILTER OPENER

## 14. MEASURE UNITS CONVERSION

### LENGTH

Unità	yd	m	ft	in
yd	1	0,91	3	36
m	1,09	1	3,28	39,37
ft	$3,33 \cdot 10^{-1}$	$30,48 \cdot 10^{-2}$	1	12
in	$2,78 \cdot 10^{-2}$	$2,54 \cdot 10^{-2}$	$8,33 \cdot 10^{-2}$	1

(yd) yard; (m) meter; (ft) feet; (in) inch

### PRESSURE

Unità	atm	bar	Pa	psi
atm	1	1,01	101325	14,7
bar	$9,87 \cdot 10^{-1}$	1	105	14,5
Pa	$9,87 \cdot 10^{-6}$	$10^{-5}$	1	$1,45 \cdot 10^{-4}$
psi	$6,80 \cdot 10^{-2}$	$6,89 \cdot 10^{-2}$	$6,89 \cdot 10^3$	1

(atm) atmosphere; (Pa) pascal; (psi) pound per square foot

**MECHANICAL MOMENT**

<b>Unità</b>	<b>kgf m</b>	<b>lbf ft</b>	<b>N m</b>
<b>kgf m</b>	1	7,23	9,8062
<b>lbf ft</b>	$1,38 \cdot 10^{-1}$	1	1,36
<b>N m</b>	$1,02 \cdot 10^{-1}$	$7,38 \cdot 10^{-2}$	1

(Kgf m) Kilograms force per meter; (lbf ft) pound force per foot; (Nm) Newton per meter

**POWER**

<b>Unità</b>	<b>CV</b>	<b>hp</b>	<b>W</b>
<b>CV</b>	1	$9,86 \cdot 10^{-1}$	$7,35 \cdot 10^2$
<b>hp</b>	1,01	1	$7,46 \cdot 10^2$
<b>W</b>	$1,36 \cdot 10^{-3}$	$1,34 \cdot 10^{-3}$	1

(CV) horse power; (HP) british horse power; (W) watt

## 15. LIST OF THE REPAIR SECTIONS

For an easy consultation, the manual is composed by sections:

SECTION A	HYDROSTATIC SYSTEM REPAIR
SECTION B	TANSFER REDUCER REPAIR
SECTION C	TWO SPEED BACK GEAR REPAIR
SECTION D	CLUTCH REPLACEMENT
SECTION E	AXLES REPAIR
SECTION F	SUSPENSIONS REPAIR

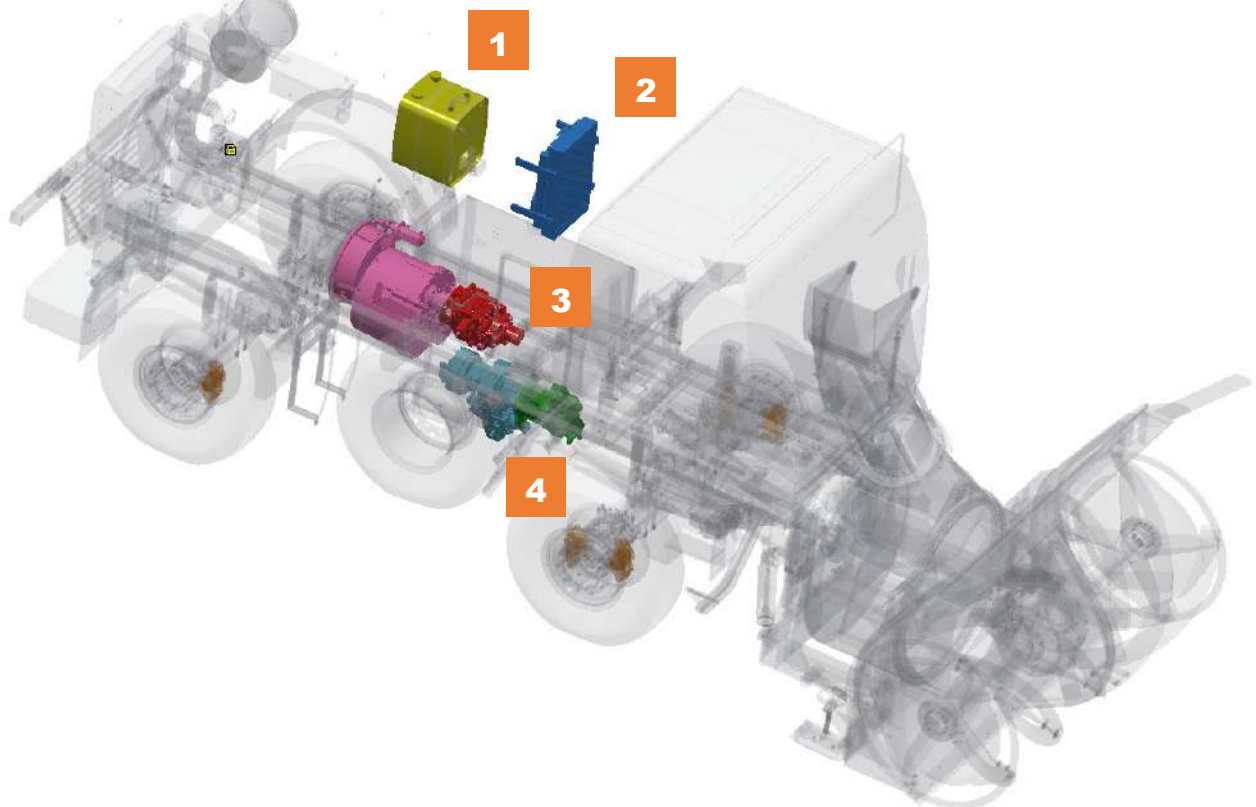
**SECTION 4**

**HYDROSTATIC SYSTEM REPAIR**

## 4.1 GENERALITY

The hydrostatic system for vehicle motion is composed of:

- 1) Oil tank in common with the hydraulic system
- 2) Heat exchanger (oil cooling) with thermostat for fan activation
- 3) Hydrostatic pump mounted on two speed back gear
- 4) Hydrostatic motor mounted on transfer





**4.2 TROUBLE SHOOTING**

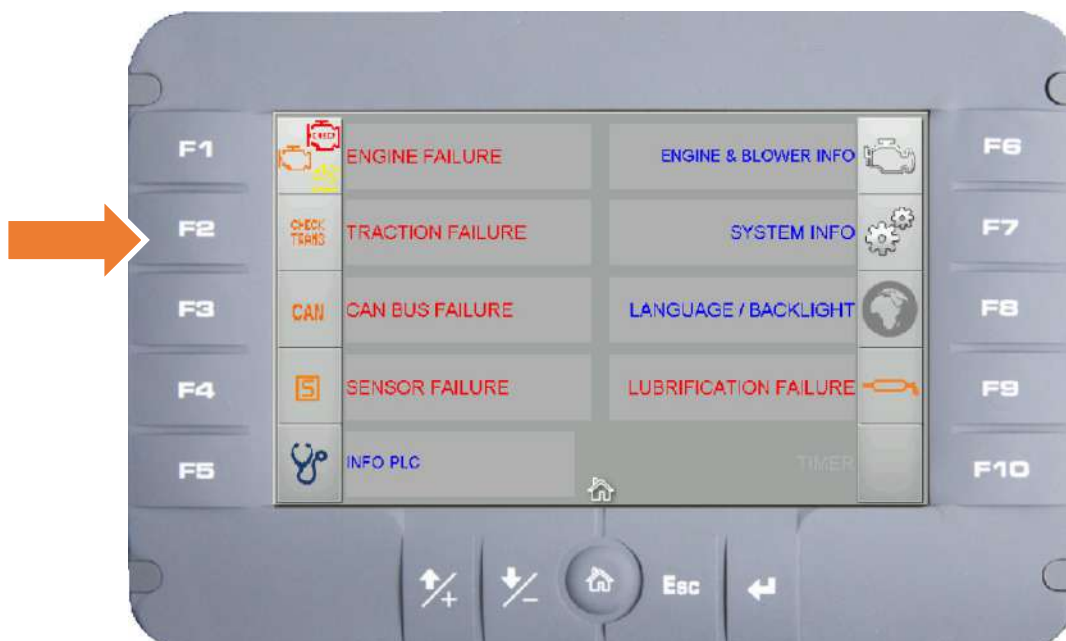
<b>FAULT</b>	<b>CAUSE</b>	<b>REMEDY</b>
<b>Trouble in the system</b>	<ul style="list-style-type: none"> <li>• Hydrostatic pump trouble</li> <li>• Hydrostatic motor trouble</li> <li>• Trouble at the motor solenoid valves</li> <li>• Trouble at the motor control module</li> <li>• Trouble at the pump solenoid valves</li> <li>• Trouble at the ECD control</li> <li>• Hydraulic oil low level</li> <li>• High temperature into the system</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the hydrostatic pump</li> <li>• Replace the hydrostatic motor</li> <li>• Replace the solenoids</li> <li>• Replace the control module</li> <li>• Replace the solenoids</li> <li>• Replace the ECD control module</li> <li>• Refill the tank Check for leaks</li> <li>• Check functionality of the heater exchanger and its thermostat. If necessary, replace.</li> </ul>
<b>The direction lever do not give the command to move the vehicle</b>	<ul style="list-style-type: none"> <li>• Failure into lever connection</li> <li>• Direction lever damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Check the direction lever cablage</li> <li>• Replace the command</li> </ul>
<b>Trottle pedal do not working properly</b>	<ul style="list-style-type: none"> <li>• Failure into pedal electric connection</li> <li>• Damaged throttle pedal driving sensor</li> <li>• Damaged throttle pedal</li> </ul>	<ul style="list-style-type: none"> <li>• Check the throttle pedal cablage</li> <li>• Replace the driving sensor</li> <li>• Replace the pedal</li> </ul>

## 4.3 HYDROSTATIC TRACTION FAILURE

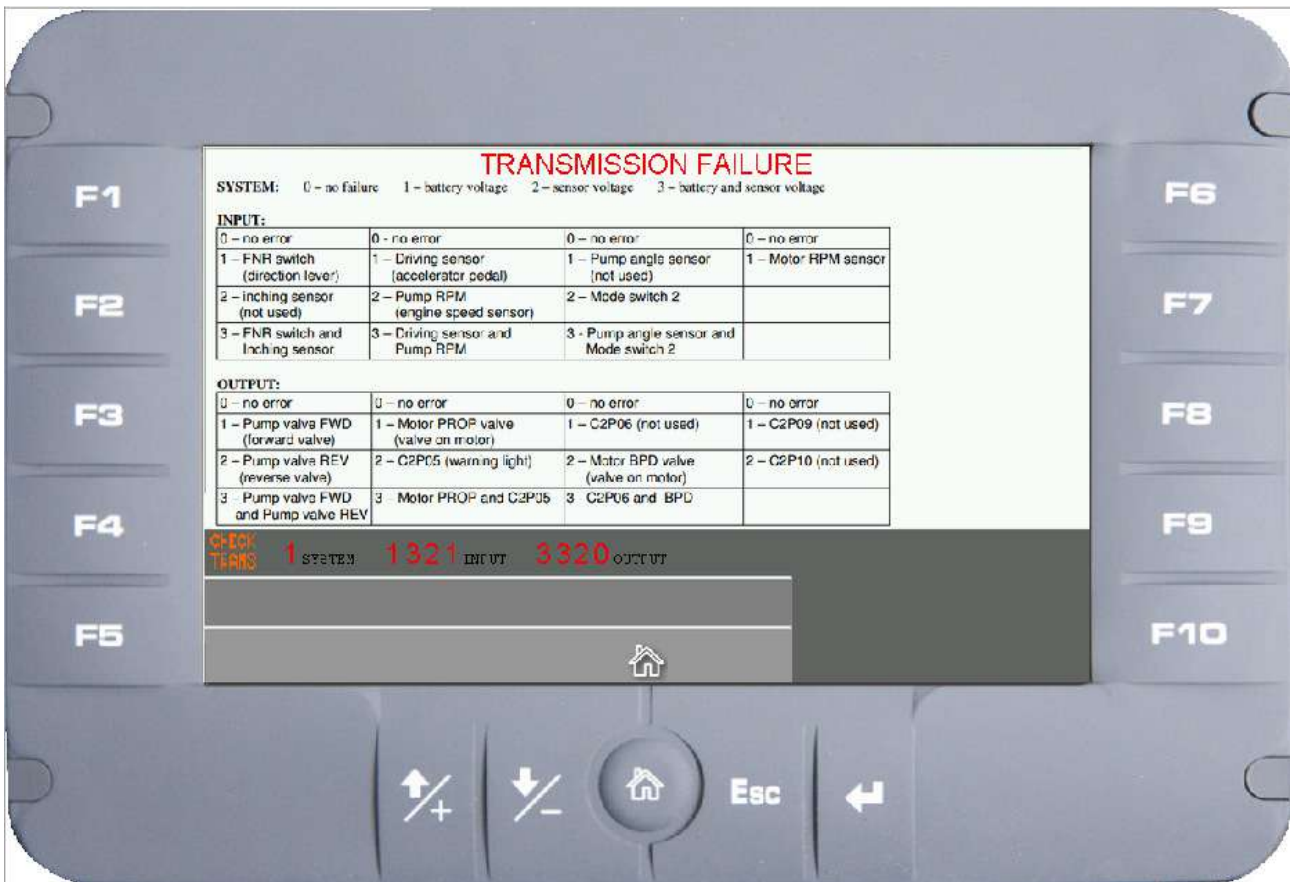
When on main monitor the write **CHECK TRANS** illuminates, it means a failure in the system.



Press the button to access the MAIN FUNCTION SHEET



Then F2 to access the hydrostatic traction failures, where there are reported the error codes and relative table with their meanings.



Error type:

1. System state    SYS    1 digit
2. Input state    IN    4 digits
3. Output state    OUT    4 digits

### SYSTEM STATE



- 0 - NO failure
- 1 - Low batteries voltage
- 2 - Low sensor voltage engine rpm
- 3 - Low batteries and sensor voltage

### INPUT STATE:



0 - NO failure	0 - NO failure	0 - NO failure	0 - NO failure
1 - FNR switch (direction lever in cab)	1 - Trottle pedal (driving sensor)	1 - Pump angle sensor (not used)	1 - RPM sensor hydraulic motor
2 - Inching sensor (not present)	2 - RPM pump engine speed sensor (on C13 engine)	2 - Mode switch 2 (not present)	2 - /
3 - FNR switch (direction lever in cab) and inching sensor	3 - Driving sensor (not present) and RPM pump	3 - Pump angle sensor and mode switch 2 (not present)	3 - /

### OUTPUT STATE:



0 - NO failure	0 - NO failure	0 - NO failure	0 - NO failure
1 - Pump valve FWD (forward valve) C2	1 - Motor valve PROP C4	1 - /	1 - /
2 - Pump valve REV (reverse valve) C1	2 - C2P05 warning light CHECK TRANS on monitor	2 - Motor valve C5 (BPD)	2 - /
3 - Pump valve FWD e pump valve REV	3 - Motor PROP C4 and C2P05	3 - /	3 - /

Legend:

FNR switch (direction lever) →



Trottle pedal driving sensor →



C2P05 warning light →



See following instruction for sensors and valves C1-C2-C4-C5 replacement.

## 4.4 HYDROSTATIC MOTOR

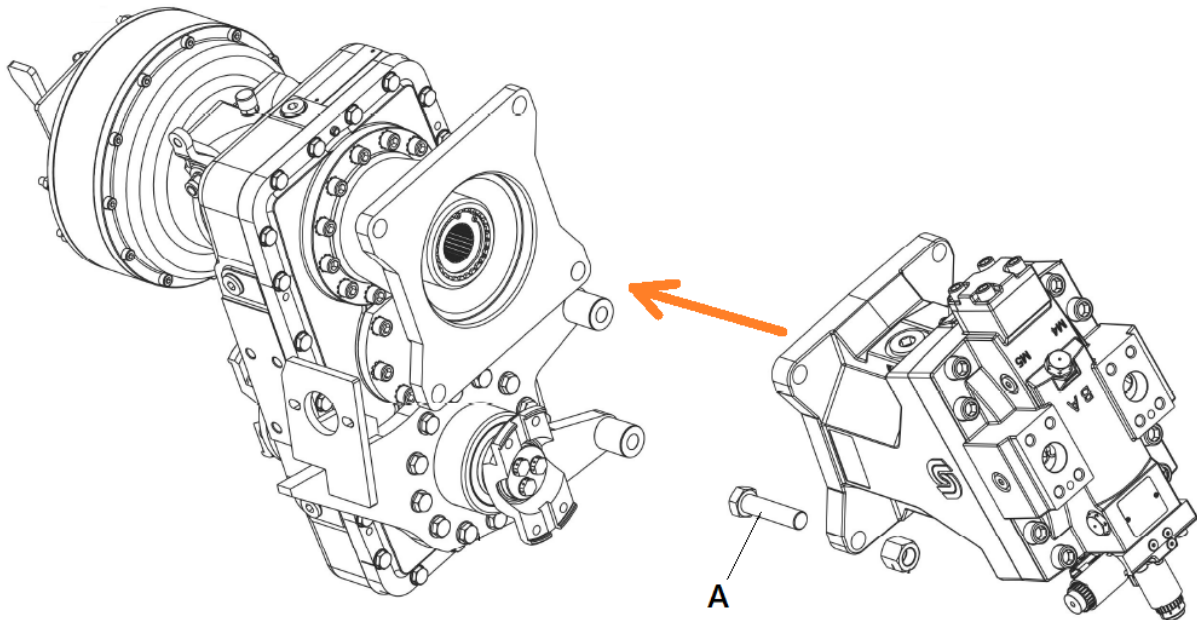
### 4.4.1 HYDROSTATIC MOTOR DISASSEMBLY



#### **WARNING!**

*Contamination can damage internal components.*

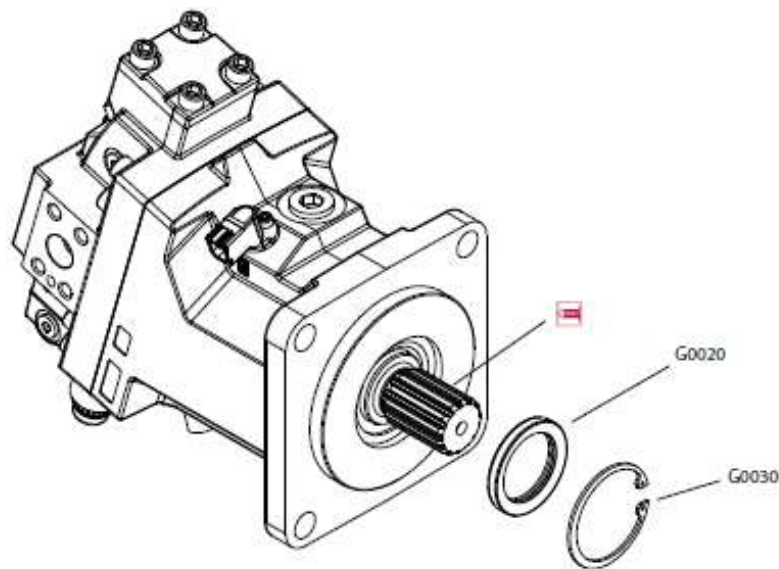
- 1) Put a vessel under the working area and disconnect all the hydraulic hoses on the motor.
- 2) Unscrew the bolts A to slide out the motor from its support (socket wrench 30 mm).



#### **To reassemble:**

- 3) Insert the motor shaft into the internal sleeve on the motor support.
- 4) Tighten the bolts A (socket wrench 30 mm).
- 5) Reinstall the hydraulic hoses.

## 4.4.2 REPLACE THE SHAFT SEAL



### Removal

- 1) Using snap ring pliers, remove retaining ring (G0030).
- 2) Use a slide-hammer style puller to remove seal (G0020). Be careful not to damage the shaft or seal bore when removing. Discard seal.

### Inspection

Inspect retaining ring for wear or damage. Replace if necessary. Inspect shaft for wear or groove at seal area.

### Assembly

- 3) Lubricate inside diameter of new seal. Cover the shaft splines with shaft cover or packing tape to avoid damaging the seal during installation.
- 5) Using a snap ring pliers, install retaining ring (G0030).
- 6) Use seal installation tool to press seal and retaining ring into housing until retaining ring snaps into its groove.

## 4.4.3 ELECTRIC PROPORTIONAL SOLENOIDS REPLACEMENT C4 AND C5

### Removal

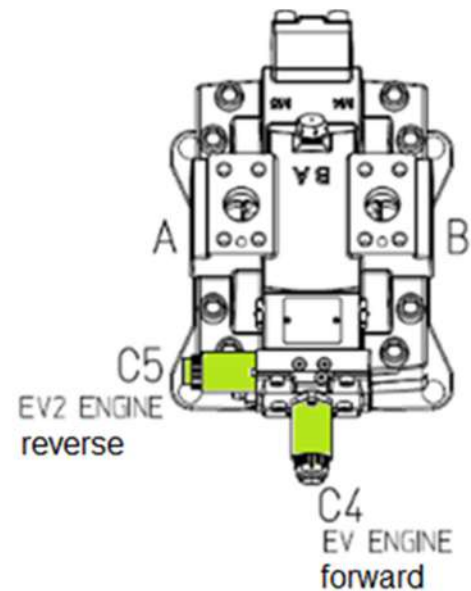
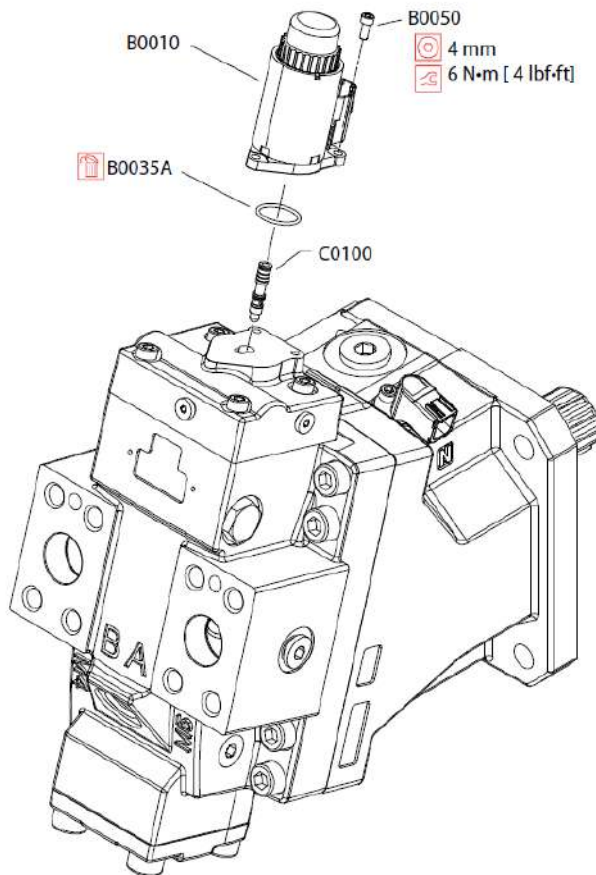
- 1) Disconnect electrical connection and remove three cap screws (B0050) using a 4 mm internal hex wrench.
- 2) Remove the solenoid (B0010) and O-ring (B0035A). Discard the O-ring.
- 3) Remove valve spool (C0100).

### Inspection

Clean and inspect valve spool and all machined surfaces for damage or wear. Replace parts if necessary.

## Assembly

- 4) Lubricate and install valve spool (C0100).
- 5) Using petroleum jelly, lubricate and install new O-ring (B0035A).
- 6) Install cap screws (B0050) using a 4 mm internal hex wrench. Torque screws to 6 N•m [4 lbf•ft].
- 7) Reconnect electrical connections and test the motor for proper operation



## 4.4.4 CONTROL MODULE REPLACEMENT

### Removal

- 1) Remove four cap screws (C0110 and/or C0120). Refer to table for wrench sizes.
- 2) Remove control (C0010) from motor. Remove and discard gasket (C0130).

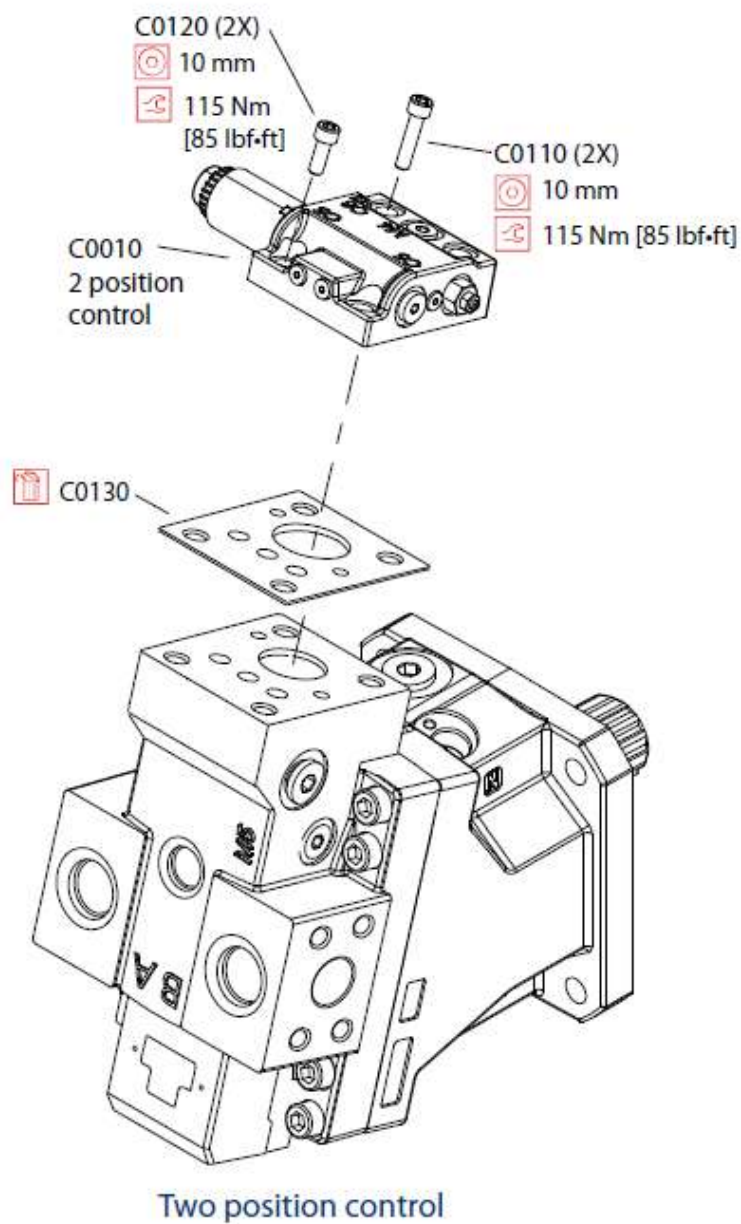
### Inspection

Clean and inspect the machined surfaces on the control and the endcap. If you find any nicks or scratches, replace control or endcap. Inspect valve spool, washer, and spring. Replace if necessary.

### Assembly

- 3) Install a new gasket (C0130).
- 4) Position control on motor.
- 5) Install four cap screws (C0110 and/or C0120).

Screw	Control	Torque	Internal Hex Wrench
C0110	Electric / Hydraulic proportional	37 N·m [27 lbf·ft]	6 mm
C0110, C0120	Two-position	115 N·m [85 lbf·ft]	10 mm



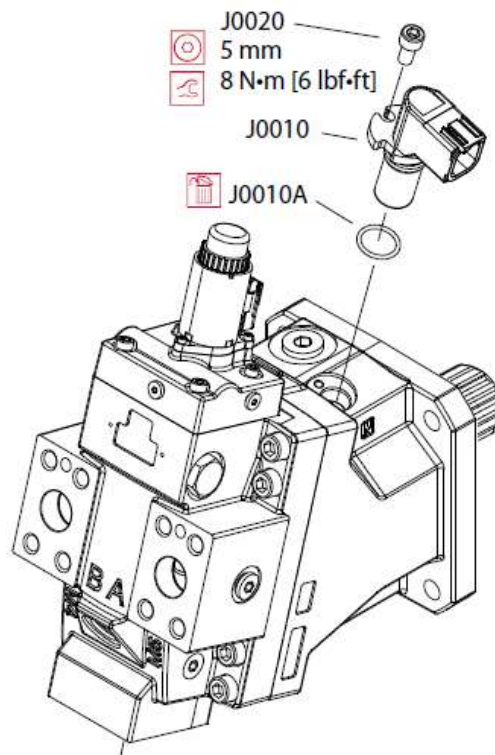
## 4.4.5 REPLACE THE SPEED SENSOR

### Removal

- 1) Using a 5 mm internal hex wrench, remove screw (J0020).
- 2) Remove speed sensor (J0010).
- 3) Discard O-ring (J0010A).

### Assembly

- 4) Lubricate and install new O-ring (J0010A).
- 5) Install speed sensor (J0010).
- 6) Install screw (J0020) using a 5 mm internal hex wrench with torque to 8 N•m [6 lbf•ft].



## 4.5 HYDROSTATIC PUMP

### 4.5.1 DISASSEMBLY

Before working on the pump, thoroughly clean the outside. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as they are disconnected, and plug all open ports to ensure that dirt and contamination do not get into the system.

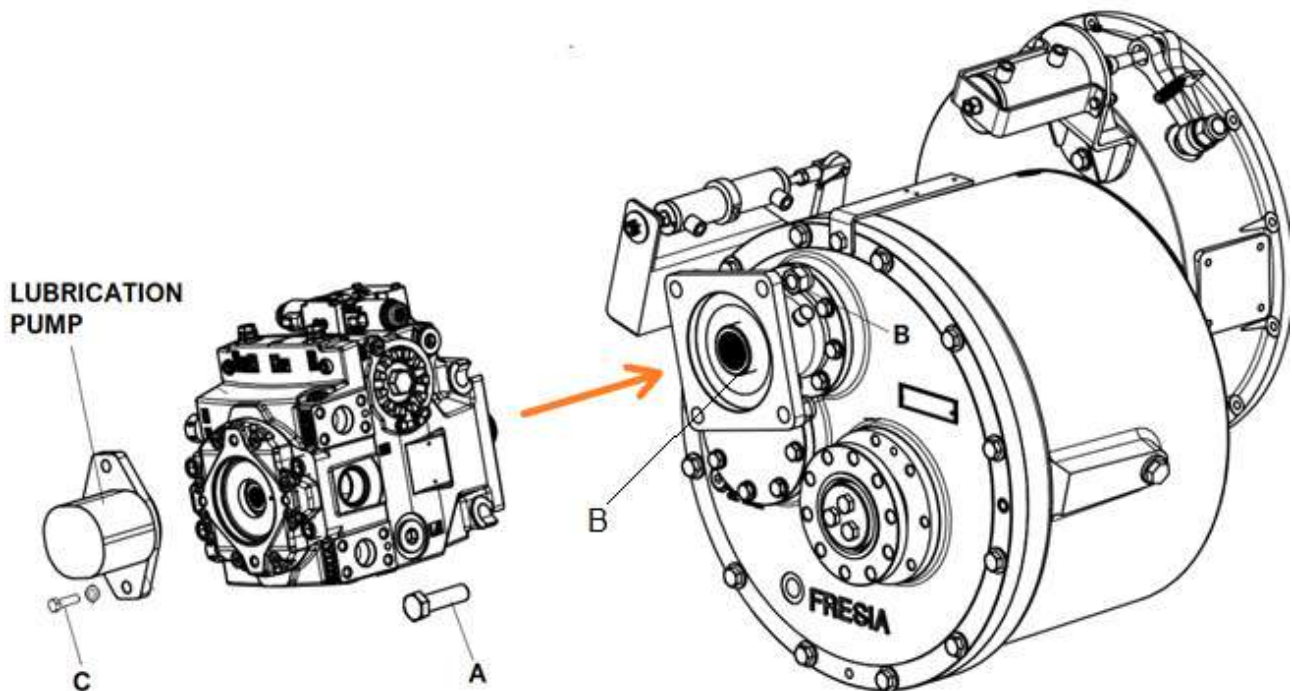


**WARNING!**  
*Contamination can damage internal components.*

- 1) Put a vessel under the working area and disconnect all the hydraulic hoses on the pump.
- 2) Remove the iron lubrication pipes;
- 3) Unscrew the bolts A to slide out the pump from the pump support (socket wrench 30 mm);

***Be careful, do not damage solenoids and electrical connections when using straps or chains to support the pump.***

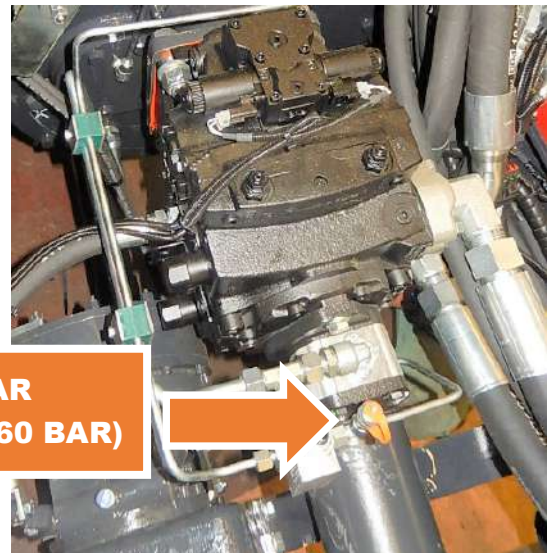
- 4) Remove the bolts C to disconnect the lubrication pump from the hydrstatic pump (socket wrench 22 mm).



## To reassemble:

Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.

- 5) Fill the pump with clean, filtered hydraulic fluid.
- 6) Insert the motor shaft into the internal sleeve B on the motor support
- 7) Tighten the bolts A (socket wrench 30 mm).
- 8) Reinstall pipes and hoses (replace if damaged).



## 4.5.2 EDC CONTROL REPLACEMENT

**Removal:** Refer to exploded diagram, next page.

- 1) Using a 5 mm internal hex wrench, remove the six cap screws (D250).
- 2) Remove the control module and gasket (D150). Discard the gasket.
- 3) If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for reinstallation.
- 4) If screen (D084) is clogged, use a hook to remove retaining ring (D098) and screen. Discard screen and replace with new screen.

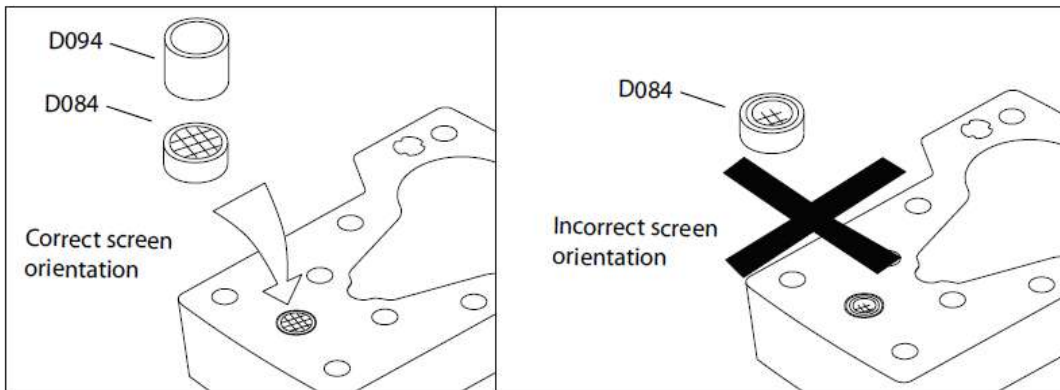
### Inspection

- 5) Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

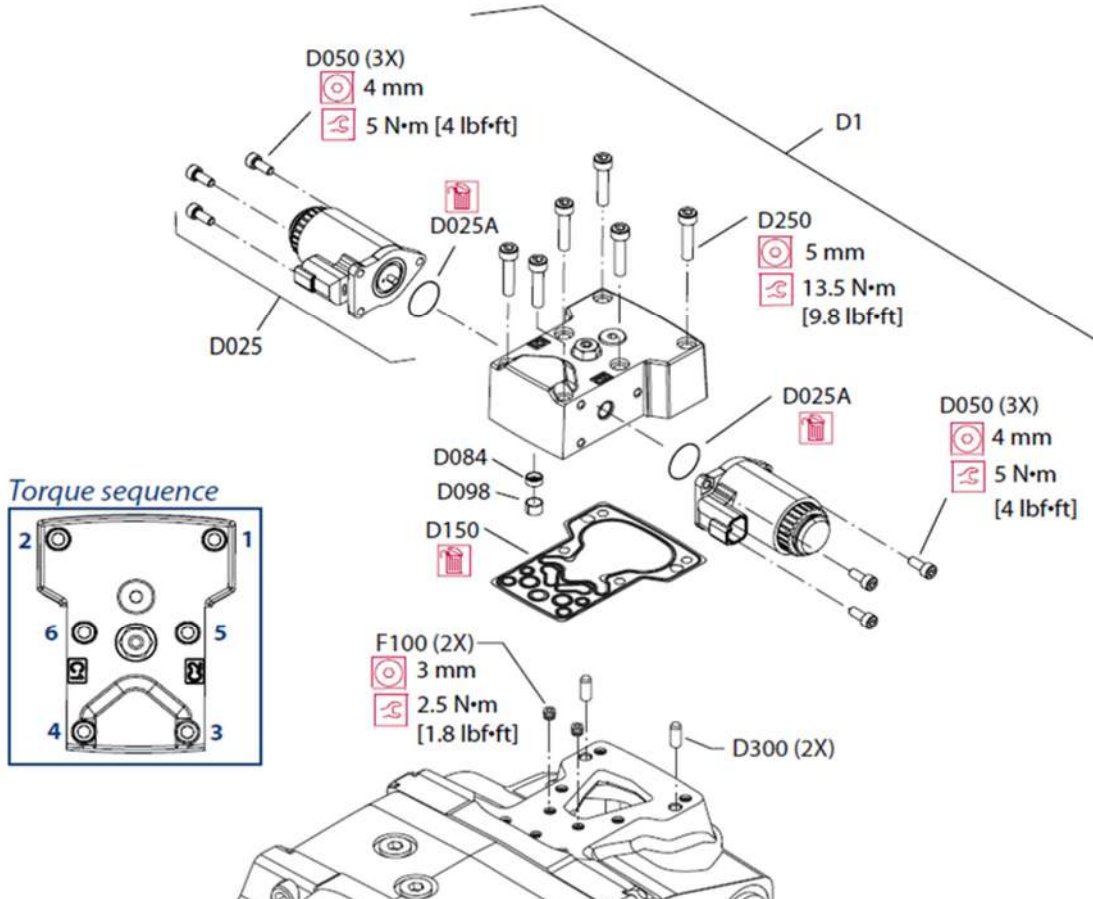
**Reassembly** Ensure you install dowel pins (D300) in housing before installing control.

- 6) Install a new gasket (D150).

### Proper Screen Orientation



- 7) If you removed screen (D084), install a new one. Install with the mesh facing outward (see drawing). Install retaining ring (D098).
- 8) If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 2.5 N•m [1.8 lbf•ft].
- 9) Install the control module and six cap screws (D250).
- 10) Using a 5 mm internal hex wrench, torque the cap screws (D250) to 13.3 N•m [9.8 lbf•ft].

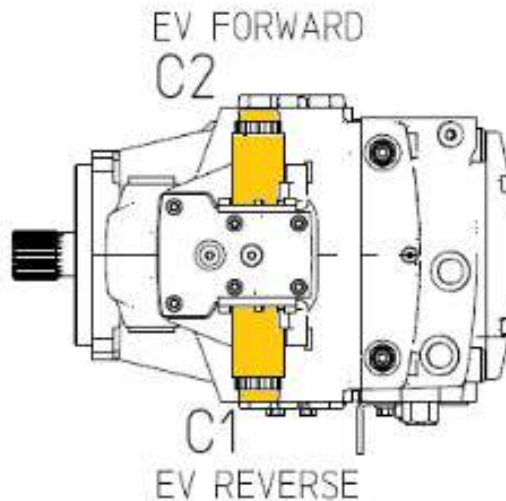


## 4.5.3 CONTROL SOLENOID REMOVAL C1 AND C2

- 1) Disconnect electrical connection and remove the three cap screws (D050) using a 4 mm internal hex wrench.
- 2) Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
- 3) If necessary, remove the coil using a 12 point 26 mm socket.

### Inspection

- 4) Inspect the machined surface on the control. If you find any nicks or scratches, replace the component. **Reassembly**
- 5) Lubricate new O-ring (D025A) using petroleum jelly and install.
- 6) Install solenoid with three cap screws (D050) using a 4 mm internal hex wrench. Torque screws to 5 N•m [4 lbf•ft]. 7) Install coil using a 12 point 26 mm socket. Torque coil nut to 5 N•m [3.7 lbf•ft].
- 8) Reconnect electrical connections and test the pump for proper operation.



ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

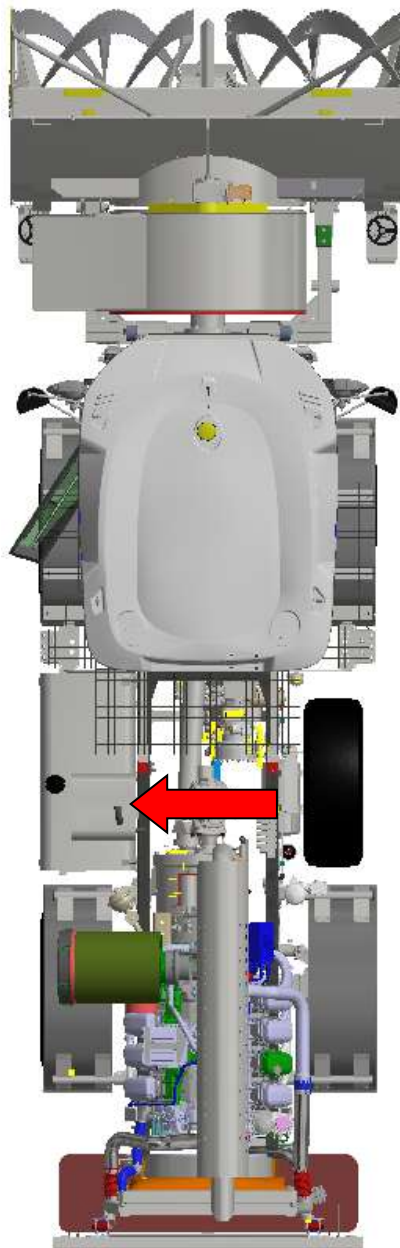
Intervention type: **HYDRAULIC AND HYDROSTATIC OIL LEVEL CHECK**

**HYDROSTATIC TRANSMISSION & HYDRAULIC SYSTEM**

Periodicity: **BEFORE STARTING**

Required time: **1 minute**

Action points:



Requested spare parts:

- Oil type TUTELA CAR G/E or equivalent.

Specific tools:

**PROCEDURE:**



*People operating on vehicle must wear protective clothes according to the regulations in force*



**NOTE:**

*An indicator light indicates quantity of hydraulic oil.*

- a) Check on control panel the tank oil level. If it is lower than **80%**, proceed as following:



- b) Fill the new oil through the upper plug (1). The correct level is about 10 cm from the top.



**WARNING:**

*The correct level is about 10 cm from the top of the tank.*

*The check must be done with cold oil.*



**WARNING:**

*Use only TUTELA CAR GI/E or equivalent.*

*The oil has to be filtered in a 10 micron.*

<input type="checkbox"/>	ELECTRIC	<input type="checkbox"/>	MECHANIC	<input checked="" type="checkbox"/>	FLUIDIC
<input type="checkbox"/>	CLEANING	<input type="checkbox"/>	LUBRIFICATION	<input type="checkbox"/>	INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

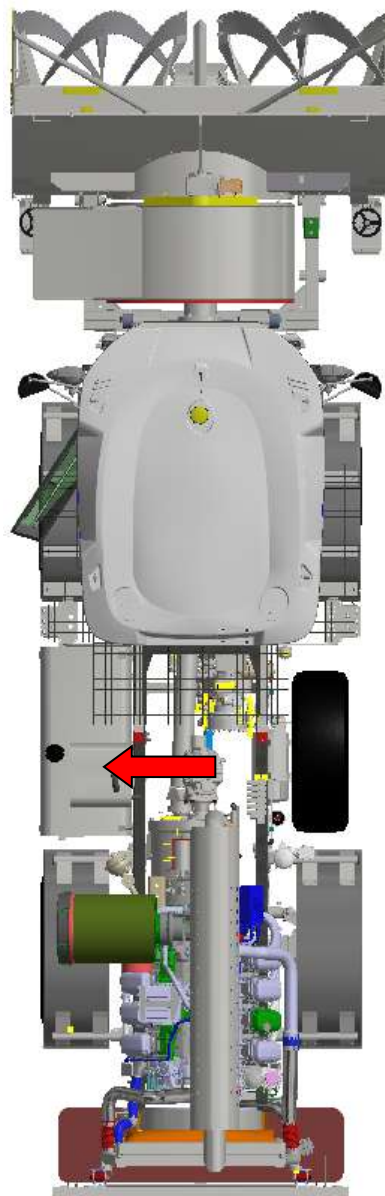
Intervention type: **HYDROSTATIC TRANSMISSION OIL FILTER REPLACEMENT**

**HYDROSTATIC TRANSMISSION & HYDRAULIC SYSTEM**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **20 minutes**

Action points:



**Requested spare parts:**  
 Filter cartridge code **00099792**  
 Oil type **TUTELA CAR GI/E** or equivalent

**Specific tools:**

## PROCEDURE



### **WARNING:**

**People operating on vehicle must wear protective clothes according to the regulations in force.**



- a) Put a container under the oil filter
- b) Remove the plastic cover.
- c) Remove the old filter and install the new one.
- d) Reinstall the cover.
- e) Run the engine and make sure there are no leaks.



### **WARNING:**

**As soon as the filter is removed, the oil becomes flowing out. At the end of the operation it is necessary to fill the tank at the correct oil level.**

**Use only TUTELA CAR GI/E oil or equivalent.**

ELECTRIC  
CLEANING

MECHANIC  
LUBRICATION

FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

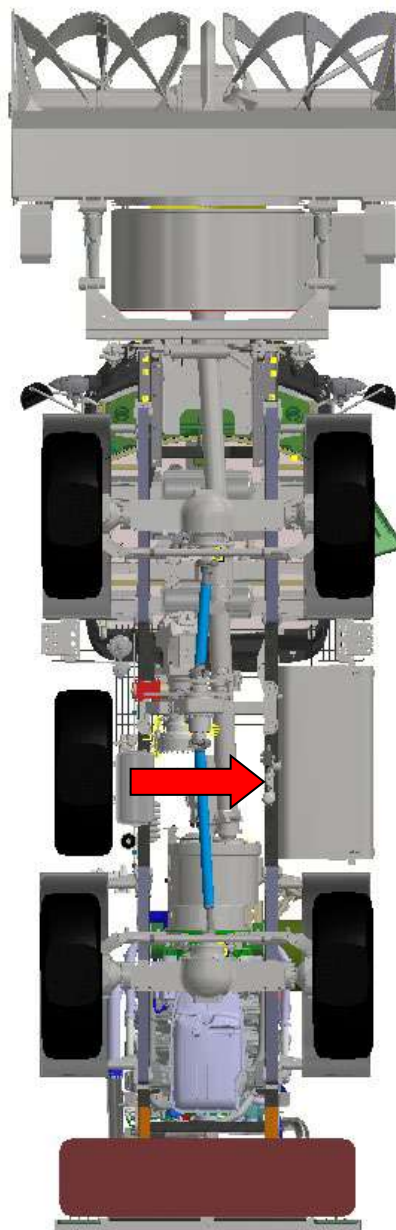
Intervention points: **HYDRAULIC OIL FILTER REPLACEMENT**

**HYDROSTATIC TRANSMISSION & HYDRAULIC SYSTEM**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **20 minutes**

Action points:



**Requested spare parts:**

- Cartridge code **00083031**
- Oil type **TUTELA CAR G/E** or equivalent.

**Specific tools:**

PROCEDURE:

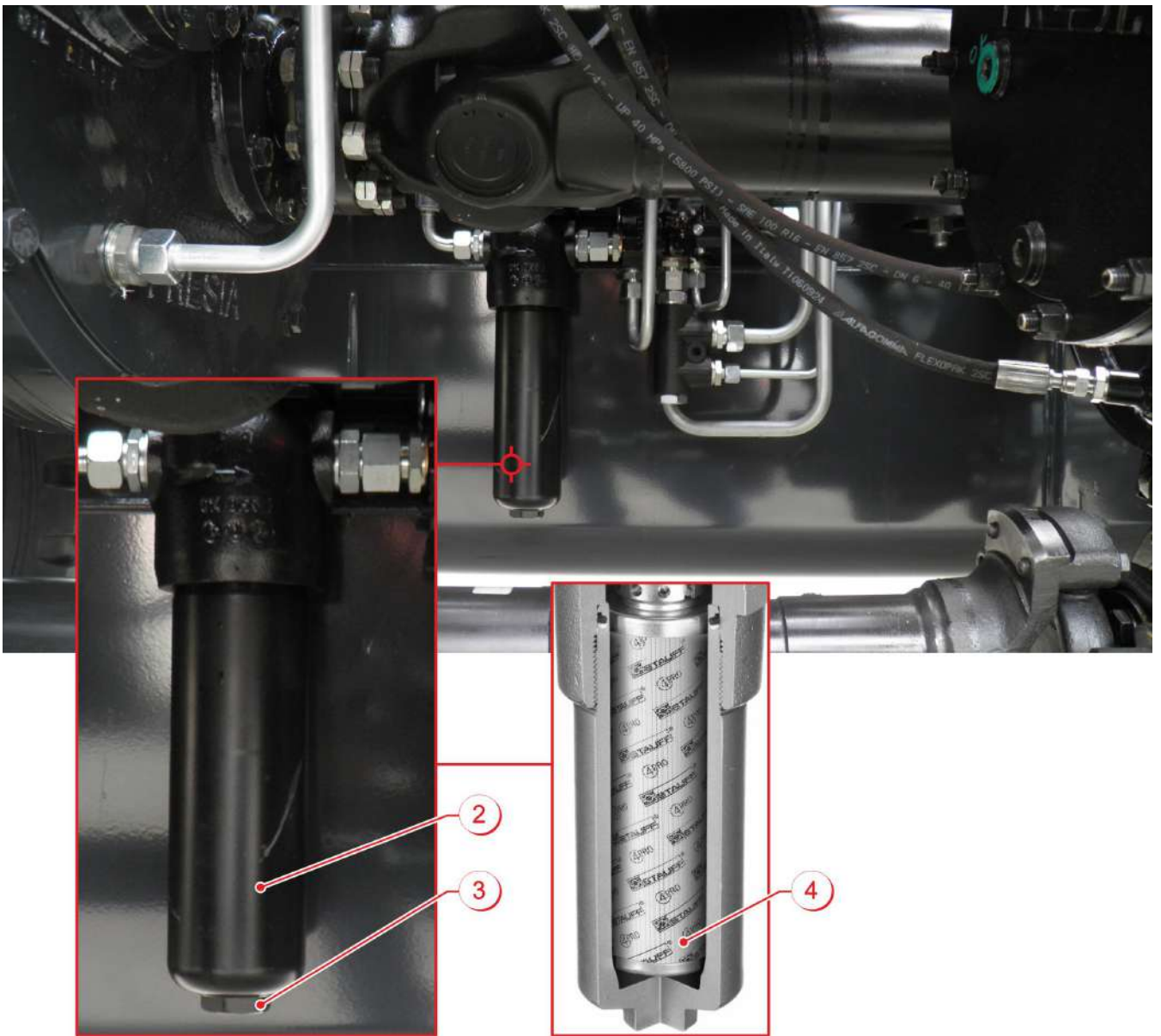


**WARNING:**

*People operating on vehicle must wear protective clothes according to the regulations in force.*



- a) Close the valve, in the back of the tank
- b) Put a container under the oil filter.



- a) Remove the housing (2) by unscrewing the nut (3).
- b) Slide out the cartridge (4)
- c) Insert the new one.
- d) Fix back the housing (2) screwing the nut (3).
- e) Open the valve (1).



**WARNING:**  
*At the end of the operation, it is necessary to refill the tank at the correct level, 10 cm from the top.*



**WARNING:**  
*Use only TUTELA CAR G1/E oil or equivalent.*

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

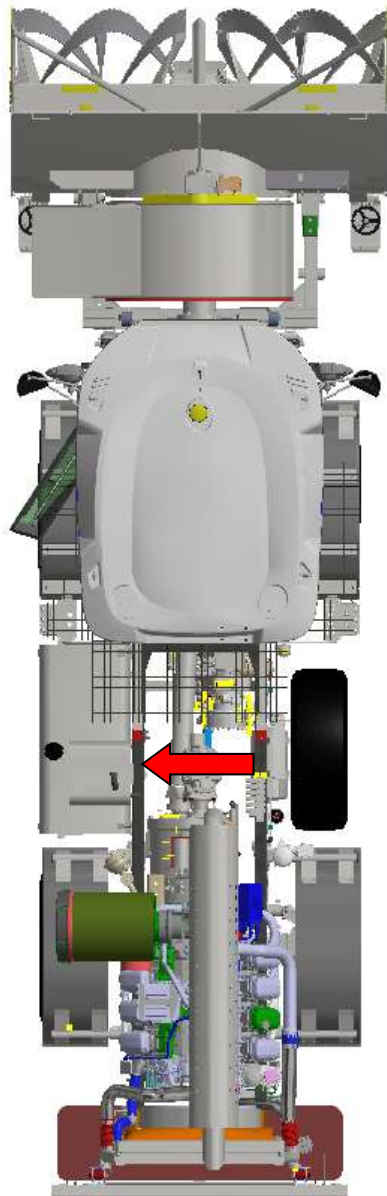
Intervention type: **HYDRAULIC AND HYDROSTATIC OIL REPLACEMENT**

**HYDROSTATIC TRANSMISSION & HYDRAULIC SYSTEM**

Periodicity: **EVERY 1000 HOURS or 2 YEARS**

Required time: **30 minutes**

Action points:



**Requested spare parts:**

- Oil type TUTELA CAR G/E or equivalent.

**Specific tools:**

- Suction pump

## PROCEDURE:



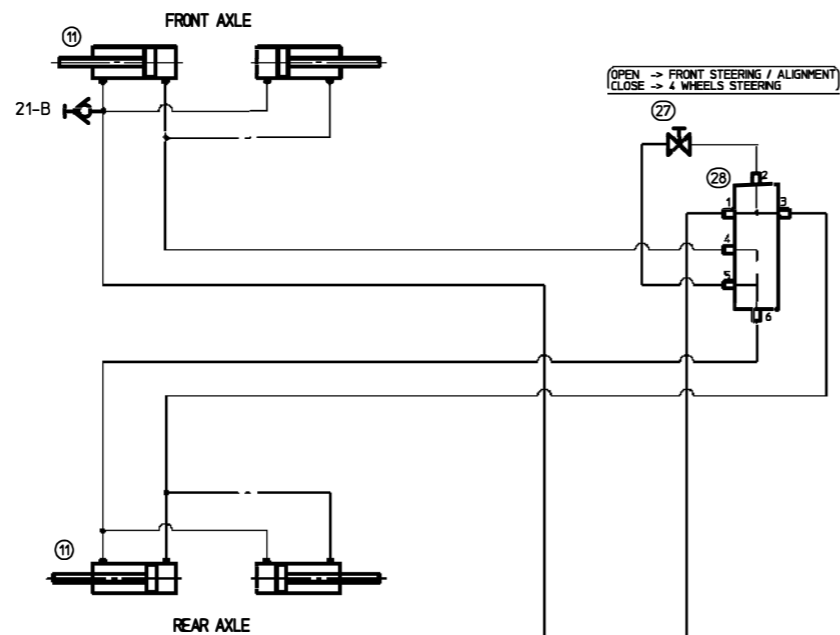
**WARNING:**  
*People operating on vehicle must wear protective clothes according to the regulations in force.*



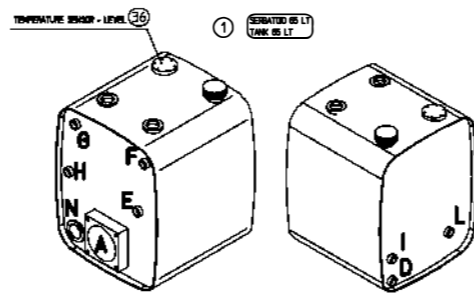
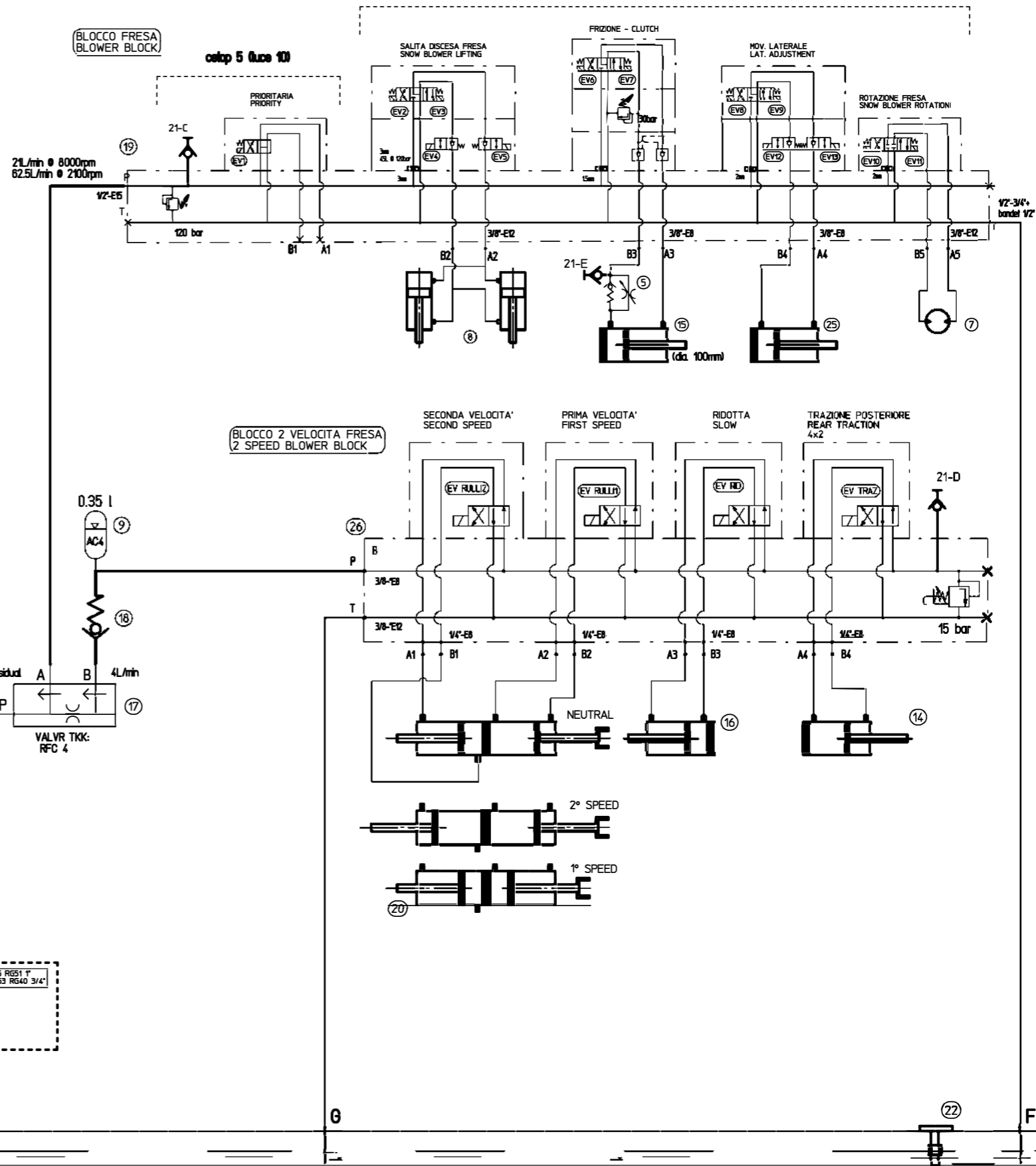
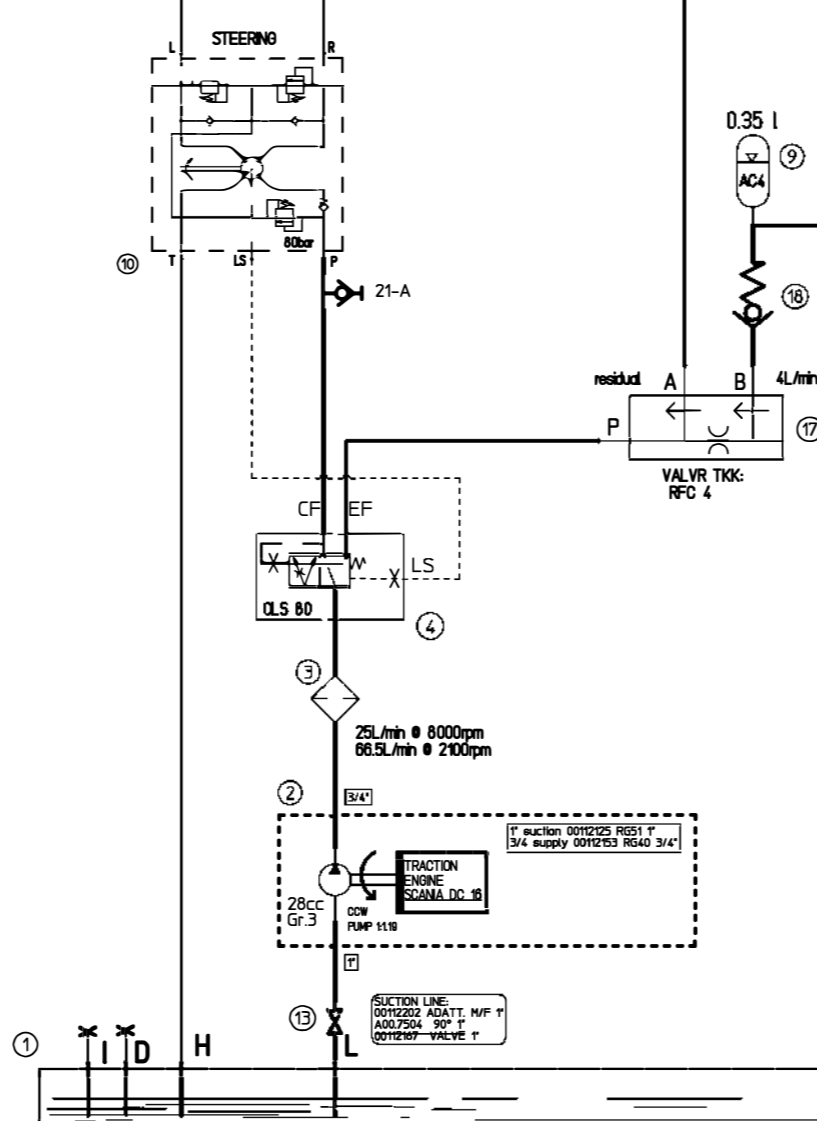
- a) Unscrew the tank cap and use a suction pump to drain out the oil.
- b) In alternative, proceed as following:
  - ✓ close the valve A;
  - ✓ Disconnect the hose from A;
  - ✓ put a container under the valve, open it and leave all the oil draining out;
  - ✓ when the tank is empty, close A and reconnect the hose;
- c) Fill the tank with new oil through the top opening until it reaches 10 cm from the cap;
- d) Screw back the tank cap on top.



**WARNING:**  
*Use only TUTELA CAR GI/E oil or equivalent.*  
*Oil must be filtered in a 10 micron.*

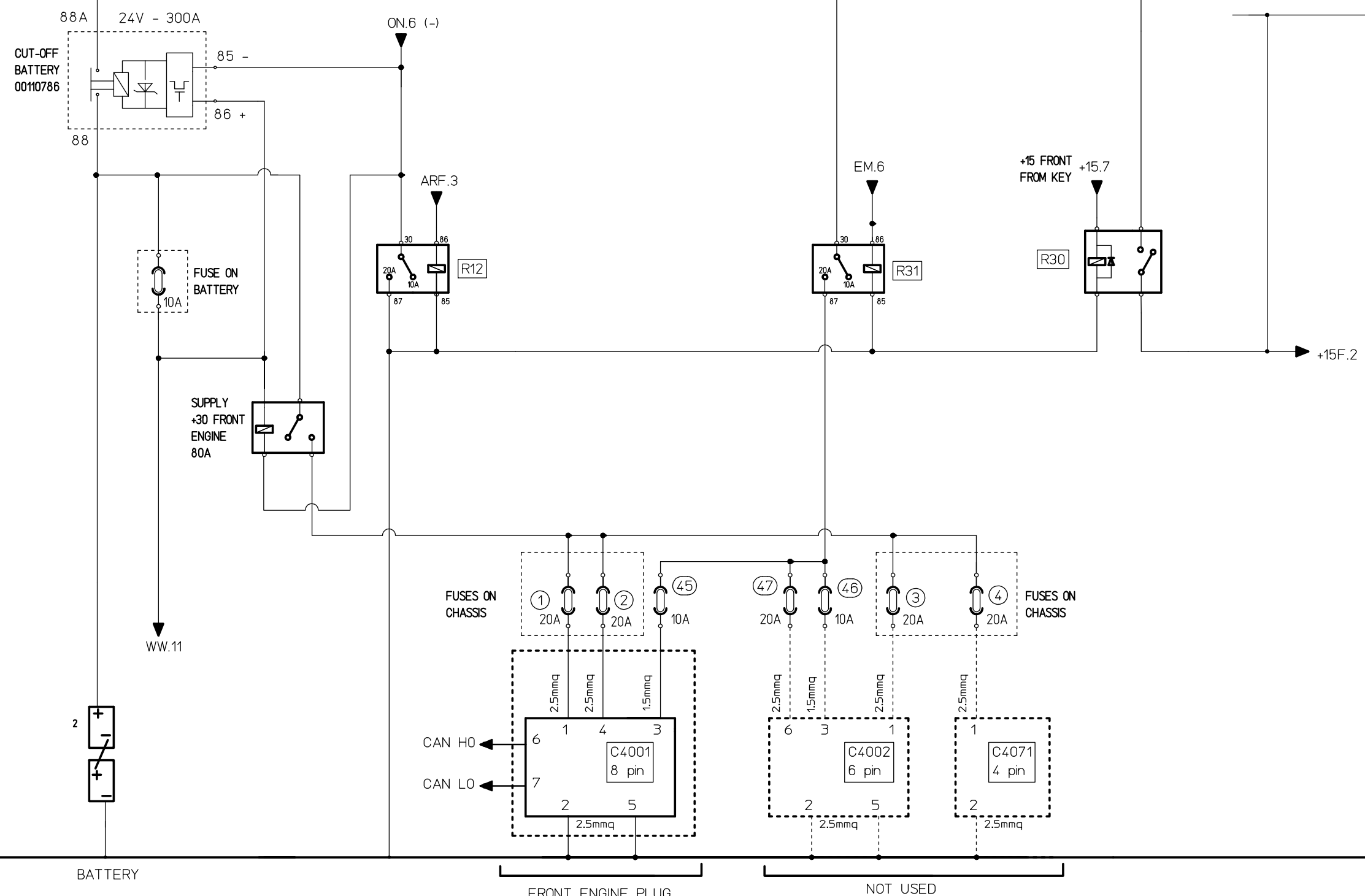


21 - POINTS PRESSURE		
		BAR
21-A	STEERING PUMP	90
21-B	STEERING	90
21-C	BLOWER BLOCK	110
21-D	TRACTION BLOCK	15
21-E	CLUTCH BLOCK	30



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QTA N°	DATA Date 28/08/2022	DESIGNER Name	D.R.
MASSA Weight	SCALA Scale	Disegnato	O.S.D.
MATERIALE / Material		SISTEMA N°	
X		SISTEMA N°	
OBSERVAZIONE / Designation		TPO Type	
HYDRAULIC SYSTEM - F90 2STI		F9025TI B2DA	
ENGINE SCANIA DC16 Stage V		CODICE Code No.	
		N° 31967	

28	00083379	1	ALIGNMENT BLOCK	
27	00010952	1	MANUAL VALVE FOR STEERING CONTROL	
26	00112148	1	TRACTION BLOCK	
25	---	2	TILT CYLINDER	
24	FL00098577	2	UP AND DOWN SNOW BLOWER	
23	00092874	1	HEATER	
22	00104462	1	TEMPERATURE SENSOR - LEVEL	
21	A00.5624	7	PRESSURE TEST POINT 1/8"	
20	FL00101443	1	FIRST AND SECOND SNOW BLOWER SPEED CYLINDER	
19	00112147	1	SNOW BLOWER BLOCK	
18	00102220	1	ONE-WAY VALVE 1/4" 0.5 bar'	
17	00111674	1	PRIORITY VALVE RFC 4	
16	FL00101504	1	SLOW CYLINDER	
15	00110358	1	CLUTCH CYLINDER (SUPPORT 00110356)	
14	FL00101505	1	TRACTION CYLINDER	
13	.00.4340	1	VALVE	
12	---	1	STEERING VALVE	
11	---	4	STEERING CYLINDER	
10	00082658	1	STEERING OSPC 200 LS	
09	00109228	1	ACCUMULATOR 0.35 L preload 9 bar	
08	FL00098577	2	UP AND DOWN SNOW BLOWER	
07	00083207	1	HYDRAULIC ENGINE OMR50	
06	00109869	1	TRASDUCTOR 0-250BAR - 0.5-4.5V ???	
05	00081196	1	CHECK VALVE WITH VARIABLE REVERSE FLOW	
04	00111766	1	PRIORITY VALVE OLS80 - DINAMICO	
03	00081381	1	OIL FILTER	
02	00112124	1	PUMP TK3 28cc - LEFT SAEB 13T (CCW)	
01	00104488	1	TANK 65 LT	
Item	Codice / Code	Q.tà	Descrizione / Description	Note



BATTERY

FRONT ENGINE PLUG

NOT USED

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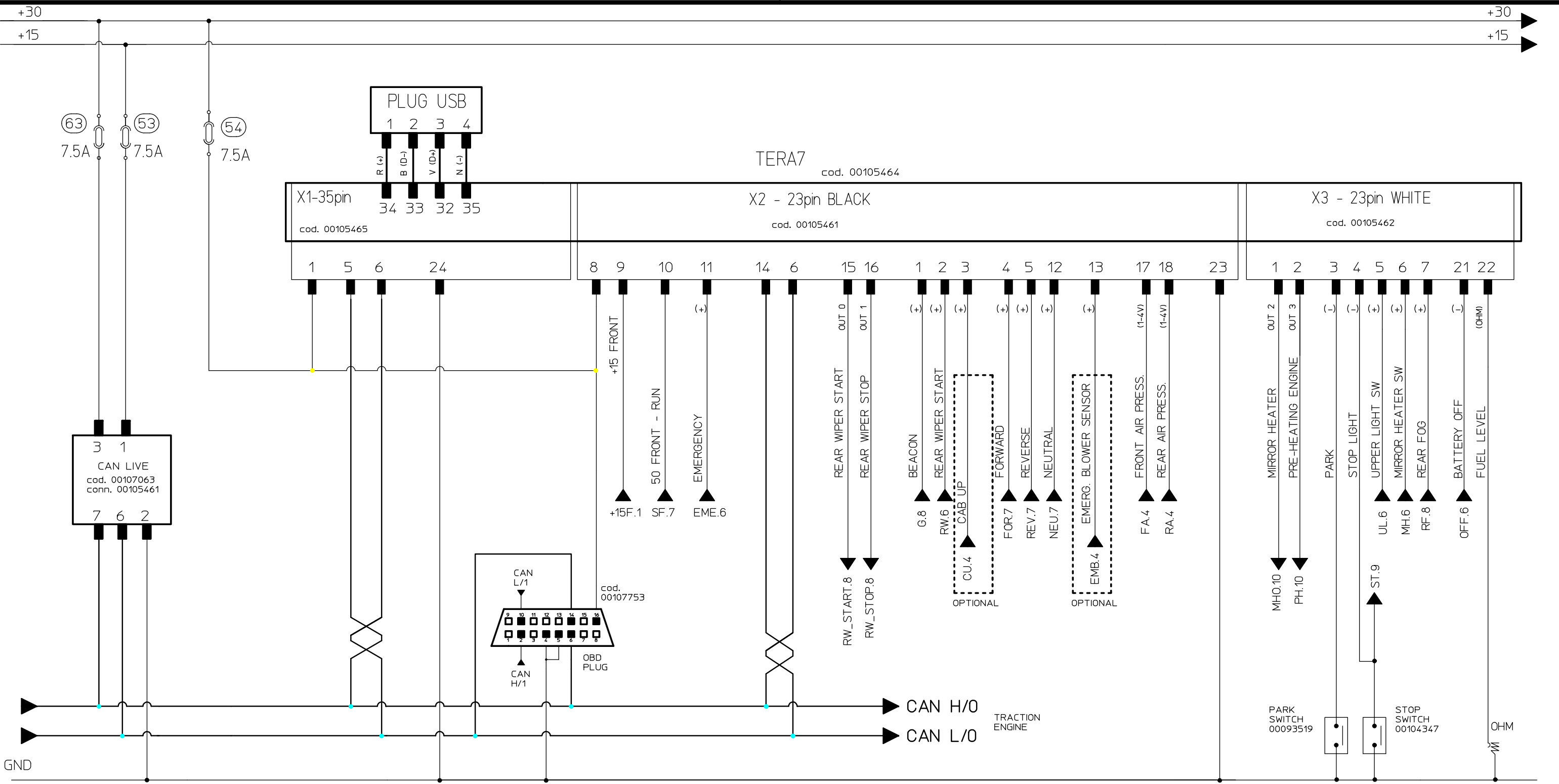
Tolleranze ed altre prescrizione generali  
 - Standar 1-2001 -  
 General tolerances and other specifications

Q.TA Nr.	.	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	.	CAD Drawing	O.S.D.

MATERIALE / Material	.	SOST.it N° Rep. for	.
.	.	SOST.dal N° Rep. by	.

DESIGNAZIONE / Designation  
**ELECTRICAL SYSTEM SCANIA ENGINE DC16**

TIPO Type	F90 INDIA
CODICE Code Nr.	.
N° / Nr	31968
FOGLIO Sheet	1/11



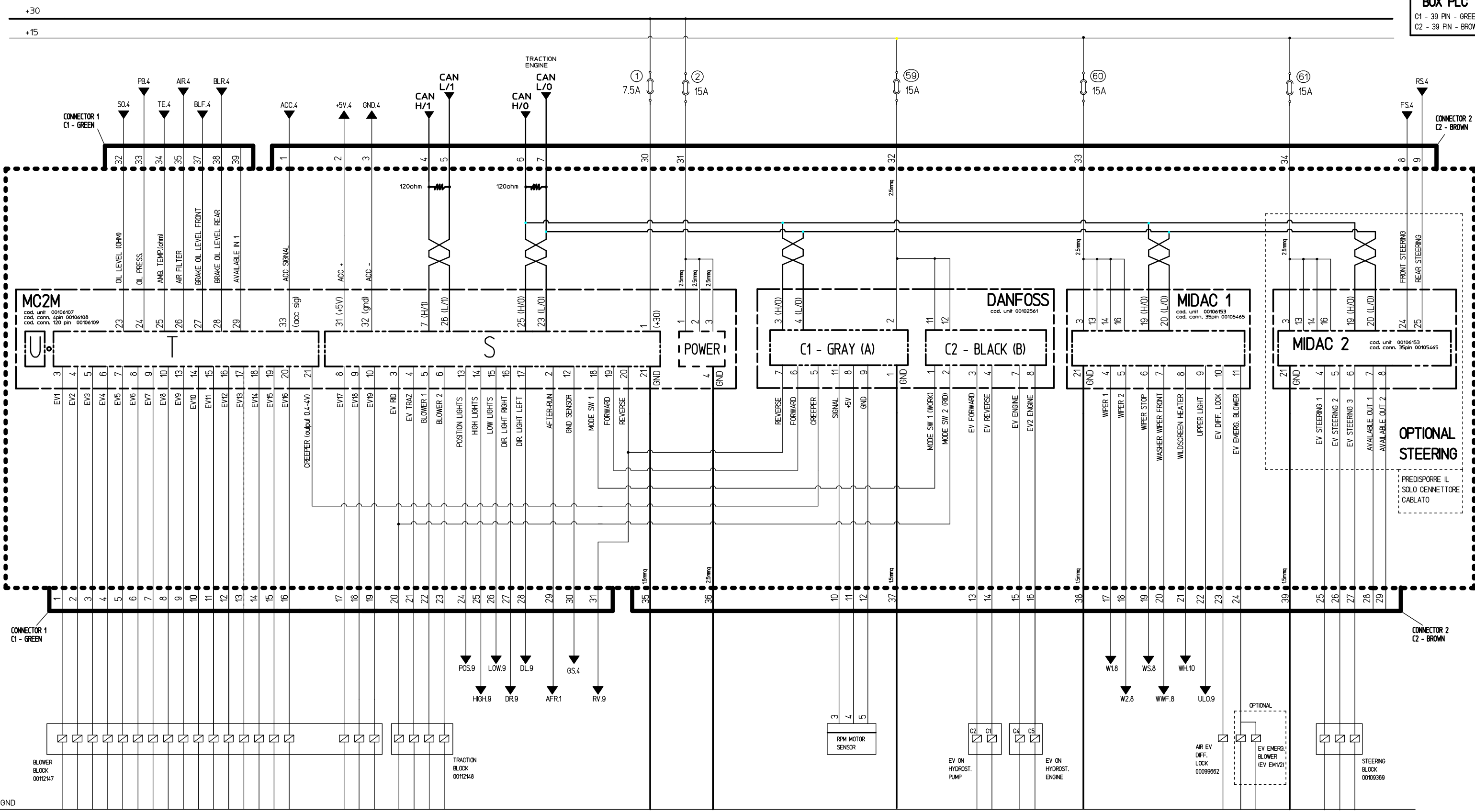
DISPLAY on dashboard TERA 7

WORK	OFF
BLOWER 1	RES
BLOWER 2	SET+
AUTOM	SET-
-	-

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Tolleranze ed altre prescrizione generali  
 - Standar 1-2001 -  
 General tolerances and other specifications

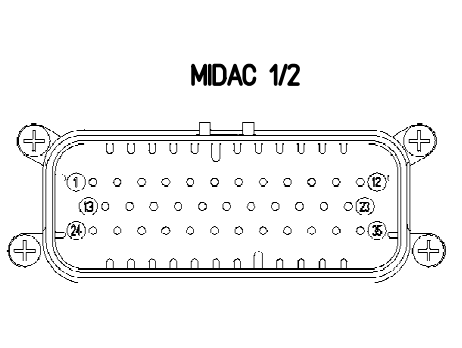
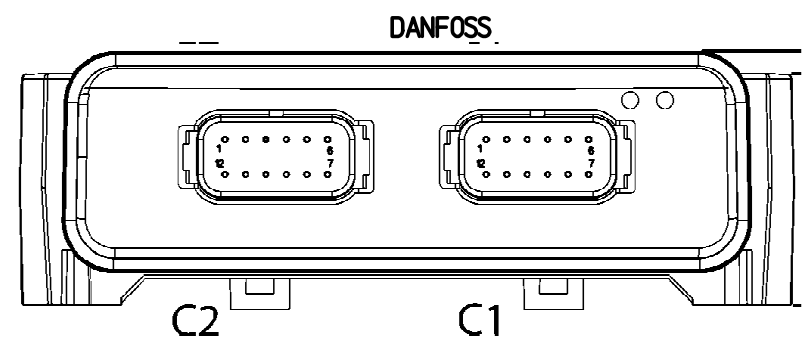
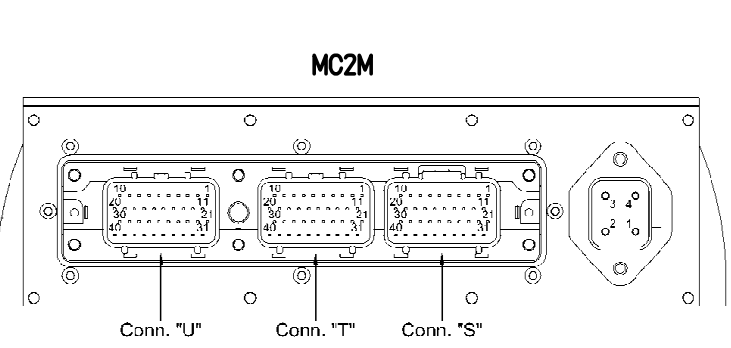
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.		SOST.dal N° Rep. by		
DESIGNAZIONE / Designation		TIPO Type		
ELECTRICAL SYSTEM TERA7 - JOYSTICK		F90 INDIA		
CANLIVE		CODICE Code Nr.		
		N° / Nr		
		31968		F0GLIO Sheet 2/11



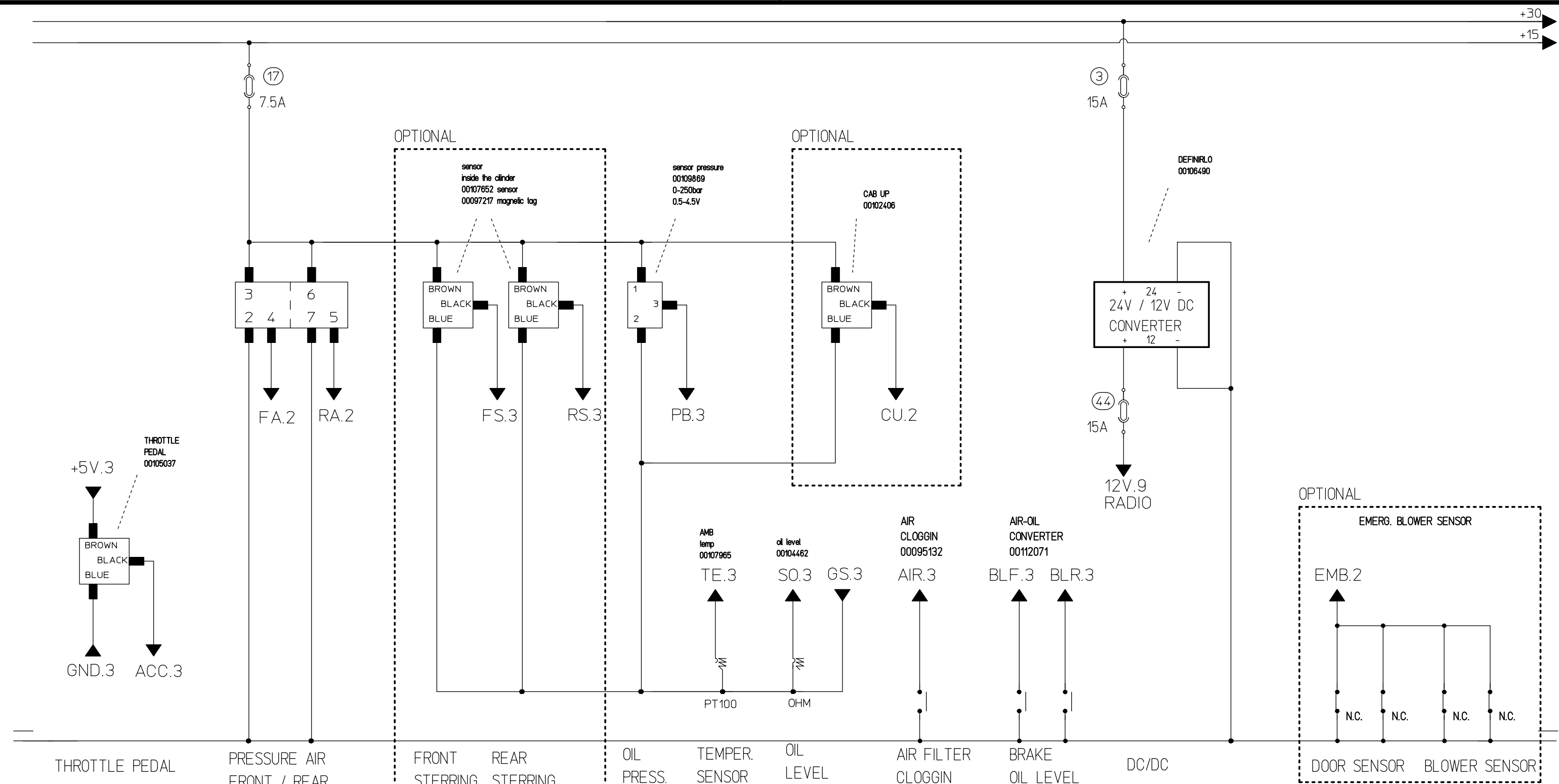
SE NON INDICATO:  
 TUTTO FILO DA 1mmq

cod. 00112165 - CABLAGGIO PLC F90 CABINA VISION

SAUER DANFOSS UNIT - TRACTION CONTROL



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Q.T.A. Nr.	X	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	X	CAD Drawing	O.S.D.
MATERIALE / Material				SOST.I N° Rep. for	
X				SOST.dal N° Rep. by	
DESIGNAZIONE / Designation				TIPO Type	
BOX PLC - F90 INDIA CABINA VISION				F90 INDIA	
				CODICE Code Nr.	
				0	
				N° / Nr	
				31968	
				Foglio Sheet	
				3/11	



THROTTLE PEDAL

PRESSURE AIR  
FRONT / REAR  
(inside the APU)  
1-4V  
0-12bar

FRONT STERRING  
REAR STERRING

OIL PRESS.  
SENSOR

TEMPER.  
SENSOR

OIL LEVEL

AIR FILTER  
CLOGGIN

BRAKE  
OIL LEVEL

DC/DC

DOOR SENSOR  
BLOWER SENSOR

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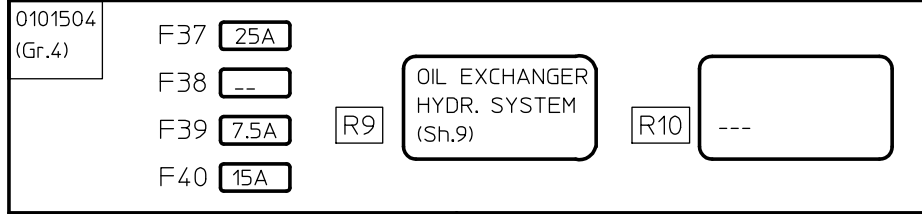
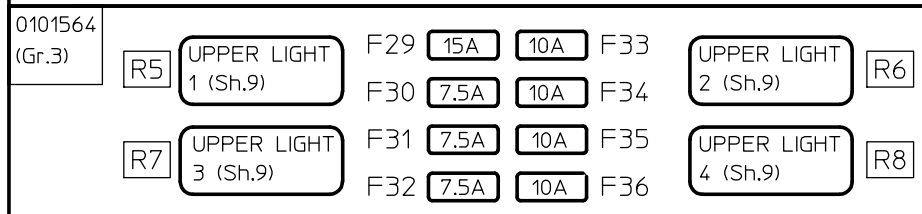
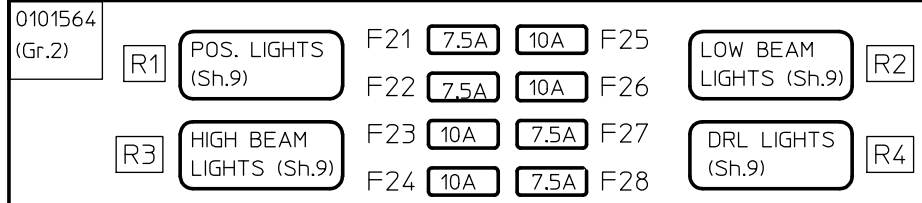
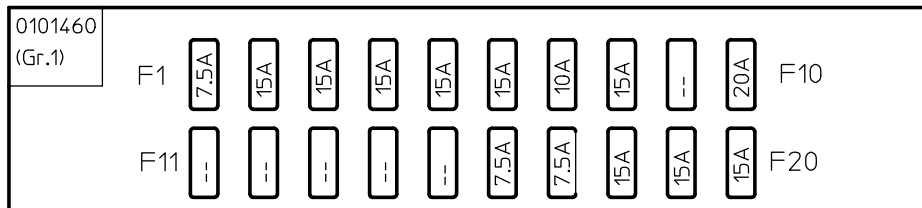
Tolleranze ed altre prescrizione generali  
- Standar 1-2001 -  
General tolerances and other specifications

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MASSA Weight	.	SCALA Scale	.	CAD Drawing	O.S.D.

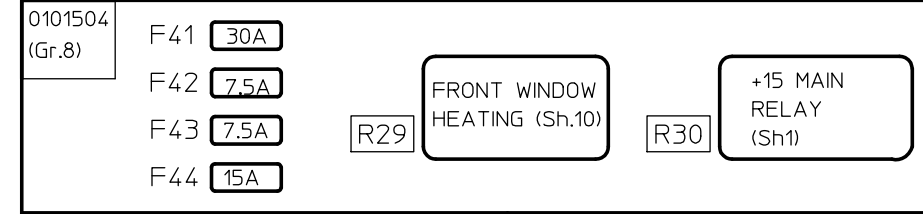
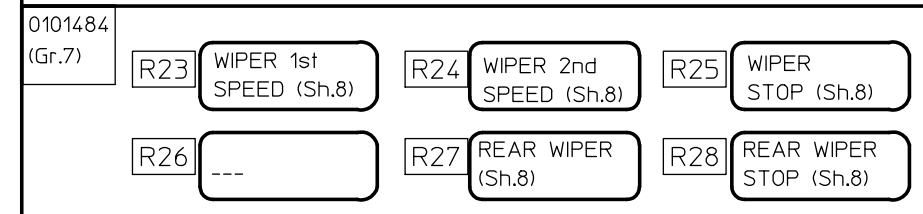
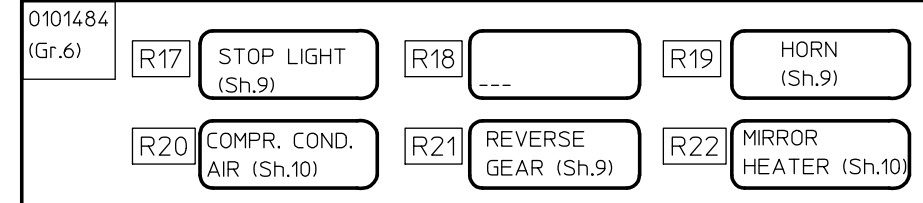
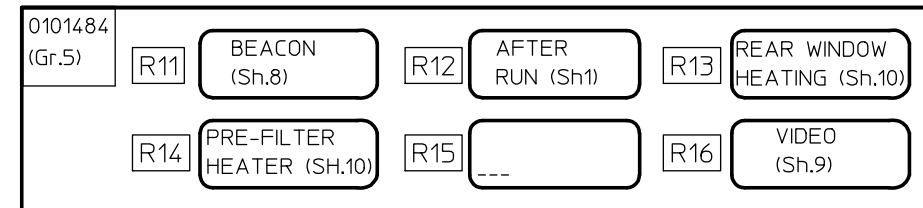
MATERIALE / Material	.	SOST.it N° Rep. for	.
	.	SOST.dal N° Rep. by	.

DESIGNAZIONE / Designation  
**ELECTRICAL SYSTEM TRANSMISISON**  
**ALLISON 4000 - SENSORS - INSTRUMENTS**

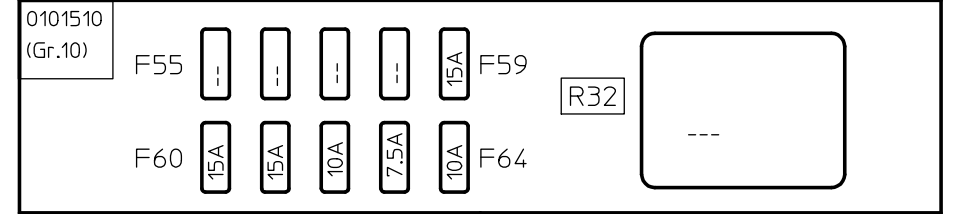
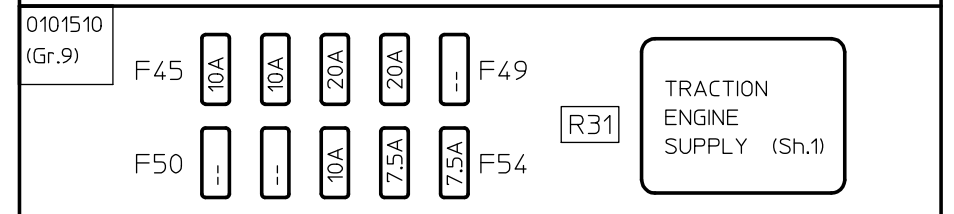
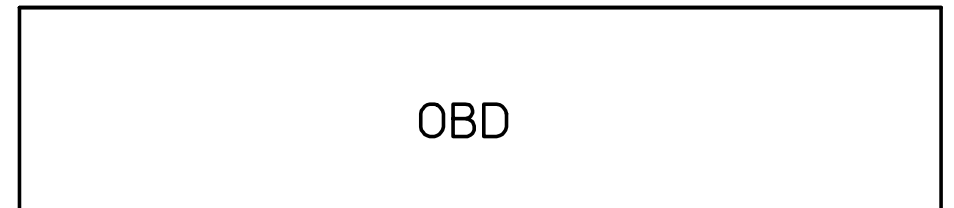
TIPO Type	F90 INDIA
CODICE Code Nr.	.
N° / Nr	31968
F0GLIO Sheet	4/11



F1 (+30)	MC2M (Sh.3)	F21	POSITION LIGHTS RIGHT (Sh.9)
F2 (+30)	MC2M (Sh.3)	F22	POSITION LIGHTS LEFT (Sh.9)
F3 (+30)	RADIO (Sh.4)	F23	LOW BEAM LIGHTS RIGHT (Sh.9)
F4 (+30)	BEACON (Sh.8)	F24	LOW BEAM LIGHTS LEFT (Sh.9)
F5 (+30)	MIRRO HEATER (Sh.10)	F25	HIGH BEAM LIGHTS RIGHT (Sh.9)
F6 (+30)	AIR DRY APU (Sh.10)	F26	HIGH BEAM LIGHTS LEFT (Sh.9)
F7 (+30)	HORN (Sh.9)	F27 (+15)	DRL LIGHTS (Sh.9)
F8 (+30)	LIGHTER (Sh.10)	F28 (+15)	REVERSE LIGHTS (Sh.9)
F9 (+30)	COMPRESS. COND. AIR (Sh.10)	F29 (+15)	SWITCH (Sh.6)
F10 (+30)	REAR WINDOW (Sh.10)	F30 (+15)	JOYSTICK (Sh.6)
F11 (+30)	-	F31 (+15)	USB (Sh.6)
F12 (+30)	-	F32 (+15)	EMERGENCY (Sh.6)
F13 (+30)	-	F33	WORK LIGHT 1 (Sh.8)
F14 (+30)	-	F34	WORK LIGHT 2 (Sh.8)
F15 (+15)	-	F35	WORK LIGHT 3 (Sh.11)
F16 (+15)	STOP LIGHTS (Sh.9)	F36	REAR WORK LIGHT (Sh.8)
F17 (+15)	SENSORS (Sh.4)	F37 (+30)	OIL EXCHANGER (Sh.10)
F18 (+15)	CAB HEATER (Sh.10)	F38 (+30)	---
F19 (+15)	FRONT WIPER (Sh.8)	F39	PARK (Sh.9)
F20 (+15)	REAR WIPER (Sh.8)	F40 (POS)	WEBASTO (Sh.11)



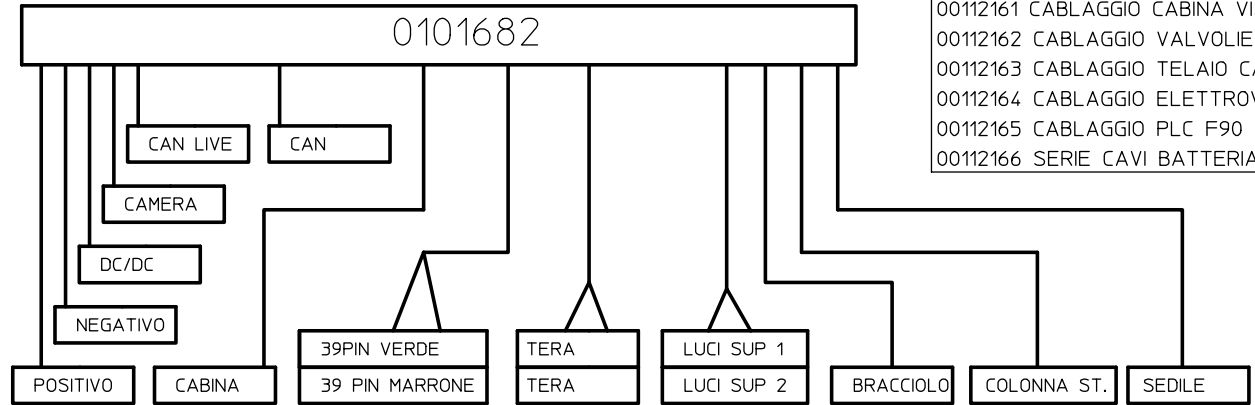
F41 (+30)	FRONT WINDOW HEATER (Sh.10)
F42	CAB LIGHTS (Sh.8)
F43	REAR FOG LIGHTS (Sh.8)
F44	12 VOLT (Sh.4)



F45 (+15)	+15 ENGINE (Sh.1)	F55 (+15)	-
F46 (+15)	+15 UREA (Sh.1)	F56 (+15)	-
F47 (+15)	+15 EGR (Sh.1)	F57 (+15)	-
F48 (+30)	FUEL FILTER (Sh.10)	F58 (+30)	-
F49 (+30)	---	F59 (+15)	DANFOSS (Sh.3)
F50 (+30)	---	F60 (+15)	MIDAC 1 (Sh.3)
F51 (+30)	---	F61 (+15)	MIDAC 2 (Sh.3)
F52 (+30)	DEVIO (Sh.7)	F62 (+15)	DEVIO (Sh.7)
F53 (+30)	CANLIVE (Sh.2)	F63 (+15)	CANLIVE (Sh.2)
F54 (+30)	MINITOR TERA 7 (Sh.2)	F64 (+15)	SEDILE (Sh.10)

0101682 CABLAGGIO VALVOLIERA CAB. VISION  
COD. 00112162

ELENCO CABLAGGIO F90 INDIA - CABINA VISION:  
00112160 CABLAGGIO LUCI SUPERIORI F90 CABINA VISION  
00112161 CABLAGGIO CABINA VISION  
00112162 CABLAGGIO VALVOLIERA CAB VISION  
00112163 CABLAGGIO TELAIO CAB VISION  
00112164 CABLAGGIO ELETTROVALVOLE CABINA VISION  
00112165 CABLAGGIO PLC F90 CABINA VISION  
00112166 SERIE CAVI BATTERIA CABINA VISION



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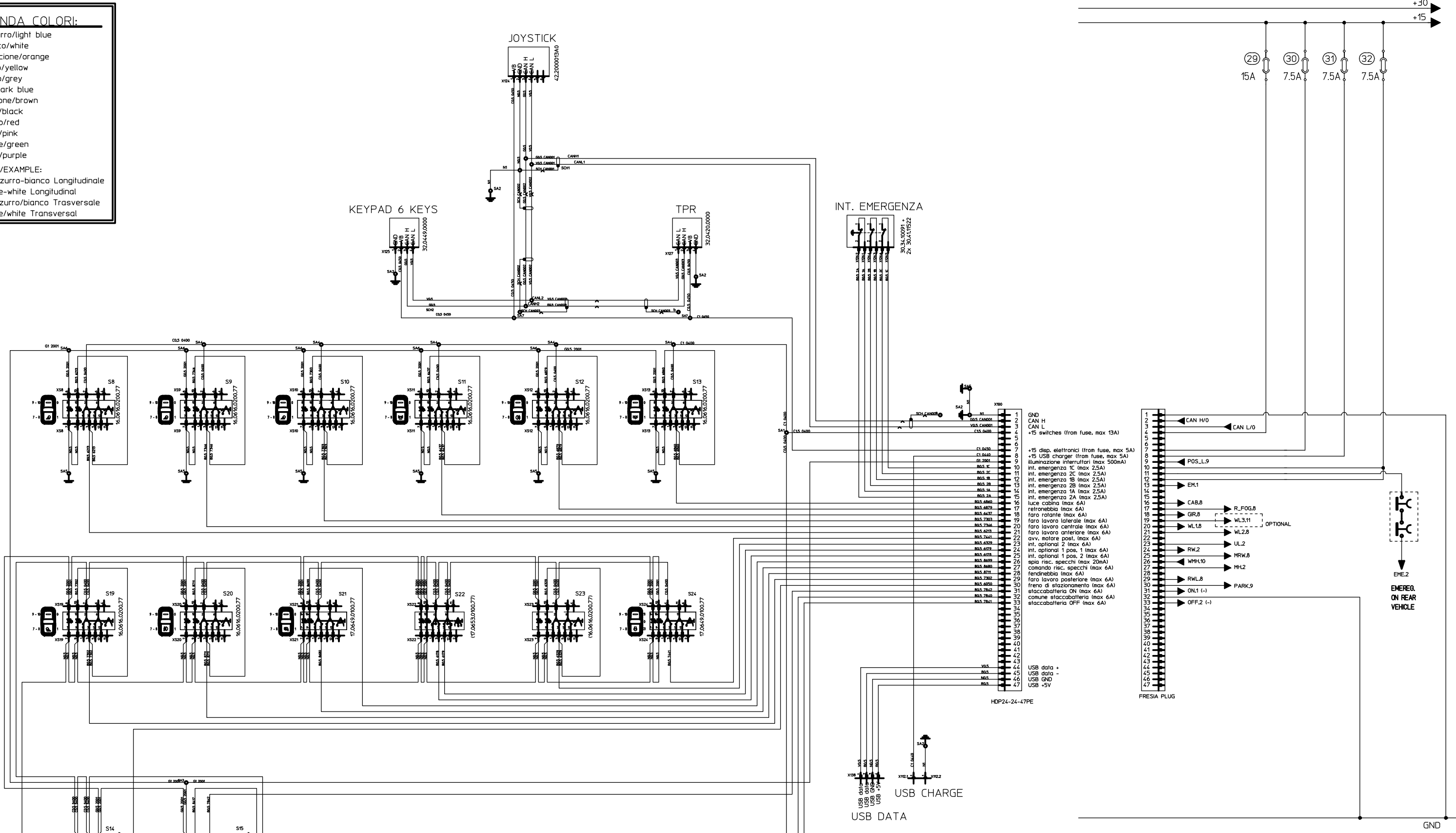
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Tolleranze ed altre prescrizioni generali  
- Standar 1-2001 -  
General tolerances and other specifications

Q.TA Nr.	.	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	.	CAD Drawing	O.S.D.
MATERIALE / Material	.	SOST.it N° Rep. for	.	SOST.dal N° Rep. by	.
DESIGNAZIONE / Designation	FUSES - RELAY	TIPO Type	F90 INDIA	CODICE Code Nr.	.
				N° Nr	31968
				Foglio Sheet	5/11

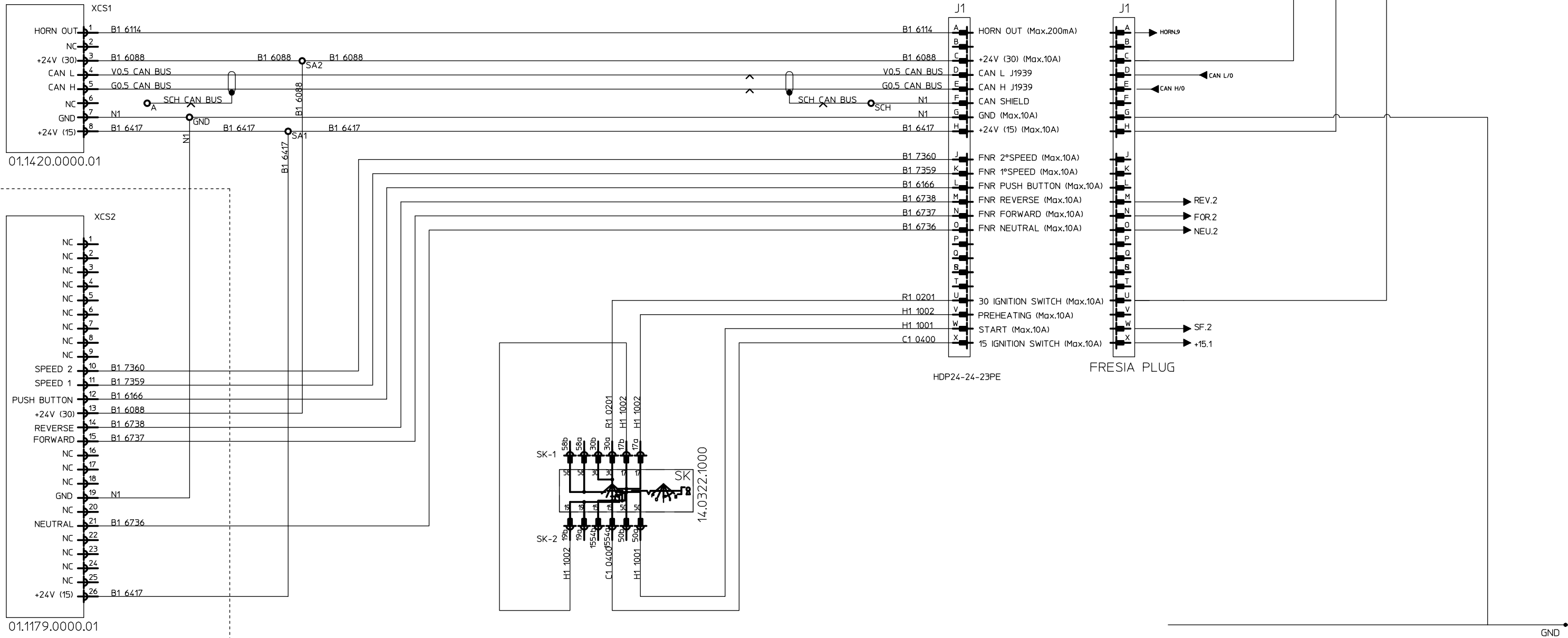
**LEGENDA COLORI:**  
 A= azzurro/light blue  
 B= bianco/white  
 C= arancione/orange  
 G= giallo/yellow  
 H= grigio/grey  
 L= blu/dark blue  
 M= marrone/brown  
 N= nero/black  
 R= rosso/red  
 S= rosa/pink  
 V= verde/green  
 Z= viola/purple

**ESEMPIO/EXAMPLE:**  
 A-B= azzurro-bianco Longitudinale  
 light blue-white Longitudinal  
 A/B= azzurro/bianco Trasversale  
 light blue/white Transversal



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Q.T.A. Nr.	X	DATA Date	26/09/2022
DIS.RE Name		DIS.RE Name	D.R.
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MATERIALE / Material		SOST.I N° Rep. for	
X		SOST.dal N° Rep. by	
DESIGNAZIONE / Designation		TIPO Type	
PANEL SWITCH SYSTEM - AS 6.0		F90 INDIA	
		CODICE Code Nr.	
		0	
		N° / Nr	
		31968	
		Foglio Sheet	
		6/11	

- A LIGHT BLUE
- B WHITE
- C ORANGE
- G YELLOW
- H GREY
- L BLUE
- M BROWN
- N BLACK
- R RED
- S PINK
- V GREEN
- Z VIOLET



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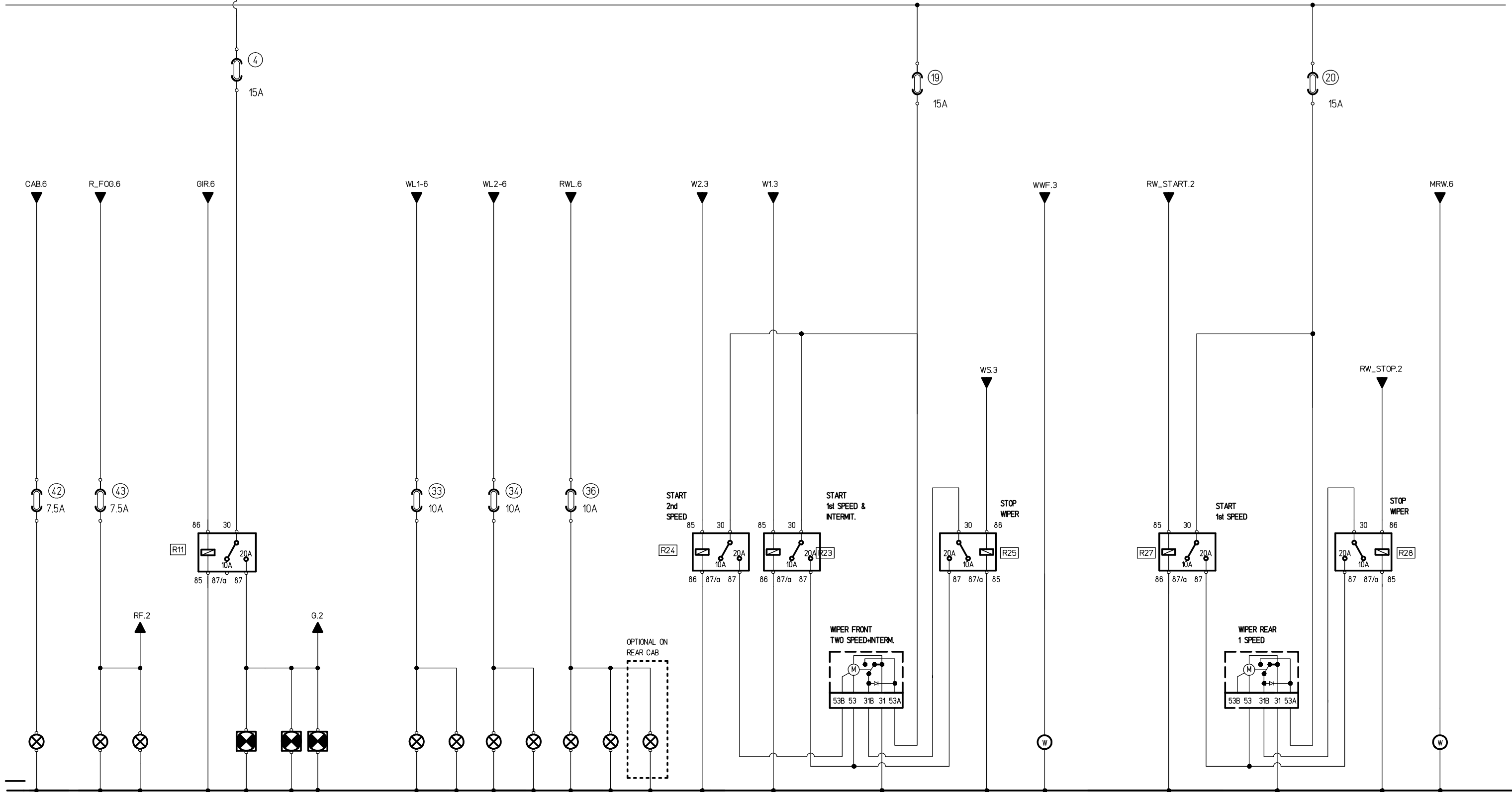
01.1179.0000.01

NOT USED FOR VEHICLE WITH ALLISON TRANSMISSION

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MASSA Weight	.	SCALA Scale	X
MATERIALE / Material X		DIS.RE Name	D.R.
DESIGNAZIONE / Designation STEERING COLUMN ATHENA 305 FULL		TIPO Type	F90 INDIA
		SOST.1 N° Rep. for	.
		SOST.dal N° Rep. by	.
		CODICE Code Nr.	0
		N° / Nr	31968
		Foglio Sheet	7/11

+30

+15

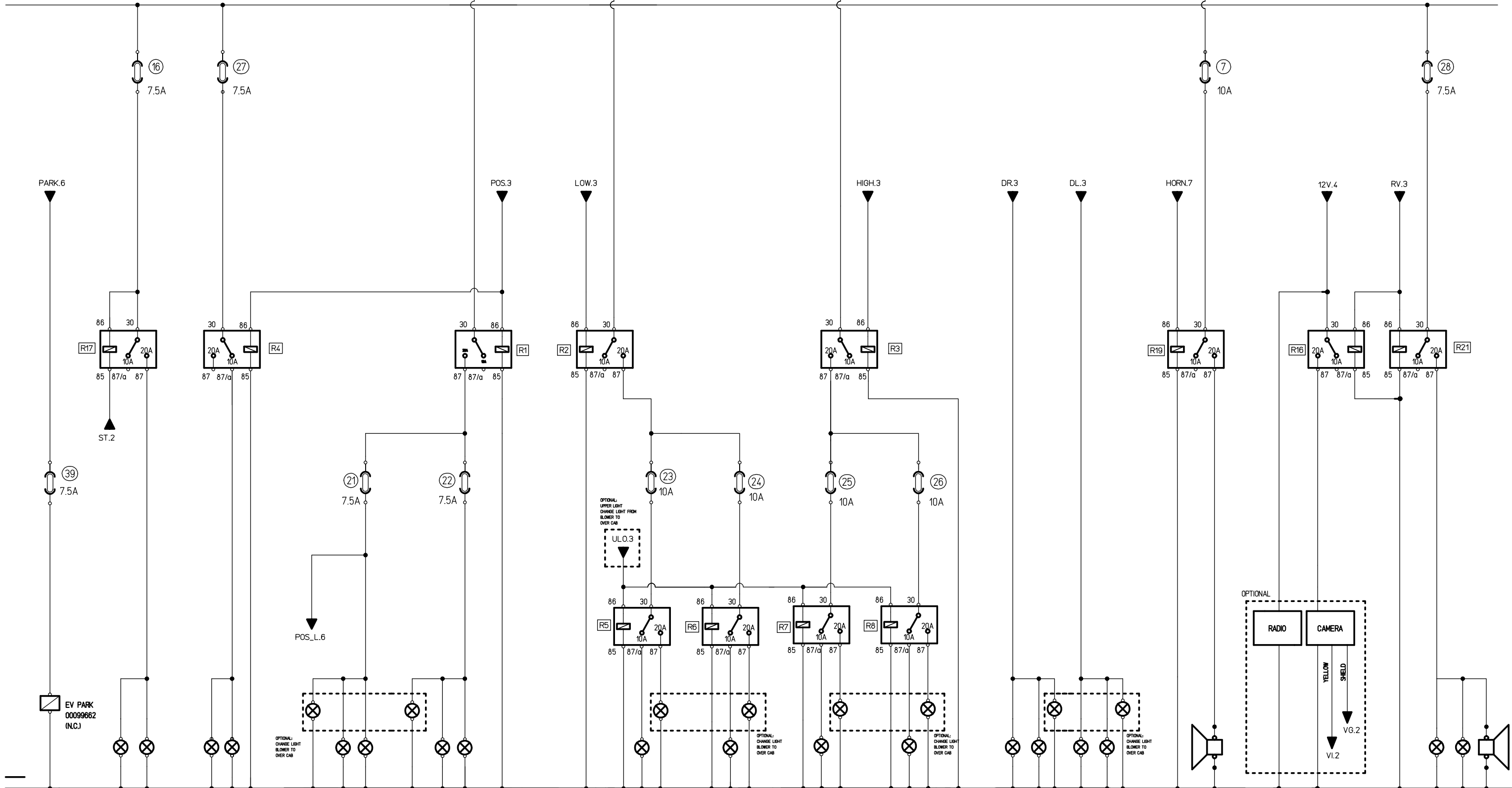


CAB LIGHTS    REAR FOG    BEACONS ON CAB    BEACONS ON REAR    WORK LIGHTS FRONT 1    WORK LIGHTS FRONT 2    WORK LIGHTS REAR    FRONT WIPER MOTOR    FRONT WASHER MOTOR    REAR WIPER MOTOR    REAR WASHER MOTOR

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Q.TA Nr.	X	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	X	CAD Drawing	O.S.D.
MATERIALE / Material			SOST. I N° Rep. for		
X			SOST. dal N° Rep. by		
DESIGNAZIONE / Designation			TIPO Type		
LIGHTS AND WIPER CONTROL			F90 INDIA		
			CODICE Code Nr.		
			0		
			N° / Nr		
			31968		
			8/11		

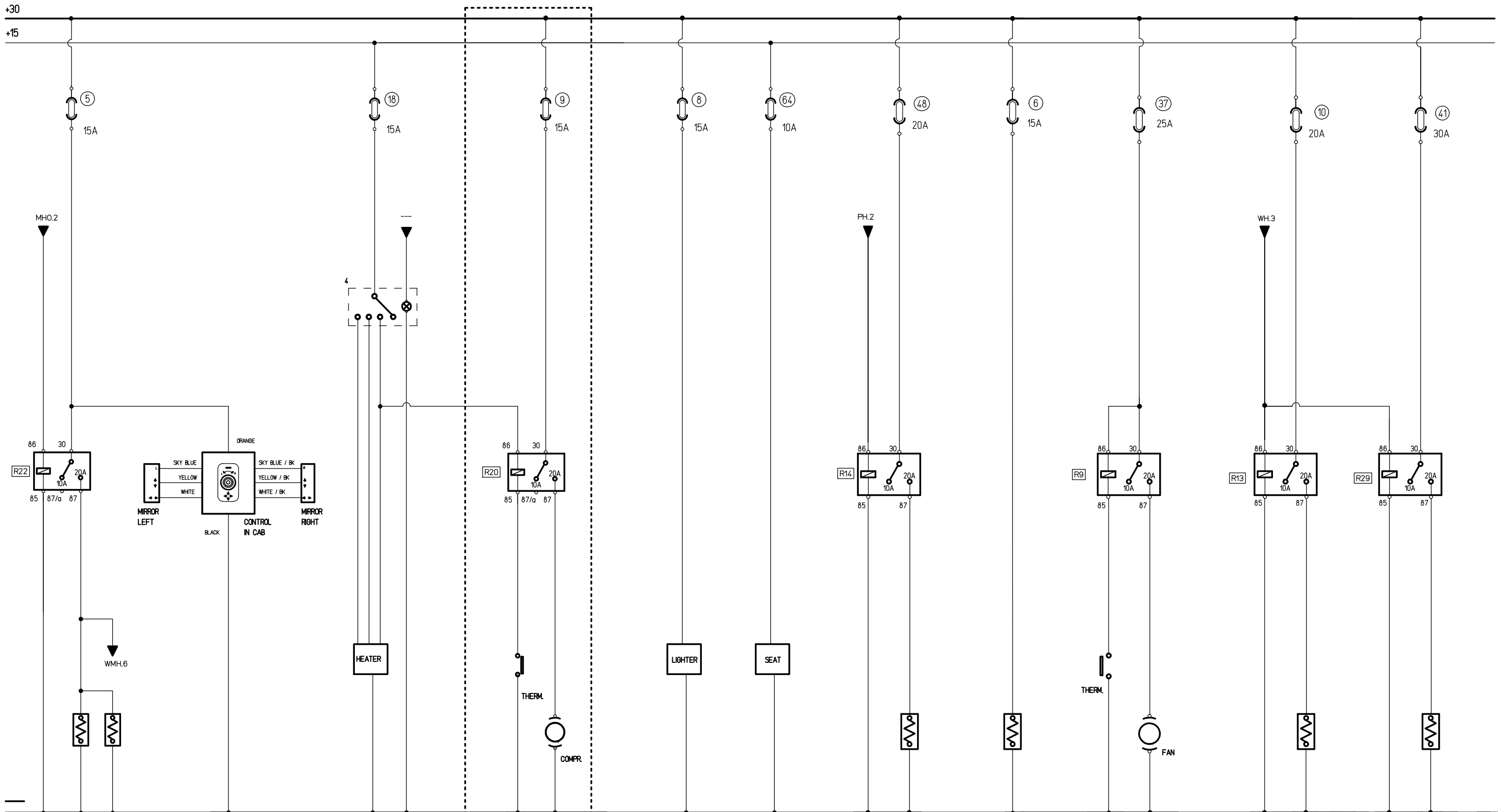
+30

+15



HAND BRAKE    STOP LIGHTS    DRL LIGHTS    POSITION LIGHTS (RIGHT, LEFT)    LOW BEAM LIGHTS    HIGH BEAM LIGHTS    DIRECTION LIGHTS    HORN    RADIO REAR CAMERA    REVERSE LIGHT - BUZZER

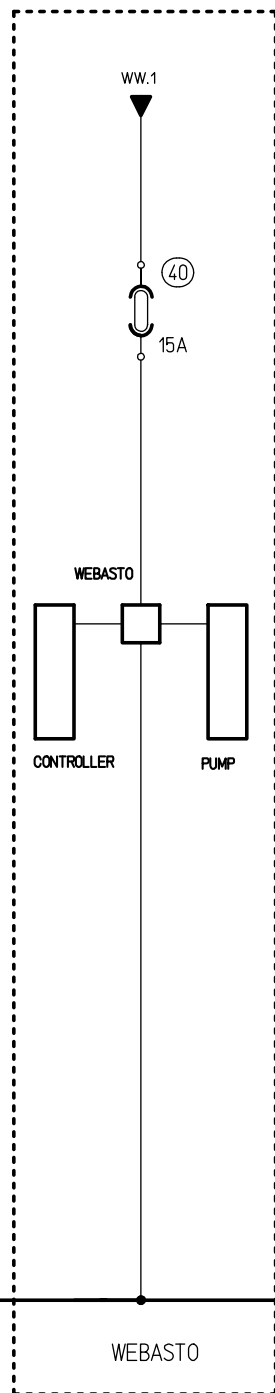
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Q.TA Nr.	X	DATA Date	26/09/2022
DIS.RE Name	D.R.	SCALA Scale	X
MASSA Weight	.		
MATERIALE / Material		SOST.1 N° Rep. for	
X		.	
DESIGNAZIONE / Designation		TIPO Type	
LIGHTS - MIRROR - HORN - CAMERA		F90 INDIA	
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		0	
		N° / Nr	
		31968	
		Foglio Sheet	
		9/11	



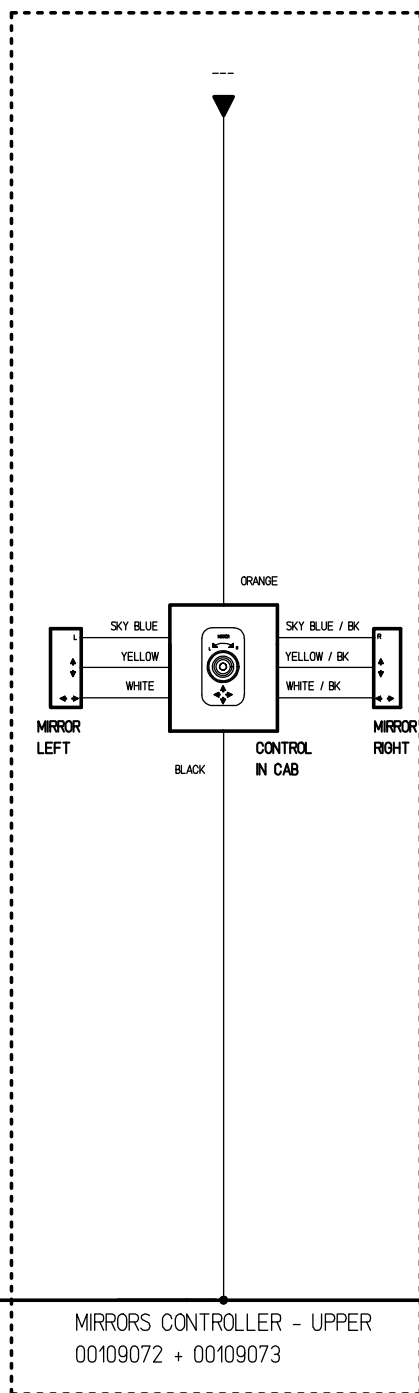
MIRRORS HEATER      MIRRORS CONTROLLER 00109072 + 00109073      HEATING CAB      COMPRESSOR CONDITIONER      LIGHTER IN CAB      PNEUMATIC SEAT IN CAB      PRE-FILTER HEATING TRACTION ENGINE      AIR DRY APU      OIL EXCHANGER HYDROSTATIC SYSTEM      REAR WINDOW HEATING      WILDSCREEN HEATING

OPTIONAL

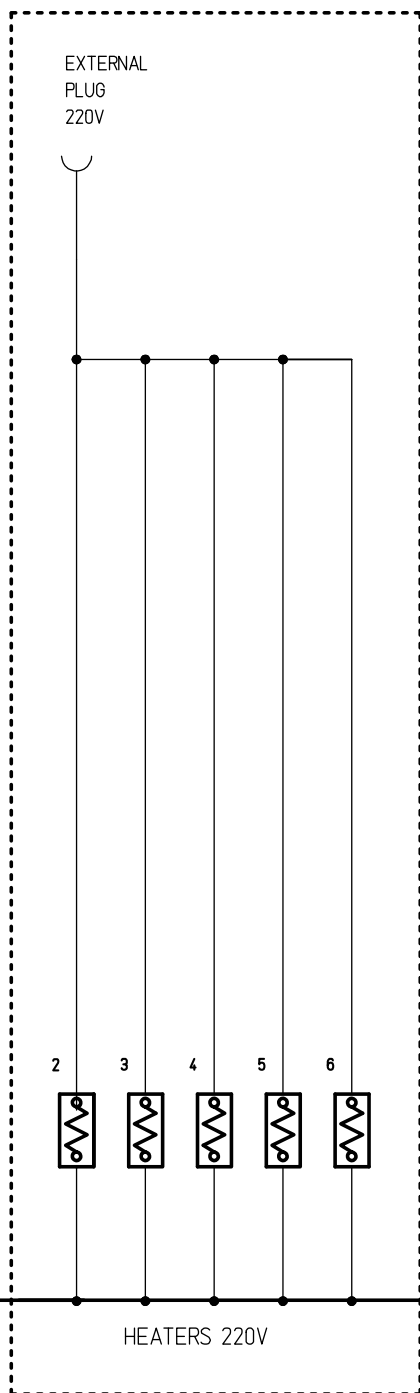
La FRESIA S.p.a. si riserva a termini di legge la proprietà di questo disegno con divieto di riprodurlo o comunicarlo a terzi senza autorizzazione scritta. As by law enacted, FRESIA S.p.A. reserves the property of this drawing. No reproduction or diffusion without written authorization.			Tolleranze ed altre prescrizioni generali FRESIA - Standard 1-2001 - General tolerances and other specifications		
Q.T.A. Nr.	X	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	X	CAD Drawing	O.S.D.
MATERIALE / Material			SOST. I N° Rep. for		
X			SOST. dal N° Rep. by		
DESIGNAZIONE / Designation			TIPO Type		
FAN - SEAT - WEBASTO - PREHEATING EXCHANGER - HEATING			F90 INDIA		
			CODICE Code Nr.		
			0		
			N° / Nr		
			31968		
			Foglio Sheet		
			10/11		



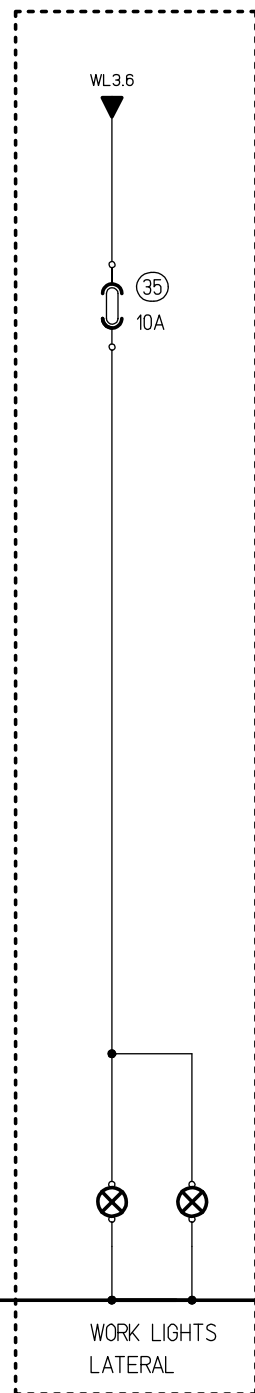
OPTIONAL



OPTIONAL



OPTIONAL



OPTIONAL

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Q.TA Nr.	X	DATA Date	26/09/2022	DIS.RE Name	D.R.
MASSA Weight	.	SCALA Scale	X	CAD Drawing	O.S.D.
MATERIALE / Material			SOST. I N° Rep. for		
X			SOST. dal N° Rep. by		
DESIGNAZIONE / Designation			TIPO Type		
OPTIONALS			F90 INDIA		
			CODICE Code Nr.		
			0		
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			31968		
			Foglio Sheet		
			11/11		

**SECTION 5  
TRANSFER REDUCER REPAIR**

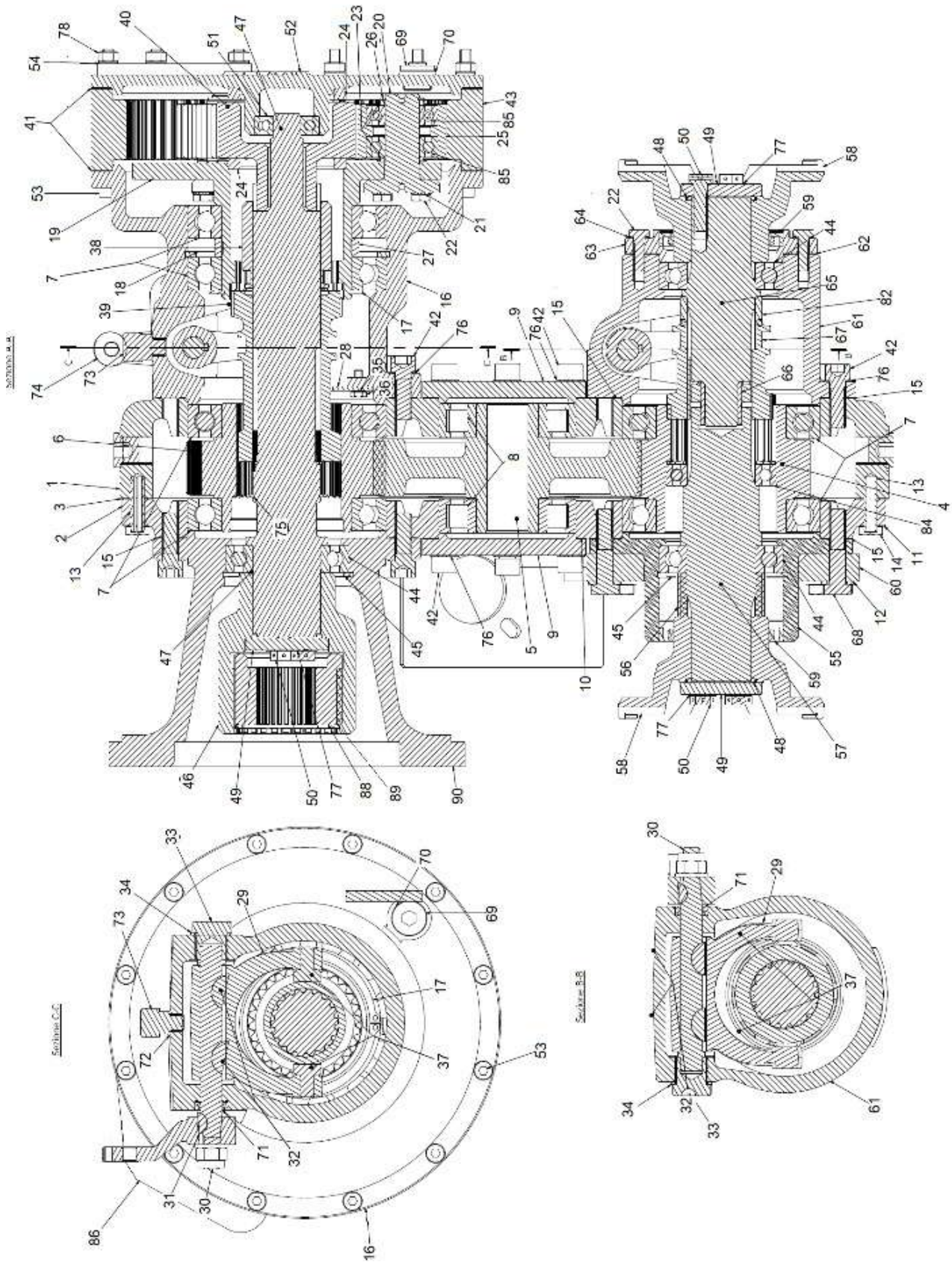
## 5.1 GENERALITY

The transfer reducer transmits the power of the hydrostatic motor to the front and to the rear axle. The mechanical reduction takes place by means of an upper epicycle gear, on the opposite side of the hydrostatic motor. The motion passes from the upper gear to the central gear (idle), which transmits it to the lower part.

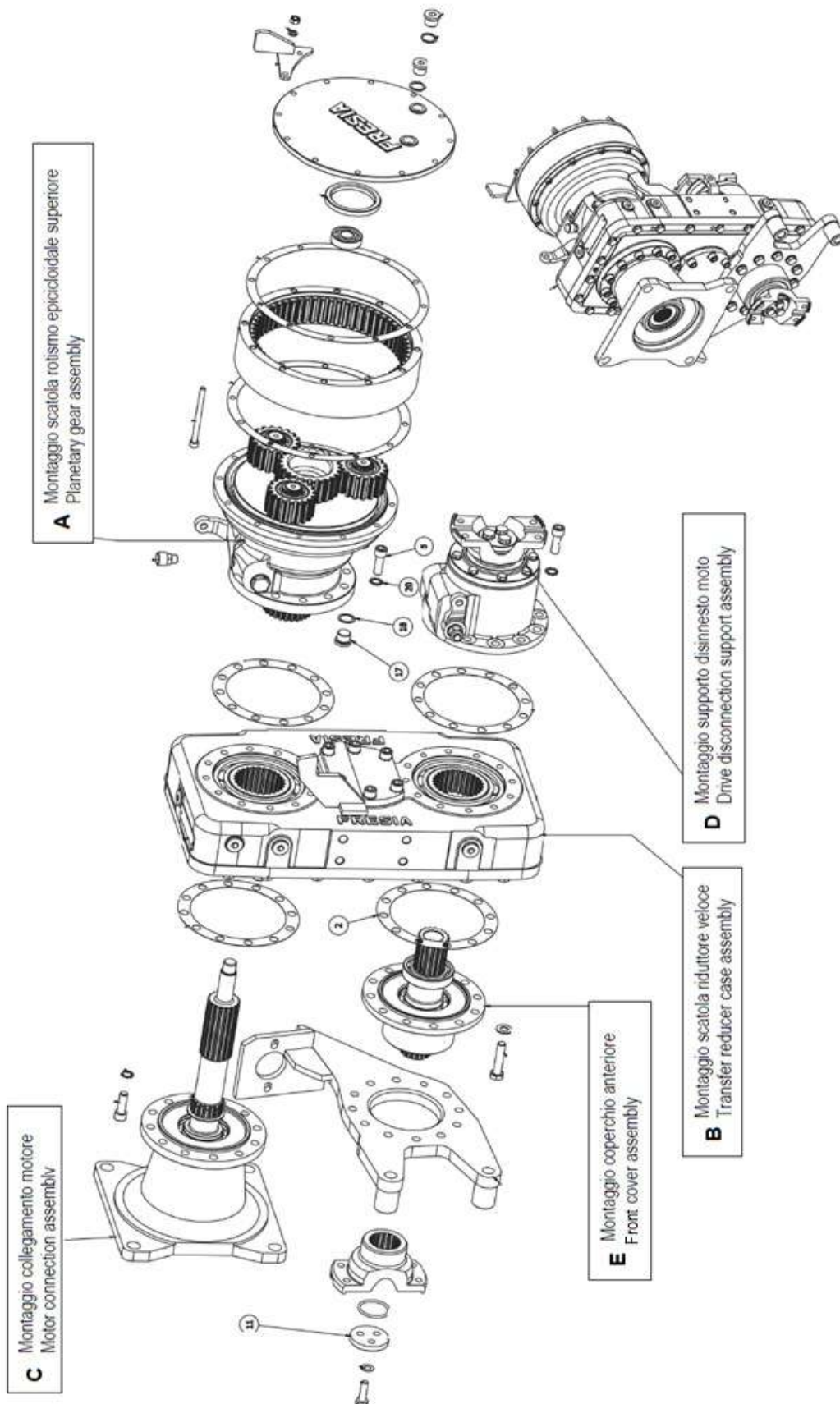
Rear-wheel drive can be cut off. The parking brake is installed at the exit of the front shaft

The front and to the rear axle. The mechanical reduction takes place by means of an upper epicycle gear, on the opposite side of the hydrostatic motor. The motion passes from the upper gear to the central gear (idle), which transmits it to the lower part. Rear-wheel drive can be cut off. The parking brake is installed at the exit of the front shaft.

## TRANSFER DRAWINGS



ITEM	Q.TY	DESCRIPTION
1	1	TRANSFER HALF CASE
2	1	COVER
3	1	PAPER GASKET
4	1	THIRD GEAR
5	1	CENTAL GEAR Z=28
6	1	DRIVE GEAR Z=27
7	6	RADIAL BEARING 6019
8	2	BEARING CYLINDRIC NJ 309 ECP
9	2	CENTAL COVER
10	2	PAPER GASKET
11	22	CONIC WASHER
12	14	WAVE WASHER D.12
13	2	ELASTIC PIN 10X40
14	22	SCREW 10X1,5X40
15	4	PAPER GASKET
16	1	UPPER PLANETARY GEAR CASE
17	1	SEEGER RING E95
18	1	SEEGER RING I 145
19	1	FUSE
20	3	PIN
21	12	SCHNORR WASHER D.8
22	20	SCREW 8X1,25X25
23	6	SPACER
24	2	SHIM
25	3	SATELITE GEAR
26	3	SEEGER RING E25
27	1	SPACER
28	1	PLATE
29	2	FORK
30	2	SHAFT
31	2	SPLINE
32	4	SPLINE
33	2	BUSHING
34	2	THICKNESS
35	2	WASHER SCHNORR D.6
36	2	6x1x16 Vite TE TF 8G ZN/ZG
37	4	SCREW 6X1X16
38	1	SECONDARY SYNCHRONZER
39	1	FIRST SYNCHRONIZER
40	1	PLANETARY GEAR
41	2	PAPER GASKET FOR INTERNAL GEAR
42	51	ALLEN SCREW 12X1,75X35
43	1	INTERNAL TOOTHED CROWN
44	3	BEARING 6210
45	2	SEEGER RING E90
46	1	SLEEVE
47	1	FIRST SHAFT
48	2	OR RING 42,86X3,53
49	3	WASHER SCHNORR D.6
50	9	SCREW
51	1	BEARING
52	1	COVER
53	12	ALLEN SCREW 8X1,25X100
54	13	PLANE WASHER
55	1	REAR COVER
56	1	SPACER
57	1	REAR SHAFT
58	2	FORK C6
59	2	OIL SEAL 70X90X10
60	1	PARKING BRAKE SUPPORT
61	1	DRIVING DISCONNECTION SUPPORT
62	1	PAPER GASKET
63	1	COVER
64	8	WAVE WASHER D.8
65	1	FRONT OUTPUT SHAFT
66	1	BUSHING
67	1	SYNCHRONIZER
68	12	SCREW 12X1,75X55
69	10	PLUG
70	10	WASHER D.20
71	2	OIL SEAL 16X24X15
72	1	WASHER
73	1	BREATHER PLUG
74	1	SCREW 6X1X16
75	1	SEEGER RING
76	51	SCHNORR WASHER
77	9	WAVE WASHER
78	12	NUT D.8
82	1	THICKNE SS RING
83	1	CONTROL LEVER
84	1	BEARING 6010
85	6	BEARING 6205
86	1	CYLINDER SUPPORT
88	1	INTERNAL SLEEVE FOR PUMP
89	1	SEEGER RING
90	1	MOTOR SUPPORT



## 5.2 TROUBLE SHOOTING

FAULT	CAUSE	REMEDY
<b>The transfer remains in fast speed</b>	<ul style="list-style-type: none"> <li>• Electrical problem</li> <li>• Hydraulic problem</li> <li>• Unregulated control cylinder</li> <li>• Damaged teeth of the following component (s): #39 first synchronizer #19 spider #38 secondary synchronizer #40 planetary gear</li> </ul>	<ul style="list-style-type: none"> <li>• See electrical section. Fuse 7 and 18, Keybord n.1, control unit MC2M</li> <li>• See Hydraulic section. EV RID or hydraulic cylinder</li> <li>• See section regulation transfer case hydraulic cylinder</li> <li>• Replace the following component (s): #39 first synchronizer #19 spider #38 secondary synchronizer #40 planetary gear</li> </ul>
<b>The transfer remains in slow speed</b>	<ul style="list-style-type: none"> <li>• Electrical problem</li> <li>• Hydraulic problem</li> <li>• Unregulated control cylinder</li> </ul>	<ul style="list-style-type: none"> <li>• See electrical section. Fuse 7 and 18, Keybord n.1, control unit MC2M</li> <li>• See Hydraulic section. EV RID or hydraulic cylinder</li> <li>• See section regulation transfer case hydraulic cylinder</li> </ul>
<b>The transfer remains in configuration 4x2</b>	<ul style="list-style-type: none"> <li>• Electrical problem</li> <li>• Hydraulic problem</li> <li>• Unregulated control cylinder</li> <li>• Damaged teeth of the following component (s): #67 synchronizer # 4 third gear</li> </ul>	<ul style="list-style-type: none"> <li>• See electrical section. Fuse 7 and 18, Keybord n.1, control unit MC2M</li> <li>• See Hydraulic section. EV TRACTION or hydraulic cylinder</li> <li>• See section regulation transfer case hydraulic cylinder</li> <li>• Replace the following component (s): #67 synchronizer # 4 third gear</li> </ul>
<b>The transfer remains in configuration 4x4</b>	<ul style="list-style-type: none"> <li>• Electrical problem</li> <li>• Hydraulic problem</li> <li>• Unregulated control cylinder</li> </ul>	<ul style="list-style-type: none"> <li>• See the electrical section: Fuse 7 and 18, Keybord n.1, control unit MC2M</li> <li>• See Hydraulic section. EV TRACTION or hydraulic cylinder</li> <li>• See section regulation transfer case hydraulic cylinder</li> </ul>
<b>Transfer noisy only in low speed</b>	<ul style="list-style-type: none"> <li>• Low oil level</li> <li>• Gear or shaft damage</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the correct oil level on the top of the transfer (remember there are two oil level)</li> <li>• Disassemble the top part of the transfer and check the damaged part</li> </ul>
<b>Transfer noisy in normal and low speed</b>	<ul style="list-style-type: none"> <li>• Low oil level</li> <li>• Gear or shaft damage</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the correct oil level of the transfer (remember that there are two oil level)</li> <li>• Disassemble the transfer and check the damaged part</li> </ul>
<b>Front fork leaks oil</b>	<ul style="list-style-type: none"> <li>• Front oil seal #59 damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the front oil seal #59</li> </ul>
<b>Rear fork leaks oil</b>	<ul style="list-style-type: none"> <li>• Rear oil seal #59 damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the rear oil seal #59</li> </ul>

## 5.3 TRANSFER UNINSTALLING FROM THE VEHICLE

To proceed for transfer repair, it is necessary to remove it from the vehicle

Move the vehicle over an inspection pit. Insert the parking brake and be sure that the vehicle is stationary.

### **DANGER – USE PROPER LIFTING EQUIPMENT**

- Empty the transfer from oil. Use a vessel to collect the wasted oil.
- Remove the hydrostatic motor (see hydrostatic system section)
- Remove the parking brake from its support (see brake system section)
- Remove the cylinders for change the speed and rear axle disconnection. Remove the pins fixing the cylinders to the levers and their supports.
- Tie accurately the transmission shafts, before disconnecting them from the transfer
- Unscrew the bolts which fix the transfer to the chassis.

### **WARNING! USE A HOIST TO LIFT THE TRANSFER.**

- Remove the brackets from the group (socket wrench 21 mm and allen key 10 for countersunk screws)

## 5.4 TRANSFER REVISION

WARNING – follow carefully the instruction reported below:

- Do not use generic tool where specific one are requested;
- Clean the components before proceeding with the repair;
- Where not differently indicated, use the torque reported on the table at the beginning of the manual;
- At the reassembly, always use new gaskets, elastic rings, split pins and washers;
- Before installing the paper gaskets, it is necessary to lubricate them;
- Fill the group with recommended oil or equivalent



## 5.5 TRANSFER DISASSEMBLY

### 5.5.1 PLANETARY GEAR REMOVING FROM THE TRANSFER (A)



Remove the screws connecting the planetary gear to the case (allen key 8 mm). (use a proper hoist).



Put the group on the bench with the cover in the lower part.



Remove the oil protection.

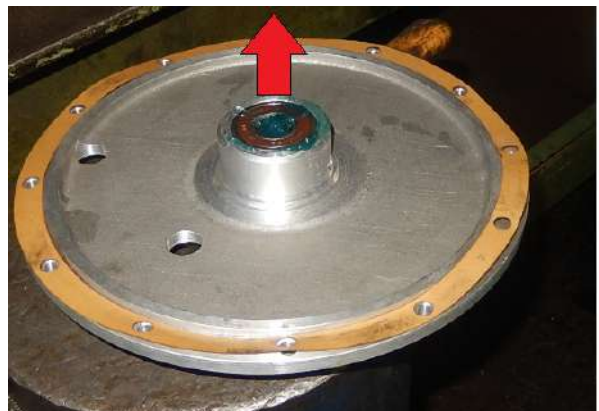


Remove the oil seal from the fork shaft.



Rotate the group and unscrew the cover bolts (socket wrench 13 mm).

Slide out the toothed sleeve and the fork shaft.



Remove the cover and extract the bearing in the center

Extract the elastic ring E95 which fixes the bearing. (use the proper pliers).



Remove the shim on the solar gear.



Extract the internal toothed wheel.



Extract the planetary holder.



Remove the solar gear.



By a means of a plier, remove the elastic rings fixing the satellites to the pins.



Remove the other shim.



Remove the satellite shims.



Heat the bearings with a thermic gun to extract them easily.



Remove the other shims.



Remove the plastic ring of the bearing and the bearing from the case.



Remove the pins (for screws Ø8 use a socket wrench 13 mm).

## 5.5.2 HYDROSTATIC MOTOR SUPPORT DISASSEMBLY (C)



Remove the elastic ring 172 #89 for internal sleeve fixing.



Extract the internal sleeve #88.



Remove the three screws fixing the external sleeve #46 to the shaft (socket wrench 16 mm). Extract the external sleeve.



Disconnect the motor support from the case (allen key 10 mm).



Put the support on a bench and extract the elastic ring 190 #45 .



Remove the bearing 6210.



Extract the primary shaft.



Remove the elastic ring #75 from the shaft.

## 5.5.3 REAR TRACTION DISCONNECTION DISASSEMBLY (D)



Disconnect the group from the case. Unscrew the allen bolts (allen key 10 mm).



Remove the washer and the fork C6, extract the OR ring (socket wrench 16 mm).



Remove the cover #63 and extract the oil seal.



Rotate the case to slide out the shaft.



Disassemble the bearing 6210 and the spacer from the shaft.

### 5.5.4 FRONT COVER AND PARKING BRAKE CYLINDER SUPPORT DISASSEMBLY (E)



Remove the washer and the fork 6C #58 (remove the three screws, socket wrench 16 mm). Extract the OR ring.

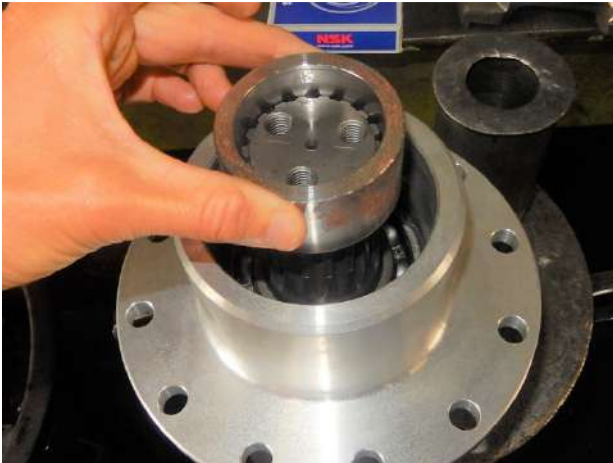


Uninstall the parking brake cylinder support (socket wrench 18 mm).

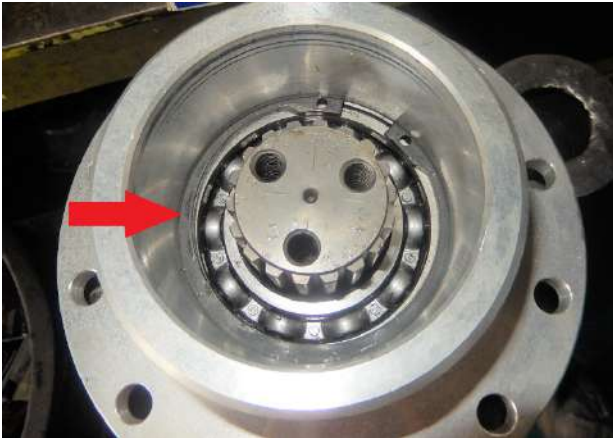
Remove the toothed sleeve, the fork shaft and the fork.



Extract the oil seal from the case.



Slide out the spacer ring.



By a means of proper pliers, extract the elastic ring I90 #45.



Rotate the group and extract the bronze bushing from the shaft.

### 5.5.5. TRANSFER CASE DISASSEMBLY (C)

Remove the back central cover from the case

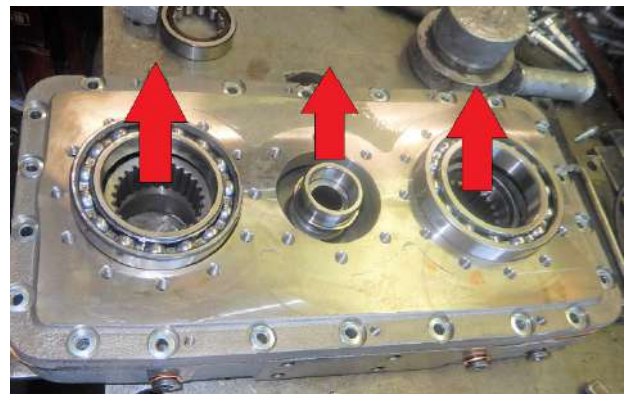
Put the case on a bench with the cover in the upper part



Extract the bearing 6010 from the lower gear



Remove lateral cover (allen key 10 mm).



Extract the bearings (nr. two 6019 #7 sand the central NJ309 ECP #8).



Unscrew the perimeter bolts (socket wrench 16 mm) and remove the case cover.



Remove the three gear from the case.



Extract the bearings.

## 5.6 TRANSFER ASSEMBLY

### 5.6.1 – PLANETARY GEAR ASSEMBLY



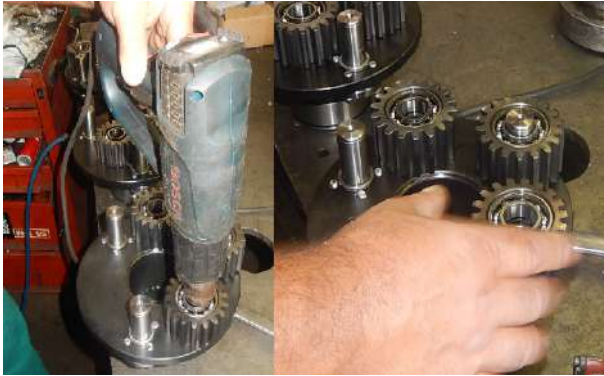
Insert the three pins #20 into the holder #19.  
Fix with screws Ø8 (socket wrench 13 mm) and schnorr washers.



Rotate the holder case and insert the shim #23.



Plant the bearing 6205 into the satellites #25, slightly beat with an hammer.



Heat the bearings internal part by a means of a thermic gun. Insert the bearings into the pins.



Put the case under a press and position the first bearing 6019 #7.



Put the shim on the opposite side.



By a means of the proper beater, insert the bearing in the bottom of the case.



By a means of a proper pliers put the elastic ring E25 #26 in the proper seat.

**IMPORTANT!: MAKE SURE THAT THE SATELITES ROTATE EASILY**



By the pliers, insert the elastic ring I145 #18 to fix the bearing.



Insert the spacer #27.



Plant the second bearing 6019.





Insert the planetary group into the case by a means of the press.



Put the plug #69-70 and copper washer.



Rotate the group and insert the elastic ring E95 for fixing. (use the proper pliers).



Put the sliding element #37 in the fork.



Insert the splines #32 into the shaft #30 slide in the shaft in the case and in the fork



Screw the bushing plug (check eventually the need of thickness).



Position the solar gear #40.



Rotate the group and insert a central shim.



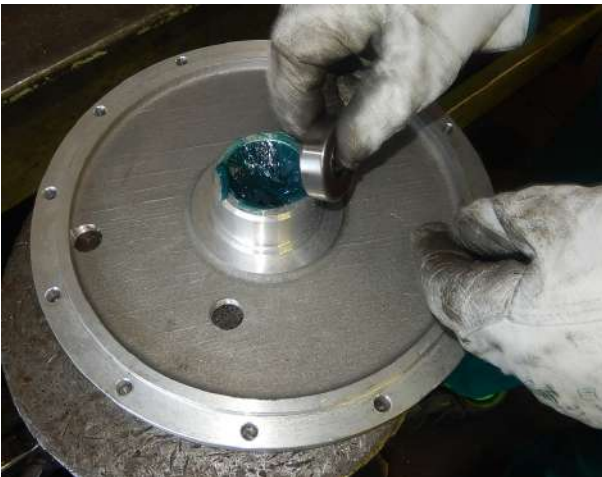
Lubricate the paper gasket and put it in the edge.



Insert the internal toothed wheel #43 on the satellites.



Position the shim on the solar gear.



Grease the seat of the bearing #51 in the cover and put in the bearing (if necessary beat slightly with an hammer).



Screw the cover on the group and install the oil plugs with copper washers.



Put the paper gasket #41 on the edge.



Inset the allen screws 10x1,5x100 for fixing.



Tighten the nuts on plane washers.



Insert the oil seal # 71 on the fork shaft.



Rotate the planetary group and insert the toothed sleeve #39 into the sliding elements of the fork.



Spread the Loctite MEDIUM on the oil protection carter seat .



Screw the oil protection with screws 6x16 and schnorr washers d.6 (socket wrench 10 mm).



Put the case on the bench on a proper support which simulates the covers height.

## 5.6.2 CASE ASSEMBLY (B)



By a beater, plant the bearings 6019 and 1'NJ309CP into their seats.



Plant the gears into the bearing (make sure that the groove is in the correct side). Use carefully beater not to damage the teeth.

**IMPORTANT!**

**THE GEAR WITH 27 TEETH MUST BE PUT IN THE UPPER PART (THE SIDE WITH NR. 2 OIL PLUGS).**



Plant the ring of the roller bearing (central) on the central gear.



Position the paper gasket (lubricate it) on the edge of the case.



Put the cover on the case.



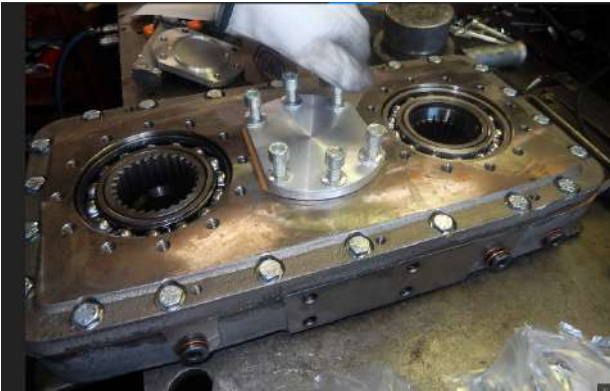
Screw the perimetral bolts (socket wrench 16 mm).



Plant the remaining bearings in the holes.

Beat slightly by an hammer.

# SNOWBLOWER F90



Mount the central covers on the case. Put the paper gasket between (lubricate it). Use allen bolts 12x1,75x35 + schnorr washer (allen key 8 mm).



Put the breather #73 on the case with washer #72 (wrench 16 mm).



Assemble the planetary gear on the assembled case (screws 12x1,75x35 + schnorr washers, allen key 8 mm).



Spread some grease on the primary shaft and install the elastic E50 in its seat.

### 5.6.3 MOTOR SUPPORT ASSEMBLY



Insert the primary axle #47 into the case.



Plant the bearing 6210 into the support.



Insert the elastic ring 190 to fix the bearing (use the proper pliers)



Rotate the support and position the paper gasket (lubricate it)

Insert the external ring #46 for entrainment and fix it with the three holes washer (screws 10X1,5X35 10.9) (socket wrench 16 mm)



Insert the intern entrainment sleeve #88.



Install the motor support on the case (screws 12x1,75x35 + conic washers) (allen key 8 mm)



Insert the elastic ring #89.



## 5.6.4 DRIVE DISCONNECTION SUPPORT ASSEMBLY (D)



Insert the sliding elements into the fork.



Insert the splines into the fork shaft.



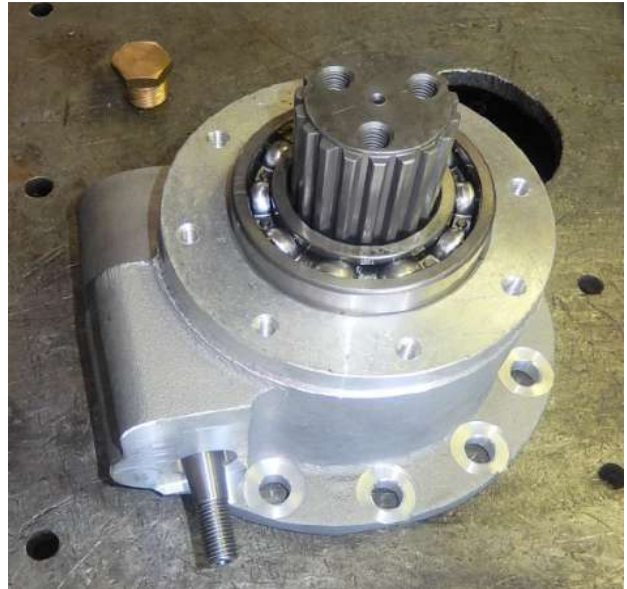
Install the fork and the toothed sleeve. Insert the fork shaft into the case and into the fork.



Plant the bearing 6210 #44 on front output shaft.



Insert the spacer ring #82



Rotate the case as in figure.



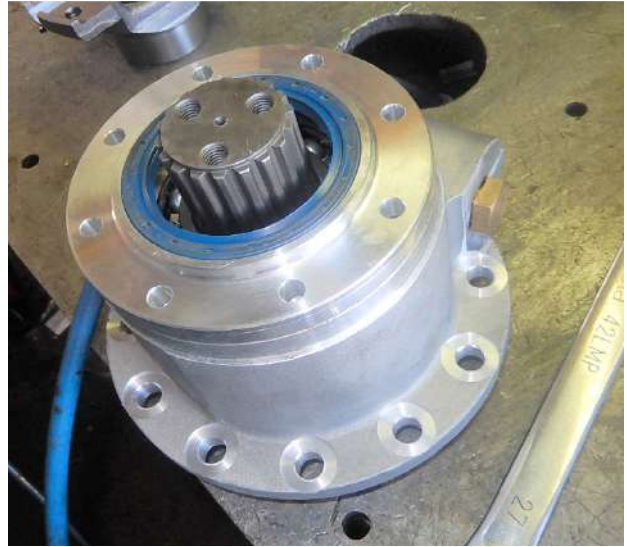
Rotate the case on the shaft



Beat slightly on the bearing by a proper punch plant the shaft and the bearing.



Insert the oil seal 70x90x10 #59 into the cover. Be careful not to damage it.



Position the paper gasket under the cover (lubricate it).



Insert the fork C6 #58 on the shaft. Position the OR ring.



# SNOWBLOWER F90

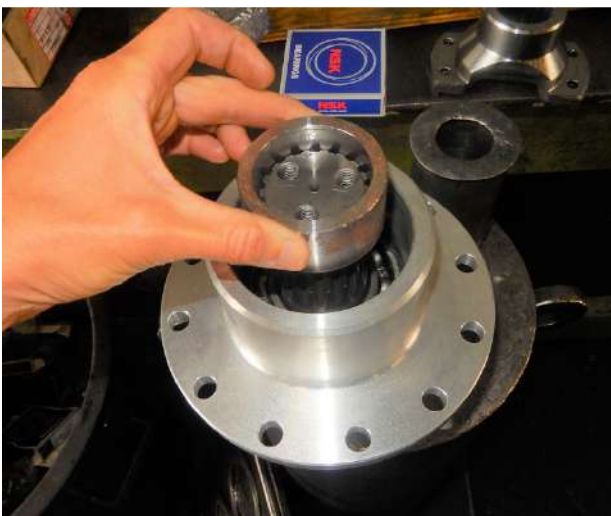
Fix the three holes washer with the nr.3 screws 10x1,5x35 10.9 (socket wrench n16 mm).

(to install the rear axle disconnection group on the case wait to have assembled the front output cover (5.6.5))

## 5.6.5 FRONT OUTPUT COVER ASSEMBLY (E)



Plant the bearing 6210 #44 in the bottom of the cover



Insert the spacer ring #82.



Plant the oil seal 70x90x10 #59, beat slightly not to damage it.





Plant the bronze bushing #66 on the shaft.



Put the assembled case with the cover into the upper part. Insert the bearing 6010 #84 into the gear ( $z=25$ ).



Put the assembly of the output shaft on the case. Lubricate the paper gasket and put it between.



Mount the brake cylinder support #60 (screws 12x1,75x55 with wave washer, socket wrench 18 mm).



Insert the fork on the output shaft C6.

# SNOWBLOWER F90



Insert the OR ring under the three holes washer



Tighten the screws 10x1,5x35 10.9 (socket wrench 16 mm).



Rotate the case and insert the paper gasket, before lubricate it.



Install the rear axle disconnection group on the case.  
(Tighten the screws 12x1,75x35 + conic washer, allen key 8 mm)



Put the oil plugs with copper washers on the transfer.  
(PICTURE OF THE TRANSFER ASSEMBLY)

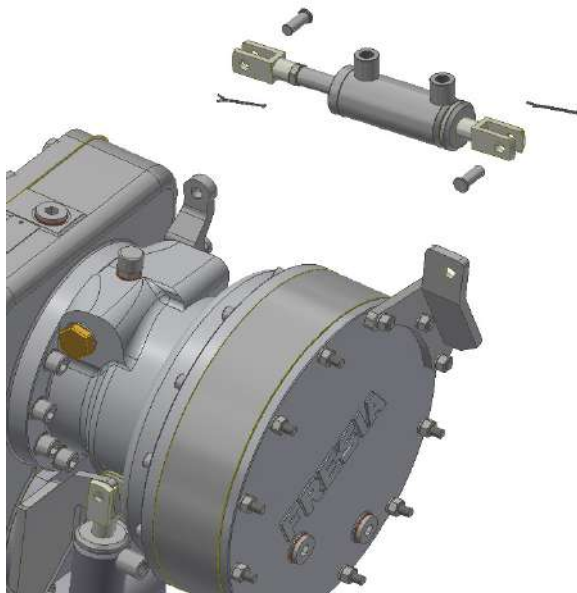
## 5.7 TRACTION AND REDUCER CYLINDERS

### 5.7.1 UNINSTALL/INSTALL THE CYLINDERS

**NOTE: following instructions are suitable for both cylinders**

**WARNING: use a vessel to collect the oil present into the cylinders**

- Remove the split pins and the pins fixing the cylinders to their supports and to the levers

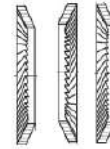


To reinstall it is important to satisfy two conditions:

- 1) Make sure that the forks are aligned each other and with the hoses connections (as in above figure). This is important to be able to insert the forks either on the support or on the lever. Furthermore it must result easy the reconnection of the hydraulic hoses. (NOTE: in case of spare parts replacement, the alignment is not guaranteed).
- 2) The insertion of the fixing pins must be easy, for this reason the holes of the forks and those of the lever and the support must be perfectly centered.

The two conditions can be achieved by performing the following operations:

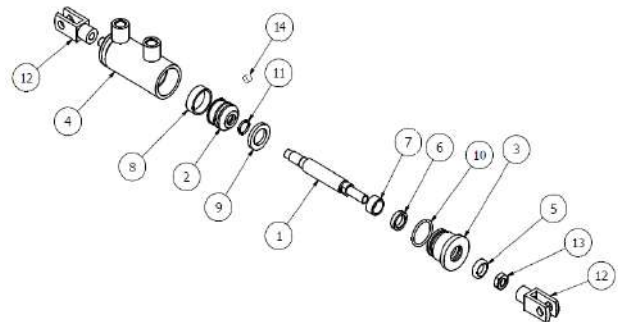
- inserting some washers schnorr  $\varnothing 10$  under the fork A (in opposite each other)



- adjusting the position of fork B acting on its counternut.

### 5.7.2 TRACTION AD REDUCER CYLINDERS

**NOTE: following instructions are suitable for both cylinders**



ELEMENT	DESCRIPTION	Q.TY
1	ROD	1
2	PISTON	1
3	HEAD END CAP	1
4	CYLINDER BARREL	1
5	SCRAPER	1
6	GASKET	1
7	ROD GUIDE F16	1
8	PISTON GUIDE F32	1
9	PISTON SEAL	1
10	OR RING 122	1
11	OR RING AS 014	1
12	FORK $\varnothing 10$	2
13	HEXAGONAL NUT	1

## Disassembly

- Remove the forks and the counter nuts from cylinder assembly
- Position the cylinder on a bench vise with soft jaws.
- Unscrew the head end cap (3).
- Slide out the rod assembly with all its gaskets from the cylinder barrel.
- Remove the external gaskets (8) (9) from the piston (2).
- Unscrew the pin (14) and unscrew the piston (2) from the rod (1).
- Slide out the head end cap (3) with its gasket from the rod.
- Extract the Or ring (11) from the piston and (5) (6) (7) (10) from the head end cap.
- Clean carefully all the parts and preform the following verifies:

### Cylinder barrel:

- a) check that no scratches are present inside.
- b) check the condition of the thread.
- c) check that the head has not clearance.

If necessary, replace.

### Rod:

- a) check that no scratches are present on surface.
- b) check the condition of the rod thread.
- c) check that the head has not clearance.

If necessary, replace.

### Head end-cap:

Check that no scratches are present in internal and external surface.

If necessary, replace.

### Piston:

Check that no scratches are present in internal and external surface.

If necessary, replace.

### Gaskets kit:

All the gaskets must be in perfect condition. If they are not, provide for the replacement.

**IMPORTANT! We suggest to change the gasket kit, everytime the cylinder is disassembled.**

## Assembly

- Position the piston rod on a bench vise with soft jaws.
- Moist with oil: the piston, the head end cap, the rod and the gasket seats.
- Insert the gaskets (6) and (7) in the head end cap.
- Insert the dust scraper (5) in its seat on the top and push it with a finger along the perimeter, to allow it a perfect adhesion. BE CAREFUL NOT TO WASTE THE SCRAPER

- Mount the OR rings (10).
- Insert the head end cap into the rod, BE CAREFUL NOT TO DAMAGE THE GASKETS.
- Insert the OR ring (11) on the piston (2).
- Screw the piston (2) on the rod and fix it by the pin (14)
- Install the gaskets (8) and (9)
- Remove the rod from the bench vise and put on the cylinder barrel.
- Moist all the internal part of the cylinder barrel with oil.
- Insert into the cylinder barrel the assembled rod BE CAREFUL NOT TO DAMAGE THE GASKETS.
- Screw the head end cap on the cylinder barrel.
- Perform a test, fulling the cylinder with pressurized oil (90 bar) Check that no leak is present.
- Reinstall counter nut and forks.

FOR INSTALLATION ON TRANSFER THE CYLINDER MUST HAVE FORKS ALIGNED (FOLLOW INSTUCTION FOR INSTALLATION)

## 5.8 TRANSFER REINSTALLING ON CHASSIS

- Reinstall the brackets on the transfer
- Mount the parking brake cylinder
- Put the transfer under the vehicle
- Lift the transfer at the height of the chassis and fix the brackets
- Connect the transfer shaft to front and rear axles
- Mount the hydrostatic motor on its support
- **OIL REFILLING**

At the end of the transfer mounting operation, refill the group with new oil.

**Use oil TUTELA W90/ M-DA or equivalent**

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: SNOWBLOWER

Model: F90

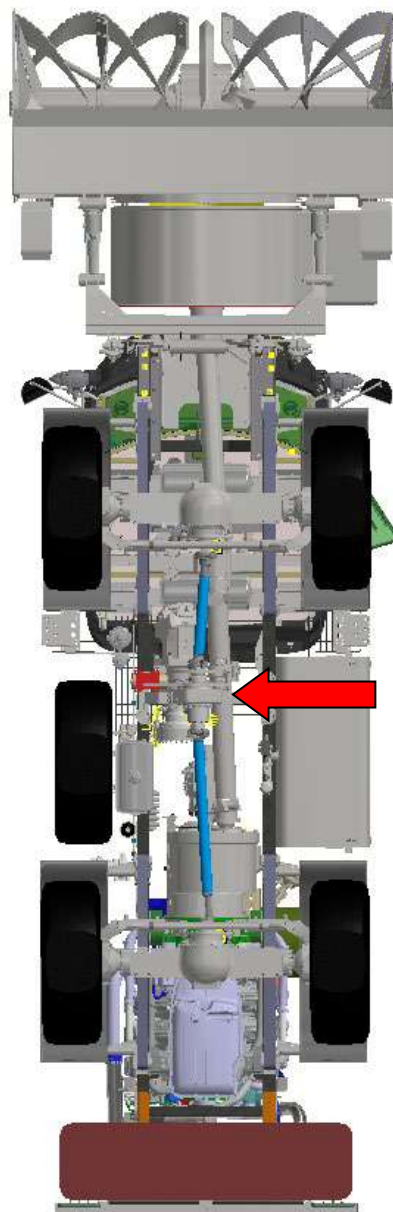
Intervention type: TRANSFER REDUCER OIL LEVEL CHECK

**TRANSFER REDUCER**

Periodicity: BEFORE STARTING

Required time: 10 minutes

Action points:



Requested spare parts:

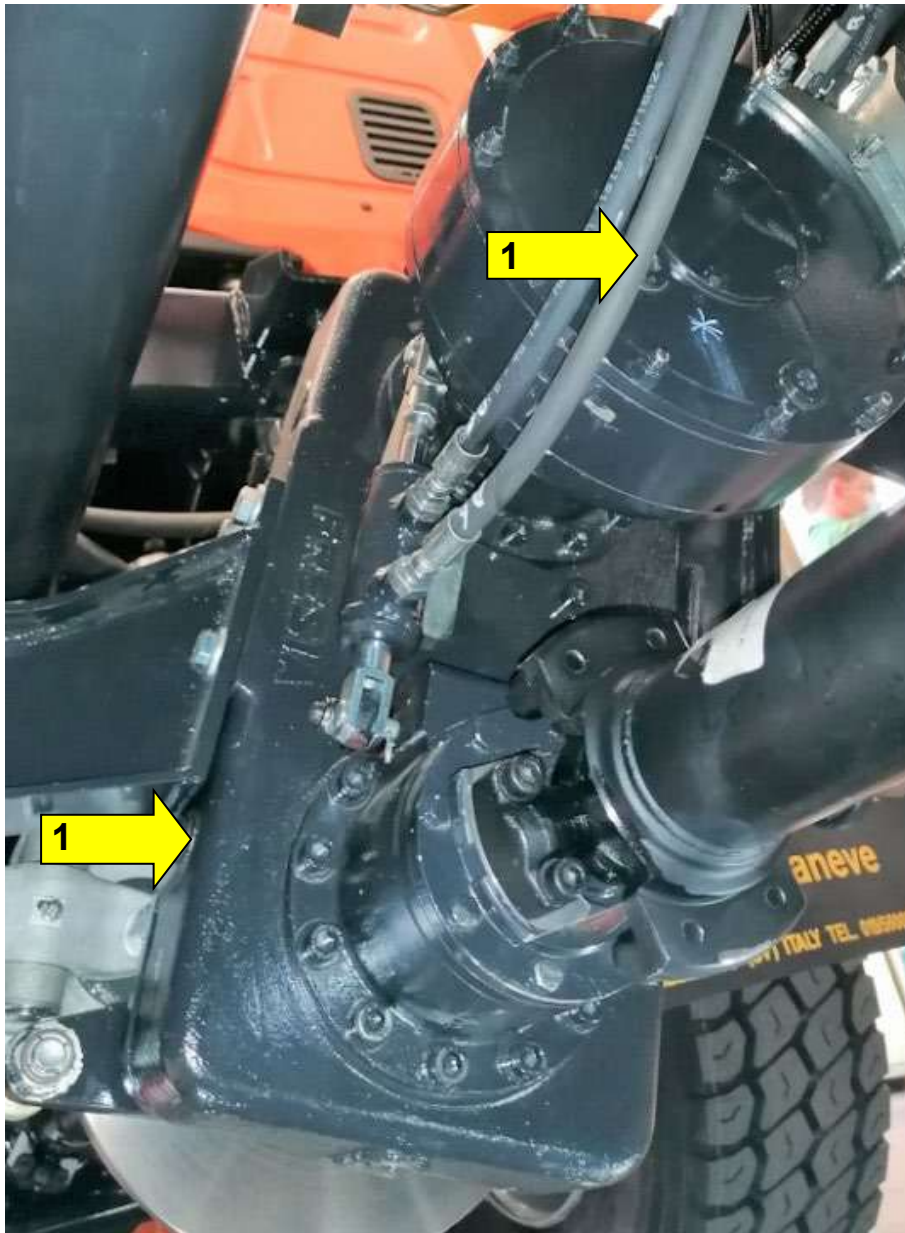
- Oil type TUTELA W90/M-DA or equivalent.

Specific tools:

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Move the vehicle over an inspection pit.
- b) Unscrew the plugs (1) and check that the oil reaches the low parts of the openings.
- c) If it is necessary, refill through the opening.
- d) Screw back the plugs (1).



**WARNING:**

*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING

MECHANIC  
LUBRICATION

FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

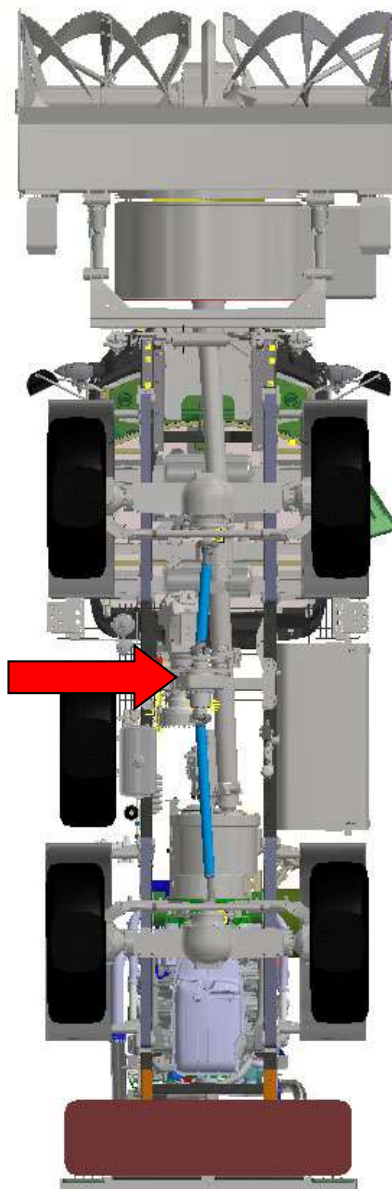
Intervention type: **TRANSFER REDUCER OIL REPLACEMENT**

**TRANSFER REDUCER**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **30 minutes**

Action points:



**Requested spare parts:**

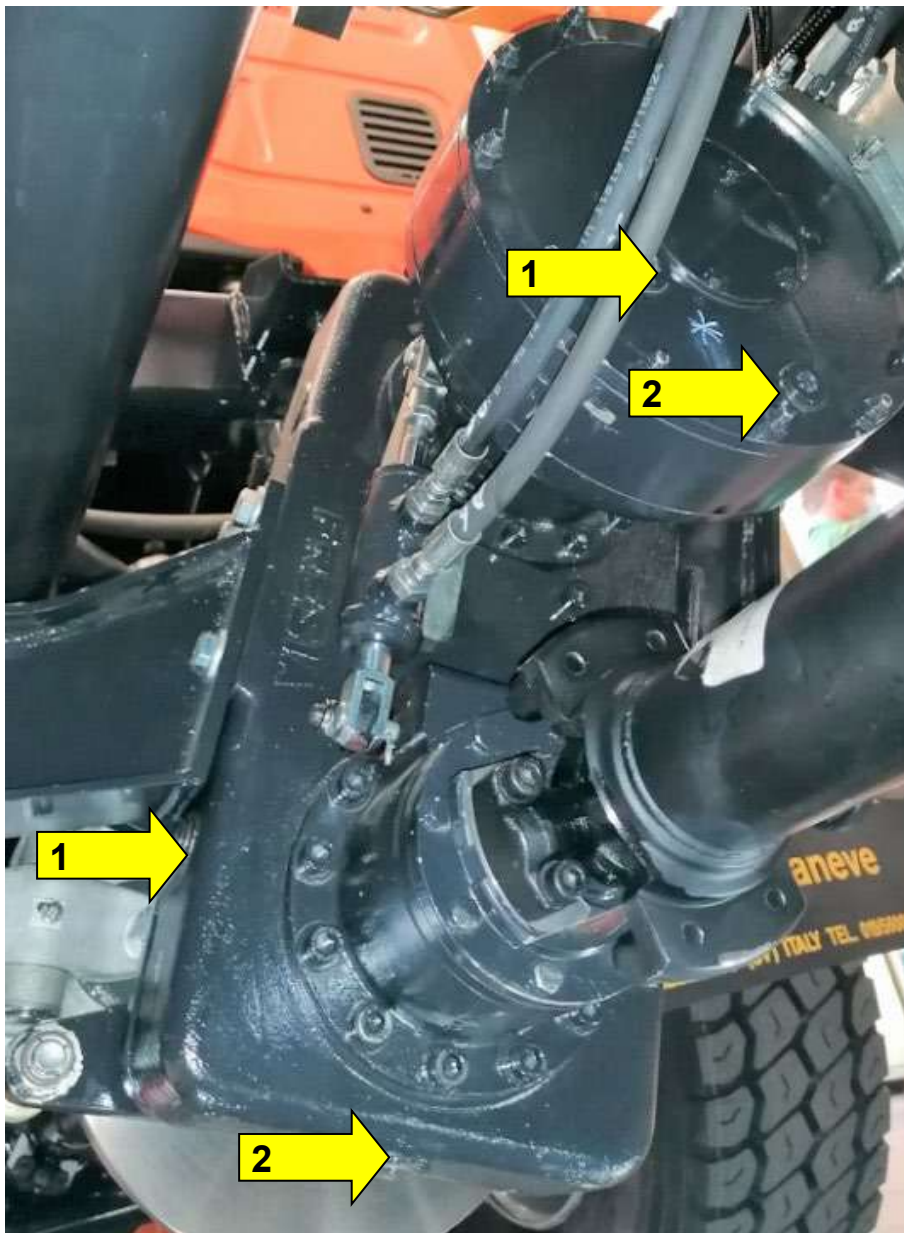
- Oil type TUTELA W90/M-DA or equivalent
- Plug washers (2) code R0082099
- Plug washers (1) code R1012552

**Specific tools:**

## PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



- Move the vehicle over an inspection pit.
- Put a container under the transfer reducer.
- Unscrew the plugs (1) and (2) and let the oil draining out.
- Screw back the plugs (2) (replace their washers).
- Pour new oil through the openings (1) until it reaches the lower part of the openings.
- Screw back the plugs (1) (replace their washers).



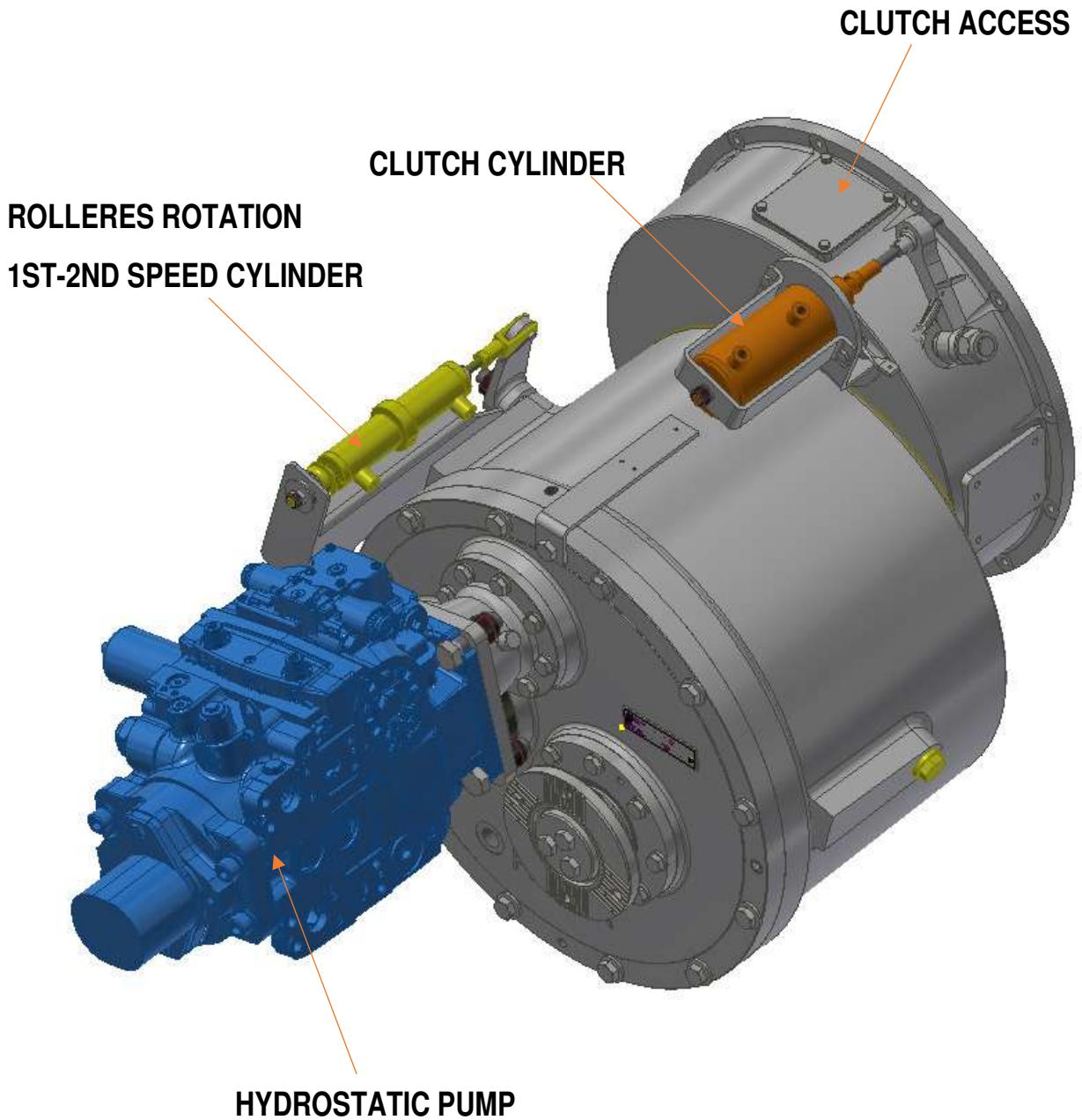
### **WARNING:**

*Use only TUTELA W90/M-DA oil or equivalent.*

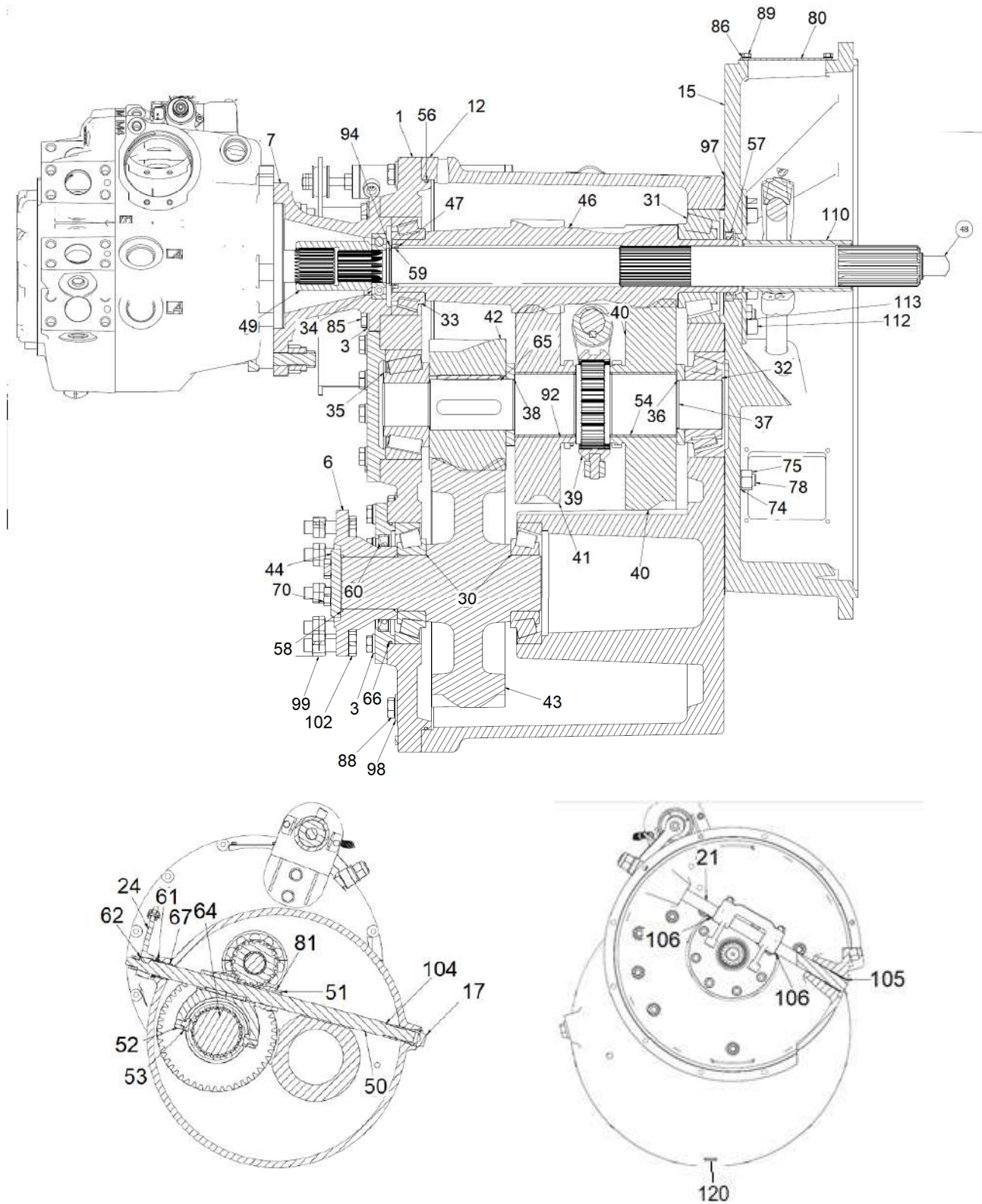
**SECTION 6  
TWO SPEED BACK GEAR  
REPAIR**

## 6.1 GENERALITY

The two speed back gear transmit the motion from the engine to the BLOWERHEAD through a shaft system. It allows the change of speed normal and fast.



## 6.2 LAYOUT DRAWING



**6.3 TROUBLE SHOOTING**

<b>PROBLEM</b>	<b>CAUSE</b>	<b>REMEDY</b>
<b>Output fork leaks oil</b>	<ul style="list-style-type: none"> <li>Oil seal #60 damaged</li> </ul>	<ul style="list-style-type: none"> <li>Replace the oil seal #60</li> </ul>
<b>Oil leak on clutch bell side</b>	<ul style="list-style-type: none"> <li>Oil seal #57 damaged</li> </ul>	<ul style="list-style-type: none"> <li>Disassemble the two speed back gear and replace the oil seal #57</li> </ul>
<b>Difficulty engaging gear (noisy when engaging gears)</b>	<ul style="list-style-type: none"> <li>Clutch hydraulic cylinder</li> <li>Two speed hydraulic cylinder</li> <li>Damaged teeth of the following component (s):                             <ul style="list-style-type: none"> <li>#39 synchronizer</li> <li>#40 synchronizer of gear 40</li> <li>#41 synchronizer of gear 41</li> </ul> </li> <li>Clutch</li> </ul>	<ul style="list-style-type: none"> <li>Check and adjust the clutch hydraulic cylinder stroke</li> <li>Check and adjust the two speed hydraulic cylinder stroke</li> <li>Replace the following component (s):                             <ul style="list-style-type: none"> <li>#39 synchronizer</li> <li>#40 gear</li> <li>#41 gear</li> </ul> </li> <li>Disassemble the two speed back gear and replace the clutch</li> </ul>
<b>Noisy into the two speed back gear</b>	<ul style="list-style-type: none"> <li>Low oil</li> <li>Bearing lubrication system</li> <li>Damaged bearing or gear</li> </ul>	<ul style="list-style-type: none"> <li>Refill the correct level of oil</li> <li>Check the bearing lubrication system</li> <li>Disassemble the two speed back gear and check the damaged part</li> </ul>

## 6.4 REMOVING THE TWO SPEED BACK GEAR FROM THE VEHICLE

Move the vehicle on an inspection pit. **Be sure that it is stationary.**

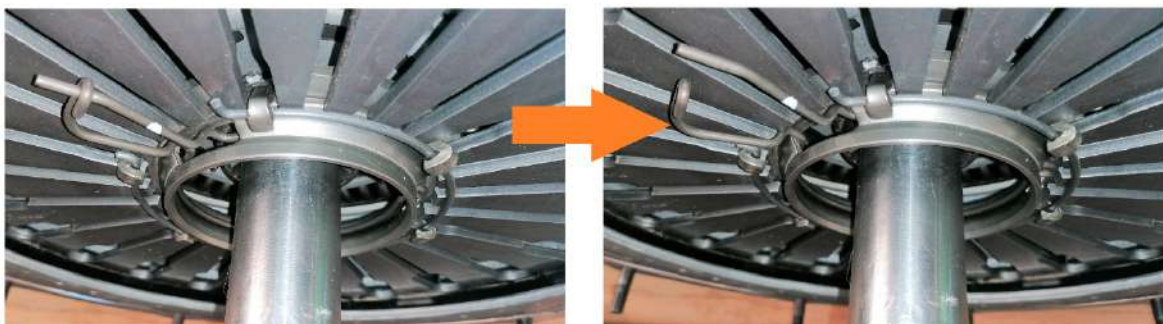


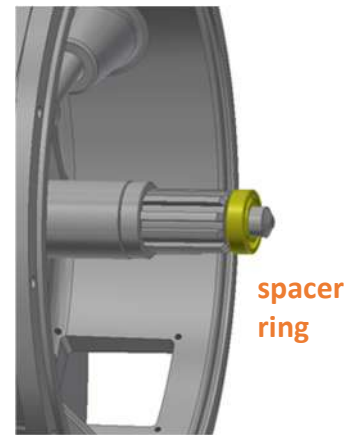
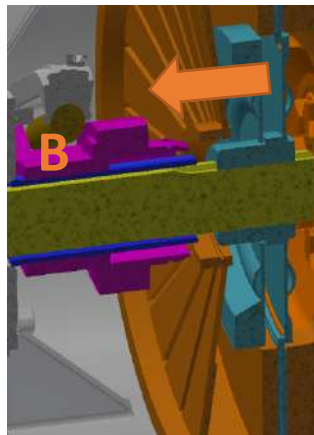
**WARNING!**  
*USE AN APPROPRIATE LIFTING SYSTEM*

- Put a vessel under the two speed back gear, remove the plug (120) and drain out all the oil (ref. to lay out 6.2).
- Remove all the hydraulic hoses and the iron pipes for lubrication.



- Remove the hydrostatic pump (see instruction in hydrostatic system section).
- Disconnect the transmission shaft from the gear (tie it with a rope to the chassis)
- Remove the cover A to access the clutch (wrench 10 mm). Open the spring lock collar to be able to disconnect the pressure plate from the sleeve B.





- Collect the spacer ring on top of the 2" shaft.
- Harness the group with a rope.
- Remove the nuts fixing the group on the engine (unscrew the fixing nut with a socket wrench 22 mm).
- Using an appropriate lifting device, low the group on a pallet to be movable by forklift.



See instruction for clutch cylinder and rollers speed cylinder uninstalling at paragr. 6.8 -6.9

## 6.5 TWO SPEED BACK GEAR DISASSEMBLY

Ref. to LAY OUT DRAWING

- 1) Put the group on the ground with the cover in the upper part. Remove the pump support (7), it is fixed by screws 12x1,75x45 10.9 (use a socket wrench 19 mm).



- 2) Remove the elastic ring (94) with the proper pliers and OR ring (47).



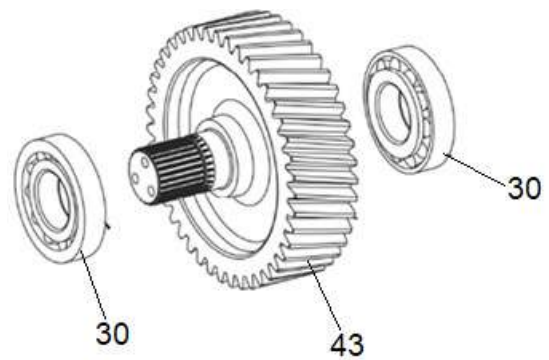
- 3) Remove the output flange (6) (socket wrench 16 mm), help yourself with an extractor.



- 4) Unloose the screws of the cover and remove it (socket wrench 22 mm).



- 5) Use a proper hoist to lift up the gears from the case. Remove before the gear in figure.



- 6) Remove the shaft for speed change (50) (use a socket wrench 22 mm to remove the fixing nut).



- 7) The shaft may result blocked. Heat the fixing sleeve (51) with a blowpipe to remove the fixing pin (81).



- 8) Use a beater to extract the shaft (50) from the case and from the fork.



- 9) If necessary, use a multigrip plier to unlock the sleeve.

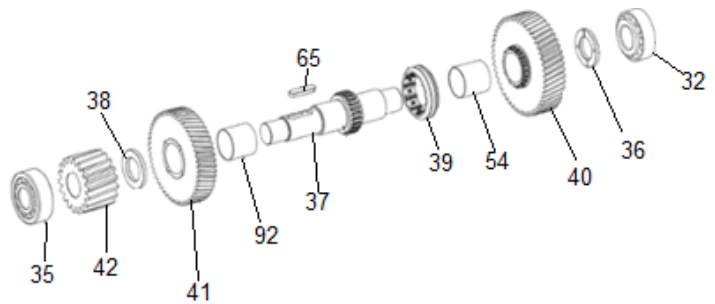


# SNOWBLOWER F90

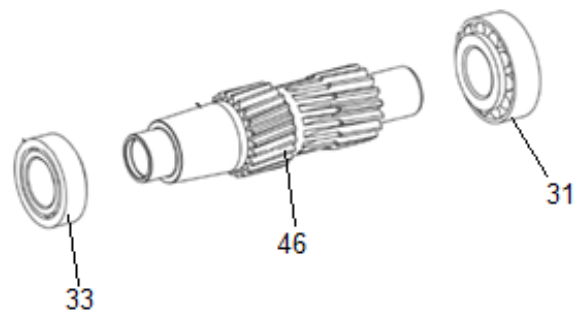
10) Extract the shaft completely.



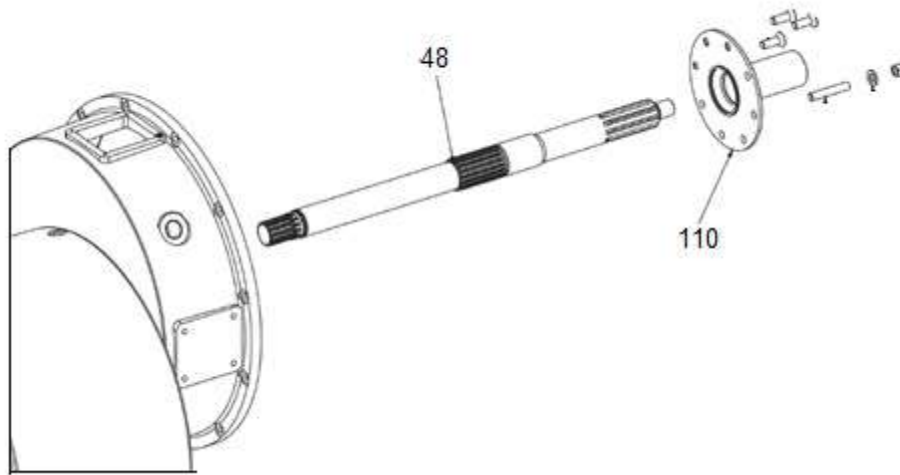
11) Lift up the two speed gears group



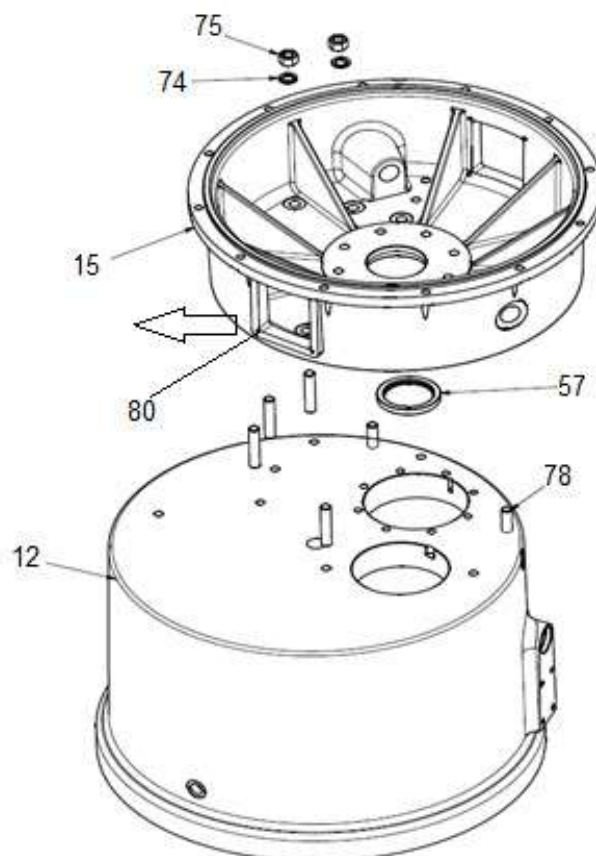
12) Remove the last gear group



- 13) Remove the driving shaft (48) unfixing the support (110). Unscrew the countersunk screws by an allen key 8 mm.



- 14) Disassemble the housing. Unscrew the nuts (75) (socket wrench 18 mm) and separate the two cases (15) and (12). Remove the stud bolts (78). Remove the seal (57) and the cover (80).



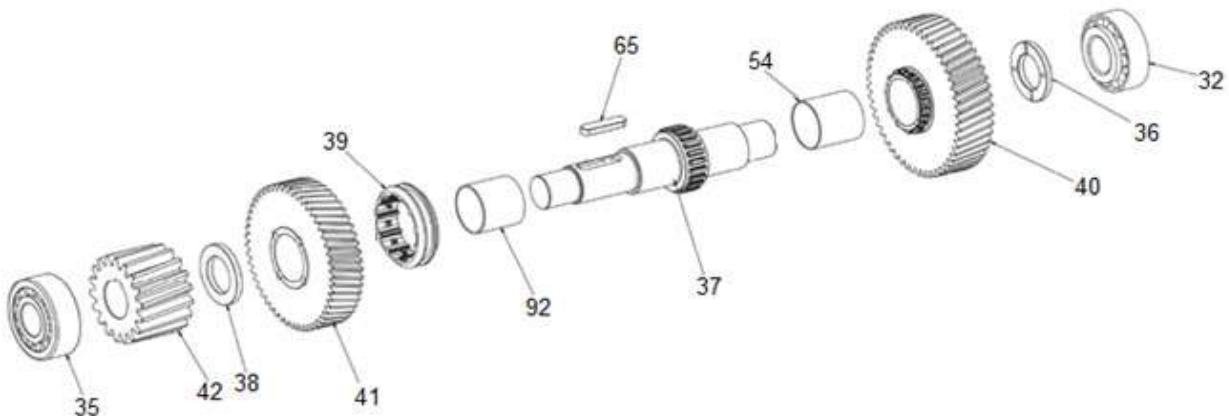
## 6.6 TWO SPEED BACK GEAR ASSEMBLY

Before proceeding for the assembly, all the parts must be carefully cleaned.

Replace the bolts and the seals, which are damaged.

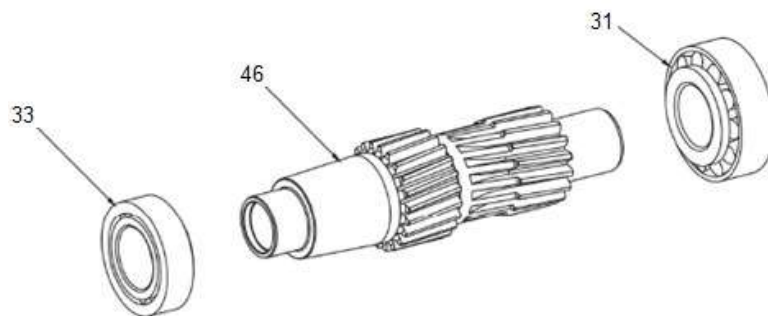
### TWO SPEED SHAFT ASSEMBLY

- 1) Plant the bushings (92) and (54) into the shaft (37)
- 2) Begin on installing the 1<sup>st</sup> speed gear (40) on the shaft
- 3) Put the shim (36) and plant the bearing (32) after having heated it with proper tool.
- 4) Overturn the assembly and slide in the sleeve (39)
- 5) Insert the 2<sup>nd</sup> speed gear (41)
- 6) Follow inserting the shim (38).
- 7) Put the spline (65) into its seat, heat the pinion (42) and the bearing (35) and plat them on the shaft



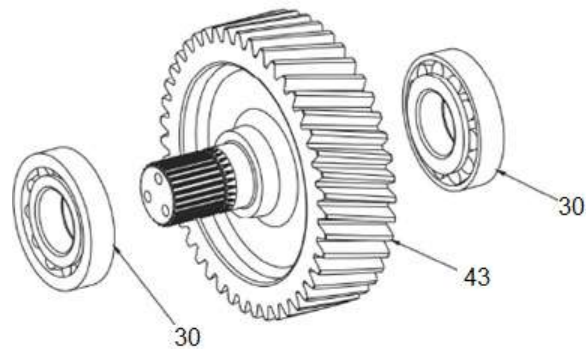
### DRIVING GEAR ASSEMBLY

- 1) Put the shaft on a bench
- 2) Heat the bearing (33) and (31) and plant them on the shaft (46)



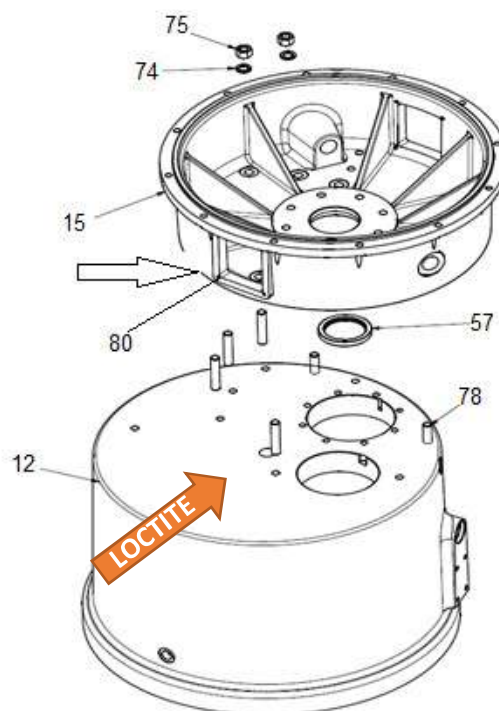
## OUTPUT GEAR ASSEMBLY

- 1) Put the shaft on a bench
- 2) Heat the bearings (30) and plant them on the shaft (43)



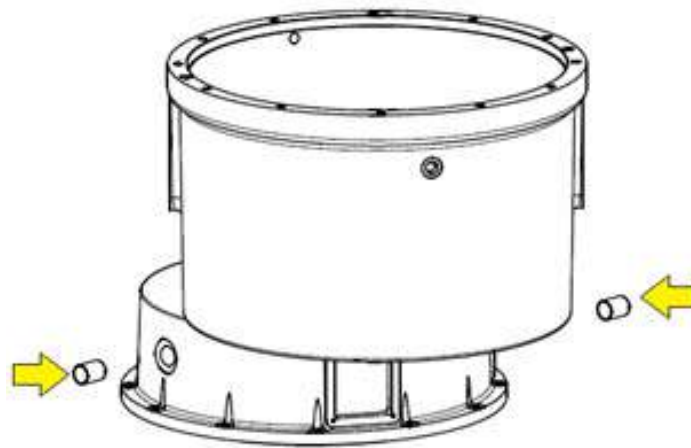
## CASE PREPARATION

- 1) Put the two speed back gear case (12) on the bench with the opening downward.
- 2) Insert the oil retainer (57) into its seat on the end bell (15).
- 3) Insert the stud bolts (78) into the case (12).
- 4) Spread a layer of Loctite 243 paste on the coupling surface and low down the bell on the case.
- 5) Put grower washers (74) on the stud bolt and tighten the nuts. (75) (socket wrench 18 mm).

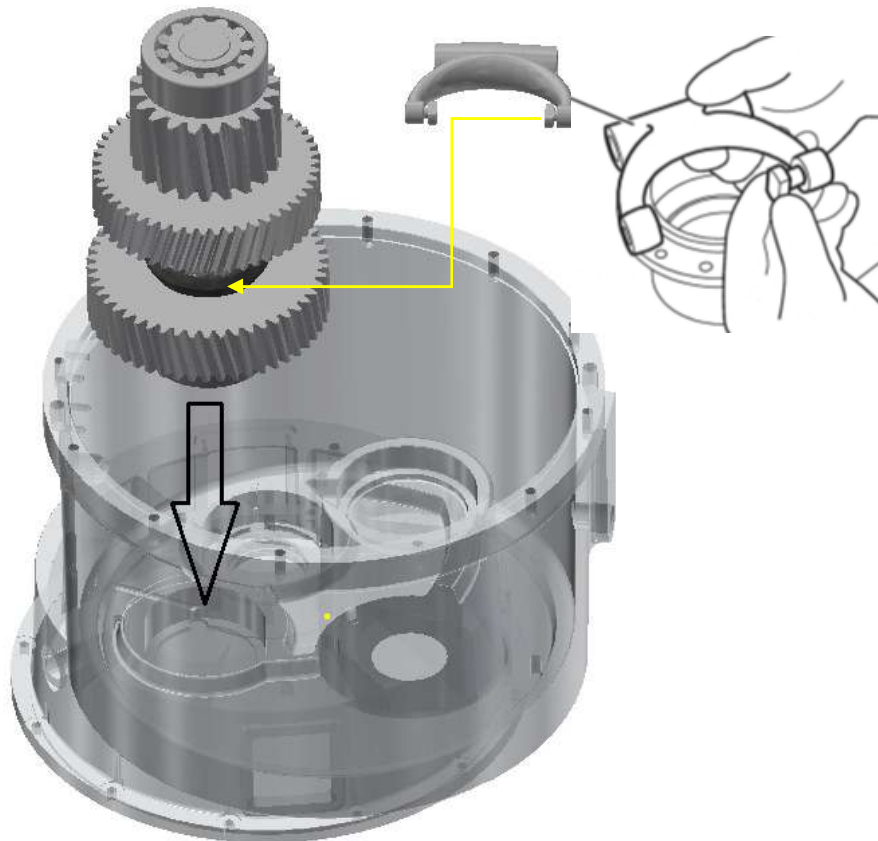


## TWO SPEED BACK GEAR WHOLE ASSEMBLY

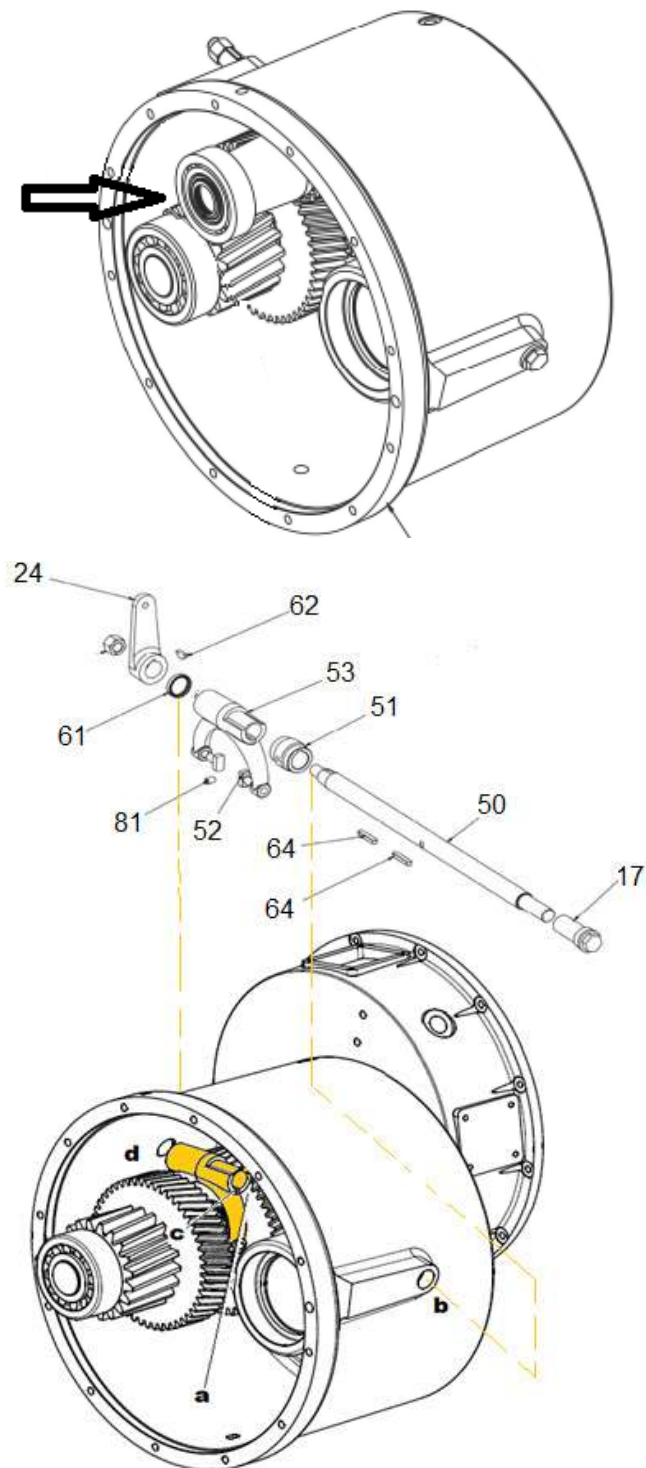
- 1) Overturn the case (use a proper lifter device).
- 2) Plant the Teflon bushings (105).



- 3) Insert the seat of the lower bearing (speed control shaft assembly) into the case and low down the whole assembly.
- 4) Place temporarily the fork and sliding element on the selector sleeve.



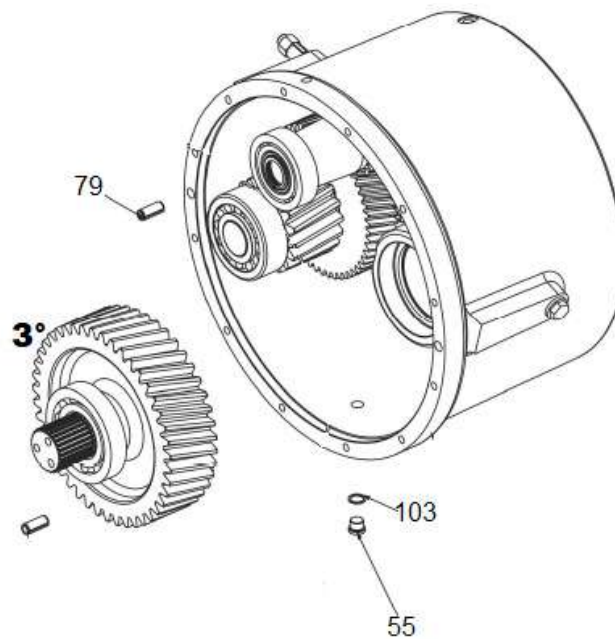
- 5) Low down in the case also the second gear assembly as indicated in the following figure.



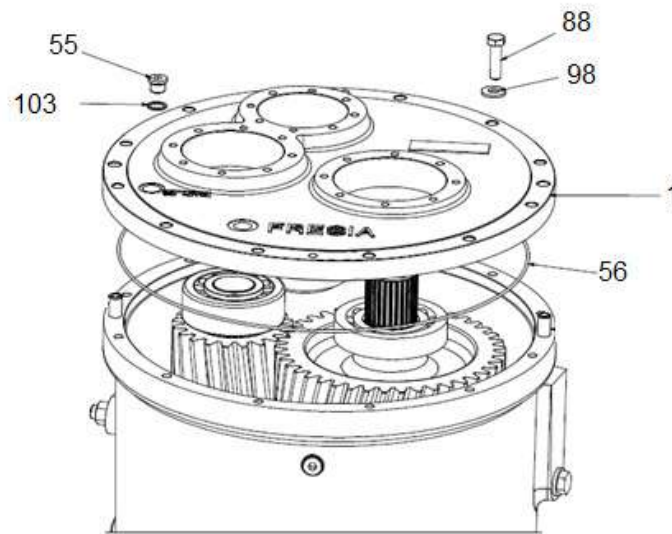
- 6) Put the spline (64) into their seats.
- 7) Left the shaft enter the spacer (51) and the fork (53). Fix it with the pin (81).

**IMPORTANT: Insert the oil seal 61 in d) from outside.**

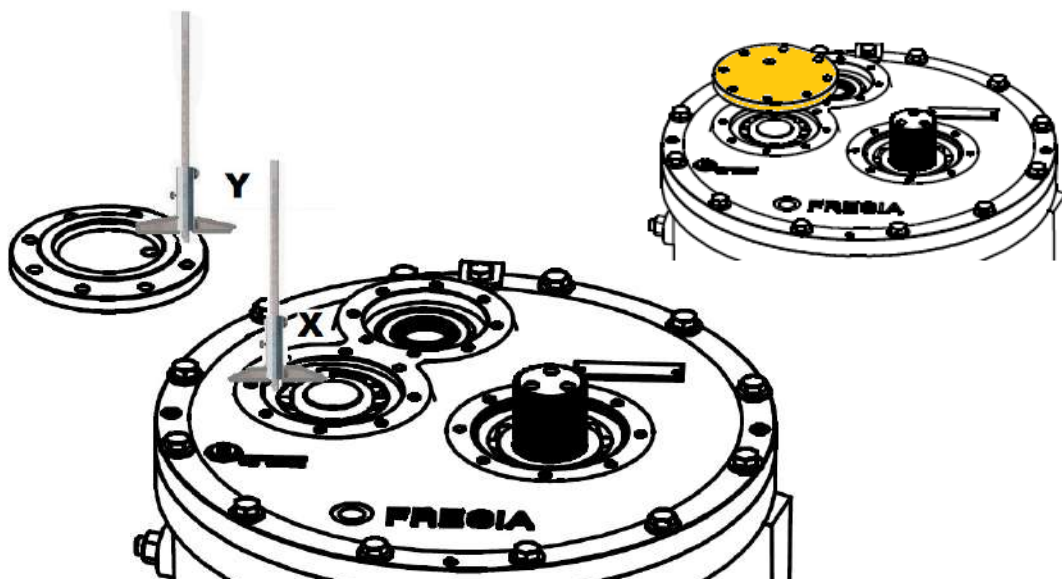
- 8) Mount the lever (24) with its key (62). Tighten the nut (wrench 27 mm).
- 9) Insert the remaining gear assembly into the case.
- 10) Plant the elastic pins (79) in the proper holes (on the case).
- 11) Screw the plug (55) and the washer (103) in the base of the case.



- 12) Lubricate the seat of the OR ring (56) on the cover (1);
- 13) Center the cover on the case by a means of the elastic pins ;
- 14) Put the washers and the screws (88-98) and tighten them;
- 15) Screw the oil plug (55) and the washer (103);

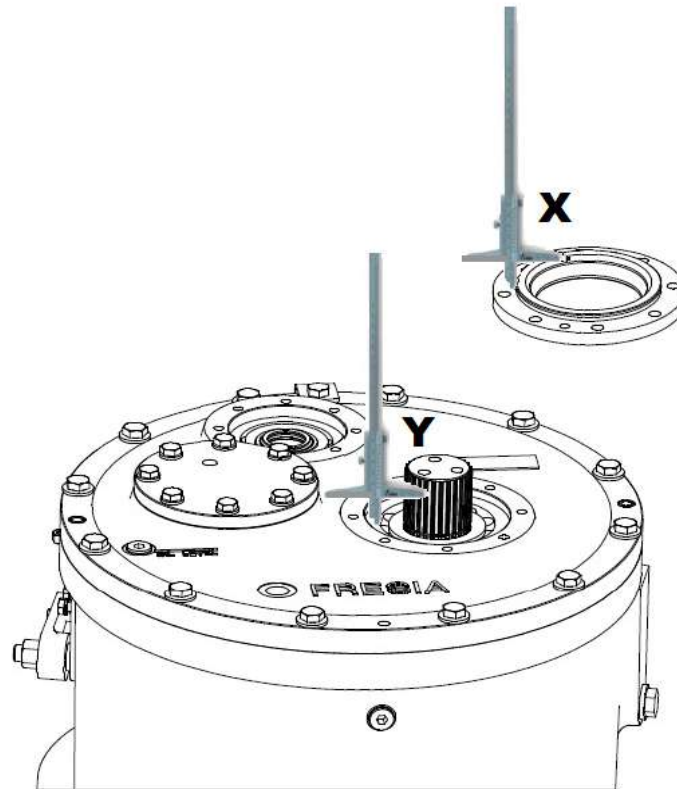


- 16) By means of a depth gauge, measure the distance between the cover top and the external ring of the roller bearing and sign it (X value)
- 17) By means of a depth gauge, measure the distance between the cover internal shoulder and the cover (yellow colour), and sign it (Y value)

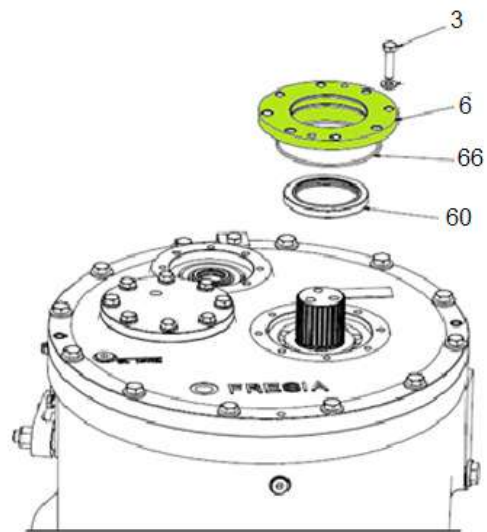


- 18) Proceed with the operation  $X - Y$ ; the result of this operation must be positive and must lay between 0,08 and 0,1 mm; should the result be different, follow these steps:
  - If the result is positive,  $> 0,1$  insert as many packings on the external ring of the taper roller bearings as it's necessary to bring this distance between 0,08 and 0,1 mm.
  - If the result is  $< 0,08$  mm, place as many packings under cover as it's necessary to bring the distance between 0,08 and 0,1 mm

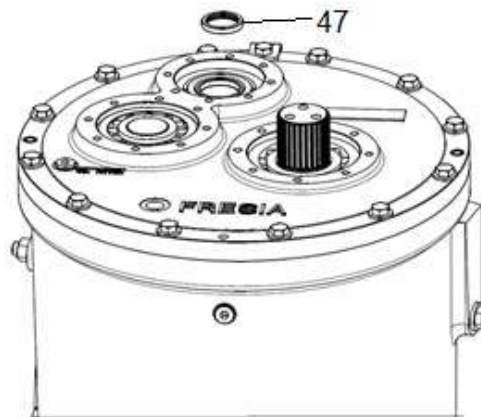
- 19) Mount the cover with proper screws and washers;
- 20) By means of a depth gauge, measure the distance between the flange cover top and the external ring of the roller bearing and sign it (X value);
- 21) By means of a depth gauge, measure the distance between the cover internal shoulder (OR ring side) and the cover and sign it (Y value);
- 22) Proceed with the operation  $X - Y$ ; the result of this operation must be positive and must lay between 0,08 and 0,1 mm; should the result be different, follow these steps:
  - If the result is positive,  $> 0,1$ , insert as many packings on the external ring of the taper roller bearings as it is necessary to bring this distance between 0,08 and 0,1 mm.
  - If the result is  $< 0,08$  mm, place as many packings under the flange cover as it's necessary to bring the distance between 0,08 and 0,1 mm



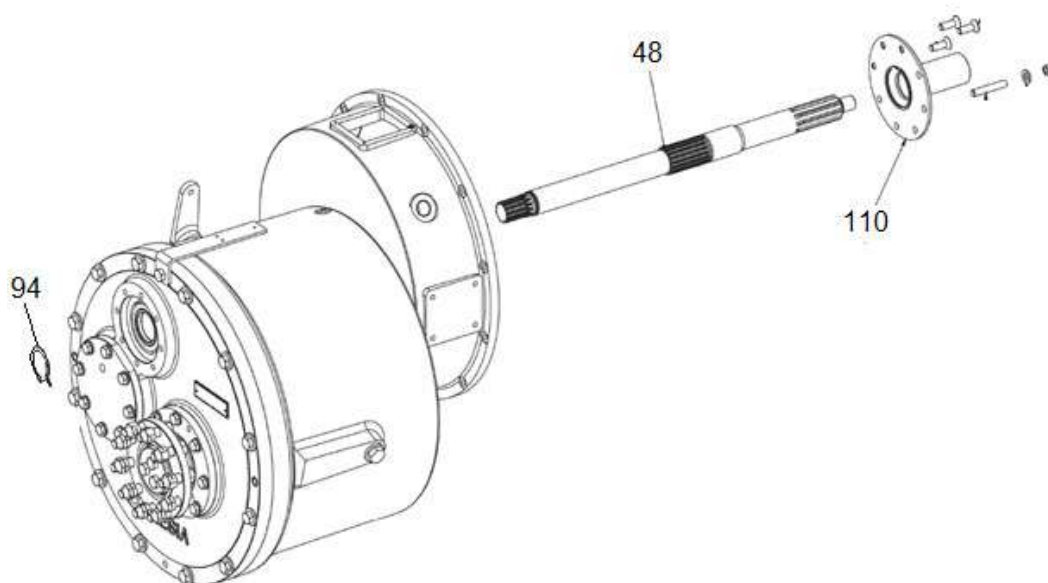
- 23) Lubricate the seat of the OR ring (66) on the flange cover, and insert the OR ring;
- 24) Put the oil seal (60) into the flange cover and mount it on the cover with proper screws and washers (2-1)



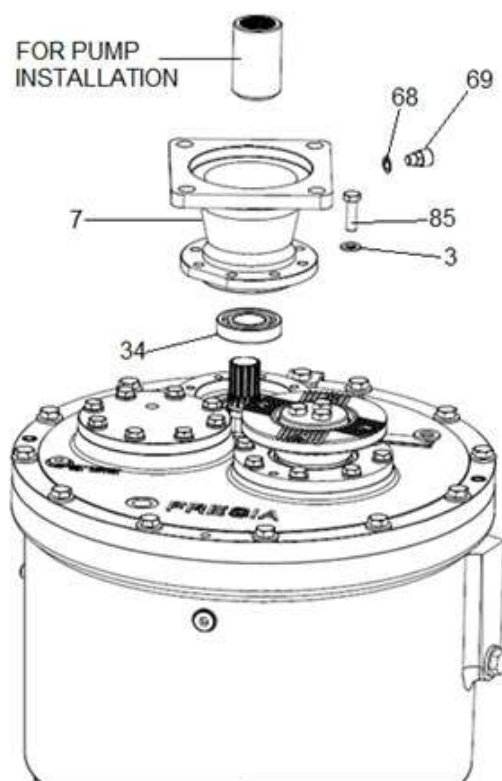
25) Put the seal with OR ring (47) into the shaft seat (following figure)



26) Insert the shaft (48) in the back hole and fix it with the elastic ring (94)



- 27) Install the pump support on the bearing (34). Fix the support with the bolts (85) 12x1,75x45 10.9 (socket wrench 19 mm). Mount the breather (69) with its washer (68), use a wrench 16 mm.



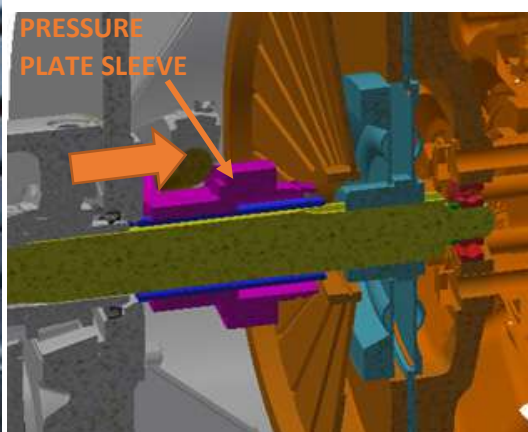
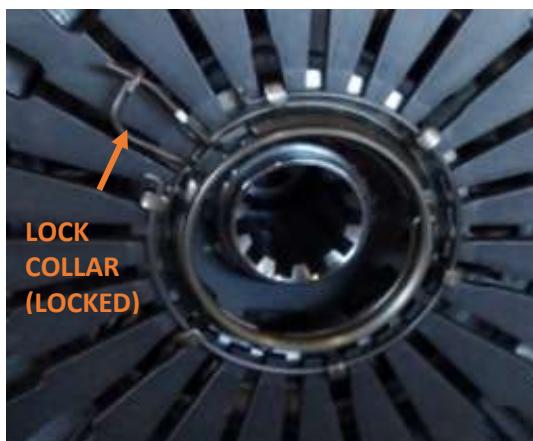
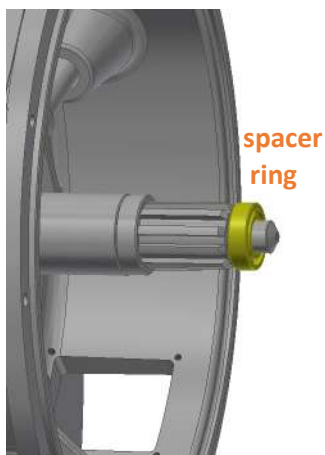
## 6.7 REINSTALLING THE TWO SPEED BACK GEAR ON THE VEHICLE

The vehicle should be parked stationary on an inspection pit.



**WARNING!**  
**USE AN APPROPRIATE LIFTING SYSTEM**

- Position the pallet with the group under the vehicle.
- With a proper hoist, lift up the group in position to couple it with the engine.
- Approach the two speed back gear to the engine inserting the shaft 2" into the clutch. Put the spacer ring on top of the shaft.
- From the housing top opening, pull the pressure plate sleeve in the spring lock collar, which must be locked.



- Fix the two speed back gear with proper nuts (use a socket wrench 22 mm).
- Mount the hydrostatic pump and its lubrication (see Hydrostatic section).
- Connect the transmission shaft and the hydraulic hoses.
- Fill the group with proper oil, until the correct level is reached.

**Use oil TUTELA W90/ M-DA o equivalent**

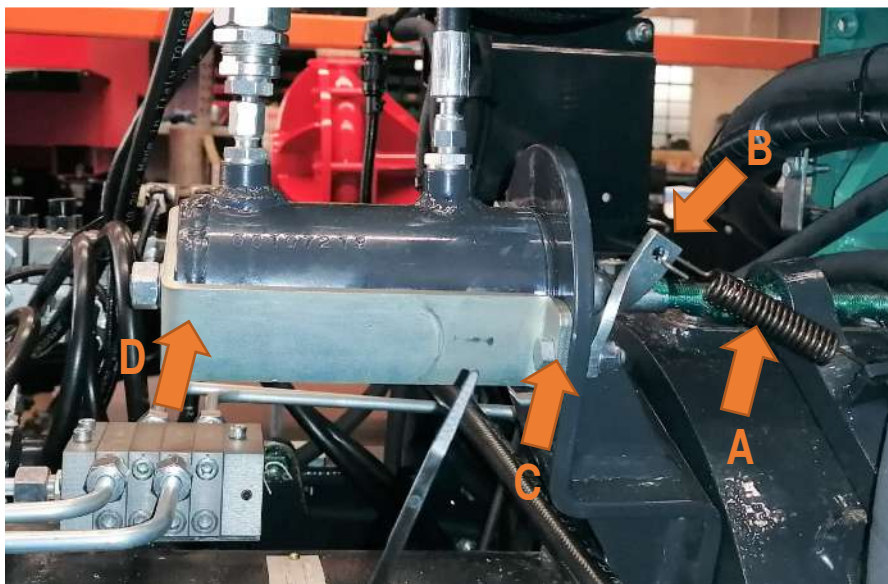
For clutch cylinder and roller speed cylinder reinstalling, see the instructions at par. 6.8-6.9

## 6.8 CLUTCH CYLINDER

### 6.8.1 CLUTCH CYLINDER UNINSTALLING

#### Remove

- 1) Unscrew the two screws fixing the cylinder on its support (C) (wrench 13 mm)
- 2) Remove the spring (A) and the small lever (B).
- 3) Remove the cylinder from back bracket (D) (wrench 19 mm)



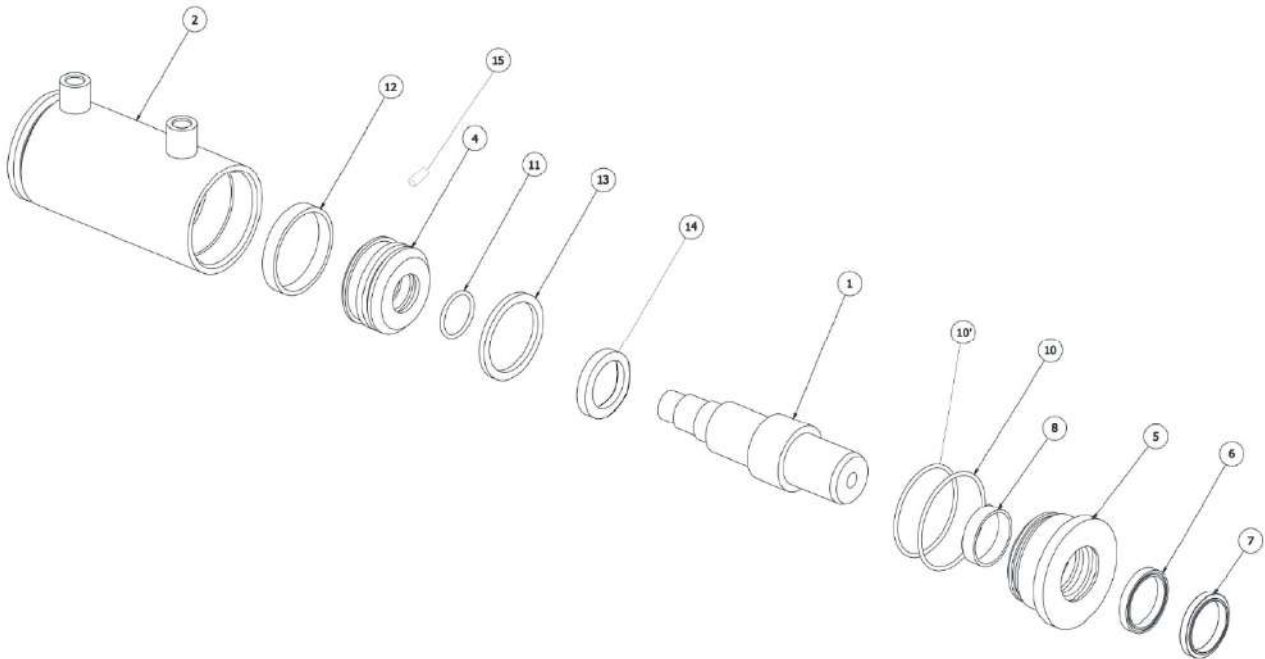
#### Reinstall

#### **IMPORTANT!**

**AFTER CYLINDER CLUTCH REINSTALLING, IT IS NECESSARY TO PERFORM THE "CLUTCH CYLINDER SETTING PROCEDURE" AS IN 6.8.3.**

- 4) Fix the cylinder on its bracket (D) (wrench 19 mm).
- 5) Fix the bracket (D) on the support (C) (wrench 13 mm).
- 6) Install the small lever (B) at the lateral screw and position the spring (A).

## 6.8.2 CLUTCH CYLINDER disassembly / assembly



<u>RIF. / REF.</u>	<u>DESCRIPTION</u>	<u>Q.TA' / Q.TY</u>
1	Rod	1
2	Housing	1
4	Piston	1
5	Head nut	1
6	Gasket	1
7	Scraper	1
8	Band	1
10	OR ring	1
10'	OR ring	1
11	OR ring	1
12	Band	1
13	Gasket	1
14	Stroke limiter	1
15	Grain	1

### Disassembly

- 1) Position the cylinder on a bench vise with soft jaws.
- 2) Unscrew the head end cap (5).
- 3) Slide out the rod assembly with all its gaskets from the cylinder barrel.
- 4) Remove the gaskets (12) and (13) from the piston (4).
- 5) Unscrew the pin (15) and unscrew the piston (4) from the rod (1).
- 6) Slide out the stroke limiter (14) and the head end cap (5) with its gasket from the rod.
- 7) Extract the OR ring (11) from the piston and (6) (7) (8) (10) (10') from the head end cap.
- 8) Clean carefully all the parts and preform the following verifies:

## Cylinder barrel:

Check that no scratches are present in the internal part.

Check the condition of the thread.

If necessary, replace.

## Rod:

Check that no scratches are present on the rod surface.

Check the condition of the rod thread.

If necessary, replace.

## Head end-cap:

Check that no scratches are present in internal and external surface.

If necessary, replace.

## Piston:

Check that no scratches are present in internal and external surface.

If necessary, replace.

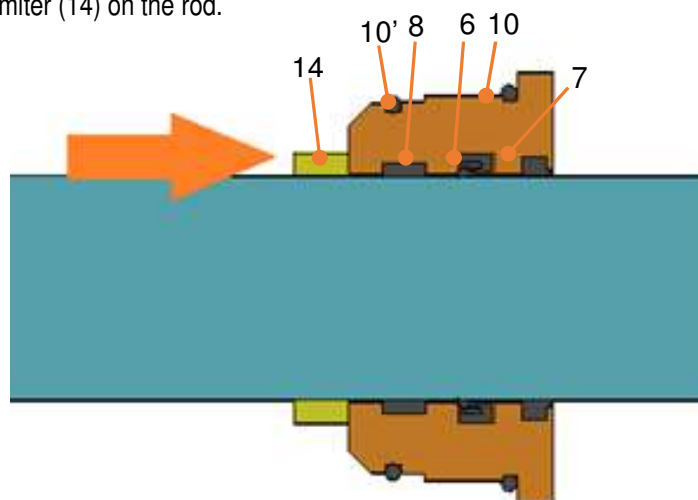
## Gaskets kit:

All the gaskets must be in perfect condition. If they are not, provide for the replacement.

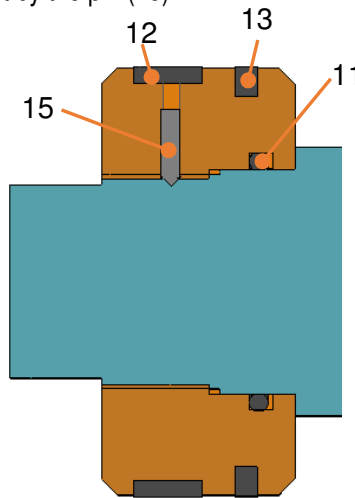
**IMPORTANT! We suggest to change the gasket kit, everytime the cylinder is disassembled.**

## Assembly

- 9) Position the rod on a bench vise with soft jaws.
- 10) Moist with oil: the piston, the head end cap, the rod and the gasket seats.
- 11) Insert the gaskets (6) and (8) in the head end cap.
- 12) Insert the dust scraper (7) in its seat on the top and push it with a finger along the perimeter, to allow it a perfect adhesion. BE CAREFUL NOT TO WASTE THE SCRAPER
- 13) Mount the two OR rings (10) and (10').
- 14) Insert the head end cap into the rod, BE CAREFUL NOT TO DAMAGE THE GASKETS.
- 15) Insert the stroke limiter (14) on the rod.



- 16) Insert the OR ring (11) on the piston (4).
- 17) Screw the piston (4) on the rod and fix it by the pin (15)



- 18) Install the gaskets (12) and (13) on the piston.
- 19) Remove the rod from the bench vise and put on the cylinder barrel.
- 20) Moist all the internal part of the cylinder barrel with oil.
- 21) Insert into the cylinder barrel the assembled rod BE CAREFUL NOT TO DAMAGE THE GASKETS.
- 22) Screw the head end cap on the cylinder barrel.
- 23) Perform a test, fulling the cylinder with pressurized oil (90 bar) Check that no leak is present.

### 6.8.3 CLUTCH CYLINDER SETTING PROCEDURE

**The procedure MUST be performed everytime coupling reinstalling the clutch cylinder.**

- 1) The access of the clutch compartment is located on the top. It is necessary to remove the upper cover (wrench 10 mm).



- 2) The following figure just shows the position where an 11 mm thickness has to be put during the setting of the clutch.



- 3) Once the thickness is in position as previously shown, act on counter nut of cylinder to adjust the position of the fork.



- 4) Adjust the bushing position by screwing/unscrewing it on the cylinder rod. This operation allows to move the fork in the right position.



- 5) Slide out the thickness and close the top cover with the four bolts (wrench 10 mm).



- 6) Spread some grease on the bushing tip



## 6.9 ROLLERES ROTATION 1ST-2ND SPEED CYLINDER

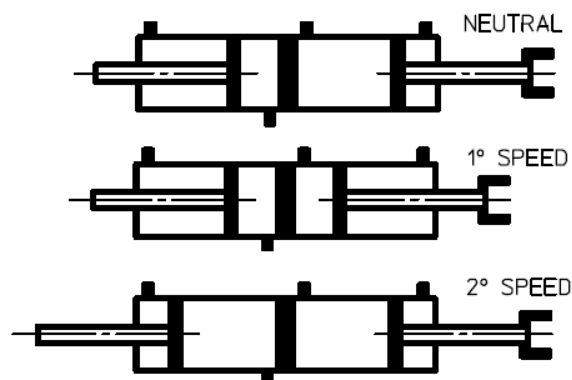
### 6.9.1 ROLLERS SPEED CYLINDER UNINSTALLING



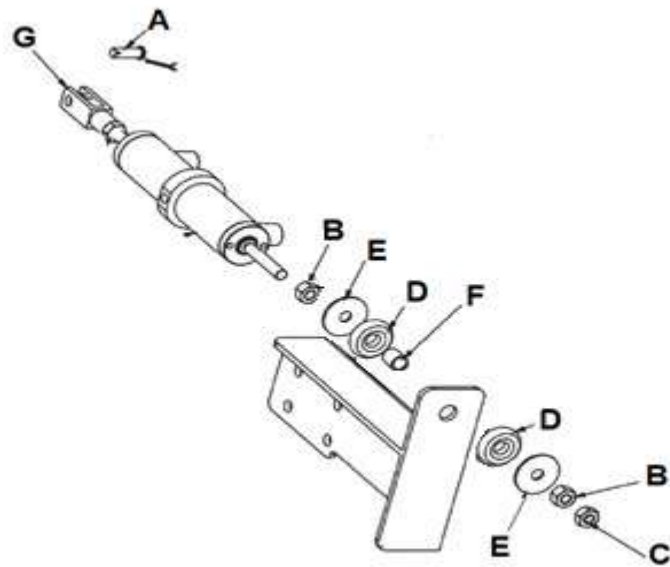
- 1) Remove the elastic pin and the pin A
- 2) Unscrew the nuts B-C and slide out the cylinder with bumpers (be careful not to loose any part)

### Reinstall

Lever D must be in position of 1<sup>st</sup> speed (so that the cylinder is totally closed).

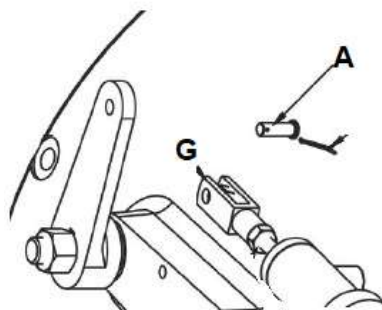


- 3) Screw back the cylinder on its support. Correct assembly in the following lay out

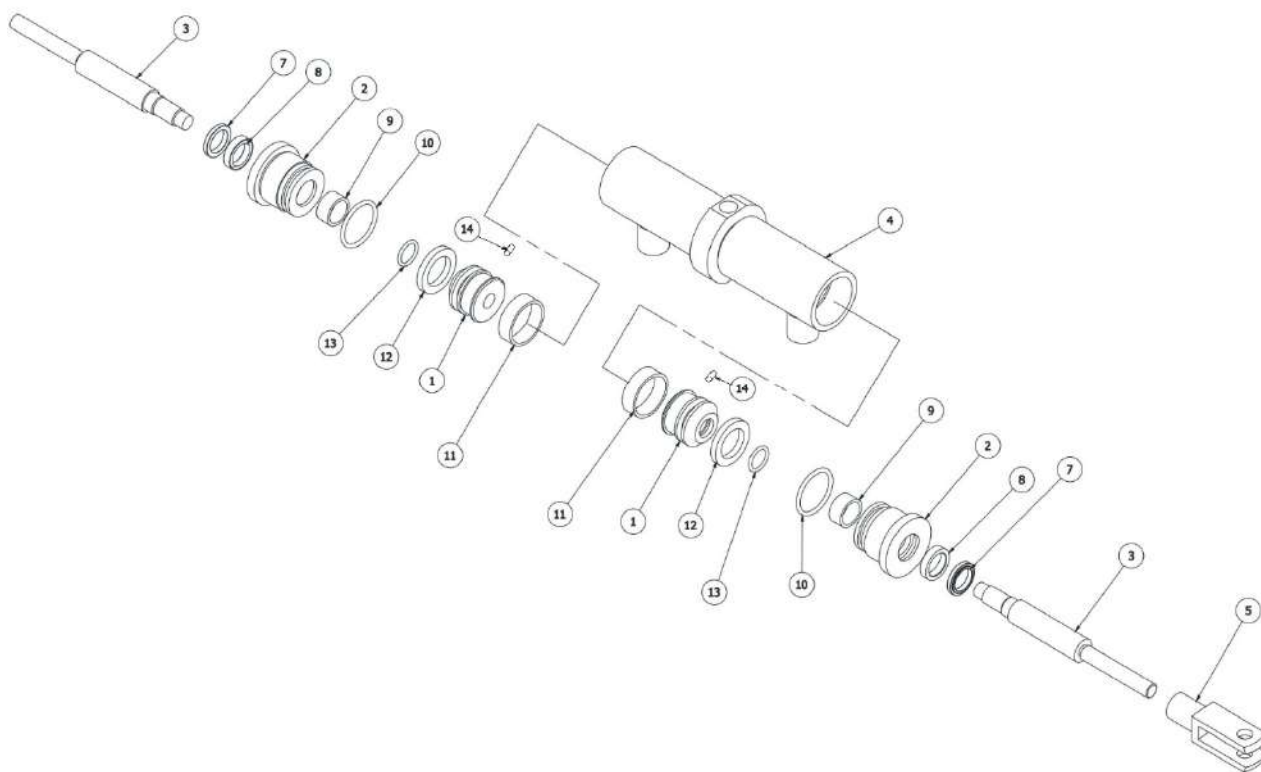


## **IMPORTANT!**

*When reinstalling, adjust the length of the cylinder so that the pin A enters easily. To adjust the length, act on the position of the fork G (by counternut)*



## 6.9.2 ROLLERS SPEED CYLINDER disassembly/assembly



<u>RIE. / REF.</u>	<u>DESCRIPTION</u>	<u>Q.TA' / Q.TY</u>
1	Piston	2
2	Head nut	2
3	Rod	2
4	Cylinder barrel	1
5	Fork	1
7*	Scraper	2
8*	Gasket	2
9*	Band	2
10*	OR ring	2
11*	Band	2
12*	Gasket	2
13*	OR ring	2
14	Pin	2

### Disassembly

- 1) Position the cylinder on a bench vise with soft jaws.
- 2) Remove the fork (5)
- 3) Unscrew the head end caps (2).

- 4) Slide out the rods assembly with all its gaskets from the cylinder barrel.
- 5) Remove the gaskets (11) and (12) from the pistons (1).
- 6) Unscrew the pins (14) and unscrew the pistons (1) from the rods (3).
- 7) Slide out the head end caps (2) with their gaskets from the rods (3).
- 8) Extract the OR ring (13) from the piston and (7) (8) (9) (10) from the head end caps.
- 9) Clean carefully all the parts and preform the following verifies:

**Cylinder barrel:**

Check that no scratches are present in the internal part.

Check the condition of the thread.

If necessary, replace.

**Rods:**

Check that no scratches are present on both rod surfaces.

Check the condition of the rods thread.

If necessary, replace.

**Head end-caps:**

Check that no scratches are present in internal and external surfaces.

If necessary, replace.

**Pistons:**

Check that no scratches are present in internal and external surfaces.

If necessary, replace.

**Gaskets kit:**

All the gaskets must be in perfect condition. If they are not, provide for the replacement.

**IMPORTANT! We suggest to change the gasket kit, everytime the cylinder is disassembled.**

**Assembly**

- 10) Position the first piston rod on a bench vise with soft jaws.
- 11) Moist with oil: the piston, the head end cap, the rod and the gasket seats.
- 12) Insert the gaskets (8) and (9) in the head end cap.
- 13) Insert the dust scraper (7) in its seat on the top and push it with a finger along the perimeter, to allow it a perfect adhesion. BE CAREFUL NOT TO WASTE THE SCRAPER
- 14) Mount the two OR ring (10).
- 15) Insert the head end cap into the rod, BE CAREFUL NOT TO DAMAGE THE GASKETS.
- 16) Insert the OR ring (13) on the piston (1).
- 17) Screw the piston (1) on the rod and fix it by the pin (14)
- 18) Install the gaskets (11) and (12) on the piston.
- 19) Remove the first rod from the bench vise and position the second one.

- 20) Proceed for the second rod as for the first one.
- 21) Position the cylinder barrel on the bench vise.
- 22) Moist all the internal part of the cylinder barrel with oil.
- 23) Insert into the cylinder barrel the assembled rods BE CAREFUL NOT TO DAMAGE THE GASKETS.
- 24) Screw the head end caps on the cylinder barrel.
- 25) Reinstall the fork (two marks "X" are present in the side where the fork must be installed).

**IMPORTANT! Install the fork in the side with two marks "X" on the barrel.**



- 26) Perform a test, fulling the cylinder with pressurized oil (90 bar) Check that no leak is present.

ELECTRIC  
CLEANING

 MECCANIC  
LUBRICATION

 FLUIDIC  
INSPECTION

**Vehicle type:** SNOWBLOWER

**Model:** F90

**Intervention type:** TWO SPEED BACK GEAR OIL LEVEL CHECK

## TWO SPEED BACK GEAR

**Periodicity:** BEFORE STARTING

**Required time:** 10 minutes

**Action points:**

**Requested spare parts:**

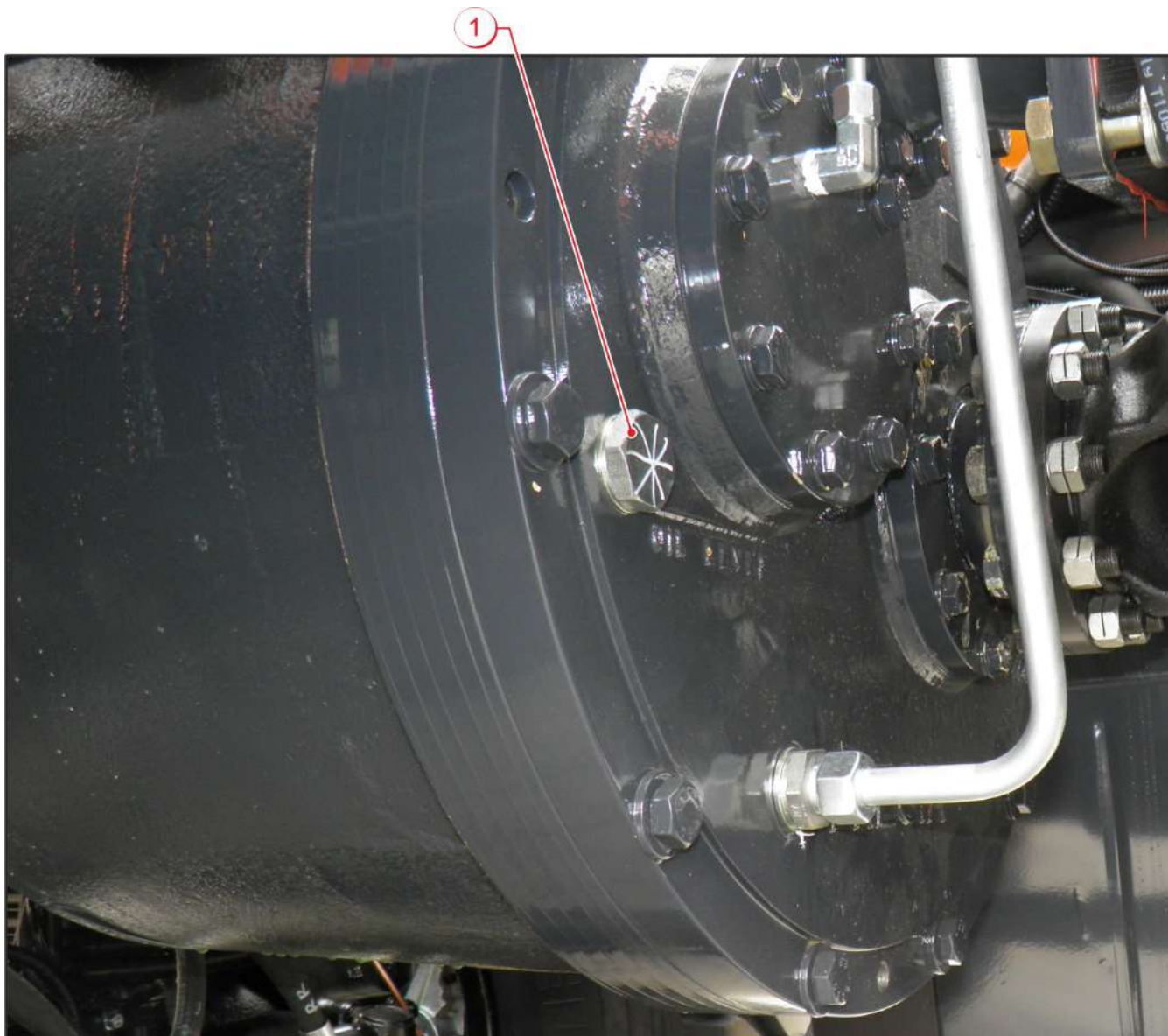
- Oil type TUTELA W90/M-DA or equivalent.

**Specific tools:**

PROCEDURE:



**WARNING:**  
*People operating on vehicle must wear protective clothes according to the regulations in force.*



- a) Move the vehicle over an inspection pit.
- b) Unscrew plug (1) and check that the level reaches the lower part of the opening.
- c) If necessary, refill.
- d) Screw back the plug (1).



**WARNING:**  
*Use only TUTELA W90/M-DA oil or equivalent.*

<input type="checkbox"/>	ELECTRIC	<input type="checkbox"/>	MECHANIC	<input checked="" type="checkbox"/>	FLUIDIC
<input type="checkbox"/>	CLEANING	<input type="checkbox"/>	LUBRICATION	<input type="checkbox"/>	INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

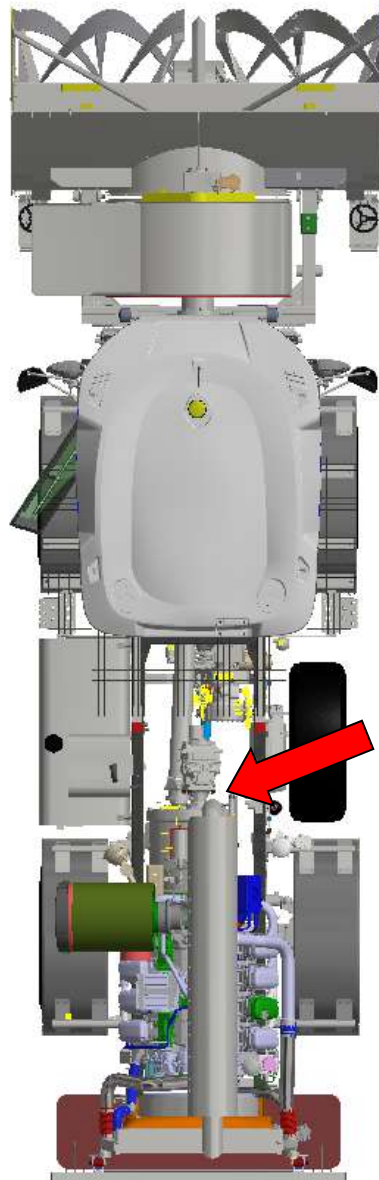
Intervention type: **TWO-SPEED BACK GEAR OIL REPLACEMENT**

**TWO SPEED BACK GEAR**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **30 minutes**

Action points:



**Requested spare parts:**

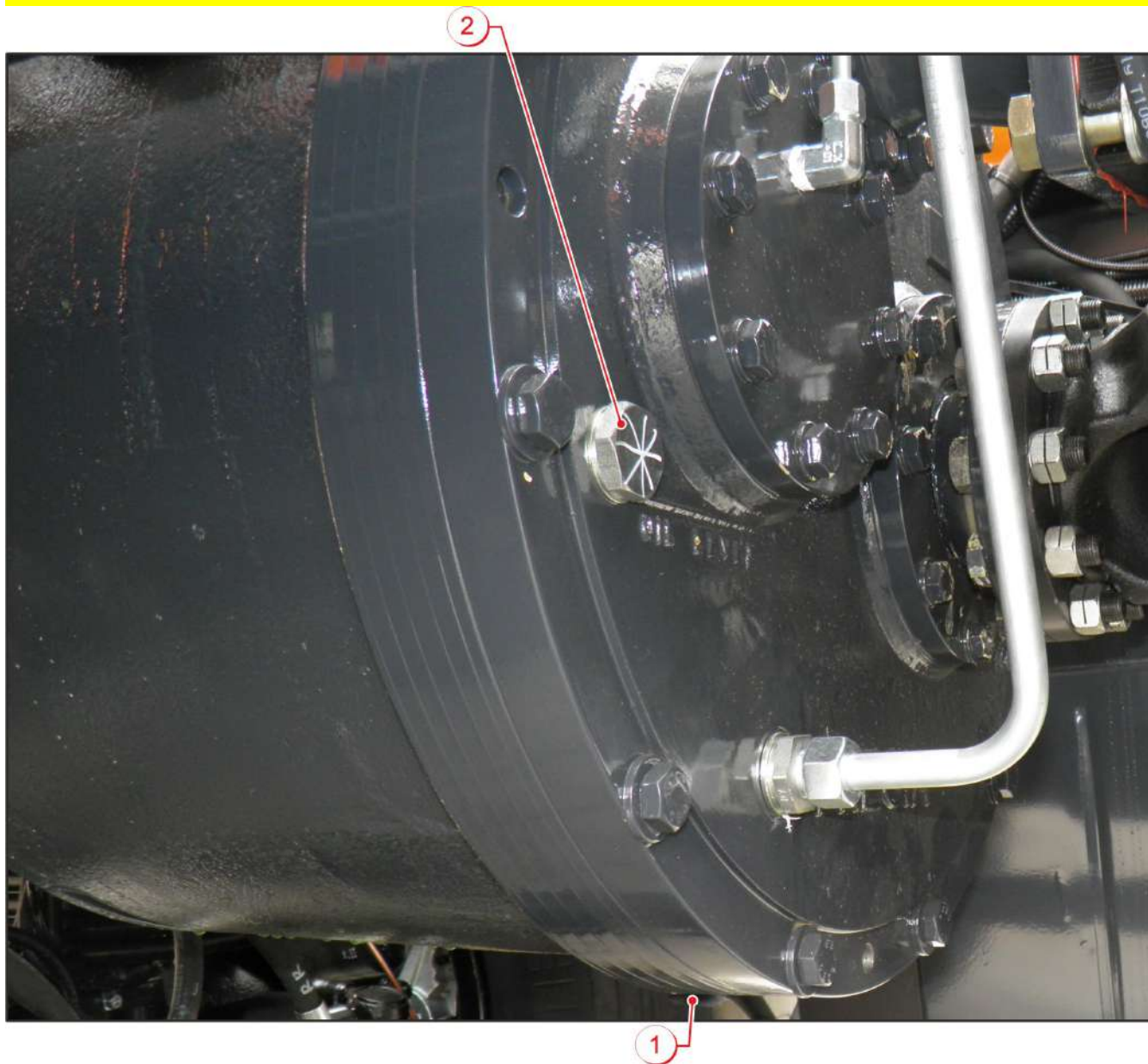
- Oil type TUTELA W90/M-DA or equivalent.
- Plugs gasket

**Specific tools:**

## PROCEDURE:



**WARNING:**  
*People operating on vehicle must wear protective clothes according to the regulations in force.*



- Move the vehicle over an inspection pit.
- Put a container under the plug (1).
- Unscrew plugs (1) and (2), let the oil completely flow out.
- When oil had completely drained screw back plug (1) (replace the gasket of plug (1)).
- Fill the new oil through the opening (2) until it reaches the lower part of the opening.
- Screw back plug (2) (replace the gasket of plug (2)).



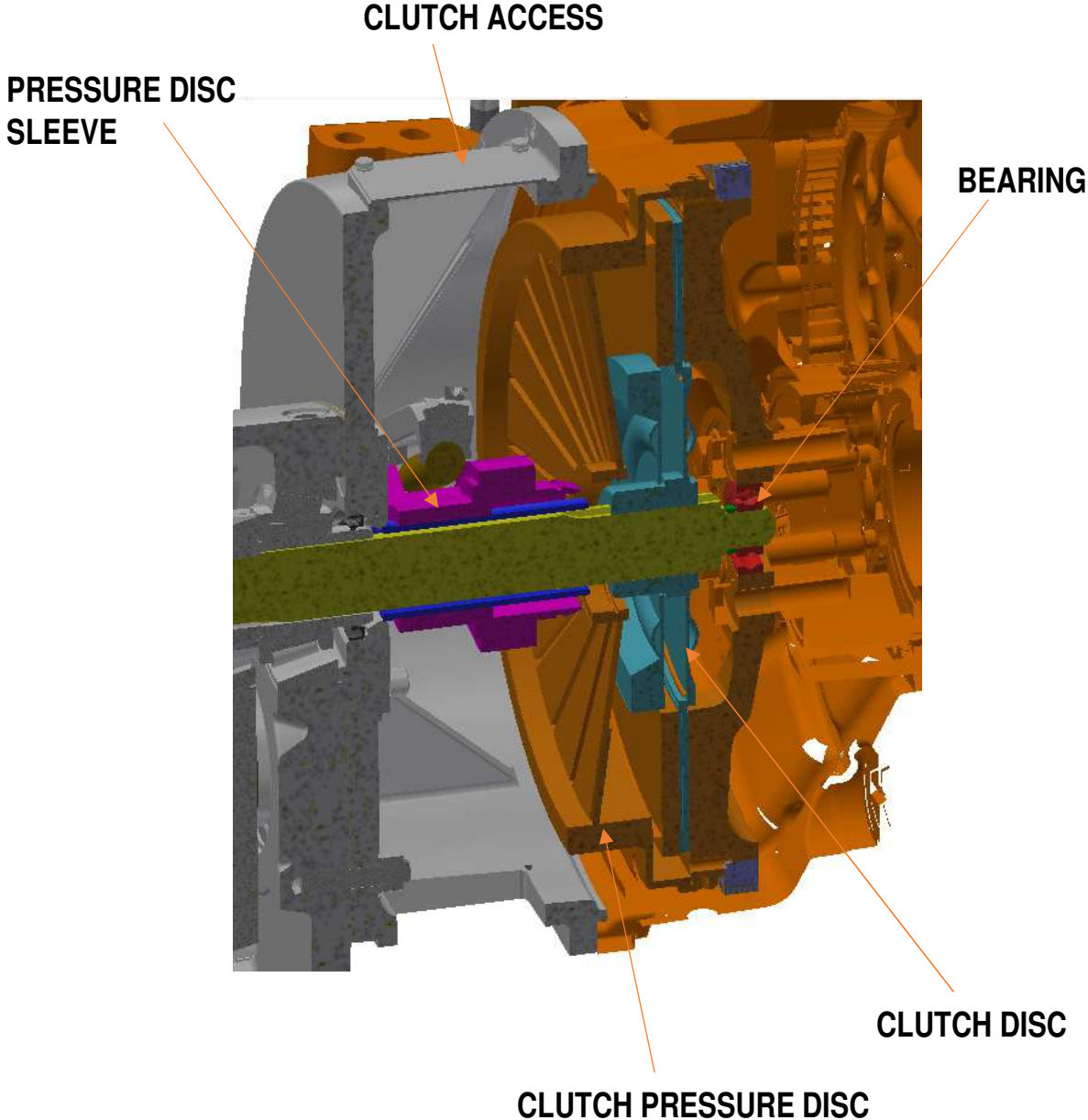
**WARNING:**  
*Use only TUTELA W90/M-DA oil or equivalent*

SECTION 6\_BIS  
**CLUTCH REPLACEMENT**

# SNOWBLOWER F90

## 6.1 CLUTCH ASSEMBLY LAY OUT

**NOTE:** The clutch installed on vehicle is a PULL type.



## 6.2 CLUTCH UNINSTALL / REINSTALL



### WARNING!

*Put the thickness as indicated, in order to avoid clutch damage*

### Remove

- 1) Put four thickness under the pins indicated by the arrows in the following picture, in order to maintain their position.



- 2) Remove the nr. 12 fixing screws, which are indicated in the circle (use a socket wrench 17 mm).
- 3) Slide out the clutch pressure disc and the disc from the fly wheel.
- 4) If necessary, extract the bearing by an extractor and replace.

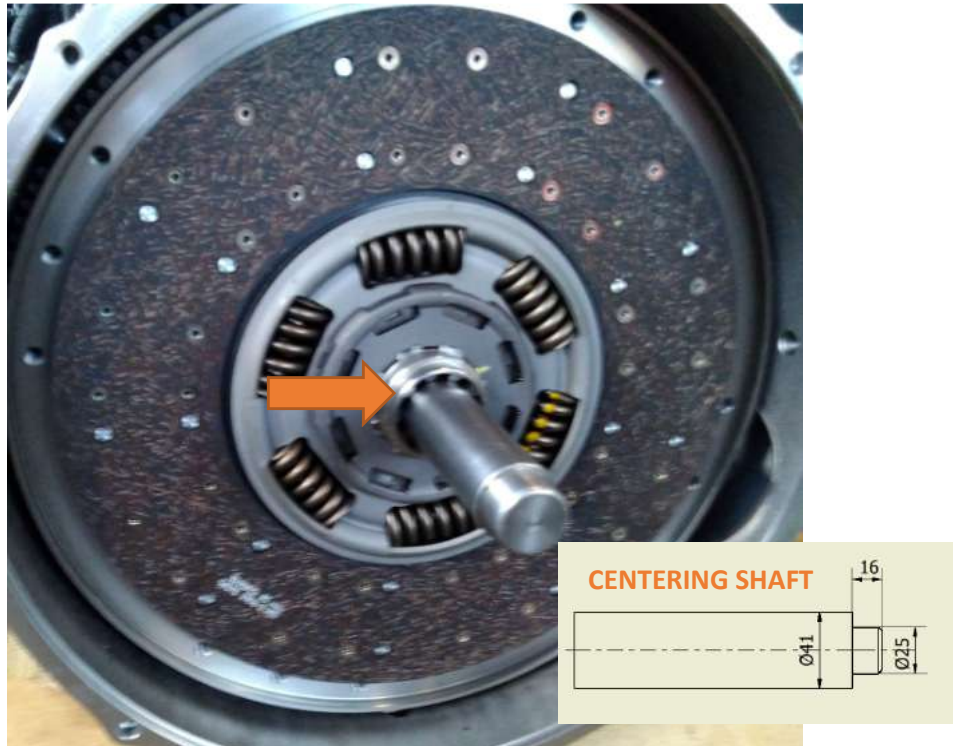


# SNOWBLOWER

## F90

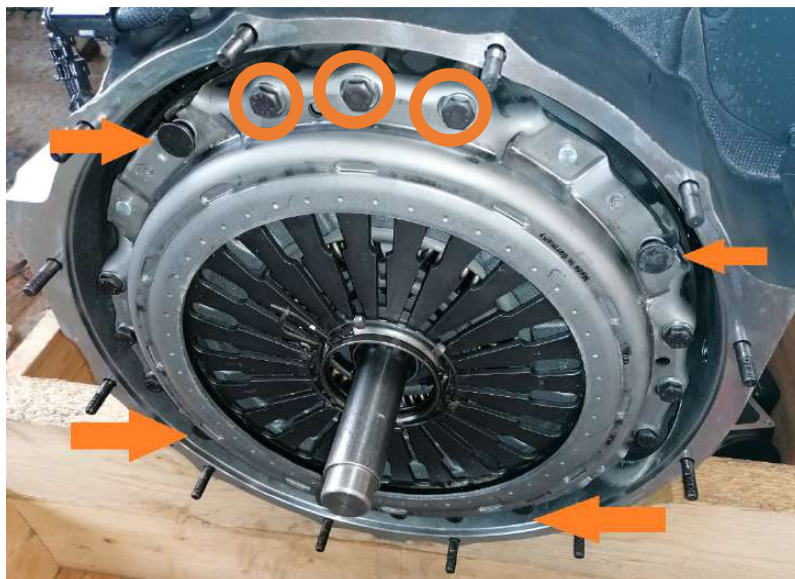
### Reinstall

- 5) Plant the bearing in its seat by a means of a rubber hammer.
- 6) Put a centering shaft in the bearing and install the clutch disc (the protrusion indicated by the arrow must be in forwards as in figure)



- 7) Install the pressure disc and fix it by nr. 12 fixing screws in the circle (tighten at **70 Nm**)

**NOTE: Under the pins indicated by the arrows must be present a thickness to maintain them in their position.**

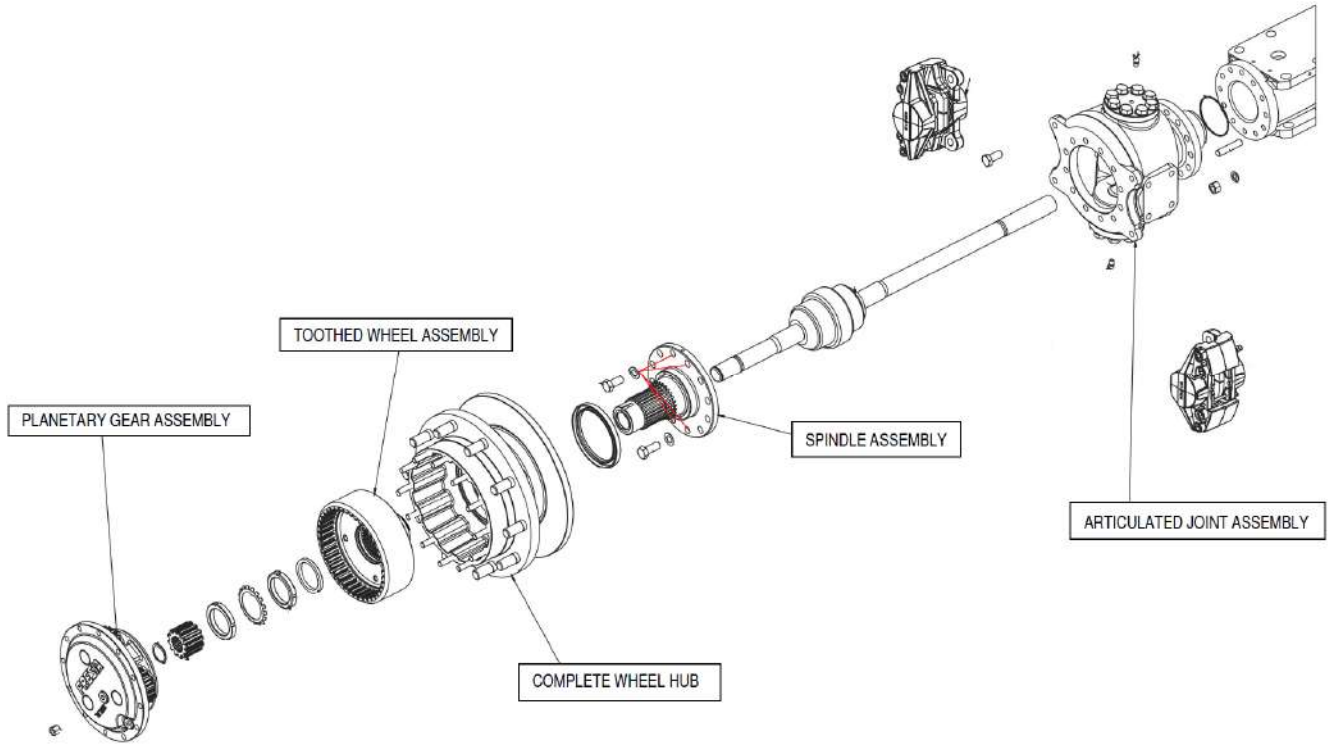


- 8) Remove the centering shaft.

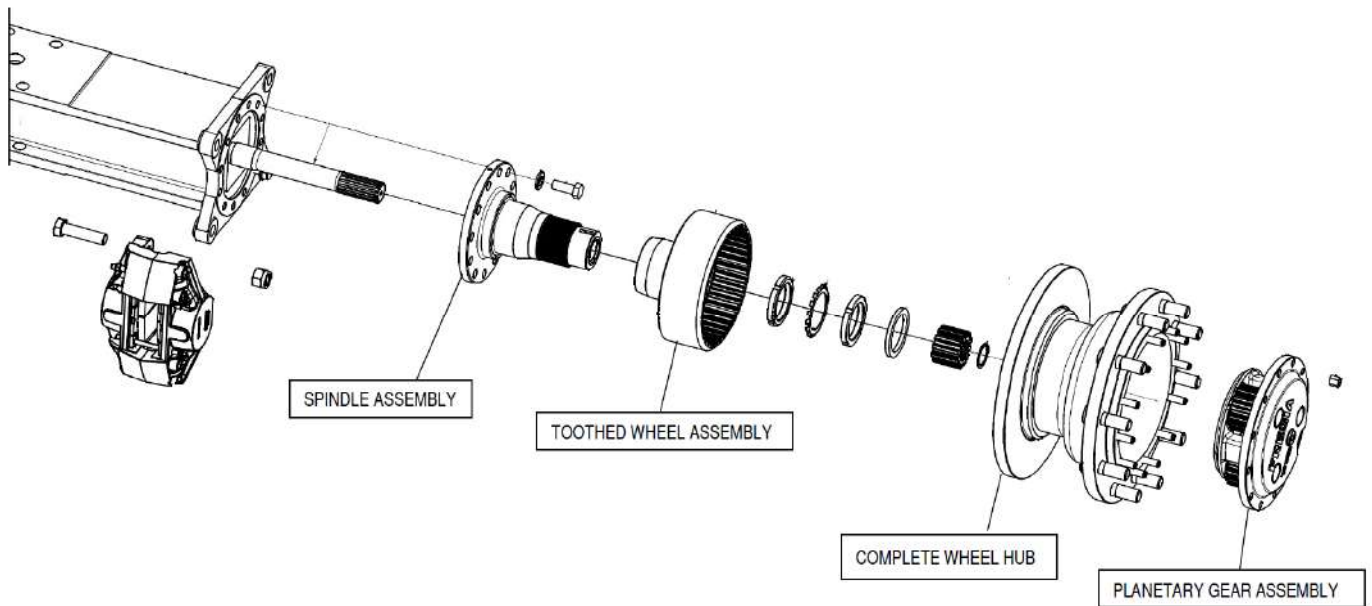
SECTION 7  
**AXLES REPAIR**

## 7.1 AXLES LAY OUT

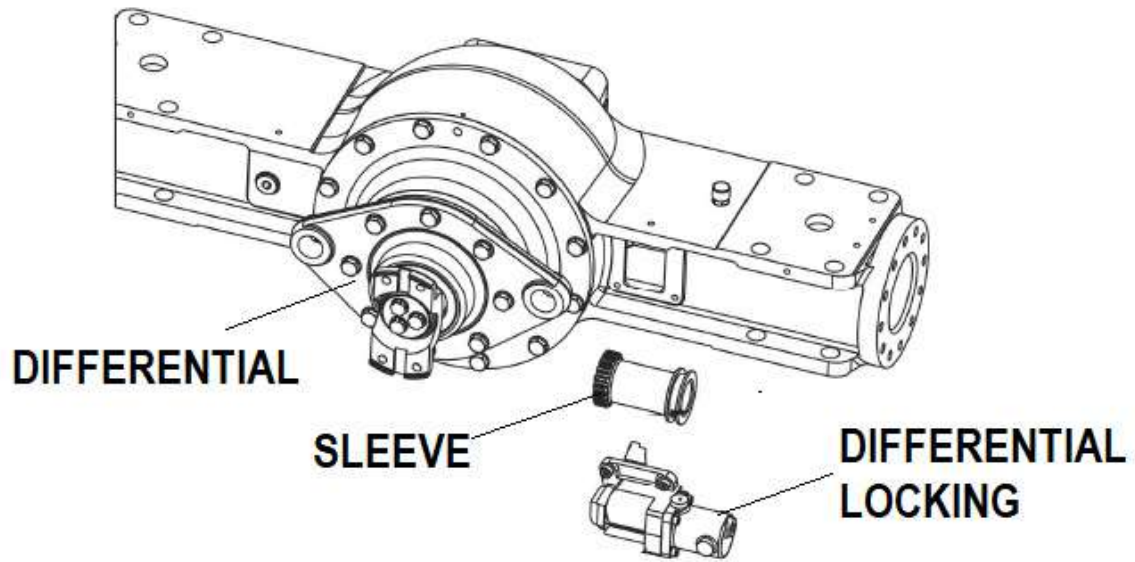
### (FRONT STEERING AXLE)

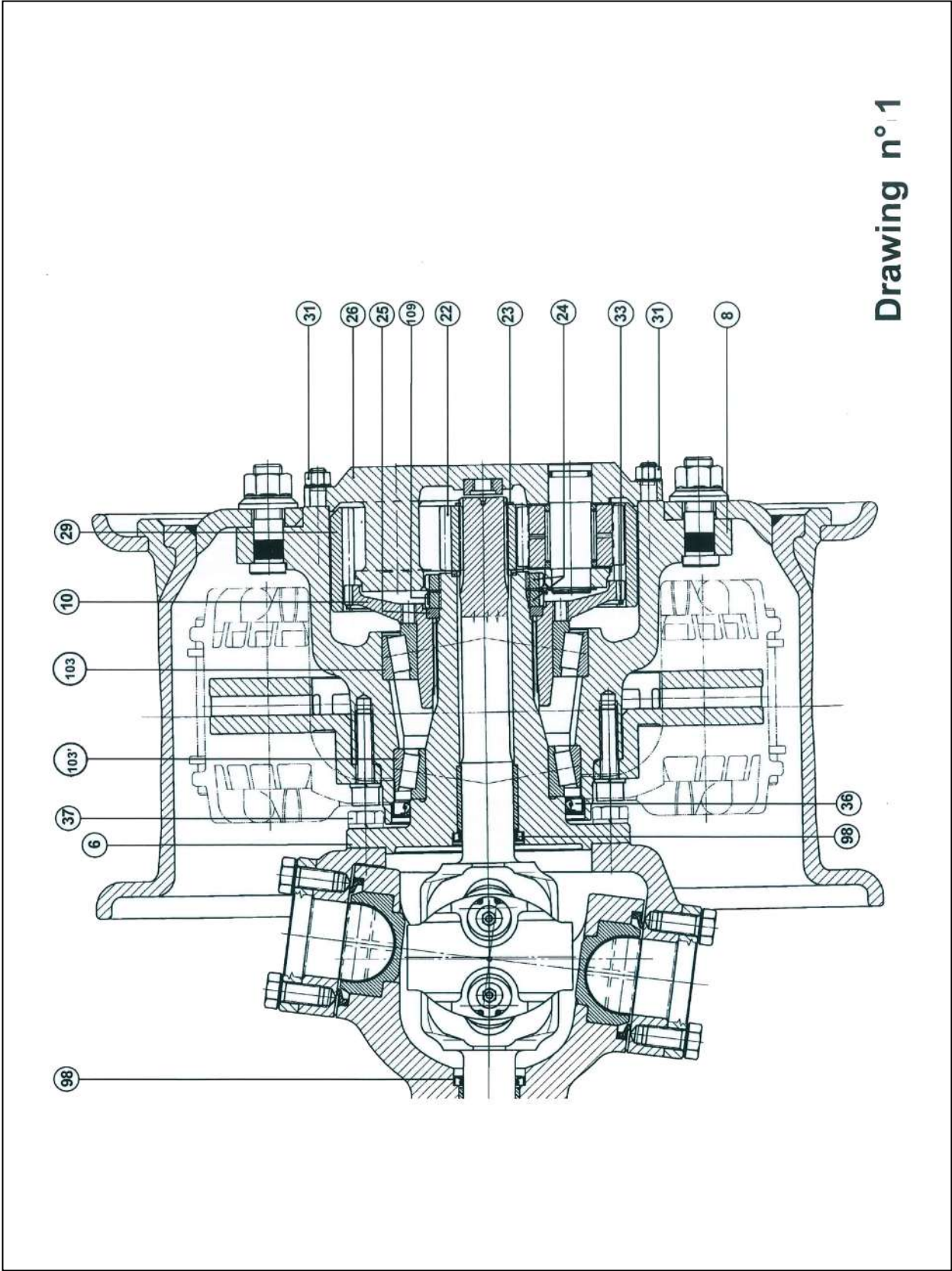


### (REAR RIGID AXLE)

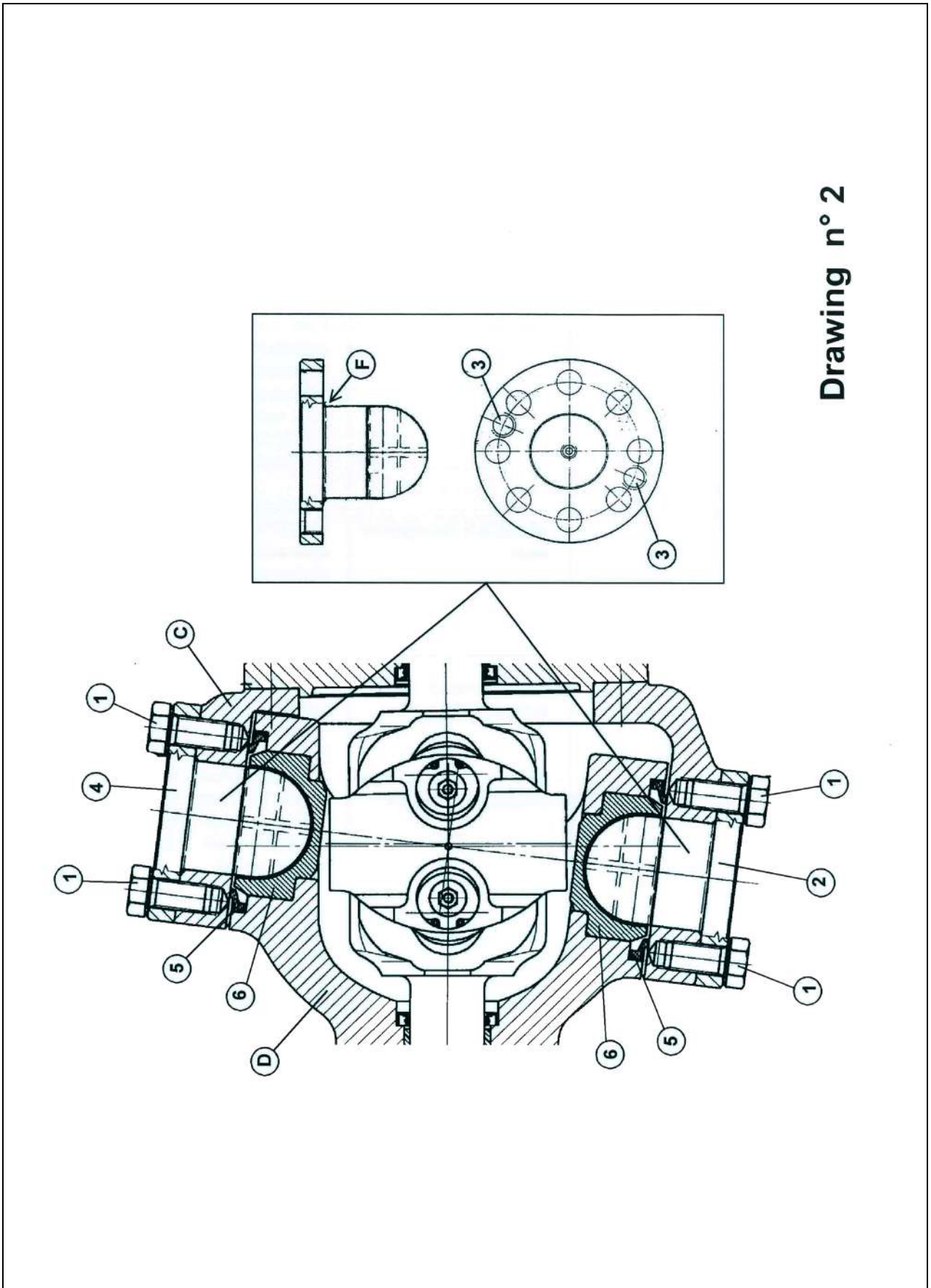


**DIFFERENTIAL AND LOCKING**

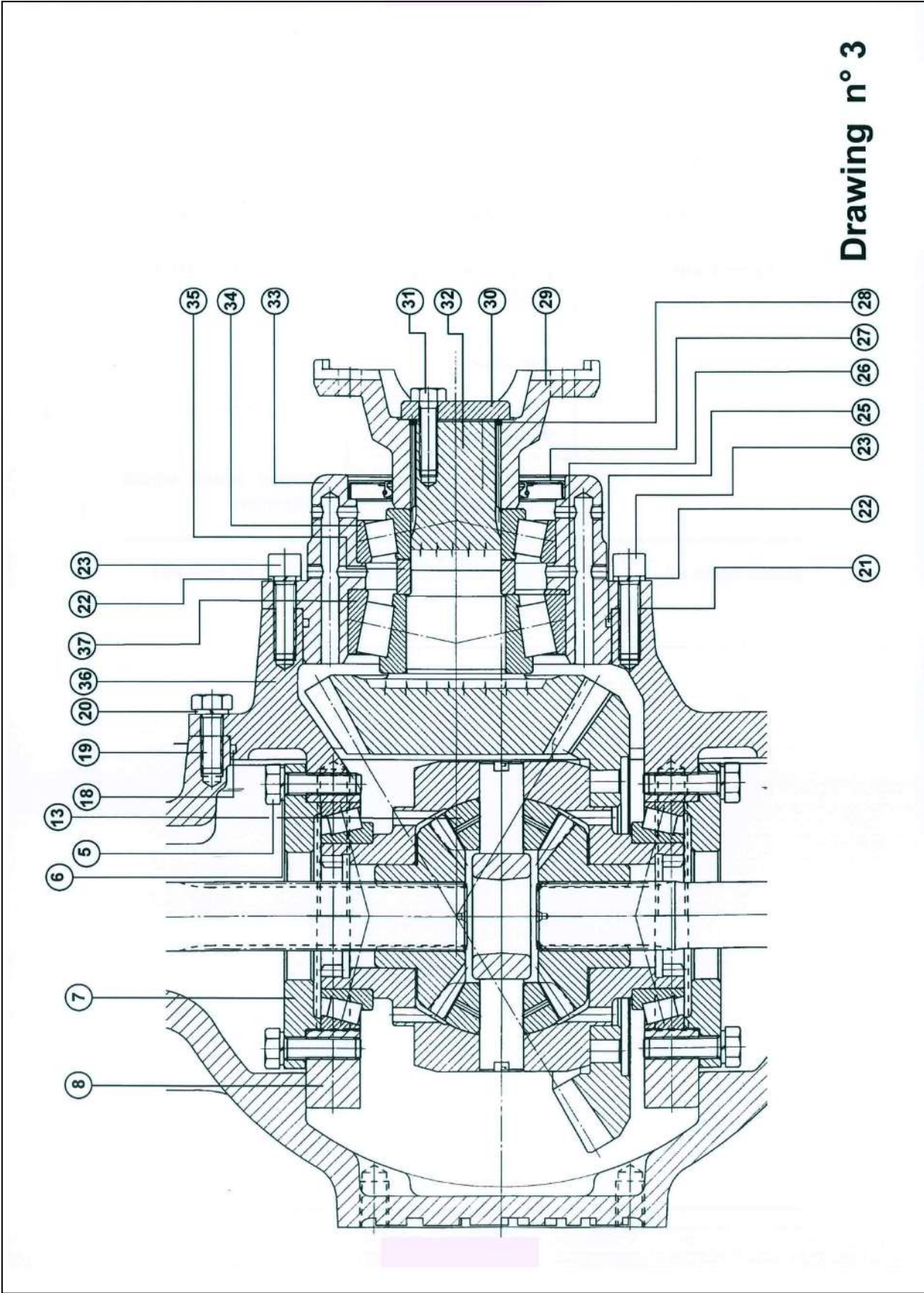




Drawing n° 1



Drawing n° 2



Drawing n° 3

## 7.2 TROUBLE SHOOTING

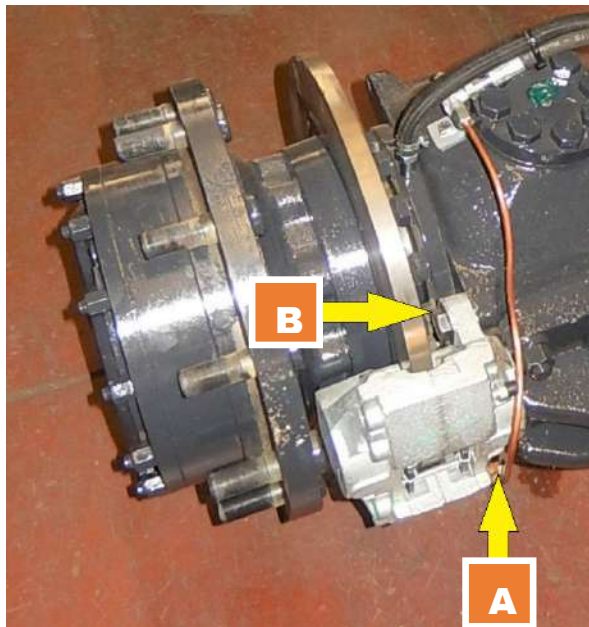
<b>FAULT</b>	<b>CAUSE</b>	<b>REMEDY</b>
<b>Wheel hubs noisy (ref. to drawing 1)</b>	<ul style="list-style-type: none"> <li>• Wheel hub bearing not adjusted</li> <li>• Wheel hub damaged or worn</li> <li>• Fault caused by oil scraper #36</li> </ul>	<ul style="list-style-type: none"> <li>• Make the hub disassembling operation from 1 to 6 (see disassembly procedure) and in the operation 8 loose one of two nuts #24, then proceed with hub assembly starting from operation 15 to 27. Finally restore the proper oil level (operation 29)</li> <li>• Substitute the bearings in the hub #103 #103'</li> <li>• Substitute the oil scraper #36. Disassemble the hub</li> </ul>
<b>Hub oil leak</b>	<ul style="list-style-type: none"> <li>• Oil leak between the hub and planetary holder</li> </ul>	<ul style="list-style-type: none"> <li>• Follow the hub disassembly procedure from 1 to 3. Mount the hub back following instruction from 25 to 27</li> </ul>
<b>Wheel hub oscillation (ref. to drawing 1)</b>	<ul style="list-style-type: none"> <li>• Wheel hub bearings not adjusted</li> </ul>	<ul style="list-style-type: none"> <li>• Disassembly operations from 1 to 6 and in the operation 8. Loose one of two nuts #24, then proceed with hub assembly starting from operation 15 to 27. Finally restore proper oil level (operation 29)</li> </ul>
<b>Wheel oscillation (ref. to drawing 2)</b>	<ul style="list-style-type: none"> <li>• Worn out bronze seat nr. 6</li> <li>• Seats #6 damaged or worn</li> </ul>	<ul style="list-style-type: none"> <li>• Remove thicknesses of position F</li> <li>• Follow all steering joint disassembly and assembly operations and replace the seats #6</li> </ul>
<b>The locking does not engage</b>	<ul style="list-style-type: none"> <li>• The electrovalve does not send oil to the differential locking</li> <li>• Locking sleeve damaged or worn</li> <li>• Locking fork damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Check the electric system electrovalve</li> <li>• Replace the sliding sleeve</li> <li>• Replace the differential locking</li> </ul>
<b>The locking does not disengage</b>	<ul style="list-style-type: none"> <li>• Locking sleeve damaged</li> <li>• Axle shaft is bent</li> </ul>	<ul style="list-style-type: none"> <li>• Replace the sliding sleeve</li> <li>• Replace the axle shaft</li> </ul>
<b>The axle does not draft</b>	<ul style="list-style-type: none"> <li>• Axle shaft damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Replace axle shaft</li> </ul>
<b>Oil leak between axle and joint (ref. to drawing 1)</b>	<ul style="list-style-type: none"> <li>• Inner oil seal #98</li> <li>• Outside oil seal #98</li> </ul>	<ul style="list-style-type: none"> <li>• Follow all the operations of axle shaft disassembly and follow all operations of axle shaft assembly</li> <li>• Follow the operations from 1) to 8) of the steering joint disassembly and follow the operations a), b), c) and d) of axle shaft assembly referred to the spindle side oil seal. Follow all the operations of steering joint assembly.</li> </ul>
<b>Noisy differential</b>	<ul style="list-style-type: none"> <li>• Adjust pinion bearings</li> </ul>	<ul style="list-style-type: none"> <li>• Pinion bearings not adjusted</li> </ul>

# SNOWBLOWER F90

	<ul style="list-style-type: none"><li>• Replace pinion bearings</li><li>• Replace crown bearings</li><li>• Replace crown wheel and pinion</li></ul>	<ul style="list-style-type: none"><li>• Pinion bearings are damaged</li><li>• Crown bearings are damaged</li><li>• Crown wheel and pinion worn</li></ul>
<b>Pinion leaks oil (ref. to drawing 3)</b>	<ul style="list-style-type: none"><li>• Oil seal #27 damaged</li></ul>	<ul style="list-style-type: none"><li>• Relace oil seal #27</li></ul>

### 7.3 PLANETARY GEAR AND WHEEL HUB DISASSEMBLY (REF. TO DWG. 1)

- 1) Drain oil from the planetary gear as indicated in the "Use and maintenance manual";
- 2) Unscrew the nuts #31 (17 mm wrench);
- 3) Remove the whole planetary holder #26;
- 4) Remove with proper pliers the seeger ring #23;
- 5) Draw out the central gear #22;
- 6) With a screwdriver lift the tooth of safety ring #109 from ring nut #24;
- 7) Remove the brake calipers (following picture):
  - a. Remove the line A from both caliper (2 calipers or front and 1 for rear);
  - b. Remove the greasing system pipe;
  - c. Remove screws B (30 mm wrench) and remove the calipers from their support.



- 8) Loose the ring nuts #24 (use the proper tool (3) - see supplied tools);
- 9) Remove the shoulder ring #10.  
(The sprocket wheel #29 will come out as well as the bearing #103,#103');
- 10) Remove the hub #8;
- 11) Remove inner bearing #103,#103';
- 12) Loose the screws #37;
- 13) Draw out the pin #6.

## 7.4 BRAKE DISK DISASSEMBLY

After the removing of the planetary gear and the wheel hub, proceed as follows:

- 1) Place the wheel hub on a bench as shown in figure;



- 2) Unscrew the allen screws fixing the brake by using an allen key (10 mm);
- 3) Remove the brake disk;
- 4) For brake disk assembly, do the same operations in reverse.

## **7.5 PLANETARY GEAR AND WHEEL HUB ASSEMBLY (REF TO DWG. 1)**

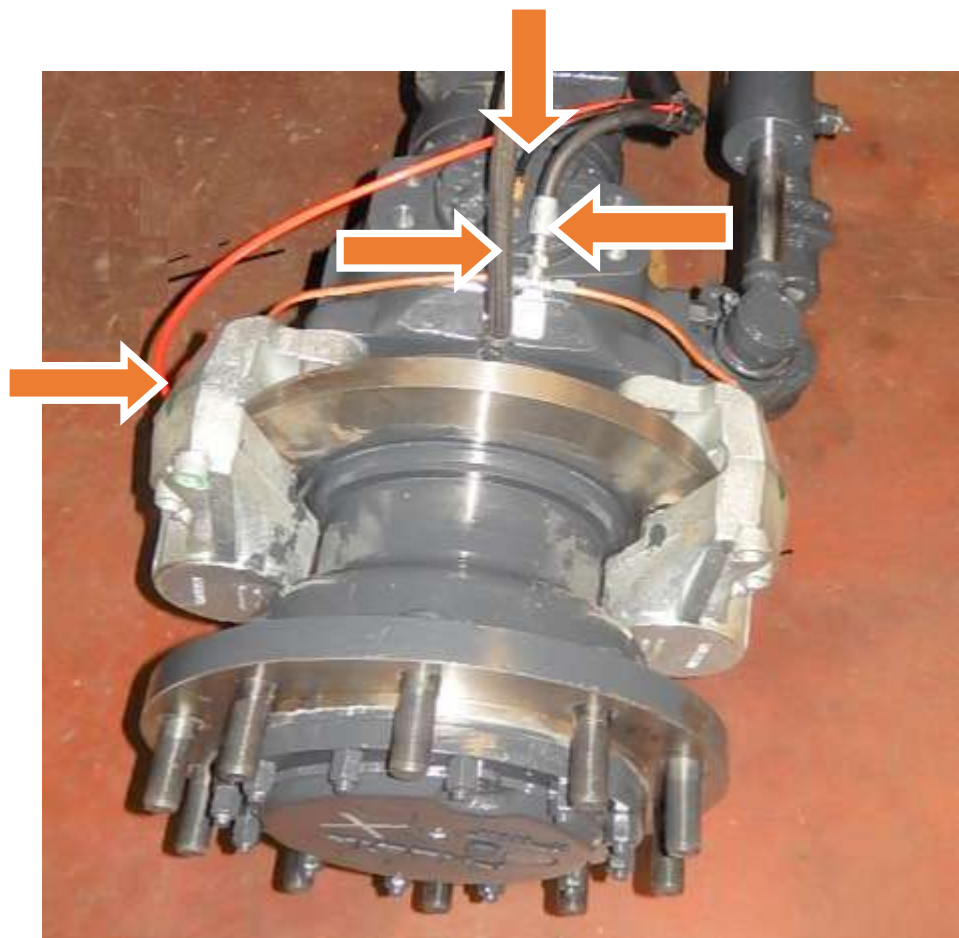
- 1) Place the hub #8 on a bench;
- 2) Insert the outside ring of bearing #103,#103' in the hub;
- 3) Make sure that the ring is tight in its position;
- 4) Turn the hub of 180 degrees.  
Repeat the operation 2) and 3) for the other ring of bearing #103,#103';
- 5) Place the other side of bearing #103,#103' on the internal side of the vehicle.  
(Bringing the inner side of the bearings at about 110 degrees, the assembly of the hub will be facilitate);
- 6) Insert the oil scraper #36. Make sure that it is properly positioned and tight;
- 7) Insert the hub #8 on the spindle #6.
- 8) Be careful not to damage the scraper #36;
- 9) Make sure that the inner bearing ring #103 is properly positioned into the hub;
- 10) Place the sprocket wheel #29 on a bench, with the part with the safety ring to the top;
- 11) Place the sprocket rim #10 in the sprocket wheel #29;
- 12) Place the safety ring #33 on the sprocket wheel #29;
- 13) Heat the inner side of bearing ring #103 up to about 110 degrees Centigrade.  
Mount it on the sprocket rim #10 and make sure it is tight;
- 14) Place the sprocket rim #10 on the pin #6;
- 15) Insert ring #25 between the sprocket rim #10 and the pin #6;
- 16) Place one of the two nuts #24 on the spindle #6 and tighten (use the supplied tool (3), see "supplied tools");
- 17) Make sure it is well adjusted on the sprocket rim #10;
- 18) Tighten the nut again, and repeat the operation 16);
- 19) Test the hub rotation turning it manually.
- 20) At this point loose the nut of 1/8 of a turn;
- 21) Insert the safety ring #109 and fold a ring tooth securing it on the nut #24;
- 22) Put on the thread of the other nut #24 some LOCTITE 510;
- 23) Tighten the nut #24 strongly and fold a tooth of the safety ring #109;

- Place the central pin #22;
- 24) Mount the seeger ring #23 on the axle shaft;
- 25) Clean accurately the hub #8 outside border and put some LOCTITE 510 on it;
- 26) Place the whole planetary gear holder #26 into the sprocket wheel #26;
- 27) Tighten bolts #31 (10 mm allen key);
- 28) Mount the brake calipers;
- 29) Restore the proper oil level as indicated in the Use & maintenance manual.

## 7.6 STEERING JOINT DISASSEMBLY (REF. TO DWG. 2 only for front axle)

**DISINSTALL STEERING CYLINDER (IN LEFT SIDE) AS INDICATED IN STEERING SECTION**

- 1) Follow the planetary gear and wheel hub disassembly instructions from points 1 to 5;
- 2) Remove the flexible hose braking and greasing systems;



- 3) Remove the screws #1 above and beneath the steering joint (24 mm wrench);
- 4) Take pin #2 out through the two thread holes #3;
- 5) Take pin #4 out through the thread holes #3;
- 6) Slide the whole hub/joint part C, taking care that the axle does not go out of the axle case;
- 7) Remove gaskets #5;
- 8) Remove seat #6.

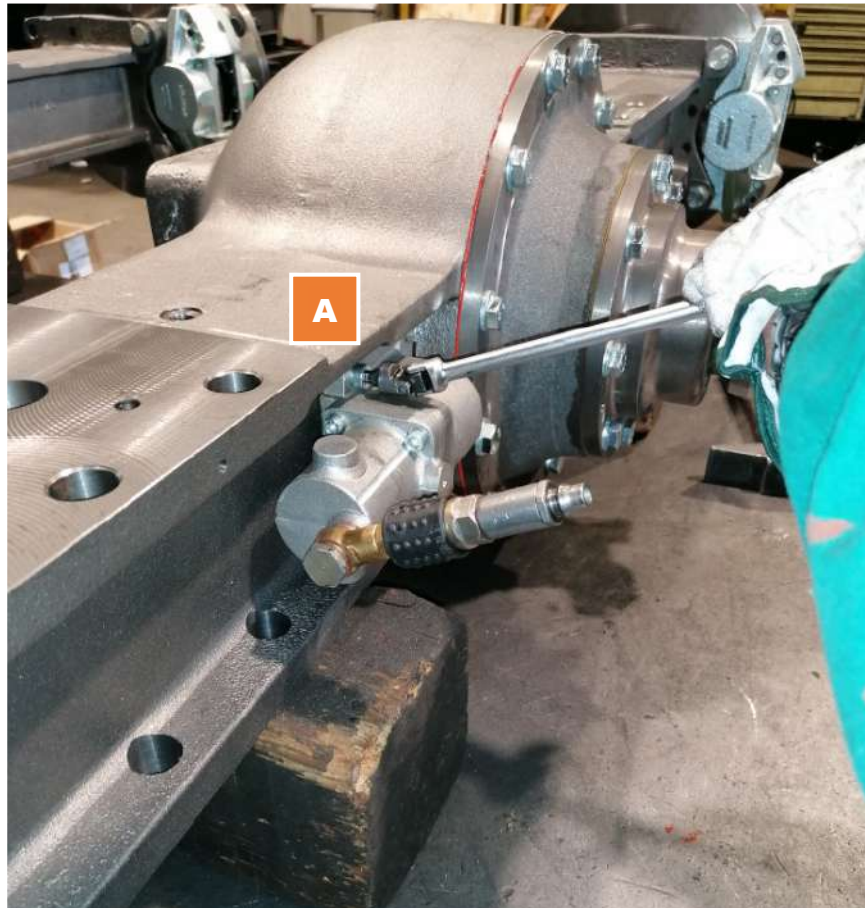
## 7.7 STEERING JOINT ASSEMBLY (REF TO DWG. 2)

Insert the seats #6 on joint D;

- 1) Place gasket #5;
- 2) Bring the joint support C in position on joint D, pulling the axle shaft inside the hub, taking care of not breaking the outside oil seal #98;
- 3) Insert pins #2 and #4.
- 4) Fix pins with the four screws #1;
- 5) Check with a lever that the joint support and the joint have no play;
- 6) Should any play be found, add spacers at pins #2 and #4 (add spacers in position F).
- 7) To insert the spacers, make the operations described at points 4) and 5) of the steering joint disassembly instructions; When no play is left, turn the joint manually.
- 8) The rotation must be done with some difficulty;
- 9) Tighten the screws #1 (24 mm wrench).
- 10) Place the central gear #22 (DWG.1);
- 11) Mount the seeger ring #23 on the axle shaft (DWG.1);
- 12) Clean accurately the hub #8 outside border and put some LOCTITE 510 on it;
- 13) Place the whole planetary gear holder #26 into the sprocket wheel #29 (DWG.1);
- 14) Tighten screws #31 (DWG.1);
- 15) Restore proper oil level as indicated in "Operating, Maintenance and Service Manual".
- 16) Reinstall the flexible hose from braking and greasing system;
- 17) Bleed the service brake as shown in the "Brake System repair section".

## 7.8 DIFFERENTIAL LOCK DISASSEMBLY

- 1) Remove the air pipe from differential lock;
- 2) Loose the allen screws A (6 mm allen key);



- 3) Pull the differential lock out as shown;

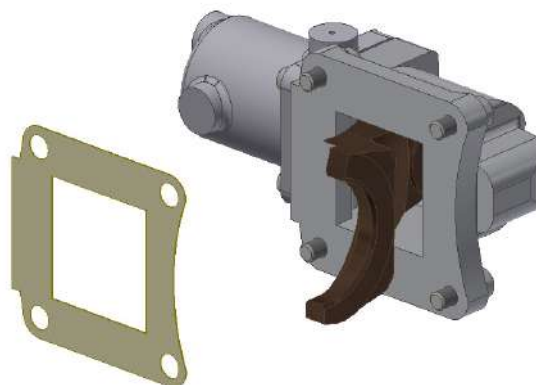


## 7.9 DIFFERENTIAL LOCK ASSEMBLY

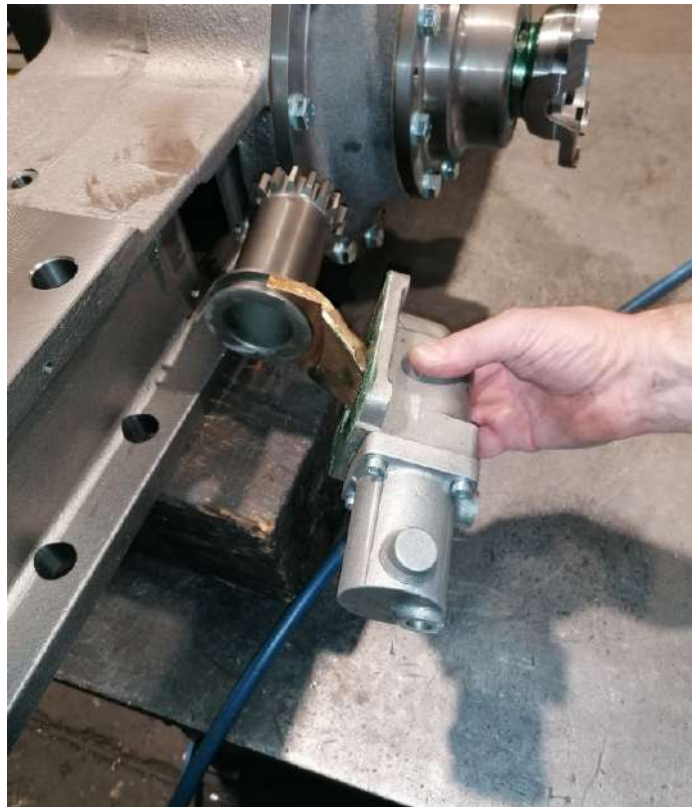
- 1) The parts necessary for the assembly are listed below:
  - a) differential lock body;
  - b) seals KIT;
  - c) screws;
  - d) grease NLGI3;
  - e) wrench;



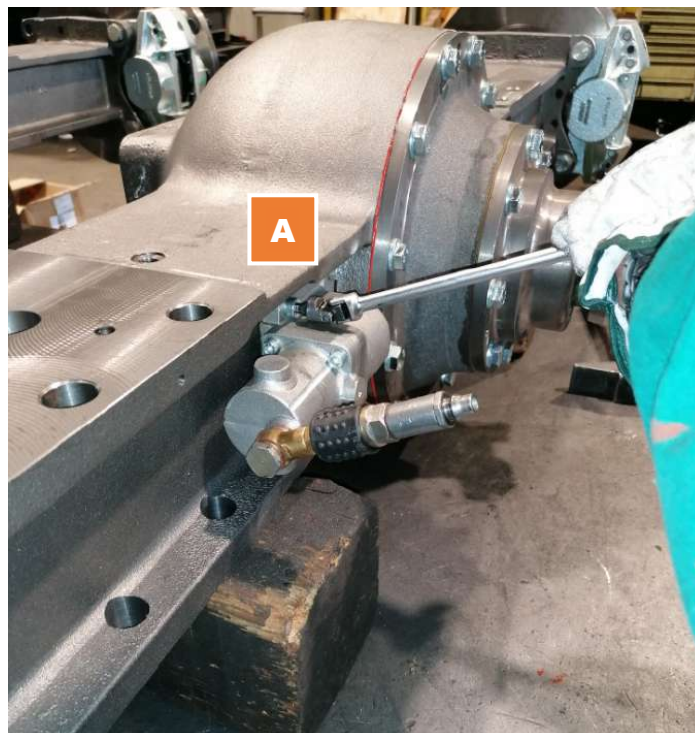
- 2) Spread some greese on the bottom surface where you are going to place the differential lock;
- 3) Put the seal around the differential lock;



- 4) Position the differential lock body checking that the locking devicefork enter the groove in the sliding sleeve;



- 5) Tighten the differential lock screws A (n° 4 screws – 6 mm wrench) on the axle.

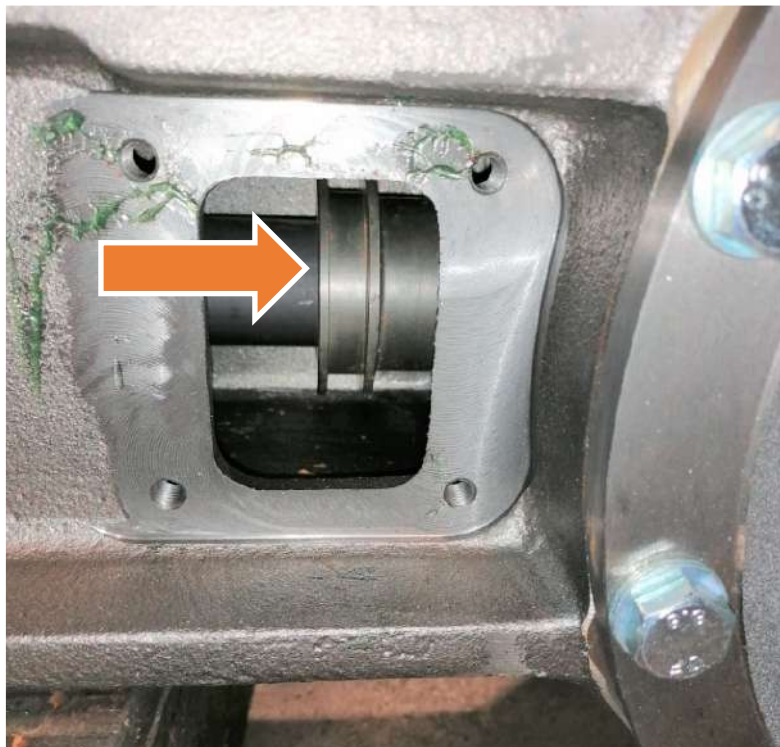


## 7.10 AXLE SHAFT REPLACEMENT

- 1) (Only for front axle) remove the steering joint
- 2) When replacing the axle shaft on differential lock side, remove the differential lock
- 3) Pull the axle shaft out taking care of removing all axle shaft parts from inside the axle;
- 4) Slide the axle shaft



**WARNING!:** When replacing the axle shaft on the differential lock side the locking collar must be pushed into the differential box through the opening as in figure.



- 5) Mount the steering joint back. If it has been replaced the axle shaft on differential lock side

### 7.11 DISASSEMBLY OF DIFFERENTIAL FROM AXLE

- 1) Pull both axle shafts out
- 2) Take the propeller shaft away from axle;
- 3) Loose the screws A (19 mm wrench) in figure;



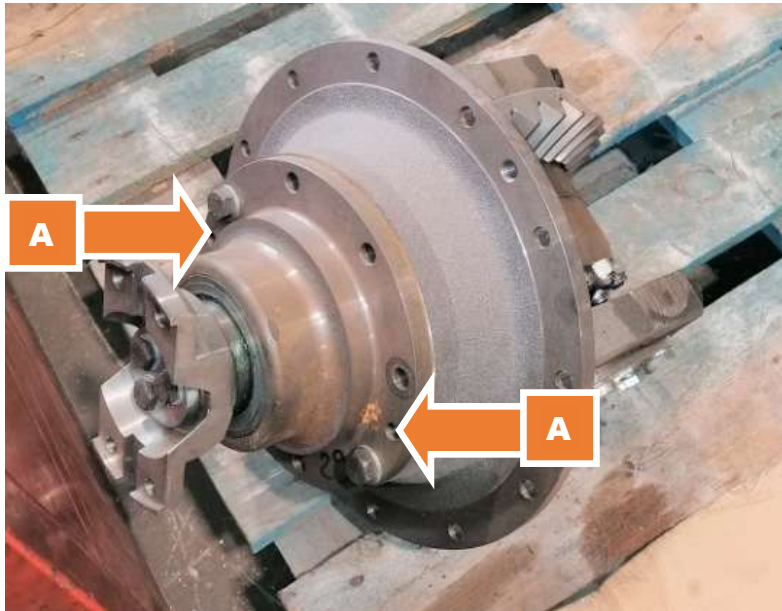
- 4) Pull the differential box out from axle.

### 7.12 ASSEMBLY OF DIFFERENTIAL ON AXLE

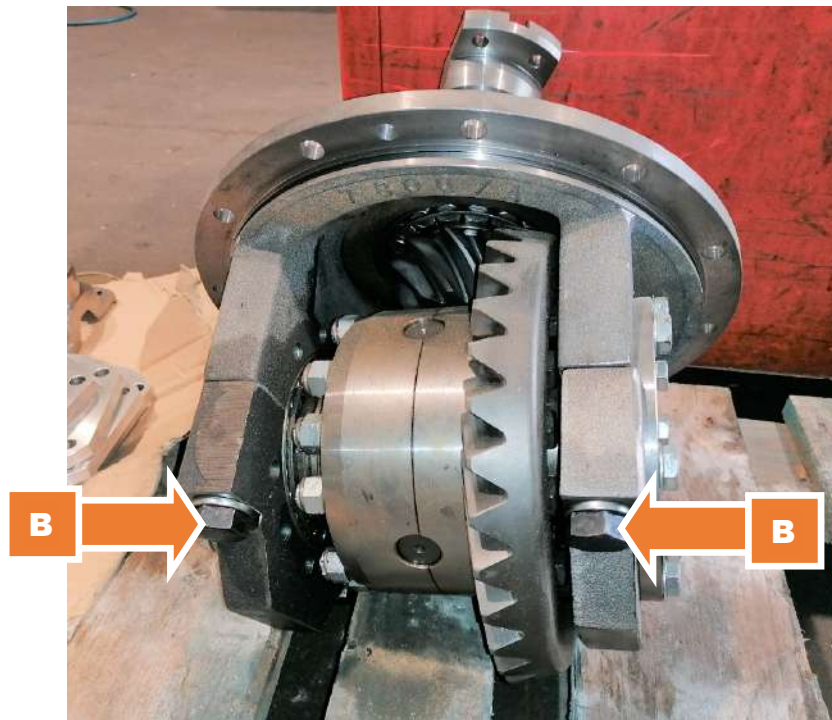
- 1) Place the differential box on axle;
- 2) Tighten screws A (19 mm wrench) as shown in previous figure;
- 3) Assembly the axle shafts;
- 4) Place the propeller shaft back on the axle.

## 7.13 DIFFERENTIAL BODY DISASSEMBLY (Drawing n° 3)

- 1) Put the differential body on a working table;
- 2) Remove the screws #31 (16 mm wrench);
- 3) Take the flange #29 out;
- 4) Remove screws #23 (19 mm wrench);
- 5) Insert two screws into the holes A (following figure) to pull the pinion group out;



- 6) Place the pinion body on a large tube with the pinion point facing downwards. With a hammer strike gently and repeatedly on the pinion to push it out;
- 7) Remove the oil seal #27;
- 8) With proper tool, remove the bearing #34;
- 9) Turn the pinion support and remove the bearing #37 (use proper tool);
- 10) Remove the O-ring #25;
- 11) Put the differential on a working table with the clamping side of the pinion body facing downwards;
- 12) Remove the screws #5 (18 mm wrench) from both flanges #7;
- 13) Remove the 4 screws B (27 mm wrench);



- 14) With a rubber hammer, strike gently on the two clamps #8 and take them out;
- 15) Remove the two covers #7;
- 16) Pull the differential crown part out;
- 17) Place the differential crown part on a working table with the crown facing upwards;
- 18) Remove the screws fixing the crown on internal differential (19 mm wrench);
- 19) Remove the crown from the differential.

#### 7.14 DIFFERENTIAL BODY ASSEMBLY (Drawing n° 3)

- 1) Clean accurately the pinion support #33;
- 2) Place the pinion support on a table with the large bearing hole facing upwards;
- 3) Insert with a striker the outside ring of bearing #37 into the pinion support. Check that it is well positioned;
- 4) Turn the pinion support of 180 degrees and insert with a striker the outside ring of bearing #34 into the pinion support checking that it is well positioned;
- 5) Place the pinion #32 on a working table with the shaft facing upwards;

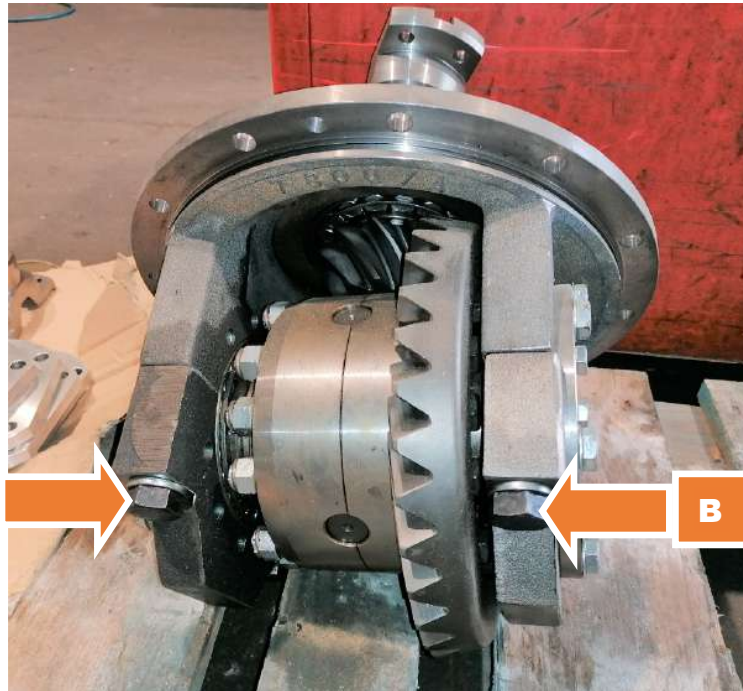
- 6) Heat with proper device the inner ring of bearing #37 at 110 degrees centigrade. Insert it into the pinion and check it is well positioned;
- 7) Insert the pinion support #33 on the pinion #32;
- 8) Place 0,2 mm of adjusting shims #26;
- 9) Place the spacer #35;
- 10) Heat with proper device the inner ring of bearing #34. Insert it into the pinion and check it is well positioned against the spacer #35;
- 11) Mount the flange #29;
- 12) Place the cover #30 on the flange and tie the three screws #31;
- 13) Place this group into a vice with alu calipers;
- 14) Place a comparator on the flange and move the flange with a lever.
- 15) The comparator should mark a play of 0,1 to 0,3 mm.
- 16) Should the play range be less or more than this value, add/remove adjusting shims #26;

**EXAMPLE!: Comparator signs 0,005 mm of play. Add shims #26 for a thickness of 0,05 to 0,25 mm.**

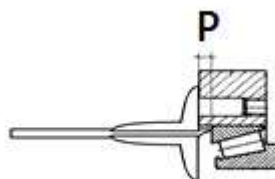
**NOTE!: It is advisable to always add shims to reach the medium tolerance (in the example above therefore it is advisable to add 0,15 mm of thickness).**

- 17) If the play registered is not correct, remove the screws #31, remove the cover #30 and flange #29.
- 18) Then pull out the inner ring of bearing #34, the spacer #35 and then add or remove the shims;
- 19) When the play registered is correct, remove the screws #31, remove the cover #30 and flange #29;
- 20) Insert on the crown holder the oil seal #27 and grease it on the borders;
- 21) Insert the flange #29;
- 22) Grease and insert the O-ring #28;
- 23) Insert the cover #30 and tighten the screws #31 (16 mm wrench);
- 24) Grease and insert the O-ring #25 in its place;
- 25) Put the differential on a working table with the crown attachment facing upwards;
- 26) Insert the crown on the differential and tighten the fixing screws (19 mm wrench);
- 27) Heat with proper device the inner ring of bearing #9 at 110 degrees centigrade. Insert it in the differential checking that it is well positioned;
- 28) Turn the crown differential group of 180 degrees and repeat the operation 27) for the other bearing;

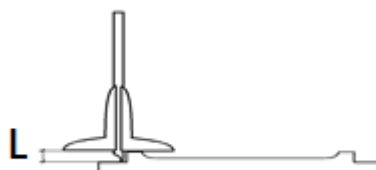
- 29) Place the differential support #36 on a working table leaning on the pinion attachment side;
- 30) Insert the outside rings #9 on bearings #9;
- 31) Place the crown differential group - bearings in its proper support;
- 32) Insert the clamps #8 on the bearings;
- 33) Tighten the four screws B (27 mm wrench);



- 34) Measure with a depth gage the distance between the point where the cover #7 touches the clamp #8 and the bearing #9. Note this measure, that will be named as P);

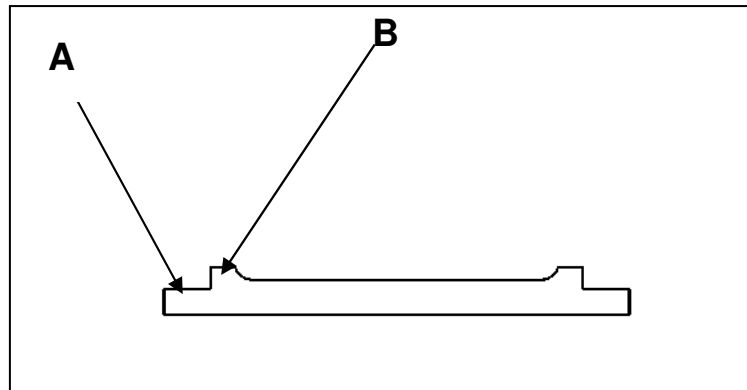


- 35) Measure with a depth gage the thickness of the cover #7 stop. Note this measure that will be named as L;



- 36) Calculate the difference between these two measures (P - L) which will be named as X;

If the resulting X value is negative, adjusting shims will be placed on the surface A of cover #7 for a total value equal to X.

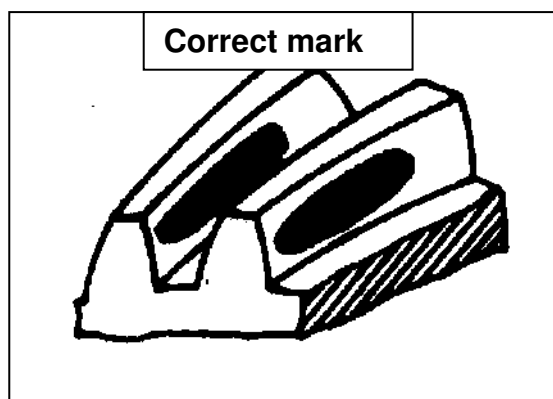


If the resulting X value is positive, adjusting shims will be placed on the surface B of cover #7 (Pict. 2.18) for a total value equal to X.

- 37) Repeat the operations 34), 35) and 36) for the other cover;
- 38) Insert the pinion group (pre-assembled) into its seal and tighten the screws #23;
- 39) Examination of the contact print:

Instructions:

Spread some dark blue on the crown teeth, then turn the crown more times onward and backward. The contact is correct if the mark on the teeth is similar to that shown;



It is important to consider this examination in two aspects:

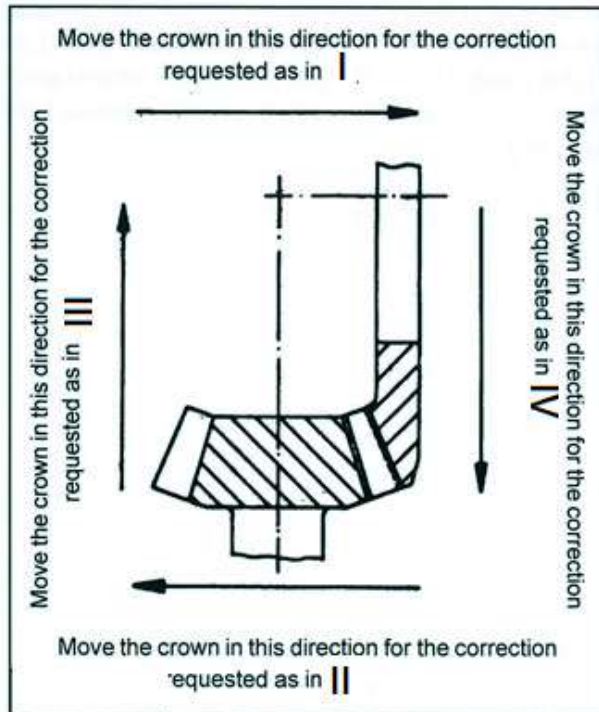
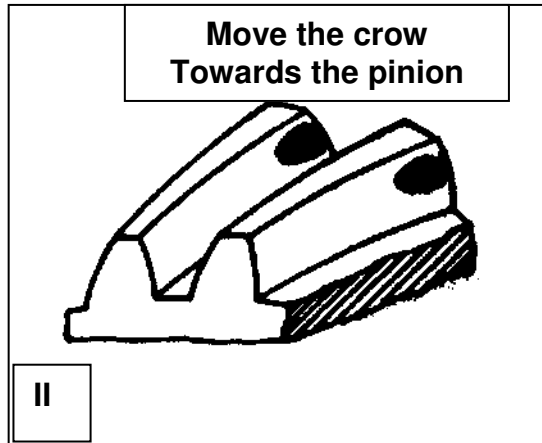
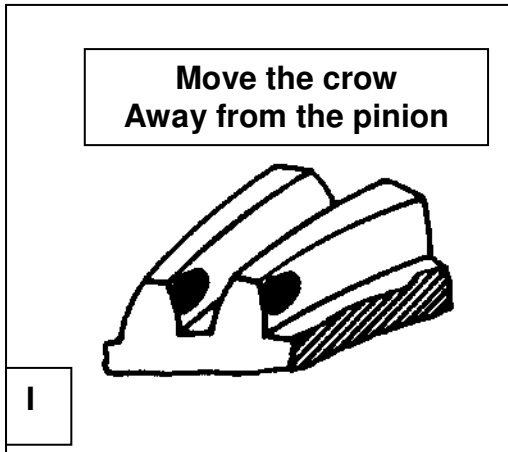
- Look at length of the mark.
- Look at the mark position in tooth height (profile mark).

The two aspects must be considered separately.

The length of mark relates to the crown movements and the profile mark relates to the pinion movements.

Length of mark:

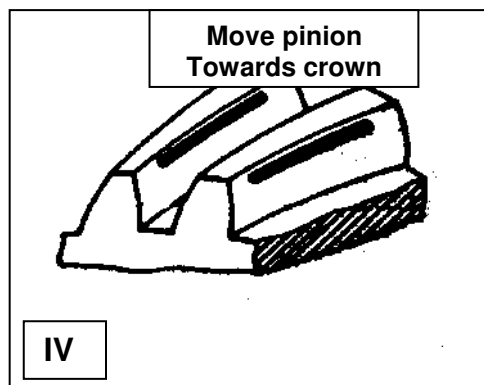
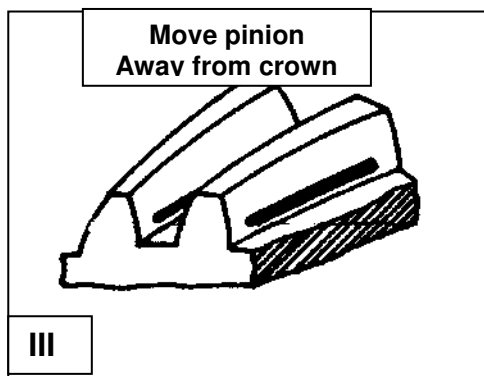
If the contact is as shown in Pict. I and Pict. II, you should act as follows.



To move the crown from one side to the other, it is necessary to place some shims on the cover #7 surface B then repeat on the opposite side the same operations 34), 35) and 36).

Profile mark:

If the contact mark is as that shown in Pict. III and Pict. IV, it is necessary to move the pinion as indicated above.



To move the pinion backwards, remove screws #23 (19 mm wrench) and place shims on the pinion holder bearing surface #33 and on the differential support #36.

To move the pinion onwards, disassemble the pinion holder group as indicated before, and place shims between pinion #32 and bearing #37;

- 40) After checking the crown teeth mark, check with a comparator that the play between pinion and crown is between 0,2 and 0,3 mm. If this is not the case, it means that the crown wheel and the pinion group is not correctly regulated, and it needs to be adjusted as before by repeating the operation 39);
- 41) Grease and insert the O-ring #18 in its seat on the differential support.

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

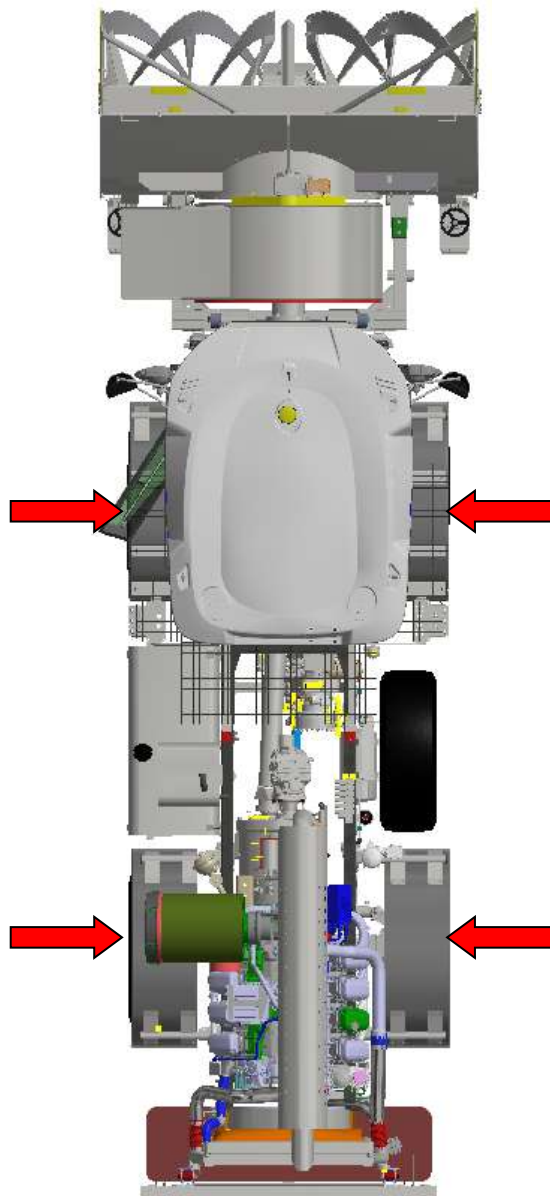
Intervention type: **WHEEL HUBS OIL LEVEL CHECK**

**AXLES**

Periodicity: **BEFORE STARTING**

Required time: **30 minutes**

Action points:



**Requested spare parts:**

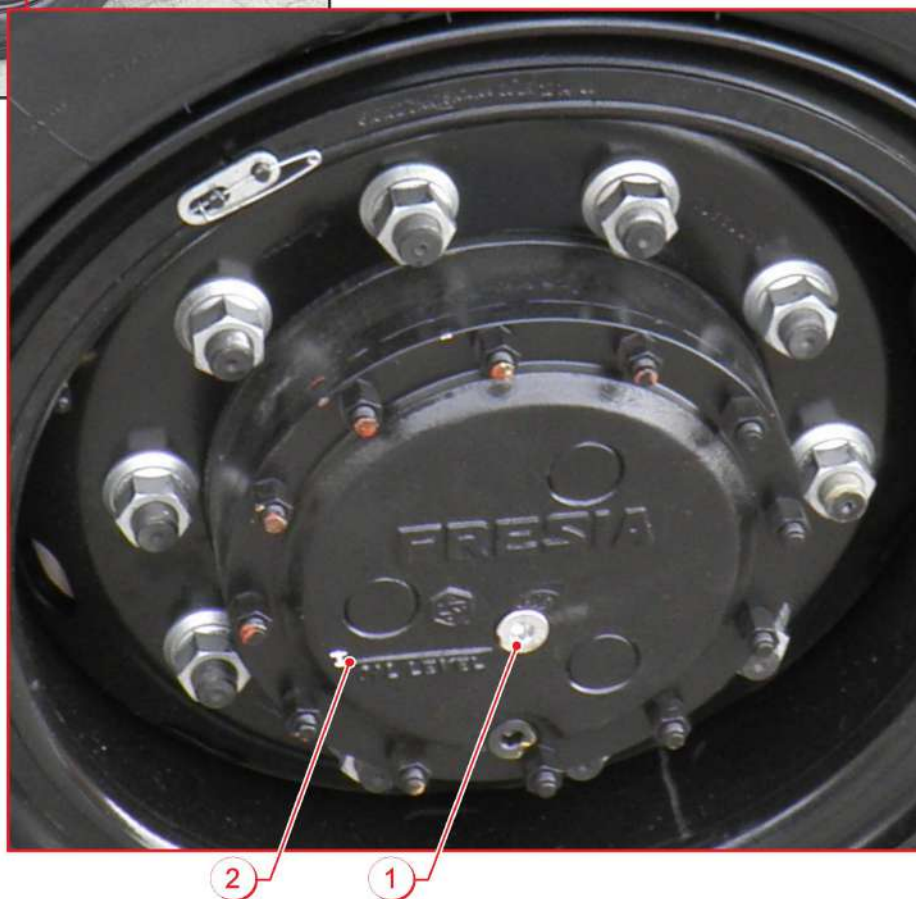
- Oil type TUTELA W90/M-DA or equivalent.

**Specific tools:**

PROCEDURE:



**WARNING:**  
*People operating on vehicle must wear protective clothes according to the regulations in force.*



- a) Unscrew the plug (1) and check that the oil reaches "OIL LEVEL"(2).
- b) If the level is low, fill oil through the opening (1).
- c) Screw back the plug (1).
- d) Repeat the operation for each hub.



**WARNING:**  
*Do not overfill!*



**WARNING:**  
*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

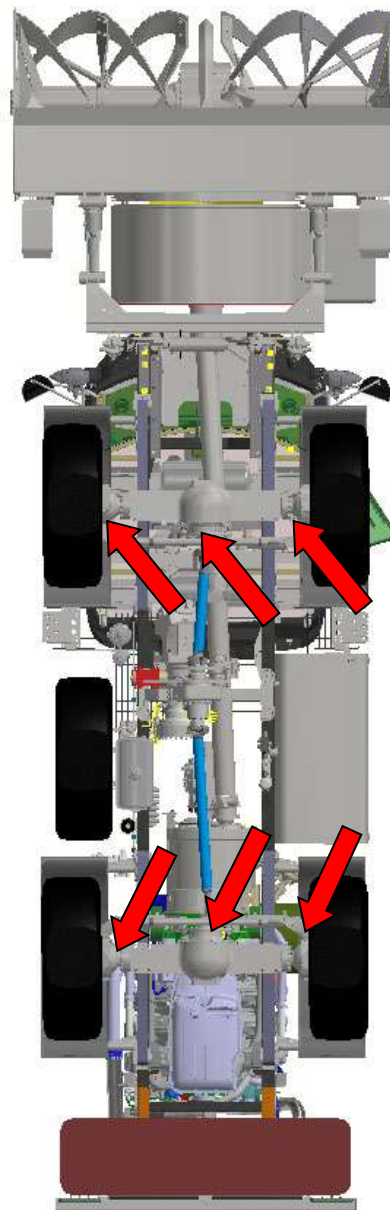
Vehicle type **SNOWBLOWER** Model: **F90**

Intervention type: **DIFFERENTIAL OIL CHECK AND STEERING HEAD GREASING**

**AXLES**

Periodicity: **BEFORE STARTING** Required time **20 minutes**

Action points:



**Requested spare parts:**

- Oil type TUTELA W90/M-DA or equivalent.

**Specific tools:**

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Drive the vehicle on an inspection pit.
- b) Unscrew the plug (1) and check that the level reaches the lower part of the opening.
- c) If it is necessary, refill.
- d) Screw back the plug (1).

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATIONFLUIDIC  
INSPECTION

Vehicle type

SNOWBLOWER

Model:

F90

Intervention type:

AXLE ARTICULATIONS, STEERING CYLINDER, SHACKLE BAR AND TRANSMISSION  
SHAFTS LUBRICATION (ONLY WHERE NOT PRESENT AUTOMATIC GREASING SYSTEM)**AXLES**

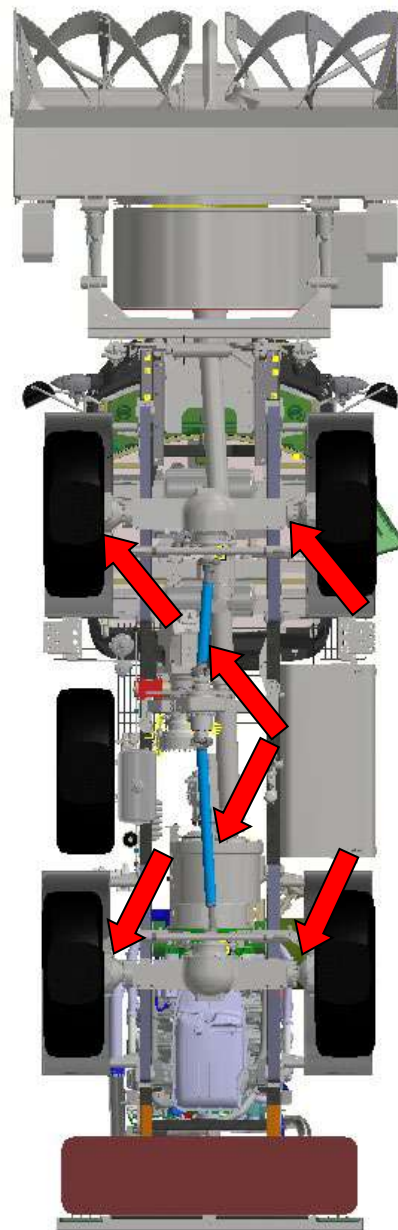
Periodicity:

BEFORE STARTING

Required time

10 minutes

Action points:



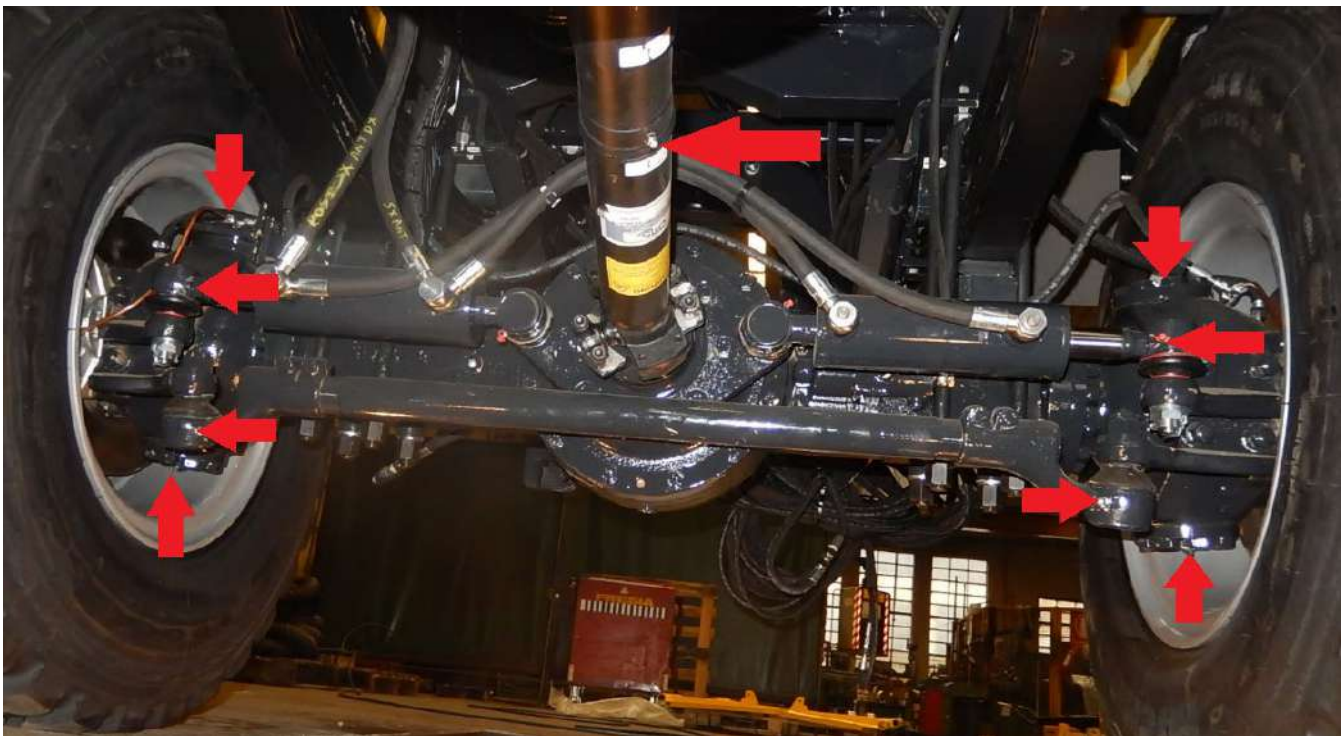
Requested spare parts:

Specific tools:

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



**NOTE:**

*Inject grease into the grease fittings on steering cylinders and coupling bar (2)(4 grease fittings each axle) and in steering articulation (3) (nr.6 grease fittings each axle) and transmission shafts (n.1 fitting for each).*

<input type="checkbox"/>	ELECTRIC	<input type="checkbox"/>	MECHANIC	<input checked="" type="checkbox"/>	FLUIDIC
<input type="checkbox"/>	CLEANING	<input type="checkbox"/>	LUBRICATION	<input type="checkbox"/>	INSPECTION

**Vehicle type:** SNOWBLOWER

**Model:** F90

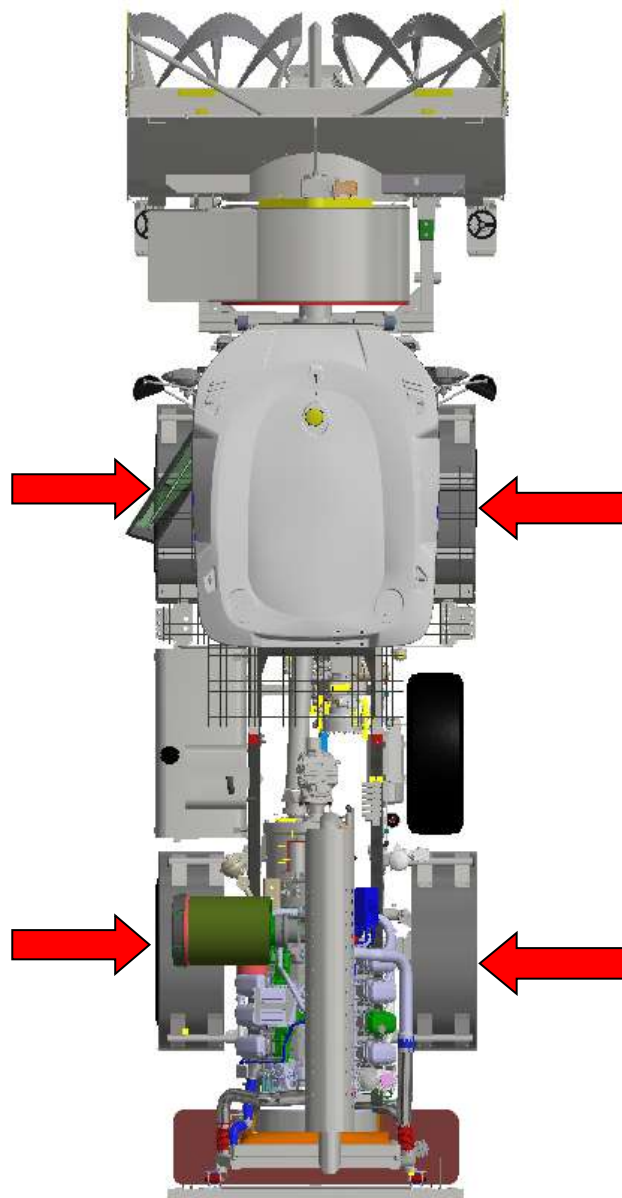
**Intervention type:** HUBS OIL REPLACEMENT

**AXLES**

**Periodicity:** BEFORE STARTING THE WORK SEASON

**Required time:** 60 minutes

**Action points:**



**Requested spare parts:**

- Oil type TUTELA W90/M-DA or equivalent.
- Seals for plugs (1) and (2) code R0082099

**Specific tools:**

## PROCEDURE:

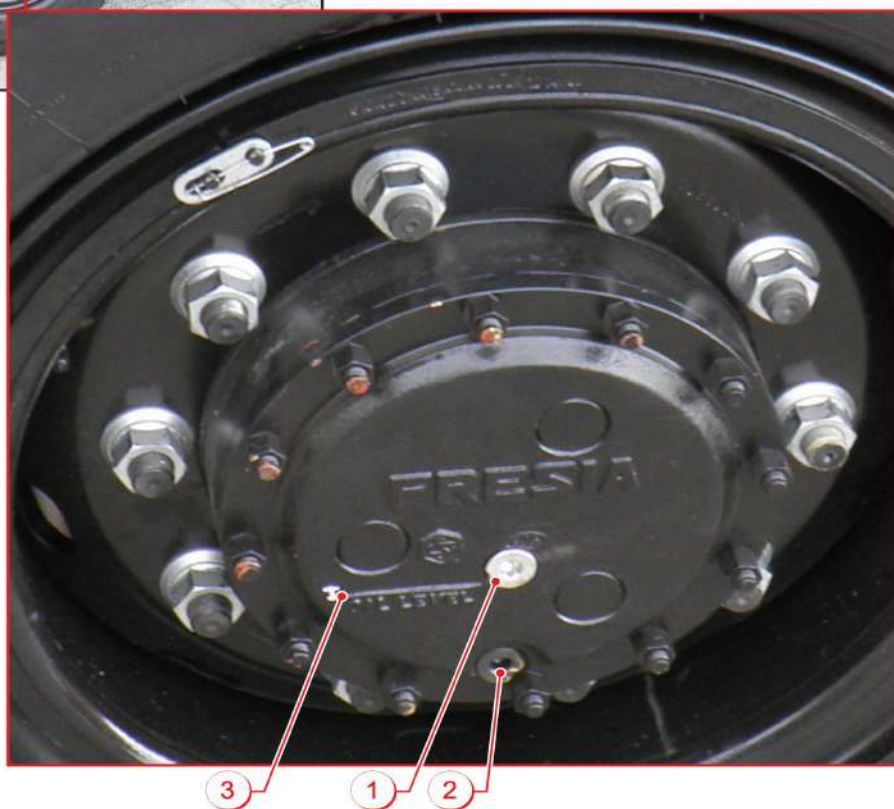


*People operating on vehicle must wear protective clothes according to the regulations in force*



### NOTE:

*It is suggested to do the operation with warm oil to make its flowing out easier.*



- Move the vehicle to have the hub in position like in picture.
- Put a container under hub.
- Unscrew plugs (1) and (2) and let all the oil flowing out.
- Screw back the plug (2) (replace plug (2) gasket).
- Fill the hub with new oil through the opening (1) till it reaches "OIL LEVEL"(3). The filling should be done slowly to allow the oil to penetrate into the gears.
- Screw back the plug (1) (replace (1) gasket).



### WARNING:

*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING

MECHANIC  
LUBRICATION

FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

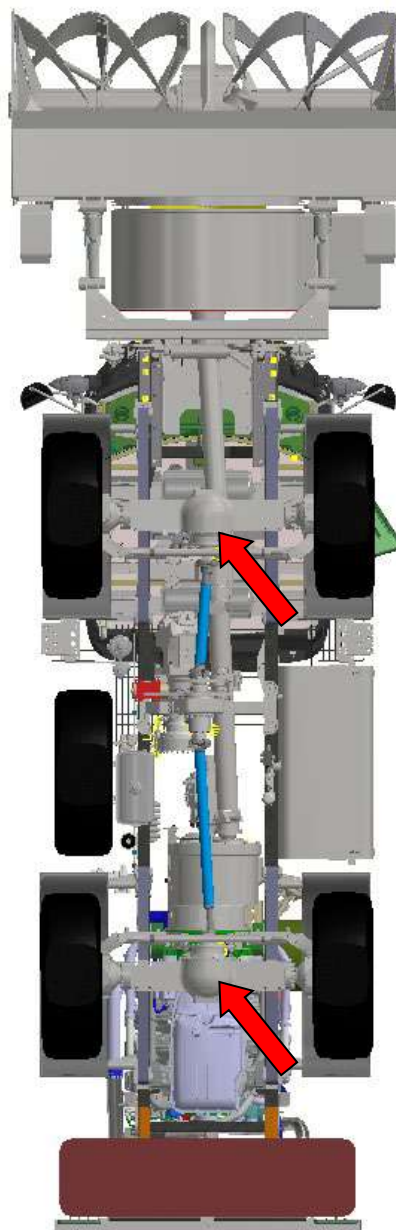
Intervention type: **DIFFERENTIAL OIL REPLACEMENT**

**AXLES**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Time required: **60 minutes**

Action points:



**Requested spare parts:**

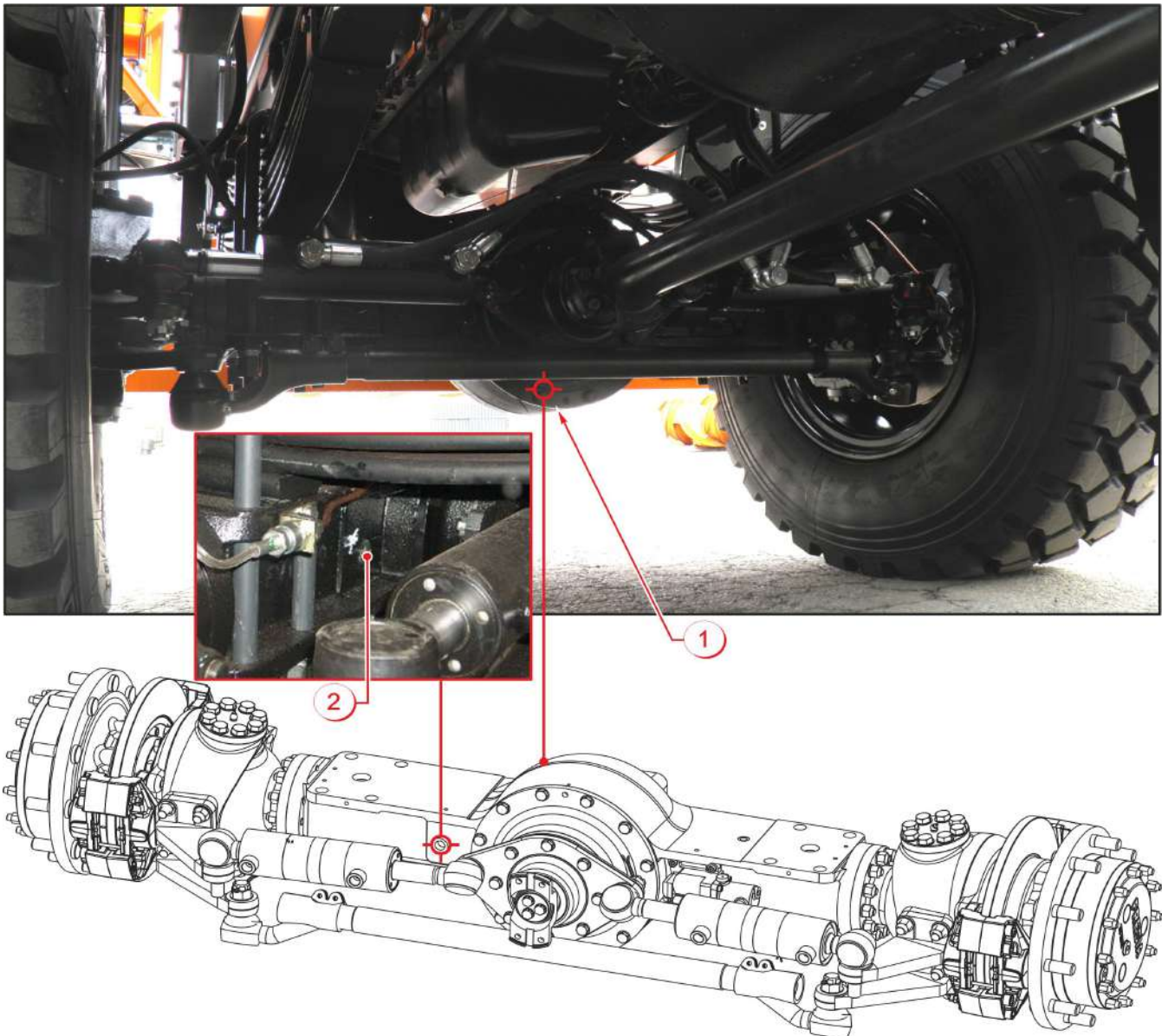
- Oil type TUTELA W90/M-DA or equivalent.
- Plug gaskets (1) and (2) code R0082099

**Specific tools:**

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Move the vehicle over an inspection pit.
- b) Put a container under the differential.
- c) Unscrew the plug (1) and let the oil flows out.
- d) Screw back the plug (1) (replace the gasket (1)).
- e) Fill new oil through the opening (2) until it reaches the lower part of the opening (replace gasket (2));
- f) Screw back plug (2).

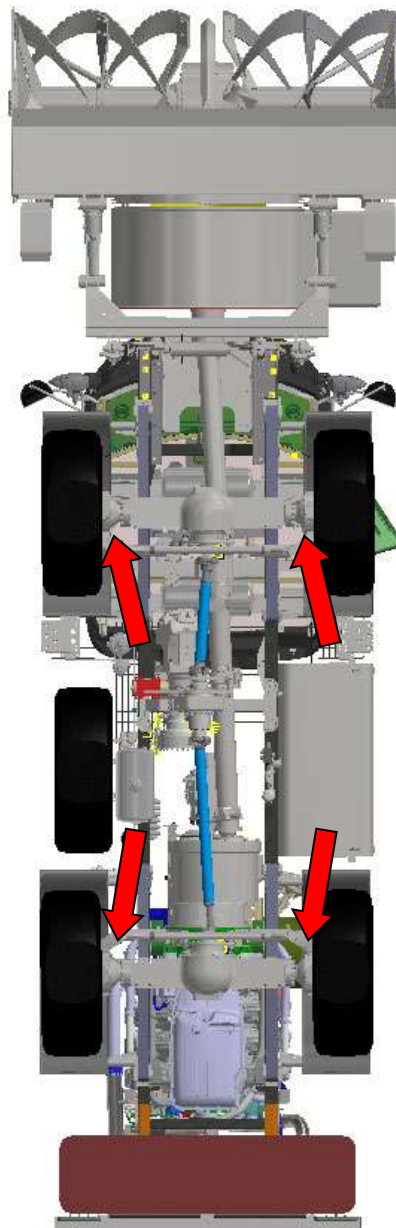


**WARNING:**

*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATIONFLUIDIC  
INSPECTIONVehicle type: **SNOWBLOWER**Model: **F90**Intervention type: **CHECK THE STEERING HEADS AND SHACKLE BAR HEADS CLEARANCE****AXLES**Periodicity: **BEFORE STARTING THE WORK SEASON**Required time: **20 minutes**

Action points:



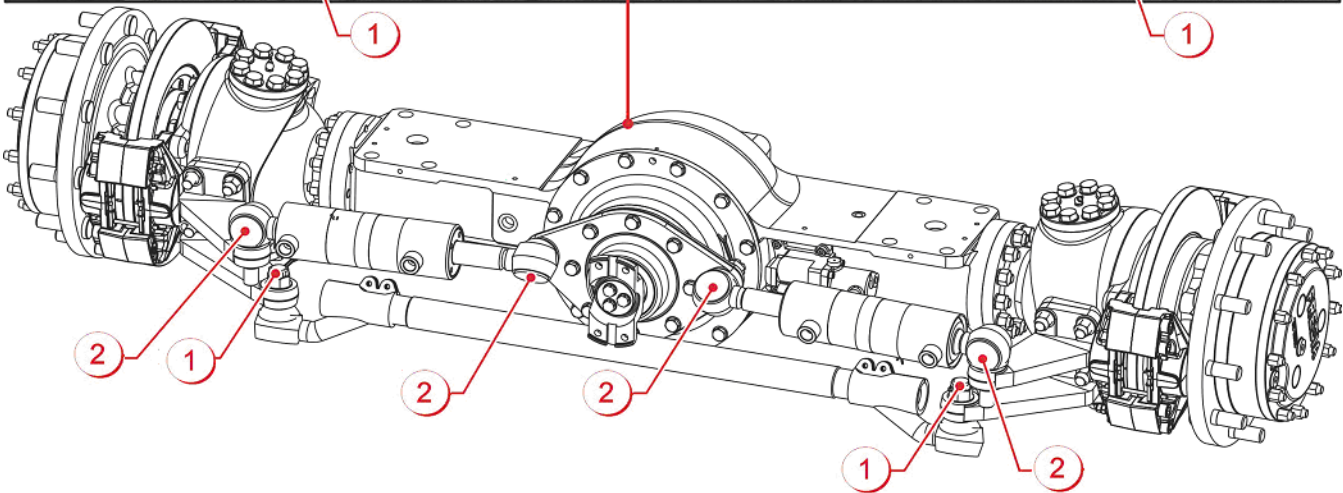
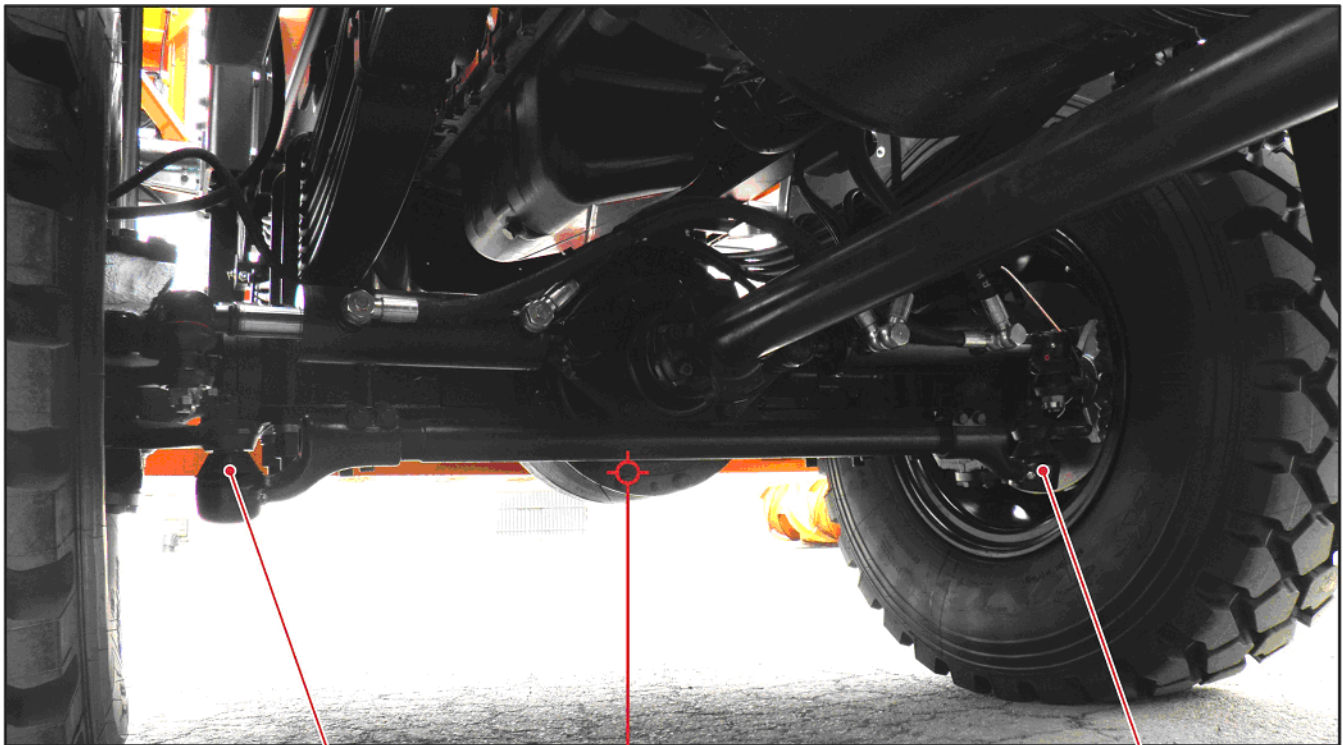
Requested spare parts:

Specific tools:

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Check the coupling bar heads (1), and the heads of steering cylinders (2) have no gaps.
- b) If it is necessary, replace them.

**SECTION 9  
SUSPENSIONS REPAIR**

## **9.1 GENERALITY**

Parabolic suspensions front and rear with shock absorbers.

The leaf springs are connected at the extremity to the supports on chassis.

**9.2 TROUBLE SHOOTING**

<b>PROBLEM</b>	<b>CAUSE</b>	<b>REMEDY</b>
<b>Noisy in the suspension</b>	<ul style="list-style-type: none"><li>• broken leaf spring</li><li>• low lubrication</li><li>• broken U bolts</li></ul>	<ul style="list-style-type: none"><li>• replace the leaf spring</li><li>• verify the lubrication</li><li>• replace U bolt</li></ul>
<b>Stiffness in the suspension</b>	<ul style="list-style-type: none"><li>• low lubrication</li></ul>	<ul style="list-style-type: none"><li>• verify the lubrication</li><li>•</li></ul>
<b>Excessive flexibility</b>	<ul style="list-style-type: none"><li>• enervation or break of the leaf spring</li><li>• damaged shock absorber</li></ul>	<ul style="list-style-type: none"><li>• replace the leaf spring</li><li>• replace the shock absorber</li></ul>

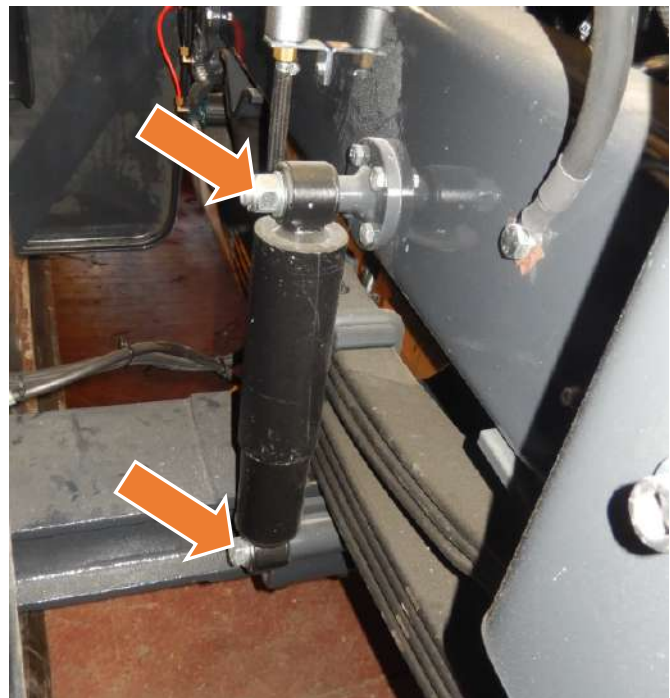
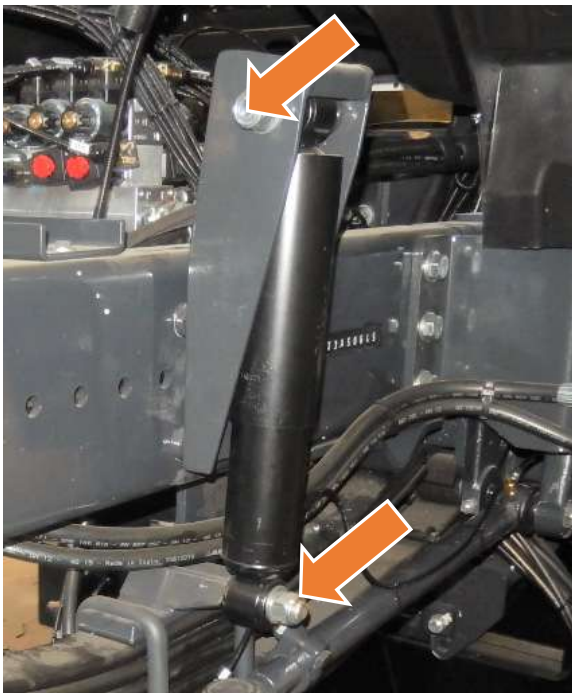
## 9.3 SHOCK ABSORBERS UNINSTALL



### WARNING!

*THE VEHICLE MUST BE STOPPED WITH ENGAGED PARKING BRAKE*

- 1) Unscrew the lower nut and then the upper nuts and remove the damaged shock absorber (wrench 30 mm).
- 2) Install the new shock absorber and fix with proper bolts.



### WARNING!

*USE ONLY ORIGINAL SPARE PARTS.*

## 9.4 LEAF SPRINGS UNINSTALL



### WARNING!

*PUT A SUPPORT UNDER THE CHASSIS AND THE AXLE BEFORE STARTING THE OPERATION*

- 1) Support properly the chassis and the axle

- 2) Remove the corresponding wheel.
- 3) Remove the corresponding shock absorber as indicated in 9.3
- 4) Unscrew the nuts A of the U-bolts (wrench 30 mm) and remove the U-bolts
- 5) (If present remove the lubrication fittings)
- 6) Unloose the screws which tighten the pins B (wrench 19 mm)
- 7) By a means of a punch and a hummer, gently beat to slide out the pins.
- 8) Remove the leaf spring (take care not to lose the spacer washers C)



Reinstall following the above procedure in reverse

**Tighten the nuts A 500 Nm (wrench 30 mm)**



**WARNING!**  
*USE ONLY ORIGINAL SPARE PARTS.*

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

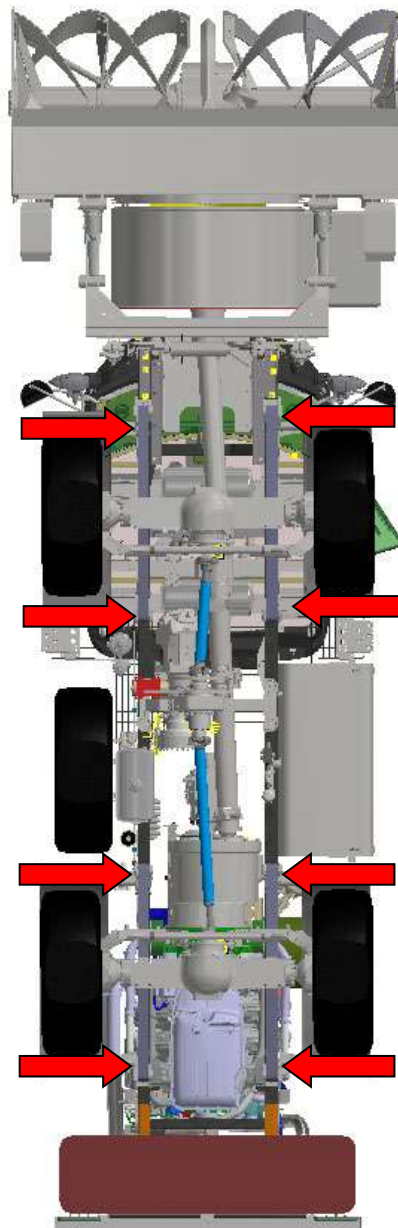
Vehicle type: **SNOWBLOWER** Model: **F90**

Intervention type: **SUSPENSIONS LUBRICATION**  
(ONLY FOR VEHICLE NOT PROVIDED OF AUTOMATIC GREASING SYSTEM)

**SUSPENSIONS**

Periodicity: **BEFORE STARTING** Required time: **15 minutes**

Action points:



Requested spare parts:

Specific tools:

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



1



1

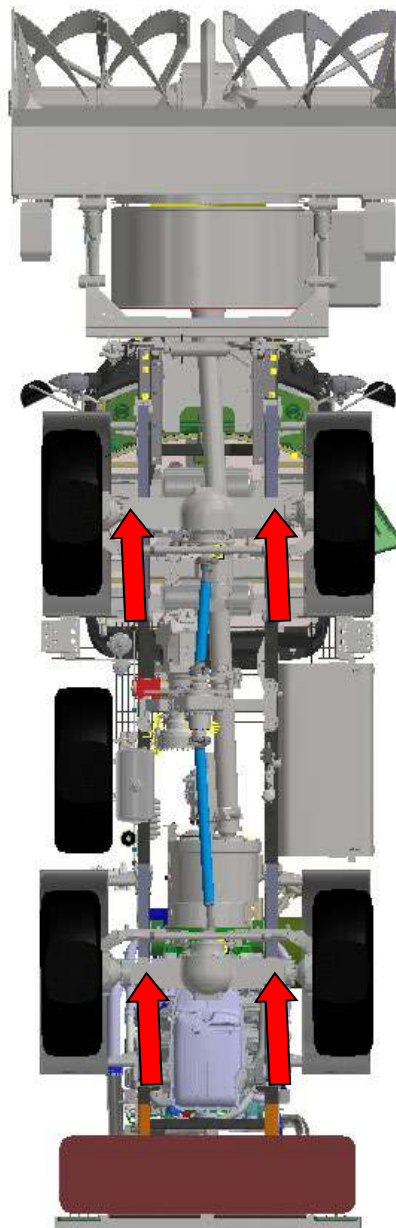


**NOTE:**

*Inject grease into the fittings (1) of the leaf springs (nr. 3 each leaf spring –nr. 12 in total).*

ELECTRIC  
CLEANINGMECHANIC  
LUBRICATIONFLUIDIC  
INSPECTIONVehicle type: **SNOWBLOWER**Model: **F90**Intervention type: **CHECK THE TOQUE OF NUTS CONNECTING AXLES TO THE LEAF SPRINGS****SUSPENSIONS**Periodicity: **BEFORE STARTING THE WORK SEASON**Required time: **20 minutes**

Action points:



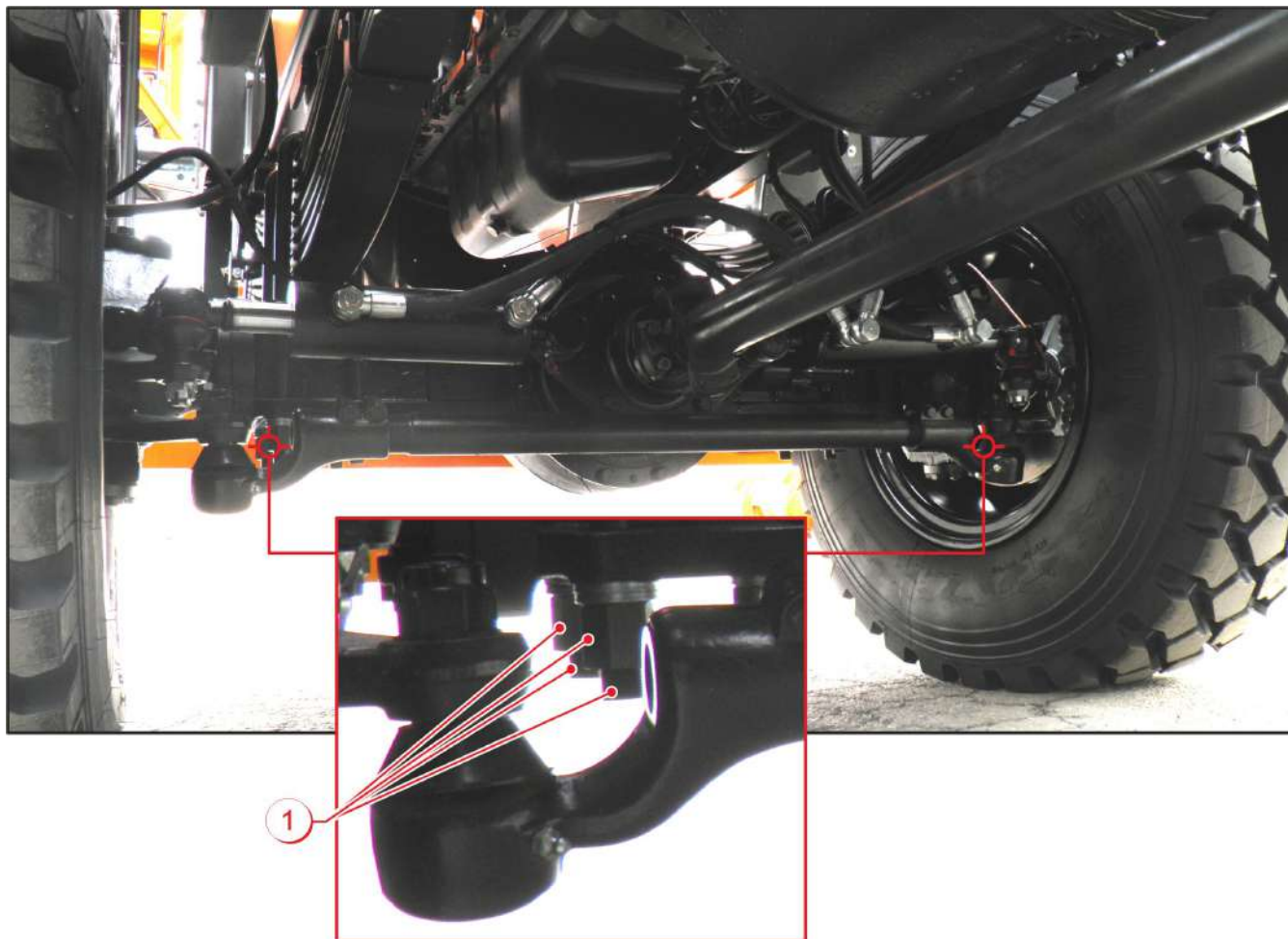
Requested spare parts:

Specific tools:

PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*



Check the torque of nut for connection of the axle to the leaf spring (1) (nr. 8 nut each axle).

Recommended torque: **500 Nm**

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATIONFLUIDIC  
INSPECTION

Vehicle type: SNOWBLOWER

Model: F90

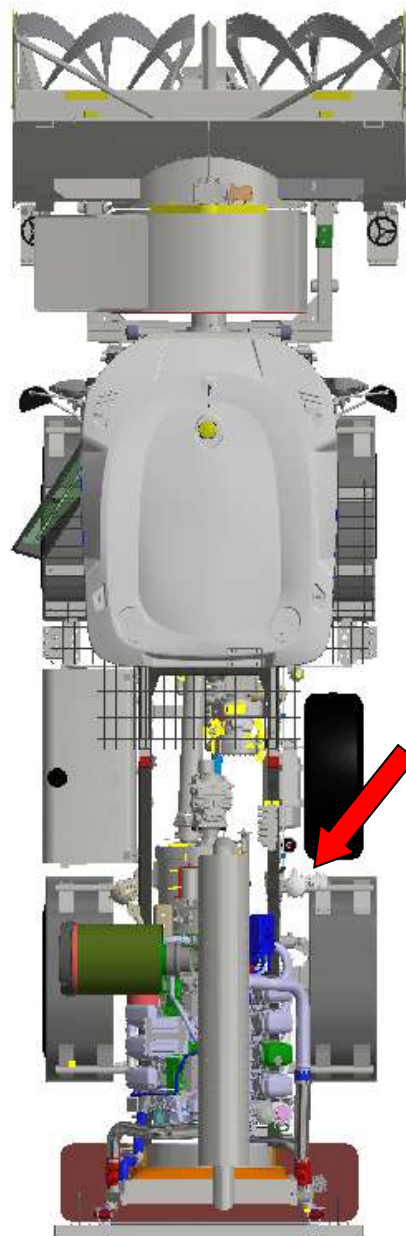
Intervention type CHANGE THE FILTER OF APU

**PNEUMATIC AND BRAKE SYSTEM**

Periodicity: BEFORE STARTING THE WORK SEASON

Required time: 15 minutes

Action points:



Requested spare parts:

Specific tools:

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

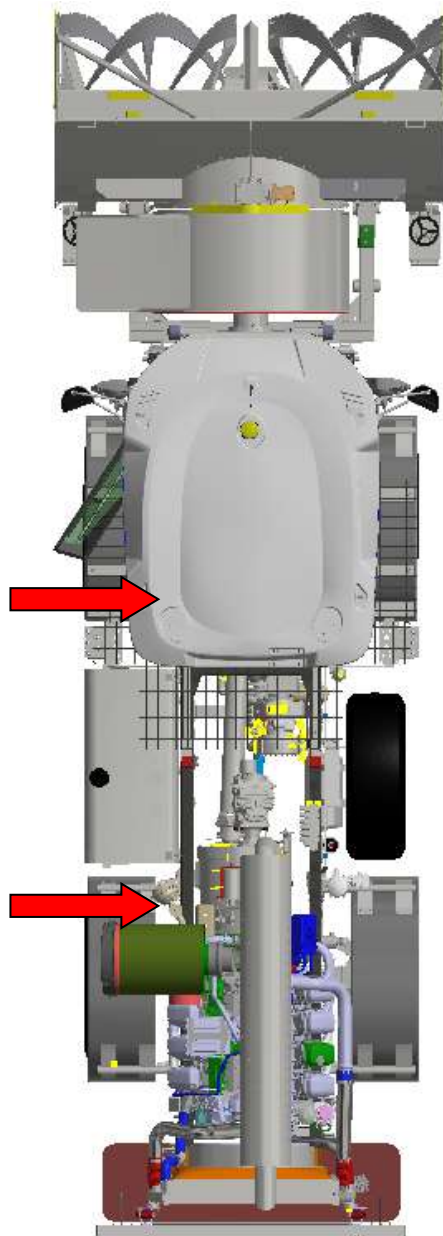
Intervention type **PNEUMOHYDRAULIC CONVERTER OIL LEVEL CHECK**

**PNEUMATIC AND BRAKE SYSTEM**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **15 minutes**

Action points:



Requested spare parts:

Specific tools:

## PROCEDURE:

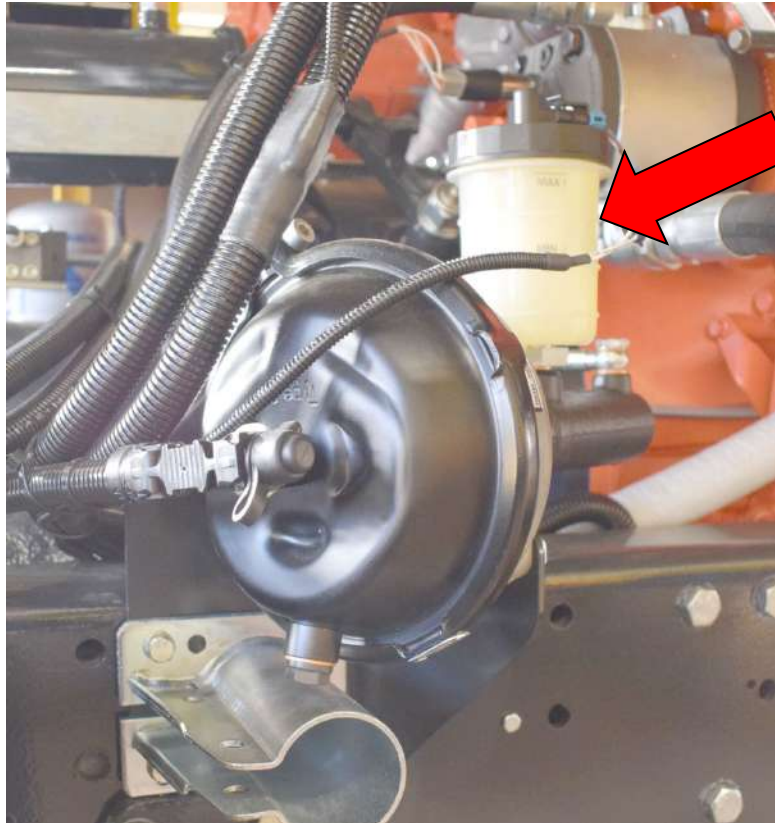


*People operating on vehicle must wear protective clothes according to the regulations in force*

Check the oil level into the pneumhydraulic converter tank. The correct level is between the minimum and maximum marks on the oil tank.

Fill with more oil when the oil level is at or below the lower mark.

Unscrew the oil plug and add oil until the correct level is restore.



ELECTRIC  
CLEANING


MECCANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

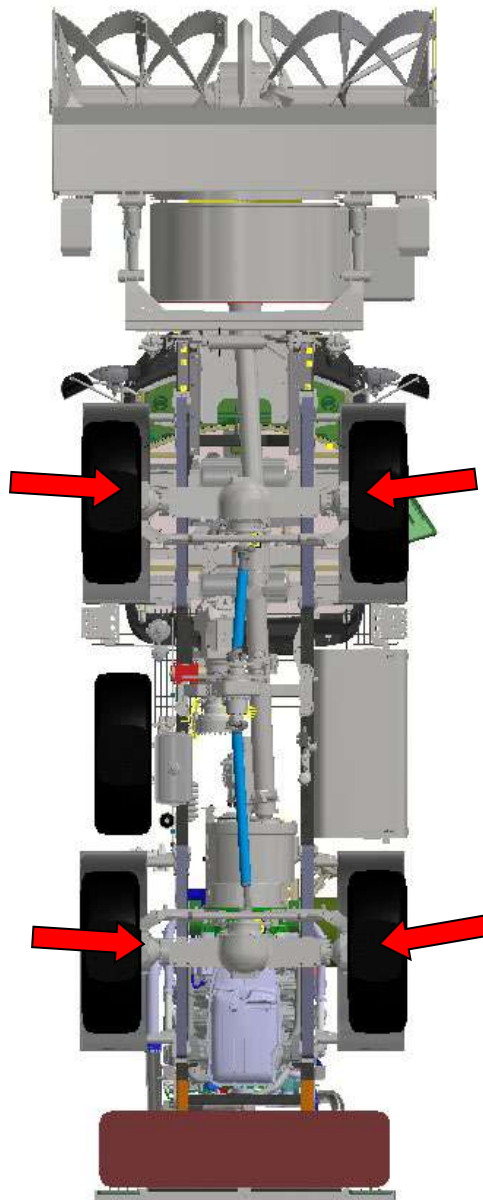
Intervention type: **CHECK THE BRAKE PADS CONSUMTION**

**BRAKES**

Periodicity: **EVERY 1000 HOURS or 2 YEARS**

Required time: **40 minutes**

Action points:



Requested spare parts:

- Brake pads cod. **003058/1**

Specific tools:

## PROCEDURE:



### **WARNING:**

**People operating on vehicle must wear protective clothes according to the regulations in force.**

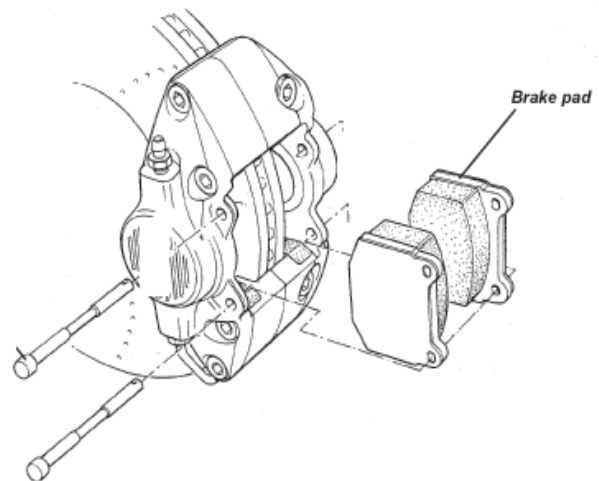
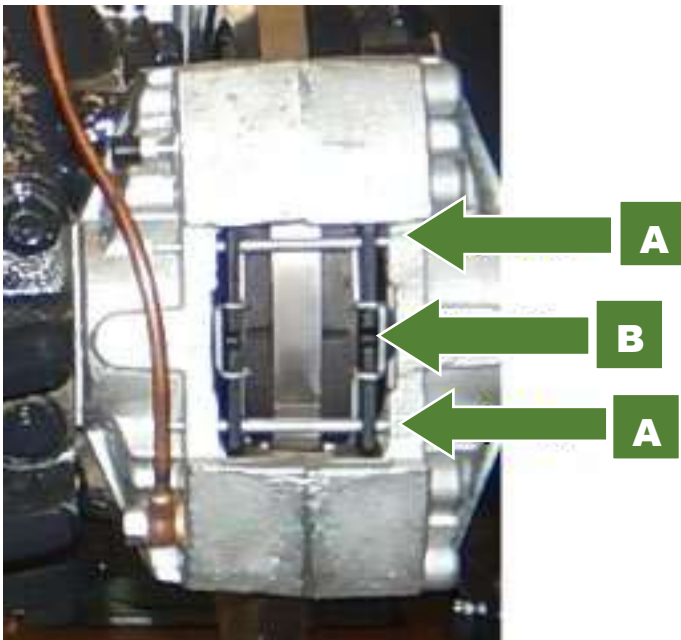
Check the status of the components.

Replace the brake pads when:

- they are heavily dirty of grease or oil.
- Their thickness is  $< 2$  mm.

Procedure for brake pads replacement:

- Lift the vehicle axle.
- Remove the wheel from the hub.
- Using a punch, remove the fixing pins A and extract the clips B.



- Slide out the worn pads.
- Insert a lever between the disc and the brake cylinder and push cylinder in backward.
- Reinstall the new pads following the procedure in reverse.
- Reinstall the wheels. Tightening torque: **470 Nm**



### **IMPORTANT:**

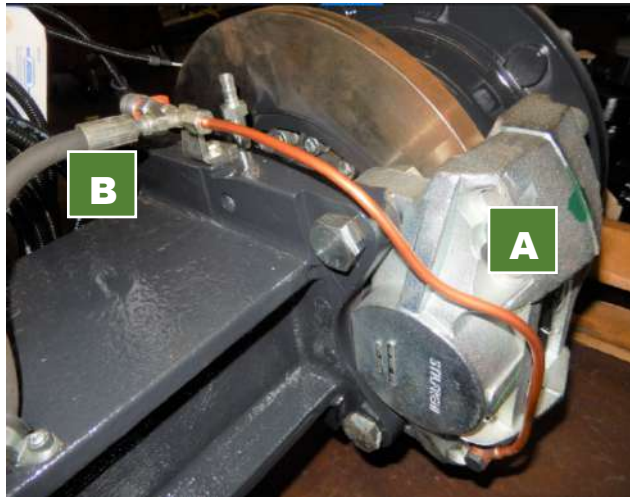
**Whenever the pads are replaced, it is recommended to bleed the system.**


## Procedure for brake system bleeding

When replacing the brake pads, it is necessary to purge the system of any air present.

With the engine at idle and the parking brake engaged, proceed as follows:

- a) Connect a purge hose to the purge fitting (A). Place the second end of the bleed hose into a container partially filled with brake fluid.

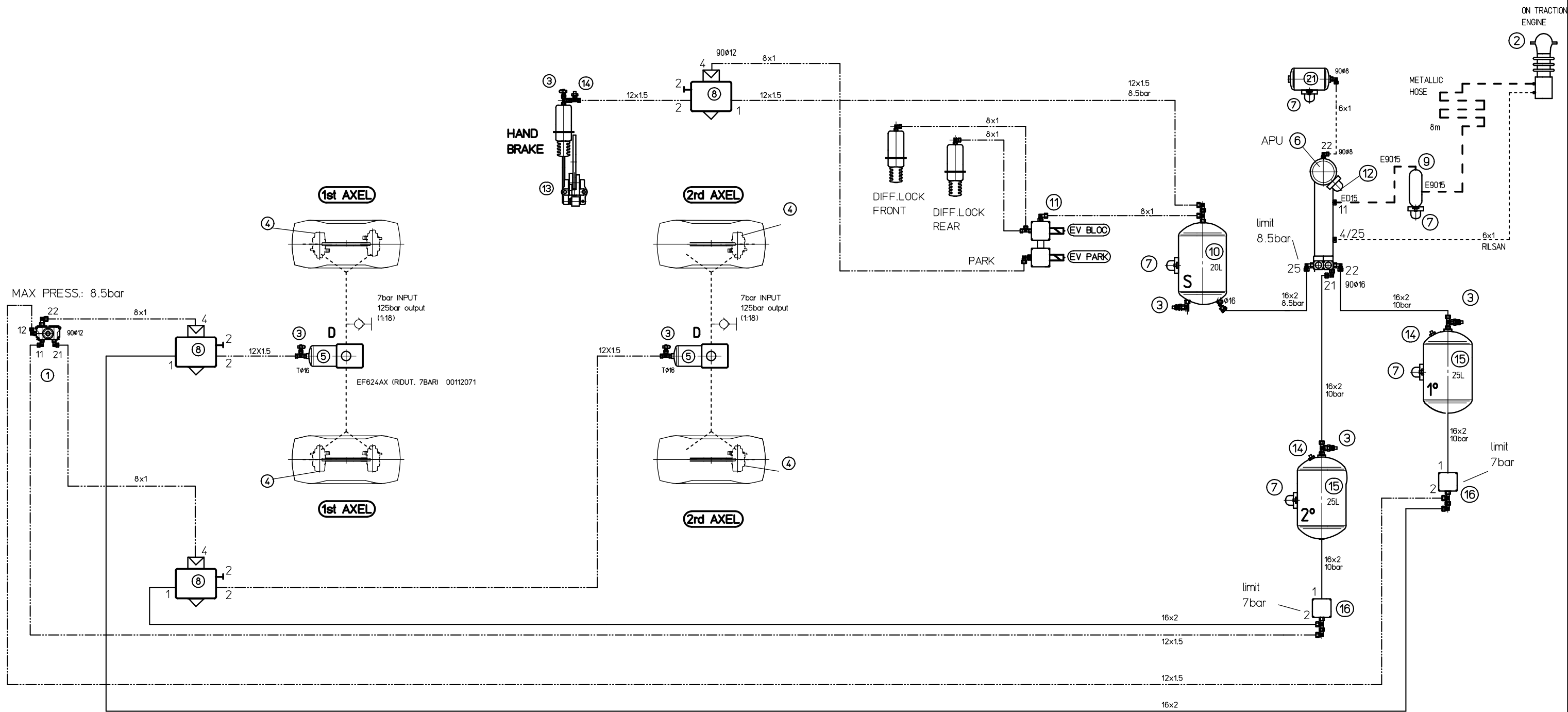


- b) Press the brake pedal repeatedly.
- c) Keep the brake pedal pressed and open the bleed screw by one turn. This operation lets the air out of the hydraulic system.
- d) Close the bleed screw.
- c) Press the brake pedal repeatedly until the pressure in the system is higher than 150 bar (icon on monitor ).
- d) Repeat the operation until only oil comes out of the bleed screw.
- e) Perform the operation for each wheel.

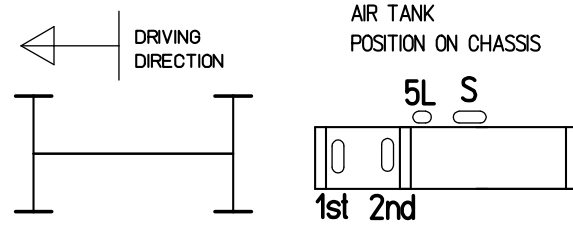
### **NOTE:**



***The exhaust oil must be disposed of according to the rules***



POS.	DESCRIPTION	Q.ty
17	Air tank for drier 5 l SMA aluminium cod. 4A15_	1
16	Limitation valve 7bar 475.010.314.0 00112158	2
15	Front / Rear axle tank 25L SMA aluminium cod. 4A2460254A	2
14	Low pressure switch and indicator N.C. 00093519	3
13	Parking brake	1
12	Stencer WABCO 432.407.015.0 00088964	1
11	Service - electrovalves NC 00112201 (KIT WEPICO)	1
10	Auxiliary service tank 20 l SMA aluminium cod. 4A2460204	1
9	Air tank drier 932.399.000.0 00080399	1
8	Relay valve 973.011.004.0 00107258	3
7	Automatic Drain valve 934.301.003.0 00101855	4
6	APU - Air drier and guard system protection 932.500.068.0 00112072	1
5	Axle pneumohydraulic converter (rap.1:20) KNOR EF624AX - 00112071	2
4	Brake 00081233	6
3	Air pressure check control WABCO 463.703.120.0 00087036	1
2	Compressor on Scania DC13 - traction engine	1
1	Brake pedal 461.317.001.0 00112064	1



- 4X4 vehicle**
- = RILSAN Ø 16x2 mm
  - = RILSAN Ø 12x1.5 mm
  - = RILSAN Ø 6x1 mm
  - - - - = FROM COMPRESSOR
  - ⊕ = CONNECTION FØ16 / 12
  - ⊕ = CONNECTION 90Ø16 / 15 / 6
  - ⊕ = CONNECTION DØ16 / 12
  - ⊕ = CONNECTION 45Ø16
  - ⊕ = CONNECTION TØ16 / 12 / 8

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17017 - MILLESIMO (SV) Italy	MASSA Masse	SCALA Scale	General tolerances and other specifications
MATERIALE / Material	DIS.RE Name D.R.		CAD HEWLETT Drawing PACKARD
DESIGNAZIONE / Designation	SOST.it N° Rep. for -		SOST.dal N° Rep. by .
<b>Brake system F90 INDIA</b>	TIPO Type F90 INDIA		CODICE Code Nr. -
	N° / Nr 31969		F0GLIO Sheet 1/1

ELECTRIC  
CLEANING


MECHANIC  
LUBRICATION


FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

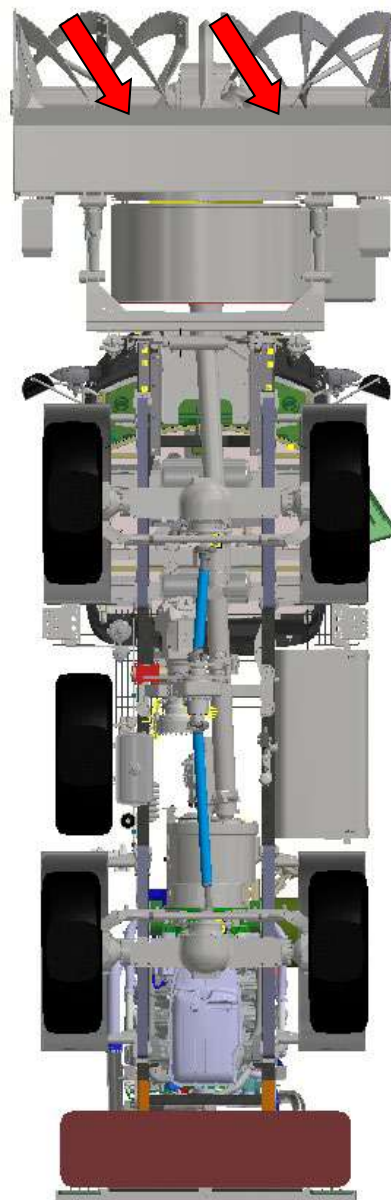
Intervention type: **BLOWER HEAD BLADE WEARING CHECK**

**BLOWER HEAD**

Periodicity: **BEFORE STARTING**

Required time: **5 minutes**

Action points:



**Requested spare parts:**

- ✓ Front iron blade code: **00011673**
- ✓ Screw (nr. 18): **V0011674**

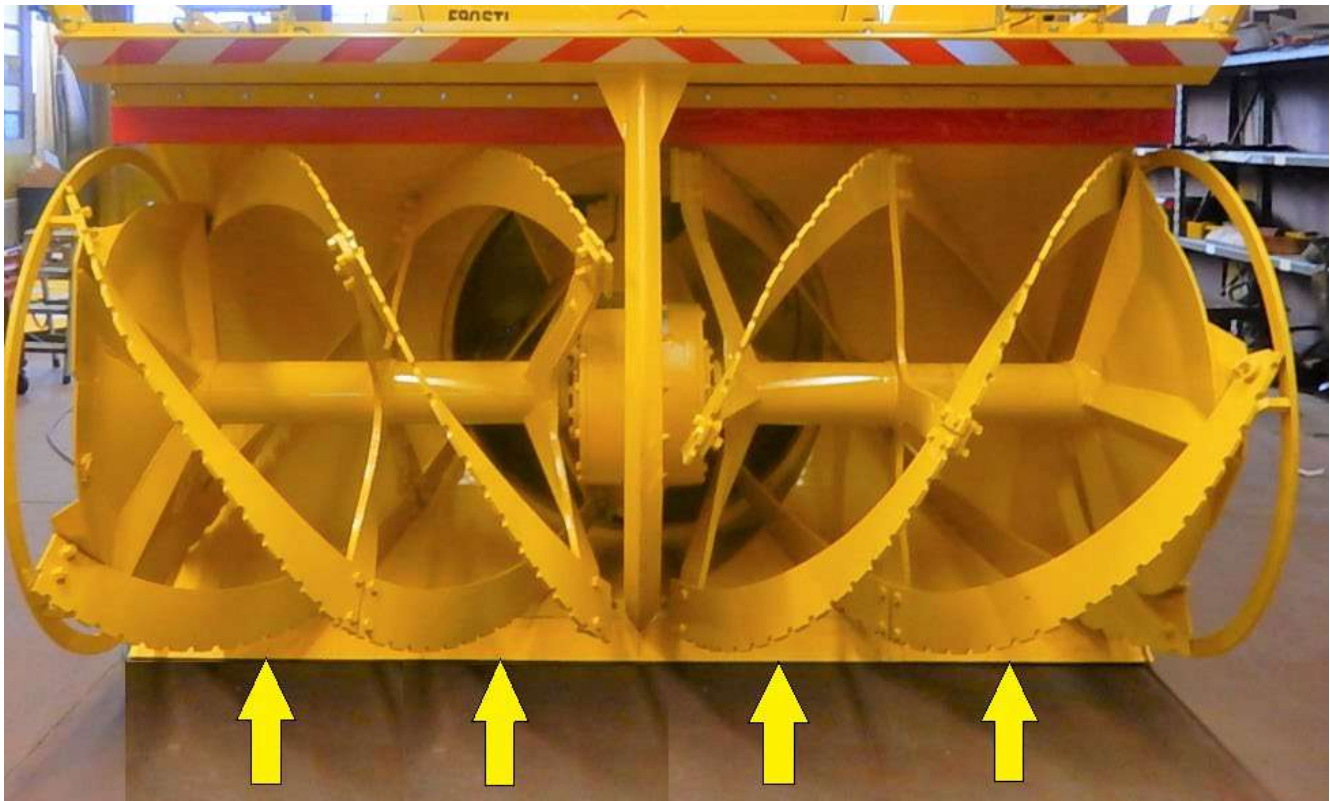
**Specific tools:**

## PROCEDURE:



### **WARNING:**

*People operating on vehicle must wear protective clothes according to the regulations in force.*



- a) Check the front blades (1) wearing.

### **IF IT IS NECESSARY, REPLACE IT:**

- b) Lift up the blower head.
- c) Shut down the engine and extract the key.
- d) Insert the blower head safety bars (see the procedure for blower head safety bars installation on chapter 4).
- e) Unscrew the screws (2) and remove the worn front blades (1);
- f) Install the new blades and fix it with the screws (2).

**Technomatic**

## Maintenance sheet

ELECTRIC

MECHANIC

FLUIDIC

Sheet n°

F\_02

	<input type="checkbox"/> CLEANING	<input type="checkbox"/> LUBRICATION	<input checked="" type="checkbox"/> INSPECTION
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Vehicle type: **SNOWBLOWER** Model: **F90**

Intervention type: **RIBBON AUGERS HELICAL CUTTERS WEARING CHECK**

**BLOWER HEAD**

Periodicity: **BEFORE STARTING** Required time: **5 minutes**

Action points:



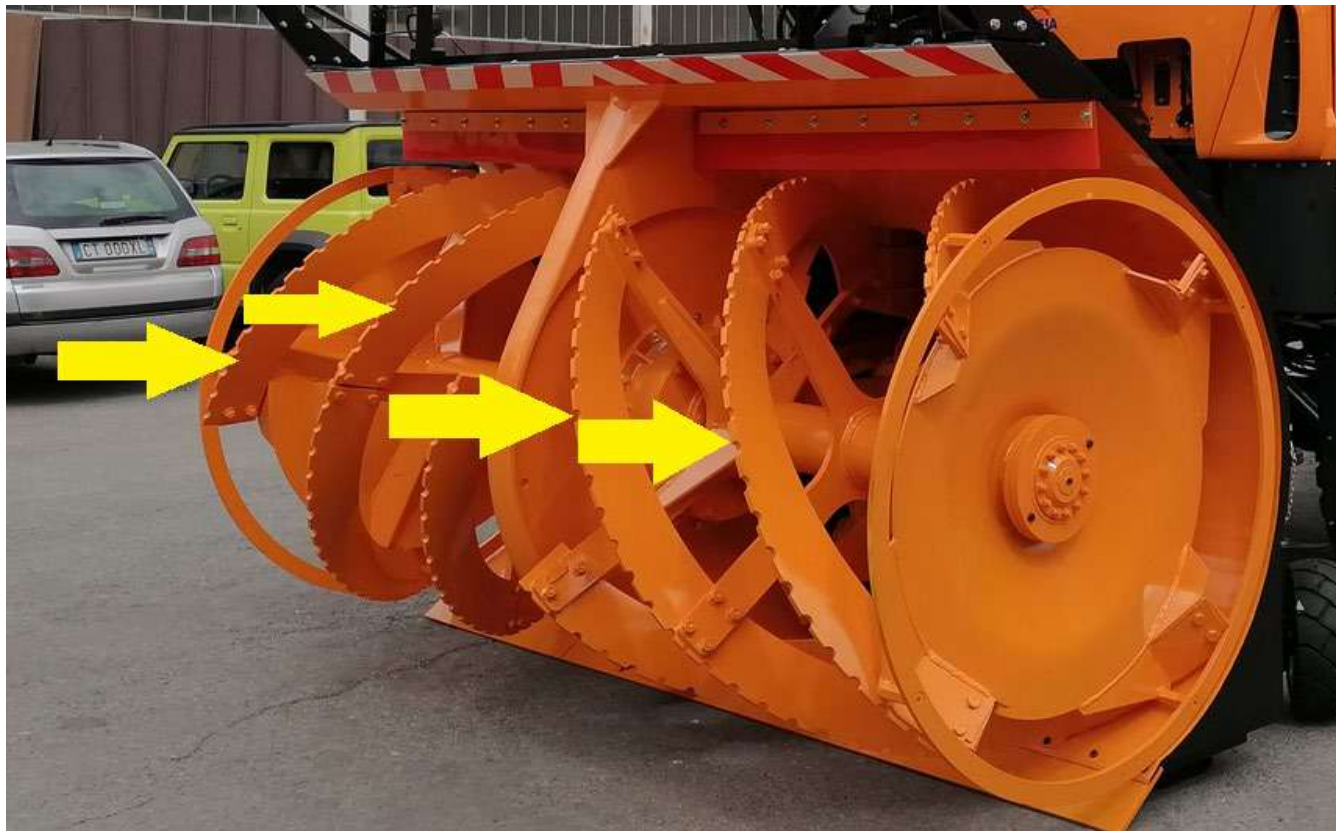
<p><b>Requested spare parts:</b></p> <ul style="list-style-type: none"> <li>• Nr. 4 Right external cutter code <b>00095214</b></li> <li>✓ Nr. 4 Right internal cutter code <b>00095217</b></li> <li>• Nr. 4 Left external cutter code <b>00095214</b></li> <li>• Nr. 4 Left internal cutter code <b>00095217</b></li> </ul>	<p><b>Specific tools:</b></p>
---	-------------------------------

## PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*

- a) Check the wearing of the helical cutters (1) of the blower head.



### IF IT IS NECESSARY, REPLACE THEM:

- b) Move the vehicle on a flat area, shut down the engine and extract the key.  
c) Remove the shear bolts in both sides (see the procedure for shear bolts replacement on chapter 4), it allows the rollers to freely rotate.  
d) Screw and remove the helical cutters.  
e) Fix the new cutters with the screws and after having replaced them.



**WARNING:**  
*Replace also the nuts of the screws.*

Table 1

PART NUMBER	DESCRIZIONE	Q.TÀ
V00.5190	Screw 16x2x55	24x2
V00.6067	Screw 18x2x40 8G	8x2
R00.5676	Washer D.16x34 SP.3,5 ZN	32x2
D00.1118	Nut 16x2x16	32x2

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATIONFLUIDIC  
INSPECTION

Vehicle type: SNOWBLOWER

Model: F90

Intervention: SECOND STAGE PADDLES WEARING CHECK

**BLOWER HEAD**

Periodicity: BEFORE STARTING

Required time: 5 minutes

Action points:



Requested spare parts:

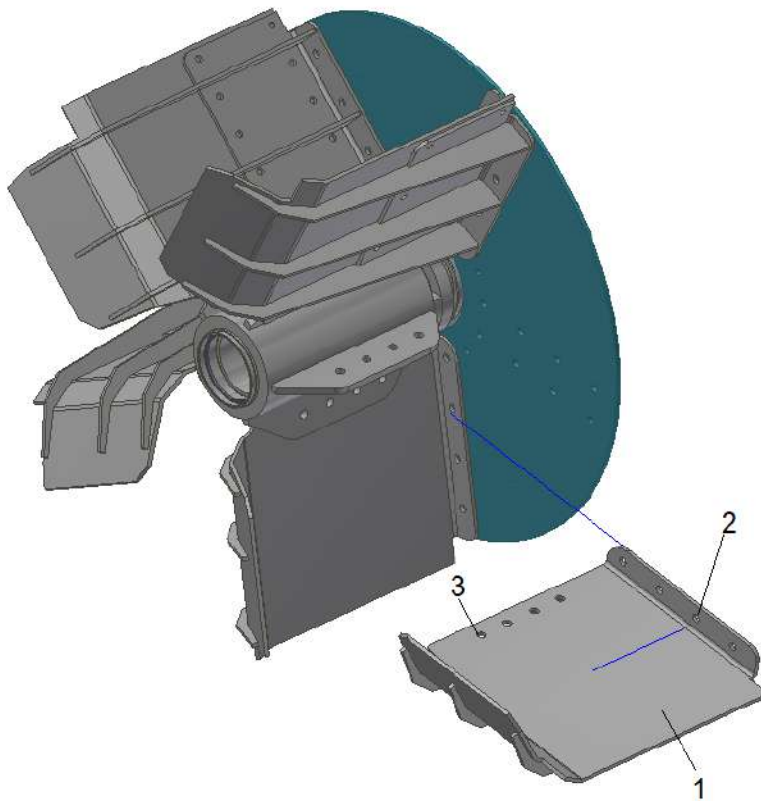
- Paddles code (nr. 5): 00107003

Specific tools:

PROCEDURE:



**People operating on vehicle must wear protective clothes according to the regulations in force**



a) Check the paddles wearing of the second stage.

IF IT IS NECESSARY, REPLACE THE IMPELLER BLADES:

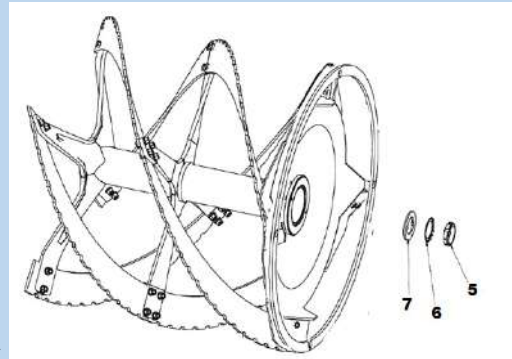
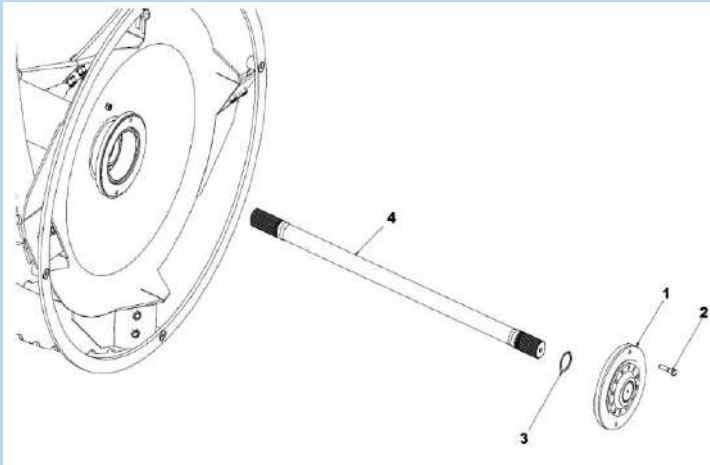


**NOTE: For the following operation, it is necessary to disconnect the blower head from the vehicle and remove one of the front auger ribbons (see the below procedures)**

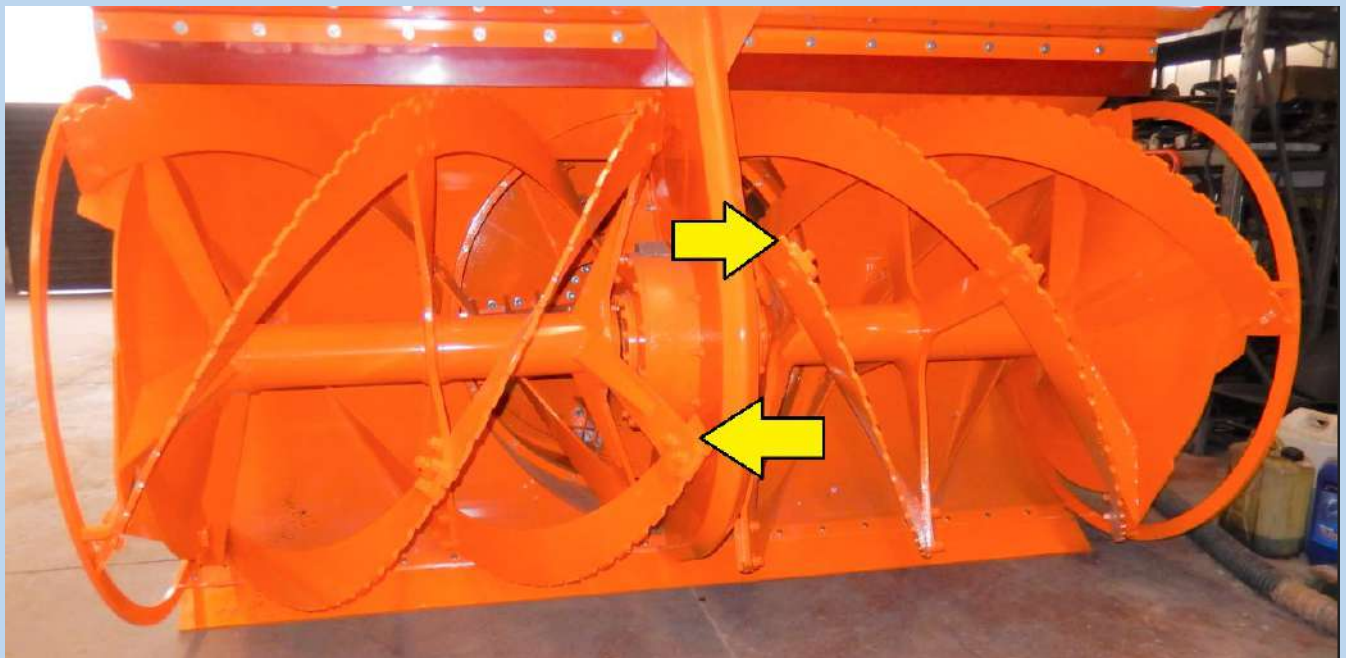
**OPERATE ON A FLAT AREA**

**PROCEDURE TO REMOVE AND REINSTALL THE AUGER RIBBON (same procedure Right/Left):**

- Unscrew the shear bolts (2) and disconnect the flange (1).
- Slide out the half-shaft (4).
- Unscrew the ring nut (5), using the proper tool, then the safety washer (6) and the washer (7)
- Slide out the auger ribbon.

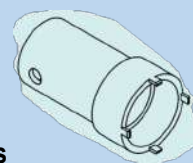


**IMPORTANT!:** reinstall the ribbon augers in a staggered arrangement as shown in the picture below. This avoids that foreign objects getting stuck between the augers, which may cause damage.



- Reinstall, following the procedure in reverse order.

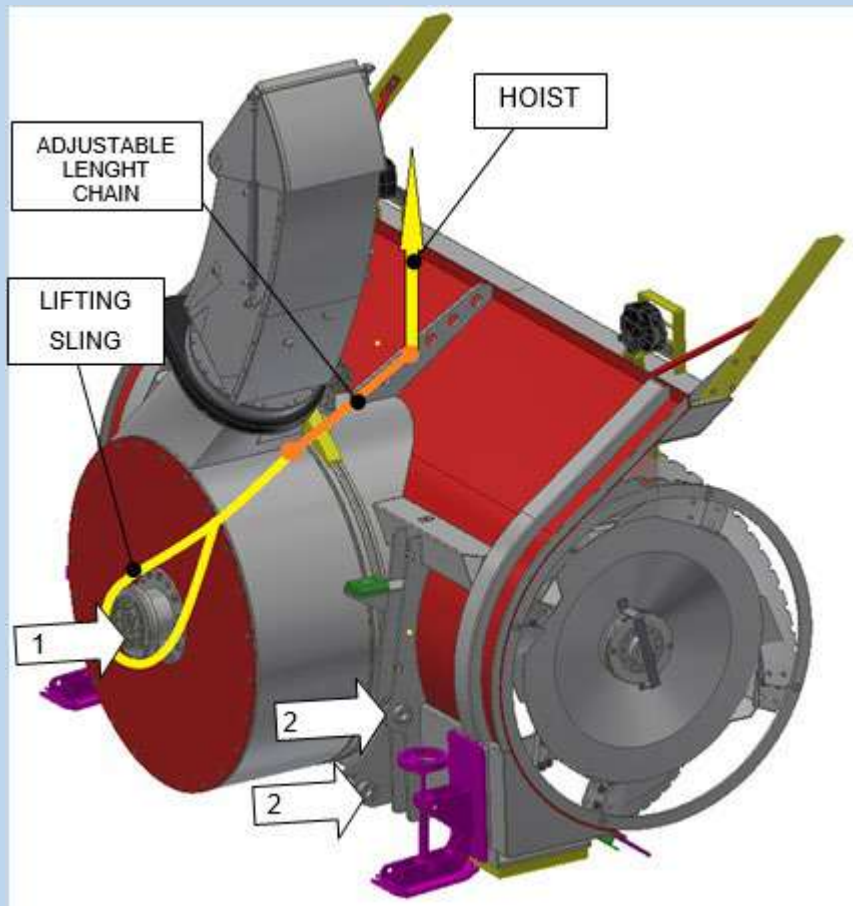
**NOTE:** Screw back the ring nut until it becomes stiff and slightly release to be able to fix it with the safety washer.



Specific tools: Special tool for ring nut of the auger ribbons

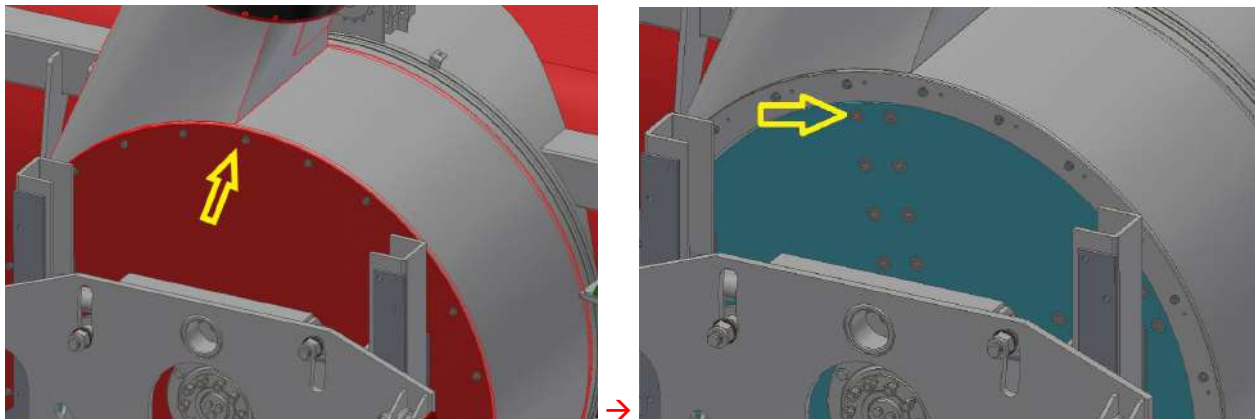
cod. 00110102

## PROCEDURE TO DISCONNECT / RECONNECT THE BLOWER HEAD FROM VEHICLE



- Park the vehicle on a flat area, the blower head must be on ground.
- Disconnect the transmission shaft from the vehicle to blower head (1) and place a lifting sling around the impeller transmission shaft.
- Lift the blower head with a proper hoist so that it remains upright.  
**IMPORTANT! To maintain the blower head upright, it is recommended to use a lifting sling around the impeller transmission shaft (1) connected to the hoist with an adjustable length chain. Adjust the length of the chain so that when lifting with the hoist the blower head will not tilt and remain horizontal.**
- Remove the pins (2) to disconnect the trestle and tie rods.
- Move the blower head away from the vehicle using the hoist.  
**WARNING: Be careful to avoid overturning blower head using a proper hoist and slings.**
- To reconnect, carefully place the blower head in position next to vehicle using the hoist.
- Insert the trestle pins.
- Reconnect the transmission shaft.

- b) Remove impeller housing cover unscrewing the bolts to access the impeller blades.



- c) Sustain the impeller assembly to avoid its rotation as it may be unbalanced once the bolts are removed.



**DANGER:**  
Be aware that the rotation of the impeller blades can cause serious injuries.

- d) Unscrew the bolts of the damaged blade and slide it out from the front of blower head housing (where the auger ribbons have previously been removed).
- e) Install the new impeller blade and fix it using new bolts.
- f) Reinstall the conveyor cover and the front auger ribbon.
- g) Reinstall the blower head on the vehicle.



**WARNING:**  
When replacing an impeller blade always replace all fixing bolts.

PART NUMBERS	DESCRIPTION	Q.TY
V00.7291	Screw 18x1,5x65	10
V00.5663	Screw 18x1,5x60	10
V00.5200	Screw 18x1,5x55	15
V00.6188	Screw 18x2,5x50 10.9	30
D00.6063	Washer	35
D0011732	Nut	30

ELECTRIC

MECHANIC

FLUIDIC

CLEANING

LUBRICATION

INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

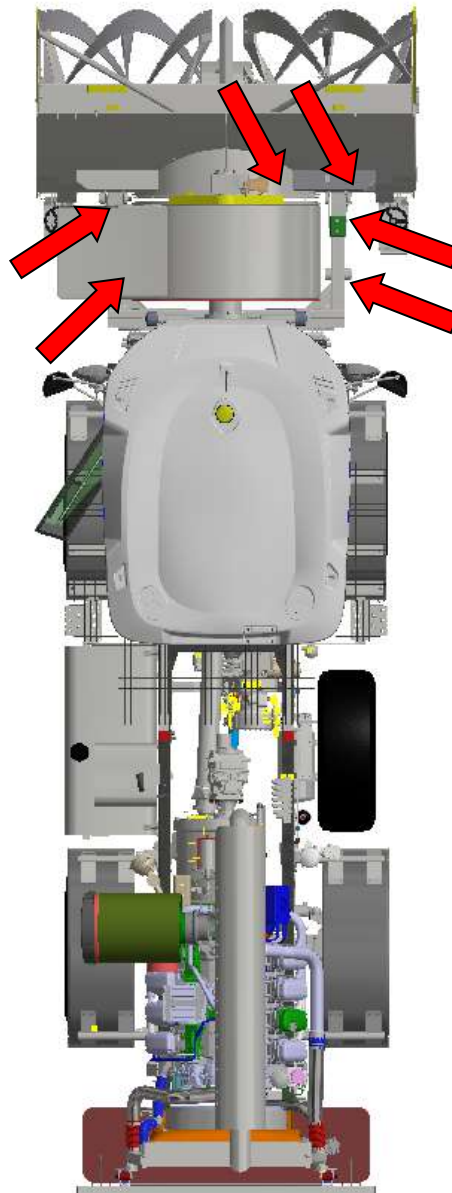
Intervention type: **BLOWER HEAD LUBRICATION**  
(ONLY FOR VEHICLE NOT PROVIDED OF AUTOMATIC GREASING SYSTEM)

**BLOWER HEAD**

Periodicity: **BEFORE STARTING**

Required time: **15 minutes**

Action points:



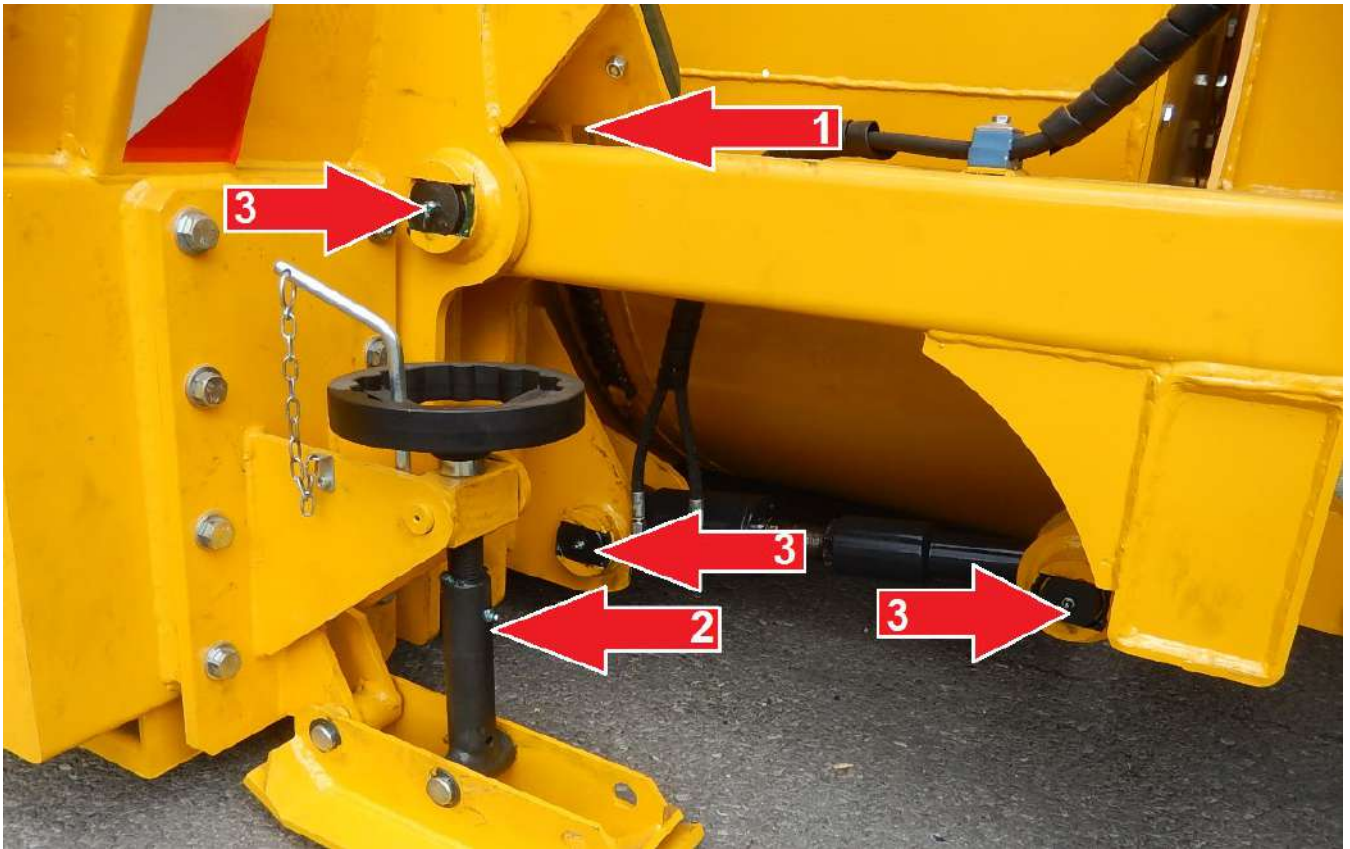
Requested spare parts:

Specific tools:

**PROCEDURE:**



*People operating on vehicle must wear protective clothes according to the regulations in force*



**NOTE:**

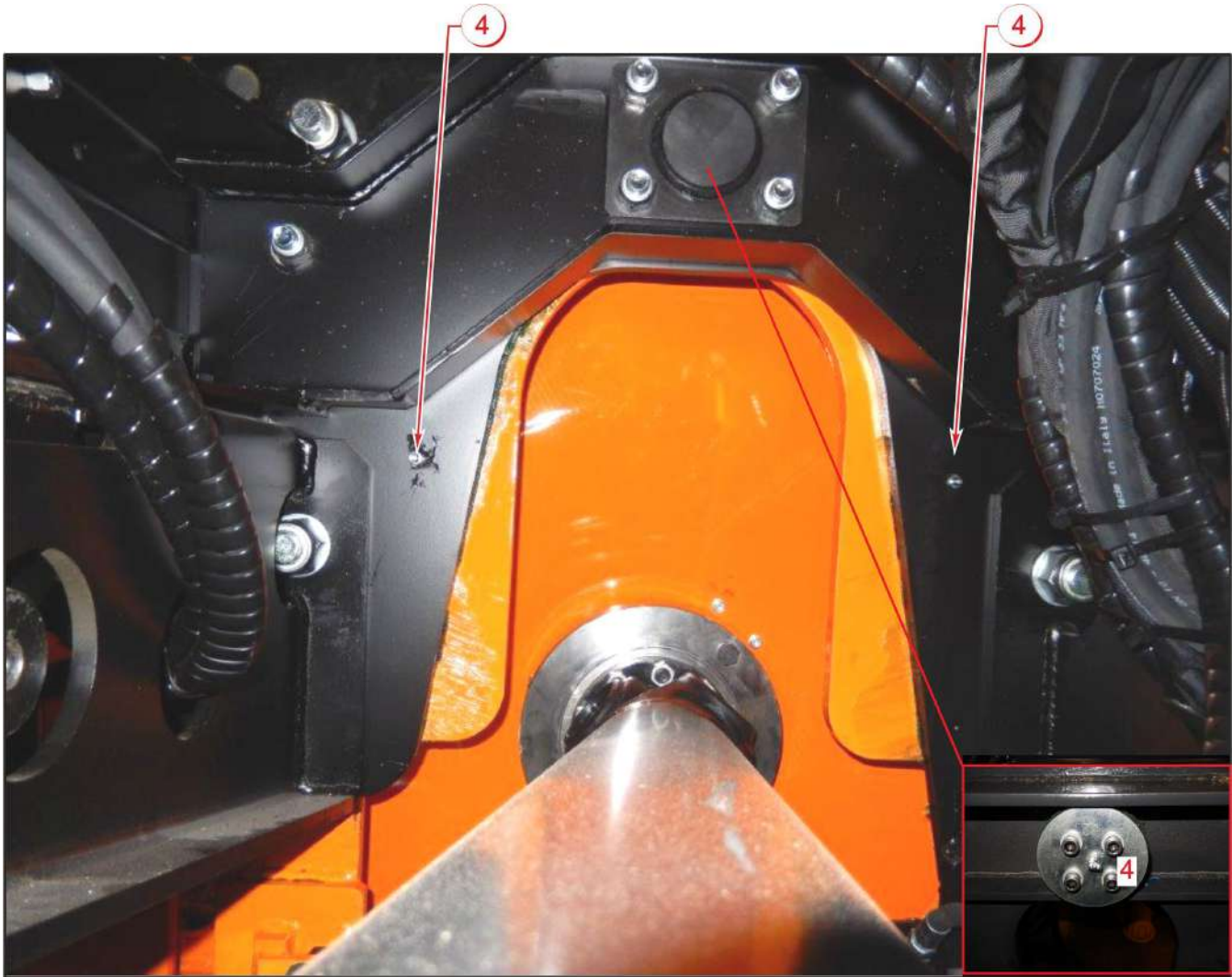
**Grease:**



- *the chain (1) for the conveyor rotation.*
- *the adjustment screws (2) of the castor wheels.*
- *the pins (3) of the blower head articulation.*

Inject grease into the fittings.

## DOCKING PLATE LUBRICATION



**NOTE:**

**Grease the front docking plate (4) injecting grease into the two fittings (4).**

Inject grease into the fittings (4).

ELECTRIC

MECHANIC

FLUIDIC

CLEANING

LUBRICATION

INSPECTION

Vehicle type: SNOWBLOWER

Model: F90

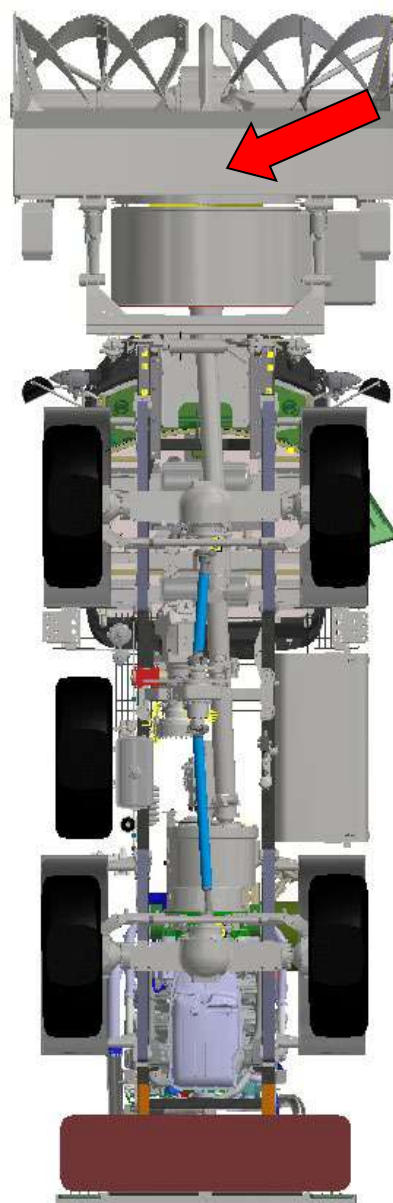
Intervention type: FIRST STAGE OIL LEVEL CHECK

**BLOWER HEAD**

Periodicity: BEFORE STARTING

Required time: 10 minutes

Action points:



Requested spare parts:

- Oil type TUTELA W90/M-DA or equivalent.

Specific tools:

**PROCEDURE:**



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Screw the plug (1) and check that the oil level reaches the lower part of the opening.
- b) If it is necessary, refill through (1).
- c) Screw back the plug (1).



**WARNING:**

*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING

MECHANIC  
LUBRICATIONS

FLUIDIC  
INSPECTION

Vehicle type: SNOWBLOWER

Model: F90

Intervention type: SECOND STAGE OIL CHECK

**BLOWER HEAD**

Periodicity: BEFORE STARTING

Required time: 10 minutes

Action points:



Requested spare parts:

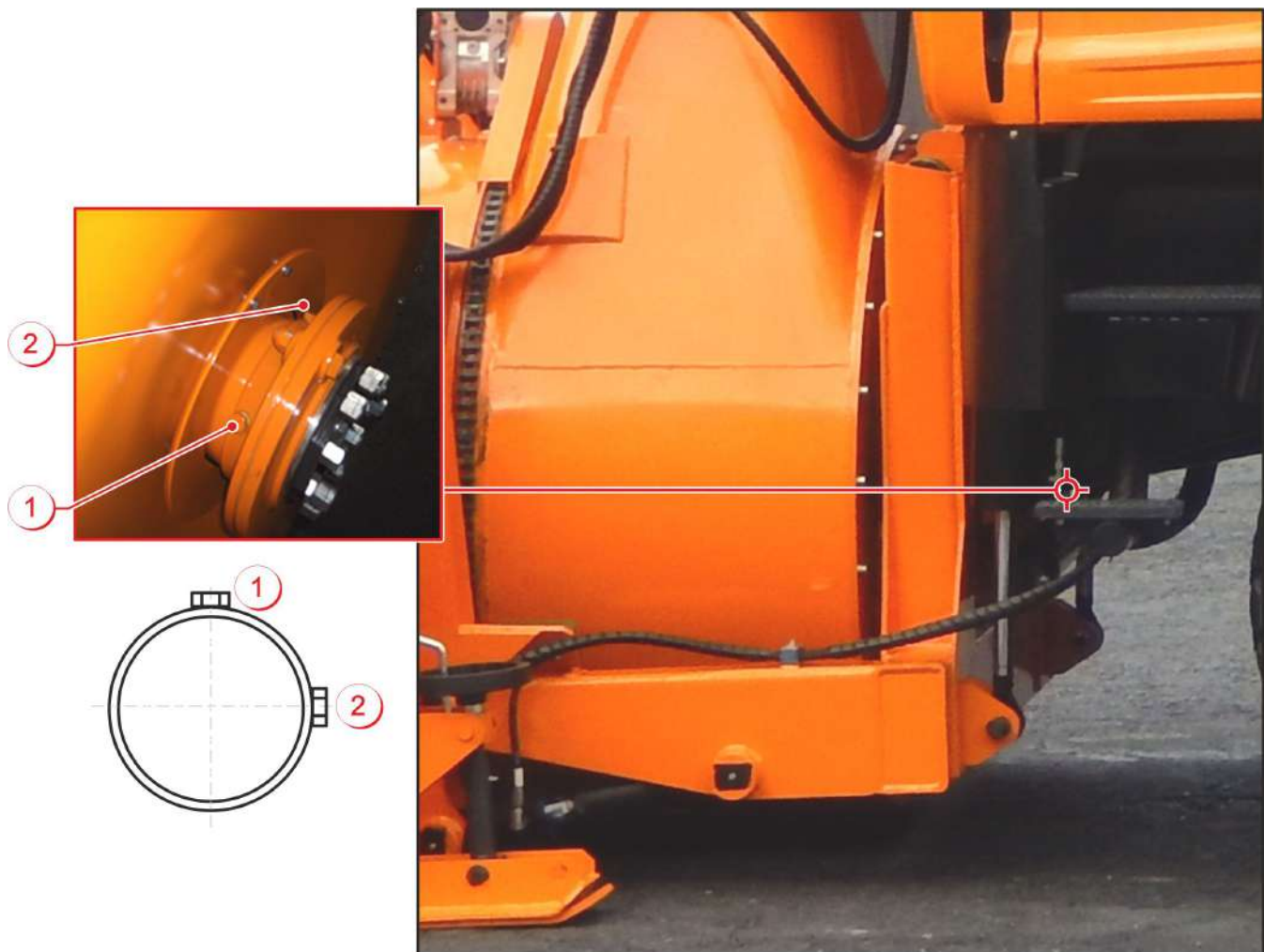
- Oil type TUTELA W90/M-DA or equivalent.

Specific tools:

**PROCEDURE:**



**People operating on vehicle must wear protective clothes according to the regulations in force**



- a) Rotate plug (1) in upper position.
- b) Pour slowly 0,5 litres of oil to allow the air to come out.
- c) Remove the plug (2) and check if the oil flows out. If not, screw back the plug (2) and add further 0,5 litres in (2).
- d) Screw again the plug (2) and let oil flowing out into the container. This is the correct procedure to have the correct level.
- e) Screw back the plug (1)



**WARNING:**

**Use only TUTELA W90/M-DA oil or equivalent.**

ELECTRIC

MECHANIC

FLUIDIC

CLEANING

LUBRICATION

INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

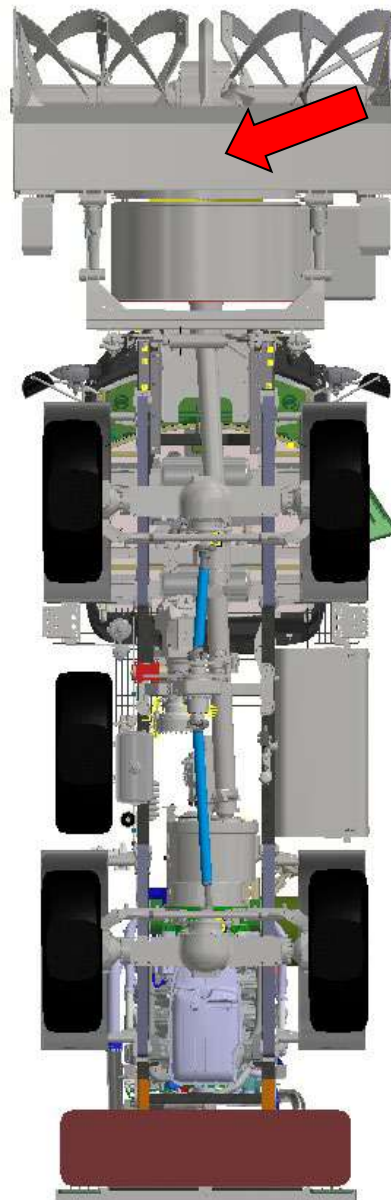
Intervention type: **FIRST STAGE OIL REPACEMENT**

**BLOWER HEAD**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **20 minuti**

Action points:



Requested spare parts:

- Oil type TUTELA W90/M-DA or equivalent.

Specific tools:

**PROCEDURE:**



**People operating on vehicle must wear protective clothes according to the regulations in force**



- a) Put a container under the plug (1).
- b) Screw the plug (1) and let all the oil flowing out.
- c) When the oil has completely drained screw back plug (1).
- d) Pour the new oil through the opening (2) till it reaches the lower part of the opening.
- e) Screw back the plug (2).



**WARNING:**

**Use only TUTELA W90/M-DA oil or equivalent.**

ELECTRIC  
CLEANING

MECHANIC  
LUBRICATION

FLUIDIC  
INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

Intervention type **SECOND STAGE OIL REPLACEMENT**

**BLOWER HEAD**

Periodicity **BEFORE STARTING THE WORK SEASON**

Required time: **20 minutes**

**Action points**



**Requested spare parts**

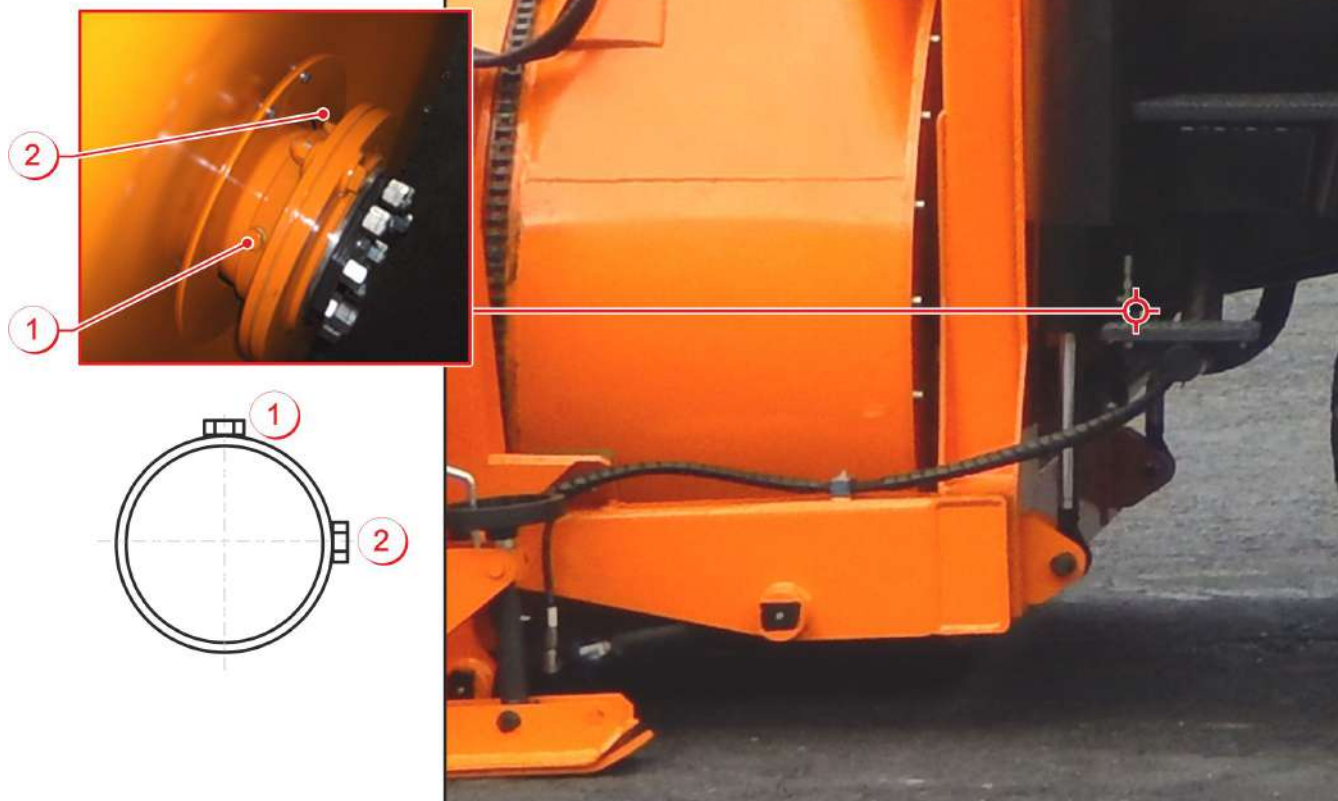
- Oil type TUTELA W90/M-DA or equivalent.

**Specific tools:**

## PROCEDURE



*People operating on vehicle must wear protective clothes according to the regulations in force*



- a) Put a container under the plug (2).
- b) Screw the plug (2) and rotate it in lower position to leave all the oil flowing out.
- c) Screw back the plug (2).
- d) Rotate (1) in the upper position.
- e) Pour slowly about 2 litres of oil in (1) to allow the air to come out.
- f) Screw the plug (2) (it should be in horizontal) and let that exceeding oil flows out.  
When the oil stops to flow, the correct lever is reached.
- g) Screw back the plugs (1) and (2).

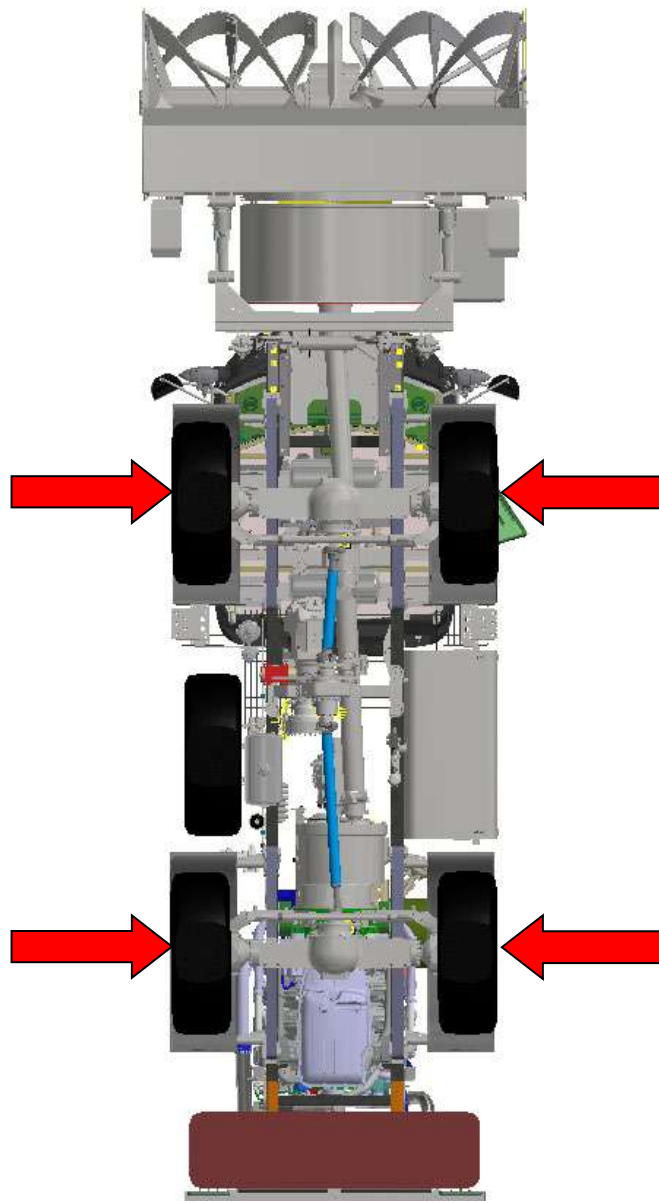


### **WARNING**

*Use only TUTELA W90/M-DA oil or equivalent.*

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATION  
FLUIDIC  
INSPECTIONVehicle type: **SNOWBLOWER**Model: **F90**Intervention type: **TYRES PRESSURE CHECK****TYRES**Periodicity: **BEFORE STARTING**Required time: **10 minutes**

Action points:



Requested spare parts:

Specific tools:

## PROCEDURE:



***People operating on vehicle must wear protective clothes according to the regulations in force***

- a) Check the pneumatic pressure.

Correct values are the following:

7,5 BAR FRONT AXLE

5 BAR REAR AXLE



### **WARNING:**

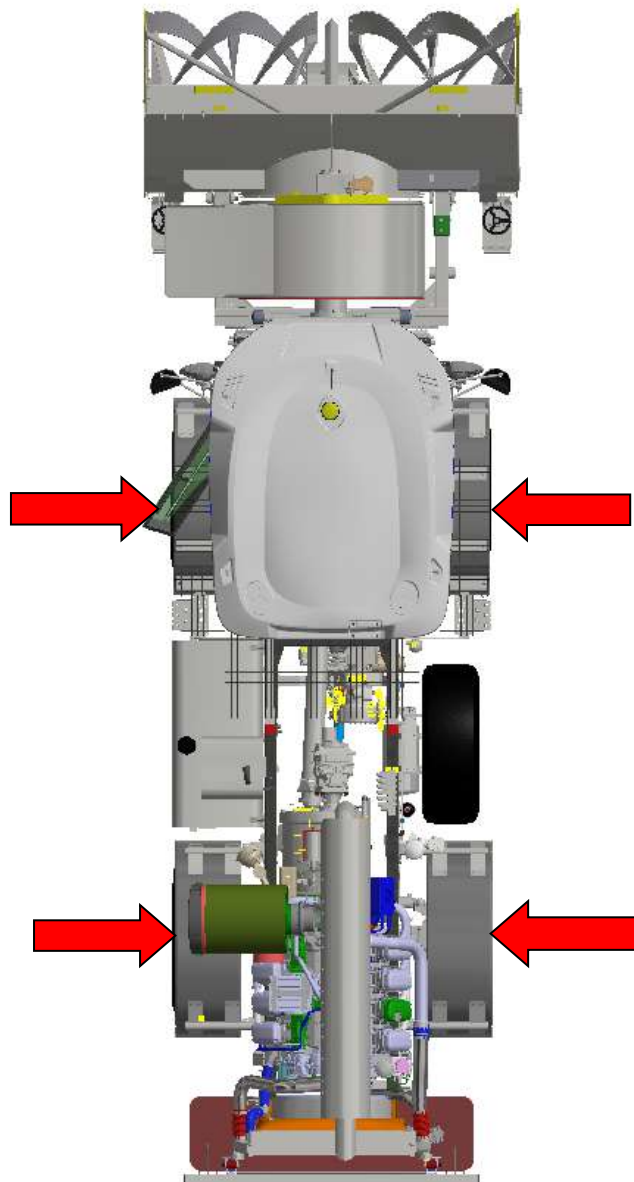
***When pressure is too LOW, they heat up causing a quick lateral wear.***



***When pressure is too HIGH, the tyre becomes stiff that cause wearing in the central part.***

ELECTRIC  
CLEANING  
MECHANIC  
LUBRICATIONFLUIDIC  
INSPECTIONVehicle type: **SNOWBLOWER**Model: **F90**Intervention type: **WHEEL NUTS TORQUE CHECK****TYRES**Periodicity: **BEFORE STARTING**Required time: **20 minutes**

Action points:



Requested spare parts:

Specific tools:

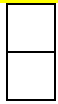
PROCEDURE:



*People operating on vehicle must wear protective clothes according to the regulations in force*

- a) Check the tightening of nuts fixing the wheels to the hubs. Tightening torque: **470 Nm**





Vehicle type: **SNOWBLOWER**

Model: **F90**

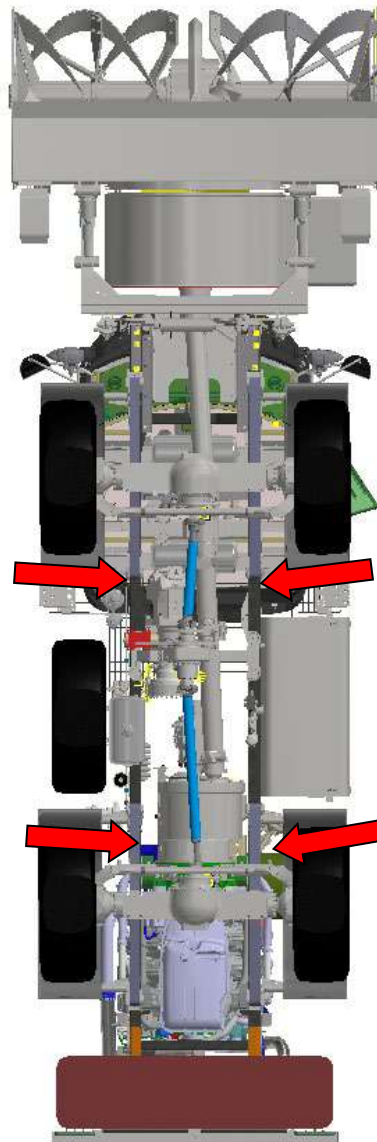
Intervention type: **RUST INHIBITOR TREATMENT FOR THE LOWER PART OF THE CHASSIS**

**CHASSIS**

Periodicity: **BEFORE STARTING THE WORK SEASON**

Required time: **40 minutes**

Action points:



**Requested spare parts:**

- DINITROL 964 or equivalent

**Specific tools:**

\* depending on the presence of aggressive substances on the ground like salt or de-icing liquid.

## PROCEDURE:



### **WARNING:**

**People operating on vehicle must wear protective clothes according to the regulations in force.**

To avoid the formation of rust in the lower parts of vehicle, which are subjected to aggressive substances on the ground like salt, de-icing liquid, etc., every year or two it is recommended to apply a corrosion protection.

Spread the anti-corrosion on all iron parts accessible under the chassis.

**The parts to be treated must be clean and free from oil and grease.**

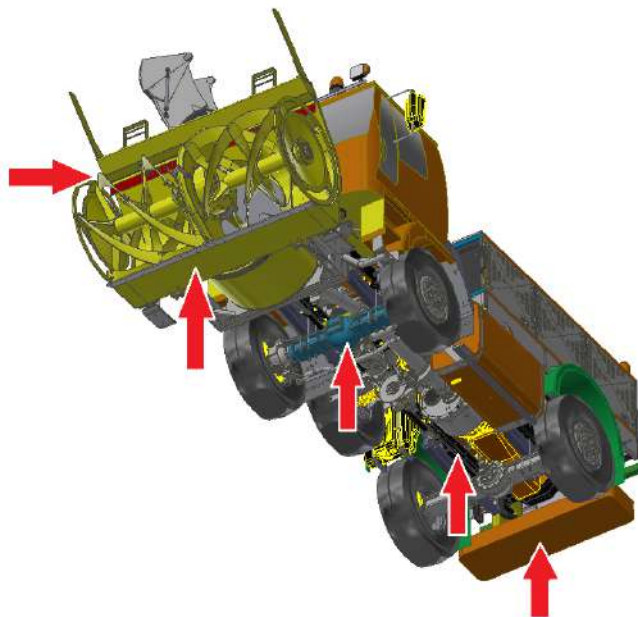
The recommended anti corrosion DINITROL 964 can be applied by spraying with manual or semi-automatic application equipment or by dipping. The water born protective is suitable for air-mix and air less spraying. Brushing is not recommended since encapsulation of air into the product may deteriorate the dry film. Stainless equipment is recommended.

Suitable application temperature is 15-30 °C.

The drying behaviour of the product is depending on the condition regarding temperature, RH and change of air.

For a quicker drying, it is helpful to increase the air change.

This is achieved by using a fan at low speed in order to remove with water the saturated air just above the applied areas.



### **Specs of anti-corrosion**

Colour:	transparent
Type of film:	hard, glasslike
Density at 23°C:	1040 kg/m <sup>3</sup>
Viscosity at 23°C, DIN 4:	30 s
Dry matter content:	38% by weight
EU VOC:	32 g/l
Flash point:	> 100°C
Recommended film thickness wet:	90 µm
Recommended layer thickness:	30 µm
Drying time, room temperature:	15 min with fan 20 – 30 minutes without fan
ph:	9
Removability:	Isopropanol
Heat resistance (160°C, 96 hrs):	very slight yellowing
Salt Spray Test, 240 hrs on most common paint systems:	No corrosion
CCT / ACT 1	20 Cycles Ri1
Humidity cabinet 2000 hrs:	no corrosion
Available in:	25 L Cannister / Container

<input type="checkbox"/>	ELECTRIC	<input type="checkbox"/>	MECCANIC	<input checked="" type="checkbox"/>	FLUIDIC
<input type="checkbox"/>	CLEANING	<input type="checkbox"/>	LUBRICATION	<input type="checkbox"/>	INSPECTION

Vehicle type: **SNOWBLOWER**

Model: **F90**

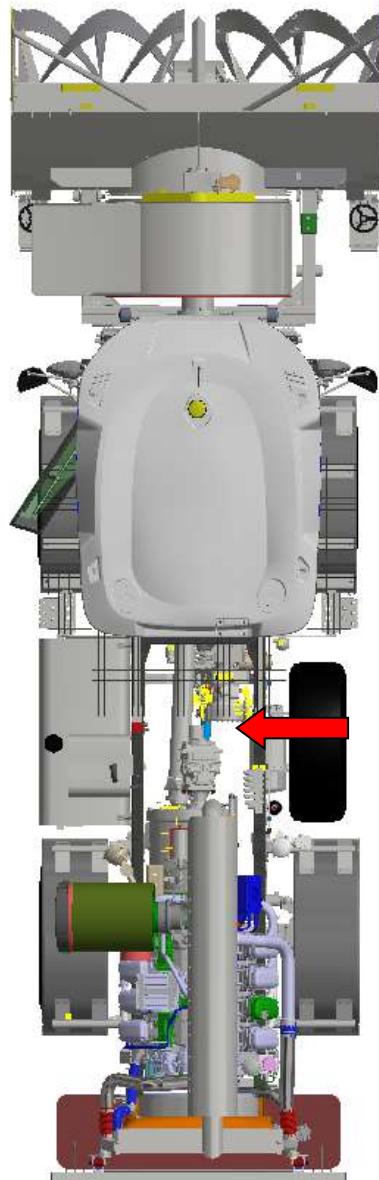
Intervention type: **CHECK THE LIQUID FOR WINDSHIELD WASHING**

**CAB**

Periodicity: **BEFORE STARTING**

Required time: **10 minutes**

Action points:



**Requested spare parts:**

- Liquid AREXONS -20 °C or equivalent

**Specific tools:**

PROCEDURE:



**WARNING:**  
*People operating on vehicle must wear protective clothes according to the regulations in force.*

The windshield washer tank is located in the front part of the rear body.



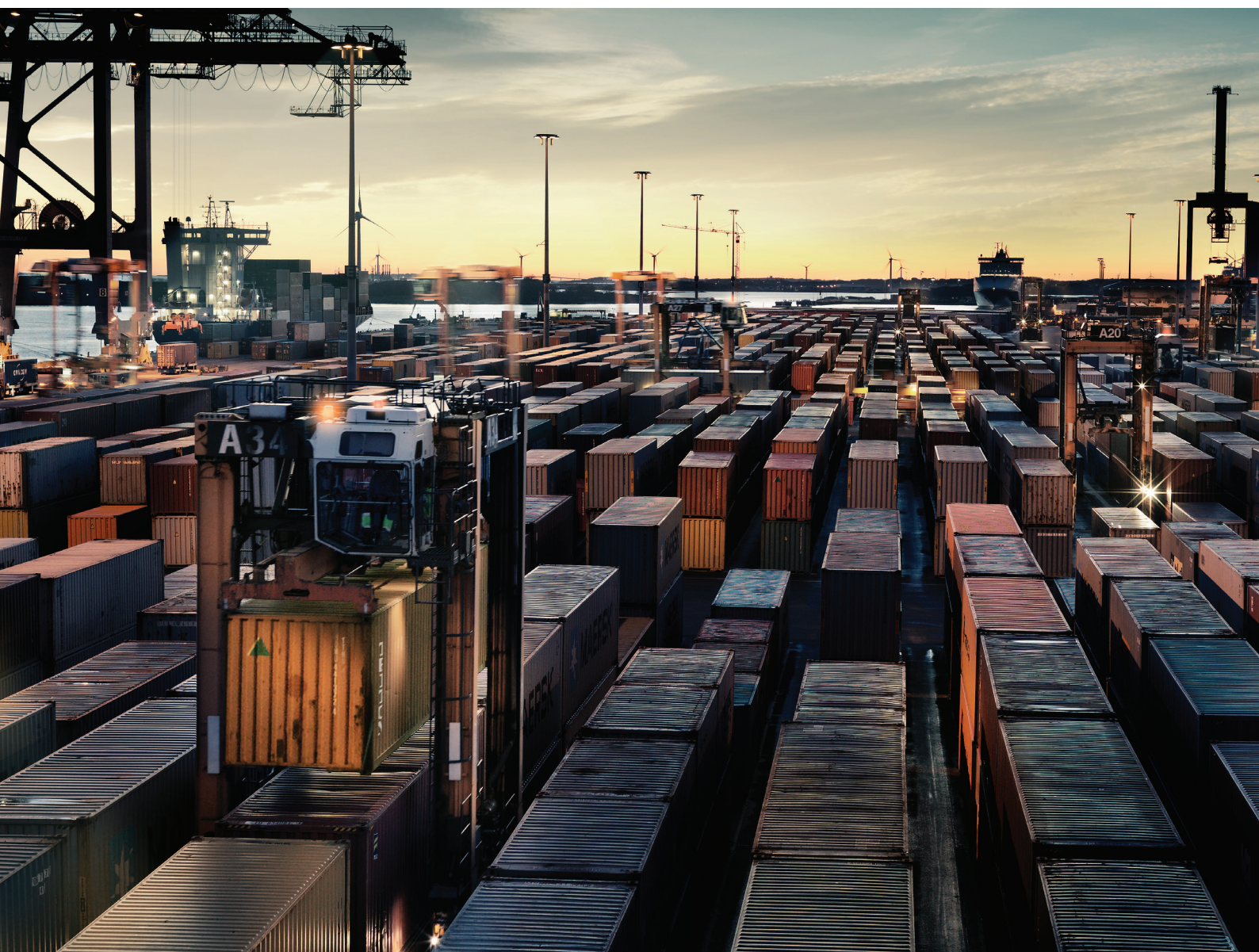
To access at windshield washer tank its necessary open the panel, which the provided key can open. Press lightly and rotate the key clockwise to open and anticlockwise to close.

Lift the capote and fill the tank with proper liquid.

V O L V O P E N T A

# OPERATOR'S MANUAL

## 16L



**ENG**

This Operator's Manual may be ordered in a different language free of charge up to 12 months after delivery, via internet.

<http://manual.volvopenta.com/coupon/>

If internet access isn't possible, please contact your Volvo Penta dealer.

**GER**

Diese Betriebsanleitung kann bis zu 12 Monate nach der Lieferung über Internet kostenlos in einer anderen Sprache bestellt werden.

<http://manual.volvopenta.com/coupon/>

Wenn Sie keinen Internet-Zugriff haben, kontaktieren Sie bitte Ihren Volvo Penta-Händler.

**FRE**

Ce manuel d'utilisation peut être commandé gratuitement sur Internet en différentes langues, jusqu'à 12 mois après la date de livraison.

<http://manual.volvopenta.com/coupon/>

Veuillez contacter votre Distributeur Volvo Penta si vous avez un problème d'accès à l'Internet.

**SPA**

El presente libro de instrucciones puede solicitarse en otro idioma diferente, libre de cargo, hasta 12 meses después de la entrega, mediante internet.

<http://manual.volvopenta.com/coupon/>

Si no se tiene acceso a internet, contacten al su concesionario Volvo Penta.

**ITA**

Il manuale per l'operatore può essere ordinato tramite Internet, in varie lingue e per consegna gratuita, entro 12 mesi dalla consegna del prodotto

<http://manual.volvopenta.com/coupon/>

Se l'accesso a Internet risulta impossibile, contattare la concessionaria Volvo Penta.

**SWE**

Denna instruktionsbok kan beställas via internet på ett annat språk gratis i upp till 12 månader efter leverans.

<http://manual.volvopenta.com/coupon/>

Kontakta din Volvo Penta-återförsäljare om du inte har tillgång till internet.

**DUT**

Dit instructieboek kan gratis via internet in een andere taal worden besteld tot 12 maanden na aflevering.

<http://manual.volvopenta.com/coupon/>

Als toegang tot het internet niet mogelijk is, neem dan contact op met uw Volvo Penta dealer.

**DAN**

Denne instruktionsbog kan bestilles gratis på et andet sprog via Internettet i op til 12 måneder efter leveringen.

<http://manual.volvopenta.com/coupon/>

Hvis det ikke er muligt at bestille via Internettet, bedes du kontakte din Volvo Penta forhandler.

**FIN**

Tämä käyttöohjekirja on tilattavissa Internetin kautta veloituksetta eri kielillä 12 kuukauden ajan toimituksen jälkeen.

<http://manual.volvopenta.com/coupon/>

Jos sinulla ei ole Internet-yhteyttä, ota yhteys lähimpään Volvo Penta jälleenmyyjään.

**POR**

Este Manual do Operador pode ser encomendada em idiomas diferentes isento de custos até 12 meses após entrega, via internet.

<http://manual.volvopenta.com/coupon/>

Se não for possível aceder à internet, contacte o seu concessionário Volvo Penta.

**GRC**

Το παρόν Βιβλίο Χρήσης μπορεί να παραγγελθεί δωρεάν σε άλλη γλώσσα μέχρι 12 μήνες μετά την παράδοση, μέσω διαδικτύου.

<http://manual.volvopenta.com/coupon/>

Εάν δεν είναι δυνατή η πρόσβαση στο ιαδίκτυο, παρακαλούμε επικοινωνήστε με το δικό σας αντιπρόσωπο της Volvo Penta.

**TUR**

Bu Kullanım Kılavuzu, teslimden 12 ay sonrasına kadar İnternet yoluyla ücretsiz olarak farklı bir dilde sipariş edilebilir.

<http://manual.volvopenta.com/coupon/>

İnternet mümkün değilse, lütfen Volvo Penta yetkili satıcınızla temasa geçin.

**CHI**

本操作手册可通过互联网以不同的言进行订购，交付后可免费使用达12个月。

<http://manual.volvopenta.com/coupon/>

如果无法访问互联网，请与沃尔沃遍达经销商联系。

**BZS**

Este Manual de operador pode ser encomendado em um idioma diferente, gratuitamente, até 12 meses após a entrega, via internet.

<http://manual.volvopenta.com/coupon/>

Caso o acesso à internet não for possível, contatar seu distribuidor Volvo Penta.

**JPN**

このオペレーターズ マニュアルの他言語版が、発行後最高12か月間、インターネットより無料で発注可能です。

<http://manual.volvopenta.com/coupon/>

インターネットにアクセスできない場合は、担当のボルボペンタディーラーまでご連絡ください。

**ARA**

من الممكن طلب دليل المشغل بلغة أخرى مجاناً عبر الإنترنت لفترة تصل إلى ١٢ شهرًا من بعد التسليم.

[http:// manual.volvopenta.com/coupon](http://manual.volvopenta.com/coupon/)

إذا كان الوصول إلى الإنترنت غير متاح، فالرجاء الاتصال بوكيل Volvo Penta.



## **WARNING!**

Operating, servicing and maintaining a marine vessel can expose you to chemicals including engine exhaust, carbon monoxide, phthalates, and lead which are known to the State of California to cause cancer and birth defects or other reproductive harm.

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. To minimize exposure, avoid breathing exhaust when operating, servicing and maintaining the engine.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Wear gloves or wash your hands frequently when servicing the vessel.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information

[www.P65warnings.ca.gov/marine](http://www.P65warnings.ca.gov/marine)

[www.p65warnings.ca.gov/products/diesel](http://www.p65warnings.ca.gov/products/diesel)



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# Foreword

## Welcome!

Volvo Penta engines are designed to fulfill Volvo's core values; quality, safety and environmental care. After more than 100 years as an engine manufacturer, the Volvo Penta brand has also become a symbol of reliability, technical innovation, top-of-the-range performance and long service life. Volvo Penta engines are used all over the world, in different operating conditions.

Make sure to thoroughly read through the Operator's Manual regarding operating and maintenance. It contains the information you need to be able to operate and maintain the engine safely and correctly. Pay careful attention to the safety instructions included in the manual.

As the owner of a Volvo Penta engine, you become part of a worldwide network of dealers and service workshop that assist you with technical advice, service requirements and replacement parts. Contact your nearest authorized Volvo Penta dealer for assistance.

It is possible to buy additional literature about your Volvo Penta engine. More information on how to do this can be found at [www.volvopenta.com](http://www.volvopenta.com).

**Information about your closest Volvo Penta dealer and other useful news and information can be found at [www.volvopenta.com](http://www.volvopenta.com) and by following Volvo Penta on Facebook.**

**V O L V O  
P E N T A**

[www.volvopenta.com](http://www.volvopenta.com)



[www.facebook.com/volvopenta](http://www.facebook.com/volvopenta)

# Safety Information

This chapter describes how safety precautions are presented in the manual and on the product. Read the chapter through very carefully before you start the engine or do any maintenance or service. It has to do with your safety; an incorrect operation can lead to personal injury and damage to products or property. It also gives you an introduction to the basic safety rules for using and looking after the engine.

If anything remains unclear or if you are unsure of something, contact your Volvo Penta dealer for assistance.

## **IMPORTANT:**

Always follow local safety instructions and regulations.

### **Safety texts have the following order of priority:**

#### **DANGER!**

Indicates a hazardous situation, which, if not avoided, result in death or serious injury.

#### **WARNING!**

Indicates a hazardous situation, which, if not avoided, could result in death or serious personal injury.

#### **CAUTION!**

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate personal injury.

#### **IMPORTANT:**

Indicates a situation, which, if not avoided, could result in property damage.

**NOTICE!** Used to draw attention to important information that facilitates work or operations.



This symbol is may be used on the product to call your attention to the fact that this is safety information. Always read such information very carefully.

Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols that have been damaged or have been painted over.



In some cases, this symbol is used on our products and refers to important information in the Operator's Manual.

Most chemicals such as engine and transmission oils, glycol, petrol and diesel oil and chemicals used in workshops such as degreasing agents, paint and solvents are harmful to health.

Carefully read the instructions on the product packaging! Always follow the safety regulations, such as the use of protective masks, goggles, gloves, etc. Make sure that other personnel are not exposed to substances that are hazardous to health. Ensure good ventilation.

Manage used and leftover chemicals in the prescribed manner.

## Daily Checks

### **▲ WARNING!**

Do not start the engine if there is reason to suspect fuel leaks or if there is explosive material nearby.

Make it a habit to give the engine and engine compartment a visual check before the engine is started and after operations, once the engine has stopped. This helps you to quickly discover fuel, coolant or oil leakages or any other abnormality that has occurred, or is about to occur.

## Personal safety equipment

### **▲ WARNING!**

Ensure that all machine guards and safety devices are in place and are functional.

### **▲ CAUTION!**

Always use appropriate safety equipment. Personal protective equipment does not eliminate the risk of injury but it will reduce the degree of injury if an accident does happen.

Some examples are ear protection, eye and face protection, protective footwear, personal protective equipment, head protection, protective clothing, gloves and respirators.



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### **▲ CAUTION!**

Never use tools or products that show signs of damage.

## Protect your eyes

### **▲ CAUTION!**

Wear safety glasses.

Always wear safety glasses if there is a risk of splintering, sparks and spray from the electrolyte (so-called battery acid), or other chemicals. Your eyes are very delicate and damage can result in loss of sight!

## Protect your skin

### ⚠ CAUTION!

Risk of skin damage.

Avoid getting oil on your skin! Prolonged or repeated exposure to oil can dry out the skin. Thereafter, irritation, dryness and eczema and other skin problems may occur.

Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before eating. Wear suitable protective creams to prevent skin from drying out and to facilitate cleaning.

## Fire safety

### ⚠ WARNING!

Fire and Explosion Risk!

Accidental spark could ignite fuel vapors.

All fuels – as well as many lubricants and chemicals – are flammable. Do not allow open flames or sparks near them. **Smoking forbidden!** Hydrogen from the batteries is also very flammable and explosive in certain mixture with air.

Ensure that the workplace is well ventilated and take the necessary precautions before welding or grinding begins. Always ensure that there is a fire extinguisher close at hand in the work area.



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## Spare parts — safety

### ⚠ WARNING!

Always use spare parts with the same quality as genuine Volvo Penta parts to minimize the risk of an explosion or fire.

Components in fuel systems and electrical systems on Volvo Penta engines are designed and manufactured to minimize the risk of explosions and fire, in accordance with applicable legal requirements.

## Used oils, filters and chemicals etc.

### ⚠ WARNING!

Risk of fire.

Store fuel soaked rags and other flammable material so that there is no danger of them catching fire.

Oil-soaked rags can spontaneously ignite under certain circumstances.

### IMPORTANT:

Used fuel and oil filters are environmentally hazardous waste and must be taken to an approved waste management facility for correct handling, as must any used lubricating oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.

## Prevent start of the engine

### **⚠ WARNING!**

Immobilize the engine by turning off the power supply with the main switch(es) and lock it (them) in the off position before starting work. Place a warning notice at the main switch.

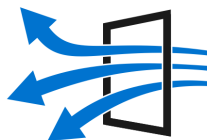
If the engine is equipped with BMS (Battery Management System), always disconnect both battery cables from the battery terminals.

## Ventilation when running the engine

### **⚠ WARNING!**

Only start the engine in a well-ventilated area. If operating the engine in a closed area ensure that there is exhaust ventilation leading out of the work area to remove exhaust gases and crankcase ventilation emissions.

The engine must not be operated in areas where there are explosive materials or stored gas.



P0024481

## Rotating parts and hot surfaces

### **⚠ DANGER!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

If the engine is in operation and operates another device, you must not, under any circumstances, staying close to the engine.



P0024808

Work on running engines is strictly prohibited. There are however adjustments that require the engine to be run. Approaching a running engine is a safety risk. Loose clothing and long hair can get caught in the rotating parts; careless movements or a dropped tool can lead to serious personal injury.

Be careful to avoid hot surfaces (exhaust pipes, turbochargers, charge air manifolds, start elements etc.) and hot fluids in pipes and hoses on engines that are running or have just stopped. Re-install all protective covers that were removed during maintenance work before starting the engine.

## Information on the engine

### **IMPORTANT:**

Make sure that all warning and information decals on the product are always visible. Replace decals which have been damaged or painted over.



P0024483



P0024688

## Prohibition on use of start spray

### **⚠ WARNING!**

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

## Before start of engine

### **⚠ WARNING!**

Never start the engine if there is reason to suspect fuel and/or gas leaks, or if there is explosive material nearby.

### **IMPORTANT:**

Only start the engine with the air filter and protective caps fitted. Foreign objects in the inlet line could cause machine damage. Also make sure that no tools or other parts have been left next to the engine.

### **⚠ WARNING!**

Never start the engine with the valve cover removed. There is a risk of personal injury. For engines with turbochargers, the rotating compressor turbine can in addition cause serious personal injuries.

## Before any work on the electrical system

### **⚠ WARNING!**

Always stop the engine first. Then disconnect the current at the main switches and any external power supply before working on the electrical system – to minimize the risk of electrical hazards.

### **IMPORTANT:**

Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables. The alternator and electronics could be damaged.

## Avoid damage to the engine control module and other electronics

### **IMPORTANT:**

Switch off the main switch before connecting or disconnecting a connector.

## Before welding work

### **IMPORTANT:**

Before any work with electric weld can begin, the connection to all control units must be disconnected. After finished welding, re-connect the connection to all control units before connecting any battery cable.

## Before any work on the cooling system

### **⚠ WARNING!**

Stop the engine and let it cool before starting work on the cooling system. Hot fluids and hot surfaces can cause burns.

## Hot coolant under pressure

### **⚠ CAUTION!**

Hot coolant can cause burns. Avoid opening the filler cap for the coolant when the engine is still hot. Steam or hot coolant can spray out and system pressure is lost.

Open the filler cap slowly and release the pressure in the cooling system if the filler cap or valve must be opened – or if a plug or a coolant hose must be removed from a hot engine.

## Hot oil under pressure

### **⚠ CAUTION!**

Hot oil can cause burns. Avoid getting hot oil on the skin. Ensure that the lubrication system is not pressurized before starting any work. Never start or operate the engine without the oil filler cap is on. There is a risk that hot oil can spray out.

## Refueling

### **⚠ WARNING!**

There is always a risk of fire and explosion during refueling. Smoking is forbidden and the engine must be stopped.

## Proper fuel quality

### **IMPORTANT:**

Always use the fuel recommended by Volvo Penta. See *Technical Data* in Operator's Manual. Other fuel can damage the engine.

Wrong fuel quality can also lead to higher service costs.

### **⚠ WARNING!**

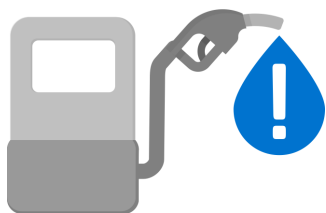
Risk of personal injury.

Wrong fuel quality in a diesel engine can cause the fuel control mechanism to bind which can cause the engine to overspeed!

## Legal requirements to use proper fuel

### **IMPORTANT:**

To meet regulatory requirements for certified emission levels must always recommended fuel according to *Technical Data* in the Operator's Manual be used.



P0024477

TWD1683GE

## Legal requirements to not alter system

### IMPORTANT:

All kind of tampering or modifications of the engine or EATS system, effecting the emission of the engine, will lead to that the type-approval for the engine becomes invalid.

## At any leak detection on the fuel system

### ⚠ WARNING!

Wear safety goggles!

Be extremely careful when searching for leaks in the fuel system high-pressure circuits. There is very high pressure in the jet from pipes and injectors. The fuel may penetrate the tissue and cause serious risk of blood infection (septicemia).



P0024488

## Handling of fuel pipes

### IMPORTANT:

High pressure pipes for fuel must not be bent or straightened under any circumstances. Cracks may occur. Damaged pipes must be replaced.

## Safe handling of batteries

### ⚠ WARNING!

Risk of fire and explosion. Never allow an open flame or electric sparks near the batteries.

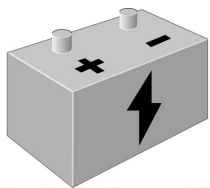
A spark caused by an incorrectly connected battery can be enough for the battery to explode with serious injuries.

Do not touch the connections during start attempts. Sparking hazard! Do not lean over batteries.

## Correct polarity of the batteries

### IMPORTANT:

Make sure that the positive (+) and negative (-) battery cables are correctly connected to the corresponding battery terminals. Wrong connection may cause severe damage to electrical equipment.



P0024468

## Risks of electrolyte in batteries

### ⚠ WARNING!

Always wear protective goggles when charging or handling batteries.

Battery electrolyte is highly corrosive.

Rinse immediately with copious amounts of water if the electrolyte gets in your eyes. Seek help from medical staff immediately after rinsing.

If the electrolyte comes into contact with unprotected skin, wash it off immediately with soap and water.

### Layout of the battery compartment

#### **IMPORTANT:**

Make sure the battery compartment is designed according to current safety standards.

### Cleaning the engine and components

#### **IMPORTANT:**

Never use a high pressure washer for cleaning of engine or engine components.



P0024486

### Cleanliness for sensitive components

#### **IMPORTANT:**

Observe meticulous cleanliness when handling system components.

Even minimal amounts of dirt could cause a breakdown.

### Adjustment of the clutch

#### **CAUTION!**

Clutch adjustments must be carried out with the engine stopped.

# Introduction

**Check that you have received the correct operator's manual before continuing reading. If not, please contact your Volvo Penta dealer.**

For engine designations, refer to *Engine*. The designation is stated on the engine plate, refer to , *page 96*.

The illustrations in this book may cover several product types, which means that there may be slight differences between the illustrations and the purchased product. This does, however, not affect the validity of the information and/or instructions in the manual. Volvo Penta reserves the right to make alterations to specifications, design features, and illustrations without prior notice.

To retain the dependability and exhaust emission control originally built into all Volvo Penta engines, it is essential that the engines and receive periodic maintenance according to the maintenance instructions.

At service, software that affects the functionality described in this manual can be updated.

## About this manual

This Operator's Manual contains the information required for the correct, safe operation and maintenance of your Volvo Penta engine. Read the Operator's manual carefully and learn to handle the engine and other equipment in a safe manner before you start the engine.

## Warranty

Your new Volvo Penta engine is covered by a limited warranty, subject to the conditions compiled in the Warranty Information. AB Volvo Penta's liability is limited to the specification in the Warranty Information and Emission Control System Warranty Statement.

Read the information carefully, as soon as possible after delivery. It includes important information about service and maintenance; the owner is responsible for being familiar with checking and implementing these. Otherwise AB Volvo Penta may deny its warranty obligations in part or in full.

**Contact your Volvo Penta dealer if you have not received information on how to access the Warranty Information or recived the Service Book.**

## Extended Coverage

With the Extended coverage options, customized for each engine's particular needs and working conditions, you can take total control of upcoming operational costs.

For more information regarding our different Services, visit [volvopenta.com](http://volvopenta.com) or contact your Volvo Penta representative.

## Running in the engine

### **The engine must be run in during its first 10 operating hours, as follows:**

Run the engine in normal operations. However, full load may not be applied other than for short periods.

Higher oil consumption is normal during the first 100– 200 hours of operation. For this reason, check the oil level more frequently than the normal recommendation.

When a disengageable clutch is installed, it should be checked more carefully during the first days. Adjustments may be necessary to compensate bedding-in of the friction plates.

## Fuel, oils and coolant

Only use the fuels and oils recommended in the Operator's Manual (Technical Data), other viscosity and quality may cause malfunctions, increased fuel consumption and possibly shorten the life of the engine.

Always change the oil, oil filters and fuel filters at the specified maintenance intervals.

Make sure to always use suitable and correctly mixed coolant.

If an unsuitable coolant has been used, or if the instructions for coolant mixture have not been followed, future warranty claims related to engine and accessories may be denied.

## Maintenance and replacement parts

Volvo Penta engines are designed for maximum reliability and long life and built to withstand a demanding environment. The engines are also designed to have a minimal environmental impact. These qualities will be maintained through regular servicing and the use of spare parts with the same quality as genuine Volvo Penta parts. If reliable and purpose-built parts are not used, your safety, health, and the machine's function may be compromised. Volvo Penta has a world-wide network of authorized dealers.

The authorized dealers are Volvo Penta product specialists, and have the accessories, genuine parts, test equipment and special tools needed for high quality service and repair work. Remember to note the engine / transmission identification number when you **order service and spare parts.**

## **Excessive strain on a product and components**

Volvo Penta products and components are not dimensioned for external loads. Never stand or step onto an engine, transmission or its components. Loads can bring about damage and the malfunction of a product or property.

## **Environmental care**

Environmental care is a core value at Volvo Penta. Energy efficiency and low emissions are among the most important product related aspects and priority focus areas for Volvo Penta business. Several of the global challenges the world faces are directly or indirectly related to power industries and transports. We recognize that Volvo Penta is part of the environmental problems, but we are also convinced that we are a part of the solution.

Volvo Penta currently has a broad engine program in which great advances have been made in reducing exhaust emissions in the same time as the fuel consumption has been improved. Through regular maintenance, the Volvo Penta engines retain its low fuel consumption and low emissions. We hope that you will be keen to preserve these qualities.

Always follow the directions in the Operator's Manual regarding fuel grades, operation and maintenance to avoid unnecessary environmental impact. Contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or exhaust smoke.

Remember always to hand in environmental hazardous waste such as drained oil, coolant, old batteries, etc. for treatment at a recycling facility. Our united efforts can make a valuable contribution to the environment.

## Certified engines

**If you own an emission-certified engine used in an area where exhaust emissions are regulated by law, this places special demands on the care and maintenance you provide your engine.**

**NOTICE!** Neglects or failure to follow the points listed here may invalidate the engine emission certificate. This means AB Volvo Penta can no longer guarantee engine conformity with the certified model. Volvo Penta is not responsible for damages or costs arising as a result of this.

- Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are equivalent to the certified engine.
- It is the responsibility of the operator/user to ensure that no intentional misuse of the engine takes place.
- Volvo Penta maintenance and service intervals must be complied with.
- Any case of malfunction must be rectified without delay.
- Only use genuine Volvo Penta parts or spare parts with the same quality as genuine Volvo Penta parts.
- Volvo Penta recommends that service to injection pumps, pump settings and injectors always are carried out by a qualified workshop.
- The engine must not be converted or modified in any way, except with accessories and service kits that Volvo Penta has approved for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.

**NOTICE!** All kind of tampering or modifications of the engine and it's EATS system will void the type-approval of this particular engine.

## Stationary emergency application

If the engine is ordered for stationary emergency applications, it can only be used for emergency operations and required maintenance and testing.

## Emission Aftertreatment System

### AdBlue®/DEF

AdBlue®/DEF <sup>(1)(2)</sup> is mandatory for the equipment/ vehicle to comply with emission directive certification.

When adding AdBlue®/DEF, the solution must fulfill ISO22241 standards. If the solution used don't fulfill the ISO standard, any warranty claims will be rejected.

Using an engine that does not use AdBlue®/DEF, or the use of low quality solution, where such is required to reduce air pollution is a punishable offense. A consequence of such a failure may entail invalidation of conditions and warranties provided in the country where the engine is used.

Filling should take place between scheduled service intervals. The consumption of AdBlue/DEF is a percentage of the fuel consumption and is varying depending on the operating conditions. For filling instructions, refer to *Filling AdBlue®/DEF* , page 77.

If the exhaust gas control system does not work correctly the operator will be informed by a fault indication.

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1. AdBlue® = Registered trademark of the Verband der Automobilindustrie e.V. (VDA ).

2. DEF = Diesel Exhaust Fluid

## Emergency Situation Inducement Override

**NOTICE!** The functionality for Emergency Situation Inducement Override only exists on engines ordered with this function. The function temporarily disables emissions controls during a qualified\* emergency situation. All other use of the function constitutes a violation of the law.

\*A qualified emergency situation is one in which the condition of an engine's emission controls poses a significant direct or indirect risk to human life. An example of direct risk would be an emission control condition that inhibits the performance of an engine being used to rescue a person from a life-threatening situation.

An example of an indirect risk would be an emission control condition that inhibits the performance of an engine being used to provide electrical power to a data center that routes "911" emergency response telecommunications.

### Activate

The function is activated manually and delays the lowering of performance due to defects in the aftertreatment system. When the function is activated the normal lowering of performance is delayed by up to 120 hours in a single activation.

Once deactivated, either by the operator or by reaching 120 hours, it cannot be reactivated without contacting an authorized Volvo Penta dealer to reset the function to its original 120 hours.

Federal regulations prohibit activating the emergency inducement override for something other than a qualified emergency situation. This violation is subject to penalties under 40 CFR 1068.101 and may assess a civil penalty.

### Deactivate

The Operator must cancel the function immediately after the emergency situation has ended, or after the cause of the lowering of performance has been corrected.

The function will automatically deactivate within a cumulative engine run time of 120 hours after the inducement override was initially activated.

The engine can be shutdown during the emergency situation, e.g. refueling, and the counter will be stopped during the shutdown. The Emergency Inducement Override will not be stopped by shutting down the engine, but needs to be manually canceled by the operator or it will automatically be deactivated if the 120 hours limit has been reached.

Failing to disable the Emergency Inducement Override after a qualified emergency situation ends, or after the problem causing the emission control strategy to interfere with engine performance has been fixed is a violation of Federal regulations and subject to penalties under 40 CFR 1068.101 and may assess a civil penalty.

**Reactivate**

The operator must request the resetting of Emergency Situation Inducement Override function to its original 120 hours after each deactivation.

To reset the function to its original 120 hours, contact an authorized Volvo Penta dealer.

The operator (or another person responsible for the engine/equipment) may request resetting the Emergency Inducement Override at any time. Volvo Penta may reset the function only if given evidence that the emergency situation is continuing, or after the operator provides the information required in the report described below, in writing or by any other means.

**Report**

The operator (or another person responsible for the engine/equipment) must send a written report to the manufacturer after each occasion the Emergency Situation Inducement Override function has been activated. The report must be sent to the manufacturer within 60 calendar days after activating the function.

The report must include the following:

- (1) Contact name, mail and email addresses, and telephone number for the responsible company or entity.
- (2) A description of the emergency situation, the location of the engine during the emergency, and the contact information for an official who can verify the emergency situation (such as a county sheriff, fire marshal, or hospital administrator).
- (3) The reason for inducement override activation during the emergency situation, such as the lack of DEF, or the failure of an emission-related sensor when the engine was needed to respond to an emergency situation.
- (4) The engine's serial number (or equivalent).
- (5) A description of the extent and duration of the engine operation while the function was active, including a statement describing whether or not the override was manually deactivated after the emergency situation ended.

Volvo Penta will send the information from the operator's report to US EPA and California ARB. Federal regulation separately prohibits submitting false information.

Failing to notify the manufacturer and send reports as required above is a violation of Federal regulations and subject to penalties under 40 CFR 1068.101 and may assess a civil penalty. In addition, knowingly submitting false information is a violation of 18 U.S.C. 1001, which may involve criminal penalties.

## Special Maintenance

**NOTICE!** The following special maintenance instructions apply solely for engine ordered with the Emergency Situation Inducement Override functionality.

When activated, the functionality will delay the lowering of performance due to defects in the after treatment system by up to 120 hours in a single activation. Continued operation after the trigger of emissions-control-system warning alarms can result in damage to the After Treatment system.

Special maintenance is required after deactivation of the Emergency Situation Inducement Override function.

Please contact an authorized Volvo Penta dealer for inspection and repair.

**NOTICE!** Operation and maintenance of engine in a manner not specified by these special maintenance instructions could result in a violation of law subject to penalties.

## Volvo Penta Dealer Network

The Volvo Penta global network of authorized dealers is at your service. We strongly recommend that you take your product to an authorized Volvo Penta dealer for service and repair. They are specialists in Volvo Penta products and have the accessories, genuine Volvo Penta parts, the special tools and the latest service information for high quality service and repair work.

### Dealer Locator Services

Locate the nearest Volvo Penta dealer through our dealer locator on [www.volvopenta.com](http://www.volvopenta.com) or download the dealer locator app to your smartphone.

## Volvo Penta Action Service

Our global dealer network, your first line of contact, is backed up by Volvo Penta Action Service, a phone based breakdown and support service providing assistance 24 hours a day, every day of the year.

### How it works

A dedicated operator will support you all the way through your case and keep you updated on status and progress.

Whenever on-site assistance or technical support is needed, the operator will put you in contact with the closest Volvo Penta dealer that can support your product.

### Phone numbers

Find your Volvo Penta Action Service phone number and more information on [www.volvopenta.com](http://www.volvopenta.com).



P0038980

# Presentation

## Engines

This Operator's Manual covers the industrial engines: TWD1682GE, TWD1683GE, TWD1683GE-B, TWD1683VE

All of the models are in-line, six-cylinder, direct injection industrial engines. They are equipped with electronic management systems (EMS), turbochargers, charge air coolers, thermostatically controlled cooling systems and electronic speed control.

TWD1682/83GE is a premium dual speed engine, switchable between 1,500 rpm (50 Hz) and 1,800 rpm (60 Hz) and delivering 570 kWm and 596 kWm respectively. The engine meets the CARB/EPA Tier 4 Final and EU Stage V requirements for engines above 560kW with the same hardware and software, as well as being EU RoHS2 compliant.

To reduce emissions, the engines are equipped with EATS systems. Refer to , *page 24*.

To retain the dependability and exhaust emission control originally built into all Volvo Penta engines, it is essential that the engines and receive periodic maintenance according to the maintenance instructions.



P0029433

## EMS (Engine Management System)

EMS is an electronic system with CAN communication (Controller Area Network) for diesel engine control. The system has been developed by Volvo Penta and includes fuel regulation and diagnostic functions. The system consists of a control unit, injectors, a number of sensors that supply the control unit with information, and connectors for diagnostics and functional checks. The engine can be connected to a communication interface comprising a CAN link and a serial link.

### Input/Output signals

The information from the sensors provides precise data about prevailing operating conditions and allows the processor in the control module to, among other things, calculate correct injection amount, injection timing and check the engine's condition.

### Fuel regulation

The engine fuel requirement is analyzed up to 100 times per second. The engine injection volume and injection timing are controlled electronically via the fuel valves in the injectors. The control unit receives signals from sensors and monitors in order to determine when the fuel valve must open and close. This means the engine always receives the correct fuel volume under all operating conditions, which means lower fuel consumption and the lowest possible exhaust emission.

### Diagnostic function

The purpose of the diagnostic function is to detect and locate any malfunctions in the EMS system, as well as to protect components from damage.

If a malfunction is detected, this is announced by warning lamps, a flashing diagnostic lamp or a text message on the instrument panel, depending on the equipment fitted. If a fault code is displayed it is used for guidance in any fault tracing. Fault codes can also be read by Volvo's VODIA tool at authorized Volvo Penta workshops.

If there is a serious malfunction, the engine will be shut down completely or the control unit may reduce power output (depending on the application). Fault codes are registered as an aid to fault tracing.

## EATS (Exhaust Aftertreatment System)

EATS (Exhaust Aftertreatment System) is used to reduce emissions and comply with statutory emission levels. In the SCR-system (Selective Catalytic Reduction) the exhaust gases are treated through the addition of AdBlue®/DEF before they pass through the catalytic converter. Sensors measure nitrogen oxide (NOx) levels in the exhaust gases.

The engine control unit calculates the optimum amount of solution to be added in relation to engine load and engine speed, to achieve efficient reduction of nitrogen oxides.

**NOTICE!** All kind of tampering or modifications of the engine and it's EATS system will void the type-approval of this particular engine.

### AdBlue®/DEF

The solution that is added to the exhaust gases is a clear, transparent liquid with a faint odor of ammonia; it consists of de-ionized water mixed with 32.5% urea (the solution must meet ISO 22241 standards / API AUS 32). The urea in the exhaust is broken down into ammonia which reacts with NOx to form harmless nitrogen and water vapor, which occur naturally in our surroundings.

The solution is not flammable or harmful to health with normal use; it is however very corrosive to metals, especially copper and aluminum.

#### **IMPORTANT:**

The use of solution that do not fulfill the ISO 22241 standard will compromise the aftertreatment system performance, increase emissions. Any warranty claims will be rejected.

**NOTICE!** The urea solution has different names in different markets, e.g. DEF or AdBlue®. The solution is designated either AdBlue or AdBlue/DEF in display messages.

### Monitoring

The system is monitored to ensure that all system components are working as they should, that the quality of the AdBlue®/DEF fulfills set standards and that the tank level is not too low. Should the system detect deviations, the maximum engine torque and engine speed will be reduced and a fault code stored in the control unit. For further information refer to *EATS Inducements, VE-engines (EU)*, page 49.

## Shut-down

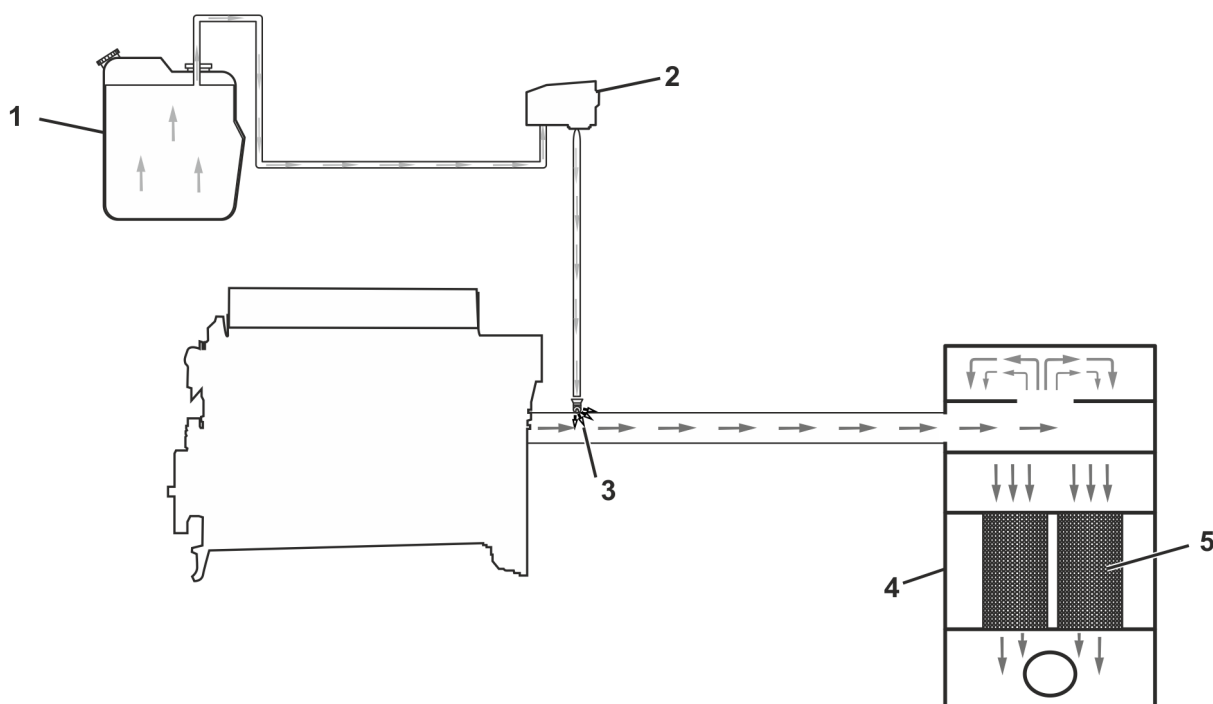
Should any solution remain in the hoses in freezing weather, the entire system can be damaged. To avoid this and any solution spillage, the system is equipped with automatic drainage when the engine is switched off so that hoses, the pump and injector are emptied and the solution runs back to the tank.

**NOTICE!** The automatic drainage only works when the engine is stopped using the ignition switch or the stop button on the instrument panel (depending on application), not if only the engine power supply is disconnected. If the system is not drained properly, solution may squirt out if the hoses are disconnected.

### ⚠ CAUTION!

The EATS system needs time to for automatically drainage and depressurizing. Wait at least two minutes after the engine been turned off before removing the AdBlue/DEF hoses.

## Overview



P0030008

### The system comprises:

- 1 AdBlue®/DEF Tank
- 2 AdBlue®/DEF Pump
- 3 AdBlue®/DEF Injector
- 4 EATS Catalyst and Muffler
- 5 Catalytic Converter

The atomized urea solution is sprayed into the exhaust gases upstream of the catalytic converter.

## AdBlue®/DEF Tank

### IMPORTANT:

Dirt/dust, oil, greases, detergents and any chemicals and natural products must be prevented from entering the Adblue/DEF tank.

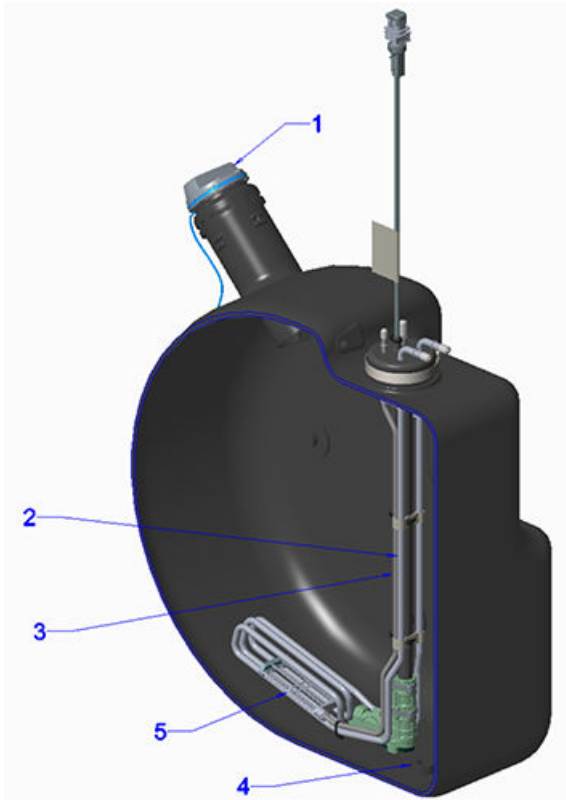
The system will be damaged if dust or dirt enters the tank clogging the filters in the dosing system. Keep the tank clean at all times.

The AdBlue®/DEF is stored in a separate, tank. The tank is available in different sizes.

There is a fitting in the tank that comprises a heating coil (2), a float (3) and a filter (5) on the suction line to prevent any particles from circulating through the system and causing disruptions. The filter must be checked and cleaned as necessary.

There is a drain plug (4) on the bottom of the tank so that the solution can be emptied when necessary, e.g. for cleaning. The tank is fitted with a breather to equalize pressure changes.

The filler pipe (1) is equipped with a blue cap to clearly indicate that the tank contains AdBlue/DEF.



P0028517

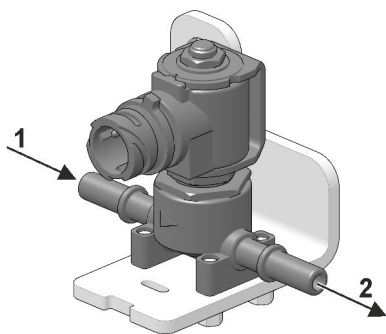
ENGINE DATA	
Fuel level	87 l ^
AdBlue/Def level	15 l
Soot load level	34 %
Exhaust temperature	211 °C
Engine speed	1500 rpm

P0028067

## Tank level

The solution consumption varies during operations. The level in the tank is shown on the gauge as a percentage of the total tank volume, or what the OEM choose to display.

The tank level signal is continuously read by the EMS. When the level falls below the set limit, the level sensor in the tank transmits a signal that stops AdBlue/DEF dosing. A fault code is set in the engine control unit, a warning lamp lights up and a fault message is shown on the control panel. If solution is not added, injection into the exhaust pipe will cease and engine torque and engine speed will be limited. When solution is added the fault message is canceled and the engine is able to revert to full power. For genset the engine will be shut down according to inducement settings. Refer to *EATS Inducements, VE-engines (EU)*, page 49 for further information.



1. From engine
2. To tank

## Heating

Because AdBlue®/DEF solution freezes at around  $-11\text{ °C}$  ( $12.2\text{ °F}$ ) the tank is equipped with a heating coil that uses engine coolant. A solenoid valve controls the flow of coolant. The hoses between the tank, pump and injectors are electrically heated and the hose connections are equipped with extra insulation.

There is a temperature sensor in the tank that transmits a signal to the control unit so that the pump cannot start until the AdBlue®/DEF solution is fluid. The standard system can handle thawing from  $-40\text{ °C}$  ( $-40\text{ °F}$ ). The system is emptied at shut down in order to prevent expansion damage due to freezing.

### **IMPORTANT:**

Hoses must be handled carefully and not twisted or bent excessively in order to avoid damaging the heating system.

## Storage

### **IMPORTANT:**

To prevent breakdown and evaporation during longterm storage, AdBlue®/DEF may not be stored at temperatures higher than  $25\text{ °C}$  ( $77\text{ °F}$ ) or in direct sunlight.

Remember that the solution expands upon freezing and to leave room for expansion in the tank when storing in spaces where there is a risk of freezing.

## Operation

### ⚠ WARNING!

In the case of any contact with eyes or skin the affected area must be thoroughly rinsed with lukewarm water. If you inhale any fumes, make sure you breathe fresh air.



P0011697



### ⚠ CAUTION!

Risk of corrosive damage.

Contact with the fluid can cause irritation and corrosion.

Wear protective gloves!

Change gloves and clothing that have been in contact with the liquid.

### ⚠ CAUTION!

Risk of material damage.

AdBlue®/DEF oxidises metal and the capillary action creeps through lines at a speed of approx. 0.6 metres per hour.

If spillage occurs, electrical connectors must be replaced immediately. Do not try to clean with water or compressed air.

AdBlue®/DEF is not a combustible product. When exposed to high temperatures it will convert to ammonia and carbon dioxide. However, do not allow the solution to come into contact with other chemicals or be mixed with other chemicals.

When handling AdBlue®/DEF it is important that electrical connectors are connected or well-encapsulated. The solution is corrosive toward certain metals such as copper and aluminum. Should oxidation occur, it cannot be removed.

If connectors come into contact with the solution they must be replaced immediately to prevent the solution from seeping further along the copper wiring.

If the solution is spilled onto the engine, wipe it away and flush with water. White crystals of concentrated AdBlue®/DEF may form in the event of a spill; wash the crystals away using water.

### IMPORTANT:

AdBlue®/DEF spillages may not be washed into drains.

If a spill should occur, the solution must be absorbed using dry sand or other non-flammable material and handled according to local and national regulations.

## Cleaning tools and clothes

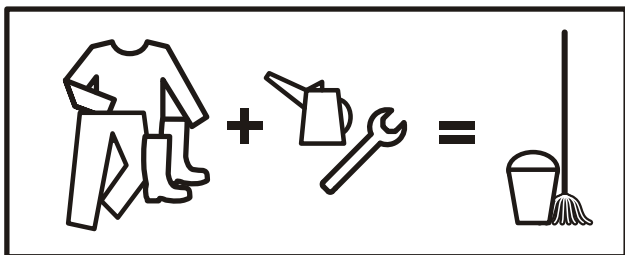
### ⚠ CAUTION!

Gloves must be changed. Take off contaminated clothes.

### ⚠ CAUTION!

Tools that come into contact with the fluid must be cleaned.

It is important that tools and clothes are thoroughly cleaned from AdBlue®/DEF so that the liquid or crystals are not transferred to other parts and cause them damaged.



p0013225

### Contact with AdBlue®/DEF

- **skin contact** — flush with copious amounts of water and remove contaminated clothing.
- **eye contact** — flush thoroughly for several minutes; contact physician as necessary.
- **inhalation** — breathe fresh air and contact physician as necessary.

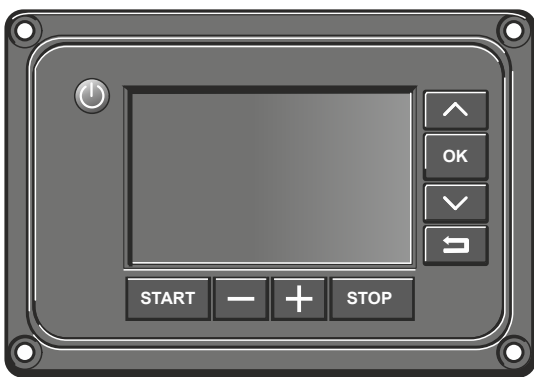
# Instruments and Controls

## Control Interface Module


The Volvo Penta Control Interface Module (CIM) instrument panel communicates with the engine control unit and has a number of functions as control, monitoring and diagnostics.

**NOTICE!** Settings and the type of engine data presented on the display may vary depending on the installation and engine model.


**NOTICE!** The menus and illustrations shown here are the English version. Refer to the section *Settings* to change the display language.




P0018811


 Turn On/Off the ignition


 **START** Start the engine


 Reduce engine rpm


 Increase engine rpm

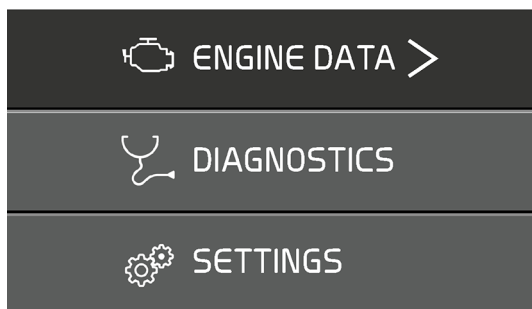
 **STOP** Stop the engine

 Scroll upwards in menus

 **OK** Select and confirm in menus

 Scroll downwards in menus

 Return to previous menu selection



P0028070

## Display

The basic view shows three main menus.



- **ENGINE DATA** (ENGINE DATA), shows current engine data.
- **DIAGNOSTICS** (DIAGNOSTICS), shows fault codes.
- **SETTINGS** (SETTINGS), shows display and engine settings.

Press **OK** to proceed in the submenus and scroll using the panel arrow buttons.

Press **←** to return to previous menu.

## Status bar

The status bar with symbols for active malfunctions is shown in the top right of the display.

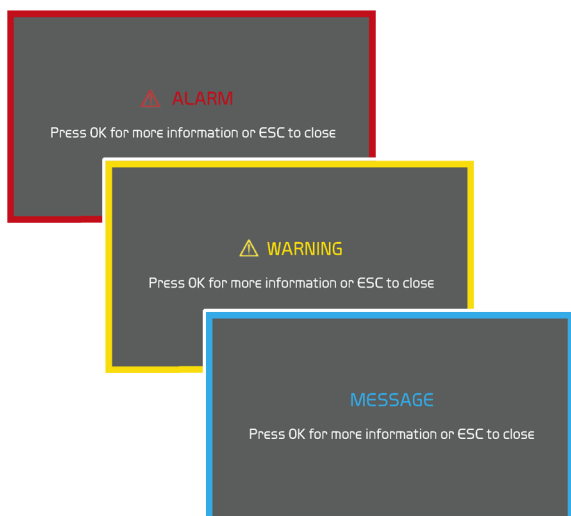
	Emission related malfunction
	EMS system malfunction

## Alarms and messages

Messages to the operator are of three types, color coded according to degree of severity.

When a message is shown on the display, press **OK** to reach the diagnostic menu to get more information regarding registered faults and instructions for remedial actions.

- **ALARM** (ALARM), red text, the system has detected a serious fault — Volvo Penta recommends to immediately contact a qualified workshop .
- **WARNING** (WARNING), yellow text, the system has detected a fault — Volvo Penta recommends to contact a qualified workshop as soon as possible.
- **MESSAGE** (MESSAGE), blue text, non-critical engine message for the operator.



P0028068

**ENGINE DATA**

Fuel level	87 l ^
AdBlue/Def level	15 l
Soot load level	34 %
Exhaust temperature	211 °C

Engine speed **1500 rpm**

P0028067

## Menus

### ENGINE DATA (ENGINE DATA)

Engine data shown may vary depending on the engine installation.

- **Engine Hours** (Engine Hour)
- **Engine Speed** (Engine Speed) (rpm)
- **Coolant Temperature** (Coolant Temperature) (°C/°F)
- **Oil Pressure** (Oil Pressure) (kPa)
- **Fuel Rate** (Fuel Rate) (l/h/gph)  
Current fuel consumption.
- **Boost Temperature** (Boost Temperature) (°C/°F)
- **Boost Pressure** (Boost Pressure) (kPa)
- **Oil Temperature** (Oil Temperature) (°C/°F)
- **Battery voltage** (V)
- **Engine load** (%)
- **Fuel delivery pressure** (bar/psi)
- **Throttle/pedal percent** (%)
- **Fuel level** (l/g)
- **Def/Aus level** (l/g)
- **Soot load level** (%)
- **Exhaust temperature** (°C/°F)

### DIAGNOSTICS (DIAGNOSTICS)

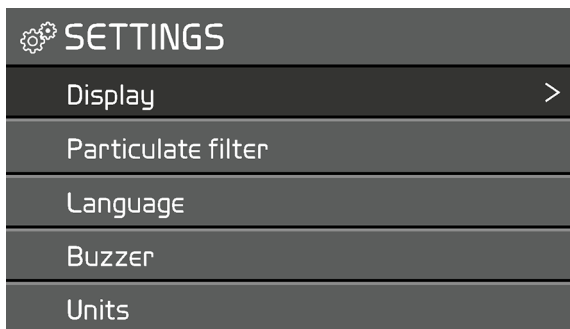
If the system detects a malfunction, the operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes. For more information regarding cause and remedies, use the arrow button to scroll to the fault concerned and press **OK**. This will also provide information about number of engine hours when the fault became active and the SPN and FMI codes.

**DIAGNOSTICS**

- Coolant level low >
- Coolant temperature high

Historical alerts

P0028065



P0028270

## SETTINGS (SETTINGS)

### Display (Display)

- **Set backlight time** (Set backlight time). On/OFF, sets backlight to run in standby mode. *On* is the default setting.
- **Set backlight brightness** (Set backlight brightness). Adjust display backlight brightness using the panel arrow buttons.
- **Set Instrument Brightness** (Set Instrument Brightness). Sets backlighting in the display instrument.
- **Change background color** (Change background color). Select background color, gray or white.

### Particulate filter, only applicable for VE

- Start regeneration, here you can manually start the regeneration when all requirements for regeneration are met.

### Language (Language)

Sets the display language; chooses between English, French, German, Spanish, Italian, Brazilian-Portuguese, Russian and Chinese.

### Buzzer

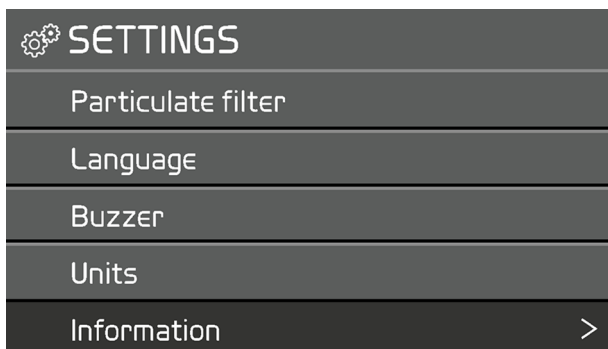
#### Enable/Disable (Enable/Disable)

Option to disable the built-in buzzer in the CIM.

### Unit

- Metric
- imperial

**NOTICE!** Here you choose which devices you want to use, metric or imperial.



P0028160

### Information

Reading CIM information

- **Engine Hardware ID** (Engine Hardware ID)
- **CIM hardware ID** (CIM hardware ID)
- **Engine Software ID** (Engine Software ID)
- **CIM Software ID** (CIM Software ID)
- **Chassis ID** (Chassis ID)

## Easy Link Instruments

The following Easy Link instruments are available:

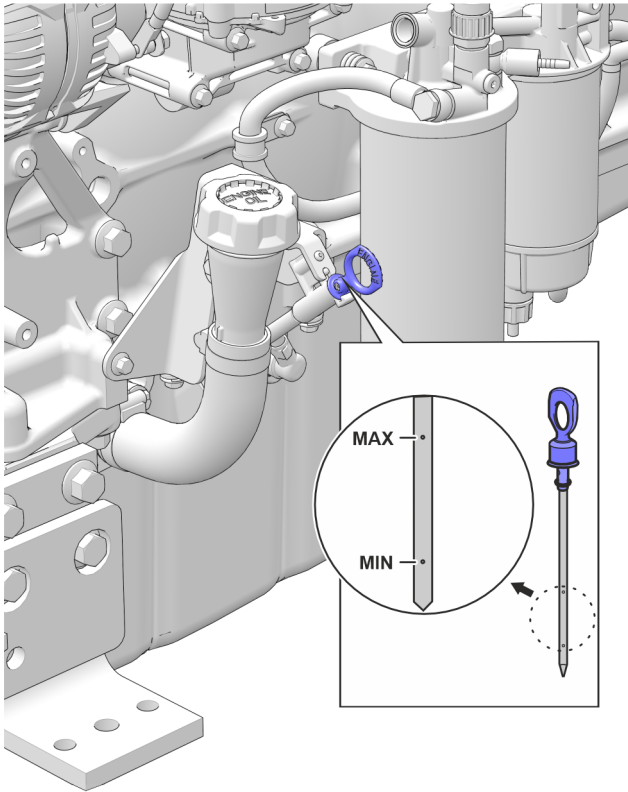
- Tachometer / hours counter (fault codes are also displayed on the tachometer display when the diagnostic button is pressed)
- Coolant temperature
- Oil pressure
- Oil temperature
- Battery voltage
- Alarm panel
- Turbo pressure

# Starting

Make it a habit of giving the engine and engine room a visual check before starting. This will help you to discover quickly if anything abnormal has happened, or is about to happen. Also check that instruments and warning displays show normal values after you have started the engine.

## **⚠ WARNING!**

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.



P0039034

## Before Starting

- Check that the oil level is between the MIN and MAX marks.  
For filling refer to *Oil level, checking and topping up*.

**NOTICE!** The engine should be placed on a level position when the oil is checked. Dipstick can be read when the engine is stopped.

- Open the fuel valves.
- Check the fuel pre-filter; refer to *Draining condensate, fuel system, page 66*.
- Check the coolant level and that the radiator is not blocked externally. Refer to *Coolant Level, Checking and Topping Up, page 71* and *Charge Air Cooler, External Cleaning, page 73*

## **⚠ WARNING!**

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

- Check that no leakage of oil, fuel or coolant is present.
- Turn the main switch(es) on.
- Move the engine speed control to idle, and open the disengageable clutch/gearbox if installed.

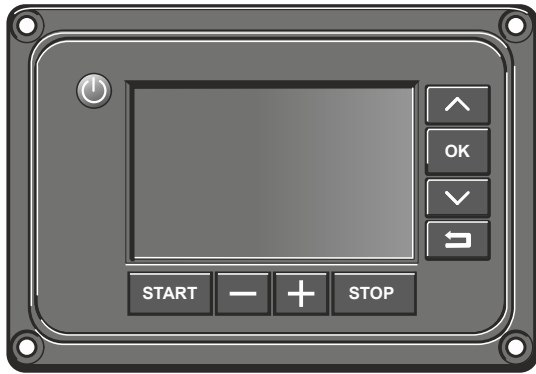
## **IMPORTANT:**

Never break the circuit with the main switch while the engine is running. Alternator and electronics could be damaged.

## Starting the Engine


The pre-heating time (optional) is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting.

The starter motor cranking time is maximized to 20 seconds. After that, the starter motor circuit is temporarily cut to protect the starter motor from overheating.



P0018811

## CIM (Control Interface Module)

- 1 Press the  button to switch on the ignition. The display switches on at the same time.
- 2 If preheat is activated, wait until heating icon has disappeared until START is requested.
- 3 Press the START button to start the engine.

## Starting Using Auxiliary Batteries

### **WARNING!**

Explosion hazard. Batteries contain and give off an explosive gas which is highly flammable and explosive. A short circuit, open flame or spark could cause a violent explosion. Ventilate well.

- 1 Check that the auxiliary batteries are connected (series or parallel) so that the rated voltage corresponds to the engine system voltage.
- 2 First connect the red (+) jumper cable to the auxiliary battery, then to the flat battery. Then connect the black (-) jumper cable to the auxiliary battery and to a location that is **somewhere away from the discharged battery**, e.g. the main switch negative terminal or the negative terminal on the starter motor.
- 3 Start the engine.

### **WARNING!**

Do not touch the connections during the start attempt: Risk of arcing.

Do not bend over any of the batteries either.

- 4 Remove the cables in the reverse order.

### **IMPORTANT:**

The ordinary cables to the standard batteries must not under any circumstances be loosened.

# Operation

Correct operating technique is very important for both fuel economy and engine life. Always let the engine warm up to normal operating temperature before operating at full power. Avoid sudden throttle openings.

## Reading the Instruments

Check all instruments directly after starting, and then regularly during operation.

**NOTICE!** On engines in continuous operation, it is recommended that the lubrication oil level is checked at least every 24 hours. Refer to *Oil level, checking and topping up*.

## Alarms

If the Control Unit receives abnormal signals from the engine, the control unit generates fault codes and alarms, in the form of lamps and audible warnings. This is done by means of CAN signals to the instrument.

More information about fault codes and fault tracing can be found in the chapter , *page 42*.

## Maneuvering

### Operation at low load

Avoid long-term operation at idle or at low load. It takes a long time for the engine to reach working temperature, resulting in high viscosity of the oil and large clearances in the engine mechanics. In cold climate, it takes even longer.

The combustion temperature and cylinder pressure can become so low that an effective combustion cannot be ensured. At these conditions unburned fuel could dilute the lubricant oil. Because of the low cylinder pressure, the piston ring performance could be affected causing oil from the crankcase to pass the rings and go further out with the exhaust gases. This mixture of unburned fuel and oil in exhaust gases is referred to as "slobber". A new engine produces more "slobber" at low load compared to an engine with more hours of operation.

At low load, the pressure in the turbocharger is low and oil could seep past the turbocharger seals and mix with the air into the engine. The consequences can be carbon build-up on valves, piston crowns and the exhaust turbine, which could affect engine performance.

Both conditions can lead to increased oil consumption and eventually external oil leakage from joints in the exhaust system. For example, leakage could be seen at the exhaust manifold, before and after the turbo, around the muffler and in worse case even in the exhaust end pipe. Consequences could lead to clogged exhaust gas recirculation systems and exhaust aftertreatment systems.

Signs of oil leaking caused by "slobber" do not indicate an engine problem but indicates low load operation. To minimize the risk of malfunctions caused by operation at low load, follow these points as a complement to normal maintenance:

- Run in the engine as soon as possible.
- Load the engine so it reaches working temperature as soon as possible.
- For VE: Turn off the engine instead of running on idle for longer periods.
- For genset turn off the engine instead of running unloaded for longer periods.
- Avoid load levels below 20% as constant operation.
- If the engine is regularly tested without load, limit the duration of the operation to 5 minutes. Run the engine at full load for about 4 hours once a year, for the carbon deposits in the engine and exhaust system to burn off.
- If visible slobber has occurred, it can be burned off by running the engine on at least 30% load for about 40-60 minutes.

# Engine Shutdown


During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion in the engine. If you expect the engine to remain unused for two months or more, it must be preserved: Refer to the chapter , page 85.

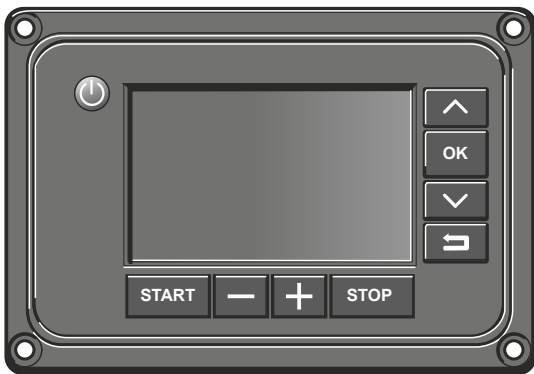
## Before Engine Shutdown

Let the engine run at high idle (1500 or 1800rpm) for a minimum of 5 minutes before the shutdown after normal use. Normal use is defined as minimum 50% load. After use with less than 50% load, high idle for approximately 3 minutes is sufficient. This allows engine temperature equalization and prevents boiling once stopped and also allows the turbochargers to cool down. This contributes to long, fault-free service life.

**NOTICE!** Do not turn off the main switch within 30 seconds after turning off the ignition. This is in order to save engine data to the engine control unit.

## Stop the Engine

- 1 Disengage the clutch, if possible.
- 2 Press the STOP button to turn off the engine.
- 3 Press the  button to turn off the ignition.



P0018811



P0025697

## Auxiliary Stop

For location of the extra stop, refer to , page 58.

### **WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

## After Engine Shutdown

- 1 Check the engine and engine compartment for leaks.
- 2 Turn off the main switches before any long stoppage.
- 3 Carry out maintenance in accordance with the schedule.

### For longer breaks in operation

During longer breaks in operation, it is recommended that the engine is warmed up at least once every two weeks. This prevents corrosion in the engine.

If you expect the engine to be unused for two months or more, it should be conserved. Refer to , *page 85* .

#### **IMPORTANT:**

If there is a risk of freezing, the coolant in the cooling system must have adequate antifreeze protection.

Refer to , *page 70*.

#### **IMPORTANT:**

A poorly charged battery can freeze and burst.

Refer to *Battery*, *page 83*.

# Fault handling

Despite regular service in accordance with the planned maintenance schedule and perfect operating conditions, faults may occur that must be remedied before operations continue. This chapter describes the diagnostics function.

## Diagnostic Function

The purpose of the diagnostic function is to monitor, control and protect the engine and its surrounding system and components from damage, as well as to ensure a minimal environmental impact.

If a malfunction is detected the diagnostic function informs of the occurred fault in the form of a fault code. The fault code provides guidance when fault tracing. All fault codes and fault messages can be found in the *Fault Code Register*.

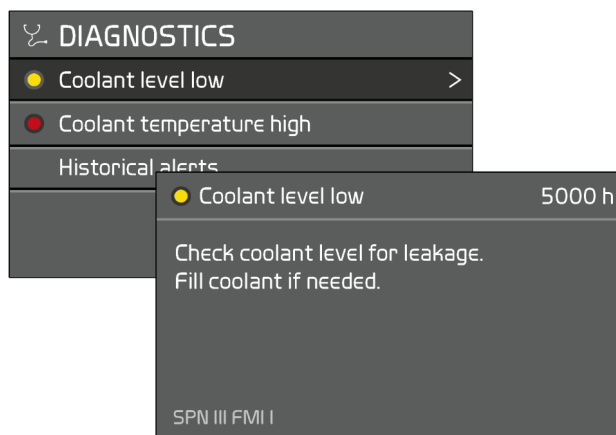
The operator is warned that there is a malfunction via the instruments. Depending on the instrumentation in use, the fault message is shown in various ways. Fault codes can also be read out by the Volvo Penta diagnostic tool.

Depending on the severity of the fault, the diagnostic function will take various actions to protect the engine and limit emissions (e.g. torque derate, idle speed only, engine shut down etc.)

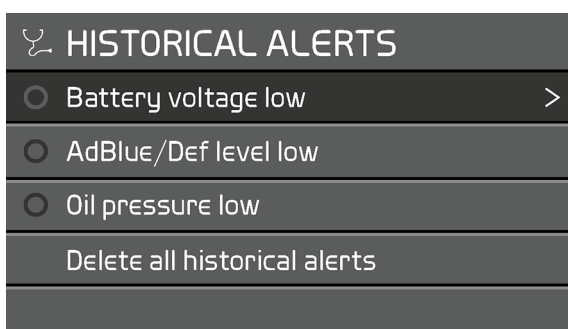
## CIM (Control Interface Module)

### DIAGNOSTICS

If the system detects a malfunction the driver/operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes. For more detailed information regarding the cause and remedies, use the arrow buttons to scroll to the fault concerned and press **OK**. This will also provide information about the number of engine hours when the fault became active and the SPN and FMI codes.



P0028529



P0028162

### Historical Alerts

When fault codes are no longer active, they end up under "Historical Alerts". There you can delete an error code at a time or delete all at once.

## Erasing fault codes

The memory of the diagnostic function is reset when the power to the engine is disconnected. When the power is switched on again, the diagnostic function will check if there are any malfunctions in the system. If so a new fault codes is registered.

If a malfunction has not been corrected it will be registered once again and has to be acknowledged again.

## Fault Tracing

A number of symptoms and possible causes of engine malfunctions are described in the table below. Always contact your Volvo Penta dealer if any problems occur which you can not solve by yourself.

### IMPORTANT:

Read through the instructions for care and maintenance in before starting work.

Refere to *Safety precautions for maintenance and service operations*.

### Symptoms and possible causes

The diagnosis button lamp flashes	Please refere to <i>Diagnostic Function</i>
Engine can not be stopped	2, 5
Starter motor does not rotate	1, 2, 3, 4, 5, 6, 7, 24
Starter motor rotates slowly	1, 2
Starter motor rotates normally but engine does not start	8, 9, 10, 11,
Engine starts but stops again	8, 9, 10, 11, 13
Engine does not reach correct operating speed at full throttle	9, 10, 11, 12, 13, 21, 25, 26
Engine runs roughly	10, 11
High fuel consumption	12, 13, 15, 25
Black exhaust smoke	12, 13
Blue or white exhaust smoke	15, 22
Too low lubrication oil pressure	16
Excessive coolant temperature	17, 18, 19, 20, 28
Too low coolant temperature	20
No, or poor charge	2, 23
Too high exhaust temperature	13, 17, 18, 19, 21, 25, 27, 28, 29, 30

- 1 Discharged batteries
- 2 Poor contact/open circuit in electrical wiring
- 3 Main switch turned off
- 4 Main fuse faulty
- 5 Faulty ignition lock
- 6 Faulty main relay
- 7 Faulty starter motor/-solenoid
- 8 No fuel:
  - fuel cocks closed
  - fuel tank empty/wrong tank connected
- 9 Blocked fuel fine-filter/pre-filter (due to contaminations, or stratification in the fuel at low temperature)
- 10 Air in the fuel system
- 11 Water/contamination in fuel
- 12 Faulty fuel injectors
- 13 In sufficient air supply to the engine:
  - blocked air filter
  - air leakage between the turbo and the engine's intake manifold
  - dirty compressor part in the turbocharger
  - faulty turbo compressor
  - poor engine room ventilation
- 14 Coolant temperature too high
- 15 Coolant temperature too low
- 16 Oil level too low
- 17 Coolant level too low
- 18 Air in the coolant system
- 19 Faulty circulation pump
- 20 Defective thermostat
- 21 Blocked charge air cooler
- 22 Oil level too high
- 23 Alternator drive belt slips
- 24 Water entry into engine
- 25 High back pressure in the exhaust system
- 26 Break in "Pot+" cable to throttle
- 27 High temperature, charge air cooler
- 28 Blocked radiator
- 29 No pressure in cooling system
- 30 Check wastegate function

## EATS Warnings and Inducements

EATS system monitoring checks the quality of the urea solution, the level in the tank and the correct function of the system components. If a fault is detected the operator is warned via the instrument panel and finally the engine will be shut down. To enable fault tracing and the remedy of any faults, the engine can be re-started according to a start schedule; refer to *EATS Inducements, VE-engines (EU)*, page 49.



**NOTICE!** Warning messages and symbols may vary depending on the installation; shown here are those seen on panels sold by Volvo Penta.

**Important!** Take prompt action in case of error code indication.

TWD1683GE-B

For TWD1683GE-B the engine will keep running and not be shut down regardless if a fault is detected, however urea solution may not be injected. Hence, *EATS Inducements, VE-engines (EU)*, page 49, will not be applicable.

### Warning Symbols

<p>Stimulus for power reduction warning. A fault has been detected in the EATS system. or The AdBlue®/DEF tank level has dropped to the first warning level.</p>	
	<ul style="list-style-type: none"> <li>• The warning symbol shines with a constant yellow light.</li> <li>• The EATS symbol shines with a constant light.</li> </ul>
<p>Major stimulus for power reduction warning. or The AdBlue®/DEF tank level has dropped to the second warning level.</p>	
	<ul style="list-style-type: none"> <li>• The warning symbol shines with a constant red light.</li> <li>• The EATS symbol flashes.</li> </ul>

**NOTICE!** The Emission control using SCR-catalyst may sometime cause some deposits inside the Exhaust After Treatment System. A thin layer of deposits (few mm's) is acceptable and should be expected - this requires no action. Occurrence of deposits may vary over time. Continuous operation at low load and low temperature increases the risk of accumulating deposits of crystallized AdBlue/DEF. If the engine is running very cold at low power for a long period of time, the crystals will not burn off naturally.

To avoid crystallization, operate the engine on higher load and temperature during extended periods of the driving cycles. If the driving cycles are alternated between cold and hot temperature, the crystals will be burnt off and removed due to the high exhaust temperatures.

To manage the EATS at sufficient temperature, avoid long periods of idling; it may also be necessary to use engine stop/start functionality, viscous clutch fan and do a careful insulation of pipes and muffler.

If deposits are present even though the engine is run at varying load and are larger in volume than a chicken's egg it is suggested to monitor the deposit size over time to ensure that there is not growth of the deposit. It is suggested taking photos including a reference object like a pen or a matchbox to be able to relate size when comparing photos over time.

Presence of deposits OUTSIDE the exhaust lines is a sign of a bad sealing in exhaust line joints. Deposits can be removed by cleaning with water and a soft brush. Joint alignments should be checked and gaskets replaced before reassembly.

For cases with deposits larger in size – please contact your local Volvo Penta representative to discuss the issue.

## Quality shortcomings and component defects

If the system signals a quality shortcoming or component defect, check the following:

- that the level sensor in the AdBlue<sup>®</sup>/DEF tank is connected.
- that system hoses and the injection valve are not clogged or disconnected.
- that the injection valve is connected.
- that the AdBlue<sup>®</sup>/DEF pump is connected.
- that the SCR system electrical cables are connected.
- that the NO<sub>x</sub> sensors are connected.
- that the exhaust temperature sensor is connected.
- that the temperature sensor for the AdBlue<sup>®</sup>/DEF is connected.
- that there are no leaks in the exhaust system where substantial amount of solution can escape.

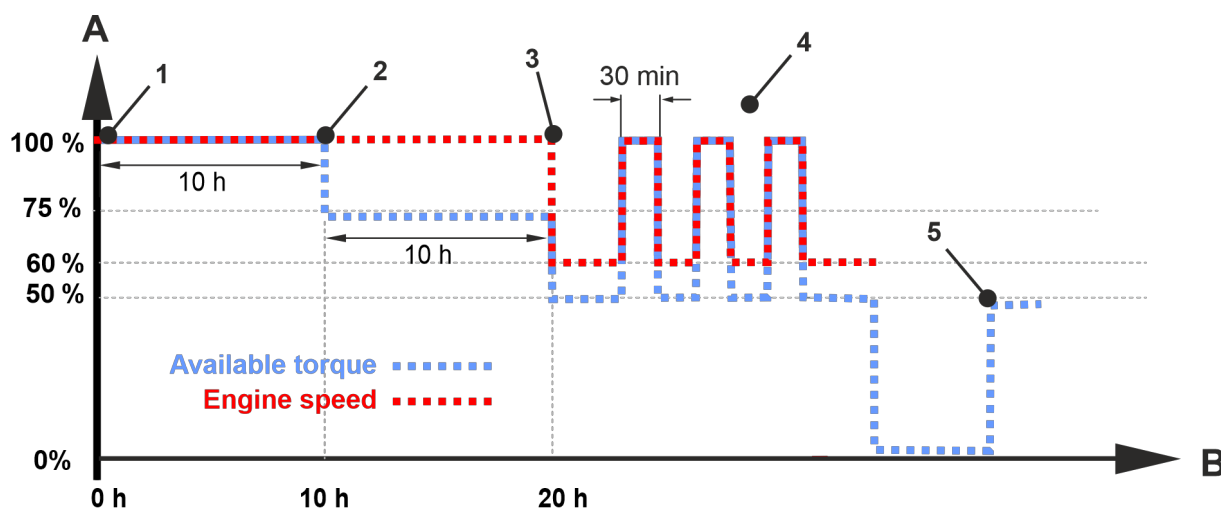
If the fault can not be reminded with any of the above, refer to *EATS Inducements, VE-engines (EU)*, page 49.

## EATS Inducements, VE-engines (EU)

### AdBlue/DEF tank level

- 1 When the level in the tank falls to 15%, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 When the tank level reaches 6%, the warning indicator turns red and the NCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 If the tank is not filled up, the engine goes into severe inducement 7 minutes after the tank level has reached 6%. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed.
- 4 If the engine is restarted when the tank level is below 6%, the engine will run for 30 minutes and then again go into severe inducement. It is possible to restart the engine three times, thereafter the engine will remain in idle speed.
- 5 To revert the engine to full power, the tank level must be above 12%. To exit the inducement, the tank level must be above 21%.

### AdBlue/DEF, dosing and quality

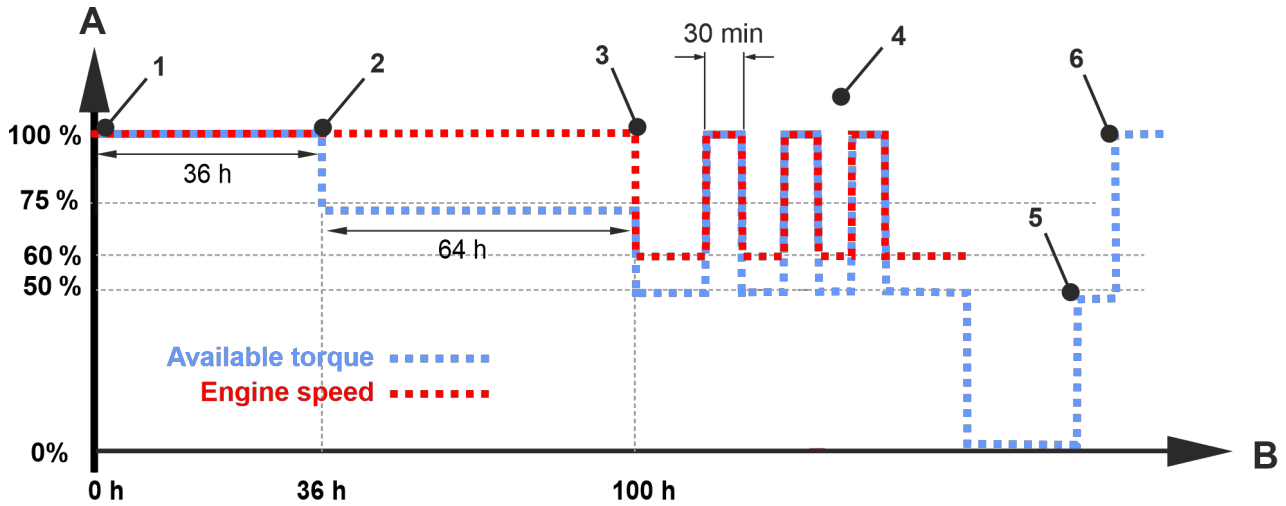


P0029877

- A Engine rpm and torque  
B Time axis

- 1 When a fault is detected a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not resolved within 10 hours the engine goes into light inducement, 75% of available torque. 7 minutes before going into inducement the warning indicator turns red and the NCD symbol starts to flash.
- 3 If the fault is still not resolved within the next 10 hours the engine goes into severe inducement. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed. Service tools is required to reset the system.
- 4 During severe inducement it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine again goes into severe inducement. Each 30-minute period requires a manual activation.
- 5 If an additional fault recurs within 40 hours after the first fault was remedied, severe inducement is activated after 2 hours.
- 6 If a fault recurs within 40 hours, default timers applies.

### Component fault



P0029876

A Engine rpm and torque

B Time axis

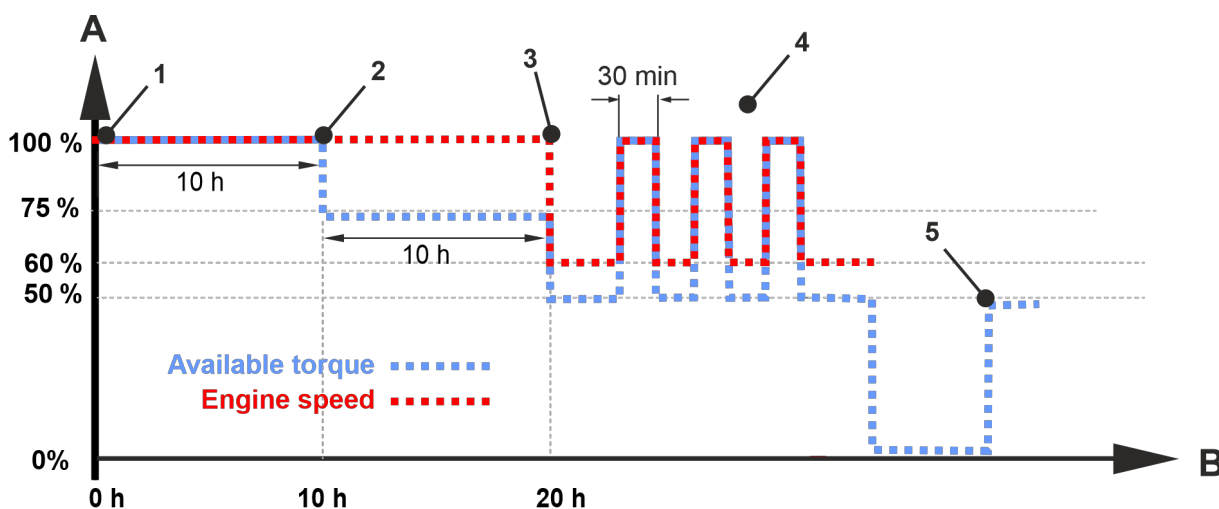
- 1 When a fault is detected a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not remedied within 36 hours the warning indicator turns red and the NCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 After a further 64 hours the engine goes into severe inducement. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed.
- 4 During severe inducement it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine again goes into severe inducement. Each 30-minute period requires a manual activation.
- 5 Upon re-start the engine will run in severe inducement mode.
- 6 When the fault is remedied the engine will revert to full power.
- 7 If a fault recurs within 40 hours, available running time will be reduced to 300 minutes from the moment the fault is detected.

## EATS Inducements, VE-engines (China IV)

### AdBlue/DEF tank level

- 1 When the level in the tank falls to 15%, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 When the tank level reaches 6%, the warning indicator turns red and the NCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 If the tank is not filled up, the engine goes into severe inducement 7 minutes after the tank level has reached 6%. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed.
- 4 If the engine is restarted when the tank level is below 6%, the engine will run for 30 minutes and then again go into severe inducement. It is possible to restart the engine three times, thereafter the engine will remain in idle speed.
- 5 To revert the engine to full power, the tank level must be above 12%. To exit the inducement, the tank level must be above 21%.

### AdBlue/DEF, dosing and quality

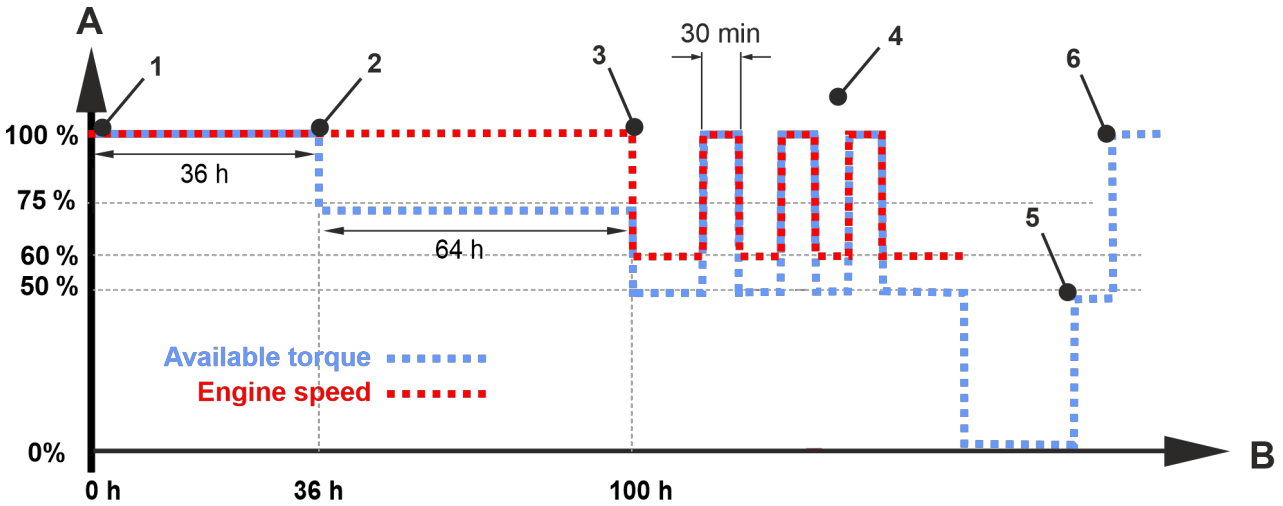


P0029877

- A Engine rpm and torque  
B Time axis

- 1 When a fault is detected a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not resolved within 10 hours the engine goes into light inducement, 75% of available torque. 7 minutes before going into inducement the warning indicator turns red and the NCD symbol starts to flash.
- 3 If the fault is still not resolved within the next 10 hours the engine goes into severe inducement. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed. Service tools is required to reset the system.
- 4 During severe inducement it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine again goes into severe inducement. Each 30-minute period requires a manual activation.
- 5 If an additional fault recurs within 40 hours after the first fault was remedied, severe inducement is activated after 2 hours.
- 6 If a fault recurs within 40 hours, default timers applies.

### Component fault, NCD (NOx Control Diagnostics)



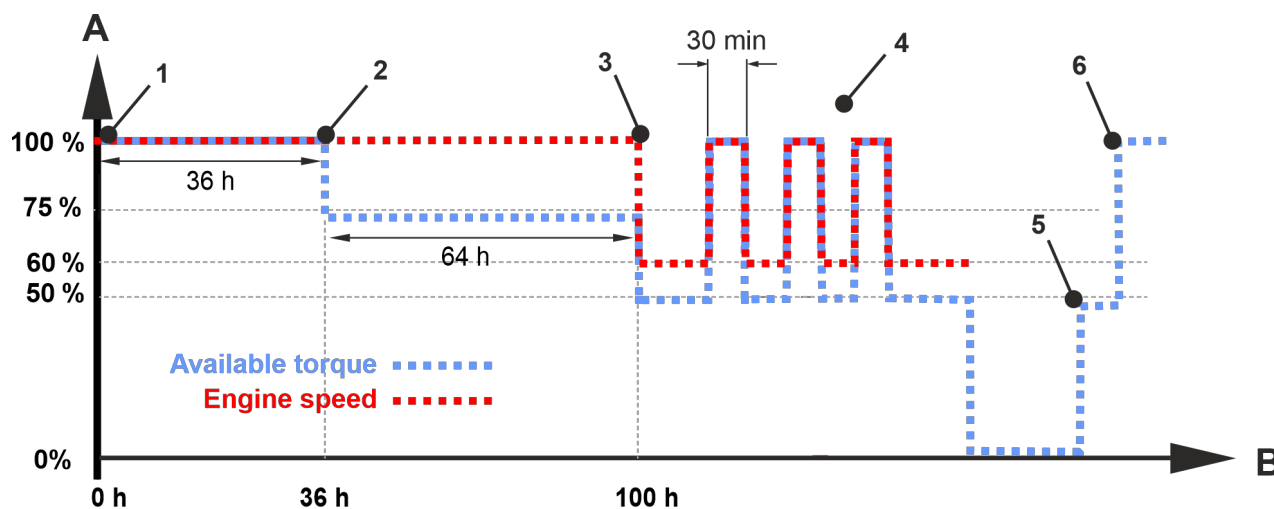
P0029876

A Engine rpm and torque

B Time axis

- 1 When a fault is detected a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not remedied within 36 hours the warning indicator turns red and the NCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 After a further 64 hours the engine goes into severe inducement. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed.
- 4 During severe inducement it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine again goes into severe inducement. Each 30-minute period requires a manual activation.
- 5 Upon re-start the engine will run in severe inducement mode.
- 6 When the fault is remedied the engine will revert to full power.
- 7 If a fault recurs within 40 hours, available running time will be reduced to 300 minutes from the moment the fault is detected.

## Component fault, PCD (Particle Control Diagnostics)



P0029876

A Engine rpm and torque

B Time axis

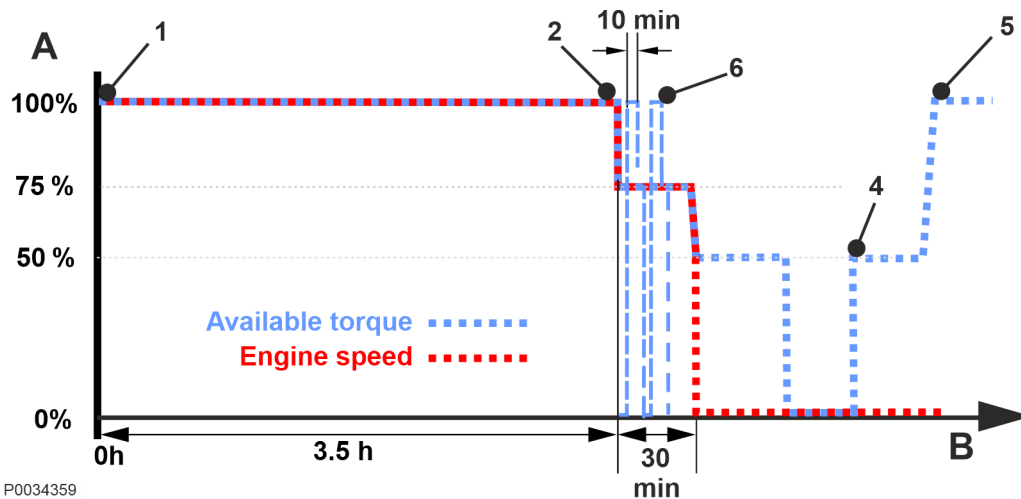
- 1 When a fault is detected a yellow warning indicator is lit in combination with a solid PCD symbol.
- 2 If the fault is not remedied within 36 hours the warning indicator turns red and the PCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 After a further 64 hours the engine goes into severe inducement. At severe inducement the engine drops to 50% of available torque level and is restricted to 60% engine speed.
- 4 During severe inducement it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine again goes into severe inducement. Each 30-minute period requires a manual activation.
- 5 Upon re-start the engine will run in severe inducement mode.
- 6 When the fault is remedied the engine will revert to full power.
- 7 If a fault recurs within 40 hours, available running time will be reduced to 300 minutes from the moment the fault is detected.

## EATS Inducements, VE-engines (combined EU/US, EU/MSHA/ CANMET)

### AdBlue/DEF tank level

- 1 When the level in the tank falls to 15%, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 When the tank level reaches 6%, the warning indicator turns red and the NCD symbol starts to flash. The engine goes into light inducement, 75% of available torque.
- 3 If the tank is not filled up, the engine goes into severe inducement 7 minutes after the tank level has reached 6%. At severe inducement the engine drops to 50% of available torque level and is restricted to idle.
- 4 If the engine is started when the tank level falls below 6%, the engine will only run at idle.
- 5 To revert the engine to full power, the tank level must be above 12%. To exit the inducement, the tank level must be above 21%.

### AdBlue/DEF high temperature, quality and component faults



- A Engine rpm and torque
- B Time axis

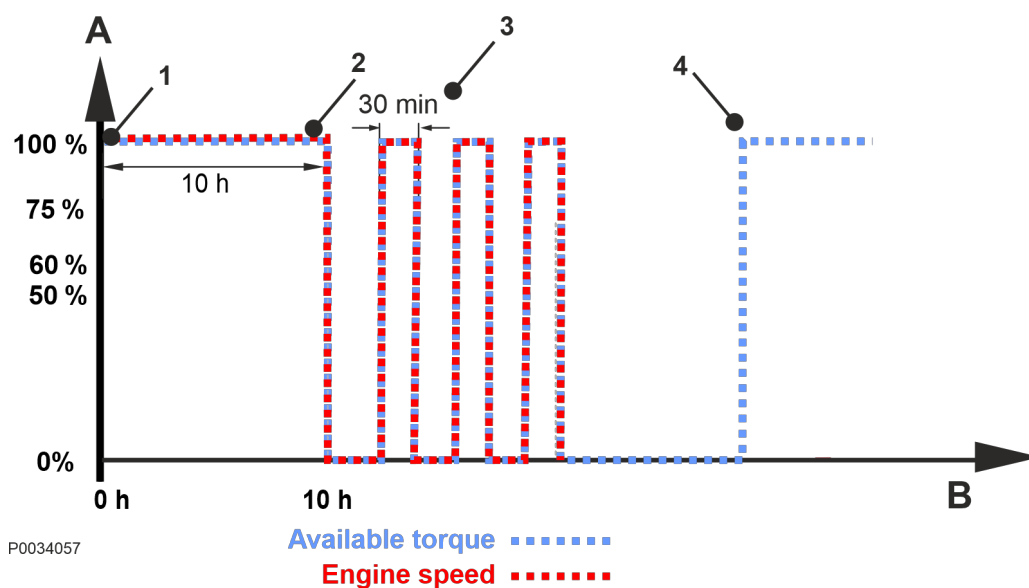
- 1 When a fault is detected, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not resolved within 3.5 hours the engine goes into light inducement, 75% of available torque. The warning indicator turns red and the NCD symbol starts to flash.
- 3 After 30 minutes, the engine will drop to idle with a 50% torque reduction. The warning indicator turns red and the NCD symbol is flashing.
- 4 Following restart, the engine will run at idle with a 50% torque reduction.
- 5 When component faults are remedied, the engine will revert to full power.
- 6 During severe inducement, it is possible to manually override the system actions and run the engine at full power for 2 x 10 minutes. After 10 minutes the engine drops to 75% power. Each 10-minute period requires a manual activation.
- 7 If an additional fault recurs within 40 hours after the first fault was remedied, severe inducement will be activated 30 minutes from the moment the fault is detected.

## EATS Inducements, GE-engines

### AdBlue/DEF tank level

- 1 When the level in the tank falls to 15%, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 When the tank level reaches 6%, the warning indicator turns red and the NCD symbol starts to flash. After 7 minutes the engine is stopped.
- 3 If the engine is started when the tank level falls below 6%, the engine will only run at idle speed.
- 4 To revert the engine to full power, the tank level must be above 12%. To exit the inducement, the tank level must be above 21%.

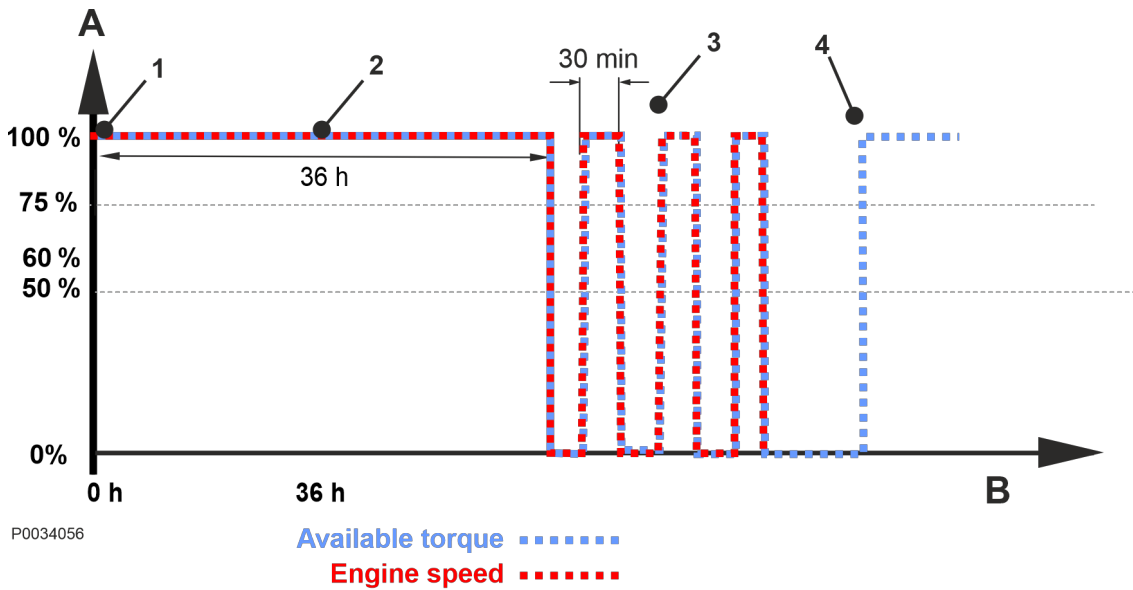
### AdBlue/DEF, dosing and quality



- A Engine rpm and torque  
B Time axis

- 1 When a fault is detected, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not resolved within 10 hours the warning indicator turns red and the NCD symbol starts to flash. After 7 minutes the engine will be stopped.
- 3 If the engine has stopped it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine shuts down again. Each 30-minute period requires a manual activation.
- 4 When the faults are remedied the engine will revert to full power.

## Component fault



A Engine rpm and torque

B Time axis

- 1 When a fault is detected, a yellow warning indicator is lit in combination with a solid NCD symbol.
- 2 If the fault is not resolved within 36 hours the warning indicator turns red and the NCD symbol starts to flash. After 7 minutes the engine will be stopped.
- 3 If the engine has stopped it is possible to manually override the system actions and run the engine at full power for 3 x 30 minutes. After 30 minutes the engine shuts down again. Each 30-minute period requires a manual activation.
- 4 When the faults are remedied the engine will revert to full power.

# Maintenance Schedule

Your Volvo Penta engine and its equipment are designed for high reliability and long life. The engines are built to have the smallest possible environmental impact. If given preventive maintenance, according to the maintenance schedule, these qualities will be retained and unnecessary malfunctions will be avoided. In order for the warranty to be valid, the owner must make sure that the services in the service intervals are performed.

**NOTICE!** For emission related warranty rights see Emission Control System Warranty Statement.

## Service Intervals

Service intervals and the service content can be found in the Service Protocol available for download at [www.volvopenta.com](http://www.volvopenta.com).

Where both operational and calendar times are specified, perform the maintenance item at whichever time is the sooner.

**NOTICE!** More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to download or purchase the Service and Maintenance handbook can be found at [www.volvopenta.com](http://www.volvopenta.com).

## Extended service intervals

The interval between engine oil changes may be extended in certain circumstances. To determine whether the service interval may be extended, Volvo Penta's conditions for extended service intervals must be met and an oil analysis performed. Contact your Volvo Penta dealer for further information.

# Maintenance

This chapter describes the most common maintenance items. Refer to *Maintenance Schedule* for service intervals. When ordering service or spare parts, always specify the engine and transmission identification number. Refer to , page 96.

**NOTICE!** More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to purchase the Service and Maintenance handbook can be found at [www.volvopenta.com](http://www.volvopenta.com).

## ⚠ CAUTION!

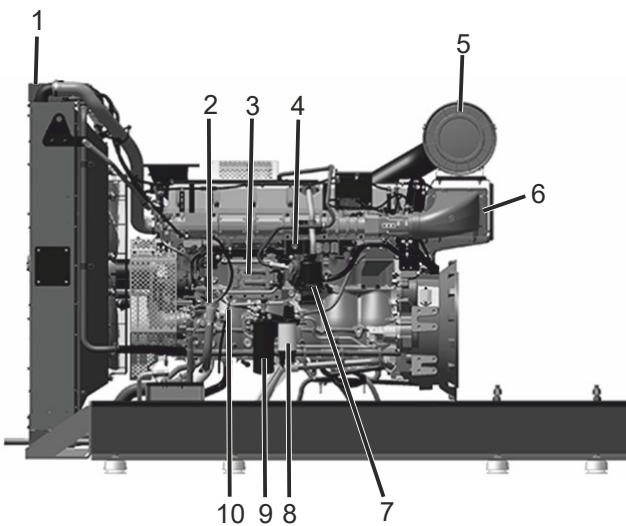
Read through the safety advice before starting any work.

## ⚠ WARNING!

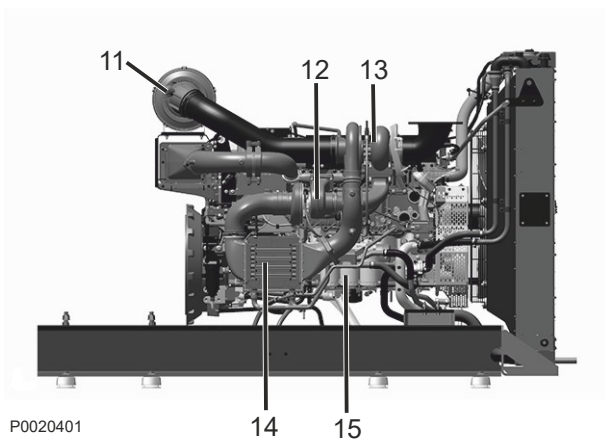
Care and maintenance work should be done with the engine stopped unless otherwise specified. Stop the engine before opening or removing the engine hatch/hood. Make it impossible to start the engine by removing the start key and cutting the system voltage with the main switches.

## Orientation

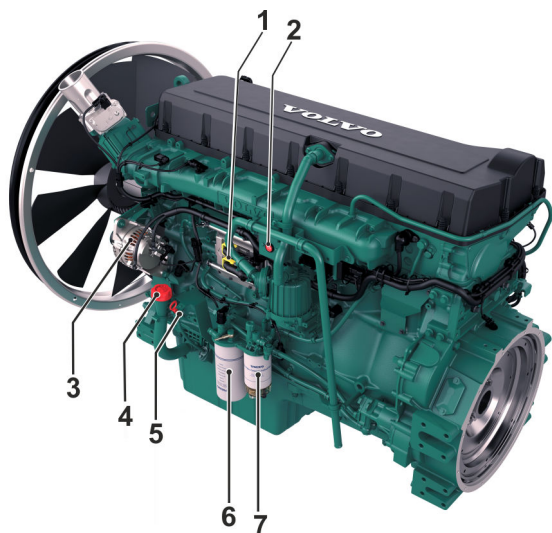
TWD1683GE, TWD1683GE-B



- 1 Expansion tanks
- 2 Oil filler cap, engine
- 3 Control Unit, EMS
- 4 Auxiliary Stop
- 5 Air Filter
- 6 Charge air cooler (High-Pressure Turbo)
- 7 Crankcase ventilation
- 8 Fuel filter, with fuel pressure monitor
- 9 Fuel prefilter with water monitor
- 10 Oil dipstick
- 11 Air filter indicator
- 12 Low-Pressure Turbo
- 13 High-Pressure Turbo
- 14 Charge air cooler (Low-Pressure Turbo)
- 15 Oil filter

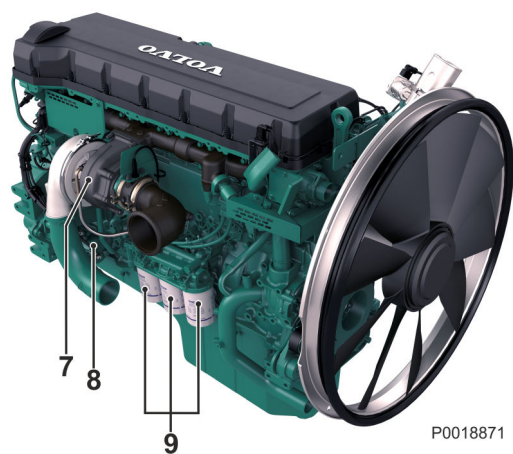


P0020401



## TWD1683VE

- 1 Control Unit, EMS
- 2 Auxiliary stop
- 3 Alternator
- 4 Oil filler cap, engine
- 5 Oil dipstick
- 6 Fuel Filter
- 7 Fuel pre-filter with water separator
- 8 Turbo
- 9 Starter motor
- 10 Oil filter



P0018871

## Engine, General

### General inspection

Make it a habit to give the engine and engine compartment a visual inspection before starting the engine and after operation once the engine has stopped. This will help you to discover quickly if anything abnormal has happened, or is about to happen.

Look especially carefully at oil, fuel and coolant leakage, loose bolts, worn or poorly tensioned drive belts, loose connections, damaged hoses and electrical cables. This inspection only takes a few minutes and can prevent serious malfunctions and expensive repairs.

#### **⚠ WARNING!**

Risk of fire.

Remove all accumulations of fuel, oil and grease when detected on the engine or in the engine room.

#### **⚠ WARNING!**

If an oil, fuel or coolant leak is detected, the cause must be investigated and the fault rectified before the engine is started.

#### **IMPORTANT:**

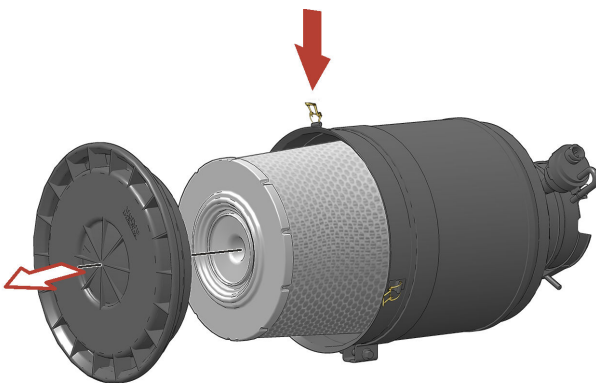
Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

## Air Filter, Check and Replace

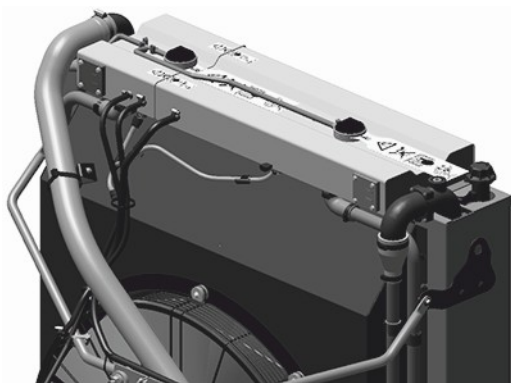
The engine is equipped with electronic air filter indication.

The control unit provides an output signal which is announced as a warning on the instrument panel. The warning indicates a pressure drop in the air filter, which must then be checked and possibly changed.

- Scrap the old filter. No cleaning or re-use is permissible
- In continuous operation, the filter should be checked every 8 hours. For operations in extremely dirty environments such as coal mines and rock crushing mills, special air filters must be used.



P0018636



P0020410

## Charge Air Pipe, Leakage Check

TWD1683GE, TWD1683GE-B

Inspect the condition of the charge air hoses, hose unions and clamps for cracks and other damage. Change as necessary.

Clamps must be tightened using a torque wrench to  $9 \pm 2$  Nm ( $6.6 \pm 1.5$  lbf.ft.).

## Drive Belt and Alternator Belt, Inspection

### **WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

### **IMPORTANT:**

Always change a belt which looks worn or cracked.

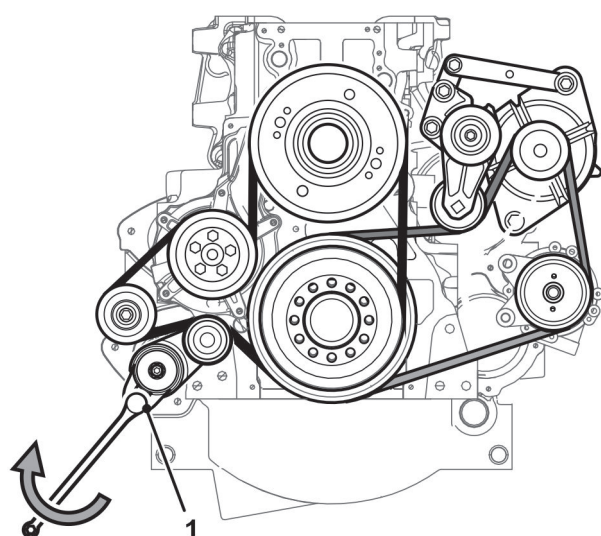
Inspections must be carried out after operations, while the belts are hot.

You should be able to depress the alternator belt and the drive belt about 3-4 mm between the pulleys.

The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted.

Check the condition of the drive belts. Replace as necessary; refer to *Alternator Belt, Replace, page 62* and *Drive Belt, Replace, page 61*.

## Drive Belt, Replace



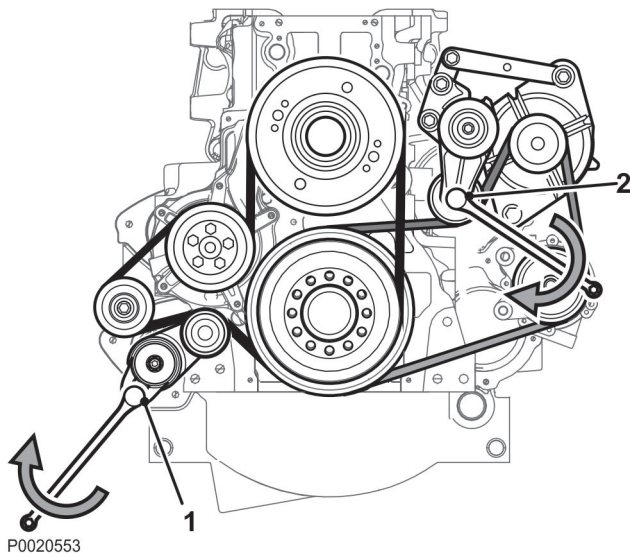
P0020554

- 1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.
- 2 Remove the fan guard and fan ring round the cooling fan.
- 3 Remove the belt guard.
- 4 Insert a 1/2" square wrench in the belt tensioner (1). Lift the wrench and remove the drive belt.
- 5 Thread the drive belt round the fan and remove it.
- 6 Check that the pulleys are clean and undamaged.
- 7 Thread the new drive belt over the fan.
- 8 Lift the 1/2" wrench and install the new drive belt.
- 9 Install the belt guards.
- 10 Install the fan guard and fan ring round the cooling fan.
- 11 Start the engine and do a function check.

## Alternator Belt, Replace

### IMPORTANT!

Always change a drive belt which appears worn or cracked.



- 1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.
- 2 Remove the fan guard and fan ring round the cooling fan.
- 3 Remove the belt guard.
- 4 Insert a 1/2" square wrench in the belt tensioner (1). Lift the wrench up and lift the water pump drive belt off.
- 5 Insert a 1/2" square wrench in the belt tensioner (2). Press the wrench down and remove the alternator/water pump belt.
- 6 Check that the pulleys are clean and undamaged.
- 7 Press the 1/2" wrench in the belt tensioner (2) down and install the new alternator/water pump drive belt.
- 8 Lift the 1/2" wrench in the belt tensioner (2) and install the new water pump drive belt.
- 9 Install the belt guards.
- 10 Install the fan guard and fan ring round the cooling fan.
- 11 Start the engine and do a function check.

## Lubrication System



P0002089

Volvo Penta only recommends the use of genuine Volvo Penta oils with the correct VDS (Volvo Drain Specification) standards.

Genuine Volvo Penta oils are extensively tested and quality assured by Volvo Penta to optimize performance, reduce fuel consumption and maximize the life of the engine.

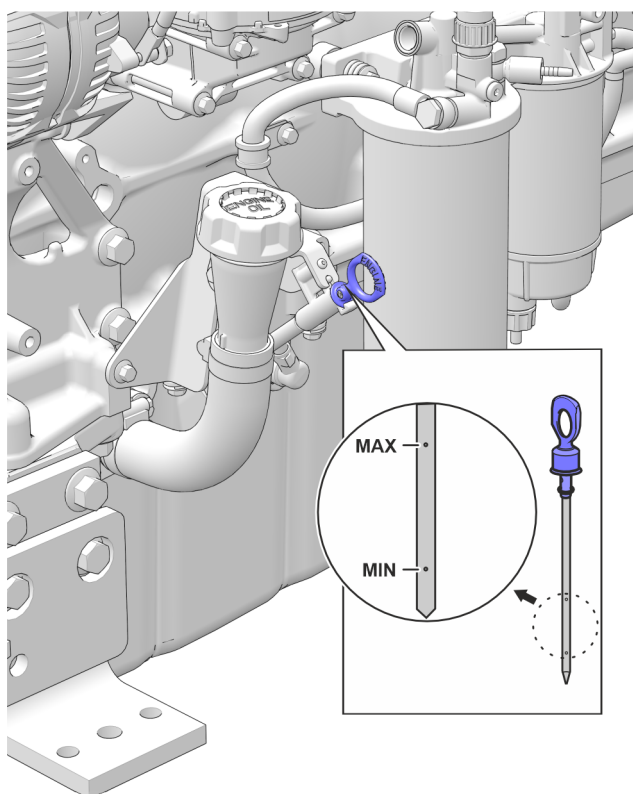
More detailed information regarding oil quality, viscosity and oil drain interval, refer to chapter Technical Data: *Lubrication System*.

## Oil level, checking and topping up

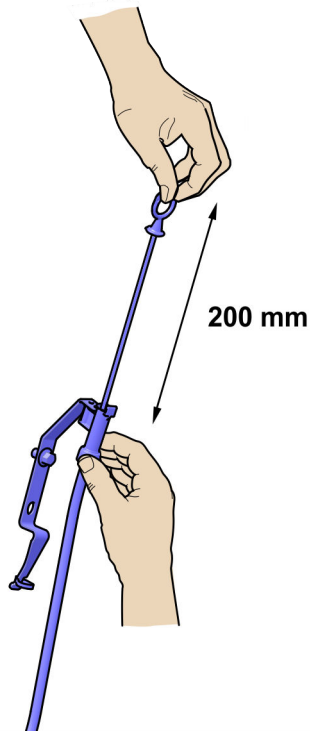
### **⚠ WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

- The engine should be placed on a level position when the oil is checked.
- The oil level is to be checked when the engine is stopped. Wait a few minutes before reading off the level, so that the oil has time to run down into the oil sump.
- The oil level must be inside the marked area on the dipstick. Never fill above the maximum limit on the oil dipstick.
- Only fill oil when the engine is stopped.
- Only use Volvo Penta recommended oils; refer to , *page 89*.
- The oil level sensor only measures the oil level when the ignition is switched to on, not continuously during operation.



P0039034

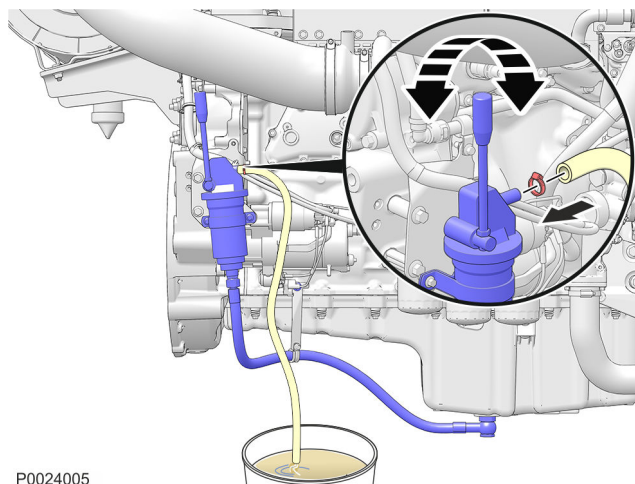


P0026405

### Checking the oil with a flexible dipstick

**IMPORTANT:**

Insert the dipstick in increments of around 200 mm, without bending the wire, for the entire length of the plastic tube.



P0024005

### Engine Oil, Replace

**⚠ WARNING!**

Hot oil and hot surfaces can cause burns.

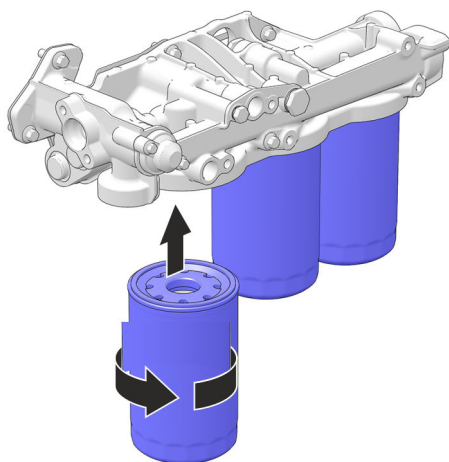
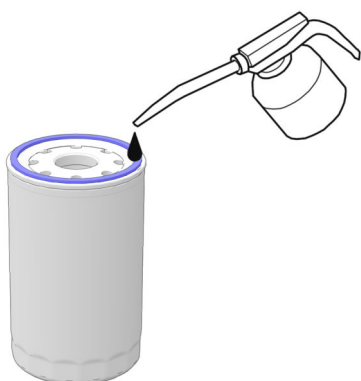
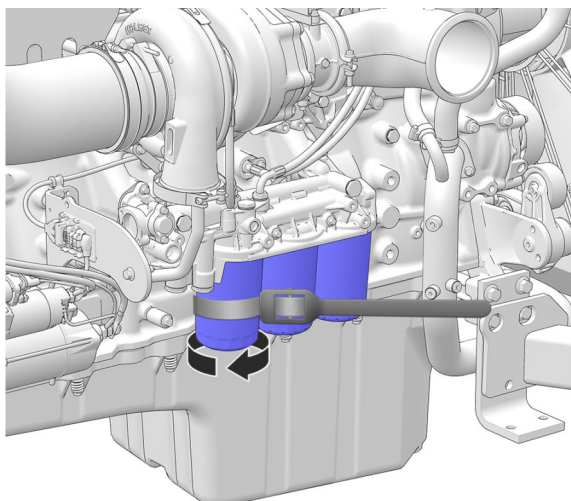
Oil changes must be done when the engine is hot.

- 1 Connect the drain hose to the oil drain pump and check that no leakage can occur.
- 2 Pump the oil out (or remove the bottom drain plug and drain the oil).  
Collect all the old oil and old filters, and hand them to a re-cycling station for destruction.
- 3 Remove the drain hose (or install the bottom drain plug).
- 4 Fill with engine oil.  
For change volume, please refer to , page 89.

## Oil Filter/By-pass Filter, Replace

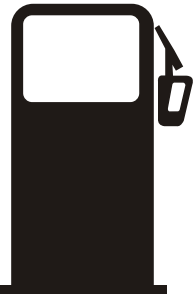
### **⚠ WARNING!**

Hot oil and hot surfaces can cause burns.



P0025685

- 1 Clean the oil filter bracket (2).
- 2 Remove all oil filters with a suitable oil filter extractor (1).
- 3 Clean the mating surface of the oil filter bracket. Make sure that no pieces of old oil seal are left behind. Carefully clean round the inside of the protective rim (2) on the oil filter bracket.
- 4 Put a thin layer of engine oil on the seal rings of the new fuel filters.
- 5 Install the new oil filters. Tighten the filters  $\frac{3}{4}$ –1 turn after they touch.
- 6 Top up with engine oil, start the engine and let it run for 20-30 seconds.
- 7 Turn off the engine, check the oil level and top up as required.
- 8 Check sealing round the oil filters.



P0002101

## Fuel System

### **⚠ WARNING!**

Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

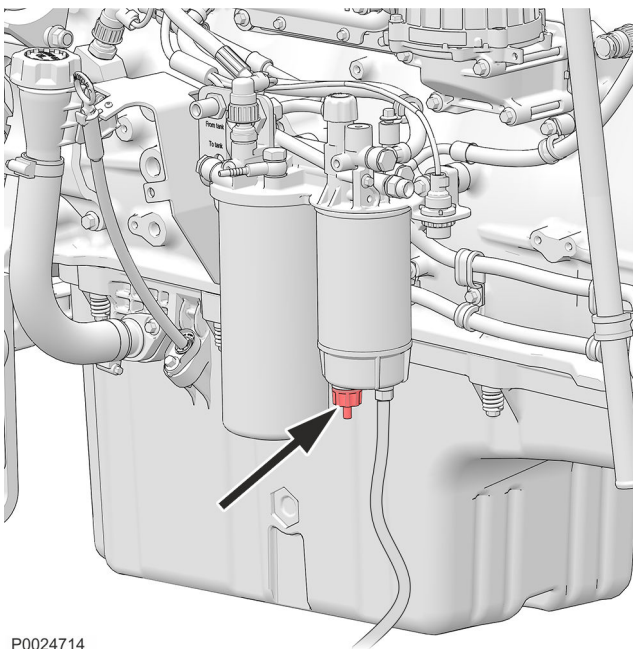
### **IMPORTANT:**

Always observe the greatest cleanliness during refueling and work on the fuel system. Only use the grades of fuel recommended in the fuel specification.

## Draining condensate, fuel system

**NOTICE!** Put a collection vessel under the fuel filter to collect the condensate and fuel.

- 1 Open the drain nipple in the base of the fuel pre-filter.
- 2 Tighten the drain tap when fuel without water starts to run out.



P0024714

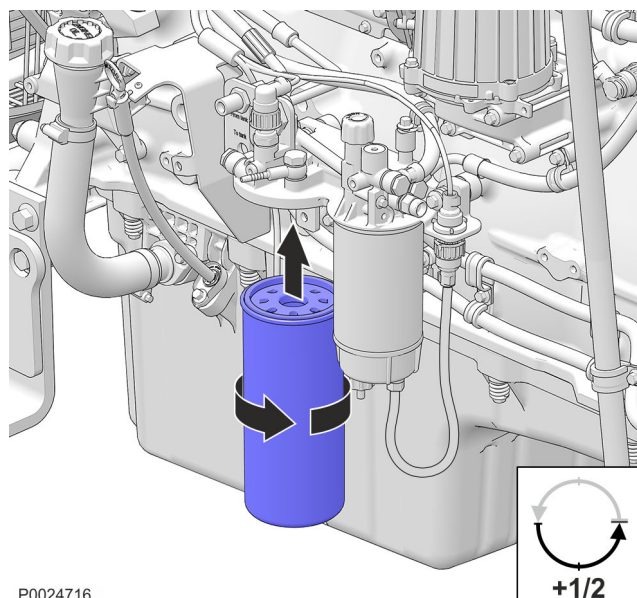
## Engine Fuel Filter Replacement

### **⚠ WARNING!**

Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

### **IMPORTANT:**

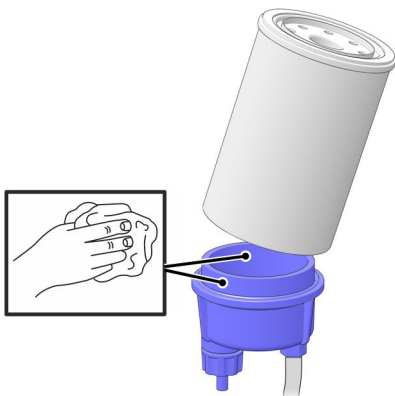
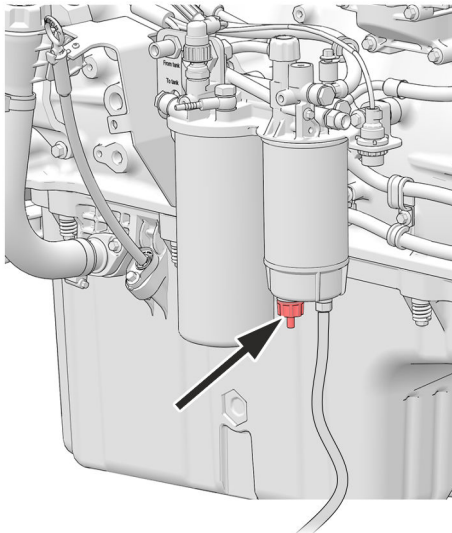
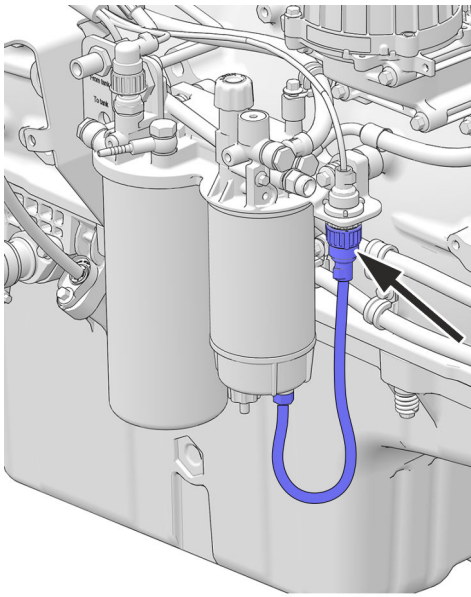
Do not fill the new fuel filter with fuel before assembly. There is a risk that contamination could get into the system and cause malfunctions or damage.



- 1 Clean round the fuel filter.
- 2 Remove the filter with a suitable filter remover. Collect any spilled fuel in a collection vessel.
- 3 Clean the filter mating surface on the filter bracket.
- 4 Lubricate the seal with diesel fuel and install the new fuel filter. Tighten the fuel filter in accordance with the instructions on the fuel filter.
- 5 If necessary, vent the fuel system, please refer to *Fuel system, bleeding, page 69*.

## Fuel Pre-filter, Replace

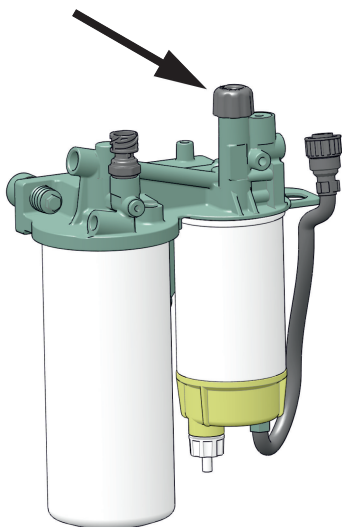
- 1 Undo the cable from the water trap sensor.
- 2 Remove the water trap filter from the filter housing. Collect any spilled fuel in a container.
- 3 Remove the lower part of the water trap from the filter.
- 4 Clean the lower part of the water trap with a soft rag. Check that the drain hole in the lower part is not blocked.
- 5 Install a new seal on the lower part and lubricate the seal with diesel fuel. Re-install the lower part of the filter.
- 6 Lubricate the seal with diesel fuel. Screw the filter onto the filter bracket by hand until the rubber seal just touches the mating surface. Then tighten a further half turn, no more.
- 7 Connect the cable to the water trap sensor.
- 8 If necessary, vent the fuel system, please refer to *Bleeding the Fuel System*.



P0025686

## Fuel system, bleeding

TWD1683GE, TWD1683GE-B



P0025497

- 1 Check that there is sufficient fuel in the tank, and that any fuel taps are open.
- 2 Release the hand pump on the fuel bracket by pushing down and twisting the plastic handle.
- 3 Vent the fuel system by pumping with the hand pump.  
Air is vented to the tank via the fuel return pipe. No breathing nipples need be opened.
- 4 Lock the hand pump, push down and twist the handle.
- 5 Start the engine and allow it to idle fast for about 10 minutes.
- 6 Perform a leakage and function check.



P0038119

## Cooling System

The cooling system ensures that the engine operates at the correct temperature. It is a closed system that should always be filled with a coolant mixture.

### IMPORTANT:

Coolant of a suitable chemical composition must be used all year round to protect the engine against internal corrosion, cavitation and freeze bursting. This even applies when there is no risk for freeze damage, to make sure the engine always has a complete corrosion protection.

Therefore, the use of anti-corrosion agents alone, or water alone as a coolant, is not permitted in Volvo Penta engines.

The coolant must be based on Organic Acid Technology (OAT). Using an improper coolant or mixing with another coolant will rapidly reduce the performance and lifetime of the engine. Material incompatibility can lead to leakages, which - in the worst case - can cause engine breakdown.

Volvo Penta strongly recommend the use of our own coolants, "Volvo Penta Coolant VCS-2 Ready Mixed" or the concentrate "Volvo Penta Coolant VCS-2", which ensure the protection of the cooling system components from corrosion, ageing, swelling and cracking, thereby ensuring optimal engine lifetime.

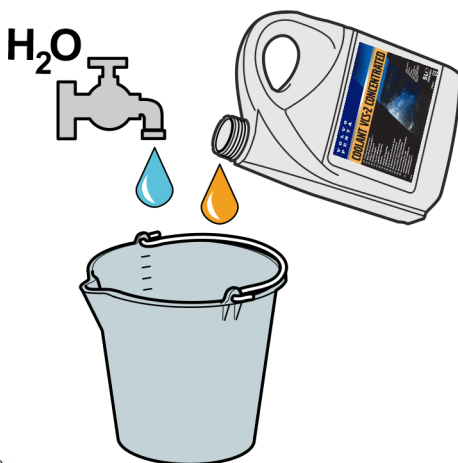
Over time the corrosion protection additives become less effective, and consequently the coolant must be changed at regular intervals to maintain sufficient protection of the engine. The latest Service Protocol that specifies service intervals can be found at [volvopenta.com](http://volvopenta.com).

### Coolant, Mixing

It is extremely important that the system is filled with the correct coolant concentration; refer to *Coolant, Mixing, page 93*.

The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Coolant, Mixing, page 93*.

**NOTICE!** If water quality can not be guaranteed, use ready mixed coolant.



P0038120

## Coolant Level, Checking and Topping Up

TWD1683VE

Coolant filling must be performed with the engine stopped. Check the coolant level daily before starting.

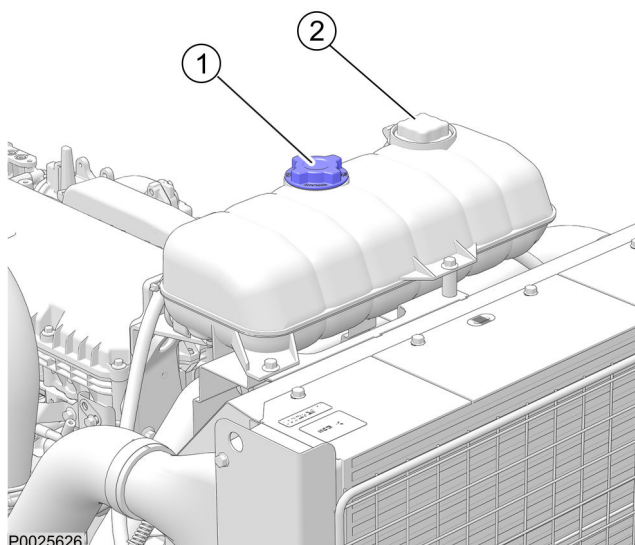
### IMPORTANT:

Only use coolant recommended by Volvo Penta. Top up with the same type of coolant as already used in the system.

VCS-2 will be backwards compatible with current VCS and they are mixable without risks.

### ⚠ WARNING!

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.



P0025626

- 1 Check that all drain ports are closed.
- 2 Only open the filler cap (1). Do not open the pressure cap (2).
- 3 Top up with coolant as required, so that the level is between MIN and MAX marks. Fill slowly, to allow air to flow out.
- 4 Close the filler caps.
- 5 Start the engine when the cooling system has been filled and vented.
- 6 Open any venting nipples shortly after starting the engine to allow trapped air to escape.
- 7 Run the engine at idle a while.
- 8 Increase engine revolutions for a few minutes. Stop the engine and check the coolant level.
- 9 Run the engine until the thermostat opens. check the level again when the engine has cooled, and top up as necessary.

## Coolant Level, Checking and Topping Up

TWD1683GE, TWD1683GE-B

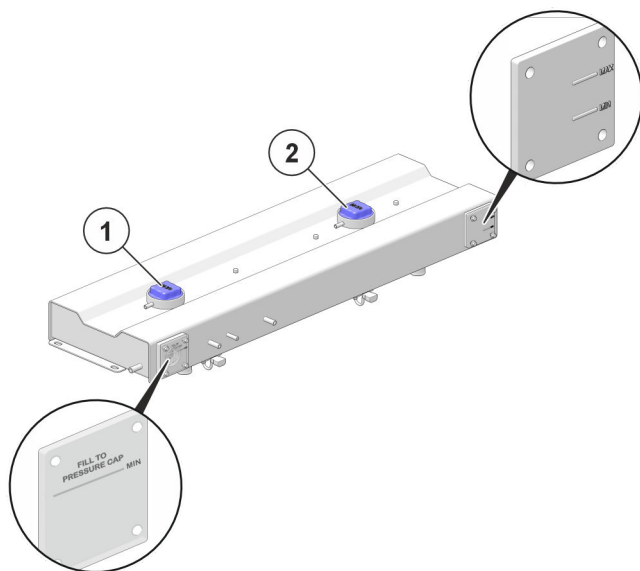
### **⚠ WARNING!**

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

### **IMPORTANT:**

Only use coolant recommended by Volvo Penta.  
Top up with the same type of coolant as already used in the system.  
VCS-2 will be backwards compatible with current VCS and they are mixable without risks.

Filling of coolant must be performed with the engine stopped. Fill up slowly, to allow the air to flow out. Check the coolant level daily before start.



P0001372

- 1 Check that all drain ports are closed
- 2 **Charge air cooling circuit**  
Open pressure cap (1) and fill to the top of the pressure cap.
- 3 **Engine cooling circuit**  
Open the pressure cap (2) and fill to MAX on the sight glass.
- 4 Close the caps.
- 5 Start the engine when the cooling system has been filled and vented.
- 6 Open any venting nipples shortly after starting the engine to allow trapped air to escape.
- 7 Run the engine at idle a while.
- 8 Increase engine revolutions for a few minutes. Stop the engine and check the coolant level.
- 9 Run the engine until the thermostat opens. check the level again when the engine has cooled, and top up as necessary.

## Coolant, Draining

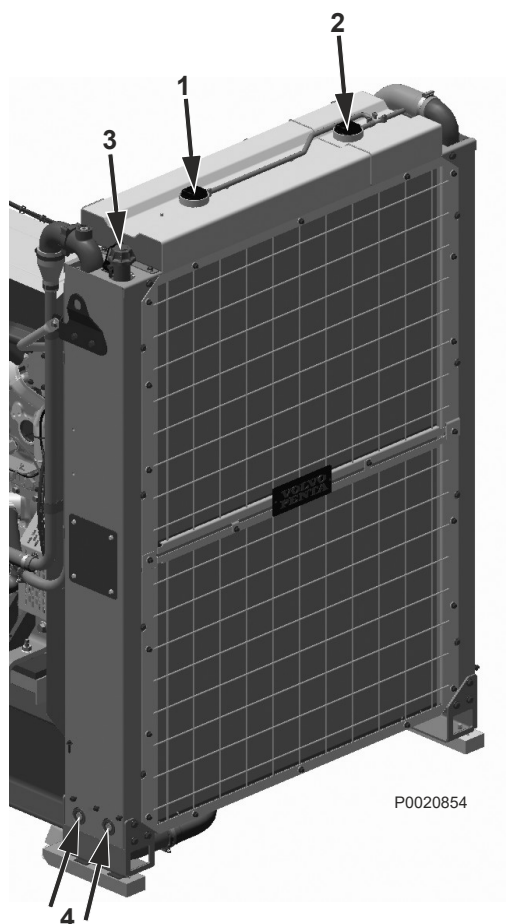
TWD1683GE, TWD1683GE-B

### **WARNING!**

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

### **IMPORTANT:**

The coolant contains corrosion-inhibiting additives. Never drain the engine cooling system on engines, which are to be put in storage.



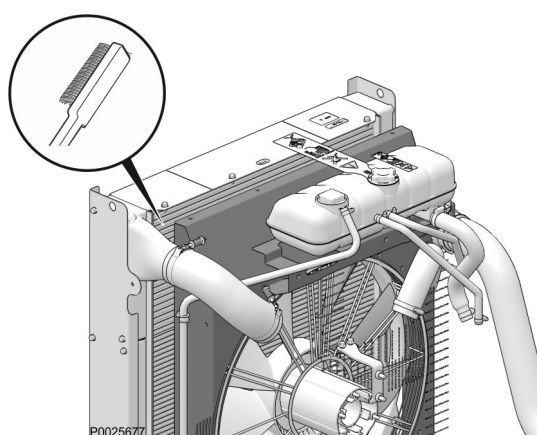
- 1 Stop the engine before draining the coolant.
- 2 Remove the caps to both the expansion tanks (1 and 2) and radiator (3).
- 3 Place a suitable vessel for the coolant to drain off into.
- 4 Open all drain points (4). Drain the coolant from the radiator and engine block using a drain hose.
- 5 Check that all coolant drains out. Clear away any deposits found inside the drain tap/plug. There is otherwise a risk that coolant will remain and cause freeze bursting. Check whether the installation has any further taps or plugs at the lowest points of the coolant lines.
- 6 Shut any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs.

## Charge Air Cooler, External Cleaning

### **IMPORTANT:**

Do not use a high pressure power washer.

Remove guards as necessary, to access the radiator. Clean with water and a mild detergent. Use a soft brush. Be careful not to damage the radiator vanes. Reinstall removed parts.



## Cooling System, Cleaning

### **⚠ WARNING!**

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

### **IMPORTANT:**

Never clean the cooling system if there is any risk of freezing, since the cleaning solution does not have any antifreeze properties.

### **IMPORTANT:**

It is extremely important that the correct concentration and volume of coolant is added to the system. Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix properly.

### **IMPORTANT:**

Always follow local safety instructions and regulations.

Cooling performance is reduced by deposits in the radiator and cooling galleries. The cooling system should be cleaned out when the coolant is changed.

- 1 Empty the cooling system. Refer to *Coolant, Draining, page 73*.
- 2 Put a hose into the expansion tank filling hole and flush with clean water, as specified by Volvo Penta—refer to section *Water quality in , page 93* until the water draining out is completely clear.
- 3 If there should still be some contamination left after flushing for a long time, cleaning can be done with coolant. Otherwise, continue as in item 8 below.
- 4 Fill the cooling system with 15-20 % mixture of concentrated coolant. Use only Volvo Penta recommended concentrated coolant mixed with clean water.
- 5 Drain the coolant after 1-2 days of operation. Remove the filler cap and possibly the lower radiator hose to increase the speed of emptying. To prevent suspended material from settling back in the system emptying should be done rapidly, within the space of 10 minutes, when the engine has not been standing still for a long time.
- 6 Flush the system immediately and thoroughly with clean hot water to prevent dirt from settling in the inner areas. Flush until the water that runs out is completely clean. Make sure that any heater controls are set to full heating during emptying.

- 7 If contamination should still be left after a long period of flushing, cleanout using Volvo Penta radiator cleaner, followed by finishing-off with Volvo Penta neutralizer. Carefully follow the instructions on the package. Otherwise, continue as in item 8 below.
- 8 When the cooling system is completely free from contamination, close the drain taps and plugs.
- 9 Fill up with Volvo Penta recommended coolant, following the instructions in the chapters entitled , *page 70* and *Coolant Level, Checking and Topping Up, page 71*.

## Cooling air filter

### **⚠ WARNING!**

Stop the engine before doing any maintenance work.

A newly-installed cooling air filter reduces cooling performance by 4 %.

### Installation

- 1 Slide one half of the filter over the fan cover (as in fig.1).
- 2 Turn the half filter until it is able to hang loosely on the fan cover (see fig. 2).
- 3 Slide on the other filter half and secure the two halves together with self-affixing velcro tape (as in fig. 3a).
- 4 Fasten the outer velcro tape around the fan cover guard (as in fig. 3b and 3c).

### Removal and cleaning

- 1 Remove the cooling filter.
- 2 Brush away any heavy dirt with a soft brush.
- 3 Rinse the filter with water.

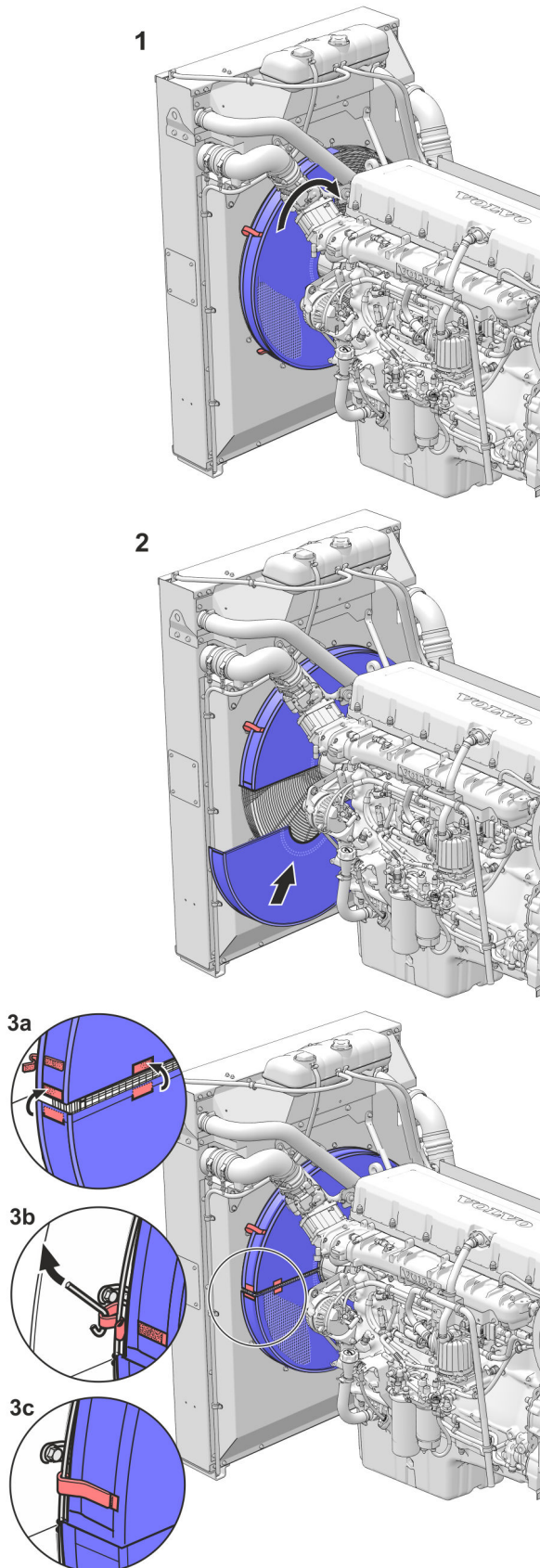
**NOTICE!** If a cleaning agent is necessary, an eco-friendly degreaser (e.g. coconut oil based) must be used as a first choice. Alternatively, use a paraffin fraction as a second choice.

Spray on the degreaser or apply it using a sponge. Allow it to act for a few minutes and then rinse with tap water.

### **IMPORTANT:**

Do not use gasoline, steam, a high-pressure washer or other cleaning agents.

- 4 Re-install the filter according to instructions.



P0025788

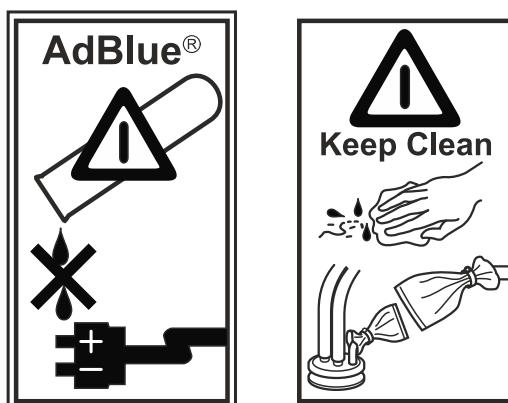
## Inlet and Exhaust System

### Filling AdBlue®/DEF

TWD1683GE, TWD1683VE

#### ⚠ CAUTION!

AdBlue®/DEF spilt onto hot components will quickly vaporize. Turn your face away!



P0011697

#### ⚠ CAUTION!

Risk of corrosive damage.

Contact with the fluid can cause irritation and corrosion.

Wear protective gloves!

Change gloves and clothing that have been in contact with the liquid.

#### ⚠ CAUTION!

Risk of material damage.

AdBlue®/DEF oxidises metal and the capillary action creeps through lines at a speed of approx. 0.6 metres per hour.

If spillage occurs, electrical connectors must be replaced immediately. Do not try to clean with water or compressed air.

#### IMPORTANT:

Dirt/dust, oil, greases, detergents and any chemicals and natural products must be prevented from entering the Adblue/DEF tank.

The system will be damaged if dust or dirt enters the tank clogging the filters in the dosing system.

Keep the tank clean at all times.

#### IMPORTANT:

Never start the engine if anything other than clean AdBlue®/DEF has been added to the tank.

#### IMPORTANT:

The use of solution that do not fulfill the ISO 22241 standard will compromise the aftertreatment system performance, increase emissions.

Any warranty claims will be rejected.



P0024301

When topping off AdBlue®/DEF a nozzle with a built-in shut-off function should be used in accordance with ISO standard 22241. These nozzles are designed not to fit any other filling equipment.

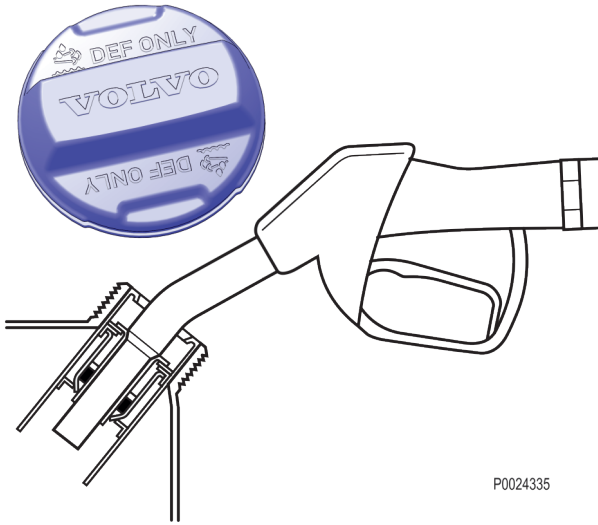
The tank cover is blue and marked with the text 'AdBlue/DEF only' to avoid confusion when filling. The ratio between the consumption of Adblue®/DEF and diesel is dimensioned as at least 1:1 to avoid the solution's running out before the diesel.

Never fill with AdBlue®/DEF other than ISO 22241 as specified by Volvo.

If this instruction is not followed the aftertreatment system may be permanently damaged. Engine power may also be affected negatively and engine components risk damage. Damage and costs arising from a failure to meet these requirements are not covered by Volvo Penta warranty obligations.

If AdBlue®/DEF is filled from a can or pump that lacks a stop function, it is important to make sure the tank is not overfilled as the solution may leak out of the breather tube. If the tank is overfilled and the solution in it freezes at temperatures below -11 °C (12.2 °F), the tank and the hoses may be permanently damaged.

Take great care not to spill the solution as it is extremely corrosive toward many materials. If a spill should occur the solution must be absorbed using dry sand or other non-flammable material and handled according to local and national regulations. Avoid spills onto soil and into waterways.



P0024335

### Erroneus filling of diesel or AdBlue®/DEF

**IMPORTANT:**

The filling of diesel or AdBlue®/DEF in the wrong tank can result in damage to the engine.

In order to avoid confusion, the AdBlue®/DEF tank has a blue filler cap and a decal affixed to the tank.

**Mistaken filling of AdBlue®/DEF in the diesel tank**

- The engine will not run at full power or will not run at all
- Injectors may be damaged
- Corrosion in the exhaust system between the turbocharger and aftertreatment system
- Expensive repairs

**Mistaken filling of diesel in the AdBlue®/DEF tank**

- The aftertreatment system may be seriously damaged
- The engine will no longer fulfill emission level requirements
- Expensive repairs

## AdBlue/DEF-Pump Filter, Change

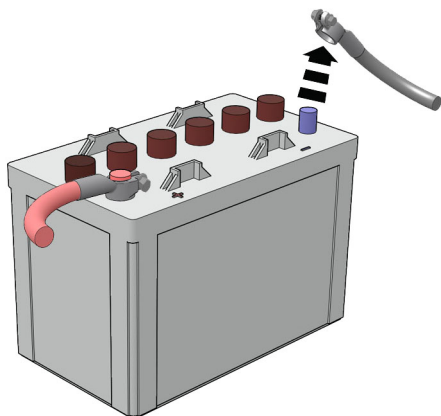
TWD1683GE, TWD1683VE

**NOTICE!** Emission-related component.

- 1 Stop the engine.

**NOTICE!** Wait until the pump unit has stopped running as it performs automatic emptying of the AdBlue®/DEF hoses.

- 2 Disconnect the battery negative terminal.

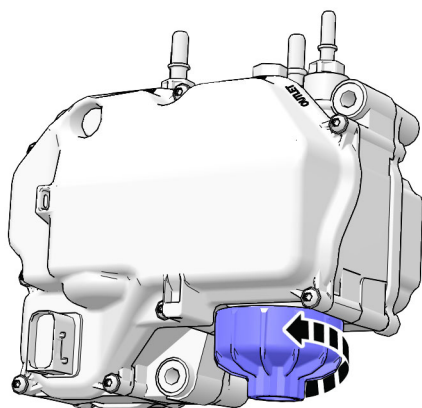


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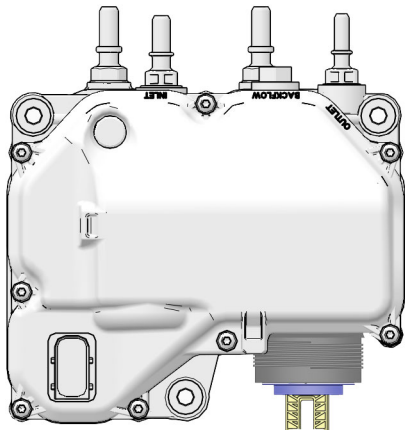
- 3 Place a collection vessel under the filter cover.

**NOTICE!** Use approved safety equipment and collection vessel.

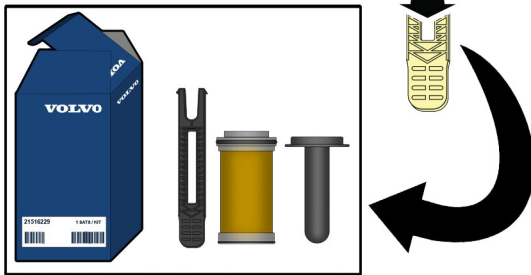
- 4 Undo the filter cover



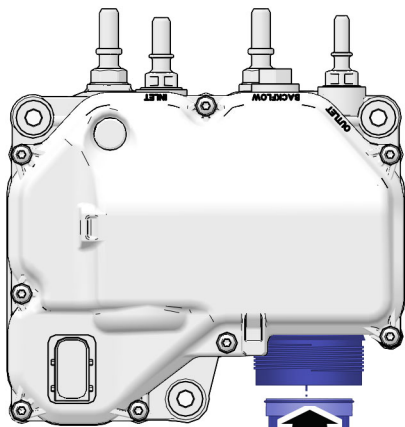
P0019389



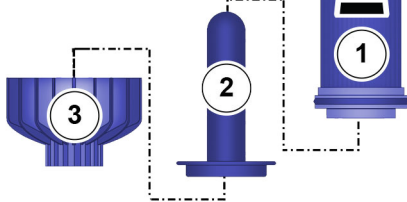
- 5 Use the puller (supplied with the filter kit) to pull out the filter by first pressing it into the filter hole until it clicks.
- 6 Pull out the filter.



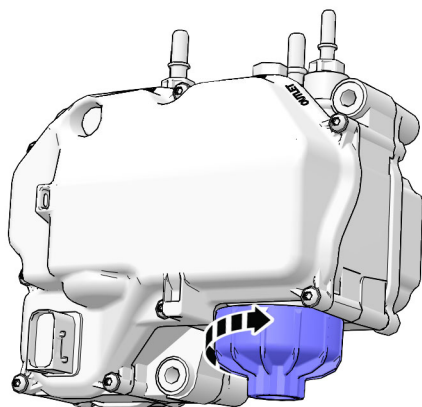
P0019390



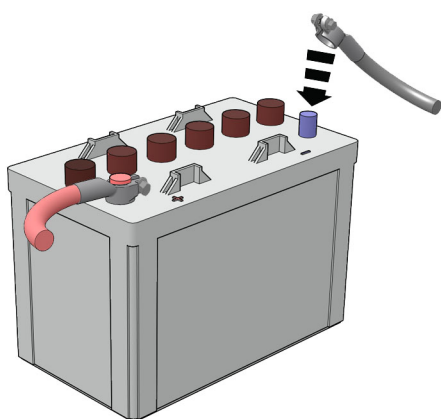
- 7 Install the new filter (1).  
Install the rubber gasket (2).  
Screw on the filter cover (3).



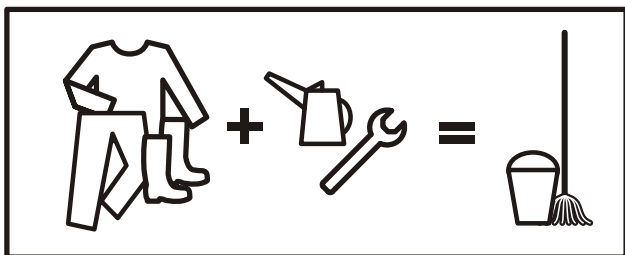
P0019391



P0019392



P0019365



p0013225

- 8 Tighten the cover.  
**Tightening torque: 20 (+5) Nm (14.8 +3.68 lbf. ft.)**

- 9 Reconnect the battery negative terminal.  
 10 Start the engine. Check for leaks; check function.  
 11 Delete any fault codes.

**NOTICE!** Care for equipment and the remaining AdBlue®/DEF.

## Electrical System

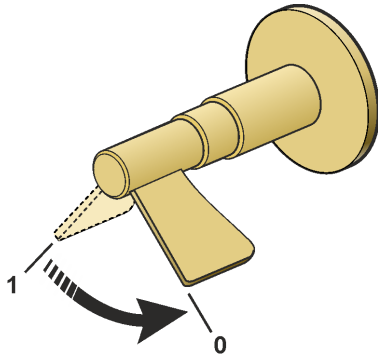
The engine is equipped with a 2-pole electrical system and an alternator.

### **WARNING!**

Always stop the engine and break the current using the main switches before working on the engine.

### **IMPORTANT:**

Contact a Volvo Penta dealer for information if any arc welding will be performed on the application. Arc welding can cause damage to the engine and the electronics.



P0002576

## Main switch

### IMPORTANT:

Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables.

The alternator and electronics could be damaged.

The main switches must never be switched off before the engine has stopped. If the circuit between the alternator and the battery is disconnected when the engine is running, the alternator and electronics may be damaged. For the same reason, the charging circuits must never be re-connected with the engine running.

## Fuses

The engine is equipped with a 10 A circuit breaker which cuts the current if overloaded.

The circuit breaker is located on the left-hand side (cold side) of the engine.

The engine stops if the fuse trips. If the circuit breaker trips frequently, an authorized Volvo Penta workshop should be contacted to investigate the cause of the overload.

## Electrical Connections

Check that electrical connections are dry, free from oxide, and that they are securely tightened.



P0002107

## Battery

### ⚠ WARNING!

Risk of fire and explosion. Never allow an open flame or electric sparks near the batteries.

### ⚠ WARNING!

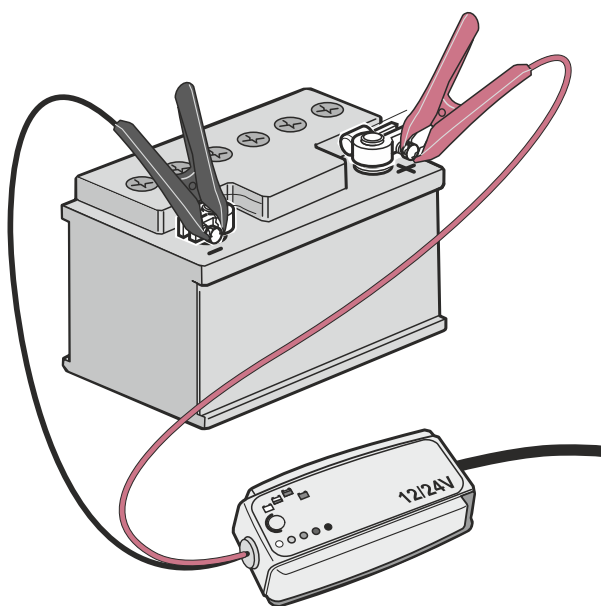
Battery electrolyte is a corrosive acid and should be handled with care. If you spill or splash electrolyte on any part of the body, immediately flush the exposed area with liberal amounts of water and seek medical attention as soon as possible.

### ⚠ WARNING!

Ventilate the engine compartment before working on batteries or battery connections.

### IMPORTANT:

Batteries can be damaged if they are left discharged, and can also freeze and burst easier in cold weather. If the engine is not going to be used for a longer period of time, the batteries should be fully charged, trickle charged if possible.



P0022892

## Maintenance

It is important to always follow the battery manufacturer's recommendation and instruction when replacing and charging batteries. Depending on battery type, the instructions for maintenance and charging may vary.

Modern batteries are normally maintenance free, but there are some actions that are recommended to increase the battery service life and avoid accidents:

- Keep the batteries clean and dry. Contamination and oxide on the batteries and battery poles can result in stray currents, voltage drop and discharge, especially in wet weather.
- Remove oxidation from the battery poles and terminals, using a brass brush.
- Tighten the terminals securely and grease them with terminal grease or petroleum jelly. Loose battery connections may cause damage to the engine's electrical system.
- Charge the battery regularly. A battery that is kept fully loaded has a maximum service life. The easiest way to check if a battery needs charging is to use a voltmeter.

**NOTICE!** If low starter battery alarm occur, the battery may get drained which might result in loss of functions and engine stopping.

## Replacing Battery

### IMPORTANT:

Make sure that the new battery fulfills the specifications in *Technical Data*. Read the information supplied with the battery before you begin the installation.

### IMPORTANT:

Do not disconnect the batteries with the engine running.

Sensitive electrical components can be immediately damaged.

### ⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

### Disconnecting (A)

- 1 Untighten the nut and remove the – cable (black).
- 2 Untighten the nut and remove the + cable (red).

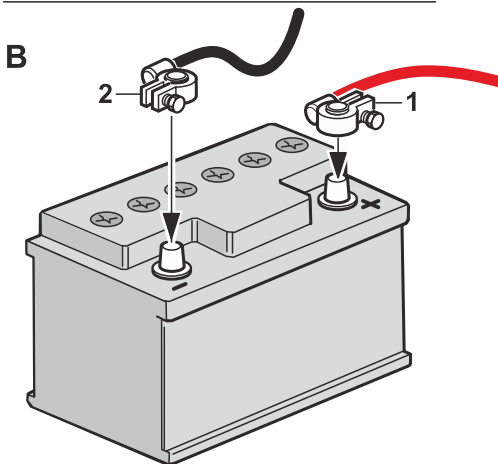
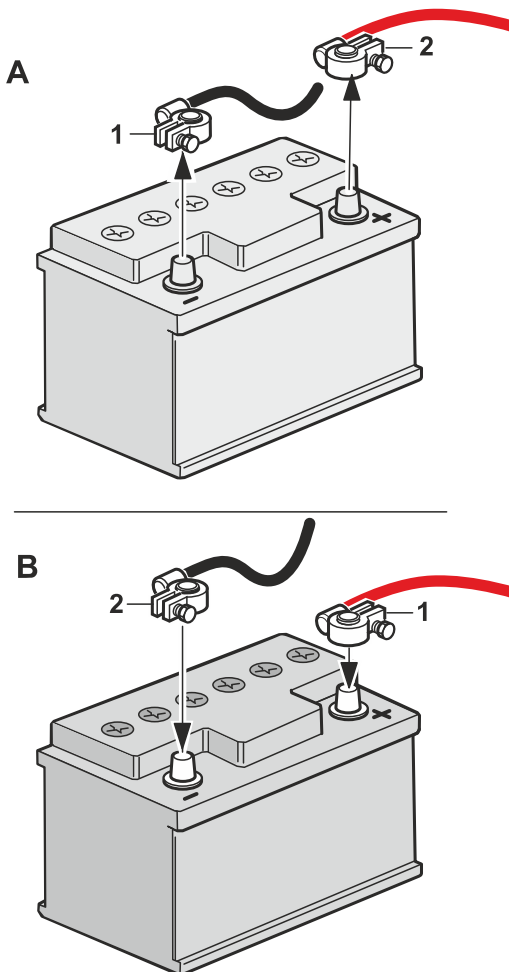
Remove the battery.

### Connecting (B)

Place the new battery.

- 1 Connect the + cable (red) to the + pole on the battery and tighten the nut.
- 2 Connect the – cable (black) to the – pole on the battery and tighten the nut.

**NOTICE!** Hand in the old battery to a re-cycling station.



P0022893

# Storage

To prevent the engine and other equipment from being harmed during long (2 months or more) periods out of service, it must be conserved. Conservation protects the engine from freezing and corrosion damages.

It is of utmost importance that the conservation is performed correctly, therefore we have compiled a checklist covering the most important points. Before taking the engine out of service for long periods, Volvo Penta recommends that the engine is checked by a qualified workshop for possible need for overhaul or repair.

## ⚠ CAUTION!

Read the chapter on Maintenance in the Operator's Manual before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and technical correct manner.

## ⚠ WARNING!

Conservations oils can be flammable and dangerous to inhale. Ensure good ventilation. Use a protective face mask when spraying.

## IMPORTANT:

Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.



P0002089

- **For up to 8 month's stoppage:**  
Change the oil and oil filter on the engine, then run the engine until warm.
- **More than 8 month's stoppage:**  
Conserve the lubrication and fuel systems with conservation oil. Refer to the section *Conservation of the lubrication and fuel systems for more than 8 months' stoppage*.
- Make sure the coolant has adequate antifreeze properties. Top up as necessary. Alternatively, you can drain the coolant (also drain the coolant filter).
- Drain any water and contamination from the fuel filters and fuel tank. Fill the fuel tank completely, to avoid condensation.
- Disconnect the battery cables, clean and charge the batteries. Trickle charge the batteries while the equipment is in storage. **A poorly charged battery can freeze and burst.**
- Clean the outside of the engine. Do not use a high pressure washer for engine cleaning. Touch up paint damage with Volvo Penta original paint.
- Put a note on the engine with the date, type of conservation and the conservation oil used.
- Cover the air filter, exhaust pipe and engine if necessary.
- Empty the AdBlue/DEF tank and rinse it with distilled water.

## Bringing Out of Storage

- Remove any covers from the engine, air filter and exhaust pipe.
- Fill the engine with the correct quality and viscosity oil into the engine, as necessary, refer to *Technical Data, Lubrication System*. Install a new oil filter if the filter was not changed during conservation.
- Install new fuel filters and bleed the fuel system.
- Check the drive belt(s).
- Check the condition of all rubber hoses, and retighten the hose clamps.
- Close the drain taps and install any drain plugs.
- Check the coolant level. Top up the coolant all the way up to the filler cap.
- Connect the fully charged batteries.
- Start the engine and warm it up at fast idle with no load.
- Check that no oil, fuel or coolant leakage occurs.
- Fill the AdBlue/DEF tank. The solution must fulfill ISO 22241 standards.

## Conservation of the lubrication and fuel systems for more than 8 months' stoppage:

- Drain the engine oil and fill up with **conservation oil\*** to just over the MIN marking on the dipstick.
- Connect the fuel suction and return hoses to a 1/3 full jerrican containing **conservation oil\*** and 2/3 diesel fuel.
- Bleed the fuel system.
- Start the engine and run at a fast idle until about 2 liters (0.6 US gal) of the fluid in the jerrican have been used. Stop the engine and re-connect the fuel suction and return lines.
- Drain the conservation oil from the engine.
- Follow the other instructions on the previous page.

\* Conservation oils are sold by oil companies.

# Technical Data

## Engines

TWD1683VE

<b>Type designation</b>	<b>TWD1683VE</b>
Power, prime/stand-by	Refer to the sales literature
Torque, prime/stand-by	Refer to the sales literature
No. of cylinders	6
Bore, mm (inch)	144 (5.67)
Stroke, mm (inch)	165 (6.50)
Displacement, liter (inch <sup>3</sup> )	16.12 (983.9)
Weight, wet, kg (lbs)	1723 (3799)
Firing order	1-5-3-6-2-4
Compression ratio	16.8:1
Low idle, r/min.	700
High idle, rpm	1900

TWD1682GE, TWD1683GE

<b>Type designation</b>	<b>TWD1682GE, TWD1683GE</b>
Power, prime/stand-by	Refer to the sales literature
Torque, prime/stand-by	Refer to the sales literature
No. of cylinders	6
Bore, mm (inch)	144 (5.67)
Stroke, mm (inch)	165 (6.50)
Displacement, liter (inch <sup>3</sup> )	16,12 (983.9)
Weight, dry, kg (lbs)	1810 (3990)
Weight, wet, kg (lbs)	1890 (4167)
Firing order	1-5-3-6-2-4
Compression ratio	16,8:1
Low idle, r/min.	900
High idle, rpm	1500, 1800

TWD1683GE-B

Type designation	TWD1683GE-B
Power, prime/stand-by	Refer to the sales literature
Torque, prime/stand-by	Refer to the sales literature
No. of cylinders	6
Bore, mm (inch)	144 (5.67)
Stroke, mm (inch)	165 (6.50)
Displacement, liter (inch <sup>3</sup> )	16,12 (983.9)
Weight, dry, kg (lbs)	1810 (3990)
Weight, wet, kg (lbs)	1890 (4167)
Firing order	1-5-3-6-2-4
Compression ratio	16,8:1
Low idle, r/min.	900
High idle, rpm	1500, 1800

## Lubrication System

<b>Oil change volume, including filter change</b>	
Composite sump (Standard)	48 liters (12.68 US gal)
Aluminum sump (Optional)	55 liters (14.53 US gal)
Additional volume: Remote oil filters (Optional)	5 liters (0.80 US gal)
<b>Oil pressure, hot engine</b>	
at operating speed	220-650 kPa (44–94 psi)
<b>Oil filter</b>	
Full flow filter	2
By-pass filter	1
<b>Lube oil pump</b>	
Type	Gear driven

### Oil recommendations

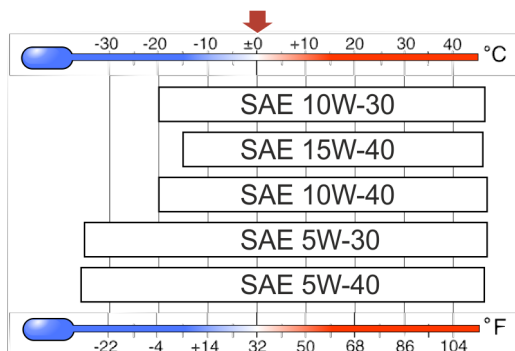
TWD1683VE

<b>Oil quality</b> (VE engines)	<b>Oil change interval, reached first in operation:</b>
VDS-4.5	<b>500</b> hours or 12 months*
* Oil change intervals/specifications (for applications with average fuel consumption exceeding 65 l/h).	
VDS-4.5	<b>1000</b> hours or 12 months*
* Oil change intervals/specifications (for applications with average fuel consumption up to 65 l/h).	

TWD1682GE, TWD1683GE, TWD1683GE-B

<b>Oil quality</b> (GE engines)	<b>Oil change interval, reached first in operation:</b>
VDS-4.5	<b>500</b> hours or 12 months

### VDS = Volvo Drain Specification



P0028382

Select the viscosity according to the table.

The temperature values refer to stable ambient temperatures.

**NOTICE!** Volvo Penta recommendation for lowest possible fuel consumption and optimal durability is to use SAE 10W-30 oil when the viscosity table allows.

## Fuel System

<b>Feed pump</b>	
Feed pressure at 900 rpm	min 100 kPa (14.5 psi)
Feed pressure at 1800 rpm	min 300 kPa (43,5 psi)
Feed pressure at full load	min 300 kPa (43,5 psi)
<b>Bypass valve</b>	
Opening pressure	400-550 kPa (58–80 psi)

TWD1683GE

<b>CO<sub>2</sub> emission<sup>(1)</sup></b>	
B7 Fuel, according to EN590	619 g/kWh
HVO Fuel, according to EN 15940	596 g/kWh
US1065 Fuel, according to ASTM D975 2D	630 g/kWh
MK1 Fuel, according to SS 155435	616 g/kWh

1) This CO<sub>2</sub> measurement results from testing over a fixed test cycle under laboratory conditions a(n) (parent) engine representative of the engine type (engine family) and shall not imply or express any guarantee of the performance of a particular engine once installed in a type of non-road mobile machinery or category T vehicle.

TWD1683VE

<b>CO<sub>2</sub> emission<sup>(1)</sup></b>	
B7 Fuel, according to EN590	637 g/kWh
HVO Fuel, according to EN 15940	612,5 g/kWh
US1065 Fuel, according to ASTM D975 2D	644,9 g/kWh
MK1 Fuel, according to SS 155435	630,7 g/kWh

1) This CO<sub>2</sub> measurement results from testing over a fixed test cycle under laboratory conditions a(n) (parent) engine representative of the engine type (engine family) and shall not imply or express any guarantee of the performance of a particular engine.

## Fuel quality requirements for emission legislation stage 5, diesel engines with exhaust aftertreatment system

### General requirements

Volvo Penta diesel engines are certified for compliance with emission legislations with the diesel test fuels specified by law. These fuels correspond with diesel fuel standards EN 590, ASTM D975-2D and EN15940. Volvo Penta engines will be compliance with emission legislation, if the engine is maintained according to service instructions and used according to intended purpose.

It is the responsibility of the fuel suppliers to always ensure that their fuels meet relevant requirements and are fit for their intended purpose. Their responsibility includes any use of additives for proper engine performance and function.

Special requirements are placed on cold-flow properties, that is, temperature limit values of fuel filterability during operation in winter conditions.

### Restrictions for specified diesel fuels

98/70/EC is not fully specified in the fuel standard from an engine warranty perspective. Below mentioned fuel parameters must be fulfilled.

- **Max density for ASTM D975 No 2-D: 860 kg/m<sup>3</sup>**  
Insufficient density reduces the power and increases the fuel consumption. Excessive density endangers the durability and function of the fuel injection equipment.

### Paraffinic fuels - HVO and GTL

Paraffinic diesel fuels ("Synthetic Diesel") have higher cetane numbers and lower densities than diesel fuels. HVO (Hydrotreated Vegetable Oils) is renewable paraffinic fuels. GTL (Gas-To-Liquid) is fossil paraffinic fuels. Volvo Penta approves the use of paraffinic diesel fuels that fulfill the standard EN15940.

Volvo Penta also approves the use of fuel blends between these paraffinic fuels and diesel fuels that comply with the quality requirements.

In general, the maximum torque and power output, depends on the density and heat value of the fuel. HVO and GTL fuel may have a power/torque loss of a couple of % compared to EN590 fuel.

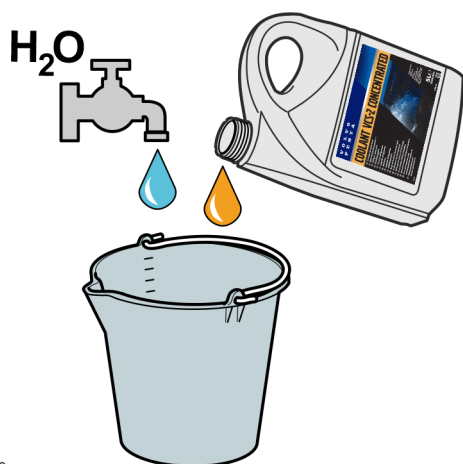


## Cooling System

Type	Pressurized, sealed
Pressure cap, max opening pressure	75 kPa (10.88 PSI)
<b>Volume (Volvo Penta cooling system)</b>	
Engine circuit (Engine with radiator, hoses and expansion tank) (Pusher system)	86 liters (22.7 US gal)
Charge air cooler circuit (Charge air coolers, hoses and expansion tank) (Pusher system)	64 liters (16.9 US gal)
<b>Thermostat</b>	
Qty	1 pc.
Opening temperature	82 °C (179.6 °F)



P0038119



P0038120

### Coolant, Mixing

**⚠ WARNING!**

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

**NOTICE!** Always use the same type of coolant that is already in the engine.

VCS-2 will be backwards compatible with current VCS and they are mixable without risks.

**Coolant shall be based on Organic Acid Technology (OAT).**

**Follow the mixing recommendation on the product.**

The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Water Quality*, page 94.

**NOTICE!** Always use “Ready Mixed” coolant if water quality cannot be determined or if it does not fulfill ASTM D4985.

**NOTICE!** Never mix more than 60% concentrated coolant with water. A greater concentration provides reduced cooling effect with the risk for overheating and reduced freeze protection.

## Water Quality



P0002094

### ASTM D4985:

Total solid particles	<300 ppm
Total hardness	<120 ppm or 7° dH
Chloride	<40 ppm
Sulfate	<100 ppm
pH value	6.5–8.5
Silica (acc. ASTM D859)	<20 ppm
Iron (acc. ASTM D1068)	<0.10 ppm
Manganese (acc. ASTM D858)	<0.05 ppm
Conductivity (acc. ASTM D1125)	<400 µS/cm
Organic content, COD <sub>Mn</sub> (acc. ISO15705:2002)	<8 ppm

## Inlet and Exhaust System

Tank	Small	Medium	Large	X Large
Usable volume (AdBlue®/DEF)	17.4 liters (4.54 US gal)	38.6 liters (10.2 US gal)	68 liters (17.96 US gal)	164.2 liters (43.38 US gal)

### Consumption of Urea

The consumption of urea varies depending on how the engine is used. For engines that meet the Nonroad Transient Cycle (NRTC), the standard consumption of urea is 5–9 percent of fuel consumption.

**NOTICE!** Urea is always filled in a separate tank in the vehicle and must never be mixed with the diesel fuel.

## Electrical System

System voltage	24V
Alternator	
voltage/max. current	28V/80A
power app.	2200W
Alternative generating equipment (optional)	
voltage/max. current	28V/110A
power app.	2800W
Battery capacity	2 pcs. series connected 12 V, max. 220 Ah
Battery electrolyte density at +25°C °	
fully charged battery	1,28 g/cm <sup>3</sup> (1,24 g/cm <sup>3</sup> )*
recharge battery at	1,20 g/cm <sup>3</sup> (1,20 g/cm <sup>3</sup> )*

\* Note. Applies to batteries with tropical acid.

## Identification Numbers

**NOTICE!** The engine labels are placed on the valve cover.

### Example of general label

<b>VOLVO PENTA</b>		
<u>PRODUCT INFORMATION</u>		
PRODUCT DESIGNATION:	B	A  Part No.
SPECIFICATION No.:	C	
CHASSI ID:	D	
SERIAL No.:	E	
POWER (kW):	F	
SPEED (rpm):	G	
MADE IN:	H	

P0024526

- A Label part number
- B Product designation
- C Specification number
- D Chassis ID
- E Serial number
- F Power (kW)
- G Engine speed (rpm)
- H Country of manufacturing

<b>VOLVO PENTA</b>		AB VOLVO PENTA	
<u>IMPORTANT ENGINE INFORMATION</u>			
ENGINE MODEL:	A	MAXIMUM ALTITUDE BEFORE DERATION:	J
POWER: kW	C	VENTILATION RATE MSHA:	O
SPEED: rpm	D	APPROVAL No. CANMET:	L
HIGH IDLE:	I		
*EC: Electronically Controlled			
VP: E			

P0028325

### Example of MSHA, CANMET certificate label

- A. Engine Model Designation
- C. Power (kW)
- D. Speed (rpm)
- E. Label part number
- I. High idle
- J. Maximum altitude
- L. Ventilation rate MSHA
- O. Approval No. CANMET

<b>VOLVO PENTA</b>		AB VOLVO PENTA	
<u>EMISSION CONTROL INFORMATION</u>		ULTRA LOW SULPHUR FUEL ONLY MAX 15 PPM SULPHUR	
ENGINE FAMILY:	B	USE VOLVO SOFTWARE SERVICE TOOL TO VERIFY ACTUAL ENGINE SETTINGS.	
POWER CATEGORY:	C		
DATE OF MANUFACTURE:	D (mm-yy)		
EXHAUST EMISSION CONTROL SYSTEM:	H		
F			
G			
THIS ENGINE COMPLIES WITH U.S. EPA AND CALIFORNIA REGULATIONS FOR E NON ROAD DIESEL ENGINES.			
Part No. A			

P0028149

### Example of EPA/CARB certificate label

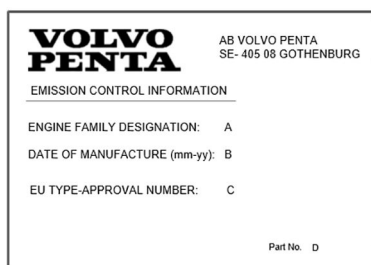
- A Label part number
- B Engine family
- C Power category
- D Date of manufacture
- E Model year
- F –
- G –
- H Exhaust emission control system



P0030549

**Example of Korea Approval label**

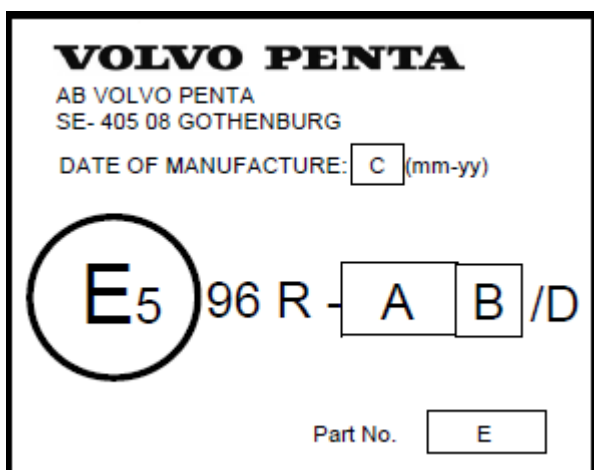
- A Approval number
- B Engine model
- C –
- D –
- E Label part number



P0029825

**Example of EU certificate label**

- A Engine family
- B Date of manufacture
- C EU Type-approval number
- D Label part number



P0032974

**Example of REG 96 certificate label**

- A Approval no.
- B Engine Category
- C Date of manufacture (mm-yy)
- D —
- E Label part number

制造商 Manufacturer	AB VOLVO PENTA	<b>VOLVO PENTA</b>	
发动机型号 Engine Model	A	发动机功率 Engine Power	C kW/rpm
生产日期 Assembly Date	B (mm-yy)	入库编号 Register Code	D
所属功率范围 Power Range	130sP≤560 kW	系族名称 Engine Family	E
排放标准 Emission Level	IV 阶段	后处理装置类型 EATS Device Type	F
此发动机符合中国非道路移动机械用发动机排放IV阶段标准 国家标准号: GB 20891-2014 THIS ENGINE CONFORMS TO STAGE IV OF CHINA NON ROAD MOBILE MACHINERY DIRECTIVE CHINA STANDARD: GB 20891-2014			
			Part No. G

P0034381

### Example of China stage IV certificate label

- A Engine model
- B Assembly date
- C Engine power kW/rpm
- D Register Code
- E Engine Family
- F EATS Device Type
- G Label part No.

# VOLVO PENTA

Declaration of incorporation for the installation of partially completed machinery in accordance with Machinery Directive 2006/42/EC, Annex II, 1B

## Engine Manufacturer:

AB Volvo Penta  
Gropegårdsgatan 11  
SE 405 08 Gothenburg, Sweden

## Product designation:

Engine size	Model
5 liter, VE	TAD540VE - TAD541VE - TAD542VE - TAD550VE - TAD551VE - TAD552VE - TAD570VE - TAD571VE - TAD572VE - TAD580VE - TAD581VE - TAD582VE - TAD583VE
8 liter, VE	TAD840VE - TAD841VE - TAD842VE - TAD843VE - TAD850VE - TAD851VE - TAD852VE - TAD852VE-B - TAD853VE - TAD870VE - TAD871VE - TAD872VE - TAD873VE - TADH880-84VE - TAD880VE - TAD881VE - TAD882VE - TAD883VE - TAD884VE
8 liter, GE	TAD840GE - TAD840GE-B - TAD841GE - TAD842GE - TAD843GE - TADH880-82GE - TAD880GE - TAD881GE - TAD882GE - TAD851GE - TAD852GE - TAD853GE
11 liter, VE	TAD1140VE - TAD1141VE - TAD1142VE - TAD1150VE - TAD1151VE - TAD1152VE - TAD1170VE - TAD1171VE - TAD1172VE - TAD1180VE - TAD1181VE - TAD1182VE - TAD1183VE
13 liter, VE	TAD1340VE - TAD1341VE - TAD1342VE - TAD1343VE - TAD1344VE - TAD1345VE - TAD1350VE - TAD1351VE - TAD1352VE - TAD1353VE - TAD1371VE - TAD1372VE - TAD1373VE - TAD1374VE - TAD1375VE - TAD1381VE - TAD1382VE - TAD1383VE - TAD1384VE - TAD1385VE
13 liter, GE	TAD1341GE-B - TAD1342GE-B - TAD1342GE-B - TAD1343GE-B - TAD1344GE-B - TAD1345GE-B - TAD1346GE - TAD1350GE - TAD1351GE - TAD1352GE - TAD1353GE - TAD1354GE - TAD1355GE - TAD1380GE - TAD1381GE - TAD1382GE
16 liter, VE	TAD1640VE-B - TAD1641VE-B - TAD1642VE-B - TAD1640VE-C - TAD1641VE-C - TAD1642VE-C - TAD1643VE - TAD1643VE-B - TAD1650VE-B - TAD1651VE - TAD1670VE - TAD1671VE - TAD1672VE - TWD1683VE
16 liter, GE	TAD1640GE-B - TAD1641GE-B - TAD1642GE-B - TWD1644GE - TWD1645GE - TAD1650GE - TAD1651GE - TWD1652GE - TWD1653GE - TWD1672GE - TWD1673GE - TWD1682GE - TWD1683GE - TWD1683GE-B
17 liter, GE	TWD1744GE

**Description:** 4-cycle diesel engine.

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I:

1.1.3, 1.1.5, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.7.1, 1.7.4, 1.7.4.1 and 1.7.4.3.

The relevant technical documentation is compiled as described in part B of Annex VII.

It is also in conformity with the relevant union harmonization legislation: EMC 2014/30/EU

The following harmonized standards have been applied:

EN ISO 12100:2010 // EN 1679-1+A1:2011 //

EN IEC 61000-6-1:2019 // EN IEC 61000-6-2:2019 // EN IEC 61000-6-3:2021 //

EN IEC 61000-6-4:2019 //

EN 12895:2015 + A1:2019 // EN-ISO 14982:2009 // EN 13766-1:2018

For engines equipped with Volvo Penta control interface module:

Paragraph 6.4 (Emergency stop) in 1679-1 + A1 2011 is not verified for engines equipped with Volvo Penta Control Interface Module. Responsibility lies with the machine manufacturer to add one or several emergencies stops in accordance with paragraph 1.2.4.3 (2006/42/EC).

For engines equipped with the Volvo Penta Start/Stop System the responsibility for the functional safety of the system lies with the machine manufacturer performing the integration.

Relevant information concerning the partially completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The engines covered by this declaration may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provision of Machinery Directive 2006/42/EC.

**Name and function:**

*Anders B Berle, Director Safety Compliance*

(The identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative.)

**Signature and title:**



Date and place of issue: 2024-04-04 Gothenburg

Phoenix no. 50334799

# VOLVO PENTA

Declaration of incorporation for the installation of partially completed machinery in accordance with Supply of machinery (Safety) Regulations 2008, placed on the UK-market

## Engine Manufacturer:

AB Volvo Penta  
Gropegårdsgatan 11  
SE 405 08 Gothenburg, Sweden

## Product designation:

Engine size	Model
5 liter, VE	TAD540VE - TAD541VE - TAD542VE - TAD550VE - TAD551VE - TAD552VE - TAD570VE - TAD571VE - TAD572VE - TAD580VE - TAD581VE - TAD582VE - TAD583VE
8 liter, VE	TAD840VE - TAD841VE - TAD842VE - TAD843VE - TAD850VE - TAD851VE - TAD852VE - TAD852VE-B - TAD853VE - TAD870VE - TAD871VE - TAD872VE - TAD873VE - TADH880-84VE - TAD880VE - TAD881VE - TAD882VE - TAD883VE - TAD884VE
8 liter, GE	TAD840GE - TAD840GE-B - TAD841GE - TAD842GE - TAD843GE - TADH880-82GE - TAD880GE - TAD881GE - TAD882GE - TAD851GE - TAD852GE - TAD853GE
11 liter, VE	TAD1140VE - TAD1141VE - TAD1142VE - TAD1150VE - TAD1151VE - TAD1152VE - TAD1170VE - TAD1171VE - TAD1172VE - TAD1180VE - TAD1181VE - TAD1182VE - TAD1183VE
13 liter, VE	TAD1340VE - TAD1341VE - TAD1342VE - TAD1343VE - TAD1344VE - TAD1345VE - TAD1350VE - TAD1351VE - TAD1352VE - TAD1353VE - TAD1371VE - TAD1372VE - TAD1373VE - TAD1374VE - TAD1375VE - TAD1381VE - TAD1382VE - TAD1383VE - TAD1384VE - TAD1385VE
13 liter, GE	TAD1341GE-B - TAD1342GE-B - TAD1342GE-B - TAD1343GE-B - TAD1344GE-B - TAD1345GE-B - TAD1346GE - TAD1350GE - TAD1351GE - TAD1352GE - TAD1353GE - TAD1354GE - TAD1355GE - TAD1380GE - TAD1381GE - TAD1382GE
16 liter, VE	TAD1640VE-B - TAD1641VE-B - TAD1642VE-B - TAD1640VE-C - TAD1641VE-C - TAD1642VE-C - TAD1643VE - TAD1643VE-B - TAD1650VE-B - TAD1651VE - TAD1670VE - TAD1671VE - TAD1672VE - TWD1683VE
16 liter, GE	TAD1640GE-B - TAD1641GE-B - TAD1642GE-B - TWD1644GE - TWD1645GE - TAD1650GE - TAD1651GE - TWD1652GE - TWD1653GE - TWD1672GE - TWD1673GE - TWD1682GE - TWD1683GE - TWD1683GE-B
17 liter, GE	TWD1744GE

**Description:** 4-cycle diesel engine.

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I:

1.1.3, 1.1.5, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.7.1, 1.7.4, 1.7.4.1 and 1.7.4.3.

The relevant technical documentation is compiled as described in part B of Annex VII.

It is also in conformity with the relevant union harmonization legislation: EMC 2014/30/EU

The following harmonized standards have been applied:

EN ISO 12100:2010 // EN 1679-1+A1:2011 //

EN IEC 61000-6-1:2019 // EN IEC 61000-6-2:2019 // EN IEC 61000-6-3:2021 //

EN IEC 61000-6-4:2019 //

EN 12895:2015 + A1:2019 // EN-ISO 14982:2009 // EN 13766-1:2018

For engines equipped with Volvo Penta control interface module:

Paragraph 6.4 (Emergency stop) in 1679-1 + A1 2011 is not verified for engines equipped with Volvo Penta Control Interface Module. Responsibility lies with the machine manufacturer to add one or several emergencies stops in accordance with paragraph 1.2.4.3 (2006/42/EC).

For engines equipped with the Volvo Penta Start/Stop System the responsibility for the functional safety of the system lies with the machine manufacturer performing the integration.

Relevant information concerning the partially completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The engines covered by this declaration may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provision of Machinery Directive 2006/42/EC.

**Name and function:**

*Anders B Berle, Director Safety Compliance*

(The identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative.)

**Signature and title:**



Date and place of issue: 2024-04-04 Gothenburg

Phoenix no. 50334795

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**V O L V O P E N T A**



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# ***Snowblower plate adjustment***

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### 1.1 PREPARATION OF THE PLATE SUPPORT

Review the thread of the hole with a threaded tap (M10x1).

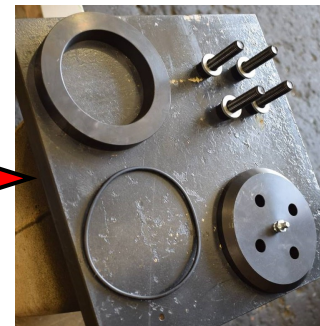
Screw the grease fitting into the hole, the grease nipple must be screwed into the inner side of the support



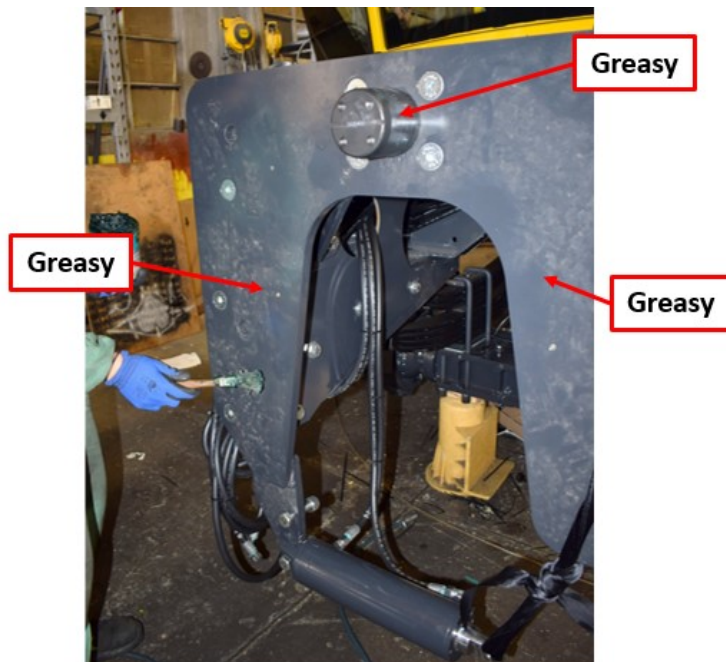
Disconnect the cylinder and place it on the ground as shown in the figure.

Unscrew the four screws and remove the following elements from the pin:

- 4 screw and 4 washer;
- Plug;
- O-ring;
- Conical spacer.



Coat the entire surface of the support with grease, including the pin.



### 1.2 REMOVING THE PLATE FROM THE SNOWBLOWER

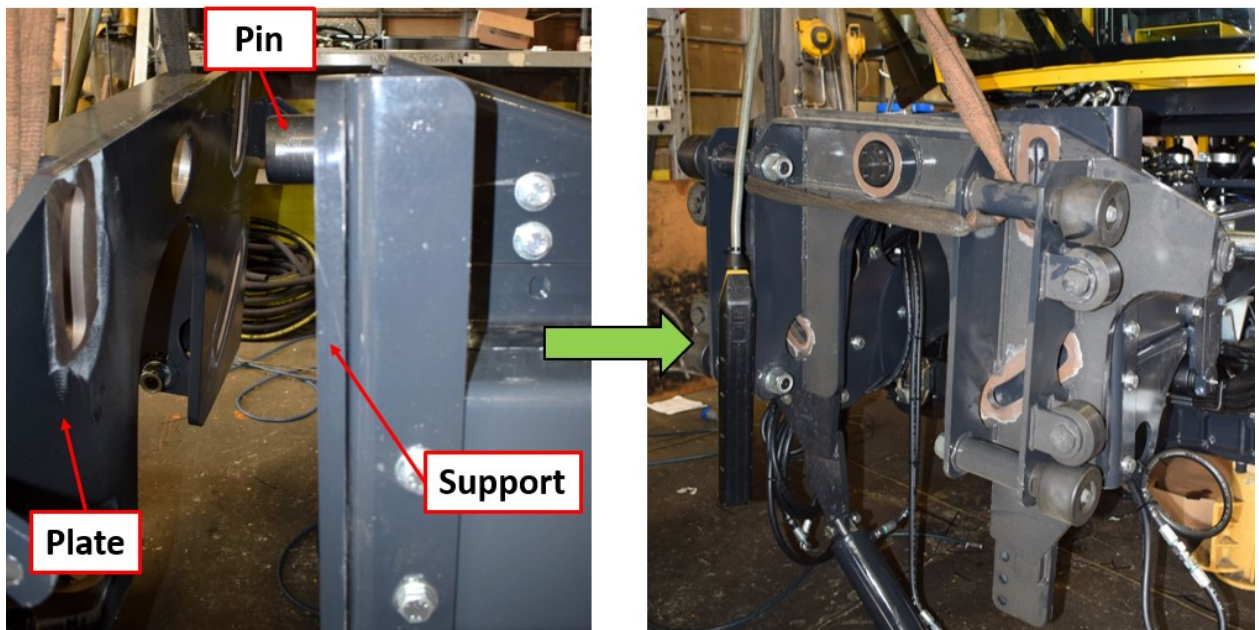
To remove the plate from the snowblowerhead, harness it as shown in the figure.  
Disconnect the lift cylinders from the plate by unscrewing nut A and removing pin B.



With the auxiliary of gantry crane, lift the plate and remove it from the trestle.

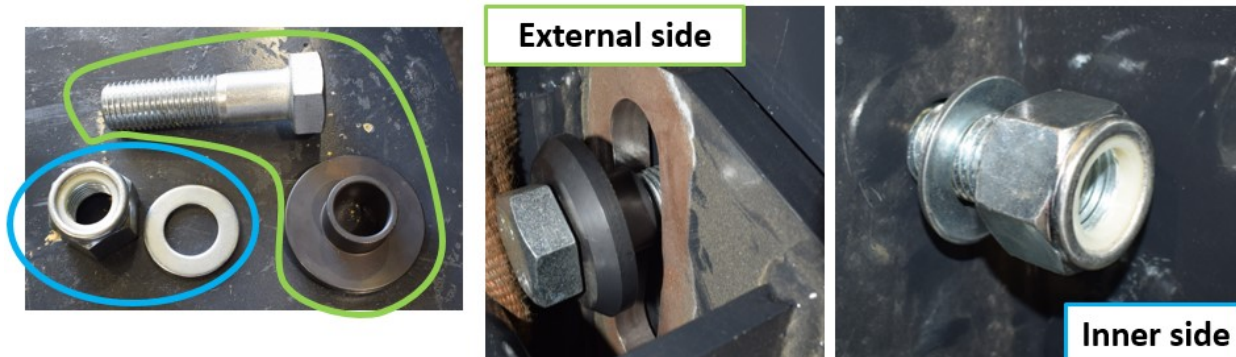
### 1.3 ASSEMBLY THE PLATE TO THE SUPPORT

With the auxiliary of gantry crane, insert the plate onto the pin of the support.



Connect the plate to the support as follows:

- External side: insert the screw with the spacer;
- Inner side: screw the nut with the washer



**WARNING:**

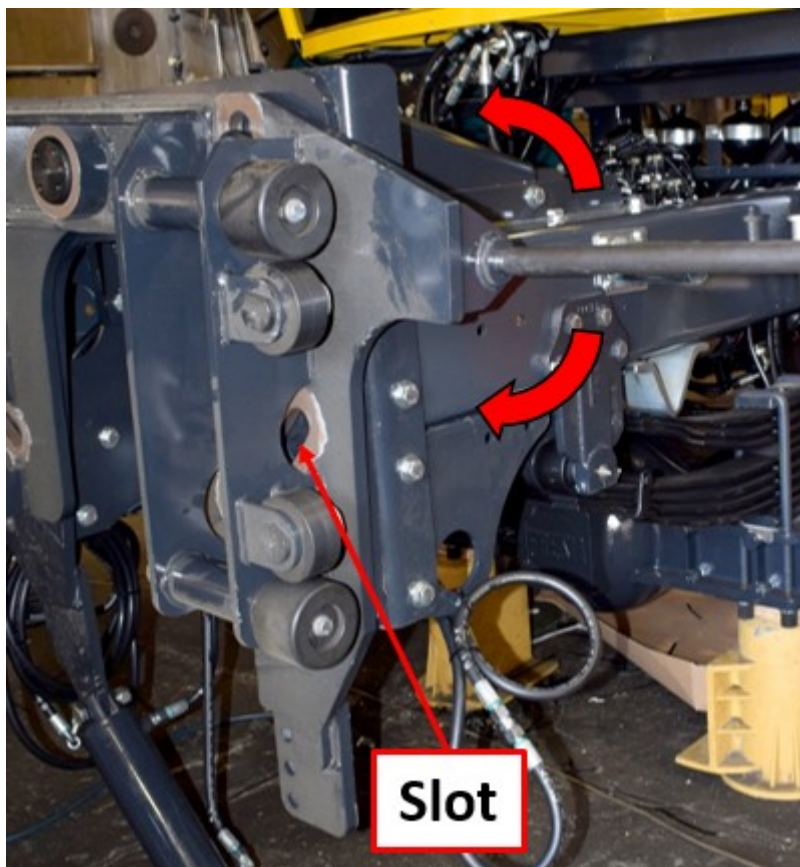
*Do not tighten the bolts.*

*These should only be brought closer together.*

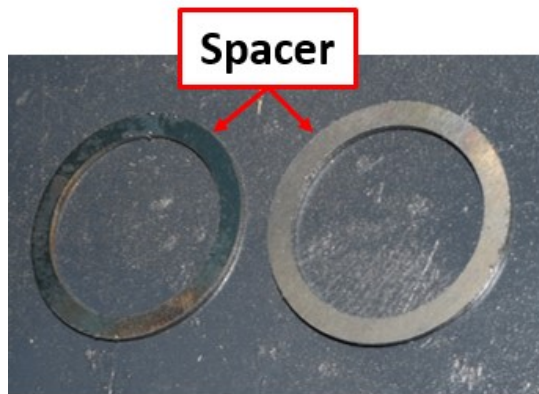
#### 1.4 PLATE CALIBRATION

Proceed by complete tightening the first bolt, leaving the remaining three bolts loose.

Check that it is possible to move the plate along the entire length of the slots.



If the plate cannot be moved or the movement is very difficult, it is necessary to insert a spacer.



Remove the bolt and insert the spacer. Different thicknesses are available, it choose the most suitable one.



**NOTE:**

*It may be necessary to insert more than one spacer*

Tighten the bolt and check the swing of the plate. Proceed to the next bolt  
Proceed in the same way for all 4 bolts.

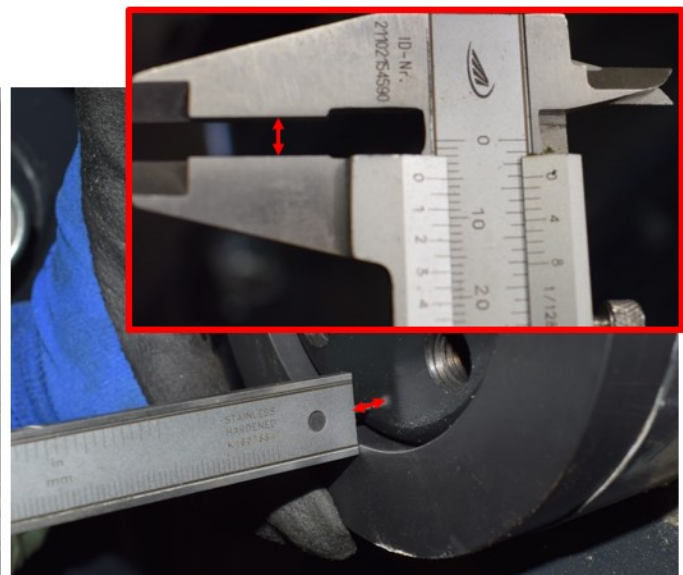
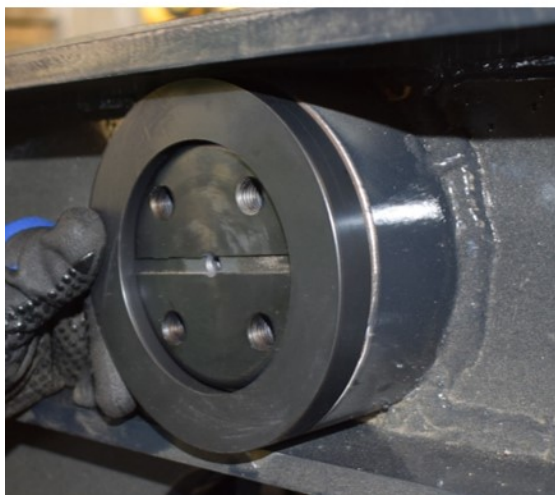


**NOTE:**

*Once all the bolts are tightened, the plate must swing along the entire length of the slots.*

**1.5 PIN ASSEMBLY**

Take the elements removed in chapter 1.1 (4 screw and 4 washer; plug, O-ring and conical spacer).  
Place the conical spacer on the pin and measure with the caliper, the distance between the pin and the spacer.



Insert the spacers into the gap between the pin and the conical spacer



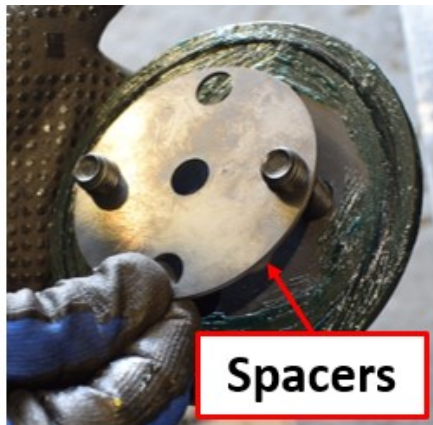
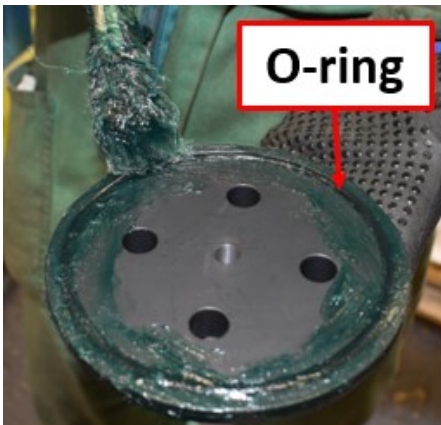
**NOTE:**

*The total thickness of the spacers must be approximately equal to the gap between the pin and the conical spacer.*

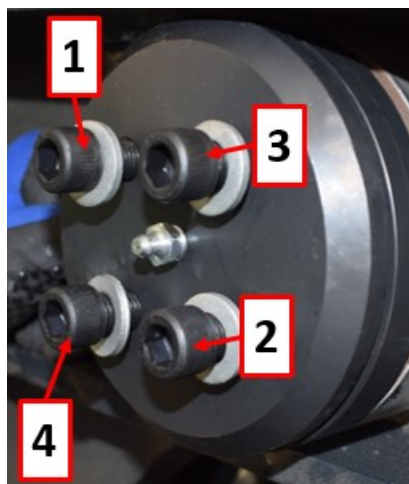


Insert the O-ring into the pin cap and grease the entire surface.

Place the cap on the pin and screw in the screws.



It is necessary to perform the torque adjustment in the following order:



**WARNING:**



Once all the bolts are tightened, the plate must swing along the entire length of the slots.

If the plate does not swing, add more spacers on the pin.