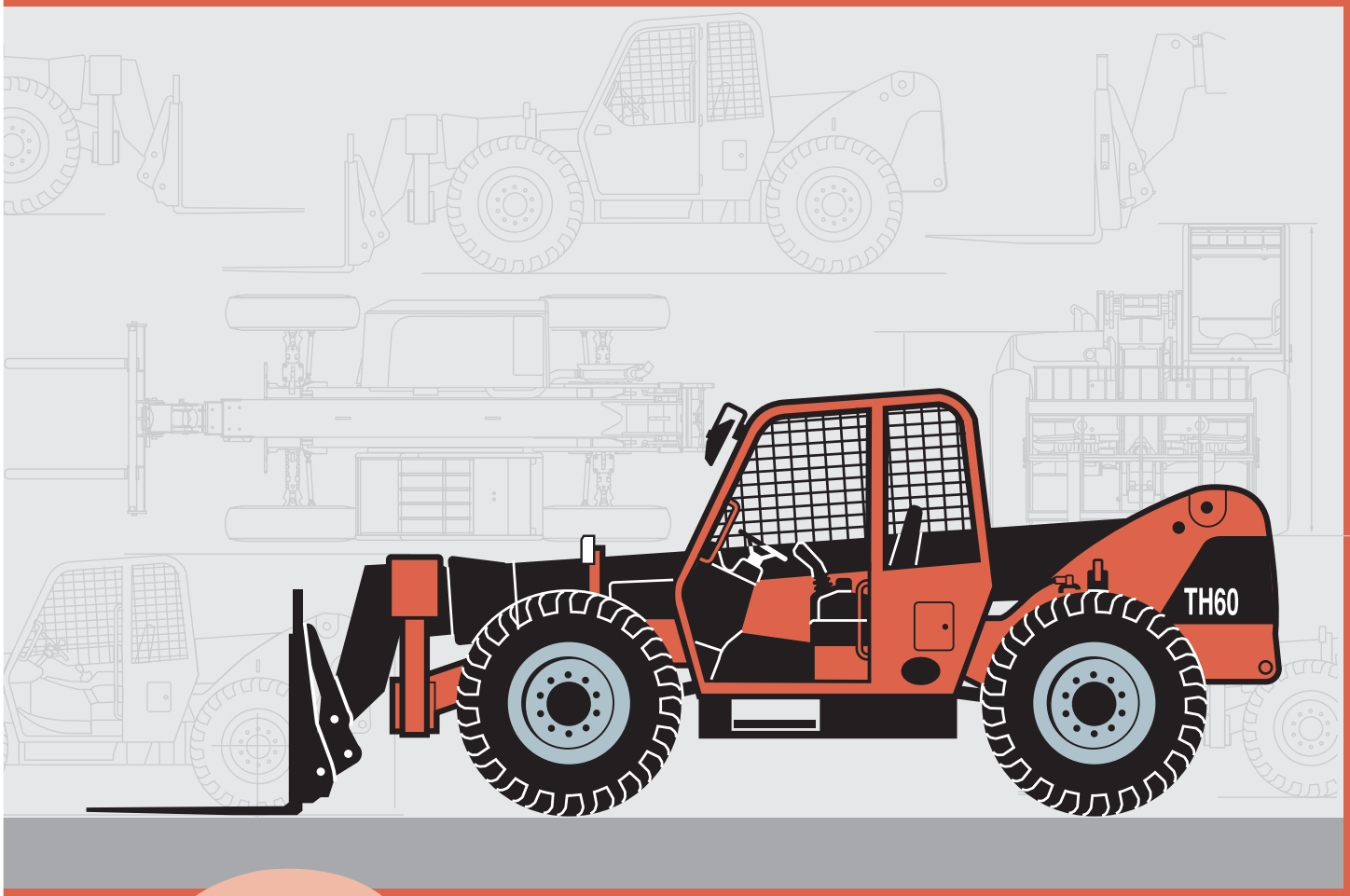
SERVICE MANUAL

TH60/TH80



PRELIMINARY DOCUMENT

Information, purpose

The organization of the information refers to the following:

Information type	Description
Specifications	Specifications give the values which are necessary for the work that is to be done.
Functional description	Functional descriptions give an introduction to how respective system is built up, the included parts and connection to function events/sequences and activation/deactivation.
Methods	Checking, reconditioning, removing/mounting, etc. Method descriptions show a safe and reliable work procedure for the work that is to be performed on the machine.
Troubleshooting	Troubleshooting should systematically lead to determination of the malfunction cause and correct service action within the shortest possible time.

Content, organization and user's instructions

The following tables account for the division of information according to the new organization for VCE's service manuals.

FOREWORD

In each binder, there is a Foreword which describes the content of the binder and gives a reference number. Each booklet has its own reference number, and can be updated and replaced individually. In case of an update, the Foreword in the binder in question is also replaced.

SECTION S, SAFETY

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
General information concerning Personal safety and machine safety. In a service manual divided according to the binder system, section S is included in **Binder 1**.	Warnings appear continuously in all information, where required. **VARNING!** **WARNING SYMBOL** This symbol appears at various points throughout the service manual in conjunction with a warning text. Its appearance means **"Warning, stay alert! Your safety is involved! Ignoring the risks can result in an accident, serious injury or death."**	

SECTION 0, SPECIFICATIONS

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
All specifications are given in section 0. This section also includes transport instructions and tools. In a service manual divided according to the binder system, section 0 is included in **Binder 1**.	Under general, there are specifications concerning the entire section.	Under respective function group, there are specifications that concern the function. In certain cases, the specifications are repeated for methods where it is suitable.

DESCRIPTION AND FUNCTION DESCRIPTION

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
Section **0**, specifications. In section 0, there is a general description of the machine.	Under general, there are descriptions and functional descriptions concerning the entire section.	Function descriptions for respective section are found in function group order in separate booklets. **Ex. Section 2 FUG 20 - 27, Descriptions, engine**

SECTION 1, SERVICE AND MAINTENANCE

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
In section 1, there is a brief description of the rules that apply to service and maintenance work. Complete instructions for performing service and maintenance are included in the **Operator's Manual** as well as **service and maintenance manual**.	**Not** described	

METHODS

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
Not described		Describes removing and mounting of components, as well as repairs, adjustments and checks that can be performed on the machine.

RECONDITIONING OF COMPONENTS

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
Reconditioning of components and included parts are described in **separate** service manuals. **Component manuals** are available for the engine, transmission, dropbox, axles as well as air conditioning.	**Not** described	

TROUBLESHOOTING

Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group
Section **3** electrical and information system. Section 3 **summarizes** all types of diagnostic information. Description of troubleshooting methodology. All warnings and error codes, troubleshooting using error codes. All control units (5 control units) are described. Description of software and all software functions. All parameters that can be set in the software are specified. All malfunction symptoms are listed with reference to respective section/function group.	In respective section under General, there is a brief description of troubleshooting with reference to section 3 in applicable cases. Basic checks for engine (Section 2) and Transmission (Section 4) are described. Control units (ECU) for engine (E-ECU) and transmission (T-ECU) are described in section 2 and 4, respectively. Performance check for engine is described in section 2.	Symptom troubleshooting and methods are described under respective function.

SERVICE TOOLS

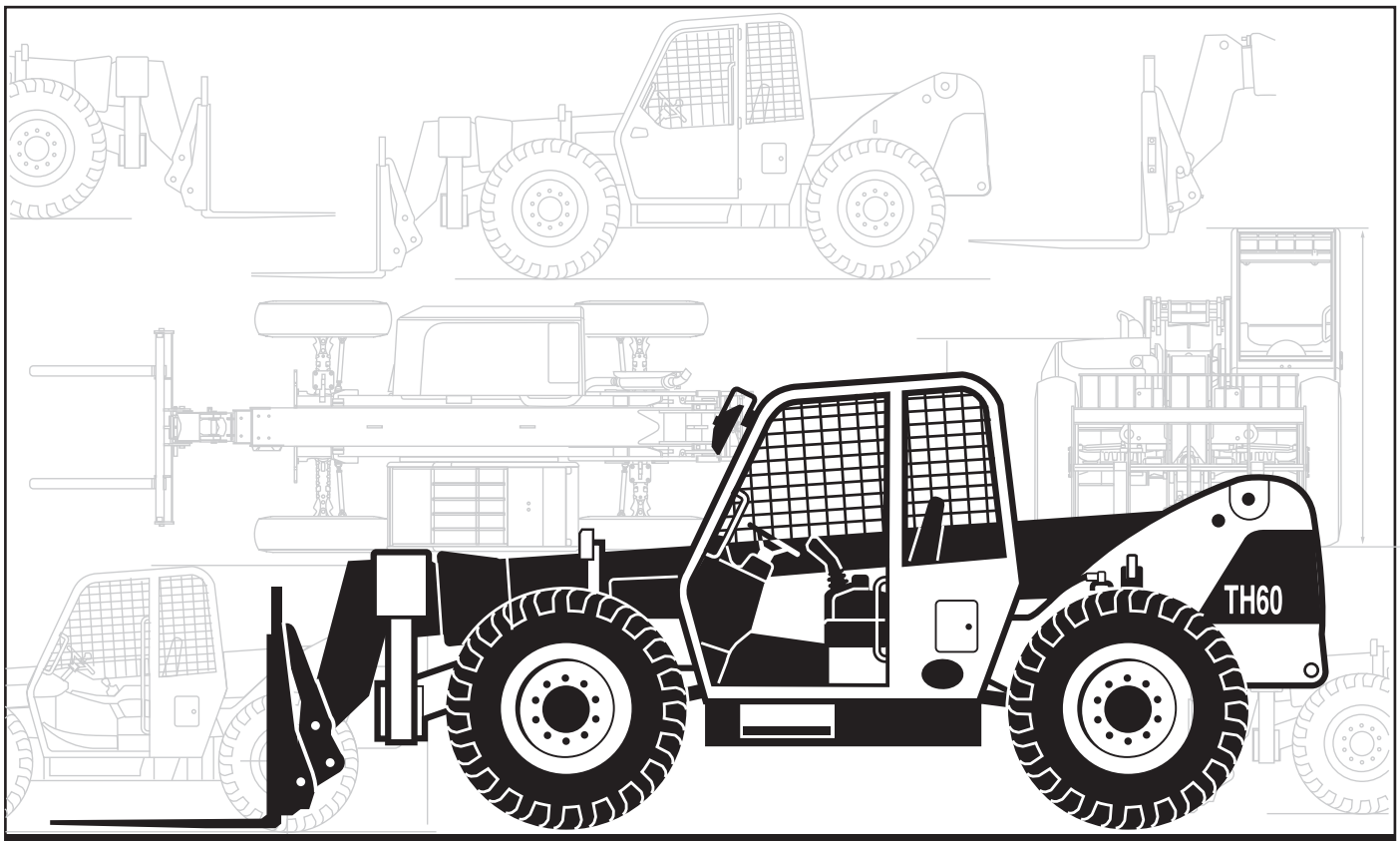
Common information for all function groups	Separate information in respective section (S, 0-9)	Separate information under respective function group

Section 2, content, structure

The primary organization follows MEC's function group index for articulated haulers. The function groups are based on MEC's company standard with 10 main groups, numbered from 0 to 9. There is an additional section on safety. The main groups are divided into sub-groups which expand in several levels.
Example of function group for fuel feed pump according to the below:

2 Engine with suspension and equipment

Level 2	Level 3	Level 4
20 General		
21 Engine		
22 Lubrication system		
23 Fuel system	230 General, common information	
	233 Fuel feed pump; filters	**2331 Fuel feed pump**
		2334 Filter; cleaners
	234 Fuel tank; refuelling pump	
	235 Fuel lines	
24 (Not used)		
25 Inlet system; Exhaust system		
26 Cooling system		
27 Engine controls		



Safety

PRELIMINARY DOCUMENT

Contents

STANDARD PARTS, SERVICE

19 GENERAL

191 Safety equipment, without own function group

Safety concerns everybody!

Always follow the instructions in the machine's operator's manual.

The operator's manual should always be kept in the cab for easy reference.

We have spent many hours engineering and producing a machine with a high level of safety and efficiency. All this time may be wasted if an individual who is about to perform service on any of our machines does not read through the safety instructions or does not follow them: for example, does not replace guards, climbs on slippery machine parts instead of using a ladder, grabs on to hoses instead of the provided handles or uses the wrong tools for the job.

Always use genuine (intended and adapted) spare parts to maintain safe and efficient machine function.

Machines seldom cause accidents. Instead, people do.

A safety-conscious person and a well-maintained machine constitute a safe, efficient and profitable combination.

Any person who does not follow the safety instructions and who ignores the warnings in this manual must make sure that their work method is safe. Otherwise, there is a great risk of serious accidents and injuries, perhaps even fatalities.

 **WARNING!**

WARNING SYMBOL

This symbol is shown at various points throughout the manual. The appearance of it means "Warning, stay alert! Your safety is involved!"

Get to know the capacities and limitations of your machine!

Safety when handling the machine

MEC is only responsible if:

- the machine has been used in a correct way and been maintained in accordance with instructions in Service Manuals and the Operator's Manual for the machine.
- prescribed service and prescribed inspections have been carried out at the stated points in time.
- the recommended lubricants according to the manual have been used.
- no security seals have been broken by other than authorised persons.
- all alterations and repairs have been carried out in the way prescribed by MEC.
- only MEC's genuine spare parts/accessories, or attachments, which meet MEC's requirements, have been used.

WARNING!

The machine operator must have sufficient skills, knowledge and instructions before operating the machine.
An untrained operator may cause serious damage, injuries and even deaths.
Therefore, it is very important that you read and follow the instructions in the Operator's Manual.
Never use a machine for which the Operator's Manual is missing.
Learn the meaning of all the warning plates, symbols and operating instructions before operating the machine.

A few simple safety rules

General

- Remedy faults or defects which affect the safety as soon as possible.
- Always wear a hard hat, safety glasses, gloves, protective shoes and other protective articles when required.
- Do not remain in front of or behind the machine while the engine is running.
- To avoid unnecessary climbing on the machine use either a long-handled rubber scraper or brush for cleaning the outsides of the windows.
- When servicing the machine and for instance when changing bulbs, a ladder may be necessary.
- Make sure that stepping surfaces, service areas, handles and anti-slip surfaces are free from oil, diesel fuel, dirt and ice and that they are changed if they are damaged or missing.
- Check at regular intervals that all anti-slip items are securely fitted. If this is not the case, they should be secured or replaced.
- When you are entering or leaving the machine, always face the machine and use the steps and hand holds. Always use both hands and one foot or both feet and one hand. Do not jump!

Before operating

- Read the Operator's Manual, before you operate the machine. Follow the operating instructions in the Opera-

tor's Manual and carry out the measures which are detailed in the manual before operating.

A few important rules are given below:

- Make a control lamp test before starting the engine by turning the ignition key to position "1", see the Operator's Manual.
- Carry out all safety checks prescribed in the Operator's Manual.

WARNING!

Never operate the machine if you are tired or under the influence of alcohol, medicine or other drugs.

- Before starting the engine indoors, make sure that the extraction capacity of the ventilation system is sufficient. The machine is provided with a diesel engine and the exhaust gases may be dangerous to your health. Make sure the ventilation is sufficiently good and avoid running the engine for a longer time than necessary particularly when the ventilation is unsatisfactory.
- Read all plates and instructions which are fitted on the machine and given in the Operator's Manual before you begin to operate or service the machine. Each of the instructions contain important information about safety, handling and service of the machine.
- Use the lap type seat belt during all operation.
- Always sit in the seat facing the front of the machine when starting the engine.
- The machine must be operational before putting it to work, that is, all faults which may cause an accident must be remedied.
- Do not operate the machine for long periods without ventilation or with a fully closed cab without having the fan running (there is risk of lack of oxygen).
- Only step on slip-protected surfaces and hold onto the available hand holds and railings.

Fig. 1 Read the Operator's Manual, plates and instructions before you start operating the machine.

Lap type seat belt

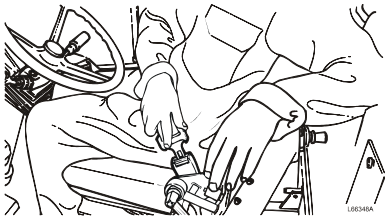


Fig. 2 Use the lap type seat belt during all operation.

- If the seat belt needs to be washed: Use a mild soap solution when washing and allow the belt to dry while it is fully pulled out, before rolling it up. Make sure the belt is fitted in a correct way.
- Change the belt immediately if it is worn, damaged or if the machine has been involved in an accident where the belt had to take some strain.
- Changes to the belt or its mountings must never be made.
- The seat belt is intended for one adult person only.
- Keep the belt rolled-up when not in use.

When the engine is running

- Respect the warning lamps. The red lamps require immediate action or consideration, see instructions in the Operator's Manual under the instrument panels section.
- Apply the parking brake and make sure that the attachment / attachment bracket is resting on the ground before you leave the machine. Unless you are putting the machine in a service position.
- Place gearshift lever and control levers in neutral positions before you leave the machine.
- Empty and place the attachment in transporting position before transport operating on a public road.
- Stop the engine before you leave the machine unattended.

When there is risk of overturning
The cab constitutes the protection for the operator and it meets the requirements for Roll Over Protective Structure (ROPS) according to the testing standard for this. See further under “CE-marking”.
A condition for the protection is that the operator is wearing the seat belt and that he or she remains in the cab, if the machine should roll over.

Falling objects
The cab is dimensioned to meet the standards required against objects falling onto the cab roof in accordance with stated testing methods, (FOPS). See further under “CE-marking”.

Emergency exits from cab
Rear window.

Safety when lifting and supporting the machine

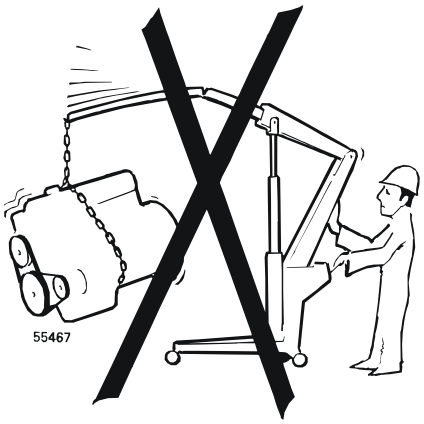


Fig. 3 Do not overload lifting or supporting equipment.

NOTE! The jack must always be relieved of weight bearing with axle stands under the raised axle before the wheel is removed!

- When lifting or supporting machine parts, use equipment with a lifting capacity that equals at least the weight of the part in question.
- All lifting devices, such as straps, slings, ratchet blocks, must comply with governing national regulations for lifting devices. We will not accept any responsibility if any lifting devices, tools or work methods are used other than those described in this publication.
- If a jack is to be used, make sure that the ground or floor is even and is sufficiently firm or strong to support the expected load.
- Prevent the machine from rolling by applying the parking brake and placing suitable wedges on both sides of the wheels which are not to be raised off the ground.
- Always use a jack with sufficient lifting capacity and position the jack according to instructions for the work that is to be done.
  Make sure that the jack is correctly positioned and is at the correct angle to the lifting point on the machine.
- Take care to position supports under the machine in a safe way.

Safety rules when servicing

This section covers general safety rules in connection with checking and service work.
Other rules, as well as information and warning texts, are given in this manual and also in the Operator's Manual.

If changes are made that affect the machine safety, the person making the changes is responsible for them.
Therefore, the following applies:

- When installing a two-way radio, mobile telephone, etc., installation must be performed according to the manufacturer's instructions in order to eliminate interference with electronic systems and components that are necessary for machine functions.
- When retrofitting equipment in or on the cab; do not drill, weld or cut the cab structure as this will reduce the operators protection in case the machine rolls over.

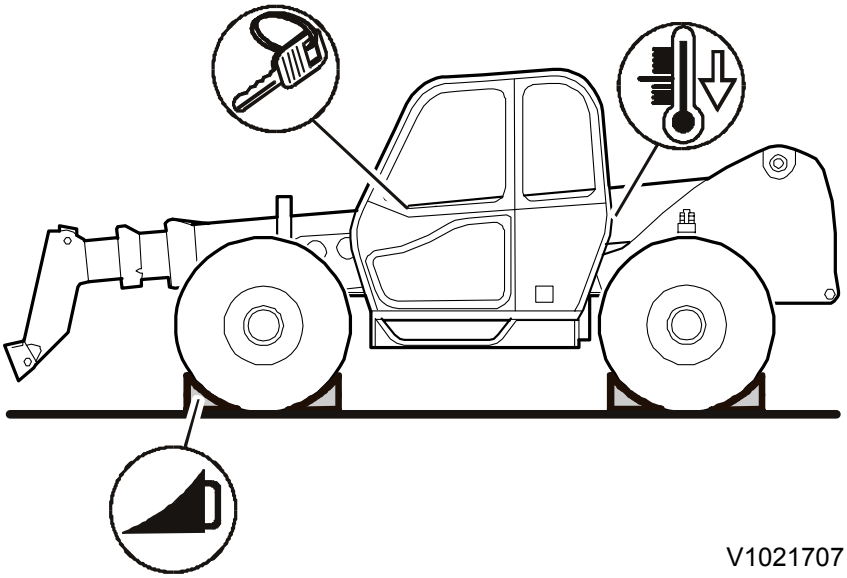
Before starting any service work:

Service work performed incorrectly can be dangerous.
Make sure that you have sufficient knowledge, correct information, the right tools and the proper equipment to perform the service work correctly.
Repair or change broken or damaged tools and equipment.

Service positions

Before you begin service work, the machine must be placed on level ground and prepared as shown below. If work has to be carried out on the machine before it has cooled, there is a risk of burns. Therefore, take care when working with hot liquids and machine parts.

Service position 1



V1021707

Fig. 4 Service position 1

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Fully lower the boom so that the boom supports to the machine frame.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

Service position 2

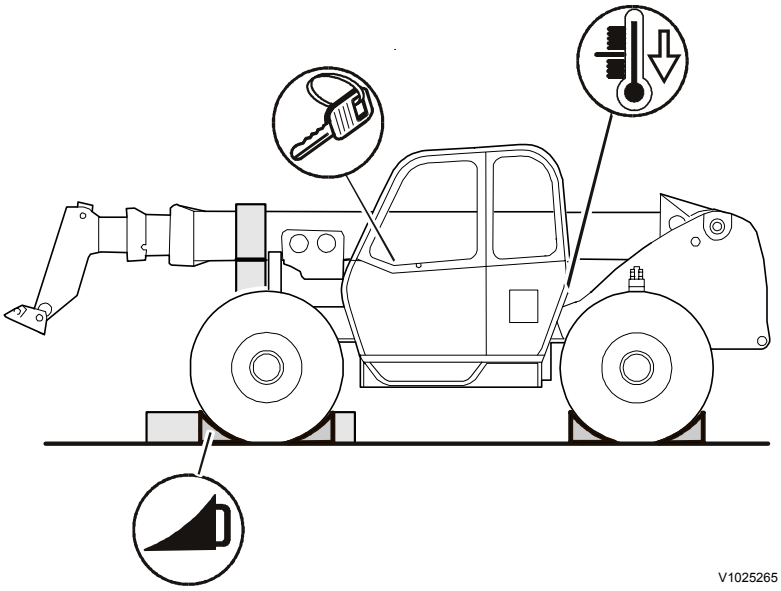


Fig. 5 Service position 2

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Place a support under the boom.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

NOTE! No work should be performed on the machine until you have sufficient knowledge and skills to do so.

General

- Machines that operate in contaminated areas (polluted environments and/or areas hazardous to health) should be specially equipped. In addition, local safety regulations apply when servicing such machines.
  See also *Checklist after a fire or heat exposure, page 16*.
- When washing the machine with a high-pressure washer, do not aim the water jet directly at non-slip surfaces that are glued on.

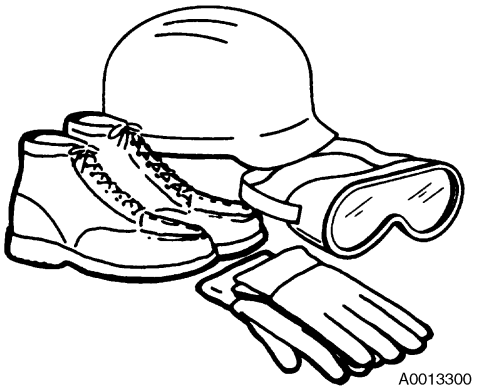


Fig. 6 Protective equipment

- If anyone is to take over the job that you have started, make sure that this person is informed as to how much of the work has been done and how much remains.
- Never wear loose objects such as a scarf or jewellery that could get caught and cause personal injury when you are working on the machine.

WARNING!

Never step on parts of the machine that are not prepared or intended for this, such as an open and raised engine hood (cover).

- Always wear a hard hat, protective goggles, gloves, work shoes and other necessary safety items that your work requires.
- Always turn off the engine when servicing the machine unless instructions on signs and plates or in this manual state otherwise.
- Turn off the engine before opening engine covers, radiator covers and similar. Make sure that no tools or other objects that can cause damage are forgotten in the machine.
- When changing oil in the engine, hydraulic system or transmission, keep in mind that the oil may be hot and can cause severe burns.

Working under raised boom

Always secure the boom with safety strut before beginning any work.

Safety when working with batteries

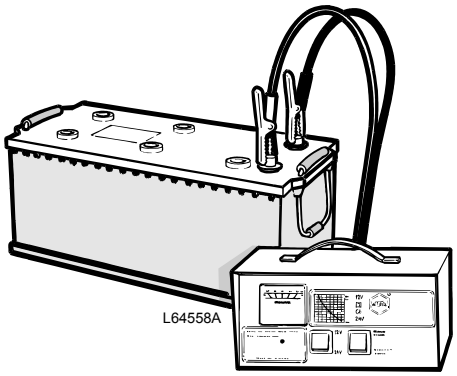


Fig. 7 Battery charging

Batteries contain sulphuric acid which is very corrosive to the human body and parts of the machine. In addition, batteries give off hydrogen gas when they are loaded (supplying electricity) or being charged.
Together with the oxygen in the air, hydrogen gas forms a very explosive mixture.

This combination, **corrosive acid and explosive gas**, means a high risk of accidents during all work with batteries used in vehicles.
Therefore, it is very important that you take great care and follow the rules below when you are working with batteries.

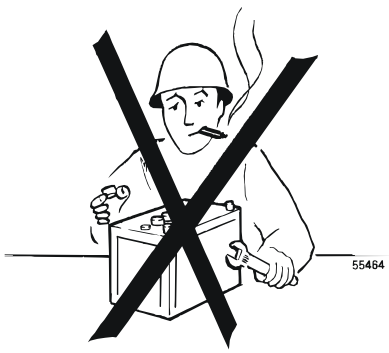


Fig. 8 Do not smoke near batteries!

Follow these instructions when charging batteries:

- Batteries give off explosive gases. Never smoke near batteries.
- Begin by disconnecting the ground lead when removing a battery. In order to reduce the risk of sparks that can cause fire, always connect the ground lead last when fitting a battery.
- Never tilt a battery to any great extent in any direction. Battery electrolyte may leak out.
- Do not connect a discharged battery in series with a fully charged battery. The current surge can cause the batteries to explode.
- Do not allow metal objects (such as tools, rings, wristwatches) to come in contact with battery terminals. Risk of fire and personal injury.
- Always cover the top of the battery with a rag or other non-conducting material when you work close to the batteries.
- Always refit the terminal caps on the batteries.
- Batteries contain substances dangerous to health and the environment. Discarded batteries must therefore be disposed of according to local and/or national regulations.

Charging batteries

Explosion hazard
When a battery is being charged, an explosive mixture of oxygen and hydrogen is formed. A short circuit, open flame or spark near the battery can cause a powerful explosion. Always turn off the charging current before disconnecting the charging clamps. Ventilate well, especially if the battery is charged in a confined space.

Corrosive sulphuric acid
The battery electrolyte contains corrosive sulphuric acid. Electrolyte spilled on bare skin must be removed immediately. Wash with soap and plenty of water. If electrolyte gets into your eyes or any other sensitive body part, rinse immediately with plenty of water and seek immediate medical attention.

Starting with booster batteries

When starting with booster batteries, the following must be observed:

Check that the booster batteries or other power source have **the same voltage** as the standard batteries.

WARNING!

Batteries may explode due to the current surge if a fully-charged battery is connected to a completely discharged battery. Personal injuries may be sustained.

Follow these steps:

1 Move the gear selector to neutral.
2 Apply the parking brake.
3 Check that the booster batteries or other power source have the same voltage as the standard batteries.
4 Do not disconnect the cables to the standard batteries!

5 Connect (+) on the booster battery to (+) on the battery nearest the starter motor.

6 Connect the other start cable from (-) on the booster battery to the machine chassis, such as on the frame member close to the starter motor.

7 Start the engine with the ignition key in the cab.

8 Once the engine has started, remove the start cable between the chassis and the booster battery negative terminal (-). Then remove the start cable between the positive terminals (+).

9 Refit the terminal caps on the battery terminals.

Fire prevention measures

General

- There is always a risk of fire. Find out which type of fire extinguisher to use, where it is located and how to use it. The fire extinguisher in the machine should be located for quick access or in an external box that can be locked.
- Fire-fighting equipment installed in or on the machine must be maintained in working order. Such equipment should be regarded as a complement to the operator's own efforts in case of a fire.
  The equipment should not be considered as a replacement of the operator's own fire fighting efforts.
- Fire extinguishers mounted on the machine or used when working on the machine must fulfil certain requirements. See the Operator's Manual.
- At the slightest sign of fire, if the situation allows it and keeping in mind your own safety, take the following action:
  – drive the machine away from the danger area.
  – lower attachment(s) to their bottom position so that the attachment rests on the ground.
  – stop the engine by turning the ignition key to the "0" position.
  – leave the cab.
  – turn off the battery disconnect switch.
  – start fighting the fire and call the fire department if necessary.

Fig. 9 Smoking and open flames are absolutely forbidden when filling fuel or any time diesel fuel is in contact with the open air.

- Smoking or open flames are absolutely forbidden close to the machine when filling fuel or at any time the fuel system is in contact with the open air.
- Diesel fuel is flammable and must not be used for cleaning. Use an approved solvent instead.
- Remember that certain solvents can cause skin rashes and are usually flammable. Avoid inhaling solvent vapour.
- Engine starting aids are flammable. Store such items in cool and adequately ventilated areas.
  Remember that such aids must not be used in combination with electric preheating of induction air.

Cleanliness

- Cleanliness is a decisive factor for operational reliability of the machine's systems. Therefore, keep the servicing area clean. Oil or water make floors and steps slippery and are also dangerous in combination with electrical systems or

tools. Oily clothes or clothes drenched in grease constitute a serious fire hazard.

- Check daily that the machine and equipment, such as underbody skid plates, are free from dirt and oil. This reduces the risk of fire and makes it easier to detect defective components or loose parts.
  IMPORTANT! If a high-pressure washer is used when cleaning, work carefully since damage may be caused to electrical components and insulation of the electrical cabling even at relatively moderate water pressure and temperature. Protect electrical cabling in a suitable manner.
- Keep the machine especially clean when operating in environments with fire hazards, such as saw mills, garbage dumps, etc. In such environments, suitable equipment to reduce the risk of accumulation of material and spontaneous combustion should be fitted (for example muffler guard, radiator screen, heavy-duty cyclone pre-cleaner, etc.).

Electrical system

- Check electrical cables with regard to chafing damage and make sure that they cannot be damaged in such a way. This applies particularly to unfused electrical cables, which are red.
  For example, electrical cables between:
  – Batteries
  – Battery-starter motor
  – Alternator-starter motor
  – Cable to engine preheating coil.
- When unfused cables have been disconnected, it is important to check that they are reconnected and clamped in such a way that they cannot be exposed to chafing. Unfused cables must not rest against oil and fuel hoses.
- When fitting any optional equipment, make sure that all cables (circuits) are connected across a fuse and routed and clamped so that there is no risk of chafing.

Fuel, hydraulic and brake systems

- Check to make sure that there is no chafing damage to fuel, hydraulic and brake hoses.

Welding and grinding

- Welding and grinding on the machine may only be done in a clean area and not in places that contain combustible liquids, such as fuel tanks, hydraulic pipes or similar.
  Work with extra care when welding and grinding near flammable objects.
  IMPORTANT! A fire extinguisher should be easily accessible during all welding work.
- Never weld on a painted surface without first removing the paint. Welding on a painted surface generates, in addition to health-hazardous vapours, technically inferior welds which may lead to future failures, with subsequent accidents.

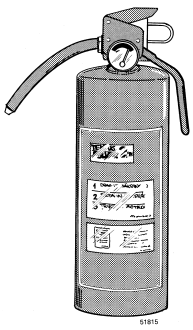


Fig. 10 Fire extinguisher

Actions after a fire: see “Checklist after a fire or heat exposure”.

Checklist after a fire or heat exposure

If a machine has been damaged by fire or been exposed to intense heat, the following precautionary measures according to the following check list must under all circumstances be followed:

- As a precaution, seal rings (O-rings or axle/shaft seals) should always be handled as if they were made of fluor rubber, see also section “Fluor rubber”.

  WARNING!

  Avoid splashing when washing a machine damaged by fire. For this reason, never use high-pressure washing equipment.

- Never touch burned components or parts with your bare hands when there is a risk that you may be exposed to contact with melted polymers. First, wash thoroughly with plenty of lime water (a solution or a suspension of calcium hydroxide, i.e. slaked lime).
  Use thick, protective gloves made of rubber and wear goggles that are certain to protect your eyes.
- Seek medical attention if your skin may have come in contact with burnt fluor rubber. The skin should be treated with Hydrofluoric Acid Burn Jelly or similar.
  Symptoms may not appear until several hours after contact with burnt fluor rubber.
- Discard protective gloves, rags and other items that may have come into contact with burnt fluor rubber.

CE marking and declaration of conformity

(Only applies to machines marketed within the EU/EEA.)

This machine is CE-marked. This means that, when delivered, the machine meets the applicable "Essential Health and Safety Requirements", which are given in the EU Machine Safety Directive. If changes are made that affect the safety of the machine, the person making the changes is responsible for the same.

As proof that the requirements are met, the machine is supplied with an EU Declaration of Conformity, issued by MEC Construction Equipment for each individual machine. This EU declaration also covers attachments manufactured by MEC
. The documentation is a valuable document, which should be kept safe and retained for at least 10 years. The document should always accompany the machine when it is sold.

If the machine is used for other purposes or with other attachments than described in this manual, safety must be maintained at all times and in each individual case. The person carrying out such action is also responsible for the action which, in some cases, may require a new CE marking and the issue of a new EU Declaration of Conformity.

EU EMC Directive

The electronic equipment of the machine may in some cases cause interference with other electronic equipment, or the equipment may be adversely affected by external electromagnetic interference, which may constitute safety risks.

The EU EMC directive on "Electromagnetic conformity" provides a general description of what demands can be made on the machine from a safety perspective, where permitted limits have been determined and given according to international standards.

A machine or device which meets the requirements should be CE-marked. Our machines have been specifically tested for electromagnetic interference. The CE marking of the machine and the declaration of conformity also cover the EMC directive.

If other electronic equipment is fitted to this machine, the equipment must be CE-marked and tested on the machine with regard to electromagnetic interference.

Unauthorized modifications of the Roll Over Protective Structure (ROPS)

Never make any unauthorized modifications to the ROPS, such as lowering the height of the roof, drilling, welding on fire extinguisher brackets, radio aerial brackets or other equipment.

Such unauthorized modifications will affect the structural strength of the ROPS cab and will void the certification.

The Roll Over Protective Structure (ROPS) has been approved following testing and meets standards according to ISO 3471: 1994 and SAE 1040 MAY 94.

The cab has also been tested and approved according to FOPS standard as defined by ISO 3449: 1997 and ISO 6055: 1997.

All planned modifications must be reviewed in advance by our Engineering Department in order to determine whether the alteration can be made without affecting the certification.

It is important that all persons in your organisation, including management, are made fully aware of these rules involving ROPS.

If anyone in your company discovers that a certain machine was modified in a non-approved manner, your company must notify the customer and manufacturer if writing regarding which machine it was and how it was modified.

NOTE! Modifications or removal of material which affects sound, i.e. noise-insulating material, noise-damping or noise-absorbing material may not be performed. Further, making new holes/ openings in the cab or engine compartment is not allowed as this may increase the sound level in the cab.

Some simple rules regarding tyre handling

WARNING!

A tyre fitted on a split rim may explode causing severe injury or even death.

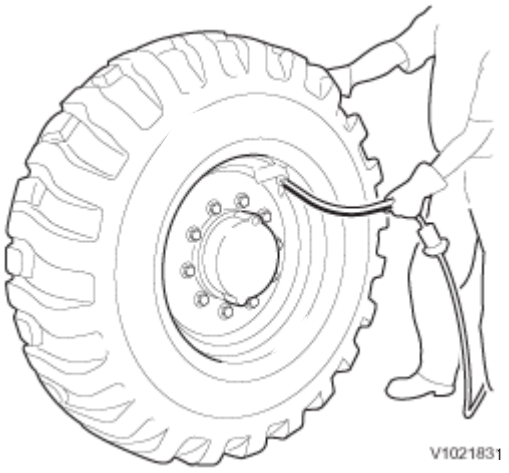


Fig. 11
Never stand to the side of the tyre while inflating.

Inflating

- Never stand to the side of the tyre while inflating.
- Never stand to the side of the tyre while inflating which is fitted on a split rim. Use a self-locking outlet with a hose long enough to allow you to stand outside of the hazard zone during inflation, see the illustration.
- Make sure that the hazard zone is clear when the tyre is inflated.
- The machine must be unladen when checking tyre pressure.
- Spare tyres should only be filled with enough air to allow the rim parts to be held in place.
- Secure a loose wheel with an inflation cage, cable or chains before inflating. Before removing the inflation cage, check that the tyre is properly fitted to the rim. Adjustments should be made before the wheel is inflated.
- Do not attempt to adjust side rings or lock rings when the tyre is inflated.
- Tyres used at less than 80% of normal pressure and rims or tyres suspected of being damaged should not be inflated with the wheel attached to the machine.

Fitting of tyres and rims

- Handling of tyres should be performed by authorised personnel only.
- The tyre should be deflated before removal from the machine.
- Never install a tyre on a rim that has not been recommended for that tyre.
- Never assemble rim parts for different dimensions or use damaged or faulty parts.
- Exercise caution if using reconditioned wheel details. Welding errors, faulty heating or soldering may have weakened the parts and may cause the detail to break.
- Make sure the lock ring groove in the rim is cleaned from foreign matter and rust before fitting the lock ring.
- Use a lubricant recommended by the tyre manufacturer when fitting onto the rim.

Repairing tyres and rims

- Never cut, weld nor heat the wheel parts in any manner.
- Exercise caution when using bead breakers and hydraulic jacks. Remain outside the hazard zone when removing foreign objects from the tyres. A bead breaker that releases can cause severe personal injury and may result in death.

Working on the electrical system of the machine

- Only use test instruments with a light-emitting diode, never a test light with a light bulb, for example, during troubleshooting of the electrical system!
  The high firing voltage of the bulb can destroy expensive electronic components.
- When installing a two-way radio, mobile phone, etc., installation must be performed according to manufacturer's instructions in order to eliminate interference with electronic systems and components intended for the function of the machine.

Safety for work on hydraulic systems

The hydraulic systems in our TL 70/90 work at very high pressures, up to approx. 25 MPa (250 bar) (3626 psi). In order to prevent serious personal injuries, it's important that the systems are maintained correctly and that all persons who come into contact with the machines are very careful and very alert to any defects.

Those who follow the simple rules below have laid a good foundation for accident prevention.

General

- Never adjust a pressure limiting valve to a higher pressure than that recommended by the manufacturer.
- A hydraulic hose that swells, for example, at a connection, indicates that it's about to burst. Replace the hose as soon as possible! Pay attention to leaks from hydraulic hoses and connections. Repair the leakage before the part bursts!
- **Scrapped accumulators** Empty the accumulators gas and remove the gas valve. Plug the oil port.

  NOTE! It is dangerous to disconnect the gas valve when the accumulator is pressurized.

WARNING!

If the pressure is not released before opening the system, oil under high pressure will jet out, resulting in serious personal injuries.

Pressure release

When the engine has been stopped, there remains an accumulated pressure in the system 14.5 MPa (145 bar) (2100 psi).. The remaining pressure in the system must be lowered, so-called depressurization (releasing pressure), before hose connections, plugs, etc. are opened in the hydraulic system or brake system.

1 Lower attatchment(s) to the ground.
2 Turn off the engine and remove the ignition key.
3 Release the system pressure by moving the control levers forward and rearward several times with full strokes.

- All pressurised vessels must be opened very carefully, so that any residual pressure is released.
- Check-tightening of leaking couplings and connections should only be done after all the pressure in the system has been completely released.

- All pressurized tanks/vessels shall be opened carefully so that any residual pressure is released.
- Check-tightening of leaking couplings and connections may only performed after the system is completely depressurized.

WARNING!

In case of hydraulic hose leaks that show up as very fine jets - remember the high pressure: the jet can

easily penetrate your hand, for example, and cause serious injuries.

- To check for leaks, use a steel plate or stiff board, **never use your hands**.

Health risks associated with paints, plastics and rubber

Work on painted surfaces

No welding or torch-cutting is allowed on painted surfaces.
All paint is broken down when heated and forms a wide variety of substances that may be irritating and very hazardous to health after prolonged or repeated exposure.

The following safety instructions must be followed:

- Remove all paint by sand-blasting at least 10 cm (4 in.) around the welding or cutting point (use suitable breathing protection).
  If the work area cannot be sand-blasted, remove the paint in another way, for example, with a paint remover (solvent).
  NOTE! When using paint removers (solvents), use an air extractor, breathing protection and protective gloves.
- High-speed grinding machines and grinding discs also heat the paint and must only be used if there's an air extractor on the grinding machine. Use breathing protection as well.

Rubber and plastics

WARNING!

When heated, rubber and plastics can give off gases which are dangerous to health and the environment.

The following safety instructions must be followed:

- Do not weld or cut near polymer materials (rubber and plastics) without first protecting them from the heat.
- Never burn polymer materials when scrapping them.
- Be careful when handling machines that have been exposed to fire or other intense heat. Also, refer to “Check-list after a fire or other heat exposure”.
- Always use protective gloves, protective glasses/goggles and breathing protection.

Fluor rubber

WARNING!

Risk of serious corrosive injuries!

WARNING!

When hydrogen fluoride rubber is heated, there is a risk of hydrogen fluoride gas build-up already at approx. 320 °C (610 °F). When inhaled, the gas is extremely corrosive to respiratory tracts.

Certain seals designed to withstand high operating temperatures (for example, in engines, transmissions, axles, brakes, hydraulic motors and pumps) may be made of fluor rubber, which will form hydrogen fluoride and hydrofluoric acid when exposed to intense heat.

This acid is highly acidic and corrosive. It cannot be rinsed or washed off the skin, and causes very severe burn and corrosive injuries that take a very long time to heal. As a rule, injured tissue must be removed surgically.

The acid may remain on machine parts for a very long time (several years) after a fire.

NOTE! It may take several hours after contact with the acid before any symptoms become apparent.

If swelling, redness or burning sensations appear and contact with heated fluor rubber is suspected, contact a physician immediately. If a machine or a component for a machine has been exposed to fire or other intense heat, it shall be handled by specially trained personnel.

Thick protective neoprene rubber gloves and tight-fitting protective goggles must be used during all handling of machines after a fire.

WARNING!

Never burn painted parts or parts made of plastics or rubber after they have been discarded. This work must be done by a licensed waste management plant.

Decontamination
The area around a heated part that is suspected of being made of fluor rubber must be decontaminated by thorough and ample washing with lime water (a solution or suspension of calcium hydroxide, that is, slaked lime in water). After the work has been completed, wash the protective gloves in lime water and discard them.

The safety instructions in the following checklist must be followed under all circumstances if a machine has been exposed to a fire or other intense heat:

Safety when handling oils and fuel

- When changing oil in the engine, hydraulic system or transmission: Remember that the oil may be hot and can cause burns.
- Engine, hydraulic and transmission oils as well as diesel fuel have a corrosive effect on mucous membranes, for example, in eyes and throat and on skin. Therefore, take special care to keep such oils away from these sensitive body parts.
- When emptying/draining oils or fuel, steps must be taken to avoid unnecessary spills. In places where a container for collecting the liquid cannot be used, use a pump or connect a hose to ensure safe handling. Oil released or spilled on the ground will harm the environment and could also cause a fire.
  Waste oil/fluids must always be taken care of by a company authorized for such work.
- Remember the fire hazard!

Pressure setting and leak detection

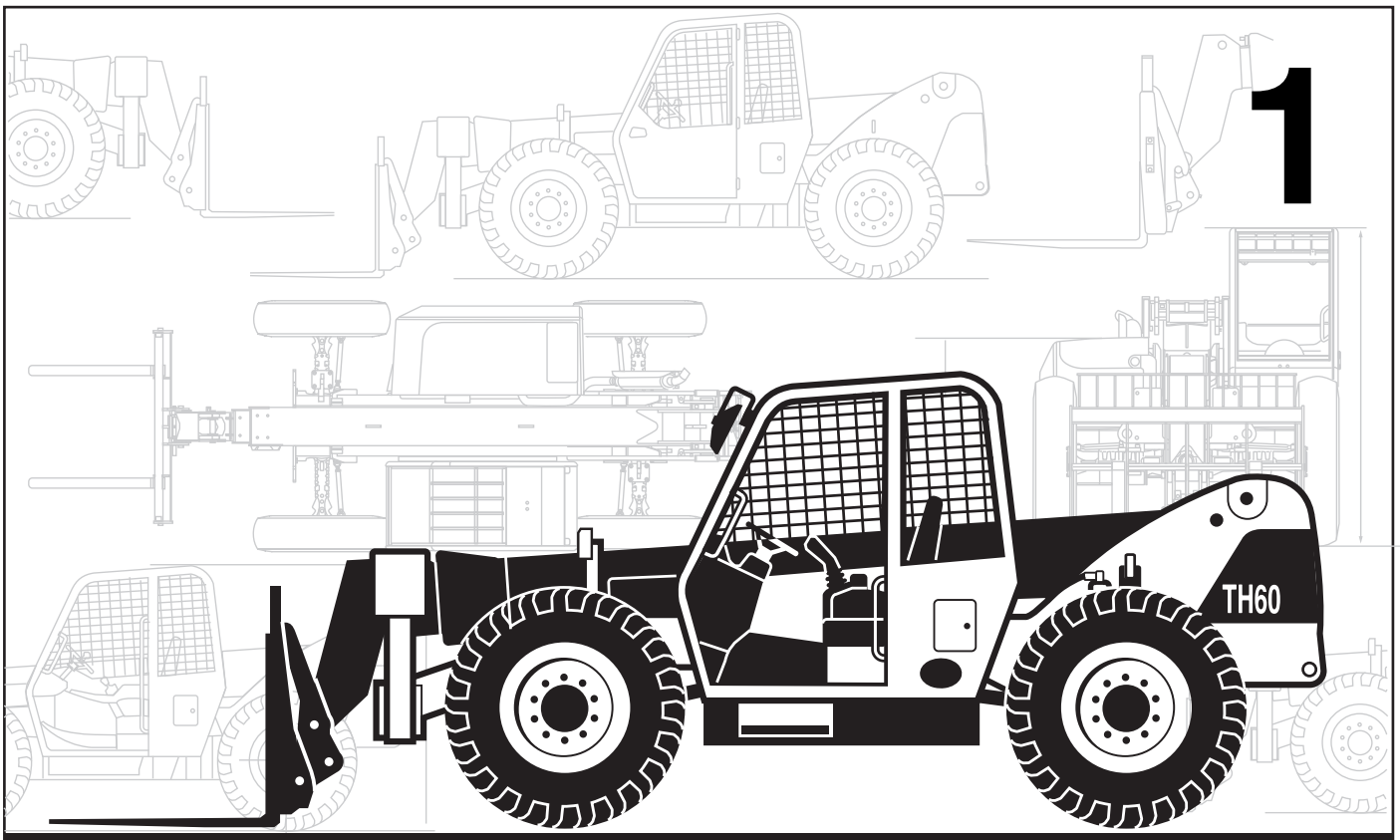
WARNING!

Hot hydraulic oil and hydraulic oil under pressure may result in severe personal injuries

Observe the following safety precautions:

- Lever and pedal movements should be made slowly in order to avoid sudden or unexpected machine movements and excessive pressures.
- Interrupt the pressure increase as soon as the specified pressure has been reached.
- Make changes in small increments when setting pressure adjustment devices whose sensitivity is not known. This is especially important with regard to the servo circuit, which is pressurized as soon as the engine is started.
- Check and calibrate the pressure checking equipment regularly and replace damaged components.

1



Service and Maintenance

PRELIMINARY DOCUMENT

Contents

STANDARD PARTS, SERVICE

11 STANDARD PARTS

110 General

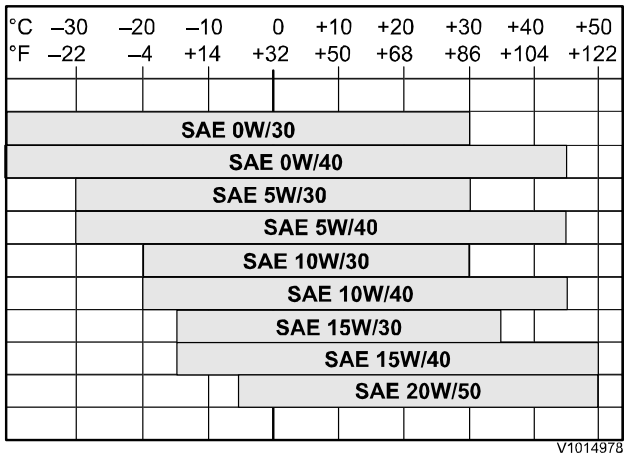
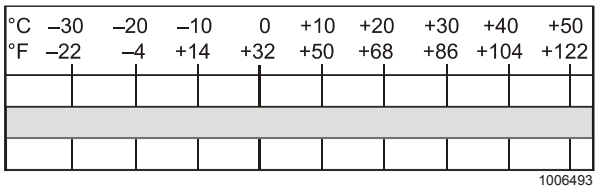
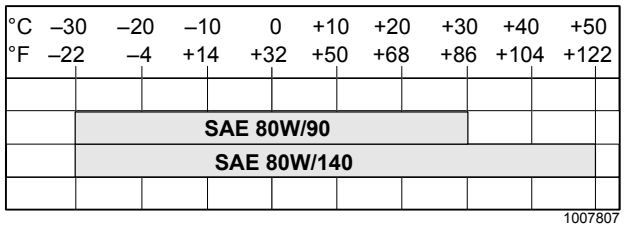
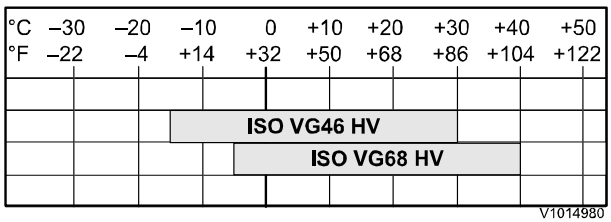
Service

For the machine to operate at the lowest possible cost, it must receive thorough and complete maintenance. Intervals for maintenance and lubrication refer to normal operating and environmental conditions. Maintenance work is described in the Operator's manual. For other adjustments and repairs, an authorized brand-name workshop should be used.

16 LUBRICANT; FUEL; OTHER FLUID

160 General

Recommended lubricants, oils

	Oil grade	Recommended viscosity at varying ambient temperatures
Engine *) For severe operations ACEA E3-96 (CCMC-D5) is recommended to give optimum service life.	**Engine oil** MEC Diesel Engine Oil MEC VDS API CF API CF-4 API CG-4 API CH-4 ACEA E1-E3 -96 ACEA E4 -98 DHD-1	
Axles and transmission MEC WB 101 For trade names and oil requirements, see Specifications, Axles in the Operator"s Manual for the respective machine.		
Hubs and dropbox	**MEC Super Transmission Oil** API GL–5	
Hydraulic system Steering system Working hydraulics	**Hydraulic oil MEC Super Hydraulic Oil** ISO 6743 / 4HV	

17 SERVICE

170 General, common info about 171 - 179

Replacement parts

For reference when ordering replacement parts or making service inquires, record the model and serial numbers of your machine.

They are stamped on the serial number plate on the left side of the machine.

Service methods

Appropriate service methods and proper repair procedures are essential for safe, reliable operation of MC loaders and safety of the individual doing the work. This Service Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will assure reliability.

There are many variations in procedures, techniques, tools and parts for servicing machines, as well as work skills. This manual cannot possibly anticipate all such variations and provide advice or cautions for each one. Accordingly, anyone who intends to depart from the instructions in this manual must first consider personal safety and then machine integrity.

NOTE! MEC recommends the use of enviromentally sound waste storage and disposal practises. Never drain fluids on the ground or into a sewer or catch basin. Use suitable collection containers, then store and/or dispose of waste products in an approved and safe manner. Check and obey all federal, state and/or local regulations regarding waste storage, disposal and recycling.

Disclaimer

MEC reserves the right to make changes to and to add improvements upon its products at any time without public notice or obligation. MEC also reserves the right to discontinue manufacturing any product at its discretion at any time.

Bearings

Removal

Bearings should never be removed unless absolutely necessary. Always use the recommended puller to reduce the risk of bearing or related component damage.

When bearings or bushing are removed, check that the bearings is free from discoloration, nicks, scuffing and signs of overheating. If in doubt, replace the bearing or bushing.

Cleaning

Bearings acceptable for service should be cleaned in a suitable solvent and immersed in a clean lubricating oil until needed.

Installation

Be sure bearings are installed with care during servicing, maintenance and repair.

All bearings on this machine are installed as a press fit.

When possible, always install the bearing into the rotating part first.

Use the proper tools or a press when installing a bearing or bushing.

In the absence of the proper tools or a press, heat the bearings and/or casing in hot oil to assist in the installation.

Hoses and tubes

Inspection

If the hose end connections are damaged, always replace hoses and tubes. Damaged, dented, crushed or leaking hose fittings restrict oil flow and the operation of the parts being served. Fittings showing signs of movement from their original position have failed and must be replaced.

Be sure hoses are in good condition. If in doubt, replace them.

Replace hoses if the following occur:

- chafed outer cover
- concealed corrosion of wire reinforcement
- ballooning (**replace immediately!**)
- kinked, crushed, stretched or deformed.

Installation

When installing a new hose, loosely connect each end and take the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

If a hose is replaced on a moving part, be sure it does not foul by moving the part through its complete range of travel.

Be sure any hose which has been installed is not kinked, twisted or exposed to any sharp edges.

Free moving, unsupported hoses must never touch each other or related work surfaces. This causes chafing, reducing hose life.

Pressure testing

1. Prior to pressure testing, be sure all hoses are in good condition and all fittings are tight.
2. Use a pressure gauge with a range that is high enough to measure the specified pressure.
3. Comply with the correct procedure to prevent damage to the system or the equipment and to eliminate the possibility of injury.

General part replacement

Replace O-rings, seals and gaskets whenever they are disturbed. Never mix new and old seals or O-rings regardless of condition. Always lubricate new seals and O-rings with 10W30 oil before installation.

Replace all used elastic locknuts with new parts.

When replacing parts, use the correct tool.

Cleaning prior to repair

Clean the exterior of all parts before repairing. Dirt and abrasive dust reduce the efficient work life of the part and lead to costly replacement.

Use cleaning fluids and solvents which are suitable for cleaning parts and do not risk the safety of the user. Certain types of fluids damage rubber parts and/or cause skin irritation.

The following precautions must be observed to insure hydraulic cleanliness:

1. Flush hose and tube assemblies with a solvent compatible with hose assemblies. Blow out excess solvent with shop air.
2. Cap hydraulic fittings and protect threads until installation.
3. Cap hoses and tube assemblies until installation.
4. Flush hydraulic reservoir, fuel tank and chain case housings with a suitable solvent to remove any foreign debris.
5. Protect system components from airborne contaminants. Plug all cylinder, valve, reservoir, tank and pump openings until installation.
6. Use clean, filtered motor oil when filling the system. See *Recommended lubricants, oils, page 6*.

173 Maintenance

Service positions

Before you begin service work, the machine must be placed on level ground and prepared as shown below. If work has to be carried out on the machine before it has cooled, there is a risk of burns.Therefore, take care when working with hot liquids and machine parts.

Service position 1

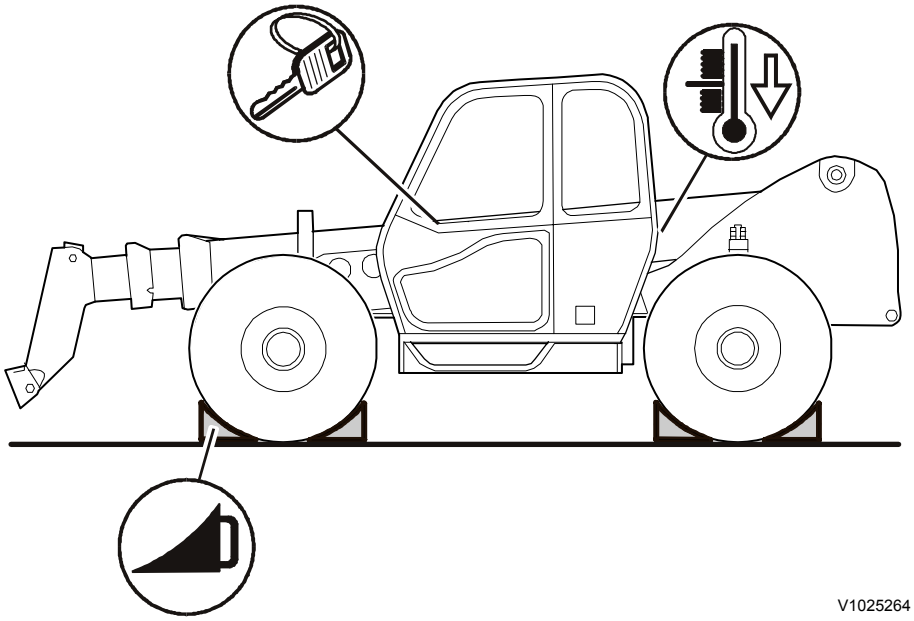


Fig. 1

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Fully lower the boom so that the boom supports to the machine frame.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

Service position 2

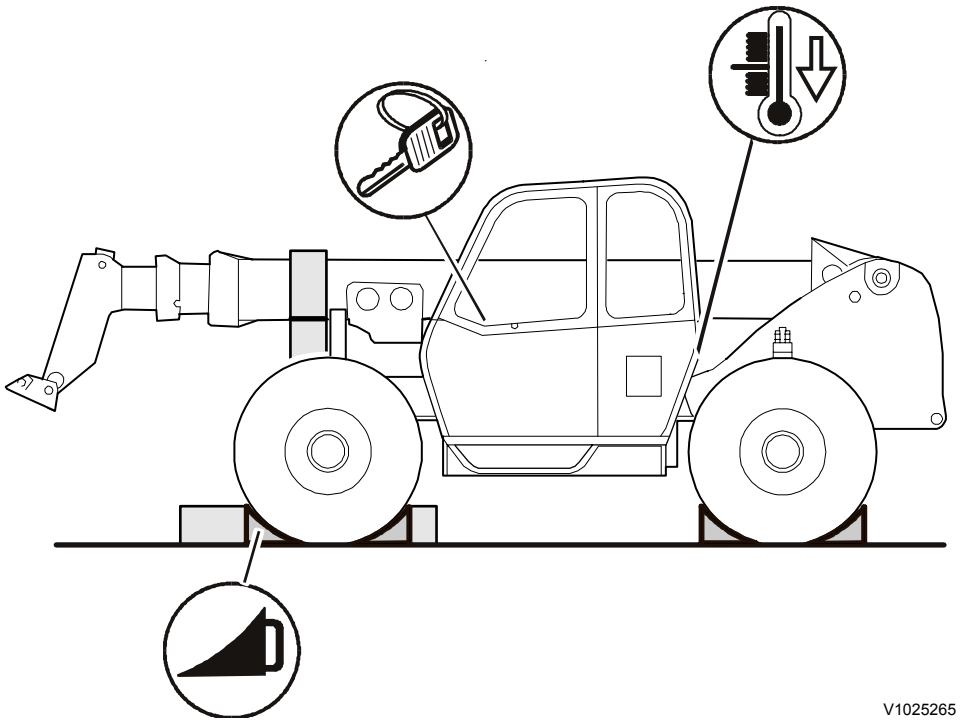


Fig. 2

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Place a support under the boom.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

176 Emergency measures

Hydraulic cylinder Parking brake, manual release

Op. no.

1 Place the machine in service position, see section. *Safety rules when servicing, page 22*.

2 Release the parking brake by giving a hammer blow to the external ring of the check unit .

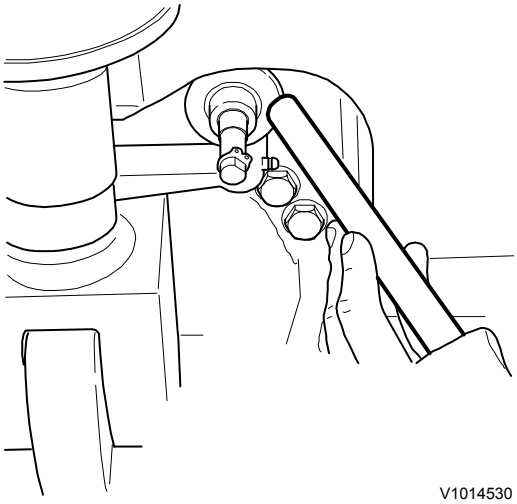


Fig. 3 V1014530

Reset the parking brake

3 Reset the parking brake by starting the machine and introduce pressure into the braking system. Check that, at end of the piston stroke, the check unit is actually engaged onto the rod.

Recovering and towing

WARNING!

Before starting any recovery or towing work, make sure that the parking brake is applied and the wheels are blocked to prevent the machine from rolling. Extreme caution must be observed in connection with towing to prevent accidents and personal injuries.

WARNING!

If the engine cannot be started, the brake and steering functions will be severely limited. In such cases, towing should only be performed in an emergency situation by experienced and trained personnel and only for the shortest possible distance (see towing). If possible, transport the machine on a trailer.

General

If possible, the engine should be running while recovering/ towing the machine to ensure satisfactory braking and steering performance.

Recovering

Use a towbar, heavy-gauge cable or chain connected to the towing eyes at the front or rear of the machine to tow the machine to a suitable place or passable road.

Towing

- Lower the boom to convenient towing height.
- If the machine has to be towed to a workshop after recovery, use a towbar or heavy-gauge towing cable connected to the front towing eyes.
- A towbar must always be used if the machine that is to be towed has no brake function.
- The towing vehicle or machine must always be at least as heavy as the towed machine and have sufficient engine

and braking power to tow and brake both machines on uphill and downhill grades.
– Always tow the shortest possible distance.
– Maximum towing speed under all conditions is 10 km/h.
– Place the transmission in neutral and release the parking brake. See section Hydraulic cylider parking brake manual release. *Hydraulic cylinder Parking brake, manual release, page 12* if the machine does not work under it own power.

After recovering/towing

The following safety measures should be taken before removing the towbar, heavy-gauge cable or chain after recovering/towing:

1 Park the machine on a level surface.

2 Apply the parking brake.

3 Block the wheels to prevent the machine from rolling.

Retracting and lowering the boom without hydraulic power

Op. no.

Tools:
Minimess hose

NOTE! In case of loss of hydraulic power, it can be necessary to retract and lower the boom manually.

NOTE! The boom must be retracted first and then lowered. Lowering the boom while its still extended may cause forward instability, resulting in machine tip over.

NOTE! If the boom already is in a horizontal position, it must be retracted with a winch.

1 Secure the risk zone around the machine from unauthorized persons.

2 Remove load and secure the machine.

3 Block the wheels.

4 Secure the boom with a suitable stand or packing.

5 Open the rear hatch on the machine.

6 Loosen the lock nut on the extend cylinder counterbalance valve. Turn the socket head screw clockwise until the boom retracts.

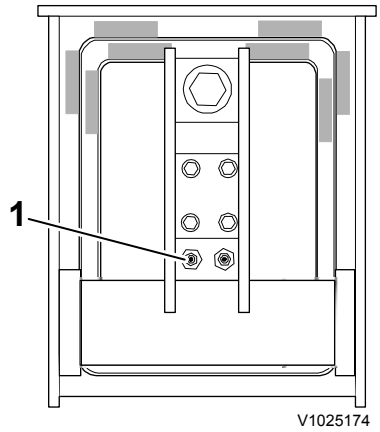


Fig. 4 Rear view
1 Counterbalance valve

WARNING!

Risk of injuries from crushing!

There is no working clearance between the boom and frame when the boom is lowered.

7 Support the front end of the boom with a suitable lifting device and remove the stand or packing.

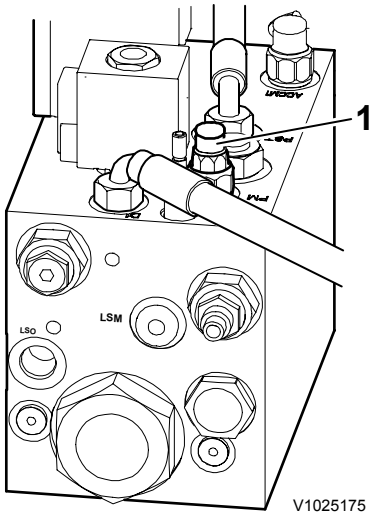


Fig. 5 Section of main valve manifold
1 Pressure port PM

8 Attach a minimess hose to the pressure nipple port PM on the hydraulic main valve manifold.

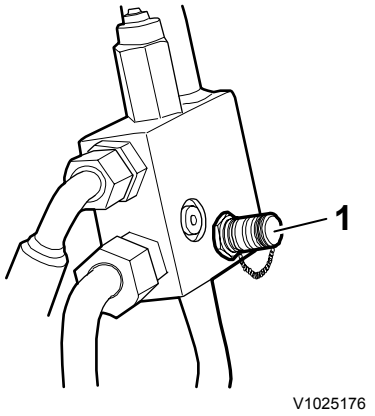


Fig. 6 Lift cylinder valve block
1 Nipple

9 Attach the other end of the minimess hose to the nipple on the lift cylinder valve block.
The boom will lower very slowly.

NOTE! The extend cylinder counterbalance valve must be replaced after the setting has been altered to retract the boom. Contact a workshop authorized by MEC.

Jump starting

Auxiliary start

WARNING!

Never boost-start the machine by connecting directly to the starter motor. This may result in uncontrolled machine movements. When using another machine to boost-start, it must not touch the machine that is being started.

Auxiliary start with start cables

Check the following before connecting;

- That the ignition is OFF in **both** machines
- That the machine cannot start to move when started
- That the machines have the same system voltage
- That the start cables are dimensioned for the max. current rating that the battery can generate
- Start cables, with regards to cracks, oxidation and other defects
- That battery cables are intact and connections are connected securely
- That the machines do not touch each other

WARNING!

When using start cables, the positive and negative connection must not come into contact. Risk of personal injury.

Connect start cables as follows:

- Connect the first start cable (A) to the battery's plus terminal (1) on the machine to be started
- Connect the other end of the cable (A) to the battery's plus terminal (2) on the assisting machine
- Connect the other start cable (B) to the battery's minus terminal (3) on the assisting machine
- Connect the other end of the cable (B) to the frame (4) on the machine to be started. Check that good electric contact is obtained.

Auxiliary start:

- Check that the start cables are connected securely and correctly (figure)
- Start the engine in the assisting machine
- Start the engine in the machine to be started. If the engine does not start within 30 seconds, wait for at least two minutes before the next start attempt.

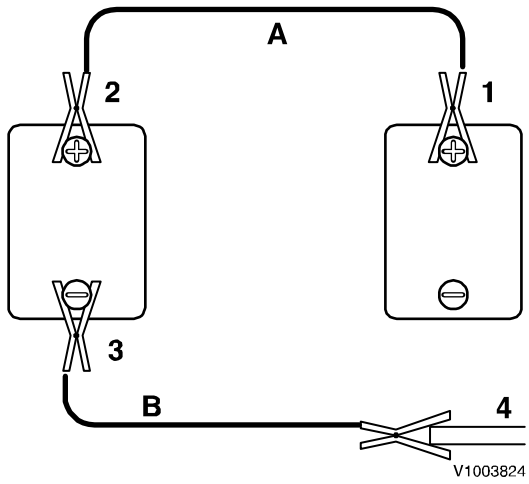


Fig. 7 Connecting start cables

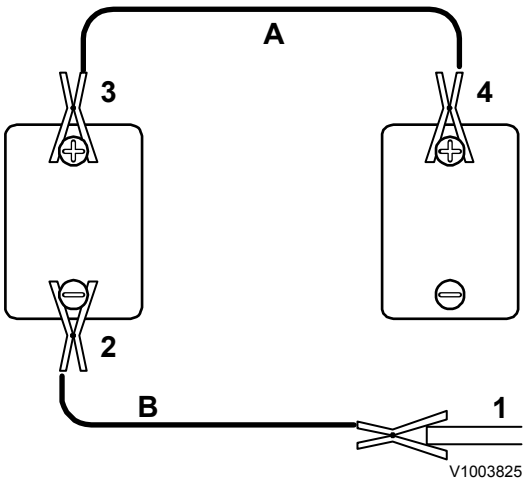


Fig. 8 Removing start cables

Remove the start cables as follows:

- Remove the cable (B) from the frame (1) on the machine that has been started with auxiliary start.
- Remove the other end of the start cable (B) from the battery's minus terminal (2) on the assisting machine
- Remove the cable (A) from the battery's plus terminal (3) on the assisting machine
- Remove the other end of the start cable (A) from the battery's plus terminal (4) on the machine that has been started with auxiliary start.

19 GENERAL

190 General

Boom and Chassis , inspection

Main chassis

retract the boom, raise it, and support it with a suitable stand or overhead sling. Check the entire frame. Check all mounting points carefully (cab, engine, boom, axles, etc.), along with any towing attachments or mounting points.

Cab

Check carefully. do not repair by welding.

Outriggers (if equipped)

Lowe the outriggers until they touch the ground. Inspect each carefully. Check the pads, pins, cylinders and weldments.

Boom

Extend the boom fully, then set the attachment carriage on the ground. Check each boom section thoroughly.

Attachment carrier

Check the carriage and attachment.

Cylinder anchor points

Check all cylinder anchor points and pins for signs of wear and stress.

191 Safety equipment, without own function group

Safety concerns everybody!

Always follow the instructions in the machine's operator's manual.

The operator's manual should always be kept in the cab for easy reference.

We have spent many hours engineering and producing a machine with a high level of safety and efficiency. All this time may be wasted if an individual who is about to perform service on any of our machines does not read through the safety instructions or does not follow them: for example, does not replace guards, climbs on slippery machine parts instead of using a ladder, grabs on to hoses instead of the provided handles or uses the wrong tools for the job.

Always use genuine (intended and adapted) spare parts to maintain safe and efficient machine function.

Machines seldom cause accidents. Instead, people do.

A safety-conscious person and a well-maintained machine constitute a safe, efficient and profitable combination.

Any person who does not follow the safety instructions and who ignores the warnings in this manual must make sure that their work method is safe. Otherwise, there is a great risk of serious accidents and injuries, perhaps even fatalities.

WARNING!

WARNING SYMBOL

This symbol is shown at various points throughout the manual. The appearance of it means "Warning, stay alert! Your safety is involved!"

Get to know the capacities and limitations of your machine!

Safety when handling the machine

MEC is only responsible if:

- the machine has been used in a correct way and been maintained in accordance with instructions in Service Manuals and the Operator's Manual for the machine.
- prescribed service and prescribed inspections have been carried out at the stated points in time.
- the recommended lubricants according to the manual have been used.
- no security seals have been broken by other than authorised persons.
- all alterations and repairs have been carried out in the way prescribed by MEC.
- only MEC's genuine spare parts/accessories, or attachments, which meet MEC's requirements, have been used.

WARNING!

The machine operator must have sufficient skills, knowledge and instructions before operating the machine.
An untrained operator may cause serious damage, injuries and even deaths.
Therefore, it is very important that you read and follow the instructions in the Operator’s Manual.
Never use a machine for which the Operator’s Manual is missing.
Learn the meaning of all the warning plates, symbols and operating instructions before operating the machine.

A few simple safety rules

General

- Remedy faults or defects which affect the safety as soon as possible.
- Always wear a hard hat, safety glasses, gloves, protective shoes and other protective articles when required.
- Do not remain in front of or behind the machine while the engine is running.
- To avoid unnecessary climbing on the machine use either a long-handled rubber scraper or brush for cleaning the outsides of the windows.
- When servicing the machine and for instance when changing bulbs, a ladder may be necessary.
- Make sure that stepping surfaces, service areas, handles and anti-slip surfaces are free from oil, diesel fuel, dirt and ice and that they are changed if they are damaged or missing.
- Check at regular intervals that all anti-slip items are securely fitted. If this is not the case, they should be secured or replaced.
- When you are entering or leaving the machine, always face the machine and use the steps and hand holds. Always use both hands and one foot or both feet and one hand. Do not jump!

Before operating

- Read the Operator's Manual, before you operate the machine. Follow the operating instructions in the Operator's Manual and carry out the measures which are detailed in the manual before operating.

  A few important rules are given below:
- Make a control lamp test before starting the engine by turning the ignition key to position "1", see the Operator's Manual.
- Carry out all safety checks prescribed in the Operator's Manual.

WARNING!

Never operate the machine if you are tired or under the influence of alcohol, medicine or other drugs.

- Before starting the engine indoors, make sure that the extraction capacity of the ventilation system is sufficient. The machine is provided with a diesel engine and the exhaust gases may be dangerous to your health. Make sure the ventilation is sufficiently good and avoid running

the engine for a longer time than necessary particularly when the ventilation is unsatisfactory.
- Read all plates and instructions which are fitted on the machine and given in the Operator's Manual before you begin to operate or service the machine. Each of the instructions contain important information about safety, handling and service of the machine.
- Use the lap type seat belt during all operation.
- Always sit in the seat facing the front of the machine when starting the engine.
- The machine must be operational before putting it to work, that is, all faults which may cause an accident must be remedied.
- Do not operate the machine for long periods without ventilation or with a fully closed cab without having the fan running (there is risk of lack of oxygen).
- Only step on slip-protected surfaces and hold onto the available hand holds and railings.

Fig. 9 Read the Operator's Manual, plates and instructions before you start operating the machine.

Lap type seat belt

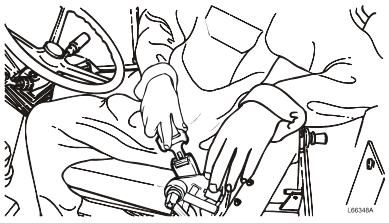


Fig. 10 Use the lap type seat belt during all operation.

- If the seat belt needs to be washed: Use a mild soap solution when washing and allow the belt to dry while it is fully pulled out, before rolling it up. Make sure the belt is fitted in a correct way.
- Change the belt immediately if it is worn, damaged or if the machine has been involved in an accident where the belt had to take some strain.
- Changes to the belt or its mountings must never be made.
- The seat belt is intended for one adult person only.
- Keep the belt rolled-up when not in use.

When the engine is running

- Respect the warning lamps. The red lamps require immediate action or consideration, see instructions in the Operator's Manual under the instrument panels section.
- Apply the parking brake and make sure that the attachment / attachment bracket is resting on the ground before you leave the machine. Unless you are putting the machine in a service position.
- Place gearshift lever and control levers in neutral positions before you leave the machine.
- Empty and place the attachment in transporting position before transport operating on a public road.
- Stop the engine before you leave the machine unattended.

When there is risk of overturning

The cab constitutes the protection for the operator and it meets the requirements for Roll Over Protective Structure (ROPS) according to the testing standard for this. See further under “CE-marking”.

A condition for the protection is that the operator is wearing the seat belt and that he or she remains in the cab, if the machine should roll over.

Falling objects
The cab is dimensioned to meet the standards required against objects falling onto the cab roof in accordance with stated testing methods, (FOPS). See further under “CE-marking”.

Emergency exits from cab
Rear window.

Safety when lifting and supporting the machine

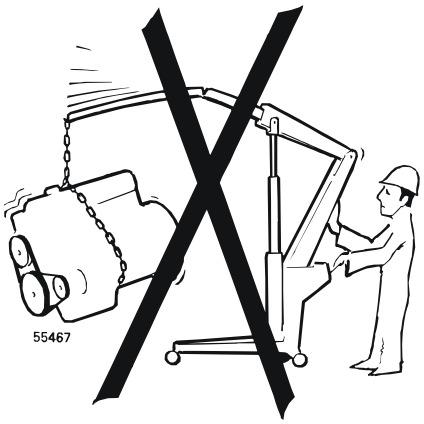


Fig. 11 Do not overload lifting or supporting equipment.

NOTE! The jack must always be relieved of weight bearing with axle stands under the raised axle before the wheel is removed!

- When lifting or supporting machine parts, use equipment with a lifting capacity that equals at least the weight of the part in question.
- All lifting devices, such as straps, slings, ratchet blocks, must comply with governing national regulations for lifting devices. We will not accept any responsibility if any lifting devices, tools or work methods are used other than those described in this publication.
- If a jack is to be used, make sure that the ground or floor is even and is sufficiently firm or strong to support the expected load.
- Prevent the machine from rolling by applying the parking brake and placing suitable wedges on both sides of the wheels which are not to be raised off the ground.
- Always use a jack with sufficient lifting capacity and position the jack according to instructions for the work that is to be done.
  Make sure that the jack is correctly positioned and is at the correct angle to the lifting point on the machine.
- Take care to position supports under the machine in a safe way.

Safety rules when servicing

This section covers general safety rules in connection with checking and service work.
Other rules, as well as information and warning texts, are given in this manual and also in the Operator’s Manual.

If changes are made that affect the machine safety, the person making the changes is responsible for them.
Therefore, the following applies:

- When installing a two-way radio, mobile telephone, etc., installation must be performed according to the manufacturer’s instructions in order to eliminate interference with electronic systems and components that are necessary for machine functions.
- When retrofitting equipment in or on the cab; do not drill, weld or cut the cab structure as this will reduce the operators protection in case the machine rolls over.

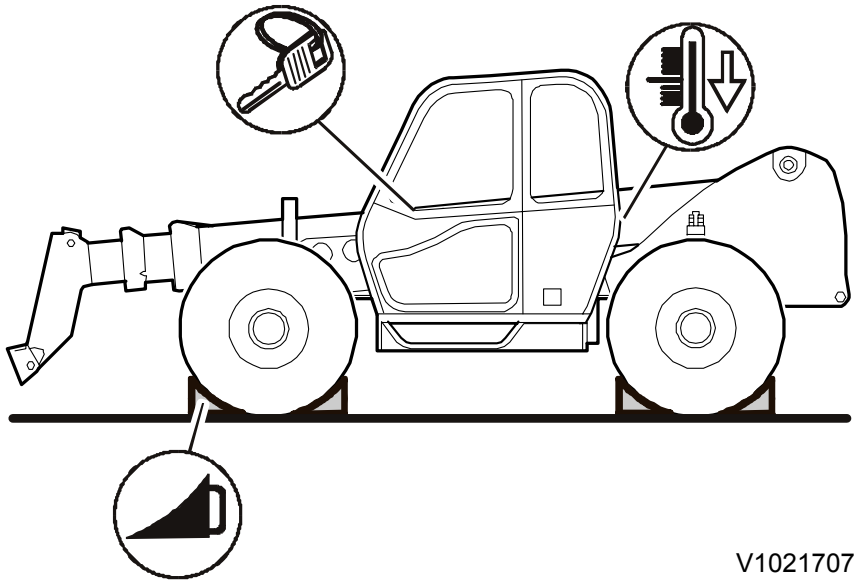
Before starting any service work:

Service work performed incorrectly can be dangerous.
Make sure that you have sufficient knowledge, correct information, the right tools and the proper equipment to perform the service work correctly.
Repair or change broken or damaged tools and equipment.

Service positions

Before you begin service work, the machine must be placed on level ground and prepared as shown below. If work has to be carried out on the machine before it has cooled, there is a risk of burns. Therefore, take care when working with hot liquids and machine parts.

Service position 1



V1021707

Fig. 12 Service position 1

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Fully lower the boom so that the boom supports to the machine frame.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

Service position 2

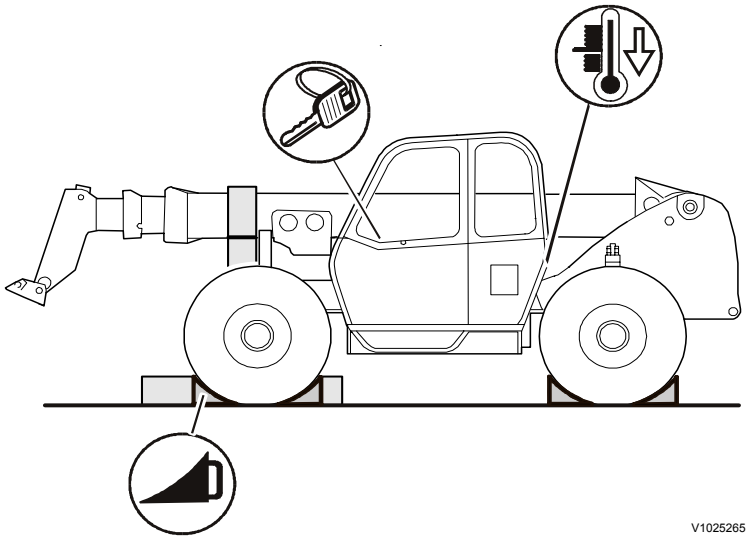


Fig. 13 Service position 2

1 Remove the attachment from the attachment bracket.
2 Fully retract the boom.
3 Place a support under the boom.
4 Park the machine on firm level ground.
5 Apply the parking brake.
6 Turn off the engine.
7 Remove the ignition key.
8 Allow the machine to cool down.

WARNING!

If work must be done on the machine before it has cooled down; beware of hot fluids and hot components that can cause severe burns.

9 Attach a black and yellow label to the steering wheel with the message "forbidden to start the engine".
10 Unfasten seat belt and exit the machine using the handles.
11 Block the wheels.

NOTE! No work should be performed on the machine until you have sufficient knowledge and skills to do so.

General

- Machines that operate in contaminated areas (polluted environments and/or areas hazardous to health) should be specially equipped. In addition, local safety regulations apply when servicing such machines.
  See also *Checklist after a fire or heat exposure, page 29*.
- When washing the machine with a high-pressure washer, do not aim the water jet directly at non-slip surfaces that are glued on.

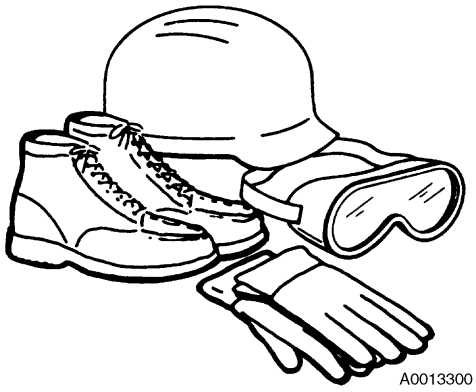


Fig. 14 Protective equipment

- If anyone is to take over the job that you have started, make sure that this person is informed as to how much of the work has been done and how much remains.
- Never wear loose objects such as a scarf or jewellery that could get caught and cause personal injury when you are working on the machine.

WARNING!

Never step on parts of the machine that are not prepared or intended for this, such as an open and raised engine hood (cover).

- Always wear a hard hat, protective goggles, gloves, work shoes and other necessary safety items that your work requires.
- Always turn off the engine when servicing the machine unless instructions on signs and plates or in this manual state otherwise.
- Turn off the engine before opening engine covers, radiator covers and similar. Make sure that no tools or other objects that can cause damage are forgotten in the machine.
- When changing oil in the engine, hydraulic system or transmission, keep in mind that the oil may be hot and can cause severe burns.

Working under raised boom

Always secure the boom with safety strut before beginning any work.

Safety when working with batteries

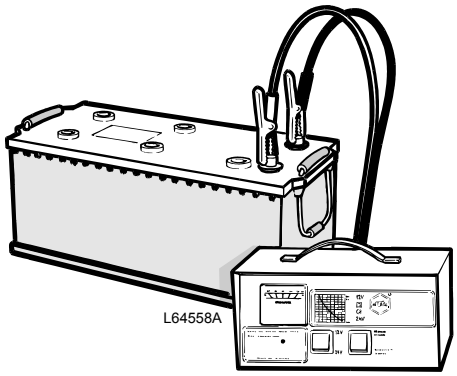


Fig. 15 Battery charging

Batteries contain sulphuric acid which is very corrosive to the human body and parts of the machine. In addition, batteries give off hydrogen gas when they are loaded (supplying electricity) or being charged.
Together with the oxygen in the air, hydrogen gas forms a very explosive mixture.

This combination, **corrosive acid and explosive gas**, means a high risk of accidents during all work with batteries used in vehicles.
Therefore, it is very important that you take great care and follow the rules below when you are working with batteries.

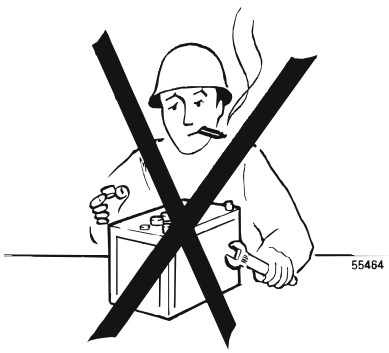


Fig. 16 Do not smoke near batteries!

Follow these instructions when charging batteries:

- Batteries give off explosive gases. Never smoke near batteries.
- Begin by disconnecting the ground lead when removing a battery. In order to reduce the risk of sparks that can cause fire, always connect the ground lead last when fitting a battery.
- Never tilt a battery to any great extent in any direction. Battery electrolyte may leak out.
- Do not connect a discharged battery in series with a fully charged battery. The current surge can cause the batteries to explode.
- Do not allow metal objects (such as tools, rings, wristwatches) to come in contact with battery terminals. Risk of fire and personal injury.
- Always cover the top of the battery with a rag or other non-conducting material when you work close to the batteries.
- Always refit the terminal caps on the batteries.
- Batteries contain substances dangerous to health and the environment. Discarded batteries must therefore be disposed of according to local and/or national regulations.

Charging batteries

Explosion hazard
When a battery is being charged, an explosive mixture of oxygen and hydrogen is formed. A short circuit, open flame or spark near the battery can cause a powerful explosion. Always turn off the charging current before disconnecting the charging clamps. Ventilate well, especially if the battery is charged in a confined space.

Corrosive sulphuric acid
The battery electrolyte contains corrosive sulphuric acid. Electrolyte spilled on bare skin must be removed immediately. Wash with soap and plenty of water. If electrolyte gets into your eyes or any other sensitive body part, rinse immediately with plenty of water and seek immediate medical attention.

Starting with booster batteries

When starting with booster batteries, the following must be observed:

Check that the booster batteries or other power source have **the same voltage** as the standard batteries.

WARNING!

Batteries may explode due to the current surge if a fully-charged battery is connected to a completely discharged battery. Personal injuries may be sustained.

Follow these steps:

1 Move the gear selector to neutral.

2 Apply the parking brake.

3 Check that the booster batteries or other power source have the same voltage as the standard batteries.

4 Do not disconnect the cables to the standard batteries!

5 Connect (+) on the booster battery to (+) on the battery nearest the starter motor.

6 Connect the other start cable from (-) on the booster battery to the machine chassis, such as on the frame member close to the starter motor.

7 Start the engine with the ignition key in the cab.

8 Once the engine has started, remove the start cable between the chassis and the booster battery negative terminal (-). Then remove the start cable between the positive terminals (+).

9 Refit the terminal caps on the battery terminals.

Fire prevention measures

General

- There is always a risk of fire. Find out which type of fire extinguisher to use, where it is located and how to use it. The fire extinguisher in the machine should be located for quick access or in an external box that can be locked.
- Fire-fighting equipment installed in or on the machine must be maintained in working order. Such equipment should be regarded as a complement to the operator's own efforts in case of a fire.
  The equipment should not be considered as a replacement of the operator's own fire fighting efforts.
- Fire extinguishers mounted on the machine or used when working on the machine must fulfil certain requirements. See the Operator's Manual.
- At the slightest sign of fire, if the situation allows it and keeping in mind your own safety, take the following action:

Fig. 17 Smoking and open flames are absolutely forbidden when filling fuel or any time diesel fuel is in contact with the open air.

– drive the machine away from the danger area.
– lower attachment(s) to their bottom position so that the attachment rests on the ground.
– stop the engine by turning the ignition key to the "0" position.
– leave the cab.
– turn off the battery disconnect switch.
– start fighting the fire and call the fire department if necessary.

- Smoking or open flames are absolutely forbidden close to the machine when filling fuel or at any time the fuel system is in contact with the open air.
- Diesel fuel is flammable and must not be used for cleaning. Use an approved solvent instead.
- Remember that certain solvents can cause skin rashes and are usually flammable. Avoid inhaling solvent vapour.
- Engine starting aids are flammable. Store such items in cool and adequately ventilated areas.
  Remember that such aids must not be used in combination with electric preheating of induction air.

Cleanliness

- Cleanliness is a decisive factor for operational reliability of the machine's systems. Therefore, keep the servicing area clean. Oil or water make floors and steps slippery and are also dangerous in combination with electrical systems or tools. Oily clothes or clothes drenched in grease constitute a serious fire hazard.
- Check daily that the machine and equipment, such as underbody skid plates, are free from dirt and oil. This reduces the risk of fire and makes it easier to detect defective components or loose parts.
  IMPORTANT! If a high-pressure washer is used when cleaning, work carefully since damage may be caused to electrical components and insulation of the electrical cabling even at relatively moderate water pressure and temperature. Protect electrical cabling in a suitable manner.
- Keep the machine especially clean when operating in environments with fire hazards, such as saw mills, garbage dumps, etc. In such environments, suitable equipment to reduce the risk of accumulation of material and spontaneous combustion should be fitted (for example muffler guard, radiator screen, heavy-duty cyclone pre-cleaner, etc.).

Electrical system

- Check electrical cables with regard to chafing damage and make sure that they cannot be damaged in such a way. This applies particularly to unfused electrical cables, which are red.
  For example, electrical cables between:
  – Batteries
  – Battery-starter motor
  – Alternator-starter motor
  – Cable to engine preheating coil.
- When unfused cables have been disconnected, it is important to check that they are reconnected and clamped in

such a way that they cannot be exposed to chafing. Unfused cables must not rest against oil and fuel hoses.
- When fitting any optional equipment, make sure that all cables (circuits) are connected across a fuse and routed and clamped so that there is no risk of chafing.

Fuel, hydraulic and brake systems

- Check to make sure that there is no chafing damage to fuel, hydraulic and brake hoses.

Welding and grinding

- Welding and grinding on the machine may only be done in a clean area and not in places that contain combustible liquids, such as fuel tanks, hydraulic pipes or similar.
  Work with extra care when welding and grinding near flammable objects.
  IMPORTANT! A fire extinguisher should be easily accessible during all welding work.
- Never weld on a painted surface without first removing the paint. Welding on a painted surface generates, in addition to health-hazardous vapours, technically inferior welds which may lead to future failures, with subsequent accidents.

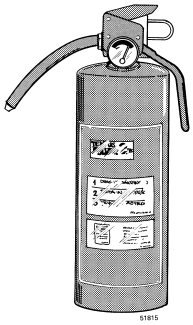


Fig. 18 Fire extinguisher

Actions after a fire: see “Checklist after a fire or heat exposure”.

Checklist after a fire or heat exposure

If a machine has been damaged by fire or been exposed to intense heat, the following precautionary measures according to the following check list must under all circumstances be followed:

- As a precaution, seal rings (O-rings or axle/shaft seals) should always be handled as if they were made of fluor rubber, see also section “Fluor rubber”.

WARNING!

Avoid splashing when washing a machine damaged by fire. For this reason, never use high-pressure washing equipment.

- Never touch burned components or parts with your bare hands when there is a risk that you may be exposed to contact with melted polymers. First, wash thoroughly with plenty of lime water (a solution or a suspension of calcium hydroxide, i.e. slaked lime).
  Use thick, protective gloves made of rubber and wear goggles that are certain to protect your eyes.
- Seek medical attention if your skin may have come in contact with burnt fluor rubber. The skin should be treated with Hydrofluoric Acid Burn Jelly or similar.
  Symptoms may not appear until several hours after contact with burnt fluor rubber.
- Discard protective gloves, rags and other items that may have come into contact with burnt fluor rubber.

CE marking and declaration of conformity

(Only applies to machines marketed within the EU/EEA.)

This machine is CE-marked. This means that, when delivered, the machine meets the applicable "Essential Health and Safety Requirements", which are given in the EU Machine Safety Directive. If changes are made that affect the safety of the machine, the person making the changes is responsible for the same.

As proof that the requirements are met, the machine is supplied with an EU Declaration of Conformity, issued by MEC for each individual machine. This EU declaration also covers attachments manufactured by MEC. The documentation is a valuable document, which should be kept safe and retained for at least 10 years. The document should always accompany the machine when it is sold.

If the machine is used for other purposes or with other attachments than described in this manual, safety must be maintained at all times and in each individual case. The person carrying out such action is also responsible for the action which, in some cases, may require a new CE marking and the issue of a new EU Declaration of Conformity.

EU EMC Directive

The electronic equipment of the machine may in some cases cause interference with other electronic equipment, or the equipment may be adversely affected by external electromagnetic interference, which may constitute safety risks.

The EU EMC directive on "Electromagnetic conformity" provides a general description of what demands can be made on the machine from a safety perspective, where permitted limits have been determined and given according to international standards.

A machine or device which meets the requirements should be CE-marked. Our machines have been specifically tested for electromagnetic interference. The CE marking of the machine and the declaration of conformity also cover the EMC directive.

If other electronic equipment is fitted to this machine, the equipment must be CE-marked and tested on the machine with regard to electromagnetic interference.

Unauthorized modifications of the Roll Over Protective Structure (ROPS)

Never make any unauthorized modifications to the ROPS, such as lowering the height of the roof, drilling, welding on fire extinguisher brackets, radio aerial brackets or other equipment.

Such unauthorized modifications will affect the structural strength of the ROPS cab and will void the certification.

The Roll Over Protective Structure (ROPS) has been approved following testing and meets standards according to ISO 3471: 1994 and SAE 1040 MAY 94.

The cab has also been tested and approved according to FOPS standard as defined by ISO 3449: 1997 and ISO 6055: 1997.

All planned modifications must be reviewed in advance by our Engineering Department in order to determine whether the alteration can be made without affecting the certification.

It is important that all persons in your organisation, including management, are made fully aware of these rules involving ROPS.

If anyone in your company discovers that a certain machine was modified in a non-approved manner, your company must notify the customer and manufacturer if writing regarding which machine it was and how it was modified.

NOTE! Modifications or removal of material which affects sound, i.e. noise-insulating material, noise-damping or noise-absorbing material may not be performed. Further, making new holes/ openings in the cab or engine compartment is not allowed as this may increase the sound level in the cab.

Some simple rules regarding tyre handling

WARNING!

A tyre fitted on a split rim may explode causing severe injury or even death.

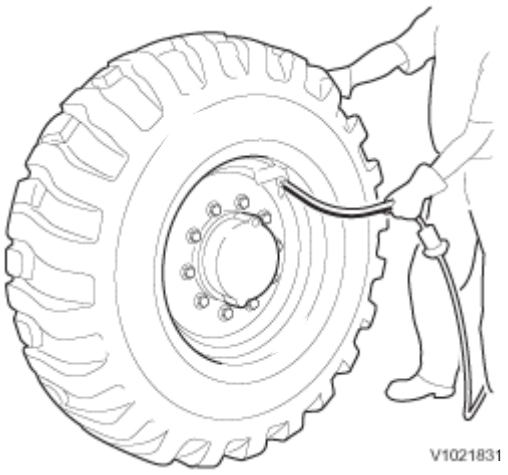


Fig. 19
Never stand to the side of the tyre while inflating.

Inflating

- Never stand to the side of the tyre while inflating.
- Never stand to the side of the tyre while inflating which is fitted on a split rim. Use a self-locking outlet with a hose long enough to allow you to stand outside of the hazard zone during inflation, see the illustration.
- Make sure that the hazard zone is clear when the tyre is inflated.
- The machine must be unladen when checking tyre pressure.
- Spare tyres should only be filled with enough air to allow the rim parts to be held in place.
- Secure a loose wheel with an inflation cage, cable or chains before inflating. Before removing the inflation cage, check that the tyre is properly fitted to the rim. Adjustments should be made before the wheel is inflated.
- Do not attempt to adjust side rings or lock rings when the tyre is inflated.
- Tyres used at less than 80% of normal pressure and rims or tyres suspected of being damaged should not be inflated with the wheel attached to the machine.

Fitting of tyres and rims

- Handling of tyres should be performed by authorised personnel only.
- The tyre should be deflated before removal from the machine.
- Never install a tyre on a rim that has not been recommended for that tyre.
- Never assemble rim parts for different dimensions or use damaged or faulty parts.
- Exercise caution if using reconditioned wheel details. Welding errors, faulty heating or soldering may have weakened the parts and may cause the detail to break.
- Make sure the lock ring groove in the rim is cleaned from foreign matter and rust before fitting the lock ring.
- Use a lubricant recommended by the tyre manufacturer when fitting onto the rim.

Repairing tyres and rims

- Never cut, weld nor heat the wheel parts in any manner.
- Exercise caution when using bead breakers and hydraulic jacks. Remain outside the hazard zone when removing foreign objects from the tyres. A bead breaker that releases can cause severe personal injury and may result in death.

Working on the electrical system of the machine

- Only use test instruments with a light-emitting diode, never a test light with a light bulb, for example, during troubleshooting of the electrical system!
  The high firing voltage of the bulb can destroy expensive electronic components.
- When installing a two-way radio, mobile phone, etc., installation must be performed according to manufacturer's instructions in order to eliminate interference with electronic systems and components intended for the function of the machine.

Safety for work on hydraulic systems

The hydraulic systems in our TL 70/90 work at very high pressures, up to approx. 25 MPa (250 bar) (3626 psi). In order to prevent serious personal injuries, it's important that the systems are maintained correctly and that all persons who come into contact with the machines are very careful and very alert to any defects.

Those who follow the simple rules below have laid a good foundation for accident prevention.

General

- Never adjust a pressure limiting valve to a higher pressure than that recommended by the manufacturer.
- A hydraulic hose that swells, for example, at a connection, indicates that it's about to burst. Replace the hose as soon as possible! Pay attention to leaks from hydraulic hoses and connections. Repair the leakage before the part bursts!
- **Scrapped accumulators** Empty the accumulators gas and remove the gas valve. Plug the oil port.

  NOTE! It is dangerous to disconnect the gas valve when the accumulator is pressurized.

WARNING!

If the pressure is not released before opening the system, oil under high pressure will jet out, resulting in serious personal injuries.

Pressure release

When the engine has been stopped, there remains an accumulated pressure in the system 14.5 MPa (145 bar) (2100 psi).. The remaining pressure in the system must be lowered, so-called depressurization (releasing pressure), before hose connections, plugs, etc. are opened in the hydraulic system or brake system.

1 Lower attatchment(s) to the ground.
2 Turn off the engine and remove the ignition key.
3 Release the system pressure by moving the control levers forward and rearward several times with full strokes.

- All pressurised vessels must be opened very carefully, so that any residual pressure is released.
- Check-tightening of leaking couplings and connections should only be done after all the pressure in the system has been completely released.

- All pressurized tanks/vessels shall be opened carefully so that any residual pressure is released.
- Check-tightening of leaking couplings and connections may only performed after the system is completely depressurized.

WARNING!

In case of hydraulic hose leaks that show up as very fine jets - remember the high pressure: the jet can easily penetrate your hand, for example, and cause serious injuries.

- To check for leaks, use a steel plate or stiff board, **never use your hands**.

Health risks associated with paints, plastics and rubber

Work on painted surfaces

No welding or torch-cutting is allowed on painted surfaces.
All paint is broken down when heated and forms a wide variety of substances that may be irritating and very hazardous to health after prolonged or repeated exposure.

The following safety instructions must be followed:

- Remove all paint by sand-blasting at least 10 cm (4 in.) around the welding or cutting point (use suitable breathing protection).
  If the work area cannot be sand-blasted, remove the paint in another way, for example, with a paint remover (solvent).
  NOTE! When using paint removers (solvents), use an air extractor, breathing protection and protective gloves.
- High-speed grinding machines and grinding discs also heat the paint and must only be used if there's an air extractor on the grinding machine. Use breathing protection as well.

Rubber and plastics

WARNING!

When heated, rubber and plastics can give off gases which are dangerous to health and the environment.

The following safety instructions must be followed:

- Do not weld or cut near polymer materials (rubber and plastics) without first protecting them from the heat.
- Never burn polymer materials when scrapping them.
- Be careful when handling machines that have been exposed to fire or other intense heat. Also, refer to “Checklist after a fire or other heat exposure”.
- Always use protective gloves, protective glasses/goggles and breathing protection.

Flour rubber

WARNING!

Risk of serious corrosive injuries!

WARNING!

When hydrogen fluoride rubber is heated, there is a risk of hydrogen fluoride gas build-up already at approx. 320 °C (610 °F). When inhaled, the gas is extremely corrosive to respiratory tracts.

Certain seals designed to withstand high operating temperatures (for example, in engines, transmissions, axles, brakes, hydraulic motors and pumps) may be made of fluor rubber, which will form hydrogen fluoride and hydrofluoric acid when exposed to intense heat.

This acid is highly acidic and corrosive. It cannot be rinsed or washed off the skin, and causes very severe burn and corrosive injuries that take a very long time to heal. As a rule, injured tissue must be removed surgically.

The acid may remain on machine parts for a very long time (several years) after a fire.

NOTE! It may take several hours after contact with the acid before any symptoms become apparent.

If swelling, redness or burning sensations appear and contact with heated fluor rubber is suspected, contact a physician immediately. If a machine or a component for a machine has been exposed to fire or other intense heat, it shall be handled by specially trained personnel.

Thick protective neoprene rubber gloves and tight-fitting protective goggles must be used during all handling of machines after a fire.

WARNING!

Never burn painted parts or parts made of plastics or rubber after they have been discarded. This work must be done by a licensed waste management plant.

Decontamination
The area around a heated part that is suspected of being made of fluor rubber must be decontaminated by thorough and ample washing with lime water (a solution or suspension of calcium hydroxide, that is, slaked lime in water). After the work has been completed, wash the protective gloves in lime water and discard them.

The safety instructions in the following checklist must be followed under all circumstances if a machine has been exposed to a fire or other intense heat:

Safety when handling oils and fuel

- When changing oil in the engine, hydraulic system or transmission: Remember that the oil may be hot and can cause burns.
- Engine, hydraulic and transmission oils as well as diesel fuel have a corrosive effect on mucous membranes, for example, in eyes and throat and on skin. Therefore, take special care to keep such oils away from these sensitive body parts.
- When emptying/draining oils or fuel, steps must be taken to avoid unnecessary spills. In places where a container for collecting the liquid cannot be used, use a pump or connect a hose to ensure safe handling. Oil released or spilled on the ground will harm the environment and could also cause a fire.
  Waste oil/fluids must always be taken care of by a company authorized for such work.
- Remember the fire hazard!

Pressure setting and leak detection

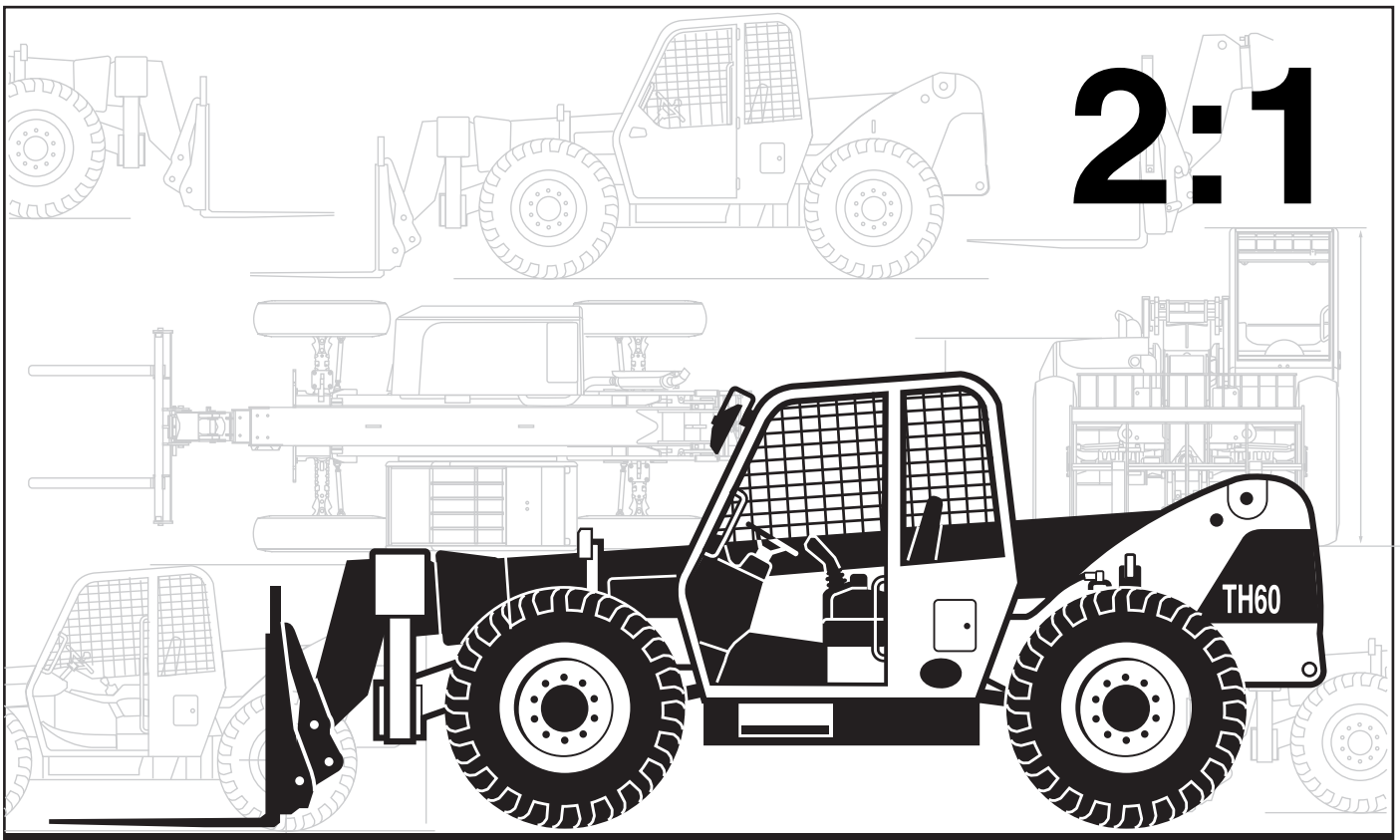
WARNING!

Hot hydraulic oil and hydraulic oil under pressure may result in severe personal injuries

Observe the following safety precautions:

- Lever and pedal movements should be made slowly in order to avoid sudden or unexpected machine movements and excessive pressures.
- Interrupt the pressure increase as soon as the specified pressure has been reached.
- Make changes in small increments when setting pressure adjustment devices whose sensitivity is not known. This is especially important with regard to the servo circuit, which is pressurized as soon as the engine is started.
- Check and calibrate the pressure checking equipment regularly and replace damaged components.

2:1



Engine, Description

PRELIMINARY DOCUMENT

Contents

ENGINE WITH MOUNTING AND EQUIPMENT

20 GENERAL

200 General, engine installation and its function

Engine specifications

General	
Make	Deutz
Designation	D4D CDE2
Type	Dry sleeve
Product number	–EG:–00619224
Aspiration (standard)	Turbo
Number of cylinders	4
Bore	101 mm (3.98 in)
Engine RPM (governed)	2500 RPM
Stroke	126 mm (4.96 in)
Displacement	4.038 dm3 (246.5 in3)
Number of valves	8
Rotation direction	CCW
Compression ratio	19.0:1
Firing sequence	1–3–4–2
Low idle	900 rpm
High idle	2565 rpm
Weight (dry)	380 kg (840 lb)

Performance		
Max. flywheel output at 2000 rpm	ISO 9249/DIN 6271 net	68 kW (91 hp)
	SAE J1349 gross	70 kW (94 hp)
	SAE J1349 net	68 kW (91 hp)
	DIN 79929 net	68 kW (91 hp)
Max torque at 1500 rpm	ISO 9249/DIN 6271 net	385 Nm (284 lbf ft)
	SAE J1349 gross	389 Nm (287 lbf ft)
	SAE J1349 net	385 Nm (284 lbf ft)
	DIN 79929 net	385 Nm (284 lbf ft)

Valve mechanism	
Valve arrangement	Overhead valves
Valve clearance	
inlet valve	0.30 mm (0.0118 in)
exhaust valve	0.50 mm (0.0196 in)

Lubrication system	
Type	Forced feed circulation lubrication
Lube pump type	Gear driven
Oil pressure > 1100 rpm	0.45 MPa (4.5 bar) (65 psi)
Oil pressure minimum (warm engine, low idling	0.08 MPa (0.8 bar) (12 psi)
Oil temperature, normal	80 °C (176 °F)
Oil temperature, max	125 °C (257 °F)
Oil flow at 2500 rpm	65 litres (17.2 US gal) per minute
Oil filter, filtering size	0.012 mm (0.0005 in)
Pressure relief valve opening pressure	1.00 MPa (10 bar) (145 psi)
Oil filter bypass valve opening pressure	0.25 MPa (2.5 bar) (36 psi)
Pressure regulating valve opening pressure	0.40 MPa (4 bar) (58 psi)

Fuel system	
Type	Direct injection
Cold–starting device	Preheating element in inlet manifold

Fuel feed pump	
Make	Dana
Type	Gear pump
Feed pressure	0.5 MPa (5 bar) (72 psi)
Feed pressure after fuel filter (minimum, at 1500 rpm)	0.28 MPa (2.8 bar) (41 psi)
Relief valve opening pressure	0.6 MPa (6 bar) (87 psi)
Bypass valve opening pressure	0.050 MPa (0.5 bar) (7 psi)
Fuel flow (minimum, at 220 rpm)	9 litres (2.4 US gal) per minute

Injection pump	
Make	Bosch
Timing setting	5° btdc

Injectors	
Quantity	4
Bore	0.203 mm (0.008 in)
Opening pressure	22 MPa (220 bar) (3190 psi)
Adjusting pressure	22 MPa (220 bar) (3190 psi)
Max pressure	160 MPa (1600 bar) (23200 psi)
Check leakage	20 MPa (200 bar) (2900 psi) for 10 sec

Turbocharger	
Make	Schweitzer
Designation	S200

Air cleaner with connections, air pre–heater	
Type of air cleaner	Two stage
Preheating coil	In induction manifold

Cooling system	
Type	Liquid–cooled with integrated oil cooler
Coolant pump type	Belt–driven centrifugal pump
Thermostat type	Piston thermostat
Thermostat begins to open at	83 °C (181.4 °F)
Thermostat fully open at	95 °C (203 °F)
Pressure valves opens at	0.05 MPa (0.5 bar) (7.3 psi)

Thermostat	
Type	Piston thermostat
Quantity	1
Begins to open at	83 °C (181 °F)
Fully open at	95 °C (203 °F)
Pressure	0.05 MPa (0.5 bar) (7.3 psi)

Coolant pump	
Type	Belt driven centrifugal
Flow at 2200 rpm	158 litres (41.7 US gal) per minute
Working pressure max	0.05 MPa (0.5 bar) (7.3 psi)

Cold start	
Cold start aid (standard)	Engine air pre–heater
Cold start aid (optional)	Engine water heater

Engine, weights

Engine (dry)	380 kg (838 lb)
Engine hood	20 kg (44 lb)
Cooler	27 kg (60 lb)

Engine, capacities

Engine oil including filter	12 liter (3.2 US gallon)
Cooling system	14 liter (3.7 US gallon)
Fuel tank	122 liter (32.2 US gallon)

Engine, tightening torques

Engine mounting to engine	185 Nm (136 lbf ft)
Engine mounting to frame	173 ±15 Nm (127 ±11 lbf ft)
Propeller shaft to gearbox	61–81 Nm (45–60 lbf ft)

Engine D4D, component location

Component location right hand side

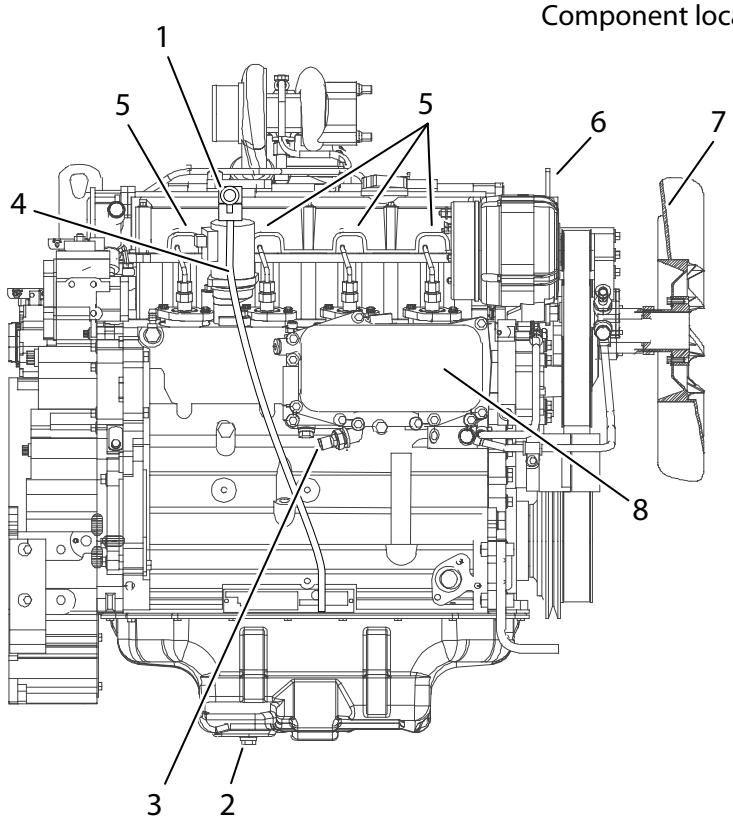


Fig. 1

1 Oil dipstick (late models)
2 Oil drain plug
3 Oil pressure switch
4 Shut off solenoid
5 Injection pumps + solenoids
6 Alternator
7 Cooling fan
8 Oil cooler

Component location left hand side

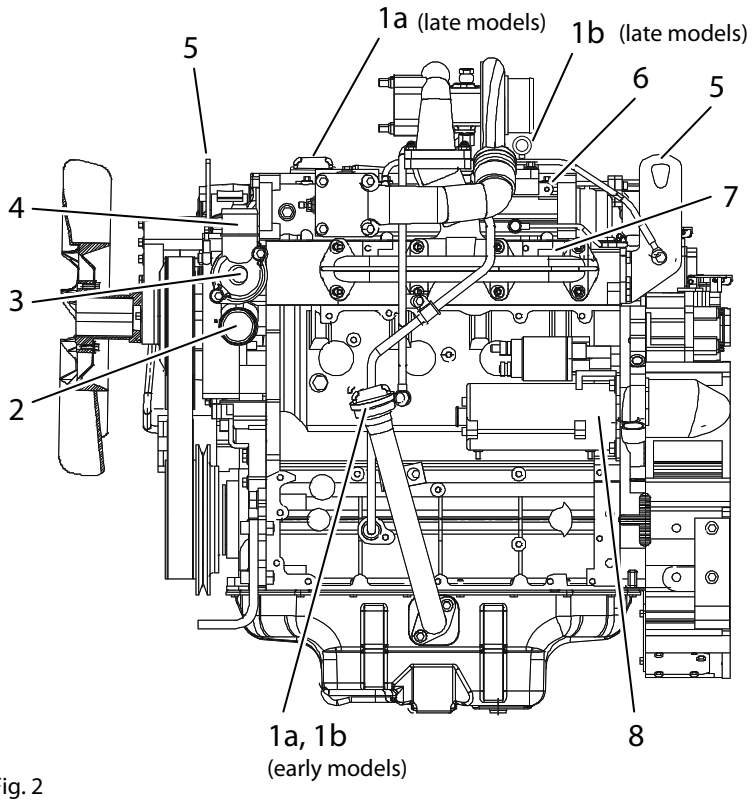


Fig. 2

1a	Oil filler	5	Engine lifting eyes
1b	Oil dipstick	6	Inlet manifold
2	Coolant in	7	Exaust manifold
3	Thermostat	8	Starter motor
4	Coolant out		

Component location rear side

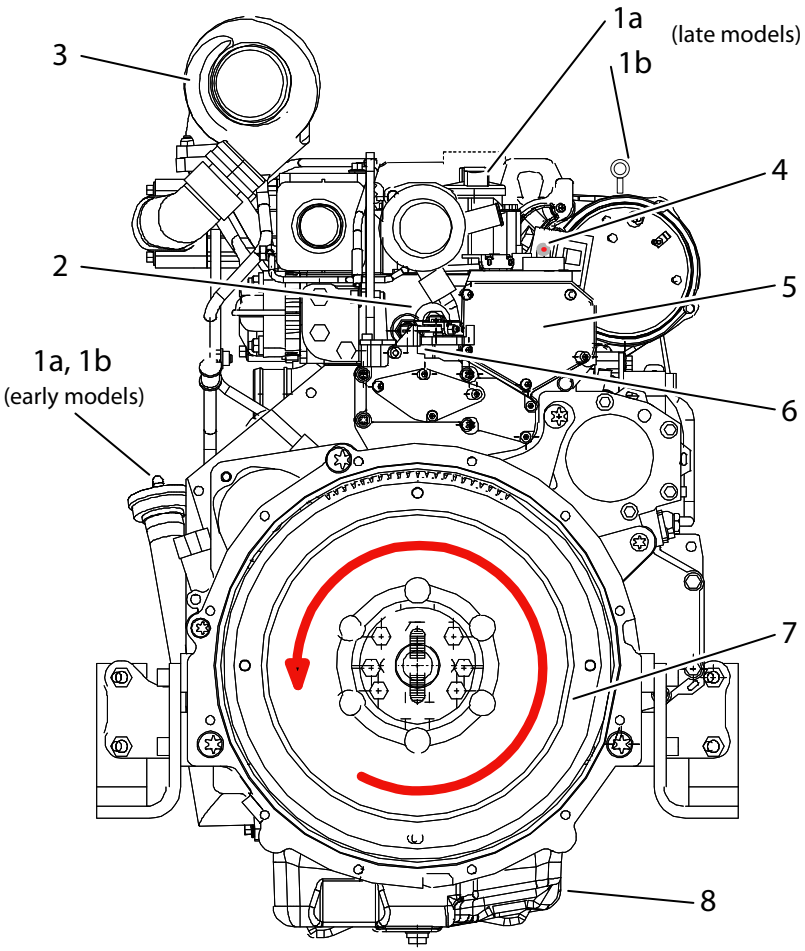


Fig. 3

1a	Oil filler	5	Governor
1b	Oil dipstick	6	Accelerator
2	Coolant temperature sensor	7	Flywheel
3	Turbo charger	8	Sump
4	Start Solenoid		

Component location front

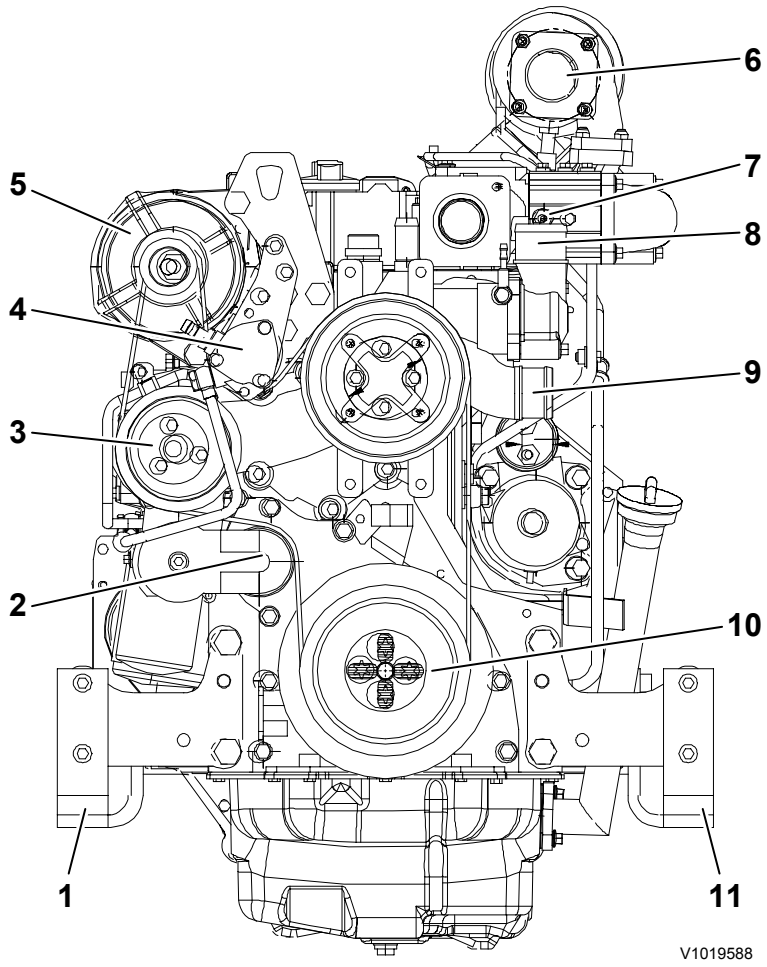


Fig. 4

1	Right engine mount bracket	7	Pre–heater
2	V–belt and tension pulley	8	Coolant out
3	Water pump	9	Coolant in
4	Fuel pump	10	Crankshaft pulley
5	Alternator	11	Left engine mount bracket
6	Turbo charger Exhaust		

Component location, plan–view

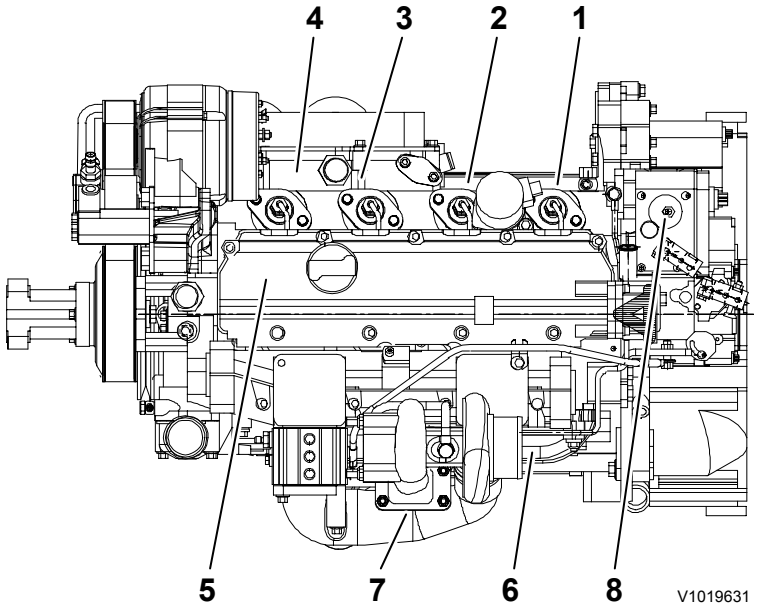


Fig. 5

1	First cylinder	5	Valve cover
2	Second cylinder	6	Air inlet
3	Third cylinder	7	Exhaust
4	Fourth cylinder	8	Govenor

Nameplate and engine serial number

The nameplate is affixed on the top of the engine, beside of the oil cap. The engine serial number is stamped on the nameplate and on the crankcase side
The engine model and engine serial number must be indicated when ordering spare parts.

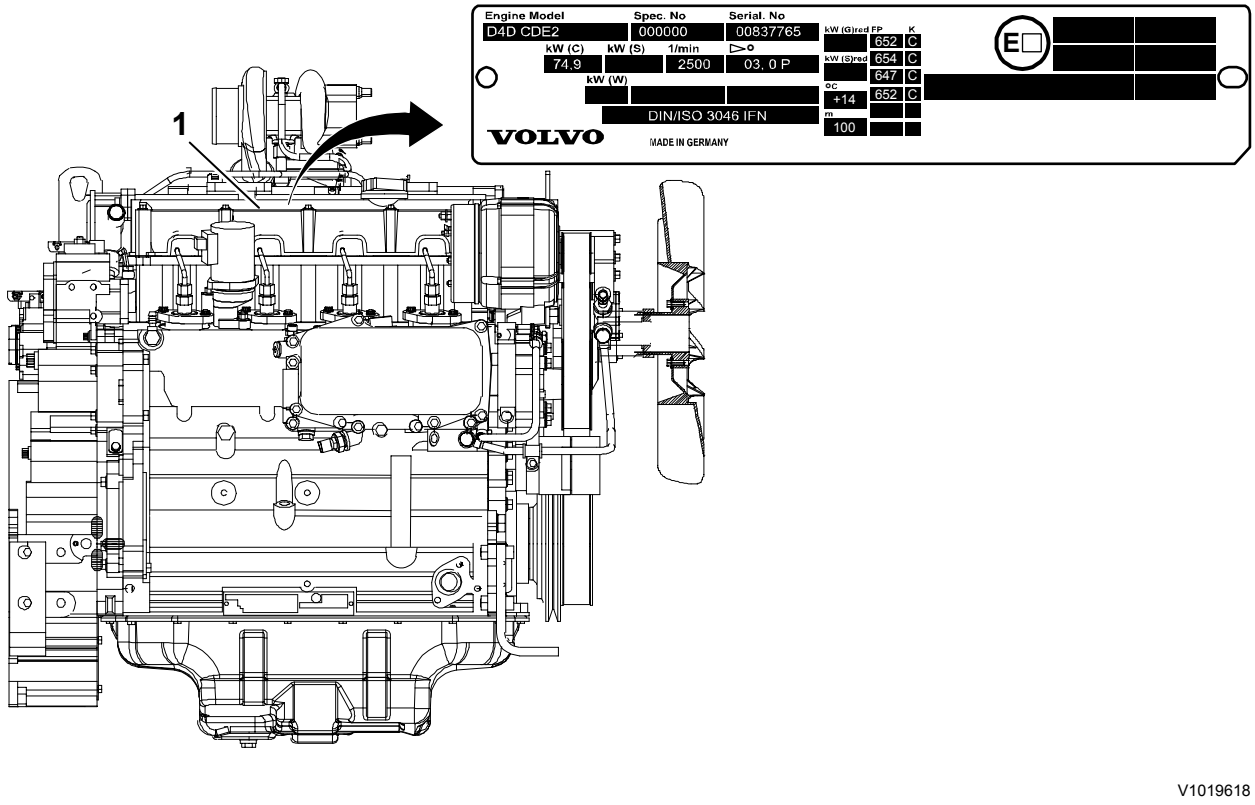


Fig. 6
1 Nameplate with engine model and serial number

Cylinder numbering

- The cylinders are numbered, beginning at the flywheel end.
- The direction of engine rotation is counter–clockwise when facing the flywheel.

Firing order: D4D CDE2 1–3–4–2

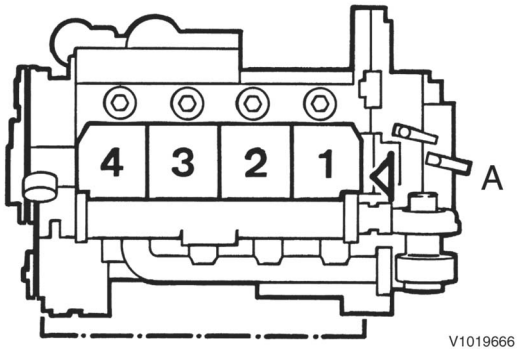
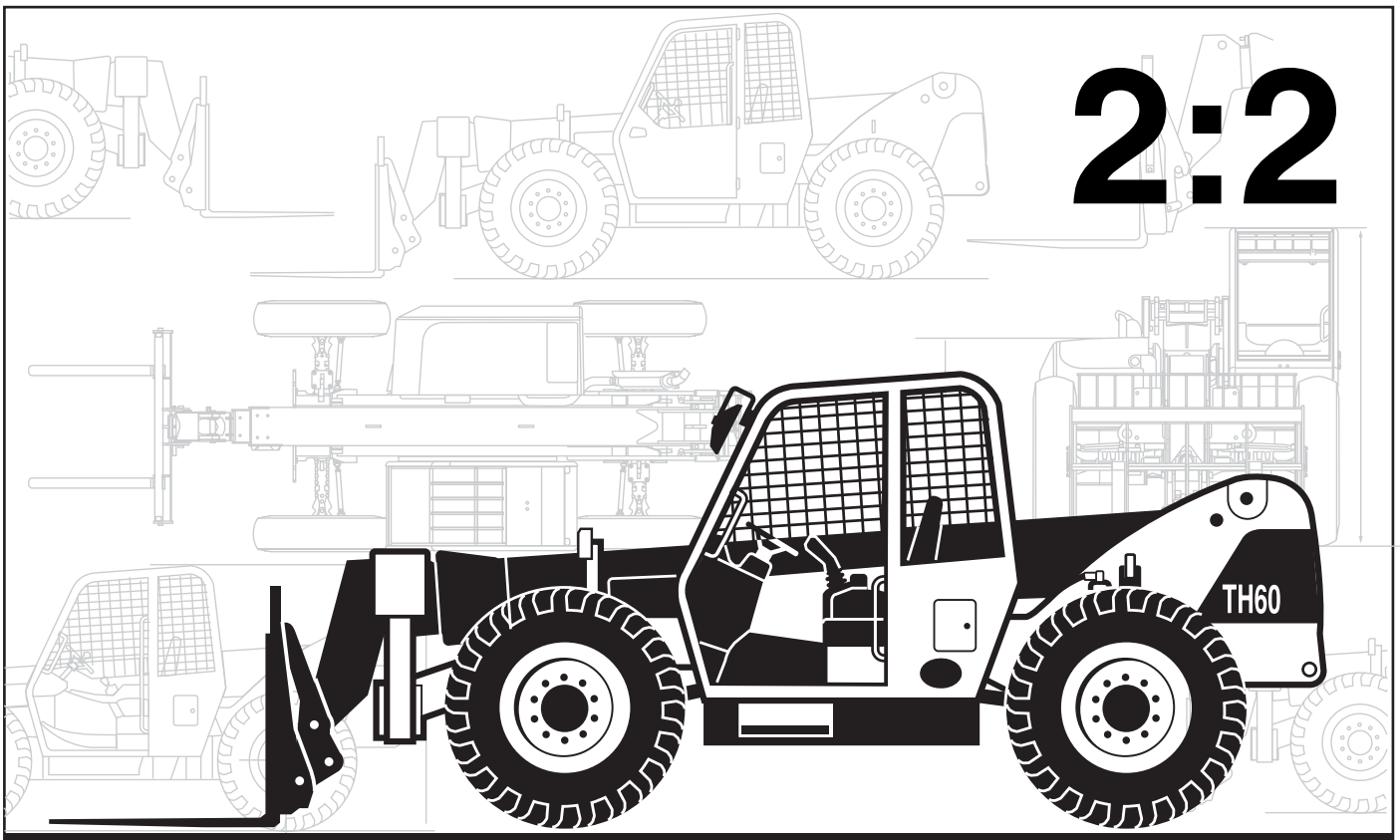


Fig. 7
A Flywheel side

2:2



Engine,
Repair Instructions

PRELIMINARY DOCUMENT

Contents

ENGINE WITH MOUNTING AND EQUIPMENT

21 ENGINE

210 General, common info about 211 - 218

Engine and transmission assembly, removal from main frame

Op. no. 21073

1 Put the machine in service position 1 , see *TH60/80, 191, Safety rules when servicing*.

2 Remove the gas spring at it's upper ball joint and remove the hinges from the engine hood.

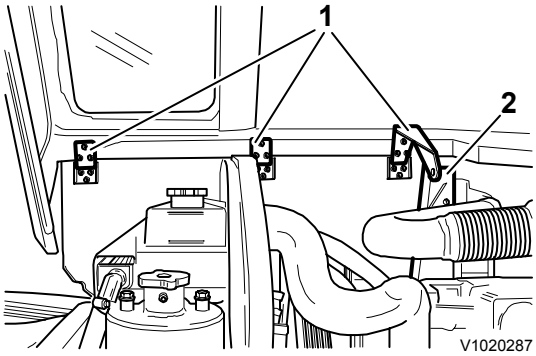


Fig. 2
1 Hinge
2 Gas spring

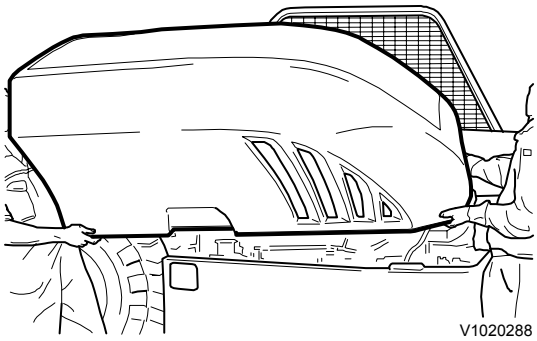


Fig. 3

3 Remove the engine hood.

WARNING!

If the battery's plus terminal is short-circuited to the minus terminal or to the chassis, there is a risk of explosion or fire. Therefore, always protect the battery terminals.

WARNING!

The battery electrolyte contains corrosive sulphuric acid. Electrolyte spilled on bare skin should be removed immediately. Wash the affected area with soap and plenty of water. If electrolyte gets into your eyes or any other sensitive body part, rinse immediately with plenty of water and seek immediate medical attention.

4 Open the battery hatch. Tag and disconnect the battery terminals, start with negative terminal to prevent sparks and short-circiuts. Remove the cable support from the hatch and remove the complete hatch including the battery from the machine.

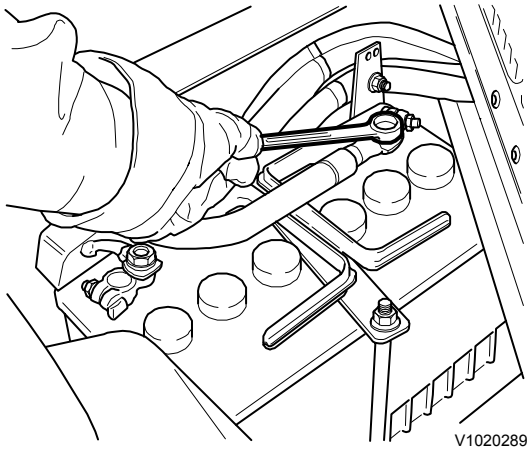


Fig. 4

5 Remove the rear dirt guard.

WARNING!

Hot oil and hot engine coolant can cause severe burns!

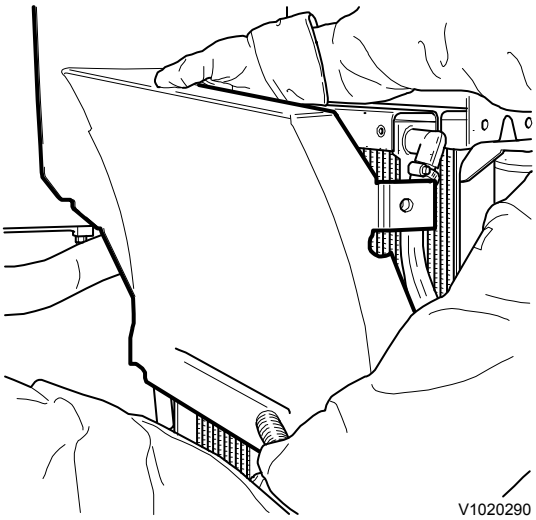


Fig. 5

6 Drain the oil from the hydraulic tank.

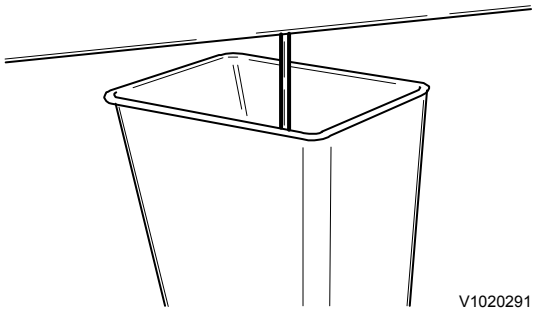


Fig. 6

7 Drain the coolant from the radiator.

WARNING!

Exhaust system components get very hot and can cause severe burns.

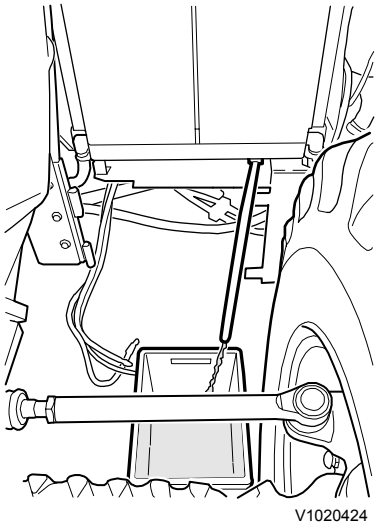


Fig. 7

8 Remove the exhaust pipe from the exhaust manifold.

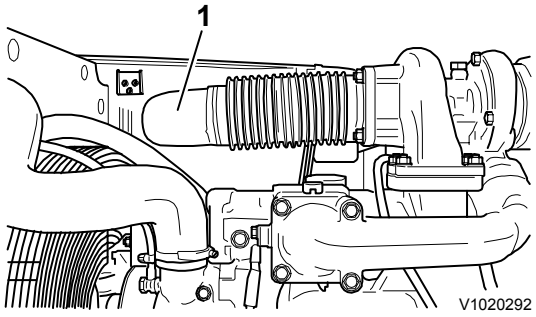


Fig. 8
1 Exhaust pipe

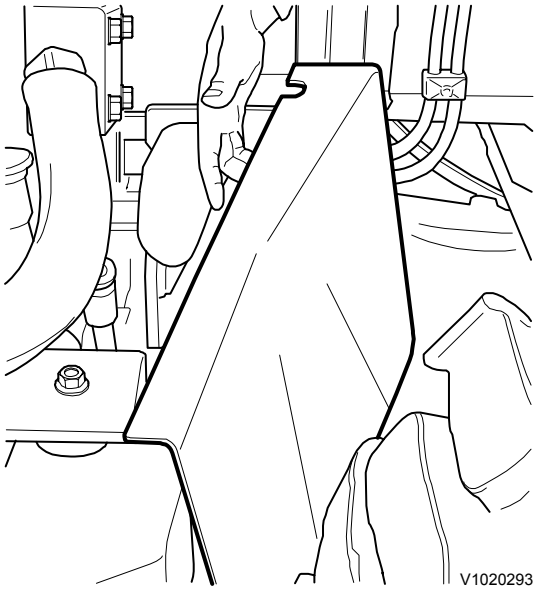


Fig. 9

9 Remove the front dirt guard.

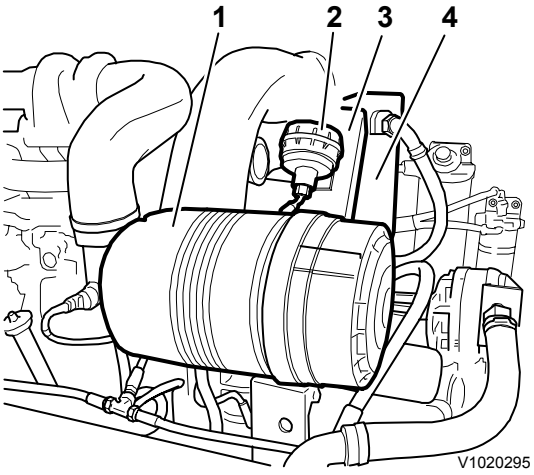


Fig. 10
1 Air cleaner
2 Breather
3 Filter bracket
4 Oil filter

10 Remove the air cleaner, the hydraulic tank breather and the remote engine lubrication filter from the filter bracket. Remove the filter bracket.

NOTE! Plug all tubes, hoses and connections while removing.

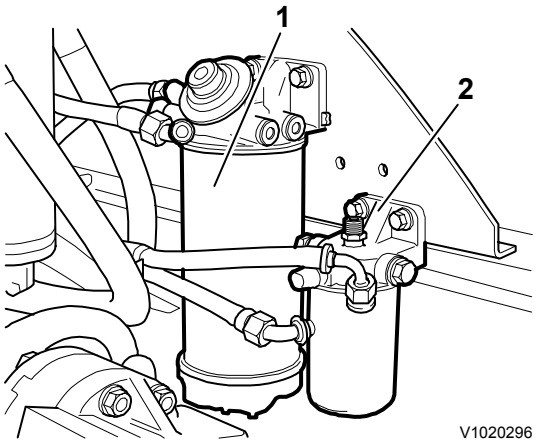


Fig. 11
1 Water separator
2 Fuel filter

11 Tag, remove and plug hoses for fuel filter and water separator.

WARNING!

Hot hydraulic oil and hydraulic oil under pressure may result in severe personal injuries

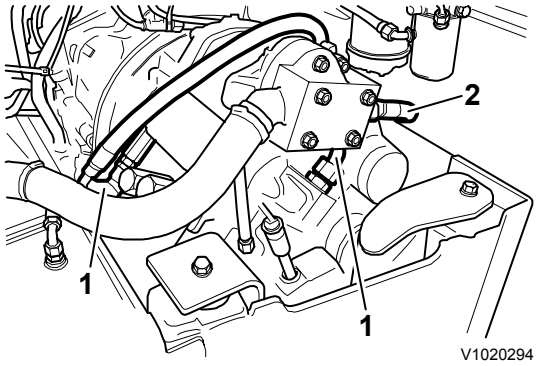


Fig. 12
1 Hoses to transmission
2 Hose from pump

12 Tag, remove and plug the hydraulic hose from the pumps pressure side.
Tag, remove and plug hoses from the transmission.
NOTE! Drain all the residual oil from hoses and coolers into a suitable container.

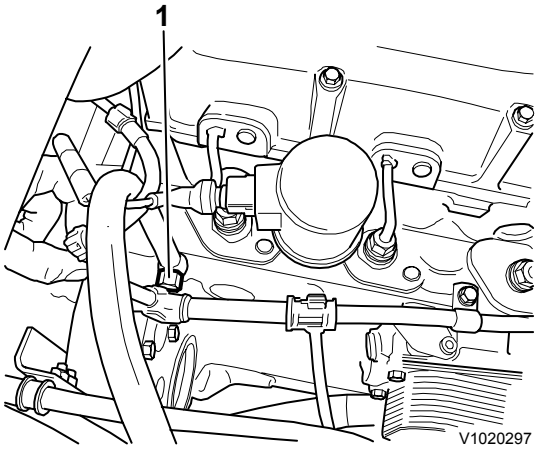


Fig. 13 View from above
1 Fuel return hose

13 Disconnect the fuel return line from the engine.

WARNING!

Risk of burn injuries! The oil may be hot.

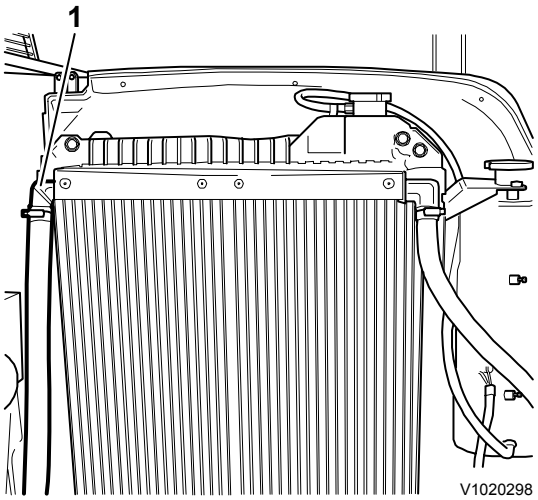


Fig. 14
1 Hose

14 Tag, remove and plug the upper left hydraulic hose from the oil cooler.

NOTE! Drain all the residual oil from hoses and coolers into a suitable container.

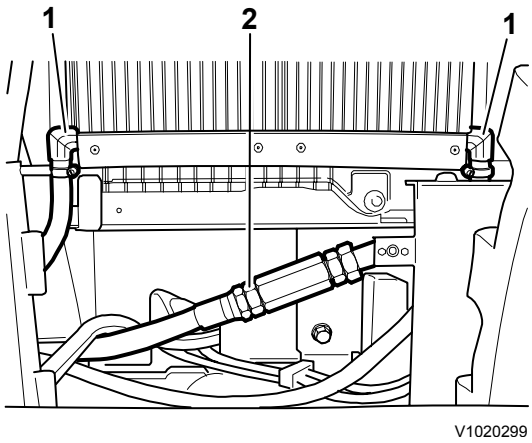


Fig. 15
1 Hose
2 Hose

15 Tag, remove and plug the two lower hydraulic hoses from the oil coolers. Disconnect and plug the hose beneath the oil coolers.

NOTE! Drain all the residual oil from hoses and coolers into a suitable container.

16 Remove the throttle cable.

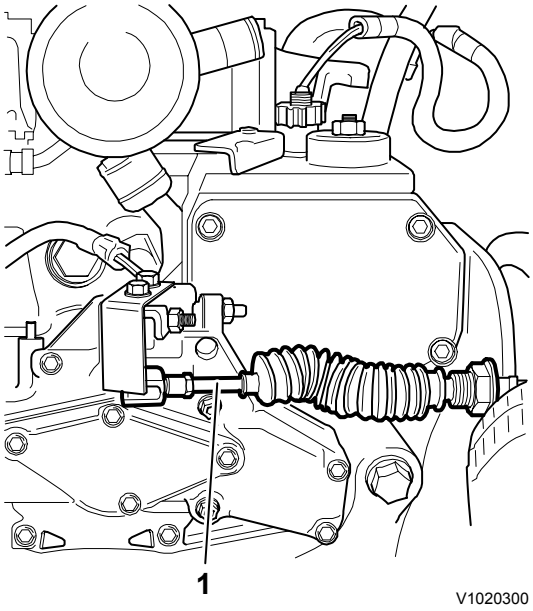


Fig. 16
1 Throttle cable

17 Tag, remove and plug the hydraulic hoses from the front inner side of hydraulic tank.
NOTE! Drain all the residual oil from hoses and coolers into a suitable container.

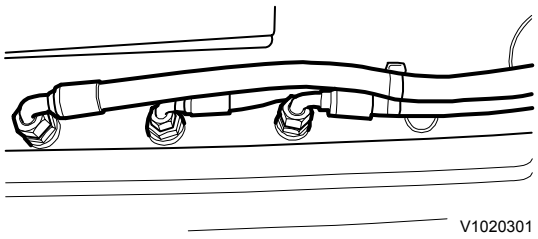


Fig. 17

18 Tag, remove and plug the hydraulic hose from the rear inner side of hydraulic tank.
NOTE! Drain all the residual oil from hoses and coolers into a suitable container.

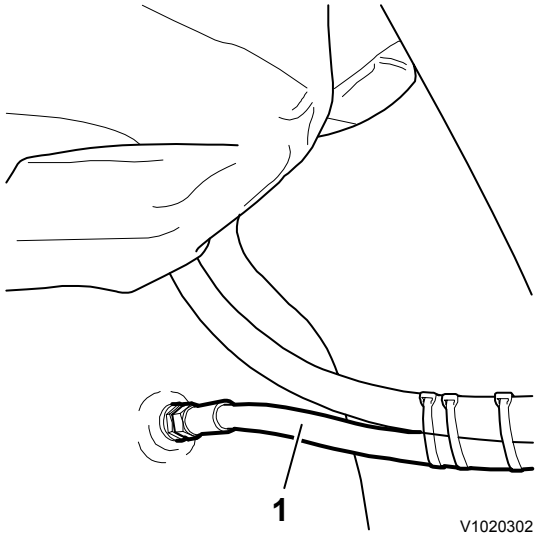


Fig. 18
1 Hose

Fig. 19

19 Disconnect the propeller shafts from the drop-box.

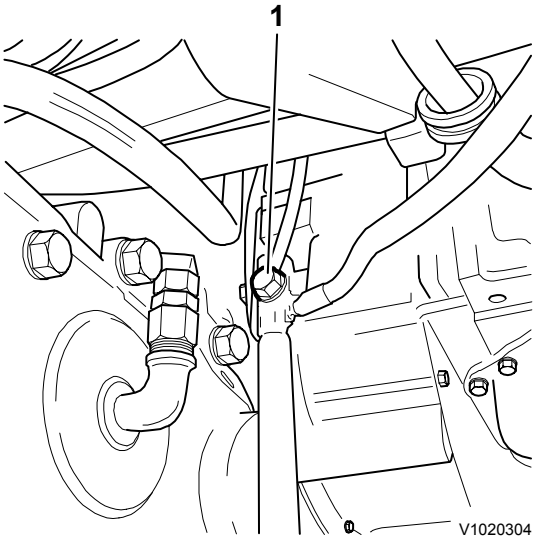


Fig. 20
1 Ground point

20 Disconnect the ground wires from the engine block.

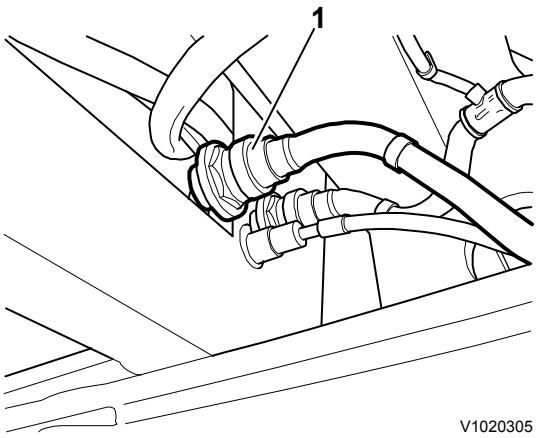


Fig. 21
1 Engine wiring harness

21 Disconnect the engine electrical harness CN1 from it's connecting point at the main frame.

NOTE! The weight of engine-transmission installation including radiator and hydraulic tank is **1000 kg (2200 lb)**.

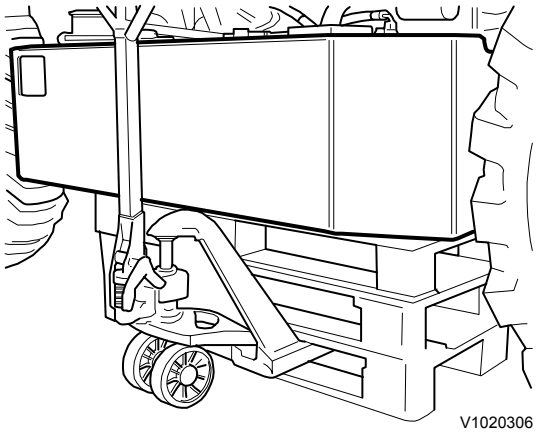


Fig. 22

22 Use EUR pallets on top of each other or similar as a sub-frame to put under the hydraulic tank assembly. Lift until the subframe slightly lifts the tank assembly.

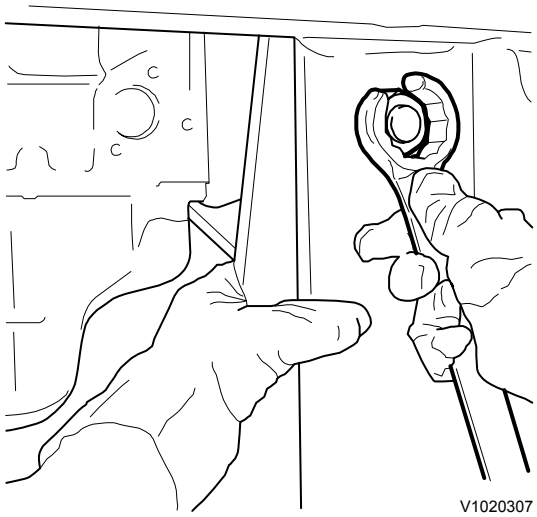


Fig. 23

23 Loosen the nuts holding the tank assembly to the main frame. Adjust the height so the bolt brackets come loose.

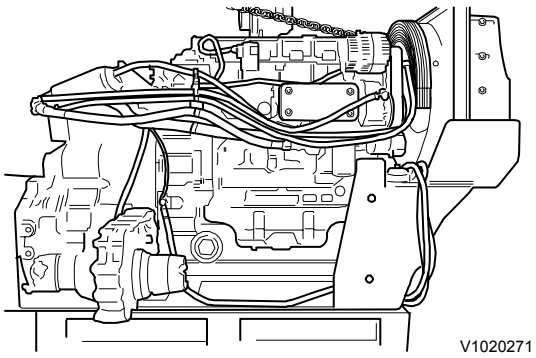


Fig. 24

24 Lift and pull out the hydraulic tank assembly.

Engine and transmission, removal from the hydraulic tank assembly

Op. no.

To be able to remove the engine and transmission from the hydraulic tank assembly, its necessary to perform the procedures shown in *Engine and transmission assembly, removal from main frame, page 5*.

WARNING!

Risk of injuries caused by crushing

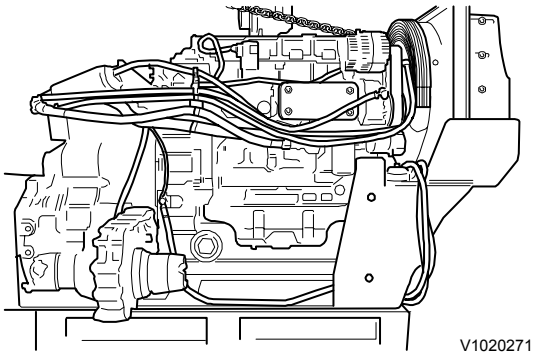


Fig. 25

1 Put the engine frame assembly on a level and solid surface.

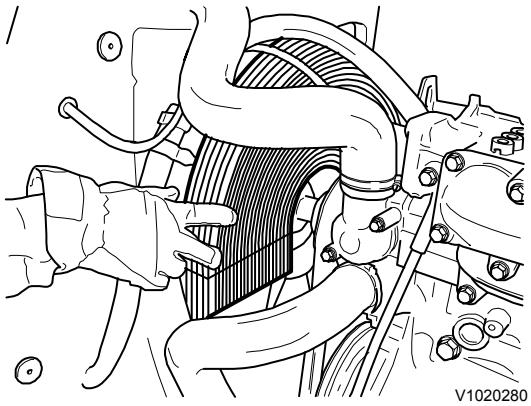


Fig. 26

2 Remove the radiator hoses and the fan blade guard.

3 Remove the suction hose between hydraulic tank and hydraulic pump.

4 **Only if the engine will be replaced:** tag and remove the engine wiring harness and all hoses connected to the engine. Plug all hose ends.

Engine and transmission removal, cont.

NOTE! Weight of the engine and transmission is approximately **710 kg (1565 lb)**

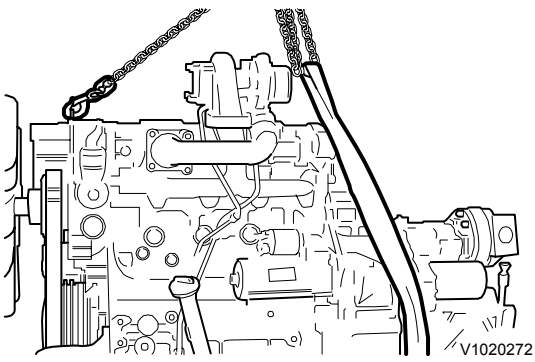


Fig. 27

5 Secure the engine and transmission with lift slings and a hoist device.

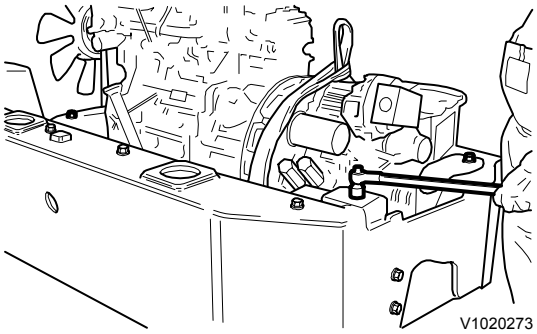


Fig. 28

6 Remove all slack in the lift equipment and remove the four engine mountings.

7 Lift the engine and transmission out of the hydraulic tank/ engine frame assembly.

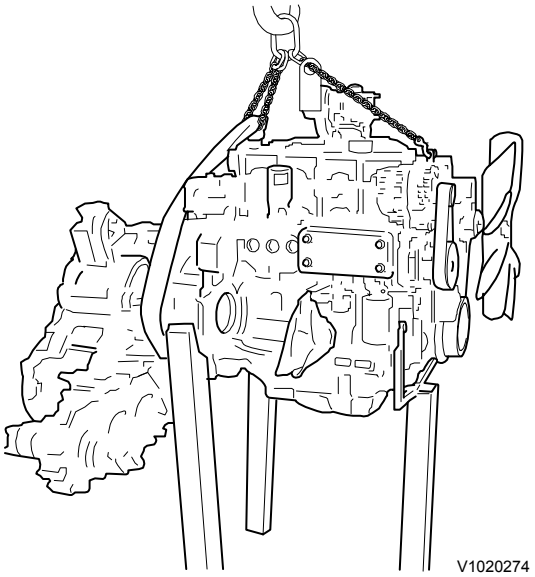


Fig. 29

8 Put the engine and transmission on a suitable and safe surface, for example stands.

Transmission removal from removed engine

Op. no. 42183

See *, page 15* for information how to remove the engine and transmission from the hydraulic tank/engine frame assembly.

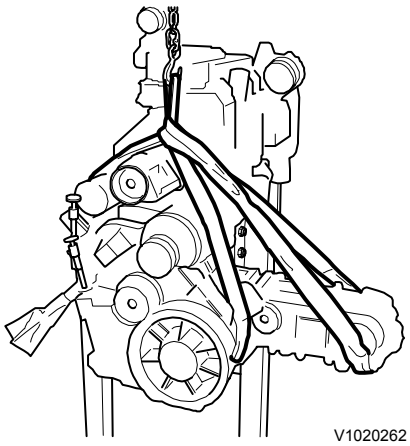


Fig. 30

1 Secure the transmission with at least 2 slings to keep it level while lifting.

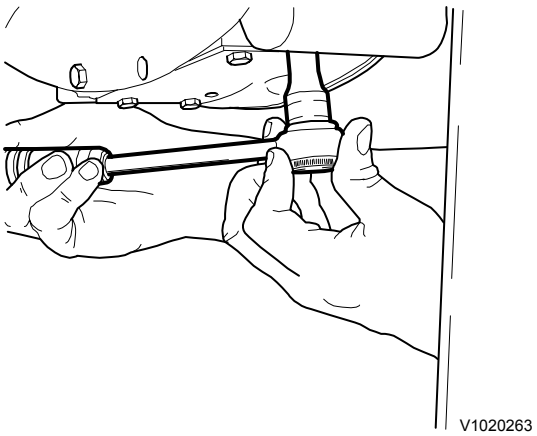


Fig. 31

2 Remove the cover at the bottom of the engine, close to the transmission housing.

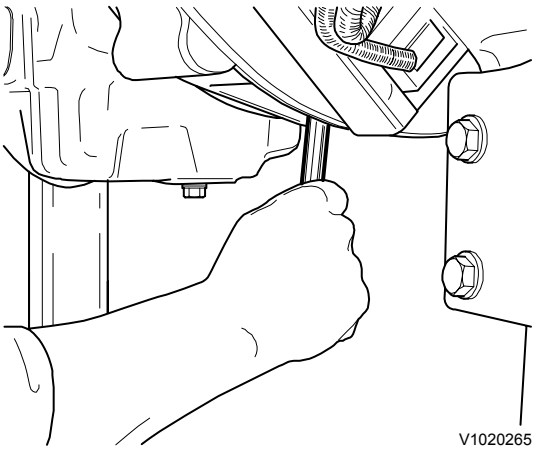


Fig. 32

3 Remove the bolts (8 pcs) that hold the flexplates to the flywheel. Use tool 999 86 76 to rotate the engine step by step.

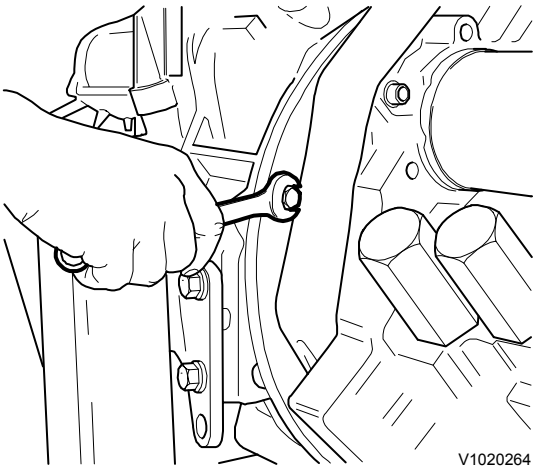


Fig. 33

4 Remove all slack in the lift slings and remove the bolts between the transmission housing and the engine block.

NOTE! Weight of transmission approximately **290 kg (640 lb)**.

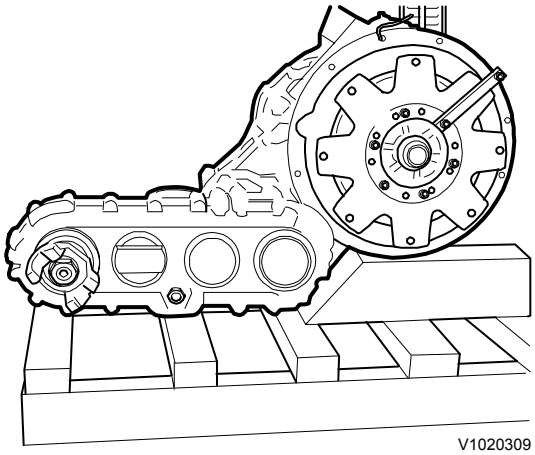


Fig. 34

5 Lift and place the transmission on a suitable surface.

6 **Only if the engine is to be replaced:** then all necessary hardware must be transferred to the replacement engine.
Such as:
- Electrical wiring harness
- Starter
- Radiator fan blade and hoses
- Fuel hoses
- Lubrication hoses for remote oil filter
- Engine mounting brackets

7 **Only if the transmission is to be replaced:** then all necessary hardware must be transferred to the replacement transmission.
Such as:
- Hydraulic pump
- Rear engine–transmission brackets

Transmission installation on removed engine

Op. no. 42184

NOTE! Make sure that the engine is securely supported on stands or on a solid work bench before attaching the transmission.

NOTE! Weight of transmission, approximately **290 kg (640 lb).**

1 Secure the transmission with at least 2 lift slings to keep it level while lifting. Lift the transmission and align it to the engine.

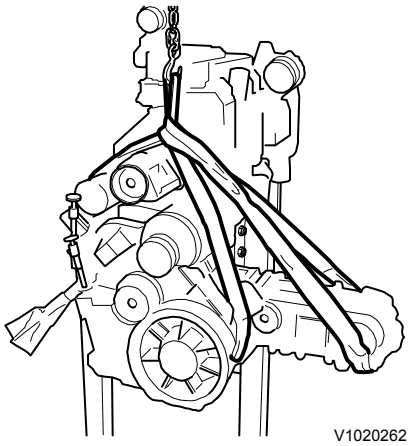


Fig. 35

2 Install the bolts that hold the transmission case to the engine block.
NOTE! Torque **75 Nm (55 lbf ft).**

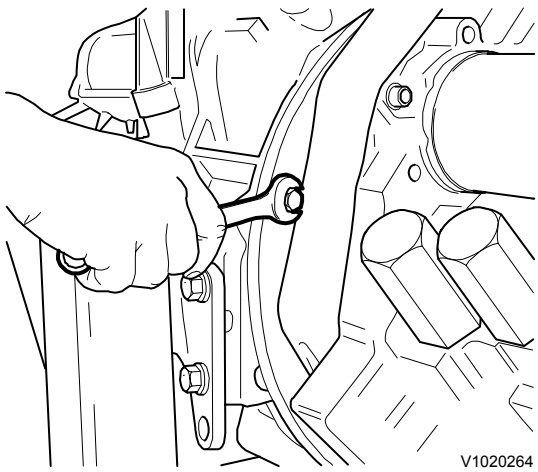


Fig. 36

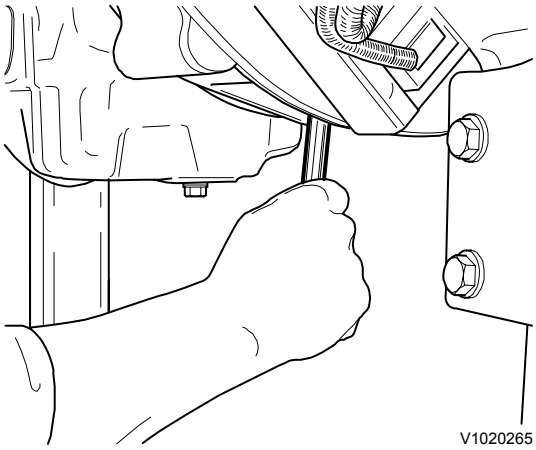


Fig. 37

3 Install the bolts (8 pcs) that hold the flexplates to the flywheel. Use Use tool 999 86 76 to rotate the engine step by step.

NOTE! Torque **35 Nm (26 lbf ft).**

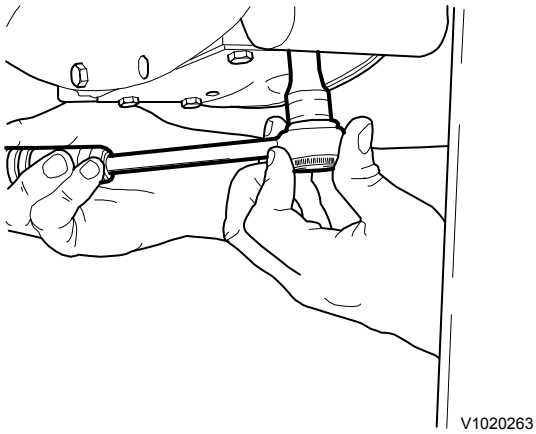


Fig. 38 V1020263

4 Install the cover at the bottom of the engine.

5 Remove the lift slings.

6 **Only if the engine has been replaced:** reinstall all removed hardware from the original engine.

Only if transmission has been replaced: reinstall all removed hardware from the original transmission.

Engine and transmission, installation to hydraulic tank/engine frame assembly

To perform this procedure see previous instructions in *Transmission installation on removed engine, page 18*

Op. no.

1 Secure the engine and transmission assembly with lift slings.

WARNING!

Risk of injuries caused by crushing

NOTE! Weight for engine and transmission case: approximately **710 kg (1565 lb).**

2 Install the rear engine–transmission mounting brackets.
NOTE! Torque for mounting brackets: **185 Nm (136 lbf ft).**

3 Install the hydraulic pump.
NOTE! Inspect the hydraulic pump gasket and replace if necessary.

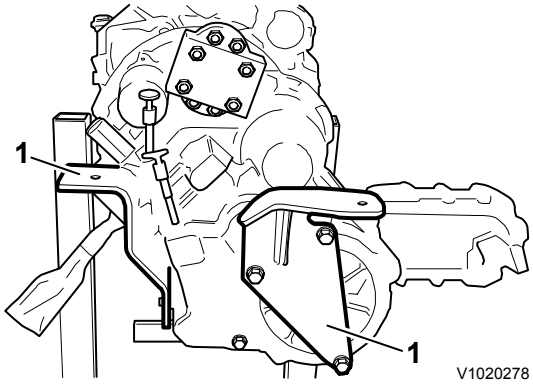


Fig. 39
1 Rear mounting

4 Install the front engine mounting brackets.
NOTE! Torque for mounting brackets: **185 Nm (136 lbf ft).**

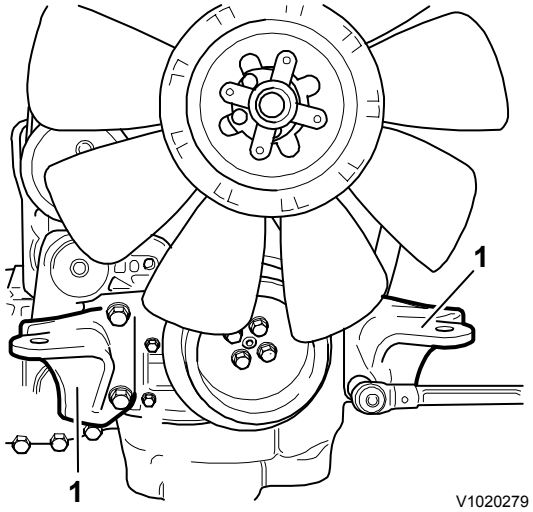


Fig. 40
1 Front mounting

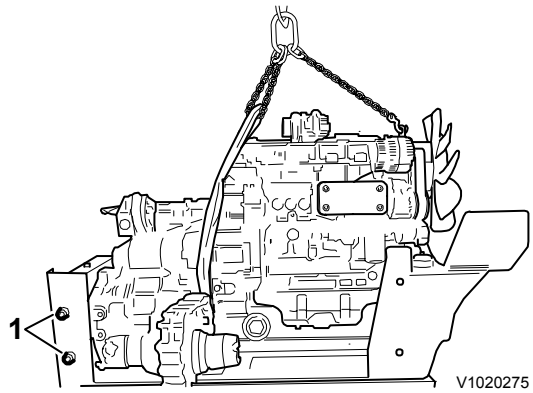


Fig. 41
1 Front end frame mounting bracket nuts

5 Install the front end frame mounting bracket from inside into the hydraulic tank and engine frame assembly, temporary secure the bracket with corresponding nuts. The bracket can not be installed afterwards.

6 Lift the engine and transmission assembly into the hydraulic tank and engine frame assembly.

NOTE! Inspect the rubber mounts before they are reinstalled. They must be in good condition and in the same thickness.

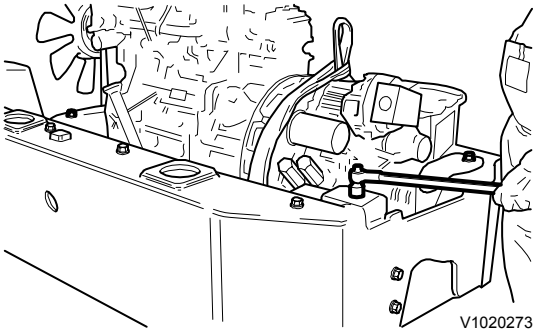


Fig. 42

7 Install the four engine mounting bolts. Tighten the front and rear bolts.
NOTE! Torque to **175 Nm (129 lbf ft).**

8 Remove the lift slings.

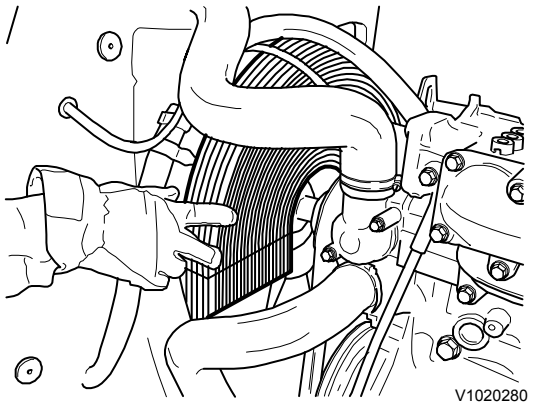


Fig. 43

9 Reinstall the radiator hoses and fan blade guard.

Engine and transmission assembly, installation to main frame

Op. no.

To be able to perform this procedure, first see instructions in *, page 20.*

NOTE! The weight of engine-transmission installation including radiator and hydraulic tank is **1000 kg (2200 lb)**.

WARNING!

Risk of injuries caused by crushing

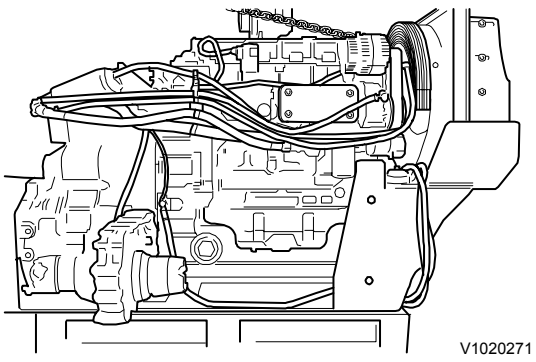


Fig. 44

1 Put the complete engine, transmission and hydraulic tank assembly on a level and stable subframe. For example EUR pallets or similar.

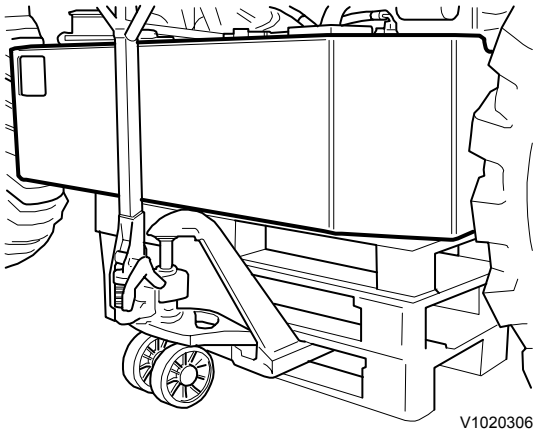


Fig. 45

2 Lift and push the complete assembly into it's position in the main frame. Adjust the height to install the hydraulic tank frame to the machine main frame.

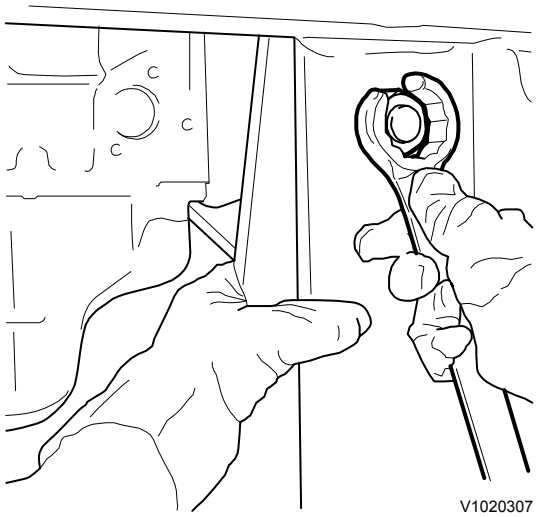


Fig. 46

3 Tighten the nuts from under the machine.
NOTE! Torque to:**1050 Nm (775 lbf ft).**

NOTE! Strap all wires and hydraulic hoses to prevent them from rubbing against any sharp edges!

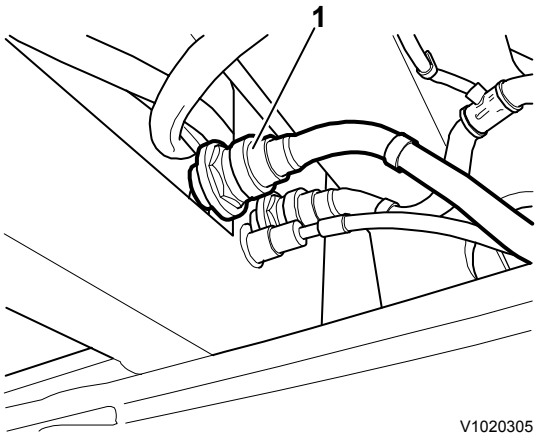


Fig. 47
1 Engine wiring harness

4 Connect the engine wiring harness CN1 to it's connecting point at the main frame.

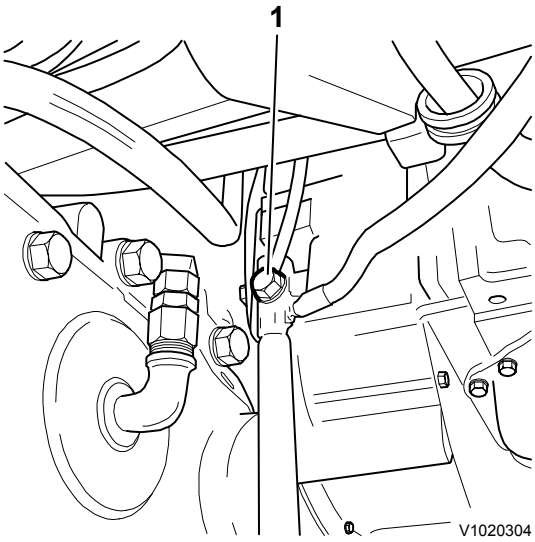


Fig. 48
1 Ground point

5 Connect the ground wires to the engine block.

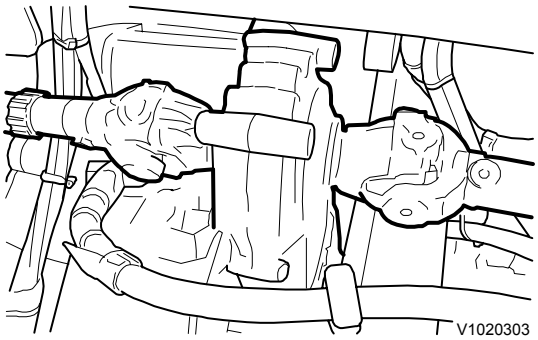


Fig. 49

6 Connect the propeller shafts to the drop-box.
NOTE! Always use new bolts according to MEC Parts.
NOTE! Torque to **71±10 Nm (52±7 lbf ft).**

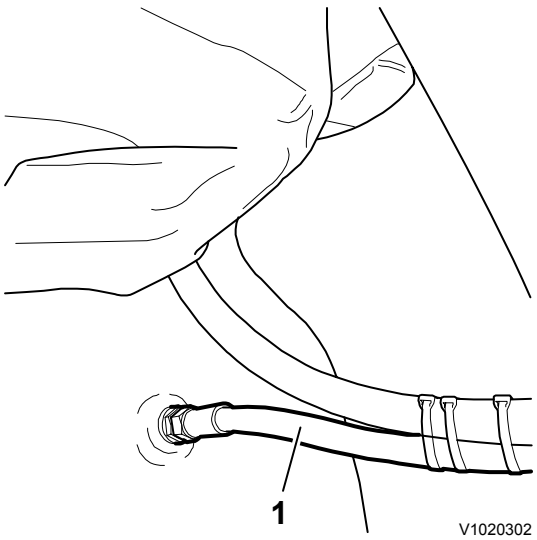


Fig. 50
1 Hose

7 Unplug and connect the hydraulic hose to the rear inner side of the hydraulic tank.

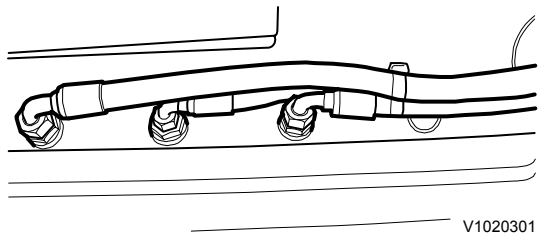


Fig. 51

8 Unplug and connect the hydraulic hoses to the front inner side of the hydraulic tank.

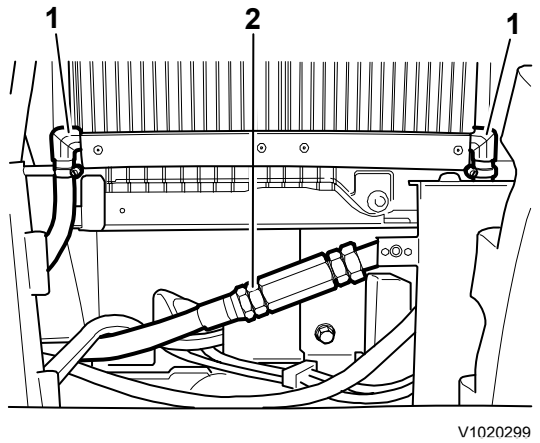


Fig. 52
1 Hose
2 Hose

9 Unplug and connect the two lower hydraulic hoses to the oil coolers. Connect the hose beneath the oil coolers.

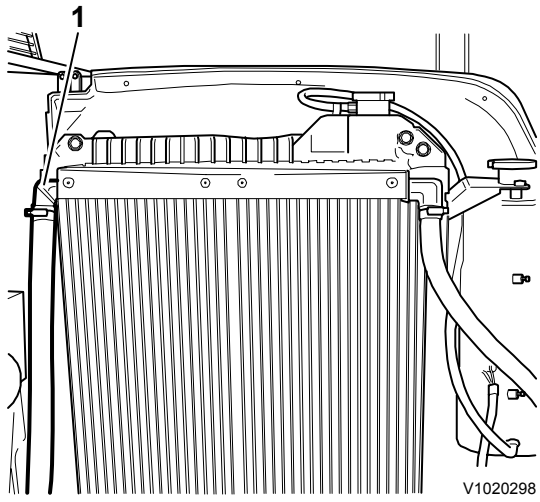


Fig. 53
1 Hose

10 Unplug and connect the upper left hydraulic hose to the oil cooler.

11 Connect the throttle cable.

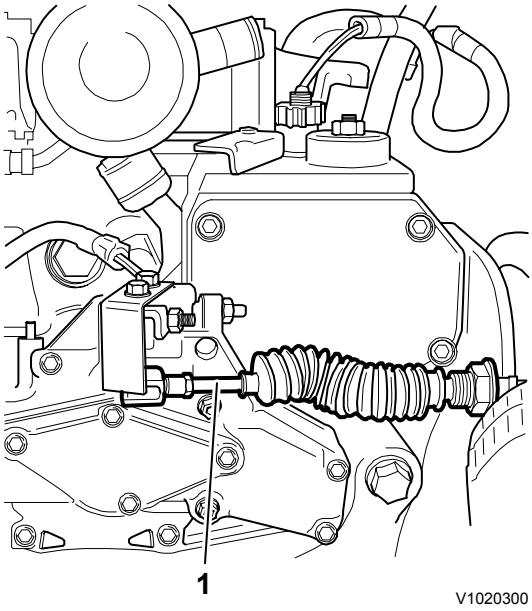


Fig. 54
1 Throttle cable

12 Connect the fuel return line to the engine.

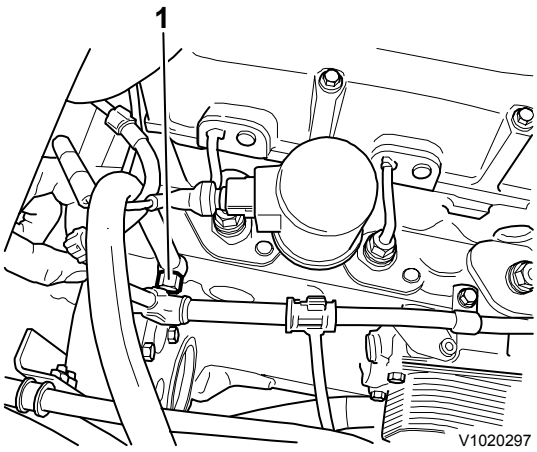


Fig. 55 View from above
1 Fuel return hose

13 Unplug and connect the hoses for fuel filter and water separator.

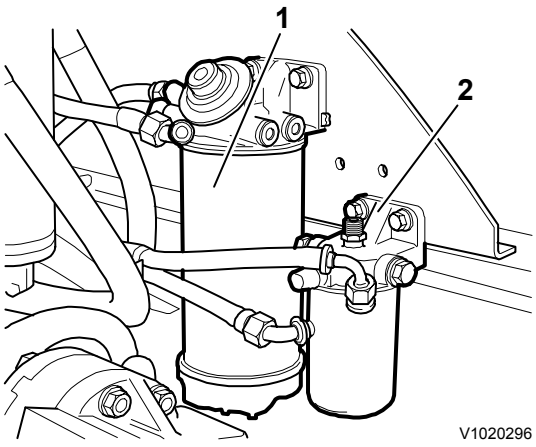


Fig. 56
1 Water separator
2 Fuel filter

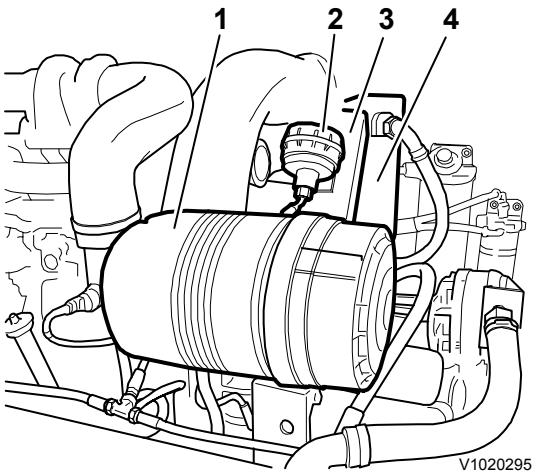


Fig. 57
1 Air cleaner
2 Breather
3 Filter bracket
4 Oil filter

14 Install the filter bracket. Install the remote engine lubrication filter, the hydraulic tank breather and the air cleaner.

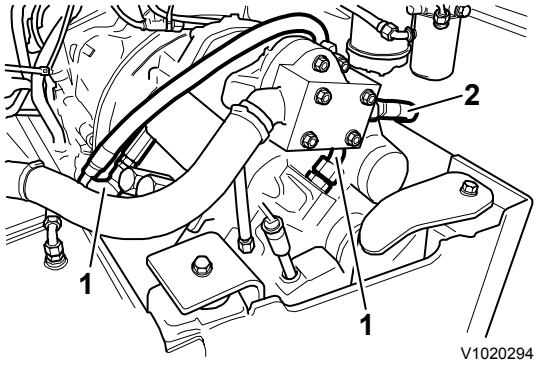


Fig. 58
1 Hoses to transmission
2 Hose from pump

15 Unplug the hoses and connect to the transmission casing and the pump pressure side.

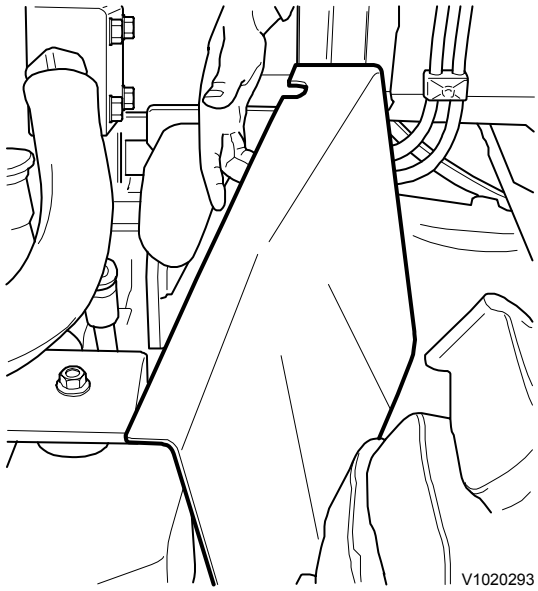


Fig. 59

16 Install the front dirt guard.

17 Make sure the drain plug is tightened and refill the hydraulic tank. See operators manual for instructions and *TH60/TH80 Recommended lubricants, oils* for specifications.

18 Make sure the drain plug is tightened and refill the radiator with coolant. See operators manual for instructions and specifications.

NOTE! Make sure the filler caps are reinstalled in their original positions. The cap for expansion tank is marked 50 kPa.

19 Inspect engine oil level. See operators manual for instructions and *TH60/TH80 Recommended lubricants, oils* for specifications.

20 Inspect transmission oil level. See operators manual for instructions and *TH60/TH90 Recommended lubricants, oils* for specifications.

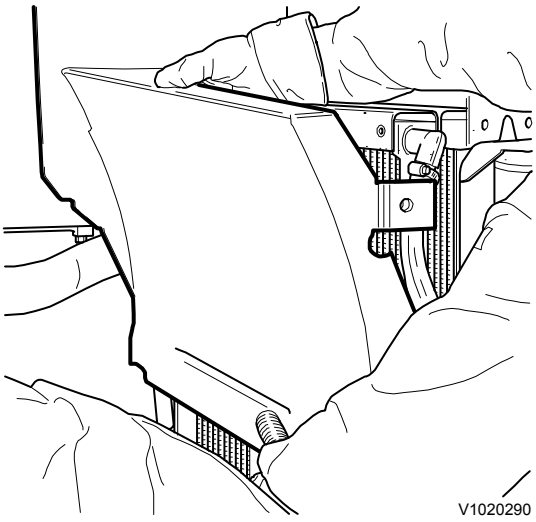


Fig. 60

21 Install the rear dirt guard.

WARNING!

If the battery's plus terminal is short-circuited to the minus terminal or to the chassis, there is a risk of explosion or fire. Therefore, always protect the battery terminals.

WARNING!

The battery electrolyte contains corrosive sulphuric acid. Electrolyte spilled on bare skin should be removed immediately. Wash the affected area with soap and plenty of water. If electrolyte gets into your eyes or any other sensitive body part, rinse immediately with plenty of water and seek immediate medical attention.

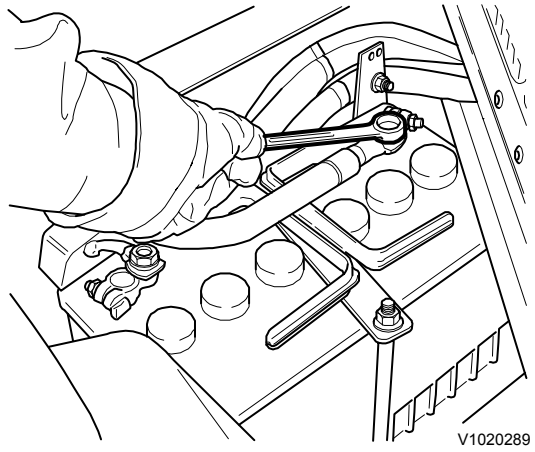


Fig. 61

22 Install the battery hatch and connect the battery terminals. Connect negative terminal as the last one.

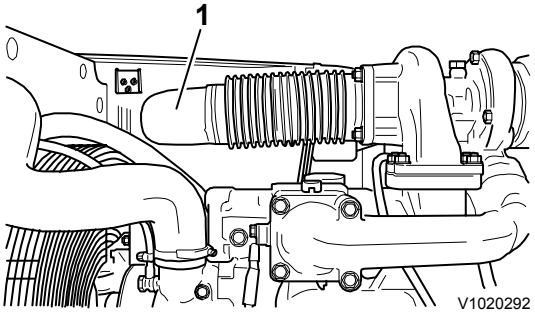


Fig. 62
1 Exhaust pipe

23 Install the exhaust pipe to the exhaust manifold. Make sure that the exhaust pipe is in a horizontal position and no stress is put to the flexible section.

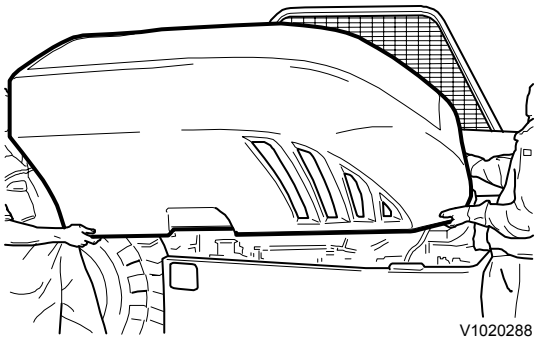


Fig. 63

24 Put the engine hood in place.

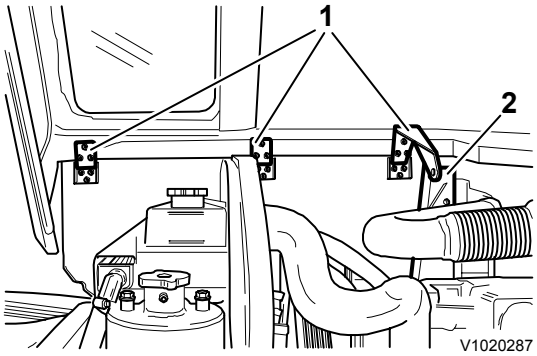


Fig. 64 V1020287
1 Hinges
2 Gas spring

25 Reinstall the hinges and connect the gas spring at it's upper ball joint.

26 Bleed the fuel system if required. See operators manual for instructions.

27 Start the engine and control all functions. Inspect for any liquid leakage. Run the engine till it's operating temperature. Turn off the engine and allow to cool down.

WARNING!

Open the radiator cap carefully if the engine is warm. High pressure in the radiator may cause hot coolant to jet out.

28 Inspect all fluid levels and refill if necessary. See operators manual for instructions.

211 Cylinder head

Cylinder, design structure

The D4D with a bore about 101 mm has a crankcase with integrated cylinder liners, i.e crankcase and liners form one casting.

Cylinder head, design structure

The cylinder heads of the D4D are made of grey cast iron and designed as block–type heads. The combustion air enters vertically and the exhaust air is discharged laterally. Inlet and outlet are located on one side of the cylinder head.

Determining cylinder head gasket

Op. no. 21102

Tools:
9998678 Measuring tool

Dial gauge

The thickness of the cylinder head gasket is responsible for the correct piston crown clearance of the engine. Piston crown clearance (0.65 mm) essentially influence the combustion and thus:

- Power
- Fuel consumption
- Exhaust emission

Measuring piston projection

A dial gauge with a fixture (measuring tool) is needed to measure the piston projection.

1 Install the dial gauge into measuring tool 999 86 78 and place on cylinder block with spacer washers.

NOTE! Put the spacer washers on the block and not on the liner edges.

2 Set the dial gauge in the level of the crankcase surface to zero.

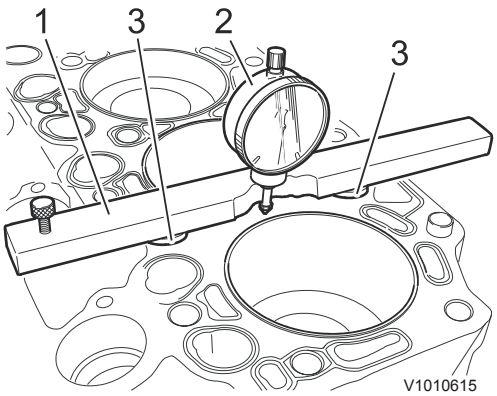


Fig. 66
1 999 86 78
2 Dial gauge
3 Spacer washers

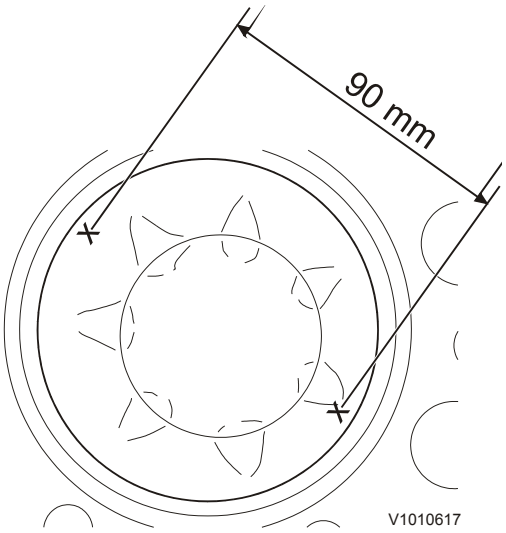


Fig. 67 Checking point area

3 Position the dial gauge within the checking point area. Turn the crankshaft to find the highest position of the piston. Read the height from the dial gauge, the checking points must be kept within the specified area.

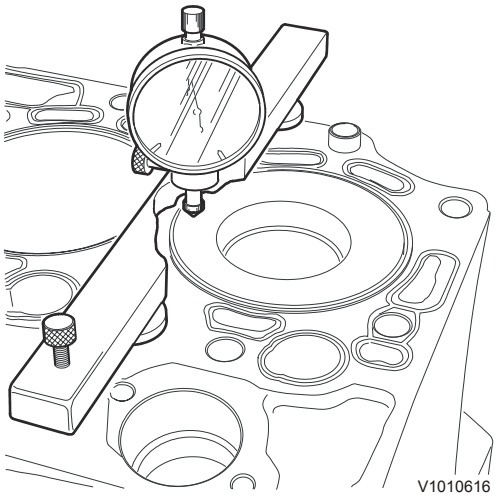


Fig. 68

4 Measure all pistons in the same way. Make a note of each value and use the highest piston projection value to determine the cylinder head gasket according to table.

Piston projection	Identification of cylinder head gasket
0.33 – 0.55 mm	1 hole
0.56 – 0.65 mm	2 holes
0.66 – 0.76 mm	3 holes

1 hole = 1.2 mm; 2 holes = 1.3 mm; 3 holes = 1.4 mm;

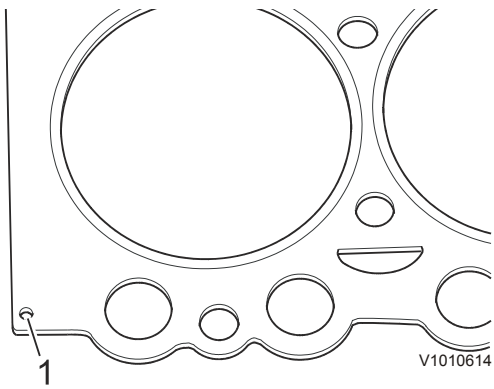


Fig. 69 Cylinder head gasket marking
1 Marking, number of holes

Cylinder head

Fitting cylinder head

Prior to fitting the cylinder head onto crankcase, the sealing surfaces for the cylinder head gasket must be clean and free from oil. Pay attention to dowel sleeves

Lightly oil the cylinder head bolts.

NOTE! It is absolutely necessary to observe the bolt tightening order in the adjacent schematic.

1st step:	30 Nm
2nd step:	80 Nm
3rd step:	90°

Tightening order

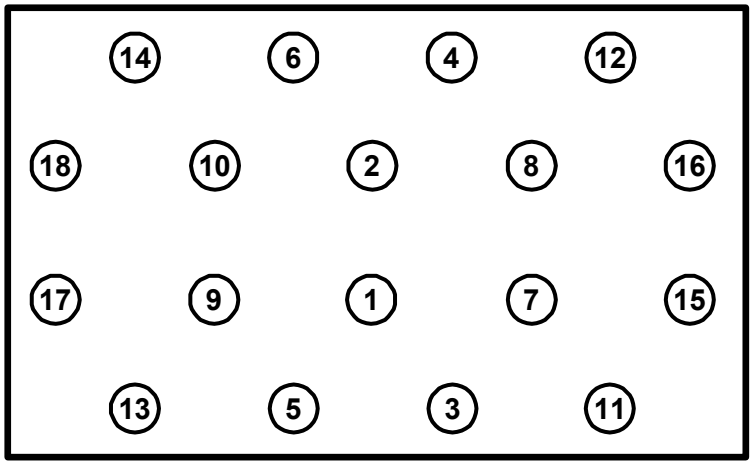


Fig. 70 Exhaust manifold side at upper end of figure.

214 Valve mechanism

Valves

The engine is provided with one inlet and one exhaust valve per cylinder. The valves guides are shrunk in the cylinder head. The valve seat inserts are also shrunk in the cylinder head.

The valves are turned by eccentric actuation through the rocker arms.

NOTE! The coloured mark on the spring must show to the bottom.

Rocker arm lubrication is integrated in the lube oil circuit. The oil is supplied via tappets and push–rods.

Valve clearance adjustment

The valve clearance must be checked and adjusted at specified intervals (see operation manual). To do this, the engine oil temperature must be 20–80 °C (68–176 °F).

Adjustment:

1 Remove the valve cover.
2 Turn crankshaft until both valves in cylinder 1 are overlapping. Overlapping means that the exhaust valve is about to close and the inlet valve is about to open.

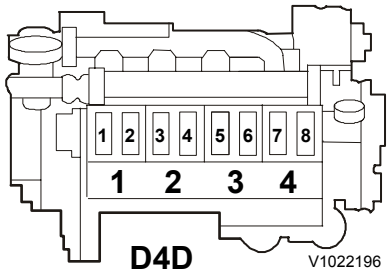


Fig. 71 Position of valves.
D4D: 1, 3, 5 and 7 are exhaust valves
D4D: 2, 4, 6 and 8 are inlet valves

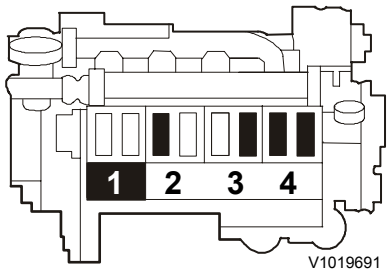


Fig. 72

3 Adjust clearance of valves marked in black in figure.
Inlet valve: **0.30 mm (0.0118 in)**
Outlet valve: **0.50 mm (0.0197 in)**
Mark respective rocker arm with chalk to show that adjustment has been done.
NOTE! The valve clearance should be increased by **0.1 mm (0.004 in)** when the cylinder head gasket has been replaced. Adjust to normal valve clearance after 50 hours of operation.

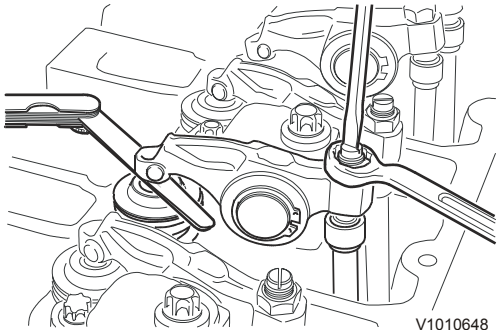


Fig. 73

4 Tighten the lock nut to **20 Nm (14.8 lbf ft)**. Check the adjustment again with a feeler gauge.

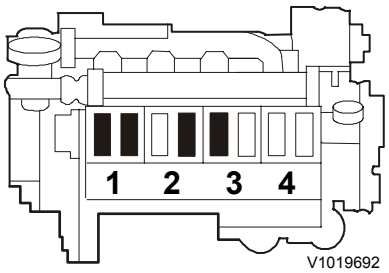


Fig. 74

5 Turn crankshaft one full revolution (360°). Now adjust clearance of valves marked black in figure.
6 Tighten the lock nut to **20 Nm (14.8 lbf ft)**. Check the adjustment again with a feeler gauge.
Reinstall the valve cover. Tighten the bolts to **11 Nm (8 lbf ft)**.

215 Engine transmission; camshaft

Camshaft

Camshaft

The camshaft is mounted on 5 bearings. The running surface of bearings and came are induction–hardened.

Each bearing runs in a bearing bush pressed into the crankcase. There is one inlet, exhaust and injection pump cam per cylinder. The axial stop for the camshaft is located in the timing chest cover.

216 Crank shaft; connecting rod; vibration damper; fly wheel

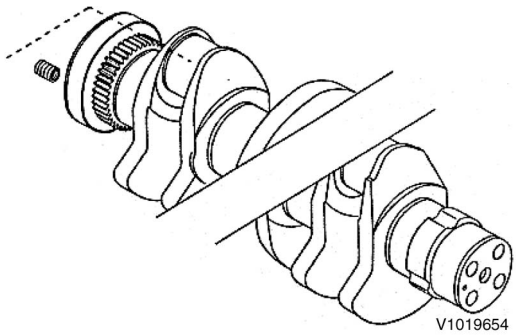


Fig. 75 V1019654

Crankshaft

The forged crankshaft of the D4D engine series is provided with integrated balance weights. The drive gear for the timing gears and the flywheel flange are shrunk on.

Connecting rod

The connecting rod of forged steel is fitted at the big end bearing bore with a balance weight in order to compensate the manufacturing tolerances with regard to weight and position of the centre of gravity.

Piston

The piston of the D4D CDE2 engine are made of special aluminium alloy. The piston bowl has a small amount of eccentricity to the piston axis. The piston must be so installed that the flywheel symbol on the piston top faces the flywheel.

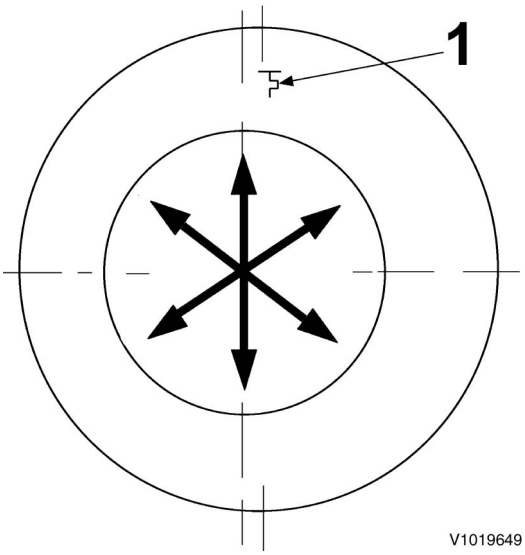


Fig. 76
1 Fly wheel symbol

Piston cooling

The piston is cooled by spraying lube oil against the inside of the piston top. The 2–hole piston cooling nozzles made of plastic are fitted in the main bearing pedestals.

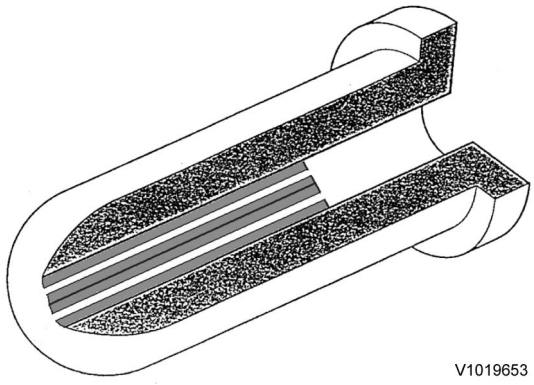


Fig. 77 V1019653

22 LUBRICATING SYSTEM

220 General, common info about 221 - 224

Lubrication system, description

The lube oil is supplied by the lube oil pump trough the oil cooler to the oil filter. Both components are mounted to the lube oil cooler housing which is flanged to the crankcase. Downstream of the filter the lube oil flows into the main gallery and secondary gallery. From here the oil is ducted to the lubrication points.

The main oil gallery supplies:

- Crankshaft
- Camshaft
- Valve tappets
- Roller tappets

The secondary oil gallery supplies:

- Exhaust turbocharger

Lubrication and oil system

Lubrication general description

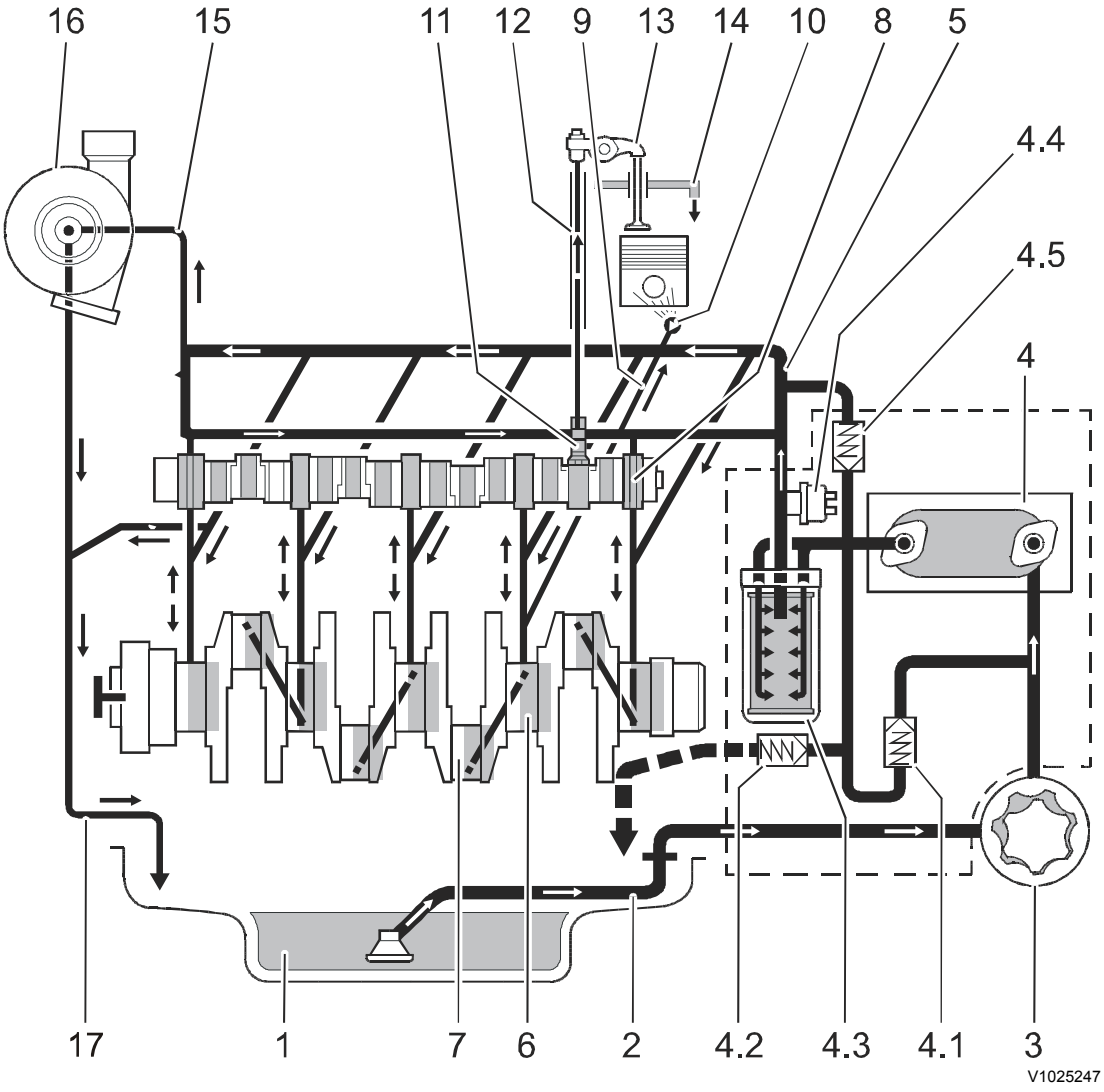


Fig. 78 Lubrication oil circuit

1	Oil sump	7	Crankshaft big–end bearing
2	Intake line	8	Camshaft bearing
3	Lubricating oil pump	9	Line to piston cooling spray nozzle
4	Lubricating oil cooler	10	Piston cooling spray nozzle
4.1	Heat exchanger bypass valve	11	Valve lifter with rocker arm shot lubrication
4.2	Relief valve	12	Pushrod, oil supply for rocker arm lubrication
4.3	Lube oil replacement filter	13	Rocker arm
4.4	Oil pressure sensor	14	Return line to oil sump
4.5	Oil filter control valve (inside filter)	15	Oil line to turbocharger
5	Main oil pipe	16	Turbocharger
6	Crankshaft main bearing	17	Oil line from turbocharger

Wiring diagram, lube oil circuit

Item	Description	Remark
1	Lube oil pump	
2	Oil cooler	
3	Bypass valve oil cooler	Opening pressure: p = 2.1 ±0.35 bar
4	Oil filter	With bypass valve (5)
5	Bypass valve oil filter	Opening pressure: p = 2.5 ±0.5 bar
6	Pressure regulating valve	Opening pressure: p = 4.0 ±0.4 bar
7	Exhaust turbocharger	

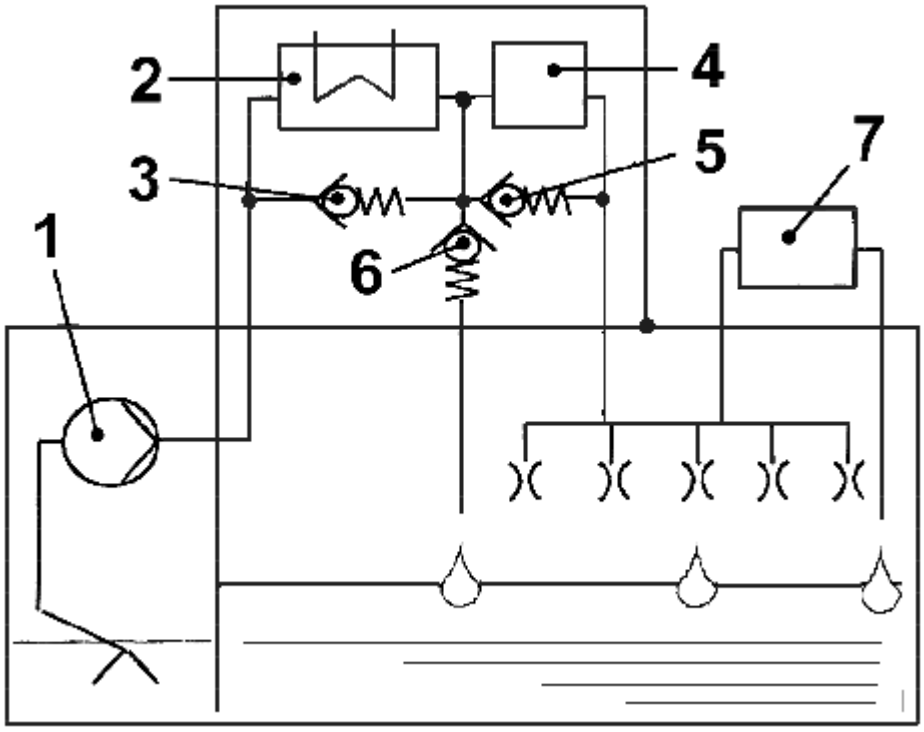


Fig. 79 V1019700

23 FUEL SYSTEM

230 General (common info about 233 - 238)

Fuel system, general

The D4D engine operate according to the direct injection principle. The piston bowl has a small amount of eccentricity to the piston axis. The fuel is injected via single injection pumps. The maximum pressure reaches up to **1350 bar (19580 PSI).**

- 6– hole nozzles
- Compression 19 : 1
- Max. injection pressure 1350 bar (19580 PSI)

Fuel system design structure

Fuel system

The fuel is delivered by the fuel feed pump (3) from tank (1) via the filter (5) to the supply duct of the single injection pumps integrated in the crankcase.
From the single injection pumps the fuel is supplied through the injection lines (8) to the injectors (9). At the end of the supply duct is fitted the pressure holding valve (10), **5 bar (72 PSI)**

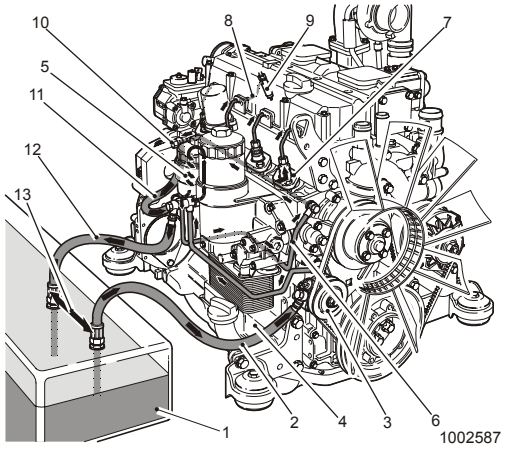


Fig. 80 V1019532 General fuel system circuit
Some parts might look different or have another location.

1	Fuel tank	8	Delivery pipe to injector
2	Line to fuel feed pump	9	Injector
3	Fuel feed pump	10	Banjo bolt with pressure maintenance valve
4	Line to fuel filter	11	Leak–off fuel line
5	Fuel filter	12	Return line to fuel tank
6	Line to injection pumps	13	Maintain maximum possible distance
7	Injection pump		

Fuel filter

Fuel filters must be replaced according to instructions in the operators manual. The filters must also be changed whenever there is excessive water in the fuel system or when the engine shows noticeable and sudden loss in power.

Draining water from the fuel water separator

The presence of water in fuel will cause the engine to run rough and to smoke excessively. If the water is not drained, it may cause engine damage. The main fuel filter incorporates a fuel/water separator. Drain this daily if water contamination is suspected. If water contamination is not suspected, its good practice to drain the fuel/water separator weekly, as condensation inside the tank will cause some water to be present.

233 Fuel pump; filter; strainer

Fuel feed pump

The fuel feed pump is designed as a rotary pump which is driven via the Poly–V–belt.
The pump is provided with a two–way valve.
The over pressure relief valve (1) is designed as a plunger valve and opens at **5.5 bar (80 PSI)**. This valve simultaneously limits the system pressure to **9.5 bar (138 PSI)**.
The bypass valve (2) is a ball valve. When the fuel lines have run empty, the fuel system can be primed with a hand pump. This prevents an excessive engine starting procedure. (Starter protection).

NOTE! Do not reduce the line cross section and connection to fuel feed pump, as this may results in engine power loss.

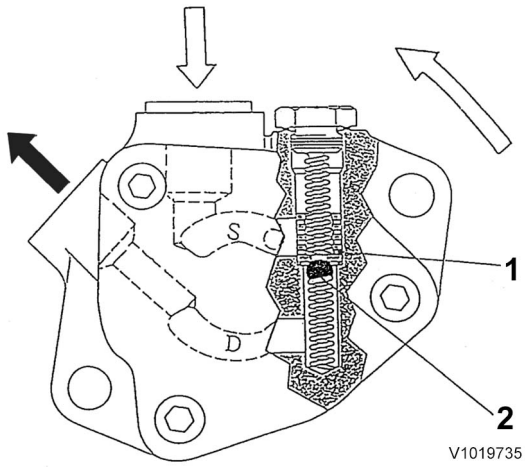


Fig. 81 V1019735
1 Over pressure relief valve
2 Bypass valve

236 Injection pump; regulator; pump companion

Injection system

The engine is provided with single injection pumps.

Commencement of delivery

The setting of the commencement of delivery (COD) influence:

- Fuel consumption
- Power
- Exhaust emissions of the engine

The commencement of delivery is set without tolerance. It is indicated in C/A degrees BTDC of the piston (see nameplate) and is dependent on application, power and speed setting respectively optimization of the engine.

237 Injector; delivery pipe

Governor

The governor is mechanical variable–speed governor with centrifugal measuring element.

NOTE! All governor settings may only be conducted by trained specialists.

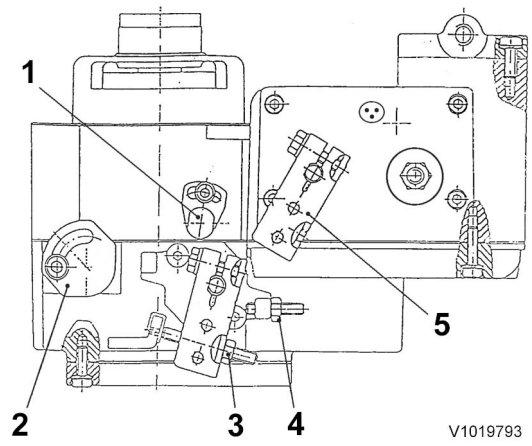


Fig. 82 V1019793

1 Beginning of torque cont
2 Speed droop
3 Low idling
4 High idling
5 Stop lever

Governor, external view

Injector

Injection nozzle

The injection nozzles have a replacement interval at **3000** operating hours.

25 INLET SYSTEM; EXHAUST SYSTEM

250 General, common info about 251 - 258

Engine, air intake filter

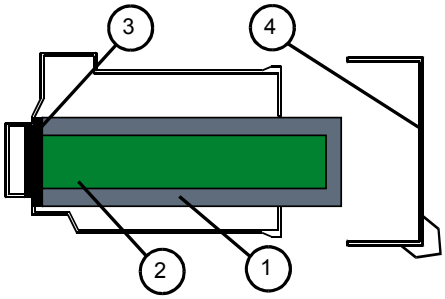


Fig. 83 V1014927
General description of air cleaner

1 Primary element
2 Secondary element
3 Inlet tube
4 Housing cover

The air cleaner prevents dust and other impurities from entering the engine. The air passes through the primary filter and then through the secondary filter.
See operators manual for maintenance.

26 COOLING SYSTEM

260 General, common info about 261 - 269

Cooling system

Cooling system, general description

The cooling circuits of the D4D engine are closed (forced circulation cooling), continuous–flow cooling is not permitted.

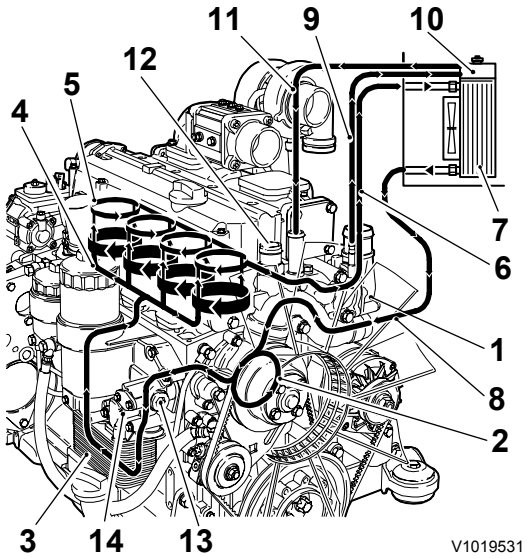


Fig. 84 V1019531 General cooling system circuit

1	Thermostat housing	8	Line from radiator to engine
2	Coolant pump	9	Ventilation line from cylinder head to expansion tank
3	Lubrication oil cooler	10	Expansion tank
4	Cylinder cooling	11	Line from expansion tank to engine
5	Cylinder head cooling	12	Coolant return from heater
6	Line from engine to radiator	13	Coolant supply to heater (V–belt version, M 26x1.5)
7	Radiator	14	Coolant supply to heater (Poly v–belt version, M 18x1.5)

Draining cooling system

Draining

For draining the cooling system undo screw at the Left hand side of the crankcase and catch coolant in a suitable container and dispose of. There after tighten screw again.

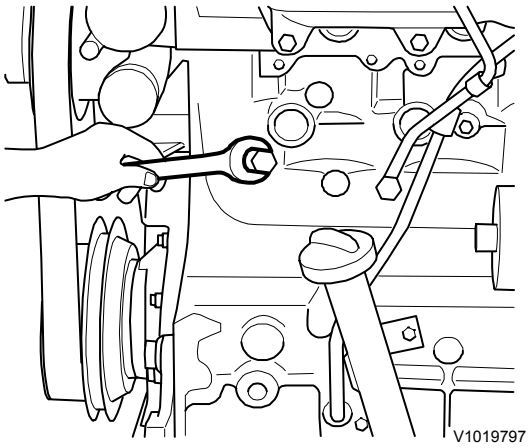
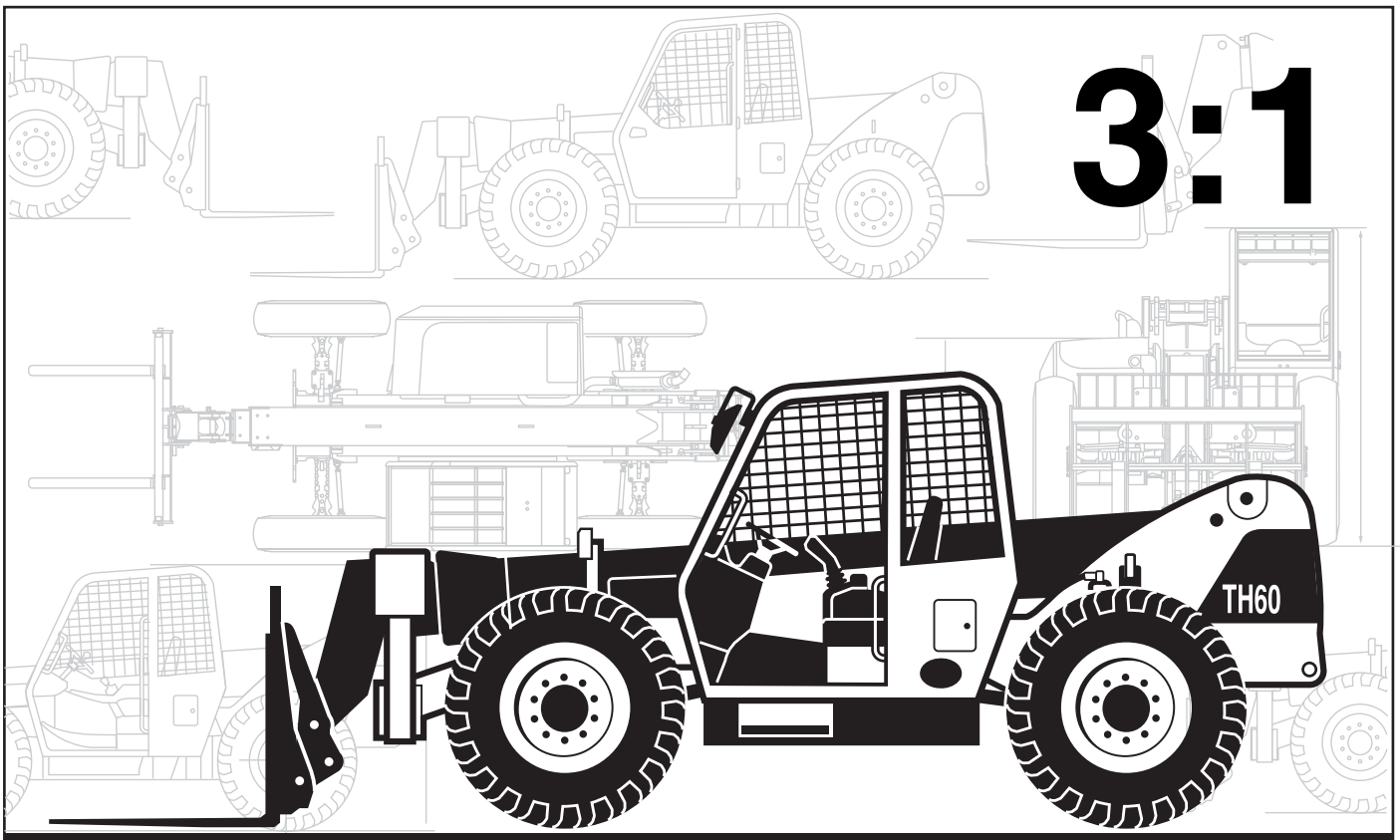


Fig. 85 V1019797

3:1



Electrical and Information System, Description

PRELIMINARY DOCUMENT

Contents

ELEC. SYSTEM; WARNING SYSTEM; INFORMATION SYSTEM; INSTRUMENTS

30 GENERAL

300 Comprehensive info, electrical system

Electrical system, special instructions for servicing, general

WARNING!

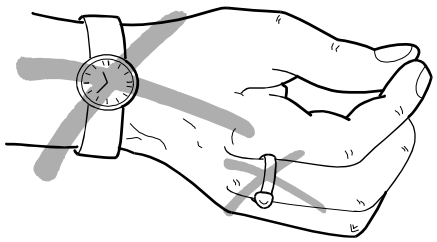
No changes may be made to the electrical system without prior approval from MEC. Changes may affect machine functions and can result in risks for personal injury or machine damage.

WARNING!

Carelessness when working with the electrical system may result in risks of serious personal injuries as well as machine damage.
When working on the electrical system, the following instructions as well as instructions in respective section must be followed carefully.

WARNING!

Always remove watches, rings, bracelets and other metallic objects from the body before starting to work on the electrical system.



A1520400

Fig. 1

WARNING!

Never boost-start the machine by connecting directly to the starter motor. This may result in uncontrolled machine movements. When using another machine to boost-start, it must not touch the machine that is being started.

IMPORTANT! Incorrect connection may result in permanent damage to electrical/electronic components. Always ensure use of correct connection point and polarity.
Never test if a cable/connection is supplied with electric power by producing "sparks". This may permanently damage electrical/electronic components.

Electrical system, special instructions for servicing, electrical components, batteries

WARNING!

During rapid charging of batteries, always remove the cell caps. During charging, an explosive mixture of oxygen and hydrogen is formed. A short-circuit, open flame or spark near the battery can cause a powerful explosion. Always turn off the charging current before disconnecting the charging clamps. Ventilate well, especially if the battery is being charged in a confined area.
The battery electrolyte contains corrosive sulphuric acid. Remove spilled electrolyte from the skin immediately. Wash with soap and plenty of water. If electrolyte has splashed into the eyes or on any other sensitive body part, rinse immediately with plenty of water and contact a physician immediately.

WARNING!

The batteries could explode due to the current surge if a fully charged battery is connected to a completely discharged battery. Since the batteries contain sulphuric acid, this could result in personal injuries.

WARNING!

Never charge a frozen battery. Explosion hazard!

- Never turn off the main electric power or disconnect the battery cables when the engine is running.
- The battery's minus connection must always be disconnected before removing or installing components and connections in the electrical system.
- Fully charged and otherwise fully functional batteries shall be used when checking or testing in the electrical system. If the batteries are not fully charged, they shall be charged or replaced.
- During battery charging, the cable connections shall always be removed from the battery.
- When replacing batteries connected in series, these shall have the same capacity (for example, 170 Ah). The batteries should be of the same age (equivalent).
  The reason for this is that the charging current needed to charge the battery to a certain voltage changes with the age of the battery.
- Only batteries may used for assisted (auxiliary) starts. Starter units and/or batteries connected in series may cause excessive voltage and may seriously damage electrical components.

Electrical system, special instructions for servicing, electrical components, alternator and charging regulator

- Before any alternator or regulator tests are performed, the batteries and electrical cabling must be checked for insulation, loose connections and corrosion. Check the alternator belts. All defects according to the above must be corrected before starting any electrical testing.
- Check the alternator belt and, if needed, make any necessary adjustments/repairs before troubleshooting. At correct belt tension, the belt should "give" when pressure is applied to it.

  IMPORTANT! Always connect cabling in a safe manner and make sure that cables are free from rust/dirt. A disconnected cable may cause damage to both alternator and charging regulator.

  IMPORTANT! Never disconnect the alternator connections when the engine is running. This may damage both alternator and charging regulator.

  IMPORTANT! Make sure that the alternator plus connection is **not** connected to the frame. This will damage the alternator, and may also damage the regulator.

Electrical system, special instructions for servicing, actions when working on machine

1. For electric welding on the machine, the battery cables must be disconnected and the connectors must be unplugged from the control units.
   NOTE! See instructions for electric welding in *MC60/70, 191, Safety during electric welding*.
2. During blasting work on the machine, work very carefully to prevent damage to electrical cabling and components.
3. Never aim the jet directly at electrical components when using a high-pressure washer.
   This is especially important when using a combination of warm water and degreaser agent.
4. Before drilling or making any holes, pin-point the exact position of any electrical components in the area.
   IMPORTANT! Drilling and other modifications to the cab structure are forbidden! The reason is that the ROPS protection may not function as intended if the cab structure is modified.

Grounding points (chassis ground)

The machine's grounding points are very important parts of the electrical system, as all sub-systems' voltage levels are referred to the machine's grounding points as 0 volt. If there's contact problem at a grounding point/chassis ground, it will have a negative effect on the electrical system.

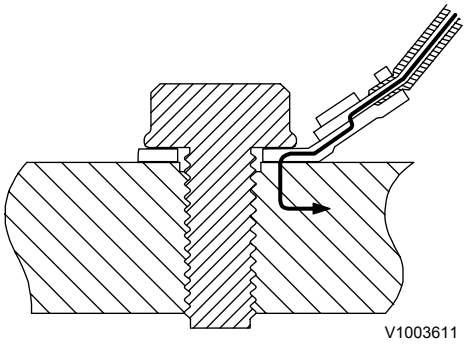


Fig. 3 Example of bolted joint as grounding point

Several cables are often interconnected at the same grounding point, which means that several functions and systems can be affected by the quality of the grounding point.

It's very important that the electrical connection at a grounding point is correct, that is:

- there is no paint or dirt on the contact surface between the cable terminal and grounding point/chassis ground.
- there is no corrosion on the contact surface between the cable terminal and grounding point.
- bolts and nuts are securely tightened.

Unprotected grounding points should always be provided with corrosion protection.

A defect at a grounding point can have effects in systems and functions that at first glance don't appear to have anything to do with that grounding point. This malfunctions can be very difficult to find.

Auxiliary start

WARNING!

Never boost-start the machine by connecting directly to the starter motor. This may result in uncontrolled machine movements. When using another machine to boost-start, it must not touch the machine that is being started.

Auxiliary start with start cables

Check the following before connecting;

– That the ignition is OFF in **both** machines
– That the machine cannot start to move when started
– That the machines have the same system voltage
– That the start cables are dimensioned for the max. current rating that the battery can generate
– Start cables, with regards to cracks, oxidation and other defects
– That battery cables are intact and connections are connected securely
– That the machines do not touch each other

WARNING!

When using start cables, the positive and negative connection must not come into contact. Risk of personal injury.

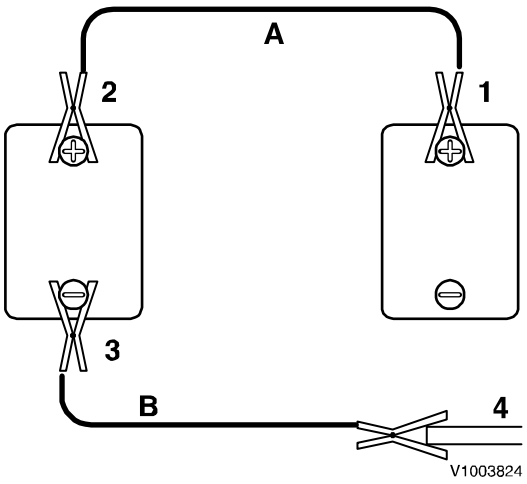


Fig. 4 Connecting start cables

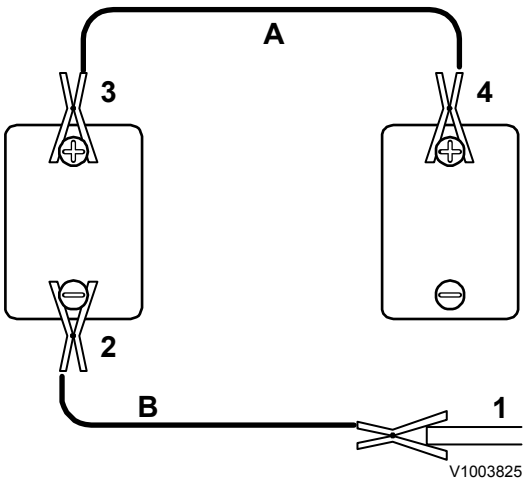


Fig. 5 Removing start cables

Connect start cables as follows:

- Connect the first start cable (A) to the battery's plus terminal (1) on the machine to be started
- Connect the other end of the cable (A) to the battery's plus terminal (2) on the assisting machine
- Connect the other start cable (B) to the battery's minus terminal (3) on the assisting machine
- Connect the other end of the cable (B) to the frame (4) on the machine to be started. Check that good electric contact is obtained.

Auxiliary start:

- Check that the start cables are connected securely and correctly (figure)
- Start the engine in the assisting machine
- Start the engine in the machine to be started. If the engine does not start within 30 seconds, wait for at least two minutes before the next start attempt.

Remove the start cables as follows:

- Remove the cable (B) from the frame (1) on the machine that has been started with auxiliary start.
- Remove the other end of the start cable (B) from the battery's minus terminal (2) on the assisting machine
- Remove the cable (A) from the battery's plus terminal (3) on the assisting machine
- Remove the other end of the start cable (A) from the battery's plus terminal (4) on the machine that has been started with auxiliary start.

Joystick ECU, specifications

General

Weight	0.2 kg (0.44 lb)
Operating temperature	–40 to +70 °C
Voltage supply	9 – 34 Vdc
Current consumption (idle)	60 mA (28 Vdc) 40 mA (14 Vdc)
Data interface	Mechanical encoder
VREF output	4.9 – 5.1 Vdc, 30 mA (28 V)

Outputs

Current / PWM outputs number	2 double
Type current mode	Current – closed loop
PWM mode	Voltage – open loop
Min. threshold	50 mA
Max. load	3000 mA
Dither frequency	25 – 333 Hz
Resolution	1 mA

Inputs

Voltage inputs number	2
Signal range	0 – 5 Vdc
Resolution	5 mV
Digital inputs number	2
Signal high	4 Vdc – V_{BAT}
Signal low	0 – 1 Vdc

Joystick ECU, description

The joystick ECU controls two joysticks, P1 and P2. P1 is for the Frame level and P2 is for the Fork tilt. The Solenoid valves MA 11, MA 12, MA 13 and MA 14 are pulse modulated (PWM)

Frame level (P1)

Press the joystick to the left to tilt the machine left. MA 11 is activated.
Press the joystick to the right to tilt the machine right. MA 12 is activated.

ECU pin 7	+ fead 4.9 – 5.1 Vdc, 30mA (28 V)	To P1 pin 2
ECU pin 15	– fead	To P1 pin 1
ECU pin 8	Input signal 0.5 v – 4.5 V	To P1 pin 3

Fork tilt (P2)

Press the joystick forward for tilting the fork tilt up. MA 13 is activated.
Press the joystick backwards for tilting the fork tilt down. MA 14 is activated.

ECU pin 7	+ fead 4.9 – 5.1 Vdc, 30mA (28 V)	To P2 pin 2
ECU pin 15	– fead	To P2 pin 1
ECU pin 16	Input signal 0.5 v – 4.5 V	To P2 pin 3

31 BATTERY

311 Battery

Battery, safety

The following WARNING is intended to supplement and does not replace the warnings and information provided on the battery by the battery manufacturer. See also *TH60/TH80 191, Safety when working with batteries*.

WARNING!

Batteries contain corrosive acid. Handle batteries according to instructions in Section 3 and Section Safety.

WARNING!

The batteries could explode due to the current surge if a fully charged battery is connected to a completely discharged battery. Since the batteries contain sulphuric acid, this could result in personal injuries.

WARNING!

During rapid charging of batteries, always remove the cell caps. During charging, an explosive mixture of oxygen and hydrogen is formed. A short-circuit, open flame or spark near the battery can cause a powerful explosion. Always turn off the charging current before disconnecting the charging clamps. Ventilate well, especially if the battery is being charged in a confined area.
The battery electrolyte contains corrosive sulphuric acid. Remove spilled electrolyte from the skin immediately. Wash with soap and plenty of water. If electrolyte has splashed into the eyes or on any other sensitive body part, rinse immediately with plenty of water and contact a physician immediately.

Battery, specifications

System voltage 12 V

Battery	
Parts no.	11301737
Quantity	1
Ground connection	Minus
Battery capacity	170 Ah
Battery disconnect switch connected on (–) side	Minus
CCA	900 A

Charge level	**Voltage**
Fully charged battery	12,7 V
Half charged battery	12,4 V
Discharged battery	11,6 V and lower

Battery electrolyte density	
Fully charged battery	1,28 kg/dm^3
Battery should be recharged at	1,25 kg/dm^3

Battery, description

The machine is equipped with one battery that gives a total of 12 V with 170 Ah capacity. The battery is located in the compartment in back of the engine.

The battery should be in good condition when troubleshooting the electrical system. If needed, charge the battery with a battery charger, see Battery, charging

When a battery is at rest, there is a certain spontaneous discharge, which accelerates with increase in storage temperature. A fully charged battery, stored in a temperature of –20 °C (–4 °F), loses insignificant charge during a three–month period. If the same battery is stored at +20 °C (+86 °F), it is only half charged after three months.

Therefor, always store batteries as cool as possible!

Battery, charging

WARNING!

During battery charging, hydrogen gas is formed. Hydrogen gas is flammable and may be explosive. A short-circuit, open flame or spark near the battery can cause a powerful explosion. Therefore, ventilate well. Never smoke near batteries.

WARNING!

The battery electrolyte contains corrosive sulphuric acid. Electrolyte spilled on bare skin should be removed immediately. Wash the affected area with soap and plenty of water. If electrolyte gets into your eyes or any other sensitive body part, rinse immediately with plenty of water and seek immediate medical attention.

– Batteries must only be charged using a battery charger.
– Check the battery terminal connections and make sure that they are adequately tightened and free from corrosion and dirt.
– Check the battery voltage when the batteries are at rest, that is, before starting. Each battery must be at least half-charged.

IMPORTANT! Always disconnect the electric power to the battery charger before the charging clamps are removed.

33 STARTING SYSTEM

330 General, common info about 331 - 334

Starter motor, specifikation

Starter motor	
Voltage	12 VDC
Power rating	3 kW
Number of gear teeth	9

Starter motor, description

See *TLH6/TH90 370, Wiring diagram T01*. The starter motor (MO 1) has a built–in solenoid which is energized via the start relay (RE 1) in the battery box.

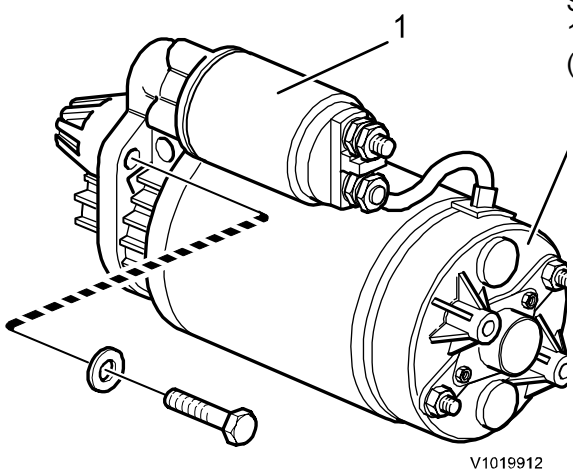


Fig. 6 Starter motor and fittings
1 Solenoid
2 Starter motor

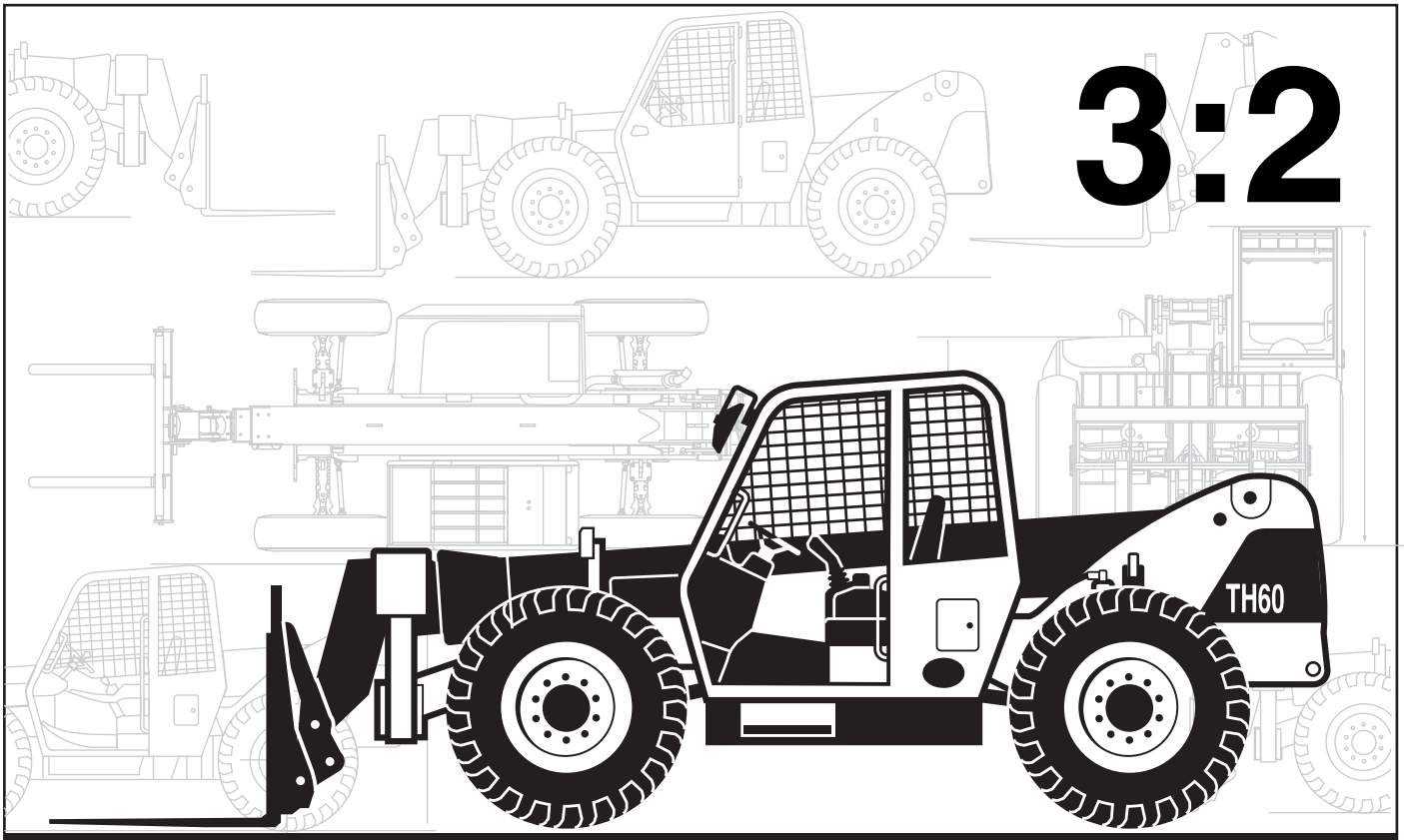
35 LIGHTING

350 General, common info about 351 - 356

Lighting, specifications

Lightning bulbs	Watt	Socket
Travel lights, asymmetrical		
Main/upper beam	55 W	H7
Dipped/lower beam	55 W	H3
Parking lights	5 W	BA 15 s
Marker lights	5 W	BA 15 s
Stop lights	21 W	BA 15 s
Direction lights	21 W	BA 15 s
Work light	55 W	H3
Rotating beacon	21 W	H3
Cab light	21 W	BA 15 s

3:2



Electrical and Information System, Cable and Fuses

PRELIMINARY DOCUMENT

Contents

ELEC. SYSTEMS

37 CABLE; FUSE; RELAY

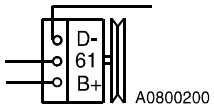
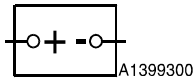
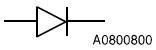
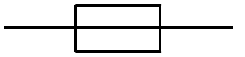
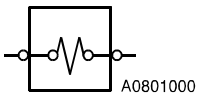
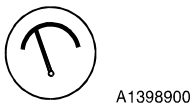
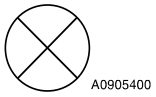
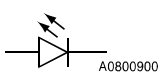
370 General, common info about 371 - 379

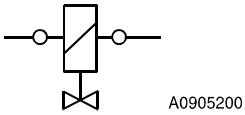
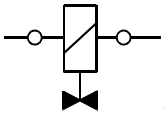
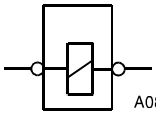
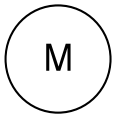
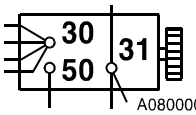
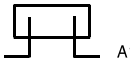
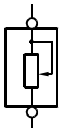
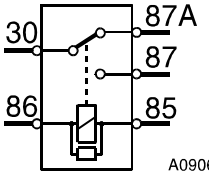
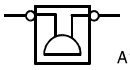
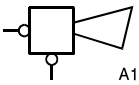
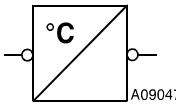
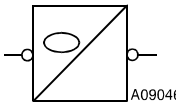
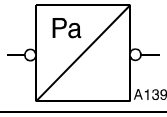
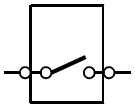
Cable coulors

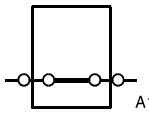
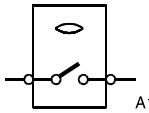
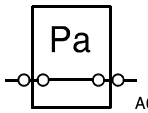
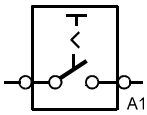
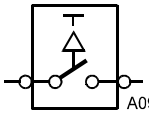
The cable colours used in wiring diagrams are indicated in the table below.

Code	Colour	Code	Colour
BL	Blue	R	Red
BN	Brown	SB	Black
GN	Green	VO	Violet
GR	Grey	W	White
OR	Orange	Y	Yellow
P	Pink		

Electrical symbols and designations

Designation	Symbol	Explanation, designation
AL		Alternator with charging regulator
BA		Battery
DI		Diode
FC, **FH**, **FU**		Fuse
GC, **GE**, **GF**, **GFSM**, **GR**		Grounding point
HE		Heating coil, i.e. heated seat cushion
		Cigarette lighter socket
IM		Instrument
		Display
LA		Light, continuous light i.e. low beam light
		Light, flashing light, i.e. direction indicators
LC		Control light, continuous light i.e. engine oil pressure, high beam indication
		Control light, flashing light, i.e. central warning light, direction indicators
		Light-emitting diode

Designation	Symbol	Explanation, designation
MA	 A0905200	Solenoid valve for control of *air*
	 A0905300	Solenoid valve for control of *oil*
	 A0800100	Solenoid, i.e. hold solenoid for bucket lockout.
MO	 A0905100	Electric motor, i.e. fan motor
	 A0800000	Starter motor
PO	 A1399400	Voltage outlet (socket)
R	 A1399100	Rheostat, i.e., instrument lighting
RE	 A0906400	Relay: No control current on 86–85, contact position 30–87A Control current on 86–85, contact position 30–87, **RE**
SA	 A1399600	Audible signal, i.e., buzzer
	 A1399700	Audible signal, i.e., horn
SE	 A0904700	Temperature sensor, i.e. engine oil temperature
	 A0904600	Level sensor, i.e. fuel level
	 A1398400	Pressure sensor, i.e., control pressure hydraulics
	 A0904500	Position monitor, closing, i.e. lever position

Designation	Symbol	Explanation, designation
SE	 A1399800	Position monitor, opening, i.e. return filter monitor
	 A1399900	Level monitor, i.e. coolant level
	 A0906200	Pressure monitor, i.e. air filter
SW	 A1397600	Single terminal switch with manual on and off, i.e. activation of air conditioning
	 A0905900	Single terminal switch with manual on and automatic off, i.e. horn

Summary of codes in wiring diagrams

AL	Alternators
BA	Batteries
DI	Diodes
FC	Fuses
FH	Fuses
FU	Fuses on circuit board
GC	Grounding point cab
GE	Grounding point engine
GF	Grounding point front
GFSM	Grounding point starter motor
GR	Grounding point rear
HE	Heating, heating coil
IM	Instruments and information display unit
LA	Lights
LC	Control lights
MA	Solenoid valves
MO	Motors
PO	Power outlets (sockets)
R	Rheostats
RE	Relays
RF	Flasher relays
SA	Audible signals
SE	Sensors and monitors
SW	Switches

Wiring diagram T01

BA – Battery		
BA 1		Battery

AL – Alternator		
AL 1		Alternator

SW – Switch		
SW 1		Start Key switch
SW 2		Battery disconnect switch
SW 6		Seat switch

RE – Relays		
RE 1		Starter relay
RE 3		Neutral relay

FU – Fuse (Fuses in fuse box)		
FU 3		Starter relay

FU – Fuse (Fuses in battery compartment)		
FU 17		Starter motor fuse
RE 20		Start key fuse

MO – Motor		
MO 1		Starter motor

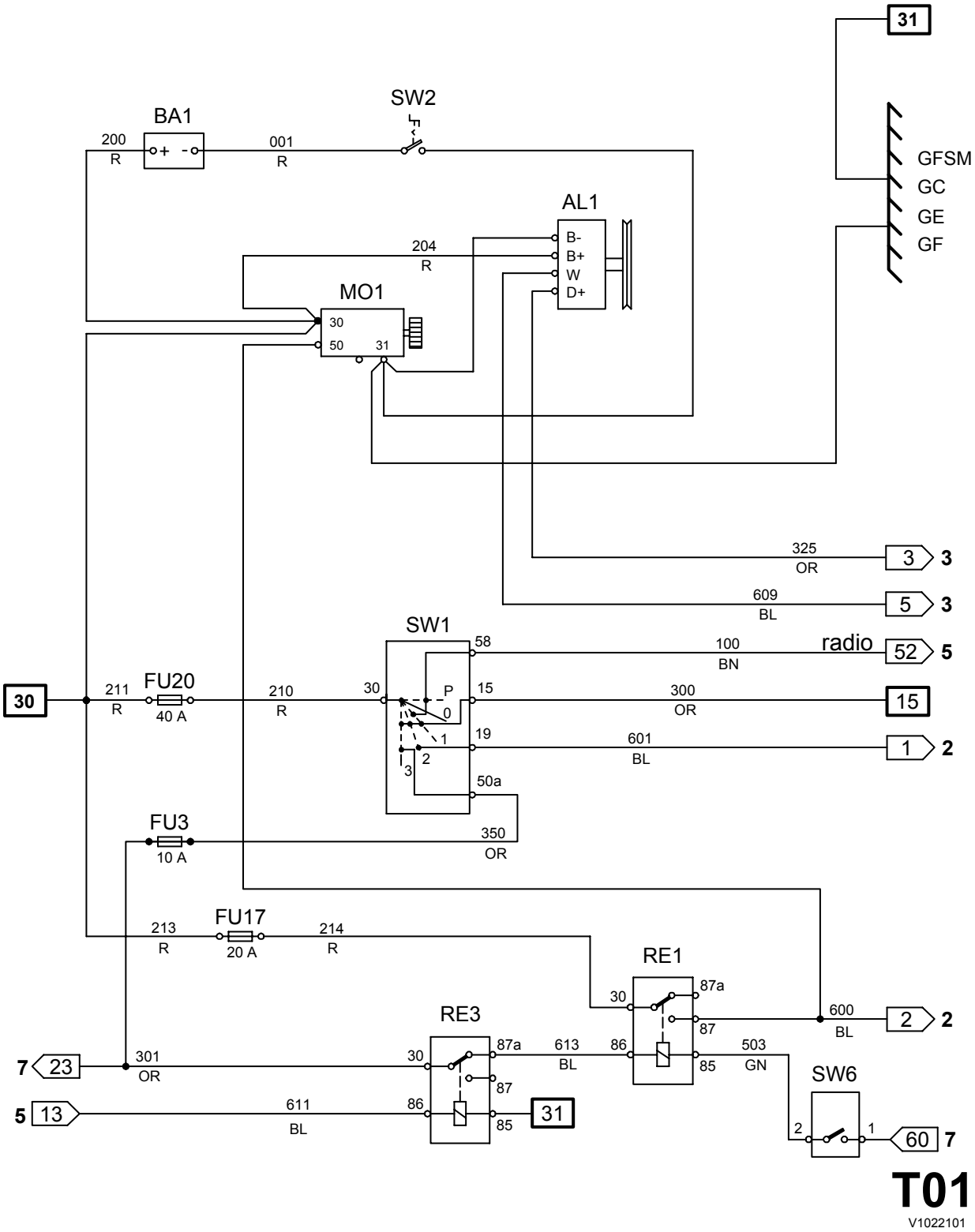

31
GFSM
GC
GE
GF
BA1
200
R
001
R
SW2
AL1
B-
B+
W
D+
204
R
MO1
30
50
31
325
OR
3
3
609
BL
5
3
SW1
58
100
BN
radio
52
5
30
211
R
FU20
40 A
210
R
30
P
0
1
2
3
15
300
OR
15
19
601
BL
1
2
50a
FU3
10 A
350
OR
FU17
213
R
20 A
214
R
RE1
30
87a
87
600
BL
2
2
RE3
30
87a
613
BL
86
85
503
GN
87
7
23
301
OR
5
13
611
BL
86
85
31
SW6
2
1
60
7
T01
V1022101

Fig. 1

Wiring diagram T02

SW – Switch		
SW 5		Coolant level switch

RE – Relays		
RE 2		Preheating relay

FU – Fuse (Fuses in fuse box)		
FU 2		Preheater relay

FU – Fuse (Fuses in battery compartment)		
FU 18		Preheater fuse

HE – Heating coils		
HE 1		Preheater

SE – Temperature sensors/monitors		
SE 2		Coolant temperature
SE 9		Fuel indicator

SE – Pressure sensors/monitors		
SE 6		Engine oil pressure
SE 7		Air filter pressure

MA – Solenoid valves		
MA 1		Engine governor
MA 7		Fuel stop valve

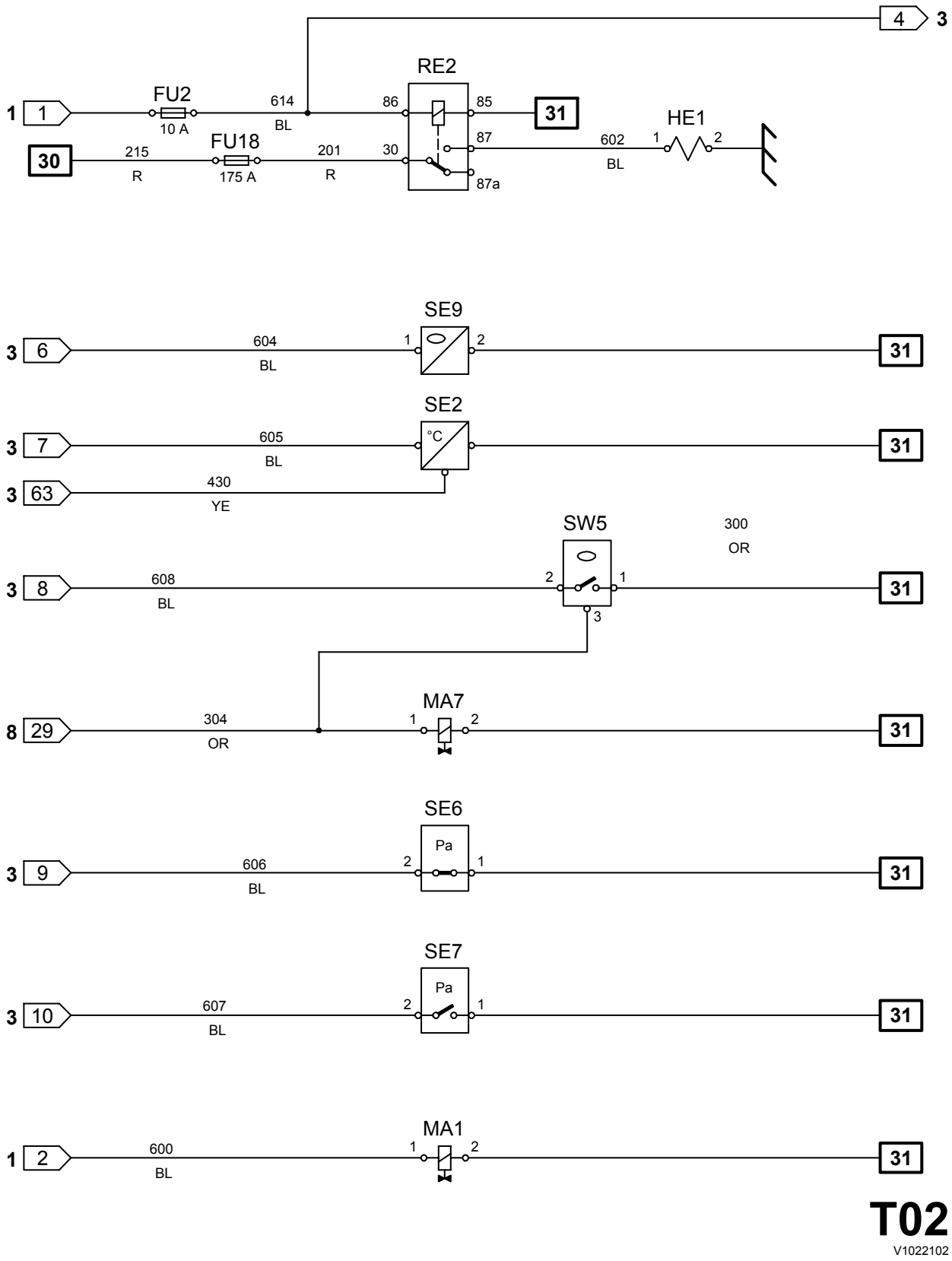

4
3
RE2
1
1
FU2
10 A
614
BL
86
85
31
HE1
87
602
BL
1
2
30
215
R
FU18
175 A
201
R
30
87a
SE9
3
6
604
BL
1
2
31
SE2
3
7
605
BL
°C
31
3
63
430
YE
SW5
300
OR
3
8
608
BL
2
1
3
31
MA7
8
29
304
OR
1
2
31
SE6
Pa
3
9
606
BL
2
1
31
SE7
Pa
3
10
607
BL
2
1
31
MA1
1
2
600
BL
1
2
31
T02
V1022102

Fig. 2

Wiring diagram T03

R – Resistor		
R 1		Battery charging light

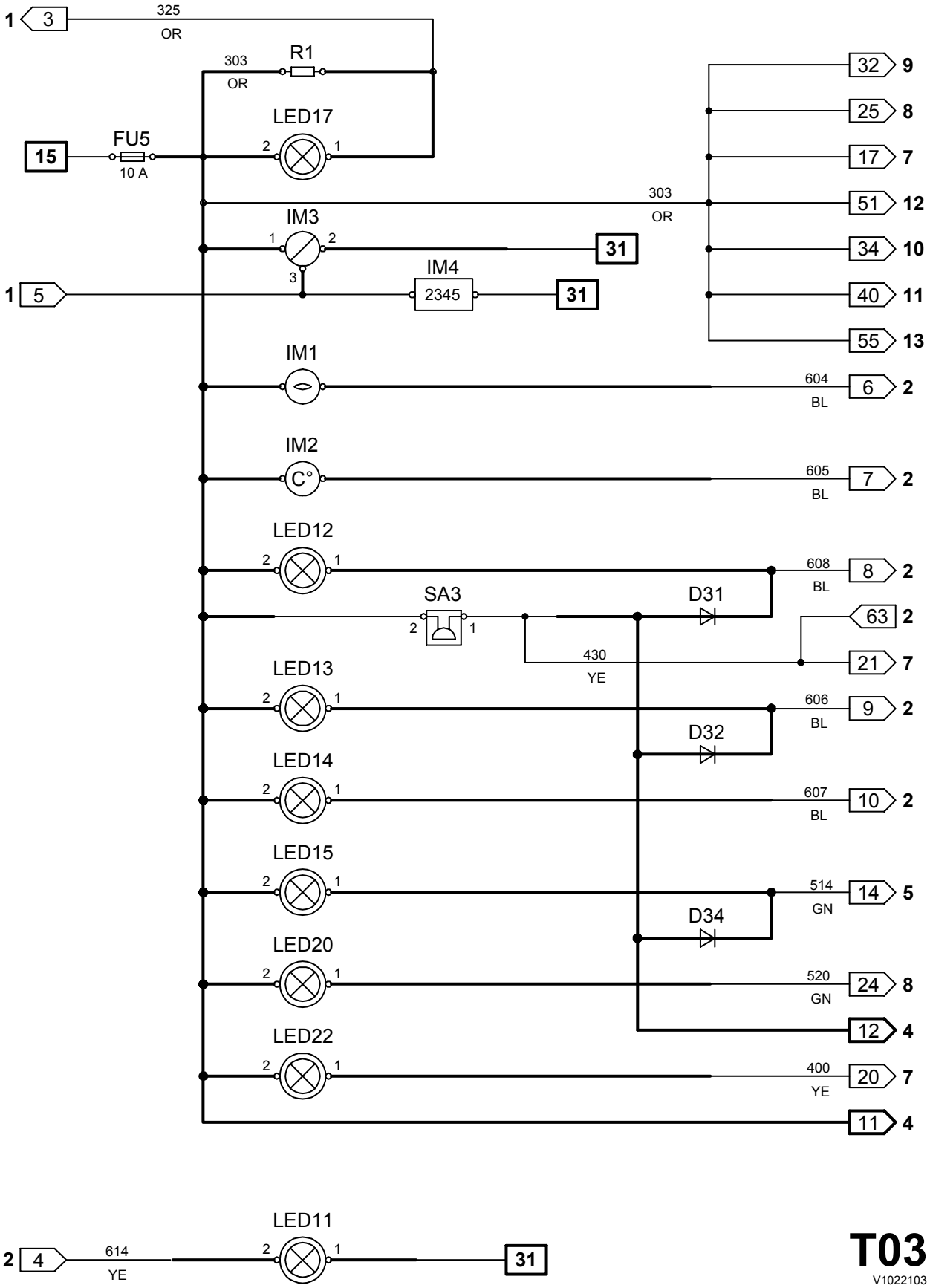
FU – Fuse (Fuses in fuse box)		
FU 5		Hour meter

LED – Indicators		
LED 11		Preheater lamp
LED 12		Water temp
LED 13		Engine oil pressure
LED 14		Air filter pressure
LED 15		Transmission oil pressure
LED 17		Battery charging light
LED 20		Axle lock
LED 22		High beam

SA – Sounders		
SA 3		Warning buzzer

IM – Instruments		
IM 1		Fuel indicator
IM 2		Water temperature indicator
IM 3		Hour meter
IM 4		External hour meter

D – Diodes		
D 31		
D 32		
D 34		



T03
V1022103

Fig. 3

Wiring diagram T04

LED – Indicators		
LED 16		Blinker light
LED 18		Hydraulic oil filter
LED 19		High hydraulic oil temperature
LED 21		Low hydraulic oil temperature
LED 27		Low brake oil pressure

D – Diodes		
D 33		
D 35		

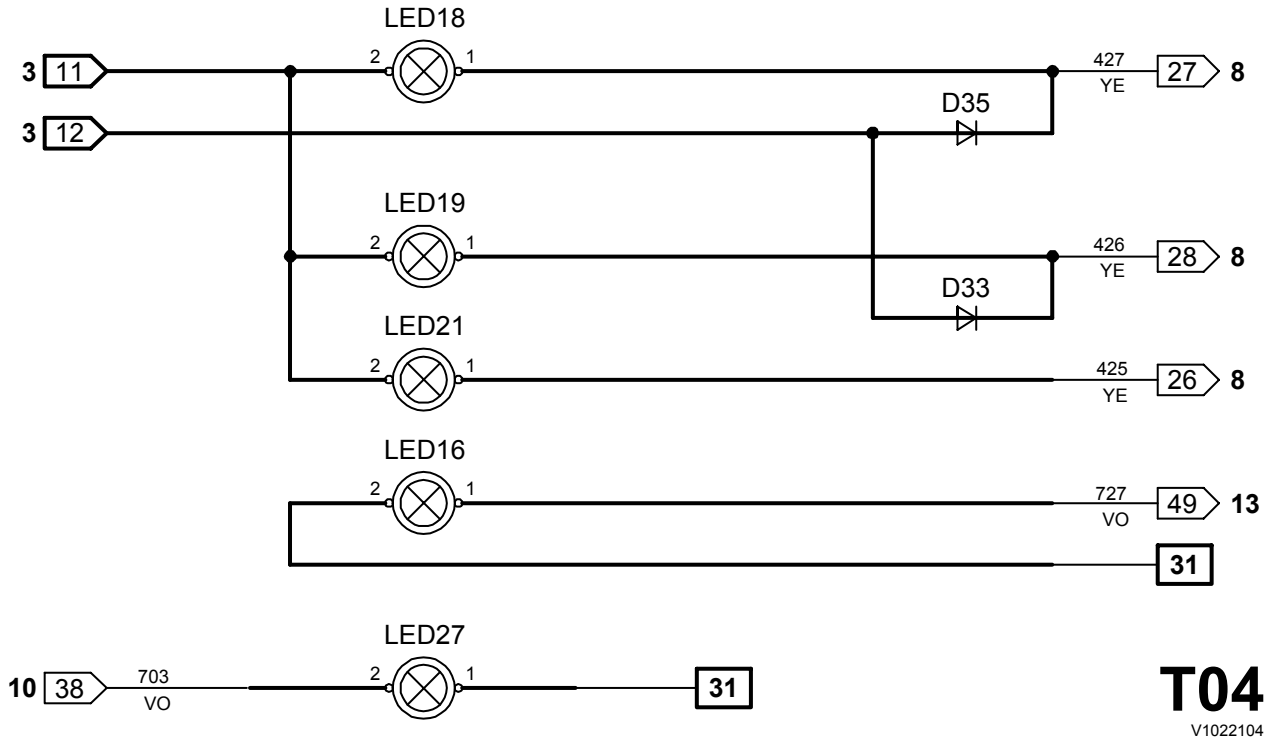

LED18
3 11
3 12
2
1
427
YE
27
8
D35
LED19
426
YE
28
8
D33
LED21
425
YE
26
8
LED16
727
VO
49
13
31
LED27
10 38
703
VO
31
T04
V1022104

Fig. 4

Wiring diagram T05

SW – Switch		
SW 4		Left combi switch

RE – Relays		
RE 7		Forward speed
RE 9		Gear box valve D
RE 10		Gear box valve C
RE 11		Reverse speed

FU – Fuse (Fuses in fuse box)		
FU 6		Combi switch
FU 12		Horn

SA – Sounders		
SA 1		Front horn
SA 4		Reverse warning

MA – Solenoid valves		
MA 5		Forward speed
MA 6		Reverse speed
MA 8		Gear box valve C
MA 9		Gear box valve D
MA 10		Gear box valve E

D – Diods		
D 5		Reverse speed
D 6		Forward speed

SE – Sensor		
SE 1		Transmission oil temperature

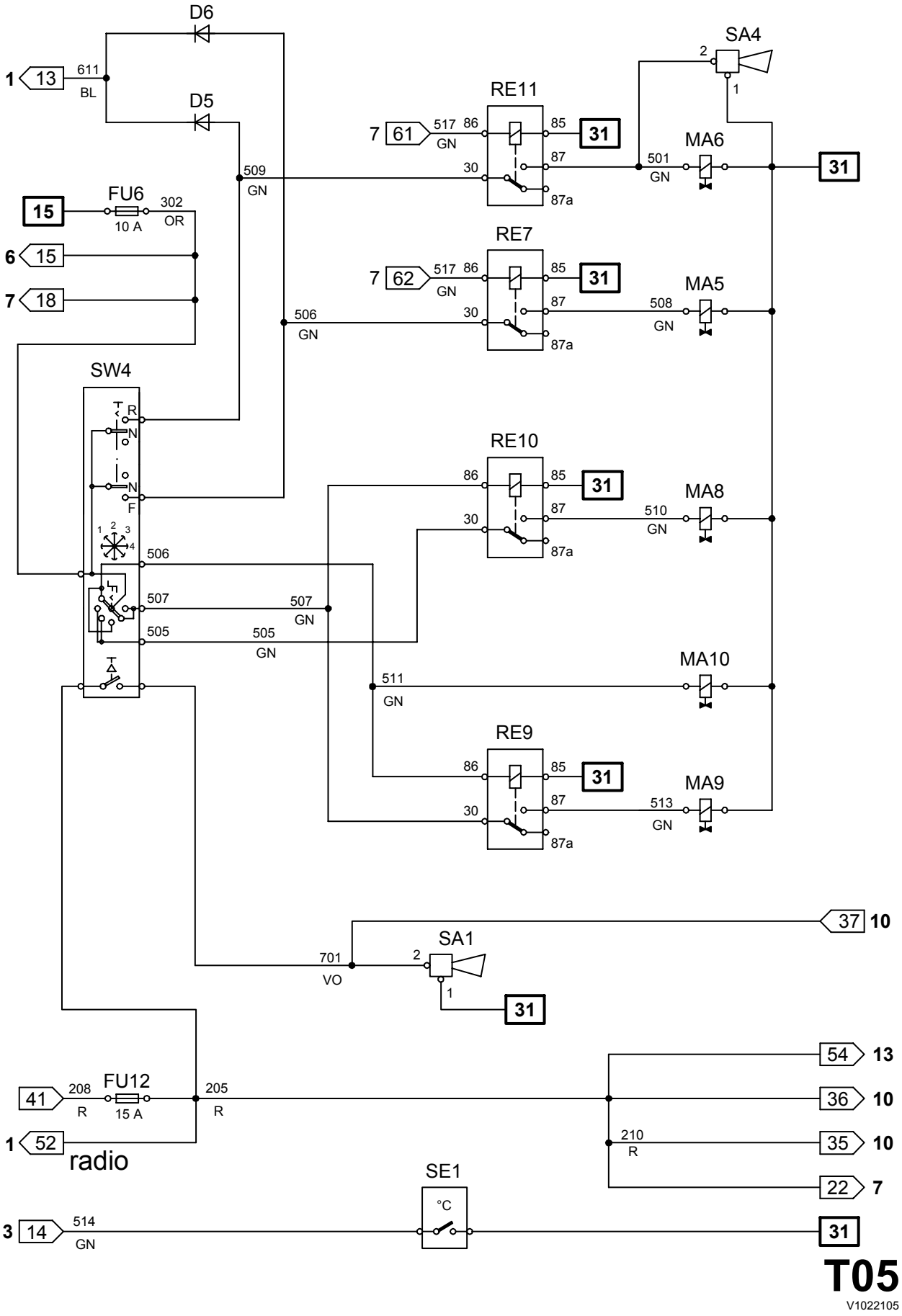

D6
D5
1
13
611
BL
509
GN
FU6
15
302
OR
10 A
6
15
7
18
SW4
R
N
F
1
2
3
4
506
507
505
SA4
2
1
RE11
7
61
517
GN
86
85
31
87
30
87a
501
GN
MA6
31
RE7
7
62
517
GN
86
85
31
87
30
87a
506
GN
508
GN
MA5
RE10
86
85
31
87
30
87a
510
GN
MA8
507
GN
505
GN
511
GN
MA10
RE9
86
85
31
87
30
87a
513
GN
MA9
37
10
SA1
701
VO
2
1
31
54
13
36
10
35
10
22
7
FU12
41
208
R
15 A
205
R
1
52
radio
210
R
SE1
°C
3
14
514
GN
31
T05
V1022105

Fig. 5

Wiring diagram T06

SW – Switch		
SW 12		4 wheels steer / 2 wheels / crab steering

MA – Solenoid valves		
MA 2		4 wheel steer
MA 3		Crab steer

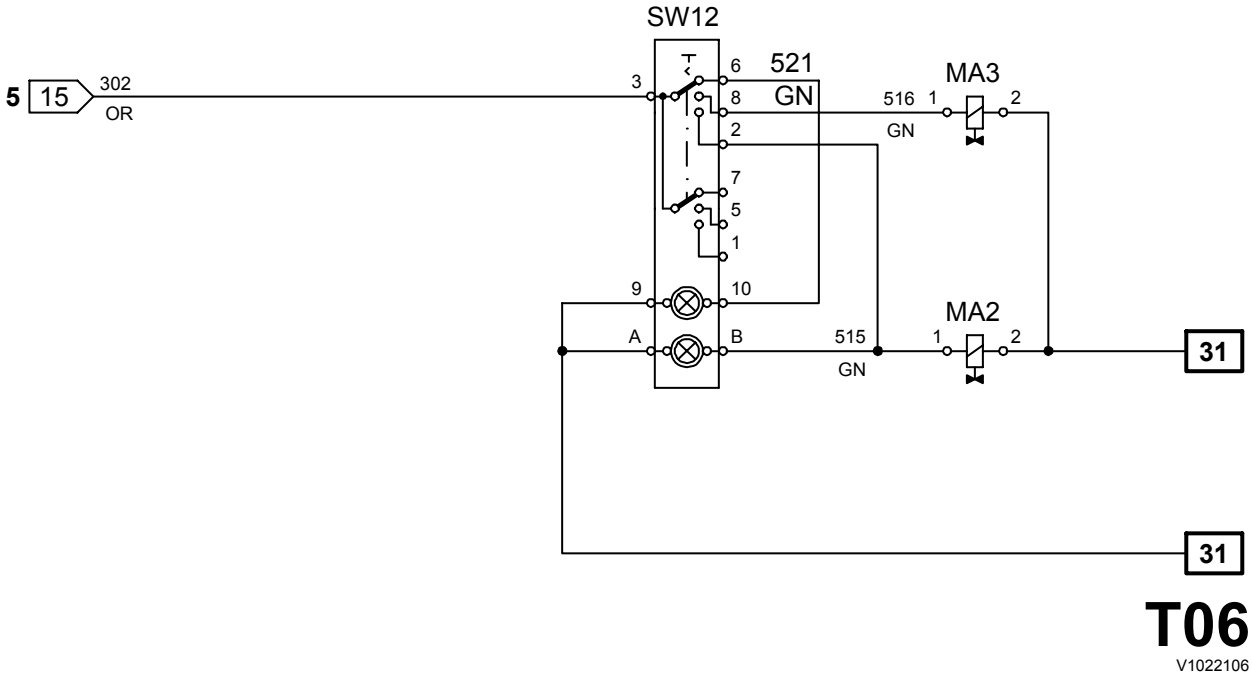

SW12
5
15
302
OR
3
6
521
GN
8
2
7
5
1
9
10
A
B
515
GN
MA3
516
1
2
GN
MA2
1
2
31
31
T06
V1022106

Fig. 6

Wiring diagram T07

SW – Switch		
SW 10		Parking brake

RE – Relays		
RE 13		Low accumulator oil pressure
RE 14		Preaccumulator
RE 15		Preaccumulator indicator
RE 16		Stop motor
RE 24		Park brake light

MA – Solenoid valves		
MA 4		Park brake
MA 17		Preaccumulator switch

D – Diods		
D 7		Low accumulator pressure
D 8		Horn
D 9		Preaccumulator
D 14		

SE – Sensor		
SE 5		Low accumulator pressure

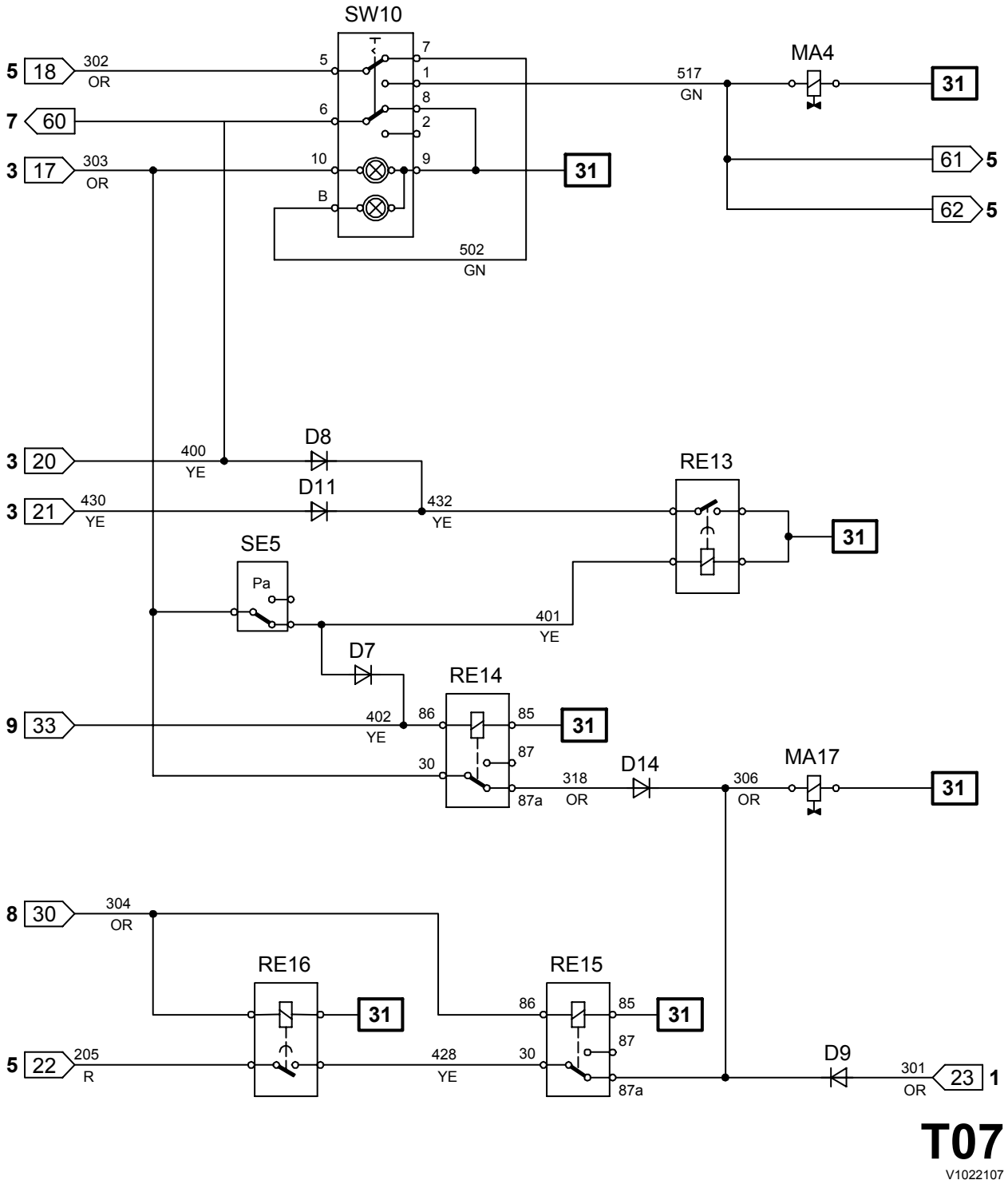

SW10
MA4
RE13
SE5
Pa
D8
D11
D7
RE14
D14
MA17
RE16
RE15
D9
5 18 302 OR
7 60
3 17 303 OR
3 20 400 YE
3 21 430 YE
9 33
8 30 304 OR
5 22 205 R
517 GN
61 5
62 5
502 GN
432 YE
401 YE
402 YE
318 OR
306 OR
428 YE
301 OR
23 1
31
T07
V1022107

Fig. 7

Wiring diagram T08

RE – Relays		
RE 17		Axle lock
RE 18		Hydraulic oil filter pressure
RE 25		Axle lock relay

FU – Fuse (Fuses in fuse box)		
FU 7		Control unit

MA – Solenoid valves		
MA 11		Frame level
MA 12		Frame level
MA 13		Fork tilt
MA 14		Fork tilt
MA 15		Axle lock
MA 16		Axle lock

P 1		Frame level joystick
P 2		Fork tilt joystick

SE – Temperature sensors/monitors		
SE 3		Hydraulic oil, high temperature
SE 4		Hydraulic oil, low temperature

SE – Pressure sensors/monitors		
SE 8		Hydraulic oil filter pressure
SE 10		Proximity sensor

ECU		Control unit

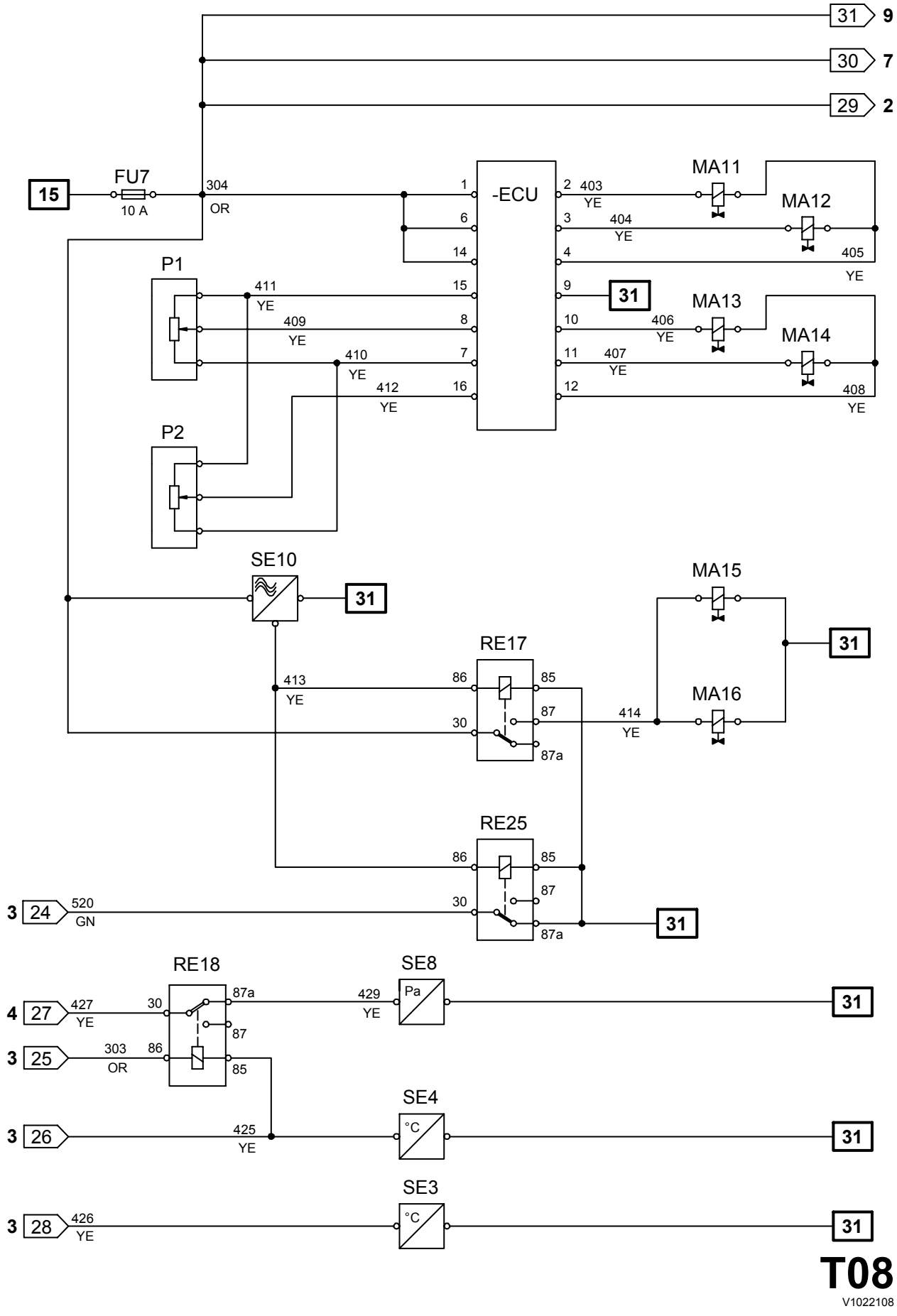

31 9
30 7
29 2
15
FU7
10 A
304
OR
-ECU
1
6
14
2 403 YE
3 404 YE
4 405 YE
9
31
10 406 YE
11 407 YE
12 408 YE
MA11
MA12
MA13
MA14
P1
411 YE
409 YE
410 YE
412 YE
15
8
7
16
P2
SE10
31
MA15
MA16
RE17
413 YE
86
85
87
30
87a
414 YE
RE25
3 24 520 GN
RE18
4 27 427 YE
3 25 303 OR
30
87a
87
86
85
SE8
429 YE
Pa
SE4
3 26 425 YE
°C
SE3
3 28 426 YE
T08
V1022108

Fig. 8

Wiring diagram T09

SW – Switch		
SW 8		Hydraulic lock
SW 13		Left stabilizer
SW 14		Right stabilizer
SW 19		
SW 20		

RE – Relays		
RE 19		Auxiliary 1
RE 20		Auxiliary 2

FU – Fuse (Fuses in fuse box)		
FU 8		Stabilizer and auxiliary

MA – Solenoid valves		
MA 18		Hydraulic lock
MA 19		Auxiliary 1
MA 20		Auxiliary 2
MA 21		Left stabilizer up
MA 22		Left stabilizer down
MA 23		Right stabilizer up
MA 24		Right stabilizer down

D – Diods		
D 10		

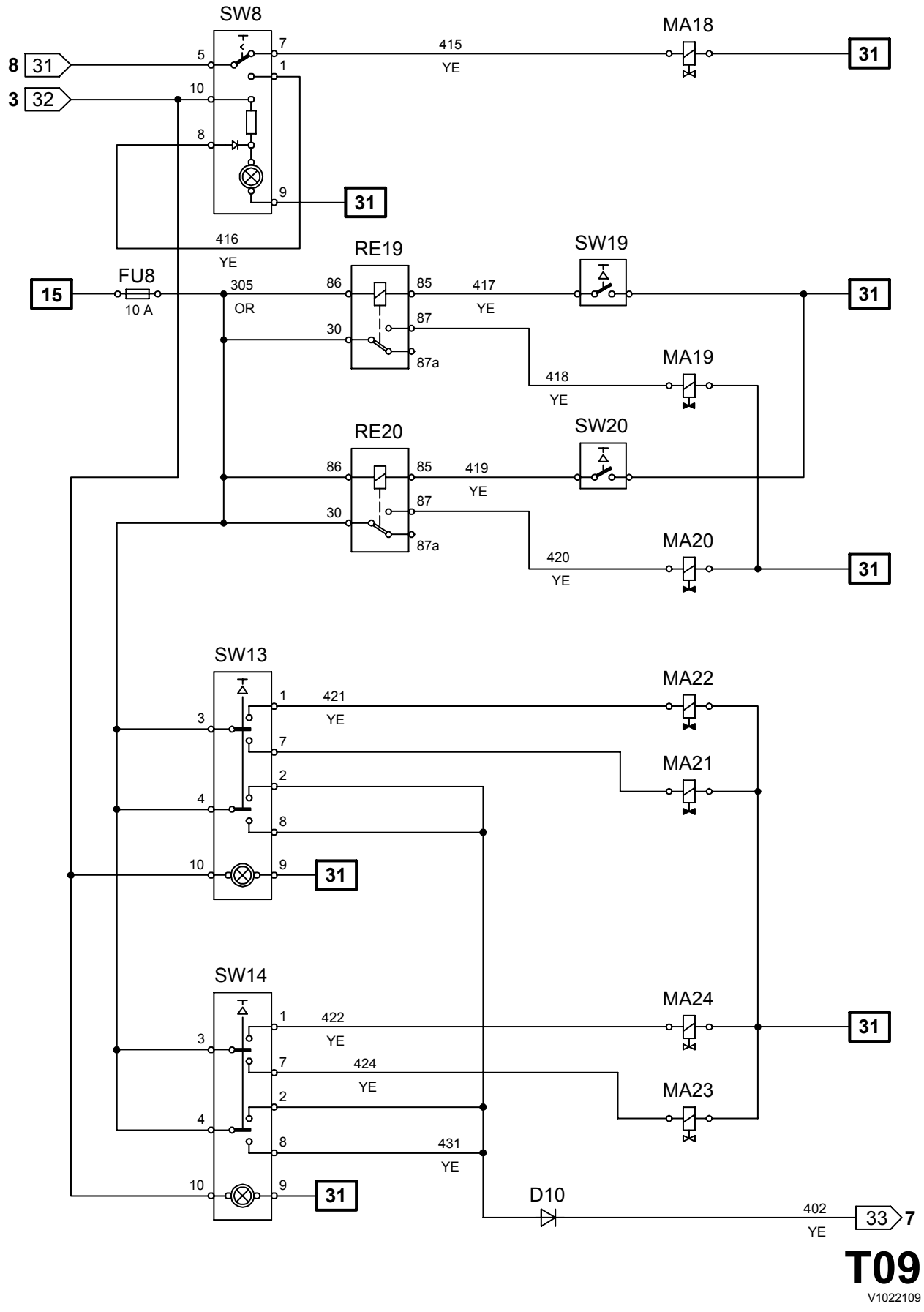

SW8
MA18
8 31
3 32
5
7
1
10
8
9
31
415
YE
31
416
YE
RE19
SW19
FU8
15
10 A
305
OR
86
85
417
YE
31
30
87
87a
MA19
418
YE
RE20
SW20
86
85
419
YE
30
87
87a
MA20
420
YE
31
SW13
MA22
1
421
YE
3
7
MA21
2
4
8
10
9
31
SW14
MA24
1
422
YE
31
3
7
424
YE
MA23
2
4
8
431
YE
10
9
31
D10
402
YE
33
7
T09
V1022109

Fig. 9

Wiring diagram T10

SW – Switch		
SW 3		Left combi switch
SW 9		Marker lamp

FU – Fuse		
FU 4		Left marker lamp
FU 10		??
FU 11		Marker lamp
FU 16		Right marker lamp

LA – Lamp		
LA 1		Main beam right
LA 2		Main beam left
LA 3		Full beam right
LA 4		Full beam left
LA 5		Rear right marker lamp
LA 6		Front right marker lamp
LA 25		Rear left marker lamp
LA 26		Front left marker lamp

RE – Relay		
RE 24		Plus after key switch

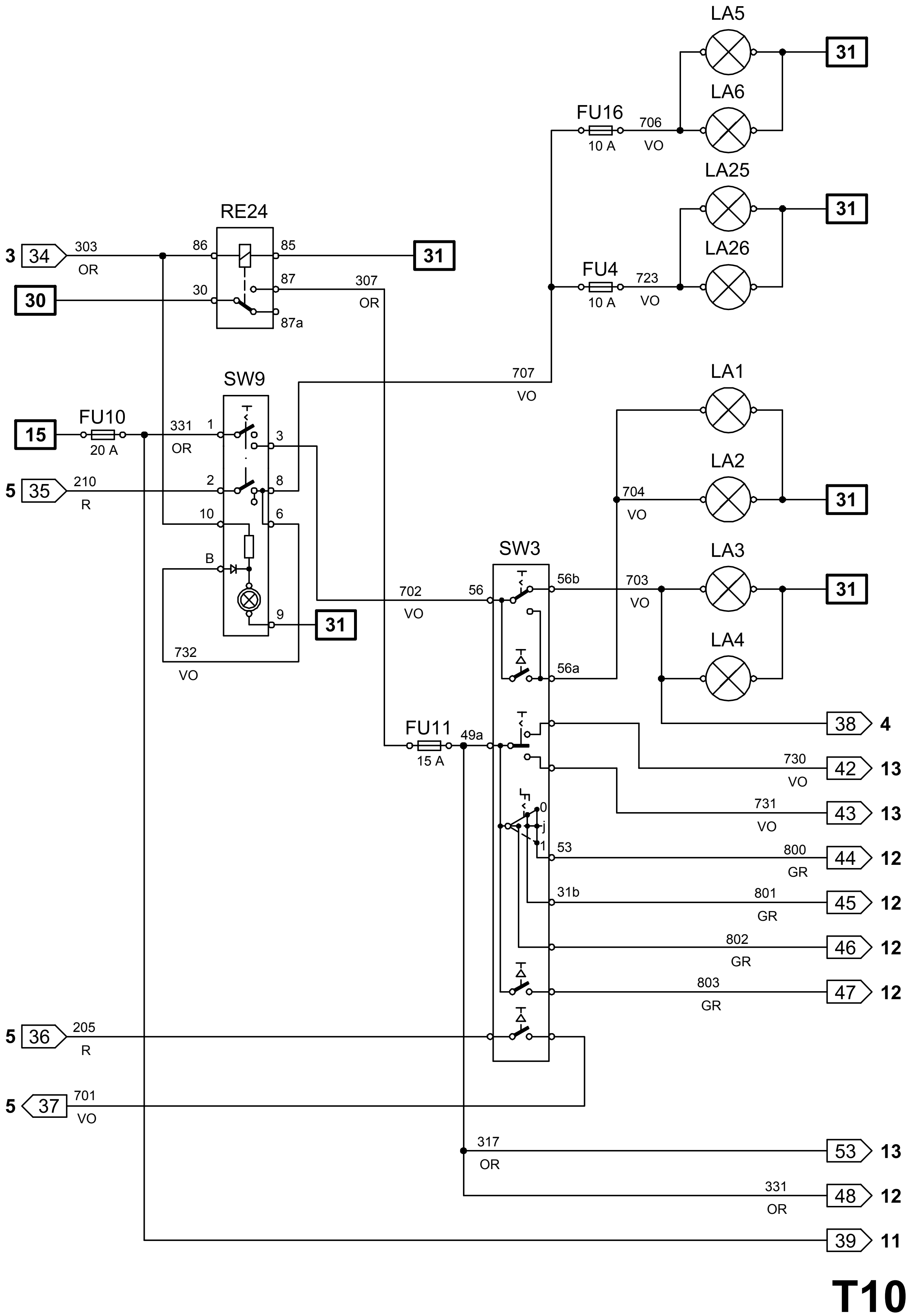

LA5
LA6
FU16
706
10 A
VO
31
LA25
LA26
FU4
723
10 A
VO
31
RE24
3
34
303
OR
86
85
31
87
307
OR
30
30
87a
SW9
707
VO
LA1
15
FU10
20 A
331
OR
1
3
LA2
5
35
210
R
2
8
704
VO
31
10
6
B
SW3
LA3
702
VO
56
56b
703
VO
31
9
31
732
VO
LA4
56a
FU11
15 A
49a
38
4
730
VO
42
13
731
VO
43
13
0
j
1
53
800
GR
44
12
31b
801
GR
45
12
802
GR
46
12
803
GR
47
12
5
36
205
R
5
37
701
VO
317
OR
53
13
331
OR
48
12
39
11
T10
V1022110

Fig. 10

Wiring diagram T11

SW – Switch		
SW 15		Rotation beacon
SW 18		Work lights
SW 35		Cab light

RE – Relays		
RE 21		Work light

FU – Fuse (Fuses in fuse box)		
FU 13		Cigarette lighter and power outlet
FU 14		Rear working lights
FU 15		Front working lights

FU – Fuse (Fuses in battery compartment)		
FU 19		D+
FU 22		D+

LA – Lights		
LA 7		Brake light
LA 8		Brake light
LA 13		Cab rear work light
LA 14		Cab rear work light
LA 15		Boom work light
LA 16		Boom work light
LA 17		Cab front work light
LA 18		Cab front work light
LA 21		Cab light
LA 23		Rotating beacon lamp

FC –		
FC 9		

PO – Plug		
PO1		Plug 1
PO2		Plug 2

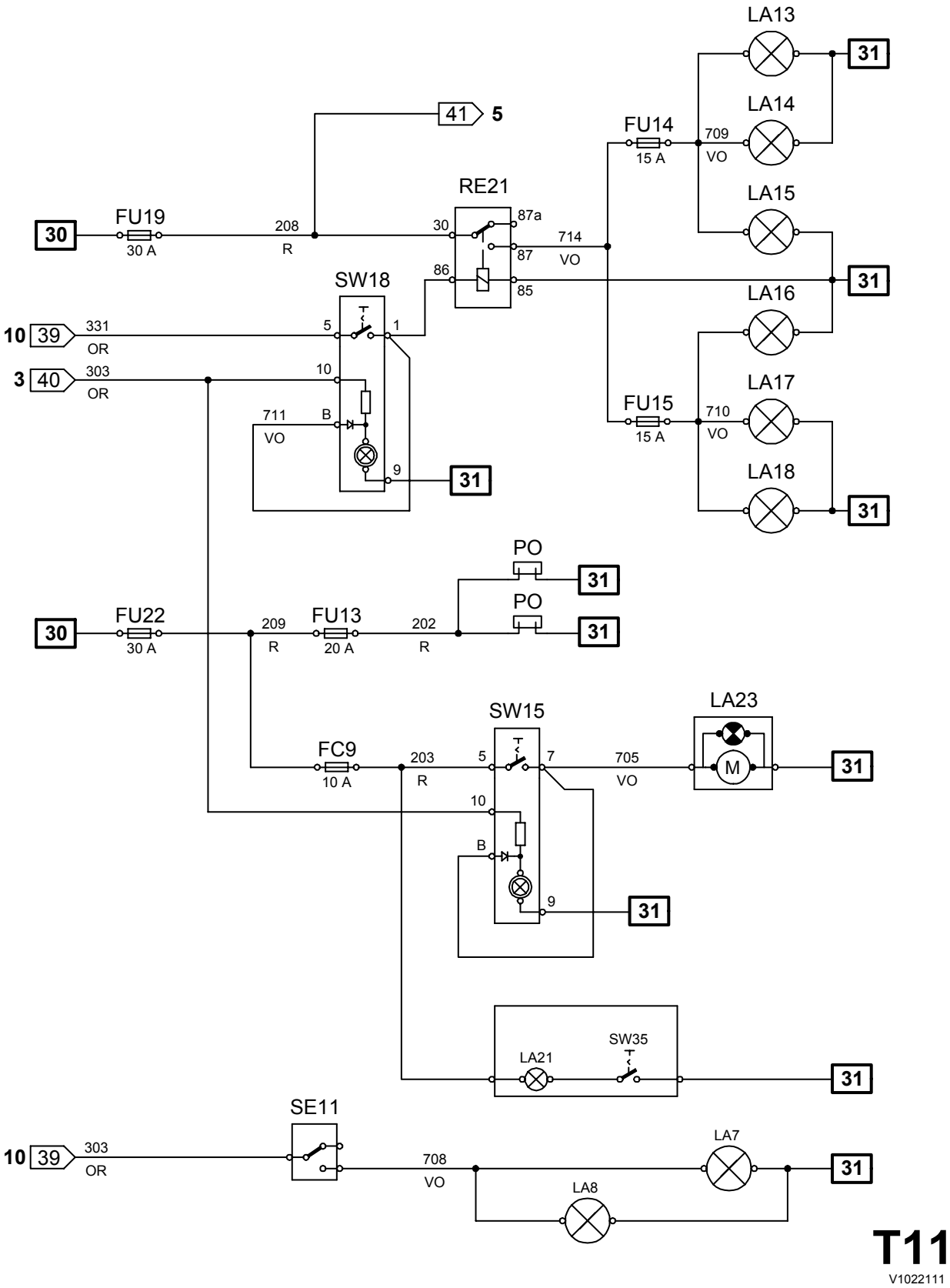

LA13
31
41
5
LA14
FU14
709
VO
15 A
RE21
LA15
30
FU19
30 A
208
R
87a
30
87
714
VO
86
85
31
SW18
LA16
10
39
331
OR
5
1
3
40
303
OR
10
711
B
VO
FU15
LA17
710
VO
15 A
9
31
LA18
31
PO
31
PO
31
30
FU22
30 A
209
R
FU13
20 A
202
R
LA23
SW15
FC9
10 A
203
R
5
7
705
VO
M
31
10
B
9
31
SW35
LA21
31
SE11
10
39
303
OR
708
VO
LA7
31
LA8
T11
V1022111

Fig. 11

Wiring diagram T12

MO – Motors		
MO 3		Front wiper
MO 4		Front washer pump
MO 5		Rear wiper
MO 6		Rear washer pump
MO 7		Roof wiper motor

SW – Switches		
SW 17		Rear wiper

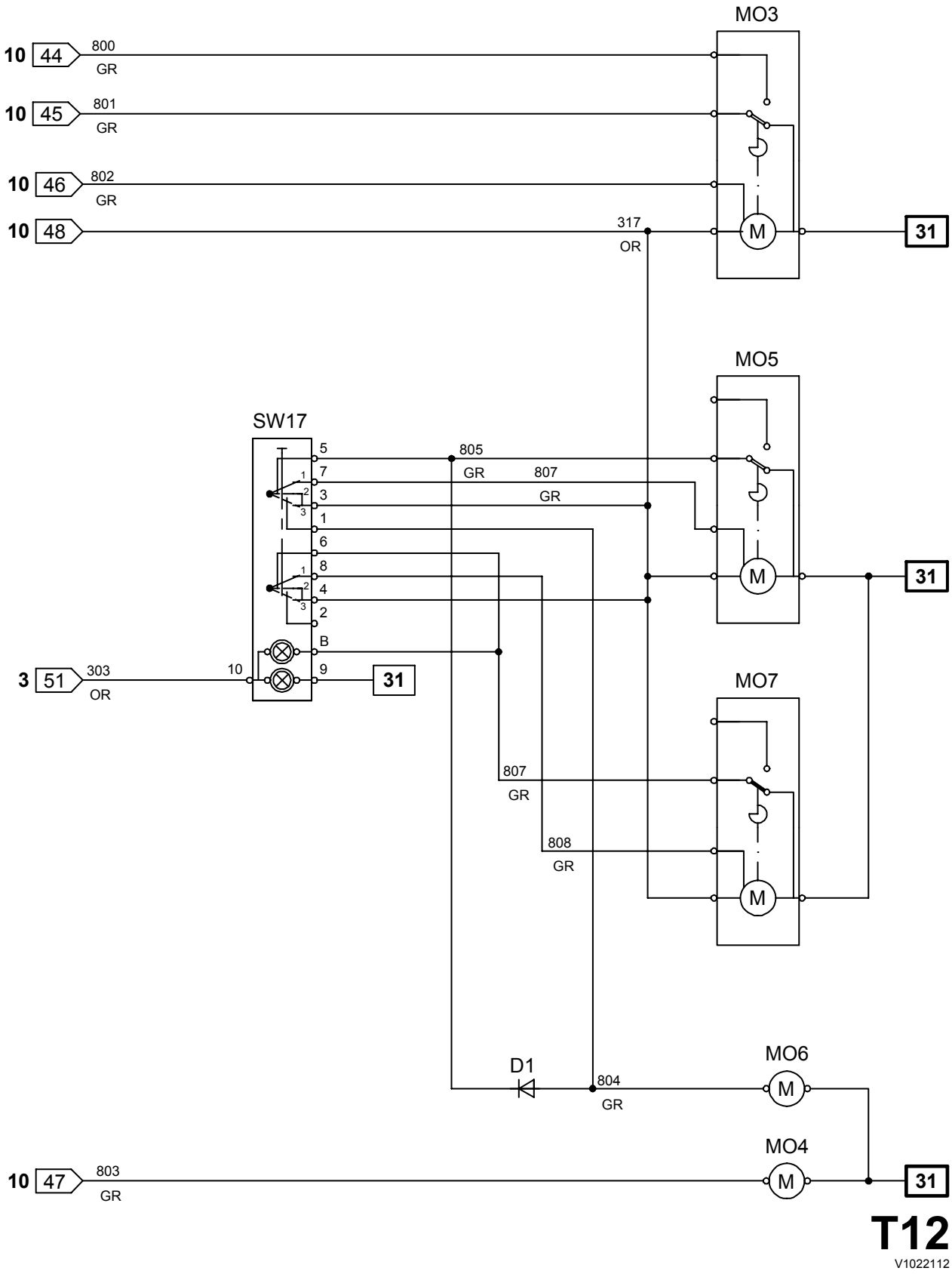

MO3
10 44
800
GR
10 45
801
GR
10 46
802
GR
10 48
317
OR
M
31
MO5
SW17
5
7
3
1
6
8
4
2
B
9
805
GR
807
GR
3 51
303
OR
10
31
MO7
807
GR
808
GR
D1
804
GR
MO6
MO4
10 47
803
GR
T12
V1022112

Fig. 12

Wiring diagram T13

LA – Lights		
LA 9		Front right blink light
LA 10		Front left blink light
LA 11		Rear right blink light
LA 12		Rear left blink light

SW – Switches		
SW 7		Direction switch

RE – Relays		
RE 23		Blink relay
RE 28		Right blink relay
RE 29		Left blink relay

D – Diodes		
D 16		Right blink light
RE 17		Light blink left

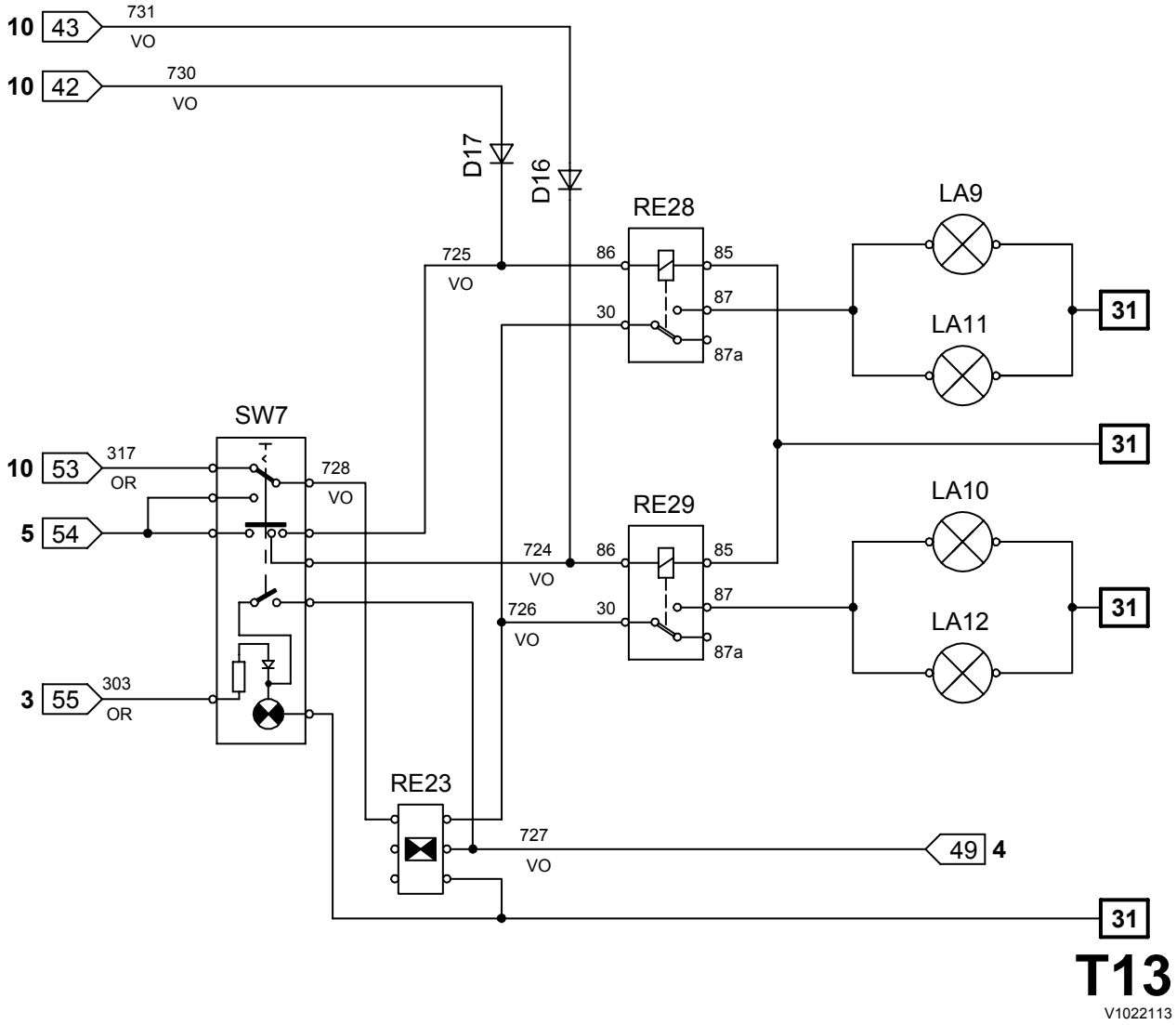

10 43
731
VO
10 42
730
VO
D17
D16
RE28
LA9
725
VO
86
85
87
30
87a
LA11
31
SW7
10 53
317
OR
728
VO
5 54
31
LA10
RE29
724
VO
86
85
87
726
VO
30
87a
LA12
31
3 55
303
OR
RE23
727
VO
49 4
31
T13
V1022113

Fig. 13

372 Electrical distribution box; fuse; relay; circuit breaker

Fuse

Main fuses

The main fuses are located inside the engine compartment.

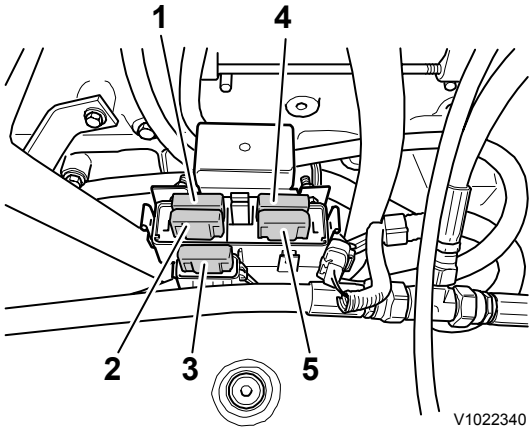


Fig. 14

FU	A	Function	FU	A	Function
1	20 A	After Key	4	40 A	Key switch
2	30 A	Signal light and output power	5	30 A	Horn and work light
3	20 A	Starter motor			

Fuses

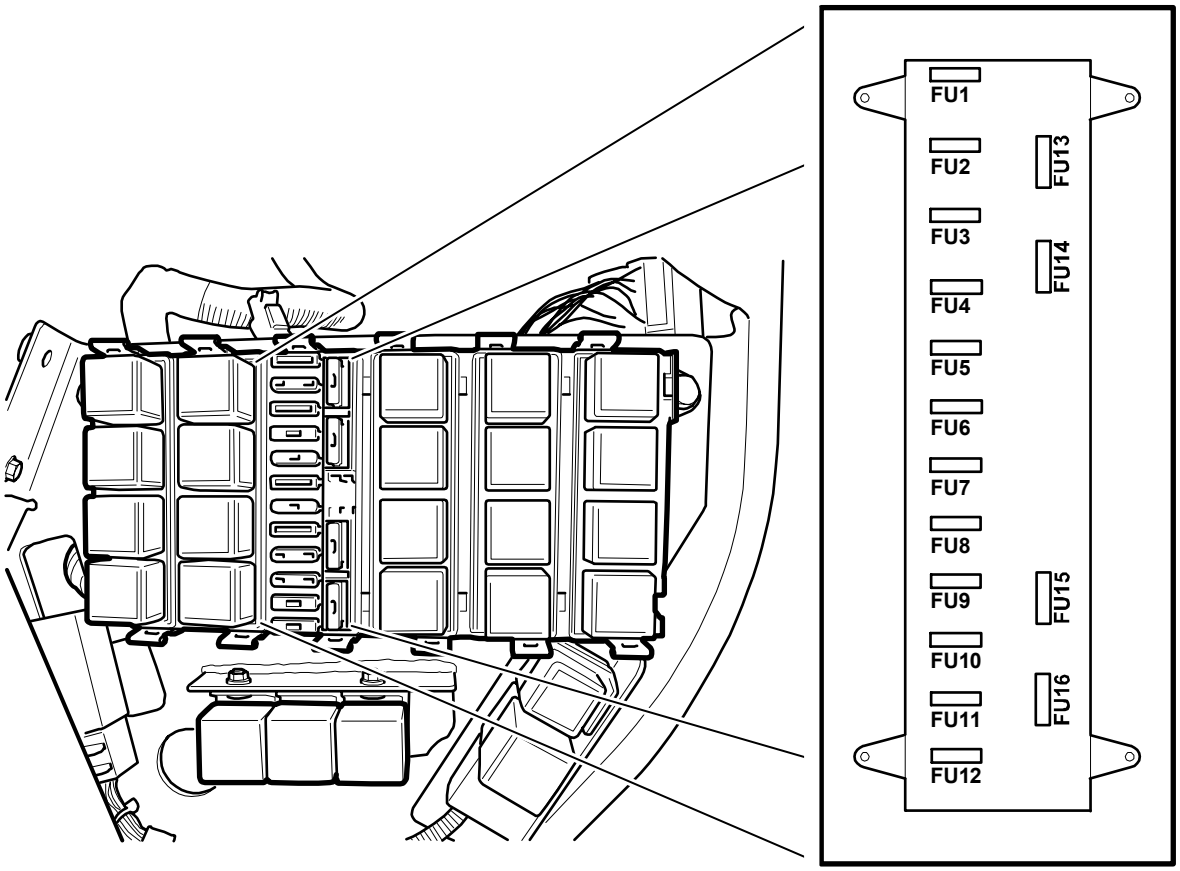


Fig. 15

Never install a fuse with a higher rating than the value given on the decal inside the fuse box. There is a risk of fire on the circuit board.

FU	A	Function	FU	A	Function
1	10	Radio	9	10	Rotating beacon
2	10	Preheater	10	20	Lamps
3	10	Starter relay fuse	11	15	Wipers
4	10	Position lights	12	15	Light and horn
5	10	Hour recorder	13	20	Cigarette lighter
6	10	Transmission control unit	14	15	Working lights
7	10	Power outlet	15	15	Working lights
8	10	Optional hydraulic function	16	10	Position lights

Relay

Relays

Never install relay with a higher rating than value given below.

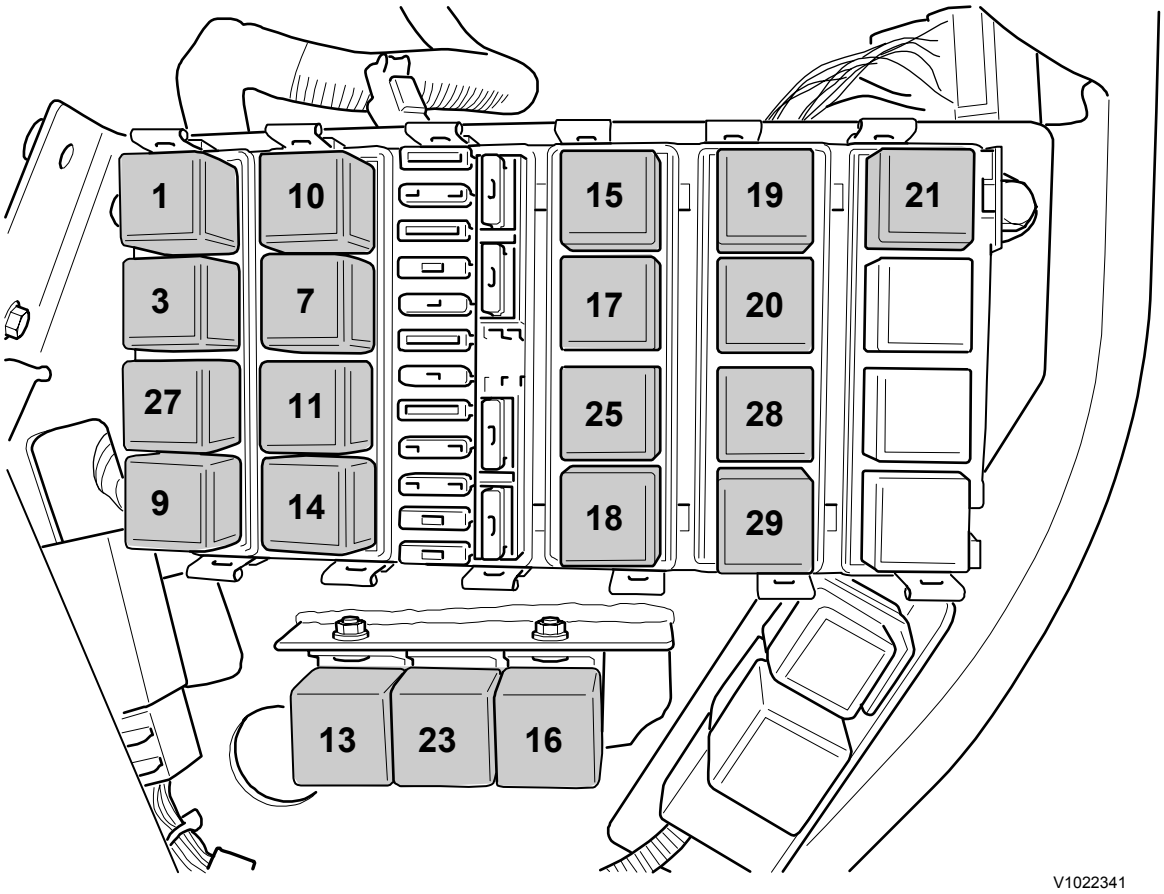


Fig. 16

RE	A	Function
1	30	Starter
3	30	Neutral
7	30	Forward speed
9	30	Gear box valve D
10	30	Gear box valve D
11	30	Reverse speed
13	30	Low accumulator pressure
14	30	Pre accumulator
15	30	Pre accumulator indicator
16	30	Stop motor

RE	A	Function
17	30	Axle lock
18	30	Hydraulic oil filter pressure
19	30	Auxiliary 1
20	30	Auxiliary 2
21	30	Work light
23	30	Blink relay
25	30	Axle lock
27	30	Plus after key
28	30	Right blink light
29	30	Left blink light

38 INSTRUMENT; SENSOR; WARNING AND INFORMATION SYSTEM

380 General, common info about 383 - 387

Control switches

Control switches are located on the dashboard with the exception of the Frame level switch, witch is located on the right arm rest near the Control lever.

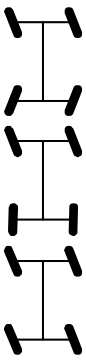
Parking brake set


A1346600

Two position switch; Engage the parking brake

NOTE! WARNING!!!

Steering mode


V1015055

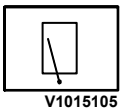
Three position switch; top is Four wheel/Round mode, middle is Two wheel mode, bottom is Crab mode. See section Steering, operating instructions. *TH60/TH80, 050, Steering, operating instructions*

Front wiper


V1015104

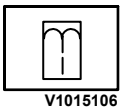
Two position Switch; Turns on main wiper on the front window of enclosed cabs

Top wiper


V1015105

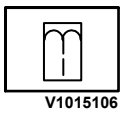
Two position Switch; Turns on wiper on the top window of enclosed cabs.

Top washer


V1015106

Two position momentary Switch; Sprays window wash solution onto the top window of enclosed cabs

Creep mode


V1015106

Two position momentary Switch; Shifts transmission into highest gear. Use this drive mode when moving close to your landing area where slow, controlled movements is necessary.

Work lights


V1015121

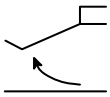
Two position Switch; Turns on work lights on machines so equipped

Hazard lights

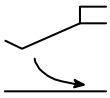

V1015054

Two position Switch; Turns on flashing hazard lights on machines so eqipped.

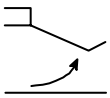
Left stabilizer



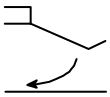
Three position momentary switch; Raises and lowers the left stabilizer on machine so equipped.


V1015122

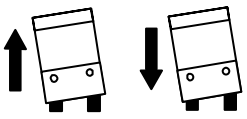
Right stabilizer



Three position momentary switch; Raises and lowers the right stabilizer on machine so equipped.

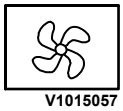

V1015123

Frame level


V1015056

Three position momentary switch; Allows the operator to level the frame before elevating the boom

Heater fan

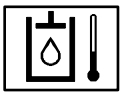

V1015057

Two position switch; Turns on the heater fan on machine so equipped.

Indicator lights


V1015045

Hydraulic oil filter


V1015052

Hydraulic oil temperature


V1015044

Brake pressure


V1015049

Parking brake engaged


V1015053

Oil temperature


V1015047

Oil pressure


V1015046

Water temperature


A1345700

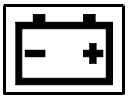
Transmission oil temerature


A1346100

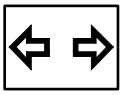
Air filter


V1015050

Glow on plug (only at start–up)


A1345400

Charging system


V1015051

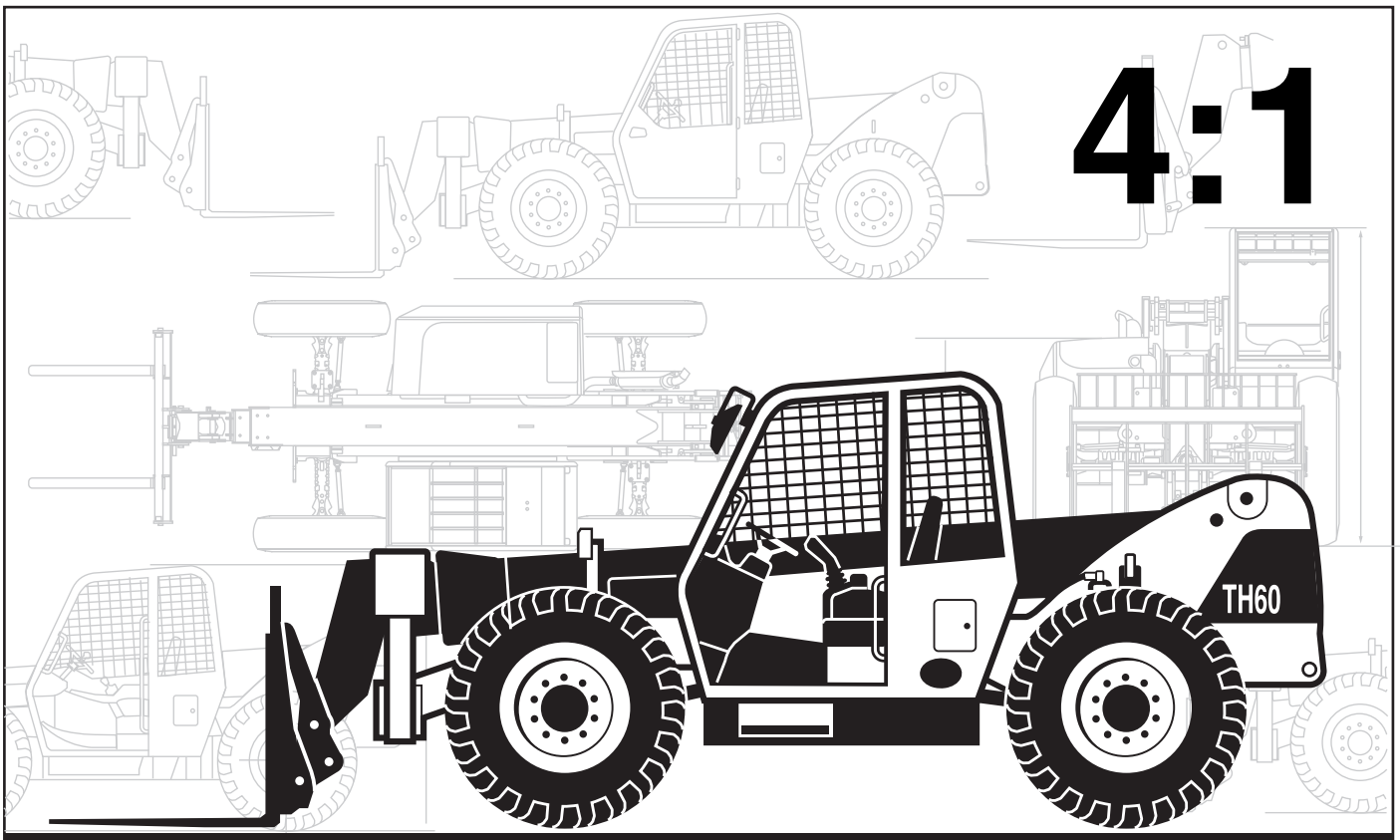
Turn signal


A1345900

High beam lights

Hazard lights

4:1



Power Transmission, Description

PRELIMINARY DOCUMENT

Contents

POWER TRANSMISSION

40 GENERAL

400 General, common info about 410 - 436

Transmission, specifications

Transmission	
Type	Power transmission
Designation	T1200
Torque converter, ratio	2:1
Number of gears forward/reverse	4/4
Pump flow t 33.4 r/s (2000 rpm)	53 litres (14 US gal) per minute
Gear shifting system	Electro hydraulic
Filter	External spin on

Speed range forward/reverse	
Gear	Forward/reverse
1st	3.1 mph (5.1 kph)
2nd	6.8 mph (11 kph)
3rd	13.7 mph (22 kph)
4th	21.1 mph (34 kph)

Transmission ratio	
Gear	Forward/reverse
1st	4.47
2nd	2.05
3rd	1.00
4th	0.66

Drop box, specifications

Type	Shaft drop box
Drop box ratio	1:1

42 TRANSMISSION, HYDRAULIC CONTROL

420 General

Transmission, temperatures and pressures, specifications

Temperatures	
Operating temperature[a]	70–120 °C (158–248 °F)
Max allowed temperature (neutral - port 31)	120 °C (248 °F)

a. Measured at temperature check port converter out (port 71)

Pressures	
Transmission regulator pressure (neutral - port 31)	12.76 bar (185 psi) at 600 rpm 19.31 bar (280 psi) at 2000 rpm
Clutch pressures - 1st clutch: port 41 - 2nd clutch: port 42 - 3rd clutch: port 43 - Forward High clutch: port 44 - Forward clutch: port 45 - Reverse clutch: port 46	
Clutch activated	16.5–19.3 bar (240–280 psi) at 1800 rpm
Clutch released	0–0.2 bar (0–3 psi) at 1800 rpm
Lubrication pressure (port 33) (at ±1850 rpm)	2.9–4.0 bar (42–58 psi) at 49 l/min (13 gpm) pump flow
Safety valve, cracking pressure	8.27–10.20 bar (120–148 psi), measured at port 32 with converter out shut off.
Filter bypass valve	set at 2.1–3.5 bar (30–50 psi)
Transmission out pressure (port 32) at 49 l/min (13 gpm) pump flow (±1850 rpm) and max. 8.27 bar (120 psi) at no load governed speed	2.9–6.41 bar (42–93 psi)
Pump flow at 2000 rpm in neutral	53 l/min minimum (14 gpm)

NOTE! All pressures and flows to be measured with oil temperature of 82–93 °C (180–200 °F).

Transmission, overview

Basically the T12000 transmission is composed of five main assemblies:

1 Converter, pump drive section and pressure regulating valve.
2 Input shaft and directional clutches.
3 Range clutches.
4 Output section.
5 Transmission solenoids.

Converter, pump drive and pressure regulating valve, description

Engine power is transmitted from the engine to the impeller cover.

This element is the pump portion of the hydraulic torque convertre and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump that picks up fluid at its centre and discharges it at the outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft of the torque converter. this element recieves fluid at its outer diameter and discharges it at its centre.

The reaction member of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element. This recirculation will make the converter to multiply torque.

The torque multiplication is function of the blading (impeller, turbine and reaction member) and the converter output speed (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).

Therefor we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing.

The hydrauloc pump is connected with the pump drive gear. This pump drive gear is driven by the impeller hub gear. Since the impeller hub gear is connected with the impeller cover, the pump speed is in direct relation with engine speed.

NOTE! The pressure regulator valve is mounted behind the filter adapter housing.

Input shaft and directional clutches, description

The turbine shaft driven from the turbine transmits power to the forward, High 4 or reverse clutch.

These clutches consists of a drum with internal splines and a bore to recieve a hydraulic actuated piston. The piston is oil tight by teh use of sealing rings. The steel discs with external splines, and friction discs with internal splines, are alternated until the required total is achieved.

A back-up plate is then inserted and secured with a retainer ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, the solenoid will direct oil under pressure through tubes and passages to the selected clutch shafts.

Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

Pressure of the oil forces the piston and discs against the back-up plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows the to drive as one unit.

When the clutch is released, a return spring will push the piston back and oil will drain back via the solenoid, the bleed valve or holes in the clutch piston into the transmission pump.

These bleed valves will only allow quick escape of oil when the pressure to the piston is released.

The T12000 transmission, 3-speed version, has one reverse clutch and one forward clutch. This in combination with the 3 range clutches results in the transmission having 3 forward and 3 reverse speeds.

The T12000 transmission, 4- and 6-speed versions, have one reverse clutch and two forward clutches (forward and High 4). This in combination with the 3 range clutches results in teh transmission having 4 forward (for the 4-speed) or 6 forward (for the 6-speed) and 3 reverse speeds.

The engagement of the directional clutches (forward and reverse) are modulated. This means that clutch pressure is built up gradually. This will enable the unit to make forward, revers shifts while the vehicle is still moving and will allow smooth engagement of drive. The modulation is done hydraulically.

Range clutches and output section, description

Range clutches

Once a directional clutch is engaged power is transmitted to the range clutches (1st, 2nd or 3rd). Operation and actuation of the range clutches is similar to the directional clutches. The engagement of the range clutches is not modulated.

Output section

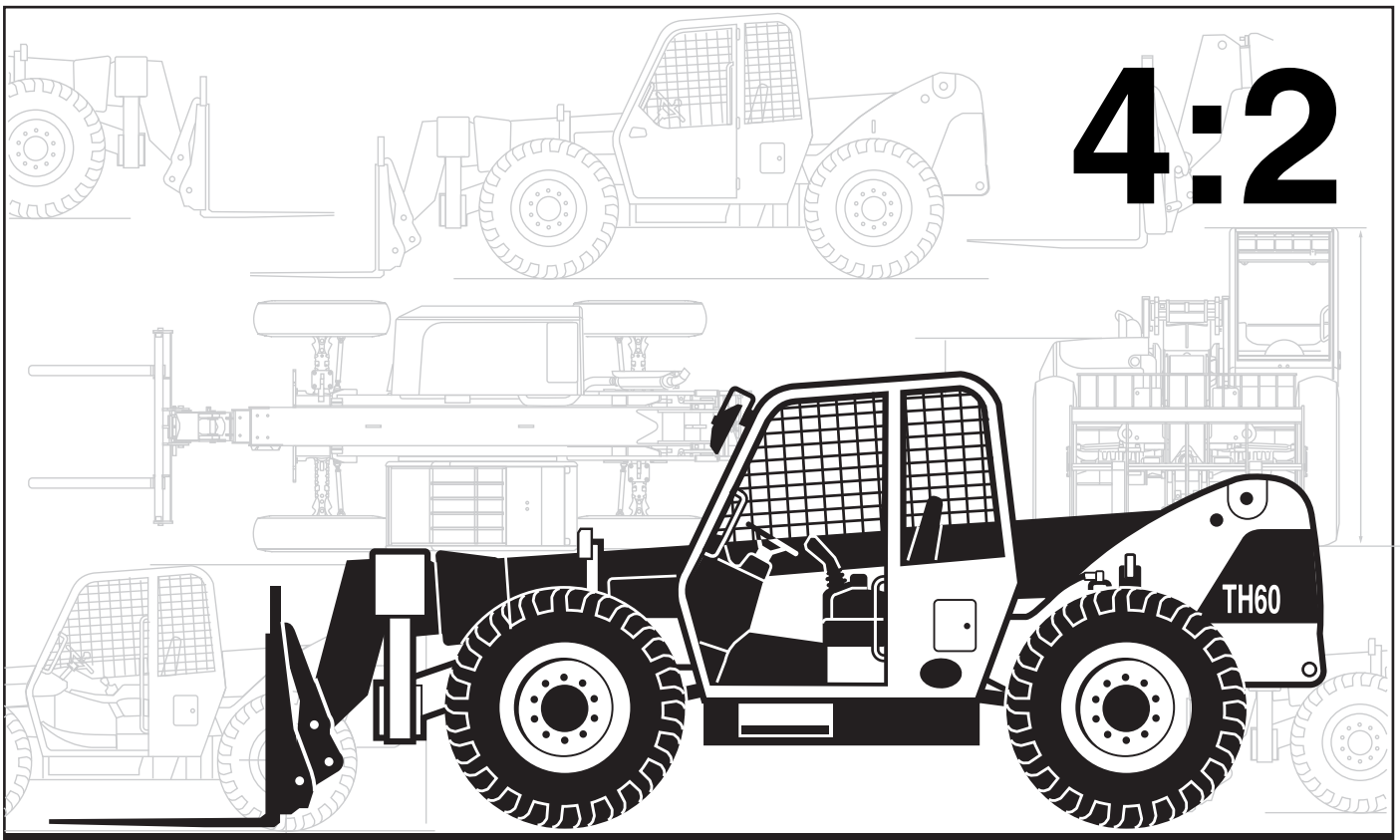
With a range clutch engaged, power is finally transmitted to the output shaft. Output rotation is same as the engine rotation when the forward clutch is engaged.

A front axle disconnect is optional and is located on the output shaft. The drive to the front axle can be disconnected or connected by manual shifting.

Transmission controls, description

The transmission is controlled by the direction and range solenoids. The solenoids are mounted on the left side of the transmission case. When the selected direction and range solenoids are energised, oil under pressure will flow through tubes and passages to the selected clutch shafts. Oil sealing rings are located on the clutch shafts. These rings direct oil under pressure through a drilled passage way in the shaft to the desired clutch.

4:2



Power Transmission, Repair Instructions

PRELIMINARY DOCUMENT

Contents

POWER TRANSMISSION

43 GEARBOX,

430 General

Transfer case, oil filling

NOTE! The transfer case is a separate, sealed unit and does not share oil with the transmission.

Op. no.

1 Put the machine in service position 1, see *TH60/TH80 191, Safety rules when servicing*.

2 Clean the area around the sight glass on the transfer case. Inspect the oil level, it should be in the middle of the sight glass.

3 Fill, if necessary with oil according to specifications, see section *TH60/TH80 160, Recommended lubricants, oils*. Clean the area around the fill plug before it is removed.

4 Reinstall the fill plug.

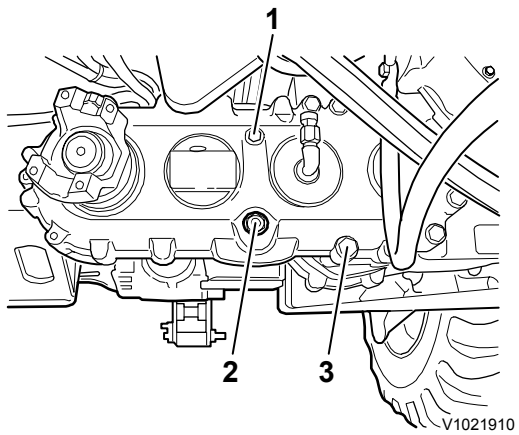


Fig. 1
1 Fill plug
2 Sight glass
3 Drain plug

45 PROPELLER SHAFT

451 Propeller shaft, complete

Specification

All propeller shafts consists of two universal joint and a slip yoke assembly. Both of the universal joints and the slip yoke assembly must be lubricated every 250 h, there are 3 grease nipples on each shaft. Do not lubricate with a high pressure grease gun. Maximum grease gun pressure 15 bar (217 psi).
Grease with lithium base with EP additives and consistency NLGI No. 2.

Torque

Propeller shaft	Nm	lbf ft
Front propeller shaft	71 ±10	52 ±7
Rear propeller shaft	71 ±10	52 ±7

46 FRONT AXLE; REAR AXLE

460 General, common info about 461 - 468

Drive axles, oil filling

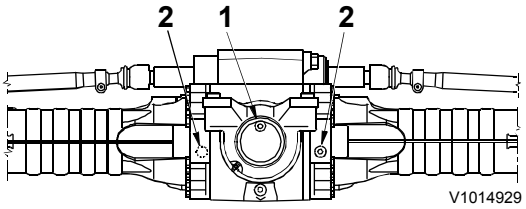


Fig. 2 V1014929
1 Fill plug
2 Oil level plug

Op. no.

1 Put the machine in service position 1, See *TH60/TH80 191, Safety rules when servicing*.

2 Clean area around the oil level plug on the transfer case, then remove the plug. The oil should be in level with the bottom of the threads.

3 Clean the area around the fill plug before removing it to add oil. Fill if necessary with oil according to the MEC specifications shown in *TH60/TH80 160, Recommended lubricants, oils*. Fill to the bottom of the threads.

NOTE! Use of oil with the wrong API specifications will cause brake noise and may prematurely wear the brake components.

4 Clean and install the plug.

Planetary reduction hubs, oil filling

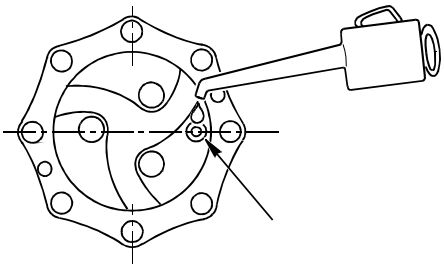


Fig. 3 V1014937

1 Put the machine into service position 1. See *TH60/TH80 191, Safety rules when servicing*.
2 To properly check the oil level, the plug must be on the horizontal centerline of the hub. Clean the area around the plug on the hub, then remove the plug.
3 Fill if necessary with, oil according to specification shown in *TH60/TH80 160, Recommended lubricants, oils* to the bottom of the threads.
4 Clean and install the plug.
5 Repeat the procedure for the other three planetary reductions hubs.

461 Front axle

Front axle, specification

Front axle	
Type	Drive/steer axle
Differential gear ratio	1: 3.875
Hub reduction gear ratio	1: 6.00
Total gear ratio	1: 23.25
Steering angle	45°
Axle track width over flanges	2180 mm (85.8 in)
Capacities (front axle including differential)	8.7 lit (2.3 US gal)
Weight (front axle (dry))	470 kg (1036 lb)

Front axle, capacities

Front axle	
Capacities, including differential and hubs	11.7 lit (3.1 US gal)

Hub, hub reduction

Hub reduction

Hub reduction	
Hub reduction gear ratio	1: 6.00
Number of satelites	4
Oil volume per hub	1.5 l (0.40 US gal)

463 Rear axle 1

Rear axle, specification

Rear axle	
Type	Drive/steer axle
Differential gear ratio	1: 3.875
Hub reduction gear ratio	1: 6.00
Total gear ratio	1: 23.25
Steering angle	45°
Axle track width over flanges	2180 mm (85.8 in)
Capacities (front axle including differential)	8.7 lit (2.3 US gal)
Weights (front axle (dry))	457 kg (1007 lb)

Rear axle, capacities

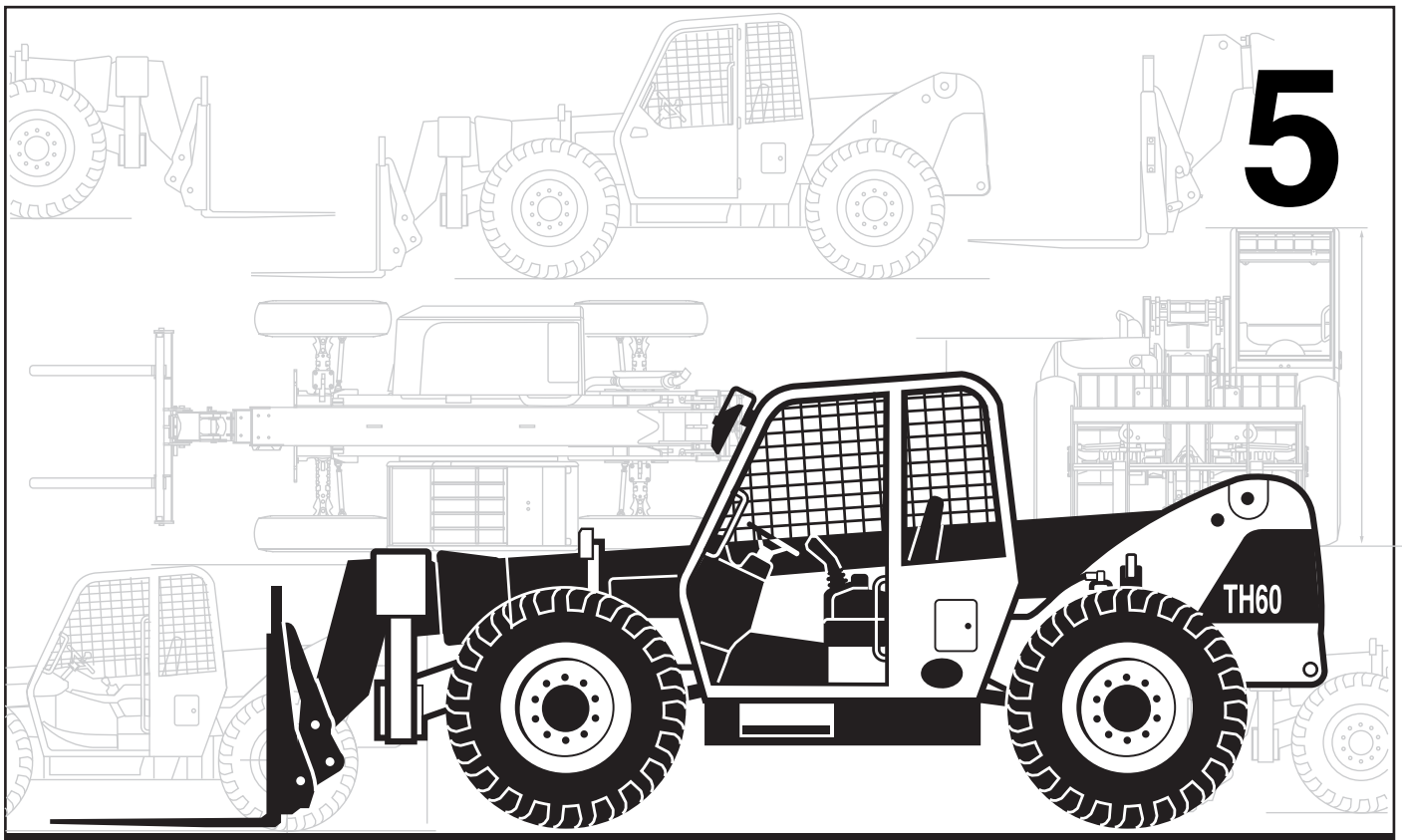
Rear axle	
Capacities, including differential and hubs	11.7 lit (3.1 US gal)

Hub; hub reduction

Hub reduction

Hub reduction	
Hub reduction gear ratio	1: 6.00
Number of satelites	4
Oil volume per hub	1.5 l (0.40 US gal)

5



Brakes

PRELIMINARY DOCUMENT

Contents

BRAKE

51 WHEEL BRAKE

510 General, common info about 511 - 519

Service Brake

The service brakes are a hydraulically actuated, multi plate, oil bath type, housed inside the axle housing on either side of the differential. They are designed to provide long trouble free service life by utilizing the oil in the axle to cool the brake assembly, and by using the gear reduction at the hub to reduce the braking effort.

Service brake, inspection

1 Put the machine in Service position 1, see *TH60/TH80, 191, Safety rules when servicing*.
2 Remove the oil level plugs (2). One is on the front side and one is on the rear side of the axles.

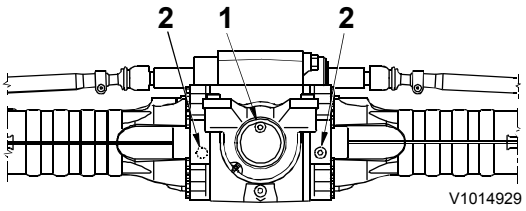


Fig. 1
2 Oil level plug

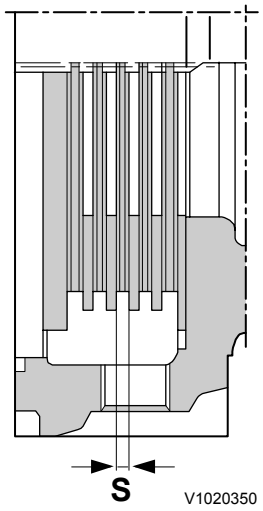


Fig. 2

3 Apply the brakes, and while they are applied, measure the distance between the disc using a feeler gauge. The minimum distance (S) between the discs is **4.5 mm (0.177 in).** If the brakes are worn beyond the wear limit, the brake discs must be replaced.
4 Repeat steps 1 – 3 on the other axle.

52 HYDRAULIC BRAKE SYSTEM

520 General, common info about 520 - 522

Service brake, bleeding

NOTE! The service brakes operate on hydraulic system pressure and fluid. There is no fluid reservoir to fill or maintain.

Perform this procedure in the following order: Right rear brake, left rear brake, right front brake, left front brake.

1 Put machine in service position 1, see *TH60/TH80, 191, Safety rules when servicing*.

2 Ensure that the hydraulic oil is at the proper level in the main hydraulic tank.

3 Start the engine and leave it running throughout the procedure.

4 fit a clear hose over the brake bleed valve so the oil can be directed into a drain pan.

5 Have an assistant depress the brake pedal while the bleed valve is opened. Watch for air in the oil as it flows through the clear hose.

6 Once the oil flows free of air, close the bleed valve.

7 Test brakes for proper function.

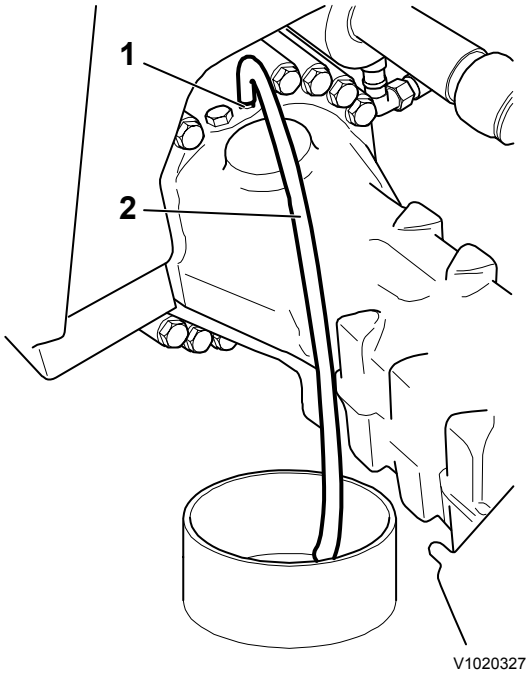


Fig. 3
1 Bleed nipple
2 Hose

Pressure settings accumulator system

Tools:
11666020 Manometer 0–250 bar
14290262 Adapter Tema– Minimess
14290266 Hose

Accumulator pressure

1 Put the machine in service position 1, see *TH60/TH80, 191, Safety rules when servicing*.

2 Run the hydraulic system until the oil temperature is **38 °C – 50 °C (100 °F – 122 °F).**

WARNING!

Hot hydraulic oil and hydraulic oil under pressure may result in severe personal injuries

3 Open the rear cover to get access to the hydraulic main valve.

4 Connect the pressure gauge to pressure nipple ACCM1. The nipple is located to the right side, at the intake manifold. (no picture yet)

5 Start the engine and run at **2500 rpm**. Roll the fork all the way up and hold at relief.

6 Read the pressure gauge.
Correct maximum pressure is: **210 ±5 Bar (3046 ±72 PSI).**

7 Replace cartridge if the correct pressure cant be achieved.

8 Remove the pressure gauge and close the rear cover.

55 PARKING BRAKE

550 General, common info about 551 - 554

Hydraulic cylinder Parking brake, manual release

1 Place the machine in service position, see section *TLH6/TH80, 191, Safety rules when servicing*.

2 Release the parking brake by giving a hammer blow to the external ring of the check unit .

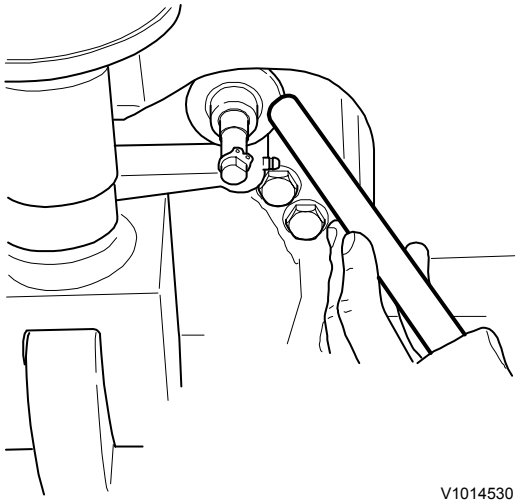
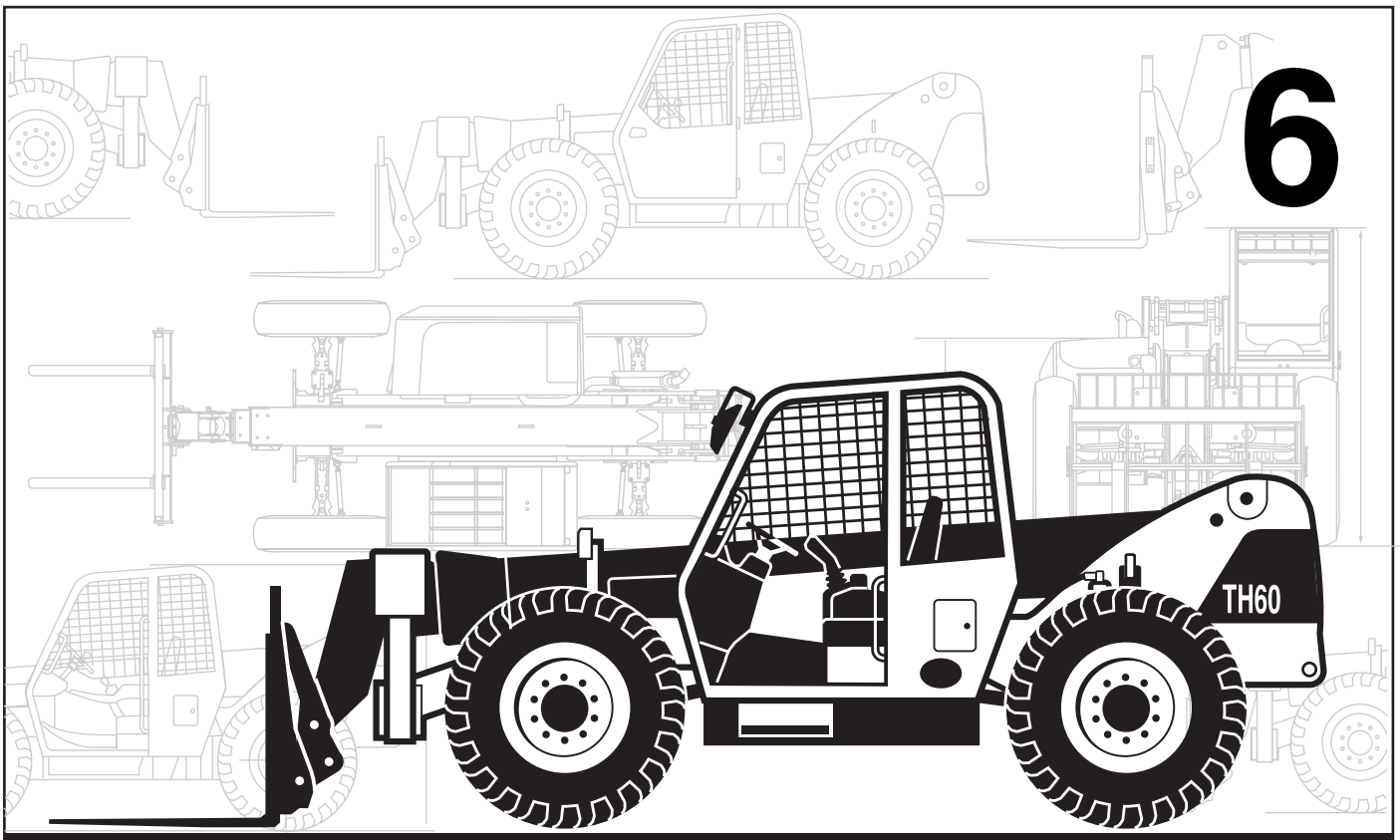


Fig. 4 Parking brake lever

Reset the parking brake

3 Reset the parking brake by starting the machine and introduce pressure into the braking system. Check that, at end of the piston stroke, the check unit is actually engaged onto the rod.

6



Steering

PRELIMINARY DOCUMENT

Contents

STEERING

60 GENERAL

600 Comprehensive info, steering

Steering system, specifications

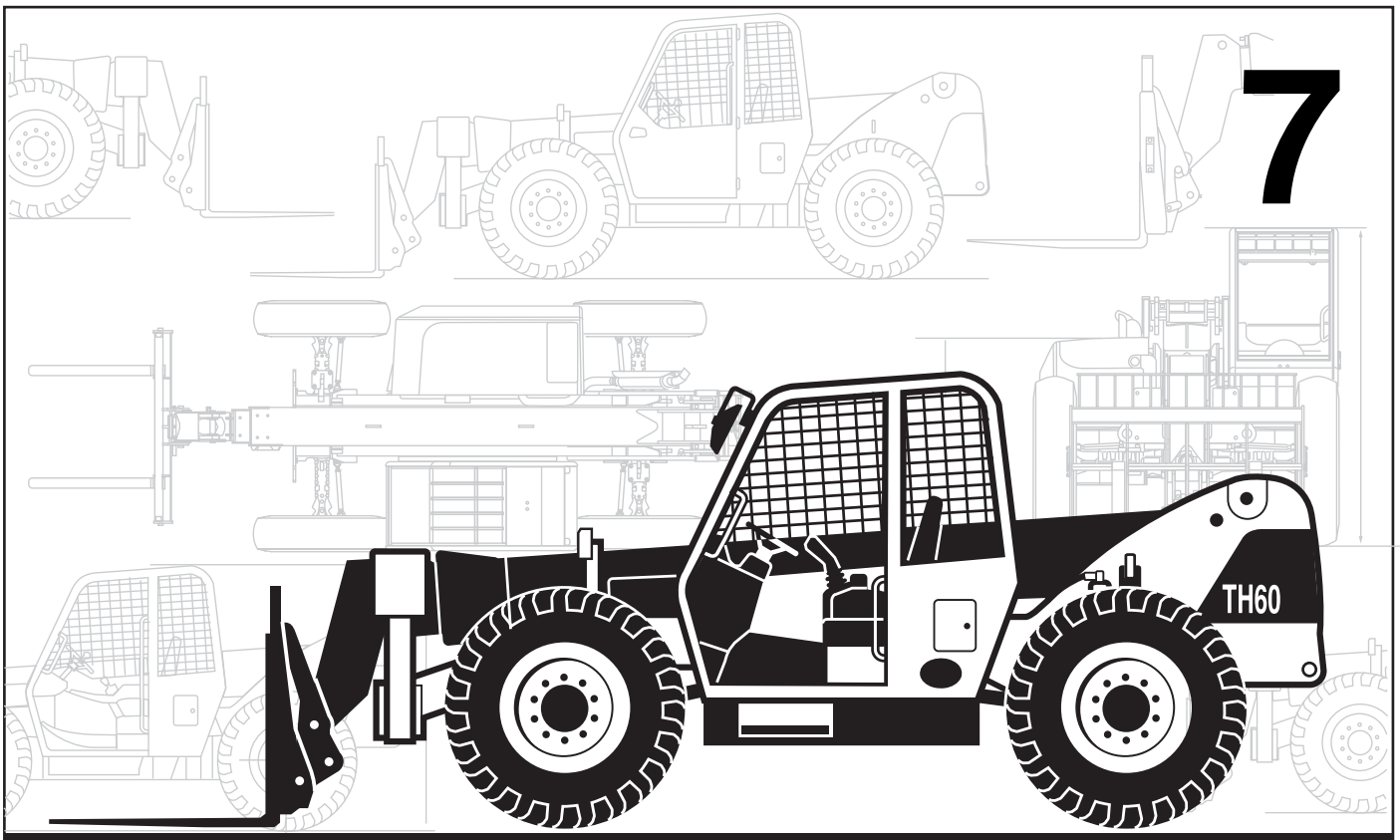
Steering system	
Type	Powered orbitol
Number of steering wheel revolution, total	3.5
Steering angle	45 degree steering angle
Turning radius between walls	3.9 meters (12 ft 11 in)

Pressure build up, steering

The figures in the text below refer to the Hydraulic diagram A *TH60/TH80, 990, Hydraulic diagram A*.

The oil flow continues into the pressure regulator **(7)** which reduce the steering pressure to **175 bar (2538 psi)** if other functions requires higher system pressure. If no other functions are used, then the LS- pressure limits the steering pressure to **159 bar (2306 psi)** by pressure limiting valve **(5)**.
The steering valve is of the type: orbitrol. The steering valve delivers a LS-signal through the shuttle valves **(4)**. The LS- signal affects the priority valve **(6)** and the pressure regulator **(2)**.

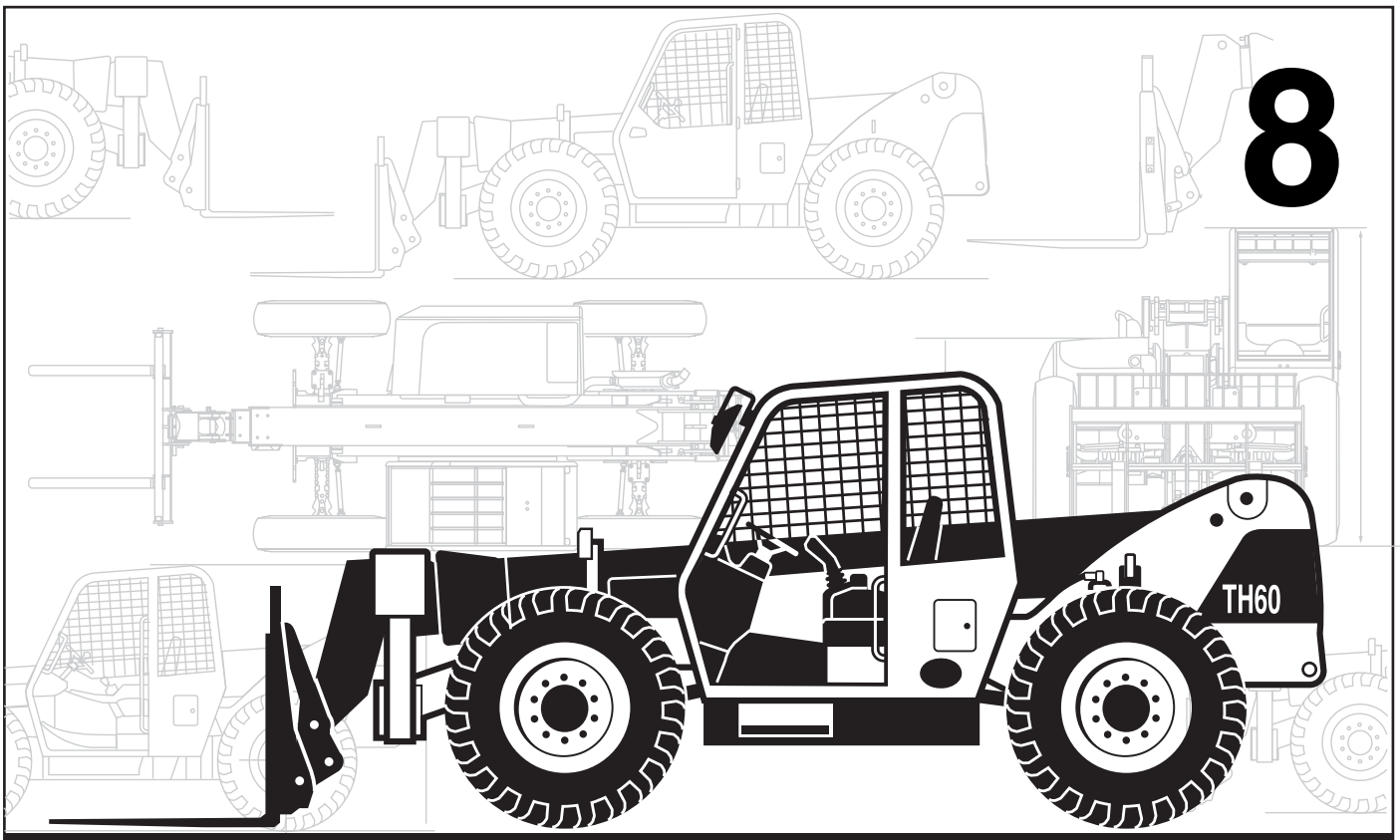
7



Frame

PRELIMINARY DOCUMENT

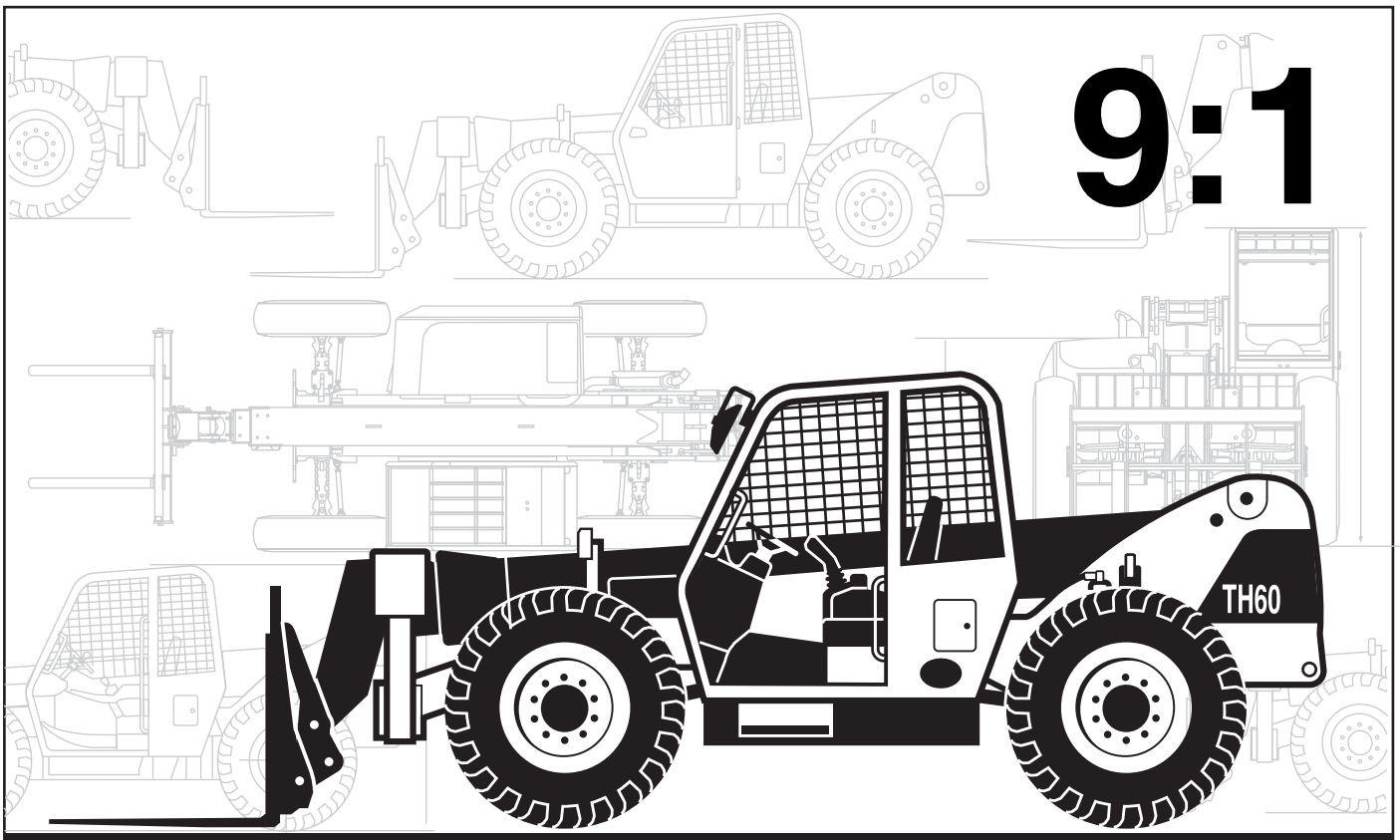
8



Cab

PRELIMINARY DOCUMENT

9:1



Hydraulic System, Description

PRELIMINARY DOCUMENT

Contents

HYDRAULIC SYSTEM; DIGGING/ HANDLING/ GRADING EQUIPM.; MISC. EQUIP.

90 GENERAL

900 General

Hydraulic system, description

The machine is equipped with a load-sensing hydraulic system (LS-system). This system is equipped with a fixed displacement gear pump. The boom and attachment tilt functions are flow sharing in case the flow demand is greater than what the pump can deliver, the flow is divided proportionally according to the operator's lever movements.

The hydraulic oil tank is common to hydraulic system and steering system. It is provided with a return oil filter positioned on the right–hand side of the machine . Venting is through a breather filter with a built in counter pressure.

One gear pump provide all hydraulics with oil. The pump is positioned on the transmission. When the steering or brakes are used, these systems are in priority.

The working pump also serves the servo system with oil.

Functions are controlled by a five spool control valve. The control valve is of the closed centre type. This means that no oil passes through the control valve in neutral position.

Pressure build up, general

The figures in the text below refer to the Hydraulic diagram A.
TH60/TH80, 990, Hydraulic diagram A
The pump **(1)**placed on the transmission pumps oil to the pressure regulator **(2)**. When the hydraulic pressure exceeds **20 bar (290 psi)** and there is no LS signal, the oil will be directed to the tank. The pressure will remain on **20 bar (290 psi)**. This is the stand-by pressure. The pressure limiting valve **(3)** drains the LS pressure to tank when the maximum system pressure **240 bar (3480 psi)** is reached.
The oil goes to the priority valve **(6)** which priorities brakes, steering and servo pressure.
Tilt up and boom lift uses maximum system pressure **240 bar (3480 psi)**, other working hydraulic functions are maximized to **175 bar (2538 psi)** by pressure limiting valve **(19)**.

Pressure build up, brakes

The figures in the text below refer to the Hydraulic diagram A. *TH60/TH80, 990, Hydraulic diagram A*
The oil flow continues to the pressure regulator **(8)** which reduces the brake accumulator charge to **210 bar (3045 psi).** The pressure switch SE 5 **(16)** reads the pressure in the accumulator circuit and energizes MA 17 **(9)** when pressure is between**150 – 182 bar (2176 – 2640 psi)**. MA 17 **(9)** then changes position and drains the LS– circuit, the pump pressure decreases if no other functions are in operation. When the pressure is between**149 – 128 bar (2161 – 1856 psi)**, the power to MA 17 is cut and the pressure increases again. The MA 17 is also energized when the ignition key is in start position.

Pressure build up, servo system

The figures in the text below refer to the Hydraulic diagram A *TH60/TH80, 990, Hydraulic diagram A*.

The oil flow continues through strainer **(10)** into pressure regulator **(11)** which reduce the servo pressure to **30 bar (435 psi).** When the seat sensor is activated, the MA 18 **(13)** will be energized and the servo circuit will be pressurized.
The servo pressure is also used to release the spring applied parking brake **(14)** via the MA 4 **(12)**.

Pressure build up, steering

The figures in the text below refer to the Hydraulic diagram A *TH60/TH80, 990, Hydraulic diagram A*.

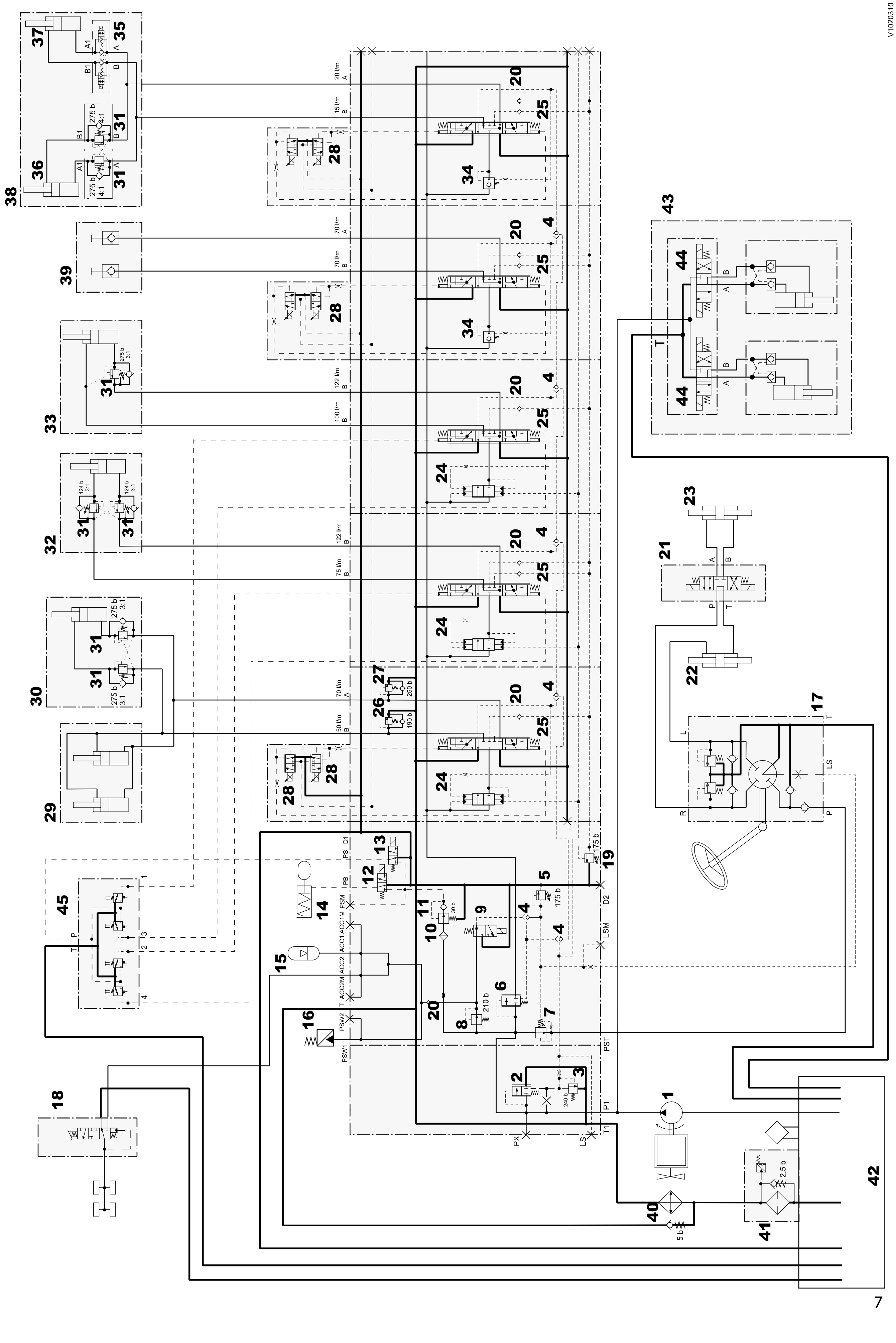
The oil flow continues into the pressure regulator **(7)** which reduce the steering pressure to **175 bar (2538 psi)** if other functions requires higher system pressure. If no other functions are used, then the LS- pressure limits the steering pressure to **159 bar (2306 psi)** by pressure limiting valve **(5)**.
The steering valve is of the type: orbitrol. The steering valve delivers a LS-signal through the shuttle valves **(4)**. The LS-signal affects the priority valve **(6)** and the pressure regulator **(2)**.

Hydraulic pressure, specifications

Function at High idle	Checking points according to hydraulic diagram	Pressure					
		MPa		PSI		bar	
Servo pressure	PS–port	3	±0.5	435	±73	30	±5
∆p LS–pressure/Pump pressure	PM–LS–port (LS–port on manifold)	2	±0.2	290	±29	20	±2
Pump pressure Boom and tilt, up	PM–port	24	±0.5	3480	±73	240	±5
Pressure regulator for brake accumulator, (Max. pressure)	ACC1M–port	21	±0.5	3046	±73	210	±5
Pressure in brake accumulator, SE5 (Max. pressure)	ACC1M–port	15.0 – 18.2		2176 – 2640		150 – 182	
Pressure in brake accumulator, SE5 (Min. pressure)	ACC1M–port	14.9 – 12.8		2161 – 1856		149 – 128	
Precharge pressure in brake accumulator – @70°F	Port on accumulator	4.83	± 0.24	700	±35	48.3	±2.4
Steering, pressure limiting valve LS	LS–port	15.9	±0.5	2306	±73	159	±5
Steering, pressure regulator	PM–port	17.5		2538		175	
Pressure limiting valve for Boom down, Tilt down, Extend and Extra hydraulic outlet, Frame level	PM–port	17.5		2538		175	

Hydraulic diagram, complete

1 Pump
2 Pressure regulator
3 Pressure limiting valve, max pressure (240 bar)
4 Shuttle valve
5 Pressure limiting valve, max. pressure steering (159 bar)
6 Priority valve, steering and brake
7 Pressure regulator, steering (175 bar)
8 Pressure regulator, brake (210 bar)
9 MA 17 Solenoid valve, accumulator charging
10 Strainer
11 Pressure regulator, pilot pressure and parking brake
12 MA 4 Solenoid valve parking brake
13 MA 18 Solenoid valve pilot pressure
14 Parking brake cylinder
15 Accumulator
16 SE 5 Switch for charging accumulator
17 Steering unit
18 Foot brake valve
19 Pressure limiting valve, (175 bar)
20 Non return valve
21 Steering selector (Crab steering, 4-wheel)
22 Front steering cylinder
23 Rear steering cylinder
24 Pressure and flow compensator
25 Valve spool
26 Pressure relief valve (190 bar), tilt down
27 Pressure relief valve (250 bar), tilt up
28 Proportional solenoid valve
29 Slave cylinder for self level
30 Tilt cylinder
31 Load retainer and line rupture valve
32 Extend cylinder
33 Lift cylinder
34 Pressure compensator
35 Solenoid valve frame level
36 Front cylinder frame level
37 Rear cylinder frame level
38 Frame level
39 Extra hydraulic outlet
40 Oil cooler
41 Oil filter
42 Hydraulic oil tank
43 Stabilizer
44 Solenoid valve
45 Joystick


V1020310

Cylinder repair

Disassembly

1 Remove the head from the cylinder body.

2 Carefully slide the rod assembly out of the cylinder.

3 Remove all seal kit components (wipers, rod seals, o-rings, and back-up rings) from the head and piston.

4 Inspect all the parts for scratches, pitting, or polishing. Scratches or pitting deep enough to catch the fingernail are unacceptable; replace the cylinder. Polishing is a sign of uneven loading. When this occurs, the part must be checked for roundness. Use the following recommendations for different cylinder sizes.
Cylinders more out of round than shown in table should be replaced.

Cylinder size (bore)		Maximum out of roundness	
(inches)	(mm)	(inches)	(mm)
< 7	< 178	0.003	0.076
≥ 7	≥ 178	0.005	0.127

Assembly

NOTE! Torque all hardware to the specifications listed in the General Information section of this manual unless otherwise specified.

5 Lubricate all components with clean hydraulic fluid.

NOTE! To avoid cutting the seals, do not use sharp-edged tool during replacement. After installing the seals, wait at least one hour before assembling the cylinder to allow the seals to elastically restore their original shape.

6 Install the new components from the seal kits.

7 Lubricate the seals in the head and carefully slide it onto the rod, dust seal end first. Slide the spacer onto the rod (if equipped). Install the o-ring and piston on the end of the rod.
Torque the piston nut according to table:

Description	Piston nut torque
Extend cylinder	410–475 Nm (300–350 lbf ft)
Lift cylinder	2170–2710 Nm (1600–2000 lbf ft)
Tilt cylinder	1900–2300 Nm (1400–1700 lbf ft)
Frame level cylinder	1525–1865 Nm (1125–1375 lbf ft)
Slave cylinder	510–610 Nm (375–450 lbf ft)
Stabilizer cylinder	1085–1355 Nm (800–1000 lbf ft)

8 Lubricate the seals on the piston and the head.

9 Carefully slide the rod assembly into the cylinder.

10 Secure the head to the cylinder.

91 WORKING HYDRAULICS; SERVO HYDRAULICS

913 Pump, working hydraulics

Hydraulic pump, specifications

NOTE! Values are settings and theoretical values, not to be used for testing.

Hydraulic pump	
Type	Gear pump
Designation	CPB 032 R2 AX AL
Displacement	cu. in. / rev 3.14 cc/rev 51.49
Capacity @ 2500 rpm (Theoretical)	128.73 l/min (US 33.98 GPM)
Continuous Pressure	25 MPa (250 bar) (3600 PSI)
Intermittent Pressure	27.5 MPa (275 bar) (4000 PSI)
Peak Pressure	31 MPa (310 bar) (4500 PSI)
Minimum speed at 2500 PSI	600 rpm
Rotational direction	Clockwise
Weight	20.90 lbs (9.48 kgs)

Hydraulic pump, description

The pump is a fixed displacement gear pump. The principle for such a pump is described in the picture below.

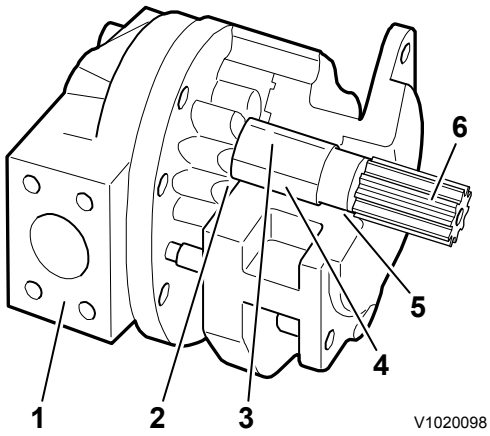


Fig. 2
1 Inlet
2 Pressure plate
3 Shaft journals
4 Bushings
5 Shaft seal
6 One piece shaft & gear

94 UNIT, LOAD HANDLING

940 General, common info about 941 - 945

Retracting and lowering the boom without hydraulic power

Tools:
Minimess hose

NOTE! In case of loss of hydraulic power, it can be necessary to retract and lower the boom manually.

NOTE! The boom must be retracted first and then lowered. Lowering the boom while its still extended may cause forward instability, resulting in machine tip over.

NOTE! If the boom already is in a horizontal position, it must be retracted with a winch.

1 Secure the risk zone around the machine from unauthorized persons.

2 Remove load and secure the machine.

3 Block the wheels.

4 Secure the boom with a suitable stand or packing.

5 Open the rear hatch on the machine.

6 Loosen the lock nut on the extend cylinder counterbalance valve. Turn the socket head screw clockwise until the boom retracts.

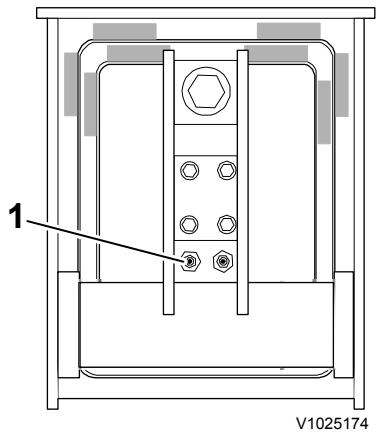


Fig. 3 Rear view
1 Counterbalance valve

WARNING!

Risk of injuries from crushing!

There is no working clearance between the boom and frame when the boom is lowered.

7 Support the front end of the boom with a suitable lifting device and remove the stand or packing.

8 Attach a minimess hose to the pressure nipple port PM on the hydraulic main valve manifold.

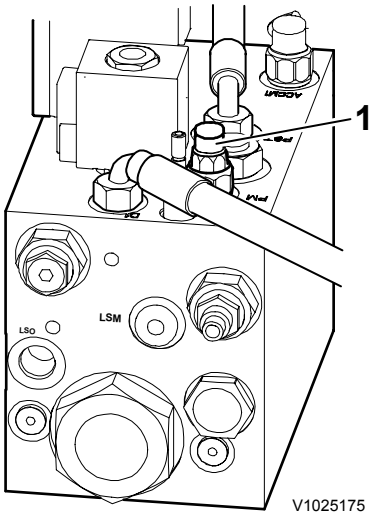


Fig. 4 Section of main valve manifold
1 Pressure port PM

9 Attach the other end of the minimess hose to the nipple on the lift cylinder valve block.
The boom will lower very slowly.

NOTE! The extend cylinder counterbalance valve must be replaced after the setting has been altered to retract the boom. Contact a workshop authorized by MEC.

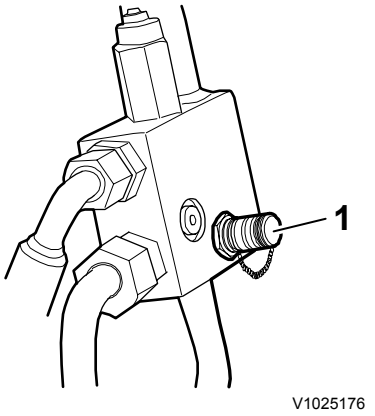
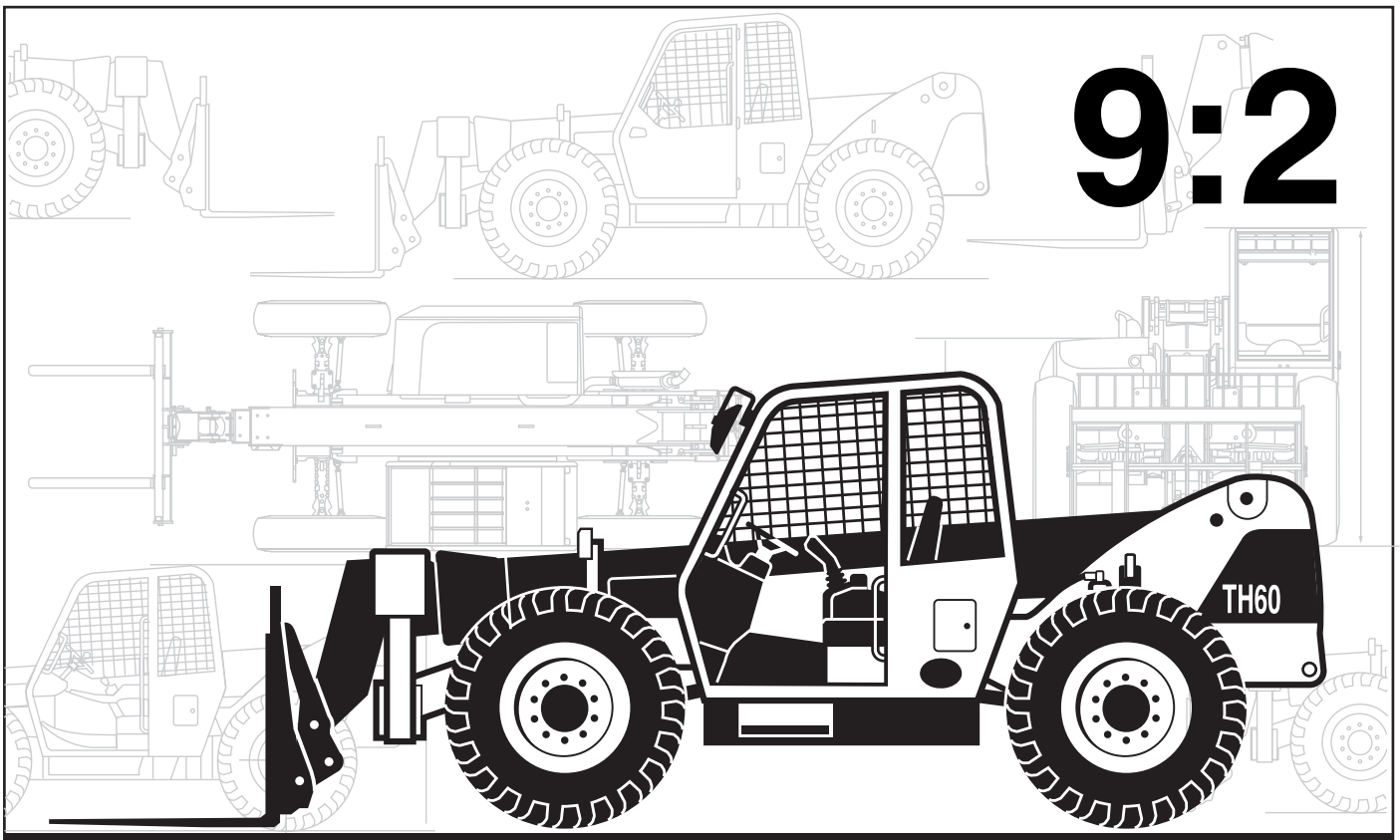


Fig. 5 Lift cylinder valve block
1 Nipple

9:2



Hydraulic System, Repair Instructions

PRELIMINARY DOCUMENT

Contents

HYDRAULIC SYSTEM; DIGGING/ HANDLING/ GRADING EQUIPM.; MISC. EQUIP.

91 WORKING HYDRAULICS; SERVO HYDRAULICS

914 Servo hydraulic system

Pressure limiting valve

Pressure settings, limiting valve

Tools:
11666020 Manometer 0–250 bar
14290262 Adapter Tema– Minimess
14290266 Hose

Servo pressure

1 Put the machine in service position 1, see *TH60/TH80, 191, Safety rules when servicing*.

2 Run the hydraulic system until the oil temperature is **38 °C – 50 °C (100 °F – 122 °F).**

WARNING!

Hot hydraulic oil and hydraulic oil under pressure may result in severe personal injuries

3 Open the rear cover to get access to the hydraulic main valve.

4 Connect the pressure gauge to pressure nipple PS. The nipple is located to the left side of the main valve.

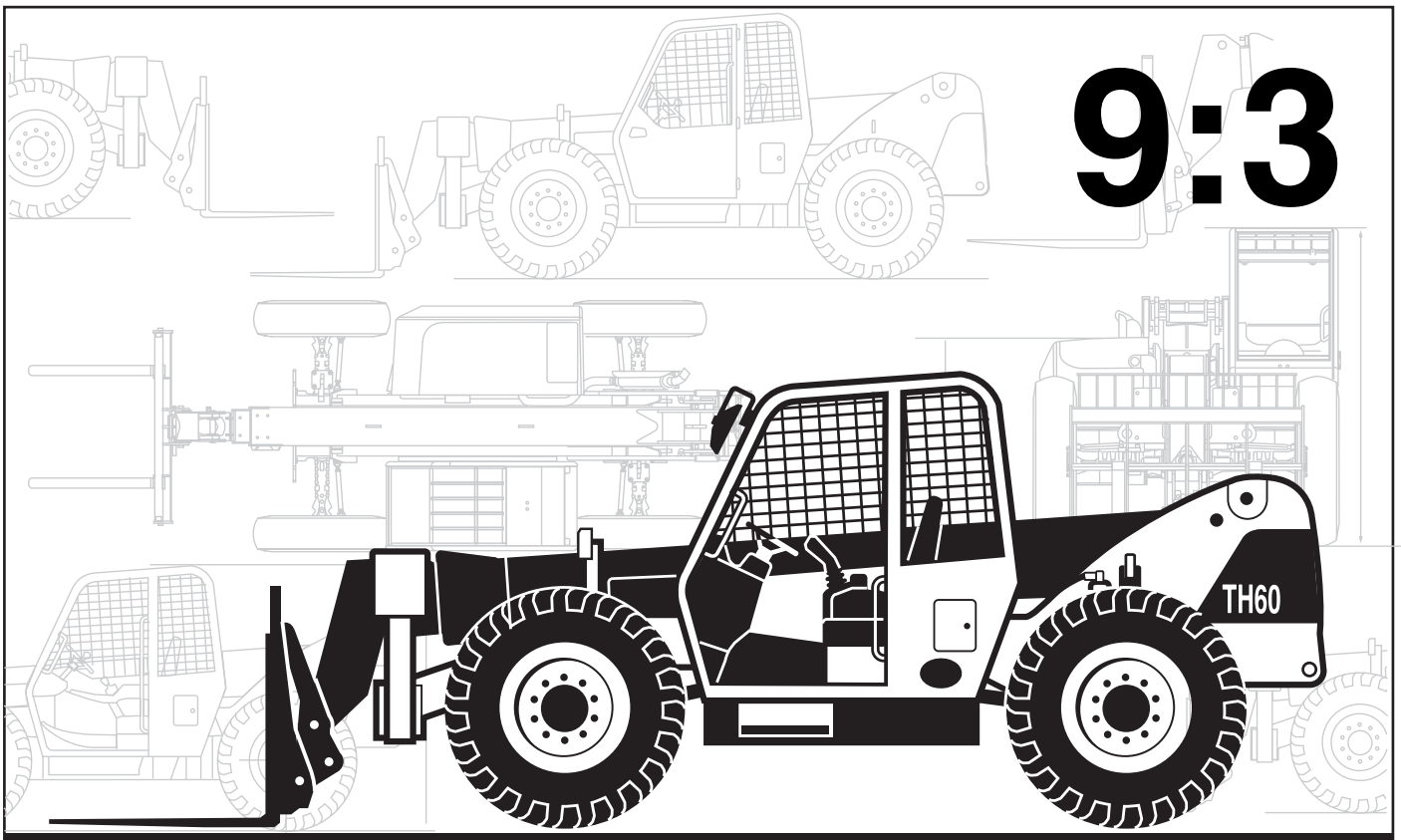
5 Start the engine and run at **2500 rpm**. Lower the boom until stroke end and keep it under pressure.

6 Read the pressure gauge.
Correct maximum pressure is: **30 ±5 Bar (435 ±72 PSI).**

7 The servo pressure is not adjustable! Replace cartridge and measure the servo pressure again to verify it is correct.

8 Remove the pressure gauge and close the rear cover.

9:3



Hydraulic System, Diagrams

PRELIMINARY DOCUMENT

Contents

HYDRAULIC SYSTEM; DIGGING/ HANDLING/ GRADING EQUIPM.; MISC. EQUIP.

94 UNIT, LOAD HANDLING

942 Boom, load handling

Boom, extend cylinder and chains, removal and installation

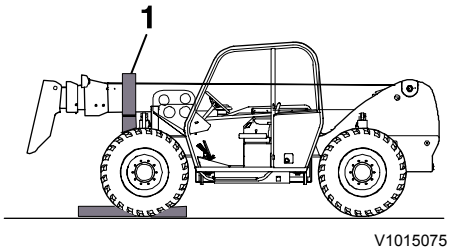


Fig. 1
1 Boom support

Removal

IMPORTANT! Plug all pipes, hoses and connections when removing.

1 Remove fork carriage or other attachment from the boom.

2 Park the machine on a firm, level surface with the parking brake set and the wheels chocked.

3 Support the boom in a horizontal position with the boom fully retracted. Use a stand to support the boom.

4 Extend the tilt cylinder as much as needed for future removal of piston rod end.

5 Open and remove the rear cover.

6 Remove the oil tubes from the rear of the boom.

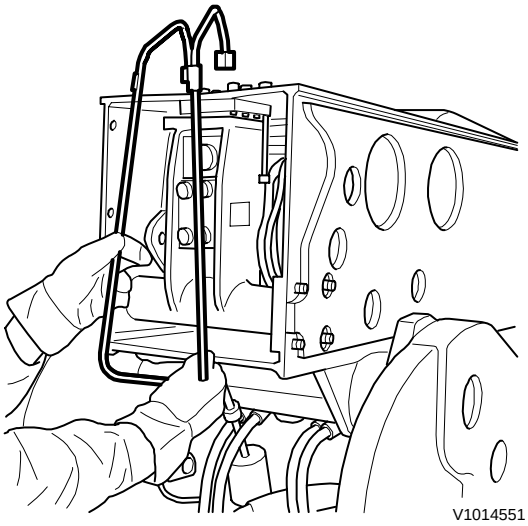


Fig. 2

7 Remove the extend chain adjustment bolt and the retaining plate from the cylinder support bracket at the rear of the boom.

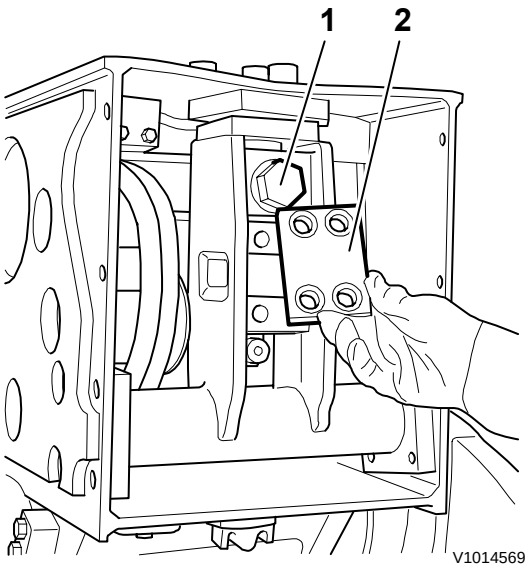


Fig. 3
1 Chain adjustment bolt
2 Retaining plate

8 Remove the cylinder support bracket.

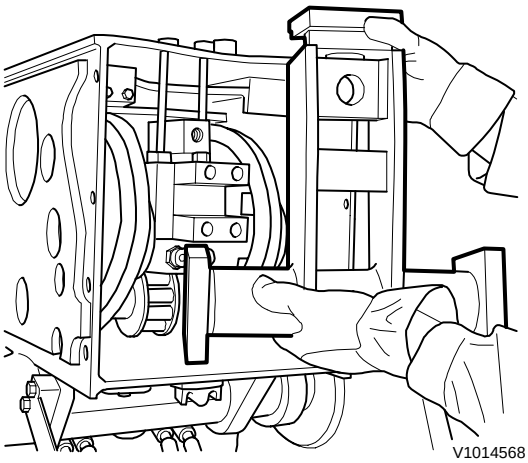


Fig. 4

9 Remove the extension oil tubes.

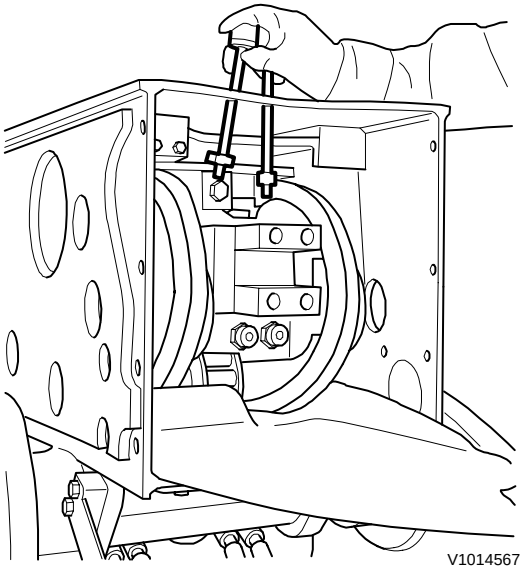


Fig. 5

10 Secure the upper tilt cylinder end with a sling and disconnect the hoses from the tilt cylinder.

11 Remove the retaining ring and drive out the upper pin with a hammer and a driver. Lift or pull the tilt cylinder slightly forward for better access to remove the hydraulic hoses for the auxiliary output if the machine is so equipped.

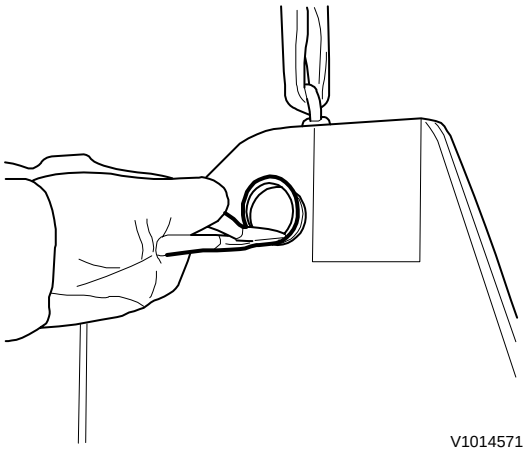


Fig. 6

12 Remove the hose guide rollers. Also remove the rollers to the left for auxiliary output hoses if machine is so equipped.

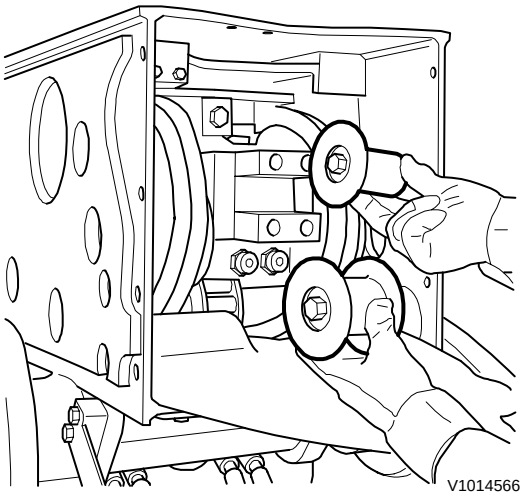


Fig. 7

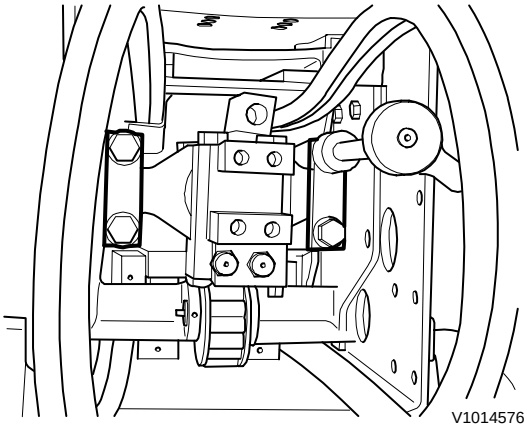


Fig. 8

13 Pull out the hoses enough to get access to the cylinder retaining plates and remove them.

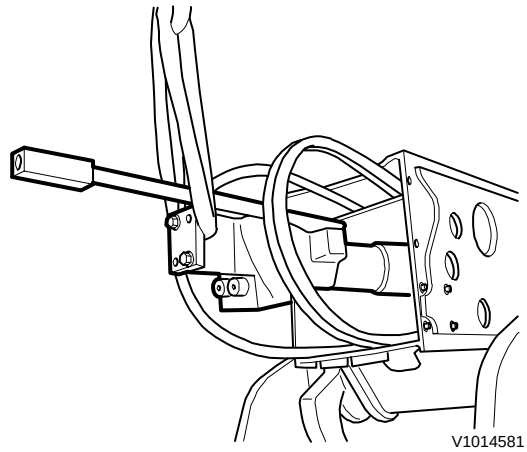


Fig. 9

14 Attach a sling to the clevis end of the cylinder and reinstall the retaining plate. Extract the cylinder out from the boom until the entire extension chain rod is visible.

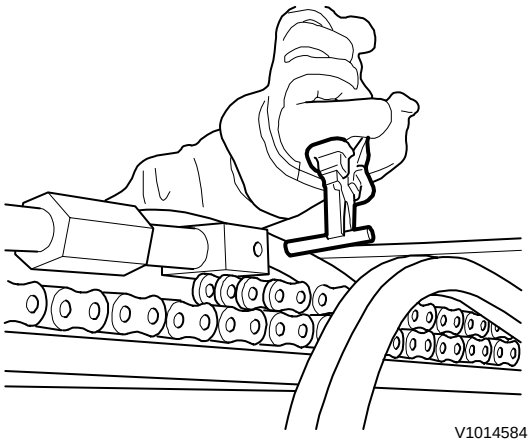


Fig. 10

15 Remove the pin that attaches the extension chain to the rod. Remove the rod and put the chain on top of the boom.

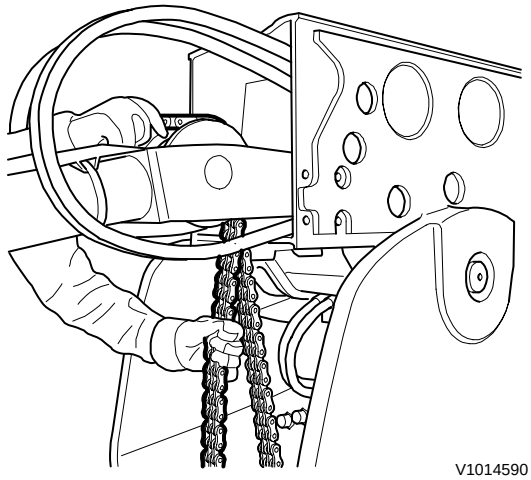


Fig. 11

16 Extract the cylinder until the front chain guide roller stops at the chain block. Lower the extracted end of the cylinder until the front chain guide roller clears the chain block and extract the cylinder until the chain guide roller passes the chain block.
Keep the front end of the cylinder inside the boom assembly and pull the extension chain through the chain guide roller.

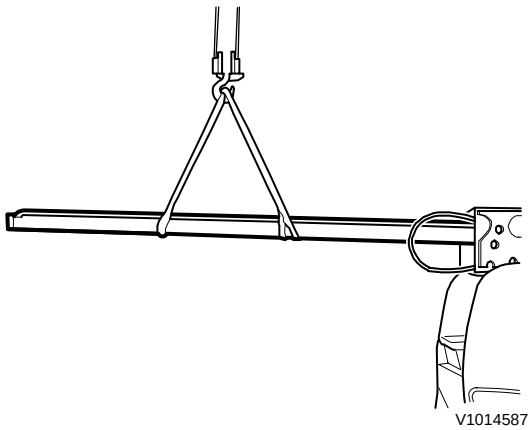


Fig. 12

17 Attach a second sling to the cylinder and lift in a level position.

NOTE! Cylinder weight: **195 kg (430 lb).**

18 Put the cylinder on suitable supports.

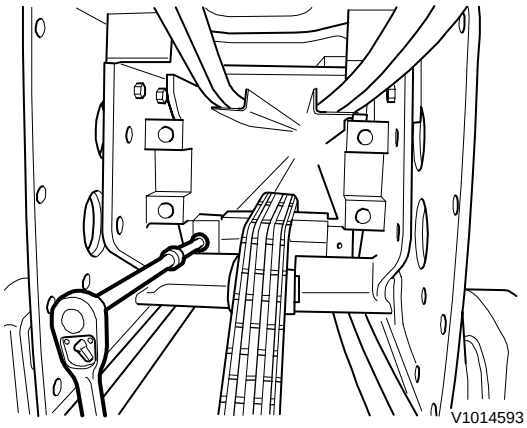


Fig. 13

19 Remove the set screws for the chain block pin.

20 Drive the chain block pin out with a hammer and a driver.

21 Lift the chain block out from the boom section 2.

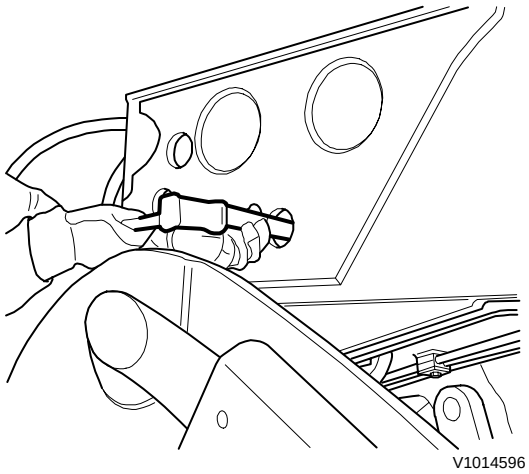


Fig. 14

22 Remove the set screws for the chain guide roller pin.

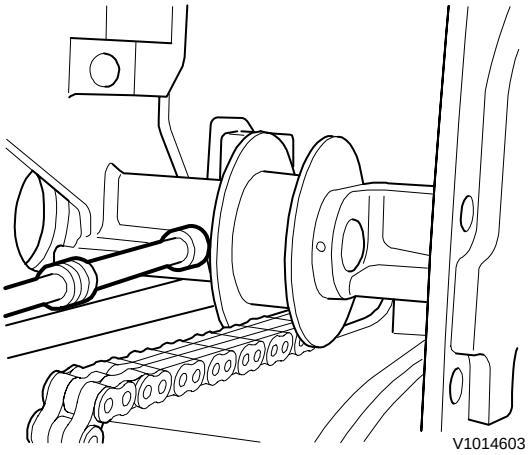


Fig. 15

23 Drive the pin out with a hammer and a driver.

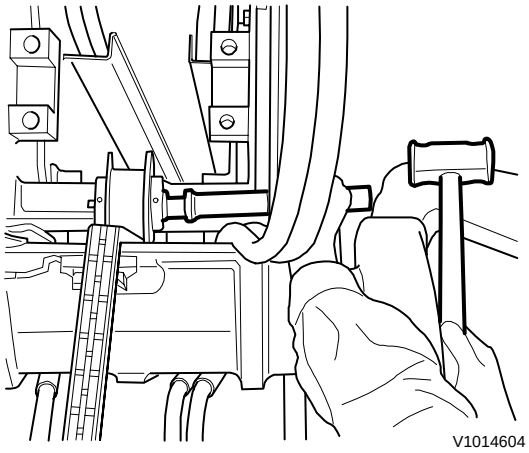


Fig. 16

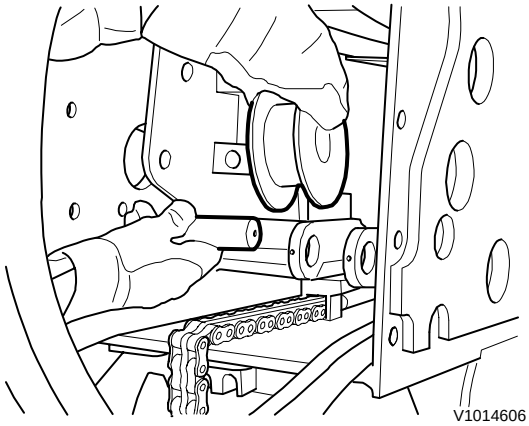


Fig. 17

24 Remove the pin and chain guide roller.

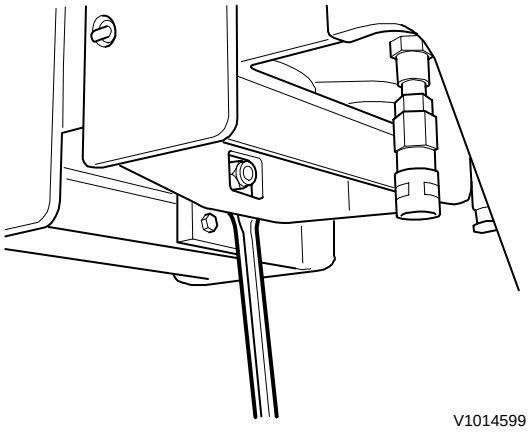


Fig. 18

25 Remove the retraction chain adjustment nut and it's fastening plate.

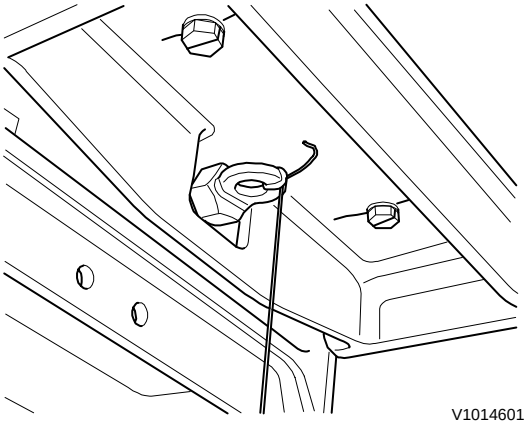


Fig. 19

26 Attach a rope to the chain rod end. A nut with a welded washer can be of great help. The rope is used as guide when the new chain is installed.

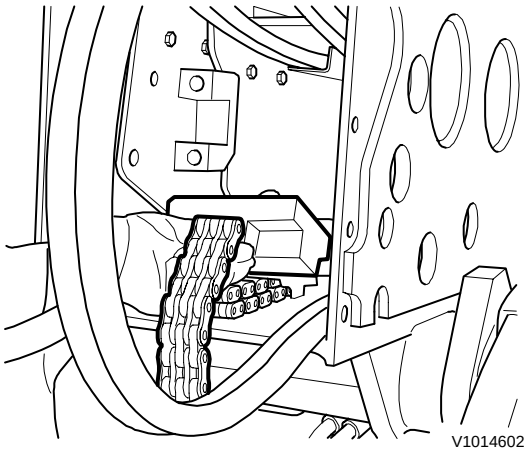


Fig. 20

27 Lift up the chain block and pull out the retraction chain at the rear end of the boom assembly.

28 Make sure that the rope is kept in between the boom sections 1 and 2.

Installation

Inspect and make sure that both chains and chain guide rollers are in good condition according to instructions in: *Boom chains and chain guide rollers wear inspection, page 43*.

29 Attach the retraction chain to the rope between the boom sections 1 and 2.

30 Lightly lubricate the chain with motor oil as it is inserted and pull until the chain anchor comes out the front end.

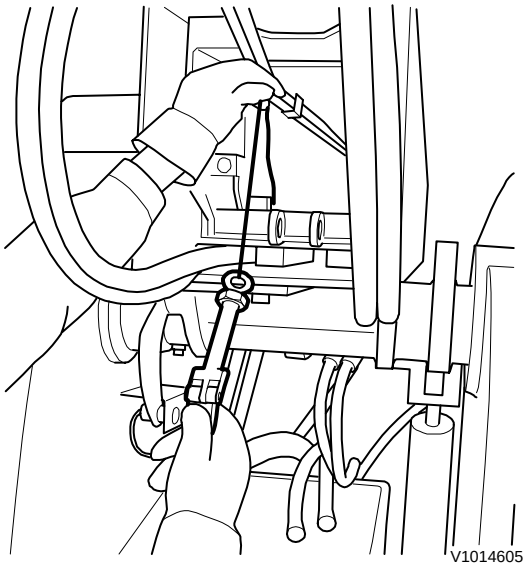


Fig. 21

NOTE! Lubricate the chain with multigrade SAE 20W/50 oil while installed.

NOTE! Do not apply grease to the chain. Grease will coat only the outside of the chain and will seal out the necessary lubricating oil.

31 Install the front fastening plate and tighten the anchor nut lightly.

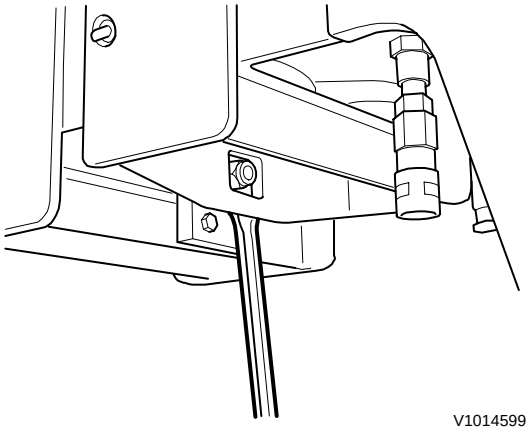


Fig. 22

32 Install the chain guide roller.

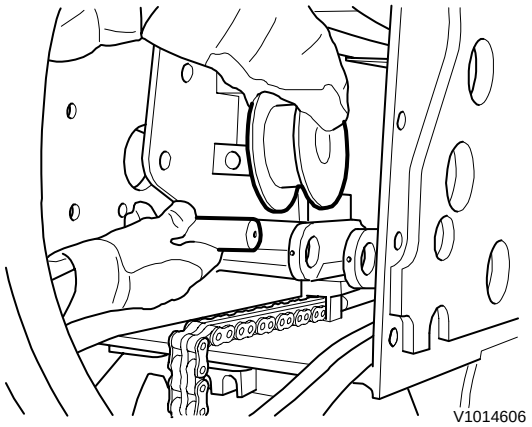


Fig. 23

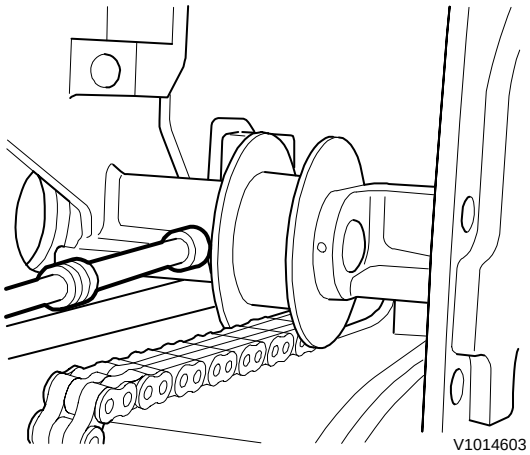


Fig. 24

33 Make sure the set screws apply tension on the pin's flat surface.

NOTE! Use Loctite 242 and torque the set screws to **11 Nm (100 lbf in)**.

34 Secure both chains to the chain block and secure with cotter pins.

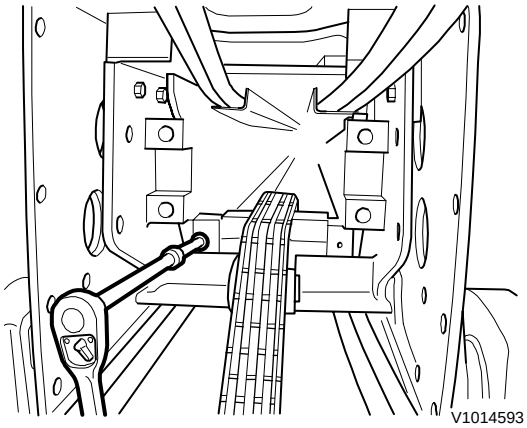


Fig. 25

35 Install the chain block to the rear end of boom section 3, make sure the block is levelled and parallel to the boom. Install the pin and secure set screws with Loctite 242.

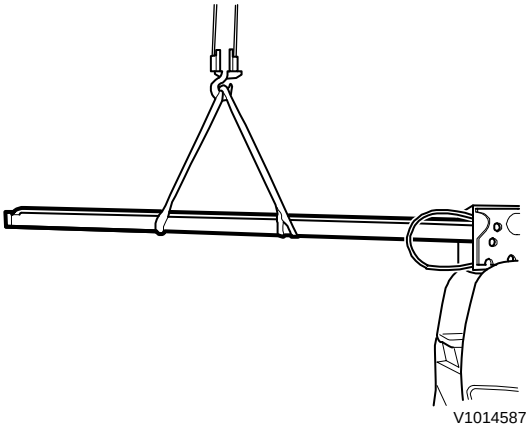


Fig. 26

36 Secure the extension cylinder with 2 slings and lift in a level position. Insert the front sheave end to the boom assembly.

NOTE! Cylinder weight: **195 kg (430 lb)**.

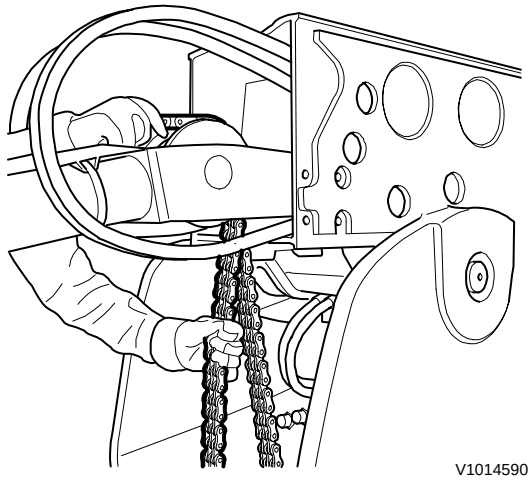


Fig. 27

37 Pull the extension chain up around the chain guide roller and put the chain in the chain guide channel.

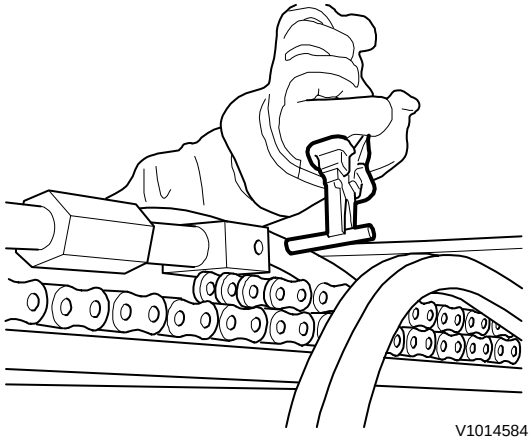


Fig. 28

38 Secure the chain to the chain rod's anchor. Secure the hex block between rod and anchor with Loctite 242.

39 Temporary strap the chain rod to the extension cylinder. The straps prevents the rod from falling down from the cylinder.

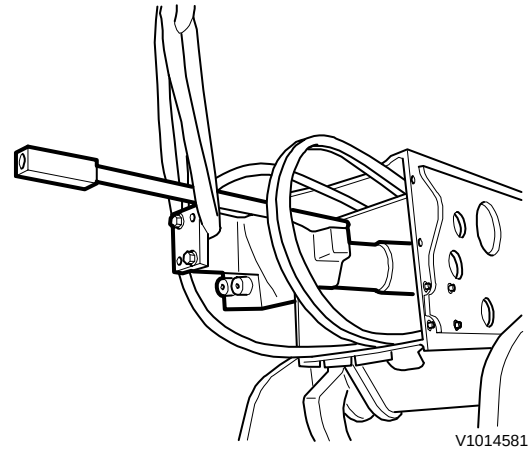


Fig. 29

40 Lower the extracted end of the cylinder until the front end sheave clears the chain block. Insert until the sheave end passes the chain block. Lift the extracted end of the cylinder to a level and insert the complete cylinder into boom 3. Feed the extension chain into the boom sections while inserted, cut the straps as the chain rod goes into the boom assembly. Secure the threaded block to the outer rod end. **Do not** use Loctite 242 since this block must be adjustable when the chain is tensioned.

NOTE! Lubricate the chain with multigrade SAE 20W/50 oil while installed.

NOTE! Do not apply grease to the chain. Grease will coat only the outside of the chain and will seal out the necessary lubricating oil.

41 Remove the sling.

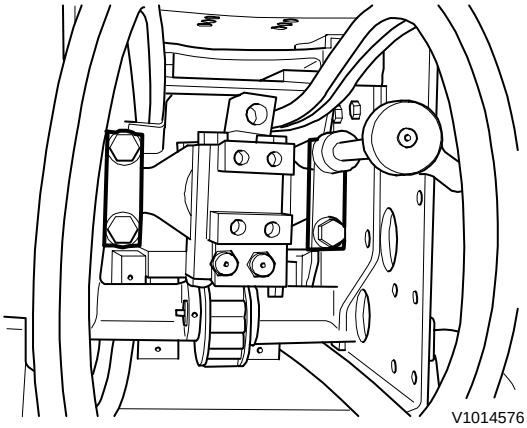


Fig. 30

42 Secure the extend cylinder to boom section 2 and secure the bolts with Loctite 242.

NOTE! Torque the bolts diagonally to **460 Nm (338 lbf ft).**

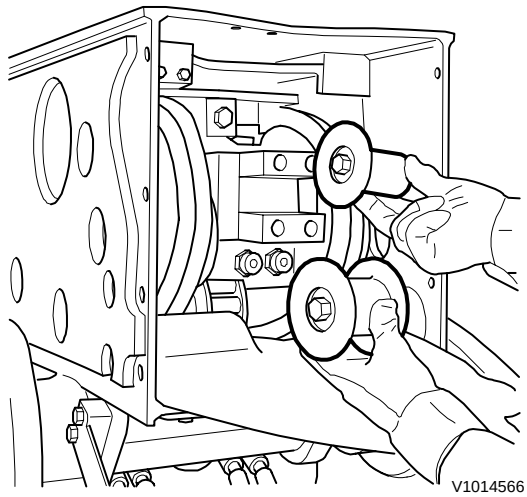


Fig. 31

43 Install hose guide rollers. For tilt cylinder to the right and for auxiliary to the left if machine is so equipped.

44 Push the hoses forward and reconnect them at the front end tilt cylinder and auxiliary output.

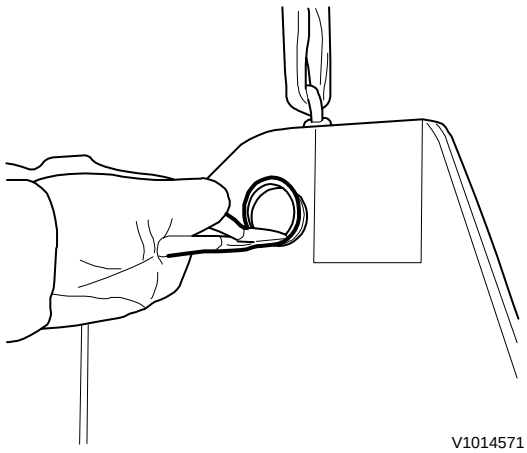


Fig. 32

45 Reinstall the upper pin to the tilt cylinder and secure the pin with the retaining ring.

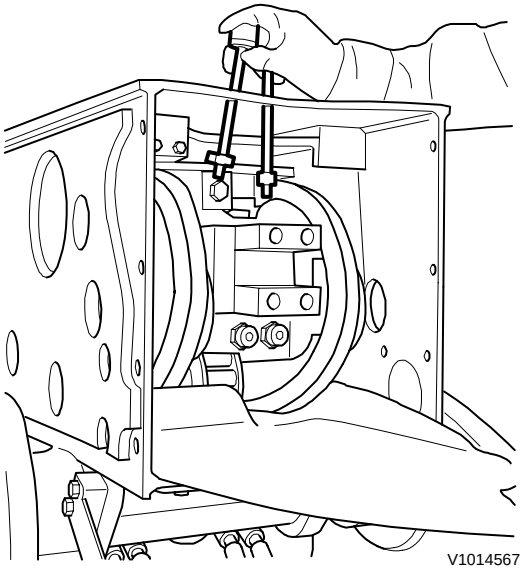


Fig. 33

46 Reinstall the oil extension tubes to the extend cylinder.

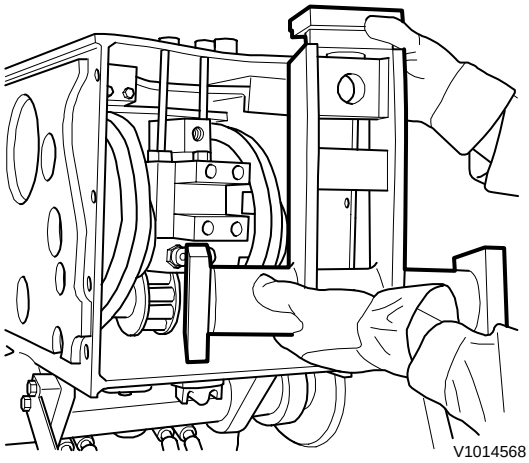


Fig. 34

47 Install the cylinder support bracket and secure the bolts with Loctite 242.

NOTE! Torque the bolts diagonally to **110 Nm (81 lbf ft)**. Ensure the bracket is set evenly without any binding.

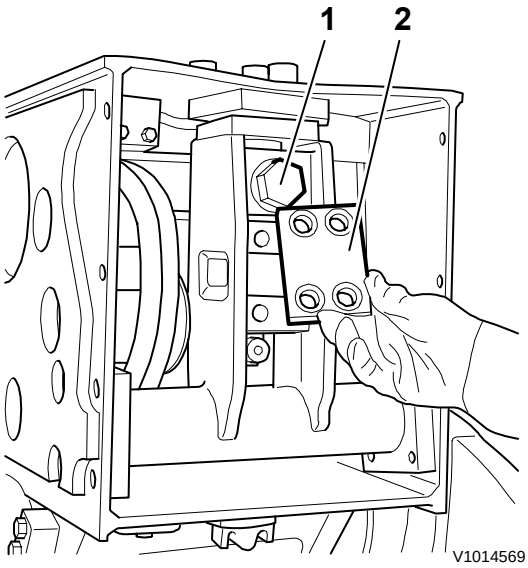


Fig. 35
1 Chain adjustment bolt
2 Retaining plate

48 Install the bolt to the extension chain hex block and tighten lightly.

49 Install the retaining plate and secure the bolts with Loctite 242.
NOTE! Torque diagonally to **245 Nm (180 lbf ft)**.

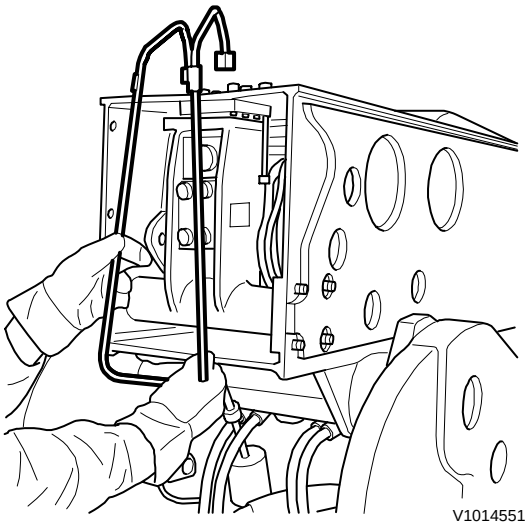


Fig. 36

50 Install the oil tubes at the rear of boom.

51 Reinstall the rear cover.

See further instructions in *Boom chain adjustment, page 46* for setting the tension of chains.

Extend cylinder, repair

For repair of the extend cylinder, its necessary to remove the cylinder from the boom assembly. See section removal in *Boom, extend cylinder and chains, removal and installation, page 3*.
See *TH60/TH80, 900, Cylinder repair* for instructions to repair the cylinder.

Boom sections, removal, overhaul and installation

Tools:
11667001 Handle
11667060 Drive plate
11667085 Drive plate
11667090 Drive plate
11667105 Drive plate

To be able to perform this instruction, it's necessary to perform the instructions in the following instructions first. See section removal in *Boom, extend cylinder and chains, removal and installation, page 3*, removing the hoses, see section removal in *Hydraulic hoses, removal and installation, page 37* and tilt cylinder removal, see *Tilt cylinder, removal and installation, page 51*

WARNING!

Risk of injuries caused by crushing

1 Remove fork carriage or other attachment from the boom.

2 Park the machine on a firm, level surface with the parking brake set and the wheels chocked.

3 Support the boom in a horizontal position with the boom fully retracted. Use a stand to support the boom.

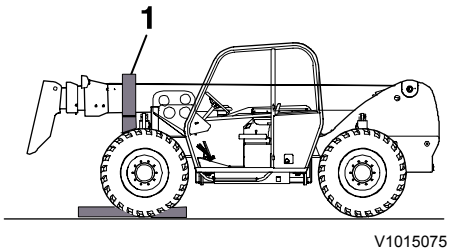


Fig. 37
1 Boom support

Boom section 3, removal

NOTE! Use a M8 screw or a threaded rod with a length of approximately **100 mm (4 in)** to get a hold of the pads as the securing bolts are removed.

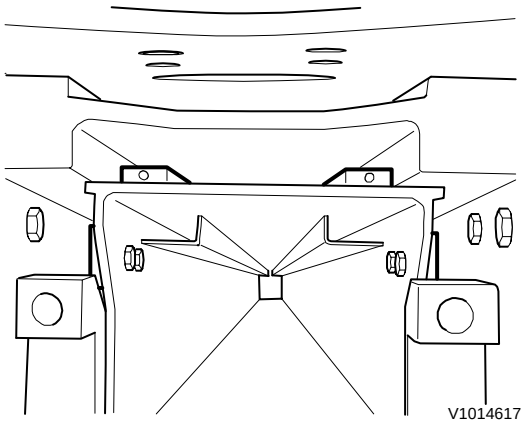


Fig. 38

4 Remove all wear pads from rear end of boom section 3. Two on top, one on each side and one at the bottom.

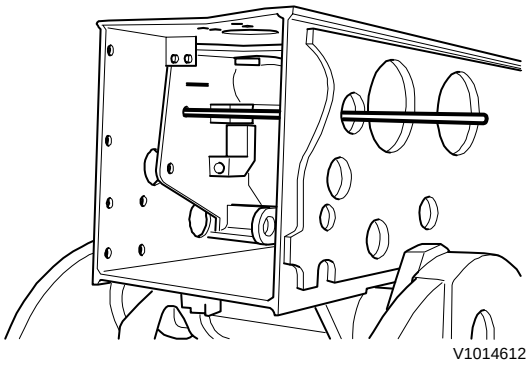


Fig. 39

5 Secure boom section 2 to section 1 with a rod to keep them together while extracting boom 3.

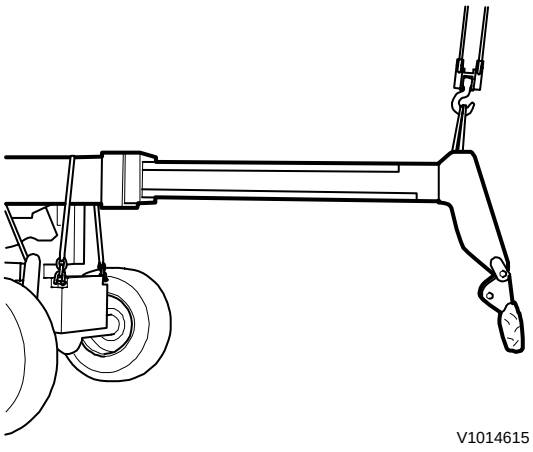


Fig. 40

6 Attach a sling to the front end of section 3 and extract approximately **3 m (120 in).**

NOTE! Total length of boom section 3: **5.1 m (200 in).**

7 Attach a second sling to the boom and extract it fully from the boom.

NOTE! Weight of boom section 3: **557 kg (1230 lb).**

8 Put the boom section 3 on stands or a suitable fixture.

Boom section 2, removal

9 Remove the securing rod from boom section 1 and 2. Remove the retaining plates and the rear upper wear pads from boom section 2.

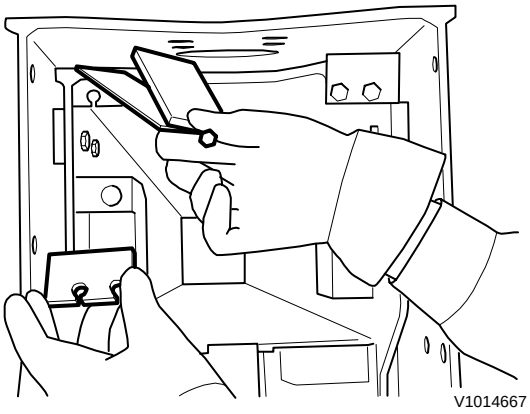


Fig. 41

10 Remove the rear wear pads at the sides from boom section 2, one at each side.

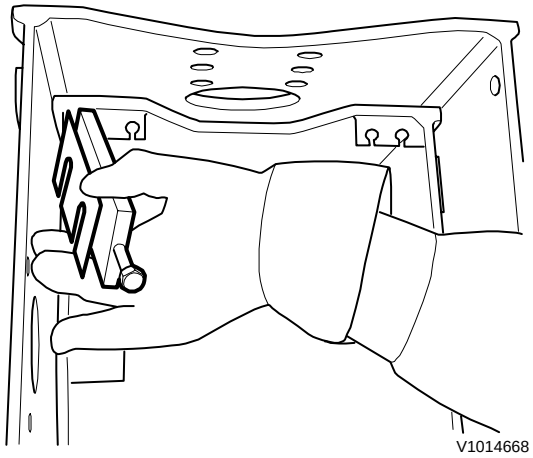


Fig. 42

11 Use a pair of clamps to unload the wear pads mounted on the bottom of boom section 2. Remove the bottom wear pads.

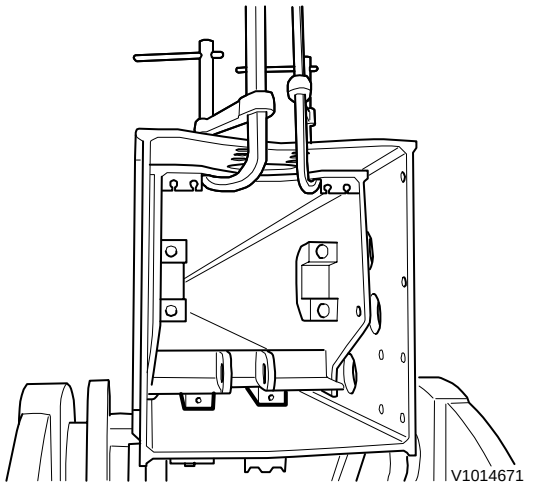


Fig. 43

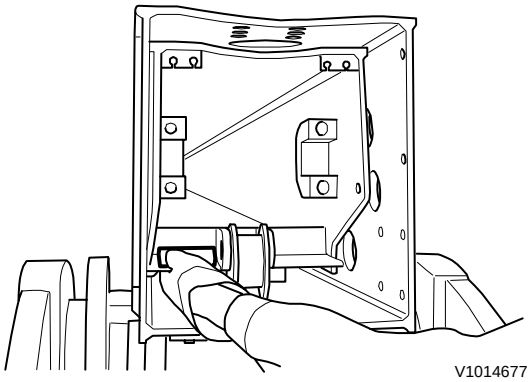


Fig. 44

12 Reinstall the chain guide wheel and it's pin, and then loosen the clamps. The chain guide wheel will ease the extraction of the boom section 2.

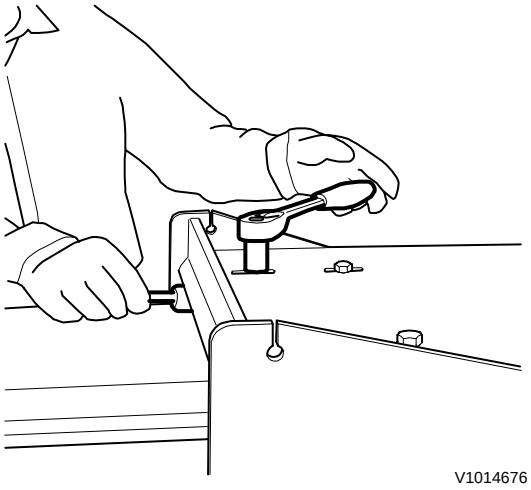


Fig. 45

13 Attach a sling to boom section 2 and extract approximately **0.5 m (20 in).**

14 Give some slack to the sling and remove the upper front wear pads from boom section 1.

15 Extract boom section 2 approximately **3 m (120 in).**
NOTE! Total length of boom section 2: **4.85 m (190 in).**

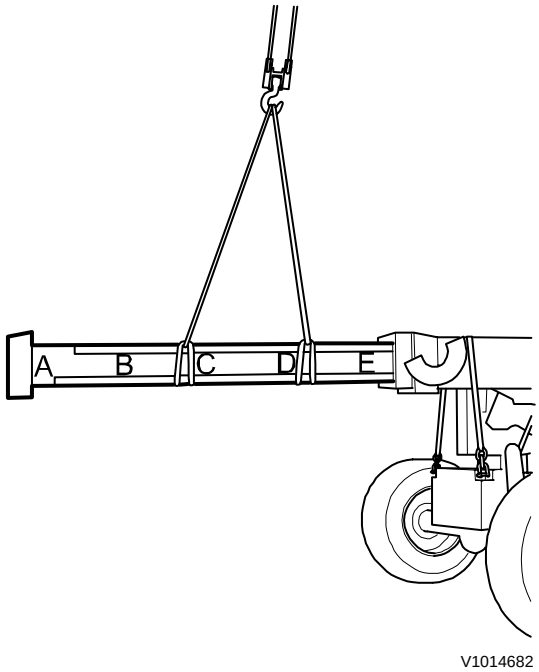


Fig. 46

16 Attach a second sling to the boom and lift in a level position.
NOTE! Weight of boom section 2: **470 kg (1040 lb).**

17 Put the boom section 2 on stands or a suitable fixture and remove the front inner and outer wear pads. A total number of 8 pads.

Boom section 1, removal

It is necessary to remove the front end support to the lift cylinder before the boom section 1 is removed.

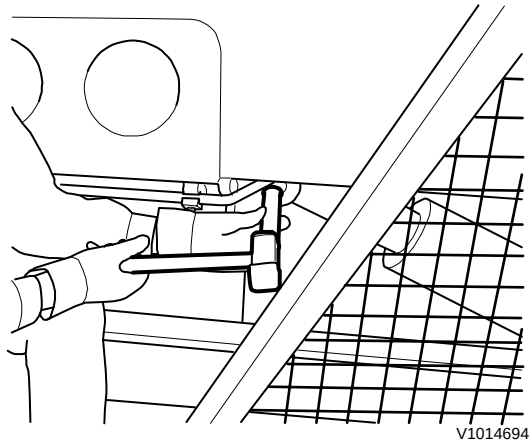


Fig. 47

18 Secure the lift cylinder with a sling and remove the front end pin.

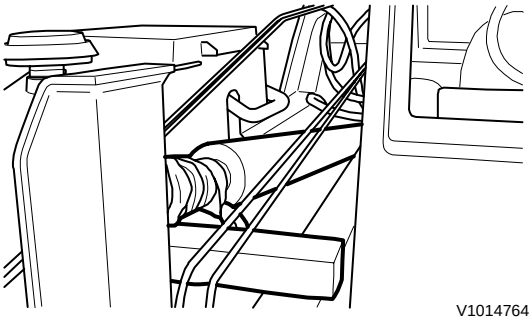


Fig. 48

19 Secure the front end of boom section 1 with a sling and lift until the front end of the lift cylinder clears from the support bracket at the boom section 1.
Lower the lift cylinder and support it to the front end of the main frame.
Remove the hydraulic oil tubes along the boom and lay them on the main frame.

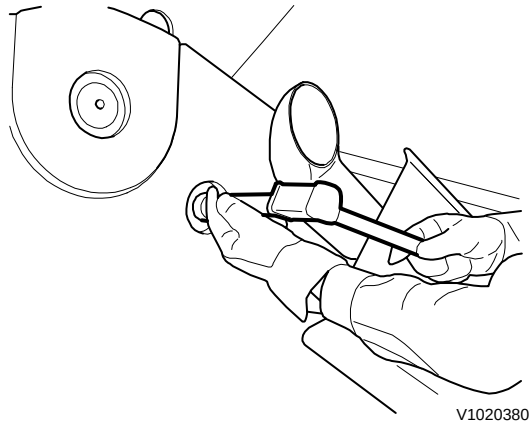


Fig. 49

20 Temporary remove the vertical front end support and lower the boom section 1 until the upper support for the slave cylinders facing the holes in the main frame.
Disconnect the upper joint to the slave cylinders attached to the boom section 1, by first removing the lock screw and then drive the pin out with a hammer and a driver.

21 Reposition the boom section 1 in it's horizontal position by using the front end support previously removed.

22 Remove the locking screws to the boom main pin.

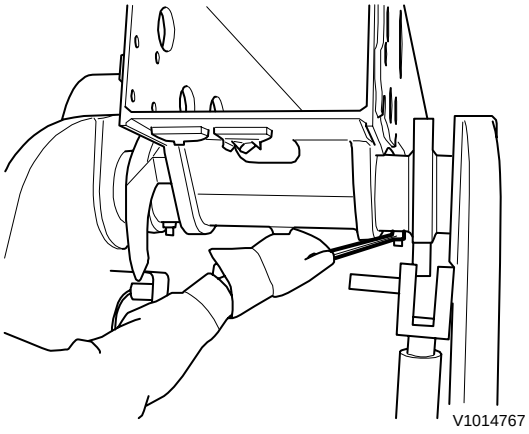


Fig. 50

23 Remove the height indicator plate from the boom.

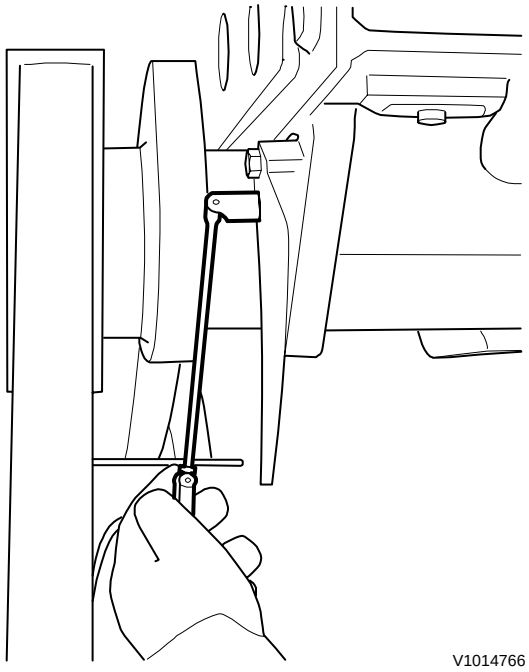


Fig. 51

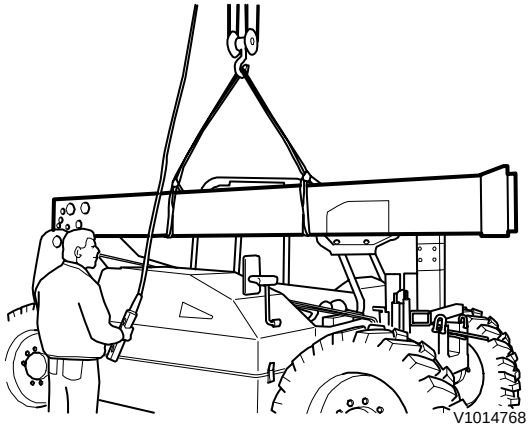


Fig. 52

24 Secure the boom with two lift slings and lift until the rear boom main pin is unloaded.

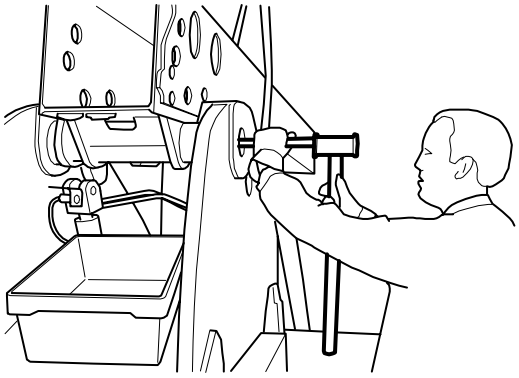


Fig. 53

25 Drive the main pin out from the boom joint. There is a threaded hole in one end of the main pin to attach a puller if extra force is needed.

26 Lift the boom section 1 and place on stands or a suitable fixture.

NOTE! Weight of boom section 1: **750 kg (1655 lb).**
Remove the front inner side and bottom wear pads.
Remove the outer boom guide pads.
Remove the thrust washers located at the bearings in the frame.

Boom main pin bearing, removal and installation

NOTE! When the bearings are removed, clean and control that the bearing surfaces are in good condition.

27 Drive out the bearing. Use tools: handle 11667001 and drive plate 11667085.

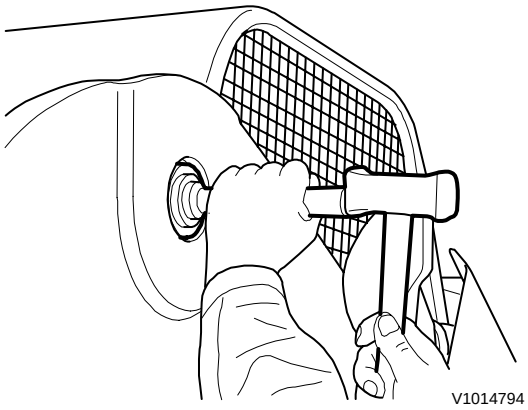


Fig. 54

28 Drive in the new bearing by using the same handle 11667001 and drive plate 11667105.

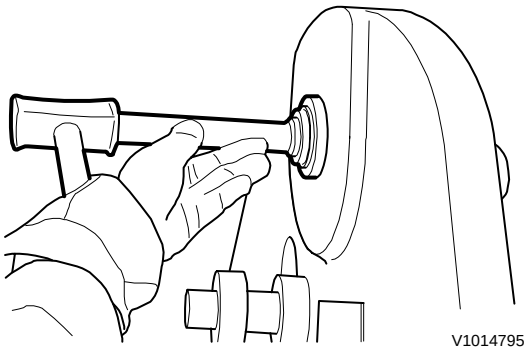


Fig. 55

Lift cylinder, removal and installation while boom is removed

Removal

IMPORTANT! Plug all pipes, hoses and connections when removing.

29 Tag and remove the hoses from the lift cylinder.

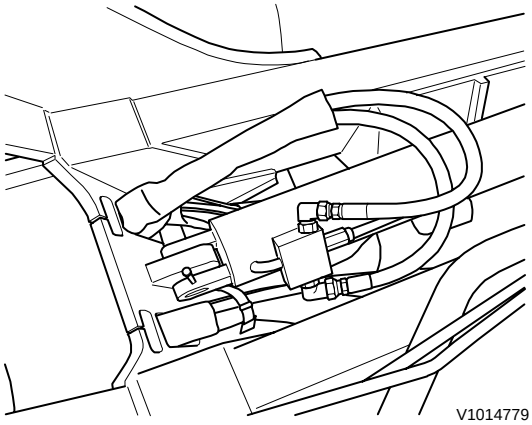


Fig. 56

30 Secure the lift cylinder with a sling and remove the locking screw for the cylinder pin.

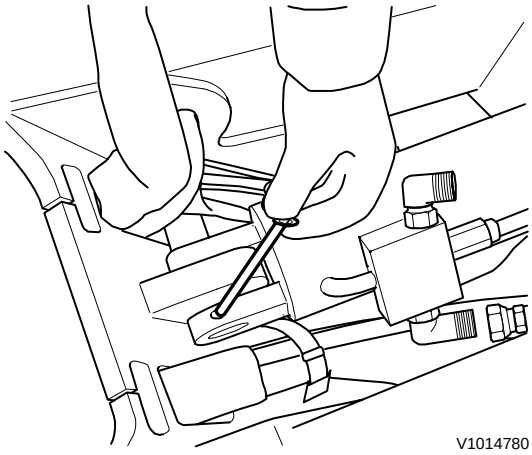


Fig. 57

31 Remove the pin with a hammer and a driver. Use the holes in the side of the frame for better access.

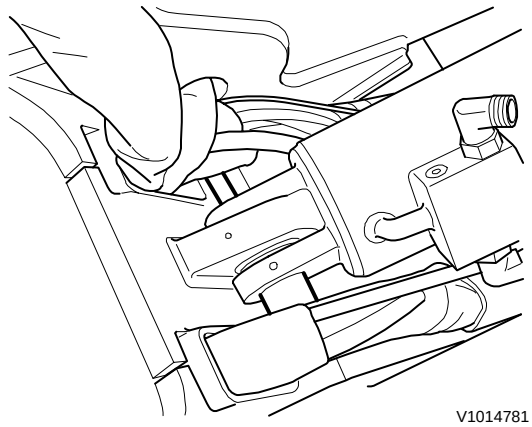


Fig. 58

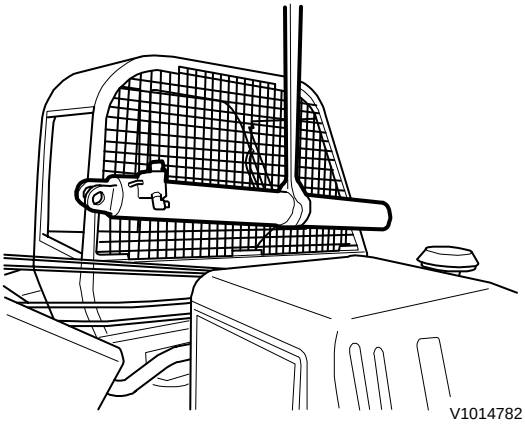


Fig. 59

32 Lift the cylinder out from the frame.
NOTE! Weight of lift cylinder: **200 kg (440 lb).**

33 If the bearing in the lower lift cylinder support is to be replaced. Drive the bearing out with a hammer and driver, the bearing must be driven out to the right.

34 Reinstall the new bearing with a hammer and drive plate 11667090. The bearing must be driven in from the right hand side of the machine.

Installation

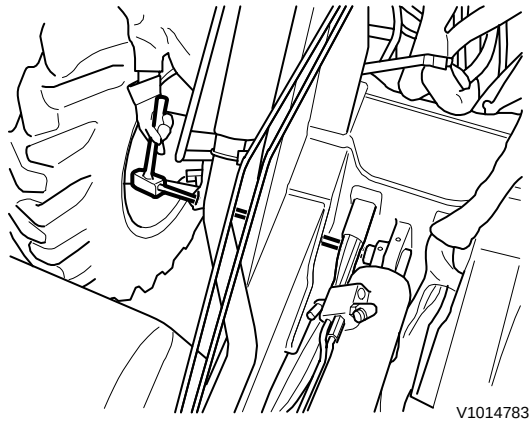


Fig. 60

35 Lift the cylinder in place and install the pin. Use a driver and the hole in the side of the frame for better access.
NOTE! Weight of lift cylinder: **200 kg (440 lb).**

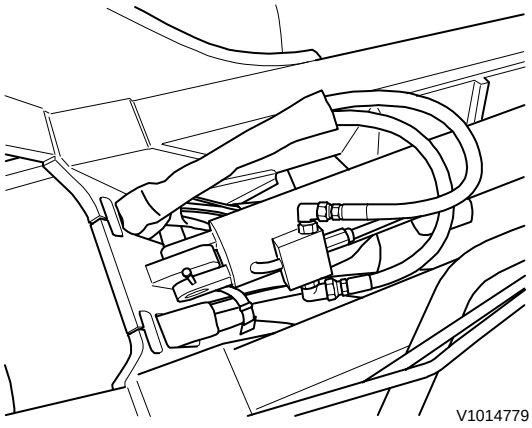


Fig. 61

36 Connect the hydraulic hoses according to previous marking.

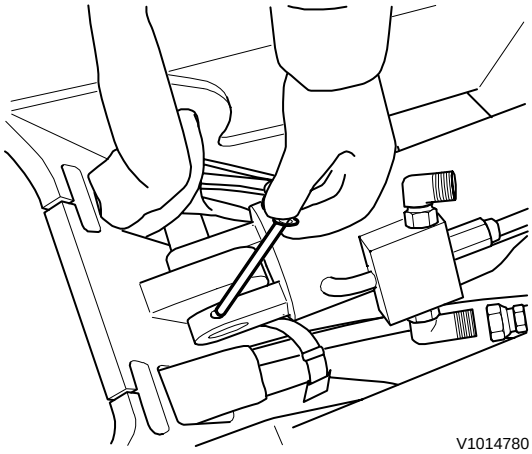


Fig. 62

37 Install the locking screw.

38 Lower the lift cylinder to it's frame support.

Slave cylinders, removal while booms are removed

IMPORTANT! Plug all pipes, hoses and connections when removing.

39 Attach a sling to the slave cylinder and fold it slightly forward for better access when removing the locking screw.

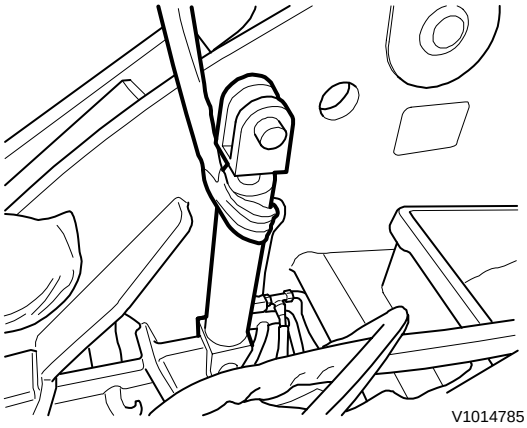


Fig. 63

40 Tag and remove the hydraulic hoses from the slave cylinder. Remove the locking screw.

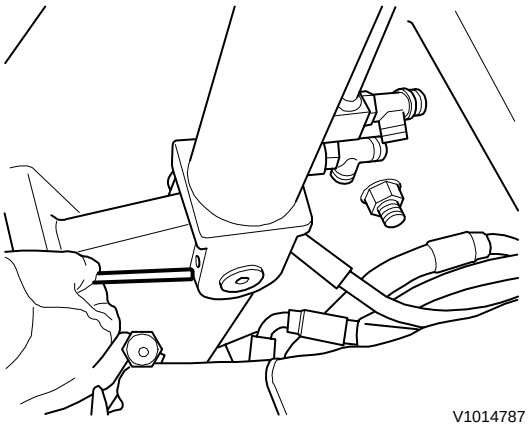


Fig. 64

41 Drive out the lower pin to the slave cylinder.

42 Remove the slave cylinder.
NOTE! Weight of slave cylinder: **20 kg (44 lb).**

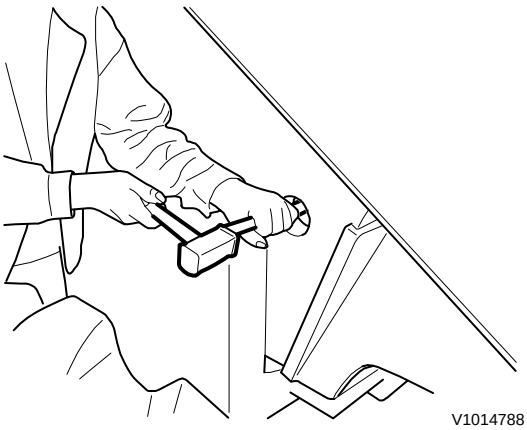


Fig. 65

Slave cylinders lower supporting point, removal and installation

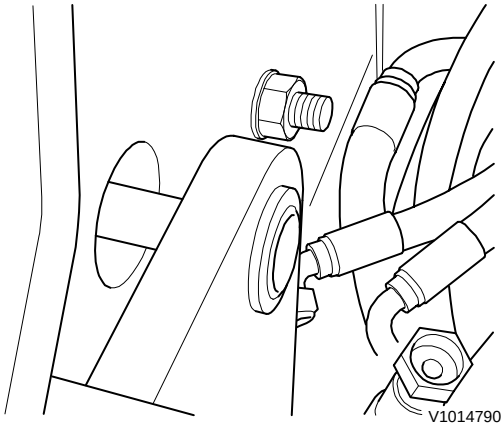


Fig. 66

43 Drive the bearing out with a hammer and a driver. Use tools: handle 11667001 and drive plate 11667060.

44 Drive in the new bearing by using the same tools.

Slave cylinders, installation while booms are removed

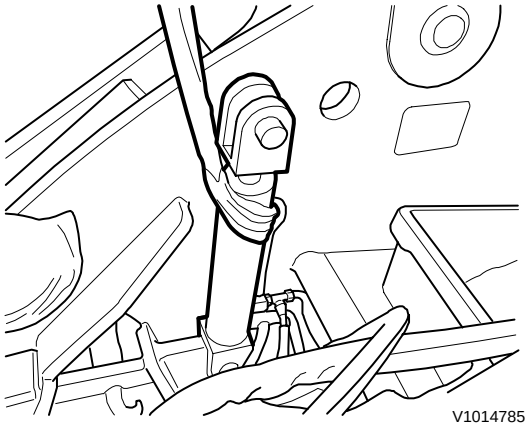


Fig. 67

45 Lift the slave cylinder in place and install the pin.
NOTE! Weight of slave cylinder: **20 kg (44 lb).**

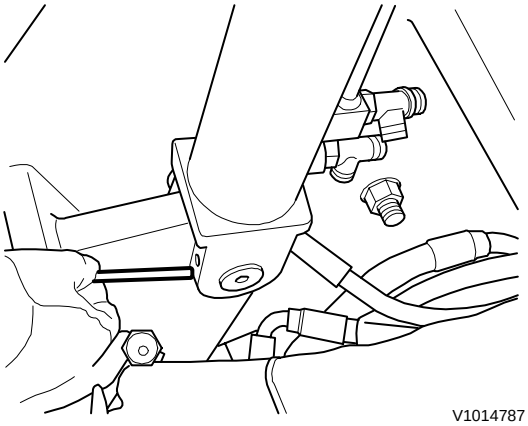


Fig. 68

46 Lock the pins with the locking screws and connect the hydraulic hoses according to previous marking.

Slave cylinders upper supporting point, removal and installation while booms are removed

Removal

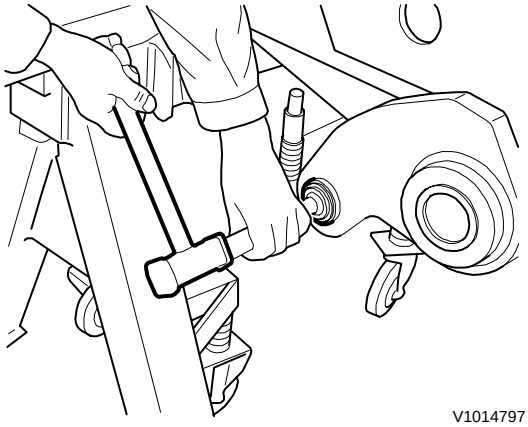


Fig. 69

47 **For high boom versions.** Drive the bearing out with a hammer and a driver. Use tools: handle 11667001 and drive plate 11667060.
For low boom versions. Pull the bearing out with a puller.

Installation

48 **For both high and low boom versions.** Drive in the new bearing by using the tools: handle 11667001 and drive plate 11667060.

Boom sections, installation

49 Grease the thrust washers, use the adhesitivity from the grease and fix them on the inner side of the main frame.

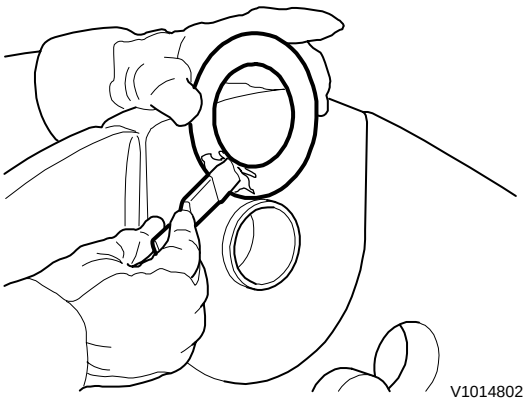


Fig. 70

Boom section 1, installation

50 Secure boom section 1 with two lift slings and lift into place in the main frame. Drive the main pin in and secure with locking screws.

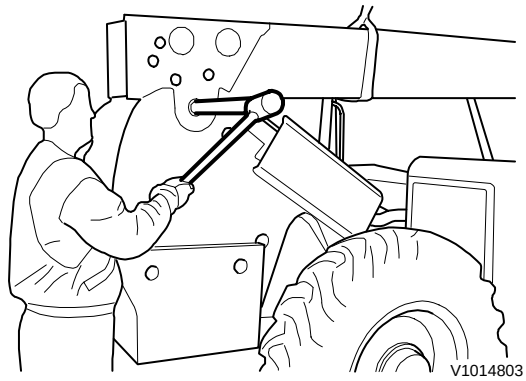


Fig. 71

51 Lower the boom till the upper supports for the slave cylinders are in line with the holes in the main frame. Attach the slave cylinders and drive the pins in. Secure the pins with locking screws.

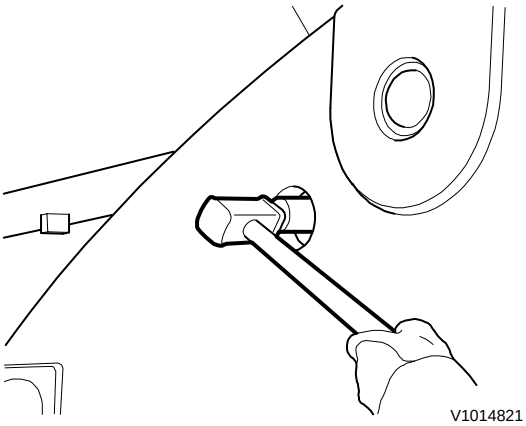


Fig. 72

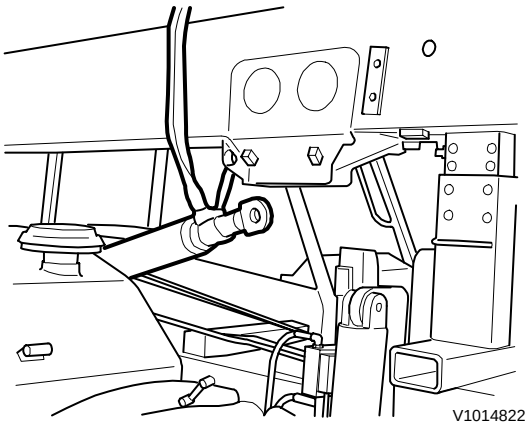


Fig. 73

52 Raise the boom to a suitable height and install the front end of the lift cylinder.

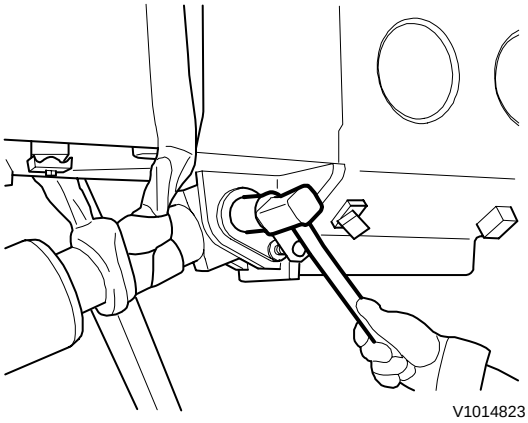


Fig. 74

53 Drive the pin in and secure the lock screw with Loctite 242.

54 Support the boom in a level position.

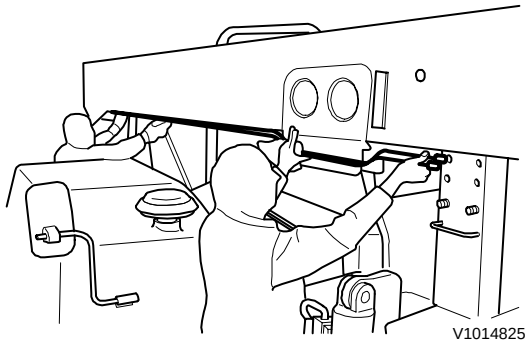


Fig. 75

55 Reinstall the oil supply tubes along the boom section 1.

Boom section 2, installation

NOTE! All wear pads should be tightened to a torque of **54 Nm (39 lbf ft)** if nothing else is stated. All bolts should be secured with Loctite 242. All pads must be greased with a NLGI Grade 2 grease.

NOTE! Preferably install new wear pads in all positions when reinstalling.

Each boom wear pad is chamfered at each end. This is designed as a wear indicator. Never install pads that are worn close to or below the chamfer. **The boom will be damaged** if the wear pads are worn below the chamfer.

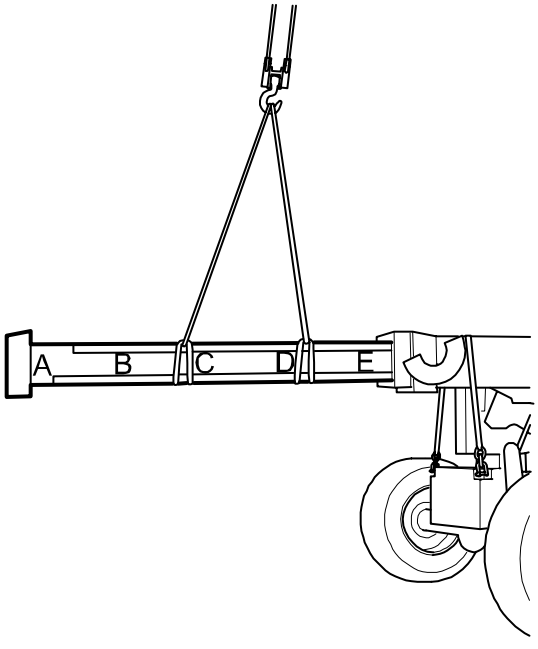
NOTE! Top pad: Always inspect that the clearance between top wear pads and section doesn't exceed **3 mm (0.125 in)**. If so, install shims to produce a gap smaller than stated.

Side pads: Always inspect that the total clearance between sections doesn't exceed **3 mm (0.125 in)**. If so, install shims to produce a gap smaller than stated and as equal as possible on both sides

56 Install the front inner side and front bottom wear pads in boom section 1.
Install the outer boom guide pads.

57 Make sure that the chain guide wheel still is in place in the rear end of boom section 2. With the wheel in place, the boom section will roll smoothly in place when installing. Install all the front inside wear pads in boom section 2 while the boom still is on stands or fixture.

58 Secure boom with 2 slings and lift in a level position. Insert boom section 2 into section 1 as long as possible with both slings attached.



V1014682

Fig. 76

59 Remove the inner sling and insert the boom until approximately 0.5 m (20 in) remains.

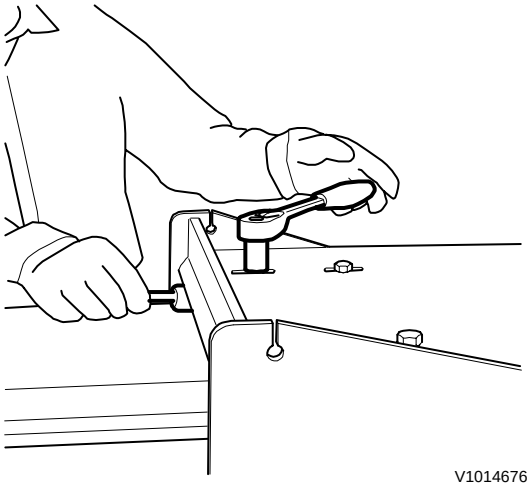


Fig. 77

60 Lower the outer end of section 2 and install the upper wear pads in boom section 1. Control the play, install shims if necessary.
Fully insert boom section 2.

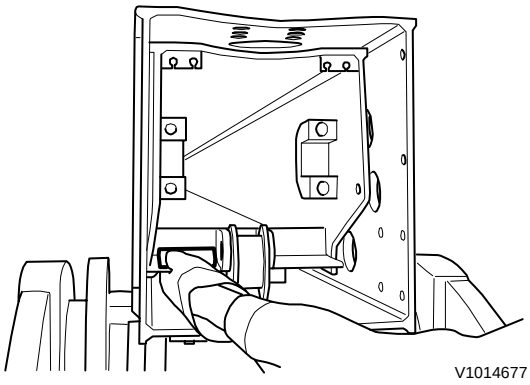


Fig. 78

61 Use a pair of clamps to unload the chain guide wheel and remove the wheel and pin.

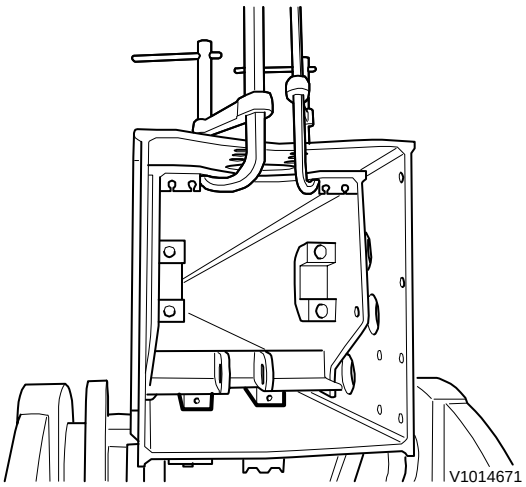


Fig. 79

62 Install the lower rear wear pads on boom section 2 while the clamps still are in place.

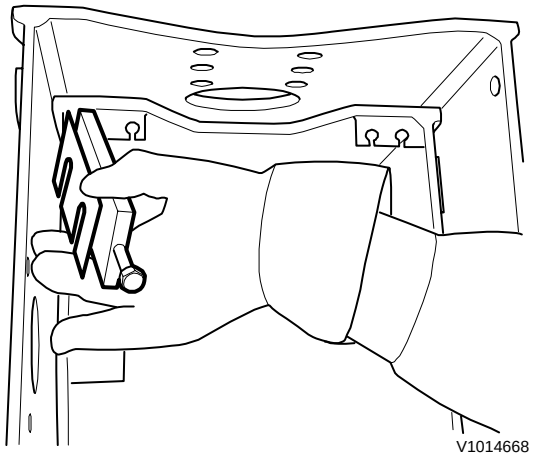


Fig. 80

63 Remove the clamps and install the side wear pads. Control the play between sections, install shims if necessary.

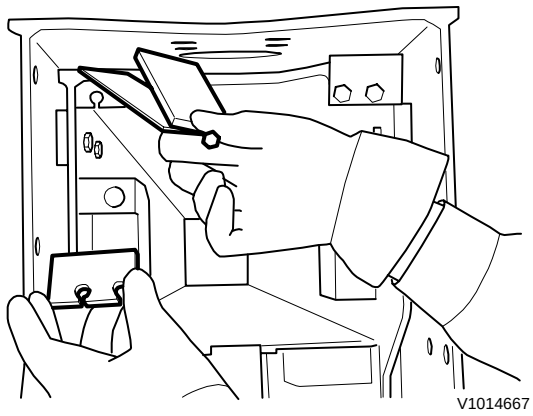


Fig. 81

64 Install the upper rear wear pads to section 2 and secure with corresponding hardware.

NOTE! Torque hardware to **27 Nm (20 lbf ft).**

NOTE! These rear upper wear pads on boom section 2 can **not** be shimmed! If the play between sections is higher than stated, then the lower rear pads on section 2 has to be shimmed.

Boom section 3, installation

65 Install the lower rear wear pad to section 3.

66 Secure boom section 3 with 2 slings and lift in a level position. Insert boom section 3 as long as possible with both slings attached.

67 Remove the inner sling and fully insert section 3 into section 2.

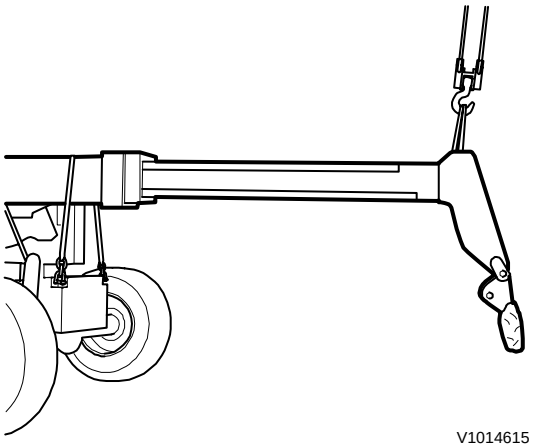


Fig. 82

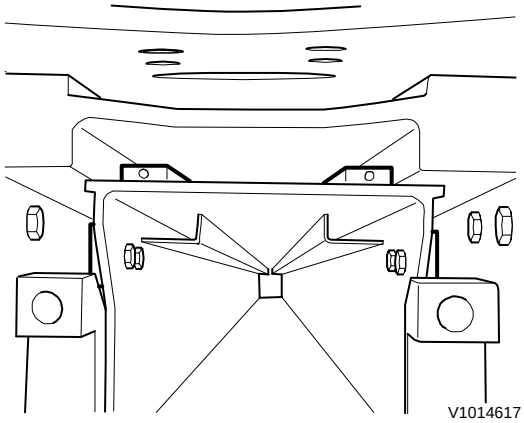


Fig. 83

68 Install the rear end wear pads to boom section 3. Two on top and one at each side.
Control the play between sections, use shims if necessary.

Hydraulic hoses, removal and installation

NOTE! Plug all tubes, hoses and connections when removing.

Removal

1 Put the machine in service position 1. See *TH60/TH80, 191, Safety rules when servicing*

2 Remove the hoses from tilt cylinder and the auxiliary fittings if so equipped.

3 Open the rear cover.

4 Remove the oil tubes from the rear of the boom.

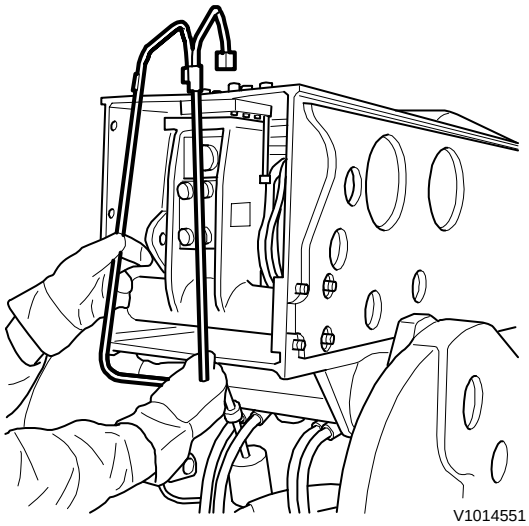


Fig. 84

5 Remove the extend chain adjustment bolt and the retaining plate from the cylinder support bracket at the rear of the boom.

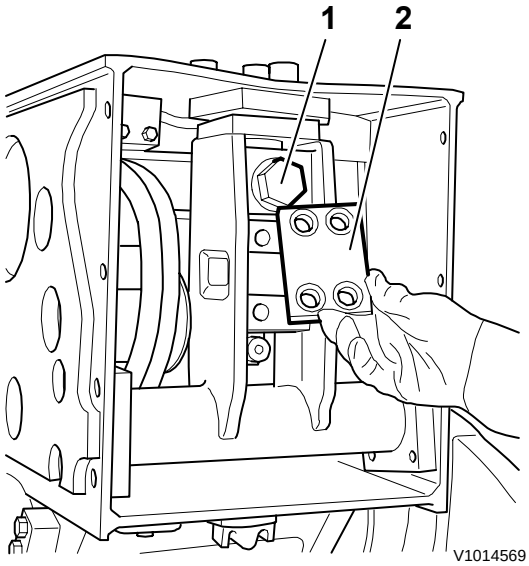


Fig. 85
1 Chain adjustment bolt
2 Retaining plate

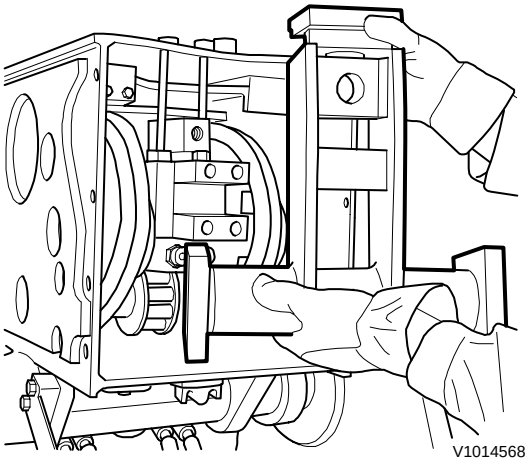


Fig. 86

6 Remove the cylinder support bracket. Pull out the upper part of the hydraulic hoses.

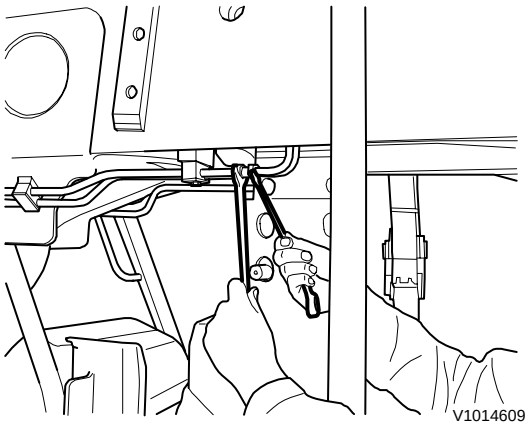


Fig. 87

7 Remove the horseshoe tubes from the supply tubes at the bottom of the boom.

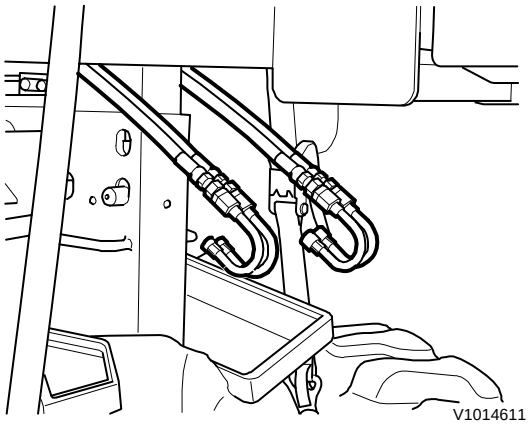


Fig. 88

8 Pull the horseshoe tubes out as far as needed to access the hose fittings. Remove the horseshoe tubes.

9 Pull the hoses out from the boom from the rear end.

Installation.

10 Push the hoses into the boom and connect them to the horseshoe tubes at the bottom front end of the boom section 1.

11 Attach the horseshoe tubes to the supply tubes and pull all slack in the hoses to the rear of the boom.

12 Feed the hydraulic hoses through the channels at the rear of the boom until they come out the front of boom section 3.

13 Attach the hoses to tilt cylinder and auxiliary fittings if so equipped.

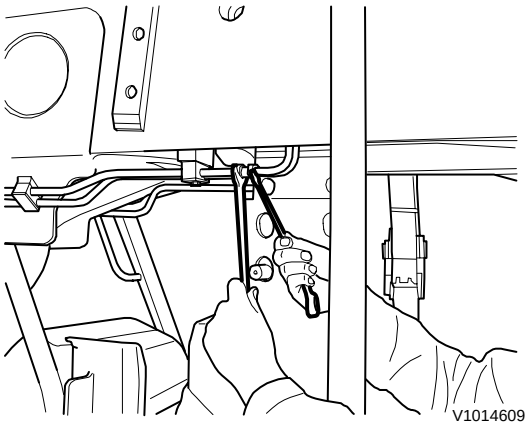


Fig. 89

14 Install the cylinder support bracket and secure the bolts with Loctite 242.
NOTE! Torque the bolts to: **110 Nm (81 lbf ft).** Ensure the bracket is set evenly without any binding.

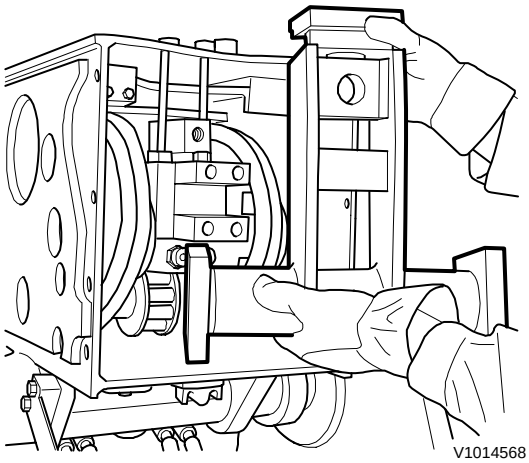


Fig. 90

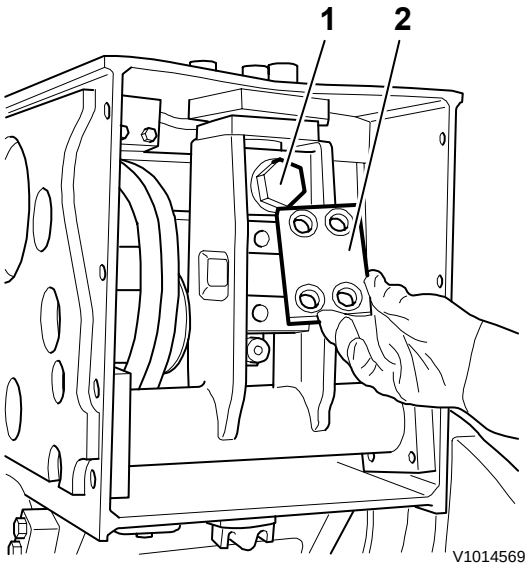


Fig. 91
1 Extension chain bolt
2 Retaining plate

15 Install the extension chain tension bolt and tighten lightly.
NOTE! Do not torque the extension chain tension bolt at this time. The retraction chain adjustment nut must be inspected first.

16 Install the retaining plate and secure the bolts with Loctite 242.
NOTE! Torque bolts diagonally to: **245 Nm (180 lbf ft).**

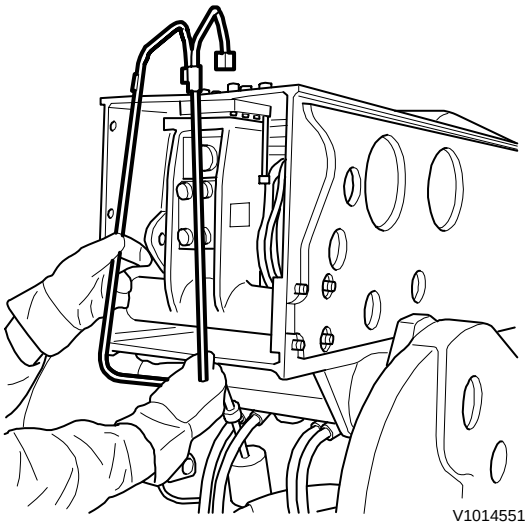


Fig. 92

17 Install the rear oil tubes between the extend tubes and hoses.

Adjust the boom chains, see *Boom chain adjustment, page 46* for further instructions.

18 Install the rear cover.

944 Jibb, load handling

Boom wear pads adjustment or replacement

See the following sections to determine if the pads need to be shimmed or replaced.

NOTE! Each boom wear pad is chamfered at each end. This is designed as a wear indicator. Never install pads that are worn close to or below the chamfer. **The boom will be damaged** if the wear pads are worn below the chamfer.

NOTE! Wear pad securing bolt length is important. Be sure that the bolts are returned to the same location from which they were removed.

NOTE! All bolts should be secured with Loctite 242 and tightened to a torque of **54 Nm (39 lbf ft).**

NOTE! All pads must be greased while installed. Use NLGI Grade 2 grease.

Shims are available in the following thicknesses.

1 1.0 mm (0.039 in)
2 3.0 mm (0.125 in)
3 5.0 mm (0.197 in)
4 10.00 mm (0.39 in) Only for boom section 1 bottom front end and boom section 2 upper rear end.

Boom front wear pads - all

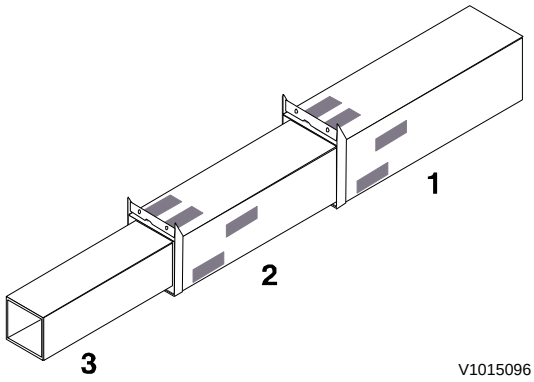


Fig. 93

1 Extend the boom approximately **3 m (10 ft)** and lower onto a suitable stand or packing, placed under the third section.

2 Loosen the wear pad securing bolts for the **bottom** pads. Install enough shims so the clearance doesn't exceed **3 mm (0.125 in)**.
When adjusting the side wear pads, install the shims as required to produce an equal gap between the boom sections at either side. One side may require more shims than the other. The total clearance must not exceed **3 mm (0.125 in).**

3 Secure the bolts with Loctite 242 and tighten to a torque of **54 Nm (39 lbf ft)**.

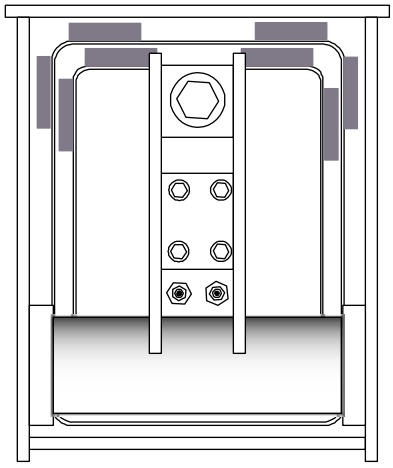


Fig. 94

Boom section 2 upper rear wear pads

The upper wear pads of boom section 2 can **not** be shimmed. If they are worn beyond the specified clearance, they must be replaced.

4 Lower and retract the boom to the fully stowed position.

5 Remove the upper wear pad retaining brackets and hardware from the boom.

6 Insert a M8 screw, length approximately 100 mm (4 in) into the wear pads. Use the screw as a handle, remove the wear pads.

7 Install the new pads in the same manor and then remove the M8 screw once the pads are in place. Install the retaining brackets using the original hardware.

NOTE! Torque hardware to **27 Nm (20 lbf ft).**

Boom section 3 upper rear wear pads

8 Loosen the wear pad retaining bolt and install enough shims so the clearance between wear pad and boom section doesn't exceed **3 mm (0.125 in)**.

9 Secure the bolts with Loctite 242 and tighten to a torque of **54 Nm (39 lbf ft)**.

Side rear wear pads - all

10 Loosen the side wear pad securing bolts. Add the clearance between wear pad and boom section from each side (add the measurements from corresponding side pads together, lower left and lower right, and upper left and upper right). Install enough shims so the total clearance doesn't exceed **3 mm (0.125 in)**. Install shims as required to produce an equal gap between the boom sections at either side. One side may require more shims then the other.

11 Secure the bolts with Loctite 242 and tighten to a torque of **54 Nm (39 lbf ft)**.

Boom chains and chain guide rollers wear inspection

Boom chains

1 Remove extend cylinder and the chains from the boom. Refer to the removal section in instruction entitled *Boom, extend cylinder and chains, removal and installation, page 3*

Carefully inspect individual links for the following conditions. If any of the following conditions exist, the chain must be replaced. When replacing chains always replace the chain anchor pins as well.

2 Broken, missing or cracked plates.

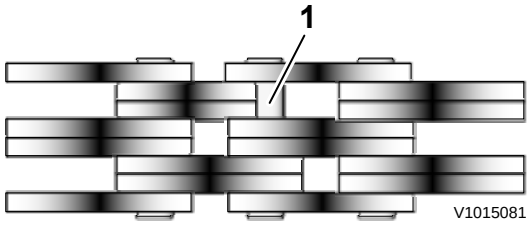


Fig. 95

3 Excessive surface rust and pitting.

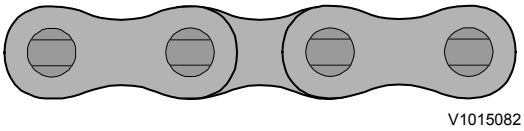


Fig. 96

4 Binding links, links that no longer rotate freely.

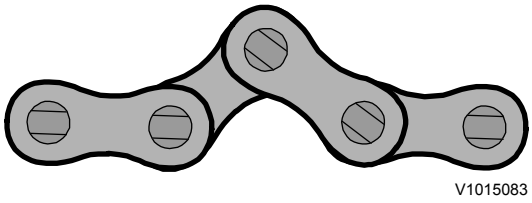


Fig. 97

5 Loose or broken pins.

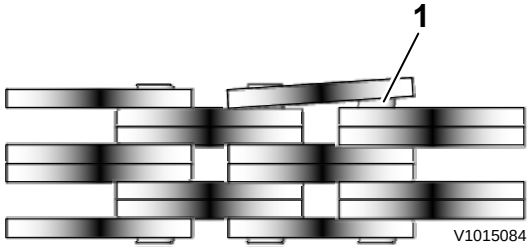


Fig. 98

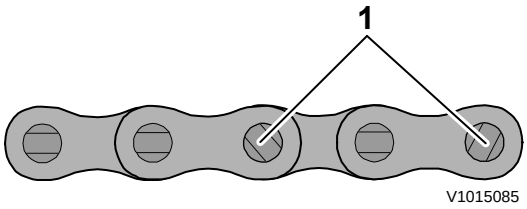


Fig. 99

6 Rotated pins.

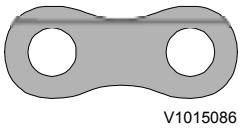


Fig. 100

7 Excessive exterior wear; pay special attention to the areas that make contact with the guide rollers most often.

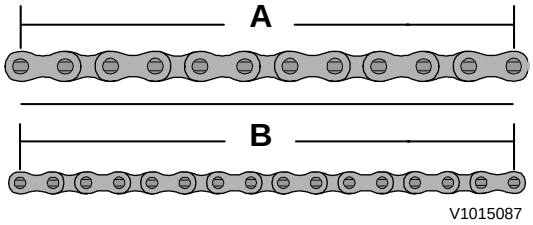


Fig. 101

8 Measure chain elongation. Apply **68 kg (150 lb)** of pull to chain. Measure the distance between pin centres and refer to the following illustration for maximum allowable wear length. Measure at five different locations on each chain. If any measurement exceeds the wear limit, the chain must be replaced.

Item	Designation	Number of pitches	Original length		Maximum wear length	
			(mm)	(inch)	(mm)	(inch)
A	Extend chain	12	304.8	12	313.9	12.36
B	Retract chain	16	304.8	12	313.9	12.36

Chain guide rollers

9 Remove the extend chain guide roller from the front end of the extend cylinder.

10 Inspect the guide rollers, pins, and bushings for wear. Any noticeable wear on any of these parts will require its replacement.

11 Inspect the lubrication passages and grease fittings to ensure proper flow of grease through the pins.

Chain lubrication

12 Once the boom chains have been inspected, it is very important to lubricate before installation. Use motor oil to lubricate the chains, a multigrade SAE 20W/50 would be suitable. It is impossible to lubricate the boom chains once they are in place.

13 Use a towel and/or wire brush, to remove any grease or dirt that may prevent the penetration of new oil into the joints.

14 Apply small amounts of motor oil to each joint. Rotate the joint to ensure full penetration of oil. Wipe any excess oil from the chain.

NOTE! Do not apply grease to the chain. Grease will coat only the outside of the chain and will seal out the necessary lubricating oil.

Boom chains tension inspection

The boom chains are contained completely within the boom sections and are not visible from the exterior. Measuring the distance between the top brackets of section 2 and 3 will indicate the chain tension.

1 Fully retract the boom.

2 Raise the boom to full height to allow all sections to fully retract.

3 Lower the boom until the attachment is approximately **50 mm (2 in)** from the ground.

4 Set the parking brake and turn off the engine.

5 Measure the distance between the top brackets of section 2 and 3. If the distance is less than **28 mm (1.125 in)**, then the chain requires adjustment. See *Boom chain adjustment, page 46* for further instructions.

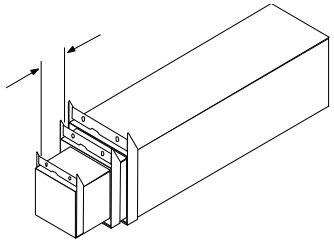


Fig. 102 V1021811

Boom chain adjustment

Op. no.

1 Retract the boom until the distance between the brackets (on top of boom section 2 and 3) measure approximately **30 mm (1.25 in)**.

2 Remove the spacers and mounting hardware from the top bracket of boom section 3 and reinstall them in the gap between boom 2 and 3.

3 Tighten the hardware until the spacers are snug between the brackets. The screw must be installed through both the brackets and the spacer.

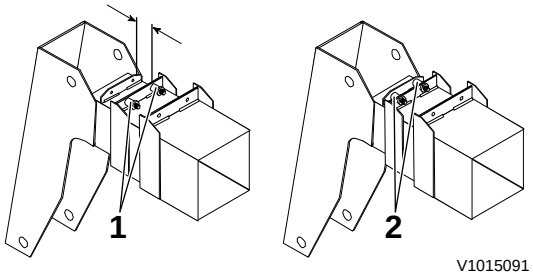


Fig. 103
1 Spacer position when not in use
2 Spacer position when used

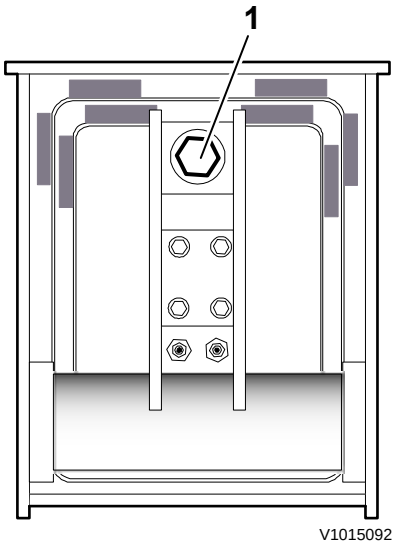


Fig. 104
1 Extension chain adjusting bolt

4 The extension chain adjusting bolt is located at the rear of the boom. Loosen the extension chain adjusting bolt while the retraction chain nut is tightened.

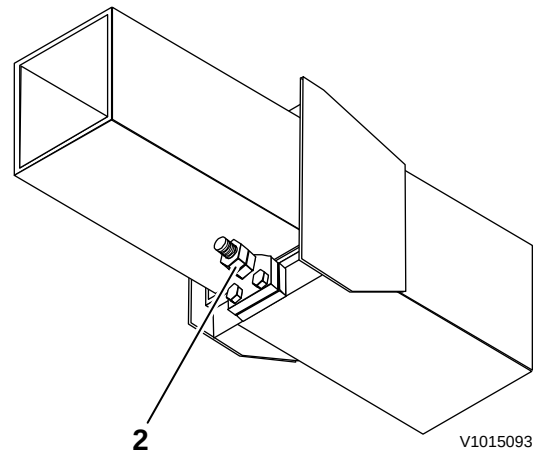


Fig. 105
2. Retraction chain adjustment nut

5 The retraction chain adjustment nut is located beneath the first boom section. Tighten the retraction chain adjustment nut to **35 Nm (25 lbf ft).**

6 Tighten the extension chain adjusting bolt to **70 Nm (50 lbf ft).**

7 Remove the spacers from between the brackets and install them in their original position (facing forward on boom section 3).

945 Lifting frame work with mounting and link arm system

Lift cylinder, incl mountings

Lift cylinder removal and installation

Removal

1 Put the machine in service position 2. See *TH60/TH80, 191, Safety rules when servicing*.

2 Secure the lift cylinder with at least two slings.

NOTE! Plug all tubes, hoses and connections while removing.

WARNING!

Be careful when removing the cylinder, risk of crushing injuries.

3 Remove the front end lock screw and pin.

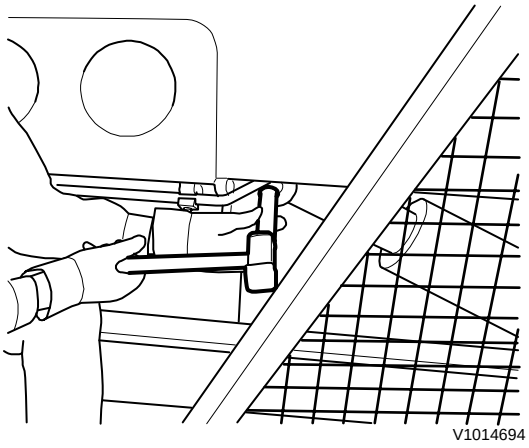


Fig. 106

4 Tag and remove the hydraulic hoses from the lift cylinder.

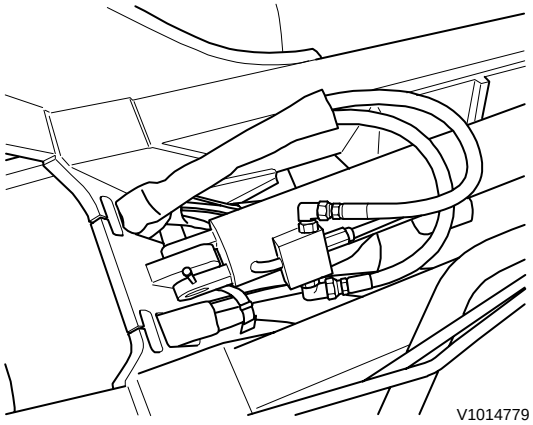


Fig. 107

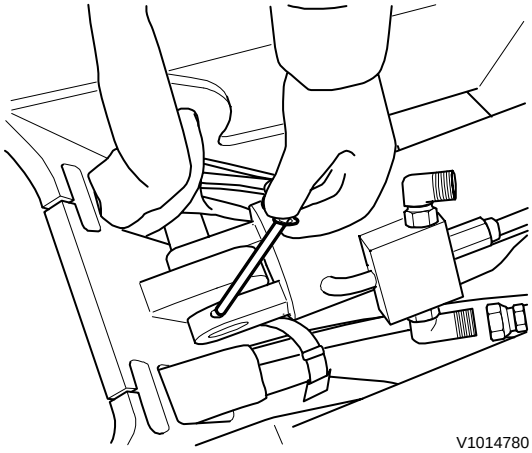


Fig. 108

5 Remove the rear end lock screw and the pin.

6 Lift the cylinder out from the machine and put it on a work bench. Weight of lift cylinder: **200 kg (440 lb)**.

7 See *TH60/TH80, 900, Cylinder repair* for instructions to repair the cylinder.

Installation

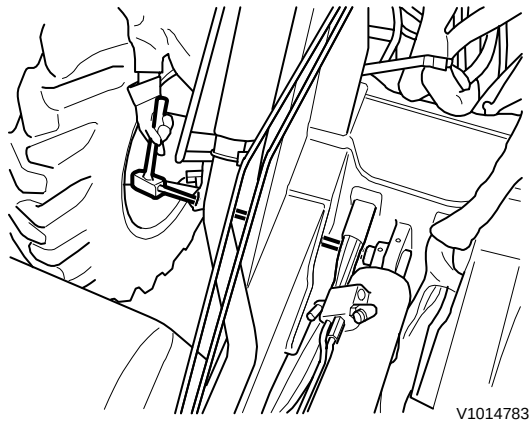


Fig. 109

8 Secure the lift cylinder with at least two slings and lift into the machine. Weight of lift cylinder: **200 kg (440 lb)**.

9 Install the rear end pin. Use a driver and the holes in the frame for better access.

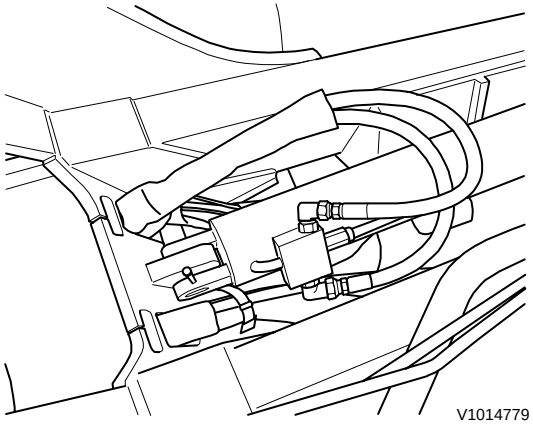


Fig. 110

10 Connect the hoses according to previous marking and install the lock screw.

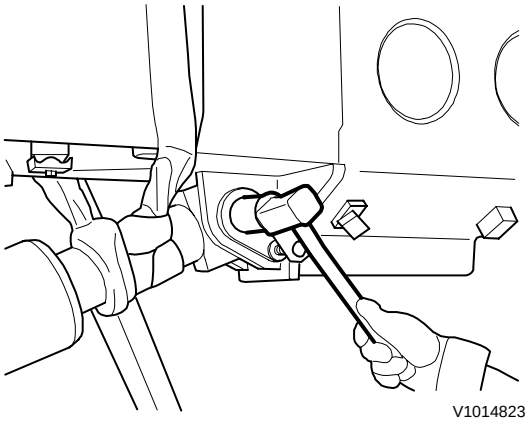


Fig. 111

11 Position the front end of lift cylinder and install the front end pin. Secure the lock screw with Loctite 242.

Tilting cylinder, incl mountings

Tilt cylinder, removal and installation

Put machine in service position 1, see *TH60/TH80, 191, Safety rules when servicing*

Removal

1 Secure the tilt cylinder with a sling and remove the retaining ring from the upper cylinder support.

IMPORTANT! Plug all pipes, hoses and connections when removing.

2 Lift or pull the cylinder slightly forward for better access to the hydraulic hose connections. Remove the hoses.

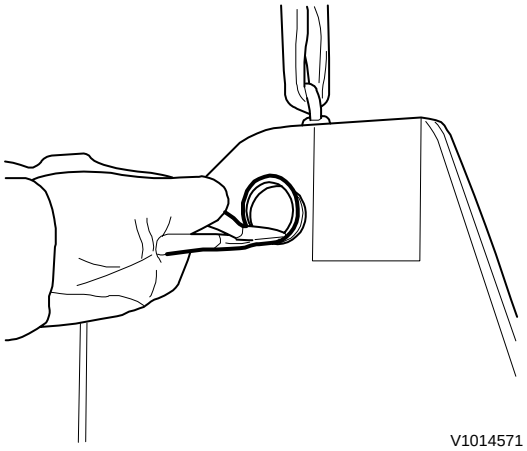


Fig. 112

3 Remove the locking screw and drive the pin out from the tilt cylinder.

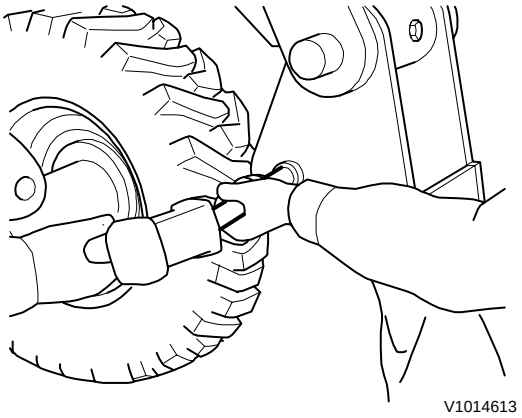


Fig. 113

4 Lift the tilt cylinder out from the boom.
Cylinder weight: **55 kg (120 lb).**

5 Put the cylinder on a work bench or similar level surface.

For tilt cylinder overhaul, see *TH60/TH80, 900, Cylinder repair*.

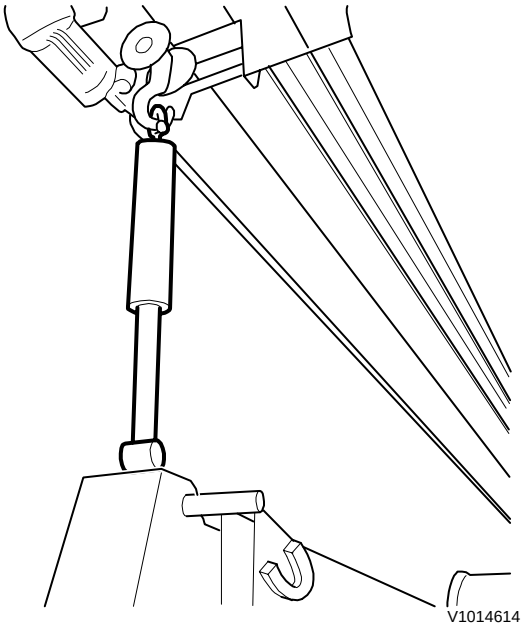


Fig. 114

Installation

6 Secure the tilt cylinder with a sling and lift into the boom section.
Cylinder weight: **55 kg (120 lb).**

7 Lower the cylinder and install the pin for the piston rod end. Secure the pin with lock screw.

8 Connect the hydraulic hoses to the tilt cylinder.

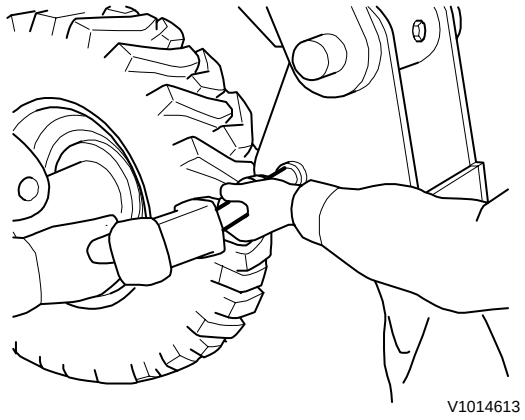


Fig. 115

9 Install the pin and the retaining ring to the cylinder support.

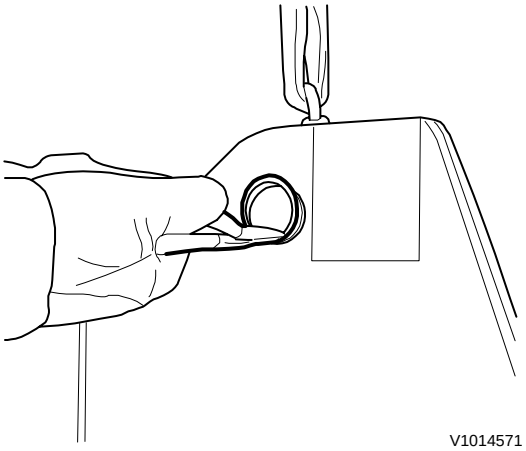


Fig. 116

Slave cylinder, removal and installation

Removal

1 Put the machine in service position 1. See *TH60/TH80, 191, Safety rules when servicing*.

2 Secure the slave cylinder with a sling.

NOTE! Plug all tubes, hoses and connections while removing.

3 Remove the upper lock screw and pin.

4 Tag and remove the hydraulic hoses from the slave cylinder and remove the lower lock screw.

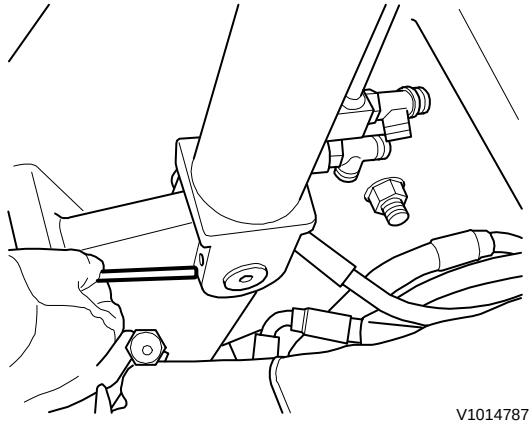


Fig. 117

5 Remove the lower pin with a hammer and driver.

6 Lift the cylinder out from the machine and put it on a work bench. Weight of slave cylinder: **20 kg (44 lb)**.

7 See *TH60/TH80, 900, Cylinder repair* for instructions to repair the cylinder.

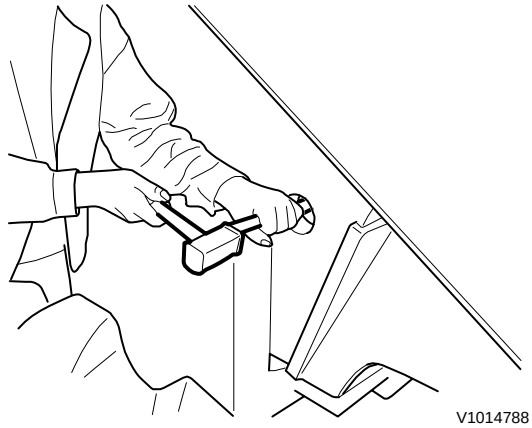


Fig. 118

Installation

8 Secure the slave cylinder with a sling and lift into the machine. Weight of slave cylinder: **20 kg (44 lb)**.

9 Install the lower pin.

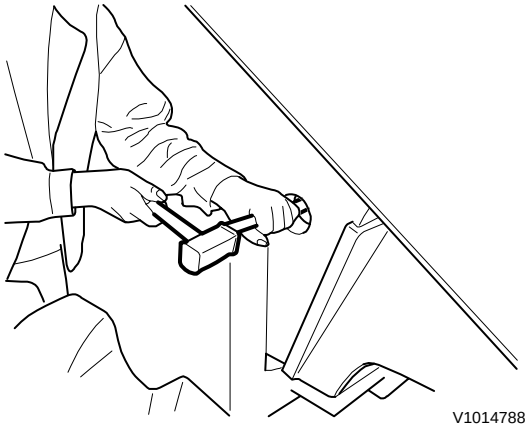


Fig. 119

10 Install the lock screw for the lower pin and reconnect the hydraulic hoses.

11 Install the upper pin and it's lock screw.

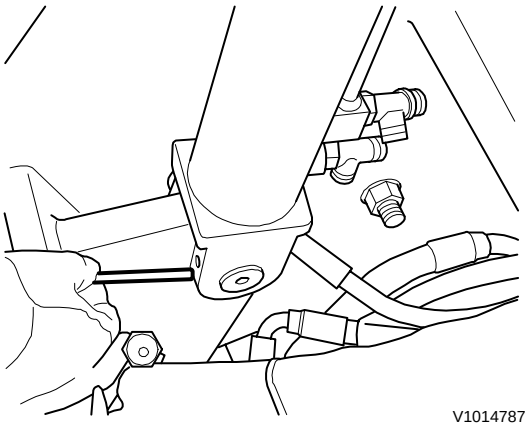


Fig. 120

Limited Owner Warranty

MEC Aerial Platform Sales Corp. warrants its equipment to the original purchaser against defects in material and/or workmanship under normal use and service for one (1) year from date of registered sale or date the unit left the factory if not registered. MEC Aerial Platform Sales Corp. further warrants the structural weldments of the main frame and scissor arms to be free from defects in material or workmanship for five (5) years from date of registered sale or date unit left the factory if not registered. Excluded from such warranty is the battery(s) which carries a ninety (90) day warranty from described purchase date. Warranty claims within such warranty period shall be limited to repair or replacement, MEC Aerial Platform Sales Corp's option, of the defective part in question and labor to perform the necessary repair or replacement based on MEC Aerial Platform Sales Corp's then current flat rate, provided the defective part in question is shipped prepaid to MEC Aerial Platform Sales Corp. and is found upon inspection by MEC Aerial Platform Sales Corp. to be defective in material and/or workmanship. MEC Aerial Platform Sales Corp. shall not be liable for any consequential, incidental or contingent damages whatsoever. Use of other than factory authorized parts; misuse, improper maintenance, or modification of the equipment voids this warranty. The foregoing warranty is exclusive and in lieu of all other warranties, express or implied. All such other warranties, including implied warranties of merchantability and of fitness for a particular purpose, are hereby excluded. No Dealer, Sales Representative, or other person purporting to act on behalf of MEC Aerial Platform Sales Corp. is authorized to alter the terms of this warranty, or in any manner assume on behalf of MEC Aerial Platform Sales Corp. any liability or obligation which exceeds MEC Aerial Platform Sales Corp's obligations under this warranty.

Aerial Platforms Sales Corp.
1775 Park Street, Suite 77 • Selma, CA 93662 USA
Ph: 1-866-379-7278 • 559-263-9626 • Fax: 559-263-9631
www.mecawp.com