SERVICE MANUAL

F106.6 / F106.6A
F156.6 / F156.6A

Grader

Print No. 87726937A

NEW HOLLAND CONSTRUCTION

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CNH Baumaschinen GmbH
Product documentation
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TO THE READER

This repair manual is intended for **professional repair technicians**. It contains important information, needed for carrying out specialised repair work.

Please read carefully through the **repair manual**, and also the operating instructions, before undertaking any repair work.

Use the **repair manual**, but also use the **operating instructions** and **parts catalogue** for reference and guidance, even if you are already familiar with the technology used in graders.

The repair manual will allow the experienced construction machine mechanic to carry out the necessary repair work correctly.

USE

The repair manual describes the machine model in the form it was originally delivered. It does not describe any implements and modifications that maybe added later.

The repair manual contains the following information:

- Safety instructions
- Technical data and special tools
- Function description
- Performance test
- Troubleshooting and fault correction
- Repair instructions

The **Safety Instructions** section describes the recommended procedures for preventing the risk of injuries to the operator and the personnel responsible for maintaining and working on the machine.

The **Specifications** section contains service data, conversion tables and lists of special tools and maintenance materials required. The other sections contain the following information for each mechanical assembly:

- technical description and information regarding the operation of essential systems and equipment;
- information about performance tests on the machine;
- troubleshooting and information for identifying faults on the machine;
- technical information necessary for repair operations on the machine, the equipment necessary for carrying out repairs, information about maintenance standards, procedures for removal/installation and for disassembly/ assembly.

You can use the list of contents to find the necessary information easily.

The illustrations are partially simplified to make them more easily understood.

Although it may result in apparent differences with your particular grader model, this is intended to make the information clearer.

REPAIR

Carry out the required repair operations as soon as possible. Doing so will reduce repair costs and increase the availability of your grader.

In all repair operations, always follow the instructions in the workshop manual and the operating instructions. Customer Service will be pleased to carry out for you any extensive operations not described in the workshop manual.

Always use only **original replacement parts**.

FURTHER REFERENCE MATERIAL

In addition to the present manual, please also refer to the following documentation:

- Operating instructions
- Parts catalogue

NOTES:

Section

0

SAFETY INSTRUCTIONS

CNH Baumaschinen GmbH
Product documentation
13581 Berlin, Staakener Str. 53-63

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PARAGRAPH 0

LIST OF CONTENTS

1 BASIC SAFETY INFORMATION

1.1 Warning notes and symbols

The following symbols are used in the operating instructions to indicate particularly important information:

CAUTION: *Safety rules and procedures, designed to protect the driver and others from mortal dangers or injuries, and to prevent serious damage to property.*

NOTE: *Notes and precautions to avoid damage to machinery and property.*

1.2 Correct use

This machine is constructed according to the recognized mechanical safety regulations, and using state-of-the-art technology. Nevertheless, when in operation, situations can occur that present serious or mortal dangers to the operator and third parties, or which could cause damage to the machine and other property.

The machine should be used only if it is in proper operating condition, and only by operators who are aware of the dangers, know the safety procedures, and have read the operating instructions! The important notes are placed at the start of this section. Immediately repair any faults (or have them repaired) if these could have a prejudicial effect on safety.

This Grader is principally designed for:

- Creating a double course
- Clearing top soils
- Scarifying old road surfaces and hard ground
- Cutting embankments
- Clearing ice and snow
- Placing, spreading, mixing, and compressing materials.

The Grader can also be used in conjunction with other operating equipment for special applications. The Technical Data provide clear information on this subject.

Proper use of the machine also means following the operating instructions and applying the inspection and maintenance conditions.

Using the grader for any other purpose, for example:

- transporting personnel,
- as a working platform,
- towing or carrying loads without attaching the proper working attachments, is considered improper use.

Improper use of the machine can pose mortal danger to operating personnel or other persons, or may result in physical injuries, or may cause damage to property.

The manufacturer, supplier will not be liable for any damage resulting from improper use. In this case, the user alone will be responsible.

Noise emission data as stated in statutory order 3 pursuant to the mechanical safety law of 18/01/1991 or EC machinery guideline 89/392/EWG.

Using the earth-moving equipment properly, with ISO 7096 standard driver seats, will ensure that the measured vibration frequencies (measured as described in ISO 2631 Part 1) meet the requirements regarding protection from whole-body vibrations.

1.3 Organizational procedures

Keep the operating instructions stored at the location where the machine is used, and in a place where they can be easily accessed, for example in the holder provided!

In addition to the operating instructions, follow and draw attention to the general legal regulations and other obligatory requirements regarding accident prevention and environmental protection!

These requirements may, for example, concern the handling of dangerous goods, the making available / wearing of personal protective equipment or highway code regulations.

Supplement the operating instructions with additional instructions, including supervisory and reporting duties, in order to take account of specific operating conditions, for example, Particular work plans, working processes or personnel.

Before starting work, personnel appointed to carry out work on the machine must have read the operating instructions, and particularly the Safety Information section. It will be too late to do this when the actual work has begun. This especially applies to personnel employed occasionally, for example, for setting up or maintaining the machine.

You must at least check occasionally that personnel can demonstrate safety and risk awareness when working!

Loose or long hair must be tied up, and personnel must not wear loose clothing or jewellery, including rings. These are a potential risk, for example, if they are caught up or pulled in by machinery.

Where necessary, or when specified by the regulations, personal protective equipment must be worn!

Pay attention to the safety information and warning notices on the machine!

Check that all safety information and warning notices at or on the machine remain fully and clearly legible.

If there are any changes that affect safety or the operating behaviour of the machine, stop the machine immediately and inform the person or department responsible.

Modifications, conversions or retrofits that might affect safety must not be made to the machine without the approval of the supplier! This also applies to the installation or re-adjustment of safety devices and valves, or welding work on load-bearing parts.

Replacement parts must meet the technical requirements stated by the manufacturer. This can be ensured by always using original replacement parts.

Replace hydraulic hoses at the proper times or at the stated intervals, even if no defects affecting safety are visible!

For the periodic checks / inspections, keep to the specified intervals or the times specified in the operating instructions.

When maintenance work is being carried out, fire extinguishers and their operating instructions must be displayed at a suitable place!

Pay attention to fire detection and firefighting devices.

1.4 Personnel selection and qualifications - basic responsibilities

Only trained and reliable personnel should be allowed to work on or with the machine. Apply the minimum age required by law.

Only use personnel who have been suitably trained or instructed, and clearly set out the responsibilities assigned for operating, setting up, maintenance, and repair!

Ensure that only the personnel appointed for the task concerned is allowed to work on or with the machine!

Define the responsibilities of the driver (also in relation to highway code regulations) and authorize him/her to reject third-party instructions that would lead to a breach of safety regulations.

Personnel being trained, instructed or briefed, or persons undergoing general training, must only be allowed to work on or with the machine if they are given constant supervision by an experienced person!

Work on the machine's electrical equipment should only be carried out by a qualified electrician, or a trained technician under the supervision and guidance of a qualified electrician, in accordance with the electrical regulations.

Work on the chassis, an the brake and steering systems should only be carried out by personnel trained for this purpose!

Only personnel with the necessary skills and experience should be allowed to work on the hydraulic systems.

1.5 Safety information for specific phases of operation

Normal operation

Refrain from any working methods that might be prejudicial to safety!

Before starting work, familiarize yourself with the particular working environment at the location concerned. Working environment includes, for example, obstacles in the working/traffic area, load-bearing capacity of the ground, and safety barriers necessary at the worksite relative to public traffic areas.

Take steps to ensure that the machine is only operated when in a safe and operative condition!

Only operate the machine if all safety devices and safety-related systems, for example, removable safeguards, emergency shut-off devices, noise insulation, extractor systems, are present and in operative condition.

The machine must be inspected at least once in each shift for visible damage and defects! Any changes that occur (including changes in operational behaviour) must be reported immediately to the department or person responsible! If necessary, stop the machine immediately and secure it.

If there is a malfunction, stop the machine immediately and secure it! Faults must be repaired immediately!

Start the machine only from the driver's position.

Follow the operating instructions, during the switch-on/switch-off procedures.

Before starting up the machine, ensure that no one will be put at risk by when the machine is started!

Before starting work / driving, check whether the brake, steering, lighting and signalling systems are operational.

Before moving off, always check that attachments are secured to prevent accidents!

If using public roads, streets, or other areas, follow the regulations in the highway code and, if necessary, make the machine road-worthy as required by the highway code before doing so.

In conditions of poor visibility or when dark, always switch on the vehicle lights!

Passengers should only sit in the passenger seats provided for this purpose.

When passing through underpasses, bridges, tunnels, under overhead lines, etc., always check that there is sufficient headroom!

Always keep at a sufficient distance from the edges of trenches and embankments.

Do not use any working methods that might endanger the stability of the machine!

Do not drive with overhead attachments positioned in a transverse direction; always drive with attachments and loads lowered and near the ground, especially when driving uphill/downhill!

When on a gradient, always adapt vehicle speed to the particular conditions! Always change to the lowered position in advance of the gradient, never while driving on it!

Before leaving the driver's seat, always immobilise the machine to prevent it moving off accidentally, and to prevent access by unauthorized persons. Switch off the engine!

1.6 Special operations when using the machine, servicing and fault repair work as part of working procedure, waste disposal

Apply the intervals specified in the operating instructions for adjustment, maintenance, and inspection tasks, and pay attention to the replacement data for parts and components. These tasks should only be carried out by qualified personnel!

Inform the operating personnel before starting special or repair operations! Appoint supervisors.

When carrying out any tasks related to the operating, retrofitting or adjusting of the machine and its safety devices, and to maintenance, inspection or repair work, follow the switch-on/switch-off procedures described in the operating instructions and the notes concerning repair operations.

Whenever required, seal off the repair area, leaving plenty of room!

If the machine is switched off completely for maintenance and repair work, it must be secured to prevent it being switched on accidentally:

- Take out the key and
- attach a warning sign.

Only carry out maintenance and repair work when the machine is parked on a level, sufficiently load-bearing surface and secured to prevent it moving off or collapsing!

When being replaced, individual components and major assemblies should be carefully fastened and secured to the lifting gear. Only use suitable and correctly functioning lifting gear, and load-handling equipment with sufficient carrying capacity. Do not stand or work under suspended loads!

Only appoint experienced persons to attach loads and instruct crane drivers! The instructor must stand where they are visible to the operator, or be in contact with him by voice communications.

For assembly work carried out above body height, use the appropriate safety hoists and work platforms provided for this purpose.

Do not use machine parts as hoists!

For maintenance work at greater heights, wear fall-protection!

Keep all handles, steps, guard rails, landings, platforms and ladders clear of dirt, snow and ice!

At the start of maintenance/repair work, clean any oil, fuel, or operating fluids from the machine, and particularly from screw connections or other connections. Do not use aggressive cleaning agents! Use fibre-free cleaning cloths!

If cleaning the machine using water or a steam jet (high-pressure cleaner) or other cleaning equipment, seal off or cover all openings where water/steam/cleaning agents should not be allowed to enter for safety or functional reasons. Electric motors and switching cabinets are particularly at risk.

When carrying out cleaning work, ensure that heat sensors connected to fire detection and extinguishing systems cannot come into contact with hot cleaning fluids. These might trigger the fire extinguishing system.

After cleaning, remove all covers and sealing plugs completely!

After cleaning all fuel, engine oil, brake fluid, and hydraulic fluid pipes, examine them for leaks, loose connections, chafe marks and damage! Repair any defects immediately!

When carrying out maintenance and repair work, always tighten any loose screw connections.

If safety devices have to be removed for setting-up, maintenance and repair work, these should be replaced immediately and inspected when the maintenance/repair work is completed.

Dispose of operating fluids, auxiliary products and replacement parts safely, and without damage to the environment!

1.7 Notes on special types of hazard

1.7.1 Electrical energy

Use only original fuses with the correct current rating! Switch the machine off immediately if there are faults in the electrical system.

Keep the machine at a sufficient distance from overhead power lines. If working close to overhead power lines, keep the equipment away from the lines. Danger of death!

Find out the what the required safety clearances are.

If contact is made with high-voltage lines:

- Do not leave the machine.
- Drive the machine out of the danger area.
- Warn persons on the ground not to come near, or to touch the machine.
- Have the voltage switched off.
- Only leave the machine when the contacted/damaged power line has been safely de-energized.

The machine's electrical equipment should be regularly inspected. Faults such as loose connections or braised cables must be corrected immediately.

1.7.2 Gas, dust, vapour, smoke

Only operate combustion engines and fuel-driven heaters in well-ventilated areas!

If using the equipment in an enclosed space, ensure there is sufficient ventilation before starting.

Follow the local regulations applying at the worksite.

Only carry out welding, firing, or grinding work on the machine if this has been explicitly approved - risk of fire and explosions!

Before carrying out welding, firing or grinding work, clean away dust and combustible materials from the machine and its surroundings, and provide adequate ventilation (risk of explosion)!

1.7.3 Hydraulic, pneumatic system

Regularly inspect all pipes, hoses, and screw connections for leaks and visible damage. Repair any damage immediately! Spurting oil can cause burns and other injuries.

Before starting repair work, any system blocks and pressure lines (hydraulic, compressed air) that are to be opened up must first be depressurized as indicated in the descriptions of the assemblies.

Hydraulic and compressed air lines must be correctly laid and assembled. Do not get the connections mixed up!

Valves, and the length and quality of hoses must meet the requirements.

1.7.4 Noise

Noise insulation devices must be in the protection position during operation.

Wear the prescribed personal ear protection!

1.7.5 Oil, grease and other chemical substances

If handling oil, grease or other chemical substances, follow the safety instructions for the product concerned!

Be careful when handling operating fluids and auxiliary materials (risk of burns and scalds).

1.8 Transport, towing and restarting

Towing, loading and transporting should be carried out only as described in the operating instructions!

If towing, use the specified transport position, and keep to the permitted speed and distance!

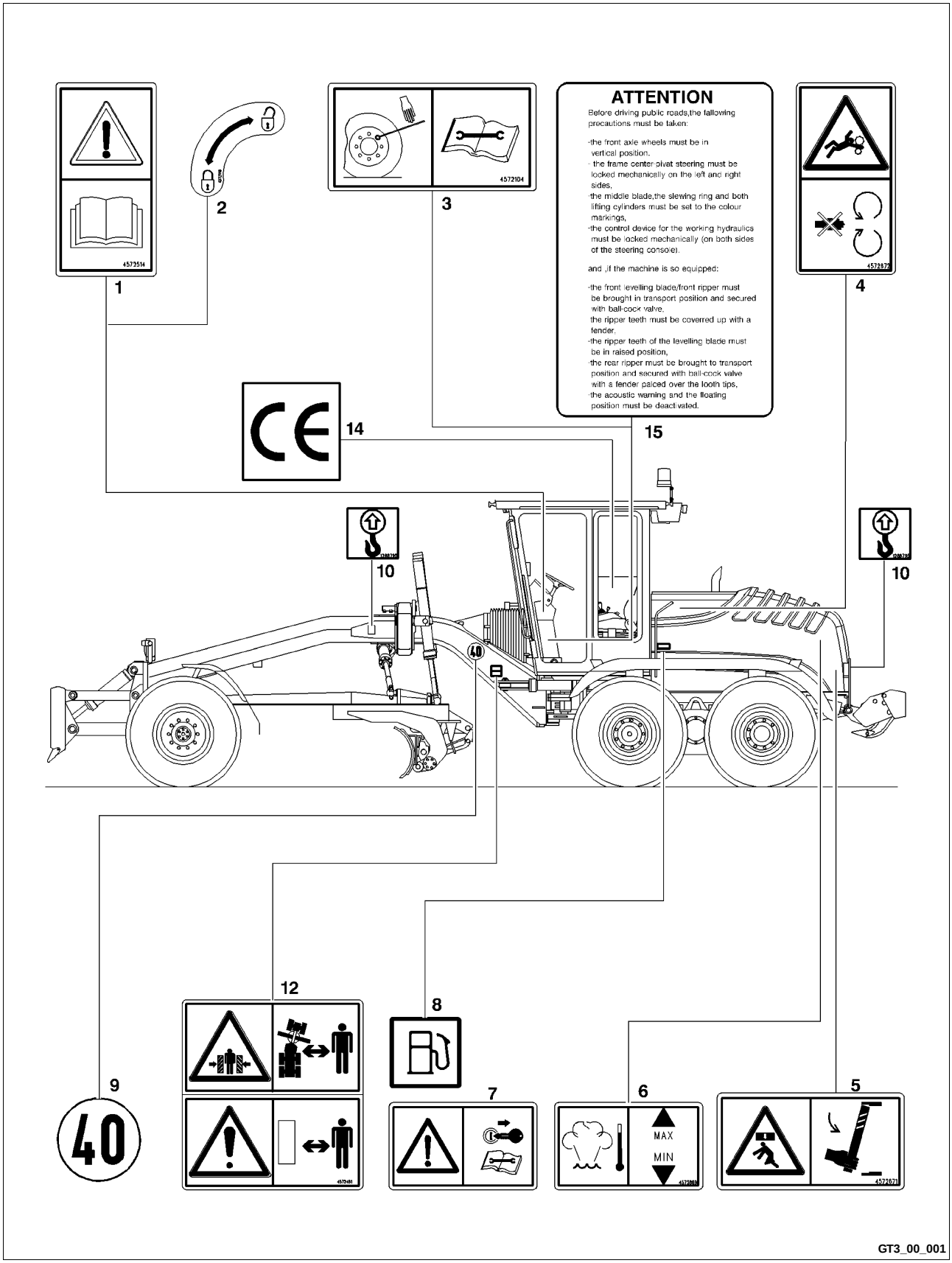
Only use suitable means of transport and lifting gear, with sufficient load-carrying capacity.

When restarting, follow only the procedure described in the operating instructions.

NOTES:

2 WARNING AND INSTRUCTION PLATES

2.1 Left side of vehicle



CAUTION: *Read the warning signs and instruction plates on the machine.*

Keep these signs and plates clean and legible.

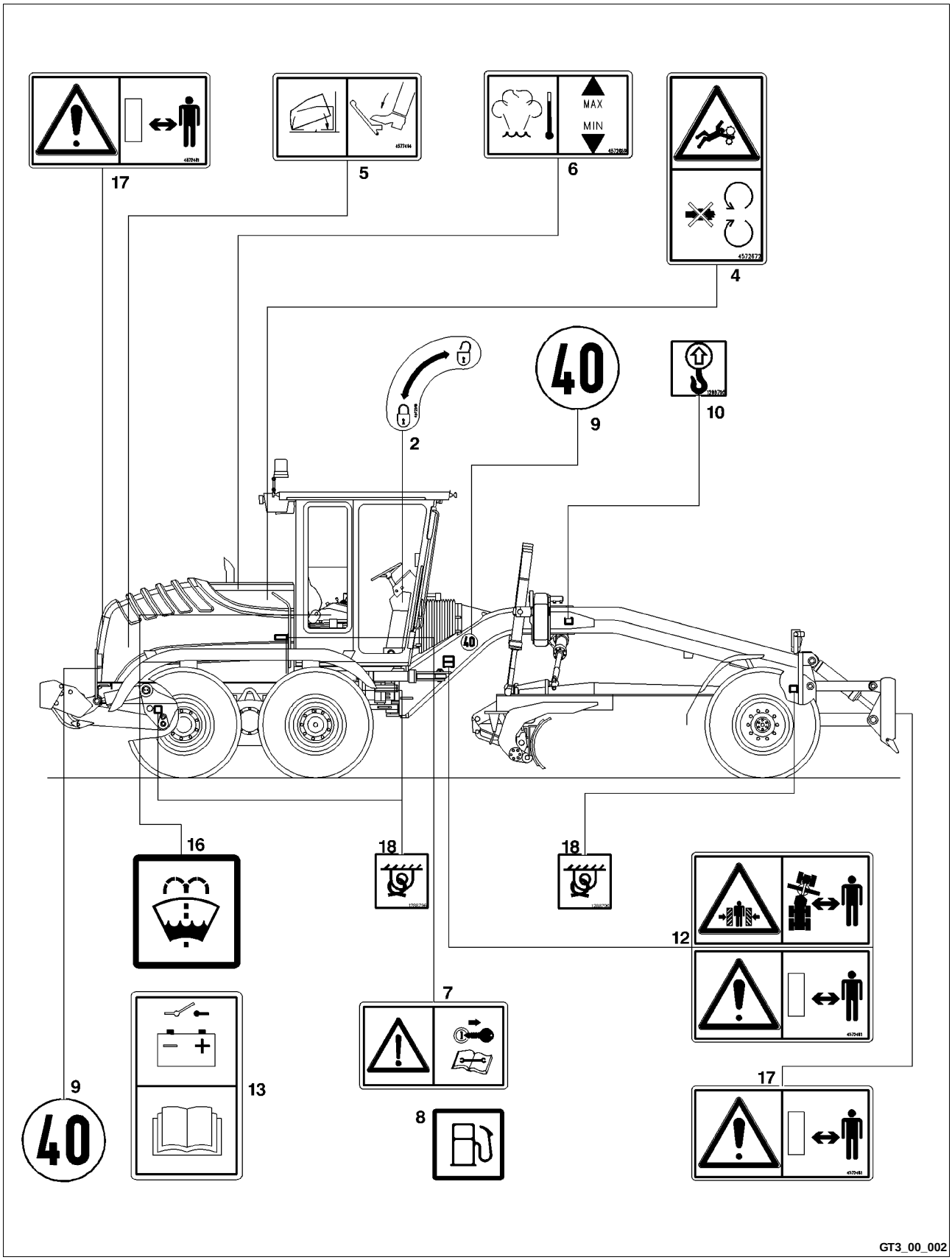
Replace these plates immediately if they are no longer legible.

New warning signs and instruction plates can be obtained from the spare parts department. When ordering, part numbers can be found on the replacement parts lists for the machine.

Legend for left side

1. Do not start up the machine before you have read and understood the operating instructions.
2. At this point, the equipment can be secured against accidental start-up.
3. Inspect wheel nuts regularly - see the operating instructions.
4. **Risk of injury** from hot or rotating parts in the engine compartment. Only open the engine compartment cover when the engine has stopped.
7. **Risk of injury** due to unauthorized starting of the machine. Before working on the machine, switch off the engine and remove the key.
9. This plate indicates the maximum speed permitted on public roads.
10. Lashing ropes or chains must be attached here if the machine is to be transported.
11. **Risk of injury** due to hot or pressurized hydraulic fluid. Follow the operating instructions.
12. **Risk of injury** by crushing. Do not start up the machine if anyone is near the articulated joint.
Risk of injury by crushing. Do not start up the machine if anyone is standing between the machine and an adjoining barrier.
14. The CE symbol certifies that this machine has been constructed according to the European regulations on mechanical safety. L_{WA} indicates the level of noise emissions in dB_A, as stated in EC standard 2000/14/EG).
15. **Driving on public roads.** This plate indicates the steps to be taken before driving on public roads.

2.2 Right side of vehicle



CAUTION: *Read the warning signs and instruction plates on the machine.*

Keep these signs and plates clean and legible.

Replace them immediately if they are no longer legible.

New warning and instruction plates can be obtained from the spare parts department. When ordering, part numbers can be found on the replacement parts lists for the machine.

Legend for left side

2. At this point, the equipment can be protected from accidental start-up.

4. **Risk of injury** from hot or rotating parts in the engine compartment. Only open the engine compartment cover when the engine has stopped.

5. **Risk of injury** if engine hood falls shut. Close the engine hood by releasing the safety rod with the foot. Read the operating instructions before carrying out repair / maintenance work.

6. **Risk of injury** from hot coolant. Only take off the radiator cap once the radiator has cooled down. Coolant level marking.

7. **Risk of injury** due to unauthorized starting of the machine. Before working on the machine, switch off the engine and remove the key.

8. Fuel tank, fill with diesel fuel here.

9. This plate indicates the maximum speed permitted on public roads.

10. Lashing ropes or chains must be attached here if the machine is to be transported.

12. **Risk of injury** by crushing. Do not start up the machine if anyone is near the articulated joint.
Risk of injury by crushing. Do not start up the machine if anyone is standing between the machine and an adjoining barrier.

13. Alternator, regulator and electronic assemblies may be damaged if the battery is disconnected while the engine is running. Therefore, switch off the engine before disconnecting and removing the battery.

16. Windscreen washer system. Water can be added here for the windscreen washer system.

17. **Risk of injury** by crushing. Do not start up the machine if anyone is standing between the machine and an adjoining barrier.

NOTES:

3 OPERATION

3.1 General Remarks

Do not operate the machine until you have read and understood the operating instructions.

Pay particular attention to:

the **'Basic Safety Information'** and all the warning signs and instruction plates attached to the machine.

Before starting the machine, familiarize yourself with the locations, functions and operating directions of the controls. Operate the controls only from the driver's seat.

Keep the operating instructions stored permanently at the machine.

OPERATING PERSONNEL

Operating personnel must be experienced in working with and operating this or similar machines.

The required skills can be acquired through a course of instruction lasting a few days, which could be provided by a service technician, or by attending a driver training course.

PERSONAL PROTECTIVE EQUIPMENT AND WORK CLOTHES

Wear a hard hat and protective shoes with non-slip soles. Smooth soles can slip on steps and pedals, thus causing injuries or operator errors.

Wear close-fitting work clothes when operating the machine. Loose or wide items of clothing can cause the control lever to be operated accidentally.

SEAT BELT

On machines with seat belts for operating personnel:
Check the seat belt attached to the driver's seat. Replace immediately if damaged, or after an accident. Put the seat belt on before starting work.

OPERATING CONDITION OF THE MACHINE

Only operate the machine if in a reliable operating condition, and only as required by the regulations. Always follow the safety instructions.

Always carry out inspections and maintenance work punctually (or have them carried out).

Only operate the machine with the attachments and component combinations approved by the manufacturer. See the Technical Data for clear information on this subject.

Only attach and work with different equipment or component combinations if the manufacturer has checked and approved the planned type of assembly.

Before starting work / driving, check whether the brake, steering, lighting and signalling systems are operational.

Poor visibility can lead to accidents. Clean the windows, and the lenses on lamps, before operating the machine.

Check whether all warning signs and instruction plates on the machine are present, and that they are clearly legible.

GETTING IN AND OUT

Face towards the machine when getting in or out.

Use only the steps, platforms and handles provided when getting in or out.

Keep steps, platforms and handles in a condition where they provide a secure grip. Clean them immediately if they become soiled with oil, grease, soil, mud, snow, ice, or other matter.

DANGER AREA

The danger area is that area around the machine where anyone might come within the range of movement of the machine, its working equipment and attachments, swinging loads, falling loads, or downward moving tools.

PERSONS IN THE DANGER AREA

Warn bystanders with a horn signal before starting the machine.

Check that no one is standing within the danger area around the machine. Stop working until all persons have moved out of the danger area.

MARSHALLER

The marshaller must stand outside the danger area.

You should have the marshaller assist you:

- if you are unable to see the entire danger area around the machine,
- when reversing,
- when manoeuvring.

Use only signs that will be understood both by you and the marshaller, or use a communication device (for example radio telephone / camera). The marshaller will not be able to understand unaided speech because of the operating noise from the machine.

Remain in constant contact with the marshaller.

Stop the machine immediately, if your lose contact with the marshaller.

SECURING THE MACHINE

Secure the machine as described in the section ‘Securing the machine’, before:

- attaching/removing working equipment,
- switching the machine off after everyday operations,
- carrying out maintenance or repair work.

3.2 Fuelling

RISK OF EXPLOSION

Fuel and fuel vapour are easily ignited and can explode into flame. Therefore, avoid causing sparks and do not use naked flames such as lighters or matches for illumination.

POSSIBLE RISKS TO HEALTH

Diesel fuel and fuel vapour can be injurious to health. Fuel should not be swallowed. Also, avoid prolonged contact with the skin. Do not inhale fuel vapour. Wear protective gloves or use a barrier cream. Do not eat, drink or smoke while fuelling.

AVOIDING DAMAGE TO THE ENVIRONMENT

Avoid allowing fuel to overflow. Do not allow fuel to penetrate into the soil, as this is dangerous for the environment.

Spilled fuel should be soaked up immediately with a cleaning cloth or binding agent, then disposed of in an environmentally responsible way.

Fuel accidents should be reported immediately to the licensee or his agent.

SECURING THE MACHINE

When fuelling, secure the machine to prevent unauthorized start-up:

Park the machine on level ground with sufficient load-carrying capacity, lower the working equipment to the ground, switch off fuel-driven auxiliary heaters and air conditioning systems, switch off the engine, apply the hand brake, take the key out of the key switch for the electrical system.

Fuelling always takes place on the ground, with the operator in standing position.

FUELLING

Read and apply the ‘Fuelling safety instructions’ before filling up with fuel.

FUELLING FROM CANS

If the machine is mostly or regularly fuelled from cans or drums, there is a greater risk that dirt particles and water will penetrate into the fuel system.

In this case:

- always pour in the fuel through a fine-mesh strainer
- only use siphon pipes along with a fine filter
- drain the fuel filter more often than indicated in the maintenance plan
- drain the water and sediment from the fuel tank more often
- replace all fuel filters at shorter intervals.

CAUTION: *NEVER FILL WITH BIODIESEL*

Biodiesel can damage the engine and injection system.

Use only diesel fuel produced from mineral oil, which meets EN 590 standard. For more information, contact your dealer’s service department.

3.3 Fuelling system (optional)

RISK OF EXPLOSION!
Do not smoke, and keep away from naked flames. Fuel and fuel vapour are inflammable; Danger of fire.

Switch off fuel-driven auxiliary heaters and air conditioning systems.

PROTECTING HEALTH AND THE ENVIRONMENT
Fuel can be harmful to the skin, so wear protective gloves or use a barrier cream.

Do not spill fuel or allow it to penetrate the soil - this would endanger the environment. Spilled fuel should be soaked up immediately with a cleaning cloth or binding agent, then disposed of in an environmentally responsible way.

Report accidents with fuel immediately to the machine licensee, or his agent.

SECURING THE MACHINE
When fuelling, secure the machine to prevent unauthorized start-up:

- Lower working equipment to the ground
- Switch off the engine
- Take the key out of the electrical system key switch.

INCREASED RISK OF CONTAMINATION
If the machine is mostly or regularly fuelled from tanks or drums, there is an increased risk of contamination of the fuel system.

In this case, the fuel prefilter must be drained and cleaned more often than indicated in the maintenance plan.

The fuel filter must also be replaced at shorter intervals.

3.4 Driving

BEFORE MOVING OFF

Before operating the machine, clean your work shoes to remove clinging soil, mud, snow, ice, grease and oil. These could cause the shoes to slip on the steps or pedals, thus causing unwanted movements.

Before moving off, adjust the driver's seat, steering column and mirror, and fasten your seat belt.

Do not carry passengers on the machine.

Before moving off, warn any bystanders with the signal horn.

NO TOWING

This machine is not suitable for towing trailers or other vehicles; Doing so would cause damage to axles and gears. The tow coupling is intended only for towing or recovering the machine from hazard areas, or for lashing onto transport vehicles; see 'Towing/recovery'.

DRIVING WITH HANGING LOADS

Ensure that the wheels provide sufficient ground adhesion; only this will ensure braking/steering effectiveness. Do not drive with hanging loads positioned cross-wise; Do not attempt a U-turn with such loads. Do not attempt to position such loads using the articulated joint.

REVERSING

When reversing, the view of the danger area is reduced. Therefore, obtain assistance from an experienced marshaller. Agree on the meaning of signals with the marshaller, to ensure that the signals from the marshaller are correctly understood.

PARKING THE MACHINE

Machines parked on slopes can move off by themselves.
Therefore, always park the machine on an even, horizontal surface, lower the working equipment and its support to the ground.

DRIVING OVER LONGER DISTANCES

The share should not extend into the steering area of the front wheels, or of the steering linkage.

The central warning lamp should not flash when the driver enters, otherwise determine the cause and switch off.

If driving on public roads:

- Keep to the conditions of the general operating licence.
- Close the driver cab doors.
- Take along a first-aid box, hazard warning triangle and warning lamp.
- Check the content of the first-aid box. Replace items that have been used, or which have become unusable.

With the engine running, check:

- that the steering wheel moves easily, by turning it briefly to the left and right, and that the steering gear responds.
- Drive a short distance and operate the brake to check that the service brake is working effectively.

Never allow the machine to roll with the gear lever in the 'N' position, for example when driving downhill.
If driving with the door open, this should be engaged in the end position.
Before moving off, bring the machine up to operating temperature as described in the 'Operating instructions - warming up'.

Only then should the engine be placed under full load.

SEAT BELT

Fasten your seat belt before every trip.

Do not pass the seat belt over rigid or breakable objects, for example a bunch of keys or spectacles. This could result in bodily injuries.

The seat belt must always lie firmly against the body and should not catch on anything.

The belt buckle guide should not be obstructed (for example, with papers), otherwise the buckle tongue will not engage.

Seat belts that are damaged, or which were stressed during an accident and have therefore been stretched, must be replaced.

ADJUSTING THE STEERING COLUMN

Do not adjust the steering column while driving.
Your attention will be distracted - RISK OF ACCIDENT!

Before adjusting the steering column:

- Stop the machine
- Gear lever in neutral position
- Apply the hand brake

3.5 Towing /recovery

Tow the machine with the tow bar or tow rope only.

The tow bar / tow rope should not be damaged. It must be designed so that the calculated load at rupture is three times the tractive force of the towing machine.

The towing vehicle must have sufficient tractive force. Drive slowly and carefully.

No one should be standing near the tow bar/rope.

Only tow the machine if the brakes and steering are functional and the machine cannot be transported any other way.

If these are not functional, only tow the machine as far as is necessary to recover the machine from danger areas.

After recovery, the machine must be secured to prevent it rolling, and prevent unauthorized start-up.

Before transporting over long distances, either repair the machine or load it onto a transport vehicle.

Towing speed should not go above 10 km/h.

Tow the machine out of the danger area only, otherwise tow it on a low-bed trailer.

Towing any further can cause damage to the transmission.

3.5.1 Towing devices

The towing devices should not be used for towing trailers.

3.5.2 Transport

Only load up and transport the machine if all the requirements of the safety regulations are met.

Arrange the loading and transport with a company that is experienced in the transport of abnormal loads.

Responsibility for the loading and transport is borne by the transport company or their authorised representative.

To reduce the risk of slipping, clean the drive-on ramps and loading area on the transport vehicle, and the wheels of the machine, to remove oil, grease, soil, mud, snow, ice and other matter.

Use anchoring equipment with sufficient load-holding capacity (for the weight specifications of the machine, see the ‘Technical Data’ section).

3.5.3 Crane loading

If loading with a crane, lock the articulated joint.

3.6 Everyday operation

Read carefully through the sections ‘Basic safety instructions’ and ‘Operation - General information’ and follow the instructions given.

Before starting work, examine the worksite for embedded gas and water pipes, and electrical power lines. Damaging these lines can cause a life-threatening situation!

Before operating the machine, clean your work shoes to remove clinging soil, mud, snow, ice, grease and oil.
These could cause the shoes to slip on the steps or pedals, thus causing unwanted movements.

If driving with the door open, engage the door in the end position.

Warn bystanders with a horn signal before starting work.

Do not drive with hanging loads positioned cross-wise.

Do not attempt a U-turn with such loads. Do not attempt to position such loads using the articulated joint.

Stop working if anyone is standing within the danger area around the machine. Start working only when all persons have moved out of the danger area.

Always operate and use the machine in such a way that it remains stable.

Ditches and trenches can collapse. Keep at a safe distance.

3.7 Using the grader

Due to the versatility of the grader and the diversity of the materials, there are many possible applications and working methods. We therefore recommend having the driver instructed by the manufacturer.
Read and pay attention to: ‘Operating instructions - Warming up’.

Do not exceed the machine’s permitted transverse/longitudinal tilt angle. Doing so will reduce or interrupt the engine lubrication.

The permitted tilt angles of the machine are:

- Transverse tilt:
  Left / right 35° 35°
- Longitudinal tilt:
  Downward / upward 35° 35°

If the engine temperature, oil pressure or alternator warning lamps come on, lower the working equipment immediately and switch the engine off.

3.8 Working equipment

PERSONNEL

The assembly operations should be carried out only by operating or maintenance personnel who possess the required skills.

If the personnel lack the necessary skills, they should be carefully guided by experienced personnel.

They must have read and understood the operating instructions, particularly the 'Basic safety information' section.

During the assembly operations, only experienced personnel must be allowed to start the machine in order to make adjustments to the working tool.

Operator errors with the machine or the working equipment can result in life-threatening situations.

PERSONAL PROTECTIVE EQUIPMENT AND WORK CLOTHES

Wear close-fitting work clothes when working with the machine. Loose or wide items of clothing can become caught in machine parts, and thus cause injuries.

Wear a hard hat, protective shoes and gloves.

TOOLS AND ACCESSORIES

Tools, lifting gear, lifting accessories, support frames and other equipment must be in a reliable working condition.

When driving in or removing fastening bolts, metal splinters may fly off and cause injury. Therefore, use a brass or copper drift for driving in or removing bolts, and wear safety glasses.

Use only the steps, platforms and handles provided when getting in or out.

Keep steps, platforms and handles in a condition where they provide a secure grip. Clean them immediately if they become soiled with oil, grease, soil, mud, snow, ice, or other matter.

SECURING THE WORKING EQUIPMENT

Lower the working equipment to the ground, so that it will not move when mechanical or hydraulic connections are loosened.

If the machine has to be jacked up, secure the front axle with wedges to prevent swinging.

If working near the articulation, lock the joint. Remove all locking and securing devices when the work is complete.

If work tools or tool parts are to be attached or removed, or adjusted while in position, they should be secured with suspension/propping equipment to prevent unintentional movement, slipping or falling.

SECURING THE MACHINE

Only carry out work on the working equipment if the machine has been secured as described in the section 'Securing the machine'.

CHOOSING THE WORKING EQUIPMENT

The machine can be equipped with a variety of working equipment. The components of the working equipment are made up of hydraulic cylinders and connecting parts. Various component combinations are possible in order to adapt the working equipment optimally to the type of application.

Only use equipment and component combinations with the machine, if these have been expressly approved by the manufacturer for this machine.

Equipment supplied by other manufacturers, to which EC machines guideline 89/392 EWG applies, should only be attached and operated if they carry:

- the manufacturer's statement of conformity,
- the statement of compatibility.

3.9 SECURING THE MACHINE

RISK OF INJURY

The machine should not be started by unauthorized persons.

It should therefore be protected.

Secure the machine as described below:

- Before any maintenance or repair work on the machine.
- Whenever attaching or changing the working equipment.
- Park the machine on level ground with sufficient load-carrying capacity.
- Lower the working equipment to the ground.
- Apply the hand brake.

NOTE: *Do not stop the engine when under full load, but let it run for about three to five minutes to allow temperature balancing.*

- Switch off the engine.
- Take the key out of the electrical system key switch.
- Depressurize the hydraulic system.
- Lock the articulated joint.
- Secure open engine hoods.
- Secure the machine with chocks to prevent it rolling.
- Switch off the battery main switch and remove the control lever.
- Before working on the electrical system, disconnect the batteries.
- Before carrying out welding operations on the machine, read the section ‘Repair - Welding work’.

4 INSPECTION AND MAINTENANCE

4.1 General information

Repair manual

Before starting work, personnel appointed to carry out work on the machine must have read and understood the repair manual.

Pay particular attention to:

'Basic Safety Information' and all the warning signs and instruction plates attached to the machine.

The repair manual contains all the technical information necessary for carrying out maintenance and repair work on the machine. Work on the machine should only be carried out by personnel trained for this purpose!

INSPECTION AND MAINTENANCE PERSONNEL

The inspecting and maintenance personnel must have experience in the inspection and maintenance of these or similar machines.

The required skills can be acquired through a course of instruction lasting a few days, which could be provided by a service technician, or by attending a driver training course.

PERSONAL PROTECTIVE EQUIPMENT AND WORK CLOTHES

Wear close-fitting work clothes when working with the machine. Loose or wide items of clothing can become caught in machine parts, and thus cause injuries.

Wear a hard hat, protective shoes and gloves, and ear protection if there is loud noise.

SECURING THE WORKING EQUIPMENT

Lower the working equipment to the ground, so that it will not move when mechanical or hydraulic connections are loosened.

If working near the articulation, lock the joint. Remove all locking and securing devices when the work is complete. If the machine has to be jacked up, secure the front axle with wedges to prevent swinging.

If working equipment or tool parts are to be attached or removed, or adjusted while in position, they should be secured with suspension/propping equipment to prevent unintentional movement, slipping or falling.

SECURING THE MACHINE

Only carry out work on the working equipment if the machine has been secured as described in the section 'Securing the machine'.

GETTING IN AND OUT

Use only the steps, platforms and handles provided when getting in or out.

Keep steps, platforms and handles in a condition where they provide a secure grip. Clean them immediately if they become soiled with oil, grease, soil, mud, snow, ice, or other matter.

Face towards the machine when getting in or out.

CHECK THE CONDITION OF TOOLS

Only work with fully functional and reliable tools.

Choose only tools that are suitable for the task.

Ill-fitting wrenches, for example, may slip off and cause injury.

CLEANING OPERATIONS

Before starting work, clean up any assemblies located in the work area.

The choice of cleaning agent will depend on the type of material in the parts to be cleaned.

Example: Do not use solvents or steam jets to clean electrical or rubber components.

Use only fibre-free cleaning cloths to clean the hydraulic system or the engine.

Cleaning agents and solvents can give off highly inflammable or noxious vapours.

Only use such products in areas that are well ventilated - do not inhale the vapour, and do not smoke.

Do not allow cleaning agents and solvents to come into contact with the skin. Wear solvent-resistant gloves.

Follow the instructions on the product packaging.

HANDLING COMBUSTIBLE FLUIDS

When handling combustible fluids:

- do not smoke,
- no open lights or naked flames.

Fuel and other operating fluids often have low flashpoints and are easily ignited.

Do not use water to extinguish burning fluids. Use the following:

- powder extinguisher,
- carbon dioxide or
- foam extinguishing equipment.

When it comes into contact with burning fluids, water will vaporise abruptly and cause burning oil to spray over a large area.

Water will cause short-circuiting in the electrical system, thus possibly creating additional dangers. Notify the fire department.

FASTENINGS AND FIXING ELEMENTS

Check fastenings and fixing elements, for example, bolts, nuts, washers, before re-using.

Replace damaged parts.

HANDLING OILS AND LUBRICANTS

Risk of burns due to the uncontrolled release of hot lubricants or hydraulic fluid.

If burns occur, chill immediately with running water, then apply a dry bandage.

Stand out of the direction of the oil spray.

Avoid contact with the skin. Wear gloves and close-fitting work clothes.

Old oils can be injurious to health if they come into contact with the skin. If this occurs, wash the skin thoroughly with warm soapy water and apply a protective cream. Do not use fuels or solvents to clean the skin.

If you have accidentally swallowed oil, do not induce vomiting, but seek medial assistance immediately.

VISIBLE OIL LEAKS

If there is a visible oil leak, repair the leak immediately.

Leaking oil is a danger to the environment!

Use an oil binding agent to absorb any spilled oil. Gather up the binding agent and dispose of separately from other waste.

RELEASE RESIDUAL PRESSURE IN THE HYDRAULIC SYSTEM

Hydraulic systems should only be opened after they have been depressurized. Even when the machine is parked on a horizontal surface, the working equipment lowered to the ground, and the drive motor switched off, a considerable amount of residual pressure can remain in some parts of the hydraulic system, for example, primary pressure due to the final hydraulic movements before the machine stops.

Residual pressure is only released gradually. If work on the hydraulic system is required immediately after switching off, release the residual pressure as described in the section ‘Hydraulic system’.

SCREW CONNECTIONS, PIPES, HYDRAULIC HOSES

Repair any leaks in the pipe system immediately.

A fine spray of hydraulic fluid at high pressure can penetrate the skin.

Do not try to locate leaks with the fingers, but use a piece of cardboard and wear protective goggles.

If fluid has penetrated the skin, seek medical assistance immediately.

Do not repair damaged pipes, but replace them with new ones.

Replace hydraulic hoses immediately if there is visible damage or seepage.

Only re-tighten leaking screw plugs after depressurizing.

Leaking oil is a danger to the environment!

DISPOSE OF ENVIRONMENTALLY

Oil, grease, brake fluid, cleaning agents, solvents and parts containing oil, for example, filters, cleaning cloths, replaced parts and unusable machine parts should be disposed of separately from each other, with respect for the environment.

Do not include these materials with normal household waste.

Put them into the containers provided for this purpose.

Even bio-degradable 'environment-friendly' hydraulic fluid must be disposed of separately, like any other oil.

Do not allow oils and oily waste to penetrate the soil or water courses, as this would endanger the environment!

SEALING SURFACES

Clean the sealing surfaces before assembling.

ENGINE EXHAUST

Exhaust gases are harmful to health - do not inhale.

If working in enclosed spaces an exhaust gases are present, use an extractor to evacuate the gases and keep the room well ventilated.

HANDLING BATTERIES

Batteries give off explosive gases.

Do not bring open lights or naked flames near batteries, and do not smoke.

Remove the batteries, if welding or grinding work is to be carried out nearby. Take the batteries to a safe distance.

Battery acid is poisonous and corrosive.

Avoid contact with the skin, mouth, eyes and clothing. Do not spill battery acid, and do not inhale acid vapour.

When handling batteries, wear acid-resistant gloves, close-fitting clothes and protective goggles.

If acid comes into contact with the skin, wash thoroughly with water and seek medical assistance.

If acid spray gets into the eyes, rinse thoroughly with running water and call an eye specialist immediately, or go to a hospital A&E department.

Do not place tools on the battery. This can cause a short circuit, which would ruin the battery and could cause injury.

Do not wear metal necklaces, bracelets or watch straps when working on the battery. Metal parts can cause a short circuit and possible burn injuries.

Dispose of old batteries separately from other waste, and with respect for the environment.

BEFORE WORKING ON THE ELECTRICAL SYSTEM

Before working on the electrical system, when there is a possibility of tools, spare parts, etc. touching electric wires and contacts, disconnect the battery:

- disconnect the negative terminal first, then the positive.

When work is complete:

- connect the positive terminal first, then the negative.

Read and pay attention to the ‘Electrical system’ section.

CHOOSING OILS / LUBRICANTS

Only use the recommended grades, select viscosities according to temperature level.

FILTERS

Replace all filter elements and cartridges at the specified intervals.

All filters are carefully selected to suit the equipment concerned. Trouble-free operation and long service life for the engine and hydraulic assemblies can only be ensured by using original replacement parts.

SEALS

When removing components, pay attention to their seals.

Before installing, check the seals and replace them even if only slightly damaged.

Check that they are correctly seated when assembling.

CHECK OIL LEVEL / OIL CHANGE

Place the machine horizontally. Change the oil when the machine is warm. Warm oil flows better and carries particles in suspension better (oil carbon and abrasion particles).

GREASE LUBRICATION

Clean the lubricating nipples, then lubricate as indicated in the lubrication plan.

AFTER MAINTENANCE

To prevent corrosion damage, coat all bare metal machine parts with a film of grease.

When the work is completed, re-attach all safety devices.

Only start the drive motor when no one is working on the machine.

Carry out a function test on the machine.

4.2 Fuel system

RISK OF EXPLOSION DUE TO FUEL VAPOUR

Fuel vapour is highly inflammable and can burst into flame. Therefore, avoid causing sparks and do not use naked flames such as lighters or matches for illumination.

If you have to work on the fuel system:

- switch off the engine and auxiliary heater,
- secure the machine,
- avoid using naked flames,
- do not eat, drink or smoke.

POSSIBLE RISKS TO HEALTH

Diesel fuel and drained water / fuel mixtures can be injurious to health. These fluids are harmful if swallowed.

Also, avoid prolonged contact with the skin.

Do not inhale fuel vapour. Wear protective gloves or use a barrier cream.

AVOIDING DAMAGE TO THE ENVIRONMENT

Collect overflowing fuel in a container and dispose of it without causing damage to the environment.

Dispose of fuel filters and fuel-soaked cleaning cloths separately from other waste.

NOTE: *NEVER FILL WITH BIODIESEL!*

Biodiesel can damage the engine and injection system.

Use only diesel fuel produced from mineral oil, which meets EN 590 standard.

For more information, contact your dealer's service department.

FUELLING FROM CANS

If the machine is mostly or regularly fuelled from cans or drums, there is a greater risk that dirt particles and water will penetrate into the fuel system.

In this case:

- always pour in the fuel through a fine-mesh strainer,
- drain the fuel filter more often than indicated in the maintenance plan,
- drain the water and sediment from the fuel tank at shorter intervals,
- replace all fuel filters at shorter intervals.

4.3 Electrical system

Risk of injury from battery acid and gases.

Wear protective goggles, work gloves and close-fitting work clothes.

BEFORE WORKING ON THE ELECTRICAL SYSTEM

Switch off the engine.

Turn the electrical system key switch to the **0** and take out the key.

Turn the battery main switch to the **OFF** position and remove the control lever.

Disconnect the control units and control console from the on-board electrical system.

Before working on the electrical system, when there is a possibility of tools, spare parts, etc. touching electric wires and contacts, disconnect the batteries.

- Disconnect the negative terminal first, then the positive.

When work is complete:

- connect the positive terminal first, then the negative.

Read and apply the ‘Operating instructions-Alternator, control units and control console’.

Read and pay attention to the section ‘Inspection and maintenance - General information’.

Use only measuring instruments for carrying out voltage tests and continuity checks. Do not use test lamps.

Do not ‘short to ground’.

The resulting short circuit will cause damage to the alternator or to the electronics.

ALTERNATOR

Never disconnect the electrical connections at the alternator, regulator or battery while the engine is running.

This will damage the alternator and regulator.

When connecting the batteries, do not mix up the cables (check the polarities).

Use only measuring instruments for carrying out voltage tests and continuity checks.

Do not use test lamps.

Do not ‘short to ground’.

The resulting short circuit will cause damage to the alternator and regulator.

When the engine is started, the alternator is actuated (pre-excited) by an electronic circuit. This ensures that the alternator is able to deliver power.

This circuit is part of the main electronic system in the control console.

A LED (charge indicator) on the control console indicates whether the alternator is functioning correctly. This LED must light up when the key switch is turned to the On position; it should go off once the engine is running.

If this is not the case, then there is a fault in the alternator electrical circuit or in the control console.

To prevent further damage, the cause of the fault must be found and resolved as quickly as possible.

Contact your dealer’s service department.