

DCE 90-180
DCE 70-32E3 - 70-35E4
2006 -



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1 Foreword

1.1 About the Operator's Manual

General

Thank you for choosing Kalmar Industries as your machine supplier. We hope that we'll meet your expectations.

This Operator's manual contains information that you must keep in mind for safe handling and optimal use of your new Kalmar machine.

Purpose of the Operator's Manual

This Operator's manual applies to machine DCE 90-180.

The Operator's manual describes how the machine must be operated and maintained in the correct manner.

Kalmar Industries will not accept any responsibility for machine modifications without permission from Kalmar Industries as well as if other lifting devices, tools or work methods are used other than those described in this manual.

Storage

The Operator's manual must always be kept in the machine.

About the machine version

The information in this Operator's manual corresponds to the machine's design and appearance at the time of delivery from Kalmar Industries. Due to customer adaptations, there may be variations and/or deviations.

Kalmar Industries reserves the right to change specifications and equipment without prior notice. All data and information in this manual are valid at the time of publication.

Copyright

Kalmar Industries AB

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Duplication by any means, such as copying, printing etc., is prohibited.

Manufacturer

This machine is manufactured by Kalmar Industries AB, SE-341 81 Ljungby, Sweden.

1.1.1 Reading instructions

Warning information

Warning descriptions in this Operator's manual concern your safety. The warnings provide information about potential dangers that, if not heeded, could lead to personal injury or product damage.



DANGER

Situations that could lead to severe personal injury or death if regulations are not followed.



WARNING

Situations that could lead to personal injury if regulations are not followed.



CAUTION

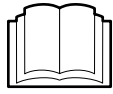
Situations that could lead to product damage if regulations are not followed.

Important information

Important information is denoted with NOTE and is intended to facilitate the work process, handling or to increase understanding of the information.

NOTE

Important information that is not related to safety.



Read the Operator's manual

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Read the Operator's manual

The symbol to the left is used in certain cases on the machine and refers to important information in the Operator's manual.



Read the Maintenance manual

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Read the Maintenance manual

The symbol to the left is used in certain cases on the machine and refers to important information in the Maintenance manual.



Indicates optional equipment

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Optional equipment

There is a wide range of optional equipment for the machine. Each description of optional equipment in the Operator's manual is marked with a symbol and contains an explanatory text. The symbol is highly visible and is placed next to the text and figure item in question.

See the machine card for complete specifications of the machine's product alternatives and optional equipment.

1.2 About the documentation kit

The documentation kit

The following documents are supplied with the machine:

- Operator's manual DCE 90-180 (in cab with machine)
- Maintenance manual DCE 90-180
- Spare parts catalogue with machine card

Supplementary documentation can be ordered for this machine:

- Workshop manual DCE 90-180.
- Subcontractor documentation for e.g. engine, transmission and drive axle.

Ordering of documentation

Documentation is ordered from the dealership.

Always indicate publication number when ordering.

1.3 Inspection and maintenance

General

For satisfactory function of the machine at the lowest cost, maintenance must be performed correctly. Intervals for care and lubrication refer to normal environment and operating conditions.

Maintenance work described in this Operator's manual can be performed by the operator, see chapter *6 Inspection and maintenance*. This section describes the running checks and actions that the operator should perform in conjunction with work shifts.

Maintenance

For other maintenance not included in this Operator's manual (service and repairs), an authorized service workshop should be contacted.

2 Safety

General

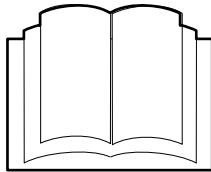
Safety rules are intended to reduce the risk of personal injuries as well as damage to the load or other property.

Only personnel trained for this machine may come into contact with, drive, carry out service or be present in the work area during operations.

The safety information in this Operator's manual is for Your information and safety. It cannot, and is not intended to, cover all operational eventualities. A trained responsible driver is the only way to guarantee safe and long use of the machine.

The machine was thoroughly tested and set-up prior to leaving the factory. This does not prevent the possibility of damage in transit. The machine must be carefully inspected to ensure correct function before it is first used.

Important to read the Operator's Manual



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Incorrect handling can lead to personal injury and damage to product and/or property. Therefore, read the operator's manual thoroughly before starting to use the machine. The operator's manual contains important information about your Kalmar machine, about operating the machine, safety during operation, and about daily maintenance of the machine. You will also find a lot of valuable information that will make your work easier.

The operator's manual must always be kept in the machine. If it is lost, replace it immediately with a new operator's manual.

NOTE

Never use a machine that does not have an operator's manual.

Ask your foreman or supervisor if there is anything in the text you do not understand or if you feel information is missing in any area.

Intended use

- The machine may only be used for the purpose for which it is designed and adapted, that is, to lift and transport goods (the weight of which is not to exceed the machine's maximum rated load capacity). If it is used in another way or in potentially dangerous environments (for example, explosive environments, areas with dust containing asbestos), special safety regulations must be followed and the machine must be equipped for such operation.

- The machine may not be modified or rebuilt so that its function or performance is altered, for example, areas that affect lift capacity, visibility conditions from the cab, protective equipment, brakes, steering or lifting equipment, without specific permission from Kalmar Industries. When modifications/rebuilds authorized by Kalmar Industries have been performed, the affected machine plates and documentation must be updated so that they are valid for the modification/rebuild.

The machine may only be modified or rebuilt if Kalmar Industries accepts product liability (without any other manufacturer assuming product liability). Modifications and rebuilds may only be performed if there is knowledge to implement and test modifications and rebuilds. Modifications and rebuilds must be documented (date and actions) and the organization responsible must be indicated with name and address. Plates and decals must be updated according to the machine's new version.

- The machine may not be operated on public roads unless it has been adapted according to national road safety regulations.
- It is always the machine owner's responsibility to ensure that the machine has approved fire-fighting equipment that complies with mandatory regulations.

Operator requirements

- The machine may only be operated by specially trained operators who have the management's permission to operate the machine.
- Laws and regulations regarding driver's licenses, operator ID, etc. must always be followed.
- The operator must be aware of, and follow, all local safety regulations.
- The driver must follow the manufacturer's instructions.
- The driver must read and understand the machine's warning and information plates and understand and be able to use the machine safety and warning equipment.

Prohibited operation of machine

Operation of the machine is prohibited:

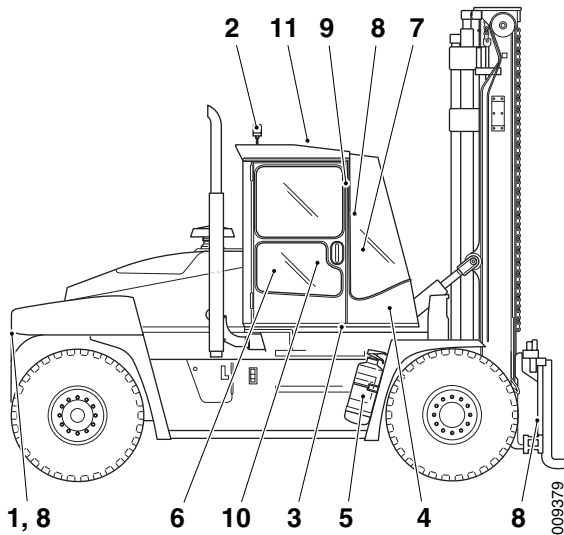
- If safety and warning equipment, such as rear-view mirrors, headlamps and the indication systems, etc. do not function correctly.
- In case of defective brakes, steering or lifting equipment.
- If unauthorized vehicles or persons are in the work area.
- If the machine has been repaired, modified or adjusted without the supervisor's/work management's permission.
- If the machine is fitted with tyres not approved by Kalmar Industries.

2.1 Safety equipment

General

A good working environment has safety and emergency equipment to make the operator's work easier and safer.

The machine may be equipped with the following safety equipment:



1. Reversing alarm

2. Rotating warning lamp/flashing warning lamp

The rotating warning lamp may be vertically adjustable.

3. Horn

4. Electrically operated loud horn

5. Fire extinguisher

The fire extinguisher is normally located on the left front fender, but can also be located on the right front fender or inside the cab.

If the machine is equipped with a fire extinguisher, it should be of type ABE according to EN 3 parts 1, 2, 4 and 5. This type of extinguisher can put out fires in both solid organic materials and fluids. Suitable fire extinguishing equipment can be ordered from Kalmar Industries.

6. Seat belt

7. Buzzer in cab to indicate alarm or forgotten action, for example, the driver leaving the driver's seat without applying the parking brake.

8. TV camera with monitor

Is used for improving the rear view vision when manoeuvring and/or load handling with the machine. The monitor is usually located inside the cab at the front door post.

9. Exterior mirrors

Used to give improved visibility when operating and load handling.

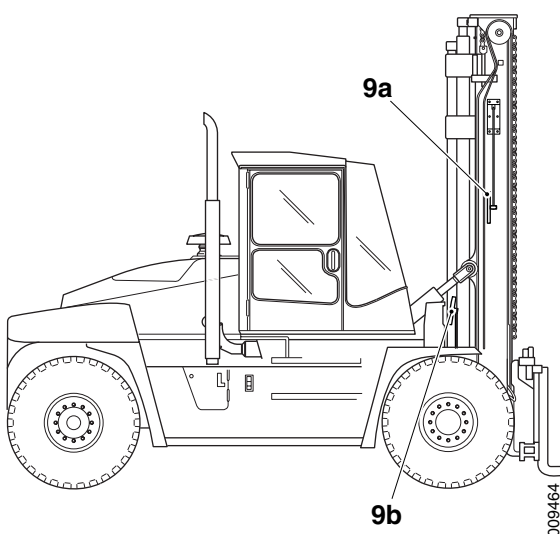
9a shows hidden area in front of the machine

9b shows concealed areas at the side/behind the machine

10. Breaker switch for load handling

(servo circuits, only in case of controls electric servo for load handling).

11. Protective grille for roof window



2.2 CE marking

CE marking

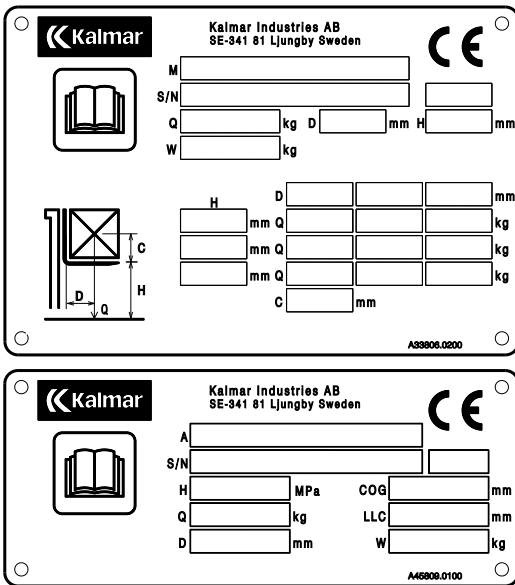
(Declaration of Conformity, applies to all machines sold within the EU/EEA).

This machine is CE marked. This means that, when delivered, the machine meets all applicable “Essential Health and Safety Requirements”, stipulated in the EU Machinery Directive, 98/37/EG and other EU directives applicable to this type of machinery.

As proof that the requirements are complied with, an EC Declaration of Conformity is supplied, issued by Kalmar Industries for each and every machine. This Declaration of Conformity also covers attachments and options manufactured by Kalmar Industries. The documentation is a valuable document which must be stored securely and saved for at least 10 years. The documentation must always accompany the machine when sold.

Anyone making modifications that affect the safety of the machine also assumes responsibility for these. If the machine is used for other purposes, or with other appliances than the ones mentioned in this instruction manual, safety must be ensured in each individual case. The machine owner is responsible for ensuring that the machine is used in ways specified in the instruction manual. Other areas of application might require new CE marking and the issue of a new EC Declaration of Conformity.

For additional information, see standards under chapter 8 *Environment and standards*.



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Machine plates for CE marking

2.3 ANSI/ASME marking

ANSI/ASME marking

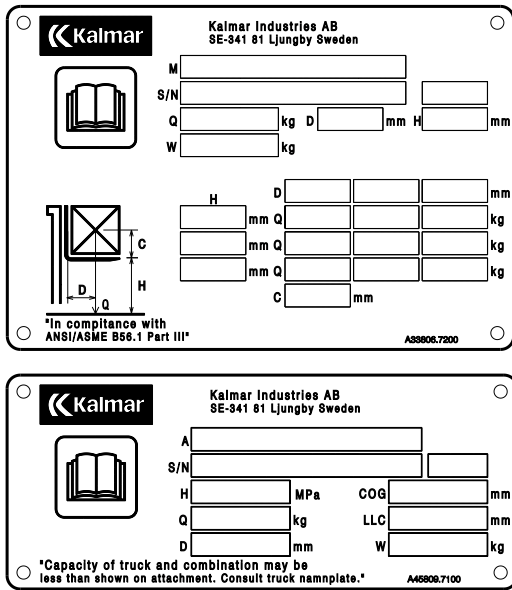
(Applies to all machines for the North American market).

This machine is ANSI/ASME marked. This means that when delivered, it complies with the basic safety requirements in ANSI/ASME B56.1.

Anyone making modifications that affect the safety of the machine also assumes responsibility for these.

If the machine is used for other purposes, or with other appliances than the ones mentioned in this instruction manual, safety must be ensured in each individual case. The machine owner is responsible for ensuring that the machine is used in ways specified in the instruction manual.

For additional information, see standards under chapter 8 *Environment and standards*.



Machine plates for ANSI/ASME marking

2.4 Keep in mind

Interrupted operation and/or parking



WARNING

Always switch the ignition off when the machine is left, e.g. when parking or at the end of each shift etc.

Danger!

Interrupt the current using the battery disconnect switch.

NOTE

Always check that a gear is not engaged before the ignition key is turned or the breaker switch for load handling is reset.

NOTE

Never leave the driver's seat without first applying the parking brake (ON position).

NOTE

Always remove the ignition key if the machine is to be left unattended.

During work shifts



DANGER

Forks or another attachment is a tool that handles heavy loads.

Fatal danger and risk of property damage!

Make sure that no persons stand or walk under a raised tool, regardless of whether it is loaded or not.



WARNING

The machine's work area is large and visibility from the operator's cab is restricted.

Fatal danger and risk of property damage!

Keep in mind:

- Always check that no persons are in the way of the machine or its equipment. Check that the area overhead is clear. The machine must be stopped if unauthorized vehicles or persons are in the work area.
- The operator must always face in the direction of travel and should operate with special care where persons or vehicles may appear.
- The operator must adjust travel speed according to the nature of the load, visibility conditions, road conditions, etc.
- The operator must pay extra attention and operate with special care near electrical power lines, viaducts, dock sides, ramps, gates/doors, etc.
- Always operate carefully so that the machine or attachment does not collide with posts, power lines, etc.
- Use available visibility equipment such as rear-view mirrors and TV camera.
- The driver must always wear a seat belt when driving the vehicle.



WARNING

Transport of loads is associated with great risks.

Risk of roll-over and tipping over! Risk of load damage to property! Fatal danger!

Respect the machine's lift capacity and operate with great care during load handling:

- **The machine should only be operated on even surfaces which are intended for the machine's gross weight and ground loading.**
- **All loads should be carried in the transport position. Always operate carefully; keep in mind the width and height so that the mast or forks/ attachment does not collide with posts, power lines, etc.**
- **Do not transport the loads in the high position since this may cause the machine to roll or tip over.**
- **Always operate with the load against the grade on uphill or downhill grades, never turn or run across a grade.**
- **Operate the machine in reverse if the transported load obscures visibility to the front.**
- **No persons may stand under a lifted load.**
- **The operator must always adjust the speed when turning to prevent skidding and risk of roll-over or tipping over.**
- **The operator must always adjust the speed when turning to prevent skidding and risk of roll-over or tipping over.**

In the event of the machine rolling or tipping over, hold on to the steering wheel and stay in the cab. Do NOT try to jump out of the cab before all movement has stopped.

Local regulations may apply when handling special loads. Check and observe them.

 **WARNING**

The machine's load capacity is limited.

Risk of roll-over and tipping over!

**It is prohibited to exceed the machine's load capacity.
See marking plate and load diagram.**

 **WARNING**

The strength of the roof window may be severely reduced in case of exposure to substances containing: aromatic hydrocarbons, ketones, esters and chlorinated hydrocarbons.

Low strength! Danger!

Check the roof window's surface at regular intervals. Only use water with an anti-freeze fluid or mild cleaning agents when cleaning. Rinse with plenty of lukewarm water. Replace a damaged roof window immediately if it is cracked or scratched!

 **WARNING**

Scratches or other damage to the roof window results in reduced strength.

Low strength!

Replace a damaged roof window immediately.

 **WARNING**

Lifting loads in very windy conditions is associated with great danger

Risk of roll-over and tipping over! Fatal danger!

Avoid lifting loads in heavy winds.

 **WARNING**

The machine emits exhaust gas during driving.

Fatal danger in case of poor ventilation!

**Avoid driving indoors in poorly ventilated premises.
Use an air extractor!**

 **WARNING**

The work position on the machine is located up high.

Risk of falling and injury!

**Always use the steps and handles when you climb up
or down from the machine. Always face the machine.
Do not jump!**

 **WARNING**

Cab doors must always be closed during operation.

**Risk of personal injury and crushing in case of roll-
over and tipping!**

Always close the door(s) during the work shift.

 **WARNING**

**Passengers are only allowed in the cab if there is a
specific passenger seat. It is prohibited to carry
passengers on the machine outside the cab or on the
load.**

Danger!

**Passengers in the cab must use the permanently
installed passenger seat and safety belt if fitted.**

 **WARNING**

The parking brake can be used as an **EMERGENCY BRAKE**.

Braking performance of the parking brake may be lost as the brake pads get worn down. Unwanted movement of parked machine!

After any emergency braking with the parking brake, check the brake pads as soon as possible. Change, if needed!

If the parking brake has been released manually, the parking brake must always be reset in order to give the machine parking brake function again.

 **WARNING**

The machine's hydraulic system contains a high-pressure accumulator.

Danger!

Always be very careful when working with the hydraulic system, and avoid standing close to hydraulic components or hoses. The accumulator must be drained before any work is carried out on the hydraulic system (see Maintenance manual).

 **WARNING**

Handle batteries and connectors with great care during charging and boosting (jump starting).

Risk of short-circuiting! Warning for hydrogen gas development! Risk of scalding/burn injuries!

Batteries must always be equipped with protective caps over the terminals and connections. Connect positive (plus) terminals first. Then connect the negative (minus) terminals to prevent sparks that may ignite the hydrogen gas.

**WARNING**

The machine uses oils and lubricants.

Health hazard during long-term contact!

Avoid contact with oils and lubricants. Use protective gloves.

**WARNING**

The fire extinguisher contains dry chemicals.

Danger of breathing difficulties if used in an enclosed area!

Use the fire extinguisher from outside into the area to be extinguished. After use, the area must be properly ventilated.

NOTE

Mobile phones and communication radios may be used in the cab. The equipment should not be used while operating or handling loads, as your concentration on operating is reduced.

Kalmar Industries will not assume any responsibility for optional equipment not installed by Kalmar Industries or by a fitter approved by Kalmar Industries.

3 Summary

3.1 Description DCE 90-180

General

Machine DCE 90-180 is a forklift truck of medium capacity for all types of load handling. It has a lift capacity of 9 to 18 tonnes. The machine has a lift mast. The machine has three alternatives for lift masts (different lift heights):

1. Duplex
2. Duplex free-lift
3. Triplex free-lift

This section provides a short presentation of the machine's components, see *General page 22*.

3.1.1 Identification of the machine

Type designation of fork lift truck

Each Kalmar machine has a type designation. Type designation DCE 120-12 (example) indicates the following:

- D – Diesel engine
- C – Counterweight forklift
- E – Generation
- 120 – Lift capacity, decitonne
- 12 – Distance to centre of gravity, in decimetres

Machine card

When ordering and after putting the machine into operation, it is possible to modify and adapt Kalmar Industries' machines in different ways with product alternatives and optional equipment. This makes it possible to satisfy a very broad range of customers.

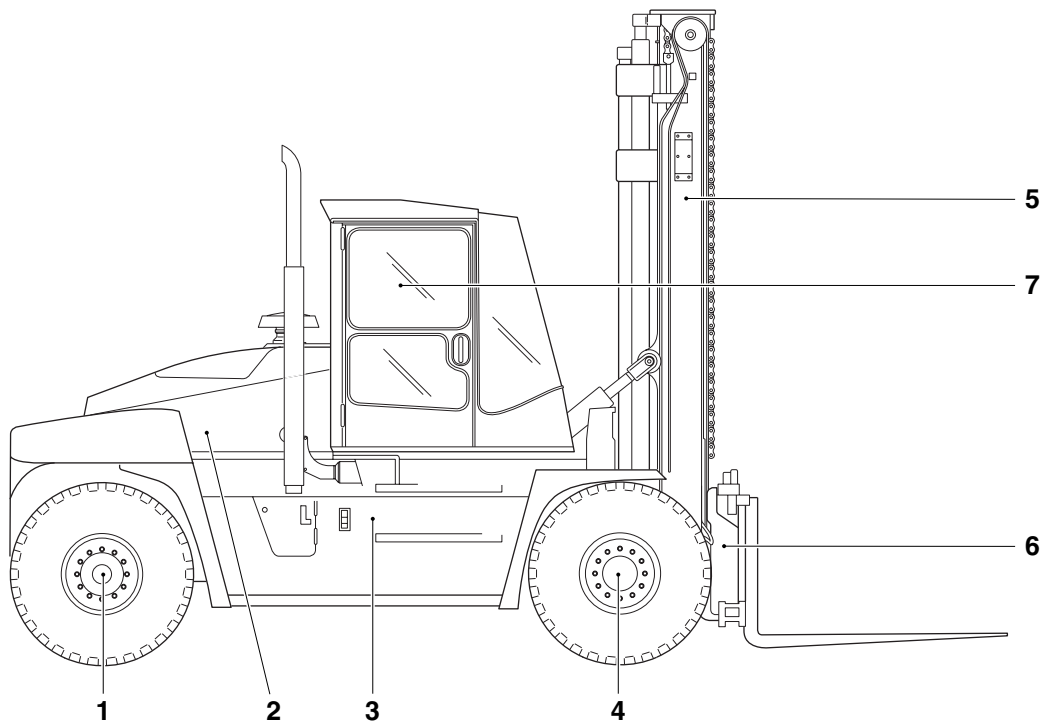
A machine card is delivered together with the spare parts catalogue. The machine card contains a complete specification of the machine's product alternatives and optional equipment.

The machine card must be updated when the machine is modified and Kalmar Industries must be informed.

3.1.2 General description

General

This section provides a short presentation of the machine's components, which are shown in the illustration below.



1. Steering axle
2. Engine
3. Transmission
4. Drive axle
5. Load handling, lift mast
6. Load handling, fork assembly
7. Cab

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Engine

The machine has several engine alternatives. The engines are straight 6-cylinder, turbocharged low-emission engines with intercooler. The engine provides power for propulsion and working hydraulics.

The machine is equipped with one of the following engine alternatives:

- Volvo TAD650 (147 kW)
- Volvo TAD720 (181 kW)
- Cummins QSB5.9 (129 kW)
- Cummins QSB5.9 (164 kW)
- CAT C6.6 (136 kW)

Transmission

The transmission is available as manual or fully automatic with a torque converter. It has 3 forward gears and 3 reverse gears. The hydraulic pumps for working hydraulics are mounted on the transmission.

The machine is equipped with one of the following transmission alternatives:

- Dana TE13000
- Dana TE17000
- ZF 3WG161

Drive axle

The drive axle (front axle) is equipped with a differential and hub reductions of the planetary gear type.

Brakes

The machine has one brake circuit and is equipped with hydraulically operated brakes. The brake units consist of fully sealed oil-cooled disc brakes with external cooling.

The parking brake is controlled electro-hydraulically and brakes with a disc brake. The disc brake acts on the drive axle's input shaft. The parking brake is applied automatically in case of voltage loss (with spring force) and is released by hydraulic pressure.

Steering

The machine is steered via the steering axle (rear axle). A double-acting hydraulic cylinder acts on the wheel pair. Steering is progressive, that is, rapid movement of the steering wheel gives greater steering response per steering wheel rotation. This means that the machine is easier to manoeuvre in limited areas.

Load handling

The lift mast and fork assembly are used for load handling. The load is moved vertically and is tilted (angled) forward or back.

The fork assembly is available in different versions, normally one of the following options:

- Fork carriage with manually moveable forks
- Side shift carriage
- Side shift carriage with fork spreading
- Side shift carriage with fork spreading and centre levelling

The forks are hooked onto the carriage and can be moved manually. Carriage can be equipped with coil ram, extended forks, attachment for empty container, etc.

+ Optimum speed (an extra hydraulic pump) optimises the lift speed.

+ Optimum rev optimises the engine rpm when stationary in relation to the load and the lift speed to give lower fuel consumption, noise level and emissions.

+ Optimum drive (hydrostat control) makes inching possible at higher rpm and thus faster lift speed is obtained.

Electrical system

The electrical system consists of electrical and electromagnetic components such as battery, switches, cable harnesses, solenoid valves, fuses and relays. It has a computer based control and monitoring system that control and monitors certain functions of the machine.

Control and monitoring system, KCS

The machine is equipped with KCS, an electronic control and monitoring system, which monitors and handles certain systems in the machine that require KCS, for example, engine and transmission.

The control and monitoring system makes maintenance and operation easier and more effective.

Cab

Three different cabs are available. Instrumentation and equipment is customer and model adaptable.

- Cab Spirit Delta

Spirit Delta is a closed cab constructed of a structural frame to withstand falling loads. It is equipped with a fresh air system with filtered inlet, recirculation as well as heating or climate control system (+).

The roof window is made of high tensile strength material and withstands heavy blows, for example, from falling objects.

- FlexGuard Cab:

FlexGuard is an open cab constructed of a structural frame to withstand falling loads.

- FlexCab Cab:

FlexCab is an enclosed cab constructed of a structural frame to withstand falling loads. It is equipped with a heater unit and can be equipped with air conditioning for the cabin air (+).

Hydraulic system

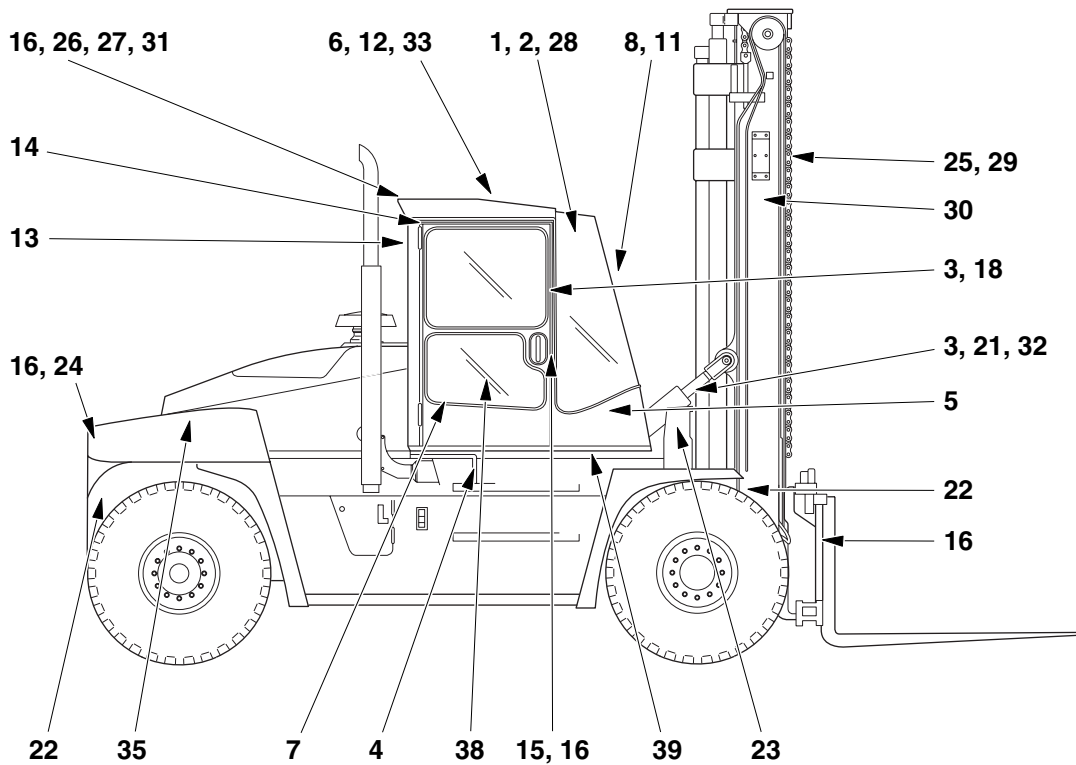
The hydraulic system includes the sub-functions brakes, steering, load handling and cab. The system consists of a feed circuit with hydraulic tank, hydraulic pump, filter and accumulator.

Hydraulic pumps are available in two versions:

- gear pumps
- load-sensing variable pumps (+)
















The pumps have different locations, depending on engine/transmission alternative.











Other equipment Spirit Delta



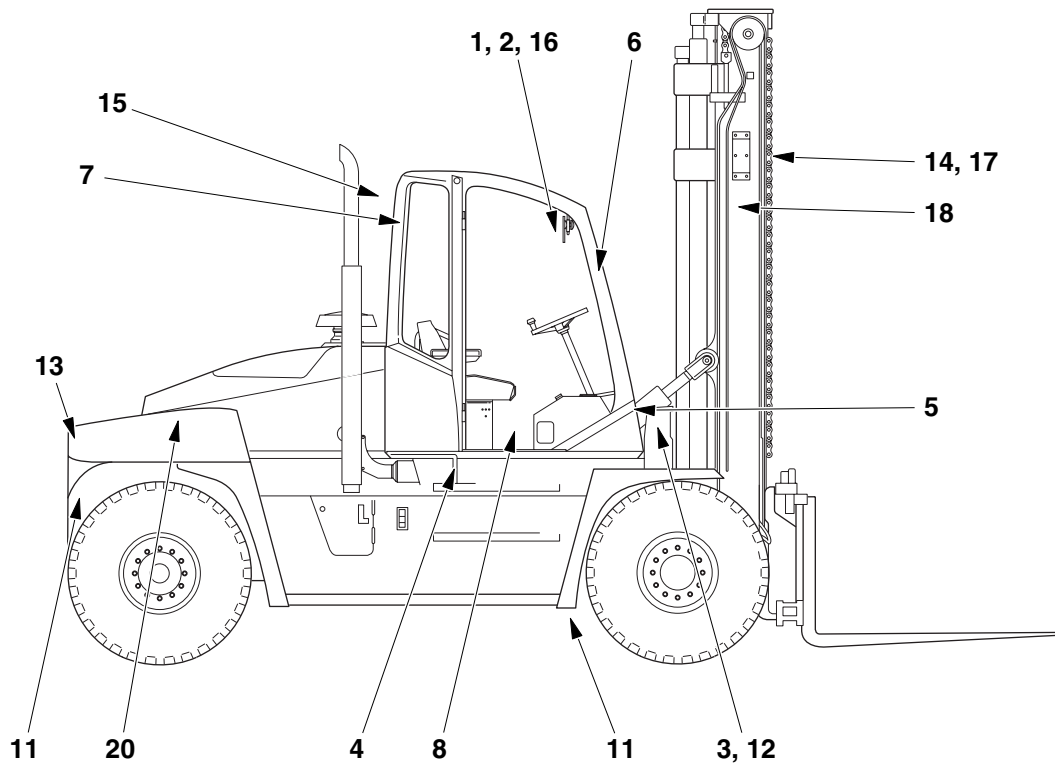
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- 1 Rear-view mirror
- 2 Extra rear view mirror (in cab) **+**
- 3 External rear-view mirrors **+**
- 4 Horn
Placed under cab.
- 5 Electrically operated loud horn **+**
The horn is located on the right-hand side of the cab (under the side window) and the electrically powered compressor is located under the cab.
- 6 Roof window extra strong (12 mm) **+**
Standard roof window is 6 mm.
- 7 Passenger seat **+**
- 8 Laminated windscreen **+**
- 9 Tinted windows **+**
(Not marked in the figure).
- 10 Opening window left door **+**
(Not marked in the figure).

- 11 Sun visor, windscreen 
Window blind for vertical movement with a string on the right. Can be secured in the desired position.
- 12 Sun visor roof window 
Can be pulled out for attaching at the front edge of the roof window in 2 hooks.
- 13 Sun visor rear window 
Window blind for vertical movement with a string on the right. Can be secured in the desired position.
- 14 Sound system 
Directions for use are enclosed.
- 15 Writing desk with lamps 
For handling paperwork in the cab. The writing desk and its lamps are placed inside the cab on the right.
- 16 TV camera with monitor 
Used to increase visibility in the rear when manoeuvring and handling a load with the machine. The camera is located on the counterweight, the cab or on the lifting equipment. The monitor is located in the cab.
- 17 Socket 12/24 VDC  (Not positioned in figure)
The socket is fused and marked. Four sockets, located on the left-hand instrument panel, on the tops of the A pillars and the lower rear plastic housing on the right-hand side.
- 18 External handle for cab step 
- 19 Slip protection on e.g., steps.
(Not marked in the figure).
- 20 Aluminium slip-protection for lamp protection and front fenders 
(Not marked in the figure).
- 21 Step between tilt cylinders 
- 22 Mud flaps for drive and steering wheels 
- 23 Protective grille for headlamps 
- 24 Protective grille for tail lamps 
- 25 Protective grille for working lamps, mast 
- 26 Working lamps, cab roof, rear edge, 2 lamps
- 27 Extra working lamps cab roof rear edge, 2, 4 or 6 lamps 

- 28 Extra working lamps for cab roof front edge, 2 lamps 
- 29 Working lamps, mast, 2 lamps
- 30 Extra working lamps, mast, 2 lamps 
- 31 Extra working lamps for container handling, 4 lamps
On rear edge of cab roof.
- 32 Extra working lamps between tilt cylinders, 1 lamp 
- 33 Manoeuvrable spot lamp 
- 34 Toolkit 
(Not marked in the figure).
- 35 Piling holder 
- 36 Heater:  (Not marked in the figure)
A: 230 V for connecting an engine heater with or without cabin heater (located at instep on left-hand side)
B: Socket for cabin heater
C: Cabin heater
D: Hydraulic tank oil heater mains current 220/380V
- 37 Extra emission control:  (Not marked in the figure)
A: Catalyst, replaces standard silencer
B: Particle filter, exhaust cleaner located on right side (replaces muffler and end-pipe)
- 38 Reversible driver's station 
- 39 Elevation frame cab 
Mounted between cab and frame.












Other equipment FlexGuard/FlexCab



The figure shows a machine with FlexGuard.

- 1 Rear-view mirror
- 2 Extra rear view mirror (in cab) **+**
- 3 External rear-view mirrors **+**
- 4 Horn
Placed under cab.
- 5 Electrically operated loud horn **+**
The horn is located on the front of the cab and the electrically powered compressor is located under the cab.
- 6 Laminated windscreen **+**
- 7 Sound system, 24 VDC **+**
Directions for use are enclosed.
- 8 Socket 12/24 VDC **+**
The socket is fused and marked.
- 9 Slip protection on e.g., steps.
(Not marked in the figure).

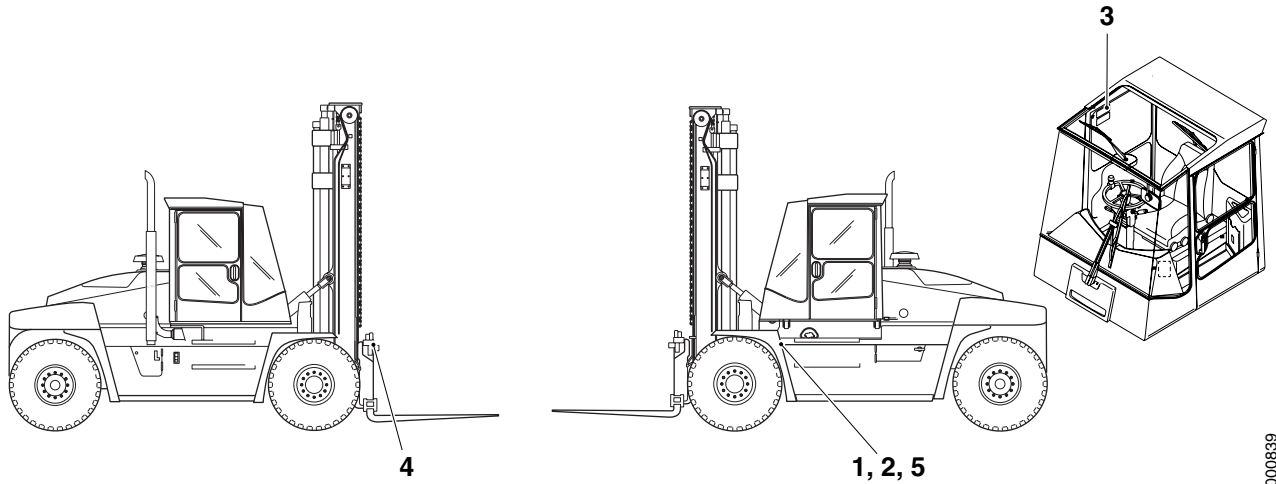
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- 10 Aluminium slip-protection for lamp protection and front fenders 
(Not marked in the figure).
- 11 Mud flaps for drive and steering wheels 
- 12 Protective grille for headlamps 
- 13 Protective grille for tail lamps 
- 14 Protective grille for working lamps, mast 
- 15 Working lamps, cab roof, rear edge, 2 lamps
- 16 Extra working lamps for cab roof front edge, 2 lamps 
- 17 Working lamps, mast, 2 lamps
- 18 Extra working lamps, mast, 2 lamps 
- 19 Toolkit 
(Not marked in the figure).
- 20 Piling holder 
- 21 Heater:  (Not marked in the figure)
230 V for connecting engine heater (located at cab footstep on left-hand side).
- 22 Extra emission control:  (Not marked in the figure)
A: Catalyst, replaces standard silencer
B: Particle filter, exhaust cleaner located on right side (replaces muffler and end-pipe)

3.2 Plates

Product plates

The following shows what plates must be on the machine when operating in EU/EEA, there are more variants in other markets. When ordering spare parts and when enquiring per telephone or correspondence, the model designation and serial number must be given according to the plates. The plates' spare part number is indicated on respective plate.



Kalmar		Kalmar Industries AB SE-341 81 Ljungby Sweden		CE	
M	<input type="text"/>				
S/N	<input type="text"/>				
Q	kg	D	mm	H	mm
W	kg				
H	mm	D	<input type="text"/>	<input type="text"/>	mm
	mm	Q	<input type="text"/>	<input type="text"/>	kg
	mm	Q	<input type="text"/>	<input type="text"/>	kg
	mm	Q	<input type="text"/>	<input type="text"/>	kg
		C	<input type="text"/> mm		

A33806..0200 002078

1 Machine plate (example), A33806

M= Machine model

S/N = Serial number for the machine / Year of manufacture

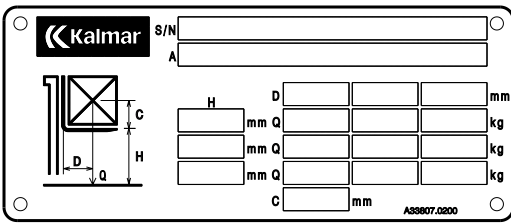
Q, D, H = Indicates classed load capacity (Q) according to EN1551 at centre of gravity distance (D) up to lifting height (H)

W = Machine's operating weight (without load)

Q, D, C, H = Approved load at lifting height (H) at respective distance (so-called load centre) horizontally and vertically from mast and forks (D and C).

Machine plates can only be ordered with complete engraving.

0008039



- Additional plate for the machine (example), A33807 Specifications for the machine's approved lifting equipment.

NOTE

The plate's design depends on attachment type.

S/N= Serial number for the machine

A= Identification number for attachment

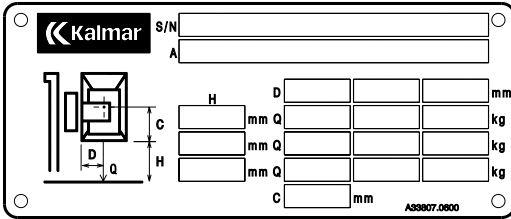
H= Lift height

D= Centre of gravity, distance

Q= Lift capacity

C= Centre of gravity, height. Distance from forks up to the load's vertical centre of gravity.

Plates can only be ordered with complete engraving.



- Additional plate for capacity (example), A33808 Specifications for the machine's approved lifting equipment. The plate is also found in the cab for driver information. Corresponds with plates items 1 and 2.

NOTE

The plate's design depends on attachment type.

S/N= Serial number for the machine

A= Identification number for attachment

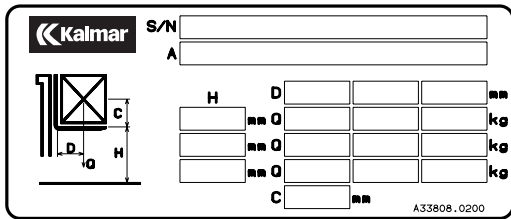
H= Lift height

D= Centre of gravity, distance

Q= Maximum load

C= Centre of gravity, height. Distance from forks/underneath of load up to the load's centre of gravity

Plates can only be ordered with complete engraving.



- Type plate for attachment (example), A45809

A= Identification number for attachment

S/N = Serial number for the attachment / Year of manufacture

H= Maximum hydraulic pressure for attachment

Q= Maximum load

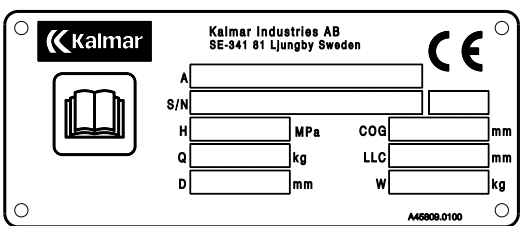
D= Approved centre of gravity distance from fork/leading edge of attachment for maximum load

COG= Centre of gravity for dead weight of attachment (without load)

LLC= Lost load distance due to the attachment

W= Dead weight of attachment (without load)

Plates can only be ordered with complete engraving.





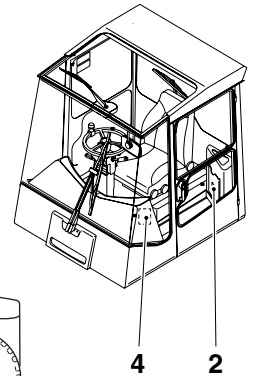
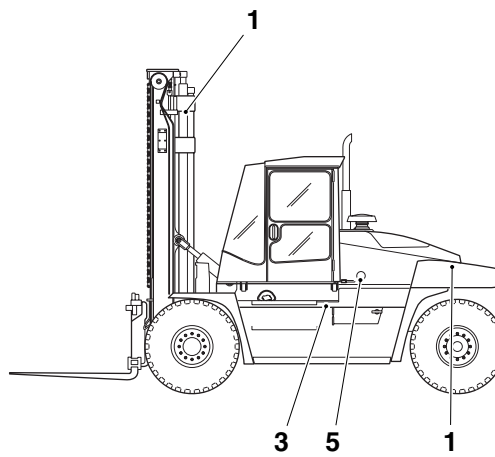
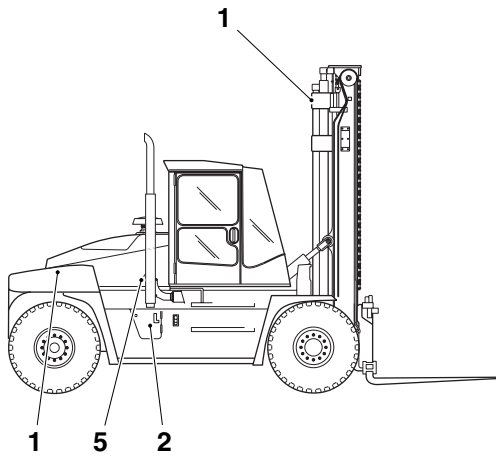
- 5 Plate for certified sound output (example), A42483
LWA (external) = Total sound intensity at machine.
Legal requirement in EU/EEA.

001834

Warning and information plates

The following figures show the warning texts and information texts that are located on the machine. The operator must be aware of the warnings and must also follow the instructions and information given on the plates.

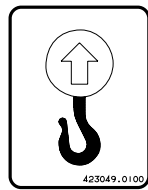
Make sure that warning and information symbols on the machine and its components are always easy to see and legible. Symbols that have been damaged or painted over must be replaced immediately.



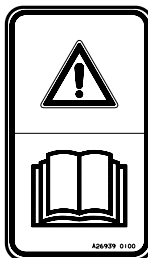
000846

Chassis, cab

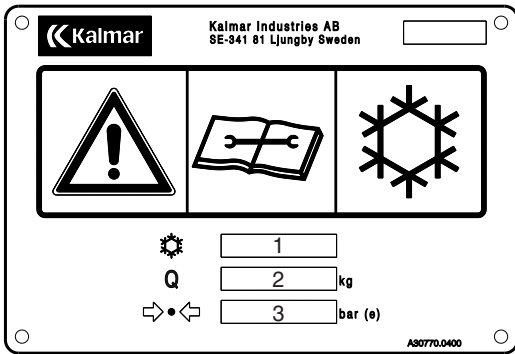
- 1 Lift point, 423049.0100
Attachment point for lifting device when lifting the machine. Lift points are found:
 - mast
 - rear
- 2 Warning! A26939.0100
Warning! Read the operator's manual for information.



000276



000277



3 Warning! A30770.0400

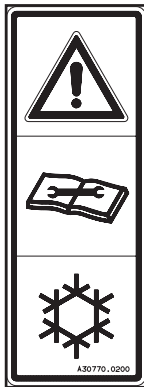
Climate control system. Filling of refrigerant or other work on the air conditioning system requires special authorization (observe national legislation and local regulations).

1= Refrigerant, type

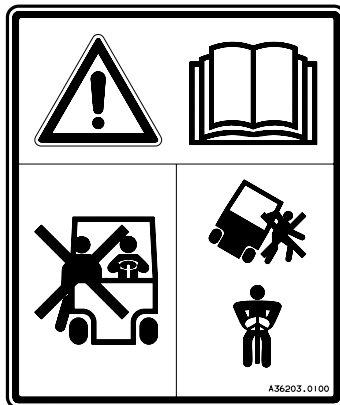
2= Amount, kg

3= Pressure, bar

The plate is also found on condenser, compressor and by the air inlet (leading edge, cab) as plate A30770.0200.



003561

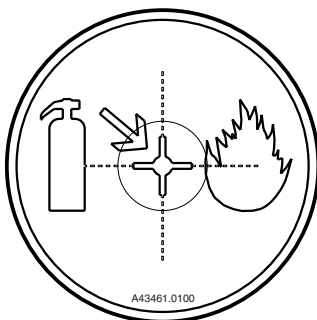


Safety

4 Warning! A36203.0100

- No passengers allowed. Passengers may only ride in the cab if it is equipped with a permanently mounted passenger seat.
- Do not jump. Always stop the machine in event of risk of tipping over/roll-over, and hold on to the steering wheel.

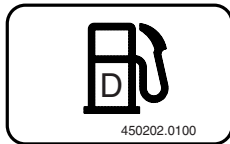
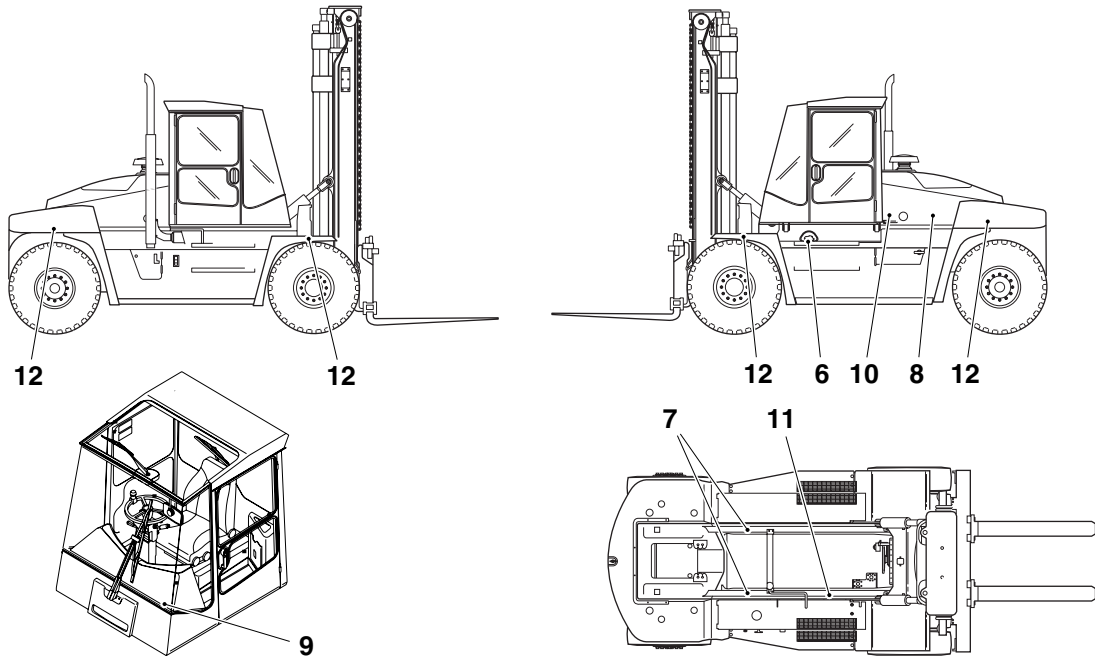
000847



5 Fire extinguisher, A43461.0100

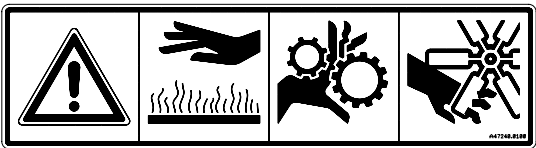
Indicates where extinguishing should take place in case of fire in the engine compartment. The nozzle of the fire extinguisher is pressed through the plate.

001833

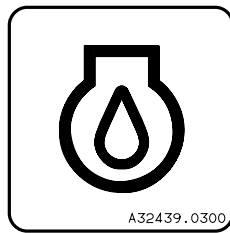


450202.0100

000286

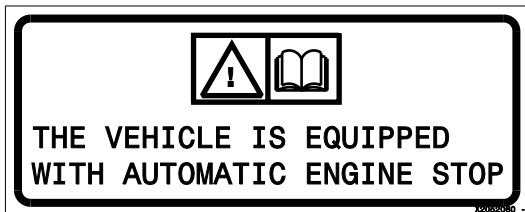


004255



A32439.0300

000851

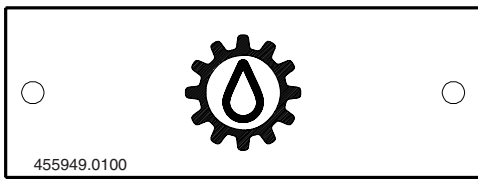


005456

Engine

- 6 Filling point, fuel, 450202.0100
- 7 Warning! A47240.0100
Hot surfaces.
Rotating parts.
Rotating fan.
- 8 Filling point, engine oil, A32439.0300
Located under engine hood.
- 9 Automatic engine stopping 923934.0745

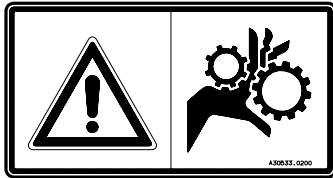
007019



000852

Power transmission, wheels

10 Filling point, transmission oil, 455949.0100



000853

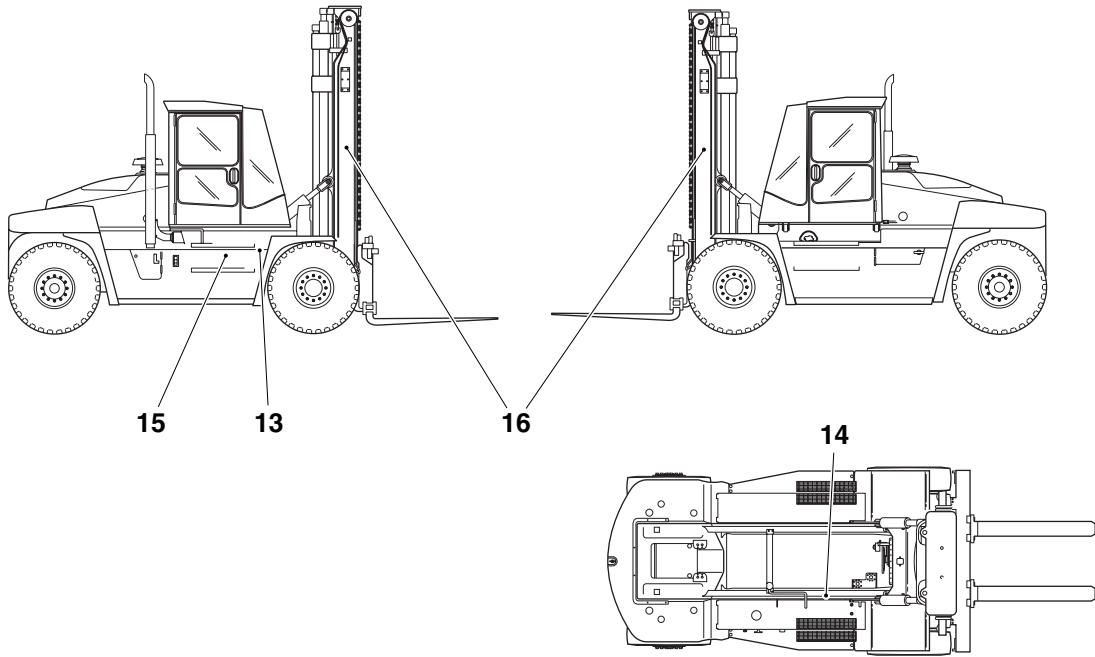
11 A30533.0200 Warning!
Rotating parts.

000854

12 Air pressure, factory-mounted tyres
A32049.0300 0.7 MPa
A32049.0500 0.8 MPa
A32049.0700 0.9 MPa
A32049.0100 1.0 MPa**NOTE**

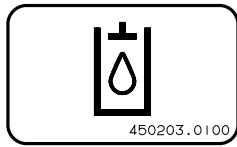
Read section 6 Inspection and maintenance for safety when handling wheels.

If factory-installed tyres are replaced by another tyre brand, the specified tyre pressures may change! Contact Kalmar Industries. The plate for tyre air pressure must be replaced with a plate with the applicable tyre pressure!



Hydraulic system

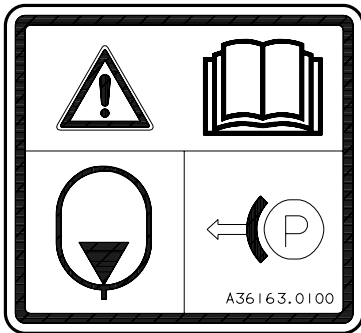
13 Filling point, hydraulic oil, 450203.0100



000292

14 Warning! A36163.0100

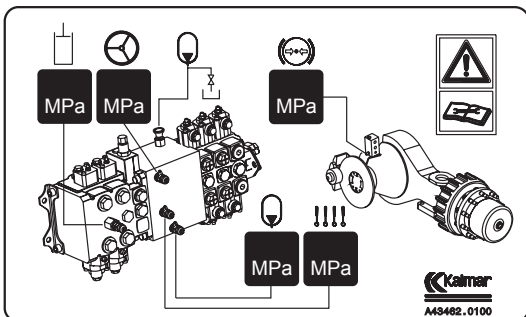
Pressure. Always release the pressure from the accumulator before working on the hydraulic system.



002497

15 Hydraulic pressure, A43462.0100

Specifies the machine's set pressures. The specifications are engraved.



000856

007020

**Mast and attachment**

16 Warning! A30771.0100

Never walk under loads, the attachment or forks and never stand on the forks.

 **DANGER**

Forks and other attachments (with or without load) are easily manoeuvred, very strong tools.

Fatal danger and risk of property damage!

Make sure that nobody stands under a raised attachment, regardless of whether it is loaded or not.

000658

4 Instruments and controls

General

Do not operate the machine before you know the location and function of instruments and controls, and completely understand how they are used!

This chapter provides general information about instruments, switches, controls and other equipment in the machine's cab.

NOTE

Thoroughly read the following chapter about instruments and controls.

Optional equipment

There is a wide range of optional equipment for the machine. Each description of optional equipment in the Operator's manual is marked with a symbol and contains an explanatory text. The symbol is highly visible and is placed next to the text and figure item in question.

See the machine card for complete specifications of the machine's product alternatives and optional equipment.



Indicates optional equipment

000264

4.1 Summary

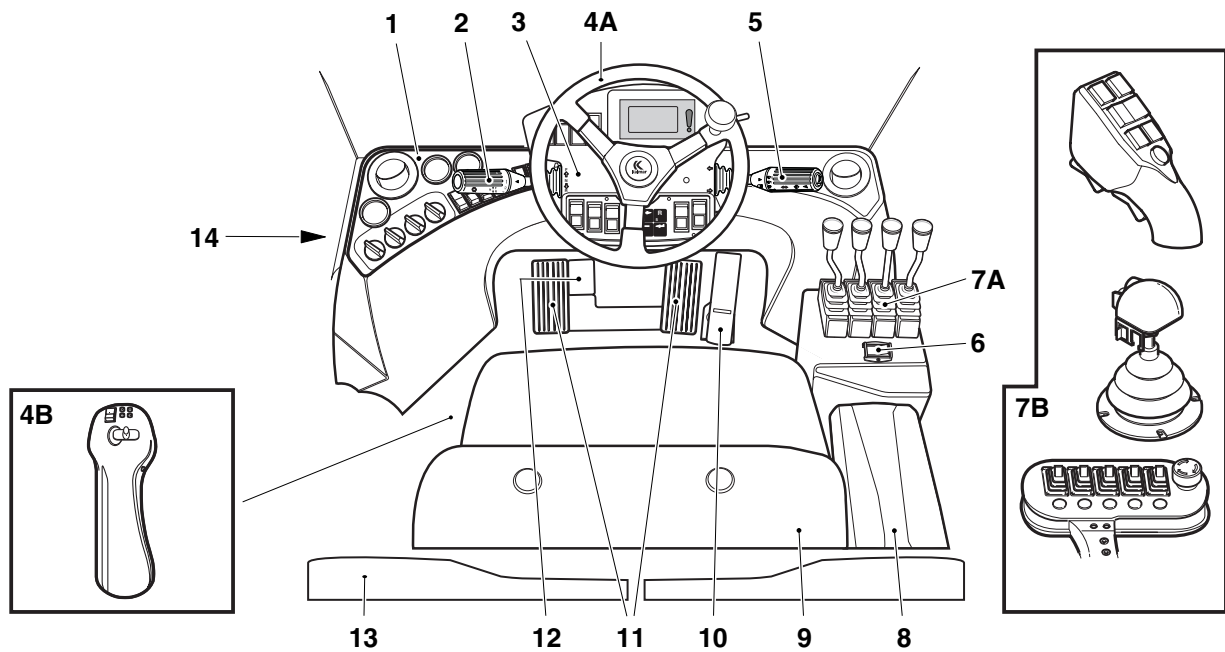
General

The cab's instrumentation and panels depend on the cab alternative:
(Alternative placement may occur according to customer's wishes)





- Spirit Delta. See *Cab overview Spirit Delta page 41*.
- FlexGuard and FlexCab. See *Cab overview FlexGuard and Flex-Cab page 48*.

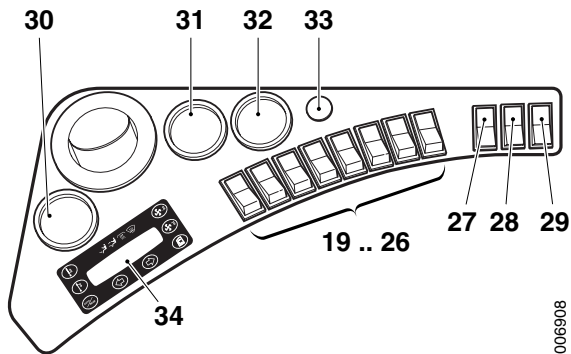
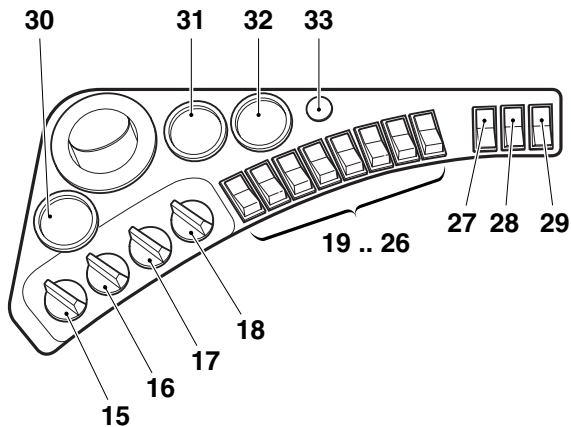
4.1.1 Spirit Delta

Cab overview Spirit Delta



009107

- 1 Left-hand instrument panel
- 2 Gear and direction of travel selector
- 3 Steering wheel panel
- 4A Steering wheel
- 4B Joystick or mini-wheel 
- 5 Multi-function lever
- 6 Parking brake
- 7A Control for load handling
- 7B Alternative control for load handling 
- 8 Arm rest
- 9 Driver's seat
- 10 Accelerator pedal
- Accelerator with function for selecting travel direction (forward/reverse) 
- 11 Brake pedals
- 12 Inching pedal 
- 13 Fuse box with fuses and relays
- 14 Operating time gauge



Left-hand instrument panel, upper with heater unit and lower with climate control system

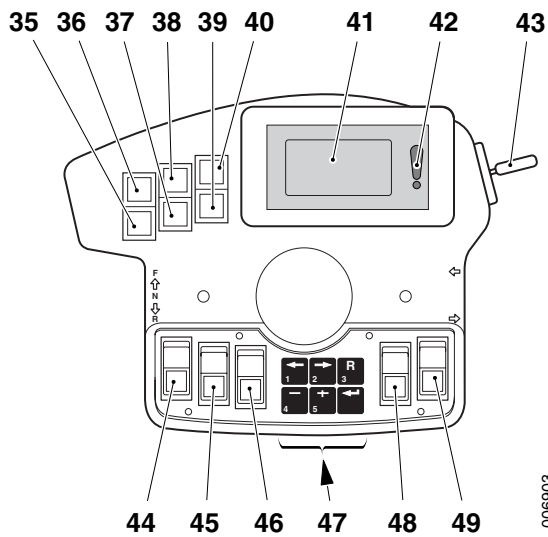
Left-hand instrument panel

- 15 Control for heating
- 16 Controls for fan
- 17 Controls for defroster/cab
- 18 Controls for cooling AC
- 19 Switch for recirculation/fresh air
(Only for heater unit with cooling AC)
- 20 Switch for cooling AC
Switch for extra working lamps
- 21 Switch for working lamps on mast
- 22 Switch for extra working lamps
- 23 Switch for extra working lamps
- 24 Switch for rotating warning lamp
- 25 Switch for warning lamp
- 26 Switch for headlamps
- 27 Switch for seat heating
(May appear in driver's seat)
- 28 Switch for central lubrication
- 29 Switch for pause heater
- 30 Spare
- 31 Spare
- 32 Spare
- 33 Socket for 12/24V
- 34 Climate control system ECC
See section 4.12.1.2 *Climate control unit ECC*.

Steering wheel panel

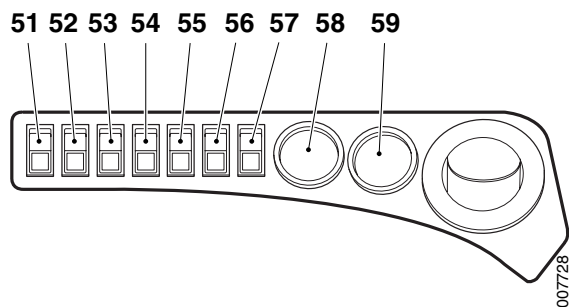
A buzzer (not visible) is integrated under the steering wheel panel. It is activated if:

- a start attempt is made with a gear engaged and the parking brake is not activated
- the parking brake is not activated when the operator leaves the driver's seat
- the machine has a low coolant level, low brake pressure or a fault in the parking brake
- error codes occur, a short audible signal sounds







Steering wheel panel

- 35 Warning lamp for exhaust cleaning (particle filter) **+**
- 36 Warning lamp for air filter replacement **+**
- 37 Indicator lamp for vertical hold **+**
- 38 Warning lamp for low battery charging
- 39 Indicator lamp for main beam
- 40 Indicator lamp for direction indicators
- 41 Display for the control and monitoring system, KCS
- 42 Alarm indicator for control and monitoring system, KCS
- 43 Ignition switch
- 44 Switch for reversible driver's seat **+**
- 45 Switch for engagement and disengagement of alternative direction of travel selector **+**
- Switch for engagement/disengagement of alternative gear selector **+**
- 46 Switch for inching pedal **+**
- 47 Function keys for control and monitoring system, KCS
- 48 Switch for windscreen wiper, rear
- 49 Switch for windscreen wiper, roof



Right-hand instrument panel

Right-hand instrument panel

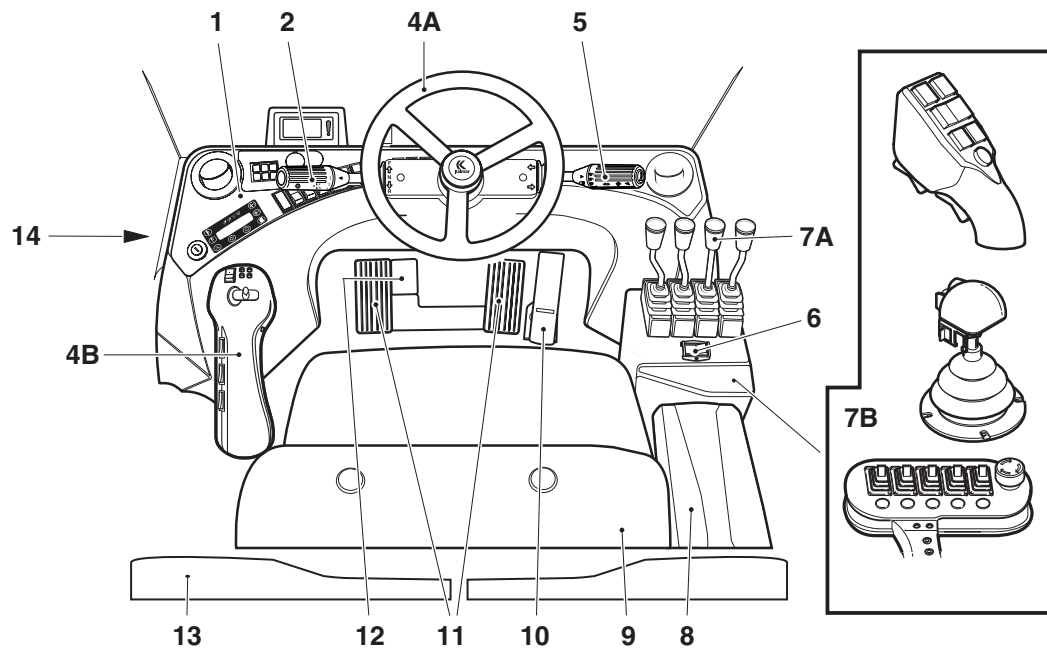
- 51 Switch for reversing alarm cutout 
- 52 Switch for raising/lowering the driver's seat 
- 53 Switch for extra working lamps 
- 54 Switch for electrically heated rear-view mirrors 
- 55 Spare
- 56 Spare
- 57 Spare
- 58 Spare
- 59 Spare

Control for load handling

For more controls for load handling and their functions, see section 4.8 *Load handling*.

Cab overview Spirit Delta

⊕ (applies to cab with moved KCS display).



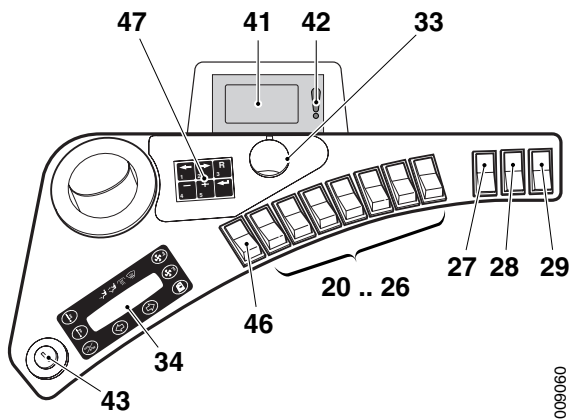
0091106

- 1 Left-hand instrument panel
- 2 Gear and direction of travel selector
- 3 Not used
- 4A Steering wheel
- 4B Joystick or mini-wheel ⊕
- 5 Multi-function lever
- 6 Parking brake
- 7A Control for load handling
- 7B Alternative control for load handling ⊕
- 8 Arm rest
- 9 Driver's seat
- 10 Accelerator pedal
- Accelerator with function for selecting travel direction (forward/reverse) ⊕
- 11 Brake pedals
- 12 Inching pedal ⊕
- 13 Fuse box with fuses and relays
- 14 Operating time gauge

Left-hand instrument panel

A buzzer (not visible) is integrated under the left instrument panel. It is activated if:

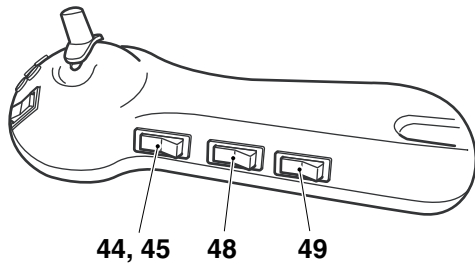
- a start attempt is made with a gear engaged and the parking brake is not activated
- the parking brake is not activated when the operator leaves the driver's seat
- the machine has a low coolant level, low brake pressure or a fault in the parking brake
- error codes occur, a short audible signal sounds



Left-hand instrument panel

009060

- 20 Switch for extra working lamps
- 21 Switch for working lamps on mast
- 22 Switch for extra working lamps
- 23 Switch for extra working lamps
- 24 Switch for rotating warning lamp
- 25 Switch for warning lamp
- 26 Switch for headlamps
- 27 Switch for seat heating
(May appear in driver's seat)
- 28 Switch for central lubrication
- 29 Switch for pause heater
- 33 Socket for 12/24V
- 34 Climate control system ECC
See section 4.12.1.2 *Climate control unit ECC*.
- 41 Display for the control and monitoring system, KCS
- 42 Alarm indicator for control and monitoring system, KCS
- 43 Ignition switch
- 46 Switch for inching pedal
- 47 Function keys for control and monitoring system, KCS

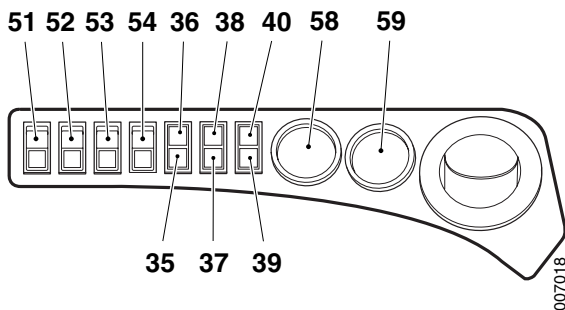


Arm rest

006997

Arm rest

- 44 Switch for reversible driver's seat
- 45 Switch for engagement and disengagement of alternative direction of travel selector
- Switch for engagement/disengagement of alternative gear selector
- 48 Switch for windscreen wiper, rear
- 49 Switch for windscreen wiper, roof



Right-hand instrument panel

007018

Right-hand instrument panel

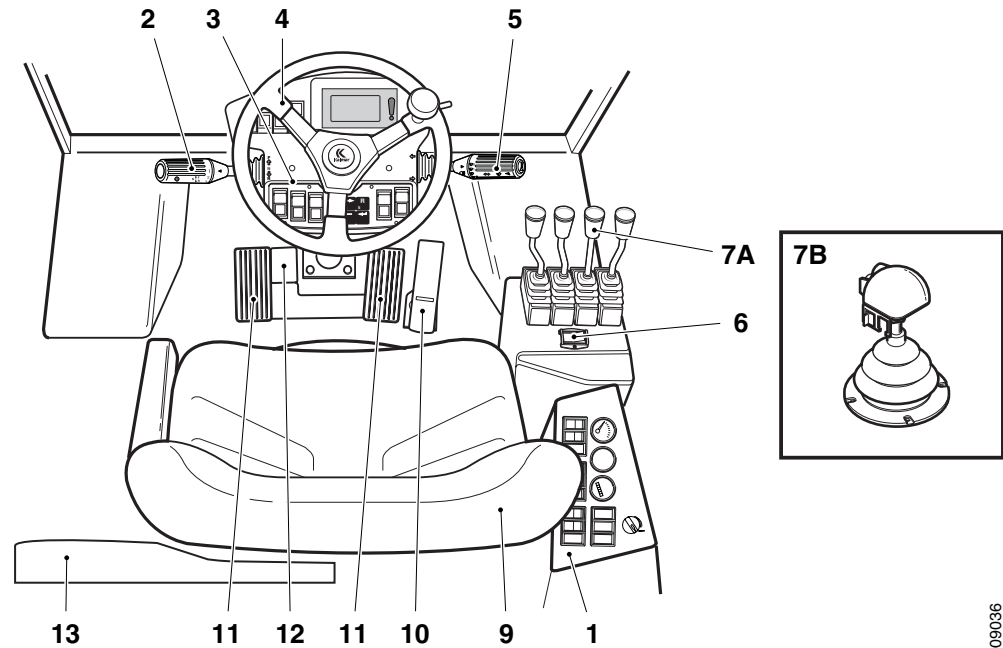
- 35 Warning lamp for exhaust cleaning (particle filter)
- 36 Warning lamp for air filter replacement
- 37 Indicator lamp for vertical hold
- 38 Warning lamp for low battery charging
- 39 Indicator lamp for main beam
- 40 Indicator lamp for direction indicators
- 51 Switch for reversing alarm cutout
- 52 Switch for raising/lowering the driver's seat
- 53 Switch for extra working lamps
- 54 Switch for electrically heated rear-view mirrors
- 58 Spare
- 59 Spare




Control for load handling

For more controls for load handling and their functions, see section 4.8 *Load handling*.

4.1.2 FlexGuard and FlexCab

Cab overview FlexGuard and FlexCab



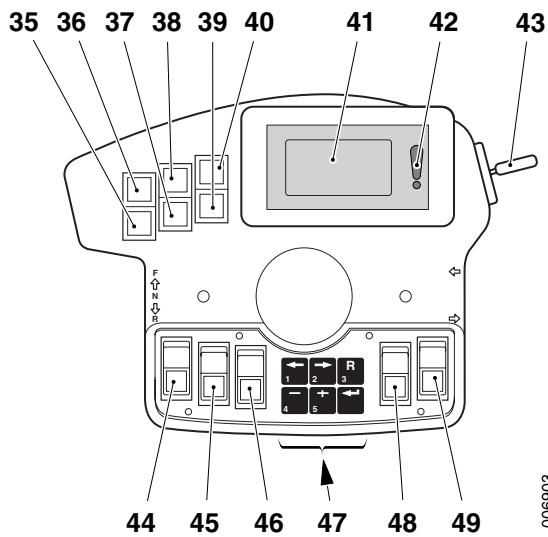
- 1 Instrument panel
- 2 Gear and direction of travel selector
- 3 Steering wheel panel
- 4 Steering wheel
- 5 Multi-function lever
- 6 Parking brake
- 7A Control for load handling
- 7B Alternative control for load handling 
- 9 Driver's seat
- 10 Accelerator pedal
- Accelerator with function for selecting travel direction (forward/reverse) 
- 11 Brake pedals
- 12 Inching pedal 
- 13 Fuse box with fuses and relays

009036

Steering wheel panel

A buzzer (not visible) is integrated under the steering wheel panel. It is activated if:

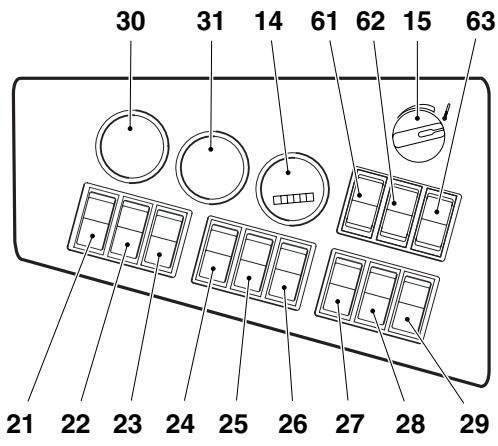
- a start attempt is made with a gear engaged and the parking brake is not activated
- the parking brake is not activated when the operator leaves the driver's seat
- the machine has a low coolant level, low brake pressure or a fault in the parking brake
- error codes occur, a short audible signal sounds



006903

Steering wheel panel

- 35 Spare
- 36 Spare
- 37 Indicator lamp for vertical hold
- 38 Warning lamp for low battery charging
- 39 Indicator lamp for main beam
- 40 Indicator lamp for direction indicators
- 41 Display for the control and monitoring system, KCS
- 42 Alarm indicator for control and monitoring system, KCS
- 43 Ignition switch
- 44 Spare
- 45 Switch for engagement and disengagement of alternative direction of travel selector
- Switch for engagement/disengagement of alternative gear selector
- 46 Switch for inching pedal
- 47 Function keys for control and monitoring system, KCS
- 48 Switch for windscreen wiper, rear
- 49 Switch for windscreen wiper, roof

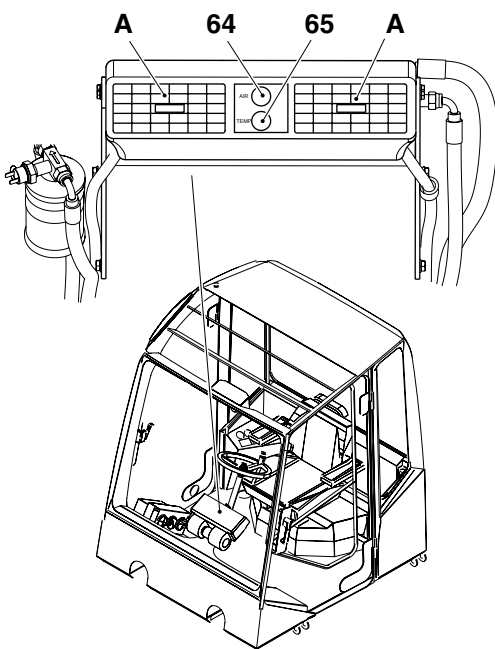


Instrument panel

006919

Instrument panel

- 14 Operating time gauge
- 15 Controls for heating
- 21 Switch for working lamps on mast
- 22 Switch for extra working lamps
- 23 Switch for extra working lamps
- 24 Switch for rotating warning lamp
- 25 Switch for warning lamp
- 26 Switch for headlamps
- 27 Switch for seat heating
(May appear in driver's seat)
- 28 Switch for central lubrication
- 29 Spare
- 30 Spare
- 31 Spare
- 61 Spare
- 62 Spare
- 63 Switch for fan



Cooling unit in the cab

006930

Controls for air conditioning

- 64 Controls for fan
- 65 Controls for cooling

Control for load handling

For more controls for load handling and their functions, see section 4.8 *Load handling*.

4.2 Warning and indicator lamps

General

This section describes the warning and indicator lamps in the cab. They indicate the status of sub-systems/systems. An activated warning lamp should be attended to immediately. An activated indicator lamp informs of imminent action.

Warning and indicator lamps are grouped in the steering wheel panel.

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

Warning lamp for exhaust cleaning (35)



The lamp (red) is activated when the particle filter needs to be cleaned or there is another problem. The warning lamp has no symbol. Determine the cause and take appropriate action. For cleaning, see section 5.4.9 *Stopping machine - parking* or see separate manual for particle filter.

Warning lamp for air filter replacement (36)




The lamp (red) is activated when the air filter needs to be replaced or there is another problem. Determine the cause and take appropriate action. Contact service.

A buzzer in the cab instrument panel is activated at the same time as this lamp.

Indicator lamp for vertical hold (37)



The lamp (orange) shows the status for vertical hold (automatic tilt). Vertical hold is activated/deactivated with switch on control electric servo for load handling. The indicator lamp has no symbol.

The lamp (orange) can also be located on the mast .

The vertical hold status is displayed according to:

- Lamp flashes. The vertical position of the mast is adjusting.
- Lamp gives constant light. The mast is in vertical position.
- Lamp extinguished. vertical hold is not active.



004254



000297

Warning lamp for low battery charging (38)

The lamp (red) warns in case of missing charge to the batteries. The lamp is activated if the voltage from the alternator is lower than the battery voltage.

Determine the cause and take appropriate action. Contact service.

NOTE

Do not operate the machine when the Low Battery Charge lamp lights.



000309

Indicator lamp for main beam (39)

The lamp (blue) is activated when main beam is activated.



000310

Indicator lamp for direction indicators (40)

The lamp (green) flashes when direction indicators or warning lamps are on.



000402

Alarm indicator, control and monitoring system, KCS (42)

The indicator lamp (red) calls the operator's attention. It shines continuously when an error code is shown in the display for the control and monitoring system (KCS).

The warning lamp (red) is activated if the control and monitoring system has one or more error codes, active or passive. See section 4.13 "Control and monitoring system, KCS" for detailed information.

The indicator lamp is lit while there are active error codes ("STOP", "Warning" or "Information").

Indicator lamp for locked twistlocks (81)



The lamp (green) indicates that the attachment twistlocks are locked (the load is secured). The indicator lamp has no symbol.

Indicator lamp for attachment alignment (82)



The lamp (orange) indicates that the attachment is aligned with the load (ready for locking of the twistlocks). The indicator lamp has no symbol.

Indicator lamp for unlocked twistlocks (83)



The lamp (red) indicates that the attachment twistlocks are unlocked (the load is not secured). The indicator lamp has no symbol.

4.3 Instruments

General

This section describes the analogue instruments in the cab. The gauges or digits indicate levels/statuses of sub-systems/systems.

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

Operating time gauge (14)

The operating time gauge shows the number of hours that the engine has been running.

The gauge is used to determine when the machine is due for periodic maintenance. All time intervals for periodic maintenance are based on the machine's operating time in hours.



001342

4.4 Ignition switch (43)

General

This section describes the ignition switch.

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

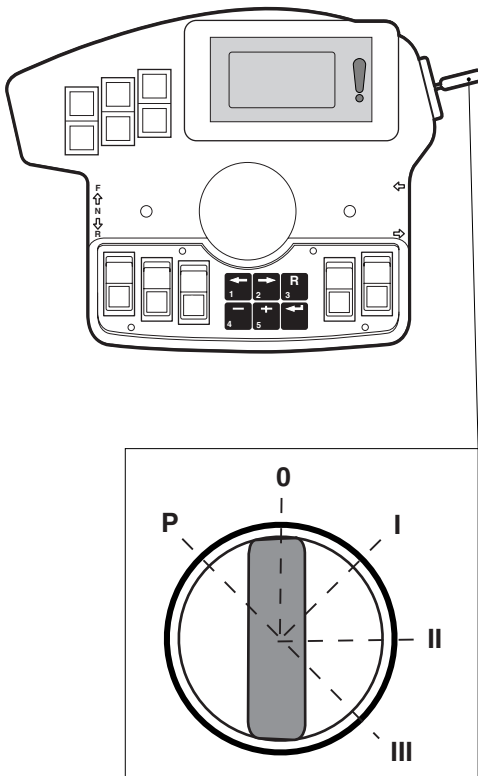
Ignition switch's function

- P No function.
- 0 Stop position. Everything is off, key can be removed.
- I Operating position.
Power (current) to all electrical functions. The control units for engine and transmission are ready for start.
In cold weather, preheating is used. The engine's inlet air is warmed with a heater matrix to a suitable temperature. During preheating the symbol for preheating is shown in the display. Wait until the symbol for preheating goes out before the key is turned to position III.
- II No function.
- III Start position.
Engagement of starter motor for engine start.

NOTE

The machine has an electrical restart interlock that protects the starter motor from engaging when the engine is rotating.

Conditions for starter motor engagement are that the gear lever is in neutral position and that the engine is not already running.



007005

Start key

4.5 Switches

General

This section describes the switches in the cab. Each switch controls a function. Contrast for background lighting is adjusted with the function keys “-/4” and “+/5” for the control and monitoring system

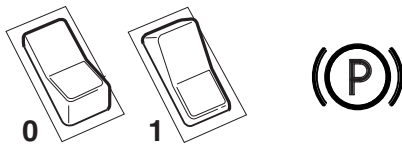
Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

Switch for parking brake (6)

Switch (red) for applying parking brake.

Position 0 - Parking brake off.

Position 1 –Parking brake on.



000331

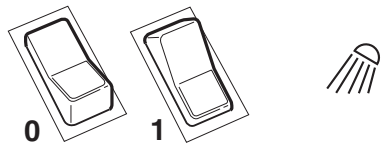
Switch for extra working lamps (20)



Switch (green) for extra working lamps.

Position 0 – Lighting off.

Position 1 – Lighting on.



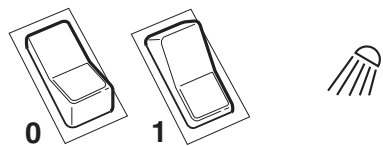
000319

Switch for working lamps on mast (21)

Switch (green) for working lamps on the mast.

Position 0 – Lighting off.

Position 1 – Lighting on.



000318

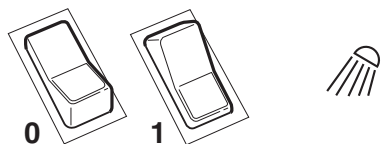
Switch for extra working lamps (22)



Switch (green) for extra working lamps.

Position 0 – Lighting off.

Position 1 – Lighting on.



000319

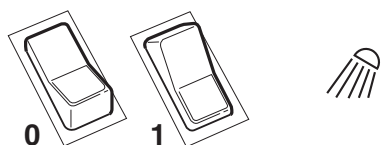
Switch for extra working lamps (23)



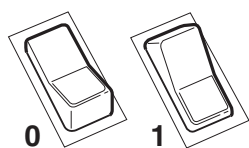
Switch (green) for extra working lamps.

Position 0 – Lighting off.

Position 1 – Lighting on.



000319



000321

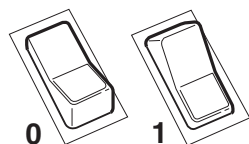
Switch for rotating warning lamp (24)



Switch (green) for rotating warning lamp, used to draw attention to machine and to warn for potential hazards or dangers.

Position 0 - Rotating warning lamp off.

Position 1 - Rotating warning lamp on.



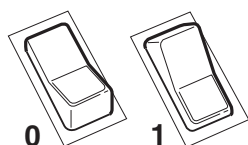
000322

Switch for warning lamps (25)

Switch (red) for warning lamps, used to draw attention to machine in connection with parking hazard.

Position 0 - Warning lamps off.

Position 1 - Warning lamps on.



000323

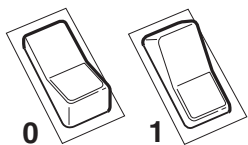
Switch for headlamps (26)



Switch (green) for headlamps. Also activates tail lamps and side running lamps.

Position 0 - Headlamps off.

Position 1 - Headlamps on.



000324

Switch for seat heating (27)

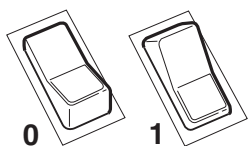


Switch (green) for seat heating.

Certain seat models have switches on the seat and have a different appearance.

Position 0 - Seat heat off.

Position 1 - Seat heat on.



000325

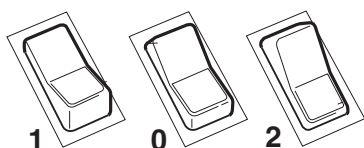
Switch for central lubrication (28)



Switch (green) for central lubrication of machine. Rocker switch. The lamp is lit when lubrication is occurring.

Position 0 - Central lubrication is carried out at a pre-determined interval.

Position 1 - The pump for central lubrication performs one lubrication sequence.



001279

Switch for reversible driver's seat (44)



Switch (green) for reversible driver's seat.

Position 0 - Rest position.

Position 1 - Turn right.

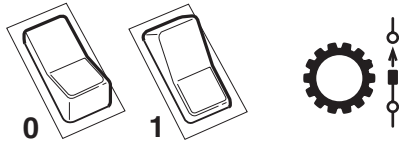
Position 2 - Turn left.

Switch for engagement and disengagement of alternative direction of travel selector (45)



Switch (green) for engagement and disengagement of alternative direction of travel selector.

Position 0 – Ordinary gear and direction of travel selector is engaged, that is, alternative travel direction selector is disengaged. The lamp in the switch is off.



009493

NOTE

Alternative direction of travel selector on the joystick or mini-wheel is automatically connected when the joystick or mini-wheel is activated and the switch for engagement and disengagement of alternative direction of travel selector is in position 0.

Position 1 – Alternative travel direction selector on control for load handling (4-lever, 5-lever, electric servo) or in accelerator is activated. Then the ordinary gear and travel direction selector is deactivated. The lamp in the switch is on.

NOTE

When the switch is in position 1 the engine start inlock is engaged and thus cannot be started.

Switch for engagement/disengagement of alternative gear selector (45)



Switch (green) for engagement/disengagement of alternative gear selector.

NOTE

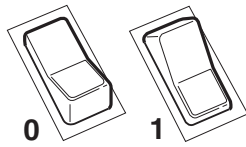
The same switches used to engage and disengage the alternative direction of travel selector are used to engage and disengage the alternative gear selector.

Position 0 – Ordinary gear and direction of travel selector is engaged, that is, alternative travel direction selector is disengaged. The lamp in the switch is off.

NOTE

Alternative gear selector on the joystick or mini-wheel is automatically connected when the joystick or mini-wheel is activated and the switch for engagement and disengagement of alternative gear selector is in position 0.

Position 1 – Alternative gear selector on control for load handling (4-lever, 5-lever, electric servo). Then the ordinary gear and travel direction selector is deactivated. The lamp in the switch is on.



007191

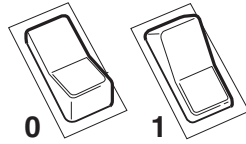
Switch for inching (46)



Switch (green) for inching.

Position 0 - Inching off.

Position 1 – Inching on.



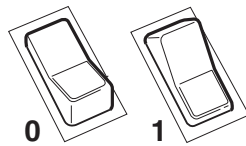
000891

Switch for windscreen wiper, rear (48)

Switch (green) for windscreen wiper on rear window.

Position 0 – Windscreen wiper off.

Position 1 – Windscreen wiper on.



000892

Switch for windscreen wiper, roof (49)

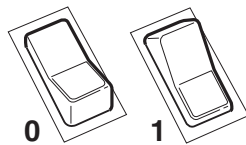
Switch (green) for windshield wiper on roof window.

Position 0 – Windscreen wiper off.

Position 1 – Windscreen wiper on.

NOTE

The wiper should not be run when the polycarbonate plastic roof window is dry.



002899

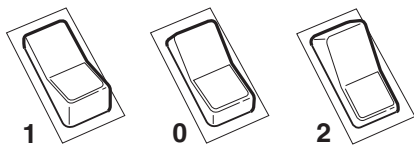
Switch for reversing alarm cutout (51)



Switch (green), for switching off the machine's reversing alarm.

Position 0 - Reversing alarm on.

Position 1 - Reversing alarm off.



002448

Switch for raising/lowering driver's seat (52)

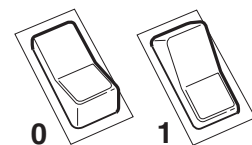


Switch (green) for raising/lowering driver's seat.

Position 0 - Rest position.

Position 1 - Raising.

Position 2 - Lowering.



000319

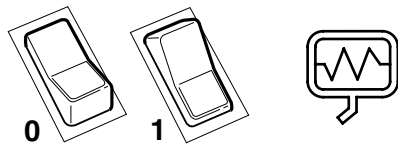
Switch for extra working lamps (53)



Switch (green) for extra working lamps.

Position 0 – Lighting off.

Position 1 – Lighting on.



Switch for electrically heated rear-view mirrors (54)



Switch (green) for electric heating of the rear-view mirrors.

Position 0 – Rear view mirror heating, off.

Position 1 – Rear view mirror heating, on (symbol illuminated).

001634

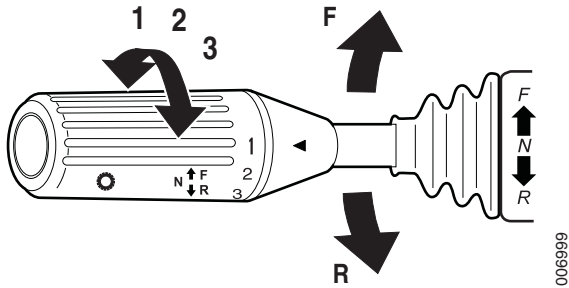
4.6 Gear and direction of travel selector (2)

General

This section describes the functions of the gear and direction of travel selector.

There are two alternative gear and direction of travel selectors:

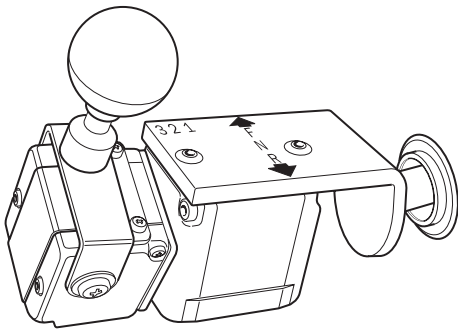
- gear lever



666900

- RMH 

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.




868000

Shifting program and travel direction

Shifting program and travel direction are selected with the gear and direction of travel selector.

Selection of travel direction:

- F - Forward
- N - Neutral
- R – Reverse (audible warning signal )

The transmission limits change of direction of travel until the correct speed and engine rpm are reached, usually 3 km/h and 1500 rpm, by engaging neutral position. There may be differences in speed and engine rpm limits between different models.

There is a manual or automatic transmission. For manual shifting, gear selection is handled manually by the operator. For automatic shifting, gear selection is handled automatically by the transmission according to gear position 1.2 or 3 selected by the operator.

Selection of gear (manual) or gear position (automatic):

- 1 – Manual: First gear. Automatic: locked to first gear.
- 2 – Manual: Second gear. Automatic: shifts between first and second gear.
- 3 – Manual: Third gear. Automatic: shifts between first, second and third gear.

Manual gear changing can be selected if the machine is equipped with automatic gear changing. This occurs by, with a service code, entering the KCS menu system in the display and selecting "AUTOMATIC GEAR SHIFT OFF" value 1.

4.7 Multi-function lever (5)

General

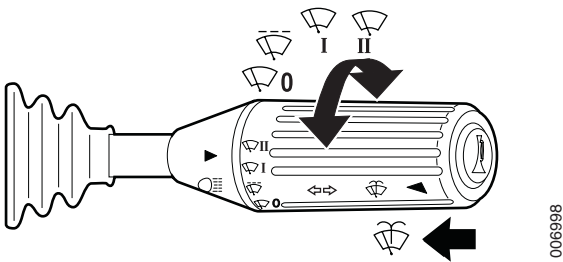
This section describes the functions of the multi-function lever.

Numbers in brackets refer to positions in *Cab overview Spirit Delta page 41* and *Cab overview FlexGuard and FlexCab page 48*.

Windscreen wiper and washer

The windscreen wipers and washer are controlled by the multi-function lever (position 5). Turn the control to the following positions:

- 0 - No wiper action
- J - Intermittent wiper
- I – Continuous wiper action
- II – Continuous wiper action (position II has the same speed as position I)
- Push the control towards the steering wheel to wash windscreen, roof window and rear window.

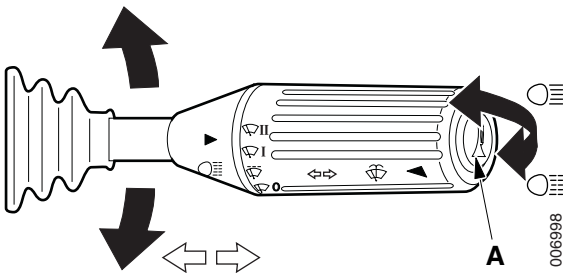


006998

Light control, horn and direction indicators

Headlamps and horn are controlled with the multi-function lever (position 5).

- With headlamps on: Multi-function lever is used to switch between main and low beams. Move the control towards yourself to switch between main and low beams.
- With headlamps off: Multi-function lever is used to flash with the headlamps (high beams). Move the control away from yourself for main beam flash, return is automatic.
- Press the button (position A) for horn.
- Move the lever rearward or forward for the left and right-hand direction indicator.



006998

4.8 Load handling






General

This section describes the functions of the controls for load handling. The control functions when handling forks and other attachments. It is possible to vary the speed of the different hydraulic functions, lift, tilt, etc. by varying the amplitude of the lever stroke. It is also possible to vary the speed of the hydraulic functions with engine speed.





NOTE

Position of a control is need-adapted and may thus differ from this section. See plates on machine.

There are six alternative controls for load handling:

- *Control with 4 or 5 levers page 64.*
- *Electric servo with up to 5 levers page 65. *
- *Electric servo with control lever page 66. *
- *Control lever page 67. *
- *Buttons for optional functions page 68. *
- *Key for by-pass (76) page 71. *

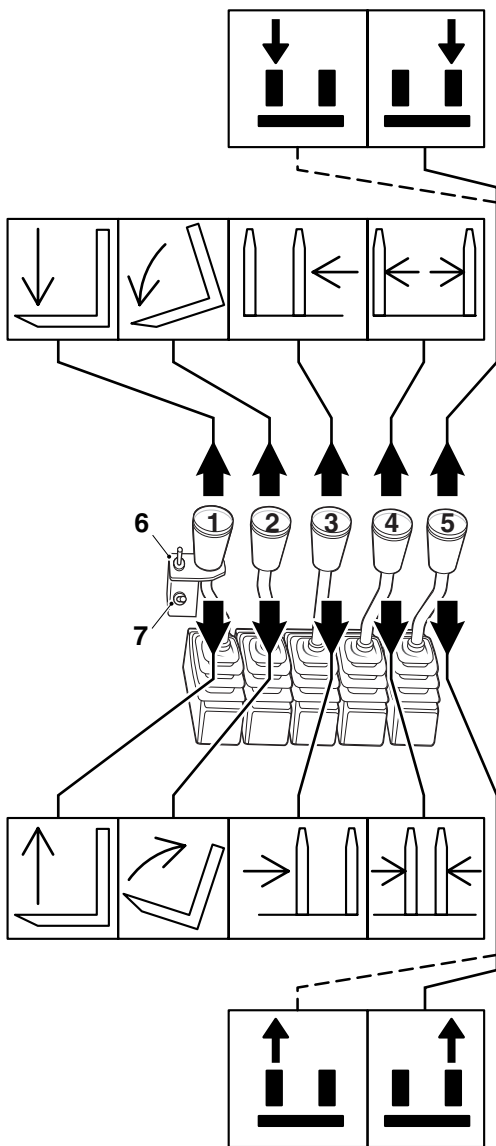
The following instruments are available (in and outside the cab) for load handling:

- *Indicator lamps for side lift attachment page 69. *
- *Indicator lamps for attachment page 70. *
- *Operational menu for lifting height pre-selection  See section 4.13 KCS system.*
- *Operational menu for scales  See section 4.13 KCS system.*

Numbers in brackets refer to positions in *Cab overview Spirit Delta page 41* and *Cab overview FlexGuard and FlexCab page 48*.

4.8.1 Control for load handling

Control with 4 or 5 levers



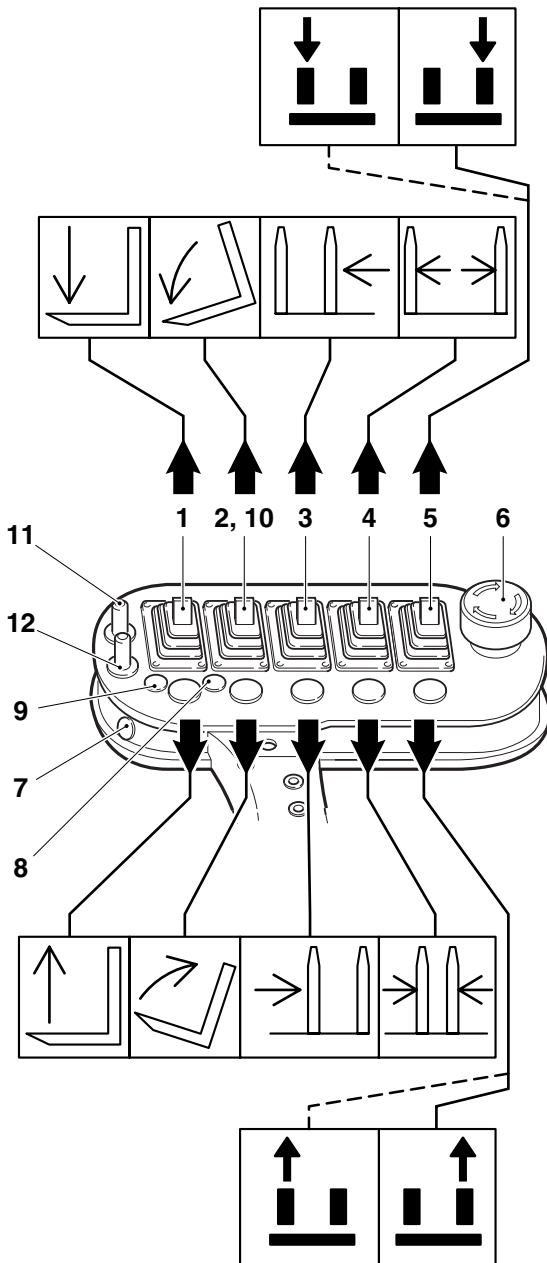
1. Lift/lower
 - LIFT – pull the lever backwards.
 - LOWER – push the lever forwards.
 - Lowering speed can only be varied with the lever operation - it is not influenced by engine speed.
2. Tilt
 - REVERSE – pull the lever backwards.
 - FORWARD – push the lever forwards.
3. Side shift
 - LEFT – push the lever forwards.
 - RIGHT – pull the lever backwards.
 - Forks cannot be side shifted if fork spreading is at max. out.
4. Spreading
 - OUT – push the lever forwards.
 - IN – pull the lever backwards.
 - Spreading locks when one fork runs against the end-position. Side shift to centre and spread position again.
 - Spreading side lift attachment **+**
 - INCREASE SPREADING – move lever forward.
 - DECREASE SPREADING – pull lever back.
5. Levelling **+**
 - FORK UP – pull the lever backwards.
 - FORK DOWN – push the lever forwards.
 - Levelling acts on the right or left fork.
 - Locking / releasing twistlocks for side lift attachment. **+**
 - RELEASE TWISTLOCKS – move lever forward.
 - LOCK TWISTLOCKS – pull lever back.
6. Selecting travel direction **+**
 - Travel direction FORWARD – set switch forward.
 - Travel direction NEUTRAL – set switch in middle.
 - Travel direction REVERSE – set switch backwards.
7. Selecting gear **+**
 - GEAR 1 – set switch downward.
 - GEAR 2 – set switch in middle.
 - GEAR 3 – set switch upward.

003927

Electric servo with up to 5 levels



Electric servo uses fingertip-controlled linear levers.



004241

1. Lift/lower

LIFT – pull the lever backwards.

LOWER – push the lever forwards.

Lowering speed can only be varied with the lever stroke - it is not influenced by engine speed.

2. Tilt

REVERSE – pull the lever backwards.

FORWARD - move lever forward.

Function for vertical hold is deactivated in case of lever movement.

3. Side shift

LEFT - move lever forward.

RIGHT – pull the lever backwards.

Forks cannot be side shifted if fork spreading is at max. out.

4. Spreading

OUT – push the lever forwards.

IN – pull the lever backwards.

Spreading locks when one fork runs against the end-position. Side shift to centre - spread again.

5. Levelling

FORK UP – pull the lever backwards.

FORK DOWN – push the lever forwards.

Fork levelling acts on right or left fork.

6. Breaker switch for load handling (servo circuits)

7. Switch for lifting height pre-selection (off/on)

8. Selecting lifting height pre-selection, reduce

9. Selecting lifting height pre-selection, increase

10. Switch for vertical hold (off/on)

11. Selecting travel direction

Travel direction FORWARD – set switch forward.

Travel direction NEUTRAL – set switch in middle.

Travel direction REVERSE – set switch backwards.

12. Selecting gear

GEAR 1 – set switch backward.

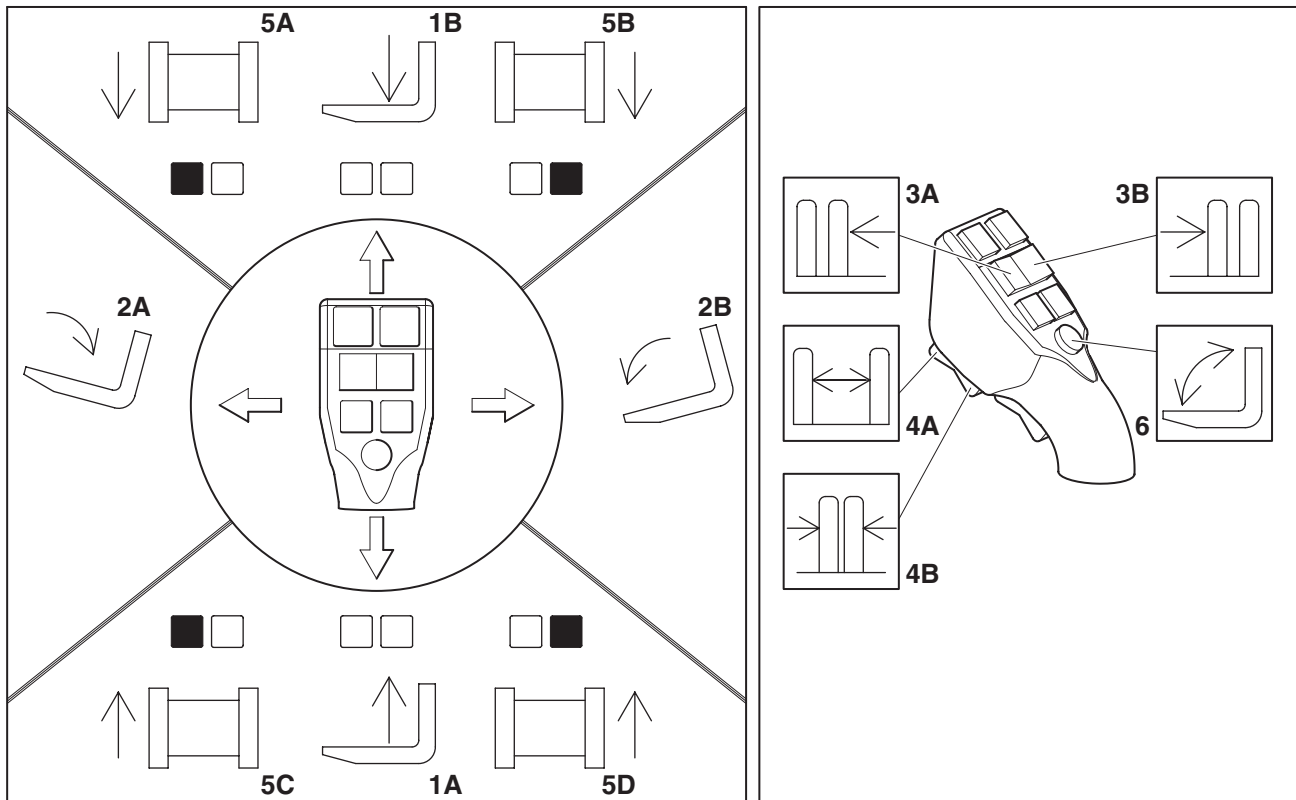
GEAR 2 – set switch in middle.

GEAR 3 – set switch forward.

Electric servo with control lever



The control lever controls functions when handling forks and side lift attachment. Its function pattern is need-adapted and may thus differ from this section. See plates on machine.



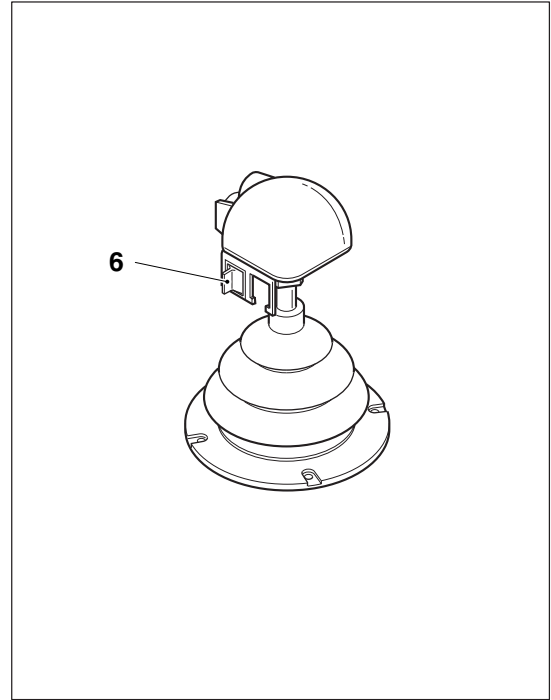
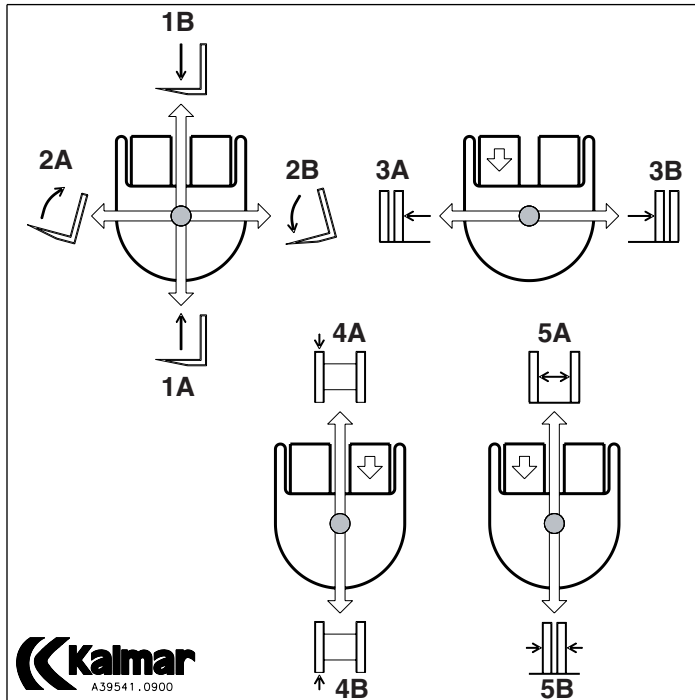
003921

- 1A. Lift
- 1B. Lower
- 2A. Tilt back
- 2B. Tilt forward
- 3A. Side shift, left
- 3B. Side shift, right
- 4A. Spreading, increase
- 4B. Spreading, reduce
- 5A. Levelling, left, down
- 5B. Levelling, right, down
- 5C. Levelling, left, up
- 5D. Levelling, right, up
- 6. Switch for vertical hold (off/on)

Control lever



The control lever controls functions when handling forks and side lift attachment. Its function pattern is need-adapted and may thus differ from this section. See plates on machine.



007279

- 1A. Lift
- 1B. Lower
- 2A. Tilt back
- 2B. Tilt forward
- 3A. Side shift, left
- 3B. Side shift, right
- 4A. Levelling, fork down
- 4B. Levelling, fork up
- 5A. Spreading, increase
- 5B. Spreading, reduce

6. Selecting travel direction

Travel direction FORWARD – set switch forward.

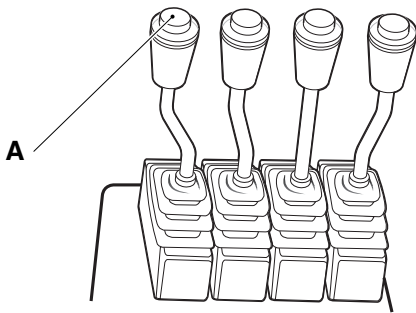
Travel direction NEUTRAL – set switch in middle.

Travel direction REVERSE – set switch backwards.

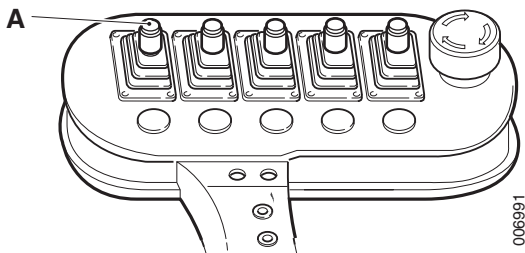
Buttons for optional functions



Buttons for optional functions are found on the control lever (position A), as needed. Function and number of buttons are need-adapted.



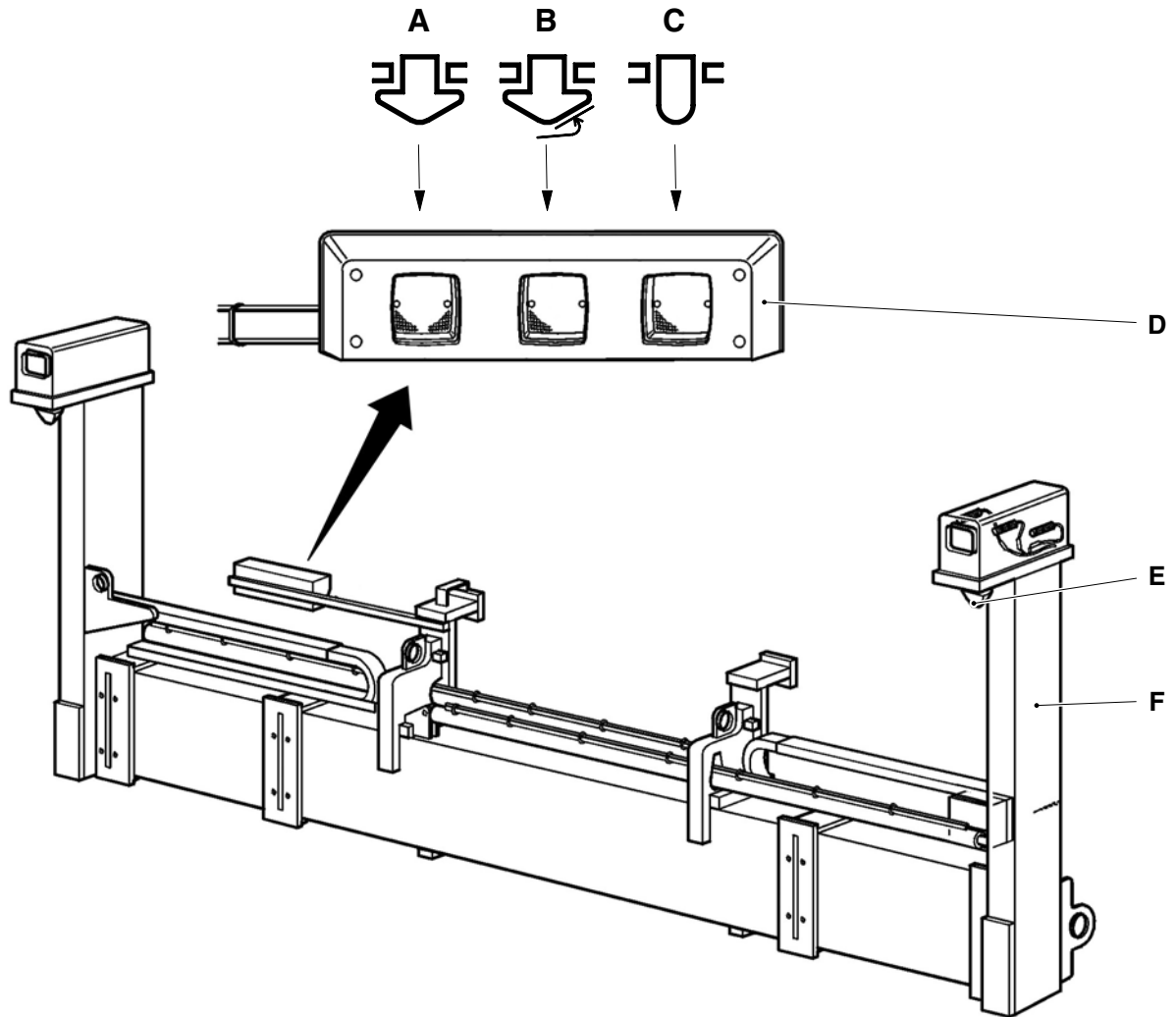
Hydraulic servo controls



Electric servo controls

4.8.2 Other for load handling

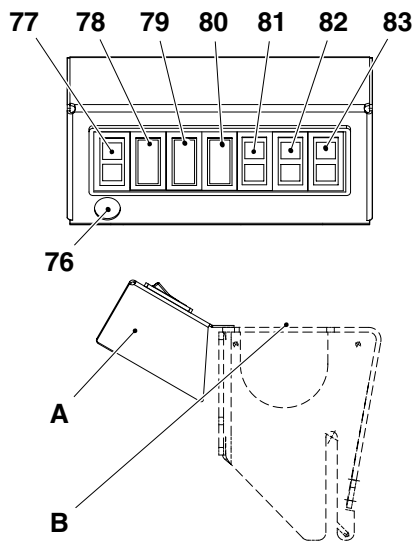
Indicator lamps for side lift attachment



There is a lamp panel with indicator lamps on the side lift attachment that is used when load handling with the attachment. The panel uses coloured lights to indicate if and when twistlocks are locked/unlocked, that is, when the load is secured/released.

- A. Twistlocks locked (load secured), green.
- B. Alignment attachment's corners, orange.
- C. Twistlocks unlocked (load not secured), red.
- D. Lamp panel.
- E. Twistlock.
- F. Complete side lift attachment.

003930



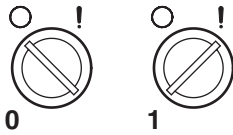
Indicator lamps for attachment



There are three indicator lamps used when handling loads with the attachment. They are located on a panel by the control for load handling. The panel uses coloured lights to indicate if and when twistlocks are locked/unlocked, that is, when the load is secured/released, as well as vertical hold.

- 76 Key for by-passing of load handling functions
- 77 Indicator lamp automatic shut-off
- 78 Switch stop at 30'
- 79 Spare
- 80 Spare
- 81 Indicator lamp for locked twistlocks, green
- 82 Indicator lamp for alignment attachment, yellow
- 83 Indicator lamp for unlocked twistlocks, red
- A Panel for indicator lamps attachment
- B Control for load handling

004258



002447

Key for by-pass (76)

Bypassing the machine's safety interlock.

If desired, the operator can disconnect all safety interlocks on the machine.

Position 0 gives normal function

Position 1 allows the operator to:

- lock or unlock the twistlocks without alignment
- adjust the attachment longitudinally with locked twistlocks
- lift without indication of locked or open twistlocks.

The key position indicates when bypassing of load handling functions is activated.

WARNING

Safety interlocks are blocked.

No safety systems are connected!

Only use the by-pass in emergencies!

WARNING

By-pass of load handling functions may not be used when lifting or transporting loads.

Extreme hazard to personal health and risk of property damage

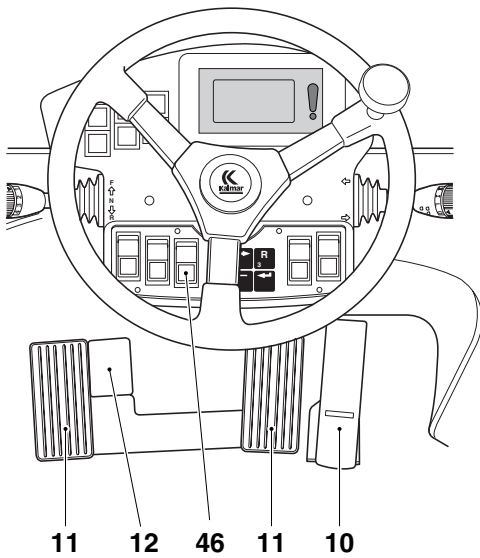
Only use the by-pass in emergencies.

4.9 Pedals

General

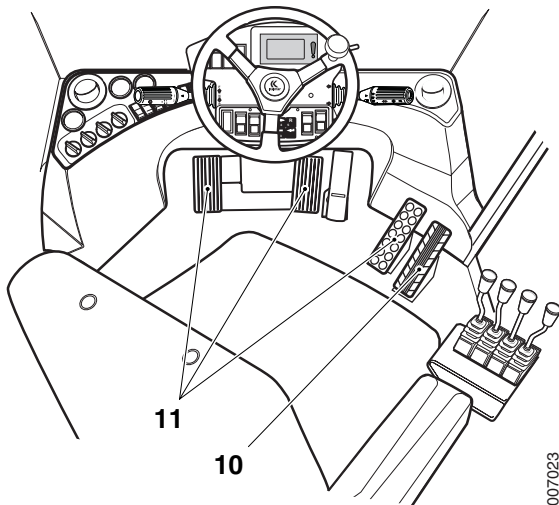
This section describes the machine's foot-operated functions.

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.



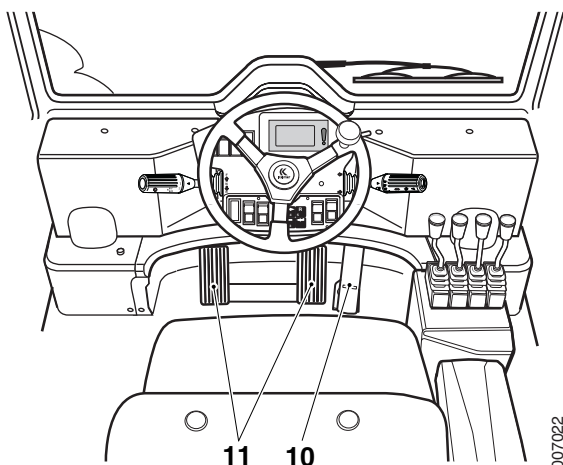
006934


- 10. Accelerator pedal
- 11. Brake pedals
- 12. Inching pedal
- 46. Switch for inching pedal



007023

- Extra pedals for reversible driver's seat
- 10. Accelerator pedal (normal accelerator pedal is disconnected)
 - 11. Brake pedal



Extra pedals for reversible driver's seat . The illustration shows the driver's seat in the rotated position.

10. Accelerator pedal

11. Brake pedals

Accelerator pedal (10)

The accelerator pedal (position 10) is electronic and controls the engine speed via the CAN bus and the KCS system.

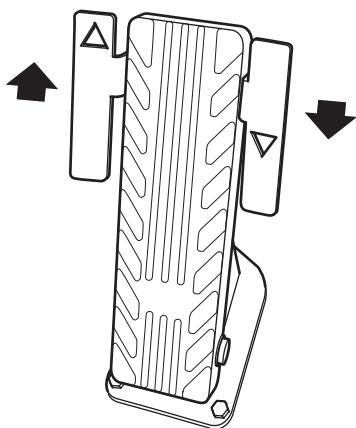


With Optirev, the hydraulic function gives the lift system, with the machine free wheeling, gear selector in neutral or parking brake applied, automatic throttle opening to give increased hydraulic effect.

Accelerator pedal with function for selecting travel direction (10)



The accelerator pedal has the same function as above. Travel direction can be selected with the accelerator pedal. Two switches are placed in the upper part of the pedal for selecting travel direction forward (left side) or reverse (right side).



Brake pedals (11)

The brake pedals (position 11) are hydraulic and are connected to the machine's hydraulic system. The brake pedals are used for the service brake.

The accumulator store energy so there is brake pressure even if the engine should stop. If the accumulator pressure is too low an error code is shown in the display.


The brake function is available in different versions:

- Brake without inching

The service brake is combined with the clutch and at a certain pressure, drive is disconnected completely.

If the brake pedal is applied without disengagement occurring the engine can help to brake the machine when the accelerator pedal is released.

The hydraulic functions can be used when a gear is engaged.

- Brake with inching . The inching function does not work with extra pedals (with swivel or reversible driver's seat).

Available in two versions:

- Switch (position 46) for inching

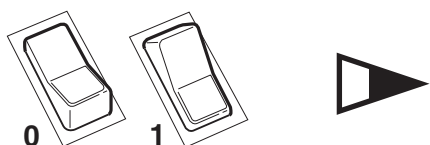
Position 0 - Inching not activated. The brake is activated with the brake pedal and disengagement occurs when the pedal is pushed down more than 70%.

Position 1 - Inching activated. Inching and braking are controlled by the brake pedal. When the pedal is pressed down the drive starts to slip, so-called inching. If the brake pedal is pressed more than 70% the drive disengages completely.

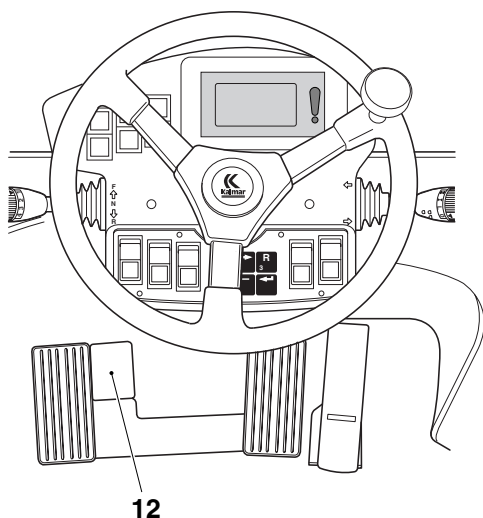
- Inching pedal (position 12).

The brake is activated with the brake pedal and disengagement occurs when the pedal is pushed down more than 70%.

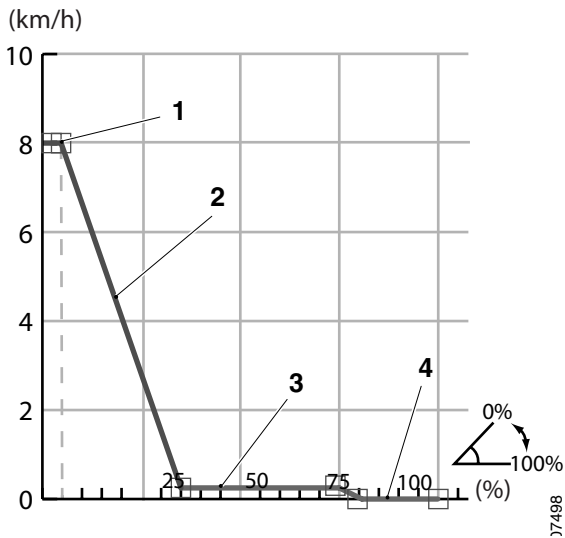
When the brake and inching pedals are pressed down at the same time a micro switch is affected and the drive starts to slip, so-called inching.



007191



007497



Inching speed dependent on pedal position

1. No inching
2. Variable speed
3. Lowest speed (fixed inching)
4. Inching (stationary)

Inching




Inching permits precision driving at low speed at the same time as the engine retains a high speed, which allows power to be released for the operating hydraulics. When inching is activated the drive starts slipping. When the pedal is 70% depressed the drive is release completely. The function is disconnected in case of overload.

The hydraulic functions can be used when a gear is engaged.

4.10 Steering wheel (4)

General

This section describes the control devices for steering. The following alternatives are available for steering the machine:


- steering wheel with fixed or adjustable steering column .
- joystick  (for cab alternative Spirit Delta)
- mini-wheel  (for cab alternative Spirit Delta)

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

Steering wheel

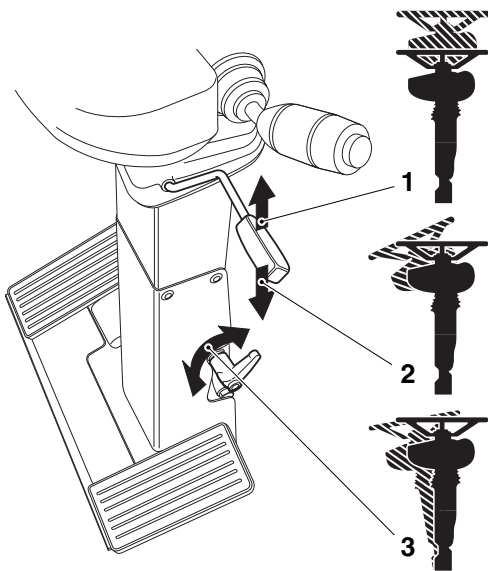
Clockwise rotation of the steering wheel steers the machine to the right, and vice versa.

The steering wheel's (position 4) and instrument panel's angle and height can be adjusted to the required operating position.

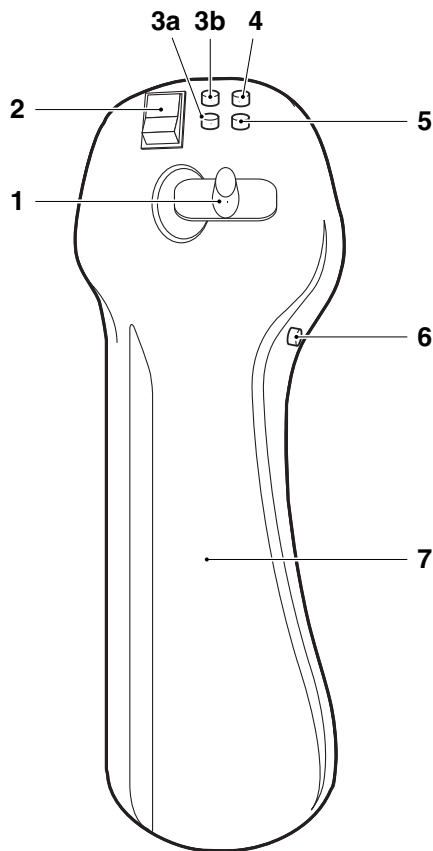
1. Steering wheel height.
To adjust: Move upper lever upward.
2. Steering wheel panel angle.
To adjust: Move upper lever downward.
3. Steering column angle. 
To adjust: Slacken off the lower knob and adjust to the required position. Tighten the knob securely after adjusting.

NOTE

Adjustment possibilities only applicable to cab alternative Spirit Delta.



001637



Joystick steering

⊕ For cab alternative Spirit Delta.

The steering joystick is an electro-hydraulic system, mounted in the left-hand armrest, to steer the machine using a linear joystick. When the joystick is moved to the right, the machine steers right, and vice versa. The steering angle is inversely proportional to the machine's speed, that is, low speed gives greater wheel angle, and vice versa.

The system is available in two versions:

- with feedback of the wheel's position, that is, when the joystick is released the wheels return to middle position.
- without feedback of the wheel's position, that is, when the joystick is released the wheels remain and must be steered back.

The standard steering wheel is equipped with a sensor that detects any steering wheel movements in an emergency situation. As soon as the operator starts to steer with the standard steering wheel, the joystick is disengaged and the alternative travel direction and gear selectors return to the ordinary selectors.

1. Joystick.
2. Travel direction selector F/N/R. Direction of travel selector on the joystick control console (arm rest) is automatically activated when joystick control is engaged.

NOTE

If the switch for engagement and disengagement of alternative direction of travel selector (position 45) is available the condition is that it is in the "0" position.

forward = F, middle position = N, reverse = R

3. Gear selection. 3a = shift up, 3b = shift down. (Not available for automatic gear changing)

The gear selector on the joystick control console (arm rest) is automatically activated when joystick control is engaged.

NOTE

If the switch for engagement and disengagement of alternative gear selector (position 46) is available the condition is that it is in the "0" position.

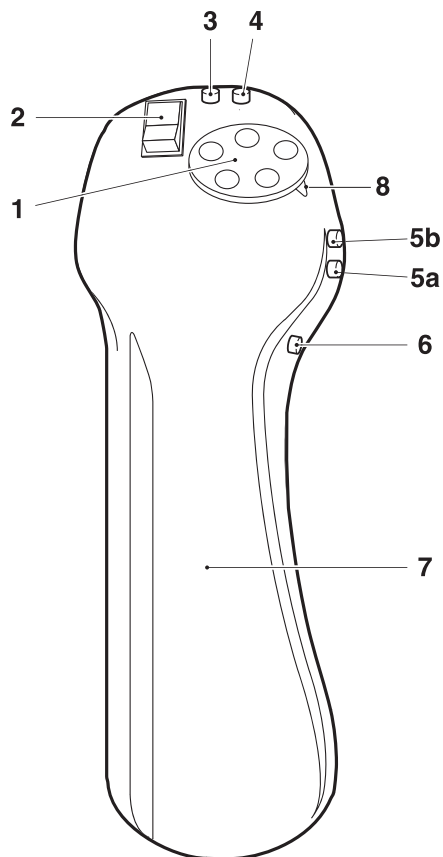
Press 3a to upshift (one press for each gear) and 3b to downshift. Shifting always begins with 1st gear at start or after the direction of travel selector has passed N.

4. Button for engaging joystick.

Condition: Speed must be below 3 km/h. If speed is above 3 km/h the joystick cannot be engaged. The lamp in the travel direction selector (position 2) is constantly illuminated when joystick steering is engaged.

5. Audible signal.
6. For optional equipment. ⊕

001448



001447

7. Arm rest.

Mini-wheel

For cab alternative Spirit Delta.

Mini-wheel is an electro-hydraulic system, mounted in the left-hand armrest, to steer the machine using a small steering wheel. Clockwise rotation of the steering wheel steers the machine to the right, and vice versa. The ground wheels always follow the mini-wheel's position. If the mini-wheel is released, the ground wheels and the mini-wheel remain in the current position.

The standard steering wheel is equipped with a sensor that detects any steering wheel movements in an emergency situation. As soon as the operator starts to steer with the standard steering wheel, the mini-wheel is disengaged.

1. Mini-wheel.
The mini-wheel position on the arm rest is adjustable.
2. Travel direction selector F/N/R. Direction of travel selector on the joystick control console (arm rest) is automatically activated when joystick control is engaged.

NOTE

If the switch for engagement and disengagement of alternative direction of travel selector (position 45) is available the condition is that it is in the "0" position.

forward = F, middle position = N, reverse = R

3. Audible signal.
4. For optional equipment.
5. Gear selection. 5a = shift up, 5b = shift down. (Not available for automatic gear changing)

The gear selector on the joystick control console (arm rest) is automatically activated when joystick control is engaged.

NOTE

If the switch for engagement and disengagement of alternative gear selector (position 46) is available the condition is that it is in the "0" position.













Press 5a to upshift (one press for each gear) and 5b to downshift. Shifting always begins with 1st gear at start or after the direction of travel selector has passed N.





6. Button for engaging mini-wheel.
Condition: Speed must be below 3 km/h. If speed is over 3 km/h, mini-wheel steering cannot be engaged. The lamp in the travel direction selector (position 2) is activated with a fixed glow when mini-wheel steering is engaged.
7. Arm rest.
8. Lock lever for adjusting the position of the mini-wheel on the arm rest.

4.11 Driver's seat (9)

General

This section describes the driver's seat in the cab. The following alternative seats are available:

- Driver's seat Bege is equipped with:
 - mechanical adjustment of height and suspension
 - air suspension 
 - integrated horizontal suspension (can be switched off) 
 - can be rotated 40° 
 - mechanically adjustable lower back (lumbar) support
 - mechanically adjustable seat cushion angle
 - seat belt, 2-point
 - seat belt, 3-point 
 - head restraint 
 - adjustable arm rest, right
 - adjustable arm rest, left 
 - seat heater 
 - ventilated seat and backrest cushions (air-vent). The seat requires compressed air. The selection contains an externally mounted compressor on the underside of the cab floor. 
- Driver's seat Isringhausen 6500.  The seat is equipped with:
 - air suspension
 - air adjustable lumbar support
 - mechanically adjustable seat cushion angle
 - mechanically adjustable damping
 - horizontal suspension (can be shut off)
 - seat belt, 2-point
 - seat belt, 3-point 
 - head restraint 
 - adjustable arm rest, right
 - adjustable arm rest, left 
 - seat heater
 - integrated compressor

- Driver's seat Grammer Actimo XXL. 
The seat is equipped with:
 - air suspension (height)
 - air adjustable lumbar support
 - mechanically adjustable seat cushion angle
 - mechanically adjustable seat length
 - mechanically adjustable damping
 - integrated horizontal suspension
 - seat belt, 2-point
 - head restraint 
 - adjustable arm rest, right
 - adjustable arm rest, left 
 - seat heater
 - integrated compressor
- Driver's seat Grammer MSG 20.
The seat is equipped with:
 - mechanical adjustment of height
 - adjustable angle
 - seat belt
- Driver's seat Isringhausen 6000. 
The seat is equipped with:
 - mechanical adjustment of height
 - mechanically adjustable seat cushion angle
 - mechanically adjustable damping
 - integrated horizontal suspension
 - seat belt, 2-point
 - adjustable arm rest, right
- Driver's seat Grammer Maximo XXL. 
The seat is equipped with:
 - air suspension (height)
 - air adjustable lumbar support
 - mechanically adjustable seat cushion angle
 - mechanically adjustable seat length
 - mechanically adjustable damping
 - integrated horizontal suspension
 - seat belt, 2-point
 - adjustable arm rest, right
 - seat heater
 - integrated compressor

NOTE

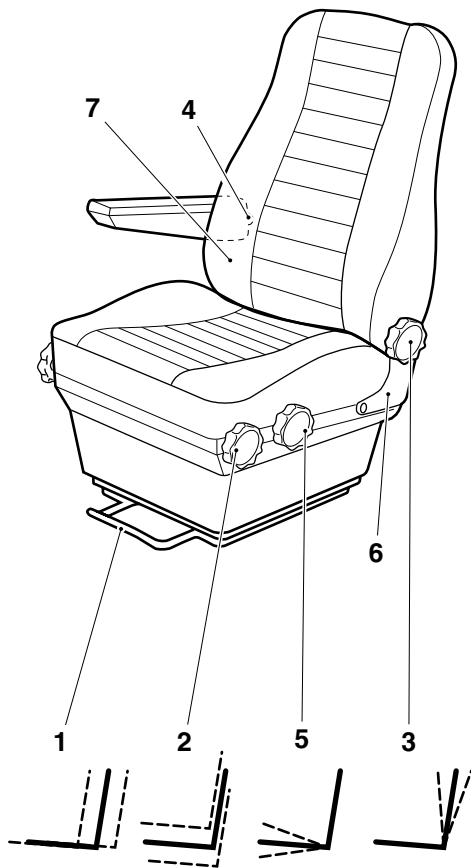
Other alternative driver's seats may be installed.

Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

Driver's seat Bege

(Only applies to machines equipped with operator's cab Spirit Delta)


The driver's seat (position 9) is equipped with several controls for adjustment as follows (adjusting is easier when the seat is unloaded):




000342


Driver's seat with adjustment possibilities

1. Distance to pedals.
Release the seat with the lever and move the seat fore or aft.
2. Height of seat.
With mechanical elevation of seat height:
Turn the knob clockwise or counter-clockwise until the required height is obtained.

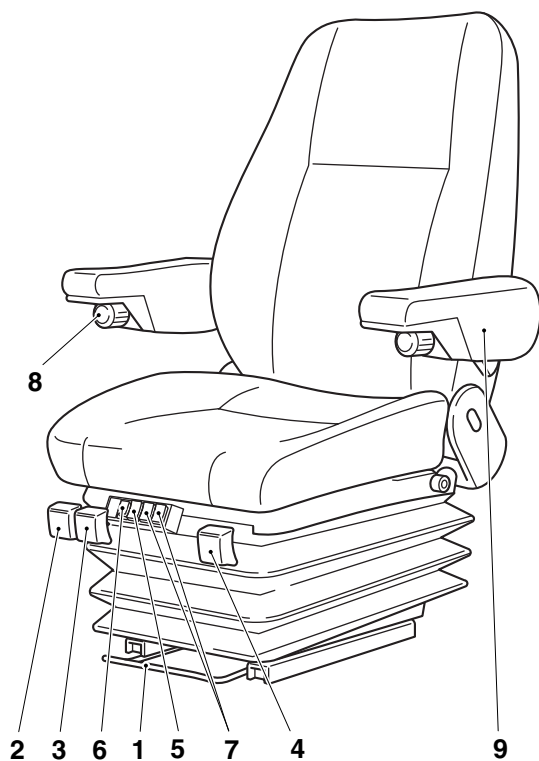
With air suspension elevation of seat height: 
Turn the knob counter-clockwise to lower seat height. Turn the knob clockwise to increase seat height. The suspensions corresponds automatically to the operator's body weight.

Leaving the cab is facilitated if the suspension is evacuated by pulling the control (position 6) to the outer end-position (seat sinks to lowest level). When entering the cab, push in the control to the inner end-position (the seat elevates to the set position).
3. Backrest rake.
Turn the knob until the required position is obtained.
4. Adjustment arm rest right.
Adjustment arm rest left. 
5. Variable angling of seat and backrest.
Turn the knob until the required position is obtained.
6. Adjustment of suspension travel in two steps (lever located on back of seat):
Suspension active – Lever against seat's centre line. Used during normal operation.
Suspension locked – Lever against seat's outside. Can only be performed when the seat height reaches a lock position. Used when suspension is not wanted.
7. Lumbar support.
Turn the knob until the required firmness in lumbar support is obtained.


Driver's seat Isringhausen 6500

 (Only applies to machine equipped with operator's cab Spirit Delta)

The driver's seat (position 9) is equipped with controls for adjustment as follows (adjusting is easier when the seat is unloaded):



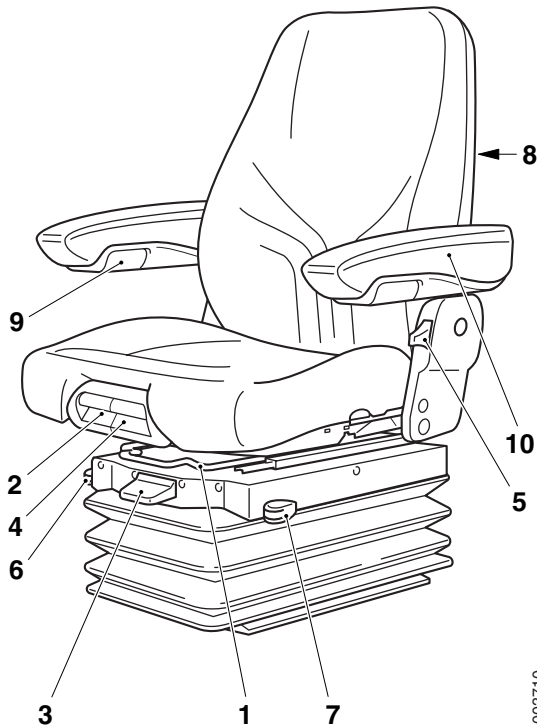
003712

1. Distance to pedals.
Release the seat with lever (1) and move the seat forwards or backwards. Release the lever to lock the seat.
2. Raising/lowering seat level.
Lift the control (2) to raise/lower the seat.
When the required height has been set, release the control.
3. Seat angle.
Lift control (3) and adjust the angle by loading/unloading the front of the seat.
4. Backrest rake.
Lift control (4) and adjust the angle by loading/unloading the backrest.
5. Damping adjustment.
Press "+" for more damping.
Press "-" for less damping.
6. Seat heating.
Thermostatically controlled heating for seat cushion and backrest.
Press the button to activate / deactivate. The indication lamp is illuminated when seat heating is activated.
7. Lumbar support. Integrated pneumatic system.
Press the buttons (7) to fill or empty the air chambers for optimal body fit of the back support.
8. Arm rest angle can be continuously adjusted using the knurled knob.
9. Arm rest left 

Driver's seat Grammer Actimo XXL

+ (Only applies to machine equipped with operator's cab Spirit Delta)

The driver's seat (position 9) is equipped with controls for adjustment as follows (adjusting is easier when the seat is unloaded):



003710

1. Distance to pedals.
Release the seat with lever (1) and move the seat forwards or backwards. Release the lever to lock the seat.
2. Seat cushion adjustment.
Lift control (2) and adjust the seat cushion forwards or backwards.
3. Raising/lowering seat level.
Lift the control (3) to raise the seat.
Press control (3) down to lower the seat.
When the required height has been set, release the control.
4. Seat angle.
Lift control (4) and adjust the angle by loading/unloading the front of the seat.
5. Backrest rake.
Lift control (5) and adjust the angle by loading/unloading the backrest.
6. Damping adjustment.
Turn control (6) forwards in stages, for harder damping.
Turn control (6) backwards in stages, for softer damping.
7. Plane damping.
Turn control (7) to the rear-facing position to permit damping.
Turn control (7) to the forwards-facing position to prevent damping.
8. Lumbar support. Integrated pneumatic system.
Press the buttons to fill or empty the air chambers for optimal body fit of the back support.
9. Arm rest angle can be continuously adjusted using the knurled knob.
10. Arm rest left **+**

Driver's seat Grammer MSG20

(Only applies to machines equipped with operator's cab FlexGuard/FlexCab)

The driver's seat (position 9) is equipped with controls for adjustment as follows (adjusting is easier when the seat is unloaded):

1. Backrest rake.
2. Distance to pedals.

Release the seat with lever (2) and move the seat forwards or backwards.

3. Seat height is adjusted with control (3).

Use the control to adjust seat height. Move the control downward to elevate the seat. Move the control downward until it stops and the seat height returns to the lowest level.

The suspensions corresponds automatically to the operator's body weight.



000540

Driver's seat Isringhausen 6000

+ (Only applies to machines equipped with operator's cab FlexGuard/FlexCab)

The driver's seat (position 9) is equipped with controls for adjustment as follows (adjusting is easier when the seat is unloaded):

1. Distance to pedals.

Release the seat with lever (1) and move the seat forwards or backwards. Release the lever to lock the seat.

2. Raising/lowering seat level.

Lift the control (2) to raise/lower the seat.

When the required height has been set, release the control.

3. Seat angle.

Lift control (3) and adjust the angle by loading/unloading the front of the seat.

4. Backrest rake.

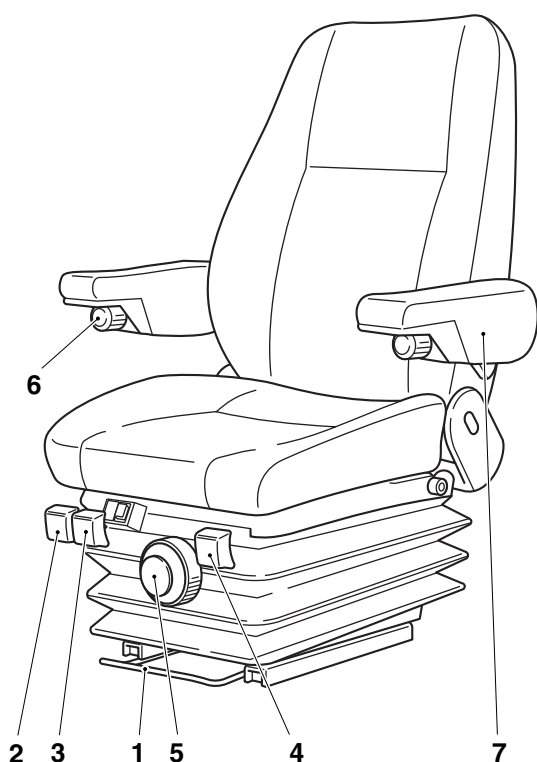
Lift control (4) and adjust the angle by loading/unloading the backrest.

5. Damping adjustment/weight setting.

Turn the knob to set the required damping level.

6. Arm rest angle can be continuously adjusted using the knurled knob.

7. Arm rest left **+**

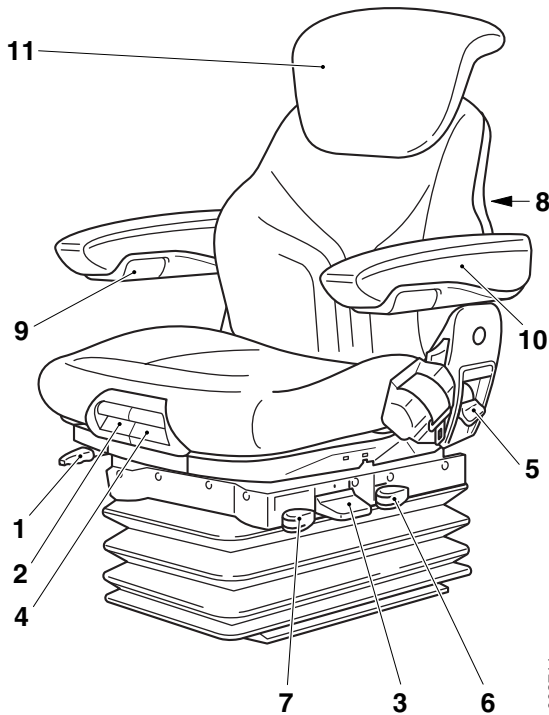


003713

Driver's seat Grammer Maximo XXL

+ (Only applies to machines equipped with operator's cab Flex-Guard/FlexCab)

The driver's seat (position 9) is equipped with controls for adjustment as follows (adjusting is easier when the seat is unloaded):



003711

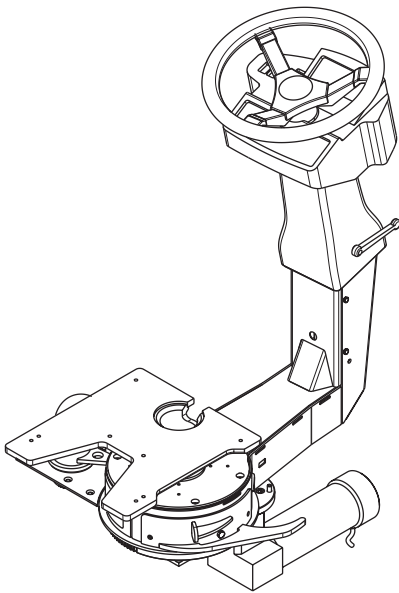
1. Distance to pedals.
Release the seat with lever (1) and move the seat forwards or backwards. Release the lever to lock the seat.
2. Seat cushion adjustment.
Lift control (2) and adjust the seat cushion forwards or backwards.
3. Raising/lowering seat level.
Lift the control (3) to raise/lower the seat.
When the required height has been set, release the control.
4. Seat angle.
Lift control (4) and adjust the angle by loading/unloading the front of the seat.
5. Backrest rake.
Lift control (5) and adjust the angle by loading/unloading the backrest.
6. Damping adjustment.
Turn control (6) forwards in stages, for harder damping.
Turn control (6) backwards in stages, for softer damping.
7. Plane damping.
Turn control (7) to the rear-facing position to permit damping.
Turn control (7) to the forwards-facing position to prevent damping.
8. Lumbar support. Integrated pneumatic system.
Press the buttons to fill or empty the air chambers for optimal body fit of the back support.
9. Arm rest angle can be continuously adjusted using the knurled knob.
10. Arm rest left **+**
11. Seat backrest.
Adjust the seat backrest to the required position.

Reversible driver's station



The driver's station, with driver's seat, is available electrically reversible. The seat bracket has an integrated steering column and steering wheel with panel. It turns with the bracket when changing around. The driver's seat is not different to the other seat alternatives. The reversible driver's station has double pedals. The steering wheel and hand controls move when turning.

The driver's station is turned using the switch for reversible driver's station. See *Switch for reversible driver's seat (44) page 56*.



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4.12 Heating unit/climate control system

Cab alternative

This section describes the heater unit and/or climate control system for the following cab alternatives:

- Spirit Delta
- FlexCab

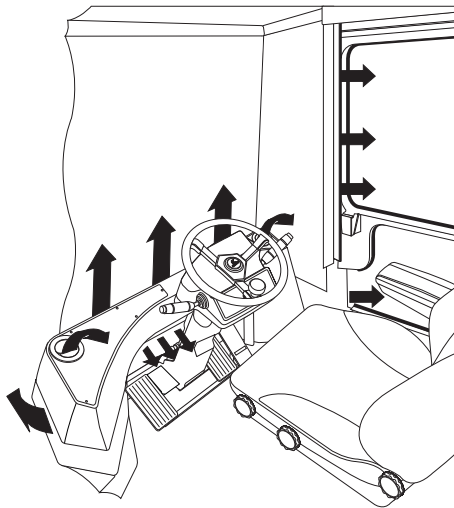
Numbers in brackets refer to positions in *Cab overview Spirit Delta* page 41 and *Cab overview FlexGuard and FlexCab* page 48.

4.12.1 Spirit Delta

General

Cab alternative Spirit Delta can be equipped with one of the following options:

- heating unit
- heating unit with cooling AC (manual control of heating, cooling, dehumidification and air flow)
- Climate control system ECC (automatic control of heating, cooling, dehumidification and air flow)



001971

Air inlets to cab

4.12.1.1 Heating unit

General

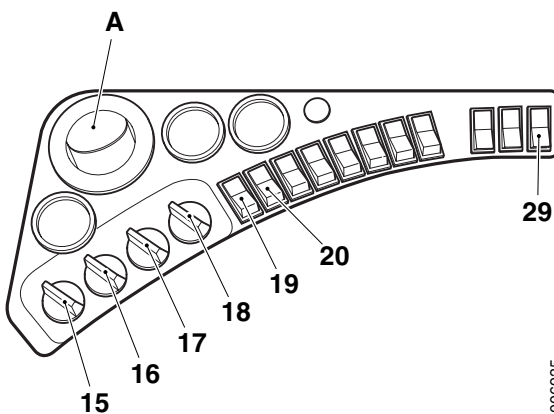
The heating unit is available as the following alternatives:

- heating unit
- heating unit with cooling AC

The heating unit is connected to the engine cooling system and provides heat when the engine is warm.

The fan is operated with the control (position 16) in steps 0-I-II-III. Heating is controlled with the rotary control (position 15) and cooling with the rotary control (position 18). Air distribution is controlled with the control (position 17).

Recirculation is turned on and off with switch (position 19) ().



006935

Panel heating unit

Cooling AC is turned on and off with switch (position 20) (⊕). The panel has vents (position A).

The fresh air inlet is provided with a filter and can be equipped with a fine filter for pollen (⊕).

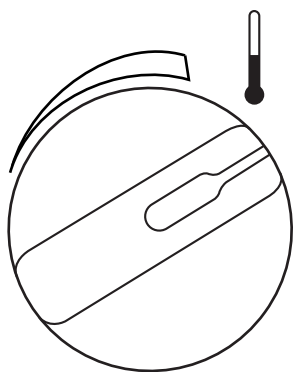
Pause heater is switched on and off by switch (position 29) (⊕) and activated when the ignition key is in position P and the engine is hot.

NOTE

The driver's door and windows must be closed for satisfactory function of heating unit.

Controls for heating (15)

Rotating knob (position 15) provides continuous adjustment of heat supply. Turn clockwise for more heating, anti-clockwise to reduce or shut off the heating.

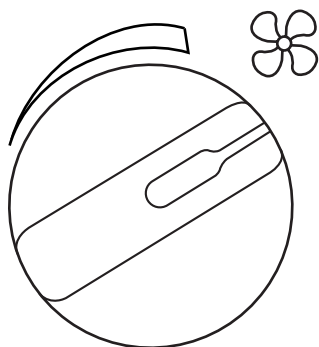


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Controls for fan (16)

The rotary control (position 16) handles inlet of fresh air to the cab. Turn clockwise to increase fan speed, thus increasing fresh air into the cab, counter-clockwise to reduce inlet of fresh air.

The fan is adjusted in three stages 0 - I - II - III with the knob.



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Controls for defroster/cab (17)

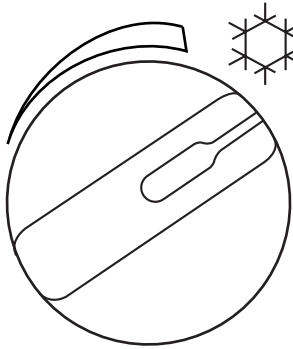
The rotary control (position 17) handles the distribution of fresh air to the cab. Air is distributed to the lower cab space (legs) and defroster (window). Left position for lower cab space, middle position for cab space and right position for defroster.



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Controls for cooling AC (18)

The rotary knob (position 18) provides continuous adjustment of cooling supply. Turn clockwise for more cooling, anti-clockwise to reduce or shut off the cooling.



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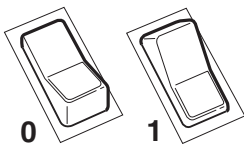
Switch for recirculation/fresh air (19)

(Only for heater unit with cooling AC)

Switch (green) to handle air circulation in the cab.

Position 0 - Fresh air inlet open.

Position 1 – Fresh air inlet closed, cab air recirculation.



000542

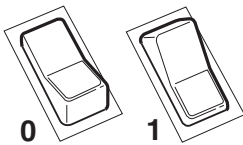
Switch for cooling AC (20)

(Only for heater unit with cooling AC)

Switch (green) to handle the cooling function. Rocker switch.

Position 0 – Cooling function off.

Position 1 – Cooling function on. The air conditioning's cooling function does not start if the fan control (position 16) is at position zero.



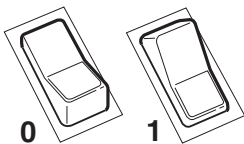
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Switch for pause heater (29)

Switch to activate the pause heater function (position 29).

Position 0 - Pause heater on. Pause heater is activated when the ignition key is in position P and the engine is hot.

Position 1 - Pause heater off.



002900

4.12.1.2 Climate control system ECC

General



The climate control system automatically controls the interior temperature, to provide the required temperature irrespective of ambient conditions. The system is always set to AUTO mode and 21°, irrespective of the setting when last shut off.

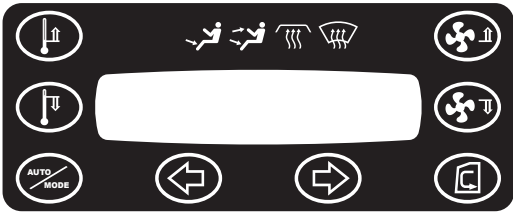
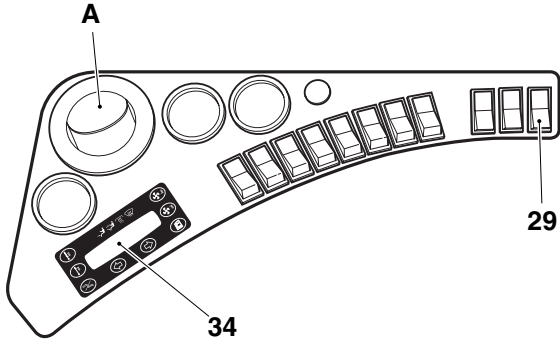
The heating unit is connected to the engine cooling system and provides heat when the engine is warm. The air conditioning's functions are controlled with the function keys.

The air intake is equipped with a filter and may be equipped with a fine-textured filter for pollen (⊕).

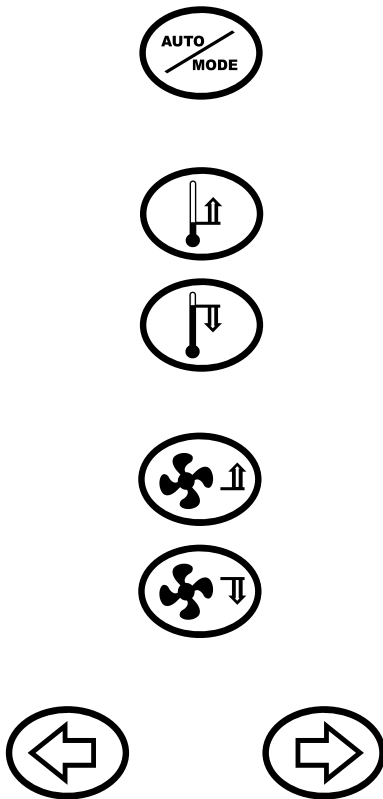
Pause heater is switched on and off by switch (position 29) (⊕) and activated when the ignition key is in position P and the engine is hot.

NOTE

The driver's door and windows must be closed for satisfactory function of the air conditioning.



A. Panel vent



AUTO mode

The temperature, air distribution and fan speed are adjusted automatically in AUTO mode. The selected temperature and AUTO are shown on the display.

Temperature

Set the required temperature with the buttons.

Fan

Set the required fan speed with the buttons. Speed can be adjusted between 0-100%.

Air distribution

Select the required function with the buttons. The selected air distribution is indicated with a square underneath the relevant symbol.

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003568

Air to floor.



003569

Air to both floor and panel vents.



003570

Air to windscreen.



003571

Maximum defroster.



003572

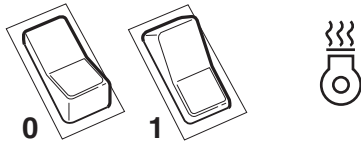
Recirculation

The cab air is recirculated, that is, no fresh air is drawn into the operator's cab. REC is shown on the display when the function is activated. Shut off recirculation by pressing the button again.

Switch for pause heater (29)



Switch to activate the pause heater function (position 29).




002900

Position 0 - Pause heater on. Pause heater is activated when the ignition key is in position P and the engine is hot.

Position 1 - Pause heater off.

4.12.2 FlexCab

General

Cab alternative FlexCab is equipped with a heater unit and can be equipped with air conditioning .

Numbers in brackets refer to positions in *Cab overview FlexGuard and FlexCab* page 48.

4.12.2.1 Heating unit

General



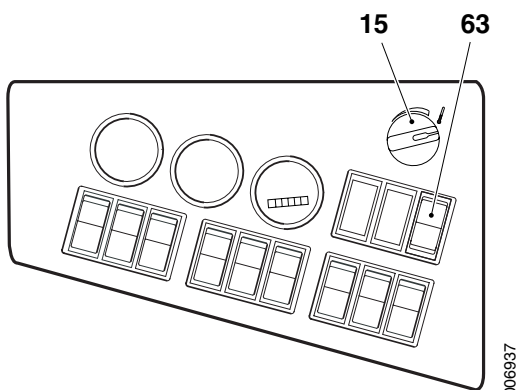
The heating unit is connected to the engine cooling system and provides heat when the engine is warm.

The fan in the unit is controlled in stages 0-I-II with the fan switch (position 63).

The heating is controlled with the heating control (position 15).

NOTE

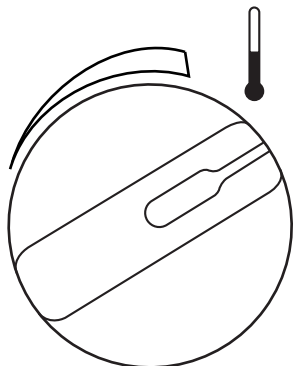
The operator's door and all windows should be closed for satisfactory function of heating.



006937

Controls for heating (15)

The rotating knob (position 15) provides continuous adjustment of heat supply. Turn clockwise for more heating, anti-clockwise to reduce or shut off the heating.



000547

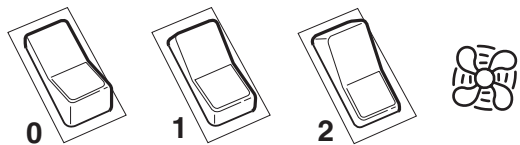
Switch for fan (63)

Switch (green) for fan (position 63).

Position 0 - Fan shut off.

Position 1 - Low fan speed.

Position 2 - High fan speed.



003309

4.12.2.2 Cooling, AC

General



The AC is completely separate from the heater unit, and has a separate cooling matrix installed in front of the steering column, which circulates and cools the air in the cab. The air vents are adjustable for individual air flow setting.

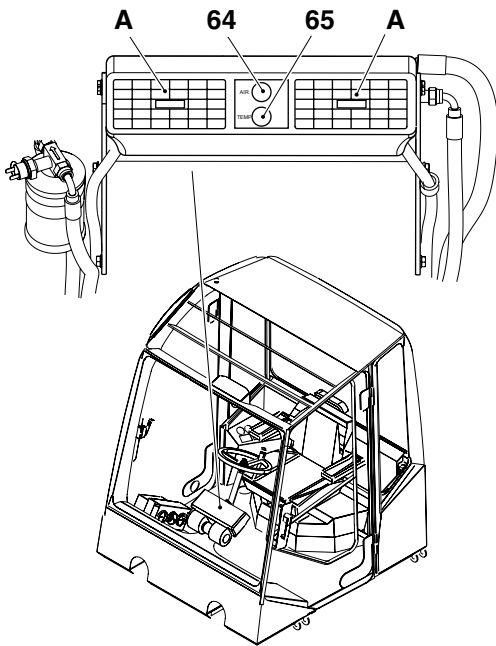
The fan speed is controlled in stages 0 - I - II - III with the fan switch (position 64).

Cooling action can be constantly adjusted with the cooling control (position 65).

NOTE

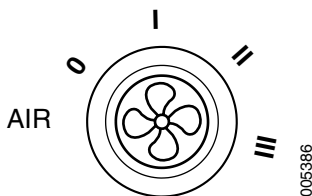
Doors and windows should be shut, for the air conditioning to work satisfactorily.

Numbers in brackets refer to positions in *Cab overview FlexGuard and FlexCab* page 48.



006930

- Cooling unit in cab.
- 64. Fan controls
- 65. Cooling effect control
- A. Air vent

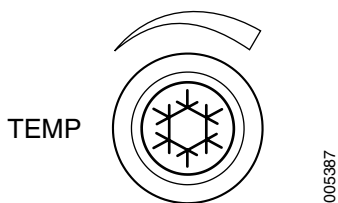


005386

Controls for fan (64)

The knob (position 64) controls the fan speed in the cooling unit. Turn it clockwise to increase fan speed and increase air flow, or anti-clockwise to reduce air flow.

The fan is adjusted in three stages 0 - I - II - III with the knob.



005387

Controls for cooling AC (65)

The rotary knob (position 65) provides continuous adjustment of cooling supply. Turn clockwise for more cooling, anti-clockwise to reduce or shut off the cooling.

Cooling only functions when the engine is running.

4.13 KCS system

General

This section describes the control and monitoring system, KCS.

The machine is equipped with an electronic system for control and monitoring of the machine's different functions.

The system gives the operator information in the form of:

- Error code information

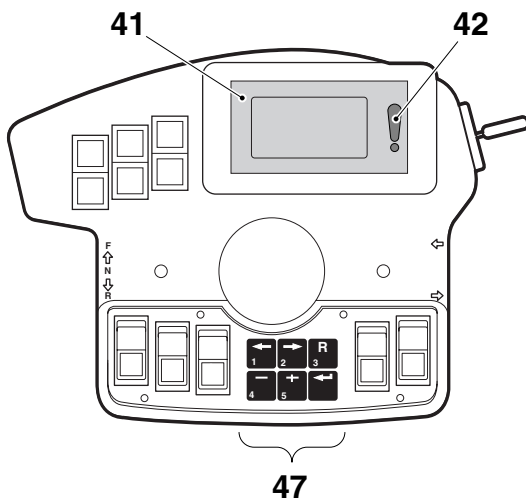
Three levels of error code information can be displayed. On generation of an error code, the alarm indicator for the control and monitoring system (position 42) lights. See section 5.3 *Handling error codes*.

- Operating information

Operating information includes, machine speed, engine rpm, fuel level, etc.

The information is presented on the steering wheel panel's display (position 41). The function keys (position 47) are used to navigate the display menus for service and troubleshooting, for example.

Numbers in brackets refer to positions in *Cab overview Spirit Delta page 41* and *Cab overview FlexGuard and FlexCab page 48*.



41. Display for control and monitoring system (KCS)
 42. Alarm indicator for control and monitoring system
 47. Function keys for control and monitoring system (KCS)

The other appearances of the steering wheel panel are examples

006900

4.13.1 Operational menus

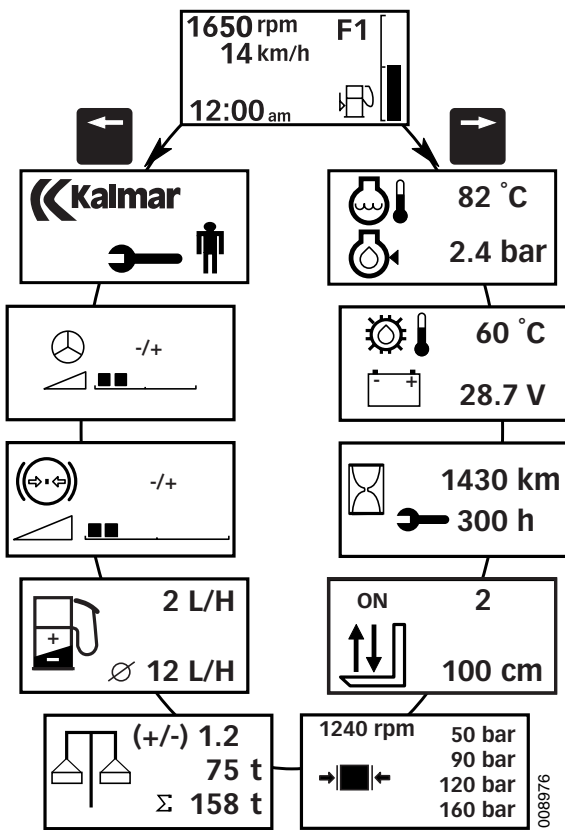
General

After starting the machine, the operational menu with engine rpm, speed, current gear, time and fuel level is displayed. Menus are selected with the right arrow and left arrow function keys. Each time a key is pressed, the display changes to the next menu. To return quickly to the original display, press and hold in the Reset (R) function key.

This section describes the information that can be obtained from different operational menus. Figures are indicated with example data.

NOTE

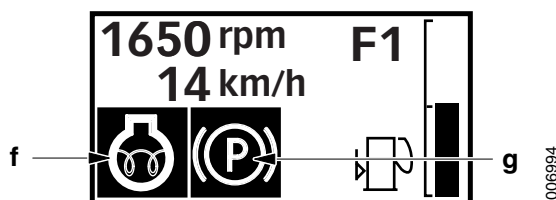
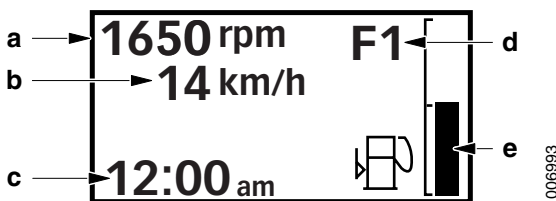
The availability of the menus is dependent on the machine's equipment.



4.13.1.1 Operational menu

Description

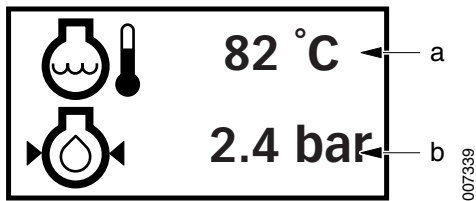
- a. Shows current engine speed (rpm).
- b. Shows current speed in km/h.
- c. Shows current time.
- d. Shows current gear.
F – forward, N – neutral, R – reverse. 1-3 indicate gear position.
- e. Shows current fuel level.
- f. Displayed when preheating is active.
- g. Flashes when the parking brake is activated.



4.13.1.2 Operational menu for engine

Description

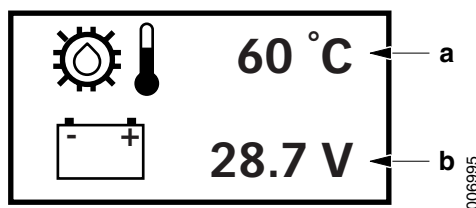
- a. Shows current coolant temperature in °C.
- b. Shows engine's current oil pressure in bar.



4.13.1.3 Operational menu for transmission and electrical system

Description

- a. Shows gearbox oil temperature in °C.
- b. Shows current battery voltage in Volt.



4.13.1.4 Operational menu for service interval

Description

- a. Shows total distance travelled since last service in km.
- b. Shows time (in hours) to next service.

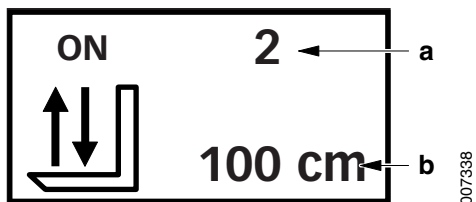


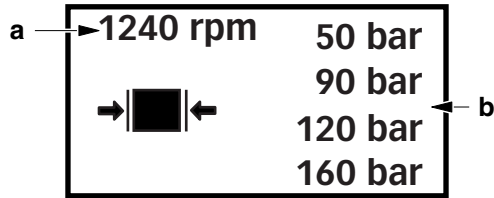
4.13.1.5 Operational menu for lifting height pre-selection

Description



- a. Shows current selection of lifting height 1-15.
- b. Shows desired lifting height in cm.





4.13.1.6 Operational menu for paper handling

Description



Menu is available for paper handling attachment, which handles paper bales by clamping down on the bale.

In machines with four clamp pressure the desired pressure is selected using a rotary control in the electric servo panel. The attachment's clamp pressure can be from 1 to 4.

- a. Shows current engine speed (rpm).
- b. Shows desired clamping pressure in bar.

4.13.1.7 Operational menu for scale

Description

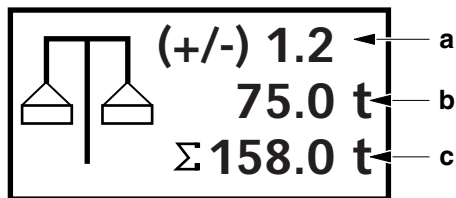


- a. Shows dead weight (tare) in tonnes.

The value shown in the row (b) can be reset to zero (off-set) using the function keys for minus and plus. Set value is shown in row (a). Shows 0-3.0 tonnes.

- b. Current weight in tonnes (net weight).
- c. Total weight in tonnes (gross weight).

The value shown in row (b) can be added to the row (c) with the function key for Return. The value in the row (c) can be reset by pressing function keys Reset and Return at the same time.



NOTE

For accurate weighing the scale must be calibrated at regular intervals using a known weight. The weight should be heavy for greatest accuracy.

The weight of the load is shown in the operational menu for scales.

For work instructions, see section 5.4.4 *Load handling functions, scales*.

4.13.1.8 Operational menu for fuel consumption

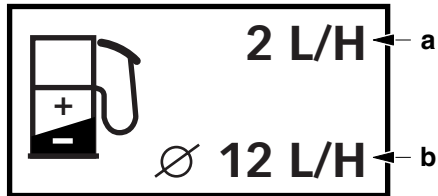
Description



Menu for fuel consumption.

- a. Displays current fuel consumption in litres/h or gallon/h.
- b. Displays average fuel consumption in litres/h or gallons/h.

Average fuel consumption can be reset by pressing Reset and Return at the same time.



007003

4.13.1.9 Operational menu for Optimum drive

Description



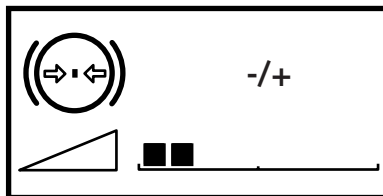
Menu is available for the function Optimum drive, which gives faster lift speed when inching. The accelerator position controls the inching speed and the lift lever controls the engine's power (rpm) - completely independent of each other. The accelerator pedal also works as a brake during normal operation.

The service brake's effect on the accelerator pedal's position is set from 1 to 9.

Change the sensitivity with the function keys "-/4" and "+/5".

At 1 the service brake action is low (fast inching). At 9 the service brake action is high (slow inching).

The setting is saved when the ignition is switched off and at start-up starts with the value next time.



007342

4.13.1.10 Operational menu for joystick steering/mini-wheel

Description

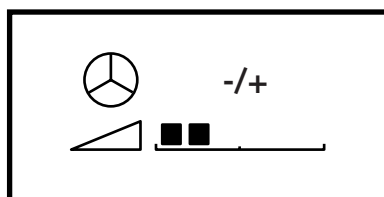


Menu is available for functions "Joystick" steering" or "Mini-wheel". The steering's sensitivity is set from 1-9.

Change the sensitivity with the function keys "-/4" and "+/5".

At 1 steering is very slow (forgiving). At 9 steering is very fast (sensitive).

The start value is set in the service menus for joystick steering/Mini-wheel.

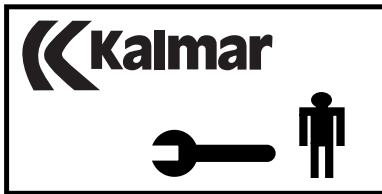


007343

4.13.1.11 Operational menu for service

Description

This menu is only used by service personnel.



007344

5 Handling

General

The machine is intended to be used in the way described in the Operator's manual. If the machine is used in other ways or in potentially dangerous or hazardous conditions, for example, an explosive environment, special safety regulations must be followed and the machine must be equipped for such conditions and environments.

NOTE

It is the operator's responsibility to ensure that the machine is brought in for service every 500 operating hours. Procedures are described in the maintenance manual.

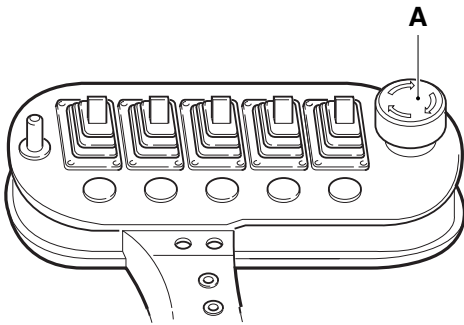
The information in the chapter for handling the machine does not relieve the operator of the responsibility of following laws or other national regulations for road safety and work safety.

Awareness, alertness, good judgement and respect for applicable safety regulations are prerequisites for avoiding accidents.

Environmental impact

It is important that the machine is used in a way that makes as little environmental impact as possible regarding fuel consumption, exhaust and noise emissions. Keep in mind:

- Plan the work and optimise the use of the machine.
- Avoid driving using full acceleration when transporting.
- Do not rev the engine unnecessarily when load handling.
- Optimise driving with reference to acceleration and braking.
- Minimise the time that the machine is at idle speed. Do not allow the machine to run at idle speed during breaks in work.



001403

Emergency equipment

The following emergency equipment is available on the machine:

- Emergency cab exit, right door.

In an emergency:

1. Open the emergency exit right door with handle on inside.

- Breaker switch for load handling (servo circuits, only in case of controls electric servo for load handling).

In an emergency:

1. Press breaker switch (position A) immediately.

All load handling function stops.

2. Reset breaker switch (turn clockwise).

- Fire extinguisher 

The fire extinguisher is located on a front fender or inside the cab.

In case of an engine fire, press the fire extinguisher in through the perforation in the plate for fire extinguishers on the side of the engine hood.

WARNING

By-pass of load handling functions may not be used when lifting or transporting loads.

Extreme hazard to personal health and risk of property damage.

Only use the by-pass in emergencies.

5.1 Running-in

General

The machine should be operated with great care during the running-in period. The purpose is to give bearing surfaces hard and polished surfaces, which considerably extends the service life.

Recommended running-in period is 50 operating hours. This gives fewer malfunctions. Increase the load successively during these 50 hours.

NOTE

Check oil pressure and temperature regularly.

5.2 Daily inspection

General

Daily inspection of the machine is extremely important in order to ensure that it is safe both for the operator and its surroundings.

It is recommended that every operator performs the checks before a new work shift. In this way, operators can avoid running defective machines with malfunctions that have been generated or caused during an earlier work shift.



WARNING

Never operate a defective machine.

Fatal danger and risk of property damage!

Notify the foreman/supervisor immediately if defects are found on the machine during daily inspection!

For work instructions, see section 6.1 *Daily inspection*.

5.3 Error codes

General

An error code indicates that there is some malfunction in the machine. The error codes must be used by operators and service technicians to identify the problem and to select a suitable action.

In case of an error code indication, it is very important to identify the error code and to perform an action to correct the problem.

Actions with error codes



WARNING

Stop alarms indicate a malfunction in the machine which may affect safety of the operator and others in the vicinity or may cause a breakdown. – Read off the error code, Switch off the engine and carry out actions according to the error code table.

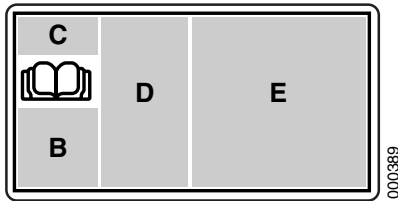
Warning and information alarms indicate malfunctions of such character that work does not have to be stopped. The machine's capacity may be limited and certain functions may not work. – Carry out actions according to the error code table as soon as possible.

- 1 Stop the machine and identify the error code level and special error code number, see section *Error code indication page 107*.
Stop the engine in the event of a Stop alarm or let the engine run in the event of Warning or Information alarms.

NOTE

In the event of a serious malfunction, the engine will be emergency stopped. After an emergency stop it is possible to restart the engine for approx. 25 seconds to move the machine from an unsuitable position.

If several error codes come from the engine, these are shown rolling, that is, all active error codes are displayed in the same field at approx 1s intervals.



- 2 The error code is shown automatically on the display.

Note all error codes. For explanation, see *Display figure for error code information page 108*.

Scroll between the error codes using the right or left arrow keys. Error code information disappears once its cause has been remedied.

Deactivate display of error codes by pressing the Reset (R) function key:

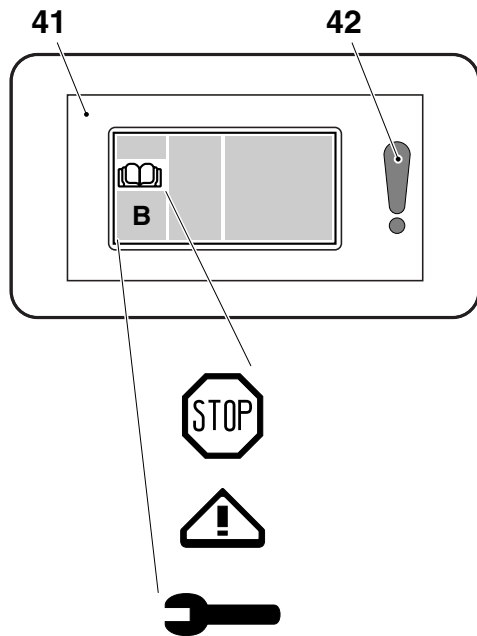
- In the event of Stop: If the cause of the error code remains, the error code will reappear within one minute.
- In the event of Warning or Information: If the cause of the error code remains, the error code will reappear within three minutes.
- If the cause of the error code is gone, error code display will automatically deactivate within 30 seconds.

- 3 Park the machine in a suitable location.

For error code level “STOP” – Stop the engine.

For error code level “WARNING” or “INFORMATION” – Leave the engine running or switch the machine off.

- 4 Read the information for the error code/error codes in the error code table and perform the recommended actions.
 - *Error codes Control unit EDU 795 (KCS display) page 112*
 - *Error codes control unit ECU 790 page 112*
 - *Error codes control unit ECU 796 page 114*
 - *Error codes control unit ECU 792 page 117*
 - *Error codes engine page 118*
 - *Error codes transmission page 130*
- 5 Restart the engine and check in the display that error codes are gone according to step 2.



B. Error code level symbol

41. Display for the control and monitoring system (KCS)

42. Indicator for the control and monitoring system (KCS)

007192

5.3.1 Error code indication

General

An error code is indicated by a lit indicator for active error codes (position 42). Error codes are classified into three levels based on severity.

The error code levels are indicated as follows:

- STOP is indicated with a STOP sign on the display, together with continuous red light from the indicator control and monitoring system (position 42).

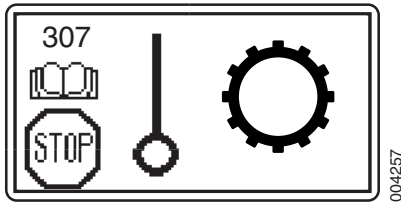
Error code with level Stop is shown automatically on the display.

- Warning is indicated by a warning triangle in the display together with a steady red glow from the indicator for the control and monitoring system (position 42).

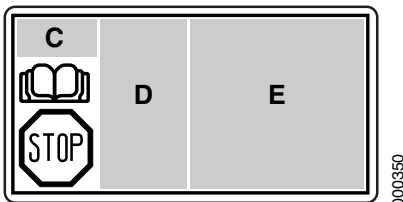
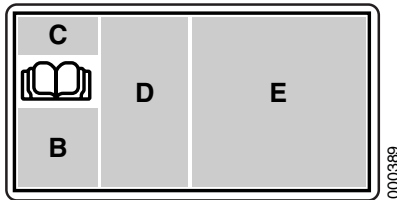
Error code with level Warning is shown automatically on display.

- Information is indicated by a spanner in the display together with a constant red light from the indicator for the control and monitoring system (position 42).

Error code with level Information is shown automatically in the display.



Example figure, automatic display figure



5.3.2 Error code information in display

Error code display

Error code information is shown with display figures and symbols that indicate what error has occurred.

The error codes and images can be temporarily removed using the Reset (R) function key, at which time they disappear from the display. If the error code is active, it reappears in the display within 1-3 minutes.

NOTE

If error code disappears automatically, it may be due to the following:

- *the output signal that generated the error code is no longer active, e.g. the control lever has been released or the engine is off.*
- *loose connection.*

Display figure for error code information

The control and monitoring system's display is divided into four fields where the information is shown (see figure to the left).

- Field B: Error code level is shown with a symbol.
- Field C: Shows error code.
- Field D: Shows type of error.
- Field E: Indicates which function is affected by the error code.
- The book symbol means that information is available in the Operator's manual.

Field B: Error code level

The control and monitoring system gives error code information in three levels, which are indicated with a symbol in the lower left corner (B) on the display unit.

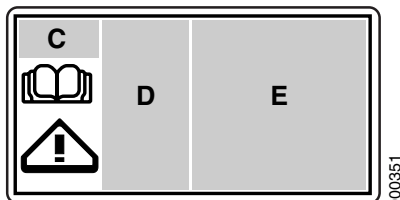
STOP

Indicates a serious malfunction that may affect operator safety or cause machine breakdown. The error code must be rectified immediately. Stop working with the machine and call a service technician as soon as possible.

The error code is shown automatically in the display.

Actions at STOP:

- A. Park the machine immediately.
Note the error code number.
- B. Switch off the engine.
- C. Contact service.



WARNING

Indicates a malfunction in the machine that should be attended to as soon as possible. A service technician should be called as soon as possible after finished work shift.

The error code is shown automatically in the display.

Actions at Warning:

- A. Rectify the error code as soon as possible but work with the machine can continue safely.
- B. See information in error code table
 - *Error codes Control unit EDU 795 (KCS display) page 112*
 - *Error codes control unit ECU 790 page 112*
 - *Error codes control unit ECU 796 page 114*
 - *Error codes control unit ECU 792 page 117*
 - *Error codes engine page 118*
 - *Error codes transmission page 130*

If the error code number is not in the error code table, rectify according to step C.
- C. Contact service, for example after a completed shift.

INFORMATION

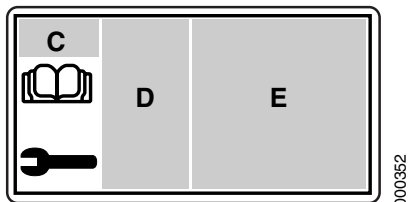
Information for the operator that something should be attended to, for example, low fuel level. Take appropriate action to eliminate error code condition as soon as possible. See chapter 6 *Inspection and maintenance*.

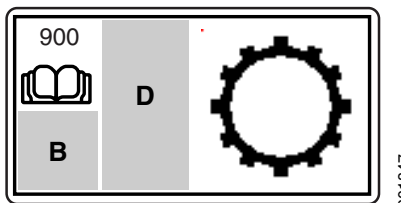
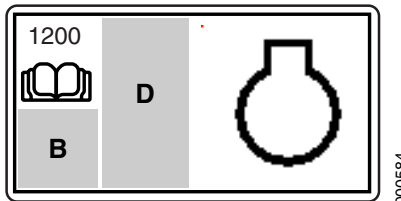
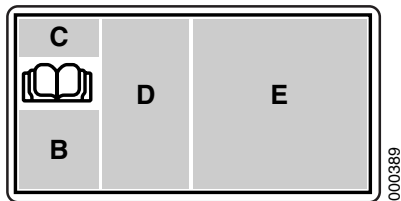
The error code is shown automatically in the display.

Actions at information

- A. Continued work with the machine.
- B. At a suitable point, see information in error code table
 - *Error codes Control unit EDU 795 (KCS display) page 112*
 - *Error codes control unit ECU 790 page 112*
 - *Error codes control unit ECU 796 page 114*
 - *Error codes control unit ECU 792 page 117*
 - *Error codes engine page 118*
 - *Error codes transmission page 130*

If the error code number is not in the error code table, rectify according to step C.
- C. Contact service, for example after a completed shift.





Field C: Error code number

The control and monitoring system generates error codes from three sub-systems:

- Machine:

Shown with error code XXX in the display, see *Error codes Control unit EDU 795 (KCS display) page 112*, *Error codes control unit ECU 790 page 112*, *Error codes control unit ECU 796 page 114* and *Error codes control unit ECU 792 page 117*.

- Engine

Shown with code 1200 and error code number X.X.X (position D) in display, see *Error codes engine page 118*.

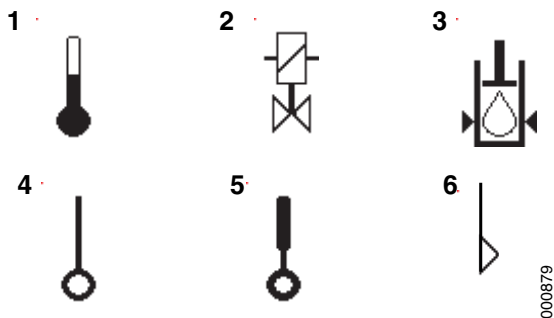
NOTE

If several error codes come from the engine, these are shown rolling, that is, all active error codes are displayed in the same field at approx 1s intervals.

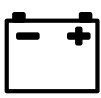




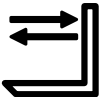

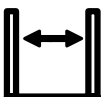
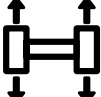



















- Transmission:

Shown with code 900 and error code number (position D) and error code level (position B) in the display. If more error codes are generated by the transmission they are displayed as rolling at approx 1s intervals. For error code table, see *Error codes transmission page 130*.

Field D: Type of error



1. Too high/too low temperature.
2. Incorrect signal to solenoid.
3. Incorrect hydraulic pressure
4. Incorrect sensor signal.
5. Incorrect signal from control.
6. Too high/too low level.

1		2		3		<p>Field E: Indicates which function is affected by the error code.</p> <ol style="list-style-type: none"> 1. Battery voltage. 2. Hydraulic functions. 3. Communication. 4. ECU hardware defect. 5. Lift up/down. 6. Forks tilt. 7. Forks side shift. 8. Forks spreading. 9. Levelling. 10. Engine. 11. Coolant engine. 12. Engine oil. 13. Oil pressure engine. 14. Transmission. 15. Oil pressure transmission. 16. Hydrostatic transmission. 17. Pedal. 18. Brake system. 19. Time. 20. Electronic scales. 21. Fuel. 22. Steering. 23. Clamping attachment. 24. Emergency stop. 25. Reversible driver's seat. 26. Air or particle filter. 27. Fuel economy. 28. Parking brake.
4		5		6		
7		8		9		
10		11		12		
13		14		15		
16		17		18		
19		20		21		
22		23		24		
25		26		27		
28						

007010

5.3.3 Error code tables

General

Error codes are arranged in numerical order. The error code tables contain the following information:

- Code –shows error code.
- Description – Gives description of error code and any limits to the machine that occur in connection with the relevant error code.
- Action - Shows STOP/WARNING/INFORMATION for action according to the error code level, with or without detailed information.

If the error code is not in the tables, contact service.

Error codes Control unit EDU 795 (KCS display)

Table 1. Error codes for EDU 795

Code	Description	Action
1	Time for service interval has been exceeded.	INFORMATION
10	Communication error ECU 790. Impossible to continue operation.	STOP!
11	Communication, defective cable ECU 790 - EDU 795. Impossible to continue operation.	WARNING!
12	Communication error ECU 793.	STOP!
13	Communication error ECU 794.	STOP!
14	Communication ECU 796, no reply.	STOP!
15	Communication, defective cable ECU 795 - ECU 796.	WARNING!
16	Communication, defective cable ECU 796 - ECU 790.	WARNING!
17	Memory error, check sum EDU 795. Impossible to continue operation, display not functioning.	WARNING!
18	Communication ECU 792, no reply.	STOP!

Error codes control unit ECU 790

Table 2. Error codes ECU 790

Code	Description	Action
301	Power supply error ECU 790. Reduction of engine rpm.	STOP: Check fuses according to the Operator's manual, and the battery voltage and acidity. Contact service if the fault remains.
303	Reference voltage error, 5V, ECU 790. Reduction of engine rpm.	STOP!
304	Sensor malfunction for electric scales.	WARNING!
305	Speed sensor malfunction. Reduction of engine rpm.	STOP!
306	Engine rpm sensor malfunction. Reduction of engine rpm.	STOP!

Code	Description	Action
307	Gear selector malfunction. Reduction of engine rpm.	STOP!
320	Sensor malfunction hydrostatic operating pressure (forward). Reduction of engine rpm.	STOP!
321	Sensor malfunction hydrostatic operating pressure (reverse). Reduction of engine rpm.	STOP!
322	Malfunction of lift lever's hydraulic pressure sensor. Engine rpm does not increase when using lift lever.	WARNING!
323	Short-circuit or open circuit, output signal EDC valve pump (forward). Reduction of engine rpm.	STOP!
324	Short-circuit or open circuit, output signal EDC valve pump (reverse). Reduction of engine rpm.	STOP!
325	Short-circuit or open circuit, output signal PDC valve hydraulic motor. Reduction of engine rpm.	STOP!
350	Battery voltage low.	WARNING!
351	Battery voltage high.	WARNING!
352	Fuel level low. Possible to continue operation.	INFORMATION! Fill with fuel.
353	Sensor malfunction fuel level. Possible to continue operation.	INFORMATION!
354	Coolant level low. Reduction of engine rpm.	STOP! Fill with coolant.
355	Hydraulic oil temperature high.	WARNING! Do not use hydraulic functions until the hydraulic oil temperature falls below 70°C. Contact service if the fault remains.
356	Sensor error, hydraulic oil temperature. Possible to continue operation.	INFORMATION!
357	Brake system, accumulator pressure low. Reduction of engine rpm.	STOP! The pressure in the accumulator, that is, the brake pressure is too low and the service brake capacity is limited. Check the accumulators' sealing if the pressure does not build up and is not maintained, see chapter 6 <i>Inspection and maintenance</i> . Contact service.
370	Particle filter engine. Clean within 30 minutes.	INFORMATION! Clean particle filter within 30 minutes. See section 5.4.9 <i>Stopping machine - parking</i> or see separate manual for particle filter.
371	Particle filter engine. Clean immediately. Reduction of engine rpm.	STOP! Clean particle filter. See section 5.4.9 <i>Stopping machine - parking</i> or see separate manual for particle filter.

Code	Description	Action
372	Particle filter engine. High pressure. Reduction of engine rpm.	STOP! Clean particle filter. See section 5.4.9 <i>Stopping machine - parking</i> or see separate manual for particle filter.
380	Error, accelerator pedal (Left Front). Reduction of engine rpm.	STOP!
381	Error, accelerator pedal (Right Front). Reduction of engine rpm.	STOP!
382	Error, accelerator pedal LR (Left Rear). Reduction of engine rpm.	STOP!
383	Error, accelerator pedal RR (Right Rear). Reduction of engine rpm.	STOP!
384	Error, servo motor for injector pump engine. Reduction of engine rpm.	STOP!
390	Error on valve for variable pump for Optimum speed/Optimum rev, short-circuit or open circuit at terminal.	WARNING!
400	Reversible driver's seat. Defective sensor. Only forward operation is possible.	WARNING! Stop the machine. Turn the driver's seat to position for forward operation. Contact service.
401	Overload lift and tilt. Reduction of speed.	WARNING!
402	Parking brake error. The parking brake cannot be released.	STOP!
404	Defective coolant level sensor.	WARNING!
405	Defective position sensor for seat reversing. Limitation of function.	WARNING!
406	Signal error from power cell stub axle or tilt cylinder Overload protection does not work.	WARNING!

Error codes control unit ECU 796

Table 3. Error codes ECU 796

Code	Description	Action
601	Voltage feed error, ECU 796.	STOP!
602	Memory error, check sum ECU 796.	STOP! Restart ECU 796 by switching the ignition off and on, load the program. Contact service if the fault remains.
603	Reference voltage 10 V error, ECU 796.	STOP!
604	Voltage feed error PWM outputs, ECU 796. Hydraulics not functioning.	INFORMATION! Turn off the hydraulic functions. For electric servo, check if the breaker switch for load handling is pressed down.
605	Communication error XA-PWM, K2. Hydraulic functions not functioning.	INFORMATION! Restart ECU 796 by switching the ignition on and off. Contact service if the fault remains.

Code	Description	Action
606	Communication error XA-PWM, K3. Hydraulic functions not functioning.	INFORMATION! Restart ECU 796 by switching the ignition on and off. Contact service if the fault remains.
610	Input signal from lever for hydraulic function 1 error. Hydraulic function 1 not functioning.	INFORMATION! Do not use hydraulic function 1.
611	Input signal from lever for hydraulic function 2 error. Hydraulic function 2 not functioning.	INFORMATION! Do not use hydraulic function 2.
612	Input signal from lever for hydraulic function 3 error. Hydraulic function 3 not functioning.	INFORMATION! Do not use hydraulic function 3.
613	Input signal from lever for hydraulic function 4 error. Hydraulic function 4 not functioning.	INFORMATION! Do not use hydraulic function 4.
614	Input signal from lever for hydraulic function 5 error. Hydraulic function 5 not functioning.	INFORMATION! Do not use hydraulic function 5.
615	Short-circuit or open-circuit for steering valve hydraulic function 1A at terminal K2:3. Hydraulic function 1 not functioning.	INFORMATION! Do not use hydraulic function 1.
616	Short-circuit or open-circuit for steering valve hydraulic function 1B at terminal K2:4. Hydraulic function 1 not functioning.	INFORMATION! Do not use hydraulic function 1.
617	Short-circuit or open-circuit for steering valve hydraulic function 2A at terminal K2:5. Hydraulic function 2 not functioning.	INFORMATION! Do not use hydraulic function 2.
618	Short-circuit or open-circuit for steering valve hydraulic function 2B at terminal K2:6. Hydraulic function 2 not functioning.	INFORMATION! Do not use hydraulic function 2.
619	Short-circuit or open-circuit for steering valve hydraulic function 3A at terminal K2:7. Hydraulic function 3 not functioning.	INFORMATION! Do not use hydraulic function 3.
620	Short-circuit or open-circuit for steering valve hydraulic function 3B at terminal K2:8. Hydraulic function 3 not functioning.	INFORMATION! Do not use hydraulic function 3.
621	Short-circuit or open-circuit for steering valve hydraulic function 4A at terminal K2:11. Hydraulic function 4 not functioning.	INFORMATION! Do not use hydraulic function 4.
622	Short-circuit or open-circuit for steering valve hydraulic function 4B at terminal K2:12. Hydraulic function 4 not functioning.	INFORMATION! Do not use hydraulic function 4.
623	Short-circuit or open-circuit for steering valve hydraulic function 5A at terminal K2:13. Hydraulic function 5 not functioning.	INFORMATION! Do not use hydraulic function 5.
624	Short-circuit or open-circuit for steering valve hydraulic function 5B at terminal K2:14. Hydraulic function 5 not functioning.	INFORMATION! Do not use hydraulic function 5.
626	Sensor error for vertical hold. Vertical hold not functioning.	INFORMATION: Turn off vertical hold.
627	Sensor error for pre-selected lift height. Lifting height pre-selection not functioning.	INFORMATION! Switch off lifting height pre-selection.
628	CTX communication error. Clamping control not responding. Only manual clamping function possible.	WARNING! CTX clamping unit not functioning. Select manual clamping control.

Code	Description	Action
630	Defective pressure sensor P1, Clamping attachment. The selected attachment pressure is approximate. WARNING! No automatic pressure increase if the attachment pressure drops.	WARNING! No automatic pressure increase if the attachment pressure drops.
631	Defective pressure sensor P2, Clamping attachment. The selected attachment pressure is approximate. WARNING! No automatic pressure increase if the attachment pressure drops.	WARNING! No automatic pressure increase if the attachment pressure drops. Contact service.
632	Short-circuit or open circuit in hydraulic function steering valve at terminal K3:3. Hydraulic function clamping attachment not working.	WARNING! Do not use hydraulic function clamping attachment.
633	Short-circuit or open circuit for steering valve attachment pressure ON/OFF. Hydraulic function clamping attachment not working.	WARNING! Do not use hydraulic function clamping attachment.
634	Short-circuit or open circuit for steering valve left arm ON/OFF. Hydraulic function left arm not working.	WARNING! Do not use hydraulic function left arm.
635	Short-circuit or open circuit for steering valve right arm ON/OFF. Hydraulic function right arm not working.	WARNING! Do not use hydraulic function right arm.
636	Short-circuit or open circuit for steering valve upper left arm ON/OFF. Hydraulic function upper left arm not working.	WARNING! Do not use hydraulic function upper left arm.
637	Short-circuit or open circuit for steering valve middle right arm ON/OFF. Hydraulic function middle right arm not working.	WARNING! Do not use hydraulic function right arm.
638	Short-circuit or open circuit for steering valve middle left arm ON/OFF. Hydraulic function middle left arm not working.	WARNING! Do not use hydraulic function left arm.
639	Short-circuit or open circuit for steering valve upper right arm ON/OFF. Hydraulic function upper right arm not working.	WARNING! Do not use hydraulic function upper right arm.
642	Pressure sensor clamping attachment opening, defective. Hydraulic function clamping attachment not working.	WARNING! Do not use hydraulic function clamping attachment.
643	Pressure sensor clamping attachment closing, defective. Hydraulic function clamping attachment not working.	WARNING! Do not use hydraulic function clamping attachment.
644	Breaker right/left arm defective. Do not use shut-off right/left arm.	WARNING! Shut-off right/left arm not working.
645	Max. load exceeded. Max. speed 1 km/h.	WARNING! Lower the load.
646	Upper left by-pass valve on clamping attachment not working. Hydraulic function clamping attachment left-hand side not working.	WARNING!
647	Middle left by-pass valve on clamping attachment not working. Hydraulic function clamping attachment left-hand side not working.	WARNING!
648	Left sequence valve on clamping attachment not working. Hydraulic function clamping attachment left-hand side not working.	WARNING!
650	Upper right by-pass valve on clamping attachment not working. Hydraulic function clamping attachment right-hand side not working.	WARNING!
651	Middle right by-pass valve on clamping attachment not working. Hydraulic function clamping attachment right-hand side not working.	WARNING!
652	Right sequence valve on clamping attachment not working. Hydraulic function clamping attachment right-hand side not working.	WARNING!

Code	Description	Action
654	Pressure sensor P3 left long arm on clamping attachment defective. Hydraulic function clamping attachment left-hand side not working.	WARNING!
655	Pressure sensor P3 left short arm on clamping attachment defective. Hydraulic function clamping attachment left-hand side not working.	WARNING!
656	Pressure sensor P3 right long arm on clamping attachment defective. Hydraulic function clamping attachment right-hand side not working.	WARNING!
657	Pressure sensor P3 right short arm on clamping attachment defective. Hydraulic function clamping attachment right-hand side not working.	WARNING!
658	Fault in switch for selecting clamping pressure. Clamping pressure one is selected.	WARNING!
659	Pressure sensor P1 left arm on clamping attachment defective. No automatic increment of the clamping pressure.	WARNING!
660	Pressure sensor P2 left arm on clamping attachment defective. No automatic increment of the clamping pressure.	WARNING!
661	Pressure sensor P1 right arm on clamping attachment defective. No automatic increment of the clamping pressure.	WARNING!
662	Pressure sensor P3 right arm on clamping attachment defective. No automatic increment of the clamping pressure.	WARNING!
900	Error code from control unit transmission.	WARNING! See <i>Error codes transmission page 130</i> .
1200	Error code from control unit engine.	WARNING! See <i>Error codes engine page 118</i> .

Error codes control unit ECU 792

Table 4. Error codes ECU 792


Code	Description	Action
1501	Sensor error, steering with feedback. Alternative steering switches off automatically.	STOP! Use standard steering.
1502	Joystick error. Alternative steering switches off automatically.	STOP! Use standard steering.
1503	Mini-wheel potentiometer error. Alternative steering switches off automatically.	STOP! Use standard steering.
1504	Short-circuit or open circuit, output signal for right steering valve. Alternative steering switches off automatically.	STOP! Use standard steering.
1505	Short-circuit or open circuit on output signal for left steering valve. Alternative steering switches off automatically.	STOP! Use standard steering.
1506	Power supply error, ECU 792. Reduction of engine rpm.	STOP! Check fuses according to the Operator's manual. Contact service if the fault remains.
1507	Reference voltage error 5V, ECU 792. Reduction of engine rpm.	STOP!


Error codes engine

Use the SPN/FMI code when contacting the engine suppliers.

- Display shows error code according to SAE J1939
SPN/FMI
- J1587 indicates error codes according to SAE J1587 (at Volvo: Vodia).
PID or SID / FMI (P indicates PID, S indicates SID).

Table 5. Error codes Volvo TAD650VE and TAD750VE

		Description	Action
SPN/FMI	J1587		
94	PID 94	Fuel pressure sensor short circuited to positive (+) / minus (-) or open circuit or feed pressure too low.	WARNING!
97	PID 97	Water in fuel or short-circuit, open circuit, error in indicator.	WARNING! Drain fuel pre-filter
100	PID 100	Oil pressure sensor short circuited to positive (+) / minus (-) or open circuit or oil pressure too low.	WARNING! Check the oil level
102	PID 102	Boost pressure sensor short circuited to positive (+) / minus (-) or open circuit. Alternatively for high boost pressure	WARNING!
105	PID 105	Charge air temperature sensor short circuited to positive (+) / minus (-) or open circuit or coolant temperature too high.	WARNING! Check the coolant level
106	PID 106	Boost pressure sensor short circuited to positive (+) / minus (-) or open circuit. Alternatively for high boost pressure	WARNING!
	PID 107	Air filter sensor short circuited to positive (+) / minus (-) or open circuit.	WARNING!
110	PID 110	Coolant temperature sensor short circuited to positive (+) / minus (-) or open circuit or coolant temperature too high.	WARNING! Check the coolant level
111	PID 111	Low coolant level	STOP! Check the coolant level and the coolant level warning function.
111	PID 111	Coolant sensor short circuited to positive (+) or fault in sensor.	WARNING!
158	PID 158	Battery voltage EMS, fault in the alternator, battery or battery cables alternatively battery voltage EMS, short-circuited to minus (-) or fault in the alternator, battery or battery cables	WARNING!

		Description	Action
SPN/FMI	J1587		
164	PID 164	Injection pressure, fault in the fuel supply or in the fuel pump alternatively fault in the cable harnesses or sensor.	WARNING! Check fuel filter
172	PID 172	Air temperature sensor, inlet, short circuited to minus (-) or open circuit.	WARNING!
190	PID 190	Engine speed too high	WARNING!
626	PID 45	Preheating relay short circuited to positive (+) / minus (-) or open circuit.	WARNING!
629	SID 254	Fault in control unit, CIU. Fault in the EEPROM, CIU or flash memory, CIU or fault in the CIU control unit alternatively internal fault in the EMS control unit.	WARNING!
636	SID 21	RPM sensor, cam wheel, no signal, abnormal frequency or fault in the sensor.	WARNING!
637	SID 21	RPM sensor, flywheel, no or intermittent signal from the sensor, abnormal frequency or fault in the sensor.	WARNING!
639	SID 231	Fault in data link (CAN), CIU	WARNING!
639	SID 240	Memory fault in EMS, memory fault in the EMS engine control module:	WARNING!
639 2017	PSID 231	Data link (CAN), EMS 2, internal fault in the control module.	WARNING!
651	SID 1	Injector cylinder #1, electrical fault or alternatively fault in the compression or injector.	WARNING!
652	SID 2	Injector cylinder #2, electrical fault or alternatively fault in the compression or injector.	WARNING!
653	SID 3	Injector cylinder #3, electrical fault or alternatively fault in the compression or injector.	WARNING!
654	SID 4	Injector cylinder #4, electrical fault or alternatively fault in the compression or injector.	WARNING!
655	SID 5	Injector cylinder #5, electrical fault or alternatively fault in the compression or injector.	WARNING!
656	SID 6	Injector cylinder #6, electrical fault or alternatively fault in the compression or injector.	WARNING!
677	SID 39 PPID 3	Start output/Starter motor relay short circuited to positive (+) / minus (-) or activated too long.	WARNING!
679	SID 42	Injection pressure, regulator, fault in the cable harnesses or in the actuator.	WARNING!






		Description	Action
SPN/FMI	J1587		
679	PSID 97	Pressure valve, leakage in PRV (pressure release valve) or PRV has jammed in open/closed position.	WARNING!
729	SID 70	Preheating sensor, fault in the cable harnesses or in preheating relay.	WARNING!
970	PPID 6	Start input CIU, short circuited to minus (-), open circuit or activated too long.	WARNING!
1239	PSID 96	Pressure in fuel rail, leakage in high pressure fuel system or in high pressure pipe to injector.	WARNING!
2791	PPID 19	Internal EGR, fault in cable harnesses (boost pressure sensor) or mechanical fault in IEGR.	WARNING!
520195	PPID 6	Stop input EMS, short circuited to minus (-) or open circuit.	WARNING!


Table 6. Error codes Cummins QSB6.7


		Description	Action
SPN/FMI			
84 / 10		Circuit sensor, engine speed – Abnormally large variations	WARNING!
84 / 2		Sensor circuit, engine speed - Incorrect, uneven or jerky.	WARNING!
91 / 0		Position sensor accelerator pedal - Abnormal frequency, pulse width or period time.	WARNING!
91 / 1		Position sensor accelerator pedal - Abnormal frequency, pulse width or period time.	WARNING!
91 / 19		SAE J1939 multiplexing, system error accelerator sensor - CAN bus data error.	WARNING!
91 / 2		Position sensor accelerator pedal	WARNING!
91 / 3		Position sensor accelerator pedal, circuit fault- Abnormally high voltage or short circuit to higher voltage.	WARNING!
91 / 4		Position sensor accelerator pedal, circuit fault - Abnormally low voltage or short-circuit to higher voltage.	WARNING!
94 / 1		Fuel pump feed pressure fault - Data applicable, but below normal operating range.	WARNING!
94 / 18		Fuel pump feed pressure fault - Data applicable, but below normal operating range.	WARNING!
94 / 2		Fuel pressure sensor - Incorrect, uneven or jerky.	WARNING!

	Description	Action
SPN/FMI		
97 / 15	Water in fuel, indicator high - Data applicable, but above normal operating range.	WARNING!
97 / 3	Sensor circuit water in fuel- Abnormally high voltage or short-circuit to higher voltage.	WARNING!
97 / 4	Sensor circuit water in fuel- Abnormally low voltage or short-circuit to lower voltage.	WARNING!
100 / 1	Engine oil pressure low - Data applicable, but above normal operating range.	STOP! Very serious!
100 / 18	Engine oil pressure low - Data applicable, but below normal operating range.	WARNING!
100 / 2	Pressure sensor engine oil, circuit error - Incorrect, uneven or jerky.	WARNING!
100 / 3	Pressure sensor, engine oil, circuit fault- Abnormally high voltage or short-circuit to higher voltage.	WARNING!
100 / 4	Pressure sensor, engine oil, circuit fault - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
102 / 2	Pressure sensor circuit inlet manifold - Incorrect, uneven or jerky	WARNING!
102 / 3	Pressure sensor inlet manifold - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
102 / 4	Pressure sensor inlet manifold - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
103 / 10	Turbo speed – Abnormally large variations.	WARNING!
103 / 16	Turbo #1 high speed - Data applicable, but above normal operating range.	WARNING!
103 / 18	Turbo #1 low speed - Data applicable, but below normal operating range.	WARNING!
105 / 0	Circuit temperature sensor inlet manifold - Data applicable, but above normal operating range.	STOP! Very serious!
105 / 15	Temperature inlet manifold high - Data applicable, but above normal operating range.	WARNING!
105 / 3	Temperature sensor inlet manifold - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
105 / 4	Temperature sensor inlet manifold - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
108 / 2	Air pressure sensor - Incorrect, uneven or jerky.	WARNING!
108 / 3	Sensor air pressure - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
108 / 4	Sensor air pressure - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
110 / 0	Engine coolant temperature high - Data applicable, but above normal operating range.	STOP! Very serious!
110 / 15	Engine coolant temperature high - Data applicable, but above normal operating range.	WARNING!

 SPN/FMI	Description	Action
110 / 16	Engine coolant temperature high - Data applicable, but above normal operating range.	WARNING!
110 / 2	Engine coolant sensor, circuit error. - Incorrect, uneven or jerky.	WARNING!
110 / 3	Sensor coolant engine, circuit fault- Abnormally high voltage or short-circuit to higher voltage.	WARNING!
110 / 4	Sensor coolant engine, circuit fault- Abnormally low voltage or short-circuit to lower voltage.	WARNING!
111 / 1	Coolant level engine low - Data applicable, but below normal operating range.	STOP! Very serious!
111 / 3	Level sensor coolant circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
111 / 4	Level sensor coolant circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
157 / 0	Fuel pressure high - Data applicable, but above normal operating range.	WARNING!
157 / 16	Measurement injection pressure bank 1, high pressure - Data applicable, but above normal operating range.	WARNING!
157 / 18	Measurement injection pressure bank 1, low pressure - Data applicable, but above normal operating range.	WARNING!
157 / 2	Fuel pressure sensor error - Incorrect, uneven or jerky.	WARNING!
157 / 3	Measuring injection pressure bank 1, circuit fault- Abnormally high voltage or short-circuit to higher voltage.	WARNING!
157 / 4	Measuring injection pressure bank 1, circuit fault - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
167 / 1	Generator low voltage - Data applicable, but below normal operating range.	STOP! Very serious!
167 / 16	Generator high voltage - Data applicable, but above normal operating range.	WARNING!
167 / 18	Generator low voltage - Data applicable, but below normal operating range.	WARNING!
168 / 16	Battery #1 voltage high - Data applicable, but above normal operating range.	WARNING!
168 / 18	Battery #1 voltage low - Data applicable, but below normal operating range.	WARNING!
171 / 3	Ambient temperature sensor, circuit fault- Abnormally high voltage or short-circuit to higher voltage.	WARNING!
171 / 4	Ambient temperature sensor, circuit fault - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
190 / 0	Engine over-revs - Data applicable, but above normal operating range.	STOP! Very serious!
190 / 2	Main Rpm sensor fault - incorrect, uneven or jerky.	WARNING!
190 / 2	Rpm/position sensor - Incorrect, uneven or jerky.	WARNING!

	Description	Action
SPN/FMI		
251 / 2	Real-time clock, power supply interruption - Incorrect, uneven or jerky.	WARNING!
441 / 3	Reserve temperature sensor circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
441 / 4	Reserve temperature sensor circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
558 / 13	Idle validation circuit accelerator pedal- Values outside calibration values.	WARNING!
558 / 2	Idle validation circuit accelerator pedal - Incorrect, uneven or jerky.	WARNING!
558 / 4	Idle validation circuit accelerator pedal - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
611 / 2	Power take-off switch - Incorrect, uneven or jerky.	WARNING!
611 / 3	Power supply no. 4, sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
611 / 4	Power supply no. 3, sensor - Abnormally low voltage or short circuit to lower voltage.	WARNING!
611 / 4	Power supply no. 4, sensor - Abnormally low voltage or short circuit to lower voltage.	WARNING!
612 / 2	The engine speed and position sensor circuit has lost the input signals from the magnetic sensor - Incorrect, uneven or jerky.	WARNING!
627 / 2	Power supply interrupted despite ignition in ON position - Incorrect, uneven or jerky.	WARNING!
627 / 2	Power supply interrupted despite ignition in ON position - Incorrect, uneven or jerky.	WARNING!
629 / 12	Engine control module internal fault – Defective unit or component.	WARNING!
629 / 12	Power supply injectors – Defective unit or component.	WARNING!
630 / 2	Engine control module, memory error. - Incorrect, uneven or jerky.	WARNING!
630 / 31	Engine control module, RAM memory error – Not available	WARNING!
633 / 31	Fuel valve, circuit fault – Not available	WARNING!
639 / 13	SAE J1939 multiplexing configuration error – Values outside calibration values.	WARNING!
639 / 9	SAE J1939 multiplexing PGN time limitation exceeded – Abnormal update speed.	WARNING!
641 / 3	Variable Turbo Geometry valve circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
641 / 4	Variable Turbo Geometry valve circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
644 / 2	External speed sensor input - Incorrect, uneven or jerky.	WARNING!

 SPN/FMI	Description	Action
647 / 3	Circuit fault switch cooling fan - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
647 / 4	Circuit fault switch cooling fan - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
651 / 5	Injector solenoid cylinder # 1 circuit - Abnormally low current or open circuit.	WARNING!
651 / 7	Injector cylinder #1 – Incorrect reply from mechanical system.	WARNING!
652 / 5	Injector solenoid cylinder # 2 circuit - Abnormally low current or open circuit.	WARNING!
652 / 7	Injector cylinder #2 – Incorrect reply from mechanical system.	WARNING!
653 / 5	Injector solenoid cylinder # 3 circuit - Abnormally low current or open circuit.	WARNING!
653 / 7	Injector cylinder #3 – Incorrect reply from mechanical system.	WARNING!
654 / 5	Injector solenoid cylinder # 4 circuit - Abnormally low current or open circuit.	WARNING!
654 / 7	Injector cylinder #4 – Incorrect reply from mechanical system.	WARNING!
655 / 5	Injector solenoid cylinder # 5 circuit - Abnormally low current or open circuit.	WARNING!
655 / 7	Injector cylinder #5 – Incorrect reply from mechanical system.	WARNING!
656 / 5	Injector solenoid cylinder # 6 circuit - Abnormally low current or open circuit.	WARNING!
656 / 7	Injector cylinder #6 – Incorrect reply from mechanical system.	WARNING!
677 / 3	Starter relay circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
677 / 4	Starter relay circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
697 / 3	External PWM driver circuit 1 - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
697 / 4	External PWM driver circuit 1 - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
703 / 11	Sensor secondary equipment input #3 (OEM) – Unidentifiable fault.	WARNING!
723 / 2	Engine rpm/position camshaft synchronizing fault - Incorrect, uneven or jerky	WARNING!
723 / 2	Engine rpm sensor (camshaft) fault – Incorrect, uneven or jerky	WARNING!
723 / 2	Engine rpm/position sensor - Incorrect, uneven or jerky.	WARNING!
723 / 7	Engine speed (rpm) sensor incorrectly set mechanically between camshaft and crankshaft – Incorrect reply from mechanical system.	WARNING!
729 / 3	Air preheating element circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
729 / 4	Air preheating element circuit - Abnormally low voltage or short circuit to lower voltage.	WARNING!

	Description	Action
SPN/FMI		
974 / 19	SAE J1939 multiplexing, value error remote accelerator sensor – Received data incorrect.	WARNING!
974 / 3	Position sensor accelerator pedal, circuit fault- Abnormally high voltage or short circuit to higher voltage.	WARNING!
974 / 4	Position sensor accelerator pedal, circuit fault - Abnormally low voltage or short-circuit to higher voltage.	WARNING!
1043 / 3	Power supply circuit accelerator pedal or lever - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1043 / 4	Sensor power supply circuit engine rpm/position sensor - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
1043 / 4	Power supply circuit accelerator pedal or lever - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
1072 / 3	Signal engine brake circuit #1 - Abnormally high voltage or short circuit to higher voltage.	WARNING!
1072 / 4	Signal engine brake circuit #1 - Abnormally low voltage or short circuit to lower voltage.	WARNING!
1073 / 3	Signal engine brake circuit #2 - Abnormally high voltage or short circuit to higher voltage.	WARNING!
1073 / 4	Signal engine brake circuit #2 - Abnormally low voltage or short circuit to lower voltage.	WARNING!
1075 / 3	Fuel suction pump circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1075 / 4	Fuel suction pump circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
1079 / 3	Sensor power supply circuit #1 - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1079 / 4	Sensor power supply circuit #1 - Abnormally low voltage or short circuit to lower voltage.	WARNING!
1080 / 3	Sensor power supply circuit #2 - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1080 / 4	Sensor power supply circuit #2 - Abnormally low voltage or short circuit to lower voltage.	WARNING!
1172 / 3	Turbocharger temperature sensor circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1172 / 4	Turbocharger temperature sensor circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!






	Description	Action
SPN/FMI		
1347 / 3	High pressure fuel valve circuit - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1347 / 4	High pressure fuel valve circuit - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
1347 / 7	Fuel pump – Incorrect reply from mechanical system.	WARNING!
1347 / 7	High pressure fuel valve no. 1 – Incorrect reply from mechanical system.	WARNING!
1377 / 2	Switch circuit multiple synchronising unit - Incorrect, uneven or jerky.	WARNING!
1378 / 31	Change oil and oil filter, conditions exist – Not available	WARNING! Service.
1388 / 3	External pressure sensor input - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
1388 / 4	External pressure sensor input - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
2623 / 3		WARNING!
2623 / 4		WARNING!
2629 / 15	Boost pressure temperature output calculated - Data applicable, but above normal operating range.	WARNING!
2789 / 15	Boost pressure temperature input calculated - Data applicable, but above normal operating range.	WARNING!


Table 7. Error codes Caterpillar C6.6

	Description	Action
SPN/FMI		
91/02	Secondary position sensor accelerator pedal - Incorrect, uneven or jerky.	WARNING!
91/03	Secondary position sensor accelerator pedal - Abnormally high voltage or short circuit to higher voltage.	WARNING!
91/04	Secondary position sensor accelerator pedal - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
91/08	Secondary position sensor accelerator pedal – Abnormal frequency	WARNING!
91/02	Position sensor accelerator pedal - Incorrect, uneven or jerky.	WARNING!
91/03	Position sensor accelerator pedal - Abnormally high voltage or short circuit to higher voltage.	WARNING!

 SPN/FMI	Description	Action
91/04	Position sensor accelerator pedal - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
91/08	Position sensor accelerator pedal – Abnormal frequency	WARNING!
91/12	Position sensor accelerator pedal – Defective unit or component.	WARNING!
91/12	Secondary position sensor accelerator pedal – Defective unit or component.	WARNING!
100/01	Low engine oil pressure.	STOP!
100/03	Engine oil pressure sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
100/04	Engine oil pressure sensor - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
100/10	Engine oil pressure sensor – Abnormally large variations.	WARNING!
100/17	Low engine oil pressure.	WARNING! Check the oil level in the engine, see <i>6.2.6 Engine oil</i>
100/18	Low engine oil pressure.	WARNING! Check the oil level in the engine, see <i>6.2.6 Engine oil</i>
102/10	Pressure sensor inlet manifold – Abnormally large variations	WARNING!
102/16	Pressure sensor inlet manifold - High inlet pressure.	WARNING!
102/18	Pressure sensor inlet manifold - Low inlet pressure.	WARNING!
105/03	Temperature sensor inlet manifold - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
105/04	Temperature sensor inlet manifold - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
105/15	High temperature inlet manifold.	WARNING!
105/16	High temperature inlet manifold.	WARNING!
106/03	Pressure sensor inlet manifold - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
106/04	Pressure sensor inlet manifold - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
106/10	Pressure sensor circuit inlet manifold – Inlet pressure sensor 5V Power supply open circuit.	WARNING!
107/15	Clogged air filter.	WARNING!

	Description	Action
SPN/FMI		
110/00	High coolant temperature engine.	STOP! Check the coolant level, see 6.2.5 <i>Cooling system</i> .
110/03	Sensor coolant engine - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
110/04	Sensor coolant engine - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
110/15	High coolant temperature engine.	WARNING! Check the coolant level, see 6.2.5 <i>Cooling system</i> .
110/16	High coolant temperature engine.	WARNING! Check the coolant level, see 6.2.5 <i>Cooling system</i> .
157/16	High pressure high pressure pipe.	WARNING!
157/18	Low pressure high pressure pipe.	WARNING!
157/03	Fuel rail pressure sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
157/04	Fuel rail pressure sensor - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
158/02	Ignition switch - Incorrect, uneven or jerky.	WARNING!
168/00	Engine control module- Battery voltage too high.	WARNING!
168/01	Engine control module- Battery voltage too low.	WARNING!
168/02	Engine control module, - Incorrect, uneven or jerky.	WARNING!
190/08	Engine speed – Abnormal frequency.	WARNING!
190/15	Engine speed - Engine overspeed	WARNING!
558/2	Position sensor accelerator pedal - Incorrect, uneven or jerky.	WARNING!
558/2	Secondary position sensor accelerator pedal - Incorrect, uneven or jerky.	WARNING!
630/02	Parameter error - Incorrect, uneven or jerky.	WARNING!
631/02	Engine software - Incorrect, uneven or jerky.	WARNING!
637/11	Primary/Secondary speed signal - Error cannot be identified	WARNING!
637/13	Primary/Secondary speed signal - Calibration necessary.	WARNING!
639/9	J1939 CAN buss error. Abnormal updating speed.	WARNING!
646/05	Turbo pressure release valve - Low current.	WARNING!
646/06	Turbo pressure release valve - High current.	WARNING!
651/02	Cylinder #1 Injector - Incorrect, uneven or jerky.	WARNING!


	Description	Action
SPN/FMI		
651/05	Injector cylinder #1 – Injector low current.	WARNING!
651/06	Injector cylinder #1 – Injector high current.	WARNING!
651/07	Injector cylinder #1 – Incorrect reply from mechanical system.	WARNING!
652/02	Cylinder #2 Injector - Incorrect, uneven or jerky.	WARNING!
652/05	Injector cylinder #2 – Injector low current.	WARNING!
652/06	Injector cylinder #2 – Injector high current.	WARNING!
652/07	Injector cylinder #2 – Incorrect reply from mechanical system.	WARNING!
653/02	Cylinder #3 Injector - Incorrect, uneven or jerky.	WARNING!
653/05	Injector cylinder #3 – Injector low current.	WARNING!
653/06	Injector cylinder #3 – Injector high current.	WARNING!
653/07	Injector cylinder #3 – Incorrect reply from mechanical system.	WARNING!
654/02	Cylinder #4 Injector - Incorrect, uneven or jerky.	WARNING!
654/05	Injector cylinder #4 – Injector low current.	WARNING!
654/06	Injector cylinder #4 – Injector high current.	WARNING!
654/07	Injector cylinder #4 – Incorrect reply from mechanical system.	WARNING!
655/02	Cylinder #5 Injector - Incorrect, uneven or jerky.	WARNING!
655/05	Injector cylinder #5 – Injector low current.	WARNING!
655/06	Injector cylinder #5 – Injector high current.	WARNING!
655/07	Injector cylinder #5 – Incorrect reply from mechanical system.	WARNING!
656/02	Cylinder #6 Injector - Incorrect, uneven or jerky.	WARNING!
656/05	Injector cylinder #6 – Injector low current.	WARNING!
656/06	Injector cylinder #6 – Injector high current.	WARNING!
656/07	Injector cylinder #6 – Incorrect reply from mechanical system.	WARNING!
676/05	Relay preheating element - Low current.	WARNING!
676/06	Relay preheating element - High current.	WARNING!
678/03	8V Power supply, control module ECU794 - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
678/04	8V Power supply, control module ECU794 - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
723/08	Secondary speed sensor – Abnormal frequency.	WARNING!
1079/03	5V power supply - Abnormally high voltage or short-circuit to higher voltage.	WARNING!


	Description	Action
SPN/FMI		
1079/04	5V power supply - Abnormally low voltage or short circuit to lower voltage.	WARNING!
1188/07	Turbo pressure release valve – Incorrect reply from mechanical system.	WARNING!
1347/05	High pressure pump – Injector low current.	WARNING!
1347/06	High pressure pump – Injector high current.	WARNING!
1347/07	High pressure pump – Incorrect reply from mechanical system.	WARNING!
2789/15	High exhaust temperature.	WARNING!


Error codes transmission


Error codes from control unit ECU 793 for the transmission have general error code level “WARNING”, but fault codes from the transmission can indicate another error code level according to the action column in table 9 below.


Table 8. Error codes Dana TE13000 and TE17000


	Description	Action
Code		
00.50	Memory problem internal in CPU. Transmission in locked neutral position (“shut down”).	STOP!
00.51	Memory problem internal in CPU. Transmission in locked neutral position (“shut down”).	STOP!
00.52	Memory problem external to CPU. Transmission in locked neutral position (“shut down”).	STOP!
00.53	Problem with flash memory. Transmission in locked neutral position (“shut down”).	STOP!
20.60	“Pressure feedback” signal. Indicates low oil pressure when there should be pressure. Transmission in locked neutral position (“shut down”).	STOP!
20.61	“Pressure feedback” signal. Indicates normal oil pressure when there should be no pressure. Transmission in locked neutral position (“shut down”).	STOP!
30.04	Battery voltage too low.	STOP!
30.05	Battery voltage too high.	WARNING!
31.00	Voltage supply to sensor: Vsense (8V) not within approved range -> too low.	WARNING!


 Code	Description	Action
31.01	Voltage supply to sensor: Vsense (8V) not within approved range -> too high.	WARNING!
40.06	Incorrect direction from gear selector. Transmission in neutral position.	WARNING!
40.08	The direction of the driver's seat was changed when: the Parking brake was not activated, and/or the gear selector was not in neutral position and /or the machine was not stationary. Transmission in neutral position.	INFORMATION! Stop the machine, move the gear selector to neutral position and activate the parking brake until the fault disappears.
41.06	Incorrect gear selection from gear selector. The control unit does not permit changing shift range, the machine can be operated however.	WARNING!
42.04	Actual gear ratio too low. One or more clutches slips.	STOP! or WARNING!
42.05	Actual gear ratio too high. One or more clutches slips.	STOP! or WARNING!
43.03	The torque converter's temperature is outside the temperature sensor's range.	WARNING!
43.07	Torque converter's temperature above 100 °C.	WARNING! Note the error, stop and allow the temperature in the torque converter to fall or try to reduce the temperature by smoother driving.
43.08	Torque converter's temperature above 125 °C. The control unit protects the transmission and does not allow the temperature in the torque converter to exceed the parameter. Transmission in neutral position, and if the engine is also checked the engine power is reduced to 50%.	WARNING! Stop the machine, select neutral and accelerate fully (limited to 50 %) in order to cool the transmission oil so that the temperature falls below 100 °C (error code 43.03 disappears). When the temperature in the torque converter is below 100 °C, start operating the machine again.
44.10	No EEC2 message from the engine control unit in time. Position accelerator pedal, message from engine control unit.	WARNING!
45.06	Incorrect logic from digital inputs to speed limiting. Control unit reduces the power to reduced speed.	INFORMATION!
50.00	Analogue input 0 (lead A11) related error: analogue input short-circuited to ground. Control unit transmission activates "limp home".	STOP!
50.01	Analogue input 0 (lead A11) related error: analogue input is not connected. Control unit transmission activates "limp home".	STOP!


	Description	Action
Code		
51.00	Analogue input 1 (lead A28) related error: analogue input short-circuited to ground. The control unit limits the monitoring of the transmission temperature to the lowest of the set values, this results in poor temperature compensation.	WARNING!
51.01	Analogue input 1 (lead A28) related error: analogue input is not connected. The control unit limits the monitoring of the transmission temperature to the lowest of the set values, this results in poor temperature compensation.	WARNING!
52.00	Analogue input 2 (lead A29) related error: analogue input short-circuited to ground. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
52.01	Analogue input 2 (lead A29) related error: analogue input is not connected. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
53.00	Analogue input 3 (lead B17) related error: analogue input short-circuited to ground. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
53.01	Analogue input 3 (lead B17) related error: analogue input is not connected. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
54.00	Analogue input 4 (lead B02) related error: analogue input short-circuited to ground. The control unit indicates the fault, the control unit uses the analogue input ANI4 as a reference for the current supply to the analogue inputs ANI2, ANI3, ANI5 and ANI6.	WARNING!
54.01	Analogue input 4 (lead B02) related error: analogue input is not connected. The control unit indicates the fault, the control unit uses the analogue input ANI4 as a reference for the current supply to the analogue inputs ANI2, ANI3, ANI5 and ANI6.	WARNING!
55.00	Analogue input 5 (lead B04) related error: analogue input short-circuited to ground. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
55.01	Analogue input 5 (lead B04) related error: analogue input is not connected. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
56.00	Analogue input 6 (lead B06) related error: analogue input short-circuited to ground. The control unit indicates the fault and uses the lowest set value.	INFORMATION!
56.01	Analogue input 6 (lead B06) related error: analogue input is not connected. The control unit indicates the fault and uses the lowest set value.	INFORMATION!

	Description	Action
Code		
60.00	“Drum speed” channel 0 (lead A22) related error: speed channel is short-circuited to ground. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
60.01	“Drum speed” channel 0 (lead A22) related error: speed channel is not connected. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
61.00	“Output speed” channel 1 (lead A24) related error: speed channel is short-circuited to ground. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
61.01	“Output speed” channel 1 (lead A24) related error: speed channel not connected. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
62.00	“Engine speed” channel 2 (lead A26) related error: speed channel is short circuited to ground. If several speed signals or engine speed signals are incorrect the transmission control unit activates “limp home”.	STOP! or WARNING!
62.01	“Engine speed” channel 2 (lead A26) related error: speed channel not connected. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
63.00	“Turbine speed” channel 3 (lead B11) related error: speed channel is short circuited to ground. If several speed signals or engine speed signals are incorrect the transmission control unit activates “limp home”.	STOP! or WARNING!
63.01	“Turbine speed” channel 3 (lead B11) related error: speed channel not connected. If several speed signals or engine speed signals are incorrect, the transmission control unit activates “limp home”.	STOP! or WARNING!
70.00	Analogue output signal 0 (lead A02 and A03) related error: output signal lines twisted, or sensor lead is connected to battery (+), or positive lead short-circuited to ground. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. If not, the opposite travel direction to the original choice must be selected for the transmission to work. Contact service.

	Description	Action
Code		
70.01	Analogue output signal 0 (lead A02 and A03) related error: output signal not connected or short-circuited to battery. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Opposite travel direction than the original choice must be selected for the transmission to work. Contact service.
70.02	Analogue output signal 0 (lead A02 and A03) related error: output signal exceeds 1400 mA. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Opposite travel direction than the original choice must be selected for the transmission to work. Contact service.
70.03	Analogue output signal 0 (lead A02 and A03) related error: current value for output signal is not within approved range. Incorrect impedance. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Opposite travel direction than the original choice must be selected for the transmission to work. Contact service.
71.00	Analogue output signal 1 (lead A04 and A05) related error: output signal lines twisted, or sensor lead is connected to battery (+), or positive lead short-circuited to ground. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Contact service.
71.01	Analogue output signal 1 (lead A04 and A05) related error: output signal not connected or short-circuited to battery. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Contact service.
71.02	Analogue output signal 1 (lead A04 and A05) related error: output signal exceeds 1400 mA. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Contact service.
71.03	Analogue output signal 1 (lead A04 and A05) related error: current value for output signal is not within approved range. Incorrect impedance. Control unit transmission activates "limp home".	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode "Limp Home". Contact service.

	Description	Action
Code		
72.00	Analogue output signal 2 (lead A06 and A07) related error: output signal lines twisted, or sensor lead is connected to battery (+), or positive lead short-circuited to ground. Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. If not, the opposite travel direction to the original choice must be selected for the transmission to work.</p> <p>Contact service.</p>
72.01	Analogue output signal 2 (lead A06 and A07) related error: output signal not connected or short-circuited to battery. Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. If not, the opposite travel direction to the original choice must be selected for the transmission to work.</p> <p>Contact service.</p>
72.02	Analogue output signal 2 (lead A06 and A07) related error: output signal exceeds 1400 mA. Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. If not, the opposite travel direction to the original choice must be selected for the transmission to work.</p> <p>Contact service.</p>
72.03	Analogue output signal 2 (lead A06 and A07) related error: current value for output signal is not within approved range. Incorrect impedance. Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. If not, the opposite travel direction to the original choice must be selected for the transmission to work.</p> <p>Contact service.</p>
73.00	Analogue output signal 3 (lead A08 and A09) related error: output signal lines twisted, or sensor lead is connected to battery (+), or positive lead short-circuited to ground. Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”.</p> <p>Contact service.</p>
73.01	Analogue output signal 3 (lead A08 and A09) related error: output signal not connected or positive lead connected to battery (+). Control unit transmission activates “limp home”.	<p>STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”.</p> <p>Contact service.</p>

	Description	Action
Code		
73.02	Analogue output signal 3 (lead A08 and A09) related error: output signal exceeds 1400 mA. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
73.03	Analogue output signal 3 (lead A08 and A09) related error: current value for output signal is not within approved range. Incorrect impedance. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
74.00	Analogue output signal 4 (lead B01) related error: output signal short-circuited to ground.	WARNING!
74.01	Analogue output signal 4 (lead B01) related error: output signal not connected or short-circuited to battery.	WARNING!
74.02	Analogue output signal 4 (lead B01) related error: output signal exceeds 1400 mA.	WARNING!
74.03	Analogue output signal 4 (lead B01) related error: current value for output signal is not within approved range. Incorrect impedance.	WARNING!
75.00	Analogue output signal 5 (lead B03) related error: output signal short-circuited to ground.	WARNING!
75.01	Analogue output signal 5 (lead B03) related error: output signal not connected or short-circuited to battery.	WARNING!
75.02	Analogue output signal 5 (lead B03) related error: output signal exceeds 1400 mA.	WARNING!
75.03	Analogue output signal 5 (lead B03) related error: current value for output signal is not within approved range. Incorrect impedance.	WARNING!
76.00	Analogue output signal 6 (lead B05) related error: output signal short-circuited to ground.	STOP!
76.01	Analogue output signal 6 (lead B05) related error: output signal not connected or short-circuited to battery.	STOP!
76.02	Analogue output signal 6 (lead B05) related error: output signal exceeds 1400 mA.	STOP!
76.03	Analogue output signal 6 (lead B05) related error: current value for output signal is not within approved range. Incorrect impedance.	STOP!
80.00	Digital output signal 0 (lead A10) related error: output signal short-circuited to ground. Transmission in locked neutral position (“shut down”).	STOP!


	Description	Action
Code		
80.01	Digital output signal 0 (lead A10) related error: output signal not connected or short-circuited to battery. Transmission in locked neutral position (“shut down”).	STOP!
81.00	Digital output signal 1 (lead A15) related error: output signal short-circuited to ground. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
81.01	Digital output signal 1 (lead A15) related error: output signal not connected or short-circuited to battery. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
82.00	Digital output signal 2 (lead A16) related error: output signal short-circuited to ground. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
82.01	Digital output signal 2 (lead A16) related error: output signal not connected or short-circuited to battery. Control unit transmission activates “limp home”.	STOP! Stop the machine, select neutral and then select travel direction reverse. If it works the transmission will work but in mode “Limp Home”. Contact service.
83.00	Digital output signal 3 (lead A20) related error: output signal short-circuited to ground. Transmission in locked neutral position (“shut down”).	STOP!
83.01	Digital output signal 3 (lead A20) related error: output signal not connected or short-circuited to battery. Transmission in locked neutral position (“shut down”).	STOP!
90.xx - 99.xx	System error. Transmission in locked neutral position (“shut down”).	STOP! or INFORMATION!
99.90	Incorrect software is loaded in FLASH memory. Transmission in locked neutral position (“shut down”).	STOP!
99.95	High CAN bus load detected: APC200 cannot handle all incoming messages because of too many CAN messages.	INFORMATION!


¹ Figure in KCS display (position D) or ECU 793.


For serious transmission errors, the control unit uses two modes with reduced functionality to protect the transmission from damage. These are:


- “Limp home”, GPOS / CPOS in display indicates the letters LH.
In this mode the operator can use the transmission’s two first gears in both directions. If the malfunction occurs in a higher gear the operator has to downshift manually to first or second to continue. The control unit uses standard values for modulating clutches.
- “Shut down”, GPOS / CPOS in display indicates the letters Sd.
In this mode the transmission is permanently in neutral as there is no oil pressure to enable gear selection.


Table 9. Error codes ZF 3WG161


		Description	Action
SPN/FMI	ZF code (hex)		
5000/12	11	Logic error on the signal from the gear selector and gear selection 1-2. Transmission locked in neutral (“transmission shut down”).	STOP!
5010/12	12	Logic error on the signal from the gear selector for the selected gear direction forward, neutral or reverse. Transmission in locked neutral position (“transmission shut down”).	STOP!
5020/12	13	Logic error on the signal from the engine’s power limitation system.	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5040/12	15	Logic error on the signal from the extra gear selector for the selected gear direction forward, neutral or reverse. Transmission in locked neutral position (“transmission shut down”) when extra gear selector is used.	WARNING!
5050/12	16	Logic error on the signal from axle connection.	WARNING!
5110/3	25	Signal input for temperature sensor gearbox sump - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5110/4	26	Signal input for temperature sensor gearbox sump - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5120/3	27	Signal input for temperature sensor torque converter’s oil temperature - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5120/4	28	Signal input for temperature sensor torque converter’s oil temperature - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5130/3	29	Signal input for parking brake sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!


		Description	Action
SPN/FMI	ZF code (hex)		
5130/4	2A	Signal input for parking brake sensor - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5135/3	2C	Signal input for DLM control module in cab - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5135/4	2D	Signal input for DLM control module in cab - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5137/3	2E	Signal input for DLM steering angle sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5137/4	2F	Signal input for DLM steering angle sensor - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5313/12	2B	Signal from inching pedal incorrect. Inching not functioning.	WARNING!
5140/3	31	Engine rpm - Abnormally high voltage or short-circuit to higher voltage. Transmission limited according to "Substitute clutch control".	WARNING!
5140/4	32	Engine rpm - Abnormally low voltage or short-circuit to lower voltage. Transmission limited according to "Substitute clutch control".	WARNING!
5140/12	33	Engine rpm - Logic error. Transmission limited according to "Substitute clutch control".	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5150/3	34	Turbine speed - Abnormally high voltage or short-circuit to higher voltage. Transmission limited according to "Substitute clutch control", on output tachometer sensor error, the transmission control unit activates "limp home".	WARNING!
5150/4	35	Turbine speed - Abnormally low voltage or short-circuit to lower voltage. Transmission limited according to "Substitute clutch control", on output tachometer sensor error, the transmission control unit activates "limp home".	WARNING!
5150/12	36	Internal speed - Logic error. Transmission limited according to "Substitute clutch control", on output tachometer sensor error, the transmission control unit activates "limp home".	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5160/3	37	Internal speed - Abnormally high voltage or short-circuit to higher voltage. Transmission limited according to "Substitute clutch control".	WARNING!


		Description	Action
SPN/FMI	ZF code (hex)		
5160/4	38	Internal speed - Abnormally low voltage or short-circuit to lower voltage. Transmission limited according to "Substitute clutch control".	WARNING!
5160/12	39	Internal speed - Logic error. Transmission limited according to "Substitute clutch control".	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5170/3	3A	Output speed - Abnormally high voltage or short-circuit to higher voltage. Transmission limited according to "Substitute clutch control", on turbine speed sensor error the transmission control unit activates "limp home".	WARNING!
5170/4	3B	Output speed - Abnormally low voltage or short-circuit to lower voltage. Transmission limited according to "Substitute clutch control", on turbine speed sensor error the transmission control unit activates "limp home".	WARNING!
5170/12	3C	Output speed - Logic error. Transmission limited according to "Substitute clutch control", on turbine speed sensor error the transmission control unit activates "limp home".	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5180/2	3E	Speed from the propeller shaft does not correspond with other tachometer sensors. Transmission limited according to "Substitute clutch control", on turbine speed sensor error the transmission control unit activates "limp home".	WARNING! Restart ECU 793 by switching the ignition on and off. Contact service if the fault remains.
5260/9	54	Timeout for CAN message DCT1 from the display unit.	WARNING!
5270/9	E5	Timeout for CAN message DISPID1 from the display unit. Control unit transmission activates "limp home".	WARNING!
5390/2	61	AEB calibration signal. CAN signal for start of calibration of clutch plates is incorrect.	WARNING!
5480/3	71	Clutch K1 - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5480/4	72	Clutch K1 - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!

		Description	Action
SPN/FMI	ZF code (hex)		
5480/5	73	Clutch K1 - Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5490/3	74	Clutch K2 - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5490/4	75	Clutch K2 - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5490/5	76	Clutch K2 - Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5500/3	77	Clutch K3 - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5500/4	78	Clutch K3 - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5500/5	79	Clutch K3 - Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5510/3	81	Clutch K4 - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5510/4	82	Clutch K4 - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5510/5	83	Clutch K4 - Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!

		Description	Action
SPN/FMI	ZF code (hex)		
5520/3	84	Clutch KV - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5520/4	85	Clutch KV - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5520/5	86	Clutch KV- Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5530/3	87	Clutch KR - Abnormally high voltage or short-circuit to higher voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5530/4	88	Clutch KR - Abnormally low voltage or short-circuit to lower voltage. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5530/5	89	Clutch KR - Abnormally low current or open circuit. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5535/3	8B	DLM transverse output - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5535/4	8A	DLM transverse output - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5536/3	8E	DLM indicator lamp - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5536/5	8F	DLM indicator lamp - Abnormally low current or open circuit.	WARNING!
5545/3	D8	DLM longitudinal output - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5545/4	D7	DLM longitudinal output - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5560/5	93	Relay reversing alarm - Abnormally low current or open circuit.	WARNING!

		Description	Action
SPN/FMI	ZF code (hex)		
5570/3	95	Relay reversing alarm - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5570/4	94	Relay start interlock - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5570/5	96	Relay start interlock - Abnormally low current or open circuit.	WARNING!
5620/3	A6	Output for warning signal - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5620/4	A4	Output for warning signal - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5620/5	A5	Output for warning signal - Abnormally low current or open circuit.	WARNING!
5660/2	B1	Clutch K1 slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5665/2	B2	Clutch K2 slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5670/2	B3	Clutch K3 slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5675/2	B4	Clutch K4 slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5680/2	B5	Clutch KV slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5685/2	B6	Clutch KR slips. Control unit transmission activates "limp home". With an ongoing error on another gear, the transmission control unit activates "TCU shutdown".	STOP!
5700/0	B7	High oil temperature in the oil sump.	WARNING! Stop and allow the temperature to fall or try to reduce the temperature by smoother driving. Check the oil level in the transmission.
5730/0	BA	Oil filter. Voltage to differential pressure switch outside of permitted limit value.	WARNING! Check the oil filter.
5720/0	B9	Maximum speed engine.	WARNING!

		Description	Action
SPN/FMI	ZF code (hex)		
5745/15	BC	Maximum speed output.	WARNING!
5751/0	C0	Engine torque or output too high.	WARNING!
5752/0	C1	Output transmission torque too high.	WARNING!
5755/15	C2	Input transmission torque too high.	WARNING!
5760/0	C3	High oil temperature in torque converter.	WARNING! Stop and allow the temperature to fall or try to reduce the temperature by smoother driving. Check the oil level in the transmission.
5770/3	C4	Joystick status indicator - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5770/4	C5	Joystick status indicator - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5770/5	C6	Joystick status indicator - Abnormally low current or open circuit.	WARNING!
5810/3	D1	Power supply to sensor - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5810/4	D2	Power supply to sensor - Abnormally low voltage or short circuit to lower voltage.	WARNING!
5820/3	D4	High battery voltage. Transmission control unit activates "TCU shutdown"	STOP!
5820/4	D3	Low battery voltage. Transmission control unit activates "TCU shutdown"	STOP!
5830/2	D5	Error on valve power supply VPS1. Transmission control unit activates "TCU shutdown"	STOP!
5840/2	D6	Error on valve power supply VPS2. Transmission control unit activates "TCU shutdown"	STOP!
5860/3	E3	Display output - Abnormally high voltage or short-circuit to higher voltage.	WARNING!
5860/4	E4	Display output - Abnormally low voltage or short-circuit to lower voltage.	WARNING!
5880/2	E6	Prohibited ID request via CAN. Transmission in neutral. Transmission control unit activates "TCU shutdown"	STOP!
5890/2	F1	General EEPROM error.	WARNING!
5900/13	F2	Configuration lost. Transmission control unit activates "TCU shutdown"	STOP!

		Description	Action
SPN/FMI	ZF code (hex)		
5910/13	F3	Application error. Transmission control unit activates "TCU shutdown"	STOP!
5930/7	F5	Clutch error. Transmission control unit activates "TCU shutdown"	STOP!
5930/13	F6	Calibration value from inching pedal or clutch modulation not in memory. Inching not functioning.	WARNING!

For serious transmission errors, the control unit uses four modes with reduced functionality to protect the transmission from damage. These are:

- "Substitute clutch control".

In this state the driver can use the machine as normal. However, gear shifting and change of travel direction does not take place under the control of normal modulation. The control unit uses standard values for modulating clutches.

- "Limp home".

In this state the driver can use one of the transmission gears in each direction, and in some cases only in one direction. To continue driving with a fault and the limitation "Limp home" active, the machine must be stopped, coming to a standstill, the gear selector moved to neutral before a gear can be selected again.

- "Transmission shut down".

In this state the transmission is permanently in neutral as the solenoid valves for the clutches and parts of the power supply to the transmission are shutoff. Park the machine and switch off the engine.

- "TCU shut down".

In this state the transmission is permanently in neutral as all the solenoid valves and all power supplies to the transmission are shutoff. Park the machine and switch off the engine.

Error codes ECC



Table 10. Error codes ECC

Error code	Description	Recommended action
Heater valve Open	Open circuit in water valve or in cables between ECC control unit and water valve.	Contact service.
Heater valve Short	Short-circuit in water valve or in cables between ECC control unit and water valve.	Contact service.
Heater valve Stuck	The water valve has got stuck or has been blocked by a foreign body.	Contact service.
Inside sensor Open	Open circuit in sensor, cabin temperature, or cables between the ECC control unit and the sensor, cabin temperature.	Contact service.
Inside sensor Short	Short-circuit in sensor, cabin temperature, or cables between the ECC control unit and the sensor, cabin temperature.	Contact service.
Outside sensor Open	Open circuit in sensor, outside temperature, or cables between the ECC control unit and the sensor, outside temperature.	Contact service.
Outside sensor Short	Short-circuit in sensor, outside temperature, or cables between the ECC control unit and the sensor, outside temperature.	Contact service.
De-icing sensor Open	Open circuit in sensor, de-icing, or cables between the ECC control unit and the sensor, de-icing.	Contact service.
De-icing sensor Short	Short-circuit in sensor, de-icing, or cables between the ECC control unit and the sensor, de-icing.	Contact service.
Aftercoil sensor Open	Open circuit in sensor, after heat exchanger, or cables between the ECC control unit and the sensor, after heat exchanger.	Contact service.
Aftercoil sensor Short	Short-circuit in sensor, after heat exchanger, or cables between the ECC control unit and the sensor, after heat exchanger.	Contact service.
AC system failure	Probably abnormal pressure in refrigerant circuit.	<p>The fault may be temporary and if so, it can be rectified by re-setting the ECC.</p> <p>Reset the ECC by switching off the ignition and re-starting the truck. Go to the fault indication menu on the ECC and press the button to reduce the fan speed for a few seconds, see section <i>Error codes ECC page 146</i>.</p> <p>If the fault remains after re-starting, contact service.</p>

5.4 Operating

5.4.1 While operating

General



WARNING

Never use a machine without first performing the daily inspection.

Fatal danger and risk of property damage!

For work instruction, see section 6.1 Daily inspection. Notify the foreman/supervisor if defects are found on the machine during daily inspection!



WARNING

If the machine is equipped with seat belts they must be used.

 **WARNING**

The machine's work area is large and visibility from the operator's cab is restricted.

Fatal danger and risk of property damage!

Keep in mind:

- Always check that no persons are in the way of the machine or its equipment. Check that the area overhead is clear. The machine must be stopped if unauthorized vehicles or persons are in the work area.
- The operator must always face in the direction of travel and should operate with special care where persons or vehicles may appear.
- The operator must adjust travel speed according to the nature of the load, visibility conditions, road conditions, etc.
- The operator must pay extra attention and operate with special care near electrical power lines, viaducts, dock sides, ramps, gates/doors, etc.
- Always operate carefully so that the machine or attachment does not collide with posts, power lines, etc.
- Use available visibility equipment such as rear-view mirrors and TV camera.

 **WARNING**

When the reversing alarm is switched off, the driver must be extra careful.

Fatal danger!

Always check that no persons are in the way of the machine or its equipment.

WARNING

Do not let the engine idle for a long time.

Risk of engine damage!

Turn off the engine during breaks in operation and load handling.


Instructions

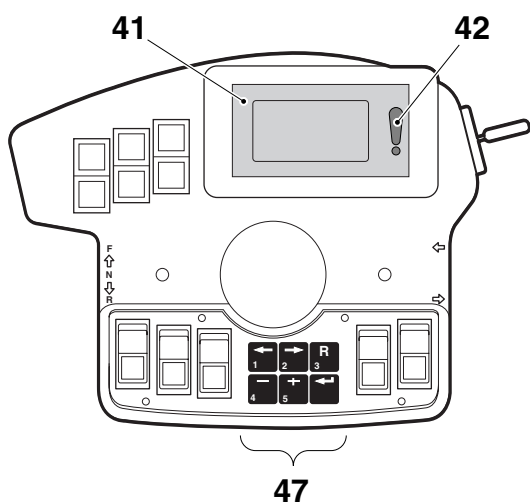
Make a habit of checking the following at regular intervals while operating:

- that the coolant temperature is within the approved range (approx. 82-95 °C is normal depending on the load).
- that the fuel indicator in the display shows that there is fuel in the tank.

NOTE

The tank should never be run dry.

- that all warning lamps are off.
- that horn, lighting, brake lamps and direction indicators function correctly.
- that all hydraulic functions function correctly.
- that no error codes have been generated (shown on operator's display with error code indication and symbol). See section 5.3 *Error codes*.
- If there is extra exhaust cleaning (particle filter):  that warning lamp for exhaust cleaning (position 35) is not lit continuously or that the pressure gauge for particle filter is within red range (150 mbar). Then exhaust cleaning needs to be cleaned, see section 5.4.9 *Stopping machine - parking* or see separate manual for particle filter.
The lamp may flash at high engine load.



006936

Steering wheel panel

41. Display control and monitoring system, KCS
 42. Indicator control and monitoring system, KCS
 47. Function keys control and monitoring system, KCS

5.4.2 Starting engine

General

WARNING

If it is difficult to start the engine, do not use start spray.

Risk of explosion!


In case of start problems, contact service.

Instructions

1. Set the gear and direction of travel selector to neutral.

The gear and direction of travel selector must be in neutral in order for the engine to start.

NOTE

If there is extra exhaust cleaning (particle filter) :

Check that the machine is not connected for cleaning.

2. Turn the ignition key to the operating position, position I.

Current is now supplied to all electrical functions.

In case of cold weather, preheating can be used. During preheating, the engine's inlet air is preheated to a suitable temperature. Symbol for preheating is shown in the display.

When the symbol disappears, turn to start position, position III.

The symbol for preheating is not displayed if the engine is hot or ambient temperature is sufficiently high.

3. Let the starter motor crank the engine; release the key when the engine fires.

The machine has an electrical restart interlock that protects the starter motor from engaging when the engine is rotating.

NOTE

IF THE ENGINE DOES NOT START, try again after 15-20 seconds. Do not run the starter motor for longer than 10 seconds at each start attempt.

If the engine still does not start, this indicates that there is an error that has to be located and repaired. Contact service.

5.4.3 Warming up

General

WARNING

Never rev a cold engine at high engine speeds.

Risk of engine damage!

Run the engine at 1400-1500 rpm until it starts to get warm.

WARNING

Do not let the engine idle for a long time.

Risk of engine damage!

Turn off the engine during breaks in operation and load handling.

Instructions



In case of extremely cold weather, the machine must not be used for demanding work before operating temperature has been reached.

- It is very important that the engine oil is warmed up and circulates well before the turbocharger starts to operate at high rpm.
- Start working with the machine with some caution until its cooling water has reached a normal working temperature (approx 82-95 °C), full power from the engine can then be used.
- Warm the hydraulic oil to operating temperature. Run hydraulic functions without load for a short time before starting to work.

5.4.4 Gear shifting

General

There are three types of transmission for the machine:

- manual
- Automatic with speed limit 
Speed limit is pre-set. Alteration is only carried out by an authorised service technician.
- Automatic 

With automatic transmission, the system shifts to a lower/higher gear under certain conditions, such as torque, engine speed, travel speed, etc.

It is possible to choose between manual or automatic shifting. Select automatic or manual shifting by going into the KCS menus with the service code for "AUTOMATIC GEARSHIFT ECU793" and select "AUTOMATIC GEARSHIFT OFF" value 0 or 1.

General information about the automatic transmission:

- Has a built-in control and monitoring system, giving optimised drive.
- Shows current gear on control and monitoring system's display.
- Normally, operation is started in first gear. In the KCS menus one can set start on 2nd gear and disengagement on and off.
- A reverse interlock prevents the machine from changing direction too quickly, i.e. prevents damage to the transmission. The reverse interlock is automatic and depends on engine rpm and speed.



WARNING

Change travel direction with great care. The machine has reverse interlock as standard but the service life of the gearbox is increased if changes in directions are carried out at lower speeds and engine rpm.

Risk of machine damage! Shafts may break!

Only change travel direction within the tolerances allowed by the reverse interlock.

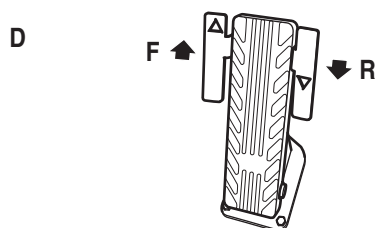
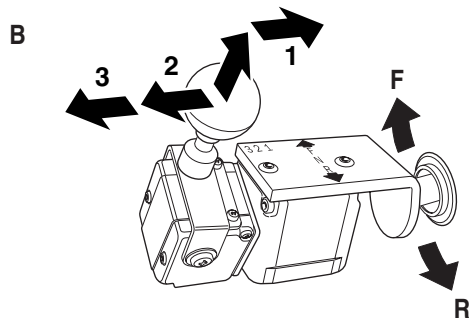
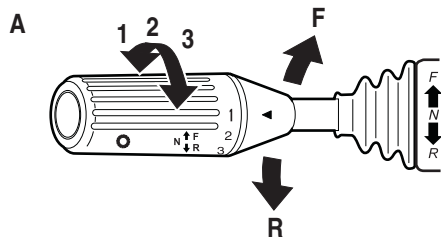
Manual transmission, instructions

The machine has three forward gears and three reverse gears. Use manual transmission as follows:

- 1 Let the engine idle. Select direction of travel. Travel direction can be selected in five ways:

NOTE

Selection of travel direction selector must be performed with the switch for activating/deactivating alternative travel direction selector (position 45). When the switch is in position 1 the engine start inlock is engaged and thus cannot be started.




- A. Gear and direction of travel selector

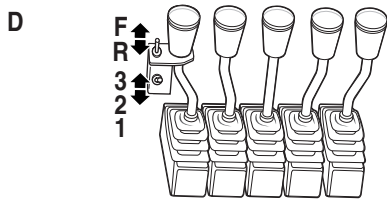
Move lever forward for travel direction forward and back for reverse travel direction.

- B. Gear and direction of travel selector RMH

Move lever forward for travel direction forward and back for reverse travel direction.

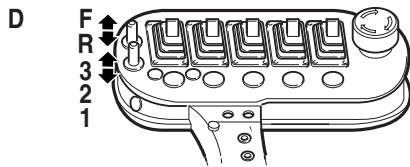
- C. Accelerator pedal with function for selecting travel direction 

Press down the right upper part of the pedal for reverse travel direction and left upper part for travel direction forward.

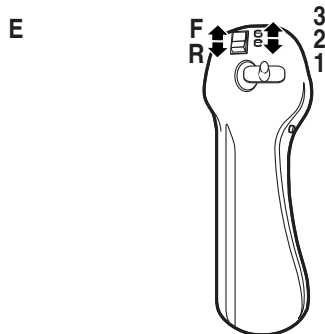


- D. Travel direction selector on control for load handling (4-lever, 5-lever, electric servo)

Move lever forward for travel direction forward and back for reverse travel direction.



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- E. Travel direction selector on joystick or mini-wheel

Move switch forward for travel direction forward and back for reverse travel direction.

- 2 Select gear. Start in first gear, starting in higher gear may lead to overheating. Gears can be selected in five ways:

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NOTE

Selection of the gear selector must be performed with the switch for activating/deactivating alternative gear selector (position 46).

- A. Gear and direction of travel selector
Engage a gear by turning the handle forward or backward. For start in first gear: Turn back to position 1.
- B. Gear and direction of travel selector RMH
Engage a gear by moving the lever to the left or right. For start in first gear: Lift the lever and move to the right.
- C. Gear selector on control for load handling 4-lever and 5-lever
Engage a gear by moving the switch up, to the middle or down. For start in first gear: Switch down.
- D. Gear selector on control for load handling electric servo
Engage a gear by moving the switch forward, to the middle or backward. For start in first gear: Switch backward.
- E. Gear selector on joystick
Engage a gear by pressing the buttons for up and downshift. For start in first gear: Press once on button for upshift.
- 3 Release the parking brake, increase the throttle carefully and the machine starts to move.

- 4 For upshifting:
- Select higher gear with relevant control (turn/pull/set switch).
- For downshifting:
- Select lower gear with relevant control (turn/pull/set switch).
 - Release the accelerator pedal at which the lower gear engages when a suitable speed and engine rpm has been reached.
 - Apply throttle again. Remember to increase throttle before the lower gear is selected, otherwise the machine will be subjected to forceful retardation.

Automatic transmission, instructions



The machine has three forward gears and three reverse gears. Use automatic transmission as follows:

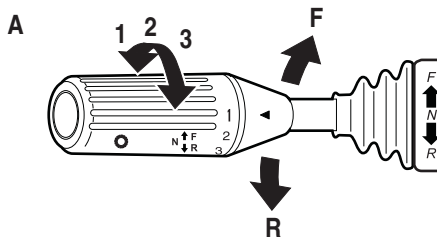
- 1 Let the engine idle. Select direction of travel. Travel direction can be selected in five ways:

NOTE

Selection of travel direction selector must be performed with the switch for activating/deactivating alternative travel direction selector (position 45). When the switch is in position 1 the engine start inlock is engaged and thus cannot be started.

- A. Gear and direction of travel selector

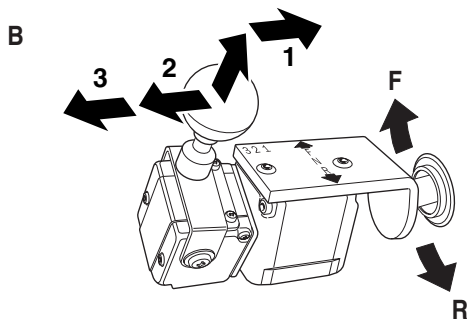
Move lever forward for travel direction forward and back for reverse travel direction.



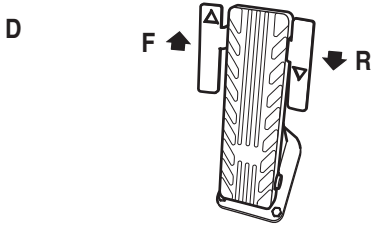
007011

- B. Gear and direction of travel selector RMH


Move lever forward for travel direction forward and back for reverse travel direction.



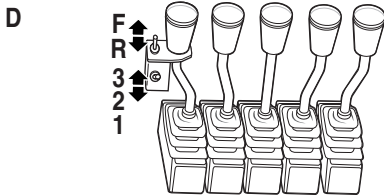
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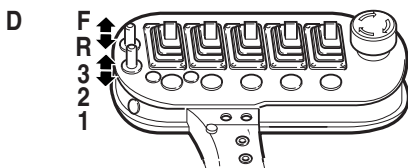
C. Accelerator pedal with function for selecting travel direction 

Press down the right upper part of the pedal for reverse travel direction and left upper part for travel direction forward.

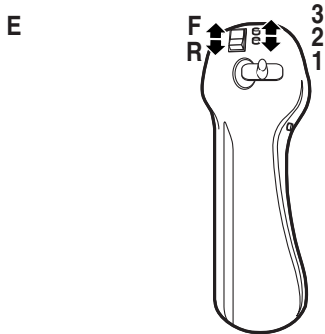


D. Travel direction selector on control for load handling (4-lever, 5-lever, electric servo) 


Move lever forward for travel direction forward and back for reverse travel direction.



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E. Travel direction selector on joystick or mini-wheel 

Move switch forward for travel direction forward and back for reverse travel direction.

2 Select gear position as needed:

Gear position 1 means that automatic shifting only uses first gear. Gear position 2 means that automatic shifting uses first and second gear. Gear position 3 means that automatic shifting uses all gears (1, 2 and 3).

3 Release the parking brake, increase the throttle carefully and the machine starts to move.

The machine's speed is completely regulated via the accelerator and gears are selected automatically during both upshifts and downshifts.

5.4.5 Steering

General

The machine has power steering. Steering movement from steering wheel, joystick or mini-wheel is transmitted hydraulically to the steering wheels.



WARNING

The machine must not roll on a downhill grade if the engine is not running.

**There is no hydraulic pressure or steering capacity!
Danger!**

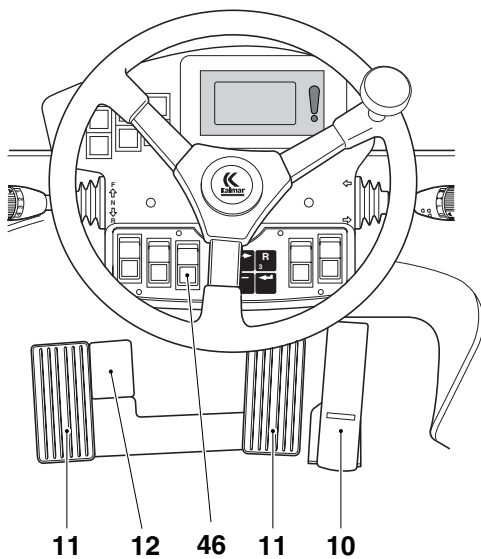
Keep the engine running for hydraulic pressure.

5.4.6 Service brake

General

The brake pedal (position 11) is used as service brake.


Use brakes smoothly yet firmly. There is brake pressure for some time after the engine has been turned off, the pressure has been accumulated during operation. If the accumulator pressure falls below a certain level, an error code is shown in the display. Check the accumulator's sealing if the pressure does not build up and is not maintained, see chapter 6 *Inspection and maintenance*.




006934

10. Accelerator pedal

11. Brake pedals

12. Inching pedal 

46. Switch for inching pedal 

Service brake without inching

The service brake is combined with a clutch release. At a certain brake pressure, drive is disengaged completely.

If the brake pedal is applied without disengagement occurring the engine can help to brake the machine when the accelerator pedal is released.

Service brake with inching

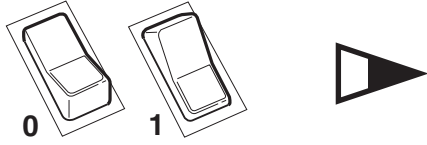


Switch for inching pedal

Position 0 - Inching not activated. The brake is activated with the brake pedal and disengagement occurs when the pedal is pushed down more than 70%.

Position 1 - Inching activated. Inching and braking are controlled by the brake pedal. When the pedal is pressed down the drive starts to slip, so-called inching.

If the brake pedal is pressed more than 70% the drive disengages completely.

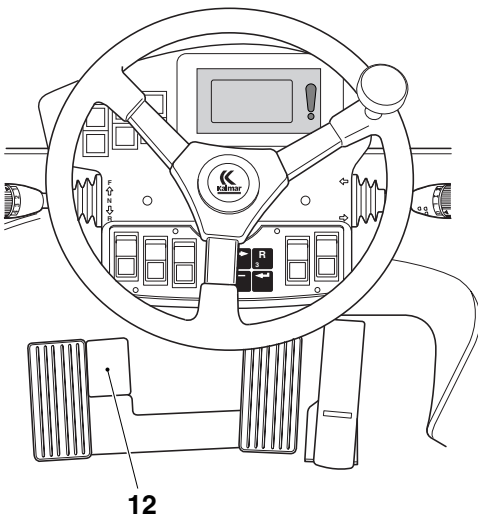


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Inching pedal

The brake is activated with the brake pedal and disengagement occurs when the pedal is pushed down more than 70%.

When the brake and inching pedals are pressed down at the same time a micro switch is affected and the drive starts to slip, so-called inching.



007497

Optimum drive



The function enables increased productivity and safety. Optimum drive gives conditions for inching while allowing maximum lifting. The difference from electronic inching (inching pedal) is that the operator does not have to use the brake pedal to control the speed, which makes the function both safer and faster.

The accelerator pedal position controls speed and the lift lever controls the engine's power (rpm) - completely independent of each other. The accelerator pedal also works as a brake during normal operation.

The service brake's effect on the accelerator's position is set from 1 to 9 with information menu for Optimum drive, see section 4.13.1.8 *Operational menu for Optimum drive*.

5.4.7 Parking brake

General

WARNING

Never leave the driver's seat without first applying the parking brake.

Risk of machine starting to roll! Danger!

Apply the parking brake before leaving the driver's seat.

The parking brake is operated with the switch (position 6) on the hydraulic control panel. The warning lamp for parking brake (in the switch) lights red and the symbol is displayed when the switch for parking brake is depressed).

Instructions

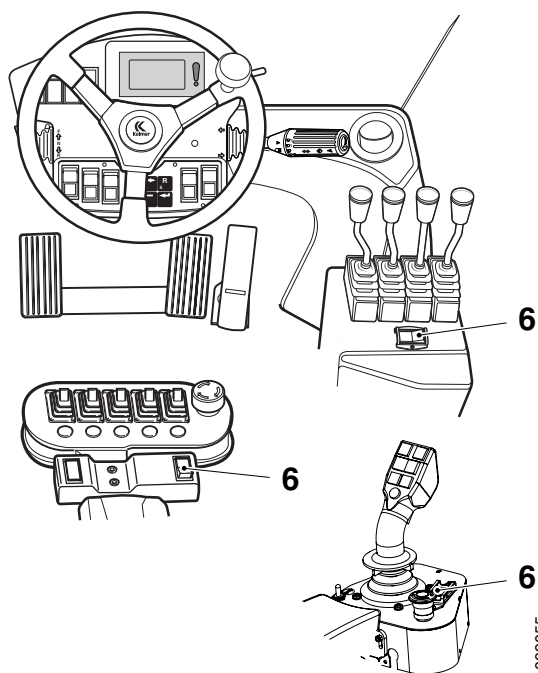
The parking brake is applied:

- When the switch for parking brake is pressed down (warning lamp for parking brake lights red and the symbol is displayed).
- The parking brake is automatically applied when the engine is stopped.

An audible signal is activated if the operator gets up from the driver's seat without first applying the parking brake.

If the accumulator pressure falls below a certain level, an error code is shown in the display. In event of an error code for low accumulator pressure the service brake capacity is reduced. Finally, the parking brake is applied automatically by a powerful spring in the brake cylinder. Check the accumulator's sealing if the pressure does not build up and is not maintained, see chapter 6 *Inspection and maintenance*.

If the machine has to be moved, see section 7 *Transporting the machine*.



6. Switch for parking brake

Emergency brake

The parking brake can be used as an emergency brake in emergency situations.



WARNING

The parking brake can be used as an EMERGENCY BRAKE.

Brake pads wear out and lose their braking performance! Unwanted movement of parked machine!




After any emergency braking with the parking brake the brake pads must be checked as soon as possible. Change, if needed! Braking performance of the parking brake may be lost as the brake pads get worn down.

If the parking brake has been released manually, the parking brake must always be reset in order to give the machine parking brake function again.

5.4.8 Heating unit/ climate control system

General

This section describes operation in:

- cab Spirit Delta with:
 - heating unit
 - heating unit with cooling AC (manual control of heating, cooling, dehumidification and air flow) 
 - Climate control system ECC (automatic control of heating, cooling, dehumidification and air flow) 
- FlexCab is equipped with a heater unit and can be equipped with air conditioning 


NOTE

The operator's door and windows must be closed for satisfactory function of heating unit /Climate control system ECC.


5.4.8.1 Spirit Delta with heating unit/heating unit with cooling AC


General

The heating or climate control system is connected to the engine's cooling system and provides heat when the engine is warm.

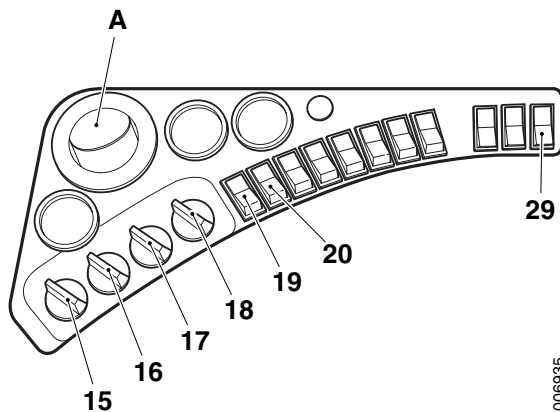
- The heating unit has manual control of heat and air flow.
-  Heating unit with cooling, AC, has manual control of heat, cooling dehumidification and air flow.

The fan is operated with the rotary control (position 16). Heating is controlled with the rotary control (position 15) and cooling with the rotary control (position 18).

Air distribution is controlled with the rotary control (position 17). Recirculation is turned on and off with switch (position 19) .

Cooling AC is turned on and off with switch (position 20) .

The panel has panel vents (position A).




Panel heating unit

006935


NOTE

Use cooling AC (position 20) every now and then in wintertime for lubrication and continued good function of the AC compressor.


When the ambient temperature is below -3°C, the cooling unit does not work if the cooling circuit is too cold.

Pause heater is switched on and off by switch (position 29)  and activated when the ignition key is position 0 and the engine is hot.


Warm weather

- 1 Set the desired fan speed (position 16).
Use fresh air inlet (position 19). 
- 2 Set temperature (position 15).
- 3 Set the control for defroster/cab (position 17) in defroster position.
- 4 Open the panel vents, if needed.

Very warm weather or mist on windows

- 1 Set the desired fan speed (position 16).
Use fresh air inlet (position 19). 
- 2 Set temperature (position 15).
- 3 Set the control for defroster/cab (position 17) in defroster position and aim the panel vents at the upper part of the cab.

Cold weather

- 1 Set the desired fan speed (position 16).
Use fresh air inlet (position 19). 
- 2 Set temperature (position 15).
- 3 Set the control for defroster/cab (position 17) in defroster position or floor.

Cooling, AC

AC cooling provides air conditioning with manual setting of heating, cooling and fan.

NOTE

For best comfort, avoid directing the flow of air directly onto your body when using the AC. Aim the flow of air at the top of the cab, and increase the fan capacity as necessary. Cooling capacity increases if the recirculation control is switched on.

1. Use fresh air inlet (position 19).
Use recirculation (position 19) in case of very warm weather and high humidity.
2. Set temperature to cool (position 15).
3. Turn on cooling AC (position 20).
4. Set the cooling control for cooling AC (position 18) as needed.
5. Open the panel vents aimed at the roof.

Air drying with cooling AC



Cooling AC dehumidifies the air, e.g., in case of mist on the windows.

1. Use recirculation (position 19).
2. Turn on cooling AC (position 20).
3. Set the cooling AC control to maximum cooling output (position 18).
4. Set the control for defroster/cab (position 17) in defroster position.
5. Set max. fan speed (position 16).
6. Set temperature to max. heat flow (position 15).
7. Aim the panel vents towards the roof.

When the windows are mist-free, set the desired temperature (position 15), desired fan speed and aim the panel vents.

NOTE

When the ambient temperature is below -3°C, the cooling unit does not work if the cooling circuit is too cold.

Pause heater



When the pause heater is activated, the ignition key is in position 0 and the engine is hot, coolant is pumped through the heater unit and the fan operates at low speed. The cab is heated until the engine has cooled. When the coolant temperature falls below approx. 40°C all voltage supply to the pump and fan is interrupted and heating stops.

NOTE

Pause heat is always available as long as the switch is in position 1 and starts as soon the ignition key is in 0 position and the engine coolant temperature exceeds approx. 40°C.

1. Turn on pause heater (position 29). The function starts when the engine coolant temperature exceeds approx. 40°C and the ignition key is in position 0.
2. Set temperature to max. heat flow (position 15).
3. Set the fan speed to position I (position 16).

The cab remains warm for longer periods if the fan speed is low.

5.4.8.2 Spirit Delta with climate control system ECC

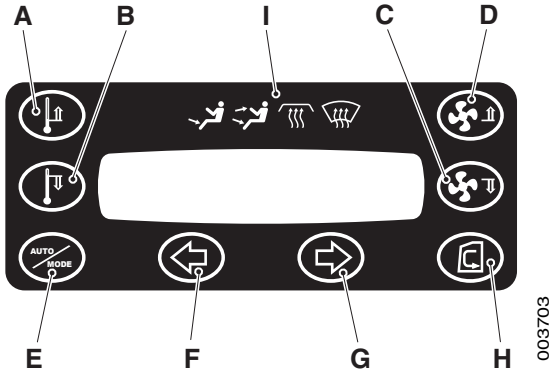
General



The climate control system automatically controls the interior temperature, to provide the required temperature irrespective of ambient conditions. The system is always set to AUTO mode and 21°, irrespective of the setting when last shut off.

NOTE

When the ambient temperature is below -3°C, the cooling unit does not work if the cooling circuit is too cold.



- A. Increase temperature
- B. Reduce temperature
- C. Reduce fan speed
- D. Increase fan speed
- E. Auto mode
- F. Select air distribution
- G. Select air distribution
- H. Recirculation
- I. Air distribution

003703

Setting the temperature

The required temperature is increased or reduced by means of the temperature setting buttons. The temperature can be controlled between 17°C and 27°C. The end positions give max and min temperature where no control takes place, the unit then just gives max or min heating.

003565

Setting the fan speed

The fan speed can be adjusted manually between 0-100%, using the buttons. At 0%, the fan is completely shut off and the compressor is disconnected. The graph in the display shows that the fan speed has been manually selected.

003566

Choosing air distribution

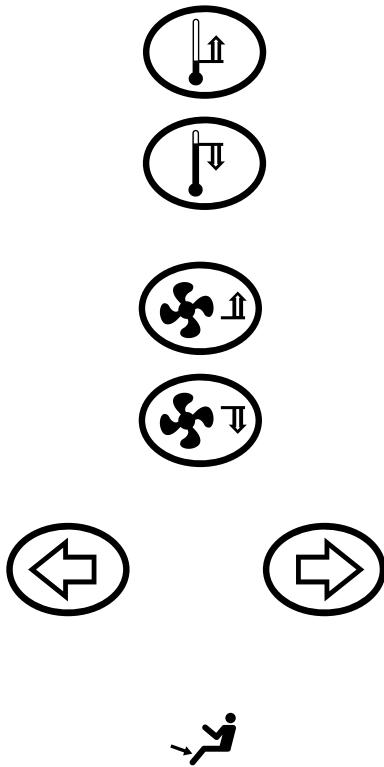
Air distribution can be adjusted manually, using the buttons. An arrow (^) in the display indicates the air distribution selected. Floor position is only available manually, automatic switches between windscreen and floor/panel vents.

003567

The following choices of air distribution can be made:

Air to floor.

003568





003569

Air to both floor and ventilation vents.



003570

Air to windscreen.



003571

Max defrost.



003571

Start max defroster

Max defroster is started by moving the arrow (^) furthest right, by using the air distribution selection buttons.

In this position, the unit gives full heat and there is no temperature control, the AC is on and the fans give 100%.

The unit automatically returns to auto mode after 9 minutes. For manual shut-off, press the auto button briefly.

Air recirculation

Air recirculation can be obtained manually by pressing the recirculation button. When recirculation is activated "REC" is shown on the display. To de-activate, press the recirculation button again.



003572

Return to auto mode

Auto mode is regained by pressing the auto button briefly. Note that there is a certain time delay before the display changes - do not press several times.



003702

NOTE

There is a short time delay before Auto is shown on the display. Do not press again.

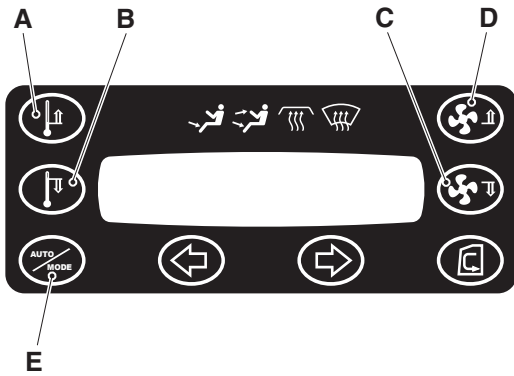
Auto/menu function

A brief press on the auto button scrolls through the following functions:

1. Auto
2. Cool - economy mode. The compressor only runs when necessary. No heating.
3. Heat - economy mode. No compressor operation, just heating.



003702



- A. Scroll in menu
- B. Scroll in menu
- C. Adjust values
- D. Adjust values
- E. Auto mode

003707

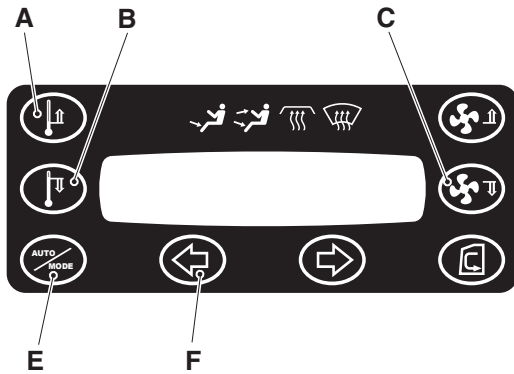
Adjusting the display

The display adjustment menu can be accessed by pressing the auto button (position E) for several seconds. The following can be adjusted in this menu:

1. Illumination
2. Contrast.
3. Switch between °C and °F.
4. Language.

Scroll through the menu choices, using the temperature buttons (positions A and B) and adjust with the fan buttons (positions C and D).

Return by briefly pressing the auto button (position E).



- A. Scroll between error messages
- B. Scroll between error messages
- C. Reset pressure monitor
- D. -
- E. Auto mode
- F. Error cause

003708

Fault indication

If there is a fault in any sensor, or if the pressure monitor has tripped, "ERROR" flashes on the display.

Keep the auto button (position E) depressed for a few seconds to show the current fault(s) as text on the display.

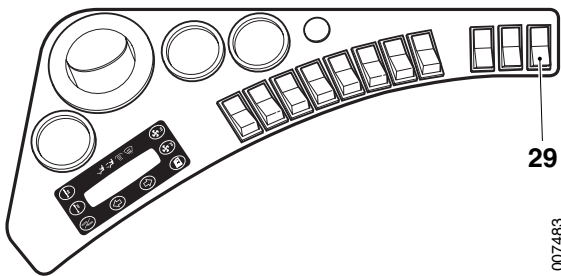
Scroll between error messages, using the temperature buttons (positions A and B). The selected error message is indicated with an arrow on the display.

The fault cause is indicated with a left arrow (position F).

The pressure monitor is re-set with the button for reducing fan speed (position C). Keep the button depressed for several seconds to reset.

Return by briefly pressing the auto button (position E).

For error code table, see *Error codes ECC page 146*.



29

007483

Pause heater



When the pause heater is activated, the ignition key is in position 0 and the engine is hot, coolant is pumped through the heater unit and the fan operates at low speed. The cab is heated until the engine has cooled. When the coolant temperature falls below approx. 40°C all voltage supply to the pump and fan is interrupted and heating stops.

NOTE


Pause heat is always available as long as the switch is in position 1 and starts as soon the ignition key is in 0 position and the engine coolant temperature exceeds approx. 40°C.

1. Turn on pause heater (position 29). The function starts when the engine coolant temperature exceeds approx. 40°C and the ignition key is in position 0.
2. Temperature and fan speed is regulated automatically.

5.4.8.3 FlexCab

General

The heating and AC units are two completely independent systems.

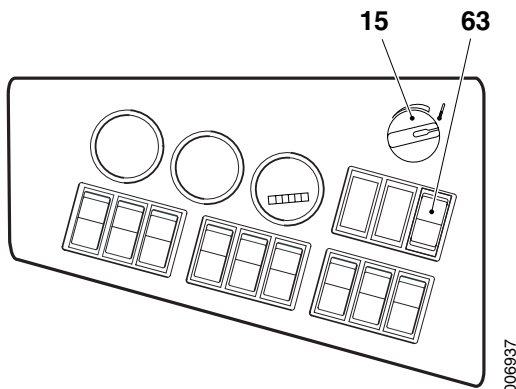
- The heating unit has manual control of heat and air flow.
-  AC cooling has manual control of heating and air flow.

Heating unit

The heating unit is connected to the engine cooling system and provides heat when the engine is warm.

The fan in the unit is activated by a switch (position 51).

Heating is adjusted by a control (position 15).



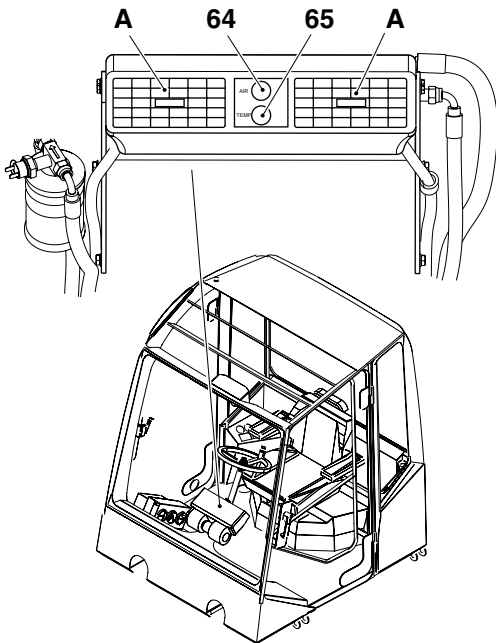
006937

Warm weather

- 1 Set the desired fan speed (position 51).
- 2 Set control for heating (position 15) in position 0.

Very warm weather or mist on windows

- 1 Set the desired fan speed (position 51).
- 2 Set control for heating (position 15) in position 0.
- 3 Close the panel vents, so that all the air will be blown on to the windscreen.



Cooling unit in cab.
 64. Fan controls
 65. Cooling effect control
 A. Air vent

Cold weather

- 1 Set the desired fan speed (position 51).
- 2 Set the control for heating (position 15) in the desired position.
- 3 Open any panel vents, so that all air flows down onto the floor.

AC unit



The air conditioning (AC) circulates and cools the air inside the cab.

The fan speed is controlled in four stages 0 - I - II - III with the fan switch (position 64).

Cooling action can be constantly adjusted with the cooling control (position 65). The AC compressor only works if the fan is switched on, the cooling control is set to cooling and the engine is running. The air vents are adjustable for individual air flow setting.

NOTE

Use the AC installation occasionally during the winter as well, for lubrication and continual optimum function.

NOTE

When the ambient temperature is below -3°C, the cooling unit does not work if the cooling circuit is too cold.

Setting the AC unit.

The air conditioning unit has manual adjustment of cooling and the fan.

1. Turn off the heat in the heater unit.
 For maximum cooling effect, switch the heater unit off completely.

NOTE

Switching the heater unit off completely means that no fresh air is supplied to the cab. This can result in poor air.

2. Adjust the fan (position 64) as necessary.
3. Adjust the cooling effect (position 65) as necessary.

NOTE

For best comfort, avoid directing the flow of air directly onto your body when using the AC. Aim the flow of air at the top of the cab, and increase the fan capacity as necessary. Cooling capacity increases if the recirculation control is switched on.

5.4.9 Stopping engine – parking

General

NOTE

Never disconnect the main electric power with the battery disconnect switch when the engine is running! The voltage regulator may be damaged.



WARNING

Always switch the ignition off when the machine is left, e.g. when parking or at the end of each shift etc.

Danger!


Interrupt the current using the battery disconnect switch.

Instructions


1. Stop the machine and move the gear and direction of travel selector to neutral position (N).
2. Apply the parking brake.
3. Tilt the mast slightly forward so that the bottom of the forks rest on the ground. Lower the forks to the ground.
4. Let the engine run 1 minute at idle speed before stopping the engine so that the engine cools down slightly and the turbo bearings are lubricated.
5. Stop the engine by turning the start key to position 0.

During longer stoppages, such as parking or at the end of the shift, the battery disconnect switch should be moved to the OFF (0) position.

Certain machines are equipped with automatic engine stop in

case: 

- Coolant temperature is too high.
- Lubrication oil pressure is too low.
- The operator leaves the machine for some time without stopping the engine, normally 5 minutes.

6. If there is extra exhaust cleaning (particle filter): 

Connect the cleaning unit on the machine or at the machine's parking site.

Connect the cabling and air hose. Turn on current to activate cleaning.



CAUTION

Never interrupt burning off.

Cleaning is complete:

- after 8 hours, the ammeter must indicate zero Ampere.
- after 8 hours, the indicator lamp must light green.
- after 40 minutes, the indicator lamp must light green.



WARNING

During cleaning, hot air that can ignite flammable material flows out of the exhaust pipe.

Fire danger!

Do not cover the filter or have flammable material near the filter.

5.5 Load handling

General

During all lifting work, make sure that the max. lift capacity is not exceeded; see machine plate or load diagram.

The forklift's capacity is indicated by three parameters:

- position of load's centre of gravity
- lift height
- size of the load

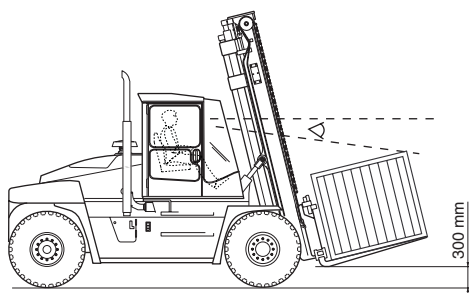
The capacity varies between models and versions, see the machine and type plates, section 3.2 *Plates*.

It is important to estimate the position of the centre of gravity. If the machine appears to be side-heavy, the load should be lowered and adjusted with side shift so that the load's centre of gravity is moved to a position along the machine's centre line.

The function load handling covers lifting, lowering, turning, angling and hold loads. Load handling also includes lifting devices for handling different types of load for example side lift attachments.

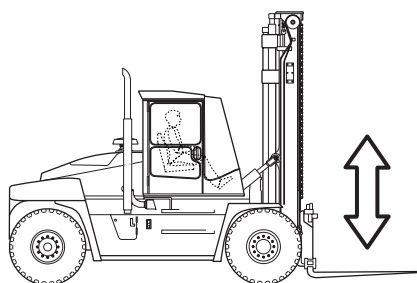
Load handling sub-functions.

- Lift/lower
- Tilt
- Side shift
- Spreading
- Levelling



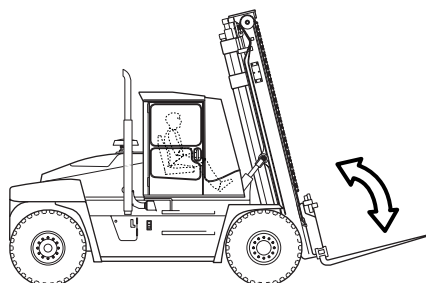
Transport position

007345



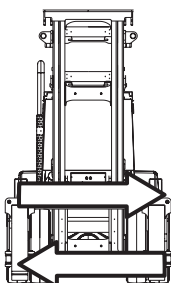
Lift and lower

006939



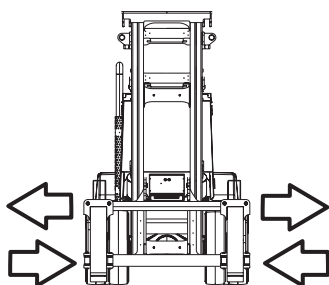
Tilt

006938



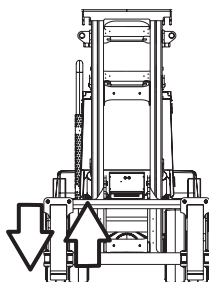
Side shift

007012



Spreading

007013



Levelling

007014

Optimum rev



Optimum rev optimises the engine rpm according to the current power need. This results in a lower noise level, lower fuel consumption and lower exhaust emissions during load handling.



The Optimum rev function intelligently controls a variable pump in relation to the engine's rpm, the load in question and the load handling control's deflection during lift sequences. The pump is load-sensing which results in only the oil volume (flow) and the pressure that is required at each moment being added to the flow and pressure delivered by the fixed pump. The variable pump works in parallel with the fixed pump.

The function Optimum rev is activated at clutch disengagement.

5.5.1 Lifting a load

General

There are different types of attachments for load handling, the most common are.

- forks
- side lift attachment for container handling 
- coil ram 



DANGER

Respect the machine's lift capacity and operate with great care during load handling:

- **Never handle unstable or loosely loaded goods. Take great care when handling long, high or wide goods to prevent the load from sliding off, damaging or tipping the machine.**
- **Remember to avoid exceeding the maximum lifting capacity, please refer to the type plate. Estimate the position of the centre of gravity, when necessary, and estimate the loading capacity using the loading diagram in the cab.**
- **Never tilt the mast forward when carrying loads.**
- **No persons may stand under a lifted load.**

There is a risk that the load can tip over, be dropped, or there could be property damage or danger to life!

Always ensure that the load rests securely before lifting.



DANGER

Check that the attachment is marked with a type plate from Kalmar Industries or another manufacturer. Every attachment must have a plate with capacity information.

Fatal danger and risk of property damage!

Make sure that only approved attachments are used.

Optimum speed

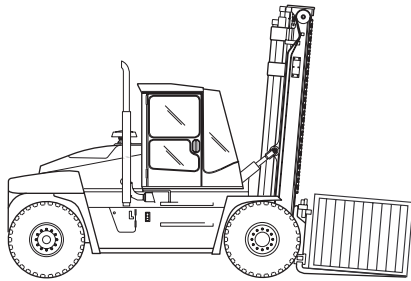


Optimum speed optimises lifting speed and can increase it by up to 50% (without load).

The Optimum speed function intelligently controls a variable pump in relation to the engine's current capacity and load in question when lifting. This creates maximum lift speed for every situation. The pump is load-sensing which results in only the oil volume (flow) and the pressure that is required at each moment being added to the flow and pressure delivered by the fixed pump. The variable pump works in parallel with the fixed pump.

The function Optimum speed is activated at the function lift.

Instructions for forks



001843

- 1 Run the machine towards the load, as close as possible.
 - Try to line up the machine's centre line the load's centre of gravity.
 - Approach angle towards load should be as straight as possible.
 - Tilt the mast slightly forward.
 - Lower the forks as low as possible, adjust the fork positioning and move the forks in under the load.
 - tilt the mast backwards to make the forks horizontal.
- 2 Hold the vehicle stationary with the service brake (and possibly the inching pedal).
Alternatively, apply the parking brake if desired and/or shift to neutral gear. If necessary, place chocks under the driving wheels



DANGER

The operator should pay extra attention and operate with special care near electrical power lines, viaducts, docksides, ramps, gates/doors, etc.

Fatal danger!

Apply the parking brake and use stop blocks.

- 3 Lift the load and tilt back the mast slightly.
If the machine appears to be side-heavy - the load should be lowered and adjusted with side shift so that the load's centre of gravity is moved to a position along the machine's centre line.



WARNING

Forks (with or without load) are an easily operated tool with great strength.

Fatal danger and risk of property damage!

Make sure that nobody stands under a raised attachment, regardless of whether it is loaded or not. Exercise great care while operating.

5.5.2 Transporting load

General

WARNING

Transport of loads is associated with great risks.

Risk of roll-over and tipping over! Risk of load damage to property! Fatal danger!

Respect the machine's lift capacity and operate with great care during load handling:

- **The machine should only be operated on even surfaces which are intended for the machine's gross weight and ground loading.**
- **All loads should be carried in the transport position. Always operate carefully; keep in mind the width and height so that the mast or forks/ attachment does not collide with posts, power lines, etc.**
- **Do not transport the loads in the high position since this may cause the machine to roll or tip over.**
- **Always operate with the load against the grade on uphill or downhill grades, never turn or run across a grade.**
- **Operate the machine in reverse if the transported load obscures visibility to the front.**
- **No persons may stand under a lifted load.**
- **The operator must always adjust the speed when turning to prevent skidding and risk of roll-over or tipping over.**
- **The operator must always adjust the speed when turning to prevent skidding and risk of roll-over or tipping over.**

In the event of the machine rolling or tipping over, hold on to the steering wheel and stay in the cab. Do NOT try to jump out of the cab before all movement has stopped.

Local regulations may apply when handling special loads. Check and observe them.

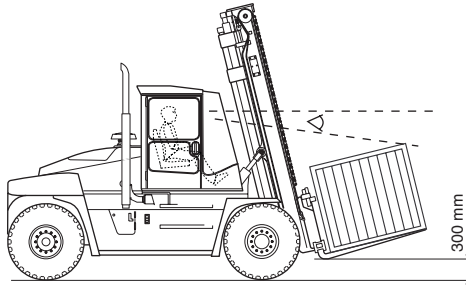
Instructions for forks

- 1 Lift the load a short distance off the ground. Back away from the loading site.
- 2 Adjust the load height and tilt angle to transport position, see *Transport position page 177*.

Transport position

The transport position should be assumed when the machine is to be operated with or without a load, which minimizes the risk of tipping/rolling over and imbalance while operating. In transport position, the mast is tilted back and the load is lifted slightly, approx 300 mm (see figure to the left). The load's centre of gravity should be centred sideways (laterally).

If the load conceals the view forwards the machine must be reversed.



Transport position

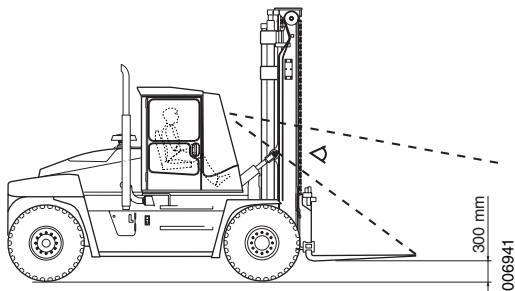
006942

NOTE

Local regulations may apply when handling special loads. Check and observe them.

Transport position should also be assumed when the machine is to be operated without load, in order to maximize the operator's field of view.

At transport position without load the mast must be vertical and the forks lifted slightly above the ground, approx 300mm. (See figure to left). The forks must be side shifted so that a fork end is visible through the mast, in this way the total length of the machine including forks is visible.



Transport position without load

006941

Operating on gradients

It is important to operate with extreme care on gradients since there is an increased risk of tipping and rolling over. Remember the ramp in-cline.

NOTE

When braking, use only the service brake pedal (right brake pedal) to retain engine braking. Avoid using inching.

- When operating with a load.

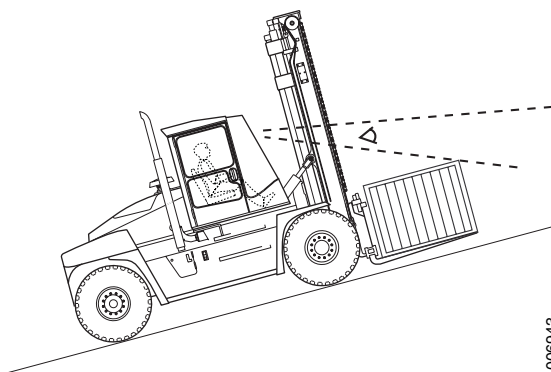
Adjust the load height and tilt angle to transport position, see *Transport position page 177*.

Always drive with the lifting equipment inclined upwards, regardless of direction of travel, that is, the truck must be reversed down an incline.

- When operating without a load.

Lower the attachment and tilt the mast as far back as possible.

Always drive with the lifting equipment inclined upwards, regardless of direction of travel, that is, the truck must be reversed down an incline.



Operating with load on gradient

006943

Working near overhead high voltage power lines

Operate with extreme care in all work near overhead high voltage power lines, keeping in mind the extensive reach capacity of the mast and load.



DANGER

The machine comes into contact with overhead high voltage power lines. Remain in the driver's seat and call for help!

Fatal danger!

Remain seated in the cab. Wait for help.

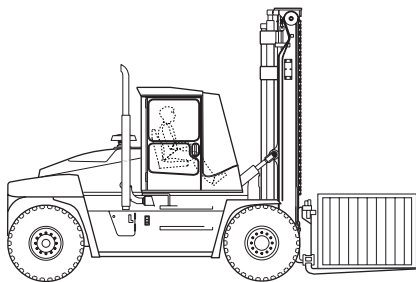
5.5.3 Unloading

General

There are different types of lifting attachments for load handling, e.g. forks, booms and side lift attachments for container handling.

Instructions for forks

- 1 Operate forward and stop in front of the unloading site.
 - When needed, lift the load sufficiently (but not higher) for unloading.
 - Approach angle towards the load should be as straight as possible.
 - Tilt the mast to vertical position.
- 2 Operate forward slowly until the load is in position above the unloading surface.
- 3 Apply the parking brake if desired or keep the machine still using the service brake (and the inching pedal if necessary). Alternatively move the gear selector to neutral position.
- 4 Lower the load slowly and make sure that it stands securely on the unloading surface, for example, level ground or a stack.
- 5 Reverse away from the stack slowly and lower the forks to transport position.



006944

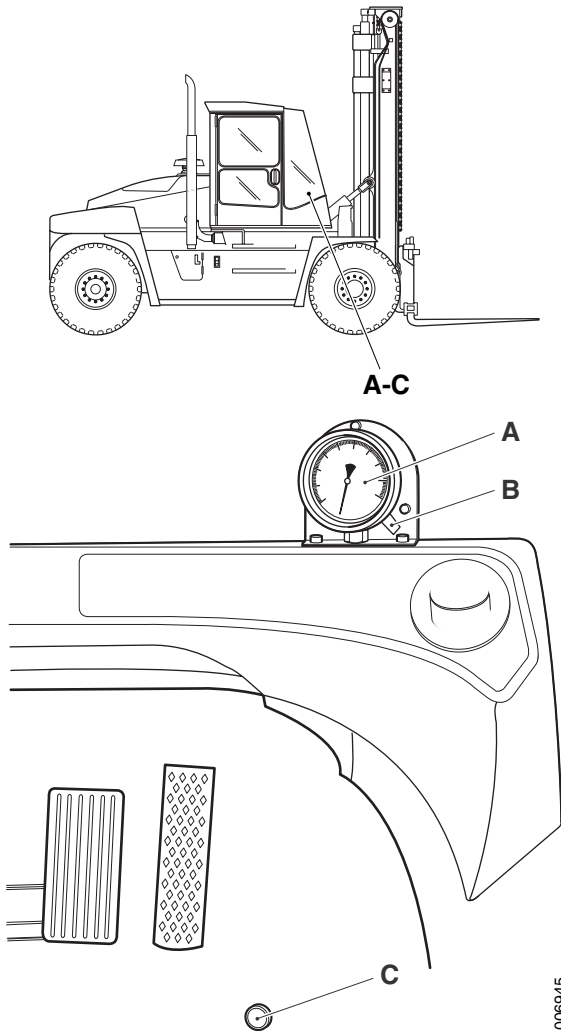
5.5.4 Functions for load handling

Hydraulic weight indicator



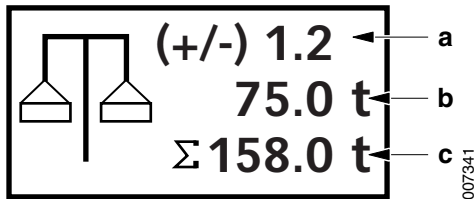
The load weight is checked as follows:

- 1 Lift approx 1.5 m without load.
- 2 Lower approx 5 cm to remove friction etc.
- 3 Press the foot button.
- 4 Check the indicator and rest if necessary by turning the knob.
- 5 Carry out load handling.
- 6 Lift approx 1.5 m.
- 7 Lower approx 5 cm.
- 8 Read the indicator.



006945

- A. Weight indicator
- B. Knob
- C. Foot button



Scales

(Controls electric servo for load handling only).

NOTE

For accurate weighing the scales must be calibrated at regular intervals using a known weight, as heavy as possible. For calibration, contact service personnel.

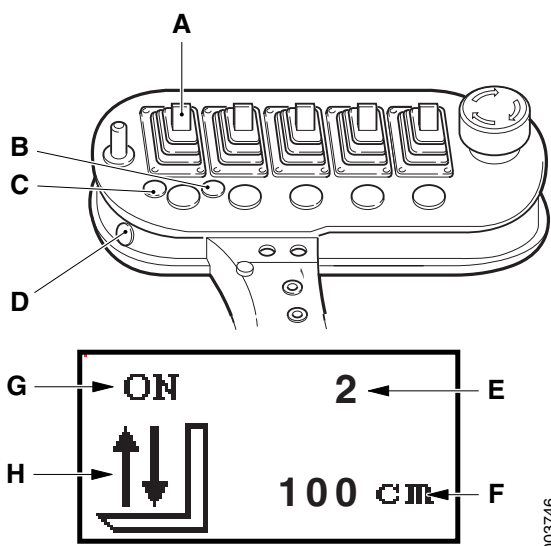
The weight of the load is approximated using the operational menu for scales.

- 1 Set the mast vertical.
- 2 Check that current weight in the display shows 0, otherwise reset using the function keys for plus and minus.
- 3 Place the load at the same centre of gravity distance as when calibrating.
- 4 Perform the lift movement and then lower the load approx. 30 cm.
- 5 Select the operational menu for scales.
 - a. Shows dead weight (tare) in tonnes.

The value shown in the row (b) can be reset to zero (off-set) using the function keys for minus and plus. Set value is shown in row (a).

- b. Current weight in tonnes (net weight).
- c. Total weight in tonnes (gross weight).

The value shown in row (b) can be added to the row (c) with the function key for Return. The value in the row (c) can be reset by pressing function keys Reset and Return at the same time.





003746

- A. Lever for lifting and lowering
- B. Switch for increasing the lifting height pre-selection (1-15).
- C. Switch for reducing the lifting height pre-selection (1-15).
- D. Switch for lifting height pre-selection.
- E. Selected level for lifting height pre-selection (1-15)
- F. Retrieved lifting height for current lifting height pre-selection
- G. Lifting height pre-selection ON or OFF
- H. Indication of the direction in which the load has to be moved to reach the desired lifting height.



Lifting height pre-selection





Lifting height pre-selection can be pre-defined for 15 different heights. The lift height is shown in cm and the accuracy is +/- 15 mm.

The desired lifting height (1-15) is selected by increasing or reducing it by means of the function key  and  on the steering wheel panel terminal. Alternatively, the increase and reduce buttons beside the lifting lever can be used (pos. B and C in the figure). The selected lifting height is shown on the control and monitoring system display.

Programming pre-selection 1-15:

- Place the fork assembly at the desired lift height. Select lifting height pre-selection 1-15 (position E). The switches for decreasing (position C) and increasing (position B) or  and  are pressed simultaneously for a second.
- Set lift height is shown in the operational menu for lifting height pre-selection (position F).
- The lowest and highest lift heights can be calibrated with a service code.

- 1 Perform load handling, for example lift/lower load.
- 2 Select pre-selection 1-15. Select with switch (position B and C) or  and . When lifting height is selected, the function is activated and ON (position G) is shown on the display.

When lift height has been selected, activate lift- and lower function with lever (position A) to move the forks (or attachment) to the selected lift height. An arrow (position H) in the display indicates whether the load should be raised or lowered. When the fork assembly is closing on the lift height, lifting- or lowering speed is decreasing. Note that the lever must be activated during the move.

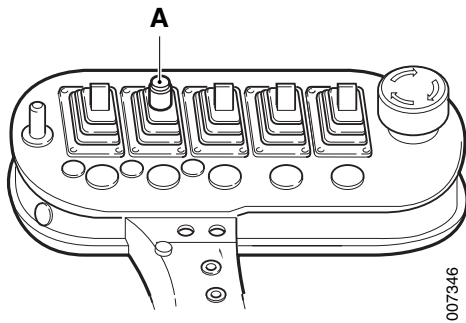
Lifting height pre-selection can be activated or de-activated with this switch (position D), i.e. it switches between ON and OFF (position G). This can be useful if:

- the lifting equipment has reached the selected lifting height but some height adjustment is needed. Switch to OFF and adjust lift height with the lever (position A).
- the desired lifting height pre-selection (position E) is displayed but the function is in the OFF mode. Switch to ON and activate the lever (position A).

End-position damping at the lowest and the highest lift heights give soft stops.

- 3 Continue load handling.

Lifting height pre-selection works continually until the function is deactivated (switched off) with the switch (position D) on the hydraulic control electric servo.



007346

Vertical hold



vertical hold tries to continuously keep the load vertical. The system is load compensating and also considers machine descending when load is lifted/set down from/to the ground. Compensation is achieved after the function for lifting/lowering has completed.

The function for vertical hold is activated with the switch (position B).

- 1 Perform load handling, for example lift/lower load.
- 2 Activate the function for vertical hold with the switch (position A).

The indication lamp (orange) for vertical hold on mast or the steering wheel panel gives the status:

- The indicator flashes: The vertical position of the mast is adjusting.
- The indicator lights continuously: The mast is in vertical position.
- The indicator is out: vertical hold is not active.

- 3 Continue load handling.

Function for vertical hold is continuous until deactivated by of movement of the tilt lever.

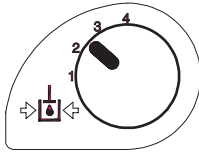
Automatic clamping function



Can only be installed on machines equipped with paper handling equipment.

When Kalmar's KCS automatic clamping unit is used, the pre-set clamping pressure is always reached on the rolls. If the pressure falls during the time that the roll is clamped, the pressure is automatically increased to the pre-selected value. There are two versions of KCS automatic clamping:

- One preselected pressure. This pressure can be set to any value between 50-160 bar, using the service code.
- The driver can choose one of four pre-selected clamp pressures by means of a switch. These pressures can be set to any value between 50-160 bar, using the service code.



Switch, clamp pressure

006203

A green lamp on the mast light continuously when the pre-set pressure has been reached. If the pressure needs to be adjusted, the lamp will flash briefly.

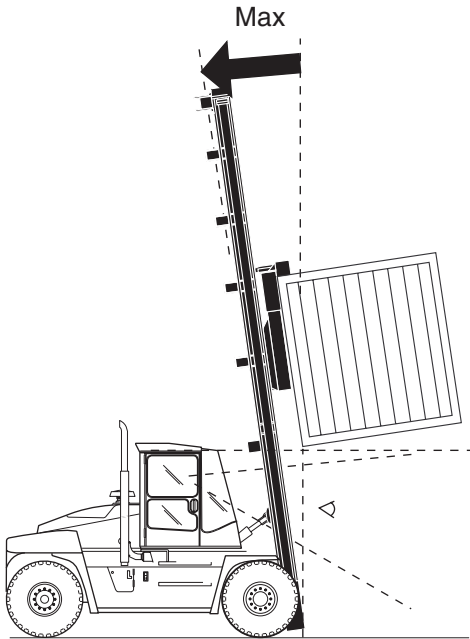
- 1 Select clamp pressure, only applies if the machine is equipped with a clamp pressure selection switch
- 2 Carry out load handling, e.g. place the clamp round a roll of paper.
- 3 Check the green lamp on the mast
 - a. The lamp flashes while the system optimises pressure.
 - b. The lamp gives lights continuously when the pressure has been reached.
 - c. The lamp goes out when the clamp is open.

Side lift attachment



General

Keep in mind when handling side lift attachment with empty container:



Transport position with side lift attachment

001949

WARNING

Never operate a machine where the indicator lamps do not work.

Danger of reduced safety when load handling!

If the indicator lamps do not function the machine must be taken out of service and repaired.

- Before beginning work, check the function of the lateral lift attachment's indicator lamps.

It is forbidden to use the attachment if the lamps give incorrect indication or do not work.

Use of the attachment without functional indicator lamps is a great safety risk.

- The brakes should always be operated gently with great care according to prevailing conditions.
- When operating without a load, the side lift attachment should be lowered all the way.
- When operating with a load, the machine should be in transport position, see figure.
- It is forbidden to operate the machine with a load higher than the position illustrated in the figure. The side lift attachment, with or without load, may only be raised higher than illustrated when stacking.
- After stacking, the side lift attachment must always return to transport position (with load) or lowest position (without load) before the machine may be operated.
- The mast must always be tilted all the way back when operating, see figure.

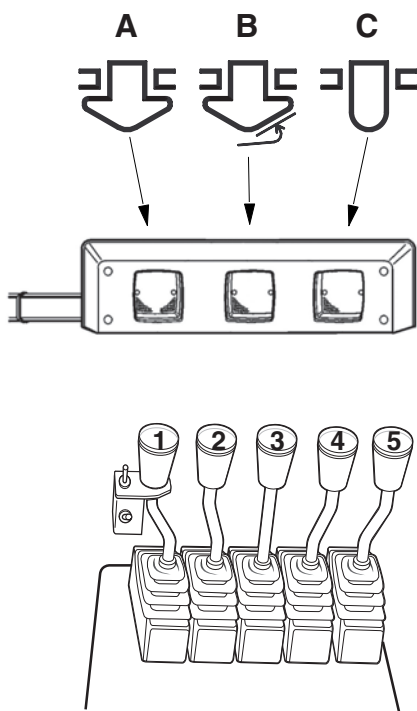
- If forward visibility is obstructed by the load, the operator should reverse.

WARNING

The side lift attachment (with or without load) is an easily operated tool with great strength.

Fatal danger and risk of property damage!

Make sure that nobody stands under a raised attachment, regardless of whether it is loaded or not. Exercise great care while operating.



Lift technique

- 1 Set spreading to relevant container length (position 4).
- 2 Drive slowly toward the container, adjust side shift (position 3).
- 3 Tilt the mast slightly forward (position 2), approx. 2°, lower the side lift (position 1) to the container and fit both twistlocks in the container's lock holes so that both sides of the side lift rest on the container. Check that lamp position B is lit.
- 4 Lock twistlocks (position 5). Check that lamp position A is lit.
- 5 Tilt the mast back and lift. Check that lamp position B goes out when the container is lifted.
- 6 Transport the container in transport position. Reverse if the container obstructs visibility.
- 7 Releasing the container: Lower the container to the surface. Check that lamp position B is lit. Release the twistlocks. Check that lamp position C lights.

NOTE

For load handling with control lever, see plates in machine.

003933

Fork shaft system



WARNING

Take care when changing the attachment or the replaceable forks etc.

Risk of pinch injury!

WARNING

Always ensure that forks, inverted forks or coil ram are always stored in a secure place.

Forks

Removing

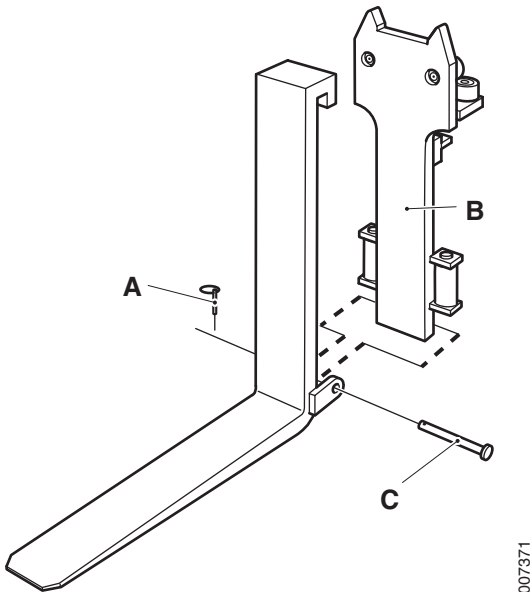
Carry out the following procedure to remove the forks:

- Place the forks in the storage position.
- Remove the locking rings/locking pins (position A) and tap out the pins (position C) that secure the forks to the shafts (position B).
- Tilt backwards and reverse away from the forks.

Re-fitting

Use the following procedure to re-install the forks:

- Always ensure that the locking pins are locked in position with the locking ring/locking pin.



007371

- A. Locking ring or locking pin
 B. Fork shaft
 C. Locking pin

6 Inspection and maintenance

General

This chapter describes:

- **DAILY INSPECTION**– performed by the operator.
Daily inspection describes the routine inspection that significantly contributes to making the machine a safe and reliable work place.
- **MAINTENANCE** – performed by the operator.
Maintenance describes some simple maintenance actions.
- **SERVICE** – performed by trained service technicians.
Advanced maintenance is performed according to a service schedule and by service technicians. Advanced maintenance is described in the service manual.
It is the operator's responsibility to ensure that the machine is brought in for service every 500 operating hours. Actions are described in the maintenance manual
- **ERROR CODE INFORMATION** – read off by the operator.
Error code information is read off by the operator from the control and monitoring system's display in the cab. Depending on the type of error code, it is handled by the operator or a service technician.

NOTE

All time information refers to operating time, that is, the time that is shown by the operating time gauge on the panel.



CAUTION

Only genuine spare parts from Kalmar Industries may be used.

This is in order to comply with warranty and service agreement conditions!

Use spare parts and fluids approved by Kalmar Industries to fulfil warranty terms.

6.1 Daily inspection

General

Daily inspection of the machine is extremely important in order to ensure that it is safe both for the operator and its surroundings.

It is recommended that every operator performs the checks before a new work shift. In this way, operators can avoid running defective machines with malfunctions that have been generated or caused during an earlier work shift.



WARNING

Never use a machine without first performing the daily inspection.

Fatal danger and risk of property damage!

Notify the foreman/supervisor if defects are found on the machine during daily inspection!

Instructions

Perform the following checks:

1. Visual external check of the machine. Walk around the machine and check the following:
 - Leakage from engine, transmission, drive axle, steering cylinder, hydraulic hoses and hydraulic cylinders
 - Loose wheel nuts
After changing the wheels, it is important to check the wheel nuts (after approx. 4-5 hours operating time).
 - Damage to rims
 - Uneven tyre wear - remove any glass, metal filings, etc. from the tyres
 - If the machine is equipped with side lift attachment; check that the sensors for twistlocks and alignment are clean and free of grease
 - Tyre pressure


- Damage or crack formation on critical components and their mounts such as lifting chains, fork, mast and tilt cylinder mounts



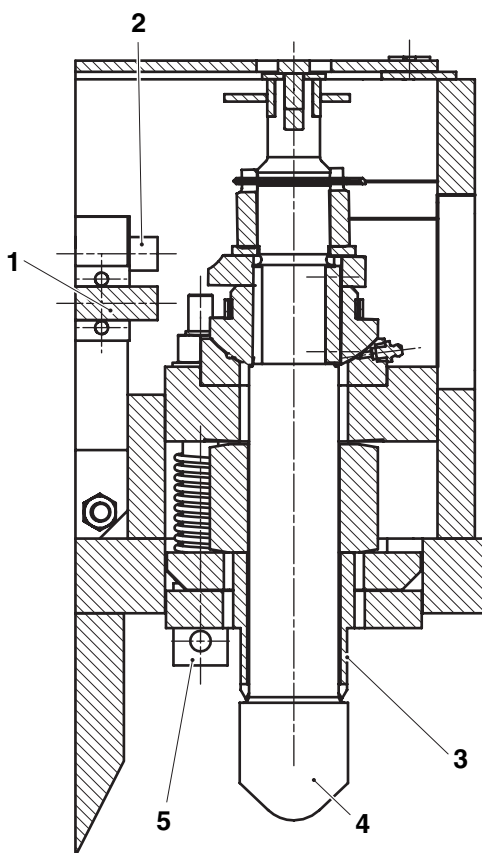
DANGER

The machine must be stopped immediately and left for servicing if there are signs of damage or cracks to welds.

Mortal danger and risk of property damage if damaged or cracks in welds are not rectified!

- Communication equipment - Direction indicators, brake lamps, headlamps and reflectors with regards to damage
 - Cab with regards to damage and dirty windows, rear-view mirrors
 - If the machine is equipped with a hydraulic oil cooler, check the function.
2. Check fluid levels for the following fluids according to description, see section 6.2 *Maintenance*. Top up, if needed, with the correct fluid:
 - Hydraulic oil
 - Hydraulic oil for brake system 
 - Batteries' electrolyte level
 - Coolant
 - Washer fluid – windows
 - Engine oil
 - Transmission oil
 3. Check the engine indicator for air filter and check and if necessary drain the fuel pre-filter. For a description, see section 6.2 *Maintenance*.
 4. Start the machine according to instructions and check:
 - Instruments – warning lamps, indicators, any error codes
 - Fuel level - the gauge must not show empty tank
 - Lighting, direction indicators, horn, brake lamps, flashing hazard warning lamps
 - Windscreen wipers
 - Check that the mirrors are intact, clean and correctly adjusted.
 - Cooling function of AC and ECC

5. Operate the machine slowly/carefully and check the following functions:
 - Brakes – test brake at least three times
 - Steering – in both directions
 - Transmission – all gears – forward and reverse
 - Noise from engine, transmission or drive axle
6. Run all functions with hydraulic cylinders (lift, tilt, side shift and fork positioning) to their end-positions for lubrication of cylinder barrels and piston rods.
7. If the machine is equipped with a side lift attachment, check the lift attachment and that:
 - The indicator lamps for twistlocks and alignment function





1. Sensor twistlock
2. Sensor alignment
3. Lock control
4. Lift pin
5. Alignment pin

WARNING

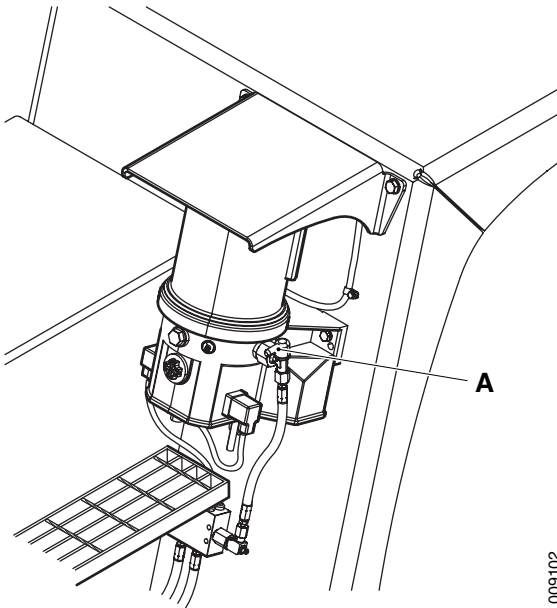
Make sure that the engine is switched off when working with twistlocks.

Twistlocks can be locked automatically if all sensors for alignment are activated manually.


- The alignment pins at the twistlocks can easily be moved up and down. Note that an alignment pin which rubs in the upper position can indicate alignment although the frame is not against the container.
 - Check that twistlocks function. This is done by lifting an empty container until the "Alignment" lamp goes out. It must not now be possible to release the twistlocks.
8. Check the machine's operating hours – notify the foreman/supervisor if the machine is close to a service interval.
 9. Notify the foreman/supervisor immediately if a machine defect has been detected.
 10. In cold weather:
 - check that the wiper blades have not frozen in position
 - remove snow from air inlets and cooling fins
 - anti-freeze in washer fluid
 - connect heater for cab and engine 
 11. If there is extra exhaust cleaning (particle filter): 

Short-circuit the pin on the pressure indicator and check if the signal lamp is lit.

Seal the exhaust pipe momentarily and check if the signal lamp indicates high back pressure. If not, clean the exhaust pipes from soot.



009102

12. With central lubrication 

Check that grease has not been forced out from the security valve (position A). This is a sign that the central lubrication is not working correctly.

13. Check for any active error codes.

See section 5.3 *Error codes*.

6.2 Maintenance

General

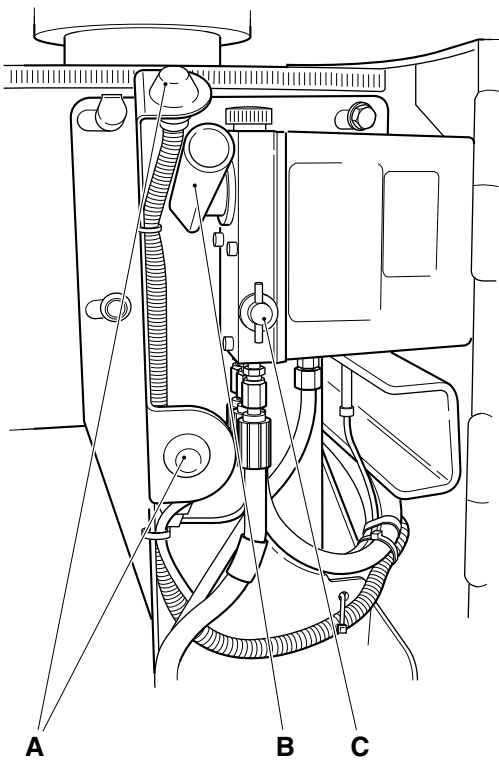
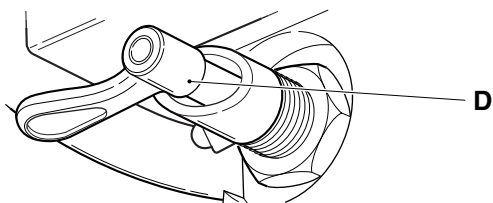
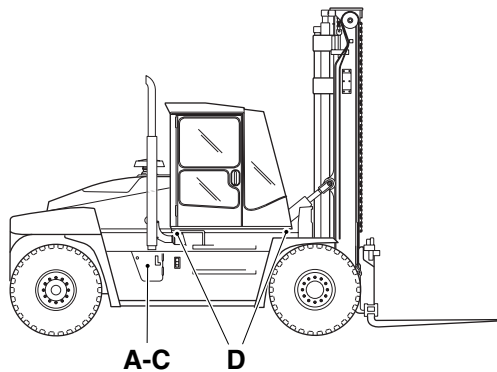
The following maintenance is described in this chapter:

- *Cleanliness, general page 194*
- *Fuel system, general page 196*
- *Windscreen washer, general page 199*
- *Air filter engine, general page 200*
- *Cooling system, general page 202*
- *Engine oil, general page 203*
- *Transmission oil, general page 205*
- *Hydraulic system, general page 206*
- *Tyres and rims, general page 207*
- *Accumulators, general page 211*
- *Central lubrication, general page 212*
- *Battery and battery disconnect switch, general page 214*
- *Main fuses for electrical system, general page 216*
- *Fuses for electrical system, general page 217*
- *Lighting, general page 221*

Safety during maintenance

Observe the following when maintenance work is to be performed:

- Always turn off the engine during service work. Only exception is when service work requires engine power.
- Use stop blocks by the wheels.
- No work may be carried out on the machine without the correct knowledge and skills to do the work correctly. Service performed incorrectly may be dangerous.
- Always wear a hard hat, protective glasses, gloves, work shoes and other protective items as required by the work situation.
- Read all plates and instructions on the machine and in the Operator's manual before carrying out any maintenance. Each one contains important information about handling and service.
- Avoid spills when draining/filling oils and fuel. Use reservoirs/ tanks, pumps, hoses, etc. for safe handling. Oils and fuel cause damage to the environment. Must be disposed of by an authorised company.
- The accumulator must always be depressurised before work on the hydraulic system.
- The unit for air inlet to the Spirit Delta cab (at front part of cab) is provided with slip protection and can be used as a platform to stand on when performing maintenance at the front part of the cab.



- A. Button for electric tilting 
 B. Pump rod bracket
 C. Pump valve
 D. Lock handle (illustration shows open position)

Tilting the cab

The cab must always be tilted past the balanced position. If the space to the side is insufficient, always secure the cab with a stay to prevent accidental lowering.

Preparations:

- Set the gear and direction of travel selector in neutral position.
- Tilt the mast forward and lower the forks.
- Apply the parking brake.
- Check the cab for any loose items.
- Close the doors.

Tilting

1. Turn both lock handles (position D) so that they end up in their outer position to release the cab from the frame.
2. Set the pump valve (position C) in right hand position.
3. Fit the pump rod in its bracket (position B).
4. Pump until the cab is in the end-position.

Lowering

1. Set the pump valve (position C) in left-hand position.
2. Fit the pump rod in its bracket (position B).
3. Pump all the way until the cab rests on the frame.
4. Turn both lock handles (position D) so that they end up in their outer position to lock the cab to the frame.

Electric tilting



1. Open the cover for cab tipping.
2. Turn both lock handles (position D) so that they end up in their outer position to release the cab from the frame.
3. Set the pump valve (position C) in right hand position.
4. Use the control buttons (position A) to raise the cab to end-position. Press in both buttons at the same time.

Electric lowering



1. Set the pump valve (position C) in left-hand position.
2. Use the control buttons (position A) to lower the cab until it rests on the frame. Press in both buttons at the same time.
3. Turn both lock handles (position D) so that they end up in their outer position to lock the cab to the frame.
4. Close the cover.

000859

6.2.1 Cleanliness

Cleanliness, general

Dirt has a negative impact on performance (heat problems). Experience shows that clean machines have fewer malfunctions.

The machine should be washed regularly for optimal function. Keep the following in mind when washing the machine:

- Use mild cleaning agents.
Use a de-greaser when needed. Scrub when needed.
- Use a high-pressure washer, wide water jet.



CAUTION

Washing sensitive components with a high pressure washer can lead to short circuits and cause faults.

Product damage!

Do not use a high-pressure washer on the battery compartment, electrical components, control units, connectors, cabling joints, cylinder seals, stub axles, axle seals and chains.

NOTE

Do not rinse off the particle filter on the exhaust system toxic waste may be released and be rinsed into the sewer.

NOTE

After washing with de-greaser, the hydraulic cylinders should be run in and out a few times to obtain satisfactory lubrication once again.



CAUTION

Cleaning agents contain different solvents.

Health hazard and flammable.

Provide adequate ventilation when cleaning the machine. Avoid skin contact, use protective gloves. If dizziness occurs when using cleaning agents, get into fresh air immediately and seek medical attention. If cleaning agent has splashed into the eyes, rinse immediately with plenty of water and seek immediate medical attention.



CAUTION

Parts can flung around when using compressed air for cleaning.

Danger - risk of injury!

Use protective gloves and eye protection. Take care that neither yourself or bystanders are injured.



WARNING

The strength of the roof window may be severely reduced in case of exposure to substances containing: aromatic hydrocarbons, ketones, esters and chlorinated hydrocarbons.

Low strength! Danger!

Check the roof window's surface at regular intervals. Only use water with an anti-freeze fluid or mild cleaning agents when cleaning. Rinse with plenty of lukewarm water. Replace a damaged roof window immediately if it is cracked or scratched!



WARNING

Scratches or other damage to the roof window results in reduced strength.

Low strength!

Replace a damaged roof window immediately.

The inside of the cab on the machine should also be kept clean for best functionality.

- Plastics: Vacuum, brush/wipe with a damp cloth. Use a mild detergent and always wipe with a cloth dampened in clean water.
- Textiles: Vacuum, brush/clean with furniture or carpet cleaner, according to the instructions on the packaging.

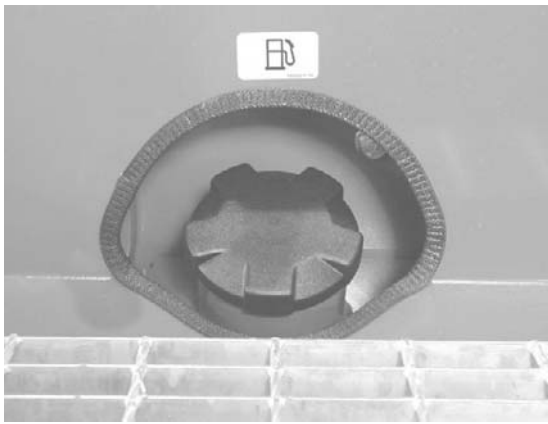
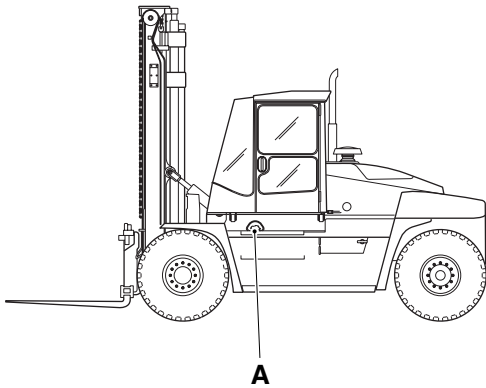
6.2.2 Fuel system

Fuel system, general

The filler pipe is located on the machine's left-hand side.

NOTE

Make sure that the area around the tank cap is clean when refuelling.



000873

A. Refuelling point

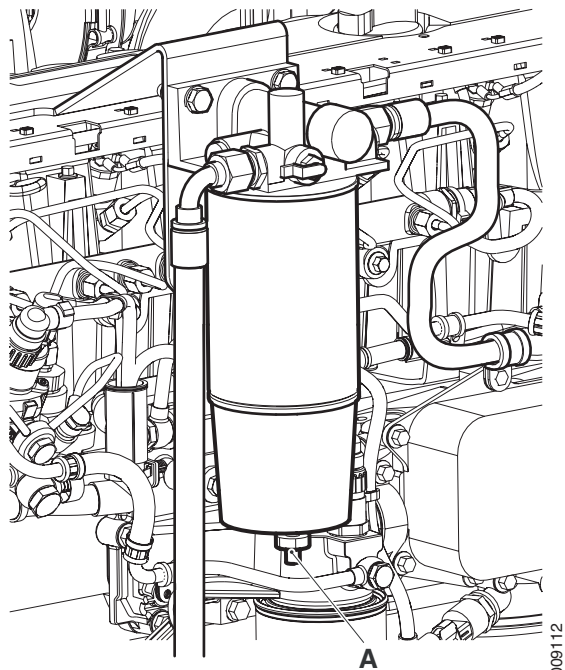
WARNING

Fuel is highly flammable and a health hazard.

Fire hazard! Health hazard!

Handle with great care and avoid all possible ignition sources, such as cigarettes and sparks. Avoid skin contact, use protective gloves. In case of skin contact and spills on clothes, wash the skin and change clothes.

- Always fill up with diesel fuel.
- Never use additives in the diesel fuel.
- In wintertime, try to fill up immediately after finished operation. This prevents condensation in the fuel tank. Do not use anti-condensation agents, for example, alcohol, in the fuel.
- Do not refuel when the engine is running.
- Make sure that the fuel nozzle is connected securely in the filler pipe (to prevent spills and generation of static electricity).
- Clean around the filler pipe after refuelling and handle used rags, wiped up fuel, etc. in an environmentally sound manner.
- For tank volume, see chapter 9 *Specifications*.



009112

Volvo
A. Water separator

Fuel pre-filter, instructions

NOTE

The water separator must be drained of water when necessary.

DANGER

Fire risk.

Fatal danger!

Fuel is highly flammable. Do not smoke near the machine when working on the fuel system.

- 1 Stop the engine and switch off the main current.
- 2 Place a container under the fuel pre-filter.
- 3 Drain the fuel pre-filter of water.

Open the drain tap on the underside (position A), close the tap when clear fuel (no water bubbles) runs out. Only tighten the tap by hand.

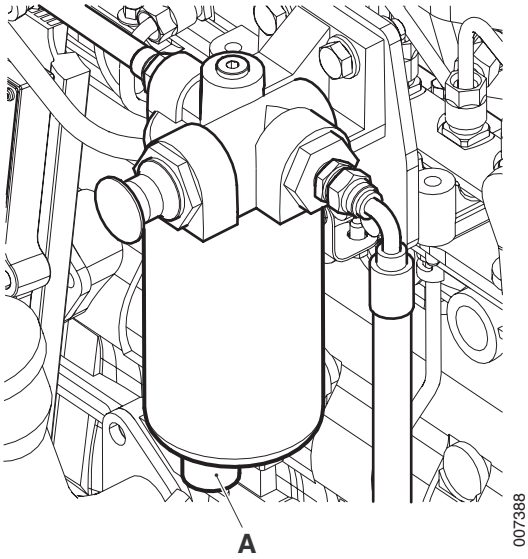
WARNING

Fuel on the hands.

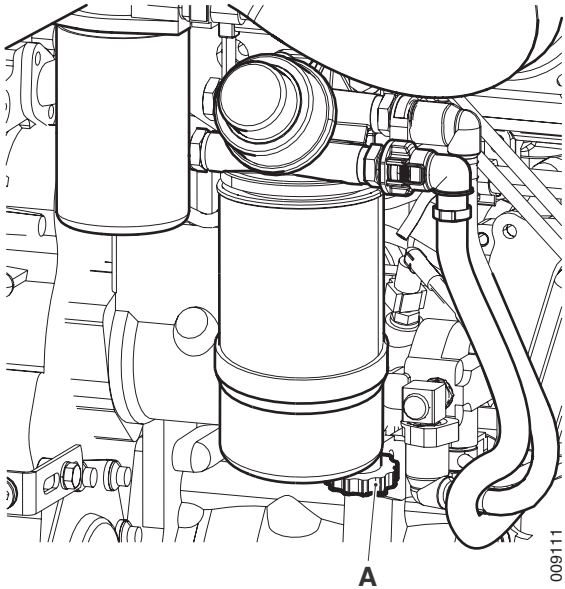
Rashes and irritation.

Avoid skin contact with fuel, use protective gloves.

- 4 Remove the container. Handle the fuel as environmentally dangerous and flammable waste.



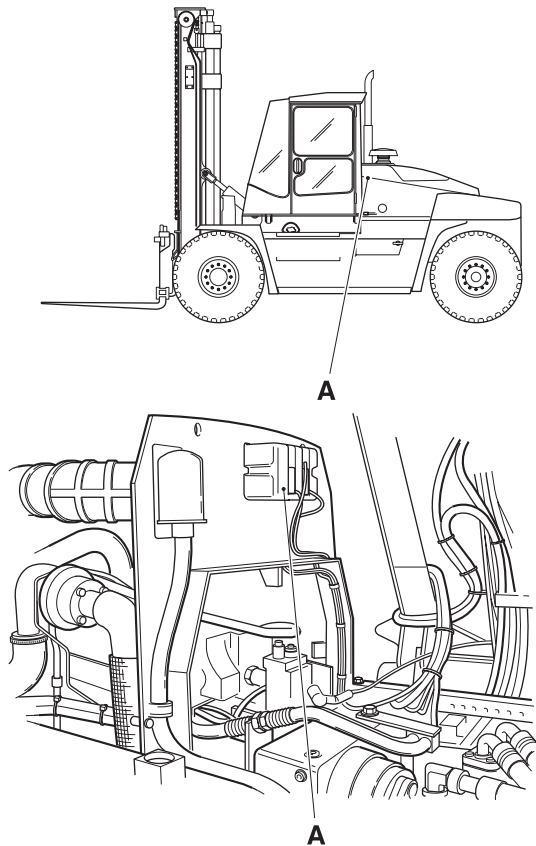
Cummins QSB6.7
A. Water separator



Caterpillar C6.6
A. Water separator

6.2.3 Windscreen washer

Windscreen washer, general



A. Washer fluid reservoir

WARNING

Only use clean water with an anti-freeze agent, for example, anti-freeze fluid.

**The strength of the roof window may be affected!
Danger!**

The strength of the roof window may be severely reduced in case of exposure to substances containing: Aromatic hydrocarbons, ketones, esters and chlorinated hydrocarbons.

The washer fluid reservoir (position A) is located in the front part of the engine compartment.

Instructions

Check that the reservoir contains enough washer fluid. Top up, if needed. For volume, see chapter 9 *Specifications*.

Use anti-freeze fluid in wintertime. Choose a suitable concentration (mix of water/anti-freeze fluid) according to the winter conditions and outdoor temperatures.

007511

6.2.4 Air filter engine

Air filter engine, general

NOTE

Poorly filtered induction air quickly results in serious engine damage.

The filter is replaced by the service technician during routine inspections and service. When the machine is used in dusty air, the filter may be clogged after a relatively short time.

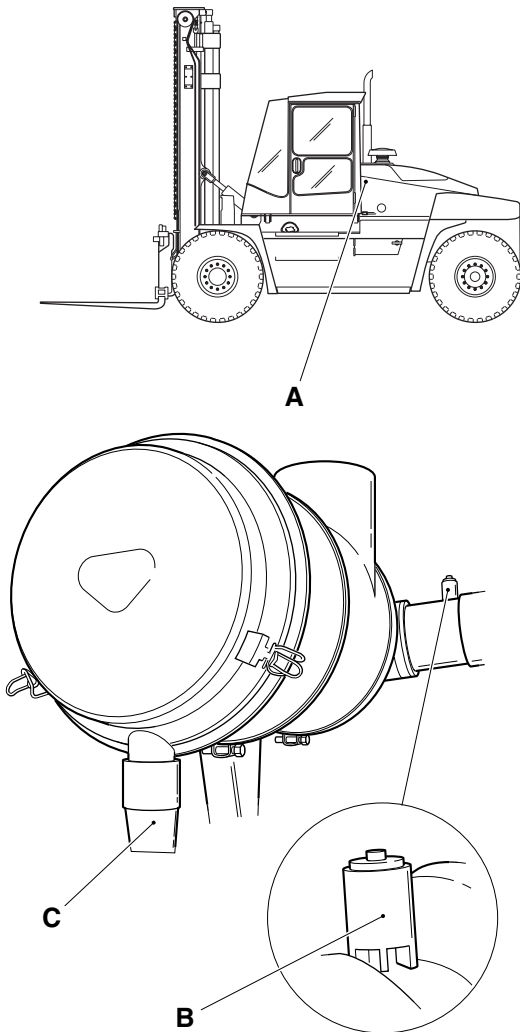
In the induction system, between the engine and air filter (position A), there is an indicator (position B) which lights red when the air filter is clogged.

The air filter has a dust reservoir (position C) which is usually emptied during operations due to vibrations in the induction system. It can also be emptied manually by shaking.

Instructions

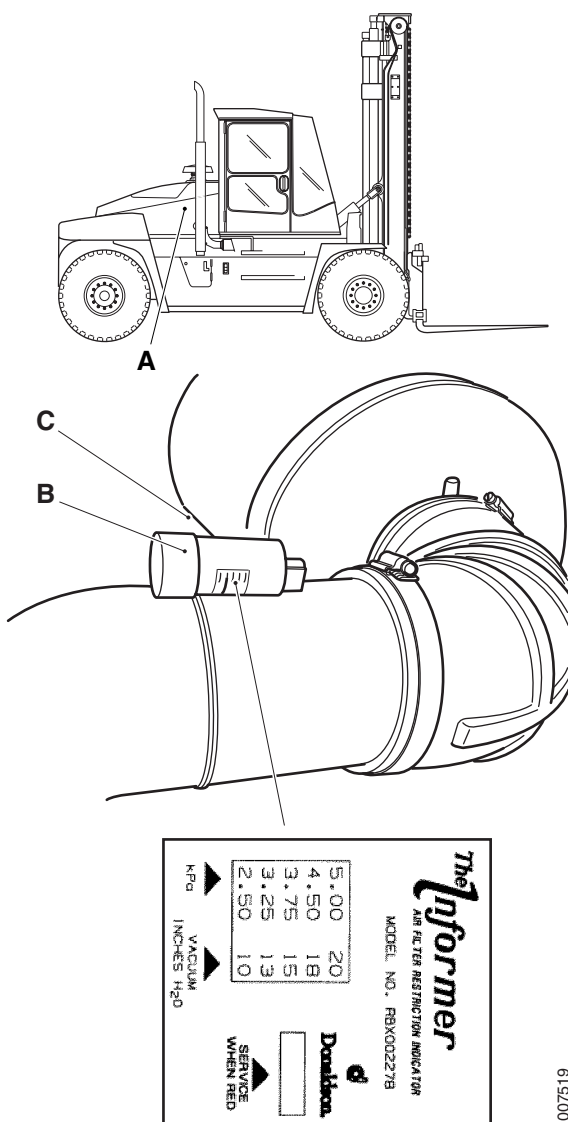
Check the indicator regularly and contact service as soon as the indicator shows a red signal.

The indicator can be reset.



- A. Position of air filter holder
- B. Indicator for replacement
- C. Dust reservoir

000662



615/100



In the induction system, between the engine and air filter there is an indicator (position A) which gives a scale of how clogged the air filter is. The indicator also shows red when the filter insert must be replaced.

Instructions

Check the indicator regularly and contact service as soon as the indicator shows a red signal.

The indicator can be reset.

- A. Position of air filter holder
- B. Indicator for replacement
- C. Dust reservoir

6.2.5 Cooling system

Cooling system, general

Coolant is filled via the system's expansion tank (position B). The coolant level should be between the MIN and MAX markings (position C) on the expansion tank.

In case the coolant temperature is too high, the high pressure escapes through the opening in the pressure cap (position B).

NOTE

Do not open the pressure cap until the coolant temperature has dropped. Hot coolant may spray up and out!

If the coolant level is too low an error code will be shown in the control and monitoring system display (position 41):

NOTE

Too low a coolant level may cause engine damage or may cause the engine to stop.

Instructions

WARNING

The cooling system is pressurized. Steam or hot coolant may spray out.

Risk of scalding/burn injuries!

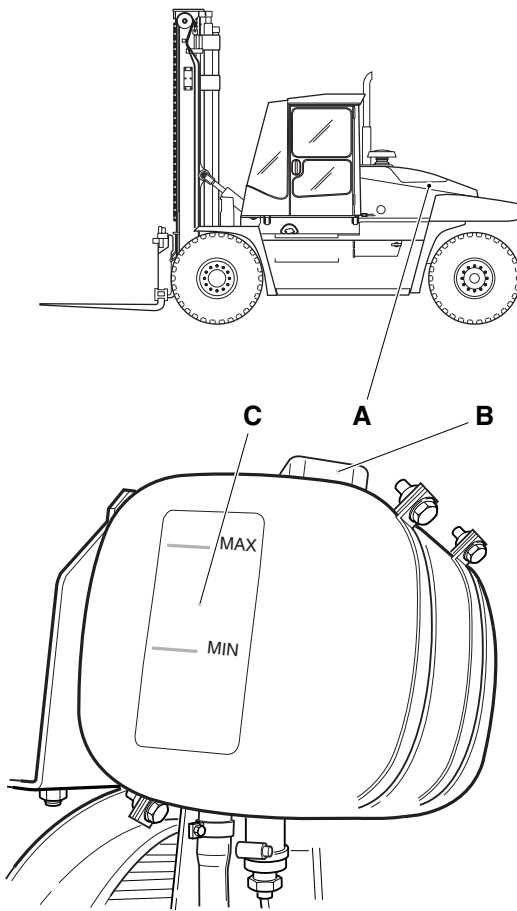
Open the pressure cap (position B) very carefully when the engine is hot. Wait until the coolant has cooled down before topping up.

WARNING

Glycol and anti corrosion agents are health hazards.

Health hazard!

Handle with care. Avoid skin contact, use protective eyewear and protective gloves. In case of skin contact, wash your hands.



- A. Position for coolant reservoir (expansion tank)
 B. Pressure cap for filling
 C. Level marking, MIN and MAX

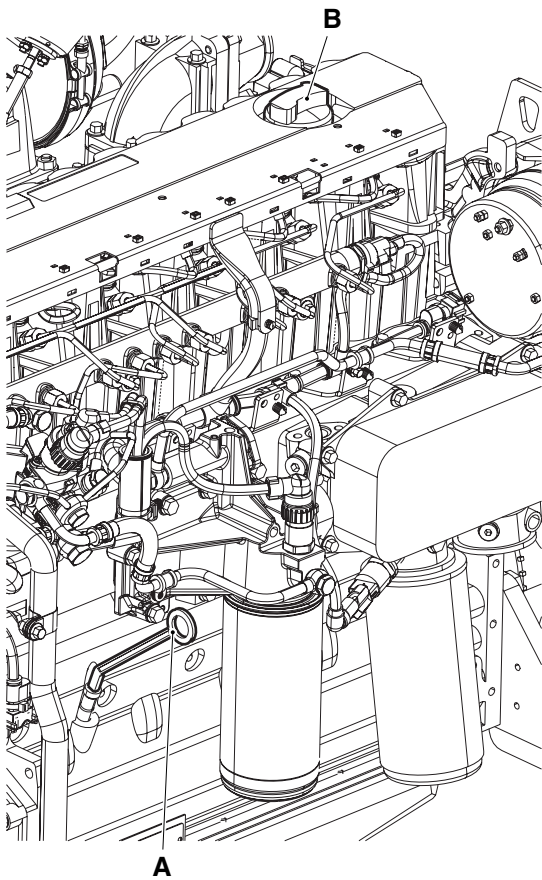
000863

If needed, top up with water (add at least 50 % glycol). For volume, see chapter 9 *Specifications*.

Anti-corrosion agent must always be added if glycol is not used. However, anti-corrosion agents do not contain anti-freeze and may only be used if the outdoor temperature is always above 0 °C.

6.2.6 Engine oil

Engine oil, general



007509

Volvo

A. Dipstick

B. Filling

WARNING

Avoid prolonged skin contact with engine oil.

Health hazard!

Use protective gloves.

The engine oil filler point (position B) and dipstick (position A) are located under the engine hood. For Volvo engines, it is on the left-hand side, for Cummins engines, it is on the right-hand side and for Caterpillar filling is on right-hand side and the dipstick on the left-hand side.

Instructions

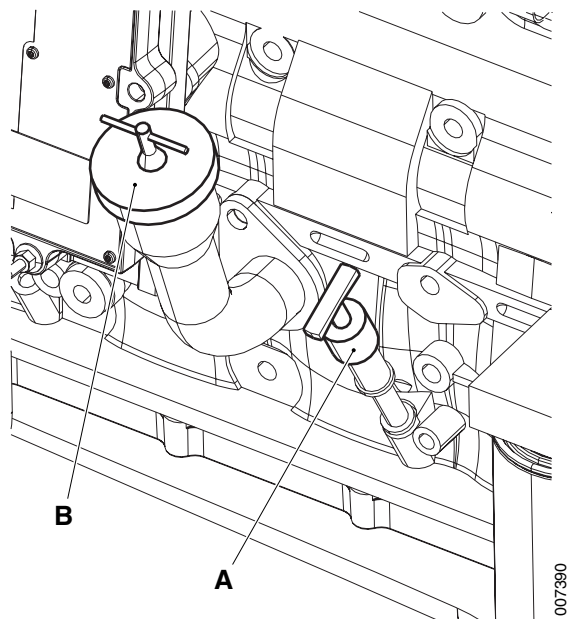
Check the oil level when the engine is at operating temperature. The dipstick has two markings, MAX. and MIN., the oil level should be between these markings.

- Wipe off the dipstick before checking.
- Fill engine oil (position B) when needed (for volume, see chapter 9 *Specifications*).

It is recommended that oil is filled when the engine and oil are at operating temperature. Fill - wait awhile - check the dipstick.

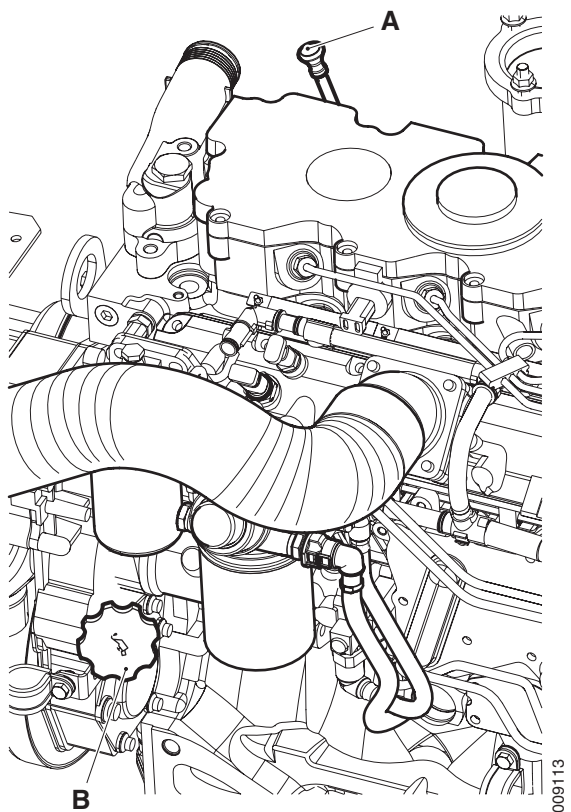
NOTE

Fill oil with care to prevent other fluids or particles from contaminating the oil. Contamination means risk of engine damage.



Cummins QSB6.7

- A. Dipstick
- B. Filling

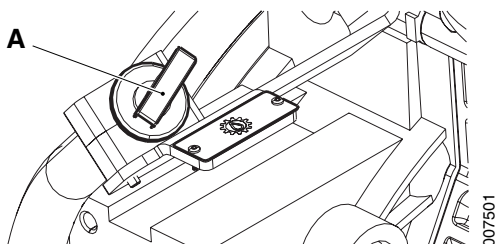
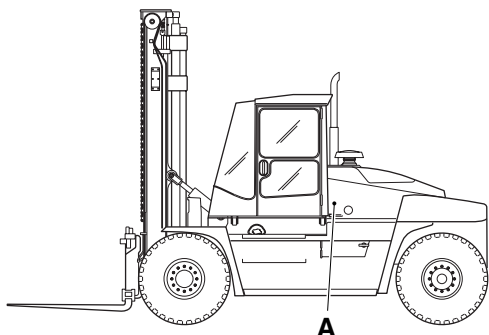


Caterpillar C6.6

- A. Dipstick
- B. Filling

6.2.7 Transmission oil

Transmission oil, general



A. Dipstick and filling point

WARNING

Avoid prolonged skin contact with transmission oil.

Health hazard!

Use protective gloves.

The transmission oil filler pipe (position A) and dipstick (position A) are located under the engine hood on the left-hand side.

Instructions

Check the oil level with the engine running at idle speed and the transmission in neutral and at operating temperature (approx. 60-70 °C). The dipstick has two markings, MAX. and MIN., the oil level should be between these markings.

- Wipe off the dipstick before checking.

NOTE

The oil dipstick is long. Use protective gloves.

- Fill transmission oil (position A) when needed (for volume, see chapter 9 *Specifications*).

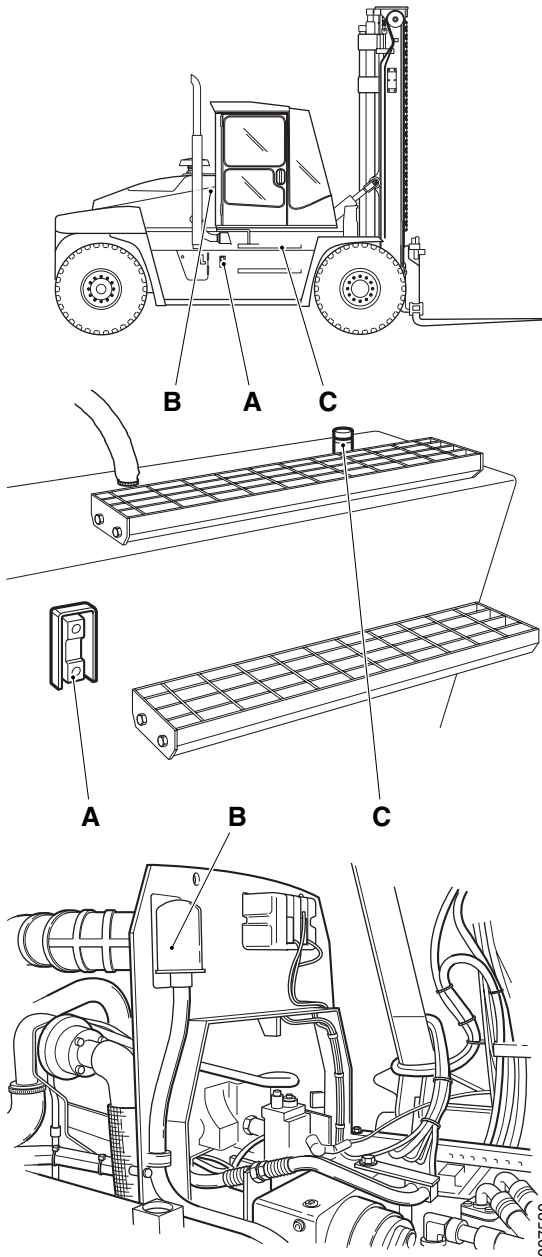
It is recommended that oil is filled when the transmission is at operating temperature. Fill - wait awhile - check the dipstick.

NOTE

Work carefully when filling transmission oil to prevent other fluids or particles from contaminating the oil. Other fluids or particles in the transmission oil means a risk of transmission damage.

6.2.8 Hydraulic system

Hydraulic system, general



- A. Level glass
- B. Breather filter
- C. Filling point

WARNING

Avoid prolonged skin contact with hydraulic oil.

Health hazard!

Use protective gloves.

The hydraulic oil tank is located on the machine's right-hand side.

Instructions

Check the oil level (position A) when all hydraulic pistons are in the retracted position. The level should be in the middle of the level glass. Top up oil (position C) as needed (for volume, see chapter 9 *Specifications*).

NOTE

Fill oil with care to prevent other fluids or particles from contaminating the oil. Contamination means risk of damage to the brake system and the working hydraulics.

6.2.9 Tyres and rims

Tyres and rims, general

DANGER

Changing tyres is high-risk work.

Fatal danger!

Let service personnel with the right competence and authority perform tyre changes and tyre handling!

DANGER

Penetrating objects such as crushed glass, pieces of wood, metal shavings, etc. and mechanical defects, such as uneven brake wear, can cause tyre damage.

Risk of tyre explosion! Fatal danger!

Check the tyres at regular intervals for external damage and tyre pressure.

WARNING

Spare and replacement tyres should be from manufacturers approved by Kalmar Industries.

Risk of overloaded tyres!

Use tyres approved by Kalmar Industries.

IMPORTANT

Wheels, Tyres and rims are sized and selected for each machine type so that the maximum wheel loads and driving speeds are not exceeded. Therefore, tyre size, tyre make, tyre type, rim type or rim manufacturer must not be changed without specific approval from Kalmar Industries.

WARNING

Post-tighten the wheel nuts on a new wheel after 4-5 operating hours.

Fatal danger and risk of property damage!

Tighten bolted joints alternately. Contact a service technician as needed.

Changing wheels

DANGER

When changing tyres, deflate first.

Risk of tyre explosion! Fatal danger!

Deflate tyres by loosening and removing the valve.

DANGER

Rim damage makes wheel handling extremely dangerous!

Risk of tyre explosion! Fatal danger!

Let service personnel change tyres, they have the competence and authority to handle tyres!



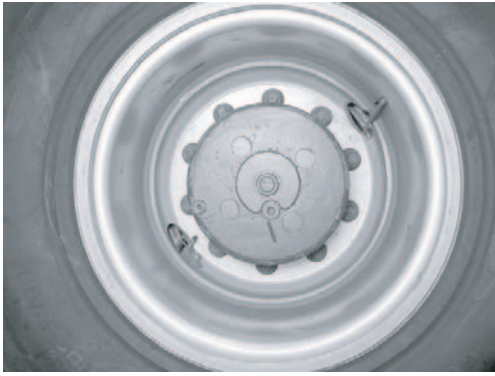
001865

Changing rear wheels:

- Lift under the steering cradle with a jack and make sure that the machine stands securely, e.g., on an axle stand.
- Deflate the tyre by loosening and removing the valve.
- Loosen bolted joints.

NOTE

Use suitable lifting equipment to secure the wheel when removing.



000867

Changing front wheels:

- Lift under the drive axle with a jack and make sure that the machine stands securely, e.g., on an axle stand.
- Deflate the tyre by loosening and removing the valve. Both the inner and outer tyres must be deflated.
- Loosen the bolted joint.

Both drive wheels on respective sides of the drive axle are secured with this bolted joint. There are spacer sections mounted between the wheels.

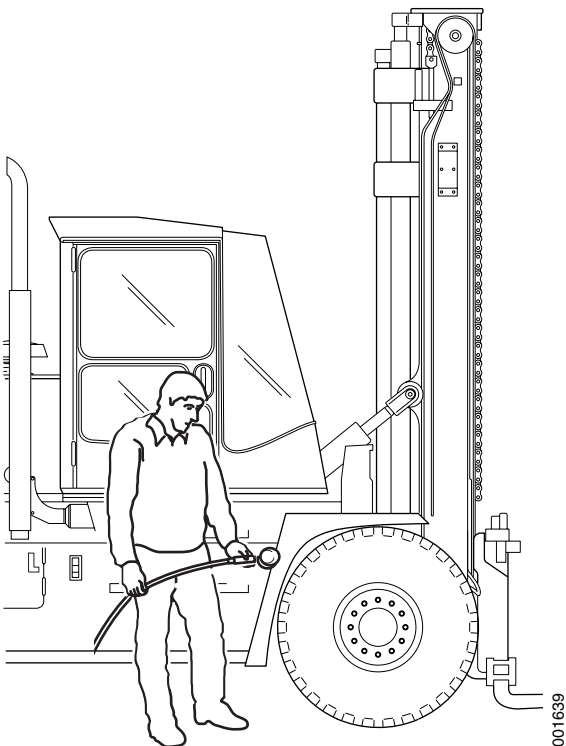
NOTE

Use suitable lifting equipment to secure the wheel when removing.

Inflating tyres

Care of compressor for inflating tyres:

- An air filter with water separator should be installed in the line from the compressor used for inflating tyres. The water filter minimizes the risk of corrosion on rims.
- Drain the water separator regularly.



001639

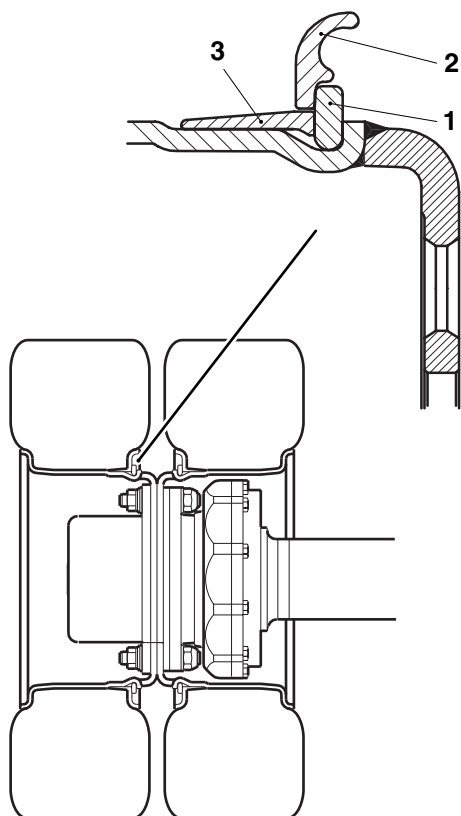


DANGER

Never stand in front of a tyre when inflating it! Do not exceed the prescribed air pressure. When changing tyre or rim version, another tyre pressure may apply, contact Kalmar Industries. The plate for tyre air pressure must be replaced with a plate with the applicable tyre pressure!

Fatal danger!

Always follow the instructions for inflating tyres to avoid serious accidents.



1. Locking ring
2. Side ring
3. Conical ring

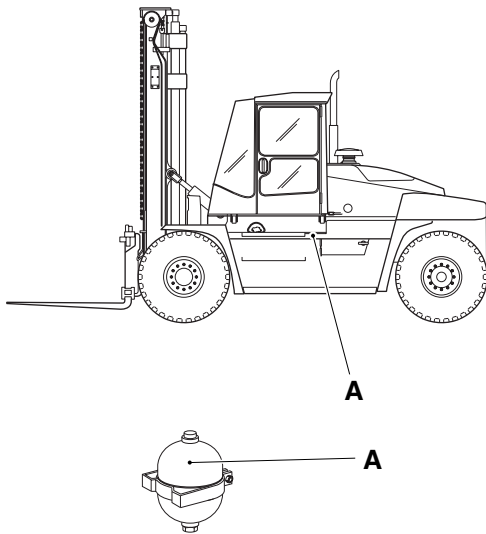
1. Before inflating, make sure that the rim's lock ring is in the correct position.

NOTE

If the tyre has been completely deflated, the rim must be dismantled and checked for any damage. Let service personnel with the right competence and authority perform tyre changes and tyre handling!

2. Connect the compressor hose with a self-locking chuck to the tyre nipple.
3. Stand obliquely behind the tyre and remain there during the entire pumping procedure to avoid being hit by pieces of rim if there is an explosion.
4. Inflate the tyre to the prescribed pressure, see chapter 9 *Specifications*. When changing tyre or rim version, another tyre pressure may apply, contact Kalmar Industries.

003770



A. Accumulator

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6.2.10 Checking accumulators

Accumulators, general

The function of the accumulator (position A) is to maintain even brake pressure and also to retain brake pressure, and thus braking action, a short time if hydraulic pressure is lost.

The accumulator is pre-charged with nitrogen gas.

Instructions

Check the seal as follows if the error code for low brake pressure is shown in the control and monitoring system display (position 41):

1. Start the engine and let it run until the accumulator is filled.
2. Stop the engine and then turn the ignition key to position I.
3. Press down the brake pedal with long pumping brake strokes, with a slight delay between each braking action.

It should be possible to brake at least six times before the error code for low brake pressure occurs.

4. Start the engine, allow the accumulator to charge and repeat the test a couple of times.

If it is not possible to brake six times before the error code for low brake pressure occurs, there is a defect in the accumulator. Contact service for troubleshooting and appropriate action as soon as possible.



WARNING

The machine's hydraulic system contains a high-pressure accumulator.

Danger!

Always be very careful when working with the hydraulic system, and avoid standing close to hydraulic components or hoses. Before working on the hydraulic system, the accumulators must be drained (see maintenance manual).

6.2.11 Central lubrication

Central lubrication, general



Central lubrication (which replaces manual lubrication) is available in different variants. The alternatives are:

- Manual, hand-pumping of lubricant at one lubrication point which then branches to all selected lubrication points.
- Automatic, pre-programmed lubrication unit for lubrication of all selected lubrication points at a set time interval. Extra lubrication is supplied when the switch in the cab is activated.

Central lubrication consists of the following components:

- Pump unit, with lubricant reservoir.
- Distribution block.
- Lines, to all selected lubrication points.
- Grease nipples, at all selected lubrication points.

Maintenance of the central lubrication system consists of refilling lubricant and a check that all connected lubrication points receive enough lubricant.

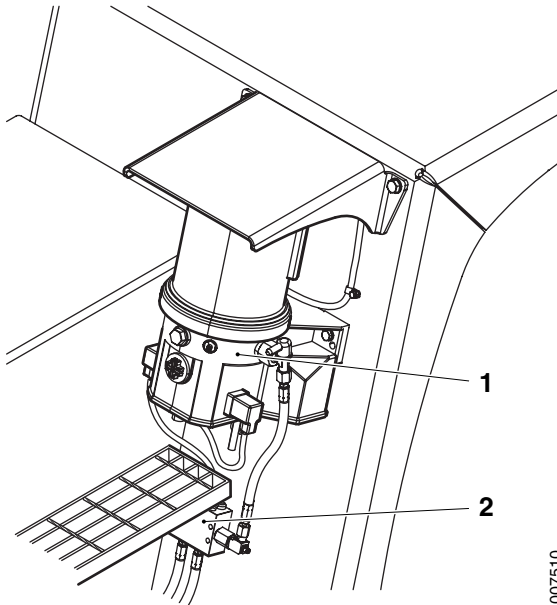
Instructions

NOTE

When working with the central lubrication, cleanness is of highest importance. Dirt and litter may cause system interruptions. Use petroleum or light gasoline to clean the system. Do not use trichlorethane or other organic solvents, for example alcohol, methanol, acetone etc.

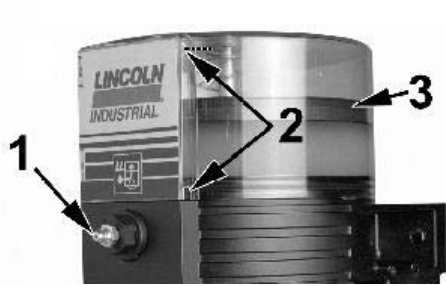
Function check of central lubrication function:

- Check that no "Er" indication is set in display on the container. This indicates a fault. Contact service.
- Check that no "LL" indication is set in display on the container. This indicates that lubricant needs to be refilled. See below.



007510

1. Pump unit
2. Distribution block



1. Refilling nipple
2. Ventilation hole
3. Plate

001948

Refilling lubricant:

- Refill the container to the “Max” marking through the nipple (position 1).
- The lubricant must be pure and must not change consistency as it ages.

Refilling lubricant when the container is empty:

- If the container is empty and then refilled, the pump may have to work a longer period of time in order to supply all lubrication points with enough lubricant.

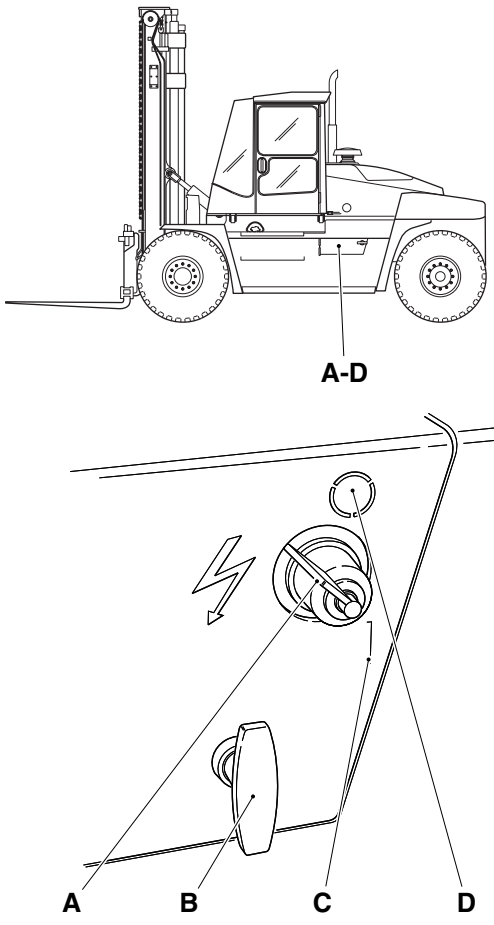
The switch for extra lubrication must be used (is placed to the left of the display on the container).

- Check that all air under the plate has disappeared (position 3).

The sealing of the plate must clean the hole on the top of the container. A small amount of lubricant must emerge to indicate that thorough venting has occurred.

6.2.12 Battery and battery disconnect switch

Battery and battery disconnect switch, general



- A. Battery disconnect switch
- B. Handle for opening/closing cover
- C. Battery disconnect switch in position on, that is, main current is connected.
- D. Battery disconnect switch in position off, that is, main current is disconnected.

WARNING

The battery's electrolyte contains corrosive sulphuric acid.

Risk of corrosive injury! Health hazard!

Use protective gloves and eye protection when working with batteries. Immediately remove any electrolyte in contact with bare skin. Wash with soap and plenty of water. If electrolyte has splashed into the eyes, rinse immediately with plenty of water and seek immediate medical attention.

WARNING

The battery's terminals may not be connected to each other or to common grounding points (chassis). This results in the short-circuit of the battery and can cause an explosion.

Corrosion damage and fire hazard! Danger!

DANGER

Always cut the machine's system voltage using the battery disconnect switch at the end of the shift, when working on the electrical system and when performing welding on the machine.

Danger!

The electrical system operates at 24 Volt. The voltage source consists of two 12 volt batteries, connected in series, charged by an alternator. The negative terminal is connected to the chassis.

The positive terminal is connected to a battery disconnect switch (position A).

Checking electrolyte level in battery

The batteries are located inside a compartment (position B) behind the steps on the machine's left side.

Checking the electrolyte level is recommended. Fill as needed with de-ionised water.

1. Turn off the battery voltage (position A) and open the compartment.
2. Check level. Fill as needed with de-ionised water.

Electrolyte's fluid surface should be 10 mm above the cells.

Batteries contain substances hazardous to the environment and personal health. Therefore, discarded batteries must be handled according to local/national regulations.

Starting with booster battery**WARNING**

Handle batteries and connectors with great care when jump starting. Do not mix up the battery poles! Follow the instructions for starting with the booster battery!

Risk of short-circuiting! Warning for hydrogen gas development! Risk of sparks and fire hazard!

1. Cut off the main power with the battery disconnect switch (position A).
2. Open the battery cover on the left-hand side of the machine.
3. Check that the engine on the machine to be given start aid is shut-off.
4. Check that the booster batteries are connected in series so that they supply 24 VDC. Do not disconnect the ordinary cables to the machine's battery.
5. Connect in the following order:
 - a. The red booster cable (+) to the discharged battery's plus terminal.
 - b. The red booster cable (+) to the booster battery's plus terminal.
 - c. The black booster cable (-) to the booster battery's negative terminal.
 - d. The black booster cable (-) to a point some distance from the discharged batteries, for example, at the minus cable's connection to the frame or directly to the engine block.

6. Start the machine providing the start aid.
7. Connect the main power using the battery disconnect switch.
8. Try to start the engine and then run the engine at heightened idling for about 10 minutes to charge the batteries.

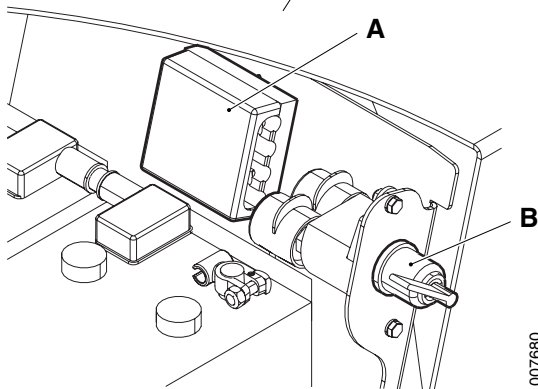
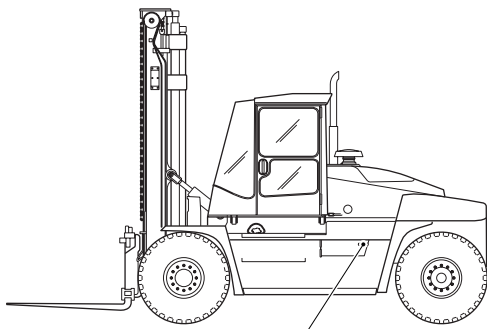
Do not move the connections during the start attempt – risk of sparks. Do not lean over any of the batteries.

9. Shutoff the batteries on both machines.

Disconnect the cables in the reverse order to when connecting them. One cable at a time! Batteries must always be equipped with protective caps over the terminals and connections.

6.2.13 Main fuses for electrical system

Main fuses for electrical system, general



A. Main fuse in battery compartment on frame
B. Battery disconnect switch

WARNING

Never use fuses with too high ampere rating.

Risk of damage or cable fire!

Follow instructions on the fuse plate for fuse type and ampere rating.

The machine's electrical system has one position for main fuses:

- A. Main fuses in battery compartment on frame, 4 fuses 25 A.

Interrupts all electrical power, except fuse number 7 in fuse holder F58-3 and fuse number 8 in fuse holder F58-4.

B Changing main fuse

When checking and changing main fuse:

1. Cut the main power using the battery disconnect switch.
See *Battery and battery disconnect switch, general page 214*.

2. Remove the plastic cover.

3. Check or replace fuses as needed.

Fuses are rated at 25 A.

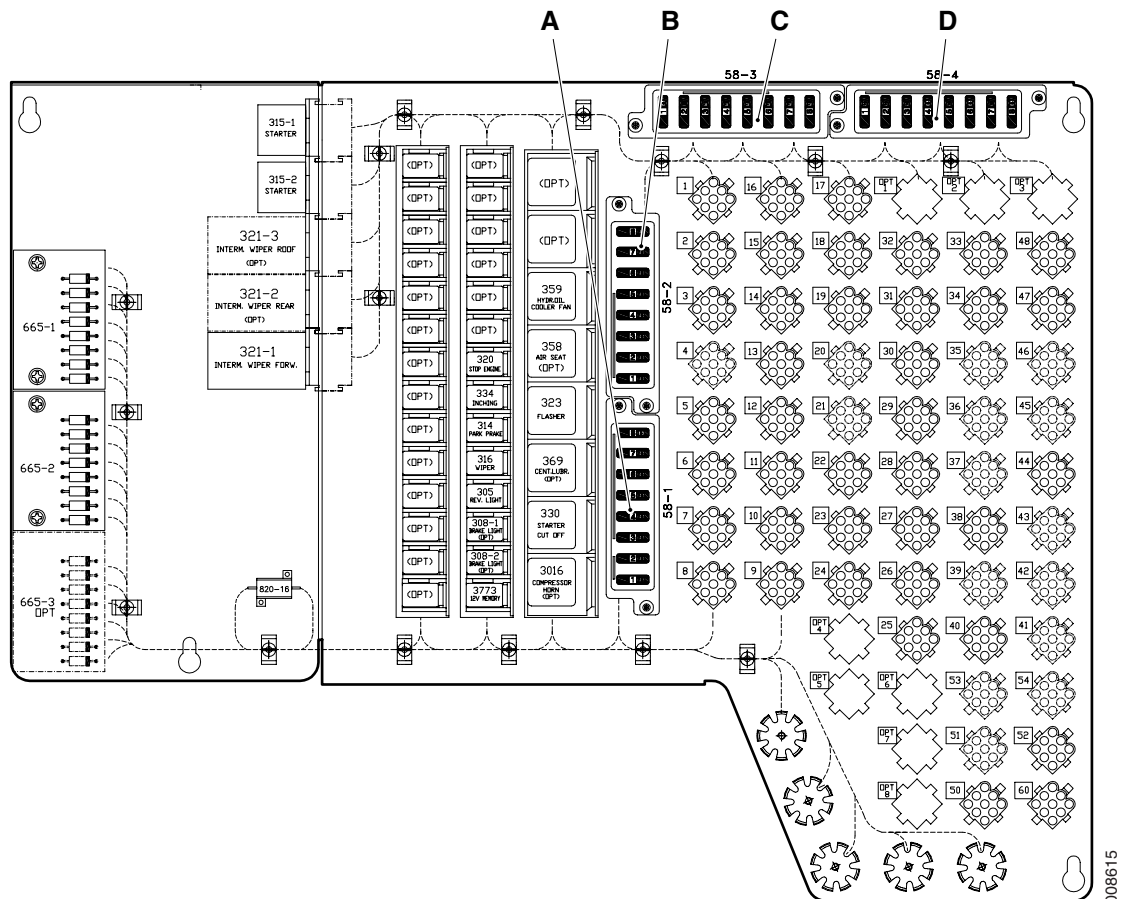
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6.2.14 Fuses for electrical system

Fuses for electrical system, general

The electrical system's fuses are located in the fuse box in the cab.

The fuse box in the cab is located behind the driver's seat in the cab. There are fuses for control units and equipment in the cab.



- A. Fuse holder F58-1
- B. Fuse holder F58-2
- C. Fuse holder F58-3
- D. Fuse holder F58-4

Table 11. Fuse holder F58-1

Connection	Fuse number/ Rating	Connection
1	1 / 15A	Ignition switch, pause heater.
2	2 / 10A	Warning lamp, parking brake, cab lighting.
3	3 / 15A	Headlamps.
4	4 / 15A	Windscreen wiper front, horn, washer motor, electrically operated loud horn.
5	5 / 15A	Roof and rear window wipers, reading light, 12V for memory (K3773).
6	6 / 15A	Rotating warning lamp, reversing lamp, reversing alarm, working lamps, mast, indicator lamp air filter.
7	7 / 15A	Working lamps, roof.
8	8 / 5A	Parking brake.

Table 12. Fuse holder F58-2

Connection	Fuse number/ Rating	Connection
1	1 / 10A	Brake lamp.
2	2 / 10A	Shifting, seat reversing, disengagement, extra travel direction selector.
3	3 / 6A 3 / 15A	Fan heat, AC (FlexCab). Fan heating, AC/ECC (Spirit Delta & Spirit Delta Space).
4	4 / 25A	Condenser for climate control system
5	5 / 10A	Interrupt switch driver's seat, 24V chassis.
6	6 / 10A	Main beam.
7	7 / 10A	Low beam.
8	8 / 10A	Tail lamps, side marker.

Table 13. Fuse holder F58-3

Connection	Fuse number/ Rating	Connection
1	1 / 5A 1 / 15A	Converter 12V. Converter 12V (For converter, 20A).
2	2 / 25A	Seat air compressor, seat heating, central lubrication.
3	3 / 15A	Extra working lamps, roof.
4	4 / -	-
5	5 / 15A	Motor for reversible driver's seat, driver's seat up/down.
6	6 / 15A	Control unit ECU792, sensor steering wheel angle
7	7 / 10A	Control unit ECU794 (for Volvo TAD650VE, TAD750VE engines).
8	8 / 10A	Control unit ECU794 ignition on.

Table 14. Fuse holder F58-4

Connection	Fuse number/ Rating	Connection
1	1 / 15A	Hydraulic oil cooling fan.
2	2 / 15A	Working lamps, frame.
3	3 / 10A	Lift functions (Automatic clamping function, shears, locking upper arm, by-passing), electric scales
4	4 / 5A	Power control unit ECU 793/APC200, relay for coolant level (engine alternative Caterpillar).
5	5 / 10A	Power supply control unit ECU 790, sensor for mast near max. lift height.
6	6 / 5A	Power supply control units EDU 795, ECU 790, ECU796.
7	7 / 10A	Power supply control unit ECU 796, breaker switch for load handling, clamp pressure sensor.
8	8 / 5A	Power control unit ECU 793/APC200.

Instructions

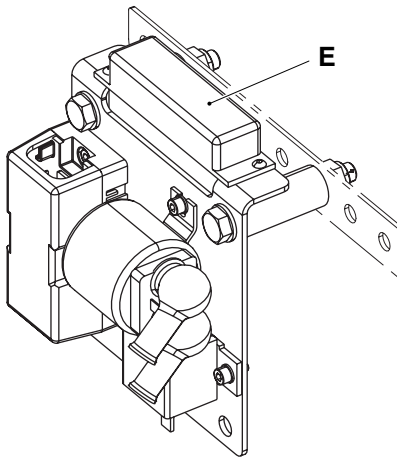
When checking and changing fuses:

1. Cut the main power using the battery disconnect switch.
See *Battery and battery disconnect switch, general page 214.*
2. Remove the cover from the fuse box.
3. Remove the plastic cover from the fuse holder.
4. Check or replace fuses as needed.

The fuse plate gives information about each fuse.

Table 15. Fuse holder (position E) for Cummins QSB6.7 engine

Connection	Fuse number/ Rating	Connection
1	1 / 5A	Control unit ECU794.
2	2 / 30A	Control unit ECU794.
3	3 / -	-
4	4 / -	-
5	5 / -	-
6	6 / -	-
7	7 / -	-
8	8 / -	-



007938

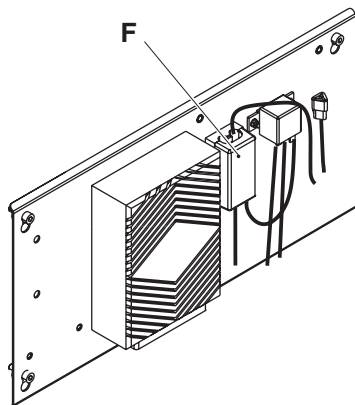


Table 16. Fuse holder F52 (position F) for CAT C6.6 engine

Con- nec- tion	Fuse number/ Rating	Connection
1	1 / 25A	Control unit ECU794.
2	2 / 50A	Preheating.

Instructions

Replacing the fuse for the motor

When checking and changing fuses:

1. Cut the main power using the battery disconnect switch.
See *Battery and battery disconnect switch, general page 214.*
2. Remove the plastic cover.
3. Check or replace fuses as needed.

009114


6.2.15 Lighting


Lighting, general

It is important that the right type of bulb is used for the respective lighting point, see section 9 *Specifications*.

Bulbs can be changed for the following:

- Instruments
- Indication lamps
- Interior lighting
- Tail lamps, red
- Brake lamp
- Indicator for driving direction
- Side lamp
- Headlamps (for main- low beams)
- Reversing lamp, white
- Working lamps incandescent light

Working lamps Xenon 

- Rotating warning lamp 

Instructions

Applies for the following:

- Headlamps (for main- low beams)
 - Reversing lamp, white
 - Working lamps
- 1 Loosen the rubber strip (position A).
 - 2 Remove the glass (position B).
 - 3 Change bulb.



A

B

000579

- A. Rubber strip
- B. Glass

6.3 Service

General

It is of the greatest importance that inspection and service are carried out at the recommended intervals.

Service is carried out by Kalmar Industries, or by Kalmar Industries' authorised service technicians.



WARNING

Service intervals must be followed. This is in order to comply with warranty and service agreement conditions!

Use Kalmar Industries Approved Spares and fluids to comply with warranty conditions.

Service is performed at intervals of 500 hrs and actions are described in the maintenance manual.



WARNING

When welding on the machine, all control units must be disconnected to prevent damage.

Disconnect the connectors from the control units!

7 Transporting the machine

Safety



DANGER

The machine must be adequately secured when transporting. The machine is heavy and can cause extensive damage in case of a fall and similar.

Fatal danger and risk of property damage!

Follow the instructions in order to secure the machine during transport.



WARNING

Always close the cab door(s) when transporting.

Danger!

7.1 Towing

General



DANGER

The machine cannot be manoeuvred or have the brakes applied when there is no hydraulic pressure.

Rolling machine! Fatal danger!

If possible, tow with retained hydraulic pressure. If it is not possible to have the engine running when towing, a tow bar must be used. Only tow short distances.



WARNING

Do not try to start the machine by towing.

Causes serious damage to engine and power transmission!

Start the engine according to instructions in the Operator's manual.

Before taking action and when you have finished towing, the parking brake must be applied and the wheels blocked to prevent the machine from rolling.

Extreme care must be observed during towing work to avoid personal injuries.

When towing, keep in mind:

- The towing vehicle should be heavier than the machine being towed.
- If possible, the engine should be running during towing in order for brakes and steering to function.

When the engine is off, there is no hydraulic pressure to the steering function and thus the machine's steering function is severely limited. Also, transmission lubrication is insufficient.

- The brakes function as long as there is pressure in the accumulator, then the service brake stops functioning and the parking brake is applied automatically. If it is then necessary to move/tow the machine, the parking brake must be released mechanically, see section 7.1.1 *Manual release of parking brake*.

- Only tow for the shortest possible distances.
- If it is necessary to tow the machine, the propeller shaft must be disconnected from the transmission and drive shaft.

7.1.1 Manual release of parking brake

Description

The parking brake is applied automatically by a powerful spring in the brake cylinder if the pressure in the hydraulic accumulator should drop below a certain level.

If the machine must be moved (towed) without sufficient pressure in the hydraulic accumulator, the parking brake must be released mechanically (manually).



DANGER

Before starting work with the parking brake, make sure that the machine cannot move accidentally when the braking action is released.

Fatal danger!

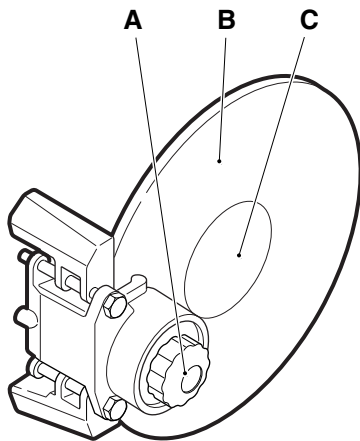
Block the wheels to avoid unwanted rolling of the machine.



DANGER

The parking brake has high spring force. If the brakes are opened incorrectly, parts may detach and fly off with high velocity and force. Follow the instruction.

Risk for personal injury!



- A. Protective cover
- B. Brake disc for parking brake
- C. Propeller shaft

The parking brake is a disc brake on the drive shaft's input shaft.

1. Remove protective cover from the calliper (position A).
2. Note the nut's position on the bolt and remove the split pin that secures the nut.
3. Screw in the nut, this compresses the brake spring. Screw until the brake pads release from the brake disc.
4. Restore the parking brake function by unscrewing the nut to the same position as in step 2. Fit a new split pin.
5. Refit protective cover on the calliper.

NOTE

If the parking brake has been released manually, the parking brake must always be reset in order to give the machine parking brake function again.

000835

7.1.2 Hydraulic release of parking brake

Description



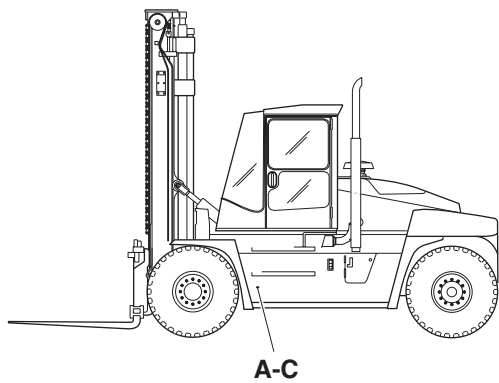
The parking brake is a disc brake on the drive shaft's input shaft.

DANGER

Before starting work with the parking brake, make sure that the machine cannot move accidentally when the braking action is released.

Fatal danger!

Block the wheels to avoid unwanted rolling of the machine.



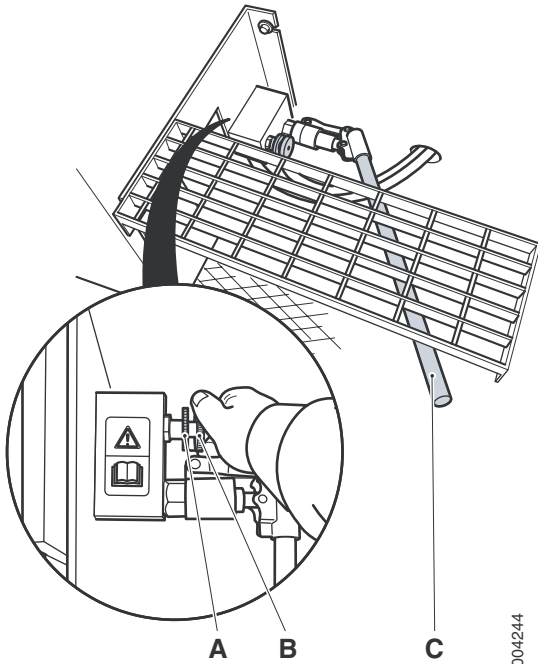
1. Ensure that the parking brake is released. See the indication for parking brake system in the display.
2. Unscrew the knob (position A) as far as possible.
3. Screw in the knobs (position B and A) as far as possible.
4. Pump about 10 times with the pump rod (position C).

Restoring the parking brake:

1. Screw out the knobs (position A and B) as far as possible.
2. Screw in the knob (position A) as far as possible.

NOTE

If the parking brake has been released hydraulically, the parking brake must always be restored in order to give the machine parking brake function.



- A. Knob for manually releasing the parking brake
 B. Knob for manually releasing the parking brake
 C. Pump rod

004244

7.2 Lifting and transporting the machine

General



DANGER

High demands are placed on the lifting and transport equipment, for example, lifting chains, hooks, etc.

Fatal danger!

Check the equipment and its capacity, lifting slings on machines and the lashing points on the transport and machine.



DANGER

Overloading loading equipment.

Fatal danger!

Lifting equipment must be dimensioned for the load. Never walk under a hanging load.

The following actions are recommended when the machine is to be transported:

- Cut the main power using the battery disconnect switch.
- Remove any fragile equipment, for example, rear-view mirrors.
- If transport is to take place on a public road:
 - Remove the mast when transporting if the height exceeds the height limitation.
- Apply the parking brake.
- Secure the machine with chains for transport on, e.g., a truck. See plate for machine's weight.
 - Front: Secure the chains to the mast, alternatively to the front wheels, left and right-hand side.

NOTE

Cross the chains when securing for optimal stability.

Rear: Secure the chains to the towing eye at the vertical counterweight, alternatively to the rear wheels.

7.2.1 Lifting the machine

General

When lifting the machine, follow the applicable safety regulations.



DANGER

High demands are placed on lifting equipment, for example, lifting chains, hooks, etc.

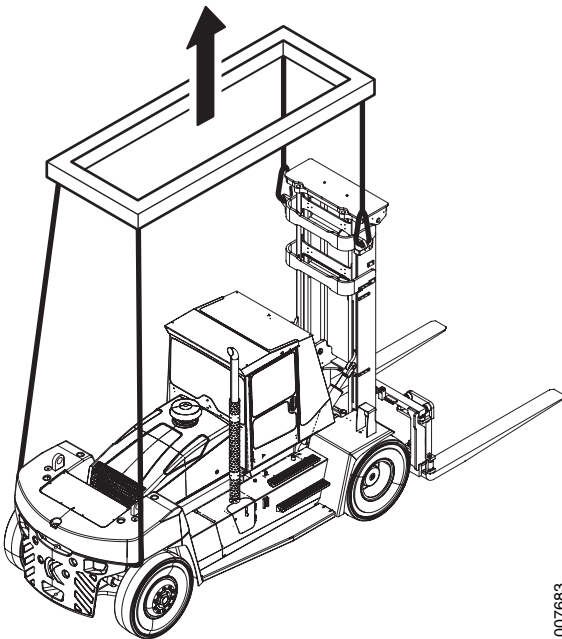
Fatal danger!

Check lifting equipment, its capacity and the lifting slings on the machine.

Instructions, lifting without lifting eyes on the counterweight

Machines without lifting eyes on the counterweight must be lifted as follows:

1. Route a lifting sling at the rear around the chassis, between the counterweight and the steering axle.
2. Place two lifting slings in the lift mast's two lifting eyes.
3. The lifting device must be adapted so that the lifting point passes through the machine's centre of gravity.

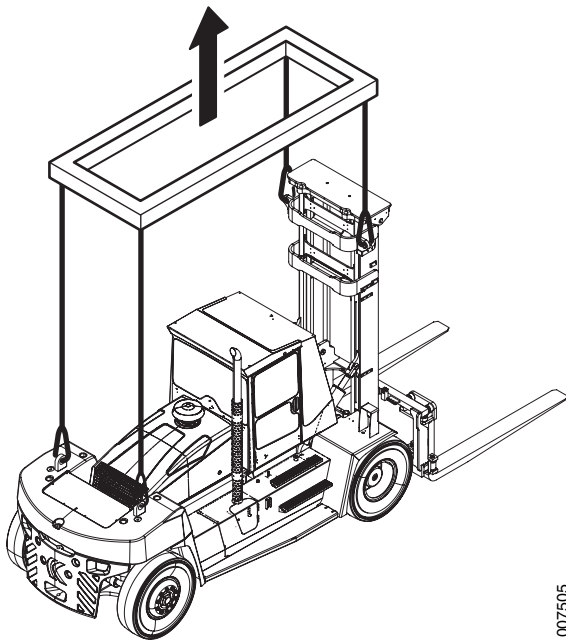


007683

Instructions, lifting with lifting eyes on counterweight

Machines with lifting eyes on the counterweight must be lifted as follows:

1. Place two lifting slings in the counterweight's two lifting eyes.
2. Place two lifting slings in the lift mast's two lifting eyes.
3. The lifting device must be adapted so that the lifting point passes through the machine's centre of gravity.



007505

7.3 Service position

General

Service position is used for service, maintenance and other situations when the machine needs to be secured.

Service position means:

- Machine parked, that is, applied parking brake.
- Fork assembly lowered and mast tilted forwards.
- Engine off.
- Main electric power off (with battery disconnect switch).
- When needed: Lift the machine on stands or reverse the machine on ramps. Stands and ramps must be the proper size for the machine's weight.

7.4 Long-term storage

General

For long-term storage of the machine, contact Kalmar Industries.

8 Environment and standards

General

The ever increasing industrialization of our world is having a significant impact on our global environment. Nature, animals and humans are exposed daily to great risks in connection with handling of chemicals in different forms.

There are still no environmentally safe chemicals, such as oils and coolants, available on the market. Therefore, everyone who handles, operates, performs service on or repairs machines must use the tools and aids necessary to protect the environment in an environmentally sound manner.

By following the simple rules below, you contribute to protecting and caring for our environment:

Recycling

Well planned recycling of the machine is the basis for terminating the life cycle and to be able to make use of materials for reuse in new products. According to calculations made by Kalmar Industries more than 90 % of the weight of the machine can be recycled.

Environmentally hazardous waste

Components such as batteries, oils and other chemicals and other materials that can be considered as environmentally hazardous waste must be taken care of in a safe manner seen from an environmental standpoint.

Discarded batteries contain substances hazardous to personal health and the environment. Therefore, handle batteries in an environmentally safe manner and according to national regulations.

Oils and fluids

Oils, that are freely released, cause damage to the environment and can also cause fire. Therefore, when emptying and draining oils or fuel, take appropriate action to prevent unnecessary spills.

Waste oils and fluids should always be taken care of by an authorised disposal company.

Pay close attention to oil leaks and other fluid leaks! Take immediate action to seal the leaks.

Air conditioning

The refrigerant in the cooling unit for the cab accelerates the greenhouse effect when discharged to the free air. Special training is required for all service work on the air conditioning system. Many countries require special certification by an authority for such work.

Working in a contaminated area

The machine must be equipped for work in a contaminated area (environmentally contaminated or hazardous to personal health) before work is started. In addition, special local regulations apply when handling and servicing such a machine.

Standards

Sound/noise, vibrations, stability and visibility, etc.

This machine complies with the harmonised standard EN 1551-1 and ANSI/ASME B56.1 "Industrial trucks - safety - Engine powered trucks with lifting capacity exceeding 10 000 kg".

CE marking

Machines for the EU/EEC market are CE marked. This means that, when delivered, the machine meets all applicable "Essential Health and Safety Requirements", stipulated in the EU Machinery Directive, 98/37/EG and other EU directives applicable to this type of machinery. For more information, see section 2.2 *CE marking*.

ANSI/ASME marking

Machines for North American markets are ANSI/ASME marked. This means that upon delivery the machine fulfils the basic safety requirements of ANSI/ASME B56.1. For more information, see section 2.3 *ANSI/ASME marking*.

EMC, electromagnetic interference

The EU's EMC directive regarding "Electromagnetic compatibility", 89/336/EG, gives a general description of the standards that may be required of a machine from a safety aspect, where the limit values have been established in international standards. A machine or device that meets these standards must be CE marked.

Kalmar's machines are especially tested with regards to electromagnetic interference in accordance with harmonised standard EN12895. The machine's CE marking and Declaration of Conformity also covers the EMC directive. If other electronic equipment is installed on the machine, it must also be CE marked and tested on the machine with regards to electromagnetic interference. It must also be approved by Kalmar Industries.

Exhaust emissions

Machines for the EU/EEC market fulfil EU Exhaust directive 97/68/EG, which means that engine exhaust emissions have been reduced in accordance with requirements.

Machines for the North American market fulfil EPA and CARB exhaust regulations, which means that engine exhaust emissions have been reduced in accordance with requirements.

Sound emissions

Machines for the EU/EEC market fulfil EU Noise directive 2000/14/EG, which means that the machine is marked with measured environmental sound emissions, which have been reduced in accordance with requirements for trucks with lift capacity over 10,000 kg.

Vibrations standard

The vibrations that the machine produces for Spirit Delta lie between 0.4 and 0.7 m/s² depending on what type of tyres and driver's seat the machine is equipped with, when measured according to the harmonised standard EN 13059. The corresponding value for Flexguard/Flexcab is 0.4-0.8 m/s².

9 Specifications

Technical data

Machine weights and dimensions vary depending on the machine's equipment. Detailed information on weight and dimension is found in the product specification and spec. sheet for the specific machine in question.

1 Engine	Volvo TAD650VE	Volvo TAD750VE	Cummins QSB6.7	Cummins QSB6.7	CAT C6.6
Output according to ISO 3046 (net output)	147 kW at 2300 rpm 136 kW at 2000 rpm	181 kW at 2300 rpm 181 kW at 2000 rpm	129 kW at 2200 rpm	164 kW at 2200 rpm	136 kW at 2200 rpm
Torque ISO 3046	750 Nm at 1600 rpm	1050 Nm at 1500 rpm	799 Nm at 1400 rpm	949 Nm at 1500 rpm	802 Nm at 1400 rpm
Max rpm	2000 rpm	2000 rpm	2200 rpm	2200 rpm	2200 rpm
No. of cylinders	6 cylinders				
Alternator, rating	2240 W	2240 W	1960 W	1960 W	2100 W
Start battery, voltage – capacity	2x12 V, 140 Ah				

2 Transmission	Dana-Spicer Off Highway		ZF
	TE13000	TE17000	3WG161
No. of gears, forward – reverse	3 – 3	3 – 3	3 – 3

3.3 Power transmission, drive shaft	DCE90-180/DCE70-32E3	DCE70-35E4
Drive axle, type	Kessler D81	Kessler D81

4 Brakes	
Service brake system – acts on wheels	Wet Disc Brake – drive wheels
Parking brake system – acts on wheels	Spring brake – drive wheels

5 Steering	
Steering system	Hydraulic servo

6 Wheels	DCE 90- 6	DCE 100- 6	DCE 120- 6	DCE 140- 6	DCE 150- 6	DCE 100- 12	DCE 120- 12	DCE 150- 12	DCE 160- 6	DCE 160- 9	DCE 160- 12	DCE 180- 6	DCE 70- 32E 3	DCE 70- 35E 4
Dimension, front and rear	11.00 - 20/16PR			12.00 - 20/20PR								12.0 0 - 20/ 20P RH D	12.00 - 20/ 20PR	
Tyre pressure, also see pressure plate	0.9 MPa									1.0 MPa		0.9 MPa		
	Note! Michelin tyres must be inflated to 1.0 MPa.													
Tyre type, front and rear	Air-inflated. Spare and replacement tyres must be of a brand name approved by Kalmar Industries.													

9 Cab	Spirit Delta	FlexCab	FlexGuard
Equivalent sound pressure level in cab according to EN12053. LpAz (internal).	max 73 dB(A)	max 78 dB(A)	max 85 dB(A)

Specifications, oils, lubricants and fluids

Any deviation from this table must be supported by written approval from Kalmar Industries.

1.2 Engine fuel system	DCE 90- 6	DCE 100- 6	DCE 120- 6	DCE 140- 6	DCE 150- 6	DCE 100- 12	DCE 120- 12	DCE 150- 12	DCE 160- 6	DCE 160- 9	DCE 160- 12	DCE 180- 6	DCE 70- 32E 3	DCE 70- 35E 4
Fuel tank, volume	140 l	200 l												
Fuel quality	Diesel, according to EN590													

1.7 Engine, cooling system	Volvo TAD650VE	Volvo TAD750VE	Cummins QSB6.7	CAT C6.6
Coolant volume	35 l	40 l	40 l (164kW) 40 l (129kW)	40 l
1.8 Engine, lubrication system				
Oil type, quality	See <i>Oils and lubricants, recommendations page 240.</i>			
Oil volume	15.5 l when changing (16 l in total).	21.5 l when changing (23 l in total)	20 l	15.5 l when changing (17.4 l in total).

2.6 Transmission, lubrication system	Dana TE13000	Dana TE17000	ZF 3WG161
Oil type	See <i>Oils and lubricants, recommendations page 240</i>		
Oil volume	35 l		33 l

3.3 Power transmission, drive shaft	DCE90-180/DCE70-32E3	DCE70-35E4
Oil quality	See <i>Oils and lubricants, recommendations page 240</i> .	
Oil volume, differential	17.5 l	18.5 l
Oil volume, hub reduction	2x2 l	

9 Frame, body, cab and accessories	FlexCab	Spirit Delta
Refrigerant climate control system	R134a	
Volume refrigerant	1200 g (see plate for climate control system)	2200 g (see plate for climate control system)
Lubricant Climate control system	ZXL100PG	
Volume lubricant	0.15 l	0.32 l
Volume washer fluid	2.5 l	

10 Common hydraulics	DCE 90-6	DCE 100-6	DCE 120-6	DCE 140-6	DCE 150-6	DCE 100-12	DCE 120-12	DCE 150-12	DCE 160-6	DCE 160-9	DCE 160-12	DCE 180-6	DCE 70-32E3	DCE 70-35E4
Oil quality	See <i>Oils and lubricants, recommendations page 240</i> .													
Oil additive	Lubrizol 3%													
Volume hydraulic oil tank	205 l	225 l												

Oils and lubricants, recommendations

The service intervals indicated by Kalmar Industries in the maintenance manual only apply if oils are selected according to the table below. The table indicates recommended viscosity for different oil types and grades depending on the ambient temperature.

Any deviation from this table must be approved in writing by Kalmar Industries, and may mean changed service intervals.

Oil type, quality	°C	-30	-20	-10	0	+10	+20	+30	+40	+50	
	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122	
1.8 Engine, lubrication system *) Volvo: VDS-2, VDS-3 API: CH-4, CI-4 ACEA: E4-99, E4-99 (Synthetic), E5, E7											
			-15°C	SAE 15W/40							
		-25°C	SAE 10W/30								
			SAE 5W/30								
Cummins CES-20071, CES-20072, CES-20076, CES-20077, CES-20078 API: CH-4/SJ, CI-4/SK ACEA: E5, E7			-15°C	SAE 15W/40							
		-25°C	SAE 10W/30								
			SAE 5W/30								
Caterpillar: **) EMA: DHD-1				SAE 15W/40							
				SAE 10W/30							
			SAE 5W/30								
2.6 Transmission, lubrication system Dana: Transmission oil ATF				DEXRON III (trademark)							
ZF: API: CD/CE/CF-4/CF/CG-4/ CH-4/CI-4/SF/SG/SH/SJ/SL ACEA: Categories A, B, E				SAE 10W, 10W/30, 10W/40							
		-25°C	SAE 15W/30, 15W/40								
			SAE 20W/20, 20W/40								
			SAE 30								
3.3 Power transmission, drive shaft Hypoid oil, API GL-5 and MIL-L-2105B				SAE 80W140							
			SAE 80W90								
			SAE 90								
				SAE 85W140							

10 Common hydraulics										
Hydraulic oil				AV 32						
SS 155434					AV 46					
Hydraulic oil						HVLP 46				
DIN 51524							HLP 68			
Hydraulic oil								ISO - LHV 46		
ISO 6743/4									ISO - LHM 68	

NOTE

Oil filters must always be replaced in conjunction with oil changes.

The interval for engine oil changes assumes that the sulphur content in the fuel does not exceed 0.5%.

*) API CH-4 or CI-4 is approved for markets outside the EU/EEA.

**) API: CH-4 and CI-4 oils are acceptable, if the requirements in Caterpillar’s ECF-1 (Engine Crankcase Fluid specification-1) are satisfied. CH-4 and CI-4 oils that do not satisfy the requirements in Caterpillar’s ECF-1 specification can result in shortened engine life.

ACEA = Association des Constructeurs Européenne d’Automobiles

API = American Petroleum Institute


CES = Cummins Engine Standard

EMA: = Engine Manufacturers Association

VDS = Volvo Drain Specification

Other matters	
Grease	Use a universal grease of the type EP acc. to NLGI Grade 2 (EP2) with 3-5% molybdenum sulphide content for all lubrication sites except glide plates. Use a Kalmar approved lubricant for glide plates. Ordered from Kalmar spare parts department. 0.65 kg cartridge for grease gun, part no. 923110.0360, and 5 kg can, part no. 923595.0003.
Electrical connection grease	Electrical connection grease 923836.0552.

Bulb specifications

Bulb	Output (W)	Socket
Instruments	3	Ba7s
Indication lamps	1,2	W2x4.6d
Interior lighting	10	S8.5
Tail lamps, red	5	BA15s
Brake lamp	21	BA15s
Indicator for driving direction	21	BA15s
Side lamps	5	SV8.5
Headlamps (for main- low beams)	75/70	P43t-38
Reversing lamp, white	70	PK22s
Work light	70	PK22s
Work light Xenon 	35	D1S Xenon tube. Insert and ballast are replaced complete.
Rotating warning lamp	70	PK22s

Unit explanations

Unit	Abbreviation
Newton meter	Nm
Kilo pound meter	kpm
Kilo Pascal	kPa
Mega Pascal	MPa
Kilowatt	kW
Kilo Joule	kJ
British thermal unit	Btu
Calorie	ca
Inch	in
Feet	ft
Yard	yd
Mile	mile
Centimetre	cm
Meter	m
Kilometre	km

Conversion table SI units

SI unit	Conversion factor	Non SI	Conversion factor	SI
Torque				
Nm	x 10.2	= kg·cm	x 0.8664	= lb·in
Nm	x 0.74	= lbf·ft	x 1.36	= Nm
Nm	x 0.102	= kg·m	x 7.22	= lb·ft
Pressure (Pa = N/m²)				
kPa	x 4.0	= in.H ₂ O	x 0.249	= kPa
kPa	x 0.30	= in.Hg	x 3.38	= kPa
kPa	x 0.145	= psi	x 6.89	= kPa
bar	x 14.5	= psi	x 0.069	= bar
kp/cm ²	x 14.22	= psi	x 0.070	= kp/cm ²
N/mm ²	x 145.04	= psi	x 0.069	= bar
MPa	x 145	= psi	x 0.00689	= MPa
Power (W = J/s)				
kW	x 1.36	= hp (cv)	x 0.736	= kW
kW	x 1.34	= bhp	x 0.746	= kW
kW	x 0.948	= Btu/s	x 1.055	= kW
W	x 0.74	= ft·lb/s	x 1.36	= W
Energy (J = Nm)				
kJ	x 0.948	= Btu	x 1.055	= kJ
J	x 0.239	= calorie	x 4.19	= J
Speed and acceleration				
m/s ²	x 3.28	= ft/s ²	x 0.305	= m/s ²
m/s	x 3.28	= ft/s	x 0.305	= m/s
km/h	x 0.62	= mph	x 1.61	= km/h
Horsepower/torque				
Bhp x 5252 rpm = TQ (lb·ft)			TQ x rpm 5252 = bhp	
Temperature				
°C = (°F – 32)/1,8	°F = (°C x 1.8) + 32			
Flow factor				
l/min (dm ³ /min)	x 0.264	= US gal/ min x 3.785		= litre/min

Conversion table length

Unit	cm	m	km	in	ft	yd	mile
cm	1	0,01	0,00001	0,3937	0,03281	0,01094	0,000006
m	100	1	0,001	39,37	3,2808	1,0936	0,00062
km	100000	1000	1	39370,7	3280,8	1093,6	0,62137
in	2,54	0,0254	0,000025	1	0,08333	0,02777	0,000015
ft	30,48	0,3048	0,000304	12	1	0,3333	0,000189
yd	91,44	0,9144	0,000914	36	3	1	0,000568
mile	160930	1609,3	1,6093	63360	5280	1760	1
1 mm = 0.1 cm - 1 mm = 0.001 m							

Conversion table area

Unit	cm ²	m ²	km ²	a	ft ²	yd ²	in ²
cm ²	1	0,0001	-	0,000001	0,001076	0,000012	0,155000
m ²	10000	1	0,000001	0,01	10,764	1,1958	1550,000
km ²	-	1000000	1	10000	1076400	1195800	-
a	0,01	100	0,0001	1	1076,4	119,58	-
ft ²	-	0,092903	-	0,000929	1	0,1111	144,000
yd ²	-	0,83613	-	0,008361	9	1	1296,00
in ²	6,4516	0,000645	-	-	0,006943	0,000771	1
1 ha = 100a 1 mile ² = 259ha = 2.59 km ²							

Conversion table volumes

Unit	cm ³ = cc	m ³	l	in ³	ft ³	yd ³
cm ³ = ml	1	0,000001	0,001	0,061024	0,000035	0,000001
m ³	1000000	1	1000	61024	35,315	1,30796
dm ³ (l)	1000	0,001	1	61,024	0,035315	0,001308
in ³	16,387	0,000016	0,01638	1	0,000578	0,000021
ft ³	28316,8	0,028317	28,317	1728	1	0,03704
yd ³	764529,8	0,76453	764,53	46656	27	1

1 gal (US) = 3785.41 cm³ = 231 in³ = 0.83267 gal (UK)

Conversion table weights

Unit	g	kg	t	oz	lb
g	1	0,001	0,000001	0,03527	0,0022
kg	1000	1	0,001	35,273	2,20459
t	1000000	1000	1	35273	2204,59
oz	28,3495	0,02835	0,000028	1	0,0625
lb	453,592	0,45359	0,000454	16	1

1 tonne (metric) = 1.1023 ton (US) = 0.9842 ton (UK)

Conversion table pressures

Unit	kp/cm ²	bar	Pa=N/m ²	kPa	lbf/in ²	lbf/ft ²
kp/cm ²	1	0,98067	98066,5	98,0665	14,2233	2048,16
bar	1,01972	1	100000	100	14,5037	2088,6
Pa=N/m ²	0,00001	0,001	1	0,001	0,00015	0,02086
kPa	0,01020	0,01	1000	1	0,14504	20,886
lbf/in ²	0,07032	0,0689	6894,76	6,89476	1	144
lbf/ft ²	0,00047	0,00047	47,88028	0,04788	0,00694	1

kg/cm² = 735.56 Dry (mmHg) = 0.96784 atm

10 Terminology

Explanation

Term	Description
AC	Air Conditioning. Heating unit with manual control of heating, cooling, dehumidification and air flow.
Accumulator	Reservoir that stores (accumulates) pressure for hydraulic functions for example.
Anti-corrosion agent	Prevents oxidising, in daily use rust inhibitor.
Attachment	The part of the machine that grips the load when lifting.
Bar	Unit for measuring pressure.
Battery disconnect switch	Interrupts the current from the battery.
Buzzer	Audible alarm for gaining the driver's attention.
Central lubrication	An automatic system for lubricating a preselected number of lubrication points.
Control valve	Valves that can be used for controlling items, for example, releasing pressure and thereby lowering a mast or a fork. See also control valve.
Counterweight	Weights adapted to the machines lifting capacity to provide counter weight when lifting.
Daily inspection	Those actions that must be carried out every day to ensure the functionality of the machine.
Decitonne	A tenth of a tonne, unit of measurement of the machine's lifting capacity.
Displacement	The oil volume that the pump can supply per pump revolution.
Display	"Window" that shows digital information on the steering wheel panel in the cab (with KCS).
Drive axle	Driving axle which receives torque from the drive line.
Drive line	Parts of the machine that contribute to the power transmission; engine, torque converter, gearbox, propeller shaft and driving axle with differential and hub reduction.
Dust reservoir	The air filter collects the coarsest particles in a dust reservoir, which empties automatically while driving.
ECC	Electronic Climate Control. Climate control system with automatic control of heating, cooling, dehumidification and air flow.
ECU	Electronic Control Unit
EDU	Electronic Display Unit
Electric servo	Load handling hydraulic components receive control signals from electro mechanical controls.
Electrolyte level	Fluid level in the battery cells.
Environmental waste	Used oil filters etc. must be handled according to applicable national laws and regulations.
Expansion tank	Reservoir for coolant.
Fixed displacement	Pump with fixed pump volume.
FlexCab	Protective cage with a strong protective frame construction. Enclosed.

Term	Description
FlexGuard	Protective cage with a strong protective frame construction. Open.
FMI	Fault Message Identifier.
Fork mountings	Mountings for forks, mounted on the lift assembly.
Forks	Lifting device that lifts the loads.
Frame members	Bearing members of the frame.
Hanging load	Raised load.
Hub reduction	Type of final drive (often with drive wheels) that reduces the speed and increases the torque from the driveline.
Hydraulic oil	Oil for hydraulic system. See specifications in the Operator's manual.
Hydraulic oil pump	Pump in the hydraulic system.
Hydraulic servo	Load handling hydraulic components receive control signals from mechanical controls.
Hydraulic system	System that uses oil pressure to transfer power to different functions.
Indicator	Manual "sensor", indicates, for example, if a filter is blocked and needs replacing.
KCS	Kalmar Control System. An electronic control and monitoring system that monitors and handles certain systems in the machine which require KCS, e.g., certain engine and transmission alternatives.
Levelling	The forks are inclined if the load is on an uneven surface.
Lift assembly	Lifts the load, located on the mast.
Lifting capacity	Indicates how great a load the machine can lift.
Lifting point	Attachment point for lifting device when lifting objects.
Low emission engine	Engine with low emissions of dangerous substances. Manufactured according to regulations.
Machine model	Machine type. Given as, for example: DCD 90-180. See also type designation.
Main fuse	Located beside the battery. Interrupts the current to every system in the machine.
Maintenance	Periodic maintenance operations so that the machine functions safely and lasts well.
Mast	Carriers of unit and load.
Operating hydraulics	All load handling functions, i.e. lift and lower, tilt, side shift, spreading and levelling.
Operating time	Number of hours that the machine has been operating, shown on the operating time gauge in the cab.
Optimum drive	Function for simulated hydrostatic control.
Optimum rev	KCS function which optimises lift speed using an extra variable hydraulic pump, at the same time as the engine speed is as low as possible.
Optimum speed	KCS function that optimises the lift speed using an extra variable hydraulic pump.
Option	Optional equipment for the machine.
Pilot oil pressure	A low control pressure, for example, to a valve.
Piston	The bar that slides into the piston cylinder and is affected by hydraulic pressure.
Planetary gear	Type of gearbox with the gears in constant mesh.
Product alternative	One of several alternatives selected for the machine, i.e. engine alternative.
Progressive steering	Faster steering wheel movements give greater steering response.

Term	Description
Proportional valve	An electro magnetically controlled valve. If a current is applied, the valve is activated proportionally to the size of the current. In everyday speech, a stepless valve, as opposed to an on/off valve. On the gearbox valve housing for example.
Recirculation	Circulation in a closed system.
Refrigerant	Liquid/gas in the Air conditioning. May only be handled by authorised trained personnel.
Serial number	Unique machine designation. On the machine plate.
Service position	How the machine must stand securely before service is started.
Servo	A small movement by the user gives a greater effect, i.e. power steering.
Servo pressure	A low control pressure to control a higher pressure, for example to a valve.
Side shift	The forks are moved parallel sideways.
SmartLink	Software for handling KCS (Kalmar Control System).
Solenoid	An electro magnetically controlled valve. See also proportional valve.
Spirit Delta	Enclosed type of cab.
SPN	Suspect Parameter Number.
Spreading	Spreading of forks, that is, changing the internal distance between the forks.
Steering axle	Wheel axle with steering.
Tilt	The mast is tilted forwards or backwards.
Top-lift	Attachment. See attachment.
Torque converter	Hydraulic, stepless clutch.
Transmission oil	Oil for the gearbox and torque converter. See specifications.
Transport safety for the vehicle	Precautions before machine transport.
Twistlocks	Two detent bolts, one in each corner of the unit, which slide into corresponding holes in the container and are twisted to lock the container into position when lifting.
Type designation	Indicates type of machine and capacity. See also machine model.
Valve slide	Moveable section of the valve. Determines the path of the oil.
Variable displacement	Controllable volume (capacity) in a pump.
Variable pump	Pump with adjustable flow speed
Wet brakes	Brake friction plates in an oil bath.
Wheelbase	Distance between the drive and steering axles.

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