
Operating instructions

This chapter contains rules which must be followed to make working with the machine safe. However, these rules do not relieve the operator from following laws or other local regulations for traffic safety, industrial safety and labour welfare.

To avoid the risk of accidents, alertness, judgement and respect for applicable safety regulations is a condition.

Running-in instructions

During the first 100 hours, the machine should be operated with a certain amount of care. During the running-in period it is important to check oil and fluid levels often. Check system pressures regularly.



Safety rules when operating

Operator duties

The machine operator must operate the machine in such a way that the risk of accidents is minimised both for the operator, other road users and persons present at the work site.

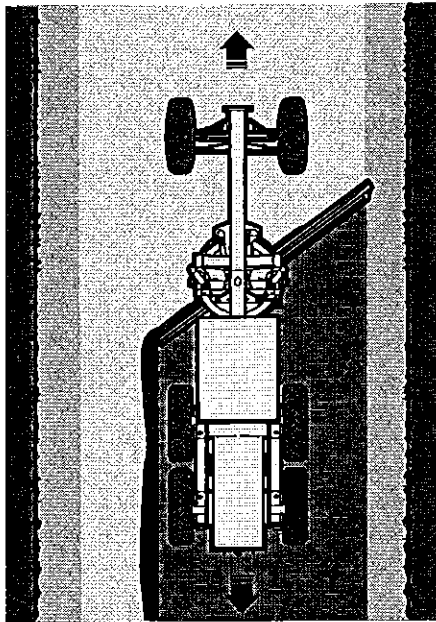
The machine operator must be thoroughly familiar with how to operate and maintain the machine and should undergo required training on the machine.

The machine operator must follow the rules and recommendations given in the Operator's Manual, but also pay attention to any statutory and national regulations or specific requirements or risks that apply at the work site.

The machine operator must be thoroughly rested and must never operate the machine under the influence of alcohol, medicine or other drugs.

The machine operator must be in charge of the working area of the machine.

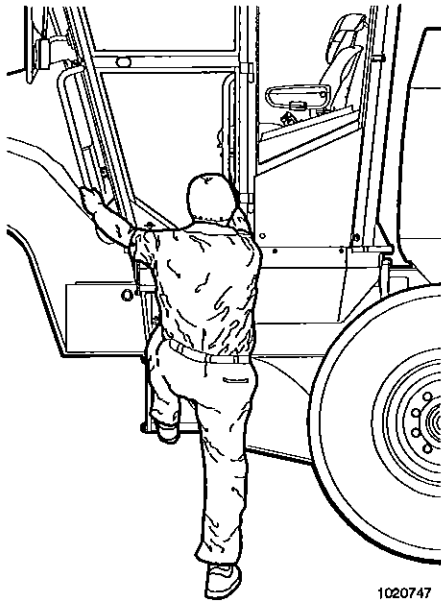
- Prevent persons from entering or remaining in the danger area – an area of at least 7 m (23 ft) around the machine. The danger area depends on the speed and direction of operating machines. The operator may allow a person to remain in the danger area, but should then observe caution and operate the machine only when the person is visible or has given clear indications of where he or she is.



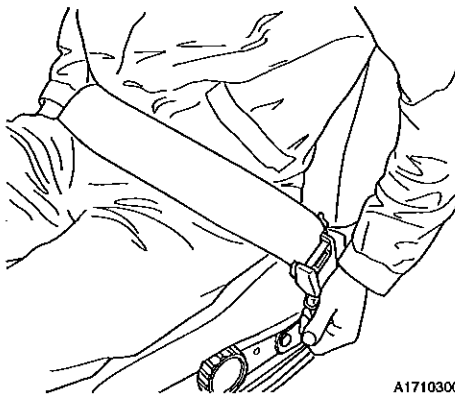
Danger area is an circle with a radius of at least 7 m (23 ft) around the machine, but it also depends on the speed and direction of the machine when operating.

WARNING!

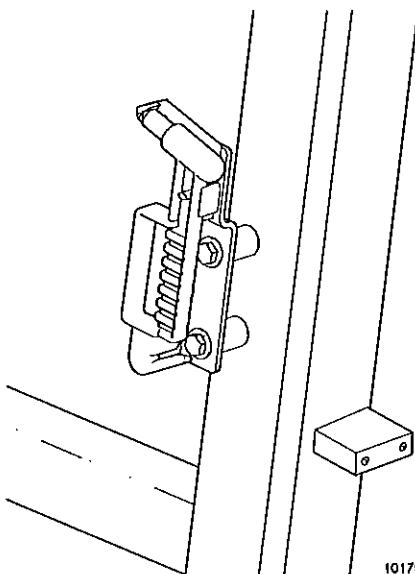
An operator of and the management for a construction machine are responsible for the working area of the machine and must turn away any person who is not authorised to be there when the machine is operating. The operator must keep a good lookout forward, rearward and to both sides to avoid the risk of running into persons or objects.



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Operator safety

- The machine must be operational, i.e. faults which can cause accidents must be rectified.
- Suitable clothing for safe handling and a hard hat should be worn.
- A loose mobile telephone must not be used as it may interfere with important electronics. The mobile telephone must be connected to the electrical system of the machine and have a fixed external aerial fitted according to the instructions of the manufacturer.
- Always sit in the operator's seat when starting the engine / machine.
- Keep your hands away from areas where there is a risk of crushing, e.g. covers, doors and windows.
- Always fasten the lap type seat belt. The seat belt must fit snug and low around your hips. The tether strap must be adjusted to suit the seat suspension.
- Use steps and handholds when entering or leaving the machine. Use the three-point grip, i.e. two hands and one foot or two feet and one hand. Always face the machine - do not jump!
- Check that any attachment is properly and securely attached.
- The vibration (shaking) which arises when operating may be harmful to the operator. Reduce this by:
 - Adjusting the seat and tightening the seat belt.
 - Adapting your speed.
- The cab is for the protection of the machine operator and it meets the requirements for Roll Over Protective Structures according to the testing standard "ROPS." Therefore, hold firmly onto the steering wheel if the machine should roll over - do not jump!
- The cab is also designed to meet the requirements for falling objects, the weight of which meets with testing methods according to "FOPS."
- The left-hand door opening is the most commonly used entrance.
- The right-hand door opening can be used as the exit in case of an emergency.
- Only step or stand on surfaces which are provided with anti-slip protection, see page 160.
- Select a gear that will prevent excessive speed when going downhill.
- If an emergency hammer is supplied, it should be located on the left-hand ROPS post. To use, strike a corner of the rear window or upper door window.
- Do not strike the center of the window glass of the front windshield. It is laminated and the glass will not shatter.

WARNING!

Never allow anyone to sit or stand on the machine when operating. Always operate the machine from the seat only and with the seat belt fastened.

- During electrical storms, do not enter or exit the machine.
 - If you are off the machine, stay well away from the machine until the storm passes.
 - If you are in the cab, remain seated with the machine stationary until the storm passes. Do not touch controls or anything metal.

Working within danger areas

It is the duty of the employer to know and mark the position of pipes for gas, water, sewage or power lines or cables on the work site and to inform the operator about these. Failure to do so may have legal consequences. When required, local authorities and communication and power companies should be contacted regarding maps, drawings and advice.

Cables and power lines must be protected against damage in a suitable way. Electric cables should, if possible, have the power turned off.

Information about where the gas and water can be turned off should be made available, so that they can be quickly turned off if they are ruptured.

- Observe great care at marked danger areas.
- Do not operate too close to the edge of a quay, ramp, etc.
- Move slowly when working in confined spaces and check that there is sufficient room for machine and load.
- When working under ground, special equipment, e.g. certified engine is required within the EU and in EES countries. Talk to your dealer.
- When working in low light conditions, e.g. buildings and tunnels, use head light.
- Do not operate the machine when visibility is poor such as a heavy fog, snow or rain.
- When working in an area which is contaminated or dangerous to one's health, the machine must be especially equipped for this purpose. Talk to your dealer. Check also local regulations before entering the area.

High voltage overhead power lines

Voltage	Min. distance to power line
0—1 kV	2m (7 ft)
1—55 kV	4 m (13 ft)
55—500 kV	6 m (20 ft)



WARNING!

Make sure that the machine does not come into contact with power lines while the power is switched on. Injuries will arise if part of your body should come into contact with a machine which is conducting electrical power.

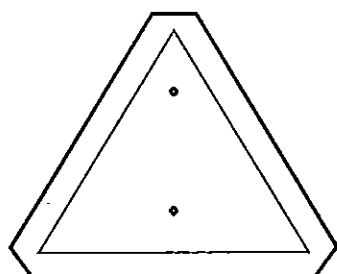
High voltage is lethal and the current sufficiently strong to destroy both machine and attachments. Your life is in danger if you come into contact with or close to high voltage power lines. Always contact the power company responsible before beginning any work near high voltage power lines. Go through the special instructions issued by the power company for work/presence near the power lines.

Regard all power lines as if they were live even if they are supposed to be without current. Working when the machine or its load at any time is closer than the minimum safety distance to a power line, is taking a very serious risk.

- Remember that the voltage of the power line determines the safety distance. Electrical flash-over may occur and damage machine and operator at fairly great distances from the power line.
- Find out what action to take if a person has been exposed to an electric shock.

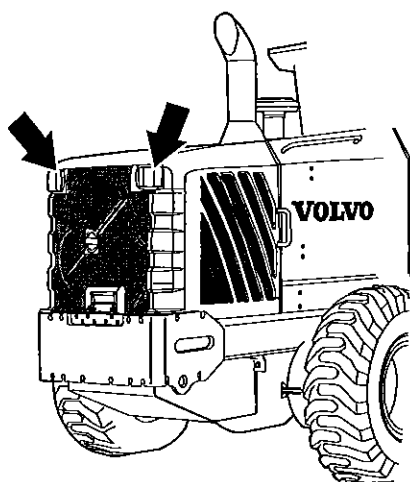
IMPORTANT! Also when transporting the machine, take overhead power lines into consideration.

There can be a visual distortion through roof window. Real distance should be reconsidered.



SMV-plate

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Travelling and operating (working) on a public road

As a machine operator you are considered to be a road user and, therefore, required to know and follow local regulations and national traffic regulations.

It is important to bear in mind that the machine, in comparison with the rest of the traffic, is a slow moving and wide vehicle, which may cause obstruction. Bear this in mind and pay attention to the traffic behind you. Facilitate overtaking.

The use of an SMV-plate (Slow Moving Vehicle plate) is recommended. It should be positioned on the machine where it is easily visible, not inside the rear window or any other window. It should be positioned at a height of 0.6–1.8 m (2–6 ft.) above the ground, measured from the lower edge of the plate.

Road signs, traffic restricting arrangements and other safety devices, which may be required when considering traffic speed and intensity or other local conditions, must be used.

The moldboard should be raised (30–40 cm = 12–16 inches above the ground).

Observe local regulations where use of rotating warning beacons is concerned.

Before roading, it is a good idea to fold down the rear taillight cluster arms and lock them in position. When not in use, fold up the rear taillight cluster arm and lock them in position. Before folding up and securing the rear taillight cluster arm, it is good practice to remove any dirt build up that may have accumulated during roading.

Make sure that large attachments do not obscure the travelling lights. According to traffic regulations the area in front of the machine must be sufficiently illuminated.

Working on slopes



WARNING!

Risk of serious injury or death.

Machine could become unstable while operating on slopes or steep grades resulting in loss of control, tipover or rollover.

Operate machine up or down slope. Avoid turning and operating across the slope. Exercise extreme caution when working on a steep grade.

The use of the machine on slopes can be split into two categories, moving up or down the slope, or moving sideways along the slope. When operating up or down (parallel) to the slope, the factors influencing gradeability and braking are most critical to safe operation. When operating across (perpendicular) to the slope, factors influencing lateral stability (resistance to rolling over) are most critical. In both categories, the factors that influence how tyres, blade and attachments interact with the ground are important.

The most important of all the factors is the skill and training of the operator. Read and understand all the material in the Operator's Manual. Operate on steeper slopes only after you have been instructed and mastered use of the machine and its features and attachments on level and slightly sloped areas. Once well trained, the operator will be able to observe and evaluate the operating environment, the task to be completed, the condition and the feel of

the machine to assess the job and make safe and effective operating decisions.

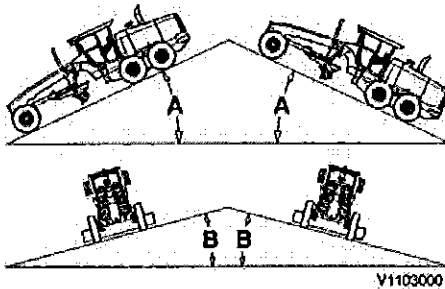
Considerations when working on grades

- **Speed of travel**
At higher speeds, forces of inertia tend to make the machine less stable. Operate the machine and functions slowly and smoothly.
- **Roughness of terrain or surface**
The machine may be less stable or have reduced ability to climb or stop with uneven terrain.
- **Type and condition of surface material**
New material may not be compacted and give way unexpectedly. Rocky surfaces may roll or slide under the tyres and cause the machine to slide downhill or overturn. Wet soil and loose rocks may greatly increase the chance of sliding.
- **Weather conditions**
When working on a steep grade, pay attention to weather and ground conditions, as they may change through the day.
- **Cab door**
Be careful; when operating the cab doors as it may be more difficult to control when the machine is on a slope. When closing the door, make certain the door is completely closed and latched.
- **Approach**
When approaching or beginning a downhill grade, operate slowly with the differential lock engaged.
- **Gear selection**
Do not operate faster or in a higher gear down grade than you would if you were climbing the grade.
- **Direction change**
Do not change direction while on a grade. Avoid travelling across a grade, when possible.
- **Machine sliding**
If the machine begins to slide downhill, lower the blade immediately.
- **Engine stall**
If the engine stops while the machine is on a grade and cannot be restarted, apply the parking brake and lower the blade to the ground before leaving the machine.
- **Wheel slide and tyre spin**
Avoid operation on grades where the wheels slide or the tyres spin.
- **Machine attachment interface**
Each attachment changes the behaviour of the machine in a different way. Understand how plows, snow wings, rippers and other attachments affect the machine's performance on a slope before beginning a task. Remember that their use may also require additional weights and counterweights that will further change how the machine reacts on a slope.
- **Component orientation**
Orientation of the standard machine components may change how the machine behaves. Stability will be affected by the wheel lean angle, articulation angle, and position of the drawbar, circle and blade.
- **Frame articulation**
Articulating the frame so the centre of the machine is uphill from the front and rear of the machine can improve lateral stability.

- **Machine balance**
Use of the blade or implements may change the wheel loading and the balance and traction of the machine.
- **Component wear**
Slope operation may increase wear on some components. Adjust the inspection and service intervals accordingly.
- **Special equipment**
Use of the machine on extreme slopes may require special equipment.

NOTE! Maximum permitted angle of operation is determined by the limits of lubrication for the engine and other components. Machine damage may occur if these angles are exceeded.

Maximum permitted angles of operation



Maximum permitted angle

A. Machine affected in the longitudinal direction

B. Machine affected in the lateral direction

Longitudinal (A)		Lateral (B)	
Continuous operation	Momentary operation	Continuous operation	Momentary operation
A = 22° (40%)	A = much greater than 22° (40%) Operation at well over 22° (40%) is possible, slope is limited by engine lubrication.	B = 18.4° (33%) Contact your Volvo Construction Equipment dealer if your application requires operation on steeper slopes.	Operation across steep grades requires extreme caution and a highly skilled operator, especially during momentary operation.

Measures before operating

- Read this Operator's Manual.
- Carry out the daily service, see pages 214 and 218. In cold weather, make sure the freezing point of the coolant is sufficiently low and the lubricating oil is intended for winter use.
- Check for faulty, loose parts or leaks, which can cause damage. Repair or replace as necessary.
- Check for cracks on the frame.
- Check the condition of the attachments (if equipped).
- Check the steps and handholds for damage or loose parts. Repair or replace as necessary.
- Clean the debris around the engine, battery and coolers.
- Check the level of hydraulic oil, refill if required.
- Check the battery disconnect switch is switched on.
- Remove the articulation pin and stow it properly.
- Make sure the fire extinguisher, if equipped, is fully charged.
- Check that hoods and covers are closed and secure.
- Check the wheels are not chocked or obstructed.
- Remove ice from windows, if necessary.
- Adjust and clean the mirrors.
- Inspect the working and other lights for proper operation.
- Check fuel level.
- Check for malfunction of the gauges in the instrument panel.
- Adjust the operator seat and fasten the lap type seat belt. The seat belt must fit snug and low around the hips. The tether strap must be adjusted to suit the seat suspension. See page 61.
- Check there are no persons in the vicinity of the machine.
- Check the back-up alarm for proper function (if equipped).
- Perform daily service brake checks. See page 195 and 196.

After operating

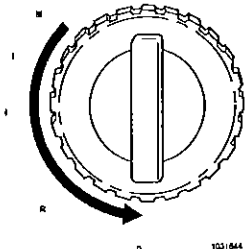
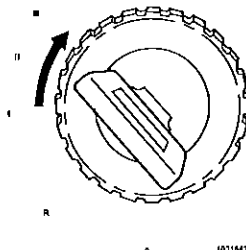
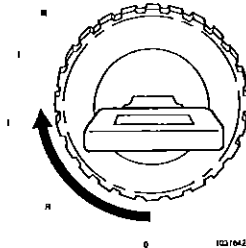
Fill the fuel tank at the end of each shift. This reduces the chance of condensation forming in the tank.

Starting engine



WARNING!

The engine must only be started with the ignition key in the cab.



- 1 Ensure the transmission shifter is in the Park (P) position. This ensures that the parking brake is applied. The engine cannot be started with the transmission shifter engaged in Forward (F), Neutral (N) or Reverse (R).
- 2 Insert the ignition key in the switch. Turn the key clockwise to the running position (I) so that a system test can take place, the duration of which is 4–5 seconds.
- 3 At the same time check that all control lamps light up and that the gauges show a reading.
- 4 Turn the ignition key clockwise to the starting position (III). Release the key when the engine starts.
- 5 If the engine does not start, turn the key counterclockwise to the (O) position before making a new starting attempt. Leave the engine running at low idle for approx. 30 seconds to ensure satisfactory lubrication of components like the turbocharger.
- 6 Check that all control and warning lamps are extinguished.

Starting engine in cold weather



WARNING!

This machine is equipped with a preheating element. Starting fluid (ether etc.) must not be used.

The preheating function will automatically activate when the coolant temperature is below $\pm 0^{\circ}\text{C}$ ($+32^{\circ}\text{F}$) on G930, G940, G960 & G946 models. For G970, G990 & G976 models the preheating function will activate when it is 12°C (54°F) at sea level. Activating temperature varies depending on barometric pressure.

- 1 Insert the ignition key in the switch. Turn the key clockwise to the running position (I).
- 2 The preheating is now activated and the control lamp lights up. After 10–50 seconds (the time depends on the coolant temperature), the preheating element will automatically deactivate and the lamp will go out.

NOTE! Preheat. If the preheat control lamp continues to light for longer than 50 seconds, the preheating circuit is still connected. In this case, do not operate the machine as there is a risk of overheating. Have the function of the element checked by a qualified service technician.

- 3 When the control lamp goes out, turn the ignition key clockwise to the starting position (III). Release the key when the engine starts.
- 4 The afterheating function automatically activates if the coolant temperature is below $\pm 0^{\circ}\text{C}$ ($+32^{\circ}\text{F}$) G930, G940, G960 & G946 models. For G970, G976 & G990 models the afterheating function will activate when it is 12°C (54°F) at sea level. Acti-

ating temperature varies depending on barometric pressure. Duration of afterheat is related to coolant temperature; 20 seconds minimum to 200 seconds maximum.

Afterheat function starts when the engine has reached the running state (above 750 rpm with the ignition key in the running position). When the afterheat function is activated, the preheat control lamp lights up.

NOTE! Afterheat. When the engine reaches a running state, the preheater could be re-activated for afterheat. If the preheat control lamp continues to light for longer than 200 seconds, the afterheating circuit is still connected. In this case do not operate the machine, as there is a risk of overheating. Have the element checked by a qualified service technician.

NOTE! Using immersion heaters to warm coolant and oil in the engine is highly recommended. If possible store the machine inside a heated facility.

Leave the engine running at low idle for 30 seconds so that the oil in the engine, transmission and hydraulic system has warmed up and become sufficiently fluid to provide proper lubrication.

NOTE! Racing the engine immediately after it has been started may damage the turbocharger.

Cold weather start-up, transmission and hydraulic systems

When operating in temperatures below -10 °C (+14 °F), store the machine inside a heated facility or use immersion heaters in the transmission case and hydraulic tank. You can use the recommended oils provided the following conditions are met: See page 223.

- Before start-up, the oil is preheated to a temperature above the minimum value for the indicated oil and viscosity range.
- The operating temperature stays above the minimum value in the applicable range.

Failure to comply with these requirements may result in a malfunction or a reduced life of the transmission or hydraulic components.

Unload function

To decrease the hydraulic load during cold weather start up, the main hydraulic pump and hydraulic fan pump are limited to a minimum displacement when the ignition key is turned to the starting position (II).

Activation of the unload function will occur if the coolant temperature is below 25°C (77 °F) and / or the hydraulic oil temperature is below 0°C (32 °F). The text - **INFO...hydraulic unload on** - appears on the display unit.

When the engine is started and the ignition key is in the running position (I), a time delay is started to keep the unload function activated. The length of delay is dependent on the hydraulic oil temperature. Each Celsius degree from 10°C to 0°C will add 1 second of delay. Each Celsius degree from -1°C and lower will add 2 seconds of delay. The unload function is deactivated after the delay time has passed.

NOTE! If oil in the hydraulic circuit is cold, hydraulic functions may move slowly. Do not attempt to operate the hydraulic functions until the hydraulic oil is warmed up otherwise hydraulic pump damage may result.

Cycle all hydraulic cylinders through their working range several times until the hydraulic functions operate normally.

Gear shifting



WARNING!

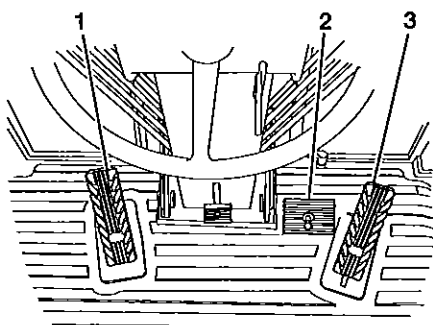
Do not allow the machine to coast (freewheel) downhill in Neutral (N). Excess speed could cause loss of control of the machine, as well as damage to the transmission.

Starting from a complete stop

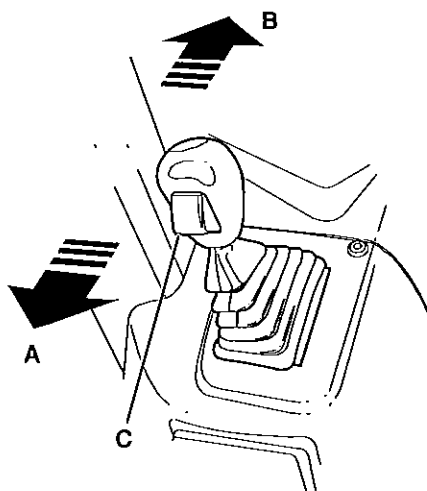
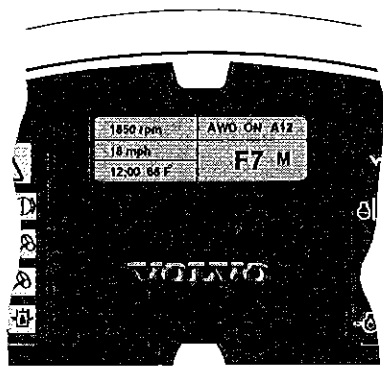
When starting from a stop always use the inching pedal.

NOTE! The inching pedal requires very low effort to operate, to reduce operator fatigue. Be careful the first couple of times before getting accustomed to the comfort of the pedal operation.

NOTE! The machine will not start to move in any forward gear higher than 5th (HTE840 transmission) or 7th (HTE1160 transmission). The machine will not start to move in any reverse gear higher than 3rd (HTE840 transmission) or 4th (HTE1160 transmission).



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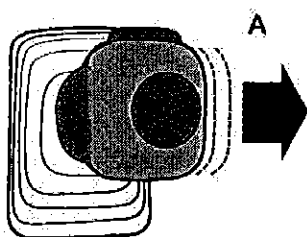
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- A Forward
- B Reverse
- C Neutral lock button

Starting out

- Raise the moldboard and all attachments off the ground. See page 70.
- If loading the machine, position the moldboard inside the tyres. Steer the front wheels to make sure they do not strike the moldboard.
- Depress the inching and service brake pedals.
- Press the transmission shifter neutral lock button. Move the shifter to the left to disengage the lever from the Park (P) position. This action releases the parking brake.
- Press the neutral lock button and move the shifter into either the Forward (F) or Reverse (R) position.
- Select the starting gear by nudging the shifter to the right or to the left. Digital text in the centre instrument display unit informs you which gear the transmission is in.
- Release the service brake pedal, then slowly release the inching pedal and accelerate as required.

NOTE! Do not rest your feet on the inching or service brake pedals when driving the machine. This can cause unnecessary wear and premature failure.



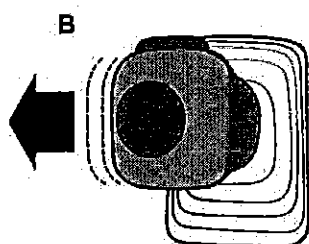
Changing gears

Once the machine is in motion, you do not have to use the inching pedal to change gears. The best shift quality can be obtained by maintaining consistent engine speed (rpm).

A To shift to a higher gear, nudge the shifter to the right and release it.

B To shift to a lower gear, nudge the shifter to the left and release.

NOTE! Downshift to an appropriate lower gear before traveling down a hill to avoid overspeeding, otherwise damage to the transmission could result.



- A Shift to higher gear
B Shift to lower gear

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Continuous ground speed matching

Ground speed matching is a standard feature, which is active in all transmission modes. To activate ground speed matching depress the inching pedal and the function performs up and down shifts from any forward or reverse gear down to the default inching gear F3 and R2 (HTE840) and F5 and R2 (HTE1160).

Whenever the operator lifts up the inching pedal the transmission will always be at the best matched gear, regardless of the machine speed or engine rpm. After coming to a complete stop the machine will always start from the default inching gear.

Changing directions using inching pedal

NOTE! Stop the machine to change directions.

- 1 Depress the inching pedal and bring the machine to a complete stop using the service brakes.
- 2 Press the neutral lock button and move the shifter forward (F) for forward travel or backward (R) for reverse travel.
- 3 Select an appropriate gear for starting depending on your working conditions. Starting in too high a gear may cause the engine to stall. Release the service brake pedal, then slowly release the inching pedal and accelerate as required.

Memory gear feature

The memory gear feature allows the operator to customise the shift patterns of the transmission to suit the job conditions.

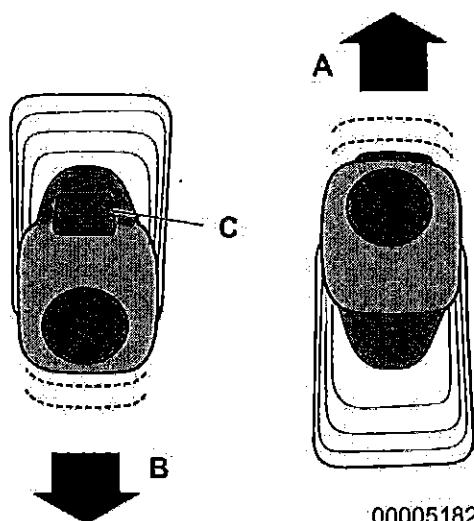
To obtain different shift patterns, such as F2 and R1, you must manually shift the transmission to that gear.

The memory feature remembers the selected gear that was last used in either Forward or Reverse, and upon returning to that direction, the V-ECU (vehicle electronic control unit) automatically selects that gear. You only have to select the required gears in either Forward or Reverse, no other programming action is needed.

Once you have obtained a valid memory gear combination, you can 'shuttle-shift' between Forward and Reverse.

If a selected combination of Forward and Reverse gears is not valid, the V-ECU automatically selects the default gear.

You must make a complete shift sequence (i.e., F-N-R or R-N-F) to use the memory gear function. If you make an incomplete shift sequence (i.e., F-N-F or R-N-R), the transmission returns to the previous Forward and Reverse gear selection.



- A Forward
B Reverse
C Neutral lock button

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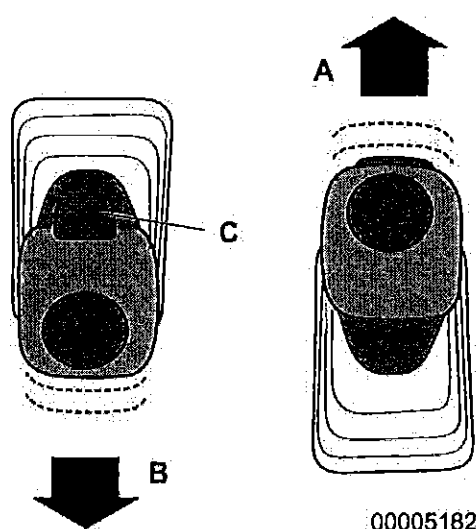
Gear shifting using the inching pedal and memory gears

NOTE! The function allows the operator to change machine direction using the inching pedal. A memory gear feature allows the operator to customise the shift pattern according to the job conditions.

Release the service brake pedal, then slowly release the inching pedal. Direction change will take place according to the following table depending on the transmission model installed.

HTE840 Manual shift		
Forward to reverse	Memory gears	Shifting
Creep	Creep, R1, R2	Shift to selected reverse memory gear. NOTE! If previous reverse gear was not a memory gear, shift is made to the default gear. NOTE! The operator may increase the reverse gear to the maximum allowable inching gear (R3).
F1	R1, R2	
F2	R1, R2	
F3	R1, R2	
F4	R1, R2	
F5	R1, R2	
F6	R2 (default gear)	Shift to reverse default gear. NOTE! The operator may increase the reverse gear to the maximum allowable inching gear (R3).
F7	R2 (default gear)	
F8	R2 (default gear)	
Reverse to forward	Memory gears	Shifting
Creep	Creep	Shift to selected forward memory gear. NOTE! If previous forward gear was not a memory gear, shift is made to the maximum allowable inching gear.
R1	Creep, F1 – F5	
R2		
R3	F1 – F5	
R4		

HTE1160		
Forward to reverse	Memory gears	Shifting
Creep	Creep, R1, R2	Shift to selected reverse memory gear.
F1	R1, R2	NOTE! If previous reverse gear was not a memory gear, shift is made to the default gear.
F2	R1, R2	
F3	R1, R2	
F4	R1, R2	
F5	R1, R2	
F6	R1, R2	NOTE! The operator may increase the reverse gear to the maximum allowable inching gear (R4).
F7	R1, R2	Shift to reverse default gear.
F8	R2 (default gear)	NOTE! The operator may increase the reverse gear to the maximum allowable inching gear (R4).
F9	R2 (default gear)	
F10	R2 (default gear)	
F11	R2 (default gear)	
Reverse to forward	Memory gears	Shifting
Creep	Creep	Shift to selected forward memory gear.
R1	Creep F1 – F7	NOTE! If previous forward gear was not a memory gear, shift is made to the maximum allowable inching gear (F7).
R2		
R3	F1 – F7	
R4	F1 – F7	
R5	F1 – F7	
R6	F1 – F7	



- A Forward
B Reverse
C Neutral lock button

Changing directions using the shuttle shift function

- 1 The shuttle shift function automatically controls the direction change of the machine without the operator having to use the inching pedal.
- 2 Press the neutral lock button and move the transmission shifter to the opposite direction of travel.
- 3 The machine will downshift appropriately (proportional to the gear selected). Do not reduce throttle rpm. Shuttle shifting will control the engine speed and transmission activation.
- 4 The shuttle shift feature is cancelled if the shifter is held in the Neutral (N) position for more than two seconds.

IMPORTANT! Use the shuttle shift function on level surfaces only. Avoid using the shuttle shift function on slopes. Loss of control or damage to the transmission could result.

Gear shifting using shuttle shifting and memory gears

NOTE! The function allows the operator to change machine direction without using the inching pedal. A memory gear feature allows the operator to customise the shift pattern according to the job conditions.

A shuttle shift from a forward gear to a reverse gear or a reverse gear to a forward gear will take place according to the following table depending on the transmission model installed.

HTE840 Automatic shuttle shift		
Forward to reverse	Memory gears	Shuttle shifting
Creep	Creep, R1, R2	Direct shuttle shift to selected reverse memory gear.
F1	R1, R2	
F2	R1, R2	
F3	R1, R2	
F4	R1, R2	Automatically downshifts to F3 before shuttle shift allowed to selected reverse memory gear.
F5	R1, R2	
F6	R2 (default gear)	Automatically downshifts to F3 before shuttle shift is allowed to default gear.
F7	R2 (default gear)	
F8	R2 (default gear)	
Reverse to forward	Memory gears	Shuttle shifting
Creep	Creep	Direct shuttle shift to selected memory gear.
R1	Creep, F1 – F3	Creep F1 – F3. Direct shuttle shift to selected forward memory gear.
R2		
R3	F1 – F3	Automatic downshifts to gear R2. Shuttle shift allowed to memory gear F3 or lower.
R4	F1 – F3	Automatic downshifts to gear R2. Shuttle shift allowed to memory gear F3 or lower.

HTE1160		
Forward to reverse	Memory gears	Shuttle shifting
Creep	Creep, R1, R2	Direct shuttle shift to selected reverse memory gear.
F1	R1, R2	
F2	R1, R2	
F3	R1, R2	
F4	R1, R2	
F5	R1, R2	
F6	R1, R2	Allowable shuttle shift. Forward gear automatically downshifts to F5 before shuttle shift allowed to selected reverse memory gear.
F7	R1, R2	
F8	R2 (default gear)	Ground speed matching downshifts to gear F7. Automatic downshifts to F5 before shuttle shift is allowed to default gear.
F9	R2 (default gear)	
F10	R2 (default gear)	
F11	R2 (default gear)	
Reverse to forward	Memory gears	Shuttle Shifting
Creep	Creep	Direct shuttle shift to selected memory gear.
R1	Creep, F1 – F5	F1 – F5. Direct shuttle shift to selected forward memory gear. F6 – F7. Shuttle shift is not allowed, defaults to F5.
R2	Creep, F1 – F5	F1 – F5. Direct shuttle shift to selected forward memory gear. F6 – F7. Shuttle shift is not allowed, defaults to F5.
R3	Creep, F1 – F5	F1 – F5. Direct shuttle shift to selected forward memory gear. F6 - F7. Shuttle shift is not allowed, defaults to F5.
R4	F1 - F5	Automatically downshifts to gear R3. Shuttle shift allowed to memory gear F5 or lower. F6 - F7. Shuttle shift is not allowed, defaults to F5.
R5	F1 - F5	Automatically downshifts to gear R3. Shuttle shift allowed to memory gear F5 or lower. F6 - F7. Shuttle shift is not allowed, defaults to F5.
R6	F1 - F5	Automatically downshifts to gear R3. Shuttle shift allowed to memory gear F5 or lower. F6 - F7. Shuttle shift is not allowed, defaults to F5.

Transmission modes

Three modes are available when controlling transmission shifting.

- Manual mode.
- Automatic mode (optional).
- Travel mode (optional).

Manual mode

Transmission operation is controlled by the operator using the transmission shifter and inching pedal.

In manual mode, the operator can activate an automatic downshift function. This reduces the need to physically use the shifter when bringing the machine to a stop. Automatic downshifting is activated when the inching pedal is depressed and the machine ground speed is approximately 3 km/h (1.8 mph). The transmission shifts to its highest allowable inching gear.

- F5 (HTE840 transmission).
- F7 (HTE1160 transmission).

Automatic mode

The automatic mode function allows the operator to set the maximum forward or reverse working gear. In this mode, the transmission automatically upshifts and downshifts to the maximum selected gear based on the engine speed (rpm).

Automatic mode is active in the following gear ranges:

- F4 – F8, R2 – R4 (HTE840 transmission).
- F6 – F11, R2– R6 (HTE1160 transmission).

If automatic mode is selected when the transmission current gear is below the working range, manual mode remains active.

F3 (HTE840 transmission) or F5 (HTE1160 transmission) becomes the minimum working gear during a shuttle shift from Reverse (R) to Forward (F) while in automatic mode. The transmission will then upshift to the minimum working gear.

Travel mode

Travel mode is intended when roading the machine. In this mode, the transmission automatically upshifts and downshifts according to the engine speed (rpm).

Travel mode is active in the following gear ranges:

- F4 – F8, R2 (HTE840 transmission).
- F6 – F11, R2 (HTE1160 transmission).

The transmission shifter, upshift and downshift functionality is disabled. Creep mode for AWD models is not allowed.

If travel mode is selected when the current gear is below the travel mode working range, the transmission will upshift automatically – based on the engine speed (rpm) – and will operate within the travel mode working range.

All Wheel Drive models

AWD (All Wheel Drive) is a hydrostatic drive system used to increase tractive effort and steering control at the front wheels during slippery conditions. Two electronically controlled, variable-displacement hydraulic pumps power the system in a closed loop circuit. Each pump supplies one front wheel motor. The wheel motors are a 2-speed, high torque, radial piston, cam lobe type. Each wheel motor has a separate speed sensor. All Wheel Drive responds in forward gears 1 to 7 (HTE840 transmission) or 1 to 10 (HTE1160 transmission) and all reverse gears.



WARNING!

Do not allow the machine to coast (freewheel) downhill in Neutral with the AWD system engaged. Excess speed could cause loss of control of the machine as well as damage to the transmission.

Memory gear feature – All Wheel Drive models

With the All Wheel Drive system engaged, switching to Creep Mode will eliminate any previously selected memory gear combination.

The memory gear feature allows you to shift between normal All Wheel Drive and Creep Mode. For example, a shift between Creep Mode forward and second gear reverse.

All Wheel Drive applications

Side loading

You can counteract the side loads encountered when working across a slope or when grading heavy material by using All Wheel Drive. Driving the front wheels against the side loads maintains directional control.

Traction and steering control

When traction is poor and the rear wheels of the machine are slipping, use All Wheel Drive to transfer power to the front wheels. By counteracting rear wheel slip, All Wheel Drive allows the machine to carry a greater load on the blade, reduces rear tyre wear and reduces shock loads on the primary drivetrain. All Wheel Drive can also provide better steering control on low traction surfaces by supplying full power to both front wheels during turns.

1850 rpm	AWD XXX A10
3 mph	F3 M
12:00 68°F	

1018049

System operation

All Wheel Drive is available in the following combinations:

- F1 – F7 forward gears (HTE840 transmission).
- F1 – F10 forward gears (HTE1160 transmission).
- All reverse gears (HTE840 and HTE1160 transmissions).

Activate the system by pressing the upper end of the switch on the pedestal instrument panel.

For additional information, see page 38.

- If AWD is switched on when the machine is moving, the machine must be slowed below 4th gear (HTE840 transmission) or 6th gear (HTE1160 transmission) for the system to engage. The AWD mode information on the display unit (XXX) will flash until the system engages.
- When upshifting, the system automatically switches to tandem drive only in 8th gear, and back to AWD in 7th gear when downshifted (HTE840 transmission).
- When upshifting, the system automatically switches to tandem drive only in 11th gear, and back to AWD in 10th gear when downshifted (HTE1160 transmission).

System deactivation

The All Wheel Drive system automatically enters into certain modes according to the following conditions:

- 1 AWD switch is placed in the OFF position – AWD system off.
- 2 Shifter is placed in Neutral (N) – AWD system in neutral.
- 3 Shifter is placed in 8th gear Forward (HTE840 transmission); 11th gear Forward (HTE1160 transmission) – AWD system on standby.
- 4 Inching or service brake pedal are depressed – AWD system on standby.
- 5 Hydraulic oil temperature in the reservoir is above normal operating range – AWD system off.
- 6 Oil level in the hydraulic tank is too low – AWD system off.
- 7 Charge pressure is too low – AWD system off.

Creep mode

Creep mode uses hydrostatic front wheel drive to power the machine from 0–4 km/h (0–2.5 mph). The rear wheels are not driving when Creep mode is activated.

In Creep mode, the engine speed is limited to 1600 rpm.

NOTE! Selecting Creep mode eliminates any memory gear combination previously used.

- With the AWD system engaged and the transmission in Forward (F) or Reverse (R), switch to Creep mode by operating the transmission shifter to 1st gear. Make one more shift to a lower gear (holding for one second) to activate Creep mode and the machine will move in the direction previously selected.
- Increase engine speed above 880 rpm to start moving. Use engine rpm to adjust to desired ground speed.
- To stop the machine or change direction, depress the inching pedal and reduce the engine speed below 880 rpm.
- Upshifting the transmission will place the system into normal AWD mode. Shift between a normal AWD gear combination and Creep mode.

NOTE! If the AWD switch is turned off while the machine is operating in Creep mode, and if the ground speed is less than 0.5 km/h (0.3 mph) for greater than one second, the transmission shifts to Neutral (N), which is the default position. You must move the inching pedal beyond 90 % to engage F1.

NOTE! If the AWD switch is turned off while the machine is operating in Creep mode, and if the ground speed is greater than 0.5 km/h (0.3 mph) then the transmission shifts directly to F1. You do not have to move the inching pedal.

Two options are available to select an operating gear.

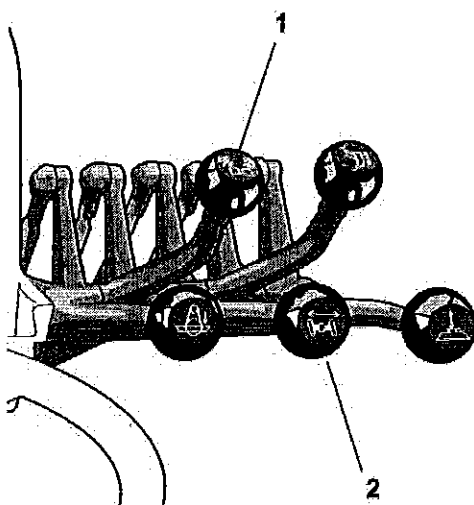
- 1 Depress and release the inching pedal. First gear will activate in the direction that the shifter has been selected.
- 2 Move the shifter into the Neutral (N) position. Depress the inching pedal and move the shifter into Forward (F) or Reverse (R). The transmission will shift to the default gear (F1 or R1). Select the appropriate gear for the job and release the inching pedal.

AWD aggression

Different tractive conditions are often encountered by the front and the rear of the machine. The AWD aggression switch is used to fine tune rotational speed differences that may occur between the front and the rear wheels when grading under diverse conditions with the All Wheel Drive system engaged. Sixteen positions are available.

For additional information, see page 38.

- Depending on conditions, a setting between 6 and 11 adjusts the front wheel speed to match the rear.
- A lower setting slows the front wheel speed compared to the rear. A higher setting increases the front wheel speed compared to the rear.



- 1 Articulation lever
2 Wheel lean lever

00005183

Steering

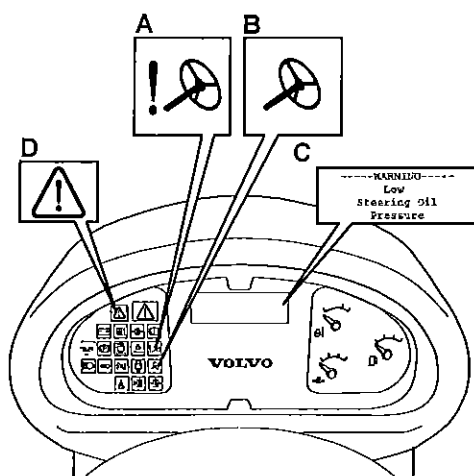
The machine has front wheel steering controlled by a closed-centre, load sensing hydrostatic steering system. Turn the steering wheel to steer the machine to the left or right. Maximum 6.2 revolutions lock to lock.



WARNING!

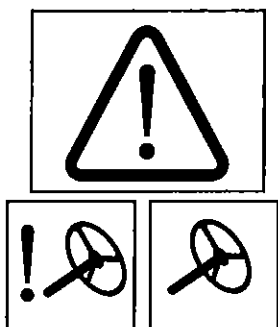
The steering system only operates when engine is running. If engine stalls, stop the machine.

If the engine stalls, stop the machine. Engage the transmission shifter in the Park (P) position. Restart the engine, if possible. If the engine cannot be started, have the engine repaired by a qualified service technician.



00005185

- A Control lamp (red) primary steering system
B Control lamp (amber) secondary steering system
C Text display
D Central warning lamp (flashing amber)



Secondary steering system (optional equipment outside EU / EAA)

This auxiliary hydraulic system allows the operator to make steering corrections more easily in the event of loss of hydraulic flow to the steering unit. The ignition key must be in the (I) (running) position to operate the system.

Operate the system long enough to bring the machine to a stop in a safe location - maximum one minute.

IMPORTANT! Do not operate the secondary steering system longer than one minute. A thermal cut-off device that protects against overheating will activate.

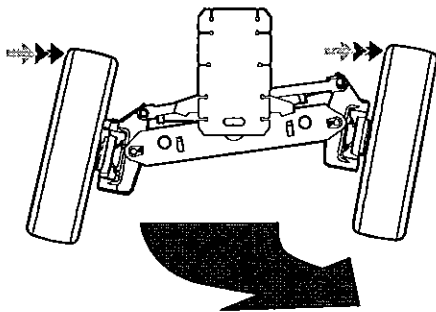
In the event of low steering oil pressure, the primary steering system control lamp (A) and the secondary steering system control lamp (B) will light up, accompanied by a buzzer, text display (C), and a flashing red central warning lamp (D).

Testing the secondary steering system

- 1 Insert and turn the ignition key to the (I) (running) position. Do not start the engine.
- 2 Press and hold the upper end of the momentary-type switch on the side console instrument panel to activate the system. The primary and secondary control lamps light up. At the same time, the amber central warning lamp flashes and information text shows on the display unit.
- 3 Check the system by turning the steering wheel.
- 4 If the steering wheel does not turn easily, there is a fault in the system.

IMPORTANT! Do not operate the machine. Have the system repaired by a qualified service technician.

- 5 Start the engine. The warning lights will extinguish and the alarm will stop sounding to indicate that the system is ready if the engine stalls.
- 6 If the warning lights stay on and alarm continues to sound with the engine running, do not drive the machine. The system is faulty and must be repaired by a qualified service technician.



1017805

Front wheel lean

Under poor traction conditions, you can reduce the turning circle of the machine by leaning the front wheels. Lean the wheels in the direction of the turn. Position the front wheels vertically again after completing the turn.

Do not use wheel lean at high speeds. Reaction is quick.

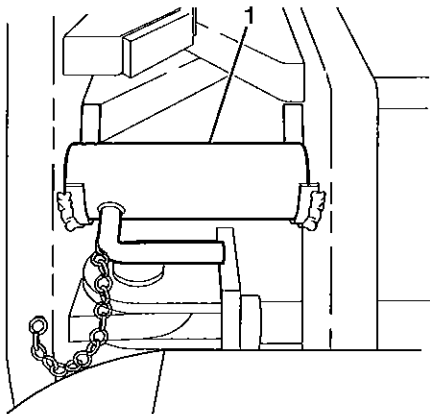
For additional information, see page 73.

Steering using articulation



WARNING!

Do not articulate the machine when operating on slopes or when roading. Machine could roll over. Always articulate the machine prior to moving onto the slope.



1017876

1 Articulation lock pin

Use the articulation lever to further reduce the machine's turning circle. Before articulating, remove the articulation lock pins.

Do not use at high speeds. Reaction is quick.

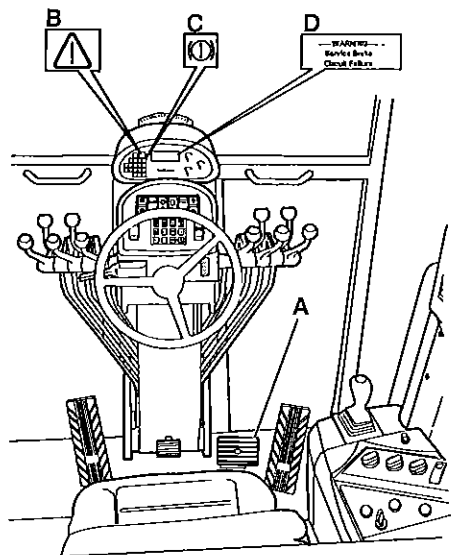
For additional information, see page 74.

- Ensure that the articulation lock pins are installed when roading the grader.
- Ensure that the control switch for locking the rear axle differential is in the UNLOCK position before turning the machine. This will reduce the turning radius and decrease tyre scuffing when operating on paved surfaces.

For additional information, see page 41.

Braking

Service brakes



1018050

- A Service brake pedal
- B Central warning lamp (red)
- C Service brake warning lamp (red)
- D Alarm text on display unit



WARNING!

Risk of fatal accidents

Brake system failure during operation may cause fatal accidents resulting in serious injuries or death. If the brake warning lamp illuminates and the alarm sounds:

- Bring machine to a safe stop
- Do not drive the machine.
- Call for repair by a qualified Volvo service technician.

Push down on the brake pedal to apply the service brakes.

The service brake system has two separate brake circuits. The system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.

Each of the two circuits function on one front and opposite rear tandem wheel. Should one circuit fail, braking remains effective on all tandem wheels through the tandem chains.

In the event of service brake circuit failure, the red warning lamp (C) lights. At the same time, the red central warning lamp (B) flashes and a display panel alarm text (D) indicates fault / error type. The buzzer sounds if the transmission shift lever is in a position other than Park (P).

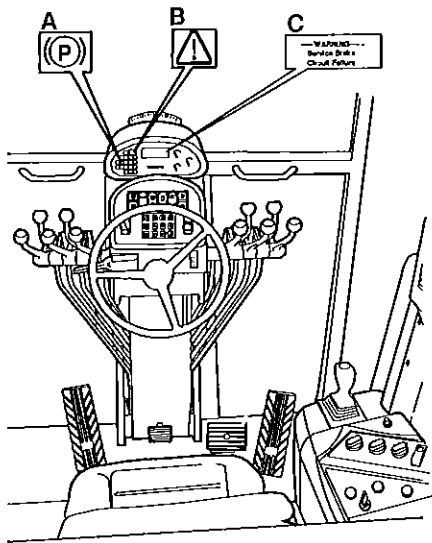
A secondary power source enables hydraulic power assist in the event of an engine failure or any situation where hydraulic oil flow to the service brake system is interrupted.

When the brake pedal is depressed, reduced braking capability is still available when the engine is not running or the key is not inserted in the ignition switch. This secondary system provides power assisted braking capability at a reduced level and automatically resets when hydraulic oil flow and pressure is restored.

IMPORTANT! Do not rest your foot on the brake pedal with the ignition key in the OFF position. This may damage the secondary brake system.

Brake adjustment

For information on adjusting the brakes, see pages 195 and 196.



1018051

- A Parking brake applied warning lamp (red)
- B Central warning lamp (red)
- C Display text



Parking brake

NOTE! Only apply the parking brake when the machine has stopped. Always apply the brake if the machine is to be left unattended.

The red warning lamp (A) lights when the parking brake is applied. If the brake is applied when the machine is in motion above 0.5 km/h (0.3 mph), the red central warning lamp (B) flashes, the buzzer sounds and alarm text shows on the display unit (C). The red or amber central warning lamp flashes depending on parking brake error condition. Alarm text indicating fault / error type is shown on the display unit (C).

With the ignition key in the (I) position and the parking brake released, the brake will be automatically applied if the switch is moved to the (R) or (O) positions.

Emergency braking

In an emergency situation, the parking brake may be used.

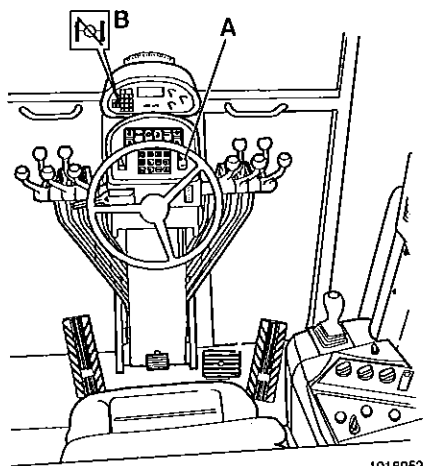
Move the transmission shifter into the Park (P) position. This will automatically apply the parking brake.



WARNING!

If the parking brake has been used in an emergency situation, the assembly must be inspected and serviced by a qualified service technician.

The parking brake is self-adjusting. For additional information, see pages 194 and 235.



A Differential lock / unlock switch
B Differential lock control lamp (amber)

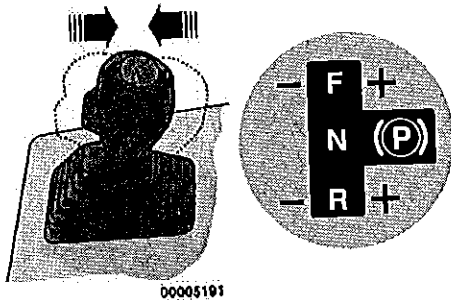
Differential lock

NOTE! Lock or unlock the differential **ONLY** when driving at slow speeds, in a straight line or if the machine is stopped. Do not lock or unlock the differential while making a turn or when the tandem wheels on one side are spinning. Damage to the differential could result.

The differential lock / unlock switch (A) is located in the pedestal instrument panel on the lower right-hand side. An amber control lamp (B) in the centre instrument panel and the indicator lamp on the switch will light up when the differential lock is in the LOCK position.

- Press the upper end of the switch to activate the differential lock (LOCK position) for normal grading operations when maximum traction is required. The control lamp will light up.
- Press the lower end of the switch to deactivate the differential lock (UNLOCK position) when differential action is required. This will reduce the turning radius and decrease tyre scuffing and strain on the drivetrain when operating on paved surfaces. The control lamp will go out.

Stopping



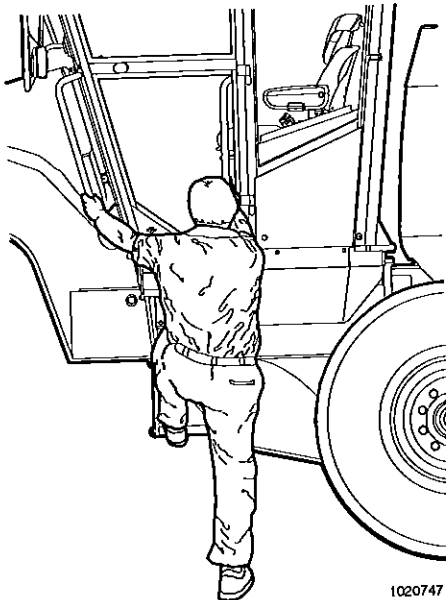
00005191

- 1 Lower the engine speed.
- 2 Slowly depress and hold down the inching and brake pedals. Depressing the inching pedal only may not stop the machine.
- 3 Use brake pedal to hold machine when transmission is in gear, inching pedal depressed and engine is running.
- 4 Move the transmission shifter into the Park (P) position. This will automatically apply the parking brake.
- 5 Release the inching and brake pedals.
- 6 Lower the moldboard and all attachments to the ground.
- 7 Run the engine at low idle a couple of minutes before stopping it in order to safeguard the lubrication and cooling of the turbo-charger.
- 8 Turn the ignition key counterclockwise to the (O) position so that the control lamps go out and the engine stops.



WARNING!

When you are entering or leaving the machine, always face the machine and use the steps or handholds to avoid slipping. Always use the "three-point" grip, i.e. both hands and one foot or both feet and one hand, when entering or leaving – Do not jump!



1020747

- 9 Use entry/exit handles to exit the machine.

Keep in mind that the theft and burglary risk can be minimised by:

- removing the ignition key when the machine is left unattended
- locking doors and covers after working hours
- turning off the current with the battery disconnect switch and removing the handle of the switch
- parking the machine where the risk of theft, burglary and damage is minimised
- removing all valuables from the cab such as cellular phone, computer, radio and bags
- chaining the machine.

By etching in the PIN-number or the national licence plate number of the machine on its windows, it is easier to identify stolen machines.

If the operator has to leave the cab while the engine is running, care must be taken so as not to turn the steering wheel or move the hydraulic control levers unintentionally.

NOTE! The interior of the cab is equipped with two additional handholds. They are welded to the bar at the bottom of the front windshield. You will find these handholds useful when entering or leaving the machine.

As an additional safety feature at night, refer to page 74 and move the cab interior (dome) light switch to the appropriate position for allowing the interior lights to illuminate when either door is opened.