DX15 / DX18

Shop Manual

K1043970AE

Serial Number 40001 and Up

DOOSAN reserves the right to improve our products in a continuing process to provide the best possible product to the market place. These improvements can be implemented at any time with no obligation to change materials on previously sold products. It is recommended that consumers periodically contact their distributors for recent documentation on purchased equipment.

This documentation may include attachments and optional equipment that is not available in your machine's package. Please call your distributor for additional items that you may require.

Illustrations used throughout this manual are used only as a representation of the actual piece of equipment, and may vary from the actual item.

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Safety

Track Excavator Safety

Edition 1

MEMO

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MEMO

SAFETY PRECAUTIONS

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX15	40001 and Up
DX18	40001 and Up

TO THE OPERATOR OF A *DOOSAN* EXCAVATOR

DANGER

Unsafe use of the excavator could lead to serious injury or death. Operating procedures, maintenance and equipment practices or traveling or shipping methods that do not follow the safety guidelines on the following pages could cause serious, potentially fatal injuries or extensive damage to the machine or nearby property.

Please respect the importance of taking responsibility for your own safety, and that of other people who may be affected by your actions.

The safety information on the following pages is organized into the following sections:

1. “General Safety Essentials” on page 1-8
2. “Location of Safety Labels” on page 1-8
3. “Work Site Precautions” on page 1-9
4. “Operation” on page 1-13
5. “Equipment” on page 1-19
6. “Maintenance” on page 1-24
7. “Shipping and Transportation” on page 1-28

SAFETY ALERT SYMBOL

Be Prepared - Get To Know All Operating and Safety Instructions.

This is the Safety Alert Symbol. Wherever it appears in this manual or on safety signs on the machine you should be alert to the potential for personal injury or accidents. Always observe safety precautions and follow recommended procedures.

Learn the Signal Words Used with the Safety Alert Symbol

The words **"CAUTION," "WARNING"** and **"DANGER"** used throughout this manual and on decals on the machine indicate degree of risk of hazards or unsafe practices. All three degrees of risk indicate that safety is involved. Observe precautions indicated whenever you see the Safety Alert "Triangle," no matter which signal word appears next to the "Exclamation Point" symbol.

CAUTION

Indicates potential of a hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against a generally unsafe practice.

WARNING

Indicates potential of a hazardous situation that, if not avoided, could result in serious injury or death. It may also be used to alert against a highly unsafe practice.

DANGER

Indicates imminent hazard of a situation that, if not avoided, is very likely to cause death or extremely serious injury. It may also be used to alert against equipment that may explode or detonate if handled or treated carelessly.

GENERAL SAFETY ESSENTIALS

Accessory Applications

The excavator has been primarily designed for moving earth with a bucket.

Use of an accessory hydraulic hammer (breaker), work in rough terrain, demolition applications or other hazardous operation may require installation of additional protective structures to safeguard the operator.

Never use machine for lifting.

The excavator is designed for excavating and loading only.

The excavator is not equipped for lifting and does not have safety devices for lifting.

HKA1013L

Figure 1

LOCATION OF SAFETY LABELS

Location of safety labels (decals) can vary from unit to unit. Refer to appropriate Operation and Maintenance Manual, and parts manual for your unit.

Always replace damaged or faded decals.

UNAUTHORIZED MODIFICATIONS

Any modification made without authorization or written approval from *DOOSAN* can create a safety hazard, for which the machine owner must be held responsible.

For safety's sake, replace all OEM parts with the correct authorized or genuine *DOOSAN* part. For example, not taking the time to replace fasteners, bolts or nuts with the correct replacement parts could lead to a condition in which the safety of critical assemblies is dangerously compromised.

WORK SITE PRECAUTIONS

Attachment Precautions

Options kits are available through your dealer. Contact *DOOSAN* for information on available one-way (single-acting) and two-way (double-acting) piping/valving/auxiliary control kits. Because *DOOSAN* cannot anticipate, identify or test all of the attachments that owners may wish to install on their machines, please contact *DOOSAN* for authorization and approval of attachments, and their compatibility with options kits.

Avoid High Voltage Cables

Serious injury or death can result from contact or proximity to high voltage electric lines. The bucket does not have to make physical contact with power lines for current to be transmitted.

Use a spotter and hand signals to stay away from power lines not clearly visible to the operator.

Voltage	Minimum Safe Distance
6.6 kV	3 m (9' 10")
33.0 kV	4 m (13' 1")
66.0 kV	5 m (16' 5")
154.0 kV	8 m (26' 3")
275.0 kV	10 m (32' 10")

Use these minimum distances as a guideline only. Depending upon the voltage in the line and atmospheric conditions, strong current shocks can occur with the boom or bucket as far away as 4 - 6 m (13 - 20 ft) from the power line. Very high voltage and rainy weather could further decrease that safety margin.

NOTE: *Before starting any type of operation near power lines (either above ground or buried cable type), you should always contact the power utility directly and work out a safety plan with them.*

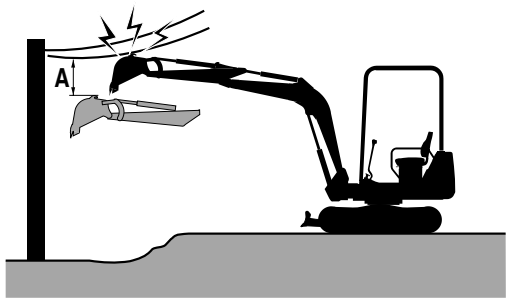

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Figure 2

Before Starting to Dig, Contact Authorities

Below ground hazards also include natural gas lines, electric cables, water mains, tunnels and buried foundations. Know what's underneath the work site before starting to dig.

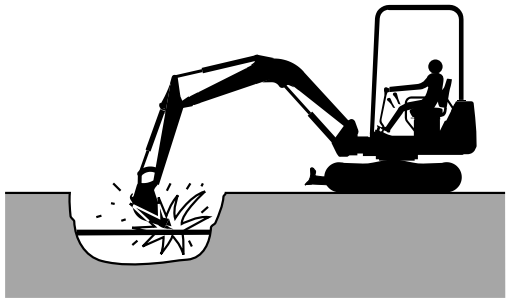

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Figure 3

Be Aware of Height Obstacles

Any type of object in the vicinity of the boom could represent a potential hazard, or cause the operator to react suddenly and cause an accident. Use a spotter or signal person working near bridges, phone lines, work site scaffolds, or other obstructions.

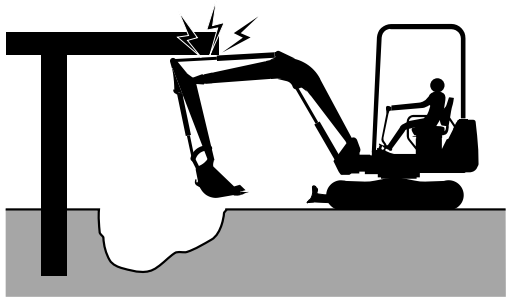

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Figure 4

Use Care on Loose Support

Working heavy loads over loose, soft ground or uneven, broken terrain can cause dangerous side load conditions and possible tipover and injury. Travel without a load or balanced load may also be hazardous.

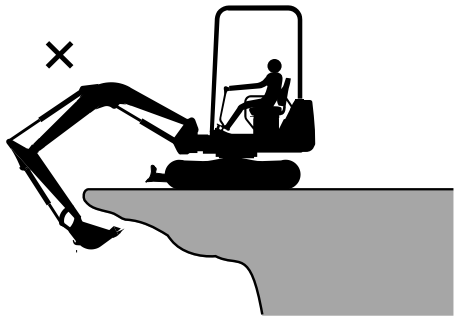
If temperatures are changing, be cautious of dark and wet patches when working or traveling over frozen ground. Stay away from ditches, overhangs and all other weak support surfaces. Halt work and install support mats or blocking if work is required in an area of poor track support.

Use Solid Support Blocking

Never rely on lift jacks or other inadequate supports when work is being done. Block tracks fore and aft to prevent any movement.

Overhangs Are Dangerous

Digging the work face under an overhang - the work area beneath a cliff or under the edge of a ditch - is dangerous. Know the height and reach limits of the excavator and plan ahead while working. Avoid creating dangerous situations by moving around the work site while making excavations. Go onto another digging area before steep overhangs are formed. Working around deep pits or along high walls or trenching may require support blocks, especially after heavy rainfalls or during spring thaws. Park the excavator away from overhangs before work shut down.



HKA1006L

Figure 5

Use Solid Support Blocking

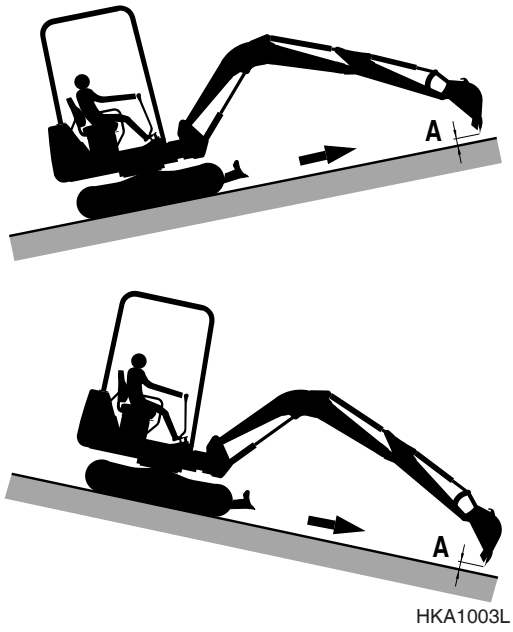
Never rely on lift jacks or other inadequate supports when work is being done. Block tracks fore and aft to prevent any movement.

Sloping Terrain Requires Caution

Dig evenly around the work site whenever possible, trying to gradually level any existing slope. If it's not possible to level the area or avoid working on a slope, reducing the size and cycling rate of the workload is recommended.

On sloping surfaces, use caution when positioning the excavator before starting a work cycle. Stay alert for unstable situations to avoid getting into them. For example, you should always avoid working the bucket over downhill crawler tracks when parked perpendicular to the slope. Slow all downhill swing movements and avoid full extensions of the bucket in a downhill direction. Lifting the bucket too high, too close to the machine, while the excavator is turned uphill can also be hazardous.

- Raise bucket when encountering small obstacles.
- Keep bucket 20 - 30 cm (8 - 12") off ground when driving on slopes.
- If machine slips, lower bucket to ground and stop immediately.
- When traveling on level ground, bring front attachment in and raise bucket 40 - 50 cm (15 - 20") with teeth facing up.



HKA1003L

Figure 6

Stay Alert for People Moving through the Work Area

When loading a truck you should always know where the driver is.

Avoid loading over the cab of a truck even if the driver is in a safe spot. Someone else could have gone inside, for any number of reasons. Avoid working where unseen passersby might be.

Slow down the work cycle and use slower travel speeds in congested or populated areas. Use a commonly understood signal so that other members of the work crew can warn the operator to slow or halt work in an impending hazard situation.

Check for hazards in the work area before starting and moving.

- Use horn or other signal to warn others when you start and move the machine.
- Use a signal man whenever the operator's vision is obstructed in any way. Make sure the signal man is in sight of the operator at all times.
- Agree on signals before operation.
- Keep bystanders and obstacles out of work area.
- Keep work areas well lighted at night.

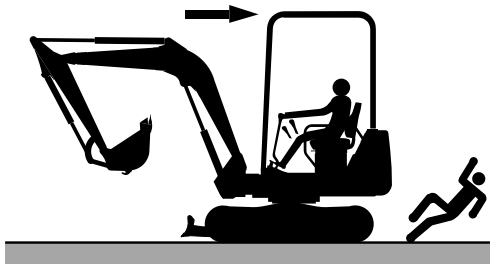


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Figure 7

BE AWARE OF AND CONFORM TO LOCAL REGULATIONS

Minimum levels of insurance coverage, work permits or certification, physical barriers around the work site or restricted hours of operation may be mandated by governing authorities. There may also be guidelines, standards or restrictions on equipment that may be used to perform certain kinds of work. Check and follow all local requirements, which may also be related to below ground hazards and power lines.

Operate While Seated at the Operator's Station ONLY

Never reach in through a window to work a control. Do not try to operate the excavator unless you're in the command position stay alert and focused on your work at all times but Do not twist out of the seat if job activity behind you (or to the side) requires your attention.

Use a spotter or signal person if you cannot see clearly and something is happening behind you.

Replace damaged safety labels and lost or damaged owner's manuals.

Do not let anyone operate the machine unless they've been fully and completely trained, in safety and in operation of the machine.

HAOA150L

Figure 8

Adjust seat

If the driver's seat is not adjusted correctly, the operator may become easily fatigued and injury and/or damage could result.

- Be sure to adjust the driver's seat at the beginning of each work period.
- Adjust driver's seat so that the operator can easily reach the pedals while his back is firmly against the lumbar support of the seat.

Before Starting the Engine

Do a "prestart" safety check:

- Walk around your machine before getting in the operator's cab. Look for evidence of leaking fluid, loose fasteners, misaligned assemblies or any other indications of possible equipment hazard.
- All equipment covers and machinery safety guards must be in place, to protect against injury while the machine is being operated.
- Look around the work site area for potential hazards, or people or property that could be at risk while operation is in progress.
- NEVER start the engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in the cab.
- A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start-up.
- Check gauges and monitor displays for normal operation before starting the engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at the start of the work cycle.

Never Use Ether Starting Aids

An electric grid type manifold heater is used for cold starting. The glowing heater element can cause ether or other starting fluid to detonate, causing injury.

HAOA311P

Figure 9

Mounting and Dismounting

NEVER get on or off a moving machine. Do not jump on/off. The entry/egress path should be clear of mud, oil and spills and mounting hardware must be kept tight and secure.

Always use handholds, steps or track shoes and maintain at least 3-point contact of hands and feet. Never use controls as handholds.

NEVER get up from the operator's seat or leave the operator's station and dismount the machine if the engine is running.

HAOD040P

Figure 10

Observe General Safety Rules

Only trained and authorized personnel, with a good knowledge and awareness of safe procedures, may be allowed to operate or perform maintenance or service on the excavator.

All personnel at the work site should be aware of assigned individual responsibilities and tasks. Communication and hand signals used should be understood by everyone.

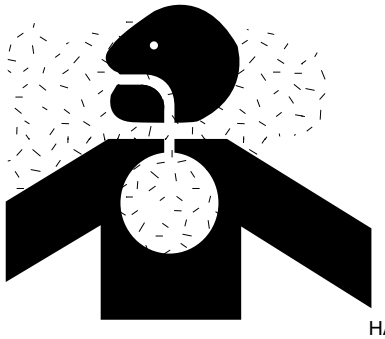
Terrain and soil conditions at the work site, approaching traffic, weather related hazards and any above or below ground obstacles or hazards should be observed and monitored by all work crew members.

Engine Ventilation

Engine exhaust gases can cause fatal accidents, and unconsciousness, loss of alertness, judgement and motor control and serious injury.

Make sure of adequate ventilation before starting the engine in any enclosed area.

You should also be aware of open windows, doors or ductwork into which exhaust may be carried, or blown by the wind, exposing others to danger.



HAOA070L

Figure 11

Asbestos Dust Hazard Prevention

Asbestos dust can be HAZARDOUS to your health if it is inhaled. Materials containing asbestos fiber can be present on work site. Breathing air that contains asbestos fiber can ultimately cause serious or fatal lung damage. To prevent lung damage from asbestos fiber, observe following precautions;

- Use a respirator that is approved for use in an asbestos-laden atmosphere.
- Never use compressed air for cleaning.
- Use water for cleaning to keep down the dust.
- Work on the machine or component with the wind at your back whenever possible.
- Always observe any rules and regulations related to the work site and working environment.

ARO1770L

Figure 12

Take Time to Provide Good Visibility

Halt work if visibility is poor. Strong rains, snow, fog and extremely dusty conditions can all obscure visibility so badly that it is best to wait for weather to change or dust to settle before continuing operation.

Night work in areas of limited visibility should be halted if installation of extra work lights on the machine (or work area) is necessary.

Keep dirt and dust off of windows and off the lens surfaces of work lights. Stop working if lights, windows or mirrors need cleaning or adjustment.

Remove Coating Before Welding or Heating

Protect yourself from noxious smoke or dust.

Welding, soldering or heating with a welding torch directly on a coated surface can produce noxious gases. Perform these operations in an open or well ventilated area.

Remove coatings from surface before welding or heating.When removing coating with a grinder, wear a welder's helmet to prevent inhaling the dust.

When using a welding flux, wipe the face of the weld with soapy or clear water. Do not store a welding flux near flame. Wait 15 minutes or more after removing coating before welding or heating.

Do Not Heat Hydraulic System and Piping

Heating hydraulic components, piping or nearby areas can produce flammable steam or gas. Take the following precautions:

- Clean flammable liquids out of piping using a nonflammable solvent before welding.
- Never weld, solder or use a welding torch on hydraulic components or nearby areas.
- Piping with hydraulic oil under pressure or rubber hoses can burst if heated directly. Be sure to use fire proof shields.

HFB1039L

Figure 13

Never Carry People In or On the Machine

Never transport other persons in or on the machine.

Riders restrict visibility, reduce concentration and may cause and/or be subject to injury.

HKA1008L

Figure 14

Fuel, Oil and Hydraulic Fluid Fire Hazards

Add fuel, oil, antifreeze and hydraulic fluid to the machine only in a well ventilated area. The machine must be parked with controls, lights and switches turned off. The engine must be off and any flames, glowing embers, auxiliary heating units or spark causing equipment must be doused, turned off and/or kept well clear of the machine.

Static electricity can produce dangerous sparks at the fuel filling nozzle. In very cold, dry weather or other conditions that could produce static discharge, keep the tip of the fuel nozzle in constant contact with the neck of the fuel filling nozzle, to provide a ground.

Keep fuel and other fluid reservoir caps tight and do not start the engine until caps have been secured.

HAOA120L

Figure 15

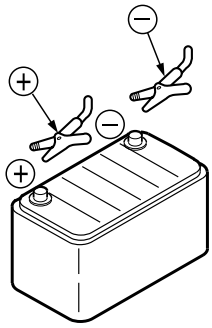
Boost Starting or Charging Engine Batteries

Turn off all electrical equipment before connecting leads to the battery. This includes electrical switches on the battery charger or boost starting equipment.

When boost starting from another machine or vehicle do not allow the two machines to touch. Wear safety glasses or goggles while required parallel battery connections - positive to positive and negative to negative - are made.

24 volt battery units consisting of two series connected twelve volt batteries have a cable connecting one positive terminal on one of the 12 volt batteries to a negative terminal on the other battery. Booster or charger cable connections must be made between the nonseries connected positive terminals and between the negative terminal of the booster battery and the metal frame of the machine being boosted or charged. Refer to the procedure and illustration in Operation and Maintenance Manual.

Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost started, should be as far away from the batteries as possible.



HAOA310L

Figure 16

Travel Controls May Produce Reversed Operations

Before starting the machine you should always check to see which end of the track frame is under the operator's cab. In the normal travel configuration, track frame travel motors are at the rear of the machine, under the engine and counterweight. If the operator swings the cab 180°, travel motors will be underneath the operator's cab, toward the front of the track frame and operating travel will be reversed.

When traveling the excavator always keep lights on; make sure that you are in compliance with all state and local regulations concerning warning flags and signs and keep the operator's cab positioned over the idler end of the track frame. That will keep travel controls in their intended configuration and at the same time, maintain the proper orientation of lights on the machine and posted flags and signs.

KEEP "PINCH POINT" AREAS CLEAR - USE CAUTION IN REVERSE AND SWING

Use a signal person in high traffic areas and whenever the operator's view is not clear, such as when traveling in reverse. Make sure that no one comes inside the swing radius of the machine.

Anyone standing near the track frames, or working assemblies of the attachment, is at risk of being caught between moving parts of the machine.

Never allow anyone to ride on any part of the machine or attachment, including any part of the turntable or operator's cab.

HKA1005L

Figure 17

Travel Precautions

Attachment control levers should not be operated while traveling.

Do not change selected travel mode (FAST/SLOW) while traveling.

Fold in work equipment so that the outer end of the boom is as close to the machine as possible, and is 200 mm - 300 mm (8" - 12") above ground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that causes 10 degrees tilt, or more.

Operate Carefully on Snow and Ice and in Very Cold Temperatures

In icy cold weather avoid sudden travel movements and stay away from even very slight slopes. The machine could skid off to one side very easily.

Snow accumulation could hide or obscure potential hazards. Use care while operating or while using the machine to clear snow.

Warming up the engine for a short period may be necessary, to avoid operating with sluggish or reduced working capacity. The jolting shocks and impact loads caused by bumping or bottoming the boom or attachment are more likely to cause severe stress in very cold temperatures. Reducing work cycle rate and work load may be necessary.

Parking Machine

Avoid making sudden stops or parking the machine wherever it happens to be at the end of the work day. Plan ahead so that the excavator will be on firm, level ground away from traffic and away from high walls, cliff edges and any area of potential water accumulation or runoff. If parking on inclines is unavoidable, block the crawler tracks to prevent movement. Lower the bucket or other working attachment completely to the ground, or to an overnight support saddle. There should be no possibility of unintended or accidental movement.

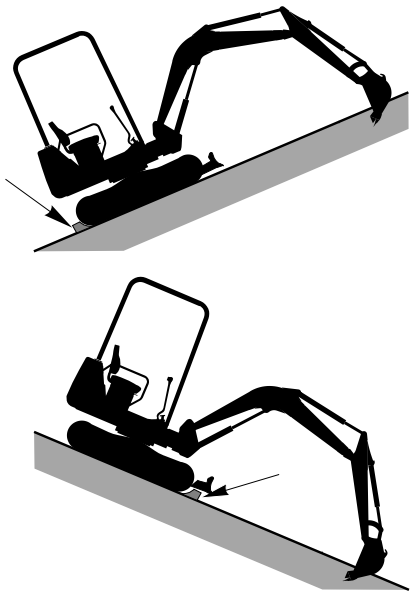


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Figure 18

Shutdown Control Functions

After the machine has been lowered to the overnight storage position and all switches and operating controls are in the "OFF" position, the control stand lock lever must be engaged. Release the left console to disable all pilot circuit control functions.

Insert the swing lock pin and engage all brakes and lock-down security equipment that may have been installed on the machine.

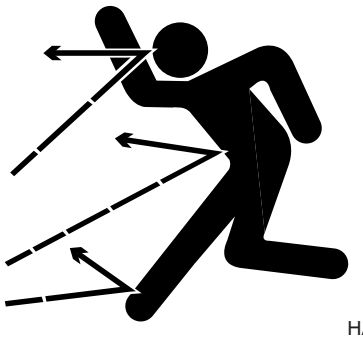
IMPORTANT

When hydraulic system maintenance or service work must be performed, you should be aware that an accumulator in the system stores fluid under pressure after system lock down, even after the control stand is raised. Release this energy by working controls with the engine off, until pressure in the pilot circuit has been completely bled away.

EQUIPMENT

Rough Operation May Require Use of Certified Safety Equipment

Work in mines, tunnels, deep pits or on loose or wet surfaces could produce danger of falling rock, roll over or hazardous flying objects. Additional protection for the operator's cab could be required in the form of a TOPS/Tip Over Protective Structure reinforcement system.



HAOA110L

Figure 19

Any reinforcement system that is installed on the machine must pass safety and certification standards and carry appropriate labeling and rating information.

Never attempt to alter or modify any type of protective structure reinforcement system, by drilling holes, welding or remounting or relocating fasteners. Any serious impact or damage to the system requires a complete integrity reevaluation. Reinstallation, recertification and/or replacement of the system may be necessary.

HAOA100L

Figure 20

Install Additional Safety Equipment If Conditions Require

When working with a breaker or in some shear work applications, a front guard over the windshield may be required. The windshield guard may or may not be OPS/certified, depending upon the specific application and working situation.

Laminate glass protection for the front, side or rear windows may also be recommended depending upon particular site conditions.

Contact your *DOOSAN* distributor for available safety guards and/or recommendations if there is any danger of getting hit by objects that could strike the operator's cab. Make sure that all other work site crew members are kept well away from the excavator and safe from potential hazards.

Movement Alarms

If the excavator is equipped with an audible travel movement alarm or visible swing movement alarm (strobe light), test the alarm on a daily basis. The audible alarm should sound as soon as the travel system is engaged. The strobe light should begin to flash as soon as the swing system is engaged.

Protect Yourself From Flying or Falling Objects

Wear safety glasses when operating in dusty or sandy conditions or when rock fragments could be thrown up by operation. Also wear protection when carrying out maintenance such as removing or installing the bucket pin, etc.

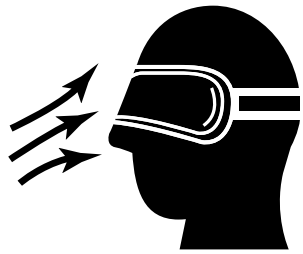


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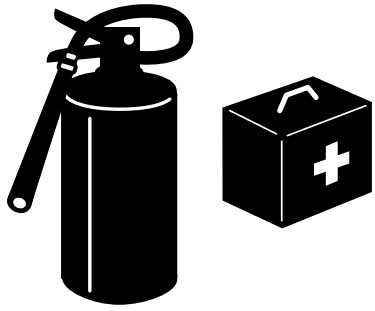
Figure 21

Keep a Fire Extinguisher at Hand

It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose "A/B/C" fire extinguisher be mounted in the cab. Check and service the fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.



HAOA080L

Figure 22

Maintain Standard Safety Equipment in Good Condition

Machinery guards and body panel covers must be in place at all times. Keep well clear of rotating parts. Pinch point hazards such as cooling fan and alternator drive belts could catch hair, jewelry or oversize or very loose clothing.

Safety labels must be replaced if they are damaged or become unreadable. The information on labels gives work crew members an important safety reminder exactly where it will do the most good. Part numbers for each label and required mounting locations are shown in Operation and Maintenance Manual.

Safety Critical Parts Must Be Replaced Periodically

Replace the following fire related components as soon as they begin to show any sign of wear, or at regular periodic intervals, whether or not deterioration is visible:

- Fuel system flexible hoses, the tank overflow drain hose and the fuel fill cap.
- Hydraulic system hoses, especially the pump outlet lines and front and rear pump branch hoses.
- Keep mounting brackets and hose and cable routing straps tight. Hose routing should have gradual bends.

Hydraulic Cylinder Seals Require Periodic Replacement

Check cylinder drift rate at regular intervals. Maximum allowable rates are included in the in this manual. Overhaul seal kits are available through *Doosan*.

High-pressure Hydraulic Lines Can Store a Great Deal of Energy

Exposed hydraulic hoses on the arm or boom could react with explosive force if struck by a falling rock, overhead obstacle or other work site hazard. *Extra safety guards may be required.* NEVER allow hoses to be hit, bent or interfered with during operation.

The Operator's Cab and Turntable Deck Should Be Kept Clean

Cleaning off accumulations of grease and dirt helps extend equipment service life. Cleaning also provides an opportunity to inspect equipment. Minor damage can be repaired or corrected before major problems result.

Keep the cab floor and consoles free of tools and personal items.

Clothing and Personal Protective Items

Contain long hair, and avoid loose clothing and jewelry. They can catch on controls or in protruding parts and cause serious injury or death.

Do not wear oily clothes. They are highly flammable.

Full eye protection, a hard hat, safety shoes and gloves may be required at the work site.

While working on the machine, never use inadequate tools. They could break or slip, causing injury, or they may not adequately perform intended functions.


HAOA020L

Figure 23

Breathing Masks, Ear Protection May Be Required

Do not forget that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause disabling or permanent injuries.

NOTE: *The equivalent continuous A-weighted sound pressure level at the workstation for this machine is given in the operation manual.*

Measurement is obtained on a dynamic machine following the procedures and cab conditions as described in ISO 6396.

NOTE: *The guaranteed sound power level emitted by the machinery for this machine is given in the operation manual.*

Measurement is obtained on a dynamic machine with the procedures as described in 2000/14/EC.

Vibration Level Information

Hands/Arms: The weighted root mean square acceleration to which the hands/arms are subjected, is less than 2.5 m/s^2.

whole body: The weighted root mean square acceleration to which the whole body is subjected, is less than 0.5 m/s^2.

Measurements are obtained on a representative machine, using measuring procedures as described in the following standard: ISO 2631/1. ISO 5349, and SAE J1166.

Battery Electrolyte and Explosive Gases Can Be Lethal

Flush eyes with water for 10 - 15 minutes if acid is splashed in the face. Anyone who swallows acid must have **immediate** medical aid. *Call the Poison Control listing in the front cover of the telephone directory.* Water, a popsicle or ice cream are likely better than old remedies that try to induce vomiting (which would expose tissue to damage twice).

Explosive battery gas can be set off by sparks from incidental contact or static discharge. Turn off all switches and the engine when working on batteries. Keep battery terminals tight. Contact between a loose terminal and post can create an explosive spark.

HAOA150L

Figure 24

Disconnect Batteries for Electrical Service Before Electrical Welding

Remove cable to negative terminal first, when disconnecting cable. **Connect positive terminal cables first when installing a battery.**

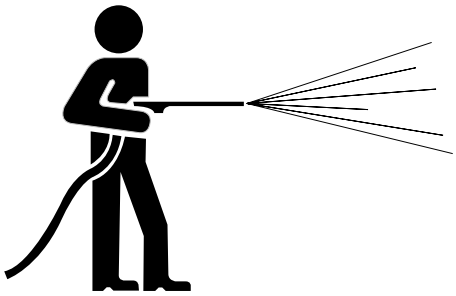
Use Low Heat Portable Lighting

Hot surfaces on trouble lights or portable work lights can set off fuel or battery explosive gases.

Keep Machine Clean at All Times

Keep machine free of oil and grease at all times.

Water will damage the electrical system. Never use water or steam on the inside of the cab, in the engine compartment or in any location where it may reach sensors, connectors or other electrical components.



HFB1030L

Figure 25

Use Warning Tag Control Lockout Procedures During Service

Alert others that service or maintenance is being performed and tag operator's cab controls - and other machine areas if required - with a warning notice. OSHA mandated control lever lockout can be made with any OSHA certified lockout device and a length of chain or cable to keep the left-hand control console in the fully raised, nonactive position.

Warning tags for controls are available from *DOOSAN* distributors.

HAOC920L

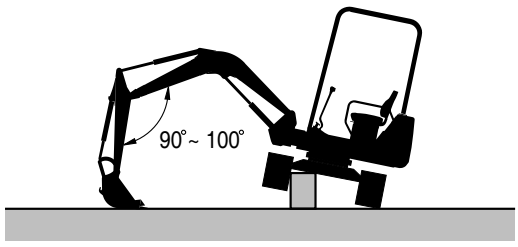
Figure 26

Do not Run the Engine If Repairs or Work Is Being Performed Alone

You should always have at least two people working together if the engine must be run during service. One person needs to remain in the operator's seat, ready to work the controls or stop the machine and shut off the engine.

Always Use Adequate Equipment Supports and Blocking

Do not allow weight or equipment loads to remain suspended. Lower everything to the ground before leaving the operator's seat. Do not use hollow, cracked or unsteady, wobbling weight supports. Do not work under any equipment supported solely by a lift jack. When inspecting or performing service under a machine that is jacked up, keep boom at a 90°-100°angle to the arm and chock tracks securely.



HBOH810L

Figure 27