

# SECTION 1 GENERAL



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## SECTION 1 GENERAL

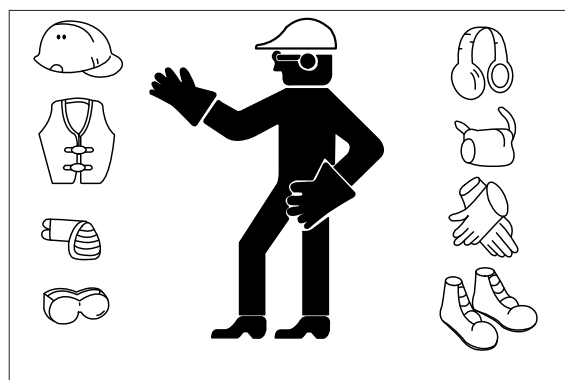
### GROUP 1 SAFETY

#### FOLLOW SAFE PROCEDURE

Unsafe work practices are dangerous. Understand service procedure before doing work; do not attempt shortcuts.

#### WEAR PROTECTIVE CLOTHING

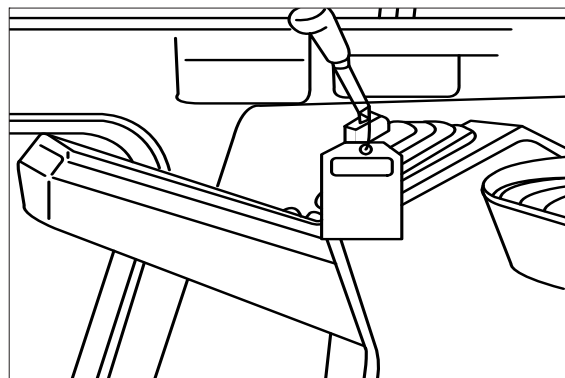
Wear close fitting clothing and safety equipment appropriate to the job.



#### WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

Before performing any work on the excavator, attach a 「Do Not Operate」 tag on the right side control lever.



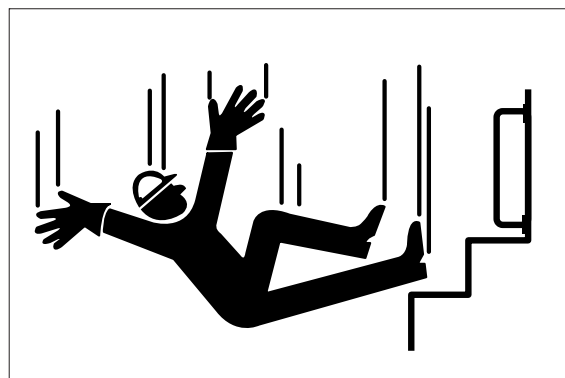
#### USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.

Never jump on or off the machine. Never mount or dismount a moving machine.

Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.

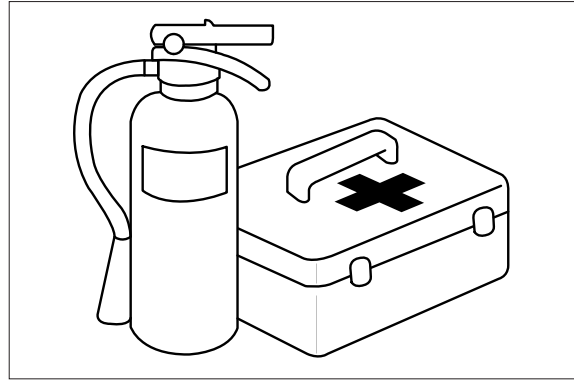


### PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

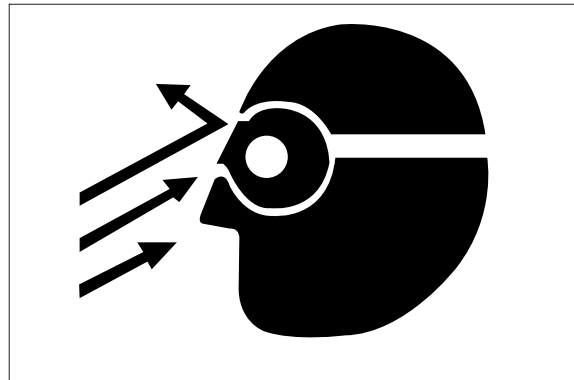
Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



### PROTECT AGAINST FLYING DEBRIS

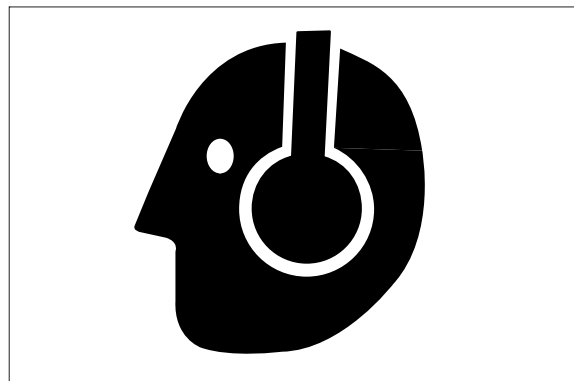
Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.



### PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

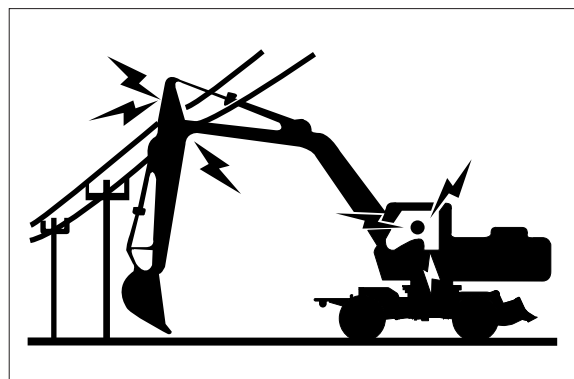
Wear a suitable hearing protective device such as ear-muffs or earplugs to protect against objectionable or uncomfortable loud noises.



### AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

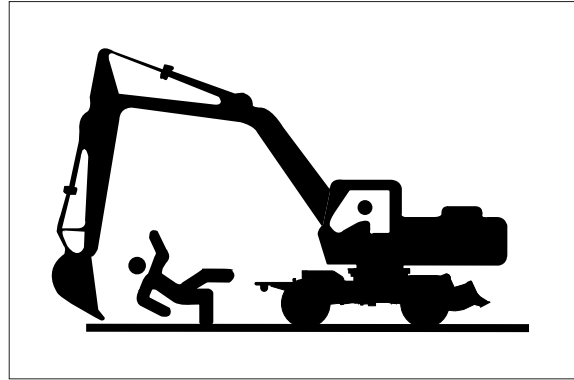
Never move any part of the machine or load closer to electric line than 3 m (10 ft) plus twice the line insulator length.



### KEEP RIDERS OFF EXCAVATOR

Only allow the operator on the excavator. Keep riders off.

Riders on excavator are subject to injury such as being struck by foreign objects and being thrown off the excavator. Riders also obstruct the operator's view resulting in the excavator being operated in an unsafe manner.

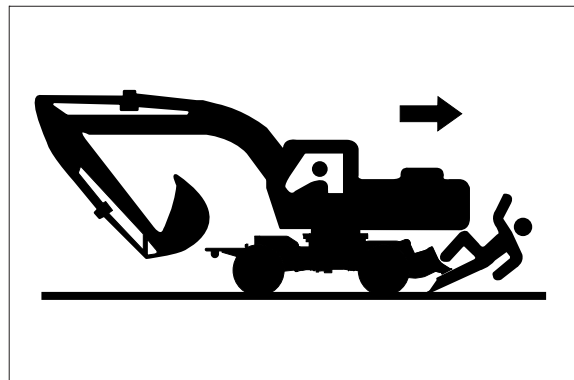


### MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the excavator starts to move.

Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



### OPERATE ONLY FROM OPERATOR'S SEAT

Avoid possible injury machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.



### PARK MACHINE SAFELY

Before working on the machine:

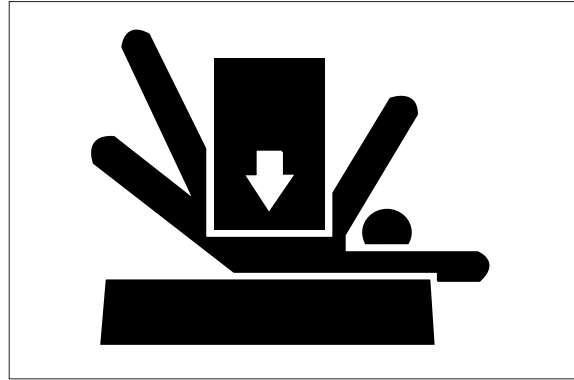
- Park machine on a level surface.
- Lower bucket to the ground.
- Turn auto idle switch off.
- Run engine at 1/2 speed without load for 2 minutes.
- Turn key switch to OFF to stop engine.
  - Remove key from switch.
- Move pilot control shutoff lever to locked position.
- Allow engine to cool.

### SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.

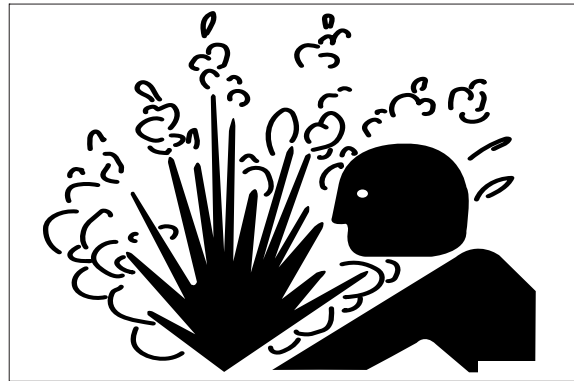
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



### SERVICE COOLING SYSTEM SAFELY

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



### HANDLE FLUIDS SAFELY-AVOID FIRES

Handle fuel with care; it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.

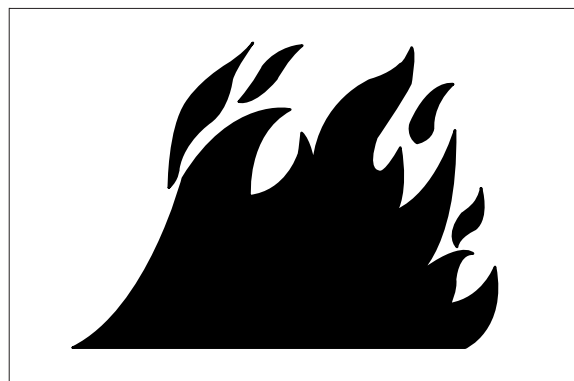
Fill fuel tank outdoors.



Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags ; they can ignite and burn spontaneously.



## BEWARE OF EXHAUST FUMES

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.

## REMOVE PAINT BEFORE WELDING OR HEATING

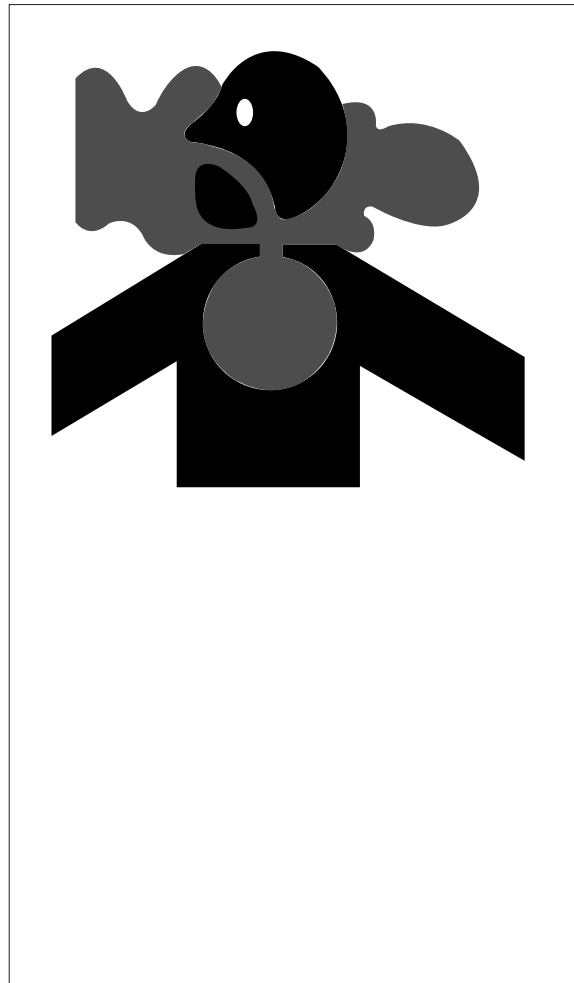
Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

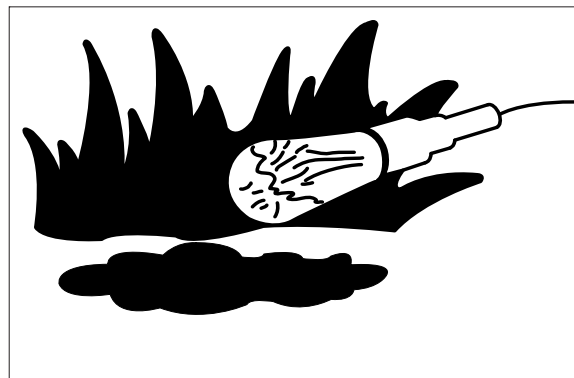
Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



## ILLUMINATE WORK AREA SAFELY

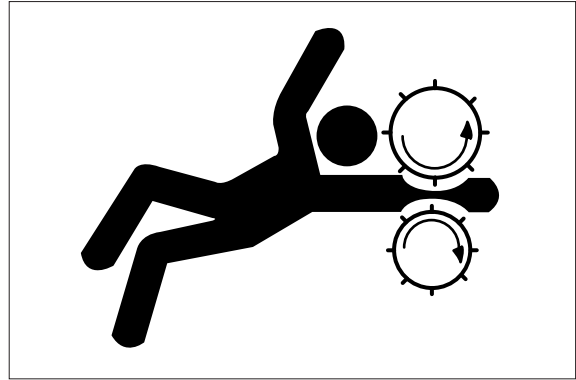
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



### SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

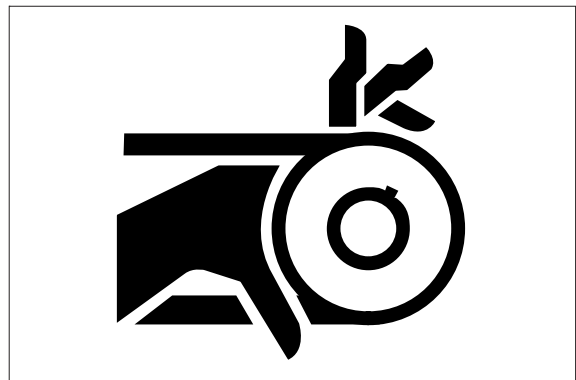
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



### STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



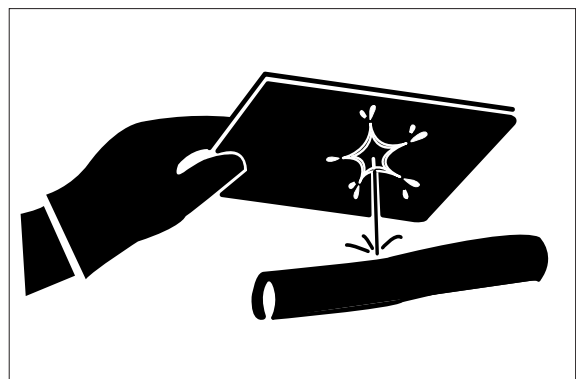
### AVOID HIGH PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.



## AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.



## PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



## PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

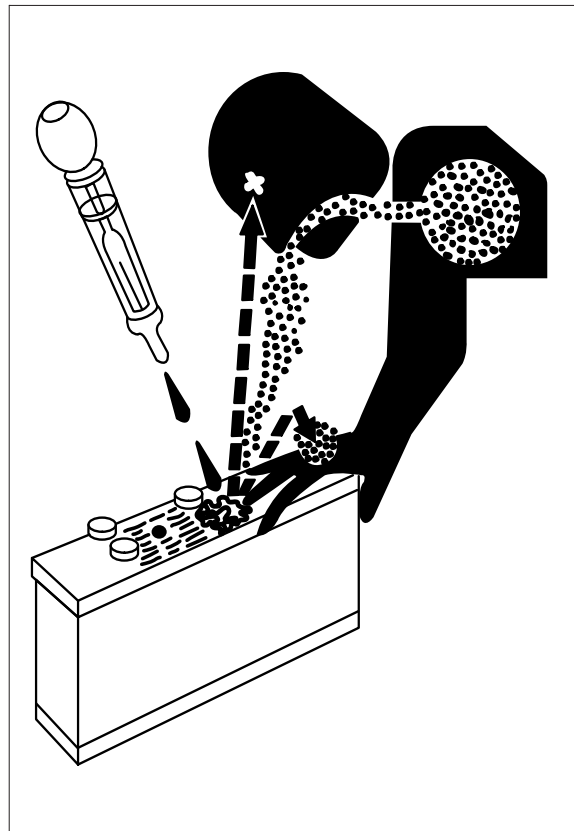
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10-15 minutes.  
Get medical attention immediately.

If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.





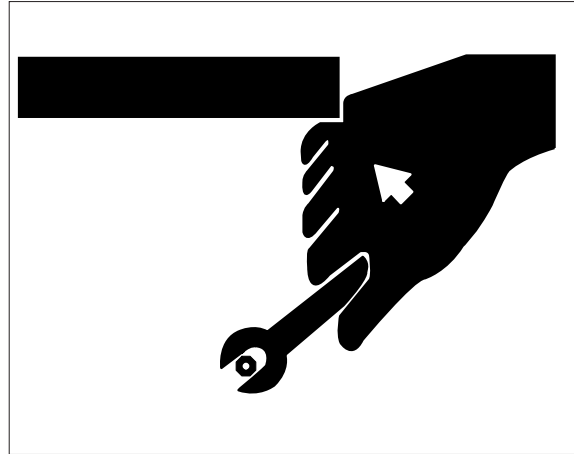
### USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts.(See Parts manual.)

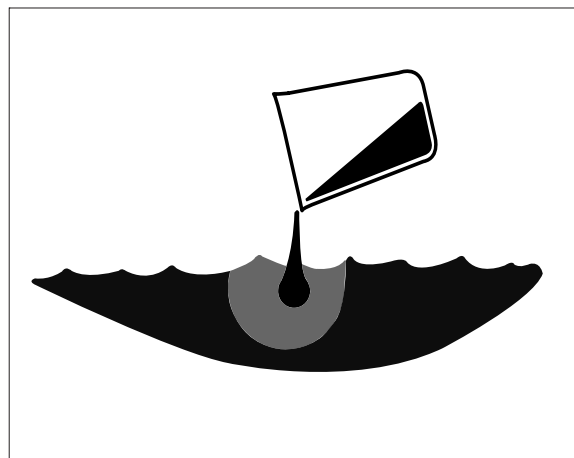


### DISPOSE OF FLUIDS PROPERLY

Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

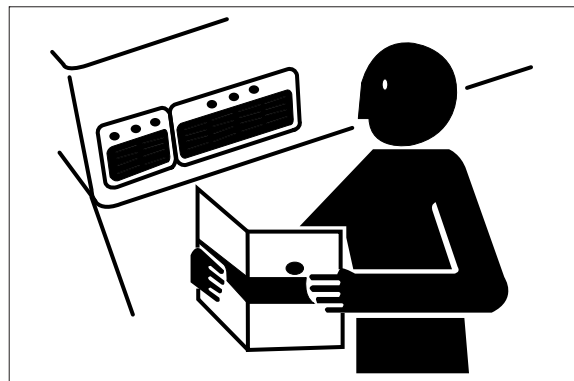
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



### REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

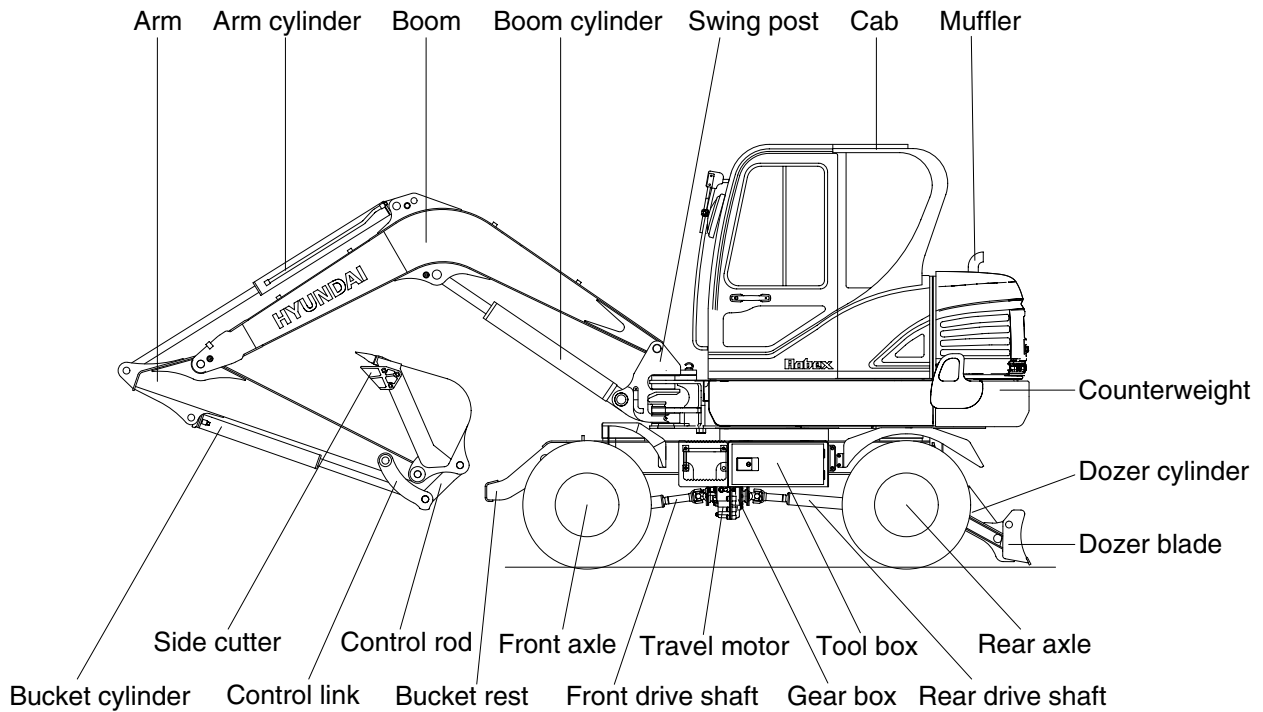
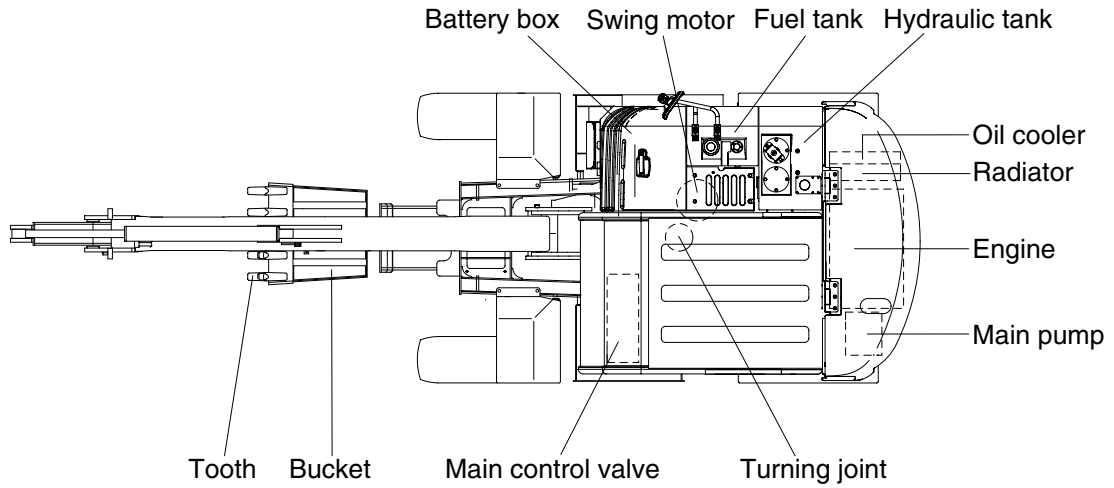


### LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

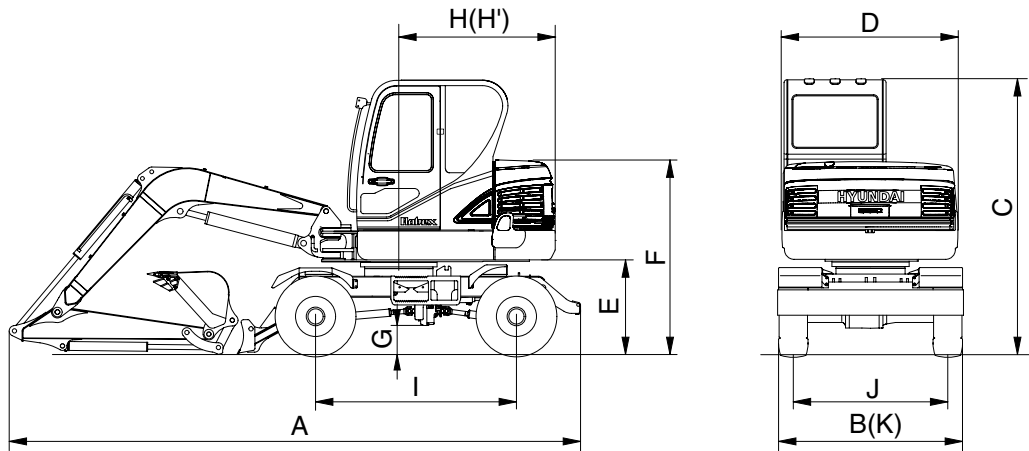
# GROUP 2 SPECIFICATIONS

## 1. MAJOR COMPONENT



## 2. SPECIFICATIONS

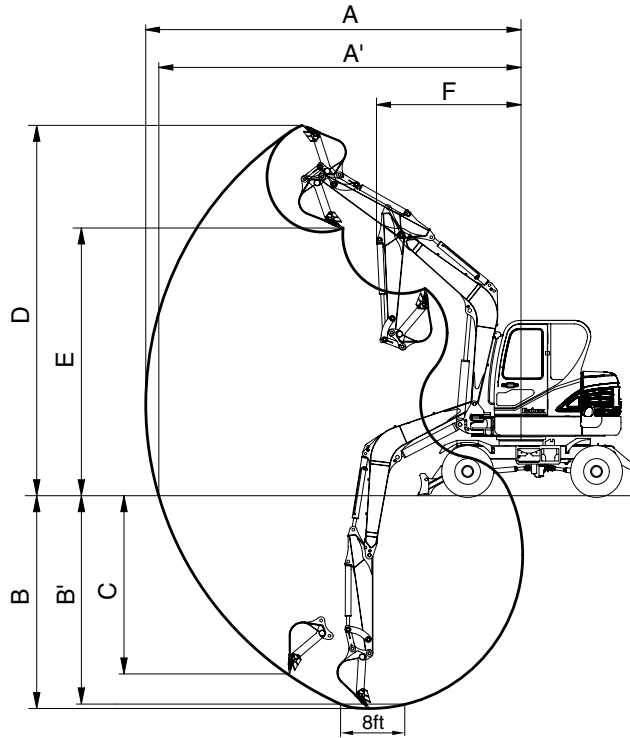
### 1) 3.0 m (9'10") MONO BOOM, 1.6 m (5' 3") ARM WITH BOOM SWING SYSTEM



Description		Unit	Specification
Operating weight		kg (lb)	5720 (12610)
Bucket capacity(SAE heaped), standard		m <sup>3</sup> (yd <sup>3</sup> )	0.21 (0.28)
Overall length	A	mm (ft-in)	6100 (20' 0")
Overall width	B		1925 ( 6' 4")
Overall height	C		2850 ( 9' 4")
Upperstructure width	D		1850 ( 6' 1")
Ground clearance of counterweight	E		986 ( 3' 3")
Engine cover height	F		1980 ( 6' 6")
Minimum ground clearance	G		290 (11.4")
Rear-end distance	H		1650 ( 5' 5")
Rear-end swing radius	H'		1650 ( 5' 5")
Wheel base	I		2100 ( 6'11")
Tread	J		1600 ( 5' 3")
Dozer blade width	K		1925 ( 6' 4")
Travel speed	Low		km/hr (mph)
	High	31 (19.4)	
Swing speed		rpm	10
Gradeability		Degree (%)	35 (70)
Max traction force		kg (lb)	3600 (7937)

### 3. WORKING RANGE

#### 1) 3.0 m (9'10") MONO BOOM WITH BOOM SWING SYSTEM



Description		1.6 m (5' 3") Arm
Max digging reach	A	6150 mm (20' 2")
Max digging reach on ground	A'	5980 mm (19' 7")
Max digging depth	B	3500 mm (11' 6")
Max digging depth (8 ft level)	B'	3100 mm (10' 2")
Max vertical wall digging depth	C	2960 mm ( 9' 9")
Max digging height	D	6070 mm (19' 11")
Max dumping height	E	4340 mm (14' 3")
Min swing radius	F	2350 mm ( 7' 9")
Boom swing radius (left/right)		80°/50°
Bucket digging force	SAE	46.7 kN
		4762 kgf
		10499 lbf
	ISO	52.5 kN
		5356 kgf
		11810 lbf
Arm crowd force	SAE	27.5 kN
		2808 kgf
		6186 lbf
	ISO	30.9 kN
		3154 kgf
		6948 lbf











#### 4. WEIGHT

Item	R60WVS PRO	
	kg	lb
Upperstructure assembly	2753	6071
Main frame weld assembly	651	1432
Engine assembly	280	620
Main pump assembly	31	72
Main control valve assembly	34	76
Swing motor assembly	77	173
Hydraulic oil tank assembly	90	200
Fuel tank assembly	60	130
Boom swing post	110	240
Counterweight	210	460
Cab assembly	300	660
Lower chassis assembly	2087	4605
Lower frame weld assembly	550	1210
Swing bearing	90	200
Travel motor assembly	50	110
Turning joint	30	70
Gear box	63	140
Front axle assembly	280	617
Rear axle assembly	200	440
Dozer blade assembly	207	455
Front attachment assembly (3.0 m boom, 1.6 m arm, 0.21 m <sup>3</sup> SAE heaped bucket)	792	1744
3.0 m boom assembly	253	559
1.6 m arm assembly	125	279
0.21 m <sup>3</sup> SAE heaped bucket assembly	167	363
Boom cylinder assembly	72	159
Arm cylinder assembly	54	117
Bucket cylinder assembly	36	82
Bucket control link assembly	40	90
Boom swing cylinder assembly	40	90
Blade cylinder assembly	33	77











## 5. LIFTING CAPACITIES

1) 3.0 m ( 9'10") boom, 1.6 m ( 5' 3") arm equipped with **0.21m<sup>3</sup>**(SAE heaped) bucket and the dozer blade down.

-  : Rating over-front
-  : Rating over-side or 360 degree

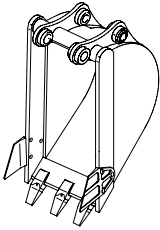
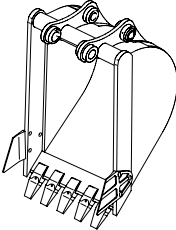
Load point height		Load radius								At max. reach		
		2.0m (6.6ft)		3.0m (9.8ft)		4.0m (13.1ft)		5.0m (16.4ft)		Capacity		Reach m(ft)
												
5.0m 16.4ft	kg lb											
4.0m 13.1ft	kg lb					*1110 *2450	1090 2400			*1100 *2430	870 1920	4.54 (14.9)
3.0m 9.8ft	kg lb					*1250 *2760	1060 2340	*1220 *2690	720 1590	*1090 *2400	700 1540	5.05 (16.6)
2.0m 6.6ft	kg lb			*2100 *4630	1580 3480	*1550 *3420	1000 2200	1260 2780	700 1540	1150 2540	630 1390	5.28 (17.3)
1.0m 3.3ft	kg lb			*2770 *6110	1460 3220	1760 3880	950 2090	1240 2730	670 1480	1130 2490	610 1340	5.28 (17.3)
0.0m 0.0ft	kg lb	*2490 *5490	*2490 *5490	2790 6150	1400 3090	1720 3790	910 2010	1220 2690	650 1430	1200 2650	640 1410	5.05 (16.6)
-1.0m -3.3ft	kg lb	*3950 *8710	2740 6040	2780 6130	1400 3090	1710 3770	910 2010			1400 3090	750 1650	4.55 (14.9)
-2.0m -6.6ft	kg lb	*3830 *8440	2810 6190	*2350 *5180	1430 3150					*1760 *3880	1070 2360	3.65 (12.0)

2) 3.0 m ( 9'10") boom, 1.6 m ( 5' 3") arm equipped with **0.21m<sup>3</sup>**(SAE heaped) bucket and the dozer blade up.

Load point height		Load radius								At max. reach		
		2.0m (6.6ft)		3.0m (9.8ft)		4.0m (13.1ft)		5.0m (16.4ft)		Capacity		Reach m(ft)
												
5.0m 16.4ft	kg lb									*1460 *3220	1410 3110	3.54 (11.6)
4.0m 13.1ft	kg lb					*1350 *2980	1180 2600			*1410 *3110	980 2160	4.48 (14.7)
3.0m 9.8ft	kg lb			*1670 *3680	*1670 *3680	*1480 *3260	1160 2560			*1360 *3000	820 1810	4.99 (16.4)
2.0m 6.6ft	kg lb			*2430 *5360	1680 3700	*1770 *3900	1110 2450	1370 3020	800 1760	1280 2820	750 1650	5.22 (17.1)
1.0m 3.3ft	kg lb			2980 6570	1580 3480	1880 4140	1070 2360	1340 2950	780 1720	1260 2780	730 1610	5.22 (17.1)
0.0m 0.0ft	kg lb	*2070 *4560	*2070 *4560	2930 6460	1540 3400	1850 4080	1040 2290			1340 2950	770 1700	4.99 (16.4)
-1.0m -3.3ft	kg lb	*4030 *8880	2940 6480	2930 6460	1550 3420	1840 4060	1040 2290			1560 3440	890 1960	4.49 (14.7)
-2.0m -6.6ft	kg lb	*3590 *7910	3010 6640	*2280 *5030	1580 3480					*1720 *3790	1250 2760	3.56 (11.7)

- Note
1. Lifting capacity are based on SAE J1097 and ISO 10567.
  2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
  3. The load point is a hook located on the back of the bucket.
  4. \*indicates load limited by hydraulic capacity.

## 6. BUCKET SELECTION GUIDE

	
0.07m <sup>3</sup> SAE heaped bucket	0.21 m <sup>3</sup> SAE heaped bucket

Capacity		Width		Weight	Recommendation
					3.0 m (9' 10") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.6 m (5' 3") arm
0.07 m <sup>3</sup> (0.09 yd <sup>3</sup> )	0.06 m <sup>3</sup> (0.08 yd <sup>3</sup> )	315 mm (12.4")	360 mm (14.2")	115 kg (255 lb)	Applicable for materials with density of 1600 kgf/m <sup>3</sup> (2700 lb/yd <sup>3</sup> ) or less
0.21 m <sup>3</sup> (0.28 yd <sup>3</sup> )	0.18 m <sup>3</sup> (0.24 yd <sup>3</sup> )	705 mm (27.8")	770 mm (30.3")	137 kg (375 lb)	

## 7. SPECIFICATIONS FOR MAJOR COMPONENTS

### 1) ENGINE

Item	Specification
Model	Yanmar 4TNV98-EPHYBU
Type	4-cycle diesel engine, low emission
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	98 × 110 mm (3.85" × 4.33")
Piston displacement	3319 cc (203 cu in)
Compression ratio	18.5 : 1
Rated gross horse power(SAE J1995)	58.2 Hp at 2400 rpm (42.5 kW at 2400 rpm)
Maximum torque at 1550rpm	20.5kgf · m (148 lbf · ft)
Engine oil quantity	11.6 l (3.1 U.S. gal)
Dry weight	270 kg (595 lb)
High idling speed	2200+ 50 rpm
Low idling speed	1050 ± 100 rpm
Rated fuel consumption	176 g/Hp · hr at 2400 rpm
Starting motor	12V-3.0 kW
Alternator	12V-100 A
Battery	1 × 12V × 100Ah

### 2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	63 cc/rev
Maximum pressure	240 kgf/cm <sup>2</sup> (3480 psi)
Rated oil flow	151.2 l /min
Rated speed	2400 rpm



### 3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	8 cc/rev
Maximum pressure	204 kgf/cm <sup>2</sup> (2958 psi)
Rated oil flow	19.2 l /min

### 4) MAIN CONTROL VALVE

Item	Specification
Type	8 spools sectional block
Operating method	LUDV
Main relief valve pressure	240 kgf/cm <sup>2</sup> (3480 psi)
Overload relief valve pressure	265 kgf/cm <sup>2</sup> (3842 psi)

### 5) SWING MOTOR

Item	Specification
Type	Two fixed displacement axial piston motor
Capacity	28.9 cc/rev
Relief pressure	230 kgf/cm <sup>2</sup> (3335 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	14 kgf · m (101 lbf · ft)
Brake release pressure	20~40 kgf/cm <sup>2</sup> (284~570 psi)
Reduction gear type	2 - stage planetary

### 6) TRAVEL MOTOR

Item	Specification
Type	Bent axis design variable displacement axial piston motor
Relief pressure	230 kgf/cm <sup>2</sup> (3335 psi)
Counterbalance valve	Applied
Capacity	80 cc

## 7) POWER TRAIN

Item	Description		Specification
Gear box	Type		2 speed hydrostatic
	Gear ratio	1st	4.06
		2nd	1.31
Parking brake	Type		Multi disc brake integrated in rear axle
	Maximum braking power		945 kgf · m (6835 lbf · ft)
Axle	Type		4 wheel drive with differential
	Gear ratio		13.65
	Brake		Multi disc brake

## 8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 110 × ø 65 × 715mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 90 × ø 55 × 850mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 80 × ø 50 × 660mm
	Cushion	Extend only
Dozer cylinder	Bore dia × Rod dia × Stroke	ø 105 × ø 55 × 189mm
	Cushion	-

※ Discoloration of cylinder rod can occur when the friction reduction additive of lubrication oil spreads on the rod surface.

※ Discoloration does not cause any harmful effect on the cylinder performance.

## 9) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R60WVS PRO	STD	0.21 m <sup>3</sup> (0.28 yd <sup>3</sup> )	0.18 m <sup>3</sup> (0.24 yd <sup>3</sup> )	5	705 mm (27.8")	770 mm (30.3")
	OPT	0.07 m <sup>3</sup> (0.09 yd <sup>3</sup> )	0.06 m <sup>3</sup> (0.08 yd <sup>3</sup> )	3	315 mm (12.4")	360 mm (14.2")

## 8. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C ( °F)							
			-50 (-58)	-30 (-22)	-20 (-4)	-10 (14)	0 (32)	10 (50)	20 (68)	30 (86)
Engine oil pan	Engine oil	12 (3.1)	★SAE 5W-40				SAE 30			
			SAE 10W				SAE 10W-30			
			SAE 15W-40							
Swing drive	Grease	0.2 (0.1)	★NLGI NO.1				NLGI NO.2			
	Gear oil	1.5 (0.4)	★SAE 75W-90				SAE 85W-140			
Gear box case	Gear oil	1.8 (0.5)								
Front axle		Center : 4.5 (1.19) Hub : 0.4 × 2 (0.11 × 2)					SAE 85W-90 LSD(GL-5)			
Rear axle		Center : 4.5 (1.19) Hub : 0.4 × 2 (0.11 × 2)								
Hydraulic tank	Hydraulic oil	Tank; 70 (18.5)	★ISO VG 15				ISO VG 32			
		System; 120 (31.7)					ISO VG 46, HBHO VG 46★ <sup>3</sup>			
							ISO VG 68			
Fuel tank	Diesel fuel★ <sup>1</sup>	120 (31.7)	★ASTM D975 NO.1				ASTM D975 NO.2			
Fitting (grease nipple)	Grease	As required	★NLGI NO.1				NLGI NO.2			
Radiator (reservoir tank)	Mixture of antifreeze and water 50 : 50★ <sup>2</sup>	10 (2.5)					Ethylene glycol base permanent type			
			★Ethylene glycol base permanent type (60 : 40)							

**SAE** : Society of Automotive Engineers  
**API** : American Petroleum Institute  
**ISO** : International Organization for Standardization  
**NLGI** : National Lubricating Grease Institute  
**ASTM** : American Society of Testing and Material  
**UTTO** : Universal Tractor Transmission Oil

★ : Cold region  
 Russia, CIS, Mongolia  
 ★<sup>1</sup> : Ultra low sulfur diesel  
 - sulfur content ≤ 15 ppm  
 ★<sup>2</sup> : Soft water  
 City water or distilled water  
 ★<sup>3</sup> : Hyundai Bio Hydraulic Oil  
 - For more information, contact HYUNDAI dealers.

※ Using any lubricating oils other than HYUNDAI genuine products may lead to a deterioration of performance and cause damage to major components.

※ Do not mix HYUNDAI genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

※ For HYUNDAI genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HYUNDAI dealers.