HYUNDAI
CONSTRUCTION EQUIPMENT

Robex 290LC-9MH

CRAWLER EXCAVATOR

SERVICE MANUAL

1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.
This service manual mainly contains the necessary technical information for operations performed in a service workshop.
For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL
This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 STRUCTURE AND FUNCTION
This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

SECTION 3 HYDRAULIC SYSTEM
This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM
This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM
This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING
This section explains the troubleshooting charts correlating **problems** to **causes**.

SECTION 7 MAINTENANCE STANDARD
This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY
This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

SECTION 9 COMPONENT MOUNTING TORQUE
This section shows bolt specifications and standard torque values needed when mounting components to the machine.

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HYUNDAI distributor for the latest information.

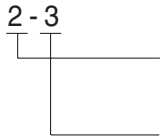
2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.
Get the most up-to-date information before you start any work.

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1



Item number(2. Structure and Function)
Consecutive page number for each item.

3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

10 - 4
10 - 4 - 1 ┐
10 - 4 - 2 ┘ Added pages
10 - 5

Revised edition mark(①②③…)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

Revisions

Revised pages are shown at the list of revised pages on the between the contents page and section 1 page.

Symbols

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
※	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.

3. CONVERSION TABLE

Method of using the Conversion Table
The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

Example

1. Method of using the Conversion Table to convert from millimeters to inches

Convert 55mm into inches.

(1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

(2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.

(3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55mm = 2.165 inches.

2. Convert 550mm into inches.

(1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55mm.

(2) Carry out the same procedure as above to convert 55mm to 2.165 inches.

(3) The original value(550mm) was divided by 10, so multiply 2.165 inches by 10(Move the decimal point one place to the right) to return to the original value.
This gives 550mm = 21.65 inches.

Millimeters to inches

1mm = 0.03937 in

	0	1	2	3	4	5 ⓑ	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
ⓐ 50	1.969	2.008	2.047	2.087	2.126	2.165 ⓒ	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1kg = 2.2046lb

	0	1	2	3	4	5	6	7	8	9
0		2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.5.	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.6076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.631	25.625	25.889	26.153

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

	0	1	2	3	4	5	6	7	8	9
		7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	396.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	10005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

	0	1	2	3	4	5	6	7	8	9
		14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	2863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	5603	2617	2631	2646	2660	2674	2688
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

TEMPERATURE

Fahrenheit-Centigrade Conversion.

A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	35	95.0	21.1	70	158.0	51.7	125	257.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	172	347.0

SECTION 1 GENERAL

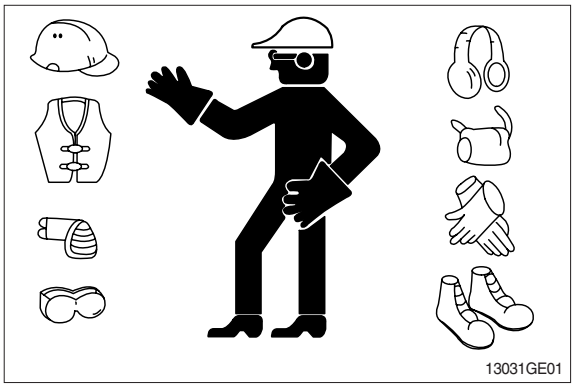
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

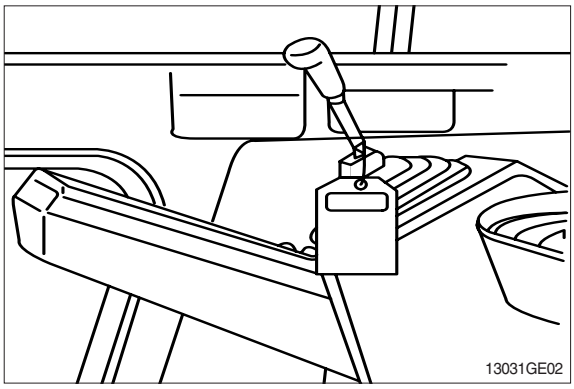
WEAR PROTECTIVE CLOTHING

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



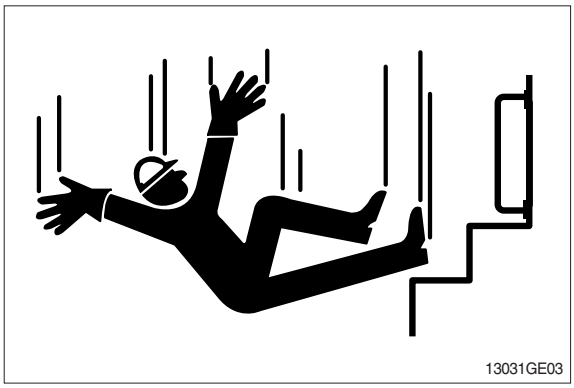
WARN OTHERS OF SERVICE WORK

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.

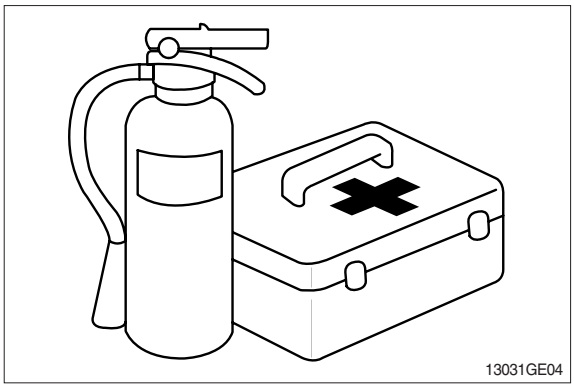


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

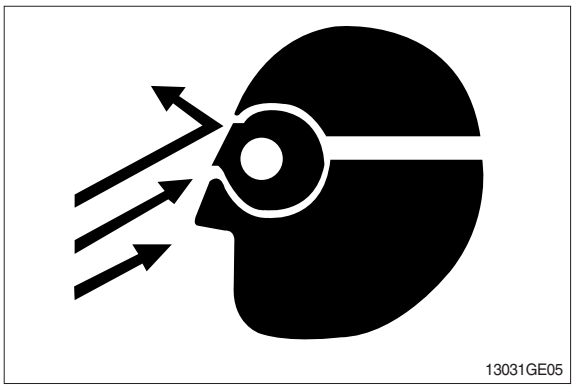
Keep a first aid kit and fire extinguisher handy.

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


13031GE04

PROTECT AGAINST FLYING DEBRIS

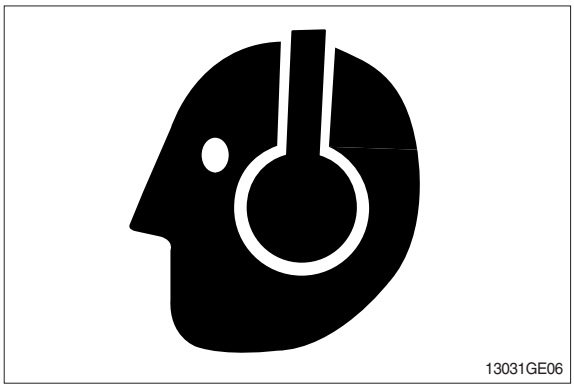
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.


13031GE05

PROTECT AGAINST NOISE

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

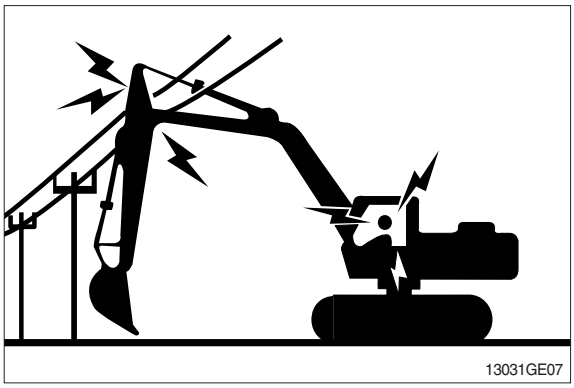
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.


13031GE06

AVOID POWER LINES

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

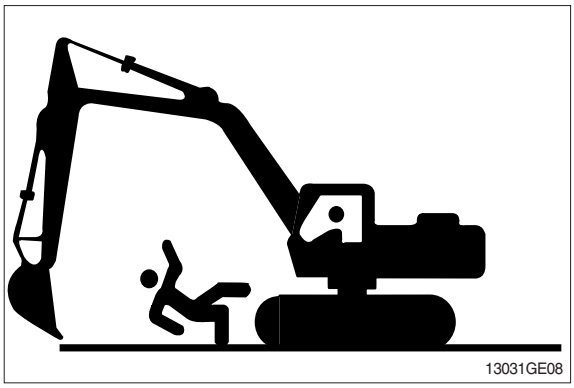
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.


13031GE07

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.

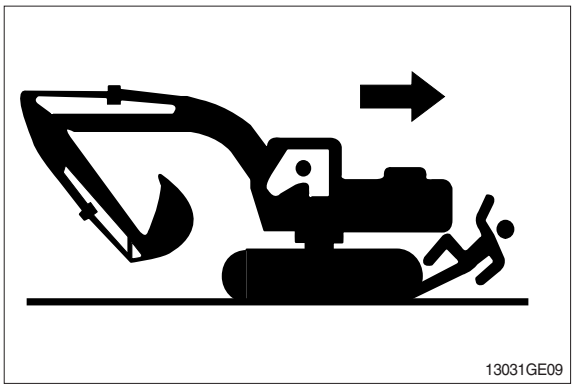

13031GE08

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.

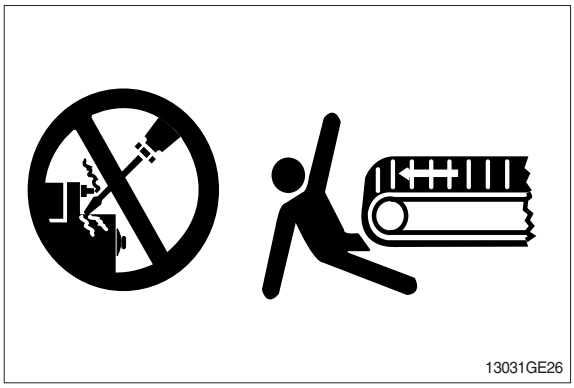
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.


13031GE09

OPERATE ONLY FORM 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.


13031GE26

PARK MACHINE SAFELY

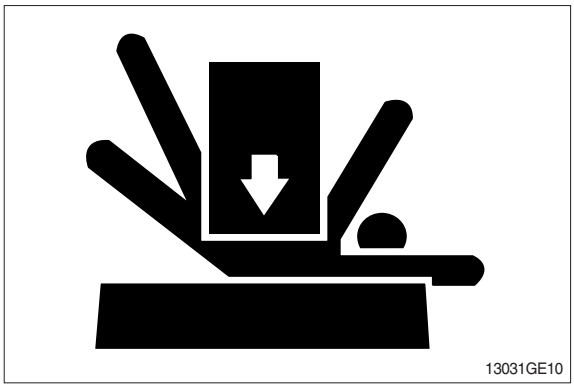
Before working on the machine:

- 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.

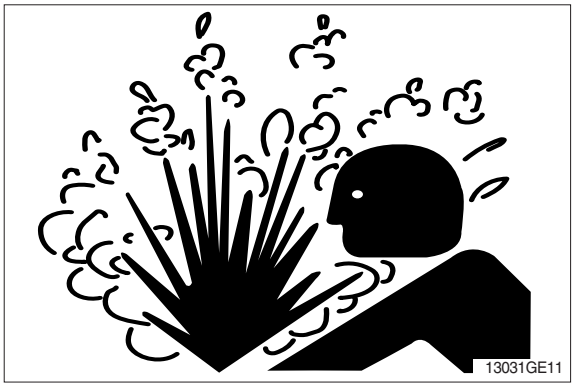
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.


13031GE10

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.


13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

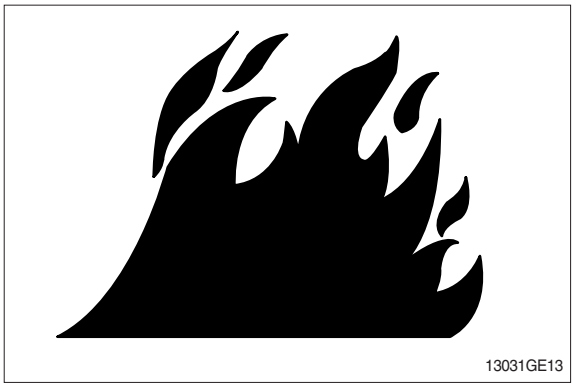
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.


13031GE12

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

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

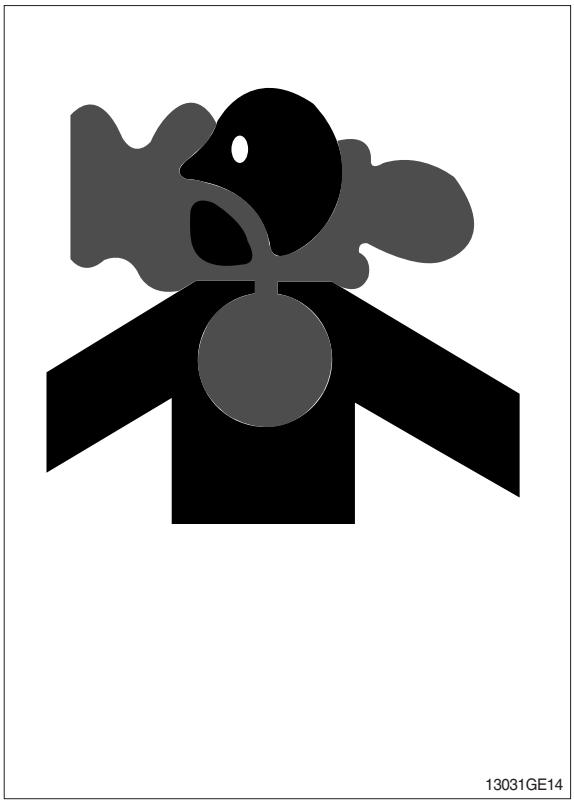
Do not store oily rags; They can ignite and burn spontaneously.


13031GE13

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.


13031GE14

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.

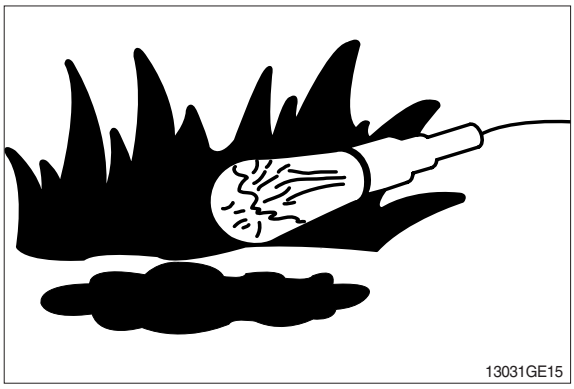
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

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

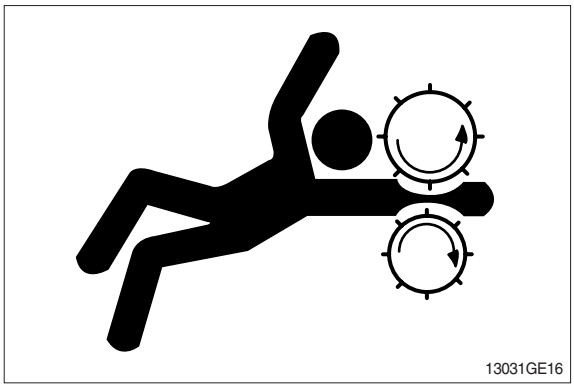
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.


13031GE15

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.

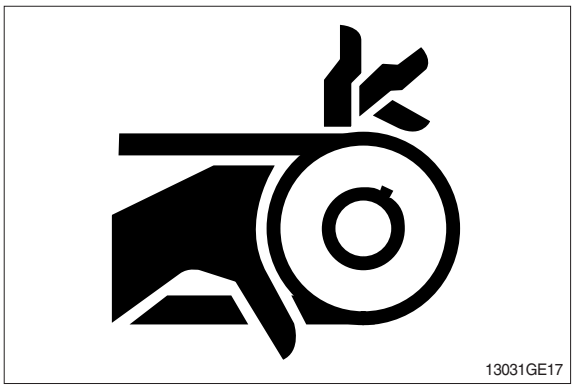
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



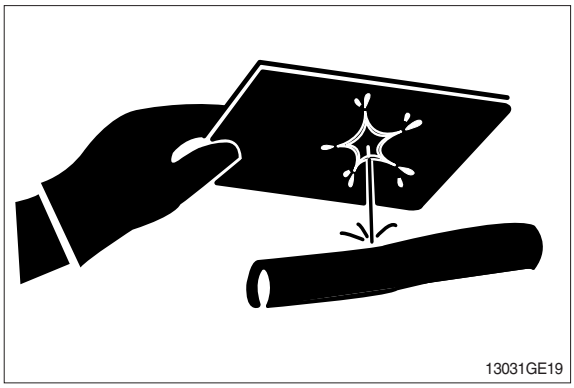
AVOID HIGH PRESSURE FLUIDS

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:

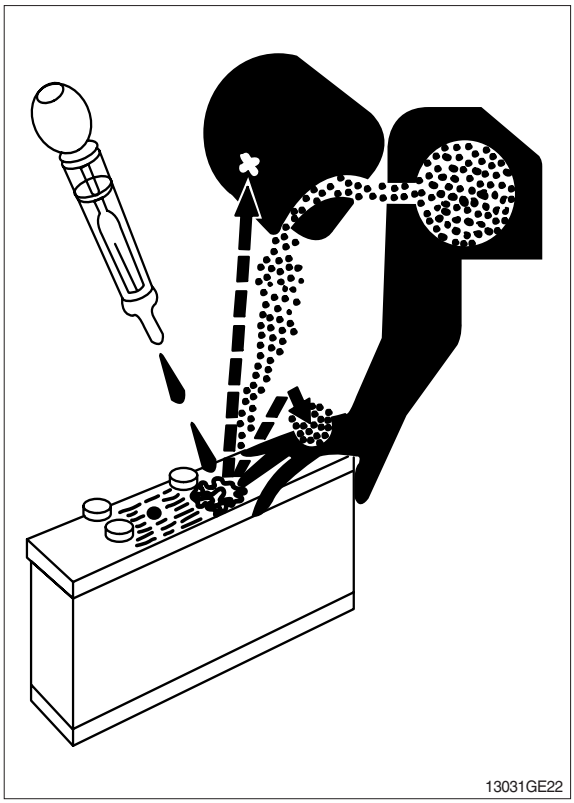
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.



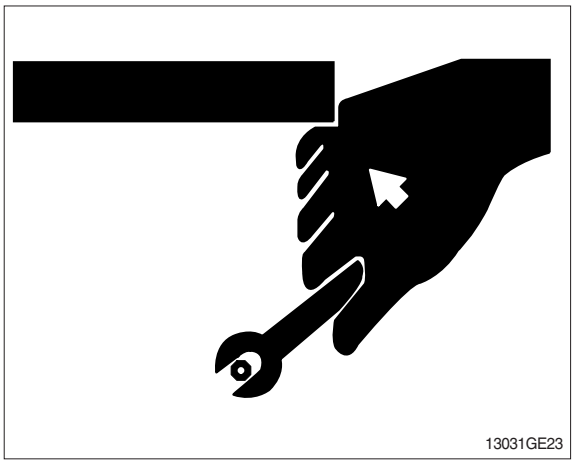
USE TOOLS PROPERLY

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 catalogue.)

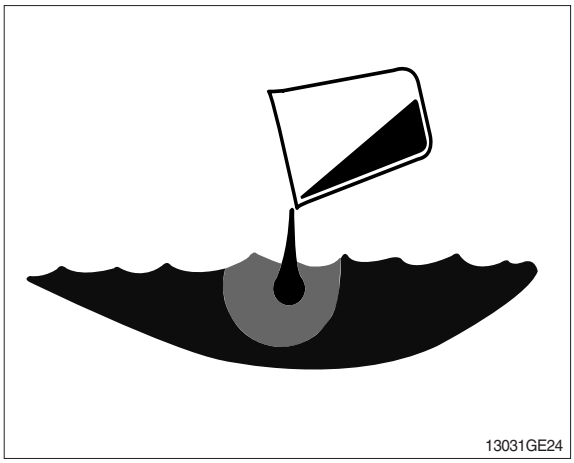


DISPOSE OF FLUIDS PROPERLY

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.

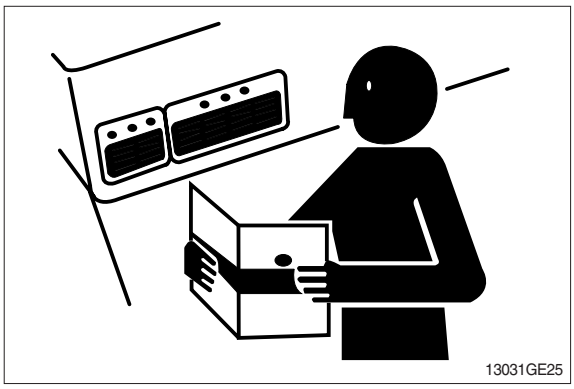
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.


13031GE24

REPLACE SAFETY SIGNS

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


13031GE25

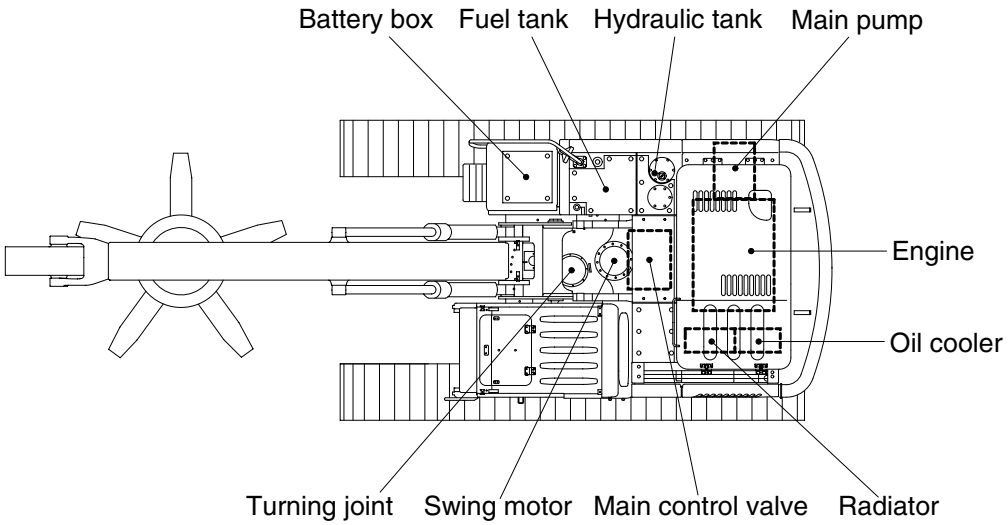
LIVE WITH SAFETY

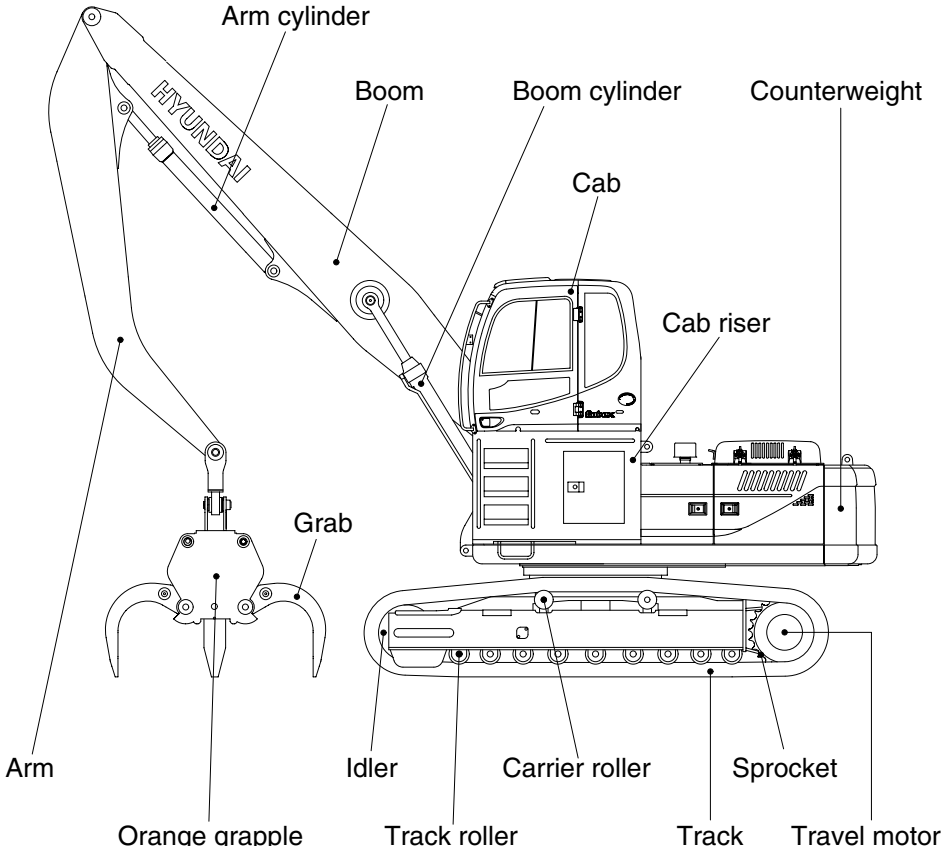
Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

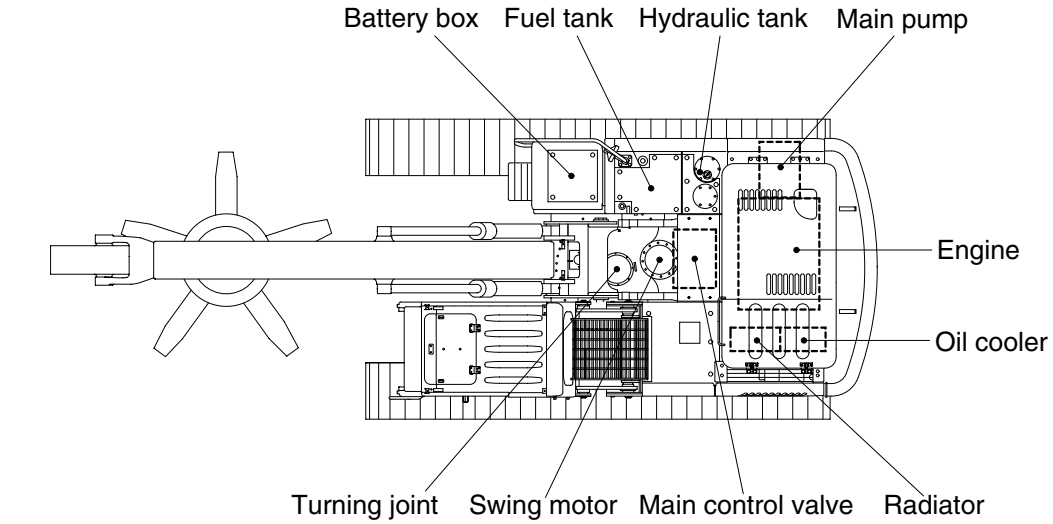
· 7.8 m (25' 7") BOOM, 5.4 m (17' 9") ARM AND 1.2 m (3' 11") TILT CAB

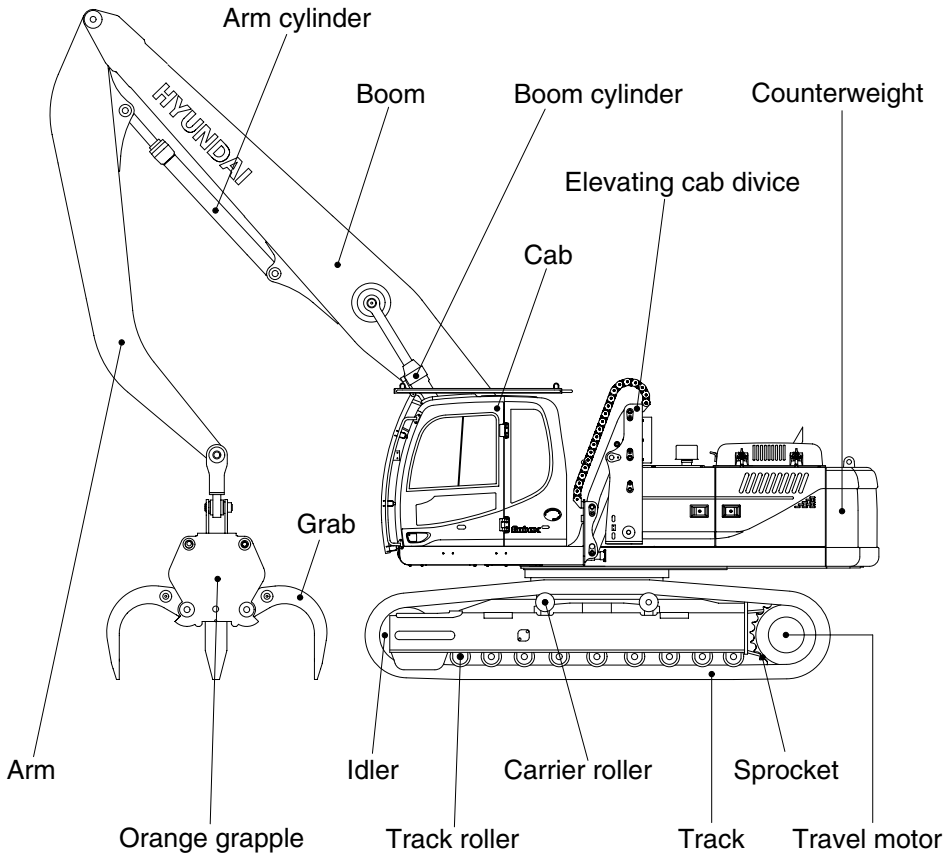




2909MH2SP01

· 7.8 m (25' 7") BOOM, 5.4 m (17' 9") ARM AND 2.0 m (6' 7") ELEVATING CAB

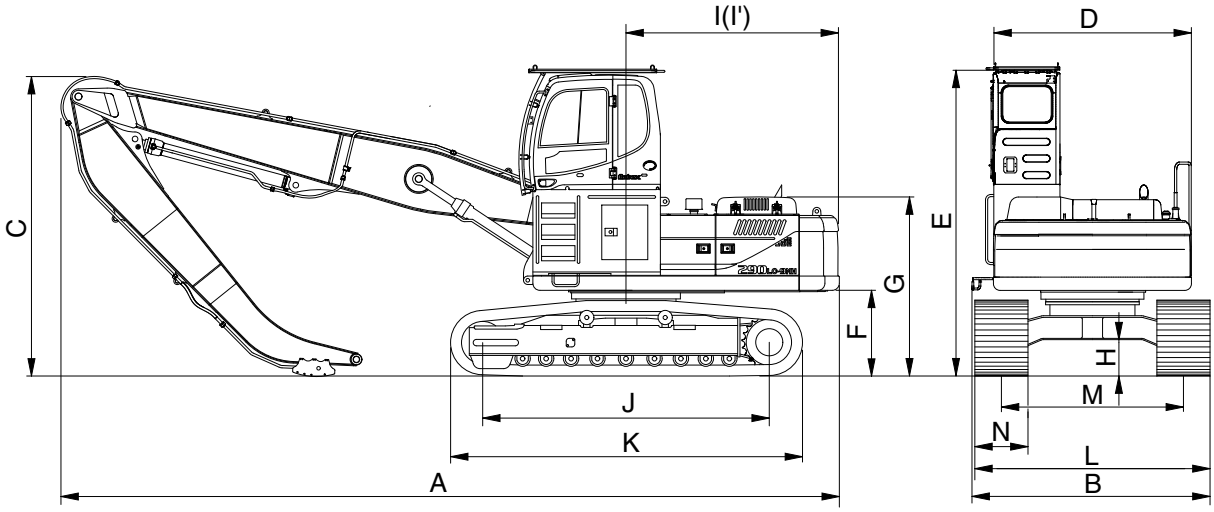




2909MH2SP05

2. SPECIFICATIONS

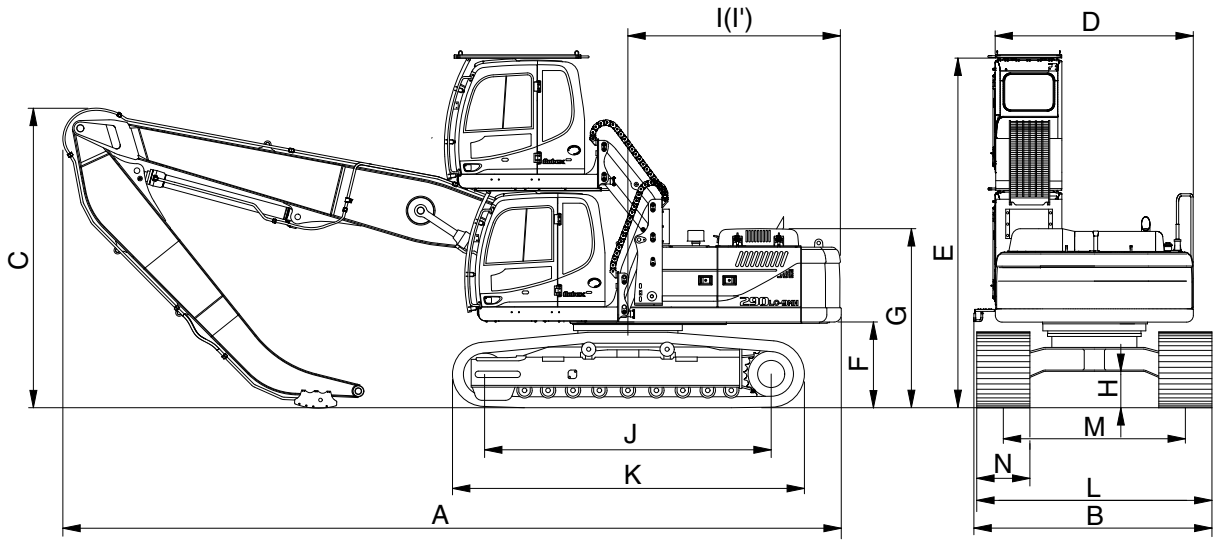
· 7.8 m (25' 7") BOOM, 5.4 m (17' 9") ARM AND 1.2 m (3' 11") TILT CAB



2909MH2SP02

Description		Unit	Specification
Operating weight		kg (lb)	32710 (72110)
Grapple capacity, standard		m^3 (yd^3)	0.90 (1.18)
Overall length	A	mm (ft-in)	11085 (36' 4")
Overall width, with 800mm shoe	B		3520 (11' 7")
Attachment height	C		4170 (13' 8")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		4445 (14' 7")
Ground clearance of counterweight	F		1185 (3' 11")
Engine cover height	G		3190 (10' 6")
Minimum ground clearance	H		500 (1' 8")
Rear-end distance	I		3120 (10' 3")
Rear-end swing radius	I'		3200 (10' 6")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4883 (16' 0")
Undercarriage width	L		3400 (11' 2")
Track gauge	M		2600 (8' 6")
Track shoe width, standard	N		800 (32")
Travel speed (low/high)		km/hr (mph)	3.5 / 5 (2.2 / 3.1)
Swing speed		rpm	10.5
Gradeability		Degree (%)	35 (70)
Ground pressure (800 mm shoe)		kgf/cm^2 (psi)	0.47 (6.68)
Max traction force		kg (lb)	27300 (60200)

· 7.8 m (25' 7") BOOM, 5.4 m (17' 9") ARM AND 2.0 m (6' 7") ELEVATING CAB

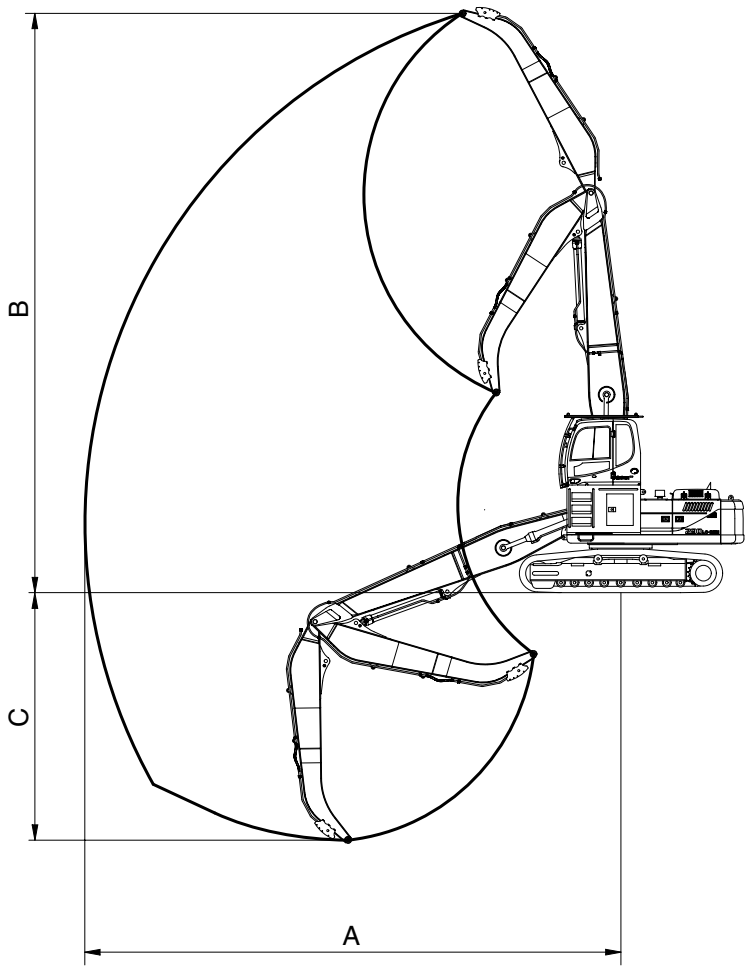


2909MH2SP04

Description		Unit	Specification
Operating weight		kg (lb)	33660 (74210)
Grapple capacity, standard		m^3 (yd^3)	0.90 (1.18)
Overall length	A	mm (ft-in)	11085 (36' 4")
Overall width, with 800mm shoe	B		3520 (11' 7")
Attachment height	C		4170 (13' 8")
Superstructure width	D		2980 (9' 9")
Overall height of cab (lowered/raised position)	E		3251 / 5042 (10' 8" / 16' 7")
Ground clearance of counterweight	F		1185 (3' 11")
Engine cover height	G		3190 (10' 6")
Minimum ground clearance	H		500 (1' 8")
Rear-end distance	I		3120 (10' 3")
Rear-end swing radius	I'		3200 (10' 6")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4883 (16' 0")
Undercarriage width	L		3400 (11' 2")
Track gauge	M		2600 (8' 6")
Track shoe width, standard	N		800 (32")
Travel speed (low/high)		km/hr (mph)	3.5 / 5 (2.2 / 3.1)
Swing speed		rpm	10.5
Gradeability		Degree (%)	35 (70)
Ground pressure (800 mm shoe)		kgf/cm^2 (psi)	0.48 (6.83)
Max traction force		kg (lb)	27300 (60200)

3. WORKING RANGE

· 7.8 m (25' 7") BOOM



2909MH2SP03

Description		5.40 m (17' 9") Arm
Max working reach	A	13090 mm (42' 11")
Max working height	B	14590 mm (47' 10")
Max working depth	C	6190 mm (20' 4")

4. WEIGHT

Item	R290LC-9MH	
	kg	lb
Upperstructure assembly (tilting cab)	17980	39640
Upperstructure assembly (elevating cab)	18930	41730
Main frame weld assembly (tilting cab)	2840	6260
Main frame weld assembly (elevating cab)	2750	6060
Engine assembly	556	1230
Main pump assembly	140	310
Main control valve assembly	220	490
Swing motor assembly	390	860
Hydraulic oil tank assembly	250	560
Fuel tank assembly	240	530
Counterweight	7300	16090
Cab and fog guard assembly	550	1210
Cab elevating device assembly	1430	3150
Tilt cab riser assembly (1.2 M)	630	1390
Lower chassis assembly	10740	23680
Track frame weld assembly	3790	8360
Swing bearing	430	950
Travel motor assembly	400	880
Turning joint	54	120
Track recoil spring	205	450
Idler	252	560
Carrier roller	35	80
Track roller	54	119
Track-chain assembly (800 mm standard triple grouser shoe)	2350	5180
Front attachment assembly (7.80 m boom, 5.40 m arm, 0.90 m^3 grapple)	5390	11880
7.80 m boom assembly	2735	6030
5.40 m arm assembly	1255	2770
0.90 m^3 grapple	1400	3090
Boom cylinder assembly	270	600
Arm cylinder assembly	360	790

5. LIFTING CAPACITIES

1) 7.8 m (25' 7") boom, 5.4 m (17' 9") arm, 800 mm (32") triple grouser shoe and cab riser.

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

Load point height		Load radius														At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		10.5 m (34.4 ft)		12.0 m (39.4 ft)		Capacity		Reach
12.0 m	kg					*7367	*7367	*6892	*6892							*6202	*6202	8.34
(39.4 ft)	lb					*16241	*16241	*15194	*15194							*13673	*13673	-27.4
10.5 m	kg							*6502	*6502	*6181	5955					*5584	5049	9.89
(34.4 ft)	lb							*14335	*14335	*13627	13128					*12311	11132	-32.4
9.0 m	kg					*6967	*6967	*6458	*6458	*6057	5994	*5755	4638			*5250	4250	11.02
(29.5 ft)	lb					*15360	*15360	*14238	*14238	*13354	13215	*12688	10225			*11575	9369	-36.1
7.5 m	kg					*7342	*7342	*6673	*6673	*6147	5936	*5727	4637			*5073	3763	11.85
(24.6 ft)	lb					*16186	*16186	*14712	*14712	*13551	13088	*12626	10224			*11183	8297	-38.9
6.0 m	kg			*9504	*9504	*8087	*8087	*7106	*7106	*6384	5810	*5826	4573	*5364	3677	*5000	3452	12.44
(19.7 ft)	lb			*20953	*20953	*17829	*17829	*15665	*15665	*14075	12808	*12845	10081	*11825	8106	*11023	7611	-40.8
4.8 m	kg			*11525	*11525	*9136	*9136	*7691	7367	*6712	5633	*5990	4471	5371	3632	4841	3255	12.83
(14.8 ft)	lb			*25408	*25408	*20141	*20141	*16956	16241	*14798	12419	*13207	9856	11841	8006	10673	7177	-42.1
3.0 m	kg			*13830	*13830	*10275	9631	*8315	7031	*7059	5433	*6163	4351	5303	3568	4694	3144	13.03
(9.8 ft)	lb			*30490	*30490	*22653	21232	*18330	15501	*15562	11978	*13587	9591	11691	7865	10349	6931	-42.7
1.5 m	kg			*4895	*4895	*11165	9076	*8820	6712	*7334	5239	*6282	4232	5234	3502	4649	3104	13.05
(4.9 ft)	lb			*10792	*10792	*24615	20009	*19445	14798	*16169	11551	*13850	9331	11539	7722	10250	6844	-42.8
Ground	kg			*3841	*3841	*11528	8685	*9062	6462	*7448	5080	6216	4134	5179	3451	*4625	3134	12.9
Line	lb			*8468	*8468	*25416	19147	*19978	14247	*16420	11199	13703	9114	11418	7608	*10197	6910	-42.3
-1.5 m	kg	*1928	*1928	*4522	*4522	*11286	8477	*8945	6305	*7319	4973	*6083	4070	*4957	3427	*4414	3240	12.57
(-4.9 ft)	lb	*4252	*4252	*9969	*9969	*24881	18688	*19720	13901	*16136	10964	*13412	8972	*10929	7556	*9731	7144	-41.2
-3.0 m	kg	*3381	*3381	*5693	*5693	*10470	8416	*8414	6241	*6870	4928	*5593	4052	*4176	3454	*4120	3442	12.04
(-9.8 ft)	lb	*7455	*7455	*12551	*12551	*23083	18554	*18549	13760	*15145	10864	*12330	8933	*9207	7616	*9084	7589	-39.5
-4.5 m	kg			*7098	*7098	*9092	8468	*7408	6263	*5996	4950	*4629	4096			*3684	*3684	11.29
(-14.8 ft)	lb			*15648	*15648	*20044	18668	*16331	13808	*13218	10913	*10206	9029			*8123	*8123	-37
-6.0 m	kg					*7077	*7077	*5801	*5801	*4484	*4484					*4376	*4376	9.11
(-19.7 ft)	lb					*15602	*15602	*12790	*12790	*9885	*9885					*9647	*9647	-29.9

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 the end pin point of front attachment.

4. *indicates load limited by hydraulic capacity.

⚠ Failure to comply to the rated load can cause possible personal injury or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

2) 7.8 m (25' 7") boom, 5.4 m (17' 9") arm, 800 mm (32") triple grouser shoe and elevating cab.

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

Load point height		Load radius														At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		10.5 m (34.4 ft)		12.0 m (39.4 ft)		Capacity		Reach
																		m (ft)
12.0 m	kg					*7367	*7367	*6892	*6892							*6202	*6202	8.34
(39.4 ft)	lb					*16241	*16241	*15194	*15194							*13673	*13673	-27.4
10.5 m	kg							*6502	*6502	*6181	6110					*5584	5188	9.89
(34.4 ft)	lb							*14335	*14335	*13627	13470					*12311	11438	-32.4
9.0 m	kg					*6967	*6967	*6458	*6458	*6057	*6057	*5755	4768			*5250	4373	11.02
(29.5 ft)	lb					*15360	*15360	*14238	*14238	*13354	*13354	*12688	10511			*11575	9640	-36.1
7.5 m	kg					*7342	*7342	*6673	*6673	*6147	6092	*5727	4767			*5073	3876	11.85
(24.6 ft)	lb					*16186	*16186	*14712	*14712	*13551	13430	*12626	10510			*11183	8546	-38.9
6.0 m	kg			*9504	*9504	*8087	*8087	*7106	*7106	*6384	5965	*5826	4702	*5364	3788	*5000	3559	12.44
(19.7 ft)	lb			*20953	*20953	*17829	*17829	*15665	*15665	*14075	13150	*12845	10367	*11825	8351	*11023	7846	-40.8
4.8 m	kg			*11525	*11525	*9136	*9136	*7691	7561	*6712	5789	*5990	4600	*5403	3743	4989	3359	12.83
(14.8 ft)	lb			*25408	*25408	*20141	*20141	*16956	16668	*14798	12762	*13207	10142	*11912	8252	10999	7405	-42.1
3.0 m	kg			*13830	*13830	*10275	9888	*8315	7225	*7059	5588	*6163	4480	*5445	3679	4840	3245	13.03
(9.8 ft)	lb			*30490	*30490	*22653	21799	*18330	15928	*15562	12320	*13587	9877	*12004	8111	10670	7155	-42.7
1.5 m	kg			*4895	*4895	*11165	9333	*8820	6906	*7334	5395	*6282	4362	5394	3614	*4791	3206	13.05
(4.9 ft)	lb			*10792	*10792	*24615	20575	*19445	15225	*16169	11893	*13850	9617	11892	7967	*10562	7067	-42.8
Ground	kg			*3841	*3841	*11528	8942	*9062	6656	*7448	5235	*6281	4264	*5304	3562	*4625	3237	12.9
Line	lb			*8468	*8468	*25416	19714	*19978	14674	*16420	11541	*13847	9400	*11693	7853	*10197	7136	-42.3
-1.5 m	kg	*1928	*1928	*4522	*4522	*11286	8734	*8945	6499	*7319	5128	*6083	4199	*4957	3539	*4414	3346	12.57
(-4.9 ft)	lb	*4252	*4252	*9969	*9969	*24881	19255	*19720	14328	*16136	11306	*13412	9258	*10929	7801	*9731	7376	-41.2
-3.0 m	kg	*3381	*3381	*5693	*5693	*10470	8673	*8414	6435	*6870	5083	*5593	4181	*4176	3566	*4120	3553	12.04
(-9.8 ft)	lb	*7455	*7455	*12551	*12551	*23083	19121	*18549	14187	*15145	11207	*12330	9219	*9207	7861	*9084	7833	-39.5
-4.5 m	kg			*7098	*7098	*9092	8725	*7408	6457	*5996	5105	*4629	4225			*3684	*3684	11.29
(-14.8 ft)	lb			*15648	*15648	*20044	19235	*16331	14235	*13218	11255	*10206	9315			*8123	*8123	-37
-6.0 m	kg					*7077	*7077	*5801	*5801	*4484	*4484					*4376	*4376	9.11
(-19.7 ft)	lb					*15602	*15602	*12790	*12790	*9885	*9885					*9647	*9647	-29.9

Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.

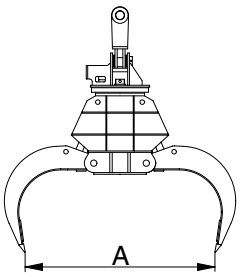
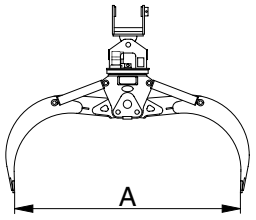
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.

3. The load point is the end pin point of front attachment.

4. *indicates load limited by hydraulic capacity.

⚠ Failure to comply to the rated load can cause possible personal injury or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

6. GRAPPLE GUIDE

Item	Lifting capacity	Max opening width (A)	Weight	
Orange grapple	★0.90 m³ (1.18 yd³)	2000 mm (6' 7")	1400 kg (3090 lb)	 300E2SP10
Wood grapple	1.90 m³ (2.49 yd³)	3500 mm (11' 6")	2100 kg (4630 lb)	 2909MH2SP06

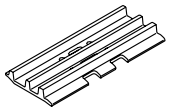
★Standard

7. UNDERCARRIAGE

1) TRACKS

X-leg type center frame is integrally welded with reinforced box-section track frames. The design includes dry tracks, lubricated rollers, idlers, sprockets, hydraulic track adjusters with shock absorbing springs and assembled track-type tractor shoes with triple grousers.

2) TYPES OF SHOES

Model	Shapes		Triple grouser	
				
R290LC-9MH Tilt cab	Shoe width	mm (in)	800 (32)	900 (36)
	Operating weight	kg (lb)	32710 (72110)	33090 (72950)
	Ground pressure	kgf/cm^2 (psi)	0.47 (6.68)	0.42 (5.97)
	Overall width	mm (ft-in)	3400 (11' 1")	3500 (11' 5")
R290LC-9MH Elevating cab	Shoe width	mm (in)	800 (32)	900 (36)
	Operating weight	kg (lb)	33660 (74210)	34040 (75040)
	Ground pressure	kgf/cm^2 (psi)	0.48 (6.83)	0.44 (6.26)
	Overall width	mm (ft-in)	3400 (11' 1")	3500 (11' 5")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	9 EA
Track shoes	48 EA

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	HYUNDAI HE6.7
Type	4-cycle turbocharged diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	107× 124 mm (4.21" × 4.88")
Piston displacement	6700 cc (409cu in)
Compression ratio	17.2 : 1
Rated gross horse power (SAE J1995)	227 Hp at 1900 rpm (169 kW at 1900 rpm)
Maximum torque	97.0 kgf · m (701 lbf · ft) at 1400 rpm
Engine oil quantity	24 ℓ (6.3 U.S. gal)
Dry weight	556 kg (1226 lb)
High idling speed	1850± 50 rpm
Low idling speed	800± 100 rpm
Rated fuel consumption	166.3 g/Hp · hr at 1900 rpm
Starting motor	24 V-4.5 kW
Alternator	24 V-90 A
Battery	2 × 12 V × 160 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 140 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 252 ℓ /min (66.6 U.S. gpm / 55.4 U.K. gpm)

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	27 ℓ/min (7.1 U.S. gpm / 5.9 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification
Type		10 spools
Operating method		Hydraulic pilot system
Main relief valve pressure		350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Port relief valve pressure	Boom	400 kgf/cm^2 (5690 psi)
	Arm	400 kgf/cm^2 (5690 psi)
	Bucket	400 kgf/cm^2 (5690 psi)

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	169.4 cc/rev
Relief pressure	300 kgf/cm^2 (4270 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	70 kgf · m (506 lbf · ft)
Brake release pressure	26 kgf/cm^2 (370 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm^2 (4980 psi)
Capacity (max / min)	154.8/88.5 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	9 kgf/cm^2 (128 psi)
Braking torque	40 kgf · m (290 lbf · ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kgf/cm^2 (92 psi)
	Maximum	26 kgf/cm^2 (370 psi)
Single operation stroke	Lever	61 mm (2.4 in)
	Pedal	123 mm (4.84 in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 140 × ø 100 × 1465 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 150 × ø 110 × 1765 mm
	Cushion	Extend and retract

※ **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) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R290LC-9MH Tilt cab	Standard	800 mm (32")	0.47 kgf/cm^2 (6.68 psi)	48	3400 mm (11' 1")
	Option	900 mm (36")	0.42 kgf/cm^2 (5.97 psi)	48	3500 mm (11' 5")
R290LC-9MH Elevating cab	Standard	800 mm (32")	0.48 kgf/cm^2 (6.83 psi)	48	3400 mm (11' 1")
	Option	900 mm (36")	0.44 kgf/cm^2 (6.26 psi)	48	3500 mm (11' 5")

10) GRAPPLE

Item		Lifting capacity	Width	
			Max opening width	Overall length
R290LC-9MH	Standard	0.90 m^3 (1.18 yd^3)	2000 mm (6' 7")	2540 mm (8' 4")
	Option	1.90 m^3 (2.49 yd^3)	3500 mm (11' 6")	3595 mm (11' 10")

9. RECOMMENDED OILS

Use only oils listed below. Do not mix different brand oil.
Please use HYUNDAI genuine oil and grease.

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) 40 (104)
Engine oil pan	Engine oil	24 (6.3)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	6.0 (1.6)	★SAE 75W-90
Final drive		8.0×2 (2.1×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank; 190 (50) System; 330 (87)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	500 (132)	★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 soft water★1	50 (13.2)	Ethylene glycol base permanent type (50 : 50) ★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

★ : Cold region
Russia, CIS, Mongolia

★1 : Soft water
City water or distilled water

SECTION 2 STRUCTURE AND FUNCTION