23.2.4 DETAIL OF HARNESS & CABLE

23.2.4.1 Inst • Main Harness (No. H-1 : PH14E01034P1)

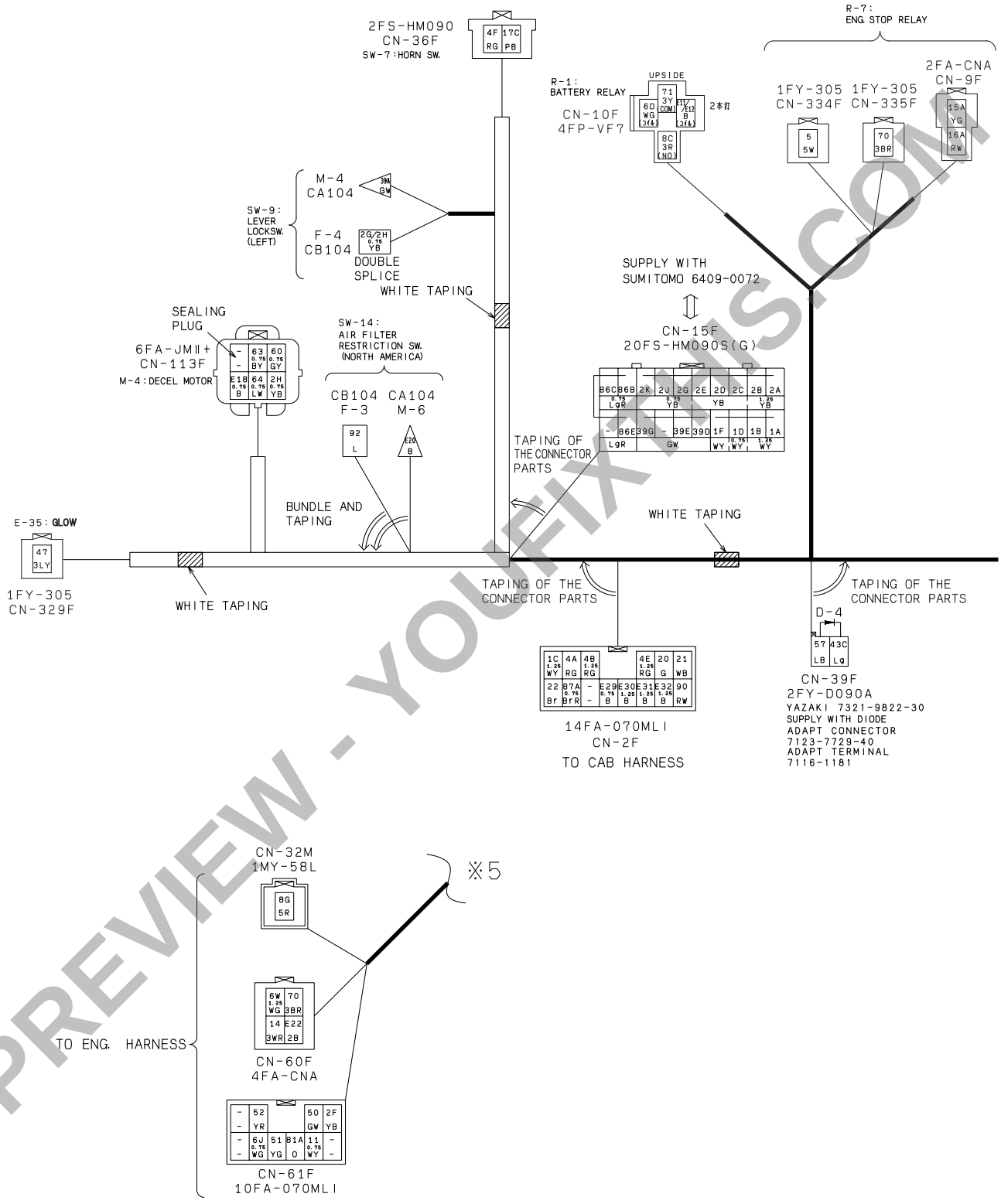


Fig. 23-20 Inst • Main Harness (No. H-1) — (1/8)

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22. HYDRAULIC SYSTEM

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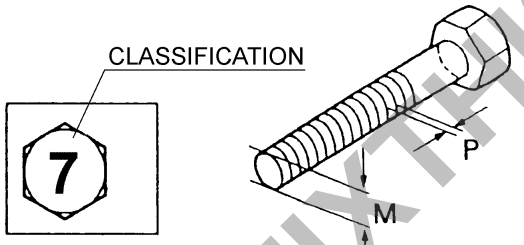
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11.1 TORQUE SPECIFICATIONS FOR CAPSCREWS & NUTS

The following Torque Specifications are provided for use when actual torque value of a fastener is not known. Check the capscrews and nuts for their looseness and dropping off before the start of daily work and at the periodical maintenance. Retighten the loosened ones, and install new ones for the dropped off. For the new machine, the check and retightening of them must be carried out at first 50 hours operation. For the replacement of them, make sure to use the same size of manufacturer's genuine parts.

Refer to the table below for the tightening and retightening of capscrews.

- The table below is not applicable for the capscrews to fix the cover, etc., made of plastic. For the tightening torque for such capscrews, consult with an authorized our Distributor. Over-tightening may cause damages on the parts to be fixed.
- In case that the tightening torque is specified in the manual, use such torque values regardless to the table below.
- Numerical indication on the capscrew head shows the classification for strength (e.g., 7 = 7 T). No indication is provided for smaller size of capscrews, M 5 or less.



11.1.1 Metric Coarse Thread Standard Tightening Torque Values. Make Certain to tighten all Capscrews & Nuts to proper torque values.

Torque value Unit : N•m (lbf•ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M6	P=1	4.4±0.5 (3.2±0.4)	3.7±0.4 (2.7±0.3)	9.6±1.0 (7.1±0.7)	8.1±0.8 (6.0±0.6)	17.4±1.8 (12.8±1.3)	14.7±1.5 (10.8±1.1)
M8	P=1.25	10.7±1.1 (7.9±0.8)	9.0±0.9 (6.6±0.7)	23.5±2.0 (17.3±1.5)	19.6±2.0 (14.5±1.5)	42.2±3.9 (31.1±2.9)	35.3±3.9 (26.0±2.9)
M10	P=1.5	21.6±2.0 (15.9±1.4)	17.9±1.8 (13.2±1.3)	46.1±4.9 (34.0±3.6)	39.2±3.9 (28.9±2.9)	83.4±8.8 (61.5±6.5)	70.6±6.9 (52.1±5.1)
M12	P=1.75	36.3±3.9 (26.8±2.9)	31.4±2.9 (23.2±2.1)	79.4±7.8 (58.6±5.8)	66.7±6.9 (49.2±5.1)	143±15 (105±11)	121±12 (89.2±8.9)
M14	P=2	57.9±5.9 (42.7±4.4)	49.0±4.9 (36.1±3.6)	126±13 (92.9±9.6)	106±10 (78.2±7.4)	226±20 (167±15)	191±19 (141±14)
M16	P=2	88.3±8.8 (65.1±6.5)	74.5±6.9 (55.0±5.1)	191±20 (141±15)	161±16 (119±12)	343±39 (253±29)	284±29 (209±21)
M18	P=2.5	122±12 (90.0±8.9)	103±10 (75.8±7.2)	265±29 (195±21)	226±20 (167±15)	481±49 (355±36)	402±39 (297±29)
M20	P=2.5	172±17 (127±13)	144±14 (106±10)	373±39 (275±29)	314±29 (232±21)	667±69 (492±51)	559±59 (412±44)
M22	P=2.5	226±20 (167±15)	192±20 (142±15)	500±49 (369±36)	422±39 (311±29)	902±88 (665±65)	755±78 (557±58)
M24	P=3	294±29 (217±21)	235±29 (173±21)	637±69 (470±51)	520±49 (383±36)	1160±118 (856±87)	941±98 (694±72)
M27	P=3	431±39 (318±29)	353±39 (260±29)	941±98 (694±72)	765±78 (564±58)	1700±167 (1250±123)	1370±137 (1010±101)

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PREFACE

(1) Working Conditions

1) Technicians : One or more technicians who are qualified by Manufacturer are needed. The technicians need five years of more experience, and they have to complete the training in the operation of this machine.

2) Facilities : General jigs, tools, apparatus, testers to be provided.
The maintenance workshop to be equipped with a good enough capacity of building with crane and inspection instruments necessary for specific self inspection activities.

3) Place : The workshop to be located on a flat land at which the work is able to perform and to which a service car or truck crane is accessible.

(2) Applicable Range of Standard Maintenance Time

1) Standard maintenance time : Direct maintenance time plus spare time.

2) Direct maintenance time : Net time actually spent for maintenance.

3) Spare time : Time for transportation of the machine for maintenance, preparation for safety work, meeting for the work and physiological time for the needs of body.

(3) Excluded Time (not included in the standard maintenance time)

1) Repairing time : Time for machining, sheet metal processing, welding, gas cutting, removing broken screw, taking care of parts and painting.

2) Items excluded from maintenance time because of uncertainty in time :
Receiving the vehicle into shop, transportation, delivery, final inspection and investigation of causes for trouble, diagnosis and inspection.

3) Indirect time : Time for field work, preparation of required parts, etc., before starting work, going to and from the site, waiting due to user's convenience at the site and paper work for reports, bills, etc.

4) Special time : Working time at early morning, at mid night and on holidays shall be separately calculated.

5) Separate calculation : The cost for service cars, trucks with crane and truck cranes shall be separately calculated.

(4) Applicable Machine for Estimation of Standard Maintenance Time

1) Standard machine.

2) A well maintained machine combined with standard attachments which has operated in a normal circumstances.

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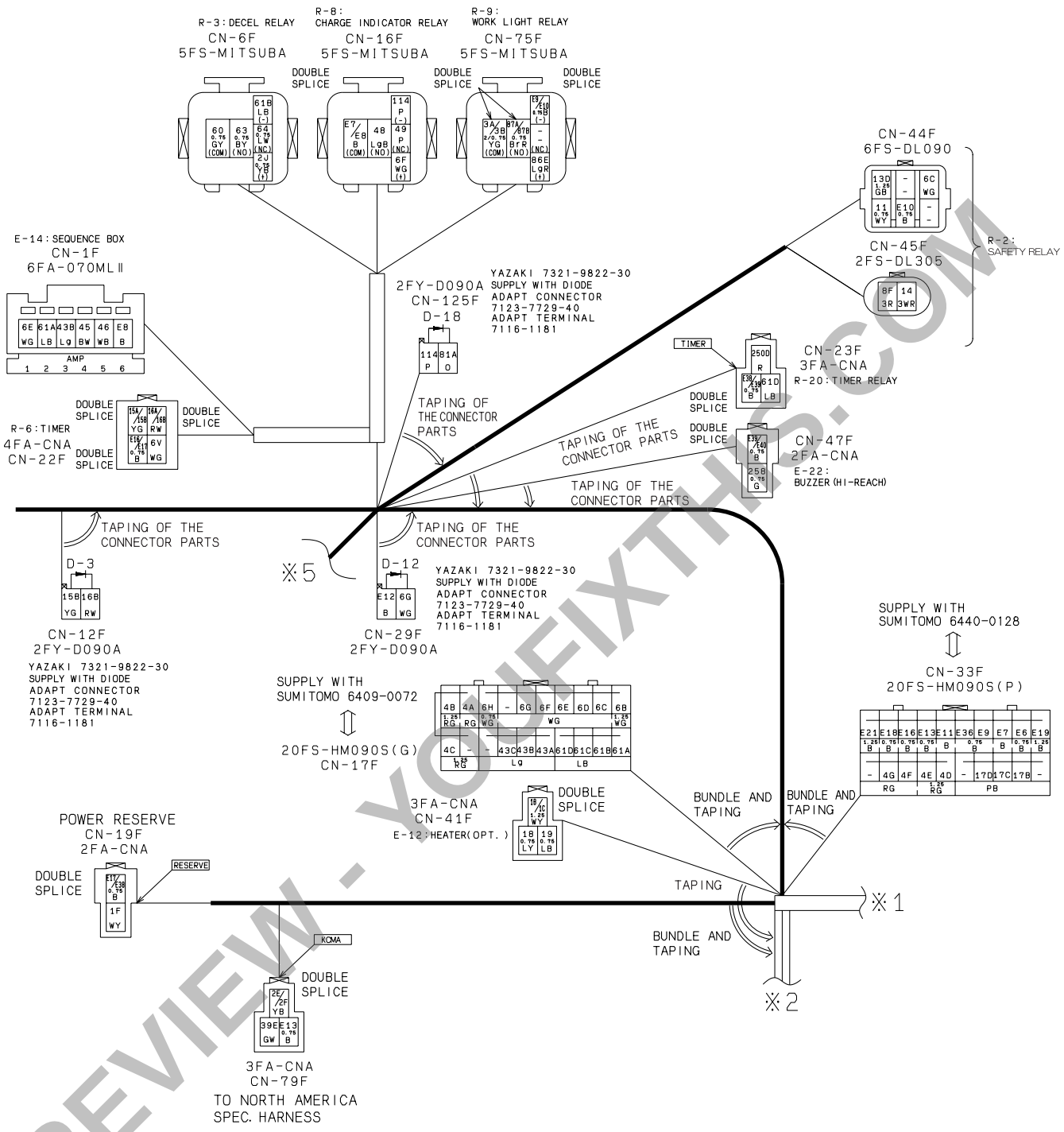


Fig. 23-21 Inst • Main Harness (No. H-1) — (2/8)

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22.3 HYDRAULIC CIRCUIT OPERATION

22.3.1 COLOR CODING STANDARD FOR HYDRAULIC

Blue :	Feed, drain circuit,	less than 0.34 MPa (50 psi)
Green :	Return, make-up circuit,	0.34~ 0.59 MPa (50~86 psi)
Purple :	Secondary pilot pressure,	0.59~3.5 MPa(85~508 psi)
Red :	Primary pilot pressure,	3.5~3.9 MPa (508~ 566 psi)
Orange :	Main pump drive pressure,	4.9~23 MPa (711~3340 psi)
Blue tone :	At valve selection	
Red valve :	When proportional valve (reducing) is operating	
Red solenoid :	In active and exciting	
Displaying the flow circuit and standby circuit when operating. Regarding the electrical symbols in this manual, refer to the electric circuit diagram.		

Note

For the hydraulic circuit operation, refer to Page 71-4 to 11 of Supporting Data that is provided at the end of this Shop Manual.

22.3.2 NEUTRAL CIRCUIT

(Refer to Page 71-5)

(1) Pilot Circuit

1) Pilot Primary Pressure Circuit
The oil delivered from the A4 port on pump assy (1) enters into the solenoid valve (13) through the line filter (19).
The pressurized oil from the port A2 of the solenoid valve (13) with the safety lock lever released (in the operating condition) is supplied to the P ports of the pilot valves for attachment (11), travel (12) and dozer (14) and nibbler & breaker (53).
Since the operating circuit is fully closed in the neutral position, the oil delivered by the pump other than the oil supplied to the Pi3 port of the control valve loses its flowing passage, and returns to the hydraulic tank (26) through the relief valve (set pressure : 3.5MPa [508 psi]) built in the solenoid valve (13).
The oil supplied to the Pi3 port is led to the tank passage through the pilot passages provided to the service spool and through the pilot passages provided to the right and left travel spools.

2) Pilot Secondary Pressure Circuit
While the pilot valves (11),(12),(14) and solenoid valve for nibbler & breaker are being in neutral, the pilot secondary pressure is not generated.
By means of operating the operating lever, the secondary pressure is generated in accordance with its motion and led to the control valve (2) from the pilot valve to shift each spool of shifting valve.

(2) Main Circuit

1) Variable Pump Circuit
The delivered oil from A1 and A2 ports on variable pump enters into P1 and P2 ports on control valve (2) respectively.
All the discharged oil from these two ports finally returns to the hydraulic oil tank (26), through each valve of travel left, boom and bucket for the P1 oil, and through each valve of travel right, swing, service and arm for the P2 oil.

2) Third Pump Circuit
The oil delivered from A3 port on 3rd pump enters into P3 port on control valve (2).
The whole amount of oil discharged through the port P3 returns to the hydraulic oil tank (26) through the selector valves for the dozer and slewing and the independent travel and flow conflux valves.

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Torque value Unit : N•m (lbf•ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M30	P=3.5	588±59 (434±44)	490±49 (361±36)	1285±127 (948±94)	1079±108 (796±80)	2300±235 (1700±173)	1940±196 (1430±145)
M33	P=3.5	794±78 (586±58)	667±69 (492±51)	1726±177 (1270±131)	1451±147 (1070±108)	3110±314 (2290±232)	2610±265 (1930±195)
M36	P=4	1030±98 (760±72)	863±88 (637±65)	2226±226 (1640±167)	1863±186 (1370±137)	4010±402 (2960±297)	3360±333 (2480±246)

11.1.2 Metric Fine Thread Standard Tightening Torque values. Make certain to tighten all Capscrews & Nuts to proper torque values.

Torque value Unit : N•m (lbf•ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M8	P=1.0	11.3±1.1 (8.3±0.8)	9.5±1.0 (7.0±0.7)	24.5±2.0 (18.1±1.5)	20.6±2.0 (15.2±1.5)	44.1±3.9 (32.5±2.9)	37.3±3.9 (27.5±2.9)
M10	P=1.25	22.6±2.0 (16.7±1.5)	18.7±1.9 (13.8±1.4)	48.1±4.9 (35.5±3.6)	41.2±3.9 (30.3±2.9)	87.3±8.8 (64.4±6.5)	73.5±6.9 (54.2±5.1)
M12	P=1.25	39.2±3.9 (28.9±2.9)	33.3±2.9 (24.6±2.1)	85.3±8.8 (62.9±6.5)	71.6±6.9 (52.8±5.1)	154±16 (114±12)	129±13 (95.2±9.6)
M16	P=1.5	92.2±8.8 (68.0±6.5)	77.5±7.8 (57.2±5.8)	196±20 (145±15)	169±17 (125±13)	363±39 (268±29)	304±29 (224±21)
M20	P=1.5	186±19 (137±14)	155±16 (114±12)	402±39 (297±29)	333±29 (246±21)	726±69 (535±51)	608±59 (448±44)
M24	P=2	314±29 (232±21)	265±29 (195±21)	686±69 (506±51)	569±59 (420±44)	1240±118 (915±87)	1030±98 (760±72)
M30	P=2	637±59 (470±44)	530±49 (391±36)	1390±137 (1030±101)	1157±118 (853±87)	2500±255 (1840±188)	2080±206 (1530±152)
M33	P=2	853±88 (629±65)	706±70 (521±52)	1860±186 (1370±137)	1550±155 (1140±114)	3350±334 (2470±246)	2790±275 (2060±203)
M36	P=3	1070±108 (789±80)	892±88 (658±65)	2330±226 (1720±167)	1940±196 (1430±145)	4200±422 (3100±311)	3500±353 (2580±260)

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32.1.3 ARM

32.1.3.1 REMOVAL OF ARM

(1) Making the arm cylinder and bucket cylinder to the most retracting conditions, get touch the arm tip with the ground.

(2) Shut off the engine and operate the arm control lever several times at the same moment, and the pressure in circuit is released.
Then put the safety lock lever in the "Locked" position, and depress the air breather on the hydraulic oil tank, release the pressure in the tank.

(3) Disconnect the 2 hoses connected to the bucket cylinder. Then apply plugs to the openings.

: 27mm

(4) Lift up the arm cylinder body with a nylon sling in order not to exert any load to the pin (E).

(5) Remove the capscrew and nuts that are preventing the pin (E) from coming out. Then remove the pin (E) and shims.

: 19mm

(6) Placing a square timber under the arm cylinder, get down the cylinder.

(7) Install the pin (E) to the original position, and install the capscrew and nuts that prevents the pin (E) from coming out. Applying a rope to the pin (E) and the arm tip, slightly lift it up in order not to exert any load to the pin (F).

(8) Remove the capscrew that is preventing the pin (F) connecting the arm and boom, from coming out. Then pull off the pin (F).

: 36mm

(9) Remove the arm assembly paying attention to the stability of arm.
Weight of arm assembly : approx.
180kg (397 lbs) — SK50SR-5

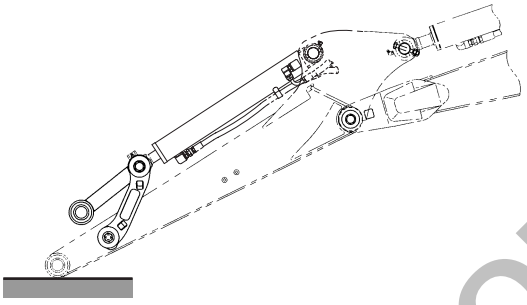


Fig. 32-5 Arm removing posture

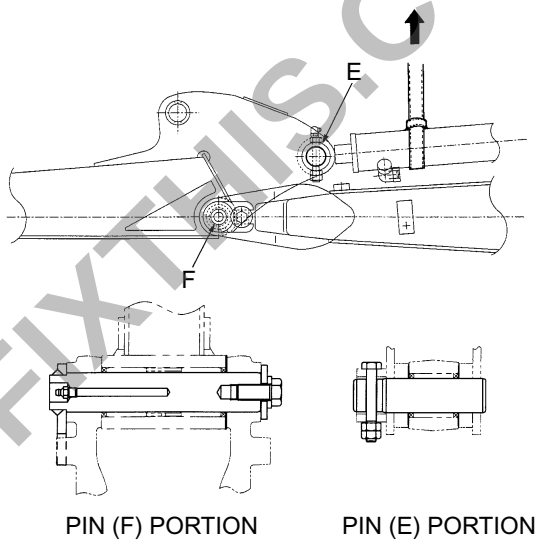


Fig. 32-6 Sectional view of Installing Pin

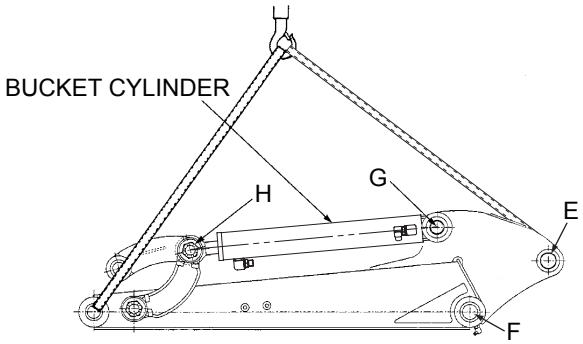


Fig. 32-7 Removal of Arm assembly

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2.3 SPECIFICATIONS AND PERFORMANCE

SPEED AND GRADEABILITY

Model		SK50SR-5			
Applicable Machines		PJ06-08890~			
Shoe Type		Rubber shoe		Iron shoe (OPT)	
Slewing Speed	min^{-1} {rpm}	8.8 {8.8}			
Travel Speed	km/h (mph)	Low (1st)	High (2nd)	Low (1st)	High (2nd)
		2.8	4.6	2.8	4.6
Gradeability	% (degree)	58(30)			

ENGINE

Model (YANMAR)		4TNV88-BXYB (EDM-4TNV88)
Type		Water-cooled, 4-cycle type Swirl chamber type diesel engine
Number of cylinders-Bore × Stroke		4 - ø88 mm × 90 mm (3.46 in × 3.54 in)
Total Displacement	L	2.189 (134 cu•in)
Output Rating	kW/min^{-1} {PS/rpm}	29.3/2,400 {40/2,400}
Maximum Torque	N•m/min^{-1} (lbf•ft/rpm)	131/1,440 (97/1,440)
Starting Motor	V × kW	12 × 2.3
Generator	V × A	12 × 55

HYDRAULIC COMPONENTS

Hydraulic Pump	Variable displacement axial piston + gear pump
Hydraulic Motor	Axial piston
Hydraulic Motor w/Reducer (Travel)	2-Axial piston, 2-Speed motor
Control Valve	11-spool multiple control valve
Cylinder (Boom, Arm, Swing, Bucket, Dozer)	Double action cylinder
Return Filter	Safety valve containing/Filter Type (30μ)

SIDE DIGGING & DOZER

Type		Boom swing by hydraulic cylinder
Boom Swing Angle	Right	60°
	Left	70°
Stroke of Dozer (above/below)	mm (in)	495 / 375 (19.5/14.8)

WEIGHT

Machine Weight	kg (lb)	Rubber shoe	Iron shoe
		4,630 (10,200)	4,730 (10,400)
Upper slewing body	kg (lb)	2,280 (5,030)	←
Travel system	kg (lb)	1,720 (3,790)	1,820 (4,010)
Attachment (Boom+STD Arm+STD Bucket)	kg (lb)	535 (1,180)	
Oil & Water	kg (lb)	95 (209)	

Note : This figure is calculated with Japanese standard bucket.

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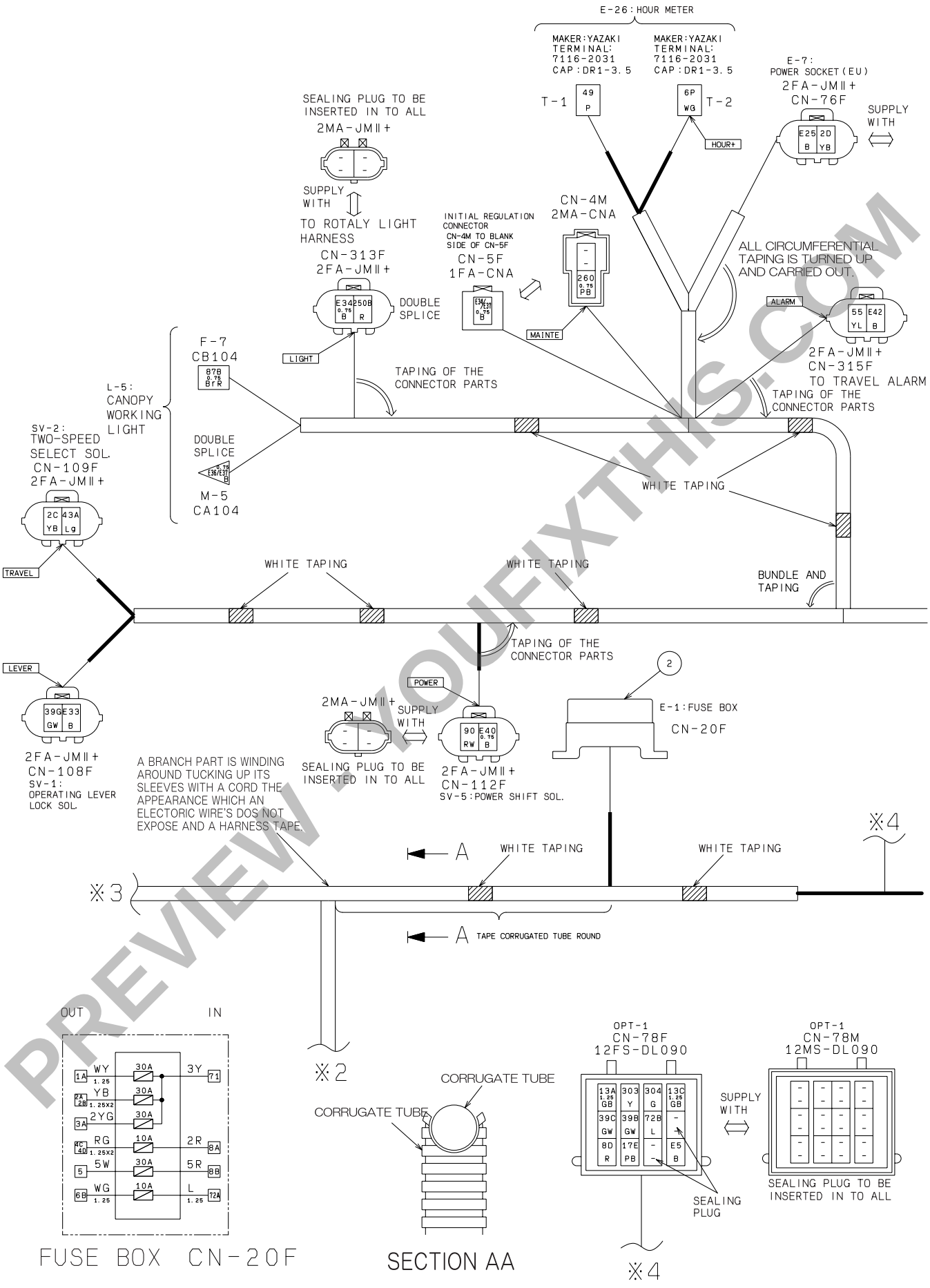


Fig. 23-22 Inst • Main Harness (No. H-1) — (3/8)

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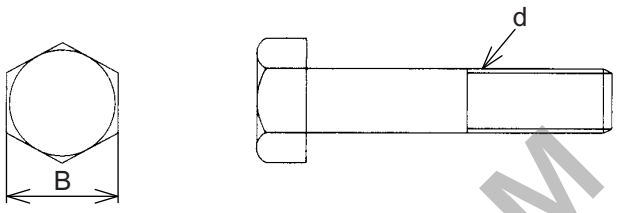
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11.2 SCREW AND TOOL SIZES

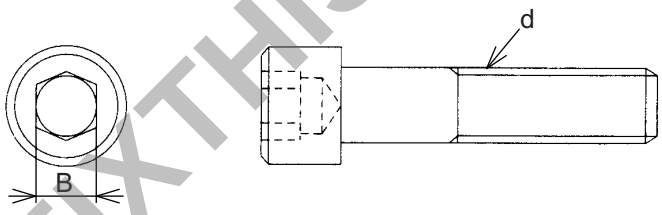
11.2.1 Capscrew

Nominal screw size (d)	B mm Tool size	Nominal screw size (d)	B mm Tool size
M6	10	M24	36
M8	13	M30	46
M10	17	M36	55
M12	19	M42	65
M16	24	M48	75
M20	30		



11.2.2 Capscrew (Socket bolt)

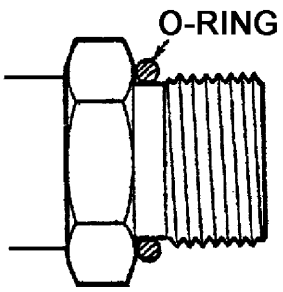
Nominal screw size (d)	B mm Tool size	Nominal screw size (d)	B mm Tool size
M6	5	M20	17
M8	6	M24	19
M10	8	M30	22
M12	10	M36	27
M14	12	M42	32
M16	14	M48	36
(M18)	14		



11.3 TORQUE SPECIFICATIONS FOR JOINTS AND HOSES

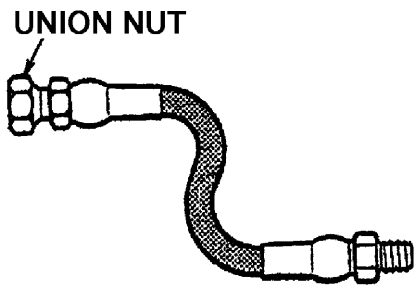
11.3.1 JOINTS FOR PIPING (O-RING SEALING TYPE)

Nominal screw size (PF)	Spanner size (mm)	Tightening torque N•m (lbf•ft)
1 / 8	14	17±2 (12±1)
1 / 4	19	36±2 (27±1)
3 / 8	22	74±5 (54±4)
1 / 2	27	108±9.8 (80±7)
3 / 4	36	162±9.8 (119±7)
1	41	255±9.8 (188±7)



11.3.2 HYDRAULIC HOSE (30° FLARE TYPE)

Nominal screw size (PF)	Spanner size (mm)	Tightening torque N•m (lbf•ft)
1 / 8	17	15±2.0 (11±1)
1 / 4	19	29±4.9 (22±4)
3 / 8	22	49±4.9 (36±4)
1 / 2	27	78±4.9 (58±4)
3 / 4	36	118±9.8 (87±7)
1	41	137±15 (101±11)



NOTE : The application of the tightening torque is subject to a dry condition.

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(10)Removal of Bucket Cylinder

1) Remove the capscrew that is preventing the rod pin (H) from coming out, then pull off the pin (H).

: 24mm

2) Remove the capscrew and nuts that are preventing the head pin (G) from coming out, then pull off the pin (G).

: 17mm

3) Apply a nylon sling to the tube of bucket cylinder, and remove the cylinder.
Weight ; approx. 27kg (60 lbs)

32.1.3.2 INSTALLATION OF ARM

Installation is performed in the reverse order of removal, including the following workings.

CAUTION

- At the alignment of pin positions, never insert your finger into the pin holes.
- Make sure to align them with visual confirmation.

(1) Make the welded area clean to inspect any cracks there.

(2) Check the dust seal for damages, and replace the faulty dust seal to new one (referring to Fig. 32-9 for the installing procedures).

(3) Referring to the Section "ATTACHMENT DIMENSIONS" of Specifications, replace the worn-out pin and bushing to new ones.

(4) Before installing the pin, apply grease to the shaft area.

(5) Referring to Fig. 32-10, install the capscrew and nuts to prevent the pin from coming out.

: 19mm, 24mm, 36mm

(6) Make sure to provide an appropriate clearance for thrust direction at the installation of pin referring to Fig. 32-10.

(7) For the adjustment for clearance, insert resin (plastic) shim first, then adjust the clearance with steel shims.

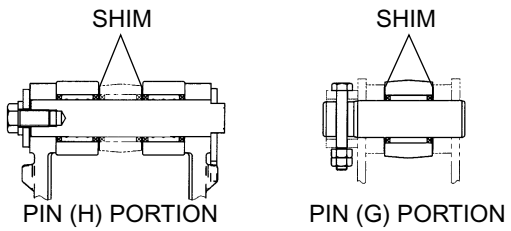


Fig. 32-8 Sectional view of Installing Pin

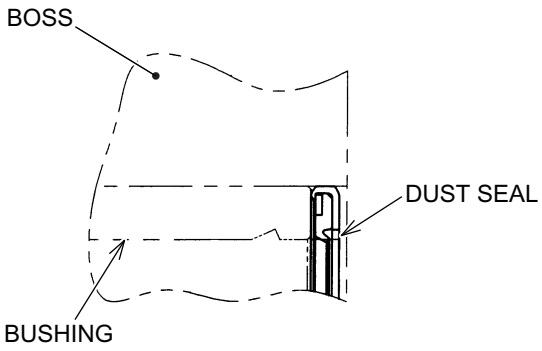


Fig. 32-9 Dust seal installation

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44. TROUBLESHOOTING (ENGINE)

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2.8 ENGINE SPECIFICATIONS

2.8.1 SPECIFICATIONS

Model		SK50SR-5	
Engine Model (YANMAR)		4TNV88-BXYB (EDM-4TNV88)	
Type		Vertical, 4-cycle water-cooled diesel engine	
No. of cylinders - Bore × Stroke		4 - 88 mm (3.46 in) × 90 mm (3.54 in)	
Total displacement		2.189 liter (134 cu•in)	
Compression ratio		19.1	
Rated output		29.3 kW (40 PS) at 2400 rpm	
Maximum torque		131 ~ 147.1 N•m (97 ~ 109lbf•ft) at 1440 rpm	
Low idling		1175±25 rpm	
High idling		2600±25 rpm	
Fuel consumption rate		Less than 242 g / kWh (178 g / PS•h)	
Allowable tilting angles		Continuous ; 30° for all direction	
Rotating direction		Counterclockwise as seen from flywheel side	
Firing order		1-3-4-2-1	
Fuel injection timing (b.T.D.C.)		15.5±1°	
Fuel injection pressure		19.6 $^{+1}_{0}$ MPa (2840 $^{+145}_{0}$ psi)	
Valve action		Open	Close
	Intake valve	b.T.D.C. 15±5°	a.B.D.C. 45±5°
	Exhaust valve	b.T.D.C. 56±5°	a.B.D.C. 18±5°
Valve clearance	Intake valve	0.2 mm (0.008 in) in cold condition	
	Exhaust valve	0.2 mm (0.008 in) in cold condition	
Thermostat action		Start 71 ± 1.5°C (160 ± 3°F) / Full open 85°C (185°F)	
Compression pressure		3.4 ± 0.1 MPa (500 ± 14 psi) at 250 rpm	
Lubrication oil pressure		0.44 MPa (64 psi) at 2300 rpm	
Dimensions L × W × H		659 × 523 × 617 mm (26.0 ×20.6 × 24.3 in)	
Dry weight		170 kg (375 lb)	
Governor		Mechanical centrifugal governor (All speed type)	
Fuel filtration		cartridge type paper filter	
Lubrication system		Forced lubrication with trochoid pump	
Cooling system		Liquid cooling / Radiator	
Starter capacity		12 V × 2.3kW	
Generator capacity		12 V × 55 A	
Starting aid		Glow plug	
Cooling water capacity : Max / Engine		6.0 / 2.7 liter (1.59 / 0.71 gal)	
Engine oil volume : Max / Effective		7.4 / 4.0 liter (1.96 / 1.06 gal)	

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13.2 PERFORMANCE INSPECTION STANDARD TABLE

13.2.1 STANDARD VALUE TABLE

Table 13-1 (1/2)

Model				SK50SR-5	
Applicable machines				PJ06-08890~	
Div.	Item		Unit	Standard value	Repairable value
Measuring condition	Hyd. oil cleanliness		Class	9 less than	—
	Hyd. oil temperature (Tank surface)		℃ (℉)	50~60 (122~140)	—
	Coolant temperature (Radiator surface)			60~90 (140~194)	—
Engine speed	Low idle		min^{-1}	1150±50	—
	High idle			2550±50	—
	Deceleration			1150±50	—
*2 Main relief valve pressure	Boom • Bucket • Travel (LH)	P1	MPa (psi)	$23.0^{+0.5}_{0}$ (3340^{+73}_{0})	—
	Arm • Swing • Travel (RH) • Service	P2		$23.0^{+0.5}_{0}$ (3340^{+73}_{0})	—
	Dozer	P3		$23.0^{+0.5}_{0}$ (3340^{+73}_{0})	—
	*1 Slew			22.6±0.5 (3280±73)	—
Pilot relief valve pressure	Pilot Line	—		3.5±0.4 (508±58)	—
*2 Port (Over load) relief valve pressure	Boom	Head Rod		$27.5^{0}_{-4.5}$ (3990^{0}_{-652})	—
	Arm	Head Rod		$25.5^{0}_{-2.5}$ (3700^{0}_{-362})	—
	Bucket	Head		$25.5^{0}_{-2.5}$ (3700^{0}_{-362})	—
	Dozer	Head		$25.5^{0}_{-2.5}$ (3700^{0}_{-362})	—
	*1 Slew	LH/RH		22.6±0.5 (3280±73)	—
Travel	Crawler Speed (5 rev.) Rubber crawler	Low	sec.	$36.2^{+1.9}_{-2.1}$	47
		high		$21.2^{+1.0}_{-1.1}$	28
	Crawler Speed (5 rev.) Iron crawler	Low		$38.2^{+2.0}_{-2.3}$	49
		High		$22.4^{+1.1}_{-1.2}$	29
	Travel Speed 10 m (32.8 ft) Rubber crawler	Low	sec.	13.7±0.7	18
		High		8.1±0.4	10
	Travel Speed 10 m (32.8 ft) Iron crawler	Low		15.0±0.7	19
		High		8.8±0.4	11
	Travel deviation		mm (in)	140^{0}_{-140} ($5.5^{0}_{-5.5}$)	280 (11.0)
	Drift due to gravity	w / P.B. (5 min)		0 (0)	1 (0.04)

*1. The pressure for slew is controlled by the relief valve attached to the slew motor.
Set pressure of this relief valve is 21.0 MPa (3050 PSi)
*2. Measure the both pressures of main relief valve and orer relief valve st pressure measuring port on main control valve.

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HYDRAULIC EXCAVATOR

SHOP MANUAL model SK50SR-5

INDEX

1	SPECIFICATIONS
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GENERAL SAFETY INFORMATION

⚠ WARNING

Do not operate or perform any maintenance on this machine until all instructions found in the OPERATOR'S MANUAL and this MANUAL have been thoroughly read and understood.
Improper operation or maintenance of this machine may cause accidents and could result in serious injury or death.
Always keep the manual in storage.
If it is missing or damaged, place an order with an authorized our Distributor for a replacement.
If you have any questions, please consult an authorized our Distributor.

(1) Most accidents, which occur during operation, are due to neglect of precautionary measures and safety rules. Sufficient care should be taken to avoid these accidents. Erroneous operation, lubrication or maintenance services are very dangerous and may cause injury or death of personnel. Therefore all precautionary measures, NOTES, DANGERS, WARNINGS and CAUTIONS contained in the manual and on the machine should be read and understood by all personnel before starting any work with or on the machine.

(2) Operation, inspection, and maintenance should be carefully carried out, and safety must be given the first priority. Messages of safety are indicated with marks. The safety information contained in the manual is intended only to supplement safety codes, insurance requirements, local laws, rules and regulations.

(3) Messages of safety appear in the manual and on the machine : All messages of safety are identified by either word of "DANGER", "WARNING" and "CAUTION".

1) **DANGER-** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury and is represented as follows:

⚠ DANGER

2) **WARNING-** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury and is represented as follows:

⚠ WARNING

3) **CAUTION-** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against possible damage to the machine and its components and is represented as follows:

⚠ CAUTION

(4) It is very difficult to forecast every danger that may occur during operation. However, safety can be ensured by fully understanding proper operating procedures for this machine according to methods recommended by Manufacturer.

(5) While operating the machine, be sure to perform work with great care, so as not to damage the machine, or allow accidents to occur.

(6) Continue studying the manual until all Safety, Operation and Maintenance procedures are completely understood by all persons working with the machine.

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2) Remove the oil seal (132) from the spindle (2)

- Never reuse the removed oil seal (132).

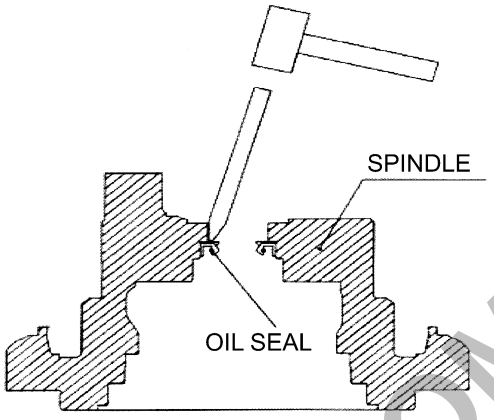


Fig. 34-147 Removing oil seal (132)

(21)Rough washing of parts

1) Separate the four parts, namely the hub (1), spindle (2), cover (13), and rear flange (201), from the other parts (hereafter referred to as built-in parts).

2) Put the hub, spindle, cover, and rear flange in a cleaning bath and clean them.

- Carefully remove dust accumulated on the surfaces of parts to make them completely clean.

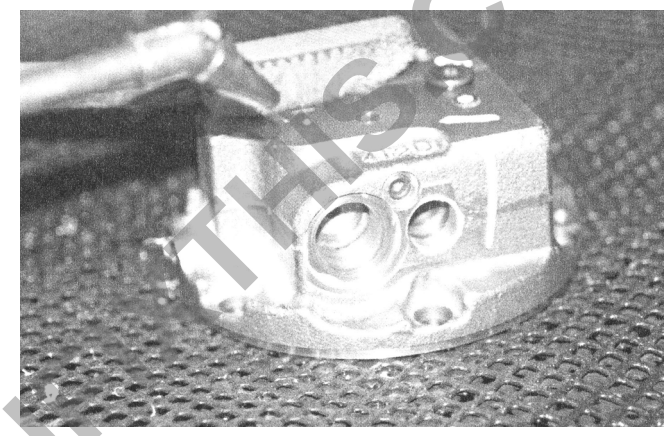


Fig. 34-148 Cleaning each part

⚠CAUTION

- Kerosene is combustible. Be careful not to cause fire, burns, and injury.

- Before cleaning stained parts, immerse them in kerosene until dust and stain become soft and are floated so as to prevent damage when cleaning.

3) Put the built-in parts in a rough cleaning bath containing kerosene and clean them.

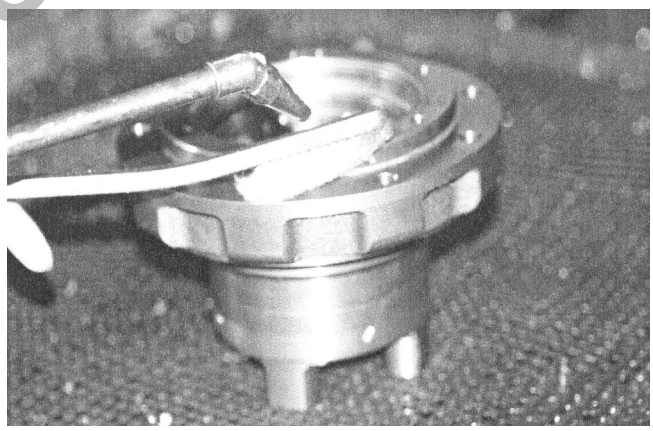


Fig. 34-149 Cleaning each section

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