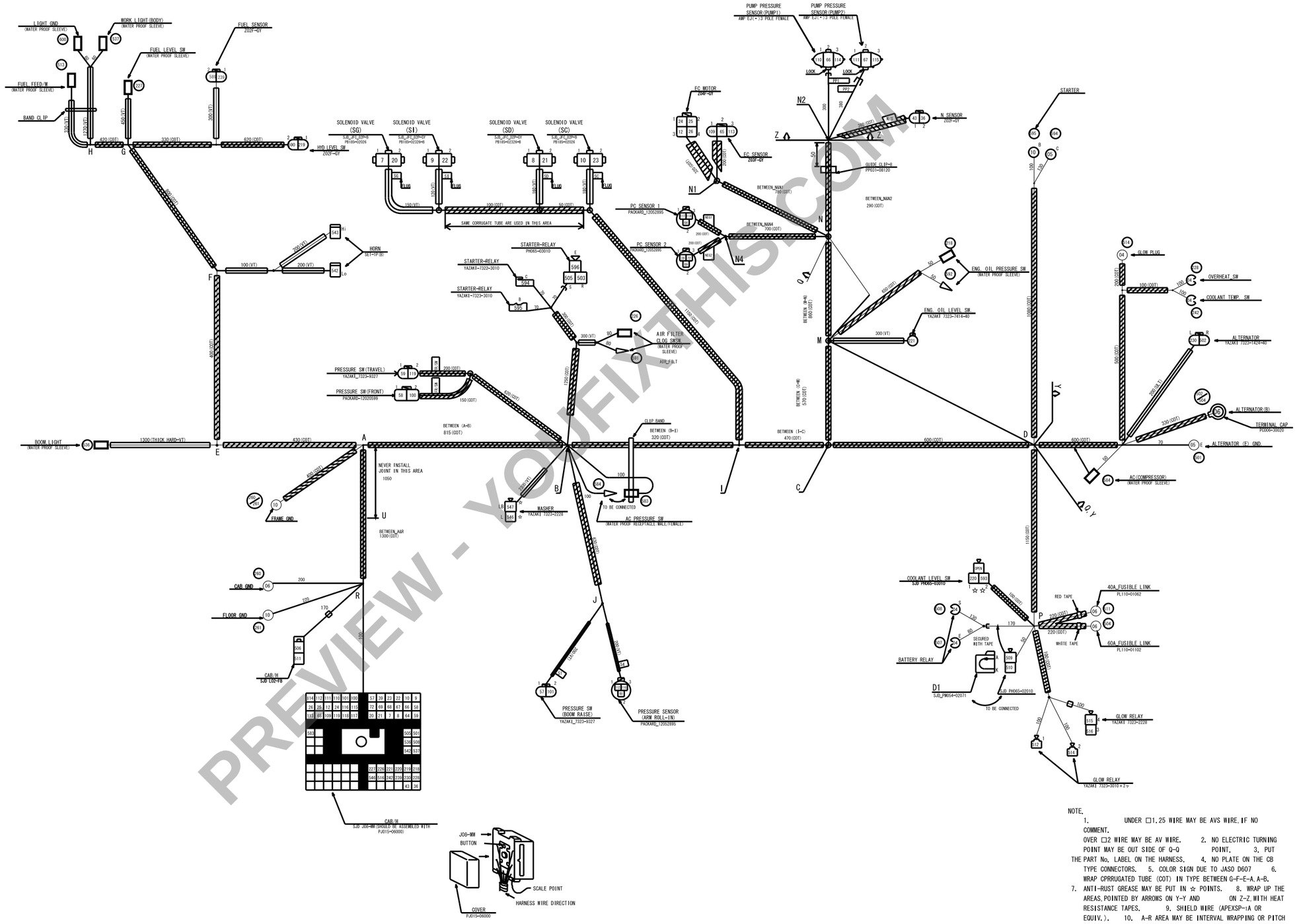
EX200-5 ENG. HARNESS

NO.	SIZE	COLOR	CIRCUIT FROM	CIRCUIT TO	COMMENT
7	0.5	LR	CAB/H	SOL (SG)-1	
8	0.5	RW	CAB/H	SOL (SE)-1	
9	0.5	LgB	CAB/H	SOL (S1)-1	
10	0.5	LGr	CAB/H	SOL (SC)-1	
12	0.5	Gr	CAB/H	EC MOTOR-3	
20	0.5	LB	CAB/H	SOL (SG)-2	
21	0.5	RY	CAB/H	SOL (SE)-2	
22	0.5	LgB	CAB/H	SOL (S1)-2	
23	0.5	LW	CAB/H	SOL (SC)-2	
24	0.5	BrR	CAB/H	EC MOTOR-1	
25	0.5	R	CAB/H	EC MOTOR-2	
26	0.5	Y	CAB/H	EC MOTOR-4	
35	0.5	B	CAB/H	N SENSOR-2	OUTER_OF_SHIELD
39	0.5	BY	CAB/H	PC SENS.2-1	
43	0.5	R	CAB/H	N SENSOR-1	INNER_OF_SHIELD
57	0.5	BR	CAB/H	PRES. SW(BM)-1	
58	0.5	BR	CAB/H	PRES. SW(TR)-1	
59	0.5	WB	CAB/H	PRES. SW(TR)-1	
64	0.5	L	CAB/H	PC SENS.1-2	
65	0.5	YB	CAB/H	EC SENS.-2	
66	0.5	RG	CAB/H	PUMP PRES. SENS.1-2	CHAVX
67	0.5	GB	CAB/H	PUMP PRES. SENS.2-2	CHAVX
68	0.5	RB	CAB/H	PRES. SENS(AM)-2	
69	0.5	BL	CAB/H	PC SENS. 2-2	
72	0.5	BP	CAB/H	PC SENS. 2-3	
100	0.5	GrB	CAB/H	PRES. SW(TR)-2	
101	0.5	GrL	CAB/H	PRES. SW(BM)-2	
109	0.5	YL	CAB/H	EC SENS.-1	
110	0.5	W	CAB/H	PUMP PRES. SENS.1-1	CHAVX
111	0.5	WR	CAB/H	PUMP PRES. SENS.2-1	CHAVX
112	0.5	YR	CAB/H	PRES. SENS.(AM)-1	
113	0.5	BrL	CAB/H	EC SENS.-3	
114	0.5	RY	CAB/H	PUMP PRES. SENS.1-3	CHAVX
115	0.5	YB	CAB/H	PUMP PRES. SENS.2-3	CHAVX
116	0.5	BrR	CAB/H	PRES. SENS.(AM)-3	
117	0.5	YB	CAB/H	PC SENS. 1-1	
118	0.5	BrL	CAB/H	PC SENS. 1-3	
119	0.5	Gr	CAB/H	PRES. SW(TR)-2	
218	0.5	MR	CAB/H	ENG OIL PRES SW-F	
219	0.5	G	CAB/H	HYD LEV. SW.-1	
220	0.5	L	CAB/H	COOLANT LEV. SW.-1	
221	0.85	MB	CAB/H	ENG OIL LEV. SW	
226	0.5	GL	CAB/H	AIR FILT CLOG SW-F	
227	0.5	RY	CAB/H	FUEL LEV. SW	
228	0.5	RL	CAB/H	OVERHEAT	AEX
230	0.5	LY	CAB/H	ALTERNATOR-L	AEX
239	0.5	Br	CAB/H	FUEL SENSOR-1	
242	0.5	MB	CAB/H	COOLANT TEMP	AEX
260	5	B	FRAME_GND	CAB_GND	
261	5	B	FRAME_GND	FLOOR_GND	
501	3	B	CAB/H	ALTERNATOR-E	
502	0.5	W	ALTERNATOR-R	ALTERNATOR-R	
503	0.85	WG	(503) (●)	STARTER RELAY-M	
504	8	W	60A_FUSIBLE_LINK	ALTERNATOR-S	
505	1.25	BW	CAB/H	STARTER RELAY-C	
506	5	W	(506) (●)	CAB/H	
507	2	B	(507)	BAT. RELAY-E	
508	2	BW	CAB/H	BAT. RELAY-S	
509	2	B	(509)	D1-A	
510	2	BW	(510) (●)	D1-K	
511	3	R	40A_FUSIBLE_LINK	CAB/H	
512	3	R	(512) (●)	GLOW RELAY-1	
513	2	RB	(513) (●)	FUEL_FEED/M	
514	3	BY	GLOW RELAY-2	GLOW	
515	0.5	B	(515)	GLOW RELAY-4	
516	0.5	GY	CAB/H	GLOW RELAY-3	
536	2	RL	CAB/H	WORK_LIGHT (BODY)	
537	2	R	CAB/H	WORK_LIGHT (BODY)	
542	0.85	RG	CAB/H	HORN-LO	AV
543	0.85	RG	(543) (●)	HORN-HI	AV
546	0.5	Pu	CAB/H	WASHER-L	
547	0.5	B	(547)	WASHER-LB	
583	0.85	W	CAB/H	A/C_SW-F	
584	0.85	WR	A/C	A/C_SW-W	
589	0.5	B	(589)	FUEL SENSOR-2	
590	0.5	B	(590)	HYD. LEV. SW-2	
591	0.5	B	(591)	AIR FILT. CLOG SW	
592	0.5	B	(592)	ENG OIL PRES SW-M	
593	0.5	B	(593)	COOLANT LEV.-2	
594	5	RB	STARTER-C	STARTER RELAY-C	
595	5	RL	STARTER-S	STARTER RELAY-S	
596	1.25	B	(596)	STARTER RELAY-C	
600	2	B	(600)	LIGHT_GND	



NOTE.

1. UNDER □1.25 WIRE MAY BE AVS WIRE. IF NO COMMENT.
2. OVER □2 WIRE MAY BE AV WIRE.
3. NO ELECTRIC TURNING POINT MAY BE OUT SIDE OF Q-Q
4. PUT THE PART No. LABEL ON THE HARNESS.
5. NO PLATE ON THE CB TYPE CONNECTORS.
6. COLOR SIGN DUE TO JASO D607
7. WRAP CPRRUGATED TUBE (COT) IN TYPE BETWEEN G-F-E-A, A-B.
8. ANTI-RUST GREASE MAY BE PUT IN ☆ POINTS.
9. WRAP UP THE AREAS.POINTED BY ARROWS ON Y-Y AND ON Z-Z.WITH HEAT RESISTANCE TAPES.
10. SHIELD WIRE (APEXSP-1A OR EQUIV.).
11. A-R AREA MAY BE INTERVAL WRAPPING OR PITCH WRAPPING.
12. * MARKED JOINT MAY BE WRAPPED BY SELF-FUSION TAPE OR MAY BE PUT ON R DIRECTION FROM U POINT. OR MAY BE ○ DOUBLE JOINT ON THE HOLE TYPE CONNECTOR.

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ENGINE ACCESSORIES

RADIATOR ASSEMBLY

Type	Radiator/Oil cooler tandem type assembly	
Weight	82 kg (181 lb)	
	Radiator	Oil cooler
Capacity	6.7 L (1.8 US gal)	5.1 L (1.3 US gal)
Air-tight testing pressure	68.6 kPa (0.7 kgf/cm^2, 10 psi)	981 kPa (10 kgf/cm^2, 14 psi)
Cap opening pressure	49 kPa (0.5 kgf/cm^2, 7 psi)	–

BATTERY

Capacity	96 Ah (5 hours), 120 Ah (20 hours)
Voltage	12 V
Weight	33 kg (73 lb)×2

HYDRAULIC DEVICES

MAIN PUMP

Model	HPV102FW
Type	Variable displacement plunger pump: regulator attached type
Max. flow (Theoritical value)	185 L/min (48.8 US gpm)×2

PILOT PUMP

Model	HY/ZFS 11/16.8
Type	Fixed displacement type gear pump
Max. flow (Theoritical value)	32.8 L/min (8.7 US gpm) HP Mode: 36.1 L/min (9.5 US gpm)

CONTROL VALVE

Model	KVMG-200H
Type	Pilot pressure operated type (4-spool+5-spool)
Main relief pressure	Normal: 34.3 MPa (350 kgf/cm^2, 4977 psi) 110 L/min (29.0 US gpm) Power boost: 36.3 Mpa (370 kgf/cm^2, 5261 psi) 110 L/min (29.0 US gpm)
Overload relief pressure	37.3 MPa (380 kgf/cm^2, 5404 psi) 50 L/min (13.2 US gpm) (Boom raise/lower, Arm roll-in, Bucket roll-in) 39.2 MPa (400 kgf/cm^2, 5688 psi) 50 L/min (13.2 US gpm) (Arm roll-out, Bucket roll-out)

SWING DEVICE

Type	Two-stage planetary reduction type

SWING MOTOR

Model	M2X146B
Type	Swash-plate type, fixed-displacement plunger motor

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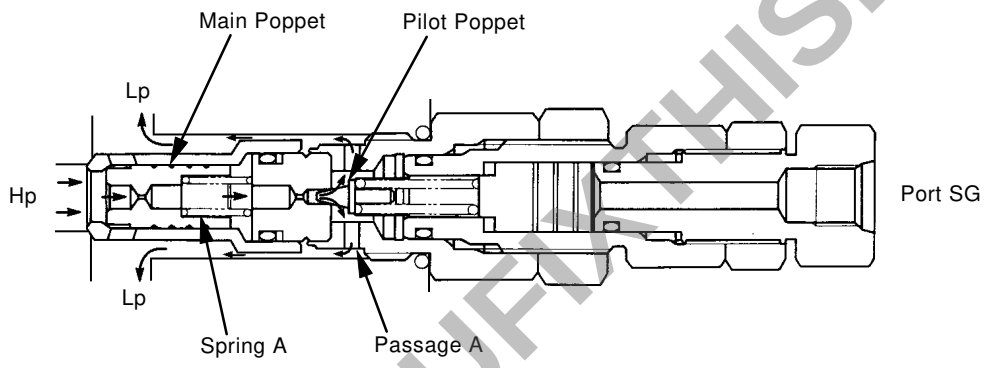
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MAIN RELIEF VALVE

The main relief valve regulates main circuit pressure.
The set pressure of the main relief valve is shifted by the pilot pressure guided via the solenoid valve unit (SG). (Refer to the Control System Group in the SYSTEM Section.)

Valve Operation

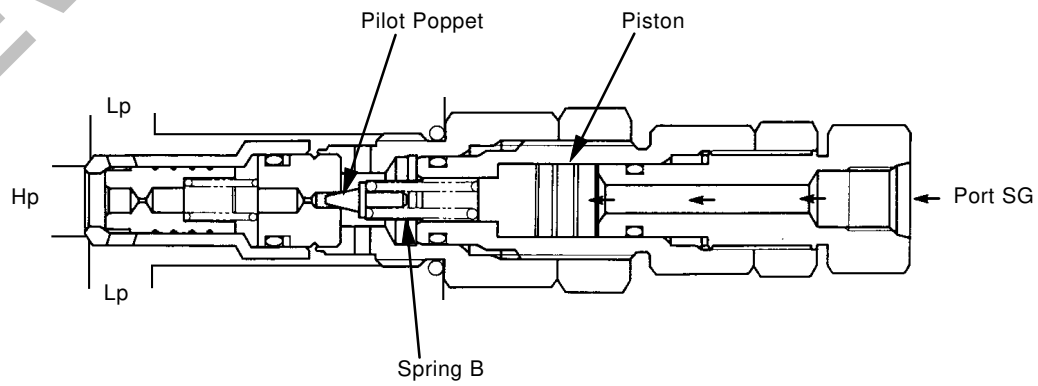
When the pilot pressure is not guided to the main relief valve via the solenoid valve unit (SG):
When oil pressure at port Hp matches the spring set force, the pilot poppet opens. Oil at port Hp flows to port Lp through passage A.
As the pilot poppet opens, oil pressure in spring chamber A decreases, opening the main poppet, thus directly routing pressure oil at port Hp to port Lp.



T157-02-05-003

When the pilot pressure is guided to the main relief valve via the solenoid valve unit (SG):
When the pilot pressure via the solenoid valve unit exerts on port SG, the piston is pushed to the left in the set position, increasing the compressional force of spring B, thus requiring higher port Hp pressure to open the pilot poppet.

For this reason, the main relief valve set pressure increases.



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ENGINE COMPRESSION PRESSURE

Summary:

1. Measure compression pressure in the cylinders to check for a decline in engine power.
2. Check exhaust gas color and the amount of blow-by gas from the crankcase. Keep track of engine oil consumption.
3. Check for abnormalities in the intake system, including the air filter.

Preparation:

1. Confirm that valve clearances are correct.
2. Confirm that the batteries are charged properly.
3. Run the engine until the coolant temperature gauge reaches the operating range.
4. Stop the engine. Remove glow plugs from each cylinder.
5. Install an adaptor (EX200-5, 200LC-5: Isuzu 5-85317-001-0, EX220-5, 220LC-5, 230LC-5, 270-5, 270LC-5: Hino 09408-1010, 1030) and compression gauge in place of the glow plug in one cylinder. (Be sure to sufficiently tighten the adaptor and compression gauge to prevent air leakage.)

Measurement:

1. Turn the starter to crank the engine. Record the compression pressure of each cylinder.
2. Repeat measurement three times for each cylinder and calculate the mean values.

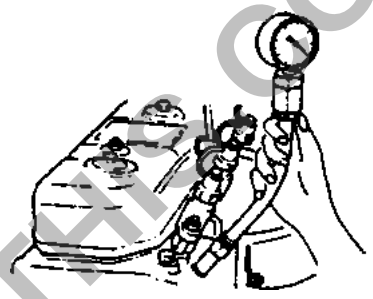
Evaluation:

Refer to Group-5 in this section.

Remedy:

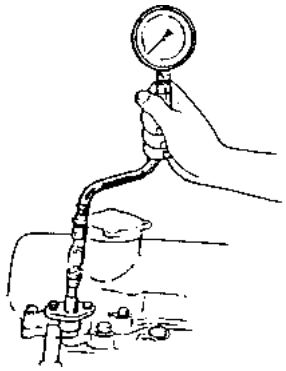
Refer to engine shop manual.

(EX200-5, 200LC-5)



T157-05-02-001

(EX220-5, 220LC-5, 230LC-5, 270-5, 270LC-5)



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PERFORMANCE TEST DESIGNATION	EX220-5, 220LC-5, 230LC-5 (Performance Standard)	Remarks
MAXIMUM SWINGABLE SLANT ANGLE (deg.)	19.2° or possibly more	2.96 m Arm 1.0 m^3(PCSA heaped) bucket
HYDRAULIC CYLINDER CYCLE TIME (sec)		2.96 m Arm 1.0 m^3(PCSA heaped) bucket
Boom Raise	3.1±0.3	
Boom Lower	2.5±0.3	
Arm Roll-In	3.9±0.3	
Arm Roll-Out	2.6±0.3	
Bucket Roll-In	4.1±0.3	
Bucket Roll-Out	2.5±0.3	
DIG FUNCTION DRIFT CHECK (mm/5 min)		2.96 m Arm 1.0 m^3(PCSA heaped) bucket
Boom Cylinder	20 or less	
Arm Cylinder	20 or less	
Bucket Cylinder	20 or less	
Bucket Bottom	150 or less	
CONTROL LEVER OPERATING FORCE (kgf)		HITACHI Lever Pattern
Boom Lever	2.0 or less	
Arm Lever (ISO Lever Pattern: Swing Lever)	1.7 or less	
Bucket Lever	1.7 or less	
Swing Lever (ISO Lever Pattern: Arm Lever)	2.0 or less	
Travel Lever	2.5 or less	
CONTROL LEVER STROKE (mm)		HITACHI Lever Pattern
Boom Lever	105±10	
Arm Lever (ISO Lever Pattern: Swing Lever)	83±10	
Bucket Lever	83±10	
Swing Lever (ISO Lever Pattern: Arm Lever)	105±10	
Travel Lever	115±10	

NOTE: 1 kgf = 9.807 N

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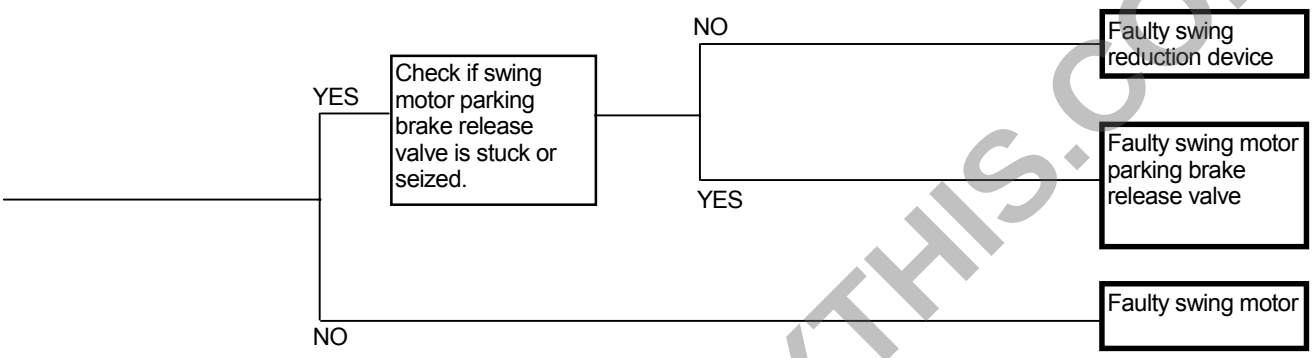
RELATIONSHIP BETWEEN MACHINE TROUBLE SYMPTOMS AND PARTS IN TROUBLE

This table indicates the probable machine trouble symptoms by part item when each part is failed and procedures to determine if the part has failed.

Part Name		EC Motor	EC Sensor	Engine Control Dial
Part function		• To operate governor lever.	• To detect the slow-idle speed governor lever position (2.5 V).	• To instruct the engine target speed governor lever position.
Control System Trouble		• Governor lever does not move.	• Whenever key switch is ON, governor lever position is learned as in the slow idle speed position differing from the correct position. Accordingly, engine speed is controlled afterward with the discrepancy which occurred at this time.	• Even if engine control dial is operated, engine speed is unchanged. • If harness to engine control dial is broken, target speed 1600 min^{-1} is used as the backup value.
Machine Symptom		• Even if engine control dial is operated, engine speed does not increase from slow speed range. • Starter rotates but engine fails to start occasionally. • While engine is running at a faster than specific speed, if harness to EC motor is broken, engine stalls. • While engine is running at a slower than specific speed, if harness to EC motor is broken, engine becomes uncontrollable. Engine does not stop even if key switch is turned OFF.	• If the discrepancy occurred to the slower side, engine speed is changed by engine control dial. However, engine speed control range stays slower than normal. (Note: If the discrepancy occurred to the faster side, when engine control dial is turned to the fastest position, EC motor continues moving. However, EC motor is a worm gear type so that governor lever is kept holding at the full stroke position. If engine control dial is turned to the slowest position, governor lever returns to the slow idle position.) • When engine is started, engine speed fluctuates. • Engine start may become difficult.	• Engine speed is constantly held at 1600 min^{-1}. (Auto-idle function operates, and engine can be stopped by turning key switch.)
Trouble shooting Procedures	By Dr.EX Self-Diagnosing Function	—	Fault code 01 is displayed.	Fault code 07 is displayed.
	By Dr.EX Monitor Function	—	Monitor Item: EC Angle	Monitor item: Target Engine Speed
	By Lamp Harness Check	• Install lamp harness (ST7125). Then, check output signal from EC and check if harness is normal.	—	—
	By Other Check/ Measurements	—	—	—
Note		• Engine is stopped by EC motor. No engine stop motor is provided. However, a fuel cutoff cable is installed.	• If EC sensor is failed, engine learning operation becomes impossible.	—
Descriptions in (Operational Principle)Technical Manual		T2-1	T2-1	T2-1

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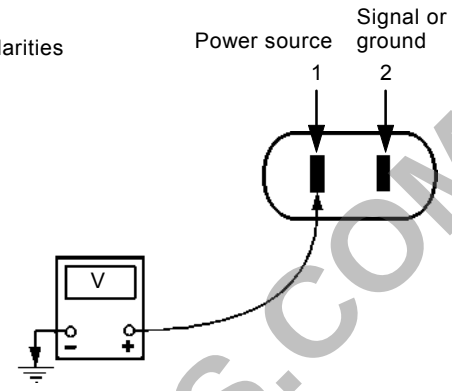
5 Voltage Circuit

- **Voltage between terminal No.1 and the vehicle frame (ground)**
  With the key switch turned OFF, disconnect the sensor connector.
  Measure the voltage between terminal No.1 on the machine harness side connector and the vehicle (ground) under the following conditions.

  - Key switch position: ON
  - Tester black terminal (negative): Connected to the vehicle (ground)
  - Tester red terminal (positive): Connected to terminal No.1

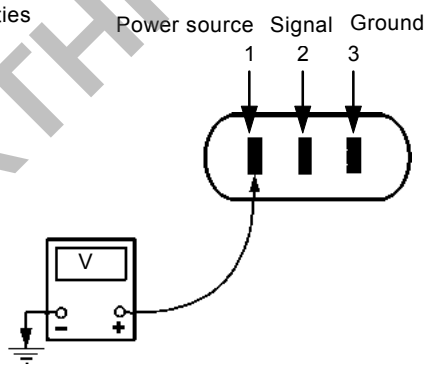
  Evaluation:
  If the measuring voltage is within 5±0.5 volts, the circuit up to terminal No.1 is normal.

Two polarities



T107-07-05-006

Three polarities



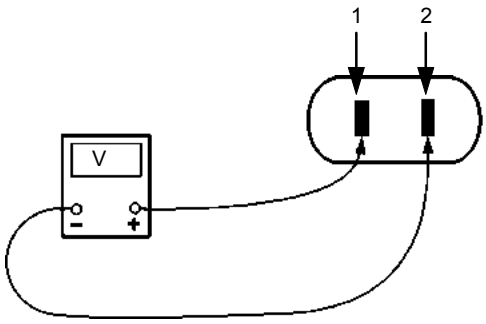
T107-07-05-007

- **Voltage between terminal No.1 and the ground terminal**
  With the key switch turned OFF, disconnect the sensor connector.
  Measure the voltage between terminal No.1 on the machine harness side connector and the ground terminal (terminal No.2 for two polarities, or terminal No.3 for three polarities) under the following conditions.

  - Key switch position: ON
  - Tester black terminal (negative): Connected to the ground terminal (terminal No.2 or 3)
  - Tester red terminal (positive): Connected to terminal No.1

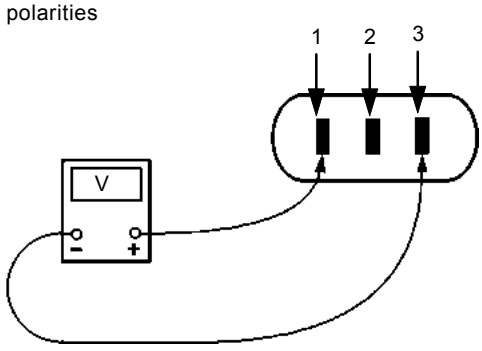
  Evaluation:
  If the measuring voltage is within 5±0.5 volts, the circuit up to terminal No.1 or the ground terminal is normal.

Two polarities



T107-07-05-008

Three polarities

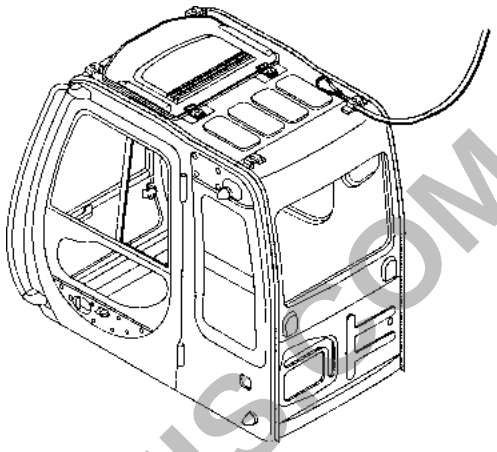


T107-07-05-009

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9. Attach cab to hoist using lifting straps.

CAUTION: The approximate weight of cab; 250 kg (551 lb)



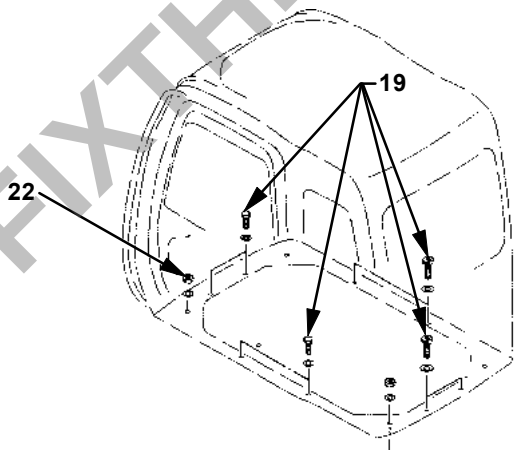
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10. Remove bolts (19) and nut (22).

: 17 mm

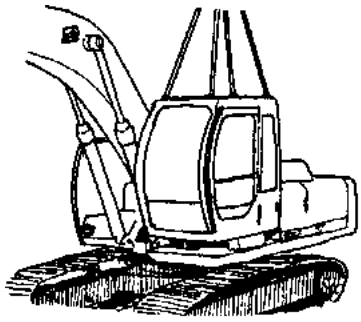
: 24 mm

: 8 mm



W157-02-01-010

11. Carefully remove cab.



W157-02-01-001

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Removal

NOTE: Attach caps to hoses and pipes.
Attach labels or tags to hoses and pipes, to aid in assembly.

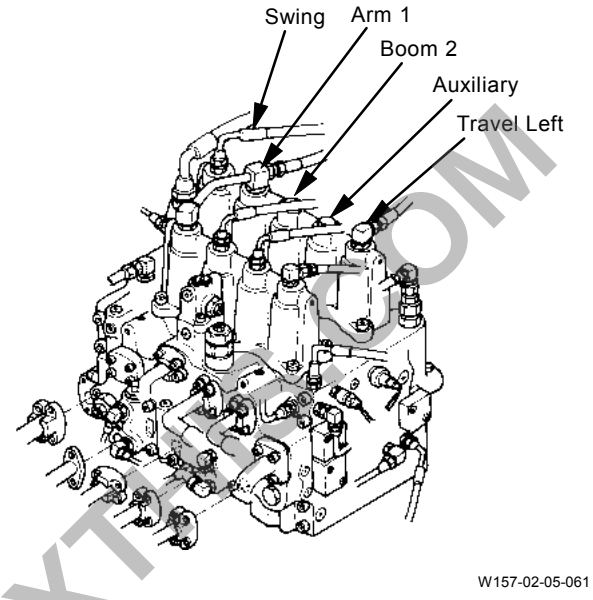
1. Disconnect all hoses, pipes and connectors from the control valve.

: 17 mm
: 9.8 N·m (1 kgf·m, 7 lbf·ft)
: 19 mm
: 34 N·m (3.5 kgf·m, 25 lbf·ft)
: 22 mm
: 49 N·m (5 kgf·m, 36 lbf·ft)
: 36 mm
: 175 N·m (18 kgf·m, 130 lbf·ft)
: 8 mm
: 64 N·m (6.5 kgf·m, 147 lbf·ft)
: 10 mm
: 108 N·m (11 kgf·m, 80 lbf·ft)

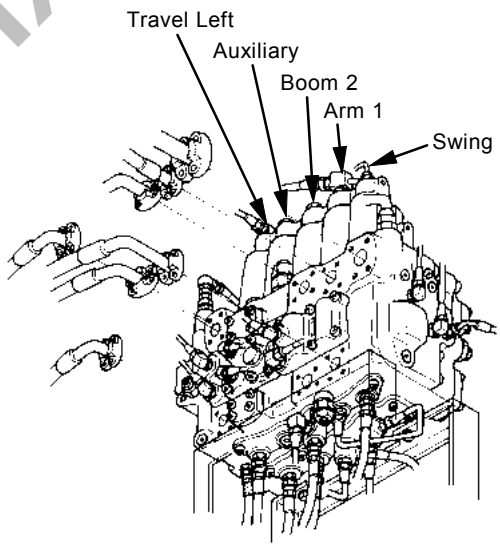
CAUTION: Control valve assembly weight: 240 kg (530 lb)

2. Remove control valve mounting bolts.

: 24 mm
: 205 N·m (21 kgf·m, 150 lbf·ft)



W157-02-05-061



W157-02-05-011

Installation

NOTE: Refer to "Removal" section above for wrench sizes and tightening torques.

1. Install control valve to frame and tighten the bolts.

2. Connect all hoses, pipes and connectors to the control valve.

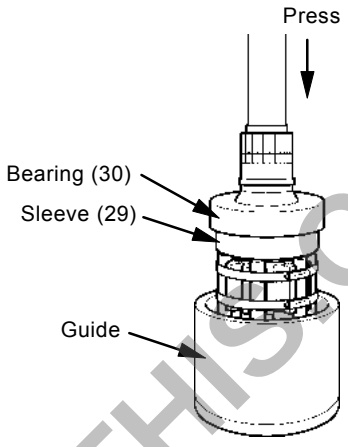
IMPORTANT: After completing installation:
Check hydraulic oil level. Add oil if necessary. Run the engine. Check the engine components for any oil leakage.

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CAUTION: Be sure to use the guide when pushing propeller shaft (27) with a press.

12. Attach propeller shaft (27) with the special tool to a press. Then, remove propeller shaft (27).
13. Remove sleeve (29) from shaft (27). Remove O-ring (28) from sleeve (29).
14. Remove bearing (15) from housing (31).
15. Drive spring pin (6) out of first stage carrier (21) using a round bar and a hammer
16. Remove pins (5) (3 used), first stage planetary gears (9) (3 used), thrust plates (7) (6 used), and needle bearings (8) (3 used) from first stage carrier (21).
17. Remove thrust plates (4) from first stage carrier (21).
18. Disassemble second stage carrier (17) assembly referring to steps 14 to 16 above. (Note that no needle bearings are used on the second stage planetary gears.)



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Removal

1. Remove ball joint (10).

   : 13 mm

NOTE: Attach labels or tags to hoses and pipes, to aid in assembly.

2. Disconnect pilot hoses (1 to 9).

   : 17, 19, 22 mm

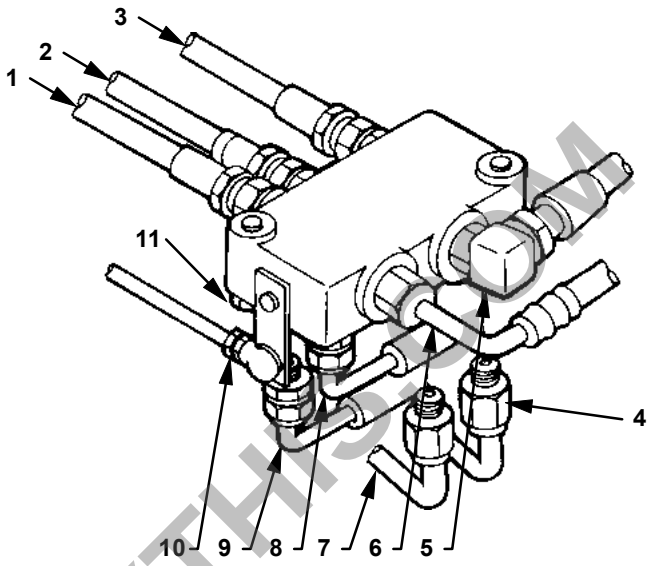
3. Remove bolts (11) to remove the pilot shut-off valve.

   : 8 mm

Installation

1. Install the pilot shut-off valve using bolts (11).
2. Connect pilot hoses (1 to 9).
3. Install ball joint (10).

Wrench Size	Tightening Torque			Remark
(mm)	N·m	kgf·m	lbf·ft	
: 13	10	1	7	Nut
: 22	39	4	29	Hoses
: 8	20	2	15	Bolt
: 17	49	5	36	Bolt
: 19	29	3	22	Hoses

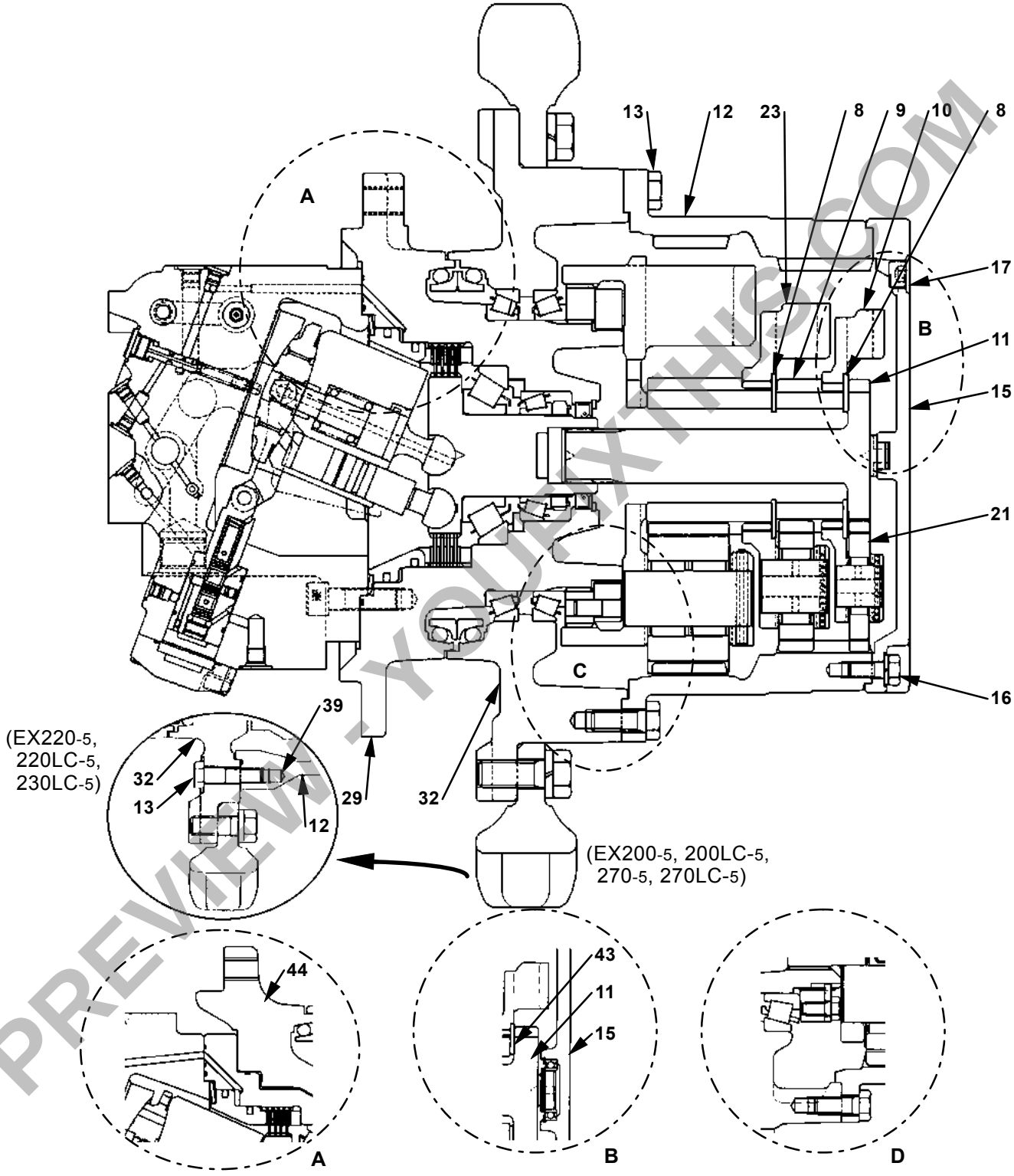


W157-02-08-001

1 - Hose P2 : (To Swing and Arm Pilot Valve)
2 - Hose P1 : (To Travel Left and Right Pilot Valve)
3 - Hose P3 : (To Boom and Bucket Pilot Valve)
4 - Hose T6 : (From Bucket and Boom)
5 - Hose DP : (To Solenoid Valve Unit)
6 - Hose PF : (From Pilot Relief Valve)
7 - Hose T5 : (From Swing and Arm Pilot Valve)
8 - Hose T4 : (From Travel Left and Right Pilot Valve)
9 - Hose A4 : (To Shockless Valve)
10 - Ball Joint
11 - Bolt

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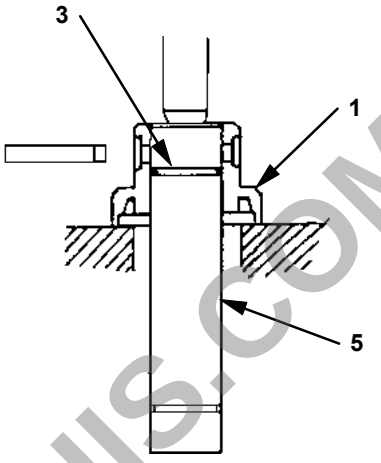
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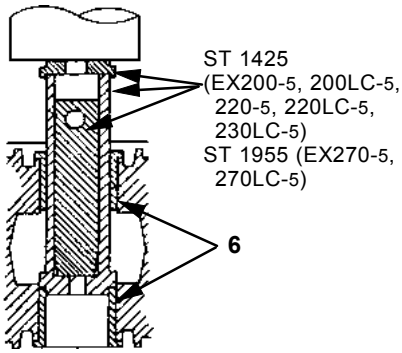
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5. Press out axle (5) to remove bearing (1) and O-ring (3).



6. Remove bushings (6), using special tool.

   Special Tool: ST 1425
   (EX200-5, 200LC-5, 220-5, 220LC-5, 230LC-5)
   ST 1955 (EX270-5, 270LC-5)

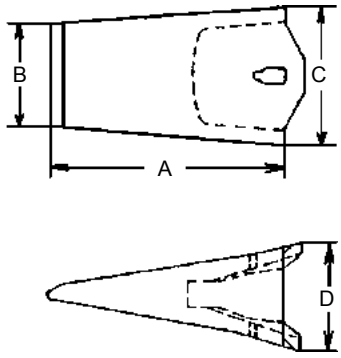


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Point

(EX200-5, 200LC-5)



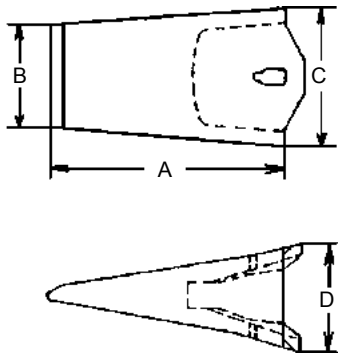
W105-04-01-020

Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	198.5 (7.81)	99.3 (3.91)	Replace
B	94 (3.70)	-	
C	111 (4.37)	-	
D	96 (3.78)	-	

Point

(EX220-5, 220LC-5, 230LC-5, 270-5, 270LC-5)



W105-04-01-020

Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	223 (8.78)	111.5 (4.39)	Replace
B	96 (3.78)	-	
C	130 (5.12)	-	
D	105 (4.13)	-	

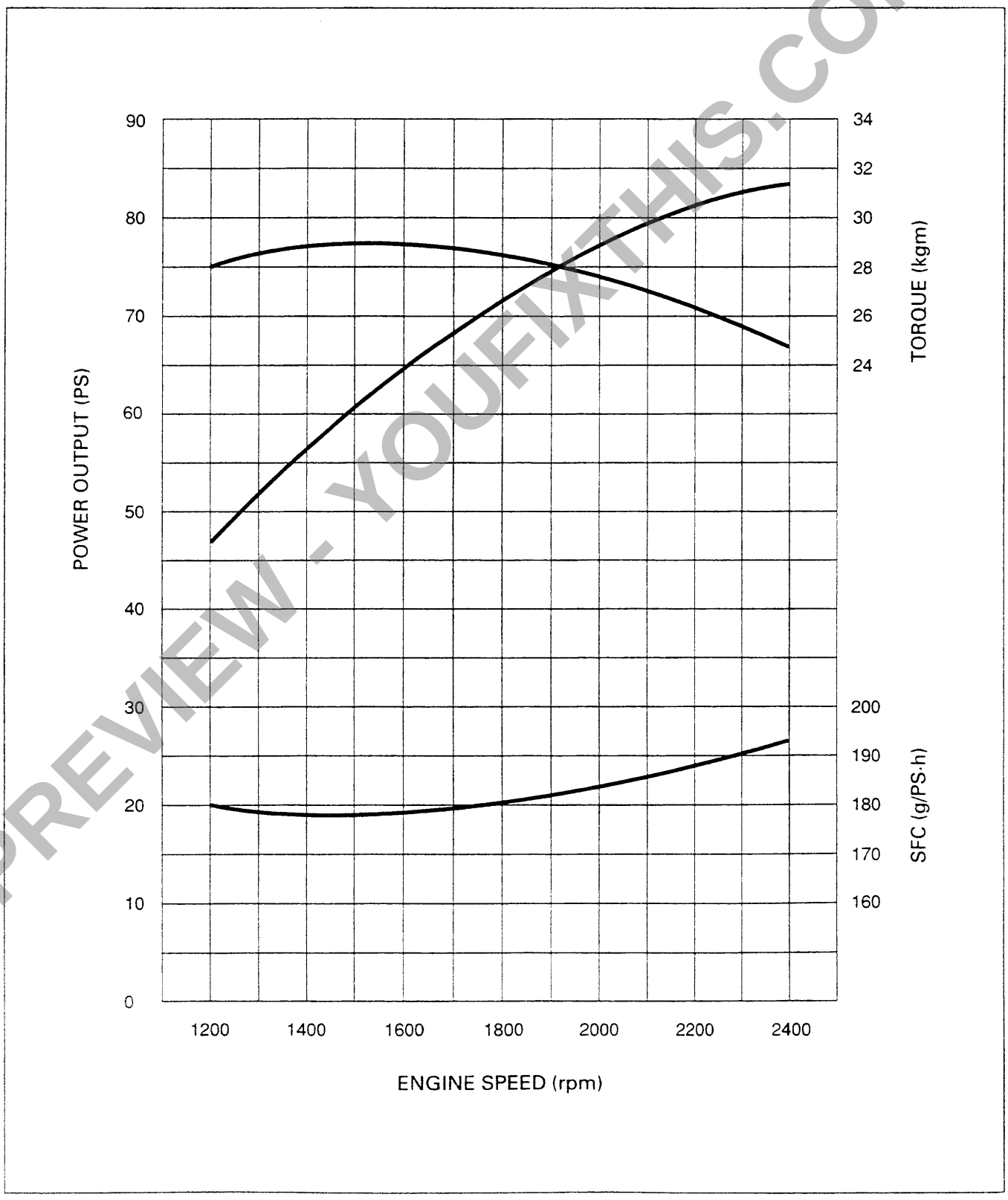
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PERFORMANCE CURVE

3. MODEL A-4BG1PG

CONDITION:

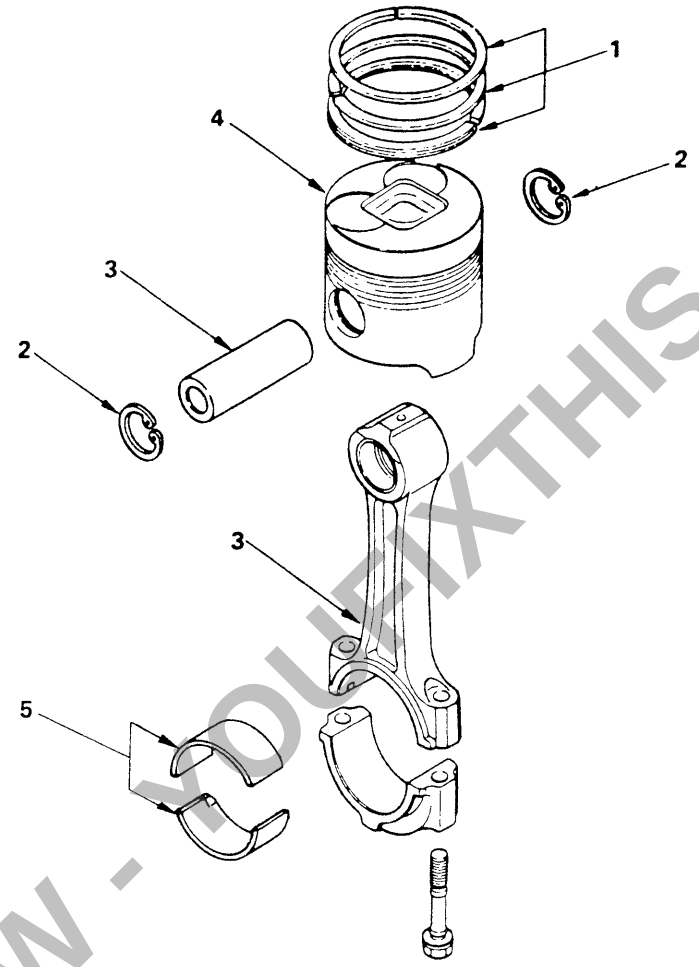
Ambient condition	: JIS standard	Air cleaner	: None
Break-in	: More than 30 hours	Generator	: No Load
Cooling fan	: 540ϕ	Exhaust silencer	: None



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PISTON AND CONNECTING ROD DISASSEMBLY STEPS



Disassembly Steps

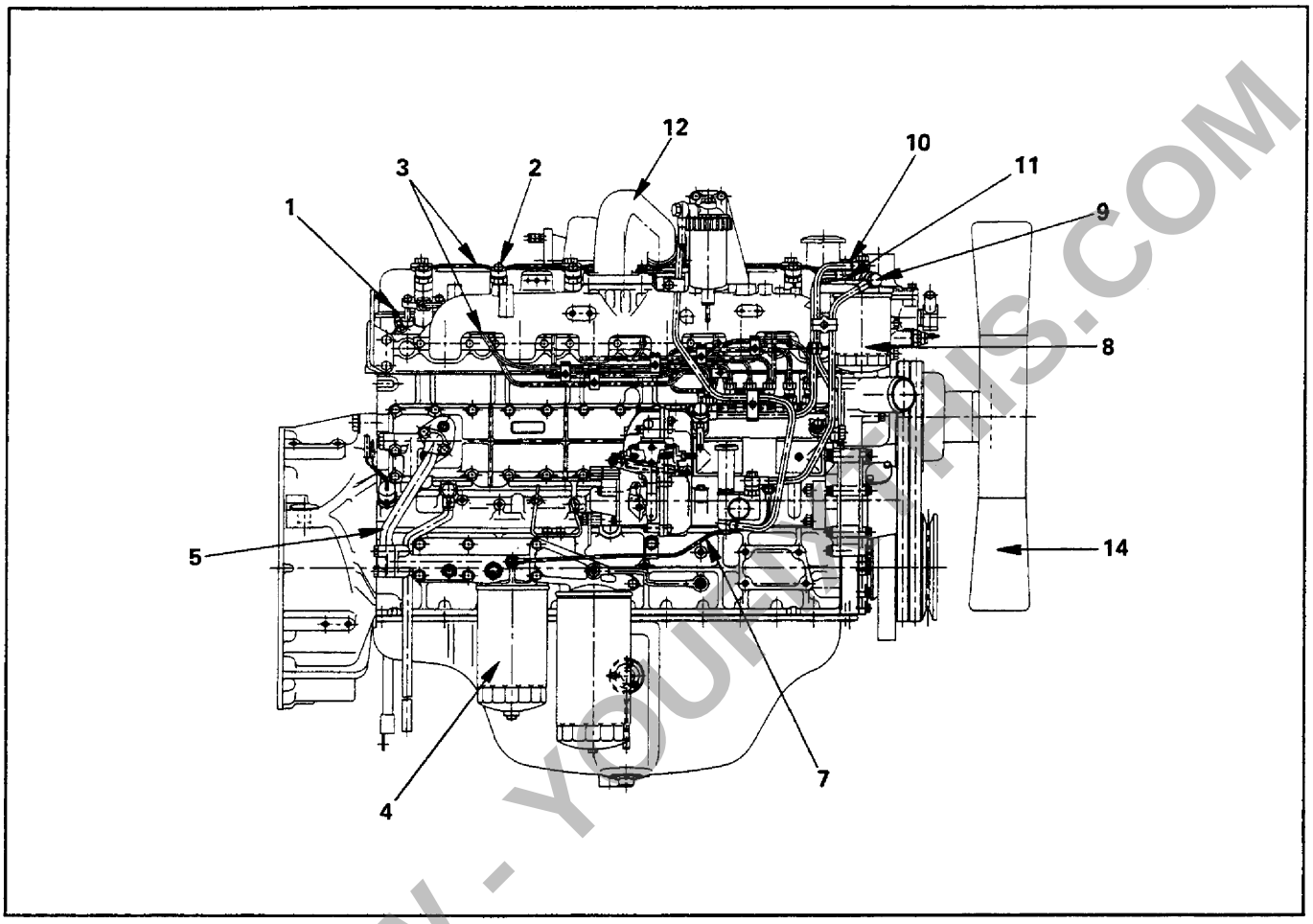
▲ 1. Piston rings
▲ 2. Snap ring
▲ 3. Piston pin and connecting rod
4. Piston
5. Connecting rod bearing

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EXTERNAL PARTS REASSEMBLY STEPS (Right-hand Side)

MODEL 6BG1T



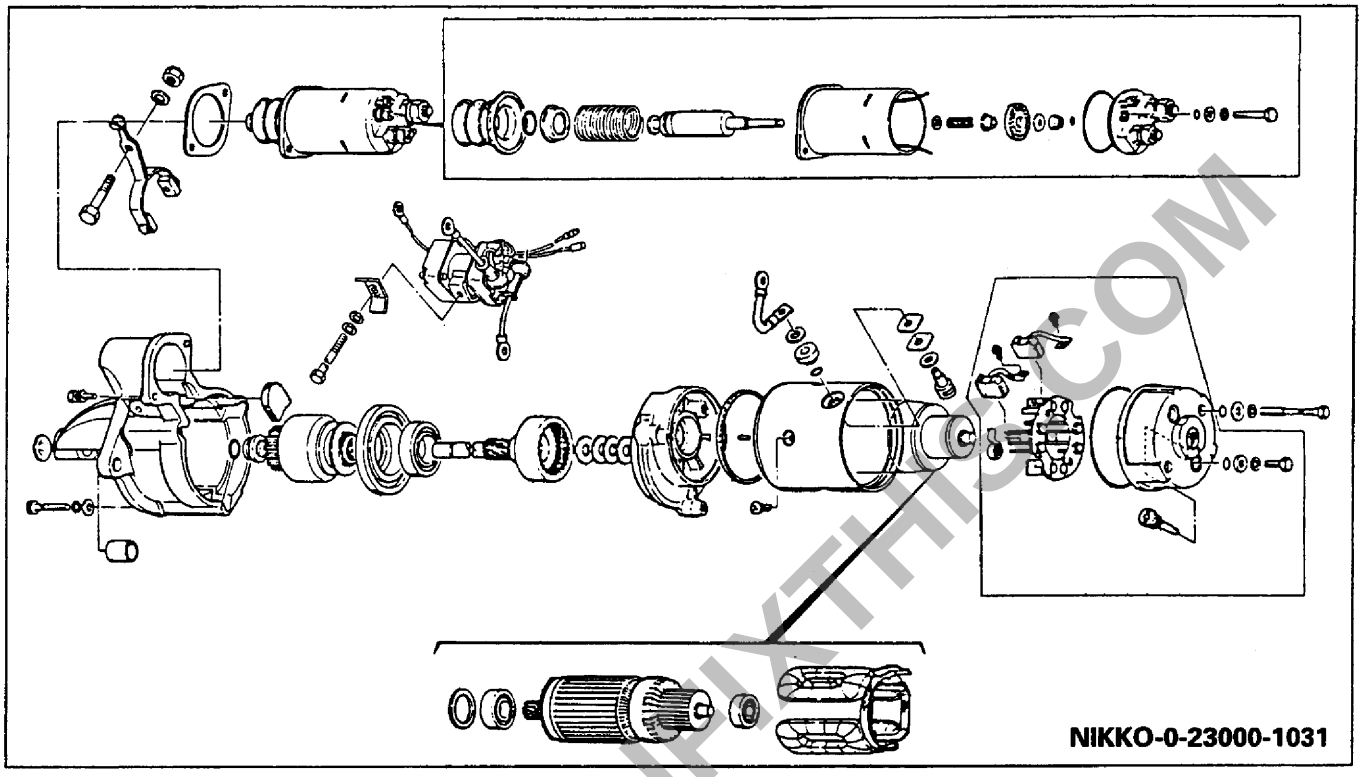
Reassembly Steps

1. Glow plug
▲ 2. Injection nozzle
▲ 3. Injection pipe and fuel leak off pipe
▲ 4. Oil filter
5. Oil pipe; filter to cooler
6. Not installed
7. Oil pipe; injection pump to engine body
8. Fuel filter
▲ 9. Fuel pipe; feed pump to fuel filter
▲ 10. Fuel pipe; fuel filter to injection pump
▲ 11. Fuel return pipe
▲ 12. Intake pipe
13. Not installed
14. Cooling fan

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STARTER MOTOR EXPLODED VIEW



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TIGHTENING TORQUE OF STANDARD BOLT

Unit: N·m {kgf·cm / lbf·ft}

Bolt identification	Tightening conditions \ Bolt diameter (mm)	4	6	8	10	12	14	16	18	20	22	24
4, 5	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	0.99 – 1.47 {10 – 15 / 0.8–1.0}	3.54 – 5.19 {36 – 53 / 2.7 – 3.8}	8.63 – 12.55 {88 – 128 / 7 – 9}	17.07 – 25.00 {174 – 255 / 13 – 18}	29.82 – 43.63 {304 – 445 / 22 – 32}	47.67 – 69.82 {486 – 712 / 36 – 51}	74.34 – 108.85 {758 – 1,110 / 55 – 80}	101.99 – 150.04 {1,040 – 1,530 / 76 – 110}	145.14 – 212.81 {1,480 – 2,170 / 108 – 156}	199.08 – 292.23 {2,030 – 2,980 / 147 – 215}	251.06 – 367.74 {2,560 – 3,750 / 86 – 271}
	Cast iron or aluminum tightening surface. Washers. Medium conditions.	1.38 – 1.96 {14 – 20 / 1.1 – 1.4}	4.71 – 6.96 {48 – 71 / 3.5 – 5.1}	11.48 – 16.86 {117 – 172 / 9 – 12}	22.76 – 33.34 {232–340 / 17 – 24}	39.72 – 58.05 {405 – 592 / 30 – 42}	63.45 – 93.16 {647 – 950 / 47 – 68}	99.05 – 145.13 {1,010 – 1,480 / 74 – 107}	136.32 – 200.05 {1,390 – 2,040 / 101 – 147}	193.20 – 284.39 {1,970 – 2,900 / 143 – 209}	264.78 – 389.32 {2,700 – 3,970 / 196 – 287}	334.41 – 490.33 {3,410 – 5,000 / 247 – 361}
	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	1.67 – 2.45 {17 – 25 / 1.3 – 1.8}	5.89 – 8.62 {60 – 88 / 4.4 – 6.3}	14.32 – 20.98 {146 – 214 / 11 – 15}	28.44 – 41.67 {290 – 425 / 21 – 30}	49.63 – 72.76 {506 – 742 / 37 – 53}	79.34 – 115.71 {809 – 1,180 / 59 – 85}	123.57 – 181.42 {1,260 – 1,850 / 92 – 133}	170.64 – 249.08 {1,740 – 2,540 / 126 – 183}	241.25 – 355.00 {2,460 – 3,620 / 178 – 261}	331.47 – 485.42 {3,380 – 4,950 / 245 – 358}	417.77 – 612.91 {4,260 – 6,250 / 309 – 452}
6, 7	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	1.57 – 2.35 {16 – 24 / 1.2 – 1.7}	5.69 – 8.13 {58 – 83 / 4.2 – 6.0}	13.54 – 19.71 {138 – 201 / 10 – 14}	26.78 – 39.22 {273 – 400 / 20 – 28}	46.78 – 68.64 {477 – 700 / 35 – 50}	74.93 – 109.83 {764 – 1,120 / 56 – 81}	116.70 – 171.61 {1,190 – 1,750 / 87 – 126}	160.83 – 235.35 {1,640 – 2,400 / 119 – 173}	227.52 – 334.40 {2,320 – 3,410 / 168 – 246}	311.86 – 458.95 {3,180 – 4,680 / 231 – 338}	394.23 – 525.63 {4,020 – 5,360 / 291 – 387}
	Cast iron or aluminum tightening surface. Washers. Medium conditions.	2.16 – 3.13 {22 – 32 / 1.6 – 2.3}	7.36 – 10.78 {75 – 110 / 5.5 – 7.9}	17.95 – 26.47 {183 – 270 / 14 – 19}	35.70 – 52.26 {364 – 533 / 27 – 38}	62.38 – 91.39 {636 – 932 / 47 – 67}	100.03 – 147.09 {1,020 – 1,500 / 74 – 108}	155.93 – 228.49 {1,590 – 2,330 / 116 – 168}	213.79 – 313.81 {2,180 – 3,200 / 158 – 231}	304.01 – 446.20 {3,100 – 4,550 / 225 – 329}	416.79 – 608.99 {4,250 – 6,210 / 308 – 449}	525.64 – 769.82 {5,360 – 7,850 / 388 – 567}
	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	2.65 – 3.92 {27 – 40 / 2.0 – 2.8}	9.22 – 13.53 {94 – 138 / 6.8 – 9.9}	22.46 – 32.95 {229 – 336 / 17 – 24}	44.63 – 65.41 {455 – 667 / 33 – 48}	77.97 – 114.24 {795 – 1,165 / 58 – 84}	124.55 – 183.38 {1,270 – 1,870 / 92 – 135}	195.16 – 286.35 {1,990 – 2,920 / 144 – 211}	267.73 – 392.26 {2,730 – 4,000 / 198 – 289}	379.52 – 557.01 {3,870 – 5,680 / 280 – 410}	520.74 – 764.91 {5,310 – 7,800 / 385 – 564}	657.05 – 965.95 {6,700 – 9,850 / 485 – 712}
8, 9, 10, 11	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	2.36 – 3.13 {24 – 32 / 1.8 – 2.3}	8.05 – 10.78 {82 – 110 / 6.0 – 7.9}	19.62 – 26.18 {200 – 267 / 15 – 19}	38.94 – 56.29 {397 – 574 / 29 – 41}	68.06 – 90.71 {694 – 925 / 51 – 66}	99.05 – 145.13 {1,010 – 1,980 / 74 – 107}	169.66 – 226.53 {1,730 – 2,310 / 126 – 167}	233.40 – 310.87 {2,380 – 3,170 / 173 – 229}	331.47 – 442.27 {3,380 – 4,510 / 244 – 326}	454.05 – 605.07 {4,630 – 6,170 / 335 – 446}	573.69 – 763.93 {5,850 – 7,790 / 424 – 563}
	Cast iron or aluminum tightening surface. Washers. Medium conditions.	3.14 – 4.11 {32 – 42 / 2.4 – 3.0}	10.79 – 14.31 {110 – 146 / 8.0 – 10.5}	26.19 – 34.91 {267 – 356 / 19 – 25}	51.88 – 69.23 {529 – 706 / 39 – 51}	90.72 – 120.62 {925 – 1,230 / 67 – 88}	145.14 – 193.19 {1,480 – 1,970 / 108 – 142}	226.54 – 302.04 {2,310 – 3,080 / 168 – 222}	310.88 – 414.82 {3,170 – 4,230 / 230 – 305}	442.28 – 589.37 {4,510 – 6,010 / 327 – 434}	605 .08 – 807.08 {6,170 – 8,230 / 447 – 595}	763.94–1,018.91 {7,790–10,390 / 564 – 751}
	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	3.93 – 5.19 {40 – 53 / 2.9 – 3.8}	13.44 – 17.94 {137 – 183 / 10.0 – 13.2}	32.76 – 43.63 {334 – 445 / 25 – 32}	64.93 – 86.49 {662 – 882 / 48 – 63}	113.76 – 151.02 {1,160 – 1,540 / 84 – 111}	181.43 – 242.22 {1,850 – 2,470 / 134 – 178}	283.42 – 377.55 {2,890 – 3,850 / 210 – 278}	389.33 – 518.77 {3,970 – 5,290 / 288 – 382}	553.10 – 736.47 {5,640 – 7,510 / 408 – 543}	757.08 – 1,009.10 {7,720 –10,290 / 559 – 744}	955.17–1,273.88 {9,740–12,990 / 705 – 939}

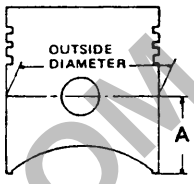
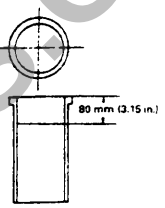
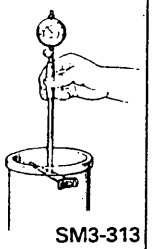
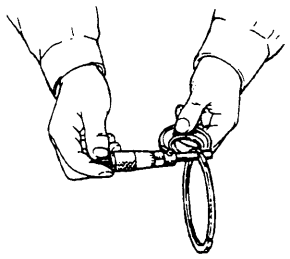
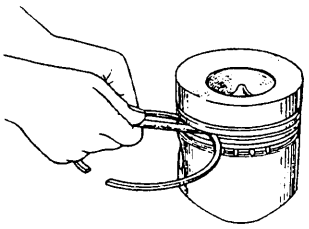
NOTE: The torque values given in this table should be applied where bolt torque is not specified.

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INSPECTION AND REPAIR

Unit: mm {in}

Inspection Item			Standard	Limit	Remedy	Inspection Procedure
Piston Diameter			110 {4.331} at A: H07D–21{0.8267} H07C-T–64.2{2.528}	—	Replace piston and/or liner	 SM3-910
Cylinder Liner Inside Diameter			110 {4.33}	110.15 {4.3366}		
Clearance between Piston and Cylinder Liner	H07D		0.053–0.085 {0.0021–0.0033}	—		 SM3-432  SM3-313
	H07C-T		0.192–0.224 {0.0076–0.0088}			
Projection of Cylinder Liner			0.01–0.08 {0.0003–0.0031}	—		
Piston Ring Breadth	Top	H07D	3.00 {0.1181}	2.90 {0.1141}	Replace	 SM3-379
		H07C-T	—	—		
	2nd		2.00 {0.787}	1.90 {0.0748}		
	3rd	H07D	—	—		
		H07C-T	2.50 {0.0984}	2.40 {0.0944}		
	Oil		4.00 {0.1574}	3.90 {0.1535}		
Piston Ring Groove Breadth	Top	H07D	3.00 {0.1181}	3.20 {0.1259}	Replace piston	 SM3-2101
		H07C-T	—	—		
	2nd		2.00 {0.787}	2.20 {0.0866}		
	3rd	H07D	—	—		
		H07C-T	2.50 {0.0984}	2.70 {0.1062}		
	Oil		4.00 {0.1574}	4.10 {0.1614}		

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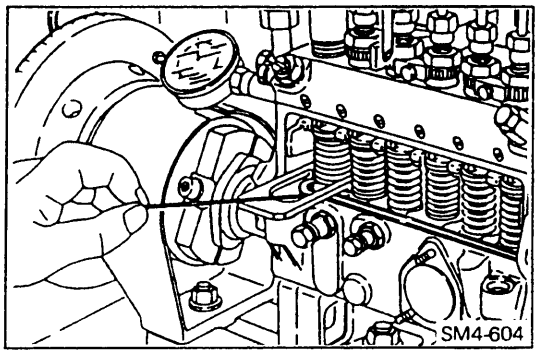
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TROUBLESHOOTING

Symptom	Possible cause	Remedy/Prevention
A lot of exhaust is emitted but the engine does not start or is difficult to start. (Auxiliary starting device: Standard specifications)	**Auxiliary starting device**	
	• Loose wiring of heater signal or defective heater signal	Repair or replace.
	• Defective heater plug	Replace.
	• Defective wiring between heater and plug	Repair.
(Auxiliary starting device: Option specifications)	• Defective power relay	Repiar or replace.
	• Defective heater plug	Replace.
	• Defective wiring between heater and plug	Repair.
	• Defective sensing resistor	Replace.
	• Defective heater control timer	Replace.
Solenoid does not operate when engine is running, even if abnormal signal is input. (Engine does not stop.)	**Emergency stop relay**	
	• Alternator malfunctions	Repair or replace.
	• Insufficient battery voltage	Charge or replace.
	• Faulty connection at N terminal of emergency relay	Repair.
	• Defective solenoid	Replace.
Solenoid operates with starter switch is turned ON	**Emergency stop relay**	
	• Faulty connection at R1 terminal	Repair.
	• Faulty connection at B and C terminal	Repair.
When the starter switch is turned OFF, the battery relay switch goes OFF and the solenoid fails to operate.	**Battery**	
	• Insufficient voltage	Charge or replace.
	Alternator	
	• Malfunctions	Repair or replace.
Starter chattering or improper plunging	**Battery**	
	• Insufficient voltage	Charge or replace.
	Starter block relay	
	• Faulty connection at terminals	Repair.
	• Internal circuit abnormal	Replace.
	• Relay switch abnormality (faulty contacts) improper sliding between rod and moving core, or open-circuit or burnt out coil	Replace.
	Starter switch	
	• Faulty connection at terminals	

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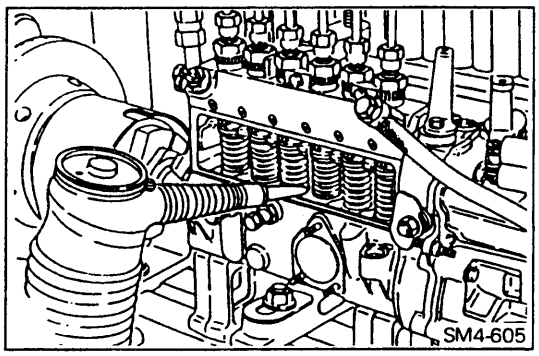

SM4-604

ADJUSTMENT

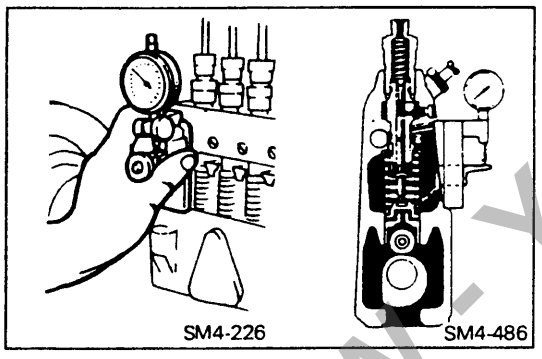
PREPARATION

1. Mount the injection pump correctly on the pump tester.
2. Attach a rack measuring device to the control rack and set to "0".
3. Install calibration nozzles and lines.

Nozzles and Lines: Refer to "CHAPTER C. CALIBRATION".


SM4-605

4. Install the cover on the feed pump mounting surface and fill the pump camshaft chamber with engine oil.

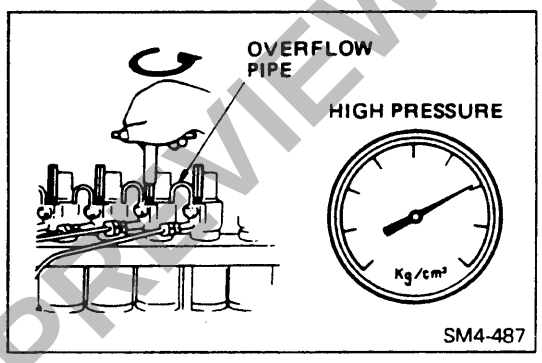

SM4-226 SM4-486

ADJUSTING THE INJECTION TIMING

1. Preparation of the pre-stroke.

a) Remove the plate cover.

b) Install a pre-stroke measuring instrument.
Bring the tappet of the first cylinder to its bottom dead center, and set the pointer tip on the tappet.



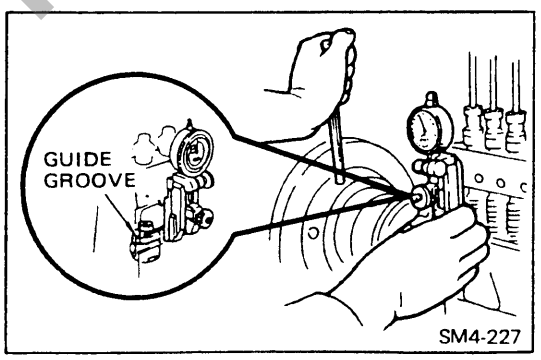
SM4-487

2. Measure the pre-stroke (No.1 plunger)

a) Set the control rack at full-load position.

b) Loosen the overflow screw of each nozzle holder.

c) Operate the high-pressure pump of the pump tester and let fuel run out of the overflow line.



SM4-227

d) Move the angle dial to set the first cylinder of the pump to bottom dead center and adjust the pre-stroke gauge to zero.

NOTE: Bottom dead center is the point at which the pointer of the dial gauge does not move even when the angle dial is rotated while fuel is flowing from the overflow line.

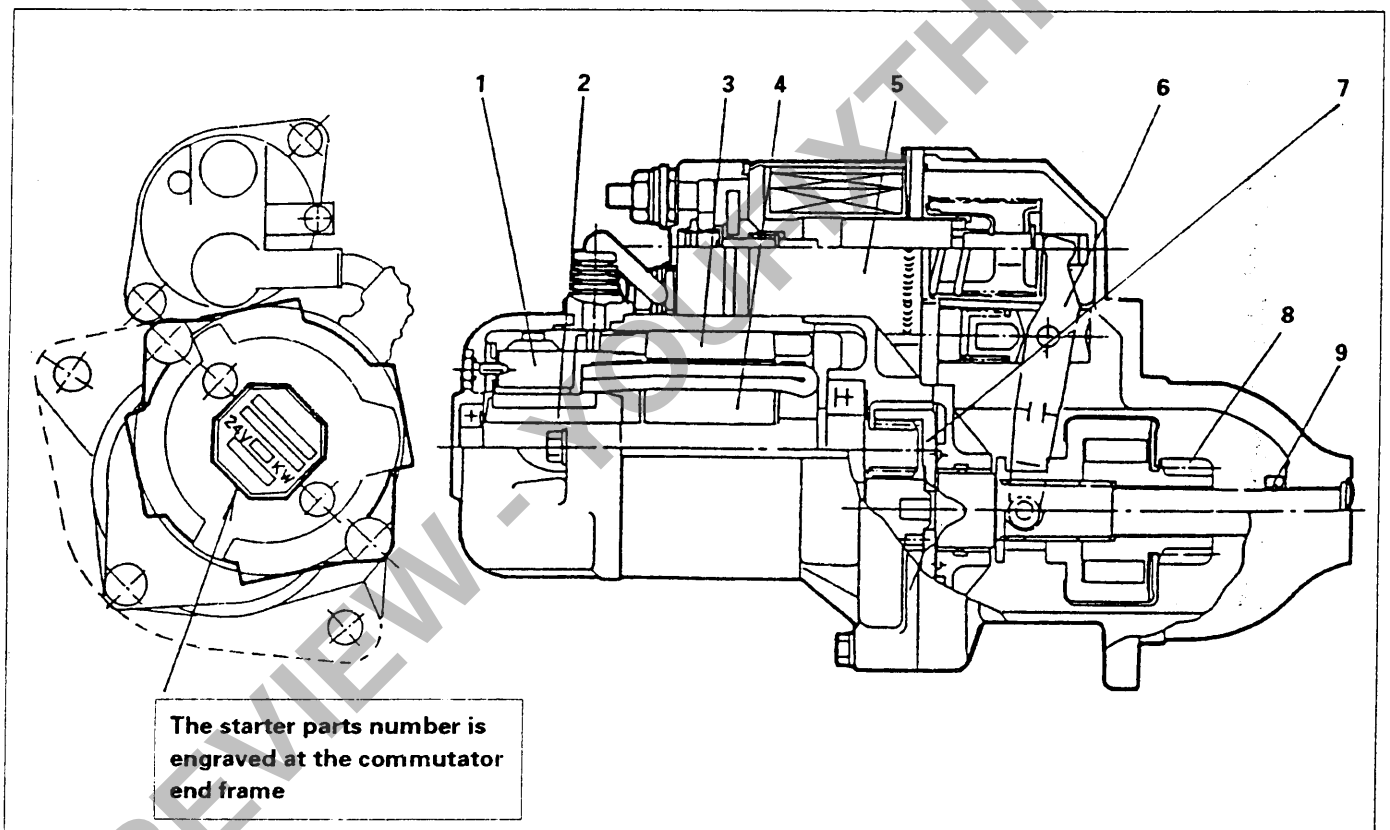
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DATA AND SPECIFICATIONS

Parts number	28100-1810, 1820, 1891, 1900, 1901, 1980, 2010, 2062, 2063, 2090, 2130
Type	Reduction gear type
Rated output	24V, 4.5kW
Number of teeth of pinion	11
Module	3
Rotating direction	Clockwise (Seen from pinion side)

DESCRIPTION



1. Brush
2. Commutator
3. Field coil
4. Armature
5. Magnetic switch
6. Pinion shift lever
7. Reduction gear
8. Clutch and pinion
9. Pinion stopper

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