# 22.3 HYDRAULIC CIRCUIT OPERATION

## 22.3.1 COLOR CODING STANDARD FOR HYDRAULIC

| HYDRAULIC SCHEMATIC COLOR CODING | | |
|---|---|---|
| Blue: | Secondary pilot pressure | 0.59~3.5 MPa (85~508 psi) |
| Green: | Primary pilot pressure | 3.5~3.9 MPa (508~ 566 psi) |
| Red: | Main pump pressure | 4.9~23 MPa 711~3340 psi) |
| Blue tone: | At valve selection | |
| Red valve: | When proportional valve (reducing) is operating | |
| Red solenoid: | Activated | |
| Displaying the flow circuit and standby circuit when operating.<br>Regarding the electrical symbols in this manual, refer to the electric circuit diagram. | | |

**NOTE:** *For the hydraulic circuit operation, refer to* Fold Out Schematics*.*

## 22.3.2 NEUTRAL CIRCUIT

(Refer to Fold Out Schematics)

1. PILOT CIRCUIT
   1. Pilot primary pressure circuit

      Oil from port A4 on the pump (1) enters the solenoid valve (13) through the line filter (19)

      Pressurized oil from port A2 of the solenoid valve (13) with the safety lock lever released (in the operating position) is supplied to the P ports of the pilot valves for attachment (11), travel (12) and dozer (14).

      Since the operating circuit is fully closed in the neutral position, the oil from the pump, except the oil supplied to the Pp1 port of the control valve, is returned to the hydraulic tank (26) through the relief valve (set pressure: 3.5MPa [508 psi]) built in the solenoid valve (13).

      Hydraulic oil to Pp1 port provides pressure to the service spool and pilot controls for the travel circuit.

   1. Pilot secondary pressure circuit

      While the pilot valves (11),(12) and (14) are in neutral, pilot secondary pressure is not generated.

      By operating the control lever, secondary pressure is generated and sent to the control valve (2) from the pilot valve to shift each spool of shifting valve.

2. MAIN CIRCUIT
   1. Variable pump circuit

      The oil from A1 and A2 ports on the variable pump goes to the P1 and P2 ports on control valve (2).

      The oil from these two ports return 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 from A3 port on 3rd pump goes to the P3 port on control valve (2).

      The oil from P3 returns to the hydraulic oil tank (26) through the selector valves for the dozer, slewing, and the independent travel and flow conflux valves.

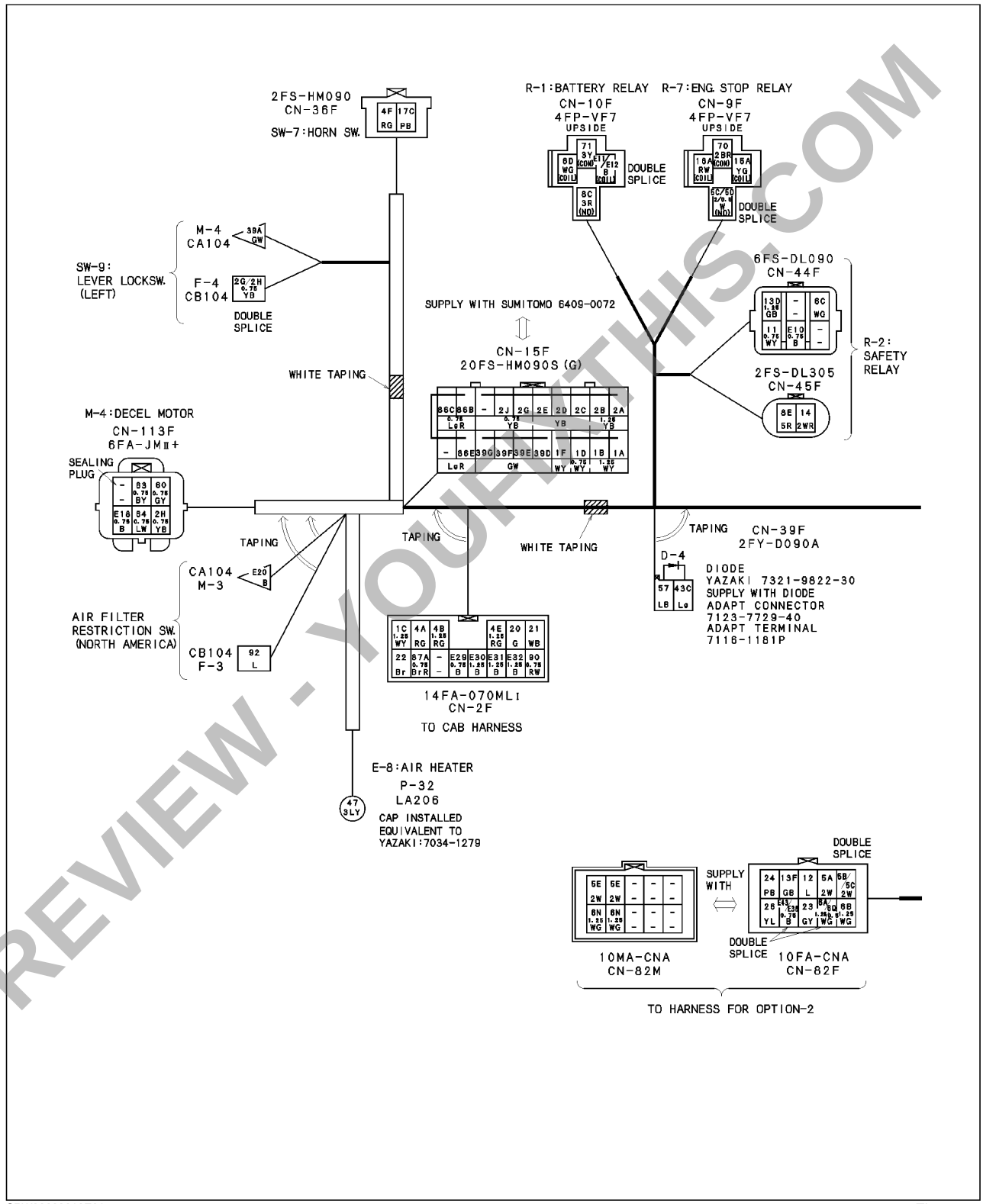
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## 23.2.4 DETAIL OF HARNESS & CABLE

### 23.2.4.1 INST • MAIN HARNESS (NO. H-1)




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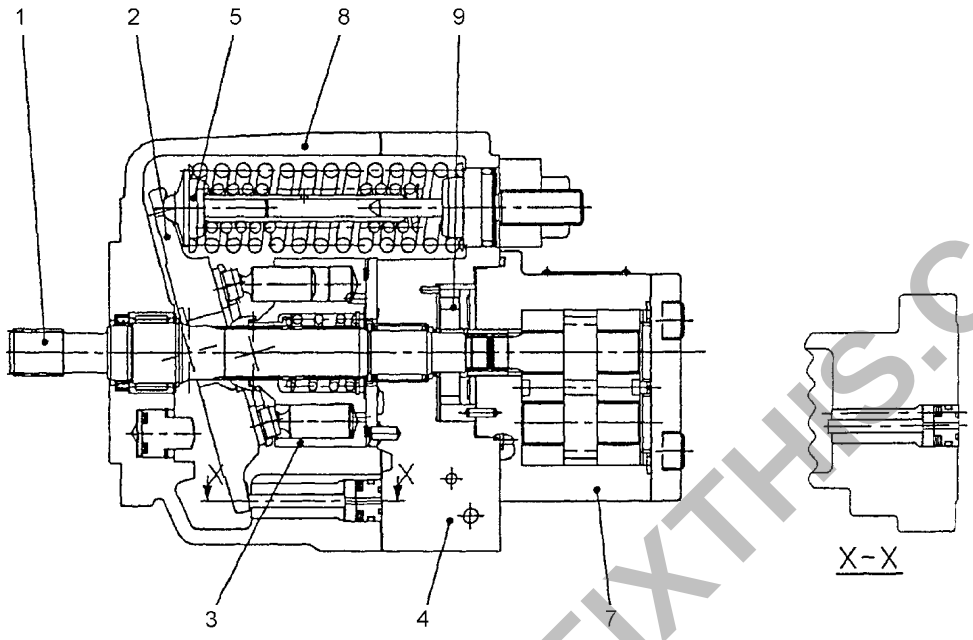
Figure 25

**FIG. 23-17 INST • MAIN HARNESS (NO. H-1) — (1/8)**



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### 24.1.1.2 CONSTRUCTION FUNCTION




| No. | NAME | No. | NAME |
|---|---|---|---|
| 1 | Shaft assy | 7 | Gear pump assy |
| 2 | Swash plate assy | 8 | Housing assy |
| 3 | Rotary group | 9 | Trochoid pump assy |
| 4 | Cover assy | | |
| 5 | Spring assy | | |

SPW24000002E01

Figure 2

**FIG. 24-2**

1. Piston pump

   The pump is a variable displacement double piston pump which delivers two equal flows with one cylinder block and has only one inlet port. The flow is separated into two flows by the control plate on the cover and is supplied to two delivery ports on the cover.

   The hydraulic pressure produced by the delivery oil acts on the hanger, resists the spring force, and tilts the hanger. As the piston stroke is changed by the tilting of the hanger, the flow rate varies.

   The 3rd pump, pilot pump, is installed on the same shaft with a coupling.

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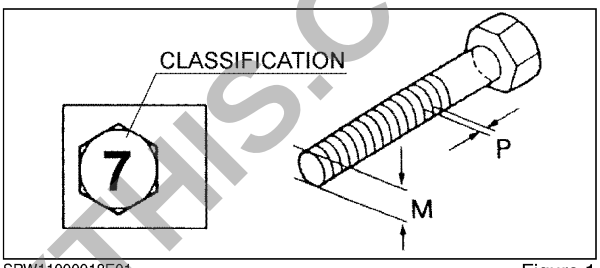
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# 11.1 TORQUE SPECIFICATIONS FOR CAPSCREWS AND NUTS

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 tightness and the loss of before starting work and at periodic maintenance. Retighten and replace as needed. For a new machine, check and retorque after the first 50 hours operation. Replace with genuine parts.

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

1. The table below is not applicable for the capscrews that secure plastic covers. For the tightening torque for such capscrews, contact your dealer. Over-tightening may cause damage to the plastic parts.
2. In case that the tightening torque is specified in the manual, use those torque values regardless to the table below.
3. 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, M5 or less.




SPW11000018E01 Figure 1

## 11.1.1 METRIC COARSE THREAD STANDARD TIGHTENING TORQUE VALUES

Make sure to tighten all Capscrews and Nuts to proper torque values.

| METRIC COARSE THREAD STANDARD TIGHTENING TORQUE VALUES | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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) |
| 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) |



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CHAPTER 23

# EH30.B AND EH35.B HYDRAULIC EXCAVATORS

# ELECTRICAL SYSTEM

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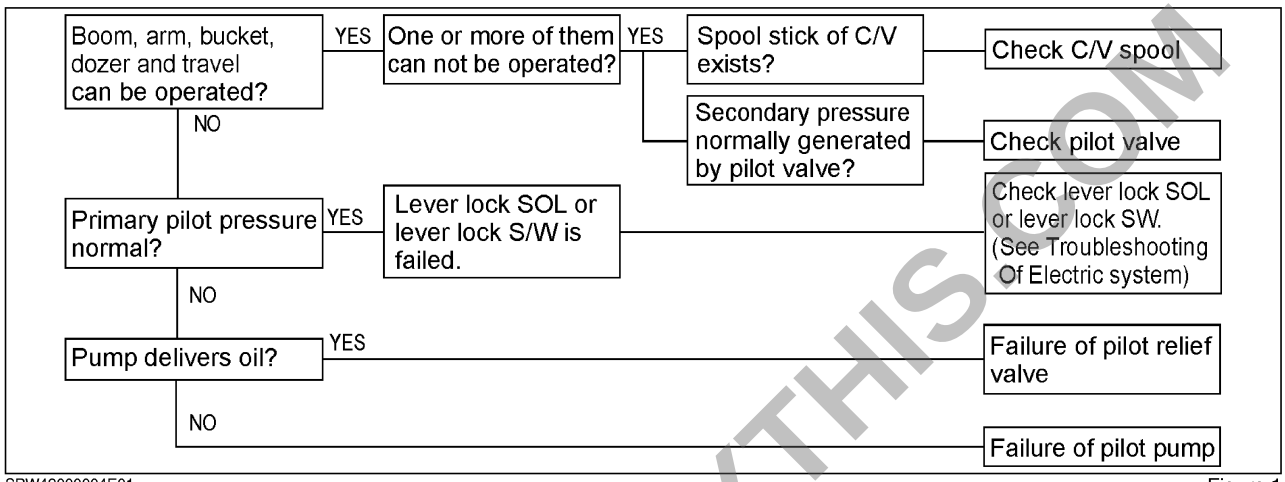
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# 42.3 TROUBLESHOOTING

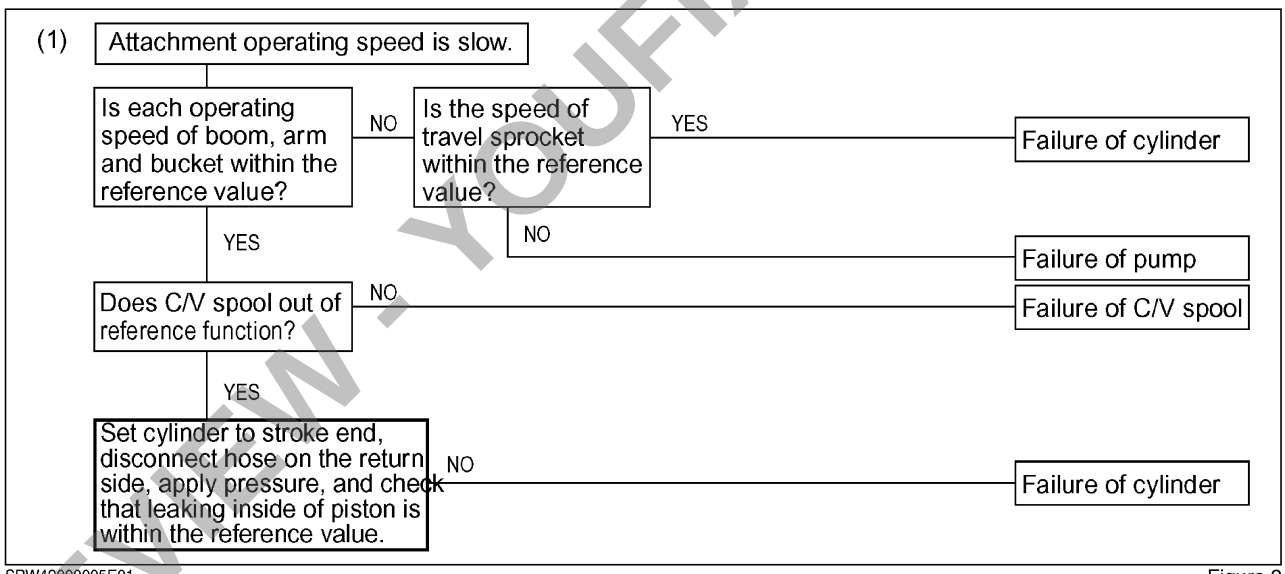
## 42.3.1 ATTACHMENT

### 42.3.1.1 ATTACHMENT OPERATIONAL FAILURE (EXCLUDING SWING OPERATIONS)




SPW42000004E01 Figure 1

### 42.3.1.2 ATTACHMENT SPEED IS SLOW




SPW42000005E01 Figure 2

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# 2.3 SPECIFICATIONS AND PERFORMANCE

## 2.3.1 SPEED AND GRADE ABILITY

| Model | | EH30.B | | | | EH35.B | | | |
|---|---|---|---|---|---|---|---|---|---|
| Applicable Machines | | PW11-30001~ | | | | PX12-11001~ | | | |
| Shoe Type | | Rubber shoe | | steel shoe (OPT) | | Rubber shoe | | steel shoe (OPT) | |
| Shoe Type | | Rubber shoe | | steel shoe (OPT) | | Rubber shoe | | steel shoe (OPT) | |
| Slewing Speed | $min^{-1}$ {rpm} | 8.9 {8.9} | | | | 8.9 {8.9} | | | |
| Travel Speed | km/h (mph) | Low (1st) | High (2nd) | Low (1st) | High (2nd) | Low (1st) | High (2nd) | Low (1st) | High (2nd) |
| | | 2.5 | 4.5 | 2.5 | 4.5 | 2.5 | 4.5 | 2.5 | 4.5 |
| Grade ability | % (degree) | 58(30) | | | | | | | |

## 2.3.2 ENGINE

| | | |
|---|---|---|
| Model (YANMAR) | | 3TNV88-PYB |
| Type | | Water-cooled, 4-cycle type Swirl chamber type diesel engine |
| Number of cylinders-Bore x Stroke | | 3 - ø88 mm x 90 mm (3.46 in x 3.54 in) |
| Total Displacement | L | 1.642 (100.2 cu•in) |
| Output Rating | $kW/min^{-1}$ {PS/rpm} | 21.2/2,400 {29/2,400} |
| Maximum Torque | $N•m/min^{-1}$ (lbf•ft/rpm) | 98.4/1,440 (72.6/1,440) |
| Starting Motor | V x kW | 12 x 1.7 |
| Generator | V x A | 12 x 55 |

## 2.3.3 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 | 10-spool multiple control valve |
| Cylinder (Boom, Arm, Swing, Bucket, Dozer) | Double action cylinder |
| Return Filter | Safety valve containing/Filter Type (30) |

## 2.3.4 SIDE DIGGING AND DOZER

| Type | | Boom swing by hydraulic cylinder | |
|---|---|---|---|
| Boom Swing Angle | Right | 60° | |
| | Left | 70° | |
| Stroke of Dozer (above/below) | mm (in) | 560 / 410 (22.0/16.1) | 540 / 440 (21.3/17.3) |

## 2.3.5 WEIGHT

| | | RUBBER SHOE | STEEL SHOE | RUBBER SHOE | STEEL SHOE |
|---|---|---|---|---|---|
| Machine Weight | kg (lb) | 3,030 (6680) | 3,140 (6920) | 3,610 (7960) | 3,730 (8220) |
| Upper slewing body | kg (lb) | 1,680 (3700) | 1,680 (3700) | 1,930 (4260) | 1,930 (4260) |
| Travel system | kg (lb) | 1,050 (2320) | 1,160 (2560) | 1,140 (2520) | 1,260 (2780) |
| Attachment (Boom + STD Arm + STD Bucket) | kg (lb) | 370 (815) | | 460 (1020) | |
| Oil & Water | kg (lb) | 80 (175) | | ¨ | |

**NOTE 1:** *This figure is calculated with standard bucket.*

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# 12.1 WORKING STANDARDS FOR TIME TABLES

### 12.1.1 WORKING CONDITIONS

1. Technicians:
   One or more technicians who are qualified by Manufacturer are needed. The technicians need five years or more experience, 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 should be equipped with a crane and inspection instruments necessary for specific self inspection activities.
3. Place:
   The workshop should be located on a flat land with a service truck and a crane are available.

### 12.1.2 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. Additional time:
   Time for transportation of the machine for maintenance, preparation for a safe work site.

### 12.1.3 EXCLUDED TIME

**NOTE:** *Not included in 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. Over time:
   Over time should be calculated separately.
5. Separate calculation:
   The cost for service cars, trucks with crane and truck cranes should be calculated separately.

### 12.1.4 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.

### 12.1.5 STANDARD MAINTENANCE TIME TABLE

1. Units of working time:
   6 minutes = 0.1 hour
2. Calculating method of standard maintenance time:
   Maintenance time = Working time × Number of workers
   Working time = Maintenance time / Number of workers)
3. When more than one job is done,
   A. Add each standard maintenance time
   B. A time is given except for covers that are easily removed by hand.
   C. Assembly (Assy) works include the following works marked with black dot •
4. O / H:
   The removing and installing time are not included.
5. Abbreviations used in the Standard Working Time Table.

| Abbreviations | | | | | |
|---|---|---|---|---|---|
| Assembly | ASSY | Engine | E/G | Solenoid | SOL |
| Attachment | ATT | Flexible hose | F hose | Switch | SW |
| Bearing | BRG | Installation | Inst. | Valve | V |
| Control valve | C/V | Overhaul | O/H | | |
| Cylinder | Cyl | Removal | Rem. | | |

### 12.1.6 CLASSIFICATION OF WORK CODE

| GROUP | | REMARKS |
|---|---|---|
| No. | Description | |
| 01 | Attachment | To indicate removing, installing, replacement and overhaul. |
| 02 | Canopy and Guard | |
| 03 | Upper Structure | |
| 04 | Under carriage | |

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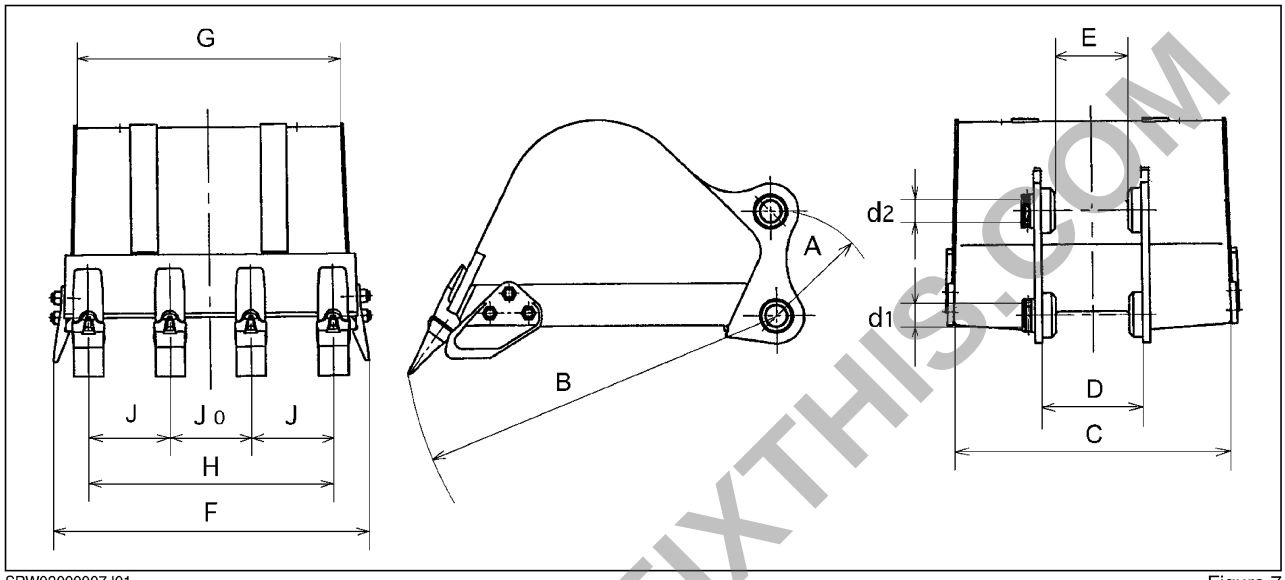
| Revision History | | | | |
|---|---|---|---|---|
| Issue | Issue Date | Applicable Machines | Remarks | |
| First Edition | August, 2004 | EH30.B: PW11–30001~<br>EH35.B: PX12–11001~ | S5PW0006E01 (Section 1 title page) | |
| | | | | |
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# 3.3 BUCKET

## 3.3.1 BUCKET DIMENSIONAL DRAWINGS




SPW03000007J01

Figure 7

| BUCKET DIMENSIONS | | | |
|---|---|---|---|
| No. | Model | EH30.B | EH35.B |
| | Heaped Capacity $m^3$ (cu.yd) | 0.09 (0.118) | 0.11 (0.144) |
| A | Distance between pin and bracket | 200 (7.87") | 200 (7.87") |
| B | Distance between bucket pin and tooth end | R712 (2'4.03") | R712 (2'4.03") |
| C | Inner width of bucket top end | 430 (1'4.93") | 530 (1'8.87") |
| D | Inner width of lug | 193 (7.60") | 193 (7.60") |
| E | Inner width of bracket | 141 (5.55") | 141 (5.55") |
| F | Outer width of side cutter | 500 (1'7.69") | 600 (1'11.62") |
| G | Outer width of bucket bottom plate | 404.5 (1'3.93") | 505 (1'7.88") |
| H | Outer tooth distance | 367 (1'2.45") | 468 (1'6.43") |
| J | Pitch between teeth | 122 (4.80") | 156 (6.14") |
| J0 | Pitch between teeth | 123 (4.83") | 156 (6.14") |
| d1 | Pin dia. | 40 (1.57") | 40 (1.57") |
| d2 | Pin dia. | 40 (1.57") | 40 (1.57") |
| **NOTE 1:** *Standard bucket.* | | | |
| Unit: MM. (ft-in) | | | |

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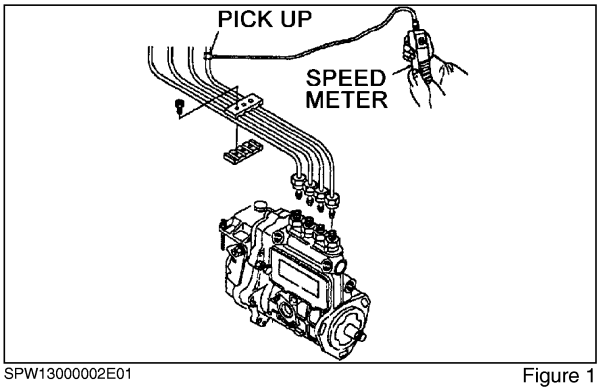
# 13.3 MEASURING ENGINE SPEED

## 13.3.1 ENGINE SPEED MEASUREMENT

1. Measuring Instruments

   A. Diesel Tachometer (Measuring engine speed by means of applying a pick-up to one of injection lines)

   B. Surface Thermometer (Measuring the surface temperature with contact of a probe with the surface of hydraulic reservoir or radiator)




SPW13000002E01 Figure 1

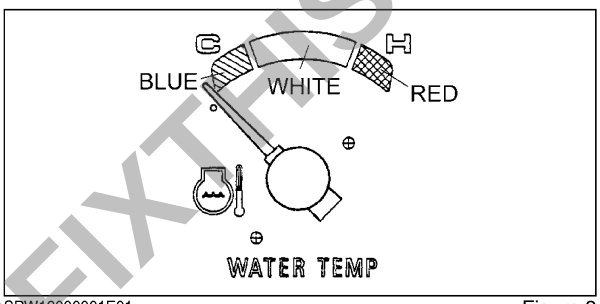
**FIG. 13-1 ENGINE SPEED MEASUREMENT (THE ABOVE FIGURE SHOWS CONCEPT)**

2. Engine Warming up Operation

   Start up the engine, and run until the coolant temperature is within the operating range, 60 to 90°C (140 to 194°F).

   Check the coolant temperature with the temperature gauge in the instrument panel. The white color zone shows approximately 67 to 105°C (153 to 221°F) temperature range.

   When the indicator is located at around center of the white zone, it is suitable for the engine operation.




SPW13000001E01 Figure 2

3. Engine Speed Measurement

   A. Attach the pick up of the tachometer to one of injection lines. (Refer to Fig. 13-1)

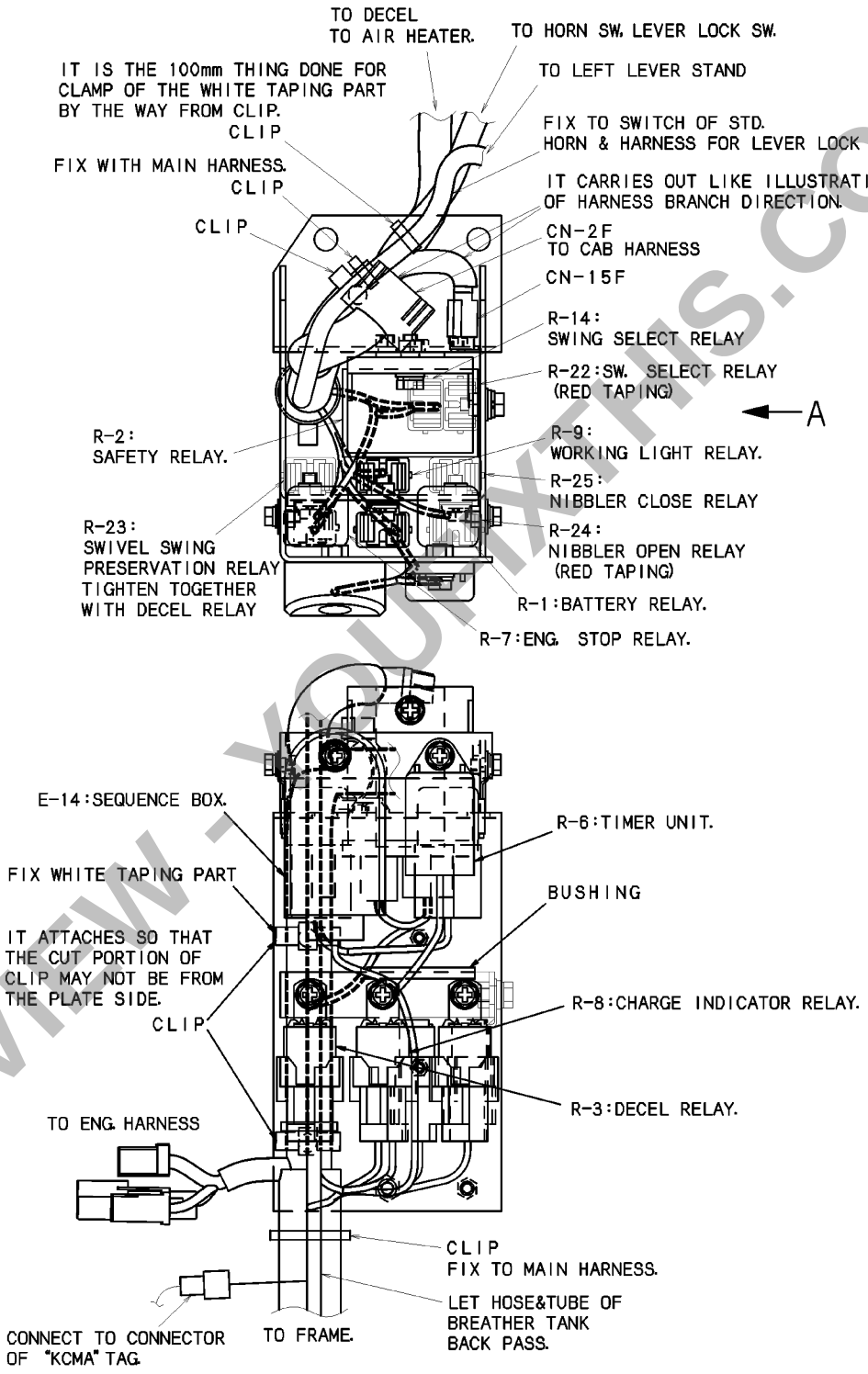
   B. Measure the engine speed at idling with no load, and compare it to the figure in the STANDARD VALUE TABLE.

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### 23.2.3.3 RELAY UNIT PORTION




SPW23000035E01

Figure 15

**FIG. 23-9 RELAY UNIT PORTION (1/2)**

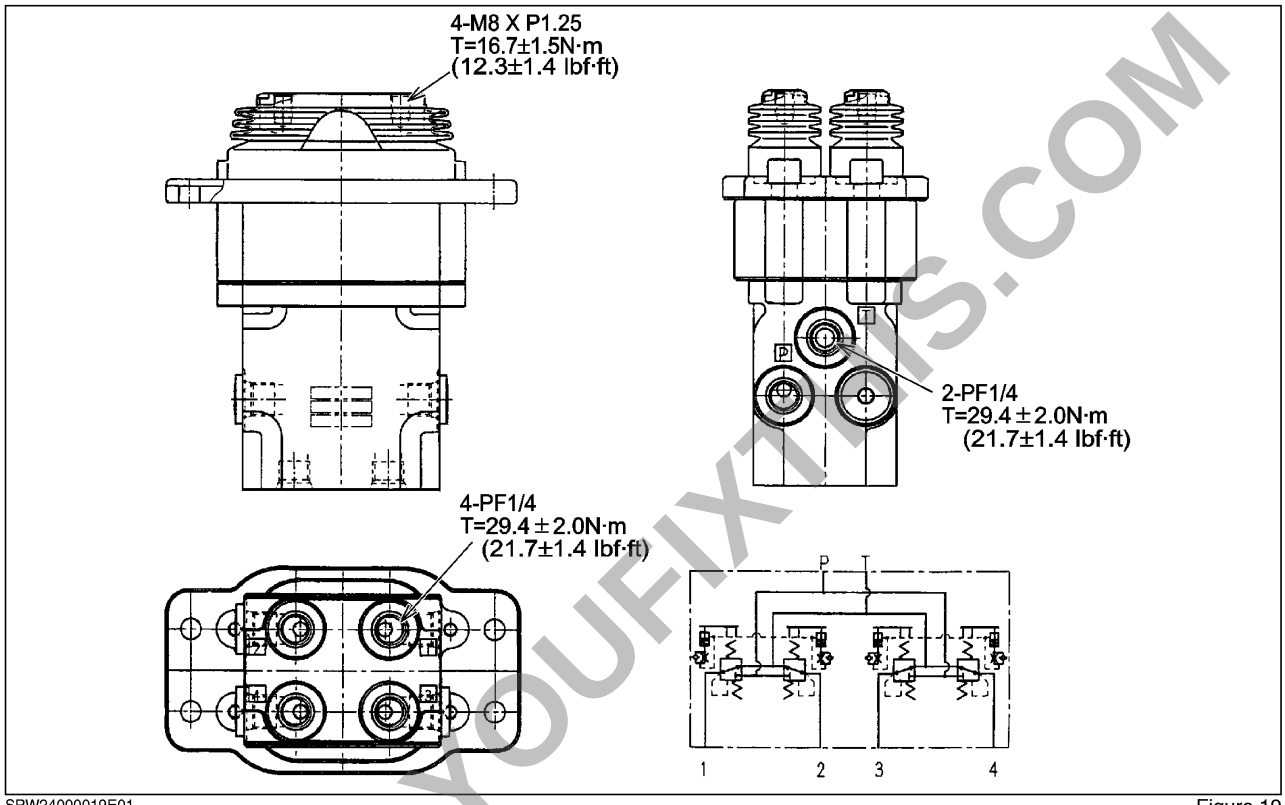


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## 24.1.3 PILOT VALVE (TRAVEL)

### 24.1.3.1 SUMMARY

24.1.3.1.1 GENERAL VIEW



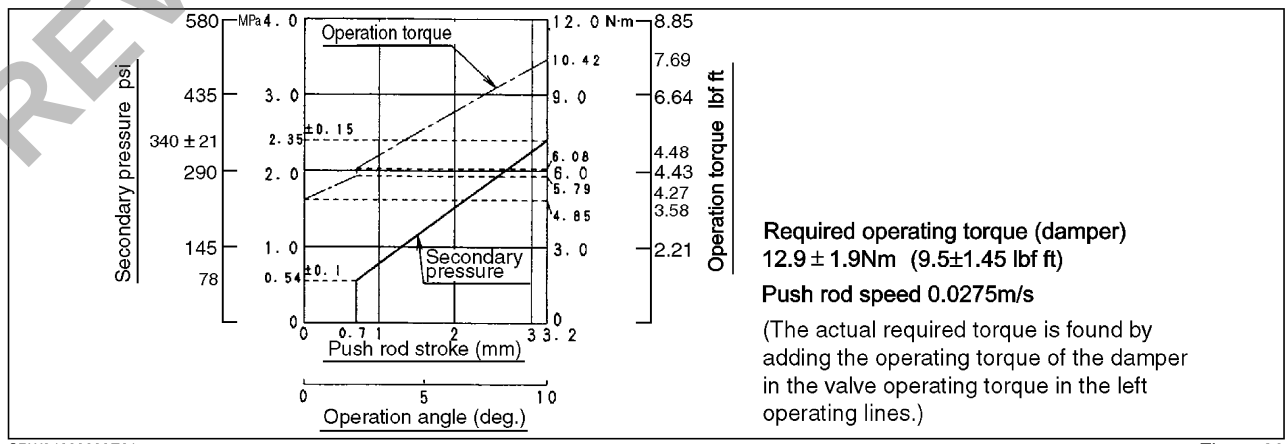

SPW24000019E01

Figure 19

24.1.3.1.2 SPECIFICATIONS

| ITEM | SPECIFICATIONS |
|---|---|
| Model (Type) | PVD6P4001 |
| Max. primary pressure | 6.9MPa (1000 psi) |
| Rated flow | 10 L/min (2.6 gal/min) |
| Weight | 3.9 kg (8.6 lb) |

24.1.3.1.3 PERFORMANCE CHARACTERISTICS




SPW24000020E01

Figure 20



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### 24.1.8.3 FUNCTION (EXAMPLE FOR BOOM CYLINDER)

1. Fundamental Function

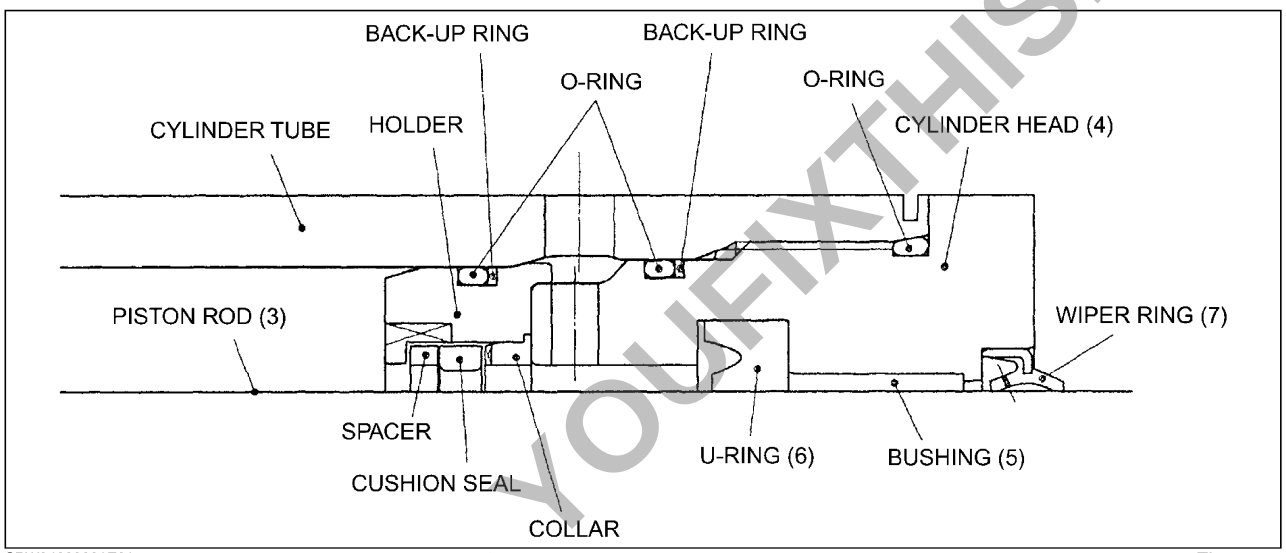
   This is a kind of hydraulic actuator that converts the energy in pressurized oil supplied by the hydraulic pump to a large force linear direction by means of the piston. Changing over the operating direction for either extension or retraction by means of actuating the valve lever to change over the direction of pressurized oil flow. Such conversion of energy force and change over the operating direction are of the fundamental function of this cylinder.

2. Function of each Part

   The following description is based on a cylinder with a typical structure (Boom cylinder).

   1. Cylinder Head Assy

      The cylinder head assy also works as a bearing by the means of a pressed bushing (5) in the cylinder head (4). Oil leakage is prevented by insertion of the U-ring (6) into the bore of cylinder head. The dust invasion is protected by pressing the wiper ring (7) into the bore of cylinder head.




SPW24000081E01

Figure 79

**FIG. 24-36 CYLINDER HEAD ASSY**

A. Bushing (5)

The bushing (5) is pressed into the bore on cylinder head to support the piston rod. The bushing (5) bears radial load imposed on the cylinder, and performs linear movement against the piston rod at high facial pressure, and minimized the eccentricity of piston rod that badly affects to the sealing effect by supporting its one end.

B. Wiper Ring (7)

The wiper ring (7) is located at the entrance where the piston rod comes in and out. Its function is to protect invasion of dust and water into the cylinder to secure good sealing effect of the U-ring (6), as well as to remove dust and mud adhered on the piston rod.

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### 32.1.4.2 INSTALLATION OF BOOM

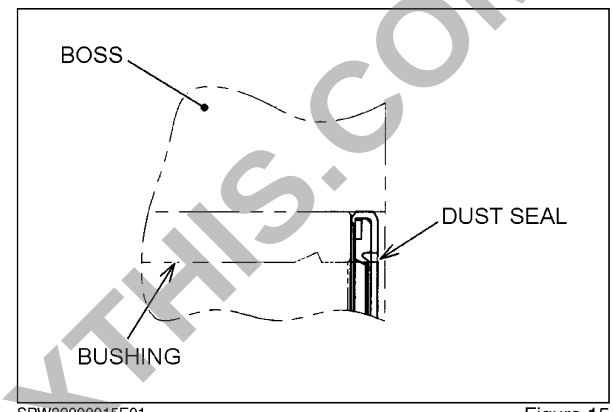
Installation is performed in the reverse order of removal, including the following.

**CAUTION:** *When aligning the pin position, do not put your finger in the pin holes in any circumstances, align them visually.*

1. Clean the welded part of the structures and check that there is no cracks on the parts.
2. Check the dust seals for damage, replace as needed (referring to Fig. 32-15 for installing procedures).
3. Inspect pins and bushings according to the Section “ATTACHMENT DIMENSIONS” and “SPECIFICATIONS”.
4. Before inserting the pin, apply grease to the shaft.
5. Referring to Fig. 32-16, install the capscrew and nuts that secure the pin.

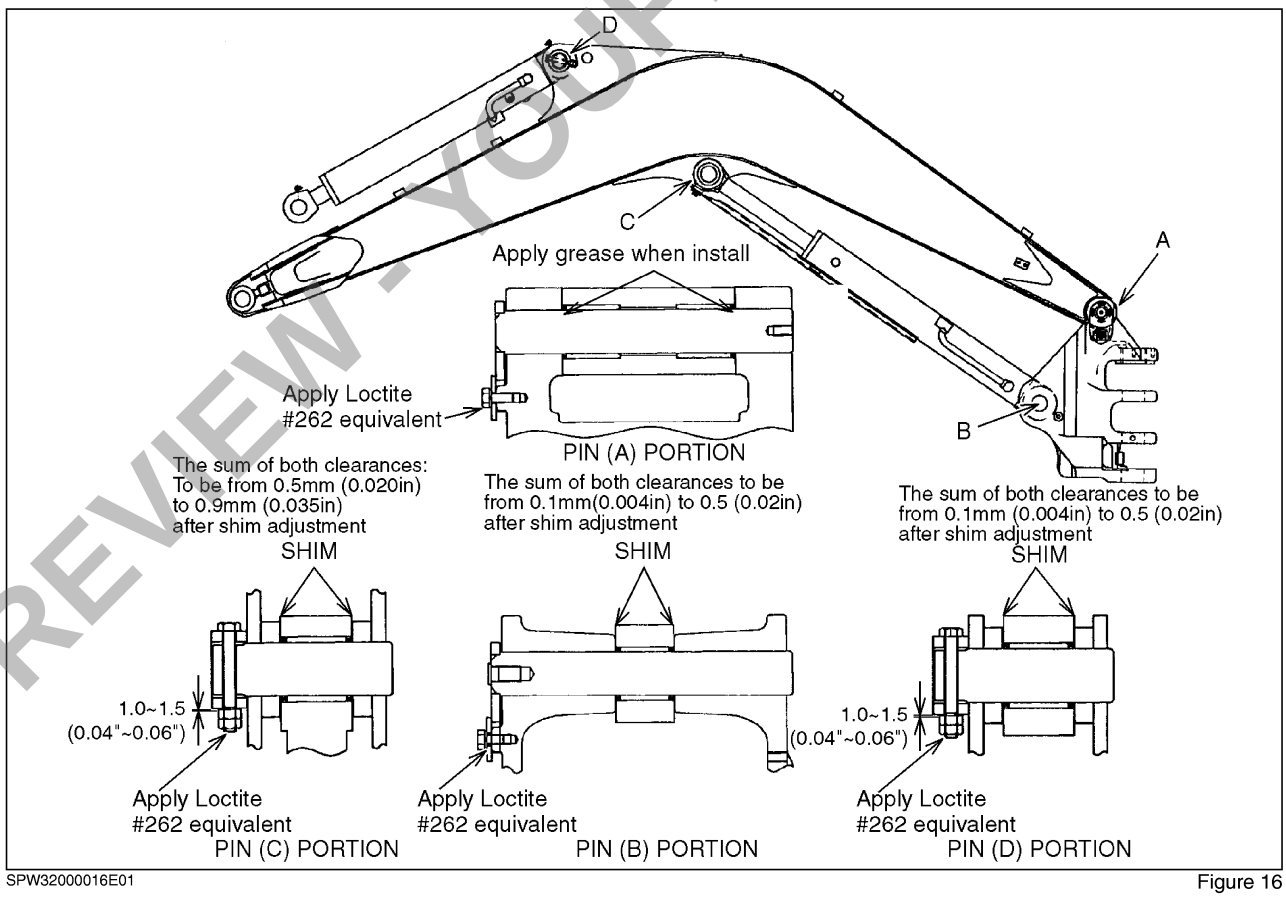
: 17mm

6. Refer to Fig. 32-16 for capscrew nut installation, also see procedures for checking for bushing clearance.
7. For the adjustment of clearance, insert plastic shim first, then adjust the clearance with steel shims.




SPW32000015E01 Figure 15

**FIG. 32-15 DUST SEAL INSTALLATION**




SPW32000016E01 Figure 16

**FIG. 32-16 SECTIONAL VIEW OF INSTALLING PIN**



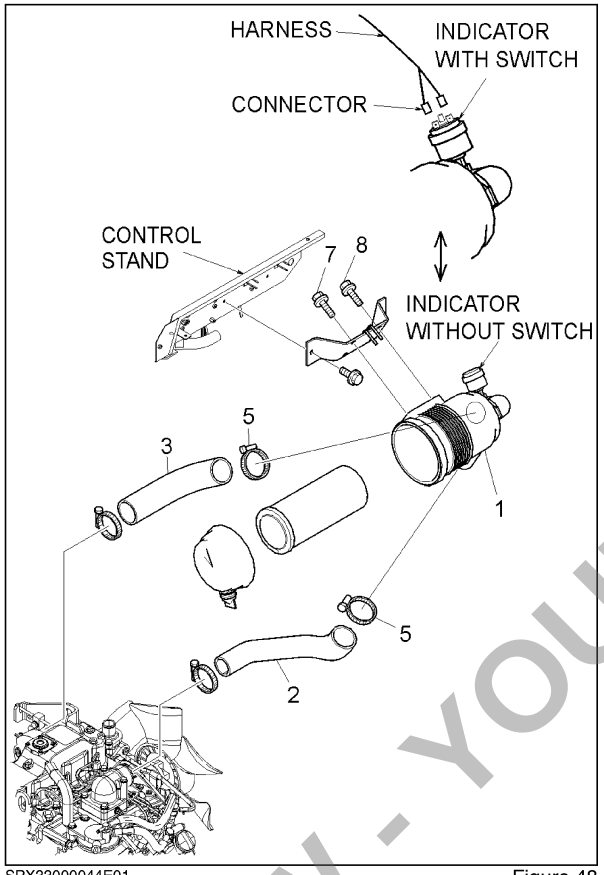
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### 33.1.12 AIR CLEANER

#### 33.1.12.1 REMOVAL PREPARATION

Open the rear hood assembly.

#### 33.1.12.2 REMOVAL




SPX33000044E01 Figure 48

**FIG. 33-38 AIR CLEANER REMOVAL**

1. Disconnect connectors from the indicator on the air-cleaner (1), if equipped.
2. Loosen the clamp (5) to remove the air hoses (2) and (3)

   : Flat tip screwdriver
3. Loosen two M8×20 (7) and two M8×25 (8) sems-bolts to remove the air cleaner assembly (1).

   : 13 mm

#### 33.1.12.3 INSTALLATION

Assemble the air cleaner in reverse order of the removal.

- Tightening torque

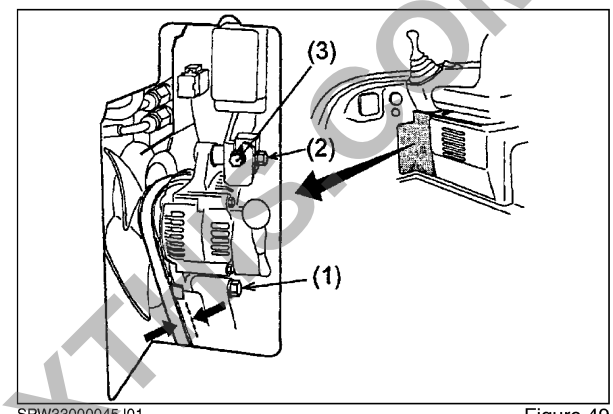
  Sems-bolts (7) and (8): 23.5 Nm (17 lb ft)

### 33.1.13 GENERATOR

#### 33.1.13.1 REMOVAL PREPARATION

1. Remove the cover at the lower right of the seat (See 33.1.11.1 (page 33-22)).
2. Disconnect the negative battery terminal.

#### 33.1.13.2 REMOVAL



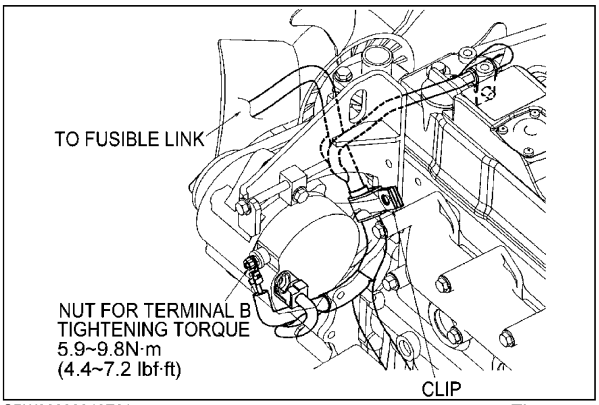

SPW33000045J01 Figure 49

**FIG. 33-39 GENERATOR REMOVAL**

1. Disconnect the connector and remove the nut (M6) for the terminal B.
2. Remove the capscrews (1), (2), and (3).

   : 13mm
3. Remove the V-belt and the generator.

#### 33.1.13.3 INSTALLATION




SPW33000046E01 Figure 50

**FIG. 33-40 GENERATOR TERMINAL**

1. Install the generator in reverse order of the removal.
2. V-belt tension

   Press the middle of the V-belt with a thumb to adjust the deflection within the following range:

   Deflection: 10 to 15 mm (0.39 to 0.59 inch)

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E. Aligning the two positioning pins (9) on the lock valve cover with the lock valve body, slowly press the lock valve cover onto the lock valve body.

F. Tighten the bolts (20) with a 5 mm Allen wrench to the specified torque.
T=9.8~10.8 Nm (7.2~8.0 lb ft)

**NOTE:** *Tighten up the bolts alternatively so that the lock valve is flat on the section.*

7. Assembling relief valve and overload relief valve.
   - The relief valve is essential for performance and safety, it is very difficult to reset the pressure, if the valve is faulty, replace it with a new assembly.

**NOTE:** *The assembling procedures described below are only for reference only after disassembling to investigate the cause of the fault.*

8. The figures in parentheses following the part names in the description are the item numbers in the cross-sectional drawing (Fig. 33-82 page 33-65).

   A. Place spring guide (16) in adjusting screw (7) and then spring (9).

   B. Shake the adjusting screw lightly and be sure that the spring guide (16) and spring (9) are seated. Place the poppet (6) in plug (4) and tighten adjusting screw (7) lightly.

   C. Hand tighten lock nut M14 (8). Place spring (10) and piston (3) in poppet (2), place them in socket (1).

   D. Check that piston (3) is inserted in the hole of the top end of plug (4). Tighten body (5) and plug (4) to the specified torque
   T=58.8 Nm (43 lb ft)

   E. Adjust the pressure with adjusting screw (7) using a 4 mm Allen wrench, tighten lock nut M14 (8) to the specified torque
   T=19.6Nm (14 lb ft)

9. Assembling anticavitation valve.
   - The anticavitation valve is essential for performance and safety, if faulty, replace it with a new assembly.

**NOTE:** *The assembling procedures described below are only for reference only after disassembling to investigate the cause of the fault.*

10. The figures in parentheses following the part names in the description are the item numbers in the cross-sectional drawing (Fig. 33-83 page 33-65).

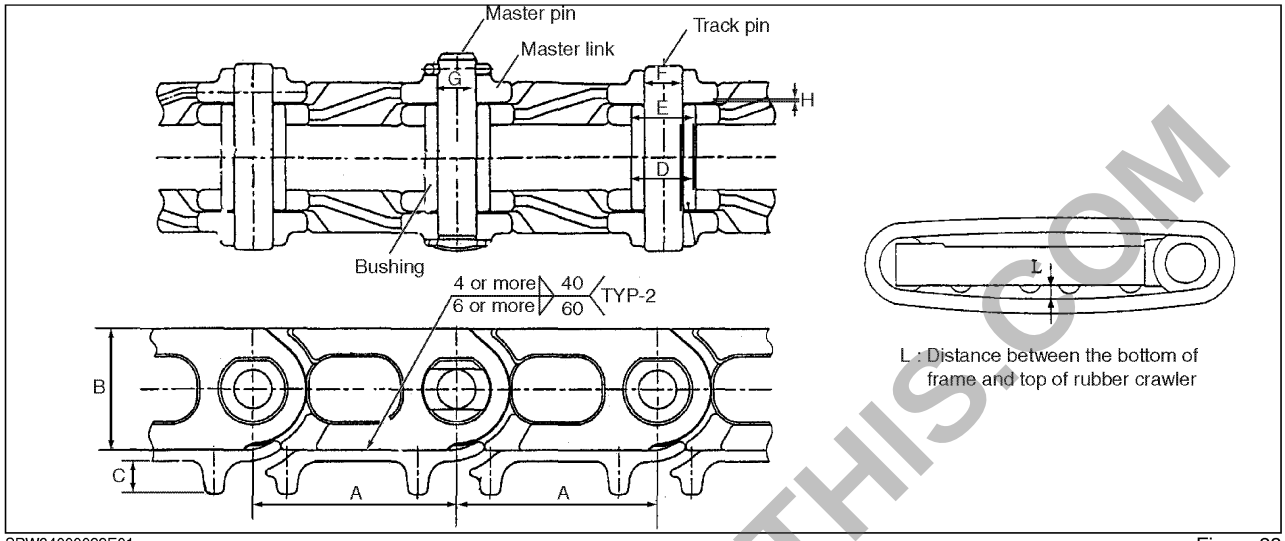
    A. Place anti cavitation valve (1) in body (2), and spring (4). Install and tighten the plug (3) to the specified torque.
    T=58.8 Nm (43 lb ft)

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2. Steel track (Track link)




SPW34000022E01

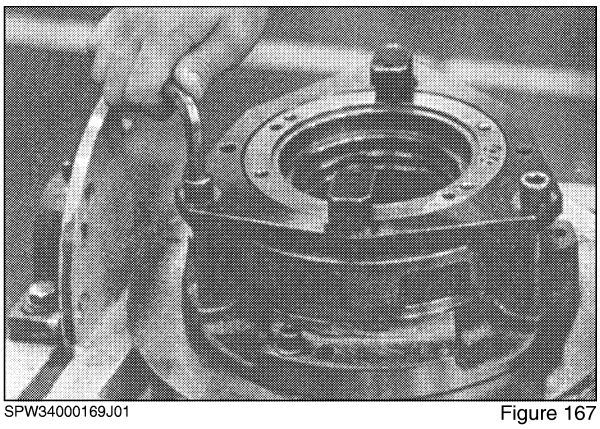
Figure 23

Unit: mm (in)

| Symbol | ITEM | Reference value | | Repairable level | Service limit | Remedy |
|---|---|---|---|---|---|---|
| A | Link pitch | 101.6 (4.0) | | 105 (4.14) | 107 (4.24) | Parts over the critical value in use should be replaced with link assembly. |
| B | Link height | 60 (2.4) | | 57 (2.24) | 56 (2.20) | |
| C | Height of shoe lug | 16.5 (0.65) | | 10 (0.39) | 8 (0.32) | |
| D | Bushing O.D. | $\phi32.2^{0}_{-0.04}$ ($\phi1.27^{0}_{-0.002}$) | | ø30 (ø1.18) | ø28 (ø1.10) | |
| E | Interference of bushing and link | Basic dimension | | Fit | Fit | Replace |
| | | Shaft | $\phi32.2^{0}_{-0.04}$ ($\phi1.27^{0}_{-0.002}$) | Interference 0.11~0.20 (0.0043~0.0079) | Interference 0 | |
| | | Hole | $\phi32^{+0.05}_{0}$ ($\phi1.26^{+0.002}_{0}$) | | | |
| F | Interference of track pin and link | Shaft | $\phi19.2^{+0.06}_{0}$ ($\phi0.76^{+0.003}_{0}$) | Interference 0.15~0.26 (0.006~0.010) | Interference 0 | |
| | | Hole | $\phi19^{+0.05}_{0}$ ($\phi0.75^{+0.002}_{0}$) | | | |
| G | Fitting of master pin and link | Shaft | $\phi18.93^{+0.05}_{0}$ ($\phi0.745^{+0.002}_{0}$) | Clearance 0.02~0.12 (0.0008~0.0047) | — | Replace link. |
| | | Hole | $\phi19^{+0.05}_{0}$ ($\phi0.75^{+0.002}_{0}$) | | | |
| H | Clearance gap of link | 0.9 (One side) (0.035) | | 4 (both side) (0.157) | 6 (both side) (0.236) | Replace |
| — | Welding of link and shoe | To be free from weld crack, blow hole, etc. | | | | Repair weld. |
| L | Slack of iron track | 115~130mm (4.5~5.1) | | — | | Adjust the tension. |



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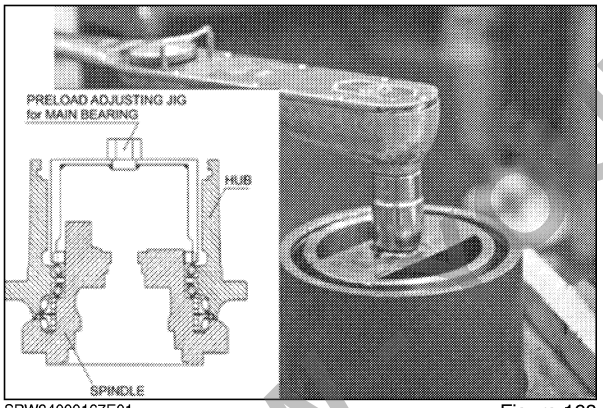


SPW34000169J01 Figure 167

**FIG. 34-149 INSTALL FIXING PLATE**

E. Secure the hub (1) and the spindle (2) with fixing plate in diagonal position.
Tightening torque: 59±20 Nm (43±14 lb ft)

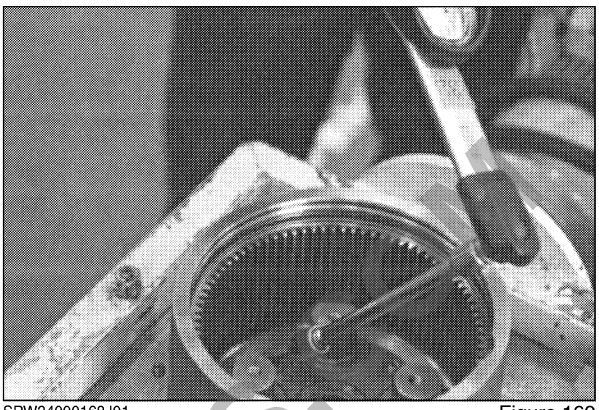
F. Turn the travel motor over.
(Reduction unit side up.)




SPW34000167E01 Figure 168

**FIG. 34-147 INSTALLING RING NUT (22)**

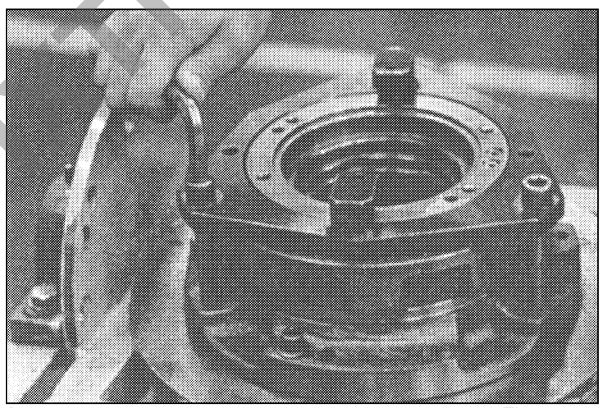
G. Tighten the ring nut (22) into the spindle using jig.
Tightening torque: 324±29 Nm (239±22 lb ft)



SPW34000168J01 Figure 169

**FIG. 34-148 ATTACHING HEXAGON SET SCREW (47)**

H. Tighten two hexagon socket set screws (47).
Tightening torque: 4.9±1.0 Nm (3.7±0.7 lb ft)



SPW34000169J01 Figure 170

**FIG. 34-149 REMOVING FIXING PLATE**

I. Turn the travel motor over. (Motor side up.)

J. Remove the clamp plates from the workbench.

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## NOTES

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(8) 4TNV94L

| Engine name | | Unit | 4TNV94L | | | | | |
|---|---|---|---|---|---|---|---|---|
| Engine specification class | | - | CL | | VM | | | |
| Type | | - | Vertical, in-line, 4-cycle, water-cooled diesel engine | | | | | |
| Combustion chamber | | - | Direct injection | | | | | |
| Number of cylinders | | - | 4 | | | | | |
| Cylinder bore×stroke | | mm×mm | 94×110 | | | | | |
| Displacement | | L | 3.053 | | | | | |
| Continuous rating | Revolving speed | $Min^{-1}$ | 1500 | 1800 | - | | | |
| | Output | kW (hp) | 26.1 (35.5) | 31.3 (42.5) | - | | | |
| Rated output | Revolving speed | $Min^{-1}$ | 1500 | 1800 | 2000 | 2200 | 2400 | 2500 |
| | Output | kW (hp) | 29.1 (39.5) | 34.6 (47.0) | 35.3 (48.0) | 38.2 (52.0) | 41.6 (56.5) | 43.0 (58.5) |
| Max. no-load speed (±25) | | $min^{-1}$ | 1600 | 1895 | 2180 | 2400 | 2590 | 2700 |
| Ignition order | | - | 1-3-4-2-1(No.1 cylinder on flywheel side) | | | | | |
| Power take off | | - | Flywheel | | | | | |
| Direction of rotation | | - | Counterclockwise (viewed from flywheel) | | | | | |
| Cooling system | | - | Radiator | | | | | |
| Lubrication system | | - | Forced lubrication with trochoid pump | | | | | |
| Starting system | | - | Electric | | | | | |
| Applicable fuel | | - | Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.) | | | | | |
| Applicable lubricant | | - | API grade class CD or CF | | | | | |
| Lubricant capacity (oil pan) * | Total | L | 10.2 | | | | | |
| | Effective | L | 4.5 | | | | | |
| Coolant water capacity (engine only) | | L | 4.2 | | | | | |
| Engine dimensions ** (with flywheel housing) | Overall length | mm | 719 | | | | | |
| | Overall width | mm | 498 | | | | | |
| | Overall height | mm | 717 | | | | | |
| Engine mass (dry) ** (with flywheel housing) | | kg | 245 (equivalent to SAE#3) | | 235 (equivalent to SAE#4) | | | |
| Cooling fan (std.) | | mm | 410 mm O/D, 6 blades pusher type | | | | | |
| Crankshaft V pulley diameter & Fun V pulley diameter (std.) | | mm | 130×130 | | | | | |

* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.
** Engine mass and dimensions without radiator

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## 3.3 Troubleshooting by measuring Compression Pressure

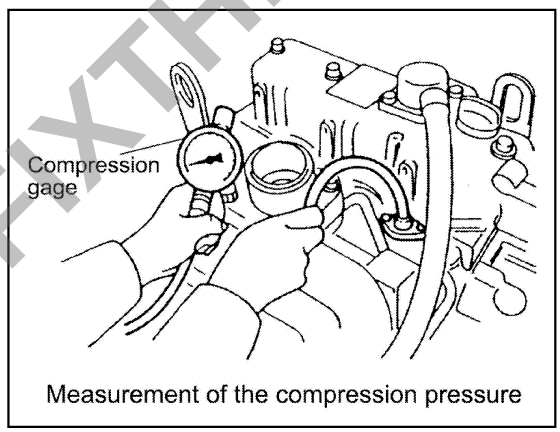
Compression pressure drop is one of major causes of increasing blowby gas (lubricating oil contamination or increased lubricating oil consumption as a resultant phenomenon) or starting failure. The compression pressure is affected by the following factors:

1) Degree of clearance between piston and cylinder
2) Degree of clearance at intake/exhaust valve seat
3) Gas leak from nozzle gasket or cylinder head gasket

In other words, the pressure drops due to increased parts wear and reduced durability resulting from long use of the engine.
A pressure drop may also be caused by scratched cylinder or piston by dust entrance from the dirty air cleaner element or worn or broken piston ring. Measure the compression pressure to diagnose presence of any abnormality in the engine.

### (1) Compression pressure measurement method

1) After warming up the engine, remove the fuel injection pipe and valves from the cylinder to be measured.
2) Crank the engine before installing the compression gage adapter.
*1) Perform cranking with the stop handle at the stop position (no injection state).
*2) See 12.2-18 in Chapter 12 for the compression gage and compression gage adapter.
3) Install the compression gage and compression gage adapter at the cylinder to be measured.
*1)Never forget to install a gasket at the tip end of the adapter.
4) With the engine set to the same state as in 2)*1), crank the engine by the starter motor until the compression gage reading is stabilized.



Measurement of the compression pressure

### (2) Standard compression pressure

Engine compression pressure list (reference value)

| Engine mode | Compression pressure at 250 $min^{-1}$ MPa ($kgf/cm^2$) | | Deviation among cylinders MPa ($kgf/cm^2$) |
|---|---|---|---|
| | Standard | Limit | |
| 3TNV82A | 3.16±0.1 (31±1) | 2.45±0.1 (25±1) | 0.2～0.3 (2～3) |
| 3/4TNV84 | 3.24±0.1 (33±1) | 2.55±0.1 (26±1) | |
| 3/4TNV84T | 2.94±0.1 (30±1) | 2.45±0.1 (25±1) | |
| TNV88～106(T) | 3.43±0.1 (35±1) | 2.75±0.1 (28±1) | |

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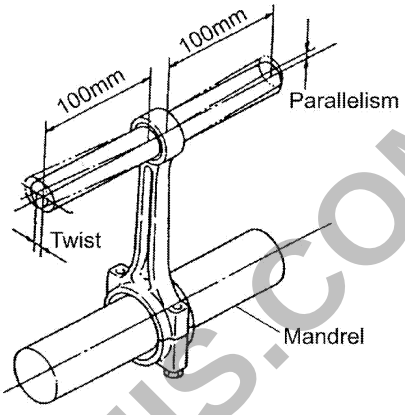
### (5) Connecting rod

(a) Appearance inspection
Inspect the portion near the boundary of the chamfered portion and I-beam section of the big and small ends of the connecting rod as well as the portion near the oil hole of the bushing at the small end for cracks, deformation, and discoloration.

(b) Twist and parallelism measurement Use a connecting rod aligner and measure the twist and bend.

mm

| Item | Standard dimension | Limit dimension |
|---|---|---|
| Twist and parallelism | 0.03 or less per 100mm | 0.08 |

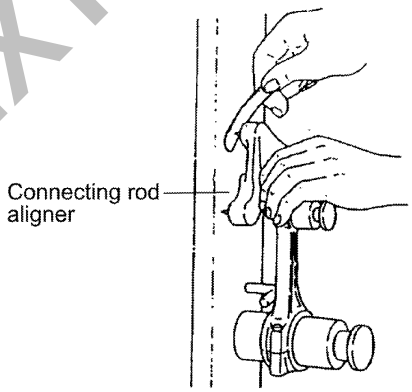


**Twist and parallelism measurement**

(c) Rod small end measurement
Measure the pin outside diameter according to 4.4.5.(4)(a) described above.

mm

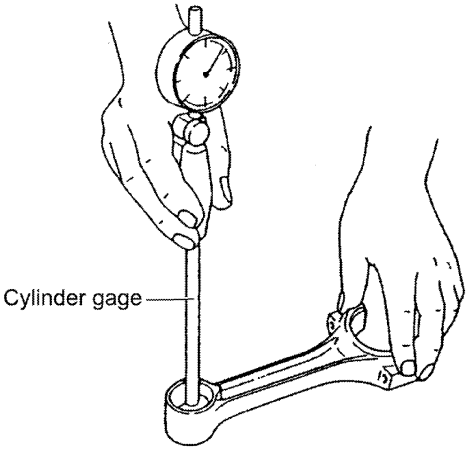
| Model | Item | Standard | Limit |
|---|---|---|---|
| 3TNV82A | Piston pin I.D. bushing | 23.025~23.038 | 23.068 |
| | Pin O.D. | 22.995~23.000 | 22.967 |
| | Clearance | 0.025~0.043 | 0.101 |
| TNV84~88 | Piston pin I.D. bushing | 26.025~26.038 | 26.068 |
| | Pin O.D. | 25.995~26.000 | 25.967 |
| | Clearance | 0.025~0.043 | 0.101 |
| 4TNV94L·98 | Piston pin I.D. bushing | 30.025~30.038 | 30.068 |
| | Pin O.D. | 29.987~30.000 | 29.959 |
| | Clearance | 0.025~0.051 | 0.109 |
| 4TNV106(T) | Piston pin I.D. bushing | 37.025~37.038 | 37.068 |
| | Pin O.D. | 36.989~37.000 | 36.961 |
| | Clearance | 0.025~0.049 | 0.107 |



**Twist measurement using a connecting rod aligner**

If the bushing is to be replaced because the oil clearance exceeds the limit, use spare part.

| Model | Service part code |
|---|---|
| 3TNV82A | 119810-23910 |
| TNV84~88 | 129100-23910 |
| 4TNV94L·98(T) | 129900-23910 |
| 4TNV106(T) | 123900-23910 |



**Connecting rod small end**

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(b) Series coil continuity test
Check continuity between the S and M terminals. Good if continuity exists.

If no continuity (coil disconnection), replace the magnetic switch.

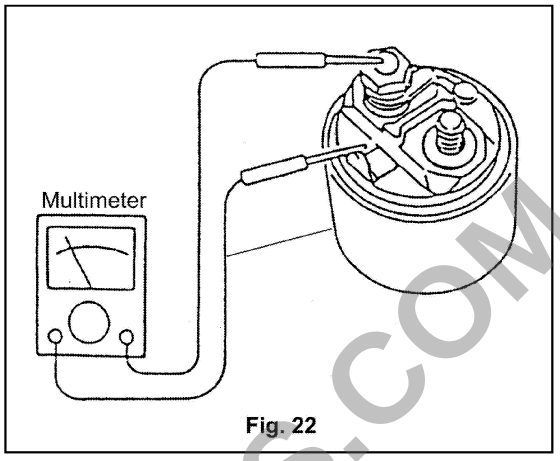


Fig. 22

(c) Contact continuity test
Depress the magnetic switch with the plunger at the bottom. Check continuity between the B and M terminals with a multimeter. Good if continuity exists.

If no continuity (coil continuity defect), replace the magnetic switch.

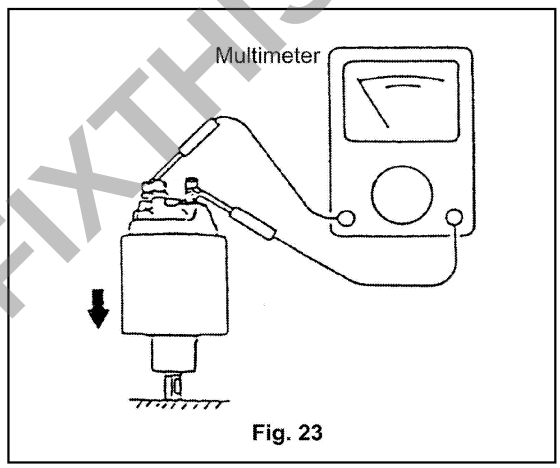
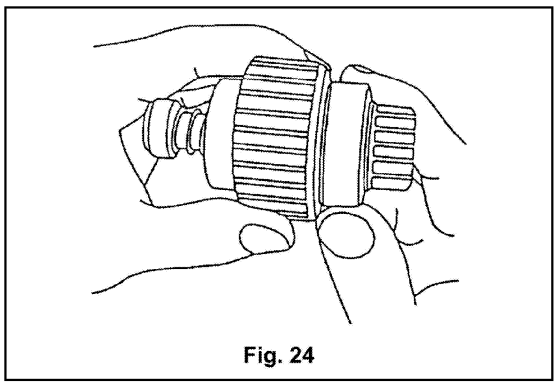


Fig. 23

(6) Pinion clutch

(a) Pinion inspection
Manually rotate the pinion. Inspect if it is rotated smoothly in the driving direction, and is locked in the opposite direction. Replace the pinion clutch if abnormal.


Fig. 24

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