

# Shop Manual

HYDRAULIC  
EXCAVATOR

**PC228US -3E0**  
**PC228USLC-3E0**

SERIAL NUMBERS PC228US- 40001 and up  
PC228USLC- 40001

**ecot3**

**KOMATSU**

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# HYDRAULIC EXCAVATOR

## PC228US-3E0 PC228USLC-3E0

Machine model	Serial number
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PC228US-3E0	40001 and up
PC228USLC-3E0	40001 and up

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## 00 Index and foreword

### Index

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Composition of shop manual .....	2
Table of contents .....	4

## Composition of shop manual

The contents of this shop manual are shown together with Form No. in a list.

Note 1: Always keep the latest version of this manual in accordance with this list and utilize accordingly.

The marks shown to the right of Form No. denote the following:

○: New issue (to be filed additionally) ●: Revision (to be replaced for each Form No.)

Note 2: This shop manual can be supplied for each Form No.

Note 3: To file this shop manual in the special binder for management, handle it as follows:

- Place a divider on the top of each section in the file after matching the Tub No. with No. indicated next to each Section Name shown in the table below:
- File overview and other materials in sections in the order shown below and utilize them accordingly.

Section Title	Form Number
Shop Manual, contents binder, binder label and tabs	SEN01418-10
00 Index and foreword	SEN01419-10
Index	SEN01420-10 ●
Foreword and general information	SEN01421-02
01 Specification	SEN01422-01
Specification and technical data	SEN01423-01
10 Structure, function and maintenance standard	SEN01424-04
Engine and cooling system	SEN01425-00
Power train	SEN01426-00
Undercarriage and frame	SEN01427-00
Hydraulic system, Part 1	SEN01428-00
Hydraulic system, Part 2	SEN01429-01
Hydraulic system, Part 3	SEN01430-01 ●
Work equipment	SEN01431-00
Cab and its attachments	SEN01432-00
Electrical system	SEN01433-03
20 Standard value table	SEN01434-02
Standard service value table	SEN01441-02
30 Testing and adjusting	SEN01435-05
Testing and adjusting, Part 1	SEN01879-04
Testing and adjusting, Part 2	SEN01880-04
Testing and adjusting, Part 3	SEN01881-03
40 Troubleshooting	SEN01436-04
Failure code table and fuse locations	SEN01882-04
General information on troubleshooting	SEN01883-03
Troubleshooting by failure code (Display of code), Part 1	SEN01884-02
Troubleshooting by failure code (Display of code), Part 2	SEN01885-04
Troubleshooting by failure code (Display of code), Part 3	SEN01886-02
Troubleshooting by failure code (Display of code), Part 4	SEN01887-02
Troubleshooting of electrical system (E-mode)	SEN01888-02

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Troubleshooting of hydraulic and mechanical system (H-mode)	SEN01889-02
Troubleshooting of engine (S-mode)	SEN01890-03
50 Disassembly and assembly	SEN01437-05
General information on disassembly and assembly	SEN01923-03
Engine and cooling system	SEN01924-04
Power train	SEN01925-01
Undercarriage and frame	SEN01926-02
Hydraulic system	SEN01927-02
Work equipment	SEN01928-01
Cab and its attachments	SEN01929-01
Electrical system	SEN01930-01
90 Diagrams and drawings	SEN01438-02
Hydraulic diagrams and drawings	SEN01439-01
Electrical diagrams and drawings	SEN01440-02

## Table of contents

00 Index and foreword	
Index	SEN01420-10
Composition of shop manual .....	2
Table of contents.....	4
Foreword and general information	SEN01421-02
Safety notice .....	2
How to read the shop manual.....	7
Explanation of terms for maintenance standard .....	9
Handling of electric equipment and hydraulic component .....	11
Handling of connectors newly used for engines .....	20
How to read electric wire code.....	23
Precautions when carrying out operation .....	26
Method of disassembling and connecting push-pull type coupler .....	29
Standard tightening torque table.....	32
Conversion table.....	36
01 Specification	
Specification and technical data	SEN01423-01
Specification dimension drawings.....	2
Working range diagram .....	3
Specifications .....	4
Weight table .....	6
Table of fuel, coolant and lubricants .....	8
10 Structure, function and maintenance standard	
Engine and cooling system	SEN01425-00
Engine related parts.....	2
Radiator, oil cooler, aftercooler and fuel cooler.....	3
Power train	SEN01426-00
Power train.....	2
Final drive .....	4
Swing machinery .....	6
Swing circle.....	8
Undercarriage and frame	SEN01427-00
Track frame.....	2
Idler.....	4
Carrier roller.....	6
Track roller .....	7
Track shoe .....	8
Hydraulic system, Part 1	SEN01428-00
Hydraulic equipment layout drawing.....	2
Hydraulic tank .....	4
Hydraulic pump.....	6
Hydraulic system, Part 2	SEN01429-01
Control valve.....	2
CLSS .....	14
Functions and operation by valve .....	18
Merge-divider valve .....	33
Attachment circuit selector valve .....	56
Hydraulic drift prevention valve.....	58
Hydraulic system, Part 3	SEN01430-01
Valve control .....	2
PPC valve .....	4
PPC Accumulator .....	22

Return oil filter .....	23
Center swivel joint .....	24
Travel motor.....	25
Swing motor.....	35
Hydraulic cylinder .....	44
Work equipment .....	SEN01431-00
Dimensions of components .....	4
Cab and its attachments .....	SEN01432-00
Air conditioner piping .....	2
Electrical system .....	SEN01433-03
Engine control.....	2
Electrical control system.....	12
Monitor system .....	38
Sensor .....	56
KOMTRAX system .....	59
20 Standard value table .....	
Standard service value table .....	SEN01441-02
Standard value table for engine related parts.....	2
Standard value table for chassis .....	3
30 Testing and adjusting .....	
Testing and adjusting, Part 1 .....	SEN01879-04
Tools for testing, adjusting, and troubleshooting .....	3
Sketches of special tools .....	8
Testing engine speed.....	9
Testing intake air pressure (boost pressure) .....	10
Checking exhaust gas color .....	11
Adjusting valve clearance.....	12
Testing compression pressure.....	14
Testing blow-by pressure.....	17
Testing engine oil pressure.....	18
Handling fuel system parts .....	19
Releasing residual pressure from fuel system.....	19
Testing fuel pressure .....	20
Reduced cylinder mode operation.....	23
No-injection cranking .....	23
Testing fuel delivery, return rate and leakage .....	24
Bleeding air from fuel circuit .....	27
Checking fuel circuit for leakage.....	28
Checking and adjusting air conditioner compressor belt tension .....	29
Replacement of fan belt.....	30
Testing and adjusting, Part 2 .....	SEN01880-04
Testing clearance in swing circle bearings .....	2
Checking and adjusting track shoe tension .....	3
Testing and adjusting hydraulic oil pressure in hydraulic circuit for work equipment, swing and travel.....	4
Testing control circuit oil pressure .....	8
Testing and adjusting pump PC control circuit oil pressure .....	9
Testing and adjusting pump LS control circuit oil pressure.....	12
Testing solenoid valve output pressure .....	17
Testing PPC valve output pressure .....	20
Adjusting play of work equipment and swing PPC valves .....	21
Inspection of locations of hydraulic drift of work equipment .....	22
Release of residual pressure from hydraulic circuit.....	24
Testing oil leakage .....	25

Bleeding air from each part.....	28
Procedure for replacing boom angle potentiometer.....	30
Inspection procedures for diode .....	31
Adjusting mirrors.....	32
Testing and adjusting, Part 3	SEN01881-03
Special functions of machine monitor .....	2
Handling voltage circuit of engine controller .....	30
Starting KOMTRAX terminal operations .....	31
Indicator lamps of KOMTRAX terminal.....	35
Preparation work for troubleshooting of electrical system .....	38
Pm-clinic service.....	40
40 Troubleshooting	
Failure code table and fuse locations	SEN01882-04
Failure code table .....	2
Fuse locations.....	5
General information on troubleshooting	SEN01883-03
Points to remember when troubleshooting .....	2
Sequence of events in troubleshooting.....	3
Checks before troubleshooting.....	4
Classification and troubleshooting steps .....	5
Information in troubleshooting table.....	6
Possible problems and troubleshooting No. ....	8
Connection table for connector pin numbers .....	11
T- branch box and T- branch adapter table.....	47
Troubleshooting by failure code (Display of code), Part 1	SEN01884-02
Failure code [AA10NX] Air cleaner Clogging.....	3
Failure code [AB00KE] Charge Voltage Low .....	4
Failure code [B@BAZG] Eng Oil Press Low.....	6
Failure code [B@BAZK] Eng Oil Level Low.....	7
Failure code [B@BCNS] Eng Water Overheat .....	8
Failure code [B@BCZK] Eng Water Level Low .....	9
Failure code [B@HANS] Hyd Oil Overheat .....	10
Failure code [CA111] EMC Critical Internal Failure.....	10
Failure code [CA115] Eng Ne and Bkup Speed Sens Error.....	11
Failure code [CA122] Chg Air Press Sensor High Error .....	12
Failure code [CA123] Chg Air Press Sensor Low Error .....	14
Failure code [CA131] Throttle Sensor High Error .....	16
Failure code [CA132] Throttle Sensor Low Error .....	18
Failure code [CA144] Coolant Temp Sens High Error .....	20
Failure code [CA145] Coolant Temp Sens Low Error .....	22
Failure code [CA153] Chg Air Temp Sensor High Error .....	24
Failure code [CA154] Chg Air Temp Sensor Low Error .....	26
Failure code [CA155] Chg Air Temp High Speed Derate.....	28
Failure code [CA187] Sens Supply 2 Volt Low Error .....	30
Failure code [CA221] Ambient Press Sens High Error .....	32
Failure code [CA222] Ambient Press Sens Low Error .....	34
Failure code [CA227] Sens Supply 2 Volt High Error .....	36
Failure code [CA234] Eng. Overspeed .....	37
Failure code [CA238] Ne Speed Sens Supply Volt Error .....	38
Failure code [CA271] IMV/PCV1 Short Error.....	39
Failure code [CA272] IMV/PCV1 Open Error .....	40
Failure code [CA322] Inj #1 (L#1) Open/Short Error .....	42
Failure code [CA323] Inj #5 (L#5) Open/Short Error .....	44
Failure code [CA324] Inj #3 (L#3) Open/Short Error .....	46
Failure code [CA325] Inj #6 (L#6) Open/Short Error .....	48
Failure code [CA331] Inj #2 (L#2) Open/Short Error .....	50

Failure code [CA332] Inj #4 (L#4) Open/Short Error .....	52
Troubleshooting by failure code (Display of code), Part 2	SEN01885-04
Failure code [CA342] Calibration Code Incompatibility .....	3
Failure code [CA351] Injectors Drive Circuit Error.....	4
Failure code [CA352] Sens Supply 1 Volt Low Error .....	6
Failure code [CA386] Sens Supply 1 Volt High Error .....	8
Failure code [CA428] Water in Fuel Sensor High Error.....	10
Failure code [CA429] Water in Fuel Sensor Low Error.....	12
Failure code [CA435] Eng Oil Press Sw Error.....	14
Failure code [CA441] Battery Voltage Low Error.....	15
Failure code [CA442] Battery Voltage High Error .....	18
Failure code [CA449] Rail Press Very High Error.....	20
Failure code [CA451] Rail Press Sensor High Error.....	22
Failure code [CA452] Rail Press Sensor Low Error .....	24
Failure code [CA488] Chg Air Temp High Torque Derate.....	26
Failure code [CA553] Rail Press High Error .....	26
Failure code [CA559] Rail Press Low Error.....	27
Failure code [CA689] Eng Ne Speed Sensor Error .....	29
Failure code [CA731] Eng Bkup Speed Sens Phase Error.....	31
Failure code [CA757] All Continuous Data Lost Error .....	32
Failure code [CA778] Eng Bkup Speed Sensor Error.....	34
Failure code [CA1633] KOMNET Datalink Timeout Error.....	36
Failure code [CA2185] Throt Sens Sup Volt High Error .....	38
Failure code [CA2186] Throt Sens Sup Volt Low Error .....	39
Failure code [CA2249] Rail Press Very Low Error.....	40
Failure code [CA2311] IMV Solenoid Error.....	42
Failure code [CA2555] Grid Htr Relay Volt High Error.....	44
Failure code [CA2556] Grid Htr Relay Volt Low Error .....	46
Troubleshooting by failure code (Display of code), Part 3	SEN01886-02
Failure code [D110KB] Battery Relay Drive Short Circuit.....	2
Failure code [D196KA] Service Return Relay Disc. ....	4
Failure code [D196KB] Service Return Relay S/C .....	6
Failure code [DA22KK] Pump Solenoid Power Low Error.....	8
Failure code [DA25KP] 5V Sensor 1 Power Abnormality .....	10
Failure code [DA2RMC] CAN Discon (Pump Con Detected) .....	12
Failure code [DA2SKQ] Model Selection Abnormality.....	14
Failure code [DAFRMC] CAN Discon (Monitor Detected) .....	16
Failure code [DGH2KB] Hyd Oil Sensor Short .....	18
Failure code [DHPAMA] F Pump Press Sensor Abnormality.....	20
Failure code [DHPBMA] R Pump Press Sensor Abnormality.....	22
Failure code [DHSAMA] Sw RH PPC Press Sen. Abnormality .....	24
Failure code [DHSBMA] Sw LH PPC Press Sen. Abnormality.....	26
Troubleshooting by failure code (Display of code), Part 4	SEN01887-02
Failure code [DW43KA] Travel Speed Sol Open Circuit.....	4
Failure code [DW43KB] Travel Speed Sol Short Circuit .....	6
Failure code [DW45KA] Swing Brake Sol Open Circuit.....	8
Failure code [DW45KB] Swing Brake Sol Short Circuit.....	12
Failure code [DW91KA] Travel Junction Sol Open Circuit.....	14
Failure code [DW91KB] Travel Junction Sol Short Circuit.....	16
Failure code [DW4GKA] Boom Slow Down Sol. Disc.....	18
Failure code [DW4GKB] Boom Slow Down Sol. S/C.....	20
Failure code [DWJ0KA] Merge-divider Sol Open Circuit .....	22
Failure code [DWJ0KB] Merge-divider Sol Short Circuit .....	24
Failure code [DWK0KA] 2-stage Relief Sol Open Circuit .....	26
Failure code [DWK0KB] 2-stage Relief Sol Short Circuit .....	28
Failure code [DXA0KA] PC-EPC Sol Open Circuit.....	30
Failure code [DXA0KB] PC-EPC Sol Short Circuit .....	32
Failure code [DXE0KA] LS-EPC Sol Open Circuit .....	34



Failure code [DXE0KB] LS-EPC Sol Short Circuit.....	36
Failure code [DXE4KA] Service Current EPC Open Circuit .....	38
Failure code [DXE4KB] Service Current EPC Short Circuit.....	39
Failure code [DY20KA] Wiper Working Abnormality.....	40
Failure code [DY20MA] Wiper Parking Abnormality .....	42
Failure code [DY2CKB] Washer Drive Short Circuit .....	44
Failure code [DY2DKB] Wiper Drive (Fwd) Short Circuit.....	46
Failure code [DY2EKB] Wiper Drive (Rev) Short Circuit .....	48
Troubleshooting of electrical system (E-mode) .....	SEN01888-02
Before carrying out troubleshooting of electrical system .....	3
Information contained in troubleshooting table .....	5
E-1 Engine does not start .....	6
E-2 Auto-decelerator does not operate.....	9
E-3 Automatic warming-up system does not operate .....	11
E-4 Preheater does not operate .....	12
E-5 All work equipment, swing, and travel mechanism do not move.....	14
E-6 Power maximizing function does not operate .....	16
E-7 Machine monitor does not display at all .....	18
E-8 Machine monitor does not display some items .....	20
E-9 Contents of display by machine monitor are different from applicable machine .....	20
E-10 Fuel level monitor was lighted in red while engine running.....	21
E-11 Engine coolant temperature gauge does not indicate normally .....	22
E-12 Hydraulic oil temperature gauge does not indicate normally .....	24
E-13 Fuel level gauge does not indicate normally .....	25
E-14 Swing lock monitor does not indicate normally .....	26
E-15 When monitor switch is operated, monitor displays nothing .....	28
E-16 Windshield wiper and window washer do not operate .....	30
E-17 Monitoring function fails to display “boom raise” normally .....	34
E-18 Monitoring function fails to display “boom lower” normally.....	35
E-19 Monitoring function fails to display “arm IN” normally .....	36
E-20 Monitoring function fails to display “arm OUT” normally .....	37
E-21 Monitoring function fails to display “bucket CURL” normally.....	38
E-22 Monitoring function fails to display “bucket DUMP” normally .....	39
E-23 Monitoring function fails to display “swing left” normally .....	40
E-24 Monitoring function fails to display “swing right” normally .....	42
E-25 Monitoring function fails to display “travel” normally .....	44
E-26 Monitoring function fails to display “travel differential pressure” normally.....	46
E-27 Monitoring function fails to display “service” normally.....	48
E-28 The KOMTRAX system does not work properly .....	50
E-29 Air conditioner does not operate .....	52
E-30 Travel alarm does not sound or does not stop sounding .....	54
E-31 Horn does not sound.....	56
E-32 Attachment circuit does not change .....	58
Troubleshooting of hydraulic and mechanical system (H-mode) .....	SEN01889-02
System chart for hydraulic and mechanical systems.....	4
Information contained in troubleshooting table .....	6
H-1 All work equipment lack power, or travel and swing speeds are slow .....	7
H-2 Engine speed sharply drops or engine stalls .....	9
H-3 No work equipment, travel or swing move .....	10
H-4 Abnormal noise is heard from around hydraulic pump .....	10
H-5 Auto-decelerator does not work .....	11
H-6 Fine control mode does not function.....	11
H-7 Boom moves slowly or lacks power .....	12
H-8 Arm moves slowly or lacks power .....	13
H-9 Bucket moves slowly or lacks power .....	14
H-10 Work equipment does not move in its single operation.....	14
H-11 Work equipment has a bit too large hydraulic drift .....	15
H-12 Work equipment has big time lag.....	16

H-13 Other work equipment moves when relieving single circuit .....	16
H-14 One-touch power max. switch does not operate .....	16
H-15 In compound operation, work equipment with larger load moves slowly .....	17
H-16 In swing + boom RAISE operation, boom moves slowly .....	17
H-17 In swing + travel, travel speed drops sharply .....	17
H-18 Machine swerves in travel .....	18
H-19 Machine travels slowly .....	19
H-20 Machine cannot be easily steered or lacks power .....	20
H-21 Travel speed does not shift, or it is slower or faster than preset speed .....	21
H-22 Track shoe does not turn (on one side only) .....	21
H-23 Machine does not swing .....	22
H-24 Swing acceleration is poor, or swing speed is slow .....	24
H-25 Excessive overrun when stopping swing .....	26
H-26 There is big shock when stopping swing .....	27
H-27 There is big abnormal noise caused when stopping swing .....	27
H-28 Swing natural drift is too big .....	28
H-29 Attachment circuit does not change .....	29
H-30 Flow rate in attachment circuit cannot be adjusted .....	29
Troubleshooting of engine (S-mode) .....	SEN01890-03
Method of using troubleshooting chart .....	3
S-1 Starting performance is poor .....	6
S-2 Engine does not start .....	7
S-3 Engine does not pick up smoothly .....	10
S-4 Engine stops during operations .....	11
S-5 Engine does not rotate smoothly .....	12
S-6 Engine lack output (or lacks power) .....	13
S-7 Exhaust smoke is black (incomplete combustion) .....	14
S-8 Oil consumption is excessive (or exhaust smoke is blue) .....	15
S-9 Oil becomes contaminated quickly .....	16
S-10 Fuel consumption is excessive .....	17
S-11 Oil is in coolant (or coolant spurts back or coolant level goes down) .....	18
S-12 Oil pressure drops .....	19
S-13 Oil level rises (Entry of coolant/fuel) .....	20
S-14 Coolant temperature becomes too high (overheating) .....	21
S-15 Abnormal noise is made .....	22
S-16 Vibration is excessive .....	23
50 Disassembly and assembly .....	
General information on disassembly and assembly .....	SEN01923-03
How to read this manual .....	2
Coating materials list .....	4
Special tools list .....	7
Sketches of special tools .....	10
Engine and cooling system .....	SEN01924-04
Removal and installation of fuel supply pump assembly .....	2
Removal and installation of fuel injector assembly .....	5
Removal and installation of engine front seal .....	11
Removal and installation of engine rear seal .....	13
Removal and installation of cylinder head assembly .....	16
Removal and installation of radiator assembly .....	29
Removal and installation of hydraulic oil cooler assembly .....	32
Removal and installation of aftercooler assembly .....	34
Removal and installation of fuel cooler assembly .....	36
Removal and installation of engine assembly .....	38
Removal and installation of fuel tank assembly .....	40
Power train .....	SEN01925-01
Removal and installation of travel motor and final drive assembly .....	2

Disassembly and assembly of final drive assembly.....	3
Removal and installation of swing machinery assembly.....	11
Disassembly and assembly of swing machinery assembly .....	13
Removal and installation of swing circle assembly.....	21
Undercarriage and frame	SEN01926-02
Disassembly and assembly of track roller assembly .....	2
Disassembly and assembly of idler assembly .....	3
Disassembly and assembly of recoil spring.....	6
Expansion and installation of track shoe assembly .....	8
Removal and installation of revolving frame .....	10
Removal and installation of counterweight assembly .....	12
Removal and installation of maintenance counterweight (at rear of engine).....	13
Removal and installation of maintenance counterweight assembly (above pump) .....	14
Hydraulic system	SEN01927-02
Removal and installation of center swivel joint assembly .....	2
Disassembly and assembly of center swivel joint.....	4
Removal and installation of hydraulic tank assembly .....	5
Removal and installation of work equipment pump .....	7
Removal and installation of control valve assembly .....	11
Disassembly and assembly of control valve assembly.....	13
Disassembly and assembly of work equipment PPC valve assembly.....	15
Disassembly and assembly of travel PPC valve assembly .....	17
Disassembly and assembly of hydraulic cylinder assembly .....	20
Work equipment	SEN01928-01
Removal and installation of work equipment assembly .....	2
Cab and its attachments	SEN01929-01
Removal and installation of operator's cab assembly.....	2
Removal and installation of operator's cab glass (Stuck glass).....	4
Removal and installation of front window assembly .....	13
Removal and installation of floor frame assembly .....	14
Electrical system	SEN01930-01
Removal and installation of air conditioner compressor assembly .....	2
Removal and installation of air conditioner condenser assembly .....	4
Removal and installation of air conditioner unit assembly .....	5
Removal and installation of machine monitor assembly .....	7
Removal and installation of pump controller assembly.....	8
Removal and installation of engine controller assembly .....	9
Removal and installation of KOMTRAX communication modem assembly .....	11
90 Diagrams and drawings	
Hydraulic diagrams and drawings	SEN01439-01
Hydraulic circuit diagram .....	3
Electrical diagrams and drawings	SEN01440-02
Electrical circuit diagram.....	3
Connector list and stereogram.....	17



PC228US, 228USLC-3E0 Hydraulic excavator

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# HYDRAULIC EXCAVATOR

## PC228US-3E0 PC228USLC-3E0

### Machine model      Serial number

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## 00 Index and foreword

### Foreword and general information

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---


Safety notice .....	2
How to read the shop manual .....	7
Explanation of terms for maintenance standard .....	9
Handling of electric equipment and hydraulic component .....	11
Handling of connectors newly used for engines .....	20
How to read electric wire code .....	23
Precautions when carrying out operation .....	26
Method of disassembling and connecting push-pull type coupler .....	29
Standard tightening torque table .....	32
Conversion table .....	36

## Safety notice


(Rev. 2008/08)

### Important safety notice

Proper service and repair are extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol  is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

#### 1. General precautions

 **Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully before operating the machine. In addition, read this manual and understand its contents before starting the work.**

- 1) Before carrying out any greasing or repairs, read all the safety labels stuck to the machine. For the locations of the safety labels and detailed explanation of precautions, see the Operation and Maintenance Manual.
- 2) Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt, water, or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.
- 3) When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
  - Always wear safety glasses when hitting parts with a hammer.
  - Always wear safety glasses when grinding parts with a grinder, etc.
- 4) When carrying out any operation with 2 or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR warning signs in the operator's compartment.
- 5) Only qualified workers must carry out work and operation which require license or qualification.
- 6) Keep all tools in good condition, learn the correct way to use them, and use the proper ones of them. Before starting work, thoroughly check the tools, machine, forklift, service car, etc.
- 7) If welding repairs are needed, always have a trained and experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, shielding goggles, cap and other clothes suited for welding work.
- 8) Before starting work, warm up your body thoroughly to start work under good condition.
- 9) Avoid continuing work for long hours and take rests at proper intervals to keep your body in good condition. Take rests in specified safe places.

#### Safety points

1	Good arrangement
2	Correct work clothes
3	Following work standard
4	Making and checking signs
5	Prohibition of operation and handling by unlicensed workers
6	Safety check before starting work
7	Wearing protective goggles (for cleaning or grinding work)
8	Wearing shielding goggles and protectors (for welding work)
9	Good physical condition and preparation
10	Precautions against work which you are not used to or you are used to too much

## 2. Preparations for work

- 1) Before adding oil or making any repairs, park the machine on a hard and level ground, and apply the parking brake and block the wheels or tracks to prevent the machine from moving.
- 2) Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If this is not possible, insert the lock pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
- 3) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting work.
- 4) Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

## 3. Precautions during work

- 1) Before disconnecting or removing components of the oil, water, or air circuits, first release the pressure completely from the circuit. When removing the oil filler cap, a drain plug, or an oil pressure pickup plug, loosen it slowly to prevent the oil from spurting out.
- 2) The coolant and oil in the circuits are hot when the engine is stopped, so be careful not to get scalded. Wait for the oil and coolant to cool before carrying out any work on the oil or water circuits.
- 3) Before starting work, stop the engine. When working on or around a rotating part, in particular, stop the engine. When checking the machine without stopping the engine (measuring oil pressure, revolving speed, temperature, etc.), take extreme care not to get rolled or caught in rotating parts or moving parts.
- 4) Before starting work, remove the leads from the battery. Always remove the lead from the negative (-) terminal first.
- 5) When raising a heavy component (heavier than 25 kg), use a hoist or crane. Before starting work, check that the slings (wire ropes, chains, and hooks) are free from damage. Always use slings which have ample capacity and install them to proper places. Operate the hoist or crane slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
- 6) When removing a cover which is under internal pressure or under pressure from a spring, always leave 2 bolts in diagonal positions. Loosen those bolts gradually and alternately to release the pressure, and then remove the cover.
- 7) When removing components, be careful not to break or damage the electrical wiring. Damaged wiring may cause electrical fires.
- 8) When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip and can even start fires.
- 9) As a general rule, do not use gasoline to wash parts. Do not use it to clean electrical parts, in particular.
- 10) Be sure to assemble all parts again in their original places. Replace any damaged parts and parts which must not be reused with new parts. When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is operated.
- 11) When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. In addition, check that connecting parts are correctly installed.
- 12) When assembling or installing parts, always tighten them to the specified torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
- 13) When aligning 2 holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
- 14) When measuring hydraulic pressure, check that the measuring tools are correctly assembled.
- 15) Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.
- 16) If the engine is operated for a long time in a place which is not ventilated well, you may suffer from gas poisoning. Accordingly, open the windows and doors to ventilate well.



**4. Precautions for sling work and making signs**

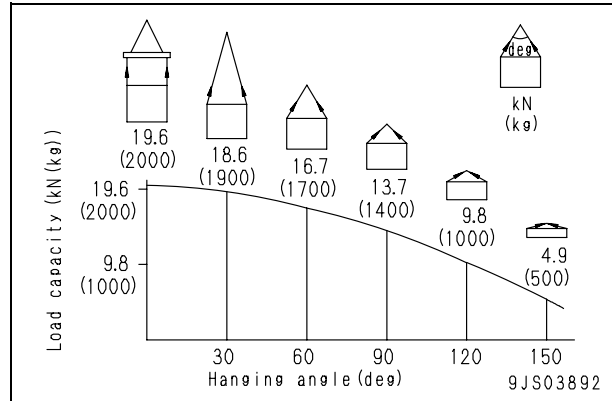
1) Only one appointed worker must make signs and co-workers must communicate with each other frequently. The appointed sign maker must make specified signs clearly at a place where he is well seen from the operator's seat and where he can see the working condition easily. The sign maker must always stand in front of the load and guide the operator safely.

- Do not stand under the load.
- Do not step on the load.

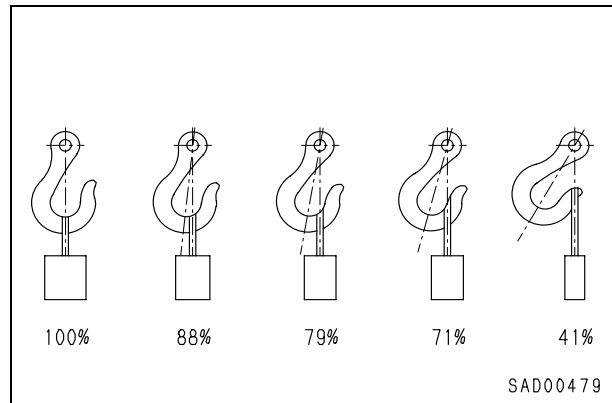
- 2) Check the slings before starting sling work.
- 3) Keep putting on gloves during sling work. (Put on leather gloves, if available.)
- 4) Measure the weight of the load by the eye and check its center of gravity.
- 5) Use proper sling according to the weight of the load and method of slinging. If too thick wire ropes are used to sling a light load, the load may slip and fall.
- 6) Do not sling a load with 1 wire rope alone. If it is slung so, it may rotate and may slip out of the rope. Install 2 or more wire ropes symmetrically.

**⚠ Slinging with 1 rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.**

- 7) Limit the hanging angle to 60°, as a rule. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with 2 or more ropes, the force subjected to each rope will increase with the hanging angle. The table below shows the variation of allowable load in kN {kg} when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 19.6 kN {2,000 kg} of total weight can be suspended. This weight is reduced to 9.8 kN {1,000 kg} when the 2 ropes make a hanging angle of 120°. If the 2 ropes sling a 19.6 kN {2,000 kg} load at a lifting angle of 150°, each of them is subjected to a force as large as 39.2 kN {4,000 kg}.



- 8) When installing wire ropes to an angular load, apply pads to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.
- 9) Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.
- 10) Apply wire ropes to the middle portion of the hook.
  - Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The hook has the maximum strength at the middle portion.




- 11) Do not use twisted or kinked wire ropes.
- 12) When lifting up a load, observe the following.
  - Wind in the crane slowly until wire ropes are stretched. When settling the wire ropes with the hand, do not grasp them but press them from above. If you grasp them, your fingers may be caught.
  - After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and pads.

- If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
  - Do not lift up the load slantingly.
- 13) When lifting down a load, observe the following.
- When lifting down a load, stop it temporarily at 30 cm above the floor, and then lower it slowly.
  - Check that the load is stable, and then remove the sling.
  - Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

#### 5. Precautions for using mobile crane

- ★ Read the Operation and Maintenance Manual of the crane carefully in advance and operate the crane safely.

#### 6. Precautions for using overhead hoist crane

**▲ When raising a heavy part (heavier than 25 kg), use a hoist, etc. In Disassembly and assembly, the weight of a part heavier than 25 kg is indicated after the mark of .**

- 1) Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, electric shock prevention earth leakage breaker, crane collision prevention device, and power application warning lamp, and check safety.
- 2) Observe the signs for sling work.
- 3) Operate the hoist at a safe place.
- 4) Check the direction indicator plates (east, west, south, and north) and the directions of the control buttons without fail.
- 5) Do not sling a load slantingly. Do not move the crane while the slung load is swinging.
- 6) Do not raise or lower a load while the crane is moving longitudinally or laterally.
- 7) Do not drag a sling.
- 8) When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
- 9) Consider the travel route in advance and lift up a load to a safe height.
- 10) Place the control switch on a position where it will not be an obstacle to work and passage.
- 11) After operating the hoist, do not swing the control switch.
- 12) Remember the position of the main switch so that you can turn off the power immediately in an emergency.

- 13) If the hoist stops because of a power failure, turn the power switch OFF. When turning on a switch which was turned OFF by the electric shock prevention earth leakage breaker, check that the devices related to that switch are not in operation state.
- 14) If you find an obstacle around the hoist, stop the operation.
- 15) After finishing the work, stop the hoist at the specified position and raise the hook to at least 2 m above the floor. Do not leave the sling installed to the hook.

#### 7. Selecting wire ropes

- 1) Select adequate ropes depending on the weight of parts to be hoisted, referring to the table below.

Wire ropes  
(Standard "Z" twist ropes without galvanizing)  
(JIS G3525, No. 6, Type 6X37-A)

Nominal diameter of rope mm	Allowable load	
	kN	ton
10	8.8	0.9
12	12.7	1.3
14	17.3	1.7
16	22.6	2.3
18	28.6	2.9
20	35.3	3.6
25	55.3	5.6
30	79.6	8.1
40	141.6	14.4
50	221.6	22.6
60	318.3	32.4

- ★ The allowable load is one-sixth of the breaking strength of the rope used (Safety coefficient: 6).

## 8. Precautions for disconnecting and connecting hoses and tubes in air conditioner circuit

### 1) Disconnection

**⚠ For the environment, the air conditioner of this machine uses the refrigerant (air conditioner gas: R134a) which has fewer factors of the depletion of the ozone layer. However, it does not mean that you may discharge the refrigerant into the atmosphere as it is. Be sure to recover the refrigerant when disconnecting the refrigerant gas circuit and then reuse it.**

★ Ask professional traders for collecting and filling operation of refrigerant (R134a).

★ Never release the refrigerant (R134a) to the atmosphere.

**⚠ If the refrigerant gas gets in your eyes or contacts your skin, you may lose your sight and your skin may be frozen. Accordingly, put on safety glasses, safety gloves and safety clothes when recovering or adding the refrigerant. Refrigerant gas must be recovered and added by a qualified person.**

### 2) Connection

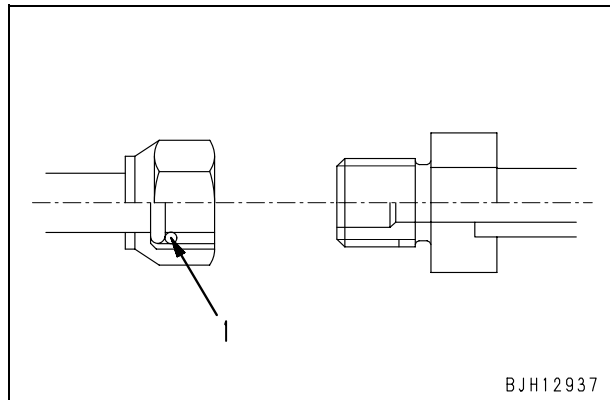
1] When installing the air conditioner circuit hoses and tubes, take care that dirt, dust, water, etc. will not enter them.

2] When connecting the air conditioner hoses and tubes, check that O-rings (1) are fitted to their joints.

3] Check that each O-ring is not damaged or deteriorated.

4] When connecting the refrigerant piping, apply compressor oil for refrigerant (R134a) (**DENSO: ND-OIL8, VALEO THERMAL SYSTEMS: ZXL100PG (equivalent to PAG46)**) to its O-rings.

★ Example of O-ring (Fitted to every joint of hoses and tubes)



★ For tightening torque, see the precautions for installation in each section of "Disassembly and assembly".

## How to read the shop manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult KOMATSU distributors.
- Materials and specifications are subject to change without notice.
- Shop manuals are divided into the “Chassis volume” and “Engine volume”. For the engine unit, see the engine volume of the engine model mounted on the machine.

### 1. Composition of shop manual

This shop manual contains the necessary technical information for services performed in a workshop. For ease of understanding, the manual is divided into the following sections.

#### 00. Index and foreword

This section explains the shop manuals list, table of contents, safety, and basic information.

#### 01. Specification

This section explains the specifications of the machine.

#### 10. Structure, function and maintenance standard

This section explains the structure, function, and maintenance standard values of each component. The structure and function sub-section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting. The maintenance standard sub-section explains the criteria and remedies for disassembly and service.

#### 20. Standard value table

This section explains the standard values for new machine and judgement criteria for testing, adjusting, and troubleshooting. This standard value table is used to check the standard values in testing and adjusting and to judge parts in troubleshooting.

#### 30. Testing and adjusting

This section explains measuring instruments and measuring methods for testing and adjusting, and method of adjusting each part. The standard values and judgement criteria for testing and adjusting are explained in Testing and adjusting.

#### 40. Troubleshooting

This section explains how to find out failed parts and how to repair them. The troubleshooting is divided by failure modes. The “S mode” of the troubleshooting related to the engine may be also explained in the Chassis volume and Engine volume. In this case, see the Chassis volume.

#### 50. Disassembly and assembly

This section explains the special tools and procedures for removing, installing, disassembling, and assembling each component, as well as precautions for them. In addition, tightening torque and quantity and weight of coating material, oil, grease, and coolant necessary for the work are also explained.

#### 90. Diagrams and drawings (chassis volume)/Repair and replacement of parts (engine volume)

- Chassis volume  
This section gives hydraulic circuit diagrams and electrical circuit diagrams.
- Engine volume  
This section explains the method of reproducing, repairing, and replacing parts.

### 2. Revision and distribution

Any additions, revisions, or other change of notices will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.