

Shop Manual

WHEEL LOADER

WA320-7

SERIAL NUMBERS 80001 and up

KOMATSU

SHOP MANUAL

WHEEL LOADER

WA320-7

Model Serial Number

WA320-7 80001 and up

00 Index and foreword

00 Index and foreword

Index

Index (ALL-0310-001-A-00-A)

00 Index and foreword	00-1
Index	00-2
Foreword, safety and general information	00-17
Important safety notice	00-17
How to read the shop manual	00-24
Explanation of terms for maintenance standard	00-26
Handling equipment of fuel system devices	00-28
Handling of intake system parts	00-29
Handling of hydraulic equipment	00-30
Method of disconnecting and connecting of push-pull type coupler	00-32
Handling of electrical equipment	00-35
How to read electric wire code	00-43
Precautions when performing operation	00-46
Practical use of KOMTRAX	00-51
Standard tightening torque table	00-52
List of abbreviation	00-58
Conversion table	00-63
01 Specification	01-1
Table of contents	01-2
Specifications	01-3
Specification drawing	01-3
Specifications	01-7
Weight table	01-17
Table of fuel, coolant, and lubricants	01-21
10 Structure and function	10-1
Table of contents	10-2
Engine and cooling system	10-4
Engine related parts	10-4
KVTG	10-6
EGR system piping drawing	10-13
EGR system circuit diagram	10-15
EGR valve	10-17
EGR cooler	10-19
KCCV layout drawing	10-20
KCCV ventilator	10-22
KDPF	10-24
Cooling system	10-28
Cooling fan motor	10-30
Power train	10-40
Power train system	10-40
Layout of power train parts	10-42
Damper	10-43
HST pump	10-44
HST motor1	10-57
HST motor2	10-59
Transfer	10-64
Clutch solenoid valve	10-71
Drive shaft	10-73
Axle	10-74
Differential	10-76
Torque proportional differential	10-80
Limited slip differential	10-82
Final drive	10-87
Steering system	10-89
Layout of steering devices	10-89
Steering column	10-90
Priority valve	10-91
Cushion valve	10-95

Emergency steering valve.....	10-96
Orbitrol valve	10-99
Brake system	10-105
Layout of brake parts.....	10-105
Brake accumulator charge valve.....	10-107
Brake valve	10-112
Brake accumulator	10-116
Slack adjuster.....	10-117
Brake	10-119
Parking brake control	10-122
Parking brake	10-123
Parking brake solenoid valve	10-124
Undercarriage and frame.....	10-126
Axle mount	10-126
Center hinge pin	10-128
Tire	10-129
Hydraulic system	10-131
Hydraulic component layout.....	10-131
Work equipment control	10-133
Hydraulic tank.....	10-134
Double type gear pump	10-137
Steering and work equipment pump.....	10-138
Control valve	10-150
CLSS.....	10-160
Hydraulic circuit diagram and names of valves.....	10-164
Self-pressure reducing valve.....	10-177
Work equipment PPC valve	10-182
Work equipment lock solenoid valve	10-190
PPC circuit accumulator	10-191
ECSS accumulator.....	10-192
Work equipment	10-193
Work equipment linkage	10-193
Bucket	10-194
Cab and its attachments.....	10-195
ROPS cab.....	10-195
Cab mount	10-197
Electrical system	10-198
Engine control system	10-198
Preheating system	10-201
Engine output limit function	10-203
Automatic warm-up function.....	10-204
Parking brake control system.....	10-205
System operating lamp function.....	10-209
Battery disconnect switch function	10-210
HST controller system.....	10-212
Machine monitor system.....	10-252
Rearview monitor system.....	10-273
KOMTRAX system.....	10-276
System component parts	10-279
Sensor	10-302
20 Standard value tables.....	20-1
Table of contents	20-2
Standard service value table.....	20-3
Standard value table for engine	20-3
Standard value table for machine	20-5
Standard value table for electrical system.....	20-17
30 Testing and adjusting	30-1
Table of contents	30-2
Related information on testing and adjusting	30-4

Tools for testing and adjusting	30-4
Sketch of tools for testing and adjusting	30-10
Engine and cooling system	30-11
Testing engine speed	30-11
Testing boost pressure	30-12
Testing exhaust gas temperature	30-14
Testing exhaust gas color	30-15
Testing and adjusting valve clearance	30-17
Testing compression pressure	30-20
Testing blowby pressure	30-24
Testing engine oil pressure	30-25
Testing EGR valve and KVGT driving oil pressure	30-26
Testing fuel pressure	30-27
Testing fuel discharge, return and leakage	30-32
Bleeding air from fuel system	30-37
Testing fuel circuit for leakage	30-39
Handling cylinder cutout mode operation	30-40
Handling no-injection cranking operation	30-41
Testing of KDPF and muffler stack for looseness and damage	30-42
Testing of installed condition of cylinder heads and manifolds	30-43
Testing engine piping for damage and looseness	30-44
Testing and adjusting air conditioner compressor belt tension	30-45
Replacing alternator belt	30-46
Power train	30-47
Testing oil leakage from axle final drive	30-47
Testing drive shaft for looseness, backlash, and damage	30-48
Testing accelerator pedal	30-49
Testing and adjusting HST oil pressure	30-50
Testing transfer clutch control pressure	30-53
Steering system	30-54
Testing directional lever	30-54
Testing steering wheel	30-55
Testing work equipment control lever	30-57
Testing and adjusting steering circuit oil pressure	30-59
Bleeding air from steering cylinder circuit	30-61
Brake system	30-62
Testing brake pedal	30-62
Testing braking performance	30-63
Testing and adjusting of accumulator charge pressure	30-64
Testing wheel brake oil pressure	30-66
Testing lowering of wheel brake pressure	30-67
Testing wear of wheel brake disc	30-69
Bleeding air from wheel brake circuit	30-70
Releasing remaining pressure in brake accumulator circuit	30-71
Testing parking brake performance	30-72
Testing wear of parking brake disc	30-73
Testing parking brake release pressure	30-74
Method of releasing parking brake manually	30-75
Hydraulic system	30-76
Testing cooling fan speed	30-76
Testing cooling fan pump circuit oil pressure	30-77
Bleeding air from hydraulic fan circuit	30-79
Testing and adjusting work equipment PPC oil pressure	30-80
Testing and adjusting work equipment oil pressure	30-82
Bleeding air from work equipment circuit	30-86
Releasing remaining pressure from work equipment circuit	30-87
Testing ECSS accumulator nitrogen gas pressure and procedure for charging accumulator with nitrogen gas	30-89
Work equipment	30-93

Testing and adjusting bucket positioner and bucket proximity switch	30-93
Testing and adjusting boom position detection lever	30-95
Electrical system	30-96
Adjusting replaced, reassembled or added sensor, controller, etc. with machine monitor	30-96
Special functions of machine monitor	30-97
Adjusting rearview camera angle	30-176
Handling voltage circuit of engine controller	30-177
Handling battery disconnect switch	30-178
Testing diodes	30-179
Pm clinic	30-180
Pm Clinic service	30-180
Check sheet	30-181
40 Troubleshooting	40-1
Table of contents	40-2
Related information on troubleshooting	40-11
Troubleshooting points	40-11
Sequence of events in troubleshooting	40-13
Checks before troubleshooting	40-15
Inspection procedure before troubleshooting	40-17
Preparation for troubleshooting of electrical system	40-34
Classification and procedures for troubleshooting	40-40
Symptom and troubleshooting numbers	40-43
Information in troubleshooting table	40-46
Procedure for troubleshooting wiring harness of pressure sensor system for open circuit	40-48
Connector list and layout	40-51
Connector contact identification	40-65
T-branch box and T-branch adapter table	40-103
Fuse location table	40-108
Precautions for KDPF (KCSF and KDOC) Cleaning and Replacement	40-111
Precautions when performing troubleshooting of machine monitor	40-114
Processing procedure of harness checker for troubleshooting of machine monitor LCD unit	40-116
Preparation of dummy temperature sensor (for KDOC and KDPF temperature sensors)	40-121
Preparation of short circuit electrical connector (for failure codes [CA1883] and [CA3135])	40-122
Failure codes table	40-123
Troubleshooting by failure code (Display of code)	40-135
Failure code [2F00MA] Failure of Parking Brake Circuit	40-135
Failure code [2F00MB] Malfunction of Parking Brake	40-138
Failure code [2G42ZG] Accumulator Oil Pressure Low (Front)	40-140
Failure code [2G43ZG] Accumulator Oil Pressure Low (Rear)	40-142
Failure code [6091NX] HST Oil Filter Clogging	40-144
Failure code [7RHYKA] Disconnection of Fan Variable Control Sol.	40-146
Failure code [7RHYKB] Ground Fault of Fan Variable Control Sol.	40-148
Failure code [7RHYKY] Hot Short of Fan Variable Control Sol.	40-150
Failure code [879AKA] A/C Inner Sensor Open Circuit	40-152
Failure code [879AKB] A/C Inner Sensor Short Circuit	40-153
Failure code [879BKA] A/C Outer Sensor Open Circuit	40-154
Failure code [879BKB] A/C Outer Sensor Short Circuit	40-155
Failure code [879CKA] Ventilating Sensor Open Circuit	40-156
Failure code [879CKB] Ventilating Sensor Short Circuit	40-157
Failure code [879DKZ] Sunlight Sensor Open or Short Circuit	40-158
Failure code [879EMC] Ventilation Damper Abnormality	40-159
Failure code [879FMC] Air Mix Damper Abnormality	40-160
Failure code [989L00] Engine Controller Lock Caution 1	40-161
Failure code [989M00] Engine Controller Lock Caution 2	40-162

00 Index and foreword

Index

Failure code [989N00] Engine Controller Lock Caution 3	40-163
Failure code [A1U0N3] HC Desorb Request 1	40-164
Failure code [A1U0N4] HC Desorb Request 2	40-166
Failure code [AA10NX] Air Cleaner Clogging	40-168
Failure code [B@BAZG] Eng Oil Press Low	40-170
Failure code [B@BAZK] Engine Oil Level Low	40-171
Failure code [B@BCNS] Eng Water Overheat	40-173
Failure code [B@BCZK] Eng Water Level Low	40-174
Failure code [B@CRNS] HST Oil Temp. Overheat	40-176
Failure code [CA115] Eng Ne and Bkup Speed Sens Error	40-177
Failure code [CA122] Chg Air Press Sensor High Error	40-178
Failure code [CA123] Chg Air Press Sensor Low Error	40-180
Failure code [CA131] Throttle Sensor High Error	40-182
Failure code [CA132] Throttle Sensor Low Error	40-184
Failure code [CA144] Coolant Temp Sens High Error	40-186
Failure code [CA145] Coolant Temp Sens Low Error	40-188
Failure code [CA153] Chg Air Temp Sensor High Error	40-190
Failure code [CA154] Chg Air Temp Sensor Low Error	40-192
Failure code [CA187] Sensor 2 Supply Volt Low Error	40-194
Failure code [CA221] Ambient Press Sensor High Error	40-196
Failure code [CA222] Ambient Press Sensor Low Error	40-198
Failure code [CA227] Sensor 2 Supply Volt High Error	40-200
Failure code [CA234] Eng Overspeed	40-201
Failure code [CA238] Ne Speed Sensor Supply Volt Error	40-202
Failure code [CA239] Ne Speed Sens Supply Volt High Error	40-203
Failure code [CA271] IMV/PCV1 Short Error	40-204
Failure code [CA272] IMV/PCV1 Open Error	40-206
Failure code [CA295] Ambient Press Sens In Range Error	40-208
Failure code [CA322] Inj #1(L#1) Open/Short Error	40-209
Failure code [CA323] Inj #5(L#5) Open/Short Error	40-211
Failure code [CA324] Inj #3(L#3) Open/Short Error	40-213
Failure code [CA325] Inj #6(L#6) Open/Short Error	40-215
Failure code [CA331] Inj #2(L#2) Open/Short Error	40-217
Failure code [CA332] Inj #4(L#4) Open/Short Error	40-219
Failure code [CA343] ECM Critical Internal Failure	40-221
Failure code [CA351] Injectors Drive Circuit Error	40-222
Failure code [CA352] Sensor 1 Supply Volt Low Error	40-223
Failure code [CA356] Mass Air Flow Sensor High Error	40-225
Failure code [CA357] Mass Air Flow Sensor Low Error	40-227
Failure code [CA386] Sensor 1 Supply Volt High Error	40-229
Failure code [CA428] Water in Fuel Sensor High Error	40-230
Failure code [CA429] Water in Fuel Sensor Low Error	40-232
Failure code [CA431] Idle Validation Sw Error	40-234
Failure code [CA432] Idle Validation Process Error	40-237
Failure code [CA435] Eng Oil Press Sw Error	40-240
Failure code [CA441] Battery Voltage Low Error	40-241
Failure code [CA442] Battery Voltage High Error	40-243
Failure code [CA449] Rail Press Very High Error	40-244
Failure code [CA451] Rail Press Sensor High Error	40-245
Failure code [CA452] Rail Press Sensor Low Error	40-247
Failure code [CA488] Chg Air Temp High Torque Derate	40-249
Failure code [CA515] Rail Press Sens Sup Volt High Error	40-250
Failure code [CA516] Rail Press Sens Sup Volt Low Error	40-252
Failure code [CA553] Rail Press High Error	40-254
Failure code [CA555] Crankcase Press High Error 1	40-255
Failure code [CA556] Crankcase Press High Error 2	40-256
Failure code [CA559] Rail Press Low Error	40-257
Failure code [CA595] Turbo Speed High Error 2	40-259
Failure code [CA687] Turbo Speed Low Error	40-260

Failure code [CA689] Eng Ne Speed Sensor Error	40-262
Failure code [CA691] Intake Air Temp Sens High Error	40-264
Failure code [CA692] Intake Air Temp Sens Low Error	40-266
Failure code [CA697] ECM Internal Temp Sensor High Error	40-268
Failure code [CA698] ECM Int Temp Sensor Low Error	40-269
Failure code [CA731] Eng Bkup Speed Sens Phase Error	40-270
Failure code [CA778] Eng Bkup Speed Sensor Error	40-272
Failure code [CA1117] Persistent Data Lost Error	40-277
Failure code [CA1664] KDOC Malfunction	40-278
Failure code [CA1691] Regeneration Ineffective	40-281
Failure code [CA1695] Sensor 5 Supply Volt High Error	40-284
Failure code [CA1696] Sensor 5 Supply Volt Low Error	40-285
Failure code [CA1843] Crankcase Press Sens High Error	40-287
Failure code [CA1844] Crankcase Press Sens Low Error	40-289
Failure code [CA1879] KDPF Delta P Sensor High Error	40-291
Failure code [CA1881] KDPF Delta P Sensor Low Error	40-293
Failure code [CA1883] KDPF Delta P Sens In Range Error	40-295
Failure code [CA1921] KDPF Soot Load High Error 1	40-299
Failure code [CA1922] KDPF Soot Load High Error 2	40-302
Failure code [CA1942] Crankcase Press Sens In Range Error	40-307
Failure code [CA1993] KDPF Delta Pressure Low Error	40-308
Failure code [CA2185] Throt Sensor Sup Volt High Error	40-311
Failure code [CA2186] Throt Sensor Sup Volt Low Error	40-313
Failure code [CA2249] Rail Press Very Low Error	40-315
Failure code [CA2271] EGR Valve Pos Sens High Error	40-316
Failure code [CA2272] EGR Valve Pos Sens Low Error	40-318
Failure code [CA2288] Turbo Speed High Error 1	40-321
Failure code [CA2311] IMV Solenoid Error	40-322
Failure code [CA2349] EGR Valve Solenoid Open Error	40-323
Failure code [CA2353] EGR Valve Solenoid Short Error	40-325
Failure code [CA2357] EGR Valve Servo Error	40-327
Failure code [CA2373] Exhaust Manifold Press Sens High error	40-328
Failure code [CA2374] Exhaust Manifold Press Sens Low error	40-330
Failure code [CA2375] EGR Orifice Temp Sens High Error	40-332
Failure code [CA2376] EGR Orifice Temp Sens Low Error	40-334
Failure code [CA2381] KVGt Pos Sens High Error	40-336
Failure code [CA2382] KVGt Pos Sens Low Error	40-338
Failure code [CA2383] KVGt Solenoid Open Error	40-341
Failure code [CA2386] KVGt Solenoid Short Error	40-343
Failure code [CA2387] KVGt Servo Error	40-345
Failure code [CA2554] Exh Manifold Press Sens In Range Error	40-346
Failure code [CA2555] Grid Htr Relay Volt Low Error	40-347
Failure code [CA2556] Grid Htr Relay Volt High Error	40-349
Failure code [CA2637] KDOC Face Plugging	40-351
Failure code [CA2639] Manual Stationary Regeneration Request	40-353
Failure code [CA2961] EGR Orifice Temp High Error 1	40-356
Failure code [CA2973] Chg Air Press Sensor In Range Error	40-357
Failure code [CA3133] KDPF Outlet Press Sens High Error	40-358
Failure code [CA3134] KDPF Outlet Press Sens Low Error	40-360
Failure code [CA3135] KDPF Outlet Press Sens In Range Error	40-362
Failure code [CA3251] KDOC Inlet Temp High Error	40-366
Failure code [CA3253] KDOC Temp Error - Non Regeneration	40-369
Failure code [CA3254] KDOC Outlet Temp High Error 1	40-372
Failure code [CA3255] KDPF Temp Error - Non Regeneration	40-375
Failure code [CA3256] KDPF Outlet Temp High Error 1	40-378
Failure code [CA3311] KDOC Outlet Temp High Error 2	40-381
Failure code [CA3312] KDPF Outlet Temp High Error 2	40-384
Failure code [CA3313] KDOC Inlet Temp Sensor Low Error	40-387
Failure code [CA3314] KDOC Inlet Temp Sens High Error	40-390

Failure code [CA3315] KDOC Inlet Temp Sens In Range Error.....	40-393
Failure code [CA3316] KDOC Outlet Temp Sens Low Error	40-397
Failure code [CA3317] KDOC Outlet Temp Sens High Error.....	40-400
Failure code [CA3318] KDOC Outlet Temp Sens In Range Error	40-403
Failure code [CA3319] KDPF Outlet Temp Sens High Error	40-407
Failure code [CA3321] KDPF Outlet Temp Sens Low Error	40-410
Failure code [CA3322] KDPF Outlet Temp Sens In Range Error.....	40-413
Failure code [CA3419] Mass Air Flow Sensor Sup Volt High Error	40-417
Failure code [CA3421] Mass Air Flow Sensor Sup Volt Low Error.....	40-419
Failure code [CA3741] Rail Press Valve Trip Error.....	40-421
Failure code [D110L4] Disconnection of Battery Relay Signal.....	40-422
Failure code [D160KA] Disconnection of Backup Lamp Relay Output.....	40-424
Failure code [D160KY] Hot Short of Backup Lamp Relay Output.....	40-426
Failure code [D191KA] Disconnection of Neutral Output Relay.....	40-428
Failure code [D191KB] Ground Fault of Neutral Output Relay	40-430
Failure code [D191KY] Hot Short of Neutral Output Relay.....	40-432
Failure code [D192KA] Disconnection of ECSS Solenoid.....	40-434
Failure code [D192KB] Ground Fault of ECSS Solenoid	40-436
Failure code [D192KY] Hot Short of ECSS Solenoid	40-437
Failure code [D19JKZ] Personal Code Relay Abnormality.....	40-438
Failure code [D1B0KA] Disconnection of HST Safety Relay.....	40-440
Failure code [D1B0KB] Ground Fault of HST Safety Relay	40-442
Failure code [D1B0KY] Hot Short of HST Safety Relay.....	40-444
Failure code [D1B0MC] Malfunction of HST Safety Relay	40-446
Failure code [D1E6KA] Disconnection of Parking Brake Relay.....	40-447
Failure code [D1E6KB] Ground Fault of Parking Brake Relay.....	40-449
Failure code [D1E6KY] Hot Short of Parking Brake Relay	40-451
Failure code [D5ZHKA] Failure of Key SW C Signal	40-453
Failure code [D5ZHKB] Key SW C Signal Short Circuit.....	40-455
Failure code [D5ZHL6] Disconnection of Key SW C	40-457
Failure code [D811MC] KOMTRAX Error.....	40-458
Failure code [D862KA] GPS Antenna Open Circuit	40-459
Failure code [D8ALKA] Operating Lamp Open Circuit (KOMTRAX).....	40-460
Failure code [D8ALKB] Operating Lamp Short Circuit (KOMTRAX).....	40-462
Failure code [D8AQK4] CAN2 Discon (KOMTRAX) 2.....	40-464
Failure code [D8AQKR] CAN2 Discon (KOMTRAX).....	40-465
Failure code [DAF0KT] Abnormality of Non-volatile Memory (MON)	40-467
Failure code [DAF0MB] Monitor ROM Abnormality.....	40-468
Failure code [DAF0MC] Monitor Error	40-469
Failure code [DAF3KK] Controller Power Source Low (MON).....	40-470
Failure code [DAF8KB] Camera Power Supply Short Circuit	40-472
Failure code [DAFDKB] Monitor 12V Power Output Short Circuit.....	40-473
Failure code [DAFGMC] GPS Module Error.....	40-474
Failure code [DAFLKA] Operating Lamp Open Circuit (MON).....	40-475
Failure code [DAFLKB] Operating Lamp Short Circuit (MON).....	40-477
Failure code [DAFQKR] CAN2 Discon (Monitor)	40-479
Failure code [DAJ0KK] Controller Power Source Low (HST).....	40-480
Failure code [DAJ0KT] Abnormality of Non-volatile Memory (HST).....	40-483
Failure code [DAJ0MC] HST Con Error	40-484
Failure code [DAJ1KA] Disconnection of Key SW ACC (HST).....	40-485
Failure code [DAJ2KK] Solenoid Power Source Low (HST)	40-487
Failure code [DAJ4KB] Ground Fault of Sol. Self-Holding Relay	40-490
Failure code [DAJ4KZ] Failure of Sol. Self-Holding Relay	40-492
Failure code [DAJ5KX] Failure of 5V Power Source 0.....	40-494
Failure code [DAJ6KX] Failure of 5V Power Source 1.....	40-496
Failure code [DAJ9KQ] Inconsistency of Model Selection (HST)	40-498
Failure code [DAJLKA] Operating Lamp Open Circuit (HST).....	40-499
Failure code [DAJLKB] Operating Lamp Short Circuit (HST)	40-501
Failure code [DAJQKR] CAN2 Discon (HST Con)	40-503

Failure code [DAJRKR] CAN1 Discon (HST Con)	40-504
Failure code [DAJRMA] Inconsistency of Option Selection (HST)	40-505
Failure code [DAZ9KQ] A/C Model Selection Abnormality	40-506
Failure code [DAZQKR] CAN2 Discon (Aircon ECU)	40-507
Failure code [DB2QKR] CAN2 Discon (Engine Con)	40-508
Failure code [DB2RKR] CAN1 Discon (Engine Con)	40-513
Failure code [DD1ALD] Ground Fault of Remote Positioner Set SW	40-517
Failure code [DDAAL6] Discon of Engine Shutdown Secondary Switch	40-519
Failure code [DDB2L4] Stop Lamp Switch Signal Malfunction	40-521
Failure code [DDB6L4] Parking Brake Signal Malfunction	40-523
Failure code [DDD7KA] Failure of Variable Speed Control	40-526
Failure code [DDD7KY] Hot Short of Variable Speed Control	40-528
Failure code [DDK3KA] FNR SW Input Signal Disconnection	40-530
Failure code [DDK3KB] FNR SW Input Signal Short Circuit	40-532
Failure code [DDK6KA] FNR Lever Input Signal Disconnection	40-534
Failure code [DDK6KB] FNR Lever Input Signal Short Circuit	40-537
Failure code [DDNRLD] Ground Fault of Work Equip. Lock Switch	40-539
Failure code [DF10KA] Disconnection of Speed Range Input	40-541
Failure code [DF10KB] Ground Fault of Speed Range Input	40-544
Failure code [DGH1KX] Out of Range of HST Oil Temp. Sensor	40-547
Failure code [DGR2KB] Ground Fault of Brake Oil Temp. Sensor	40-549
Failure code [DGR2KZ] Failure of Brake Oil Temp. Sensor	40-551
Failure code [DHA4KA] Failure of Air Cleaner Sensor Circuit	40-553
Failure code [DHHBKA] Failure of HST Press. Sens. Circuit (MA)	40-555
Failure code [DHHBKY] Hot Short of HST Press. Sens. Circuit (MA)	40-557
Failure code [DHHCKA] Failure of HST Press. Sens. Circuit (MB)	40-559
Failure code [DHHCKY] Hot Short of HST Press. Sens. Circuit (MB)	40-561
Failure code [DHPCKA] Failure of Boom Press. Sensor (Bottom)	40-563
Failure code [DHPCKY] Hot Short of Boom Press. Sensor (Bottom)	40-565
Failure code [DHPEKA] Failure of Steering & Loader Pump Press	40-567
Failure code [DHPEKY] Hot Short of Steering & Loader Pump Press	40-569
Failure code [DHS8KA] Failure of Boom Raise PPC Sens. Circuit	40-571
Failure code [DHS8KY] Hot Short of Boom Raise PPC Sens. Circuit	40-573
Failure code [DHS9KA] Failure of Boom Lower PPC Sens. Circuit	40-575
Failure code [DHS9KY] Hot Short of Boom Lower PPC Sens. Circuit	40-577
Failure code [DHSDKA] Failure of Bucket Dump PPC Sens. Circuit	40-579
Failure code [DHSDKY] Hot Short of Bucket Dump PPC Sens. Circuit	40-581
Failure code [DHSNKA] Failure of Bucket Tilt PPC Sens. Circuit	40-583
Failure code [DHSNKY] Hot Short of Bucket Tilt PPC Sens. Circuit	40-585
Failure code [DHT8ZG] Steering Oil Pressure Low	40-587
Failure code [DHTCL6] Failure of HST Oil Filter Sensor Circuit	40-588
Failure code [DJF1KA] Disconnection of Fuel Level Sensor	40-590
Failure code [DK55KA] Failure of FNR Lever Potentio	40-592
Failure code [DK55KY] Hot Short of FNR Lever Potentio Circuit	40-595
Failure code [DK55L5] Failure of FNR Lever Potentio	40-597
Failure code [DK5DKA] Failure of 3rd Lever Potentio (Main)	40-598
Failure code [DK5DKY] Hot Short of 3rd Lever Potentio (Main)	40-601
Failure code [DK5DL8] 3rd Lever Potentio (Main & Sub) Disagree	40-604
Failure code [DK5EKA] Failure of 3rd Lever Potentio (Sub)	40-607
Failure code [DK5EKY] Hot Short of 3rd Lever Potentio (Sub)	40-610
Failure code [DK70KA] Failure of inching sensor Circuit	40-613
Failure code [DK70KY] Hot Short of inching sensor Circuit	40-616
Failure code [DKA0KA] Failure of Boom Angle Sensor	40-618
Failure code [DKA0KY] Hot Short of Boom Angle Sensor Circuit	40-620
Failure code [DKA0L0] Boom Angle Sensor Dislocation	40-622
Failure code [DLM3KA] Disconnection of Radiator Fan Speed Sensor	40-624
Failure code [DLM3LC] Failure of Radiator Fan Speed Sensor	40-626
Failure code [DLT3KX] Vehicle Speed Sensor Circuit Failure (B)	40-628
Failure code [DLT4KX] Vehicle Speed Sensor Circuit Failure (A)	40-630

Failure code [DLT4L0] Vehicle Speed Sensor Failure (A & B).....	40-632
Failure code [DLT4LC] Vehicle Speed Sensor Failure (A or B)	40-635
Failure code [DPQ1KR] LIN Discon (Switch Panel)	40-637
Failure code [DPQ2KR] LIN Discon (LED Unit)	40-640
Failure code [DPQ3KR] LIN Discon (Rear View Monitor)	40-643
Failure code [DSJ0KR] CAN2 Discon (Meter Unit)	40-646
Failure code [DT22KB] Ground Fault of Work Equip. Lock Indic.	40-648
Failure code [DV00KB] Ground Fault of Buzzer Output.....	40-650
Failure code [DW26KA] Disconnection of Motor 2 Solenoid	40-652
Failure code [DW26KB] Ground Fault of Motor 2 Solenoid	40-654
Failure code [DW26KY] Hot Short of Motor 2 Solenoid	40-656
Failure code [DW4BKA] Disconnection of Parking Brake Valve	40-658
Failure code [DW4BKB] Ground Fault of Parking Brake Valve.....	40-660
Failure code [DW4BKY] Hot Short of Parking Brake Valve	40-662
Failure code [DW4RKA] Disconnection of Bucket EPC Sol. (Tilt).....	40-663
Failure code [DW4RKB] Ground Fault of Bucket EPC Solenoid (Tilt)	40-665
Failure code [DW4RKY] Hot Short of Bucket EPC Solenoid (Tilt).....	40-667
Failure code [DWM1KA] Disconnection of Neutral Lock Solenoid	40-668
Failure code [DWM1KB] Ground Fault of Neutral Lock Solenoid.....	40-670
Failure code [DWM1KY] Hot Short of Neutral Lock Solenoid	40-672
Failure code [DWN6KA] Disconnection of Detent Solenoid (Boom)	40-673
Failure code [DWN6KB] Ground Fault of Detent Solenoid (Boom)	40-675
Failure code [DWN6KY] Hot Short of Detent Solenoid (Boom)	40-677
Failure code [DWN8KA] Disconnection of Detent Solenoid (Bucket).....	40-679
Failure code [DWN8KB] Ground Fault of Detent Solenoid (Bucket).....	40-681
Failure code [DWN8KY] Hot Short of Detent Solenoid (Bucket).....	40-683
Failure code [DX19KA] Disconnection of Motor 1 Solenoid	40-684
Failure code [DX19KB] Ground Fault of Motor 1 Solenoid.....	40-686
Failure code [DX19KY] Hot Short of Motor 1 Solenoid	40-688
Failure code [DX20KA] Disconnection of Clutch Control Solenoid	40-690
Failure code [DX20KB] Ground Fault of Clutch Control Solenoid	40-692
Failure code [DX20KY] Hot Short of Clutch Control Solenoid	40-694
Failure code [DXAWKA] Disconnection of HST Pump EPC Sol.	40-696
Failure code [DXAWKB] Ground Fault of HST Pump EPC Sol.....	40-698
Failure code [DXAWKY] Hot Short of HST Pump EPC Sol.	40-700
Failure code [DXH7KA] Disconnection of Reverse Solenoid	40-702
Failure code [DXH7KB] Ground Fault of Reverse Solenoid	40-704
Failure code [DXH7KY] Hot Short of Reverse Solenoid	40-706
Failure code [DXH8KA] Disconnection of Forward Solenoid.....	40-708
Failure code [DXH8KB] Ground Fault of Forward Solenoid	40-710
Failure code [DXH8KY] Hot Short of Forward Solenoid.....	40-712
Failure code [DXHJKA] Disconnection of 3rd EPC Solenoid (EXT).....	40-714
Failure code [DXHJKB] Ground Fault of 3rd EPC Solenoid (EXT).....	40-716
Failure code [DXHJKY] Hot Short of 3rd EPC Solenoid (EXT).....	40-718
Failure code [DXHKKA] Disconnection of 3rd EPC Solenoid (RET)	40-719
Failure code [DXHKKB] Ground Fault of 3rd EPC Solenoid (RET).....	40-721
Failure code [DXHKKY] Hot Short of 3rd EPC Solenoid (RET)	40-723
Failure code [H2K0KA] Failure of Quick Coupler Lock Signal	40-724
Failure code [H2K0KY] Hot Short of Quick Coupler Lock Signal	40-727
Failure code [J141N1] Steering Pump Over Run	40-729
Failure code [LA00L3] Failure of Fan Reverse	40-730
Failure code [M100N1] HST Pump Over Run	40-731
Failure code [M400N1] HST Motor 1 Over Run	40-732
Troubleshooting of electrical system (E-mode)	40-733
E-1 Engine does not start.....	40-733
E-2 Manual preheating system does not work.....	40-740
E-3 Automatic preheating system does not work.....	40-743
E-4 While preheating is working, preheating monitor does not light up	40-745

E-6 LCD unit on machine monitor displays nothing.....	40-750
E-7 Backlight of LCD unit on machine monitor is abnormal (Backlight goes out or flickers).....	40-752
E-8 LCD on machine monitor does not display properly.....	40-754
E-9 Meter unit display on machine monitor is abnormal.....	40-756
E-10 Night lighting lamp of meter unit on machine monitor is abnormal.....	40-759
E-11 Caution LED on machine monitor is abnormal.....	40-762
E-12 LED of switch panel on machine monitor is abnormal or switches does not operate properly.....	40-764
E-13 Two switches operation of switch panel on machine monitor does not function.....	40-766
E-14 Switch panel buzzer of machine monitor is abnormal.....	40-769
E-15 Rearview monitor does not light up or backlight flickers.....	40-771
E-16 Rearview monitor images are not displayed clearly.....	40-774
E-17 Rearview monitor brightness cannot be adjusted.....	40-777
E-18 Night lighting lamp of rearview monitor is abnormal.....	40-780
E-19 Some items of gauges and caution lamps on machine monitor are not displayed properly.....	40-782
E-20 Parking brake indicator lamp does not light when the parking brake is set to ON (Parking) position.....	40-783
E-21 When brake accumulator oil pressure drops, the brake oil pressure caution lamp does not light.....	40-787
E-22 Air cleaner clogging indicator lamp does not light.....	40-789
E-23 Radiator coolant level caution lamp does not light.....	40-791
E-24 Indication of HST oil temperature gauge does not increase, or HST oil temperature caution lamp does not light.....	40-793
E-25 When brake pedal (inching pedal) is depressed, inching function does not work (travel speed or traction force does not lower), or while not depressed, inching function operates.....	40-794
E-26 Fuel level gauge does not indicate correct level.....	40-796
E-27 Seat belt caution lamp indication is abnormal.....	40-798
E-28 Horn does not sound.....	40-799
E-29 Horn does not stop sounding.....	40-802
E-30 Alarm buzzer does not sound.....	40-804
E-31 When starting switch is in ON position, alarm buzzer does not stop sounding.....	40-806
E-32 When emergency HST pump drive switch is operated, emergency HST pump does not work or when emergency HST pump drive switch is not operated, emergency HST pump works.....	40-807
E-33 Setting does not change while operating traction control switch.....	40-809
E-34 Parking brake does not work even if it is applied, or the brake drags when parking brake is released and FR drive is operated.....	40-811
E-35 Remote positioner does not work or cannot be released.....	40-814
E-36 Bucket positioner does not work or cannot be released.....	40-816
E-37 Direction selector (FNR) switch mode is not selected or not released.....	40-819
E-38 PZ auto tilt-in does not work.....	40-821
E-39 Tractraction level does not display MAX when max traction switch is turned ON.....	40-824
E-40 ECSS function cannot be selected or cannot be released.....	40-826
E-41 None of headlamp, clearance lamp, and tail lamp lights.....	40-828
E-42 Clearance lamp, tail lamp and license plate lamp do not light up or go out.....	40-830
E-43 Both High and Low beams of headlamp do not light up or go out.....	40-834
E-44 Low beam of headlamp does not light up or go out.....	40-838
E-45 High beam of headlamp does not light up or go out.....	40-840
E-46 Front working lamp does not light up or go out.....	40-842
E-47 Rear working lamp does not light up or go out.....	40-846
E-48 All of turn signal lamps and hazard lamps do not flash or go out.....	40-850
E-49 Turn signal lamps do not flash or go out.....	40-853
E-50 Hazard lamp does not flash or go out.....	40-856
E-51 Brake lamp does not light or stays lighted.....	40-859
E-52 Backup lamp does not light up or does not go out.....	40-862
E-53 Backup buzzer does not sound or continues to sound.....	40-865

E-54 Front wiper does not operate	40-867
E-55 Rear wiper does not operate	40-870
E-56 Window washer does not operate	40-872
E-57 KOMTRAX system does not operate normally	40-875
Troubleshooting of hydraulic and mechanical system (H-mode)	40-877
Information described in troubleshooting table (H-mode)	40-877
System chart of hydraulic and mechanical systems	40-878
Failure mode and cause table	40-880
H-1 Machine does not travel forward or backward	40-887
H-2 Machine does not travel forward (Machine travels backward normally)	40-890
H-3 Machine does not travel backward (Machine travels forward normally)	40-891
H-4 Machine does not travel forward or backward fast	40-892
H-5 Machine does not travel forward fast (Machine travel backward fast)	40-896
H-6 Machine does not travel backward fast (Machine travel forward fast)	40-897
H-7 Machine lacks power neither when traveling forward nor backward	40-898
H-8 Machine lacks power when traveling forward (Machine has sufficient power when traveling backward)	40-901
H-9 Machine lacks power when traveling backward (Machine have sufficient power when traveling forward)	40-902
H-10 Engine stalls during travel or engine speed drops significantly	40-903
H-11 Steering wheel is too heavy to turn	40-904
H-12 Steering wheel is heavy to turn	40-906
H-13 Machine sways or large shocks are made while machine turns	40-907
H-14 Machine unintentionally turns when machine travels	40-908
H-15 Wheel brakes do not work or are weak	40-909
H-16 Wheel brakes are not released or drag	40-910
H-17 Parking brake does not work or it is weak	40-911
H-18 Parking brake is not released or drags	40-912
H-19 Boom does not rise	40-913
H-20 Boom moves slow or boom lacks lifting force	40-915
H-21 Rising boom slows down at certain height	40-917
H-22 Lift cylinders do not serve to hold bucket (bucket rises off ground)	40-918
H-23 Hydraulic drift of boom is large	40-919
H-24 Boom moves up and down during operation	40-920
H-25 Bucket does not tilt back	40-921
H-26 Bucket moves slow or lacks tilt force	40-923
H-27 Bucket decelerates during tilt-back operation	40-925
H-28 Bucket cylinder does not hold bucket on ground	40-926
H-29 Hydraulic drift of bucket is large	40-927
H-30 Bucket tilts back and forth during carrying load	40-928
H-31 Boom and bucket control levers do not move smoothly and are heavy to move	40-929
H-32 Operating work equipment causes engine speed to lower significantly or engine to stall	40-930
H-33 Large shocks are made when work equipment starts to move and stops	40-931
H-34 When certain work equipment is relieved hydraulically, other work equipment moves	40-932
H-35 E.C.S.S. (travel damper) does not work and machine pitches and bounces	40-933
H-36 Fan speed is abnormal (too high or low, or fan does not rotate)	40-934
H-37 Unusual noise is heard from around fan	40-936
Troubleshooting of engine (S-mode)	40-937
Information described in troubleshooting table (S mode)	40-937
S-1 Engine does not crank when starting switch is turned to START position	40-938
S-2 Engine cranks but no exhaust smoke comes out	40-939
S-3 Fuel is being injected but engine does not start (misfiring: engine cranks but does not start)	40-940
S-4 Engine startability is poor	40-941
S-5 Engine does not pick up smoothly	40-943
S-6 Engine stops during operation	40-945
S-7 Engine runs rough or is unstable	40-947

S-8 Engine lacks power	40-948
S-9 KDPF gets clogged in a short time	40-950
S-10 Engine oil consumption is excessive	40-952
S-11 Engine oil becomes contaminated early	40-953
S-12 Fuel consumption is excessive	40-954
S-13 Oil is in coolant (or coolant spurts or coolant level goes down)	40-955
S-14 Oil pressure drops	40-956
S-15 Fuel mixes into engine oil	40-957
S-16 Water mixes into engine oil (milky)	40-958
S-17 Coolant temperature rises too high (overheating)	40-959
S-18 Unusual noise is heard	40-960
S-19 Vibration is excessive	40-961
S-20 Air cannot be bled from fuel circuit	40-963
S-21 Active regeneration is executed frequently	40-964
S-22 Active regeneration takes time	40-965
S-23 White smoke is exhausted during active regeneration	40-966
50 Disassembly and assembly	50-1
Table of contents	50-2
Related information on disassembly and assembly	50-4
How to read this manual	50-4
Coating materials list	50-6
Special tools list	50-10
Sketches of special tools	50-15
Engine and cooling system	50-28
Removal and installation of supply pump assembly	50-28
Removal and installation of injector assembly	50-31
Removal and installation of cylinder head assembly	50-40
Removal and installation of engine hood assembly	50-53
Removal and installation of radiator core assembly	50-55
Removal and installation of aftercooler	50-57
Removal and installation of hydraulic oil cooler	50-58
Removal and installation of engine assembly	50-59
Removal and installation of engine front oil seal	50-67
Removal and installation of engine rear oil seal	50-70
Removal and installation of cooling fan and fan motor assembly	50-73
Removal and installation of KDPF assembly	50-75
Disassembly and assembly of KDPF assembly	50-78
Removal and installation of KCCV assembly	50-87
Removal and installation of air cleaner assembly	50-88
Removal and installation of KVGT assembly	50-89
Removal and installation of EGR (Exhaust Gas Recirculation) valve assembly	50-92
Removal and installation of EGR (Exhaust Gas Recirculation) cooler assembly	50-94
Removal and installation of alternator belt	50-96
Removal and installation of fuel tank assembly	50-97
Power train	50-100
Removal and installation of transfer assembly	50-100
Disassembly and assembly of transfer assembly	50-104
Removal and installation of front axle assembly	50-135
Removal and installation of rear axle assembly	50-137
Disassembly and assembly of axle housing assembly	50-140
Disassembly and assembly of differential assembly	50-152
Undercarriage and frame	50-174
Removal and installation of center hinge pin	50-174
Removal and installation of counterweight assembly	50-183
Hydraulic system	50-187
Removal and installation of hydraulic tank assembly	50-187
Removal and installation of control valve assembly	50-191
Disassembly and assembly of control valve assembly	50-195
Removal and installation of hydraulic pump assembly	50-198

Removal and installation of HST motor1 assembly.....	50-203
Removal and installation of HST motor2 assembly.....	50-205
Disassembly and assembly of hydraulic cylinder assembly.....	50-207
Work equipment.....	50-214
Removal and installation of work equipment assembly.....	50-214
Cab and its attachments.....	50-220
Removal and installation of operator's cab and floor frame assembly.....	50-220
Removal and installation of operator's cab glass (adhered glass).....	50-225
Removal and installation of operator's seat assembly.....	50-233
Removal and installation of seat belt.....	50-235
Removal and installation of air conditioner unit assembly.....	50-236
Removal and installation of air conditioner compressor.....	50-241
Removal and installation of air conditioner condenser.....	50-243
Electrical system.....	50-245
Removal and installation of machine monitor assembly.....	50-245
Removal and installation of engine controller assembly.....	50-247
Removal and installation of HST controller assembly.....	50-249
Removal and installation of air conditioner controller assembly.....	50-251
Removal and installation of monitor controller assembly.....	50-252
Removal and installation of mass air flow and temperature sensor.....	50-254
Removal and installation of KOMTRAX terminal assembly.....	50-255
60 Maintenance standard.....	60-1
Table of contents.....	60-2
Engine and cooling system.....	60-3
Engine related parts.....	60-3
Cooling fan motor.....	60-4
Power train.....	60-6
Damper.....	60-6
Transfer.....	60-7
Drive shaft.....	60-14
Axle.....	60-15
Differential.....	60-17
Limited slip differential.....	60-21
Final drive.....	60-23
Steering system.....	60-25
Steering column.....	60-25
Priority valve.....	60-26
Emergency steering valve.....	60-27
Steering cylinder.....	60-28
Brake system.....	60-30
Brake accumulator charge valve.....	60-30
Slack adjuster.....	60-31
Brake.....	60-32
Parking brake.....	60-34
Parking brake solenoid valve.....	60-35
Undercarriage and frame.....	60-36
Axle mount.....	60-36
Center hinge pin.....	60-38
Hydraulic system.....	60-41
Hydraulic tank.....	60-41
Double type gear pump.....	60-42
Steering and work equipment pump.....	60-43
Control valve.....	60-47
Self-pressure reducing valve.....	60-60
Work equipment PPC valve.....	60-62
Work equipment lock solenoid valve.....	60-64
Work equipment.....	60-65
Work equipment linkage.....	60-65
Bucket.....	60-69

Work equipment cylinder	60-71
Cab and its attachments	60-72
Cab mount	60-72
Electrical system	60-73
Bucket positioner	60-73
Fork positioner	60-74
Remote boom positioner	60-75
80 Appendix	80-1
Table of contents	80-2
Air conditioner components	80-3
Precautions for refrigerant	80-3
Air conditioner component	80-4
Configuration and function of refrigeration cycle	80-6
Outline of refrigeration cycle	80-7
Air conditioner unit	80-9
Dual pressure switch	80-14
Air conditioner controller	80-15
Compressor	80-16
Condenser	80-17
Receiver drier	80-18
Sunlight sensor	80-20
Outer temperature sensor (outside air temperature sensor)	80-21
Procedure for testing and troubleshooting	80-22
Circuit diagram and arrangement of connector pins	80-24
System diagram	80-27
Parts and connectors layout	80-30
Testing with self-diagnosis function	80-35
How to open the electrical system abnormality record screen in service mode of the machine monitor	80-36
Testing temperature control system	80-38
Testing vent (mode) changeover	80-40
Testing FRESH/RECIRC air changeover	80-42
Testing evaporator temperature sensor	80-44
Testing relays	80-46
Troubleshooting chart 1	80-48
Troubleshooting chart 2	80-49
Information in troubleshooting table	80-51
Failure code list related to air conditioner	80-52
Failure code [879AKA] A/C Inner Sensor Open Circuit	80-53
Failure code [879AKB] A/C Inner Sensor Short Circuit	80-55
Failure code [879BKA] A/C Outer Sensor Open Circuit	80-57
Failure code [879BKB] A/C Outer Sensor Short Circuit	80-59
Failure code [879CKA] Ventilating Sensor Open Circuit	80-61
Failure code [879CKB] Ventilating Sensor Short Circuit	80-63
Failure code [879DKZ] Sunlight Sensor Open or Short Circuit	80-65
Failure code [879EMC] Ventilation Damper Abnormality	80-67
Failure code [879FMC] Air Mix Damper Abnormality	80-70
A-1 Troubleshooting for power supply and CAN communication system (Air conditioner does not operate)	80-73
A-2 Troubleshooting for compressor and refrigerant system (Air is not cooled)	80-76
A-3 Troubleshooting for blower motor system (No air comes out or air flow is abnormal)	80-79
A-4 Troubleshooting for FRESH/RECIRC air changeover	80-82
Troubleshooting with gauge pressure	80-84
Connection of service tool	80-87
Precautions for disconnecting and connecting hoses and tubes in air conditioner circuit	80-89
Handling of compressor oil	80-91
90 Diagrams and drawings	90-1

00 Index and foreword


Index

Table of contents	90-2
Hydraulic circuit diagram	90-3
Symbols in hydraulic circuit diagram	90-3
Hydraulic circuit diagram.....	90-7
Electric circuit diagram	90-9
Symbols in electric circuit diagram	90-9
Electrical circuit diagram of machine body	90-13
Electrical circuit diagram of floor	90-23
Index.....	1


Foreword, safety and general information (ALL-0370-001-A-00-A)

Important safety notice (ALL-1120-012-A-01-A)

(Rev. 2012/10)

- Appropriate servicing and repair are extremely important to ensure safe operation of the machine. The shop manual describes the effective and safe servicing and repair methods recommended by Komatsu. Some of these methods require the use of the special tools designed by Komatsu for the specific purpose.
- The symbol mark  is used for such matters that require special cautions during the work. The work indicated by the caution mark should be performed according to the instructions with special attention to the cautions. Should hazardous situation occur or be anticipated during such work, be sure to keep safe first and take every necessary measure.

General precautions

 **Inappropriate handling causes an extreme danger. Read and understand what is described in the operation and maintenance manual before operating the machine. Read and understand what is described in this manual before starting the work.**

- Before performing 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.
- Locate a place in the repair workshop to keep the 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.
- When performing any work, always wear the safety shoes and helmet. Do not wear loose work cloths, or clothes with buttons missing.
 1. Always wear the protective eyeglasses when hitting parts with a hammer.
 2. Always wear the protective eyeglasses when grinding parts with a grinder, etc.
- When performing any work with 2 or more workers, always agree on the working procedure before starting. While working, always keep conversations of the work between your fellow workers and your self on any step of the work. During the work, hang the warning tag of "UNDER WORKING" in the operator's compartment.
- Only qualified workers must perform the work and operation which require license or qualification.
- Keep the tools in good condition. And learn the correct way to use the tools, and use the proper ones among them. Before starting the work, thoroughly check the tools, lift truck, service vehicle, etc.
- If welding repairs is required, always have a trained and experienced welder with good

knowledge of welding perform the work. When performing welding work, always wear welding gloves, apron, shielding goggles, cap, etc.

- Before starting work, warm up your body thoroughly to start work under good condition.
- Avoid continuing work for long hours and take rests with proper intervals to keep your body in good condition. Take a rest in a specified safe place.

Safety points

1	Good arrangement
2	Correct work clothes
3	Observance of work standard
4	Practice of making and checking signals
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

Preparation

- Before adding oil or making any repairs, place the machine on a firm and level ground, and apply the parking brake and chock the wheels or tracks to prevent the machine from moving.
- Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If it is not possible to lower the equipment to the ground, insert the lock pin or use blocks to prevent the work equipment from falling. And be sure to lock all the work equipment control levers and hang a warning tag on them.
- When performing the disassembling or assembling work, support the machine securely with blocks, jacks, or stands before starting the work.
- Remove all of mud and oil from the steps or other places used to get on and off the machine completely. Always use the handrails, ladders of

steps when getting on or off the machine. Never jump on or off the machine. When the scaffold is not provided, use steps or stepladder to secure your footing.

Precautions during work

- For the machine equipped with the battery disconnect switch, check that the system operating lamp is turned off before starting the work. Then, turn the battery disconnect switch to OFF (○) position and remove the switch key. For the machine not equipped with the battery disconnect switch, remove the cable from the battery before starting the work. Be sure to remove the negative end (-) of the battery cable first.
- Release the remaining pressure in the circuits completely before the work when the parts in the circuits of oil, fuel, coolant and air are disconnected or removed. When the cap of the oil filter, drain plug or oil pressure pickup plug is removed, loose them slowly to prevent the oil from spurting out.
- When removing or installing the checking plug or the piping in the fuel circuit, wait 30 seconds or longer after the engine is shut down and start the work after the remaining pressure is released from the fuel circuit.
- Immediately after the engine is shut down, the coolant and oil in the circuits are hot. Be careful not to get scalded by the hot coolant and oil. Start the work after checking that the coolant and oil are cooled down sufficiently.
- Start the work after the engine is shut down. Be sure to shut down the engine when working on or around the rotating parts in particular. When checking the machine without shutting down the engine (measuring oil pressure, rotational speed, oil or coolant temperature), take extreme care not to get caught in the rotating parts or the working equipment.
- The hoist or crane must be used to sling the components weighing 25 kg or heavier. Check the slings (wire rope, nylon sling, chain and hook) for damage before the work. Use the slings with ample capacity and install them to the 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.
- When removing the part which is under internal pressure or reaction force of the spring, always leave 2 bolts in diagonal positions. Loosen those 2 bolts gradually and alternately and release the pressure, then, remove the part.
- When removing the part, be careful not to break or damage the electrical wiring. The damaged wiring may cause electrical fires.
- When removing piping, prevent the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it off immediately. Fuel or oil on the floor can cause you to slip and can even cause fires.
- As a general rule, do not use gasoline to wash parts. Do not use gasoline to clean the electrical parts, in particular.
- Reinstall the parts removed to their original places. Replace the damaged parts and the parts which must not be used with new ones. When installing the hoses and wiring harnesses, be careful that they are not damaged by contacting with other parts when the machine is operated.
- When connecting the high pressure hoses and tubes, make sure that they are not twisted. The damaged high pressure hoses and tubes are very dangerous when they are installed. So, be extremely careful when connecting the high pressure pipings. In addition, check that their connections are correct.
- When assembling or installing the parts, be sure to tighten the bolts to the specified torque. When installing the protective parts such as guards, or the parts which vibrate violently or rotate at high speeds, be sure to check that they are installed correctly.
- When aligning 2 holes, never insert your fingers or hand into the holes. Align the holes with care so that your fingers are not caught in the hole.
- When measuring hydraulic pressure, check that the measuring tools are correctly installed.
- Pay attention to safety when removing and installing the tracks of the track type machines. When removing the track, it separates suddenly. The workers should not stand at either end of the track.
- If the engine is operated for a long time in a closed place which is not ventilated well, you may suffer from gas poisoning. Accordingly, open the windows and doors to ventilate the place well.

Precautions for slinging work and making signals

- Only one appointed worker must make signals and co-worker must communicate with each other frequently. The appointed signaler must make specified signals clearly at the place where the signaler is well seen from the operator's seat and where the signaler can see the working condition easily. The signaler must always stand in front of the load and guide the operator safely.
 1. Do not stand under the load.
 2. Do not step on the load.
- Check the slings before starting sling work.