

SHOP MANUAL

KOMATSU

D31E, P, PL, PLL-18

D31P-18A

D31S, Q-18

D37E, P-2

MACHINE MODEL	SERIAL No.	MACHINE MODEL	SERIAL No.
D31E-18	40001 and up	D31S-18	40001 and up
D31P-18	40001 and up	D31Q-18	40001 and up
D31P-18A	40001 and up	D37E-2	1501 and up
D31PL-18	40001 and up	D37P-2	1501 and up
D31PLL-18	40001 and up		

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- D31-18 and D37-2 mount the 6D95L and S6D95L engine. For details of the engine, see the 95 Series Engine Shop Manual.

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IMPORTANT SAFETY NOTICE

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

To prevent injury to workers, the symbols  and  are 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.



SAFETY

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. 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.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two 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 signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.

6. 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 or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety 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.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. 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.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.
Check that the wire rope, chains and hooks are free from damage.
Always use lifting equipment which has ample capacity.
Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
Replace any damaged parts 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 being operated.
20. 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. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening 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.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. 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.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This 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.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your KOMATSU distributor for the latest information.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model

Engine volume: Issued for each engine series

Electrical volume : } Each issued as one
Attachments volume : } volume to cover all models

These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

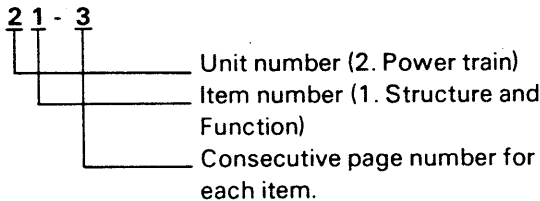
DISTRIBUTION AND UPDATING

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

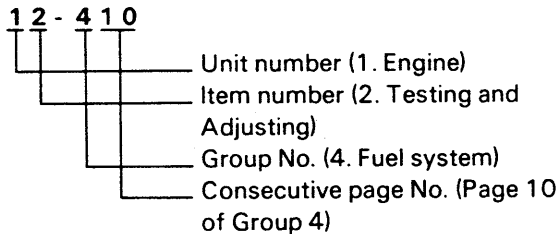
FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.

Example 1 (Chassis volume):

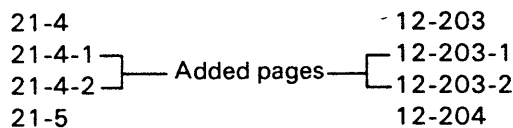


Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.

Example:



REVISED EDITION MARK (① ② ③....)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

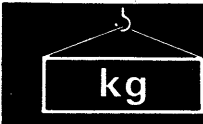
Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

SYMBOLS

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS



⚠ Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol kg

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:

- Check for removal of all bolts fastening the part to the relative parts.
- Check for existence of another part causing interference with the part to be removed.

2. Wire ropes

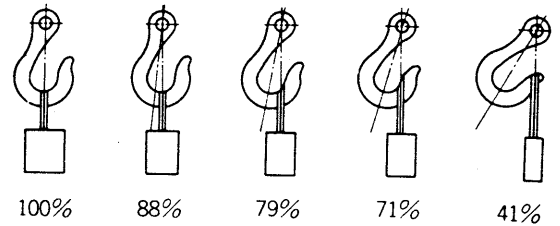
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes (Standard "Z" or "S" twist ropes without galvanizing)	
Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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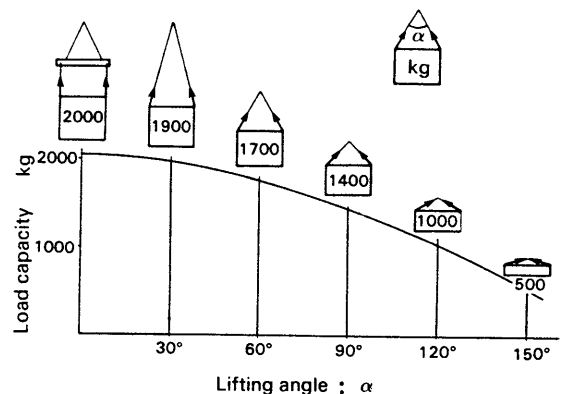
3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ Slinging with one 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.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.

When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.

When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.





FS0065



STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of "Disassembly and Assembly".

Thread diameter of bolt (mm)	Width across flat (mm)		
		kgm	Nm
6	10	1.35 ± 0.15	13.2 ± 1.4
8	13	3.2 ± 0.3	31.4 ± 2.9
10	17	6.7 ± 0.7	65.7 ± 6.8
12	19	11.5 ± 1.0	112 ± 9.8
14	22	18.0 ± 2.0	177 ± 19
16	24	28.5 ± 3	279 ± 29
18	27	39 ± 4	383 ± 39
20	30	56 ± 6	549 ± 58
22	32	76 ± 8	745 ± 78
24	36	94.5 ± 10	927 ± 98
27	41	135 ± 15	1320 ± 140
30	46	175 ± 20	1720 ± 190
33	50	225 ± 25	2210 ± 240
36	55	280 ± 30	2750 ± 290
39	60	335 ± 35	3280 ± 340

This torque table does not apply to the bolts with which nylon packings or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

★ Nm (newton meter): 1Nm ≅ 0.1 kgm

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

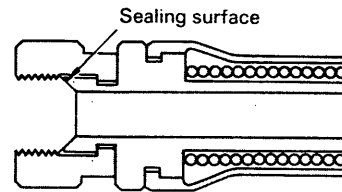
Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7 ± 0.7	65.7 ± 6.8
12	17	11.5 ± 1	112 ± 9.8
16	22	28.5 ± 3	279 ± 29

STANDARD TIGHTENING TORQUE



3. TIGHTENING TORQUE FOR NUTS OF FLARED

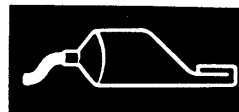
Use these torques for nut part of flared.



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Thread diameter of nut part (mm)	Width across flats of nut part (mm)	Tightening torque	
		kgm	Nm
14	19	2.5 ± 0.5	24.5 ± 4.9
18	24	5 ± 2	49 ± 19.6
22	27	8 ± 2	78.5 ± 19.6
24	32	14 ± 3	137.3 ± 29.4
30	36	18 ± 3	176.5 ± 29.4
33	41	20 ± 5	196.1 ± 49
36	46	25 ± 5	245.2 ± 49
42	55	30 ± 5	294.2 ± 49

COATING MATERIALS



The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

Nomenclature	Komatsu code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs.
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.
	LT-2*	Preventing bolts, nuts and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
Liquid gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 – 0.08 mm)
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-LI	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	—	Used for protecting battery electrode terminals from corrosion.

*LT-2 is also called LOCTITE in the shop manuals.



ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.

This wire code table will help you understand WIRING DIAGRAMS.

Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

CLASSIFICATION BY THICKNESS


Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	Dia. of strands (mm)	Cross section (mm ²)			
01	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
02	26	0.32	2.09	3.1	20	Lighting, signal etc.
05	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Circuits		Starting	Charging	Lighting	Signal	Instrument	Other
	Classification							
1	Primary	Code	B	W	R	G	Y	L
		Color	Black	White	Red	Green	Yellow	Blue
2	Auxiliary	Code	BW	WR	RW	GW	YR	LW
		Color	Black & White	White & Red	Red & White	Green & White	Yellow & Red	Blue & White
3	Auxiliary	Code	BY	WB	RB	GR	YB	LR
		Color	Black & Yellow	White & Black	Red & Black	Green & Red	Yellow & Black	Blue & Red
4	Auxiliary	Code	BR	WL	RY	GY	YG	LY
		Color	Black & Red	White & Blue	Red & Yellow	Green & Yellow	Yellow & Green	Blue & Yellow
5	Auxiliary	Code	—	WY	RG	GB	YL	LB
		Color	—	White & Yellow	Red & Green	Green & Black	Yellow & Blue	Blue & Black
6	Auxiliary	Code	—	WG	RL	GL	YW	
		Color	—	White & Green	Red & Blue	Green & Blue	Yellow & White	



WEIGHT TABLE D31E,P,PL-18, D31P-18A

 This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine Model	D31E-18	D31P-18A	D31P-18	D31PL-18	D31PLL-18
Serial No.	40001 and up	40001 and up	40001 and up	40001 and up	40001 and up
Engine and main clutch assembly	450	450	450	450	450
• Engine assembly	420	420	420	420	420
• Main clutch assembly	27	27	27	27	27
Radiator assembly	37	37	37	37	37
Fuel tank assembly (with fuel)	175	175	175	175	175
HYDOROSHIFT transmission assembly	232	232	232	232	232
• Modulating valve assembly	6	6	6	6	6
• Speed and inching valve assembly	8	8	8	8	8
Bevel gear shaft and steering clutch assembly	140	140	140	140	140
• Steering clutch assembly (each side)	48	48	48	48	48
• Brake band assembly (each side)	9	9	9	9	9
• Bevel gear shaft	9	9	9	9	9
• Bevel gear	15	15	15	15	15
Steering control valve assembly	9	9	9	9	9
Final drive case (each side)	45	45	45	69	69
Sprocket (each side)	41	41	41	41	41
Main frame assembly	690	700	700	720	720
• Main frame and steering case	623	624	624	624	624
• Sprocket shaft (each side)	32	37	32	45	45
Track group assembly (each side)	478	523	530	530	665
• Track frame (each side)	106	127	132	132	163
• Idler assembly (each side)	95	95	95	95	95
• Track roller assembly (each)	27	27	27	27	27
• Carrier roller assembly (each)	20	20	20	20	20
Track shoe assembly (each side)	880	1,350	1,350	1,610	1,800
Cross bar	106	128	106	106	106

011418

Unit: kg

Machine Model	D31E-18	D31P-18A	D31P-18	D31PL-18	D31PLL-18
Serial No.	40001 and up	40001 and up	40001 and up	40001 and up	40001 and up
Hydraulic tank assembly	70	70	70	70	70
Hydraulic control valve assembly	25	25	20	20	20
Blade lift cylinder assembly (each side)	24	24	34	34	34
Blade tilt cylinder assembly	18	18	22	22	22
Blade angle cylinder assembly (each side)	24	24	—	—	—
Power angle and tilt/dozer assembly	726	787			
• Blade	360	412	—	—	—
• U-frame	261	261			
Straight tilt/dozer assembly			678		
• Blade			349		
• Straight frame (each side)	—	—	82		
• Blade tilt cylinder assembly			22		
• Tilt brace			14		
Radiator guard	51	51	152	152	
Engine underguard	42	42	42	42	42
Transmission underguard	36	39	39	39	39
Hood	38	38	39	39	39
Loader frame	116	116	98	98	98
Operator's seat assembly	21	21	21	21	21
Canopy assembly	95	95	95	95	95

011418

WEIGHT TABLE D37E, P-2



This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine Model	D37E-2		D37P-2	
	Serial No. 1501 – 2500	2501 and up	1501 – 2000	2001 and up
Engine and damper assembly	450	460	450	460
• Engine assembly	420	430	420	430
• Damper assembly	27	27	27	27
Radiator assembly	37	40	37	40
Fuel tank assembly	175	175	175	175
HYDROSHIFT transmission assembly	232	232	232	232
• Modulating valve assembly	6	6	6	6
• Speed and inching valve assembly	8	8	8	8
Bevel gear shaft and steering clutch assembly	140	140	140	140
• Steering clutch assembly (each side)	48	48	48	48
• Brake band assembly (each side)	9	9	9	9
• Bevel gear shaft	9	9	9	9
• Bevel gear	15	15	15	15
Steering control valve assembly	9	9	9	9
Final drive case (each side)	45	45	53	53
Sprocket assembly (each side)	41	41	41	41
Main frame assembly	660	660	670	670
• Main frame and steering case assembly	596	596	596	596
• Sprocket shaft (each side)	32	32	37	37
Track group assembly (each side)	523	523	523	663
• Track frame (each side)	127	127	127	197
• Idler assembly (each side)	95	95	95	95
• Track roller assembly (each)	27	27	27	27
• Carrier roller assembly (each)	20	20	20	20
Track shoe assembly	980	980	1,350	1,350
Cross bar	106	106	128	128

011418

Unit: kg

Machine Model	D37E-2		D37P-2	
	1501 – 2500	2501 and up	1501 – 2000	2001 and up
Hydraulic tank assembly	70	70	70	70
Hydraulic control valve assembly	25	25	25	25
Blade lift cylinder assembly (each)	24	24	24	24
Blade tilt cylinder assembly	18	18	18	18
Blade angle cylinder assembly (each)	24	24	24	24
Power angle and tilt dozer assembly	749	749	770	770
• Blade	383	383	424	424
• U-frame	260	260	260	260
Radiator guard	51	51	51	51
Engine underguard	42	42	42	42
Transmission underguard	39	39	39	39
Hood	38	37	38	37
Loader frame	123	124	123	124
Operator's seat assembly	21	21	21	21

011418

WEIGHT TABLE D31S,Q-18

 This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine Model	D31S-18	D31Q-18
Serial No.	40001 and up	40001 and up
Engine and damper assembly	450	450
• Engine assembly	420	420
• Damper assembly	27	27
Radiator assembly	37	37
Fuel tank assembly (with fuel)	175	175
HYDROSHIFT transmission assembly	232	232
• Modulating valve assembly	6	6
• Speed and inching valve assembly	8	8
Bevel gear shaft and steering clutch assembly	140	140
• Steering clutch assembly (each side)	48	48
• Brake band assembly (each side)	9	9
• Bevel gear shaft	9	9
• Bevel gear	15	15
Steering control valve assembly	9	9
Final drive case (each side)	45	53
Sprocket (each side)	41	41
Main frame assembly	680	680
• Main frame and steering case	612	612
• Sprocket shaft (each side)	32	37
Track group assembly (each side)	478	478
• Track frame (each side)	106	106
• Idler assembly (each side)	95	95
• Track roller assembly (each)	27	27
• Carrier roller assembly (each)	20	20

011418

Unit: kg

Machine Model	D31S-18	D31Q-18
Serial No.	40001 and up	40001 and up
Track shoe assembly (each side)	1,000	1,210
Cross bar	106	106
Hydraulic tank assembly	70	70
Hydraulic control valve assembly	20	20
Bucket lift cylinder assembly (each side)	43	43
Bucket dump cylinder assembly (each side)	33	33
Lift arm assembly	487	487
Bucket dump lever (Inside)	23	23
Bucket dump lever (Outside)	26	26
Bucket assembly (with tooth)	357	384
Radiator guard	51	51
Engine underguard	42	42
Transmission underguard	36	36
Hood	38	38
Loader frame	282	282
Operator's seat assembly	21	21
Canopy assembly	95	95

011418

FUEL, COOLANT AND LUBRICANTS

PROPER SELECTION OF FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE					CAPACITY (ℓ)	
		14 -10	32 0	50 10	68 20	86° F 30° C	Specified	Refill
Engine oil pan		SAE 30					D31E,P,PL PLL-18 D31P-18A D31S,Q-18 11 D37E,P-2 11.5	9 9.5
		SAE 10W						
		SAE 10-30						
		SAE 15W-40						
Transmission case Transfer case (incl. bevel gear case) Steering clutch case Final drive case (each)	Engine oil	SAE 30					16 17.5	13 17
		SAE 30					30	30
		SAE 10W					D31E,P,S-18 D37E-2: 9.5	9.5
		SAE 10W					D31P-18A, D31Q-18, D37P-2: 12	12
		SAE 10W					D31PL,PLL -18: 15	15
Hydraulic tank		SAE 10W					D31E,P-18 D31P-18A D31S,Q-18 D37E,P-2 49 D31P,PL, PLL-18: 45	33 33
		SAE 10W-30						
		SAE 15W-40						
Idler (each) Track roller (each) Carrier roller (each)		SAE 30					0.15 0.15 0.115	0.15 0.15 0.115
		SAE 30						
Fuel tank	Diesel fuel	*					118	-
		ASTM D975 No.2						
Cooling system	Water	Add antifreeze					22	-

* ASTM D975 No.1

NOTE:

ASTM: American Society of Testing and Material
 SAE: Society of Automotive Engineers
 API: American Petroleum Institute

Specified capacity: Total amount of oil including oil for components and oil in piping.

Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual. Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

- (2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40, even though an atmospheric temperature goes up to 10°C more or less in the day time.
- (3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.