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1 Maintenance Safety Instructions

WARNING

Beware of serious or fatal injury when carrying out maintenance to the crane:

- Lower all loads down to the ground.
- Shut off all controlling systems.
- Shut off the engine, and do not start the maintenance work until all the parts come to a standstill.
- Note special instructions if the maintenance work requires the engine to be running.
- Display warning plates on outside the operator's cab to warn that the crane is under maintenance and do not start the engine.
- Do not start the engine until all the tag and lock are taken away.

1.1 Overview

1. This chapter of “Maintenance Safety Instructions” provides a general overview of potential hazards when performing lubrication and maintenance to the crane.
2. In the Lubrication and Maintenance Instruction Section of this manual the hazard notices mentioned in this section will be applied to specific situations.
3. Perform the adjustment and maintenance tasks at the specified times. Replace components per schedule.
4. Keep all handles, steps, and walkways free from dust, snow and ice.
5. During lubrication and maintenance, unauthorized persons are not allowed to approach the crane.
6. Wear required personal protection equipment for each given situation.
7. Maintenance performed at a height over 2m (6'7") requires the use of an elevated work platform and safety harness.
8. When pressure-washing the crane, avoid electrical components and connectors.
9. Keep the crane clean for early detection of oil leaks, cracked, or loose connections, or any other abnormality. especially keep the oil nozzle, vent hole, and dipstick clean from dust.
10. Only use replacement parts authorized by the manufacturer.
11. The crane equipment needs to be inspected and reauthorized per regulations.
12. An important item in preserving the long life of the machine is keeping dirt out of working parts. Enclosed compartments, seals, and filters have been provided to keep the supply of air, fuel, and lubricants clean. It is important that these enclosures be maintained.
13. Whenever hydraulic, fuel, lubricating oil lines, or air lines are disconnected, clean the adjacent area as well as the point of disconnect. As soon as the disconnection is made, cap, plug, or tape each line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.
14. Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

CAUTION

- Lubrication schedule for parts supplied by a third party manufacturer, e.g. the engine, shall comply with the service manual provided by the third party manufacturer, e.g. the Service Manual provided by the engine manufacturer.
- When performing any maintenance and repair work, safety instructions of the listed lubrication, maintenance and adjustment work must be followed.

1.2 Maintenance Personnel

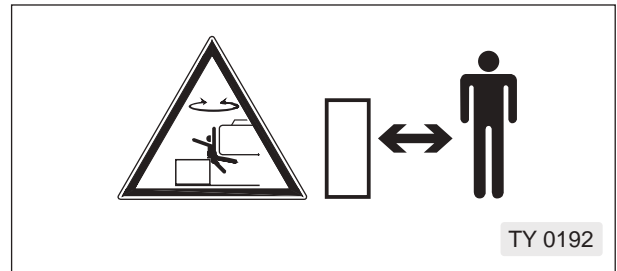
- Only specialist personnel can perform maintenance work.
- This especially applies to maintenance on Electric system, hydraulic system, engine and all brakes.

1.3 Risks during Maintenance

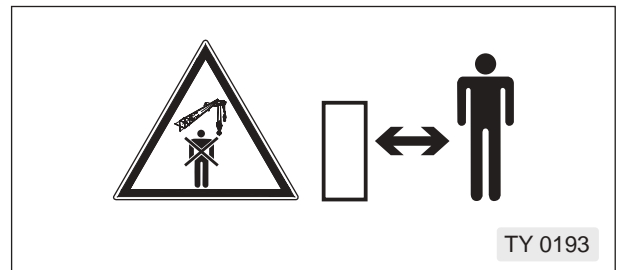
- Special care is required during lubrication and maintenance work to avoid potential hazards.
- Observe operation requirements listed in corresponding chapters of the lubrication and maintenance instructions.

1.3.1 Crushing/Impact Hazard

- No standing within the slewing radius. As there are crushing/impact hazards within the slewing radius (as shown in Fig. TY 0192).
- The affected points are:
 - Counterweights
 - Upperworks
 - Hook blocks



- No standing under the booms. As the booms may fall and cause crushing/impact hazards (as shown in Fig. TY 0193).
- The affected points are:
 - Main boom
 - Jib
 - Masts

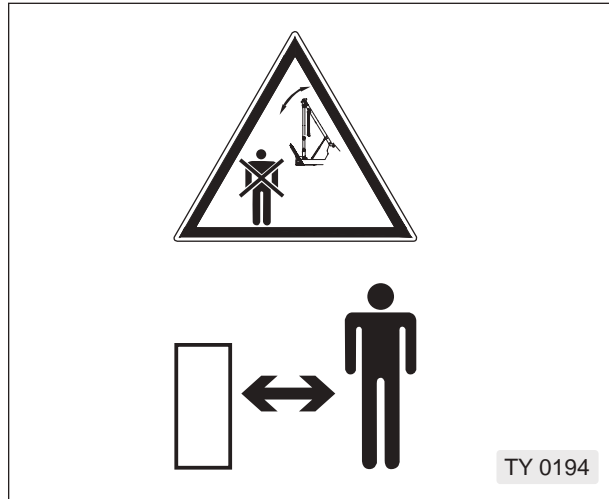


Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual

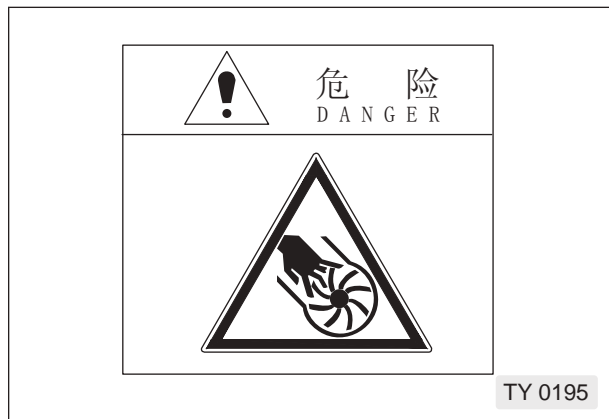


- A-frame falling hazard. The A-frame may fall and cause crushing hazards.
- The affected points are:
 - A-frame
 - Masts



1.3.2 Entangling and Dragging Hazard

- Protect your hands, legs, and entire body from moving parts which may entangle or drag you causing serious injury.
- The affected points are:
 - Wire ropes/all pulleys
 - All winches
 - Crawler traveling mechanism
 - Slewing mechanism



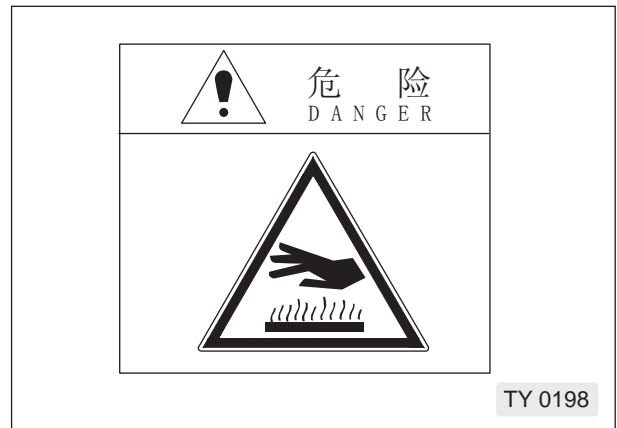
1.3.3 Slipping, Tumbling, and Falling Hazard

- Always maintain a firm hand grip upon the crane when walking on catwalks and climbing ladders.
- The affected points are: all the mounting positions and walking areas.



1.3.4 Thermal Hazard

- The affected points are:
 - Exhaust system of engine
 - Hydraulic system at working temperature



1.3.5 Gas, Dust, and Smoke

- Make sure there is sufficient ventilation during refueling.

1.3.6 Risk from Pressure Remaining in the Hydraulic System

- In certain situations, e.g. damage due to hydraulic components like pipes, hoses, and valves, may cause the machine to come to a standstill, while some parts of the system may remain under pressure. The sudden release of the hydraulic fluid or gas may cause injury.

1.4 Fire Prevention

1.4.1 Preventive Measures against the Risk of Fire

- Keep the crane clean, especially from inflammable materials. During maintenance of the hydraulic system, the engine, and the fuel system, clean the crane thoroughly. Remove all residual lubricating oil, fuel or detergent.

Table 5-1 Check the Hydraulic System, Engine and Fuel System

	Fire prevention checks onto	Check for
1	Fuel pipes lines	Leakage
2	Engine oil pipes lines	Loose connections
3	Hydraulic oil pipes lines	Cracked or damaged pipes and hoses

Replace all damaged parts immediately.

1.4.2 Other Checks and Replacement

- Check locking connections, all electrical lines, plug connections and electrical board for damage. Replace all damaged parts immediately.
- The operator's cab must be equipped with a fire extinguisher. The safety sign for fire extinguisher is shown as follows in Fig. TY 0199:



Safety Sign of Fire Extinguisher

1.5 Precautions before Lubrication and Maintenance Work

1. Inform the operator that the crane will be taken out of service and appoint a person to oversee the work to be done.
2. Shut off the engine.
Note: Only run the engine if instructions specially require such.
3. Park the crane by setting it on level solid ground (make sure that the ground has sufficient bearing capacity), or taking similar measures to prevent it from moving (e.g. blocking the crawler pads with special steel chocks).
4. Make sure that the crane cannot be started by unauthorized people (by locking the cab door), and place corresponding warning signs, when maintenance is being performed.
5. Clean the crane before starting maintenance, especially remove the lubricating oil, fuel or any additives at connections and couplings. Do not use aggressive cleaning agent. Use non-fiber cleaning cloth.
6. Before cleaning the crane with water or steam jet (high-pressure detergent) or any other detergent, cover or tape up all openings that might be adversely affected by water, steam or detergent (from a view point of safety or function) (e.g. electrical cabinet).
7. After cleaning, completely remove the covers or tapes, and check to ensure there is no water in these areas.
8. After cleaning, check the fuel lines, engine oil pipes and hydraulic oil pipes for leakage, loosened connections, cracked parts and damage.
9. Replace the damage parts immediately.
10. As lubricating oil might overflow in the process of maintenance and installation work, proper containers and absorbent materials must be prepared in advance.

注 意 CAUTION
<p>停机操作: 需将机器速度回到怠速状态运行10min左右后再停机。</p>
<p>Shutting down Operation: Machine should run at idle speed for about 10 minutes before shutting down.</p>
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Safety Instructions for Shutdown Operation

注 意 CAUTION
<p>在未阅读和了解操作保养手册及其上的警告条例之前，不得使用或在机器上作业。否则，不按指示操作机器会导致人员伤亡或机器损坏。</p>
<p>No operating or working on the machine before reading and learning operation and maintenance manuals and warning items. otherwise, casualties or damages would happen without obeying instructions.</p>
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Safety Instructions for Shutdown Operation

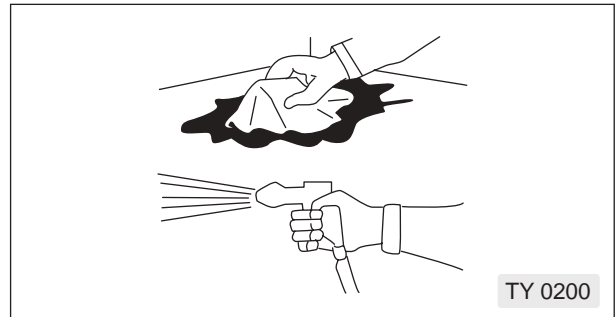


Diagram of Cleaning and Wiping

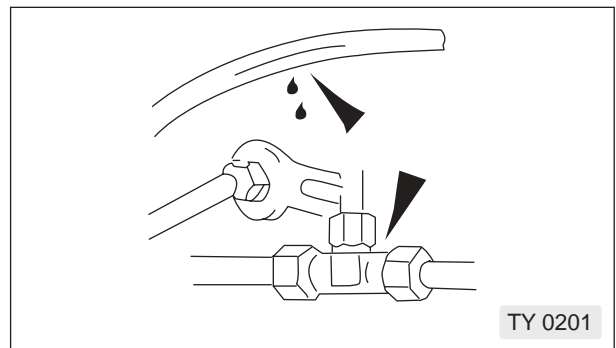


Diagram of Positions Requiring Special Cleaning

1.6 Precautions during Lubrication and Maintenance Work

The performance of Lubrication and Maintenance Work requires appropriate space and auxiliary devices.

Follow the specifications in the Safety Instructions of the Operating Manual.

1. Carefully cordon off the specified area.
2. While replacing single components or large assemblies, place them securely on auxiliary devices and make sure that they are not subject to any risk or damage.
3. Only use auxiliary devices that can operate properly and have sufficient load-bearing capacity.
4. Do not stand, walk or work under a suspended load.
5. Only appoint experienced personnel to attach loads and send signals to the crane operator. The signalman must be within the crane operator's sight or have verbal communication with the operator.
6. Tighten all loose screws and bolts when carrying out the maintenance and repair work.
7. If safety devices need to be disassembled during maintenance process, they must be reinstalled, and immediately checked after completion of maintenance.
8. Make sure all working materials, other consumables and replacement parts are used in an environment-friendly and safe manner.
9. Make sure tarpaulin and inflammable materials etc. are stored far away from places with potential fire hazards. Be careful when removing them.
10. Check or inspect the electrical devices of the crane regularly. Loose connections and burned or frayed cables must be repaired or replaced immediately.
11. Only qualified electricians or trained personnel under supervision of qualified electrician can perform maintenance on the electrical system or working medium according to the electrical technical specifications.
12. Only original fuse with correct current intensity can be used. In case of any power failure, shut off the crane immediately.
13. Regularly check the hoses and couplings of the hydraulic system for leakage and external damage. Rectify or replace any damaged parts immediately.
14. The lubrication or repair of hydraulic devices can only be performed by staff with special knowledge and experience in hydraulic devices (the system must be depressurized).
15. Pressurized oil can lead to personal injury and fire.
16. Observe the safety specifications related to the product when dealing with lubricating oil, lubricating grease and other chemicals.
17. Avoid over-lubrication which causes unnecessary waste but also poses the following problems:
 - Too much oil may infiltrate into the friction surfaces and cause operation failures.
 - Lubricating oil or grease drops on the catwalks may cause people to slip and fall.
 - Over-Full oil level may cause the lubricating oil to bubble and cause the oil temperature to rise too high, and result in making the oil overflow from the tank.
 - Too much lubricating oil or grease can push out the sealing lips of bearings when the pressure is high.
18. Take care while dealing with thermal consumables (scalding and burning hazard).
19. Make sure no tools are left on the equipment after completion of the work. Falling or unsecured tools may cause life-threatening, or severe injuries.
20. Carry out regular inspection according to the schedule (see part 3.4).

1.7 Repair Work Safety Instructions

The lubrication and maintenance instructions exclude information about how to carry out repair work. If needed, contact the customer service department of our company.

However, some general safety instructions about repair work are still available as follows:

- Welding, burning and grinding work can only be performed after getting specific approval for doing so, otherwise there is high risk of fire and explosion.
- Clean dust and inflammable materials on and around the crane, and ensure sufficient ventilation (as there is risk of explosion) before welding, burning and grinding.
- Before carrying out operation onto the hydraulic system, depressurize all parts that need to be opened.
- No changes, additions or modifications should be made to the crane without prior approval from the manufacturer.

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2 Fuel , Lubricating Oil, Lubricating Grease, Coolant and the Capacities

2.1 Overview

Table 5-2 Capacities of Fuel , Lubricating Oil, Lubricating Grease and Coolant

Filling Point	Capacity(L) (gal)	Lubricating Oil/Coolant
Diesel Engine	23.8L (6.29gal)	Refer to specifications about lubricating oil and lubricant in Cummins Engine operation and maintenance instructions. Grade of engine oil must meet the requirements of the CH-4/SJ standard by API.
Slewing reducer	Approx. 7 L (1.85gal)	Industrial gear oil 220 (40°C(104°F))LS2
Main hoisting winch reducer	Approx. 16L (4.23gal)	Industrial gear oil 220 (40°C(104°F))LS2
Auxiliary hoisting winch reducer	Approx. 8.5 L (2.25gal)	Industrial gear oil 220 (40°C(104°F))LS2
Boom luffing winch reducer	Approx. 3.5 L (0.92 gal)	Industrial gear oil 220 (40°C(104°F))LS2
Hydraulic system (with tank)	Approx. 275L (72.65gal)	L-HM46 anti-wear hydraulic oil
Fuel system	380L (100.39 gal)	#0 or #-10
Cooling system	33L (8.72gal)	Coolant (selected according to lowest local temperature)
Traveling system	22L(5.81gal)	Industrial gear oil 220 (40°C(104°F))LS2

-- The specified capacities are approximate values. In order to get the accurate values, the maintenance staff must carry out inspection by using provided check points, level plugs, dipsticks or sight windows.

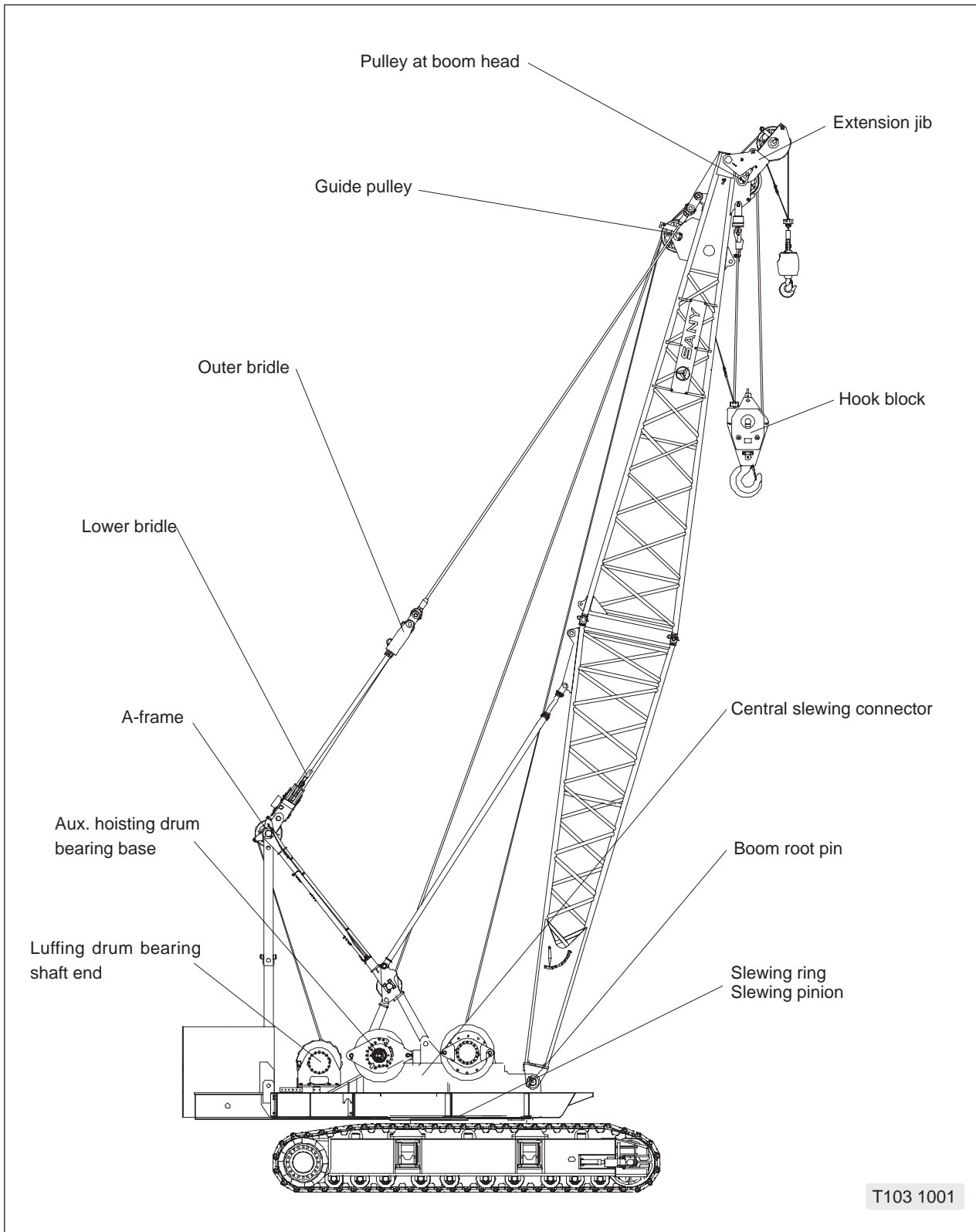
-- If fluids used fail to meet these requirements, we shall not be liable for any damage caused hereby even within the warranty period.

Filling Point	Total	Lubrication Interval (hour)	Lubricating Grease
Main, aux. drum bearing base.	2	250	#2 MoS ₂ Li-based grease (summer) #3 MoS ₂ Li-based grease (winter)
Boom luffing drum bearing base.	1	250	
A-frame	2	50	
Slewing ring	9	50	
Slewing ring gear pinion	1	250	
Extension boom	1	250	
Boom head pulley, Guide pulley	9	250	
Jib head pulley, Guide pulley, support roller	14	250	
Hook block	2	250	
Outer bridle	8	250	
Lower bridle	7	250	
Boom root pin	2	50	

- The specified capacities are approximate values. In order to get the accurate values, the maintenance staff must carry out inspection by using provided check points, level plugs, dipsticks or sight windows.
- If fluids used fail to meet these requirements, we shall not be liable for any damage caused hereby even within the warranty period.
- Lubrication and lubrication interval for other parts refer to 3 Lubrication.

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Position of Oil Filling

2.2 Table of Recommended Common Grease

Table 5-3 Recommended Engine Oil

Suitable Temperature °C(°F)	-40 (-40)	-30 (-22)	-20 (-4)	-15 (5)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)	50 (122)
Designation										
SAE15W - 40				—	—	—	—	—	—	—▶
SAE10W - 30			—	—	—	—	—	▶		
SAE5W - 30		◀	—	—	—	—	—	—		

⚠ CAUTION

- Select top-grade lubrication oil with quality level: CF-4, CG-4 and CH-4.
- Use of high viscosity lubricating oil can reduce engine oil consumption, improve engine performance in cold weather and maintain lubrication at high operating temperatures. It is recommended to use SAE15W-40 engine oil for most climates.
- Low viscosity engine oil can be used with limitation, for example, SAE10W-30 can be used to help startup and provide sufficient engine oil flow when the ambient temperature is below -5°C(23°F). However, long-term and continuous use of low viscosity engine oil will reduce the service life of the engine due to abrasion.

Section 1 Maintenance



Table 5-4 Recommended Engine Fuel

Light diesel oil (GB252-2000)

Suitable Temperature °C(°F) Designation	-40	-30	-20	-10	0	10	20	30	40	50
	(-40)	(-22)	(-4)	(14)	(32)	(50)	(68)	(86)	(104)	(122)
#10										→
#0										→
#-10										→
#-20										→
#-35										→

⚠ CAUTION

- In most operating situations, using ASTH #2 fuel and diesel with the minimum cetane number of 40 can achieve the optimal economic efficiency and performance. Places of high altitude or with very low ambient temperature require fuel with cetane number more than 40 to avoid flameout and too much smoke.
- When using low-sulfur fuel, its cloud point must be 10°C(50°F) lower than the minimum expected fuel temperature at least. The cloud point refers to the temperature when the wax crystal in the diesel starts to be shaped.
- When using diesel with commercially general designation, its sulfur content should be lower than 0.5%.
- Keep the fuel clean and free from moisture and impurities.

Table 5-5 Recommended Lubricating Grease

Suitable Season Name	Summer	Winter
#2 MoS ₂ Li-based grease	→	
#3 MoS ₂ Li-based grease		→

Note: The maximum operating temperature of lubricating grease must be 20-30°C(68-86°F) lower than its dropping point.

Table 5-6 Recommended Gear Oil

Suitable Temperature °C(°F)	-40 (-40)	-30 (-22)	-20 (-4)	-10 (14)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)	50 (122)
Designation										
220LS2									→	

Table 5-7 Recommended Hydraulic Oil

Suitable Temperature °C(°F)	-40 (-40)	-30 (-22)	-20 (-4)	-10 (14)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)	50 (122)
Designation										
L-HM46 Antiwear hydraulic oil									→	
L-HV32 Low temperature antiwear hydraulic oil		←								
L-HM68 antiwear Hydraulic oil										→

⚠ CAUTION

- L-HM46 anti-wear hydraulic oil can be used in a wide range, and suitable for ordinary regions.
- L-HV32 Low temperature (flow point: -42°C(-43.6°F)) hydraulic oil is usually used in extremely cold regions (-30°C(-22°F) or below), such as Russia, China's north-eastern region.
- L-HM68 Anti-wear Hydraulic oil is usually used in tropical areas such as Middle East and India.
- Choose the appropriate hydraulic oil according to the region where the crane operates. The responsibility of changing oil (with charge) lies on the company before the main machine is delivered from the factory and hereafter lies on the customer.

- When operating in ambient temperature below 0°C(32°F), the following warm-up procedures must be carried out to ensure the safety of hydraulic system:
- Start the engine and run at idle speed for 7-10 minutes before speed up to 1000-1200r/min, and continue to run the engine for 30-40 minutes or longer without load or any operation hereafter, which means to raise the temperature of hydraulic oil up to over 20 °C(68°F).
 - Start normal operation after completing these warm-up procedures, meanwhile adjust the length of warm-up period according to the ambient temperature. During normal operation, actions of control levers and pedals should be slow and pay close attention to the running status of the system. Hydraulic components might be damaged if operating with hydraulic oil temperature below 20°C(68°F).

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3 Lubrication and Maintenance Form of Various Components

3.1 Precautions for Inspection and Maintenance

- Perform on level and solid ground in an environment that is clean and free from disturbances.
- While carrying out inspection and maintenance on the hydraulic parts, try to perform in an environment that is clean and free from disturbances.
- It is very dangerous to check and adjust the crane when it is operating with a load. Check and maintenance can only be performed after shutting off the engine and removing the load. At the same time, display a sign of “Under Inspection and Maintenance” at the door of the cab.
- It is strictly prohibited to adjust the components in the hydraulic system such as pump, valves, motor etc.

3.2 Purpose of Crane Maintenance

The purposes of crane maintenance are:

- Make preparation for the operation.
- Keep optimal performance.
- Avoid downtime.
- Maintain the service value of the crane.
- Reduce repair expenses.

3.3 Lubrication

3.3.1 Check Status of the Crane

The crane operator should inspect the crane daily by a visual check according to the lubrication and maintenance schedule.

For example:

- Check the oil level and oil quality.
- Check the tank and filtering system, to ensure these systems are kept clean and operate properly.
- Check the hoses and pipelines for leakage.

-- Check the installation of the transmission devices (i.e. reducers, the engine, valves).

-- Check whether the rope is lubricated, whether there is strain, abrasion or signs of abnormal wear.

These regular visual checks often can detect damages early, so that the problem can be solved quickly.

In this way it can reduce the need for a shutdown due to the failure of the crane.

3.3.2 Preventive Maintenance

Preventive maintenance includes some measures in “Check Status of the Crane”.

Checking the crane status can detect abrasion, damage or defect early, and can solve these problems as soon as possible.

This can help the crane under operation to avoid breakdown and repair.

Various related measures must be taken.

For example:

- Check the safety devices.
- Compare the desired value and actual value of the hydraulic system and electric system, such as voltage, hydraulic system pressure etc.
- Check the functions of the hydraulic system and electric system.
- Check the inflation pressure of the accumulator.
- Analyze the quality of the hydraulic oil and transmission oil.
- Check the noise level and vibration level of various transmission cases.
- Check the bearings for damage and abrasion.
- Check the crane components for damage and abrasion.
- Check the wire ropes for damage and abrasion.

Keep records of the proper visual check and functional check process as well as the check results.

Write inspection report as basis for future repair. Proper implementation of the inspections, regular repetition and result records are essential factors for the success of these measures.

3.3.3 Tightening Connecting Bolts, Nuts and Hydraulic Pipes

In daily inspection and monthly inspection, check connecting bolts and nuts of each part for looseness and loss, check hydraulic pipes for looseness, and tighten the loose parts or replace the missing parts accordingly.



1. Check and tighten the bolts and pipes in the routine check, monthly check and annually check.
2. Tighten the hydraulic pipes as per the torque value described in Table 5-7. If the torque exceeds the prescribed value, deform may occur at the sealing joint of pipe connectors, and even cracks may form when casting connectors are used.
3. The hydraulic components should have no scratches at the joint facings and they must be cleaned carefully to prevent dust coming in.

Table 5-7 Table of Tightening Torque for Hydraulic Pipes

Nominal Diameter		1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"
Torque Value (N•m)(ft•lb)	Pipe Connector, Pipe Thread (High Pressure)	--	50 (36.88)	70 (51.63)	95 (70.07)	180 (132.76)	210 (154.89)	350 (258.15)	550 (405.66)
	Pipe Thread (Low Pressure)	15 (11.06)	20 (14.75)	30 (22.13)	50 (36.88)	70 (51.63)	110 (81.13)	160 (118.01)	200 (147.51)

3.4 Lubrication and Maintenance Schedule

! CAUTION

The inspection schedule can be carried out according to the working hour or the planned date, whichever comes earlier. Each inspection shall not only cover the planned tasks but also all the ones carried out previously.

! CAUTION

For the maintenance of the engine, refer to the specific operating manual provided by the engine manufacturer.

! CAUTION

- The time interval specified in this schedule applies to the “general situation”, which is decided by the experience gained during using the lubricating oil and by the suggestion provided by the supplier. In adverse operation conditions such as excessive dust, corrosive air, abnormal outdoor temperature, massive load, extreme frequent or long-time operation cycle, can shorten the lubrication interval. Before there is sufficient experience for self-made schedule, the schedule provided in this chapter shall be followed.
- The following problems found in the routine inspection such as over-heat in bearing and lining, moving parts looseness, and rust accumulation in moving parts, indicate that there is lack of lubrication, which requires shortening the lubrication interval of problematic parts.



Section 1 Maintenance

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Item	Task	Interval of Operating Hours																
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*	
4	Engine system																	
4.1	Engine																	
4.1.1	Inspecting engine oil capacity	•																
4.1.2	Replacing engine oil								•									
4.1.3	Replacing engine oil filter								•									
4.1.4	Inspecting pump, engine, and engine mounting bolts	•								Tight-up								
4.2	Fuel System																	
4.2.1	Inspecting fuel pre-filter and drainage																	
4.2.2	Replacing fuel filter element	•																
4.2.3	Cleaning filter mesh of fuel tank								•									
4.2.4	Fuel system-Inspecting pipelines													•				
4.2.5	Inspecting fuel capacity and refilling if necessary																	
4.3	Cooling system	•																
4.3.1	Cooling system-Inspecting liquid level																	
4.3.2	Inspecting and cleaning cooling system	•																
4.3.3	Cooling system-replacing coolant																	
	Replacing water filter																	•

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.

6* -- About the interval of operating hours, comply with the regulations in the precautions of this chapter.



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Item	Task	Interval of Operating Hours																
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*	
6	Slewing Reducer																	
6.1	Slewing reducer-Inspecting oil level		•															
6.2	Slewing reducer-Replacing oil								•									
6.3	Slewing reducer-Checking brake									•								
6.4	Checking connecting bolts of slewing mechanism				•													
6.5	Inspecting slewing reducer visually	•																
7	Hoisting Winch																	
7.1.1	Main hoisting winch reducer-Inspecting oil level		•															
7.1.2	Main hoisting winch reducer-Replacing oil								•									
7.1.3	Main hoisting winch reducer-Lubricating bearing																	
7.1.4	Main hoisting winch reducer-Checking brake																	
7.1.5	Main hoisting winch reducer-Checking connecting bolts		•															
7.2.1	Aux. hoisting winch reducer-Inspecting oil level				•													
7.2.2	Aux. hoisting winch reducer-Replacing oil																	

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.

6*-- About the interval of operating hours, comply with the regulations in the precautions of this chapter.

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Item	Task	Interval of Operating Hours															
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*
7.2.3	Aux. hoisting winch-Lubricating bearing																
7.2.4	Aux. hoisting winch-Checking braking																
7.2.5	Aux. hoisting winch-Checking connecting bolt		•		•												
8	Luffing Winch																
8.1	Boom luffing winch-Inspecting oil level				•												•
8.2	Boom luffing winch-Replacing oil																
8.3	Boom luffing winch-Lubricating bearing																•
8.4	Boom luffing winch-Checking brake																•
8.5	Boom luffing winch-Checking connecting bolt		•		•												
9	Lowerworks																
9.1	Inspecting oil level of traveling reducer		•														
9.2	Replacing oil of traveling reducer																
9.3	Lubricating crawler connecting pin				•												
9.4	Maintaining hydraulic cylinder																
9.5	Adjusting crawler tensioning device																•
9.6	Checking connecting bolt		•		•												•

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.
 6* -- About the interval of operating hours, comply with the regulations in the precautions of this chapter.



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Item	Task	Interval of Operating Hours																
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*	
	Checking connecting bolt of support roller				•													
	Checking connecting bolt of track roller				•													
10	Hydraulic System																	
10.1	Hydraulic oil tank-Inspecting oil level and oil color	•																
10.2	Hydraulic oil tank-Replacing return oil filter element							Initial	•									
10.3	Hydraulic oil tank-Cleaning suction oil filter element							Initial	•									
10.4	Hydraulic oil tank-Replacing air filter element												•					•
10.5	Servo system-Replacing pipe filter element											Initial	•					•
	Inspecting hydraulic oil tank for residues																	
10.6	Replacing hydraulic oil															Initial	•	
10.6.3	Draining hydraulic oil tank																	
10.7	Checking the hydraulic system for leakage	•																
10.8	Checking pressure hose		•															
10.9	Replacing pressure hose																	•
At least every 6 years																		

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.

6* -- About the interval of operating hours, comply with the regulations in the precautions of this chapter.



Item	Task	Interval of Operating Hours															
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*
	Hydraulic system-Tightening hydraulic pipes	•								•							
10.10	Hydraulic system-Check Inflation Pressure of Accumulator										•			•			
11	Electric system																
11.1	Checking lighting system	•															
11.2	Checking limit switches	•														•	
11.3	Checking battery maintenance				•												
11.4	Preventative measures against cable fire	•														•	
12	Maintenance and Inspection on Air Conditioner													•			
12.1	Inspection on air conditioner	At least once per year at the beginning of the cooling period															
12.2	Air conditioner maintenance	At the beginning, in the middle and the end of the cooling period															
13	Operator's Cab																
13.1	Windshield wiper-Checking the function		•														
13.2	Checking windshield wiper solution reservoir	•															
	Mounting bolts of operator's cab			•													

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.
 6*-- About the interval of operating hours, comply with the regulations in the precautions of this chapter.



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Item	Task	Interval of Operating Hours																
		1*	2*	3*	50	100	150	200	250	500	1000	1500	2000	3000	4*	5*	6*	
14	Others																	
14.1	Lubricating Pin of boom system			•														
14.2	Lubricating hook blocks				•													
14.3	Wire ropes	•											•					
14.3.1	Lubricating wire ropes																•	
14.3.2	Cleaning wire ropes																•	
14.4	Pulleys									•							•	
14.4.1	Checking pulley bearings																•	
14.4.2	Checking pulleys	•															•	
	Counterweight connecting bolts	•															•	
15	Checking the Crane																	
15.1	Visual inspection	•																•
15.2	Regular inspection										•							
15.2.1	Checking large-scale steel structure									•							•	
15.2.2	Checking winches									•							•	
15.2.3	Checking hook blocks									•							•	

1*-- Daily before starting work 2*-- Weekly 3*-- Monthly 4* -- At least once a year 5*-- Before erecting the boom system, only for boom and jib parts.

6* -- About the interval of operating hours, comply with the regulations in the precautions of this chapter.

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□ 4 Engine System (Tier III)

4.1 Engine

Refer to the maintenance instructions and precautions of engine in the operating instructions provided by the engine manufacture.

While preparing the motor for cleaning, must make sure that:

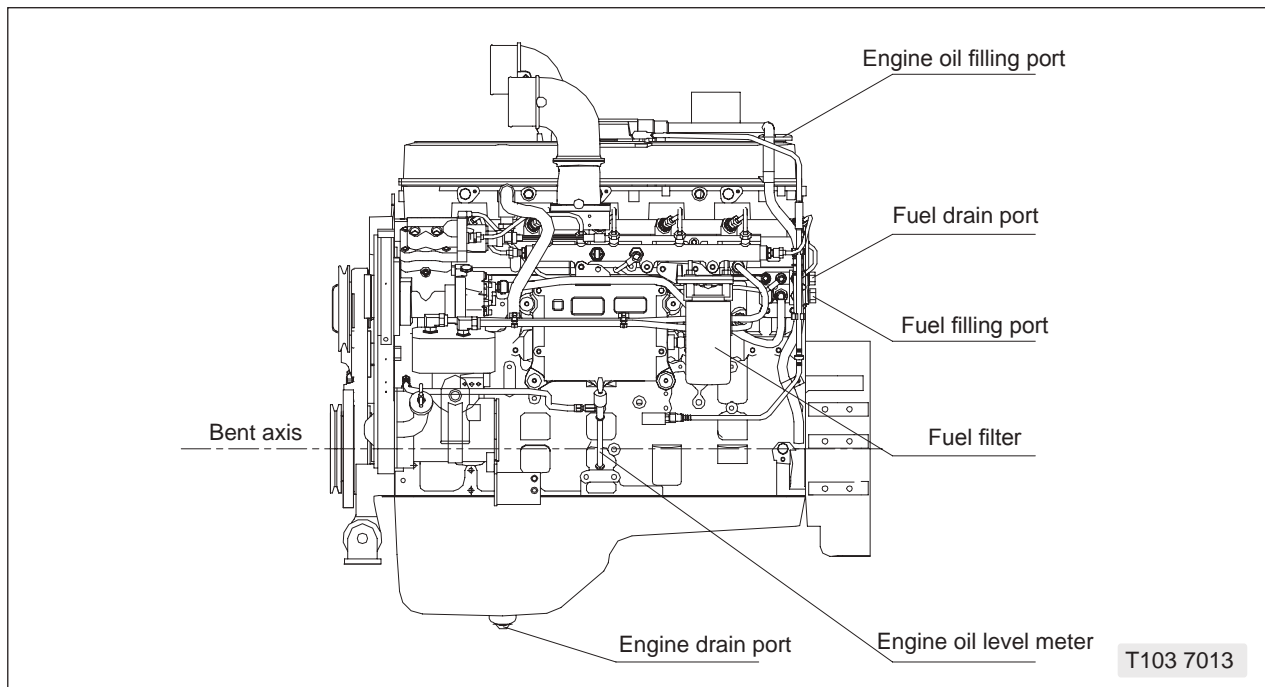
1. During the cleaning process, water injection spray should not directly point to the starting motor and the engine.
2. Before cleaning, disassemble the starting motor with the bearing opening facing downwards.

⚠ CAUTION

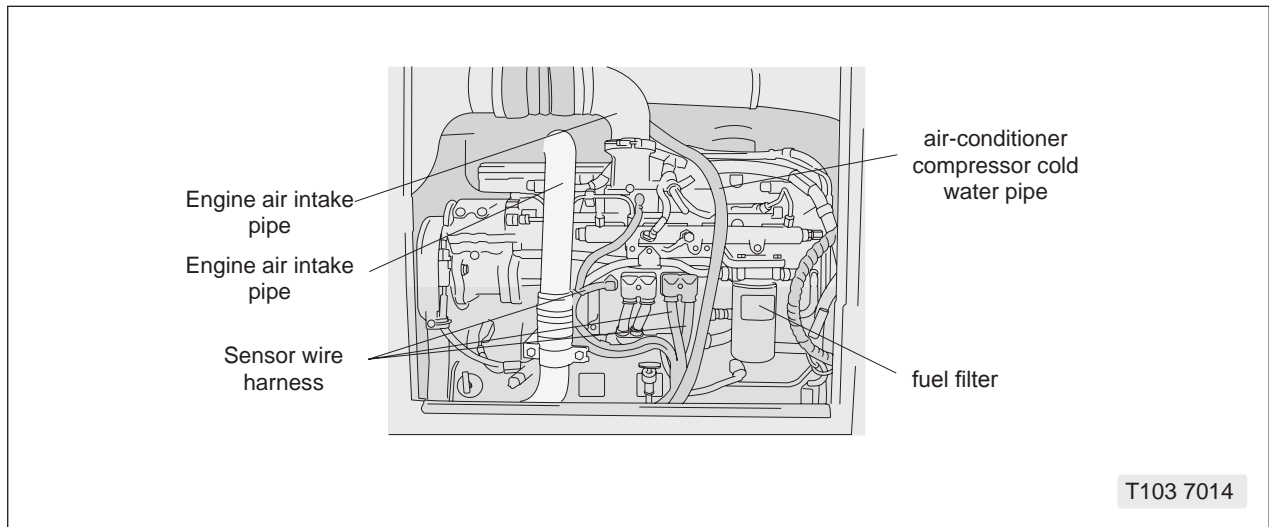
Use the light diesel in compliance with GB252-2000 and carry out periodic maintenance as per the maintenance instructions provided by the engine manufacturer. The engine manufacturer will take no responsibility for any engine fuel system fault caused by use of improper diesel.

⚠ CAUTION

Burning and scalding hazard. Maintenance in the engine area should be subject to the rule of cooling for 60 minutes after shut-off.



Structure of Engine System (Tier III)



Profile of Engine (TierIII)

- Check its status for any abnormality when starting up the engine,
- Check the connecting bolts in the engine area visually each time before starting up the engine or every day. As all the securing bolts are applied with bolt thread sealant, they normally will not loosen up and a visual inspection would be sufficient. Remove the bolts that are loose, broken, or defective and replace with new ones,
- Operate the crane according to the operating instructions and load charts. Check the securing bolts regularly as required, avoiding risks caused by bolt fatigue.

Section 1 Maintenance

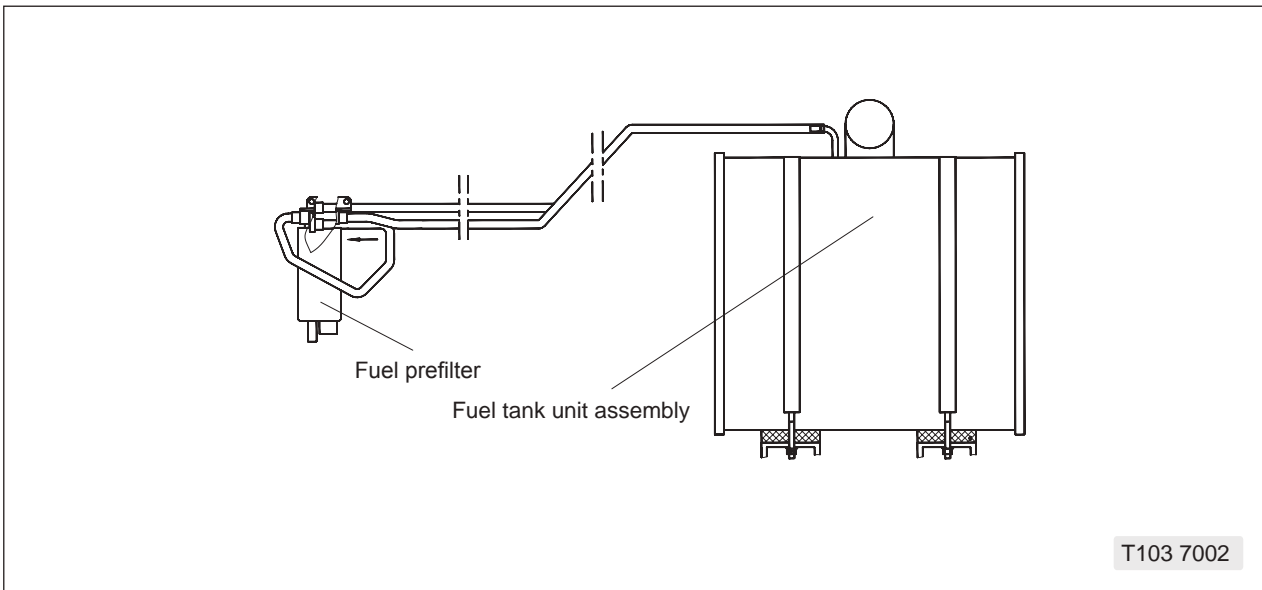
SCC1000C Crawler Crane — Maintenance Manual



4.2 Fuel System

Precautions of the fuel system:

- Use light diesel in compliance with GB252-2000,
- Drain water from fuel-water separator daily before starting the engine,
- Replace the filter element regularly,
- Check fuel tank breather and the tank regularly.

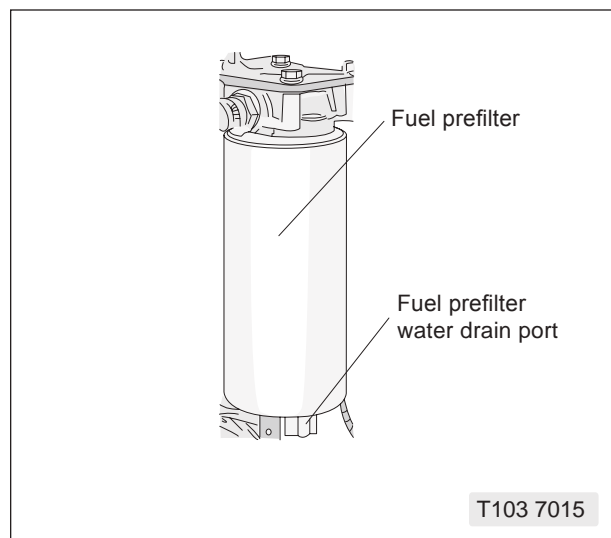


Fuel System

4.2.1 Draining Fuel-Water Separator

- Drain the water from the fuel-water separator daily before starting the engine.
- Open the drain valve by hand. Turn the drain valve counterclockwise. Drain the fluid and sediment out of the filter sump until clear fuel is visible. Then turn the drain valve clockwise to close it.
- Have a spare filter element prepared, and on hand, as contaminated fuel will plug the filter.
- Filter of diesel engine.

Refer to the maintenance instruction and precautions of described oil filter in the operating instructions provide by engine manufacturer.



Draining Fuel-Water Separator

⚠ CAUTION

Do not overtighten the valve when closing the drain valve as overtightening can damage the threads.

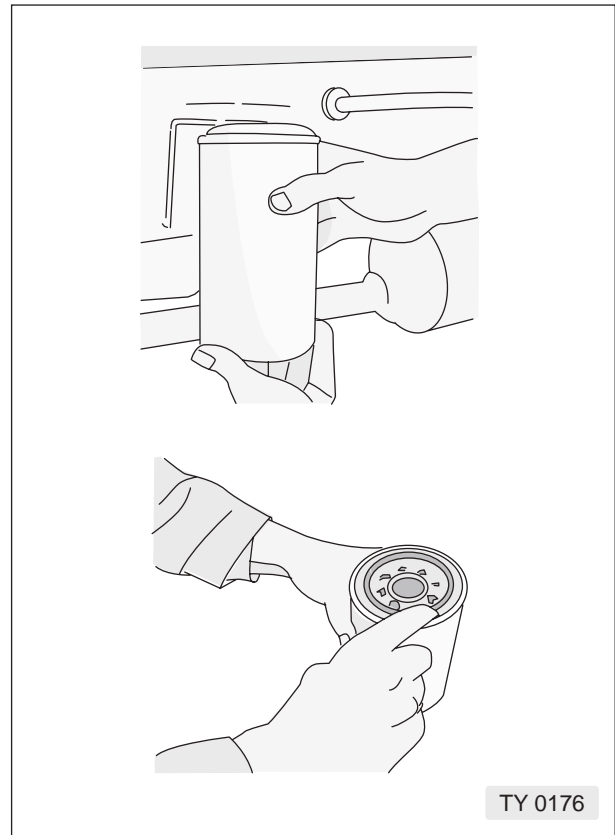
⚠ CAUTION

The replacing interval of filter elements depends on the pollution degree of the fuel. Fuel blockage can lead to decrease in fuel and power supply and to startup difficulties. When the power is significantly reduced, the filter element must be replaced.

4.2.2 Replacing the Fuel Filter

- Always prepare a filter element when replacing the filter as filling the tank with severely contaminated fuel can block the filter.
- Only use the fuel filter element approved by engine manufacturer. Replace the fuel filter regularly, otherwise, it may cause damage to high pressure fuel pump and fuel injector.

1. Clean the external surface of the filter before removing it.
2. Place a container directly below the fuel filter. Remove the fuel filter and drain the fuel off the pipeline.
3. Discard the fuel filter properly according to the local environment laws. Use a piece of clean cloth to wipe surface around base of the filter housing.
4. Apply a thin layer of oil on the O-ring of the new filter and install it.
5. Tighten the filter manually until it reaches the filter base and then screw continually by another 3/4 thread.
6. Install and tighten the fuel drain plug.
7. Start the engine to check for leaks.



Replacement Process of Fuel Filter

Section 1 Maintenance

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4.2.3 Checking Fuel Tank

- 1- Fastening belt
- 2- Sensor
- 3- Fuel filling pipe assembly
- 4- Fuel return pipe assembly
- 5- Fuel filling port
- 6- Fuel level meter
- 7- End cap

-- Drain the water and sediment from the fuel tank regularly.

The draining can only be carried out when the fuel tank is almost empty. When there is little fuel left in the tank, prepare an appropriate container. Open the drain plug, drain the water and sediment out of the tank. Clean the seal ring and close the drain plug.

- Check breather at fuel fill regularly to make sure that it is not blocked by dust or other debris.
- Check the fuel tank regularly. Clean the tank promptly if it is found dirty.

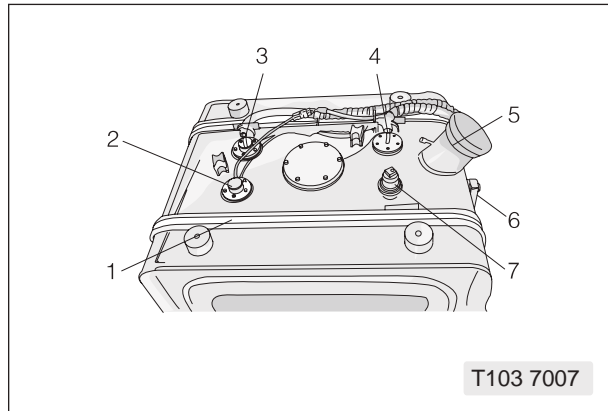
The fuel tank must be cleaned immediately if any of the following situations occurs: deep green or brown sludge buildup on tank wall on tank wall or exposed on other surface of the fuel tank, black or brown debris belt suspends in the water at tank bottom, or odor like hydrogen sulfide comes out of the tank.

4.2.4 Checking the Fuel System Pipelines

Besides visual check (e.g. oil level check), the fuel system in the engine room should be checked once per year. The following parts must be checked:

The pipe and hose connections should not have oil leaks and must be tight.

While repeatedly using certain accessory, the connection between the hose and hose joint must be checked, to ensure the mounting is firm. If it can not be confirmed whether the mounting is firm, one more hose clamp should be used to tighten the hose, or replace all hoses.



Fuel Tank Assembly

CAUTION

- Replace the pipelines and/or hoses that are damaged due to mechanical defects, thermal effects or others that are in a deteriorated state.
- Ensure sufficient distance is maintained between all pipelines, hoses and engine components (e.g. turbocharger), and ensure no friction occurs between them.

4.2.5 Refilling the Fuel

Fill up the fuel tank after the completion of each day's work to reduce the formation of condensation. Fill fuel into the tank with a pump.

CAUTION

The fuel filling pump cannot be left running idle.

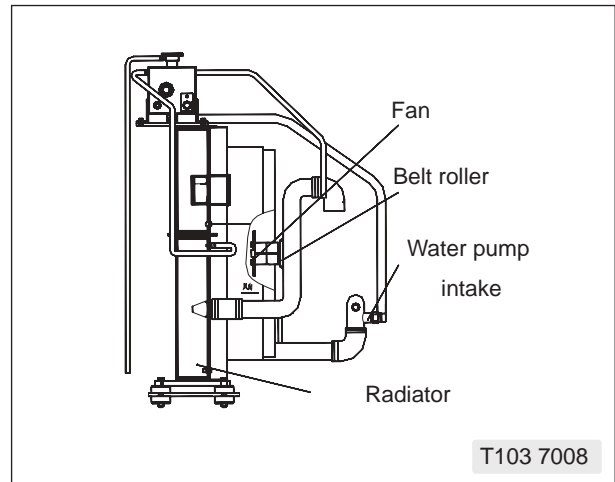
4.3 Cooling System

4.3.1 Cooling System Diagram

1. Antifreeze is essential in every climate. Check coolant level daily before starting the engine. Refill coolant if the coolant level is below the sight glass on expansion tank.
2. Only use the antifreeze designated by the manufacturer. Use of inappropriate antifreeze can cause damage (or corrosion) to the engine, such as leaks in water pump. Do not add cold coolant to a hot engine. Allow the engine to cool to below 50°C before adding coolant of the same specifications. Otherwise the engine casting will be damaged.
3. Check the radiator and fan regularly. Be sure that the radiator is not blocked by leaves, dust or other debris. Clean the radiator, as required.
4. A visual inspection of the drive belts (fan, alternator, etc.) is required daily. Check for wear and cracks before starting the engine. Transverse cracks are acceptable. Replace the belt if any longitudinal crack is found.
5. Only use the coolant filter approved by the engine manufacturer. Replace the filter element regularly. The antifreeze must be added with an appropriate amount of DCA4 to prevent air corrosion to the cylinder liner or corrosion to the cooling system.

DANGER

No fire near the fuel.
No smoking when refilling. Otherwise, there is fire hazard which may lead to property loss, personal injury and death.



Cooling System

DANGER

Burning and scalding hazard.
Ensure 60 minutes cooling before implementing the described work.

4.3.2 Checking the Coolant

Visually inspect whether the coolant level reaches the height of the inspection hole, and refill coolant if not.

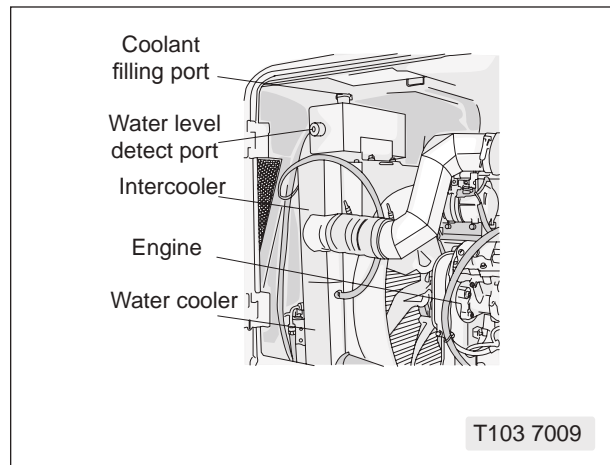
CAUTION

- Only open the cap of the engine's cooling system after the engine's cooled down, otherwise, the system will be subject to pressure and could cause an accident.
- While filling the cooling system, make sure not to form an air pocket. The absorption of air in the system will lead to engine damage.

4.3.3 Refilling the Coolant

Procedures for refilling coolant:

1. Open the radiator cap slowly to release the system pressure after the engine cool down.
2. Visually check whether the coolant level is above the inspection hole on the expansion tank. If not, refill the coolant.
3. Replenish coolant level in the tank through the inlet port of the expansion tank. If the radiator and the expansion tank are full of coolant, start the engine to run at idle speed for approx. 5 minutes. Then the coolant level will decrease.
4. Shut off the engine and remove the key. Refill the coolant to the level of the inspection hole of the expansion tank.
5. Replace the radiator cap.



Coolant Filling Port

4.3.4 Cleaning the Radiator and Replacing the Coolant

- Apply only medium air pressure so you will not damage the radiator core. Spray the compressed air or water to the radiator, until the radiator core is clean of dust, insects etc.
- If the coolant reaches extremely high temperature at normal air temperature, the inside of the cooling system might be polluted. In this case, the cooling system must be thoroughly cleaned, to remove the grease, calcium deposits and rust of the cooling pipeline system.
- For more details, Refer to the operation instructions of the engine manufacturer.
- Mineral-free water should be used: otherwise the engine cooling system will build up scale. Nor de-mineralized water can be used. When filling the system, pause for several times, to stabilize the coolant level, so that any air inside will escape.
- During the whole year, the coolant should be mixed with anti-corrosive and antifreeze liquid (see the operating instructions of the engine). The antifreeze liquid does not have any side effects to the refined coolant.

DANGER

- Burning and scalding hazard.
- Ensure 60 minutes cooling before implementing the described work.
- The radiator cap must be removed while cleaning the cooling components.

DANGER

No fire near the fuel.
No smoking when refilling. Otherwise, there is fire hazard which may lead to property loss, personal injury and death.

CAUTION

The fuel feed pump cannot be left running idle.

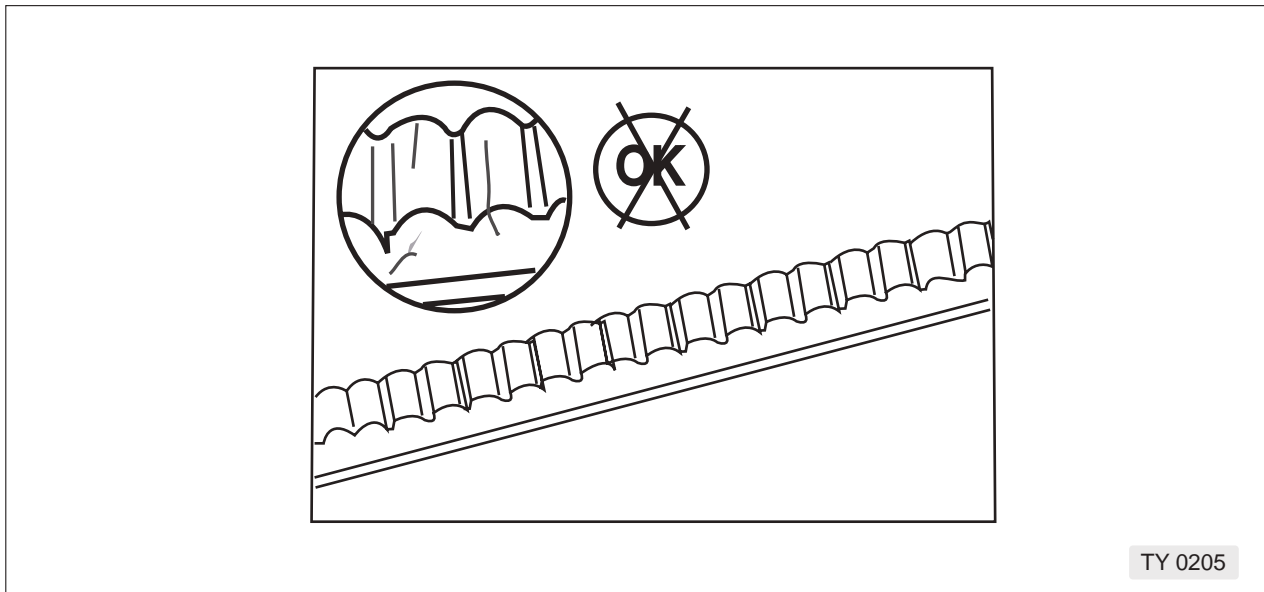
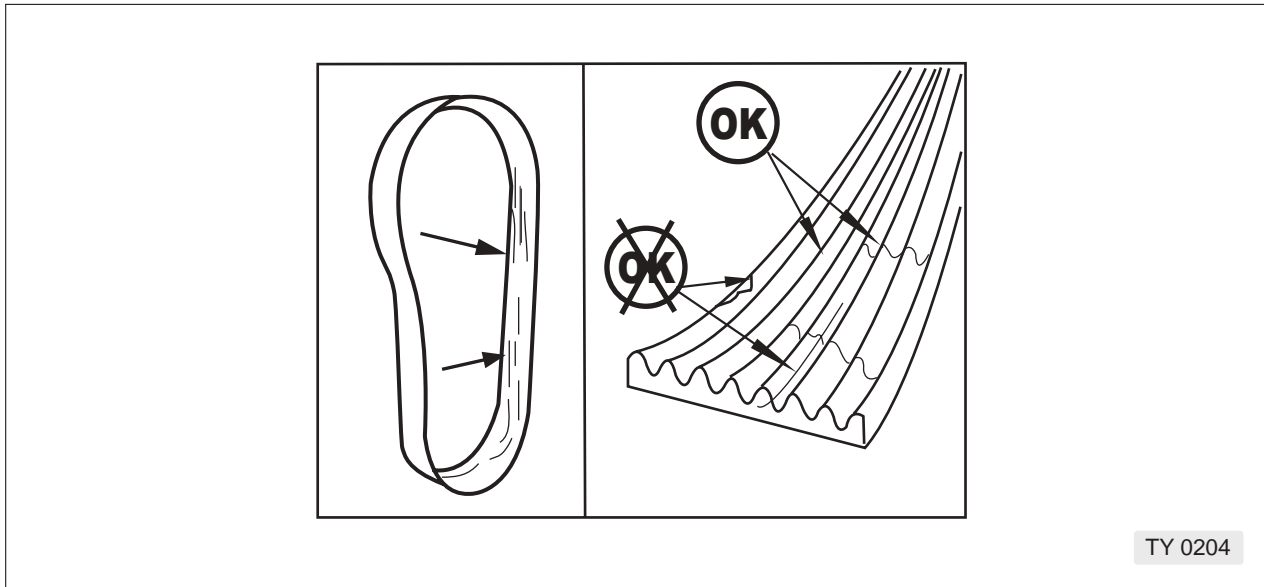
Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual



4.3.5 Checking Drive Belt

Engine fan belt is a wear-prone part with a service life of 1 year or 1000 hours. The engine manufacturer takes no responsibility for repairing after 1 year or 1000 hours, whichever comes first. Replace belt as described in the maintenance manual provided by the engine manufacturer.

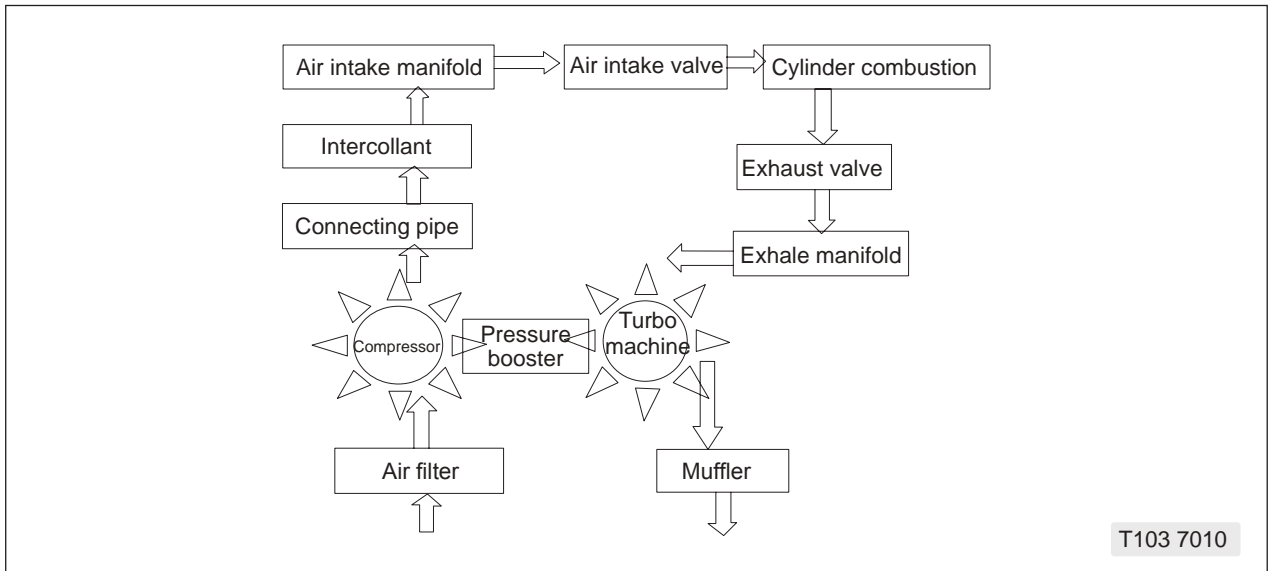


4.4 Air Intake System

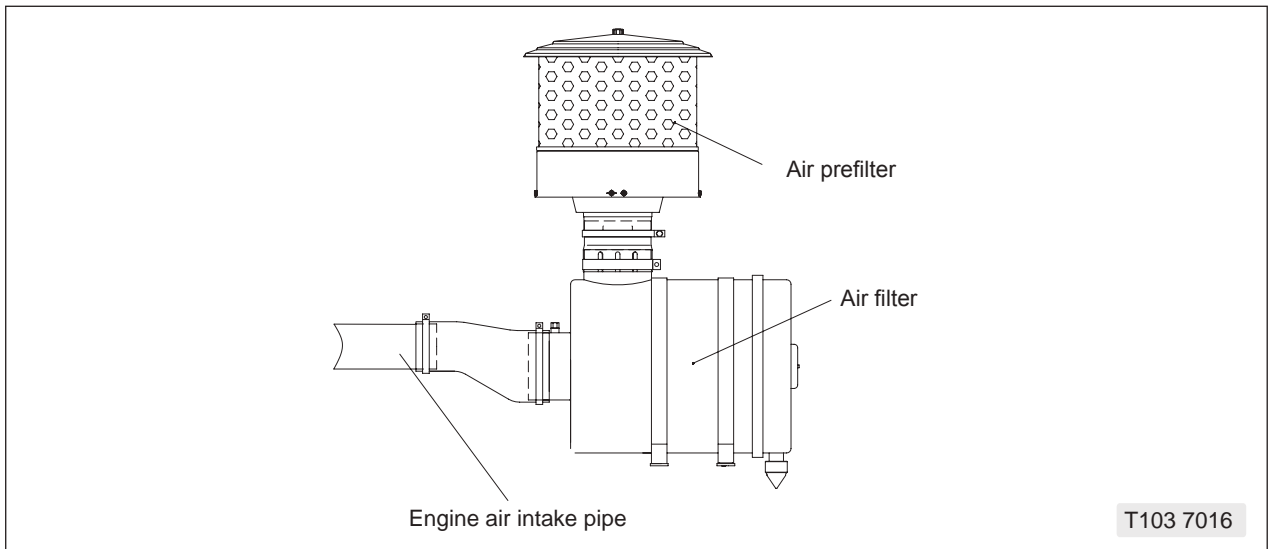
4.4.1 Air Intake System Diagram

Precautions of the air intake system:

1. Check the air intake piping daily for leaks or cracks in piping, or loose clamp.
2. Remove the dust in the collector of air filter.
3. Visually inspect the warning indicator indicating air intake blockage in air filter every day. Clean the filter element of air filter if it is blocked or even replace the filter element with a new one as necessary.
4. Use the filter element and safety filter element as designated. Otherwise, it will cause engine premature wear.



Flow Chart of Air Inlet (Outlet) System



Air Intake System

Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual

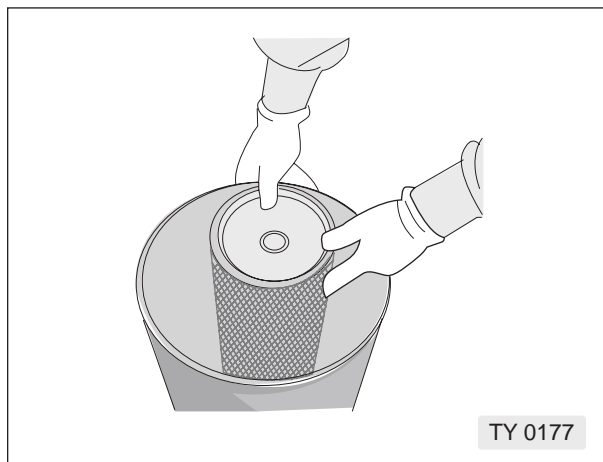


4.4.2 Checking the Filter Element

It is recommended to have the spare filter elements on hand for standby. While cleaning other parts, these spare parts can be used.

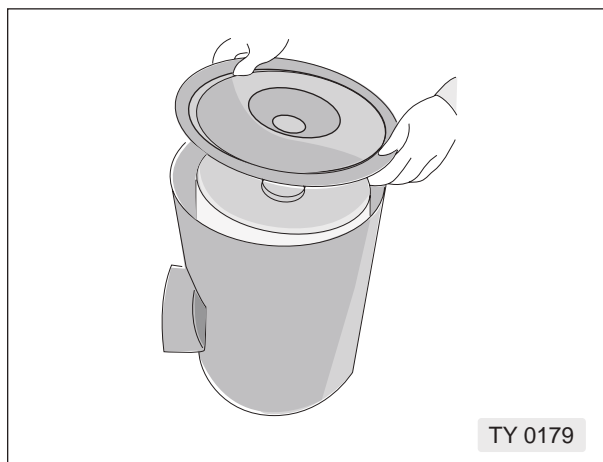
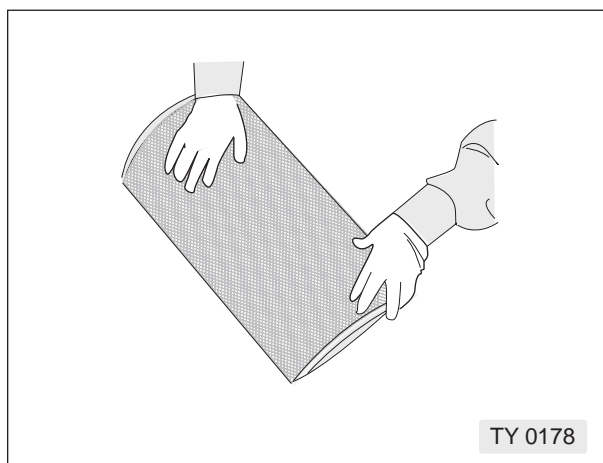
Regularly maintain the air filter.

1. Remove the filter core,
2. Visually check whether there is any appearance of damage,
3. Gently wipe,
4. Wipe inside the casing of the filter as shown in the picture,
5. When there is no damage, reinstall it, otherwise replace it.



CAUTION

- Wear protective gloves and clothing while using compressed air to clean the filter element. The air pressure should not exceed maximum 5 bars (72.57psi).
- Do not clean the filter element by patting or tapping.
- Do not use damaged filter element.



Checking Procedures

4.4.3 Cleaning and/or Replacing the Filter Element of Air Filter

⚠ CAUTION

- Never remove the air filter while the engine is running.
- The air filter element should be replaced according to the manufactures recommendations. At least after cleaning for 5 times.
- After using the filter for 2 years, the filter element must be replaced.

1. Shut off the engine. Release the locking clamp, and remove the air filter cover from the air filter body.
2. Remove the blocked filter element from the casing.
3. Clean and check the filter element. When necessary, replace the filter core.
4. Before installing new/clean filter element, the seals and seal bracket in the air filter casing must be thoroughly cleaned.
5. Insert the new/clean filter element into the air filter casing.
6. After completing the maintenance, reset the maintenance indicator (arrow) to the original position.



Diagram of Checking Procedures

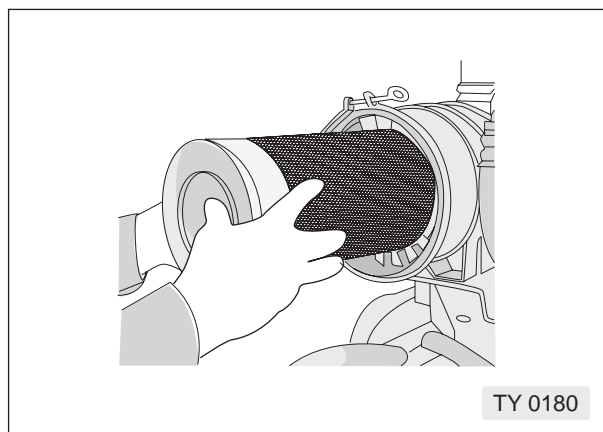


Diagram of Taking out the Filter Element

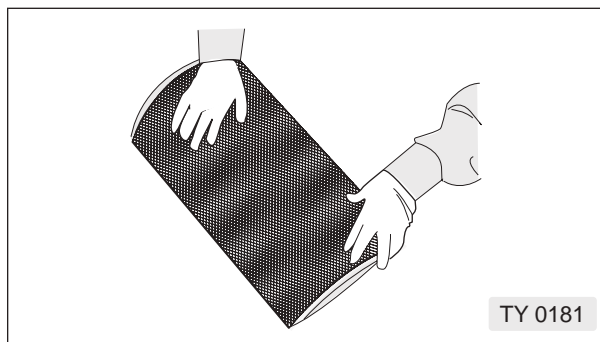
Section 1 Maintenance

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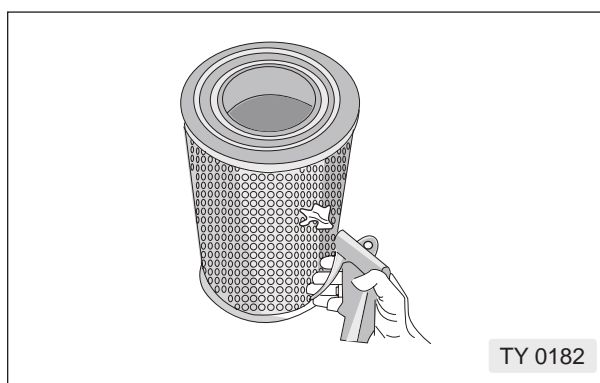


4.4.4 Air Filter Cleaning

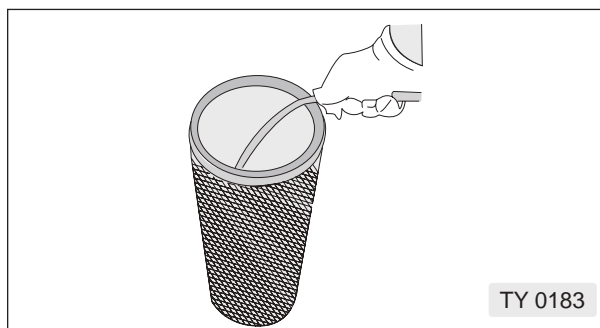
1. A temporary method is by shaking off. If the filter cannot be cleaned with the compressed air, the dust on the filter core can be shaken off. Repeatedly and gently pat the outer surface of the filter core to remove the dust. (see Fig. TY0181). Avoid damaging the filter core.
2. The method of using compressed air can be used. Compressed air max. 5 bar (72.57psi). Dry compressed air can be used to blow the filter surface (see Fig. TY0182), and then blow the inner surface of the filter (see Fig. TY0183).
3. Clean the sealed support (see Fig. TY 0184).



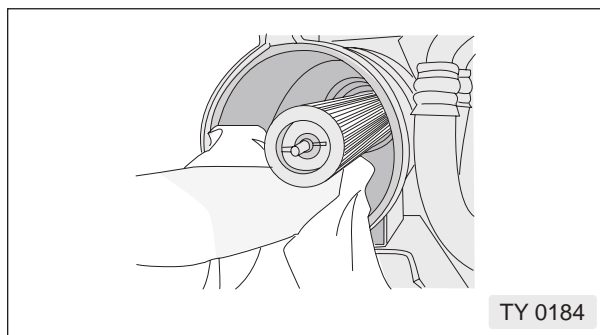
Shaking off Dust from the Filter Element



Blowing the Filter Surface with Compressed Air



Blowing Filter Outer Surface with Compressed Air

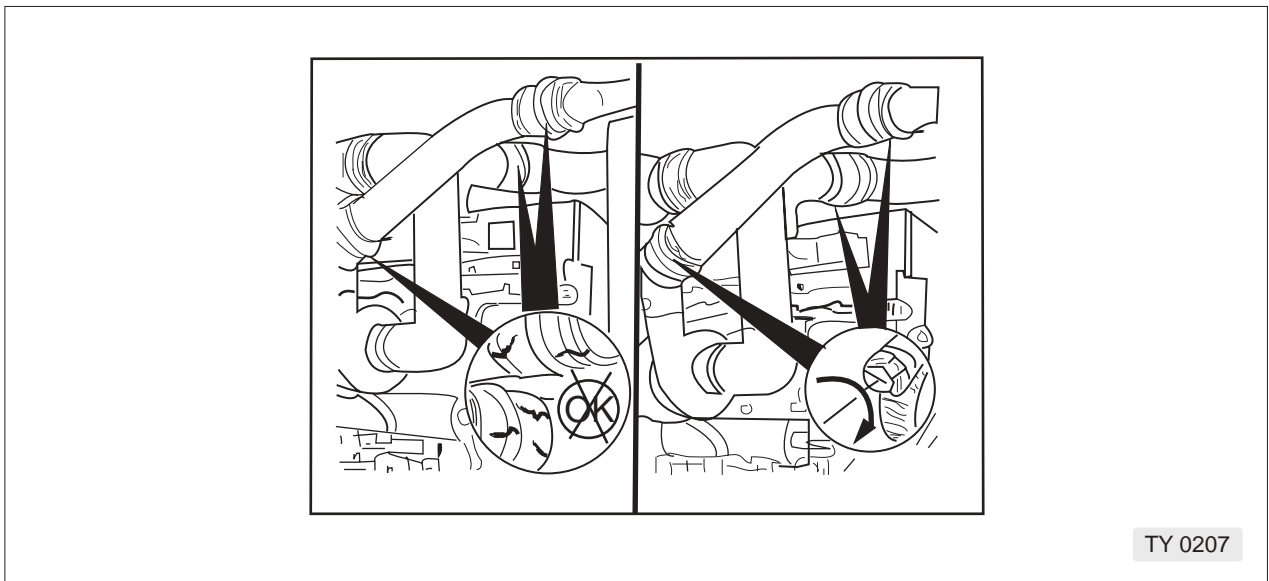
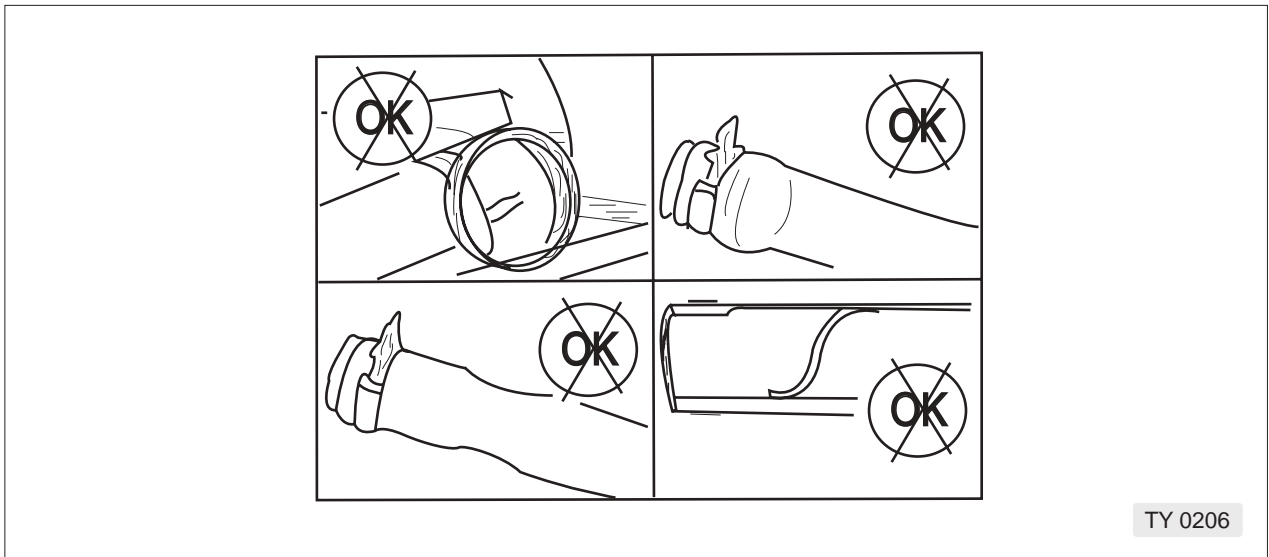


Cleaning Sealed Support

4.4.5 Checking Air Intake Piping and Pipe Clamp

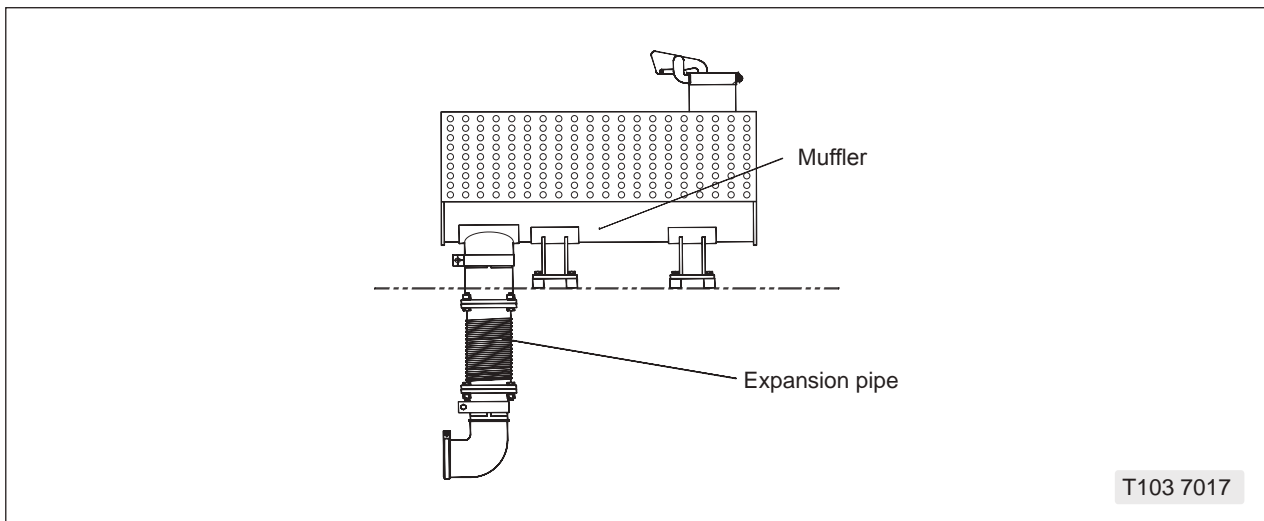
Check the air intake piping for cracks, deformation, loose clamps. Replace the damaged pipes and tighten loose clamps if the situation illustrated in the following figure occurs. Replace the clamp if necessary.

Note: The piston ring can be seriously worn even quite a little amount of dirt entering the engine. Make sure that the air intake system is clean and has no leaks.



4.5 Visual Check of the Exhaust System

- Check whether the exhaust system has any leaks.
- Pipeline or cables are not allowed to be laid in dangerous area of heat emission near the exhaust system.



Exhaust System

4.6 Checking and Replacing Engine Oil

4.6.1 Checking the Oil Level

Check the engine oil level before commencing work. Take out the dipstick and wipe it. Then replace the dipstick and pull it back out of the hole. If the oil level is within the scale marks, the oil level is normal.

CAUTION

When checking the oil level, the crane must be on level ground. Otherwise, the checking result is not correct.

4.6.2 Replacing Engine Oil

1. Use a piece of clean cloth to wipe surface around the engine oil filling hole and remove the cap.
2. Place a container(25L(6.6 gal) or larger) below oil drain screw plug on the engine oil pan and remove the oil drain screw plug to release engine oil.
3. Properly remove the engine oil filter and discard it. Use a piece of clean cloth to wipe surface around base of the engine oil filter housing.
4. Apply a thin layer of engine oil on the O-ring of the new engine oil filter and install it.
5. Tighten the filter manually till it reaches the filter base and then screw continually by another 3/4 thread.
6. Install and tighten the oil drain screw plug.
7. Pursuant to specification and volume of oil used for the engine recommended in this manual, fill the proper level of engine oil meeting the specifications into the engine oil filling hole.
8. Install the cap of the engine oil filling hole.
9. Start the engine to check for leaks. Shut off the engine and remove the key. After several minutes, pull out the engine dipstick to check the level of the engine oil.

WARNING

- Do not open the oil drain screw plug when the engine oil is hot to avoid risk of scalding.
- Any breach of this regulation may cause serious personal injury and death.

4.7 Precautions for Serving the Engine

The following service requirements are important for the normal function of the engine and must be observed accordingly:

1. Before start-up, inspect:

- 1) Coolant level,
- 2) Fuel level,
- 3) Engine oil level,
- 4) Whether the air filter element is blocked,
- 5) Whether there is water inside the fuel filter,
- 6) The hand throttle is set to the Idle speed position,
- 7) Whether all connecting pipelines are complete,
- 8) Battery and its electrical cables and connectors.
- 9) Cracks or deformation in the fan, loose connection.

2. Drain water from the fuel-water separator every day.

Open the drain port located at the bottom of the fuel-water separator and close it only after water is drained completely.

3. In routine maintenance, must check:

- 1) Engine oil level and coolant level,
- 2) Leaks,
- 3) Whether the parts are loose or damaged,
- 4) Whether the driving belt is worn out or damaged,
- 5) The external change in the diesel,
- 6) Whether water is drained off the fuel-water separator.

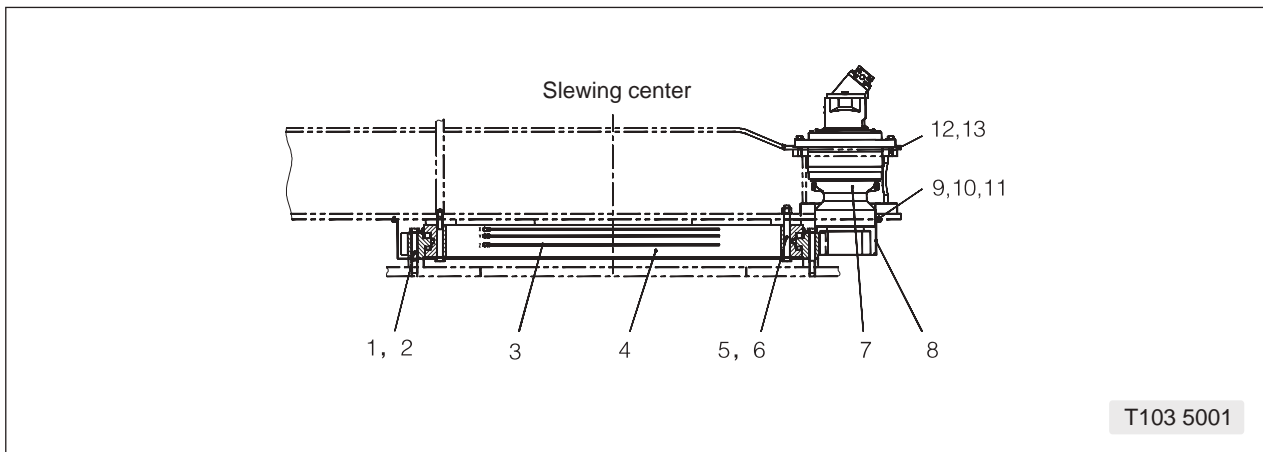


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5 Slewing Bearing

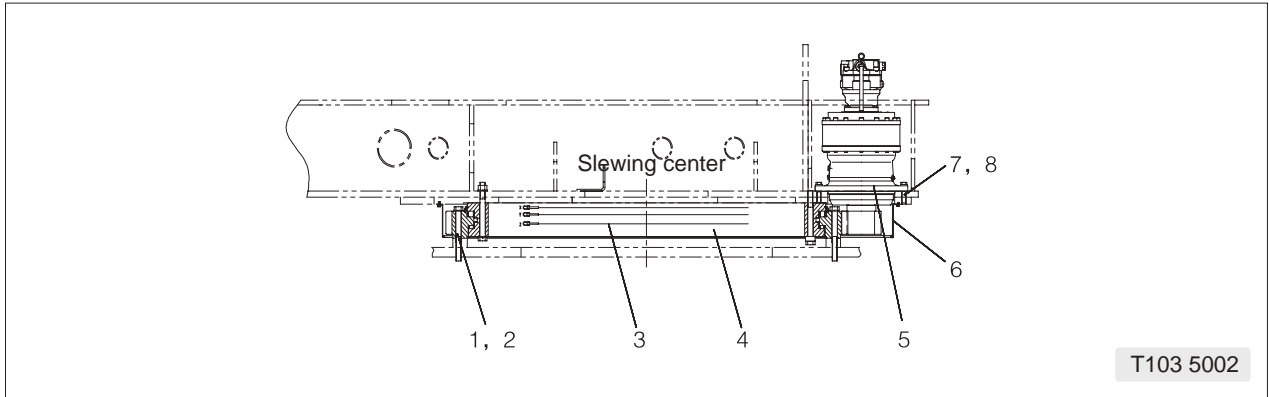
5.1 Lubricating inside of the Slewing Bearing

5.1.1 Structure of the Slewing Bearing



Slewing Mechanism (Rexroth)

1	Bolt	8	Dust cap
2	Washer	9	Bolt
3	Lubricating pipeline	10	Washer
4	Slew ring	11	Washer
5	Bolt	12	Bolt
6	Nut	13	Washer
7	Slewing reducer		



Slewing Mechanism (Kawasaki)

1	Bolt	5	Slewing reducer
2	Washer	6	Dust cap
3	Lubricating pipeline	7	Bolt
4	Slewing ring	8	Wahser

5.1.2 Lubrication Requirements

During use, pay attention to the operation of the slewing bearing. If there is any noise, impact, sudden increase in rotational speed, the machine should be immediately shut down for examination and troubleshooting, when necessary disassembly may be needed for examination.

⚠ DANGER

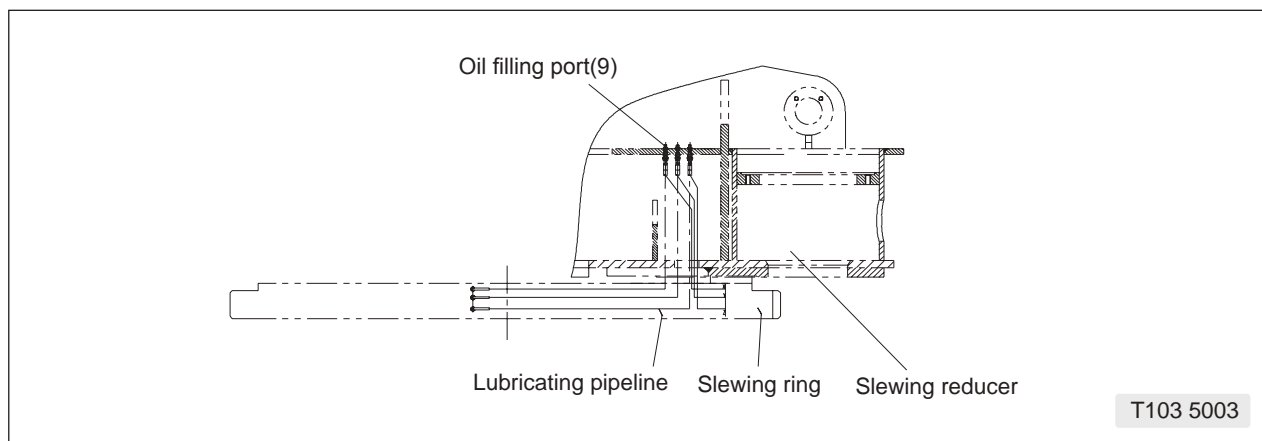
- There is a danger of being dragged into area to the slewing pinion while implementing maintenance. Pay attention to the attached warning sign.
- Crushing and shearing hazard.
- While carrying out the following tasks, make sure that when performing necessary slewing and luffing movements, none of the maintenance staff are in dangerous areas between the main boom, upperworks and rollers or between lowerworks and rollers, except for the crane operator (in the operator's cab).

⚠ WARNING

Avoid direct exposure of the ring to the sun during use. Never use water to directly rinse the slewing bearing, in case the water enters the roller path, take strict precautions against approach or entry of hard impurities in the pinion meshing area.

⚠ CAUTION

The crane operator and lubrication staff must always maintain contact by hand signals or verbal communication.



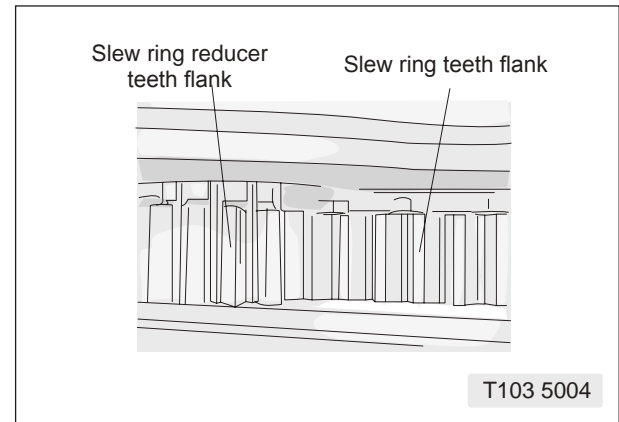
Slewing Bearing Lubrication Pipeline Diagram

The slewing bearing is lubricated by the pipeline:

1. In normal operating conditions, perform central lubrication to the slewing bearing when it operates for every 8 hours.
2. New lubricating grease must be applied sufficiently before and after long-term shutdown of the machine.
3. For various lubrications, the roller path must be filled with lubricating grease, until it oozes from the seal.
4. While filling lubricating grease, make sure to slowly rotate the slewing bearing, so that the lubricating grease is filled equally.
5. Frequently check the integrity of the sealing, if the sealing tape is found to be damaged, replace it immediately, if it is found to fall off, restore it in time.
6. Lubricate the slewing surface by oil feed pipe.
7. The slewing bearing pinion surface should be cleaned every 250 operating hours, and be applied with lubricating grease.

5.2 Lubrication of the Slewing Bearing Pinion Surface

See section 2 of this chapter for lubricating grease types and lubrication interval for slewing bearing pinion surface.



Lubrication of Slewing Bearing Gear Pinion Surface

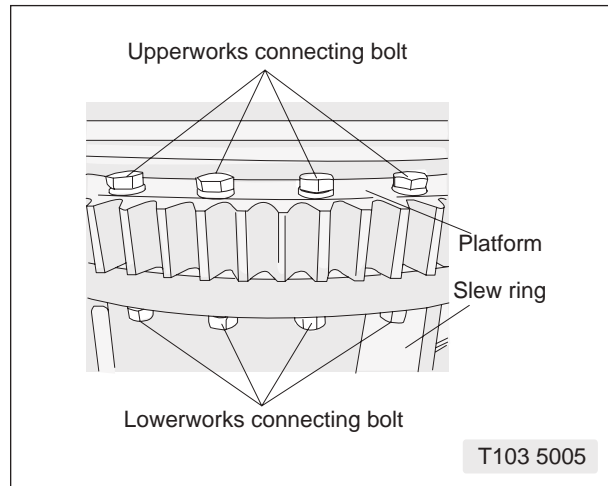
Section 1 Maintenance



5.3 Checking the Slewing Bearing Bolt

Visual check must be performed for the bolts on the slewing bearing before every lifting operation, or at least perform such examination once per day.

- Before screwing down every bolt, apply the wire-locking adhesive (locking 1243) on all surfaces under the bolt head that connect the bolts.
- After the slewing bearing has operated for 100 hours, the torque of the bolts should be checked, after that, check once for every 500-hours operation, sufficient torque values must be maintained, normally the bolts need to be replaced every 7 years or after operation of 4,000 hours.
- Operate the crane according to the requirements of the operation instructions and load charts. Regularly check the bolts as required. Before securing every bolt, apply the bolt thread sealant (Model 1243) on all surfaces under the bolt head that connect the bolts. so that the danger of bolt fatigue damage can be avoided.



Position of Slewing Bearing Connection Bolts

CAUTION

If slewing bearing needs being replaced, all of the bolts must be replaced.

Position	Mounting position	Diameter (mm)	Pre-tightening Torque
1	Upperworks	Bolt M30	1800 N•m (1327ft•lb)
2	Lowerworks	Bolt M30	1800 N•m (1327ft•lb)



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□ 6 Slewing Reducer (Kawasaki)

⚠ CAUTION

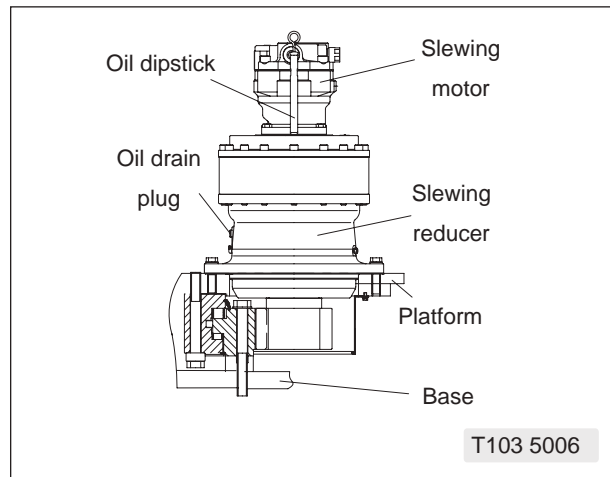
Select the appropriate slewing reducer according to actual configuration of the crane.

6.1 Slewing Reducer - Checking the Oil Level

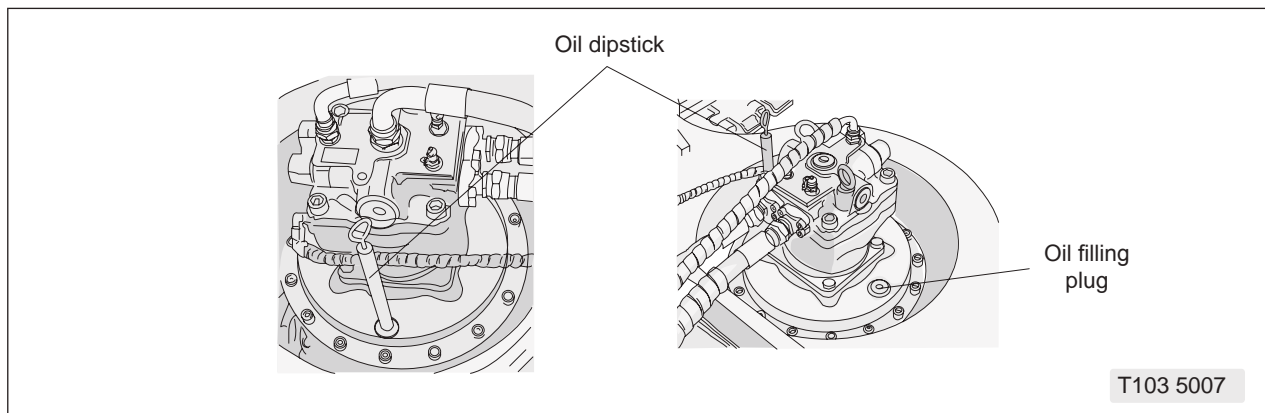
- Operation of refilling lubricating oil Refer to 6.2 Changing Oil.
- Part the crane on a horizontal surface, and remove the dipstick or the oil filling plug. If the oil surface reaches the mark of the dipstick or can be seen at the filling hole, the oil is sufficient.

⚠ CAUTION

If any oil leaks are found during checking the oil level, the operation must be temporarily stopped, and the system should be disassembled for examination.



Structure and Mounting Position of Slewing Reducer



Checking Oil Level

6.2 Slewing Reducer - Changing Oil

When changing oil, drain the used oil when it is hot, i.e. change the oil after the machine has been operating for a long period.

Make sure that the crane is at non-working state when refilling oil. The procedure as follows:

1. Remove the fill plug and prepare a container to hold oil.
2. Pull out the dipstick and remove the drain plug.
3. Drain old oil into the container. Reinstall the drain plug.
4. Fill approximately 10.5L (2.77gal) gear oil with a pump through fill port to dipstick mark.
5. Reinstall fill plug and dipstick. Wipe reducer surface clean. Check whether there is any leaks on the surface after 10 to 20 minutes.

Abide by environmental laws when disposing of used oil.

6.3 Slewing Reducer - Checking the Brake

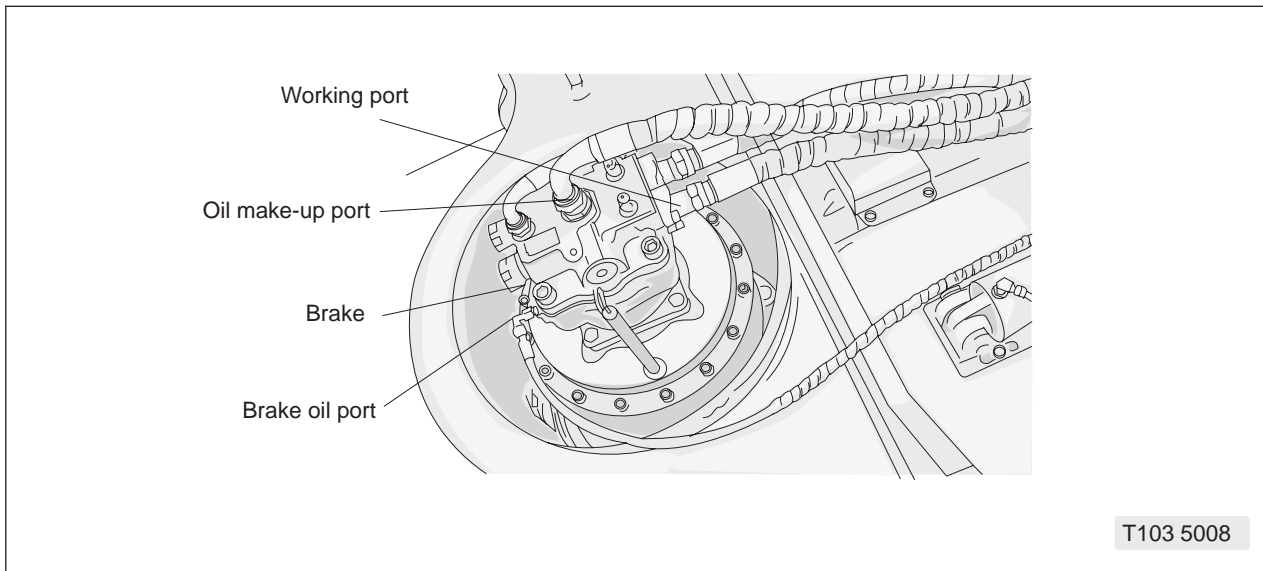
- Check whether the slewing reducer brake has any leaks, and whether the operation is normal.
- Regularly check the brake of the slewing reducer.
- Check the base, crawlers and upperworks.

CAUTION

Only trained and experienced technicians can perform this work. If the brake can not work well, it may lead to accidents.

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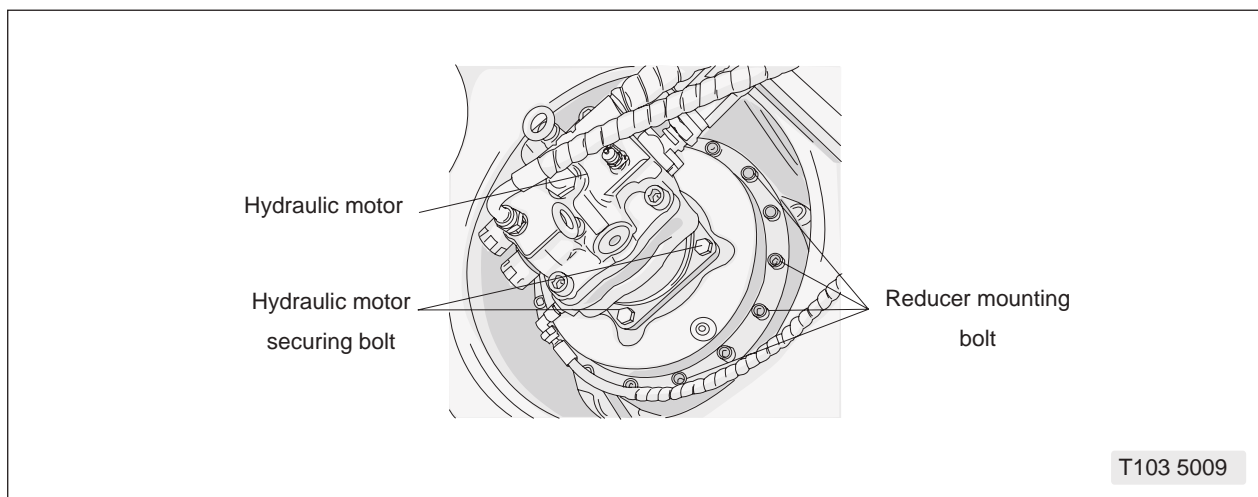
Brake of slewing reducer (Built-In)

Check the brake of the slewing reducer according to the following procedure:

1. Start the engine.
2. Operate the slewing brake switch to apply the brake.
3. Operate the left handle, and slowly rotate the upperworks of the crane towards the right and left, stalling overflow.
4. If the crane stays at the original position, the brake works correct.
5. If the crane is not at the original position, the braking performance of the slewing reducer must be checked.

6.4 Slewing Reducer - Checking the Connecting Bolt

- As all the securing bolts are applied with thread sealant, they normally will not be tightened and a visual inspection is sufficient.
- Remove bolts that are loosen, broken, or defective, and replace with new ones.
- **Apply a little amount of thread sealant on thread and surface of all bolts.**
- **Check the slewing reducer cap, pipelines, and bearing housings for leaks.**



Structure and Mounting Position of Slewing Reducer

Torque Value of Reducer Mounting Bolts			
Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M20(13/16")	10.9	650N•m(480ft•lb)	○

Torque Value of Hydraulic Motor Securing Bolts			
Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M20(13/16")	10.9	650N•m(480ft•lb)	○

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□ 7 Hoisting Winch (Kawasaki)

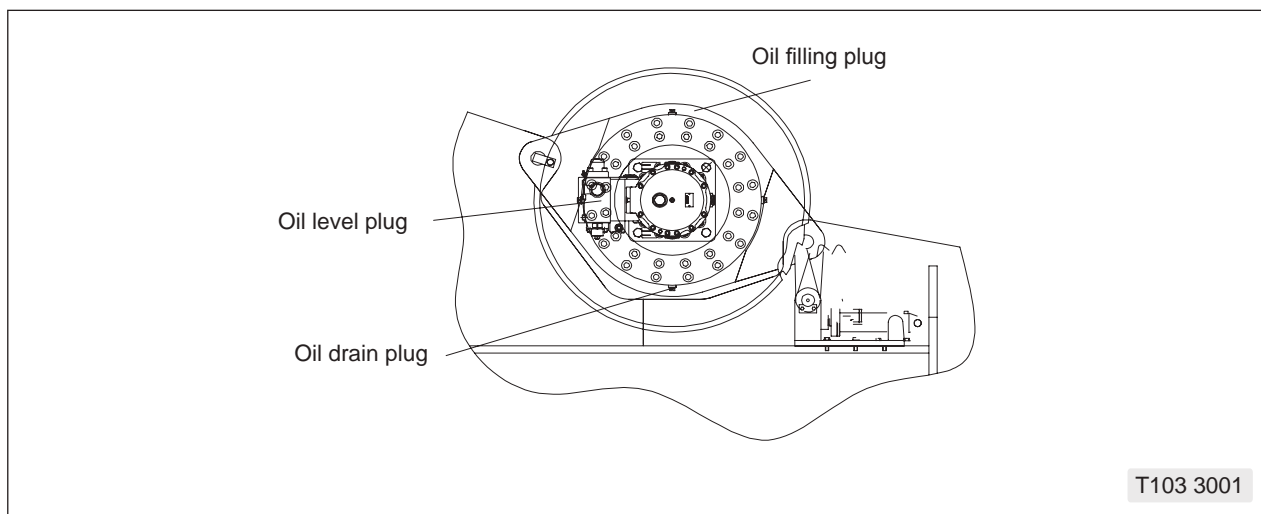
□ 7.1 Main Hoisting Winch (Without Free-Fall Function)

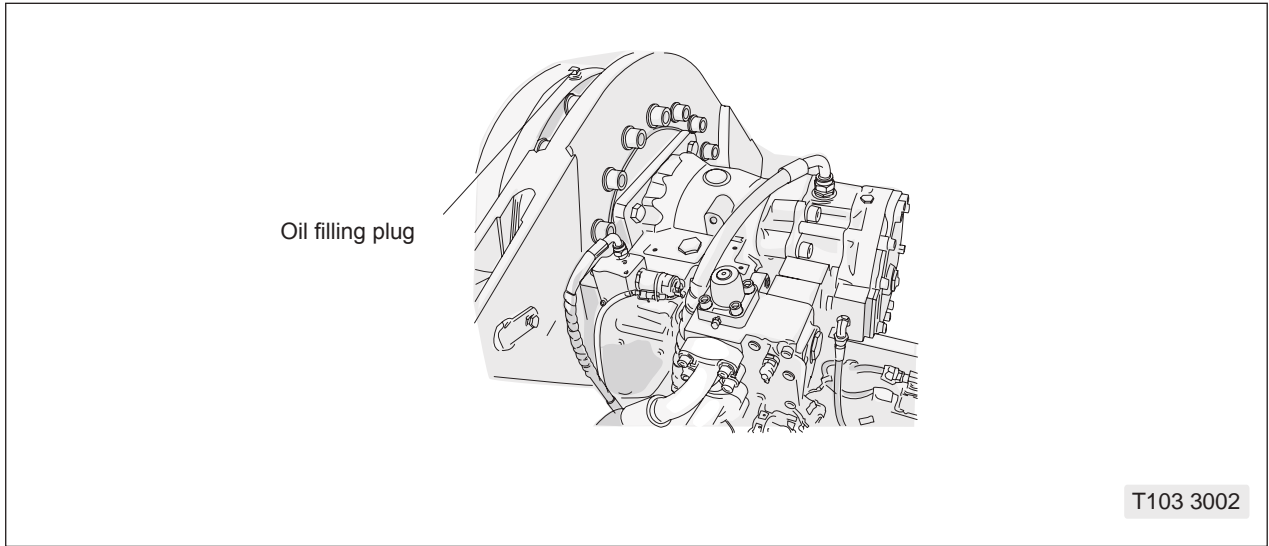
7.1.1 Main Hoisting Winch - Checking the Oil Level

Oil level must reach the level plug.
Refer to Section 7.1.2 “Replacing the Lubricating Oil” for the procedures of refilling lubricating oil.

⚠ DANGER

Danger of dragging or entanglement.
Great care must be taken while performing maintenance, inspection or installation.
Danger of being dragged into the area between the winch and wire ropes could result.





Checking Oil Level of Main Hoisting Winch

Checking procedures:

1. Park the machine on a flat level surface,
2. Remove the oil level plug,
3. If the oil surface can be seen, the oil is sufficient.
If not, the oil is insufficient (see Fig.T103 3001).

 **CAUTION**

If an oil leak is detected while checking the oil level, stop the operation temporarily and disassemble the system for further check. Such work can only be carried out by trained and experienced professionals.

7.1.2 Main Hoisting Winch - Replacing the Lubricating Oil

Abide by environmental laws when disposing of used oil.

1. Unscrew the filling plug on the reducer,
2. Prepare the container for oil,
3. Unscrew the oil level plug,
4. Unscrew the drain plug,
5. Drain the used oil into the prepared container,
6. Install the drain plug,
7. Then fill new oil through the filling port, until the new oil comes out of the oil level check hole,
8. Install the filling plug,
9. Install the oil level plug.

CAUTION

Before changing oil, drain the used oil while it is hot, i.e. change oil after the machine has been operating for a long period.

7.1.3 Main Hoisting Winch - Lubricating Winch Drum Bearing

Lubricating method: Fill through the oil filling port on the side without reducer (see Fig. T103 3003).

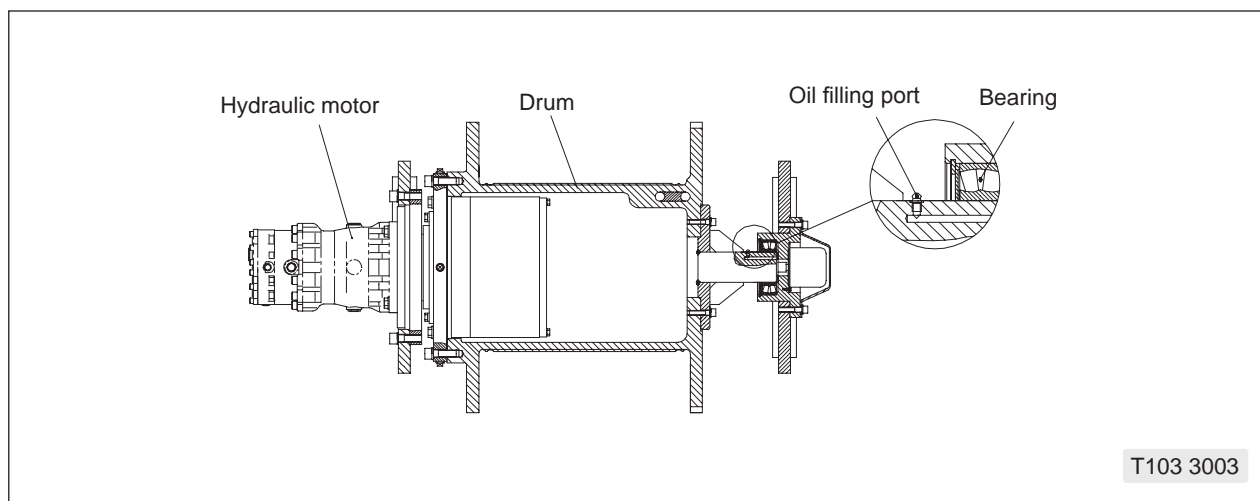


Diagram for Bearing Lubrication

7.1.4 Main Hoisting Winch - Checking the Brake

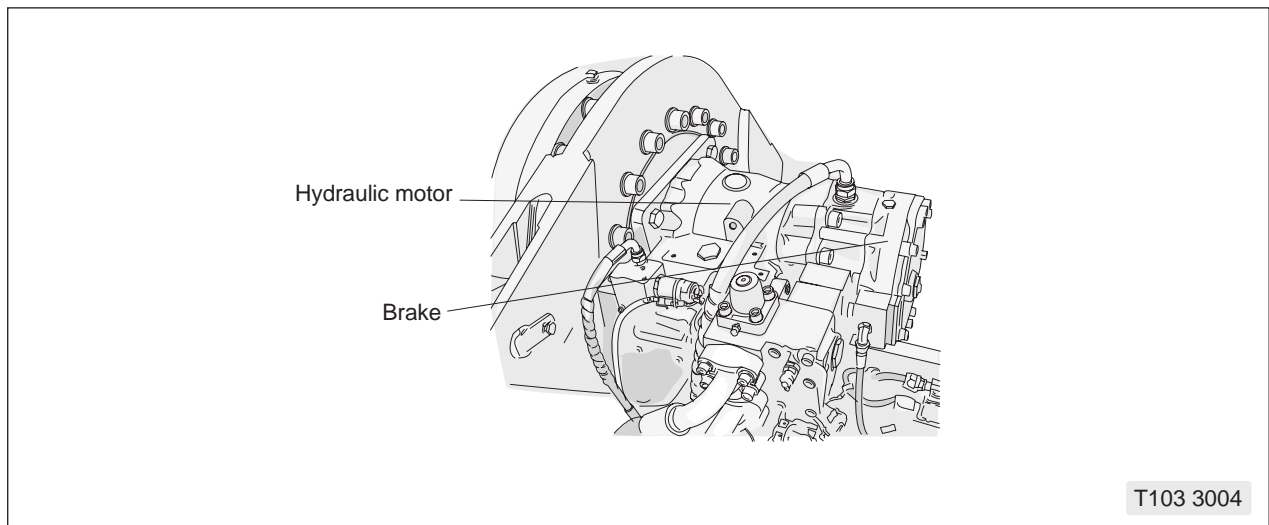
- The performance of the braking disc of the hoisting winch must be regularly checked to ensure normal braking.
 - Before restarting the work, replace all defective components, and clean the brake.
- If oil stains on the brake plates cannot be completely erased, these plates must be replaced.

CAUTION

- Replace the brake immediately if any defect is found in it.
- Such work can only be carried out by trained and experienced professionals.

WARNING

If the brake cannot work well, it may lead to accidents.



Position of Main Hoisting Winch Brake (Built-In)

Procedures for checking the performance of the hoisting winch brake:

1. Start the engine, and run at a speed slightly higher than idle speed.
2. Load the corresponding hoisting winch with the max. load the rope can bear.
3. Operate the handle backwards to completely lift up the load.
4. Operate the corresponding winch handle to the neutral position.
5. Mark "X" on the winch drum and a corresponding "X" on the bracket.
6. Operate the upperworks to make the load freely suspended in the air for about 2-3 minutes.
7. During this period, do not operate the winch drum. The sign "X" on the winch drum must be consistent with the sign "X" on the bracket, otherwise, check the winch brake.

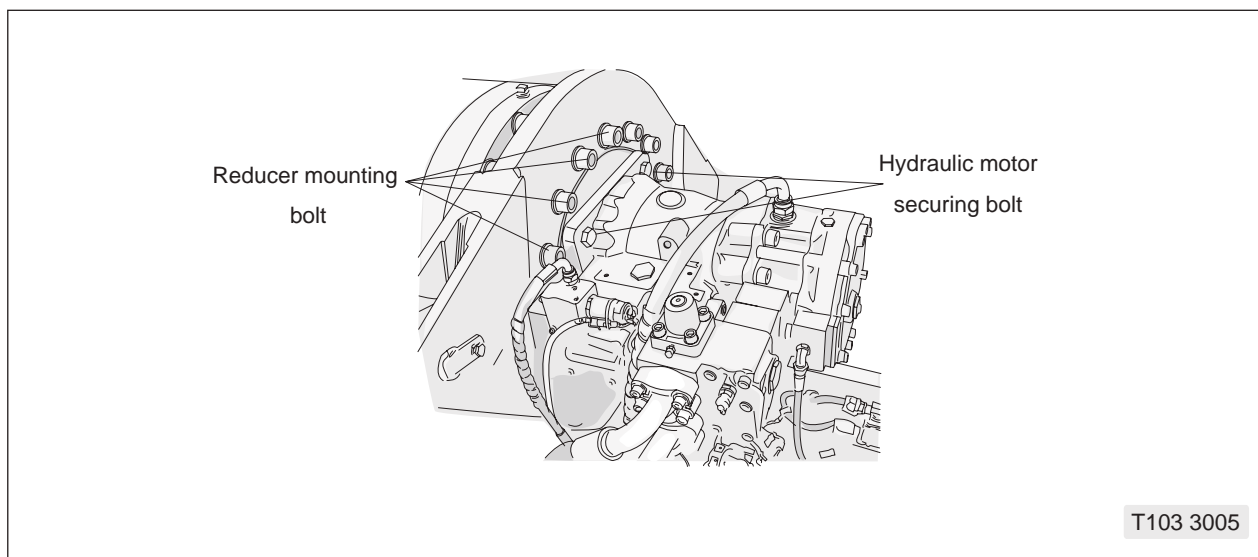
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7.1.5 Main Hoisting Winch - Checking the Connecting Bolts

- As all the securing bolts are applied with bolt thread sealant, they normally will not loosen up and a visual inspection would be sufficient.
- Any bolt that is found loose, broken or defective must be replaced.
- Apply a little amount of thread sealant on thread and surface of all bolts.
- Check the slewing reducer cap, pipelines, and bearing housings for leaks.



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Structure and Mounting Position of Aux. Hoisting Winch

Torque Value of Reducer Mounting Bolts and Bracket

Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M24(15/16")	10.9	940~1120N•m(693~826ft•lb)	○

Torque Value of Hydraulic Motor Securing Bolts and Bracket

Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M20(13/16")	10.9	650N•m(480ft•lb)	○



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□ 8 Boom Luffing Winch (Kawasaki)

8.1 Boom Luffing Winch - Checking the Oil Level

Refer to 8.2 “Changing Oil” for the operating of filling lubricating oil.

Checking procedures:

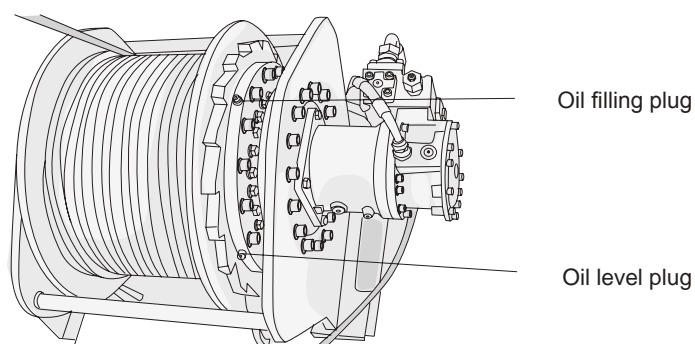
1. Park the machine on a flat level surface,
2. Remove the oil level plug,
3. If the oil surface can be seen, the oil is sufficient.

DANGER

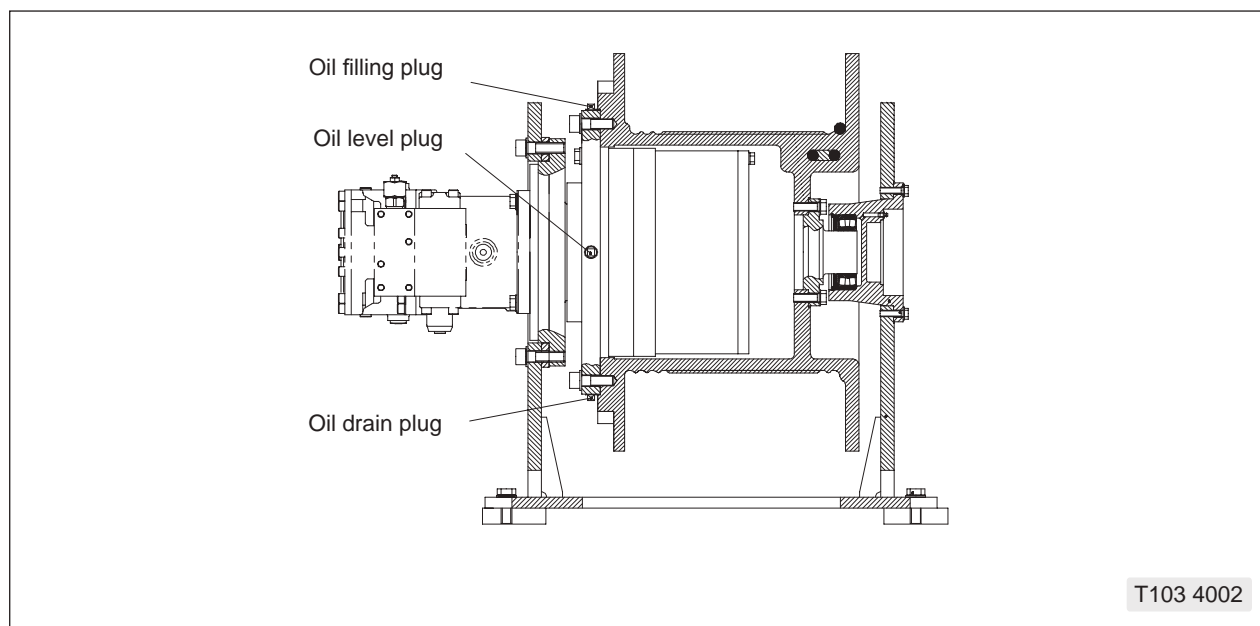
Danger of dragging or entanglement.
Pay special attention while implementing the maintenance, inspection and installation, because there is danger of being dragged into area between the winch and wire ropes.

CAUTION

If an oil leak is detected while checking the oil level, the operation must be temporarily stopped, and the system should be disassembled for examination. This work can only be carried out by trained and experienced professionals.



T103 4001



8.2 Boom Luffing Winch - Changing Oil

Abide by environmental laws when disposing of used oil.

Detach the load before changing oil.

1. Unscrew the filling plug on the reducer,
2. Prepare the container for oil,
3. Unscrew the oil level plug,
4. Unscrew the drain plug,
5. Drain the used oil into the prepared container,
6. Install the drain plug,
7. Then fill new oil through the filling port, until the new oil comes out of the oil level check hole,
8. Install the filling plug,
9. Install the oil level plug.

CAUTION

When changing oil, drain it when the oil is hot, i.e. change the oil after the machine has been operating for a long period.

CAUTION

When changing oil, usually the main boom is first horizontally placed or disassembled.

8.3 Boom Luffing Winch - Lubricating Winch Drum Bearing

Lubricating method: Fill through the oil filling port on the side without reducer (see Fig. T103 4003).

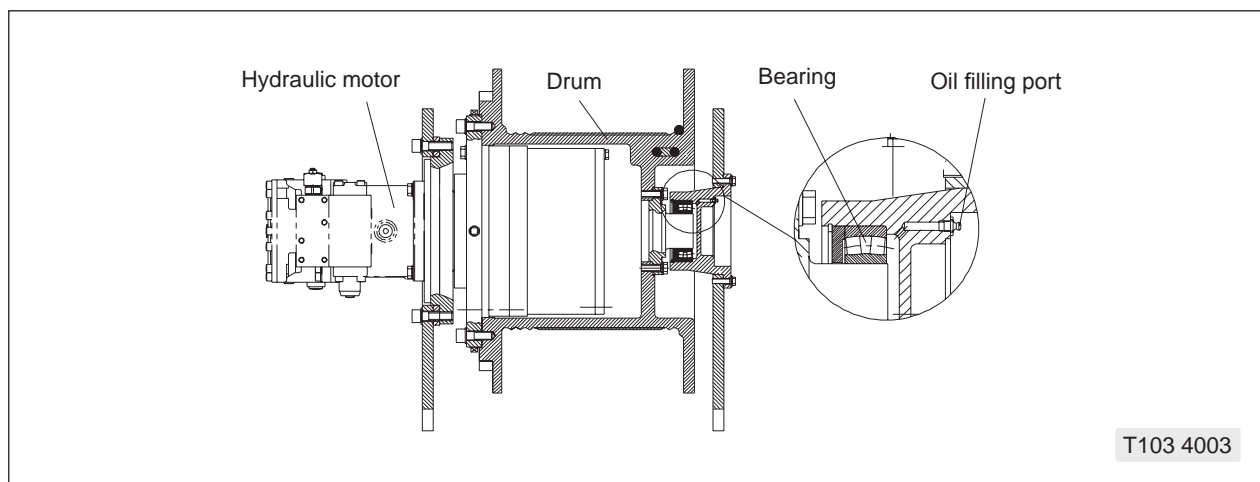


Diagram for Boom Luffing Winch Bearing Lubrication

8.4 Boom Luffing Winch - Checking the Brake

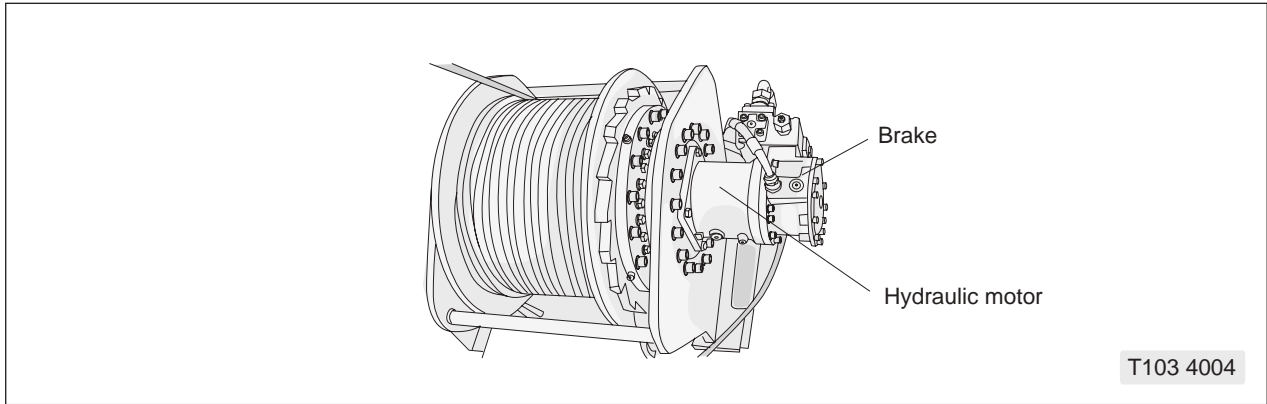
- The performance of the braking disc of the luffing winch must be regularly checked to ensure normal braking.
- Check if the luffing winch reducer brake has leakage, and if the operation is normal.

CAUTION

- Replace the brake immediately if any defect is found in it.
- This work can only be carried out by trained and experienced professionals.

WARNING

If the brake can not work well, it can lead to accidents.



T103 4004

Position of Boom Luffing Winch Brake (Built-In)

Check the brake of the luffing reducer in the following conditions:

- When lifting with the full extensional boom + the full extensional jib or the full extensional boom,
- When lifting the max. load,

Check the brake when lifting the max. load:

1. Lift up the load until it is barely above the ground (around 10cm (3/8")).
2. Suspend the load lifting operation.
 - With the engine running, do not perform any other actions.
 - All control handles in the operator's cab are in the neutral position.
3. Mark "x" on the drum and on the upperworks bracket of the luffing reducer.
4. Keep the crane under the load working condition for around 2 minutes.
5. Check the sign "x" on the winding drum and on the upperworks bracket:
 - The sign "x" remains there = the brake works properly
 - The sign "x" is moved (luffing winch slipping) = the brake must be further examined.

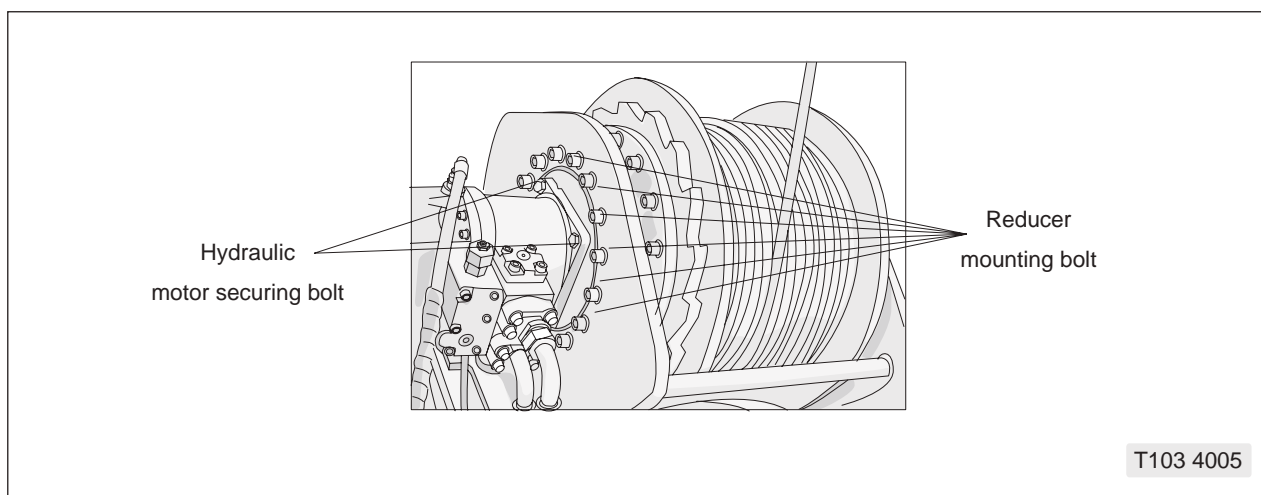
Before performing each lifting operation, check the brake on the boom luffing reducer.

1. Perform hoisting as described in the installation instructions (Chapter 4).
2. While performing the lifting operation, lift up the

- last equipment component parked on the ground until it barely leaves the ground.
3. Stop the load lifting operation.
 - With the engine running, do not perform any other actions.
 - All control handles in the operator's cab are in the neutral position.
4. Make a sign "x" on the corresponding winding drum and on the A-frame.
5. Keep the crane under the load working condition for around 2 minutes.
6. Check the sign "x" on the winding drum and on the A-frame:
 - The sign "x" remains there = the brake works properly
 - The sign "x" is moved (luffing winch slipping) = the brake must be further examined.

8.5 Boom Luffing Winch - Checking the Connecting Bolt

- As all the securing bolts are applied with bolt thread sealant, they normally will not loosen up and a visual inspection would be sufficient.
- Remove the bolts that are loose, broken, or defective and replace with new ones.



Structure and Mounting Position of Boom Luffing Winch

Torque Value of Reducer Mounting Bolts and Bracket

Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M20(13/16")	10.9	650N•m(480ft•lb)	○

Torque Value of Hydraulic Motor Securing Bolts and Bracket

Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M16(5/8")	10.9	350N•m(258ft•lb)	○

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9 Lowerworks

9.1 Checking the Oil Level of Traveling Reducer

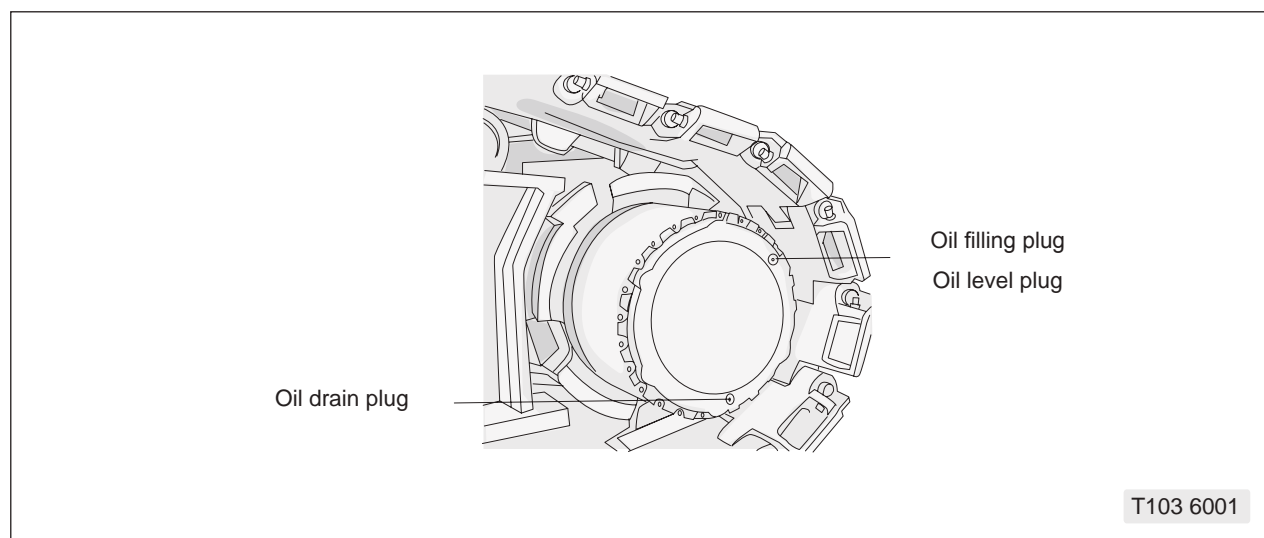
1. Check the reducer for any abnormal noise.
2. Unscrew the oil level plug.
3. When the crane is parked on horizontal ground, if the lubricating oil reaches the inspection hole, the oil level is correct.
4. When necessary, add lubricating oil through the oil filling port.
5. Replace the oil level plug.

DANGER

There is a danger around the upperworks and the crawlers when the crane is slewing. Be especially careful while performing maintenance, inspection and hoisting work in these areas.

CAUTION

- Shut off the driving motor before making any operation to the lowerworks.
- If an oil leak is still detected while checking the oil level, stop the operation temporarily and disassemble the travel device to check.



T103 6001

Checking Oil Level of Traveling Reducer

9.2 Replacing Oil in Traveling Reducer

Make sure to be environment-friendly while disposing used oil.

Filling oil needs to be done with special tools.

When changing oil, drain it when the oil is hot, i.e. change the oil after the machine has been operating for a long period.

1. Unscrew the drain plug and oil level plug, and drain the oil into appropriate container.
2. Before cleaning, use flushing oil (warm and clean) to rinse off impurities and foreign objects from the gears.
3. Replace the drain plug, and fill with new oil. When the lubricating oil reaches the inspection hole then the oil level is correct.
4. Replace and tighten the oil level plug.

9.3 Checking and Lubricating the Crawler

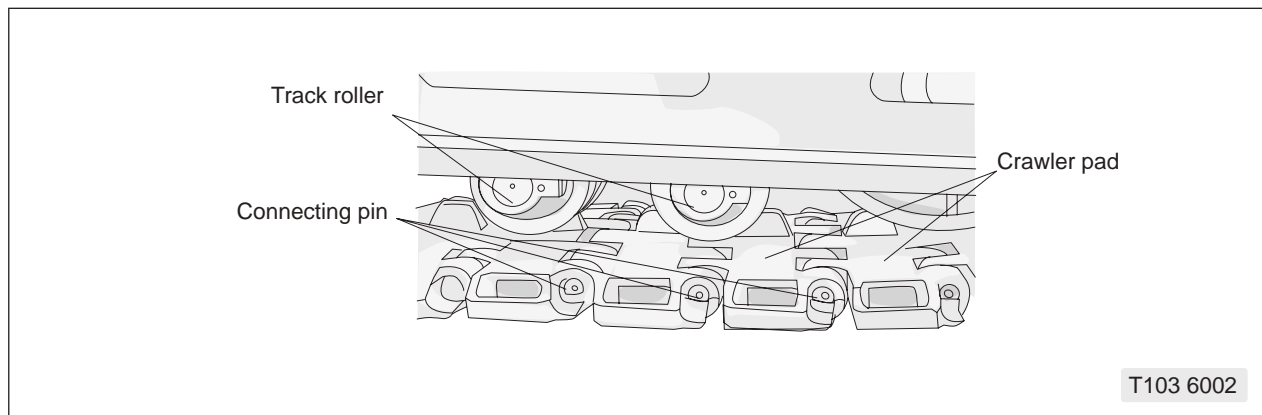
- Lubricate the crawler connecting pins among the crawler components, and check the crawler tension if there are any operating noises detected.
- After cleaning the crawler and before tensioning the crawler components, lubricate the crawler pins.

CAUTION

- **Before every traveling operation, all connecting pins must be thoroughly lubricated.**
- **When the crawlers are dirty, it is absolutely necessary to clean them.**

Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual



Crawler Pads and Connecting Pins

Normally insufficient lubrication of crawler connecting pin or improper tightening of the crawler pad will lead to operating noise and premature wear, and dirty crawlers will also lead to these conditions.

Therefore, **the following contents should be regularly checked**, at least check once every month or check before every operation, or check after the crane has traveled for a long distance.

1. Crawler traveling device (wear, lubrication of crawler pins and tightening of the crawler pads).
2. Track roller or supporting roller of the crawler (wear, lubrication and function of rollers).
3. Driving motors of the crawler (wear, lubrication of the reducer).
4. Dirt on the crawler. When the crawler is dirty, more energy is needed to move the crane. Therefore, the torque at the mobile part of the crawler is severe.
5. Lubrication of the crawler pins may be needed. At the upper part of the crawler, apply lubrication on the pins that connect the crawler pads. Drive the crane forward, until the lower part of the crawler is on the supporting roller. Apply lubricant onto the crawler pins at this part.

9.4 Maintaining Hydraulic Cylinders of the Lowerworks

- Check the outrigger cylinders for leaks, normal function, or rust.
- For cranes operating in corrosive environment (seaside, chemical plant, or steel plant), if they are not used for more than one day an acid-free protective lubricating grease must be applied on the exposed chromium surface of the piston rods to avoid corrosion.

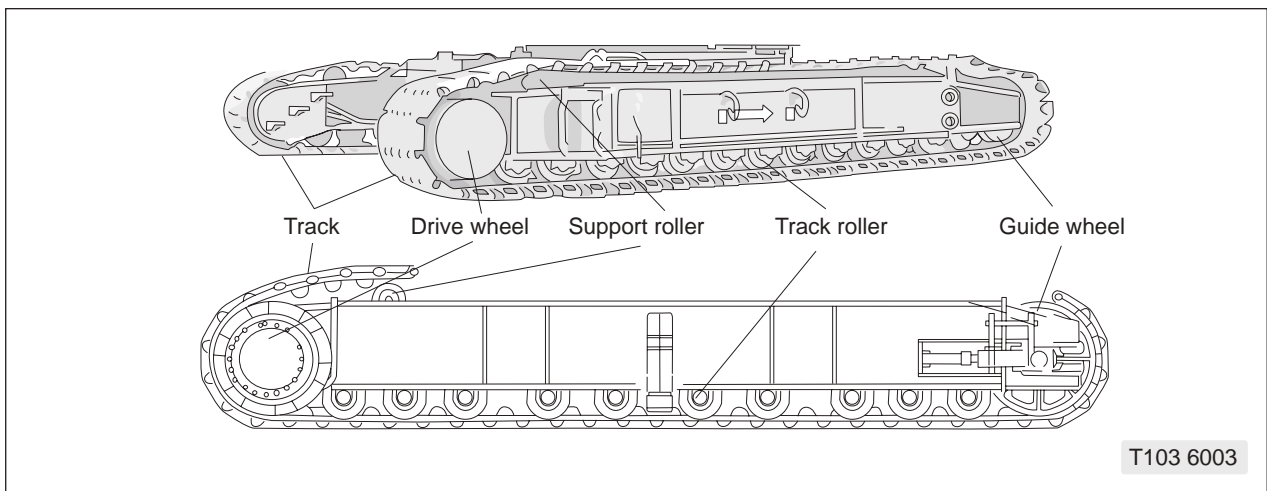
9.5 Adjusting Tension of the Crawler

- Before checking the tension of the crawler, the crawler pad must be cleaned.

Checking tension of the crawlers:

The relaxation of the crawler components is the standard to check whether the crawler component is sufficiently tightened.

If the crawler component has been properly cleaned and tightened its relaxation must be $40\pm 5\text{mm}$. If it is too loose or too tight, the crawler component must be tightened or loosened (See Fig. T103 6003 and T103 6004).



Rollers and Crawler of the Crawler Traveling Device

Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual

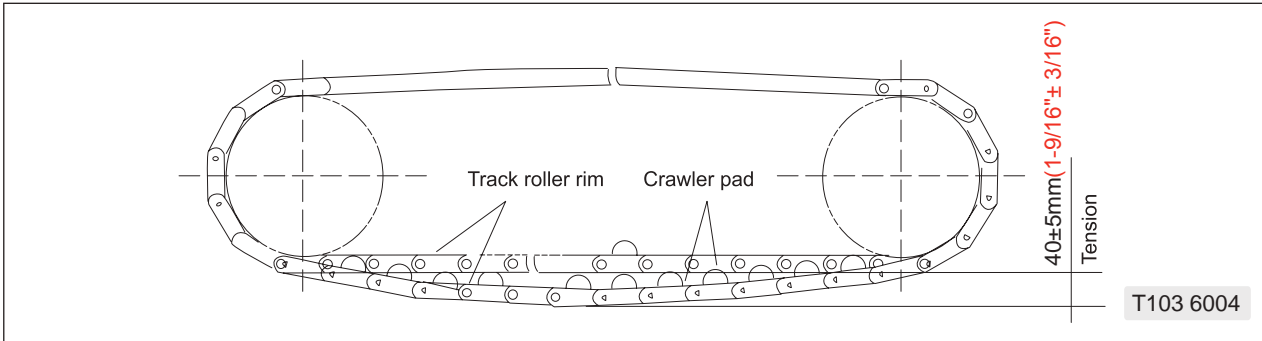
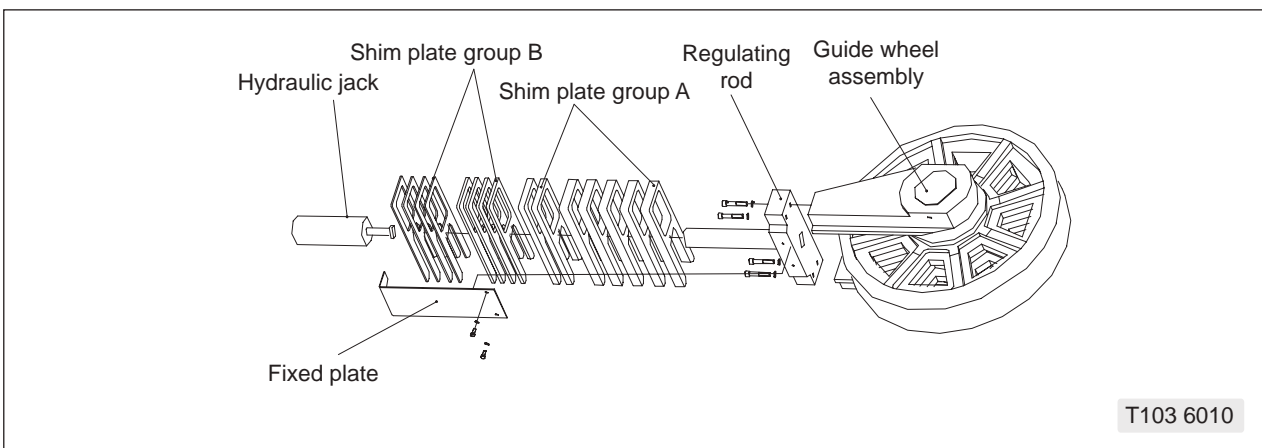


Diagram of Crawler Relaxation Check

The adjustment of crawler tension must be performed with the machine on level ground. Before the adjustment, move the crane a little ahead, so that the relaxed part of the crawler is located above the driving wheel, which facilitates the adjustment.

Adjustment steps:

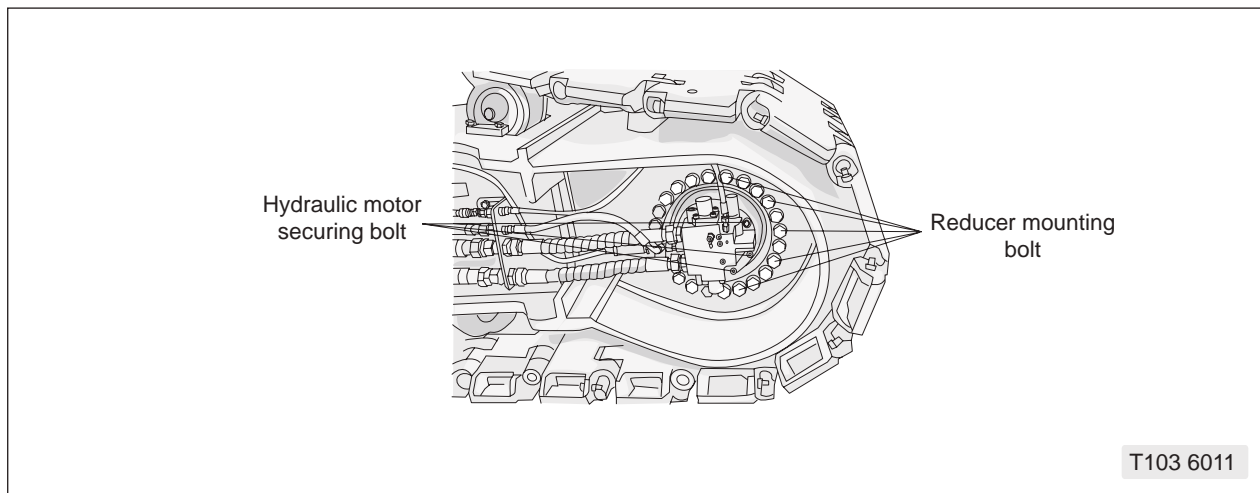
- 1) Remove the bolts and covers on both sides.
- 2) Align both hydraulic jacks in natural status respectively with the shaft.
- 3) Slowly pump the jack handle at the same time, so that it pushes the shaft and the guide wheel forward, there will be a gap between crawler frame and the group A shim plates.
- 4) After adjusting to proper tension is achieved, stop the action of the hydraulic jack. Select appropriate shim plates from group B to fill the gap between the crawler frame and group A shim plates, and then replace the cover.



Adjusting Tension of the Crawler

9.6 Checking and Tightening Connecting Bolt

As all the securing bolts are applied with bolt thread sealant, they normally require no tightening and a visual inspection is sufficient. Remove bolts that are loose, broken or defective, and replace with new ones.



Schematic Diagram of Travel Reducer

Torque Value of Reducer Mounting Bolts and Bracket			
Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M30(1-3/16")	10.9	1850N•m(1364ft•lb)	○
M24(15/16")	10.9	1030N•m(759ft•lb)	○

Torque Value of Hydraulic Motor Securing Bolts and Bracket			
Diameter(mm)	Grade	Pre-tightening Torque	Screw sealant
M20(13/16")	10.9	650N•m(480ft•lb)	○

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10 Hydraulic System

10.1 Hydraulic Oil Tank

10.1.1 Hydraulic Oil Tank - Checking the Oil

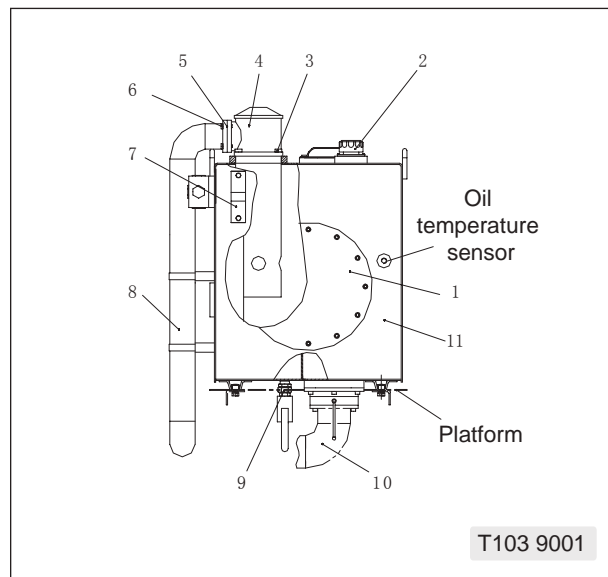
Level

Before starting the engine, check the oil volume in the hydraulic oil tank. If the oil in the tank is found decreasing too fast, it means there is a leak in the pipeline or hydraulic components. The pipeline connections should be tightened or hydraulic components should be replaced. If the hydraulic oil temperature is too low (below 20°C (68°F)) and oil has poor liquidity, operating in a rush at this time might lead to damage of the hydraulic components. If the temperature is too high (above 80°C(176°F)), the deterioration speed of hydraulic oil will accelerate and service life of the hydraulic components will ultimately be shortened. Therefore, after the engine starts in a low temperature environment, perform sufficient warm-up operation to make the oil temperature reach around 20°C (68°F).

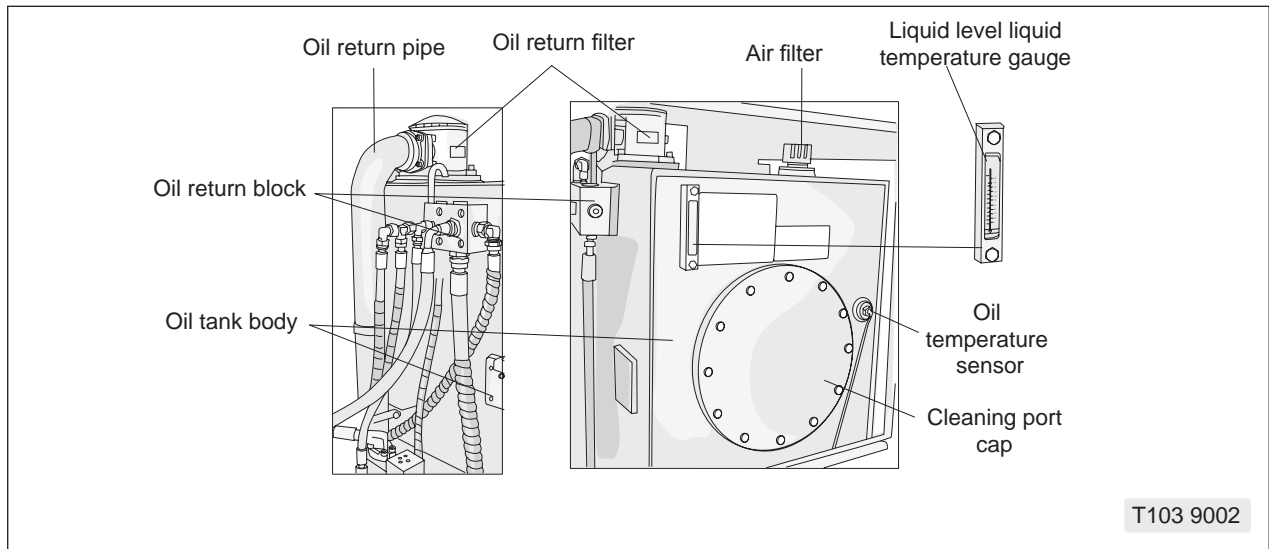
Serial No.	Name
1	Cleaning port cap
2	Air filter
3	Screw
4	Oil return filter
5	Shim
6	Screw
7	Liquid level & liquid temperature gauge
8	Oil return pipe
9	Pipe connector
10	Main oil suction pipe
11	Oil tank body

! CAUTION

Burning hazard.
Pay special attention to the hydraulic components under the engine cover, which may have heat danger.
Ensure sufficient cooling time, or wear protective clothing.



Hydraulic Oil Tank



Hydraulic Oil Tank

- The oil level of the hydraulic oil tank can be checked through the site glass on the hydraulic oil tank.
- When the crane is placed level, if the hydraulic oil reaches the oil level marking of the level gauge, then the level is correct.
- During the operation, hydraulic oil should be filled at the 1/2 position of liquid level meter.
- Before filling the oil, oil tank must be checked for cleanness.
- Oil leakage is prohibited after filling the oil.
- Concerning the hydraulic oil tank construction diagram, refer to parts manual-hydraulic oil tank.

10.1.2 Hydraulic Oil Tank - Replacing Return Oil Filter Element

Repeat this procedure for all filtering devices:

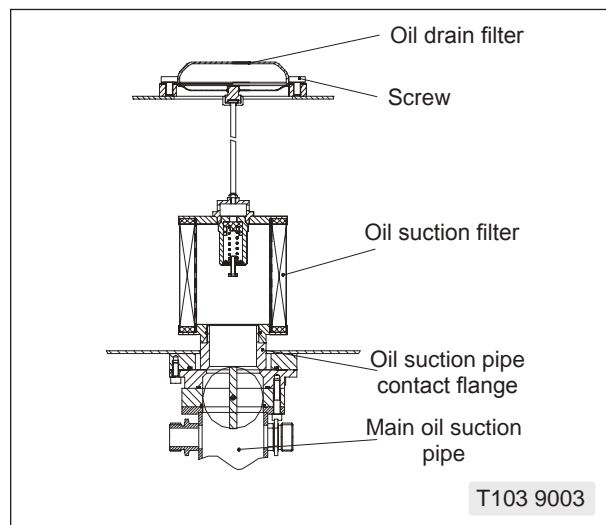
1. Lower the suspended load down to ground and shut off the engine.
2. Unload the system.
3. Unscrew the Big Red Cap on the return oil filter and pull the whole element of return oil filter out of the tank. (Return oil filter is a self-sealing design, and the oil cannot flow out after it has been removed.)
4. Replace the filter element.
5. Install and tighten the filter cap. Take care not to tip the element. The tightening torque for the shell mounting bolt is $50\text{N}\cdot\text{m}$ ($36.88\text{ft}\cdot\text{lb}$).

CAUTION

Cycle of replacement: After repairing the hydraulic system, the filtering device should be checked after 250 working hours for the first time, after that, the filter element should be replaced every 500 working hours. If the sealing gasket is damaged, it should be replaced.

10.1.3 Hydraulic Oil Tank - Cleaning Oil Suction Filter

- Repeat this procedure for all filtering devices.
 - Cleaning process of oil suction filter:
1. Oil suction filter is installed inside the hydraulic oil tank. Remove the ventilation equipment and oil suction filter can be seen.
 2. Take out the oil suction filter from the ventilation equipment. Filter element of oil suction filter can be reused after being cleaned.
 3. Clean off the metallic powder on the handle when cleaning the filter element.



Position of Rexroth Oil Suction Filter

10.1.4 Hydraulic Oil Tank - Replacing Air Filter

Element

- Element of air filter should be replaced frequently in adverse surrounding conditions.
- 1. Remove the blocked filter element.
- 2. Install the new filter element.

10.2 Replacing Element of Pipeline Filter Element

- Use a wrench to remove the hexagon head below the casing by pulling downward at the same time so as to pull out the filter element together with the casing. Replace the filter element and clean interior of the casing.
- When replacing the filter element, note that the filter should not be reversed. Otherwise, it may cause serious consequences.
- The first time the filter should be checked after 250 working hours, then it should be replaced every 500 hours.
- The replacement of the hydraulic filter regularly is an important part of service, which guarantees the hydraulic system work for a long period.

10.3 Checking and Replacing Hydraulic Oil

10.3.1 Checking Hydraulic Oil

Table 5-10 Check Hydraulic Oil for Foreign Objects and Deterioration

Checking contents	Foreign object	Experimental container	Judging method
Invasion of foreign objects	Dust and metallic powder from outside	Test tube (transparent), fresh oil	When the engine is started, take a sample from the hydraulic oil tank or pipeline to compare its turbidity with fresh oil.
	Water	Test tube or transparent container, fresh oil	Oil inside hydraulic oil tank becomes muddy. heat up muddy oil sample slightly, and water can be found at the bottom, take out muddy oil sample and plug in hot iron piece, and it shall give a sound like water dropping onto heated iron plate. Before starting the engine, screw open oil drain valve of the hydraulic oil tank to take out oil sample to observe water descending.
Deterioration		Test tube or transparent container, fresh oil	Take an oil sample from the hydraulic oil tank or pipeline to inject into the container to compare its color and smell with fresh oil. Oxide or deteriorated oil shall become gray tan in color and heavily deteriorated oil shall exert stinky smell.

10.3.2 Replacing Hydraulic Oil

- If any abnormality is found in the hydraulic oil, replace the hydraulic oil no matter how long the machine has been operated. If the hydraulic oil is polluted or deteriorated for a short time, find out the causes first and then replace the oil.
- If hydraulic oil volume is found insufficient during maintenance and repairing, it is required to refill to the amount marked by the sight glass. The refilled oil should be of the same designation with the original oil in the oil tank.
- Pay attention to environment protection when dealing with hydraulic oil.

When replacing hydraulic oil, the crane should be parked on level ground and the hydraulic oil is at working temperature.

1. Discharge hydraulic oil into proper container through oil outlet at bottom of the oil tank.
2. Clean the hydraulic oil tank and seal the oil outlet.
3. Remove the screw and the upper cap of air filter, fill fresh hydraulic oil through filter mesh to the mark line on sight glass.

CAUTION

- **When all outrigger cylinders are extended out, the oil should also be filled above the lowest line mark (minimum oil level), otherwise, the hydraulic pump may be damaged.**
- **It is required to use the designated hydraulic oil. Prevent dust and sand from entering the oil tank. Wash clean the oil tank and filter. If hydraulic oil replaced is different from the original type, the oil tank must be cleaned thoroughly and hydraulic oil inside the pipeline and hydraulic components should be completely replaced.**

10.3.3 Hydraulic Oil Replacement Interval

- In a new machine the oil should be replaced after 1000 hours or after half a year, after that, it shall be replaced after every 2000 hours or annually.
- Volume of hydraulic oil: The hydraulic oil tank can be filled with 275L(72.7gal) hydraulic oil and the entire machine uses 365L(96.4gal) oil.

10.3.4 Drain Water from Hydraulic Oil Tank

As influenced by the circumstance, water may enter the hydraulic oil. So it is required to discharge water from the oil tank regularly to prevent the hydraulic oil from deteriorating and emulsification so as to affect normal work of the system.

It is required that water should be discharged monthly, while for area with high humidity, weekly. The specific method is as below, park the machine on a level position to stop for 24 hours. Open the ball valve on the oil tank to discharge about 4L (1.06gal) oil each time. If there is a large amount of water it is recommended to discharge more. Then refill hydraulic oil to proper level.

10.4 Checking the Hydraulic System for Leakage

Ensure that all pipelines and hoses have proper clearance from engine parts with high temperature (like exhaust system) and that they shall not rub each other.

CAUTION

Pipeline and connector of hydraulic pump inside the engine damaged due to mechanical effect/heat effect or other effect should be replaced.

10.5 Checking the Pressure Hose

Regularly check whether all hoses have leaks. Even the smallest damage is found in visual check, the defective hose must be replaced immediately.

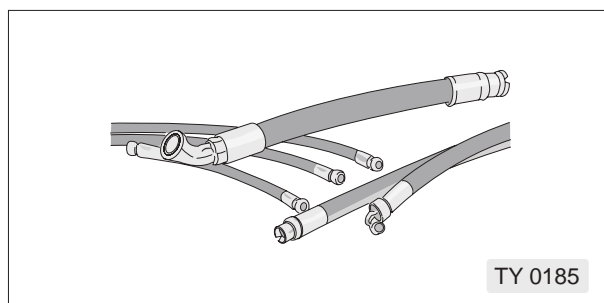
-- Defects that may occur to hose:

1. Connector sliding inside the hose.
2. The exterior layer damaged, cut, or worn (any strengthening layer is exposed).
3. The hose hardened, full of cracks or burnt.
4. The connector has cracks, or is damaged, severely corroded.
5. The connector or hose leaks.
6. The hose protective layer is broken, pressed flat, or twisted.
7. Exterior layer of the hose blisters or softens.

Other contents for visual check:

-- The following items should be screwed tightly, repaired, or replaced as needed:

1. Leakage at oil ports of the machine.
2. Blockage by dirt.
3. Pipe clip, protective sleeve, protective object.
4. System oil level, fluid category, air breather cap.



Profile of Hydraulic Rubber Pipe Assembly

10.6 Replacing the Pressure Hose

Even if it is identified as not damaged, the hose should also be replaced after 6 years of use, which includes the longest storage period of 2 years.

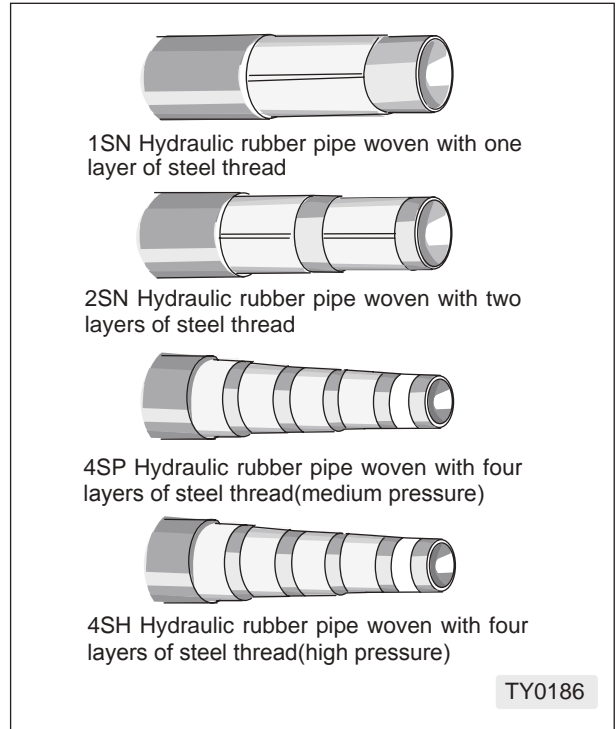
10.6.1 Types of Hydraulic Hose

1SN: Hydraulic rubber pipe woven with one layer of steel thread.

2SN: Hydraulic rubber pipe woven with two layers of steel thread

4SP: Hydraulic rubber pipe woven with four layers of steel thread (medium pressure)

4SH: Hydraulic rubber pipe woven with four layers of steel thread (high pressure)



10.6.2 Identification of Hydraulic Hose

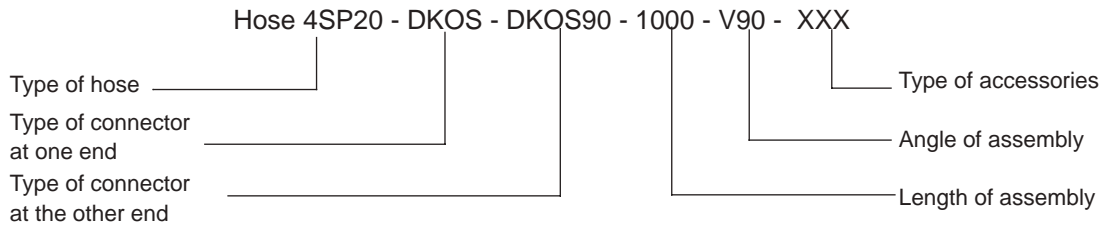
Calculate working time and storage time based on manufacturing date marked on hydraulic hose.

When removing a sleeve-type pipe connector, a new sleeve and pipe connected should be used to replace.

All components of hydraulic pipeline must be cleaned before being installed.

On the hydraulic hose are printed with the following items:

1. Manufacturer
2. Hose type (category)
3. Nominal diameter
4. Standard DIN Diagram
5. Manufacturing date (manufacturing season and year)

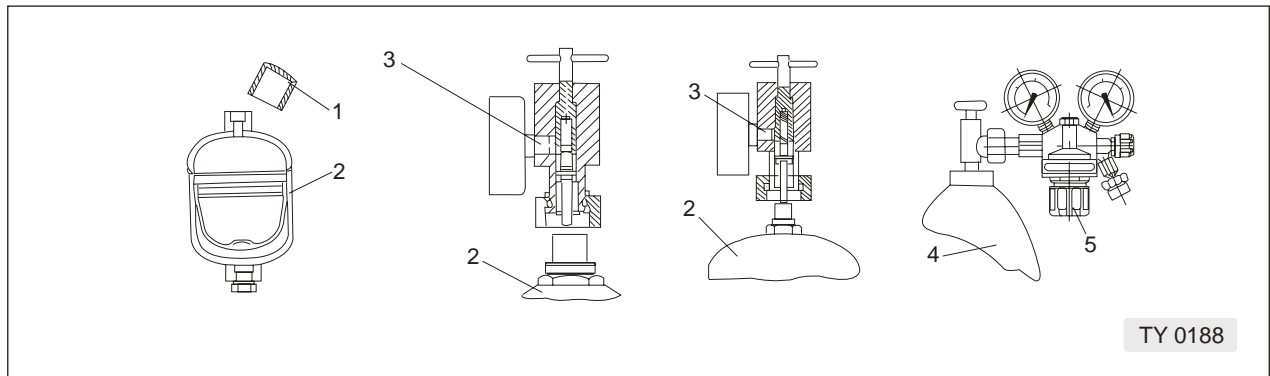


Identification of Hydraulic Hose

10.7 Hydraulic System - Checking the Initial Pressure in the Accumulator

! DANGER

This check can be performed only by professionals who are trained in oil filling and device testing. Otherwise, it may lead to personal injury or death.



Checking on Pressure of the Accumulator

Serial No.	Name
1	Crash helmet
2	Accumulator
3	Filling and test device
4	Nitrogen cylinder
5	Decompressor

Checking the accumulator in the following procedures:

1. Shut off the engine and set ignition switch at "OFF".
2. Reduce pressure of the hydraulic system. Empty hydraulic oil out of accumulator (2) completely. If there is a testing fitting, this check can be done with the use of a pressure gauge or by slowly releasing the connector nut on the hydraulic pipeline of the fuel pipe connector of the accumulator. When the pressure gauge indicates no pressure or hydraulic oil no longer

escapes at the connector nut, pressure of the system is successfully reduced.

3. Remove protective cap (1) on air valve of accumulator (2) and install the filling and testing device (3).
4. Open the air valve after the filling and testing device is screwed on and read out pressure increase value on the pressure gauge of the testing device.

The pressure of the accumulator: Rexroth hydraulic system 15 bar (218psi), Kawasaki hydraulic system 16 bar (232psi).

5. If the pressure is not enough, it is required to fill nitrogen into the accumulator through the filling device (3) to reach relative pressure.
6. After initial filling, wait for 2~3 minutes and then check the pressure, refill when necessary.
 - To check original pressure inside the air bag, it is required to use a filling and testing device. The crane's hydraulic system uses a membrane accumulator or airbag accumulator to be filled with nitrogen gas. They are located on the platform.
 - Only when the accumulator is installed and filled with proper pressure can its relative parts run normally.
 - It is necessary to check original pressure value regularly.
 - When filling the accumulator to get an initial pressure, check the pressure gauge at the testing joint.
 - If pressure in the corresponding hydraulic loop does not increase accordingly when boosting pressure for the accumulator, it indicates that the membrane inside the accumulator is defective. The accumulator must be replaced.

 **CAUTION**

- **Only nitrogen can be used to charge the accumulator. If the value of the pressure is found reduced significantly (about 60%) in initial check, it is required to check the accumulator again after about 3-4 weeks. If at that time the pressure value keeps reducing, the accumulator should be replaced.**
- **Only nitrogen can be used to fill the accumulator. Pressure reducer (5) should be installed on the nitrogen cylinder (4).**
- **The accumulator can be repaired only by the manufacturer or a workshop approved by the manufacturer.**
- **The repaired accumulator should be checked and accepted by approved experts.**
- **A new inspection certificate should be issued for the accumulator.**

10.8 Precautions on Maintaining the Hydraulic System

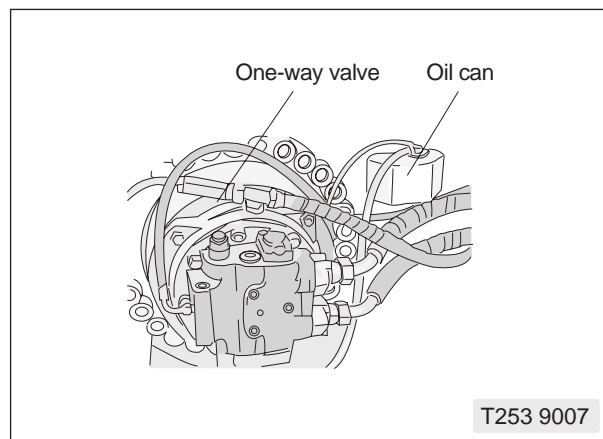
1. Service life and performance reliability of the hydraulic machine and its hydraulic components are related to reasonableness of its use and maintenance. If you want your equipment to run at peak performance for a long time, attention should be paid to the following:
 - Understand details of hydraulic system of the crawler crane through careful reading of the operation manual.
 - Perform correct routine maintenance and regular keeping checks of the hydraulic system as per requirements. Incorrect maintenance and checking shall be harmful to the system.
 - Use the proper hydraulic oil, as pursuant to the specific standards.
 - Replace the elements of the hydraulic filter regularly as this guarantees the hydraulic system shall work normally for a long period.
 - When replacing hydraulic components, hydraulic hose or filling the hydraulic oil, make sure to pay attention and keep the hydraulic system clean.
 - Clean equipment——when dismantling the damaged hydraulic part and hydraulic hose, it is required to carefully clean pollutants close to the hydraulic part or hose connector. Make sure no pollutant enters the hydraulic system in the process of dismantling. It is not recommended to dismantle part of the hose of the hydraulic system when no protective measure has been taken in adverse weather conditions.
 - Clean hydraulic oil——Pay attention to the degree to which the hydraulic oil is polluted and its humidity to avoid any pollutant entering the hydraulic oil tank. Oil added in should be filtered. It would be better to fill in the oil by use of an oil filtering system with intensive filtering device.
 - Clean new part——strictly check whether the new part or hydraulic hose is clean. The new part should have anti-corrosion oil inside. Check whether the part is damaged during transportation.
2. After the hydraulic system being repaired and checked and before being restarted, the following items should be checked:
 - Whether the oil tank is clean and filled with hydraulic oil as required?
 - Is the pipeline clean and well installed?
 - Does the oil filter correspond with the system being used?
 - When necessary, fill oil into the oil pump and shell of the motor.

10.9 One-Way Valve & Oil Can

At all of oil drain port in traveling hydraulic motor which uses quick coupling, one-way valve and oil can has been installed in order to prevent motor from damage owing to blockage of motor oil drain pipe.

When the quick coupling of motor oil drain pipe is pull-off, the motor oil drain pipe is blocked so that the pressure of oil drain is high. Once the value of pressure was elevated to certain value, the hydraulic oil will pour into oil can by one-way valve in order to protect the motor from damaging.

Considering the sealed capability of one-way valve, in normal circumstance, there are a little oil leaking into oil can. Check the oil level at oil can weekly, if the maximum liquid level is overrun, clean the oil, then keep being used.



Kawasaki motor

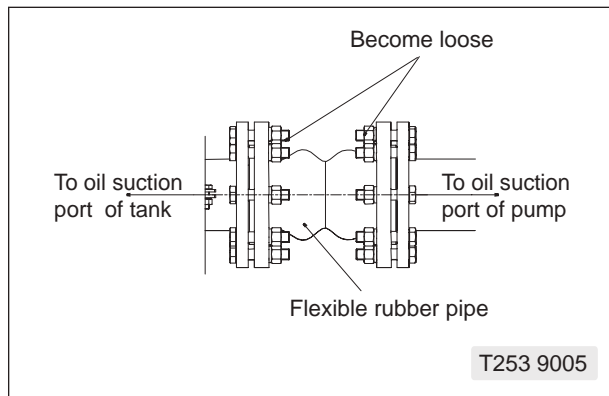
CAUTION

- Oil in the oil can can't be filled into van tank to be reused.
- If there are a large mount of oil pouring out while the crane is working regularly, shut off the crane and notify our technician, don't change the oil circuit by yourself.

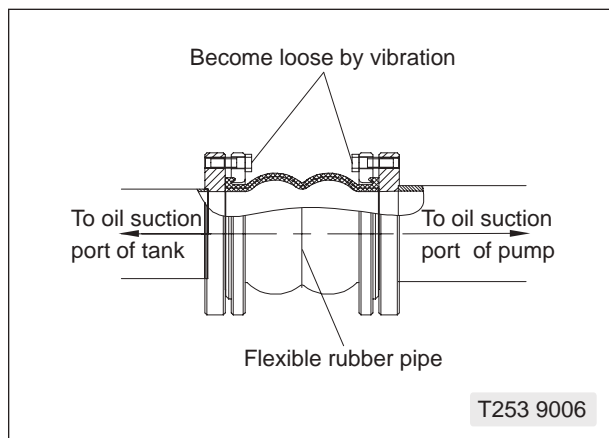
10.10 Tightening the Connecting Bolt

As flexible rubber pipe is installed in the pipeline between oil suction ports of tank and pump, the connecting bolts (or screws) at both ends of the rubber pipe may become loose, which effects the sealing of two flange facings and cause leaks. Therefore, it is required to check the bolts at both ends of the rubber pipe every day.

As the connecting method shown in Fig.T253 9005



As the connecting method shown in Fig.T253 9006



Diameter (mm)(in)	Grade	Pre-tightening Torque (N•m)(ft·lb)	Thread sealant
M16(5/8")	8.8	116~144(85~106)	○

10.11 Precautions in Quick Coupling Maintenance

Quick coupling is a precise hydraulic component with complicated internal structure. Its service life largely influenced by maintenance and serving. Extra care must be taken to deal with the following issues when using quick coupling:

1. Clean dirt (i.e. sand, metallic particle) from male and female connectors of the quick coupling before each installation. If not, the dirt will either induce wear to sealings in the coupling and cause leaks, or even worse, dirt may enter the flow and cause contamination in the whole hydraulic system and damage to other hydraulic elements, which will ultimately reduce the service life of the overall crane.
2. For installation, push the male connector into the female and then screw it into the female by their threads until the retaining ring is in locking position (which will ensure safety in emergency). The torque of a wrench may cause damage to the quick coupling, thus do not screw the male connector to the female connector with a wrench.
3. Remove dirt from the coupling after dismantling and install the dustproof cap to prevent any damage which may influence service life of the coupling.
4. Secure the quick couplings during transportation to avoid any crush damage.
5. In no case can the quick coupling be treaded on.

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11 Electrical System

11.1 Checking the Lighting System

Check whether the system can run normally and repair any fault immediately.

11.2 Checking the Limit Switches

See “Safety Devices” in “Operating Instructions”.

11.3 Battery Maintenance

Battery is the power supply for machine to start the engine, control electric apparatus, lighting and auxiliary electric equipment, which is crucial to the operation of the crane. Technical performances of battery used in this crane completely meet the regulations of the PRC Standard on Starting Lead-acid Battery (GB/T5008-2005). Hence, it is necessary to maintain it in perfect condition so that it can perform as required.

1. There is an indicator displaying the battery charge status on the cover of the battery box. When the indicator is green, the battery can function normally; when the indicator is black, the battery requires to be charged; when the indicator is white, the battery should be replaced.
2. The battery should be charged in time in the event that it is lack of electricity during use, so as to prevent performance reduction caused by sulfation.
3. Do not over-charge the battery during use or charging, prevent the battery from early failure caused by loss of water, grid growth, or paste shedding.
4. If the crane is to be out of use for a long period of time (usu. 15 days), batteries that are already installed and used in the crane should be

removed from the crane and stored in a dry and ventilating area. The removed battery should also be charged every 3-6 months (according to when the indicator turns black).

5. The battery should be stored in a dry and clean area with good ventilation and ambient temperature of 5~25°C(41~77°F). The battery shall not be exposed to the sun and keep at least 2m (6'7") away from a heat source. High ambient temperature may weaken the battery performance.
6. A little amount gas may be produced when charging the battery. Therefore, it is required to check the vent hole on the battery regularly, so as to prevent explosion caused by blockage of vent hole.

11.4 Preventive Measures against Cable Fire

11.4.1 Fault Reasons for Fire in Electrical Parts or Cable

1. Fault in electrical parts or system
Fires in electrical parts or cable of electric system are usually not caused by technical fault but by carelessness or improper operation. When replacing a part during repair work, it is

CAUTION

- In time of short circuit, the fuse can protect cable of the electric system.
- The fuse cannot be bridged, even the easiest one.
- Fuse with a larger value (high current) cannot be used in any circumstance.

absolutely important to use the original part. Impact on electric system caused by use of non-original parts are neglected due to difficulty in checking to the cause of the fault. Maintain the same wire size when replacing wires.

Current can be only identified through its effects, one of which is heat effect.

2. Fuse fault

As a rule, charged conducting wire generates some amount of heat. A current stronger than permissible amps can lead to high temperature and even cause a fire.

To prevent high temperature, even fire accident, caused by strong current, fuse should be installed in each circuit. If the current exceeds the maximum value allowed, the fuse can cut off current automatically.

Fuse fault is one of the main reasons that lead to a cable fire.

3. Other reasons that lead to a cable fire may be:

- 1) Use of cable or cable joint (in case the cable is not long enough) that is damaged or defective.
- 2) Use of consumable part or operation unit (relay, motor, switch, light, etc.) that is damaged or defective.
- 3) Excessive consumable part is connected to a fuse (cable and fuse is overloaded).
- 4) Installation of battery with excessive size and different design (battery box of excessive size is installed, danger of short circuit).
- 5) Water permeates into electric system parts, electrical parts are grounded or short circuit.
- 6) Due to insufficient maintenance and inspection work, or the electric equipment is aged.

The above reasons may work independently or combine to cause a cable fire.

11.4.2 Measures to Prevent Fire in Electric Parts or Cable

If the following methods are observed, the above problems can be effectively prevented.

1. The crane's electrical equipment should be checked / inspected regularly.
2. Some potential problems should be corrected immediately, such as loose connection, hot cable. Similarly, causes of these problems should be checked and removed in time.
3. Check whether all cables, connectors and terminals are loose or damaged. If any oxidation has formed at the terminals or on battery poles, the fault part must be rectified or replaced immediately and further protective measures must be taken.
4. Only use original spare parts and original fuse with regulated intensity (refer to Contents of Spare Parts or Electric Wiring Diagram),
5. If power supply is at fault, the crane should be shut down immediately.
6. Electric system should not be changed and/or supplemented and modified without permit by the manufacturer.
7. Ensure that an overall inspection and maintenance must be carried out by professional electricians of crawler crane at least annually.

 **CAUTION**

Only qualified electrician or other worker guided and supervised by qualified electrician is allowed to carry out this job on the electric system or electrical equipment as per electrical and technical regulations.

11.5 Check Crane after a Thunderstorm

After a thunderstorm while prior to operation, check electric devices for normal operation, in particular following parts:

- (1) Force sensor
- (2) Angle sensor
- (3) Safety limit switches
- (4) Anemometer
- (5) Pharos

If there is any abnormal signal transmitting occurred to these devices after a thunderstorm, lower the boom and check the surge protector in the junction box on boom for damage. If the surge protector is found damaged, replace it immediately.

The surge protection applied in this crane has a certain service life, which may be damaged after several thunderstorms or one severe thunderstorm. It therefore requires periodical check. Any surge protector found damaged must be replaced immediately.

- (6) Winch: check for damage, in particular damage of ball bearings and cylinder roller bearings.
- (7) Slewing bearing: slowly rotate the slewing device for inspection, and listen to peculiar noise during slewing, in particular during slewing of the slewing bearing rolling disc.

11.6 Fuse

Table 5-12 Position of Fuses

Code	Value/ ampere	Position of the part	Description
06F1	3	Electric cabinet	Power supply for Controller (U2) and (U3)
06F2	3	Electric cabinet	Power supply for current sensor(servo pressure/ engine speed sensor/fuel level/anemometer)
06F3	5	Electric cabinet	Power supply for engine
06F4	10	Electric cabinet	Back-up system
06F5	10	Electric cabinet	Power supply for hand lights at left and right platforms
06F6	30	Electric cabinet	Power supply for fuel valve/ECM
06F7	20	Electric cabinet	U2 Output power supply
06F8	20	Electric cabinet	U3 outupt power supply
06F9	3	Electric cabinet	Tri-color alarming light/gradienter/alarming light
06F10	10	Electric cabinet	Lowerworks (power supply for lowerworks remote control box)
06F11	10	Electric cabinet	Valves (quick valves ofmain/aux. hoisting motor, boom luffing winch actuator motor, and lubricating system). powersupply for proximity switches (jib upper limit switch, A-frame erection switch, etc.)
06F12	3	Electric cabinet	Power supply for boom
23F2	3	Fuse box in operator cab	Power supply for Module (U1)
23F3	3	Fuse box in operator cab	Power supply for radio
23F4	5	Fuse box in operator cab	Power supply for Video monitoring system
23F5	5	Fuse box in operator cab	Power supply for load moment limiter
23F6	3	Fuse box in operator cab	Power supply for control system
23F7	30	Fuse box in operator cab	Power supply for ignition system
23F8	3	Fuse box in operator cab	Power supply for pharos
23F9	5	Fuse box in operator cab	Power supply for control panels/levers
23F10	3	Fuse box in operator cab	Switches (on-seat lock and function locking)/ compulsory lubrication
23F11	10	Fuse box in operator cab	Working light
23F12	5	Fuse box in operator cab	Power supply for windscreen wiper
23F13	10	Fuse box in operator cab	U1 Output power supply
23F14	20	Fuse box in operator cab	Power supply for air conditioner

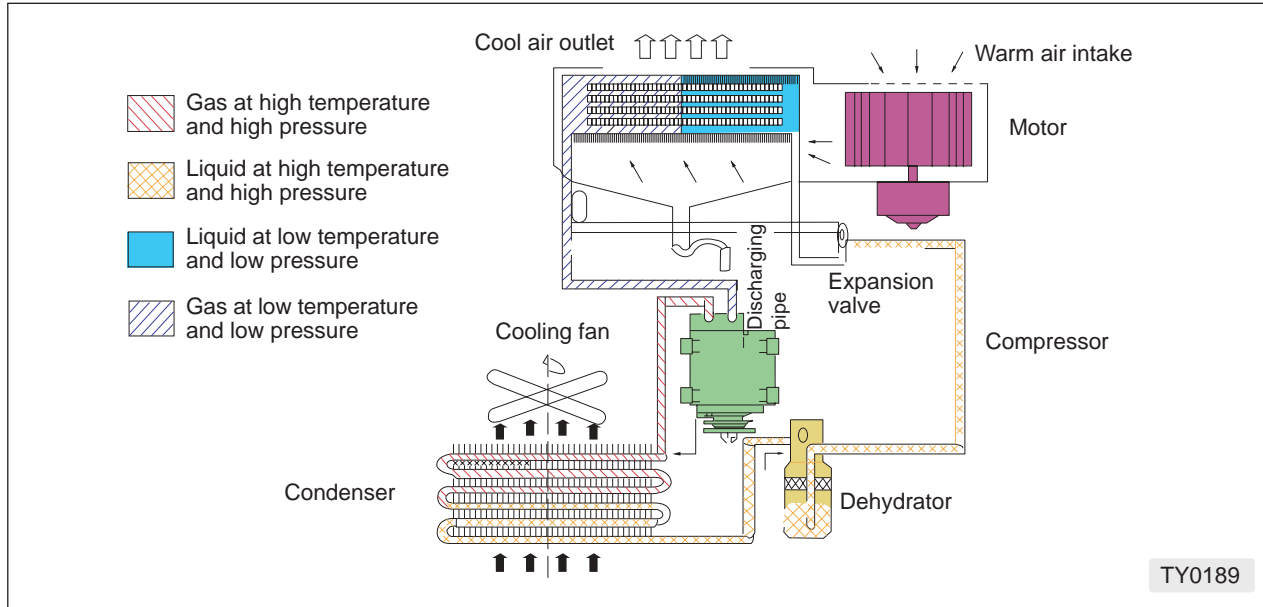
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12 Air Conditioning Device

12.1 Checking Air Conditioning Device

12.1.1 Composition of Air Conditioning Device



Composition of Air Conditioning Equipment

1. Evaporator

The evaporator can make the liquid refrigerant absorb heat in the air after throttling expansion through expansion valve and use evaporating fan to blow cold air into the cab.

2. Temperature Sensor

Temperature sensor can sense the temperature of exhaust air and return air in evaporator chamber and control pull-in of compressor's clutch to keep indoor temperature within the scope set up and prevent the evaporator from freezing.

Note: The sensor should be installed at regulated position (as designed by air conditioner manufacturer).

3. Expansion Valve

Expansion valve is to throttle and reduce pressure of liquid refrigerant at high temperature and high pressure to become foggy refrigerant at low temperature and low pressure to enter the evaporator (that is, separate refrigerants at high pressure side and low pressure side).

-- Adjust refrigerant flow automatically.

-- Control refrigerant flow to prevent liquid impact and abnormal over-heat.

4. Heating

Heating is a heat exchanger that injects heated cooling water in the engine into the heater core to heat up the indoor temperature through cold air in the cab.

5. Inner/outer Filter Mesh

It can block foreign matter such as dust when absorbing inner and outer air.

Note: The filtering mesh should be cleaned or replaced regularly.

6. Compressor

Compressor can obtain power through the engine's belt drive to absorb evaporated coolant at low temperature and low pressure from evaporator to transform it into coolant in a gas state at a high temperature and high pressure compressed to send into condenser.

7. Condenser

Condenser is a heat exchanger that uses the fan of the engine's water tank to transform refrigerant gas at a high temperature high pressure into high temperature low pressure liquid refrigerant.

8. Dehydrator

Dehydrator can filter impurities from liquid refrigerant in the condenser to store the refrigerant by moisture in its absorbing system.

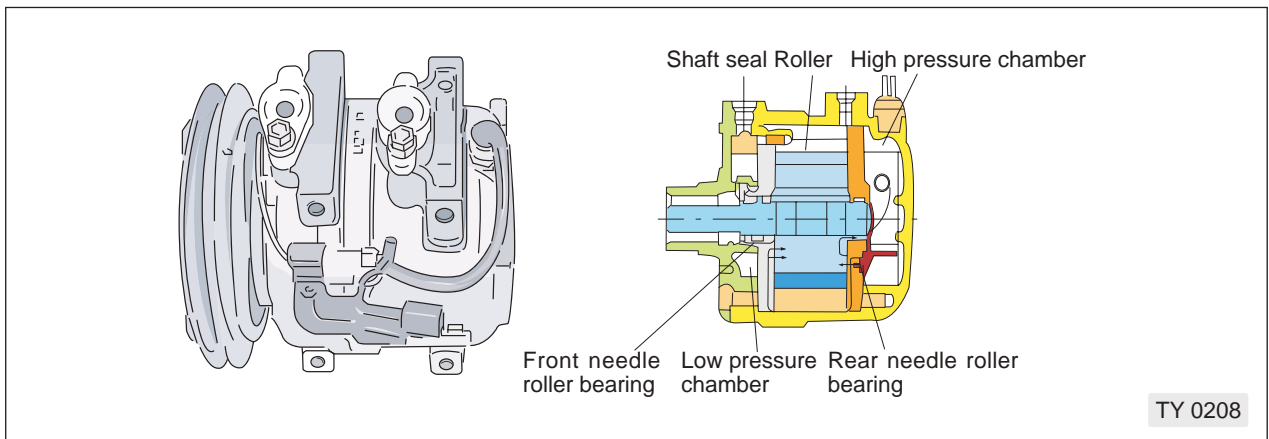
12.1.2 Checking Air Conditioning Device

To ensure the air conditioning equipment can work normally, it should be checked regularly. See checking contents in the attached table on next page.

We recommend that the checking is carried out at primary cooling stage.

At primary stage, middle stage and end of the cooling, the following maintenance work should be done:

1. Check the belt tension and installation of compressor.
2. Check the level of the refrigerant by observing the sight glass on the liquid container.



Profile and composition of A/C compressor

Section 1 Maintenance

SCC1000C Crawler Crane — Maintenance Manual



Table 5-13 Contents for Regular Check

Items	Checking contents	Interval		
		Daily	Half a year	1 year
Pipeline assembly	Ill fastening, with distance		√	√
	Connection is loose, nut and bolt loose	√	√	
Connection bolt	Connection is loose, nut and bolt loose and falling off		√	√
Transmission belt	Loose and bending	√		√
	Degrading: Abrasion, scar, crack		√	√
	Noise, bad smell or abnormal heat			√
Condenser assembly	Radiating fins lodging			√
	Blocked by foreign matter (rubbish, dust, insect or grass, etc)	√	√	√
A/C wind switch	Starting inspection, wind volume, switch control	√		√
	Switching function	√		√
Refrigerant leaked	Leakage at pipeline connections	√	√	
	Leakage inside parts and components (compressor, condenser, evaporator, dehydrator)			√
Volume of refrigerant	Check refrigerant volume (observe through liquid checking window)	√		√
Noise	Compressor (including without load)		√	
	Condenser fan, evaporator fan		√	
Temperature difference in dehydrator	Difference in dehydrator temperature indicates that dehydrator is blocked.			√

12.2 Maintenance of Air Conditioning Device

When filter element is blocked, air volume may reduce and the power of air conditioner may decrease. The filter element should be checked every 3 months to clean or replace.

1. Inner filter element

Dismantle: Lift up filter element's hanging hook lightly and remove filter element to clean or replace.

2. Outer filter element

Dismantle: Release upper and lower bolt hook, and remove outer filter element to clean or replace.

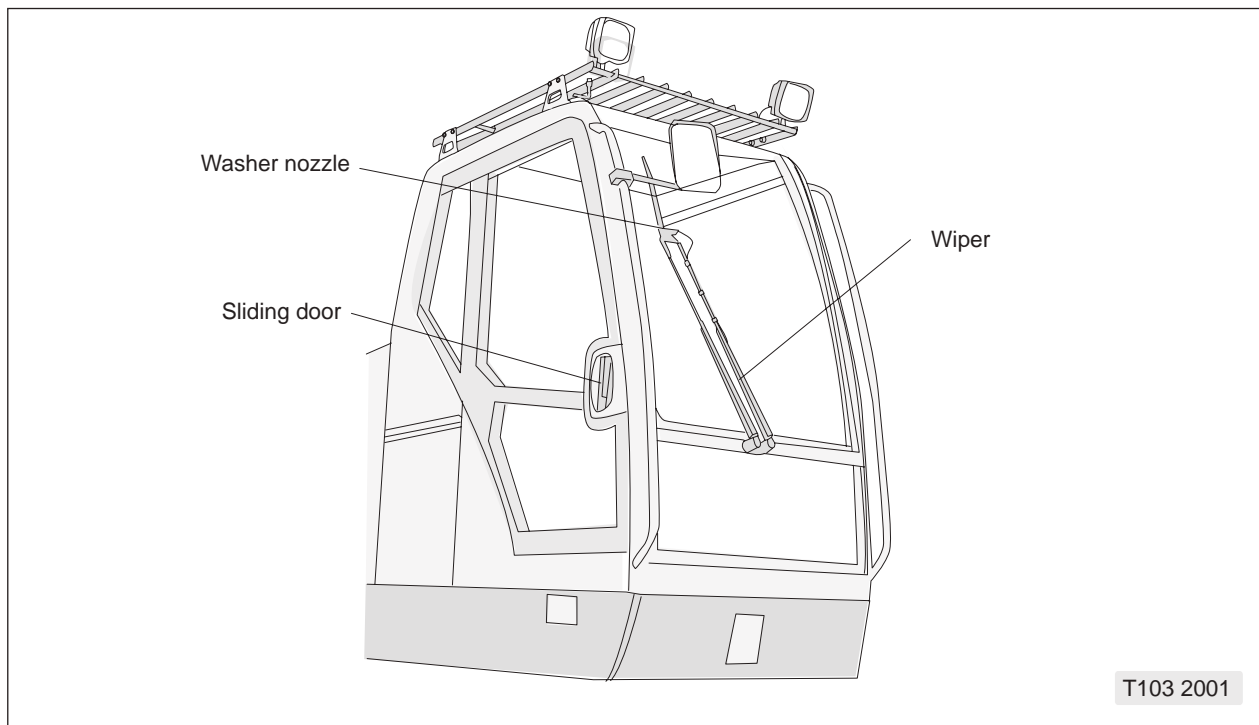
12.3 During-Operation Precautions

1. When used for a long time, the operator's cab should be ventilated with fresh air all the time.
2. Do not set the temperature too low.
3. To lubricate the compressor, air conditioning device should be operated at least 10 minutes each month.

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13 Operator's Cab



Operator's Cab

CAUTION

Before winter comes, certain amount (depending on the actual temperature) of anti-freezing liquid should be added into the water.

13.1 Checking the Windshield Wiper

Check the windshield wiper for normal function every week.

CAUTION

The wiper is prohibited to dry scrap (i.e. the wiper washer nozzle does not spray water on the windshield, as in such a case, the wiper blades confront excessive resistance and may cause the engine burn-out).

13.2 Checking the Sliding Door

If the working site is near the seaside or humid area, it is required to open the sliding door once a week to prevent any difficulty in opening due to humidity.

13.3 Refill the Windshield Wiper Solution Reservoir

Check the position of the nozzles and water level of the reservoir.

The reservoir is located at the rear part of the right control box in the cab. Open the air conditioner's inspection cover to add water into the reservoir. It is required to refill the reservoir from time to time and add little amount of detergent if necessary.

13.4 Checking the Traveling Levers

Check the traveling control levers and brake pedals for damage and normal function.

13.5 Checking the Slewing Brake and Lock

Check the slewing locking pins for proper operation.

13.6 Checking the Switches, Buttons and Control Levers

Check each switch, button for connection and normal function, check each control lever for normal function.

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14 Others

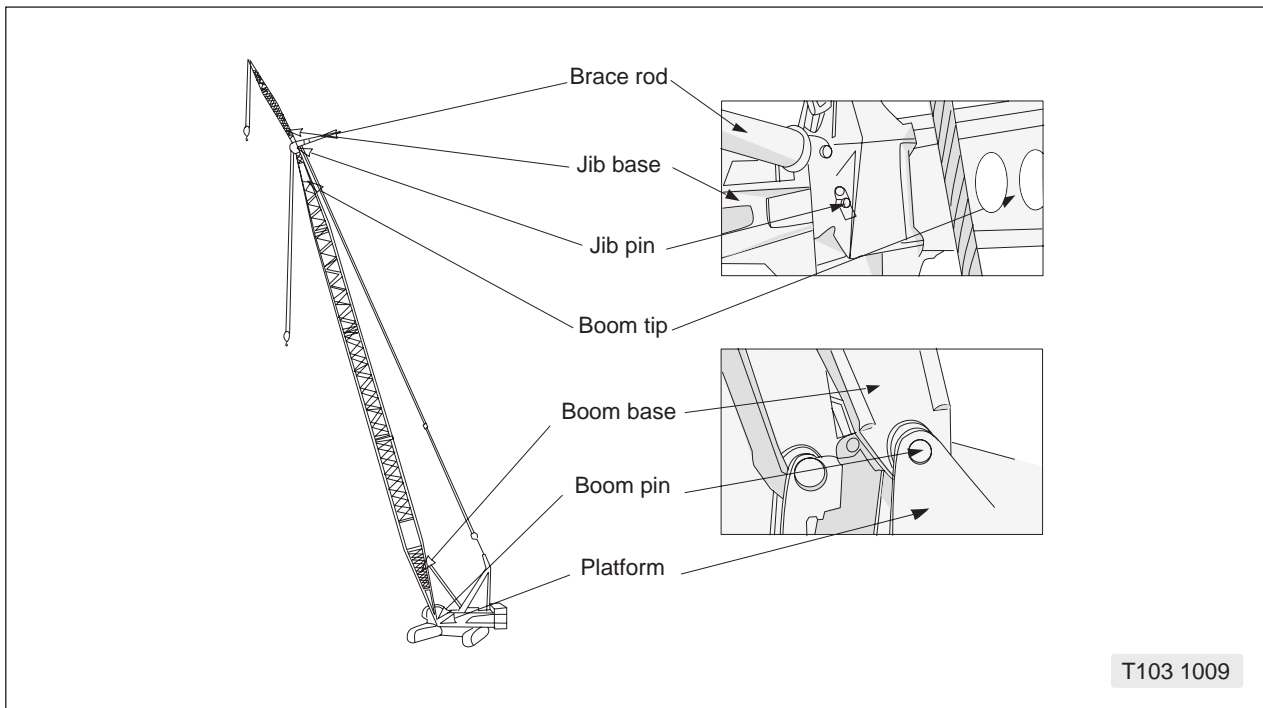
14.1 Lubricating Pins on Boom

Lubricating boom root pins (by central lubricating system).

Lubricating connecting pins on boom system.

CAUTION

Before installing the crane equipment, lubricate all connecting pins that are installed in corresponding pin holes.



Lubrication at Hinge Pin of Boom Base

14.2 Lubricating the Hook Blocks

“A” - “9T(9.9UST)” hook block

It should be disassembled to add lubricating grease.

“B” - “25T(27.5UST)” hook block

“C” - “50T(55UST)” hook block

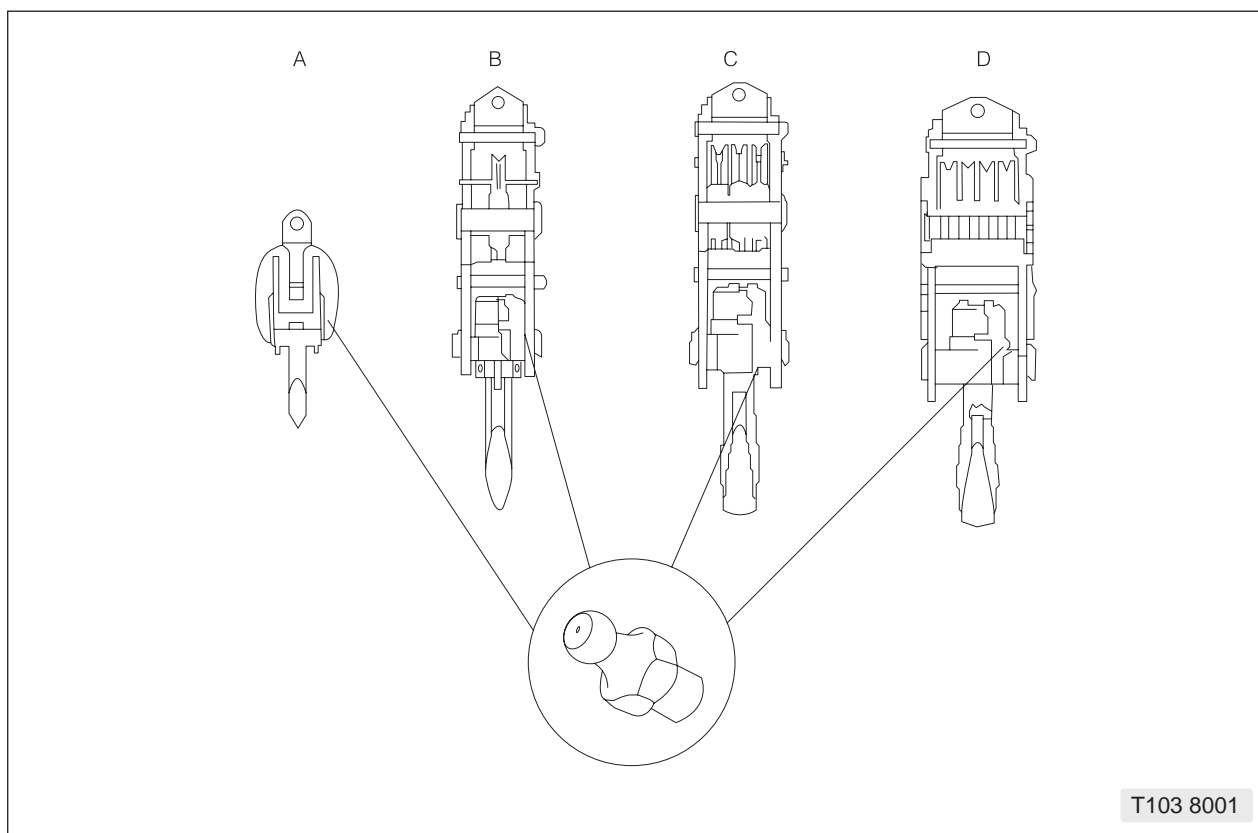
“D” - “100T(110UST)” hook block

Lubricate all hook blocks through grease nozzles.

Lubrication schedule of hook block pulleys and bearings see 3.4 Lubrication and Maintenance Schedule.

 **DANGER**

Danger of dragging or entanglement.
When implementing maintenance, inspection and installation services, special attention should be paid to danger of being entangled or dragged in between the hook block pulleys and wire ropes.



T103 8001

Lubricating Nipples on Hook Blocks

14.3 Wire Ropes

! DANGER

- Danger of protruding metal wires in the rope.
- When dealing with wire ropes, the protruding wires may cause injury.
- It is required to wear gloves to protect the hands.
- There is a danger of being scraped or scratched

! WARNING

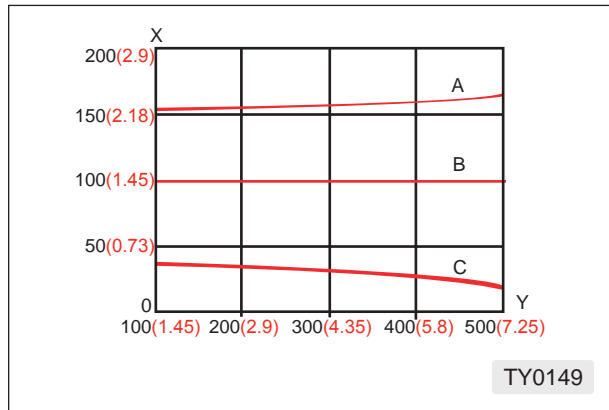
- Danger of dragging or entanglement.
- When implementing maintenance, inspection and installation services, special attention should be paid to danger of being entangled or dragged in between the following equipments:
 - Wire ropes on winches
 - Wire ropes on pulleys of main boom or other boom frames
 - Wire ropes on hook block pulleys
 - They must be handled with great care.

14.3.1 Lubricating the Wire Ropes

During manufacturing, the wire ropes are sufficiently lubricated to prevent rust and improve friction coefficient of the wire ropes internally, and between the wire rope and pulley or between wire rope and winch. This primary lubrication can only last for a limited period of time. Therefore, the wire rope should be lubricated regularly from time to time.

The wire rope should be lubricated regularly according to the actual working conditions, especially the bending areas. If the wire rope cannot be lubricated during operation, expected service life will be shortened. Therefore, it is required to pay closer attention to the wire ropes.

See the following figure for effect of lubrication and repeated lubrication on the life span of wire ropes (Fig. TY0149).



Effect of Lubricating Methods on Life Span of Wire Ropes

- X Interval bending number (%)
- Y Tension stress (N/mm²) (psi)
- A Lubrication and repeated lubrication
- B Lubrication
- C Remove oil contaminant

To prolong the wire rope's life span and prevent it from getting rusty, it should be greased frequently, as shown by Fig. TY0150

CAUTION

- The wire rope should be lubricated from the very beginning, instead of lubricating on spot after damage is found.
- Observe all prevailing standards and national regulations.

14.3.2 Cleaning the Wire Ropes

The outside of the dirty wire rope should be cleaned frequently, especially when the wire ropes are used in a strongly corrosive circumstance, or at a place quite close to active chemical material.

14.3.3 Checking the Wire Ropes

14.3.3.1 Overview

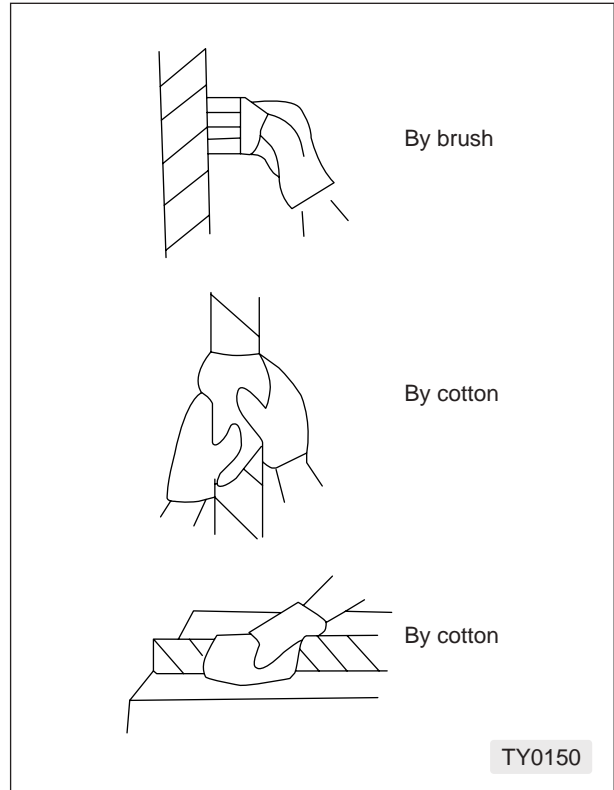
Wire rope is a kind of basic expandable component with limited service life. Many of the wire rope's properties may change in its service life. For example, the breaking force usually increases in the early stage of using, but decreases sharply after arriving at a certain maximum value.

The reason for the decrease in breaking force is the increased percentage of metal loss caused by wear and corrosion, both of which are generated by broken rope strands and rope structure change.

14.3.3.2 Interval

According to ISO 4309 Cranes — Wire Ropes — Care, maintenance, installation, examination and discard, it is suggested that visual check on the wire rope and fixture of wire terminations should be implemented routinely to prevent any potential damage.

Besides, safety operation inspection of the wire rope should be carried out regularly by trained



Methods for Applying Grease on Wire Ropes

Section 1 Maintenance

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expert.

After a massive load bearing an invisible damage is anticipated, the inspection interval shall be reduced accordingly (to several hours if necessary). The wire rope must be checked in the following circumstances: the wire rope to be reused after long time storage, before re-operating the crane after it is disassembled and moved to a new operating site, after an accident occurs, or a damage related to the wire rope occurs.

14.3.3.3 Checking Scope

The working life of the wire rope varies in relation to the use of the machine. No matter if it is used for hoisting or luffing, the wire rope must be strictly checked regularly. Once damage is found, the wire rope must be replaced immediately.

14.3.3.4 Check

1. Routine check: all visible parts of the wire rope shall be inspected as much as possible each working day so as to detect general damage and deformation. Particular attention shall be paid to the rope at points of attachment to the crane. Any obvious change found shall be reported. Then find out the causes and deal with the problem in time.

2. The supervisor must carry out periodic check (for common parts and terminations).

To determine the inspection interval, the following issues should be taken into consideration:

- The statutory requirements covering the application in the country of use.
- The type of crane and the environmental conditions in which it operates.
- The classification group of the crane.
- The results of previous inspections.
- The length of time the rope has been in service.

3. Special inspection as regulated by check of common parts and terminations (excluding rigging).

-- The rope shall be inspected if an accident has occurred which could have caused damage

to the wire rope and/or its termination, or if a rope has been brought back into operation after dismantling followed by re-assembly.

-- If the crane has been out of operation for three months or more, the ropes should be inspected before re-use.

4. If a wire rope solely or partially operates on synthetic pulleys or metal pulleys with a synthetic lining, wire breaks can occur internally in large numbers before there is any external visible evidence of broken wires or of substantial wear on the periphery of the rope. Therefore, it is necessary to establish a special wire rope inspection schedule based on history inspection records of the wire rope, which shall take into consideration both the routine inspection in service and detailed inspection records.

The part of the rope on which the lubricant has dried or denatured should be maintained with special care. Discard standard for wire ropes used exclusively for hoisting equipment shall be based on information exchanged between the hoisting equipment manufacturer and the wire rope manufacturer.

5. Check of common parts:

Although the wire ropes shall be inspected for its full length, special attention should be paid to the following parts:

- Termination points of both moving and retaining parts.
- The part of the rope passing through the pulley set or over pulleys. When the crane performs repetitive operations, special attention should be paid to the rope lengths that pass over pulleys when the crane is under a loaded condition.
- The part of the rope passing through a fixed pulley.
- The part of the rope that may be worn out due to external factors.
- Internals of the rope, for corrosion and fatigue.
- The part of the rope exposed in thermal circumstance.

6. Check of rope terminations (excluding rigging)

The part of the wire rope where it is played out from the termination shall be inspected as it is dangerous if fatigue (broken wires) occurs in these parts. The terminal fittings themselves should be also checked for deformation or wear. Similar inspection must be carried out on termination with pressed or forged rope ferrules. Check the material of the ferrule for crack and for possibility of slipping between the ferrule and the rope.

Removable terminations (wedge connector, wire rope clip, pressing plate, etc.) shall be checked for broken wires inside the wire rope and the termination, and for tightness of wedge socket and wire rope clip. The inspection should also include an assessment that the terminations completely meet requirements by relative standards and operation regulations.

Eye splices should only be used at tail of the splice to protect the hands from protruding steel wires. Remaining parts of the splice should be checked by naked eyes for broken wires at any time.

If broken wires are obviously located close to or inside the terminations, the wire rope can be shortened and reinstalled the terminations for use. However, the remaining length of the wire rope must satisfy requirements for minimum wraps winding on the winch.

14.3.4 Replacing the Wire Ropes

Replacement of wire ropes depends on number of broken wires, wear and corrosion. In case of any one of the following situations, the wire rope must be replaced immediately.

1. Broken wires

If more than 10% of single wires in one lay length of the wire rope are broken (excluding filling steel wires).

2. Broken wire

When broken wires appear at the terminations or nearby, it indicates that stress at this part is very high even the quantity of broken wires is small.

If rope length allows, cut off the part with broken wires and re-install the wire rope reasonably.

3. Locally gathered broken wires

If broken wires are close together within a length less than 6d (d: nominal diameter of the wire rope) or gathered within any single strand, even if the quantity of broken wires is small.

4. Increase of broken wires

Broken wires start to appear after a certain period of use, and the number of broken wires keeps progressively increasing over time.

5. Broken strands

A complete strand is broken and rope diameter reduces due to damaged rope core.

6. Decrease of elasticity

All the following phenomena indicate decrease in elasticity: reduced rope diameter, elongation of lay length, lack of clearance between wires and between strands. Although no broken wire appears at this time, the wire rope obviously becomes stiffer, which may lead to sudden broken under dynamic load. In this case, discard the wire rope immediately.

7. Corrosion

When serious external and internal corrosion occurs to the wire rope, its average value is decreased. Hence its static breaking force and operation stability will be reduced accordingly.

8. Wear

Wear of the wire rope can be “internal” and “external”. Internal wear is caused by rub between rope strands and wires when the wire rope bends upward or downward, while external wear is caused by movement between the wire rope and pulley or when dragging the wire rope on the ground.

When lubrication is insufficient and dust exists, abrasion will be more serious. If compared with nominal diameter, diameter of the wire rope reduces by 10% or more, the wire rope should be replaced even if no broken rope strand is found.

9. Deformation

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Deformation of the wire rope is a visible change in the wire rope structure and can cause slack and distortion on exterior of the wire rope. The external deformation includes:

- Spiral deformation
- Ball-shape deformation
- Formation of wire loop
- Slack single wire or strand
- Kink
- Contraction
- Flattening
- Curl deformation
- Breaking and bending

10. Increase of permanent elongation.

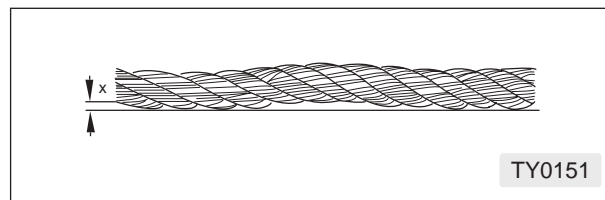
11. Reduction in rope diameter, including that resulting from damaged rope core,

In addition to the above, fatigue is main reason that leads to damage in the wire rope in some applications. Even when the defect cannot be found externally, there may already be broken wires inside. Hence, even if wire rope that is approved by the above inspections while its actual operation hour has reached 2000 hours, it must be replaced as well.

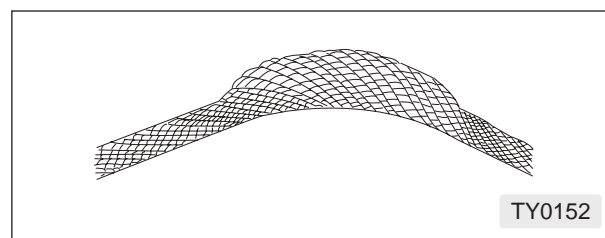
! CAUTION

If deformation X has reached $1/3 d$ or larger (d is the nominal diameter of the wire rope), the wire rope must be replaced.

- When outer bearing of the wire becomes slack or outer rope strands are longer than the inner ones, wire rope with steel core will form ball-shape deformation.
- If external wires or strands slip relatively to inner wires or strands, the longer part will bend to some direction.



Spiral deformation



Ball-shape deformation

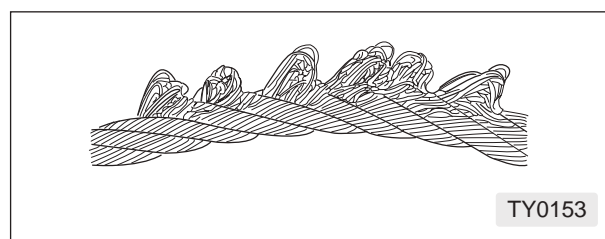
! CAUTION

If ball-shape deformation is formed, the wire rope must be replaced.

- If wire loop is formed, a share of wires or a group of wires will protrude structure of the wire rope on one side to face the pulley like hair.

! CAUTION

If obvious change occurs to structure of the wire rope due to wire loop formed, the wire rope must be replaced.



Formation of wire loop

Section 1 Maintenance

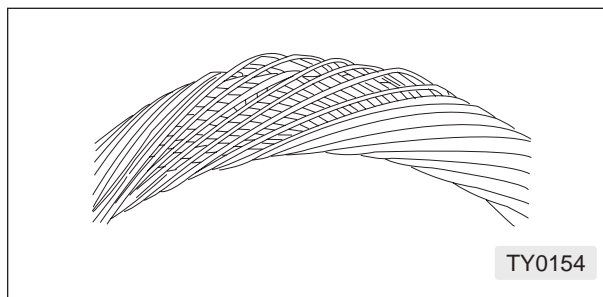
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-- If single wire or rope strand of the wire rope becomes slack, the load will be transferred to outer wires or strands.

This means that the slack wires or strands do not bear the tension assigned, so as to cause other wires or rope strands to be overloaded.

If wire rope moves on the pulley, the bending tension will increase and cause wires broken earlier.



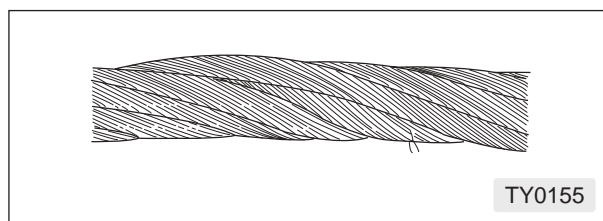
Slack Single Wire or Rope Strand

CAUTION

If the wire becomes slack due to rust and abrasion, it must be replaced. If it becomes slack due to other reasons, it is required to decide whether to replace it according to the number of broken wires.

-- Kink refers to thickened rope that appears repeatedly for a long time. Matter inserted in the thickened part often protrudes out of the wire rope.

Rope strands at the thickened part form an arch, leading to broken rope.



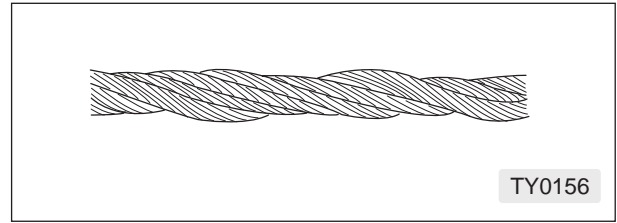
Kink

CAUTION

Wire rope with a lot of kinks must be replaced.

-- Contraction refers to diameter reduction of the wire rope in short expansion direction.

Check carefully whether the parts of wire ropes in front of fixed rope tail contract. Contraction of these parts is usually hard to find.

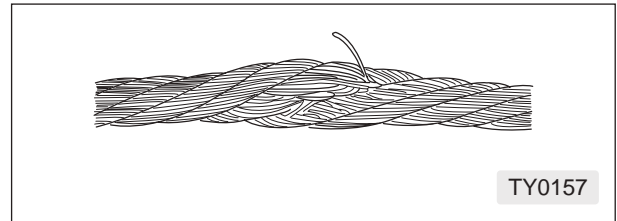


Contraction

⚠ CAUTION

Wire rope that contracts at a lot of places must be replaced.

-- Flattening refers to permanent deformation of the wire rope caused by press.
-- Flattening leads to increase of rope cracks.



Flattening

-- Curl deformation
Curl deformation is generated when dragging bearing wire rope at edges.

⚠ CAUTION

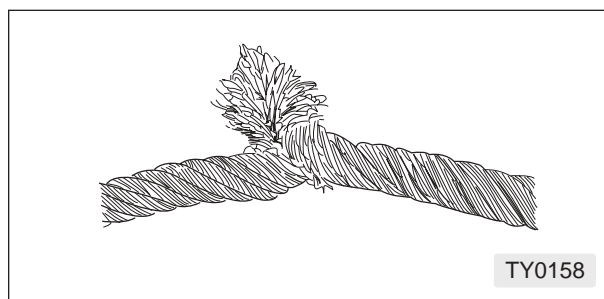
Wire rope with curl deformation must be replaced.

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-- Breaking refers to deformation of wire rope produced when directly dragging wire rope in shape of small loop and the wire rope fails to set off this deformation by rotating around its axle.

CAUTION

Wire rope that breaks at one or more places should be replaced.

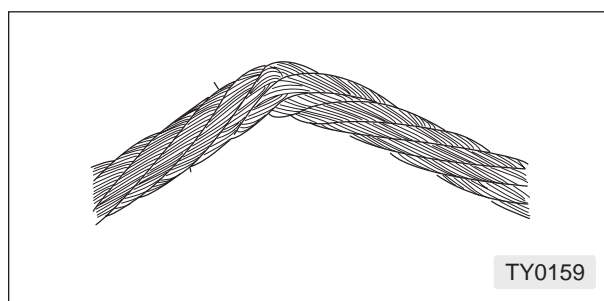


Breaking

TY0158

-- Bending is deformation of the wire rope caused by massive external impact.

In addition to the above, fatigue is the reason that leads to damage in the wire rope in some applications. Even when the defect cannot be found externally, there may be broken wires inside. Hence, even if wire rope that is approved by the above inspections while its actual operation hour has reached 2000 hours, it must be replaced as well.



Bending

TY0159

CAUTION

The bending wire rope must be replaced.

14.3.5 General Instructions on Operation and Installation

14.3.5.1 Transport

For wire ropes, there may be problem even in stage of transport: the fork of forklift truck that moves below the reel or into the rope coil may damage surface of the wire ropes.

When transporting wire rope in coils or on reels of wire rope, it is required to prevent the wire rope from contacting the hook block or fork directly. Instead, hoisting belt should be used to lift the wire ropes(TY0165).

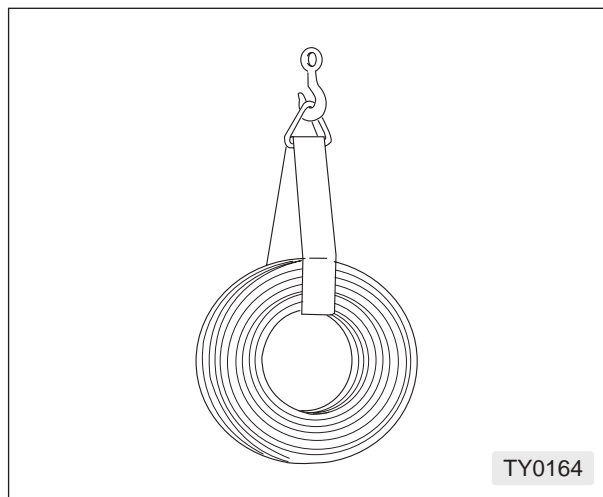
The best way to lift wire ropes on reels is to hoist by the rod through the reel axle(TY0164).

14.3.5.2 Storage

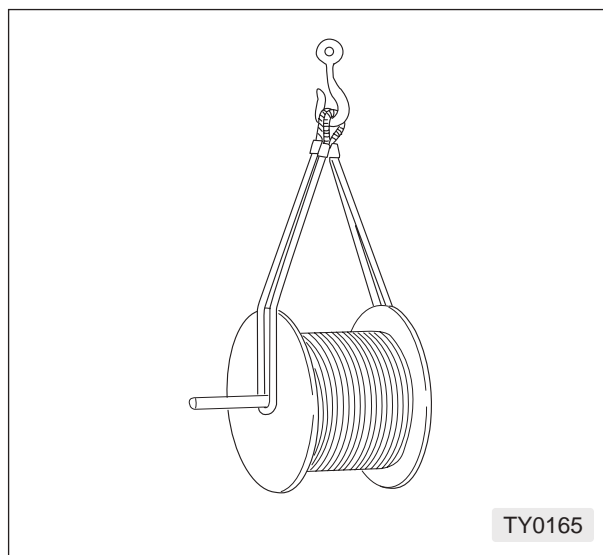
Wire ropes shall be stored in cool, clean, dry and shielded circumstances and shall not be in contact with the floor. Instead, they can be placed on trays. If outdoor storage cannot be avoided, the wire ropes should be covered against moisture.

A plastic film can prevent rainfall perfectly. However, condensed water may form beneath it which cannot escape and may cause permanent damage to the wire ropes. In this case, a layer of hemp bags can be laid between the plastic film and wire ropes.

When storing a large number of spare parts, the general principle is: first in, first out. That is, when delivering the wire rope, the same order should be followed. In this way, it can be avoided to store the wire rope for many years before putting it into use.



Transport wire ropes in coils



Transport wire ropes on reels

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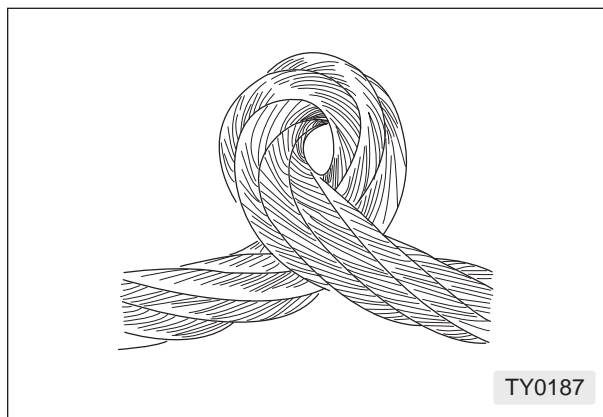
14.3.5.3 Installation

When installing wire rope, make sure that wire ropes are reeled onto the system from in the right direction from reel or coil of wire rope and that the wire ropes are not twisted or damaged externally.

Keep the wire rope in coils from twisting by using a turntable or rolling it out on the ground. When rolling the wire rope out on the ground, ensure the ground is as clean as possible. For example, if sand sticks to lubricant on the wire rope, and it enters between the pulley of the equipment and the wire rope, damages will be caused to the wire rope.

The better method to unwind wire ropes on reels is using a turntable or bracket. One method often recommended in some literatures is to roll the wire ropes on reels on the ground. But in actual practice, this method does not work well.

In no case should the wire rope be dragged laterally from the reel or coil. Wire rope that is dragged laterally from the reel or coil can produce a resistance to the torque worked on it and loops may form as a result. When the wire rope is under load, these loops will be dragged into knots, leading to permanent deformation. Wire rope with knot is not safe for use and must be replaced.



Dragging out Wire Rope Laterally Leads to Damage

14.3.5.4 Installation Procedures

Best installation method varies with the system. In each case, a method by which it is least possible to cause twist or damage to the wire rope due to contacting structural components following the typical work schedule should be selected as the optimal method.

For some equipment, it is suggested that the old wire rope be removed first before the new wire rope being installed. For other equipment, especially large scale equipment, it is suggested that the old wire rope be used to guide the new one.

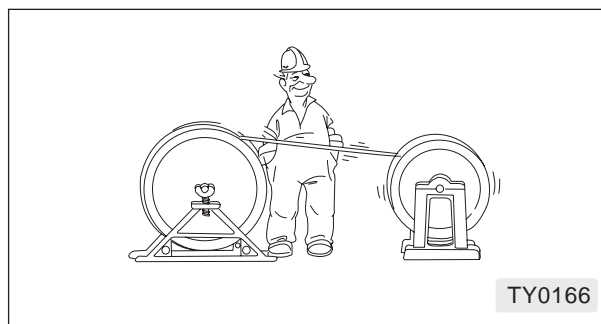
There is still another possibility, especially when starting to wind the wire rope, to use thinner auxiliary rope to drag the actual wire rope through. In each case, it is required to consider choosing which method to reeve the wire rope: by dragging the wire rope through the reeving device, or by winding the wire rope directly on to the winch first and then drag it through manually or by an assistant reeving device.

If one end of the wire rope is fixed and cannot be disassembled, the only way is to drag the free end (the other end) through the rope winding device.

14.3.5.5 Rewinding

From perspective of manufacturing, each wire rope takes a certain bending tendency because it was dragged out of basket stranding machine through transfer tray. Hence the wire rope provide to the user bend in this direction. When re-winding it from the reel onto the winch, the wire rope must be wound in this direction.

If the wire rope is re-wound in a direction opposite to its bending tendency, it may either tend to rotate between the reel and the winch or rotate later when in operation to its ideal bending tendency. Both cases can cause structural change to the wire rope.



Rewinding

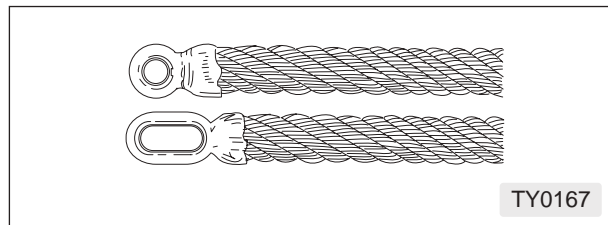
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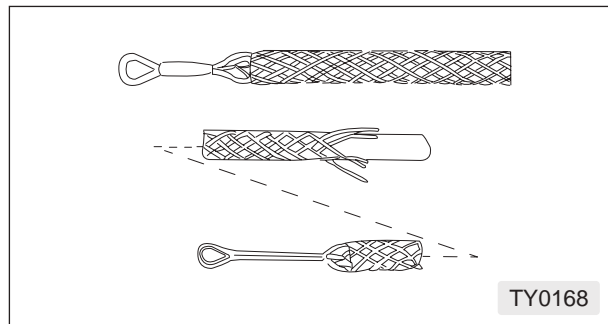


14.3.5.6 Dragging the Wire Rope by Reeving Rope

- If using the wire rope to be dismantled or the reeving rope to drag the new wire rope, make sure these ropes are tightly fastened. In addition, make sure the auxiliary rope cannot be twisted. For example, untwisted wire ropes or triangular strand ropes are especially suitable for being used as auxiliary ropes. When using traditional wire ropes, make sure that at least their direction of twist are the same with that of the wire rope to be dragged.
- When using the old wire rope to drag the new one through, ends of both wire ropes are usually welded together. Such a connection may cause the twist of old wire rope formed during operation to be transferred to the new wire rope, which will further lead to extensive damage even in the installation stage.
- Wire rope connection method that is less problematic is to weld the two rings or chain links on to the terminations. Then connect the rings or chain links by use of rope strands or thin ropes. Such a connection has satisfactory load bearing capacity, can be bent, and can prevent twist being transferred from the old wire rope to the new one (TY0167). By using two rope strands, the number of rotations in the rope strands after installation can display to what degree the old wire rope on the equipment was twisted.
- Using wiring sleeves to connect wire terminations has even bigger potentials. Wiring sleeves are woven rope strands which are connect to the wire terminations and fitted with adhesive tapes. When bearing load, the wiring sleeves are dragged tightly and hold the wire terminations by friction force (TY0168).



Profile of Wire Rope Connector



Using Wiring Sleeve to Connect Wire Rope

14.3.5.7 Winding Loaded Wire Ropes

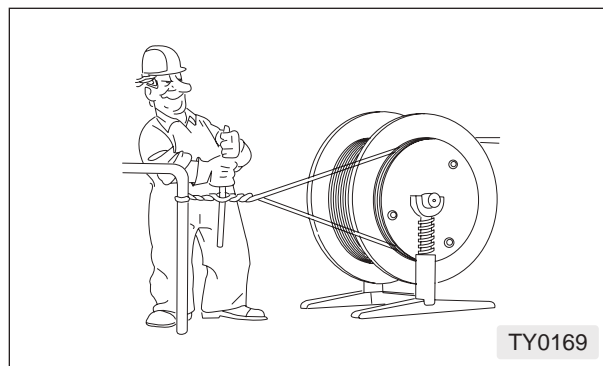
When the wire rope is needed to be wound onto the winch, make sure it is wound tightly and correctly. This is very important for multi-layer winding, especially when using the fold-line groove winding system.

If the underlying layers are too loose, the upper ones may be pressed into between rope strands of the underlying layers when the wire rope is under load. This may cause extensive damage to the wire rope.

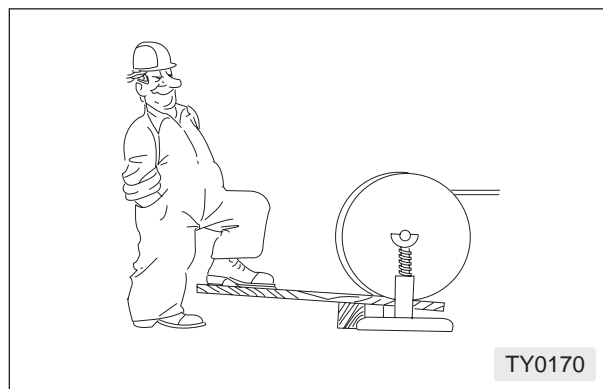
Because the wire rope drawn out may even be stuck in this part, winding direction of the winch may be reversed suddenly, which will cause the load moving downward to be lifted abruptly.

The wire rope should be pre-tightened with a minimum breaking force of about 2% in advance.

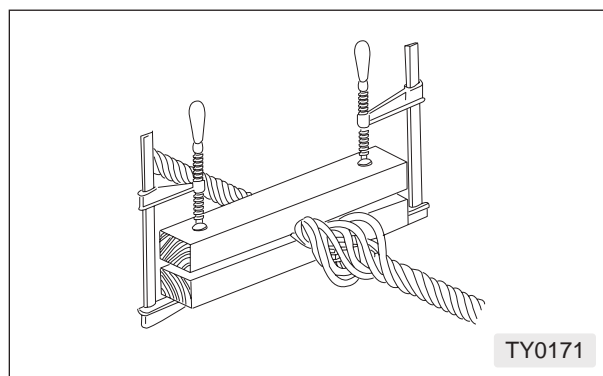
A board or brake disc on the reel can be used to brake the wire disc flange. The brake ropes (hemp ropes with a steel core) are provided by the wire rope manufacturer.



Use brake disc on the reel to brake the wire disc flange



Use a board to brake the wire disc flange



Do not attempt to pre-tighten the wire rope in advance by squeezing it

14.3.5.8 Running In

After the wire rope has been installed and before the hoisting operation is resumed, it is required to carry out a number of operational cycles of the mechanism at reduced load, to allow the component part of the wire rope to adjust to the actual operating conditions.

But usually the actual situation is often the opposite: after the wire rope is installed, overloading check is usually implemented by imposing loads which are more than the value allowed by the system's bearing capacity.

14.3.5.9 Cutting into Sections

The users often should cut the wire rope into several sections or shorten it. There are several methods to do so. The wire ropes with a diameter of 8mm (3") can be divided by a wire rope cutter. For those with larger diameter, mechanical or hydraulic cutters can be used. But if power supply is accessible, it is suggested that a pneumatic or electric right angled grinder be used.

In each case, the wire ropes must be carefully connected to the nearest cutting point to prevent the wear at terminations or change in lay length.

It is required to use iron wire to tie up ends of wire ropes because insulating tape cannot prevent the wire rope from structural change.

First mark the cutting points with chalk or insulating tape.

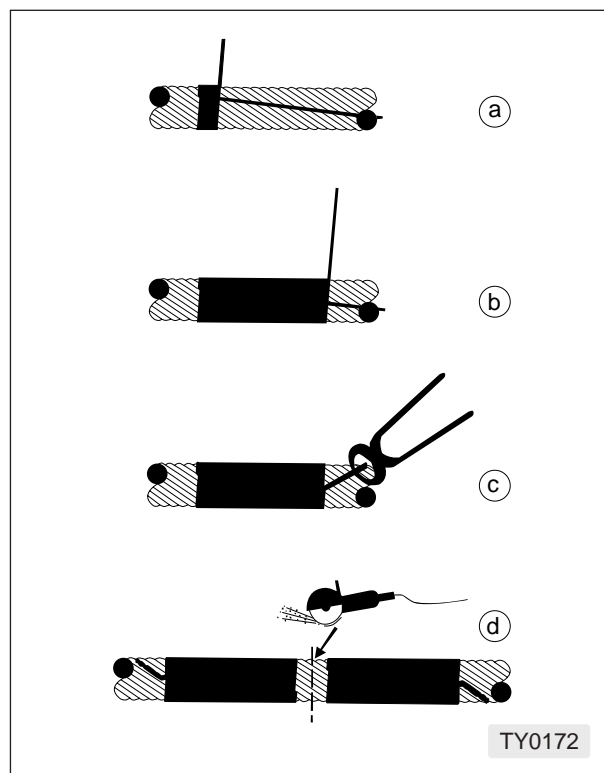
Place one end of the steel wire at a length four times of the wire rope diameter along the length of the wire rope and then tie the steel wire together with the wire rope at the cutting point (a).

Twist the steel rope on the wire rope tightly (b) along the wire rope for a length about 3 times of the wire rope diameter.

Then use pincers to pull the twisted steel wires tightly and twist it together with the other end (c).

Use the pincers to shorten length of the twisted steel wires to approx. one diameter of the wire rope and then strike them slightly so that ends of the steel wires enter the dent between two external strands of the wire rope. It can prevent accidents by doing so.

After corresponding preparation done on the other side of the cutting point, the wire rope can be cut (d). Three coils at a length approx. of the wire rope diameter, instead of one long coil, can be wound on each side of the cutting point.



Steps to cut into sections

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14.4 Pulleys

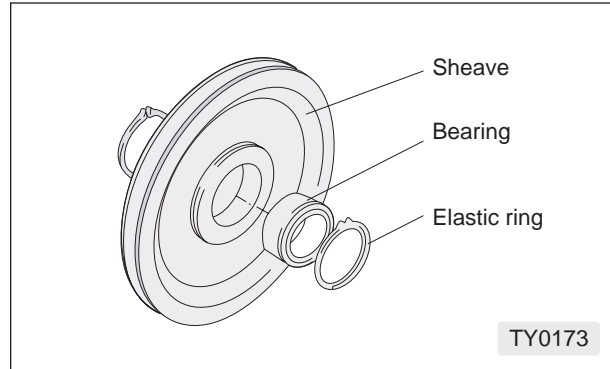
14.4.1 Checking Bearings on the Pulleys

The pulley should be checked once a year, including:

- Whether the lubricating grease appears
- Part sealed up at axle end
- Elastic ring
- Operation noise, rolling resistance
- Bearing gap

If roller bearing on relative pulley is found defective, it must be replaced.

If the elastic ring is found damaged, it must be replaced.



Pulley

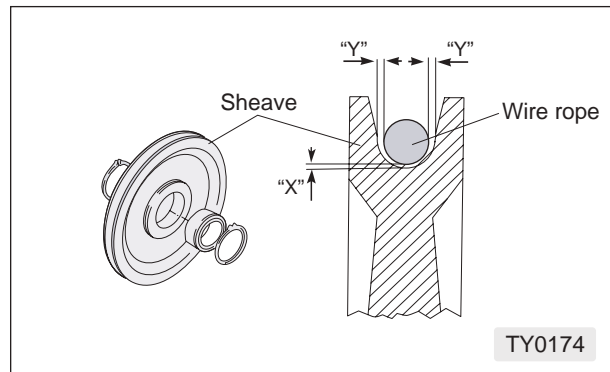
! DANGER

Danger of dragging or entanglement. When implementing maintenance, inspection and installation services, special attention to be paid to danger of being involved or dragged into area between the pulley and the wire rope.

14.4.2 Checking the Pulleys

Checking contents

1. Check all pulleys for cracks, dents or similar damages.
2. Check all pulleys for wear:
 - Bottom "X" $\leq 3\text{mm}$ ($1/8"$)
Distance "X" equals to difference between new bottom and actual bottom.
 - Side "Y" $\leq 5\text{mm}$ ($3/16"$)
Distance "Y" equals to length between wire rope and surface of the pulley.



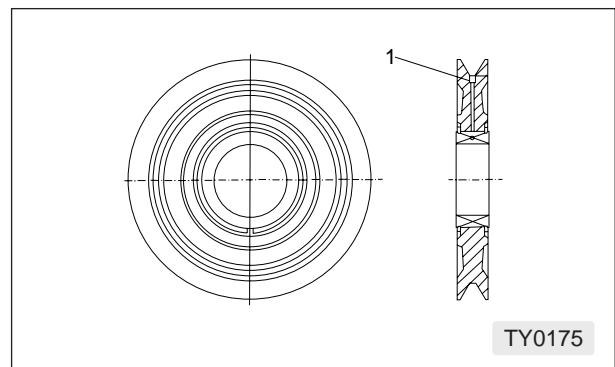
Checking the Pulley

⚠ CAUTION

- The pulley with damages such as cracks dents or bends must be replaced immediately.
- The pulley that arrives at maximum wear degree must be replaced.

14.4.3 Lubricating Pulley Bearings

Use lubricating nipple (1) to lubricate each pulley.



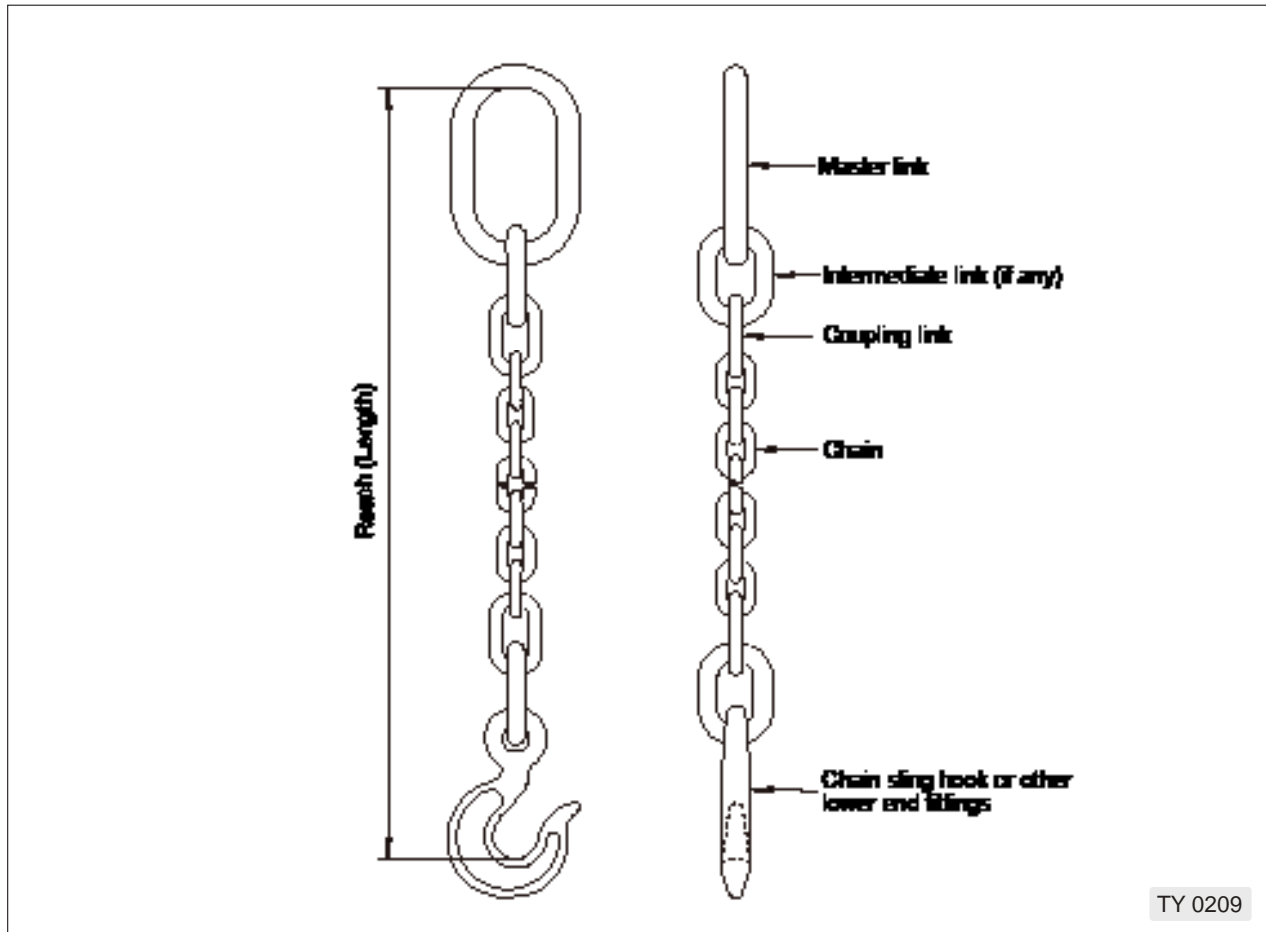
Lubrication of pulley bearing

14.5 Riggings

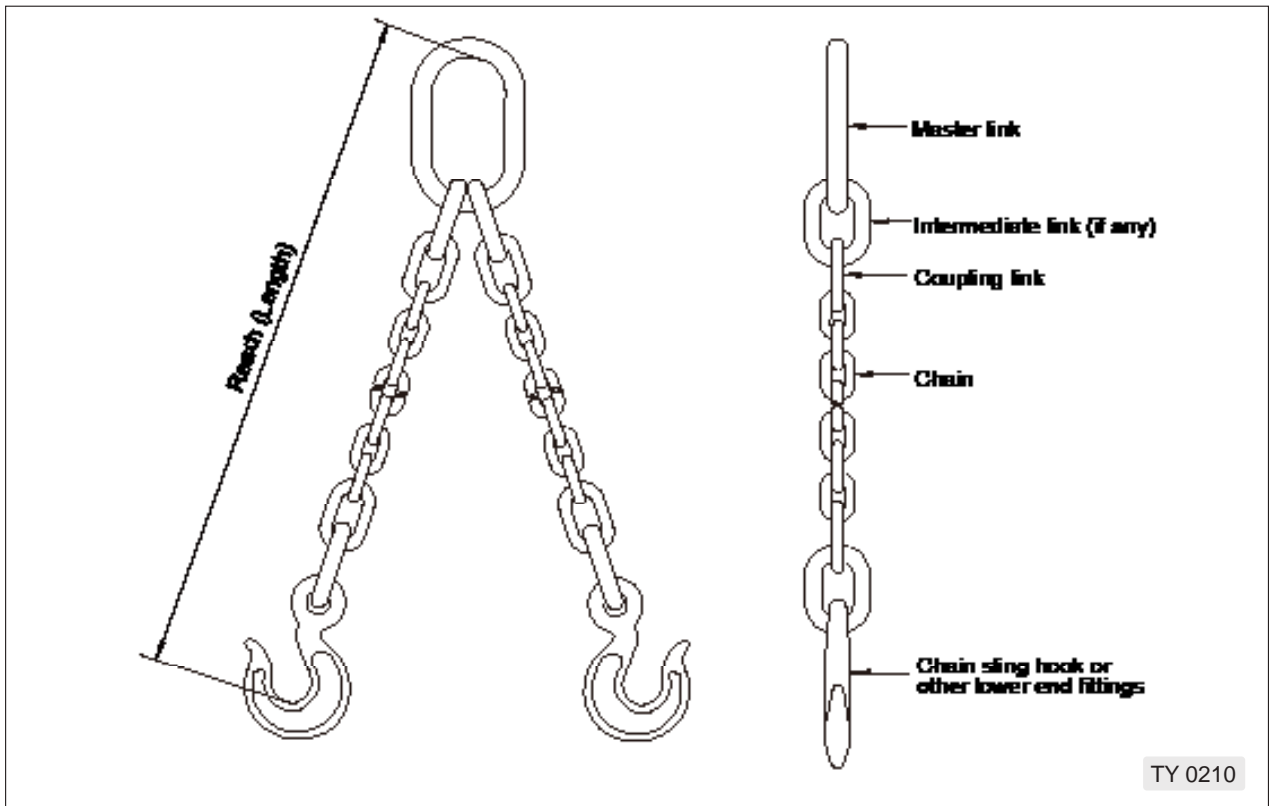
14.5.1 Chain Slings for Lifting Application

Chain sling is a combination of chain equipment composing of one or more chains with upper and lower end fittings. As per the requirements of international standards, they are used to attach a load to the hook of a crane or other lifting machines. Due to the potential risks existing in the application of chain slings, one risk is lifting failure which may cause the load falling and hence damage the load. and another risk is personal injury, correct use and maintenance is extremely essential in terms of accident prevention, safe operation, efficiency, service life, and operation cost reduction.

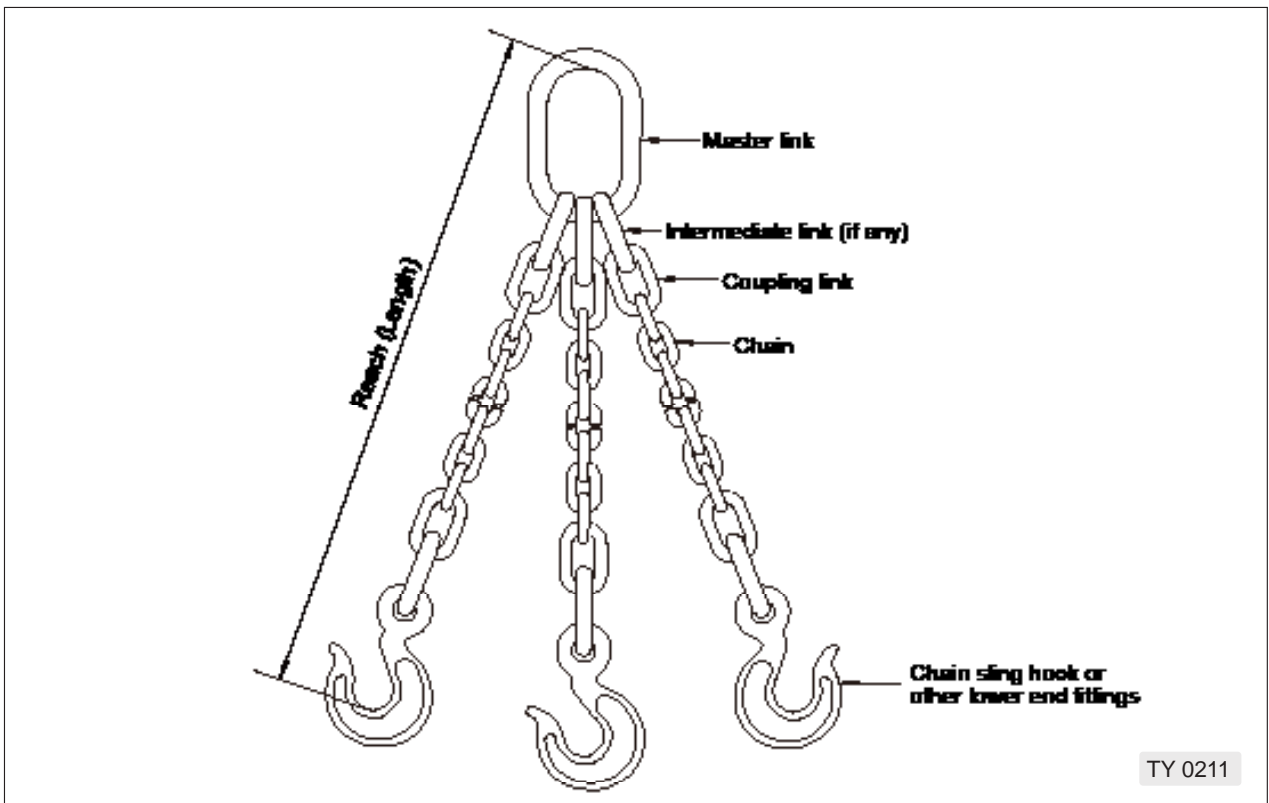
There are 5 types of chain slings based on the shape: single leg chain slings, two leg chain slings, three leg chain slings, four leg chain slings, and endless slings, as shown in the following figures:



Single Leg Chain Sling



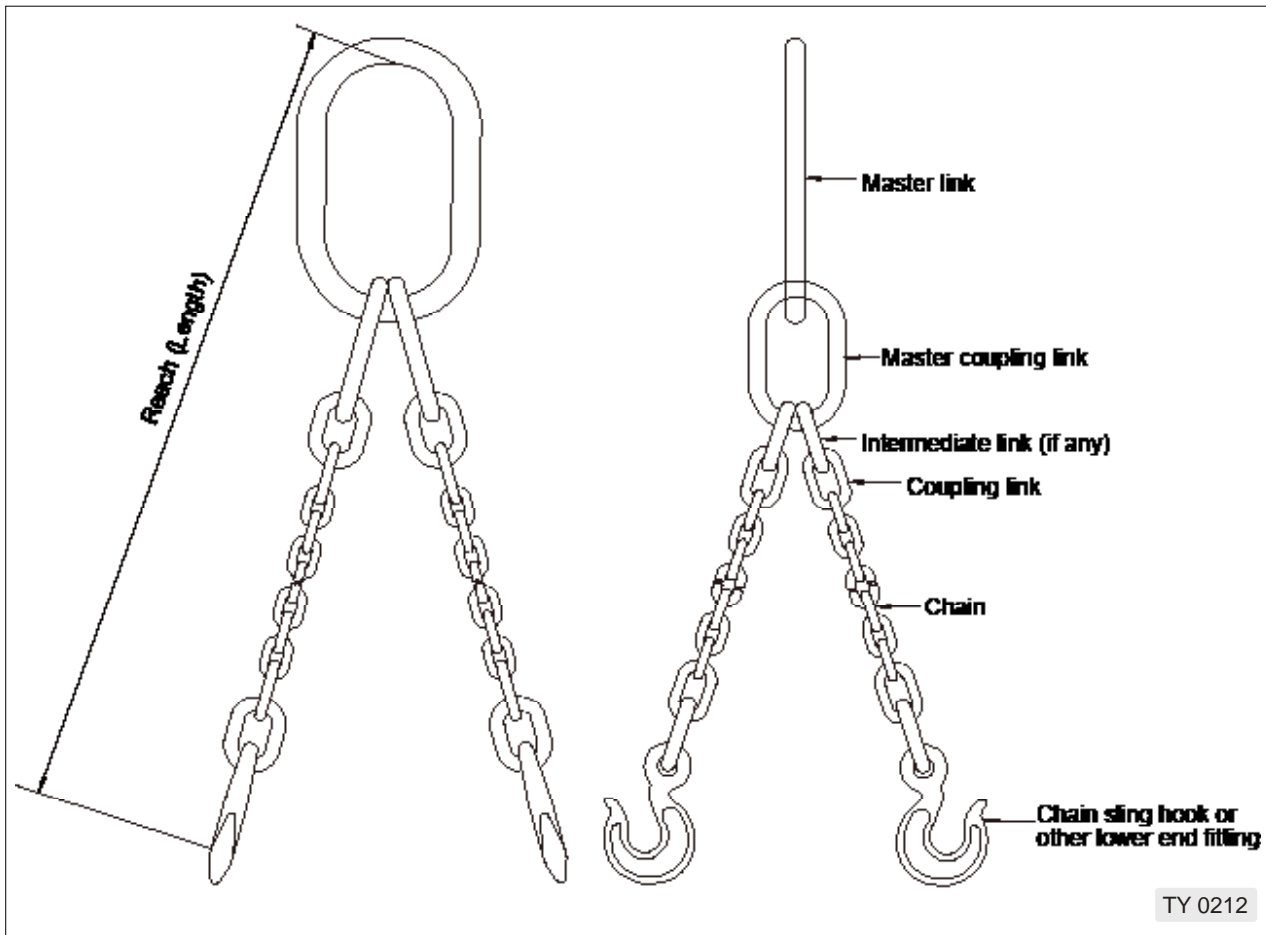
Two Leg Chain Sling



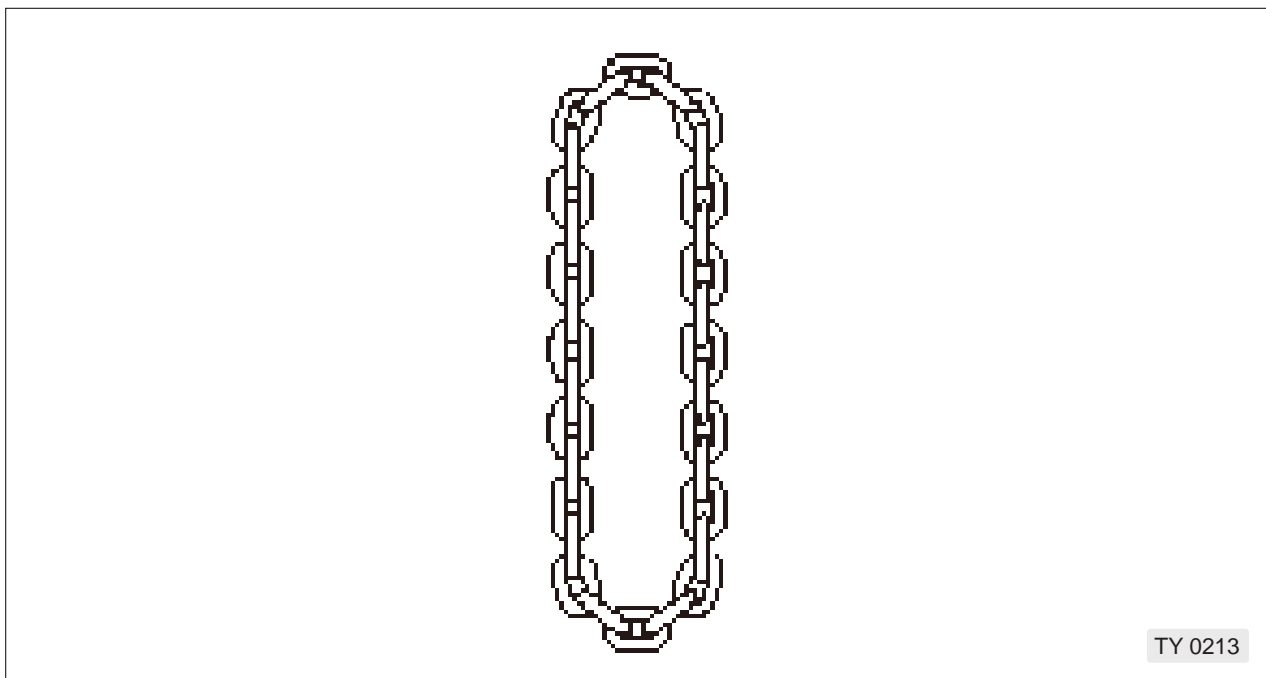
Three Leg Chain Sling

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Four Leg Chain Sling



Endless Chain Sling

14.5.2 Use and Maintenance of Chain Slings

14.5.2.1 Correct Use of Chain Slings

Select the correct slings to be used before a lift by taking the following into consideration: number of legs, diameter of the chain, Working Load Limit (WLL), and Working Load Limit at different sling angles in the case of multi-leg slings.

Use of chain slings must comply with relevant regulations and safety requirements. Chain slings shall not be twisted or kinked. Never drag slings from under loads when the load is resting on the sling.

Sharp edges and corners in contact with the slings should be padded to prevent damage. A regulator can be used to avoid shock loading and to maintain balance as necessary. The load attached to a hook shall be centered in the bottom of the hook bowl and never tip load the hook. Never use the chain slings in contact with acidic solution or fumes, as which may cause corrosion, embrittlement mechanism or cracks to the slings. If the slings may come into use in such conditions, consult the manufacturer first. Never galvanize or subject the chain sling to electroplating, coating or any plating treatment involving heating or acid washing without the approval of the manufacturer. A qualified expert shall perform risk assessment and make corresponding adjustment to Working Load Limit (WLL) before lifting a load that is important or dangerous.

Ensure that the chain slings are in accordance with the requirements of the order before initial use and that a test certificate is attached, on which information like Working Load Limit (WLL) and identification is in compliance with that identified on the sling. Inspect chain slings for damage and wear before each use. Correct any problem found as per the maintenance regulations. Static weight of the load shall not exceed the Working Load Limit (WLL) of the chain sling.

Follow these conditions to protect the slings from twisting or tilting in a lift:

- (1) For single leg chain slings, the contact point is right above the center of gravity of the load.
- (2) For two leg chain slings, the contact points distribute on both sides above the center of gravity of the load.
- (3) For three or four leg slings, the contact point shall distribute evenly on the plane above the center of gravity of the load and the legs had better distribute evenly as well.

For multi-leg chain slings, select the correct type of sling and contact points to ensure that each leg angle β is within the permissible range specified. All the leg angles are recommended to be the same. The leg angle β shall not be less than 15 degrees. The hook shall match with the lifting point and the load shall be centered in the bowl, other than the tip, of the hook. Position hooks of multi-leg slings facing outward from the load in spite of the specially structured hooks used in unconventional conditions. For a load without proper lifting point, the chain sling shall contain the load from under the load and the Working Load Limit (WLL) shall reduce to the 80% of the rated load. Make sure that chain slings will not kink in double-sling contain lift and that angle β shall not be greater than 60 degrees. The Working Load Limit (WLL) is conventionally calculated on the basis that all legs of the chain sling are applied with equal load. For multi-leg chain slings, each leg bears unequal load if the angles between legs are different and the leg with smallest angle bears the most load. In extreme conditions, the load is totally applied to the vertical one among all legs. The load is still considered as being evenly distributed in the following conditions:

- (1) The load does not exceed 80% of the Working Load Limit (WLL) of the sling.
- (2) All the leg angles are not less than 15 degrees.
- (3) All leg angles are equal or the maximum deviation from each other is 15 degrees. Except for the above conditions, the Working Load Limit (WLL) shall reduce by 50%. The operator shall keep hands and other parts of the body clear to avoid injury when tensioning chain

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slings. Check chain slings for security and that the load holds balanced in one plane after the chain sling is tensioned and the load is slightly lifted. This practice is particularly important for basket hitch or similar as the load is held balanced at its position due to friction force. For multi-leg chain slings, when using less than the full number of legs, reduce the Working Load Limit (WLL) in proportion to the number of legs in use. For a two leg chain sling with one leg in use, reduce maximum load to 1/2 of the nominal WLL. For a three or four leg chain sling with two legs in use, reduce maximum load to 2/3 of the nominal WLL, for a three or four leg chain sling with one leg in use, reduce maximum load to 1/3 of the nominal WLL. Back the hook of free legs to the master link to avoid danger during transportation.

14.5.2.2 Storage, Inspection and Maintenance of Chain Sling

Store the sling on a specially designed rack and back the lower end hooks onto the master link.

The chain sling shall be stored in an area dry and sufficiently ventilated. The storage area should also be free of humidity to avoid electrochemical corrosion as noticeable cracks tend to occur under corrosion pitting of high-strength chain slings. Chains shall be protected from corrosion if they are to be out of use for a period of time. Back leg hooks free of load to the master link. Avoid damage or impact to the slings during transportation as stress concentration tends to occur in damaged slings in use and may therefore cause early breaks.

Make regular and irregular inspections of the chain sling for damage and wear. Chain slings must be inspected by a qualified person at least annually. The inspection interval also depends on the use conditions. Carry out crack detection every three years with professional instrument or equipment. If the user holds any doubt to the safe conditions of chain slings, the slings must be withdrawn from service and be inspected by a qualified person.

Dirt, oil contaminates, and corrosive agents must be removed from chain slings prior to inspection. The cleaning methods shall not damage the basic materials of the sling. Hydrogen embrittlement, material wear, deformation, cracks, and other surface damages must be avoided.

The chain sling must be removed from service and be maintained and repaired if any of the following defects is noticed:

- (1) Illegible identification or labeling of the Working Load Limit (WLL) of the chain sling.
- (2) Deformation in master link, chain, and other components. plastic deformation in chain link with external length exceeding by 3% of nominal length and internal length exceeding by 5% of nominal length.
- (3) Leg length of multi-leg slings varies noticeably.
- (4) The hook shows signs of stretch widthwise, such as the remarkable increase in throat opening, and the throat opening dimension increase shall not exceed 10% of the nominal dimension.
- (5) The wear at hook bowl is no less than 5%.
- (6) Chain diameter reduces by 10% (average value of the two measurements which are perpendicular to each other) of the nominal diameter due to wear between links or between link and other parts. the diameter of master link, master coupling link, intermediate link, or coupling link reduces by greater than 15% of the nominal diameter due to wear.
- (7) Surface condition, such as cuts, nicks, gouges, cracks, excessive corrosion, discoloration due to excessive heat, link bends and twist or other defects.

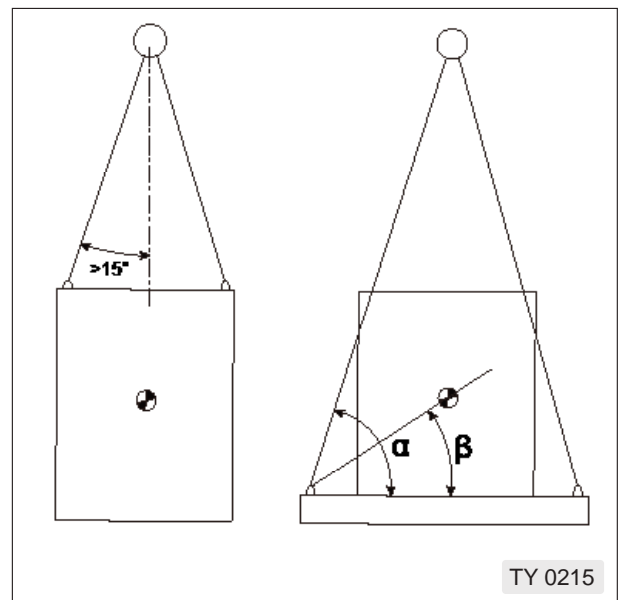
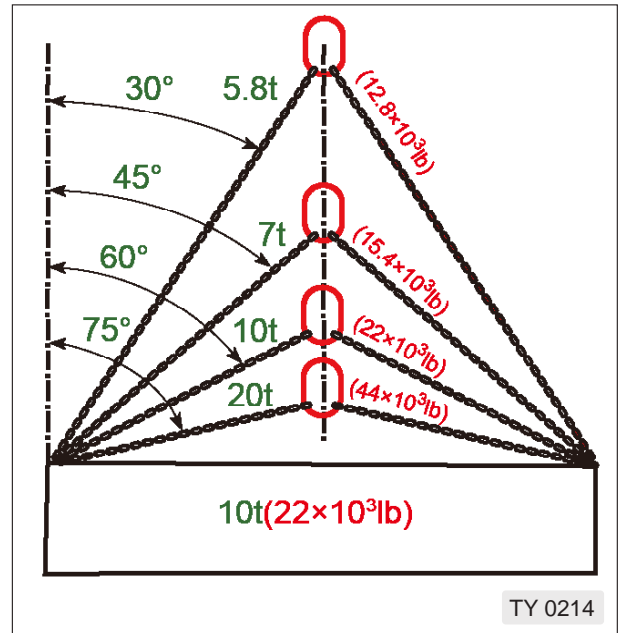
All sling components must comply with relevant national or international standards. If any link of the leg needs to be replaced, the whole leg shall be replaced. Repair like welding shall be performed only by the sling manufacturer.

Sling components with cracks, noticeable deformation, and excessive corrosion must be replaced. Minor defects like gouges and nicks

can be rectified by careful grinding and the cross section after grinding shall not be less than specified value. If it is a mechanically connected element that has been repaired and such an element has been tested as per relevant standards by the manufacturer and is attached with a certificate of such test, load test to such an element will not be required.

14.5.3 Operation Requirements and Inspection Criteria of Riggings

1. Do not use the sling to lift a load greater the rated load.
2. The load applied on a sling increases with the enlargement of leg angles measured from vertical. When the leg angles enlarge over a limit value, it may cause local overload to the sling or even sudden break of the sling, the latter of which is hazardous.
3. Each leg angle from vertical shall not be greater than 60 degrees (i.e. angle between two adjacent legs shall not be greater than 120 degrees). An example of a chain sling lifting a 10t load is shown in Fig. TY0214, in which the load applied to each leg at each specific angle is illustrated. In crawler self-assembly duty of this crane, the reference angle between legs shall be less than 60 degrees.
4. Ensure that the lifting point is right above the center of gravity of the load or that the leg angle α measured from horizontal is always greater than angle β measure from horizontal to the line passing through the center of gravity of the load and securing point, which will keep the load from tilting or slipping during the lift. When multi-leg chain slings are used, each leg angle measured from vertical shall not be less than 15 degrees, i. e. the angle between adjacent legs shall not be less than 30 degrees to ensure stable and balanced lift (see Fig. TY0215).

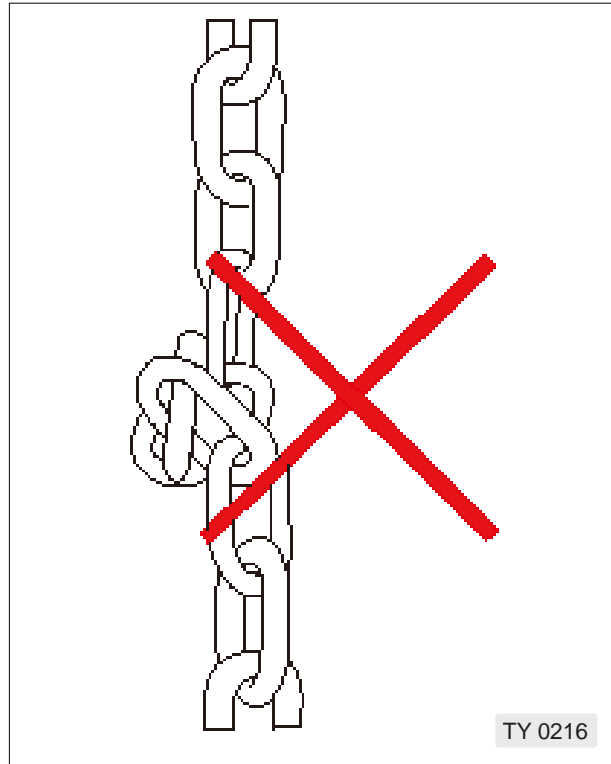


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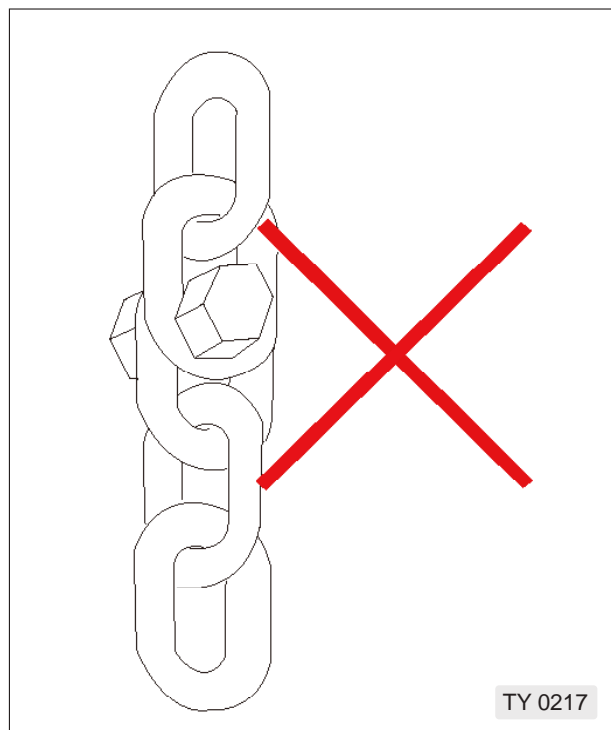
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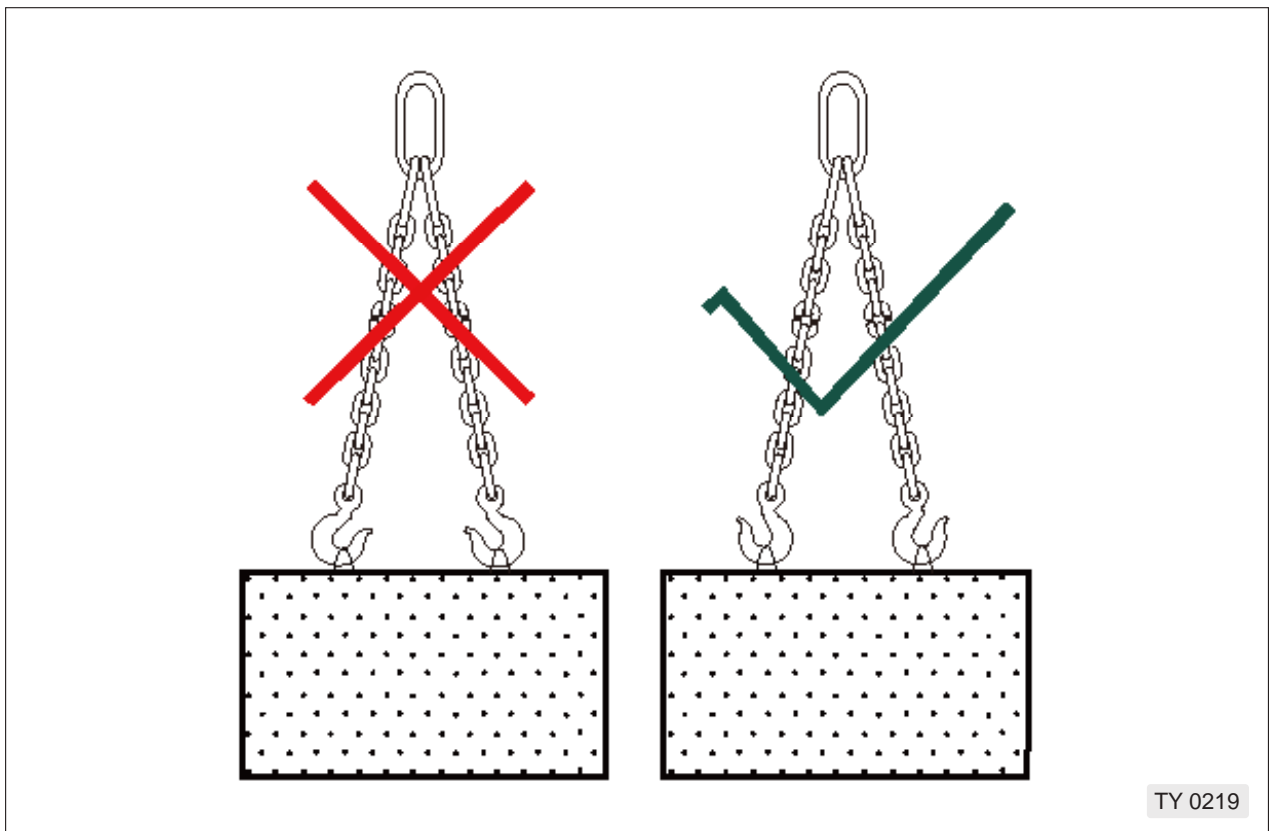
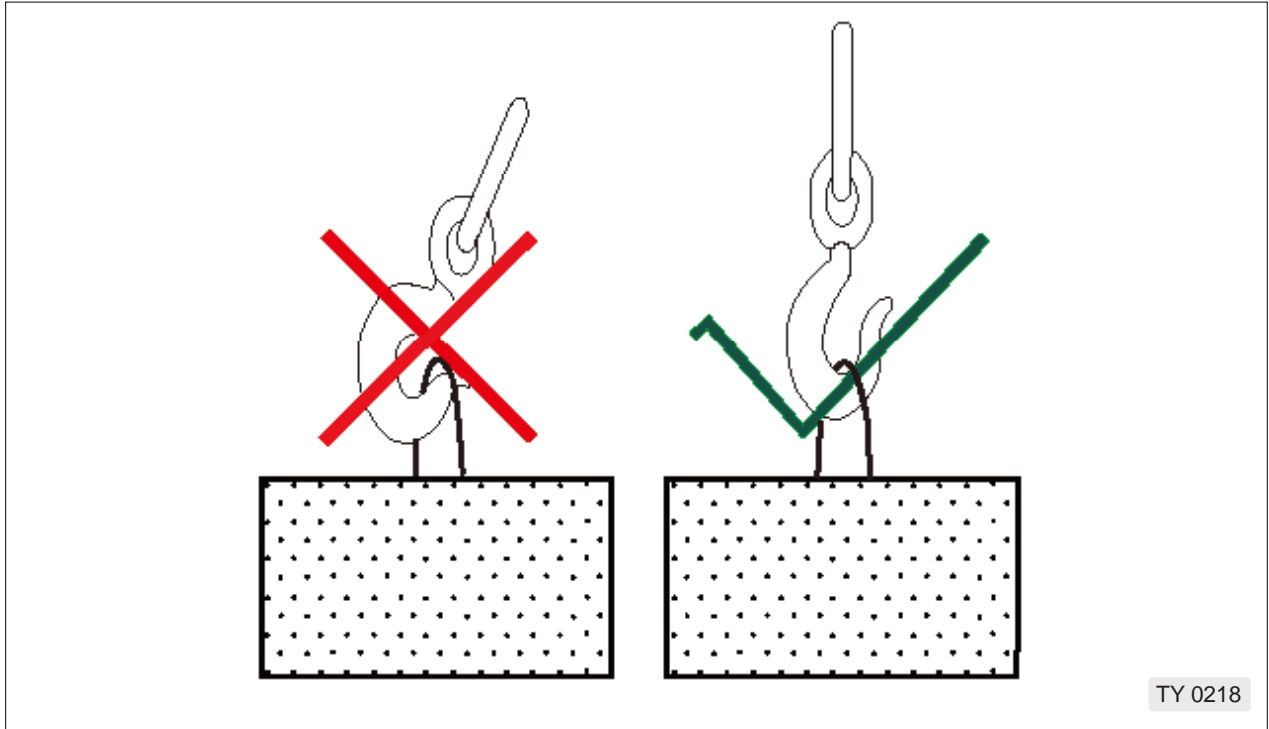
5. There shall not be kink, twist or knot between links. each chain link shall hinge freely with adjacent links (see Fig. TY0216).



6. It is prohibited to use the chain sling in shocking and vibrating conditions, sever corrosive environment, or at extreme temperatures (below $-30^{\circ}\text{C}(-22^{\circ}\text{F})$ or above $200^{\circ}\text{C}(392^{\circ}\text{F})$). Special order is required for riggings operated in such conditions.
7. Do not connect the chains with unqualified coupling elements (see Fig.TY0217).



8. Attach the load to the bottom of the hook bowl and never to the hook tip (see Fig. TY0218). As a rule, position hooks to face outward from the load when lift a load (see Fig. TY0219).

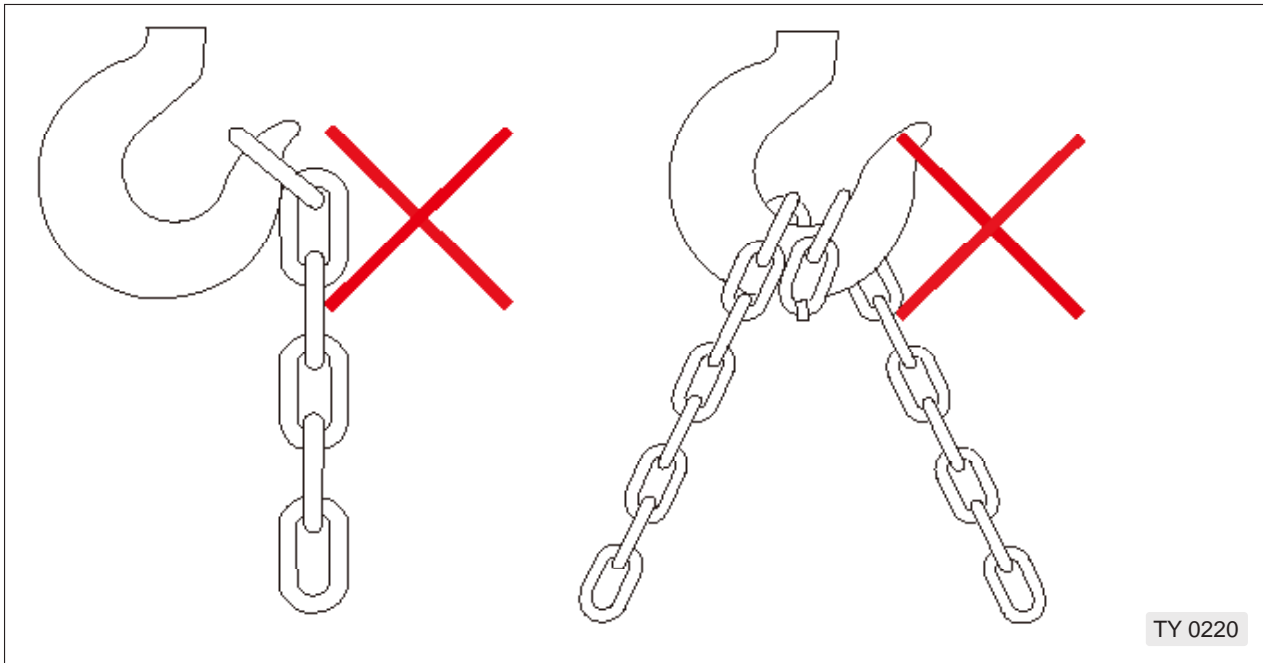


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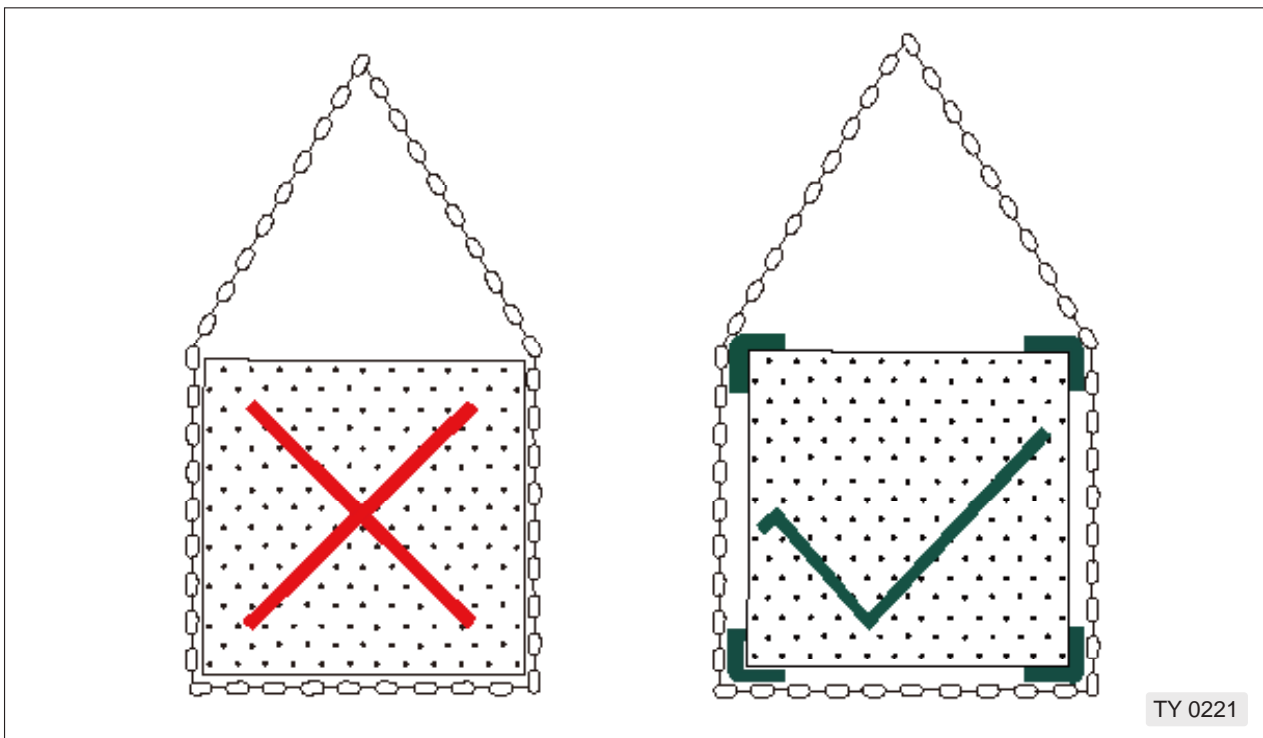
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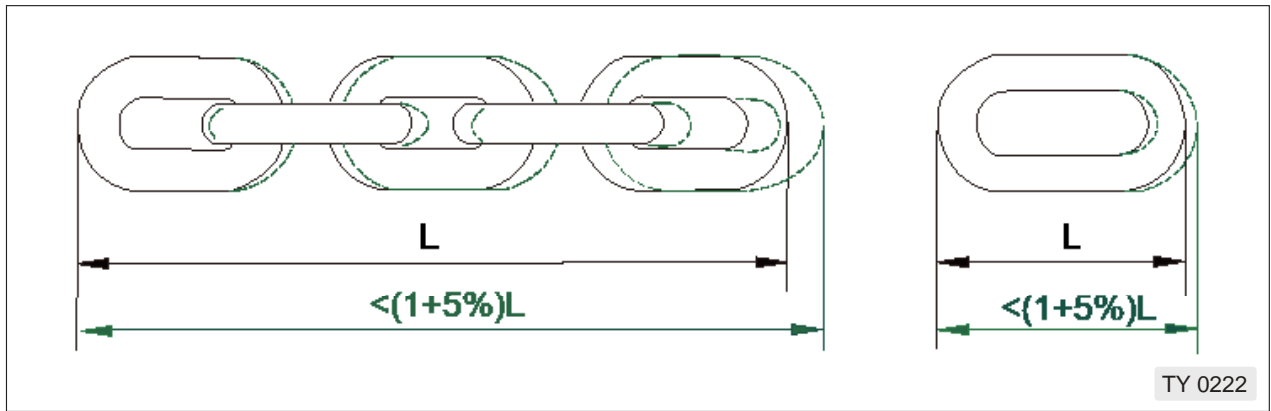
9. Do not attach the bearing chain link directly to the tip of crane hook or wind the chain around the crane hook (see Fig. TY0220).



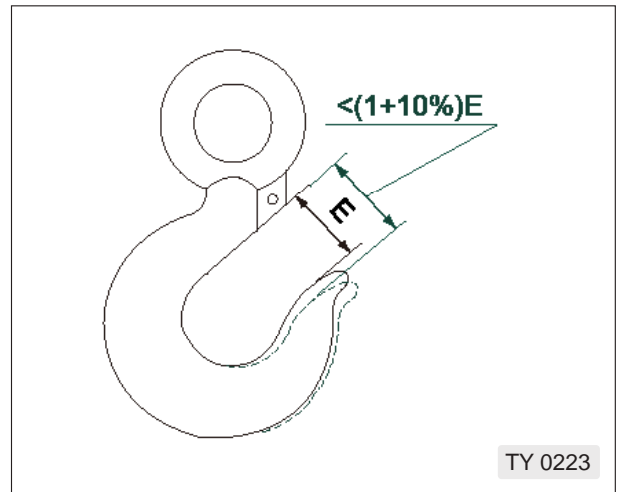
10. Lift, lower and stop a load steadily. Make sure that the load is balanced to its center of gravity and avoid shock loading. Do not leave the load suspended on chain slings for a long period of time.
11. When the endless chain sling goes around the load, use padding at sharp edges and corners to protect the sling and the load from damage (see Fig. TY0221).



12. Never attempt to pull chain slings from under loads forcefully or let the load roll on the sling.
13. Chain slings shall be handled gently and carefully. It is prohibited to fling, drop, or drag chain slings on the floor to avoid any deformation, superficial or internal damage.
14. Chain sling inspection criteria
 - 1) Permissible wear of chain slings shall not exceed 10% of the chain link bar diameter or the thickness of any attachment, any chain with wear greater than that value must be withdrawn from service.
 - 2) Discard chain slings when torsion of master link exceeds 10 degree measured from the untwisted plane of master link.
 - 3) Chain slings must be removed from service when cracks, bends, or twists appear in any part of the chain sling, and when chain links get stuck and cannot hinge freely with adjacent links and such a problem cannot be rectified.
 - 4) Permanent stretch of chains and single links shall not exceed 5% of the original dimension (See Fig. TY0222).



15. Hook removal criteria
 - 1) Cracks.
 - 2) Hazardous cross-sectional wear or corrosion reach 5% of the original dimension.
 - 3) The torsion angle of hook body exceeds 10 degrees.
 - 4) Hook bent opening increases by 10% of the nominal dimension (See Fig. TY0223).
16. It is prohibited to repair or re-process (including welding, heating, heat treatment, and surface chemical treatment by chemical methods) the riggings.



14.6 Measures to Protect Exposed Shaft Surfaces

Although the quality is superior, the surfaces of shaft can also be easily corroded in a corrosive situation. If shut-down time of the crane exceeds one day, it is required to coat protective acid-free lubricating grease to avoid corrosion on exposed surfaces.

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15 Checking the Crane

15.1 Visual Check

Carry out visual check on the following parts before operation every day.

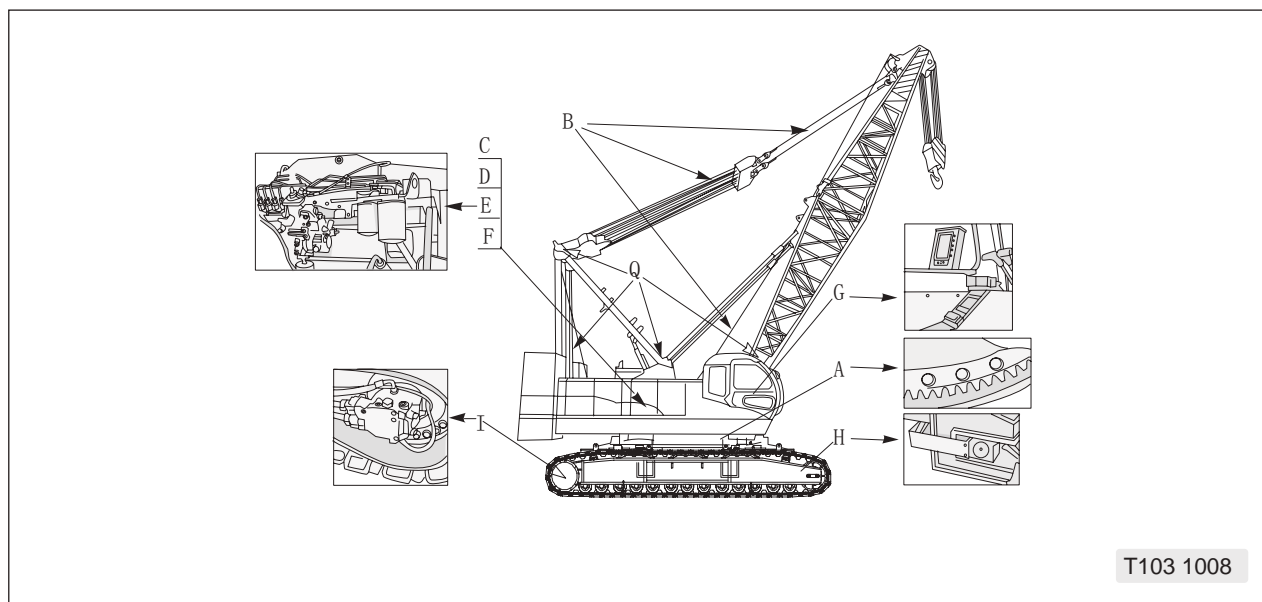


Diagram of Checking Parts of Main Machine

- A = Slewing ring - check whether the gear teeth are sufficiently lubricated.
- B = Check whether lubricating oil film on the wire rope is undamaged and whether the wire rope is damaged.
- C = Check the hydraulic system for leakage or damage and check the oil level.
- D = Check the machine cover for loss, damage, tightness or loss of bolt.
Safety signs should be visible and undamaged.
- E = Check the engine for possible leaks, fuel leaks, or for polluted fuel or oil.
- F = Check the cooling system for leakage, damage or pollution.
- G = Check whether all apparatuses and displays function correctly and whether there is any damage.
- H = Check the tension mechanism to see whether the guide wheel is damaged and it is appropriately tensioned.
- I = Check whether travel driving device leaks.
- Q = Use safety device to check all hoisting booms and their connecting pins for damage.

The crane operator is responsible for regular check of the crane in line with applicable national and international regulations.

The following information is based upon contents related to routine check of the crane stipulated by Crane Accident Prevention Regulation.

Routine check is mainly visual check and function check.

Mainly including:

- Check whether the crane is in line with information in Inspection Handbook (Crane Log).
- Check damage, abrasion, corrosion and other changes in the parts and equipment.
- Check the accuracy and effectiveness of safety equipment and breaks.

Check of the crane is responsibility of owner and trained personnel.



Checking results must be recorded in Inspection Handbook and certified by the inspector.

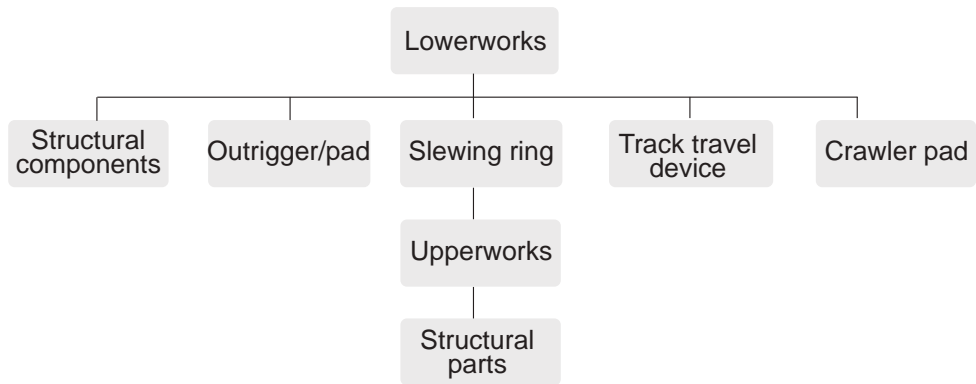
15.2 Regular Check

15.2.1 Checking Large Scale Steel Structure

15.2.1.1 Upperworks and Lowerworks

Checking contents:

Crack, Deformation, Abrasion, Safety and tightness of loosened parts, Corrosion and anti-corrosion.

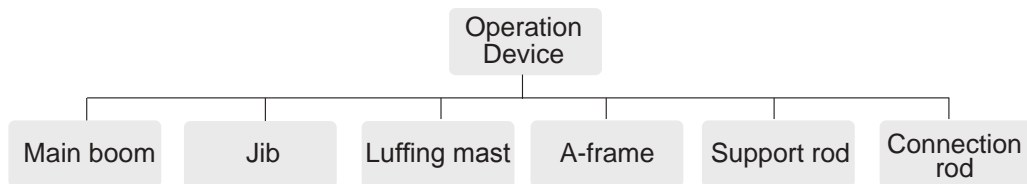


Schematic Diagram of Checking Parts of Upperworks and Lowerworks

15.2.1.2 Operation Device

Checking contents:

Crack, Deformation, Abrasion, Safety and tightness of loose parts, Free movement of the bearing, Components and wire rope, Corrosion and anti-corrosion, Extension rate, Plasticity deformation, Painting quality, Installation of wire rope and rope guard roller



15.2.1.3 Counterweight

Checking contents:

Whether all parts are complete and correctly connected.

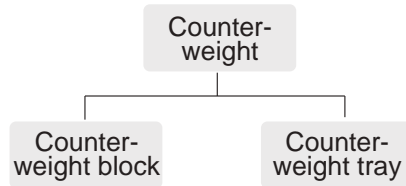
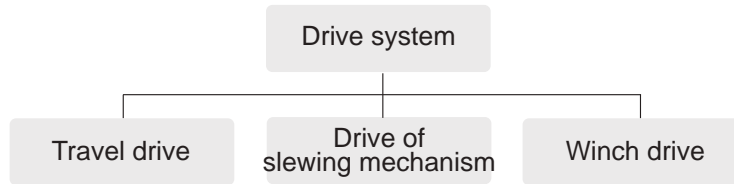


Diagram of checking parts of counterweight

15.2.1.4 Drive System

Safety and tightness of loose parts, Status, function and noise, Whether start and stop steadily, Idling operation, Coupling and the brake's abrasion, Effectiveness of slewing locking device. Installation of wire rope and auxiliary pipe.

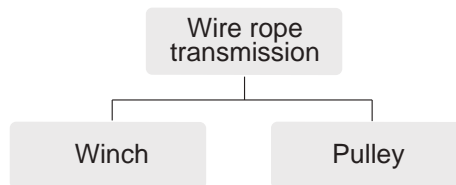


Schematic Diagram of Checking Parts of Drive System

15.2.1.5 Transmission of Wire Rope

Checking contents:

Configuration and storage of winch and pulley (abrasion of rope groove and flanged wheel).



Schematic Diagram of Checking Parts of Wire Rope

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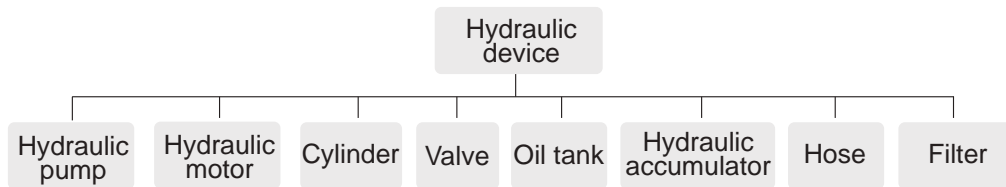
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15.2.1.6 Hydraulic Device

Checking contents:

Connection between equipment, Working status, Function, Noise, Leakage, Status and volume of hydraulic oil, Inflation pressure.

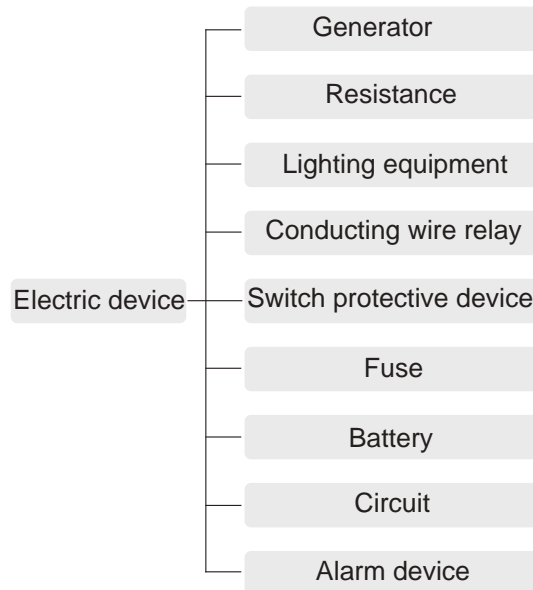


Schematic Diagram of Checking Parts of Hydraulic Device

15.2.1.7 Electric Device

Checking contents:

Connection, Status, Function, Insulation, Prevent direct contact with parts with electricity, Prevent indirect contact, Installation.



Schematic Diagram of Checking Parts of Electric Equipment

15.2.1.8 Controlling Device of Travel Driving

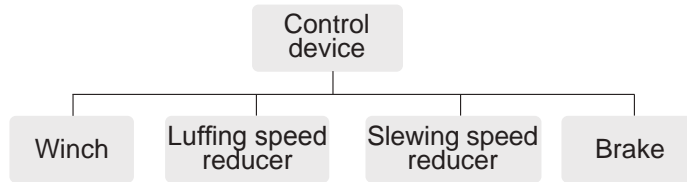
Checking contents:

Status, Function, Shut down, Steady operation, Idling operation of the moveable device (clearance at axle terminals) , Lights and display of signals, Signs, Brakes.

15.2.1.9 Checking Controlling Devices of Each Drive Device

Checking contents:

Status, Function, Shut down, Function of fixing gear, Signs, Check the brake with load (test load within hoisting capacity).



Schematic Diagram of Checking Parts of Drive Device

15.2.1.10 Checking Controlling Devices of Auxiliary Equipment

Checking contents:

Status, Function.

15.2.2 Checking Winches

It is not sufficient to check the outside by visual check. Improper maintenance, use of defective sealing components, operation by non-professional or overloading shall shorten life span of the winch. Thus, special worker should be sent to conduct the following inspection.

Checking contents:

Check intervals - every 1000 operating hours, at least once every year.

Check the oil level.

Check the oil color.

Check whether there is other matter, this check should be performed by qualified laboratory.

Check visually.

Check the brake on winch transmission device.

Load levels	Load lineage rate K_p	Definition
Light Q1	$K_p \leq 0.125$	Seldom hoist rated working load, frequently light weight
Middle Q2	$0.125 < K_p \leq 0.25$	Hoist a few rated working load, frequently middle weight
Heavy Q3	$0.250 < K_p \leq 0.500$	Sometime hoist rated working load, often heavy weight
Heavier Q4	$0.500 < K_p \leq 1.000$	Often hoist rated working load

15.2.3 Checking the Hook Blocks

- As working condition of the hook blocks varies each day, it requires to carry out check on hook blocks at every working shift. Pay close attention to any defect that may affect the safety during operation and eliminate any defect found before using the hook blocks.
- 1. Refill suitable lubricating oil to the pulleys regularly,
- 2. Check all the bolts and screws. Ensure all the locking pins are complete and function correctly,
- 3. Check the hook blocks for cracks and rust,
- 4. Check whether the wear of grooves and flanges are even. check the pulley for looseness or wobbling, which indicate the spindles or spindle sleeves are damaged,
- 5. Ensure each moving part of the hook block can run freely and there is not much clearance between them. Abnormal running indicates that the spindles or sleeves are damaged or insufficiently lubricated,
- 6. Check whether the locking device for each nut is solid,
- 7. Check the hook clamps for completeness,
- Check of the hook blocks should be done by experts annually. This check can find fault at an earlier time to prevent accident. Any fault found and correction measure taken should be recorded, and then check whether the fault found is solved.
- If it is required to further dispose after the corrosion is removed, size of screw core should not exceed 5% during the disposal, otherwise, the hook should be replaced.

 **CAUTION**

Nut on the shaft should be removed. Check whether the bolts and working axles are corroded or worn out.

15.3 Checking the Other Parts

15.3.1 Ladder

Part	Checking contents
Ladder	Firmness and status

15.3.2 Guardrail

Part	Checking contents
Bottom plate, Cover plate, Handrail	Firmness and status, Completeness, Effectiveness

15.3.3 Safety Device

Part	Checking contents
Load moment limiter Boom limit device Over-hoist limit device Switch equipment Alarm device Locking device Anemometer	Firmness and status Perfection Function

15.3.4 Safety Signs

Part	Checking contents
Plate	Completeness and readability

15.4 Check and Maintenance under Special Working Conditions

15.4.1 Working in Mud, Water, Rain, and Snow

1. Before operation: Check whether the plugs and pins are tight.
2. After operation: Clean the crane and check whether bolts and nuts are tight or are missing/ if so replace. Refill oil and lubricating grease.

15.4.2 Working at Seaside

1. Before operation: Check whether the plugs and pins are tight, apply oil and grease onto the rusty and corroded part, especially connecting rods and control levers.
2. After operation: Thoroughly clean salt off the machine and apply oil and grease onto the rusty part, maintain electric components carefully to avoid corrosion.

15.4.3 Dusty Circumstances

1. Air filter: Clean filter element and dust collector in advance.
2. Radiator: Clean radiator central part frequently to avoid being blocked.
3. Fuel device: Clean filter's components in advance.
4. Electric parts: Clean contact surface of the starter and sensor carefully.

15.4.4 Stony Circumstances

Tension of the tracks should be less tight than in common circumstances. Pay attention whether the travel part is damaged, cracked, or worn out and whether the bolts or nuts are loose or missing.

15.4.5 Site with Falling Stones

The cab must be equipped with a protective shield.

15.4.6 Cold Climate

Use lubricant of good viscosity and less viscosity. Battery must be charged in advance.

15.4.7 Other Working Conditions

1. Abrasion of pulleys on boom luffing mast, pulley set at platform's rear and working equipment varies with their location, when checking routinely, check pulley abrasion and replace in time.
2. When repairing and reinstall the track roller, its direction should be changed to prolong life span of surface of guide rails.

15.5 Storage of the Crane

It is required to carry out the following measures to keep the performance of the crane after storage:

1. Store for less than 30 days

- Clean the crane, keep it dry and conduct overall lubrication.
- Cover the crane against dust.

2. Store for one month to a year

- Clean the crane thoroughly and check the travel device for any abnormality,
- Keep the crane dry,
- Apply a thin film of lubricating oil onto rusty components and conduct overall lubrication,
- Lubricate the gears of slewing bearing,
- Replace gear oil and hydraulic oil,
- Replace all the filter elements,
- Dismantle the battery and charge it to full, dismantle the ground terminal,
- Drain cooling water and display a “No Water” sign. Cover the diesel engine with a piece of plastic film against dampness and dust when the crane is stored in a warehouse,
- Store the tools after counting them,
- Keep the engine running at low speed and with no load randomly once a month, which can efficiently prevent over-wear in actual running caused by broken plastic film or rust. During the storage, pay close attention to the temperature fluctuation in diesel engine cylinder cover.

Notes:

1. A lubricating operation is the continuous and repeating operation of traveling, slewing, and hoisting after the crane is warmed up.
2. Pay close attention to the quality of the lubricant when re-using the crane, as lubricant decomposition may occur easily when the crane is infrequently operated.

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16 Troubleshooting Guide

Table 5-15 Troubleshooting Guide - Engine

No.	Problem	Cause	Solution
1	Start motor has no response when the engine is ignited.	1. The fuse 23F13 is open circuit.	1. Replace the same capability fuse.
		2. The starter motor has fault.	2. Replace the starter motor.
		3. 5 KM3 has fault.	3. Replace the contactor.
		4. U1 is damaged.	4. Replace the U1 controller.
		5. Communication failure in U1 and U2.	5. Check the CAN Bus for U1.
		6. Low battery voltage.	6. Charge or replace the battery.
		7. Engine rotational speed sensor fault (In non-starting status, reading of engine rotational speed exceeds 900 rpm).	7. Replace the rotational speed sensor
		8. Seat interlock switch fault.	8. Check the seat interlock switch for correct function. check related wirings for correct function.
		9. Function locking switch fault.	9. Function locking switch fault or function locking lever is set at the working position.
2	Engine is difficult to start or cannot start (with smoke emitted)	1. Fuel level is low.	1. Refuel.
		2. Low battery voltage.	2. Check the battery and power supply circuit.
		3. Rotational speed of the engine is slow.	3. If the engine's rotational speed is less than 150 rpm, refer to the engine symptom tree.
		4. Vehicle additional power is too high.	4. Check whether it can be started with load.
		5. Fuel leakage.	5. Check whether fuel pipe, fuel pipe connector, or fuel filter leaks.
		6. Resistance of air intake system exceeds the value stipulated by technical specification.	6. Check resistance of air intake system. If necessary, clean or replace air filter and air intake pipe.
		7. Fuel grade differs from applicable type or fuel quality is inferior with impurity.	7. Use the correct fuel to fulfill the requirements.
		8. Fuel filter is blocked.	8. Measure fuel pressure at fuel filter's intake and outlet.
		9. Fuel supply is not enough.	9. Check fuel flow through the filter to find out where the fuel is blocked.
		10. Fuel pump has fault.	10. Check whether the fuel pump runs normally. check output pressure of the pump. If necessary, replace fuel pump.
		11. Position of throttle lever is wrong.	11. Check and adjust the position of the throttle lever.
		12. Cannot work normally due to cold weather.	12. Check, repair or replace starting assisting device for cold weather.
		13. Fuel system has air inside.	13. Release air from fuel system and check the fuel suction pipe for air leakage.

No.	Problem	Cause	Solution
3	Engine rotates but cannot start (no smoke emitted)	1. Fuel level is low or no fuel in fuel tank.	1. Refuel.
		2. Fuel grade differs from applicable type or fuel is inferior.	2. Use fuel fulfilling the requirements.
		3. Fault with OEM engine protection system.	3. Isolate OEM engine protection system.
		4. Low battery voltage.	4. Check the battery and power circuit.
		5. Fault with ignition switch circuit.	5. Check circuit of ignition switch.
		6. Abnormal power supply to the Electronic Control Module (the ECM).	6. a. Check fuse 06F3 and 06F6 for open circuit. if yes, replace the fuse. b. Check whether the emergency button is engaged. if yes, disengage the emergency button. c. Check whether the main power manual switch is open circuit. if yes, close the switch.
		7. Connector of conductor wire harness is wet.	7. Use electric cleaner to dry the connector.
		8. Oil system has air inside.	8. Check whether oil system has air inside. screw tight or replace fuel pipe, fuel pipe connector and fuel filter when necessary.
		9. The ECM is locked.	9. Disconnect the battery cable for 30 seconds. then connect battery cable and start the engine.
		10. Fuel filter is blocked.	10. Measure fuel pressure at fuel filter's intake and outlet.
		11. Fault with fuel pump.	11. Check whether the fuel pump runs normally. check output pressure of the pump. If necessary, replace the fuel pump.
		12. Fuel return pipe is blocked.	11. Check whether the fuel pump runs normally. check output pressure of the pump. If necessary, replace the fuel pump.
		13. Throttle lever is adjusted incorrectly or damaged.	13. Adjust or repair the throttle lever.
4	Engine can be started but cannot keep running	1. Fuel system has air inside.	1. Release air from fuel system and check the fuel supply pipe for air leakage.
		2. Fuel filter is blocked.	2. Drain fuel separator or replace fuel filter.
		3. Fuel solidification due to cold weather.	3. Replace with fuel used for cold weather.
		4. There is impurity in the fuel.	4. Filter or replace the fuel.

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No.	Problem	Cause	Solution
5	Engine cannot be shut off normally	1. Fault with fuel cut-off valve.	1. Check whether the conducting wire is loose and verify that fuel cut-off valve functions. check and confirm cut-off control lever is at RUN position.
		2. Air intake system absorbs smoke when the engine is running.	2. Check air intake pipeline, find out and isolate smoke source.
		3. Fuel leaks.	3. Check whether fuel pipe, fuel pipe connector and fuel filter leak.
		4. Diode 24V1 short circuit (breakdown)	4. Replace the diode.
6	Large amount of black smoke emitted	1. Fuel grade differs from applicable type or fuel is inferior.	1. Use fuel satisfying the codes.
		2. Leakage in air intake or exhaust.	2. Check whether there is loosened or damaged pipeline connector or lost pipe plug. Check turbocharger and exhaust manifold.
		3. Resistance of air intake system is too high.	3. Check resistance of air intake system. if necessary, clean or replace air intake filter and air intake pipe.
		4. Air intercooler is damaged or blocked.	4. Check whether air intercooler is blocked or leaks.
7	Large amount of white smoke emitted	1. Incorrect startup procedures.	1. Verify correct startup procedures.
		2. Engine is too cold.	2. Warm up the engine to working temperature.
		3. Engine is operated in a lower circumstance temperature.	3. Take heat protection measures on the engine.
		4. Fault with starting assisting device.	4. Check whether cold starting assisting device is working normally.
		5. Temperature of coolant is lower than technical specification.	5. Temperature of referred coolant is lower than normal value.
		6. Fuel grade differs from applicable type or fuel is inferior.	6. Use fuel satisfying the codes.
		7. Leakage in air intake or exhaust.	7. Check whether there is loose or damaged pipeline connector or lost pipe plug. Check turbocharger and exhaust manifold.
		8. Resistance of air intake system is higher than technical specification.	8. Check resistance of air intake system. if necessary, clean or replace air intake filter and air intake pipe.
		9. Air intercooler is damaged or blocked.	9. Check whether air intercooler is blocked or leaks.

No.	Problem	Cause	Solution
8	Turbocharger leaks engine oil or fuel	1. Engine runs for a long time with small load or no load.	1. Avoid running the engine for a long time with small load or no load.
		2. Engine oil or fuel enters turbocharger.	2. Disassemble air intake pipe to check whether there is engine oil or fuel.
		3. Turbocharger oil return pipe is blocked.	3. Disassemble turbocharger oil return pipe and check resistance.
		4. Engine oil supply pipe of turbocharger is loose or leaks.	4. If necessary, check and tighten connector of engine oil supply pipe.
9	Coolant has impurity	Coolant has rusty soot, without using coolant meeting technical specification.	Discharge and rinse the cooling system and fill coolant that meets technical specification.
10	There is fuel or engine oil inside the exhaust manifold.	1. Resistance of air intake system is too high.	1. Check resistance of air intake system. if necessary, clean or replace air intake filter and air intake pipe.
		2. Turbocharger oil return pipe is blocked.	2. Disassemble turbocharger oil return pipe and check whether it is blocked, clean or replace fuel return pipe.
		3. Leakage at oil seal of turbocharger.	3. Check whether there is engine oil in air intake and exhaust pipes. if necessary, replace oil seal of turbocharger.
11	Engine is unstable at idle Speed	1. Leakage in air intake or exhaust.	1. Check whether there is loose or damaged pipeline connector or lost pipe plug. Check installation of turbocharger and exhaust pipe.
		2. Resistance of air intake system is higher than technical specification.	2. Check resistance of air intake system. if necessary, clean or replace air intake filter and air intake pipe.
		3. Air intercooler is damaged or blocked.	3. Check whether air intercooler is blocked or leaks.
		4. Electric fault code functions.	4. Refer to instruction on how to read current fault code. if fault code functions, contact with engine repairing center specially appointed.
12	Engine is unstable at idle Speed	1. Fuel level of the fuel tank is too low.	1. Add fuel into fuel tank.
		2. Electric fault code functions.	2. Refer to instruction on how to read current fault code. if fault code functions, contact with designated engine service center.
		3. Connector of conducting wire coil is wet.	3. Use electric cleaner to dry the connector.
		4. Oil system has air inside.	4. Release air from oil system and check whether fuel suction pipe leaks air.
		5. Fuel filter is blocked.	5. Measure fuel pressure at fuel filter's intake and outlet.

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No.	Problem	Cause	Solution
12	Engine is unstable at idle Speed	6. Fuel supply is not sufficient.	6. Check fuel flow through the filter to find out where the fuel is blocked.
		7. Too much load at idle speed.	7. Use PTO feature if attaching load when running the engine at low speed.
		8. Fuel grade differs from applicable type or fuel is inferior.	8. Use superior or recommended fuel.
13	Temperature of coolant is too high	1. Liquid level of coolant is too low.	1. Add coolant.
		2. Radiating fin of water tank is damaged or is blocked by impurity.	2. Check radiating fin of water tank to clean and repair.
		3. Fan drive belt is loose.	3. Check belt tension pulley.
		4. The temperature sensor is damaged.	4. Check temperature sensor and cable.
14	Loss of coolant	1. Water tank or heater leaks.	1. Check water tank, heater, hose and connector to find out leakage.
		2. Leakage outside engine.	2. Check whether there is leakage at seal or gasket of the engine and its components.
15	Impurity in engine oil	Too much engine oil sedimentation.	Replace engine oil or filter.
16	Too much smoke when loaded	1. Engine load is big.	1. Reduce load or change to low shift.
		2. Oil system has air inside.	2. Discharge air from fuel system.
		3. Air filter is blocked.	3. Clean or replace air filter.
17	Engine cannot reach rated rotational speed when loaded	1. Overloaded.	1. Reduce load.
		2. Fault with rotational speed counter.	2. Check rotational speed counter.
18	Fuel knock	1. Engine is overloaded.	1. Reduce load.
		2. Engine is too cold.	2. Warm up the engine to working temperature.
		3. Fuel system has air inside.	3. Check whether fuel system has air inside. screw tight or replace fuel pipe, fuel pipe connector, fuel tank, fuel suction pipe and fuel filter when necessary.
		4. Fuel grade differs from applicable type or fuel is inferior.	4. Use superior or recommended fuel.
		5. Fuel leaks.	5. Check the fuel pipe connectors, fuel pipes and fuel filters for leakage.
		6. Fuel filter is blocked.	6. Measure fuel pressure at fuel filter's intake and outlet.
		7. Fuel supply is not sufficient.	7. Check fuel flow through the filter to find out where the fuel is blocked.
		8. Fault with fuel pump.	8. Check whether fuel pump runs normally and check pump output pressure.

No.	Problem	Cause	Solution
18	Fuel knock	9. Engine suspension is worn out, damaged or incorrect.	9. Check engine suspension.
		10. Connector of conductor wire harness is wet.	10. Use electric cleaner to dry the connector.
19	Engine stalls	1. Fuel has impurity.	1. Replace with superior fuel.
		2. Fuel system has air inside.	2. Release air from fuel system and check whether fuel suction pipe leaks air.
		3. Fault with power supply of engine controller.	3. a. Check fuse 06F3 and fuse 06F6 for open circuit. if yes, replace the fuses. b. Check the conducting wires for open circuit. if yes, replace the wire or reconnect the wire.
20	Output power is too low.	1. Vehicle is overloaded.	1. Reduce load or switch to low shift.
		2. Engine oil level is too high.	2. Discharge engine oil to proper oil level.
		3. Fuel system has air inside.	3. Release air from fuel system and check whether fuel suction pipe leaks air.
		4. Fuel quality is bad.	4. Use superior fuel.
		5. Valve clearance is incorrect.	5. Adjust valve clearance.
		6. Fuel injector is damaged.	6. Replace fuel injector.
21	Excessive fuel consumption	1. Operation technology is incorrect.	1. Check and repair where leaks.
		2. Electric fault code functions.	2. Refer to instruction on how to read current fault code. if fault code functions, contact with engine repairing center specially appointed.
		3. Fuel leaks.	3. Use superior fuel.
		4. Leakage in air intake or exhaust.	4. Check whether there is loose or damaged pipeline connector or lost pipe plug. Check installation of turbocharger and exhaust pipe.
		5. Resistance of air intake system is higher than technical specification.	5. Check resistance of air intake system. if necessary, clean or replace air intake filter and air intake pipe.
		6. Oil level of engine oil is lower than technical specification.	6. Check oil level of engine oil. If necessary add or drain engine oil.
		7. Turbocharger fuel return pipe is blocked.	7. Disassemble turbocharger fuel return pipe and check whether it is blocked, clean or replace fuel return pipe.
21	Excessive fuel consumption	8. Leakage at fuel seal of turbocharger	8. Check whether there is engine oil in air intake and exhaust pipes. if necessary, replace fuel seal of turbocharger.
		9. Fuel quality is inferior.	9. Change shift, reduce speed and operate at idle speed correctly.

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No.	Problem	Cause	Solution
22	Engine noise is too loud	1. Fan drive belt is loose, tight or not aligned.	1. Check fan drive belt.
		2. Engine oil is too thin or is diluted.	2. Refer to technical specification of engine oil
		3. Vibration damper is damaged.	3. Check the vibration damper
		4. Leakage in air intake or exhaust.	4. Check whether there is loose or damaged pipeline connector or lost pipe plug. Check turbocharger and exhaust manifold.
		5. Resistance of air intake system is higher than technical specification.	5. Check resistance of air intake.
		6. Temperature of coolant is higher than technical specification.	6. Temperature of referred coolant is higher than normal value.
		7. Engine suspension is worn out, damaged or incorrect.	7. Check engine suspension
		8. Noise of fan, hydraulic pump or compressor is too loud.	8. Isolate each component and check the noise
		9. Fan is loosened, damaged, or hub axial clearance is too large.	9. Check the fan
23	Consumption of engine oil is huge	1. Ventilating system of crankcase is blocked.	1. Check and clean respirator and ventilating pipe of crankcase.
		2. Engine oil is not satisfying the specifications.	2. Replace engine oil and filter. Use recommended engine oil.
		3. Interval of replacing engine oil is too long.	3. Verify the interval of replacing engine oil is correct.
		4. Engine oil leakage (outside).	4. Check whether there is engine oil leaking out of engine. Tighten the bolt, pipe plug and pipe connector. Replace the gasket when necessary.
		5. Leakage at fuel seal of turbocharger.	5. Check whether there is engine oil in air intake and exhaust pipes.
		6. Piston ring is broken or overlap in opening direction.	6. Check whether the exhaust has blue smoke.
		7. Verify amount of engine oil consumed.	7. Check ratio between amount of engine oil consumed and operation time.
24	Engine oil polluted	1. Too much engine oil sludge.	1. Replace engine oil and filter. Refer to symptom tree of too much oil sludge deposit in crankcase.
		2. Engine oil is polluted by coolant and fuel.	2. Replace engine oil and filter.
		3. Fault with fuel pump.	3. Check whether the fuel pump runs normally. check output pressure of the pump. If necessary, replace fuel pump.
		4. Engine oil in bulk is polluted.	4. Check engine oil in bulk supplied. Empty engine oil and use unpolluted engine oil to replace. Replace engine oil filter.

No.	Problem	Cause	Solution
25	Loss of engine oil	1. Engine oil leakage (outside).	1. Check whether there is engine oil leaked out of engine. Screw tight the bolt, pipe plug and pipe connector. Replace the gasket when necessary.
		2. Oil level of engine oil is lower than technical specification.	2. Check oil level of engine oil. Add or remove engine oil when necessary.
		3. Engine oil does not meet technical specification under the working conditions.	3. Replace engine oil and filter.
		4. Fault with engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor or in correct installation position.	4. Check whether engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor can work normally and whether installation position is correct.
		5. Electric fault code functions.	5. Refer to instruction on how to read current fault code.
		6. Leakage on engine oil cooler.	6. Check whether engine oil cooler has leakage or crack.
		7. Serious blow-by.	7. Check whether blow-by exists.
		8. Leakage at fuel seal of turbocharger	8. Check whether fuel seal of turbocharger leaks.
26	Too much oil sludge deposited in crankcase	1. Engine oil in bulk is polluted.	1. Check engine oil supplied in bulk.
		2. Temperature of coolant is lower than technical specification.	2. Temperature of referred coolant is lower than normal value.
		3. Ventilating system of crankcase is blocked.	3. Check and clean respirator and ventilating pipe of crankcase.
		4. Fuel grade differs from applicable type or fuel quality is too low.	4. Use fuel satisfying the codes.
26	Too much oil sludge deposited in crankcase	5. Engine oil does not meet technical specification under the working conditions.	5. Replace engine oil and filter.
27	Engine oil pressure is high	1. Temperature of coolant is lower than technical specification.	1. Check the cooling system.
		2. Engine oil does not meet technical specification under the working conditions.	2. Replace engine oil and filter.
		3. Fault with engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor or in correct installation position.	3. Check whether engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor can work normally and whether installation position is correct.
		4. Electric fault code functions.	4. Refer to instruction on how to read current fault code.

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No.	Problem	Cause	Solution
28	Engine oil pressure is low	1. Engine's performance curve during running exceeds technical specification.	1. Refer to data table of engine's technical specification.
		2. Engine oil does not meet technical specification under the working conditions.	2. Replace engine oil and filter.
		3. Engine oil is diluted by water.	3. Check whether engine oil dipstick, rainproof cap or cap of filling hole is lost. replace engine oil.
		4. Engine oil filter is blocked.	4. Replace engine oil and engine oil filter.
		5. Engine oil is polluted by coolant and fuel.	5. Refer to pollution symptom tree of engine oil.
		6. Engine oil leakage (outside).	6. Check whether there is engine oil leaking out of engine. Tighten the bolt, pipe plug and pipe connector. Replace the gasket when necessary.
		7. Oil level of engine oil is higher or lower than technical specification.	7. Check oil level of engine oil. Add or remove engine oil when necessary.
		8. Electric fault code functions.	8. Refer to instruction on how to read current fault code.
		9. Fault with engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor or in correct installation position.	9. Check whether engine oil pressure switch, engine oil pressure gauge, engine oil pressure sensor can work normally and whether installation position is correct.
29	A.C. generator fails to be charged or sufficiently charged	1. Battery connector is loose or corroded.	1. Clean and tight battery connector.
		2. AC generator belt slips.	2. Check and adjust belt tension pulley.
		3. AC generator belt pulley is loose.	3. Tight fixing screw of belt pulley.
		4. Generator grounding is not good.	4. Check the ground wire.
		5. The generator is damaged.	5. Replace the generator.
		6. Manual switch of general power supply is open.	6. Connect the manual switch of general power supply.
30	Water leaked or undercharged in the generator	1. Water pipe is aging.	1. Replace the engine water pipe.
		2. Fixing pipe clamp is loosening.	2. Fasten the pipe clamp
31	Rotational speed of engine doesn't show	Rotational speed sensor connector is loosening or damaged	Inspect and reconnect or exchange the sensor.
32	Weight hoisting is weak, the speed of engine is descending.	Fuel filter core is blocked.	Exchange the fuel core

No.	Problem	Cause	Solution
33	Two frame or full frame is showed in the engine oil pressure	Engine oil pressure sensor is damaged.	Exchange the sensor.
34	Engine water temperature is alarming	The sensor has malfunction which result in the fact that the temperature of coolant has not been detected	Exchange the sensor
35	The generator doesn't work	Generator relay contact is sintering.	Wipe the contact, normally
36	The generator throttle mechanism is on clamping stagnation	There are some malfunction on the generator throttle.	Exchange the generator mechanism.
37	Battery jar can't be charging, the charging indicator lamp is light.	The generator connector is loosing.	Fasten the connector.
38	The ignition switch of engine is damaged	The engine can't be ignited.	Fasten the connector.
39	The engine can't be started occasionally	The earth line of battery jar is loosing.	Fasten the earth line of battery jar.
40	While loading, the engine is easy to flamout.	Power limiter has not been adjusted properly.	Adjust the power limiter or restart the engine after remove the loading.

Table 5-16 Troubleshooting Guide - Electrical System

No.	Problem	Cause	Solution
1	The entire crane has no power supply with the ignition switch turned on.	1. Battery switch at junction box TB9 is off.	1. Turn on the battery switch.
		2. Battery low power or damaged.	2. Test with a multimeter, charge or replace the battery.
		3. The wire 30# connecting the power supply and contactor 5KM4 is loose or disconnected.	3. Check the circuit.
		4. The wire 0504# connecting the relay 5KA2 and Module A has fault.	4. Check the circuit.
		5. The wire 0506# connecting the relay 5KA2 and contactor 5KM4 has fault.	5. Check the circuit.
		6. Fuse 23F7 (30A) open circuit.	6. Replace fuse 23F7.
		7. Contactor 5KM4 is damaged.	7. Replace contactor 5KM4.
		8. Relay 5KA2 is damaged.	8. Replace relay 5KA2.
		9. Ignition switch 24SW1 is damaged.	9. Replace the ignition switch 24SW1.
		10. Diode 24V1 is open circuit.	10. Replace diode 24V1.
2	Start motor has no response when the engine is ignited.	1. Communication failure.	1. Check the CAN Bus for correct connection.
		2. The display set is incorrect.	2. Reset the display.
		3. The wire 0503# connecting contactor 5KM3 and Module A is loose or open circuit.	3. Check the circuit.
		4. The wire 2401# connecting ignition switch 24SW1 and Module A is loose or open circuit.	4. Check the circuit.
		5. Charge signal fault	5. Check the wire 0203# or replace the generator.
		6. The wire 0505# connecting relay 5KA1 and contactor 5KM2 has fault (for Stage II engines).	6. Check the circuit.

No.	Problem	Cause	Solution
2	Start motor has no response when the engine is ignited.	7. The wire 0502# connecting relay 5KA1 and Module A has fault (for Stage II engines).	7. Check the circuit.
		8. Contactor 5KM2 or 5KM3 is damaged.	8. Replace the damaged contactor.
		9. Relay 5KA1 is damaged.	9. Replace the damaged relay.
		10. Ignition switch 24SW1 is damaged.	10. Replace the damaged ignition switch.
		11. The starter motor has fault.	11. Repair or replace the starter motor.
		12. Fuses 23F2 and 23F13 open circuit.	12. Replace these fuses.
		13. Battery low voltage.	13. Charge or replace the battery.
		14. In non-starting condition, read out value of engine rotational speed is larger than 750 rpm.	14. Check the rotational speed sensor and related circuits.
		15. Seat interlock switch/circuit has fault.	15. Check the seat interlock for normal function. check the related circuits for normal function.
3	Not enough power to start the engine	16. Function locking switch/circuit has fault.	16. Set the function locking switch of lever at the working position.
		1. The battery is lack of electricity.	1. Charge the battery as required or parallel connect batteries of other equipment.
		2. Fuel solenoid valve 04Y2 has fault (for Stage II engines).	2. Replace the solenoid valve.
		3. The oil supply pipeline is blocked.	3. Clear the pipeline and keep flow in the pipeline is unrestricted.
4	Engine rotational speed cannot be controlled.	4. Starter motor has fault.	4. Adjust, replace or repair by experts.
		1. The throttle is not calibrated or incorrect.	1. Re-calibrate the throttle.
		2. The wire 2408# (accelerator switch) or wire 2806# (accelerator pedal) is loose or open circuit.	2. Check the circuit.
5	The engine oil pressure alarm keeps flickering.	3. Throttle cable is damaged (for Stage II engines).	3. Replace the throttle cable.
		1. The engine oil pressure alarm point is set incorrectly.	1. Reset the alarm point.
		2. The pressure sensor has fault.	2. Clean or replace the pressure sensor.
		3. The engine should be replaced.	3. Replace the engine oil.

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No.	Problem	Cause	Solution
6	Main/aux. hoisting winch cannot lift.	1. Overload.	1. Reduce the load or set the working mode switch at the Assembling position and operate steadily.
		2. Servo pressure unloading valve YV11 is not open.	2. Release the operation locking.
		3. Main and aux. hoisting locking switches 24SA2 and 24SA3 are engaged.	3. Release the locking.
		4. Main/aux. hoisting winch over hoist.	4. Do not lift the load or raise the boom.
		5. Surge protectors 31F9 and 31F10 are damaged.	5. Replace the surge protectors.
		6. The wires 1301# and 1303# connecting controllers and lifting safety valves YV1 and YV3.	6. Check the circuit.
		7. Plugs of lifting safety valves YV1 and YV3 are damaged.	7. Replace the plugs.
		8. The wires 2404# and 2405# connecting locking switches 24SA2 and 24A3 and Module A are loose.	8. Check the circuit.
		9. Locking switches 24SA2 and 24SA3 are damaged.	9. Replace the locking switches.
		10. The wire 1401# connecting servo unloading valve YV11 and the controller has fault.	10. Check the circuit.
		11. Plug of servo unloading valve YV11 is damaged.	11. Replace the plug.
		12. The wire 2808# of function locking switch and wire 2809# of seat interlock have fault.	12 Check the circuit.
		13. Controller has fault.	13. Replace the controller and update the program.
7	Main/aux. hoisting winch cannot lower.	1. Servo pressure unloading valve YV11 is not open.	1. Release the operation locking.
		2. Main and aux. hoisting locking switches 24SA2 and 24SA3 are engaged.	2. Release the locking.
		3. Pawl and ratchet control valves YV12 and YV13 are locked.	3. Release the pawl and ratchet control valves.
		4. Main/aux. hoisting winch over roll-out.	4. Do not lower the load or the boom.

No.	Problem	Cause	Solution
7	Main/aux. hoisting winch cannot lower.	5. Surge protectors 31F9 and 31F10 are damaged.	5. Replace the surge protectors.
		6. The wires 1302# and 1304# connecting controllers and lowering safety valves YV2 and YV4.	6. Check the circuit.
		7. Plugs of lowering safety valves YV2 and YV4 are damaged.	7. Replace the plugs.
		8. The wires 2404# and 2405# connecting locking switches 24SA2 and 24A3 and Module A are loose.	8. Check the circuit.
		9. Locking switches 24SA2 and 24SA3 are damaged.	9. Replace the switches.
		10. The wire 1401# connecting servo unloading valve YV11 and the controller has fault.	10. Check the circuit.
		11. Valve head of servo unloading valve is damaged.	11. Replace the valve head.
		12. The wire 2808# of function locking switch and wire 2809# of seat interlock have fault.	12. Check the circuit.
8	Main/aux. hook block upper limit failure.	13. Controller has fault.	13. Replace the controller and update the program.
		1. The working mode switch is at the Assembling position.	1. Set the working mode switch at the Operating position.
		2. The wires 3103# and 3104# connecting the controller and over-hoist limit switches 32S1 and 32S2 have fault.	2. Check the circuit.
9	Main/aux. hook block lower limit failure.	3. Over-hoist limit switches 32S1 and 32S2 are damaged or short circuit.	3. Replace the switches.
		1. The working mode switch is at the Assembling position.	1. Set the working mode switch at the Operating position.
		2. The wires 1205# and 1206# connecting the controller and 3-wraps protection switch have fault.	2. Check the circuit.
		3. The wire connecting 0612# and XS03-13 has fault.	3. Check the circuit.
		4. The 3-wraps protection switch is damaged.	4. Replace the 3-wraps protection switch.

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No.	Problem	Cause	Solution
10	Boom/jib luffing winch cannot raise.	1. Servo pressure unloading valve YV11 is not open.	1. Release the function locking.
		2. The boom/jib luffing upper limit is reached.	2. Do not raise the boom/jib or lift the hook block.
		3. Boom and jib luffing locking switches 24SA4 and 24SA5 are engaged.	3. Release the locking.
		4. The wires 1305# and 1307# connecting controllers and boom/jib raising safety valves YV5 and YV7 have fault.	4. Check the circuit.
		5. Plugs of boom/jib raising safety valves YV5 and YV7 are damaged.	5. Replace the plugs.
		6. Surge protectors 31F11, 31F2, and 31F3 (for the 250t and smaller crane) or 36F1 and 36F2 (for the 320t crane) are damaged.	6. Replace the protectors.
		7. The wires 2406# and 2407# connecting Module U1 and boom/jib locking switches have fault.	7. Check the circuit.
		8. Boom luffing locking switch is damaged.	8. Replace the switch.
		9. The wires 1102# and 3301# connecting controller and boom/jib upper limit proximity switches have fault.	9. Check the circuit.
		10. Boom/jib upper limit proximity switch is damaged.	10. Replace the switch.
		11. The wires 102#, 103#, 104#, 105#, 106#, and 107# connecting boom/jib angle sensors and host computer of load moment limiter (Robway).	11. Checking the connecting wires.
		12. Boom/jib angle sensor is damaged.	12. Replace the sensor.
		13. The wire 2808# of function locking switch and wire 2809# of seat interlock have fault.	13. Check the circuit.
		14. Controller has fault.	14. Replace the controller and update the program.

No.	Problem	Cause	Solution
11	Boom/jib luffing winch cannot lower.	1. The crane is overloaded.	1. Reduce the load.
		2. Servo pressure unloading valve YV11 is not open.	2. Release the function locking.
		3. Boom and jib pawl and ratchet control valves YV14 and YV15 are locked.	3. Open the control valves.
		4. Boom/jib lower limit is reached.	4. Do not lower the boom/jib or the hook block.
		5. Boom and jib luffing locking switches 24SA4 and 24SA5 are engaged.	5. Release the locking.
		6. Main/aux. hoisting winch is over-hoisted.	6. Lower the load.
		7. The wires 1306# and 1308# connecting controllers and boom/jib lowering safety valves YV6 and YV8 have fault.	7. Check the circuit.
		8. Plugs of boom/jib lowering safety valves YV6 and YV8 are damaged.	8. Replace the valve.
		9. Surge protectors 31F11, 31F2, and 31F3 (for the 250t and smaller crane) or 36F1 and 36F2 (for the 320t crane) are damaged.	9. Replace the protector.
		10. The wires 2406# and 2407# connecting Module U1 and boom/jib locking switches have fault.	10. Check the circuit.
		11. Boom luffing locking switch is damaged.	11. Replace the switch.
		12. The wires 102#, 103#, 104#, 105#, 106#, and 107# connecting boom/jib angle sensors and host computer of load moment limiter (Robway).	12. Check the circuit.
		13. Boom/jib angle sensor is damaged.	13. Replace the sensor.
		14. The wire 2808# of function locking switch and wire 2809# of seat interlock have fault.	14. Check the circuit.
		15. Controller has fault.	15. Replace the controller and update the program.

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No.	Problem	Cause	Solution
12	Boom/jib luffing upper limit failure.	1. The working mode switch is at the Assembling position.	1. Set the working mode switch at the Operating position.
		2. The load moment limiter is not calibrated correctly.	2. Re-calibrate the parameters of the load moment limiter.
		3. The wires 1102# and 3301# connecting the controller and boom/jib upper limit proximity switch 11SQ1 and 33S1 have fault.	3. Check the circuit.
		4. Boom and jib upper limit switches 11SQ1 and 33S1 are damaged.	4. Replace the switches.
		5. The wires 102#, 103#, 104#, 105#, 106#, and 107# connecting boom/jib angle sensors and host computer of load moment limiter (Robway).	5. Check the circuit.
		6. Boom/jib angle sensor is damaged.	6. Replace the sensor.
		7. Controller has fault.	7. Replace the controller and update the program.
13	Boom/jib luffing lower limit failure.	1. The working mode switch is at the Assembling position.	1. Set the working mode switch at the Operating position.
		2. The load moment limiter is not calibrated correctly.	2. Re-calibrate the parameters of the load moment limiter.
		3. The wires 102#, 103#, 104#, 105#, 106#, and 107# connecting boom/jib angle sensors and host computer of load moment limiter (Robway).	3. Check the circuit.
		4. Boom/jib angle sensor is damaged.	4. Replace the sensor.
		5. Controller has fault.	5. Replace the controller and update the program.
14	Anemometer has fault.	1. No voltage signal or low voltage signal.	1. Check voltage signal of the anemometer.
		2. The wires 3101# and 3102# connecting the anemometer and controller has fault.	2. Check the circuit.
		3. Fuse 06F2 (3A) open circuit.	3. Replace the fuse.

No.	Problem	Cause	Solution
14	Anemometer has fault.	4. Relay 7KA1 in the electrical cabinet is loose or damaged.	4. Check the connection or replace the relay.
		5. Surge protectors 31F6, 31F7,	5. Replace the protector.
		6. The anemometer is damaged.	6. Replace the anemometer.
15	Pharos lights off.	1. The wire 2601# connecting the pharos and rocker switch has fault.	1. Check the circuit.
		2. Wire 2309# of the pharos is loose.	2. Check the circuit.
		3. Fuse 23F8 (3A) open circuit.	3. Replace the fuse.
		4. Surge protector 31F12 is damaged.	4. Replace the protector.
		5. Rocker switch is damaged.	5. Replace the rocker switch.
		6. Pharos is damaged.	6. Replace the pharos.
16	Free fall failure.	1. The wires 1502# and 1503# connecting free fall solenoid valves YV21 and YV22 have fault.	1. Check the circuit.
		2. The wire 2510# connecting free fall switch 25SW1 and Module A has fault.	2. Check the circuit.
		3. The wire 2807# connecting free fall switch 28SQ1 and Module A has fault.	3. Check the circuit.
		4. Plugs of free fall solenoid valve YV21 and YV22 have fault.	4. Replace the plugs.
		5. Free fall allow switch or start switch is damaged.	5. Replace the switch.

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Table 5-17 Troubleshooting Guide - Load Moment Limiter

No.	Problem	Cause	Solution
1	Moment limiter has black screen.	1. The wire connecting the display and host computer has fault.	1. Check the circuit.
		2. Fuse 23F5(5A) is damaged.	2. Replace the fuse.
		3. The display is damaged.	3. Replace the display.
2	No information shown on the display after the engine is started.	1. Voltage signal is low.	1. Check the power and connecting wires.
		2. Data is not download	2. Download data again.
		3. The display is damaged.	3. Replace the display.
		4. The main board is damaged.	4. Replace the main board.
3	Angle is displayed but weight is not.	1. The wires 108#, 109#, and 110# (for boom) and 111#, 112#, and 113# (for jib) connecting host computer and force sensor have fault.	1. Check the circuit.
		2. The force sensor is damaged.	2. Replace the force sensor.
4	Weight is displayed but angle is not.	1. The wires 102#, 103#, and 104# (for boom) and 105#, 106#, and 107# (for jib) connecting host computer and angle sensor have fault.	1. Check the circuit.
		2. The angle sensor is damaged.	2. Replace the angle sensor.
5	The display shows no information from time to time.	1. Voltage signal is low.	1. Check the power and connecting wires.
		2. The display is damaged.	2. Replace the display.
6	Obvious difference between the displayed weight and the actual weight.	1. The calibration is incorrect.	1. Re-calibrate.
		2. The connecting wire of force sensor is loose.	2. Check the connecting wire.
		3. The force sensor is damaged.	3. Replace the force sensor.
		4. The main board is damaged.	4. Repair the main board and contact the manufacturer of the load moment limiter.
7	The empty hook has been calibrated, but the displayed weight of empty hook still changes when turn on the ignition switch.	1. The calibration is incorrect.	1. Re-calibrate.
		2. The connecting wire of force sensor is loose.	2. Check the connecting wire.
		3. The force sensor is damaged.	3. Replace the force sensor.
		4. The main board is damaged.	4. Repair the main board and contact the manufacturer of the load moment limiter.

No.	Problem	Cause	Solution
8	Obvious difference between displayed value and actual value of empty hook.	1. The calibration is incorrect.	1. Re-calibrate the empty hook.
		2. The force sensor is damaged.	2. Replace the force sensor.
9	Only the empty hook weight is displayed no matter a light or a heavy load is attached.	1. The calibration is incorrect.	1. Re-calibrate.
		2. The connecting wire of force sensor is loose.	2. Check the connecting wire.
		3. The force sensor is damaged.	3. Replace the force sensor.
		4. The main board is damaged.	4. Repair the main board and contact the manufacturer of the load moment limiter.
10	Communication failure.	1. CAN Bus is connected incorrectly or the terminal resistor is not installed.	1. Re-connect the wire or the resistor.
		2. The initial set of the display is incorrect.	2. Re-calibrate.

Table 5-18 Troubleshooting Guide - Air Conditioner

No.	Problem	Cause	Solution
1	The fan doesn't run	1. Electrical wiring or connectors are disconnected.	1. Check the circuit.
		2. Wind volume switch, relay or temperature control switch is damaged.	2. Replace the switch.
		3. The fuse is open circuit or battery voltage is low.	3. Replace the fuse or the battery.
		4. The fan is damaged.	4. Replace the fan.
2	The fan runs normally but the wind volume is small.	1. There is obstacle around the air suction port.	1. Clean the air suction port.
		2. Fin blocked in the evaporator or condenser.	2. Clean.
		3. Restricted heat transmission.	3. Check.
		4. Fan blade is stuck or damaged.	4. Repair or replace the fan.
3	Compress fails to run or runs with resistance.	1. The clutch fails to engage due to open circuit or loose connection of the electrical circuit.	1. Check the circuit.
		2. The compressor belt is too relaxed.	2. Tighten the belt.
		3. Broken wire or failed wire in the clutch coil.	3. Replace the clutch coil.
		4. Too much or little refrigerant.	4. Check the amount of the refrigerant.
4	Too little refrigerant	1. Refrigerant leaks.	1. Debug the leaking positions.
		2. The amount of refrigerant that was filled is too little.	2. Refill with proper amount of refrigerant.
5	Frost formed on the surface of the low-pressure pipe.	1. The expansion valve is opened too wide.	1. Replace the expansion valve.
		2. Temperature sensing unit contact failure.	2. Install the temperature sensing unit correctly.
		3. Too much refrigerant.	3. Drain some of the refrigerant to a proper amount.
6	Read values of both the high-pressure gauge and the low-pressure gauge are lower than normal values.	Insufficient refrigerant.	Fill with refrigerant.
7	Read value of the low-pressure auge is negative sometimes.	The low-pressure hose is blocked, or the expansion valve is blocked by ice or dirt.	Repair the system. If blocked by ice, the liquid container should be replace.

No.	Problem	Cause	Solution
8	The evaporator is frozen.	Temperature controller failure.	Replace the temperature controller.
9	The intake of expansion valve is cold and frosts.	The expansion valve is blocked.	Clean or replace the expansion valve.
10	The outlet of expansion valve is not cold and the read value of low pressure is negative sometimes.	The temperature sensing pipe or unit of expansion valve has air leakage.	Replace.
11	The read values of both the high pressure and the low pressure are higher than actual values.	1. There is air leakage in the circulating system.	1. Drain the circulating system and refill with refrigerant after vacuum the system.
		2. Too much refrigerant is filled.	2. Drain a proper amount of refrigerant.
12	The condenser is blocked by dust or the condenser fan is damaged.	The condensing effect is not good.	Clean or replace the condenser.
13	The read value of high pressure is lower than actual value, and the read value of the low pressure is negative sometimes. The compressor has fault.	1. Insufficient refrigerant.	1. Refill with refrigerant.
		2. The low pressure pipe is blocked.	2. Clean.
		3. The compressor and the high pressure pipe is hot, and there is fault inside.	3. Check and replace.
14	The hot water valve is damaged.	The warm air offset the effect of the cool air, and the cooling effect is not good.	Replace the hot water solenoid valve.

Table 5-19 Troubleshooting Guide - Combined Instruments

No.	Problem	Cause	Solution
1	Black screen	1. Fuse 23F6(3A) open circuit.	1. Replace the fuse.
		2. The wire 2307# is loose or open circuit.	2. Check the circuit.
		3. The display is damaged.	3. Replace the display.
2	The display shows no information from time to time.	1. Voltage signal is low.	1. Check the voltage value to confirm whether the wire 2307# has a problem.
		2. CAN BUS connection is loose.	2. Check the connecting wire.
		3. The display is damaged.	3. Replace the display.
3	The displayed data is incorrect or an alarm is raised unexpectedly without any fault occurs.	1. The CAN BUS is connected incorrectly.	1. Check whether the CAN H is connected to CAN H2 and whether the CAN L is connected to CAN L2.
		2. Related sensor is damaged.	2. Replace the sensor.
		3. Display is damaged.	3. Replace the display.

Table 5-20 Troubleshooting Guide - Auxiliary System

No.	Problem	Cause	Solution
1	Winch lighting and working indicator is off.	1. The wires 2605#, 2606#, and 2607# connecting the rocker switches and lightings.	1. Check the circuit.
		2. Fuse 23F11(10A) open circuit.	2. Replace the fuse.
		3. The bulb is damaged.	3. Replace the bulb.
		4. Rocker switch is damaged.	4. Replace rocker switch.
2	The ceiling light in the cab is off.	1. Fuse 23F8(3A) open circuit.	1. Replace the fuse.
		2. The wire 2309# connecting the ceiling lamp is loose.	2. Check the circuit.
		3. The bulb is damaged.	3. Replace the bulb.
3	The radio fails to work	1. The wire 2304# connecting the radio has fault.	1. Check the circuit.
		2. The fuse 23F3(3A) open circuit.	2. Replace the fuse.
		3. The radio is damaged.	3. Replace the radio.
4	The wiper doesn't work.	1. Wiring between the wiper and the rocker switch has fault.	1. Check the circuit.
		2. Fuse 23F12(5A) open circuit.	2. Replace the fuse.
		3. Rocker switch is damaged.	3. Replace the rocker switch.
		4. Electric motor 26M1 (upper wiper) or 26M2 (lower wiper) has fault.	4. Repair or replace.
		5. The drive mechanism is stuck or damaged.	5. Repair or replace.
5	Monitor display black screen or shows no information.	1. The wires 2302# and 2805# connecting the monitor screen and Module 29U1 are loose.	1. Check the circuit.
		2. The wires 2801#, 2802#, 2803# connecting the monitor display and the cameras have fault.	2. Check the circuit.
		3. Fuse 23F1 (5A) open circuit.	3. Replace the fuse.
		4. The wire 2602# connecting the rocker switch and power module has fault.	4. Check the circuit.
		5. Fuse 23F4 open circuit.	5. Replace the fuse.
		6. The camera is damaged.	6. Replace the camera.
		7. Power module 29U1 is damaged.	7. Replace the module.
		8. Rocker switch is damaged.	8. Replace the switch.
6	The working mode switch failure.	1. The wire 2403# (Superstructure assembling) or 2510# (Undercarriage assembling) connecting the switch and Module A has fault.	1. Check the circuit.
		2. Fuse 23F9(5A) open circuit.	2. Replace the fuse.
		3. The switch is damaged.	3. Replace the switch.
		4. The controller is damaged.	4. Replace the controller and update the program.

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No.	Problem	Cause	Solution
7	The buzzer fails to sound an alarm when a fault occurs.	1. The wire 2501# connecting the buzzer and Module A has fault.	1. Check the circuit.
		2. The buzzer is damaged.	2. Replace the buzzer.
		3. The controller is damaged.	3. Replace the controller and update the program.
9	The alarm sound cannot be mute.	1. The wire 2705# connecting the mute button on right control lever and Module A is damaged.	1. Check the circuit.
		2. The wire 2310# is loose.	2. Check the circuit.
		3. Fuse 23F9(5A) open circuit.	3. Replace the fuse.
		4. The mute button is damaged.	4. Replace the mute button.
9	Fault indicator is off.	1. The wire 2502# connecting the indicator and Module A has fault.	1. Check the circuit.
		2. The indicator is damaged.	2. Replace the indicator.
		3. The controller is damaged.	3. Replace the controller and update the program.
10	Slewing failure.	1. Slewing is locked.	1. Set the Swing pin switch at the Release position.
		2. Slewing is locked by button on control lever.	2. Press the button on the control lever.
		3. The wire 1203# connecting slewing proximity switch 12SQ3 and Module B has fault.	3. Check the circuit.
		4. The wire 1408# connecting the slewing brake solenoid valve YV19 and Module B has fault.	4. Check the circuit.
		5. The wire 1501# connecting the slewing locking release solenoid valve YV20 and Module B, and 1504# connecting slewing locking release solenoid 2 (for the 150t crane) and Module B have fault.	5. Check the circuit.
		6. The wire 2504# connecting Swing pin switch and Module A has fault.	6. Check the circuit.
		7. Fuse 23F9 (5A) open circuit.	7. Replace the fuse.
		8. The plug of slewing brake solenoid valve YV19 is damaged.	8. Replace the plug.
		9. The valve head of slewing locking release solenoid valve YV20 is damaged.	9. Replace the valve head.
		10. The Swing pin switch is damaged.	10. Replace the switch.
		11. Slewing proximity switch 12SQ3 is damaged.	11. Replace the switch.
		12. The slewing brake button on the control lever is damaged.	12. Replace the button.

No.	Problem	Cause	Solution
11	Slewing micro-motion failure.	1. The Swing micro-motion switch 25SA4 is off.	1. Set the switch at on.
		2. The wire 1604# connecting slow valve of slewing pump YV31 and Module B has fault.	2. Check the circuit.
		3. The wire 2507# connecting Swing micro-motion switch and Module A has fault.	3. Check the circuit.
		4. The Swing micro-motion switch is damaged.	4. Replace the switch.
		5. The valve head of slewing pump slow valve is damaged.	5. Replace the valve head.
12	Main pump micro-motion failure.	1. Main pump micro-motion switch 25SA2 is off.	1. Set the switch at on.
		2. The wire 1603# connecting main pump inching valve YV29 and Module B has fault.	2. Check the circuit.
		3. The wire 2506# connecting Main pump micro-motion switch and Module A has fault.	3. Check the circuit.
		4. The valve head of main pump inching valve is damaged.	4. Replace the valve head.
		5. The main pump micro-motion switch is damaged.	5. Replace the switch.
13	The audio-visual alarming light at rear of left/right platform has fault.	1. The wire 1007# connecting the audio-visual alarming light and Module B.	1. Check the circuit.
		2. The wire 0610# connecting the alarming light is loose.	2. Check the circuit.
		3. The fuse 06F9(3A) open circuit.	3. Replace the fuse.
		4. The wire 1104# connecting slewing pressure switch SP1 and Module B has fault.	4. Check the circuit.
		5. The wire 1105# connecting slewing pressure switch SP2 and Module B has fault.	5. Check the circuit.
		6. The wire 0612# connecting the pressure switch is loose.	6. Check the circuit.
		7. The fuse 06F11(10A) open circuit.	7. Replace the fuse.
		8. The slewing pressure switch or the traveling pressure switch is damaged.	8. Replace the switch.
		9. The controller is damaged.	9. Replace the controller and update the program.
14	The slewing flickering light is off.	1. The wire 0703# connecting the light and Module B has fault.	1. Check the circuit.
		2. The wire 1104# connecting the slewing pressure switch SP1 and Module B has fault.	2. Check the circuit.
		3. The wire 0612# is loose.	3. Check the circuit.
		4. The slewing pressure switch is damaged.	4. Replace the switch.
		5. The slewing flickering light is damaged.	5. Replace the switch.
		6. The controller has fault.	6. Replace the controller and update the program.

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No.	Problem	Cause	Solution
15	The tri-color light is off or incorrect.	1. The wires 0702#, 0703#, and 0704# connecting the tri-color light and Module B have fault.	1. Check the circuit.
		2. The calibration of load moment limiter is incorrect.	2. Re-calibrate.
		3. Fuse 06F9(3A) is damaged.	3. Replace the fuse.
		4. The tri-color light is damaged.	4. Replace the fuse.
		5. The controller program has fault.	5. Replace the controller and update the program.
16	The gradienter	1. The wire connecting the gradienter and the CAN Bus has fault.	1. Check whether the gradienter is connected to CAN H1 and CAN L1.
		2. The CAN Bus is not installed with a resistor (60 ohm)	2. Installed with a resistor.
		3. The wire 0610# connecting the gradienter is loose.	3. Check the circuit.
		4. The fuse 06F9 (3A) open circuit.	4. Replace the fuse.
		5. The gradienter is damaged.	5. Replace the gradienter.
17	The horn fails to sound.	1. The wire 1008# connecting the horn and Module B has fault.	1. Check the circuit.
		2. The wire 2701# or 2704# connecting the horn button on control lever and Module A has fault.	2. Check the circuit.
		3. The fuse 23F9 (5A) open circuit.	3. Replace the fuse.
		4. The horn is damaged.	4. Replace the horn.
		5. The horn button on control lever is damaged.	5. Replace the button.
		6. The program of controller has fault.	6. Replace the controller and update the program.
18	Reverse travel fails.	1. The wire 2811# connecting reverse travel control valve YV23 and Module A and wire 2812# connecting reverse travel control valve YV24 and Module A have fault.	1. Check the circuit.
		2. The wire 1201# connecting reverse travel proximity switch 12SQ1 and controller has fault.	2. Check the circuit.
		3. Fuse 06F11 open circuit.	3. Replace the fuse.
		4. Head of reverse travel valve is damaged.	4. Replace the valve head.
		5. Reverse travel proximity switch is damaged.	5. Replace the fuse.
		6. The program of controller has fault.	6. Replace the controller and update the program.

No.	Problem	Cause	Solution
19	A-frame cannot be erected.	1. The Working mode switch is not at the Assembling position.	1. Set the switch at the Assembling position
		2. The wires 1802# and 1803# connecting A-frame cylinder solenoid valves YV51 and YV52 have fault.	2. Check the circuit.
		3. The head of solenoid valve is damaged.	3. Replace the valve head.
		4. The wire 1204# connecting A-frame erecting proximity switch 12SQ4 and controller has fault.	4. Check the circuit.
		5. The proximity switch 12SQ4 is damaged.	5. Replace the switch.
		6. Fuse 06F11 (10A) open circuit.	6. Replace the fuse.
		7. Switches on remote control box are damaged.	7. Replace the switch.
20	The outrigger cylinders fail to act.	1. The Working mode switch is not set at the Assembling position.	1. Set the switch at the Assembling position.
		2. The wire connecting the outrigger cylinder solenoid valve has fault.	2. Check the circuit.
		3. The head of related solenoid valve is damaged.	3. Replace the valve head.
		4. Switches on remote control box are damaged.	4. Replace the switch.
21	The oil fan motor fails to act when the hydraulic oil temperature is over 55°C.	1. The Working mode switch is not set at the Assembling position.	1. Set the switch at the Assembling position.
		2. The wire connecting power pin solenoid valve and the remote control box has fault.	2. Check the circuit.
		3. The plug of solenoid valve is damaged.	3. Replace the plug.
		4. Switches on remote control box are damaged.	4. Replace the switch.
22	The oil fan motor fails to act when the hydraulic oil temperature is over 55°C.	1. The Working mode switch is set at the Assembling position.	1. Set the switch at the operating position
		2. The wire connecting oil temperature sensor and controller has fault.	2. Check the circuit.
		3. The oil temperature sensor is damaged.	3. Replace the sensor.
		4. The wire 1703# connecting the oil fan motor control valve YV47 and Module B has fault.	4. Check the circuit.
		5. The valve head of oil motor control valve is damaged.	5. Replace the valve head.
23	High speed traveling fails to work.	1. The wire 1405# connecting the high speed traveling solenoid valve YV17 and Module B has fault.	1. Check the circuit.
		2. The wire 2503# connecting the speed adjusting switch 25RP1 and Module A has fault.	2. Check the circuit.

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No.	Problem	Cause	Solution
23	High speed traveling fails to work.	3. The valve head of high speed traveling solenoid valve YV 17 is damaged.	3. Replace the valve head.
		4. Speed adjusting switch 25RP1 is damaged.	4. Replace the switch.
24	Communication failure.	1. The 120 ohm resistor installed between CAN H1 and CAN L1, or between CAN H2 and CAN L2, is not connected or damaged.	1. Connect or replace the resistor.
		2. The wiring in the electric cabinet is incorrect.	2. Check the wiring inside the electric cabinet.
		3. The wire connecting the failure module and CAN Bus is loose or open circuit.	3. Check the related circuit.
		4. The controller is damaged.	4. Replace the controller.

Table 5-21 Troubleshooting Guide - Hydraulic System

No.	Problem	Cause	Solution
1	Traveling off track both at low speed and high speed.	1. The pedal valves have fault.	1. Replace the pedal valve.
		2. The max. flows of main valves are not consistent.	2. Adjust the max. flow of main valves.
		3. The output flows of pumps are not consistent.	3. Adjust the output flows of pumps.
		4. The start and shut of traveling brake is not consistent.	4. Inspect and repair the solenoid of control valve set.
		5. The pressure on load-back port of main pump is different.	5. Adjust the pressure of load-back of main pump.
2	The crawlers travel un-synchronously.	1. The traveling pilot valve spool stroke is incorrect or the spool is damaged.	Adjust the pilot valve spool stroke or replace the spool.
		2. The traveling spool is worn due to dirty hydraulic oil.	
3	Traveling off track at high speed, but not at low speed.	The max. flows of two main valves are not consistent.	Adjust the max. flows of the two main valves.
4	Low speed traveling failure.	The traveling pedal valve has fault and no low pressure is put out.	Check the circuit or replace the traveling pedal valve.
5	Pawl cannot reset.	1. Solenoid valve spool is blocked.	1. Clean the spool.
		2. The pawl cylinder is stuck or the spring breaks.	2. Clean the pawl cylinder or replace the spring.
6	Oil temperature is too high but oil radiator fails to work.	1. Electric apparatus's oil temperature sensor is damaged.	1. Replace the sensor.
		2. Coil of solenoid valve that controls the radiator is burnt or the valve spool is damaged.	2. Replace the solenoid valve.
		3. Auxiliary gear pump or motor is damaged.	3. Replace the gear pump or the motor.
		4. The Working mode switch is set at the "Undercarriage assembling" position.	4. Change the working mode.
7	Hydraulic oil alarm is detected.	The filter element is blocked.	Replace the filter element.
8	Oil leakage at vent hole of pawl cylinder solenoid valve.	The solenoid valve is damaged.	Replace the solenoid valve.
9	Oil leakage at manually reversal valve P port and connecting pipe with central	The hose is damaged.	Exchange the hose.

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No.	Problem	Cause	Solution
10	Oil leakage at main control valve connecting hose.	The hose is damaged.	Exchange the hose
11	Oil leakage at central slewing connector, main valve oil port, motor oil port.	The O-ring is aging.	Exchange the O-ring.
12	Oil leakage at connector of servo oil pressure gauge.	Contact is not good.	Exchange the connector.
13	Oil leakage at valve high pressure hose.	Hose is broken.	Exchange the hose.
14	No action in slewing.	The brake cylinder of slewing is not open.the valve core of slewing is clamped.The servo oil pipe has malfunction.	Inspect the slewing releasing solenoid connector or exchange the solenoid. Inspect the main valve. Inspect servo output pressure.
15	Luffing can arise only, can't be descending.	1. The core of main valve is clamped, can move one-way.	1. Inspect the main valve core.
		2. The descending oil circuit of servo oil circuit is blocked.	2. Clean the servo oil circuit pipe.
		3. The servo luffing lever is damaged.	3. Replace the servo luffing lever.
16	Luffing with loading is week	The oil pipe luffing A port and B port is reversely connected.	Correct A、 B port oil pipe or servo oil pipe.
17	Oil leakage at luffing motor oil port.	The O-ring is aging.	Exchange the O-ring.
18	Oil leakage at main winch、 luffing pawl cylinder.	Pawl cylinder sealed ring is aging.	Replace the pawl cylinder sealed ring.
19	Oil leakage at main winch, aux. winch servo oil pipe.	O-ring is aging.	Replace the O-ring.

No.	Problem	Cause	Solution
20	The proportional solenoid relay of oil pump doesn't work. The pressure of main system is high.	The proportional solenoid relay of oil pump is damaged.	Replace the proportional solenoid relay of pump.
21	No action during free-fall operation.	1. While the clutch control valve is started, the pressure output is unnormal.	1. Adjust the pressure, while control valve is started.
		2. The brake of free-fall is not started.	2. Check the brake.
22	Oil leakage at hydraulic lock of outrigger	The O-ring of outrigger hydraulic lock is damaged.	Replace the O-ring of outrigger hydraulic lock.
23	Oil leakage at sextuple solenoid set.	The interior of valve set is clamped stagnation, the sealed ring is aging.	Replace the sealed ring while clean the valve set.
24	No convergence in main winch.	The circuit of main winch convergence button is broken.	Reconnect
25	Oil leakage at jack quick coupling.	The quick coupling is damaged.	Replace the quick coupling.

Table 5-22 Troubleshooting Guide - Mechanical Transmission System

No.	Problem	Cause	Solution
1	Traveling off track	1. Tension of left and right tracks differ.	1. Adjust tension device.
		2. The crawlers are slack.	2. Adjust tension device.
2	Big travel damp	1. The crawler is tensioned too tightly.	1. Adjust track's tension device
		2. Road surface is soft.	2. Feed and pack to make the road surface hard and even
3	The crawlers skid	1. The crawlers are slack.	1. Adjust and tension the track
		2. The crawler pads are worn.	2. Replace the crawler pads.
4	Track roller leaks oil or cannot move	Installing surface of the track roller is not even, causing sealing gasket of the track roller to deform.	Loosen the bolt and add a 1mm(1/16") iron sheet to keep the gap not more than 1mm(1/16") and then tighten the bolt.
5	Drive wheel and crawler pads mesh abnormally	1. The crawler is slack.	1. Use jack to tension the track.
		2. Cast drive wheel meshes with teeth of the crawler pad un-smoothly.	2. Grind and rectify the rim of drive wheel to make it round.
6	Luffing motor damp is loose, fuel supply is not equal, and motor vibrates	Damper bolt is loose.	Tighten the damper bolt.
7	Main winch vibrates violently	No damper is installed on main winch balance valve	Install damper to main winch balance valve
8	Slew ring rotates reversly sometime	The mounting location of wire rope is not right.	Move the wire rope to the guide wheel for wire rope of aux. winch
9	Slewing reducer vibrates	The fixed bolt of slewing reducer is losing.	Fix the bolt.
10	The rotating is reversing occasionally		Exchange the slewing hand lever.
11	The braking of slewing is too slow		Dismantle the damping connector
12	There is noise during the rotating		Refill the gear oil, supply the butter
13	Luffing, slewing and traveling brake is slipping	The brake block is abrading.	Inspect and exchange the brake block.

No.	Problem	Cause	Solution
14	The luffing stall	The bolt of luffing valve core is loosing.	Fix the bolt.
15	The luffing pawl can not reset.	The reset spring of luffing pawl is not flexible.	Exchange the reset spring.
16	The luffing pawl can not be locked.	The pin roll of luffing pawl is rusty.	Oil the pin roll, make it more flexible.
17	The speed of main winch hoisting is slow	The stroke of main winch valve core loosing is not enough.	Fix the bolt.
18	The stroke of main winch descending is shortened, the falling of main winch is slow.	The bolt of descending valve core of main winch is loosing.	Fix the bolt.
19	Main winch hoisting doesn't work occasionally.		Exchange the right hand lever.
20	The hoisting of main or aux. winch or drum of luffing can't rotating.	The reducer has malfunction.	Inspect and repair the reducer.
		The lock of pawl is not released.	Release the pawl.
		The brake of main and aux. hoisting has not been open.	Open the main and aux. hoisting brake.
		The clutch of main an aux. hoisting has not been open.	Open the main and aux. hoisting clutch.
21	The brake of free-fall is single-abrading.		Adjusting.
22	There is no action in aux. winch.	The brake block of aux. winch has been burnout.	Exchange the fork chip.
23	While operating, the A-frame direction wheel is sounding.		Washing the butter pipe, fill the butter.
24	The counterweight was assembled unevenly.		The counterweight was not aligned one by one.
25	The operating is laboursome.	The connecting rod, shifting yoke or pin , shaft is rusty.	Clean the rust, fill the lubricating oil.

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