

ZOOMLION

Crawler Crane Maintenance Manual

ZCC1300

ZCC1800

ZCC2600

Edition 1 Jan 2020

To Users

Zoomlion appreciates your selection of ZOOMLION crawler crane for your application.

No one should operate the crane unless they read and understand the information in this manual.

Regular inspection and maintenance of crane are very important to make full use of crane performance, ensure safe crane operation and extend the service life of crane. Therefore, we offer you this *MAINTENANCE MANUAL* to facilitate your inspection and maintenance work.

This manual details the inspection and maintenance work of ZOOMLION crawler crane, and lists some common problems that may occur and their solutions.

For safety's sake, do not maintain the crane before you fully understand the contents in *MAINTENANCE MANUAL*, *OPERATOR'S MANUAL* and other technical documents. If there is anything in this manual you do not understand, please contact local service engineer of Zoomlion, and they will provide you efficient technical support in time. Any risks associated with unspecified and improper use are the sole responsibility of the crane's owner, operator or user.

Unauthorized person is not allowed to dismantle or adjust the hydraulic elements during maintenance. When the hydraulic system of crane fails or the components are damaged, please contact local service engineer of Zoomlion.

The data (data, specifications, illustrations) in this manual is for cranes in production at the time of this manual's publication. We reserve the right to make changes to this manual at any time, without obligation.

The manual has been translated to be best of our knowledge. Zoomlion assumes no liability for translation errors. The Chinese version of the *MAINTENANCE MANUAL* is solely applicable for factual accuracy.

Thank you!

Mobile Crane Branch Company of Zoomlion Heavy Industry Science and Technology Co., Ltd.

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Safety Instructions

DANGER, WARNING, CAUTION and NOTICE labels are on signs and decals, and as you read this manual to show important instructions. In this manual, the labels follow the paragraph or item they apply to. The markers are as follows:



Refers to a dangerous situation which, if you do not prevent, will cause death or injury.



Refers to a possible dangerous situation which, if you do not prevent, could cause death or injury.



Refers to a possible dangerous situation which, if you do not prevent, may cause light or moderate injury.

NOTICE

Refers to a situation which, if you do not prevent, may cause property or equipment damage.

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Maintenance Manual for Crawler Crane

Chapter 1 About this Manual

Chapter 1 About this Manual

1.1 General

This manual is compiled for the users to guide crane maintenance and service work.

Read and understand the content in this manual before crane maintenance and service work.

Perform the crane maintenance and service work in accordance with the requirements stipulated in this manual, especially the information about CAUTION, WARNING and DANGER.

Violation of these regulations may cause damage to the crane, even death to personnel, which is the sole responsibility of the operator or user.

This manual is compiled according to the working status of the current crane. However, it may be different from the actual status of the crane due to technical improvements. Therefore, you can contact us if you want to know about more accurate information about the crane.



If you find any cracks in the steel structure of the crane, please contact with “customer service department” of Zoomlion and describe the position and shape of the crack.

1.2 Product identification

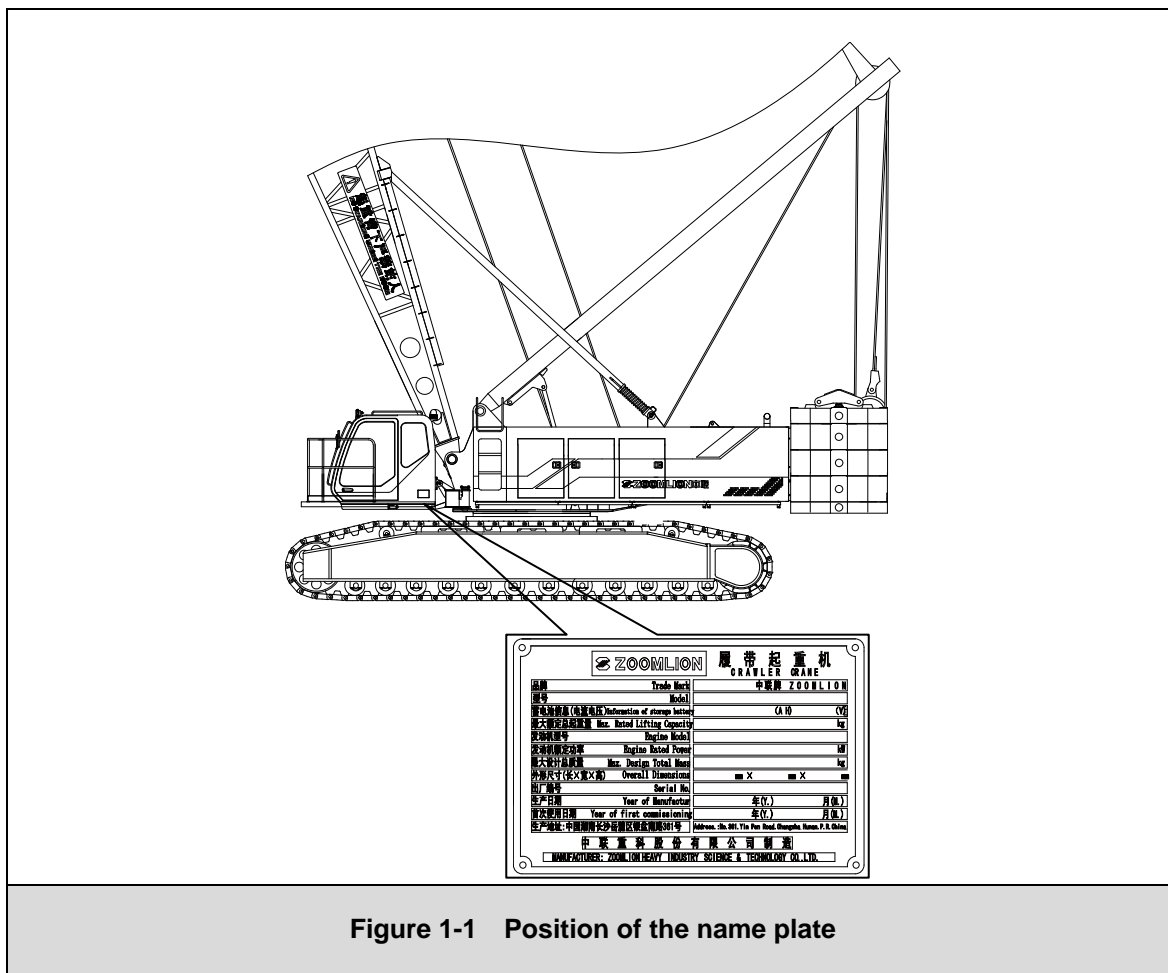


Figure 1-1 Position of the name plate

The crane name plate is located in a prominent position at the outside of the cab. The above figure shows the detailed position of the name plate.

The user can distinguish this crane from others directly via the name plate. The information on it is helpful for crane maintenance and service. Please keep it in a good condition within the service life of crane.

The serial number on the name plate is for crane identification. The users can confirm the crane components and relevant technical data by this serial number. For example, the serial number of the crane is ZCC1300-001.

1.3 Illustration and symbols

This manual has a mass of illustrations, which are schematic. The meanings of illustrations are as follows:

- a) Position of working mechanism to be operated on the crane;
- b) Sequence of operation;
- c) Correct operating way;
- d) Unpermitted or dangerous operating way

The illustrations in this manual may be different from the actual condition of crane. However, this does not hinder the user from understanding the meanings of illustrations.

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Maintenance Manual for Crawler Crane

Chapter 2 Safety Guidelines and Environmental Protection

Chapter 2 Safety Guidelines and Environmental Protection

2.1 Safety guidelines

2.1.1 General

- a) Since various dangerous factors exist during maintenance and service of the crane, this section will talk about the safety guidelines for service technician to maintain and service crane.
- b) These safety guidelines will be involved in the relevant chapter about lubrication and maintenance and explained in detail if necessary. Read and understand these safety guidelines before maintenance and service work.
- c) The maintenance work must be done by qualified personnel who have received training in crane technology, especially in electrical and hydraulic systems of crane.
- d) No unauthorized personnel are accessible to crane during maintenance and service work.
- e) Make sure that the handles, footsteps, the housing parts that can be walked on, platforms and ladders are free from dust, snow and ice.
- f) The service technician must wear tight-fitting protective clothing when servicing the crane, together with the correct personal protective gear such as safety goggles, breathing mask for the particular activity.
- g) Correctly use auxiliary equipment and set up working platform before performing high-level operation.
- h) The maintenance and service work should be done in time and spare parts should be changed according to the plan.
- i) The customer must use original spare parts which meet technical requirements specified by manufacturers.
- j) Without the permission of our “customer service department”, welding is prohibited. Unprofessional welding maintenance may cause damage, which is the sole responsibility of the operator.
- k) Do not perform any maintenance work if the service technician is tired, or he has drunk, or he has taken medicine which may affect the work.
- l) Do not reach into moving parts of the crane. The service technician must remove the ignition start key and hang the “Prohibition” sign on the cab or control device before operating these parts.
- m) Do not touch hot components, hot pipelines, hot liquid and engine body when the engine just stops. Only when the engine is cooled down for more than one hour, can the relevant maintenance work be carried out.
- n) Cut off the grounding terminal of battery and turn off mast power switch before dismantling of the battery and welding operation on the crane.

! WARNING

Follow the safety guidelines about maintenance and service before conducting any maintenance and service work.

2.1.2 Qualification and selection of the personnel

Only professionals can conduct maintenance and service work.

This regulation is especially applicable for electrical system, hydraulic system, engine system and brake system of crane.

2.1.3 Potential risks

2.1.3.1 Dangers caused by squeezing/shearing

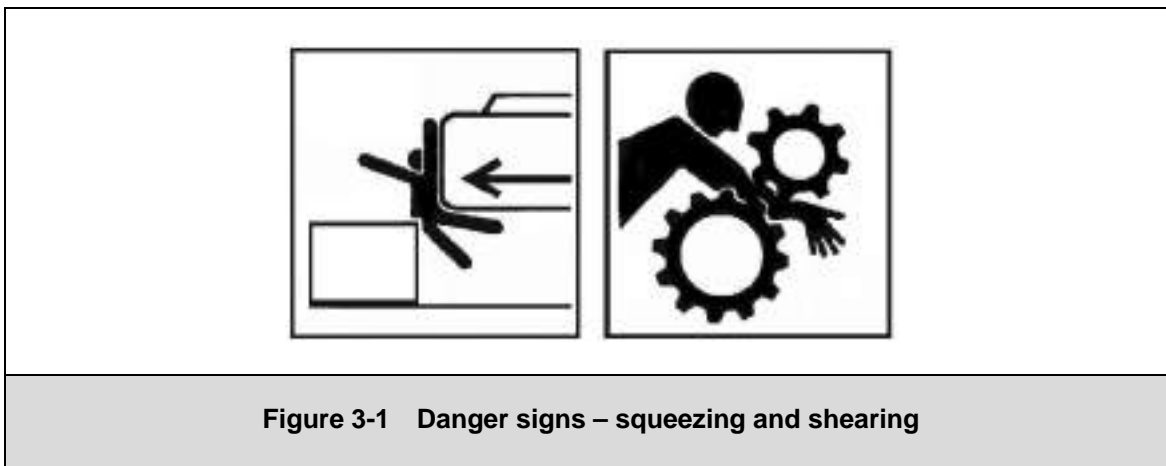


Figure 3-1 Danger signs – squeezing and shearing

Parts involved:

- a) Main boom, fixed jib, luffing jib, FA-frame, WA-frames 1 and 2
- b) A-frame
- c) Pinion gear of slewing reducer
- d) Drive sprocket and driven sprocket

2.1.3.2 Dangers caused by tangling and dragging

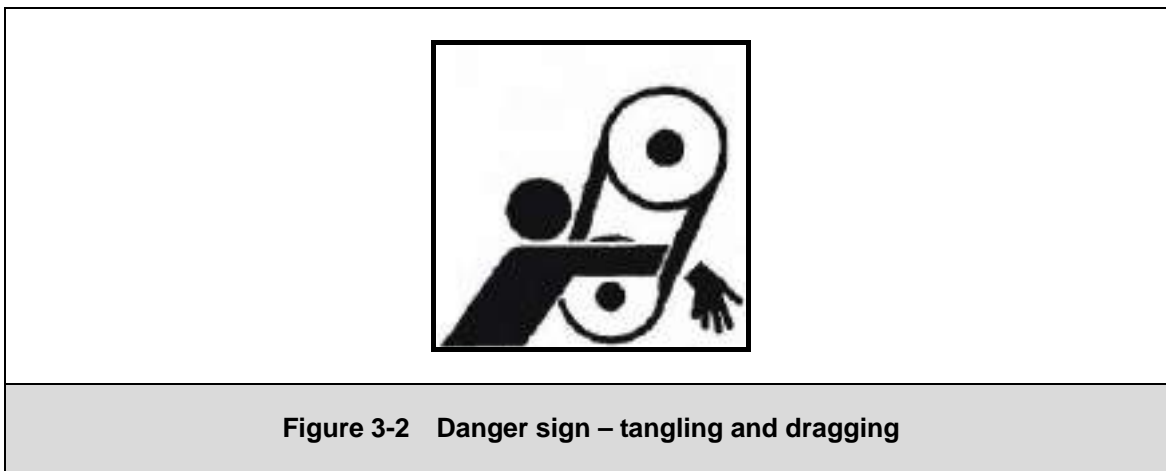


Figure 3-2 Danger sign – tangling and dragging

Parts involved:

- a) Wire ropes/rope pulleys/load hooks/slings
- b) All winches
- c) Crawler travel gear

2.1.3.3 Dangers caused by slipping, stumbling and falling



Figure 3-3 Danger sign – slipping, stumbling and falling

Only use specified thoroughfare and ladders, because the thoroughfare adopts anti slipping design and has handrails to help you keep balance.

2.1.3.4 Dangers caused by heat



Figure 3-4 Danger sign – heating

Parts involved:

- a) Engine with exhaust system
- b) Working hydraulic system

2.1.3.5 Gas, dust and smoke

Make sure enough ventilation before refueling.

2.1.3.6 Dangers caused by the residue energy in the hydraulic system

When hydraulic elements such as pipe, hose and hydraulic valve are damaged, the crane will stop working. However, some part of the system will still bear pressure and the pressure may be not released. At this time, please pay attention to the danger caused by residue pressure.

2.1.4 Preparations before maintenance and service work

2.1.4.1 Precautions



- (1) Inform the operator, and assign a supervisor.
- (2) The maintenance work must be done by qualified personnel who have received training in crane technology, especially in electrical and hydraulic systems of crane.
- (3) Shut down the diesel engine.
- (4) Only keep diesel engine running when needing to use diesel engine to maintain and lubricate the crane.
- (5) Stop the crane on the ground (make sure that the ground has enough load-bearing capacity) and take measures to prevent it from moving (for example, use wedges to fasten the track pads).
- (6) No unauthorized personnel are permitted to start the crane (the operator must take out the ignition key and lock the door of the cab when leaving it) and set a warning board.
- (7) Correctly use auxiliary equipment and set up working platform before performing high-level operation.
- (8) Clean the crane before maintenance and service work, especially removing lubrication oil, fuel oil or any additive in joints and couplings. Do not use corrosive cleaning agent, but use non-fibre cleaning cloth.
- (9) Before using water, vapor injection (high-pressure cleaning agent) or any other cleaning agent, cover or tie those openings which will be affected by water, vapor or cleaning agent (considering safety or function, for example, install a power distribution cabinet).
- (10) Remove the cover or strap after cleaning the crane, and check if there is water in these areas.
- (11) Check whether all fuel pipes, engine oil pipes and hydraulic oil pipes leak, and check pipe fittings for tight fit, crack or damage after cleaning. If any faults are found, please fix or change them immediately.
- (12) Prepare proper container and adhesive in advance because the lubrication oil may overflow during the maintenance and assembly process.

2.1.4.2 Measures to prevent fire

- a) Keep the crane clean, especially removing combustion materials. Clean the crane completely after maintaining and servicing the hydraulic system, engine and fuel system.
- b) Remove all residual lubrication oil, fuel or cleaning agent.



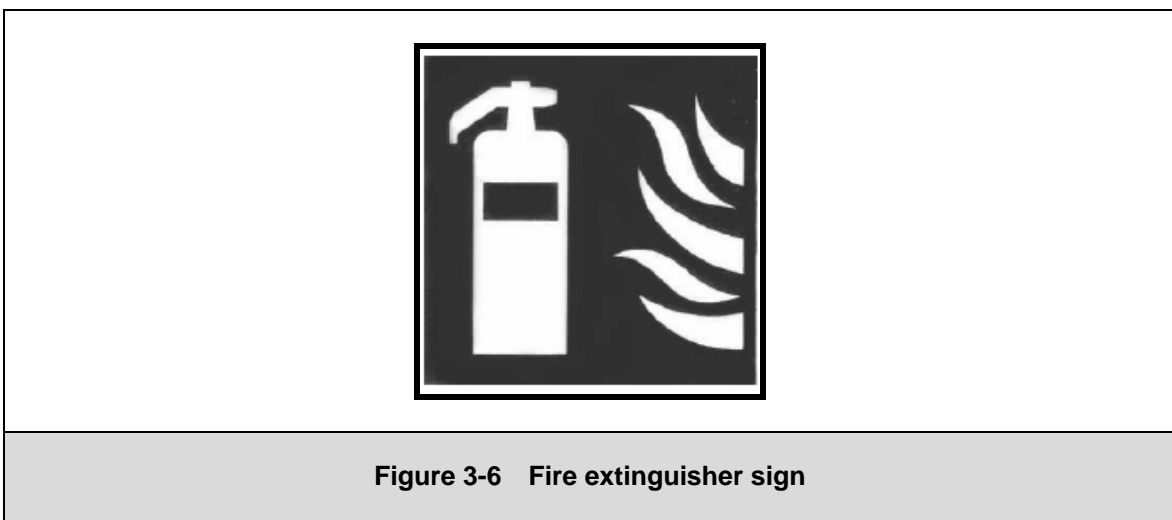
Parts involved: fuel pipes, engine oil pipes and hydraulic oil pipes

Check the pipes for oil leakage, cracks and damage, the fittings for tight fit.

If any damage is found, repair or change the pipe.

2.1.4.3 Other items to check or change

- a) Check all cables, plugs and terminal plates for damage. If any damage is found, fix or change them immediately.
- b) Refuel the fire extinguisher in time.



2.1.5 Instructions about maintenance work

Maintenance Manual doesn't include information about how to carry out maintenance work. If in need, please contact the customer service department of Zoomlion. Relevant safety instructions for maintenance work are as follows:

- a) Without permission, welding, combustion or grinding operation on the crane is prohibited. Otherwise, there is danger to cause fire and explosion!
- b) Clean the crane and remove the dust and flammable materials around before welding, combustion or grinding operation and make sure enough ventilation. Otherwise, there is danger to cause explosion!
- c) Depressurize all pipelines or containers before demounting the fittings or disconnecting the pipeline. Take preventive measures to protect personnel against injuries due to escaping hydraulic oil or air under high pressure.
- d) Without our permission, do not make any change, addition or modification to the crane. Otherwise, the crane may be in danger. This is applicable for assembly, setting of safety devices and valves, and welding of load-bearing components.

2.1.6 Notes for long-term storage

If the crane doesn't work for a long time (more than 2 weeks), do the following in order to maintain crane performance:

- a) Clean the crane completely and check travel gear for functional work.
- b) Apply lubricating oil on the components susceptible to corrosion.
- c) Demount the battery, charge it fully and then store it well. Remove the grounding terminal of battery.
- d) Drain cooling water completely and hang a board "no water" on the engine. Cover a film on the engine to prevent moisture.
- e) Make an inventory of tools and store them well.
- f) Run the crane once in a month without a load and at low speed in order to avoid excessive wear due to film damage or rust. What's more, pay special attention to the temperature change on the lid of the diesel engine.



- (1) **After warming the crane, carry out traveling movements, slewing movements or lifting movements repeatedly and continuously.**
- (2) **Pay attention to the quality of the lubricant when running the machine again. Since the lubricant may get worse due to lack of running.**

2.2 Environmental protection

Some harmful substances such as engine oil, lubricating grease, fuel, antifreeze coolant, hydraulic oil and refrigerant will be produced during maintenance. These substances and relevant contaminated rags will pollute the environment and do harm to people's health, therefore, they must not be dumped into the ground, into water or into the sewer system, and they must be recycled and disposed of according to the environmental protection regulations.

Dispose harmful substances according to the following regulations:

- a) The maintenance personnel must wear suitable protective gear such as protective clothing, protective gloves, safety goggles, breathing mask for the particular activity, since the polluted substance is corrosive and poisonous.
- b) When supplying the crane with the oil or lubricating grease which can pollute the environment, proper filling equipment such as refueling pump, oil filling device, hose, container and funnel must be used to prevent these substances from coming contact with the natural environment.
- c) Some lubricating oil may flow out when dismantling and changing the components. Some oil may get into ground or into sewer system when changing oil. This will severely pollute the environment. Therefore, a proper container must be used to collect the waste oil and other waste materials. The refrigerant can not be released into the air directly.
- d) The pollutant must be gathered together and preserved according to different categories for follow-up disposal, thus reducing the costs. During this time, take measures to prevent loss of pollutant.
- e) Use special container to move the pollutant from one position to another. Ask specialized company to recycle the pollutant. Dispose of the waste materials according to the relevant environmental protection regulations.
- f) If the pollutant comes into contact with the natural environment or person's skin due to unexpected conditions, some emergency measures must be taken. If the pollutant falls down on the ground, collect it into a container to avoid it permeating into soil or sewer system. If the pollutant is sprayed on the skin, it must be rinsed away as quickly as possible with a lot of clean water or cleaning agent. In the event of eye or mouth injuries, use an eye-bath or mouth-bath to rinse them, and seek medical attention after that.

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Maintenance Manual for Crawler Crane

Chapter 3 Description of Crane

Chapter 3 Description of Crane

3.1 Description of main components under different boom configurations

3.1.1 "Main boom" configuration

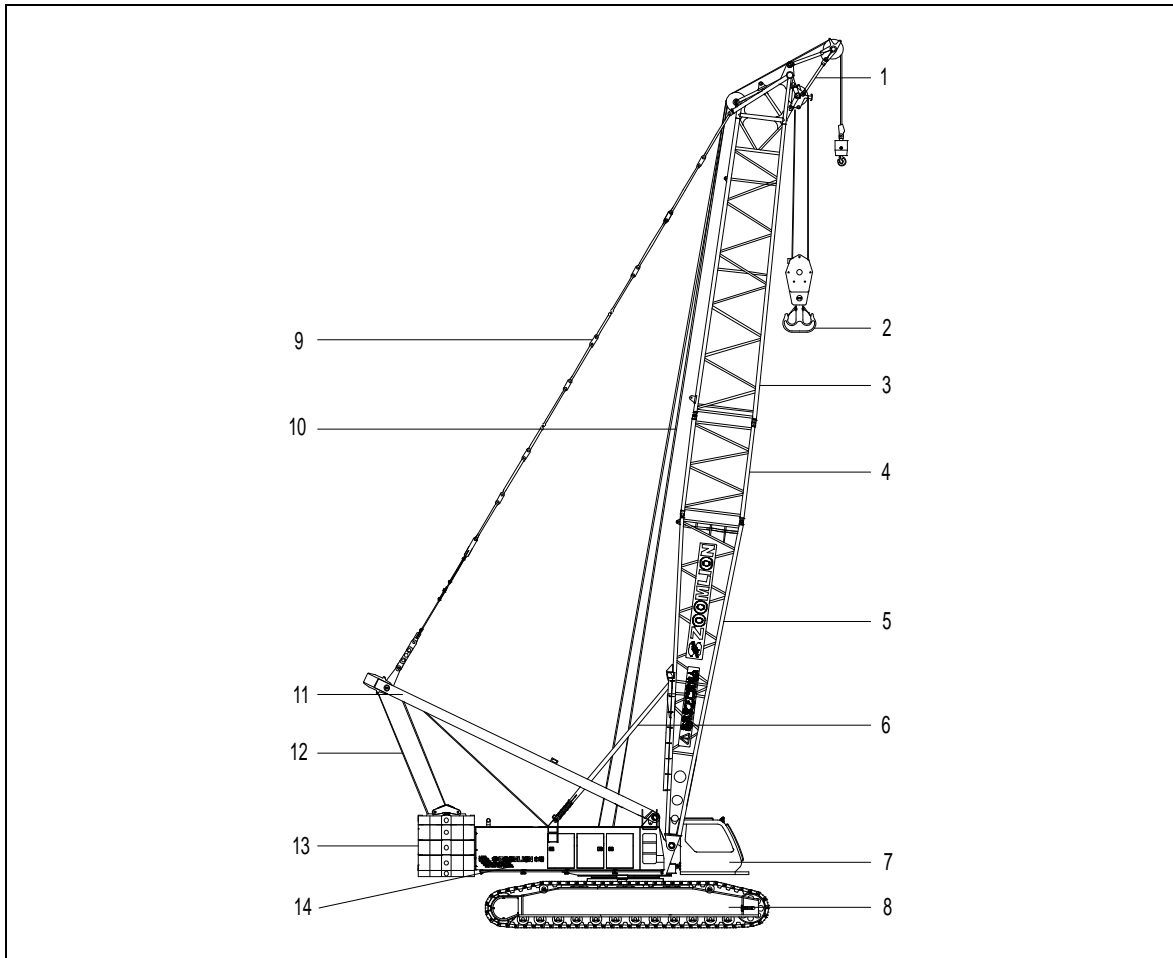


Figure 3-1 "Main boom" configuration

No.	Names of the components	No.	Names of the components
1	Tip boom	8	Crane undercarriage
2	Load hook	9	Main boom anchoring rods
3	Main boom head	10	Hoisting rope
4	Main boom intermediate section	11	A-frame
5	Main boom pivot section	12	Derricking rope
6	Main boom tilting-back support	13	Rear counterweight
7	Operator's cab	14	Slewing table

3.1.2 “Main boom with fixed jib” configuration

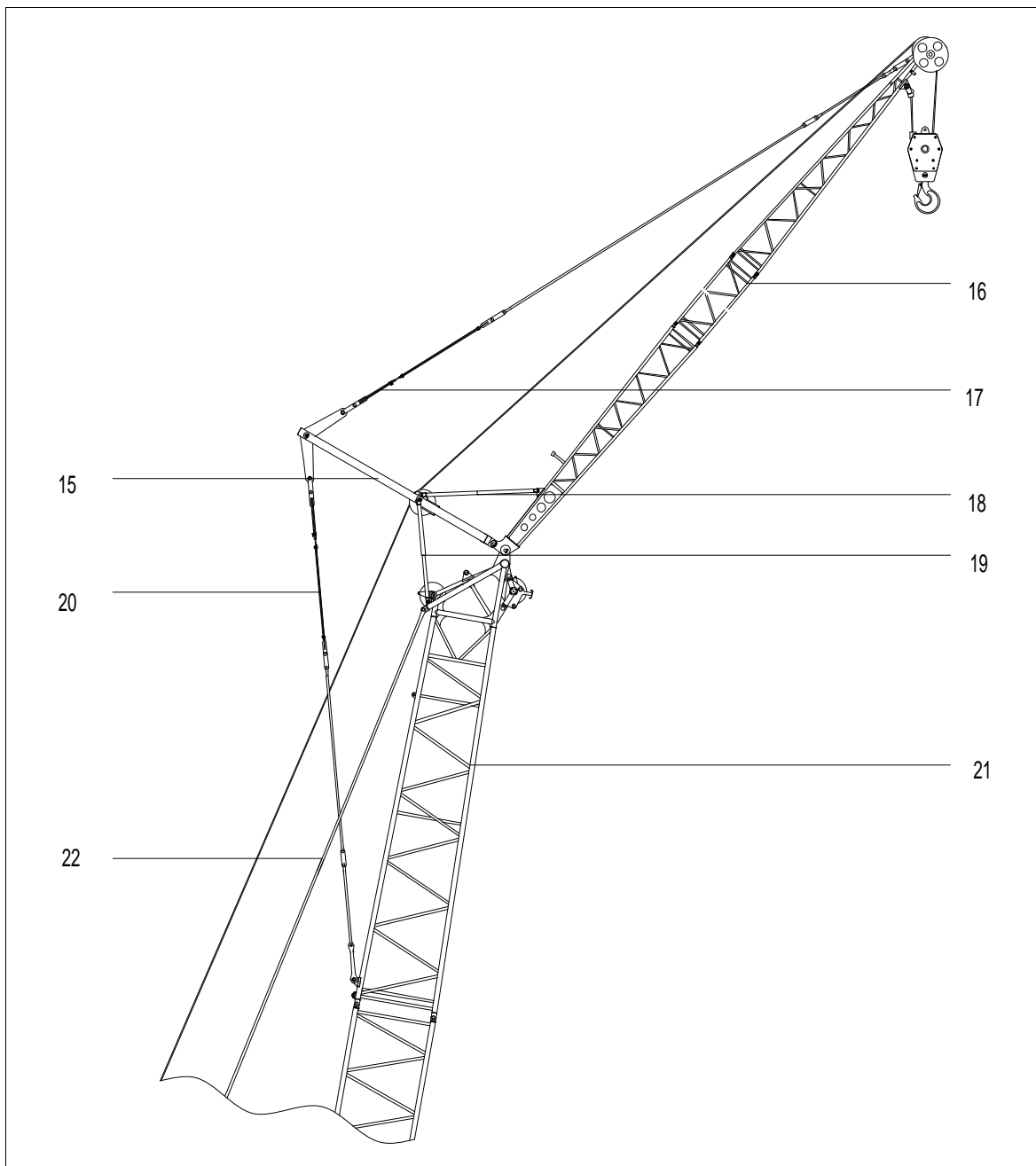
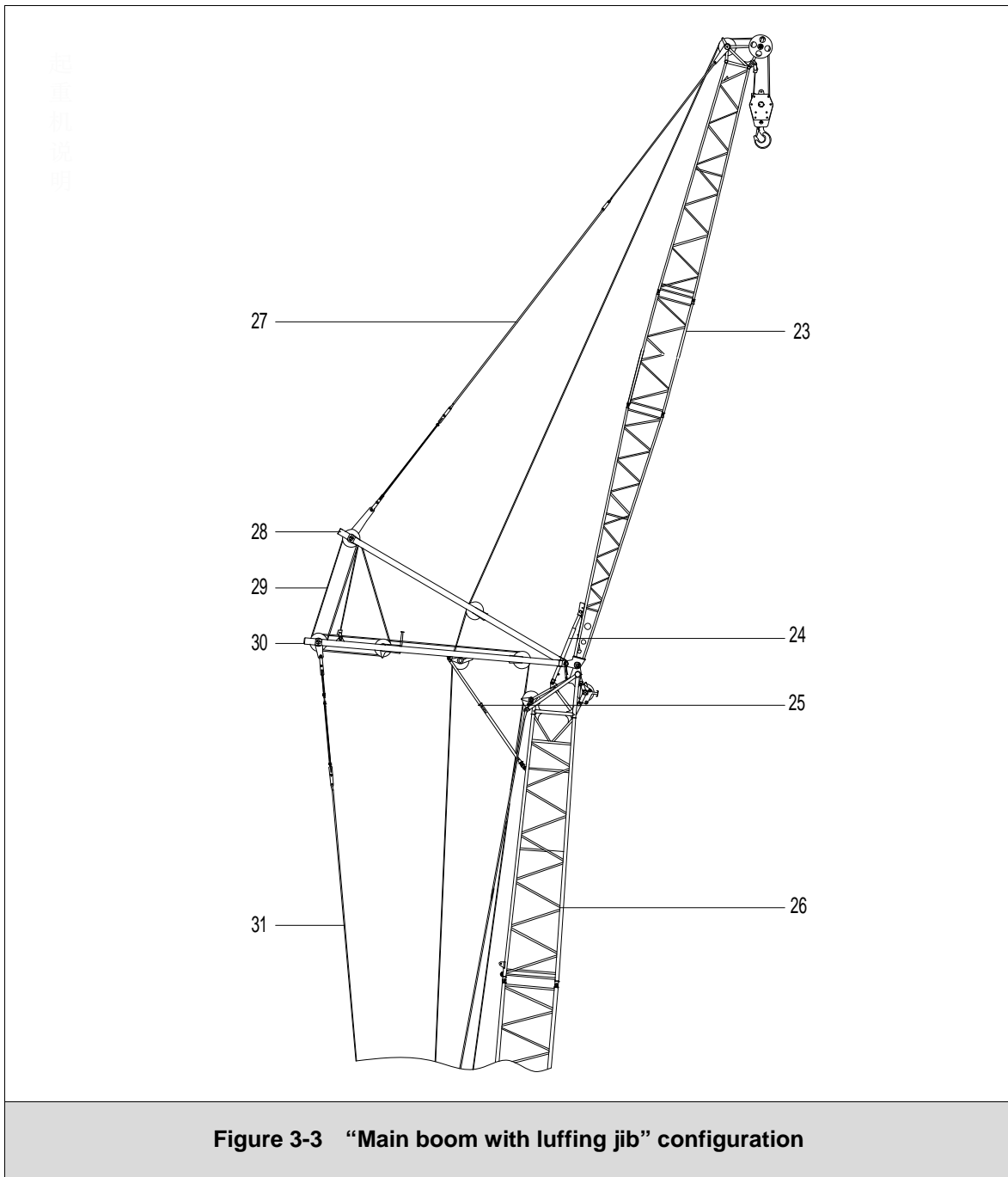


Figure 3-2 “Main boom with fixed jib” configuration

No.	Names of the components	No.	Names of the components
15	FA-frame	19	Rear tilting-back support of fixed jib
16	Fixed jib	20	Fixed jib rear anchoring rods
17	Fixed jib front anchoring rods	21	Main boom
18	Front tilting-back support of fixed jib	22	Main boom anchoring rods

3.1.3 “Main boom with luffing jib” configuration



No.	Names of the components	No.	Names of the components
23	Luffing jib	28	WA-frame 1
24	Tilting-back support for luffing jib	29	Luffing rope
25	Tilting-back support for WA-frame 2	30	WA-frame 2
26	Main boom	31	Luffing jib rear anchoring rods
27	Luffing jib front anchoring rods		

3.2 Description of main components of basic machine

3.2.1 Basic machine of ZCC1300 crawler crane

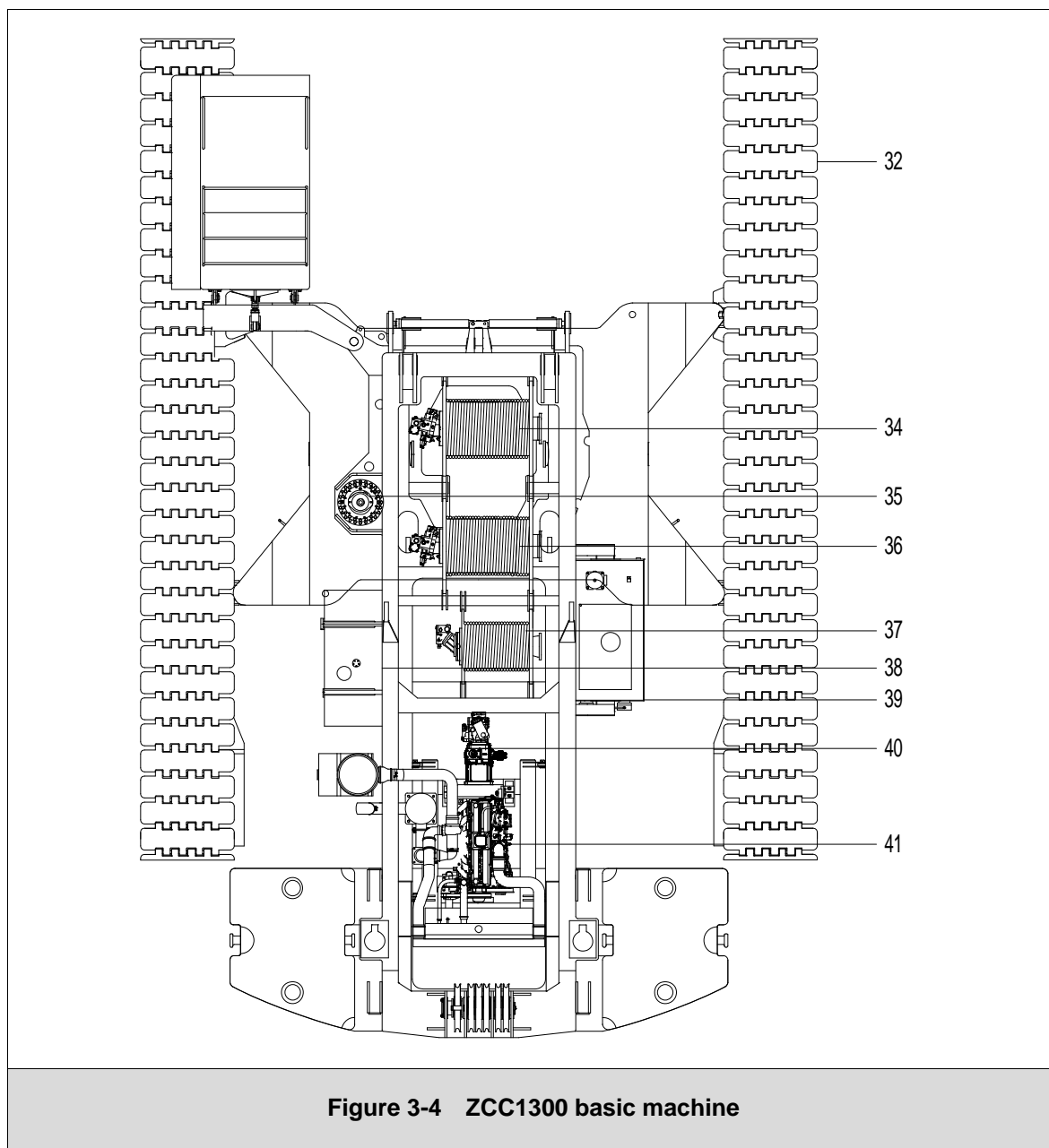


Figure 3-4 ZCC1300 basic machine

No.	Names of the components	No.	Names of the components
32	Crawler carrier assy.	38	Derricking winch
34	Undercarriage central section	39	Fuel tank
35	Hoisting winch 1	40	Hydraulic oil tank
36	Slewing mechanism	41	Oil pump device
37	Hoisting winch 2	42	Engine system

3.2.2 Basic machine of ZCC1800 crawler crane

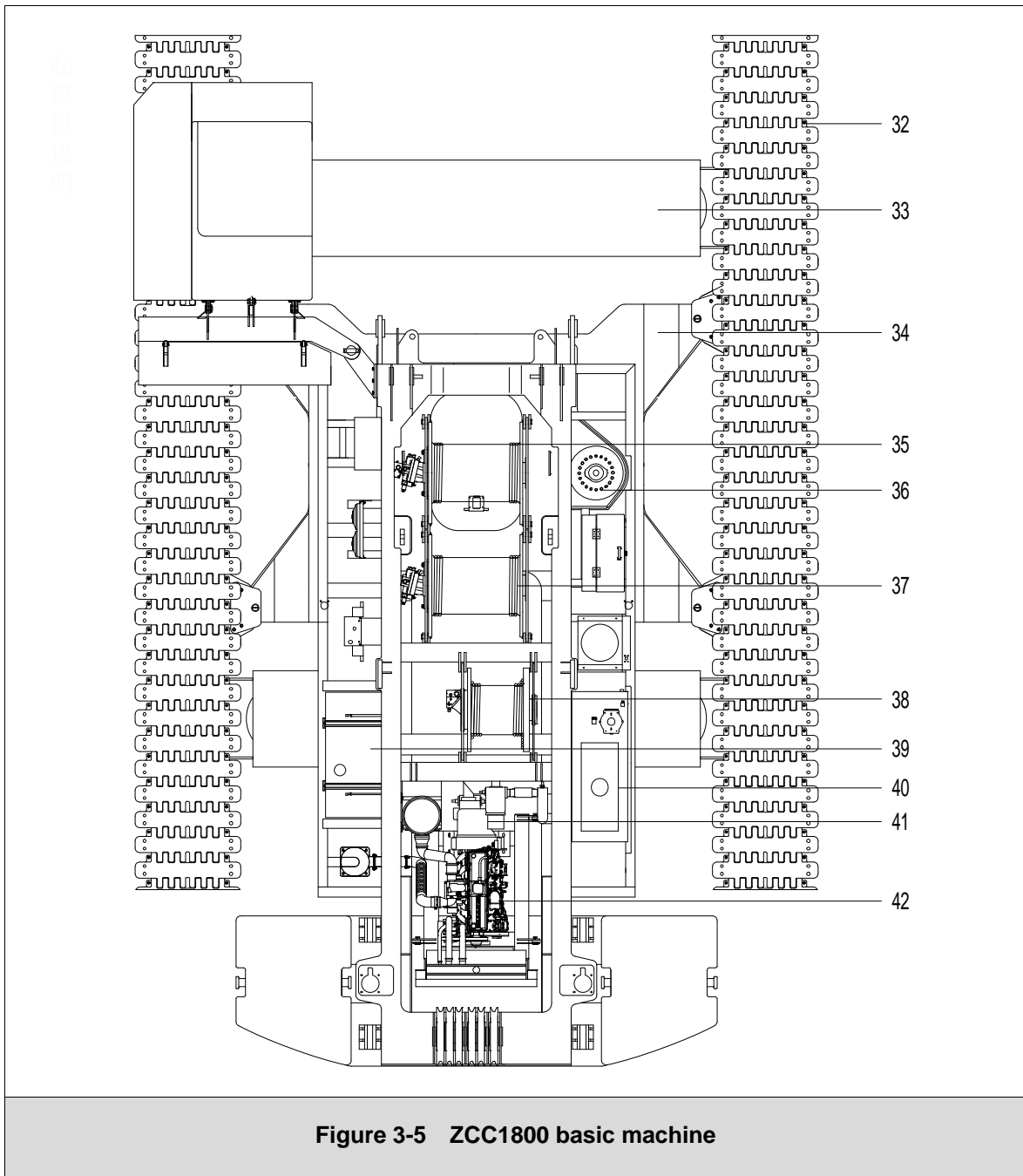


Figure 3-5 ZCC1800 basic machine

No.	Names of the components	No.	Names of the components
32	Crawler carrier assy.	38	Main boom derricking winch
33	Central counterweight	39	Fuel tank
34	Undercarriage central section	40	Hydraulic oil tank
35	Hoisting winch 1	41	Oil pump device
36	Slewing mechanism	42	Engine system
37	Hoisting winch 2		

3.2.3 Basic machine of ZCC2600 crawler crane

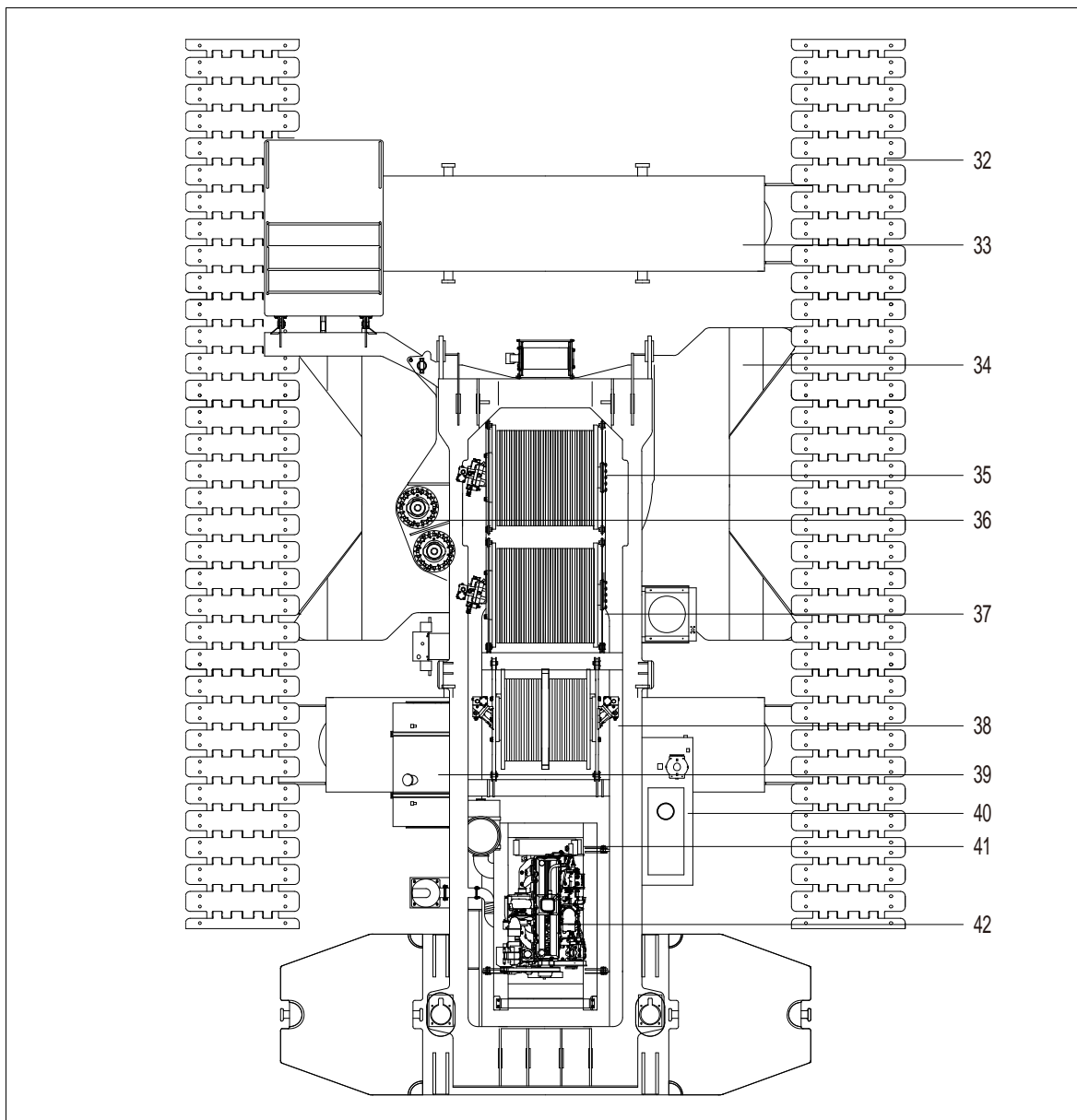


Figure 3-6 ZCC2600 basic machine

No.	Names of the components	No.	Names of the components
32	Crawler carrier assy.	38	Main boom derricking winch
33	Central counterweight	39	Fuel tank
34	Undercarriage central section	40	Hydraulic oil tank
35	Hoisting winch 1	41	Oil pump device
36	Slewing mechanism	42	Engine system
37	Hoisting winch 2		

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Maintenance Manual for Crawler Crane

Chapter 4 Maintenance

Chapter 4 Maintenance

4.1 General

- a) In addition to oil inspection and change, the maintenance and service work also involves frequent inspections to ensure that components are in good state.
- b) Appropriate equipment shall be available for the maintenance and service work. And the regulations and instructions in the *Operator's Manual for Crawler Crane* shall be followed.
- c) The safety devices, after being removed during the maintenance, should be reinstalled and inspected upon completion of the maintenance work.
- d) Fuels, lubricants and replaced parts must be safely treated in compliance with the regulations for environmental protection.

4.1.1 Aims of maintenance and service

- a) Prepare well for crane operation
- b) Keep the performance steady
- c) To make the idle time less
- d) To use the crane in a better way
- e) To make the repair costs less

4.2 Precautions

4.2.1 General precautions

- a) Wear work clothes when conducting the maintenance.
- b) Put the crane on a firm and flat site and set a warning board marked "Crane in inspection".
- c) Working at a position higher than 2m is considered as high-level operation. Use ladders and safety belts in such a situation.
- d) Act in accordance with the signals when moving a crane for maintenance.
- e) Prevent dusts and dirty articles from entering the hydraulic system during inspection or maintenance.
- f) If any items have to be maintained and adjusted immediately, maintain and adjust them at once.
- g) If repair is necessary, contact the local office of our company.
- h) In order to ensure the performances of a crane, use the accessories and lubricating grease designated by Zoomlion.
- i) Replace consumables, such as filter cartridges, in time as specified to avoid faults.
- j) When any problems are difficult to be determined in inspection or maintenance, contact the local office of our company.

4.2.2 Safety precautions

- a) Before inspecting and maintaining the crane, lower the boom on the ground, stop the engine, lock all safety devices and remove the key from ignition switch to prevent unauthorized persons from starting up the engine.



Failing to follow this instruction may cause personnel injury or death.

- b) Set up a warning board during inspection and maintenance
Before carrying out inspection and maintenance, put a warning board marked “In Inspection and Maintenance, Please Do not Start the Engine Up.” at the ignition start switch.
- c) Use clean lubricating grease
Keep the rooms for storing the lubricating grease clean. Do not make dusts, water, or other things enter the vessels. Ensure that the lubricating grease is free of water.

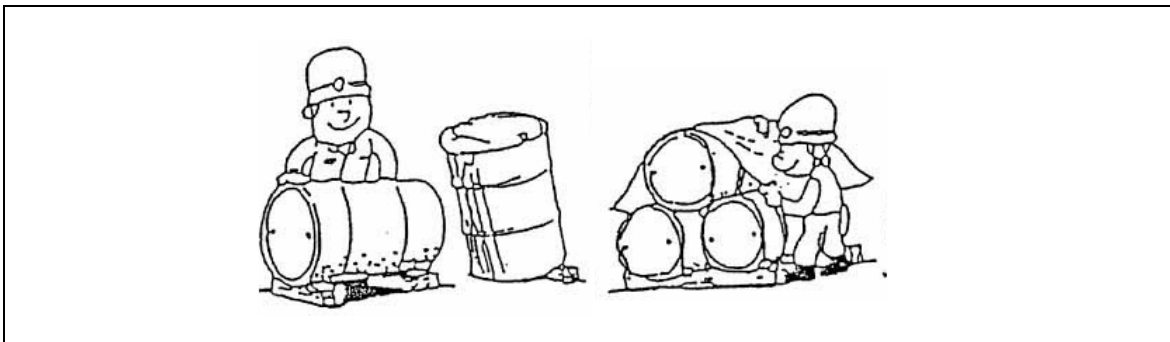


Figure 4-1 Use clean lubricating agent

- d) Keep machine clean
Clean the machine to make operator easy to detect such irregularities as oil leakage, cracks and loosening of connector. Especially keep grease nipple, air vent and oil dipstick clean.

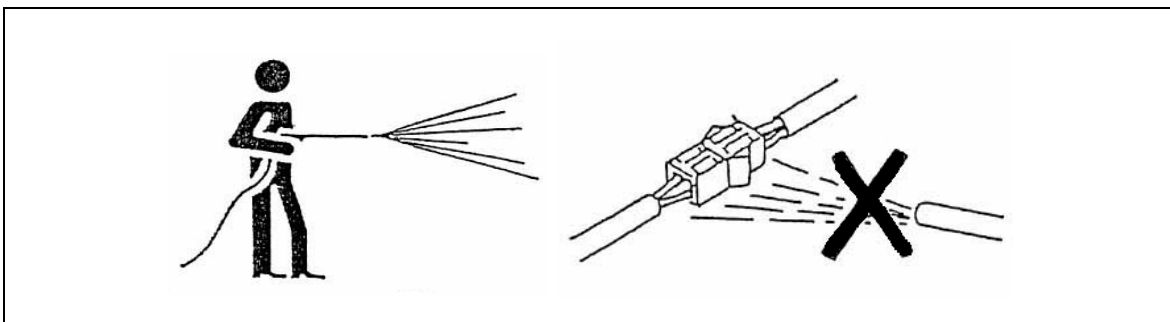


Figure 4-2 Keep machine clean

⚠ CAUTION

- (1) When cleaning the crane, do not spray water on the electrical elements and connectors.
- (2) After cleaning the crane, lubricate the rotating parts on slewing table.
- (3) Clean the operating console, control panel, floor, and the stained decorations in the cab only with the warm water that contains cleaning agents. Do not use corrosive cleaning agents.

e) Deal with oil stain

When adding or changing fuel, hydraulic oil and lubricating grease, or replacing filter cartridge, the oil will be splashed out. At this moment, wipe off oil to avoid fires.

f) Pay attention to fire prevention

The rubbish attached with oil stain or other flammable substances must be placed in a safe place. Know about the position of fire extinguisher and master its use methods.

**Figure 4-3 Prevent a fire**

g) Pay attention to the rotating parts

When checking fan belt or water pump, the operator is liable to be hurt. Therefore, he should first switch off the engine, and then check belt or water pump.

**Figure 4-4 Pay attention to rotary part**

h) Pay attention to water temperature and oil temperature

It is very dangerous to drain water, oil or replace filter cartridge immediately after the engine stops. Therefore, these operations can be done only when the temperature of engine has fallen down. When oil temperature is too low, heat oil to make its temperature reach 20 ~ 50 °C, and then drain oil.



Figure 4-5 Pay attention to water temperature and oil temperature

i) Check waste oil and old filter cartridge

Check if there have metal debris or impurities when changing oil or filter cartridge.

j) Prevent dust from entering

The dismantled hydraulic pipes and hydraulic elements must be protected by plugs or sealing covers to avoid dust entering into these pipes and elements.



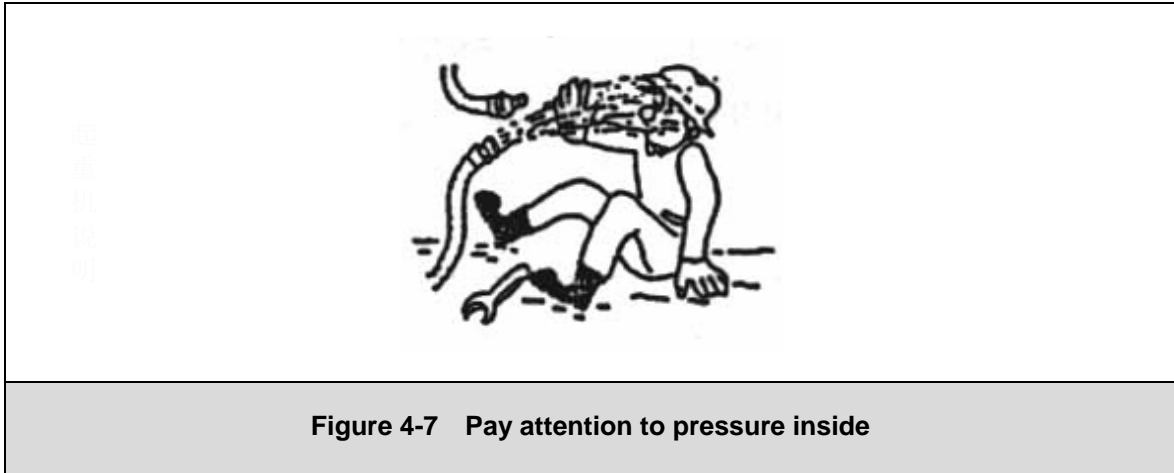
Figure 4-6 Prevent dust from entering

k) Clean joint face

After dismantling O ring or other washer, clean the sealing surface and replace sealing elements with new ones. During assembly, apply a thin layer of oil on the sealing elements.

l) Pay attention to pressure inside

Depressurize the mechanisms with internal pressure such as the hydraulic system, air compress system or fuel system before dismantling any pipelines, fittings or other components in them.



- m) Precautions for the welding process
- Cut off power supply.
 - Disconnect power lead of battery.
 - Never apply a voltage of more than 200V constantly.
 - Set up grounding device 1m away from the welding point.
 - No sealing elements or bearings are installed between welding point and grounding point.
 - Before carrying out welding operation in the vicinity of load moment limiter or controller, demount them first to prevent them against damage.
- n) Disposal of waste oil
- First drain waste oil into a container, and then dispose of it according to the requirements for industry discharge substances.
- The unauthorized personnel are prohibited to maintain the crane and replace parts.
- o) Crane periodic inspection
- In order to know about the working conditions of crawler crane and its components, please carry out periodic inspection. Inspect them before the crane works for the first time, if the crane has not been used for a long time, or before the crane works for the first time after maintenance. As to the checklist for periodic inspection, please refer to Section 7.4 “Checklist for periodic inspection” in Chapter 7.

4.3 Inspection of the crane

The crane shall be inspected by the manufacturer before delivery according to GB/T3811-2008 and relevant standards at home and abroad.

Experienced professionals shall inspect the crane at least once a year after its delivery according to the working environmental change or application conditions.

A visual check for the crane is needed before the crane starts work every time to find possible faults of the crane and to avoid accidents.

After any problems is detected, record it, maintain the crane and inspect again afterwards.



- (1) **Experienced professionals shall inspect the crane before its delivery if the crane has been modified greatly or the component parts bearing dynamic load have been maintained.**
- (2) **Experienced professional means professional technician who is engaged in crane industry for a long time and has profound knowledge in this field. He is familiar with relevant regulations, for example, labor law, accident prevention rules. He will not do things against normal and safe working condition, since he is trained specially.**
- (3) **A professional engineer means the engineer designing, making and maintaining a crane, who is familiar with various regulations and standards about crane. They inspect the crane, judge the conditions of the crane to ensure long-term and safe operation of the crane.**

4.4 Explanation of maintenance interval

The maintenance interval means that the crane maintenance work is carried out at regular intervals.

The maintenance interval can be determined by:

- a) Operating time of crane component (in hours)
- b) Calendar time (date, month and year) when the crane is in operation and storage

Generally speaking, the maintenance intervals are determined by the operating time of crane components. In special condition, the maintenance intervals are determined by the crane working and storage time.

The maintenance intervals can be determined by the operating hours of engine which can be read from the main screen in the cab.

Table 4-1 Maintenance intervals

Classification	Operating hours of engine	Maintenance interval
Daily inspection (D)	5	Every day, before startup of crane
Weekly inspection (W)	About 25	Weekly
Monthly maintenance (M1)	About 100	Monthly
Quarterly maintenance (M3)	About 250	Every 3 months
Semiannual maintenance (M6)	About 500	Every 6 months
Annual maintenance (M12)	About 1000	Yearly

4.5 Maintenance plan

Table 4-2 Maintenance intervals

No.	Components / Actions	Maintenance intervals					
		D	W	M1	M3	M6	M12
4.6	Power system						
4.6.1	Engine	Refer to <i>Operating Instructions</i> provided by engine manufacturer.					
4.6.1.1	Daily inspection	(as required in the maintenance manual of the engine)					
4.6.1.2	Inspection of the engine operation status	★					
4.6.1.3	Maintenance of the engine	(Perform the maintenance of engine according to <i>Maintenance Manual</i> . The first maintenance interval is 200h. At this time, change engine oil, fuel filter cartridge, engine oil filter cartridge and oil-water separator)					
4.6.2	Fuel system						
4.6.2.1	Inspection of fuel pipeline						★
4.6.2.2	Discharge of water from oil-water separator			★			
4.6.2.3	Replacement of filter cartridge of oil-water separator					★	
4.6.2.4	Discharge of water and sediment from the fuel tank					★	
4.6.2.5	Cleaning of the fuel tank					★	
4.6.3	Cooling system						
4.6.3.1	Inspection of coolant level	★					
4.6.3.2	Cleaning of cooling system						★
4.6.3.3	Change of the coolant						★
4.6.4	Air intake system						
4.6.4.1	Cleaning of air filter			★			
4.6.4.2	Replacement of air filter cartridges					★	
4.6.5	Exhaust system						
4.6.5.1	Visual check and daily maintenance			★			
4.7	Hoisting winches and derricking winch						

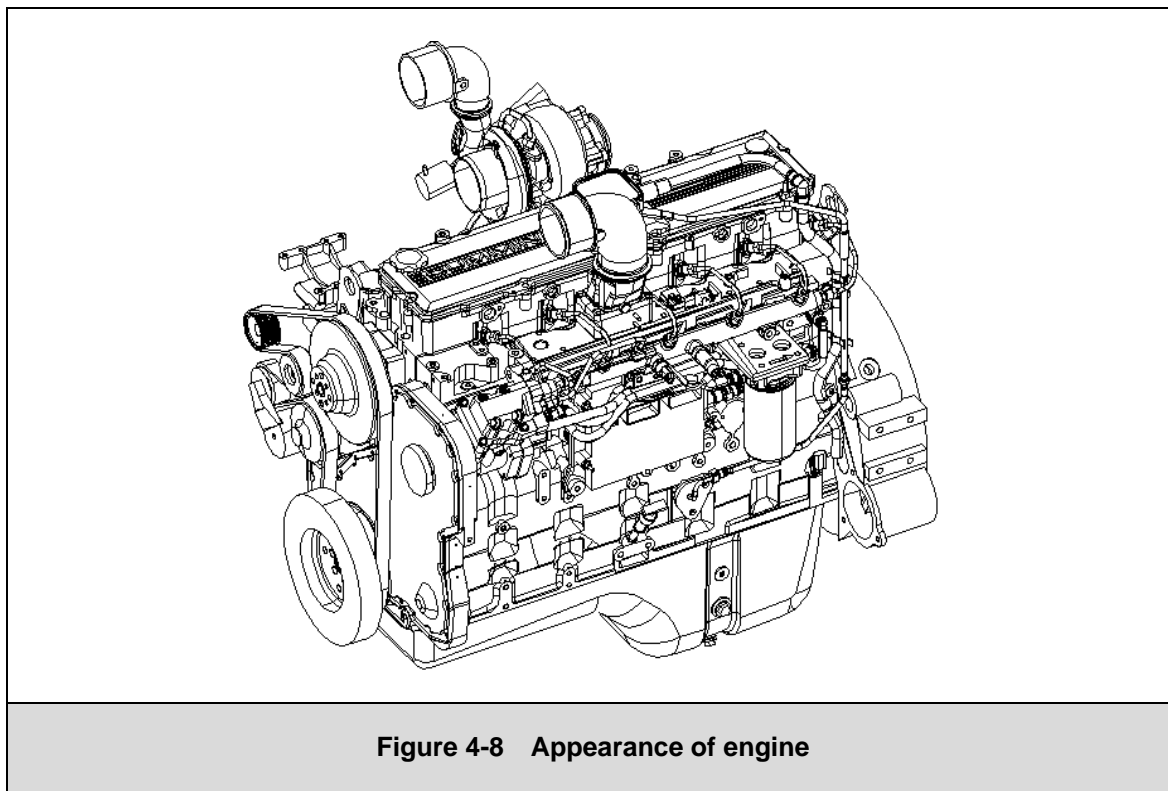
No.	Components / Actions	Maintenance intervals					
		D	W	M1	M3	M6	M12
4.7.1	Inspection of oil level of winch reducer		★				
4.7.2	Change of gear oil of winch reducer				▲		★
4.7.3	Inspection of tightening bolts of the winch reducer			★			
4.7.4	Inspection of brakes of the winch reducer						★
4.7.5	Inspection of hoisting winch reducer and derricking winch reducer						★
4.7.6	Theoretical life of winches						★
4.8	Slewing reducer and slewing ring						
4.8.1	Slewing reducer						
4.8.1.1	Inspection of oil level		★				
4.8.1.2	Change of gear oil				▲		★
4.8.1.3	Inspection of brake						★
4.8.1.4	Inspection of mounting bolts			★			
4.8.2	Slewing ring						
4.8.2.1	Inspection of bolts			★			
4.8.2.2	Routine inspection	★					
4.8.2.3	Lubrication of gear surface				★		
4.8.2.4	Lubrication of raceway				★		
4.9	Crawler and traveling reducer						
4.9.1	Crawler carrier assy.						
4.9.1.1	Inspection of the crawler			★			
4.9.1.2	Cleaning of the crawler		★				
4.9.1.3	Lubrication of the track pad connecting pin			★			
4.9.1.4	Tensioning of the track pad		★				
4.9.2	Travelling reducer						
4.9.2.1	Inspection of oil lever		★				
4.9.2.2	Change of gear oil					▲	★
4.9.2.3	Inspection of mounting bolts			★			
4.10	Hydraulic system						
4.10.1	Routine inspection	★					

No.	Components / Actions	Maintenance intervals					
		D	W	M1	M3	M6	M12
4.10.2	Hydraulic oil tank						
4.10.2.1	Inspection of hydraulic oil tank	★					
4.10.2.2	Change of oil return filter cartridge				▲	★	
4.10.2.3	Change of air filter				▲	★	
4.10.2.4	Cleaning of filter cartridge						★
4.10.2.5	Change of hydraulic oil	★ Two years					
4.10.3	Exhaust of the hydraulic system	★ Exhaust the various winch hydraulic pipes before raising the boom every time according to needs					
4.10.4	Inspection of hydraulic pipes for damage			★			
4.10.5	Cylinder inspection		★				
4.10.6	Inspection of hoses		★				
4.10.7	Safe connection and dismantling of hydraulic lines via quick-release couplings						
4.11	Electrical system						
4.11.1	Inspection of lighting system	★					
4.11.2	Inspection of limit switches	★					
4.11.3	Inspection of battery master switch	★					
4.11.4	Inspection of cable joints and dust caps	★ During each assembly and dismantling or lay down the boom					
4.11.5	Maintenance of battery						
4.12	Load hooks and pulleys						
4.12.1	Daily inspection and service of load hook	★					
4.12.2	Regular inspection of load hook						★
4.12.3	Pulley inspection						
4.12.3.1	Inspection of pulley body			★			
4.12.3.2	Inspection of pulley spindle					★	
4.12.4	Pulley lubrication				★		
4.13	Wire rope						
4.13.1	Inspection of wire rope	★					
4.13.2	Maintenance of wire rope			★			

No.	Components / Actions	Maintenance intervals					
		D	W	M1	M3	M6	M12
4.13.3	Change of wire rope	★ Change it according to inspection status and take-down standard.					
4.14	Air conditioning						
4.14.1	Daily inspection	★					
4.14.2	Maintenance of air conditioning in winter			★			
4.15	Operator's cab						
4.15.1	Inspection of windshield wipers in the cab as well as cleaning solution	★					
4.15.2	Inspection of sliding door of the cab	★					
4.15.3	Inspection of video monitoring system	★					
4.16	Lubrication system						
4.16.1	Lubrication of boom pin		★				
4.17	Key structural members						
4.17.1	Daily visual inspection	★					
4.17.2	Regular inspection						★
4.17.3	Inspection of bearing steel structural member						★
4.17.4	Other inspection	★					
Note:		▲ refers to initial maintenance, ★ refe					

4.6 Power system

4.6.1 Engine



Position of the engine: at the rear part of the slewing table.

4.6.1.1 Daily inspection

Inspect the appearance of the engine components to ensure that they are intact and function normally.

Items to be inspected:

- a) Inspect whether the air intake pipeline is securely connected and free of damage and leakage.
- b) Inspect whether the cooling water circuit, the fuel pipeline and the engine oil are all free of leakage.
- c) Inspect whether the fan blades are free of damage and whether there is clear scratch of fan blade with other component.
- d) Inspect whether the belts are worn and whether their tensions are within the normal range.
- e) Inspect whether mounting bolts (screws) of the engines and its subsidiary systems are reliably tightened and free of looseness.

4.6.1.2 Inspection of engine operation status

Inspect the engine oil pressure gauge, water temperature gauge, tachometer and warning indicator to make sure that the engine operates normally.

Inspection steps:

- a) Start engine with ignition start switch and run it at idle speed for 3-5 minutes.
- b) Accelerate the engine slowly to increase the rotational speed of the engine to about 1500r/min.
- c) Check if the readings on the tachometer change correspondingly during the acceleration.
- d) Read the values shown on the engine oil pressure gauge. They should not be less than 0.5bar at idle speed and not more than 5 bar at rated rotational speed. When they are out of the ranges mentioned above, inspect the engine, and repair it if necessary.
- e) After the engine runs normally for about 10 minutes, the readings on the water temperature gauge shall increase slowly. The highest water temperature is about 100°C.
- f) When the engine operates normally, the warning indicator of the engine does not flash.

4.6.1.3 Maintenance of the engine

The engine shall be maintained according to the requirements of the *Maintenance Manual of the Engine* prepared by the engine manufacturer and provided together with the engine.

The first maintenance interval is 200h. At this time, change engine oil, fuel filter cartridge, engine oil filter cartridge and filter cartridge of oil-water separator.



Follow the requirements below when cleaning the starting motor.

- (1) Pay special attention to environmental protection when dealing with waste oil.**
- (2) Special equipment is needed to add the oil.**



Cool down the engine for 60 min before maintenance and service work in engine area, otherwise, you may be burnt or scalded.

4.6.2 Fuel system

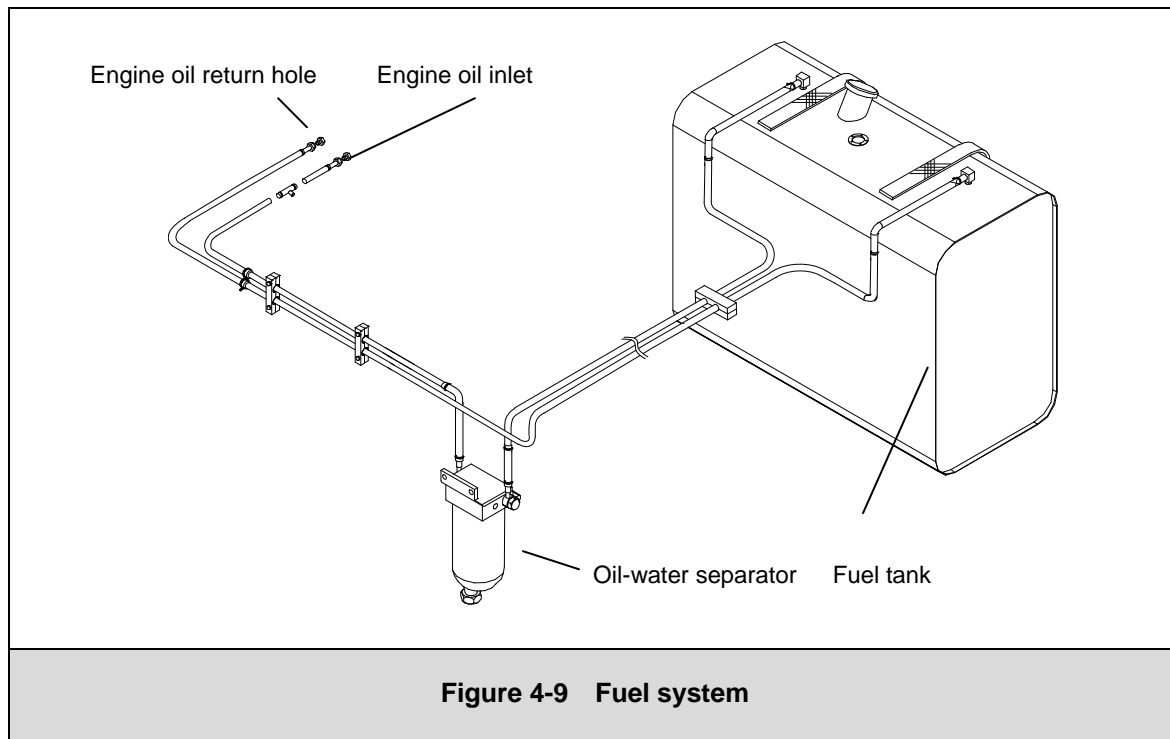


Figure 4-9 Fuel system

4.6.2.1 Inspection of fuel pipeline

Besides visual inspection (for example, oil level inspection), inspect fuel system of the engine annually. Notes:

- The pipe fittings should not leak oil and they should be fitted tightly.
- For recycled fittings, inspect the hose connection of the filling nozzle to make sure it is fastened enough. For any doubts, use the clamp to fasten the hose or change hose completely.
- Change the damaged pipe and hose due to mechanical effects, thermal effect, or other effects. Make sure keep enough distance between all pipes, hoses and high-temperature engine part (turbocharger, for instance) to avoid friction.

Items to be inspected:

- The welding seams on the diesel tank shall be free of oil leakage.
- Fuel hoses shall be free of leakage due to damage.
- Pipe fittings shall be free of oil leakage.
- The diesel pump, injection nozzle of the engine shall be free of oil leakage.
- The accumulated water in the transparent shell of the oil-water separator shall be checked. In the case of too much water in it, drainage is necessary.
- Once leakage is found, corresponding maintenance work is necessary.
- As to the requirements for the fuel quality, see section 6.3.



Use the approved fuel to extend the service life of the engine.

4.6.2.2 Discharge of water from oil-water separator

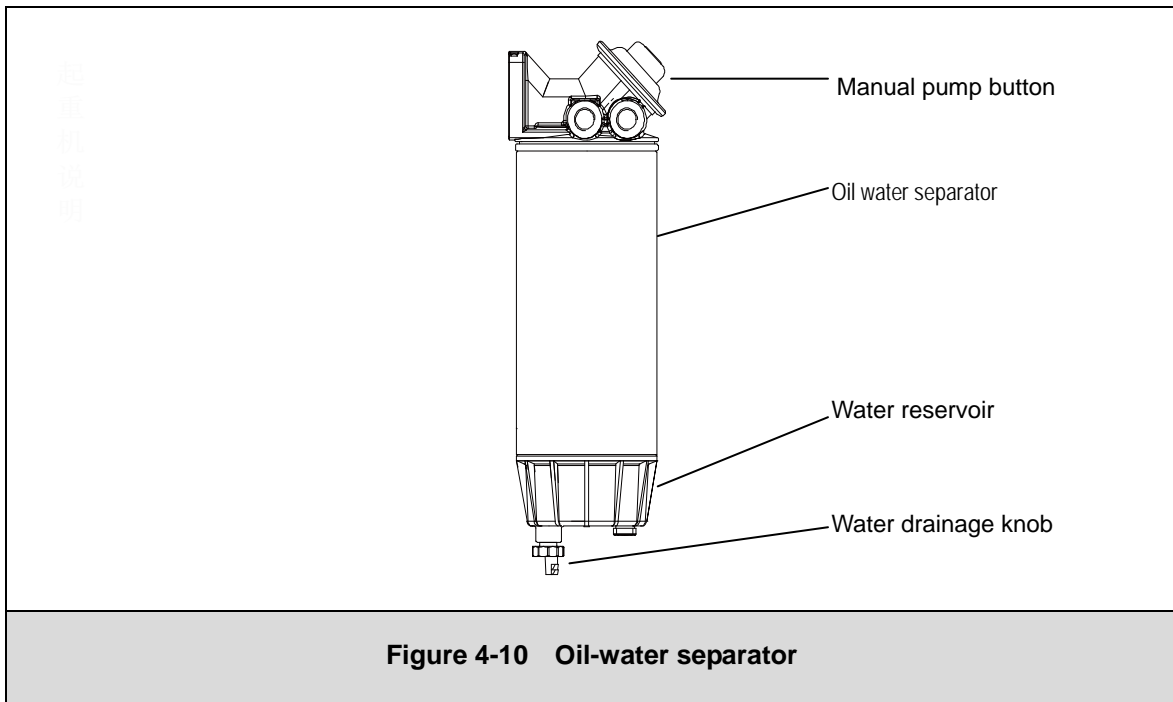


Figure 4-10 Oil-water separator

The water contained in the fuel is separated in the oil-water separator. When the water is accumulated to 1/3 of the total volume, it shall be discharged outside to prevent it from entering the engine cylinder together with the fuel.

The process of draining water out of separator is as follows:

- a) Turn off the ball valve between the oil-water separator and the fuel tank.
- b) Put a proper vessel under the oil-water separator to collect the residual water.
- c) Unscrew the water drain valve at the lower end of the oil-water separator with a wrench to make the accumulated water flow out slowly.
- d) When the diesel begins to flow out, turn off the water drain valve.
- e) Turn on the ball valve between the oil-water separator and the fuel tank.

4.6.2.3 Replacement of filter cartridge of oil-water separator

The change interval of filter cartridge of oil-water separator is determined by the pollution of fuel. When the filter cartridge is clogged, the supply of fuel and engine power will decrease, and the engine is started difficulty. If the power is reduced obviously, the filter cartridge should be replaced. Since contaminated fuel can clog the filter cartridge, it's recommended that standby filter cartridge is needed.

Please refer to maintenance instructions about oil-water separator in the operating manual provided by engine manufacturer.

Change process:

- a) Open the shutoff valve to discharge fuel. After the fuel is discharged completely, close the shutoff valve carefully. Pull out the shutoff valve, and then put it in the tool box.

- b) Demount the filter cartridge with inspection window from the head of fuel filter, and then clean the surface of O-ring.
- c) Apply O-ring and seal ring of filter with new oil or lubricating grease. Screw the inspection window on the new filter cartridge and then tighten them on the head of filter.
- d) Unscrew the vent screw and start water pump until the fuel flows out of the vent screw. At this time, screw the vent screw and start engine to check the filter cartridge for oil leak.

4.6.2.4 Draining the water and sediment from the fuel tank

In order to drain the water and sediment, unscrew the oil drain bolt, drain the fuel completely, clean the seal and screw the bolt.

Only when the fuel tank is almost empty (that is, 0 is read from the LCD screen), can this operation be done.

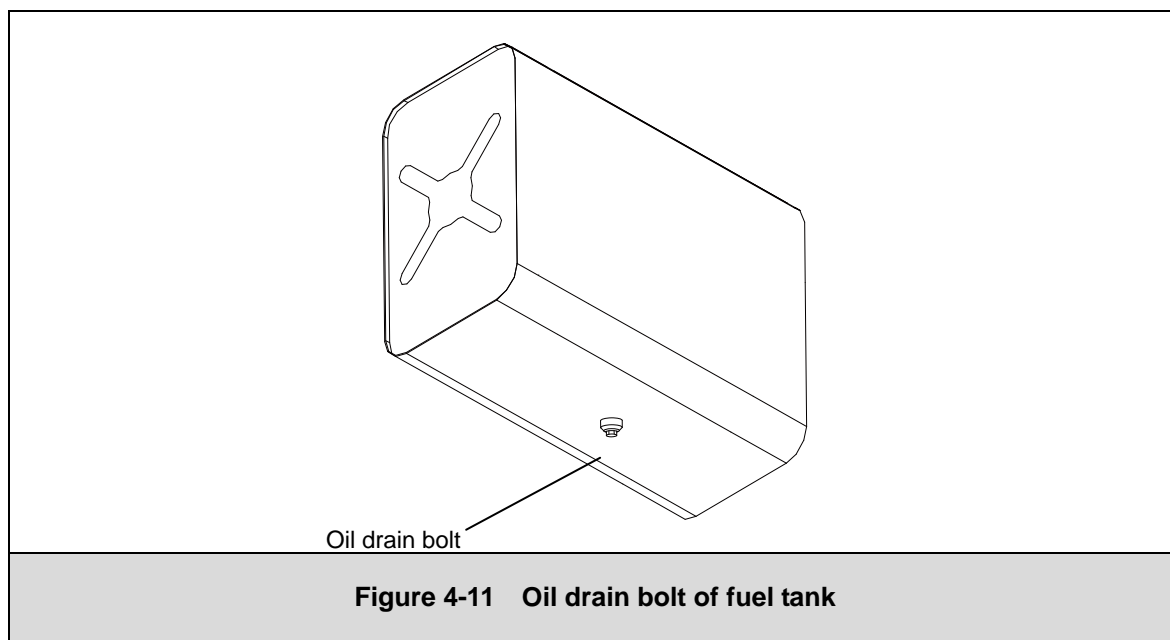


Figure 4-11 Oil drain bolt of fuel tank

4.6.2.5 Cleaning of the fuel tank

When the fuel tank has been used for half a year, oil sludge and water will be accumulated in the fuel tank. In order to keep the fuel tank clean, the fuel tank needs to be cleaned.

The cleaning method is as follows:

- a) Put a proper vessel under the fuel tank.
- b) Unscrew the oil drain bolt at the bottom of the fuel tank to make the residual oil flow out.
- c) Dismantle the air filter over the oil tank and clean the filter screen.
- d) Clean the internal surface of the oil tank with a brush and then flush it clean with diesel.
- e) Reinstall the oil drain bolt at the bottom of the fuel tank as well as the air filter.
- f) Inspect whether there is any leakage at the oil drain bolt after the diesel is injected and whether the oil level is normally indicated on the main display.
- g) Install the cover of fuel tank.



- (1) Treat the collected waste diesel according to relevant environmental protection regulations, and do not discharge it into the environment.
- (2) Take preventive measures to avoid fires when cleaning the fuel tank.

4.6.3 Cooling system

Position of cooling system: at the rear part of the slewing table, near the engine.

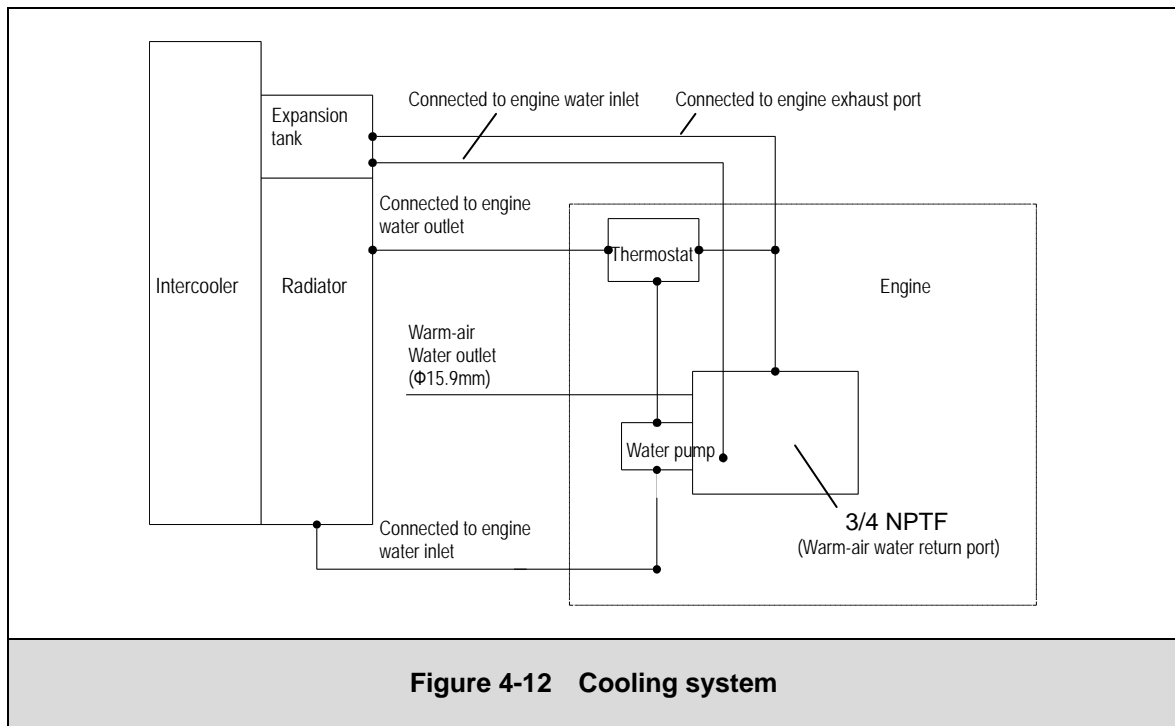


Figure 4-12 Cooling system

4.6.3.1 Inspection of coolant level

The coolant of engine might reduce continuously due to leakage and evaporation. Severe loss of the coolant will result in poor capability for heat dissipation of the engine, thus causing damages to the engine.

Method of inspecting coolant level:

- a) Observe the transparent window on one side of the expansion tank. If the coolant level can be seen in the window, then the coolant is enough. Otherwise, supplement is needed.
- b) If there is no inspection hole, open the cover of expansion tank to make sure that the coolant level is 1/2 to 2/3 of the total volume. If the coolant level is less than 1/2 of the total volume, supplement is needed.

Check the cold-proof capacity of the coolant before each cold season comes. Or you can consult the operating instructions of the engine manufacturer.

Supplement of coolant: open the cover of the expansion tank and put proper amount of coolant into it to make the fluid level be visible through the window.

As for the performance of coolant, please refer to section 6.1.

 **CAUTION**

- (1) **Before adding the coolant, stop engine and cool it down for some time. Only after the engine cools down, can you open the sealing cover of the cooling system. Otherwise, the system will be full of pressure, which will result in accident.**
- (2) **When opening the expansion water tank cover, avoid getting burnt.**
- (3) **Ensure that the added coolant is the same as the original one.**

4.6.3.2 Cleaning of the cooling system

Make sure the cooling system has cooled for 60 minutes before cleaning work on the cooling system. During the cleaning process, press it lightly to prevent damaging the cooling fan. Blow the cooler dry with compressed air in the opposite direction of the air flow. Otherwise, do the same when using water as the spray.

Under normal circumstances, if the cooling water temperature increases suddenly, it means that the internal cooler has been clogged and the outer cooler is clean and no other faults exist. In this case, clean the cooling system thoroughly. At the same time, remove the grease, calcium and rust from the cooling circuit system. For detailed information, please refer to operating instructions of engine manufacturer.

 **DANGER**

Be careful to clean the cooling system, otherwise, you may get burned or scalded.

4.6.3.3 Change of the coolant

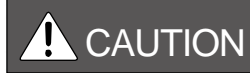
When the coolant has been used for 2 years, it must be changed. Even though the engine has not operated for a long time, the coolant also needs to be changed.

Change steps:

- a) Turn off the engine. Otherwise, the system is full of pressure, which may cause accident.
- b) Put a proper vessel under the cooling water tank to collect the coolant.
- c) Unscrew the water drain plug at the lower end of the cooling water tank to let the coolant flow into the vessel and to drain clean the old coolant.
- d) Screw the water drain plug.
- e) Inject new coolant from the water inlet of the expansion water tank. When adding coolant into the cooling system, be careful to prevent bubbles from entering into the cooling system. The sealed air will damage the engine. The water can't contain scale which can form mineral. Do not use softened water. Pause many times during the process, making the coolant level safe and stable. Allow the sealed air to come out.
- f) Start up the engine and run it for several minutes at idle speed to make the coolant free of air bubbles. Inspect the coolant level again. Add enough coolant into it according to needs.

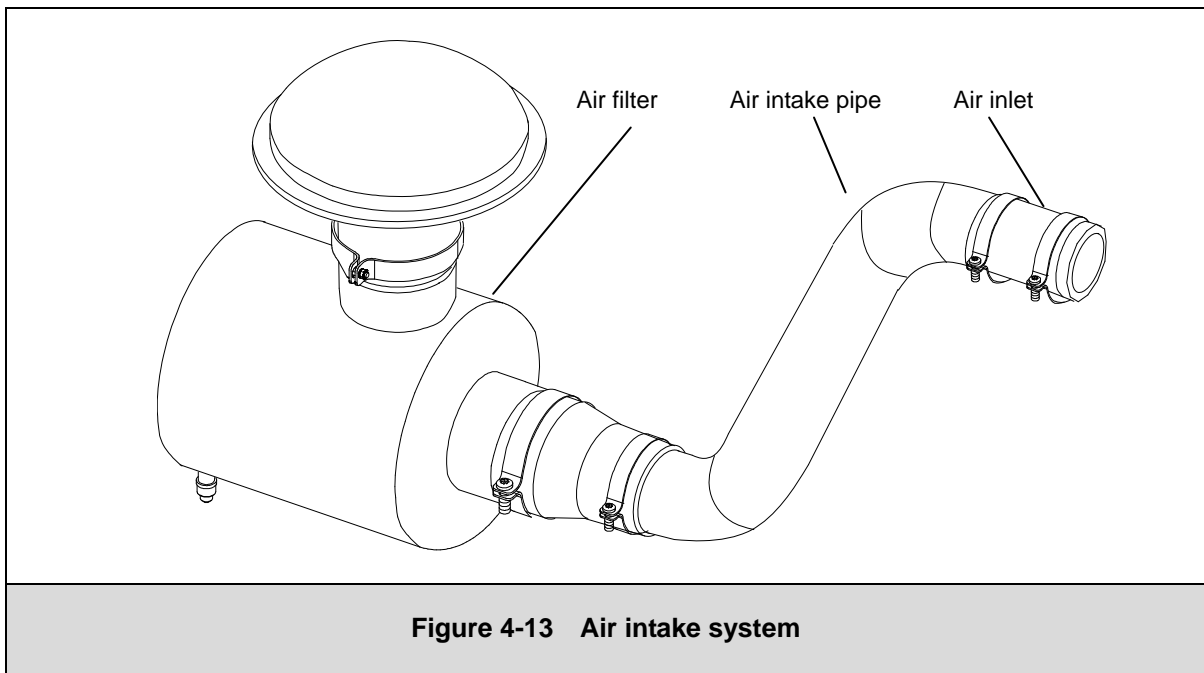
For the change interval of the coolant, refer to section 4.5.

For the performance requirements of the coolant, refer to section 6.1.



Do not drain the coolant to the natural environment.

4.6.4 Air intake system


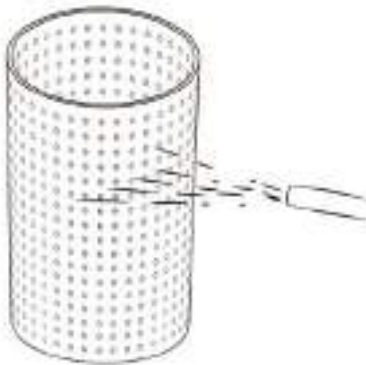
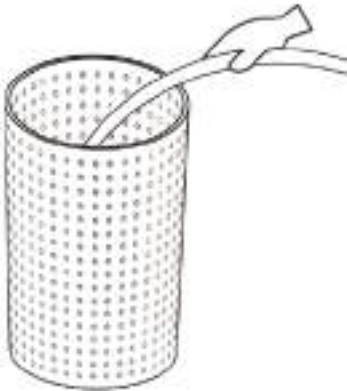
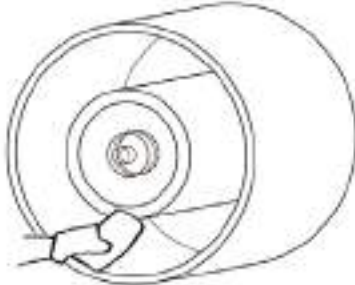


4.6.4.1 Cleaning of air filter

When the engine runs at rated rotational speed, if the pointer of air filter clog indicator is in the red area, it means that the filter cartridge is seriously clogged and needs to be cleaned.

Cleaning steps:

- a) Unscrew the bolts at the end of air filter, dismantle the tail cover and then pick out the external filter cartridge.
- b) Shake off the dust from the external filter cartridge, and blow the filter cartridge from inside to outside with compressed air.
- c) Install the external filter cartridge in the air filter and mount the tail cover.
- d) Open the dust nozzle of air filter and knock the housing slightly to eliminate the dust.
- e) Close the dust nozzle.
- f) Start engine and run it at rated speed until the pointer of air filter clog indicator is in the green area.

	
<p>a) Shake off the dust from the filter cartridge.</p>	<p>b) Blow the outer surface of filter cartridge with compressed air.</p>
	
<p>c) Blow the inner surface of filter cartridge with compressed air.</p>	<p>d) Clean the sealed supporting surface.</p>
<p align="center">Figure 4-14 Cleaning of air suction filter</p>	

! WARNING

Do not start up the engine during the cleaning work.

! CAUTION

- (1) Do not damage the filter cartridge when cleaning the external filter cartridge.
- (2) Do not clean the internal filter cartridge (safety filter cartridge). Do not clean external filter cartridge for more than 5 times.
- (3) If the corrugation or separation plate is damaged, the filter cartridge can't be used any more.

4.6.4.2 Replacement of air filter cartridge

When the external filter cartridge is cleaned for many times, its filtering performance will be degrade. At this time, the external filter cartridge must be replaced.

When changing the external filter cartridge, replace the internal filter cartridge (safety filter cartridge) at the same time.

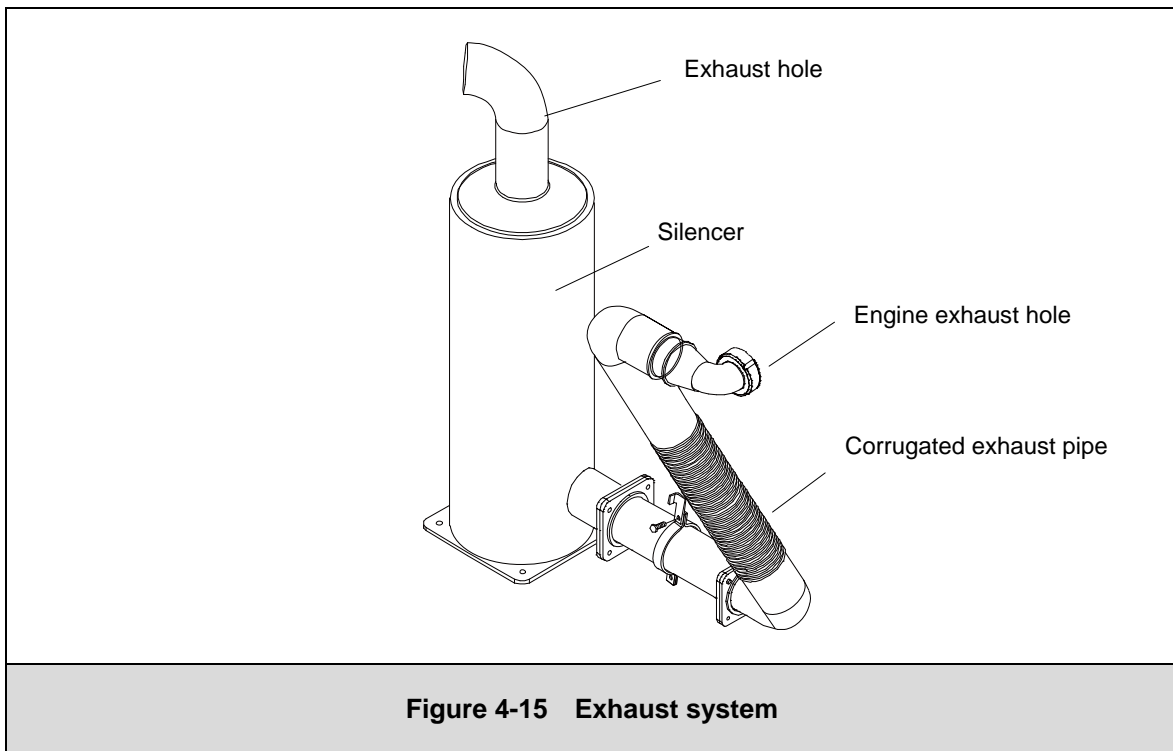
The change interval for filter cartridge is 2,000 hours or at least every 2 years. It will be shortened in the severe dust environment.

As to the change of filter cartridge, the dismantling and installation of filter cartridge can be carried out according to the method mentioned in section 4.6.4.1.



To ensure the quality of filter cartridges, purchase the filter cartridge accessories from the basic machine manufacturer.

4.6.5 Exhaust system



4.6.5.1 Visual inspection and daily maintenance

- a) Check exhaust system for leaks.
- b) No pipe or cable is placed in the thermal radiation dangerous zone near the exhaust system.
- c) Remove the accumulated carbon in the exhaust pipe regularly.

4.7 Hoisting winch and derricking winch

4.7.1 Inspection of oil level of winch reducer

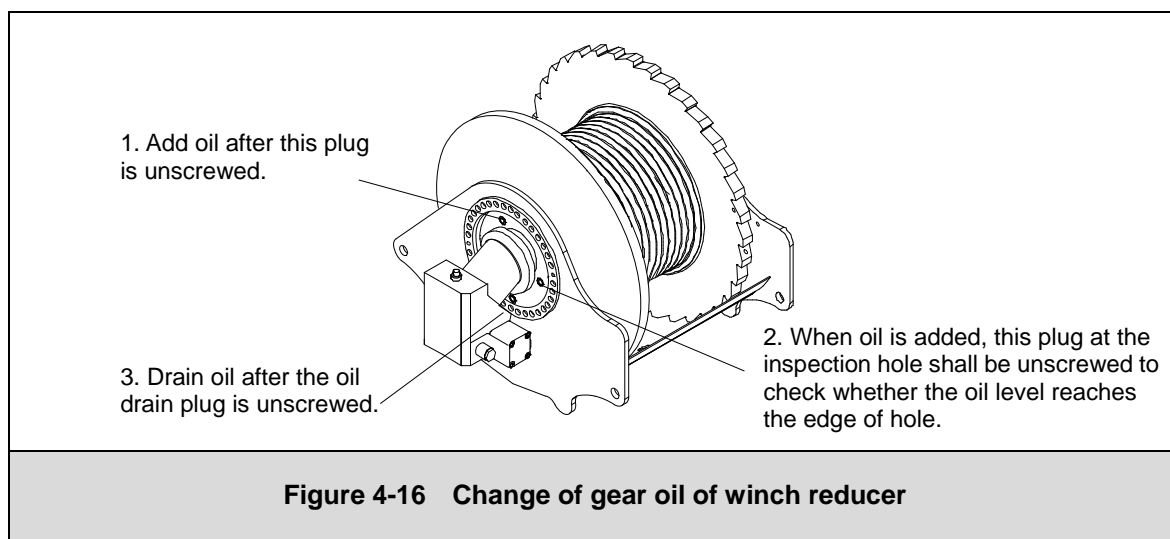
Stop the machine on the level ground, and unscrew the oil level plug. If you can see the oil level, it means that the oil is sufficient. Otherwise, gear oil is needed to refill.

Always inspect the oil level when the transmission has stopped and the oil has cooled down. During the operation, the gear box should be allotted a great amount of oil. As a result, once the system has completed debug, it's suggested that inspect the oil level again when the gear has stopped and refill the oil according to requirements. Please refer to section 4.7.2.



If oil leakage is found when inspecting the oil level, the operation should be stopped and the system should be dismantled for checking.

4.7.2 Change of gear oil of winch reducer



Use the oil brand required by section 6.4 or the brand in the name plate. You'd better use oil with high viscosity. The oil of different types should not be mixed to use, although they are made by the same manufacturer.

When gear oil has been used for a long time, it should be changed according to the following procedures:

- Put a container to hold the waste oil, unscrew the oil drain plug, and put the oil into the container.
- Screw the oil drain plug tightly after the oil is drained away completely.
- Unscrew the oil inlet plug, put a funnel into the oil inlet and add specified gear oil to marked position;
- Screw the oil inlet plug tightly.

During operation, the gear box should be allotted a great amount of oil. As a result, once the system has completed debug, it's suggested that inspect the oil level again when the gear has stopped and refill the oil according to requirements.

When main boom is on the ground, you should change gear oil for hoisting winch 1 (H1) and hoisting winch 2 (H2).

As for winch gear oil change interval and change amount, please refer to section 6.7.

! CAUTION

- (1) Pay attention to environmental protection when disposing of waste oil.
- (2) Only when the machine has operated for a long time, can the gear oil be changed. It shall be drained off when the oil is still hot.

4.7.3 Inspection of tightening bolts of winch reducer

Because all tightening bolts use Loctite glue, there is no need to tighten them again. Visual inspection is enough.

4.7.3.1 Hoisting winch reducer

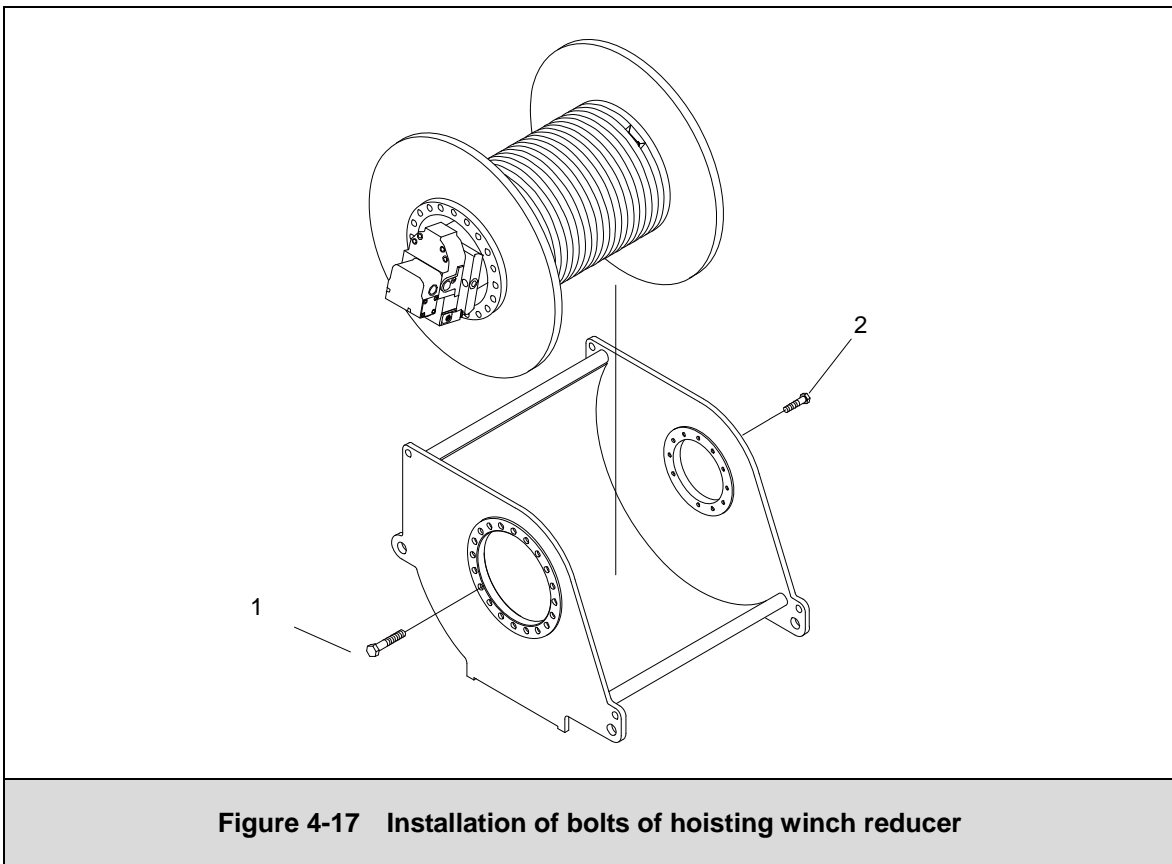


Figure 4-17 Installation of bolts of hoisting winch reducer

Table 4-3 Bolts of hoisting winch reducer

Product type	No.	Names	Specification	Use loctite glue or not	Remarks
ZCC1300	1	Bolt	M20×1.5×60-8.8	√	As to tightening torque of bolt, refer to section 7.1.
	2	Bolt	M16×50-8.8	√	
ZCC1800	1	Bolt	M24×80-8.8	√	
	2	Bolt	M16×55-8.8	√	
ZCC2600	1	Bolt	M24×80-8.8	√	
	2	Bolt	M16×50-8.8	√	

4.7.3.2 Derricking winch reducer

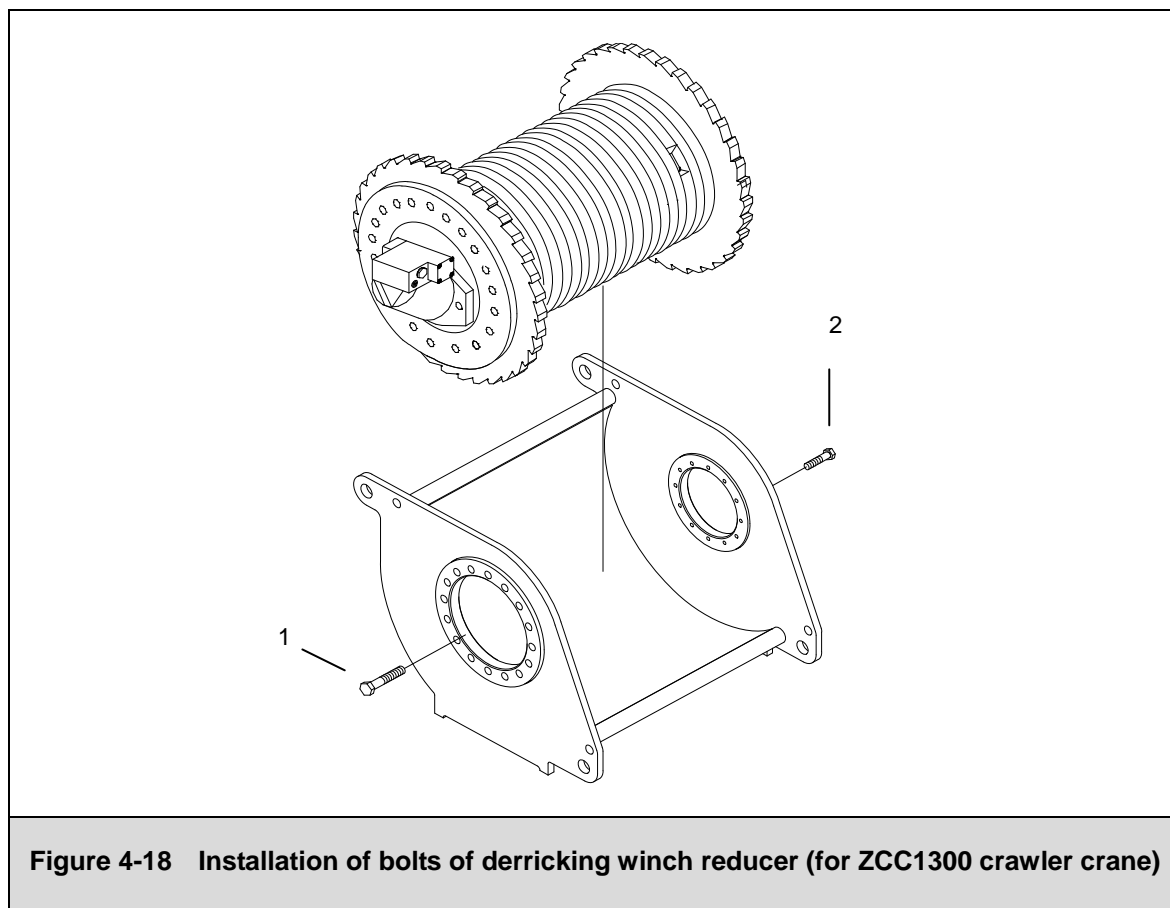


Figure 4-18 Installation of bolts of derricking winch reducer (for ZCC1300 crawler crane)

Table 4-4 Bolts of derricking winch reducer of ZCC1300 crawler crane

Product type	No.	Names	Specification	Use loctite glue or not	Remarks
ZCC1300	1	Bolt	M20×60-8.8	√	As to tightening torque of bolt, refer to section 7.1.
	2	Bolt	M12×60-8.8	√	

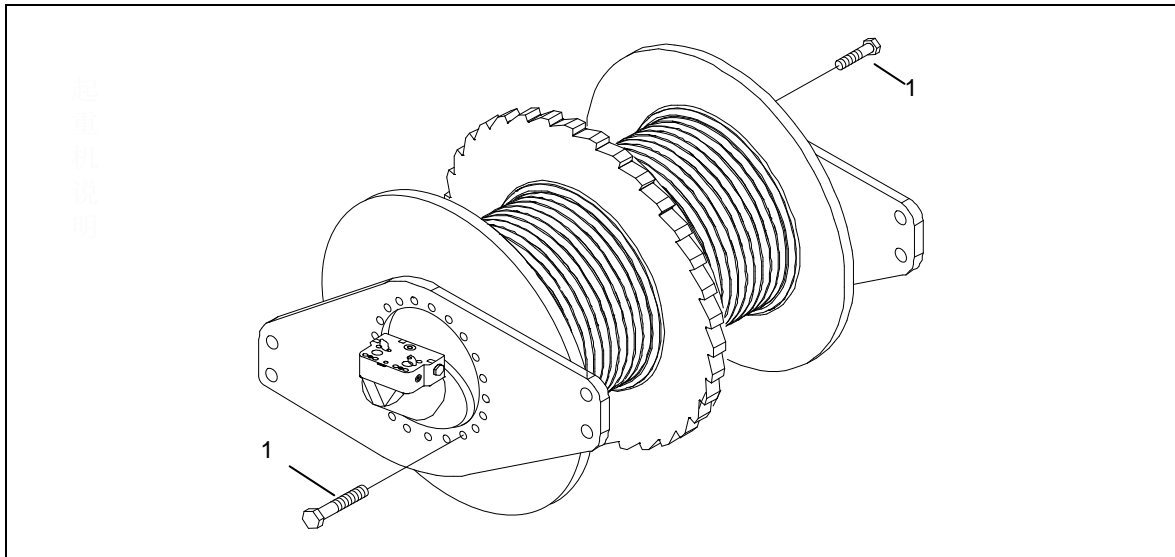


Figure 4-19 Installation of bolts of derricking winch reducer (for ZCC1800/ZCC2600 crawler crane)

Table 4-5 Bolts of derricking winch reducer of ZCC1800/ZCC2600 crawler crane

Product type	No.	Names	Specification	Use loctite glue or not	Remarks
ZCC1800	1	Bolt	M20×50-8.8	√	As to tightening torque of bolt, refer to section 7.1.
ZCC2600	1	Bolt	M24×80-8.8	√	

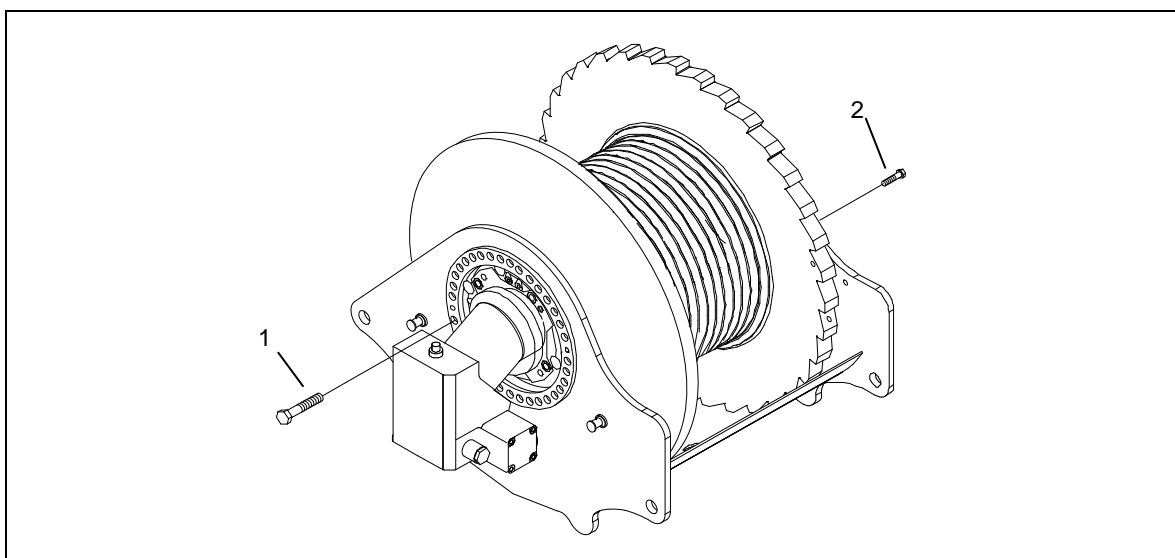


Figure 4-20 Installation of bolts of luffing jib derricking winch reducer (for ZCC2600 crawler crane)

Table 4-6 Bolts of luffing jib derricking winch reducer of ZCC2600 crawler crane

Product type	No.	Names	Specification	Use loctite glue or not	Remarks
ZCC2600	1	Bolt	M24x80-8.8	√	As to tightening torque of bolt, refer to section 7.1.
	2	Bolt	M16x50-8.8	√	



Remove the loose, cracked or defective bolts or screws, and replace them with new bolts or screws.

4.7.4 Inspection of brakes of the winch reducer

Inspect the brake of hoisting winch reducer according to the following steps:

- a) Start up the engine and run it at a speed slightly higher than idle speed.
- b) Apply a maximum load that the wire rope can bear to the corresponding hoisting winch.
- c) Operate the control lever to lift the load via the hoisting winch 1 (or 2).
- d) When the load is suspended in the air, push the control lever of the hoisting winch 1 (or 2) to the neutral position and then make a mark at a certain place on the winding drum.
- e) Keep the load in the air for several minutes and then check whether the position of the mark moves. If the position doesn't change, it indicates that the brake of the winch reducer is good.

Inspect the brake of derricking winch reducer according to the following steps:

- a) Start up the engine.
- b) Disconnect the oil pipe at the brake cylinder of the derricking winch reducer.
- c) Raise the boom via derricking winch.
- d) If the holding pressure reaches the overflow pressure of the main pump and no derricking movements are performed, it indicates that the derricking winch is effectively braked.



Only well-trained professionals can inspect the brake of winch reducer. Incomplete brake may cause accidents.



There are dangers of being dragged. Therefore, the maintenance personnel must be careful not to be dragged between the winch and wire rope during the maintenance, inspection and assembly work.

4.7.5 Inspection of hoisting winch reducer and derricking winch reducer

Both hoisting winch reducer and derricking winch reducer are designed using integrated planetary gears. The gears are designed for long service life and the drive shaft and drive gear are rated for endurance. Even though these gears are designed for long service life, an external visual inspection is not adequate, since their life can be significantly affected by bad maintenance (insufficient oil), defective seals, improper operation or overuse. The inspection must therefore be carried out by a competent inspector in accordance with the following guidelines.

a) Inspection interval

Every 1000 operating hours, at least once a year

b) Check oil level

For hoisting and derricking winches, we recommend that the oil be drained and the amount compared to the specified oil quantity.

c) Check oil color

If the oil is black and/or a burnt oil smell is detected, you can judge that the oil has been overheated. In this case, the oil must be changed at once.

d) Check for foreign substances

This inspection should be carried out in a qualified laboratory. The used oil shall be dribbled onto the specified filter medium. The oil sample is visually checked under a microscope for foreign particles. If any particles are detected, the oil must then be sent to a qualified laboratory and analyzed to determine the makeup of the particles.

e) Evaluation of foreign substances found in the oil

The maximum permissible quantity of foreign material measured by weight is 0.15% of total oil weight.

Maximum permissible foreign particle size from fine abrasion is 0.229mm.

If above values are exceeded, the drive device must be dismantled to determine the root cause of increased contamination and then the drive device should be refilled with fresh oil.



These inspections must be carried out by professionals.

f) Visual inspection

The drive devices shall be checked for leakage, since any loss of oil, in addition to polluting the environment, can lead to gearbox failure. When checking the crane every year, make sure the used theoretical service life of winches. If necessary, the crane operator must ask professionals to do the job.

 **DANGER**

Once violate the standard configuraton when determining the residual service lift, the winch may stop suddenly or unexpected fault may occur. This will cause property loose, even death.

g) Inspection of brake of drive device

Check the brake and drive device at the same time.

If the load can not be braked, the inspector must dismantle the brake device and then find the cause. If planetary gear is dismantled because of increasing contamination, the brake shall also be inspected.

 **WARNING**

Only qualified personnel with specialized knowledge can inspect the drive device and brakes.

4.7.6 Theoretical service life of winches

4.7.6.1 Theoretical service life

The service life of the winch can be calculated according to drive group and load collective of winch. Crane winches are classified on the basis of FEM98.

Drive group: $M3$

Load collective: $L1$

Load collective factor $K_m = 0.125$

Theoretical service life $D = 3200h$

 **CAUTION**

The “theoretical service life” is not equal to the real (true) life of a winch.

The actual life of a winch is affected by many additional outside factors, for example:

- a) Overloading. The crane was not used as intended.
- b) Inadequate maintenance. The oil is not changed in time.
- c) Improper operation. Excessive acceleration or deceleration of load; load falling onto the cables.
- d) Improper maintenance:
 - Using the wrong type of oil;
 - Too much or too little oil;
 - Contamination during oil change.
- e) Assembly errors during repair and maintenance
- f) Undetected oil leakage
- g) Improperly set safety devices

- h) Hidden damage from accidents
- i) Extreme environmental conditions:
 - Extremely low or high temperatures
 - Corrosive atmosphere
 - Dust and dirt

4.6.7.2 Used portion of theoretical service life

The crane operator is obligated to have the crane inspected at least once a year.

The actual operating conditions (load collective) and the winch operating hours at each inspection interval are required to determine the proportion of the theoretical service life that has actually been used.

4.6.7.3 Determining the operating condition (load collective)



For mobile crane in assembly operation, we usually use load collective $L1(Q1)$, with load collective factor $K_m = 0.125$.

Table 4-7 Calculation of theoretical service life of the winch

Load collective classification	Definition	Service life	Load collective factor	Graph
Light load $Q1$ $L1$	Engine or other relevant parts are subjected to max. load in exceptional cases. Generally, they operate at light load.	10% of the running time at maximum load (dead load and 1/1 working load); 40% of the running time with dead load and 1/3 working load; 50% of the running time only with dead load	$K_m = 0.125$	
Medium-duty load $Q2$ $L2$	Engine or other relevant parts are subjected to max. load relatively often. Generally, they operate at medium-duty load.	1/6 of the running time at maximum load (dead load and 1/1 working load); 1/6 of the running time with dead load and 2/3 working load; 1/6 of the running time with dead load and 1/3 working load; 50% of the running time only with dead load	$K_m = 0.25$	

Load collective classification	Definition	Service life	Load collective factor	Graph
Heavy-duty load <i>Q3 L3</i>	Engine or other relevant parts are frequently subjected to max. load. Generally, they operate at heavy-duty load.	50% of the running time at maximum load (dead load and 1/1 working load); 50% of the running time only with dead load.	$K_m = 0.5$	
Very heavy load <i>Q4 L4</i>	Engine or other relevant parts are regularly subjected to near maximum load	90% of the running time at maximum load (dead load and 1/1 working load); 10% of the running time only with dead load	$K_m = 1$	

4.7.6.4 Determining the effective operating hours T_i during each inspection interval

The control system of the crane can record the operating hours of engine which can be read directly from the display.

For mobile cranes used in assembly operations, the operating time for the superstructure can be estimated at 60% of the total operating hours of the crane. If the hoisting winch proportions is estimated at 20% of the superstructure operating hours, the resulting hours as a percent of the total crane operating hours is: 12%.

Calculate the effective operating hours T_i of the winch during each inspection interval



The percentage mentioned above normally is applicable to hoisting winch. For auxiliary winch or the winch on the boom frame, the actual share of total operating hours is not important. It can be guessed by the operator.

4.7.6.5 Determining the actual used portion of theoretical service life

The actually used proportion S_i of the theoretical service life is given by the following formula:

$$S_i = \frac{K_{mi}}{K_m} \times T_i$$

Where:

S_i - the used portion of theoretical service life

K_m - load collective factor

K_{mi} - load collective factor for inspection interval i

T_i - effective operating hours for inspection interval i

The actually used hour proportion is subtracted from the remaining theoretical service life D_i after each inspection interval.

If the remaining theoretical service life is not long enough to cover the next operating period, a general overhaul of the winch is required. If the theoretical service life has been reached, the winch may only be operated after conducting a general overhaul. After the general overhaul, an authorized person by the manufacturer or the manufacturer himself will declare its new theoretical life. However, the longest interval before next overhaul should not exceed 10 years.



- (1) A general overhaul of the winch is required not later than 10 years after putting the crane into service for the first time.
- (2) The general overhaul shall be arranged by operator and carried out by the manufacturer or the manufacturer's authorized representatives.

4.7.6.6 Example

Working group: $M3$

Load collective: light load $L1$

Load collective factor: $K_m = 0.125$

Theoretical service life: $D = 3200\text{h}$

Actual used proportion S of theoretical service life is calculated using the individual inspection intervals as follows:

Using condition of the crane:

When $K_m = 0.125$, the load collective is $L1$. The operating time of engine is 1800h. The winch operated about 12% of the time, i.e. $T_1 = 216\text{h}$.

The actual used proportion S_1 of theoretical service life at the time of the first inspection is therefore:

$$S_1 = \frac{0.125}{0.125} \times 216\text{h} = 216\text{h}$$

Remaining theoretical service life D_1 :

$$D_1 = 3200\text{h} - 216\text{h} = 2984\text{h}$$

Second inspection

When $K_{m2} = 0.25$, the load collective is $L2$. The operating hours of the engine is 3400h during this period:

$3400\text{h} - 1800\text{h} = 1600\text{h}$ (1800h were used during the first year of operation)

The winch operated about 12% of the time, i.e., $T_2 = 192\text{h}$.

The actual used proportion S_2 of the theoretical service life at the time of the second inspection is therefore:

$$S_2 = \frac{0.25}{0.125} \times 192\text{h} = 384\text{h}$$

Remaining theoretical service life D_2 :

$$D_2 = 2984\text{h} - 384\text{h} = 2600\text{h}$$

Do the same for the rest calculation.

When calculating, make sure that the remaining theoretical service life can survive the next work interval. Otherwise, an overhaul is needed.

4.8 Maintenance of the slewing reducer and slewing ring

4.8.1 Slewing reducer

4.8.1.1 Inspection of oil level of slewing reducer

It's normal if the oil level is higher than the oil inspection hole. Otherwise, adding gear oil is required.

CAUTION

If oil leakage is found when inspecting oil level, the inspection must be stopped and the system must be dismantled for checking.

4.8.1.2 Replacement of gear oil of slewing reducer

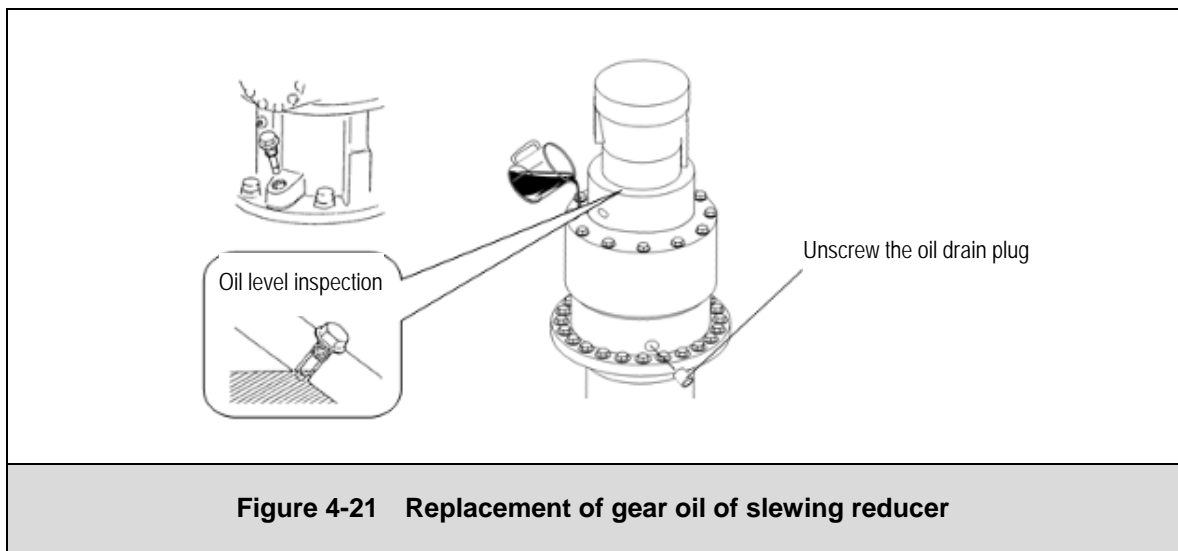


Figure 4-21 Replacement of gear oil of slewing reducer

Changing steps:

- Put a proper vessel to collect the waste oil, unscrew and remove the oil drain plug to make the oil flow out to the vessel.
- When the original gear oil has flew out completely, screw the oil drain plug tightly.
- Unscrew and remove the oil filling plug, insert the funnel into the oil filler, and add the specified gear oil until the oil level reaches the plug of the inspection hole.
- Screw the oil filling plug.

CAUTION

- Pay attention to environmental protection when disposing of waste oil.
- Only when the machine has been operated for a long time, can the gear oil be changed. It shall be drained off when the oil is still hot.

4.8.1.3 Brake inspection of slewing reducer

Check whether there exists oil leakage of slewing reducer or the brake can function normally. Replace the faulty components if abnormal operation appears. Assign only well-trained professionals to inspect the brake of slewing reducer. Incomplete brake may cause accidents. Inspect the brake of slewing mechanism according to the following order:

- a) Start up the engine.
- b) Disconnect the oil pipe at the brake cylinder of the slewing reducer.
- c) Perform the slewing movements.
- d) If the holding pressure reaches the overflow pressure of the slewing pump and no movements are performed by slewing reducer, it indicates that the slewing is effectively braked.



Assign only well-trained professionals to inspect the brake of slewing reducer. Incomplete brake may cause accidents.



There are dangers of being dragged. Therefore, the maintenance personnel must be careful not to be dragged into pinion gear during the maintenance, inspection and assembly work.

4.8.1.4 Inspection of mounting bolts of slewing reducer

Because all mounting bolts use Loctite glue, there is no need to tighten it again. Visual inspection is enough.

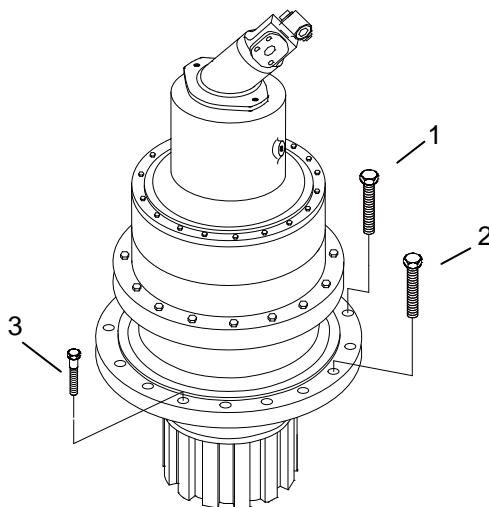


Figure 4-22 Mounting bolts of slewing mechanism for ZCC1300 crawler crane

Table 4-8 Mounting bolts of slewing mechanism for ZCC1300 crawler crane

No.	Names	Specification	Quantity	Use loctite glue or not	Remarks
1	Bolt	M16×70-8.8	19	√	As to tightening torque for bolt, please refer to section 7.1.
2	Bolt	M16×110-8.8	3	√	
3	Bolt	M16 Self-made piece	2	√	

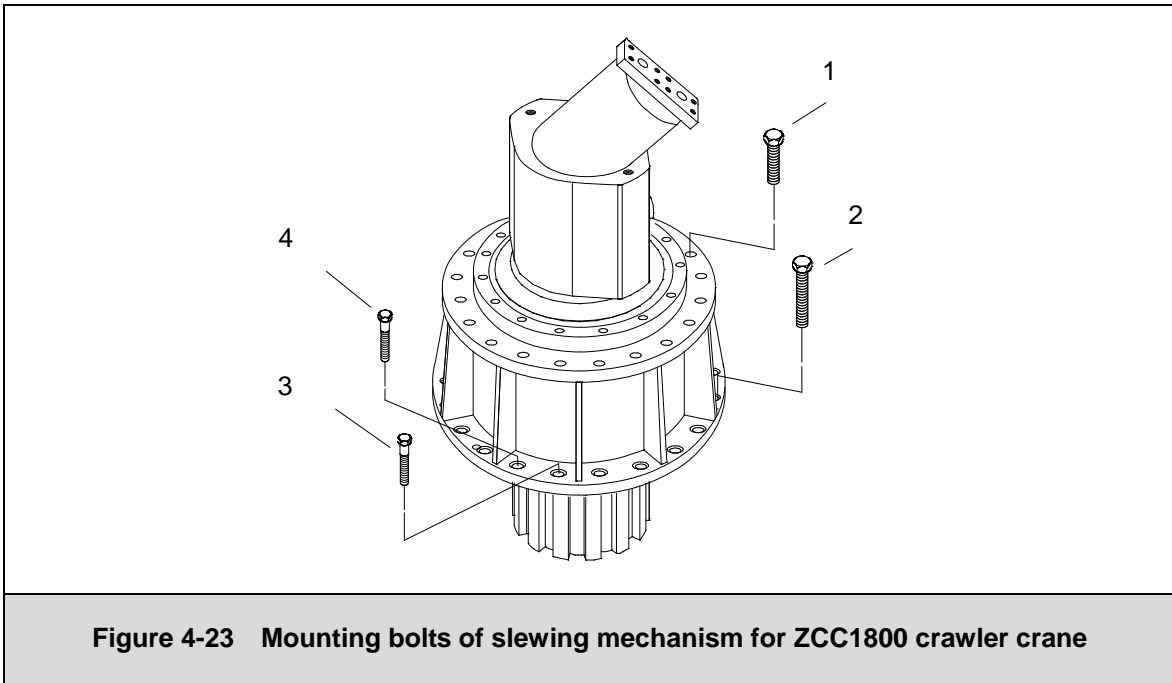


Table 4-9 Mounting bolts of slewing mechanism for ZCC1800 crawler crane

No.	Names	Specification	Quantity	Use loctite glue or not	Remarks
1	Bolt	M20×70-8.8	19	√	As to tightening torque for bolt, please refer to section 7.1.
2	Bolt	M20×80-8.8	9	√	
3	Bolt	M20	4	√	
4	Bolt	M20×130-8.8	3	√	

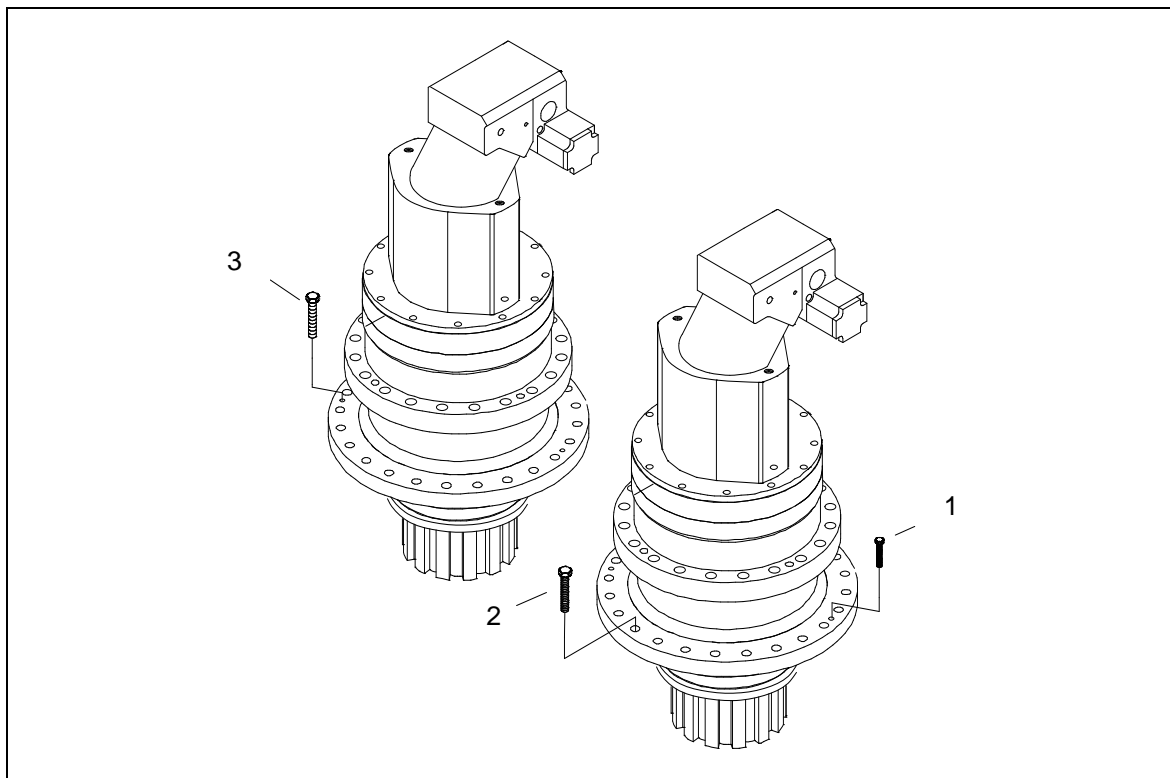


Figure 4-24 Mounting bolts of slewing mechanism for ZCC2600 crawler crane

Table 4-10 Mounting bolts of slewing mechanism for ZCC2600 crawler crane

Product type	No.	Names	Specification	Quantity	Use loctite glue or not	Remarks
ZCC2600	1	Bolt	M16×90-8.8	4	√	As to tightening torque for bolt, please refer to section 7.1.
	2	Bolt	M16×70-8.8	36	√	
	3	Bolt	M16 Self-made piece	8	√	



Remove the loose, cracked or defective bolts or screws, and replace them with new bolts or screws.

4.8.2 Slewing ring



- (1) There is danger of being dragged into pinion gear when doing the maintenance and service work.
- (2) Danger of smash and cutting. Make sure that no maintenance personnel is standing on the dangerous zone between the main boom, superstructure and the slewing ring, and also the dangerous zone between undercarriage and the slewing ring when the crane slews or changes its angle, excluding crane operator(in the operator's cab).

4.8.2.1 Inspection of slewing ring bolts

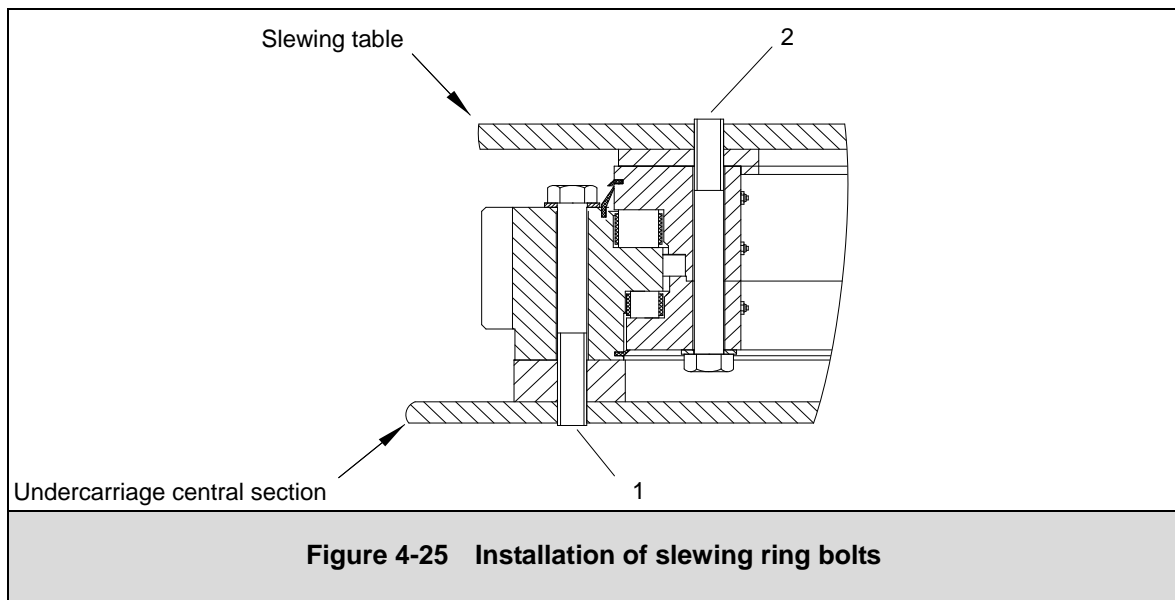


Table 4-11 Mounting bolts of slewing ring

Product type	No.	Names	Specification	Quantity	Use loctite glue or not	Remarks
ZCC1300	1	Bolt	M30×200-10.9	54	√	As to tightening torque for bolt, please refer to section 7.1.
	2	Bolt	M30×210-10.9	54	√	
ZCC1800	1	Bolt	M30×260-10.9	60	√	
	2	Bolt	M30×300-10.9	52	√	
ZCC2600	1	Bolt	M33×255-10.9	72	√	
	2	Bolt	M33×270-10.9	72	√	

a)

Inspect the bolts on the slewing ring visually before the crane works each time or at least once a week.

- b) When the slewing ring has been used for 100 working hours for the 1st time, inspect whether the bolts are loose. And inspect them again at the 300th working hour. After that, inspect them every 500 working hours. And the inspection interval shall be shortened under poor working conditions. If loose bolts are found during inspection, please stop the operation and contact with the local customer service department. Whether dismantling or inspection is decided by the factory or technician after checking.
- c) Lithium base grease is needed to fill the slewing ring before the mounting work.
- d) When bolts are replaced, wipe them clean and then tighten them after coating them with the screw thread glue.



Use the crane according to operating manual and load capacity chart or inspect the tightening bolt regularly according to requirements, which can avoid the danger of bolt weary and damage.

4.8.2.2 Routine inspection of slewing ring

- a) Inspect the flexibility of the slewing ring. If noises and impacts are found to increase suddenly, stop the crane to inspect and fix the breakdown. Dismantle and inspect the slewing ring if necessary.
- b) Regularly inspect whether there are defects such as cracks or damages on the slewing gear ring, seizing, bite and peeling of the gear surface.
- c) Frequently inspect the sealing. If the seal belt is found to be damaged, replace it in time. If it is found to peel off, reset it in time.

4.8.2.3 Lubrication of gear surface of slewing ring

Gear ring of slewing rings have been coated with the rust preventive oil before being delivered from the factory. This rust-proof oil's period of validity is usually 3 to 6 months. Upon expiration of the period of validity, they shall be coated with the rust preventive oil in time.



Prevent the slewing ring being put under the sun directly. At the same time, it is forbidden to flush the slewing rings with water directly to prevent the water from flowing into the raceway. Hard foreign matter is prohibited to approach or enter into the gear area.

4.8.2.4 Lubrication of raceway of slewing ring

Raceways must be injected with lubricating grease regularly according to the working environment. After having worked for 50hs, raceways shall be injected with the lubricating grease. After that, it should be injected with lubricating grease again every 300 working hours. The slewing ring must be injected with grease before and after a long-term placement.

If using vapor to spray on the cleaner or fixed sprayer to clean the crane, be sure not to make water come into the slewing ring connection. After that, lubrication of slewing ring is needed.

In special working environment, such as tropical zone, high humidity, many dusts and large temperature variation and having worked continuously, the lubrication interval shall be shortened.

The grease should be injected when the slewing ring operates. When the lubricating grease flows over from the seal, it indicates that the injection is completed and the over flown grease will form a thin film to seal it.

4.9 Crawler and traveling reducer

4.9.1 Crawler carrier assy.

Crawler carrier assy. is composed of crawler carrier, track roller, track carrier roller, drive sprocket, driven sprocket and track pad. It has crawler tension device. When the crawler has travelled for a long time, the crawler will come loose. Tensioning of the crawler is needed.

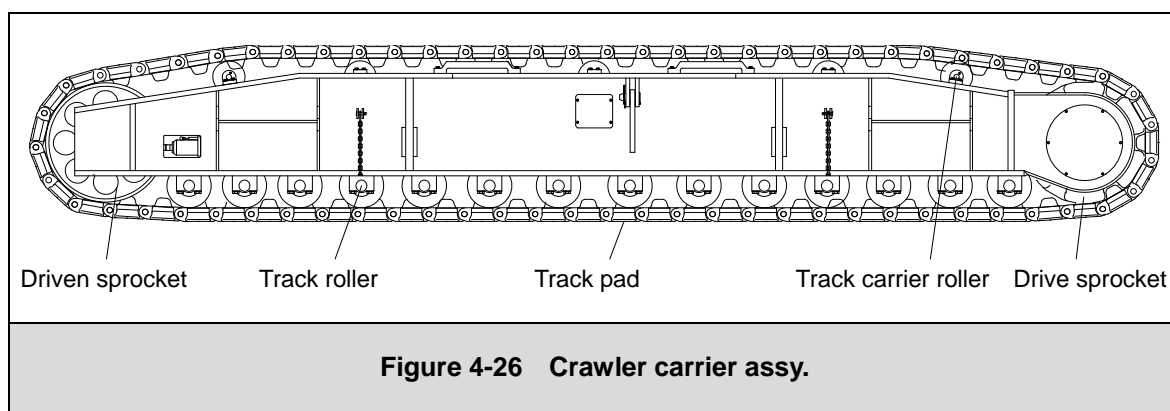


Figure 4-26 Crawler carrier assy.

DANGER

- (1) There exists danger between crawler and superstructure when the superstructure is slewing. Be careful when maintenance, inspection and hoisting operations are carried out in this area.
- (2) Turn off the motor before carrying out any operations to crawler.

4.9.1.1 Crawler inspection

Items to be inspected:

- a) The wear of travel gear and track pad connecting pin, lubrication of track pad connecting pin, and tension of track pad.
- b) The wear of the track roller or track carrier roller.
- c) The wear of driving device, lubrication of reducer and smudginess of the crawler.

CAUTION

Insufficient lubrication of track pad connecting pin, improper tension of track pad or crawler stain will cause noise and premature wear. Thus, inspection of the crawler is needed before each operation or after traveling for a long distance. The inspection interval should not exceed one month.

4.9.1.2 Cleaning of the crawler

Clean the crawler when it is dirty. Since when the crane is dirty, it needs more energy to move, thus increasing wear of the crane.

The cleaning involves wiping off the dirt on track pad, sundries on the crawler carrier, and soil being mingled in between the drive sprocket or track roller and the track pad, etc.

4.9.1.3 Lubrication of the track pad connecting pin

Put the track pad connecting pin in a proper position so that the service personnel can spray the connecting pin with lubricant. Move the crane forward until the lower track pad connecting pins are located on track carrier roller, and then spray them with lubricant. Make sure that the lubricant can penetrate into the connection hole between the track pad connection pin and the track pad.



Lubricate the track pad connecting pin after cleaning the crawler carrier and before tensing of crawler parts.

4.9.1.4 Tension of track pad

The tension of track pad is a standard judging whether the track pad is strengthened. The tension of track pad is estimated by its relaxation (L) around 40 ± 5 millimeter (for ZCC1300/ZCC1800 crawler crane) and 50 ± 5 mm (for ZCC2600 crawler crane) after proper cleaning and strengthening, and the crawler components must be tightened or loosened subject to their tightness.

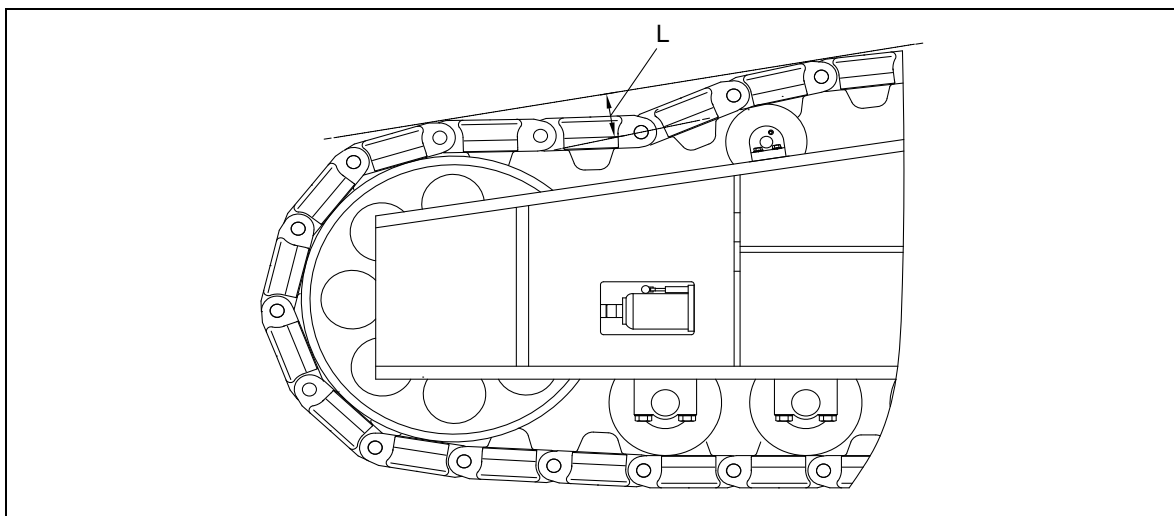


Figure 4-27 Judging of track pad tension



Slightly move the crane forwards before adjusting to concentrate the loose parts of the crawler on the top of drive sprocket, so that it can be easily adjusted.



- (1) Before checking the tension of track pad, clean the track pad first.
- (2) The tension of crawler must be adjusted when the machine is on level ground.

Adjustment steps:

- a) Remove the guard boards at both right and left sides of driven sprocket.
- b) Align the two screw jacks with the axles respectively under natural state.
- c) Press the handle of the screw jack slowly to move the axle and driven sprocket forward, causing space between slide block of driven sprocket and gaskets.
- d) After adjusting the crawler to appropriate tension, stop the movement of screw jacks and fill proper number of gaskets in the space between slide block of driven sprocket and gaskets.
- e) Drive the basic machine forward for some distances straight and check whether the upper track pad, driven sprockets both sides and the track pad of drive sprocket extend fully and whether concave occurs between track pads. If it exists, do the steps b)-d) once again, until no concave occurs after the whole track pad travels some distance straight.
- f) Take back the screw jacks at both sides. Mount the guard boards.

4.9.2 Travelling reducer

4.9.2.1 Inspection of oil level of travelling reducer

- a) Stop the crane on the level ground and remove the plug of oil level inspection hole.
- b) It's normal if the oil level is higher than the inspection hole. Otherwise, adding gear oil is required.
- c) Screw the plug of oil level inspection hole.

Oil change interval and oil change amount for travelling reducer, please refer to section 6.7.



- (1) If oil leakage is found when inspecting the oil level, the operation must be stopped. Dismantle it to have a look.
- (2) The travelling reducer has two independent oil chambers which are not connected with each other. Therefore, add oil to them respectively.

4.9.2.2 Replacement of gear oil of travelling reducer

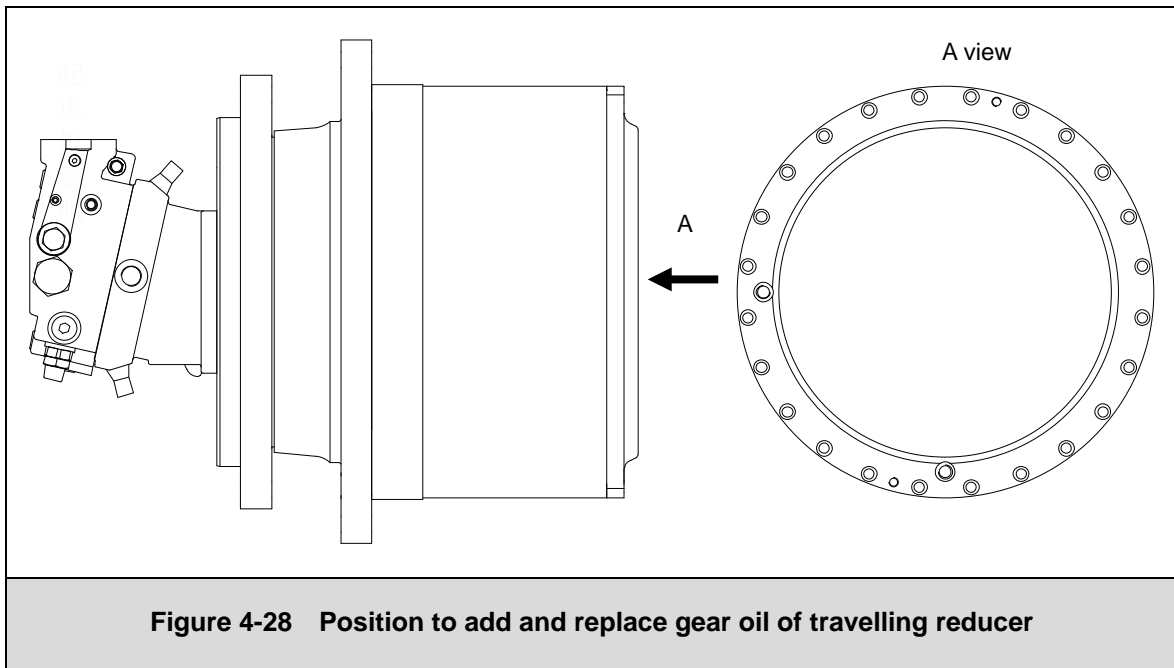


Figure 4-28 Position to add and replace gear oil of travelling reducer

Replacement steps:

- a) Unscrew and remove oil drain plug and oil filler plug on the travelling reducer, and drain original gear oil into proper vessel.
- b) Clean the gear with tepid and clean oil before adding new oil, and remove the abrasive matters and foreign matters.
- c) Screw down oil drain plug.
- d) Put funnel into oil filler to add specified gear oil until oil is visible in the inspection hole.
- e) Screw down oil filler plug.

⚠ CAUTION

- (1) Pay attention to environmental protection when disposing of waste oil.
- (2) Use special tools when changing oil.
- (3) Only when the machine has operated for a long time, can the gear oil be changed. It shall be drained off when the oil is still hot.

4.9.2.3 Inspection of mounting bolts of travelling reducer

Inspect the connection bolt and tighten it if necessary.

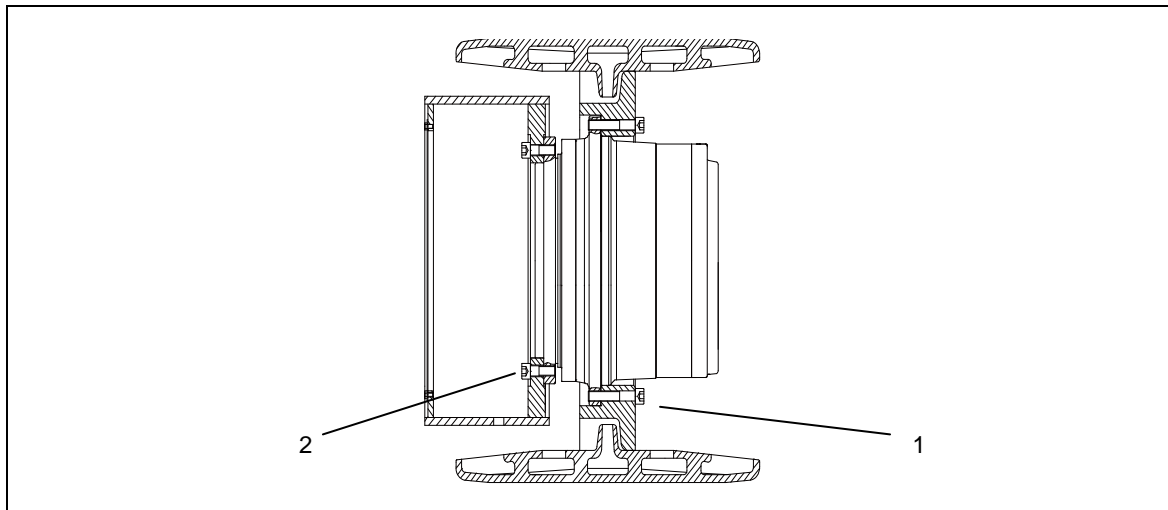


Figure 4-29 Mounting of travelling reducer bolts

Table 4-12 Travelling reducer bolts

Product type	No.	Names	Specification	Quantity	Use loctite glue or not	Remarks
ZCC1300	1	Bolt	M24x140-10.9	20	√	As to tightening torque for bolt, please refer to section 7.1.
	2	Bolt	M24x80-10.9	30	√	
ZCC1800	1	Bolt	M33x200-10.9	30	√	
	2	Bolt	M33x110-10.9	30	√	
ZCC2600	1	Bolt	M33x200-10.9	30	√	
	2	Bolt	M33x110-10.9	30	√	

! CAUTION

- (1) Since all tightening bolts are strengthened by anaerobic glue, usually there is no need to tighten them again. Visual inspection is enough.
- (2) If necessary, remove the loose, cracked or defective bolt or screw, and replace them with new bolt or screw.

4.10 Maintenance of hydraulic system

4.10.1 Routine inspection of hydraulic system

To ensure that the hydraulic system is in a good status for long-term operation, maintain the hydraulic system on time. For the inspection interval of hydraulic system, see the following table.

Table 4-13 Inspection and maintenance of hydraulic system

S/N	Inspection and maintenance items	Inspection interval (hours)							Remarks
		8	50	100	500	1000	1500	2000	
1	Oil level inspection	★							
2	Sediment inspection of hydraulic oil tank				★				
3	Replacement of the oil return filter cartridge		☆		▲				
4	Replacement of the hydraulic oil					☆		▲	730L
5	Inspection of pipelines and joints for oil leaks and damage	★							
6	Air filter clog inspection	★						▲	
7	Inspection of oil cooler for oil leaks and damage			★					
8	Inspection of hydraulic motor and oil pump for oil leaks and unusual sound	★		★					
9	Inspection of hydraulic valves for oil leaks	★		★					
10	Inspection of energy accumulator for oil leaks and damage	★			★				

Note:

The ★ sign indicates that inspection is required. The ▲ sign indicates periodic replacement.

Pay special attention to the following terms in the routine maintenance and service of hydraulic system:

- a) Proper choice of hydraulic oil can pass on pressure, lubricate, cool or seal the system. Improper hydraulic oil is the main reason causing premature breakdown of hydraulic system and reducing in durability. Choose hydraulic oil of specified brand. When need using substance oil under special circumstances, the property of the substance oil should be the same with that of original oil. Different types of hydraulic oil can't be mixed to prevent them from chemical reaction or changing property. Hydraulic oil with dark brown, milky white color or foreign taste goes bad, which can not be used.
- b) Prevent solid foreign matter from entering the hydraulic system. Clean hydraulic oil sustains the life of the hydraulic system. There are many fine matching parts in hydraulic system. Some of them have pore damper or crack. Solid foreign matter intruding can make fine matching parts damage or clog the oil way, which will endanger the safe operation of the hydraulic system. Normal ways of solid matter intruding:
 - 1) Dirty hydraulic oil;
 - 2) Dirty oil filling equipment;
 - 3) Careless oil filling, maintenance and service;
 - 4) Fine matters dropping from hydraulic elements, etc
- c) Prevent air and water coming into the hydraulic system. Under normal temperature and pressure, when there is 6% - 8% air in the hydraulic oil, the air will escape from the oil when the pressure reduces. Burst bubble can make hydraulic elements "cavitation erosion", resulting in noise. On one hand, the air can make the hydraulic oil oxidation, which can make it go bad quicker. On the other hand, a great amount of air entering the oil will make the "cavitation erosion" worse, and elasticity of hydraulic oil increases, resulting in unstable working environment, low working efficiency and damage to implementing elements. As a result, there are a few points to mention:
 - 1) Remove the air in the system after maintenance and change of the oil;
 - 2) The seal of the drive axle of the oil pump should be good. Use "bidirectional" oil seal, which can not be replaced by "one-way" oil seal. Since "one-way" oil seal can only seal the oil in one direction and can not seal the air.
 - 3) The oil inlet of hydraulic pump can not be higher than the oil level and the oil intake pipe should be sealed properly;
 - 4) The oil storage barrel should be placed upside down and its cover should be screwed tight when it's unused;
 - 5) The hydraulic oil containing much water should be filtered, and change the dried filter paper every time when you filter once;
 - 6) The oil filling equipment should be stable and clean. What's more, the hydraulic oil should be filtered when filling it. Do not remove the filter at the oil inlet of the hydraulic oil tank to increase the speed of filling oil;

- 7) Refueling personnel should wear clean gloves and overalls;
 - 8) The brand of the cleaning oil of the hydraulic system should be the same with the hydraulic oil used by the system. The oil temperature should be between 45°C to 80°C. A great amount of oil is required to flush away the impurities in the system. The hydraulic system has to be cleaned at least three times. Get it out of the system completely when the oil is still warm after cleaning. Clean the filter after that and fill new oil into it after changing new filter.
- d) Remove the dirt around the oil tank cover, unscrew the oil tank cover, clean the impurities left in the connection part, open the hydraulic oil tank cover after making sure it is clean. When dismantling the hydraulic oil refueling cover, filter cover, inspection hole, hydraulic oil pipe, and so on, avoid the flying dirt when exposing the hydraulic system. Only after thorough cleaning of dismantling part, can it be opened. When needing to use wiping materials and hammer, use the hammer with rubber in its striking side and wiping materials from which fiber impurities can not be fallen from it. Clean the hydraulic elements and hoses, assembly them after drying by high-pressure air. Use the filter with complete packaging. Wipe clean the filter internal impurities carefully using wiping materials before assembling the filter cartridge. Clean the filter while changing the oil.

4.10.2 Hydraulic oil tank

4.10.2.1 Inspection of hydraulic oil tank

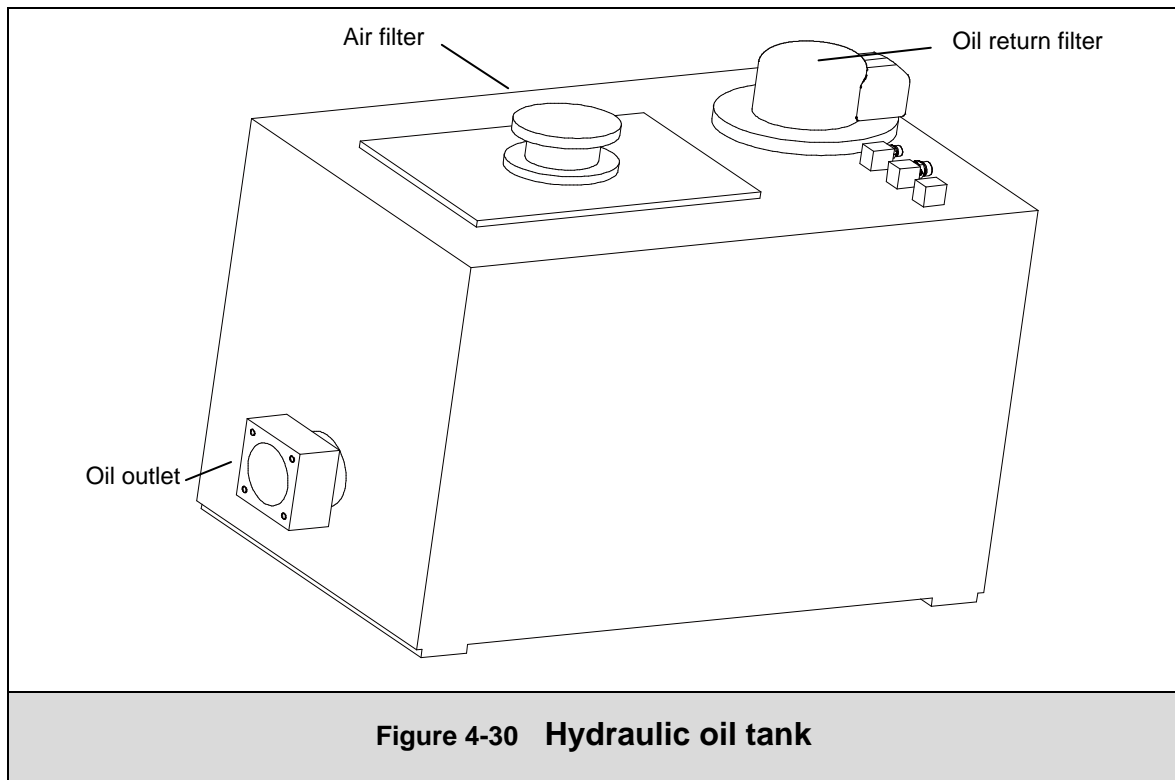


Figure 4-30 Hydraulic oil tank

Do inspect the hydraulic oil amount before starting the engine. When the crane is placed levelly, if the oil level is under the inspection level, it means that the hydraulic oil is insufficient. Only after refueling the hydraulic oil to inspection level, the engine can be started.

If the oil amount is fast reduced in the hydraulic oil tank, it means that the pipe or hydraulic elements may leak. Inspect the hydraulic pipe and elements and find the leakage point. Only start the engine after stopping the leakage.

If the oil temperature is too low (under 20 °C), the fluidity of it operation may damage the hydraulic elements. If the oil temperature is too high (above 80 °C), the worsening speed of the hydraulic oil is fast, which will reduce the service life of the hydraulic elements. As a result, after starting the engine in low temperature, preheat it fully to make the oil temperature reach 20 °C.

CAUTION

- (1) Change the hydraulic oil, however long it has run, after detecting any abnormal conditions, such as hydraulic oil pollution, shortening of worsening period. Inspect the reasons first and change the oil.
- (2) Refuel the oil if insufficient oil amount is found when maintaining and servicing the system. The brand of the supplement oil should be the same with that of the original one. Refuel the oil to the specified level.

DANGER

Pay special attention to hydraulic oil tank and the hydraulic oil element nearby. Please ensure enough cooling time to avoid the danger of scald.

4.10.2.2 Replacement of oil return filter cartridge

In order to change the filter cartridge, dismantle the filter first. The procedure for changing the filter cartridge is shown as follows:

- a) Lower the load down to the ground, turn off the engine and depressurize the system;
- b) Unscrew the bolt, and dismantle the filter cover;

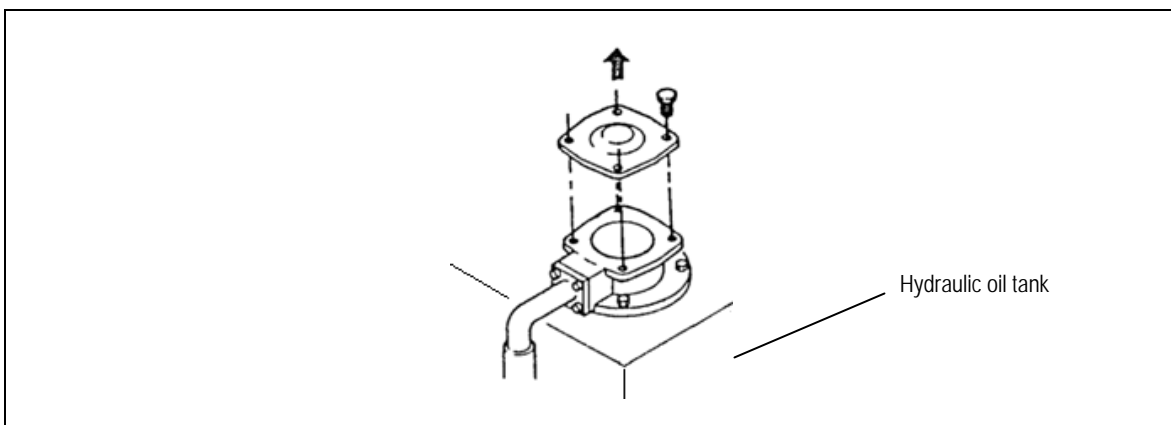


Figure 4-31 Replacement of oil return filter cartridge

- c) Take out the spring and permanent magnet steel assembly.

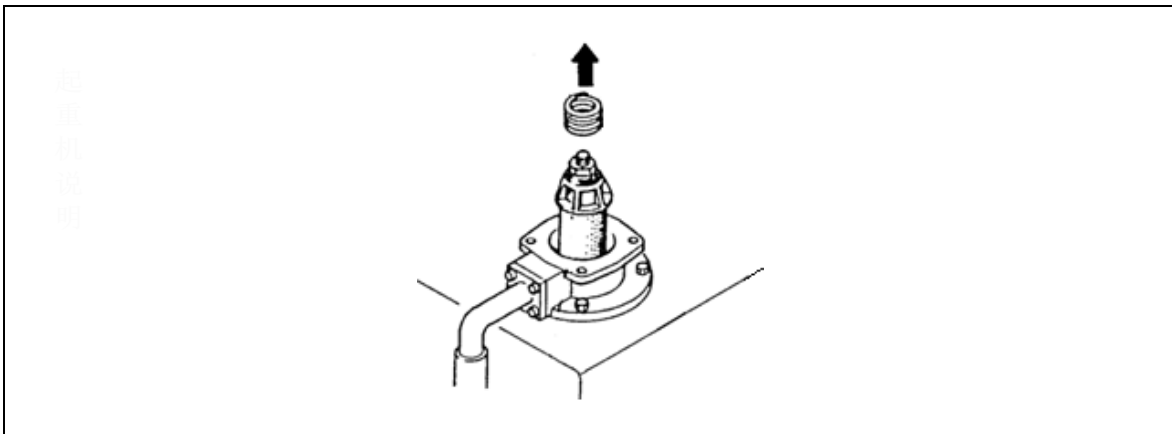


Figure 4-32 Replacement of oil return filter cartridge

- d) Take the filter cartridge out and change it;
e) Install the spring and the permanent magnet steel assembly, finally put the filter cover.

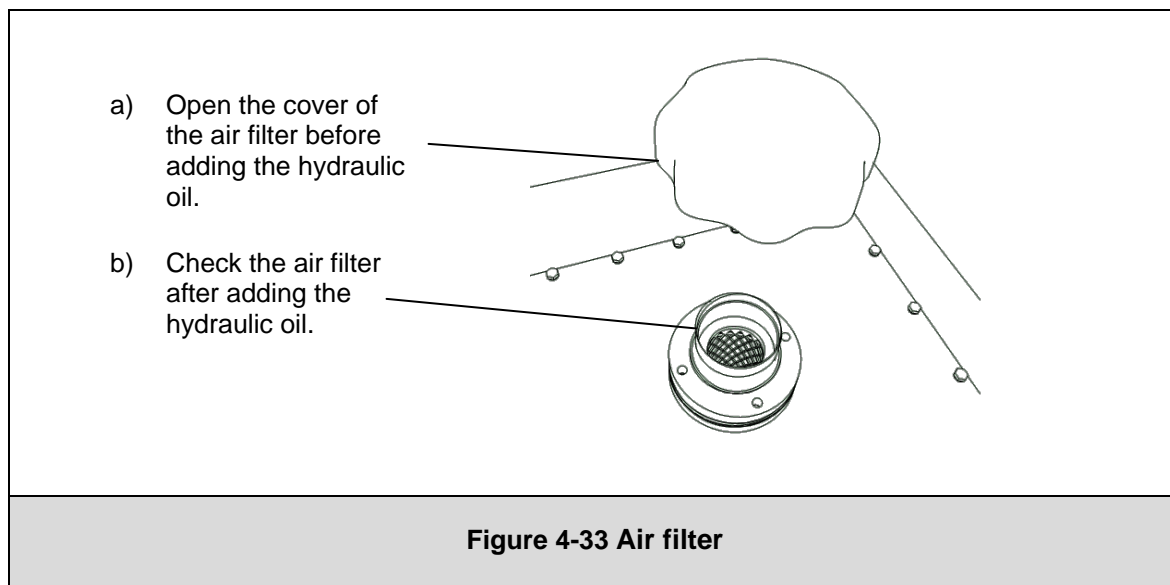
Change and /or replace the oil return filter cartridge when the hydraulic system has worked for 50 hours after maintenance and service. When the pressure switch on oil return filter is triggered, it means that the filter cartridge is clogged. At this time, change the filter cartridge. Change the oil return filter cartridge every 500 working hours. And the initial change interval is 50 hours.



- (1) Replace the filter cartridge in a proper way. Otherwise, it may lead to bad consequences.
- (2) If damage happens to sealing washer, change it at once.

4.10.2.3 Replacement of the air filter

In hydraulic system, the air filter of oil tank needs to be checked on time. After hydraulic oil is added into the hydraulic system each time, check the air filter. If there is dirt on the air filter, clean it in time. If the air filter is damaged, replace it at once.



4.10.2.4 Cleaning of the filter cartridge

Inspect the filter, find the dirt on it, and then clean the filter in time.

Steps for cleaning:

- Turn off the engine and depressurize the hydraulic system;
- Use the filter special wrench to loose bolt and dismantle it;
- Turn the cover by 45° and lift it;
- Pull the sediments collection tray and the filter cartridge in the support out from the outer shell;
- Turn the sediments collection tray left to dismantle it (openings connection);
- Dismantle the filter cartridge from the sediments collection tray and deal with it;
- Special cleaning solution or clean diesel to clean the sediments collection tray;
- Put the new filter cartridge into the sediments collection tray;
- Put the sediments collection tray and filter cartridge into the small filter connection of the outer shell;
- Put the cover on, screw the cover bolt by hand tightly;
- Start the engine and check whether the filter leaks.

4.10.2.5 Change of the hydraulic oil

Before changing hydraulic oil, the crane must be put on level ground. Oil change steps:

- Turn off the engine and depressurize the hydraulic system.
- Install the oil drain pipe on the plug of the hydraulic oil tank. Drain the hydraulic oil into a proper container.
- Release the plug. Specifically, clean the oil tank and filter with the chemical cleaning agent whose solid contamination degree does not exceed 18/15. After cleaning and airing them, clean them with fresh hydraulic oil whose solid contamination degree does not exceed 18/15. Drain the flushing oil and fill in fresh hydraulic oil again.

- d) Start the engine, run the engine at low speed to energize the oil pump. Manipulate each mechanism respectively and drain the used oil of each loop of the system one by one on the basis of fresh hydraulic oil. The used oil drained cannot flow into the hydraulic oil tank. Be sure to fill new oil into the hydraulic oil tank when changing oil in various pipes to prevent the oil pipe being vacant.
- e) Install the plug and set each element to initial working state. Fill new hydraulic oil to required level.
- f) Check whether all the shutoff valves and quick-release couplings are open. All shutoff valves and quick-release couplings must be opened to make the oil pipe flow smoothly.



- (1) Do not use the hydraulic oil for more than 24 months.**
- (2) Filter or replace hydraulic oil in time if it is found severely polluted.**
- (3) Select appropriate hydraulic oil in accordance with the ambient temperature.**
- (4) Do not mix the hydraulic oil of different grades.**
- (5) When changing the oil, flush all the original oil, and do not allow sundries like sand and dirt to enter the oil tank.**
- (6) When changing oil at each loop, constantly add fresh oil into the hydraulic oil to avoid empty oil pump.**
- (7) When starting the engine at cold areas, ensure that the minimum temperature for starting is reached, and start the engine in no-load state. After the temperature of the no-load system reaches the minimum temperature required for running, slowly apply load to the system, and keep the system running at the temperature on the minimum load.**
- (8) Pay attention to environmental protection when dealing with hydraulic oil.**

4.10.3 Exhaust of hydraulic system

Normally, the hydraulic system can exhaust automatically. As a result, the engine is allowed to run at a speed of 750 rpm (a little higher than idle speed) for ten minutes. Do not operate the control lever. Connect the hydraulic pumps during the process of pressure release circulation. Exhaust the system in pressure release state in order not to damage the sealing and hydraulic elements.

If hydraulic elements are replaced during maintenance, do pressure release circulation about 10 minutes before exhaust of the hydraulic system. There are no special instructions for this process.

All functions should be started quickly. The hydraulic cylinder should extend or retract to their final positions.

4.10.4 Inspection of hydraulic pipes for damage

Change the damaged pipes and fittings of hydraulic pumps on the slewing table due to mechanical failure, heat energy or other influences. Keep enough distance between all pipes, hoses and high-temperature engine parts (for example, turbocharger), which will not result in friction.

4.10.5 Inspection of hydraulic cylinder

Inspect the cylinders of all auxiliary equipments regularly, including:

- a) Inspect whether there exists scratch on piston rod;
- b) Inspect whether the sealing between piston rod and the cylinder leaks oil when doing the corresponding auxiliary movements;
- c) Inspect whether the piston rod of the cylinder curves when the cylinder has a long stroke.

If the part between piston rod and cylinder leaks, please ask the manufacturer or professional maintenance personnel to repair it. Try not to make the piston rod scratch. When severe scratch of piston rod leads to leakage of oil, please ask the manufacturer or professional maintenance personnel to repair it. If repair is impossible, change it. If the piston rod is too curved to work properly, please ask the manufacturer or professional maintenance personnel to replace it.

Pay attention to the following terms when using or transporting hydraulic cylinder:

- a) Package the cylinder during storage and transportation. Protect the connection surface of oil port and explosion part of piston rod via protective devices.
- b) Secure the cylinder tightly during storage and transportation to avoid collision.
- c) Secure the cylinder tightly when lifting to avoid swinging.
- d) Depressurize the loop of hydraulic cylinder to zero before dismantling the hydraulic cylinder.
- e) Prevent the components of the hydraulic cylinder against damage when dismantling it.
- f) Protect the external surface of the piston rod against collision and scratch on sealing elements. Clean the dust ring of cylinder dynamic seal and the silt exposed on piston rod frequently to prevent the impurities sticky on the surface of the piston rod, which is not easy to clean, from entering the internal cylinder to damage the piston, cylinder or sealing elements.
- g) Inspect the connection parts such as thread, bolt frequently. Screw it tightly if any looseness is detected.
- h) Lubricate the connection parts frequently to prevent it from rusting or abnormal wear when lacking of lubricating oil.

4.10.6 Inspection of hydraulic hoses

Inspect whether all hydraulic hose are damaged regularly. Replace all the damaged hoses even though slight damage is detected in these visual inspections.

The hydraulic hoses may have the following problems:

- a) External damage, such as wear, cut, crack, etc;
- b) Aging of external materials, resulting in crack;
- c) Deformations that are not natural to hoses, such as appearance slackness, severe squeezing, distortion and so on;
- d) Leakage;
- e) Not following the requirements of assembling and locating (please refer to the following points for attention for assembling hydraulic pipes);
- f) Damage of fixed equipment in hose device;
- g) Corrosion, deformation or damage of hose device;
- h) Exceed the storage time or service life.

Replace the hose 6 years later (including storage time at most 2 years) even though no damage is detected. As for the service life or storage time, please make the production date on the hydraulic hose as the standard.

When assembling a hydraulic pipeline, pay attention to the following items:

- a) Avoid distortion of a hose.

The hose will bear less pressure when it's distorted.

Distorted hose will make the connection loose.

If a hose is distorted by 7°, 10% of its service life will be reduced.

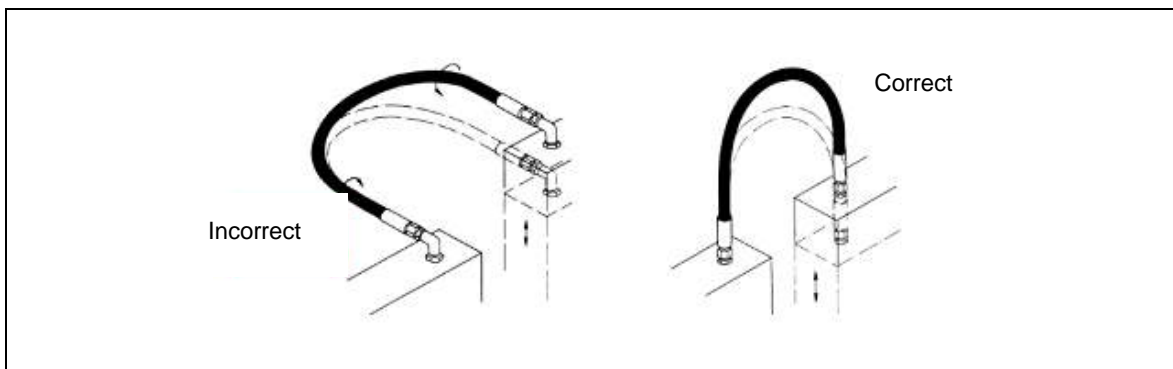


Figure 4-34 Hose illustration (I)

- b) Ensure sufficient radius of bending.
 Make sure smooth flow of fluids and avoid pipe damage effectively.
 Too small curving radius will reduce the service life of hose.

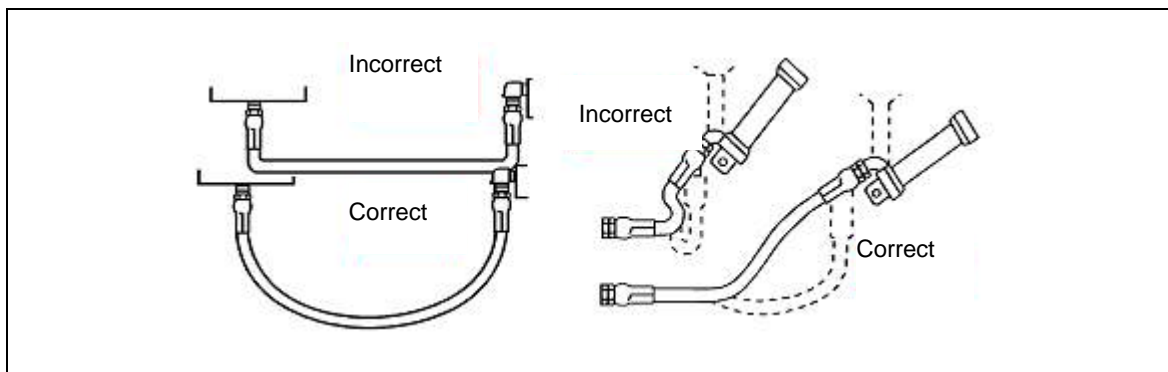


Figure 4-34 Hose illustration (II)

- c) Use elbow and other connectors when necessary.
 Can avoid too long hose.
 Can make sure neat assembly and is convenient for later maintenance.

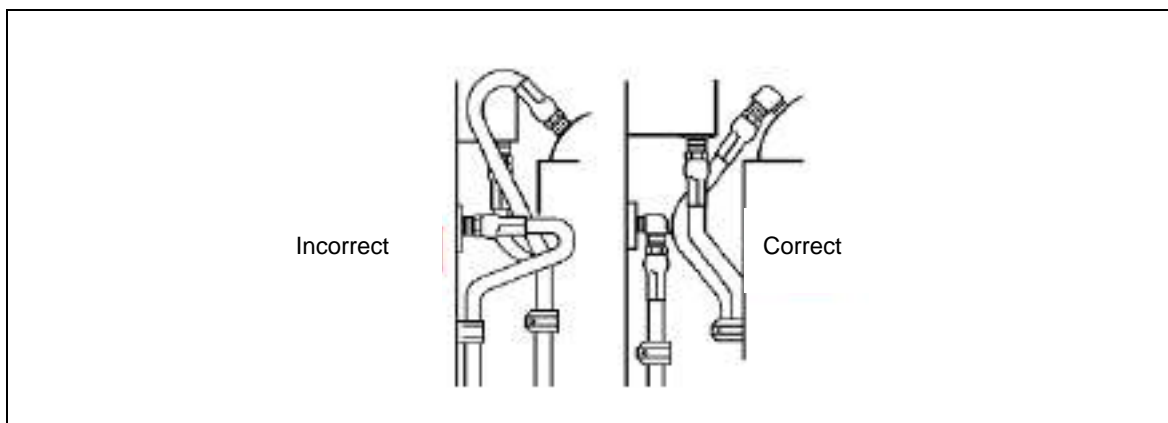


Figure 4-34 Hose illustration (III)

- d) Allow certain looseness to offset the shrinkage of the hose under pressure.
 When under pressure, the length of hose will change at a range of -4% to +2%.

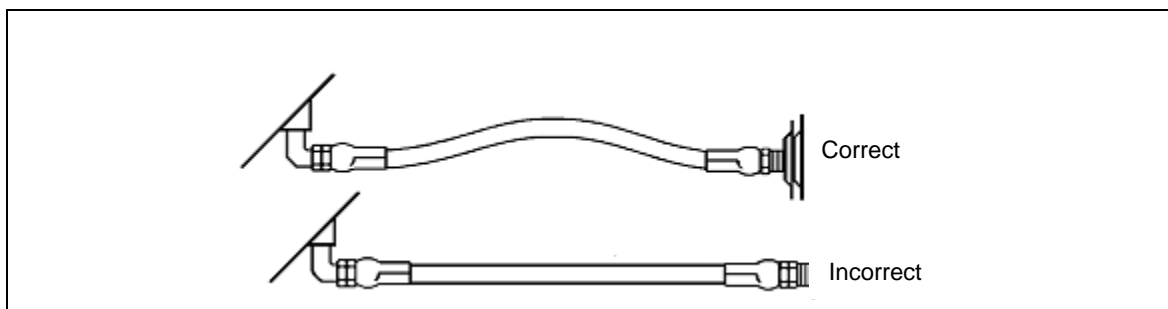
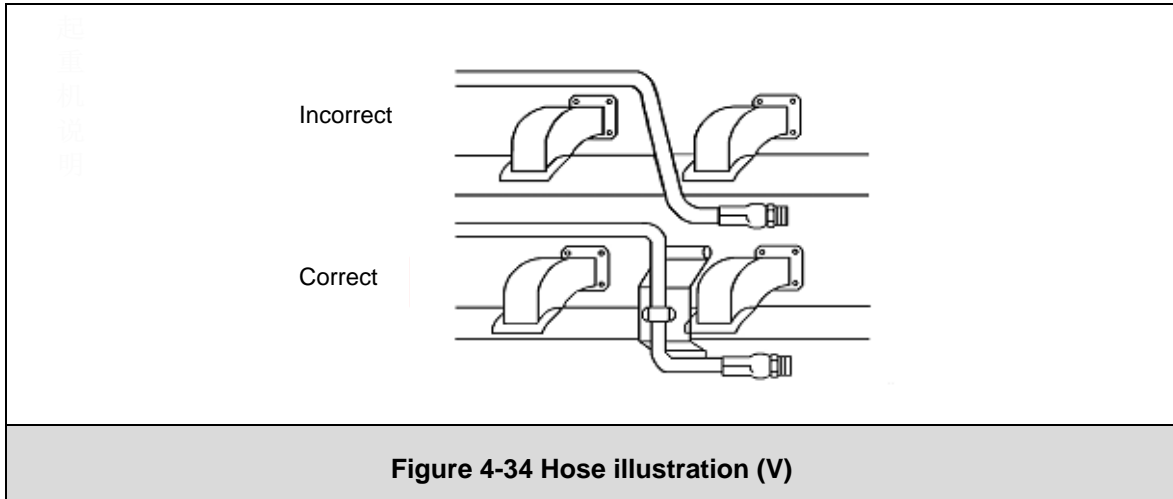
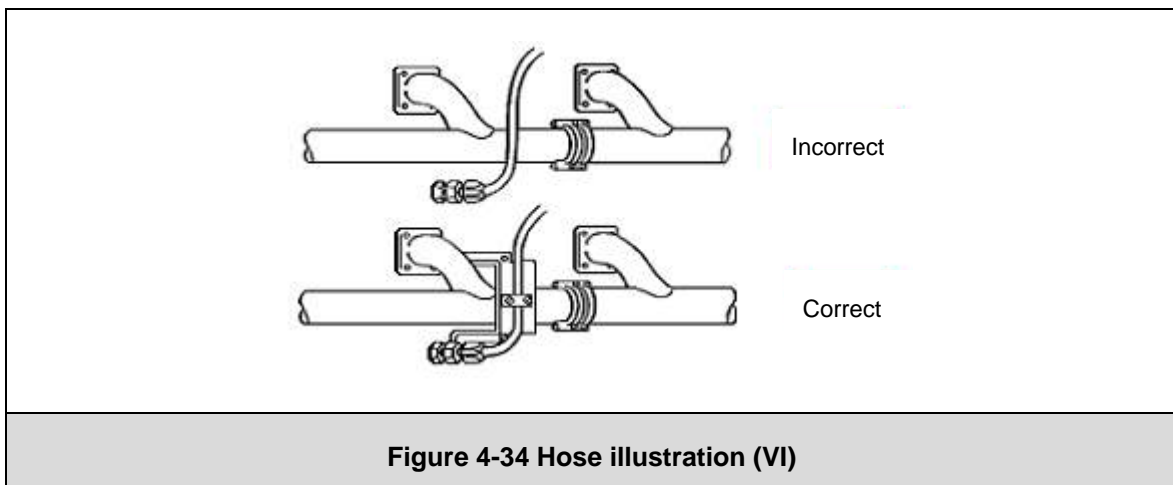


Figure 4-34 Hose illustration (IV)

- e) Ensure fixed position of a hose with a clamp:
Reduce the wear between the hose and relevant parts effectively.



- f) Arrangement of the hose:
Avoid too hot surface and sharp edges.
Avoid friction between it and other components.
Make sure enough length to do curving movement.

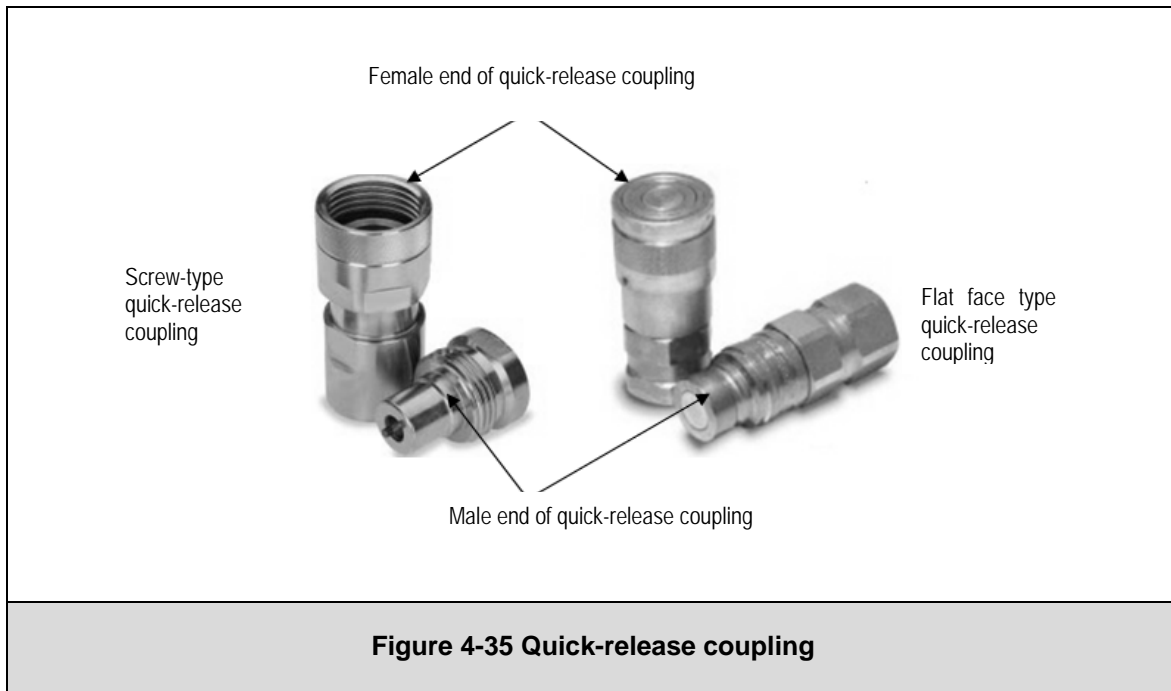


4.10.7 Safe connection and dismantling of quick-release coupling in hydraulic pipes

Points for attention when assembling:

- The quick-release coupling should be screwed tightly by hand rather than by wrench, to prevent damaging the quick-release coupling.
- If the quick-release coupling is flat face type, align the small notch on the female end with the steel ball on the male end, and then plug the male end into the female end. After a "click" sound is heard, rotate the female end of quick-release coupling until the small notch is not aligned with the steel ball to avoid unintended operation.

- c) If quick-release coupling is screw-type coupling, screw the coupling until a firm and tight fit is attained. At this time, the quick-release coupling is screwed.
- d) Screw the dust cap in time to prevent the impurities such as dust from entering when the quick-release coupling is not connected.



4.11 Maintenance of the electrical system

4.11.1 Inspection of the illumination system

Check for normal operation of the illumination system. If any faults are detected, repair them at once.

4.11.2 Inspection of hoisting limit switch

When load hook comes into contact with the limit weight during its upward movement, the hoisting limit switch is triggered, the buzzer sounds and the crane movement "lift the load hook" is cut off automatically. At this time, only lower the load hook to release the limitation.

Release the limit weight by operating the control lever to safe direction, the operation will be normal again.

4.11.3 Inspection of battery master switch

When it is night or the crane doesn't work for a long time, check that the switch is in "OFF" position.

4.11.4 Inspection of cable joints and dust caps

During assembly, dismantling and conversion of basic machine, check if the cable joints are connected with each other tightly and the dust caps are well covered.

4.11.5 Maintenance of the battery

Batteries must be well maintained and kept for use, because they function as the power supply of starting the engine, electrical control system, illumination and electrical auxiliary devices of the machine. Its technical performance accords with national standard *GB5008-91 for Crane Lead-acid Battery*. Thus it's important to maintain it well.

- a) Store the battery (a filled and charged lead-acid battery) at the temperature ranging from 5 °C to 25 °C and in a dry, clean and ventilated environment. Do not expose the battery to direct sunshine to avoid degradation of the performance caused by high ambient temperature.
- b) Do not invert and place the battery horizontally. Do not shock and press the battery mechanically.
- c) Recharge the battery in time to avoid performance degradation caused by the sulfating of the battery.
- d) Do not overcharge the battery. Avoid premature failure of the battery caused by too much water loss, growth of grid and drop of diachylon.
- e) Remove the batteries from the crane and store them in a well-ventilated and dry place if they are used for a long time (usually more than 15 days). Charge the batteries every 3-6 months (see if the indicator is black or not).

This series of lead-acid batteries for cars is produced in accordance with JIS Japan and DIN Germany. They can start the crane in 30 minutes after injecting the electrolyte. If possible, charging for 3 - 5 hours before use will result in a better starting performance.

4.11.5.1 Preparation for battery use

- a) Make sure the level of electrolyte is 10 mm higher than the minimum waterline.
- b) Make sure the blow cock is screwed tightly in case of acid leakage.
- c) Check the air hole of the blow cock to ensure a smooth venting.
- d) Pay attention to the positive and negative poles when connecting wires to avoid reverse connections.

4.11.5.2 Maintenance during battery use

- a) Inspect and maintain the battery every 200 hours.
- b) Check the battery terminal for tight fit.
- c) Keep the surface of battery clean, and apply a coat of grease or Vaseline on the terminal to prevent corrosion.
- d) Ensure that the battery filling plug is screwed tightly to prevent acid from flowing out.
- e) Check the level of battery electrolyte, which must be 15mm – 20mm higher than battery separator. When the electrolyte level falls down due to fluid evaporation, add distilled water rather than electrolyte.
- f) Check the charging condition of the crane every day, and see if the charging indicator in the operator's cab is normal.

4.11.5.3 Maintenance during battery storage

- a) If the battery is not used, demount the battery and place it in a clean, dry and well-ventilated storeroom whose temperature is kept between 5°C - 40°C. Do not store the battery when it is filled with electrolyte. In special cases, if there is a need to store the battery with electrolyte filled in or after the battery is discharged, charge the battery every month, or discharge the battery completely every three months.
- b) Do not compound the electrolyte with river water, well water or water with impurities.
- c) If the battery is fitted on the crane, but it is not used, remove one end of the battery or turn the battery master switch to "OFF" position. Detect the battery once a month, and charge it if necessary. Before the battery is used, charge it well.
- d) The electrolyte of battery contains the acid, which would corrupt the skin, eye and clothing. Therefore, take precautions to prevent the electrolyte from flowing out. If accident occurs, take the following measures:
Wash away the electrolyte if the cloth is infected with electrolyte.
Have a gargle once the electrolyte enters into the mouth, drink a lot of water or milk, and seek medical treatment.
- e) The battery has micro amount of combustible gas, therefore, keep the vent hole on the battery filling plug unimpeded, and make the battery far away from naked fire so as to avoid explosion.

4.11.6 Prevention of electrical parts or cables from catching fires

4.11.6.1 Reasons to start the fire

The fires of electrical parts or cables of electrical system result from wrong operation of relevant components or circuit, or carelessness of operator, rather than technology failure. In addition, original electrical parts are most important during maintenance. The influence of use of non-original parts on electrical system is often ignored owing to great difficulty of research, thus causing the failure of circuit.

The alive wire can generate slight heat. The strong current will lead to high temperature, thus causing fire. In order to prevent this situation occurring, even fire, the fuse must be installed in all circuits. If permissible maximum current is exceeded, the fuse will cut off the current. Therefore, the failure of fuse is one of the main reasons to catch fire.

Other reasons to cause fire:

- a) Use the cables or cable connectors which are not approved by manufacturer or have defects. For example, the length of cable is not enough.
- b) Use the expendable parts or actuating elements such as relay, motor, switch, light etc., which are not approved by manufacturer or have defects.
- c) Overloading of cables and fuses.
- d) Install an improper battery whose dimensions are too large and which does not comply with design requirements (install battery box with too large dimension, the positive terminal may cause short circuit).
- e) After the electrical parts are cleaned by water or steam, the moisture penetrates into the components of the electrical system.
- f) The condition of electrical system is poor due to lack of inspection, maintenance and service work.

To sum up, the fire may be caused by single factor or joint factors.



- (1) When short-circuit occurs, the fuse can protect the cables of electrical system.**
- (2) Do not make bridge connection of fuse.**
- (3) Do not adopt high-current fuse in any cases.**

4.11.6.2 Prevention of electrical parts or cables from catching fires

Fire of the electrical parts or cables can be prevented, and effective measures can be taken to avoid such danger.

Precautions:

- a) Inspect or exam the electrical devices of the crane regularly.
- b) Correct some deficiencies immediately, such as, loose connection, cable heat. Similarly, find reasons for this in time and correct them.

- c) Check all cables, connectors and terminals for tight fit or damages (see if there is any oxides formed on both poles of the terminal or battery), and rectify all confirmed faults immediately.
- d) Use the original spare parts and original fuse in compliance with the specified rigidity only.
- e) Close the crane immediately in case the power fails.
- f) No unauthorized replacements, supplements or modifications toward the electrical system are allowed unless approved by the manufacturer.



Maintenance and repair of the electrical system or electrical equipment must be performed, guided or supervised by qualified electrician according to electrical technology standards.

4.11.7 Circuit breaker

Table 4-14 Circuit breaker

Code	Value/A	Explanation
F1	50A	Fuse of working power of the crane
F2	150A	Engine preheating fuse
AF1	25A	Engine power fuse
AF2	10A	Power relay fuse
AF3	20A	Engine starting fuse
AF5	15A	Engine shutdown fuse
AF6	30A	Air conditioning power fuse
AF7	10A	Fuse of master lighting switch
AF8	15A	Power fuse of working floodlights for slewing table and camera
AF9	10A	Fuse of foot-operated horn power
AF10	15A	Fuse of wiper, washer, fan and interior light in the cab
AF11	15A	Fuse of oil cooler, cab tilting switch and A-frame erecting switch
AF13	15A	Remote control box power, controller power, emergency shutdown relay fuse
AF14	10A	On-board power module fuse, including camera and monitor
AF15	10A	Cigarette lighter power

4.12 Maintenance of load hooks and pulleys

4.12.1 Daily inspection and maintenance of load hook

Since the service condition of the main load hook and auxiliary load hook varies from day to day, inspection is required every day (starting with duty shifting). Pay attention to observe any defects that could affect the security before and in the process of the operation.



Deal with all defects before using main load hook and auxiliary load hook.

Daily inspection and maintenance involve the following items:

- a) Wipe the load hook clean, removing the dirt and oil stain on it.
- b) Lubricate the pulleys, rotating parts and other parts with the grease nipples, making sure all part can rotate easily.
- c) Inspect all bolts and screws, and make sure all cotter pins are complete and the openings are open.
- d) Check if the pulley groove and pulley rim are worn evenly, and if the wire rope is put into pulley groove properly, and if the pulley is fitted tightly.

Whether the pulley is needed to be changed, please refer to pulley section.

Pulley groove must be larger than the diameter of the wire rope. If the wire rope is too thick, the pulley rim will be fractured, thus increasing the wear of the wire rope and the pulley.

- e) Make sure that the rotating part of the hook moves freely and the space is not large. Any feeling of difficulty or jamming requires the inspection for bearing and shaft sleeve damage or insufficient lubrication.
- f) Inspect main hook for damage due to overloading.
- g) Inspect the elongation of side plate, extension of bore diameter, and bending, elongation or cracking of bolt.
- h) Inspect the safety catch. The safety catch must be complete, restraining the loose sling and other lifting devices on the load hook.

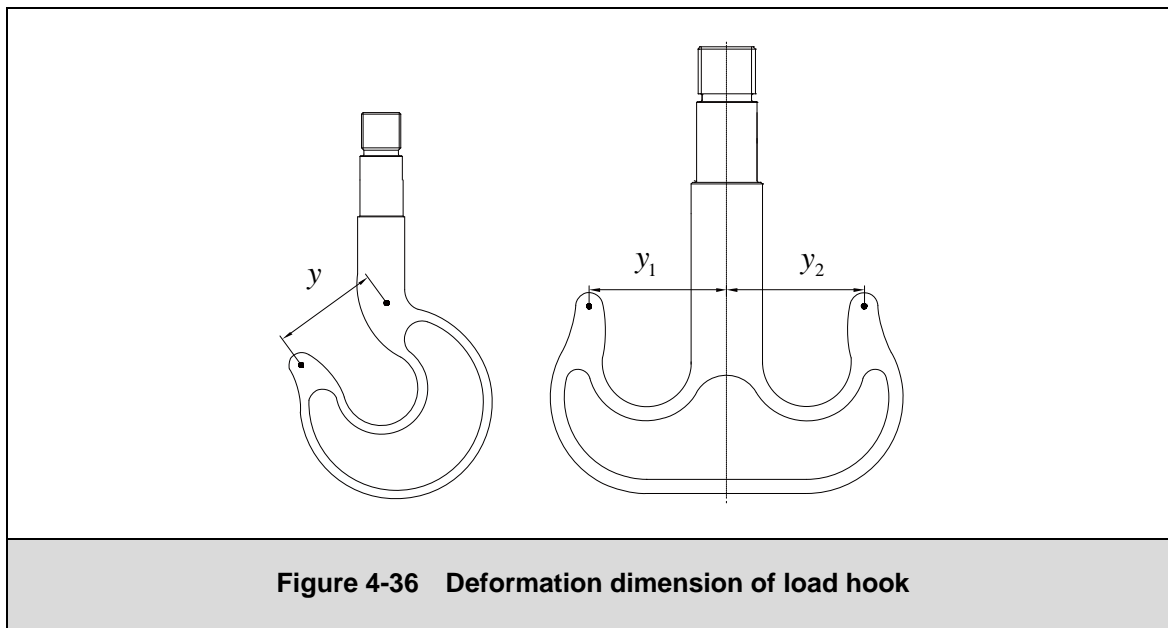


Prohibit maintaining and repairing the load hook when it is being used. The load hook must be maintained and repaired on the ground.

4.12.2 Inspection of load hook

Check load hook once a year by professionals so that the failures of load hook can be found early, thus preventing accidents. Record all the failures and repair methods. Then check whether the faults are repaired later.

a) Check load hook for deformation



Check load hook for deformation, local cold deformation and hook jaw for cracks, wear and rust. Check the joint of hook nut.

Deformation:

As to dimensions of hook jaw (“y” or “y1”+“y2”) as shown in above figure, if they are more than 10% of its original dimensions. It means the load hook is deformed. At this time, change the load hook at once. The original dimensions (“y” or “y1”+“y2”) must be marked on the load hook. Check them one by one.

Corrosion:

Unscrew and remove the load nut, and then check the thread of load nut and shaft to be operated for corrosion and wear.

If there is a need to remove the corrosion, make sure that the diameter of threaded rod is not more than 5% of its original diameter. Otherwise, change the load hook at once.

b) Check safety catch

Check if the safety catch is in a good condition so that the slack sling and other lifting device can not jump out of the load hook.



The safety catch can not be used to bear the load. The slings and other lifting devices can not be placed onto the safety catch.

c) Check load hook

The load hook must be checked at least once a year, using coloring detection, magnetic powder detection, ultrasonic detection, X-ray detection etc.



- (1) Never use the load hook with deficiency.
- (2) Never repair the load hook using welding method.

4.12.3 Inspection of pulley

4.12.3.1 Inspection of pulley body

Check all pulleys for damages like fractures, diagonal plane or similar damages.

Replace the pulleys immediately if the following damages are detected:

- a) Cracks, rim damages or relatively serious wear.
- b) The wear extent of the pulley groove wall reaches 80 % of the original wall thickness.
- c) The wear extent of the pulley groove bottom exceeds 25 % of the diameter of the wire rope.
- d) Other defects that damage the wire rope.



Pulley groove must be larger than the diameter of the wire rope. If the wire rope is too thick, the pulley rim will be fractured, thus increasing the wear of the wire rope and the pulley.

4.12.3.2 Inspection of pulley spindles

The following inspections are conducted annually for all pulley spindles:

- a) Surplus of grease.
- b) Position of sealing seat for pulley spindle.
- c) Running noise and rolling resistance.
- d) Spindle clearance.

The pulley spindle must be replaced in case defects are detected. In this situation, please inform the customer service department of Zoomlion.

4.12.4 Pulley lubrication

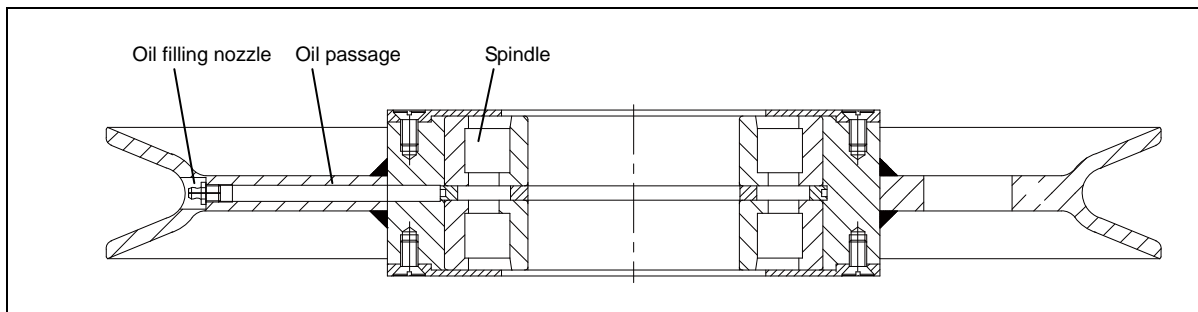


Figure 4-37 Sectional view of metal pulley

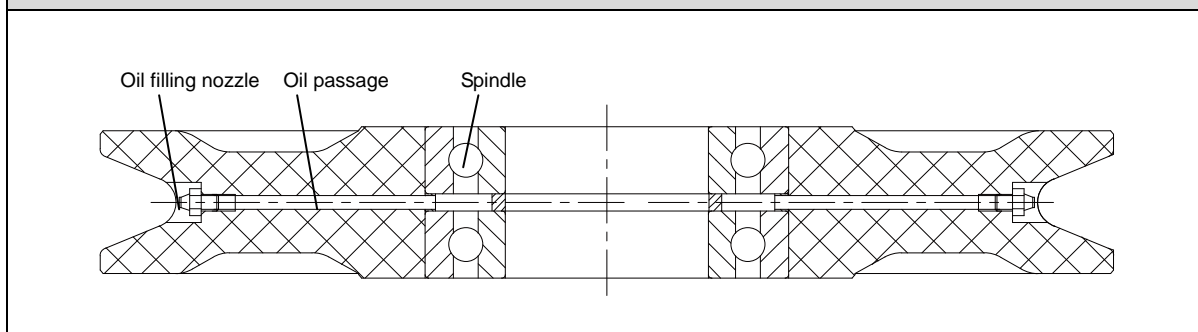


Figure 4-38 Sectional view of nylon pulley

Metal pulley is mainly used for load hook.

Nylon pulley is mainly used for crane and pulley block on the boom frame.

There are two oil filling nozzles on the pulley symmetrically. Wipe the nozzles clean before lubricating the pulley. Inject the lubricating grease into the nozzles alternately via oil gun until the fresh grease flows out of the spindle end face.

4.13 Maintenance of wire ropes

The service lives of wire ropes are different basing on the operating condition of the machine. Both hoisting rope and derricking rope must be strictly inspected regularly to find abrasion and damage in time.

4.13.1 Inspection of wire ropes

4.13.1.1 Items to be inspected

- a) Overall length of a wire rope.
- b) The position where the wire rope is frequently bent on the pulley or drum.
- c) The position where the wire rope is bent on pulley or drum at the moment when the load is lifted.
- d) In the multi-layer winding system, the position where the wire rope is in contact with the drum flange, and the transboundary zone where the upper wire rope crosses the lower wire rope.

4.13.1.2 Inspection interval

- a) It is recommended to inspect whether damage exists on wire ropes and its end points.
- b) For the first weeks after new wire ropes are installed and the fracture occurs for the first time, the inspection interval must be shorter than that in other time periods. When the overloading occurs or suspicious damage which can not be seen is detected, the inspection interval must be shortened accordingly.
- c) In addition, when operation ceasing duration is extended and the wire rope transmission gear is re-installed, or when the winch is disassembled and re-installed at a new location, or when an accident happens or damage exists during the operation of wire ropes, the inspection must be performed.

4.13.2 Maintenance of wire ropes

For dirty wire ropes, their external surface should be cleaned frequently. Especially, for the wire ropes that are used in a corrosive environment or near chemical substances, dirt on the surface should be removed in time.

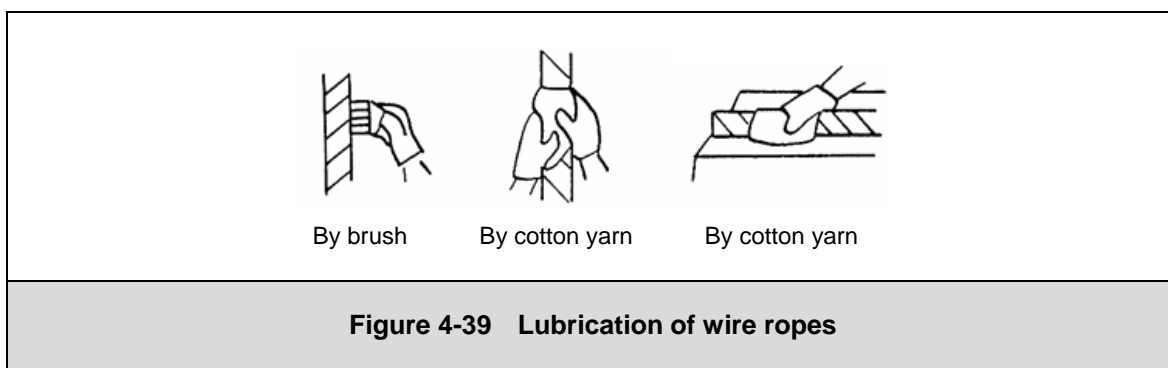
The manufacturer has sufficiently lubricated wire ropes (not only the surface of the wire rope, but also all the internal space of the wire ropes) during manufacture to prevent corrosion and reduce friction between wire rope strands, wire ropes and pulleys, and wire ropes and drums.

When black spots or rust exist on the surfaces of wire ropes, the wire ropes need secondary lubrication. Timely secondary lubrication plays a positive role in extending the operating life of wire ropes. The lubricating oil for secondary lubrication can hardly penetrate and flow into wire ropes, so it should not be applied excessively. Excessive lubricating oil will stay on the surface of a wire rope, making the check for wire rope fracture relatively difficult. It would be best to adopt acid-free grease and the lubricating oil and the grease should be heated and diluted before utilization.

The original lubrication can only last for a certain period of time. You need to lubricate it regularly.

Lubricating oil should be applied by many means, such as:

- Use the paintbrush or glove to paint the oil.
- Put the lubricating oil on the pulley area.
- Make the lubricating oil through the groove.
- Adopt packing lubrication with pressure.



It's very important to lubricate the wire ropes regularly. It's no good to lubricate the wire rope when it has already been damaged.



There is a danger of scratch.

4.13.3 Take-down criteria

Wire ropes are always damaged as a result of the combination of individual factors. The executive staff should judge the cause and decide whether the wire rope should be discarded or be used continuously.

For the damage of a wire rope, inspection personnel should firstly investigate whether it is caused by the defect of equipment, and if so, such defect should be eliminated before the wire rope is replaced.

The safe use of wire rope is assessed in accordance with the following criteria. Refer to relevant Chinese National Standards (GB/T 5972) and ISO standards (ISO 4309).

Fractured wire: In case more than 10% of the single wires (excluding filling wires) of a wire rope within one lay length fracture, for the wire rope with multilayer strands (typical multiple strand structure), fractured wires mainly exist inside. In case the lubrication at any local position becomes dry or deteriorated, special attention should be paid.

Fractured line: In case fractured wires exist at or near the end of the rope, even in a small number, it indicates that the stress at such position is great. If the length of the rope permits, the position of fractured wires should be cut out and re-installation should be performed properly.

Local aggregation of fractured wires: In case fractured lines cling together and aggregate in the range of the rope length less than $6d$ (d : diameter of wire rope) or exist almost in one strand, even though the number of fractured wires is small.

Increase of fractured wires: Fractured wires would appear after a wire rope has been used for a period of time, the number of fractured wires will increase gradually, and the interval will be shorter and shorter.

Abrasion: When the external wires are abraded to 4% of its diameter, or when the diameter of the wire rope is reduced by 7% in comparison with the nominal diameter, the sectional area of a wire rope is reduced, thus resulting in lower strength.

Fracture of rope strands: The rope core is damaged, thus reducing the rope diameter. In this case, the entire rope strand is liable to fracture.

Reduction of elasticity: Rope diameter reduces, the lay length of a wire rope extends, and the space between wires and between ropes is inadequate due to crushing of wires and ropes. These phenomena indicate the reduction of elasticity. At this moment, although no fractured wire exists, the wire rope is obviously difficult to be bended, which may abruptly break and should be discarded immediately.

Corrosion: When severe corrosion occurs at inside and outside of a wire rope.

Deformation: Deformation of wire ropes is disposed of by the following means:

Table 4-15 Dealing with deformed wire ropes











Illustration	Deformation form	Dealing methods
	Wave	In case of $d_1 \geq 4d/3$, with the rope length less than $25d$, the wire rope must be taken down, where d is nominal diameter of the rope, and d_1 is enveloping diameter of the rope after it is deformed.
	Pocket formation	When pockets are formed, the wire rope must be taken down immediately.
	Basket formation	When basket formation appears, the wire rope must be taken down immediately.
	Loop formation (for one strand)	When wire rope forms loops severely, it must be taken down.
	Loop formation (for multiple strands)	When wire rope forms loops severely, it must be taken down.

Illustration	Deformation form	Dealing methods
	Loosening of single wires	When the wires are loosened, the wire rope must be taken down.
	Contractions	The wire rope with pronounced contractions must be taken down.
	Flattening	The wire rope with flattened areas must be taken down.
	Kinks	The wire rope with severe kinks must be taken down.
	Bends	The wire rope with bends must be taken down.
	Damage caused by the effect of heat or arc welders	This can be detected by discoloration. Discolored wire rope must be taken down.

4.13.4 Comprehensive introduction of wire ropes

4.13.4.1 Transportation of wire ropes

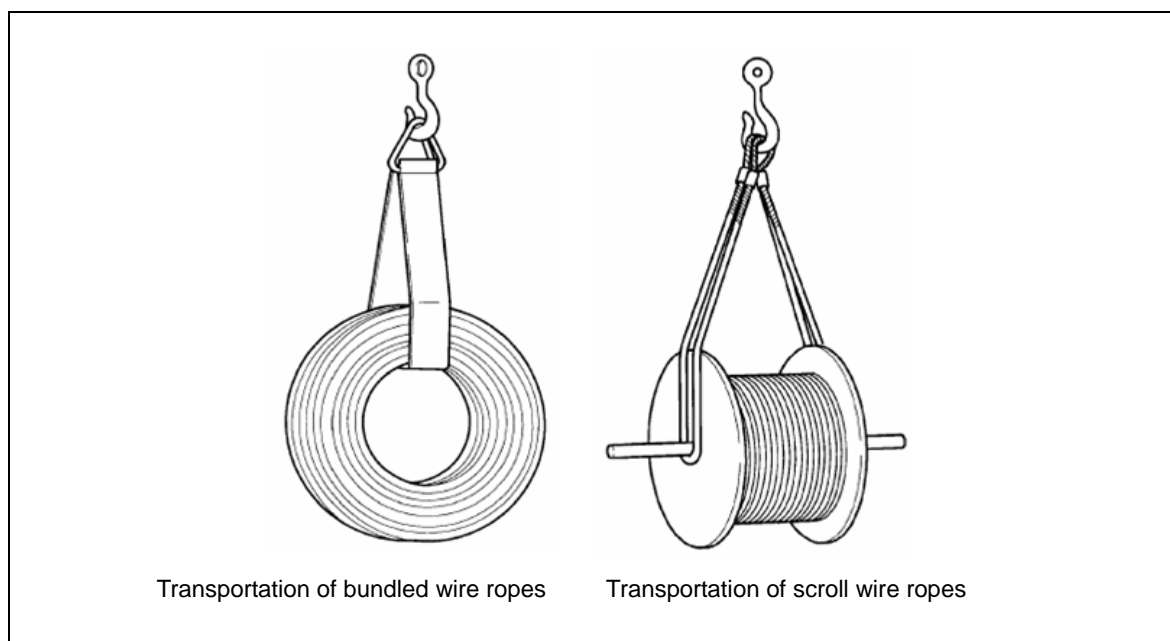


Figure 4-40 Transportation of wire ropes

The wire rope may come across some problems even in delivery stage: the fork of the forklift truck may move under the scroll or get into the rope bundle, which will damage the surface of the wire rope. When deliver bundled wire ropes or scroll wire ropes, try your best not to contact with the load hook or fork of forklift truck directly. On the contrary, use sling to lift the wire ropes. The best way to lift the scroll is to lift it through its central axle.

4.13.4.2 Storage of wire ropes

The wire rope should be placed on shady, cool, clean, dry and concealed environment. The wire ropes can not be placed on the ground directly, but can be put on goods plates.

Cover the wire ropes well to prevent it from getting humid if you can not put the wire ropes in the house. The plastic film can prevent rain well, but condensed water can be formed and can't escape, which may destroy wire ropes permanently. In this case, you can add a layer of linen to solve the problem.

When storing a great amount of spare parts, the general rule to follow is first come, first go. That's, use the wire rope in the same order as delivering them, which can avoid that a wire rope can only be used after storing for many years.

When assembling a wire rope, always make sure that wind the wire rope from its scroll or bundled wire rope to the system and the wire rope is not twined or damaged externally.

The method for bundled wire rope to avoid twining is to adopt turntable or pull it out from the ground. When using the latter method, you'd better try your best to make the ground clean. For example, if the sand is adhered to the lubricant of the wire rope, and then the sand may get into the part between the pulley and the wire rope, thus damaging the wire rope.

A better way to unwind the wire rope on the rotating axle is to use turntable or support frame. There is a frequently recommended method: roll the wire rope scroll on the ground, which is not so effective in fact.

Pulling the wire rope laterally will damage it. Thus, in any case, do not pull the wire rope laterally from its scroll or bundled wire ropes, which will resist the torque formed on the wire rope and form a ring. When the wire rope bears a load, these rings will form a knot, thus the wire rope will form unrecoverable deformation. The wire rope with knots is not safe and can't be used again. At this time, replace it at once.

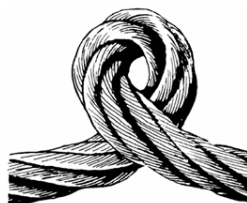


Figure 4-41 Damage due to lateral pull of the wire rope

4.13.4.3 Installation procedure of wire rope

The best way to install a wire rope is different depending on the system. In each case, choose appropriate method according to typical work progress table, which is the method most unlikely to make the wire rope distort or damage through contacting with the structural members.

For some equipment, it's suggested to remove the old wire rope and then install the new one. But to others, especially the large-size equipment, it's suggested to pull the new wire rope using the old ones.

There is another method, especially at the beginning of winding wire ropes, use the thinner auxiliary wire rope to pull the actual wire rope in.

Consider how to wind the wire rope in each case, whether pull the wire rope on the reeving device, or wind the wire rope from bundled wire ropes to wire rope drum, and then reeve the wire rope using hands or reeving device.

If one end of the wire rope is terminal connection which can not be dismantled, then pull the free end (the other end) of the wire rope to reeve the reeving device.

4.13.4.4 Secondary winding of wire rope

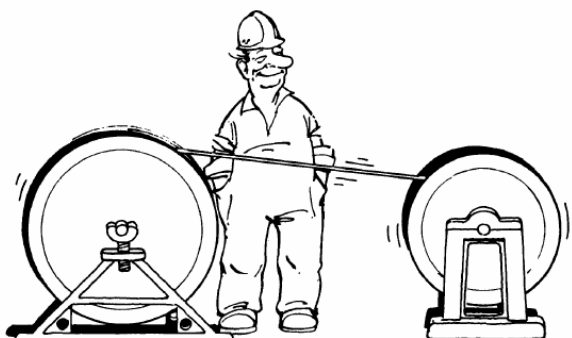


Figure 4-42 Winding of wire rope

Every wire rope is liable to curve to some degree when it is made, since the wire rope is pulled out from the planet type strander through the delivery disk. As a result, the wire rope provided to the user is curved to this direction. When the wire rope is reeved from the scroll axle to the drum, it must be reeved along this direction.

If unwinding along the opposite direction to wire rope's curving, the wire rope may rotate between the scroll axle or in later operation to reach ideal direction. The above cases will change the structure of the wire rope.

Make sure the wire rope has been fastened tightly if the wire rope to be dismantled or the auxiliary reeving rope is used to pull the new wire rope. What's more, make sure that the auxiliary reeving rope won't be twisted. For example, the untwisted wire rope and the triangular strand wire rope are especially suitable for working as auxiliary wire rope. When using traditional wire rope, make sure that their lay direction is the same as that of the pulled wire rope. Weld the terminal ends of two wire ropes frequently when using the old wire rope to pull

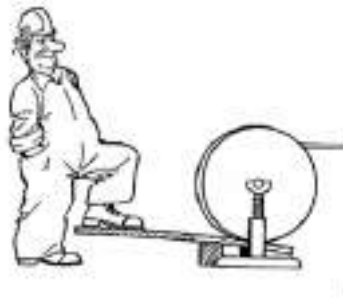
the new one. This kind of connection may distort the installed old wire rope during operation, which will pass down to the new wire rope, and damage the new wire rope to a large extent even in installation stage.

4.13.4.5 Winding wire rope with a load

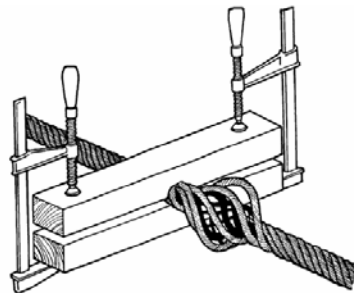
To wind the wire rope onto the drum correctly, the wire rope must be tensioned. This is very important for multi-layer rope winding. If the lower rope layer is too loose, the upper rope strands may be compressed into the lower rope strands when the wire rope is bearing a load, thus damaging the wire rope extensively. If there is a rope pulled out, the adjacent wire ropes will be wound in opposite direction, thus making the load lifted upwards suddenly. Add 1%-2% minimal breaking force to the wire rope in advance.



(a) Brake the wire flange with the brake plate on the winding shaft



(b) Brake the wire flange with one piece of board

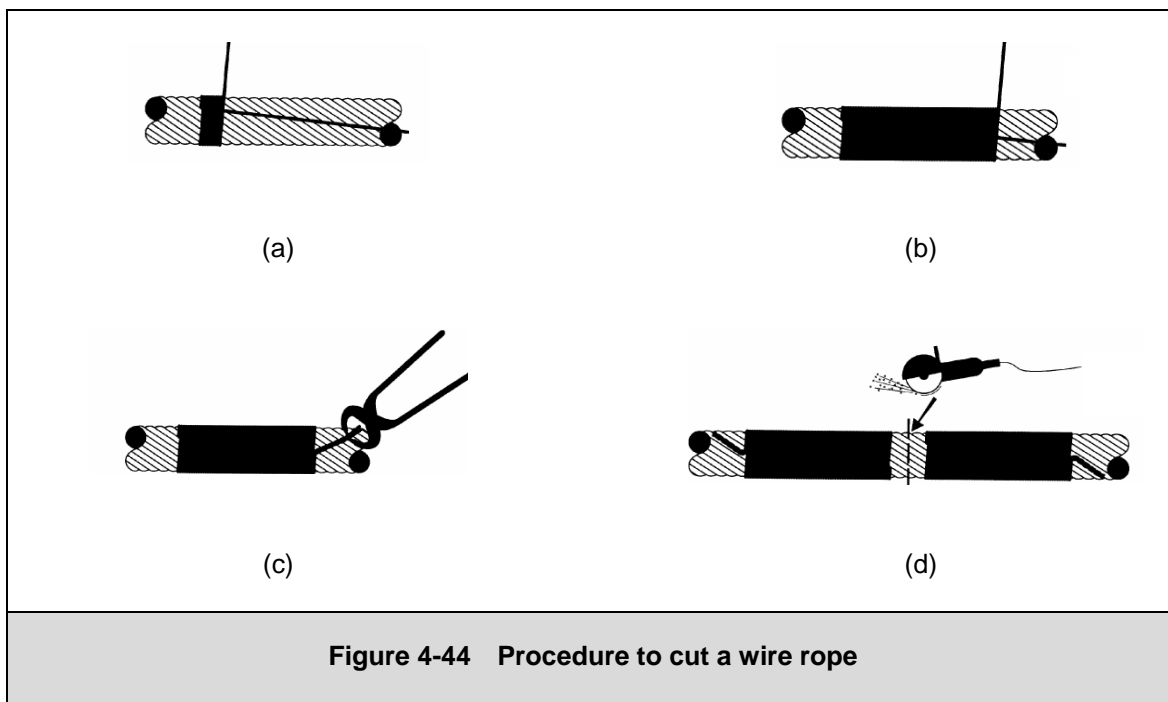


(c) Do not pre-stress on the wire rope through squeezing it

Figure 4-43 Imposing pre-stress on the winding wire rope

4.13.4.6 Cutting of wire rope

There are many ways to cut a wire rope. Use a cutterbar to cut wire rope with a diameter of 8mm. For wire ropes with a diameter more than 8mm, use mechanical or hydraulic cutterbar. If possible, use pneumatic or electrical right-angled grinder.



Process of cutting a wire rope:

- a) Bundle the end of the wire rope using steel wire before cutting. Mark a cutting point using chalk or non-conductive tape. Place the steel wire with a length of 4 times of the diameter of the wire rope near the cutting point, along the direction of the wire rope. Wind the steel wire around the wire rope.
- b) Wind the wire rope tightly until the winding length is about 3 times of the diameter of the wire rope.
- c) Pull the wound steel wire tightly using a pair of pliers, and twist it together with the other end of the steel wire.
- d) Cut the twisted steel wire. Knock the end of the steel wire lightly into the concave of the two outer strands of the wire rope to prevent scratch. Deal with the other end of the cutting point using the same way, then the wire rope can be cut off.

Wind 2 pieces of coils with a length of 3 times of diameter of wire rope at each side of the cutting point, but not a long coil.

4.14 Maintenance of air conditioning

4.14.1 Daily maintenance

- a) Regularly inspect the refrigeration equipment of the air conditioning system, especially check whether pipe fittings are fixed tightly, whether oil stains exist at the oil seal of a compressor, and whether screws are loose. If any, repair should be performed in time.
- b) Regularly inspect wire joints for tight fit to avoid accidents.
- c) Regularly remove dirty, sundries, etc. from the cooling fin of the condenser to maintain a good heat dissipation effect.
- d) Keep the air outlet unimpeded and do not put any substance at the air outlet to prevent air circulation from being impacted which will lower the evaporability of the evaporator and the refrigeration effect.
- e) Observe whether refrigerant is charged properly via the liquid window of the reservoir (when the environment temperature is 30 - 35 °C, and the engine speed is 1,600 - 1,800 RPM).



- (1) Keep supplying fresh air into the operator's cab when using it for a long time;
- (2) Do not adjust the temperature too low to lubricate the air compressor;
- (3) Open the air conditioning at least 10 minutes every month.

4.14.2 Maintenance of air conditioning in slack season

After the slack season of air conditioning (winter) comes, the air conditioning must be started every week and operated for ten minutes to make refrigerant circulate smoothly, thus avoiding refrigerant leakage caused by dry shaft seal of air compressor, keeping the air compressor in a good condition, and preventing such components as expansion valve from rusting.

When summer comes each year, the refrigerating system must be comprehensively inspected, cleaned, checked for leakage and the refrigerant must be applied regularly to ensure normal operation of the refrigerating system.

4.15 Operator's cab

4.15.1 Inspection of the windshield wiper and cleaning solution in the operator's cab

Inspect whether the windshield works properly every week. The sprinkler is located at the rear left side of the operator's seat. Add water frequently into the sprinkler and add little cleaning agent if necessary.



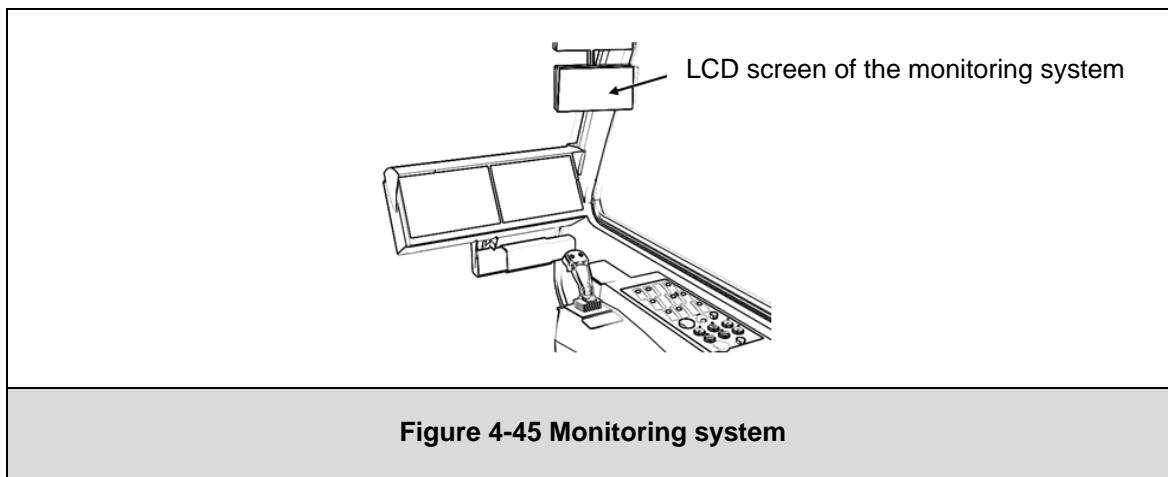
Add proper coolant before the winter comes (the amount is decided by temperature).

4.15.2 Inspection of the sliding door of the operator's cab

Open the sliding door once a week at seaside or humid area to prevent that it can't be opened due to humidity.

4.15.3 Inspection of the operator's cab video monitoring system

Check whether the monitoring system video camera works normally before using the crane every time and whether the LCD image in the operator's cab is clear.



4.16 Lubrication system

Lubricate the parts that need lubricating regularly by hand to make sure that the equipment can operate properly. The lubrication work is done by oil gun manually.

Table 4-16 Lubrication instructions

No.	Lubrication part	Lubrication interval (hour)					Remarks
		10	50	100	250	500	
1	Pulley and pulley spindle				•		
2	Connection parts of the main boom				•		
3	Connection pin spindles of cylinders				•		
4	Connection parts of derricking crown block				•		
5	Shaft end bearing of hoisting winch 3			•			Extend according to using frequency
6	Rope support bearing		•				
7	Load hook bearing and load hook shaft				•		
8	Top of jib tilting-back support mechanism				•		
9	Pin spindle with oil filling nozzle					•	
10	Hinge-point at the bottom of A-frame				•		

CAUTION

- (1) Wipe the oil filling nozzle clean before injecting lithium base grease.
- (2) The high-quality lubricating grease in oil gun must not be liquefied in high temperature, and not be solidified below freezing.
- (3) The lubricating grease of different brands can not be mixed.

4.16.1 Lubrication of boom pin

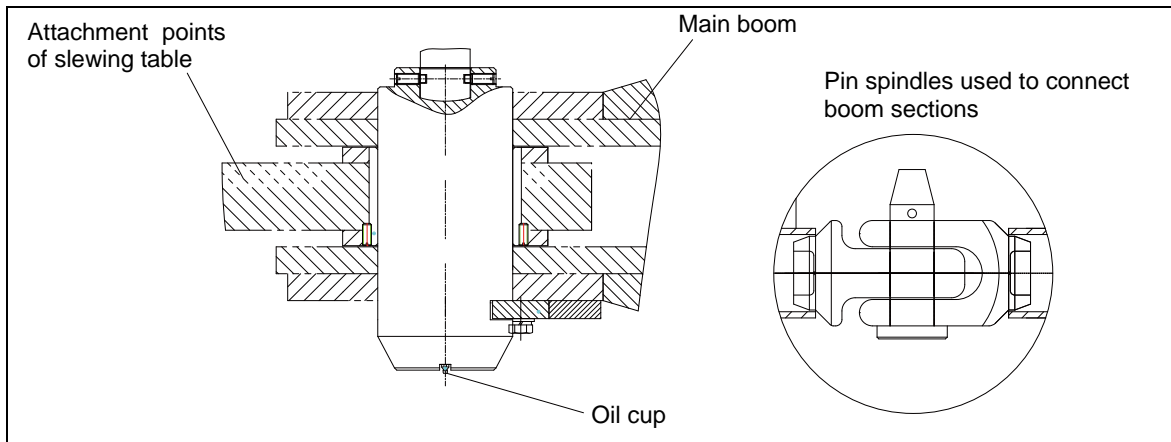


Figure 4-46 Lubrication of boom pin

Make sure that all pins (including pivot section bolting cylinder and pin spindles used to connect boom sections) are lubricated completely before raising the boom.

If the boom pins are not lubricated well, it is difficult to assemble and dismantle the boom sections.

4.17 Key structural member

4.17.1 Visual inspection

Some components must be inspected visually before operation every day. (See the following figure)

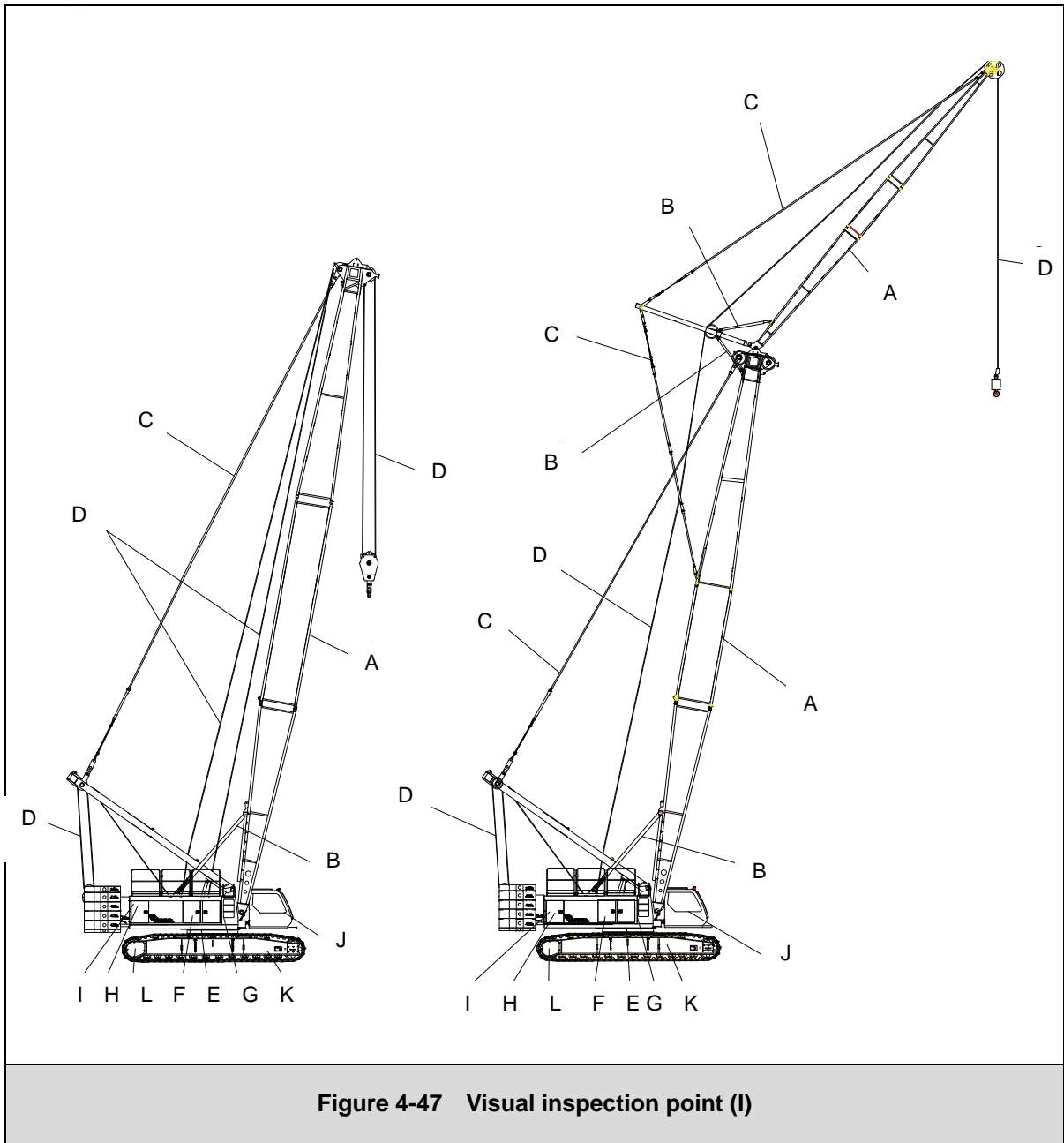


Figure 4-47 Visual inspection point (I)

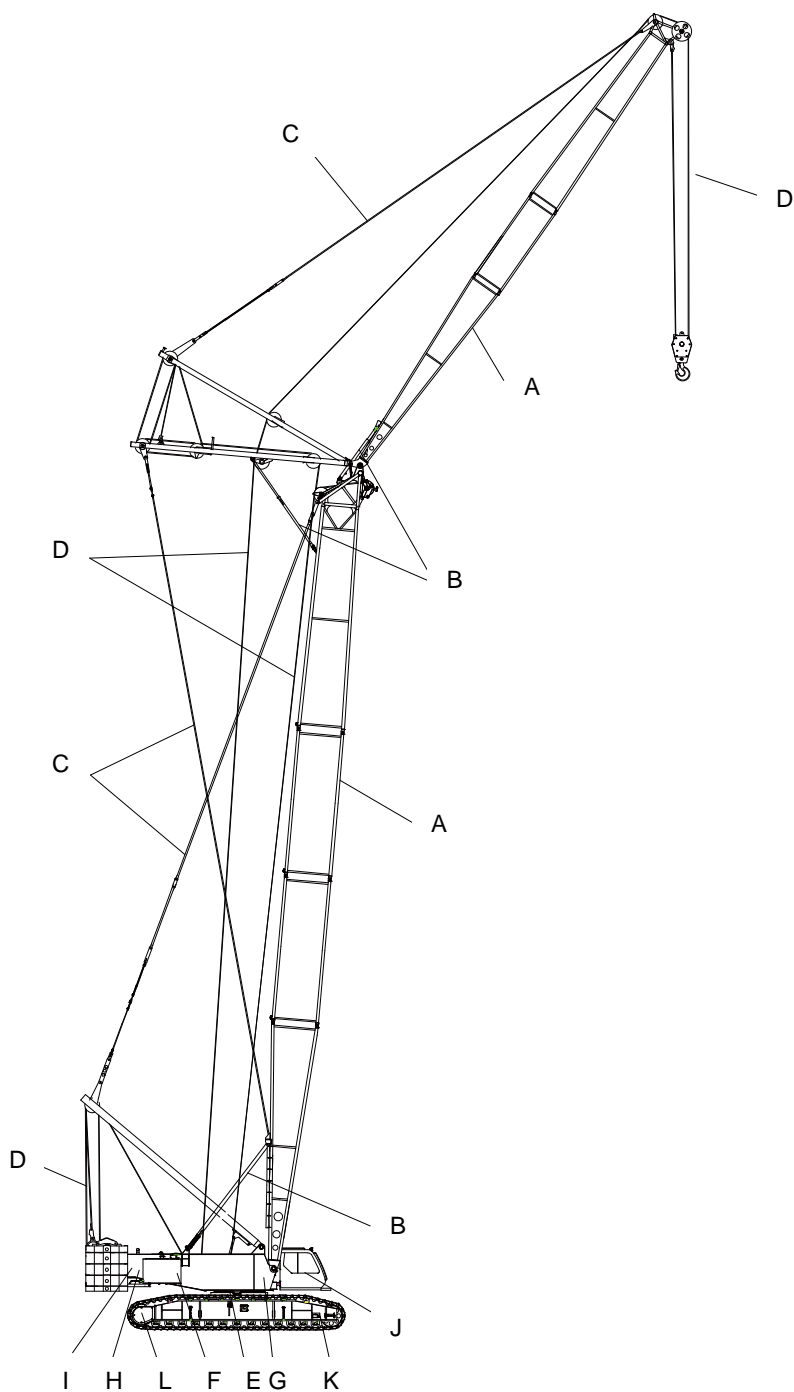


Figure 4-47 Visual inspection point (II)

CAUTION

- (1) ZCC1300 has no luffing jib working condition.
- (2) The following steel structural members are main components of the crane, and check them according to actual configuration.

4.17.1.1 Visual inspection of boom

- A - Check boom parts, connecting pins and retaining pins for tight fit and damage.
- B - Check main boom tilting-back support, tilting-back supports of jib for damage and functional work.
- C - Check anchoring rods, connecting pins and retaining pins for tight fit and damage.
- D - Check if lubricating oil film on wire rope is intact, and check wire rope for damage.

4.17.1.2 Visual inspection of superstructure and undercarriage

- E - Check if the gear of slewing ring is lubricated completely.
- F - Check hydraulic system for oil leaks and damage. Check hydraulic oil level.
- G - Check engine housing for damage and tight fit. Check if there are bolts lost.
- H - Check engine for oil leakage. Check fuel system for oil leakage and fuel for pollution.
- I - Check cooling system for oil leakage, damage and pollution.
- J - Check all instruments and screens for functional work and damage.
- K - Check driven sprocket for damage. Check if the tension of crawler is proper.
- L - Check travel drive device for oil leaks.



- (1) Crane operator is responsible for crane inspection in accordance with national and international regulations.
- (2) The crane inspection must be performed by experts and professionals who have received training in crane knowledge.

4.17.2 Periodic inspection

4.17.2.1 Inspection interval

The structural members are the load-bearing components of crane. Therefore, the inspection of structural members is necessary.

Suggested inspection interval:

- a) Check once every half a month to a month under normal working condition.
- b) Check it carefully before and after operation when the lifted load is or more than 90% of rated load.
- c) Invite an expert to check the anchoring rod carefully every year.

4.17.3 Inspection of structural members

Check structural members for the following defects:

- a) Check them for cracks.
- b) Check them for deformation.



As to the following positions pointed by arrows, you must pay attention to inspect them.

4.17.3.1 Crawler carrier

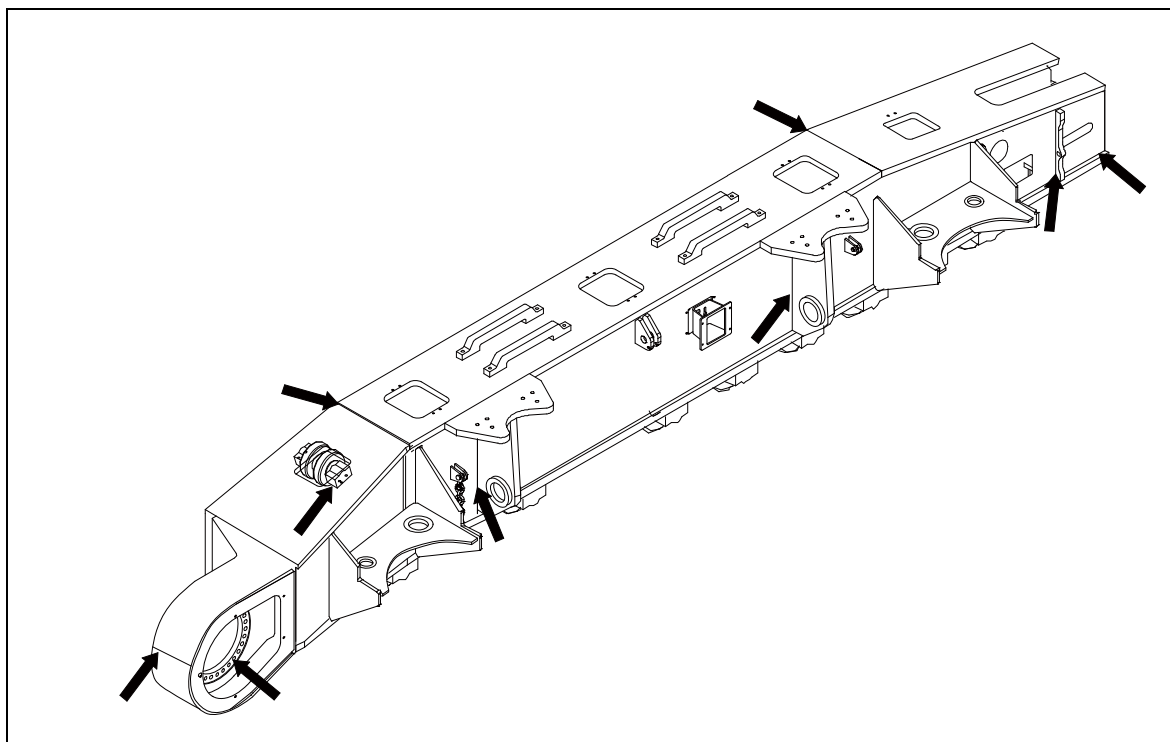


Figure 4-48 Crawler carrier

4.17.3.2 Undercarriage central section and folding bracket

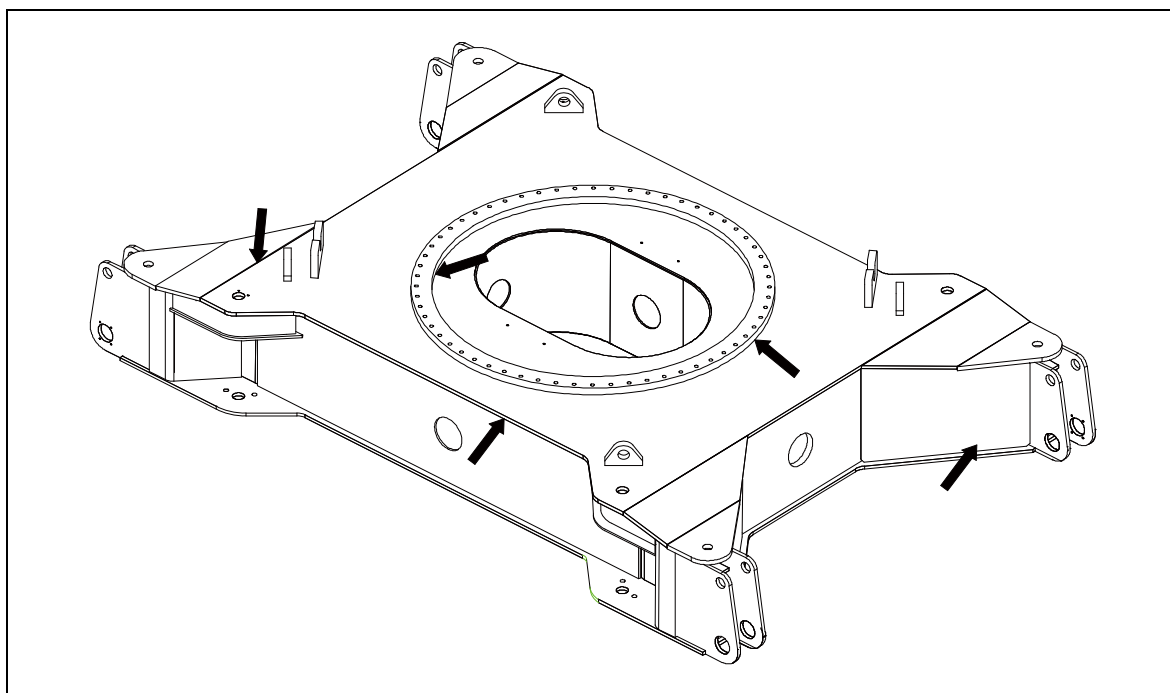
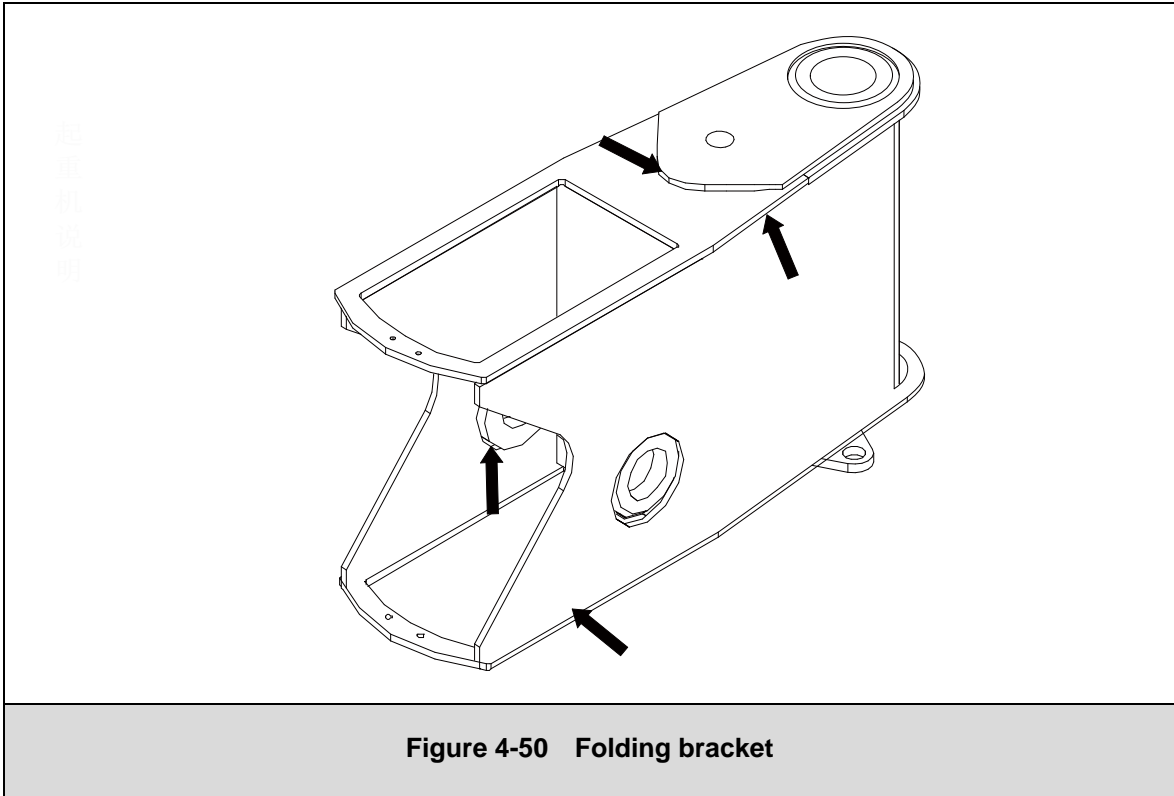
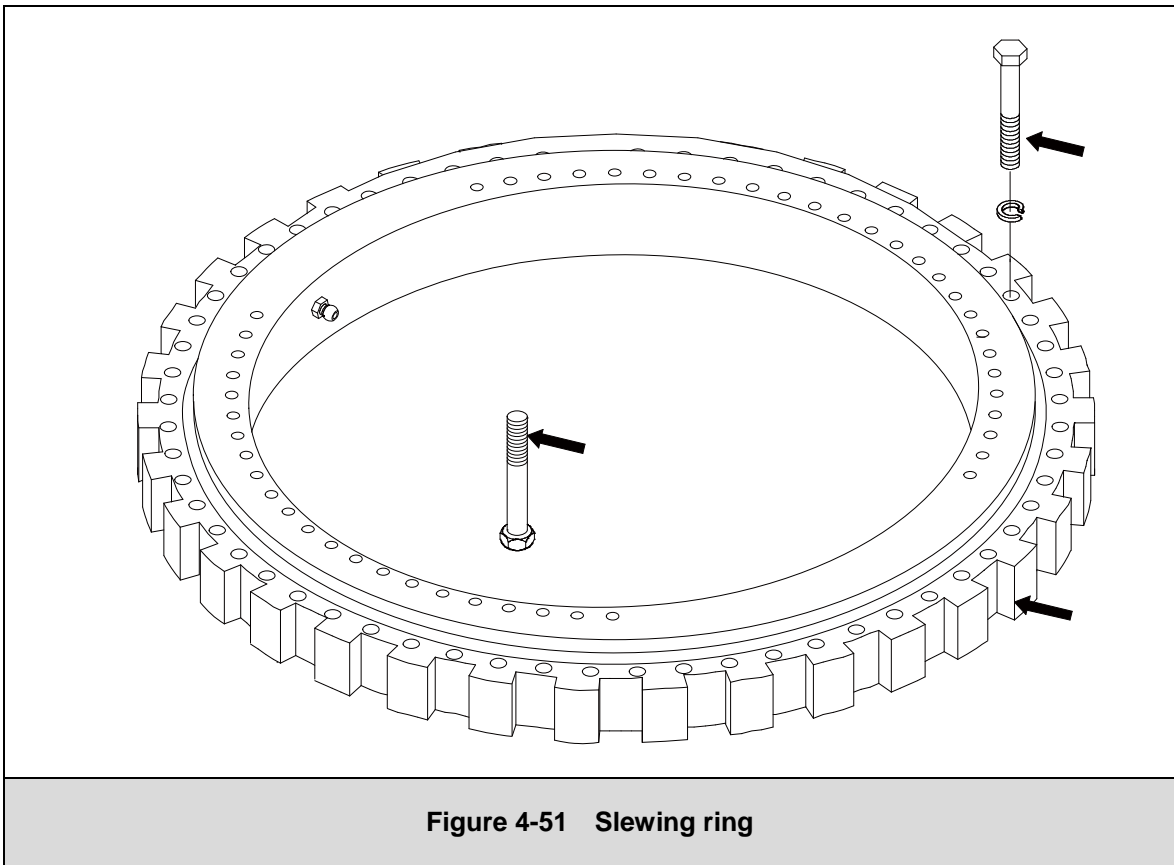


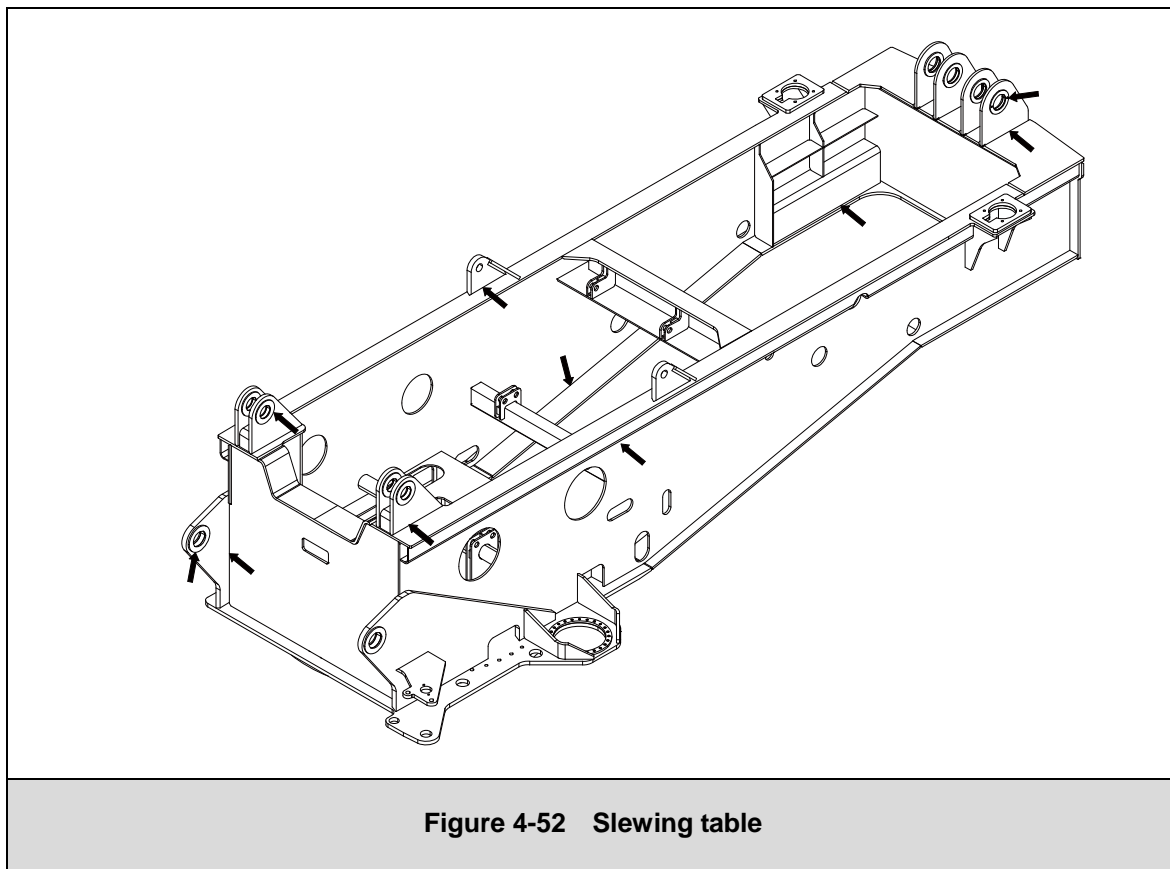
Figure 4-49 Undercarriage central section



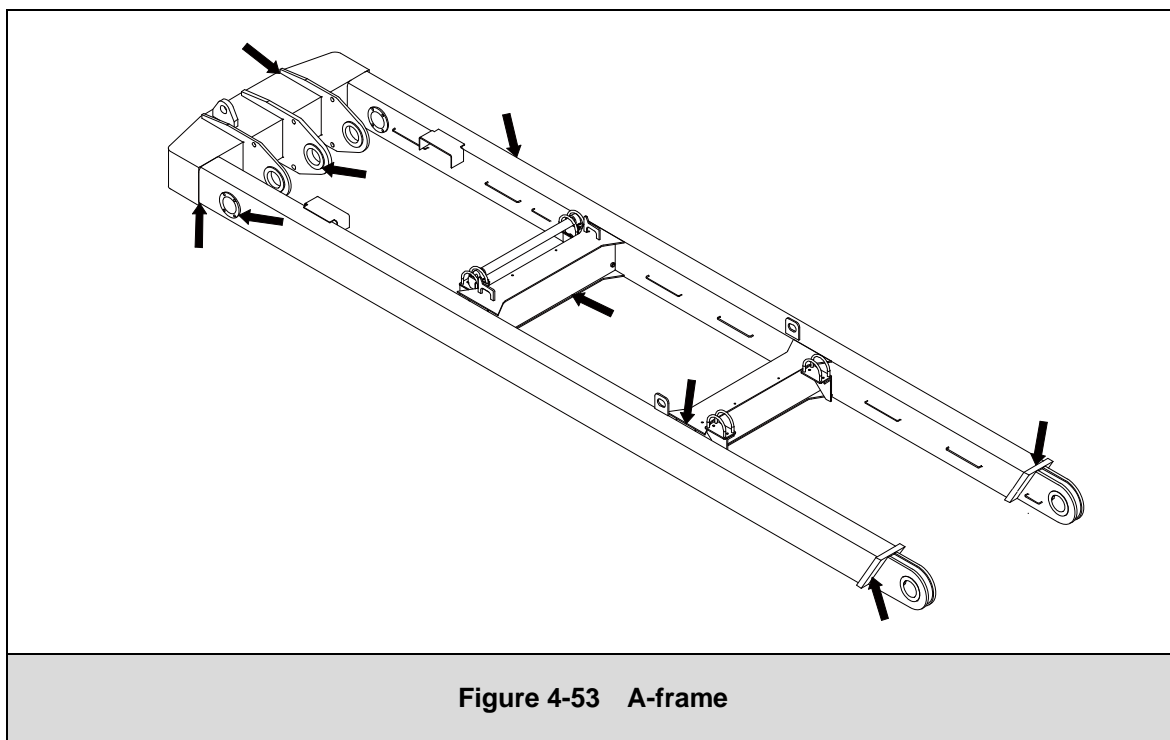
4.17.3.3 Slewing ring



4.17.3.4 Slewing table



4.17.3.5 A-frame



4.17.3.6 Boom and anchoring rods

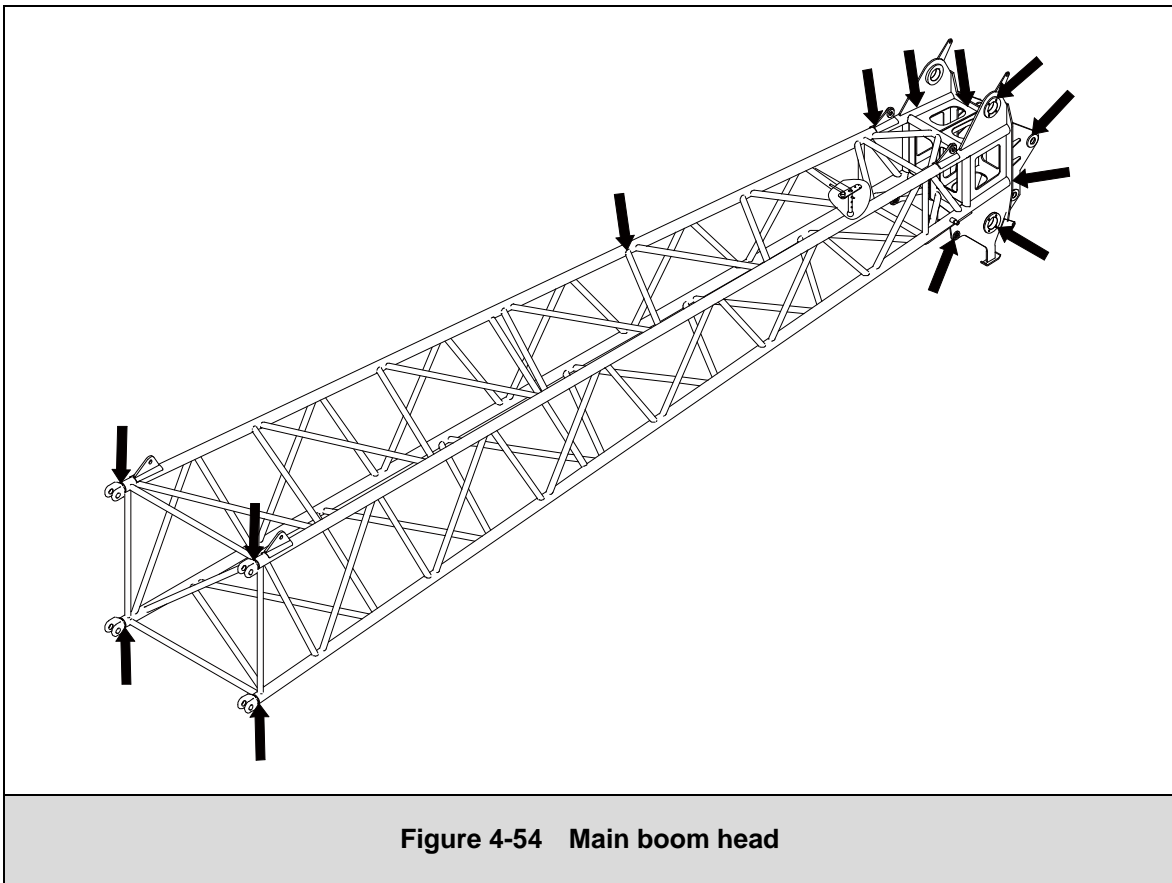
The straightness tolerance of main chord of boom section must be in line with the following table:

Table 4-17 The straightness tolerance of main chord of boom section

Length of boom section (mm)	≤3000	>3000-6000	>6000
Local straightness tolerance (mm)	2 per meter		
Overall length straightness tolerance (mm)	3	4	6

The straightness tolerance per meter of the web member of boom section must not be greater than 1.5mm.

a) Main boom head



b) Main boom pivot section

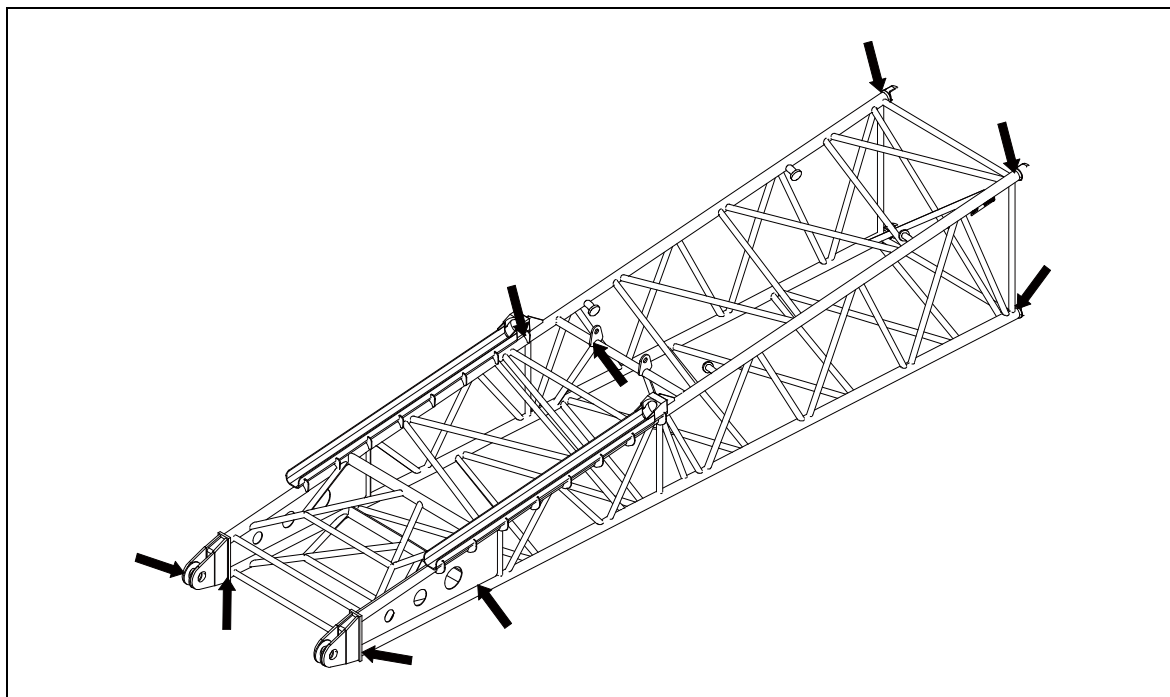


Figure 4-55 Main boom pivot section

c) 3m main boom intermediate section

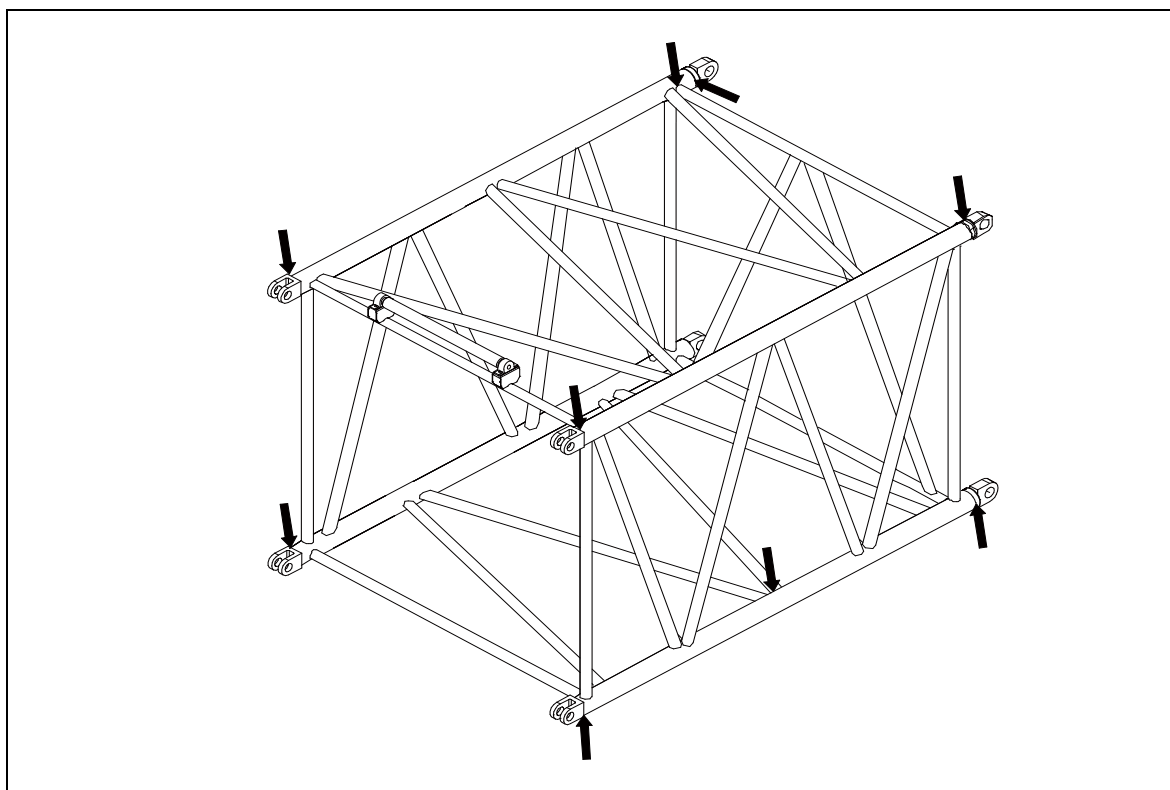
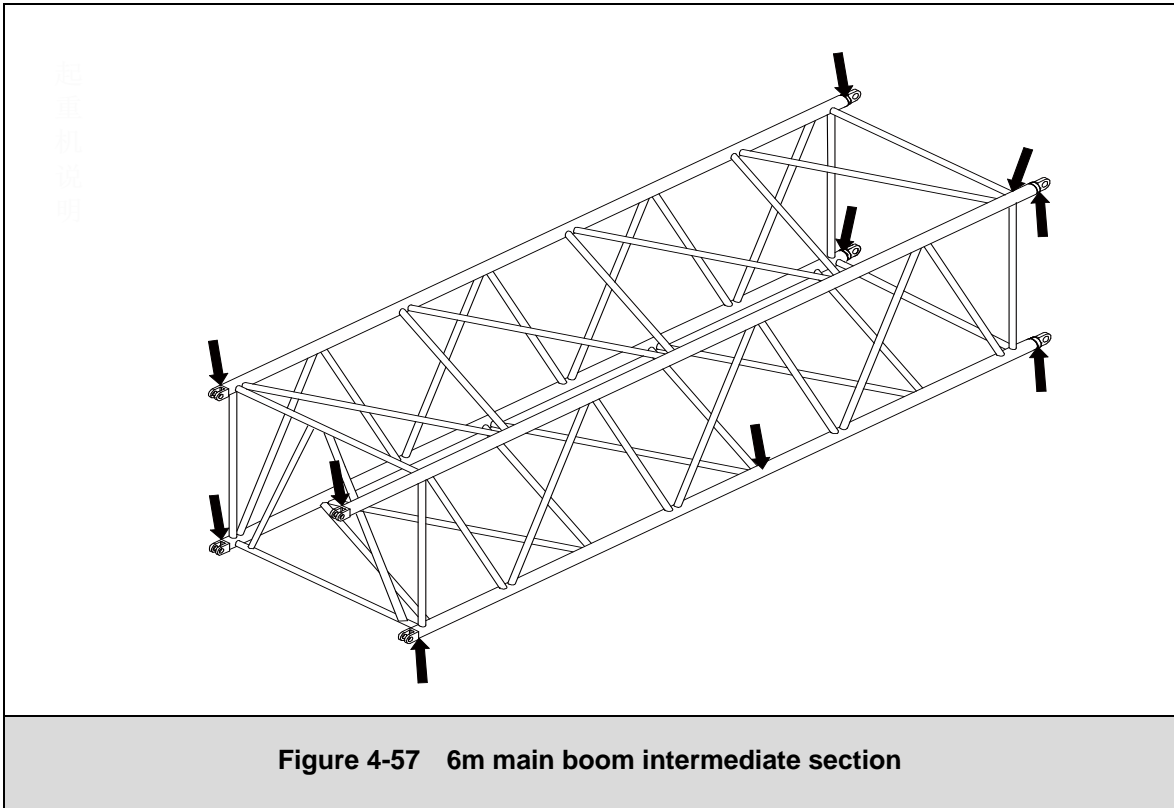
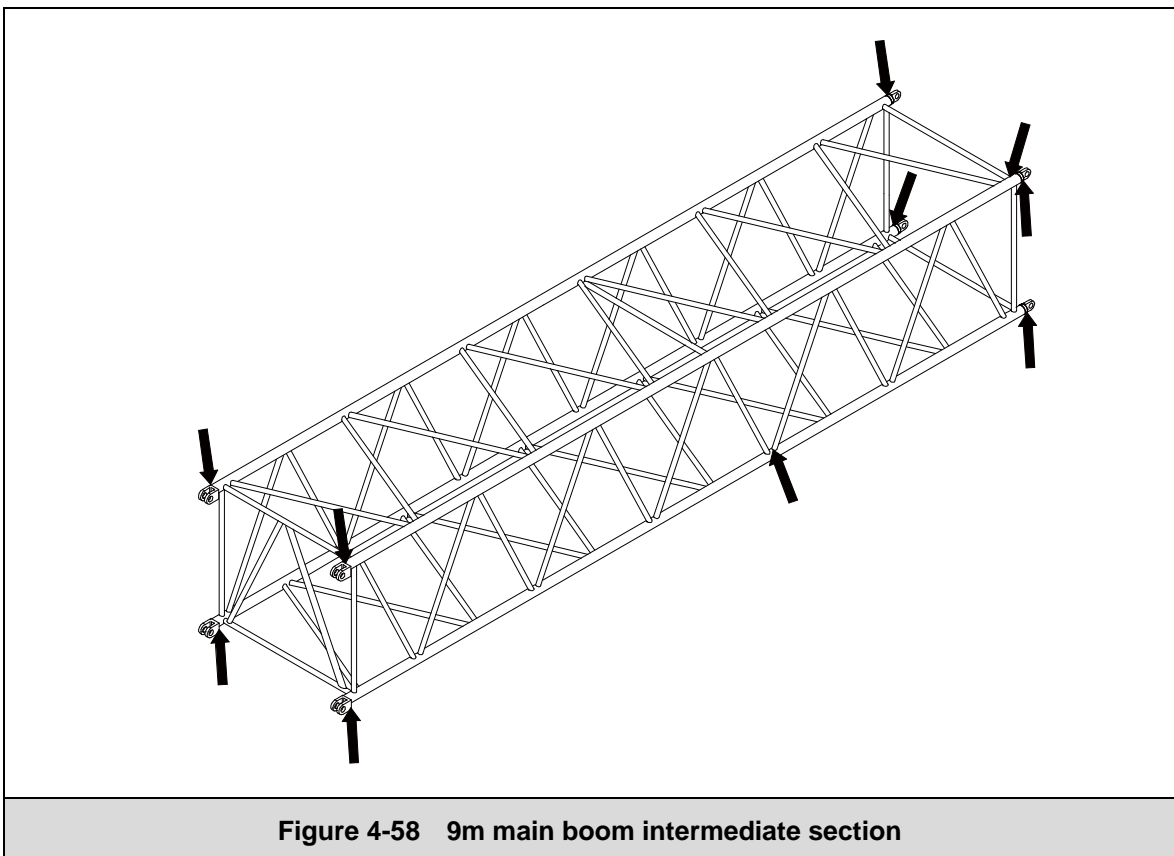


Figure 4-56 3m main boom intermediate section

d) 6m main boom intermediate section



e) 9m main boom intermediate section



f) Tip boom

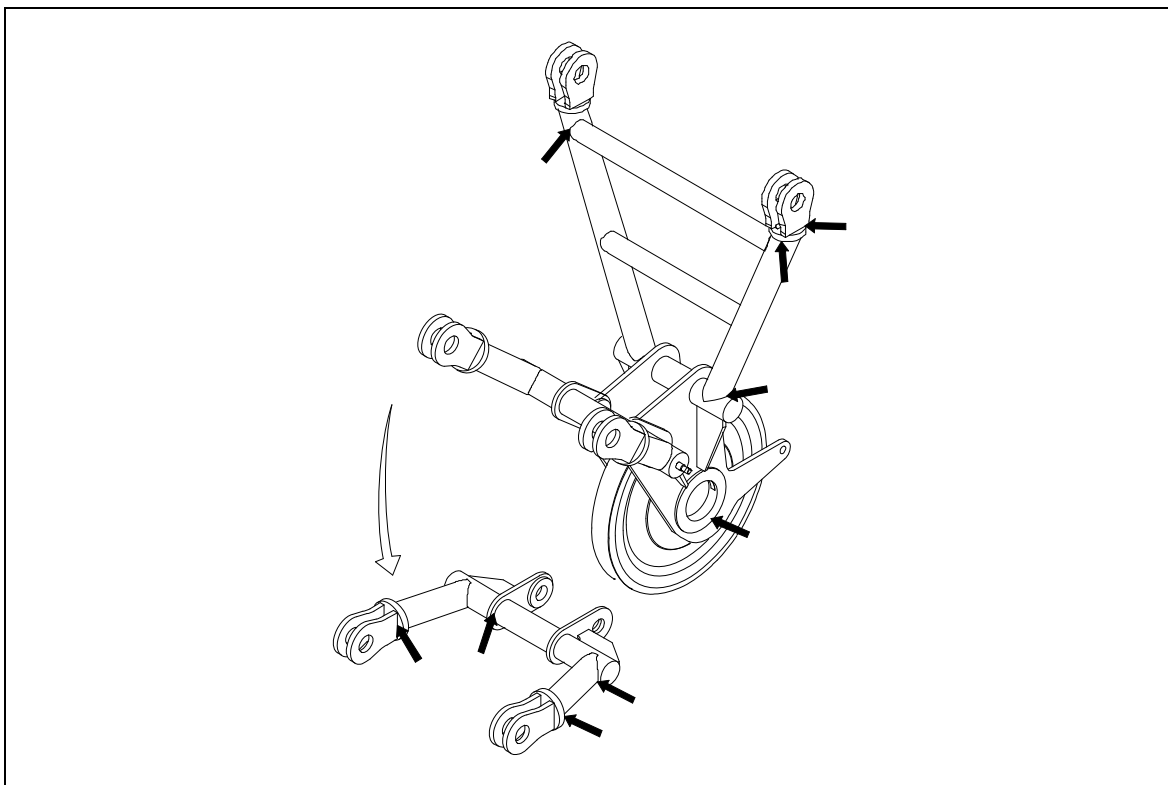


Figure 4-59 Tip boom

g) Main boom anchoring rods

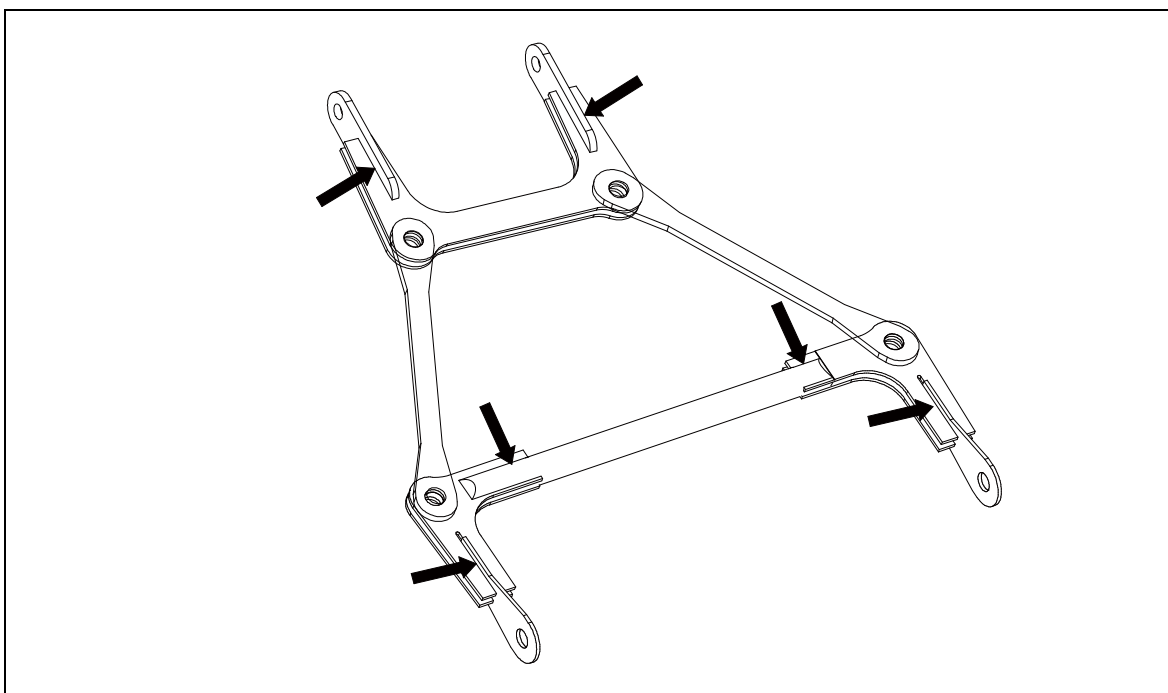


Figure 4-60 Anchoring rods

h) Fixed jib head

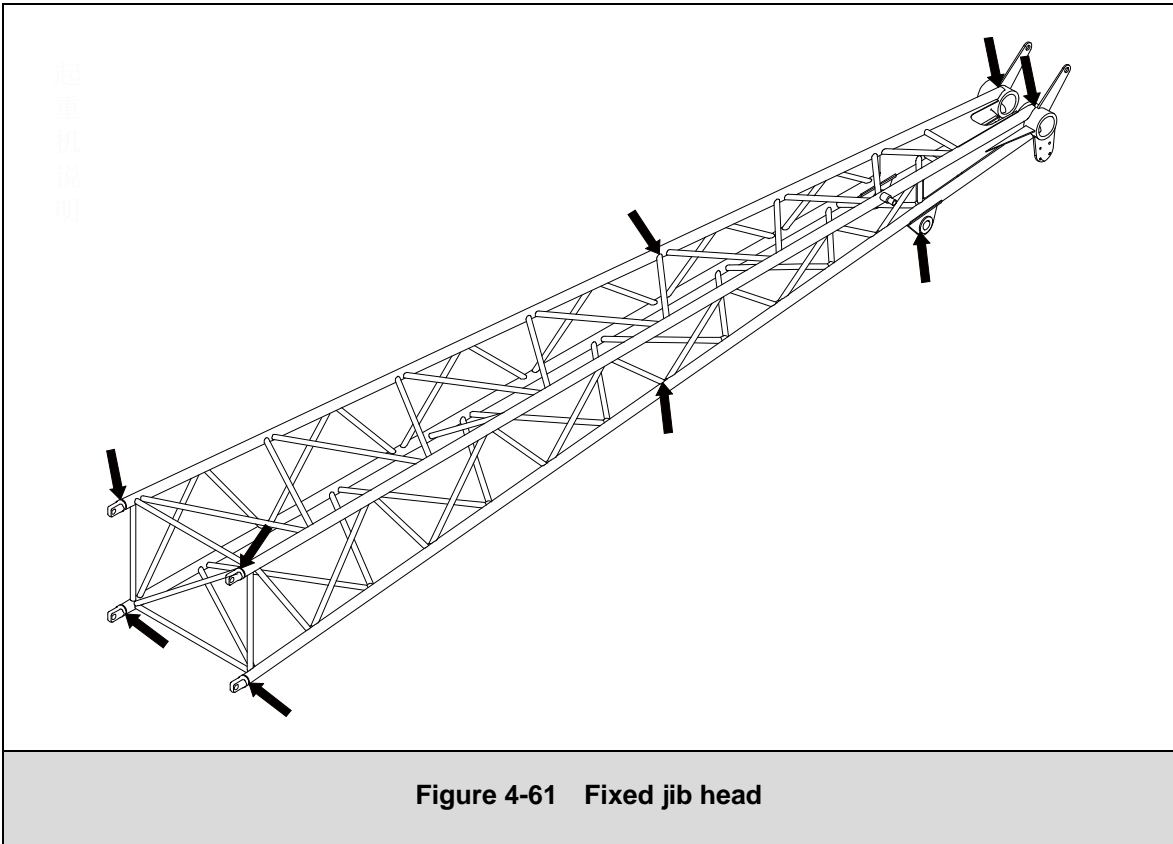


Figure 4-61 Fixed jib head

i) Fixed jib pivot section

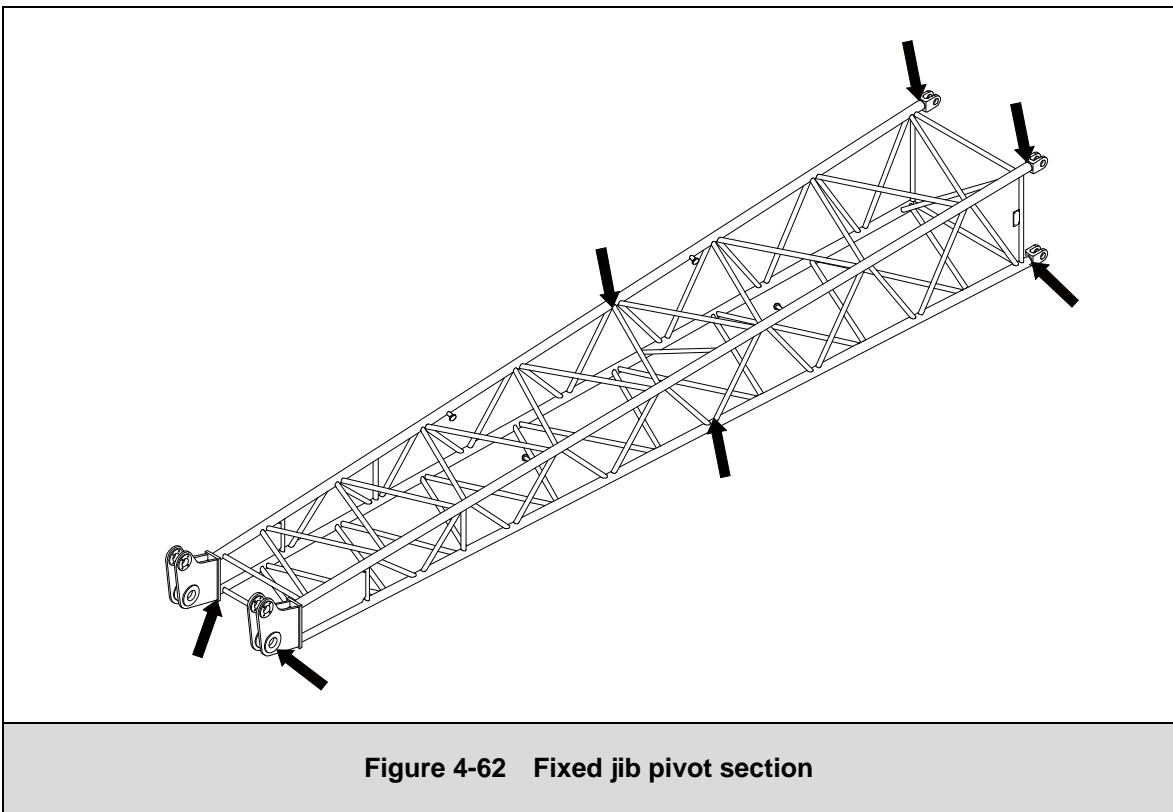
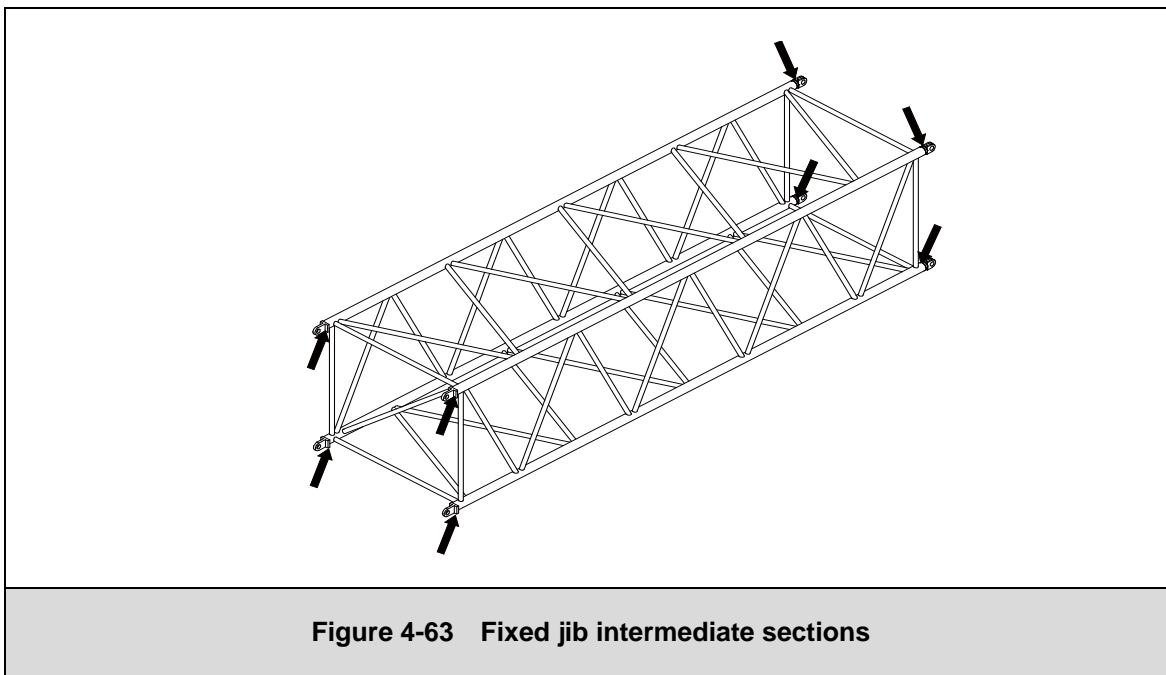
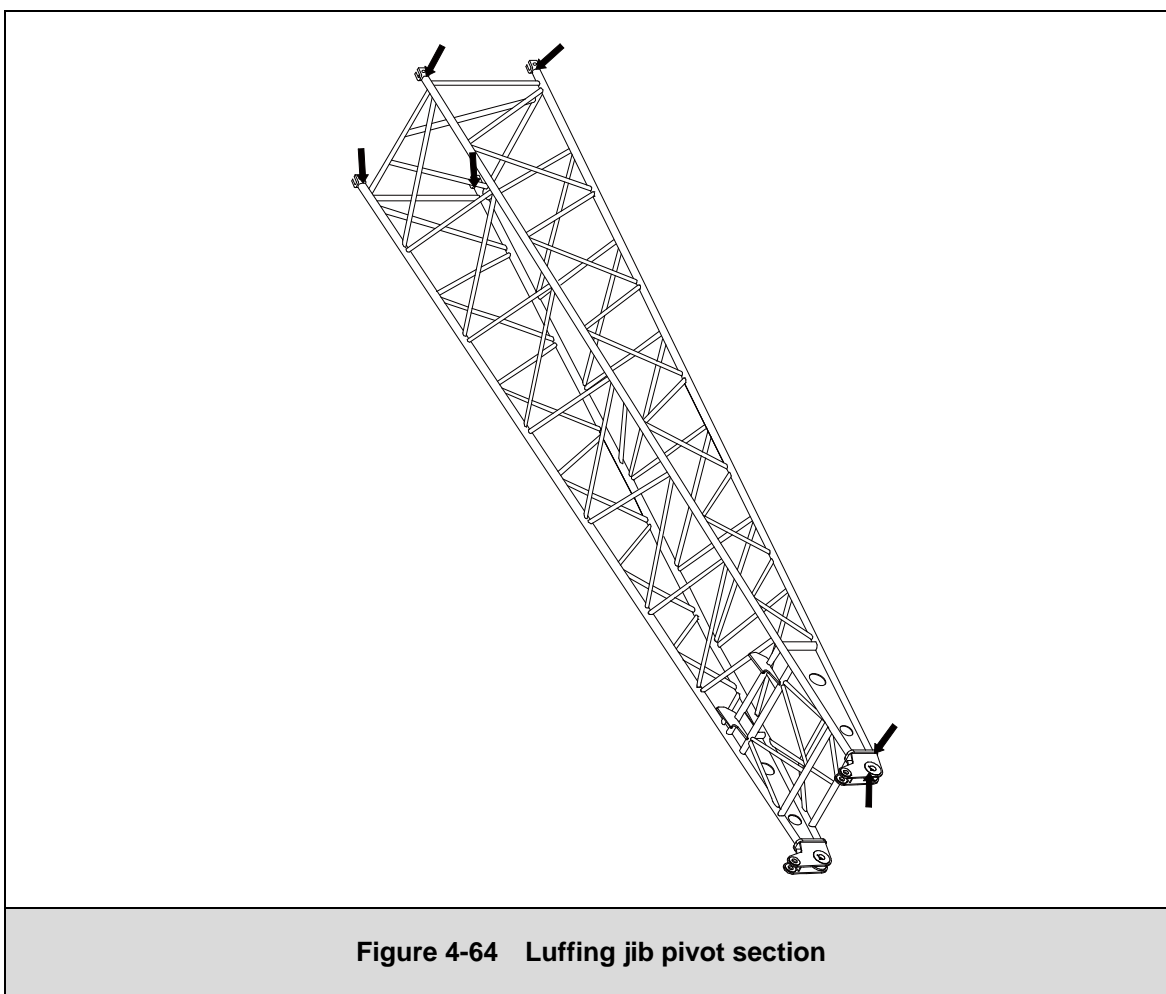


Figure 4-62 Fixed jib pivot section

j) Fixed jib intermediate sections



k) Luffing jib pivot section



l) Luffing jib head

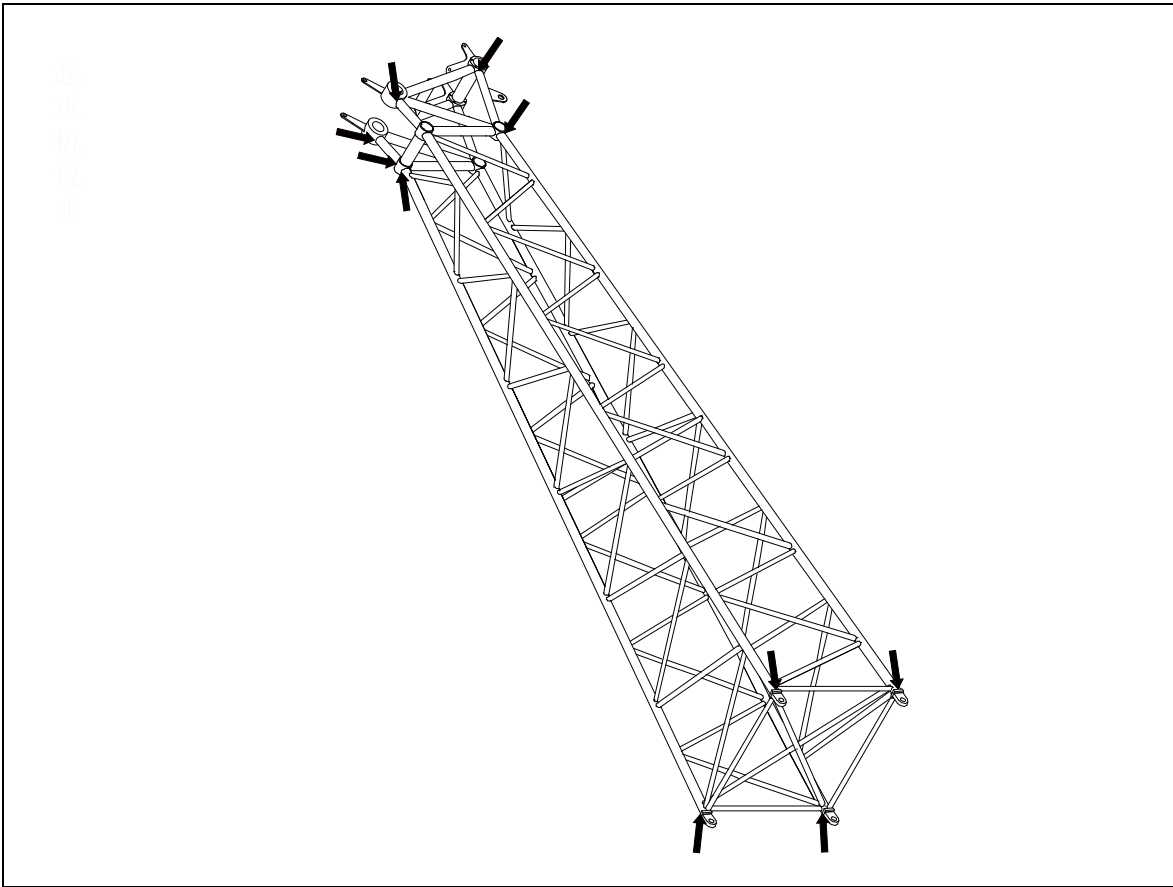


Figure 4-65 Luffing jib head

m) 3m luffing jib intermediate section

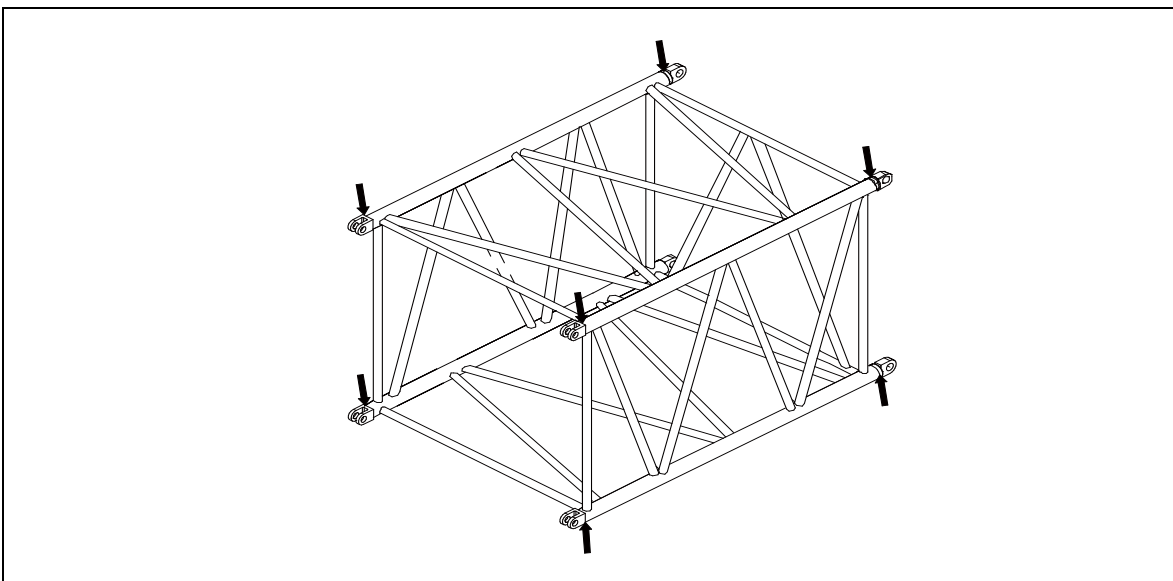
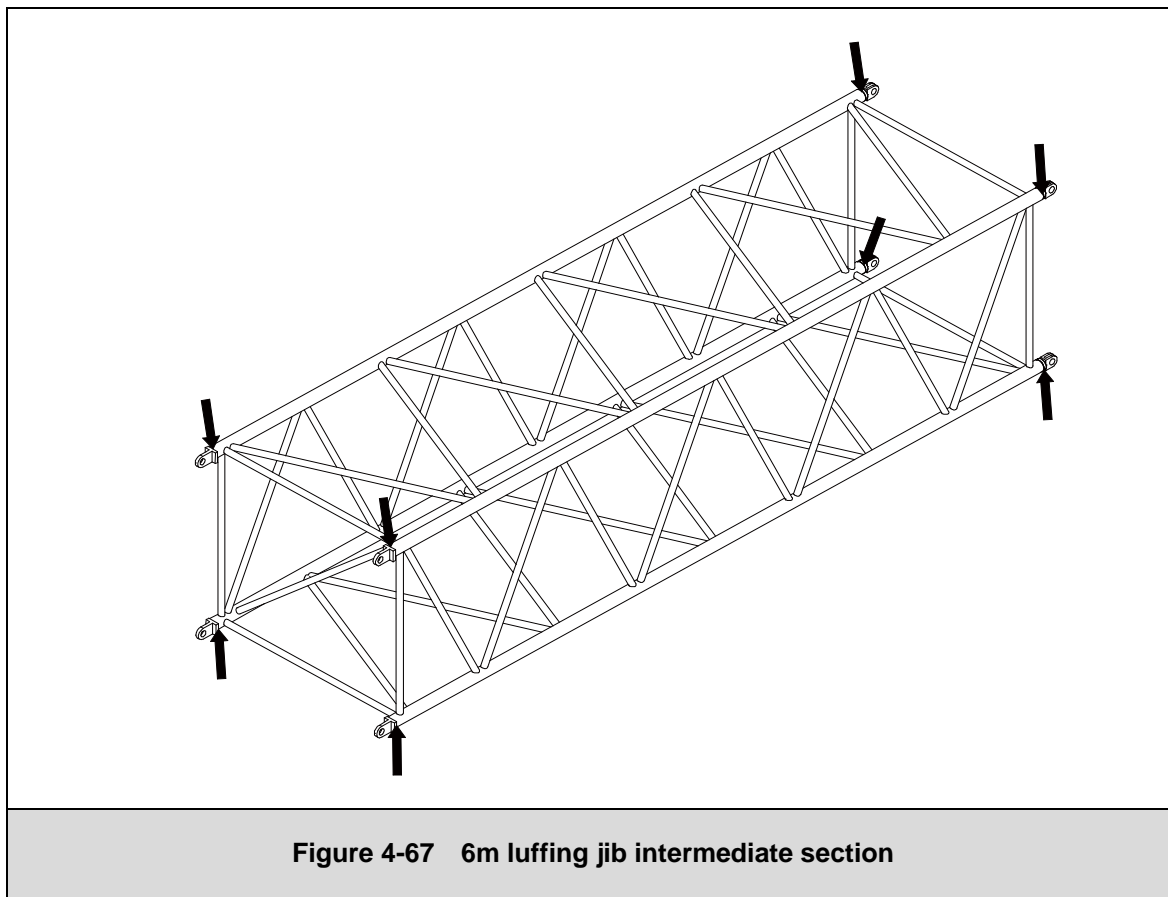
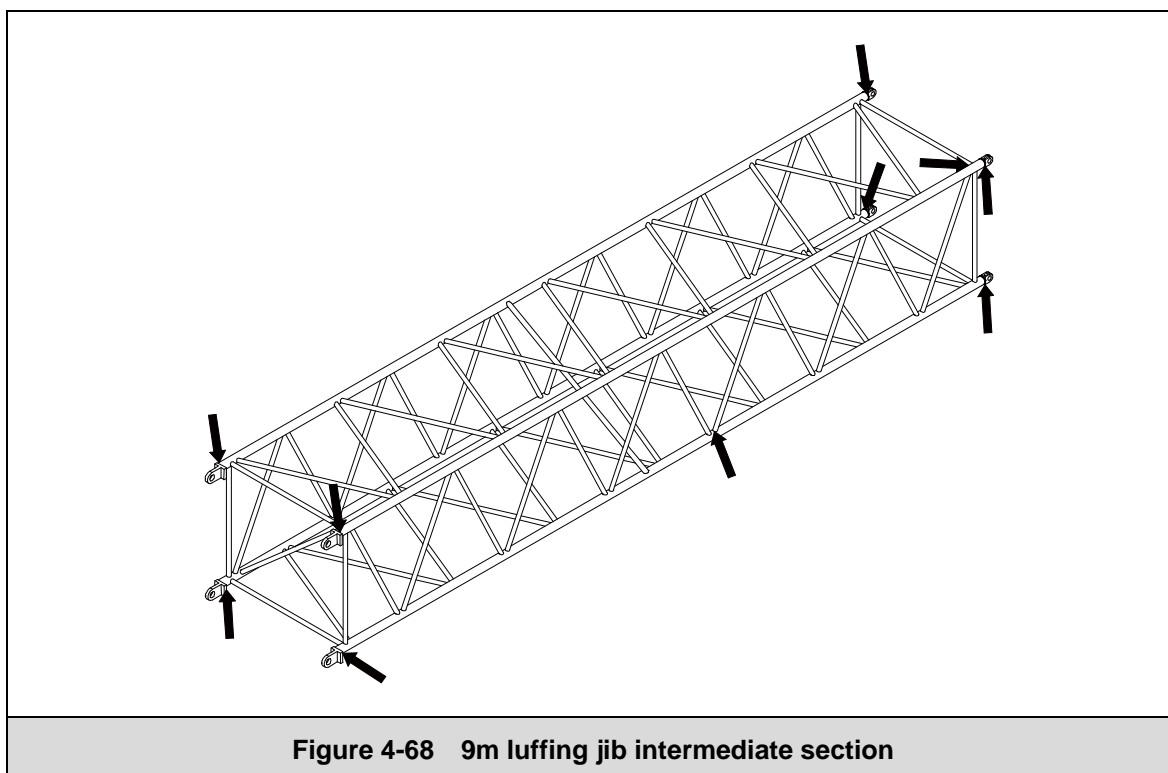


Figure 4-66 3m luffing jib intermediate section

n) 6m luffing jib intermediate section



o) 9m luffing jib intermediate section



4.17.3.7 Tilting-back support and other parts

a) FA-frame

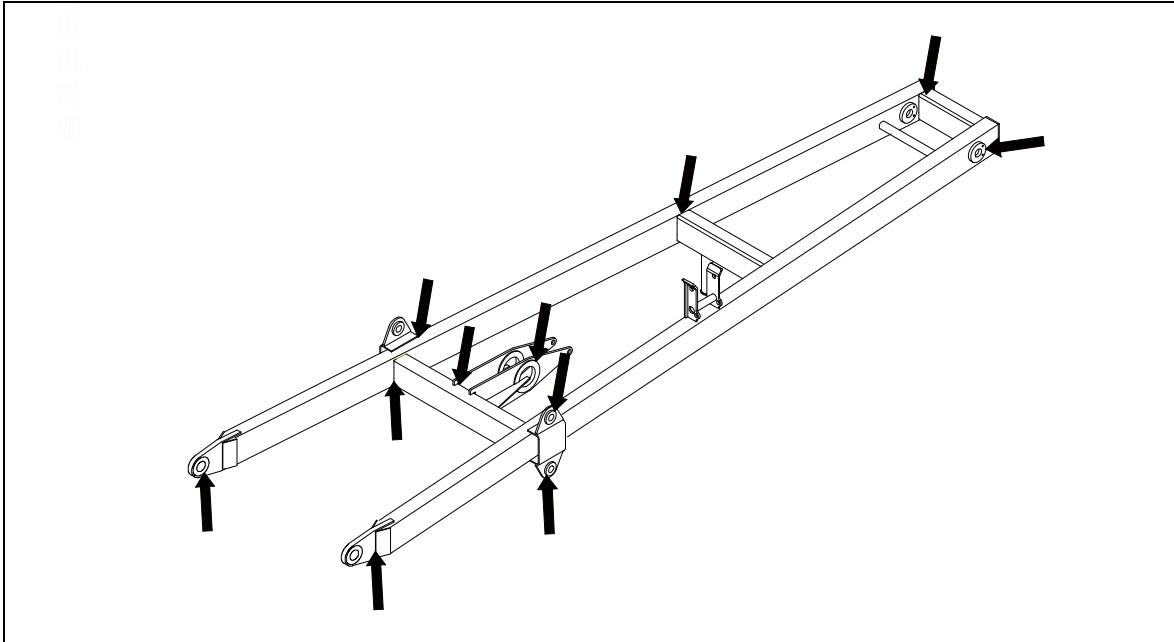


Figure 4-69 FA-frame

b) WA-frame 1

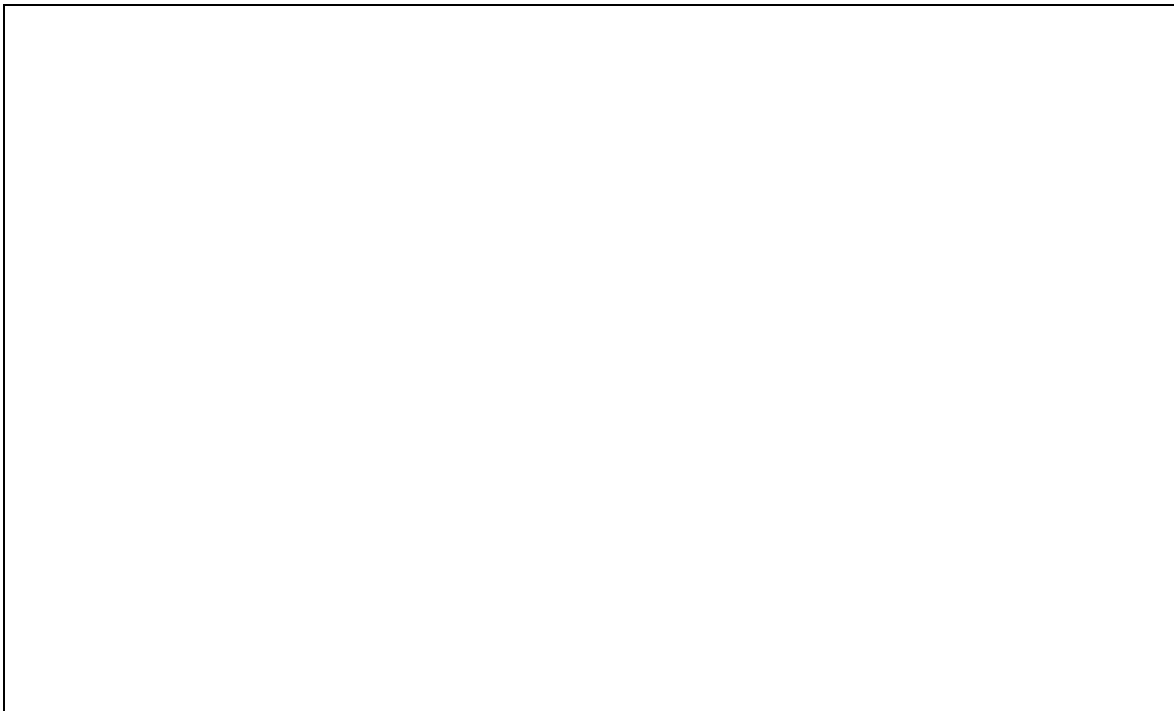


Figure 4-70 WA-frame 1

c) WA-frame 2

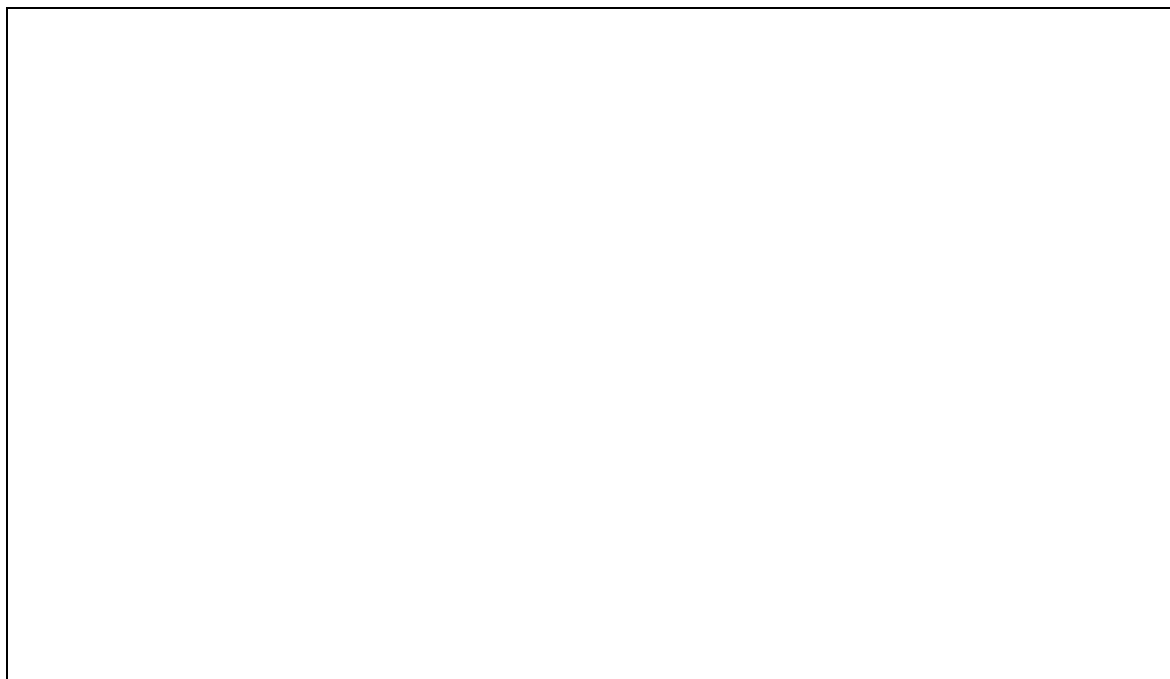


Figure 4-71 WA-frame 2

d) Main boom tilting-back support

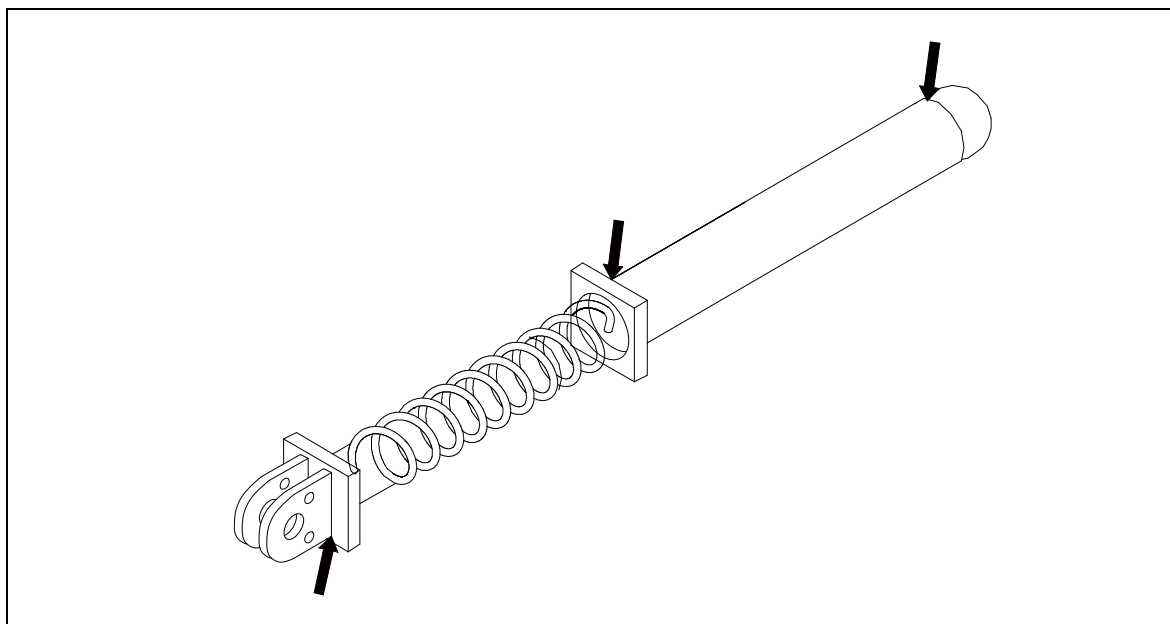
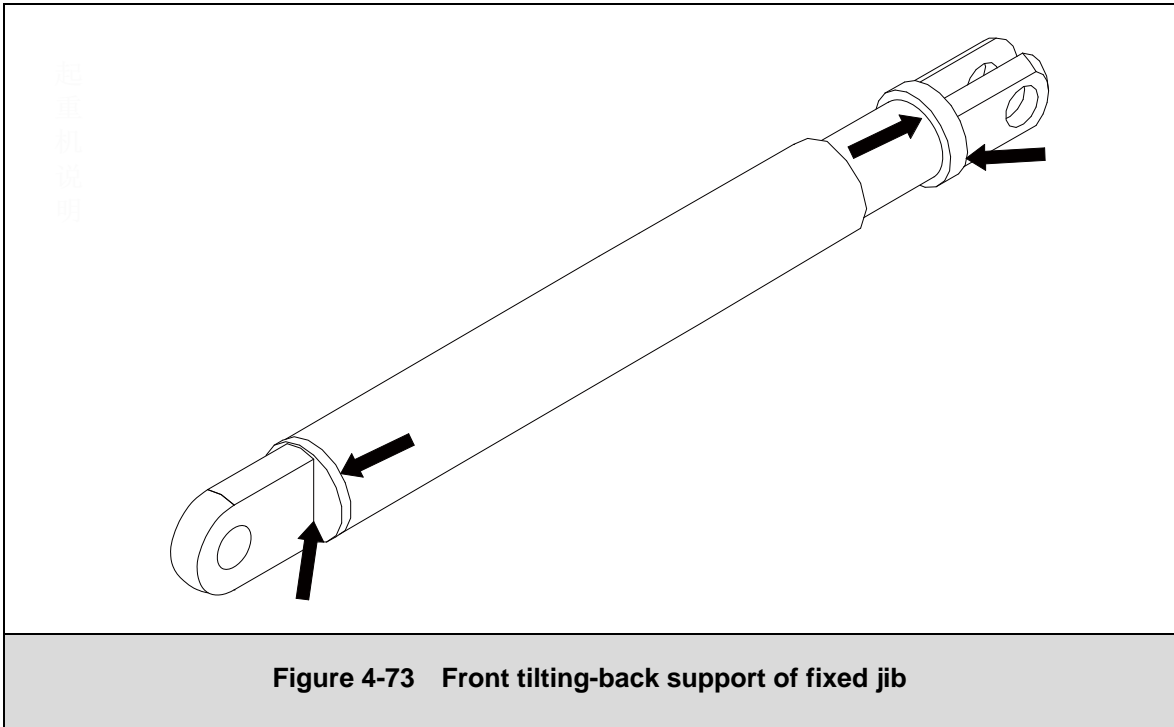
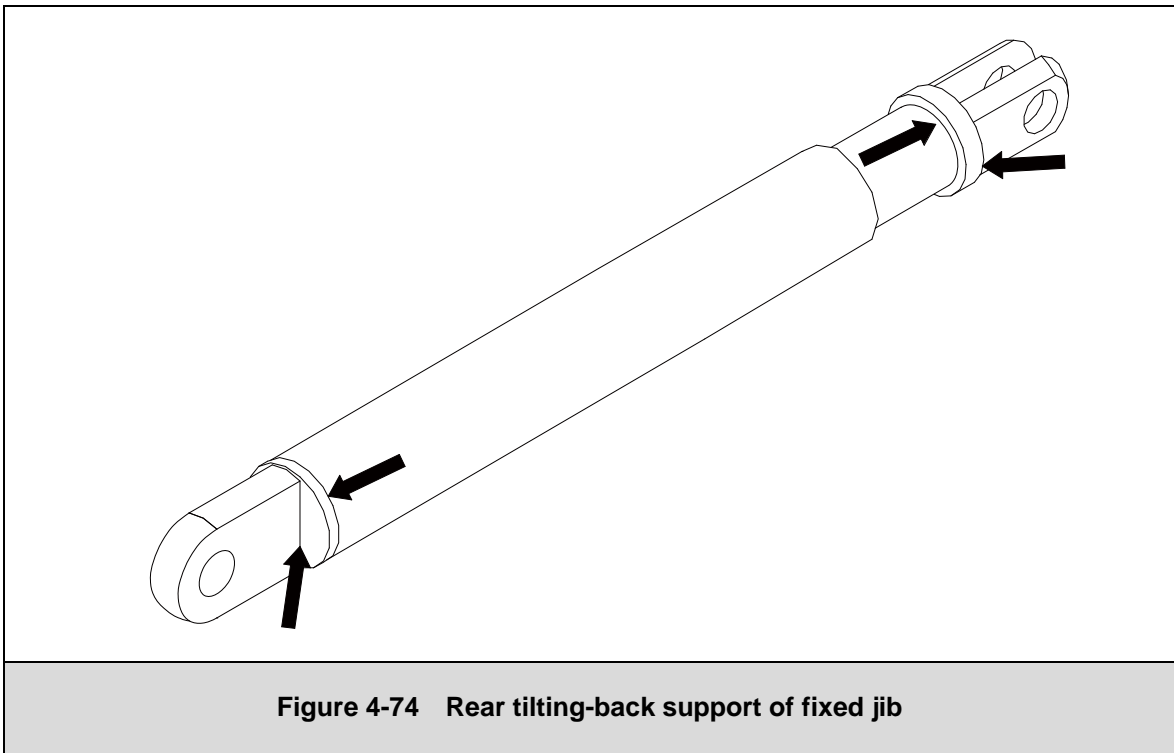


Figure 4-72 Main boom tilting-back support

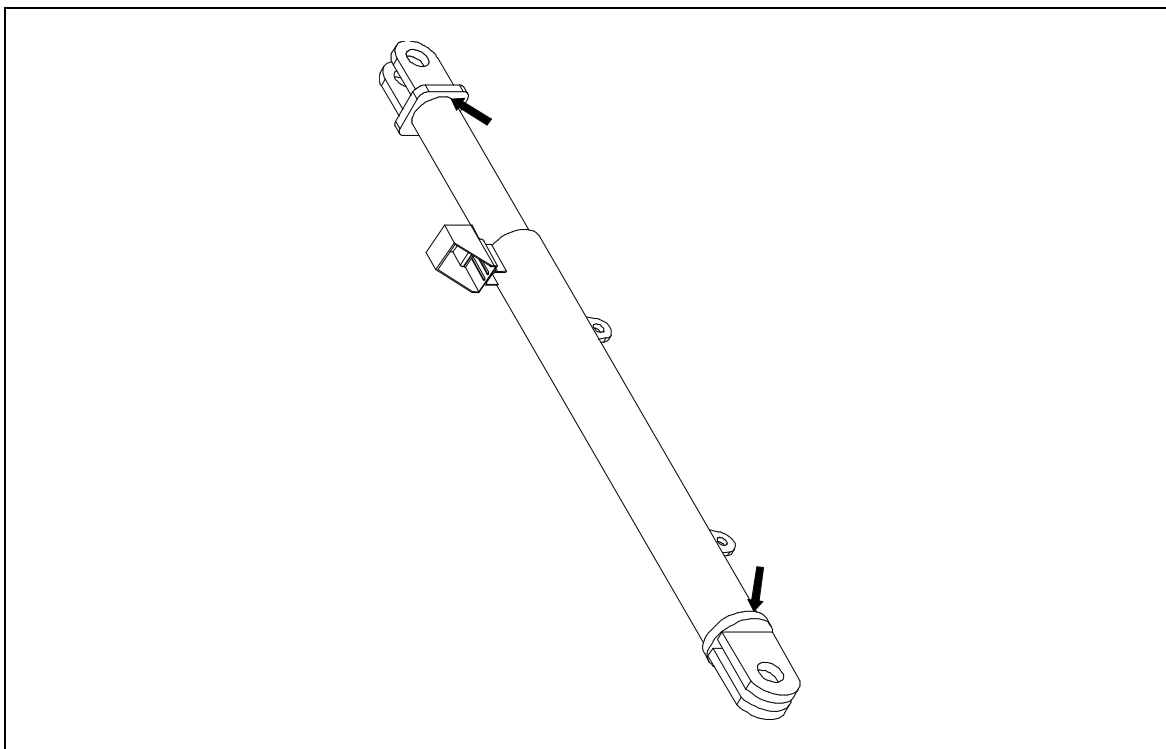
e) Front tilting-back support of fixed jib



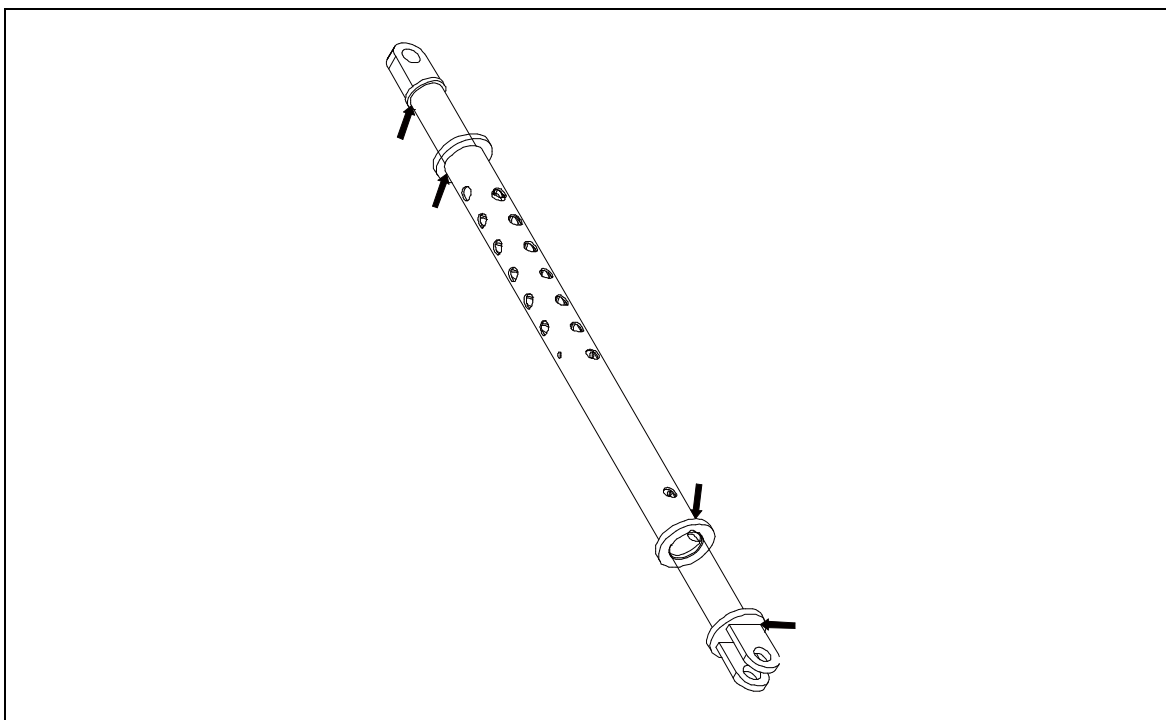
f) Rear tilting-back support of fixed jib



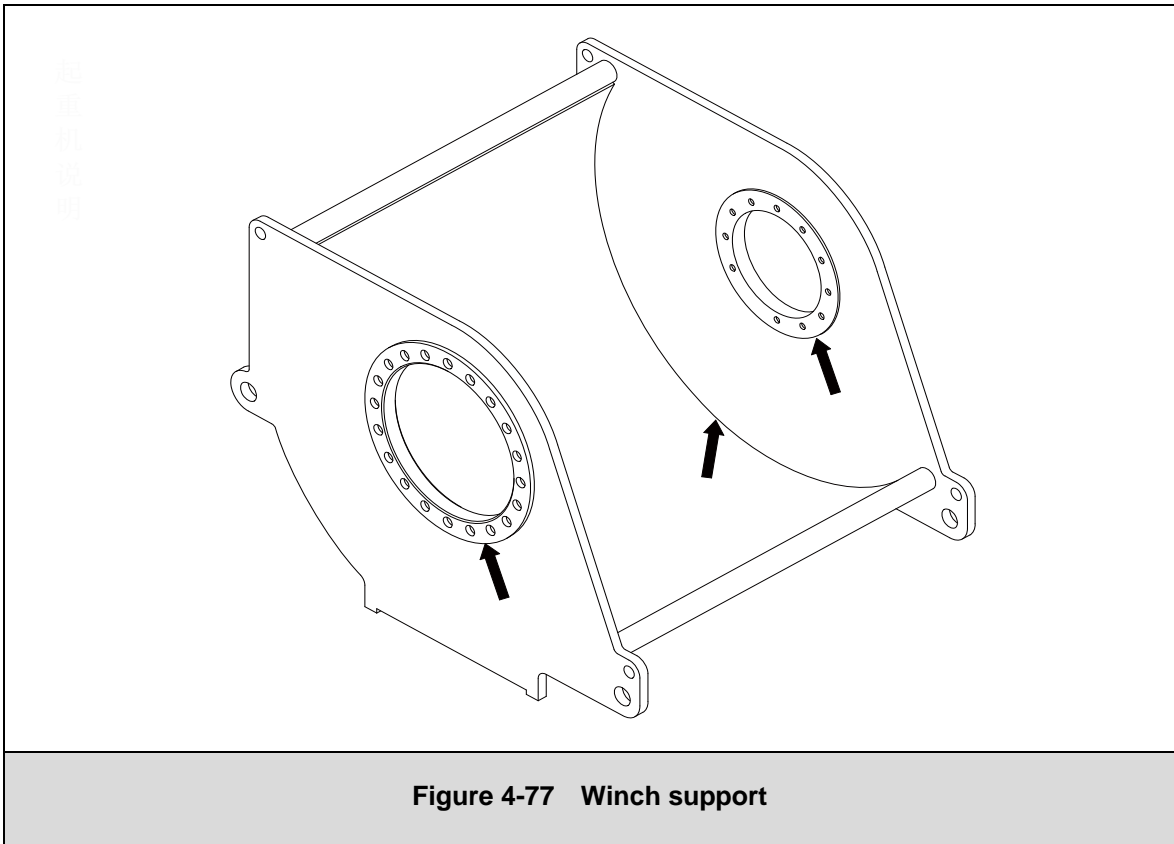
g) Tilting-back support for luffing jib

**Figure 4-75 Tilting-back support for luffing jib**

h) Tilting-back support for WA-frame 2

**Figure 4-76 Tilting-back support for WA-frame 2**

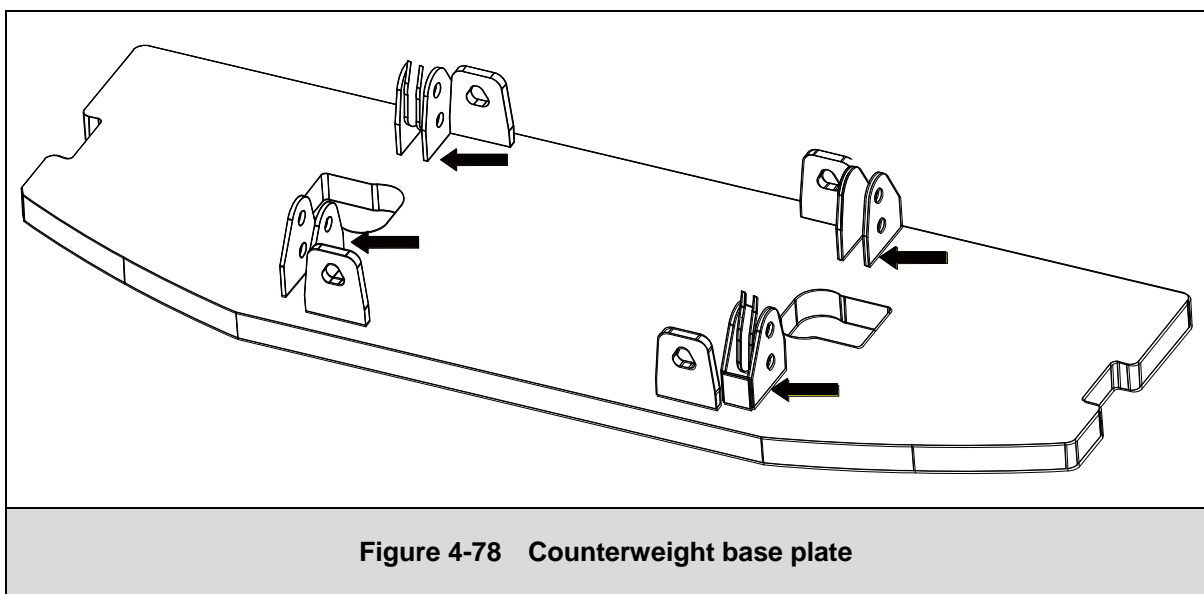
4.17.3.8 Winch support



4.17.4 Inspection of counterweight

4.17.4.1 Counterweight base plate

Inspect the welding seams at positioning blocks to ensure the counterweight plate can be positioned reliably.



4.17.5 Other inspection

4.17.5.1 Ladder

Check whether the ladder is fastened or damaged, and whether there is oil stain, ice, snow on the surface.

4.17.5.2 Guard rail

Check whether the guard rail is fastened or damaged, and whether there is oil stain, ice, snow on the surface.

4.17.5.3 Safety devices

Check safety devices for tight fit, damage and functional work.

- a) Load moment limiter
- b) Derricking (luffing) limiter
- c) Hoisting limiter
- d) Switches
- e) Warning device
- f) Locking device
- g) Anemometer

4.17.5.4 Safety signs

Check whether they are fastened, complete or intelligible.

4.18 Inspection and maintenance under special working environments

4.18.1 Working in mud, snow and rain

- a) Check whether various kinds of plug and pin are loose before operation.
- b) After the operation, clean the machine. Check whether the bolts and nuts are loose. Put oil and grease into it.

4.18.2 Working at seaside

- a) Before operation, check whether various plug and pin are loose, grease the rusty part, especially the connecting rod, control lever and so on.
- b) After the operation, clean the salt on the machine, grease the rusty part and prevent the electrical parts from rusting.

4.18.3 Dusty environment

- a) Air filter: clean the filter cartridge and dust collector in advance.
- b) Radiator: clean the central part of the radiator frequently to prevent it from being clogged.
- c) Fuel equipment: clean the fuel filter in advance.
- d) Electrical members: clean the surface of starter and sensor carefully.

4.18.4 Environment with many rocks

The tension of crawler is very slack in this circumstance. At this time, check the travel gear for damage, cracks, wear and scratch. And check the bolt and nut for tight fit.

4.18.5 Environment with falling rocks

The operator's cab should be equipped with protective cover.

4.18.6 Cold environment

Use lubricant with good and light adhesiveness. The battery should be charged in advance.

4.18.7 Other working environment

Since the wear and tear of pulley block fitted respectively on A-frame and slewing table, and other rope pulleys on the crane are different, check them for wear every day, and change them in time.

When installing the track roller after it is maintained, change the direction to extend the service life of the guide rail.

ZOOMLION

Maintenance Manual for Crawler Crane

Chapter 5 Troubleshooting

Chapter 5 Troubleshooting

5.1 Troubleshooting of mechanical drive

Some irregular phenomenon may occur during crane operation, therefore, checks must be done in time to find causes, and maintain the crane if necessary.

Table 5-1 Troubleshooting of mechanical drive

No.	Troubles	Causes	Solutions
1	The crane deviates to one side.	1. The crawler tensions on both sides are different from each other.	1. Adjust the crawler tension.
		2. The crawler is slack.	2. Adjust the crawler tension.
2	The traveling resistance is large.	1. The crawler is tight.	1. Adjust the crawler tension.
		2. The ground is soft.	2. Fill up the ground to make it solid and flat.
3	The crawler slips.	1. The crawler is slack.	1. Adjust the crawler tension.
		2. The track pad is worn.	2. Change the track pad.
4	The track roller leaks oil or it does not rotate.	The track roller is mounted unevenly, thus leading to the deformation of sealing ring of track roller.	Unscrew the bolt, pad a 1mm-thick iron plate under the track roller, leaving a space less than 1 mm, and then tighten the bolt.
5	The drive sprocket is meshed with track pad irregularly	1. The crawler is slack.	1. Tighten the crawler.
		2. The drive sprocket is meshed with track pad improperly.	2. Grind and correct the top edge of drive sprocket.

5.2 Troubleshooting of power system

Table 5-2 Troubleshooting of power system

No.	Troubles	Causes	Solutions
1	The starting motor does not rotate or it rotates weakly.	1. The battery is charged insufficiently.	1. Charge the battery.
		2. The wire connected to starting motor has come loose.	2. Tighten the wire of terminal on the motor. Weld a new terminal if necessary.
		3. The solenoid switch of starting motor fails.	
2	The engine can not start up, or the engine stops immediately after it starts.	1. The fuel tank is empty.	1. Add oil.
		2. The fuel filter is clogged.	2. Change the filter cartridge of fuel coarse filter.
		3. The fuel pipe, coarse filter or filtering screen is clogged.	3. Clean the fuel pipe, coarse filter or filtering screen.
		4. The fuel supply system or fuel filter leaks oil.	4. Check the sealing elements of fuel supply system or fuel filter.
		5. The fuel has not cold-resisting property.	5. Check the sealing elements. Clean the fuel coarse filter. Change the fuel filter. Use the fuel suitable for cold climate.
3	The engine starts difficultly.	1. The fuel temperature is too high or the sensor fails.	1. Change the fuel temperature sensor, and consult the qualified repair plant.
		2. MR (engine control) fails.	2. Show the fault record of MR, and consult the qualified repair plant.
		3. The fuel loop leaks oil or the pressure of fuel loop is too low.	3. Check the fuel loop for leaks. Make pressure test by qualified repair plant.
4	The engine stops unexpectedly.	1. MR (engine control) fails.	1. Consult the qualified repair plant.
		2. The power is cut off, or there is a short circuit at the engine shutdown button, or the engine control device fails.	2. Consult the qualified repair plant.
		3. The fuel loop leaks oil, or the pressure of fuel loop is low, or the oil pump drive is invalid.	3. Check the fuel loop for leaks. Make pressure test by qualified repair plant.

No.	Troubles	Causes	Solutions
5	The engine outputs weakly.	1. The charge-air pressure sensor fails.	1. Make a check and consult the qualified repair plant.
		2. The temperature of charge-air is too high.	
		3. The temperature sensor fails.	3. Check the temperature sensor, and change it if necessary. Consult the qualified repair plant.
		4. The fuel temperature is too low.	4. Check the temperature sensor, and change it if necessary. Check the fan speed switch and consult the qualified repair plant.
		5. The temperature of antifreeze coolant is too high.	5. Check the temperature sensor, and change it if necessary. Check the fan speed switch and consult the qualified repair plant.
		6. The brake valve of engine fails.	6. Make a visual check or functional check.
		7. The fuel supply system is clogged or leaks oil.	7. Check the fuel supply system for oil leaks, and consult the qualified repair plant.
		8. The engine control module or traveling control module fails.	8. Show the fault record of control device, and consult the qualified repair plant.
6	The engine is in emergency running mode.	The engine control device or traveling control device fails.	Show the fault record of control device, and consult the qualified repair plant.
7	The engine vibrates or runs irregularly.	The polarity of crankshaft position sensor or camshaft angle sensor is reverse.	Remove the sensor. If engine speed in emergency running mode is normal, it means that the polarity of sensor is reverse. Change the polarity at this time, and consult the qualified repair plant.

No.	Troubles	Causes	Solutions
8	The engine braking force is not good.	1. The traveling control device fails.	1. Show the fault record of traveling control device, and consult the qualified repair plant.
		2. There is defect in normally-open throttle valve.	2. Inspect the controller, and consult the qualified repair plant.
		3. The engine brake valve malfunctions.	3. Make a check for the brake valve, and consult the qualified repair plant.
9	The fuel consumption is severe.	1. The fuel temperature is too high, or the temperature sensor fails.	1. Change the fuel temperature sensor, and consult the qualified repair plant.
		2. The connecting points of pump, pipe line and nozzle fail or leak oil.	2. Detect the connecting points by test device, or consult the qualified repair plant.
10	The engine oil consumption is severe.	1. There is leakage at the outside of engine.	1. Check and repair the leaking points.
		2. The engine oil is unqualified or it is dirty.	2. Change engine oil and oil filter.
		3. The oil seal of turbocharger leaks.	3. Check the sealing elements of turbocharger, and repair the oil seal by professionals.
11	The charge indicator light lights up when the engine is running.	1. The conveying belt is slack.	1. Check the tension of the conveying belt. And change the driven sprocket if necessary.
		2. The conveying belt is worn.	2. Change the conveying belt.
		3. The generator or voltage stabilizer fails.	3. Check the generator or voltage stabilizer, and consult the qualified repair plant.
12	The temperature of engine is too high.	1. The antifreeze coolant temperature sensor fails.	1. Change the sensor.
		2. The antifreeze coolant is insufficient or the cooling system does not discharge air completely.	2. Add antifreeze coolant, and discharge air completely.
		3. The conveying belt is damaged.	3. Change the conveying belt.

No.	Troubles	Causes	Solutions
12	The temperature of engine is too high.	4. The fan is not turned on correctly.	4. Consult the qualified repair plant.
		5. The outside and inside of radiator are dirty or the radiator is blocked by lime deposit.	5. Clean the radiator or remove the lime deposit.
		6. The thermostat fails.	6. Check the thermostat, and change it if necessary. Consult the qualified repair plant.
13	The engine emits black smoke.	1. The charge-air sensor, antifreeze coolant sensor or fuel temperature sensor fails.	1. Make a check, and consult the qualified repair plant about the problem.
		2. The injector fails.	2. Consult the qualified repair plant.
		3. The exhaust turbocharger or air intake pipe fails, or the air filter is not clean.	3. Make a visual check, and consult the qualified repair plant about the problem.
		4. The normally open throttle valve fails.	4. Consult the qualified repair plant.
14	The engine emits blue smoke.	The oil level in the engine is too high, and thus the engine oil flows into combustion chamber.	Set proper oil level, and check oil level by qualified repair plant.
15	The engine emits white smoke.	There is leakage at the cylinder head or the cylinder-head gasket, thus making antifreeze coolant enter into combustion chamber.	Use compressed pressure to test the cylinder, and consult the qualified repair plant about the problem.
16	Knocking of engine	Burning failure	Consult the qualified repair plant.
17	Abnormal sound is made.	1. There is leakage in air intake pipe and exhaust pipe.	1. Repair the leaking points. And change the sealing elements if necessary.
		2. The turbine or air compressor is scraped with the cover, or the object enters into turbine or air compressor, or the bearing gets stuck into the rotary components.	2. Change the exhaust turbocharger by a qualified repair plant.

No.	Troubles	Causes	Solutions
18	The consumption of antifreeze coolant is severe.	1. Some components may leak antifreeze coolant.	1. Check the engine, oil pipeline and radiator for leaks. Repair the leaking points by professionals.
		2. The temperature of engine is too high, and the temperature of antifreeze coolant is higher than the normal temperature.	2. Eliminate the failure by professionals.
19	The temperature of antifreeze coolant is lower than the normal temperature.	1. The temperature sensor fails.	1. Detect the signal output from the temperature sensor, and change the sensor if necessary.
		2. The drive device for cooling fan fails.	2. Repair it by professionals.
		3. The thermostat fails.	3. Repair it by professionals.



If there are problems of engine, you'd better ask qualified repair plant to maintain it.

5.3 Troubleshooting of hydraulic system

Table 5-3 Troubleshooting of hydraulic system

No.	Troubles	Causes	Solutions
1	The engine runs normally, however, no pilot pressure is generated.	1. The pilot pump fails.	1. Check and repair the pilot pump. Change it if necessary.
		2. The pilot pressure relief valve fails.	2. Check and adjust the pressure of valve.
		3. The transfer case fails.	3. Check transfer case for damage.
		4. The shutoff valve of oil suction pipe is not opened.	4. Open the shutoff valve.
		5. The sensor fails or the circuit is out of order.	5. Check the sensor or the circuit. Change them if necessary.
2	The engine runs normally, however, the pilot pressure is too low.	1. There is leakage of pilot system.	1. Determine the leaking point.
		2. The pressure relief valve fails.	2. Check and adjust the overflow pressure.
		3. The pressure sensor fails.	3. Check the sensor, and change if necessary.
3	The engine runs normally, however, no crane movements are performed after moving the control lever.	1. The hydraulic pump fails.	1. Check and repair the main pump, and change it if necessary. ※
		2. The pressure relief valve fails.	2. Check pressure relief valve. ※
		3. The main overflow valve of main valve malfunctions.	3. Check and adjust the overflow pressure of main overflow valve.
		4. The valve or oil pipeline is blocked.	4. Clean the oil pipeline or valve.
		5. The controller fuse fails.	5. Change the fuse.
		6. The circuit is out of order.	6. Change the circuit.
		7. The control lever fails.	7. Change control lever.
		8. An amount of air enters into the pipeline after maintenance.	8. Run the engine without load for 5 minutes to discharge the air.
		9. The shutoff valve on hydraulic oil tank is not opened.	9. Check the shutoff valve and open it.

No.	Troubles	Causes	Solutions
4	No slewing movements are performed.	1. The shutoff valve of oil suction pipe is not opened.	1. Open the shutoff valve.
		2. The slewing valve malfunctions.	2. Check and adjust the overflow pressure of slewing valve.
		3. The slewing pump fails.	3. Check and repair the slewing pump, or change it if necessary. ※
		4. The slewing brake is not actuated.	4. Check if the pressure is output from slewing brake solenoid valve. ※
		5. The fuse of controller fails.	5. Change the fuse.
		6. The circuit is out of order.	6. Check if the brake is electrified. And change the circuit if necessary.
		7. The slewing control lever fails.	7. Change the control lever.
5	The slewing movements are performed weakly.	1. There is leakage at the inside of slewing motor.	1. Check and repair the motor, or change it if necessary.
		2. The crane is overloaded.	2. Reduce the load. ※
		3. The valves and oil pipeline of slewing hydraulic system are blocked.	3. Clean the oil pipeline and valves.
6	No traveling movements are performed or the traveling movements are carried out weakly.	1. The traveling resistance is large.	1. Reduce the traveling speed.
		2. The central revolving joint or oil pipeline of travel gear hydraulic system is blocked.	2. Clean the central revolving joint or oil pipeline of travel gear hydraulic system.
		3. The traveling motor leaks oil.	3. Check and repair the motor, or change it if necessary. ※
		4. The hydraulic pump fails.	4. Check and repair the main pump, or change it if necessary. ※
		5. The quick-release coupling is not screwed tightly.	5. Tighten the coupling with special wrench. ※
		6. The fuse of controller fails.	6. Change the fuse.
		7. The control lever fails.	7. Change the control lever.
		8. The circuit of pump unit is out of order.	8. Check the circuit.

No.	Troubles	Causes	Solutions
7	The speed of actuating assembly is low.	1. The pump or motor leaks oil.	1. Check and repair the pump or motor, or change them if necessary.
		2. The oil pipeline is blocked.	2. Clean the oil pipeline.
		3. The pilot pressure is not enough.	3. Detect the pilot pressure. ※
		4. The control lever is not placed in proper position.	4. Adjust the position of control lever.
8	No movements are performed by hoisting winch 1 (or 2), or the movements of hoisting winch 1 (or 2) are carried out weakly.	1. The hydraulic pump fails.	1. Check and repair the main pump, or change it if necessary.
		2. The oil pipeline is blocked.	2. Clean the oil pipeline.
		3. The crane is overloaded.	3. Adjust the load.
		4. The fuse of controller fails.	4. Change the fuse.
		5. The hoisting winch 1 (or 2) control lever fails.	5. Change the control lever. ※
		6. The circuit of main valve is out of order.	6. Change the circuit.
		7. The brake cylinder is not actuated.	7. Detect the starting pressure of brake cylinder.
		8. The quick-release coupling is not screwed tightly.	8. Screw the quick-release coupling tightly.
		9. The pressure of overflow valve on main valve is too low.	9. Detect the pressure of overflow valve. Reset the pressure if necessary.
9	The brake of hoisting winch 1 (or 2) is not actuated.	1. The pilot pump fails.	1. Check and repair the pilot pump, or change it if necessary.
		2. The pressure relief valve of pilot system fails.	2. Check and adjust the output pressure of valve. ※
		3. No signal is output from the controller and brake solenoid valve fails.	3. Check and repair brake solenoid valve.
		4. The oil line of brake leaks oil.	4. Check and repair sealing elements of oil line, or change them if necessary.
		5. The pipeline of pilot system is blocked.	5. Clean the pipeline.
		6. The circuit of brake is out of order.	6. Change the circuit.
		7. The fuse of controller fails.	7. Change the fuse.

No.	Troubles	Causes	Solutions
10	The hydraulic system makes noise.	1. The oil viscosity is too low.	1. Change hydraulic oil.
		2. The oil temperature is too low.	2. Preheat the hydraulic system.
		3. The back pressure of oil return pipe is too high.	3. Modify the hydraulic pipeline.
11	The oil temperature is too high.	1. The radiator or oil pipeline is blocked.	1. Clean the radiator or oil pipeline.
		2. The brand of hydraulic oil is wrong.	2. Change the hydraulic oil.
		3. The hydraulic oil deteriorates.	3. Change the hydraulic oil. ※
		4. The oil in the hydraulic oil tank is insufficient.	4. Add oil to specific value.
		5. The solenoid valve of cooler fails.	5. Change the solenoid valve.
12	The hydraulic pipeline vibrates fiercely.	1. There is an amount of air in the hydraulic system.	1. Discharge the air.
		2. The pipe clamp is loose.	2. Adjust the pipe clamp and fix the pipeline.
		3. The overflow valve or safety valve is blocked.	3. Clean the valve. ※
		4. The pump, motor or valve fail.	4. Check and repair the pump, motor or valve, or change them if necessary.
13	The pipe fitting leaks oil.	1. The pipe fitting is not screwed tightly.	1. Tighten the fitting.
		2. The sealing element is damaged.	2. Change the sealing element.
14	The hose bursts.	1. The hose does not match the applied pressure.	1. Change the hose.
		2. The hose is aging and scratched.	2. Change the hose.
		3. The fitting of hose is blocked.	3. Clean the hose and fitting.
15	The connectors of hydraulic pump and hydraulic motor leak oil.	1. The reducer leaks gear oil.	1. Change the oil seal of reducer.
		2. The hydraulic pump and hydraulic motor leak oil.	2. Detect the pressure of oil drain hole of pump and motor. If it exceeds 3bar, modify the oil drainage pipeline, and change the oil seal of pump and motor. ※



If the component marked with ※ fails, never dismember or adjust it. You must contact the crane manufacturer.

5.4 Troubleshooting of electrical system

5.4.1 Troubleshooting of cab electrics

Table 5-4 Troubleshooting of cab electrics

No.	Troubles	Causes	Solutions
1	The wiper does not work.	1. The wiper switch is damaged.	1. Change the wiper switch.
		2. The wiper motor fails.	2. Check and repair the wiper motor. Or change it if necessary.
		3. The drive device of wiper gets stuck or damaged.	3. Check and repair the drive device of wiper.
2	The fan does not work.	1. The fan motor fails.	1. Check and repair the fan motor. Or change it if necessary.
		2. The circuit is out of order.	2. Check and repair the circuit.
3	The cigarette lighter does not work.	1. The safety fuse is broken.	1. Change the fuse.
		2. The resistance wire blows out.	2. Change the wire.
		3. The circuit connection is incorrect.	3. Check and repair the circuit.
		4. Poor contact of switch.	4. Check or change the switch.
4	The radio does not work.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The radio is damaged.	2. Change the radio.
5	The interior light of cab fails.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The interior light is damaged.	2. Change the interior light.
6	Nothing is shown in the LCD screen of monitor.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The relevant video camera is damaged.	2. Change the relevant video camera.
		3. The LCD screen is damaged.	3. Change the LCD screen.
7	The rocker switch is not in functional work.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The rocker switch is damaged.	2. Change the rocker switch.

No.	Troubles	Causes	Solutions
8	The switch on control panel is not in functional work.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The switch is damaged.	2. Change the switch.
9	The control lever is not in functional work.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The control lever is damaged.	2. Change the control lever.
10	The foot-operated horn switch can not work.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The switch is damaged.	2. Change the switch.
11	The LCD screen of parameter monitor fails.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The screen is damaged. (The screen is black, blurred or the key on the screen is invalid.)	2. Change the screen.
		3. The communication to PLC fails. (The data shown is abnormal.)	3. Check and repair the circuit or consult the after-sale service man of crane manufacturer.

5.4.2 Troubleshooting of slewing table electrics

Table 5-5 Troubleshooting of slewing table electrics

No.	Troubles	Causes	Solutions
1	The battery master switch fails.	The battery master switch is damaged.	Change the battery master switch.
2	The pressure sensor fails (no pressure is shown on the screen of the cab).	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The pressure sensor is damaged.	2. Change the pressure sensor.
3	The inclination sensor fails (no inclination is shown on the screen of the lab).	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The inclination sensor is damaged.	2. Change the inclination sensor.
4	The traveling alarm does not sound the alarm.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The traveling alarm is damaged.	2. Change the traveling alarm.
		3. The controller can not output the signal.	3. Consult the after-sale service man of crane manufacturer.

No.	Troubles	Causes	Solutions
5	The basin-shaped electric horn can not sound.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The basin-shaped electric horn is damaged.	2. Change the basin-shaped electric horn.
6	The LED acoustic control light fails.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The LED acoustic control light is damaged.	2. Change the LED acoustic control light.
7	The sliding connector fails. (The undercarriage auxiliary valve is not electrified.)	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The connector is damaged.	2. Change the sliding connector.
8	The main boom angle limit switch fails.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The limit switch is damaged.	2. Change the limit switch.
9	No fuel level is shown.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The fuel level sensor is damaged.	2. Change the fuel level sensor.
10	The shutoff valve limit switch fails.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The limit switch is damaged.	2. Change the limit switch.
11	The working floodlights do not light up.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The working floodlights are damaged.	2. Change the working floodlights.

5.4.3 Troubleshooting of boom electrics

Table 5-6 Troubleshooting of boom electrics

No.	Troubles	Causes	Solutions
1	The solar lamp can not light up.	The solar lamp is damaged.	Change the solar lamp.
2	The wind speed is not shown.	1. The circuit is out of order.	1. Check and repair the circuit.
		2. The anemometer is damaged.	2. Change the anemometer.
3	The warning icon "Hoisting limit for H1/H2" flash irregularly.	1. The circuit of boom is out of order.	1. Check and repair the circuit.
		2. The hoisting limit switch is damaged.	2. Change the hoisting limit switch.

5.4.4 Troubleshooting of load moment limiter

Table 5-7 Troubleshooting of load moment limiter

No.	Troubles	Causes	Solutions
1	The screen of load moment limiter becomes black.	1. The safety fuse is broken.	1. Check and repair the safety fuse.
		2. The circuit is not connected well.	2. Check and repair the circuit.
		3. The screen is damaged.	3. Change the screen.
2	The data shown on the screen is not correct.	1. The data is set wrong.	1. Readjust the data.
		2. The selected operating mode is wrong.	2. Readjust the operating mode.
		3. The circuit is not properly connected to the interface of sensor.	3. Check and repair the circuit and interface of sensor.
		4. The sensor is damaged.	4. Change the sensor.
3	No data is shown on the screen.	1. No data is downloaded.	1. Download the data again.
		2. The main board of load moment limiter is damaged.	2. Change the load moment limiter.
		3. The communication between central unit of load moment limiter and screen fails.	3. Check the connecting cable from central unit to screen.

5.5 Troubleshooting of air conditioning system

Table 5-8 Troubleshooting of air conditioning system

No.	Troubles	Causes	Solutions
1	The system can not generate hot air.	1. The temperature control switch is damaged, or the cooling/heating rocker switch is not pushed to "heating" position.	1. Change the temperature control switch, or push the cooling/heating rocker switch to "heating" position.
		2. The hot-water valve of air conditioning system is not opened.	2. Open the hot-water valve.
		3. The water temperature of engine is too low.	3. Increase the rotational speed of engine.
		4. Wire connection is wrong.	4. Connect the earth wire.
2	The system can not generate the cold air.	1. The air compressor is damaged.	1. Change the air compressor.
		2. The air compressor belt slips.	2. Change or adjust the belt.
		3. The condenser high-pressure pipe leaks gas.	3. Change the high-pressure pipe.
		4. The high-pressure switch of air compressor is switched off.	4. Switch on the high-pressure switch, and adjust the pressure.
		5. The condenser fan is damaged.	5. Check and repair the condenser fan. Change it if necessary.
		6. The temperature controller is damaged.	6. Change the temperature controller.
		7. The refrigerant is insufficient.	7. Add refrigerant.

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Maintenance Manual for Crawler Crane

Chapter 6 Oil and Medium Application

Chapter 6 Oil and Medium Application

6.1 Antifreeze coolant

Antifreeze coolant, a mixed fluid of water and anti-freezing and anti-corrosion agent, plays the following important roles in the cooling system:

- a) Corrosion protection;
- b) Anti-freeze protection;
- c) Lower the freezing point and raise the boiling point.

It is recommended that the pure water is used to make the antifreeze coolant. The water and anti-freezing and anti-corrosion agent may mingle with each other in the proportion 50: 50. The proportion of anti-freezing and anti-corrosion agent can vary from 45% to 55%.

This antifreeze coolant with appropriate proportion enable the crane to work in -37°C temperature.

The anti-freezing and anti-corrosion agent must be added into the antifreeze coolant no matter where the crane works, to protect the cooling system.



The high-quality water is most important to cooling system, since the ordinary water has too much calcium and magnesium which will cause water scale formation, and too much chloride and sulphate that will corrode the cooling system.



- (1) **Do not add sealing agent and soluble oil to the cooling system. Otherwise, the cooling system will be damaged.**
- (2) **It is suggested to use the brand of anti-freezing and anti-corrosion agent approved by Cummins. If you want to use other brand, please consult the service centre of Cummins. Please buy the antifreeze coolant from Zoomlion.**
- (3) **The volume of antifreeze coolant is 44L. Change it every two years. If other kind of antifreeze coolant is used, please shorten the change interval.**

6.2 Lubricating oil

Table 6-1 Temperature for lubricating oil

Ambient temperature (°C)	-40	-30	-20	-10	0	10	20	30	40	50
Brand of lubricating oil										
SAE15W-40				→						
SAE10W-30			→							
SAE5W-30	→									

! CAUTION

- (1) Please select high-quality Cummins lubricating oil.
- (2) The high-viscosity lubricating oil can reduce oil consumption and help the engine to run well in cold climate. When the crane is working in high temperature, the lubricating oil (SAE15W-40) is widely used.
- (3) The low-viscosity lubricating oil (SAE10W-30) can facilitate engine startup and ensure oil fluidity when ambient temperature is below -5°C. However, long-time use of this oil will shorten engine service life due to wear and tear.
- (4) Do not mix lubricating oil of different brand or different quality grade when adding oil. The lubricating oil volume is 23 L.

6.3 Diesel oil

Table 6-1 Temperature for diesel oil

Ambient temperature (°C)	-45	-30	-15	-5	0	5	10	20	30	40	50
Brand of diesel oil											
5 #							→				
0 #						→					
-10 #				→							
-20 #			→								
-35 #		→									
-50 #	→										

The engine only uses vehicle diesel oil, which must comply with National Standard GB19147-2009.

The sulfur content of vehicle diesel oil must not exceed 350 ppm. If this sulfur content is exceeded, the diesel oil is not recommended to use. If you have to use this kind of diesel oil, you must shorten the oil change interval.

Do not add any special fuel additive into vehicle diesel oil. If a fuel additive is added, your warranty will be limited. The fuel tank capacity is 700L. Please don't add too much oil.

Top the crane up with diesel oil using the diesel pump attached to the crane or special-purpose diesel pump. If the crane is fueled via oil drum or oil tank, the oil in fuel system will not be pure, thus leading to failure of fuel system. Therefore, please filter the oil before fueling the crane.



Top the crane with qualified and clean fuel. Otherwise, it will cause severe damage to the engine!



Do not use the diesel oil together with gasoline, alcohol and other inflammable liquid. Otherwise, it will result in explosion.

6.4 Lubricating grease

Table 6-3 Property of lubricating grease

Parameter	Appearance	Drop point (°C)	Work wimble degree (1/10mm)	Moisture (%) no more than
Type				
ZL-2 lubricating grease	Smooth inunctum with the color from pale yellow to brown	175	265-295	—
ZG-3 lubricating grease	Equal inunctum with the color from pale yellow to dark brown	90	220-250	2.5

6.5 Hydraulic oil

Table 6-4 Working temperature of hydraulic oil

Ambient temperature	The lowest temperature for cold start (without load)	The lowest temperature for cold start (with load)	The lowest working temperature with load	The highest temperature of hydraulic oil	Hydraulic oil brand
Below -30°C	-40 °C	-35 °C	-15 °C	50 °C	SH 0358-95 10# aviation hydraulic oil
	-35 °C	-22 °C	-5 °C	60 °C	
Above -30°C	-28 °C	-15 °C	0 °C	70 °C	GB11118.1-94 low condensed hydraulic oil L-HS22
Between -20°C and 40°C	-20 °C	-10 °C	5 °C	80-85 °C	☆ESSO NUTO H46
					GB11118.1-94 low condensed hydraulic oil L-HV32
Above 40°C	-5 °C	-3 °C	20 °C	100 °C	ESSO NUTO H68
					GB11118.1-94 low condensed hydraulic oil L-HM68

CAUTION

- (1) If the crane starts in cold area, it should first run without load for a while. After the lowest working temperature is reached, the load can be added gradually and the system can work.
- (2) The oil property should be identical with that of the original brand when changing oil. The original oil should be washed away thoroughly. The hydraulic oil of different types can not be mixed together!
- (3) The domestic brands of hydraulic oil mainly include Kunlun, the Great Wall, Tongyi, Nanhai, Haipai, Daqing, Hengyun, Guta, Jiali, Jiarun, Haili, etc. And foreign brands such as ESSO, Mobil, etc. are also available in china.

- (4) If you find any special working conditions which are not listed in the above table, please consult the related departments of our company.
- (5) Check and measure oil temperature of the system at any time!
- (6) The suitable temperature range for hydraulic system in working condition is 20°C to 80°C. The 85°C temperature may occur for a short time or in some position.
- (7) When oil temperature is too high (nearly 100°), pay attention to the cooling of system. The working load should not be too heavy and the working frequency should not be too high.
- (8) The hydraulic oil of different types can not be mixed together!

6.6 Gear oil of reducer

Table 6-4 Temperature for gear oil

Brands of gear oil	Ambient temperature (°C)
L-CKD220 industrial closed gear oil	-10-50
75W-90	-40-20

CAUTION

- (1) The gear oil of reducer is classified under two types: mineral oil and synthetic oil. These two kinds of oil can not be mixed together to use.
- (2) The gear oil can not have any impurities such as water.
- (3) Select proper oil according to ambient temperature so as to meet the lubricating requirements of reducer in different temperatures.
- (4) Check oil level regularly. If too much oil is in reducer, the oil pressure will increase, thus leading to oil leakage, damage to the oil seal of half-shaft and braking failure. If the oil is insufficient, the gear bearing will not be lubricated well, thus enhancing wear of bearing.
- (5) Check the performance index and pollution of gear oil. If it exceeds the standard value, change the oil. During oil change, clean the gear box, and then add appropriate amount of new oil.

6.7 Oil change interval and lubricating interval

Table 6-5 Gear oil change interval

Components	Type of gear oil	Inspection interval (h)	Oil change interval (h)	Volume (L)		
				ZCC1300	ZCC1800	ZCC2600
Reducer of hoisting winch 1	L-CKD220 industrial closed gear oil	250	1000	7	8.5	9
Reducer of hoisting winch 2	L-CKD220 industrial closed gear oil	250	1000	7	8.5	9
Reducer of derricking winch	L-CKD220 industrial closed gear oil	250	1000	2.5	8.5	8.5
Slewing reducer	L-CKD220 industrial closed gear oil	250	1000	5.5	7	12
Traveling reducer	L-CKD220 industrial closed gear oil	250	1000	18×2	25×2	45×2

Table 6-6 Volume of oil

Components	Hydraulic oil/fuel/coolant	Volume (L)		
		ZCC1300	ZCC1800	ZCC2600
Hydraulic oil tank	Select proper hydraulic oil (L-HM46, L-HV32, etc.) according to ambient temperature	880	1000	700
Fuel tank	0 # or 10 # fuel	700	700	700
Engine/cooling system	Coolant	44	44	44

Table 6-7 Lubrication

Components	Lubricating points	Lubricating interval (h)	Lubricating grease
Rope pulley and pulley spindle	All rope pulleys and pulley spindles	500	ZL-2 lithium base grease
Hinged points at the bottom of A-frame	2	250	
Hinged points at the bottom of fixed jib pivot section	2	250	
Hinged points at the bottom of FA-frame	2	250	
Hinged points at the bottom of main boom pivot section	2	250	

 **CAUTION**

- (1) The volumes in above tables are approximate values. In order to obtain accurate volume, the maintenance personnel must check the inspection points via oil dipstick, inspection hole and inspection plug.
- (2) These tables include the standards of other consumable objects. If the consumable objects do not meet these standards, they would be damaged. Therefore, no liability is undertaken by our company for any error if though these consumable objects are under guarantee.

ZOOMLION

Maintenance Manual for Crawler Crane

Chapter 7 Appendix

Chapter 7 Appendix

7.1 Tightening torque of threaded parts

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			8.8 grade			9.8 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
8	Coarse thread	1.25	26.2	28.1	30.0	29.5	31.6	33.7
	Fine thread	1	28.1	30.1	32.1	31.6	33.8	36.1
	Coarse thread	1.5	51.9	55.6	59.4	58.4	62.6	66.8
10	Fine thread	1.25	54.8	58.7	62.6	61.7	66.1	70.5
	Fine thread	1	57.8	61.9	66.0	65.0	69.6	74.3
12	Coarse thread	1.75	90.6	97.0	103.5	101.9	109.2	116.4
	Fine thread	1.5	94.7	101.5	108.2	106.5	114.2	121.8
	Fine thread	1.25	98.9	106.0	113.1	111.3	119.3	127.2
14	Coarse thread	2	144.7	155.1	165.4	162.8	174.5	186.1
	Fine thread	1.5	156.2	167.3	178.5	175.7	188.2	200.8
16	Coarse thread	2	224.5	240.5	256.6	252.5	270.6	288.6
	Fine thread	1.5	239.6	256.8	273.9	269.6	288.9	308.1
18	Coarse thread	2.5	310.3	332.4	354.6	349.0	374.0	398.9
	Fine thread	1.5	348.6	373.5	398.4	392.1	420.1	448.2
20	Coarse thread	2.5	438.5	469.8	501.1	493.3	528.5	563.7
	Fine thread	2	462.1	495.1	528.1	519.8	556.9	594.1
	Fine thread	1.5	486.3	521.0	555.8	547.1	586.2	625.2

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			10.9 grade			12.9 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
8	Coarse thread	1.25	36.9	39.5	42.2	44.3	47.4	50.6
	Fine thread	1	39.5	42.3	45.1	47.3	50.7	54.1
	Coarse thread	1.5	73.0	78.2	83.5	87.6	93.9	100.2
10	Fine thread	1.25	77.1	82.6	88.1	92.5	99.1	105.7
	Fine thread	1	81.2	87.0	92.8	97.5	104.4	111.4
12	Coarse thread	1.75	127.3	136.4	145.5	152.8	163.7	174.6
	Fine thread	1.5	133.2	142.7	152.2	159.8	171.2	182.6
	Fine thread	1.25	139.1	149.1	159.0	167.0	178.9	190.8
14	Coarse thread	2	203.5	218.1	232.6	244.2	261.7	279.1
	Fine thread	1.5	219.6	235.3	251.0	263.5	282.3	301.1
16	Coarse thread	2	315.7	338.2	360.8	378.8	405.9	432.9
	Fine thread	1.5	337.0	361.1	385.1	404.4	433.3	462.2
18	Coarse thread	2.5	436.3	467.5	498.6	523.6	561.0	598.4
	Fine thread	1.5	490.2	525.2	560.2	588.2	630.2	672.2
20	Coarse thread	2.5	616.6	660.6	704.7	739.9	792.7	845.6
	Fine thread	2	649.8	696.2	742.6	779.7	835.4	891.1
	Fine thread	1.5	683.8	732.7	781.5	820.6	879.2	937.8

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			8.8 grade			9.8 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
22	Coarse thread	2.5	597.8	640.5	683.2	672.5	720.5	768.6
	Fine thread	2	626.6	671.4	716.2	705.0	755.3	805.7
	Fine thread	1.5	655.5	702.3	749.1	737.4	790.1	842.7
24	Coarse thread	3	757.6	811.7	865.8	852.3	913.2	974.1
	Fine thread	2	826.2	885.3	944.3	929.5	995.9	1062.3
	Fine thread	1.5	861.6	923.2	984.7	969.3	1038.6	1107.8
27	Coarse thread	3	1110.8	1190.1	1269.5	1249.6	1338.9	1428.2
	Fine thread	2	1198.0	1283.6	1369.2	1347.8	1444.1	1540.3
30	Coarse thread	3.5	1506.1	1613.7	1721.3	1694.4	1815.4	1936.4
	Fine thread	2	1668.9	1788.2	1907.4	1877.6	2011.7	2145.8
	Fine thread	1.5	1725.1	1848.3	1971.5	1940.7	2079.3	2218.0
33	Coarse thread	3.5	2049.7	2196.1	2342.5	2305.9	2470.6	2635.3
	Fine thread	3	2114.8	2265.9	2416.9	2379.2	2549.1	2719.1
	Fine thread	2	2248.4	2409.0	2569.6	2529.4	2710.1	2890.8
	Fine thread	1.5	2316.7	2482.2	2647.6	2606.3	2792.4	2978.6

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			10.9 grade			12.9 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
22	Coarse thread	2.5	840.6	900.6	960.7	1008.7	1080.8	1152.8
	Fine thread	2	881.2	944.1	1007.1	1057.4	1133.0	1208.5
	Fine thread	1.5	921.7	987.6	1053.4	1106.1	1185.1	1264.1
24	Coarse thread	3	1065.4	1141.5	1217.6	1278.5	1369.8	1461.1
	Fine thread	2	1161.9	1244.9	1327.9	1394.3	1493.9	1593.5
	Fine thread	1.5	1211.7	1298.2	1384.8	1454.0	1557.9	1661.7
27	Coarse thread	3	1562.1	1673.6	1785.2	1874.5	2008.4	2142.2
	Fine thread	2	1684.7	1805.1	1925.4	2021.7	2166.1	2310.5
30	Coarse thread	3.5	2118.0	2269.2	2420.5	2541.6	2723.1	2904.6
	Fine thread	2	2347.0	2514.6	2682.2	2816.3	3017.5	3218.7
	Fine thread	1.5	2425.9	2599.2	2772.5	2911.1	3119.0	3327.0
33	Coarse thread	3.5	2882.4	3088.2	3294.1	3458.8	3705.9	3952.9
	Fine thread	3	2974.0	3186.4	3398.8	3568.8	3823.7	4078.6
	Fine thread	2	3161.8	3387.7	3613.5	3794.2	4065.2	4336.2
	Fine thread	1.5	3257.8	3490.5	3723.2	3909.4	4188.6	4467.9

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			8.8 grade			9.8 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
36	Coarse thread	4	2633.1	2821.2	3009.3	2962.2	3173.8	3385.4
	Fine thread	3	2788.5	2987.6	3186.8	3137.0	3361.1	3585.2
	Fine thread	2	2948.4	3159.0	3369.6	3317.0	3553.9	3790.8
39	Coarse thread	4	3408.0	3651.4	3894.8	3834.0	4107.8	4381.7
	Fine thread	3	3591.7	3848.2	4104.8	4040.7	4329.3	4617.9
	Fine thread	1.5	3876.6	4153.5	4430.4	4361.2	4672.7	4984.2
42	Coarse thread	4.5	4216.1	4517.2	4818.4	4743.1	5081.9	5420.7
	Fine thread	3	4535.9	4859.9	5183.9	5102.9	5467.4	5831.9
	Fine thread	2	4755.8	5095.6	5435.3	5350.3	5732.5	6114.7
	Fine thread	1.5	4867.7	5215.4	5563.1	5476.2	5867.3	6258.5
48	Coarse thread	5	6332.4	6784.7	7237.0	7123.9	7632.8	8141.7
	Fine thread	3	6893.0	7385.3	7877.7	7754.6	8308.5	8862.4
	Fine thread	2	7182.3	7695.4	8208.4	8080.1	8657.3	9234.4
	Fine thread	1.5	7329.2	7852.7	8376.2	8245.3	8834.3	9423.2
56	Coarse thread	5.5	10180.7	10907.9	11635.1	11453.3	12271.4	13089.5
	Fine thread	2	11538.3	12362.4	13186.6	12980.5	13907.7	14834.9

Note:

Maximum tightening torque is computed on the basis of $0.8 \delta_s A_s$. Minimum tightening torque is on the basis of $0.7 \delta_s A_s$. Standard tightening torque is on the basis of $0.75 \delta_s A_s$.

Table 7-1 Tightening torque of threaded parts

Thread diameter mm	Thread pitch mm		Tightening torque N•m					
			10.9 grade			12.9 grade		
			MIN.	STD.	MAX.	MIN.	STD.	MAX.
36	Coarse thread	4	3702.8	3967.3	4231.8	4443.4	4760.7	5078.1
	Fine thread	3	3921.3	4201.4	4481.4	4705.5	5041.6	5377.7
	Fine thread	2	4146.2	4442.4	4738.6	4975.5	5330.9	5686.3
39	Coarse thread	4	4792.4	5134.8	5477.1	5750.9	6161.7	6572.5
	Fine thread	3	5050.8	5411.6	5772.4	6061.0	6493.9	6926.8
	Fine thread	1.5	5451.5	5840.9	6230.2	6541.8	7009.0	7476.3
42	Coarse thread	4.5	5928.9	6352.4	6775.9	7114.7	7622.9	8131.0
	Fine thread	3	6378.7	6834.3	7289.9	7654.4	8201.1	8747.9
	Fine thread	2	6687.9	7165.6	7643.3	8025.5	8598.7	9172.0
	Fine thread	1.5	6845.2	7334.1	7823.1	8214.2	8801.0	9387.7
48	Coarse thread	5	8904.9	9541.0	10177.1	10685.9	11449.2	12212.5
	Fine thread	3	9693.3	10385.6	11078.0	11631.9	12462.8	13293.6
	Fine thread	2	10100.2	10821.6	11543.1	12120.2	12985.9	13851.7
	Fine thread	1.5	10306.7	11042.9	11779.0	12368.0	13251.4	14134.9
56	Coarse thread	5.5	14316.6	15339.2	16361.9	17179.9	18407.1	19634.2
	Fine thread	2	16225.7	17384.6	18543.6	19470.8	20861.6	22252.3

Note:

Maximum tightening torque is computed on the basis of $0.8 \delta_s A_s$. Minimum tightening torque is on the basis of $0.7 \delta_s A_s$. Standard tightening torque is on the basis of $0.75 \delta_s A_s$.

7.2 Tightening torque of thread parts at pipe orifices

Table 7-2 Tightening torque of thread parts at pipe orifices (applicable to light pipe fittings)

Specification of pipe orifice	Pipe thread	1/8"	1/4"	1/4"	3/8"	1/2"	1/2"	3/4"	1"	1 1/4"	1 1/2"
	Metric taper thread	M10 ×1	M12 ×1.5	M14 ×1.5	M16 ×1.5	M18 ×1.5	M22 ×1.5	M26 ×1.5	M33 ×2	M42 ×2	M48 ×2
Specification of oil pipe		◎6	◎8	◎10	◎12	◎15	◎18	◎22	◎28	◎35	◎42
Tightening torque (N•m)	Pipe thread (light)	18	35	35	70	90	90	180	310	450	540
	Metric taper thread (light)	18	25	45	55	70	125	180	310	450	540

Table 7-3 Tightening torque of thread parts at pipe orifices (applicable to heavy pipe fittings)

Specification of pipe orifice	Pipe thread	1/4"	1/4"	3/8"	3/8"	1/2"	1/2"	3/4"	1"	1 1/4"	1 1/2"
	Metric taper thread	M12 ×1.5	M14 ×1.5	M16 ×1.5	M18 ×1.5	M20 ×1.5	M22 ×1.5	M27 ×2	M33 ×2	M42 ×2	M48 ×2
Specification of oil pipe		◎6	◎8	◎10	◎12	◎14	◎16	◎20	◎25	◎30	◎38
Tightening torque (N•m)	Pipe thread (heavy)	55	55	80	80	115	115	180	310	450	540
	Metric taper thread (heavy)	35	55	70	90	125	135	180	310	450	540

7.3 Attached tools

Table 7-4 Attached tools for ZCC1300 crawler crane

No.	ID code	Names of the tools	Quantity	Specification
1	1140102828	Pressure testing joint	1	
2	1140102829	Pressure testing joint	1	
3	1140207054	Testing hose	2	
4	1140102826	Pressure testing joint	1	
5	1140102830	Pressure testing joint	1	
6	1140102954	Pressure testing joint	2	
7	1019900189	Pressure gauge	2	
8	1019900187	Pressure gauge	1	
9	1991100004	Tool box assy.	1	
10	1102000012	Wrench	1	Φ60-Φ140
11	1090100014	Flexible strap	2	
12	1102900000	Screw jack	2	

Table 7-5 Attached tools for ZCC1800 crawler crane

No.	ID code	Names of the tools	Quantity	Specification
1	1140102828	Pressure testing joint	1	
2	1140207054	Testing hose	2	
3	1140102826	Pressure testing joint	2	
4	1140102830	Pressure testing joint	2	
5	1140102954	Pressure testing joint	2	
6	1019900189	Pressure gauge	2	
7	1019900187	Pressure gauge	1	
8	1991100004	Tool box assy.	1	
9	1090100015	Wire rope	4	Φ26
10	1090100016	Arch shackle	2	1-3/4
11	1090100014	Flexible strap	2	5T-10000
12	1102900000	Screw jack	2	
13	1019900014	Nitrogen filling tool	1	
14	1140102831	Pressure testing joint	2	
15	1140102832	Pressure testing joint	2	
16	1019900048	Pressure testing joint	1	

Table 7-6 Attached tools for ZCC2600 crawler crane

No.	ID code	Names of the tools	Quantity	Specification
1	1140102828	Pressure testing joint	1	
2	1140102829	Pressure testing joint	1	
3	1140207054	Testing hose	2	
4	1140102826	Pressure testing joint	3	
5	1140102830	Pressure testing joint	3	
6	1140102954	Pressure testing joint	2	
7	1140100647	Fitting	1	
8	1140100639	Fitting	1	
9	1140100592	Fitting	2	
10	1019900189	Pressure gauge	2	
11	1019900187	Pressure gauge	1	
12	1991100004	Tool box assy.	1	
13	1090100015	Wire rope	4	φ 26
14	1090100016	Arch shackle	1	1 3/4
15	1090100014	Flexible strap	2	
16	1102900000	Screw jack	2	
17	1019900014	Nitrogen filling tool	1	
18	1140102831	Pressure testing joint	2	
19	1140102832	Pressure testing joint	2	

7.4 Checklist for periodic inspection (only for reference)

In order to keep the crane in safe condition during operation, the inspector must carry out inspection to crane systems and components at regular intervals. For the sake of convenience, we make the following checklist for periodic inspection. You can conduct the inspections according to the inspection category.

This checklist is only for reference. The user can make your own checklist according to actual conditions.

Crane type:_____ Crane manufacturer: Zoomlion Serial Number:_____ Serial Number of user:_____

Company:_____ Inspected by:_____ Recorded by:_____ Date:_____

Table 7-7 Power system

Components inspected	Inspection intervals	Result	Remarks
Engine			Check rotational speed, water and oil temperature, oil pressure and relevant warning icons etc.
Engine mounting fastening bolts and engine housing			Check the bolts for tight fit and the housing for oil leakage
Fan blade and belt			
Antifreeze coolant level			
Engine oil level			
Radiator core			Check it for deformation and water leaks
Wind drag of air filter			
Air intake pipe			
Intercooler core			Check it for deformation and wind leaks
Fuel pipeline			Check it for oil leaks and damage
Fuel pre-filter			Check if there is water in the filter.
Fuel tank			Check if there is sediment and water in the tank. Check the tank for corrosion.
Oil level in transfer case			
Bolts and housing of transfer case			Check the bolts for tight fit and the housing for oil leakage

Table 7-8 Winch reducer

Components inspected	Inspection intervals	Result	Remarks
Status of load			Check if the load falls down uncontrollably after engine stops.
Wire rope wound onto the drum			
Sound made by the reducer when it is running			
Brake			
Gear oil level			
Support bearing			Demount the seal plate and check the lubricating condition of support bearing.
Lowering limiter			
Reducer and motor			Check them for oil leaks
Mounting screw (or bolts)			

Table 7-9 Slewing mechanism

Components inspected	Inspection intervals	Result	Remarks
Sound made by slewing reducer and slewing ring when they are running			
Gear oil level			
Brake			
Slewing reducer and motor			Check them for oil leaks
Torque of mounting bolt of slewing ring			
Lubrication on the surface of large and pinion gears			
Wear on the surface of large and pinion gears			

Table 7-10 Travel gear

Components inspected	Inspection intervals	Result	Remarks
Track pad			Check the convex teeth of track pad for wear
Pin spindles of track pad			Check them for cracks
Drive sprocket			Check the slot of drive sprocket for wear
Track roller			Check it for oil leaks and cracks
Tension of crawler			
Traveling reducer			Check it for oil leaks

Table 7-11 Hydraulic system

Components inspected	Inspection intervals	Result	Remarks
Oil level in the hydraulic oil tank			
Hydraulic oil tank			Check if there is sediment in the tank.
Change the oil filter cartridge of oil drain line			
Change hydraulic oil			
Pipelines and pipe fittings			Check them for oil leaks and damage
Air filter			Check if the filter is clogged.
Oil cooler			Check it for oil leaks and damage.
Hydraulic motor and pump			Check them for oil leaks and abnormal sound.
Valves in the hydraulic system			Check them for oil leaks
Energy accumulator			Check it for oil leaks and damage

Table 7-12 Electrical system

Components inspected	Inspection intervals	Result	Remarks
Load moment limiter			Check if the value shown is correct and the warning icon flashes when irregular condition occurs.
Hoisting limit switch			Check it for functional work
Lowering limit switch			Check it for functional work
Tilting-back limit switch			Check it for functional work
Shutoff valve limit switch			Check it for functional work
Angle limit switch			Check it for functional work
Wind speed sensor			Check if the wind speed is shown or the sensor is damaged.
Inclination sensor			Check if the inclination shown is correct or the sensor is damaged.
Pressure sensor			Check if the pressure shown is correct, valid or the sensor is damaged.
Monitoring system			Check the clearness of image, and the video for damage
Connector on the boom and slewing table			Check if the plug and socket are connected tightly, watered or they are damaged.
Oil level sensor			Check if the oil level is shown or the sensor is damaged.

Table 7-13 Load hook and pulley

Components inspected	Inspection intervals	Result	Remarks
Pulley			Check the lubricating condition of pulley
Pulley spindle			Check the sealing seat of spindle and its roll resistance
Hook shaft			Check the sealing seat of shaft and its roll resistance
Load hook			Check it for cracks and wear

Table 7-14 Wire rope

Components inspected	Inspection intervals	Result	Remarks
Wire rope for hoisting winch 1			Check rope end point, number of wire breaks and strand breaks
Wire rope for hoisting winch 2			Check rope end point, number of wire breaks and strand breaks
Derricking rope			Check rope end point, number of wire breaks and strand breaks

Table 7-15 Safety devices

Components inspected	Inspection intervals	Result	Remarks
Main boom tilting-back support cylinder			
Front tilting-back support of fixed jib			
Rear tilting-back support of fixed jib			
Tilting-back support for luffing jib			
Tilting-back support for WA-frame 2			

Table 7-16 Boom, jib and other load-bearing parts

Components inspected	Inspection intervals	Result	Remarks
Main boom			
Fixed jib			
FA-frame			
Luffing jib			
WA-frame 2			
WA-frame 1			
A-frame			
Main boom anchoring rods			
Fixed jib rear anchoring rods			
Fixed jib front anchoring rods			
Luffing jib rear anchoring rods			
Luffing jib front anchoring rods			