CRAWLER CRANE

OPERATOR'S MANUAL

ZOOMLION

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ZCC2600CR Crawler Crane
Operator’s Manual

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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.

This manual contains the instructions and data on the safety and operation of the crawler crane. Follow the operation procedures to make sure that your machine operates at MAXIMUM EFFICIENCY. The operator must keep this manual in the cab of the crane.

If there is anything in the manual that is not clear or you do not understand, please contact our service technician. We (Zoomlion) are NOT responsible for damages from an operator who does not obey the instructions in the *OPERATOR'S MANUAL*.

The *OPERATOR'S MANUAL* is an important part of the crane. If the crane becomes the property of a different person, make sure that the manual stays in the cab of the crane.

The data (data, specifications, illustrations) in this manual is for cranes in production at the time of this manuals 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 *OPERATOR'S MANUAL* is solely applicable for factual accuracy.

Thank you!

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

Safety Instructions

The following terms that are used in these operating instructions "Danger", "Warning", "Caution" and "Notice" are intended to point out certain important rules of conduct to all persons who work with the crane. The meanings of the terms are as follows:

DANGER	Refers to a dangerous situation which, if you do not prevent, will cause death or injury.
WARNING	Refers to a possible dangerous situation which, if you do not prevent, could cause death or injury.
CAUTION	Refers to a possible dangerous situation which, if you do not prevent, may cause light or moderate injury.
NOTICE	Refers to a tip or hint in the operation instructions.

Contents

Chapter 4 Crane Operation

Chapter 6 Appendix

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Operator’s Manual for Crawler Crane

Chapter 1 Safety

Chapter 1 Safety

1.1 Important instructions

1.1.1 Notes

a) Read this manual and familiarize yourself with any associated documents before operating this crane.

b) Ensure that a copy of this manual is available to any person installing, using, maintaining or repairing this crane.

c) Training should be provided to ensure safe working practices.

d) To avoid the risk of electric shock, always isolate this crane from the power supply prior to carrying out any maintenance and adjustment work or removing any guards or covers.

e) Always follow the procedures outlined in the *Operator's Manual* and *Maintenance Manual*.

f) If in doubt, do not take personal risk.

g) Only trained personnel can be allowed to install, set, operate, maintain, and commission this crane.

1.1.2 Alarms and warnings

a) As to the potential danger mentioned in this manual, affix the warning symbols in proper positions of the crane.

b) Alarm symbols

1) You can be injured if you do not obey the safety instructions as indicated on warning stickers.

2) Ensure that warnings and instruction labels attached to the crane are always complete and perfectly legible.

3) Keep warnings and instruction labels clean.

4) Replace unreadable or missing labels with new ones before operating the crane. Make sure the replacement parts include warnings or instruction labels where necessary.

⚠ CAUTION

(1) Follow the warnings and instruction labels for the sake of personal safety.

(2) For the positions of warnings and instruction labels, please see Chapter 3 "Safety Guidelines".

1.2 Component safety features

a) Do not use this crane with guards removed or incorrectly fastened.
b) Do not use this crane with safety devices maladjusted or removed.

1.3 Features for operator safety

a) Safety component – crane emergency stop button. Ensure all safety components are in place.
b) Support plates, handrails, tread plates and fixed guards are provided to assist the personnel to climb on the crane.

1.4 Environmental safety

a) A regular service should be taken on the crane strictly in accordance with maintenance procedures to ensure that engine emission is close to a minimum value.
b) Consumable materials
   1) The spilling diesel must be dealt with immediately.
   2) Only use the lubricating oil recommended in the *Maintenance Manual*.
   3) Local and national regulations must be observed strictly when disposing of the waste.
   4) Improper disposal of the waste is illegal, as it will undermine the environment.
   5) Potentially harmful waste used on this crane includes such items as hydraulic oil, fuel, coolant, filters and batteries, etc.
   6) Use leak-proof containers for draining the fluids. Do not use food or beverage containers that may mislead someone into drinking or eating them.
   7) Do not pour the waste into the ground, into sewer system or into any water source.
   8) Ensure that all consumable and replaced parts are disposed of safely and with minimum environmental impact.
c) Machine disposal. This machine must only be disposed of by a special machine breaker.

1.5 Personnel protective equipment (PPE)

a) Loose or baggy clothing can get caught in running machinery.
b) Where possible when working close to the engine or machine, only do so when they are stopped. If this is not practical, remember to keep tools, test equipment and all other parts of your body away from the moving parts.
c) For reasons of safety, long hair must be tied back or otherwise secured. The garments must be close fitting and no jewellery such as rings may be worn.
d) Correctly wear personnel protective equipment.
e) Recommended personnel protective equipment includes:
   1) Hard hat

2) Safety glasses/Goggles
3) Hearing protection device
4) Close fitting overalls
5) Safety boots
6) Industrial gloves
7) High visibility vest or jacket

1.6 Measured noise level

The condition of working site may affect the noise levels.

According to EN13000 Annex G and 2000/14/ EC standards, the sound pressure level and sound power level measured in the operator's cab are 73.9 dB(A) and 107 dB(A) respectively.

The sound pressure level measured according to ISO 7731 standard at the position 1 m away from the warning device is 97.7 dB(A).

1.7 Vibration levels

Suitable seating has been installed to reduce whole body vibrations, in line with current industry standards.

According to ISO 2631-1 standard, the crane body vibrations are A (1): 1.3 m/s^2, A (4): 0.6 m/s^2, A (8): 0.4 m/s^2 under normal operating condition.

1.8 Organizational safety measures

a) The crane must only be operated by a suitably qualified operator who holds a current license in line with national or international legislation.
b) Understand the service procedure before doing work. Keep working area clean and dry.
c) Never lubricate, clean or adjust the crane while it is moving (excluding central lubrication).
d) Keep hands, feet and clothing clear of power driven parts and running nip-points.
e) Keep all parts in good condition. Ensure that all parts are properly installed. Fix damage immediately. Replace worn and broken parts. Remove grease, oil and debris in time.
f) Disconnect battery ground cable and power supply before making adjustments on electrical systems.
g) Disconnect battery ground cable, switch off the ECM and unplug all plugs of the controllers before welding on machine.
h) During maintenance only use the correct tool for the job.
i) Never make any modifications, additions or changes which might affect safety without the manufacturer's approval.
j) In the event of safety relevant modifications or changes in the behavior of the machine during operation, stop the machine, lock it immediately and report the malfunction to the relevant authority / person.

1.9 Personnel qualification, requirements and responsibilities

a) Any work on and / or with the crane must be executed by trained, reliable and authorized personnel only.

b) The maintenance work must only be undertaken by suitable qualified engineers with specialist knowledge of this crane.

c) The work on the hydraulic system must be carried out only by personnel with special knowledge and experience of hydraulic equipment.

1.10 Safety advices regarding specific operation phases

a) Standard operation

1) Take necessary precautions to ensure that the crane is used in a safe and reliable state.

2) This crane is a conventional assembly & dismantling machine. Do not apply the crane for other purpose. Operate the crane only for its designed purpose and only if all protective and safety-orientated devices, emergency shut-off equipment, warning devices and exhaust devices are in place and fully functional.

3) Erect barrier guards in proper positions to stop unauthorized entry to this crane.

4) Before starting the engine, ensure it is safe to do so.

b) Malfunction

In the event of any malfunction or operational difficulty, stop the crane immediately.

c) Unguarded areas

1) In-running blind spots on the crane can cause serious injury or even death.

2) Do not reach into unguarded components.

3) Stop the crane before removing any safety devices.

1.11 Special Hazards

1.11.1 Electrical energy

a) External considerations and hazards

When working with the crane, maintain a safe distance from the overhead electric lines. If overhead lines are in the immediate vicinity, a risk assessment must be completed prior to operating this crane.

If the crane comes into contact with a live wire:

1) Vacate the area

2) Warn others against approaching and touching the crane.

3) Report the incident and have the live wire de-energized

4) Switch off the electrical system

b) Battery

1) Always disconnect battery leads before carrying out any maintenance to the electrical

system.

2) Recharge the battery in a well ventilated area.

3) The battery contains sulphuric acid, an electrolyte which can cause severe burns and produce explosive gases. Therefore, avoid contact with the skin, eyes or clothing.

1.11.2 Gas, dust, steam, smoke and noise

a) Always operate internal combustion engine out of doors or in a well ventilated area.

b) If the crane is operated for maintenance purposes in an enclosed area, ensure that there is sufficient ventilation.

c) Observe the rules and regulations at different working sites.

d) The dust found on the crane or produced during work on the crane must not be removed by blowing with compressed air.

e) Toxic dust / waste must only be dampened by authorized persons, placed in a sealed container and marked, to ensure safe disposal.

1.11.3 Welding or naked flames

a) Welding, flame cutting and grinding work on the crane must only be carried out if this has been expressly authorized, as there may be a risk of explosion and fire.

b) No welding should be undertaken on this crane as it will affect its structural integrity.

c) Avoid all naked flames in the vicinity of this crane.

1.11.4 Hydraulic equipment

a) The work on hydraulic system must be carried out by persons having special knowledge and experience of hydraulic system.

b) Check all lines, hoses and screwed connections regularly for leaks and obvious damage. Repair damage immediately. Sprayed oil may cause personal injury and fire.

c) Always relieve pressure from the hydraulic system before carrying out any kind of maintenance or adjustment work.

d) Depressurize all system components and pressure pipes to be removed in accordance with the specific instructions for the unit concerned before carrying out any repair work.

e) Hydraulic lines must be laid and fitted properly. Ensure that no connections are interchanged. The fittings, lengths and quality of the hoses must comply with the technical requirements.

f) Only fit replacement components of a type provided by the manufacturer.

g) Always keep hydraulic elements clean.

h) If the high-pressure hydraulic fluid leaks, it can cause serious injury to personnel nearby. Once it happens, seek medical help immediately.

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Operator’s Manual for Crawler Crane

Chapter 2 Description of Crane

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2.1 Product model

2.1.1 Product name plate and its position

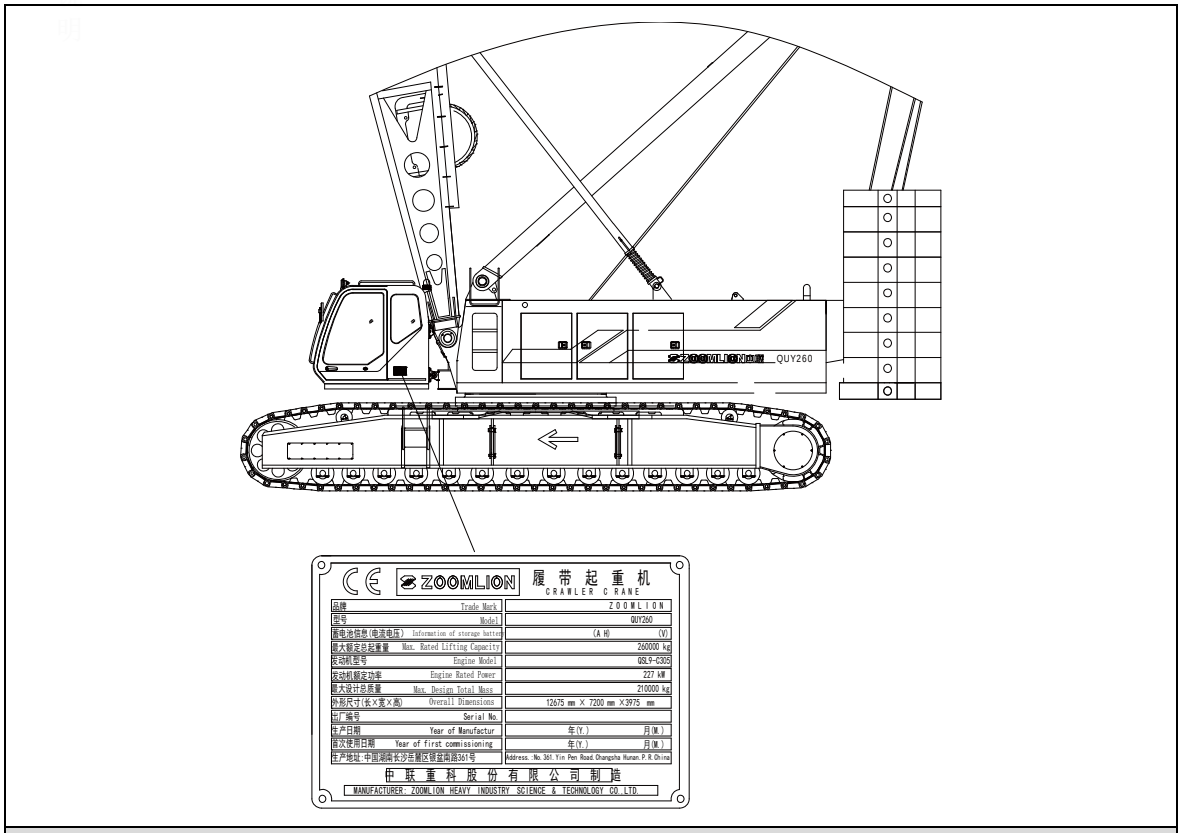


Figure 2-1 Product name plate and its position

2.1.2 Intended use of the crane

It is prohibited to transport people with this equipment! In many cases, there have been serious injuries when people have been transported using this equipment (or even on the hook or on the loads). Under such circumstances, they have no control over the crane movements and are not protected against bumps or falls. Even a small error can cause vital injury! In exceptional cases, please consult the responsible authorities concerning safety regulations.

It is expressly forbidden to use the crane for jumps with rubber ropes (bungee jumping)! Using the crane for such jumps represents a misuse of the crane and entails extreme danger for life and limb!

The crane is designed exclusively for assembly and lifting operation. Any other type of use or otherwise use which goes beyond its limits specified, such as handling of general cargo or grab operation, are not classified as intended use. The manufacturer shall not be liable for any damage caused. The operator bears full responsibility for this type of misuse.

The use of two hoisting winches for lifting loads (twin hook operation) is only permitted following permission from the crane manufacturer.

The intended use also includes the observation of *Lifting Load Capacity Chart*, *Operator's Manual* and *Maintenance Manual*.

2.1.3 Crane design calculation

2.1.3.1 General

The crane has been constructed using state of the art technology and in accordance with recognized safety regulations. Nevertheless, its use can lead to hazards for the life and limb of the operator and third parties, and/or damage to the machine and other objects.

Use the crane only when it is in full working order and only for its intended use, paying attention at all times to safety and potential hazards, and in observance of the *Operator's Manual* and *Maintenance Manual*.

Have any malfunctions which might impair safety rectified immediately.

2.1.3.2 Classification of the crane

The crane is classified as follows in accordance with ISO 4301-2, GB/T 3811 and GB/T 14560 standards:

a) Operating class: U1
b) Load collective class: Q2
c) Crane group: A1

All important components of the crane are designed and manufactured for normal assembly operation. Operating conditions or types of use other than assembly operation require the permission of the manufacturer.

2.1.3.3 Service life

Classification of the crane is based on a total operating life (service life) of 20 years under the following conditions:

a) The crane is operated as an assembly and lifting crane. The load capacity charts specified for the crane are for assembly operation only. General cargo handling or grab operation can only be permitted following express permission from the manufacturer under suitable conditions.
b) The entire number of the crane's load cycles is less than 32000. (for example, 5 load cycles each day – 10 load cycles each day, 200 days each year)

   A "load cycle" encompasses the process which begins when a load is lifted and ends when the crane is ready to lift the next load, including the time of crane operation and normal break.

c) The load spectrum coefficient of the crane should comply with the load collective class (lift the rated load rarely, but the medium-duty load frequently). For example:
For 1/6 of the load cycles, the crane is placed under the maximum load.
For 1/6 of the load cycles, the crane is with 73% of the maximum load.
For 1/6 of the load cycles, the crane is with 47% of the maximum load.
For 3/6 of the load cycles, the crane is with 20% of the maximum load.
"Load" herein means the total weight of lifting load and load handling devices (for example, lifting load + load hook + sling).
Under these circumstances, assuming that the maintenance work is carried out properly, the theoretical service life can be more than 20 years. Harder operating conditions naturally lead to a reduction in the service life.

CAUTION

(1) The winch must comply with the calculation formula for theoretical residual life. For details, refer to *Maintenance Manual*.

(2) Some components (for example, wire rope, pulley and bearing) are not designed for the entire service life of the crane, but they must be replaced after a certain amount of time of using. For relevant information, please see *Maintenance Manual*.

2.1.4 Engine type and its manufacturer

Engine type: QSL9-305
Engine manufacturer: American Cummins

2.2 Terminology

2.2.1 Boom configurations

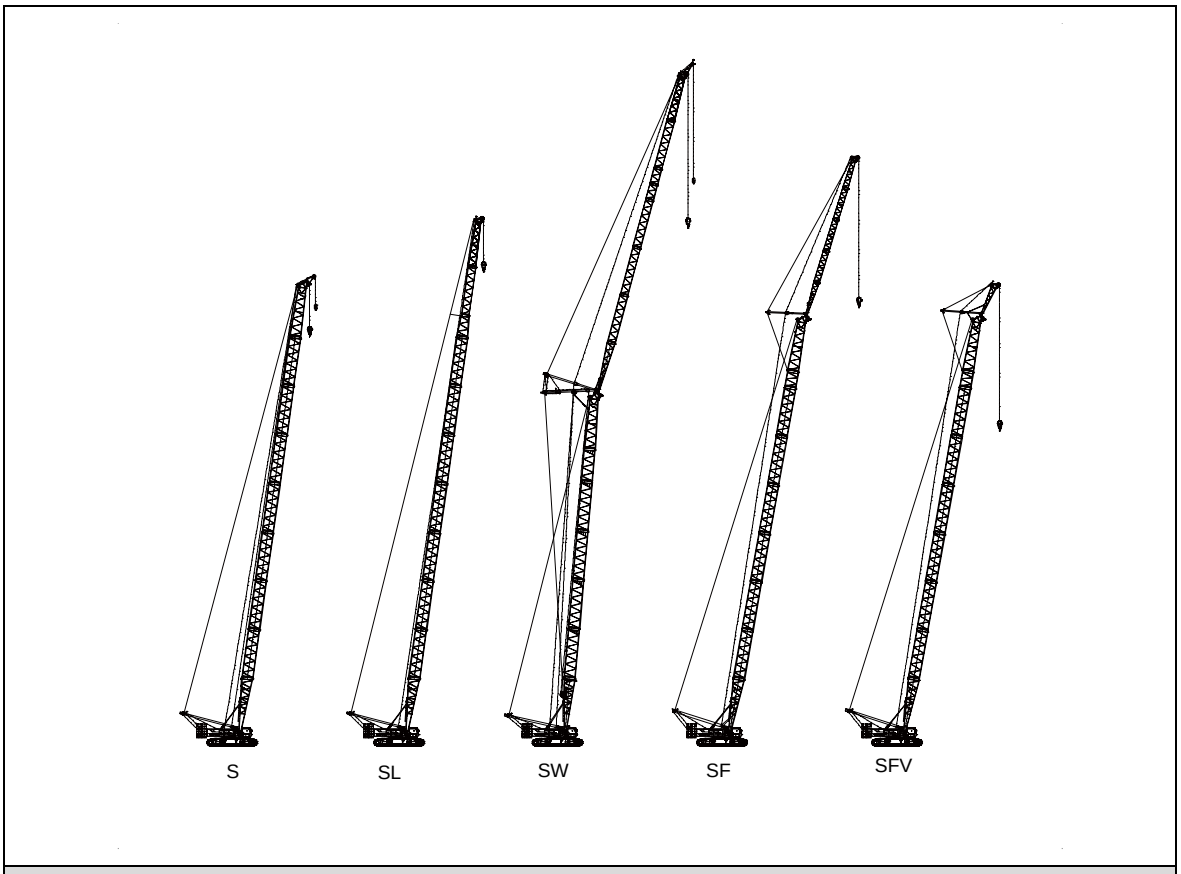


Figure 2-2 Boom configurations

Table 2-1 Description of boom configurations

Configuration No.	Description	Parameters
S	Heavy duty boom	20m-83m
SL	Light duty boom	86m-95m
SW	Luffing jib on heavy duty boom	S-boom =23m-62m W-jib = 21m-60m
SF	Fixed jib on heavy duty boom	S-boom = 29m-77m F-jib =12m-30m
SFV	Heavy fixed jib on heavy duty boom	S-boom = 41m-77m FV-jib = 6m

2.2.2 Description of crane components

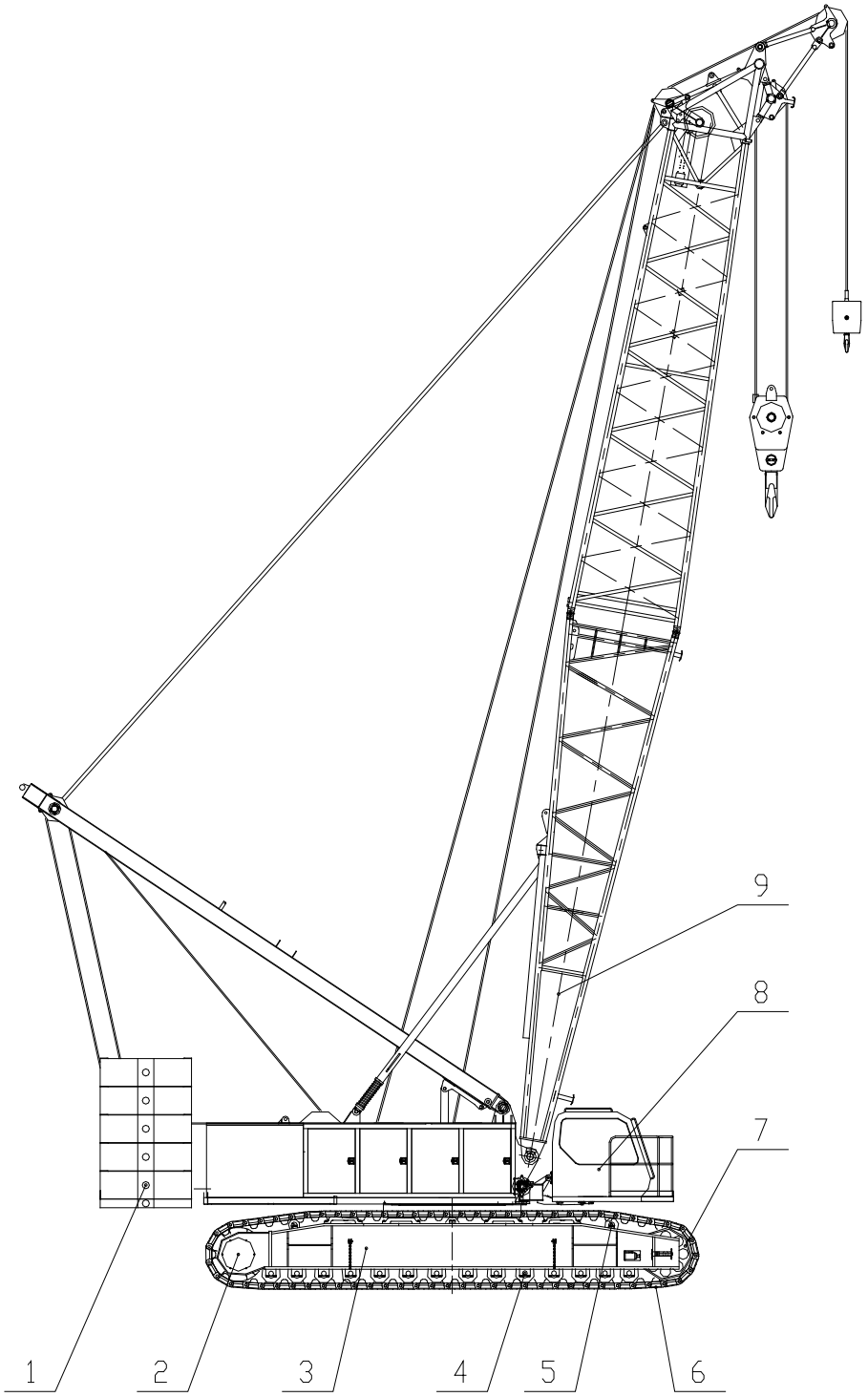


Figure 2-3 Names of the components

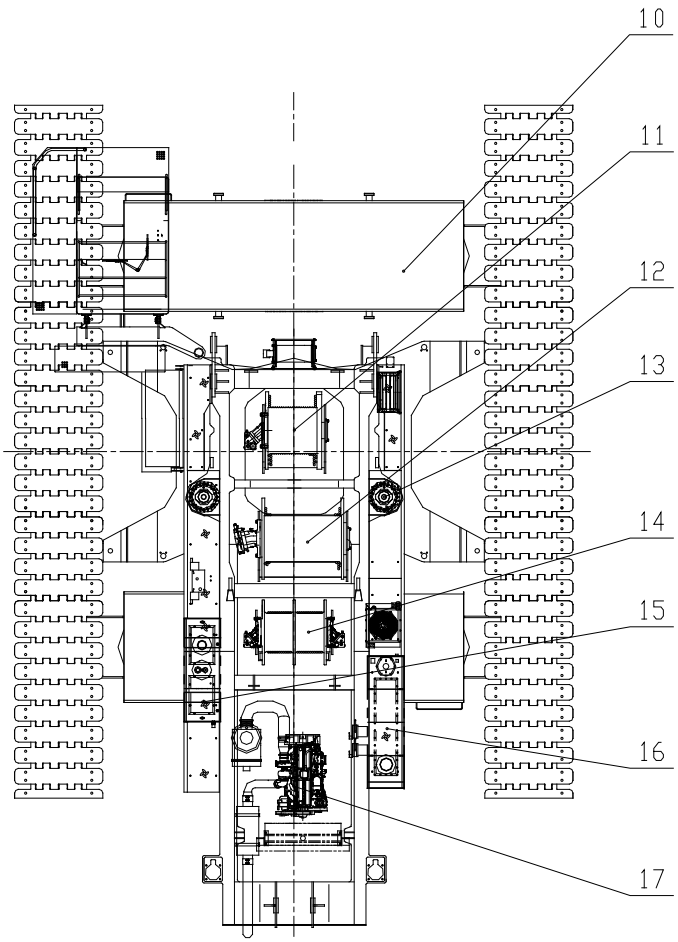


Figure 2-4 Names of the components

Table 2-2 Description of component parts

Part No.	Description	Part No.	Description
1	Counterweight	10	Central counterweight
2	Drive sprocket	11	Hoisting winch 1
3	Crawler carrier	12	Hoisting winch 2
4	Track roller	13	Slewing reducer
5	Track carrier roller	14	Main boom derricking winch
6	Track pad	15	Diesel tank
7	Driven sprocket	16	Hydraulic oil tank
8	Operator's cab	17	Engine
9	Main boom		

2.3 Product description

2.3.1 Hoisting winches

The crane is fitted with two hoisting winches: hoisting winch 1 and hoisting winch 2. Both of them are composed of concealed axial piston variable displacement motor, balance valve, reducer, normally closed brake as well as wire rope. And they are controllable independently.

The hoisting rope is high-quality rotation resistant wire rope.

Infinitely variable speed from 0 to maximum hoisting speed is available for hoisting winch 1 and hoisting winch 2, which can improve the working efficiency dramatically.

2.3.2 Main boom derricking winch

The main boom derricking winch is composed of concealed axial piston constant displacement motor, balance valve, reducer, normally closed brake as well as wire rope. And it is controllable independently.

The derricking rope is high-quality non-rotation resistant wire rope.

2.3.3 Slewing mechanism

The slewing mechanism consists of concealed dual variable displacement axial piston motor, dual gear reducer, normally closed slewing brake, and pinion gear as well as slewing ring. The superstructure can realize 360° continuous rotation via slewing ring which is driven by pinion gear.

The slewing mechanism of closed circuit system has controllable free swing function which can reduce the impacts on the crane and ensure that the slewing motion can be initiated /stopped more stably.

Infinitely variable speed from 0 to 1.2 r/min

The slewing mechanism can be locked by two mechanical locking devices in the front of slewing table during transportation.

2.3.4 Travel gear

The traveling mechanism is fitted with two variable displacement motors and two traveling reducers. Using control levers, the traveling movements can be controlled, such as traveling straight ahead/backwards, turning with a crawler, differential steering, turning on spot, and traveling with a load. This kind of design enables the crane to have high maneuverability.

Traveling speed: 0 – 1.0km/h

Gradeability: 30%

The tension degree of crawler can be adjusted by jack quickly and conveniently.

2.3.5 A-frame erecting mechanism

The A-frame erecting mechanism consists of A-frame, erection cylinder, auxiliary hydraulic system and so on. It is mainly used for the assembly, dismantling or conversion of the machine on the site.

The erection cylinder is connected to balance valve with anchoring rods. Such kind of connection allows high reliability and safety.

2.3.6 Operator's cab movement-controlling mechanism

To reduce the transport width of the basic machine, the operator's cab can be swiveled out of the side working position to the centre of slewing table.

To broaden the field of vision of crane operator, the cab can tilt backwards for 20° via tilting cylinder when the load is lifted to a high position.

2.3.7 Counterweight and its fitting & removal mechanism

The counterweight fitting & removal mechanism is composed of counterweight base plate, counterweight plate, counterweight lifting cylinder, assembly chain and counterweight bolting cylinder.

The counterweight can be fitted and removed by crane itself without the help of auxiliary crane, so the utilization rate of crane is increased and the risk of accident is decreased during fitting of counterweight.

2.3.8 References

GB3811-2008 *Design rules for cranes*

GB6067-85 *Safety rules for lifting appliances*

JG5055-94 *Safety rules for crawler crane*

JB/T5318-91 *Large crawler cranes technical conditions*

GB/T14560-93 *Technical requirements for cranes with lifting capacity up to 150 tons*

GB/T13330-91 *Test method of performance for crawler crane with lifting capacity up to 150 tons*

JG/T55-99 *Test method for the crawler cranes structures*

EN13000-2004 *Cranes-mobile cranes*

FEM

2.3.9 Classification of the crane

Complete machine: A1 Travel gear: M3

Slewing mechanism: M3 Hoisting winch: M5

Derricking mechanism: M5

2.3.10 Crane working environment

Working temperature: -20 ℃- 40 ℃

Non-working temperature: -40 ℃- -20 ℃, 40 ℃- 60 ℃

Allowed air relative humidity: 85% (100% is allowed for a short period of time)

Allowed in-service wind speed: 9.8 m/s

Allowed out-of-service wind speed: 13.8 m/s

The requirements for the ground when the crane is traveling with a load:

a) Ground inclination ≤ 0.5%

b) The ground is solid and can bear the ground pressure of crane.

c) Maximum ground pressure of crane: 0.115 MPa

2.3.11 Overall dimensions

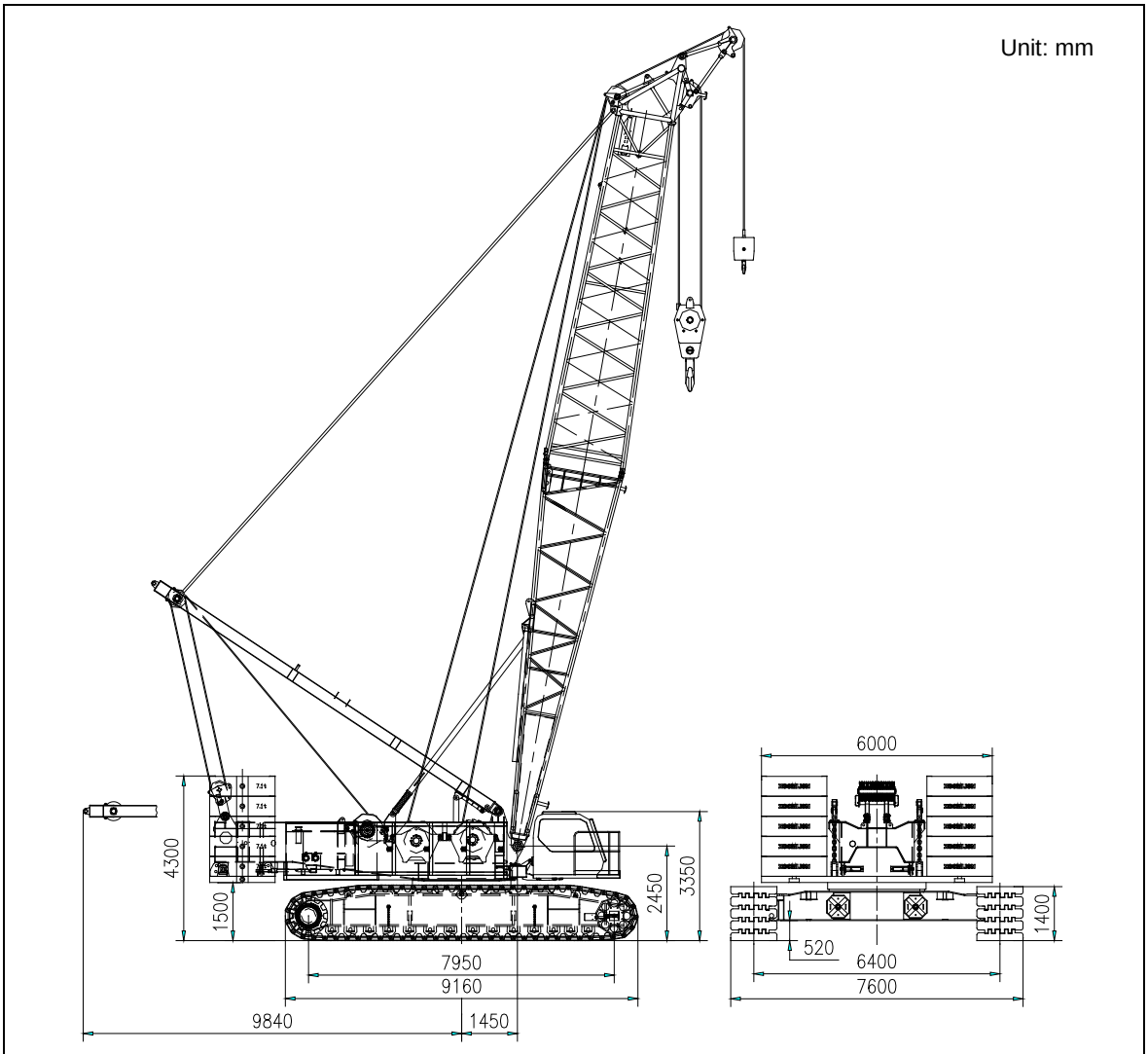


Figure 2-5 Overall dimensions

2.4 Technical data

2.4.1 Main technical parameter

Table 2-3 Weight

Basic machine	45.5 t
Rear counterweight	83.7 t
Central counterweight	32 t
Crawler carrier	2 × 24.5 t

Table 2-4 Speed

Mechanism	Speed	Rope diameter
Hoisting winch 1	120 m/min (maximum speed of single rope, the 6th rope layer)	28 mm
Hoisting winch 2	130 m/min (maximum speed of single rope, the 6th rope layer)	28 mm
Main boom derricking winch	2×40 m/min (maximum speed of single rope, the 6th rope layer)	24mm
Slewing mechanism	0 -1.0 rpm	
Gradeability	30%	

2.4.2 Type of load hook and applicable rope reeving

Table 2-5 Type of load hook and applicable rope reeving

Type of load hook	Maximum rope reeving	Weight of load hook (kg)
260 t	20	4200
160 t / 100 t	12 / 8	2800
50 t	4	1700
30 t	2	1070
16 t	1	800

2.4.3 Hoisting rope reeving and specification of wire rope

Table 2-6 Hoisting rope reeving

Reeving	Lifting Capacity (t)	Reeving	Lifting Capacity (t)	Reeving	Lifting Capacity (t)
1	15	8	111	15	196
2	29	9	124	16	207
3	44	10	137	17	218
4	58	11	149	18	232
5	72	12	161	19	246
6	85	13	173	20	260
7	98	14	184		

CAUTION

(1) If crane is working with hoisting rope reeving less than the value listed in the above table, single hoisting rope load must be checked to make sure that the max. permissible load capacity of single hoisting rope is not exceeded.

(2) Maximum permissible load capacity of single rope is 15000 kg.

(3) If the max. permissible load capacity of single hoisting rope is exceeded, the wire rope may be broke and the reducer and motor may be damaged.

Table 2-7 Wire rope parameter

Description and intended use	Hoisting rope for winch 1	Hoisting rope for winch 2	Derricking rope
Torsion-resistance or not	Yes	Yes	No
Nominal rope diameter	28 mm	28 mm	24mm
Rope length	300 m	480 m	440 m
Direction and type of lay	Left-hand lang lay	Left-hand lang lay	Right-hand ordinary lay

2.4.4 Lifting height

CAUTION

The lifting height curve is drawn without consideration of boom deflection.

a) Lifting height on S/SL boom

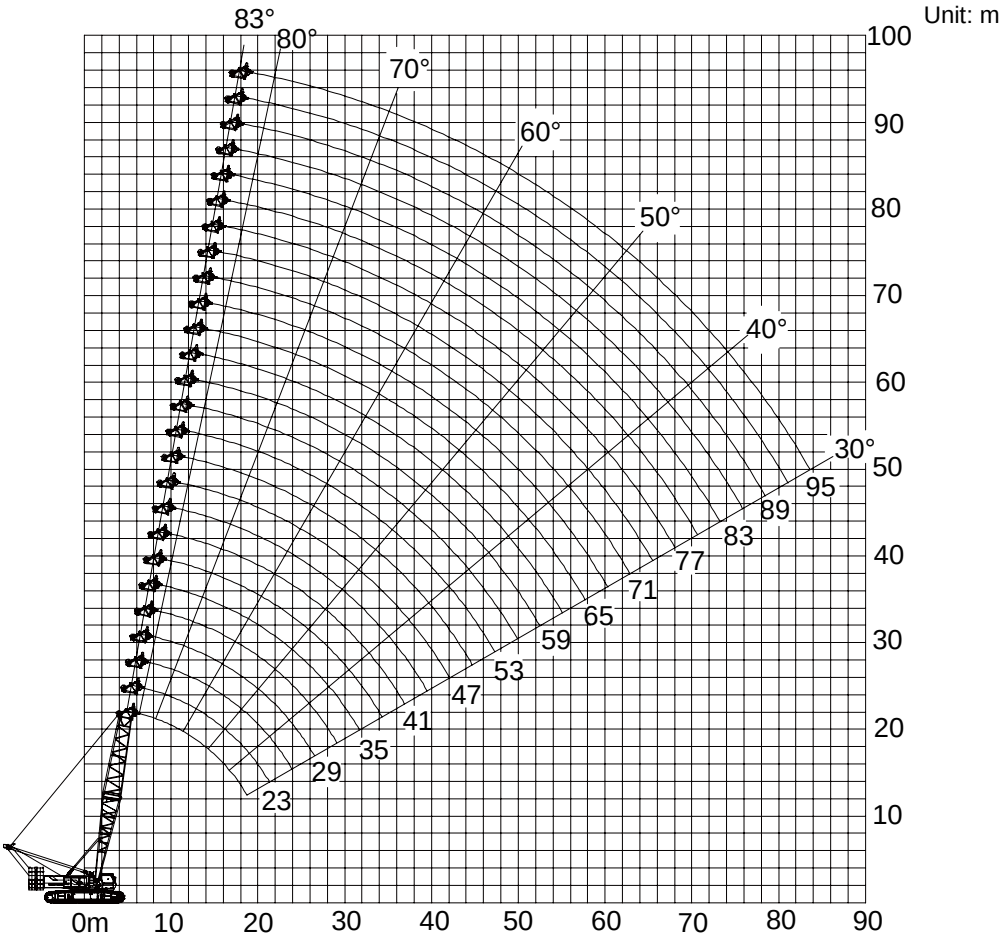


Figure 2-8 Lifting height on S/SL boom

CAUTION

(1) The X-axis indicates the working radius in meters, and the Y-axis indicates the lifting height in meters.

(2) For S/SL boom configurations, S-boom = 20 m - 83 m, and SL-boom = 86 m - 95 m.

b) Lifting height on SF boom

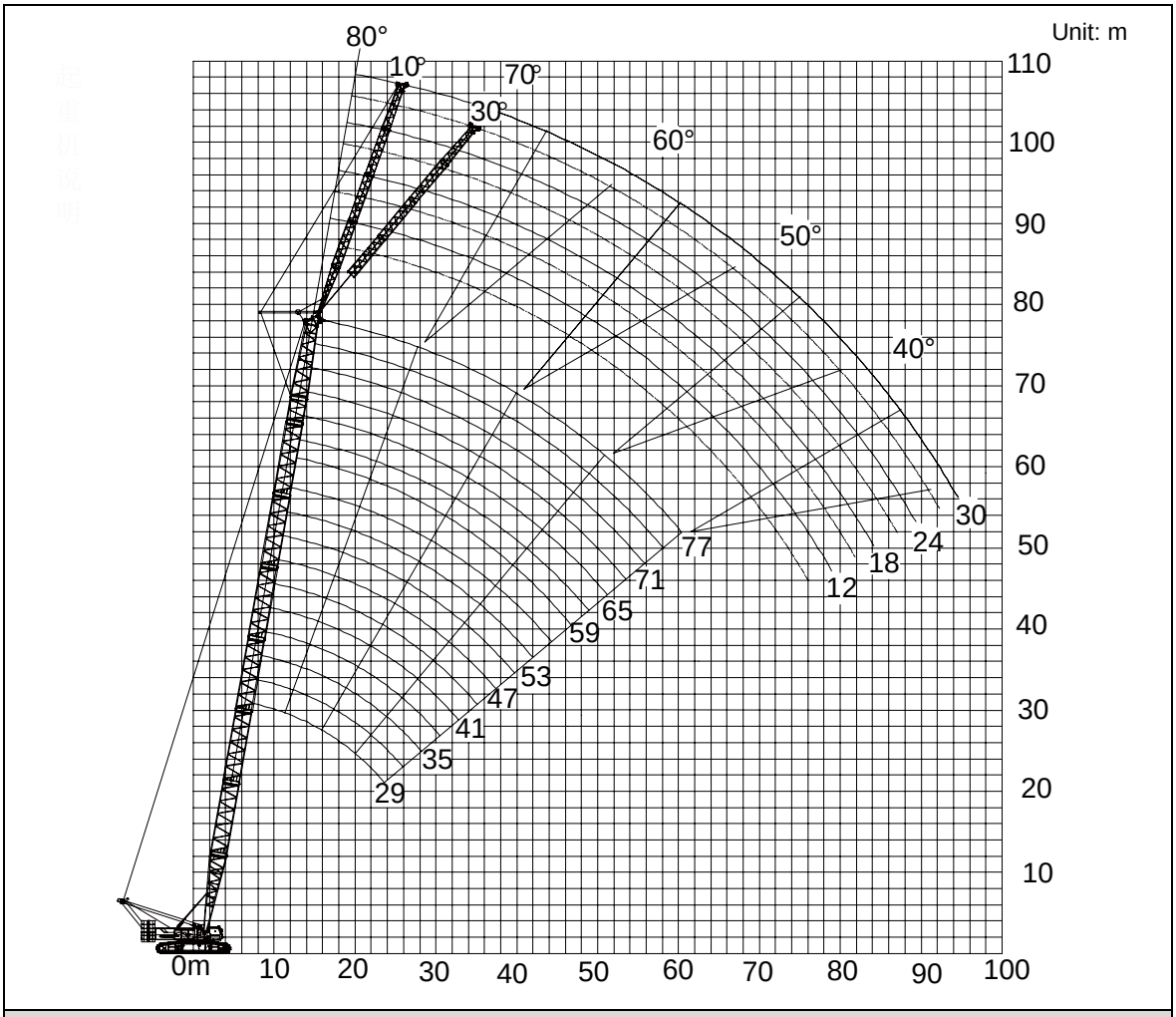


Figure 2-9 Lifting height on SF boom

CAUTION

(1) The X-axis indicates the working radius in meters, and the Y-axis indicates the lifting height in meters.

(2) For SF boom configuration, S-boom = 29 m - 77 m, F-jib = 12 m - 30 m, and F-jib angle = 10° or 30°.

c) Lifting height on SFV boom

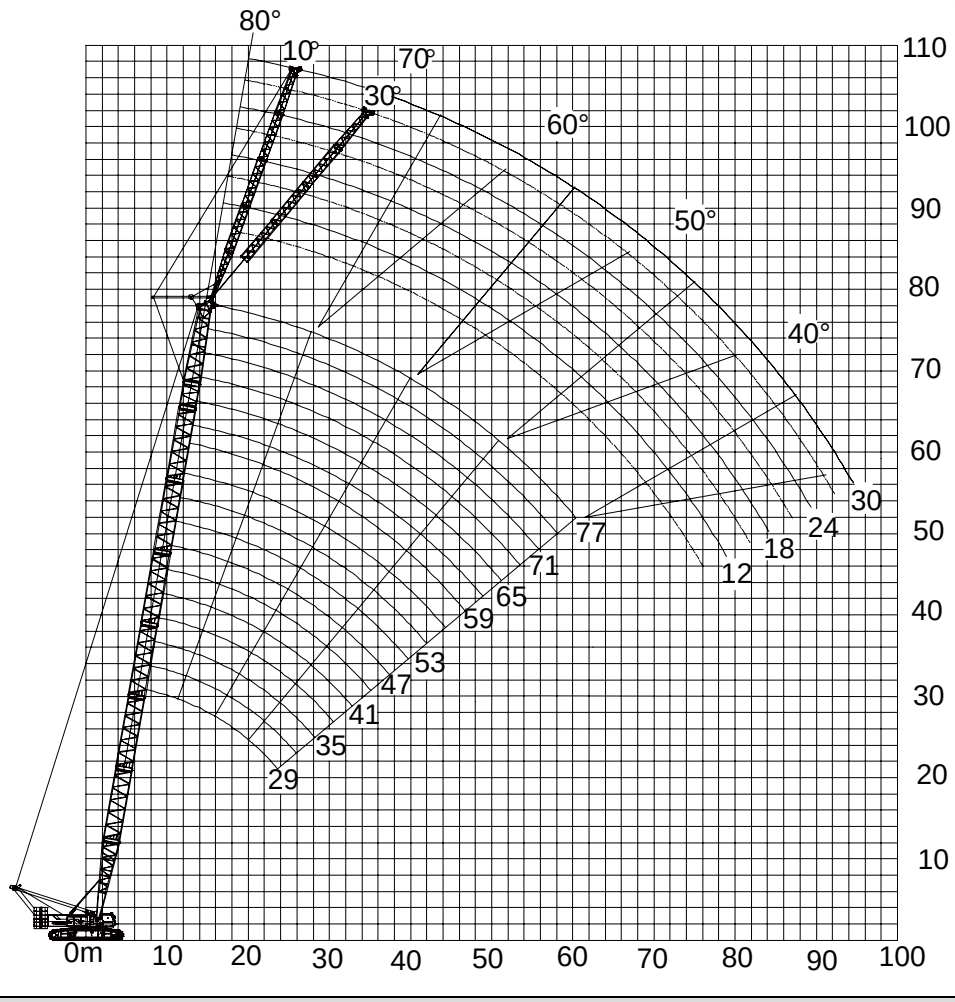


Figure 2-10 Lifting height on SFV boom

CAUTION

(1) The X-axis indicates the working radius in meters, and the Y-axis indicates the lifting height in meters.

(2) For SFV boom configuration, S-boom = 41 m - 77 m, FV-jib = 6 m, and FV-jib angle = 14° or 20°.

d) Lifting height on SW boom

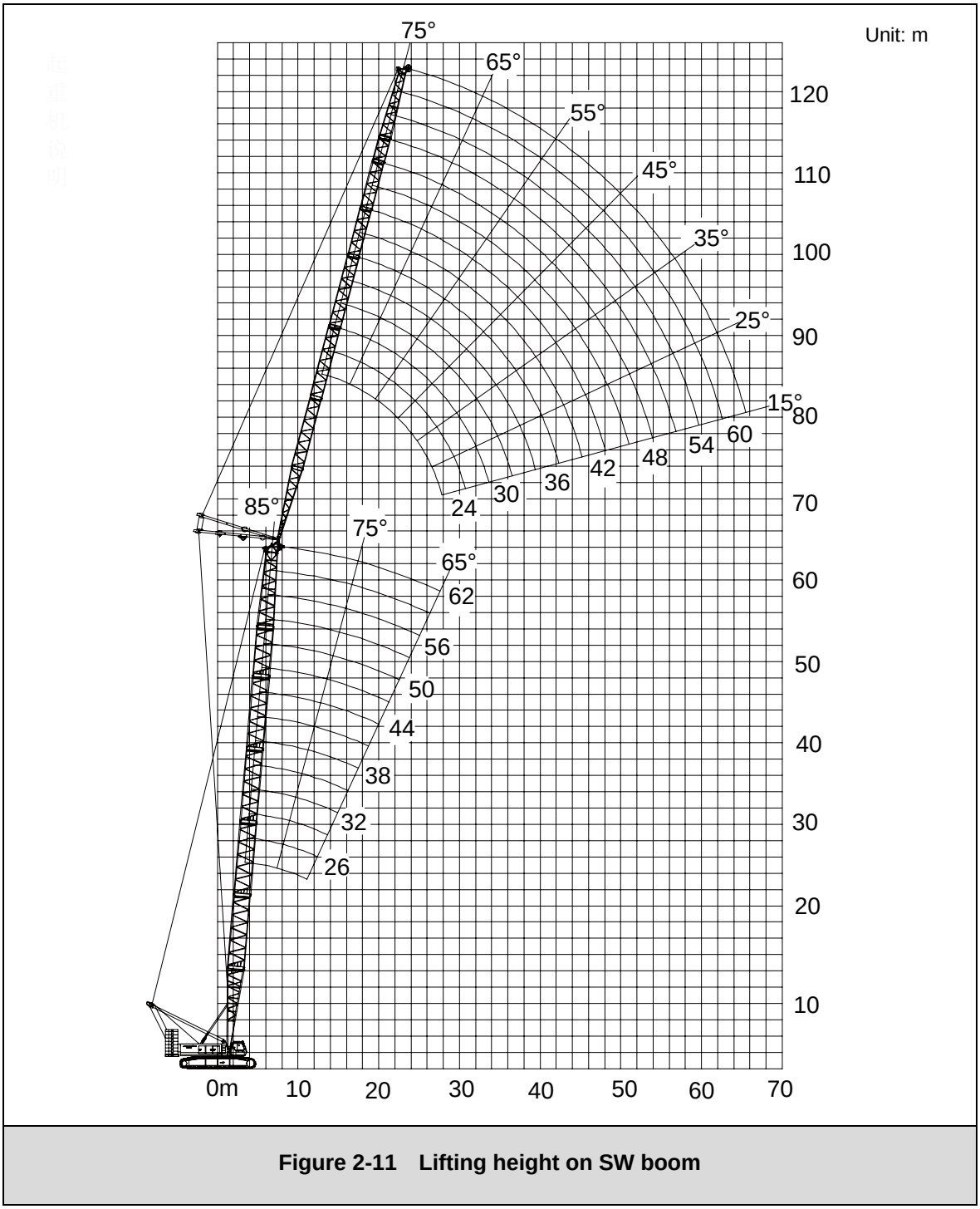


Figure 2-11 Lifting height on SW boom

CAUTION

(1) The X-axis indicates the working radius in meters, and the Y-axis indicates the lifting height in meters.

(2) For SW boom configuration, S-boom = 23 m - 62 m, and W-jib = 21 m - 60 m.

2.4.5 Lifting capacity charts

a) The values in lifting capacity charts are applicable to 360° working condition.

b) The value in lifting capacity charts is the rated total lifting capacity of crane, which is the maximum permitted lifting capacity under various boom configurations. It includes the weight of load hook, wire rope and other load handling devices.

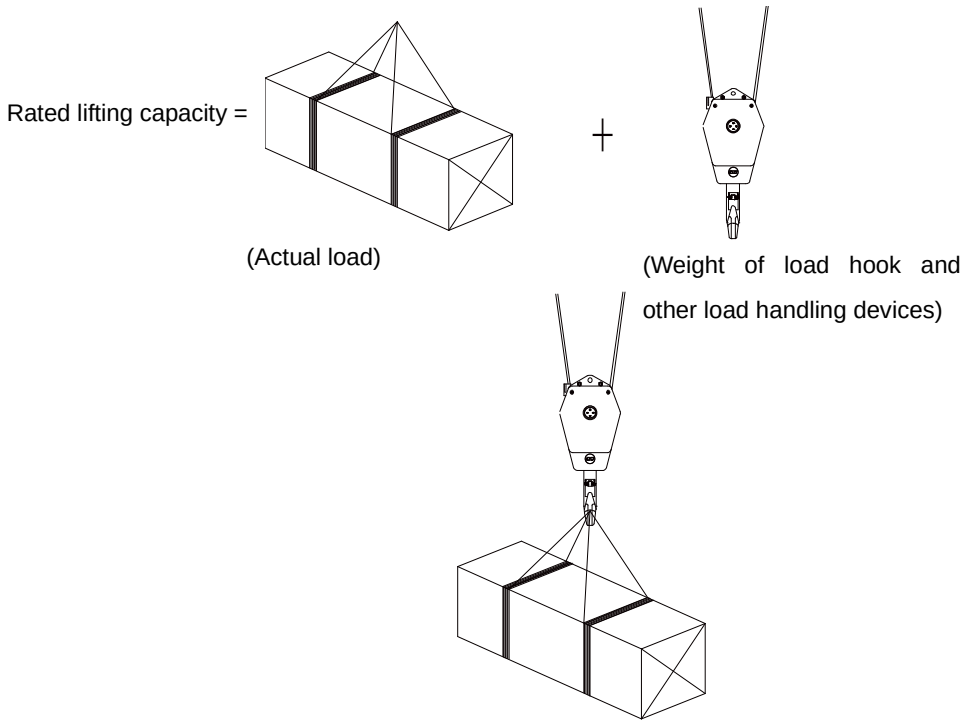


Figure 2-12 Rated lifting capacity

c) The radius in lifting capacity charts is the horizontal distance from central axle of slewing ring to centerline of hook when the crane is loaded.

d) For SF boom configuration, if main load hook is not detached from main boom head, the actual lifting capacity on fixed jib should be calculated from this formula: rated total lifting capacity – weight of main load hook – weight of auxiliary load hook – weight of wire rope – weight of other load handling devices.

e) For S boom configuration (but some sections of fixed jib are not dismantled), the actual lifting capacity on main boom is calculated in accordance with the following formula:

$$G_2 = G - G_1\left[1+\frac{L_2\cos(\alpha-\beta)}{2L_1}\right] - G_3 - G_4\left[\frac{L_2}{L_1}\cos(\alpha-\beta)+1\right]$$

Table 2-8 Formula explanation

G= Rated lifting capacity	L1=Main boom radius
G1= Jib weight	L2=Jib length
G2= Actual lifting capacity	α= Main boom angle
G3= Main load hook	β=Jib angle (10° or 30°)
G4= Auxiliary load hook	

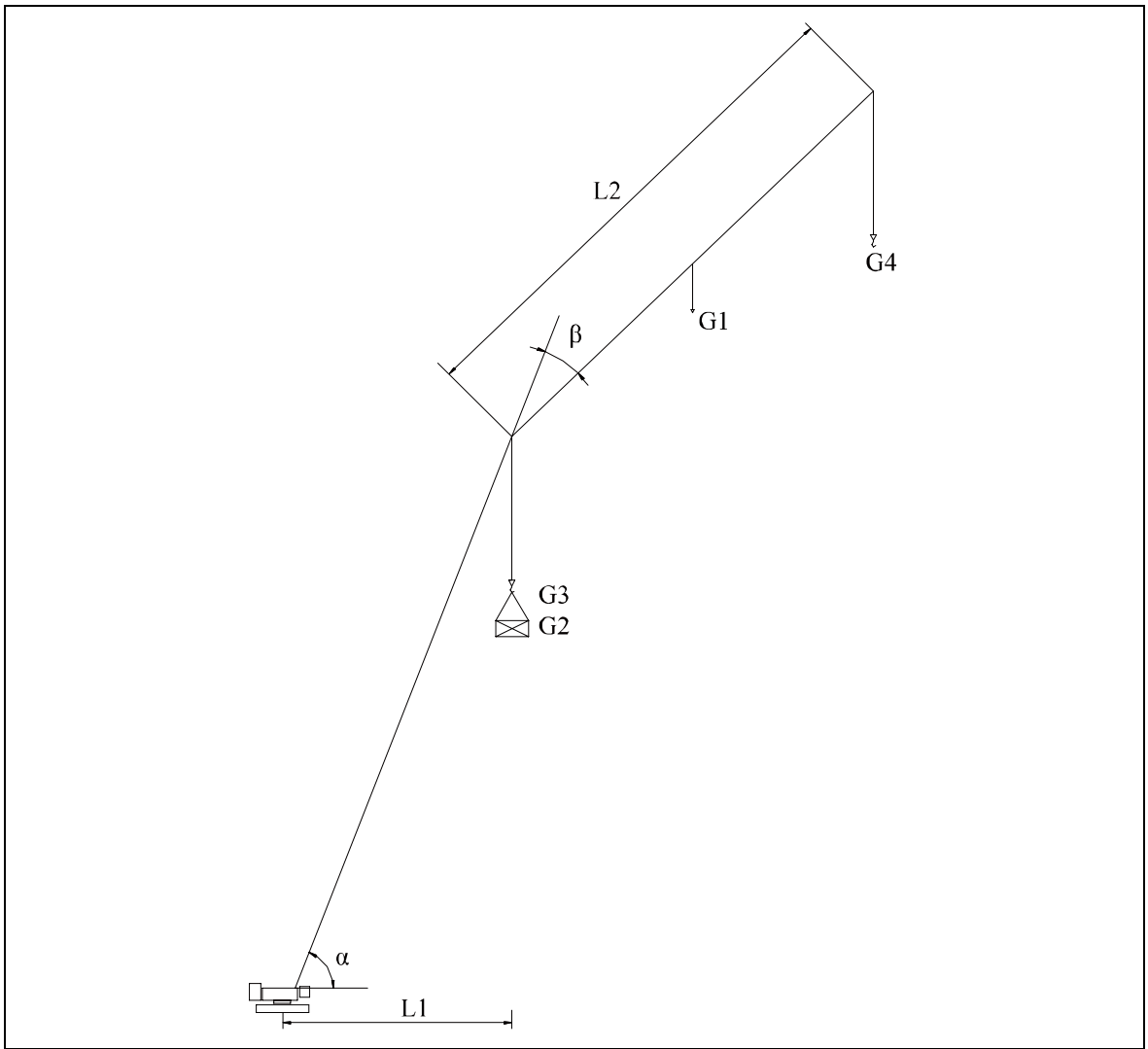


Figure 2-13 Actual lifting capacity calculation when main boom is with jib

f) The rated total lifting capacity indicates the crane's lifting capacity under different boom configurations when it is operated on firm and flat ground.

g) When tip boom is used, the lifting capacity on tip boom is the same as that on main boom within the same radius, but its max. lifting capacity should not exceed 25 t.

CAUTION

For your safety, using both load hooks is prohibited during lifting operation.

ZOOMLION

Operator’s Manual for Crawler Crane

Chapter 3 Safety Guidelines

Chapter 3 Safety Guidelines

3.1 Operational planning

In addition to a perfectly working crane and a well-trained crew, operational planning is an important precondition for safe and reliable crane operation.

The crane operator must obtain or receive the necessary information (familiarize himself with the *Operator's Manual*, basic knowledge about pneumatic, electrical and hydraulic drive, and notes for safe operation as well as operating environment) before starting the crane operation, in particular:

a) Clearly define the area of responsibility of all personnel concerned.
b) Type of crane operation and required working mode.
c) Distance between the lifting points and surrounding buildings.
d) Influence of communal facilities (including the overhead high/low voltage lines and underground gas pipes).
e) Space requirements at the work site.
f) Movement restrictions due to surrounding structures (e.g. is there another crane nearby in working).
g) Number, weight, dimensions, material of load(s) to be lifted.
h) Required lifting height and slewing radius.
i) Load-bearing capacity of soil or surface to be operated upon and its flatness.
j) Height and widths of thoroughfares leading to the site.
k) Other factors affecting the site (e.g. weather, live lines, etc.).
l) Communication means adopted between signalman and crane operator.
m) Take appropriate measures to keep people and equipment unconcerned away from the working area.
n) Basing on the above information, the crane operator must assemble the equipment required to operate the crane:
   – Required boom configuration for crane operation
   – Hook blocks/load hook
   – Counterweight weight

⚠ CAUTION

(1) A correct and complete operational planning is vital for safe and problem-free operation of the machine. The operation planner must plan a safe and reliable operational planning by obtaining and analyzing all necessary information about the operation and considering all the factors that may impair safety of the crane operation.

(2) If the crane operator does not possess all necessary and required information, it may prove impossible to carry out the intended work and accidents may be the result!

3.1.1 State-of-the-Art Technology

This crawler crane model represents the latest state-of-the-art technology.

Load capacities

The proper load capacities are found using the lifting capacity chart.

However, the equipment can still pose a hazard or danger if the safety procedures are not observed and implemented.

3.1.2 Appropriate use of the crane

Appropriate use of the crane is a fundamental safety requirement that never can be compromised.

The crane must only be used for the operations stated and explained in this *Operator's Manual*.

The manual lists the safety precautions and protective measures relevant to the proper use of the crane during assembly and dismantling, commissioning and maintenance of the crane.

Appropriate use of the crane can be considered when the following occurs:

a) National safety requirements are adhered to properly.
b) Accept and acquaint with the safety information in the *Operator's Manual*.
c) All safety devices can function normally.
d) Proper use of all fuels and lubricants as specified in relevant manual.

Appropriate use also includes proper maintenance and inspection of the crane.

Any other use of the crane without the manufacturer's written consent is always considered as inappropriate use. The crane operator in this case is liable for any consequences.

3.1.3 Results of inappropriate use

Inappropriate use of the crane may result in:

a) Life-threatening injuries and even death.
b) Damage to the equipment and/or major damage to property.
c) Cancellation of the manufacturer's warranty.

Inappropriate use of the crane includes:

a) Unauthorized modification of the crane structure without written consent from the manufacturer.
b) No acceptance test performed before commissioning the crane.
c) Commissioning the crane by unauthorized person
d) Commissioning the crane without knowing the contents of the manual
e) Use a manual without all the content or not in local language as the commissioning guidance.
f) Dangerous operation of the crane
g) Transport of personnel on the superstructure with hoisting winch
h) Lifting the load from the ground using main boom derricking winch, jib derricking winch or hook block.

i) Dragging the load on the ground
j) Excessive diagonal pull exceeding 2% of the maximum permitted hoisting load.
k) Crane operation without the specified safety devices such as load moment limiter, hoisting limiter etc
l) Crane operation without observing proper lifting capacity charts.
m) Installing spare parts not approved by the manufacturer.
n) Tilting the crane
o) Improper lifting operation when there is someone on the assembly frame.
p) Operating the crane in dangerous area

3.1.4 Areas of responsibility

The manufacturer:

a) Is responsible for the safe condition of the supplied crane, including any accessories and documentation.
b) Supervise the product performance, maintenance the crane and update the related technical documents.
c) Provide worldwide service and maintenance service.
d) Build a training center and provide training upon request for end users of the crane.

The user:

a) Ensure that only adequately trained and qualified personnel who have read and understood the *Operator's Manual* will operate and maintain the crane.
b) Assign the duties and responsibilities to the operator and maintenance personnel.
c) Provide necessary protecting device for the operator and maintenance personnel.
d) Regularly remind all personnel at the job site of safety consideration when working.
e) Quickly and properly shut down the crane as soon as possible when a safety risk is involved.
f) Perform inspection on the crane according to the local regulations.
g) Perform inspection as required by the manufacturer.
h) Make sure that the crane has been maintained and serviced at specified intervals.
i) Inform the manufacturer in time if life or property is hazardous when an accident occurs.
j) Allow the manufacturer's personnel unimpeded access to the crane in order to supervise the product performance.
k) Make operational planning for the crane.

The crane operator:

a) Is responsible for the safe operation of the crane.
b) Must at all times wear the necessary protective gear for his personal safety.
c) Make sure that all control devices are in their neutral positions before starting the engine.
d) Check the brakes, emergency stop device for functional work before daily operation.
e) Only operate the crane properly within the manufacturer's limitations as specified in lifting capacity charts.

f) Report all irregularities that may or may not affect the safe operation of the crane to superior department or user immediately.

g) Stop operation at once if safe operation is no longer possible.

h) Make sure that all control devices are in their neutral positions and the engine is turned off before leaving the operator's cab.

i) After finishing the operation, put the igniting key in the off position, take down the cab key and engine key, and lock the door to prevent unauthorized startup.

j) Keep the operator's cab, windshield, platform and step clean and free from any debris.

3.1.5 Personal protective gear

The operator must always wear appropriate protective clothing before starting, operating and maintaining the crane, in addition with the appropriate personal protective gear for the particular activity.

WARNING

There is serious danger of injury from getting stuck, caught in, or pulled into moving parts.

Precautions:

(1) Do not wear any loose clothing, scarves, open jacket or open shirt sleeves.

(2) Do not wear any jewelry.

The operator shall be equipped with the following personal protective gear:

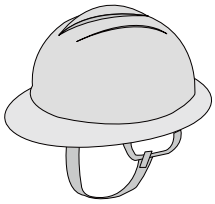


Figure 3-1 Safety helmet

Figure 3-2 Ear protectors

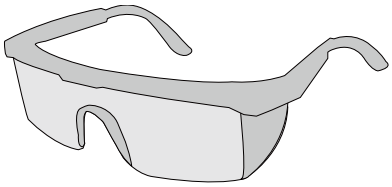
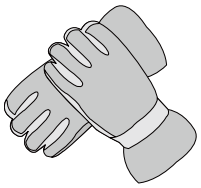


Figure 3-3 Safety goggles

Figure 3-4 Breathing mask

	
Figure 3-5 Safety boots	**Figure 3-6 Protective gloves**

CAUTION

Any operator must observe the following:

(1) Be equipped with necessary personal protective gear.

(2) Keep all personal protective gear clean.

(3) Change the damaged protective clothing and gear in time.

3.1.6 Work area

Only the operator is allowed to stay on the equipment when the crane is working.

The operator can't leave the cab at any time when the crane is working.

In order to build a safe and comfortable working environment, the following requirements should be followed:

a) Keep the cab clean. Clean the foot pedals and ashtrays and put the drinks in the designated place.

b) Don't put the magazines or other items on the control panel.

c) Don't put the tools in the cab.

d) No articles is allowed to put on the thoroughfare, such as clothes, protecting device, personal article, etc

e) The cab must always be free from snow, ice or any other obstacles.

f) Keep all the windows and rearview mirrors clean without condensed water and ice.

3.2 Safety technical notes

3.2.1 Safety instructions for crane operator

a) Safety instructions for crane operator

The crane operator's primary responsibility is to control, operate and adjust the crane in a manner that is safe for both himself and others. Therefore the crane operator should meet the following requirements.

1) The operator must be familiar with the operator's manual for the crane, and know the working principle, structure performance and the safety devices' function, as well as master the operation essentials and maintenance skills.
2) The operator should inspect brake, load hook, wire rope and safety devices before operating the crane. Any irregularities detected during inspection should be removed immediately.
3) The operator must focus his attention on his work during operation and is forbidden to chat with others. Generally speaking, the operator can only follow the signal sent out by appointed persons. For a stop signal, the operator should obey it all the time, no matter who gives it. He should refuse to accept signal which violates operation regulations. Stop the crane immediately if somebody is found climbing the crane.
4) Operator who is in low spirits or poor health is not allowed to operate the crane.
5) Crane operator and signalman should be familiar with safety rules, signals and symbols. Prohibit driving after drinking.
6) Be qualified with the work in hearing, eyesight and reaction ability. Be strong enough to operate safely, and has the ability to estimate distance, height and clearance correctly.
7) Be familiar with the usage of fire extinguisher and be well trained, and know how to survive under emergent conditions.
8) Make sure that only authorized personnel are allowed to operate the crane.

b) Safety instructions for the rigger

The rigger is responsible for ensuring that the load is slung or released safely and carefully. Therefore, he only uses suitable, undamaged lifting and slinging equipment to prevent the load from either slipping or falling. If no signalman is available, the rigger works directly with the crane operator.

Qualifications for the rigger:

1) With crane operation certificate.
2) Be qualified with the work in hearing, eyesight and reaction ability.
3) Be strong enough to move hook or component.
4) Be able to estimate the load, balance the load and judge the distance, height and clearance correctly.

5) Be trained in the skill of handling load.
6) Be able to choose proper lifting devices and components according to the loading condition.
7) Be trained in hand signals for operation and familiar to use them.
8) Be able to safely use audio equipment (such as interphone) to send out oral order exactly and clearly.
9) Be capable of conducting the operation of crane to move the load safely.
10) Make sure that only authorized personnel are allowed to carry out the work.

c) Safety instructions for the signalman

The main job of signalman is to assist crane operator to carry out safe operation. Potential damage to property or personal injury could be avoided if the crane operator carries out the crane movement following the signals given out by appointed signalman. However, only one signalman may work with the crane operator at a time.

Qualifications for signalman:

1) Familiar with the lifting task so as to cooperate with crane operator and other workers.
2) Make sure that only authorized personnel are allowed to carry out the work.
3) Be qualified with the work in hearing, eyesight and reaction ability.
4) Be able to estimate the distance, height and clearance correctly.
5) Be trained in hand signals for operating and familiar to use them.
6) Use standard hand signals for crane operation. If necessary, use a radio device to send out correct and clear order.
7) Be capable of conducting the operating of crane to move the load safely.
8) Position himself in a safe location from where he can see the whole process of operation and be seen clearly by the working personnel.

⚠ DANGER

In order to assure yourself and other person's interests, please operate the crane in accordance with specified regulations, and take precautions against possible dangers caused by improper operation.

d) Safety instructions for crane operating crew

1) Any unsafe operation must be corrected or any dangerous situations must be reported to supervisor.
2) All the persons in the vicinity of the crane must observe the acoustic warning signals of the machine so as to ensure himself and others safety.
3) All the workers must know about the content of the task and working sequence
4) Check whether dangerous situations occur during operation of the machine, and inform crane operator and signalman of the unsafe factors such as high-voltage power line, unauthorized persons and equipment, obstacles and poor ground conditions.

3.2.2 Selecting an operating site

It is very important to choose an appropriate location for crane operation in order to minimize safety risks. The operating site should be selected so that:

a) Crane movement can be carried out within the smallest possible radius.

b) No obstacles hinder necessary movements in the working radius.

c) The ground on the operating site is able to support expected loads.

DANGER

The most essential requirement for safe crane operation is working on firm ground with the capacity to support your loads.

3.2.3 Slopes and trenches

The crane may not be set up too close to slopes or trenches. A safety distance must always be kept from them depending on the type of soil.

CAUTION

Safety distance is calculated as follows:

Soft or backfilled soil = 2× depth of trench (A2 = 2×T)

Hard or grown soil = 1×depth of trench (Al = 1×T)

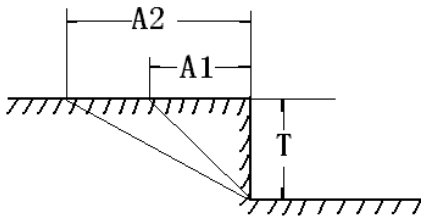


Figure 3-7 Slopes and trenches

DANGER

If a safe distance is not maintained, the slope or trench must be firmly filled. Otherwise, there is a danger that the edge of the slope or trench will collapse.

3.2.4 Permissible ground pressure

Table 3-1 Permissible ground pressure

No.	Soil type	Ground pressure (unit: ×0.1MPa)
A)	Back-filled, not naturally compacted ground	0-1
B)	Natural soil, apparently undisturbed	
1	1. Mud, peat, marshy land	0
2	Non-cohesive, sufficiently compactly layered soil	
2.1	Fine to medium grained sand	1.5
2.2	From coarse-grained sand to gravel	2
3	Cohesive soil	
3.1	Loamy	0
3.2	Soft	0.4
3.3	Stiff	1.0
3.4	Semi-solid	2.0
3.5	Hard	4.0
4	Hard rock with few fissures in healthy, weatherproof condition and in a favorable location	
4.1	In cohesive layer order	15
4.2	In massive or column-style shape	30
C)	Artificially compacted ground	
1	Asphalt	5-15
2	Concrete	
2.1	Concrete group B I	50-250
2.1	Concrete group B II	350-550

CAUTION

If there is any doubt about the load-bearing capacity of the ground at the operating site, soil test should be carried out.

3.2.5 Checking safety measures

The safety condition of the crane should be checked thoroughly prior to operating the crane, including:

a) Check whether the ground provides adequate load-bearing capacity.
b) Check whether there is sufficient safety clearance to slopes and trenches.
c) Check whether the crane is adjusted to be horizontal.
d) Check whether there are live electrical wires within the working range of the crane.
e) Check whether there are obstacles which will hinder required crane operation.

The crane operation belongs to dangerous operation, so much attention should be given to the working condition of the crane before and during crane operation.

3.2.6 Electromagnetic influences

Strong electromagnetic fields are likely to be present if the construction site is close to a transmitter.

In any case, before working with the crane near transmitters, contact Zoomlion representative. In addition, consult a high frequency specialist.

a) Every crane must be "totally" grounded. Check visually or with a simple tester to ensure that the ladder, cab and cable pulleys are grounded.
b) All personnel working on the crane or with large metal objects must protect themselves from burns by wearing non-conductive gloves and clothing while working.
c) If one feels a little increase in temperature, there is no need to panic. This is because the respective workpiece, structural steel member or undercarriage becomes "hot".
d) The temperature of objects affected by high frequency radiation depends on their "size". For example, cranes, undercarriage and coverings are "hotter".
e) Contact with other crane loads is not permitted when moving the crane. Since defects caused by burns may considerably reduce rope carrying capacity, any such occurrences must be reported immediately to the machinery supervisor so that the ropes can be inspected.
f) An insulator is required at all times between the crane load hook and tackle. It is strictly prohibited to remove this insulator.
g) The ropes are strictly prohibited from touching the above insulator.
h) Crane with attached loads may not be touched by any unprotected parts of the body after the load has been lifted or put down.
i) Do not work with a bare upper torso or in short pants.
j) To minimize absorption of high frequency radiation, loads should be transported horizontally if possible.

k) Loads must be grounded, or additional insulation used (rubber material between the tools used and gloves) when manual work is required.

l) To avoid accidents, use a safety belt when working on components that are high off the ground.

m) Dealing with explosive matter (such as refueling) may only be carried out at least 6 m away from the place where sparks could form due to handling of large metal parts. Use only rubber hoses to refuel.

n) Any accidents and unexpected events must be reported immediately to the local project manager or the safety engineer.

⚠ CAUTION

These electromagnetic fields can pose direct or indirect danger to persons or objects, for example:

(1) Effect on human organs due to temperature increase.

(2) Danger of burns or inflammation due to temperature increase.

(3) Spark or electric arc formation.

3.2.7 Safety signs

Figure 3-40 Warning: Suspended load

Figure 3-41 Warning: Dragging/entanglement

Figure 3-42 Danger: Crush hazard

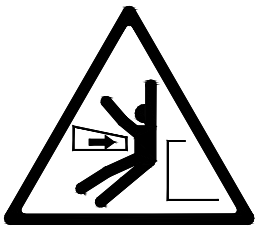


Figure 3-43 Warning: Crushing/collisions

Figure 3-44 Note: Lifting point

Figure 3-45 Warning: Risk of falling

Figure 3-46 Danger: Snagging/dragging

Figure 3-47 Danger: Risk of burn

Figure 3-48 Prohibited: No access for unauthorized personnel

Figure 3-49 Prohibited: Access prohibited

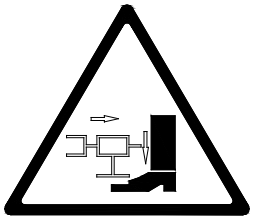


Figure 3-50 Warning: Keep off outriggers

Figure 3-51 Prohibited: Naked flames

Figure 3-52 Note: First aid kit

Figure 3-53 Note: Fire extinguisher

Figure 3-54 Warning: Do not stand under boom

Figure 3-55 Caution: Be careful in the working radius

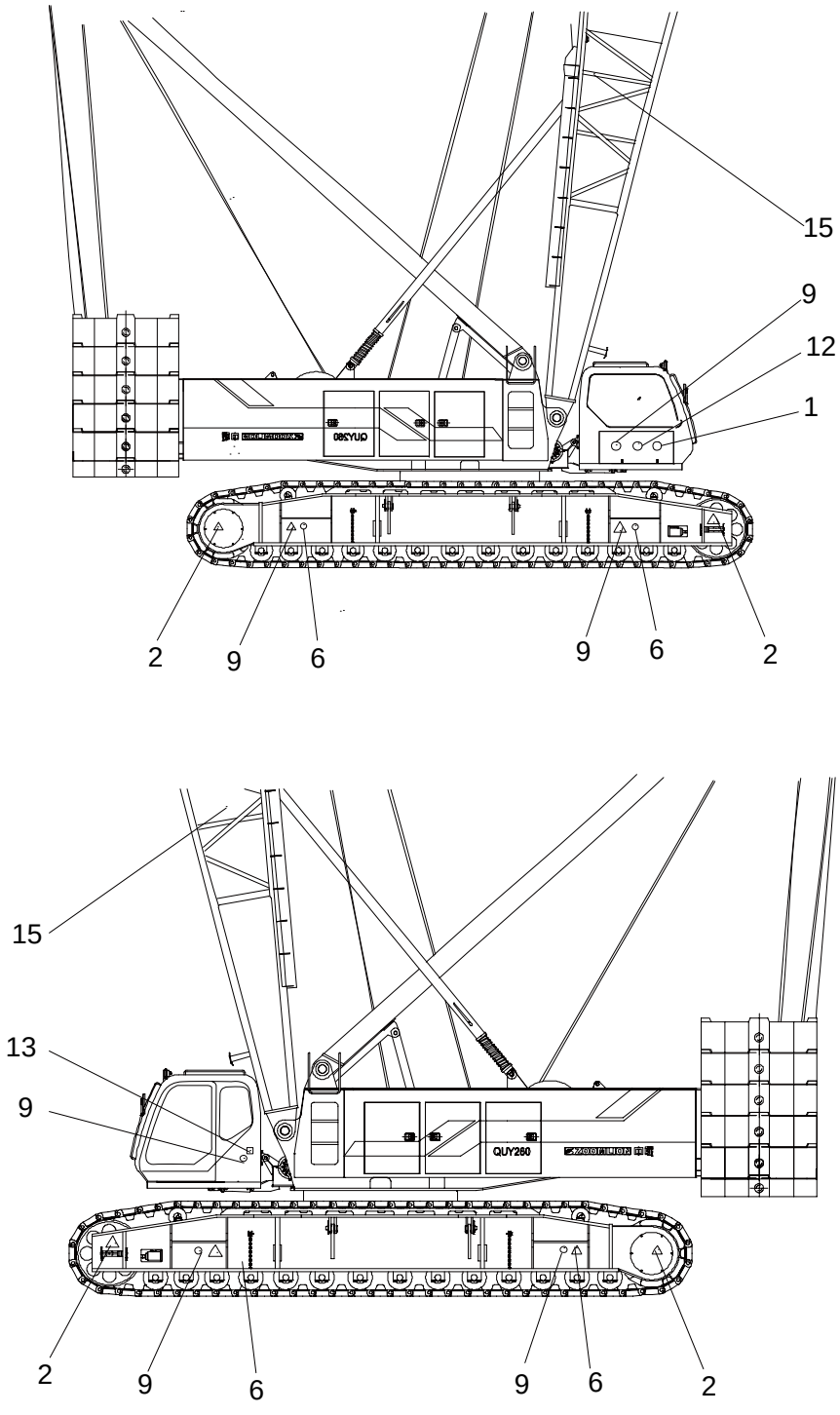


Figure 3-56 Position of safety sign

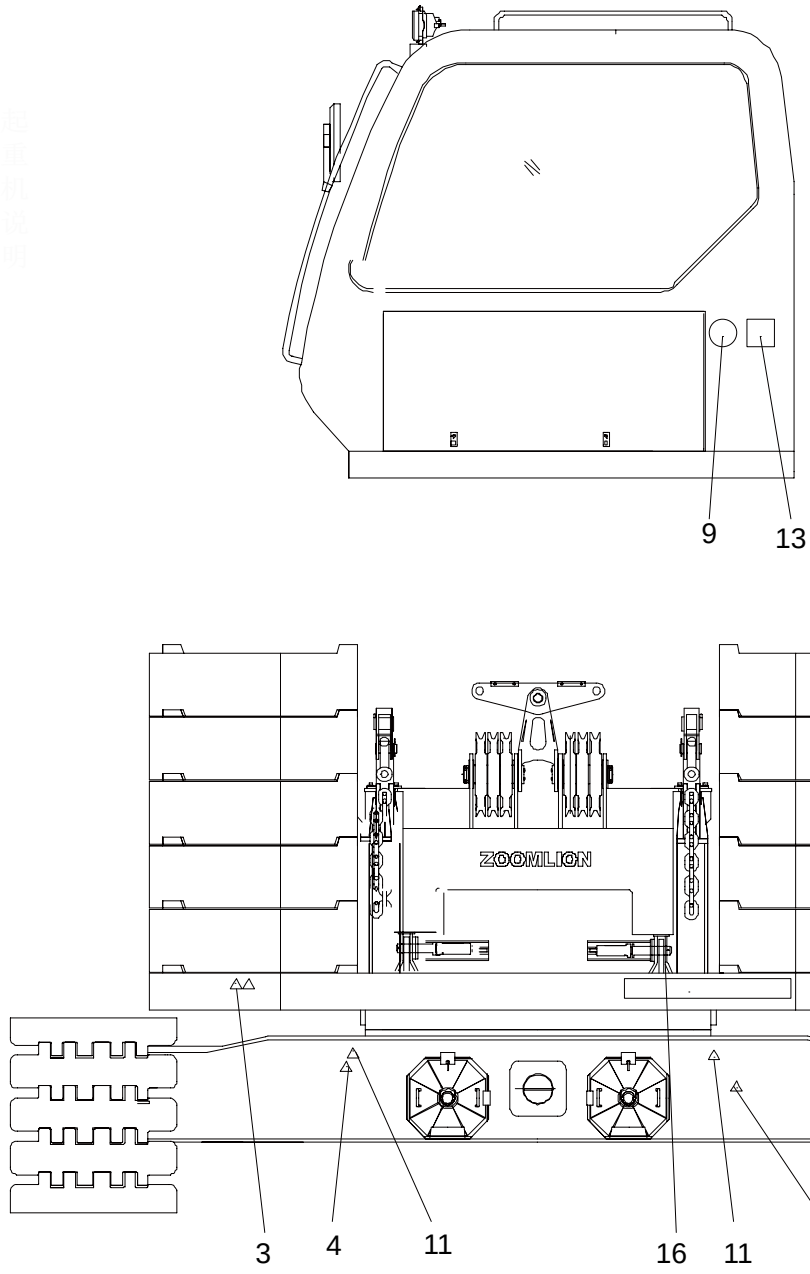


Figure 3-57 Position of safety sign

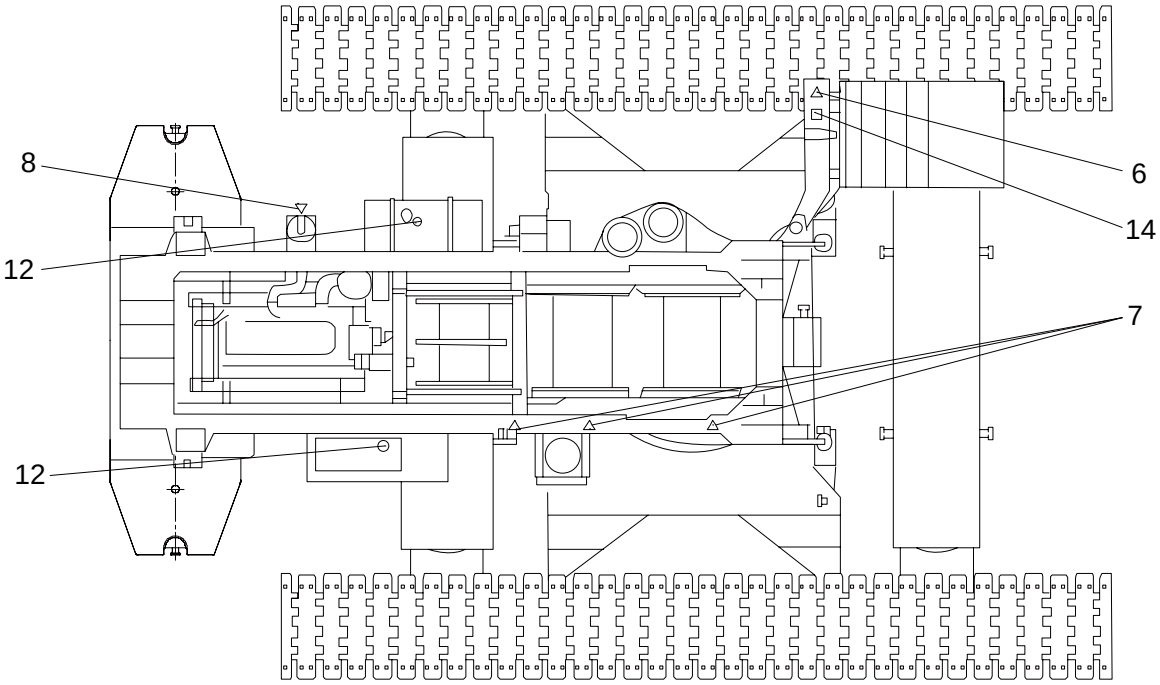


Figure 3-58 Position of safety sign

CAUTION

(1) When the safety sign is damaged or illegible, please order it from appointed service supplier.

(2) It is forbidden to cover or take off safety signs.

(3) If the safety sign is covered with dust and dirt, clean it in time.

(4) The operator's cab should be equipped with an emergency hammer which can be used to smash the window in an emergency so that the operator can run away from the cab.

3.2.8 Potential dangers existing in crane operation

a) Mechanical hazards

1) Do not stand under a suspended load!

Figure 3-59

2) No one is allowed in danger zone of the crane.

Figure 3-60

3) Do not reach into moving drives or parts of the crane

Figure 3-61

4) Access to the top of the upper carriage is only permitted:
   – To carry out assembly, maintenance or service work,
   – With appropriate safety measures against falling, such as wearing non-slip boots.
5) Do not walk on the roof of the operator's cab.

Figure 3-62

6) Secure open sliding doors or the front windscreen of the cab, as well as the open engine compartment doors, against inadvertently sliding back or closing.
7) When driving bolts or pins in or out,
   – Never stand between or below the boom sections.
   – Never align bolt connections by hand.
   – Use appropriate special tools (mandrel, stud wrench, etc).
   – Always wear safety goggles.
8) Safety instructions and preventive measures to avoid mechanical hazards:

WARNING

Dangers exist during the process of crane operation, which can endanger the operator and the persons around.

a) Only remove protective hoods and safety covers
   – When the crane has come to a standstill
   – When the crane is secured against an accidental restart.
b) Before starting operation, check that
   – All protective covers and casings are fitted correctly.
   – All the engine compartment doors are locked.
   – All the safety devices are operational.
c) Do not use cables or chains that are damaged or not up to lifting the specified load.
d) Always wear protective gloves when handling cables.
e) Do not allow limbs or objects to come into contact with the engine fans. Objects that fall into the fan will be shredded or hurled out, which can cause serious injury.

3.2.9 Injuries due to hydraulic energy

These safety instructions and preventive measures can protect against injuries:

a) Repairs to hydraulic equipment may only be carried out by qualified technicians with specialized knowledge and experience of hydraulics.
b) Before starting any repair work, depressurize all pressure hoses and the system sections that are to be opened.
c) When leaks are small, it is sometimes hardly possible to see the hydraulic oil seeping out. Never try to locate the leaks with your bare hands, always use a piece of cardboard or wood for this purpose.
d) Check all hoses, hose connections and hydraulic fittings regularly, at least once a month, for possible leaks and damage.
e) Damaged hoses and hose connections must be replaced immediately with the original manufacturer's spare parts.

Figure 3-63

WARNING

Escaping hydraulic oil under high pressure can cause serious injury if:

– **It penetrates clothing and the surface of the skin**

– **It enters the flesh and causes tissue damage and/or gets into the bloodstream.**

First aid for injuries:

Bandage injured area(s) with anti-bacterial bandage and seek medical attention at once.

Risk of burns

These safety instructions and preventive measures protect against burns:

a) Always wear protective gloves when working on or near hot components.

b) The engine cooling system is pressurized and the escaping steam can cause scald injuries. Therefore,

   1) Only check the coolant level after the cover on the equalizing reservoir has cooled to the point where it can be touched.

   2) Then turn the cover on the equalizing reservoir carefully by 90°, to release the excessive pressure before completely removing the cap.

c) Avoid touching

   1) Coolant or parts coated with hydraulic oil

   2) Hot hydraulic and/or engine oil

   3) Hot exhaust and the turbocharger

d) Carry out the cleaning and maintenance work only after the machine has totally cooled.

WARNING

Certain crane surfaces and operating media can reach an operating temperature of over 65°C [149°F].

First aid for burns:

(1) Immediately run cold water over the burn and to cool it down

(2) Cover the burn with an anti-bacterial bandage and seek medical attention immediately.

3.2.10 Risk of chemical burns

First aid after contacting with battery acid:

a) Acid spayed into the eyes or on the skin must be rinsed away as quickly as possible with clean water. In the event of eye injuries, clean the eyes with special eye washer.

b) In the event of skin injuries, cover the injured area with anti-bacterial bandage and seek medical attention immediately.

c) Neutralize escaping battery acid with a soda solution. Dissolve soda powder, available as detergent or baking powder, in water. Pour the solution carefully on the acid until it no longer foams.

Take the following safety measures to prevent the personnel again injury:

The following behaviors are prohibited near the battery acid electrolyte

a) Always disconnect battery leads before doing any maintenance to the electrical system.

b) When working with or near a battery, the operator must always wear safety goggles and protective gloves.

c) Never short circuit the battery.

d) Never place any tools on the batteries.

e) Discharged battery:

– Can burst open upon freezing.

– Stored in frost-proof rooms.

f) In storage:

1) Always keep horizontal.

2) Do not store near hot objects of any type.

3) Do not expose to direct sunlight.

4) Check whether the battery has sufficient charge every four weeks and if not, recharge the battery.

3.2.11 Risk of fire and explosion

Procedure in case of a fire:

a) Switch off the engine immediately.

b) If possible use a radio to call for help.

c) Turn ignition key to the "0" position and leave the operator's cab at once.

d) Evaluate the situation, only if there is absolutely no risk to your personal safety, you must attempt to fight the fire.

e) Use the fire extinguishers equipped on the crane to fight the fire.

f) Find the seat of the fire. Only spray the seat of the fire from below.

g) While fighting the fire, ask a co-worker to

– Alert the fire department.

– Help with extinguishing the fire by using more fire extinguishers rated for the particular type of fire.

(1) When refueling the crane, an explosive mixture of gases may be created.

(2) Escaping diesel fuel or hydraulic oil may ignite if it comes into contact with a hot surface.

(3) During high-rate charging or discharging, batteries can produce an explosive gas, even an explosion.

Follow these safety instructions and preventive measures:

a) Always know the number and location of every fire extinguisher, and familiarize yourself with how to use them.

b) Always refuel the crane in a well ventilated area.

c) Before filling the fuel tank or the hydraulic tank, the following must be turned off:

   1) The engine

   2) The cab's heater

   3) The auxiliary heating.

d) While filling the fuel tank or the hydraulic tank, smoking and the use of fire or open flames is strictly prohibited.

Figure 3-64 Smoking

Figure 3-65 Fire and open flame

Figure 3-66 Ignition sources/electrical devices

WARNING

Hydraulic oil that is on fire can only be successfully extinguished with a fire extinguisher at the very start of the fire. If not extinguished quickly, the fire will expand into a full-fledged fire resulting in a total loss of the crane.

e) When filling the fuel tank through the filler pipe, electrostatic discharges may occur between the crane and the fuel dispensing system:
   1) Always make sure that there is a good metallic contact between the pump nozzle and the filler pipe.
   2) Or before refueling, create a conductive connection between the crane and the fuel dispensing system.

f) If any fuel has spilled while refueling,
   1) Wipe all excess or spilled fuel off the equipment immediately.
   2) Neutralize any fuel on the ground with bonding agents.

g) After refueling, only start the diesel engine when:
   1) The tank cap which can be locked has been properly replaced on the tank.
   2) The crane has left the area and the suction hose of the refueling system has been removed.
   3) Auxiliary staff is no longer in the vicinity of the crane.

h) Do not use starting auxiliary device containing ether due to the risk of explosion.

i) Do not carry any combustible liquids on the crane, except for the tanks provided for this purpose.

j) Never use any combustible liquids to clean the crane.

k) In the center power unit area:
   – Never store cleaning cloths, rags, etc.
   – Always remove flammable residues and deposits (for example: pools of oil, dry leaves, pine needles, ash, waste paper, etc) regularly.

l) Routinely check that protective covers, cables and hose holders are fitted tightly.

3.2.12 Risk of poisoning and asphyxiation

Symptoms of carbon monoxide poisoning, with increasing intensity:

a) Slight: headaches, short of breath without much exertion, heart palpitations.

b) Medium: tiredness, dizziness and confusion.

c) Serious: impaired judgment, nausea with vomiting, cramps and unconsciousness. Death results from respiratory and circulatory failure.

First aid for initial carbon-monoxide poisoning

When the symptoms of poisoning appear

a) Switch off the crane engine and all fuel driven components.

b) Leave the driver's cab and the site of the machine immediately.

c) Breathe in plenty of fresh air and seek medical attention.

d) Protect yourself: ventilate closed rooms thoroughly before entering if attempting to rescue someone.

Follow these safety instructions and preventive measures:

a) Make sure there is adequate ventilation before operating the machine in an enclosed area.

b) Do not operate the auxiliary heating equipment in an enclosed area.

c) Always wear suitable protective gear when hazardous materials are nearby.

d) If a breathing mask is necessary, wear it at all times and renew the filter elements in time.

WARNING

(1) The engine exhaust gases contain carbon monoxide and other gases that are harmful to the operator's heath. Never operate the engine in a confined or poorly ventilated area.

(2) When the crane is used in areas where there are hazardous materials, such as toxic waste dumps, it is possible for the operator to come into contact with materials and gases that are injurious to health.

CAUTION

Carbon-monoxide gas:

(1) Blocks the intake of oxygen and leads to death by asphyxiation.

(2) Is odorless and colorless gas.

(3) Is heavier than air therefore, does not rise.

3.2.13 Operating near energized lines

If the power to the lines cannot be cut, the most important precaution that can be taken is to maintain the absolute limit of approach.

a) A crane's absolute limit of approach to a power line is a set distance that the operator maintains between the crane, the hook, and the load to the power lines.

b) The absolute limit of approach creates a buffer zone between the crane and the power line. Absolutely NO operation can occur within the prohibited zone if the lines are energized.

3.2.14 Establishing the prohibited zone

Standard safe distances have been established and are based on the voltage of the power lines.

a) Guidelines for safe operating distances vary by state and local regulations.

b) The table below identifies the minimum guideline an operator must maintain between the crane, the hook, and load to the power line.

Table 3-5 Safety distance

Voltage Phase to Phase	Minimum Distance in Meters	Minimum Distance in Feet
750 V -- 75 kV	3m	10ft
75 kV -- 250 kV	4.5m	15ft
250 kV -- 550kV	6m	20ft

3.2.15 Electromagnetic influences

At the site where the equipment is being used:

a) The levels and frequency distribution of electromagnetic radiated noise are usually unknown.

b) The permitted limits stipulated in the EMC standards can be greatly exceeded under certain circumstances. Unusual displays or control system responses are an indication of the electromagnetic disturbance. However, there are no clear, reproducible indicators for electromagnetic disturbance.

WARNING

Operating the equipment near an electrical transmitter, relay or radar station can cause the following:

– **A temporary or even a permanent break down of the control system.**

– **Induce dangerous electrical voltage in the metal parts of the equipment or in the lifted load, which can cause painful electric shocks.**

– **Electronic devices subsequently fitted in the cab (radio telephones, mobile phones, etc.) may also cause the control system to malfunction. Sensitive electronic devices or electronically driven medical implants can also malfunction in the vicinity of the equipment.**

c) The owner of the equipment must employ suitably qualified personnel to localize and eliminate the source of the disturbance.

Always adhere to the following safety instructions and protective measures:

a) People with pacemakers are prohibited from being in the vicinity of the equipment if optional and supplementary devices are installed that are generating strong electromagnetic fields.

b) No additional devices can be installed in the switch cabinet of the control system without prior written consent of the manufacturer.

c) Mobile phones with an output greater than 2 watts can only be used if they are at least 2 meters away from the switch cabinet.

d) Never lay the cables for radio, telephones, etc. parallel to the control cables in the cab.

CAUTION

The manufacturer:

(1) Has the required specific knowledge to effectively eliminate the disturbances.

(2) On request, undertake the required screening measures for the equipment.

3.2.16 Endangering the environment

These safety instructions and precautionary measures must always be followed:

a) Repair all leaks on the equipment immediately.

b) Neutralize escaped hydraulic and lubricating oils and fuel immediately with a binding agent.

c) Always comply with state and local environmental regulations before disposing of fuels and lubricants.

d) Use only adequate containers when draining fluids, that do not leak and are resistant to oil, fuel, and chemicals.

e) Always use approved safety containers to properly collect and dispose of the fuels and lubricants.

Fuels, oils, cleaning agents and similar liquids damage and pollute the environment if they get into the ground, into water or into the sewer system.

3.3 Rigging

3.3.1 Rigging introduction

The care and the attention to the rigging is a fundamental part of the operation safety:

a) Perform frequent and periodic inspections of the rigging hardware, wire rope, and slings.
b) A written equipment record must be kept monthly. Reviewing the history can provide vital information, for example, reveal a faster than normal wear that can be attributed to defects in the crane.
c) Remove from service rigging equipment that has been damaged.
d) Inspect rigging accessories before each shift.
e) Determine the weight of the load and choose the appropriate equipment.

3.3.2 Rigging Hardware

The strength and the integrity of the rigging hardware is another fundamental part of the safe lifting operations.

To maintain rigging hardware, frequent and periodic inspections are required.

3.3.3 Hooks

Use:

a) The hook must be selected to work with the cable, the chain, or the strap used in the lifting device.
b) The hook needs to be sized correctly so that it holds the load securely.

Types:

a) There are many types of hooks available from multiple manufacturers.
b) Hooks must be made of forged steel and equipped with safety latches.

Capacity:

a) Hooks are rated at maximum capacity for straight pulls and lose capacity when side loaded.
b) The WLL for a hook used in the manner for which it is intended must be equal to or exceed the rated load of the chain, the wire rope, or other suspension member to which it is attached.
c) The designed WLL applies only when the load is applied to the bowl or saddle of the hook.
d) The manufacturer's identification must be forged or die stamped on a low-stress and non-wearing area of the hook.

Safe Operation:

a) Do not side load hooks.
b) Force can cause failure on the safety latch.

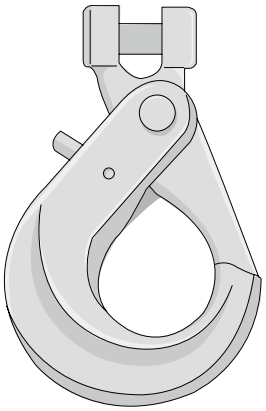


Figure 3-67 Hook

3.4 Slings

3.4.1 Slings introduction

The predominant characteristics of a sling are determined by the components of that sling.

a) For example, the strengths and the weaknesses of a wire rope are essentially the same as the strengths and the weaknesses of the wire rope from which it is made.

b) Slings are generally one of the following six types:
   1) Chain
   2) Wire rope
   3) Metal mesh
   4) Natural fiber rope
   5) Synthetic fiber rope
   6) Synthetic web

c) Usage and inspection procedures tend to place these slings into three groups with each type having its own particular advantages and disadvantages:
   1) Chain
   2) Wire and mesh rope
   3) Fiber rope and fiber web rope

d) Factors that must be taken into consideration when choosing the best sling for the job include:
   1) Size
   2) Weight
   3) Shape
   4) Temperature
   5) Sensitivity of the material to be moved
   6) Environmental conditions that the sling will be used

3.4.2 Sling identification tags

a) All slings should be labeled with identification tags.

b) The Information required to be on the identification tags is as follows:
   1) Manufacturer's name or trademark
   2) Diameter or size of the sling
   3) Material of the sling
   4) Rated load for the types of hitches used
   5) Lift angle the load rating is based

c) The minimum design (safety) coefficient of sling is 5:1.

3.5 Chain Hitches

Below are some common chain hitch configurations.

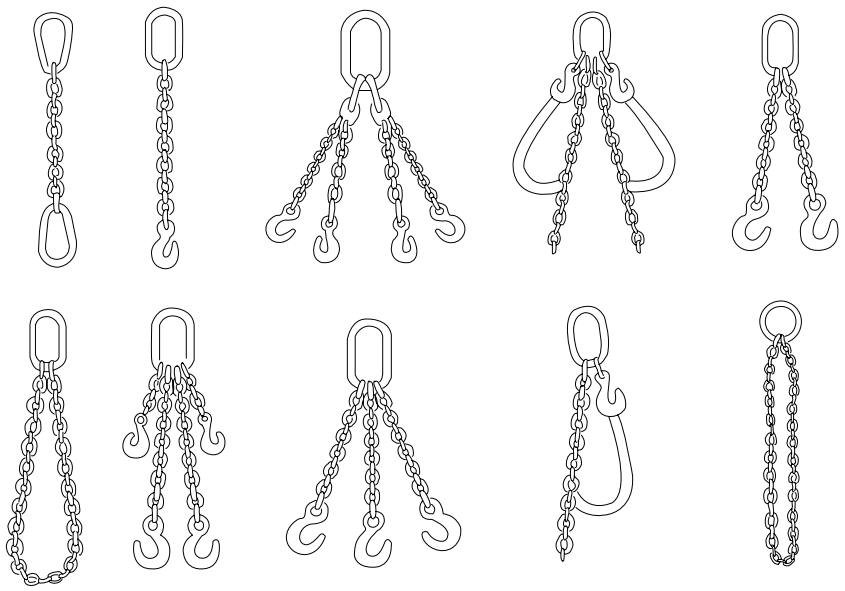


Figure 3-68 Chain Hitches

3.5.1 Sling hitches

The three primary hitches can be used to multiple configurations to further support and stabilize the load. Some common ones are listed below.

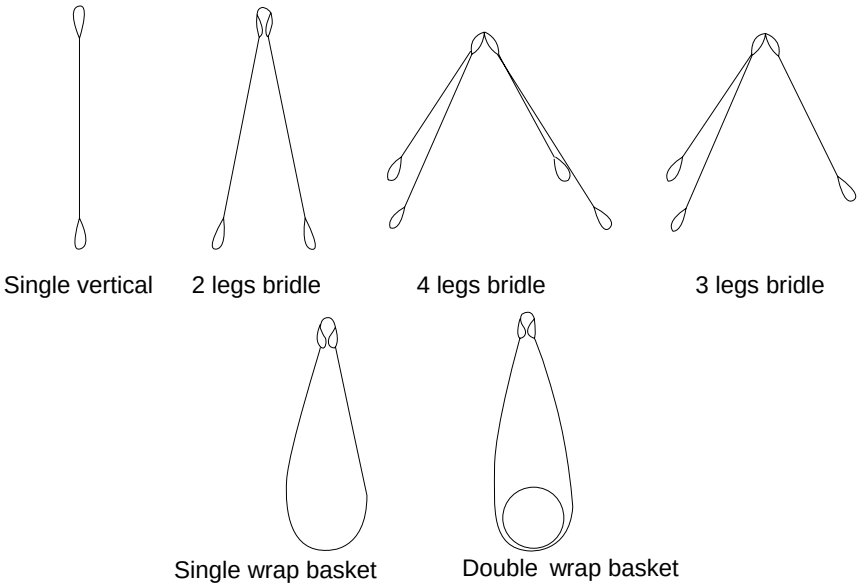


Figure 3-69 Sling hitches configuration

3.5.2 Angle of choke

The angle used on the choke hitch will affect the sling capacity. Refer to figure 3-70 and table 3-6.

Table 3-6 Angle of choke and lifting capacity

Angle of choke	Sling rated capacity (%)
90° - 120°	87
60° - 90°	74
30° - 60°	62
0° - 30°	49

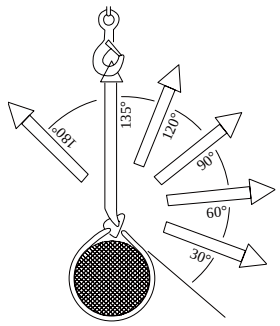


Figure 3-70 Angle of choke

3.5.3 D/d ratio

a) Depending on the hitch used, wire rope capacity will experience an efficiency loss when bent.

b) To determine the D/d ratio, distinguish the diameter of the wire rope and the diameter of the load (see the following figure).

c) A good rule to follow is to keep at least a 6:1 ratio which results in an 80% efficiency of the sling.

d) A 1:1 ratio results in only a 50% efficiency of the sling and cannot be used.

Table 3-7 D/d ratio

D/d ratio	Efficiency (%)
40	95
30	93
20	92
15	89
10	86
8	83

D/d ratio	Efficiency (%)
4	75
2	65
1	50
Never permit the D/d ratio is less than 1.	

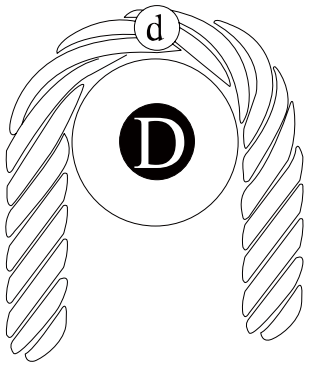


Figure 3-71 D/d ratio

3.5.4 Load angle factor

Increasing the number of sling legs on a load helps ensure better control of the load and helps distribute the weight of the load among more slings legs.

Slings are at their greatest strength on a straight pull (refer to Figure 3-72). By having the slings pull at an angle, added stress is placed on the sling. The capacity of a multiple leg sling is directly affected by the angle of the sling leg with the vertical. As the angle formed by the sling leg and the horizontal line decreases, the rated capacity of the sling also decreases (see the following Figure 3-72).

The smaller the angle between the sling leg and the horizontal is, the greater the stress on the sling leg and the smaller or lighter the load will be, which the sling can safely support. The smaller the angle is, the greater bending forces are imposed on the load will be.

The capacity can be readily determined by multiplying the sling's vertical capacity by the appropriate load angle factor.

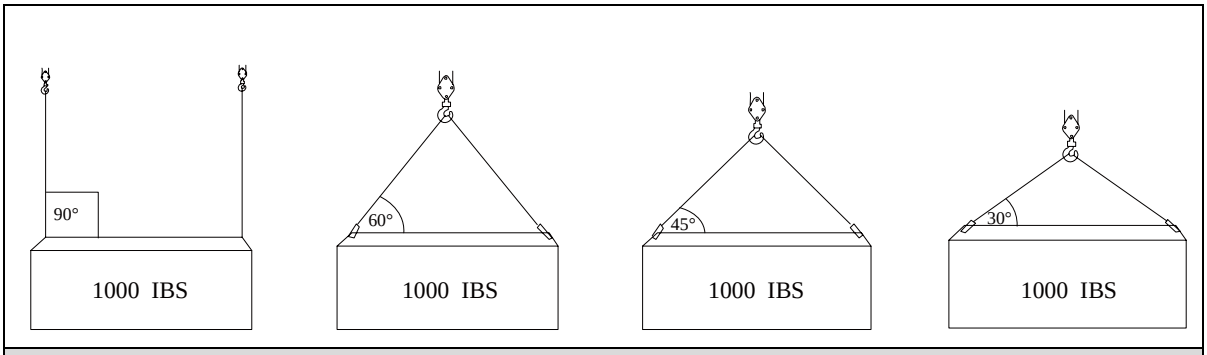


Figure 3-72 Load angle factor

3.5.5 Load share

For symmetrical loads with 2 legs:

To calculate the load for each sling leg, use the following formula:

a) Length(L) ÷Height(H) = Load angle factor

b) Multiple the load angle factor by the load weight.

c) Divide the answer by the number of legs.

d) This equals the load share of each sling leg.

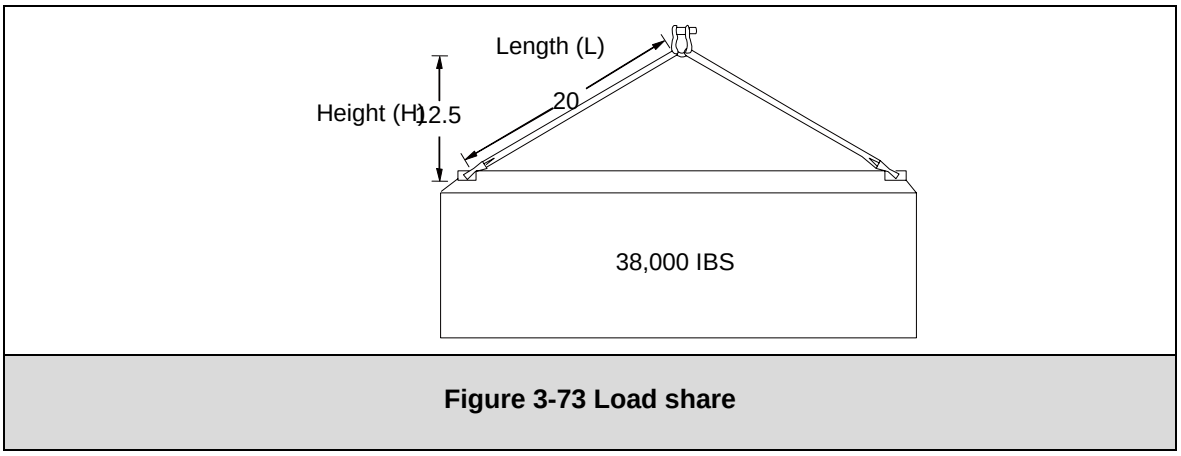


Figure 3-73 Load share

3.5.6 Load angle factor chart

When the load angle factor (LAF) has been determined, refer to the table 3-8 listing the corresponding sling angles measured in degrees. All safety standards recommend safe lifting angles to be 60° or more, and do not recommend angles lower than 45°.

Table 3-8 Load angle factor

Sling angle	Load angle factor
90°	1.000
85°	1.004
80°	1.015
75°	1.035
70°	1.064
65°	1.104
60°	1.155
55°	1.221
50°	1.305
45°	1.414
The following angles are not permitted during lifting process.	
40°	1.555
35°	1.742
30°	2.000
25°	2.364
20°	2.924
15°	3.861
10°	5.750
5°	11.49

3.5.7 Sling safety

a) Before making a lift, check to be certain that the sling is properly secured around the load and that the weight and balance of the load have been accurately determined. If the load is on the ground, do not allow the load to drag along the ground. This could damage the sling.

b) Position the hook directly over the load and seat the sling squarely within the hook bowl. This gives the operator maximum lifting efficiency without stressing the sling.

c) Make sure that the load is not lagged, clamped, or bolted to the floor.

d) Guard against shock on the load by pulling the slack sling straight slowly.

e) Apply power cautiously so as to prevent jerking at the beginning of the lift, and accelerate or decelerate slowly.

f) Check the tension on the sling. Raise the load a few inches, stop, and check for proper balance and that all items are clear of the path of travel. Never allow anyone to ride on the hook or load.

g) Keep all personnel informed while the load is being raised, moved, or lowered. The crane operator and rigger should watch the load at all times when it is in motion.

CAUTION

Never allow anyone to ride on the hook or load.

3.5.8 Sling safety guide

a) Sling must not be shortened with knots, or other makeshift devices.

b) Sling legs cannot be kinked.

c) Slings cannot be loaded in excess of their rated capacities.

d) Slings used in a basket hitch can have the loads balanced to prevent slippage.

e) Slings must be securely attached to their loads.

f) Slings must be padded or protected from the sharp edges of their loads.

g) Suspended loads must be kept clear of all obstructions.

h) All employees must be kept clear of loads that is about to be lifted and of suspended loads.

i) Hands or fingers cannot be placed between the sling and its load while the sling is being tightened around the load.

j) Do not impact on the load.

k) A sling cannot be pulled under a load when the load is resting on the ground.

3.5.9 Taglines

The safest method for a rigger to control a load suspended from a hook is with a tagline. (See the following figure)

a) Taglines are used to control load spin.

b) Keep the tagline away from the center of gravity.

c) Never wrap the tagline around your body or any limbs.

d) The rigger shall stand at the back of the load and never stand directly underneath a load.

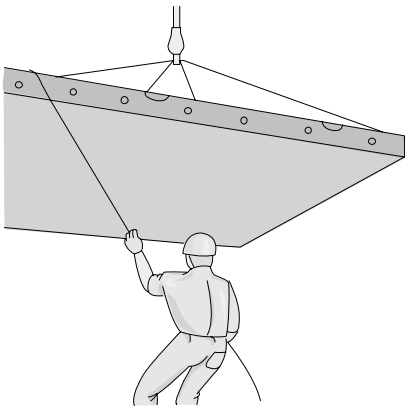


Figure 3-74 Control the Tagline

3.5.10 Load center of gravity

a) The center of gravity of an object is the point at which the weight of the object acts as though it were concentrated. It is the point at which the object may be completely supported or balanced by a single force.

b) The center of gravity of a regularly shaped object may be estimated fairly accurately by determining its approximate center.

c) Finding the center of gravity of irregularly-shaped objects can be more difficult, but it is necessary. A load will always hang from its attachment point through the center of gravity. It is important to visualize this before making a lift.

d) All loads to be lifted must be rigged above the center of gravity in order to prevent tipping and possible hazards to equipment and workers. The lifting force must always be located above the center of gravity and exert a straight vertical pull to prevent swinging of the load.

e) In all crane lifts, the center of gravity must remain below the hook and below the point of attachment for any rigging.

f) A center of gravity above the hook is unstable and will cause the load to flip as the load will attempt to 'find' the center of gravity. Similarly, loads which are not balanced horizontally can slip from the rigging.

g) The overall stability of the load is a combination of balance with respect to center of gravity, distribution of weight, and proper rigging practices.

3.5.11 Sling hook up center of gravity

a) The Center of Gravity (CG) will do at least two things when suspended.
   1) Move directly below the point of support.
   2) Move to the lowest point possible.

b) Attach the slings above the Center of Gravity of the load. If this is not possible, stabilize the load and keep the center of gravity contained with three or more sling legs.

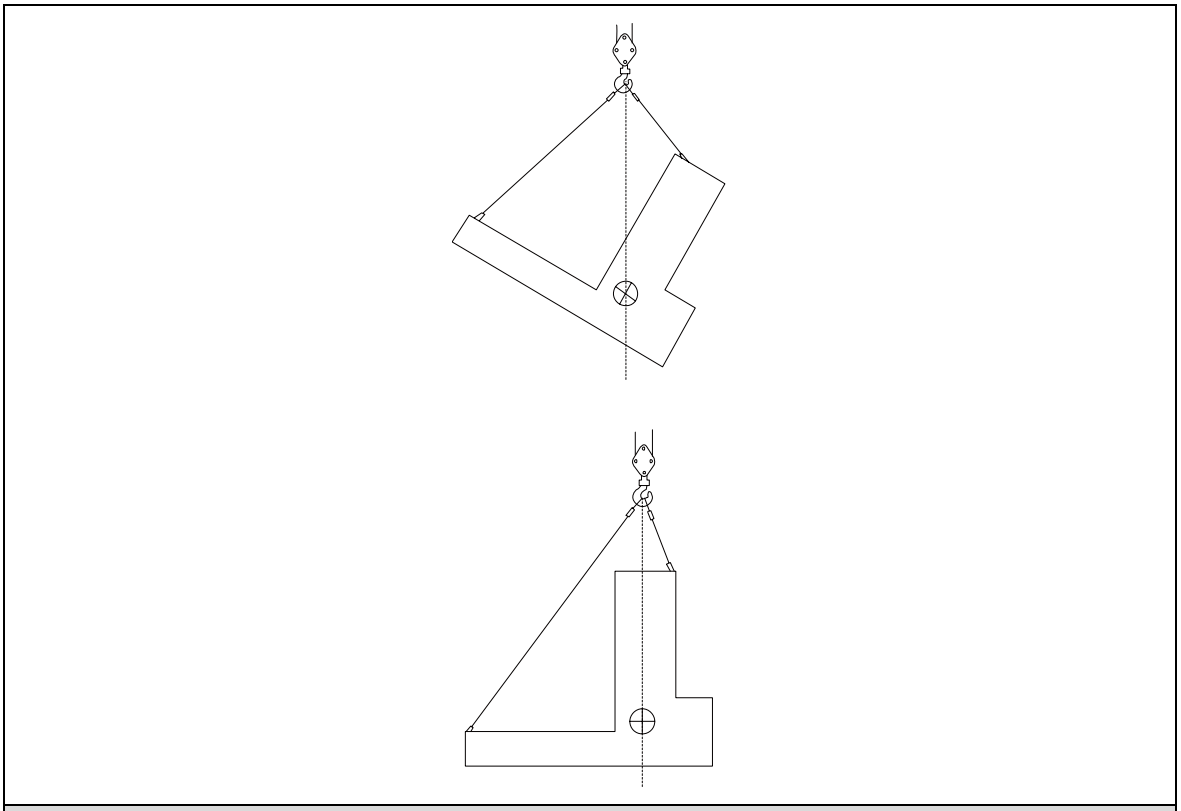


Figure 3-75 Sling Hook Up Center of Gravity

3.5.12 Estimating weights

a) Acceptable methods of determining weight:
   1) Data on manufacturing label plates
   2) Manufacturer's documentation
   3) Blueprints or drawings
   4) Shipping receipts
   5) Weigh the item
   6) Stamped or written on the load
   7) Approved calculations.

CAUTION

Never take someone's word to establish the weight of an item.

3.6 Ground conditions

3.6.1 Bearing pressure

When a crane is sitting on its supporting surface, the weight of the crane causes pressure on the ground. Pressure is exerted through its outriggers or through its tracks to the ground. How much pressure it exerts depends on the type of crane, the crane configuration, and the quadrant of operation of the working crane.

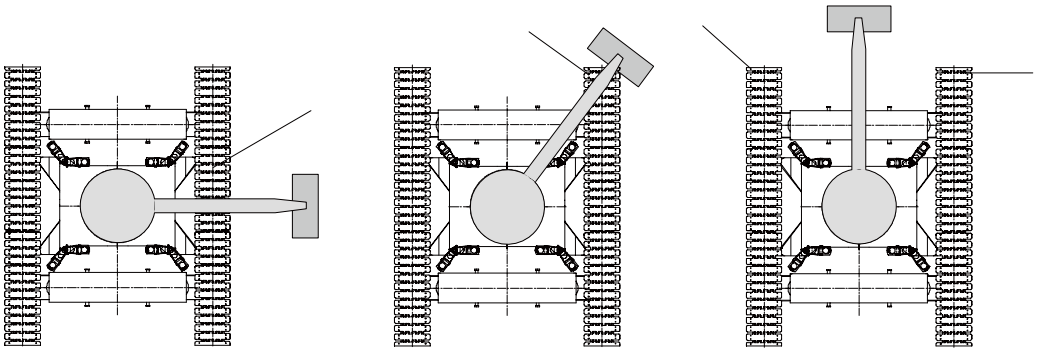


Figure 3-76 Load bearing capacity

3.7 Snow and ice

CAUTION

(1) Danger of accidents (due to chunks of ice breaking off and falling down).

(2) Increased danger of damage due to frozen height limit switches on main boom and jib.

Precautions:

– **Lay down the boom and carefully knock off the ice that has collected.**

– **Carefully remove the ice from all sensitive parts, such as limit switches, guides, etc.**

CAUTION

Snow and ice deposits on the boom:

(1) Increase the boom weight

(2) Increase the surface area the wind blows on.

These factors can lead to a premature shutdown of the movement of the crane. Work can continue, but definitely not at the maximum permitted load.

CAUTION

The load moment limiter (usually abbreviated to LMI)

(1) Must only be triggered in an emergency.

(2) Cannot be used in normal operations as a device shutting down the crane.

(3) Is not a substitute for judgment of the crane operator.

3.8 Lightning strikes

Inside the enclosed cab, the crane operator is well protected against the direct effects of lightning strikes. The cab can deflect the lightning strike over the entire unit.

If the working site is attacked by windstorm frequently or the operation range is limited, the operator is liable to put down the boom. When to lay down the main boom is a matter of opinion and is the responsibility of the crane operator, when in doubt, always lower the main boom.

It's the manufacturer's recommendation that the main boom should be laid down promptly when a storm is approaching.

Measures to take after observing or suspecting a lightning strike on the crane:

a) Thoroughly check the crane, check for any damaged cables or lines for leaks.
b) Check the entire control system.
c) Slowly move the slewing gear and listen for unusual noises in the rotary connection, especially in the slewing ring.
d) Lay down the boom and examine for damage, repair damage to the paint work at the point where the lightning struck.

When lightning strikes the crane, there is danger of serious injury or even death to all personnel in the immediate vicinity.

Precautions:

- **Lay down the boom of the crane before the storm begins.**
- **During the storm, do not go near the crane or any large metallic objects.**

A lightning strike can cause extensive damage to the crane, including:

- **Total failure of the control system.**
- **Damage to local welding spots or bearings on the rotary connection between the upper and lower carriages.**

3.9 Overhead power lines

Precautions:

Keep a safe distance from the overhead power lines as specified in national guidelines or by the authority responsible for the power lines.

If it is not possible to keep a safe distance from the overhead power lines, then the technicians of the local power company must either:

a) Turn off the power lines and ground them.

b) Divert the power lines around the site where the crane will be erected.

a) Run power cables underground through the site.

If it is not possible to keep a safe distance from the overhead power line and none of above actions is possible:

Barriers must be used to restrict the working area of the equipment in order to maintain a safe distance from the power line.

CAUTION

If the equipment touches a high voltage power line it could cause a fatal electric shock:

(1) For the equipment operator

(2) To anyone who touches the equipment, the hoisting rope or the load

(3) For everyone in the vicinity of the equipment.

The following safe distances from overhead power lines are to be maintained when operating the equipment:

Table 3-9 Safe distances from overhead power lines when operating the equipment

Nominal supply voltage (phase to phase)	Minimum distance (m)
≤50 kV (50000 volts)	3.1
50 kV - 200 KV	4.6
200 kV - 350 kV	6.1
350 kV - 500 kV	7.6
500 kV - 750 kV	10.7
750kV - 1000 kV	13.7

The following safe distances from overhead power lines are applicable during transportation or if the equipment drives on its own:

Table 3-10 Safe distances from overhead power lines when transporting the equipment

Nominal supply voltage (phase to phase)	Minimum distance (m)
≤ 750 V	1.2
750V - 50 kV	1.8
50V - 345 kV	3.1
345V - 750 kV	4.9
750V - 1000 kV	6.1

Prerequisite:

– The equipment is not carrying a load and the main boom is lowered or disassembled.

How do you find the nominal supply voltage of an overhead power line?

Certain characteristic can be used to make preliminary estimates:

Table 3-11 Characteristics of overhead power lines

Network level and nominal voltage	Low voltage supply up to 1000 V	Medium voltage supply from 1000 V up to 30 kV	High voltage supply over 30 kV
A-frame 1 form	Wooden	Mostly wooden A-frame 1, occasionally concrete or steel lattice towers	Mostly steel lattice towers or concrete A-frame 1
A-frame 1 distances	40 - 60 m	50 -100 m	200 - 400 m
Number of overhead conductors	4 or 5	3 or 6	2 or 4, or a multiple of 2
Insulators	Small (approximately a fist-sized)	Large (approximately a head-sized)	Insulator chains or stabilizers
Conductor routing	To houses and buildings	To transformer stations and electricity generating stations	To power companies, transformer substations or railway systems

CAUTION

Only the relevant power company can give the nominal voltage of an overhead power line.

Measures to take while planning the operation:

a) Always inform the relevant authorities and the power company.
b) With the competent person from the power company, discuss:
   1) The planned application
   2) The safe distance to be maintained
   3) The required safety devices.
c) All workers on the site are to be informed of the danger.
d) Set the exact procedure of how the main boom of the equipment will be raised and lowered without infringing the safe distance from the overhead power lines.

Safety precautions and protective measures when operating the equipment near overhead power lines:

a) Only start work once the work area has been checked and approved by the authorized personnel from the power company.
b) Even after it has been shut down, the power line has to be regarded as going live with voltage.
c) No one should remain in the vicinity of the equipment except the operator.
d) If the use of a signal person is the only safety measure that can be adopted when working in the vicinity of power lines, this is only acceptable for very short periods of operation. The signal person observes the equipment from a position that he has a clear all-round view and must be able to contact the operator each time the equipment comes dangerously close to the power line.
e) Never remove, shift, or cross any barriers, markers, etc., that are delimiting the working area of the equipment until the work is totally complete.

What happens if you get too close to an overhead power line?

With low voltage power lines (up to 1000 V), an over spill to the equipment will only occur if it touches the power line.

With high voltage power lines, a flashover with the formation of an electric arc will occur as soon as the equipment encroaches within a certain distance.

When a flashover occurs, flammable material, for example the hoisting load, could spontaneously combust, the equipment might catch fire.

Short circuit

When a short circuit occurs, the equipment comes into contact with at least two different conductor cables of a power line. This can apply a hazardous voltage to the equipment.

Grounding fault

If the equipment only touches one conducting cable or if a flashover occurs from a single conducting cable

a) An grounding fault results
b) Current flows over the equipment into the ground and returns to the source of voltage
c) A hazardous voltage is applied to the equipment
d) With high voltage, a hazardous resistance area also forms around the equipment.

CAUTION

Even if a conductor cable from an overhead high voltage power line has been torn down and is lying on the ground, the grounding fault with the formation of a resistance area still occurs. On the other hand, a grounding fault on a low voltage power line does not create a hazardous resistance area around the equipment.

DANGER

The safety devices of the various national electrical networks react differently in the event of a fault. It cannot be assumed that there will be an automatic and lasting shut-down of the power lines after a short-circuit or grounding fault.

The equipment or a torn down conductor cable can therefore still be under hazardous voltage levels and form a resistance area even if there is no flashover, smoke formation or crackling noises.

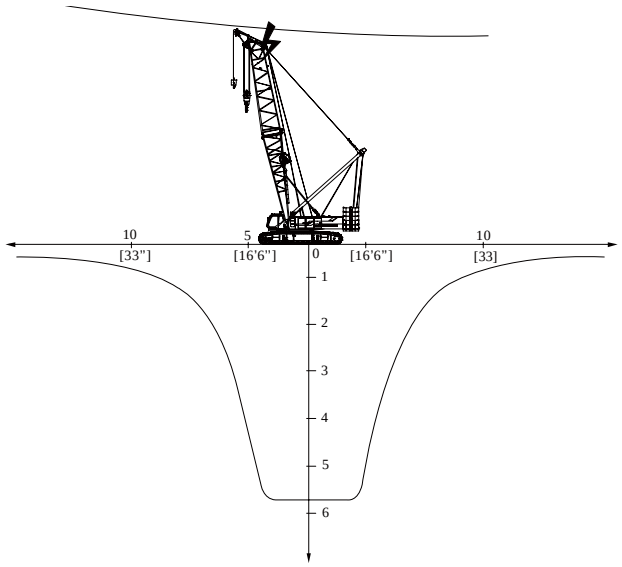


Figure 3-77 Resistance area during a grounding fault

During a grounding fault, the electrical shock is distributed from the point it enters the ground. The high voltage decreases along a funnel-shaped curve - a resistance area is formed.

The extent of the resistance area depends on the voltage, the current intensity and the ground resistance.

If someone is within the resistance area, a voltage difference, known as the step voltage, forms between his feet.

The step voltage is higher:

a) The closer the person is to the ground fault.

b) The greater is the step.

Depending on the insulating properties of his shoes, an electrical shock is created above a certain step voltage. If the person falls to the ground, a potential difference is formed immediately along his body, surpassing the level of the step voltage - a life threatening electrical shock flows through his body.

What must an equipment operator do in the event of a flashover or if a conductor cable is touched?

a) Remain calm, do not panic.

b) Do not leave the driver's cab. The driver's cab is relatively safe, unless there is an electrical disruptive discharge into the driver's cab or the equipment catches fire.

c) If the controls are still functioning, initiate travel in the opposite direction immediately and move the equipment out of the danger area:
   1) Swing the upper carriage away or move the boom and activate the travelling gear.
   2) Only stop the equipment when:
      – The prescribed safe distance from the overhead power line has been reached.
      – There is a distance of at least 10 m (33 ft) between it and any torn conductor cable lying on the ground.
   3) Inform the competent power company of the accident. Secure the area around any torn down conductor cable to prevent anyone going near it, fence off an area with a radius of 10 m (33 ft).
   4) Thoroughly inspect the equipment before resuming operation.

d) If the controls no longer functions, use the radio or call:
   1) To everyone in the vicinity not to come any close, touch the equipment, or any torn down conductor cables. Inform them to keep at least 10 m (33 ft) back from the danger zone.
   2) The relevant power company must cut the power to the power lines.

A flashover from the power line creates an electric arc which can expand considerably when the equipment is removed.

Even in such cases, continue moving the equipment away from the danger zone until the electric arc is extinguished and the prescribed safe distance away from the power line has been re-established.

Even power lines that appear to be turned off can be started again manually, or by automatic safety devices, for fault detection purposes.

Only leave the driver's cab if you have reliable confirmation that the power line has been turned off.

Leaving the equipment in an emergency:

The procedure for leaving the equipment in an emergency differs depending on whether the accident involved a low or high voltage power line.

In the case of a low voltage line, the danger is in touching parts of the equipment (including the hoisting rope, hoisting load, etc.), that are under voltage or a torn down conductor cable while at the same time being in contact with the ground.

In the case of a high voltage line, as well as the danger of touching parts of the equipment that are under voltage or a torn down conductor cable, there is an additional danger caused by the resistance area that forms around the equipment.

Procedure for low voltage incidents:

a) Jump away from the equipment, landing on both feet at the same time.
b) Jump in a direction that avoids any contact with metal objects that are touching the equipment or a power line cable.
c) When leaving the danger zone, avoid any contact with metal objects.

Procedure for high voltage incidents:

a) Jump away from the equipment, landing on both feet at the same time.
b) Jump in a direction that avoids any contact with metal objects that are touching the equipment or a power line cable.
c) Land with both feet close together to avoid exposing yourself to a dangerous step voltage.
d) Leave the resistance area: With legs pressed together, jump along on both legs until you reach the minimum safe distance of 10 m (33 ft) from the equipment.
e) While jumping away, keep well clear of any metal objects within the danger zone.

When you leave the equipment in an emergency, you are putting your life at risk:

(1) Touching the equipment and the ground at the same time will be fatal.

(2) Remaining within line resistance area is life-threatening.

Only leave the equipment if there is imminent danger to your life through flashover or fire.

When in doubt, leave the equipment as if there had been an accident involving a high voltage power line.

Instead of jumping, you can also leave the danger zone by pressing your knees together and taking small steps.

Your shoes must:

– **Always rub against each other to remain in contact with each other.**
– **Never leave the ground completely.**

What must be observed when rescuing persons in danger?

WARNING

Before any rescue attempt, find out from the person in danger what voltage the power line involved in the accident is carrying.

The measures taken during the rescue differ significantly depending on whether it is a low voltage (to 1000 V) or high voltage incident.

First aid measures following an accident involving low voltage power lines.

a) Immediately notify rescue service or fire department of the following:
   1) An electrical accident involving a low voltage power line
   2) The location of the accident
   3) The circumstances of the accident
   4) The number of injured persons
   5) Your name and telephone number.

b) Notify the relevant power company if this has not already been done by the rescue service or fire department:
   1) Inform them of the exact location of the accident.
   2) Arrange for the power lines to be switched off.
   3) Request the assistance of trained personnel from the power company.
   4) Ensure that they at least phone you back to confirm that the power lines have been turned off.

c) Secure the scene of the accident, and do not allow access to any unauthorized persons.

d) When rescuing injured person(s), obey the self-protection measures described below.

WARNING

A person injured by electricity may be still charged with a dangerous amount of voltage. Do not touch an injured person directly during rescue.

CAUTION

A dangerous resistance area does not form when low voltages are involved. Accessing the scene of the accident and rescuing injured persons is therefore possible before the power lines have been turned off.

Procedures

a) Find a piece of insulating material for self-protection: dry clothing, rubber gloves, plastic bag, dry wood, etc.

b) Approach the injured person cautiously, keep clear of all metal objects at the scene of the accident.

c) Use the insulated material to pull the injured person away from the live object, avoiding any direct contact with it.

d) Only after the contact with the live object has been broken is it safe to touch the injured person and to move him from the scene of the accident.

e) Administer first aid until the rescue services or the emergency doctor arrives.

CAUTION

Always seek medical attention immediately after every powerful electrical contact, even if there are no noticeable injuries or side effects.

First aid measures for an accident involving high voltage power lines

a) Immediately notify the rescue service or the fire department of the following:
   1) An electrical accident involving a high voltage power line
   2) The location of the accident
   3) The circumstances of the accident
   4) The number of injured persons
   5) Your name and telephone number.

b) Notify the relevant power company if this has not already been done by the rescue service or fire department:
   1) Inform them of the exact location of the accident.
   2) Arrange for the power lines to be switched off.
   3) Request the assistance of trained personnel from the power company.
   4) Clarify how you are to receive confirmation from the power company that the power lines have been turn off by a trained personnel from the power company at the scene of the accident or by a return phone call.

c) Secure the scene of the accident by erecting barriers, cordons, etc. with a radius of 10 m [33 ft]. Do not allow access to any unauthorized persons.

WARNING

Your life is at risk from electric shock when you enter the scene of the accident. If a ground fault occurs, a dangerous resistance area forms around the center of the accident. Following a short circuit, a power line that appears to be turned off could be turned back on again briefly for fault detection purposes.

CAUTION

Do not rush into a rescue situation.

b) Rescue injured persons:

1) Only after the power line has been confirmed to be shut down.

2) If possible under supervision of a trained personnel from the relevant power company.

c) Administer first aid until the rescue services or the emergency paramedics arrive.

DANGER

In the case of accidents involving high voltages, the lives of injured persons are often acutely at risk from respiratory and circulation failure.

Following the accident, begin first-aid immediately, such as CPR.

3.10 Underground cables

With special equipment, the equipment can also be used for underground working.

With underground working, it is possible to damage:

a) Underground electric cables
b) Gas pipes
c) Telephone, TV, and data cables
d) Sewage pipes, district heating supply, etc.

If a live underground cable is damaged, lives are at risk from electric shock.

There is an extreme danger of explosion and fire in the vicinity of a damaged gas pipe.

Measures to be taken during operational planning:

The construction company doing the work is responsible for gathering accurate information about possible underground cables within the working area of the equipment so that work can be done safely:

a) Obtain the relevant information from the relevant utility companies.
b) Examine the "as completed" plans of:
    1) Utility companies (electricity, gas or water)
    2) Cable users (telephone companies, factories, transport companies)
    3) Building authorities.
c) Only use the latest, up-to-date plans.
d) If there are any deviations or extensions to a project, initiate new inquiries.
e) If in doubt, localize the underground cables around the site using a locating device via search slots or test digs.
f) The relevant utility companies, cable users and public authorities:
    – Must be informed in good time about the start of the work.
    – Must be asked for written approval for the civil engineering work to be done.
g) When several construction companies are involved, their activities must be coordinated. All companies must have the same up-to-date information on underground pipes, etc. on the construction site.

Safety precautions and protective measures when operating the equipment near underground cables

a) Do not start work until you have obtained all the approvals from the utility companies and the cable users.
b) The equipment operator must obtain all relevant information about the exact location of all underground cables before starting work. These plans must be readily accessible at the construction site.

c) Operate the equipment with particular care near underground cables, all applicable national safety guidelines as well as the special guidelines and safety measures of the utility companies must be noted and obeyed.

d) In the event of any unexpected encounters with underground cables or associated warning tapes and protective coverings, cease working with the equipment immediately and inform the appropriate superiors.

e) It is prohibited to uncover underground cables with the equipment, the underground cables must only be uncovered manually by blunt tools.

f) Secure, support, or prop up all exposed underground cables so that they cannot sway, slide, or become deformed.

g) Stabilize the cable ducts and trenches and secure the edges to prevent caving.

What is to be noted in connection with gas pipes?

a) Whenever the position of the gas pipe casing changes or the casing is damaged, report this to the appropriate gas company. The gas pipe can only be backfilled after inspection, repair, and approval by specialist personnel from the gas company.

b) All devices of the gas supply network around the site must remain accessible (fittings, valve boxes, manhole covers, etc.). Existing markings and information signs must not be covered, rearranged or removed.

What happens if a gas pipe is damaged?

The escaping gas:

a) Forms an inflammable gas-air mixture around the affected area.

b) Can strike personnel or equipment if escaping from gas supply pipes under high pressure.

c) Not only endangers personnel and equipment on the site, but also passers-by and residents in the neighborhood. A gas fire can develop in seconds and spread explosively. In a conventional supply pipe with a leak of 50 mm (2"), for example, the flames can be up to 10 m (33 ft) high if the gas is escaping at a pressure of 1 bar (14.5 psi). The equipment and surrounding construction equipment will quickly be burnt.

   Even a minor change in position of the gas pipe can result in damage to other sensitive points of the gas network, for example connection points or house feeder pipes. Leaks and small leaks that are not immediately detectable are very dangerous if gas is allowed to escape over a lengthy period of time and penetrates along the gas pipe network into the surrounding buildings. An explosive gas-air mixture is formed considerably quicker in enclosed areas than in the open air. Every source of ignition, such as On/Off switches on electrical equipment or the turning on of a light, can trigger an explosion.

   Corrosion can cause leaks to form within 5 -10 years of minor damage to the casings of metal gas pipes.

What must the equipment operator do if a gas pipe is damaged and gas escapes, or a leak is suspected?

a) Stop work immediately.
b) Leave the equipment after shutting down the engine and all additional fuel powered units.
c) Alert all site personnel, avoid producing any sparks and maintain a strict no-smoking policy.
d) Shut down all construction equipment and the vehicle engines in the immediate vicinity.
e) Clear the danger area and secure a wide area with barriers. Do not allow access by an unauthorized personnel.
f) Inform the relevant gas company of the following:
   1) The extent of the damage
   2) The exact location of the site
   3) The exact circumstances of the accident
   4) How long ago the accident occurred
   5) A name and telephone number for a return call.
g) If there is the slightest suspicion that gas can leak into a building, alert the local occupants by knocking or calling. Do not ring the door bell or call them by telephone, as this may trigger an explosion.
   If the odor of gas is present in the building, especially around the area where the gas pipe is known to enter the house; do not operate any electrical systems or equipment. Open all doors and windows widely for ventilation purposes and leave the building immediately.
h) In the event of major damage, evacuate the occupants of all the surrounding buildings with the cooperation of the police or fire department.
i) Building site personnel:
   1) Must assist all specialist personnel from the gas company during the repair work.
   2) Can only leave the building site with the consent of the specialist personnel.
j) Work on the building site can only begin again if authorization has been given by the relevant gas company.

What do you do in the event of a gas fire?

Extinguishing a gas fire requires specialist knowledge.
A gas fire that has already been extinguished can flare up again if more gas escapes and breaks out in an unexpected spot.
Precautions:
(1) Alert the local fire brigade to fight the fire.
(2) Do not attempt to put out the fire before the fire brigade arrives unless lives are in danger or there is risk of major damage to property.
(3) If the gas fire is not causing any immediate danger, it is sometimes better, in certain circumstances, to let the gas burn. As soon as the gas company shuts off the gas pipe, the fire will extinguish itself.

What should be noted in connection with underground electric cables?

a) For excavation work, observe the nationally prescribed minimum distance from the underground cable (at least 1 m [3'4"]).

b) Even minor damage to the outer casing of an underground cable must be reported to the relevant power company. If dampness is allowed to penetrate, the cable will fail in the future. The location of such a fault is to be precisely measured to establish who or what caused the damage.

What happens if the equipment damages an underground cable?

a) After it: has penetrated the insulation, the equipment can become charged with a dangerously high voltage.

b) If an underground cable is sheared, burn-out at the fault location with strong electrical arcing may occur.

c) If a high-voltage power cable becomes damaged, a hazardous resistance area may form around the fault location.

WARNING

The safety devices of the various national electrical networks react differently in the event of a fault. Therefore it cannot be assumed that there will be an automatic and lasting shut-down following damage to an underground cable.

The equipment and the damaged underground cable can still be under hazardous voltage levels and form a resistance area, even if there are no flashover, smoke formation or cracking noises.

What must the operator do if the equipment damages an underground cable?

a) First, remain calm - do not panic.

b) Do not leave the driver's cab.

c) If the controls are still functioning:

   1) Initiate travel in the opposite direction immediately and break contact with the underground cable.

   2) Then drive the equipment out of the danger area.

   3) Only stop the equipment once the distance from the fault location is:

      – At least 5 m (17 ft) in the case of a low-voltage cable (up to 1000 V)

      – At least 10 m ([33 ft) in the case of a high-voltage cable, or if uncertain about the voltage of the underground cable.

   4) Inform the relevant power company of the accident. Prevent access to the area around the fault location:

      – Fence off an area with a radius of 10 m (33 ft).

   5) Thoroughly inspect the equipment before resuming operation.

d) If the control no longer functions, use the radio or call:

1) To everyone in the vicinity not to come any closer or touch the equipment, the hoisting rope or load and tell them to keep at least 10 m (33 ft) from the danger zone.

2) To arrange for the power lines to be turned off by the relevant power company.

⚠ DANGER

Even an underground cable that appears to be turned off can be started again manually or by automatic safety devices, for fault detection purposes.

⚠ CAUTION

Only leave the driver's cab if you have reliable confirmation that the underground cable has been turned off.

3.11 Crane operation with a load

Before beginning any work, the crane operator must be convinced that the crane is in safe operating condition. All safety devices, such as load moment limiter, lowering limiter switches, brakes, limit switches, and boom angle indicator etc., are in good working order.

a) The load moment limiter must be set according to the current crane configuration.

b) The lifting height of crane as given in the load capacity charts must be adhered to. The load given in the load capacity charts must not be exceeded.

c) The crane operator must know the weight and dimensions of the load before operating the crane.

d) Load handling devices, lifting equipment and hook block must be used in accordance with specified requirements.

e) Make sure that the weight of load handling devices, lifting equipment and hook block are subtracted from the load given in the lifting capacity charts.

Example:

Table 3-12 Explanation of load weight

Rated lifting capacity	30 t
Weight of load hook	1.07 t
Weight of wire rope	0.04 t
Weight of actually lifted load	28.89 t

CAUTION

In this case, the load to be lifted may not exceed 28.89 t.

3.11.1 Counterweight

The required counterweight must be installed prior to lifting operation and after the crawler carriers are extended to specific positions.

DANGER

If the counterweight is not installed properly according to the lifting capacity charts, the crane may topple over.

3.11.2 Travel without a load

3.11.2.1 Basic requirements

a) The ground must be firm and flat and can provide adequate load-bearing capacity.
b) Pay attention to trenches and hunches on the ground.
c) Consider the specified slope degree (longitudinal) and the transverse slope as well.
d) Avoid toppling over the crane due to deflection of center of gravity. Prevent the hook colliding with the boom frame, especially when the boom angle is bigger.
e) High-speed traveling without a load on flat ground is permitted but not in making a turn.
f) Crane simultaneous movements can only be carried out when travel straight without a load.
g) The operation should be stable and never initiate and/or stop the operation jerkily.

3.11.2.2 Travel on a slope

CAUTION

To travel crawler crane uphill, the following conditions must be observed:

(1) The ground must be able to support possible ground pressure.
(2) The friction coefficient between roadway and track pad must be large enough to produce enough drive forces.
(3) Slippery ground can cause the crane to slip sideways and move into an impermissible side incline position. There is a danger of accidents.
(4) The slewing table must be aligned to the crawler carriers and must be secured to prevent it from turning.
(5) The maximum permissible wind velocity is 9 m/s.
(6) Side incline is not permitted!
(7) Travel slowly and keep the center of gravity of complete vehicle within the safety range all the time.
(8) The transfer from the horizontal to the incline and vice versa must be made very evenly. The change of gradient must be continuous.

a) The boom frame is parallel with travelling direction
   1) Heavy duty boom configuration

Table 3-13 Heavy duty boom configuration

Boom length	Main boom angle	Gradient	Prerequisite
Heavy duty boom length ≤ 72 m	75°	≤ 10° (comprehensive)	The boom frame faces the uphill direction.
		≤ 3° (transverse)	
Heavy duty boom length > 72 m	75°	≤ 5° (comprehensive)	
		≤ 2° (transverse)	

2) Luffing jib on heavy duty boom configuration

Table 3-14 Luffing jib on heavy duty boom configuration

Boom length	Main boom angle	Luffing jib angle	Gradient	Prerequisite
Luffing jib on heavy duty boom ≤ 72 m	87º	65º	≤ 10º (comprehensive)	The boom frame faces the uphill direction.
			≤ 3º (transverse)	
Luffing jib on heavy duty boom > 72 m	87º	65º	≤ 5º (comprehensive)	
			≤ 2º (transverse)	

b) The boom frame is unparallel with travelling direction

1) Heavy duty boom configuration

Table 3-15 Heavy duty boom configuration

Boom length	Main boom angle	Gradient	Prerequisite
Heavy duty boom length ≤ 72 m	75º	≤ 3º (comprehensive)	The boom frame faces the uphill direction.
Heavy duty boom length > 72 m	75º	≤ 2º (comprehensive)	

2) Luffing jib on heavy duty boom configuration

Table 3-16 Luffing jib on heavy duty boom configuration

Boom length	Main boom angle	Luffing jib angle	Gradient	Prerequisite
Luffing jib on heavy duty boom ≤ 72 m	85º	65º	≤ 3º (comprehensive)	The boom frame faces the uphill direction.
Luffing jib on heavy duty boom > 72 m	85º	65º	≤ 2º (comprehensive)	

3.11.3 Travel with a load

3.11.3.1 Basic requirements

a) The crane can travel with boom frame installed and with a load.

b) When travelling with a load, refer to the lifting capacity charts and the following load reducing requirements.

c) Normally, the load should be close to the ground as possible as it can and the range should be small as possible as it can.

d) The crane can only travel with a load in low speed. The smaller change of the speed, the better.

e) Avoid swinging the load all the time (if necessary, the load should be fastened on the rope).
f) The ground must be firm and flat, and can provide adequate load-bearing capacity.
g) The largest wind velocity shouldn't exceed 9.8 m/s when travelling with a load.
h) Monitor the ground clearance of suspended ballast base plate when the crane is travelling with suspended ballast. And the boom frame must be in front of or behind the basic machine.
   – The minimum ground clearance of suspended ballast base plate is 200 mm. (The crane cannot travel if the clearance is less than this value.)
   – The maximum ground clearance of suspended ballast base plate is 400 mm. (The crane may topple over if the ground clearance is larger than this value.)
i) The load can be put down stably for any possible mistakes.
j) If necessary, the ground must be leveled.
k) The operation must be stable and never initiate and/or stop the operation jerkily.

3.11.3.2 Travel on a slope

3.11.3.2.1 Travel with a load on level ground (≤ 0.3º)

a) The boom frame is parallel with travelling direction

Note:

1) The load should be in the sight of the operator.
2) No other crane movements are allowed.

Table 3-17 Gradient under various boom configurations (when boom frame is parallel with travelling direction)

Boom configurations	Gradient	Prerequisite
Heavy duty boom	≤ 0.3º	No travel limit Largest travelling speed: 0.5 km/h
Fixed jib on heavy duty boom		
Luffing jib on heavy duty boom		

b) The boom frame is unparallel with travelling direction

Note:

1) The load should be close to the ground as possible as it can be.
2) No other crane movements are allowed.

Table 3-18 Gradient under various boom configurations (when boom frame is unparallel with travelling direction)

Boom configurations	Gradient	Prerequisite
Heavy duty boom	≤ 0.3º	The distance between the load and the ground should not exceed 20 m and the largest travelling speed is 0.5 km/h.
Fixed jib on heavy duty boom		
Luffing jib on heavy duty boom		

3.11.3.2.2 Travel with a load on level ground or slope (> 0.3º)

The boom frame direction has nothing to do with travelling direction.

Note:

a) The load should be close to the ground as possible as it can be.

b) No other crane movements are allowed.

1) Light duty boom configuration

Table 3-19 Gradient under light duty boom configuration

Boom length	Gradient	Prerequisite
Light duty boom length ≤ 72 m	≤ 1º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 20%.
	≤ 2º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 30%.
Light duty boom length > 72 m	≤ 1º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 30%.

2) Luffing jib on heavy duty boom configuration

Table 3-20 Gradient under luffing jib on heavy duty boom configuration

Boom length	Gradient	Prerequisite
Luffing jib on heavy duty boom ≤ 72 m	≤ 1º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 30%.
	≤ 2º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 40%.
Luffing jib on heavy duty boom ≤ 108 m	≤ 1º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 40%.
Luffing jib on heavy duty boom jib > 108 m	≤ 1º	The largest travelling speed is 0.5 km/h and the lifting capacity is reduced by 50%.

CAUTION

As to gradient under fixed jib on heavy duty boom configuration and wind plant jib on heavy duty boom configuration, refer to that under luffing jib on heavy duty boom configuration.

3.11.4 Requirements when transferring from the horizontal to the incline

Ensure enough length to transfer between the horizontal and the incline to make the crane travel stably.

The required length (L) of the transfers is calculated from the existing incline angle (α) and the length of the crawlers (LC):

$L = 0.5 \times \alpha \times LC$

L = Ground length of required transfer

α = angle of incline in degrees

LC = length of crawler between drive / driven sprocket

Example: when crane works with main boom, the Incline angle (α) =10°, LC=10.5 m

$L = 0.5 \times 10 \times 10.5\ m = 52.5\ m$

While driving uphill, the ratio between the front and the rear ground pressures (or between the rear and the front) must be larger than 0.3 in all travel conditions:

A: B > 0.3

A = max. ground pressure on the side of the two crawlers with less pressure

B =max. ground pressure on the side of the two crawlers with higher pressure

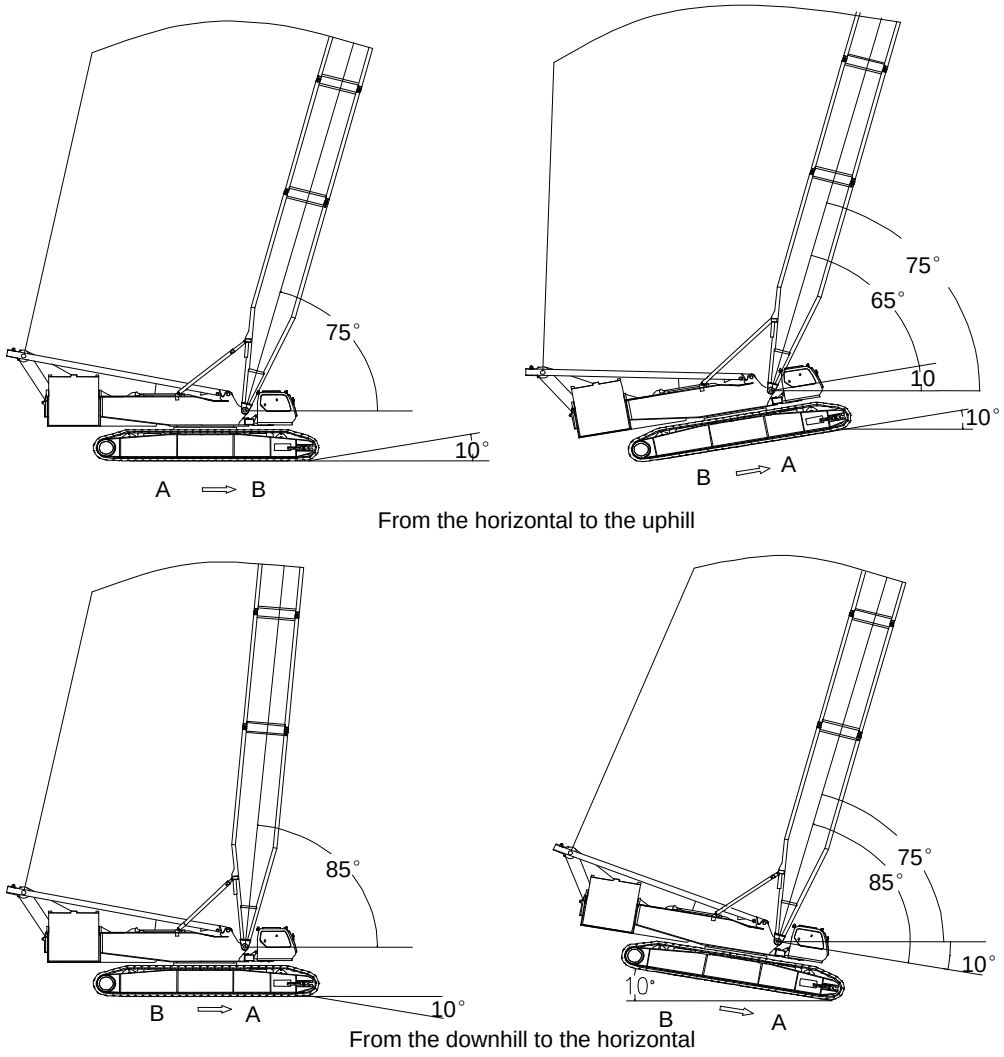


Figure 3-78 Requirements when transferring between the horizontal and the incline

DANGER

Risk of accident!

Ensure enough length to transfer between the horizontal and the incline and never make the two ends of the crawler carrier bear force and the middle part suspends. Otherwise, the crawler carrier may be damaged.

3.11.5 Crane operation □

a) Operating conditions

1) All components of the crane are in running-in state at the initial operating period. So, for the first 100 operating hours, the working load should not be too great and the working speed should not be too high. The maximum lifting load cannot exceed 80% of its rated load. And the maximum working speed is forbidden.

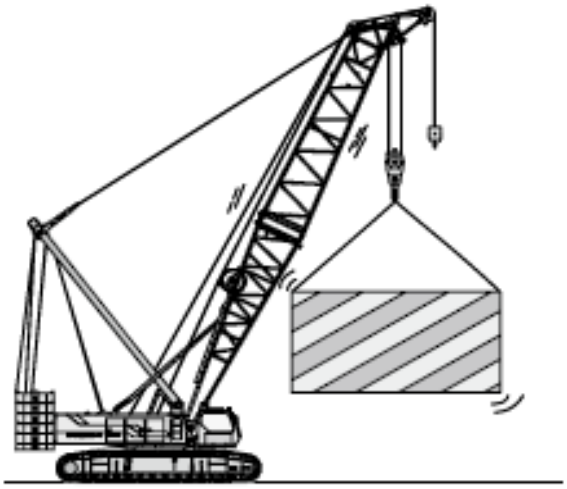


Figure 3-79

2) The ground on jobsite should be firm and flat and the gradient should not be greater than 5/1000. The complete vehicle should be level and the supporting ground should not collapse during operation. If the ground is soft, the steel plates should be placed under the track pad.

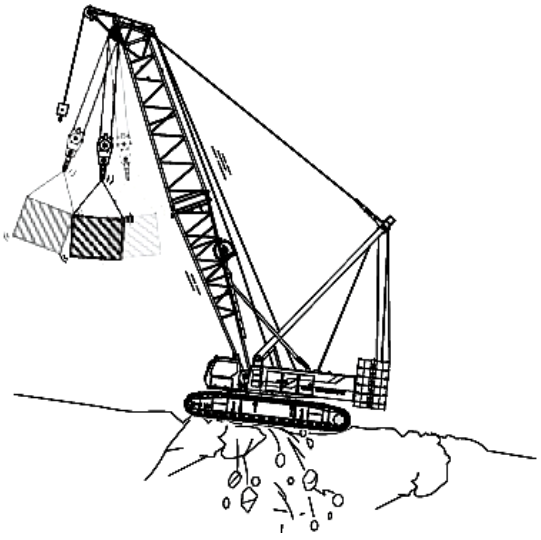


Figure 3-80

3) The permitted temperature range for crane operation is -20°C– 40°C. The humidity should not exceed 85%. However, high humidity up to 100% is only permitted for a short period of time. The crane should be operated and supported on a ground lower than 1000 m above sea level.

Figure 3-81

4) The permitted wind velocity for crane operation is at most 9.8 m/s when the crane is working. The crane is fitted with main boom, and the out-of-service wind velocity should not exceed 21 m/s. The crane is fitted with main boom as well as jib, and the out-of service wind velocity should not exceed 15 m/s.

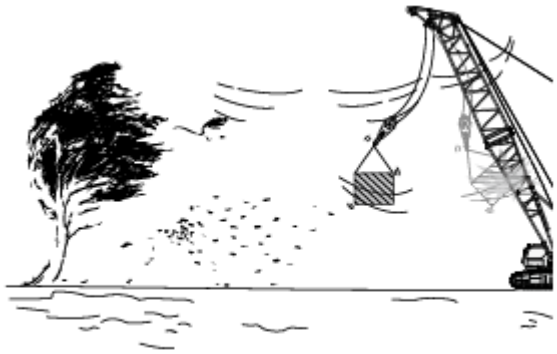


Figure 3-82

Refer to the following table for the wind force.

Table 3-21 Wind force beaufort

Wind force		Effects of the wind in the inland	
Beaufort	Description	Wind speed (m/s)	Visible effects
0	Calm	0 - 0.2	No wind, smoke rises straight up
1	Light air	0.4 - 1.4	Wind direction is shown only by observing the trail of smoke, not by the wind sock
2	Light breeze	1.6 - 3	Wind can be felt on the face, the leaves rustle, wind sock moves slightly
3	Gentle breeze	3.4 - 5.3	Leaves and thin twigs move. Wind extends a small breeze flag.
4	Moderate breeze	5.5 - 7.8	Swirls up dust and loose paper, moves twigs and thin branches
5	Fresh breeze	8 - 10.6	Small deciduous trees begin to sway, foam forms at sea.
6	Strong breeze	10.8 - 13.7	Thicker branches move; telephone lines begin to whistle, umbrellas are difficult to use
7	Stiff wind	13.9 - 17	Entire trees swaying; difficult to walk into wind
8	Gale force wind	17.2 - 20.6	Breaks twigs off trees, walking becomes difficult
9	Gale	20.8 - 24.5	Minor damage to property(chimney tops and roofing tile are blown off)
10	Severe gale	24.7 - 28.3	Trees are uprooted, significant damage to property

5) When the crane is working near the high-voltage power line, the safe clearance between any part of the crane and overhead power line should comply with the following regulations:

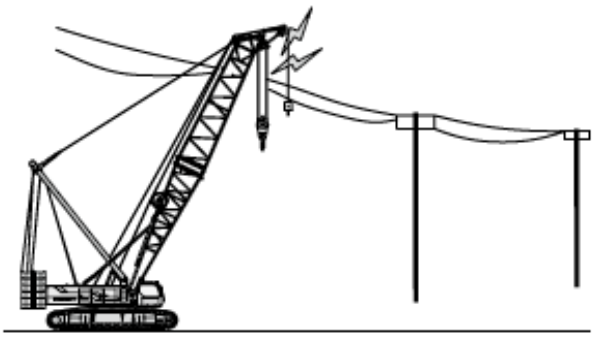


Figure 3-83

Table 3-22 Safe clearance from high-voltage power line

Output voltage of high-voltage power line (V, kV)	V ≤ 1	1 < V ≤ 15	15 < V ≤ 40	40 < V ≤ 100	100 < V ≤ 200
Safe clearance (m)	1.5	3	4	5	6

6) Only the crane without fault is allowed to work.

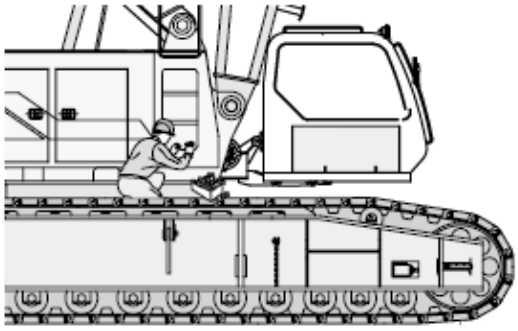


Figure 3-84

b) Instructions for safe operation

1) No person is allowed to stand under the boom when the crane is operated.

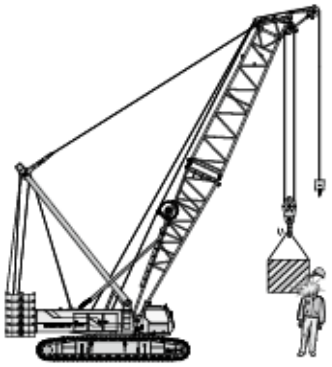


Figure 3-85

2) No person is allowed to stand on the slewing table during operation.

3) It is forbidden to lift the load over the people.

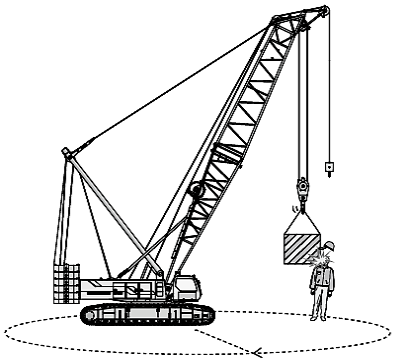


Figure 3-86

4) It is forbidden to lift the load when someone stands on it.

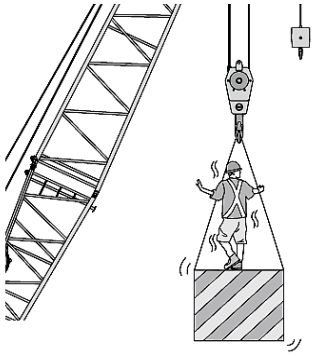


Figure 3-87

5) Overloading operation and lifting staggered load is prohibited. Never pull the load obliquely.

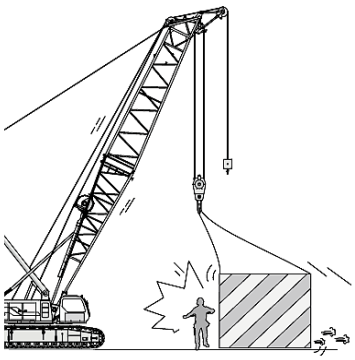


Figure 3-88

6) It is forbidden to lift the load hidden in the ground or frozen on the ground.

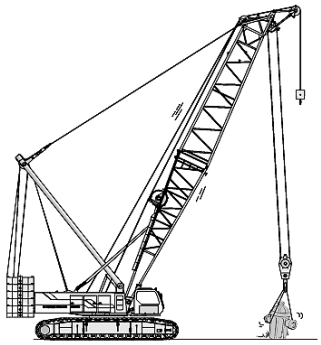


Figure 3-89

7) The crane can travel with a load of 70% of the rated load when only main boom is used. In this case, the ground should be firm and its gradient should not be more than 5/1000. The driving speed must be less than 0.5 km/h. Main boom must be located in the traveling direction.

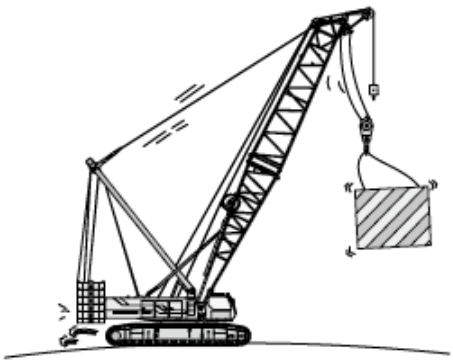


Figure 3-90

8) If the crane is operated in the vicinity of transmission systems (e.g. transmitters), strong electromagnetic field will be generated there, so measures should be taken to protect the crane against high frequency interference and all workers who stand on large metal plate should wear special isolating gloves and clothes to avoid being burnt.

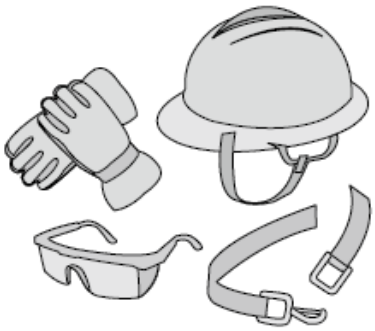


Figure 3-91

9) Under any condition, there must be at least three windings of wire rope left on the hoisting drum.

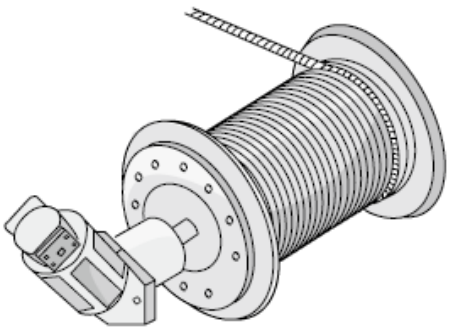


Figure 3-92

10) When a load is suspended in the air, the operator is not allowed to leave the cab.

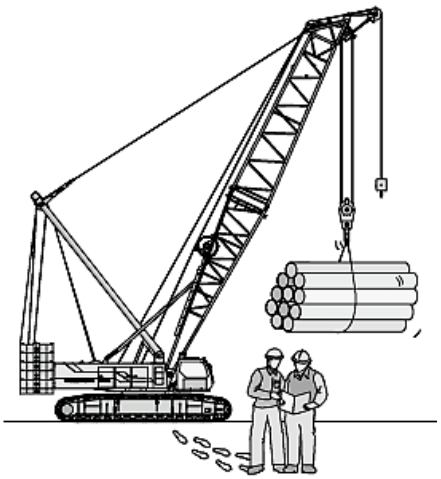


Figure 3-93

11) The operation should be carried out stably and gently. Never operate control lever jerkily and carry out switchover operation abruptly.

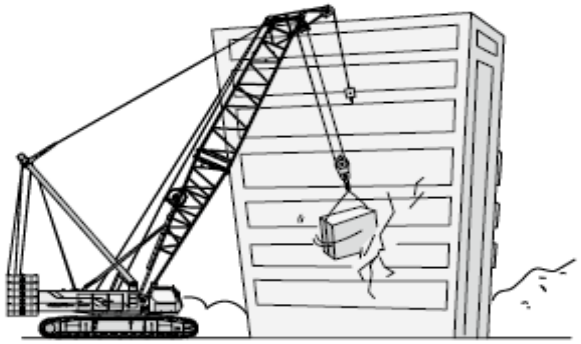


Figure 3-94

12) When actual load reaches 90% of the rated one, the load moment limiter will sound an alarm, to which high attention should be given.

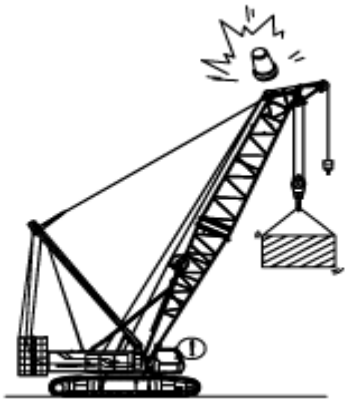


Figure 3-95

13) Serious accident may occur when climbing on/ down the crane. Only after the crane stops stably, can you climb the crane.

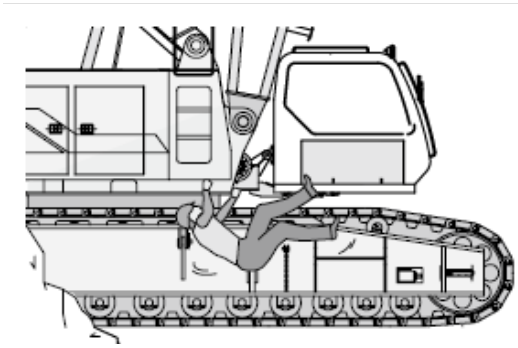


Figure 3-96

14) It is prohibited to make any modifications to the crane without permission. Otherwise you should take the consequences.

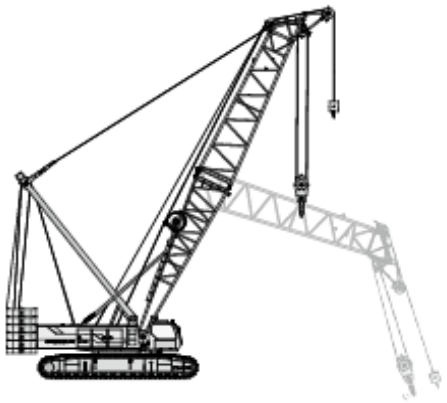


Figure 3-97

c) Stop the crane operation if one of the conditions occurs:

1) The crane is overloaded or the weight of load is uncertain.

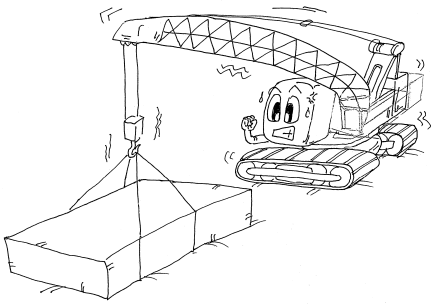


Figure 3-98

2) The load falls down due to bad binding or hanging.

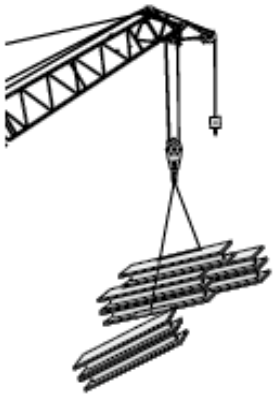


Figure 3-99

3) No protective mat is added between the edges of load and wire rope.

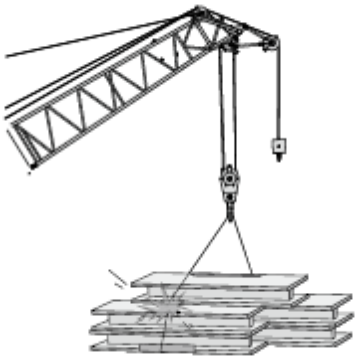


Figure 3-100

4) In case of poor visibility or darkness, it is difficult to identify the load or signal.

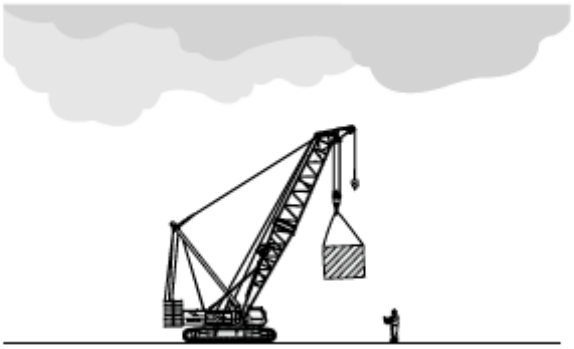


Figure 3-101

5) There is defect or damage of structure or components which will impair safe operation, for example, the brake and safety device fail, or the wire rope is damaged etc.

Figure 3-102

6) No one is permitted to ride on the load hook, slings or load.

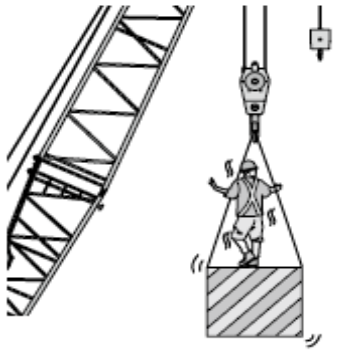


Figure 3-103

7) Leave an ample space for stopping the crane, otherwise persons nearby may be hurt by crane counterweight due to narrow distance between counterweight and surrounding building.

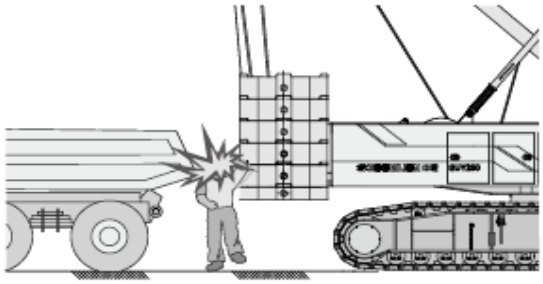


Figure 3-104

8) Keep the windows of crane operator's cab clean to ensure good visibility, stop crane operation immediately in case of poor visibility, and replace the broken window as soon as possible.

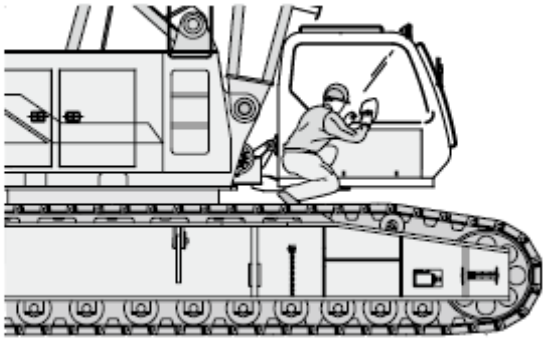


Figure 3-105

9) Keep the crane clean and dry because wet platform, ladder, tools, rubbish or other loose parts may cause you to fall down.

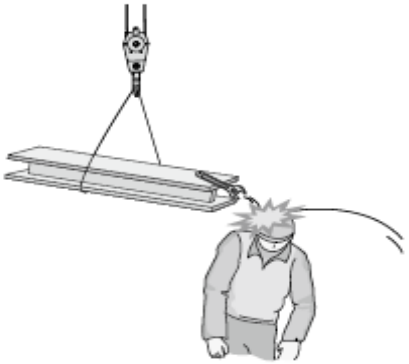


Figure 3-106

10) Drive the crane with great cautiousness, in working site or not. Observe the conditions surrounding the crane such as overhead power line, low-lying land, narrow clearance, restriction to bridge and road, uneven ground and gradient of road. If necessary, appoint a signalman to assist operator to move the crane. Lock slewing mechanism during traveling.

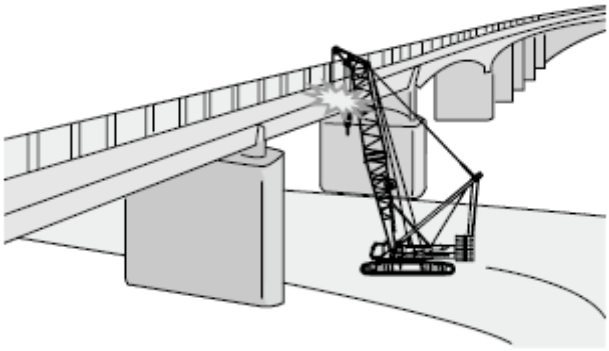


Figure 3-107

11) It is more dangerous that two cranes carry out lifting operations together. Therefore, a careful calculation must be made before commencing the work, and the following important requirements for this type of operation must be observed.
   - The load is not casually attached to the crane. It must be calculated carefully so that the actual lifting capacity of the crane cannot exceed the rated lifting capacity.
   - Ensure that each lifting tackle can bear specified load weight which is calculated during design.
   - The crane operator, signalman and other worker must evaluate the operational planning together before operation.
   - Ensure that the crane can move properly in the whole process of operation.

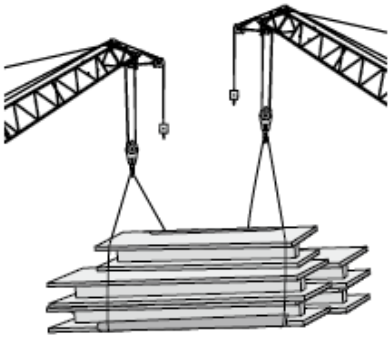


Figure 3-108

d) When you leave the machine in an emergency without taking any measures, you are putting your life at risk. Therefore, you must take the following measures prior to leaving the machine.

1) Detach the load from the hook and set it down on the ground. If necessary, lower the boom frame.
2) Apply slewing brake or lock slewing mechanism.
3) Apply parking brake.
4) Lock travel gear.
5) Cut off power supply or switch off the engine.

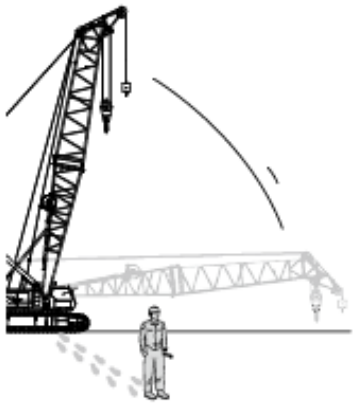


Figure 3-109

e) Do not wear loose clothing, scarves, open jackets or open shirt sleeves, and do not wear jewellery (rings, bracelets, earrings or similar). Otherwise, there is serious danger of injury from being pulled into moving machine parts.

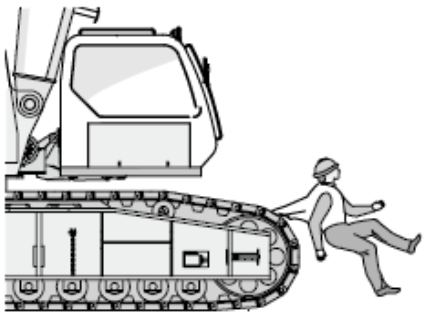


Figure 3-110

1) Do not stop crane near the bank which is possible to collapse or on low-lying land that may be washed away by water.
2) Take away the key when the crane remains idle. In this way, the unauthorized person cannot start the crane without permission.

3.11.5.1 Preparation for crane operation

Crane operator should perform the following checks before operating the crane:

a) Check the daily record of work to ensure that all regular inspections, maintenance and repair work is performed.
b) Check the derricking limiter, boom angle indicator, tilting-back supports and other safety devices for functional work.
c) Check if the load-bearing parts such as wire rope (hoisting rope and derricking rope), guy lines, boom, folding brackets, hook and load handling devices are kept in good working order.
d) Check if there are some bolts, nuts and pins lost, and the components are cracked or damaged.
e) Ensure that no modification has been made to the crane without permission, e.g., increase or decrease in counterweight plate and improper repair of boom frame.
f) After starting up the engine, check if the values shown on instruments are normal.
g) Check fuel lines and hydraulic oil lines for leakage.
h) Check all control mechanisms for functional work.
i) Check brakes and clutch. Test the braking performance by lifting a load away from the ground and suspending it in the air for a moment.
j) Keep communication between the operator and rigger.
k) Estimate the weight and dimensions of load to be lifted in advance.
l) Crane operation can be carried out within minimum working radius. No obstacles hinder the necessary movements. The ground at the job site is able to support expected loads.
m) Ensure that no obstacles are within working radius and the operator can see the load clearly from the cab. Check if the communication between operator and signalman is kept smooth so as to ensure safe crane operation.

n) Make sure that the crane has enough load-bearing capacity before operating the crane. What's more, the ground should be firm, level and flat. Never operate the crane on the soft and uneven surface or on the ground of high water content or covered with frozen soil. If the crane is set up close to trenches, reinforce the trenches to avoid landslide. If the ground does not have adequate load-bearing capacity, the crane is liable to turnover. In this case, crosstie, steel plates should be padded underneath the crawler to distribute load so that the load-bearing capacity of the ground will not be exceeded. Make sure that the crane is leveled.

3.11.5.2 Notes for crane operation

a) Estimate the weight and dimensions of load to be lifted in advance.
b) Use load handling devices (wire rope or chain) correctly. Make the vertical line of the hook pass through the center-of -gravity of the load.
c) If any part of the crawler crane or load handling devices comes into contact with the high-voltage power line, or an emergent situation occurs, the operator should stop the vehicle at once.
d) The load capacities as given in the lifting capacity charts must be adhered to. The loads given in the lifting capacity charts must not be exceeded. Driving (or slewing) too fast with a load, or setting up and loading on an uneven surface, and swinging of suspended load should be avoided.
e) Diagonal pulling (slewing or travelling) of the load to be lifted which is still in contact with the ground is prohibited.
f) It should be avoided that the load or auxiliary lifting device collides with structural members of the crawler crane.
g) If the crane gets caught in a thunderstorm during operation, the following measures should be taken at once:
   – Stop work on the crane immediately.
   – Always set down the load and boom frame on the ground.
   – Apply brake or lock winch and slewing gear.
   – Switch off the crane engine and cut off the power of load moment limiter and limit switch.
   – Ask all crane workers to leave away.
h) If the crane is struck by thunderbolt, the following checks should be performed:
   – Check whether there are burnt or damaged components.
   – Check the performance of the electrical parts and load moment limiter.
   – Check the associated components for functional work.
i) If earthquake occurs when the crane is operated, the following measures should be taken immediately:
   – Stop work on the crane immediately.

– Always set down the load and boom frame on the ground.
– Apply brake or lock winch and slewing gear.
– Switch off the crane engine and cut off the power of load moment limiter and limit switch.
– Ask all crane workers to leave away.

After earthquake, the following checks should be performed prior to crane operation:

– Check the performance of the electrical parts and load moment limiter.
– Check the associated components for functional work.

j) If any part of the crawler crane or load handling device is in contact with high-voltage lines, the best way to guarantee personal safety of the operator is to stay in the operator's cab until the danger is obviated. If the operator must leave the crane, he'd better jump rather than climb down the cab.

k) The operator's cab should be equipped with an emergency hammer which can be used to smash the window in an emergency so that the operator can run away from the cab.

l) The load moment limiter, once be triggered, should be kept in that state until the crane is not overloaded.

m) If the load moment limiter is not set to the actual configuration status of the crane, it cannot fulfill its function as a safety device.

n) Examine if the angle indicators and tension force sensor are in function.

o) The crane may topple over backwards if a load is suddenly freed since the tension created in the boom can cause it to jerk back violently.

p) Make sure that the loads and working radius contained in the lifting capacity charts are not exceeded.

q) When working in the vicinity of power cables, a sufficient safety clearance must be maintained, if the cables are not isolated by electricity engineers or the hazardous area is not fenced off.

r) For all crane movements, the crane operator must always keep the load, as well as the crane hook or hook block when the crane is not loaded, in his field of vision. If this is not possible, the crane operator may only operate the crane according to instructions given to him by a signalman. These instructions may be given in the form of hand signals or over an interphone. Whatever method is used, precautions must be taken to eliminate the risk of misunderstanding.

If all measures taken, there are still electrical discharges, the following measures should be taken:

(1) Keep calm.

(2) Do not leave the driver's/operator's cab.

(3) Tell people around the crane not to move and touch the crane.

(4) Move the crane out of the dangerous zone.

Failure to observe the above points will cause serious accident and damage!

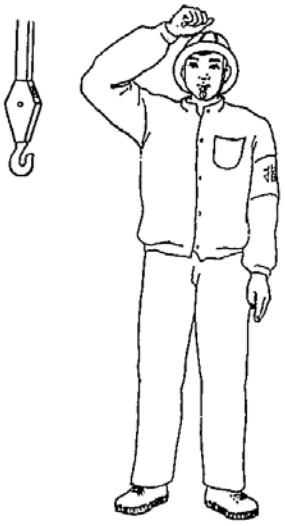
3.11.5.3 Checks after operation

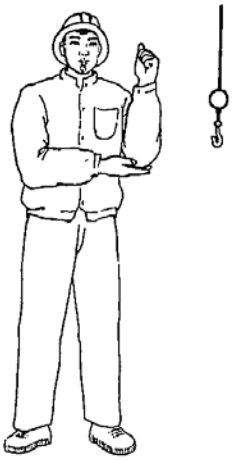
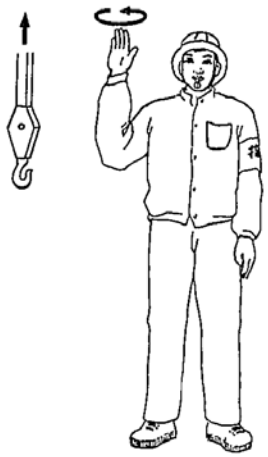
a) When the crawler crane and auxiliary lifting device are in non-working conditions, never park the vehicle near the embankment liable to collapse or low-lying land subject to be washed away by water.
b) Set down the load on the ground, and if necessary lower the boom frame to some extent. Lock the slewing gear and traveling gear and apply the brake.
c) Shut down the engine and cut off power.
d) Check if there is leakage in some place and repair it if necessary.
e) Clean such components as movable parts and exposed part of the piston rod of cylinder.
f) Check if bolts and nuts are fitted tightly. Any defects found should be eliminated at once. It is prohibited to operate the crane with fault.
g) Record the operating conditions and abnormal symptoms.
h) Check if the quantity of tools and accessories meet specified requirements.
i) Lock the operator's cab or safety devices.
j) Take precaution measures against storm or lightning strikes.
k) Take precaution measures against frostbite in winter.

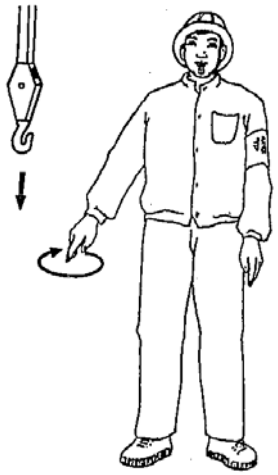
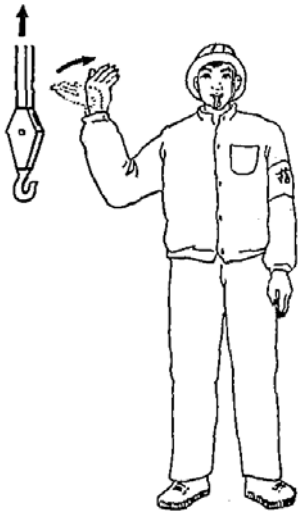
To avoid engine from freezing in winter, drain all cooling water when park the vehicle, if no anti-freeze is added into the cooling water.

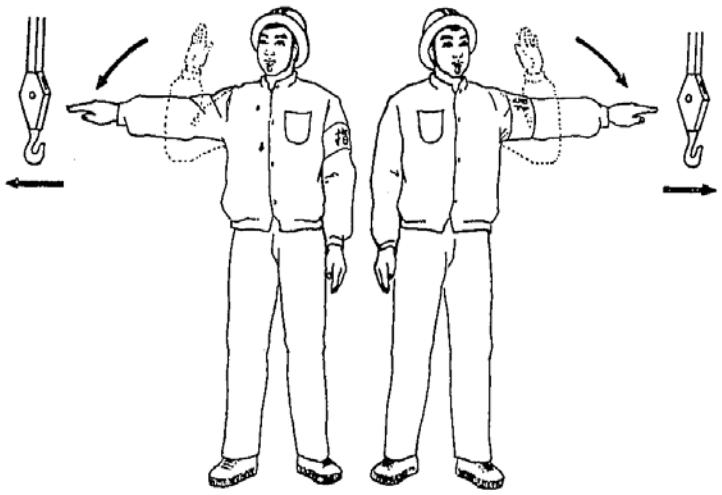
3.12 Hand signals for controlling crane operations

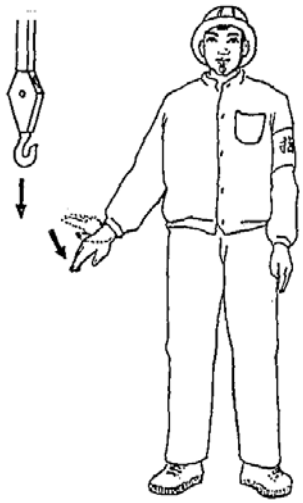
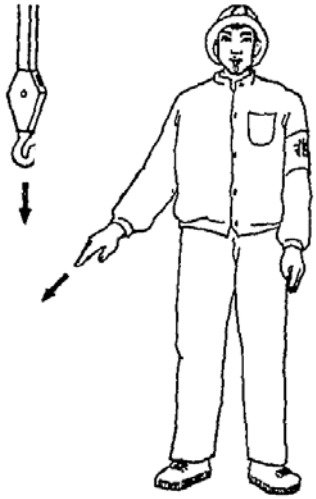
Table 3-23 Hand signals for controlling crane operations

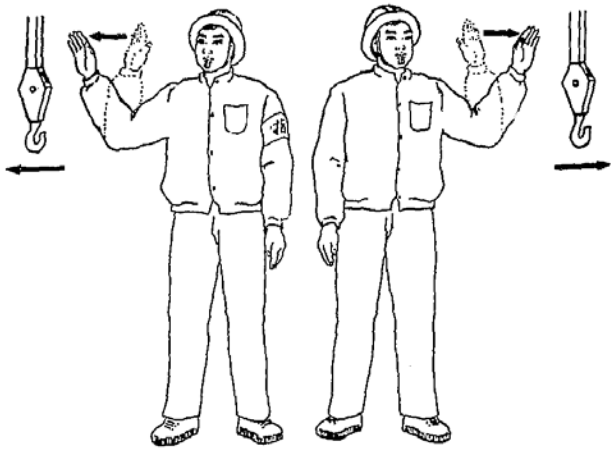
Ser. No.	1	2
Signal	Preparation	Use main hook
Description	Hold the right arm stretched out over the head, the palm facing forwards.	Tap fist on the safety helmet, then give further hand signals.
Illustration		

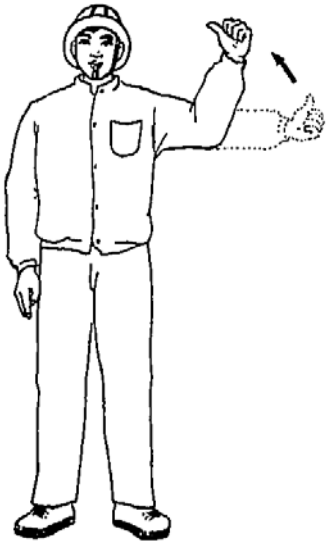
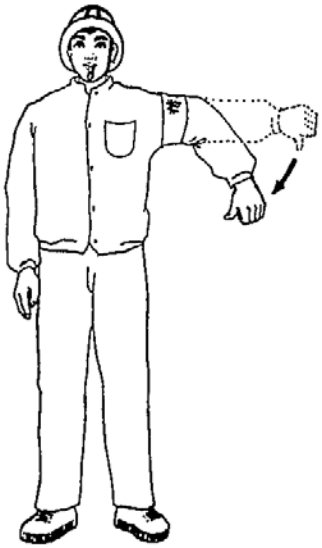
Ser. No.	3	4
Signal	Use auxiliary hook	Hoist
Description	Bend the left hand and hold it upward, tap the underside of the elbow with the right hand, then give further hand signals.	Bend the right arm and hold it upwards. The palm faces forwards. The hand makes small, circular movements.
Illustration		

Ser. No.	5	6
Signal	Lower	Raise load slowly
Description	Hold the right arm down with a 30° angle to the body. The extended index finger points downwards. The hand makes small, circular movements.	Stretch out right arm. The palm faces upwards. Wave the hand up repeatedly.
Illustration		

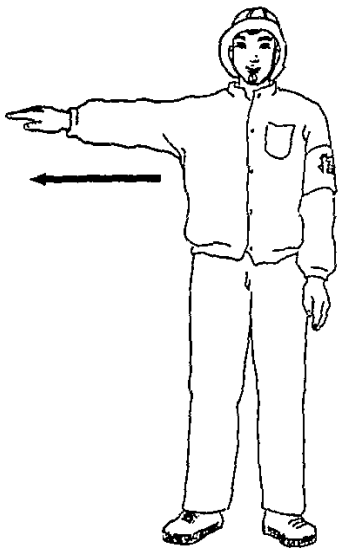
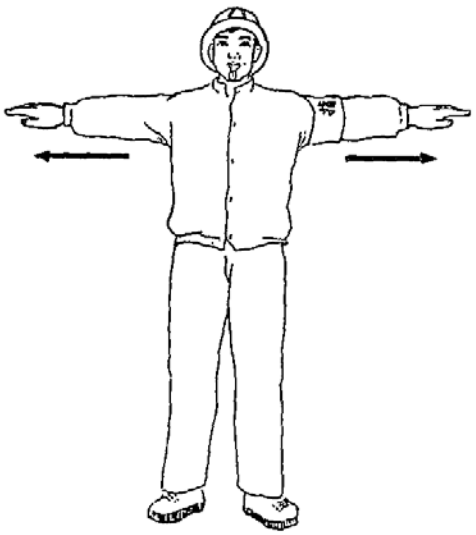
Ser. No.	7
Signal	Rotate
Description	Turn left: With right forearm vertical, the palm of the hand facing outwards, lower the forearm sideways horizontally, fingers pointing at the direction of rotation. Turn right: With left forearm vertical, the palm of the hand facing outwards, lower the forearm sideways horizontally, fingers pointing at the direction of rotation.
Illustration	

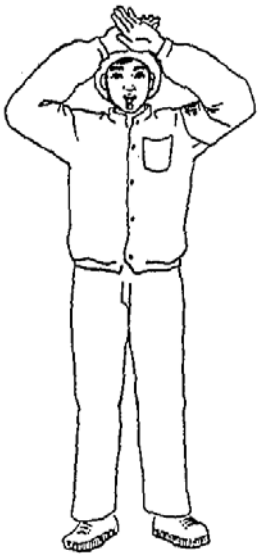
Ser. No.	8	9
Signal	Lower load slowly	Indicate load lowering position
Description	With arm extended downwards with a 30° angle to the body, palm of the hand facing downwards, wave hand down repeatedly.	Extend the fingers to point at the position where the load should fall on.
Illustration		

Ser. No.	10
Signal	Rotate slowly
Description	Turn left: With right forearm vertical, the palm of the hand facing outwards, move forearm horizontally and repeatedly, fingers pointing at the direction of rotation. Turn right: With left forearm vertical, the palm of the hand facing outwards, move forearm horizontally and repeatedly, fingers pointing at the direction of rotation.
Illustration	

Ser. No.	11	12
Signal	Raise boom	Lower boom
Description	With arm stretched sideways horizontally, thumb pointing upwards, the remaining fingers closed, wave forearm up.	With arm stretched sideways horizontally, thumb pointing downwards, the remaining fingers closed, wave forearm down.
Illustration		

Ser. No.	13	14
Signal	Raise boom slowly	Lower boom slowly
Description	Bend the left arm. Move the thumb up and down, pointing upwards. Place the right arm above it.	Bend the left arm. Move the thumb up and down, pointing downwards. Place the right arm below it.
Illustration		

Ser. No.	15	16
Signal	Stop	Emergency stop
Description	Stretch out one arm horizontally. The palm faces downwards. Swing the arm to one side of the body.	Stretch out both arms horizontally. The palms face downwards. Swing the arms to both sides of the body.
Illustration		

Ser. No.	17
Signal	End of a movement
Description	With fingers extended, cross both hands before the forehead.
Illustration	

DANGER

Suspended load is dangerous!

The crane operator must watch the load before carrying out any movements and especially pay attention to the hook or hook pulley when moving the crane without load. If it's difficult to do so, the operator can only operate it according to the signal given by the signal man, which can be conducted by hand signal or interphone. Vigilance is needed no matter which method is used to avoid misunderstanding.

DANGER

(1) We recommend using the hand signals illustrated above. However, users can decide on their own hand signals depending on actual condition, as different countries and regions may differ in the expression of hand signals.

(2) Hand signals must first be discussed and mutually agreed upon and clearly executed. Misunderstanding of hand signals may lead to serious accidents.

CAUTION

In any case, local lifting work rules and regulations must always be observed when operating abroad.

ZOOMLION

Operator’s Manual for Crawler Crane

Chapter 4 Crane Operation

Chapter 4 Crane Operation

4.1 Operating and control instruments

4.1.1 Operator's cab, overview

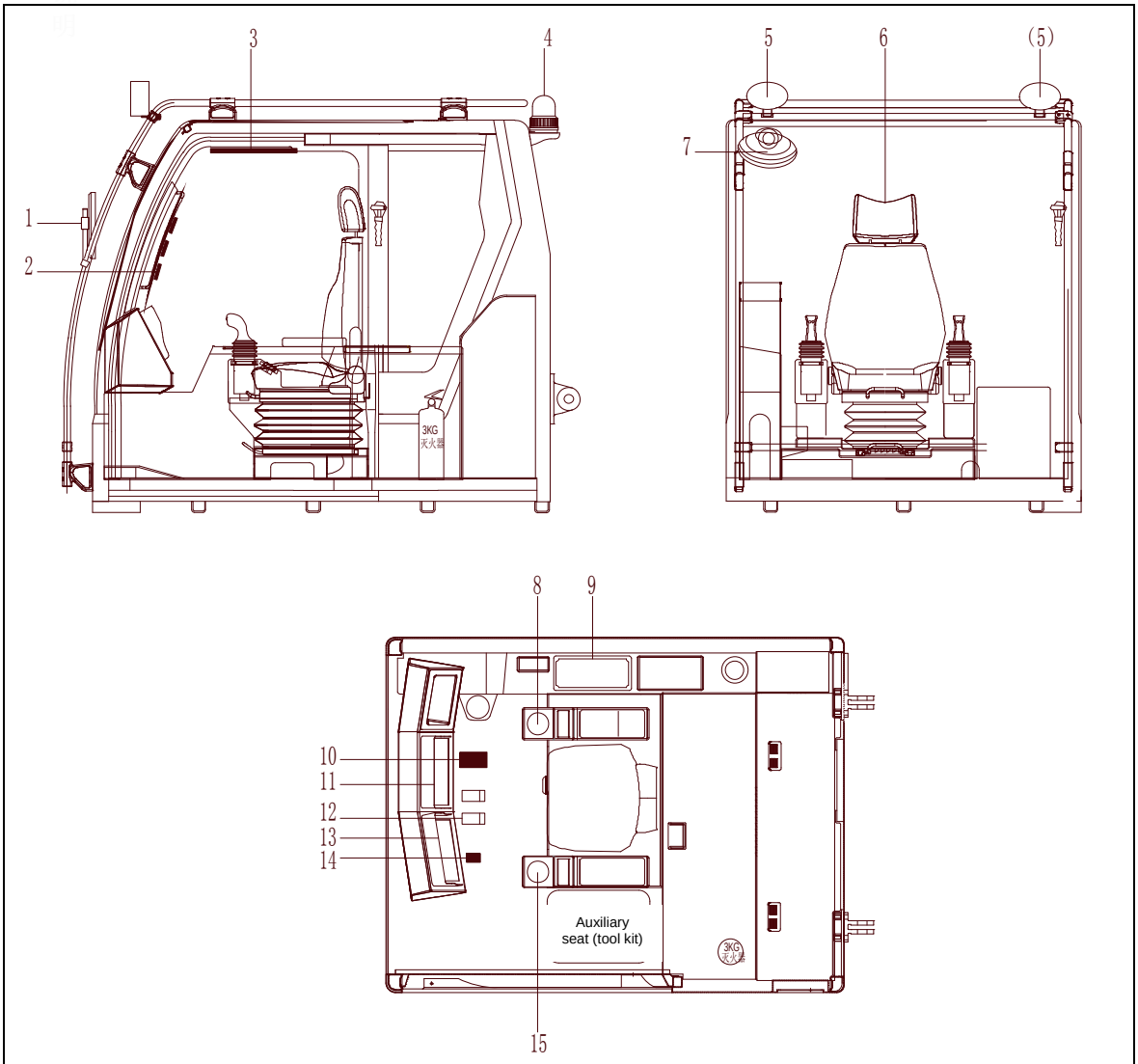


Figure 4-1 Operator's cab, overview

Table 4-1 Components in crane operator's cab

No.	Description	Remarks
1	Rearview mirror	At front left side of operator's cab to observe the left condition.
2	Winch monitoring system	Monitor the status of crane winches
3	Rocker switch	For details, see Section 4.1.4.
4	Flashing light	It flashes after the crane is electrified.
5	Work floodlight	Two work floodlights, front; One work floodlight, rear right The switch is the located near the rocker switch on the upper right side of cab.
6	Operator's seat	It is adjustable.
7	Fan	At the rear right side of operator's cab, internal It is used to cool the cab down.
8	Right control lever	Control the movements of hoisting winch 1 (H1), main boom derricking winch (E) and right travel gear (CR_R) and so on.
9	Right control panel	For details, see Section 4.1.5.
10	Accelerator pedal	Control the engine speed
11	LCD screen of control system	For details, see Section 4.2.2.
12	Travel gear pedals	The left one controls the movement of left crawler, the right one controls the movement of right crawler.
13	LCD screen of load moment limiter	
14	Foot-operated horn switch	Actuate the horn
15	Left control lever	Control the movements of hoisting winch 2 (H2), slewing mechanism (SW) and left travel gear (CR_L) and so on.

4.1.2 Left control box

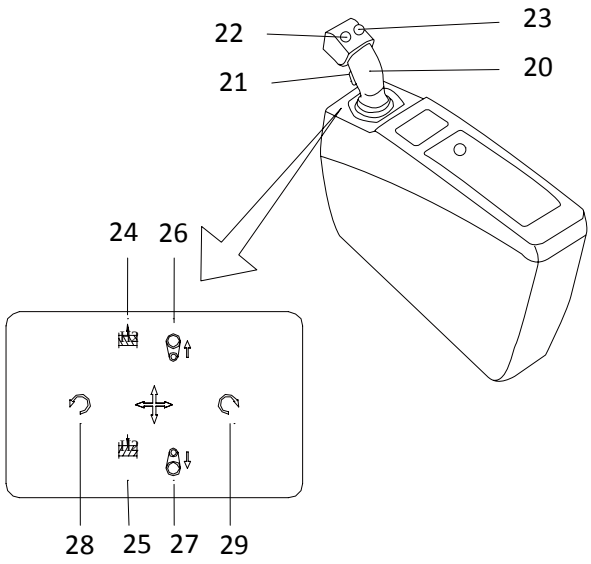


Figure 4-2 Left control box

Table 4-2 Components of left control box

No.	Description	Remarks
20	Left control lever	
21	Deadman's button	For details, please refer to CAUTION.
22	High-speed switch	Control the high speed of hoisting winch 2, slewing gear and left travel gear. For details, please refer to section 4.5.4.
23	"Swing free running" switch	For details, please refer to section 4.5.4.3
24	Symbol "reel off H2"	H2 refers to hoisting winch 2
25	Symbol "spool up H2"	
26	Symbol "left crawler forwards"	
27	Symbol "left crawler backwards"	
28	Symbol "slew to the left"	
29	Symbol "slew to the right"	

CAUTION

(1) The crane movements can be carried out only when deadman's button is pressed.

(2) The crane movements can still be carried out before the control lever is returned to neutral position with deadman's button released. However, to perform the next crane movement after returning the control lever to neutral position, the operator must press deadman's button first and then move the control lever. Otherwise, the operation of control lever is invalid.

(3) In normal condition, stop the crane movements by returning the control lever to neutral position.

(4) Make sure that the emergency stop button is triggered when needing to connect the power or start up the engine again.

4.1.3 Right control box

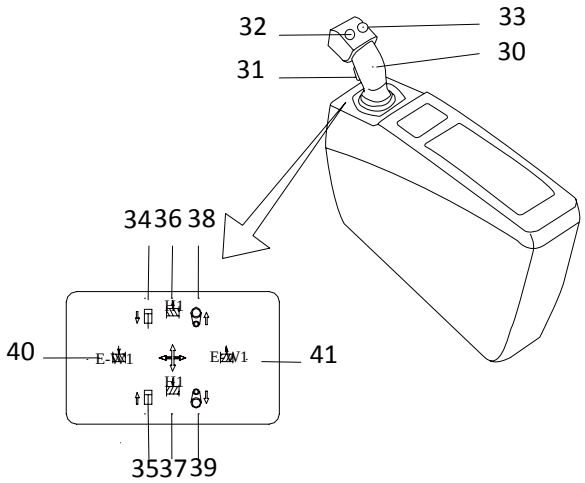


Figure 4-3 Right control box

Table 4-3 Components of right control box

No.	Description	Remarks
30	Right control lever	
31	Deadman's button	For details, please refer to CAUTION.
32	Switch	Not assigned
33	High-speed switch	Control the high speed of hoisting winch 1, luffing jib derricking winch and right travel gear. For details, please refer to section 4.5.
34	Symbol "extend mounting cylinder on A-frame"	
35	Symbol "retract mounting cylinder on A-frame"	
36	Symbol "reel off H1"	H1 refers to hoisting winch 1
37	Symbol "spool up H1"	
38	Symbol "right crawler forwards"	
39	Symbol "right crawler backwards"	
40	Symbol "spool up E/W1"	E refers to main boom derricking winch, and W1 refers to luffing jib derricking winch. Luffing jib derricking winch is not available.
41	Symbol "reel off E/W1"	

CAUTION

(1) The crane movements can be carried out only when deadman's button is pressed.

(2) The crane movements can still be carried out before the control lever is returned to neutral position with deadman's button released. However, to perform the next crane movement after returning the control lever to neutral position, the operator must press deadman's button first and then move the control lever. Otherwise, the operation of control lever is invalid.

(3) In normal condition, stop the crane movements by returning the control lever to neutral position.

4.1.4 Control panel assy.

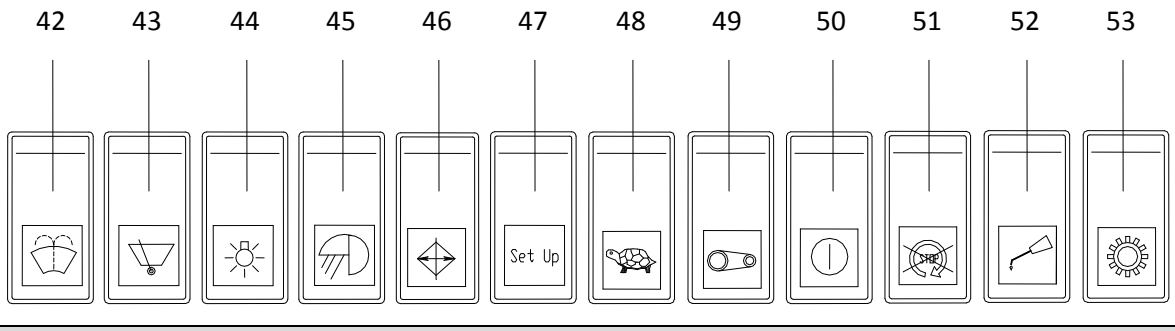
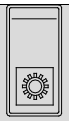


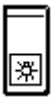
Figure 4-4 Control panel

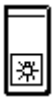
Table 4-4 Components of control panel

No.	Description	Key	Remarks
42	"Front windshield washer" switch		Control the front windshield washer
43	"Front windshield wiper" switch		Control the front windshield wiper
44	Master lighting switch		1st position: The LED on the switches of control panel lights up; 2nd position: master lighting switch
45	"Working floodlight" switch		Control all the working floodlights on the crane
46	"Oil cooling fan" switch		Pressing this switch can cool down the hydraulic oil
47	SET UP switch		For details, please refer to section 4.4
48	"Low-speed" switch		For details, please refer to section 4.5
49	"Travel" switch		To carry out traveling movements, the operator must first press this switch and then operate control lever!
50	Controller power supply switch		Control the power supply of PLC controller and LCD screen
51	"Engine shutdown" switch		Pressing this switch can shut down the engines

No.	Description	Key	Remarks
52	"Automatic lubricating system" switch		Control the automatic lubrication of lubricating points on superstructure
53	Switch		Not assigned

CAUTION

(1) Put master lighting switch  **on the 2nd position before switching on the working floodlight switch.**  .

(2) After putting master lighting switch  **on the 1st position, the LED on the rocker switches of control panel is still on.**

(3) Press the "engine shutdown" switch and hold it for more than 30 seconds, the working hours of the engine can be saved. In normal situation, using the ignition key switch to stop the engine is prohibited.

4.1.5 Right control panel

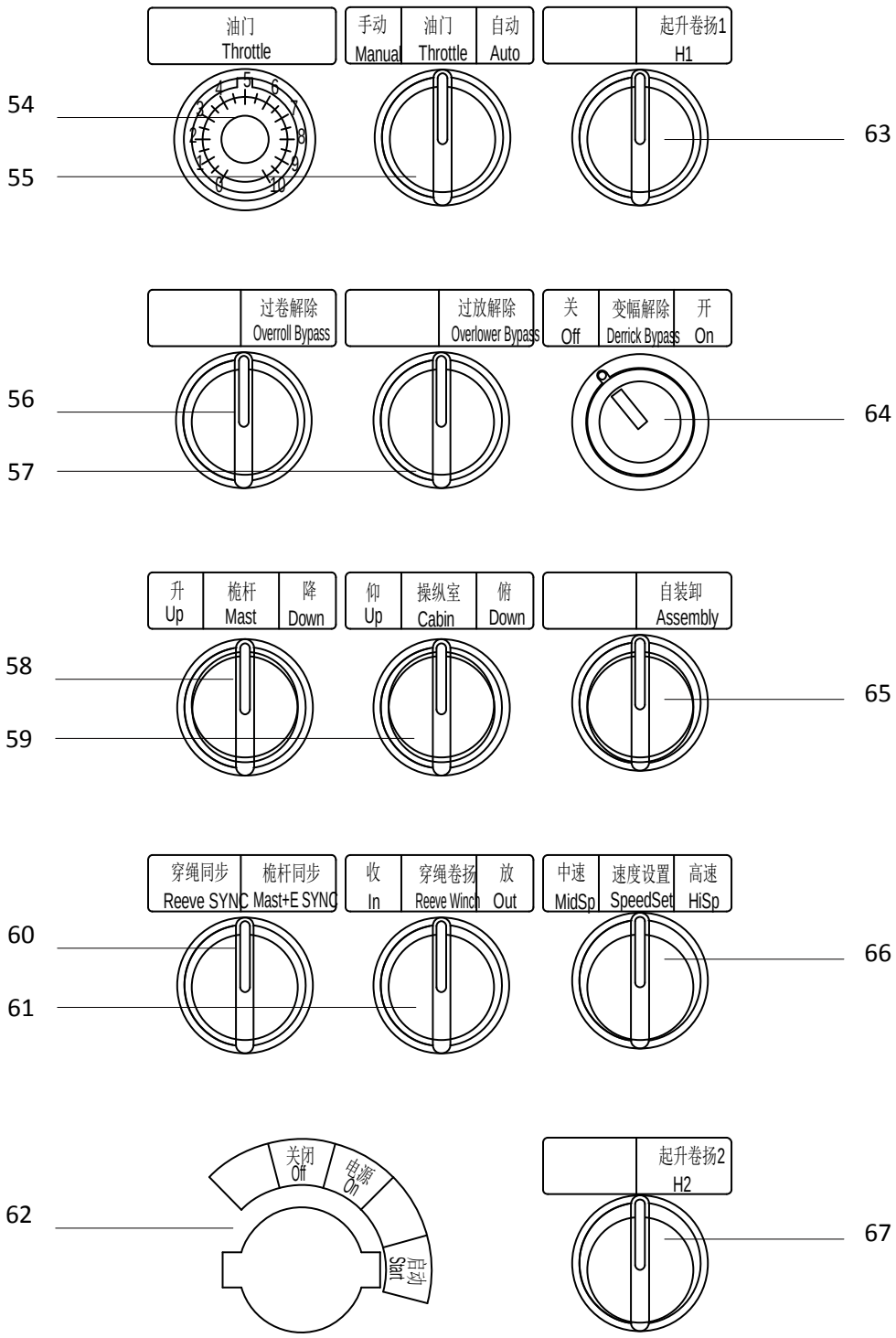


Figure 4-5 Right control panel

Table 4-5 Components on right control panel

No.	Description	Remarks
54	Throttle potentiometer	1. When the "Manual/automatic accelerator "switch is set in "manual "position, the throttle potentiometer is used to adjust engine speed. When adjusting, turn the potentiometer to the required engine speed position. 2. When the "Manual/automatic accelerator" switch is set in "automatic "position, the current potentiometer value is the maximum adjustable engine speed.
55	"Manual/automatic accelerator" switch	When the switch is set in neutral position, the engine speed is controlled by accelerator pedal. When the switch is set in "manual" position, the engine speed is controlled by throttle potentiometer. When the switch is set in "automatic" position, first turn throttle potentiometer to idle speed position, and then the engine speed automatically changes with the opening variety of control lever. The bigger the opening of control lever is, the higher the engine speed is, and vice versa.
56	Hoisting bypass switch	For details, please refer to section 4.4.
57	Lowering bypass switch	For details, please refer to section 4.4.
58	"A-frame erecting / lowering" switch	Turn the switch to left, A-frame will be erected. Turn the switch to right, A-frame will be lowered.
59	"Tilt cab forwards / backwards" switch	Turn the switch to left, the cab will tilt forwards; Turn the switch to right, the cab will tilt backwards.
60	"Synchronization" switch	"Synchronization" switch includes "Reeve sync" position and "Mast +E sync" position. 1. For detailed description of "Reeve sync", please refer to section 4.5.3.2.3. 2. For detailed description of "Mast +E sync", please refer to section 4.5.3.1.
61	"Reeving winch" switch	Turn the switch to left, reeving winch will be spooled up. Turn the switch to right, reeving winch will be reeled off.
62	Ignition starter switch	The ignition starter switch has three positions: off, power and start. When the switch is placed in "OFF" position, the power supply of the crane is turned off.

		When the switch is placed in "On" position, the power supply of the crane is turned on, including the control system, auxiliary control system and engine electrical control system. When the switch is placed in "Start" position, the starting motor of the engine is turned on, thus starting the engine. Releasing the switch after the crane starts up, the switch will return to "Start" position automatically.
63	Winch 1 (H1) selective switch	Turn the switch to right to activate winch 1 (H1).
64	Derricking bypass switch	For details, please refer to section 4.4.
65	"Assembly" switch	Turn the switch right to assembly position, the crane begins to self-assemble. For detailed description of "W1 winch", please refer to section 4.5.2.2.2. For detailed description of "Assembly", please refer to section 4.5.7.2.
66	"Speed set" switch	Turn the switch right to high-speed position, the winches (H1 & H2), slewing mechanism, traveling mechanism and derricking mechanism will work at high speed. Turn the switch left to middle-speed position, the hoisting winch will work at a speed between normal speed and high speed.
67	Winch 2 (H2) selective switch	Turn the switch to right to activate winch2 (H2).

CAUTION

(1) In cold weather, the engine will be preheated automatically after startup. Therefore, the delay of engine startup in cold weather is a normal phenomenon.

(2) "Assembly" switch can only be used when assembling and dismantling the crane.

(3) "When the "Manual/automatic accelerator" switch is set in "manual" position before starting the engine, turn "Manual ACCEL adjuster" to "MIN" position or place "Manual/automatic accelerator" switch to the neutral position.

4.2 Instruction for digital display system

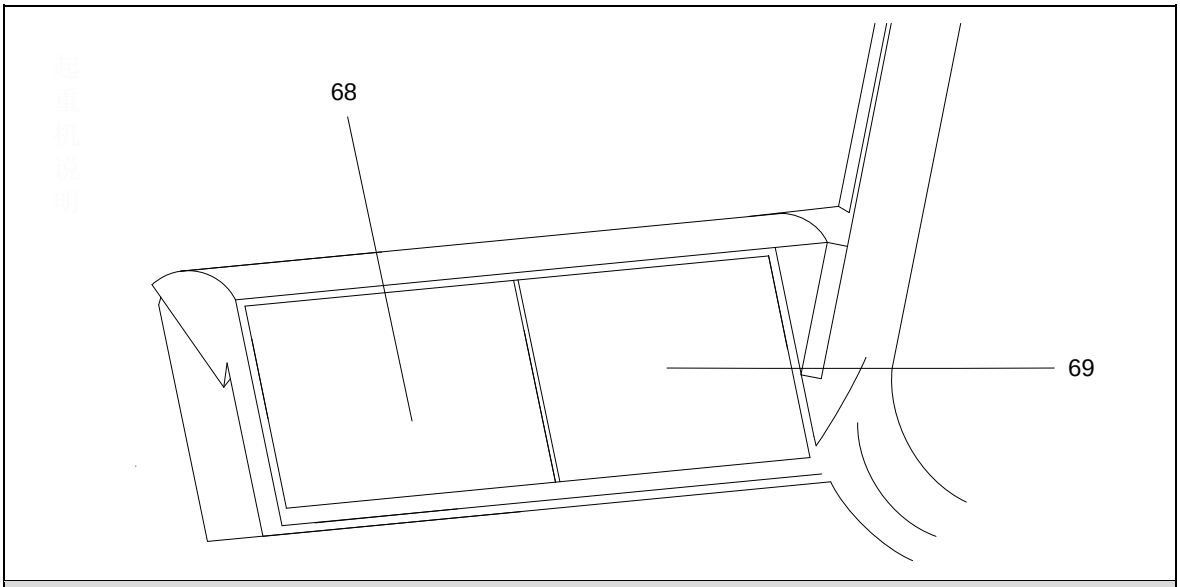


Figure 4-6 Instruction for digital display system

Table 4-6 "Digital display" system

No.	Description	Function
68	Load moment limiter	Display the information about crane
69	LCD screen of parameter monitor	Display the information about crane parameter monitor

4.2.1 Load moment limiter

As to detailed operation, refer to ***Load Moment Limiter Operating Manual***.

4.2.2 LCD screen of parameter monitor

It can display the working state of crawler crane in real time. When abnormal conditions occur, the corresponding icons on the screen will flash. The LCD screen can show engine speed, wind speed, voltage, water temperature, oil pressure, oil level, load, pressure of pumps etc.

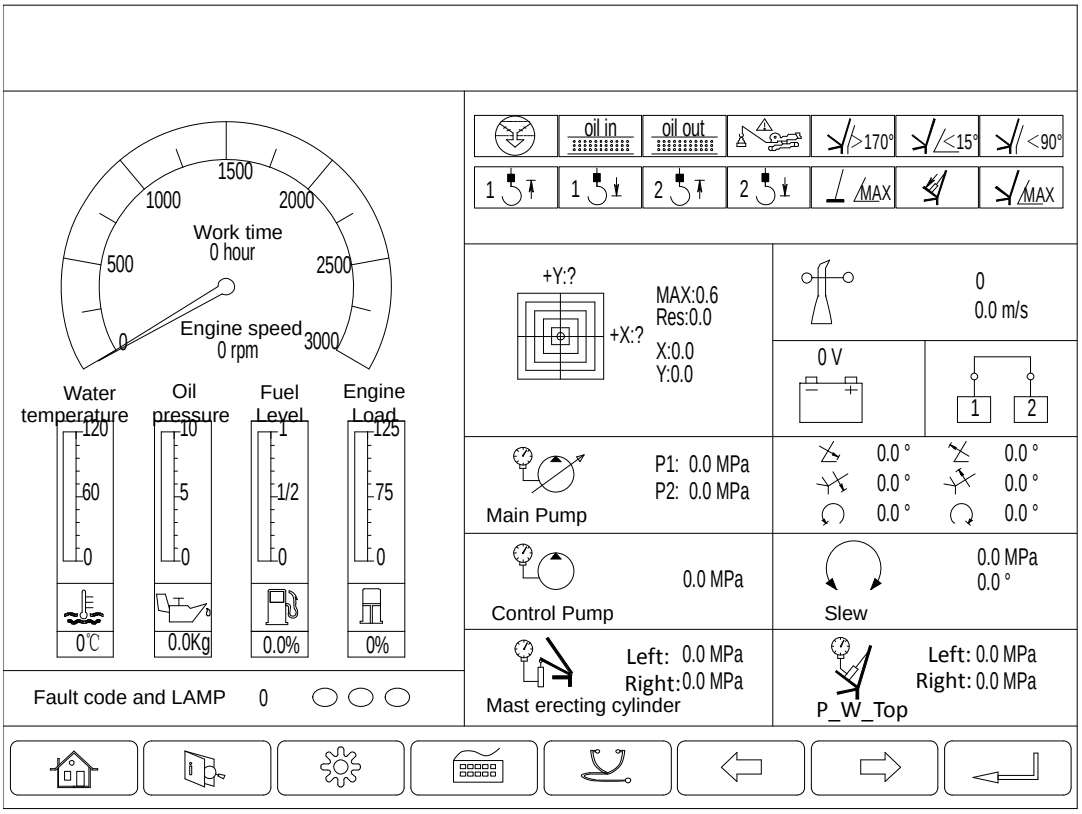


Figure 4-7 Main screen of parameter monitor

The main screen is subdivided into six main areas.

Engine information

Alarm functions

Monitored additional functions

Pressure and slewing angle

Firewall (anti-collision) function

Function key area

4.2.2.1 Engine information

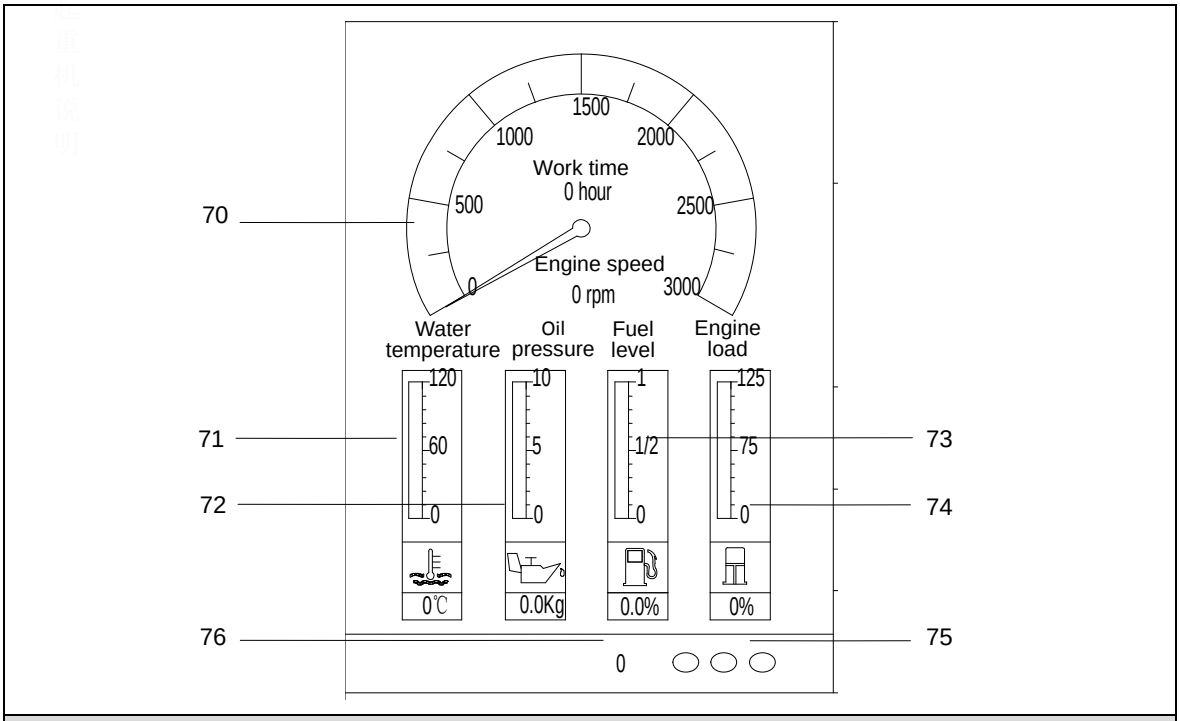


Figure 4-8 Display of engine information

Table 4-7 Display of engine information

No.	Description
70	Display of engine speed and working time
71	Display of water temperature
72	Display of engine oil pressure
73	Display of fuel level
74	Display of engine load
75	Control light "Engine fault"
76	Engine fault code

CAUTION

The fuel level(73) and engine load(74) are shown in percentage.

4.2.2.2 Alarm functions

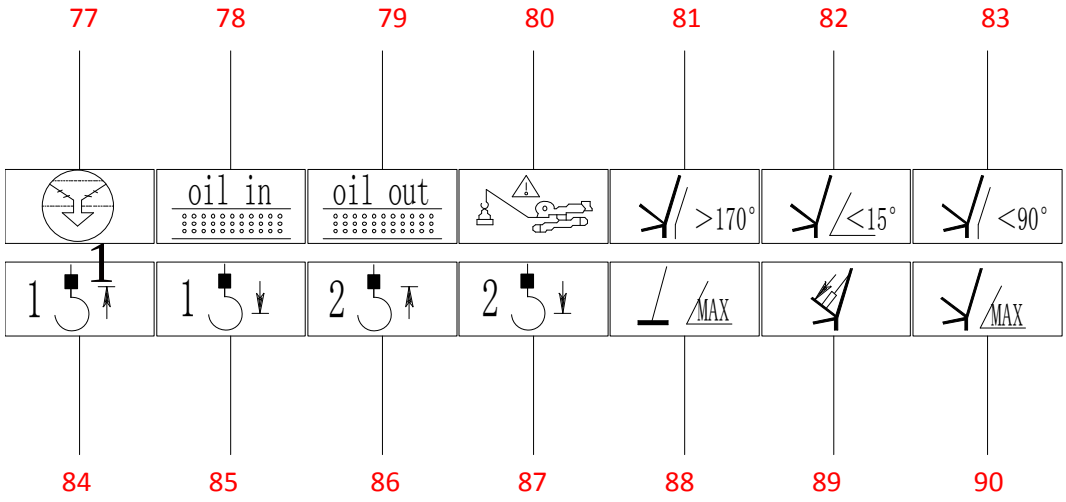
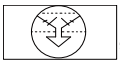
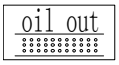
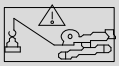
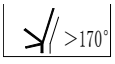
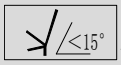
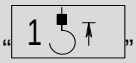
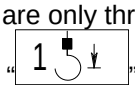
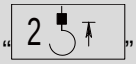
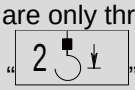


Figure 4-9 Display of alarm functions

The limit ranges of crane working state are monitored. The following icons will flash when the limits are reached.

Table 4-8 Display of alarm functions

No.	Description	Function
77	Icon "Air filter clog"	If air filter is clogged, the icon "  " will flash.
78	Icon "Oil inlet pipe clog"	If the oil inlet pipe is clogged, the icon "  " will flash.
79	Icon "Oil return pipe clog"	If the oil return pipe is clogged, the icon "  " will flash.
80	Icon "Crane overload"	When crane is overloaded, the icon "  " will flash.
81	Icon "Angle between main boom and luffing jib"	When the angle difference between main boom and luffing jib in counterclockwise direction is less than 10°, the icon "  " will flash.
82	Icon "Luffing jib angle＜15°"	When the luffing jib angle is less than 15°, the icon "  " will flash.
83	Icon "Angle between main boom and luffing jib ＜90°"	When the angle between main boom and luffing jib is

		less than 90°, the icon "  " will flash.
84	Icon "Upper limit switch on H1"	When the load hook runs against the hoisting limit switch on H1 during its upward movement, the icon "  " will flash.
85	Icon "Lower limit switch on H1"	When there are only three windings of wire rope left on H1, the icon "  " will flash.
86	Icon "Upper limit switch on H2"	When the load hook runs against the hoisting limit switch on H2 during its upward movement, the icon "  " will flash.
87	Icon "Lower limit switch on H2"	When there are only three windings of wire rope left on H2, the icon "  " will flash.
88	Icon "Main boom, 87°"	When main boom is raised to 87° position, the icon "  " will flash.
89	Icon "Tilting-back support accumulator cylinder for luffing jib strut 1"	When tilting-back support accumulator cylinder for luffing jib strut 1 is retracted to limit position, the icon "  " will flash.
90	Icon "Tilting-back support for luffing jib"	When tilting-back support for luffing jib is retracted to limit position, the icon "  " will flash.

4.2.2.3 Monitored additional functions

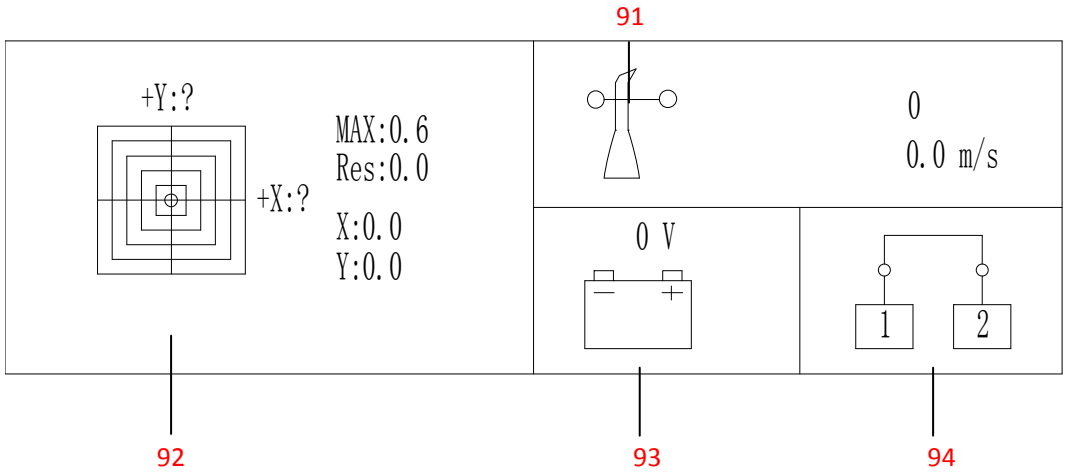


Figure 4-10 Monitored additional functions

Table 4-9 Display of monitored additional functions

No.	Description	Function
91	Wind speed	Display the current wind speed at boom head detected by anemometer
92	Crane inclination	Display the inclination of crane to the horizontal in longitudinal and lateral direction Note: The traveling direction of crane is taken as positive direction.
93	Voltage of system	Display the voltage of crane system
94	CAN bus status	When the controller bus is working properly, the dots will bounce up and down. Otherwise, they will stand still. NO.1 is PLC2024, and NO.2 is PLC2023.

4.2.2.4 Display of pressure and slewing angle

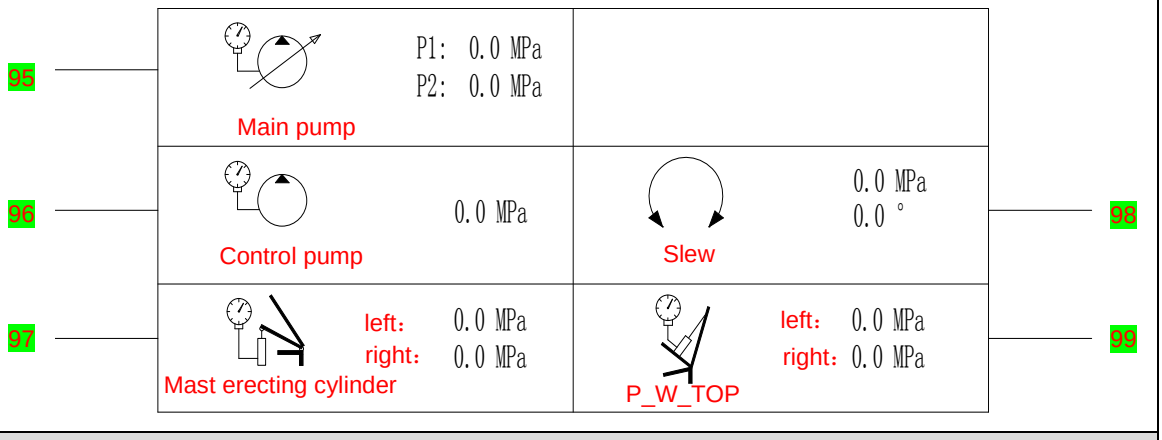


Figure 4-11 Display of pressure and slewing angle

Table 4-10 Display of pressure and slewing angle

No.	Description
95	Display of pressure in main pumps 1 and 2
96	Display of pressure in control pump
97	Display of pressure in left and right erection cylinders of A-frame
98	Display of pressure in slewing pump and slewing angle
99	Display of pressure in left and right tilting-back support cylinders for luffing jib strut 1

4.2.2.5 Firewall (anti-collision) function

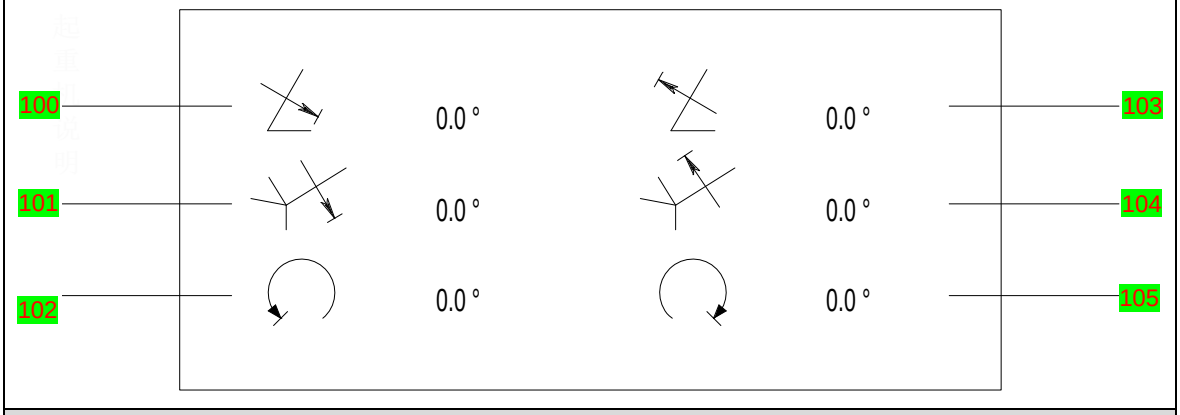


Figure 4-12 Firewall (anti-collision) function

Table 4-11 Description of firewall (anti-collision)

No.	Description	Remarks
100	Display of lower angle limit of main boom	When firewall setting is required, the main boom angle can be set in the setting page.
101	Display of upper angle limit of main boom	
102	Display of lower angle limit of luffing jib	When firewall setting is required, the luffing jib angle can be set in the setting page.
103	Display of upper angle limit of luffing jib	
104	Display of slewing leftwards limit	When firewall setting is required, the slewing angle can be set in the setting page.
105	Display of slewing rightwards limit	

4.2.2.6 Function key area

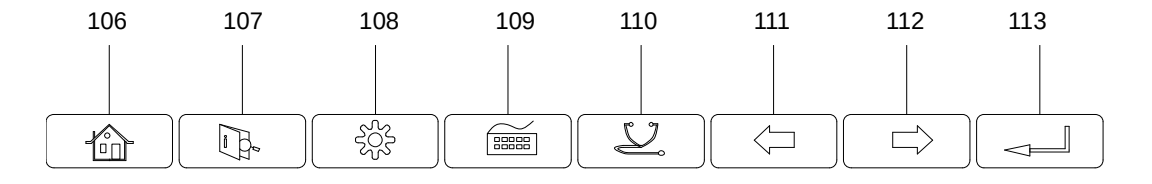
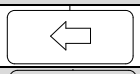
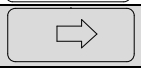
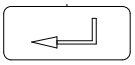


Figure 4-13 Function key area

Table 4-12 Description of function key area

No.	Description	Remarks
106	Key "main screen"	Pressing this key in any other screen can switch to "main screen" directly. The main screen is shown in the figure 4-7.
107	Key "I/O"	Press this key to enter "I/O screen". In this screen, all the input/output points of PLC can be checked for correction.
108	Key "Parameter adjustment"	This key is used to adjust relevant parameters of main motions and firewall function.
109	Language	The language can shift among Chinese, English and Russian via this key.
110	Key "working conditions"	Pressing this key can switch to "Working conditions" screen. In this screen, the required working conditions for various crane motions can be displayed. Accordingly, the work status of all mechanisms can be checked.
111		Page up
112		Page down
113		Confirm the previous operation or save the modified parameters.

Never adjust the parameters without our engineer's permission.

4.3 Startup of the crane

4.3.1 Adjustment of crane operator's seat

4.3.1.1 Vertical adjustment of headrest

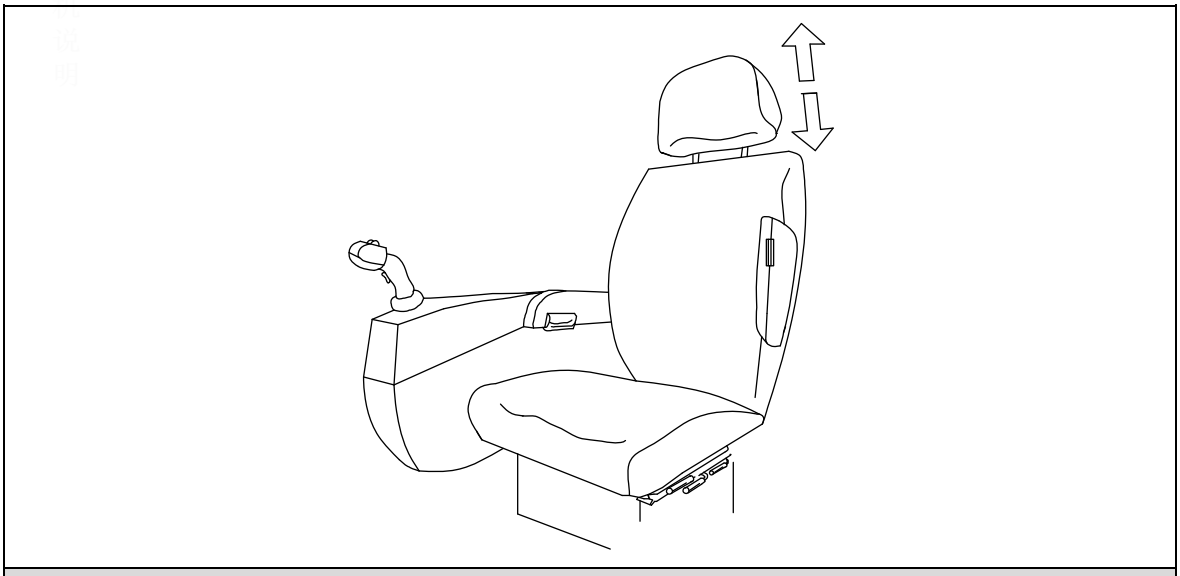


Figure 4-13 Vertical adjustment of headrest

The height of headrest can be adjusted manually with proper strength.

4.3.1.2 Adjustment of armrest

The height of armrest can be adjusted by adjusting knobs.

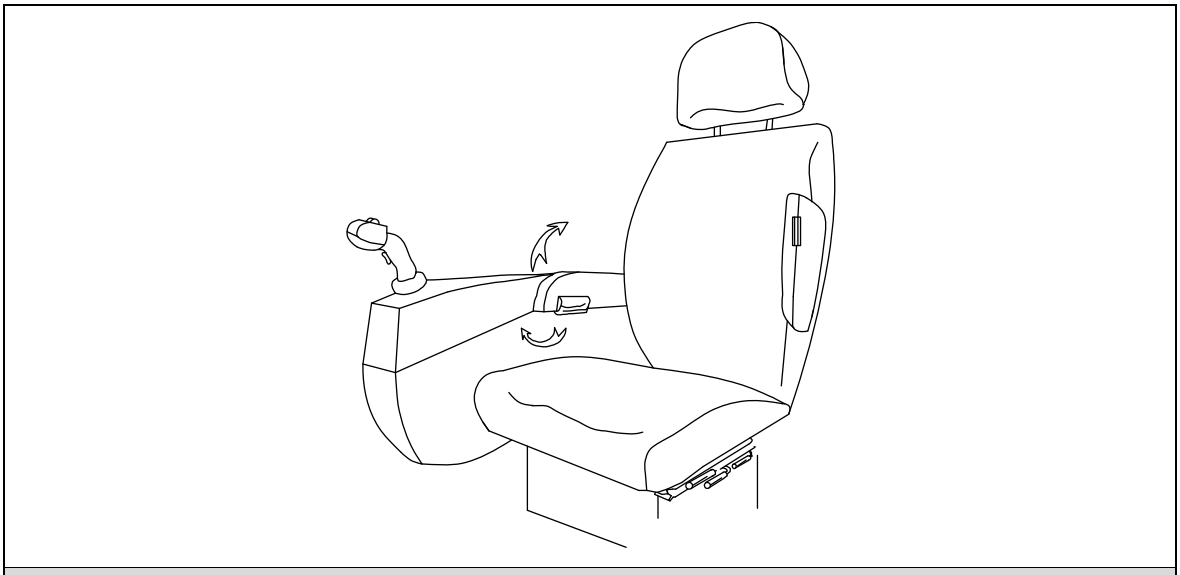


Figure 4-14 Adjustment of armrest

4.3.1.3 Horizontal adjustment of seat

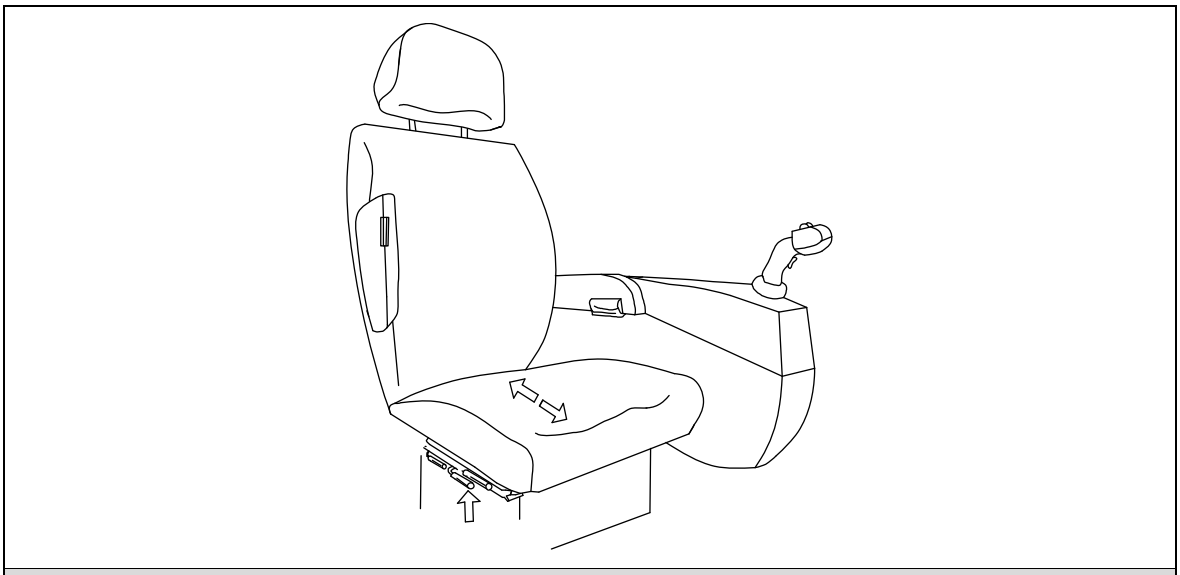


Figure 4-15 Horizontal adjustment of seat

Pull the lever upwards.

Move the seat to required position.

Release the lever.

4.3.1.4 Adjustment of the seat height

There are two levers to adjust the seat height. The front lever adjusts the height of front part of the seat, and the rear lever adjusts the height of rear part of the seat.

Pull the lever upwards, the front part of the seat is raised up.

Pull the lever upwards, the rear part of the seat is raised up.

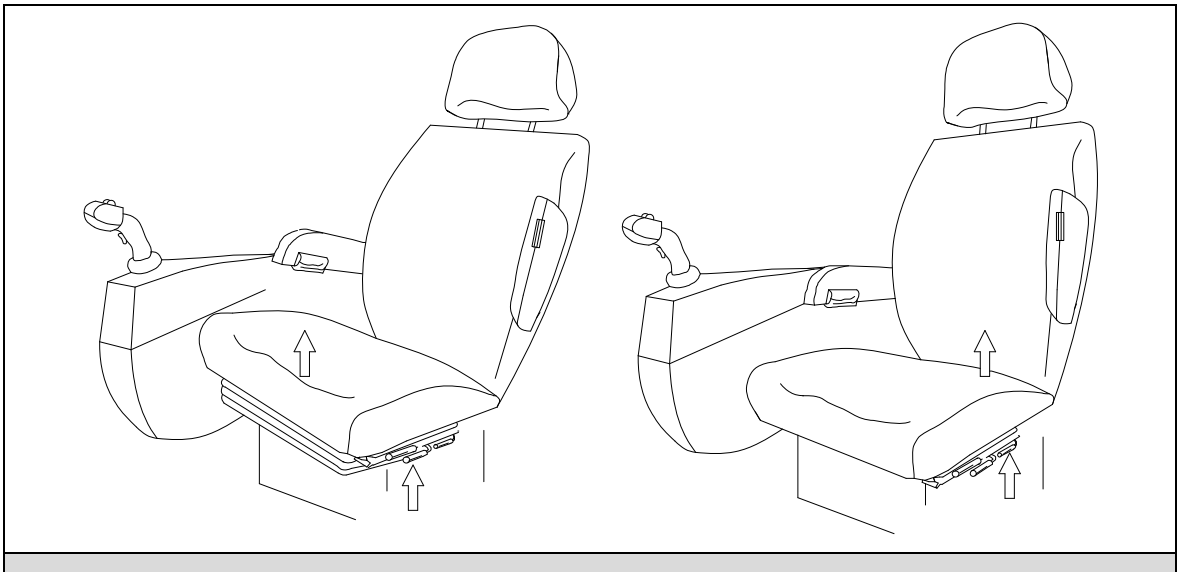


Figure 4-16 Adjustment of the seat height

4.3.1.5 Adjustment of backrest

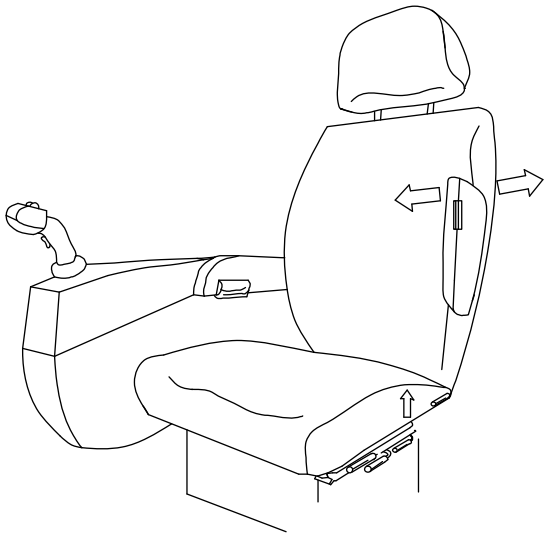


Figure 4-17 Adjustment of backrest

Pull the horizontal adjustment lever upwards, pull the backrest to proper position and release the lever.

4.3.2 Checks before startup

The following checks should be performed before startup of the engine.

a) Check oil filter and oil level
   1) Oil level of diesel engine
   2) Oil level of hydraulic oil tank
   3) Oil filter on hydraulic oil tank.

b) Check coolant level
   Add coolant to the rim on the filling nozzles.

DANGER

Never check the coolant level before the engine is cooled down. Otherwise, you may get scalded.

c) Check the general conditions of the crane
   Before starting up the crane, the operator must ensure that the following conditions are fulfilled:
   1) The crane is horizontally aligned.
   2) The gear of slewing ring must be clean and greased.☐
   3) The air inlet of oil coolant radiator is not blocked.☐
   4) All cowlings and covers on the sides must be closed and locked. ☐
   5) No person or object is within the slewing radius of the crane.
   6) No ice or snow is on wire rope, winding drum and limit switches.
   7) There are no loose parts on slewing table or on the boom.
   8) The shutoff valve on hydraulic oil tank should be opened.
   9) The battery master switch must be placed in "ON" position. Otherwise, the whole machine cannot be energized.

DANGER

Before carrying out any boom movements, make sure that there are no loose parts on the boom such as pin, retaining spring or ice. Otherwise, the falling parts may hit persons or other objects.

4.3.3 Turn on power supply

Insert ignition key into ignition lock and turn it clockwise to the 1st position, then the power supply is turned on.

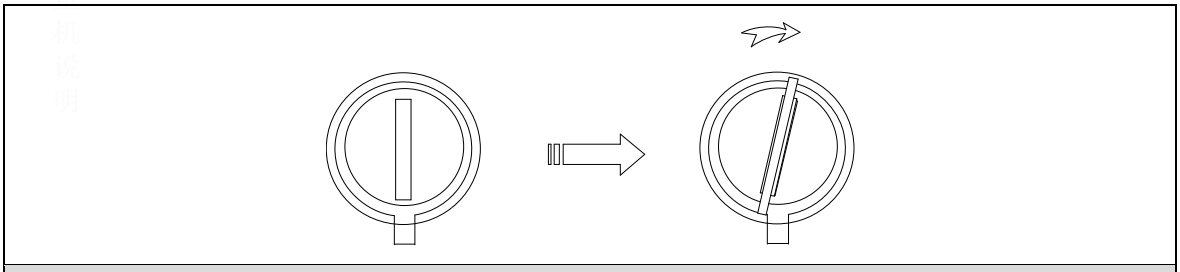


Figure 4-18 Turn on power supply

a) Digital display system

After the power supply is turned on, the LCD screen of load moment limiter and LCD screen of control system are started.

Check the following indicators and warning icons:

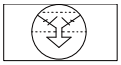
1) Icon "Engine oil pressure" (72) ☐
2) Icon "Fuel level" (73)
3) Icon "Air filter clog" (77)
4) Inclinometer (92)
5) Anemometer (91)
6) Voltage (93)
7) Bus (94)

CAUTION

(1) Correctly set current work mode on load moment limiter, otherwise, operation is not permitted to be carried out.

(2) Low engine oil pressure will impair the working efficiency of engine.

(3) Add diesel oil in time if the oil level is too low.

(4) If air filter is clogged, the icon "air filter clog"  **will flash. At this moment, clean or change air filter.**

(5) The inclination range for the superstructure: the inclination should be less than 1% in both lateral direction and longitudinal direction. If this range is exceeded, the crane operator must adjust the crane to horizontal position firstly.

(6) The maximum in-service wind speed should not exceed 9.8 m/s.

(7) The maximum out-of-service wind speed should not exceed 21 m/s when the crane is only fitted with main boom;

The maximum out-of-service wind speed should not exceed 15 m/s when the crane

is fitted with main boom and fixed jib.

If wind speed reaches or exceeds these values, the entire boom should be lowered down.

b) Right control panel

1. Illumination

Press the switch (44), the interior light in the cab will light up.

Turn the master lighting switch  to the 1st position or the 2nd position, the LED on the switches of the control panel will light up.

Press the switch  , working floodlight on slewing table will light up.

CAUTION

Before switching on the working floodlight switch  , put the master lighting switch  on the 2nd position.

2. Windshield wiper and washer

Turn on front windshield wiper and roof windshield wiper by pressing the front windshield wiper switch and roof windshield wiper switch  respectively.

When front windshield needs to be washed, please press the "front windshield washer" switch  .

3. Fan

There is a fan fitted on the rear right side of the operator's cab. Turn on the switch, the fan will run.

4. Horn☐

Check if the horn is working properly with foot-operated switch before work.

CAUTION

The horn must be actuated before starting the engine to warn the person in the vicinity of the crane.

4.3.4 Start the engine

Insert the ignition key into the ignition lock and turn it clockwise to the POWER position, and continually turn it clockwise to the START position, then the engine is started.

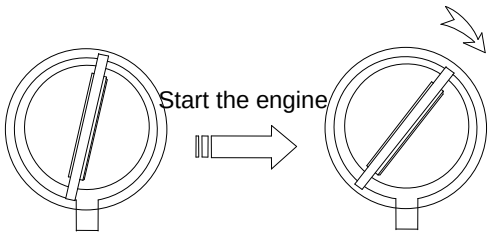
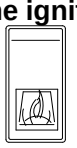


Figure 4-19 Start the engine

CAUTION

(1) When ambient temperature is low, the engine will be preheated automatically before startup. Therefore, the delay of engine startup in cold climate is a normal phenomenon.

(2) In extremely cold weather (ambient temperature < -10°C), to start the engine, you need to start the engine cold starting device first.
Place the controller power (if any) in the "Stop" state, the ignition start switch in the "Power" position, the cold starting rocker switch  **in II position, and then start the cold starting device and keep it running for about 10 minutes, finally start the engine.**
In addition, if the engine works in a cold environment with a low water temperature, the cold starting device can also be used to increase the water temperature so as to keep the water temperature within the normal working range.

(3) The engine cannot work with full load until the running temperature is reached.

4.4 Safety devices

The crane operator must check all safety devices for functional work before every crane operation.

DANGER

Operating crane with faulty safety devices is prohibited!

4.4.1 Emergency stop button

As soon as this emergency stop button is pressed,

– The electrical control system is switched off and the diesel engine shuts down.

– All crane movements stop immediately.

DANGER

The emergency stop button must only be used in case of emergency and not as a normal procedure for shutting down the diesel engine!

If an emergency stop is triggered while a load is being lifted, there may be a risk of accident owing to swinging of load.

4.4.2 Battery master switch

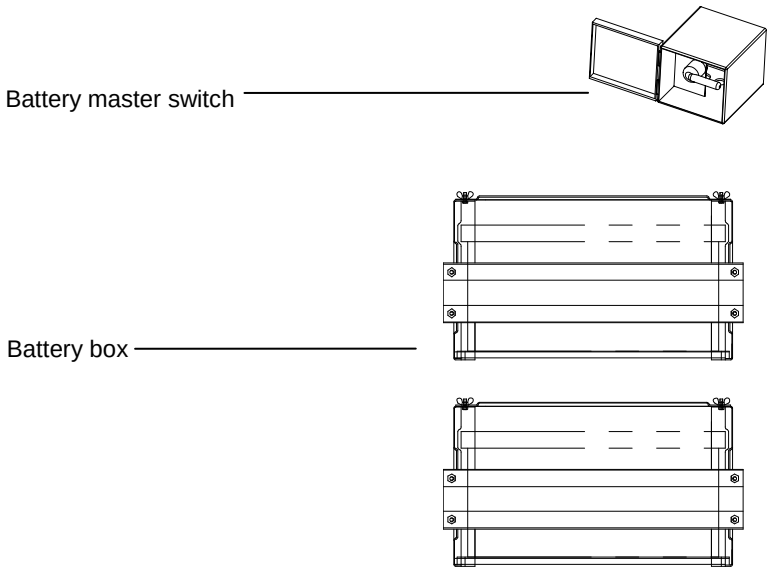


Figure 4-20 Position of battery master switch

The battery master switch is put in the rear right side of the slewing table, near the battery, which is described above. When the crane doesn't work at night or for a long time, the battery master switch should be put in "OFF" position to prevent the battery from discharging.

4.4.3 Load moment limiter

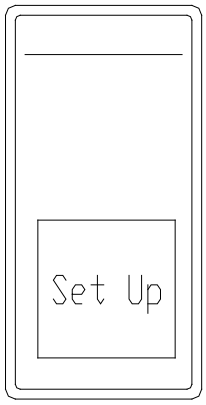
The load moment limiter switches off all crane movements that increase the load moment if the permissible load moment is exceeded. Only crane movements that reduce load moment can be carried out. Although the crane is equipped with load moment limiter, the operator can't escape the responsibility of unsafe operation. Before lifting a load, he must know the approximate weight of the load and decide if the crane is in a position to carry out this job with the help of load capacity chart.

DANGER

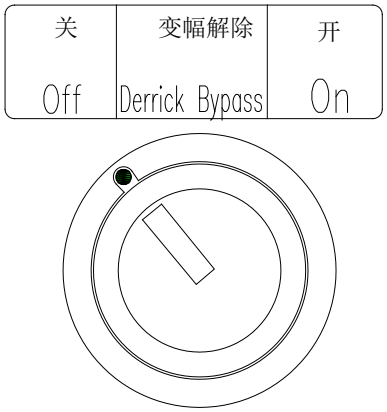
Before operating the crane, the load moment limiter must be adjusted to the current setup condition according to the lifting capacity chart. Only this way can it be able to fulfill its protective task. If the crane operator does not observe this safety regulation, there is a great danger of toppling or destroying the crane, despite the load moment limiter is working normally. The load moment limiter cannot monitor and control all possible operating conditions, which is still primarily the responsibility of the operator.

4.4.3.1 The moment percentage between 100%-110%

If the moment percentage shown on the load moment limiter is between 100%-110%, it means that the actual load of the crane is between 100%-110% of the rated load. At this time, the crane movements "spool up hoisting winch 1 or 2", "spool up derricking winch" and "reel off derricking winch" are limited. The tricolor light sends out red warning, and the buzzer sounds continuously.



"Setup" switch



"Derricking bypass" switch

Figure 4-21 Derricking bypass operation

When the control lever is in neutral position, press "Setup" switch and then release it, the limited movements "spool up hoisting winch 1 or 2" and "reel off derricking winch" will be bypassed, and the speeds of limited movements will be reduced. Meanwhile the icon  is shown on the load moment limiter.

When the control lever is in neutral position, press "Setup" switch and then release it, and turn the "derricking bypass" switch to the right as shown in the above figure, the limited movements "spool up hoisting winch 1 or 2", "spool up derricking winch" and "reel off derricking winch" will be bypassed, and the speeds of limited movements will be reduced. Meanwhile the icon  is shown on the load moment limiter.

4.4.3.2 The moment percentage more than 110%

If the moment percentage shown on the load moment limiter is more than 110%, it means that the actual load of the crane is 110% of the rated load. At this time, the crane movements "spool up hoisting winch 1 or 2" , "spool up derricking winch" and "reel off derricking winch" are limited. The tricolor light sends out red warning, and the buzzer sounds continuously.

When the control lever is in neutral position, turn "bypass key" switch clockwise and then release it, the limited movements "spool up hoisting winch 1 or 2" , "spool up derricking winch" and "reel off derricking winch" will be bypassed. However, the maximum derricking angle cannot be exceeded. The speeds of limited movements will be reduced. Meanwhile the icon 

is shown on the load moment limiter.

4.4.3.3 Unspecified rated load

If the load moment limiter enters the unspecified rated load work range, the crane movements "spool up hoisting winch 1 and 2" and "reel off derricking winch" are limited. The tricolor light will send out red warning, and the buzzer will sound continuously.

When the control lever is in neutral position, press "Setup" switch and then release it, the limited movements "spool up hoisting winches 1 and 2" and "reel off derricking winch" will be bypassed. The movements will be carried out at normal speed. Meanwhile the icons  and 

are shown on the load moment limiter.

CAUTION

(1) "Bypass" means when overload appears and the movement is limited, the operator get the permission to operate towards dangerous direction temporarily via this switch, but it doesn't mean that it excludes overload.

(2) Only when the control lever is in neutral position, can the "Setup" switch and safety bypass switch be operated, otherwise, it will be invalid.

(3) Press the "Setup" switch once and it will be activated.
The "Setup" switch will be invalid under one of the following situations:

- **Press the switch the second time.**
- **The control lever returns to neutral position for more than 10 seconds.**
- **The engine stops.**

(4) "Safety bypass" works if turn it for the first time. Turn it again, the engine stops or the working time is more than 30 minutes, it will be invalid.

(5) The movement will be slower after the "safety bypass" releases the safety restriction.

(6) The icon  **shows on the load moment limiter when the "safety bypass" switch works.**

(7) The "safety bypass" switch is placed in electrical control box for slewing table.

(8) The "safety bypass" switch can only be used by professionals and can't be used as a device for normal operation.

DANGER

(1) Bypassing the overload safety device through "safety bypass" switch can only be operated when professional supervisor is present and with special care.

(2) If bypassing the overload safety device, there will be no protective device to prevent overloading, which will increase the chance of accident!

4.4.4 Boom angle indicator

Boom angle indicator is fitted on the lower rear end of main boom pivot section (i.e. on the right side of the crane operator's cab). In this way, the operator, even in crane operator's cab, can clearly read boom angle shown on the indicator.

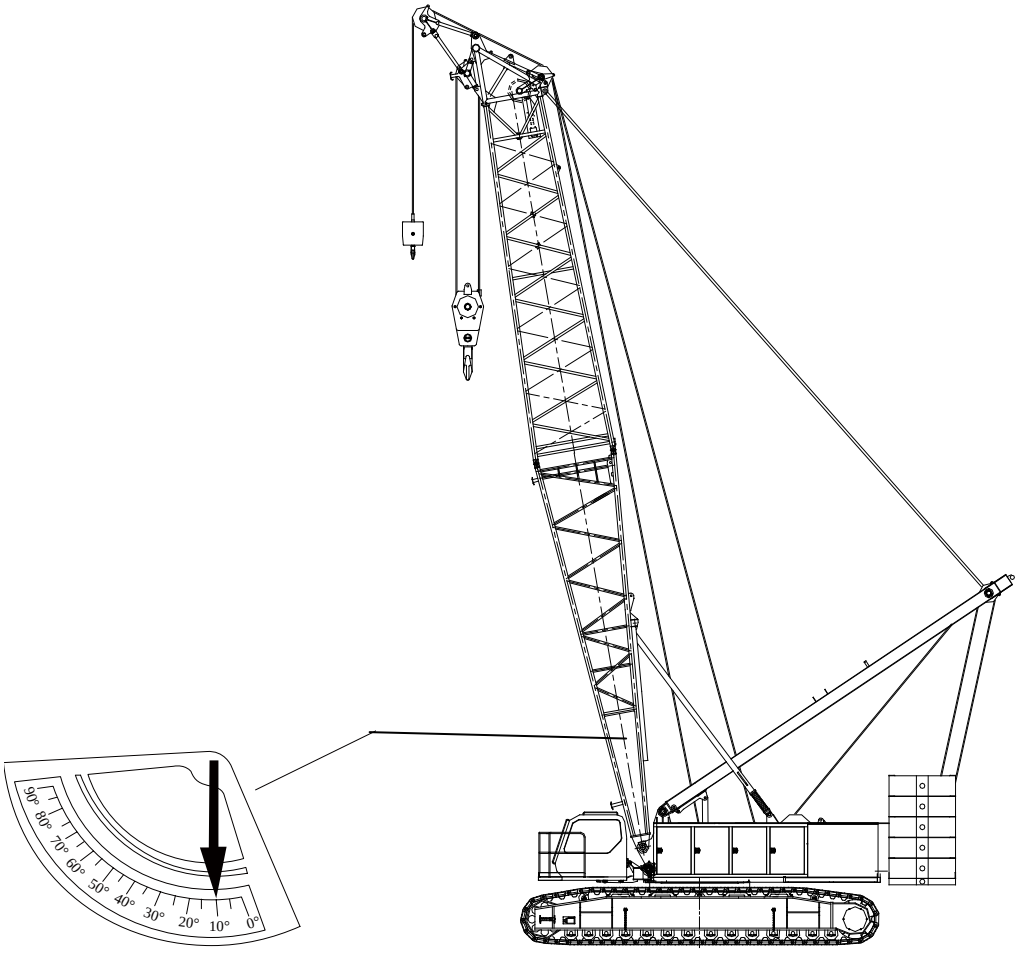


Figure 4-22 Boom angle indicator

4.4.5 Derrick limiter

It is used to detect main boom angle in real time according to the data collected by angle sensors. Once detected angle exceeds safe angle range, an alarm will be sent out and dangerous movements will be switched off so as to ensure safe crane operation.

4.4.5.1 Crane operation with main boom

When main boom angle is more than 30°, the system will be automatically switched to work mode. When main boom angle reaches 80°, the buzzer will sound. However, main boom is permitted to be raised up.

When main boom angle reaches 83°, the crane movement "raise main boom" will be cut off automatically and the buzzer will sound continuously. At this time, only "lowering main boom" is permitted.

4.4.5.2 Crane operation with main boom and fixed jib

The requirements for main boom angle under this boom configuration are the same as that under "Main boom" configuration. The fixed jib can be fitted in the angle of either 10° or 30° to main boom.

4.4.5.3 Crane operation with main boom and luffing jib

1) When the main boom is raised to 80° position, the main boom derrick speed will reduce to half of the original.
2) When the main boom is raised to 87° position, the system will cut off the movement "raise main boom" automatically and give an alarm.
3) When the main boom lowers to 65°, the system will cut off movement "lower main boom" and give an alarm. After switching to "assembly mode" or press "Setup" switch, the main boom can still be lowered down.
4) When the lower angle between main boom and luffing jib is less than 85°, crane movements "raise main boom" and "lower luffing jib" will be stopped automatically in "assembly mode" and "working mode".
5) When the upper angle between main boom and luffing jib is more than 10° and less than 15°, the luffing jib derrick speed will reduce to half of the original.
6) When luffing jib angle is 10° less than main boom angle, the system will cut off the movement "raise luffing jib" and give an alarm.
7) When the luffing jib angle is less than 15°, crane movement "lower luffing jib" will be stopped automatically. After switching to "assembly mode" or press "Setup" switch, the luffing jib can still be lowered down.

CAUTION

Under this boom configuration with main boom angle of 85°: when luffing jib angle exceeds 60°, the luffing jib with a load should not be raised / lowered at high speed. And the load should be the min. lifting capacity under this boom configuration, otherwise the luffing jib is liable to tilt backwards. Before the load is detached from the load hook, lower the luffing jib to a position(less than 60°). In other words, lower the luffing jib below 60° by the pulling force of load.

4.4.6 Lowering limiter

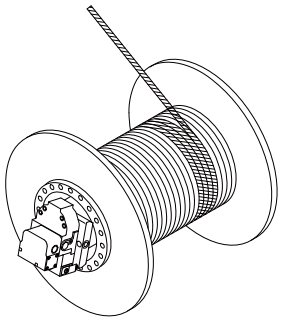


Figure 4-23 Lowering limiter

In order to prevent wire rope from being wound in the opposite direction after it is unwound completely, the lowering limit switches fitted on hoisting winches 1 and 2 are triggered when there are only 3 windings of wire rope left on the drums. Under this condition, the buzzer will sound, and the icons  and  on the main screen will flash. At this time, the movement "reel off hoisting winch" is switched off, and only the movement "spool up hoisting winch" can be carried out.

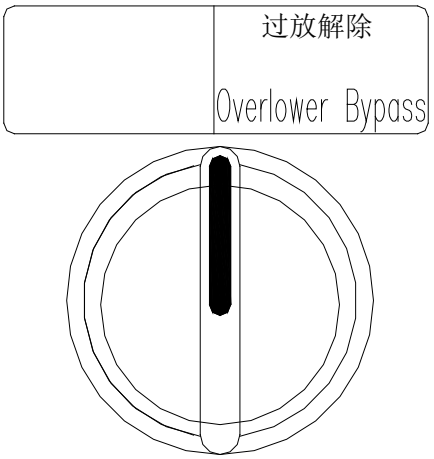


Figure 4-24 Lowering bypass

Turn the "lowering bypass" switch to the right as above, the limited movement "reel off hoisting winch 1 or 2" will be bypassed, and the icon  is shown on the load moment limiter at the same time.

CAUTION

(1) "Bypass" means when overlowering appears and the movement is limited, the operator can get the permission to operate towards dangerous direction temporarily via this switch, but it doesn't mean that the lowering limit situation is removed.

(2) The bypass of lowering limiter must be guided by a professional. He must contact with the crane operator directly and monitor the residual length of the wire rope all the time. Great care is needed to operate the crane.

DANGER

If the lowering limiter is bypassed, there will have no protective device to prevent wire over-lowering, which will increase the chance of accident!

4.4.7 Hoisting limiter

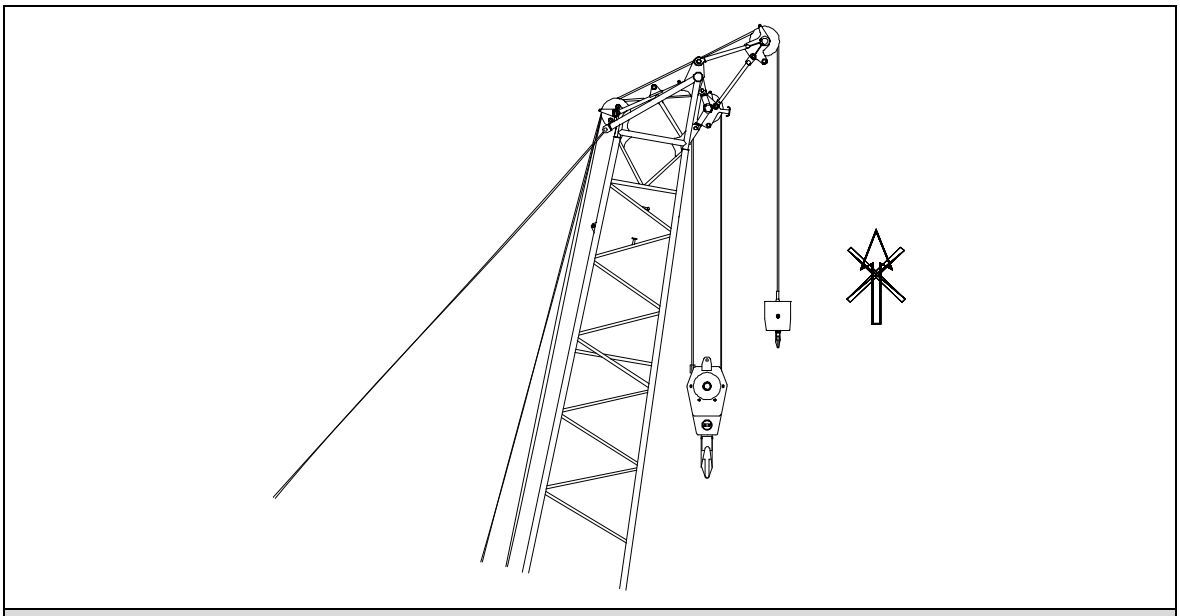


Figure 4-25 Hoisting limiter

If the load hook comes into contact with the hoisting limit switch weight during its upward movement, the hoisting limit switch is triggered, the buzzer sounds, and the crane movement "Spool up hoisting winches 1 and 2" and "reel off derricking winch" are switched off. The icons  and  on the screen will flash.

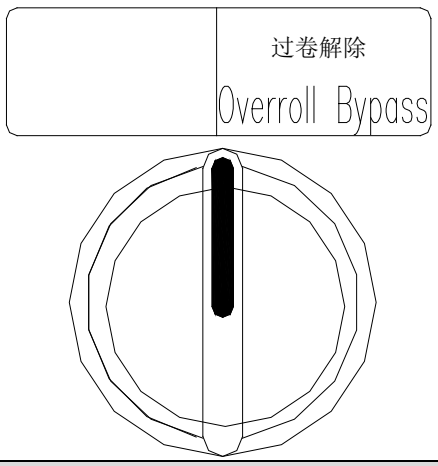


Figure 4-26 Hoisting bypass

Turn the "hoisting bypass" switch to the right as above, the cut-off movement "spool up hoisting winch H1 or H2" and "reel off derricking winch" will be bypassed, the tricolor light will send out yellow warning, the buzzer will sound continuously, and the icon  is shown on the load moment limiter at the same time.

CAUTION

(1) "Bypass" means when over-hoisting appears and the movement is limited, the operator can get the permission to operate towards dangerous direction temporarily via this switch, but it doesn't mean that the hoisting limit situation is removed.

(2) The bypass of hoisting limiter must be guided by a professional. He must contact with the crane operator directly and monitor the residual length of the wire rope all the time. Great care is needed to operate the crane.

DANGER

If the hoisting limiter is bypassed, there will be no protective device to prevent wire over-hoisting, which will increase the chance of accident!

4.4.8 Support cylinder locking device

When the high pressure oil pipe, which is connected to support cylinder, is damaged, the bidirectional hydraulic lock fitted in oil circuit can prevent pressure oil in the two chambers of support cylinder from flowing outside so as to avoid cylinder retracting or extending, and thus guaranteeing the safety of assembly and dismantling of the crawler crane.

4.4.9 Relief valve

The relief valve in the hydraulic system can restrain the pressure in the circuit from rising irregularly, thus protecting such hydraulic elements as hydraulic oil pump and hydraulic motor against damage and preventing the hydraulic system from being overloaded.

4.4.10 Anemometer

The anemometer fitted on the boom head can detect the wind speed in real time.

When the in-service wind speed exceeds 9.8 m/s, the crane operation should be stopped immediately.

When the out-of-service wind speed for "Main boom" configuration exceeds 21 m/s, the entire boom should be placed on the ground.

When the out-of-service wind speed for "Main boom with fixed jib" configuration exceeds 15 m/s, the entire boom should be placed on the ground.

The operator should constantly observe the wind speed displayed on the screen.

4.5 Crane operation

1. Prerequisites for crane operation
   a) The counterweight is fitted and secured according to load capacity charts.
   b) The crane is horizontally aligned with enough bearing capacity of the ground.
   c) The diesel engine is running.
   d) The hook block is properly reeved in accordance with the reeving chart.
   e) All safety devices are set in accordance with the load capacity charts.
   f) No person and object are within danger zone.

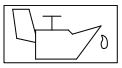
CAUTION

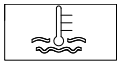
(1) Always operate the control lever slowly and carefully. This can not only ensure longer service life of crane, but also help to avoid accidents.

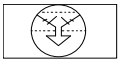
(2) During all crane movements, make sure there are neither obstacles nor persons in the danger zone.

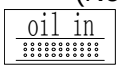
(3) Before every crane operation, at least an acoustic signal should be given.

Before engine startup, ensure that the following icons on the screen will not flash.

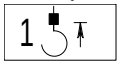
(1) Icon "Engine oil pressure"  (No.72)

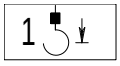
(2) Icon "Water temperature"  (No.71)

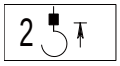
(3) Icon "Air filter clog"  (No.77)

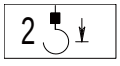
(4) Icon "Oil inlet pipe clog"  (No.78)

(5) Icon "Oil return pipe clog"  (No.79)

(6) Icon "Upper limit switch on H1"  (No.84)

(7) Icon "Lower limit switch on H1"  (No.85)

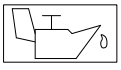
(8) Icon "Upper limit switch on H2"  (No.86)

(9) Icon "Lower limit switch on H2"  (No.87)

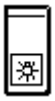
(10) Icon "Main boom, 87°"  (No.88)

WARNING

(1) If one of the above icons flashes during crane operation, stop the operation immediately and shut down the engine at once. Check the corresponding device and eliminate the fault.

(2) If the icon "Engine oil pressure"  **still flashes after engine starts, the engine should be shut down at once. If this operation is not done, the engine will be**

damaged caused by insufficient oil pressure.

(3) In order to see the positions of press-keys on the right control panel and the position of boom clearly when the crane works at night, the crane operator must turn on the LED on the keys of control panel, and the working light on the slewing table by placing master lighting switch  to the 2nd position, and then pressing "Working light on/off" switch  .

(4) During operation, always check the indicators on the display of load moment limiter. When carrying out crane movement, the operator must see the changing load condition and changing forces. The overloading condition should be recognized early, and the crane movement should be slowed down accordingly.

2. Checks during crane operation

   During crane operation, daily activate "automatic lubricating "sw  to lubricate every lubricating point for 1 to 2 hours. If the crane has been worked for a long time, press the "oil cooling f  switch to cool down the oil.

   The assistant observes the state of tricolor light on the right side of the slewing table.

   a. Green: normal (safe working state)
   b. Yellow: pre-warning (there exist dangerous factors and the buzzer sounds)
   c. Red: warning (dangerous situations occur, cut off the dangerous movements automatically)

3. The valid area for control lever movement

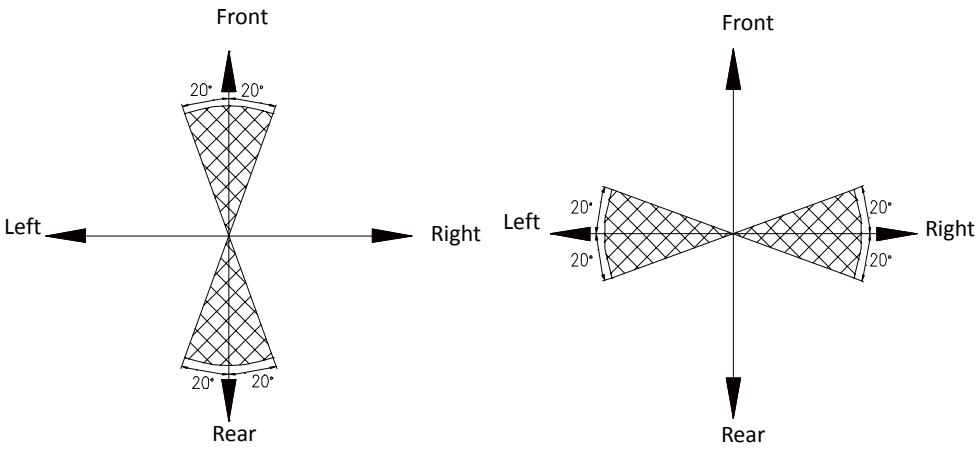


Figure 4-27 Valid area for control lever – single movement

When operating single movement by control lever, the valid area in front and rear direction of the control lever is -20°- 20°, the valid area in left and right direction is -20°- 20°,which is described as above in the grid.

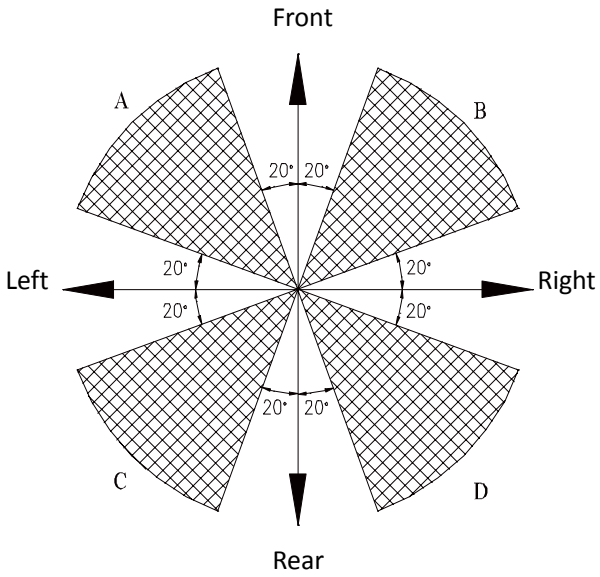


Figure 4-28 Valid area for control lever – simultaneous movement

When doing a simultaneous movement using a single control lever, the valid area for control lever movement is 20°- 70°, which is described in the above grid. The valid movement range for A, B, C, D areas is 50°.

4. Setting configuration

   For the specific methods to set configuration, please refer to load moment limiter instructions.

CAUTION

Set the corresponding configuration in the load moment limiter according to actual situation. Since the configuration will affect the control system on winch. The configuration must be set properly to avoid danger and accident.

5. "Speed setting" and the use of inching switch

   Speed setting switch can be divided into four shifts: slow, normal, middle and high. For details, please refer to section 4.5.1-4.5.4.

Table 4-12 Speed setting

Speed setting switch	Speed set	Function
Rocker switch 	Slow speed	When need to load in fixed position and position exactly, press the key, the system will design proper speed to work no matter how big the opening of the control lever, loading in fixed position and positioning exactly. The work range: hoisting winch 1, hoisting winch 2 and derricking winch.
Rotating switch 	Normal speed	The middle position of the switch means the automatic working speed of the system.
	Middle speed	When the hoisting winch needs a speed higher than "slow speed" shift, use middle speed.
	High speed	Raise the hoisting winch, travel, derrick and slew in high speed
"High speed" switch on left control lever	High speed	Raise hoisting winch H2, slew and left travel at high speed
"High speed" switch on right control lever	High speed	Raise hoisting winch H1, derrick and right travel at high speed

4.5.1 Operation of travel gear

4.5.1.1 Components of travel gear

The travel gear comprises drive sprocket, driven sprocket, track-carrier roller, track roller and track pad, crawler carrier as well as traveling reducer. Both right crawler carrier and left crawler carrier are fitted with an independent traveling reducer. The hydraulic oil in traveling motor is supplied by superstructure main pump through main valve and centre revolving joint.

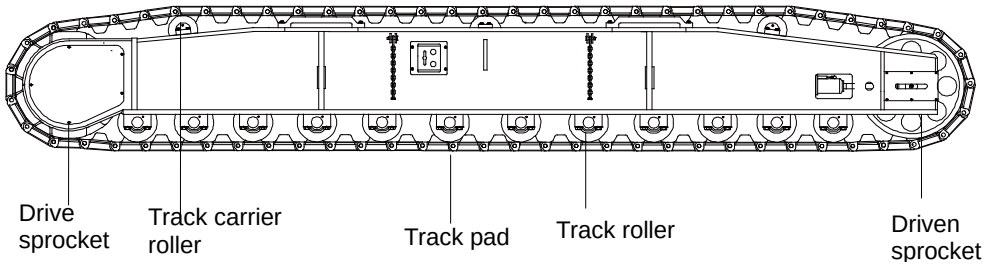


Figure 4-29 Travel gear

4.5.1.2 Operation of travel gear

The traveling movements are controlled by left and right control levers. The movements "left crawler forwards" and "left crawler backwards" are controlled by left control lever, and the movements "right crawler forwards" and "right crawler backwards" are controlled by right control lever. In this way, the crane can carry out such movements as traveling straight ahead/backwards, steering during traveling and turning on spot.

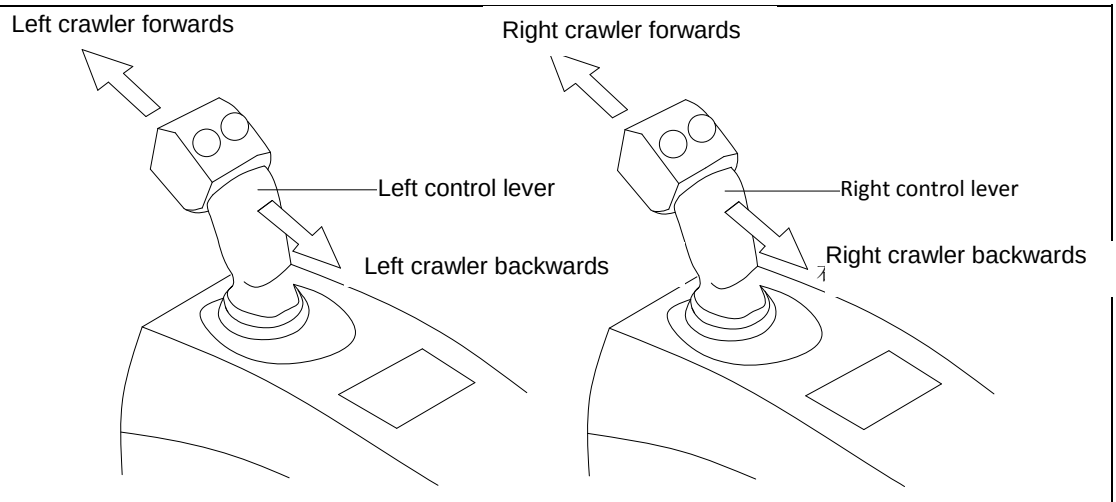


Figure 4-30 Operation of travel gear

Table 4-13 Operation of travel gear

Control lever	Operation	Movement
Left control lever	Move it forwards	Left crawler forwards
	Move it backwards	Left crawler backwards
	Return it to neutral position	Left crawler stops moving
Right control lever	Move it forwards	Right crawler forwards
	Move it backwards	Right crawler backwards
	Return it to neutral position	Right crawler stops moving

CAUTION

(1) Before carrying out traveling movement, the operator must first press traveling switch  , and then operate the control lever.

(2) When operate the control lever, first press deadman's button, then operate the control lever. Otherwise, the operation is invalid.

(3) The crane movements can still be carried out before the control lever is returned to neutral position with deadman's button released. However, to perform the next crane movement after returning the control lever to neutral position, the operator must press deadman's button first and then move the control lever. Otherwise, the operation of control lever is invalid.

(4) In normal operation, stop the crane movements by returning the control lever to neutral position.

4.5.1.2.1 Traveling on level road

Traveling straight ahead: move both control levers forwards at the same time
Traveling straight backwards: move both control levers backwards at the same time
Turning with a crawler
Turning to left: move right control lever forwards
Turning to right: move left control lever forwards

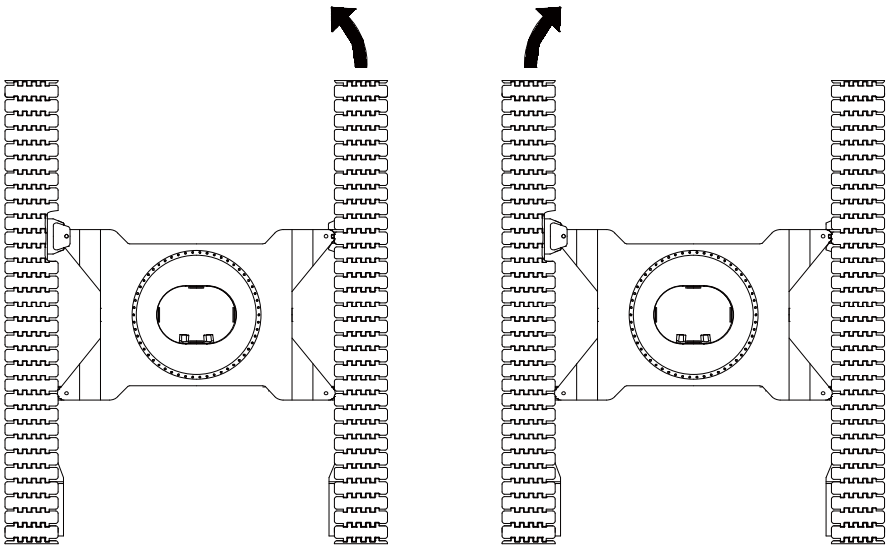


Figure 4-31 Turning to left with a crawler and turning to right with a crawler

CAUTION

When the crane is traveling with a crawler, the operator cannot use high-speed gear.

Differential steering:

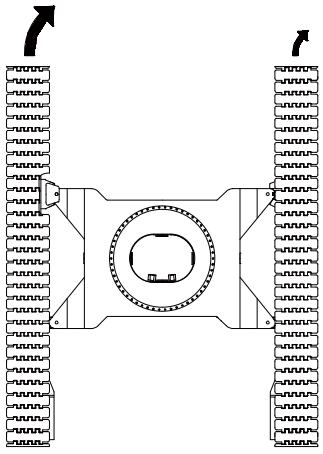


Figure 4-32 Differential steering

Steering to right: Push left control lever heavily and push right control lever slightly to make the speed of left crawler higher than that of right crawler

Steering to left: Push right control lever heavily and push left control lever slightly to make the speed of right crawler higher than that of left crawler

Turning on the spot:

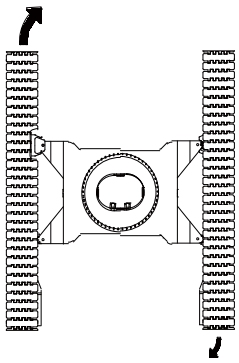


Figure 4-33 Turning on the spot

Turning to right: push right control lever backwards heavily, then right crawler will turn to left. Push left control lever forwards heavily, then left crawler will turn to right.

Turning to left: Push left control lever backwards heavily, then left crawler will turn to right. Push right control lever forwards heavily, then right crawler will turn to left.

CAUTION

(1) Leaving the crane in high gear is prohibited when the crane is turning.

(2) When there is a need to stop traveling or steering, return the control lever to neutral (zero) position, the traveling brake will be activated automatically.

(3) When the crane is traveling with a load for a long distance, it can only travel forwards with boom located straight ahead and the traveling reducer is behind the slewing table.

4.5.1.2.2 Traveling on slope

Make crawler crane travel forwards, and place slewing control lever in neutral (zero) position. When crawler crane is traveling uphill, the engine speed must be controlled within medium speed range. When crawler crane is traveling on a slope with maximum permissible gradient, it can only be fitted with basic boom, the counterweight is in uphill direction, and the drive sprocket must be in downhill direction. When it is travelling downhill, the drive sprocket is in uphill direction.

Turning on the slope

If crawler crane needs to turn on the slope, some treatments should be taken to the undulations to form a gentle slope curve (see the following diagram), which can prevent crane's center of gravity from deviating and load from concentrating on a section of crawler when crawler crane is traveling over undulations.

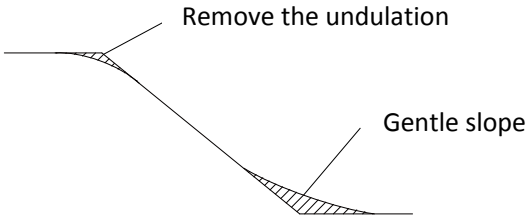


Figure 4-34 Slope treating diagram

CAUTION

(1) When crawler crane is traveling from the horizontal ground to the slope, if its center of gravity deviates forwards, the crane should be stopped to adjust the center of gravity.

(2) When crawler crane is traveling on a slope with rated gradient, it is impossible to obtain a special mass parameter according to ground condition. Therefore, in order to assure safety, the counterweight and boom should be dismantled from crane during traveling.

Traveling with suspended load:

The crane can travel with suspended load, providing that the following precautions are taken:

a) The ground surface must be flat and level (no gradient)
b) The subsoil must be capable of bearing crane's maximum service weight and the weight of suspended load.
c) The crane should travel at a speed less than 0.5 km/h, with 100% rated load on firm ground and a gradient less than 5/1000. And the boom frame should be in the front of the travelling direction.
d) Jerky crane movements must be avoided.
e) The suspended load must be lashed to prevent it from swinging.
f) Steering of crawler is forbidden.

4.5.1.3 High-speed travelling

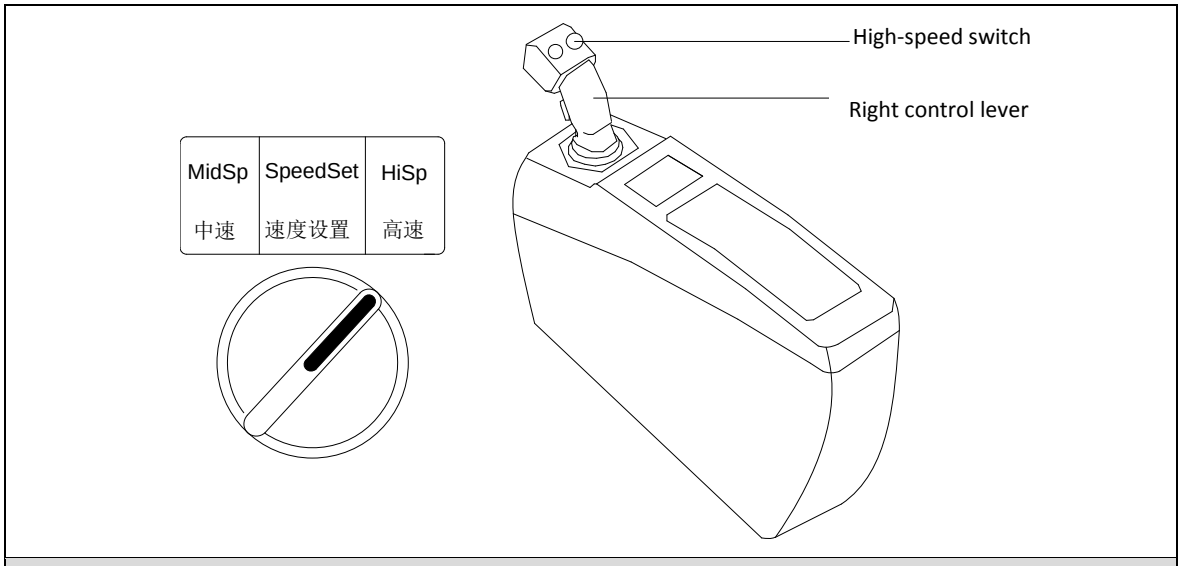


Figure 4-35 Operation of high-speed travelling

Turn the Speed Set switch to "High Speed" position or press the high-speed button on right control lever as shown in the above figure. Then operate left and right control levers to move the crane at higher speed.

CAUTION

(1) Before carrying out traveling movement, the operator must first press traveling switch , and then operate the control lever.

(2) Only when deadman's button is pressed, can the operation of control lever is valid.

(3) The crane movements can still be carried out before the control lever is returned to neutral position with deadman's button released. However, to perform the next crane movement after returning the control lever to neutral position, the operator must press deadman's button first and then move the control lever. Otherwise, the operation of control lever is invalid.

(4) In normal operation, stop the crane movements by returning the control lever to neutral position.

(5) The high-speed switch is only used when the crane is traveling straight without a load.

4.5.2 Operation of crane winches

(1) Set correct boom configuration prior to operating crane winches.

(2) Switch off traveling switch  **.**

4.5.2.1 Hoisting winch

4.5.2.1.1 Components of hoisting winch

Hoisting winch consists of hydraulic motor, winch reducer, brake, lowering limiter, hoisting limiter and wire rope as well as main load hook and auxiliary load hook. The speed of hoisting movement can be changed by adjusting the inclination angle of control lever. The bigger the inclination angle is, the quicker the hoisting / lowering speed is.

4.5.2.1.2 Operation of hoisting winch

The crane is fitted with two hoisting winches: hoisting winch 1 and hoisting winch 2. The control lever for hoisting winch 1 is fitted at the right side of operator's seat - right control lever, and the control lever for hoisting winch 2 is at the left side of operator's seat - left control lever.

1) Operation of hoisting winch 1:
   Push right control lever backwards: spool up hoisting winch 1.
   Push right control lever forwards: reel off hoisting winch 1.

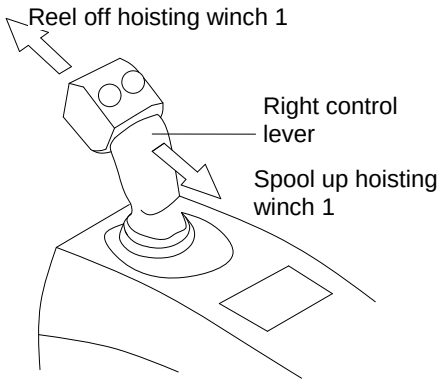


Figure 4-36 Operation of hoisting winch 1

Table 4-14 Operation of hoisting winch 1

Control lever	Operation	Movement
Right control lever	Push forwards	Reel off hoisting winch 1 to
	Push backwards	Spool up hoisting winch 1 to lift
	Return to neutral position	Hoisting winch 1 stops working

2) Operation of hoisting winch 2:

Push left control lever backwards: spool up hoisting winch 2.

Push left control lever forwards: reel off hoisting winch 2.

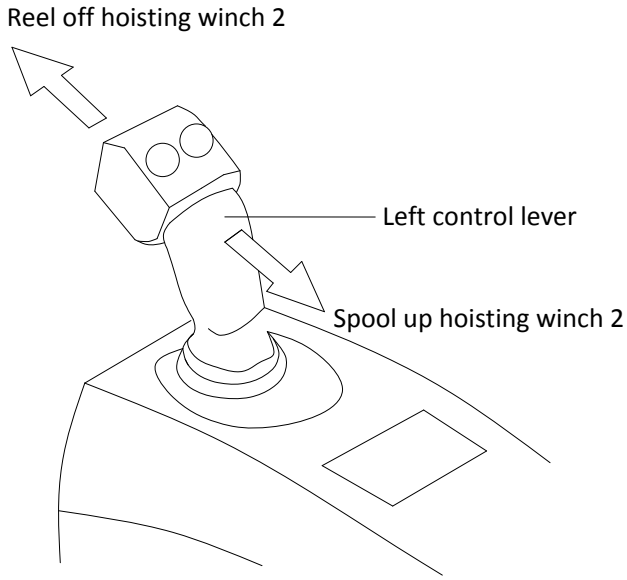


Figure 4-37 Operation of hoisting winch 2

Table 4-15 Operation of hoisting winch 2

Control lever	Operation	Movement
Left control lever	Push forwards	Reel off hoisting winch 2 to lower the load hook
	Push backwards	Spool up hoisting winch 2 to lift the load hook
	Return to neutral position	Hoisting winch 2 stops working

CAUTION

(1) Before operating winch, the operator must first choose correct boom configuration on load moment limiter according to actual situation. As to the functions of winch 1 and 2, they are determined by selected boom configuration.

(2) When spooling up or reeling off hoisting rope, keep watching the winch to make sure that there is no slack wire rope on the winch.

4.5.2.1.3 High-speed operation of hoisting winches

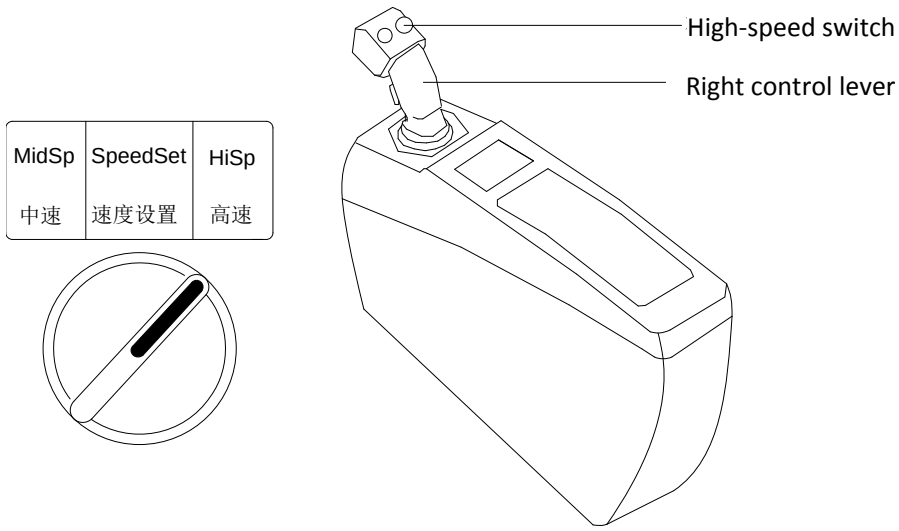


Figure 4-38 High-speed operation of hoisting winch 2

Both hoisting winch 1 and 2 have high-speed lifting and lowering functions. Turn "Speed Set" switch to "HiSp" position, operate the hoisting winch 1 or 2 to lift or lower the main load hook or auxiliary hook at high speed. But this function can only be realized when just hoisting winch 1 or 2 is working.

CAUTION

(1) Choose proper rope reeving in accordance with boom length. When the load swings due to winding wire rope, the load should be put down and be loaded again after complete unlocking of wire rope.

(2) Under any conditions, there must be at least three windings of wire rope left on the winding drum.

(3) When a load is lifted away from the ground, it should first be suspended in the air for a moment. Do not lift the load until the operator confirms that there is no safety hazard. Do not derrick and telescope the boom if the load is still in contact with the ground.

(4) Do not change the control lever between "lift hook" and "lower hook" jerkily. The operator must return the control lever to neutral position and ensure that the winding drum has stopped before changing control lever from "lift hook" to "lower hook". Otherwise, the winch components will be damaged.

(5) If main boom is extended under "Main boom" configuration, the lifting height of crane will increase accordingly, which will therefore make the wire rope not long enough. Such a problem can be solved by changing the rope reeving of wire rope. Before changing the rope reeving, fit a hoisting limit switch weight.

(6) When the crane is overloaded, or wire rope on hoisting winch 1 or 2 is excessively wound /unwound, the dangerous motions will be switched off automatically and an alarm will be given out.

(7) After the system sounds the alarm, only movements towards safe directions are permitted. If some movements towards dangerous directions are required, please refer to instructions in section 4.4.

(8) The high-speed switch is only used when the crane is working without a load or with light load and the hoisting winch is operated alone.

4.5.2.2 Derricking mechanism

4.5.2.2.1 Components of derricking mechanism

Through changing the length of wire rope reeved between derricking pulley blocks (including derricking crown block and derricking traveling block), the derricking mechanism, via main boom derricking winch, can adjust boom angle so as to change the working radius. For different boom configurations, different winches are selected.

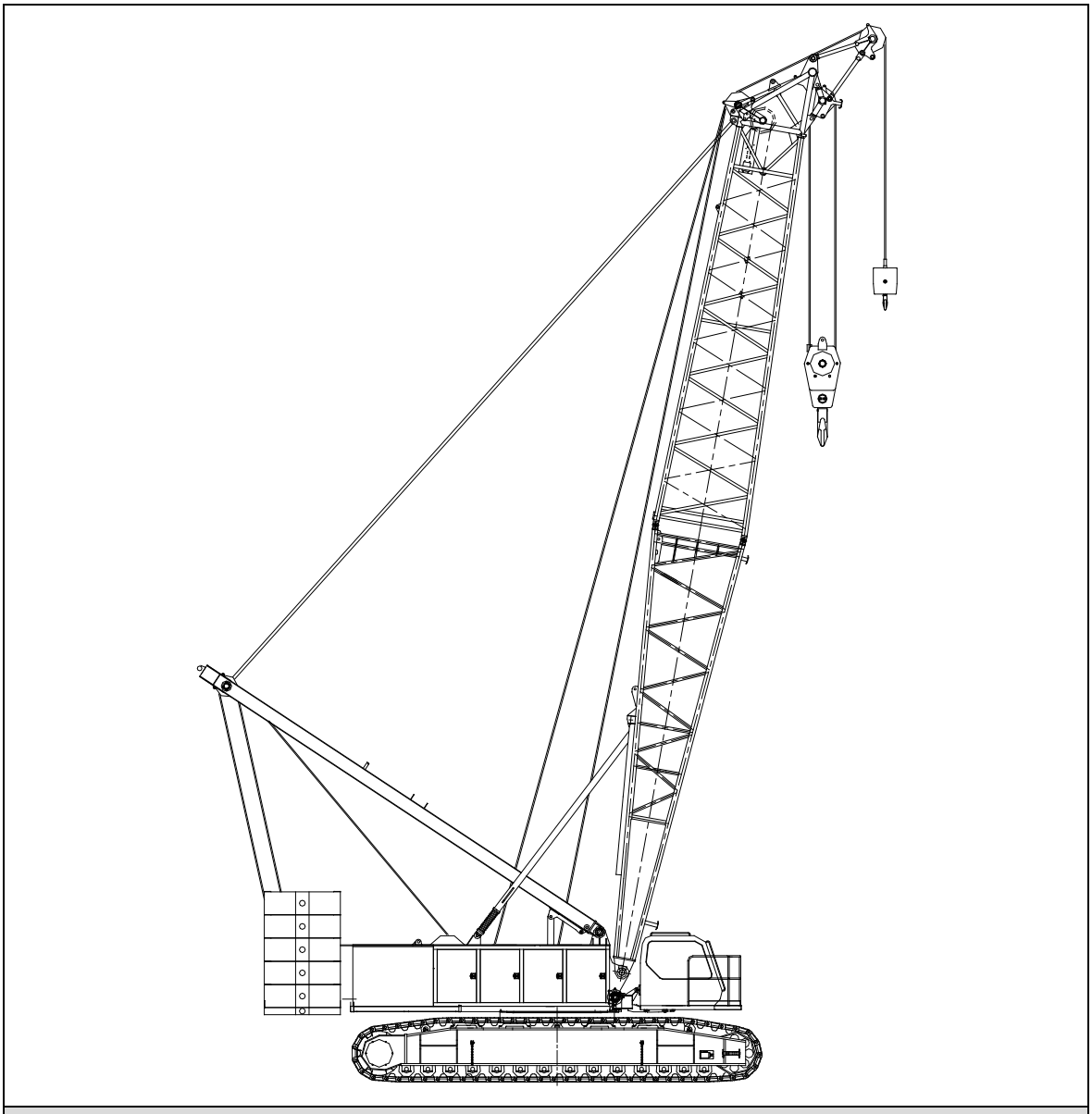


Figure 4-39 Derricking mechanism for main boom

For crane operation with main boom, crane operation with fixed jib

Main boom angle can be adjusted by changing the length of wire rope reeved between derricking blocks, which consist of derricking crown block at the tail end of slewing table and derricking traveling block on the top of A-frame.

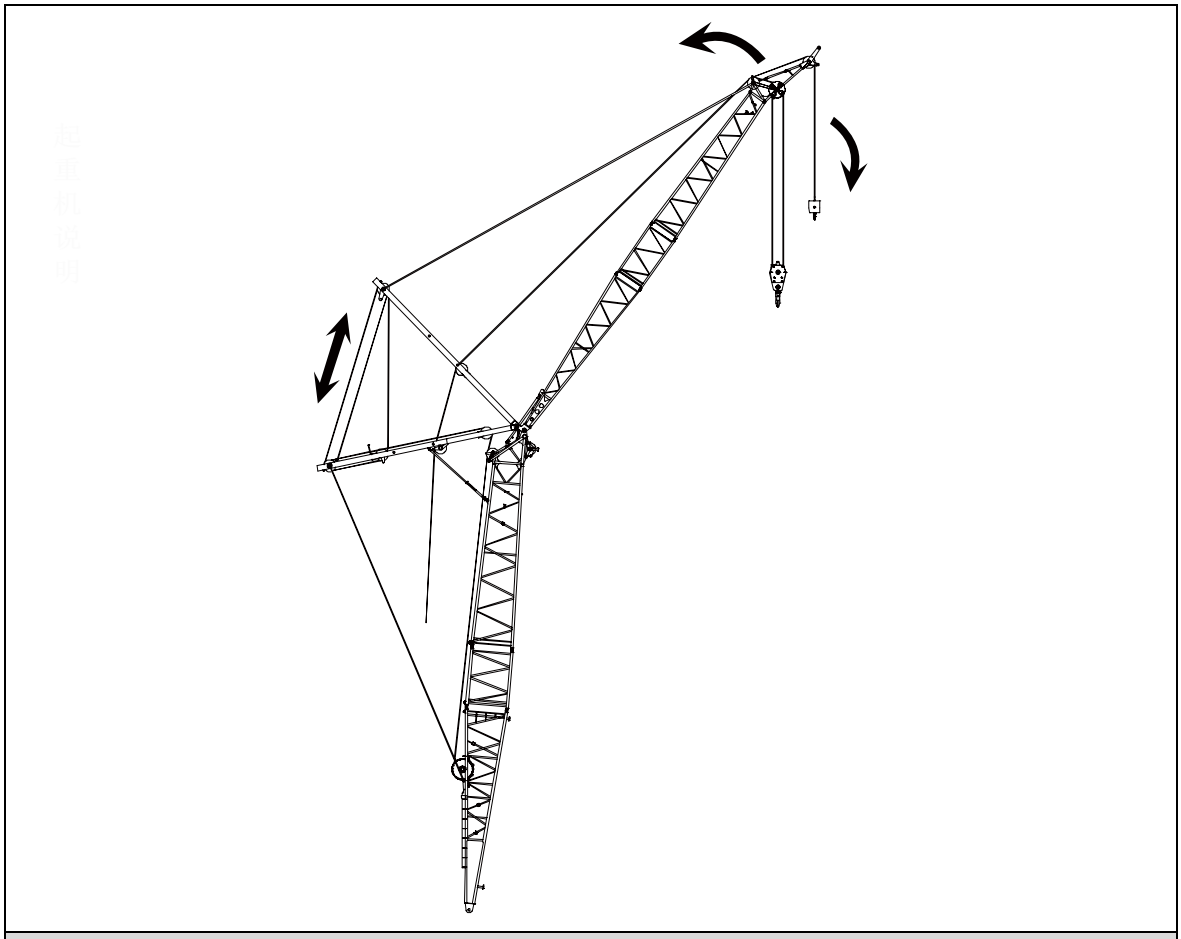


Figure 4-40 Derricking mechanism for luffing jib

CAUTION

(1) The operator must first choose boom configuration on the load moment limiter according to actual situation. The functions of derricking mechanism are determined by selected boom configuration.

(2) Switch off traveling switch prior to operating derricking winches.

4.5.2.2.2 Operation of derricking mechanism under different boom configurations

a) S/SL boom configurations

The main boom angle can vary from 0° to 83°, and the boom can be raised or lowered via main boom derricking winch.

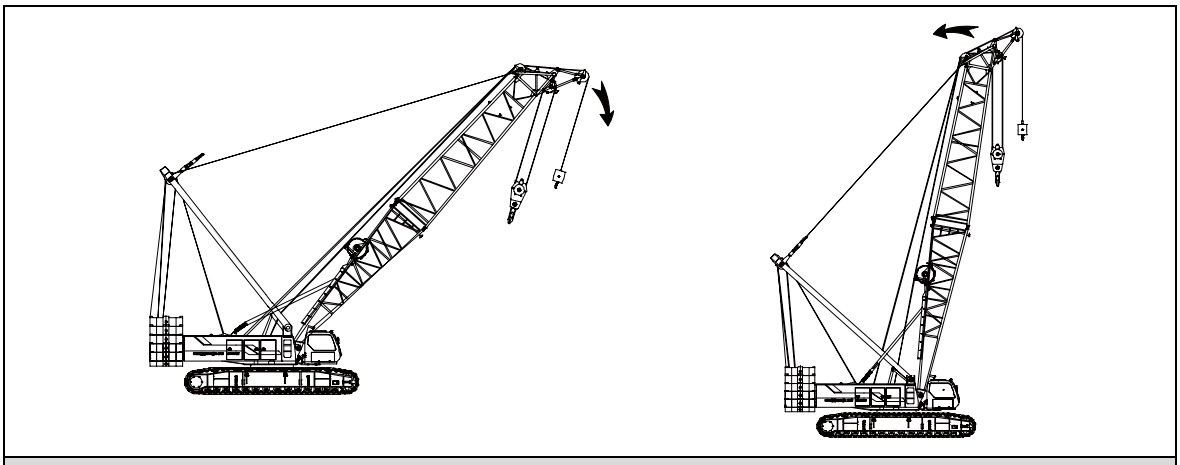


Figure 4-41 S/SL boom configuration

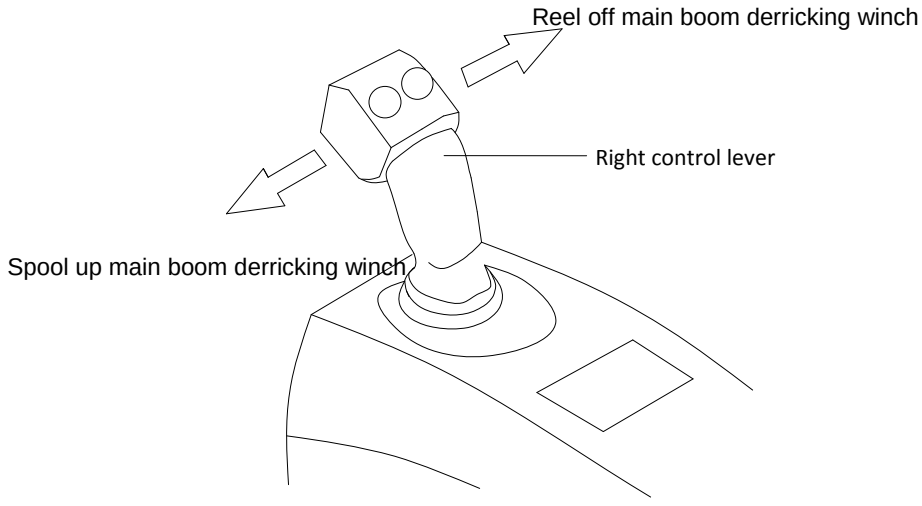


Figure 4-42 Operation of main boom derricking winch

Table 4-16 Operation of main boom derricking winch

Control lever	Operation	Movement
Right control lever	Move it to left	Spool up main boom derricking winch to raise main boom
	Move it to right	Reel off main boom derricking winch to lower main boom
	Return it to neutral position	Main boom derricking winch stops working

b) SF boom configuration

The fixed jib can be mounted in the angle of either 10° or 30° to the boom. Once the angle is set, it cannot be changed during operation.

The main boom can be raised and lowered via main boom derricking winch. The angle between fixed jib and main boom can't be changed.

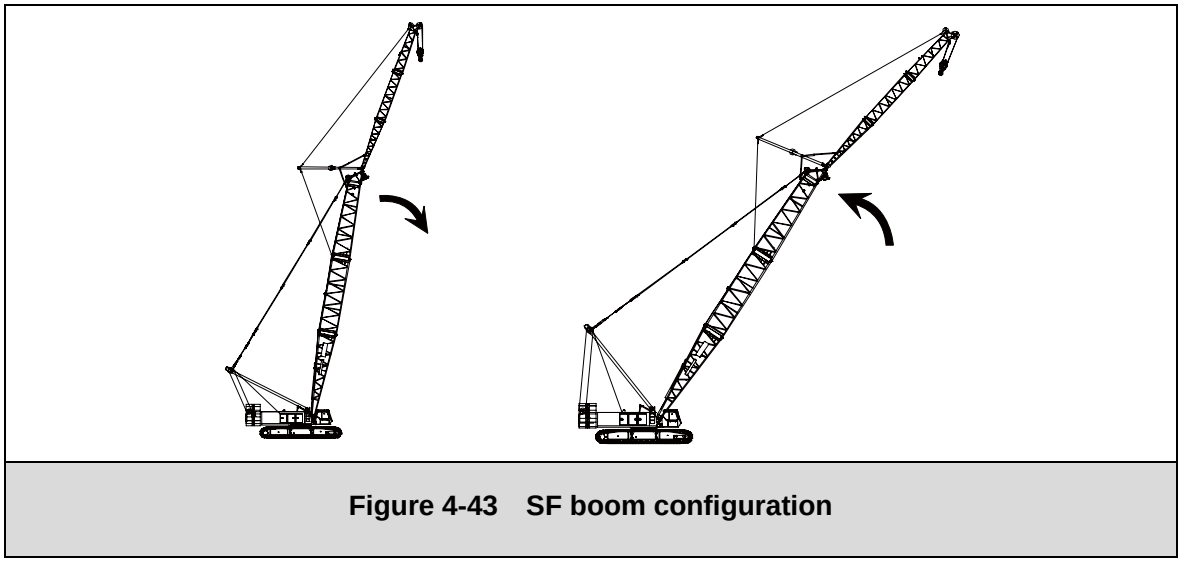


Figure 4-43 SF boom configuration

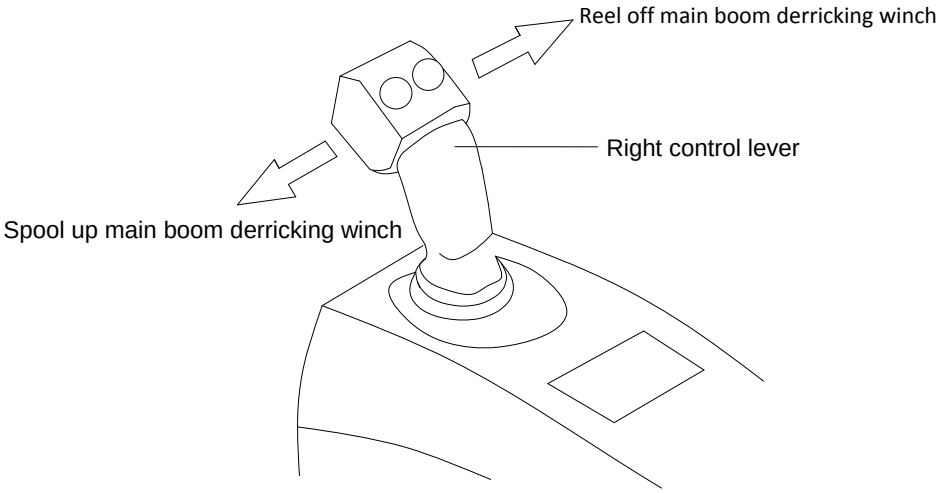


Figure 4-44 Operation of main boom derricking winch

Table 4-17 Operation of main boom derricking winch

Control lever	Operation	Movement
Right control lever	Move it to left	Spool up main boom derricking winch to raise main boom
	Move it to right	Reel off main boom derricking winch to lower main boom
	Return it to neutral position	Main boom derricking winch stops working

c) SW boom configuration

For this boom configuration, main boom can be fixed at 65°, 75° or 85° position via main boom derricking winch, while luffing jib can be raised or lowered via hoisting winch 1.

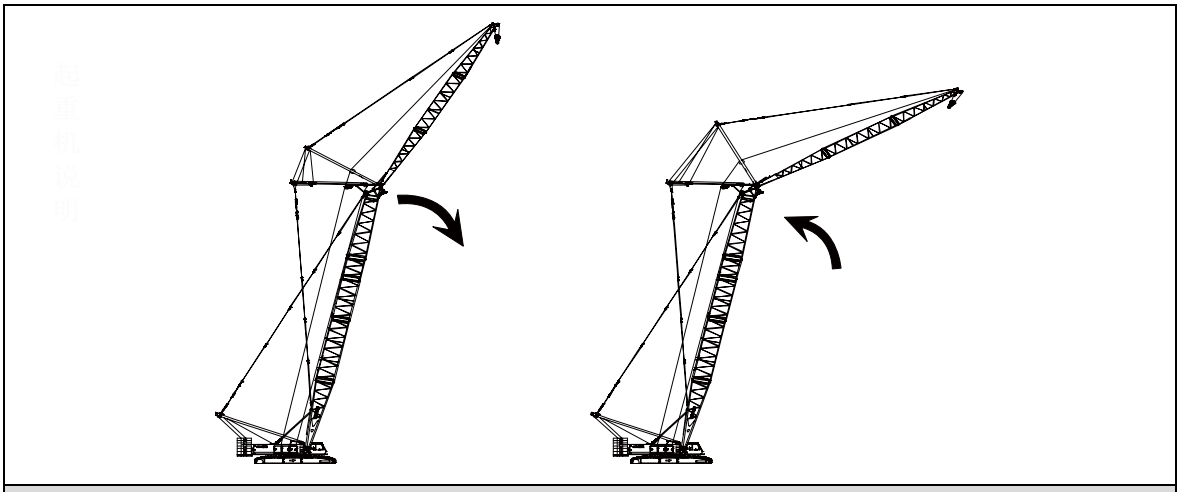


Figure 4-45 SW boom configuration

CAUTION

(1) Use main boom derricking winch to derrick main boom.

(2) Use hoisting winch 1 to derrick luffing jib.

1) Derrick the main boom

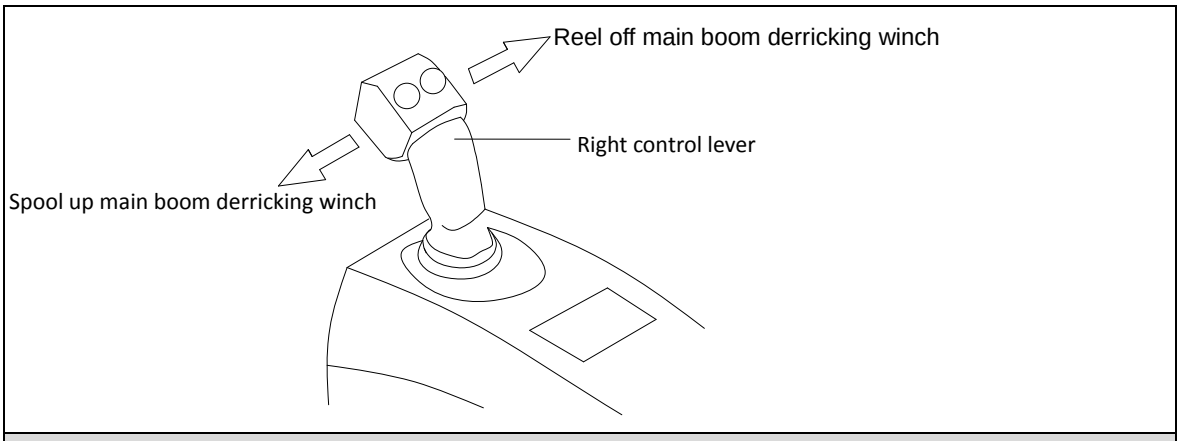


Figure 4-46 Operation of main boom derricking winch

Table 4-18 Operation of main boom derricking winch

Control lever	Operation	Movement
Right control lever	Move it to left	Spool up main boom derricking winch to raise main boom
	Move it to right	Reel off main boom derricking winch to lower main boom
	Return it to neutral position	Main boom derricking winch stops working

CAUTION

Under SW boom configuration, the main boom angle is 65°, 75° or 85°.

2) Derrick the luffing jib

– Derrick the luffing jib via hoisting winch 1

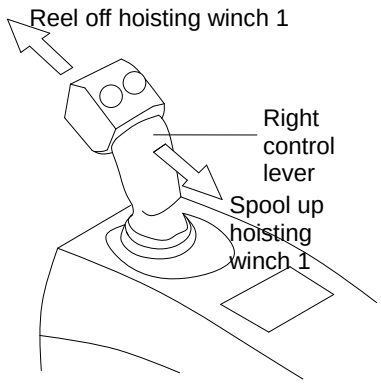


Figure 4-47 Raise/lower luffing jib via hoisting winch 1

When hoisting winch 1 is used to raise or lower luffing jib, push right control lever forwards and backwards to raise and lower luffing jib. At this time, the over-hoisting signal for H1 winch is shielded.

Table 4-19 Raise/lower luffing jib via hoisting winch 1

Control lever	Operation	Movement
Right control lever	Move forwards	Reel off hoisting winch 1 to lower luffing jib
	Move backwards	Spool up hoisting winch 1 to raise luffing jib
	Return to neutral position	Hoisting winch 1 stops working

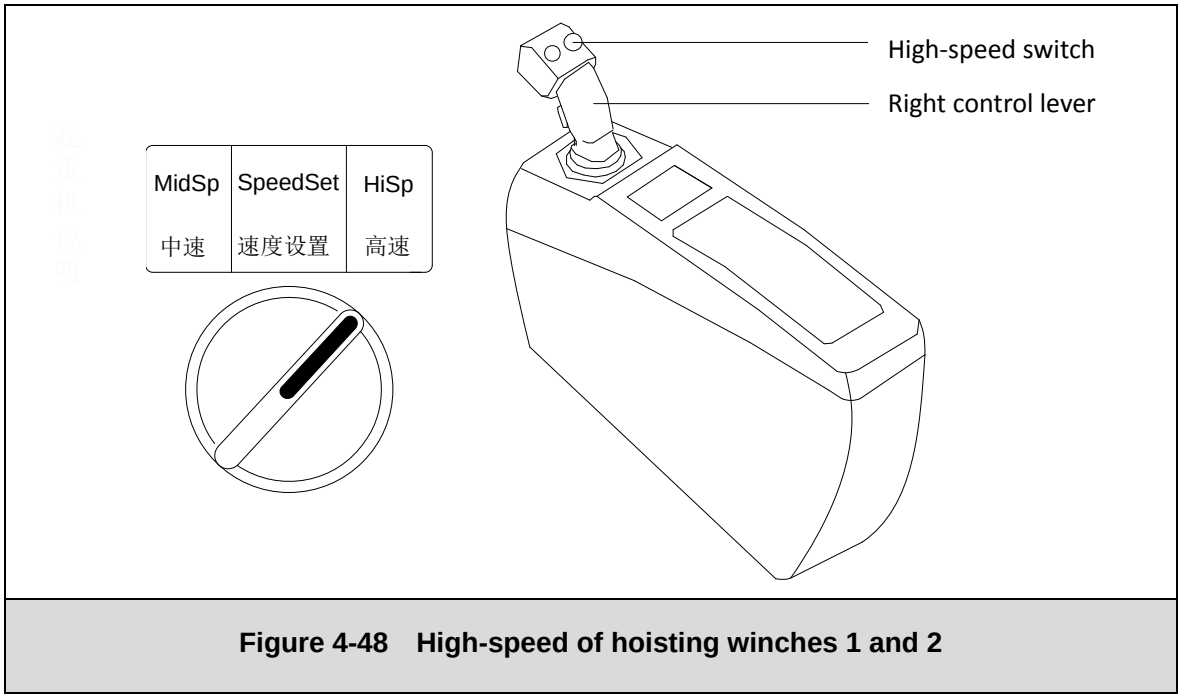


Figure 4-48 High-speed of hoisting winches 1 and 2

Turn "SpeedSet" switch to "HiSp" position, or press high-speed button on right control lever, and then push right control lever forwards and backwards, the luffing jib will be raised and lowered at high speed.

CAUTION

(1) Switch off traveling switch  prior to operating winches.

(2) Only when controlling the luffing jib alone, can the high-speed function for luffing jib be used.

CAUTION

(1) The derricking operation must be carried out stably. Otherwise, a great impact will be made on the crane with a load.

(2) Only when raising/lowering luffing jib through luffing jib derricking winch, can the luffing jib be lifted or lowered at high speed. Otherwise, it's prohibited to use high-speed function.

4.5.3 Operation of synchronizing A-frame and main boom derricking winch and synchronizing reeving winch and working winch

CAUTION

(1) The functions of synchronizing A-frame and main boom derricking winch only works for erecting the A-frame.

(2) Reeving winch synchronizing is suitable for hoisting winches.

4.5.3.1 A-frame and main boom derricking winch synchronization

a) Turn "synchronization switch" on the right control panel to "Mast (A-frame) + E sync" position, as described below.

b) Turn "A-frame erecting/lowering" switch to left "Erecting (up)" position, as described below.

c) Then the A-frame is erected, while main boom derricking winch is reeled off synchronously and automatically.

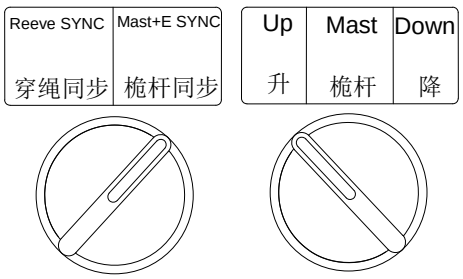


Figure 4-49 Operation of A-frame and main boom derricking winch synchronization

d) The movements "reel off main boom derricking winch" and "erect A-frame" will be carried out at the matched speed. And the movements can be stopped at any time according to actual conditions.

4.5.3.2 Operation of reeving winch

4.5.3.2.1 Prerequisite

An assistant is present to guide the hoisting rope.

DANGER

(1) Complete the assembly operation on a stable area! If it is unavoidable that the rope must be hand-guided over the boom to rope pulleys in the boom head, proceed with great caution when walking on the boom.

(2) The person guiding the rope will slip on the boom if the crane is not operated properly. There is a great danger of a serious accident!

4.5.3.2.2 Operation of reeving winch

a) Reel off reeving winch. The rope of reeving winch is reeved in accordance with the reeving diagrams, however in reverse direction with hoisting rope between the rope pulleys in the boom head and the hook block.

Turn the reeving winch switch to the right –reel off reeving winch.

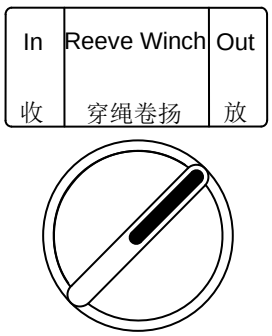


Figure 4-50 Operation of reeving winch

CAUTION

(1) When the assistant guides the hoisting rope to the rope pulley on the boom head, the crane operator must operate the reeving winch. This procedure must be done in such a manner that the rope does not slacken up on the winding drum.

(2) Reeving can be done manually or with the help of a reeving winch. If the reeving winch is used, the rope on it must first be reeved in reverse direction between the hook block and the rope pulleys on boom head and then connected with the hoisting rope of winch 1 (or winch 2).

b) Attach the rope end point of reeving winch to hoisting rope for winch 1 (or winch 2) with rope lock.

c) One operator reels off hoisting winch 1 or 2 in the cab, and spools up reeving winch at the same time. Turn the "Reeve SYNC" and "Mast +E SYNC" switch to left, then the reeving winch will spool up.

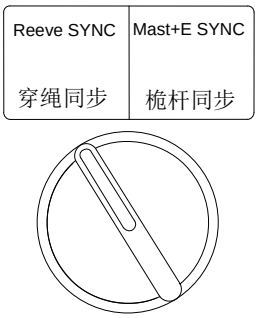


Figure 4-51 Reeving winch and hoisting winch synchronization

CAUTION

(1) Reel off winch1 (or winch 2) while spooling up reeving winch.

(2) The speed of spooling up reeving winch must be slower than the speed of reeling off winch 1 (or winch 2).

(3) After the hoisting rope for winch 1 (or winch 2) is reeved into the hook block, detach the rope lock.

4.5.3.2.3 Reeving winch and hoisting winch synchronization

Procedure for this operation: (taking hoisting winch 1 as working winch)

a) Turn "synchronization switch" to the "Reeve SYNC" position, which is described as below.

b) Push right control lever forwards and backwards, the reeving winch and hoisting winch 1 will carry out synchronous movements, namely, reeling off hoisting winch 1 and spooling up reeving winch, or spooling up hoisting winch 1 and reeling off reeving winch. (Push left control lever forwards and backwards, the reeving winch and hoisting winch 2 will carry out synchronous movements. namely reeling off hoisting winch 2 and spooling up reeving winch, or spooling up hoisting winch 2 and reeling off reeving winch)

c) After hoisting rope is reeved well, return the "synchronization" switch to neutral position, and remove the rope lock connecting the reeving rope and hoisting rope. Finally wind the reeving rope onto the reeving winch.

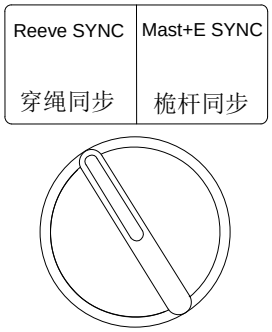


Figure 4-62 Reeving winch and hoisting winch synchronization

CAUTION

(1) The operation mentioned above must be carried out by at least two persons.

(2) After the hoisting rope is reeved correctly between rope pulleys, the "synchronization" switch must be returned to neutral position.

4.5.4 Operation of slewing mechanism

4.5.4.1 Components of slewing mechanism

The slewing mechanism consists of hydraulic motor, planetary gear reducer, brake, drive gear and slewing ring, etc. The slewing speed can be adjusted by changing the inclination angle of control lever.

An independent piston variable pump is applied to hydraulic system to supply oil, which can adjust slewing speed accurately.

4.5.4.2 Operation of slewing mechanism

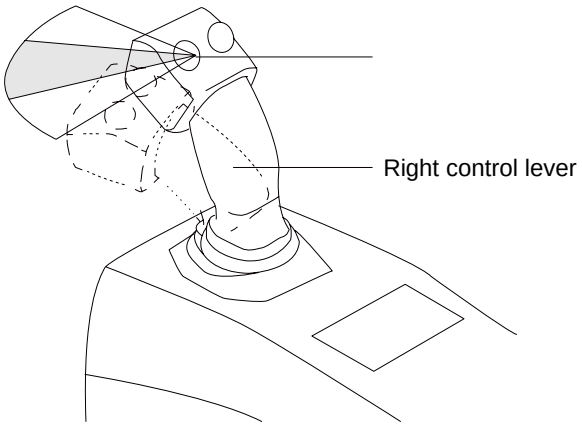


Figure 4-53 Operation of slewing mechanism

CAUTION

(1) The slewing speed must be set according to the speed range of slewing movements.

(2) Operating with high slewing speed will cause an increased risk of accidents! Before initiating any slewing movements, the operator must make sure that there are no persons or obstacles within slewing radius. Otherwise, there is an increased risk of accidents. Before carry out slewing movement, an acoustic signal should be given.

Table 4-21 Operation of slewing mechanism

Control lever	Operation	Movement
Left control lever	Move it to left	Slew the superstructure to left
	Move it to right	Slew the superstructure to right
	Return it to neutral position	Stop slewing

CAUTION

(1) The default speed of slewing mechanism is low speed. After pressing the high-speed switch of left control lever, the slewing mechanism can work at full speed.

(2) Longer boom - slower slewing speed.

(3) Heavier load - slower slewing speed.

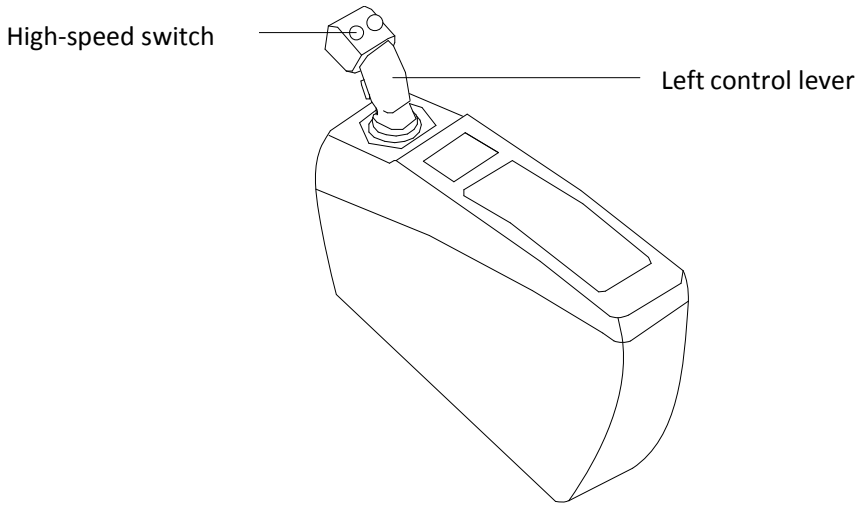


Figure 4-64 Operation of slewing mechanism

4.5.4.3 Swing free running

If a load hook is not positioned vertically over the load's center of gravity before lifting operation, the operator can press the button on the left control lever to activate swing free running mode. Or press swing free running switch when lifting the load. At this moment, the side force on the boom can make the slewing table turn to the direction of the load's center of gravity until the lifting wire rope is vertical. In this way, the boom can be protected against damage.

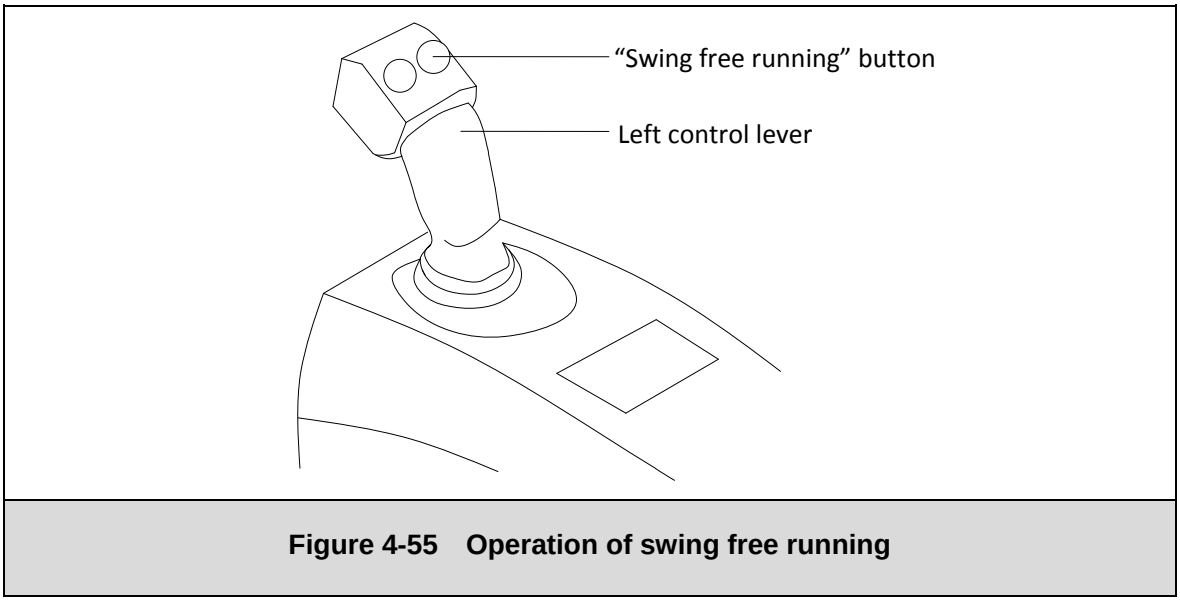


Figure 4-55 Operation of swing free running

CAUTION

(1) When carrying out the movement "Swing free running", operate control lever to lift the hook at the same time. In this way, a side force will be produced on the wire rope to make load hook vertical to boom.

(2) Before each swing of the superstructure, the crane operator must personally make sure that there are no obstacles in the crane slewing area and no person is in the danger zone. Give a short warning signal (horn) before starting a crane movement.

(3) When slewing with a load, initiate the slewing movement very carefully. It is prohibited to stop slewing movement or change slewing direction jerkily. Swinging of load is prohibited.

(4) Longer boom - slower slewing speed.

(5) Heavier load - slower slewing speed.

(6) It is not permitted to slew the superstructure on the trailer.

(7) In order to ensure safe operation, the user should check slewing ring bolts with 1800 N.m tightening torque after the initial 100 operating hours. Then check and tighten them again after 300 operating hours. After that, do the checks every 500 operating hours.

(8) When the operator has to leave the machine in traveling or transport condition, never rely solely on the slewing brake to lock the slewing mechanism. Even though the slewing brake is applied, the superstructure may still slew, because it is not a positioning lock.

(9) Activating slewing brake switch to lock slewing mechanism abruptly should be avoided, since it may cause damage to the superstructure.

4.5.5 Simultaneous operation

WARNING

(1) Set boom configuration correctly before crane operation.

(2) Turn off travelling switch before winch operation.

4.5.5.1 Crane operation with main boom

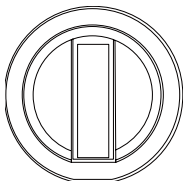


Figure 4-66 Reeving winch

a) Simultaneous operation of hoisting winch 1 and slewing mechanism

Operate the left and right control levers at the same time.

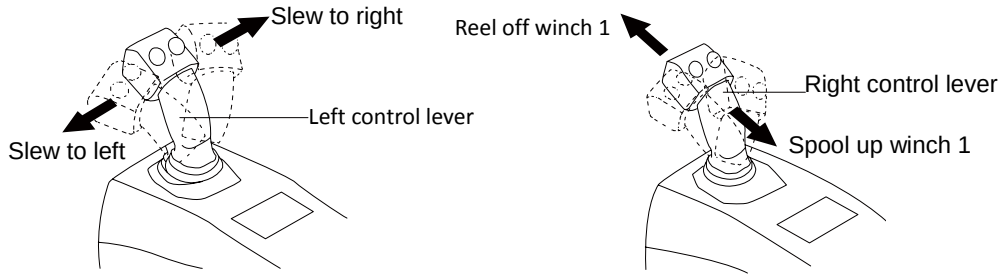


Figure 4-57 Simultaneous operation of hoisting winch 1 and slewing mechanism

Table 4-22 Simultaneous operation of hoisting winch 1 and slewing mechanism

Control levers and operations		Left control lever		
		Move to left	Return to neutral position	Move to right
Right control lever	Move forwards	Reel off winch 1 (lower load hook) and slew to left	Reel off winch 1 (lower load hook)	Reel off winch 1 (lower load hook) and slew to right
	Return to neutral position	Slew to left	Stop working	Slew to right
	Move backwards	Spool up winch 1 (lift load hook) and slew to left	Spool up winch 1 (lift load hook)	Spool up winch 1 (lift load hook) and slew to right

b) Simultaneous operation of hoisting winch 1 and derricking mechanism

Since both hoisting winch 1 and derricking mechanism are controlled by right control lever, this simultaneous movement can be achieved with the help of simultaneous operation button.

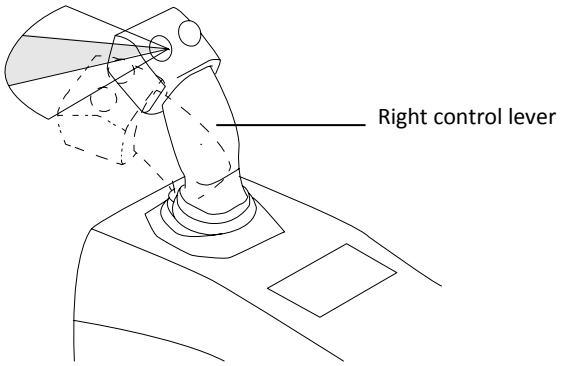


Figure 4-58 Simultaneous operation of hoisting winch 1 and derricking mechanism

Table 4-23 Simultaneous operation of hoisting winch 1 and derricking mechanism

Control levers and operation		Right control lever		
		Move to left	Return to neutral position	Move to right
Right control lever	Move forwards	Reel off winch 1 (lower load hook) and spool up main boom derricking winch (raise main boom)	Reel off winch 1 (lower load hook)	Reel off winch 1 (lower load hook) and reel off main boom derricking winch (lower main boom)

	Return to neutral position	Spool up main boom derricking winch (raise main boom)	Stop working	Reel off main boom derricking winch (derrick boom down)
	Move backwards	Spool up winch 1 (lift load hook) and spool up main boom derricking winch (lower main boom)c	Spool up winch 1 (lift load hook)	Spool up winch 1 (lift load hook) and reel off main boom derricking winch (lower main boom)

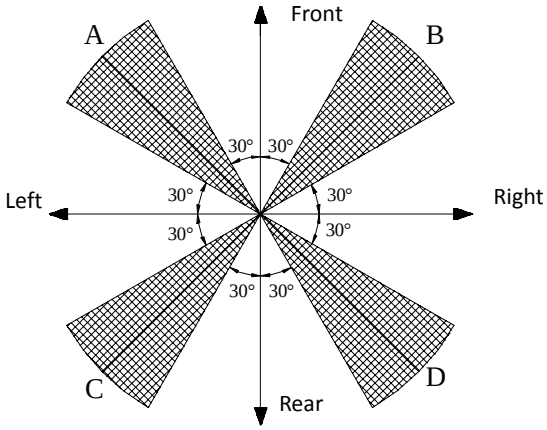


Figure 4-59 Valid work range

Note:

When carrying out simultaneous movement, the control lever must be operated within A, B, C or D areas. Otherwise, the simultaneous movement will not be achieved. (See above figure)

The simultaneous movements in following four ranges are:

A: Reel off winch 1 (lower load hook) and spool up main boom derricking winch (raise main boom).

B: Reel off winch 1 (lower load hook) and reel off main boom derricking winch (lower main boom).

C: Spool up winch 1 (lift load hook) and spool up main boom derricking winch (raise main boom).

D: Spool up winch 1 (lift load hook) and reel off main boom derricking winch (lower main boom).

When carrying out simultaneous movement, operate right control lever within above area.

The valid movement range for control lever is 30°.

c) Simultaneous operation of slewing mechanism and derricking mechanism

Operate the left and right control levers at the same time.

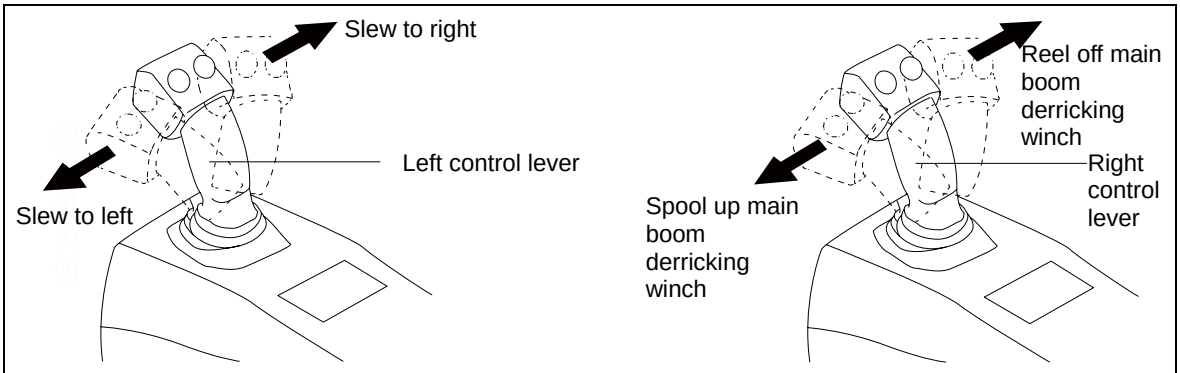


Figure 4-60 Simultaneous operation of slewing mechanism and derricking mechanism

Table 4-24 Simultaneous operation of slewing mechanism and derricking mechanism

Control levers and operation		**Right control lever**		
		Move to left	Return to neutral position	Move to right
Left control lever	Move to left	Slew to left and spool up main boom derricking winch (raise main boom)	Slew to left	Slew to left and reel off main boom derricking winch (lower main boom)
	Return to neutral position	Spool up main boom derricking winch (raise main boom)	Stop working	Reel off main boom derricking winch (lower main boom)
	Move to right	Slew to right and spool up main boom derricking winch (raise main boom)	Slew to right	Slew to right and reel off main boom derricking winch (lower main boom)

d) Simultaneous operation of hoisting winch 2 and slewing mechanism
Operate left control lever, this simultaneous movement can be achieved. (For detailed operation, see Section 4.5.5.2.)

e) Simultaneous operation of hoisting winch 2 and derricking mechanism
Operate the left and right control levers at the same time. (For detailed operation, see Section 4.5.5.2.)

4.5.5.2 Crane operation with main boom and fixed jib

a) Simultaneous operation of hoisting winch 2 and slewing mechanism

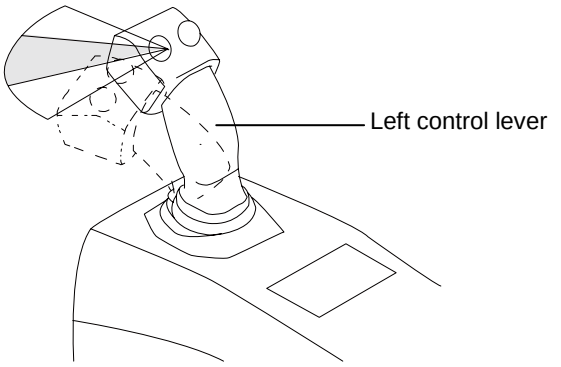


Figure 4-61 Simultaneous operation of hoisting winch 2 and slewing mechanism

Table 4-25 Simultaneous operation of hoisting winch 2 and slewing mechanism

Control levers and operation		Left control lever		
		Move to left	Return to neutral position	Move to right
Left control lever	Move forwards	Reel off winch 2 (lower load hook) and slew to left	Reel off winch 2 (lower load hook)	Reel off winch 2 (lower load hook) and slew to right
	Return to neutral position	Slew to left	Stop working	Slew to right
	Move backwards	Spool up winch 2 (lift load hook) and slew to left	Spool up winch 2 (lift load hook)	Spool up winch 2 (lift load hook) and slew to right

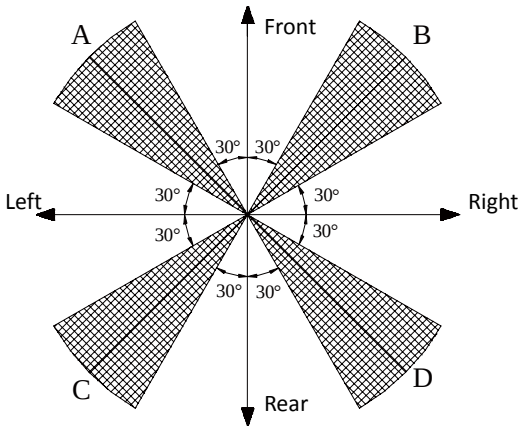


Figure 4-66 Valid work range

Note:

When carrying out simultaneous movement, the control lever must be operated within A, B, C or D areas. Otherwise, the simultaneous movement will not be achieved. (See above figure)

The simultaneous movements in following four ranges are:

A: Reel off winch 2 (lower load hook) and slew to left.

B: Reel off winch 2 (lower load hook) and slew to right.

C: Spool up winch 2 (lift load hook) and slew to left.

D: Spool up winch 2 (lift load hook) and slew to right.

When carrying out simultaneous movement, operate right control lever within above area.

The valid movement range of control lever in these four areas is 30°.

b) Simultaneous operation of hoisting winch 2 and derricking mechanism

Operate the left and right control levers at the same time.

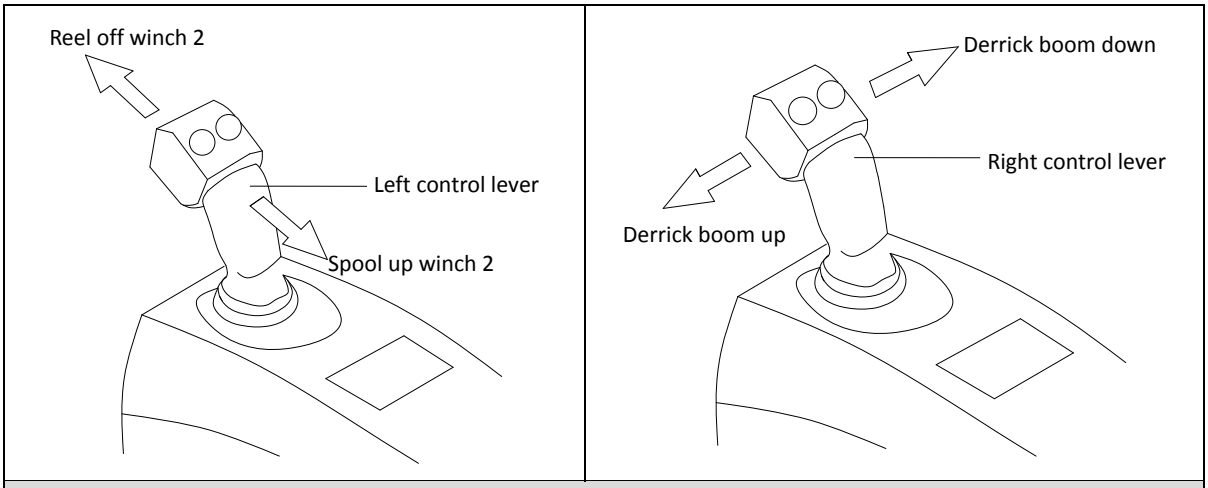


Figure 4-62 Simultaneous operation of hoisting winch 2 and derricking mechanism

Table 4-26 Simultaneous operation of hoisting winch 2 and derricking mechanism

Control lever and operation		Right control lever		
		Move to left	Return to neutral position	Move to right
Left control lever	Move forwards	Reel off winch 2 (lower load hook) and spool up main boom derricking winch (derrick boom up)	Reel off winch 2 (lower load hook)	Reel off winch 2 (lower load hook) and reel off main boom derricking winch (derrick boom down)
	Return to	Spool up main boom	Stop working	Reel off main boom

	Move backwards	Spool up winch 2 (lift load hook) and spool up main boom derricking winch (derrick boom up)	Spool up winch 2 (lift load hook)	Spool up winch 2 (lift load hook) and reel off main boom derricking winch (derrick boom down)

CAUTION

To carry out simultaneous movements, the operator only needs to move left and right control levers in corresponding directions.

c) Simultaneous operation of slewing mechanism and derricking mechanism
Operate the left and right control levers at the same time. (For detailed operation, see Section 4.5.5.1.)

d) Simultaneous operation of hoisting winch 2 and slewing mechanism
Operate the left and right control levers at the same time. (For detailed operation, see Section 4.5.5.1.)

e) Simultaneous operation of hoisting winch 2 and derricking mechanism
Operate right control lever, this simultaneous movement can be achieved. (For detailed operation, see Section 4.5.5.1.)

4.5.5.3 Crane operation with main boom and luffing jib

CAUTION

Use the hoisting winch 1 to raise/lower the luffing jib.

1) Simultaneous operation of hoisting winch 2 and hoisting winch 1
Operate the left and right control levers at the same time.

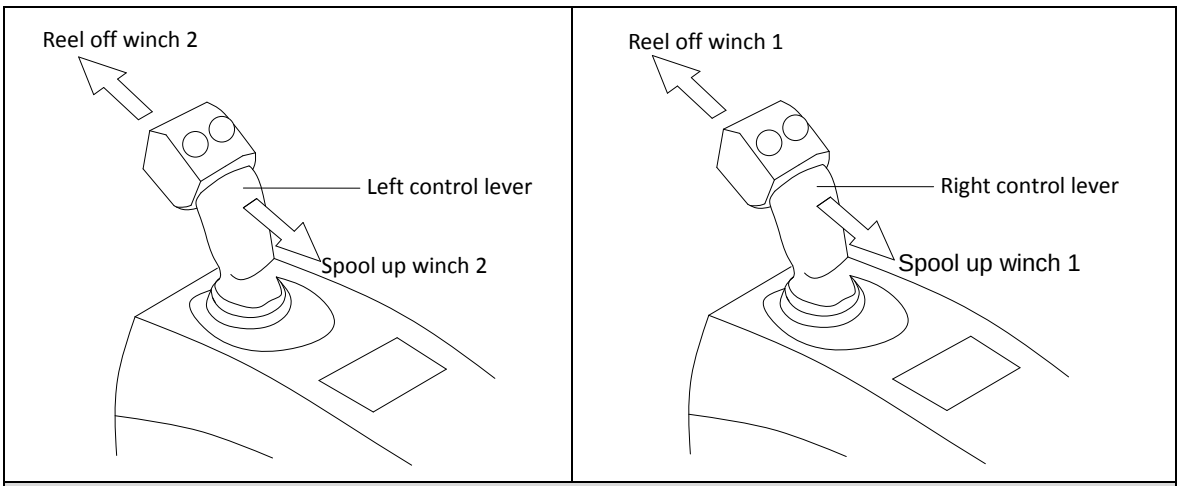


Figure 4-63 Simultaneous operation of hoisting winch 2 and hoisting winch 1

Table 4-27 Simultaneous operation of hoisting winch 2 and hoisting winch 1

Control levers and operation		Right control lever		
		Move forwards	Return to neutral position	Move backwards
Left control lever	Move forwards	Reel off winch 2 (lower load hook) and reel off winch 1 (lower luffing jib)	Reel off winch 2 (lower load hook)	Reel off winch 2 (lower load hook) and spool up winch 1 (raise luffing jib)
	Return to neutral position	Reel off winch 1 (lower luffing jib)	Stop working	Spool up winch 1 (raise luffing jib)
	Move backwards	Spool up winch 2 (lift load hook) and reel off winch 1 (lower luffing jib)	Spool up winch 2 (lift load hook)	Spool up winch 2 (lift load hook) and spool up winch 1 (raise luffing jib)

CAUTION

To carry out simultaneous movements, the operator only needs to move left and right control levers in corresponding directions.

2) Simultaneous operation of slewing mechanism and hoisting winch 1

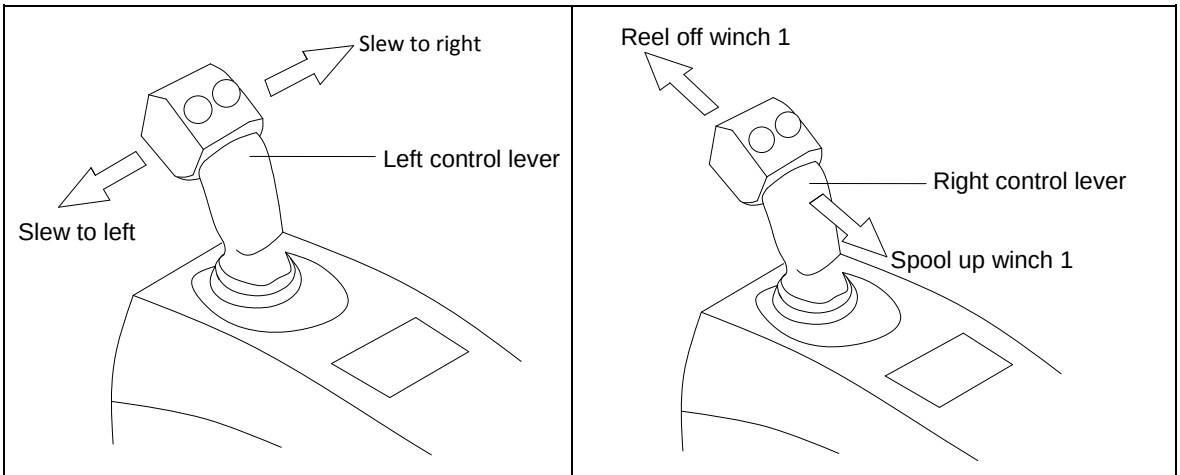


Figure 4-64 Simultaneous operation of slewing mechanism and hoisting winch 1

Table 4-28 Simultaneous operation of slewing mechanism and hoisting winch 1

Control levers and operation		Right control lever		
		Move forwards	Return to neutral position	Move backwards
Left control lever	Move to left	Slew to left and reel off winch 1 (lower luffing jib)	Slew to left	Slew to left and spool up winch 1 (raise luffing jib)
	Return to neutral position	Reel off winch 1 (lower luffing jib)	Stop working	Spool up winch 1 (raise luffing jib)
	Move to right	Slew to right and reel off winch 1 (lower luffing jib)	Slew to right	Slew to right and spool up winch 1 (raise luffing jib)

1) Simultaneous operation of hoisting winch 2 and slewing mechanism
Operate left control lever, at the same time pressing the simultaneous operation button. (For detailed operation, see Section 4.5.5.2.)

2) Simultaneous operation of slewing mechanism and derricking mechanism
Operate the left and right control levers at the same time. (For detailed operation, see Section 4.5.5.1.)

a) Use luffing jib derricking winch to raise/lower luffing jib

CAUTION

When crane is fitted with luffing jib derricking winch,

(1) Turn boom configuration switch in "main boom" position, and then use the main boom derricking winch to derrick boom up/down.

(2) Turn boom configuration switch in "luffing jib" position, and then use the luffing jib derricking winch to raise/lower luffing jib.

1) Simultaneous operation of hoisting winch 1 and slewing mechanism
Operate the left and right control levers at the same time. (For detailed operation, see Section 4.5.5.1.)

2) Simultaneous operation of hoisting winch 2 and slewing mechanism
Operate left control lever, at the same time pressing the simultaneous operation button, this simultaneous movement can be achieved. (For detailed operation, see Section 4.5.5.2.)

3) Simultaneous operation of hoisting winch 1 and luffing jib derricking winch
Operate right control lever, at the same time pressing the simultaneous operation button, this simultaneous movement can be achieved.

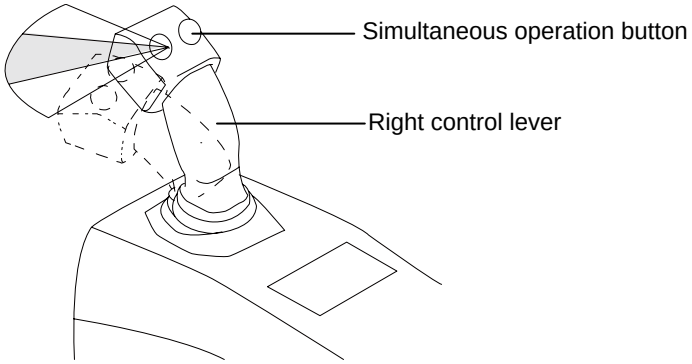


Figure 4-65 Simultaneous operation of winch 1 and luffing jib derricking winch

Table 4-29 Simultaneous operation of winch 1 and luffing jib derricking winch

Control lever and operation		**Right control lever**		
		Move forwards	Return to neutral position	Move backwards
Right control lever	Move to left	Spool up luffing jib derricking winch (raise luffing jib) and reel off winch 1 (lower load hook 2)	Spool up luffing jib derricking winch (raise luffing jib)	Spool up luffing jib derricking winch (raise luffing jib) and spool up winch 1 (lift load hook 2)
	Return to neutral position	Reel off winch 1 (lower load hook 2)	Stop working	Spool up winch 1 (lift load hook 2)
	Move to right	Reel off luffing jib derricking winch (lower luffing jib) and reel off winch 1 (lower load hook 2)	Reel off luffing jib derricking winch (lower luffing jib)	Reel off luffing jib derricking winch (lower luffing jib) and spool up winch 1 (lift load hook 2)

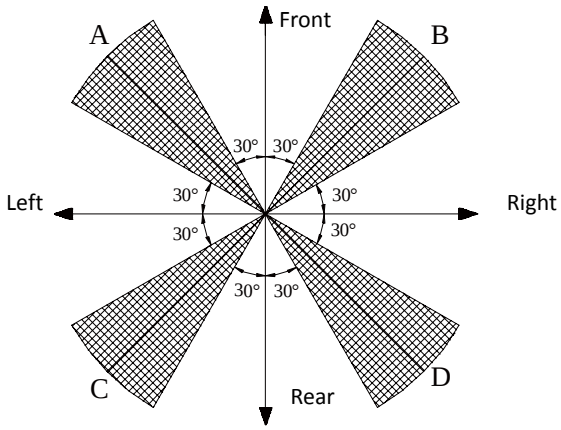


Figure 4-72 Valid work range

Note:

When carrying out simultaneous movement, the control lever must be operated within A, B, C or D areas. Otherwise, the simultaneous movement will not be achieved. (See above figure)

A: Reel off winch 1 (lower load hook 2) and spool up luffing jib derricking winch (raise luffing jib).

B: Reel off winch 1 (lower load hook 2) and reel off luffing jib derricking winch (lower luffing jib).

C: Spool up winch 1 (lift load hook 2) and spool up luffing jib derricking winch (raise luffing jib).

D: Spool up winch 1 (lift load hook 2) and reel off luffing jib derricking winch (lower luffing jib).

When carrying out simultaneous movement, operate right control lever within above area, and press the simultaneous operation button on it at the same time.

The valid movement range of control lever in these four areas is 30°.

4) Simultaneous operation of hoisting winch 2 and luffing jib derricking winch

Operate the left and right control levers at the same time.

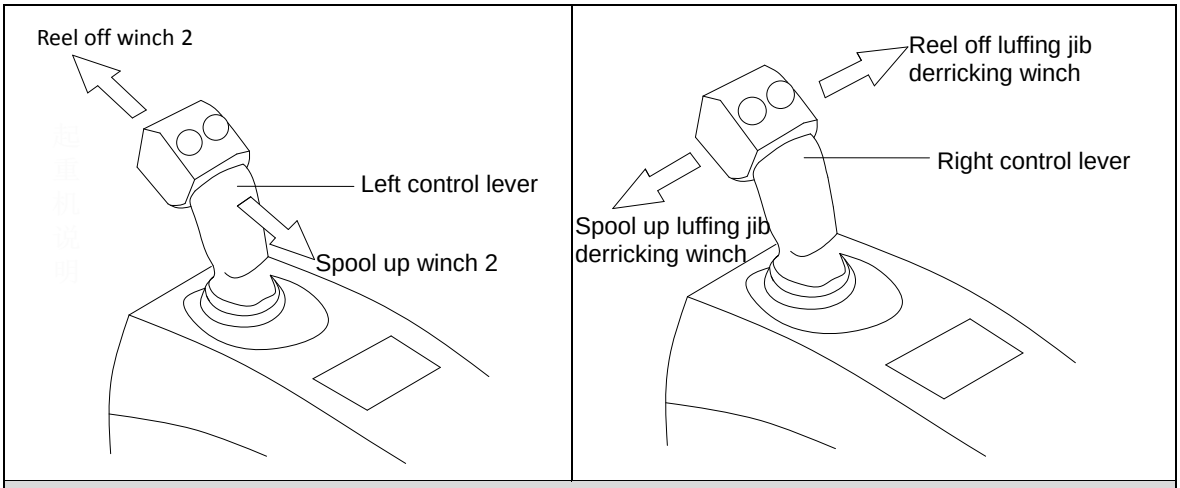


Figure 4-66 Simultaneous operation of hoisting winch 2 and luffing jib derricking winch

Table 4-30 Simultaneous operation of hoisting winch 2 and luffing jib derricking winch

Control lever and operation		Right control lever		
		Move to left	Return to neutral position	Move to right
Left control lever	Move forwards	Reel off winch 2 (lower load hook 1) and spool up luffing jib derricking winch (raise luffing jib)	Reel off winch 2 (lower load hook 1)	Reel off winch 2 (lower load hook 1) and reel off luffing jib derricking winch (lower luffing jib)
	Return to neutral position	Spool up luffing jib derricking winch (raise luffing jib)	Stop working	Reel off luffing jib derricking winch (lower luffing jib)
	Move backwards	Spool up winch 2 (lift load hook 1) and spool up luffing jib derricking winch (raise luffing jib)	Spool up winch 2 (lift load hook 1)	Spool up winch 2 (lift load hook 1) and reel off luffing jib derricking winch (lower luffing jib)

CAUTION

To carry out the simultaneous movements, the operator only needs to move both left and right control levers in corresponding directions.

5) Simultaneous operation of slewing mechanism and luffing jib derricking winch
Operate the left and right control levers at the same time.

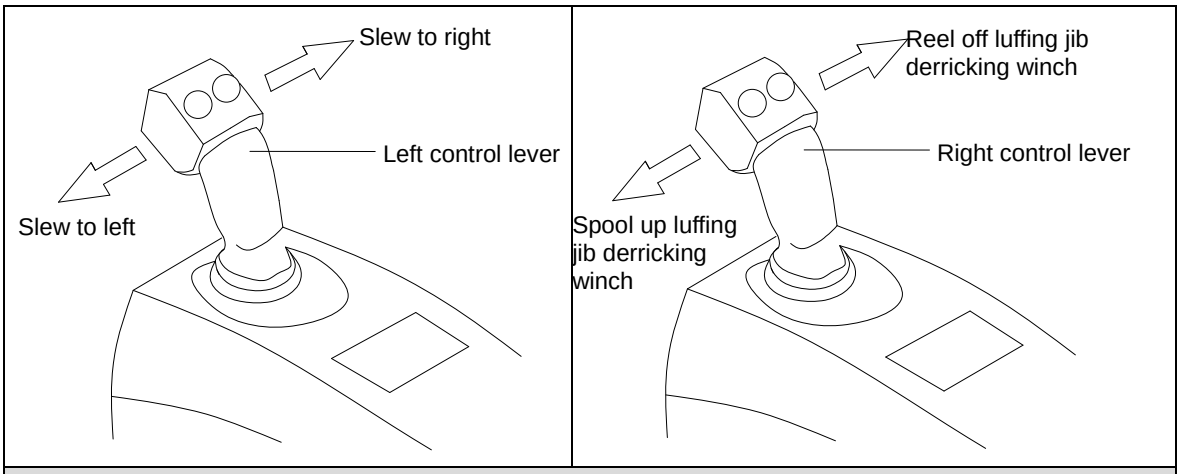


Figure 4-67 Simultaneous operation of slewing mechanism and luffing jib derricking winch

Table 4-31 Simultaneous operation of slewing mechanism and luffing jib derricking winch

Control levers and operation		Right control lever		
		Move to left	Return to neutral position	Move to right
Left control lever	Move to left	Slew to left and spool up luffing jib derricking winch (raise luffing jib)	Slew to left	Slew to left and reel off luffing jib derricking winch (lower luffing jib)
	Return to neutral position	Spool up luffing jib derricking winch (raise luffing jib)	Stop working	Reel off luffing jib derricking winch (lower luffing jib)
	Move to right	Slew to right and spool up luffing jib derricking winch (raise luffing jib)	Slew to right	Slew to right and reel off luffing jib derricking winch (lower luffing jib)

CAUTION

To carry out the simultaneous movements, the operator only needs to move both left and right control levers in corresponding directions.

Table 4-32 Simultaneous operation

No.	Simultaneous movements	Operation
1	Slewing mechanism and hoisting winch 1	Left control lever (left and right) + right control lever (forwards and backwards)
2	Slewing mechanism and main boom derricking winch	Left control lever (left and right) + right control lever (left and right)
3	Slewing mechanism and hoisting winch 2	Operate left control lever in 20°- 70° range
4	Hoisting winch 1 and main boom derricking winch	Operate right control lever in 20°- 70° range
5	Hoisting winch 2 and main boom derricking winch	Left control lever (forwards and backwards) + right control lever (left and right)
6	Hoisting winch 2 and Hoisting winch 1(for luffing jib)	Left control lever (forwards and backwards) + right control lever (forwards and backwards)
7	Slewing mechanism and Hoisting winch 1(for luffing jib)	Left control lever (left and right) + right control lever (forwards and backwards)
8	Hoisting winch 1 and luffing jib derricking winch	Operate right control lever in 20°- 70° range
9	Hoisting winch 2 and luffing jib derricking winch	Left control lever (forwards and backwards) + right control lever (left and right)
10	Slewing mechanism and luffing jib derricking winch	Left control lever (left and right)) + right control lever (left and right)

4.5.6 Operator's cab movement-controlling mechanism

Operator's cab movement-controlling mechanism consists of operator's cab, swivel arm of operator's cab, fixing pin spindle of swivel arm and operator's cab tilting cylinder.

The operator's cab, an independent cabin, can make relative movement to the basic machine. It can not only tilt forwards or backwards, but also swivel sideways. Under working condition, the cab cannot be swiveled out, but can tilt forwards and /or backwards. Only when the crane transfers from transport position to working position, can the cab be swiveled out.

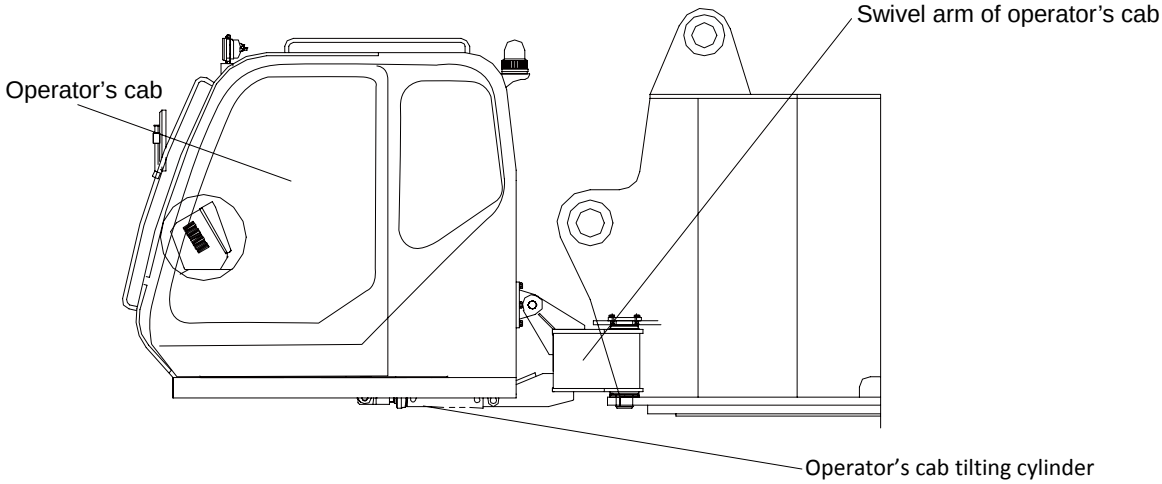


Figure 4-68 Operator's cab movement-controlling mechanism

1. Swiveling the operator's cab sideways

   To reduce the transport width of the basic machine on the low-loader, the operator's cab can be swiveled out of the side working position to the centre of slewing table.

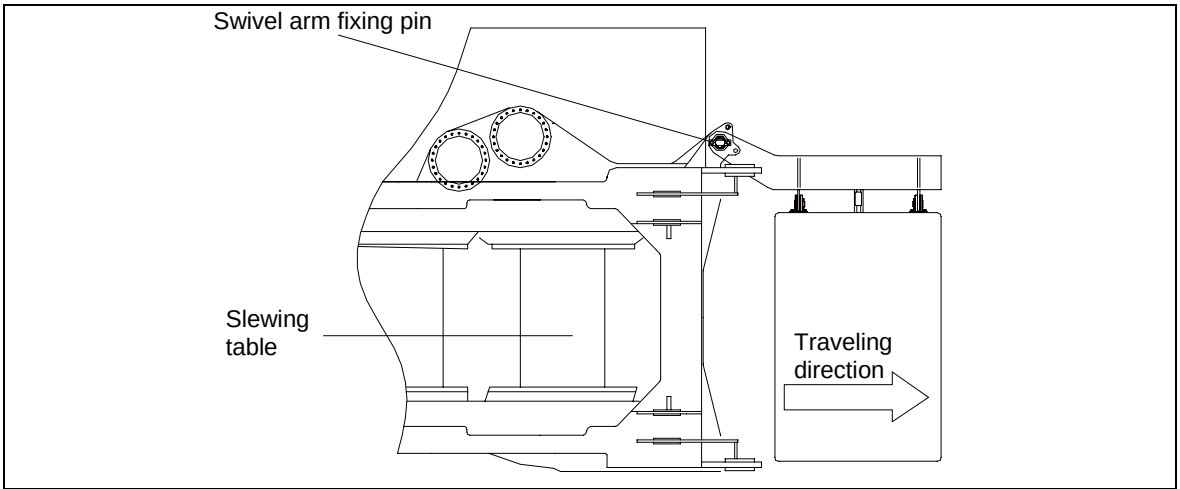


Figure 4-69 Operator's cab in transport position

Before swiveling the cab from transport position to working position, the operator must swivel the swivel arm of cab 90°and then secure it with pin spindle.

The procedure for swiveling cab to the working position:

a) Pull out the swivel arm fixing pin.

b) Swivel the swivel arm of operator's cab 90° manually.

c) Insert fixing pin spindle to secure the swivel arm after cab is in working position.

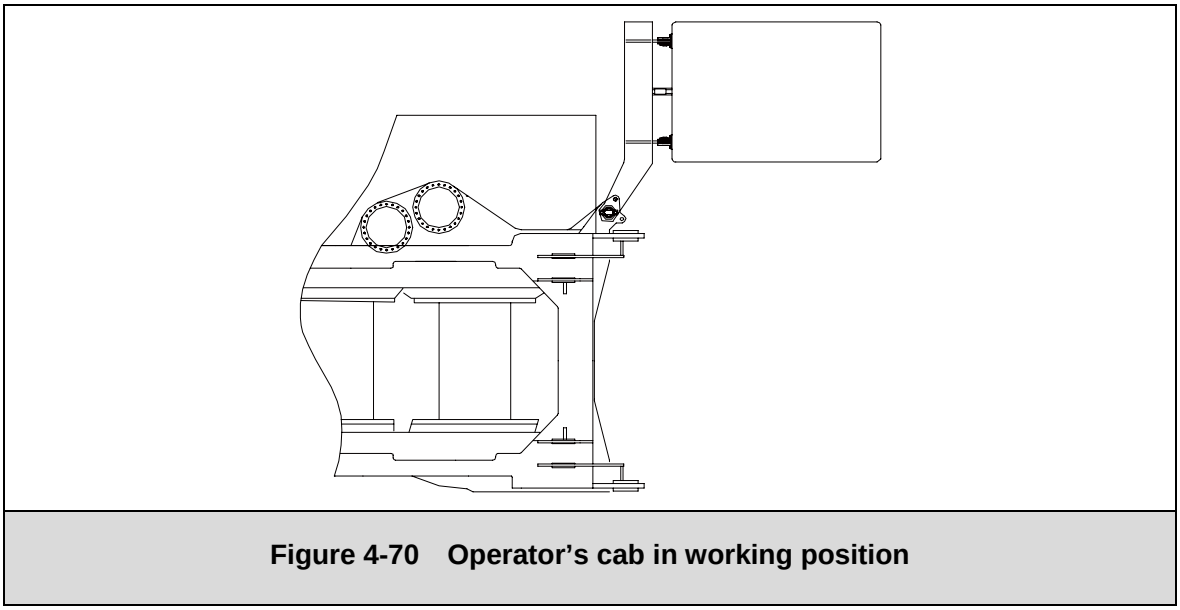


Figure 4-70 Operator's cab in working position

CAUTION

(1) Swiveling the operator's cab to the transport position is carried out in reverse order.

(2) Do not operate any other devices when swiveling the operator's cab.

(3) Close the door before swiveling the operator's cab.

(4) Take off the working floodlight on the roof of cab before swiveling the operator's cab so as to prevent them from colliding with tilting-back support of main boom.

2. Tilting the operator's cab forwards/backwards

In order to enlarge the view of crane operator, the cab can tilt forwards or backwards using tilting cylinder.

When tilting cylinder is extended completely, the cab is in horizontal position;

When tilting cylinder is retracted, the cab will tilt backwards to a maximum of 20°.

This function can be achieved by operating "Tilt cab forwards/backwards" switch in operator's cab, which can make cab stop and maintain at any position within the range of 0°- 20°.

Tilting operator's cab backwards

When the cab is horizontal, turn the "tilt cab forwards/backwards" switch to the left, then the cab will tilt backwards. After it tilts to proper position, turn the switch to neutral position.

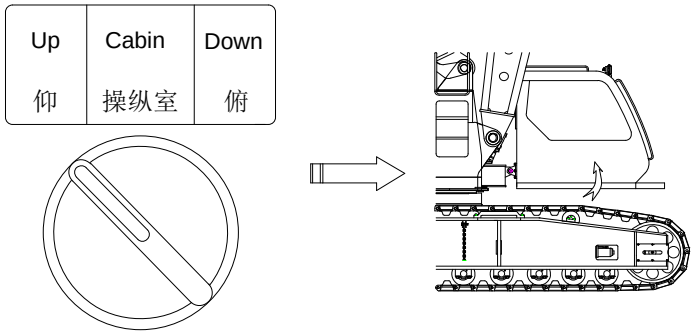


Figure 4-71 Operation of tilting cab backwards

Operation of tilting cab backwards

Turn the "tilt cab forwards/backwards" switch on the right control panel to the left, the cab will tilt backwards.

Turn the "tilt cab forwards/backwards" switch on the right control panel to the neutral position, the cab will stop tilting backwards.

Tilting operator's cab forwards

When operator's cab is tilted backwards, turn the "tilt cab forwards/backwards" switch to the right, then the cab will tilt forwards. After it tilts to proper position, turn the switch to neutral position.

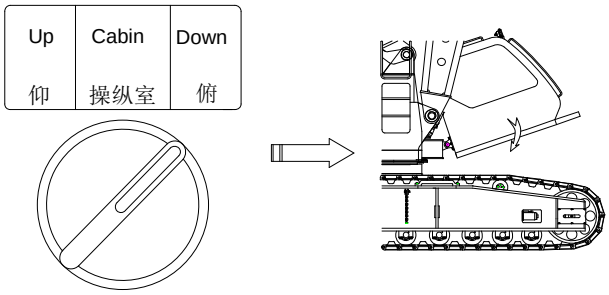


Figure 4-72 Tilting operator's cab forwards

Operation of tilting cab forwards

Turn the "tilt cab forwards/backwards" switch on the right control panel to the right, the cab will tilt forwards.

Turn the "tilt cab forwards/backwards" switch on the right control panel to the neutral position, the cab will stop tilting forwards.

4.5.7 Auxiliary remote control box

The auxiliary remote control box, located on the right side of slewing table and inside the boarding of the crane, is mainly used for self-assembly & dismantling operation. The functions of switches on it are shown in the following figure.

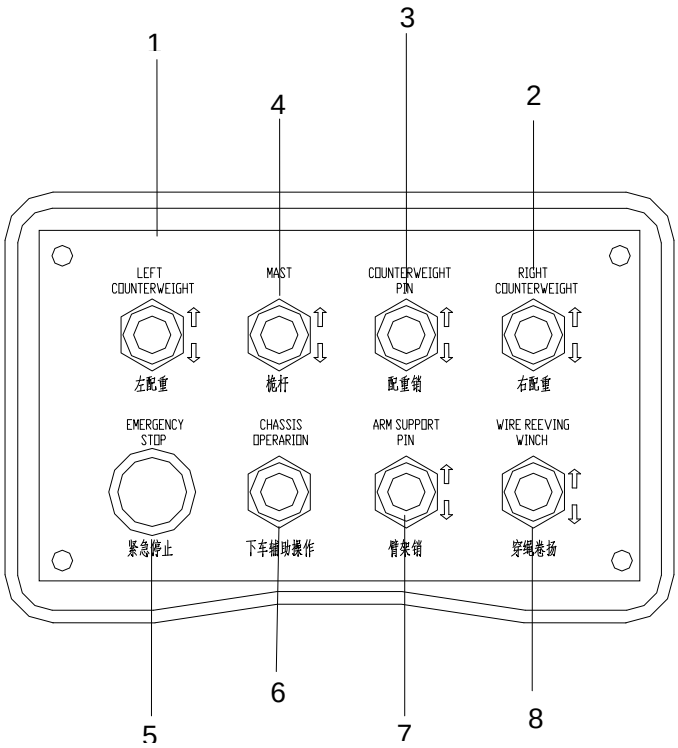


Figure 4-73 Control panel on the auxiliary remote control box

Table 4-33 Instructions for switches on the auxiliary remote control box

No.	Name of switch	Operation	Function
1	Left counterweight control switch	Push up	Extend left counterweight cylinder
		Push down	Retract left counterweight cylinder
2	Right counterweight control switch	Push up	Extend right counterweight cylinder
		Push down	Retract right counterweight cylinder
3	Counterweight bolting cylinder switch	Push up	Extend counterweight bolting cylinder
		Push down	Retract counterweight bolting cylinder
4	A-frame erecting/lowering switch	Push up	Erect A-frame
		Push down	Lower A-frame

5	Emergency stop switch	Its function is the same as that of emergency stop button on the right control panel.	
6	Undercarriage control switch	Only when this switch is turned on, can the support cylinder control levers be operated. (For details, see Section 4.5.7.1)	
7	Pivot section bolting cylinder switch	Push up	Extend bolting cylinder
		Push down	Retract bolting cylinder
8	Reeving winch switch	Push up	Spool up reeving winch
		Push down	Reel off reeving winch
		Its function is the same as that of reeving winch switch on the right control panel.	

CAUTION

As soon as the red emergency stop switch is pressed, the power supply of machine is cut off and the engine shuts down!

4.5.7.1 Undercarriage control valve

The undercarriage control valve, which is located in front of undercarriage center section, is mainly used to extend the support cylinders of crane.

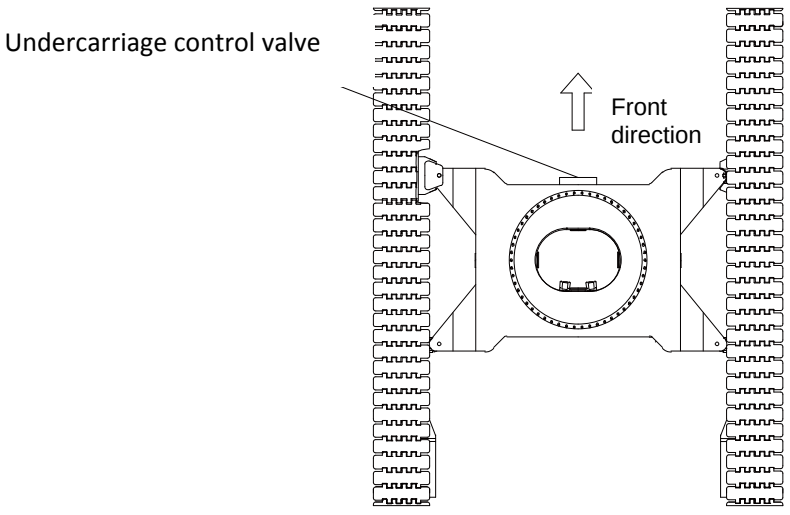


Figure 4-74 Position of undercarriage control valve

Support cylinder control levers

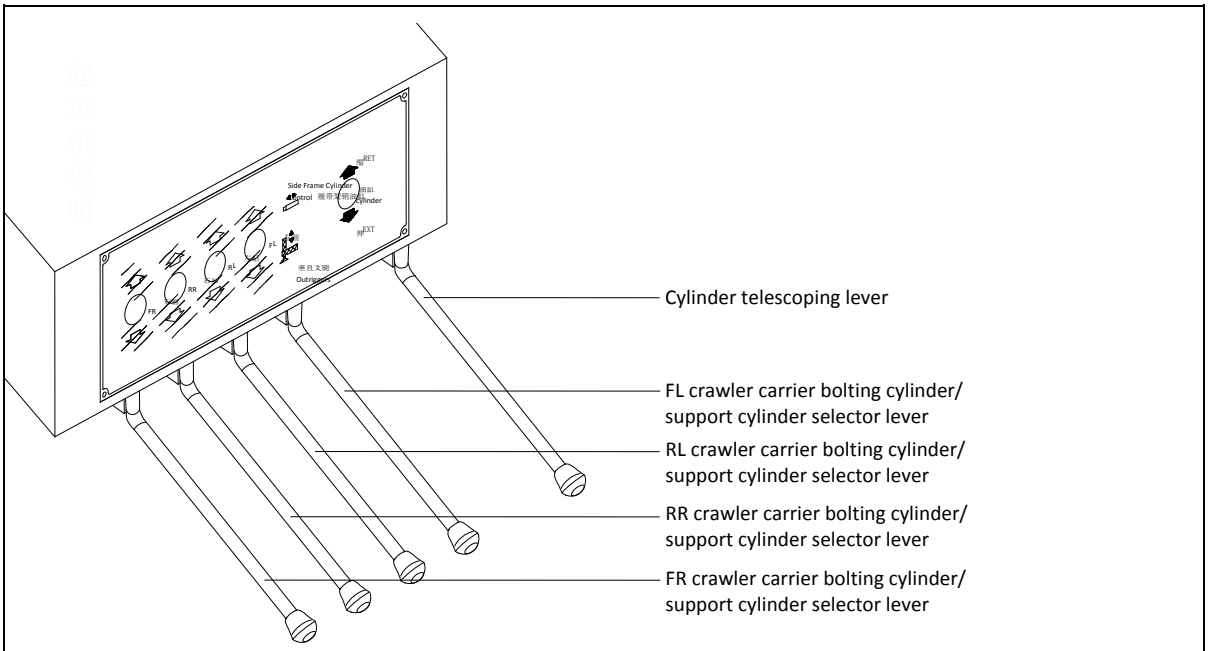


Figure 4-82 Illustrations for operation of undercarriage control valve

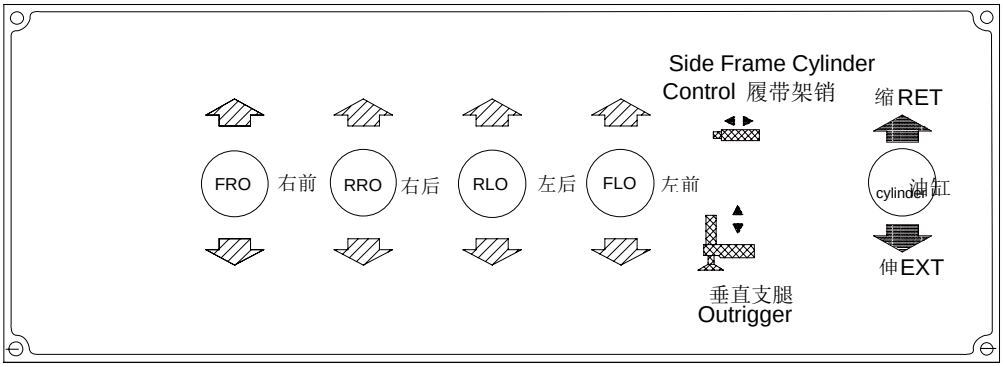


Figure 4-75 Illustrations for operation of undercarriage control valve

Operating instructions:

FR, RR, RL, FL are "four selector levers".

a) When one of the selector levers is pushed up, the crawler carrier bolting cylinder in the corresponding position is selected.

   e.g., when FR selector lever is pushed up, the FR crawler carrier bolting cylinder is selected.

b) When one of the selector levers is pushed down, the support cylinder in corresponding position is selected.

   e.g., when FR selector lever is pushed down, the FR support cylinder is selected.

c) When one of the selector levers is pushed up to select corresponding crawler carrier bolting cylinder.
   – Push up cylinder telescoping lever, the crawler carrier bolting cylinder will be retracted.
   – Push down cylinder telescoping lever, the crawler carrier bolting cylinder will be extended.

d) When one of selector levers is pushed down to select corresponding support cylinder,
   – Push up cylinder telescoping lever, the support cylinder will be retracted.
   – Push down cylinder telescoping lever, the support cylinder will be extended.

4.5.7.2 Self-assembly & dismantling mechanism

Requirements:

1) Turn on the undercarriage control switch on auxiliary remote control box.
2) Level the crane by operating crane support cylinder control levers.
3) Erect A-frame and tilt it forwards to the front of crane with erection cylinder.
   a) Operation of A-frame erection mechanism

      A-frame can be erected by operating the "A-frame erecting/lowering" switch in operator's cab, or the "A-frame erecting/lowering switch" on auxiliary remote control box. (For the details, please refer to Section 4.5.7.)

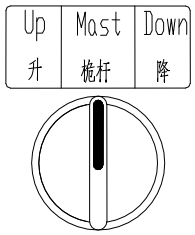


Figure 4-76 Operation of erecting/lowering A-frame

Operation of erecting/lowering A-frame:

Turn the "A-frame erecting/lowering" switch on the right control panel to the left, A-frame will be erected.

Turn the "A-frame erecting/lowering" switch on the right control panel to the right, A-frame will be lowered.

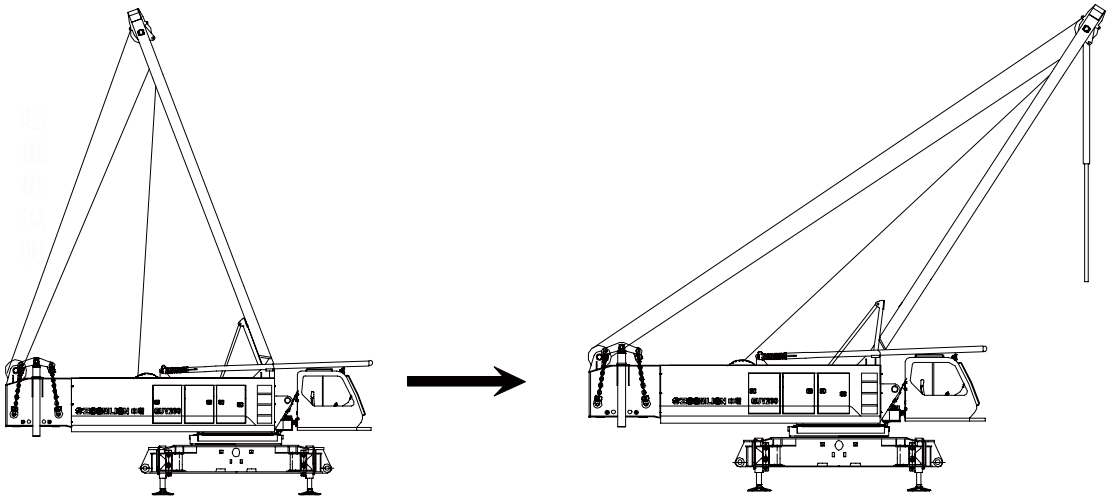


Figure 4-77 Process of erecting A-frame

CAUTION

The operation mentioned above must be carried out by two operators. One observes the conditions of A-frame, erection cylinder and derricking rope, and another operates the crane to erect A-frame.

b) Operation of self-assembly & dismantling mechanism:

1) Turn "W1 Winch/Assembly" switch on the right control panel to right.

2) Push right control lever forwards, the mounting cylinder will be extended to lower the load.

Push right control lever backwards, the mounting cylinder will be retracted to lift the load.

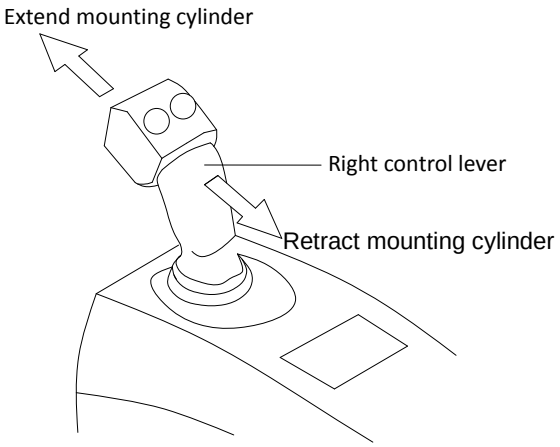


Figure 4-78 Self-assembly operation

During self-assembly & dismantling operation, turn "W1 Winch/Assembly" switch on the right control panel to right.

4.6 Rope reeving

Select proper load hook and rope reeving in accordance with operational planning and different boom configurations.

Table 4-34 Load hook and rope reeving

Type of load hook	Number of rope pulleys	Maximum rope reeving	Weight of load hook (kg)
260 t	10	20	4200
160 t /100 t	6	12 / 8	2800
50 t	2	4	1750
30 t	1	2	1070
16 t	0	1	900

4.6.1 Heavy duty boom (S)

4.6.1.1 Hoisting rope guidance and reeving

260 t load hook

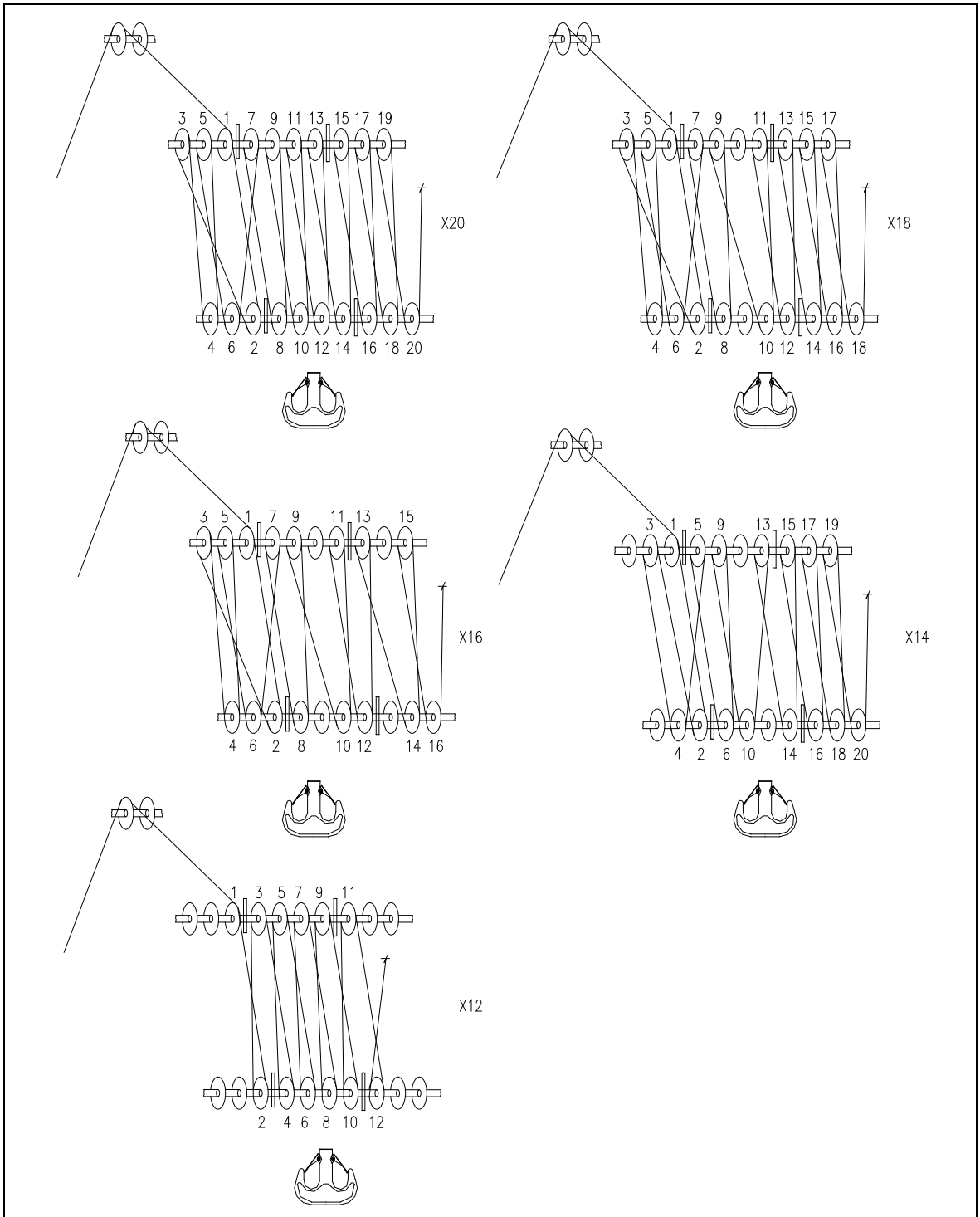


Figure 4-79 Hoisting rope guidance and reeving for 260 t load hook

160/100 t load hook

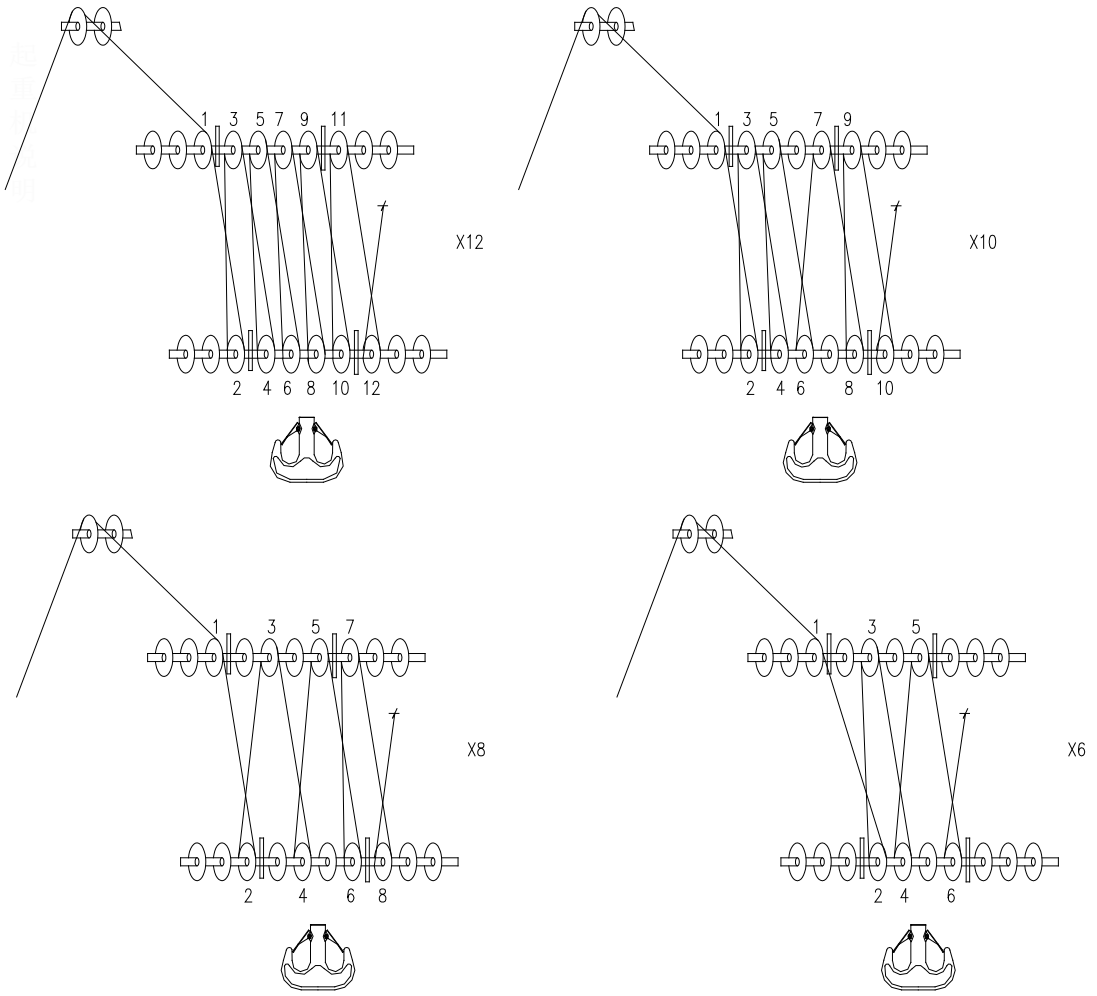


Figure 4-80 Hoisting rope guidance and reeving for 160/100 t load hook

50 t load hook

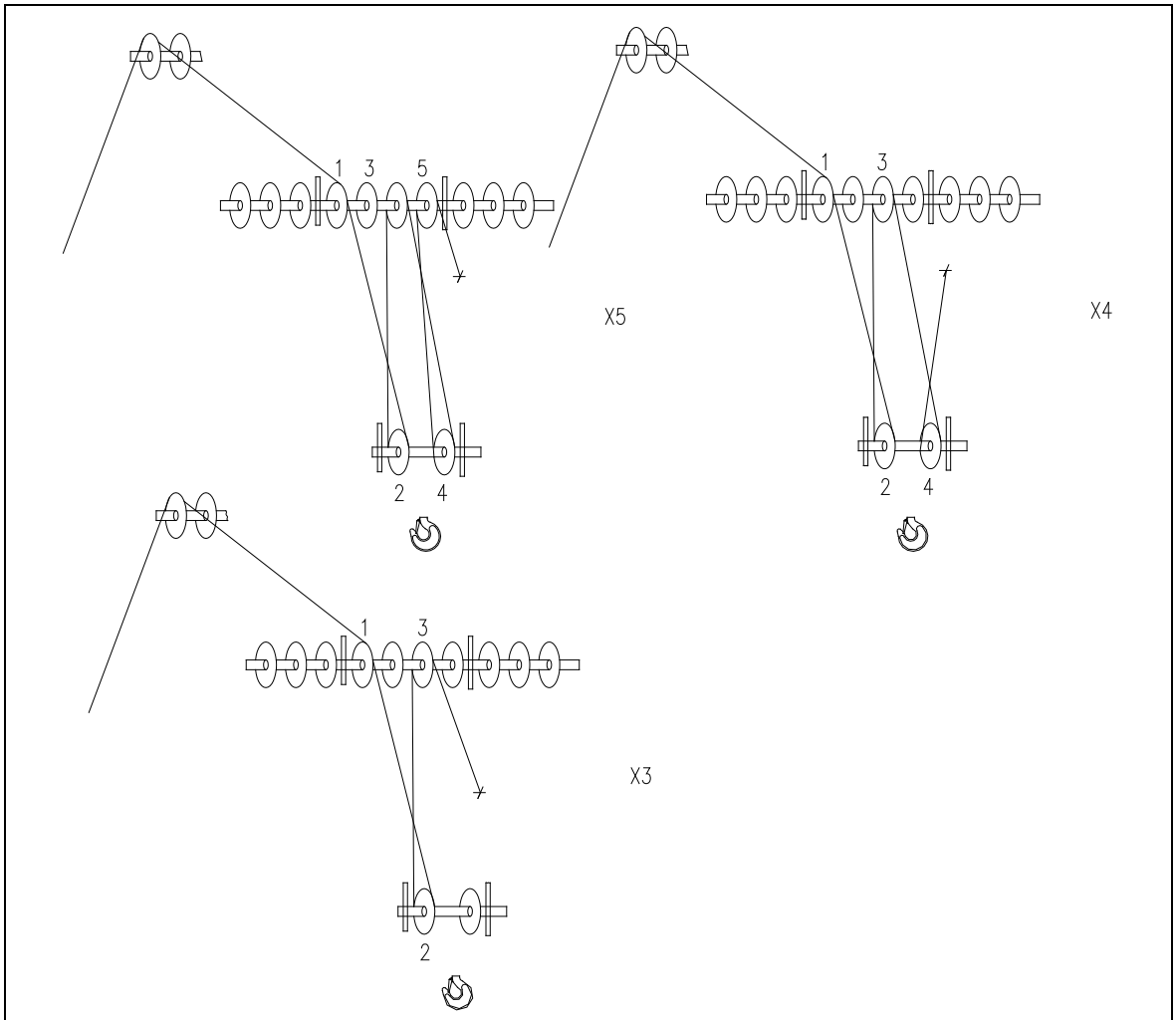


Figure 4-81 Hoisting rope guidance and reeving for 50 t load hook

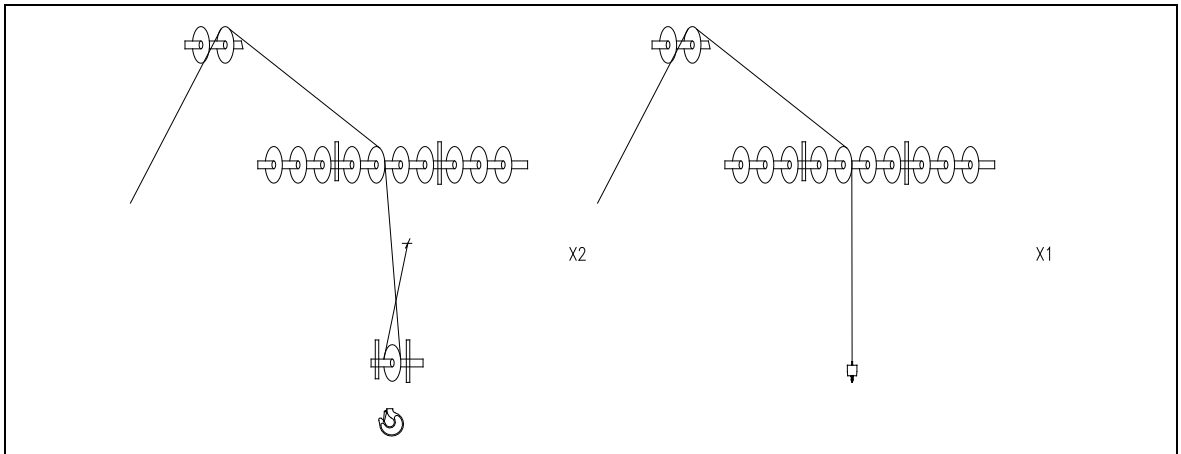


Figure 4-82 Hoisting rope guidance and reeving for other load hooks

4.6.1.2 Main boom with tip boom

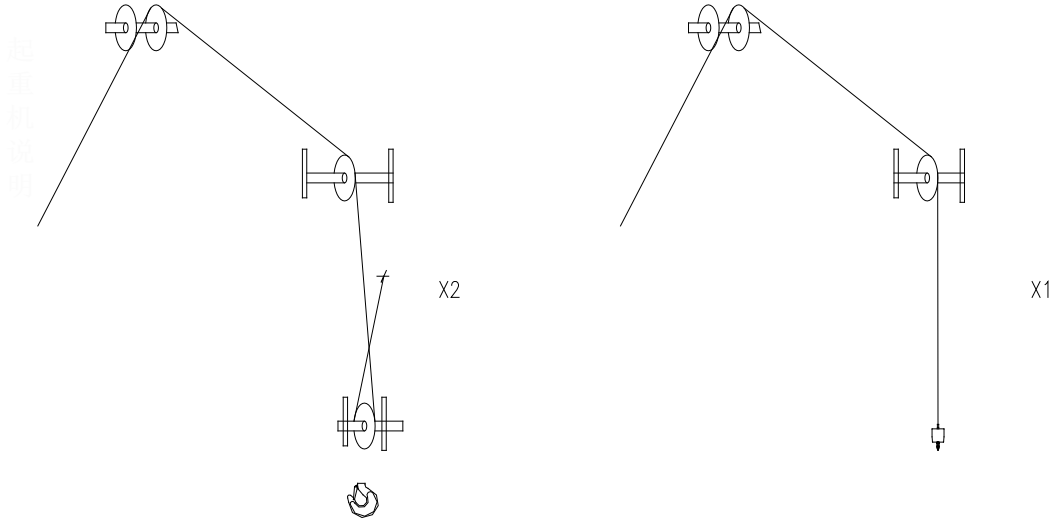


Figure 4-83 Hoisting rope guidance and reeving for main boom with tip boom

4.6.2 Light duty boom (SL)

4.6.2.1 Hoisting rope guidance and reeving

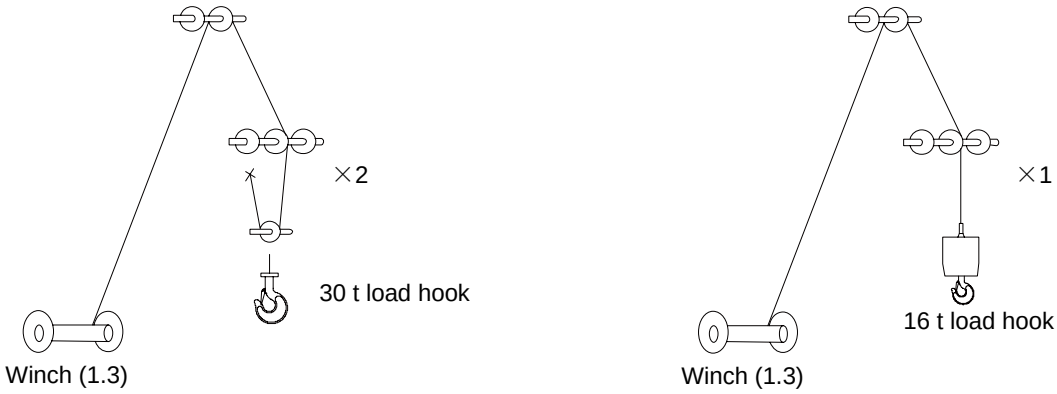


Figure 4-84 Hoisting rope guidance and reeving for main boom with light duty boom

4.6.2.2 Hoisting rope guidance and reeving for tip boom on light duty boom

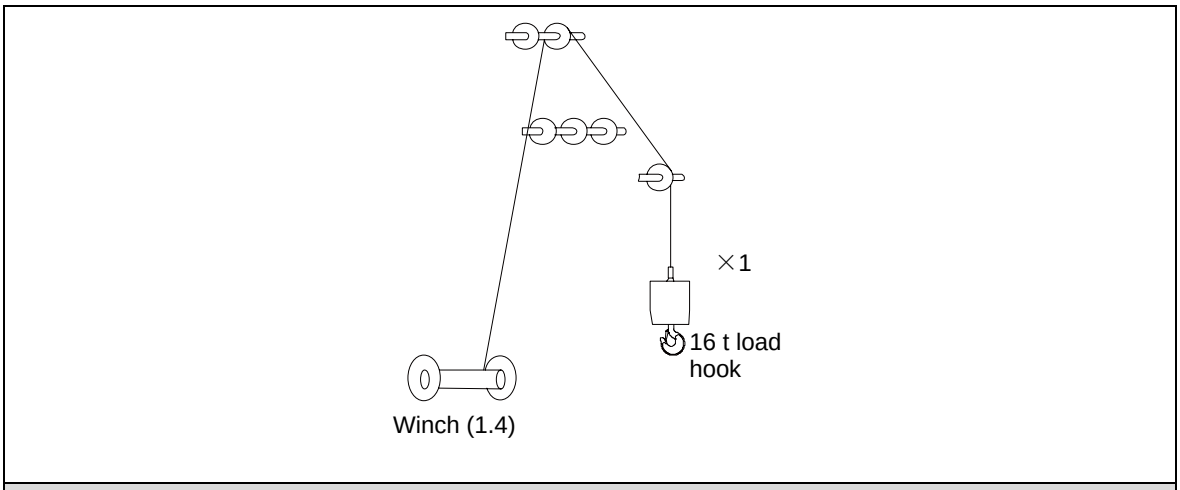


Figure 4-85 Hoisting rope guidance and reeving for tip boom on light duty boom

4.6.3 Fixed jib on heavy duty boom (SF)

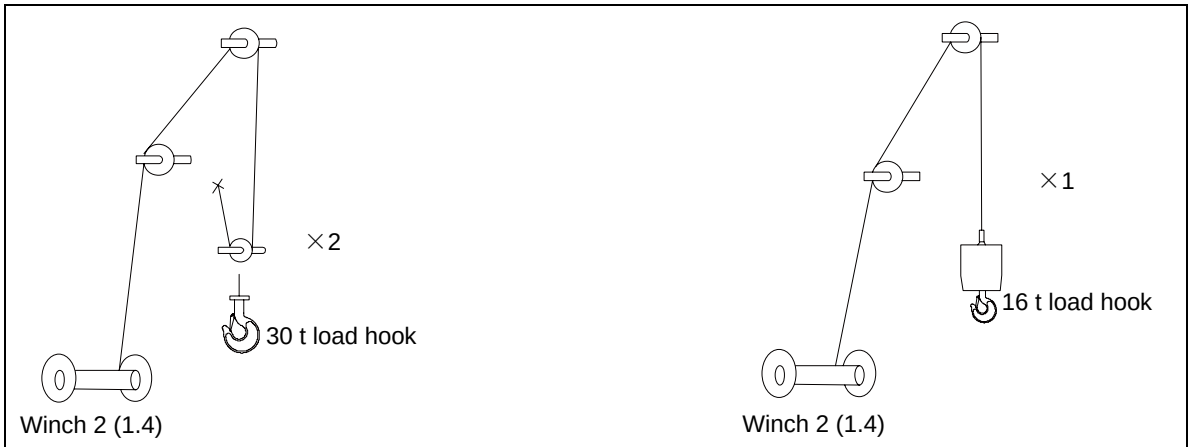


Figure 4-86 Hoisting rope guidance and reeving for main boom with fixed jib

4.6.4 Luffing jib on heavy duty boom (SW)

4.6.4.1 Hoisting rope guidance and reeving

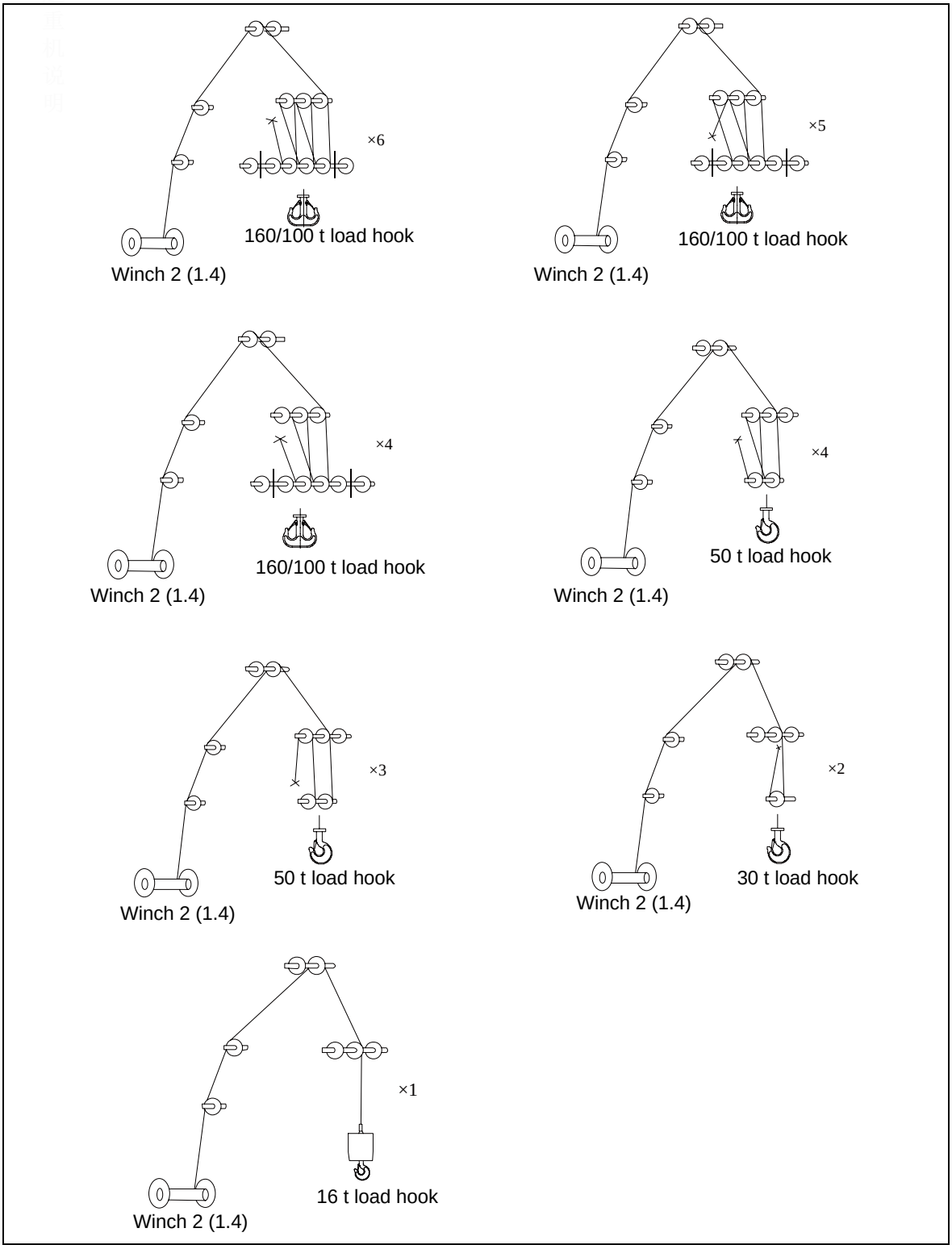


Figure 4-87 Hoisting rope guidance and reeving for main boom with luffing jib

4.6.4.2 Hoisting rope guidance for tip boom

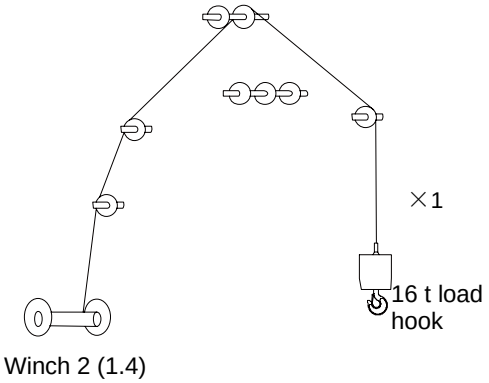


Figure 4-88 Hoisting rope guidance and reeving for tip boom on luffing jib

4.6.5 Derricking rope guidance and reeving

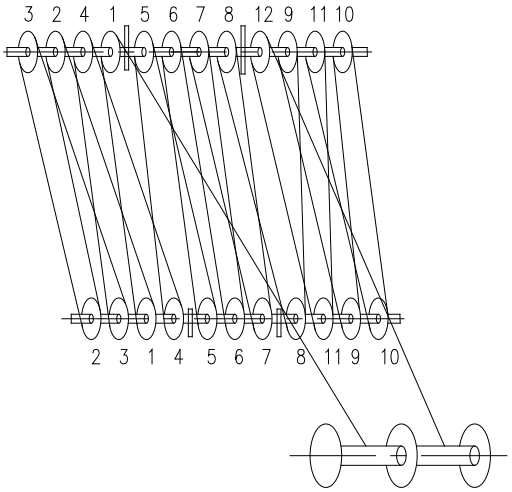


Figure 4-89 Derricking rope guidance and reeving

4.6.6 Luffing rope guidance and reeving

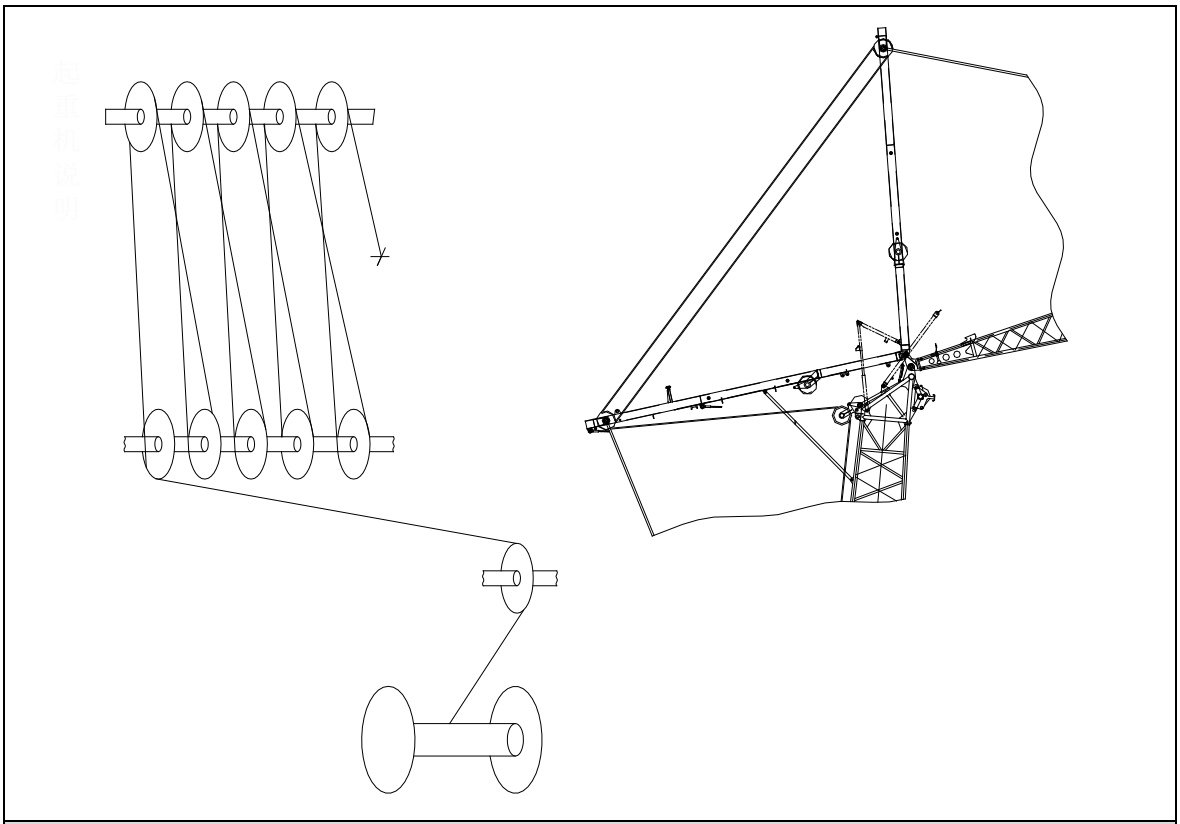


Figure 4-90 Luffing rope guidance and reeving

ZOOMLION

Operator's Manual for Crawler Crane

Chapter 5 Assembly and Dismantling

Chapter 5 Assembly and Dismantling

5.1 Safety – technical notes

5.1.1 Notes on assembly

a) Make sure that the crane complies with operating requirements. Then check the position of A-frame, anchoring rods, WA-frame 1, WA-frame 2 and sequence of boom intermediate sections one by one according to combination mode of boom length.

b) The hoisting rope must be reeved between the rope pulley on main boom head and load hook in accordance with the corresponding hoisting rope reevings specified in Rope Reeving in Chapter 4.

c) Counterweight plates must be fitted according to load capacity chart.

d) For assembly work on the crane, a safety assembly scaffolding/ working platform should be used. Improvisations are prohibited. Otherwise, there is a danger of falling down.

e) Remove obstacles away from the ground on the site before assembling and dismantling. In addition, the ground on the site should be cordoned off to prevent access by unauthorized person.

f) Assembly of the boom must be done over the front or rear of the crane undercarriage; attention must be given to choose flat and solid ground to ensure proper support of the crane.

g) The jib should be assembled in accordance with the maximum permissible boom length, and the wire rope should be installed strictly according to the hoisting rope reevings.

h) Each dismantled part should not only satisfy the requirement of load-bearing capacity under operating conditions, but also meet the art technology requirement of self-assembling /dismantling operation which must be carried out strictly in accordance with design requirement since the self-assembling /dismantling operation is a complicated lifting process.

i) Lattice components which are not in contact with the ground during assembly/disassembly must be supported by appropriate and stable objects.

j) Ensure that nobody stands underneath the boom when the boom is pinned and unpinned.

k) Following certain disassembly principles and methods, ZCC2600 crawler crane can be divided into several parts for transportation. Main parts include undercarriage centre section, slewing table, A-frame and derricking pulley blocks, whose gross weight should be controlled within 46t. The slewing table and undercarriage centre section should be placed in the same direction, and operator's cab should be swung in 90°. Crawler carrier should be transported as a whole part. Boom system can be dismembered into boom sections and jib can be placed in main boom and secured with two chains during transportation. If lattice components are not secured, the inside lattice components will slide out and fall down which may cause severe accident.

l) For crane operation with luffing jib:
Only when the angle of luffing jib to main boom reaches 100° (main boom angle is larger than 65°) and the luffing jib is not attached with a load hook, can it be raised up. To lay down the luffing jib, make sure that the angle between the main boom and luffing jib is equal to or larger than 10° when the tilting-back supports of luffing jib are yet not dismantled.

5.1.2 Checking safety measures

a) Clearly define the duty and area of responsibility of all personnel concerned.
b) Check whether the crane is adjusted to be horizontal.
c) Check whether there is sufficient safety clearance to slopes and trenches.
d) Check whether there are any live wires within the operating range of the crane and make sure that any parts of the crane are not in contact with the live-wire when crane movement is carried out.
e) Check that appropriate operating site has been selected so that the crane movements can be performed within maximum and minimum working radius.
f) Check whether there are obstacles which will hinder required crane operations.
g) Check whether the ground provides adequate load-bearing capacity.
h) Know clearly about the type of crane operation and working mode.
i) Check the distance between the lifting points and surrounding buildings.
j) Check influence of communal facilities (including the overhead high/low voltage lines and underground gas pipes).
k) Check movement restrictions due to surrounding structures (e.g. is there another crane nearby in working).
l) Check number, weight, dimensions, material of load(s) to be lifted.
m) Check required lifting height and slewing radius.
n) Check heights and widths of thoroughfares leading to the site.
o) Communication means must be agreed upon by both the signalman and crane operator.
p) Take appropriate measures to keep people unconcerned and equipment away from the working range.

To master the actual condition of lifting operation accurately and ensure safe operation, the safety measures mentioned above should be checked and a proper operational planning should be carried out.

5.1.3 Inspection of wire rope, load hook, rope pulley and anchoring rods

5.1.3.1 Checking the wire rope

The ropes must be checked by an expert before assembly and checks must be performed at regular intervals in order to detect possible damage or wear and tear at an early stage.

The ropes must be removed immediately if any of the following damage is detected:

– Breakage of a strand.
– Wire breaks.
– Reduction in the rope diameter by more than 10% of the nominal size.
– Rope deformation.

The replacement rope must comply with the original rope specifications, including length, diameter and strength rating. The hoisting limit switch must be readjusted if a new hoisting rope is used!

Damaged rope pulley should be repaired or changed prior to replacing wire rope, otherwise, new wire rope will be damaged.

The inspection and maintenance of wire rope is detailed in *Crawler Crane Service Manual*.

5.1.3.2 Checking load hook

a) Check the hook for distortions, e.g., at the hook jaw.
b) Inspect all bolts and screws, and ensure all cotter pins are complete.
c) Check that the rotary connection of hook can move easily, and the clearance is not too large.
d) Check the easy rotation of the hook: rotate the hook by hand. If it is stiff, it indicates that the bearing has been damaged.
e) Check the safety catch for completeness and functional work.
f) Check the hook for corrosion and wear.

5.1.3.3 Checking rope pulleys

a) Check rope pulley all around for damage and cracks.
b) If rope pulleys have been hit during crane operation (for example on buildings) or if they were subjected to other stress factors, they must be then extensively checked for damage or cracks.
c) Check for wear on the rope groove. Replace the pulley if the bottom of the rope pulley has been worn down more than 1/4 of the rope diameter.
d) If any damage or cracks are found, then the rope pulley must be replaced immediately. If this is not observed, there is great danger of causing a serious accident!
e) Check rope pulley for tight fit and shakes. Loose and shaken rope pulley indicates that the bearing and bearing bush are damaged.

5.1.3.4 Checking anchoring rods

a) The anchoring rods should be secured well on boom frame during transportation.
b) The anchoring rods, if removed from boom frame for transportation, must be re-assembled according to anchoring rods configuration.
c) Check the anchoring rods for cracks, wear and corrosion.
d) The anchoring rods should be checked regularly. For the items to be checked, please refer to the relevant sections in Maintenance Manual.

5.1.4 Connecting or disconnecting the hydraulic lines with quick-release couplings

When hydraulic lines are connected or disconnected using quick-release couplings please ensure that the coupling procedure is being performed correctly.

Requirements for a proper connection:

a) Depressurize hydraulic system before connecting and disconnecting (switch off the engine and wait for about 5 minutes).
b) Coupling parts (male end and female end) are plugged into each other and screwed together using the hand-tightened nut.
c) Turn the hand-tightened nut over the O-ring until a firm and tight fit is attained.
d) The hydraulic couplings may only be tightened or unscrewed by hand rather than by tools which may cause damage to couplings.

Improperly connected couplings may lead to a loss of pressure or sudden leaking, thereby causing accidents.

5.1.5 Erecting and lowering the boom

Before erecting and lowering the boom, ensure that the following prerequisites are met:

a) The crane is properly supported and leveled.
b) The counterweight plates have been attached in accordance with the load capacity chart.
c) All limit switches have been correctly fitted and are fully operational.
d) The main boom and jib have been attached in accordance with the boom configurations and operating instructions.
e) All pinned connections have been secured.
f) The hoisting rope has been correctly placed in the rope pulleys and prevented from jumping out (from rope groove) using rope retaining pins.
g) There are no loose parts on main boom or jib.
h) In winter, the main boom, jib and associated components (limit switches, rope drums, warning lamp, anemometer etc.) must be kept free of ice and snow.

CAUTION

Incorrectly fitted or faulty limit switches and falling parts (pins, retaining pins, ice etc.) can cause injury.

5.2 A-frame

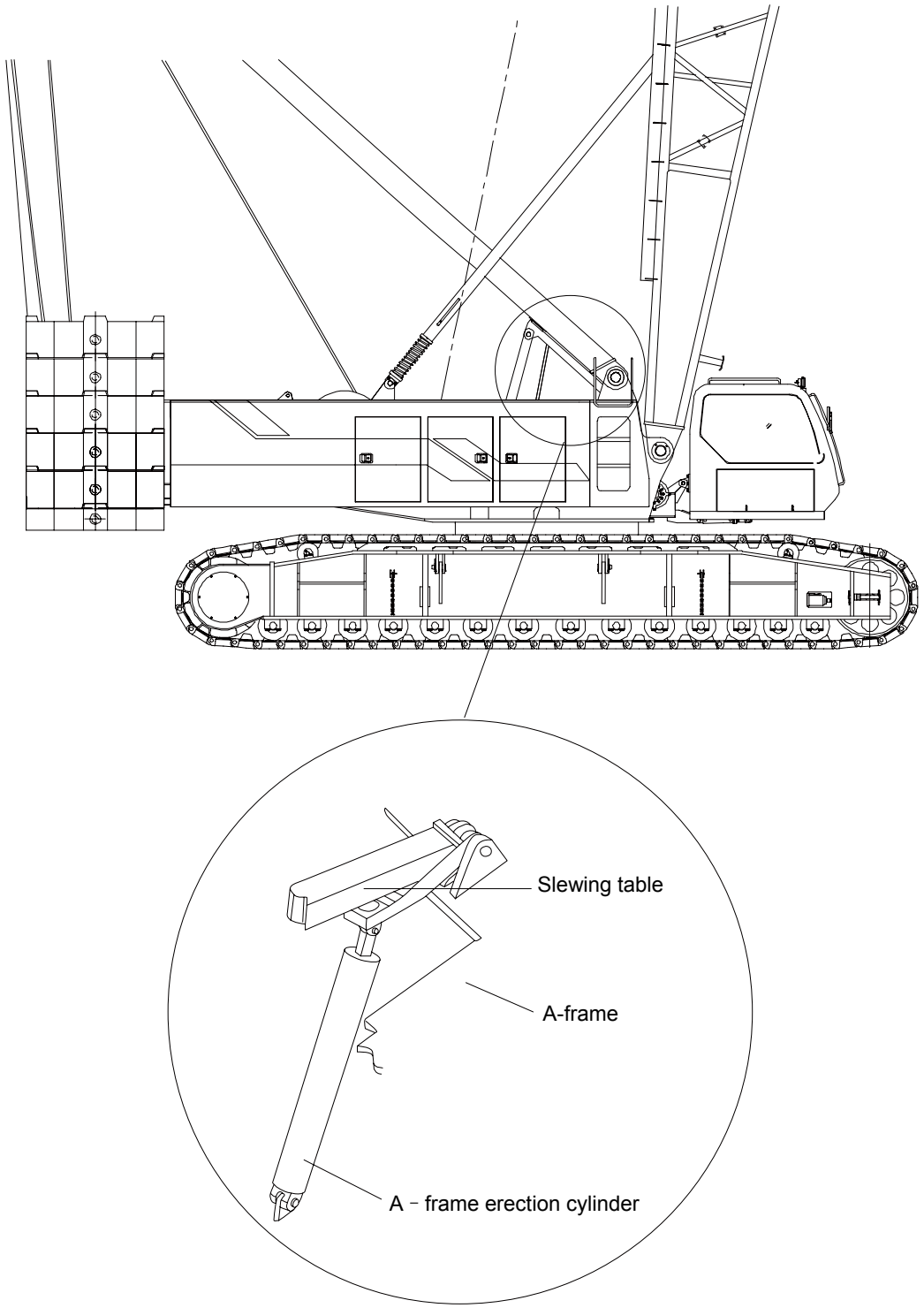


Figure 5-1 A-frame

The A-frame erecting mechanism consists of A-frame, erection cylinder and auxiliary hydraulic system, etc. It is mainly used for the assembly, dismantling or conversion of the machine on the site. Erect A-frame via the erection cylinder to the upper tilt point at approximately 110° (the angle of A-frame to the front horizontal line is 70°). When A-frame tilts forwards under its own weight, the main boom derricking winch is simultaneously operated in a lowering direction until A-frame reaches 165° (the angle of A-frame to the front horizontal line is 15°). Under this condition, the A-frame erecting mechanism can be used to connect anchoring rods and used as a mounting crane.

The function of A-frame erecting mechanism:

a) Serving as a mounting crane

After the A-frame tilts forwards to a required position, the boom sections, and crawler carriers and individual counterweight plate can be lifted by the mounting cylinder on A-frame. In the process of self assembly & dismantling, the A-frame erecting mechanism serves as a mounting crane, whose maximum lifting capacity is 25t in 5m working range.

b) Serving as a component of derricking mechanism

The derricking mechanism of the crane is composed of A-frame and boom frame. A-frame is therefore an integral part of the derricking mechanism.

5.2.1 Connecting the hydraulic lines to mounting cylinder on A-frame

The hydraulic lines to mounting cylinder are connected as follows:

a) The quick-release coupling is a hydraulic connector consisting of a female end (internal thread) and a male end (external thread).

b) To connect the hydraulic lines, the operator just needs to plug the male end of quick-release coupling into the female end of it.

c) To distinguish between the two quick-release couplings of the same type, on the mounting plate are often installed a female end of one coupling and a male end of the other coupling.

Two quick-release couplings are fitted on the left side of A-frame (see following diagram)

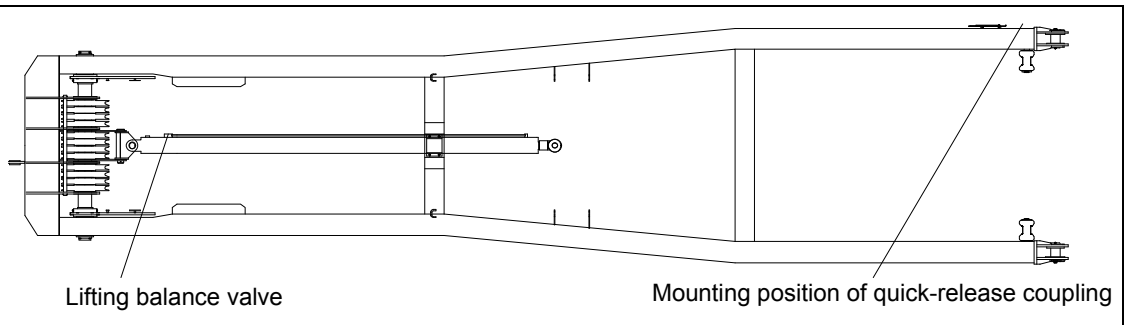


Figure 5-2 Mounting position of quick-release coupling on A-frame

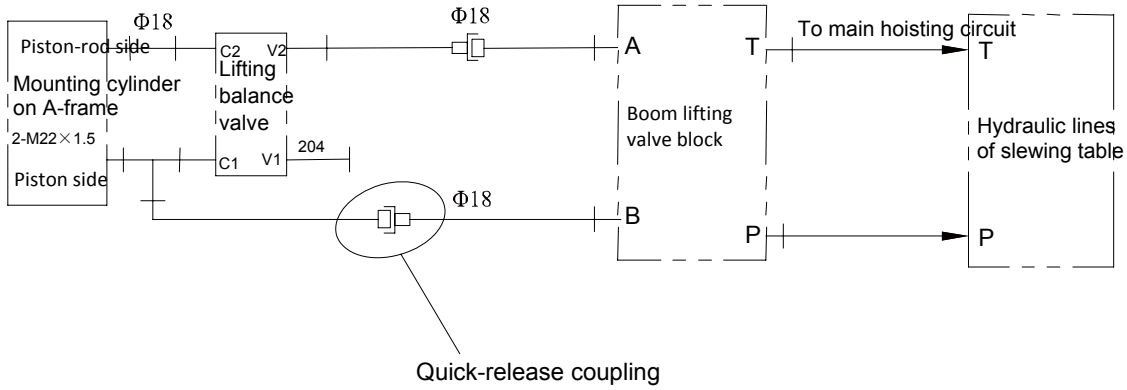


Figure 5-3 Connection of hydraulic lines

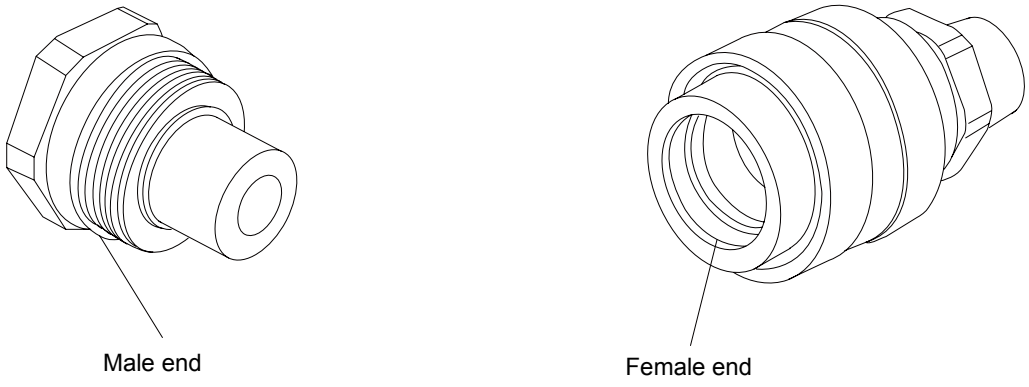


Figure 5-4 Quick-release coupling

Plug the male end of quick-release coupling to its female end.

CAUTION

When hydraulic lines are connected and disconnected via quick-release couplings, please ensure that the coupling procedure is performed correctly.

Requirements for proper connection:

(1) Depressurize hydraulic system before you connect and disconnect hydraulic lines with quick-release couplings (switch off the engine and wait for about 5 minutes.)

(2) Assemble coupling components (male and female ends) and tighten them by nut.

(3) Turn the nut until it reaches a tangible and fixed stop position.

(4) The hydraulic couplings may only be tightened or unscrewed by hand rather than by tools. Otherwise, the couplings would be damaged.

(5) It's suggested to tighten the quick-release coupling with a diameter of more than 1 cun with a wrench.

After the above quick- release coupling is connected, connect the dust wrapper of each hydraulic line.

DANGER

Improperly connected couplings may lead to pressure loss or sudden leakage, thereby causing accidents.

5.2.2 Operation of A-frame

5.2.2.1 A-frame movement control

A-frame can be erected or lowered by operating the "A-frame erecting/lowering" switch (58) in the operator's cab.

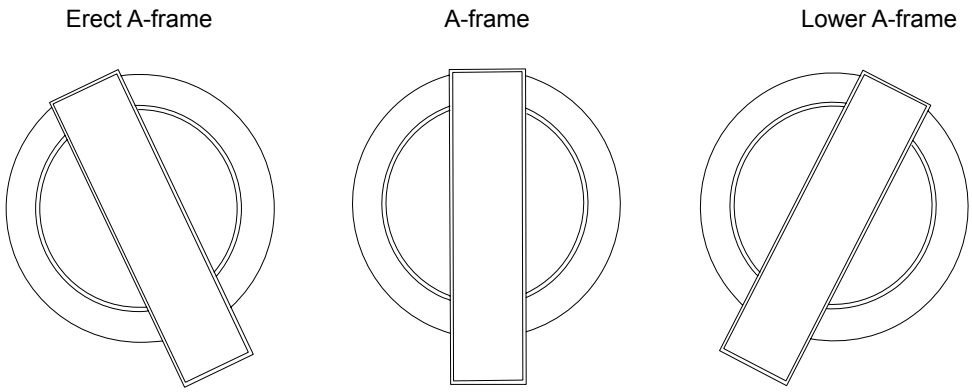


Figure 5-5 "A-frame erecting/lowering" switch

Turn the switch (58) on the right control panel to the left – erect A-frame.

Turn the switch (58) on the right control panel to the right – lower A-frame.

A-frame can also be controlled by operating the "A-frame erecting/lowering" switch on the auxiliary remote control box.

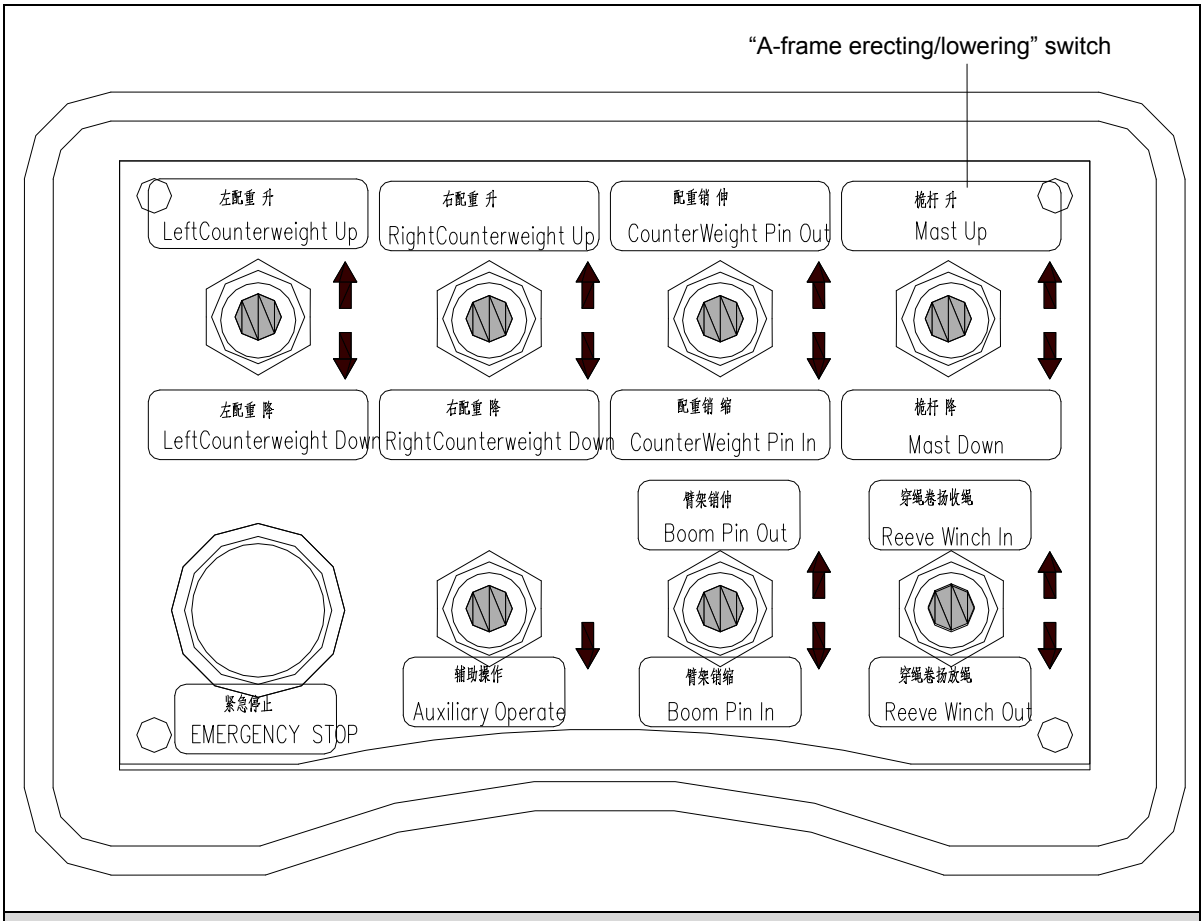


Figure 5-6 Auxiliary remote control box

Push the "A-frame erecting/lowering" switch up – erect A-frame.

Push the "A-frame erecting/lowering" switch down – lower A-frame.

CAUTION

(1) The code of control lever and switch on the control panel appeared in this chapter are detailed in section 4.1 "Control and operating instruments" of Chapter 4 "Crane Operation".

(2) The operation mentioned above should be performed by two persons. One worker gives guidance (watch the A-frame, erection cylinder and rope guiding condition on the derricking winch), while the other worker operates.

5.2.2.2 Erecting A-frame

a) Turn switch (58) in operator's cab to the left or push up "A-frame erecting/lowering" switch on the auxiliary remote control box, the erection cylinder will extend to erect A-frame from 0°position until the derricking rope between the slewing table and the derricking pulley block is tensioned, and then move the right control lever (30) to the right to reel off the main boom derricking winch.

b) After A-frame is erected to 110° position, return the switch (54) or "A-frame erecting/lowering" switch on the auxiliary remote control box to neutral position, and then the erection cylinder will stop movement. At this time, A-frame tilts forwards under its own weight, and main boom derricking winch is reeled off continuously.

CAUTION

Before operation, make sure that derricking rope is reeved between derricking pulley block on A-frame and that on slewing table and placed well in the derricking pulley block.

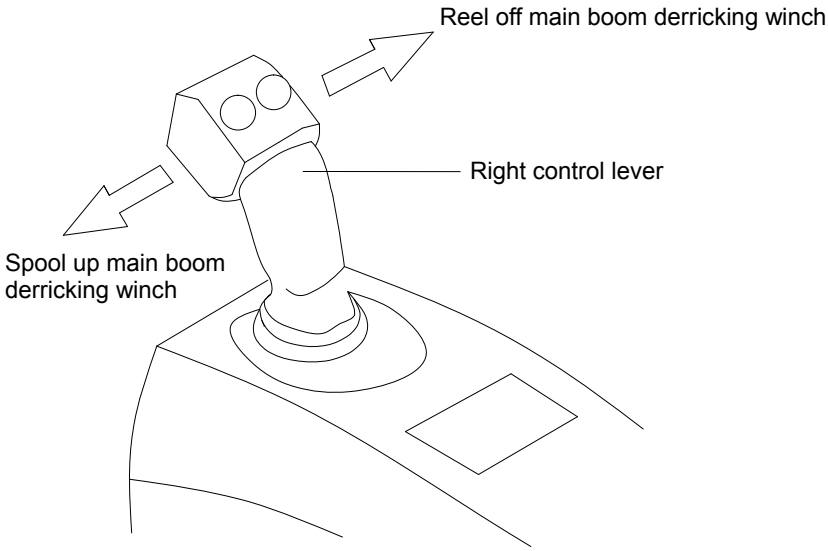


Figure 5-7 Main boom derricking winch operation

c) When A-frame tilts forwards under its own weight to 165° limit position, return right control lever (30) to neutral position to stop the movement of "reel off main boom derricking winch".

CAUTION

(1) A-frame movement limit should not be exceeded, otherwise, the crane is liable to topple over.

(2) A-frame position can be adjusted within its movement limit depending on different working requirements.

(3) No slack shall be allowed to develop in derricking rope when A-frame is in motion.

5.2.2.3 Lowering A-frame

a) Move right control lever (30) to the left to spool up main boom derricking winch, and A-frame will be raised backwards.

b) After A-frame is raised by the derricking rope to 110° position, turn the switch (58) in operator's cab to the right or push down "A-frame erecting/lowering" switch on the auxiliary remote control box, and continue to move right control lever (30) to the left to spool up main boom derricking winch. Then the erection cylinder as well as the A-frame will be retracted.

c) When the erection cylinder and A-frame return to original or required position, return the switch (58) in operator's cab or "A-frame erecting/lowering" switch on the auxiliary remote control box to neutral position, and then the erection cylinder will stop motion. At the same time, move right control lever (30) to neutral position to stop the movement of "spool up main boom derricking winch".

(1) No person may stand underneath A-frame when A-frame is moving, otherwise there is a risk of injury.

(2) No slack must be allowed to develop in derricking rope when A-frame is in motion.

5.3 Attaching crawler carriers

5.3.1 Unloading of basic machine

5.3.1.1 Checks before operation

a) Jobsite

1) The ground on the jobsite must be firm and flat. If necessary, steal plate should be padded.

2) It should be large enough for trailer traveling and auxiliary hoist operation.

b) Operating procedure and safety regulations

All operators should be familiar with operating procedure and safety regulations and clear about their areas of responsibility before operation.

c) Checks before operation

Check the basic machine before operation.

5.3.1.2. Unloading the basic machine

a) After the basic machine reaches the jobsite, remove related fixing devices and the package.

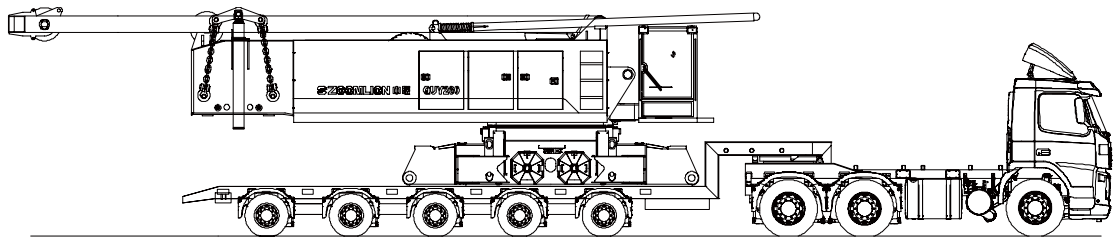


Figure 5-8 Basic machine in transport condition

b) Swivel the operator's cab from transport position to working position and then secure it with "fixing pin for swivel arms".

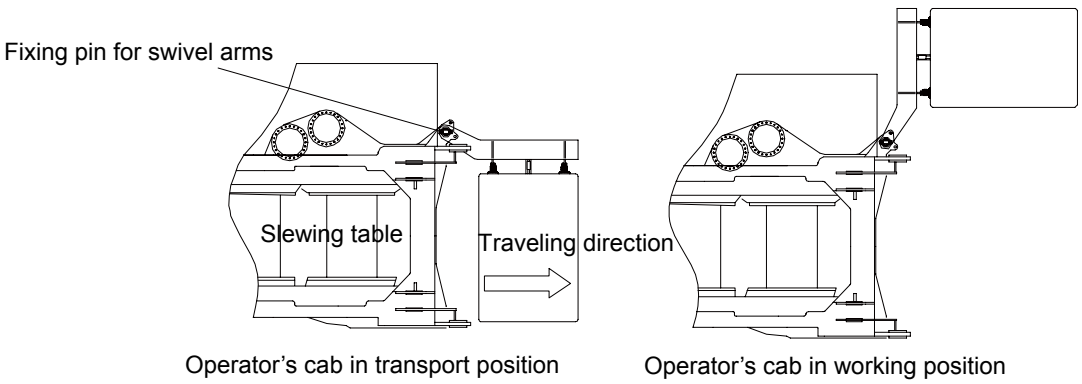


Figure 5-9 Operator's cab operation

c) Erect the A-frame upwards by erection cylinder to 110° position.

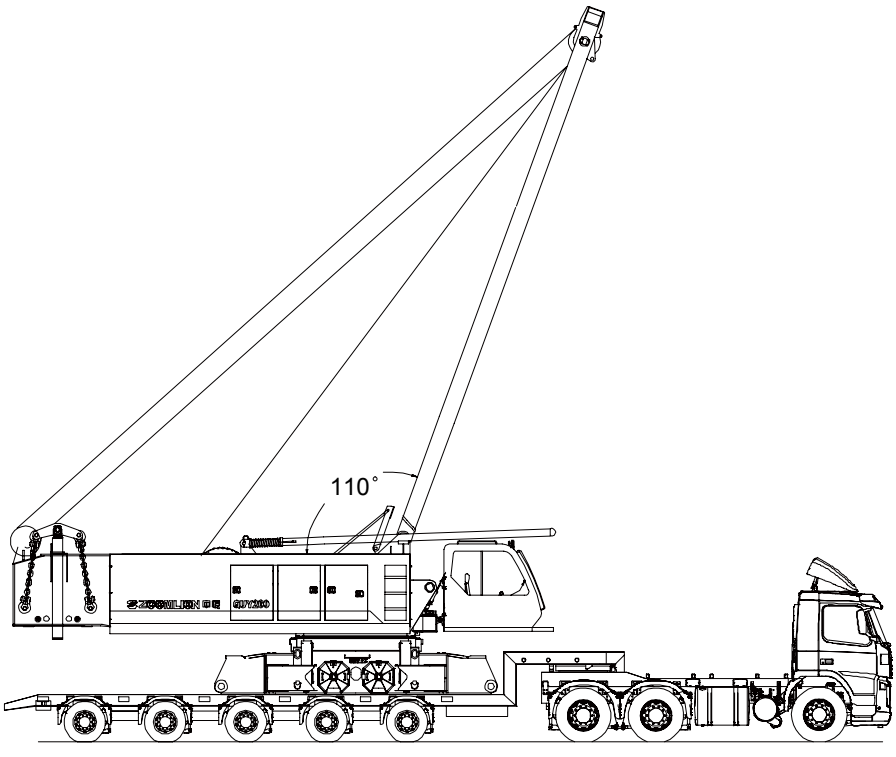


Figure 5-10 Erect A-frame

d) Support the basic machine

– Swivel the folding brackets out into the support position.
– Pull out the fixing screw for support plates on the undercarriage centre section.
– Detach the support plates and assemble them under the support cylinders.

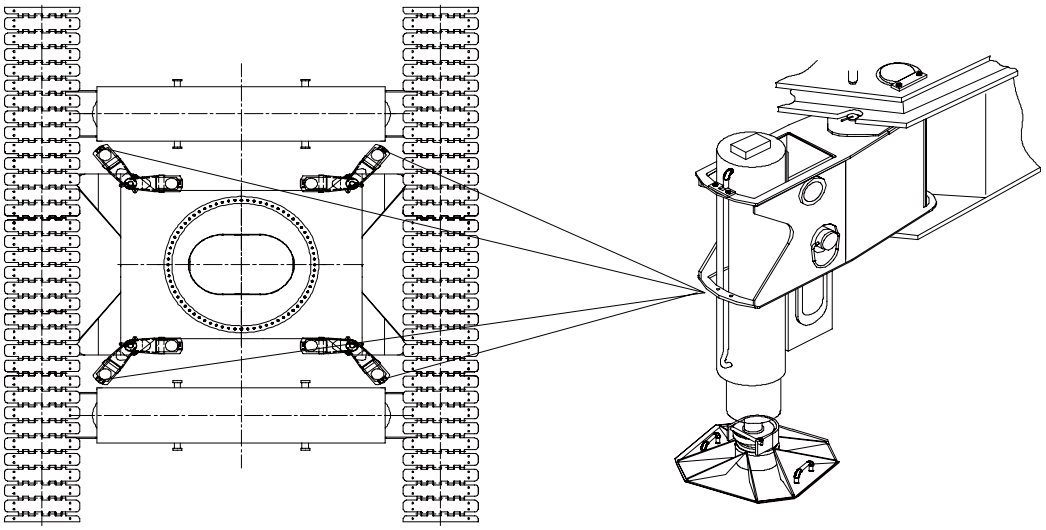


Figure 5-11 Folding bracket

e) Use wooden plates or steel plates to underlay all support plates.

Before operating the support cylinders and crawler carrier bolting cylinders, turn on "undercarriage auxiliary control switch" in the auxiliary remote control box (see Section 4.5.7), and then operate the undercarriage control levers.

Each support cylinders and crawler carrier bolting cylinders can not only be controlled independently but also operated simultaneously.

Select a support cylinder to be operated by the undercarriage control lever, and then extend the support cylinder by operating the cylinder telescoping control lever.

Note: in the assembling process, the maximum force the support cylinder can bear is 29 t.

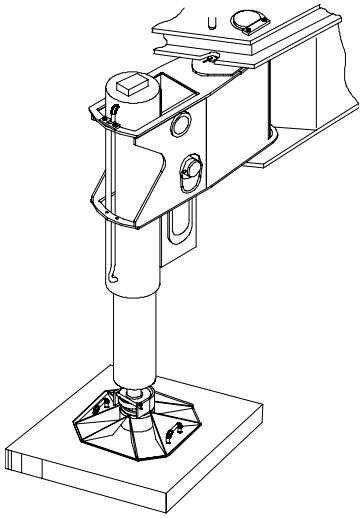


Figure 5-12 Support plate

CAUTION

(1) In no circumstance, can the extending of support cylinders be carried out by one person. At least two assistants are available to support the basic machine. One assistant operates the control levers while another assistant watches the position of support cylinders and see whether the crawler carrier bolting cylinder is extended to specified position.

(2) When the support cylinders are operated, the engine should run at low-middle speed (about 1000 – 1500 rpm).

(3) The support cylinders should be extended on firm and even ground. During operation, pay attention to the level state of basic machine.

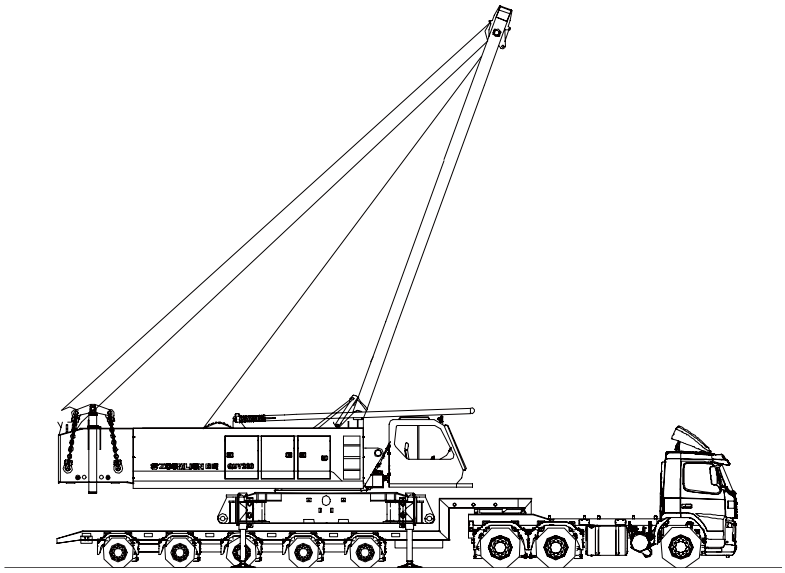


Figure 5-13 Extending support cylinders

f) Drive the low-loader away.

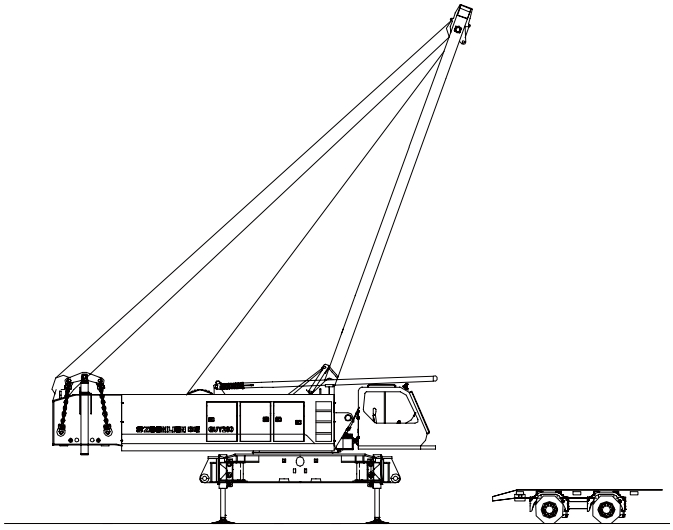


Figure 5-14 Drive the low-loader away

5.3.2 Attaching the first crawler carrier

a) Tilt the A-frame forwards according to the method in Section 5.2 "Operation of A-frame".

b) Turn "self-assembly& dismantling" switch on the right control panel to right and push the right control lever (30) forwards, and then the mounting cylinder on A-frame will be extended. Connect the mounting cylinder to crawler carrier with assembling chain.

CAUTION

Hang the twin hook on the loose end of the attachment in the holes of the floor plate underneath to prevent the crawler carrier from hanging down during mounting of the crawler carrier. Secure the lower crawler with attachment chains and hang the sling on the lifting point of crawler carrier to prevent the track pad from suspending during mounting of the crawler carrier.

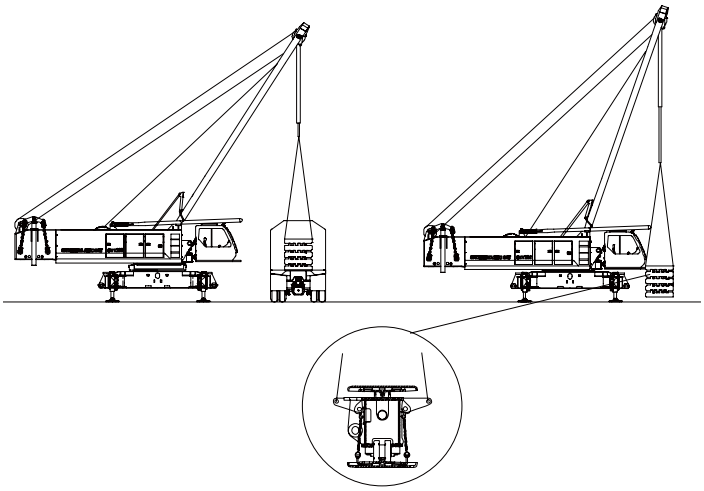


Figure 5-15 Attaching the first crawler carrier

c) Push the right control lever (30) backwards to retract the mounting cylinder to lift the first crawler carrier from the transport vehicle.

Slowly raise A-frame and adjust the mounting cylinder to align the crawler carrier exactly with the bolting points on the undercarriage centre section. Carefully and sensitively position the crawler carrier by the undercarriage centre section and upper limit plate of crawler carrier.

Turn on "undercarriage auxiliary control" switch on the auxiliary remote control box, and then extend the crawler carrier bolting cylinders with appropriate control lever. In this way, the first crawler carrier is attached onto the undercarriage centre section by the bolting cylinders.

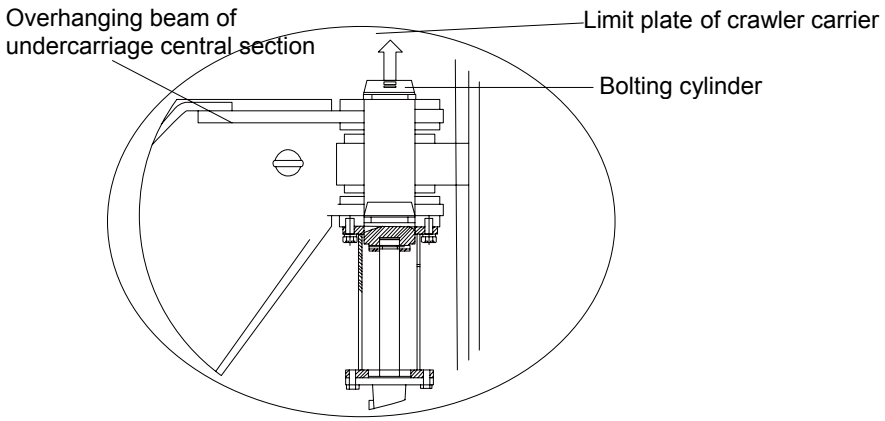


Figure 5-16 Position by limit plate

CAUTION

Bring the transport vehicle with the first crawler carrier as close as possible to the basic machine to make sure that the distance between the centre of crawler carrier and the rotation axis of the upper carriage is smaller than or equal to 5 m.

The slewing radius of hook attached to the mounting cylinder on A-frame must be smaller than or equal to 5 m.

5.3.3 Attaching the second crawler carrier

a) Slew the superstructure to a position where the second crawler carrier can be attached. The assembly sequence for the second crawler carrier is essentially the same as that for the first crawler carrier.

b) After the second crawler carrier is attached, it must be lowered on the ground by retracting the support cylinders.

c) Detach the support plates from support cylinders and fix them on undercarriage centre section.

d) Retract the support cylinders completely. Swivel inwards the folding brackets and secure them with locking pins.

e) Swivel in the locking plate on folding bracket and secure it with locking pin.

f) Establish hydraulic connection to both crawler carriers via quick-release couplings.

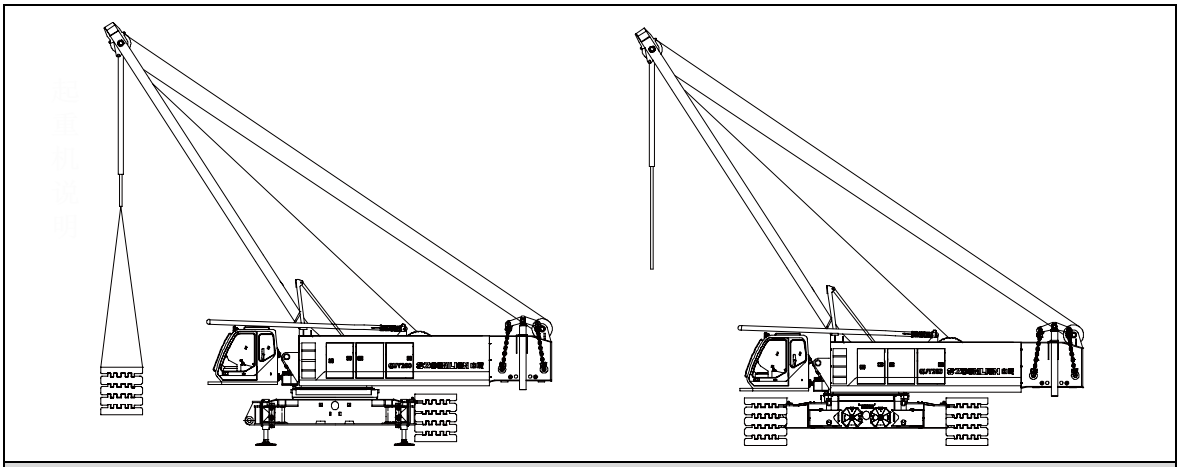


Figure 5-17 Attaching the second crawler carrier

CAUTION

(1) The slewing radius of hook attached to mounting cylinder on A-frame must be no more than 5 m, otherwise the basic machine may turn over.

(2) When mounting the crawler carrier, nobody is permitted to stand in the working radius.

(3) Crawler carrier bolting cylinders which are used to connect the crawler carriers to undercarriage centre section should be greased.

5.3.4 Connecting the hydraulic lines to the crawler carrier

There are 8 hydraulic lines in total led out from the left and right sides of undercarriage centre section, which are respectively connected to the left and right crawler carriers. Take the hydraulic connection to the left crawler carrier for example:

Connect hydraulic lines to two crawler carriers via quick-release couplings.

The quick-release coupling is a hydraulic connector consisting of a female end (internal thread) and a male end (external thread). Plug the male end of a quick-release coupling to the female end of it, the hydraulic connection can then be established.

To distinguish between the two quick-release couplings of the same type, a female end of one coupling and a male end of the other coupling are often installed on the mounting plate.

Hydraulic lines connecting diagram:

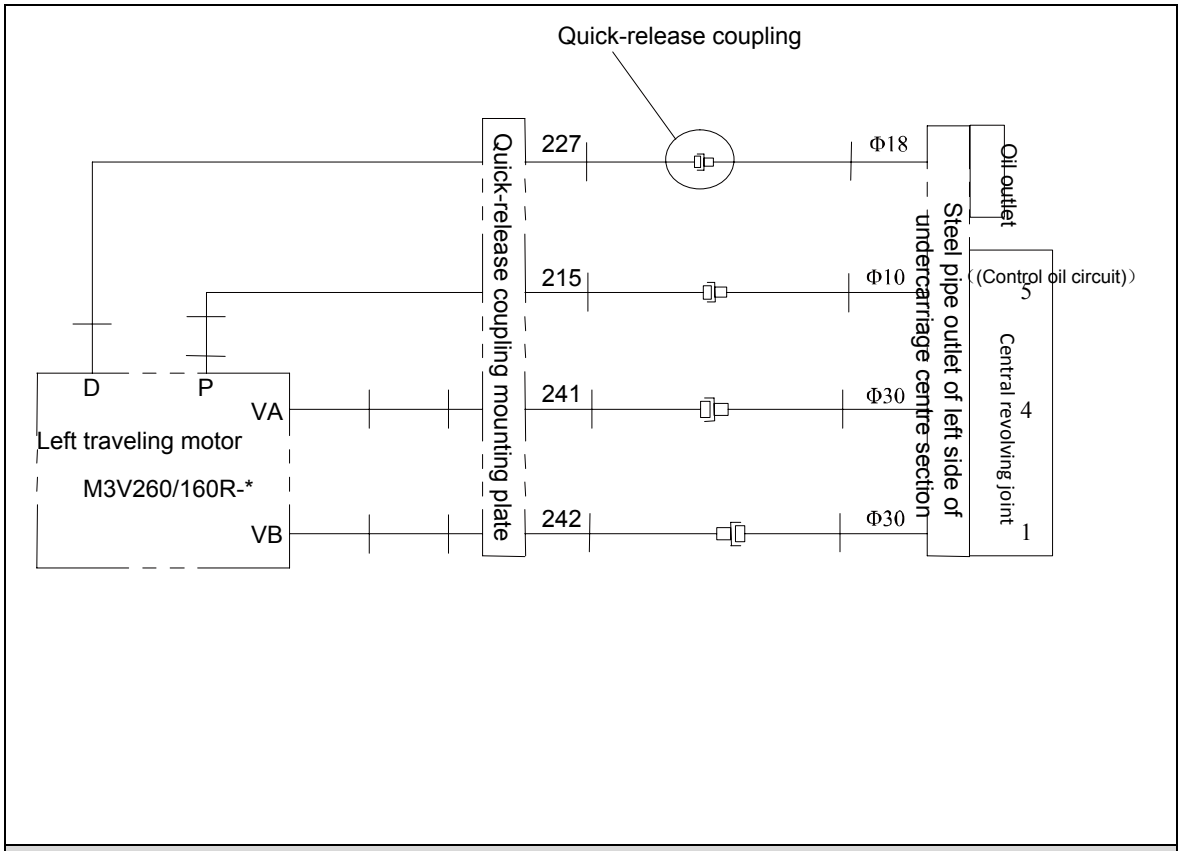


Figure 5-18 Hydraulic lines connection of undercarriage centre section

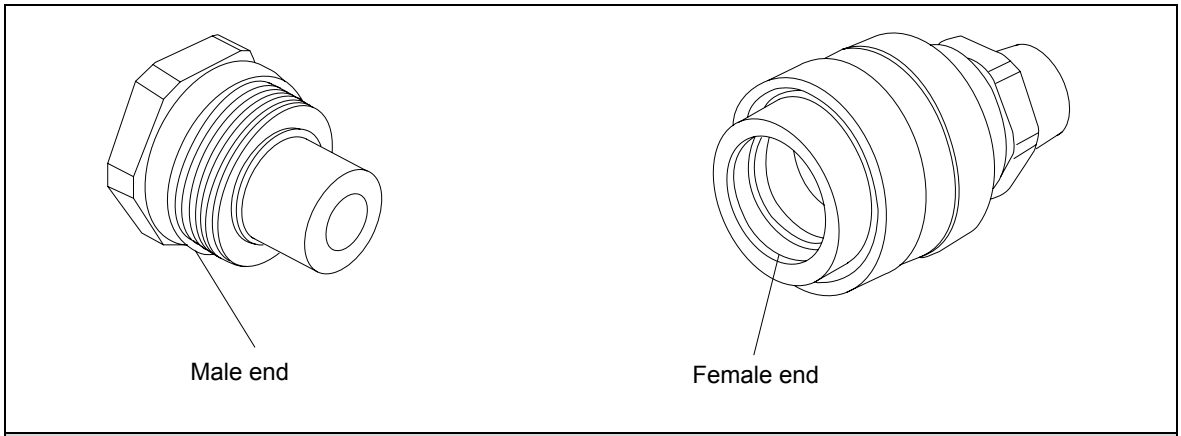


Figure 5-19 Quick-release coupling

Plug the male end of quick-release coupling to its female end.

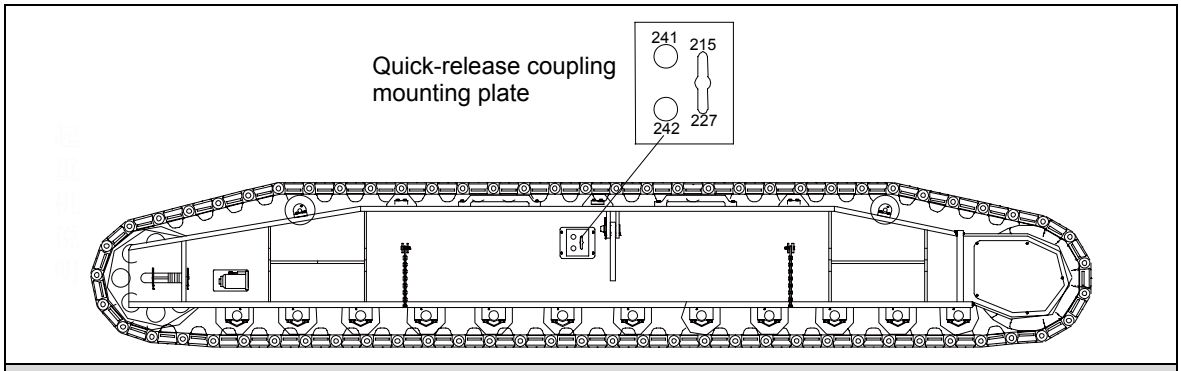


Figure 5-20 Quick-release coupling mounting plate

Fit together the dust wrapper of the hydraulic couplings and hydraulic connectors.

CAUTION

When hydraulic lines are connected and disconnected using quick-release couplings, please ensure that the coupling procedure is being performed correctly.

Requirements for a proper connection:

(1) Depressurize hydraulic system before connecting and disconnecting. Turn off engine and wait for 5 minutes.

(2) Coupling parts (male end and female end) are plugged into each other and screwed together using the hand-tightened nut.

(3) Turn the hand-tightened nut over the O-ring until a firm and tight fit is attained.

(4) The couplings may only be tightened by hand rather than by tools which will cause damage to coupling.

DANGER

Improperly connected couplings may lead to a loss of pressure or sudden leaking, thereby causing accidents.

5.4 Attaching the central counterweight

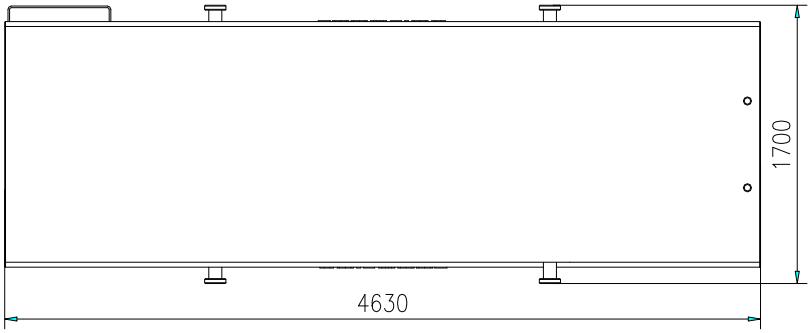


Figure 5-21 Central counterweight

The central counterweight consists of two central counterweight plates, which are located at the front and rear of the undercarriage between the crawler carriers. After the basic machine is fitted with the left and right crawler carriers, lift the first counterweight plate from transport vehicle and lay it on the supports on the inside of crawler carriers after rotating the superstructure to the front of crane. The second counterweight plate is installed at the rear end of crane in the same way (for the operation of superstructure, A-frame and mounting cylinder, please refer to Section 5.3 "attaching the crawler carriers").

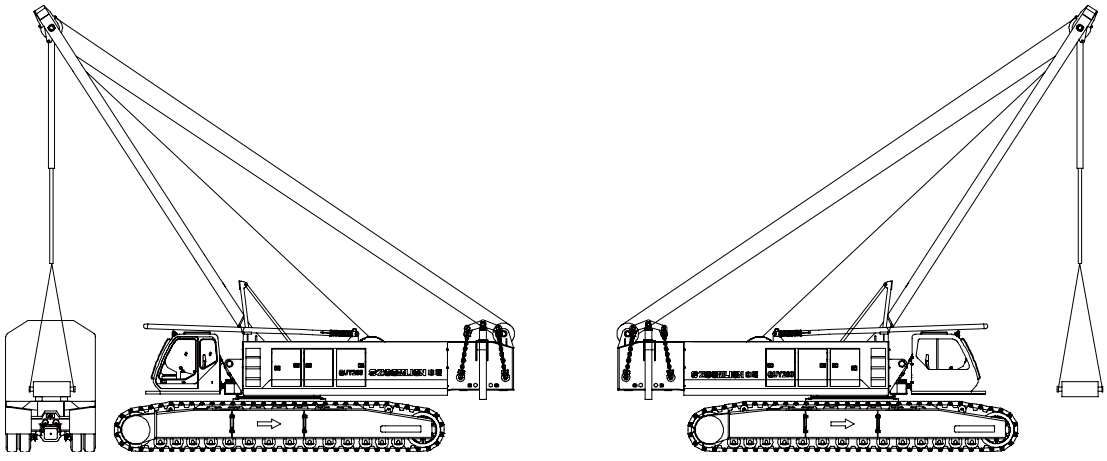


Figure 5-22 Attaching the central counterweight

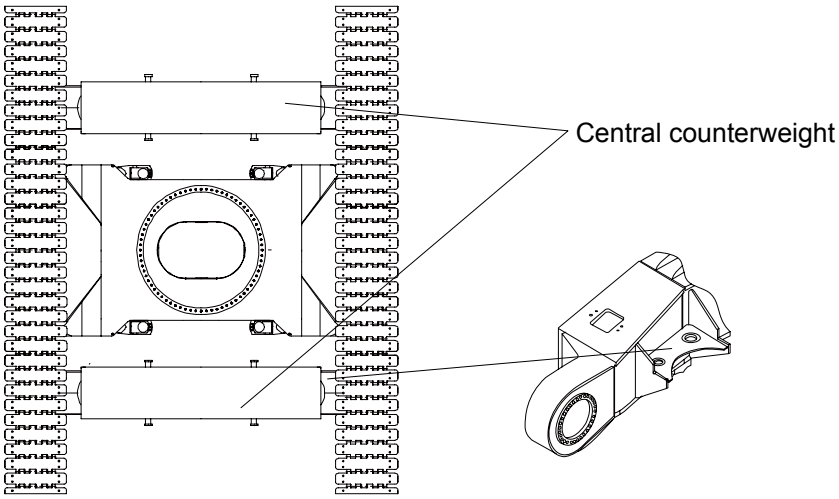


Figure 5-23 Position of the central counterweight

5.5 Assembling the rear counterweight

The rear counterweight, weighing 83.7 t in total, consists of 10 counterweight plates of 7.1 t each, a counterweight base plate of 12.7 t. The individual counterweight plates must always be stacked up symmetrically on both sides of superstructure tail-end.

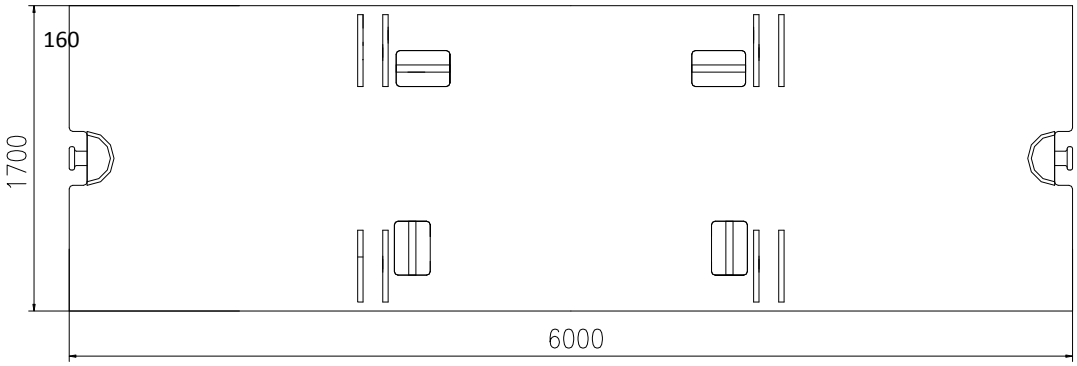


Figure 5-24 Counterweight base plate

Procedure for mounting the rear counterweight:

Lift the counterweight base plate and lay it on a flat ground, and then lift the individual counterweight plate one by one from the transport vehicle and stack them on the base plate by aligning them over the fixing position (two circular prominences) at the two sides of base plate. Fix the counterweight locking chain and secure it (the locking chain passes through the center of counterweight).

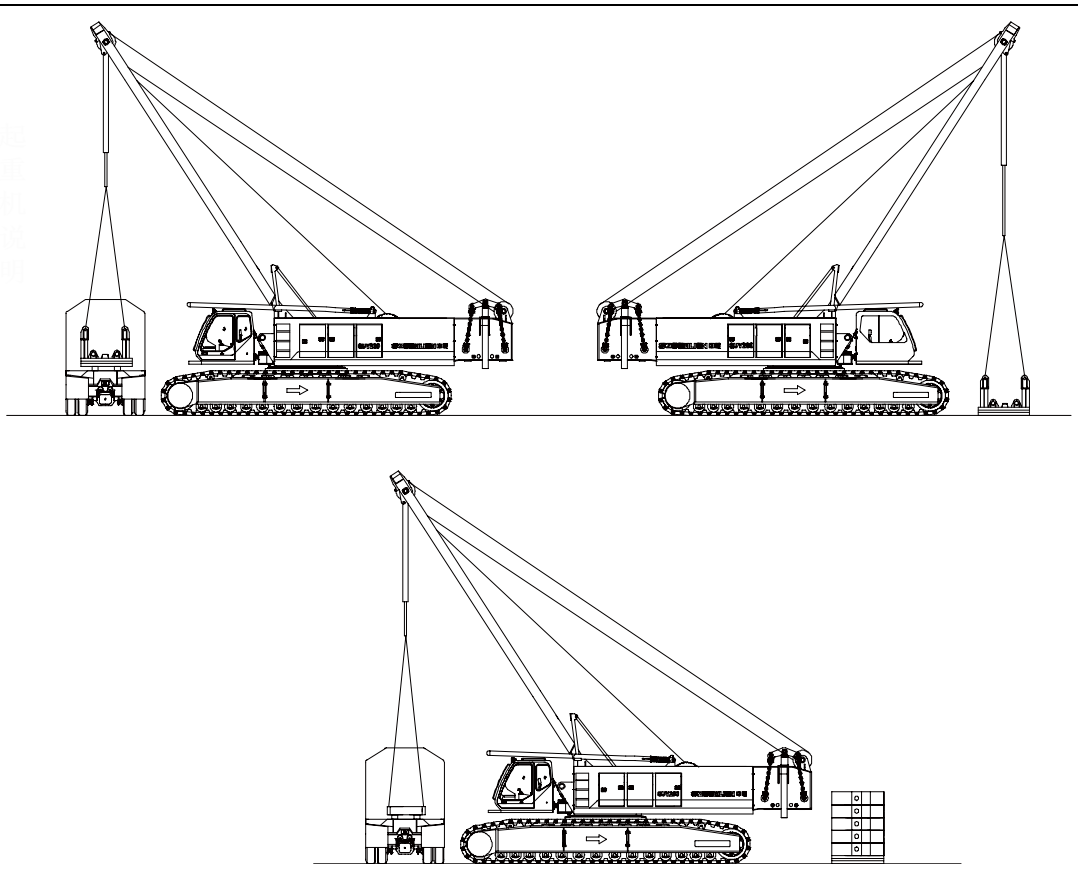


Figure 5-25 Procedure for mounting the rear counterweight

a) Push up the "counterweight left/right lifting cylinder" switches on the auxiliary remote control box, the counterweight left and right cylinders will extend to lift the counterweight.

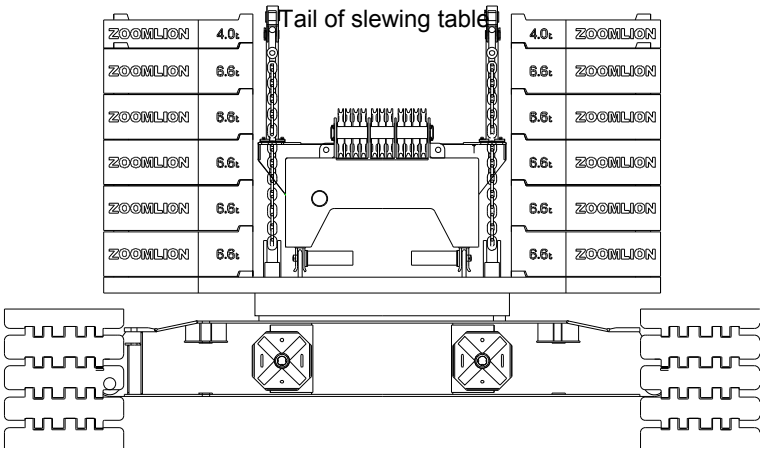


Figure 5-26 Lift the counterweight

b) If the counterweight is not level during the lifting process, adjust one counterweight cylinder via the "counterweight left/right lifting cylinder" switch to make the counterweight leveled. And then extend or retract the two counterweight cylinders simultaneously.

c) Turn on the "counterweight bolting cylinder" switch on the auxiliary remote control box to extend the counterweight bolting cylinder to required position and secure the bolting cylinder with retaining spring. After that, retract the counterweight cylinders.

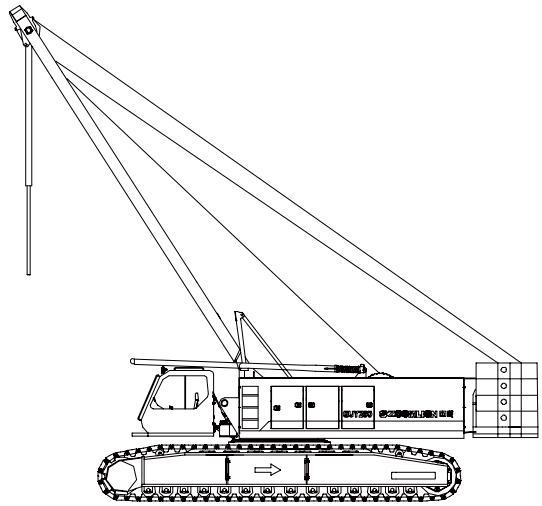


Figure 5-27 Counterweight bolting cylinder

d) The dismantling of counterweight plates is carried out in the reverse order to assembly.

CAUTION

(1) When stacking the counterweight plate on top of one another, align the upper counterweight plate over the circular prominences at the two sides of the lower counterweight plate and secure well.

(2) In any condition, the assembling and dismantling of counterweight plates should be carried out by more than two persons. A person is not permitted to perform this operation. When extending or retracting the counterweight cylinders, make sure that the counterweight base plate is level and synchronous at any time. When inclination situation occurs, the operator should synchronize them immediately through controlling the movement of one cylinder.

(3) In the process of self assembly& dismantling, A-frame can only be used to lift one counterweight plate at a time.

5.6 Available boom configurations for ZCC2600 crawler crane

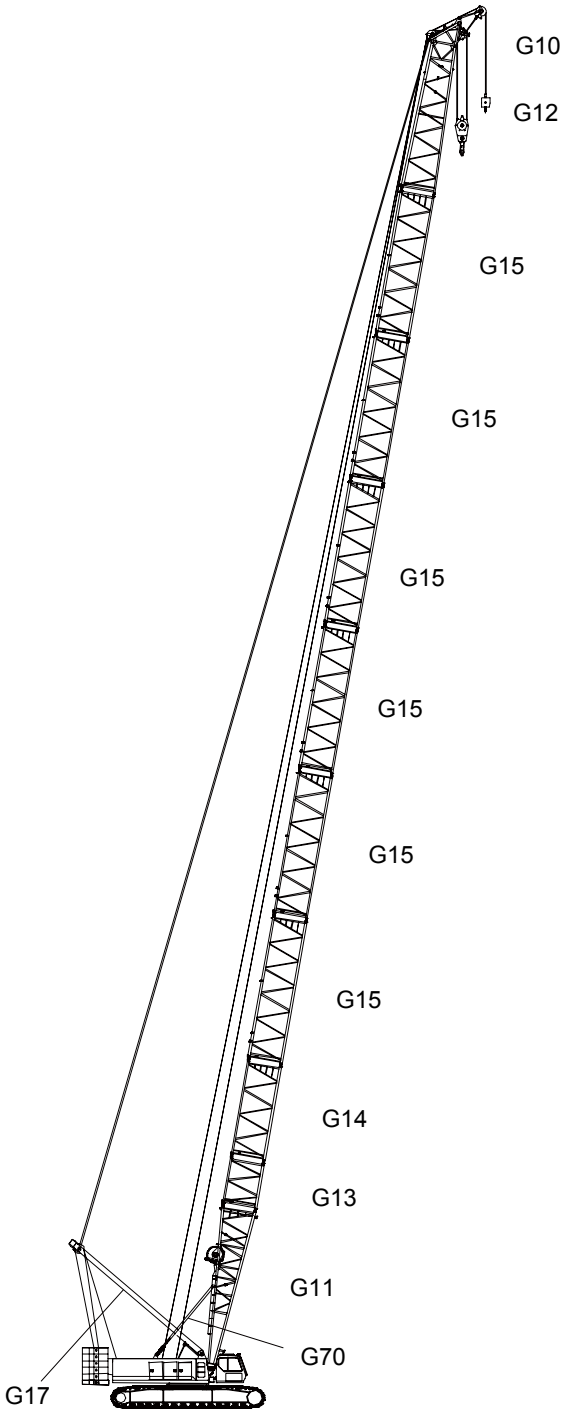


Figure 5-28 S boom configuration

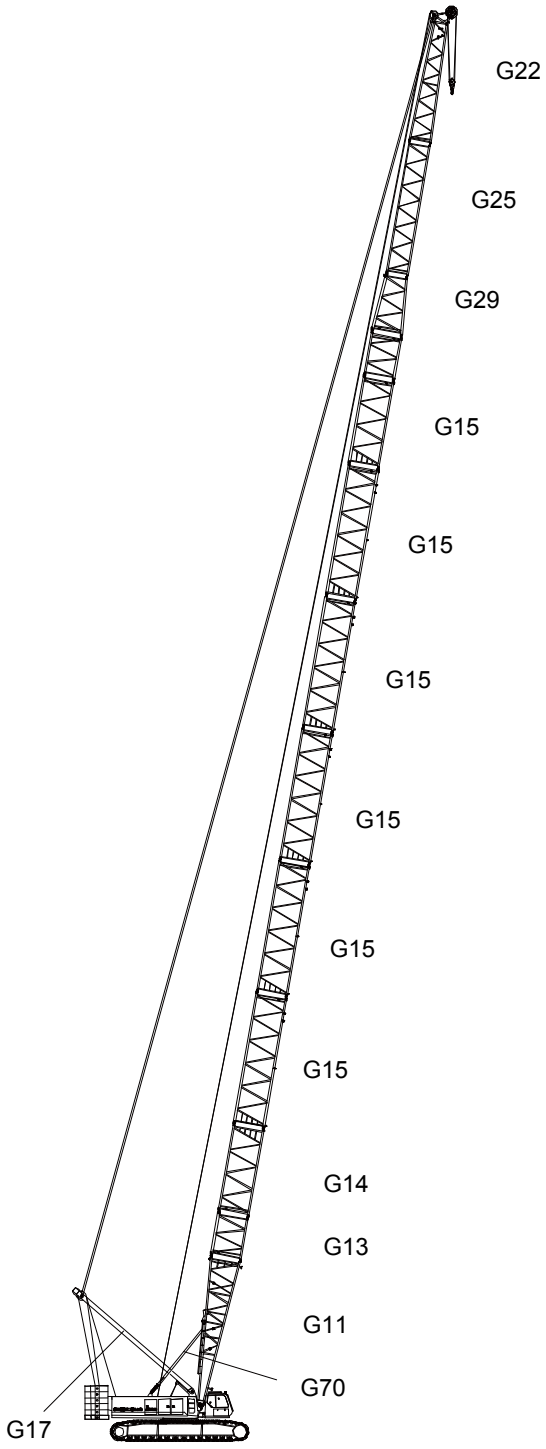


Figure 5-29 SL boom configuration

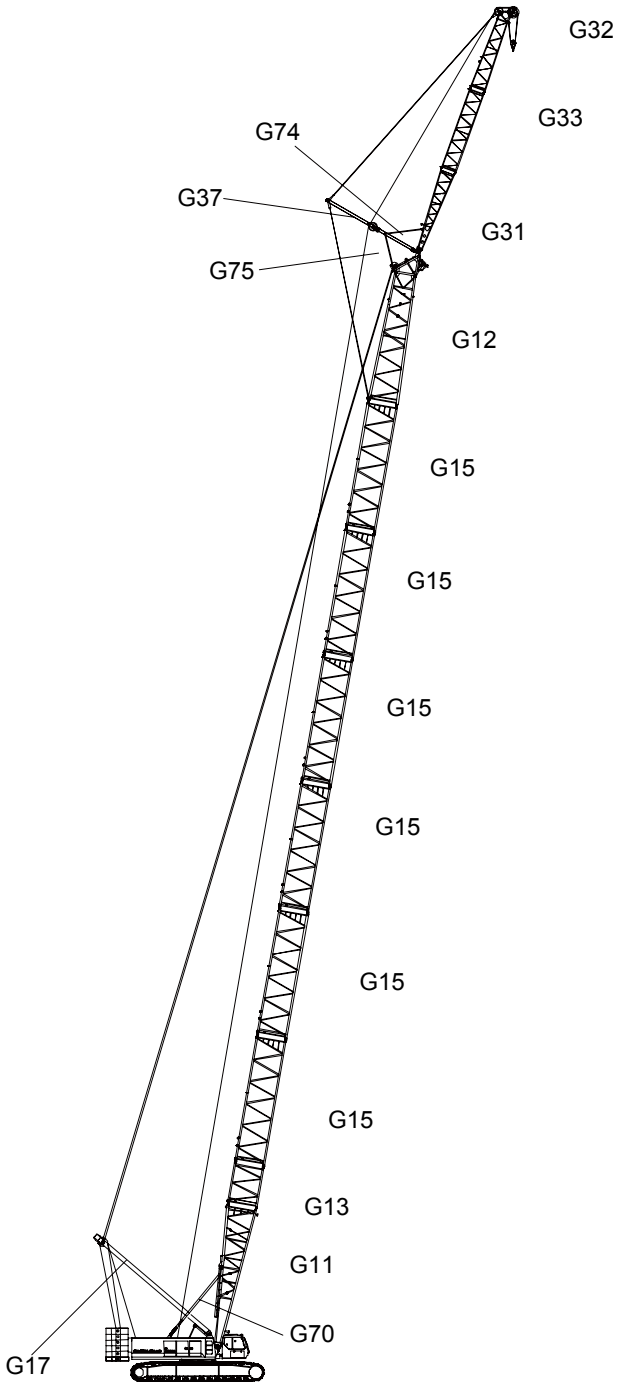


Figure 5-30 SF boom configuration

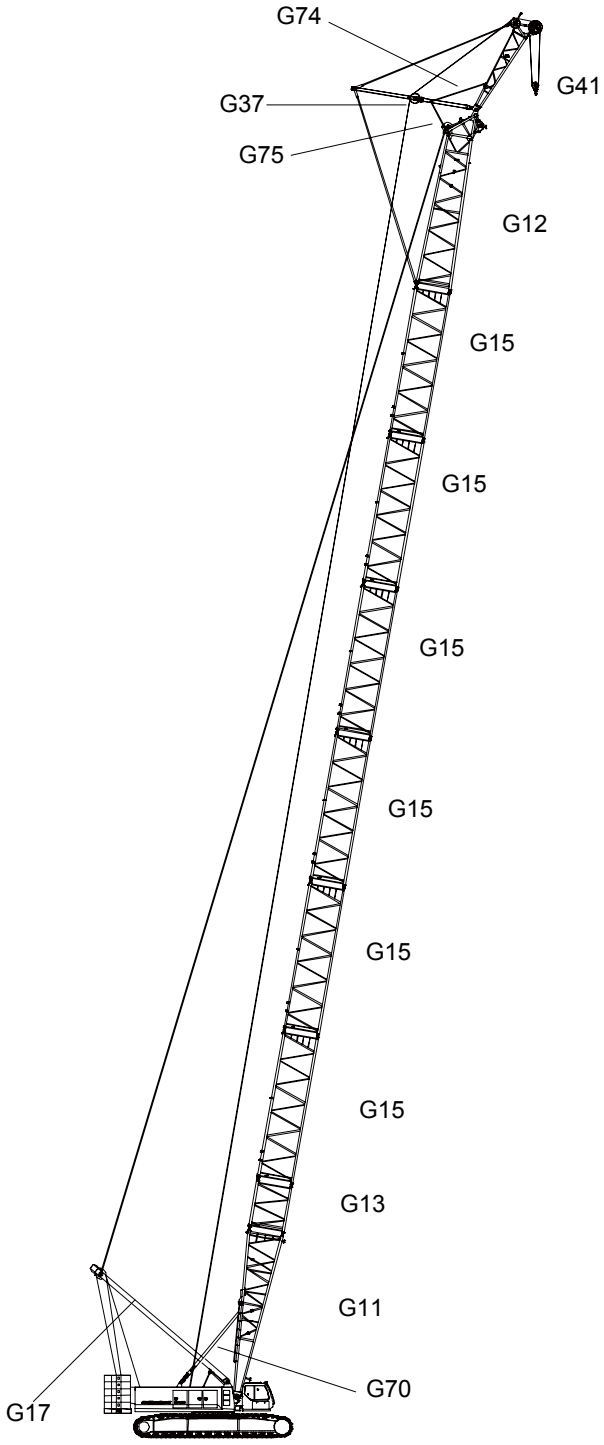


Figure 5-31 SFV boom configuration

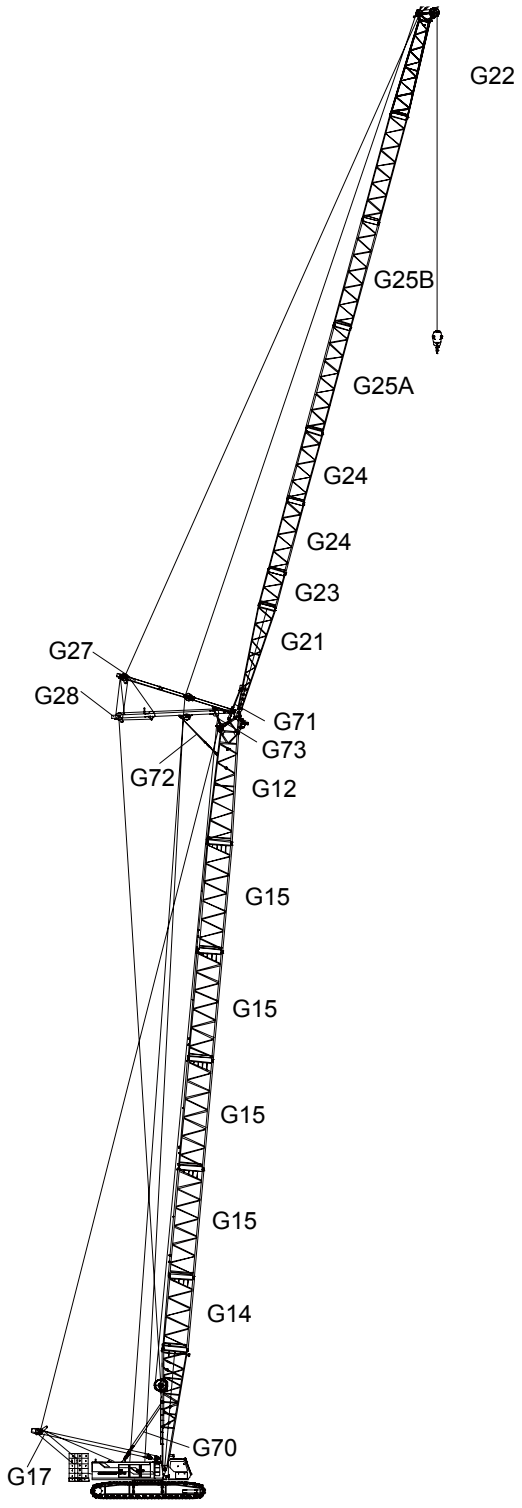


Figure 5-32 SW boom configuration

Table 5-1 Names of parts of boom frame

Part	Names of the parts	Length (m)	Weight (t)
G10	Tip boom on main boom head		0.2
G11	Main boom pivot section	10	3.02
G12	Main boom head	10	3.38
G13	Main boom intermediate section	3	0.72
G14	Main boom intermediate section	6	1.2
G15	Main boom intermediate section	9	1.78
G17	A-frame		3.14
G21	Luffing jib pivot section	9	1.05
G22	Luffing jib head	9	1.1
G23	Luffing jib intermediate section	3	0.32
G24	Luffing jib intermediate section	6	0.59
G25B	Luffing jib intermediate section	9	0.68
G25A	Luffing jib intermediate section	9	0.82
G27	WA-frame 1		1.74
G28	WA-frame 2		1.52
G29	Reducing section	4	0.82
G31	Fixed jib pivot section	6	0.47
G32	Fixed jib head	6	0.62
G33	Fixed jib intermediate section	6	0.26
G37	FA-frame		0.75
G70	Titling-back support of main boom		0.26
G71	Tilting-back support for lufffing jib		0.08
G72	Tilting-back support for WA-frame 2		0.07
G73	Tilting-back support cylinder for WA-frame 1		0.11
G74	Front tilting-back support of fixed jib		0.06
G75	Rear tilting-back support of fixed jib		0.03

CAUTION

(1) Any other boom configurations and anchoring rods combination that have not been stipulated in the operating manual are prohibited.

(2) When attaching boom sections, make sure that the intermediate sections are assembled to their specified positions, otherwise there is a risk of accidents.

5.7 Boom configuration

5.7.1 Heavy duty boom (S)

5.7.1.1 Components of heavy duty boom

The heavy duty boom, whose length varies from 20 m to 83 m, comprises basic boom and an optional number of main boom intermediate sections. The basic boom is 20 m long, including main boom pivot section (G11), main boom head (G12) and tip boom (G10). There are three types of main boom intermediate section: 3 m main boom intermediate section (G13), 6 m main boom intermediate section (G14) and 9 m main boom intermediate section (G15).

The longest heavy duty boom of 83 m, overview:

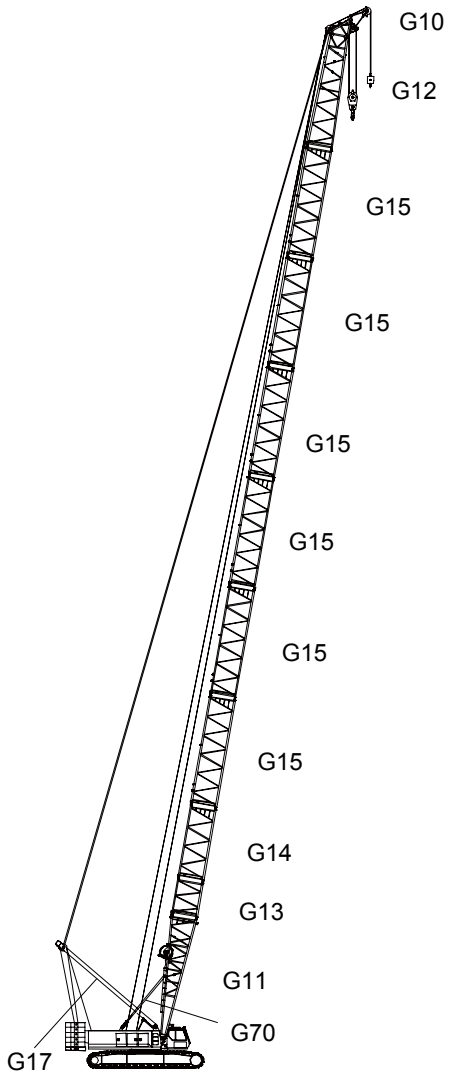


Figure 5-33 S boom configuration

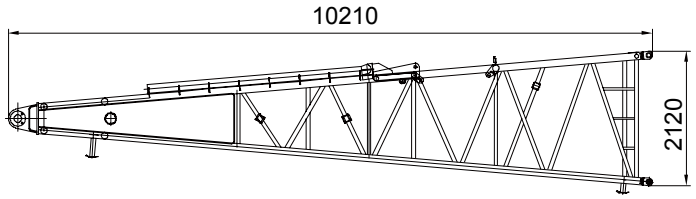


Figure 5-34 Main boom pivot section

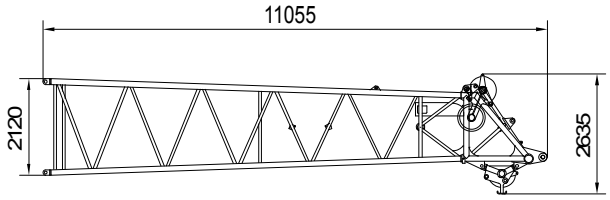


Figure 5-35 Main boom head

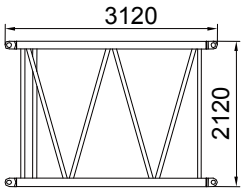


Figure 5-36 3 m main boom intermediate section

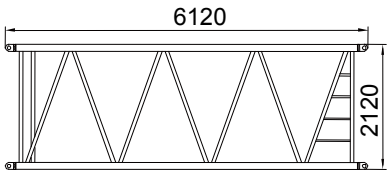


Figure 5-37 6 m main boom intermediate section

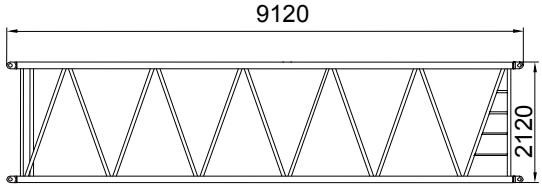


Figure 5-38 9 m main boom intermediate section

Table 5-2 Main boom assembly

Main boom length (m)	Assembly sequence of main boom sections	Main boom length (m)	Assembly sequence of main boom sections
20	G11+G12	53	G11+G14+3×G15+ G12
23	G11+G13+G12	56	G11+4×G15+ G12
26	G11+G14+ G12	59	G11+G13+4×G15+ G12
29	G11+G15+ G12	62	G11+G14+4×G15+ G12
32	G11+ G13+G15+ G12	65	G11+5×G15+ G12
35	G11+ G14+G15+ G12	68	G11+G13+5×G15+ G12
38	G11+2×G15+ G12	71	G11+G14+5×G15+ G12
41	G11+G13+2×G15+ G12	74	G11+6×G15+ G12
44	G11+G14+2×G15+ G12	77	G11+G13+6×G15+ G12
47	G11+3×G15+ G12	80	G11+G14+6×G15+ G12
50	G11+G13+3×G15+ G12	83	G11+G13+G14+6×G15+G12

5.7.1.2. Combination of anchoring rods of heavy duty boom

Each kind of boom is assigned to anchoring rods of specific length, and the anchoring rods should be connected strictly in accordance with the given method.

The connection method of anchoring rods of different main boom is shown in the following figure:

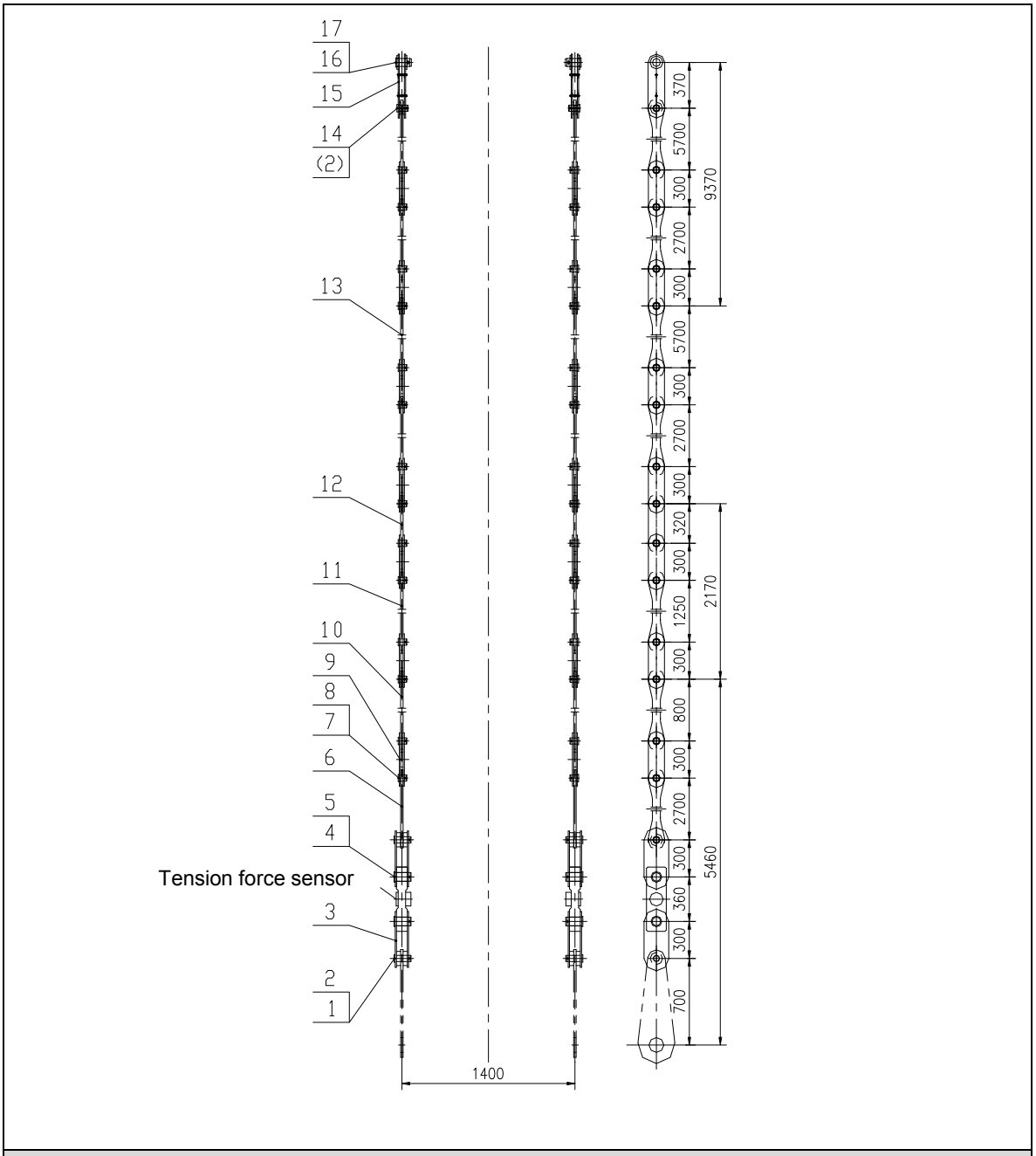
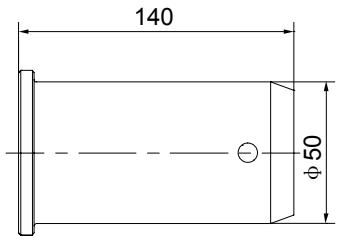
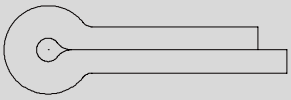
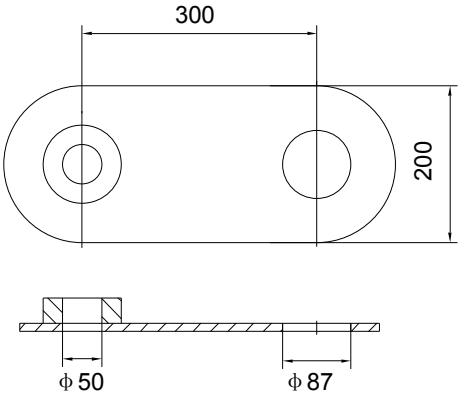
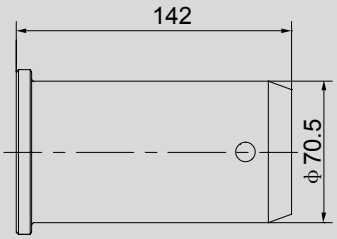
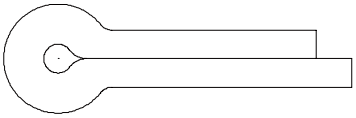
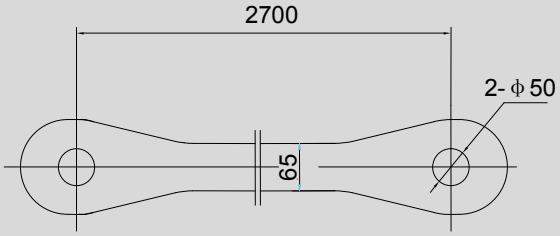
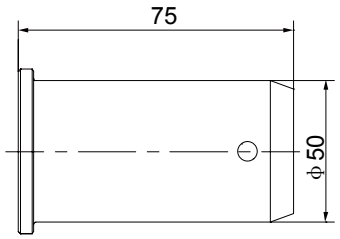
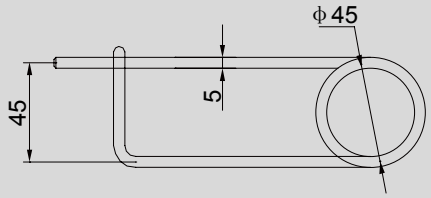
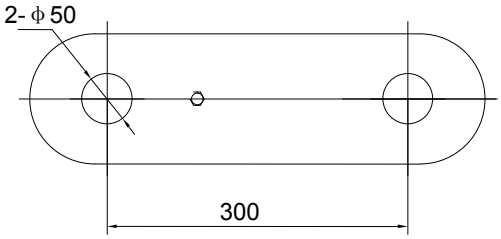
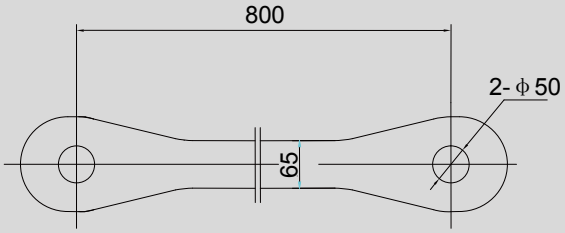
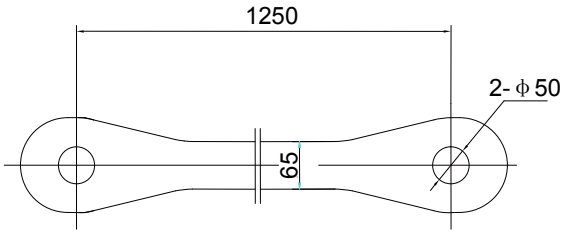
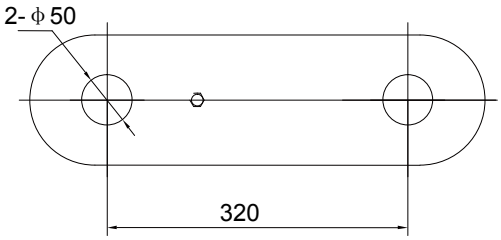
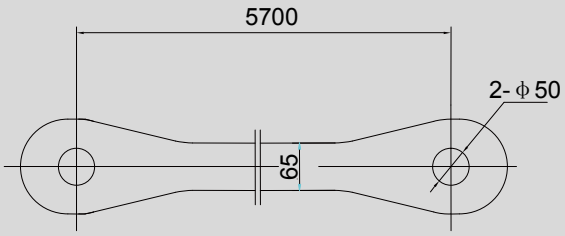
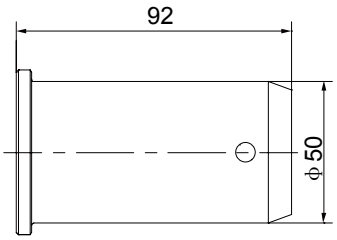
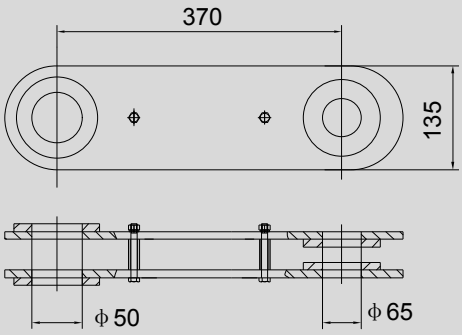
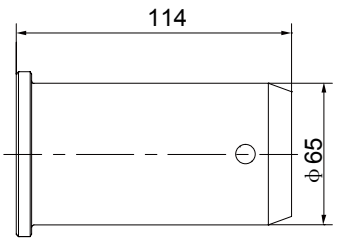
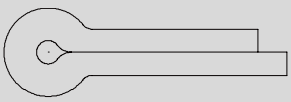


Figure 5-39 Connection of main boom anchoring rods

Table 5-3 Component parts of anchoring rods of heavy duty boom

Part No.	Description	Illustration
1	Pin spindle	
2	Cotter pin	 GB/T91-2000(8*60)
3	Reducing piece	
4	Pin spindle	
5	Cotter pin	 GB/T91-2000(10*95)
6	Single anchoring rod	

Part No.	Description	Illustration
7	Pin spindle	
8	Retaining pin	
9	Double anchoring rod	
10	Single anchoring rod	
11	Single anchoring rod	
12	Single anchoring rod	

Part No.	Description	Illustration
13	Single anchoring rod	
14	Pin spindle	
15	Reducing piece of main boom	
16	Pin spindle	
17	Cotter pin	 GB/T91-2000(8*95)

CAUTION

The part number of anchoring rods of heavy duty boom given in Section "combination of anchoring rods of heavy duty boom" is consistent with that in the above table, so the component parts of anchoring rods can be found by referring to the part number.

Principle for determining the length of heavy duty boom anchoring rods:

When basic boom is 20 m long, the length of heavy duty boom anchoring rods is 17000 mm.

When heavy duty boom length increases by 3 m, a 300 mm-long double anchoring rod (9) and a 2700 mm-long single anchoring rod (6) should be added accordingly.

When heavy duty boom length increases by 6 m, a 300 mm-long double anchoring rod (9) and a 5700 mm-long single anchoring rod (13) should be added accordingly.

When heavy duty boom length increases by 9 m, two 300 mm-long double anchoring rods (8) and a 2700 mm-long single anchoring rod (6) as well as a 5700 mm-long single anchoring rod (13) should be added accordingly.

The width of heavy duty boom anchoring rods is 65 mm, and the diameter of pin spindle is φ50 mm.

Combination of anchoring rods of heavy duty boom is shown in the following table:

Heavy duty boom length (m)	Length of anchoring rods of A-frame (5460) (mm)	Length of anchoring rods at the bottom (2170) (mm)	Length of anchoring rods of 3 m main boom intermediate section (mm)	Length of anchoring rods of 6 m main boom intermediate section (mm)	Length of anchoring rods of 9 m main boom intermediate section (mm)	Length of anchoring rods on the top (9370) (mm)	Total length of anchoring rods (mm)
20	700+300+360+300+2700+300+800	300+1250+300+320				300+2700+300+5700+370	17000
23			A				20000
26				B			23000
29			A	B			26000
32			A		A+B		29000
35				B	A+B		32000
38			A	B	A+B		35000
41			A		2×(A+B)		38000
44				B	2×(A+B)		41000
47			A	B	2×(A+B)		44000
50			A		3×(A+B)		7000
53				B	3×(A+B)		50000
56			A	B	3×(A+B)		53000
59			A		4×(A+B)		56000
62				B	4×(A+B)		59000

Heavy duty boom length (m)	Length of anchoring rods of A-frame (5460) (mm)	Length of anchoring rods at the bottom (2170) (mm)	Length of anchoring rods of 3 m main boom intermediate section (mm)	Length of anchoring rods of 6 m main boom intermediate section (mm)	Length of anchoring rods of 9 m main boom intermediate section (mm)	Length of anchoring rods on the top (9370) (mm)	Total length of anchoring rods (mm)
65			A	B	4×(A+B)		62000
68			A		5×(A+B)		65000
71				B	5×(A+B)		68000
74			A	B	5×(A+B)		71000
77			A		6×(A+B)		74000
80				B	6×(A+B)		77000
83			A	B	6×(A+B)		80000
Note: A=300+2700 B=300+5700							

5.7.2 Light duty boom (SL)

5.7.2.1 Components of light duty boom

The light duty boom, whose length varies from 86 m to 95 m, comprises main boom sections, 4 m reducing section (G29) and luffing jib sections. And main boom sections consist of main boom pivot section (G11) and an optional number of main boom intermediate sections 3 m (G13), 6 m (G14) and 9 m (G15) in length. Luffing jib sections contain luffing jib head (G22) and an optional number of luffing jib intermediate sections 3 m (G23), 6 m (G24) and 9 m (G25B) in length.

The longest light duty boom of 95 m, overview:

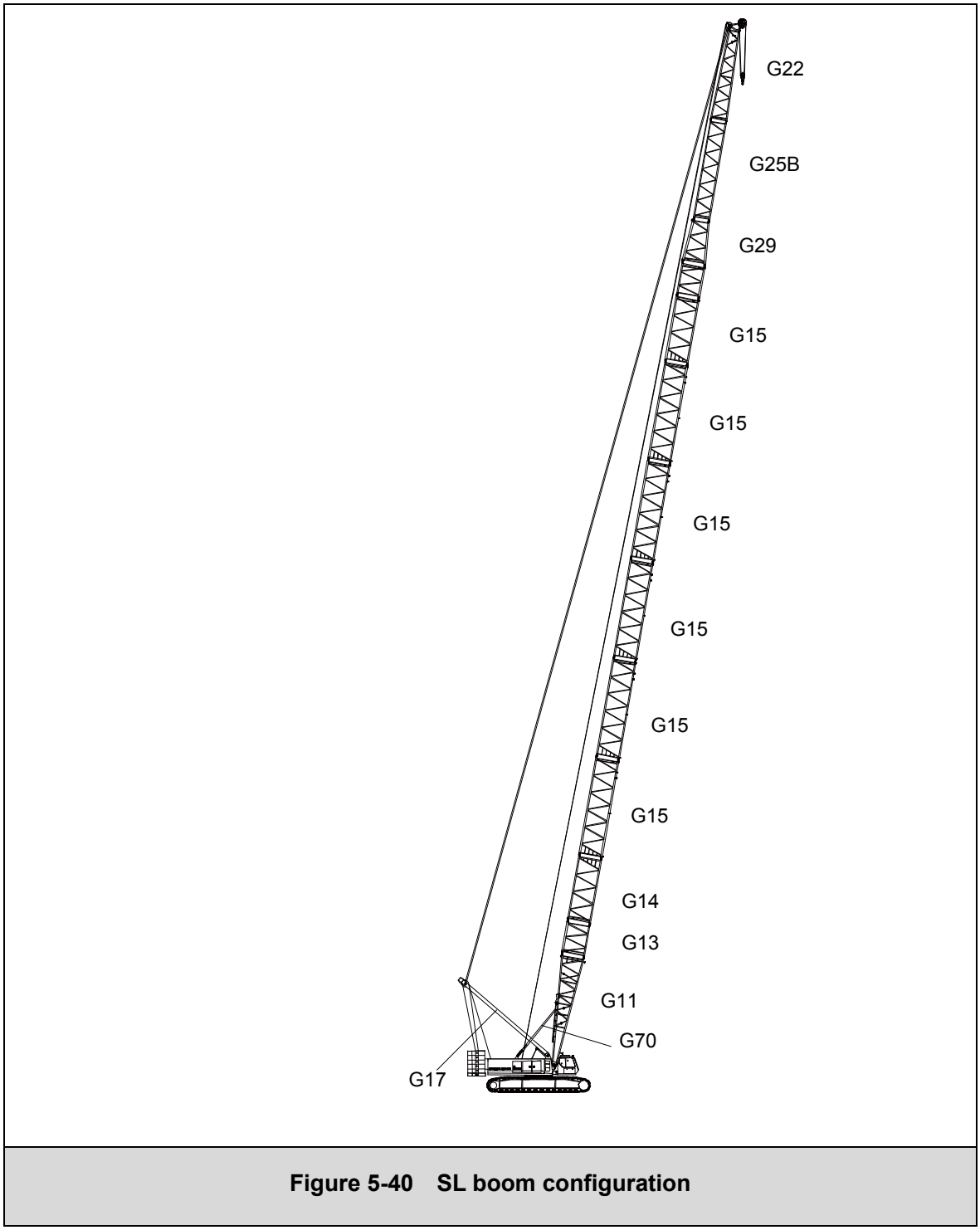


Figure 5-40 SL boom configuration

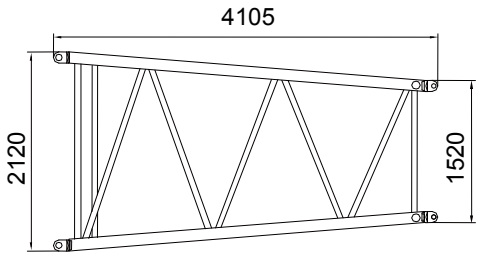


Figure 5-46 4 m reducing section

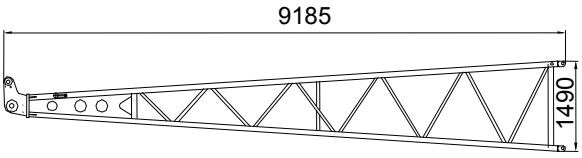


Figure 5-47 Luffing jib pivot section

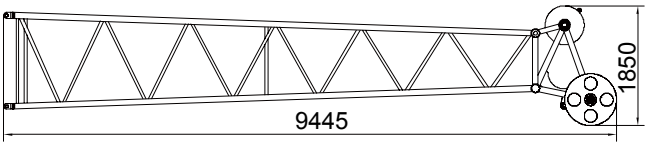


Figure 5-48 Luffing jib head

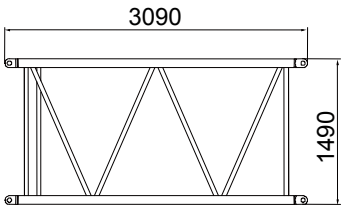


Figure 5-49 3 m luffing jib intermediate section

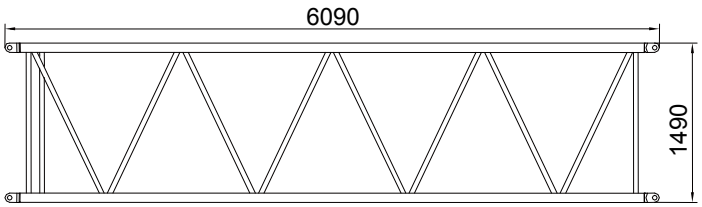


Figure 5-50 6 m luffing jib intermediate section

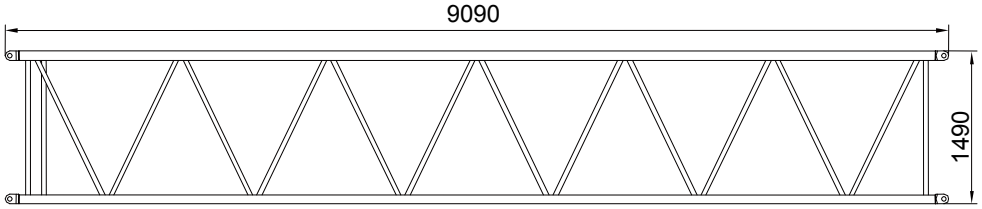


Figure 5-51 9 m luffing jib intermediate section

Table 5-4 Assembly table of light duty boom

Light duty boom length (m)	Boom assembly sequence	Light duty boom length(m)	Boom assembly sequence
86	G11+ G13+G14+6×G15+G29+G22	92	G11+ G13+G14+6×G15+G29+G24+G22
89	G11+ G13+G14+6×G15+G29+G23+G22	95	G11+ G13+G14+6×G15+G29+G25B+G22

5.7.2.2. Components of anchoring rods of light duty boom

Anchoring rods of light duty boom consists of anchoring rods of heavy duty boom and light anchoring rods.

a) Anchoring rods of heavy duty boom

The length of anchoring rods of heavy duty boom used in this boom configuration is always 70630 mm. Different lengths of anchoring rods of light duty boom can be available by adjusting the length of light anchoring rods according to the length of light duty boom.

Length of anchoring rods of A-frame (5460) (mm)	Length of anchoring rods at the bottom (2170) (mm)	Length of anchoring rods of 3 m main boom intermediate section (mm)	Length of anchoring rods of 6 m main boom intermediate section (mm)	Length of anchoring rods of 9 m main boom intermediate section (mm)	Length of anchoring rods on the top (mm)	Total length of anchoring rods of heavy duty boom (LA) (mm)
700+300+360+300+2700+300+800	300+1250+300+320	A (A=300+2700)	B (B=300+5700)	6×(A+B)		70630
Remarks: For the connection method of anchoring rods, please refer to the connection of anchoring rods of main boom.						

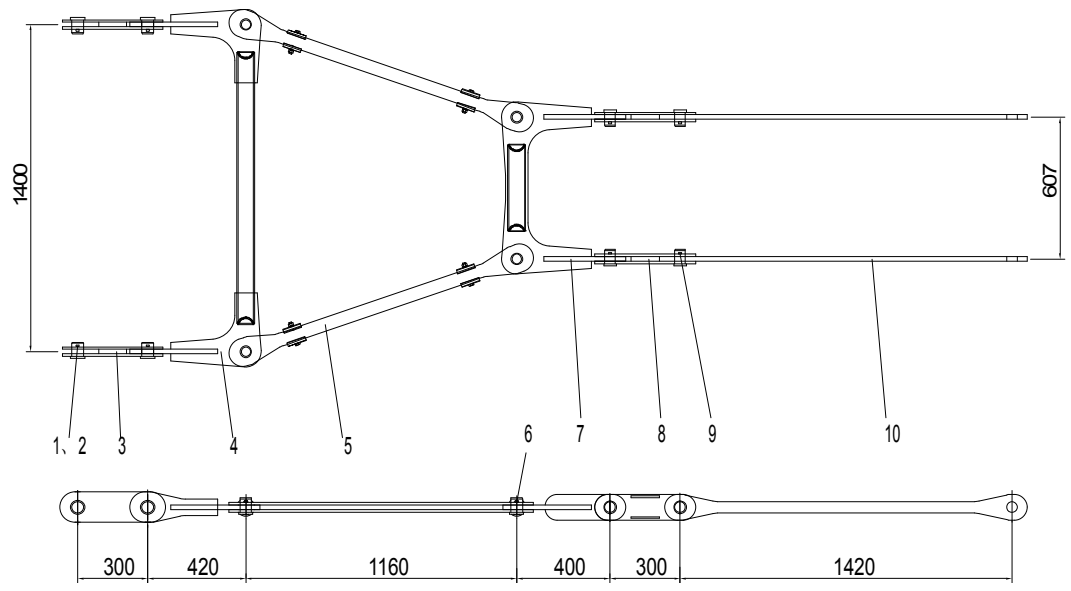
CAUTION

For part number of anchoring rods of heavy duty boom, please see Section "Combination of anchoring rods of heavy duty boom".

b) Light anchoring rods

Another component part of anchoring rods of light duty boom is the light anchoring rods. The anchoring rods shown in the following figure is the light anchoring rods assigned to 86 m light duty boom.

Upper anchoring rod of reducing section of light duty boom



Front section of anchoring rod of light duty boom

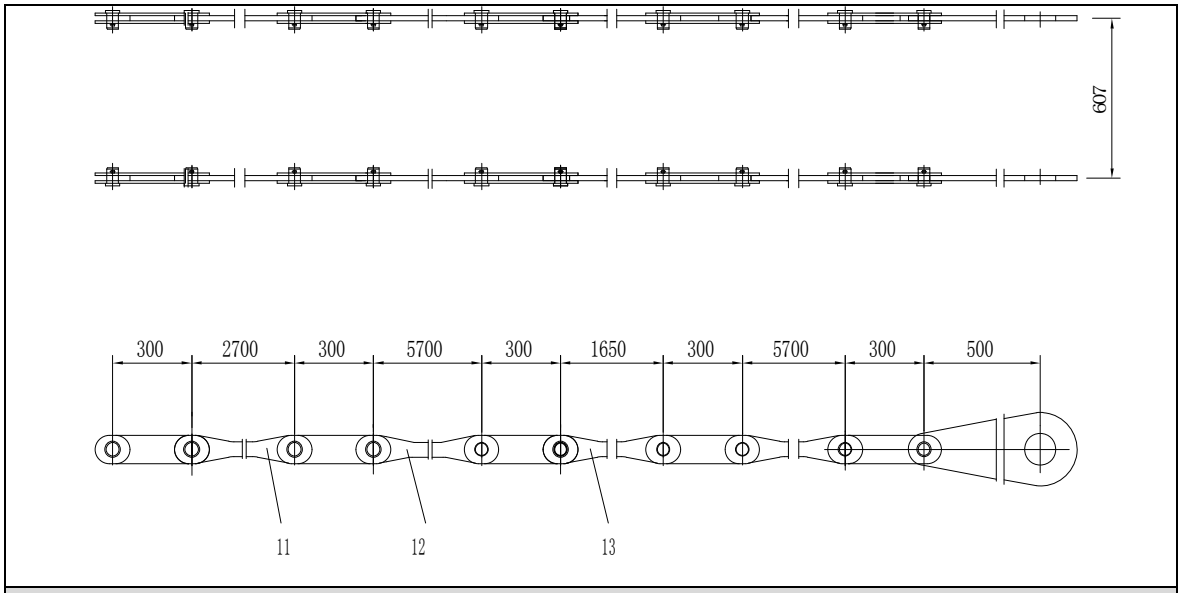
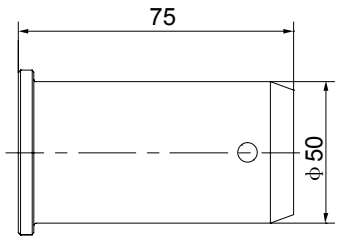
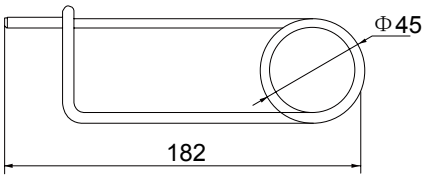
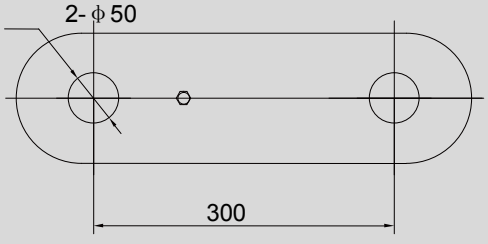
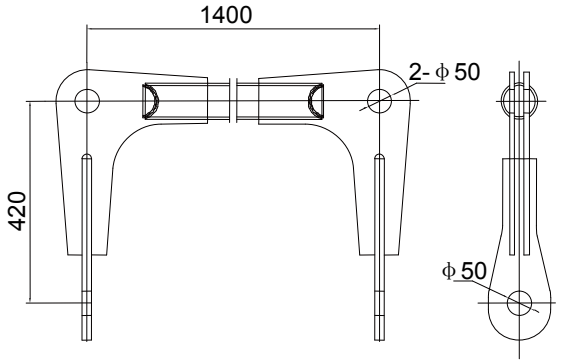
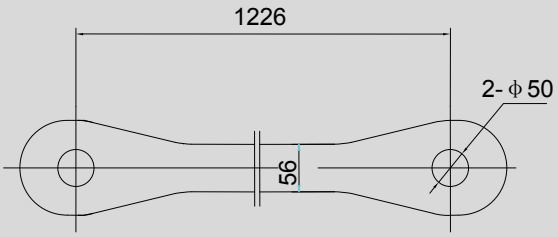
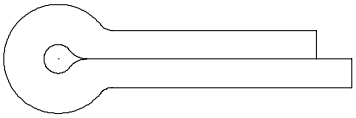
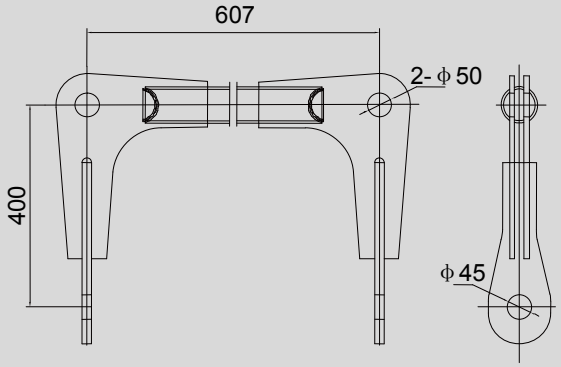
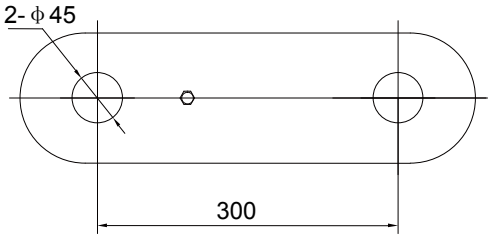
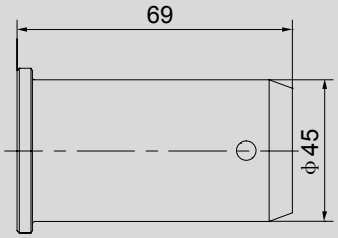
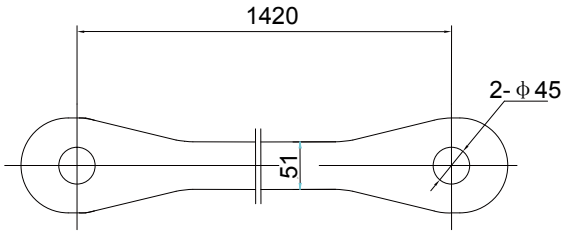
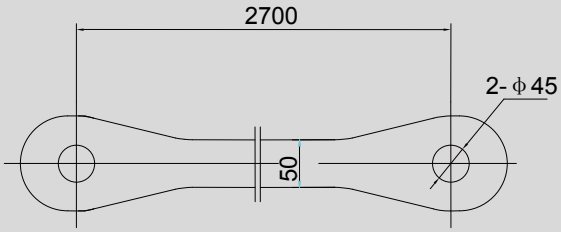
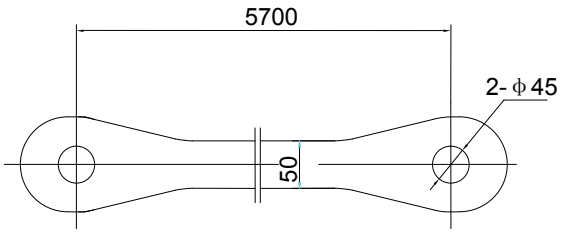
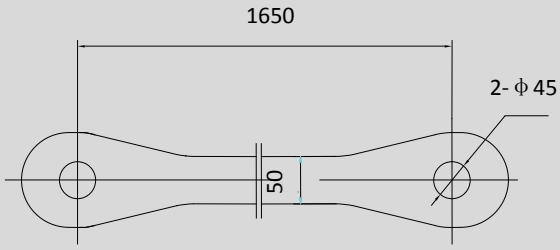


Figure 5-52 Upper anchoring rod of reducing section of light duty boom

Table 5-5 Components of anchoring rods of light duty boom

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Retaining pin	
3	Double anchoring rod	

Part No.	Description	Illustration (mm)
4	Coupling link of light duty boom	
5	Double anchoring rod	
6	Cotter pin	 GB/T91-2000（10×90）
7	Coupling link of light duty boom	
8	Double anchoring rod	

Part No.	Description	Illustration (mm)
9	Pin spindle	
10	Anchoring rod	
11	Anchoring rod	
12	Anchoring rod	
13	Double anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "light anchoring rods" are consistent with those in the above table, so the component parts of anchoring rod can be found by referring to the part number.

Table 5-6 Combination of light anchoring rods

Length of light duty boom (m)	Total length of anchoring rods of heavy duty boom (LA) （mm）	Reducing section (4000) (mm)	Luffing jib intermediate section (mm)	Luffing jib head (8750) (mm)	Total length (mm)
86	70630	300+420+1160+400+300+1420		300+1650+300+5700+300+500	83380
89			300+2700		86380
92			300+5700		89380
95			300+2700+300+5700		92380

Total length of anchoring rods of heavy duty boom (LA):: refer to Section 5.7.2.2 Components of anchoring rods of light duty boom.

5.7.2.3 Intermediate tensioners on light duty boom

The fitting of intermediate tensioners is obligatory for SL boom configuration. The installation positions of intermediate tensioners for different length of light duty boom have been shown in the following figures:

Installation position of intermediate tensioners for 86 m-long light duty boom

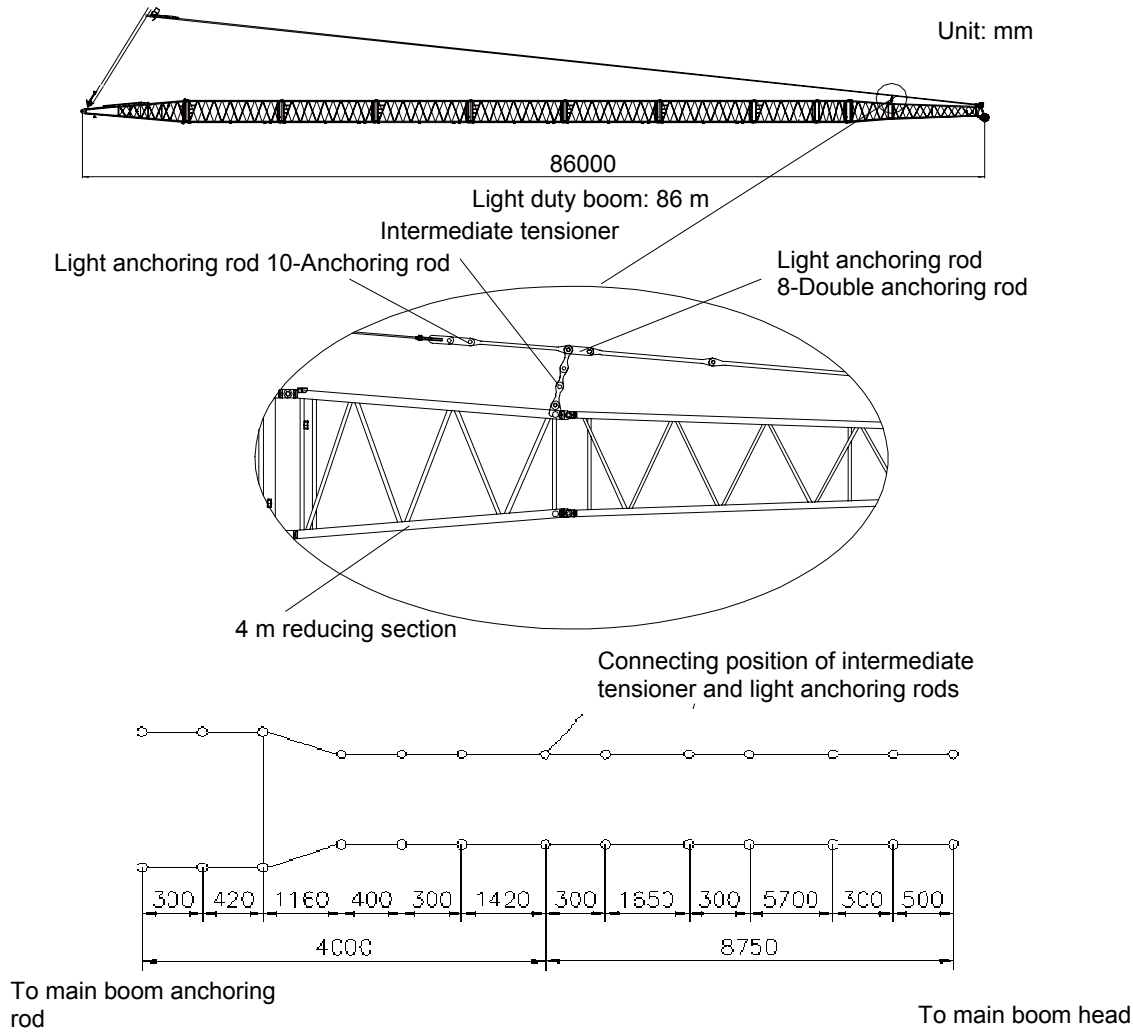


Figure 5-53 Intermediate tensioners connection with 86 m light duty boom

CAUTION

For the parts number of light anchoring rods given in the above table, please refer to Section "light anchoring rods"

Installation position of intermediate tensioners for 89 m-long light duty boom:

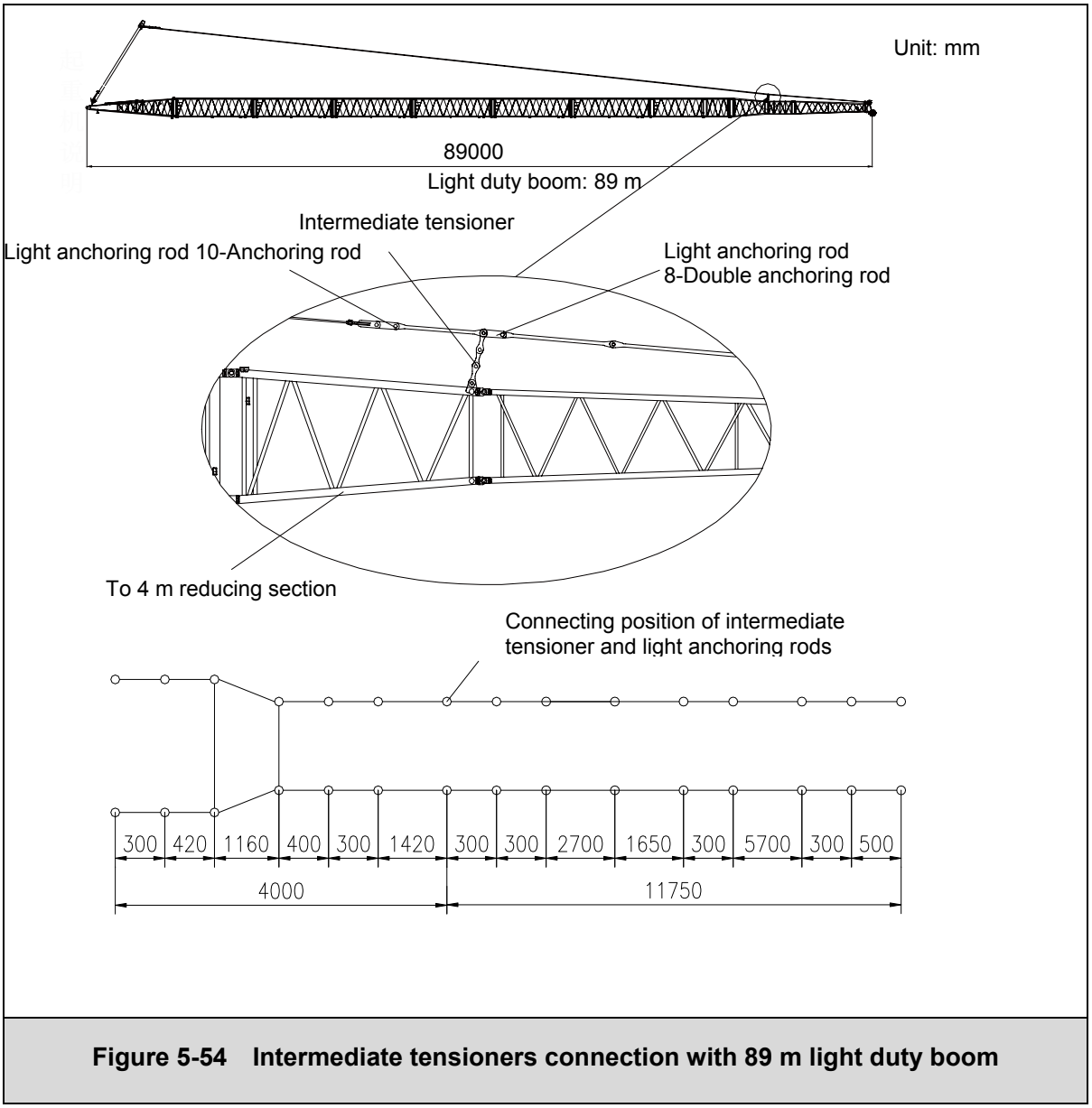


Figure 5-54 Intermediate tensioners connection with 89 m light duty boom

To main boom anchoring rod

To main boom head

CAUTION

For the parts number of light anchoring rods given in the above table, please refer to Section "light anchoring rods".

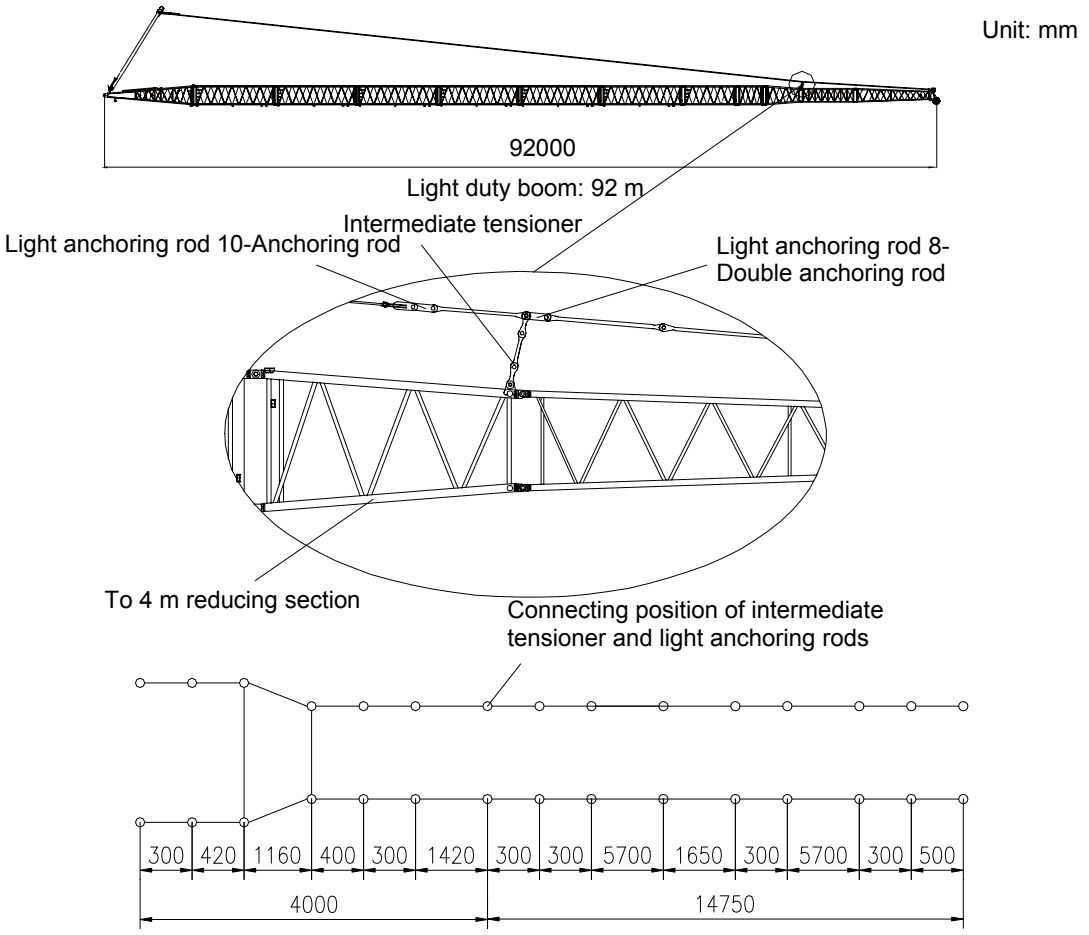


Figure 5-55 Intermediate tensioners connection with 92 m light duty boom

CAUTION

For the parts number of light anchoring rods given in the above table, please refer to Section "light anchoring rods".

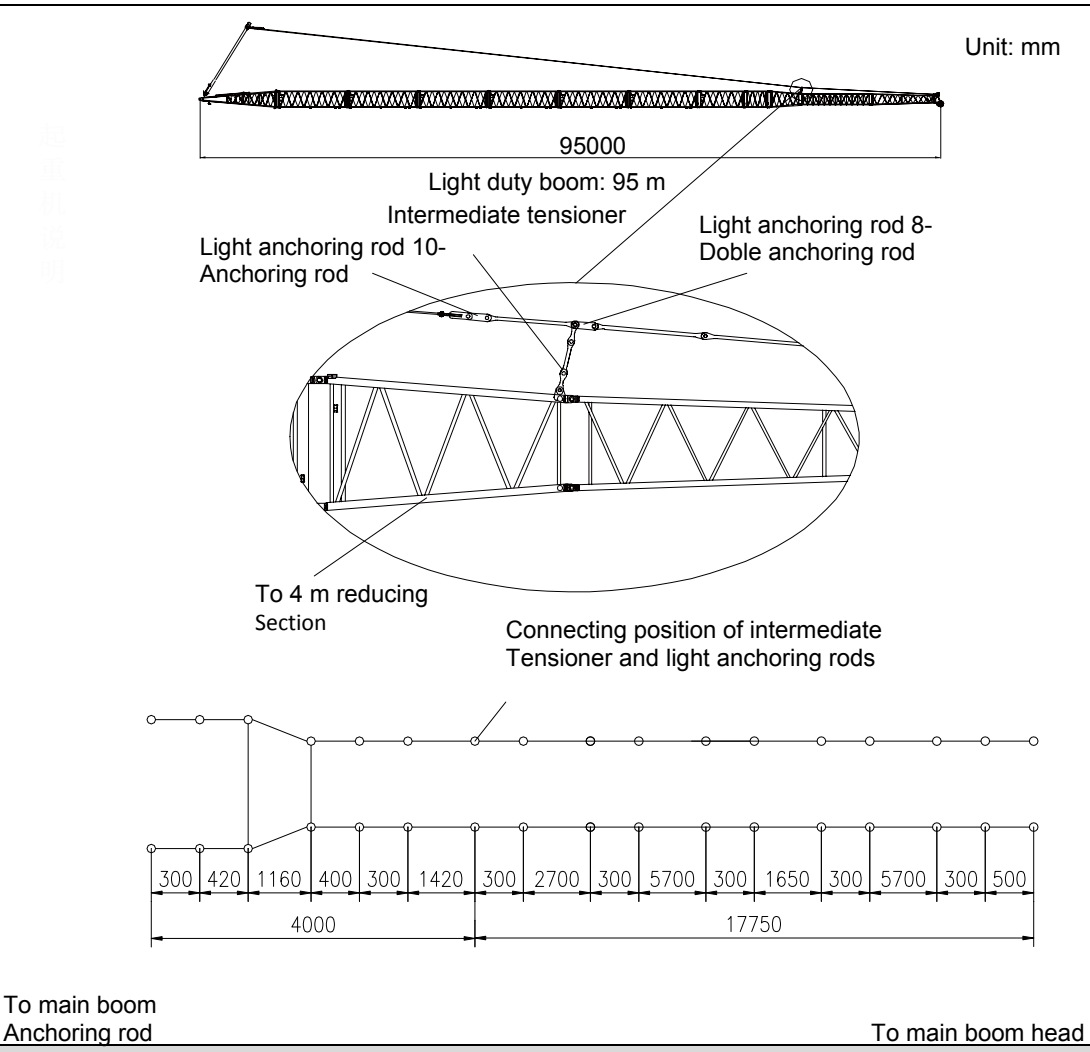


Figure 5-56 Intermediate tensioners connection with 95 m light duty boom

CAUTION

For the parts number of light anchoring rods given in the above table, please refer to Section "light anchoring rods".

Intermediate tensioners for light duty boom with different lengths

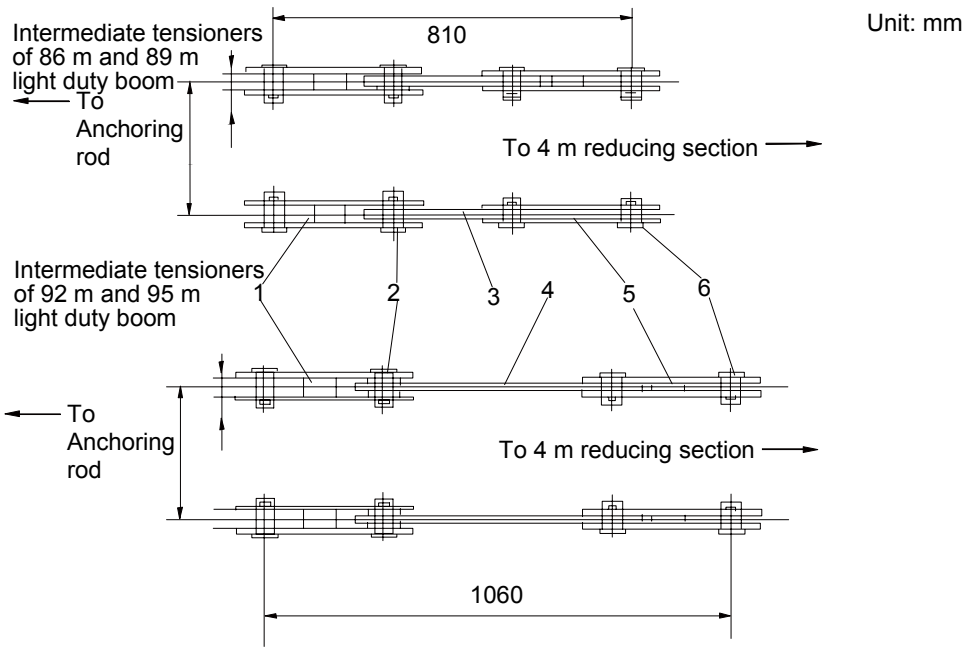
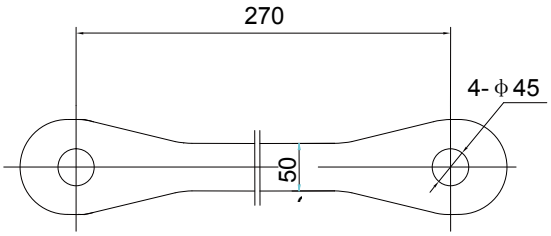
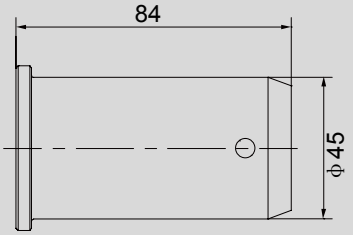
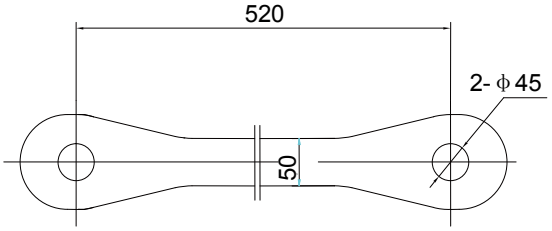
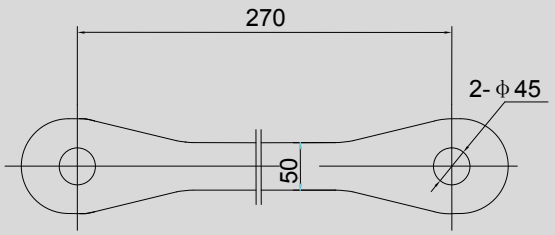
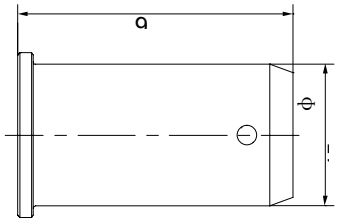
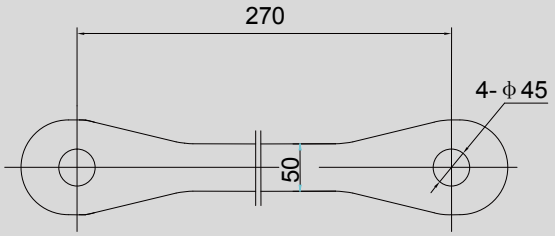
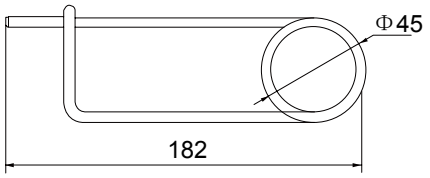


Figure 5-57 Intermediate tensioners anchoring rods

The combination of anchoring rods is shown as follows:

Table 5-7 Component parts of intermediate tensioners anchoring rods

Part No.	Description	Illustration (mm)
1	Double anchoring rod	
2	Pin spindle	
3	Plate	

4	Plate	
5	Pin spindle	
6	Double anchoring rod	
7	Retaining pin	

CAUTION

Part number of intermediate tensioners given in Section "intermediate tensioners on light duty boom" is consistent with these in the above table. Assemble the component parts of intermediate tensioners according to the corresponding part numbers.

5.7.3 Fixed jib on heavy duty boom (SF)

5.7.3.1. Components of SF boom

SF boom comprises main boom and fixed jib. The main boom length varies from 29 m to 77 m, and the fixed jib length varies from 12 m to 30 m. The fixed jib consists of fixed jib pivot section (G31), fixed jib head (G32) and an optional number of fixed jib intermediate section 6 m in length (G34).

The fixed jib can be assembled in the angle of 10° or 30° to main boom. When different fixed jib length is required, operator only needs to disconnect fixed jib pivot section from fixed jib head, and then install fixed jib intermediate sections between them. In this way, the fixed jib can be assembled to required length.

Main boom sections in this boom configuration are pinned together in the same way as that in S boom configuration.

77 m long main boom with 18 m fixed jib, overview:

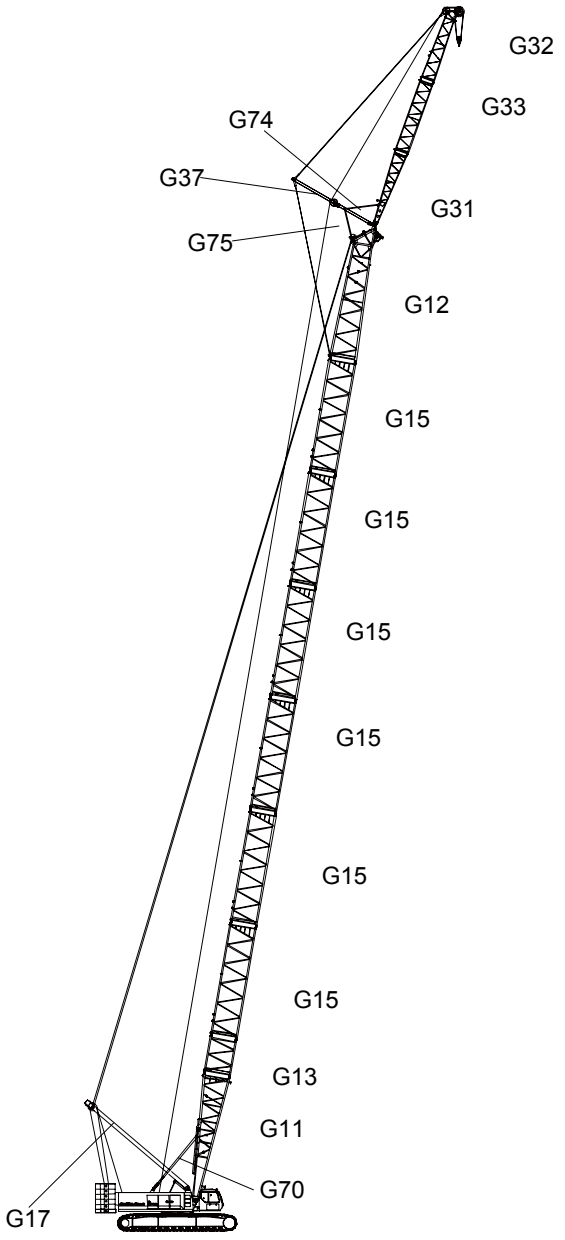


Figure 5-58 SF boom configuration

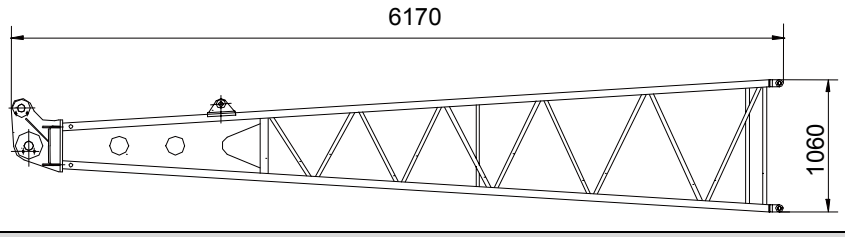


Figure 5-59 Fixed jib pivot section

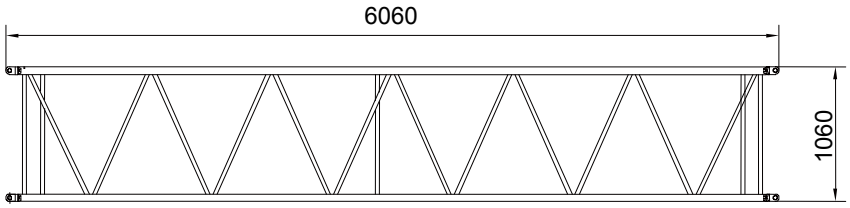


Figure 5-60 6 m fixed jib intermediate section

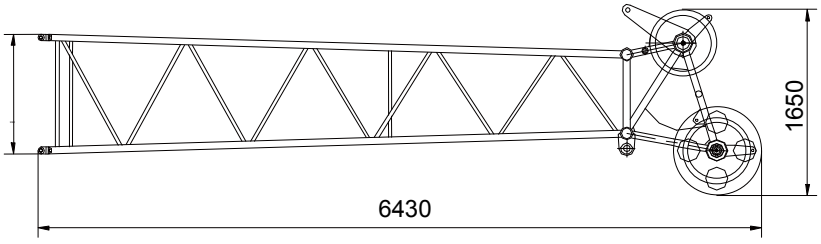


Figure 5-61 Fixed jib head

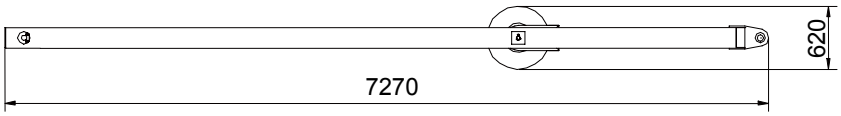


Figure 5-62 FA-frame

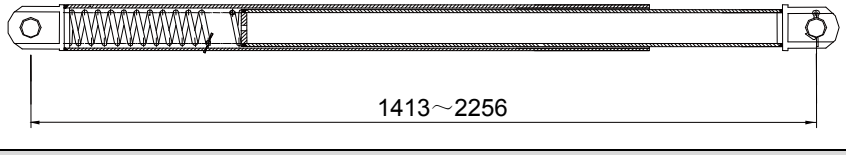


Figure 5-63 Rear tilting-back support of fixed jib

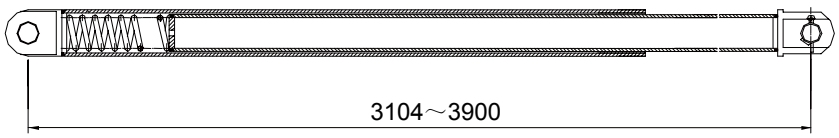


Figure 5-64 Front tilting-back support of fixed jib

CAUTION

Table 5-8 Combination of fixed jib sections

Fixed jib length (m)	Assembly sequence of fixed jib sections	Fixed jib length (m)	Assembly sequence of fixed jib sections
12	G31+G32	24	G31+2×G33+G32
18	G31+G33+G32	30	G31+3×G33+G32

5.7.3.2 Components of anchoring rods of SF boom

The anchoring rods of SF boom comprises main boom anchoring rods, fixed jib front anchoring rods and fixed jib rear anchoring rods. For the combination of main boom anchoring rods, see Section 5.7.1.2 "Combination of anchoring rods of heavy duty boom". And the combination of fixed jib anchoring rods has been given as follows.

a) Fixed jib front anchoring rods

When fixed jib is 12 m long, the fixed jib front anchoring rods is composed by the following component parts.

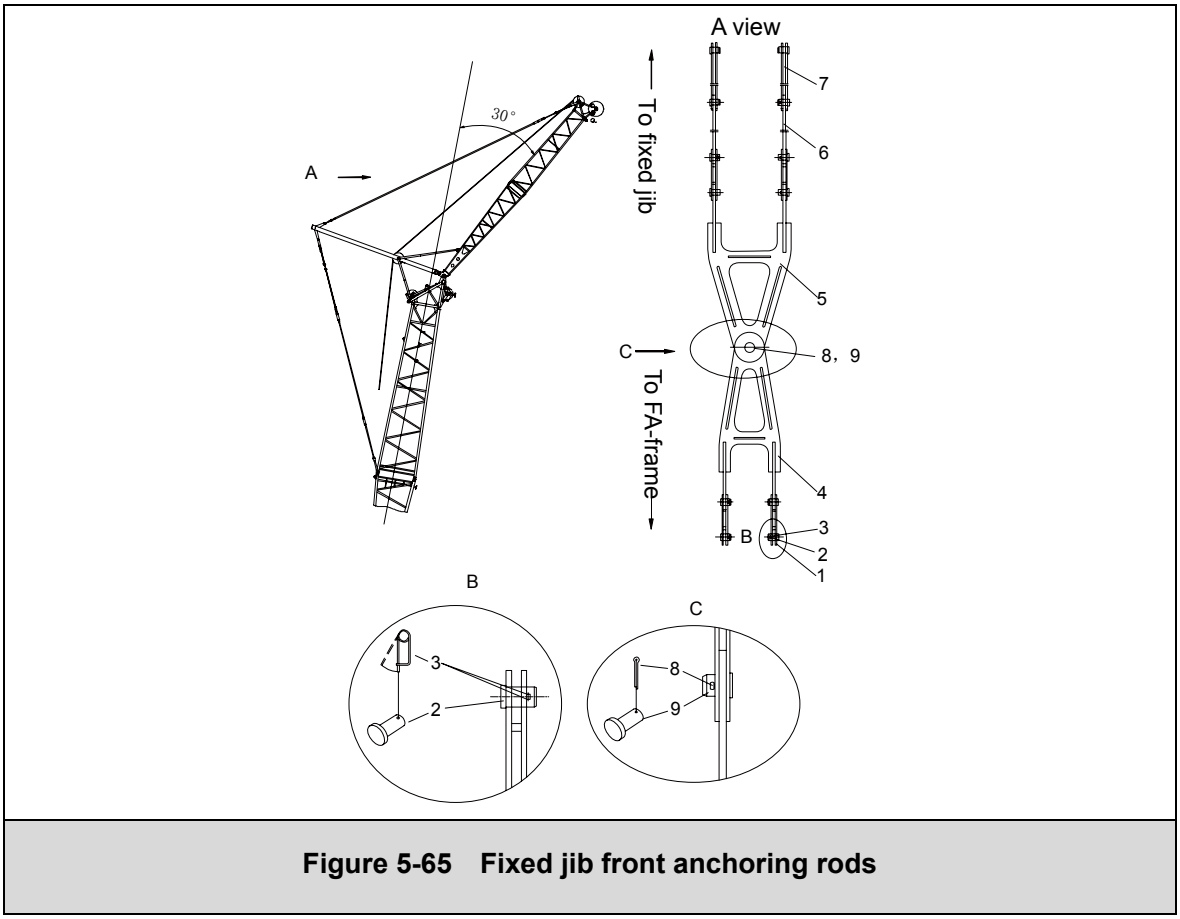
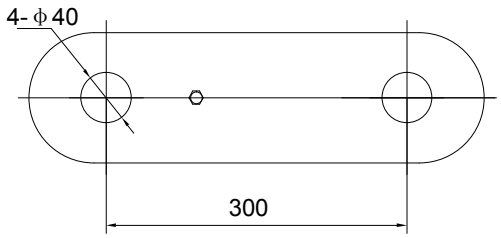
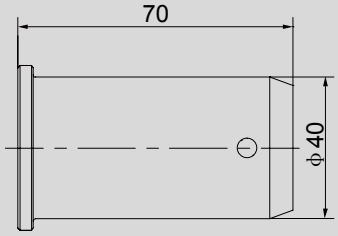
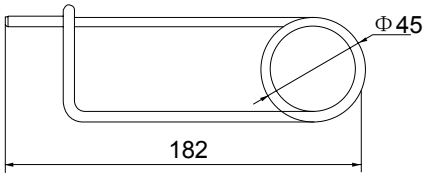
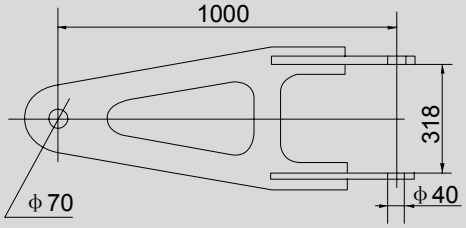
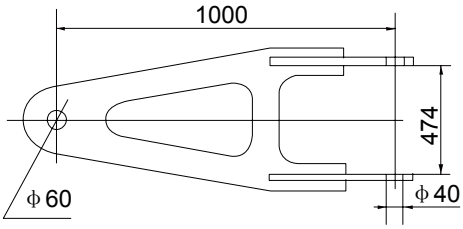
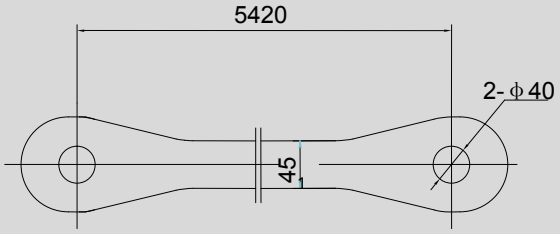
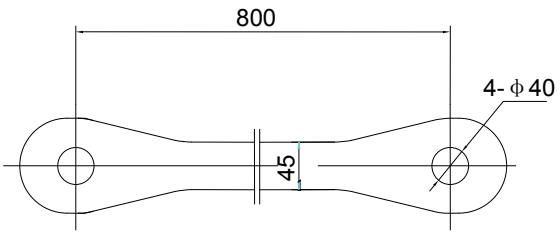
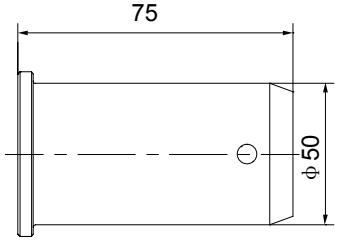


Figure 5-65 Fixed jib front anchoring rods

Table 5-9 Component parts of fixed jib front anchoring rods

Part No.	Description	Illustration (mm)
1	Double anchoring rod	
2	Pin spindle	
3	Retaining pin	

Part No.	Description	Illustration (mm)
4	Reducing double-anchoring rod	
5	Reducing single-anchoring rod	
6	Single anchoring rod	
7	Double anchoring rod	
8	Cotter pin	 GB/T91-2000（10×90）
9	Pin spindle	

CAUTION

The part numbers of anchoring rods given in Section "Fixed jib front anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

The width of fixed jib front anchoring rods is 45 mm, and the diameter of pin spindle is φ40 mm. When fixed jib is 12 m long, the corresponding front anchoring rods is 14940 mm long. When fixed jib length increases by 6 m, a 270 mm-long double anchoring rod (part no. 1) and a 5420 mm-long single anchoring rod (part no. 6) should be added accordingly.
Combination of fixed jib front anchoring rods is shown in the following table

Table 5-10 Combination of fixed jib front anchoring rods

Fixed jib length (m)	Length of fixed jib front anchoring rods (mm)	Combination of fixed jib front anchoring rods (between FA-frame to fixed jib)
12	14540	1+4+5+1+（6+1）+6+7
18	20260	1+4+5+1+2×（6+1）+6+7
24	25980	1+4+5+1+3×（6+1）+6+7
30	31700	1+4+5+1+4×（6+1）+6+7

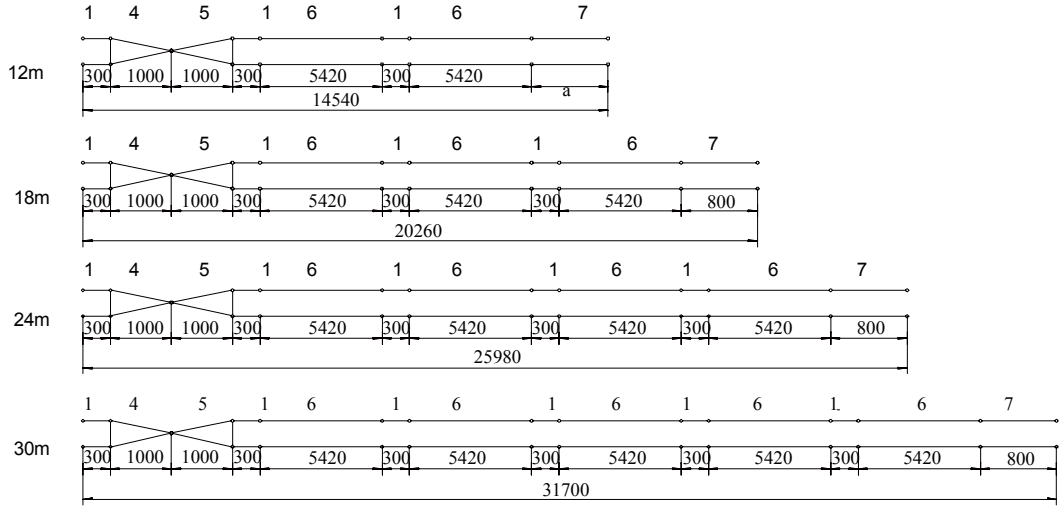


Figure 5-66 Combination of fixed jib front anchoring rods

b) Fixed jib rear anchoring rods

The width of fixed jib rear anchoring rods is 45 mm, and the diameter of pin spindle is φ40 mm.

Since the fixed jib can be mounted in the angle of either 10^{o} or 30^{o} to main boom, the fixed jib rear anchoring rods can be combined in two ways.

The following figure shows the combination of rear anchoring rods when fixed jib is mounted in the angle of 30^{o} to main boom.

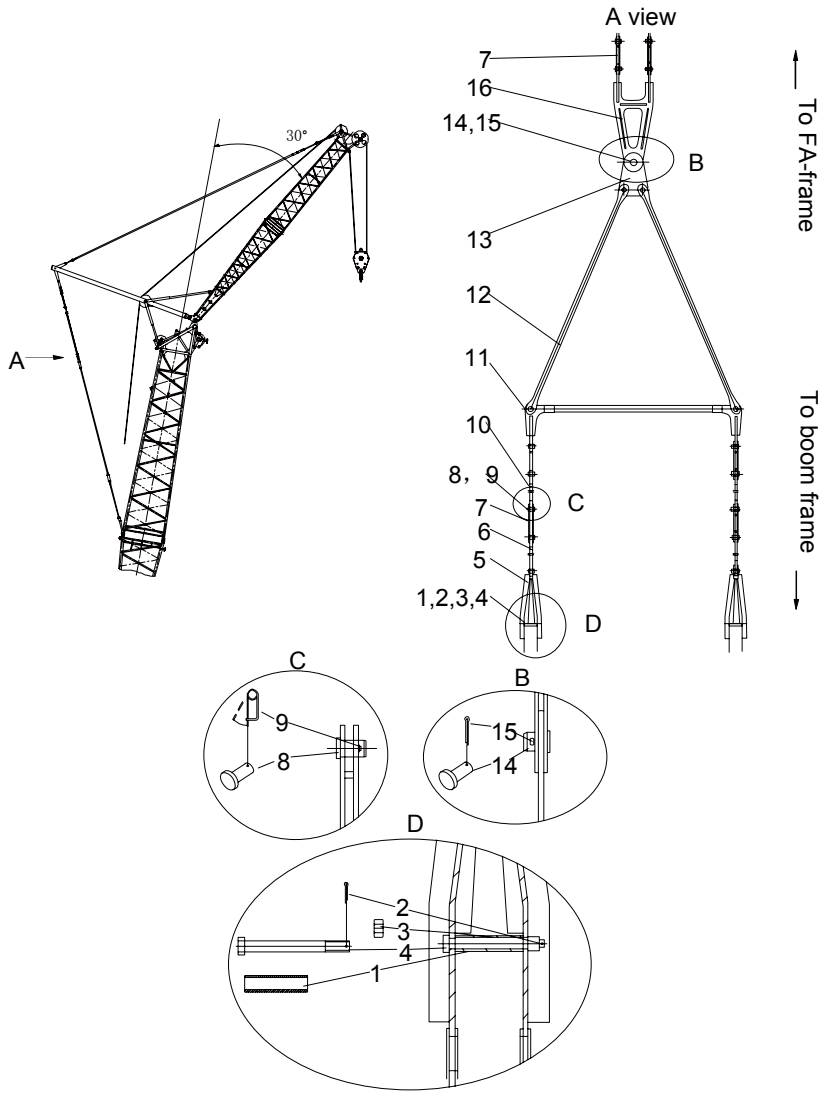
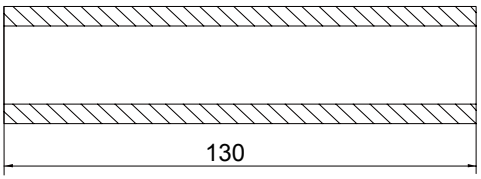
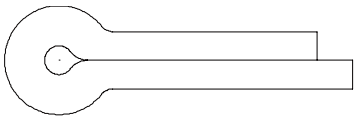
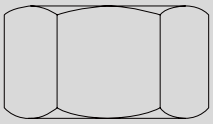
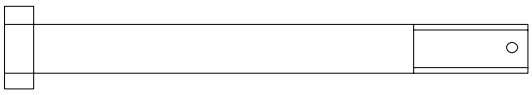
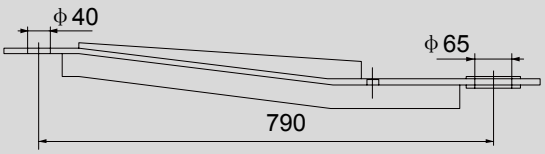
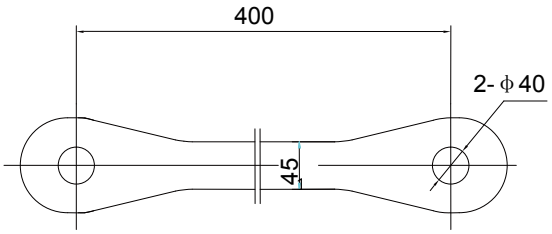
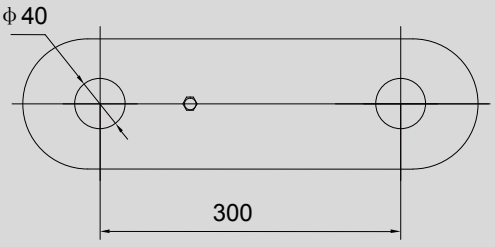
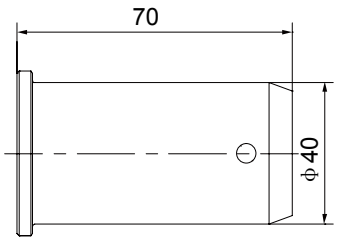
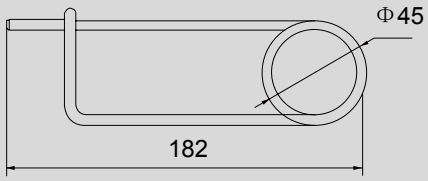
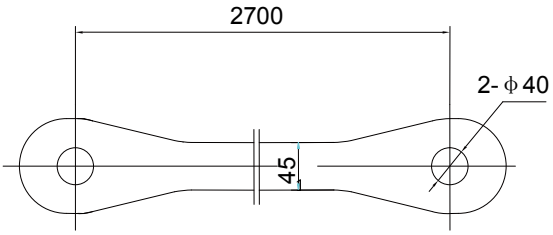
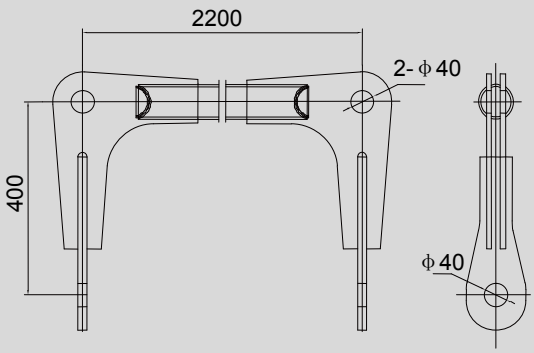
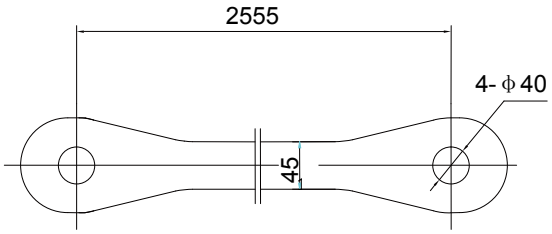
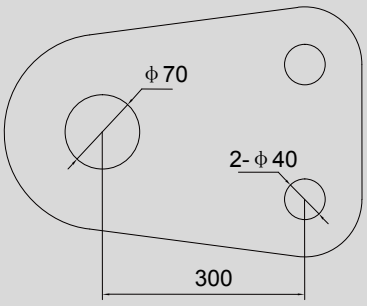
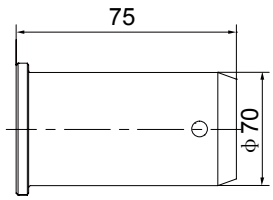
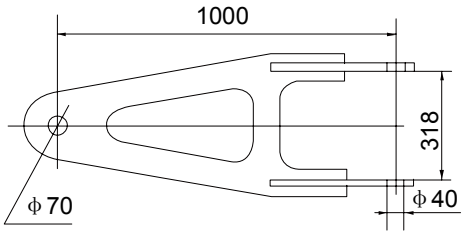
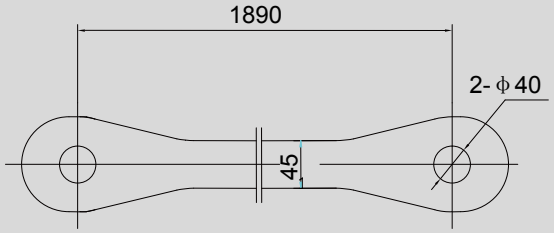
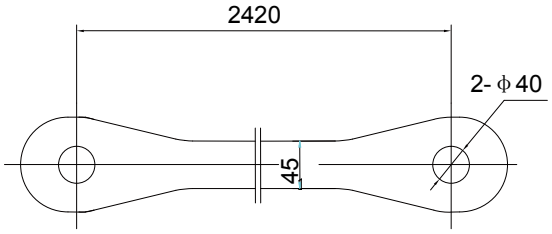


Figure 5-67 Fixed jib rear anchoring rods connection

Table 5-11 Components of fixed jib rear anchoring rods

Part No.	Description	Illustration (mm)
1	Sleeve	
2	Cotter pin	 GB/T91-2000（4×30）
3	Nut	 GB/T6170-2000（M20-8）
4	Bolt	 GB/T31.1-1988（M20×200-8.8）
5	Anchoring rod	
6	Single anchoring rod	
7	Double anchoring rod	

Part No.	Description	Illustration (mm)
8	Pin spindle	
9	Retaining pin	
10	Single anchoring rod	
11	Coupling link	
12	Double anchoring rod	
13	Reducing piece	

Part No.	Description	Illustration (mm)
14	Pin spindle	
15	Cotter pin	 GB/T91-2000(10*90)
16	Reducing double-anchoring rod	
17	Single anchoring rod	
18	Single anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "Fixed jib rear anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

Table 5-12 Combination of fixed jib rear anchoring rods

Fixed jib angle	Length of fixed jib rear anchoring rods (mm)	Combination of fixed jib rear anchoring rods (between main boom to FA-frame)
30°	13030	7+16+13+12+11+7+10+7+18+7+17+5

10°	10860	7+16+13+12+11+7+10+7+18+5

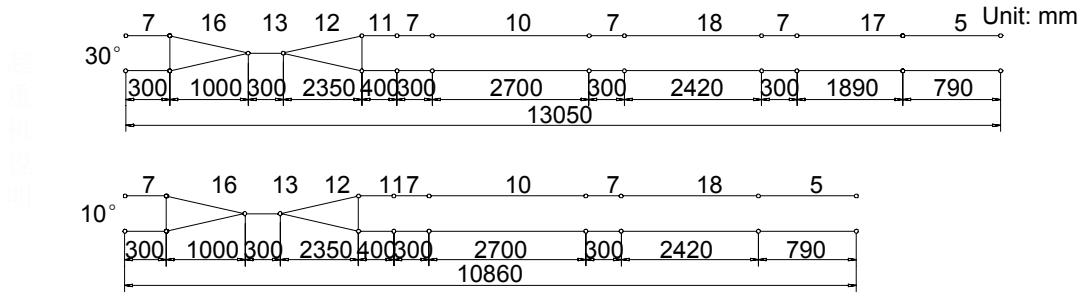


Figure 5-68 Combination of fixed jib rear anchoring rods

5.7.4 Heavy fixed jib on heavy duty boom (SFV)

5.7.4.1 Components of SFV boom

SFV boom comprises main boom (S) and heavy fixed jib (FV). The main boom length varies from 41 m to 77 m, and the heavy fixed jib length is 6 m. The heavy fixed jib can be assembled in the angle of 14° or 20° to main boom. When different main boom length is required, the operator only needs to disconnect main boom pivot section from main boom head, and then install main boom intermediate sections between them. In this way, the main boom can be assembled to required length.

Main boom sections in this boom configuration are pinned together in the same way as that in S boom configuration.

77 m long main boom with 6 m heavy fixed jib, overview:

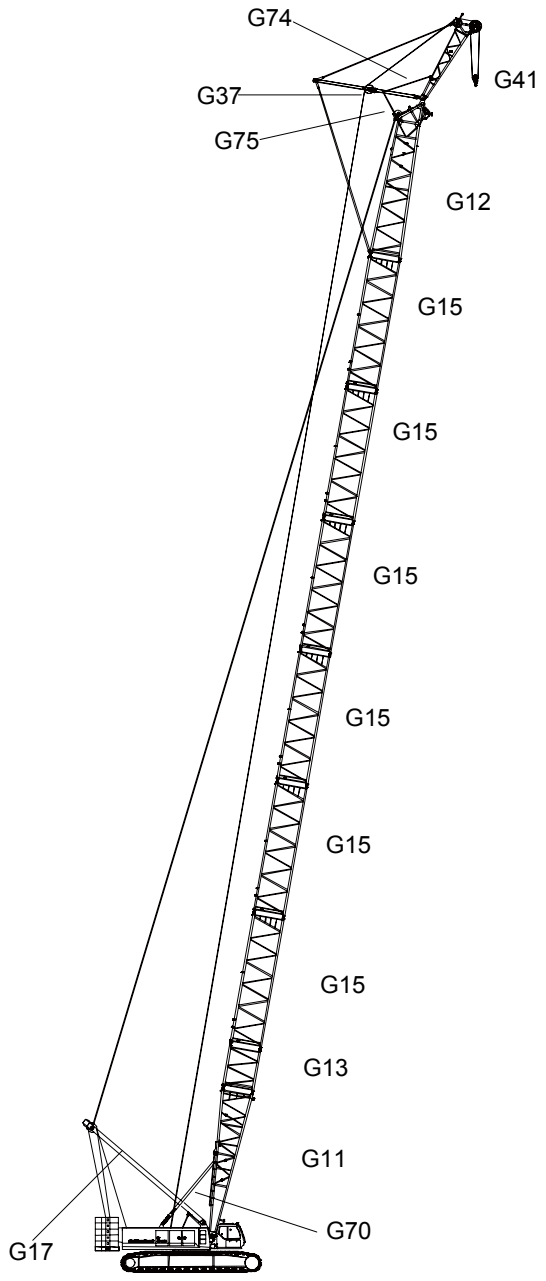


Figure 5-69 Heavy fixed jib on heavy duty boom

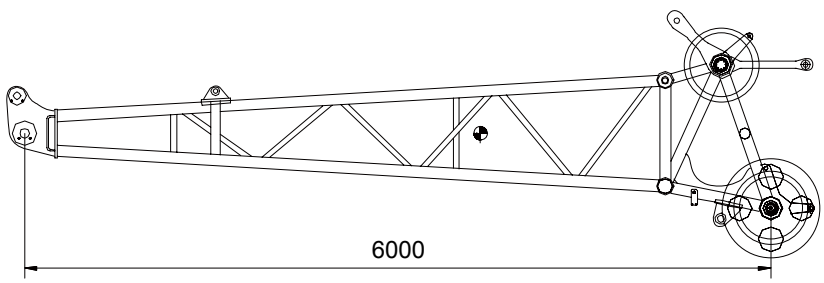


Figure 5-70 Heavy fixed jib on heavy duty boom

CAUTION

For combination of main boom sections, see Section "Components of heavy duty boom".

5.7.4.2 Components of anchoring rods of SFV boom

The anchoring rods of SFV boom comprises main boom anchoring rods, heavy fixed jib front anchoring rods and heavy fixed jib rear anchoring rods. For the combination of main boom anchoring rods, see Section 5.7.1.2 "Combination of anchoring rods of heavy duty boom". And the combination of heavy fixed jib anchoring rods is shown as follows.

a) Heavy fixed jib front anchoring rods

The heavy fixed jib front anchoring rods is composed by the following component parts, and its length is unvaried.

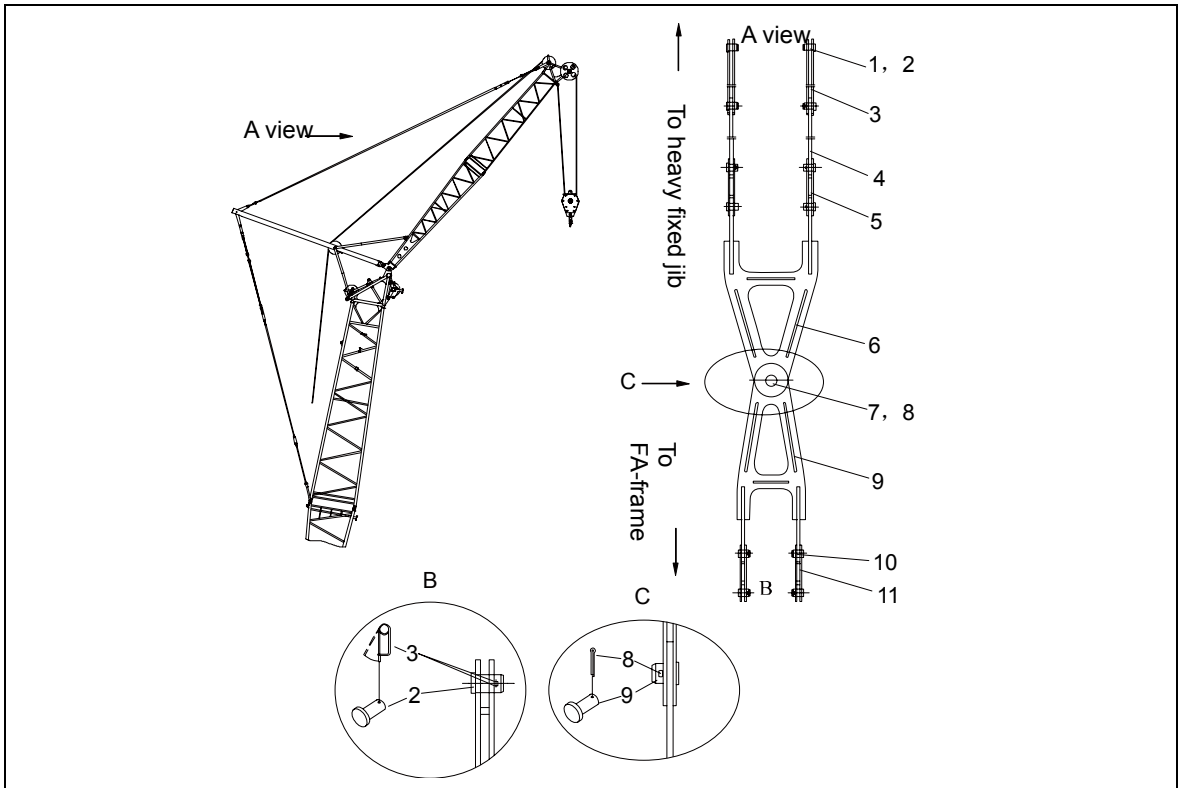
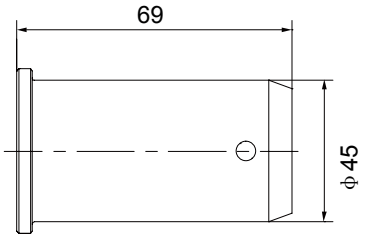
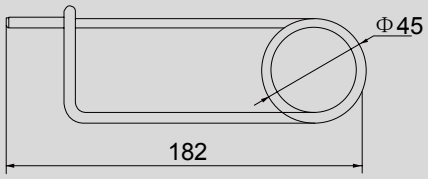
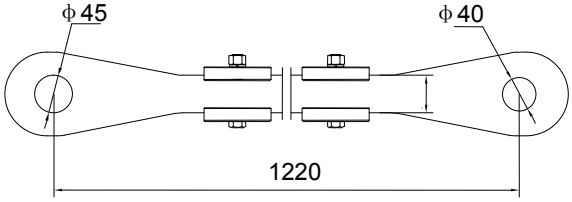
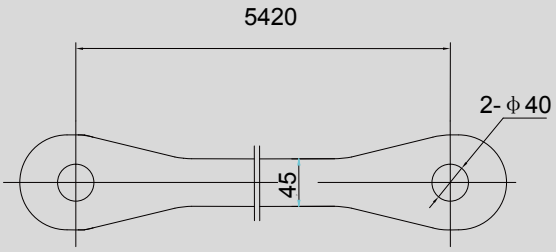
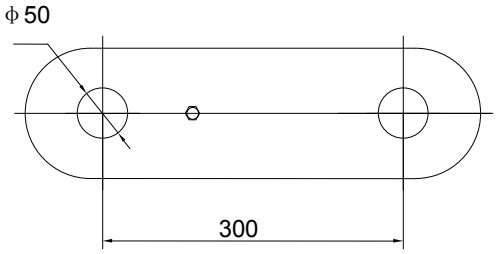
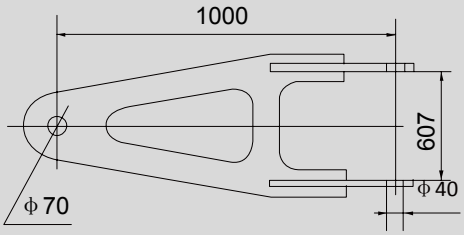
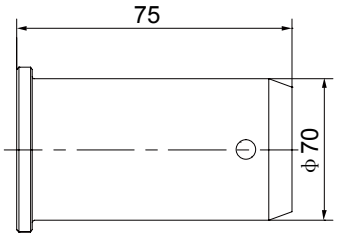
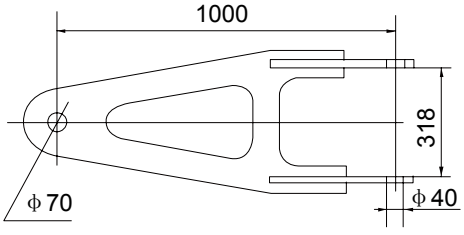
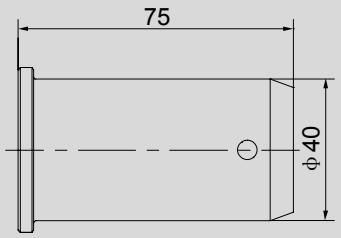


Figure 5-71 Heavy fixed jib front anchoring rods

Table 5-13 Component parts of heavy fixed jib front anchoring rods

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Retaining pin	
3	Double anchoring rod	

Part No.	Description	Illustration (mm)
4	Single anchoring rod	
5	Double anchoring rod	
6	Reducing single anchoring rod	
7	Pin spindle	
8	Cotter pin	 GB/T91-2000（10×90）
9	Reducing double anchoring rod	

Part No.	Description	Illustration (mm)
10	Pin spindle	

CAUTION

The part numbers of anchoring rods given in Section "Heavy fixed jib front anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

b) Heavy fixed jib rear anchoring rods

The width of heavy fixed jib rear anchoring rods is 45 mm, and the diameter of pin spindle is φ40 mm.

Since the heavy fixed jib can be mounted in the angle of either 14^{o} or 20^{o} to main boom, the heavy fixed jib rear anchoring rods can be combined in two ways.

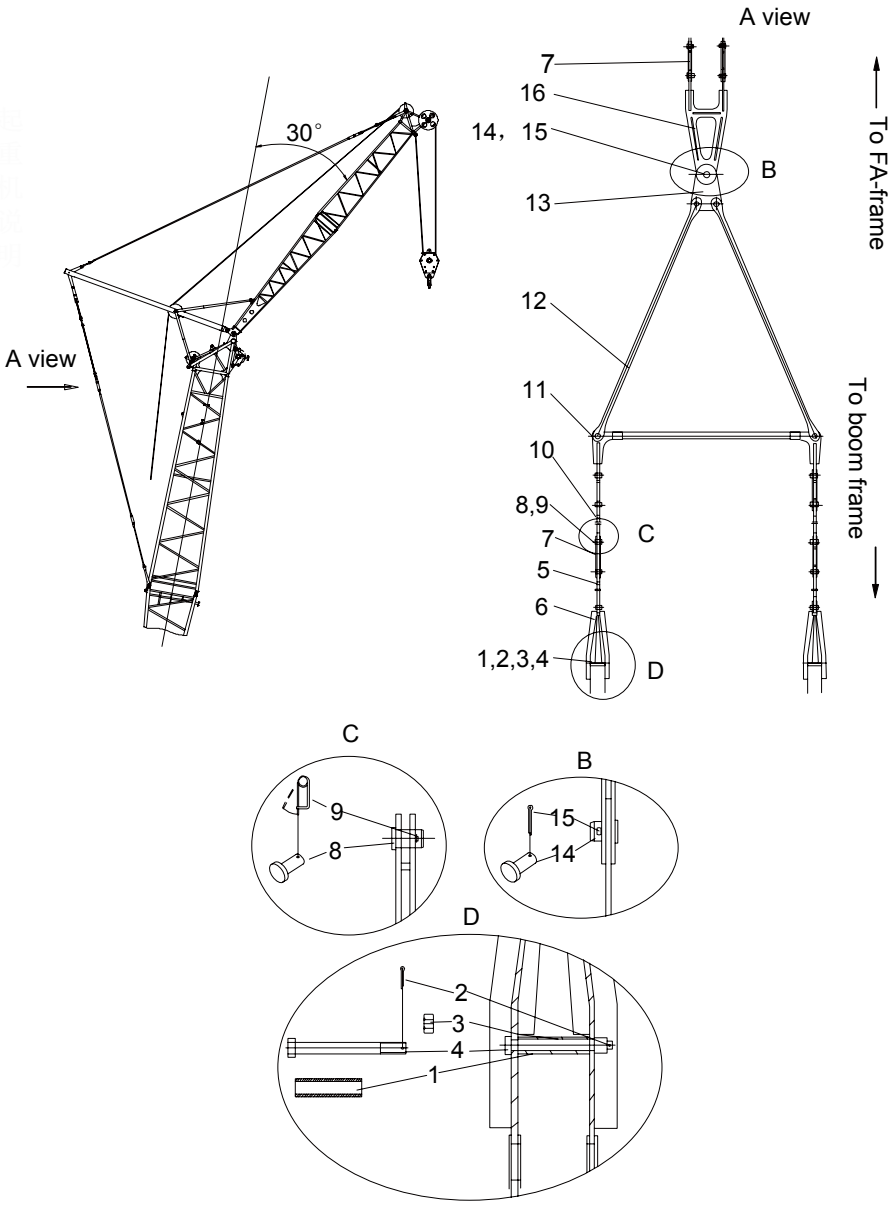
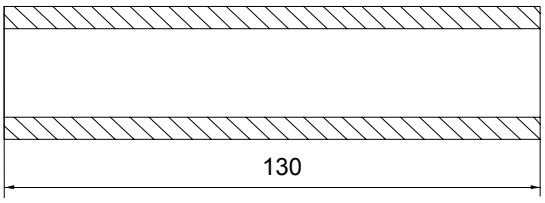
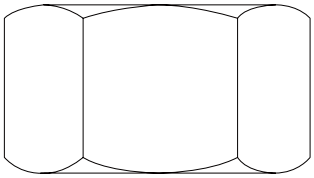
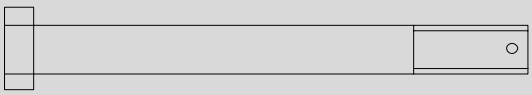
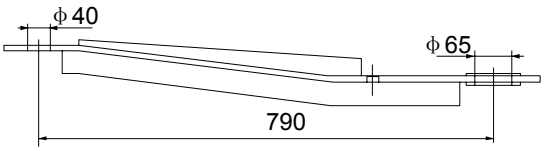
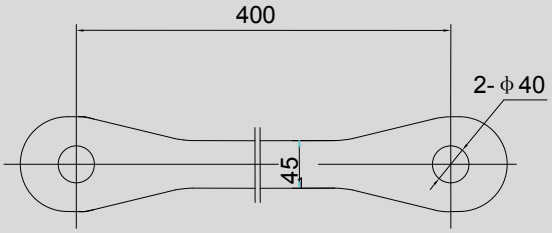
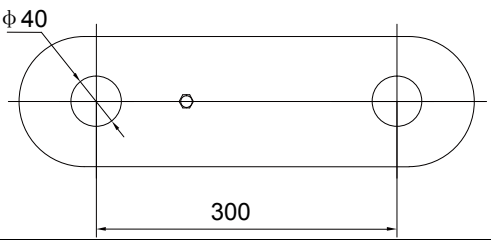
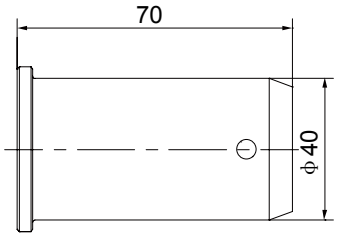
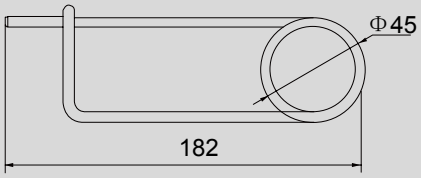
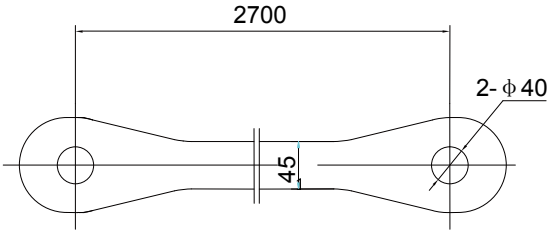
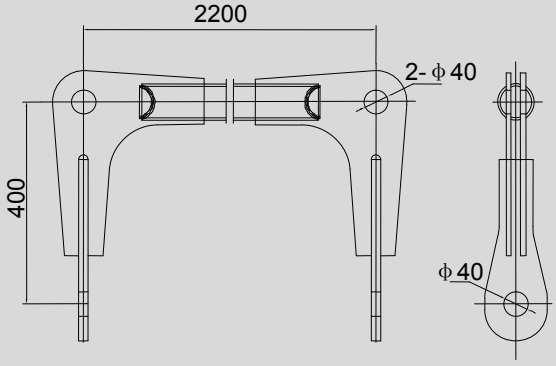
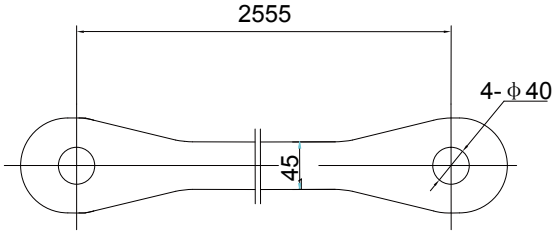
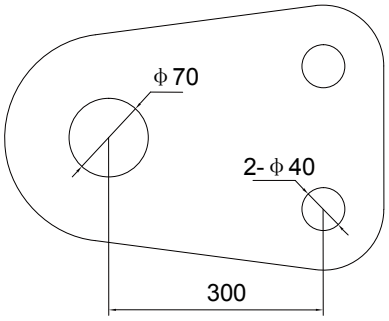
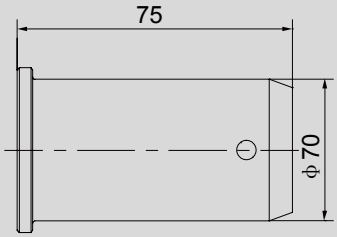
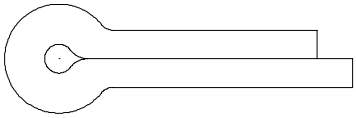
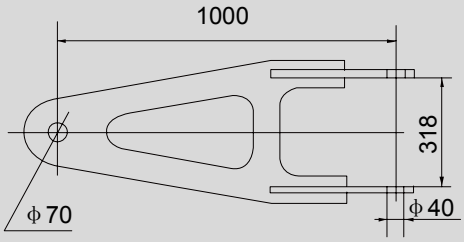
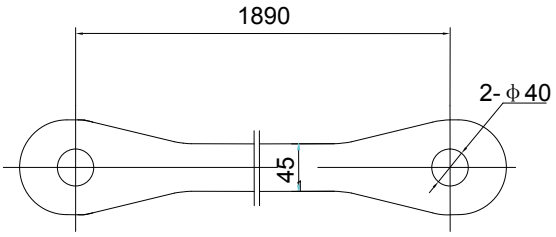
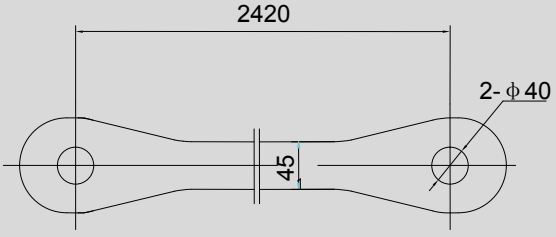


Figure 5-72 Heavy fixed jib rear anchoring rods

Table 5-14 Component parts of heavy fixed jib rear anchoring rods

Part No.	Description	Illustration (mm)
1	Sleeve	
2	Cotter pin	 GB/T91-2000（4×30）
3	Nut	 GB/T6170-2000（M20-8）
4	Bolt	 GB/T31.1-1988（M20×200-8.8）
5	Anchoring rod	
6	Single anchoring rod	
7	Double anchoring rod	

Part No.	Description	Illustration (mm)
8	Pin spindle	
9	Retaining pin	
10	Single anchoring rod	
11	Coupling link	
12	Double anchoring rod	

Part No.	Description	Illustration (mm)
13	Reducing piece	
14	Pin spindle	
15	Cotter pin	 GB/T91-2000 (10×90)
16	Reducing double-anchoring rod	
17	Single anchoring rod	
18	Single anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "Heavy fixed jib rear anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

Combination of heavy fixed jib rear anchoring rods is shown in the following table.

Table 5-15 Combination of heavy fixed jib rear anchoring rods

Heavy fixed jib angle	Length of heavy fixed jib rear anchoring rods (mm)	Combination of heavy fixed jib rear anchoring rods (between main boom to FA-frame)
20°	13030	7+16+13+12+11+7+10+7+10+7+6+5
14°	10860	7+16+13+12+11+7+10+7+10+5

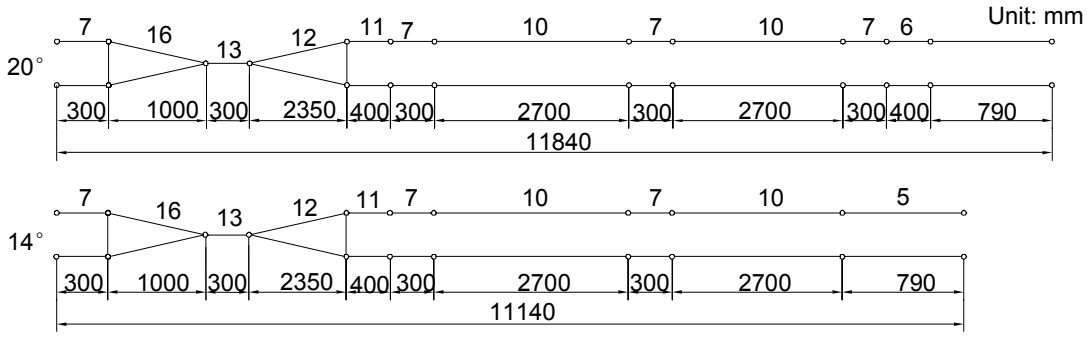


Figure 5-73 Combination of heavy fixed jib rear anchoring rods

5.7.5 Luffing jib on heavy duty boom (SW)

5.7.5.1 Components of luffing jib

The luffing jib, whose length varies from 21 m to 60 m, comprises luffing jib pivot section (G21), luffing jib head (G22) and an optional number of luffing jib intermediate sections with 3 m (G23), 6 m (G24) and 9 m (G25A, G25B) lengths.
62 m long main boom with 60 m luffing jib, overview:

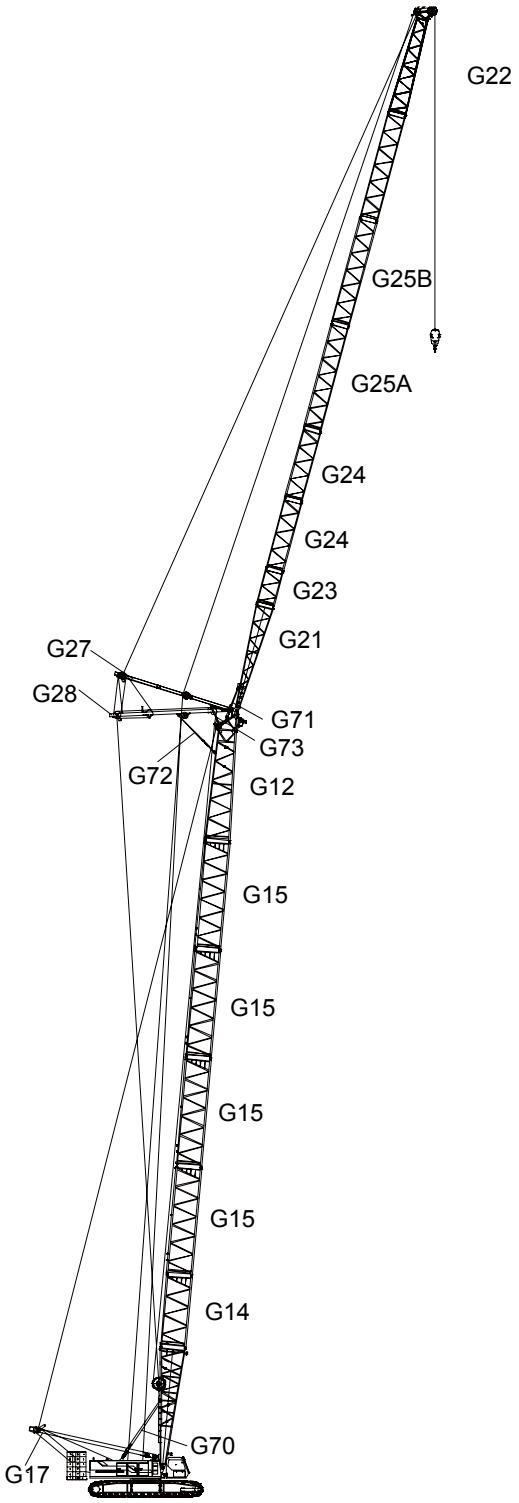
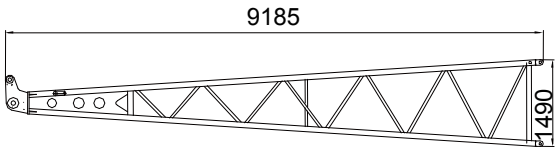
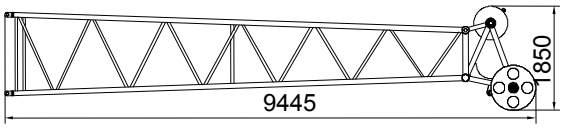


Figure 5-74 Combination of luffing jib sections



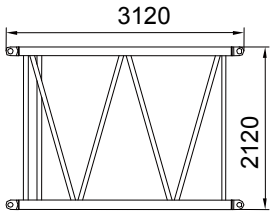
Unit: mm

Figure 5-75 Luffing jib pivot section



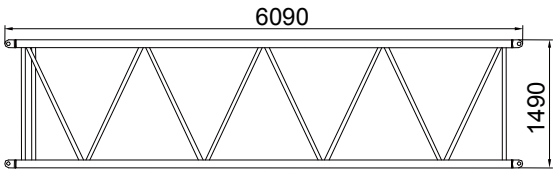
Unit: mm

Figure 5-76 Luffing jib head



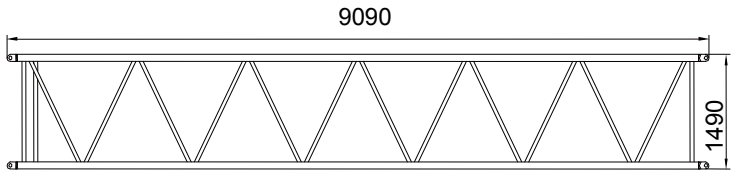
Unit: mm

Figure 5-77 3 m luffing jib intermediate section



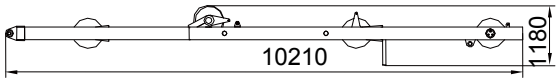
Unit: mm

Figure 5-78 6 m luffing jib intermediate section



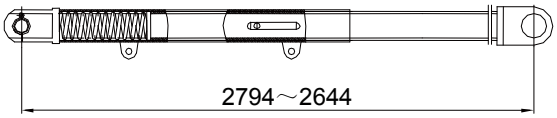
Unit: mm

Figure 5-79 9 m luffing jib intermediate section



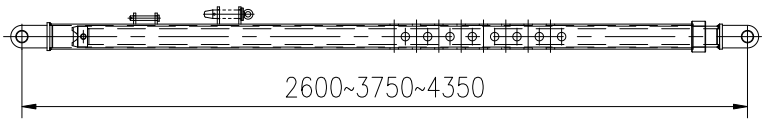
Unit: mm

Figure 5-80 WA-frame 2



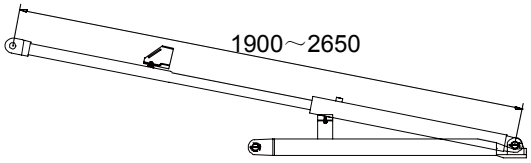
Unit: mm

Figure 5-81 Luffing jib tilting-back support



Unit: mm

Figure 5-82 Rear tilting-back support of luffing jib



Unit: mm

Figure 5-83 Rear tilting-back support cylinder of luffing jib

Table 5-16 Combination of luffing jib sections

Luffjing jib length (m)	Assembly sequence	Luffjing jib length (m)	Assembly sequence
18	G21+G22	42	G21+G24+G25A+G25B+G22
21	G21+G23+G22	45	G21+G25A+G25B×2+G22
24	G21+G24+G22	48	G21+G23+G25A+G25B×2+G22
27	G21+G25A+G22	51	G21+G24+G25A+G25B×2+G22
30	G21+G23+G25A+G22	54	G21+G23+G24+G25A+G25B×2+G22
33	G21+G24+G25A+G22	57	G21+G24×2+G25A+G25B×2+G22
36	G21+G25A+G25B+G22	60	G21+G23+G24×2+G25A+2×G25B+G22
39	G21+G23+G25A+G25B+G22		

5.7.5.2 Components of luffing jib anchoring rod

The luffing jib anchoring rods comprises luffing jib front anchoring rods and luffing jib rear anchoring rods. Their lengths are respectively determined by the length of luffing jib. The width of luffing jib front anchoring rods is 50 mm, and the diameter of pin spindle is φ45 mm.

a) Luffing jib front anchoring rods

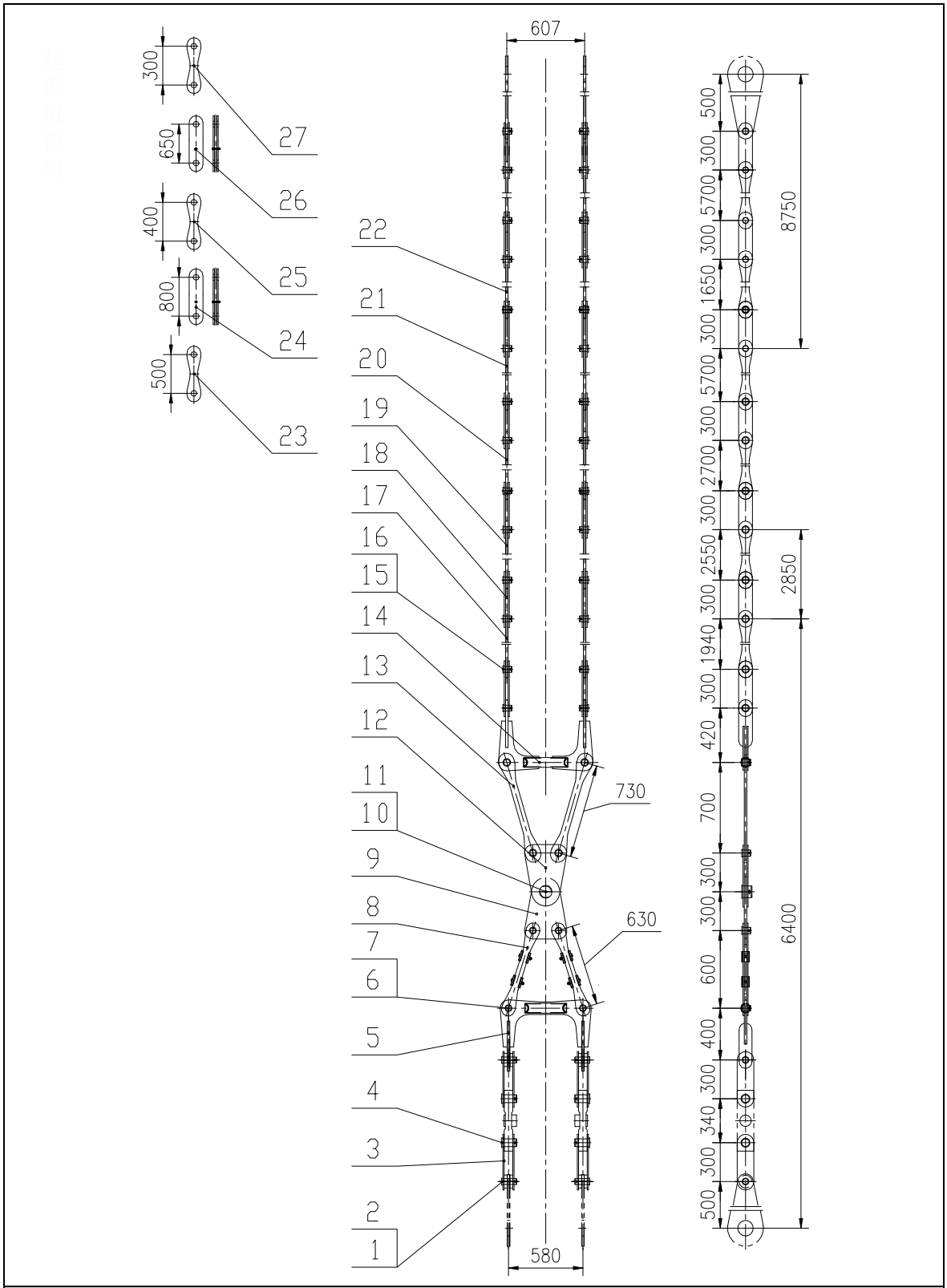
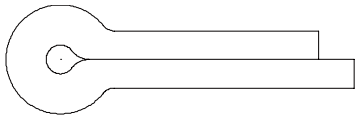
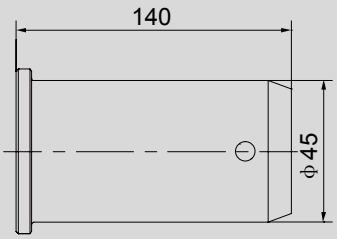
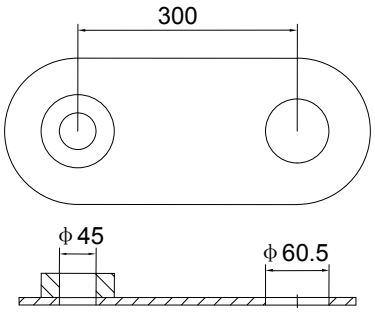
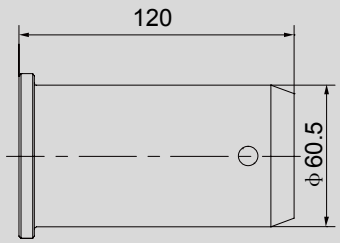
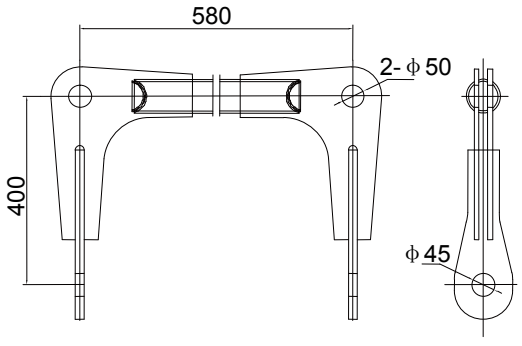
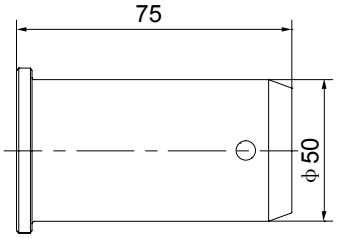
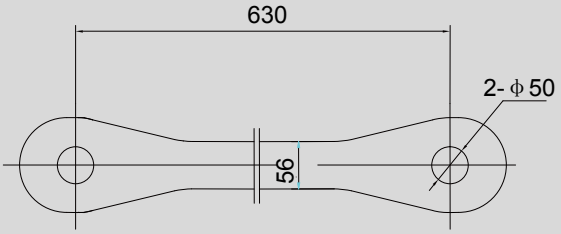
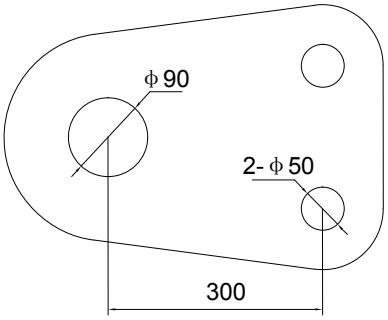
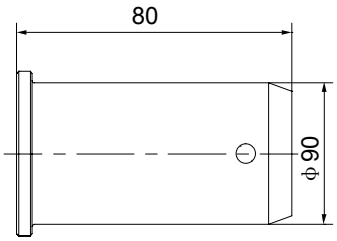
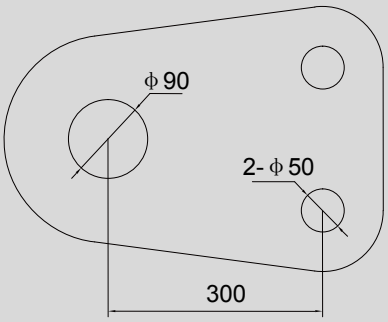
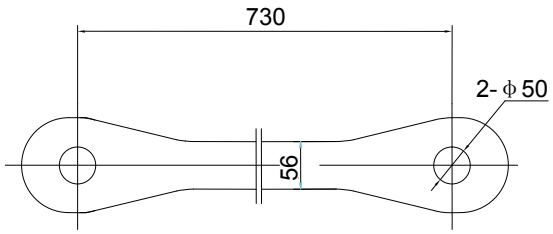
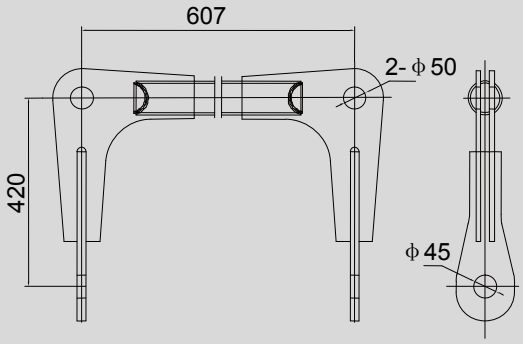
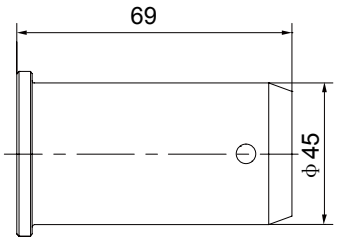
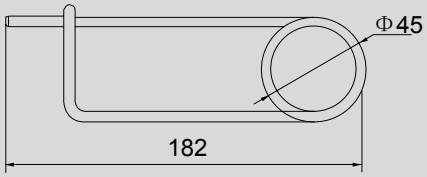
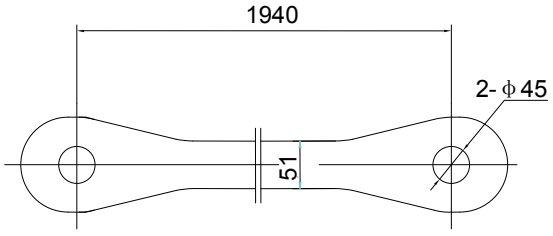
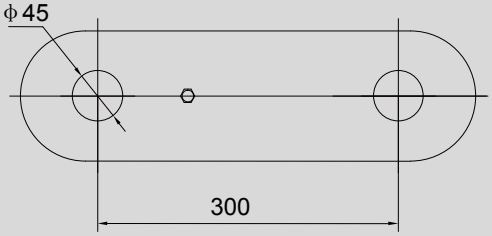


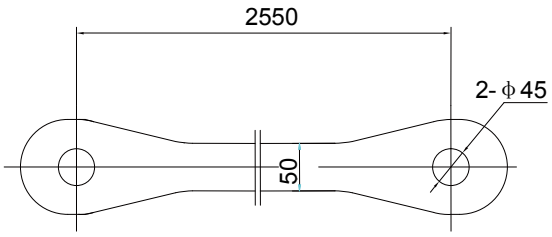
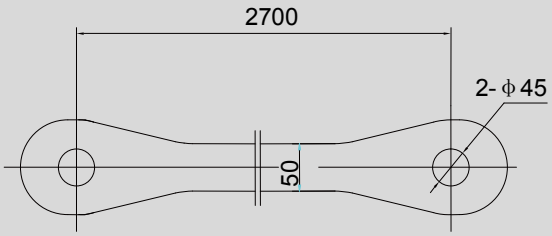
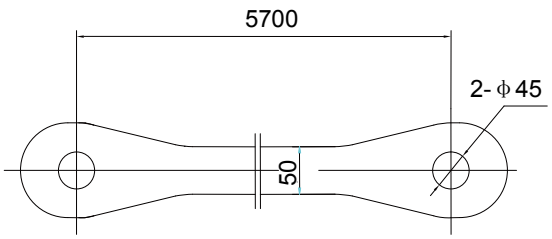
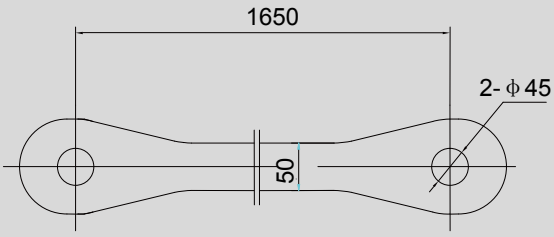
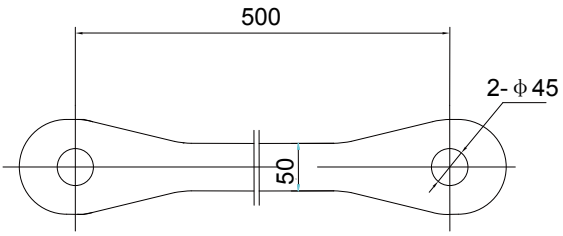
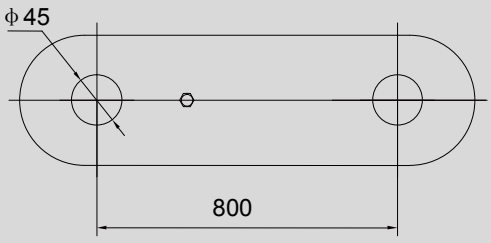
Figure 5-84 Luffing jib front anchoring rods connection

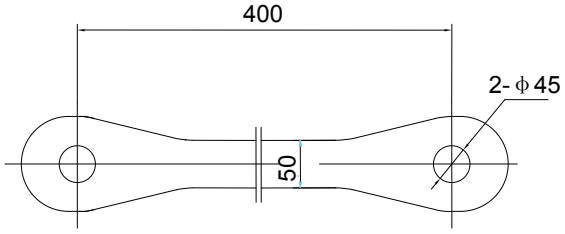
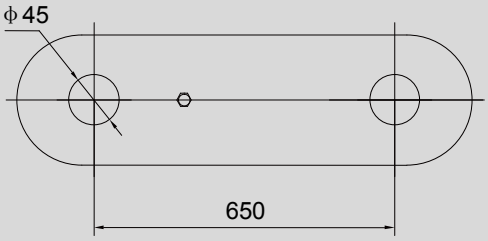
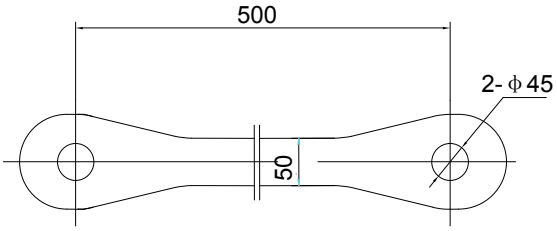
Table 5-17 Component parts of luffing jib front anchoring rods

Part No.	Description	Illustration (mm)
1	Cotter pin	 GB/T91-2000（8×60）
2	Pin spindle	
3	Anchoring rod	
4	Pin spindle	
5	Coupling link	
6	Cotter pin	 GB/T91-2000（10×90）

Part No.	Description	Illustration (mm)
7	Pin spindle	
8	Double anchoring rod	
9	Single reducing piece	
10	Cotter pin	 GB/T91-2000（10×120）
11	Pin spindle	
12	Double reducing piece	

Part No.	Description	Illustration (mm)
13	Anchoring rod	
14	Coupling link	
15	Pin spindle	
16	Retaining pin	
17	Anchoring rod	
18	Double anchoring rod	

Part No.	Description	Illustration (mm)
19	Anchoring rod	
20	Anchoring rod	
21	Double anchoring rod	
22	Anchoring rod	
23	Anchoring rod	
24	Double anchoring rod	

Part No.	Description	Illustration (mm)
25	Anchoring rod	
26	Double anchoring rod	
27	Anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "Luffing jib front anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

Table 5-18 Combination of front anchoring rods of luffing jib

Main boom length (m)	Length of anchoring rods of WA-frame 1 (6400) (mm)	Length of adjusting anchoring rods (mm)	Length of anchoring rods of main boom pivot section (mm)	Length of anchoring rods of 3 m main boom intermediate section (mm)	Length of anchoring rods of 6 m main boom intermediate section (mm)	Length of anchoring rods of 9 m main boom intermediate section (mm)	Length of anchoring rods of luffing jib head (8750) (mm)	Total length of anchoring rods (mm)
21	500+300+340+300+400+600+300+300+700+420+300+1940	800+500	300+2550	A			300+1650+300+5700+300+500	22300
24		650+400			B			25050
27		300+500				A+B		27800
30		300+400		A		A+B		30700
33		300+300			B	A+B		33600
36		800	2550			2(A+B)		36500
39		650	2550	A		2(A+B)		39350
42		650	2550		B	2(A+B)		42350
45			300+2550			3(A+B)		45000
48				A		3(A+B)		48000
51					B	3(A+B)		51000
54				A	B	3(A+B)		54000
57					2 B	3(A+B)		57000
60				A	2 B	3(A+B)		60000

Remarks: A=300+2700 B=300+5700

b) Luffing jib rear anchoring rods

The combination of the luffing jib rear anchoring rods is shown in the following figure.

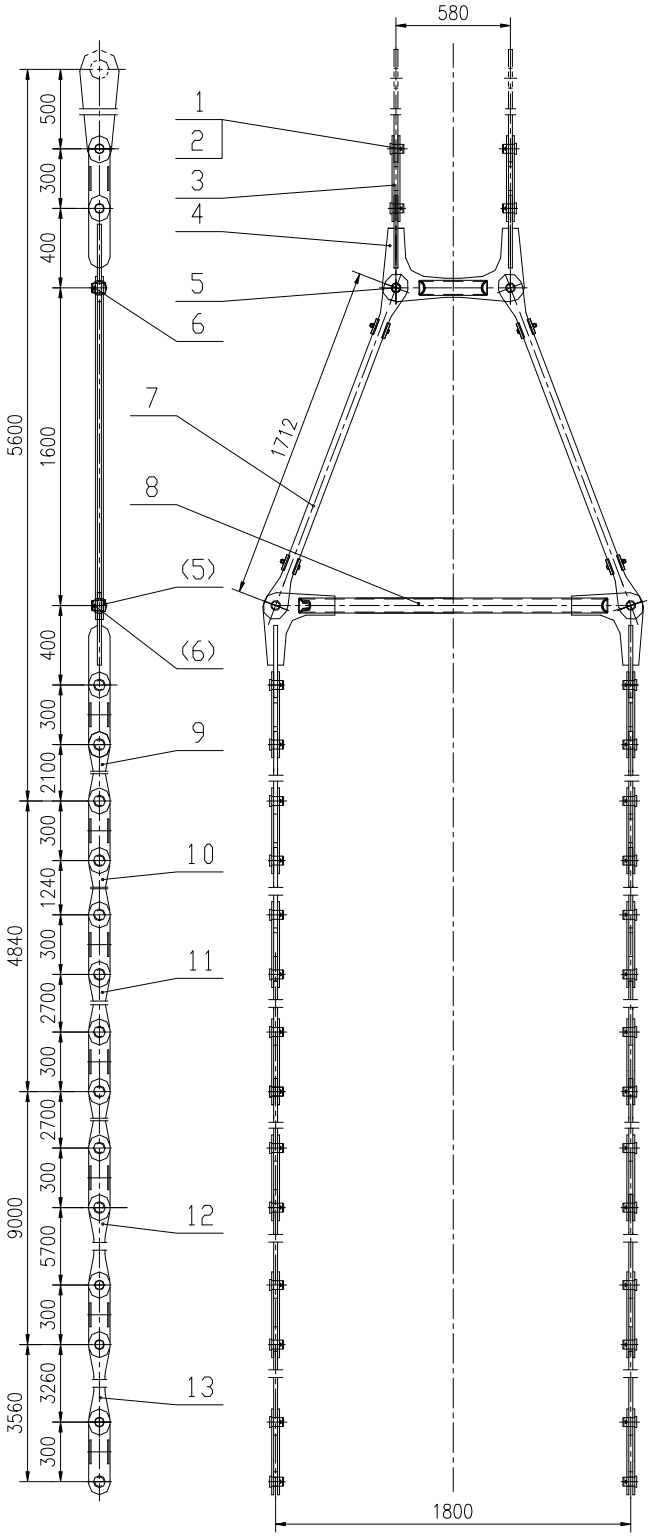
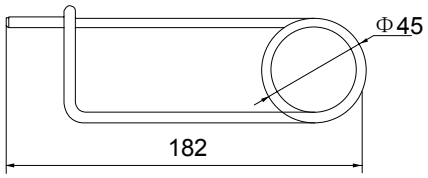
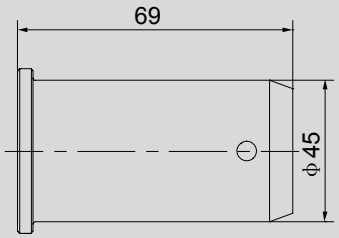
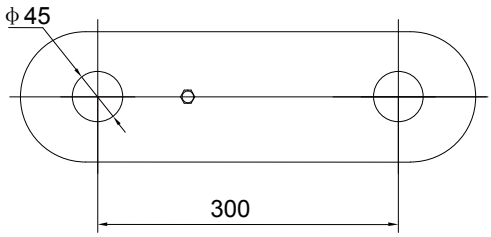
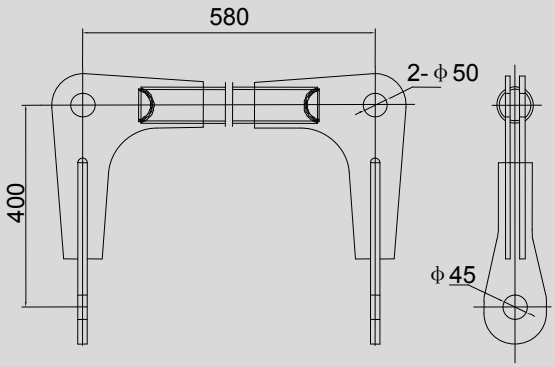
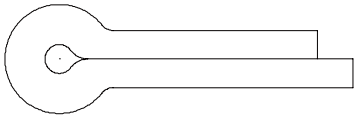
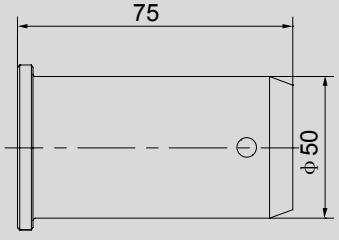
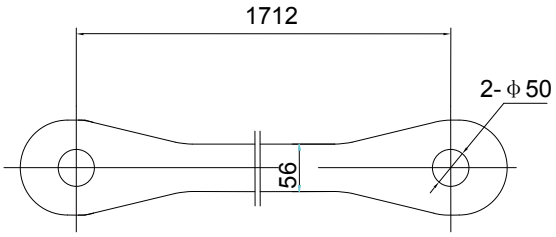
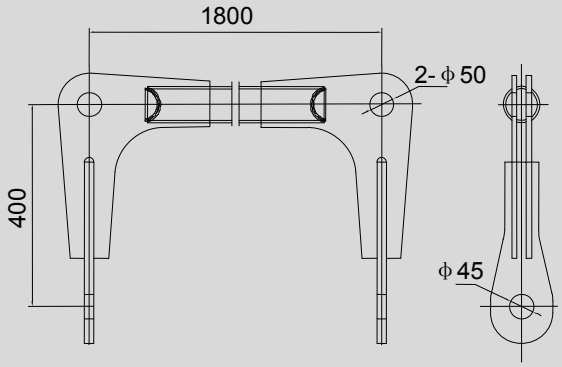
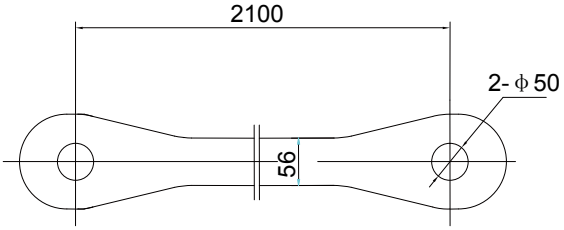
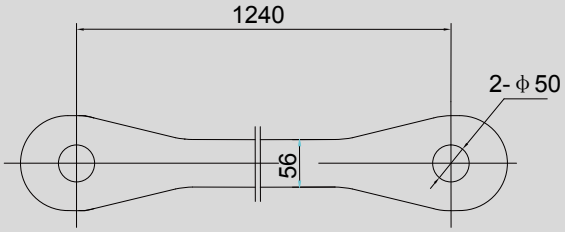
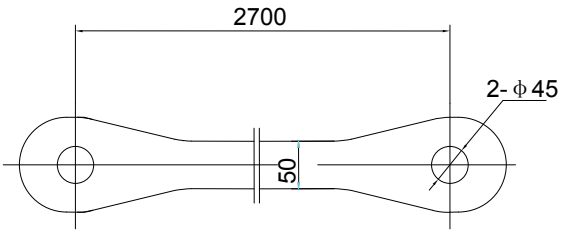
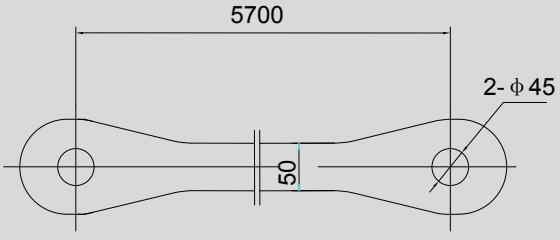
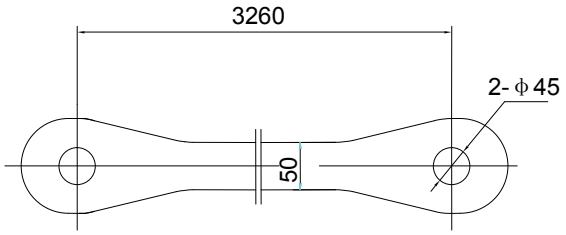


Figure 5-85 Luffing jib rear anchoring rods connection

Table 5-19 Component parts of luffing jib rear anchoring rods

Part No.	Description	Illustration (mm)
1	Retaining pin	
2	Pin spindle	
3	Double anchoring rod	
4	Coupling link	
5	Cotter pin	 GB/T91-2000（10×90）
6	Pin spindle	

7	Double anchoring rod	
8	Coupling link	
9	Single anchoring rod	
10	Single anchoring rod	
11	Anchoring rod	
12	Anchoring rod	

13	Single anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "Luffing jib rear anchoring rods" are consistent with these in the above table. Assemble the component parts of anchoring rods according to the corresponding part numbers.

Table 5-20 Combination of rear anchoring rods of luffing jib

Main boom length (m)	Length of anchoring rods of WA-frame 2 (5600) (mm)	Length of anchoring rods of main boom head (4840) (mm)	Length of anchoring rods of 3 m main boom intermediate section (mm)	Length of anchoring rods of 6 m main boom intermediate section (mm)	Length of anchoring rods of 9 m main boom intermediate section (mm)	Length of anchoring rods of main boom pivot section (3560) (mm)	Total length of anchoring rods (mm)
23	500+300+400+1600+400+300+2100	300+1240+300+2700+300	A			3260+300	17000
26				B			20000
29					A+B		23000
32			A		A+B		26000
35				B	A+B		29000
38					2(A+B)		32000
41			A		2(A+B)		35000
44				B	2(A+B)		38000
47					3(A+B)		41000
50			A		3(A+B)		44000
53				B	3(A+B)		47000
56					4(A+B)		50000
59			A		4(A+B)		53000
62				B	4(A+B)		56000

Remarks: A=300+2700 B=300+5700

5.8 Assembly and dismantling of heavy duty boom(S)

CAUTION

Before assembly or dismantling, set the "Boom configuration" switch to "main boom" position.

5.8.1 Preparations for assembly

a) Choose appropriate boom combination and relevant anchoring rods combination according to operational planning and lifting capacity chart.
b) Choose appropriate load hook and rope reeving for load to be lifted.
c) Assemble required counterweight plates.
d) Make sure that an auxiliary crane is available and operating personnel get full prepared and qualified for operation.
e) Change the "operating mode" into "assembly mode".

CAUTION

(1) After the "operating mode" is changed to "assembly mode", all safety devices built in the crane will be deactivated, the assembly, dismantling of the machine must be therefore carried out with utmost care.
(2) For assembly work on the crane, a safety assembly working platform must be used. Improvisations are prohibited. Otherwise, there is a danger of falling down.
(3) Any other boom configurations and anchoring rods combination that have not been stipulated in the operating manual are prohibited.
(4) Always bolt on the shorter intermediate sections first!
(5) If the main boom head is lifted by an auxiliary crane, at least two pieces of lifting chain with a breaking force ≥ 15 t should be used.
(6) Do not stand on the lattice boom when it is assembled.
(7) Do not stand beneath the boom when it is being pinned or unpinned.
(8) The use of square timbers or pad block to support the chord in the middle position or web members is prohibited, otherwise the boom sections will be damaged

5.8.2 Assembling main boom

After unloading the basic machine, unload each boom section from the transport vehicle via mounting cylinder on A-frame, and then attach such boom components as main boom head, main boom intermediate sections according to actual working requirement.

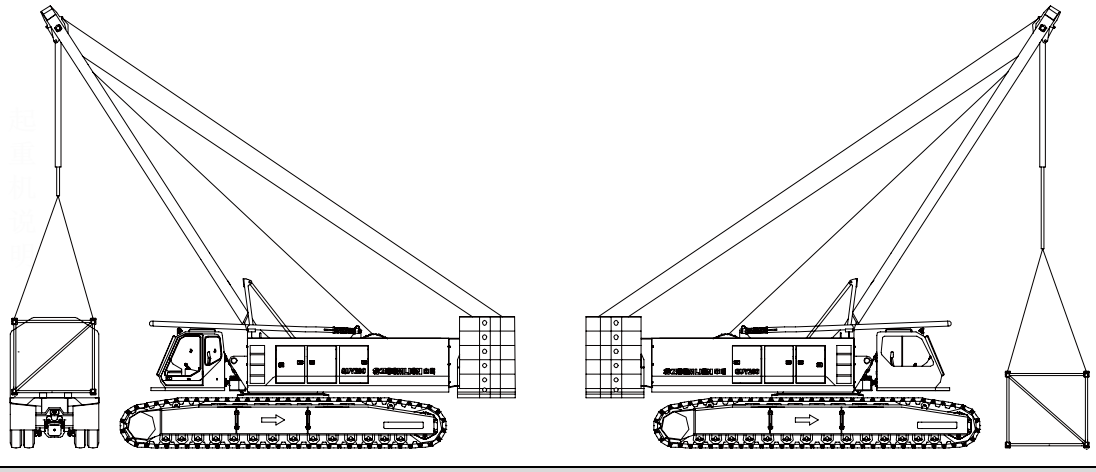


Figure 5-86 Assembling main boom

5.8.2.1 Pinning on main boom pivot section

a) After unloading the main boom pivot section from the transport vehicle, connect it to the mounting cylinder on A-frame with two lifting chains.

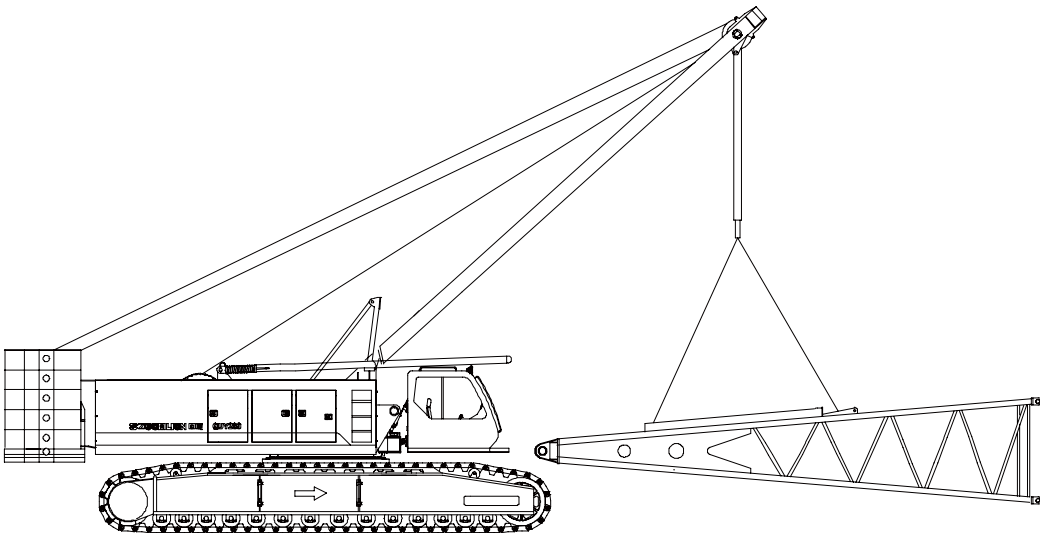


Figure 5-87 Pinning on main boom pivot section

b) Adjust A-frame to proper position by moving right control lever (30) to left or right.
Turn "self-assembly & dismantling" switch (65) on the right control panel to the right.
Adjust the mounting cylinder on A-frame by pushing right control lever (30) forwards or backwards.

c) Align the main boom pivot section with connecting points on slewing table.

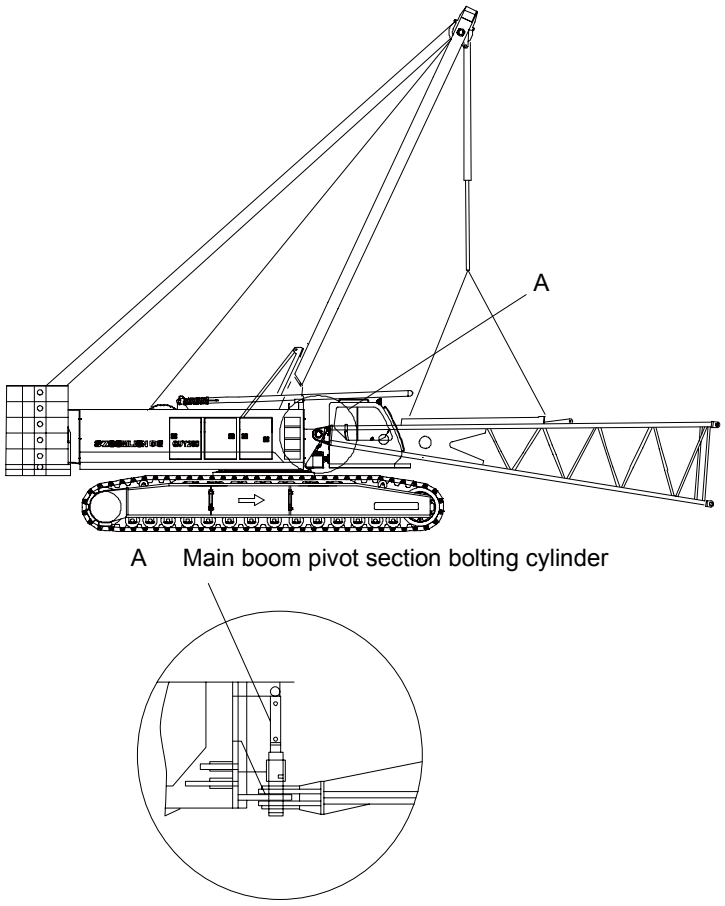


Figure 5-88 Main boom pivot section bolting cylinder

d) Activate the "pivot section bolting cylinder" switch on auxiliary remote control box to extend the pivot section bolting cylinder, and then fit the locking plate. In this way, the main boom pivot section is pinned on.

e) Remove the lifting chains from the pivot section.

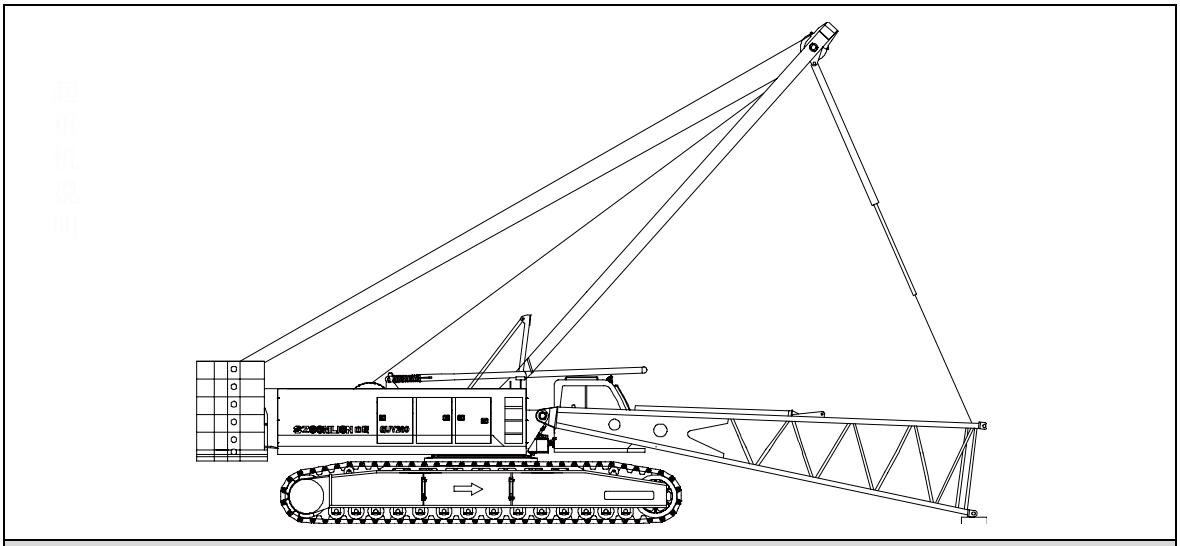


Figure 5-89 Pin main boom pivot section bolting cylinder to pivot section

5.8.2.2 Attaching main boom sections

a) Preassemble main boom sections according to Section 5.7.1 "heavy duty boom". For detailed operation, refer to the following methods:

– Pin main boom intermediate sections of 3 m, 6 m or 9 m to each other in the following sequence:

Position two intermediate sections to be pinned in such a way that the connection holes in one intermediate section are precisely aligned with those in the other intermediate section (see the following figure).

Join them with double tapered pins (1) and secure on both sides with retaining springs (2).

Join the other connecting holes in the same way.

– Pin main boom head to the assembled intermediate sections in the following sequence:

Position the assembled intermediate section in such a way that the upper connecting holes in it are aligned with those in the main boom head.

Join the upper connecting holes with double tapered pins (3) and secure on both sides with retaining springs (2).

Join the lower connecting holes in the same way.

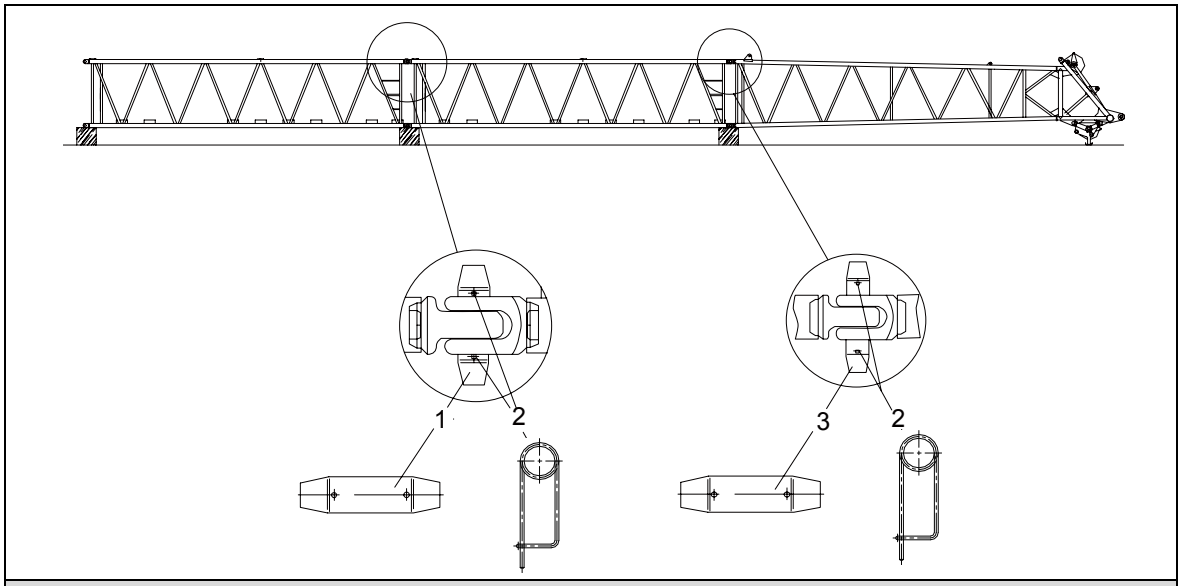
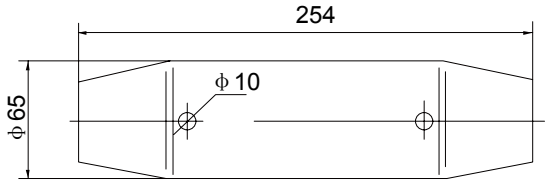
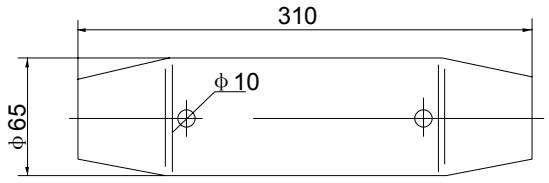


Figure 5-90 Attaching main boom sections

Table 5-21 Connecting parts of main boom section

Part No.	Description	Illustration (mm)
1	Double tapered pin	
2	Retaining spring	
3	Double tapered pin	

b) Attaching the preassembled main boom to main boom pivot section.

– Slowly drive the basic machine with main boom pivot section attached up to the preassembled main boom.

– Adjust the A-frame position by moving right control lever (30) left or right to make the upper connecting holes in adjacent main boom intermediate section are aligned with the connecting holes in pivot section.
– Join the upper connecting holes with double tapered pins (1) and secure properly on both sides with retaining springs (2).
– Adjust the mounting cylinder on A-frame until the lower connection holes in pivot section are aligned with those in adjacent main boom intermediate section.
– Join the lower connecting holes with double tapered pins (1) and secure on both sides with retaining springs (2).
– Disconnect the main boom pivot section from mounting cylinder on A-frame by removing the lifting chain.

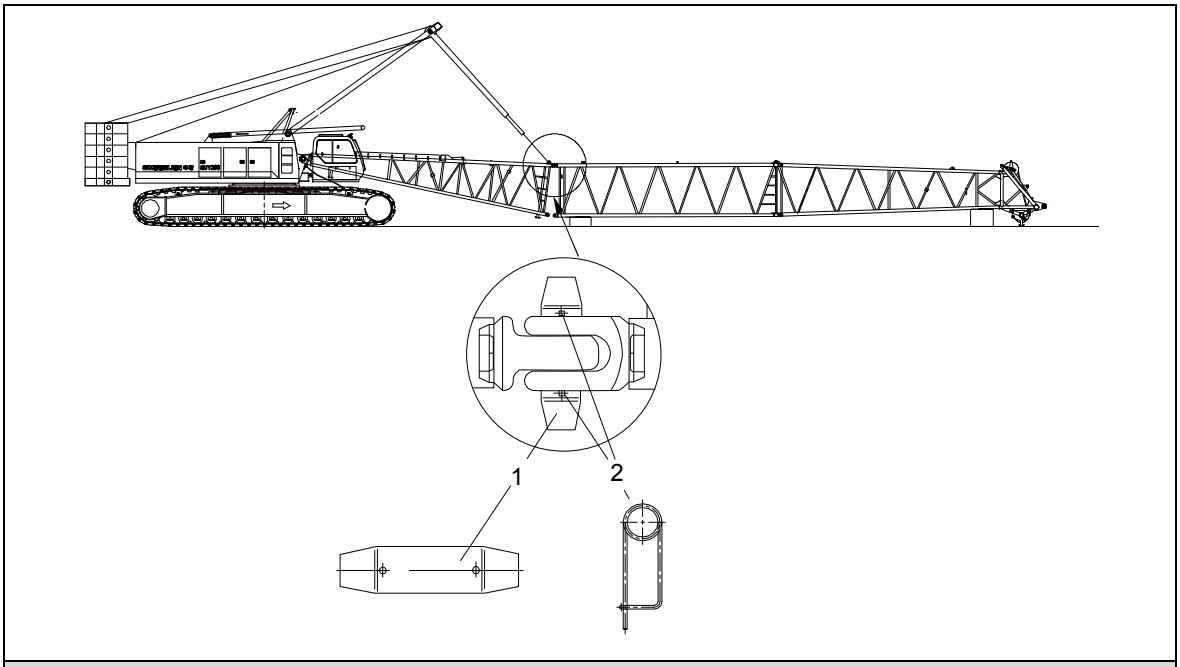
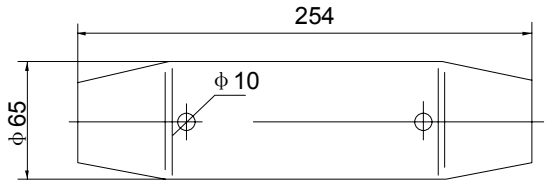


Figure 5-91 Attaching the preassembled main boom to main boom pivot section

Table 5-22 Connecting parts of pivot section

Part No.	Description	Illustration (mm)
1	Double tapered pin	

2	Retaining spring	

CAUTION

(1) It is prohibited to put hand or fingers into the connecting hole during installation.

(2) While the connecting pin is being removed, no person is allowed to stand beneath or in the boom.

(3) It is prohibited to climb up the boom, and stand or walk on the boom.

(4) Utilize a ladder or other similar tools to carry out assembly operation.

5.8.2.3 Assembling main boom anchoring rods and reeving in rope

a) Assembling main boom anchoring rods:

Connect the anchoring rods on A-frame and on main boom pivot section together, and then attach anchoring rods of main boom intermediate section and anchoring rods of main boom head to each other by pin spindles and secure them with retaining pins. (The arrangement and combination of main boom anchoring rods are specified in Section 5.7.1.3).

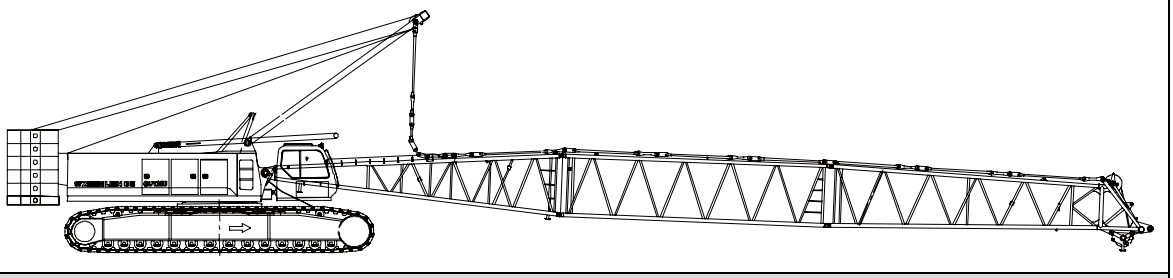


Figure 5-92 Assembling main boom anchoring rods

b) Reeving hoisting winch 2 in:

1) Move right control lever (30) to the left to wind the derricking rope until the main boom head is raised to a proper position a littler higher than the load hook, and then position the load hook directly under the main boom head.

2) Turn the switch (60) on right control panel to right or push down the "reeving winch" on the remote control box to unwind the rope of reeving winch until it approaches the load hook. Reeve the rope of reeving winch in the reverse direction between the load hook and the rope pulleys on main boom head and then pull it to tail-end of main boom (for the details, please refer to Section 4.5.3.3 "Operation of reeving winch" and Section 4.5.7 "Remote control box").

3) Push left control lever forwards to unwind hoisting rope for winch 2 until it reaches

the tail-end of main boom. Attach rope end point of reeving winch to hoisting rope for winch 1 with rope lock (see the following figure).

4) Turn the switch (60) on right control panel to left or push up the "reeving winch" on the remote control box to wind the rope of reeving winch, simultaneously unwind the hoisting rope for winch 2. Guided by the rope of reeving winch, the hoisting rope for winch 2 will then be reeved between the rope pulley and load hook. After that, stop operation on winch 2 and reeving winch, detach the rope lock. Finally, spool up the reeve winch to wind the rope end point onto the reeving winch.

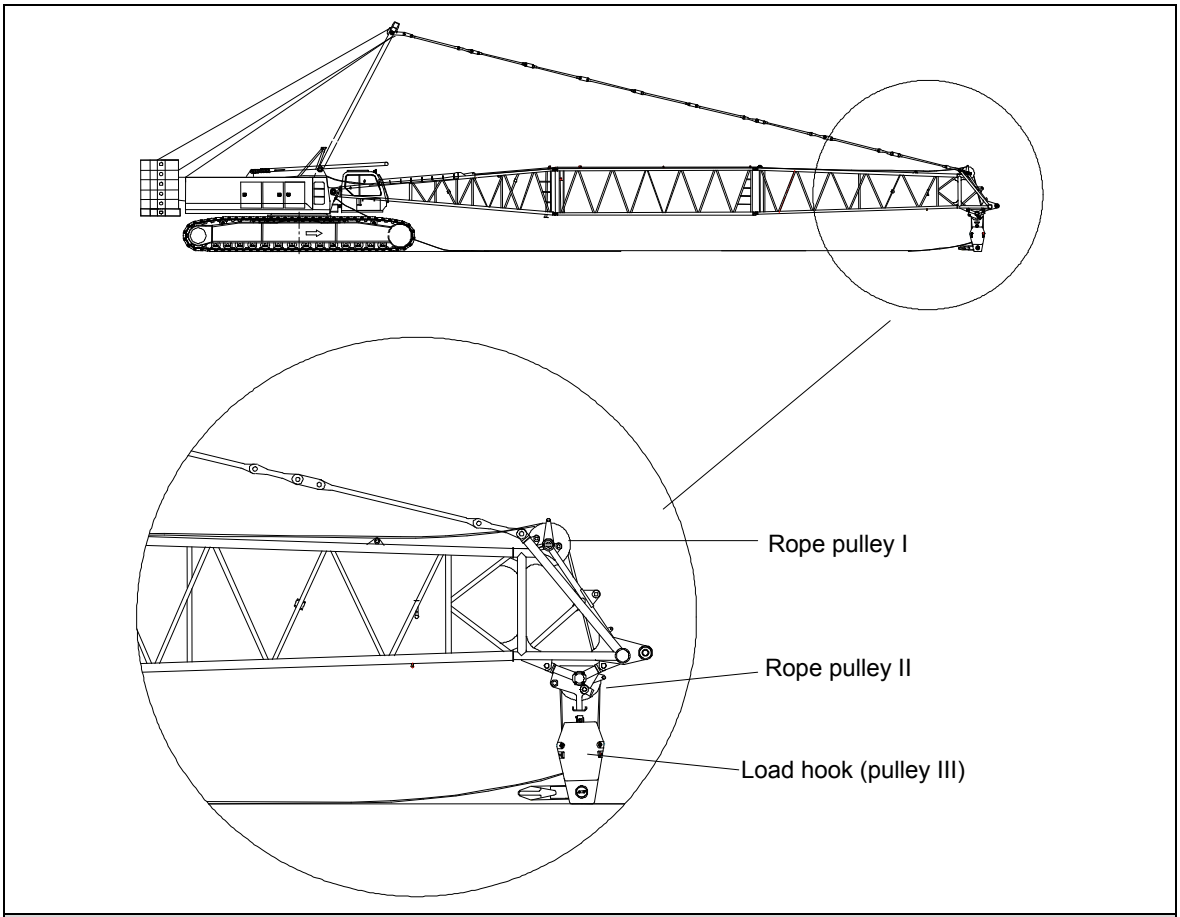


Figure 5-93 Reeving 260 t load hook (20 reevings)

Hoisting rope reeving method for 260 t load hook, for example, will be detailed here:

– According to the method stipulated in Section 4.6.1.1 "hoisting rope reeving for winch 2", reeve the rope of reeving winch in the reverse direction between rope pulleys III and rope pulleys II on main boom head and then through the rope pulleys I.

– Attach rope end point of reeving winch to hoisting rope for winch 2 with rope lock.

– Wind the rope of reeving winch and simultaneously unwind the hoisting rope for winch 2. Guided by the rope of reeving winch, the hoisting rope for winch 2 will then be reeved in desired direction between the rope pulleys and load hook (see the following figures.).

Rope reeving plans (the hoisting rope is led by rope of reeving winch):

CAUTION

(1) Working personnel who guides the wire rope should take great care to prevent against falling down when walking on the boom frame, otherwise, serious accident may occur.

(2) The rope unwinding speed from winch 2 must be faster than rope-winding speed onto reeving winch.

5.8.3 Connect electrics to main boom

5.8.3.1 Electrical line connections

CAUTION

The following figure shows the connected electrical parts on main boom. Before erecting the boom, make sure that all electrical lines are connected and safety measures are checked.

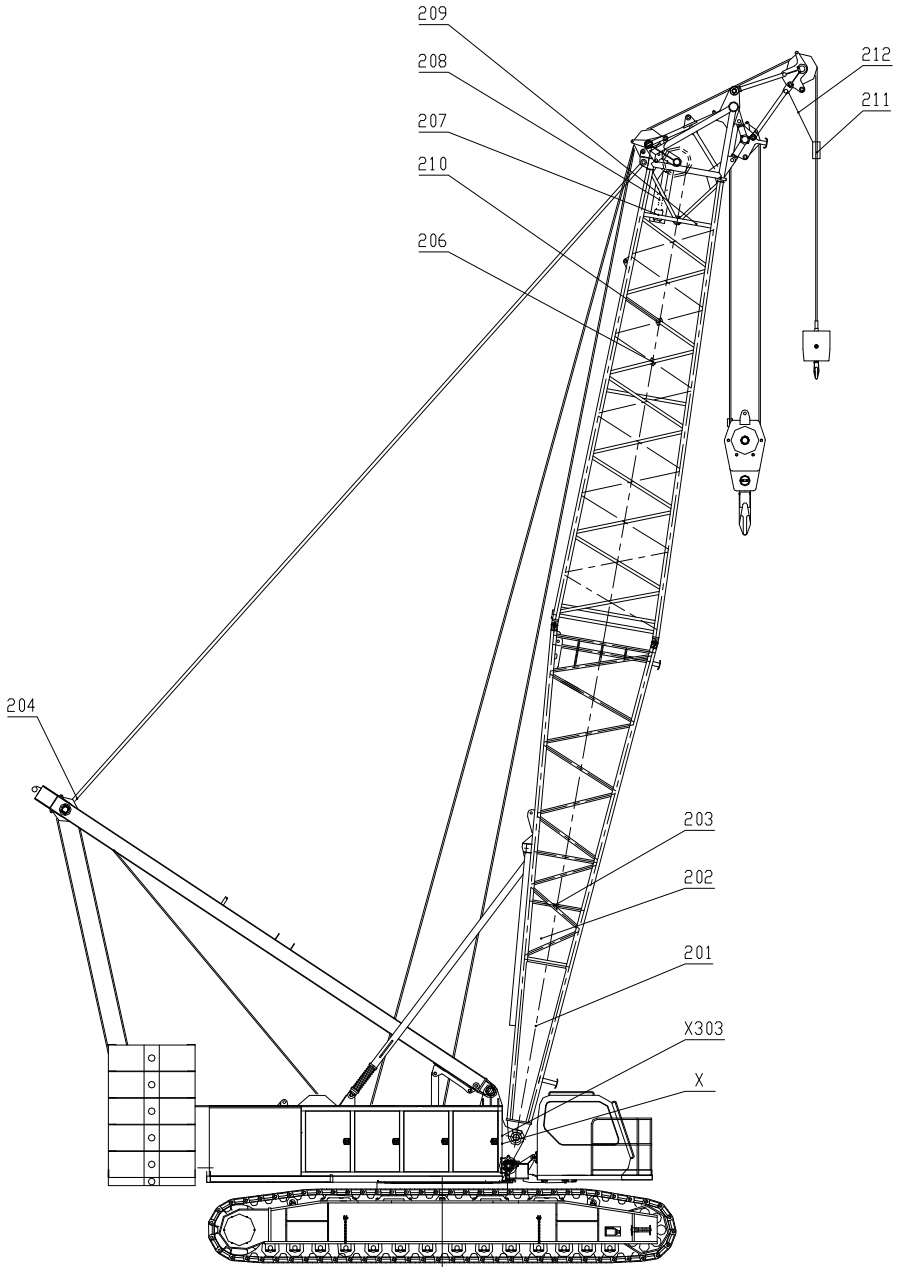


Figure 5-94 Connect electrics to main boom

Table 5-23 Layout of electrical parts on main boom

Part No.	Description	Installation position
X303	Socket ,16-hole	In the front of slewing table
X	Aviation socket	In the front of slewing table
201	Angle sensor	On main boom pivot section
202	Cable drum 1	On main boom pivot section (if safety monitoring system is used)
203	Cable drum 2	On main boom pivot section
204	Main boom tension force	On anchoring rod of A-frame
205	Anemometer	On main boom head
206	Warning lamp(1)	On main boom head
207	Main boom junction box	On main boom head
208	Control box for Load Moment Limiter on luffing jib	On main boom head(if luffing jib is used)
209	Digital Hi-Definition network ballhead camera	On main boom head (if safety monitoring system is used)
210	Cable drum 3	On main boom head(if luffing jib or fixed jib is
211	Hoisting limit switch weight	Connected with hoisting rope on main boom
212	Hoisting limit switch	Boom head, connected with hoisting limit switch weight

a) Connecting electrics to main boom pivot section

Insert the X303 cable plug on one end of the connecting cable on main boom pivot section into the X303 socket in the front of slewing table, and insert the cable plug on the other end into socket of cable drum 2.

b) Connecting electrics to main boom head

Unplug the cable plug of cable drum 2, pull the cable plug along the main boom and then insert it into the square socket on main boom junction box (FXH-5). Establish the electrical connections from the main boom junction box to associated components respectively.

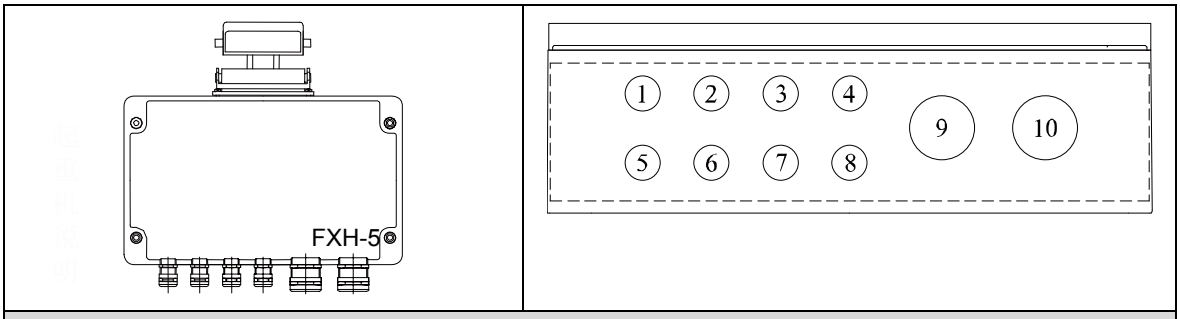


Figure 5-95 Junction box

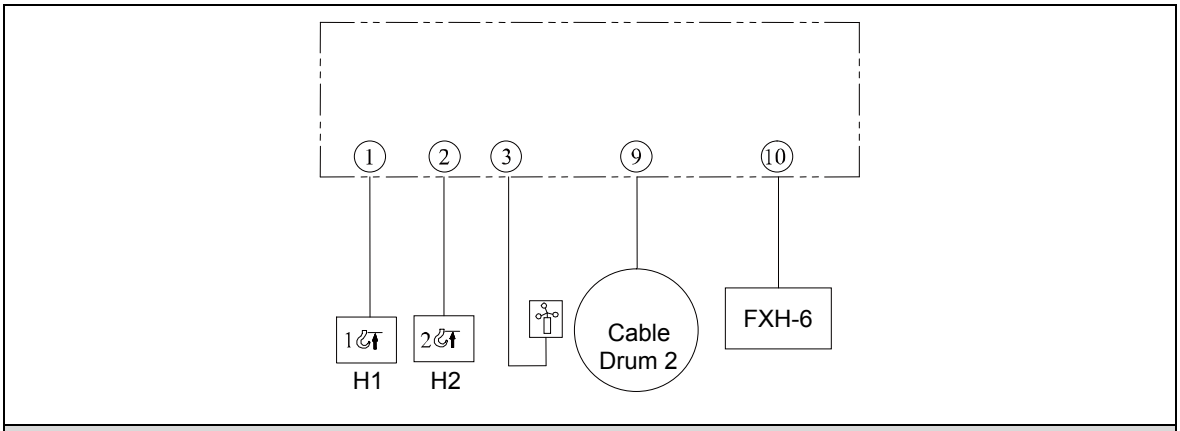


Figure 5-96 Connecting electrics to junction box

Description of sockets on main boom junction box (FXH-5):

The main boom junction box, installed on main boom head, has 10 input and output sockets in total, marked with from 1 to 10. Each socket on this junction box is described below:

Table 5-24 Main boom junction box wiring

Socket No.	Function
1	Connected to hoisting limiter switch for H1
2	Connected to anemometer
3	Hoisting limiter switch short circuit
4	Not assigned
5	Connected to hoisting limiter switch for H2
6	Not assigned
7	Not assigned
8	Not assigned

Socket No.	Function
9	Connected to cable drum 3
10	Connected to junction box 6 (when luffing jib is used) For main boom configuration, if all cables have been connected, we should fix the cables on the socket on main boom head to prevent short-circuit.

Establish electric connection from the main boom junction box to associated switches or electrical elements according to the table above.

CAUTION

For the dummy socket, the protective cover must be closed.

c) Electrical connection to Load Moment Limiter
See the *Installation Guide & User's Manual for Load Moment Limiter.*

5.8.3.2 Checks before erecting the boom

a) Check warning lamp on main boom head
Warning lamp here is a kind of solar lamp. Turn the aviation warning lamp switch to position ON, then the warning lamp charges in daylight and illuminates at light.

b) Check the anemometer
Rotate the vane of anemometer to check whether the wind velocity shown on the display in the operator's cab is normal.

c) Check hoisting limit switch for H1
Support and hold the hoisting limit switch weight for H1 to ensure that the switch is triggered, and then check that the Icon "upper limit switch on H1" on the screen will flash and the buzzer will sound.

d) Check hoisting limit switch for H2 (when the tip boom is used)
Support and hold the hoisting limit switch weight for H2 to ensure that the switch is triggered, and then check that the Icon "upper limit switch on H2" on the screen will flash and the buzzer will sound.

5.8.4 Erecting main boom

5.8.4.1 Requirements for erecting main boom

a) The crane is properly supported and level.
b) The required counterweight plates have been attached.
c) Select appropriate boom configurations according to the load to be lifted and the load capacity charts, ensure that boom sections have been connected and secured.
d) All limit switches have been correctly fitted and are fully operational.
e) All pinned connections have been secured.

f) The hoisting rope has been correctly placed in the rope pulleys and prevented from jumping out (from rope groove) using rope guard tube.

g) No person is present in the danger zone.

h) There are no loose parts on main boom.

i) In winter, the main boom, fixed jib and associated components (limit switches, rope drums, warning lamp, anemometer etc.) must be kept free of ice and snow.

CAUTION

Incorrectly fitted or faulty limit switches and falling parts (pins, retaining pins, ice etc.) can cause injury.

5.8.4.2. Erecting main boom

a) Move right control lever (30) to the left to spool up main boom derricking winch (E), and the main boom anchoring rods will be tensioned gradually.

Note:

During the erecting process, to prevent the load hook from being dragged on the ground, while moving right control lever (30) in 45° direction, until main boom reaches 30° position. When the main boom reaches 30° position, the "assembly mode" will automatically be changed into "operating mode". Then return right control lever (30) to neutral position.

b) Continue to move right control lever (30) to left until main boom is erected to required position.

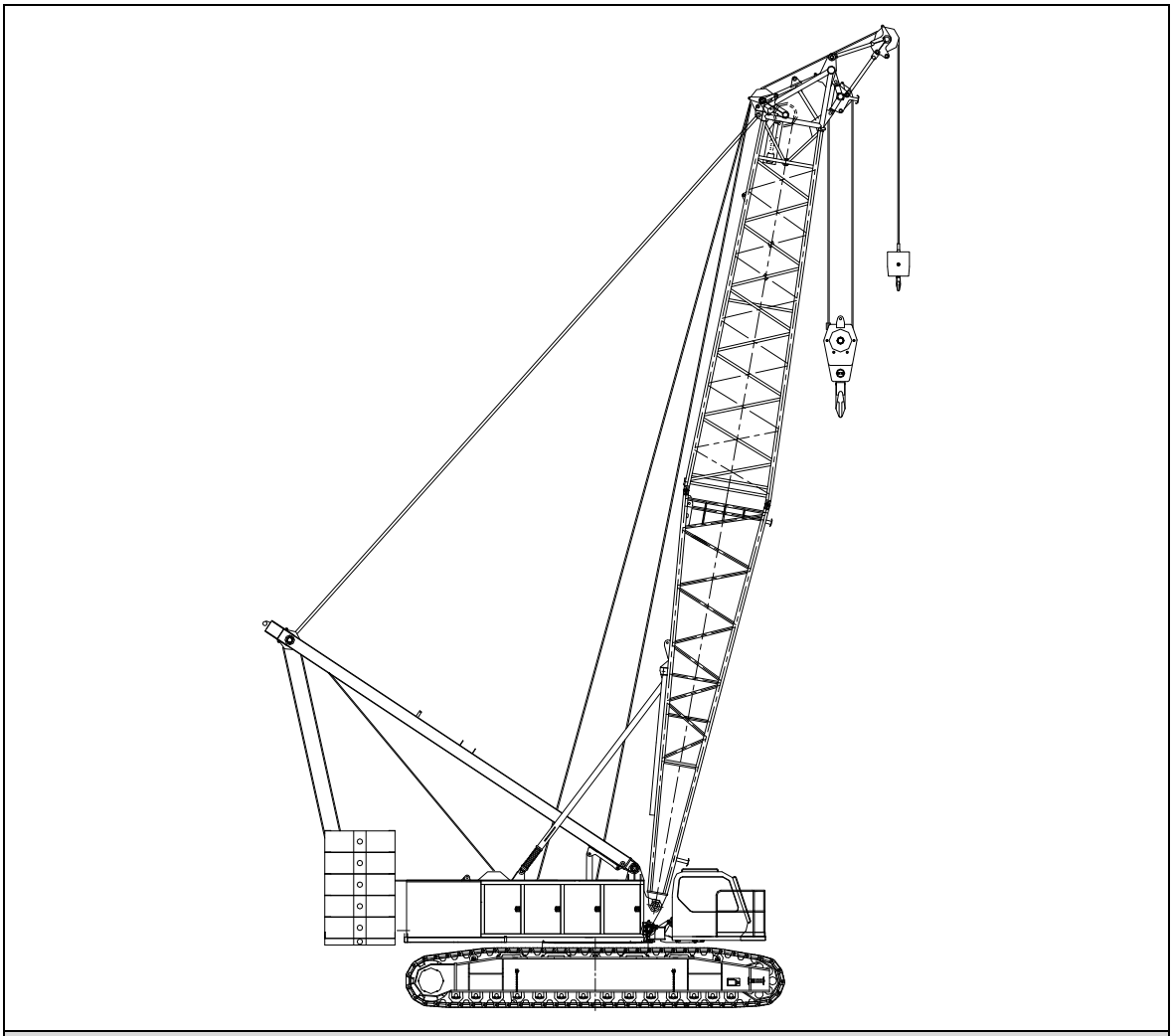


Figure 5-97 Erecting main boom

CAUTION

(1) The main boom angle can be changed between 0° to 86°. When main boom is raised to 80°, acoustic warning will be given out, and main boom can still be derricked up at the time, but the derricking-up speed is reduced to ensure safe operation of the crane. And when main boom is raised to 85°, the movement of derricking boom up will be switched off automatically along with acoustic warning being sent out, but the main boom can still be derricked up by turning the "bypass key switch" to "bypass" position. When main boom is raised to 86° position, the movement of derricking boom up will be switched off automatically along with acoustic warning being sent out. Under this condition, however, even though the "bypass key switch" is turned to "bypass" position, the main boom cannot be raised any more.

(2) Always monitor the wire rope in process of erecting main boom to make sure that the wire rope is kept in the rope groove all the time.

The boom-raising movement should be performed slowly and stably. And during the operation, the crane operator must observe the data shown on the display, while other workers must observe the surrounding areas for potential dangers.

(3) Standing beneath the boom frame is prohibited.

(4) Working radius stipulated in the Load Capacity Charts should be adhered to, even if no load is attached on the load hook! Non-observance of it is likely to cause the crane turnover.

5.8.5 Lowering and disassembling main boom

5.8.5.1 Lowering main boom

a) Move right control lever (30) to the right to reel derricking winch off, and then the main boom will be lowered gradually. When the main boom is lowered to 30° position, return the control lever (30) to neutral position.

b) Push left control lever (20) forwards to reel off hoisting winch 2 to lower stably the load hook on the ground.

c) Move right control lever (30) to the right until the main boom head comes into contact with the ground. Return right control lever (30) to neutral position.

(1) In the process of lowering main boom, the hoisting winch 2 must be reeled off to avoid the hook's collision with the pulley head.

(2) Standing within danger area of crane during operation is prohibited.

(3) The boom-lowering movement should be performed slowly and stably. And during the operation, the crane operator must observe the data shown on the display, while other workers must observe the surrounding areas for potential dangers.

5.8.5.2 Dismantling boom sections and anchoring rods

a) After the anchoring rods are lowered down on the anchoring rod supports on the relevant boom sections, remove the pin spindles from anchoring rods, and then secure them on anchoring rod supports with pin spindles for transportation.

b) Separate boom sections using self-assembly system or an auxiliary crane.

c) Lower A-frame down on the slewing table.

(1) Dismantling is carried out in the reverse order to assembly.
Warnings and safety precautions for assembly should be followed during dismantling operation.

5.9 Assembly and dismantling of main boom with luffing jib (SW)

CAUTION

(1) Before operation, select the "main boom with luffing jib" configuration on the LCD screen of load moment limiter.

(2) The luffing jib can be derricked up or down by H1 winch

Push right control lever (30) forwards or backwards to derrick the luffing jib down or up.

5.9.1 Preparations for assembling luffing jib

a) Choose appropriate boom combination and relevant anchoring rods combination according to operational planning and load capacity charts.

b) Choose the correct load hook and rope reevings for the load to be lifted.

c) Main boom is installed.

d) The required counterweight plates have been assembled.

e) The safety load indicator system of Load Moment Limiter is set according to the data given in the load capacity charts.

f) Make sure that an auxiliary crane is available and the operating personnel get full prepared and qualified for operation.

g) Change the "operating mode" to "assembly mode".

CAUTION

(1) After the "operating mode" is changed to "assembly mode", all safety devices built in the crane will be deactivated, the assembly, dismantling of the machine should therefore be carried out with utmost care.

(2) For assembly work on the crane, a safety assembly working platform should be used. Improvisations are prohibited. Otherwise, there is a danger of falling down.

(3) Any other boom configurations and anchoring rod combination that have not been stipulated in the operating manual are prohibited.

(4) Always bolt on the shorter intermediate sections first!

(5) If the main boom head is lifted by an auxiliary crane, at least two pieces of lifting chain with a breaking force≥15t should be used.

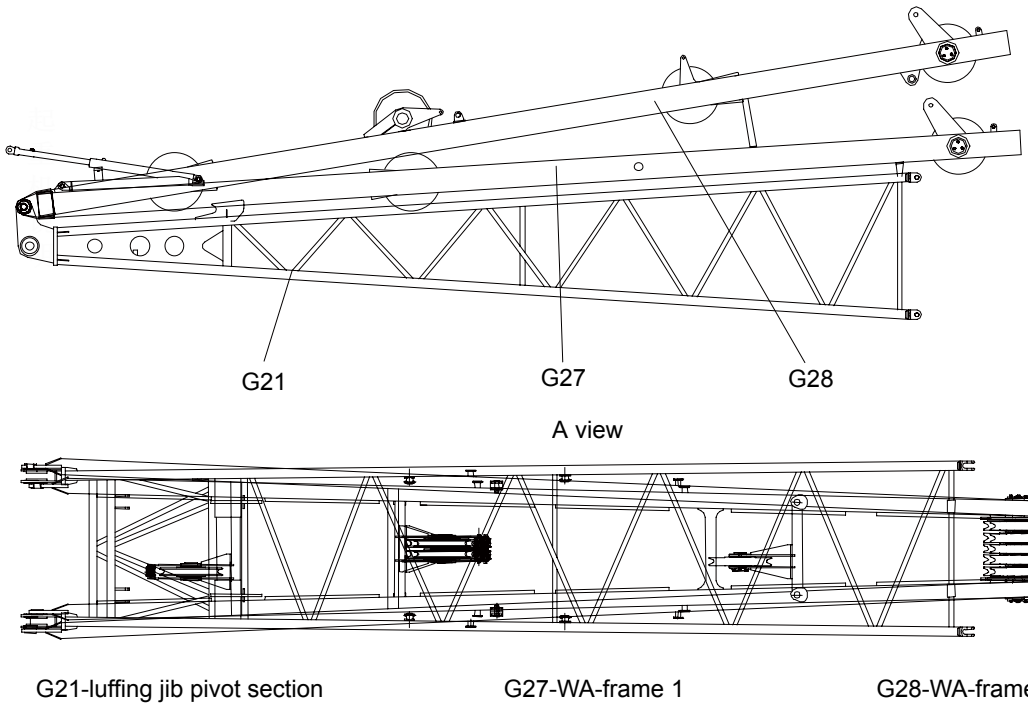
(6) Do not stand on the lattice boom when it is assembled.

(7) The use of square timbers or pad block to support the chord in the middle position or web members is prohibited, otherwise the boom sections will be damaged.

(8) Do not stand beneath the boom when it is being pinned or unpinned.

5.9.2 Assembling main boom with luffing jib

During transportation, the luffing jib pivot section (G21), WA-frame 1 (G27) and WA-frame 2 (G28) are assembled together. See the following diagram.



G21-luffing jib pivot section G27-WA-frame 1 G28-WA-frame 2

Figure 5-98 Luffing jib pivot section transportation

a) Assemble required main boom sections in accordance with Section 5.7.1.

b) Lift the luffing jib pivot section (together with WA-frames 1 and 2) with an auxiliary crane and swing to main boom head.

Attach the luffing jib pivot section to the main boom head from above.

Continue lowering the luffing jib pivot section until it can be pinned to main boom head.

Pin the luffing jib pivot piece to main boom head with pin spindles (24) and secure with bolts (21), washer (22), retaining plates (23) and retaining springs (25). Apply grease with oil cup (26). (See the following figure.)

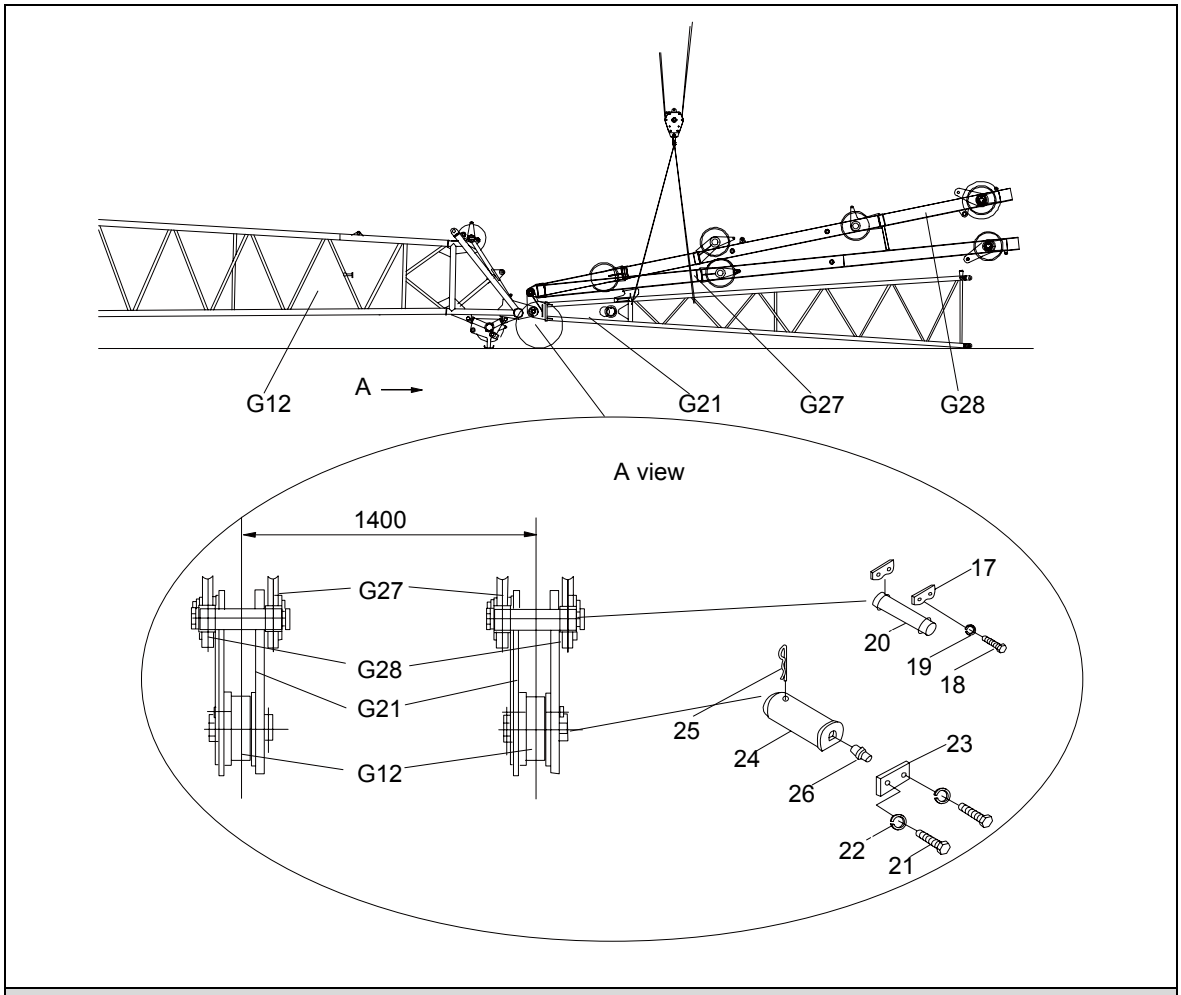
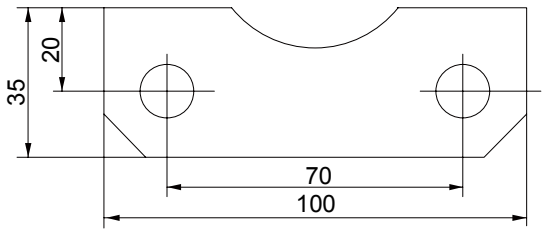
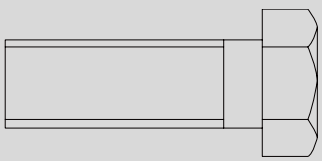
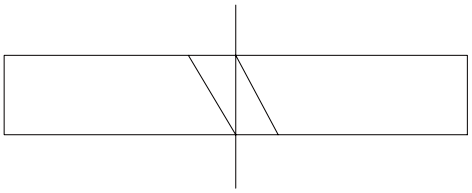
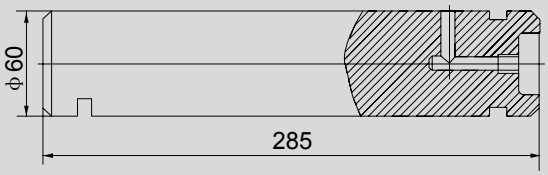
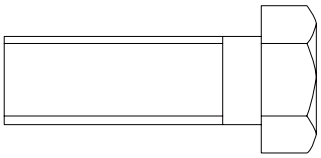
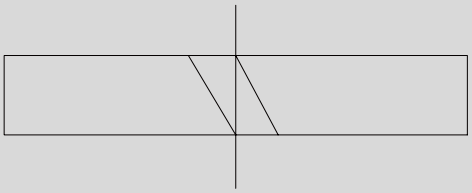
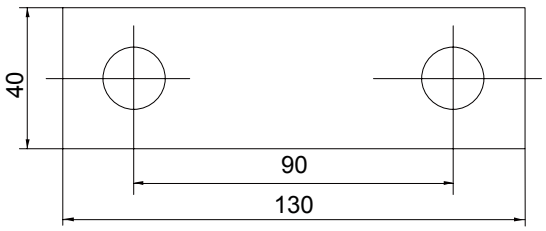
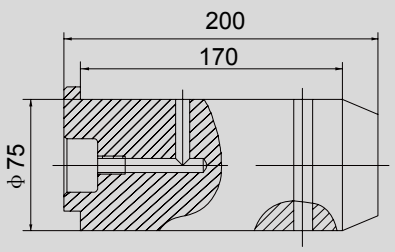
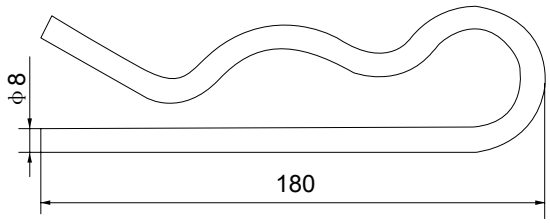


Figure 5-99 Assembly of luffing jib pivot section

Table 5-25 Connecting parts of luffing jib pivot section to main boom head

Part No.	Description	Illustration (mm)
17	Shaft end retaining plate	
18	Bolt	 GB/T5783-2000（M12×35-8.8）

Part No.	Description	Illustration (mm)
19	Washer	 GB/T93-1987（12）
20	Pin spindle	
21	Bolt	 GB/T5783-2000（M16×55-8.8）
22	Washer	 GB/T93-1987（16）
23	Retaining plate	
24	Pin spindle	
25	Retaining spring	

c) According to actual condition, choose appropriate numbers of luffing jib intermediate sections with 3 m (G23), 6 m (G24) and 9 m (G25) lengths, and then pin them together. All luffing jib intermediate sections are connected with double tapered pins (1), secured on both sides with retaining springs (2) (see the following figure).

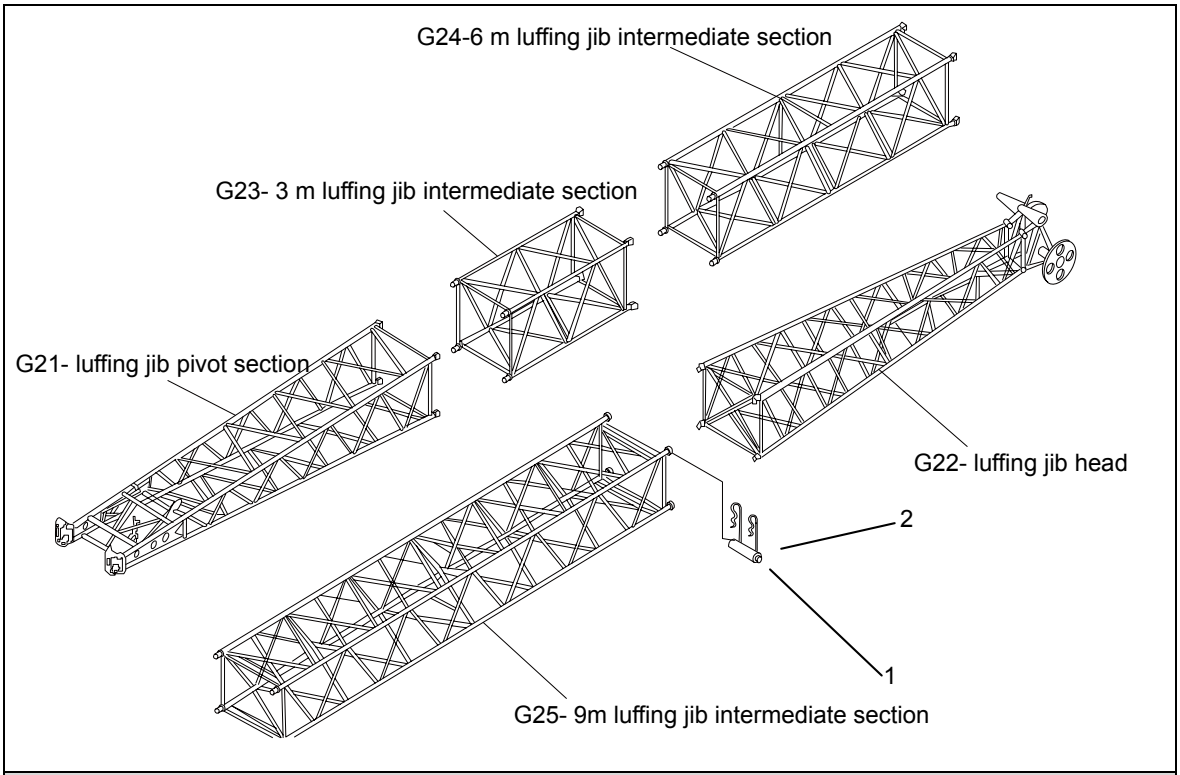
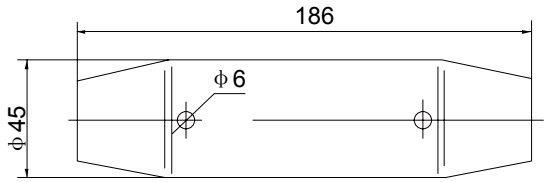


Figure 5-100 Connecting of luffing jib section

Connecting parts of luffing jib section is shown as follows:

Table 5-26 Connecting parts of luffing jib section

Part No.	Description	Illustration (mm)
1	Double tapered pin	
2	Retaining spring	

After the attachment of luffing jib is completed, preassemble partial anchoring rods to WA-frame 2 (for the part number appear in the following figure, please refer to Section 5.7.5.2-b "luffing jib rear anchoring rods") and pin adjacent anchoring rods on the jib intermediate sections to one another.

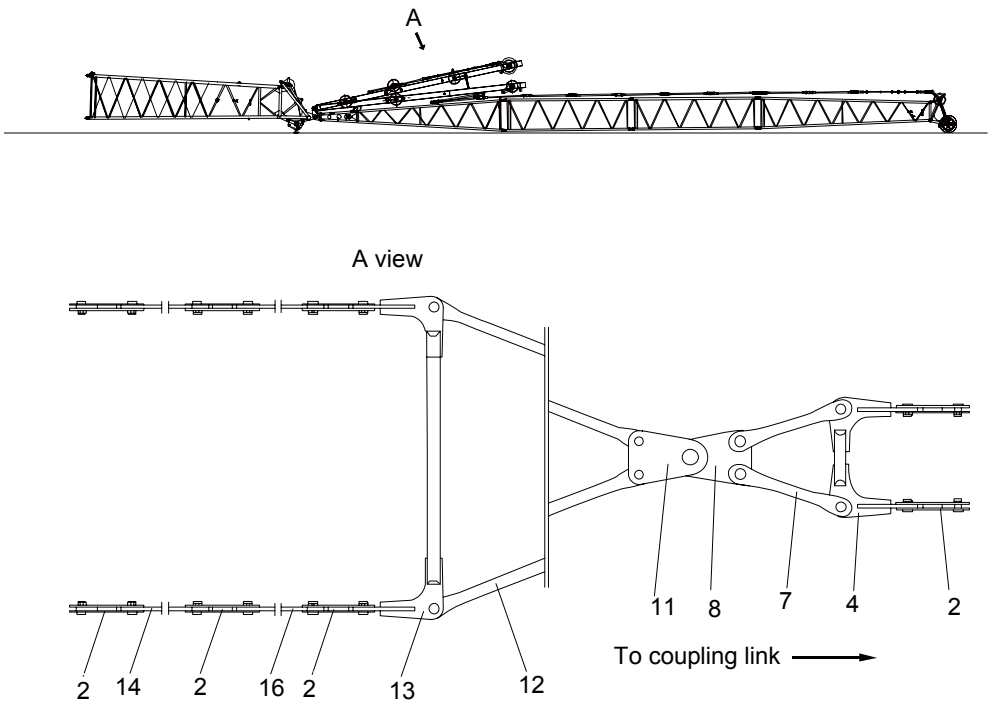


Figure 5-101 Anchoring rod connection with luffing jib

d) Assemble the tilting-back support of luffing jib and tilting-back support of WA-frame 2. Firstly ,connect the tilting-back support of luffing jib to main boom head with pin spindle (1) and secure it with cotter pin (2). And then connect the two ends of strut rod respectively to tilting-back support of luffing jib and main boom head with pin spindles (3) and (5), and secure with cotter pins (4) and (6). Finally, pin one end of the tilting-back support of WA-frame 2 to WA-frame 2 with pin spindle (7) and secure with cotter pin (8).

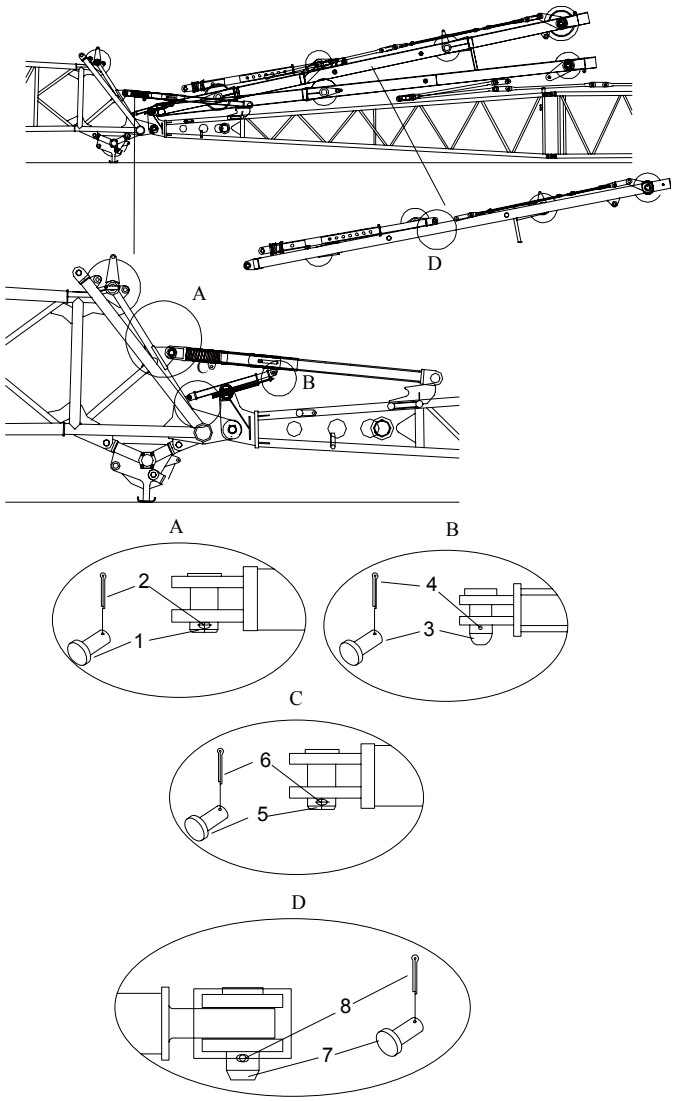
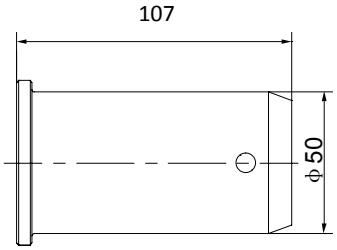
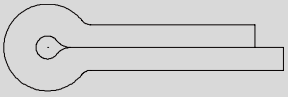
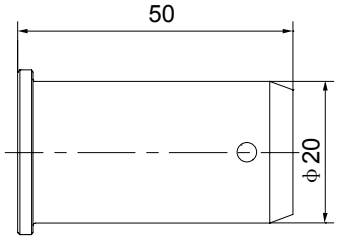
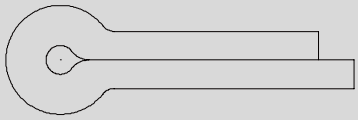
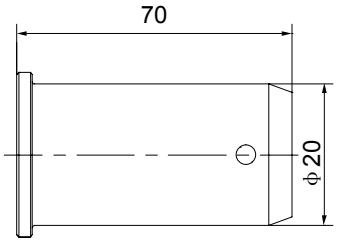
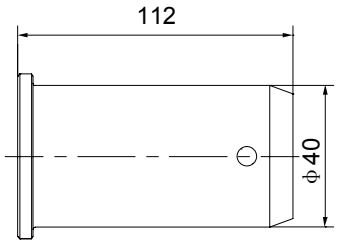
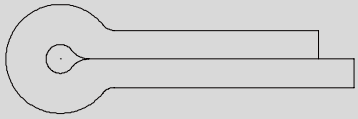


Figure 5-102 Assembly of the tilting-back support of luffing jib

Table 5-27 Connecting parts of luffing jib tilting-back support

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Cotter pin	 GB/T91-2000（10×80）

Part No.	Description	Illustration (mm)
3	Pin spindle	
4	Cotter pin	 GB/T91-2000（2.5×30）
5	Pin spindle	
6	Cotter pin	 GB/T91-2000（2.5×30）
7	Pin spindle	
8	Cotter pin	 GB/T91-2000（8×60）

e) Reeving luffing rope in

1) Turn the switch (60) to right or push down the "reeving winch" on the remote control box to unwind the rope of reeving winch.

2) Reeve the rope of reeving winch in the reverse direction between the load hook and the rope pulley on luffing jib head and then pull it to the tail-end of main boom pivot section. Attach rope end point of reeving winch to luffing rope with rope lock.

3) Turn the switch (60) to left or push up the "reeving winch" on the remote control box to wind the rope of reeving winch, while simultaneously moving right control lever (30) forwards to unwind the luffing rope.

CAUTION

(1) Before operation, the operator must choose the correct boom configuration on the LCD screen of load moment limiter and then turn the corresponding switches on the right control panel to required position to determine the function of control lever according to the current boom configuration of the crane, for example, whether the crane has luffing jib derricking winch.

(2) Working personnel who guides the wire rope should take great care to prevent against falling down when walking on the boom frame, otherwise, serious accident may occur.

(3) The rope unwinding speed from winch 1 must be faster than rope winding speed on reeving winch.

4) Guided by the rope of reeving winch, the luffing rope will then reach luffing jib head. When the luffing rope is unwound long enough, reeve it between the rope pulley on luffing jib head and load hook according to the method given in Section 4.6.6 "luffing rope reeving".

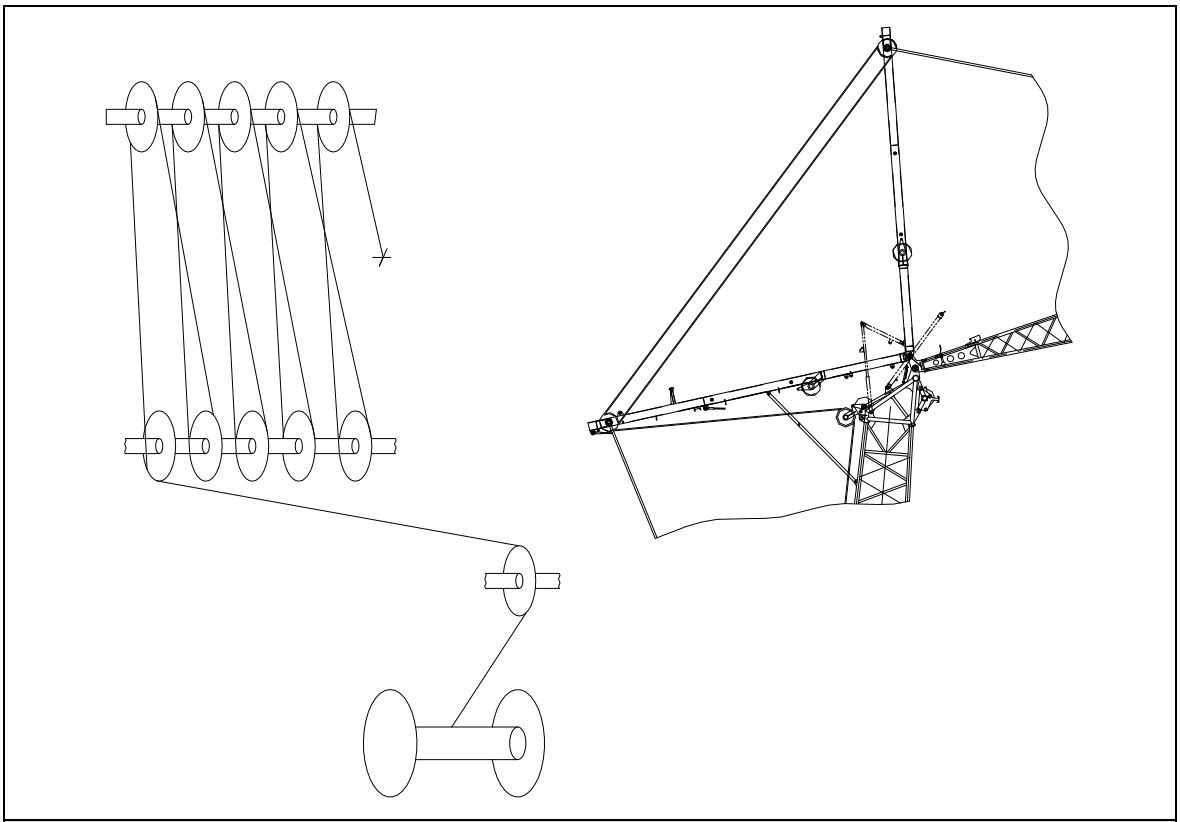


Figure 5-103 Luffing rope reeving

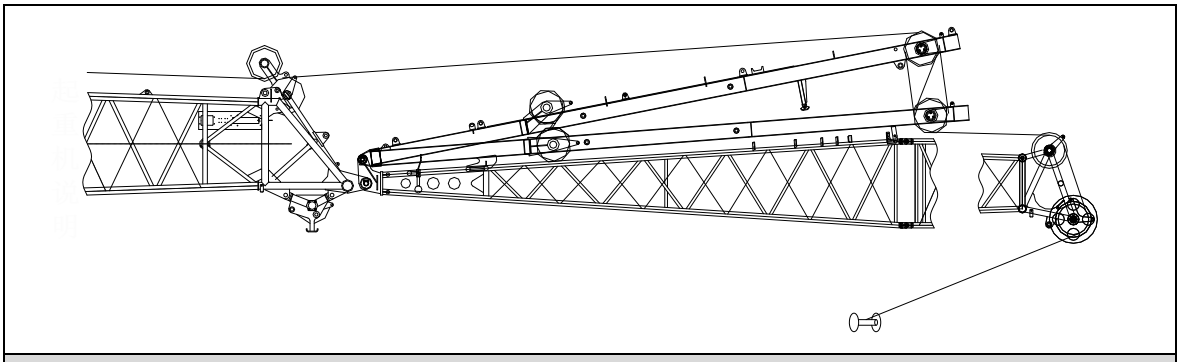


Figure 5-104 Rope of reeving winchreeving

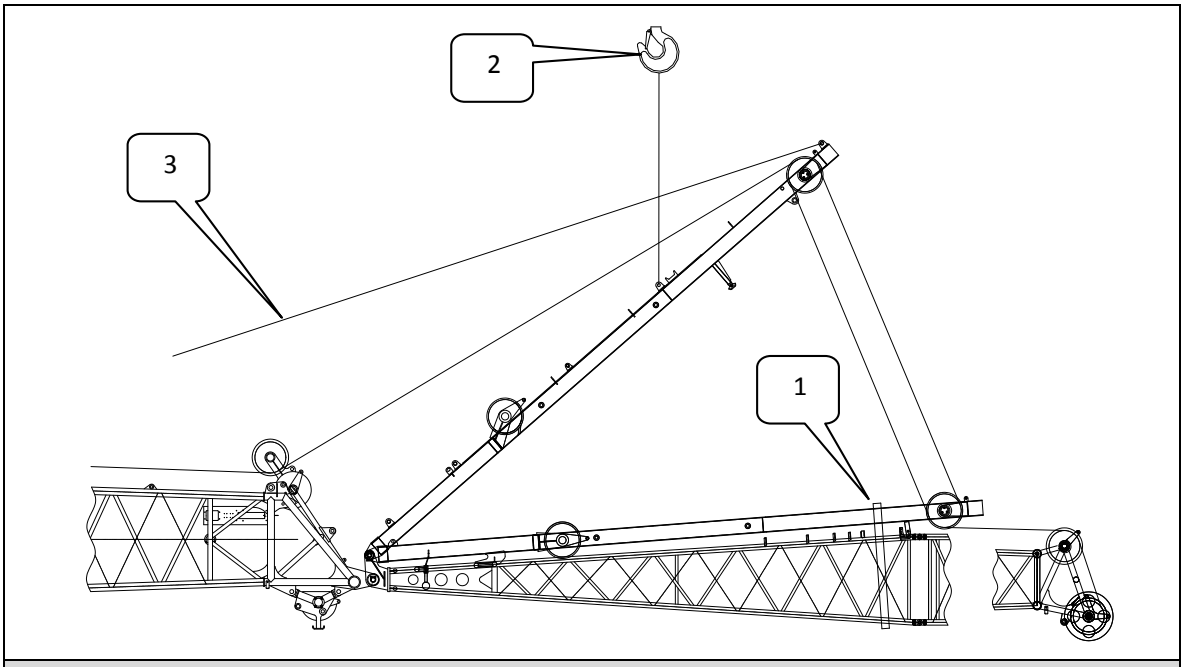


Figure 5-105 Luffing rope reeving

f) The process of luffing rope reeving is as follows:

1) Before operation, tie the WA-frame 1 to luffing jib with an attachment chain at Position 1 in order to prevent the WA-frame 2 from tilting over.
2) At Position 2, lift the WA-frame 1 by an auxiliary crane.
3) At Position 3, connect to the rope from winch H2 with an attachment chain.
4) During the process of luffing rope reeving, the auxiliary crane slowly lifts. Meanwhile, move the control lever to slowly unwind the luffing rope form luffing winch.
5) Once the WA-frame 2 is raised about 60°, tilt back it via winch H2. During the process, remember to unwind the luffing rope synchronously

CAUTION

During this operation process, the auxiliary lifting force and the pulling force of winch H2 cannot be too large. Otherwise, the boom, the jib as well as the A-frame is liable to damage. Meanwhile, the luffing jib cannot lift off the ground.

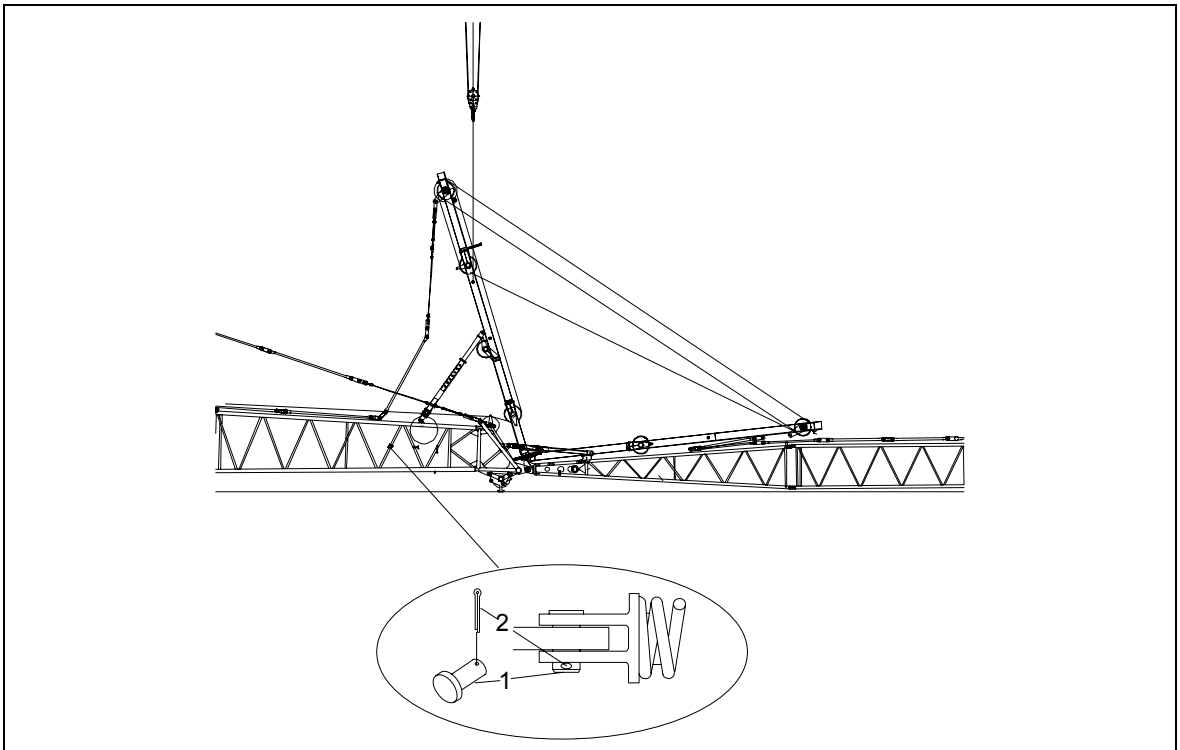
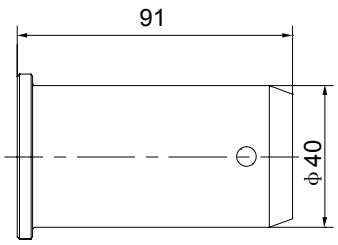


Figure 5-106 Rear tilting-back support of luffing jib

Table 5-28 Connecting parts

Part No.	Description	Illustration (mm)
1	Pin spinlde	 GB/T882-1986（B40×85）
2	Cotter pin	 GB/T91-2000（6.3×50）

g) Remove the auxiliary crane

– Push right control lever (30) backwards to wind the luffing rope until the luffing jib rear anchoring rod is tensioned slightly.

– Insert the pin spindle (2) in corresponding hole in the tilting-back support of WA-frame 2 and secure it with retaining pin (3).

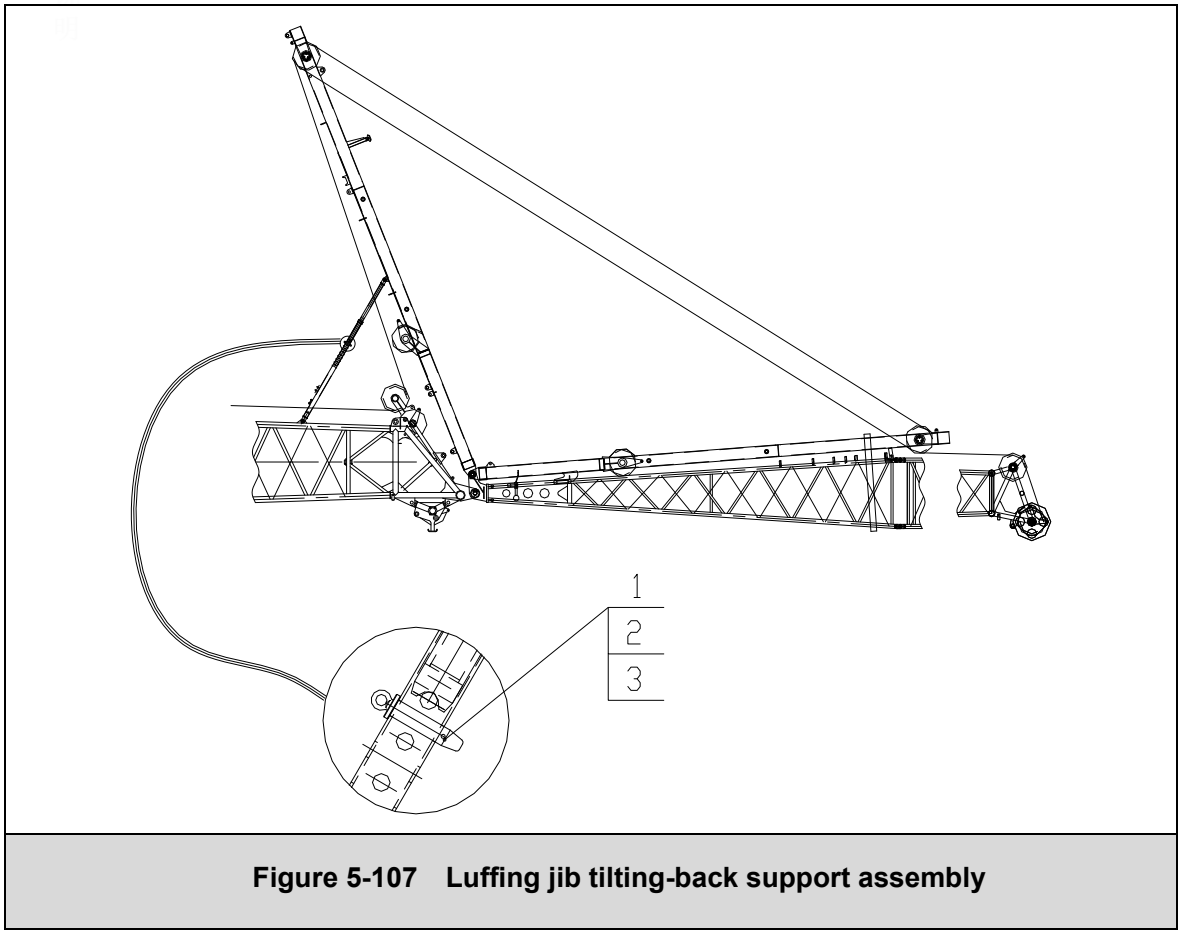
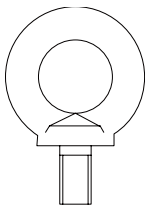
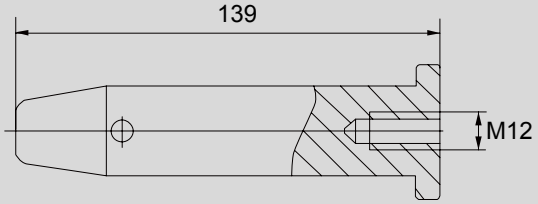
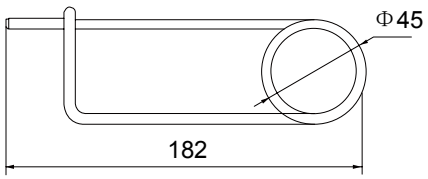


Figure 5-107 Luffing jib tilting-back support assembly

Table 5-29 Connecting parts

Part No.	Description	Illustration (mm)
1	Screw	 GB825-1988（M12）
2	Pin spindle	

		GB/T882-1986（B40×85）
3	Retaining pin	

h) Remove the attachment chain that ties the WA-frame 1 to luffing jib.

– Push right control lever (30) backwards to wind the rope onto winch 1 (if luffing winch is used to raise or lower the luffing jib, move right control lever (30) to left to wind luffing rope onto luffing winch) so as to raise the WA-frame 1 to proper position.

– Select appropriate length of front anchoring rods according to luffing jib length and then connect the front anchoring rods with WA-frame 1 (see Section 5.7.5.2-a "luffing jib front anchoring rods").

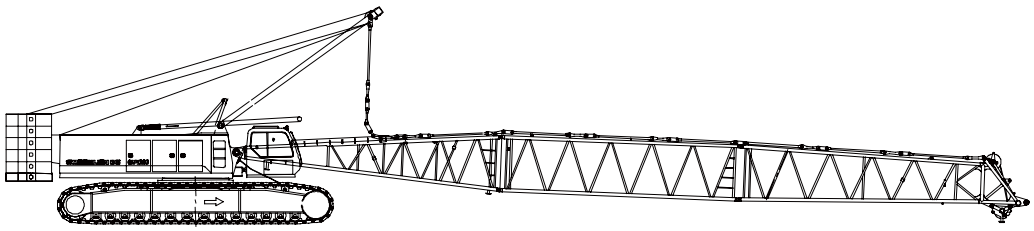


Figure 5-108 Anchoring rod connection of luffing jib

i) Connect tilting-back support cylinder for WA-frame 1 with main boom head. See the following figure.

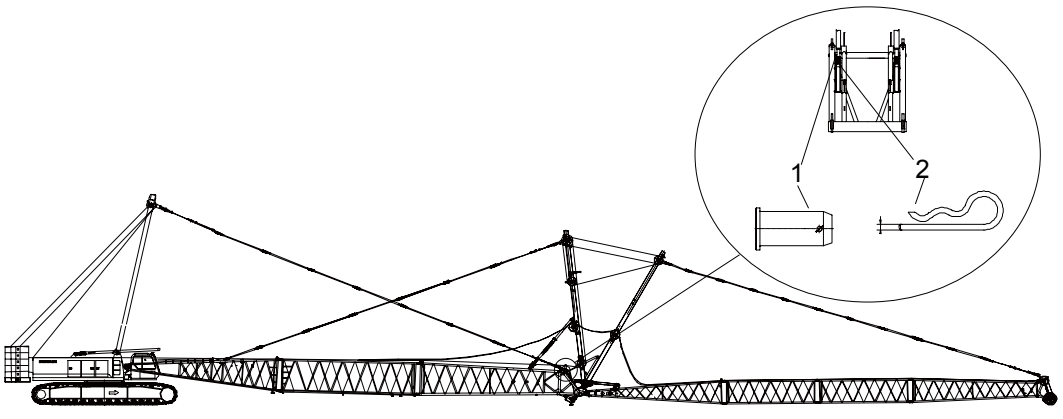
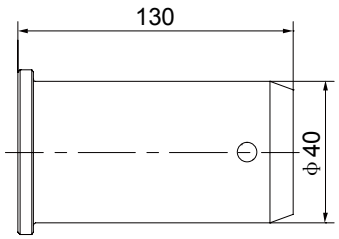


Figure 5-109 Connect tilting-back support cylinder for WA-frame 1 with main boom head

Table 5-30 Connecting parts

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Cotter pin	 GB/T91-2000（2.5×30）

j) Turn the switch (60) on right control panel (4) to right or push down the "reeving winch" on the remote control box to unwind the rope of reeving winch.

Reeve the rope of reeving winch through the rope pulley on luffing jib head and then pull it back to the tail-end of main boom pivot section.

Return the switch (60) or the "reeving winch" on the remote control box to neutral position to stop unwinding rope.

Push left control lever (20) forwards to unwind the hoisting rope of winch 2 to tail-end of main boom pivot section, and then attach the rope of reeving winch to hoisting rope of winch 2 with rope lock.

Turn the switch (60) to left or push up the "reeving winch" on the remote control box to wind the rope of reeving winch, while simultaneously unwinding the hoisting rope for winch 2. Guided by the rope of reeving winch, the hoisting rope for winch 2 will then reach luffing jib head.

5.9.3 Connect electrics to luffing jib

5.9.3.1 Electrical lines connection

CAUTION

The following figure shows the connected electrical parts on luffing jib pivot section. Before erecting the boom, make sure that all electrical lines are connected and safety measures are checked.

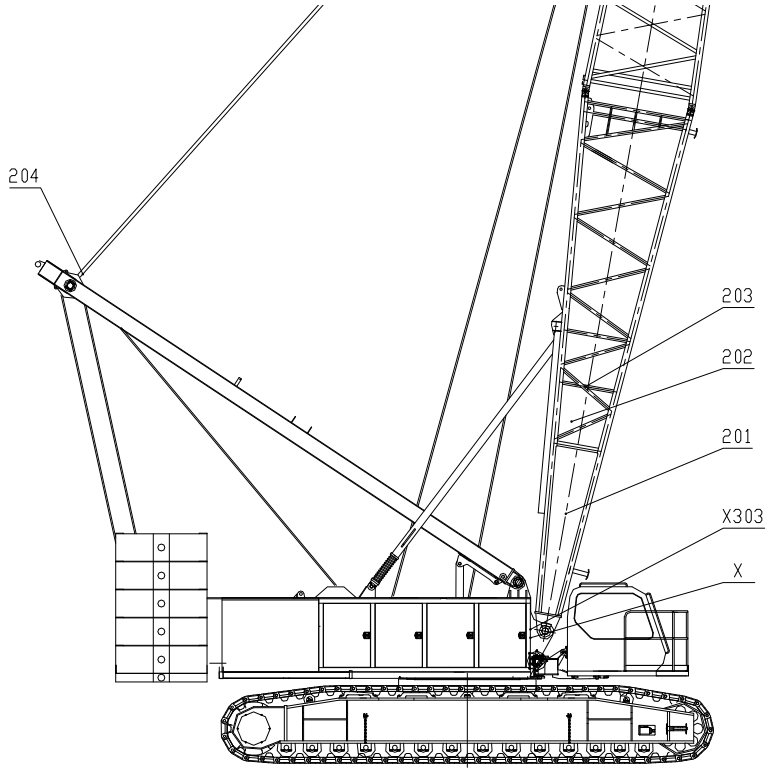


Figure 5-110 Layout of electrical pats on main boom pivot section

Table 5-31 Electrical parts on main boom pivot section

Part No.	Description	Installation position
X15	Socket ,10-hole	In the front of slewing table
201	Angle sensor	On main boom pivot section
202	Cable drum 1	On main boom pivot section
203	Cable drum 2	On main boom pivot section
204	Main boom tension force sensor	On anchoring rod of A-frame1

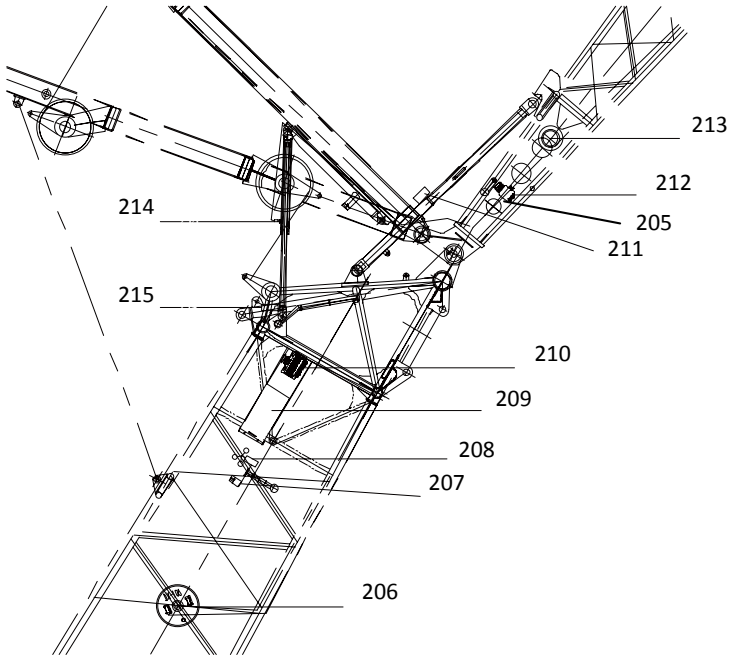


Figure 5-111 Layout of electrical parts between main boom head and luffing jib pivot section

Table 5-32 Electrical parts between main boom head and luffing jib pivot section

Part No.	Description	Installation position
205	Junction box	On luffing jib pivot section
206	Anemometer	On main boom head
207	Warning lamps (two)	On main boom head
208	Junction box	On main boom head
209	Control box for Load Moment Limiter on luffing jib	On main boom head
210	Cable drum 3	On main boom head
211	Luffing jib angle sensor	On luffing jib pivot section
212	Switch for tilting-back support of luffing jib	On tilting-back support of luffing jib (two)
213	Luffing jib angle sensor	On luffing jib pivot section
214	Limit switch for tilting-back support	On tiling-back support cylinder of

	cylinder of WA-frame 1	WA-frame 1 (two)
215	Pressure sensor for tilting-back support cylinder of WA-frame 1	On tiling-back support cylinder of WA-frame 1 (two)

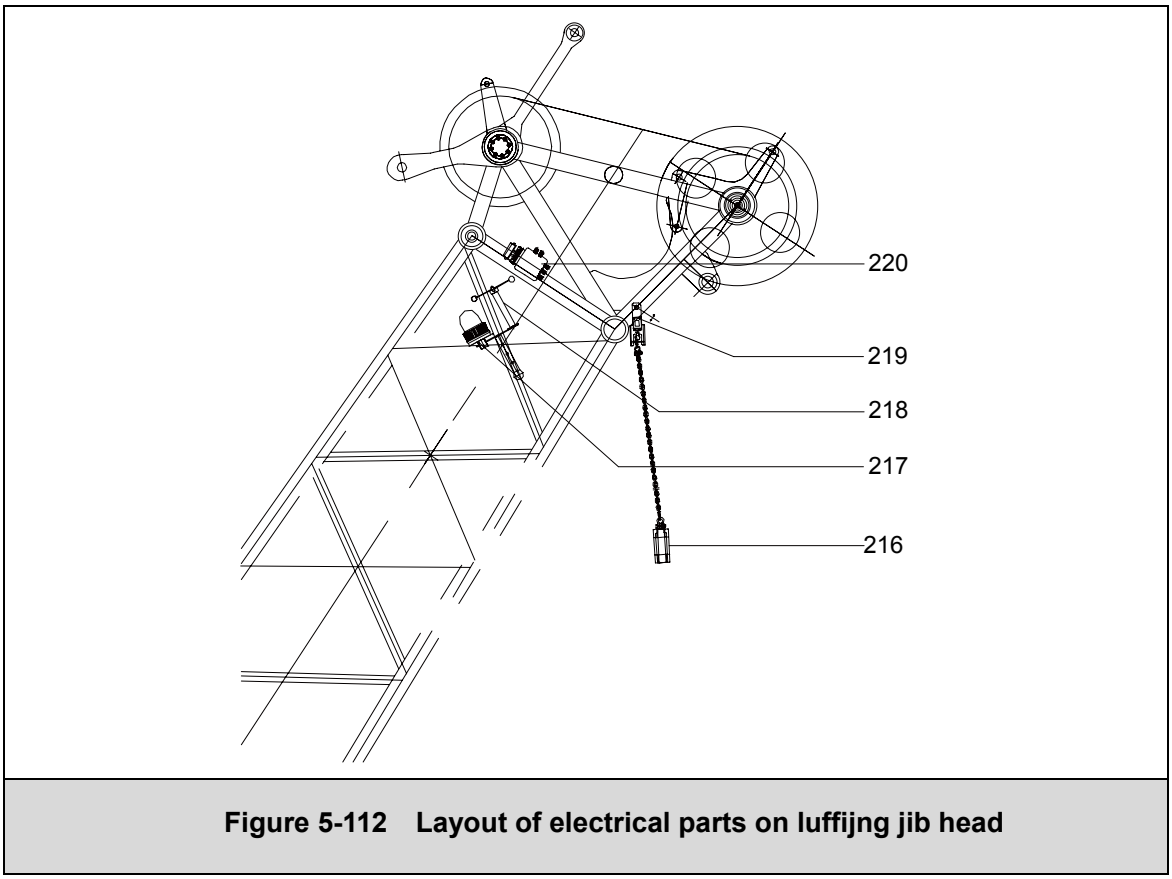


Figure 5-112 Layout of electrical parts on luffijng jib head

Table 5-33 Electrical parts on luffing jib head

Part No.	Description	Illustration (mm)
216	Hoisting limit switch weight	Connected with hoisting rope on luffing jib head
217	Warning lamp	On luffing jib head (two lamps)
218	Anemometer	On luffing jib head
219	Hoisting limit switch	Installed on luffing jib head and connected with hoisting limit switch weight (two)
220	Luffing jib junction box (junction box 7)	On Luffing jib head

a) Connecting electrics to main boom pivot section: Connect all electrical parts on main boom pivot section according to electrics connecting requirement.

b) Plug the cable plug of cable drum 2 into the 16-hole socket on main boom junction box (junction box 5) installed on main boom head.

c) Establish electrical connection from the socket 9 on main boom junction box (junction box 5) installed on main boom head to cable drum 3.

d) Establish electrical connection from socket 10 on main boom junction box (junction box 5) installed on main boom head to junction box 6 installed on luffing jib pivot section.

Pull the cable plug of cable drum 3 forward to the luffing jib head, and then insert it into the socket on junction box 7 installed on luffing jib head.

a) Establish electrical connection from associated switches to the junction box 6.

b) Establish electrical connection from associated switches and elements to the junction box 7.

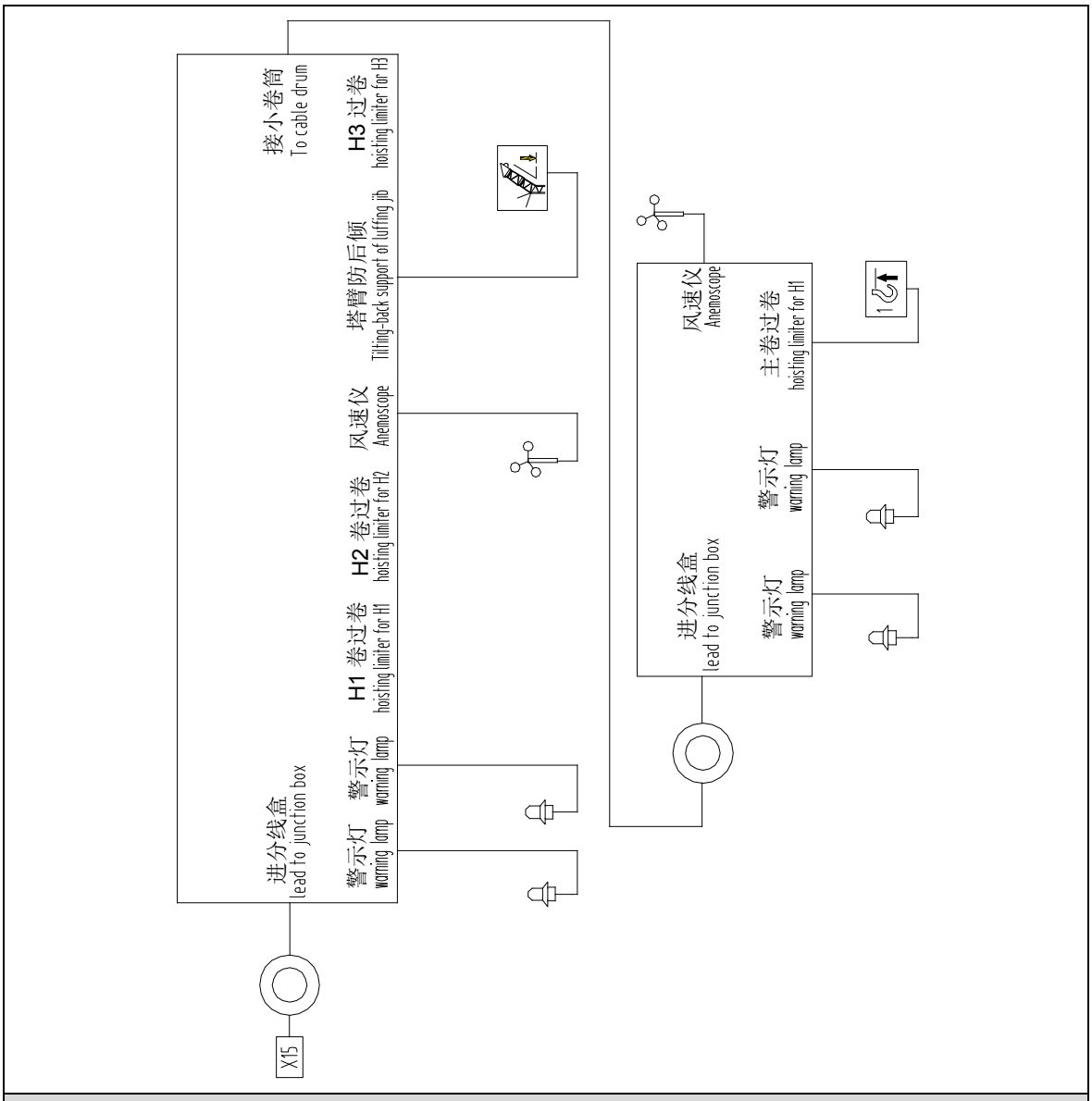


Figure 5-113 Electrical connection of luffijng jib

Electrical connection of junction box 6 (FXH-6) installed on luffing jib pivot section:

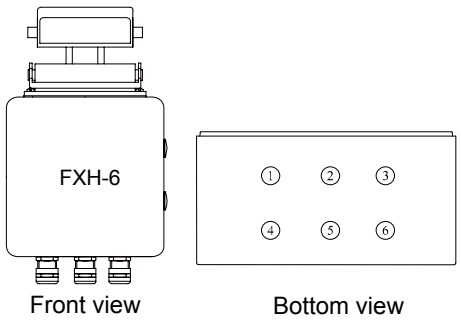


Figure 5-114 Junction box

Table 5-34 Description of sockets on junction box 6 (FXH-6)

Socket No.	Function
1	Pressure sensor for left tiling-back support cylinder of WA-frame 1
2	Pressure sensor for right tiling-back support cylinder of WA-frame 1
3	Limit switch for left tiling-back support cylinder of WA-frame 1
4	Limit switch for right tiling-back support cylinder of WA-frame 1
5	Limit switch for left tilting-back support of luffing jib
6	Limit switch for right tilting-back support of luffing jib
7	Not assigned
8	Not assigned
9	Not assigned
10	Not assigned

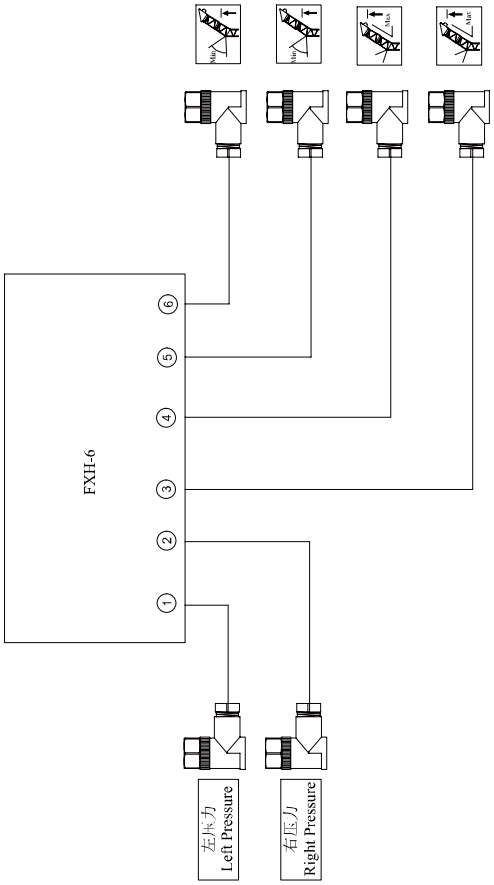


Figure 5-115 Diagram- Electrical connection of junction box 6

Electrical connection of junction box 7 (FXH-7) installed on luffing jib head:

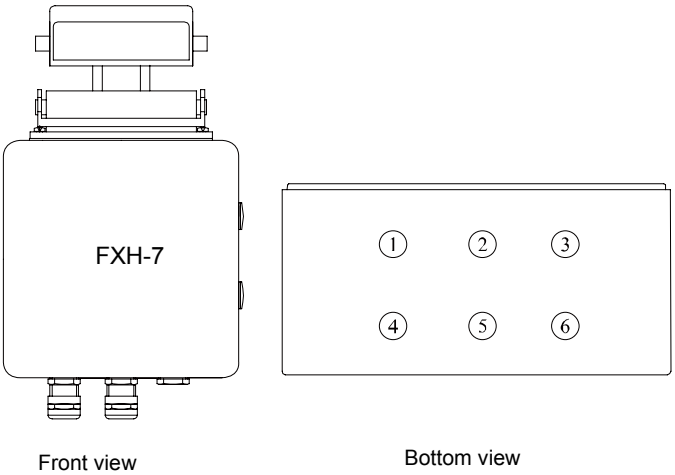


Figure 5-116 Junction box

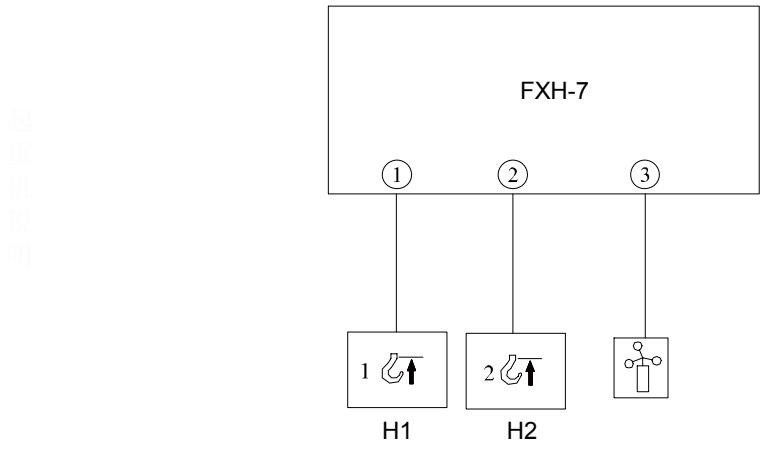


Figure 5-117 Diagram- Electrical connection of junction box 7

CAUTION

For the dummy socket, the protective cover must be closed.

Electrical connection to Load Moment Limiter
See the *Installation Guide & User's Manual* for Load Moment Limiter.

5.9.3.2 Checks before erecting the boom

a) Check warning lamp on main boom head
Warning lamp here is a kind of solar lamp. Before erecting the boom combination, the operator must set the "warning lamp on/off" switch in "on" position. The warning lamp can be checked by sheltering the solar cell plate at the top of warning lamp from sunlight. If the warning lamp flashes, it means that the warning lamp is in functional work.

b) Check the anemometer
Rotate the vane of anemometer to check whether the wind velocity shown on the display in the operator's cab is normal.

c) Check hoisting limit switch for H2
Support and hold the hoisting limit switch weight for H2 to ensure that the switch is triggered, and then check that the icon "upper limit switch on H2" on the screen will flash and the buzzer will sound.

d) Limit switch (214/211)
The limit switch is a kind of metal-inductive switch. Since there will be a maximum induction distance generated between the induction surface of the induction switch and the inspection surface, we must ensure that the actual distance between induction surface of the switch and the inspection surface is shorter than the maximum induction distance. Generally speaking, the distance (L) between them is adjusted to less than 6 mm. A certain distance is maintained between the switch and the object so as to protect the switch against damage caused by object's striking. After the limit switch is adjusted well, use a metal to approach the induction surface of the switch. If the indicator light on the switch lights up, it means that the limit switch is in functional work. Then, observe on the I/O screen in the operator's cab whether the "FALSE" is changed into "True", if so, we can conclude that both the induction switch and its circuit is in good working order (see the following figure).

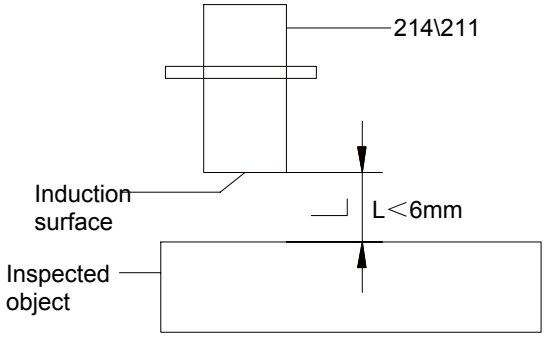


Figure 5-118 Limit switch adjustment

5.9.4 Erecting and lowering main boom with luffing jib

5.9.4.1 Requirements

a) All electrical connections have been established.
b) The limit switch control lever has been checked for smooth movement.
c) Check the warning lamp.
d) Check the anemometer.
e) Check the anemometer for smooth rotation and functional work.
f) Check the hoisting limiter switch.
g) Operate the hoisting winch, and adjust the hoisting limit switch on luffing jib head manually. Requirement for this operation: the hoisting movement of hoisting winch should be stopped when the upper limit has been exceeded, and the icon "upper limit switch" on the screen will flash.

5.9.4.2 Requirements for erecting main boom with luffing jib

a) The crane is properly supported and level.
b) The counterweight is properly installed.
c) Select appropriate boom configurations according to the load to be lifted and the load capacity chart, ensure that boom sections have been connected and secured.
d) All limit switches have been correctly fitted and are fully operational.
e) All pinned connections have been secured.
f) The hoisting rope has been correctly placed in the rope pulleys and prevented from jumping out (from rope groove) using rope guard tube.
g) No person is present in the danger zone.
h) There are no loose parts on main boom or luffing jib.
i) In winter, the main boom, luffing jib and associated components (limit switches, cable drums, warning light, anemometer etc.) must be kept free of ice and snow.

CAUTION

(1) Incorrectly fitted or faulty limit switches and falling parts (pins, retaining pins, ice etc.) can cause injury.

(2) Before erecting the boom, check that the tilting-back support for luffing jib is installed correctly. And ensure the spherical ends of tilting-back support move smoothly in the two guides on luffing jib pivot section when luffing jib is raised to the limit position. Otherwise, the luffing jib is liable to tilt backwards if the tilting-back support is not fixed properly.

5.9.4.3 Erecting main boom with luffing jib

a) Set "luffing jib" configuration on the LCD screen of Load moment limiter.

CAUTION

Performing slewing motion before the boom is erected from the ground is prohibited.

b) Erect main boom with luffing jib

Since the luffing jib can be erected by hoisting winch 1(H1), we will introduce the operating method below.

When luffing jib is erected by hoisting winch 1(H1),

- Select "luffing jib" configuration on the LCD screen of load moment limiter.
- Move right control lever (30) to the left to slowly raise main boom to a proper position.
- Push right control lever (30) forwards to unwind the rope from hoisting winch 1(H1).
- Carry out the two movements mentioned above repeatedly.

In the whole process, make sure that the luffing jib head is running with the running wheels on the ground and the angle between main boom and luffing jib is larger than or equal to 90°. If any warning signal is given out in the luffing jib lifting process, move right control lever (30) to neutral position to stop lifting movement.

CAUTION

(1) The total weight of luffing jib should be loaded on the running wheel.

(2) Check whether the wire rope on luffing winch is slack.

(3) In no circumstances can the angle between main boom and luffing jib be smaller than 90°. Otherwise, the luffing jib head and luffing jib may be damaged.

(4) Wire rope should be checked and guided by an appointed person to prevent it from being damaged due to crush.

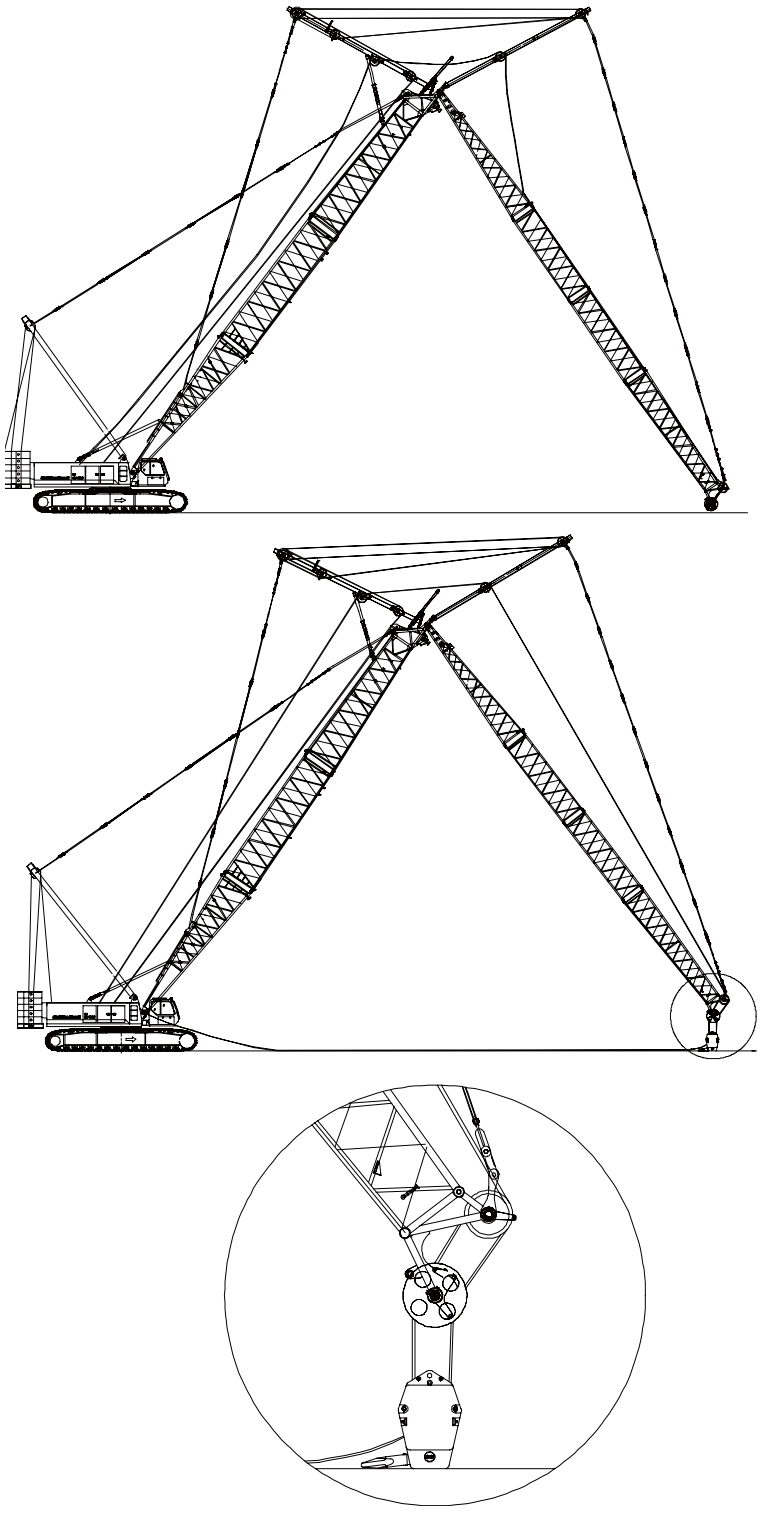


Figure 5-119 Erect main boom with luffing jib

c) Reeve the hoisting rope in with the help of rope of reeving winch

– Move right control lever (30) to the left to raise the boom until the luffing jib head is lifted away from the ground to a proper position a little higher than hook block. Finally, place the selected load hook under the luffing jib head.

– Turn the "reeving winch" rotary switch (60) on the right control panel to the right, or push the "reeving winch" switch on auxiliary remote control box downwards, to unwind the rope off reeving winch. Pull the rope of reeving winch forwards to the luffing jib head and then reeve it in the reverse direction between rope pulleys on luffing jib head and load hook, finally attach it to hoisting rope with rope lock.

– Spool up the reeving winch. The reeving winch can be spooled up by two operating methods:

Method 1:

Turn the switch (60) on the right control panel to the left, or push "reeving winch" switch on auxiliary remote control box upwards, to spool up reeving winch. At the same time, move left control lever (20) forwards to unwind the hoisting rope which will be, under the guidance of rope of reeving winch, reeved between the rope pulleys on luffing jib head and load hook. Finally, fix the rope end point onto luffing jib head or load hook.

Method 2:

Turn the "synchronization" switch (60) on right control panel to the left and push left control lever (20) forwards. Then the movements "spool up reeving winch" and "reel off hoisting winch 2 (H2)" will be carried out synchronously. During this process, make sure that the rope is neither too slack nor tightly tensioned.

d) Move right control lever (30) to the left to raise main boom, at the same time push left control lever (20) forwards to unwind the wire rope of the hoisting winch 2 to make sure that the load hook will not be dragged on the ground. After main boom is raised to the required position, return the left and right control levers (20, 30) to neutral position to make main boom and load hook stop moving.

⚠ CAUTION

(1) In the erecting process, when main boom is raised to 65° position, the "assembly mode" must be changed to the "operating mode".

(2) To prevent the luffing jib front anchoring rods from swinging to and fro, the luffing jib should be erected at constant speed slowly.

a) Push right control lever (30) backwards to spool up hoisting winch 1 so as to raise the luffing jib. Meanwhile, push left control lever (20) forwards to unwind the wire rope off the hoisting winch 2 to prevent the hook block from being dragged on the ground. After luffing jib is erected to required working position, return the left and right control levers (20, 30) to neutral position.

b) Push left control lever (20) backwards to spool up hoisting winch 2 until the load hook is lifted. Then the entire boom is erected (see the following figure).

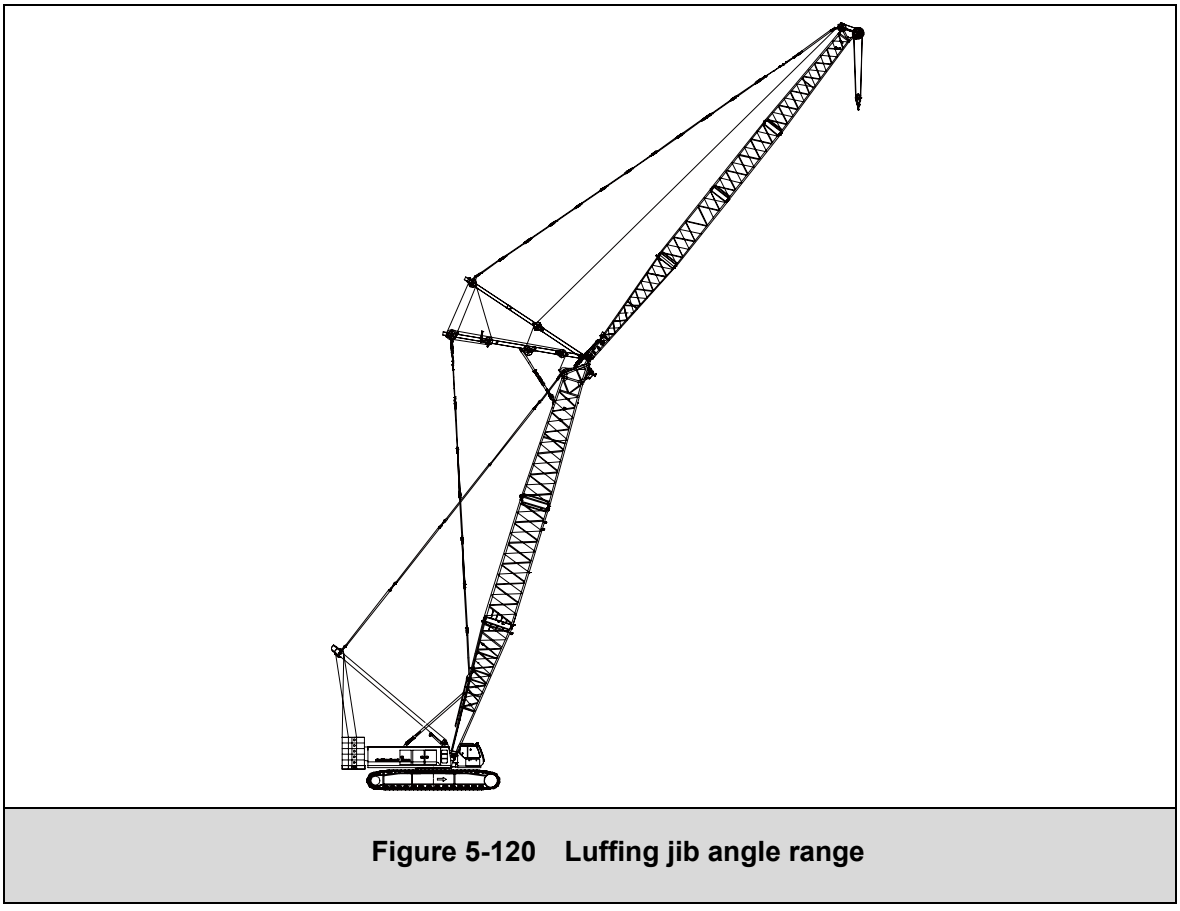


Figure 5-120 Luffing jib angle range

CAUTION

(1) When main boom angle is 85°, the luffing jib angle can be adjusted from 15° to 75°.

(2) When main boom angle is 75°, the luffing jib angle can be adjusted from 15° to 65°.

(3) When main boom angle is 65°, the luffing jib angle can be adjusted from 15° to 55°.

(4) The actual allowed angle range for luffing jib is decided by actual working condition, because safety devices such as limit switches will have a direct influence on actual working angle of luffing jib. Therefore, when some safety devices built on the crane are triggered, stop the crane operation immediately. If this is not observed, the crane boom system may be damaged or there is a risk of crane overturning.

(5) When boom angle varies from 65° to 75° or 75° to 85°, we should determine the corresponding smaller value in the rated lifting capacity chart. In order to give full play to the crane's performance, please operate the crane under the operating conditions with three prescribed boom angles.

(6) Under crane operation with main boom and luffing jib (with main boom angle of 85°): when luffing jib angle exceeds 60°, the luffing jib with a load should not be raised/lowered at high speed. And the load should be the min. lifting capacity under this boom configuration, otherwise the luffing jib is liable to overturn. Before the load is detached from the hook, lower the luffing jib to a position less than 60° by the pulling force of load.

5.9.4.4 Lowering main boom with luffing jib

a) Push left control lever forwards to reel off hoisting winch 2 so as to lower the load hook. After the load hook is lowered on the ground, it must be moved away from the position where the boom will be lowered.

b) Push right control lever forwards to operate the hoisting winch 1 in the lowering direction to lower luffing jib. When the angle between luffing jib and main boom approaches 90°, return right control lever to neutral position to make luffing jib stop moving.

CAUTION

(1) In the lowering process, when main boom is lowered to 65° position, the "operating mode" must be changed to "assembly mode".

(2) In the process of lowering main boom, the hoisting winch 1 must be reeled off to avoid the hook's collision with the pulley head.

(3) Standing within danger area of crane during operation is prohibited.

(4) The boom-lowering movement should be performed slowly and stably. And during the operation, the crane operator must observe the data shown on the display, while other workers must observe the surrounding areas for potential dangers.

c) If hoisting winch 1(H1) is used to raise/lower luffing jib, push right control lever (30) backwards to spool up hoisting winch 1. And move right control lever (30) to the right to lower main boom. Carry out the movements "Spool up hoisting winch 1" and "Lower main boom" repeatedly to ensure that the luffing jib head is running with the running wheels on the ground. Meanwhile, push left control lever (20) backwards to spool up hoisting winch 2 (H2) until main boom and luffing jib are lowered on the ground completely, and then return right control lever (30) to neutral position.

CAUTION

(1) Standing within danger area of crane during operation is prohibited.

(2) The boom-lowering movement should be performed slowly and stably. And during the operation, the crane operator must observe the data shown on the display, while other workers must observe the surrounding areas for potential dangers.

(3) To prevent the wire rope from being damaged due to crush, it should be guided by a person.

(4) In the process of lowering the boom, make anchoring rods of luffing jib hang down a little.

(5) The winding of wire rope should be supervised by a person appointed, and no person is standing within danger zone during operation.

5.9.4.5 Dismantling of main boom with luffing jib

a) Push left control lever backwards to spool up hoisting winch 2(H2).

CAUTION

The winding of wire rope should be supervised by a person appointed, and no person must stand within danger zone during operation.

b) Push right control lever forwards to reel off hoisting winch 1. After WA-frame 1 is lowered forwards to proper position, return right control lever to neutral position. At this moment, separate the front anchoring rods of WA-frame 1 from those of luffing jib. And then lower the WA-frame 1 onto the luffing jib and secure them with slings.

c) Push right control lever backwards to slightly spool up hoisting winch 1 until the luffing jib rear anchoring rods is tensioned. At this moment, remove the positioning pin for tilting-back support of WA-frame 2. After that, push right control lever forwards to reel off hoisting winch 1 to lower WA-frame 2 backwards until the tilting-back support are retracted completely, and then insert the positioning pin.

CAUTION

(1) In order to avoid breaking mounting sling, the force should not be too large when winding luffing rope to tighten the luffing jib rear anchoring rods. Otherwise, accident will occur.

(2) The end of tilting-back support should slide in guiding rails provided for that purpose.

d) Dismantle the tilting-back support of WA-frame 2 with the help of auxiliary crane, and then disconnect luffing jib rear anchoring rods from WA-frame 2.

CAUTION

When wind the wire rope onto luffing jib derricking winch, the mounting sling should not bear any load to prevent it from being broken.

e) Push right control lever forwards to reel off hoisting winch 1, slowly put WA-frame 2 on the WA-frame 1 with the help of auxiliary crane.

CAUTION

(1) At this time, WA-frame 2 is lowered down with the help of auxiliary crane rather than the hoisting rope.

(2) After WA-frame 2 is lowered to 45° position in the front, it should be lowered down by auxiliary crane and mounting rope. Do not make wire rope of hoisting winch 1 bear force, otherwise, they will be damaged.

f) Wind the rope of hoisting winch 1. Push right control lever backwards to wind the rope onto the hoisting winch 1 and fix it on the winch.

g) Dismantle luffing jib sections one by one, leaving the luffing jib pivot section assembled.

h) Detach the luffing jib pivot section (together with WA-frames 1 and 2) from the main boom head.

CAUTION

All crane movements should be carried out smoothly, and all safety precautions should be followed, otherwise accident may occur.

5.10 Assembly and dismantling of light duty boom (SL)

The SL boom comprises main boom sections and luffing jib sections. Its first 73 m-long boom is composed of main boom sections, and the second part of it is composed of luffing jib sections. The first part of it is connected to the second part by a 4 m reducing section (G29). The assembly sequence of boom sections for both parts of it and the arrangement and combination of anchoring rods as well as safety precautions have been detailed in Section 5.7.2 "Light duty boom". The connection of 4 m reducing section to main boom section and to luffing jib section is shown in the following figure.

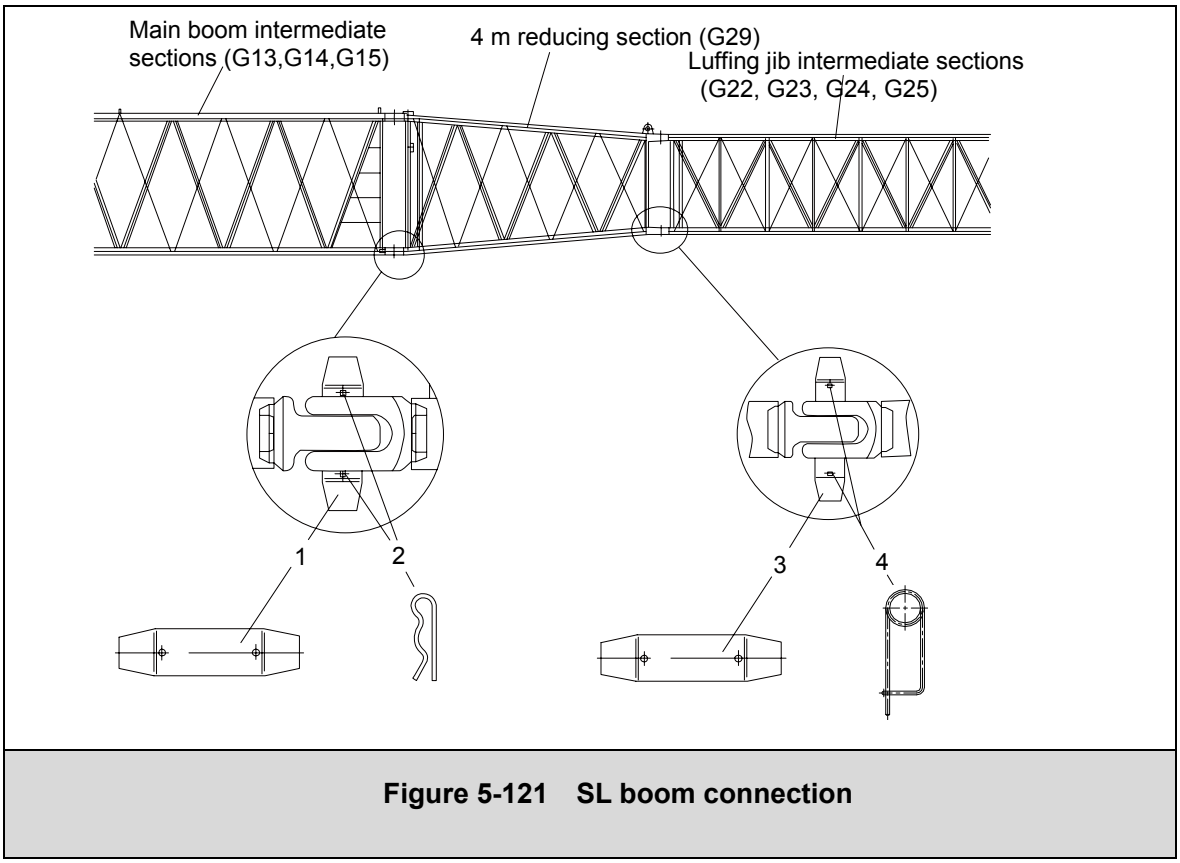
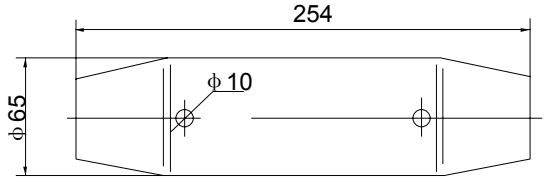
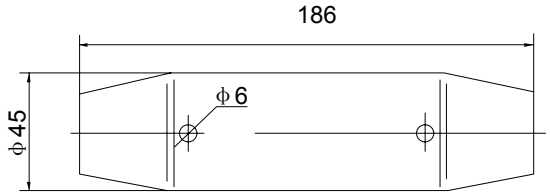
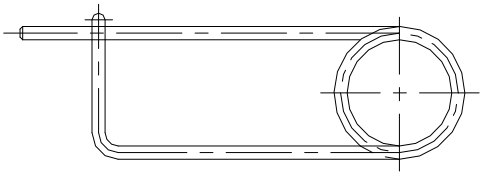


Figure 5-121 SL boom connection

Table 5-35 Connecting parts

Part No.	Description	Illustration (mm)
1	Double tapered pin	

Part No.	Description	Illustration (mm)
2	Retaining spring	
3	Double tapered pin	
4	Retaining spring	

Connecting electrics:

Insert the cable plug of X303 on main boom pivot section into the X303 socket at the front of slewing table.

Insert the cable plug of cable drum 2 into the corresponding socket on junction box installed on luffing jib head.

For electrical connections to other parts, please see the "Connect electrics to luffing jib" in Section 5.9.3.

CAUTION

For erecting and lowering of light duty boom as well as safety precautions, please refer to section 5.8.4 "Erecting main boom" and section 5.8.5 "lowering and dismantling main boom".

5.11 Assembly and dismantling of main boom with fixed jib (SF)

5.11.1 Preparations

a) The crane is properly supported and level.
b) The main boom has been installed.
c) The required counterweight plates have been assembled.
d) An auxiliary crane and working platform are available.
e) The safety indicator system of load moment limiter is set according to the data given in the load capacity charts.
f) Choose appropriate boom combination and relevant anchoring rods combination according to operational planning and boom configuration.
g) Choose the correct load hook and rope reeving for the load to be lifted.
h) Change the "operating mode" to "assembly mode".

CAUTION

(1) After the "operating mode" is changed to "assembly mode", all safety device built in the crane will be deactivated, the assembly, dismantling of the machine should therefore be carried out with utmost care.

(2) Any assembly work on crane should be carried out on safety working ground, otherwise there is a risk of accident.

(3) Do not stand beneath the boom when it is being pinned or unpinned!

5.11.2 Assembling main boom with fixed jib

CAUTION

After the "operating mode" is changed to "assembly mode", all safety device built in the crane will be deactivated, the assembly, dismantling of the machine should therefore be carried out with utmost care.

During transportation, the fixed jib pivot section (G31) and FA-frame (G37) are assembled together. See the following diagram.

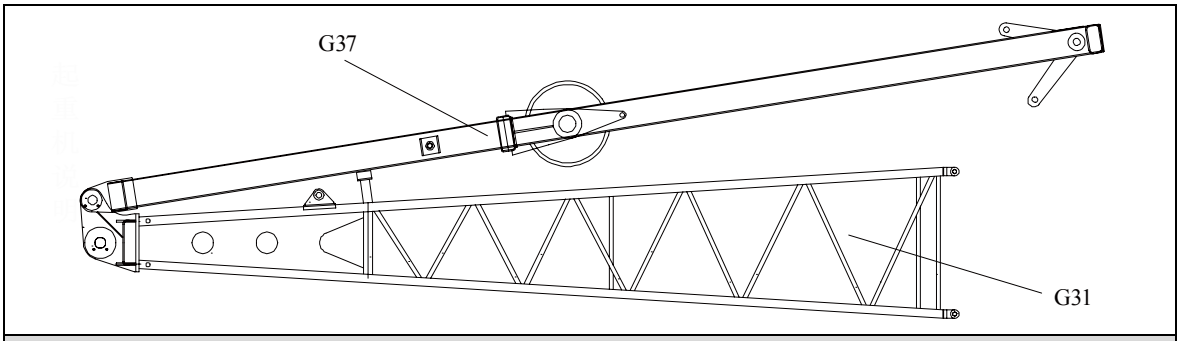


Figure 5-122 Fixed jib pivot section transportation

a) Assemble required main boom sections in accordance with Section 5.7.1 "Heavy duty boom".

b) Raise the fixed jib pivot section (together with FA-frame) with an auxiliary crane and swing to main boom head.

Attach the fixed jib pivot section to the main boom head from above.

Continue lowering the fixed jib pivot section until it can be pinned to main boom head.

Pin the fixed jib pivot piece to main boom head with pin spindles (2) and secure with bolts (5), shaft end retaining plates (3), retaining springs (1) and washer (4). (See the following figure.)

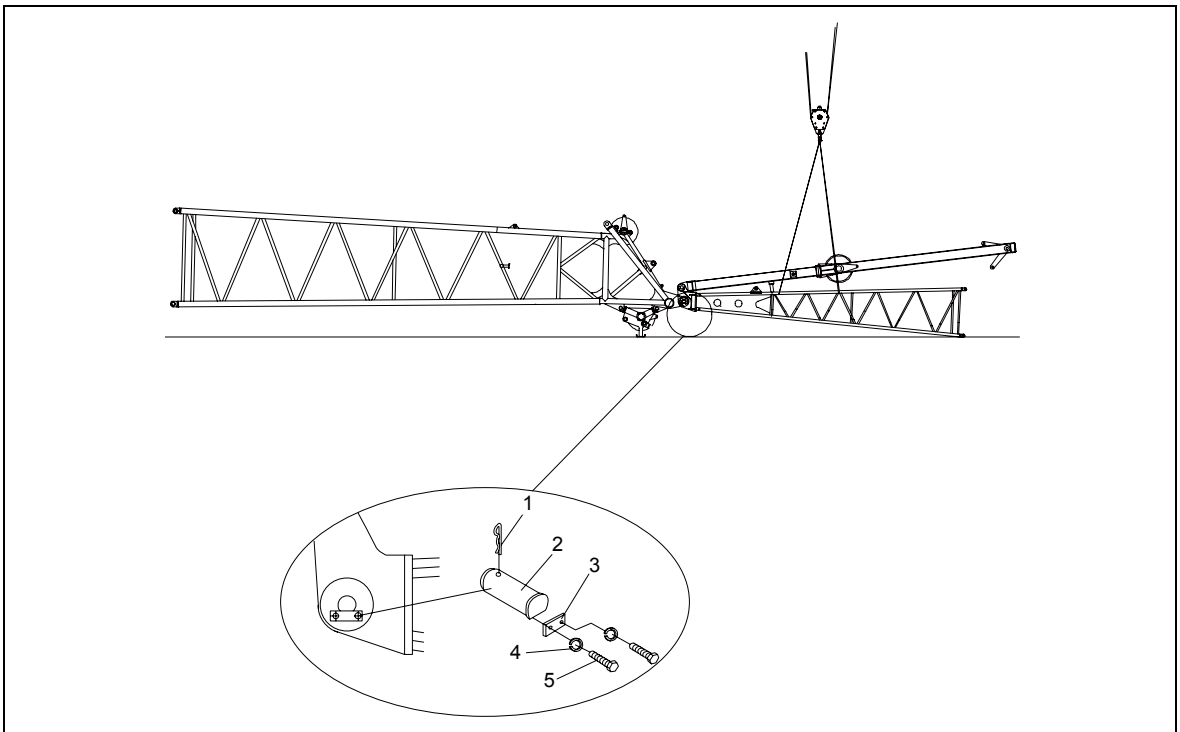
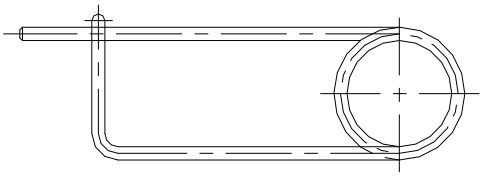
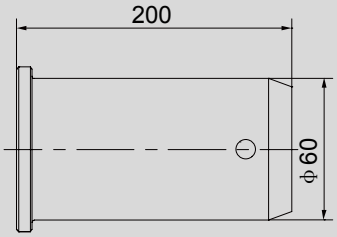
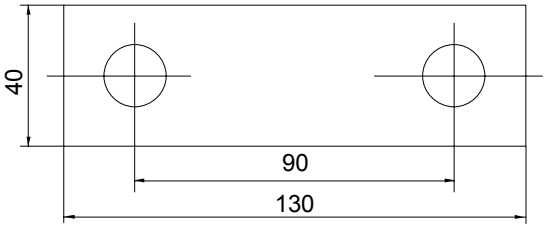
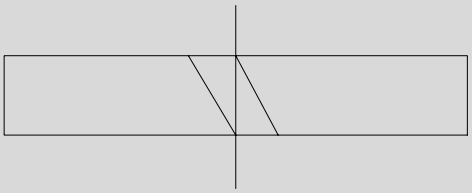
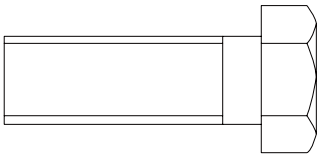


Figure 5-123 Fixed jib pivot section assembly

Table 5-36 Connecting parts

Part No.	Description	Illustration (mm)
1	Retaining spring	
2	Pin spindle	
3	Shaft end retaining plate	
4	Washer	 GB/T93-1987（16）
5	Bolt	 GB/T5783-2000（M16×55-8.8）

c) According to actual condition, choose appropriate numbers of fixed jib intermediate sections 6 m (G33) in length, and then pin them together. All jib intermediate sections are connected with double tapered pins (1), and secured on both sides with retaining springs (2) (see the following figure).

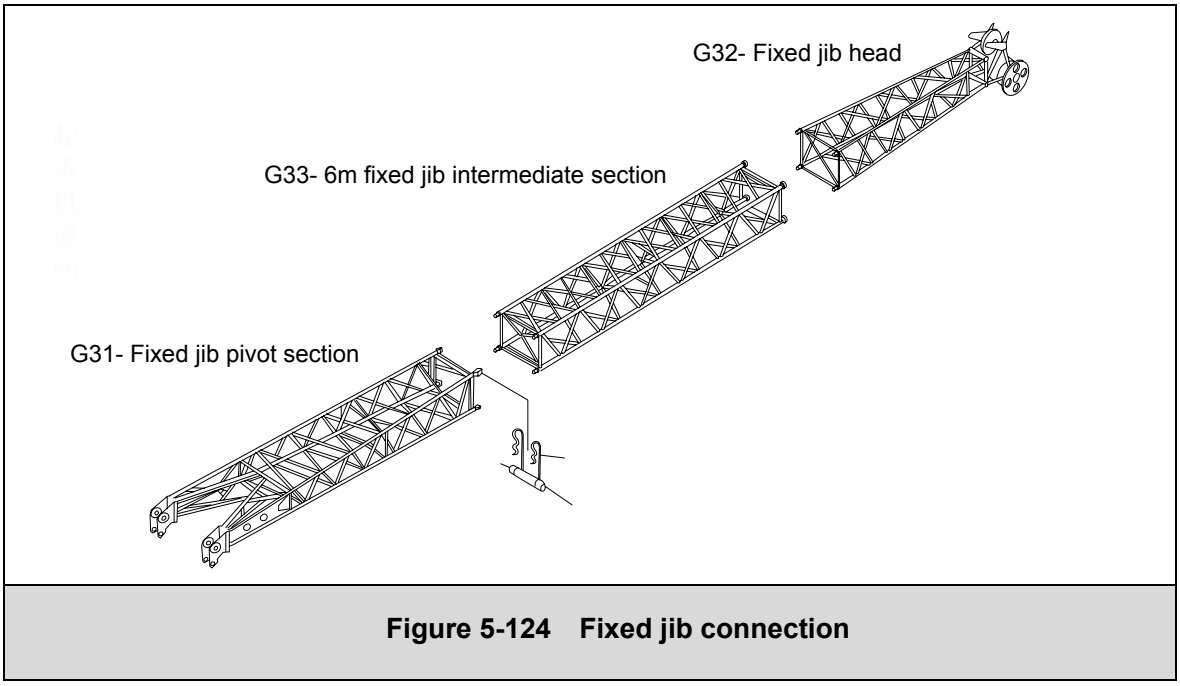
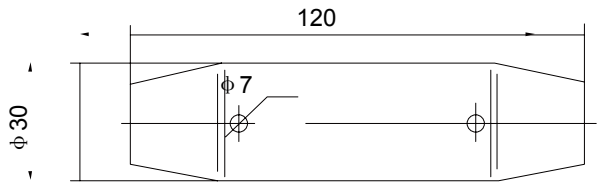


Figure 5-124 Fixed jib connection

Table 5-37 Connecting parts

Part No.	Description	Illustration (mm)
1	Double tapered pin	
2	Retaining spring	

d) Connect required main boom anchoring rods according to assembled main boom length (See Section 5.7.1.3 "Combination of anchoring rods of heavy duty boom"). Preassemble partial fixed jib rear anchoring rods to FA-frame (see the following A-view, for the part number appear in the following figure, please refer to Section 5.7.3.2-b "fixed jib rear anchoring rods"). Connect required front anchoring rods according to fixed jib length (for the arrangement and combination of front anchoring rods, please refer to section 5.7.3.2-a "fixed jib front anchoring rod").

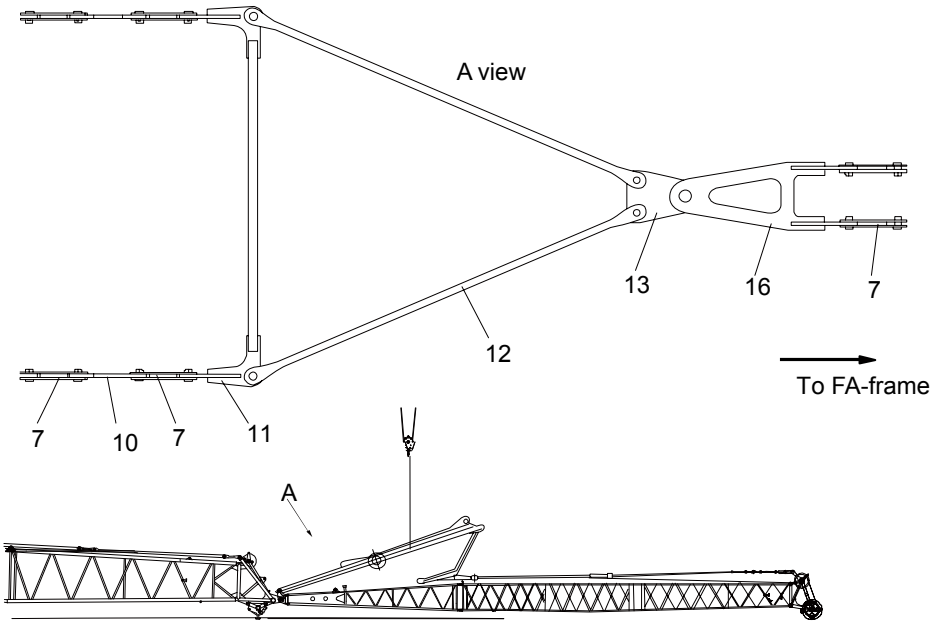


Figure 5-125 Fixed jib anchoring rods connection

e) Assemble the outer pipe of one end of front tilting-back support (G74) and rear tilting-back support (G75) to FA-frame (G37), and secure them with cotter pin (1).

Lift FA-frame (G37) with an auxiliary crane until the fixed jib front anchoring rods is tensioned slightly.

Attach the inner pipe of the other end of front tilting-back support (G74) to fixed jib pivot section with pin spindle (2) and secure with cotter pin (3).

Attach required fixed jib rear anchoring rods (see Section 5.7.3.2-b "fixed jib rear anchoring rods").

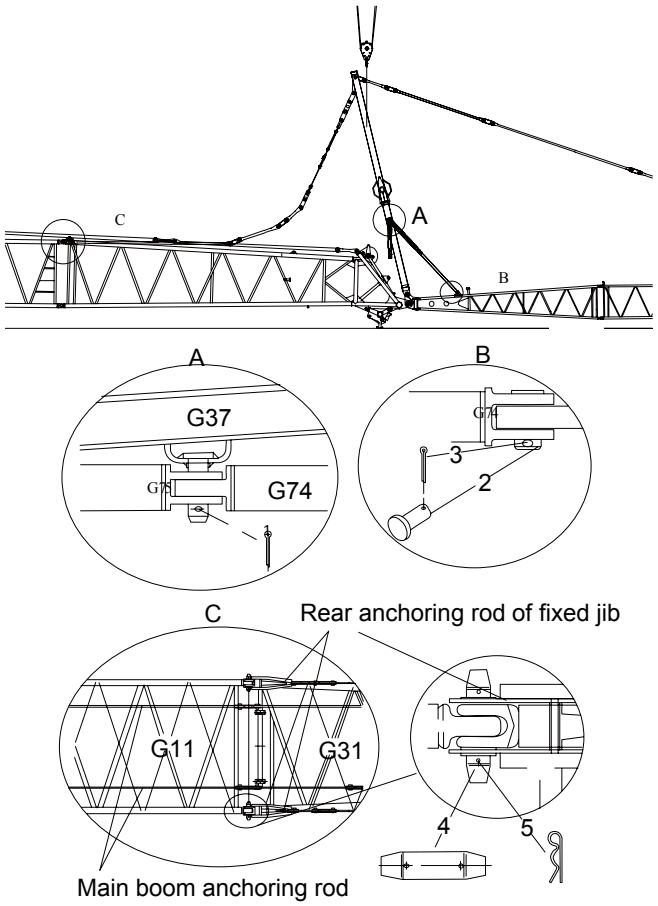
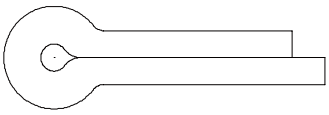
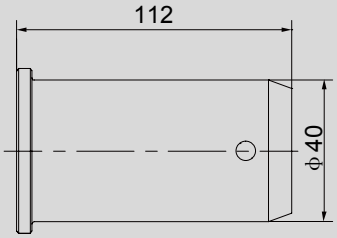
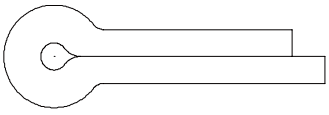
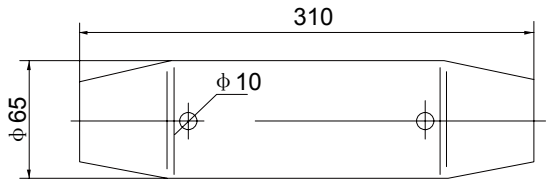


Figure 5-126 Assembly of front tilting-back support of fixed jib

Table 5-38 Connecting parts

Part No.	Description	Illustration (mm)
1	Cotter pin	 GB/T91-2000（8×60）
2	Pin spindle	
3	Cotter pin	

Part No.	Description	Illustration (mm)
		GB/T91-2000（8×60）
4	Double tapered pin	
5	Retaining spring	

f) Reeve the hoisting rope in with the help of rope of reeving winch

– Move right control lever (30) to the left to raise the boom until the luffing jib head is lifted away from the ground to a proper position a little higher than hook block. Finally, place the selected load hook under the luffing jib head.

– Turn the "reeving winch" switch (60) on the right control panel to the right, or push the "reeving winch" switch on auxiliary remote control box downwards, to unwind the rope off reeving winch. Pull the rope of reeving winch forwards to the luffing jib head and then reeve it in the reverse direction between rope pulleys on luffing jib head and load hook, finally attach it to hoisting rope with rope lock.

– Spool up the reeving winch. The reeving winch can be spooled up by two operating methods:

Method 1:

Turn the switch (60) on the right control panel to the left, or push "reeving winch" switch on auxiliary remote control box upwards, to spool up reeving winch. At the same time, move left control lever (20) forwards to unwind the hoisting rope which will be, under the guidance of rope of reeving winch, reeved between the rope pulleys on luffing jib head and load hook. Finally, fix the rope end point onto luffing jib head or load hook.

Method 2:

Turn the "synchronization" switch (60) on right control panel to the left and push left control lever (20) forwards. Then the movements "spool up reeving winch" and "reel off hoisting winch 2 (H2)" will be carried out synchronously. During this process, make sure that the rope is neither too slack nor tightly tensioned.

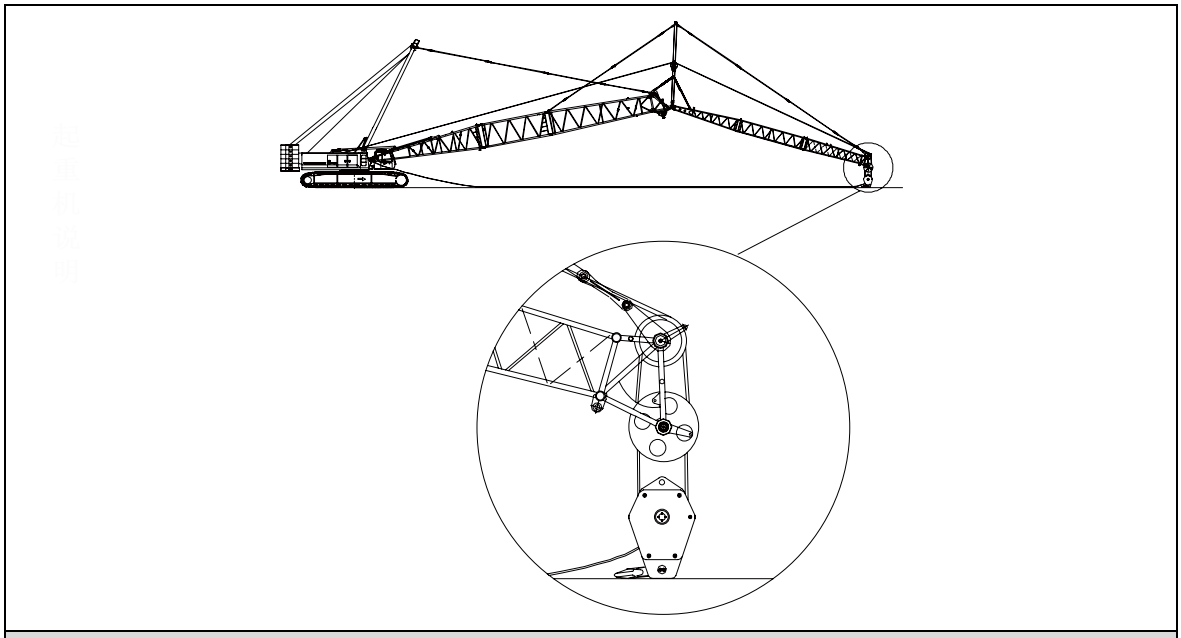


Figure 5-127 Reeving winch operation

g) Move right control lever (30) to the left to spool up main boom derricking winch. When main boom is raised to a proper position, lift the inner pipe of rear titling-back support of fixed jib (G75) with an auxiliary crane, and then connect it with outer pipe with pin spindle (1) and secure with cotter pin (2).

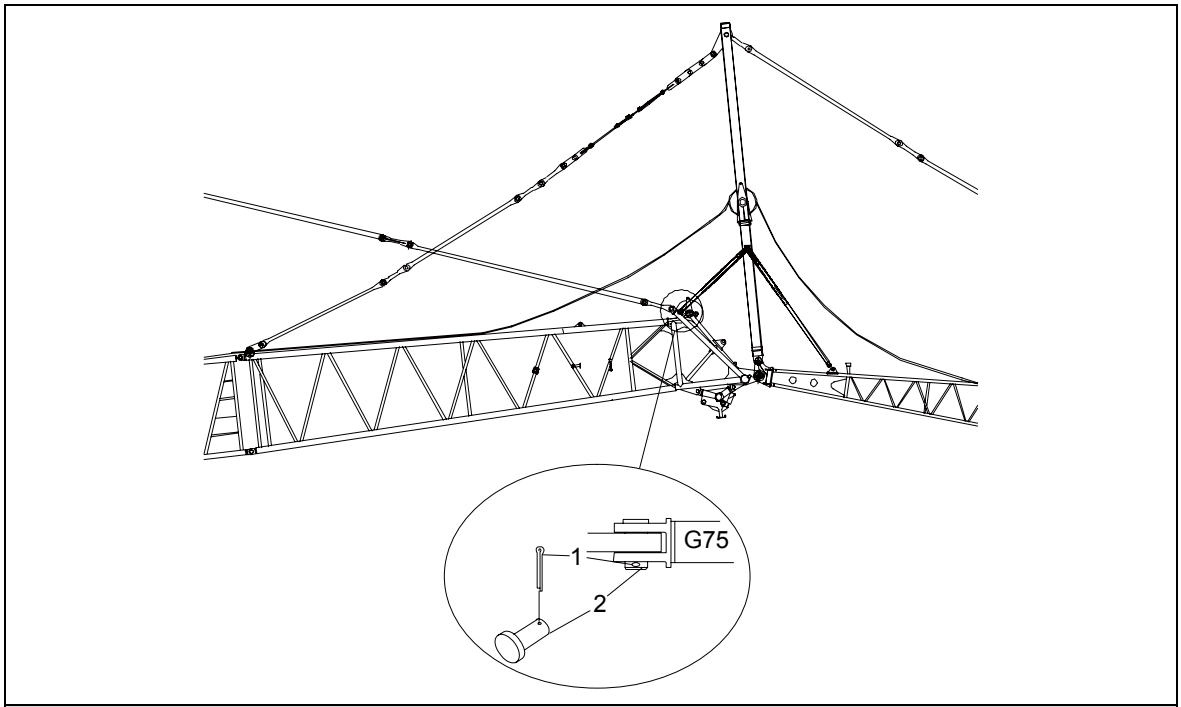
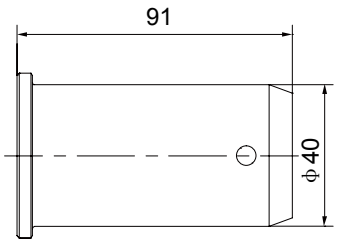
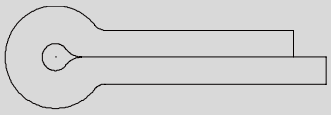


Figure 5-128 Reeving winch operation

Table 5-39 Connecting parts

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Cotter pin	 GB/T91-2000（8×60）

CAUTION

(1) Make sure that hoisting rope on fixed jib head is not exposed to crushing force.

(2) Ensure that the fixed jib head is rolling forwards on the running wheel all the time.

(3) The attachment of rear tilting-back support to main boom head should be carried out with utmost care.

5.11.3 Connect electrics to fixed jib

5.11.3.1 Electrical lines connection

CAUTION

The following figure shows the connected electrical parts on main boom with fixed jib. Before erecting the boom, make sure that all electrical lines are connected and safety measures are checked.

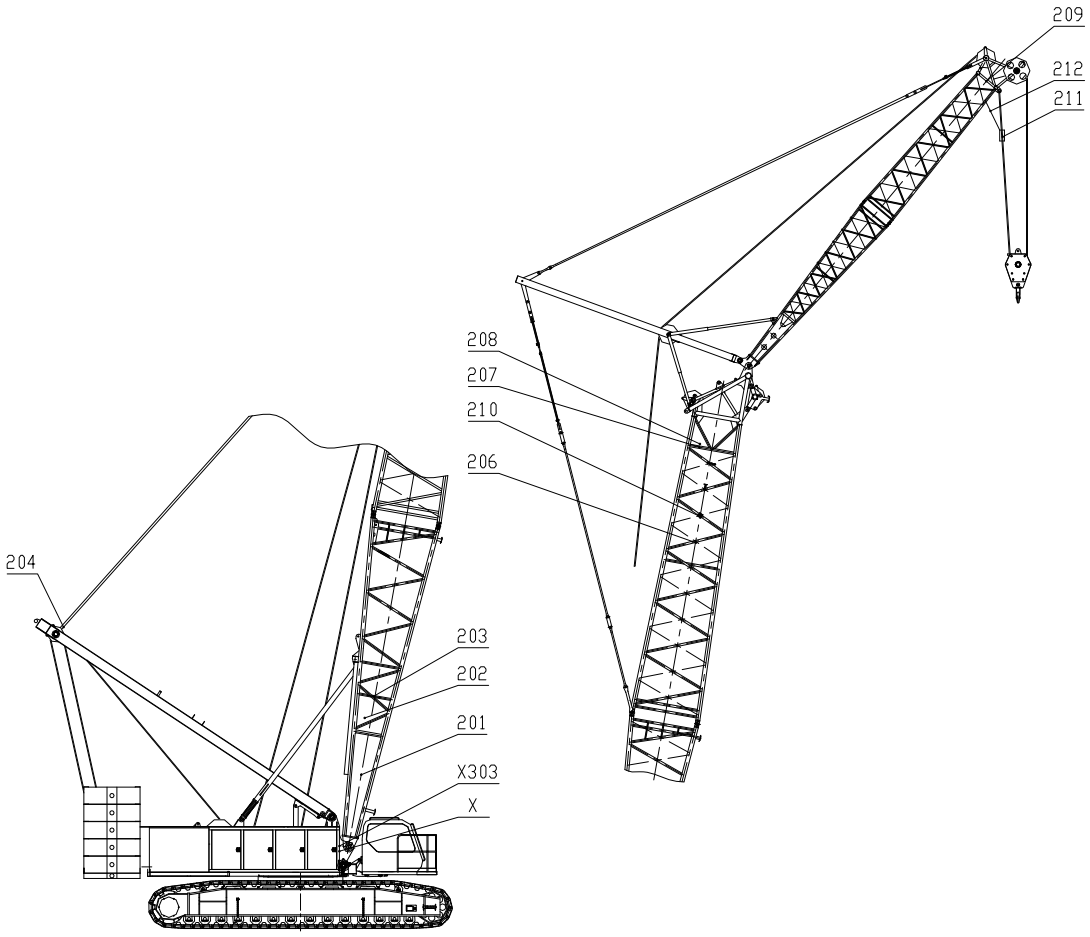


Figure 5-129 Connect electrics to fixed jib

Table 5-40 Electrical parts attached on main boom with fixed jib

Part No.	Description	Installation position
X303	Socket, 16-hole	In the front of slewing table
201	Angle sensor	On main boom pivot section
202	Cable drum 1	On main boom pivot section
203	Cable drum 2	On main boom pivot section
204	Main boom tension force sensor	On anchoring rods of A-frame
206	Main boom junction box	On main boom head
207	Control box for Load Moment Limiter on luffing jib	On main boom head
208	Cable drum 3	On main boom head
209	Anemometer	On fixed jib head
210	Warning lamp	On fixed jib head
211	Junction box of fixed jib	On fixed jib head
212	Hoisting limit switch weight	Connected to hoisting rope on fixed jib head
213	Hoisting limit switch	On fixed jib head, connected to hoisting limit switch weight

j) Connecting electrics to main boom:

Connect all electrical parts (except anemometer and warning lamp) on main boom according to electrics connecting requirement.

k) Connecting electrics to fixed jib:

a) Establish electrical connection from junction box "connecting to small cable drum" on main boom head to cable drum 3 and then pull the cable plug of cable drum 3 forwards to fixed jib head, and insert it into junction box (to junction box) on fixe jib head.

b) Establish electrical connection from associated parts to junction box installed on fixed jib head.

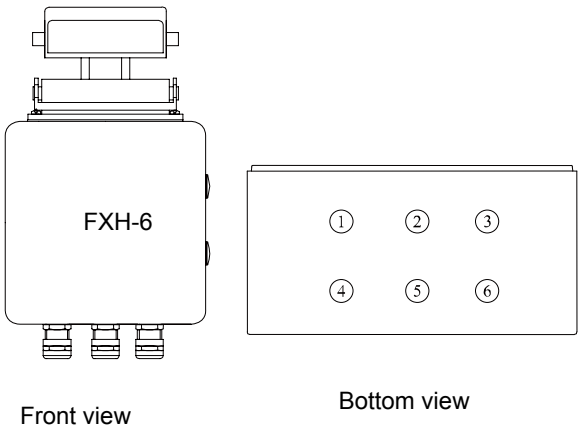


Figure 5-130 Junction box

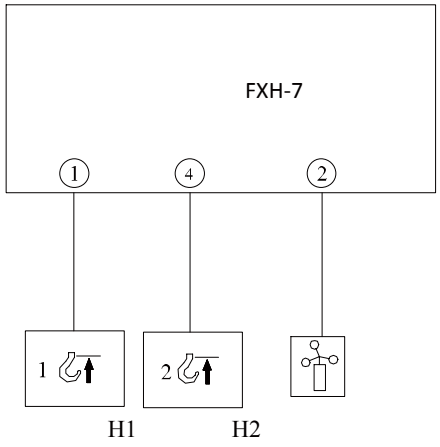


Figure 5-131 Junction box wiring

Description of sockets on junction box:
The junction box, here installed on fixed jib head, has 3 output sockets in total, marked with from 1 to 3. Each socket on this junction box is described below:

Table 5-41 Fixed jib junction box wiring

Socket No.	Function
1	Connected to hoisting limiter switch for H1
2	Connected to anemometer
4	Connected to hoisting limiter switch for H2

CAUTION

For the dummy socket, the protective cover must be closed.

Electrical connection to Load Moment Limiter
See the *Installation Guide & User's Manual* for Load Moment Limiter.

5.11.3.2 Checks before erecting main boom with fixed jib

a) Check warning lamp

Warning lamp here is a kind of solar lamp. Before erecting the boom combination, the operator must set the "warning lamp on/off" switch in "on" position. The warning lamp can be charged in daylight, and illuminates at night.

b) Check the anemometer
Rotate the vane of anemometer to check whether the wind velocity shown on the display in the operator's cab is normal.

c) Check hoisting limit switch for H2
Support and hold the hoisting limit switch weight for H2 to ensure that the switch is triggered, and then check that the icon "upper limit switch on H2" on the screen will flash and the buzzer will sound.

5.11.4 Erecting and lowering main boom with fixed jib

5.11.4.1 Prerequisites

a) All electrical connections have been established.
b) The limit switch control lever has been checked for smooth movement.
c) Check the warning lamp on the boom head.
d) Check the anemometer.
e) Check the anemometer for smooth rotation and functional working.
f) Check the hoisting limiter switch.
g) Operate the hoisting winch, and adjust the hoisting limit switch on fixed jib head manually. Requirement for this operation: the hoisting movement of hoisting winch should be stopped when the upper limit has reached, and icon "upper limit switch" on the screen will flash.

5.11.4.2 Requirements for erecting main boom with fixed jib

a) The crane is properly supported and level.
b) The counterweight plates have been attached in accordance with the lifting capacity charts.
c) Select appropriate boom configurations according to the load to be lifted and the load capacity chart, ensure that boom sections have been connected and secured.
d) All limit switches has been correctly fitted and are fully operational.
e) All pinned connections have been secured.
f) The hoisting rope has been correctly placed in the rope pulleys and prevented from

jumping out (from rope groove) using rope guard tube.

g) No person is present in the danger zone.

h) There are no loose parts on main boom or jib.

i) In winter, the main boom, fixed jib and associated components (limit switches, rope drums, warning light, anemometer etc.) must be kept free of ice and snow.

CAUTION

Incorrectly fitted or faulty limit switches and falling parts (pins, retaining pins, ice etc.) can cause injury.

5.11.4.3 Erecting main boom with fixed jib

a) Select the "fixed jib" operating mode on the screen of Load Moment Limiter in accordance with boom configurations.

CAUTION

Performing slewing motion before the fixed jib is off the ground is prohibited.

b) Move right control lever (30) to the left to raise the boom, and push left control lever (20) forwards at the same time to reel off hoisting winch 2 so that the load hook will not be dragged on the ground.

When main boom is raised to 30° position, the "assembly mode" will be changed to "operating mode" automatically. Return the left and right control levers to neutral position to stop movement.

c) Move right control lever (30) to the left to erect the boom . When the main boom with fixed jib is raised to requried working position, move right control lever (30) to neutral position.

CAUTION

(1) When main boom is raised to 83°, the movement of derricking boom up will be switched off automatically along with warning signal being sent out, but the main boom can still be derricked up by turning the bypass key switch to "bypass" position. However, when main boom is raised to 86° position, the limit switch on boom frame will be triggered, the movement of derricking boom up will be switched off automatically and warning signal will be sent out. Under this condition, even though the bypass key switch is turned to "bypass" position, the main boom can not be raised any more.

(2) The boom should be erected or set down stably at even speed.

5.11.4.4 Lowering and dismantling main boom with fixed jib

a) Move right control lever (30) to the right to lower the boom. When main boom is lowered to 30° position, return right control lever (30) to neutral position.

b) Push left control lever (20) forwards to lower the hook on the ground. After the load hook is lowered on the ground, it must be moved away from the position where the boom will be lowered.

CAUTION

To avoid load hook's colliding with the pulley head, the load hook must not be lifted too high in the process of lowering main boom with fixed jib.

c) Move right control lever (30) to the right to reel off the main boom derricking winch so as to make the fixed jib head come into contact with the ground, then disconnect the inner pipe of rear tilting-back support of fixed jib (G75) from the main boom head (See the following figure).

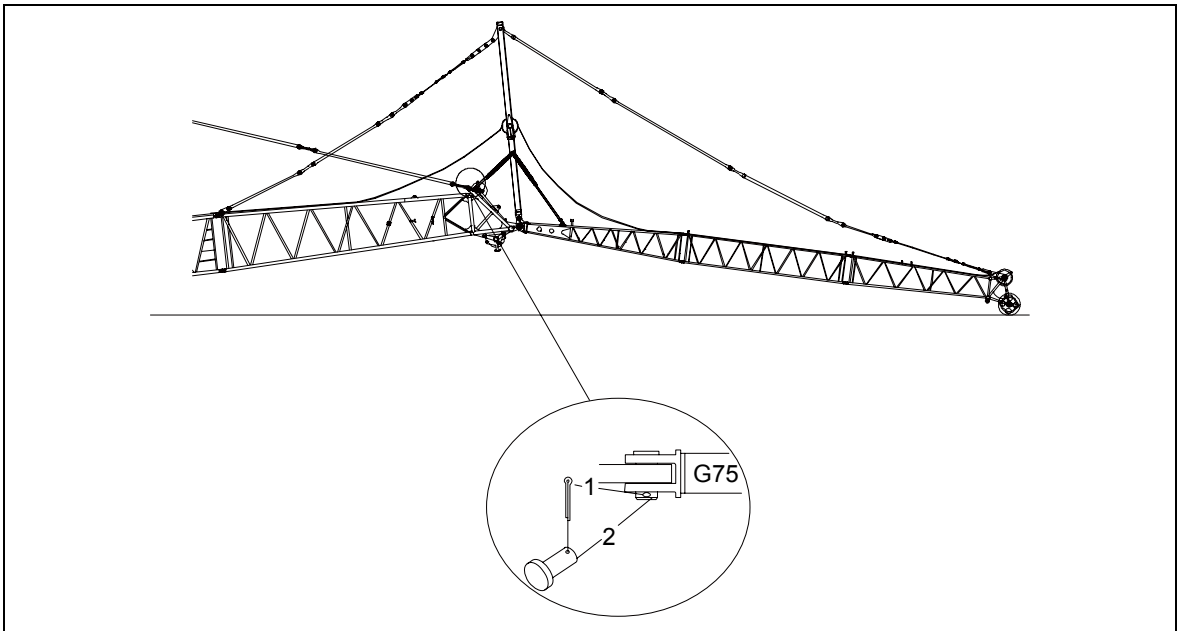
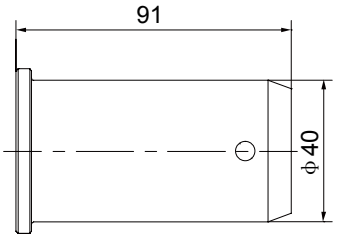
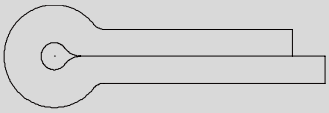


Figure 5-132 Assembly of rear tilting-back support of fixed jib

Table 5-42 Connecting parts

Part No.	Description	Illustration (mm)
1	Pin spindle	

2	Cotter pin	 GB/T91-2000（8×60）

d) Keep on moving right control lever (30) rightwards to reel off the main boom derricking winch so as to make the fixed jib head roll forwards on the running wheel until the entire boom gets into contact with the ground.
Move right control lever (30) to neutral position to stop the movement.

CAUTION

(1) The boom-lowering movement should be performed slowly and stably. And during the operation, the crane operator must observe the data shown on the display, while other workers must observe the surrounding areas for potential dangers.

(2) No standing under the boom.

(3) To prevent the wire rope from being damaged due to crush, it should be guided by a person.

e) Push left control lever (20) backwards to wind the hoisting rope onto the winch 2 and secure it.

CAUTION

The winding of wire rope should be supervised by a person appointed, and no person is standing within danger zone during operation.

f) Lift FA-frame by an auxiliary crane, and then dismantle the front and rear tilting-back support of fixed jib.
Tilt the FA-frame forwards to an appropriate position with the help of auxiliary crane, and then disassemble the fixed jib front and rear anchoring rods.

g) Dismantle the fixed jib sections one by one, leaving the fixed jib pivot section assembled.

h) Detach the fixed jib pivot section (together with FA-frame) from the main boom head.

CAUTION

All crane movements should be carried out smoothly, and all safety precautions should be followed, otherwise there is a risk of accident.

5.12 Assembly and dismantling of main boom with heavy fixed jib (SFV)

For the assembly, dismantling and erecting as well as lowering of main boom with heavy fixed jib, please refer to section 5.11 "Assembly and dismantling of main boom with fixed jib".
Connecting electrics to main boom with heavy fixed jib:

For electrical connections to main boom, please refer to section 5.8.3 "Connect electrics to main boom".

5.13 Assembly and dismantling of tip boom

For the assembly of tip boom of ZCC2600 crawler crane, please refer to the figure below.

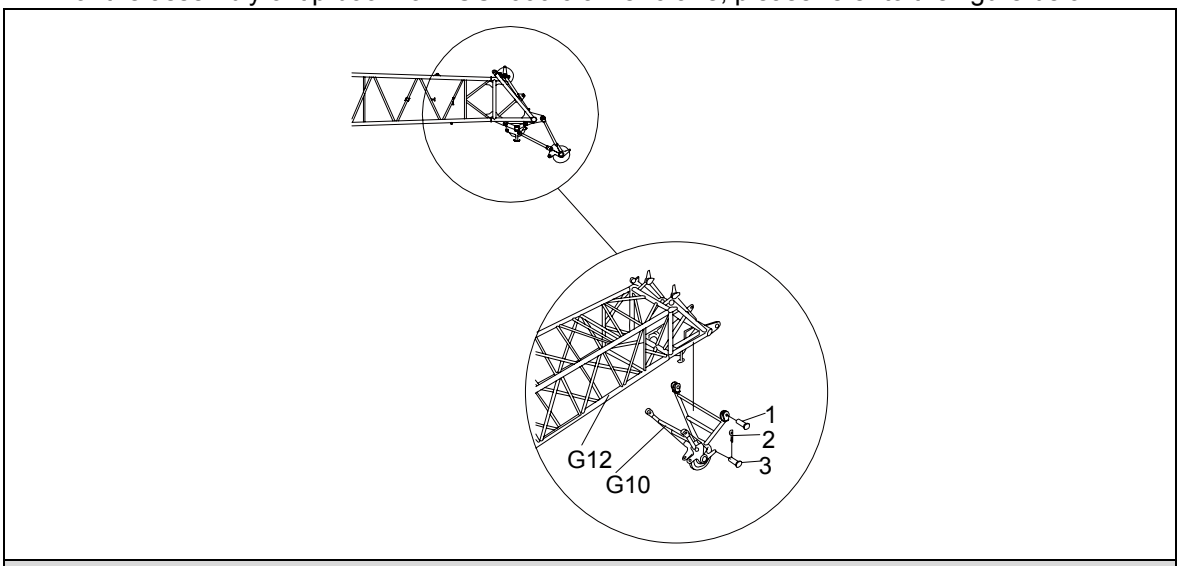
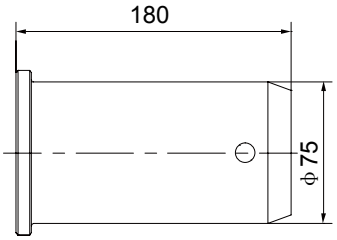
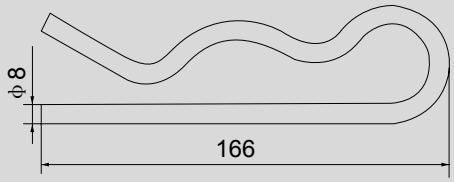
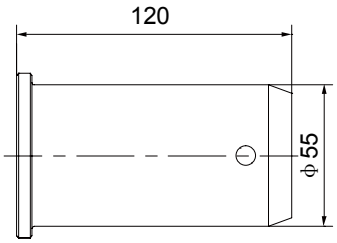


Figure 5-133 Assembly of tip boom on main boom head

Table 5-43 Connecting parts of tip boom on main boom head

Part No.	Description	Illustration (mm)
1	Pin spindle	
2	Retaining spring	
3	Pin spindle	

5.14 Transport weights and dimensions of main components

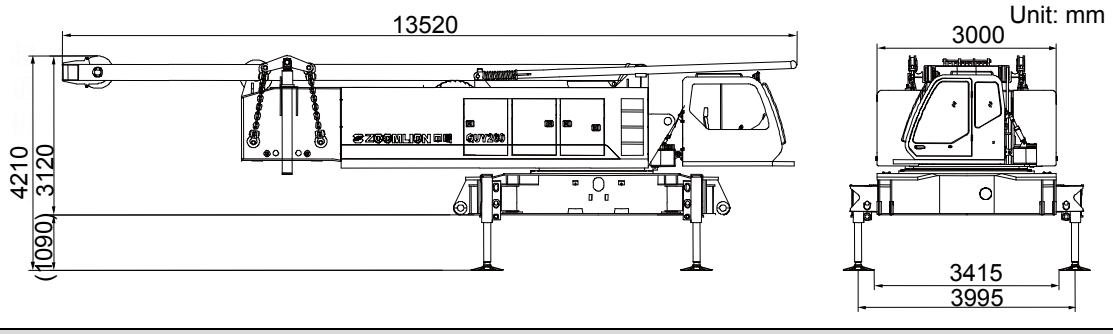


Figure 5-134 Basic machine - 45.5 t × 1

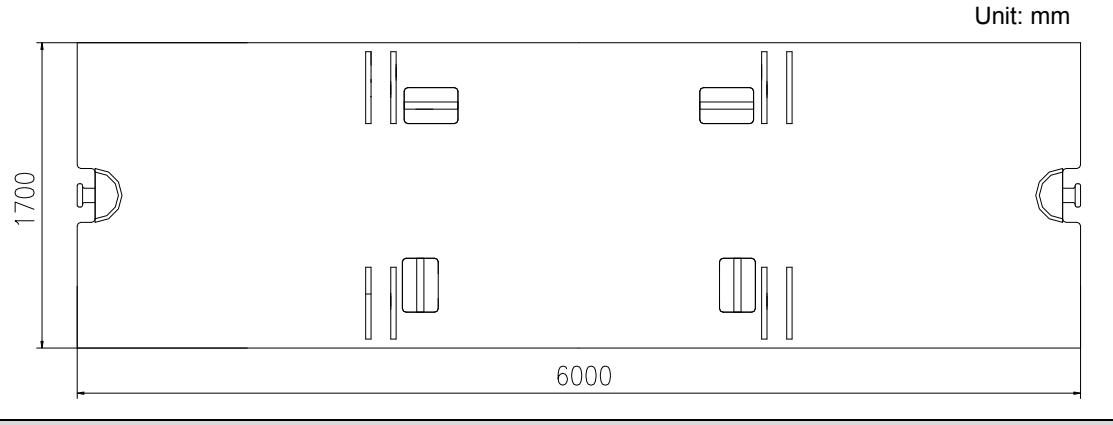


Figure 5-135 Counterweight base plate – 11 t × 1

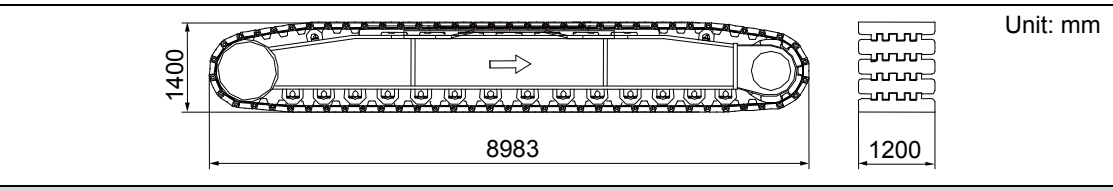
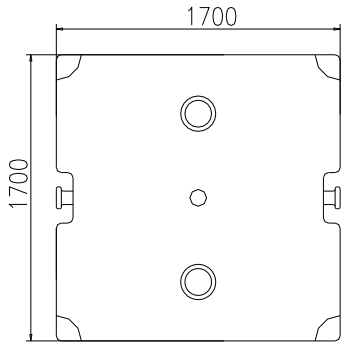
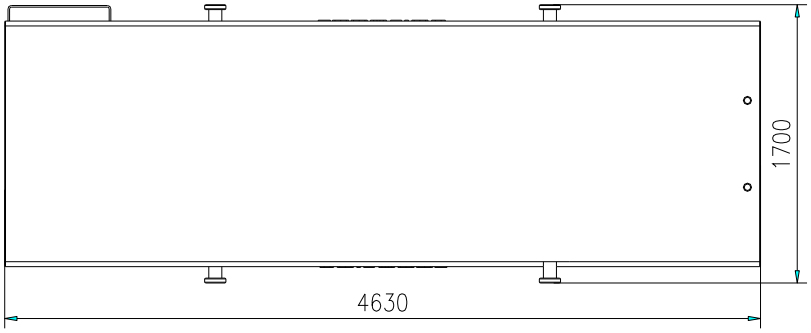


Figure 5-136 Crawler carrier assy. - 24.5 t × 2



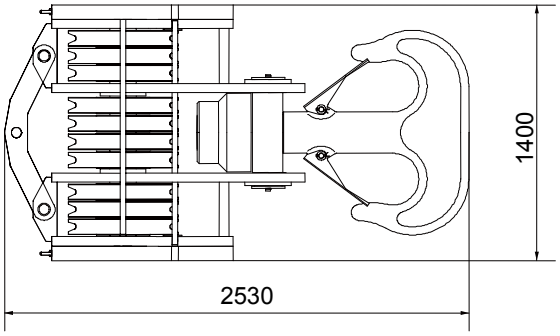
Unit: mm

Figure 5-137 Counterweight plate - 7.1 t × 10



Unit: mm

Figure 5-139 Central counterweight – 16 t × 2



Unit: mm

Figure 5-140 260 t load hook- 4.2 t × 1

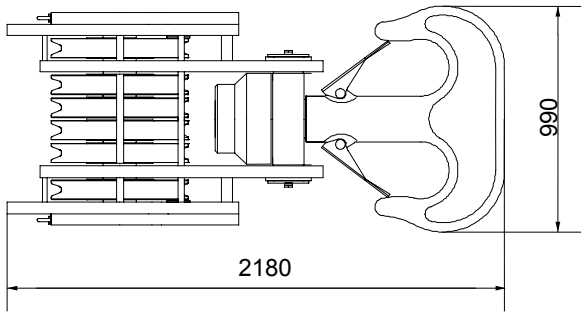


Figure 5-141 160/100 t load hook - 2.8 t × 1

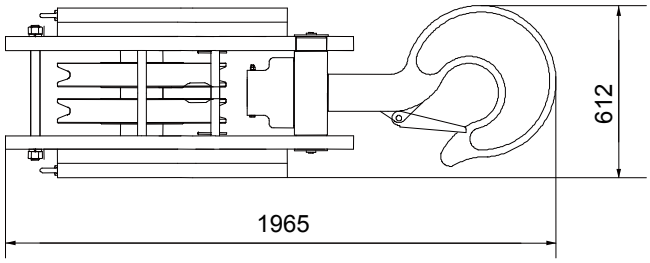


Figure 5-142 50 t load hook - 1.7 t × 1

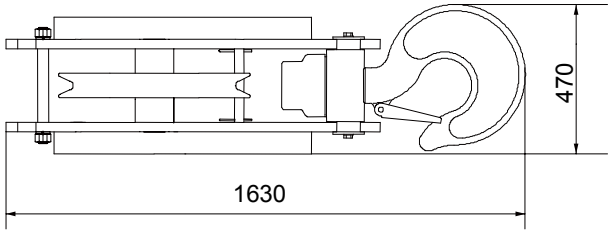


Figure 5-143 30 t load hook - 1.07 t × 1

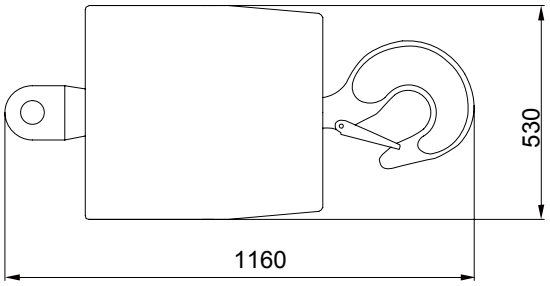


Figure 5-144 16 t load hook - 0.8 t × 1

Unit: mm

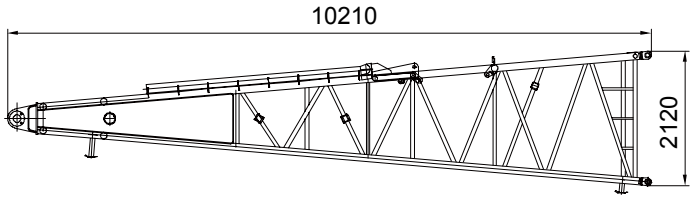


Figure 5-145 Main boom pivot section - 3.02 t × 1

Unit: mm

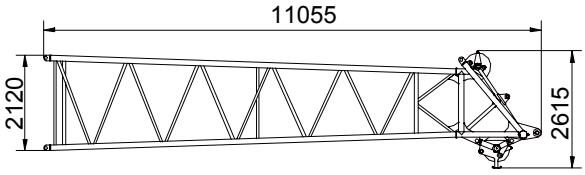


Figure 5-146 Main boom head - 3.38 t × 1

Unit: mm

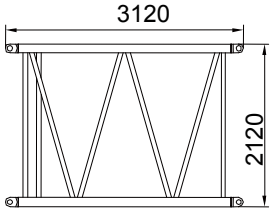


Figure 5-147 3 m main boom intermediate section - 0.72 t × 1

Unit: mm

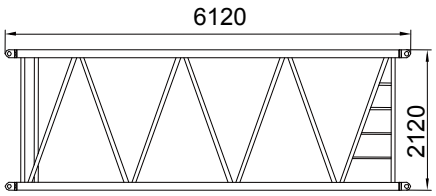


Figure 5-148 6 m main boom intermediate section - 1.2 t × 1

Unit: mm

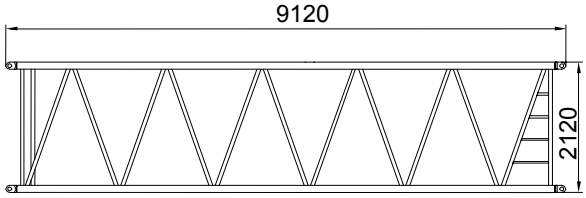
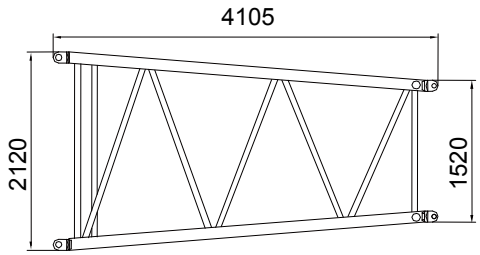
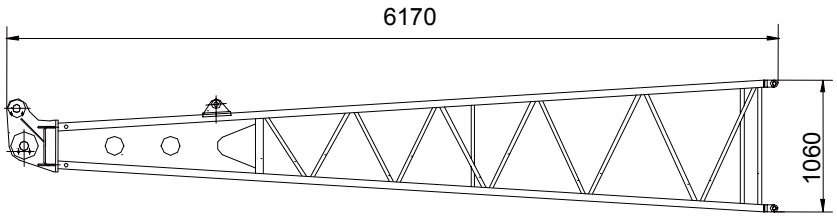


Figure 5-149 9 m main boom intermediate section - 1.78 t × 6



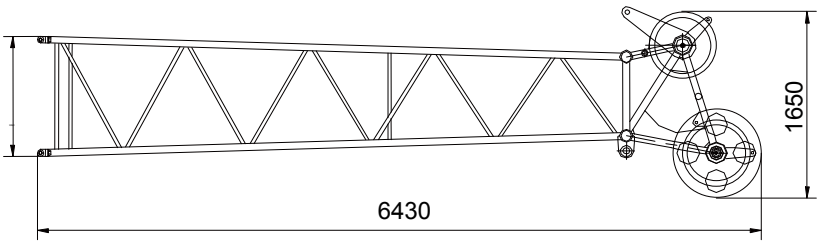
Unit: mm

Figure 5-150 4m reducing section - 0.82 t × 1



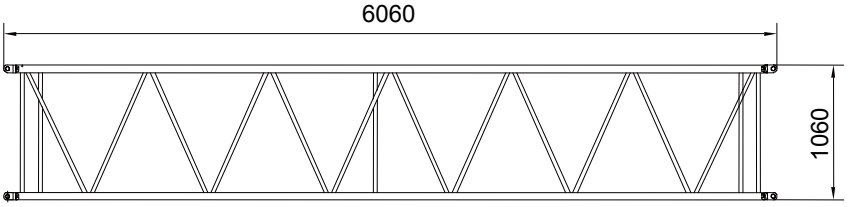
Unit: mm

Figure 5-151 Fixed jib pivot section - 0.47 t × 1



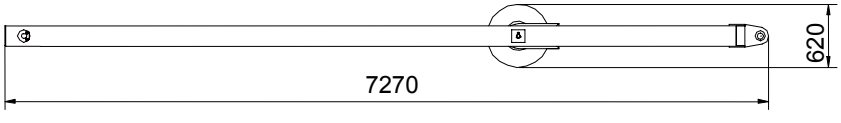
Unit: mm

Figure 5-152 Fixed jib head- 0.64 t × 1



Unit: mm

Figure 5-153 6 m fixed jib intermediate section - 0.5 t × 1



Unit: mm

Figure 5-154 FA-frame - 0.75 t × 1

Unit: mm

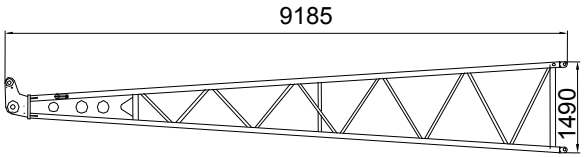


Figure 5-155 Luffing jib pivot section - 1.05 t × 1

Unit: mm

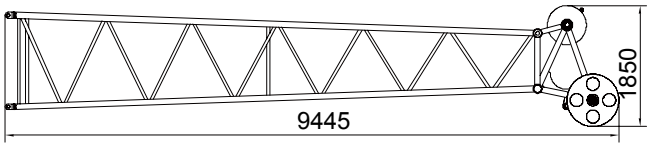


Figure 5-156 Luffing jib head - 1.1 t × 1

Unit: mm

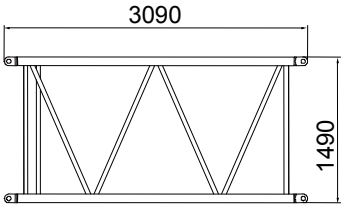


Figure 5-157 3 m luffing jib intermediate section - 0.32 t × 1

Unit: mm

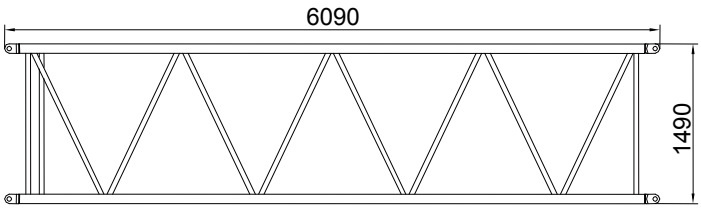


Figure 5-158 6 m luffing jib intermediate section - 0.59 t × 1

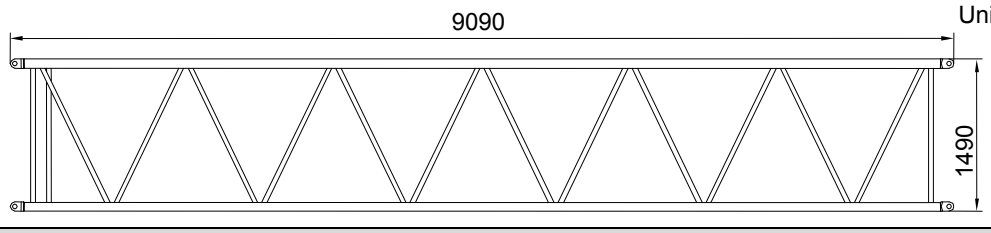


Figure 5-159 9 m luffing jib intermediate section A - 0.82 t × 1

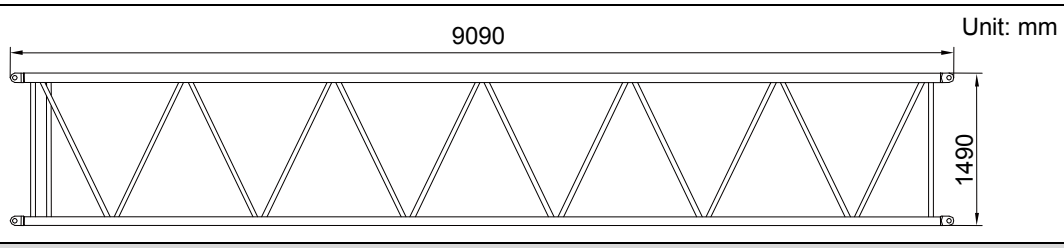


Figure 5-160 9 m luffing jib intermediate section B- 0.68 t × 1

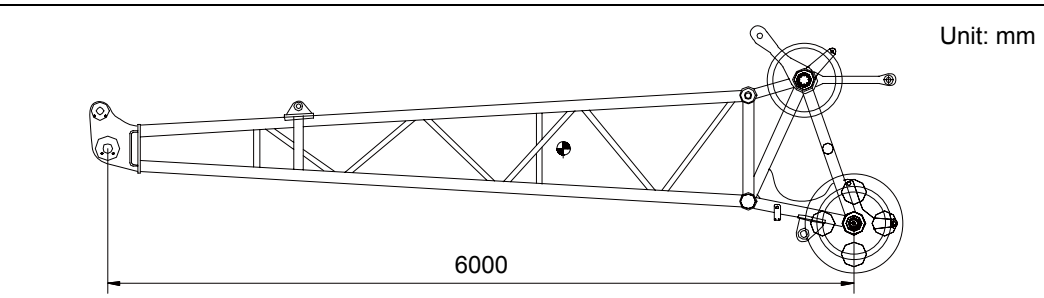


Figure 5-161 Heavy duty fixed jib – 1 t × 1

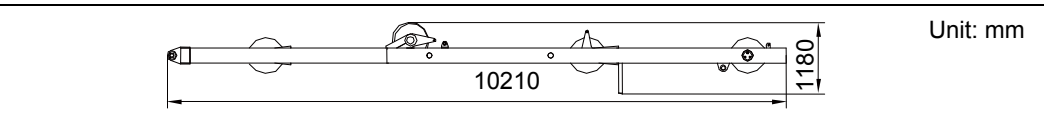


Figure 5-162 WA-frame 2 - 1.74 t × 1

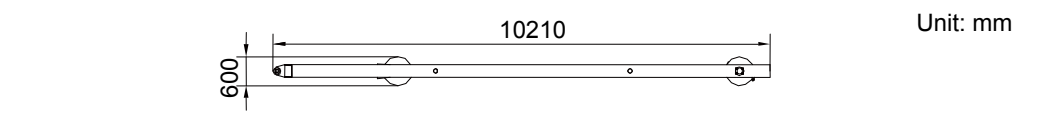


Figure 5-163 WA-frame 1- 1.52 t × 1

5.15 Requirement for crane transport

Transport means and safety precautions for transport

a) After being dismembered, the crawler crane can be transported by a low-loader, train or by other transport equipment for a long distance. During transportation, the crane is fixed by rope, with its doors and windows locked up. If necessary, take preventive measures against rain. The crawler crane should be dismembered and transported in accordance with the permissible load carrying capacity of transport vehicle and the weight, dimensions of dismantled parts which are shown in the previous figures. The transport vehicle is forbidden to be overloaded.

b) During transportation, all component parts should be fixed to prevent them from jostling and sliding.

c) To understand the detailed transport means, please consult our company.

If the crane is not used for more than 6 months, take the following protective measures.

a) Wipe off the dust and oil dirt to keep the crane clean.

b) Retract all the piston rods of the cylinders completely.

c) Put the battery in a dry and ventilating place and charge it periodically.

d) Bare surfaces of all components should be greased to prevent them from corroding.

e) Clean the wire ropes and grease them again with ZG-3 graphite calcium base grease.

f) The crane should be stored in a garage. If it is placed in the open air, it must be covered up with water-proof cloth to prevent it from corroding, and in winter antifreeze measures should be taken.

g) Starting the machine once a month and running all mechanisms with no load to check whether they are in good condition.

h) Assign a person responsible for completeness of the crane so that it can be put into operation at any time.

ZOOMLION

Operator’s Manual for Crawler Crane

Chapter 6 Appendix

Chapter 6 Appendix

6.1 Description of special heavy fixed jib on heavy duty boom

SFV-D boom configuration is used to lifting and turning over the shield tunneling machine.

6.1.1 Terminology

6.1.1.1 Boom configuration

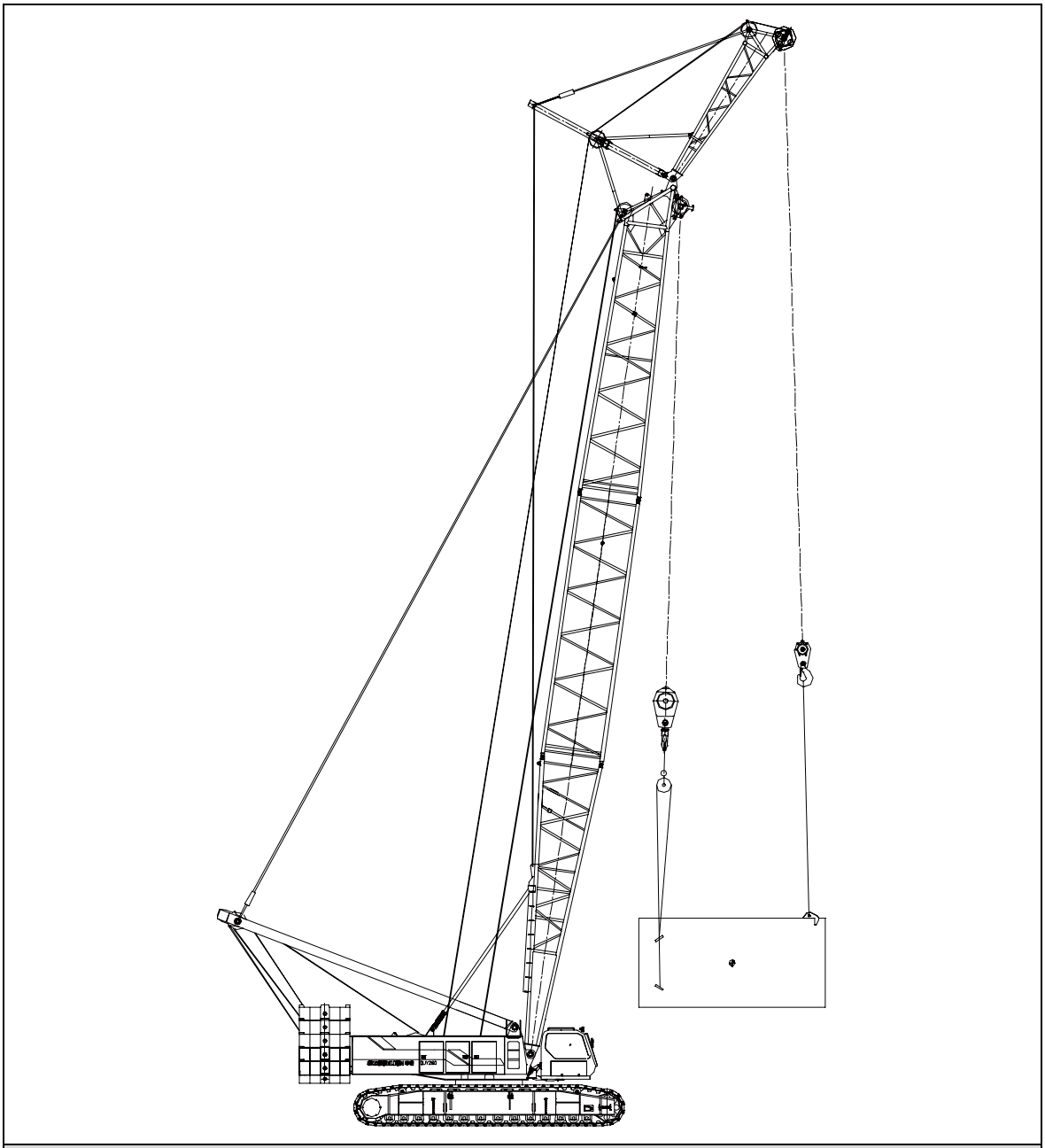


Figure 6-1 Configuration used to turning over the shield tunneling machine

Table 6-1 Instructions for boom configuration

Configuration No.	Description	Parameters
SFV-D	Special heavy fixed jib on heavy duty boom	S = 20 m – 29 m, FV = 6 m

6.1.1.2 Description of component parts and component of heavy fixed jib

a) Combination of heavy fixed jib

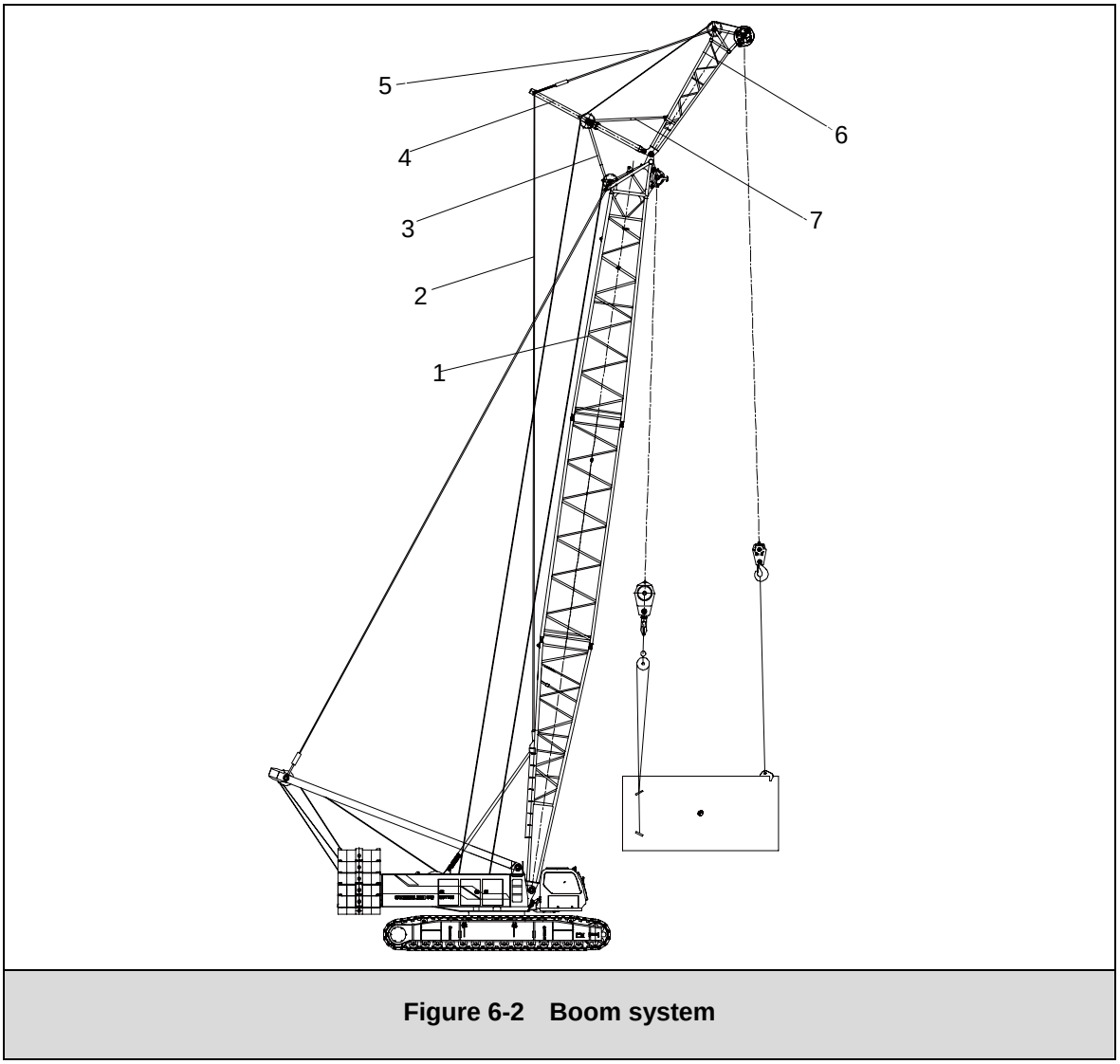


Figure 6-2 Boom system

1) Main boom G1*(S = 20 m – 29 m).
2) Rear anchoring rods for special heavy fixed jib.
3) Tilting-back support for FVA-frame G75-D.
4) FVA-frame G37-D
5) Front anchoring rods for special heavy fixed jib
6) Fixed jib G41

7) Tilting-back support for special heavy fixed jib G74-D.

CAUTION

For combination of main boom and anchoring rods, see Chapter 5 of *ZCC2600 Operator's Manual*.

b) Combination of rear anchoring rods for special heavy fixed jib

The mounting angle of rear anchoring rods for special heavy fixed jib is 25°.

The anchoring rods length is determined by main boom length.

Combination of rear anchoring rods for special heavy fixed jib is shown in the following figure.

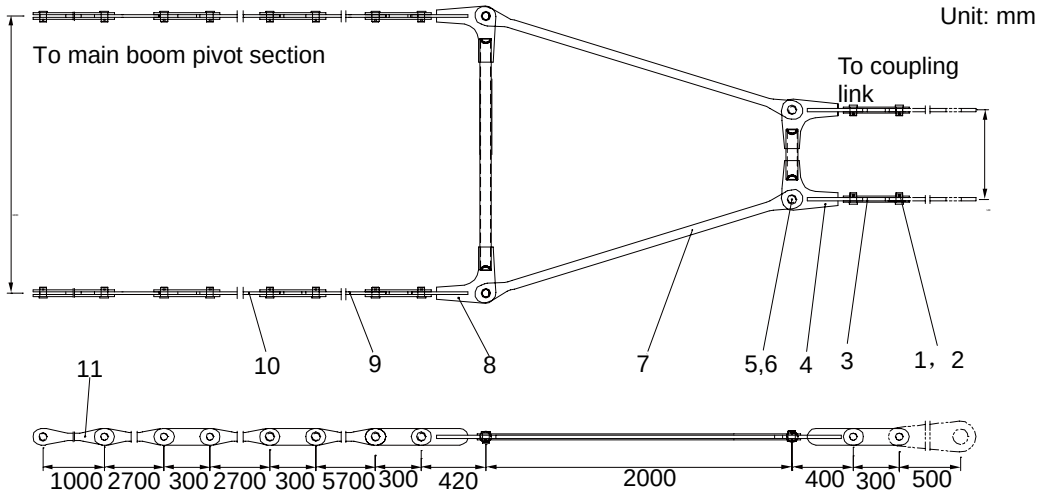


Figure 6-3 Rear anchoring rods for special heavy fixed jib

When the longest main boom length is 29m, the combination of the rear anchoring rods for special heavy fixed jib is shown in the above figure.

When main boom is 20m, 23m, 26m and 29m, the corresponding combinations of the rear anchoring rods for special heavy fixed jib are shown in the following figure.

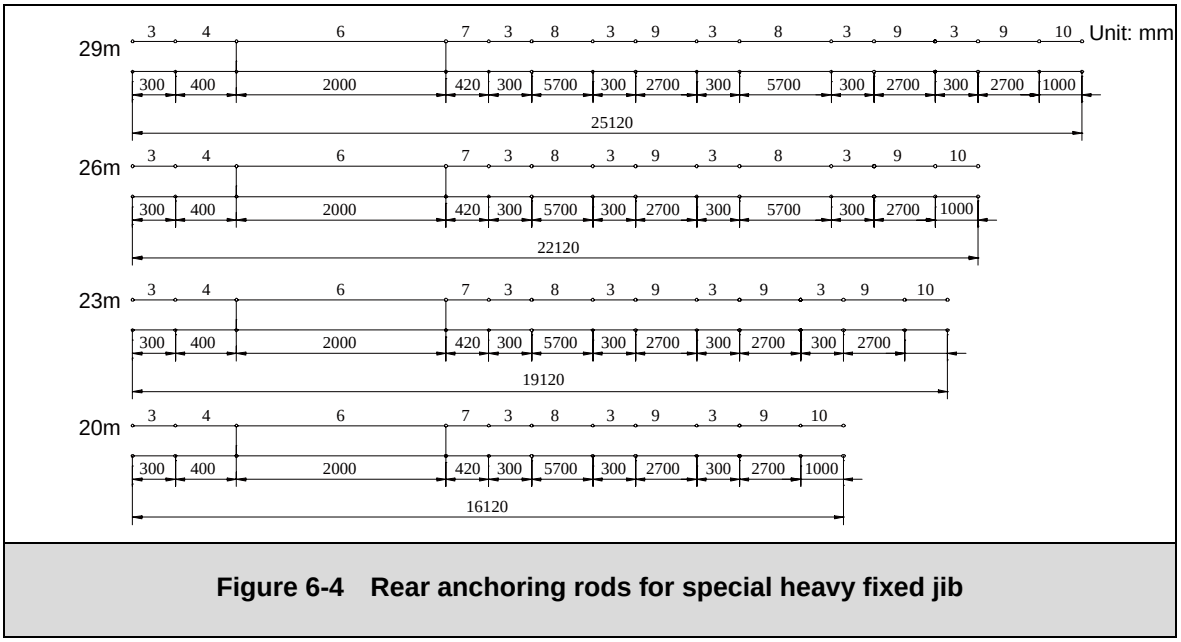
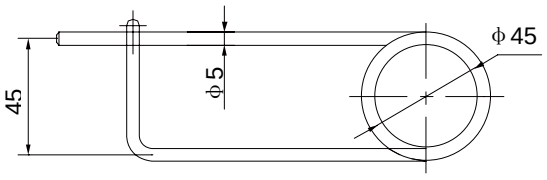
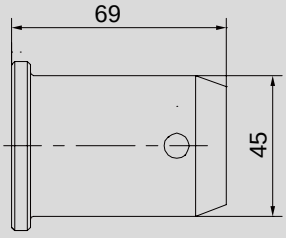


Figure 6-4 Rear anchoring rods for special heavy fixed jib

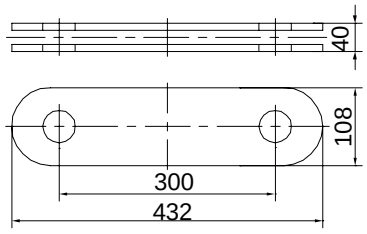
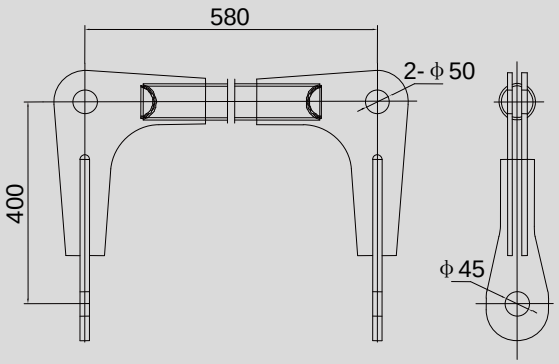
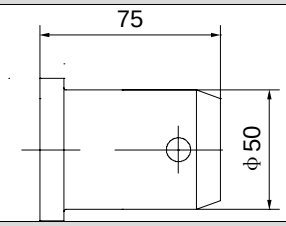
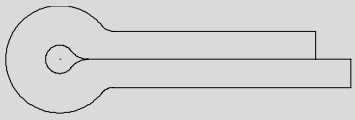
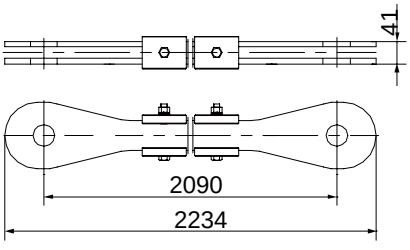
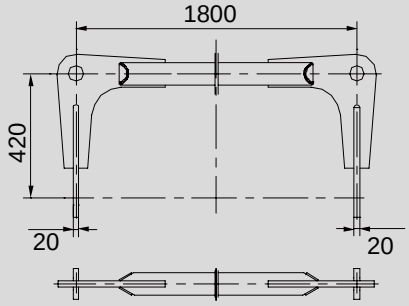
CAUTION

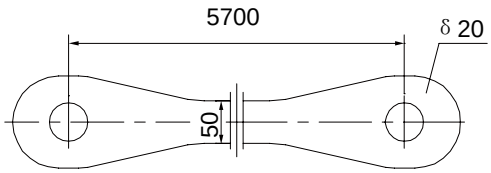
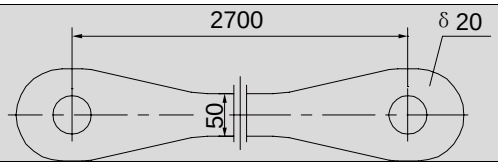
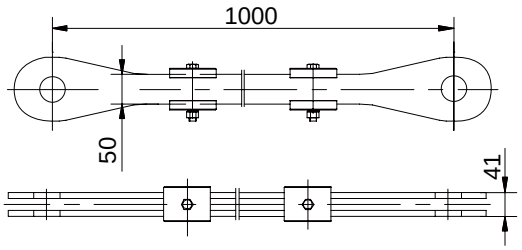
The numbers above the combination of anchoring rods are part numbers of anchoring rods, the dimensions below the combination of anchoring rods are projected lengths of component parts. The component parts corresponding to part numbers are shown in the following table.

Table 6-2 Component parts of rear anchoring rods for special heavy fixed jib

Part No.	Description	Illustration(mm)
1	Retaining pin	
2	Pin spindle	

Appendix

Part No.	Description	Illustration(mm)
3	Double anchoring rod	
4	Coupling link	
5	Pin spindle	
6	Cotter pin	 GB/T91-2000(10*90)
7	Double anchoring rod	
8	Coupling link	

Part No.	Description	Illustration(mm)
9	Anchoring rod	
10	Anchoring rod	
11	Double anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "rear anchoring rods for special heavy fixed jib" are consistent with those in the above table, so the component parts of anchoring rods can be found by referring to the part numbers when assembling.

c) Combination of front anchoring rods for special heavy fixed jib

Combination of front anchoring rods for special heavy fixed jib is shown in the following figure.

Combination of front anchoring rods for special heavy fixed jib

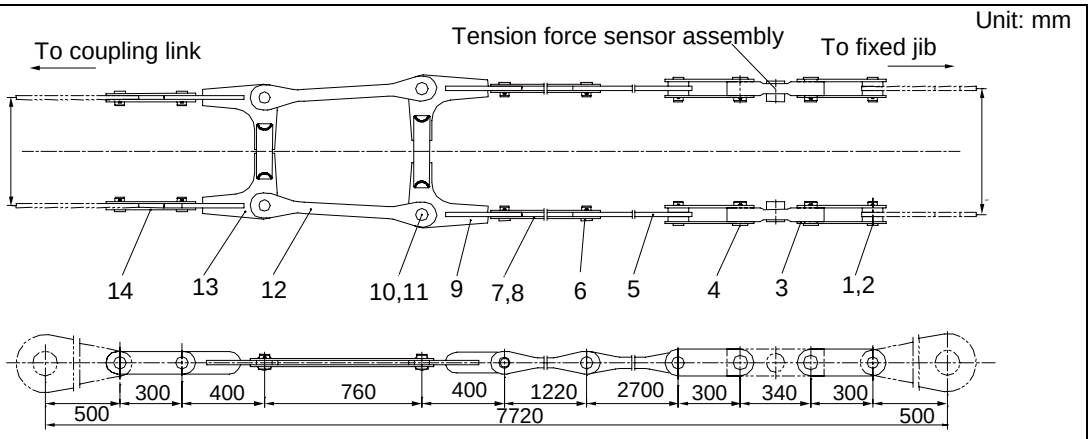
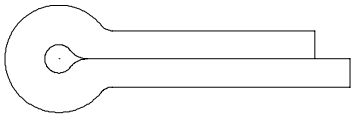
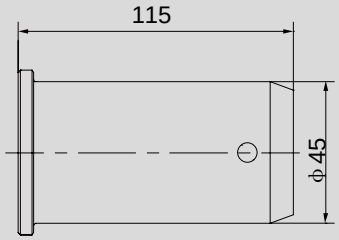
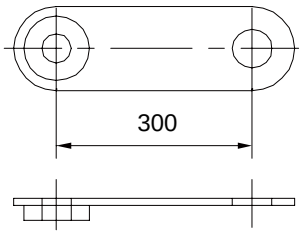
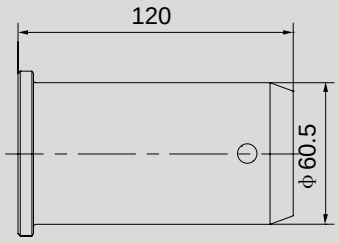
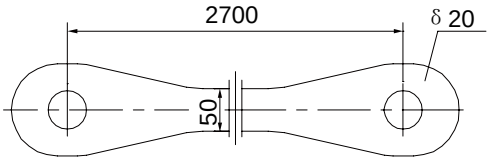
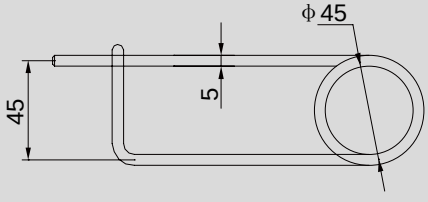
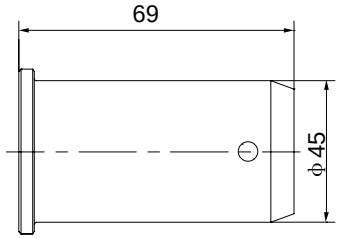
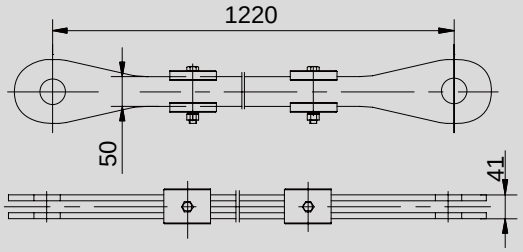
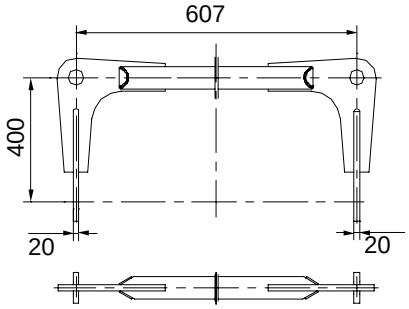
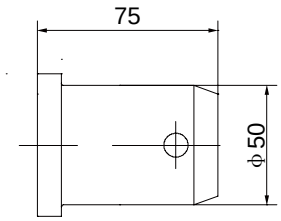
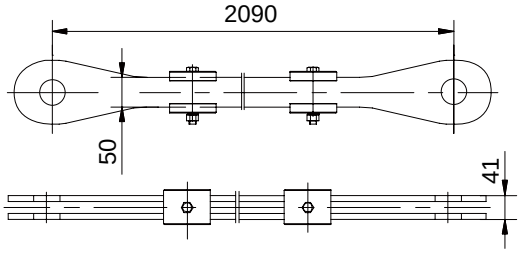


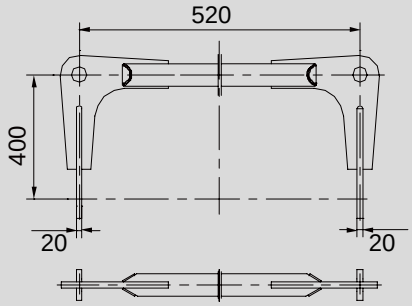
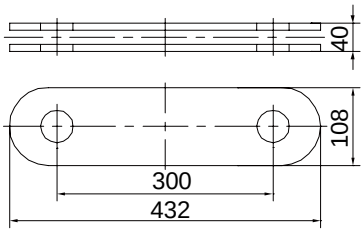
Figure 6-5 Front anchoring rods for special heavy fixed jib

The numbers above the combination of anchoring rods are part numbers of anchoring rods, the dimensions below the combination of anchoring rods are projected lengths of component parts. The component parts corresponding to part numbers are shown in the following table.

Table 6-3 Component parts of front anchoring rods for special heavy fixed jib

Part No.	Description	Illustration(mm)
1	Cotter pin	 GB/T91-2000(8*60)
2	Pin spindle	
3	Anchoring rod	
4	Pin spindle	
5	Anchoring rod	
6	Retaining pin	

Part No.	Description	Illustration(mm)
7	Pin spindle	
8	Double anchoring rod	
9	Coupling link	
10	Cotter pin	 GB/T91-2000(10*90)
11	Pin spindle	
12	Double anchoring rod	

Part No.	Description	Illustration(mm)
13	Coupling link	
14	Double anchoring rod	

CAUTION

The part numbers of anchoring rods given in Section "front anchoring rods for special heavy fixed jib" are consistent with those in the above table, so the component parts of anchoring rods can be found by referring to the part numbers when assembling.

d) Component of fixed jib tilting-back support system

Fixed jib tilting-back support system is composed of FVA-frame (G37-D), tilting-back support for FVA-frame (G75-D) and tilting-back support for special heavy fixed jib (G74-D). Their dimensions are shown in the following figure.

1) FVA-frame (G37-D)

The FVA-frame is 5 m long, 0.64 t in weight, and 1 piece/unit.

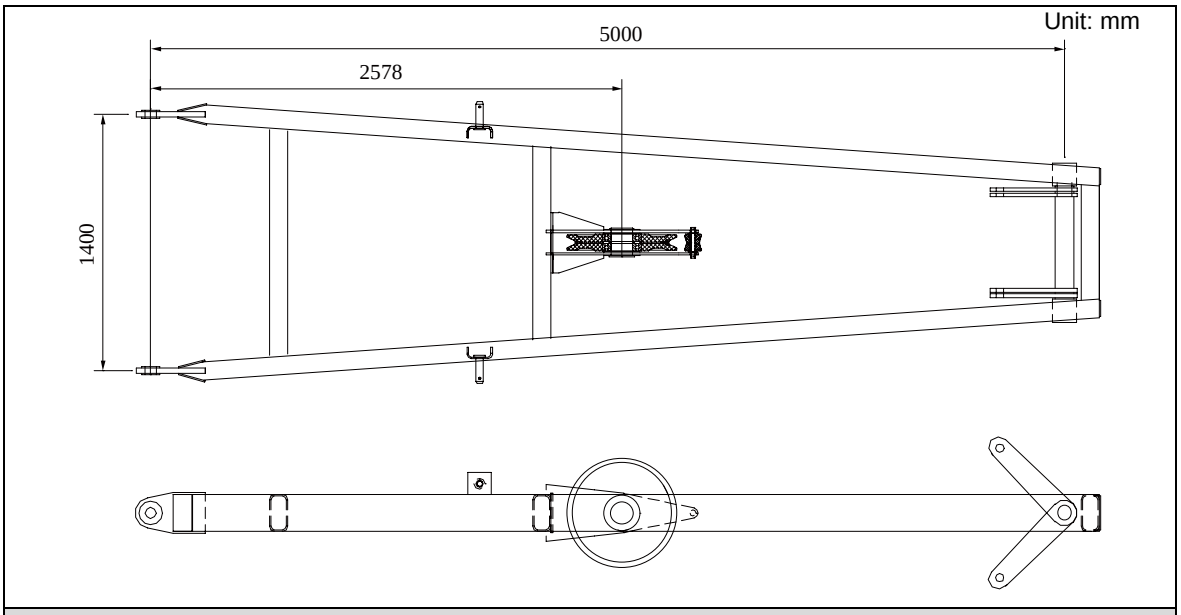


Figure 6-6 FVA-frame

CAUTION

Only when the crane is operated with heavy duty boom and special heavy fixed jib, can the FVA-frame (G37-D) be assembled.

DANGER

The special FVA-frame (G37-D) is different from the general FV-frame (G37). It is prohibited to misuse.

2) Tilting-back support for FVA-frame (G75-D)

Each crane has two tilting-back supports for FVA-frame.

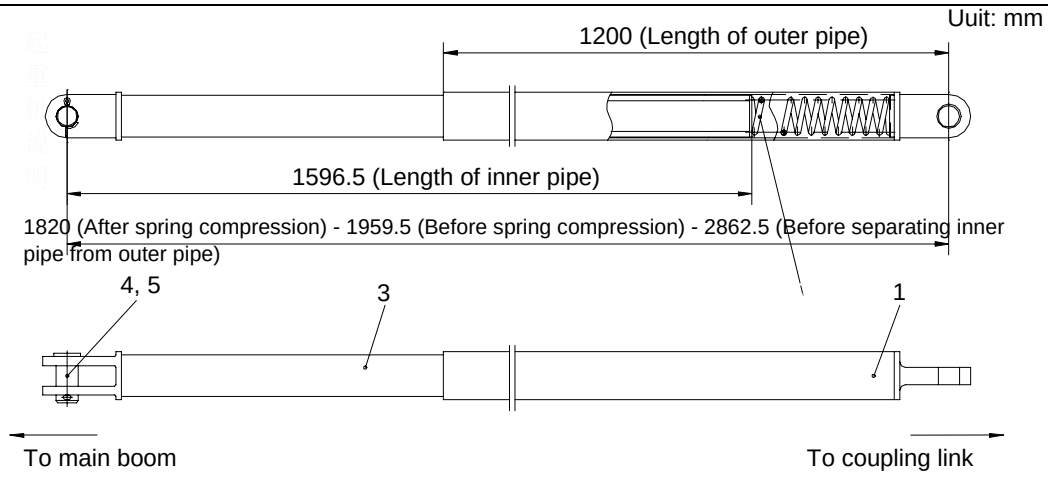
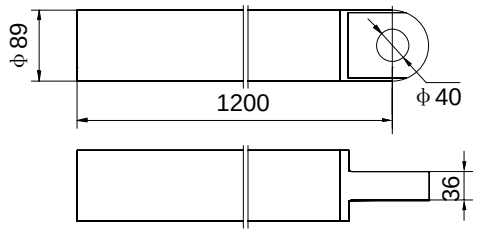
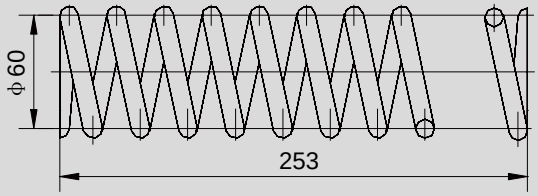
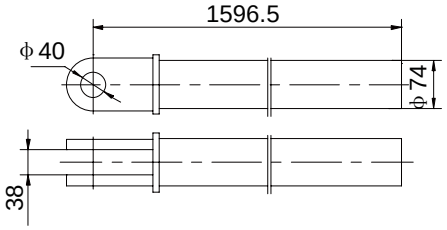
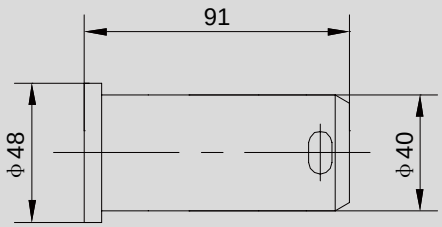
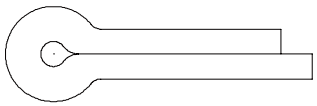


Figure 6-7 Tilting-back supports for FVA-frame

Table 6-4 Component parts of tilting-back support for FVA-frame (G75-D)

Part No.	Description	Illustration(mm)
1	Outer pipe	
2	Spring	
3	Inner pipe	

Part No.	Description	Illustration(mm)
4	Pin spindle	
5	Cotter pin	 GB/T91-2000(8*60)

CAUTION

(1) Only when the crane is operated with heavy duty boom and special heavy fixed jib, can the tilting-back support for FVA-frame (G75-D) be assembled.

(2) The part numbers in the above table are consistent with those in above figure.

DANGER

The tilting-back support for special FVA-frame (G75-D) is different from the tilting-back support for general FV-frame (G75). It is prohibited to misuse.

3) Tilting-back support for special heavy fixed jib (G74-D)

Each crane has two tilting-back supports for special heavy fixed jib.

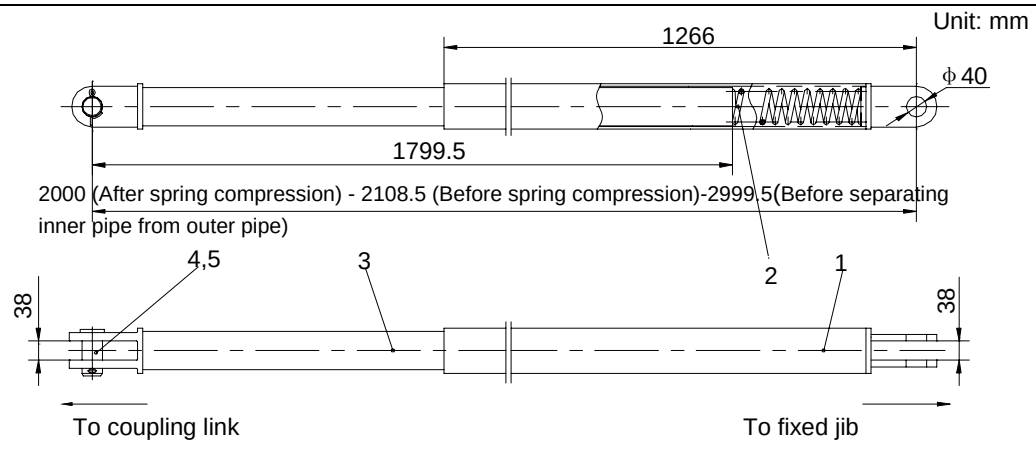
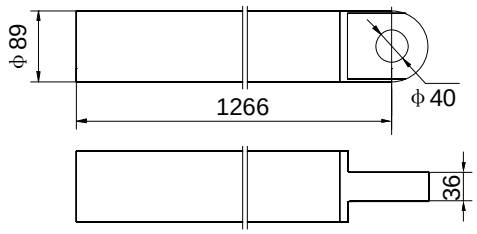
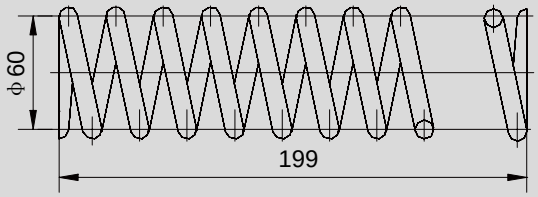
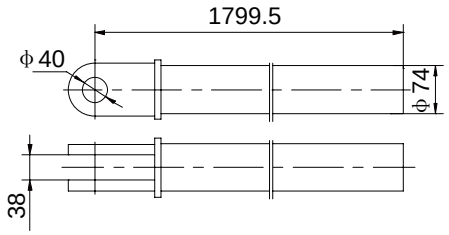
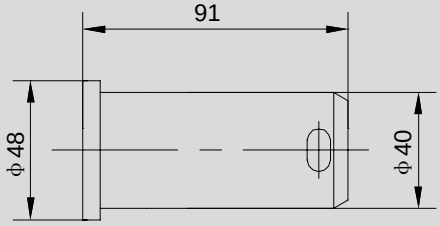
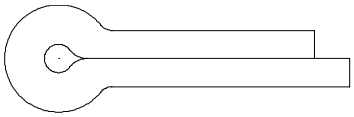


Figure 6-8 Tilting-back support for special heavy fixed jib (G74-D)

Table 6-5 Component parts of fixed jib tilting-back support for special FVA-frame (G74-D)

Part No.	Description	Illustration(mm)
1	Outer pipe	
2	Spring	
3	Inner pipe	
4	Pin spindle	
5	Cotter pin	 GB/T91-2000(8*60)

CAUTION

(1) Only when the crane is operated with heavy duty boom and special heavy fixed jib, can the tilting-back support for special heavy fixed jib (G74-D) be assembled.

(2) The part numbers in the above table are consistent with those in above figure.

DANGER

The tilting-back support for special heavy fixed jib (G74-D) is different from the

tilting-back support for general heavy fixed jib (G74). It is prohibited to misuse.

6.2 Assembly of special heavy fixed jib on heavy duty boom

6.2.1 Preparations

a) The crane is properly supported and level.
b) Choose appropriate boom combination and relevant anchoring rods combination according to operational planning and boom configuration.
c) The required counterweight plates have been assembled (assemble two 4t counterweight plates, see Section 6.2.2).
d) An auxiliary crane and working platform are available.
e) The safety load indicator system of load moment limiter is set according to the data given in the lifting capacity charts.
f) Choose the correct load hook and rope reeving for the load to be lifted.
g) Change the "operating mode" to "assembly mode".

DANGER

(1) After the "operating mode" is changed to "assembly mode", all safety device built in the crane will be deactivated, the assembly, dismantling of the machine should therefore be carried out with utmost care.
(2) Any assembly work on crane should be carried out on safety working ground, otherwise there may be a risk of accident.
(3) Do not stand beneath the boom when it is being pinned or unpinned!

6.2.2 Assembly of rear counterweight

For "special heavy fixed jib on heavy duty boom" configuration, extra two counterweight plates of 4 t each should be added, namely, the rear counterweight, weighing 91.7t in total, consists of ten counterweight plates of 7.1 t, two counterweight plates of 4 t and a counterweight base plate of 12.7 t. They are assembled on both sides of superstructure's tail. The counterweight plates of 4 t are assembled on the counterweight plates of 7.1 t.
For the details of assembly, see Chapter 5 of *ZCC2600 Operator's Manual***.**

CAUTION

(1) Each counterweight plate should be placed in slot and fixed when assembling the rear counterweight.
(2) Under this boom configuration, assemble the 2 pieces of 4 t counterweight plates after the boom is connected well.

6.2.3 Assembly of special heavy fixed jib on heavy duty boom (SFV-D)

CAUTION

Before operating the crane, set the "Boom configuration" switch to "fixed jib" position.

a) Connect main boom and main boom anchoring rods according to the required length described in Chapter 5 of *ZCC2600 Operator's Manual***.**

b) Raise the special heavy fixed jib (G41) with an auxiliary crane, attach it to the main boom head. Pin the special heavy fixed jib to main boom head with pin spindles (2) and secure with bolts (5), shaft end retaining plate (3), retaining springs (1) and washer (4).

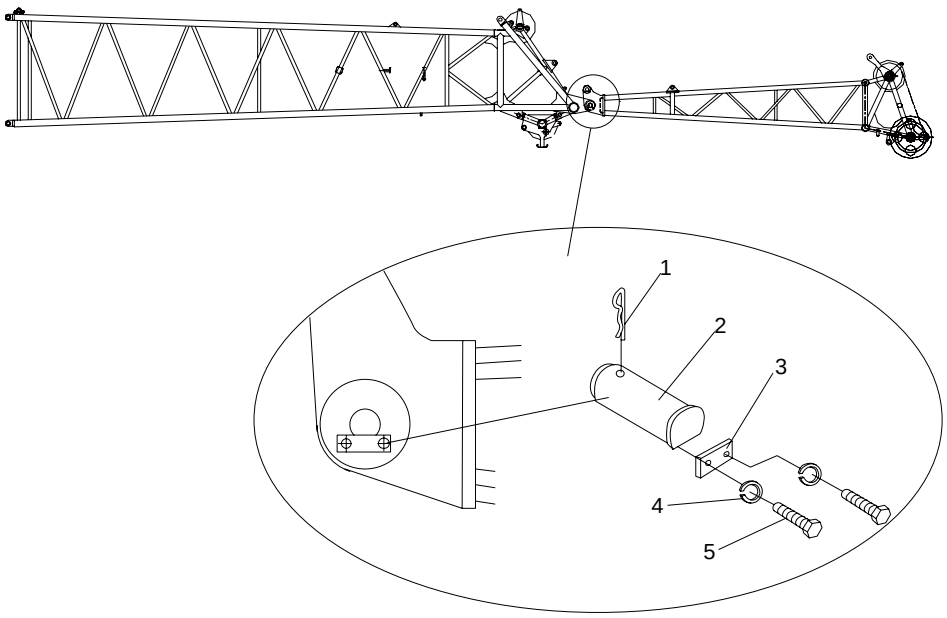
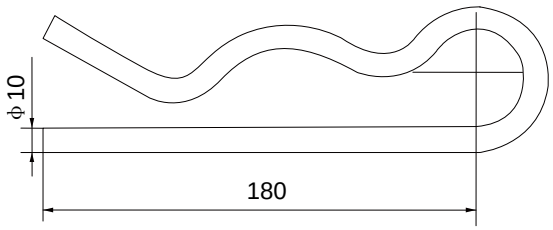
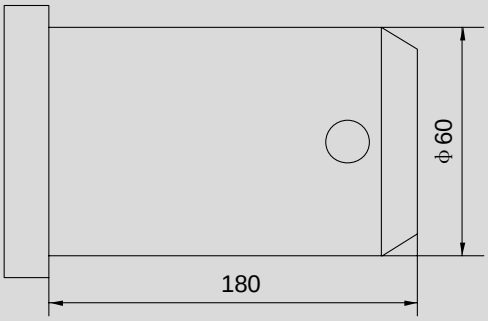
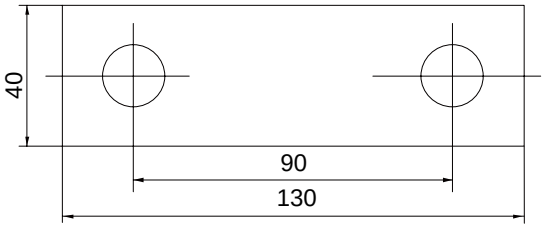
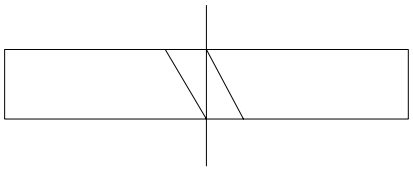
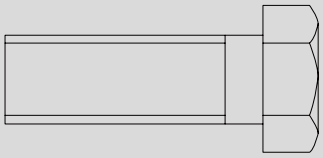


Figure 6-9 Assembly of special heavy fixed jib on heavy duty boom (SFV-D)

Table 6-5 Connecting parts of special heavy fixed jib to main boom head

Part No.	Description	Illustration (mm)
1	Retaining spring	
2	Pin spindle	
3	Shaft end retaining plate	
4	Washer	 GB/T93-1987(16)
5	Bolt	 GB/T5783-2000(M16×55-8.8)

c) Preassemble partial rear anchoring rods to FVA-frame (G37-D) (see the following A-view, for the part numbers appeared in the following figure, please refer to Section 6.1.1.2.b"Combination of rear anchoring rods for special heavy fixed jib").

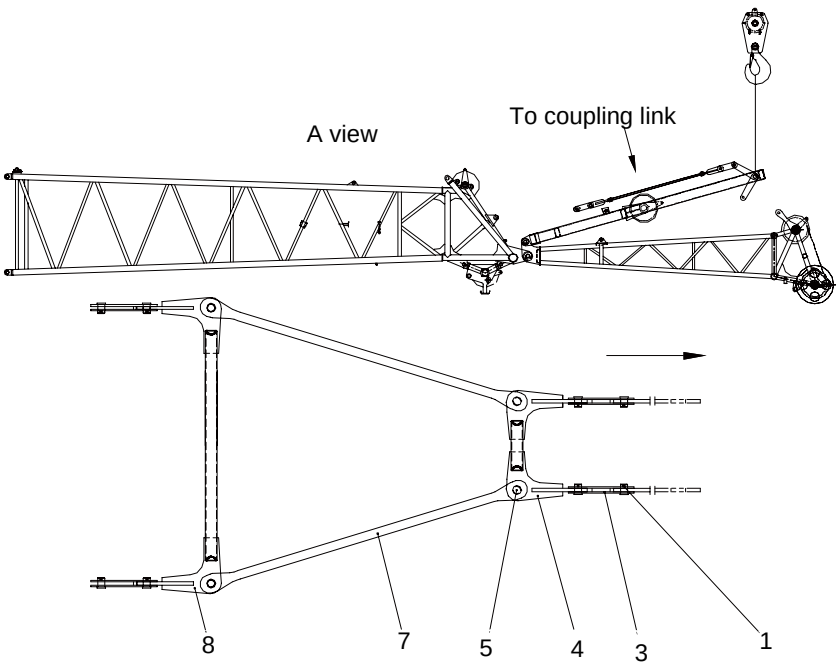


Figure 6-10 Assembly of rear anchoring rods to FVA-frame

d) Preassemble partial front anchoring rods to FVA-frame (G37-D) (see the following B-view, for the part numbers appeared in the following figure, please refer to Section 6.1.2.c "Combination of front anchoring rods for special heavy fixed jib"). Lift FVA-frame until the front anchoring rods for special heavy fixed jib is assembled.

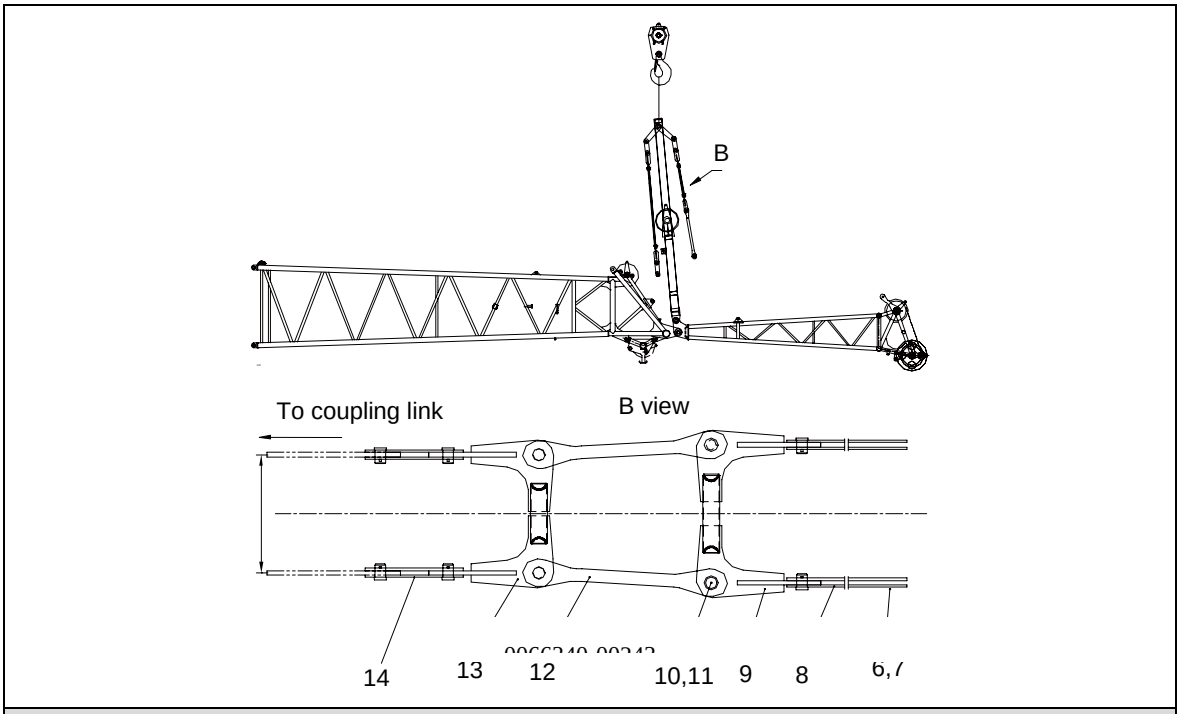


Figure 6-11 Assembly of front anchoring rods to FVA-frame

e) Connect tilting-back support system.

– Assemble the outer pipe end (1) of tilting-back support for FVA-frame (G75-D) and the inner pipe end (2) of tilting-back support for special heavy fixed jib (G74-D) to FVA-frame (G37-D) (5), and secure them with cotter pin (3).

– Assemble the inner pipe end of tilting-back support for FVA-frame (G75-D) to main boom head.

– Lift the FVA-frame (G37-D) (5) with an auxiliary crane until the front anchoring rods for special heavy fixed jib is tensioned slightly.

– Attach the outer pipe end (2) of tilting-back support for special heavy fixed jib (G74-D) (2) to heavy fixed jib pivot section and secure them with cotter pin (3) and in spindle (4.).

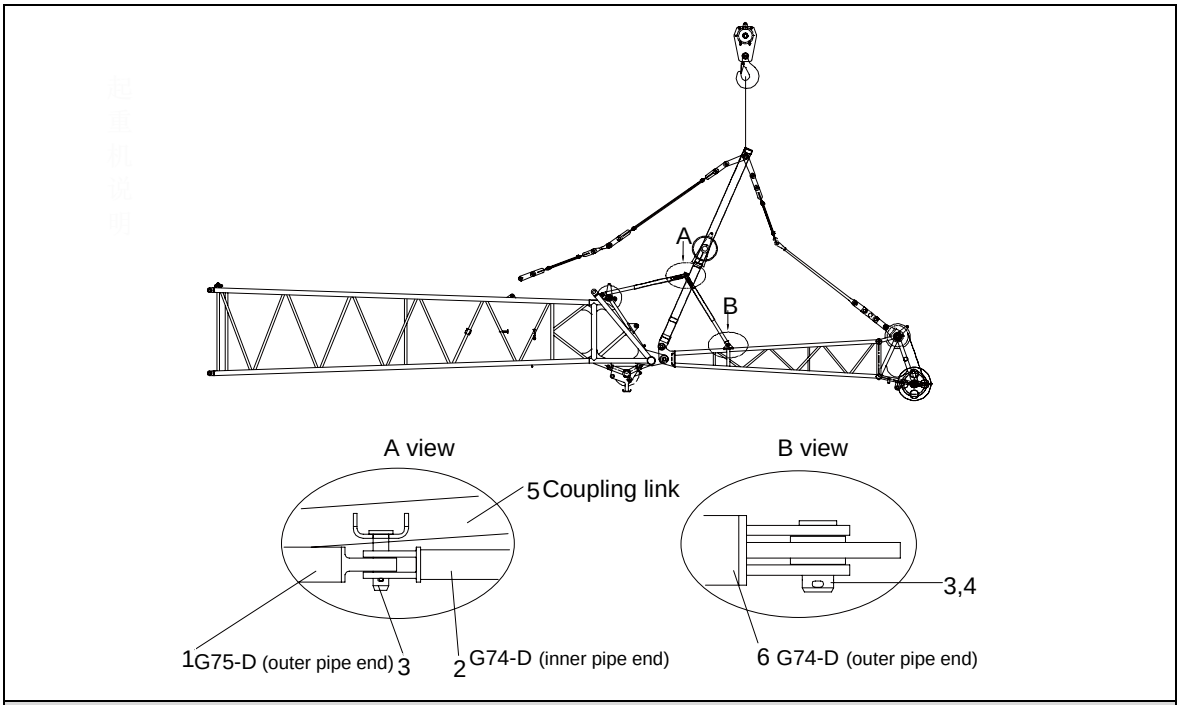
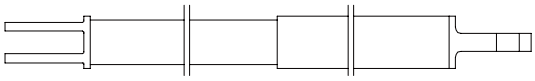
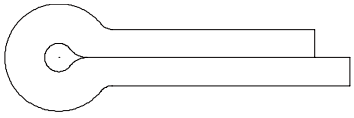
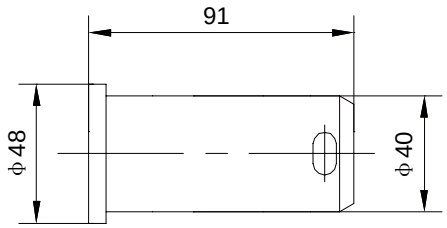
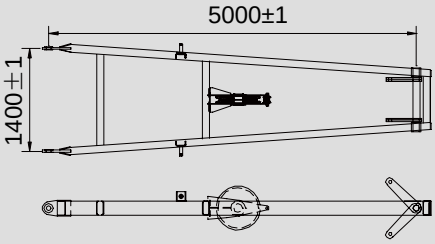


Figure 6-12 Assembly of tilting-back support system for FVA-frame

Table 6-6 Connecting parts of tilting-back support system

Part No.	Description	Illustration(mm)
1	Tilting-back support for FVA-frame(G75-D)	
2	Tilting-back support for special heavy fixed jib (G74-D)	
3	Cotter pin	 GB/T91-2000(8*60)

Part No.	Description	Illustration(mm)
4	Pin spindle	
5	FVA-frame(G37-D)	

DANGER

Read Section 6.1.1.2 of *Operator's Manual* carefully when assembling the tilting-back support system. The outer/ inner pipe of tilting-back support and the retaining spring are similar in appearance, assembly them correctly. It is prohibited to misuse.

f) Lift FA-frame G37-D (5) with an auxiliary crane and connect it to the rear anchoring rod.

g) Operate the right hand lever toward left to wind up the main derricking rope; lift up the main boom slightly and straighten the anchoring rod to make sure that the tilting-back support system is installed in place.

h) Reeve the main lifting rope of main boom on hoisting winch:

1) Lift up main boom head higher than the hook, which is right below the main boom head;

2) Turn right the switch (60) on right panel and pull down the hoisting winch switch to unwind rope. Pull the rope manually to the main boom head, reeve the rope through main boom head and hook reversely (refer to 4.6.1 for more details) and then pull back to the rear end of main boom.

3) Connect reeving rope and the rope of hoisting winch 1 through shackle. Unwind the rope of hoisting winch and fasten it at the rope head.

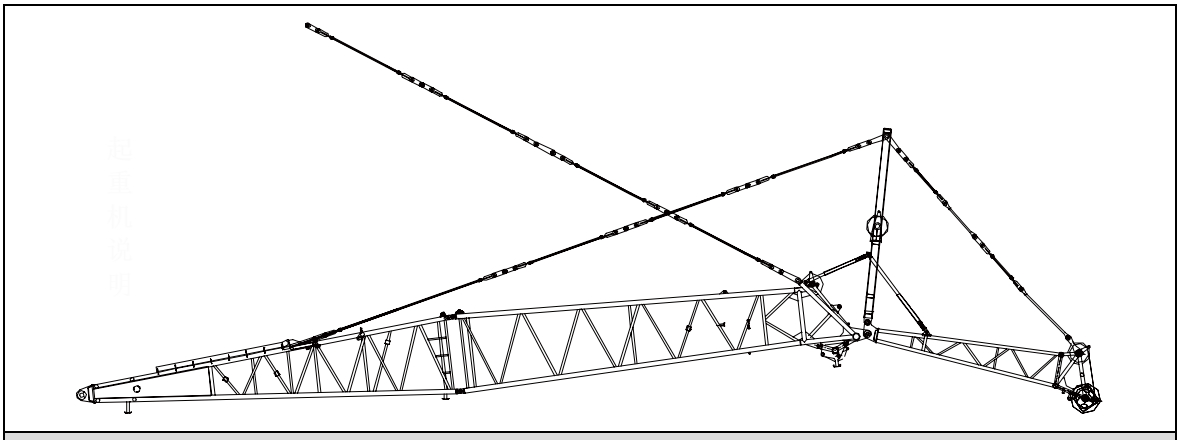


Figure 6-13 Erecting fixed jib

i) Reeve the lifting rope of heavy fixed jib according to the above-mentioned method:

1) Put the hook right below the heavy fixed jib head, unwind the rope of hoisting winch, and reeve the rope through heavy fixed jib head and hook reversely (refer to 4.6.3 for more details).
2) Unwind the rope so that it reeves through the pulley in the middle of anchoring rod to the main boom end. Connect reeving rope and the rope of hoisting winch 2 through shackle.
3) Unwind the rope of hoisting winch 2 and fasten it at the rope head.

6.2.4 Connect electrics to special heavy fixed jib

Refer to Section 5.11.3 of *ZCC2600 Operator's Manual*.

6.2.5 Erecting, lowering and dismantling special heavy fixed jib heavy duty boom (SFV-D)

Refer to Section 5.11.4 of Z*CC2600 Operator's Manual* "Erecting and lowering main boom with fixed jib".

6.3 Lifting capacity charts for SFV-D boom

DANGER

(1) The rated lifting capacity is given in t. Symbol "*/*" indicates rated lifting capacity / working radius.

(2) SFV-D boom configuration is used to lifting and turning over the shield tunneling machine.

(3) The heavy duty boom angle is fixed, the angle between special heavy fixed jib and heavy duty boom is 25°. The special heavy fixed jib is 6 m long.

(4) Under SFV-D boom configuration, extra two counterweight plates of 4t each should be added (compared with rear counterweight of 83.7t), namely, the rear

counterweight weights 91.7 t in total.

CAUTION

To avoid danger, the rear counterweight should be assembled correctly.

6.3.1 Description of special heavy fixed jib for S boom

The heavy duty boom, with heavy fixed jib of 6 m, is 20 m -29 m long. And the special heavy fixed jib angle is 25°. Only use main load hook. See the following figure.

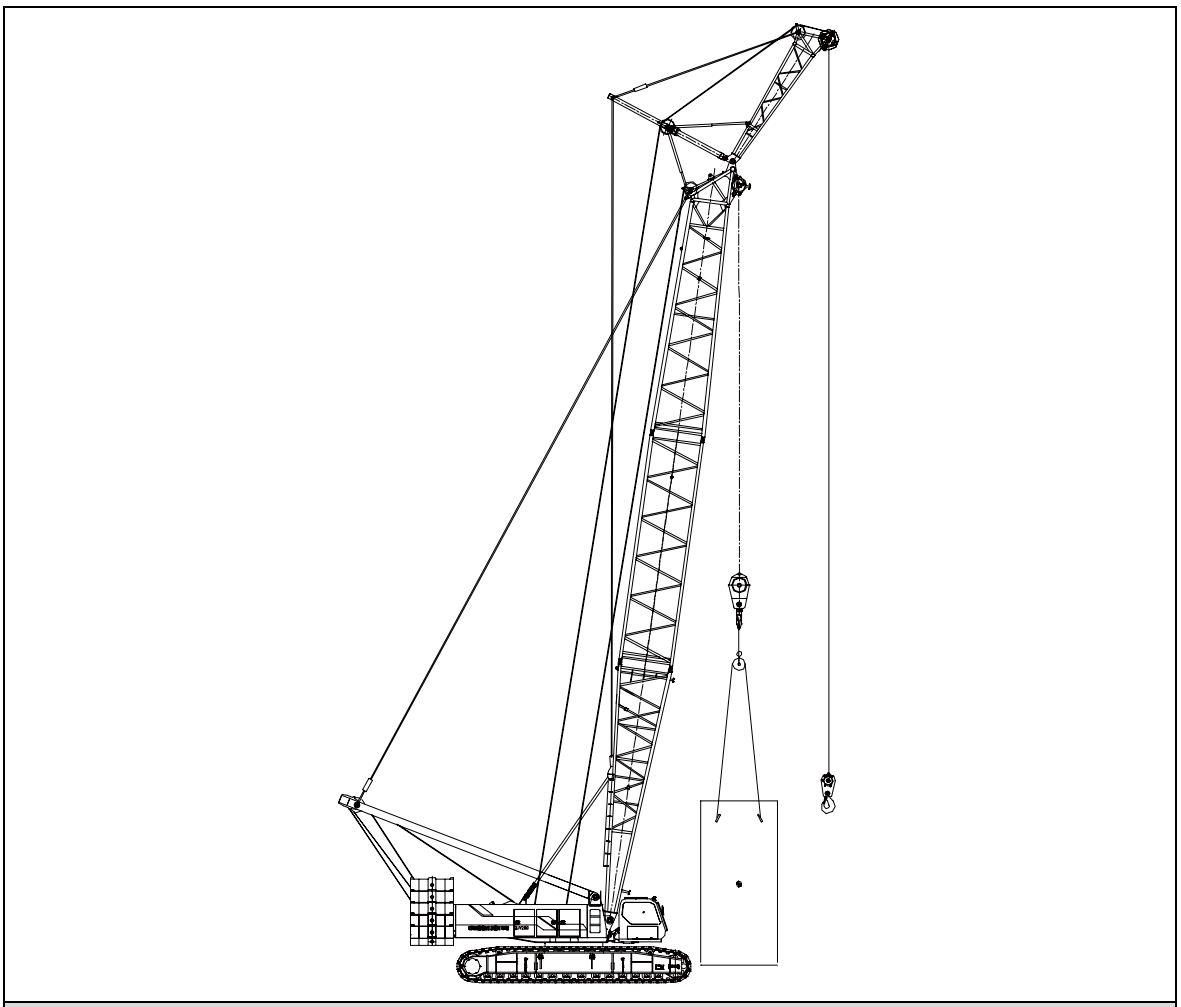


Figure 6-14 Main load hook of special heavy fixed jib working

6.3.2 Description of special heavy fixed jib for SFV-D boom

The heavy duty boom, with 260 t main load hook weighting 4.2 t, is 20 m – 29 m long. Only use auxiliary load hook.

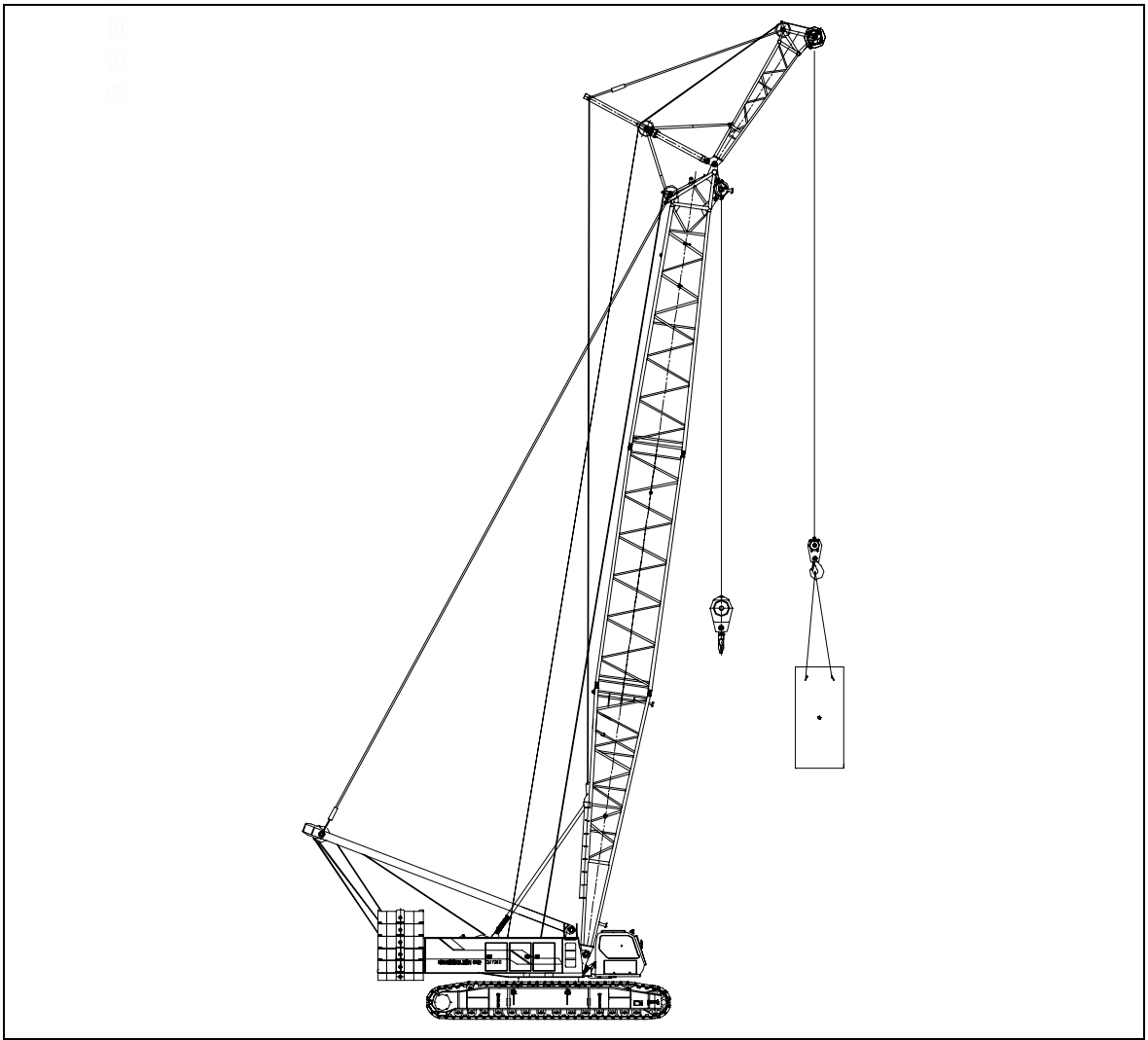


Figure 6-15 Auxiliary load hook of special heavy fixed jib working

6.3.3 Description of special heavy fixed jib for SFV-D boom used to turning over the shield tunneling machine

Use main boom and fixed jib simultaneously.

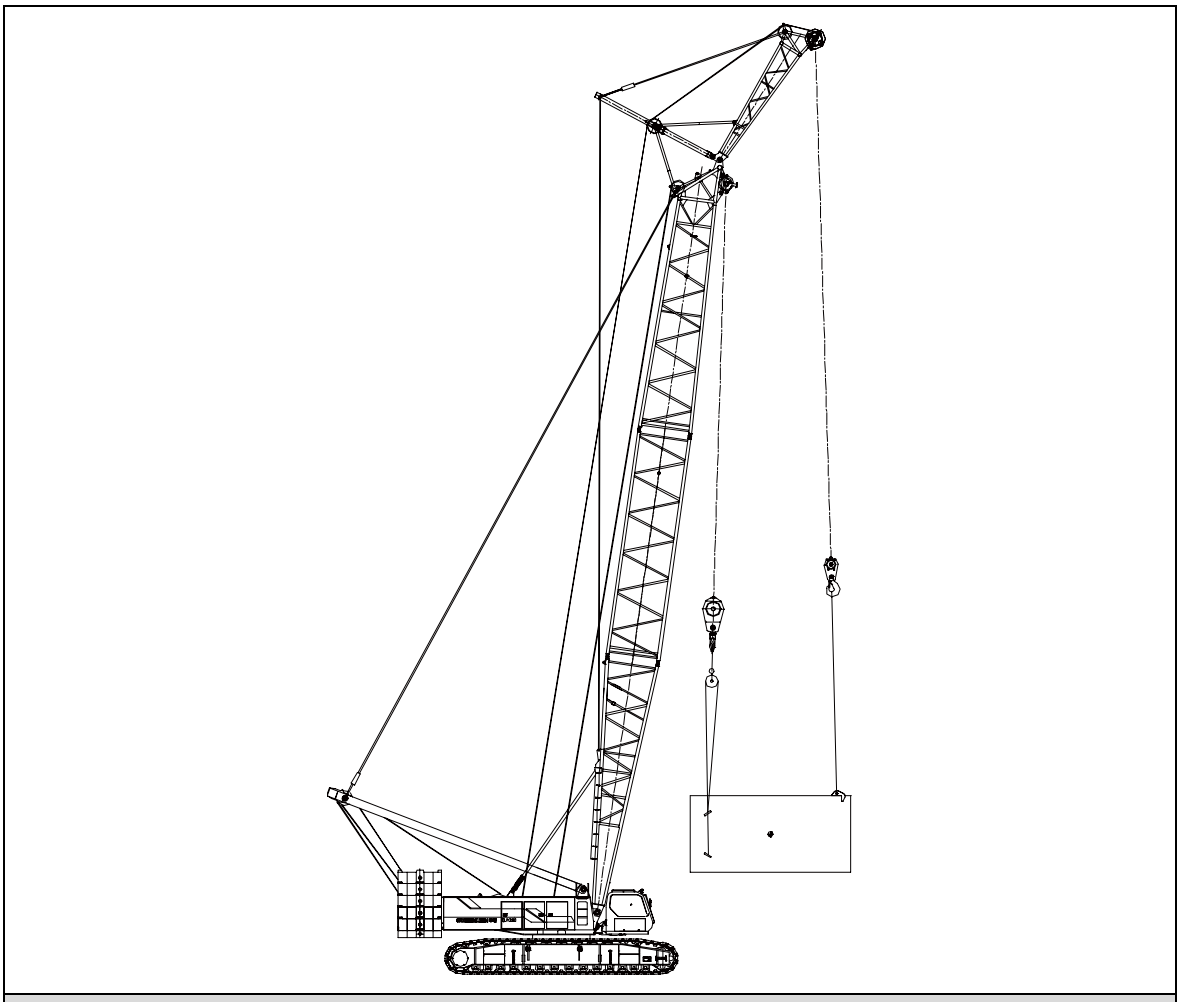


Figure 6-16 Main load hook and auxiliary load hook of special heavy fixed jib working

6.3.4 Lifting capacity charts of shield tunneling machine configuration

S-boom length: 20 m						
Main boom	Main load hook	Main load hook	Auxiliary hook	Auxiliary hook	Main load hook + auxiliary hook	Main load hook + auxiliary hook
Angle	Radius (m)	Load（t）	Radius (m)	Load（t）	Radius (m)	Load（t）
79.82	6	220	9.5	70	7.8	138
78.34	6.5	205	10.2	70	8.3	136
76.86	7	190	10.8	70	8.9	132
75.36	7.5	180	11.4	70	9.5	126
73.86	8	170	12.1	69	10.0	120
70.80	9	146	13.4	68	11.2	112
67.67	10	132	14.6	67	12.3	100
64.47	11	115	15.9	65	13.4	89
61.16	12	102	17.1	62	14.6	80
54.14	14	82	19.6	53	16.8	67
46.35	16	68	22.1	45	19.0	55
37.22	18	56	24.4	40	21.2	47

S-boom length: 23 m						
Main boom	Main load hook	Main load hook	Auxiliary hook	Auxiliary hook	Main load hook + auxiliary hook	Main load hook + auxiliary hook
Angle	Radius (m)	Load（t）	Radius (m)	Load（t）	Radius (m)	Load（t）
81.17	6	200	9.4	70	7.7	138
79.89	6.5	193	10.1	70	8.3	136
78.61	7	185	10.7	70	8.8	130
77.33	7.5	175	11.3	70	9.4	125
76.04	8	165	11.9	69	10.0	119
73.42	9	144	13.2	68	11.1	111
70.76	10	130	14.4	67	12.2	100
68.06	11	115	15.6	65	13.3	90
65.29	12	102	16.9	62	14.4	79
59.53	14	81	19.3	53	16.7	65

53.37	16	67	21.7	45	18.9	54
46.60	18	56	24.1	40	21.0	47
38.88	20	50	26.4	36	23.2	42

S-boom length: 26 m						
Main boom	Main load hook	Main load hook	Auxiliary hook	Auxiliary hook	Main load hook + auxiliary hook	Main load hook + auxiliary hook
Angle	Radius (m)	Load（t）	Radius (m)	Load（t）	Radius (m)	Load（t）
82.20	6	192	9.4	70	7.7	138
81.08	6.5	186	10.0	70	8.2	132
79.95	7	180	10.6	70	8.8	126
78.82	7.5	172	11.2	70	9.4	117
77.69	8	164	11.8	69	9.9	107
75.40	9	142	13.0	68	11.0	98
73.09	10	128	14.2	67	12.1	92
70.74	11	112	15.5	65	13.2	85
68.35	12	101	16.7	62	14.3	78
63.43	14	80	19.1	53	16.5	64
58.27	16	66	21.4	45	18.7	54
52.77	18	55	23.8	40	20.9	46
46.80	20	49	26.1	36	23.0	42
40.11	22	43	28.4	33	25.2	37
32.20	24	38	30.6	30	27.3	34

S-boom length: 29 m						
Main boom	Main load hook	Main load hook	Auxiliary hook	Auxiliary hook	Main load hook + auxiliary hook	Main load hook + auxiliary hook
Angle	Radius (m)	Load（t）	Radius (m)	Load（t）	Radius (m)	Load（t）
83.01	6	183	9.3	70	7.6	138
82.01	6.5	179	9.9	70	8.2	132
81.01	7	175	10.5	70	8.7	126
80.00	7.5	167	11.1	70	9.3	117
78.99	8	160	11.7	69	9.8	107

76.95	9	140	12.9	68	10.9	98
74.90	10	126	14.1	67	12.0	92
72.82	11	110	15.3	65	13.1	84
70.71	12	100	16.4	62	14.2	78
66.41	14	79	18.8	53	16.4	64
61.94	16	65	21.2	45	18.6	54
57.26	18	54	23.5	40	20.7	46
52.30	20	48	25.8	36	22.9	41
46.95	22	42	28.1	33	25.0	37
41.04	24	37	30.3	30	27.2	33
34.25	26	33	32.5	27	29.3	30

6.4 Computer control

Refer to *Instruction of Moment Limiter* for more details.

6.5 How to turn over the shield tunneling machine

The way of turning over the shield tunneling machine is shown in Figure 6-17 to Figure 6-21.

Step 1:

Make the crane in working condition, see Figure 6-17 (main boom length is L, main boom angle is a, horizontal distance between main boom and fixed jib derricking crown block is L1). Attach lifting device to lifting points A、B、C of shield tunneling machine. Make wire rope (4) reeve in pulley (5), and then attach the wire rope (4) to lifting points A、B. Connect wire rope and main load hook (6) by pulley (5). Connect lifting point C to auxiliary load hook (7) by wire rope.

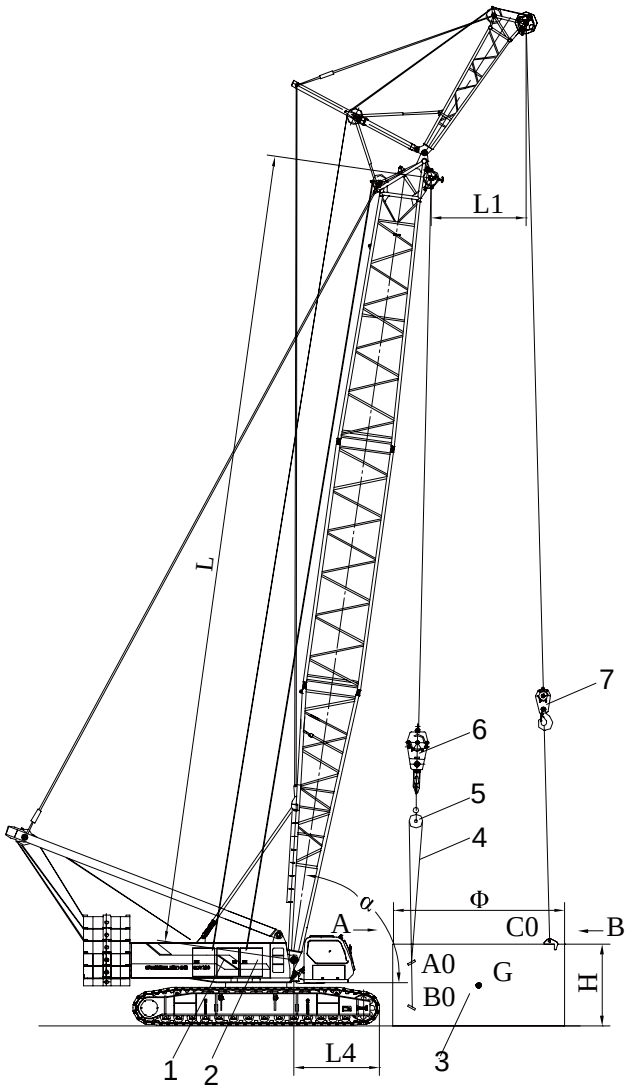


Figure 6-17 Turn over the shield tunneling machine

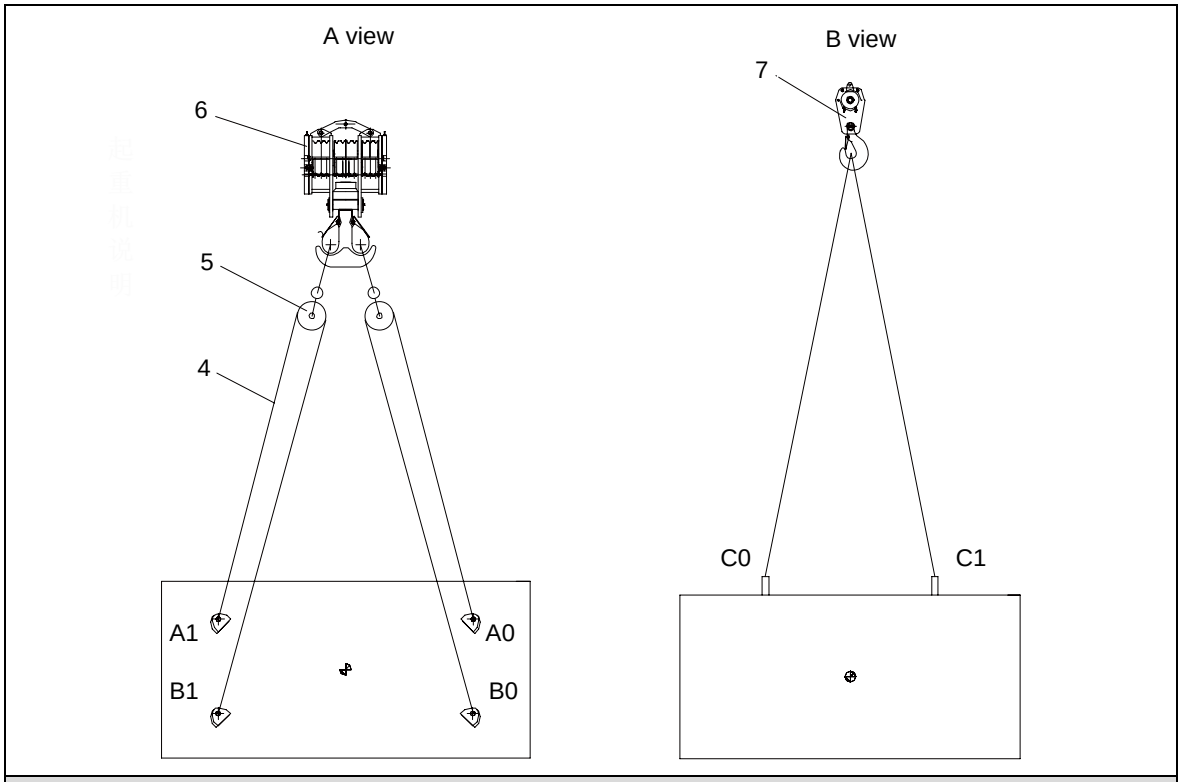


Figure 6-18 A view and B view

Step 2:

Move left control lever and right control lever together to spool up hoisting winch 1 and hoisting winch 2, main load hook (6) and auxiliary load hook (7) is lifted slowly at the same speed, shield tunneling machine is lifted horizontally until the distance between the bottom of shield tunneling machine and the ground is L2. Then stop spooling up hoisting winches 1 and 2. Load moment limiter (11) for main boom anchoring rods ensures the stability of complete vehicle. (See Figure 6-18)

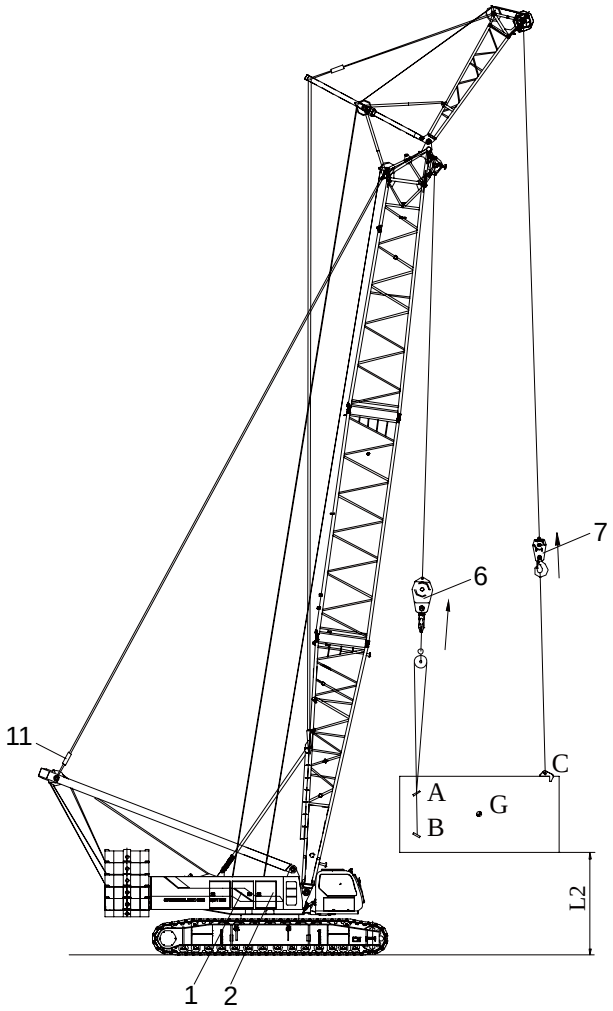


Figure 6-19 Turn over the shield tunneling machine

Step 3:

Move left control lever and right control lever together to spool up hoisting winch 1 and reel off hoisting winch 2, main load hook (6) is lifted slowly and auxiliary load hook (7) is lowered slowly at the same speed. The chain (4) of wire rope slides on the pulley (5). Keep the distance between the point D of shield tunneling machine and the ground. The load moment limiters (10, 11) for main boom anchoring rods and fixed jib front anchoring rods ensure the stability of complete vehicle. (See Figure 6-19)

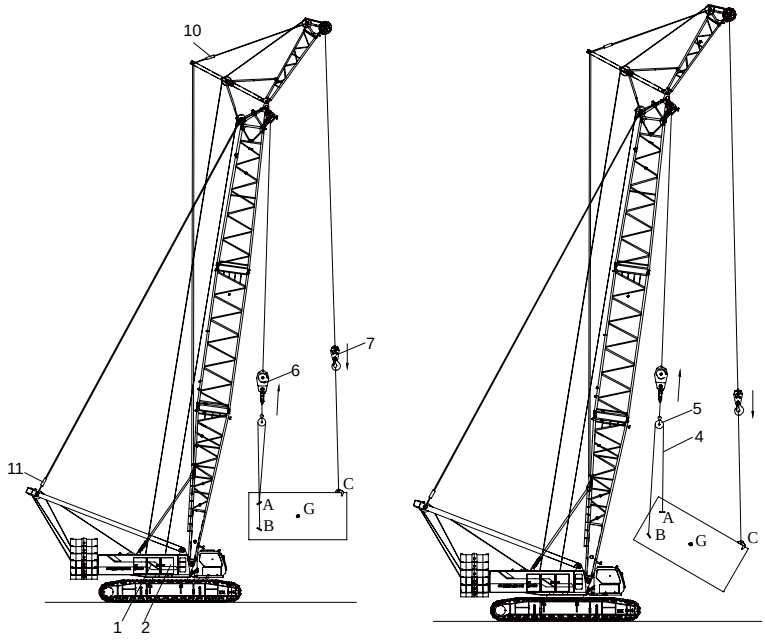


Figure 6-20 Turn over the shield tunneling machine

Step 4

Stop the lifting motion of main load hook (6), lower the auxiliary load hook (7) slowly and make chain of wire rope slide in pulley (5) until the points A and B of shield tunneling machine are in horizontal plane. Keep all the motions stably. The turning-over of shield tunneling machine is finished. (See Figure 6-20)

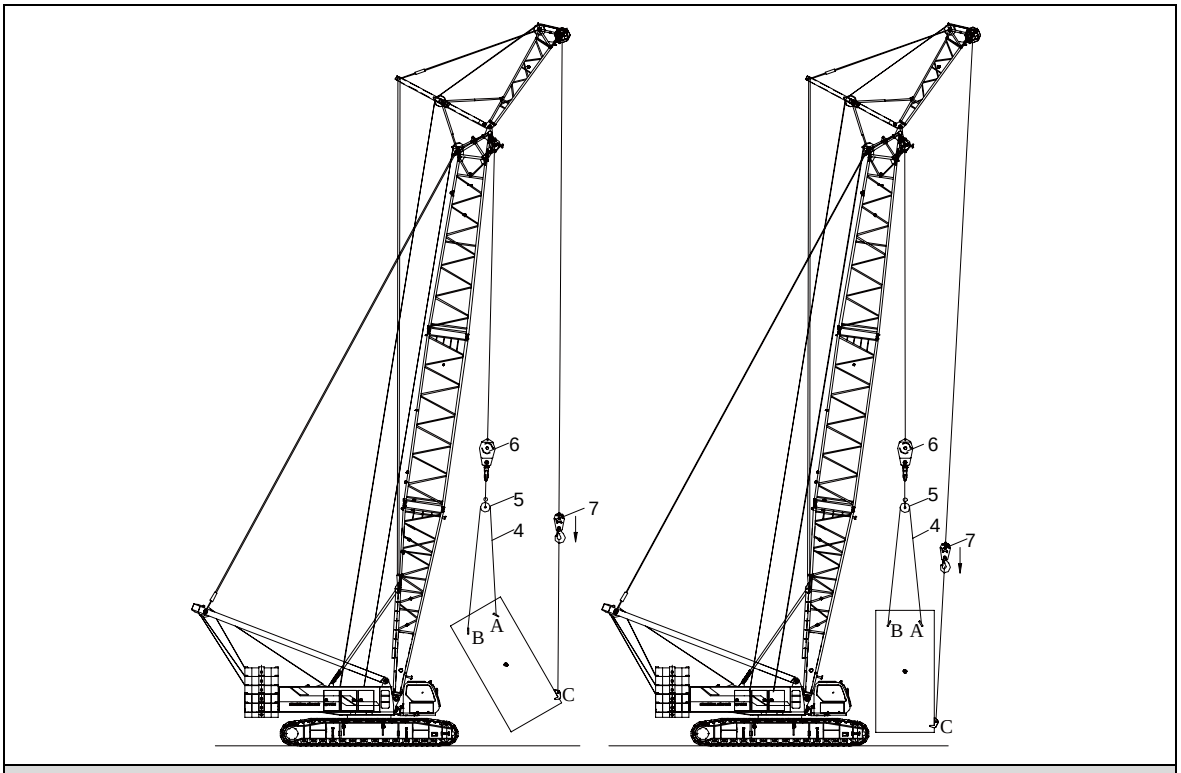


Figure 6-21 Turn over the shield tunneling machine